REPORT OF THE PHASE 1 RCRA FACILITY INVESTIGATION OF THE MIXED WASTE LANDFILL

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ACRONYMS

ASC	Analytical Services Center
BGS	Below Ground Surface
CEARP	Comprehensive Environmental Assessment and Response Program
CFR	Code of Federal Regulations
cm	Centimeters
CPS	Counts Per Second
CWL	Chemical Waste Landfill
DOE	United States Department of Energy
E & E	Ecology and Environment, Inc.
ER Program	Environmental Restoration Program
gm/cc	Grams Per Cubic Centimeter
ha-m	Hectare-meters
ID	Inside Diameter
KAFB	Kirtland Air Force Base
LLW	Low Level (Radioactive) Wastes
mg/kg	Milligrams Per Kilogram
ml/min	Milliliters Per minute
mR/hr	Milli Rems Per Hour
MWL	Mixed Waste Landfill
NMEID	New Mexico Environmental Improvement Division
OD	Outside Diameter
OSHA	Occupational Safety and Health Administration
pCi/ml	Pico Curies Per Millileter
ppb	Parts Per Billion
ppm	Parts Per Million
PID	Photoionization Detector
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
REC	Recovered
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
SNL	Sandia National Laboratories
SOP	Standard Operating Procedures
SWMU	Solid Waste Management Unit
TA	Technical Area
TCL	Target Compound List
µg/kg	Micrograms Per Kilogram
µg/L	Micrograms Per Liter
µR/hr	Micro Rems Per Hour
VOA	Volatile Organic Analysis

1 INTRODUCTION

An investigation was conducted at the Mixed Waste Landfill (MWL)(ER Program Site #76) in Technical Area III (TA-3) at Sandia National Laboratories (SNL) in Albuquerque, New Mexico to determine if a release of contaminants has occurred (Figure 1-1). The investigation, initiated in the summer of 1989, was conducted as part of the SNL Environmental Restoration (ER) Program under the management of the Environmental Programs Department.

Previous sampling studies performed at the MWL indicate greater than background concentrations of tritium at various surface locations and subsurface depths within the fenced area at the landfill (Millard et. al., 1983).

In 1987, the Comprehensive Environmental Assessment and Response Program (CEARP) Phase 1 Installation Assessment determined a positive finding for Resource Conservation Recovery Act (RCRA) regulated wastes at the MWL with a high potential for migration of wastes from the site (USDOE, 1987).

A 1987 U.S. Environmental Protection Agency (EPA) RCRA Facility Assessment (RFA) report of operations of solid waste management units (SWMUs) at SNL listed the MWL as containing RCRA regulated wastes (USEPA, 1987). The RFA reports five trenches (termed SWMUs 24, 25, 26, 27, and 28), an above-ground drum storage area, and 30 burial pits at the MWL as SWMUs 29, 30, 115, and 116. No differentiation is made as to which pits are part of which SWMU, although Pit No. 1, stated as used for depleted uranium disposal, is listed as SWMU 29. Only SWMU 29 is identified in the RFA as having received hazardous chemicals. Available records indicate that primarily low level radioactive wastes were buried

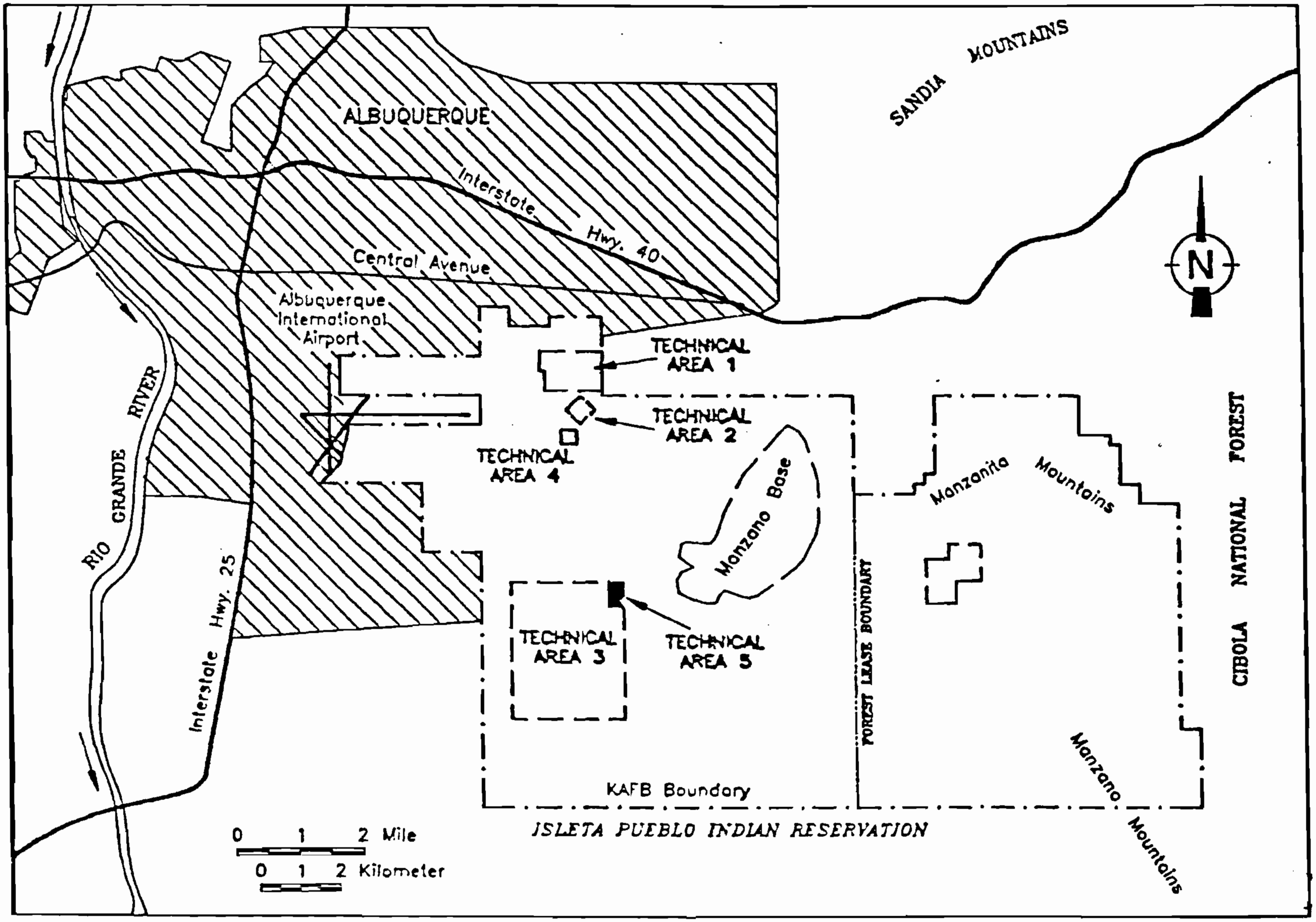

Figure 1-1: KIRTLAND AIR FORCE BASE AND SANDIA NATIONAL LABORATORIES ALBUQUERQUE AREAS

in the landfill, some of which may have contained hazardous constituents as defined by RCRA (USDOE, 1988).

None of the early studies, the Phase 1 CEARP Report, or the RFA adequately determined if contamination truly exists at the MWL, either by a lack of substantive data (early studies) or a lack of sample gathering altogether. The RFA report only reported that wastes were deposited at the MWL with no conclusion of the status of site conditions.

In 1989, a groundwater monitoring well network was designed and installed at the MWL to comply with 40 CFR (Code of Federal Regulations) 264, subpart F and the New Mexico Hazardous Waste Regulations (HWMR-5). The monitoring well network consists of three downgradient monitoring wells and one upgradient well. The monitoring wells were completed in September 1989, however, it has not been determined if proper placement of the wells has been achieved relative to the groundwater flow gradient. A stabilized piezometric surface has not been determined.

Keeping with consistency in the ER Program to investigate each CEARP identified site in the RCRA corrective action format (SNL, 1990), this investigation constitutes the first phase of a RCRA Facility Investigation. As previously mentioned, the RFA listed the MWL as a multiple SWMU facility. This RFI considered the MWL as a single SWMU, incorporating the multiple SWMUs listed in the RFA, for purposes of sample collection strategy and possible overlapping boundaries given the close proximity of pits and trenches to each other.

The objective of the RFI at the MWL is to determine the nature and extent of contamination that may emanate from a hazardous material source, and to define the source of the contamination, release mechanisms into the environment, and the transport mechanisms and pathways of contaminant migration. Because the RFI at the MWL is very complex the sampling and characterization strategy will be an iterative process, and therefore the RFI will be multi-phased. This report presents results of the first phase - Phase 1.

The purpose of this phase was to determine if a release has occurred, and to begin characterizing the nature and/or source of the release. The purpose of the Phase 2 RFI and successive phases, if necessary, is to fully characterize the nature and extent of any contaminant migration into the environment, to characterize the mechanisms and pathways of contaminant transport, and to determine all potential receptors that may be affected by the contaminant release.

The data collected from all phases of the RFI is intended to provide a basis for the decision of the need of long-term corrective measures, interim corrective actions, risk assessment, or no further action. For the MWL, the RFI data will ultimately support closure of the landfill.

The Phase 1 RFI field work at the MWL was performed in September, 1989, with additional work completed in June, 1990, and entailed the collection of air, surface soil and subsurface soil samples from multiple locations at the site. This document reports the findings of the Phase 1 RFI. Section 2 of the report presents a brief site history and description of the site location and geology. Section 3 describes the sampling methods used at the site and a summary of all work completed. Section 4 presents a detailed discussion of the site lithology as determined from the soil borings. Section 5 presents the analytical results, and Section 6 summarizes the results of the Phase 1 RFI, presents conclusions, and makes recommendations for future investigations at the MWL.

2 SITE BACKGROUND

2.1 SITE LOCATION

Sandia National Laboratories is located in the Albuquerque-Belen drainage basin in Central New Mexico. Technical Area III (TA-3) is located in the southwest portion of the SNL testing area which is within boundaries of Kirtland Air Force Base (KAFB). Geographically, the Albuquerque-Belen drainage basin is structurally bounded to the east by the Sandia, Manzanita, and Manzano Mountains, and to the west by the mesas of the Lucero Uplift. Land-surface elevations in the central part of the basin range from about 4,900 feet above sea level at the Rio Grande River to greater than 10,000 feet in the Sandia Mountains. The grade of the mesa east of the Rio Grande Valley increases toward the steep, west-facing slopes of the mountains. Alluvial fans coalesce at the base of the mountains and comprise the east mesa surface.

The Rio Grande River flows southward through Albuquerque with an annual volume of 91,533 hectare-meters (ha-m), or 742,000 acre-feet. The river is situated approximately 7 miles west of SNL.

Precipitation quantity and distribution are orographically controlled in the basin. Average annual precipitation varies from approximately 8 inches at low altitudes in the central part of the basin to about 24 inches in the Sandia and Manzano Mountains. Most of the precipitation in the central part of the basin occurs from localized summer thundershowers. The normal daily temperature ranges from 23^{o}F to 52^{o}F in the winter months and from 57^{o}F to 91^{o}F in the summer months. Average annual relative humidity is approximately 47%.

Under normal conditions, wind speeds seldom exceed 32 mph and are generally less than 8 mph. Strong winds accompanied by blowing dust occur mostly in late winter and early spring. Wind speeds reach 30 mph fewer than 48 days each year. Prevailing surface winds are from the east, but winter winds tend to blow from the north.

Vegetation type is dependent on altitude, aspect, and availability of water. Abundant riparian vegetation occurs in the Rio Grande Valley floodplain due to the shallow depth to groundwater. On the mesas, vegetation is sparse and includes sage, tumbleweed, grass, and varieties of small cactus. Near the base of the mountains, the vegetation includes juniper and pinon pine, prickly pear and cholla cactus, grasses, and wildflowers.

The MWL occupies approximately 1.6 acres in the north-central portion of TA-3, immediately west of the short sled track facility (Figure 2-1). The MWL was used for the disposal of classified and unclassified solid, low-level radioactive waste (LLW), non-radioactive hazardous waste and radioactive materials with hazardous chemical constituents (mixed wastes). The MWL consists of a series of pits and trenches for shallow land burial and is divided into two sections (USDOE, 1988a). The first section contains older, unlined cylindrical and square pits approximately 5 to 10 feet in breadth and approximately 25 feet in depth and is known as the "classified area." The pits have been covered with concrete plywood, or steel caps. Contents of some of the older pits and their volumes are not specifically known due to the absence of disposal records. The classified area also contains more recent, active pits for disposal of various waste materials. The second and newer section contains seven trenches and is termed the "unclassified area." The trenches are approximately 130 feet long, 40 feet wide and 25 feet deep (Figure 2-2).

2.2 SITE GEOLOGY

The Albuquerque-Belen drainage basin is structurally bounded on the east and west by a series of uplifted fault blocks. These blocks comprise the Sandia, Manzanita, and Manzano Mountains to the east and the Lucero uplift to the west. The fault blocks and the bedrock underlying the basin are composed of massive granitic blocks overlain by layered limestone, sandstone, and shales. Minor amounts of metamorphic and volcanic rocks occur within or on top of these fault blocks. The basin fill consists of up to 12,000 feet of Miocene-Pliocene Santa Fe Group

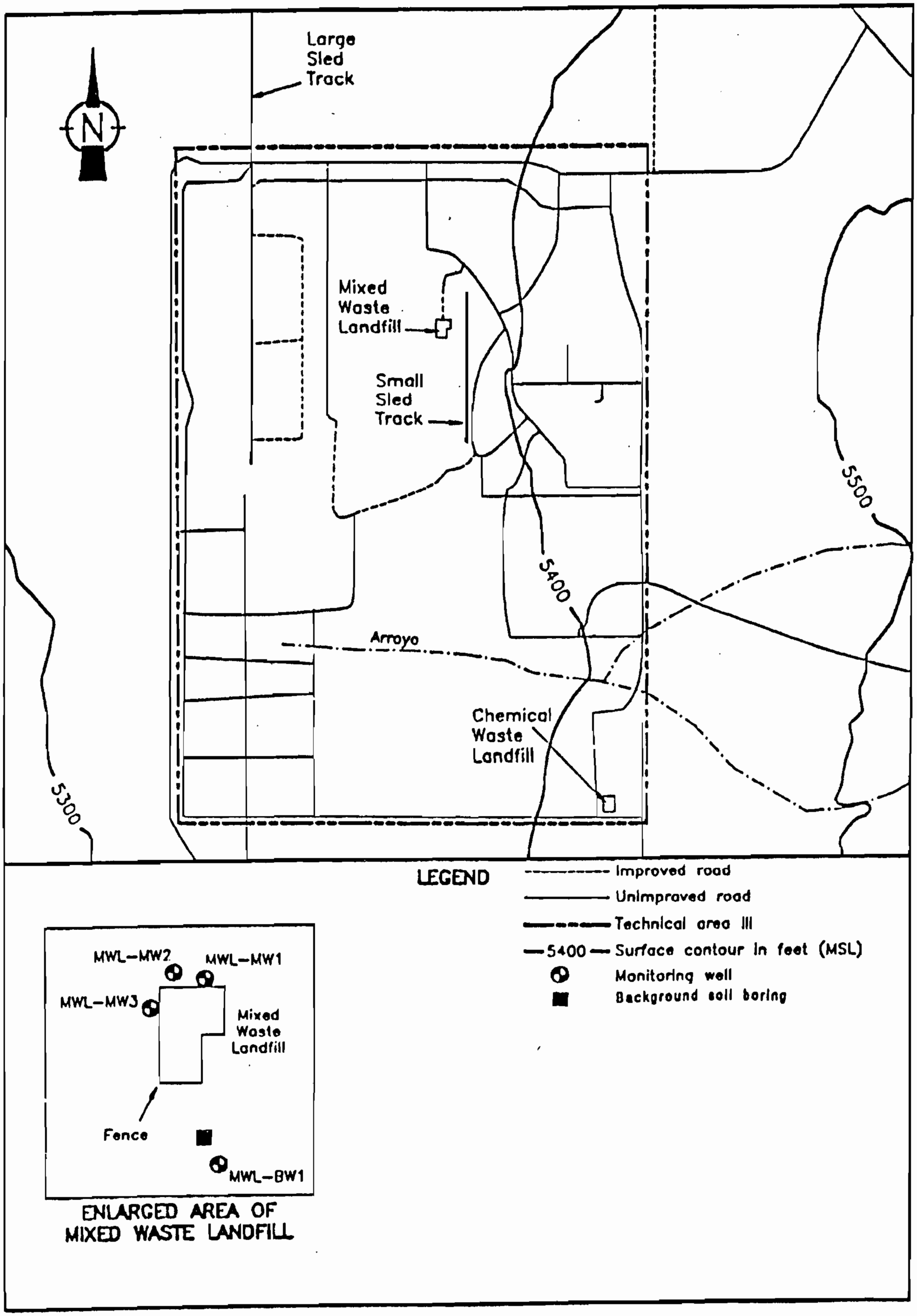

FIGURE 2-1: LOCATION OF THE MWL IN TA-3

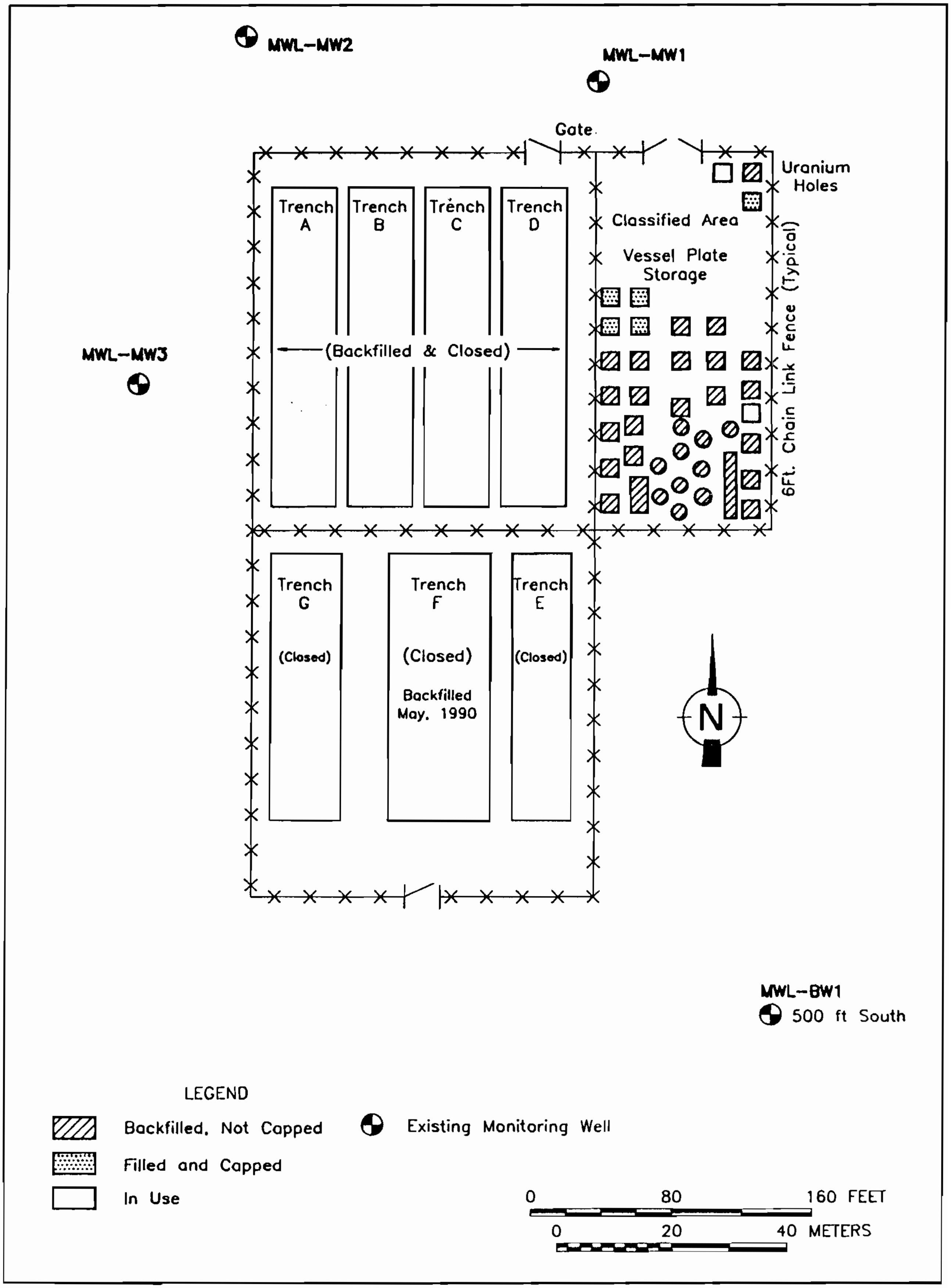

Figure 2–2: MIXED WASTE LANDFILL

sediments. These basin-fill sediments were derived in part from the erosion of the surrounding uplifted blocks. Santa Fe Group sediments are overlain by fanglomerate deposits of the Ortiz pediment surface. This extensive sheet of alluvial sands and gravels ranges in thickness from 0 to 150 feet and represents the culmination of the filling of the basin. TA-3 lies near the edge of the Ortiz surface (Kelley, 1977).

The depositional environment of the Santa Fe Group sediments in the area of the MWL may have changed from a predominantly alluvial fan environment to a fluvial environment in late Santa Fe times. At that time the Rio Grande River may have followed a course approximately 6 miles east of its present location (Kelley and Northrop, 1975). In general, alluvial fan deposits have been deposited from east to west, and are coarser-grained and less areally extensive than fluvial deposits. Ancestral Rio Grande deposits have been deposited from north to south, and are finer-grained; individual units will be more areally extensive than alluvial fan deposits.

The general stratigraphy of sediments under the MWL consists primarily of varied mixtures of fine sands and silty sands, with lenses or layers of gravels. The gravels range in size from fine to coarse and at least one horizon of predominantly gravel appears in all boreholes across the site between 90 to 100 feet below ground surface. The depositional environment for the first 100 feet of the MWL appears to have evolved from a distal alluvial fan environment. Relatively coarse, areally extensive deposits may also be related to the Ortiz pediment surface.

The upper 29 feet of soil at the MWL varies from fine sandy loam and loamy sand to fine sands throughout the profile (Daugherty, 1979). Soils are of the Tijeras-Embudo association, and are classified as well-drained, loamy, gravelly soils (USDOE, 1988d). The soils are high in calcium carbonate content, low in organic matter, and typically contain very fine sandy loams with some gravel zones.

2.3 SITE HISTORY

The MWL began accepting classified and unclassified mixed waste and LLW in 1959. Early waste deposits were placed into cylindrical pits located in the southern half of the classified disposal area (Figure 2-2). Several pits in the northeast corner of the classified area, each approximately 10 feet square and 25 feet deep, were used specifically for disposal of depleted uranium. In 1962, the "unclassified" area was open to begin receiving radioactive and mixed wastes. SNL records estimate that approximately 50,000 cubic feet of radioactive waste have been disposed of in the MWL (Millard, 1988) though the 1987 USEPA RFA states that 720,000 cubic feet of wastes have been disposed of at the MWL.

The primary radioactive wastes disposed of at the MWL consist of tritium (most prevalent in the classified area) and depleted uranium. In addition to radioactive and mixed wastes, this landfill was used as a chemical waste landfill from 1959 to 1962. No records exist detailing what chemical wastes were deposited during this time. Other waste materials disposed of at the MWL include liquid wastes; radioactive metals; low-level fission products; high-efficiency particulate air (HEPA) filters; radioactive tracers; liquid scintillation cocktail (LSC) vials; trace amounts of plutonium; tritium-contaminated equipment; and contaminated oils and other drummed liquids solidified with dirt, plaster of paris, and concrete.

In 1967, Trench D in the unclassified area was used for disposal of approximately 270,000 gallons of coolant wastewater. SNL records estimate that 1 curie (Ci) of total radioactivity, primarily from Na-24 and Mn-56 was discharged into the trench over a period of one month.

Earlier studies (Table 2-1) at the MWL demonstrated the presence of tritium in the surface soils in the vicinity of the classified area and in subsurface soil at limited locations around the classified disposal area. During these same studies, gamma spectrometry data for the same locations showed little or no presence of gamma-emitting contaminants (USDOE, 1988a). To supplement on-going annual and plant testing for radioactive contaminants, a decennial (10 year) sampling plan was

Table 2-1

SUMMARY OF STUDIES CONDUCTED AT MWL[a]

Year	General Description	Number of Samples	Media Sampled	Parameter(s)
1969	Decennial Sampling	10	Subsurface Soils	Gross Alpha Gross Beta Total Strontium Cs-137 Gamma Activity
1979	Subsurface Ion Migration Study	35	Subsurface Soils	Gross Beta Gross Alpha Total Uranium Tritium
1981	Soil Core Sampling	226	Subsurface Soils	Gross Alpha Gross Beta Gamma Activity Tritium % Moisture
1982	Surface Soil Tritium Study	100	Surface Soils	Tritium
	Air Monitoring	9	Air (Grab)	Tritium
	Soil Core Sampling (vertical migration)	76	Surface/ Subsurface Soils	Tritium

[a] Millard, et al. 1983.

instituted for the MWL beginning in 1969. The decennial sampling would require more intensive radiological sampling than normal annual analyses.

In 1969, results from 10 soil cores sampled to depths of 25 to 50 feet at 5 locations around the perimeter of the MWL indicated that there was no radionuclide migration from the site.

In 1979, as part of an ion migration study at the classified area, 35 soil samples were taken from a single pit at 1-foot intervals to a depth of 35 feet. No significant levels of alpha or beta radiation were noted through the profile, though radiation levels slightly higher than the minimum detectable limit (MDL) were observed. Twenty-five (25) of the 35 soil samples had greater than background levels of tritium, particularly below 18 feet beneath ground surface (bgs)(Millard et al., 1983).

3 SUMMARY OF WORK COMPLETED

3.1 REVIEW OF THE SCOPE OF WORK

The Phase 1 RFI at the MWL was designed to determine if contamination has migrated from the landfill and to characterize the nature and probable extent of any contaminants. To accomplish this goal, the major migratory pathways of contaminant flow were sampled and analyzed for organic, metal, and radiological parameters. The migratory pathways sampled were air, surface soils, and subsurface soils. Descriptions of sampling procedures for each pathway follow in this section.

In addition to media sampling, extensive health and safety monitoring was integral to the work performed at the MWL. Health and safety monitoring helped determine potential worker exposure to chemical, physical, and radiological hazards, as well as to monitor for potential contaminant releases from the landfill.

3.2 PRELIMINARY RADIATION SURVEY AND SITE SCREENING

A preliminary radiation survey and initial site screening for volatile organic compounds were performed prior to the initiation of extensive on-site field work to determine areas of potential radiation exposure and contamination. Information obtained from this survey established health and safety protocol and provided additional information in support of the RFI.

The preliminary radiation survey was conducted using a Bicron Microanalyst micro-R-meter and a Bicron G2 2-inch by 2-inch sodium iodide (NaI) gamma scintillation detector, connected to a Bicron Surveyor M ratemeter (ER Program SOP 6.15). Additional screening measurements were made using a Johnson TR-7 tritium monitor and a Bicron RSO-5 ion chamber. Background measurements for each instrument were taken off-site at a location approximately 3/4-mile north of the Albuquerque International Airport, and at another location approximately 200 feet north of the MWL, prior to the on-site survey and screening.

On-site gross survey and screening measurements were recorded into field logbooks with respect to the location of each reading.

The MWL perimeter was surveyed with the micro-R-meter and the NaI detector approximately one meter above the ground surface. Results equivalent to instrument background (approximately 35 μR/hr and 4000 cpm), were obtained along most of the perimeter, with the exception of the northeast and southwest areas, where measurements ranged from 2 to 4 times background (Figure 3-1). These measurements were likely due to several pits in the classified area that were not backfilled or capped, and above-ground radioactive storage in the unclassified area.

Along the eastern fence bordering the classified area, measurements ranged from twice background (approximately 70 μR/hr) to approximately 5 mR/hr and appeared to be due to the aforementioned uncapped waste pits in the classified area. Measurements in the southwest corner of the unclassified area ranged from twice background to approximately 1 mR/hr and resulted from the above-ground storage of boxes and drums of radioactive material (Figure 3-1). A ground-surface examination of the unclassified area did not show any anomalies with the exception of 2 measurements, indicated as locations 1 and 2 on Figure 3-1. At location 1, a measurement of approximately 4 times background was obtained; at location 2, where old pallets and plastic littered the ground, radiation measurements were three to four times background.

Measurements ranged from background to approximately 1.5 times background in the south half of the classified area. The northern half of the classified area contained several areas of high radiation (i.e., areas with exposure rates between 5 and 100 μR/hr) that had been previously roped off by SNL personnel and were not surveyed. Measurements near these areas ranged from 150 μR/hr to 2 mR/hr. A tritium monitor was used at the ground-surface level to detect possible tritium emanations, especially in the cracks and holes in the ground created by subsidence near the waste pit caps. No measurements above background were noted, however, reliability of the tritium monitor could not be verified for outdoor measurements due to interferences of dust and other particles.

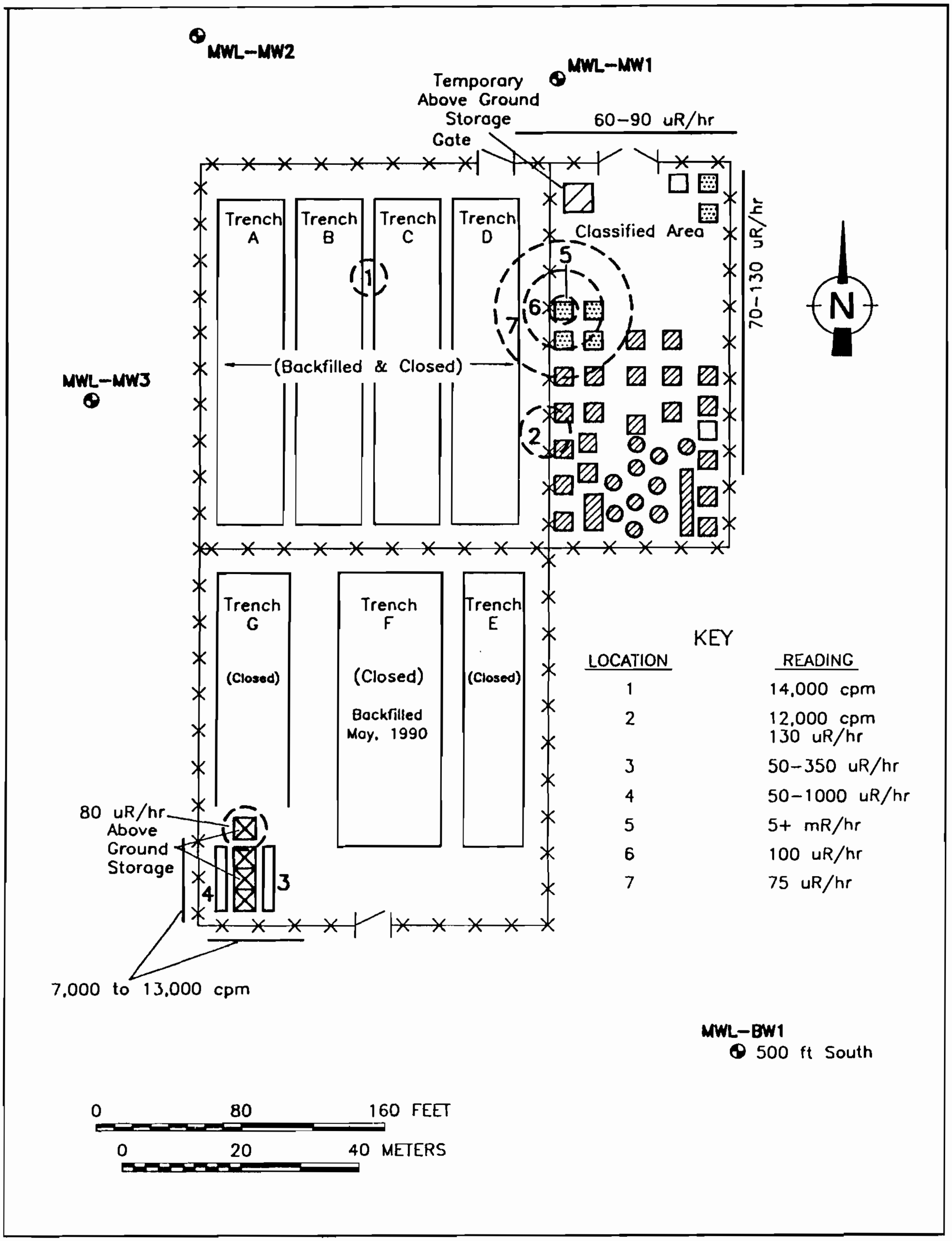

Figure 3–1: PRE WORK RADIATION SURVEY READINGS AT THE MWL

An HNu systems Model ISPI-101 photoionization detector with a 10.2 eV lamp was used to screen the entire MWL for volatile organic contaminants prior to sampling activities. No measurements above background were obtained.

3.3 AIR SAMPLING

The air sampling consisted of a background, baseline ambient air sampling, and worker health and safety monitoring via sampling of the breathing zone. Baseline ambient air sampling was conducted to define existing concentrations of airborne tritium and radioactive particulates at the MWL prior to drilling and sampling activities. These results were compared to background concentrations (locations listed in Table 3-1) and were used to determine the level of protection required for field personnel working at the MWL. The breathing zone air sampling was conducted during on-site work to document the concentration of radioactive particulates in worker breathing zones during sampling and drilling activities.

Air sampling for tritium and radioactive particulates was conducted at the MWL during August and September 1989, and during June and July, 1990 to determine fugitive emissions of tritium. Sorbent tubes were used to collect water vapor for tritium analysis, and cellulose filters were used to collect airborne particulates for gross alpha and gross beta analysis.

3.3.1 Baseline Ambient Air Sampling

Baseline air samples were collected to determine ambient air conditions for both tritium and gross alpha/beta analysis from the nine locations indicated in Figure 3-2. Location 7 was sampled twice for particulates; the two samples were collected four days apart for quality assurance. As part of the baseline sampling, background samples were collected at the four locations described in Table 3-1. One of the background locations was sampled twice for a replicate for particulates. Two field blank samples were also submitted for tritium analysis and one field blank sample was submitted for gross alpha/beta analysis. In

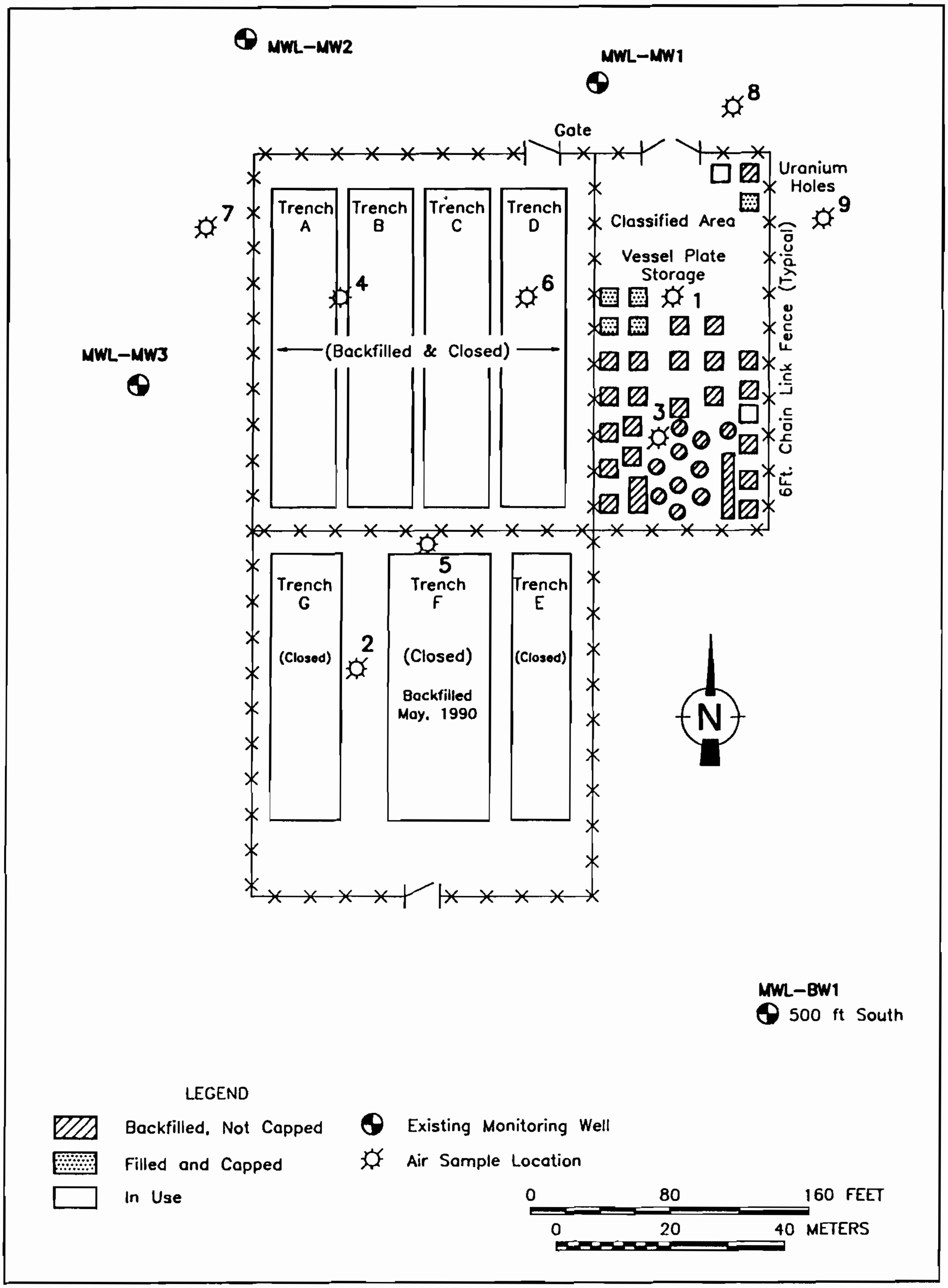

Figure 3–2: BASELINE AIR SAMPLING LOCATIONS

addition, one cellulose filter blank sample was analyzed for gross alpha and gross beta. These samples were for quality assurance.

Water vapor in the ambient air was collected on 3/8 inch (I.D.) silica sorbent tubes and analyzed for tritium content. Each sorbent tube contained 1000 mg of silica gel in the front section and 250 mg in the back section. Generally, a pair of the sorbent tubes were used in series in the sampling train, and the back tube was analyzed separately from the front tube to determine if significant amounts of tritiated water vapor had passed through the front tube. Pulse pumps and regulated personnel air pumps were used to draw air through the sampling train at rates ranging from approximately 1 ml/minute to 3000 ml/minute. The total sample volumes ranged from about 800 ml to 3000 ml. Sampling rates were determined on a volumetric basis. These sampling rates were then corrected to standard atmospheric conditions at sea level and to a temperature of 25°C.

Baseline gross alpha/beta particulate samples were collected with open-face mixed-cellulose ester filters having a diameter of 47 mm and a pore size of 0.8 micrometers. Eberline model RAS-1 low-volume air pumps were used to draw air through the filters at rates ranging from about 20 l/min to 40 l/min. Total sample volumes ranged from about 8 cubic meters to 140 cubic meters. At the end of each sampling period, air filters were placed into individual envelopes and retained for alpha and beta counting. The sampling rates were determined on a mass-flow basis.

3.3.2 Worker Breathing Zone Sampling

From September 7, 1989 to September 27, 1989, during drilling and sampling activities at the MWL, 17 particulate breathing zone samples were collected and analyzed for gross alpha/beta radiation. The samples were collected during normal duty shifts (or part of a work shift) from workers as they conducted their normal activities. Because workers were free to move from place to place during the sampling period, the sample locations are described only as the general area of the MWL. Table 1 in Appendix C lists the sample collection date and sample I.D. for the samples collected during the breathing zone gross alpha/beta study.

Table 3-1

BACKGROUND AIR SAMPLING LOCATIONS

Sample ID	Description of Location
MWL-T008,-P008	Sandia National Laboratories, Area 9970, on microwave tower about 8 feet above ground level
MWL-T009,-P009	Sandia National Laboratories, under the eastern tower of the Robotic Vehicle Compound, north Tijeras Arroyo.
MWL-T010,-P010	About 200 yards north of Interstate 40 and 200 yards E of Tramway Blvd. at 238 Monte Largo NE, Albuquerque, NM 87123
MWL-T011,-P011, and -P034	4613 Bali Court NE, New Holiday Park Edition, Albuquerque, NM 87111

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MWL-T011,-P011, and -P034	4613 Bali Court NE, New Holiday Park Edition, Albuquerque, NM 87111

Breathing-zone particulate samples were collected using open-faced polystyrene cassettes loaded with mixed-cellulose ester filters having a diameter of 37 mm and a pore size of 0.8 micrometers. At the end of the sampling period, the ends of the sampling cassette were capped and shrinkage bands were placed over the cassettes. Personnel air-sampling pumps were used to pull air through the filters at rates ranging from about 1500 ml/min to 4500 ml/min. Total sample volumes were in the range of 0.5 cubic meters to 2.5 cubic meters. Sampling rates were determined on a volumetric basis and were corrected to atmospheric conditions equivalent to sea level and to a temperature of 25°C.

3.3.3 Analytical Methods

The following analytical methods were used to determine concentrations of airborne contaminants:

Tritium was detected by liquid scintillation spectrometry. A number of sample processing methods were evaluated for recovery of water vapor from the silica gel sorbent. Sample distillation with or without added water was unsuitable since the sorbent would pop violently in the distillation pot and eventually become trapped in the condensing column. Adding the silica gel sorbent directly to an aliquot of scintillation cocktail proved the most practical means of sample preparation. Since the front and back sorbents were analyzed separately, each field sample resulted in two laboratory samples.

Background, baseline ambient air and worker breathing zone sampling was conducted to determine concentrations of radioactive particulates in the air. Air filters were allowed to decay for at least 120 hours to minimize interference from short-lived radon and thoron daughters with measurement of the long-lived activity.

The baseline and background particulate samples were analyzed for gross alpha activity with an Eberline model SAC-4 alpha scintillation detector. An Eberline model HP-210 shielded Geiger-Mueller detector, with the wire screen removed and a window thickness of approximately 1.7 mg/cm^2, was used to count the samples for gross beta activity. Background count rate and efficiency were determined daily for both the

SAC-4 and HP-210 detectors. A 50-minute counting time was used for determining the detector background count rate and for counting the samples.

Breathing zone particulate samples were analyzed for gross alpha and gross beta activity using a gas flow proportional detector whose background count rate and efficiency were determined daily. Each filter was counted for 100 minutes at the alpha plateau voltage, and for 100 minutes at the beta plateau voltage.

Net radiation activities for the particulate samples were obtained by subtracting the background and media blank sample results from the gross sample activities.

3.4 SURFACE SOIL SAMPLING

The purpose of obtaining surface soil samples at the MWL was to ascertain potential concentrations of radioactive contaminants in the upper 2 inches of soil. Previous data (USDOE, 1988) showed high levels of tritium concentrated near the surface at locations within the classified disposal area. Also, elevated concentrations of tritium were reported in sampling studies performed at the MWL in 1982 (Millard et al, 1983). The sampling of the surface soils at the MWL during this investigation was completed to substantiate these earlier studies and characterize potential contamination.

3.4.1 Surface Soil Sampling Methods and Analyses

A total of 153 samples, including 14 duplicates, were collected from the classified and unclassified areas of the MWL. Figure 3-3 shows grid locations for the samples collected. In addition, four background samples (north, east, south and west from the landfill) were collected, and seven field blanks were collected for QA verification.

Samples were collected using laboratory-clean stainless steel spoons and aluminum trays (ER Program SOP 5.8). Aliquots were collected from five locations within each grid, these being the center of the grid and near each corner of the grid (The exception to this were grids H4, H5, J5 and L5 which were inaccessible due to the open Trench F). Each composite sample was homogenized in the aluminum tray and placed into a plastic, 1-liter, wide-mouth jar with teflon-lined screw top lid and sealed with black electrician's tape. All samples were labeled with sample number, sampling date, the sample collector's names, and analytical parameters. Sample numbers were entered into logs with their corresponding grid location.

Two rinsate samples from the decontamination of field equipment were collected. All samples were submitted to TMA/Eberline for analyses for tritium, beta, and gamma radiation emitters (K-40, Th-232, Ra-226 and Cs-137). Ten percent of the samples were analyzed as a statistically viable population to determine if tritium as well as alpha, beta and gamma emitters could be detected.

3.5 SOIL BORINGS AND SUB-SURFACE SAMPLING

The drilling of soil borings at the MWL had a dual purpose: (1) collection of subsoil samples from discrete depths for chemical and radiological analyses, and (2) to characterize and describe the site lithology to 150 feet. Results from previous studies (Millard et al., 1983) suggested the presence of tritium in the samples from depths of 75 feet below the ground surface (bgs) in the classified area of the MWL. Subsoil samples were collected during the Phase 1 RFI and to supplement the earlier studies and to better characterize contamination of subsoils at the MWL.

3.5.1 Soil Boring

Eighteen soil borings were drilled to depths ranging from 75 to 150 feet, including five angled borings (15^{o} - 30^{o} from vertical) directed under the disposal pits of the landfill. Fifteen soil borings were drilled during 1989, and the remaining three soil borings, SB-8, 10, and 17, were completed during June of 1990. These three borings were angle drilled. Figure 3-4 illustrates the soil boring locations and Table 3-2 provides specific depths of the completed boreholes. The borings were drilled using two CME Model 55 drill rigs. Drilling was accomplished with 4-inch I.D. hollow-stem augers in 5-foot flights (ER Program SOP 4.1). For angled borings, 4-inch I.D. hollow-stem augers were advanced

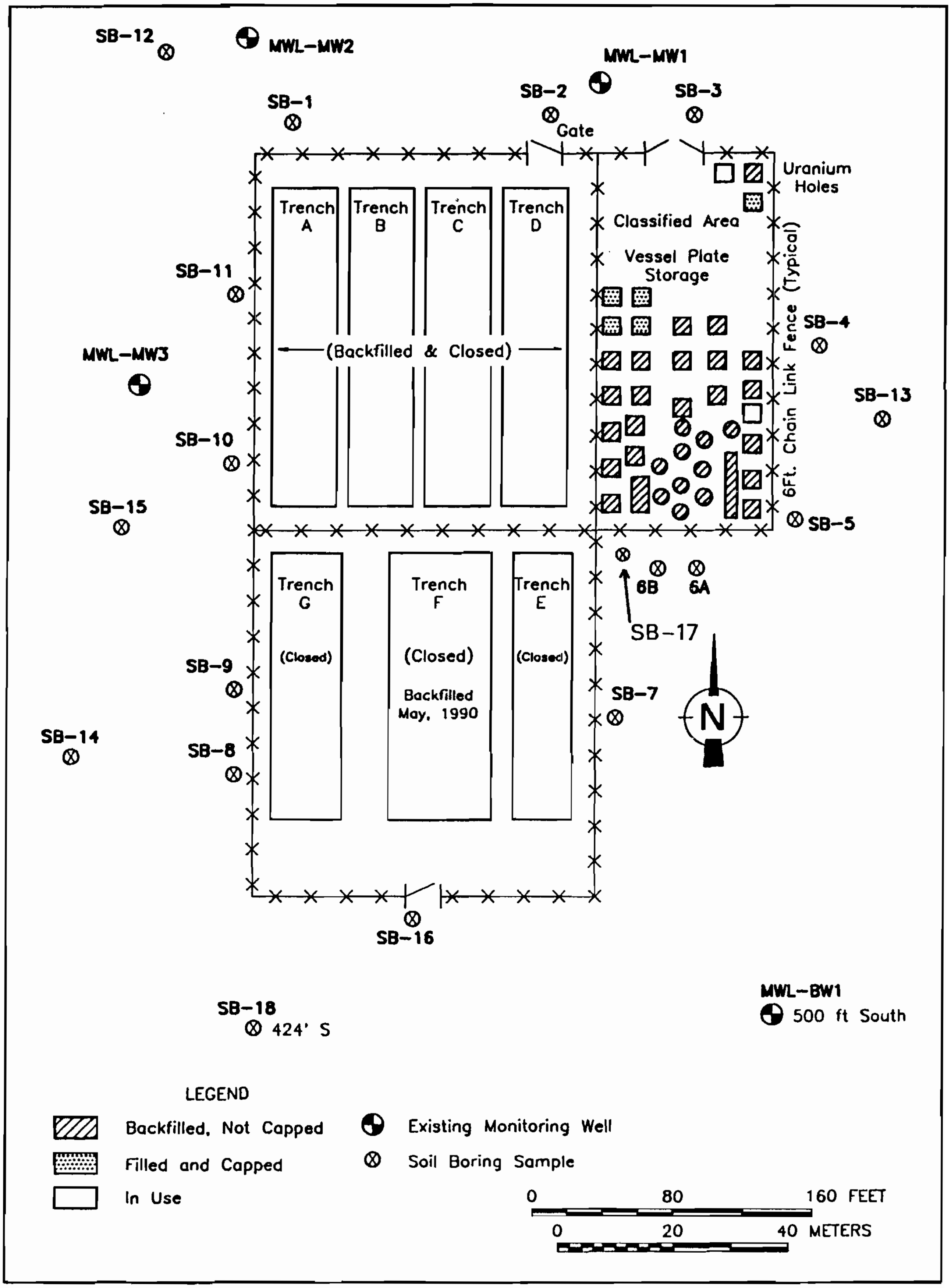


Figure 3-4: SOIL BORING LOCATIONS AT MWL

Table 3-2

SOIL BORING COMPLETION DATA
(Chronological order of completion)

Soil Boring	Planned Depth (feet)	Actual Depth (feet)	Dates of Drilling	Drilling Time (hours)	Sampling Method	No. Samples Collected	Comments
SB-18	150	150	9-7-89/9-9-89	16	Split Spoon	21	Water added down hole to loosen materials.
SB-14	100	100	9-11-89/9-12-89	10	Split Spoon	15	Screened (5 ft) PVC pipe set at 35 feet.
SB-12	100	80	9-12-89/9-12-89	6.5	Split Spoon	15	Screened PVC (5 ft) set at 51 feet.
SB-15	100	100	9-12-89/9-13-89	9	Split Spoon	15	Screened (5 ft) PVC pipe set at 45 feet.
SB-13	100	95	9-12-89/9-13-89	9	Split Spoon	13	Screened PVC (5 ft) set at 81 feet broken auger at 95 feet-recovered
SB-3	100	100	9-13-89/9-14-89	7	Split spoon	14	
SB-9	150	131	9-13-89/9-15-89	15	Split Spoon Core (a)	16	Continuous core sampling started at 45 feet.
SB-16	100	110	9-14-89/9-18-89	10	Split Spoon	15	HNu malfunction-interrupted drilling. Aluminum access tube placed to 30 feet.
SB-2	150	128	9-18-89/9-19-89	12	Core (a)	18	HNu readings in excess of two ppm, dense gravel and cobble 105-128 ft.
SB-11	100	90	9-19-89/9-19-89	8	Split Spoon	17	Aluminum access tube 30 feet.
SB-7	100	100	9-20-89/9-20-89	6	Split Spoon	15	High HNu readings from 10 to 30 feet.
SB-5	150	150	9-20-89/9-21-89	14	Core (a)	22	

(a) Continuous core sampling.

[QT]SX3034:D2722, #3488, PM = 10

Table 3-2 (Cont.)

Soil Boring	Planned Depth (feet)	Actual Depth (feet)	Dates of Drilling	Drilling Time (hours)	Sampling Method	No. Samples Collected	Comments
SB-4	100	100	9-21-89/9-21-89	6	Split Spoon	14	
*SB-1	100	75	9-25-89/9-26-89	8	Core (a)	15	30° angle (from vertical)
*SB-6	100	80	9-27-89/9-28-89	11	Core (a)	13	First Attempt to 35 feet second attempt approx. 15 ft W of first.
*SB-8	100	93.5	6-12-90/6-13/90	12.5	Core (a)	19	Added 10 gallons of water to ease drilling. 15° angle (from vertical)
*SB-10	100	80	6-14-90/6-15-90	13	Core (a)/ Split Spoon	18	15° angle (from vertical)
*SB-17	100	93.5	6-19-90/6-22-90	17	Core (a)/ Split Spoon	16	Drilled in level B protective equipment 30° angle (from vertical, directed toward trench D)

*ANGLE BORINGS: Actual completed depth is linear feet of the angled boring.
(a) Continuous core sampling.

with a modified CME Model 55 Hollow Stem Auger drill rig which permitted angled positioning at the mast, and utilized 4-inch I.D. hollow-stem augers.

Because of complex inter-layering of sands, silts, gravel, and cobbles (large stones), the borehole drilling was often difficult. Layers of gravel and cobbles were generally encountered at depths greater than 30 feet, although these layers could also be found at shallower depths. At greater depths, drilling became more difficult as stony layers were encountered. A detailed discussion of borehole lithology is presented in Section 4.

Most of the boreholes were completed to within 85% of their planned depths (Table 3-2). The completed boreholes were capped with a 2-inch thick concrete pad and marked with the soil boring number. A summary of drilling operations for each borehole is provided below.

SB-1: Soil Boring SB-1 was an angle boring (30^{o} from vertical) located immediately north of Trench A in the unclassified area. The point of entry of the augers was 18.5 feet north of the fence. A layer of cobbles encountered between 35 and 40 feet bgs caused horizontal deflection of the auger string. This deflection caused difficulty in extracting the core barrel sampler, and significantly increased the probability of the augers breaking within the borehole. The boring was stopped at 75 linear feet, or approximately 66 vertical feet in depth, at a point approximately 16 feet inside the unclassified area fence. The finished boring was grouted with a cement-bentonite (5%) mix.

SB-2: Soil boring SB-2 was located near the north gate of the unclassified area of the MWL. Sediments were primarily coarse sands, gravel, and silt. Dense limestone and cobble layers made drilling very difficult from 105 feet to 128 feet in depth and drilling ceased at 128 feet bgs. HNu PS-101 PID readings taken from inside at the top of the augers, when 128 feet of depth was reached, measured greater than 70 ppm. The completed borehole was grouted with a cement-bentonite (5%) mix.

SB-3: Soil boring SB-3 was located north of the classified area of the MWL adjacent to the burial pits in the northeast corner. Difficult drilling from intermittent cobble and gravel layers was encountered from 50 to 70 feet bgs. SB-3 was completed to a depth of 100 feet, and grouted with a cement-bentonite (5%) mix.

SB-4: Soil boring SB-4 was located along the east fence approximately 104 feet north of the southeast corner of the classified disposal area. The drilling was relatively uneventful through sands, silts, and gravels. The boring was completed to a depth of 100 feet and grouted with a cement-bentonite (5%) mix.

SB-5: Soil boring SB-5 was located at the southeast corner of the classified disposal area. Continuous core samples were collected concurrent to drilling. Drilling below 100 feet in depth was difficult due to the frequent occurrence of cobble and caliche depositions.

HNu PS-101 PID monitoring at the top of the auger string from 100 to 105 feet bgs revealed volatile organic compounds in concentrations exceeding 650 ppm. HNu readings from samples collected at 105 feet bgs indicated orgnic vapors in concentrations as high as 230 ppm. The HNu measurements diminished to 0 ppm below 110 feet in depth. The boring was completed to a depth of 150 feet and grouted to the surface with a cement-bentonite (5%) mix.

SB-6: Soil boring SB-6A was an angle boring located south of the classified area approximately 20 feet from the fence. The boring was angled toward the landfill. Dense cobbles, encountered between 25 to 35 linear feet (approximately 20 to 28 feet bgs), resulted in refusal at 35 linear feet. The soil boring was abandoned and grouted to the surface with a cement-bentonite (5%) mix. The drill rig was repositioned 15 feet west for a second angled boring attempt (6B). Cobble layers consisting of dense limestones and granites encountered at the 60 to 65 foot depth caused horizontal deflection of the drill string. Drilling was completed to 80 linear feet, or a depth of approximately 65 feet bgs. The lateral point of completion is estimated to be approximately 27 feet within the classified area boundaries. The completed boring was grouted with a cement-bentonite (5%) mix.

SB-7: Soil boring SB-7 was located along the east fence of the south one-half portion of the unclassified area, approximately 102 feet north of the southeast corner. HNu measurements of 220 ppm were noted in the drill string from 10 feet bgs. Drilling proceeded through predominant sands, gravel, and cemented silts. The boring was completed to a depth of 100 feet and grouted with a cement-bentonite (5%) mix.

SB-8: Soil boring SB-8, was located along the west fence of the unclassified area at the southwest corner of the landfill. Continuous cores were collected to a depth of 46 feet bgs. Below 46 feet samples were collected intermittently due to cobble or large stores encountered at 46 feet, 53 feet, and 65 feet bgs. The core barrel was removed in these zones. Drilling became difficult below 85 feet bgs due to binding of the augers by sands and silts. The boring was terminated at 93.5 feet bgs. The completed boring was sealed with a cement-bentonite (5%) mix.

SB-9: Soil boring SB-9 was located along the west fence of the unclassified area, approximately 120 feet north of the southwest corner of the landfill. Split-spoon sampling was employed during the first 40 feet of drilling, then released by continuous core sampling to the total borehole depth. Difficult drilling conditions prevailed at depths deeper than 65 feet due to intermittent layers of cobble and large stones. Strongly cemented silts and sands occuring deeper than 100 feet in depth slowed the drilling and eventually caused cessation of further drilling at 131 feet bgs. The borehole was backfilled with auger cuttings to 30 feet bgs. A 30-foot, 2-inch I.D. PVC pipe, capped at the bottom, was installed in the open hole. This cased hole will be used for future geophysical measurements. The annular space to the surface was backfilled with remaining auger cuttings to the ground surface.

SB-10: Soil boring SB-10 was located along the west fence of the unclassified area and adjacent to the south end of Trench A. Drilling became difficult at 27.5 feet bgs where a cobble zone was encountered. This cobble zone extended to 80 feet bgs and presented difficult drilling conditions throughout the entire boring. The boring collapsed around the augers and after repeated attempts to redrill, the boring was terminated at this depth.

SB-11: Soil boring SB-11 was located along the west fence of the unclassified area, approximately 80 feet south of the northwest corner of the landfill. Difficult drilling in dense cobbles and caliche sediments was encountered at depths from 45 to 60 feet, and at depths greater than 80 feet. Measurements of organic vapors (22 and 45 ppm) were recorded at the top of the auger string at depths of 80 and 90 feet, respectively. Binding of the augers occured at 90 feet and caused cessation of drilling at that depth. The borehole was backfilled with the auger cuttings to 30 feet bgs. At that point a 30-foot, 2-inch I.D. aluminum tube was placed to the surface for future soil moisture measurements. The annular space was filled with auger cuttings.

SB-12: Soil boring SB-12 was located northwest of the MWL, approximately 102 feet west-northwest of northwest corner of the landfill. Drilling was unencumbered to approximately 80 feet bgs. Drilling could not be advanced beyond 80 feet bgs due to tight, dense materials. The borehole was backfilled with auger cuttings to 30 feet bgs. A 30-foot, 2-inch I.D. PVC pipe with 5 feet of screened interval at the bottom was installed for future investigative purposes and the remaining annular space back-filled with cuttings to the ground-surface.

SB-13: Soil boring SB-13 was drilled approximately 81 feet northeast of the southeast corner of the classified area of the landfill. The boring was completed to a depth of 100 feet. A 30-foot, 2-inch I.D. PVC pipe with 5 feet of screened interval at the bottom was set into the borehole at 81 feet bgs for future investigative purposes. Auger cuttings were used to backfill to the ground-surface.

SB-14: Soil boring SB-14 was located approximately 81 feet west of the south half of the unclassified disposal area. Cobbles and cemented sands were encountered from 35 to 60 feet and from 70 to 80 feet, making drilling slow and difficult. However, the borehole was completed to a depth of 100 feet. A 35-foot, 2-inch I.D. PVC pipe with 5 feet of screened interval at the bottom was set into the borehole from 35-foot depth to the surface for planned soil water experiments. The remainder of the borehole annulus was backfilled with auger cuttings.

SB-15: Soil boring SB-15 was located approximately 81 feet west of the unclassified area of the MWL. The occurrence of cobble and gravel layers at depths from 3 feet to 40 feet and from 50 to 80 feet made drilling slow and difficult. At depths from 30 to 35 feet, rocks greater than 6 inches in diameter were brought to the surface by the augers. The borehole was completed to a depth of 100 feet and backfilled with auger cuttings to 45 feet bgs. A 45-foot, 2-inch I.D. PVC pipe with 5 feet of screened interval was set into the borehole at 45 feet bgs. The remaining borehole annulus was filled with auger cuttings.

SB-16: Soil boring SB-16 was drilled at the south side of the unclassified area of the MWL, immediately adjacent to the entry gate. Large cobbles were encountered from approximately 1 to 10 feet in depth. Intermittent layers of cemented sands and cobbles presented difficult drilling conditions. At 100 feet in depth, sustained readings of organic vapors 100 ppm were noted using the HNu PS-101 PID. Drilling continued to 105 feet bgs to obtain a confirmatory soil sample. The borehole was backfilled with auger cuttings to 30 feet below ground surface. A 30-foot, 2-inch I.D. aluminum access tube for monitoring soil moisture was placed from 30 feet to the ground-surface and the annulus filled with auger cuttings.

SB-17: Soil boring SB-17, was drilled at an angle at the southeast corner of the classified area. SB-17 was drilled 26° from vertical bearing N5°W beneath Trench D. The first 10 feet of the boring was cased to stabilize the borehole. Gravel was encountered at 62.5 feet bgs. The continuous core barrel sampler was abandoned due to a difficulty in drilling and soil samples were collected at five foot intervals using a split spoon sampler. The boring was terminated at 93.5 feet. The completed boring was sealed with cement-bentonite (5%) mix.

SB-18: Soil boring SB-18 was located approximately 420 feet south of the southwest corner of the unclassified area of the MWL and serves the background boring. Cobble layers from 45 to 60 feet, and again at 90 feet bgs, made drilling very difficult. After sampling at 90 feet, water was added to the borehole to loosen cemented silts and gravels in order to facilitate drilling beyond a depth of 100 feet. A total of 67 gallons of potable water, obtained from the City of Albuquerque water supply, were added downhole at depths from 95 to 150 feet bgs. SB-18 was completed to the planned depth of 150 feet. The borehole was backfilled to 50 feet bgs with auger cuttings and the remainder filled with a cement-bentonite (5%) grout mix.

3.5.2 Subsoil Sampling

Subsoil samples were collected concurrently with the drilling at depths described in the work plan. Samples were typically collected at depths of 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, and 100 feet, and at 110, 120, 130, 140, and 150 feet in soil borings that were drilled to that depth. A total of 295 samples were collected including 19 duplicates and five field blanks (Table 3-3). Samples were not obtained at depths where recovery of soil/sediment materials was inadequate. Partial samples were collected when only a fraction of full sample recovery occurred. The lithologic logs (Appendix A) illustrate sample locations, types of soils and/or sediments recovered, and the percent of recovery.

Samples were recovered by one of two methods: split-spoon samples with brass sleeve inserts; or in CME plastic tubes inserted into a 5-foot CME core barrel. Two-inch I.D. split-spoon samplers 24 inches in

Table 3-3

SUBSOIL SAMPLE DISTRIBUTION

	Samples Collected	Organic/Metal Non-Mixed Analyses (A)	Radioactive Analyses (B)	Mixed Waste Sample Analyses (C)
Soil Samples	271	177	265	8
Soil Duplicates	19	8	15	
Soil Blanks	5	5	5	
Equipment Rinsates	9	9		
Decon Water	1	1	1	
Total	304	199	285	8

A) E & E Lab
B) TMA/Eberline
C) TMA/Norcal

length with multiple brass sleeve inserts (1-7/8 inch I.D.) were used to collect samples from boreholes SB-18, SB-14, and SB-12. The split-spoon barrel was lowered down the auger flights and hammered into the geologic material at each sampling depth. Standard penetration counts were recorded in field log books for each 6-inch depth the split-spoon barrel was advanced.

Following recovery of the split-spoon sampler, the brass-encased samples were removed the split-spoon and the ends screened for organic vapors using an HNu PS-101 photoionization detector with a 10.2 volt lamp, and for alpha, beta, and gamma radiation using a Bicron Surveyor M ratemeter with a GM pancake probe. A small portion of the sample was removed for lithologic description and logging. The remaining samples were covered with aluminum foil at the open ends, sealed with black electrician's tape and coated with wax to prevent moisture or organic vapor loss. A sample tag indicating the sample number, date of collection, analytical parameters, and the sampler's names were affixed to each sample. The sample numbers were recorded on a sample tracking sheet and cross referenced with the borehole number and depth.

Split-spoon barrels of 18 inches in length and 2 inches I.D. were used to collect samples at the specified depths for soil borings SB-3, SB-4, SB-7, SB-11, SB-13, SB-15, SB-16 and SB-18. Two 9-inch brass sleeve inserts were placed into the split-spoons to contain the collected sample. The sample collection procedures were identical to those previously described with the exception that plastic caps were used to seal the ends of the brass sleeves.

Continuous core samples were collected during the drilling of boreholes SB-2, SB-5, and SB-9, as well as during the drilling of angled borings of SB-1 SB-6, SB-8, SB-10, and SB-17. A 5-foot CME split barrel (2.5-inch I.D.) with two clear, plastic (lexan) sleeve inserts (each 30 inches long) was advanced with the augers in 5-foot increments. Upon removal of the core barrel, the sample-filled (depending on percent recovery) inserts were removed, and plastic caps were immediately placed on both ends. The sample depth was marked on the bottom end of each tube. Lithologic descriptions were recorded into the log book, and analytical samples collected into brass sleeves from the bottom 2 to 3 inches of each tube. After the brass sleeves were filled, they were sealed and labeled. All samples were preserved in ice for shipment to the respective analytical laboratories.

3.6 HEALTH AND SAFETY MONITORING

Health and safety monitoring, required on all sites involving hazardous materials or wastes (29 CFR 1910), also provided information regarding the existence and possible release of contaminants from the MWL.

Continuous personnel monitoring was performed during field work using direct reading instruments to detect exposure to chemical and radioactive hazards. Radiation exposures were monitored, under the supervision of a health physicist, by use of personal thermoluminescent dosimeter (TLD) badges, pocket dosimeters, and personnel and sample monitoring using a rate meter with a GM pancake probe. Exposures to volatile organics were continually monitored using an HNu PS-101 photoionization detector.

Pocket dosimeters (DCA model 862) were used to measure exposure to gamma radiation. The dosimeters were calibrated and distributed each morning prior to work activities. Detailed logs of exposure readings from each on-site person's dosimeter were kept for tracking purposes. TLD badges are issued and worn daily at all hazardous waste sites.

The exclusion zone was continually monitored for volatile organic compounds and radiation during all work activities. Readings were taken at the top of auger flights during drilling, and in the breathing zone using both the HNu and Bicron instruments and an Eberline model HP-210 rate meter with shielded GM pancake probe. Additionally, all samples and auger cuttings were screened for potential contamination. An elevation of data collected from personnel health and safety monitoring indicated that there were no exposures to hazardous levels of organic or radioactive contaminants during field sampling and drilling activities.

To supplement field monitoring, bioassay (urine) samples were collected from personnel on-site for analysis for tritium. The laboratory results of all samples obtained from the bioassay program were negative.

3.7 DEVIATIONS FROM THE WORKPLAN

Unplanned field conditions frequently require deviations in sampling and related field activities from the site workplan. Difficult drilling and sampling conditions, physical hazards, and changing field conditions (weather, equipment failure, changes in monitoring, materials, etc.) contributed to such changes during field work at the MWL. Table 3-4 presents a summary of changes from the Phase 1 RFI workplan (SNL, 1989) for the work completed at the MWL. These changes are further described in the following paragraphs.

3.7.1 Changes in Surface Soil Sampling

A total of 164 surface soil samples including duplicates and blanks were collected at the MWL. The workplan specified the collection of 182 samples. Samples could not be collected where surface obstacles prevented access (i.e., above ground storage casks, disposal pits and associated concrete, steel, or wood caps, unyielding ground), or near areas of excessively high radiation marked areas (previously roped off by SNL). Originally, all of the samples were to be analyzed for tritium, gross beta activity, gamma emitters (gamma spectrometry), isotopic uranium, and isotopic plutonium. Ten percent of the samples (randomly selected) were analyzed to determine if the radiological parameters could be determined. The remainder of the samples were list by the laboratory. The actual analyses were for tritium, gross beta activity, gross alpha activity, gamma emitters, and isotopic uranium.

3.7.2 Subsoil Sampling

The workplan specified the collection of 302 subsurface soil samples for analyses for tritium, gross beta activity, gamma emitters,isotopic uranium (ISO-U), isotopic plutonium (ISO-P), strontium

Table 3-4

CHANGES FROM THE MWL STAGE I RFI WORKPLAN

Activity	Workplan	Completed Work
Surface Soil Sampling	182 Samples collected for analyses for Tritium, Gross Beta, Gamma Spectrometry, Isotopic-Uranium, and Isotopic Plutonium. 100% Analysis of the samples.	164 samples collected for Analyses for Tritium, Gross Alpha/Beta activity, Gamma Spectrometry, and Isotopic Uranium. Iso-Plutonium only if elevated gamma readings noted. Only 10% analyzed in 1989. Remainder to be analyzed in Phase II.
Subsoil Sampling	302 samples to be collected and analyzed for Tritium, Gross Beta Activity, Gamma Spectrometry Isotopic Plutonium Isotopic Uranium Strontium 90 TCL* Semi-Volatile Organics	285 samples collected and analyzed for: Tritium, Gross Beta activity, and Gamma Spectrometry. 214 samples analyzed for gross alpha activity 20 samples analyzed for Isotopic Uranium 20 samples analyzed for Isotopic Plutonium 185 samples analyzed for TCL Volatile Organic Cpds. TCL Semi-Volatile Organic Cpds. 70 Samples analyzed for TCL Metals
Soil Boring Drilling	18 soil borings to be drilled, including: 4 angled borings 5 deep (150') borings 9 100 ft borings	18 soil borings completed, including: 3 angled borings 4 deep borings 11 70-100 ft borings
Soil Monitoring Access Tubes	Not presented in the work plan.	4 2-inch PVC monitoring tubes with 5 feet screened (0.010 inch) at bottom 1 2-inch PVC monitoring tube capped at the bottom. 2 2-inch diameter, 30 foot long, aluminum access tubes.

*TCL: Target Compound List
HSL: Hazardous Substances List

90 (Sr-90), and semi-volatile organic compounds (target compound list), including duplicate samples. Additionally, 45 subsurface soil samples recovered from the CME core samples were to be evaluated for the hydraulic conductivity, porosity, initial moisture, and moisture retention curves.

Because of partial sample recovery, or in some cases, no sample recovery, 280 samples (including 15 duplicates) were collected and analyzed for tritium, gross beta activity, and gamma emitters. Twenty samples from SB-3 were analyzed for isotopic uranium and plutonium assays due to the proximity of this boring to uranium disposal pits.

A total of 185 soil samples were analyzed for chemical analyses for volatile organic compounds, and semi-volatile compounds in lieu of the 302 originally planned. Of those 185 samples, 70 samples were analyzed for Target Compounds List (TCL) metals.

3.7.3 Soil Monitoring Access Tubes

For the future purpose of monitoring soil moisture parameters and to determine the intrinsic permeability of sediments to water at various depths, at the MWL, either 2-inch I.D. PVC or aluminum access tubes were installed in several of the completed boreholes. Schedule 40 PVC pipe with 5 feet of 0.010-inch slotted screen at the bottom was installed in soil borings SB-12 (30 feet), SB-13 (81 feet), SB-14 (35 feet), and SB-15 (45 feet).

In borehole SB-9 a 2-inch I.D. schedule 40, PVC pipe was installed from the ground surface to 30 feet in order to perform borehole geophysics. Additionally, for future monitoring of soil moisture dynamics, 2-inch I.D. aluminum access tubes were placed from ground surface to 30 feet in boreholes SB-11 and SB-16. The moisture monitoring will be performed with a neutron probe moisture meters.

Silica sand (10-20 inch mesh) was placed in the annular space adjacent to the screened intervals in borings SB-12, SB-13, SB-14, and SB-15. In the boreholes containing the access tubes, auger cuttings were used for backfill.

3.8 QUALITY ASSURANCE/QUALITY CONTROL

The validity of field and analytical data generated by E & E was ensured through the application of specific quality assurance (QA) and quality control (QC) activities. QC consisted of a system of checks on field sampling and laboratory analysis (through the use of field blanks, duplicates, documentation of sample movement, chain-of-custody records, etc.) to provide supporting information on the quality of the analytical methods employed and the data obtained. QA/QC protocol consistent with DOE Order 5400 was applied to sample collection, control, and analysis; instrumentation calibration, operation, and maintenance; document control; and review of project deliverables.

3.8.1 Sample Collection, Control, and Analysis

Samples were collected according to applicable ER Program SOPs, as described in Section 3.4 and 3.5. Sample identification and custody procedures ensured that the quality of the samples was maintained during their collection, transportation, storage, and analyses. Sample identification and custody documentation used in this project included:

- Field Logbooks--containing comprehensive sampling information, including sample number (was to be generated using a standard format defined in the logbook), names of samplers, date and time of collection, and sampling conditions.

- Sample Labels--each sample container was identified with label or tag affixed to the container and protected with clear or Mylar tape. Labels included the sample number, date of collections, names of samplers and analyses required.

- Custody Seals--signed and dated custody seals were used to seal sample transport containers (e.g., coolers).

- Chain-of Custody Records--the chain-of-custody record provided an accurate, written record used to trace the possession and handling of each sample from collection to completion of all required analyses.

Individuals responsible for the transfer of samples signed and dated the chain-of-custody records at each point of transfer. Copies of the chain-of-custody documents were retained by the field team and included in the project file; the remainder of the records accompanied the samples to the applicable laboratory.

Samples were packaged for transportation in accordance with U.S. Department of Transportation regulations (49 CFR) and ER Program SOP 1.5. Sample lids and/or caps were secured with tape, sealed in wax,and each sample container was placed in a plastic bag prior to packaging for shipping. Absorbent material was placed around the packaged samples and samples were kept cool until shipment. Shipping containers were closed, sealed, labeled, and addressed for shipment. Each shipment contained the appropriate chain-of-custody documents and the containers were sealed with signed and dated custody seals.

3.8.2 Instrumentation Calibration, Operation and Management

Field instruments were calibrated, operated, and maintained in accordance with the ER Program SOPs and manufacturer specifications. Daily performance checks and/or calibrations were performed on all field instruments (e.g., HNu, radiation instruments, etc.) to ensure they measured and detected organic vapor and radiation accurately. Instruments that did not adequately respond were removed from service until the problems were corrected. Results of daily checks are recorded on the appropriate data form and in the instrument logbook, and are summarized in the site logbook.

3.8.3 Document Control

Document control procedures were used to coordinate the distribution, coding, storage, retrieval, and review of all data collected during sampling and other field tasks. Analytical records are maintained at each analytical facility; all other field records (including copies of analytical results) are maintained at the discretion of SNL. Raw data has been maintained in project files and copies are included in Appendix C of this report.

3.8.4 Laboratory QA/QC

Laboratory and radiochemical sample analyses were performed according to standard operating procedures outlined in the TMA/Eberline Environmental and Bioassay Analytical Procedures Manual (TMA/Eberline Albuquerque, N. M., 1989). A QC protocol, incorporating instrument calibration with traceable radioactive sources, instrument checks with reference radioactive sources, and daily background radiation counts, in addition to standard duplicate sample analyses, internal matrix spikes, and matrix spike duplicates which were (performed with each batch of samples) was implemented for this project.

Efficiency, background, resolution, and plateau characteristics of radiation detection instruments were regularly evaluated during the course of the investigation. Instruments that did not perform within established acceptance bounds were removed from operation until the problems were rectified.

Laboratory QA/QC for the organic and metals analyses included a series of sample matrix blanks and spikes to validate the efficiency of the analytical instrumentation. Instrumentation was regularly tested and calibrated for precision of results. Inoperative or malfunctioning equipment was removed from service until problems were corrected. To validate all data generated by the lab, a chemist independent of the laboratory and project scrutinized all data generated with sample tracking forms, chain-of-custody forms, and field notes and/or data to ensure that all information matched.

3.8.5 Rinsate, Duplicate, and Field Blank Samples

QC samples were used as an internal QC check of both field procedures and analytical methods. Field duplicates and field blanks (trip, routine field, or equipment blanks) were included in the sampling protocol and were not identified to the laboratory as duplicates or blanks. Laboratory-based QC consisted of standards, replicates, spikes, and blanks, and comprised approximately 10% of the data generated.

The soil sampling program for the field investigation at the MWL included the collection of 11 equipment rinsates, 23 duplicate samples, and 9 field blanks. Equipment rinsates were collected (2 from surface soil sampling and 9 from subsurface soil sampling) using distilled and de-ionized water collected in glass sample containers. The rinsate samples collected as a result of surface soil sampling were analyzed for tritium, gross beta activity, gamma emitters, and uranium. The rinsate samples collected from the subsoil sampling were analyzed for volatile organic, semi-volatile organic compounds, as well as TCL metals.

A number of duplicate surface and subsurface soil samples (14 and 19, respectively) were collected, and analyzed with the original samples as described in Section 3.4.1 and 3.5.2. Subsurface duplicates were collected in tandem with the primary samples from multiple brass sleeves within the split spoon.

Field blanks were collected as an additional QA measure. Four field blanks were collected during surface soil sampling and two during subsurface soil sampling. Field blanks were obtained in sample containers similar to those used during the surface (plastic jar) and subsurface sampling (brass sleeves) and submitted with the other samples for analyses.

Subsurface sample collection distributions are shown in Table 3-3. Analytical results of the field QA samples are discussed in Section 5.

4 GEOLOGIC INTERPRETATION

4.1 LITHOLOGIC DESCRIPTION

Eighteen soil borings, including five angle borings, were completed around and beneath the MWL. This section includes lithologic descriptions and assessment of geologic materials encountered during the drilling operations of the boreholes as well as a discussion of cross-borehole lithologic correlations.

To facilitate this discussion, borehole lithologies will be addressed according to site quadrants. The background soil boring will be considered separately due to its relatively remote location (428 feet south) from the landfill area. Lithologic cross sections illustrating sedimentation encountered in the boreholes represented by A-A′ (south half) and B-B′ (north half) in Figure 4-1 are presented in Figures 4-2 and 4-3, respectively. These cross sections show a likely lithologic representation of geologic materials at the MWL. The lithologic logs for each borehole are graphically presented in Appendix A of this report.

4.1.1 Southwestern Quadrant

Soil boring locations SB-16, SB-9 and SB-14 are located within the southwestern quadrant of the site (Figure 4-2). Surficial sediments at these holes are composed primarily of light brown, fine-grained sands to silty sands. This sand is probably of aeolian origin and is approximately 10 feet thick over this portion of the site. A thin layer of cobbles, approximately 3 feet thick, was encountered in SB-16 at a depth of 7 feet, but was not encountered in the other boreholes in this quadrant. At approximately 10 feet, these sands become interspersed with fine to medium gravels in SB-9 and SB-14. The gravels are predominantly rounded to sub-angular quartz pebbles and sub-rounded to

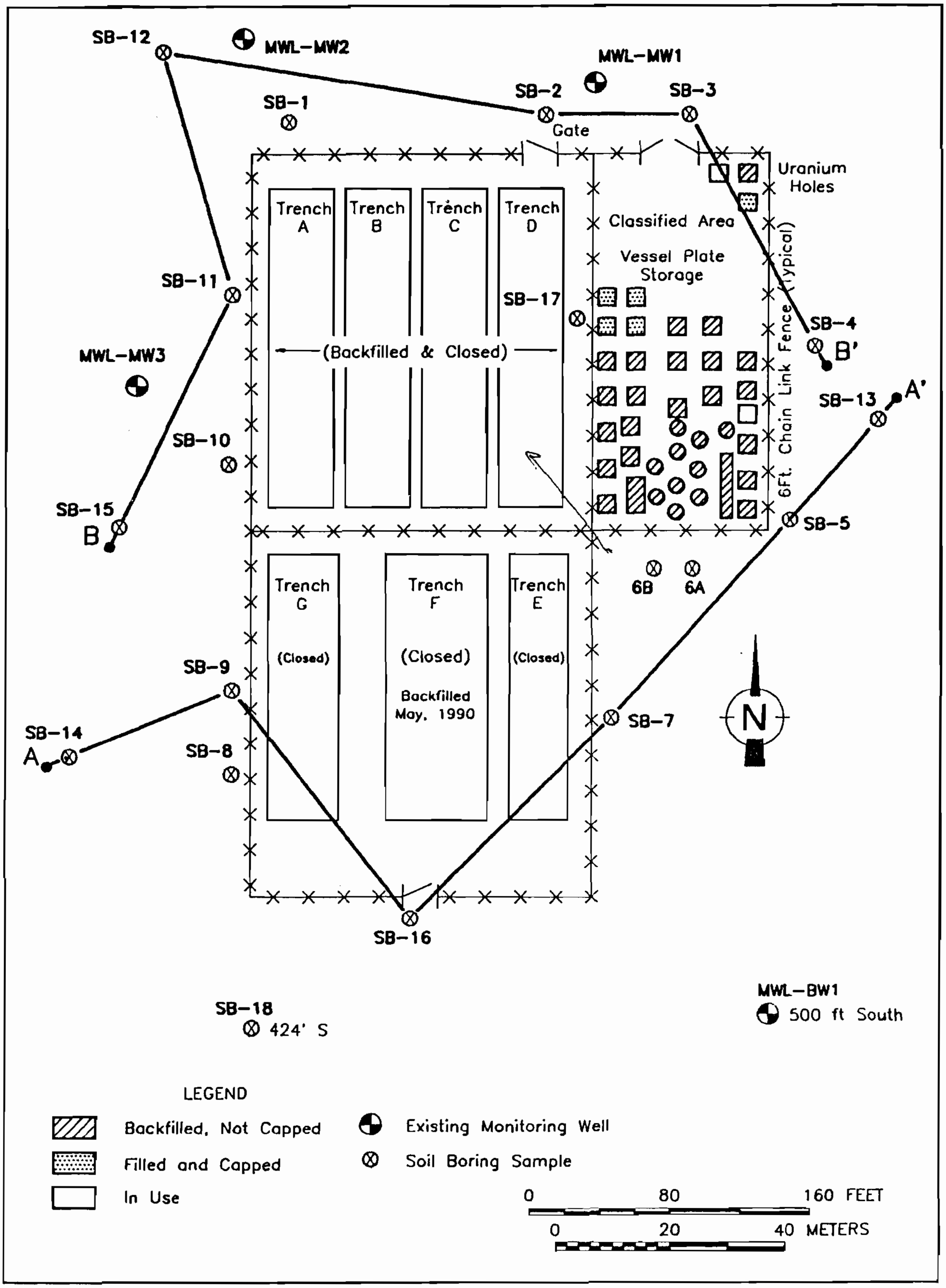


Figure 4-1: LITHOLOGIC CROSS SECTIONS: SOUTH (A-A') AND NORTH (B-B')

angular limestone clasts. These gravels are essentially absent in SB-16 though the sands were coarse-grained. All three boreholes exhibit significant calcareous zones beginning at approximately 10 to 14 feet. These zones include thin, slightly indurated caliche layers and calcareous coatings on gravel clasts. Calcareous layers and coatings are common to a depth of about 10 to 25 feet.

At approximately 35 to 40 feet bgs increasingly coarse sands and gravels were encountered for 1 to 2 feet, followed immediately by cobble-sized fragments in all 3 borings. The larger fragments are predominantly sub-rounded to angular clasts of sparitic to micritic limestone, quartzite, and various igneous rock. The matrix continues to be a dry, tan, loose sand at this depth. At approximately 45 feet, the cobble layer grades to a loose, fine-grained to silty sand, interspersed with sub-rounded to sub-angular igneous and metamorphic pebbly gravel. At this depth, SB-16 indicates an increasingly calcareous content, including small-scale caliche deposits, which are not present in either SB-9 or SB-14. The matrix material in SB-16 coarsens somewhat to medium grained sands, with less silt content, within this depth range.

From 50 to 70 feet, the lithologies of the three boreholes vary significantly. SB-14 exhibits intermittent cobble layers, each up to 6 feet in thickness, from 46 to 70 feet. Between these cobble layers, silty sands and finer gravels are prevalent. The gravel is mostly quartz and granite and is generally rounded to sub-rounded. In SB-9 no significant cobbles were encountered until 65 feet. Above this depth, the lithology is predominantly a calcareous, reddish tan, fine grained sand to silty sand, interspersed with rounded fine to medium quartz gravels. In SB-16 the same assortment of grain sizes found in SB-9 were identified, though the calcareous content was much greater, producing whitish tan sand, and the gravel was more angular, or less weathered. It should be noted that the sediments from SB-16 were consistently more calcareous and less weathered through the first 70 feet.

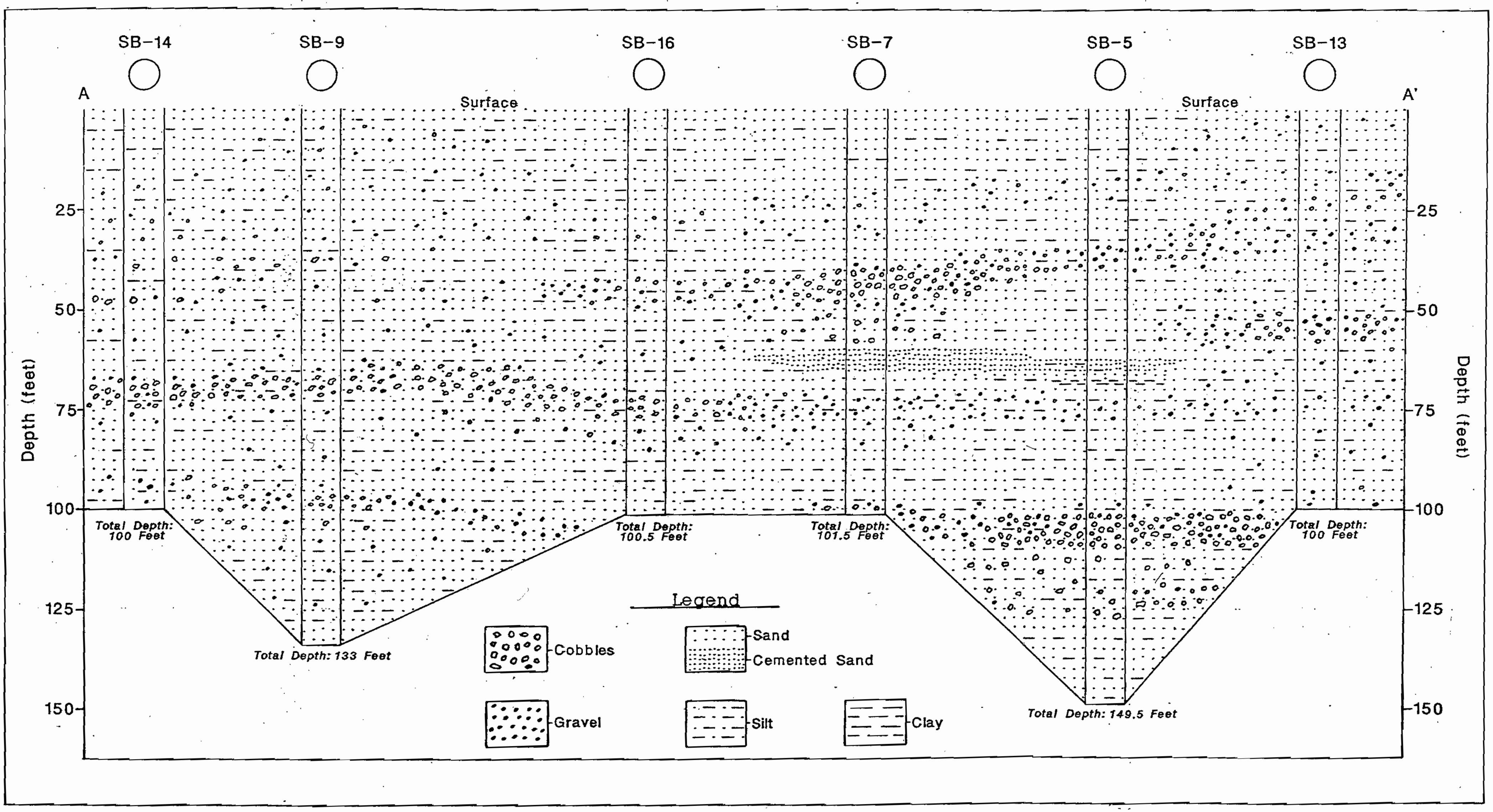
At approximately 65 feet, a continuous layer of cobbles about 7 to 10 feet thick was encountered in both SB-9 and SB-14. The cobble fragments are predominantly angular to sub-angular limestone clasts in a matrix of poorly sorted, tan to reddish tan sand and silt. In SB-16 this cobble layer is absent, and in its place is a continuation of the angular to sub-angular igneous and metamorphic gravels in a matrix of calcareous fine grained sand and silty sand.

Both SB-9 and SB-14, have another significant cobble layer that was encountered at approximately 90 to 95 feet. In SB-9 this layer is about 10 to 12 feet thick, while in SB-14 it is at least 10 feet thick and continues to the bottom of the hole, 100 feet bgs. Again, this cobble layer is absent in SB-16. From 90 to 105 feet SB-16 the gravel content decreases and is characterized by tan to whitish brown, very fine sand and silty sand. SB-16 was completed at 105 feet.

The continuation of SB-9 indicates a significant reduction of gravel and cobble content and an increase in fine grained sediments between 100 to 105 feet. From approximately 105 to 133 feet the lithology remains fairly consistent. Fine grained sands and silty sands are predominant, and there is a continual decrease in gravel and cobble content with depth. The most common source material for coarser sediments continues to be quartzite and limestone throughout this interval. There is also some caliche present at about 125 feet and a significant calcareous content throughout the bottom 20 feet of SB-9, which ends at 133 feet.

4.1.2 Southeastern Quadrant

In the southeastern quadrant of the site, borings SB-5, SB-6 and SB-7 were drilled to depths of 150, 70 and 100 feet, respectively (Figure 4-1). (SB-6 was an angle boring, 30 degrees from vertical, and 80 linear feet of drilling was required to attain an approximate depth of 70 feet, assuming negligible auger deflection.) Logs from these holes indicate that light brown, fine grained sands and silty sands predominate throughout at least the first 10 feet of sediments. In SB-7 this material extends to about 20 feet bgs. In SB-6, however, coarser sands and fine gravels are encountered in the first 6 to 8 feet, exhibiting a higher percentage of gravel-sized material than either SB-5 or SB-7, throughout the first 40 feet. These gravels, though encountered at shallower depths, are of similar composition as the



Horizontal Scale: 1 inch = 40 feet

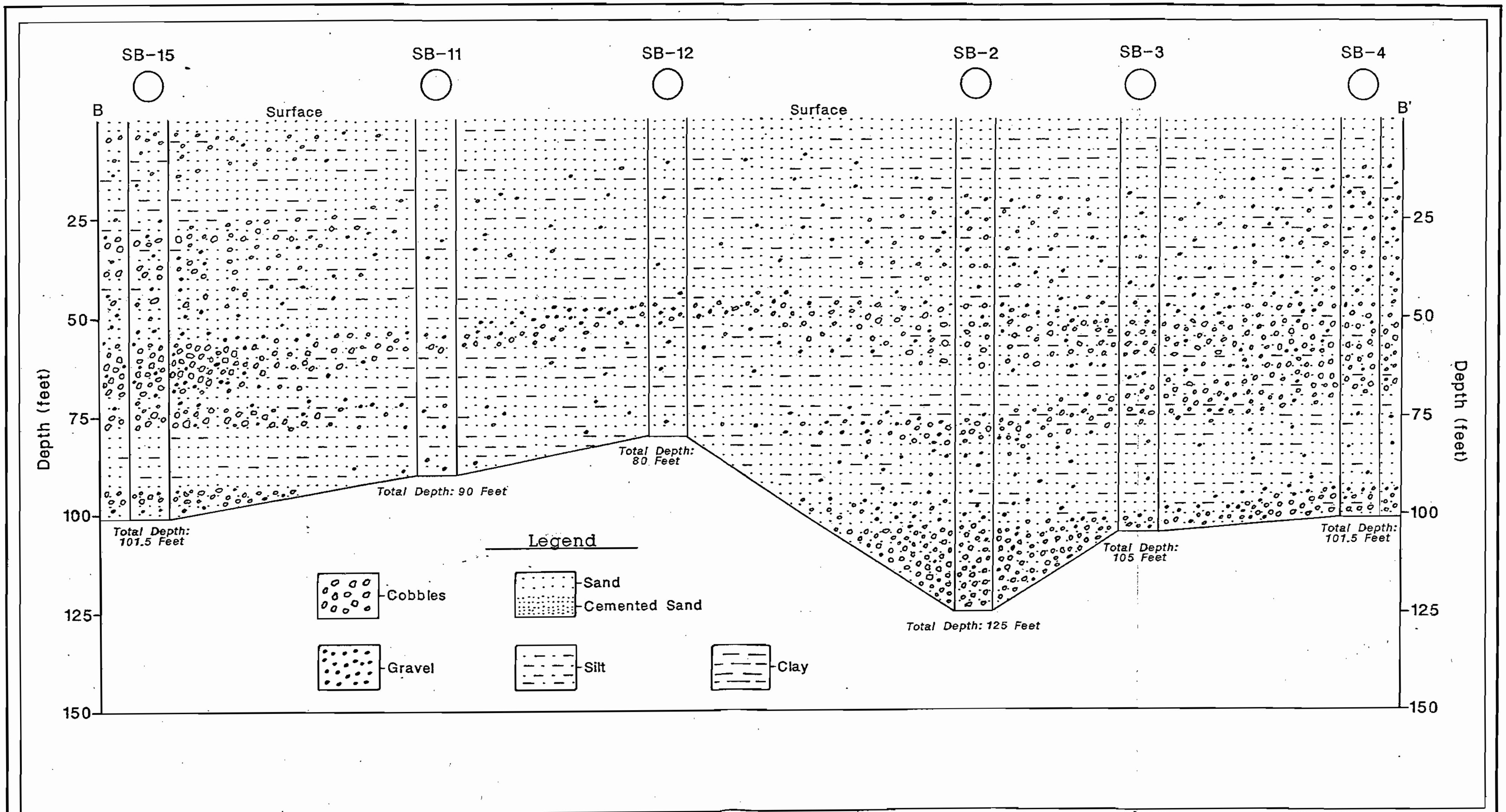
Vertical Scale: 1 inch = 25 feet

Vertical Exaggeration: 1.6

Figure 4.2

Lithologic Cross Section
Southwest And Southeast Quadrants

Sandia Mixed Waste Landfill



Horizontal Scale: 1 inch = 45 feet

Vertical Scale: 1 inch = 25 feet

Vertical Exaggeration: 1.8

Figure 4.3

Lithologic Cross Section
Northeast And Northwest Quadrants

Sandia Mixed Waste Landfill

gravels previously described in this section and include quartzite, limestone, and a lesser amount of granitic materials. A black crystalline rock presumed to be a precambrian metamorphosed granite derived from a nearby source was also identified. Drilling in SB-6 became increasingly difficult as the gravel and cobbles became more significant and, consequently, the original borehole location was abandoned after 35 linear feet (30 feet of vertical depth). A new position was chosen 15 feet to the west.

In SB-5, fine to coarse gravels begin to appear as shallow as 30 feet, although there is no further gradation into an actual cobble layer. The gravels are, however, basically of the same description as the cobbles identified in SB-7, with respect to source material and degree of weathering with the exception of a somewhat greater percentage of rounded quartz pebbles in SB-5. At 40 feet, the light brown, fine to medium sands characteristic of the site become prevalent once again in SB-5.

After repositioning SB-6, the lithology is predominated by these same sands, with a significant silt content, beginning at 30 feet bgs. At 52 feet a poorly sorted layer of silty to cobble-sized material was encountered. Once again, sub-angular clasts of quartzite, limestone, and granitic rocks are dominant. These clasts occur within a layer approximately 4 to 5 feet thick. The final 13 feet of SB-6 is characterized by light brown, fine to medium grained sand and silty sand. Some intermittent orange-brown coloration occurs for short intervals in SB-6, though this did not appear to correlate with either organic or moisture content.

In SB-7, sand with little or no gravel content occurs to a depth of approximately 40 feet. Within this top 40 feet, grain size tends to increase, though one fine grained, loosely packed layer of sand was identified from 35 to 40 feet. At 40 feet a significant layer of cobbles, primarily sub-angular limestone and quartzite clasts, begins to develop. This layer extends to approximately 48 to 50 feet, with medium sands to fine gravels predominating.

Below 50 feet, both SB-5 and SB-7 encountered more significant percentages of coarse material than was identified in SB-6 beyond this depth. In SB-7, for example, a second layer of coarse gravel and cobbles occurs between 60 to 65 feet. In this layer the gravel, primarily quartz, is rounded to sub-rounded while the larger cobbles of limestone dolomite and quartz are generally sub-angular. Another layer of medium, rounded quartz gravel occurs within a matrix of fine sand and silt, between 70 to 80 feet in SB-7. The matrix material becomes more prevalent until approximately 100 feet, where a significant increase in quartz pebbles and clasts of various source material occurs. Drilling at SB-7 was discontinued at 100 feet bgs.

This coarse layer may extend laterally to SB-5, where a layer of similar material exists between 98 to 100 feet. This layer begins with poorly sorted coarse sand and fine gravel, and grades to larger clasts of limestone and quartz in a silty sand matrix. The occurrence of cobbles decreases significantly below 110 feet and are completely absent by 125 feet. Light brown to orange-brown, fine- to medium-grained sand and silty sand dominates the lithology between 125 to 150 feet. The moisture content increases slightly within the final 25-foot segment of SB-5.

All three soil borings within the southeastern quadrant were characterized by calcareous sediment throughout, and intermittent occurrences of caliche blebs and veinlets. Caliche coatings were identified on sediments as shallow as 5 feet in SB-6, though more significant quantities of this material become evident at depths of 35 to 50 feet and greater. In addition, a well-packed, or indurated, sand layer occurs between 60 to 70 feet in all three boreholes, and is approximately 3 to 5 feet thick. Other, less indurated sediment occurs sporadically throughout the column, although there appears to be no obvious cross-borehole correlation between these slightly cemented layers.

4.1.3 Northeastern Quadrant

In the northeastern quadrant, soil borings SB-2, SB-3, SB-4 and SB-13 were drilled to depths of 125, 105, 100 and 100 feet, respectively (Figure 4-1). Once again, the first 10 to 20 feet bgs is characterized by a light brown, calcareous, fine grained sand to silty sand. In SB-4, well rounded quartz pebbles appear as shallow as 10 feet. In SB-3, only a trace amount of pebbly gravel is evident at 20 feet. In all four boreholes, however, the first gravels encountered are generally of a texture associated with fluvial deposition, though some sub-angular gravel identified in SB-2 interrupts this trend.

From 20 to 50 feet bgs, all boreholes in the northeast quadrant retain similar lithologies. Although grain sizes vary slightly throughout this segment, the predominant sediment is a light brown, calcareous, medium to silty sand matrix with fine to coarse quartz gravels interspersed in a poorly sorted distribution. Within this general classification some distinctions between boreholes can be drawn. For example, in SB-2 and SB-3 gravels tend to be more weathered, or pebbly. In SB-4 and SB-13, gravels are somewhat coarser and less weathered. In addition, SB-13 exhibited the only evidence of igneous and metamorphic clasts, mostly quartzite with traces of granite, above 50 feet in this quadrant. In all four borings the sediments within 50 feet of the surface range from non-indurated or slightly indurated.

At approximately 47 to 50 feet a significant layer of coarse gravel and cobbles is encountered in all four boreholes. In SB-2, coarse gravels first appear at about 47 feet bgs and grade to more coarse and more angular cobbles at about 50 feet. The cobbles are predominantly subrounded quartz and quartzite clasts, and sun-angular sparitic limestone/dolomite fragments. Micritic carbonates are also present, but less common. The matrix of this cobble layer is a light brown, calcareous, medium to silty sand, extending to approximately 65 feet bgs.

In SB-3, cobbles first appearing at about 49 feet comprise a continuous layer to about 61 feet. The geologic materials are nearly identical to those found in SB-2, in the same depth range.

In SB-4 the same quartzose and carbonate clasts predominate between 50 to 62 feet, while in SB-13 they form a layer between approximately 48 to 58 feet. The matrix materials in SB-4 and SB-13 are consistent with those occurring in SB-2 and SB-3.

In SB-2 and SB-3, cobbles and coarse gravel continue in intermittent layers to approximately 80 feet. These layers are separated by the typical matrix material, modified somewhat by the presence of coarse sands and interspersed, pebbly gravel.

In SB-4 there is a continuation of less coarse material, mostly poorly sorted medium sand to coarse gravel, from 62 to approximately 80 feet. In SB-13, only trace amounts of fine gravel remain within this depth interval. The predominant material within this interval, and in fact for the remainder of SB-13, is a light brown, calcareous fine to silty sand. Color varies from light brown to a reddish tan throughout the final 10 feet, 90 to 100 feet bgs. The occurrence of caliche deposits, usually as veinlets or blebs, become more frequent throughout the bottom 30 feet of SB-13.

The continuation of SB-4, SB-3 and SB-2 from 80 to 100 feet indicates a change to more abundant, and consistent, fine grained sediments. In SB-2, light brown, medium to silty sands, with interspersed pebbly gravels, are prevalent. SB-3 and SB-4 exhibit similar lithologies, with a less significant gravel content. Caliche deposits are present in all three borings though none appear to be extensive in any dimension. Both SB-3 and SB-4 terminate at approximately 100 feet and samples from this depth indicate this is probably a significant vertical transition zone at both locations. In SB-3, there is an increase in gravel content at this depth, as well as an increase in the angularity of sediments. In SB-4, cobble-size limestone and quartzose fragments are present at 100 feet, along with evidence of minor cementation.

The continuation of SB-2 confirms this prediction as a full transition of coarse gravels and cobbles occurs before 104 feet bgs. This layer of coarse sediment extends to the bottom of the hole (125 feet) and is interrupted by only one 2 to 3 foot sand layer at about 110 feet. The cobble deposit is composed primarily of sub-angular to angular carbonate clasts, with sparry to micritic textures, and sub-rounded to angular quartz and quartzite fragments. Smaller pieces of crystalline igneous rocks are also present, though less common. In addition, there is some evidence of cementation from approximately 113 to 115 feet, just below the sand layer described above. Many of the clasts also exhibit a caliche, or calcified, coating throughout this final interval.

4.1.4 Northwestern Quadrant

In the northwest quadrant, soil borings SB-15, SB-11,SB-12 and SB-1 were drilled to depths of 100, 90, 80 and 65 feet, respectively (Figure 4-1). SB-1 was an angle boring, 30 degrees from vertical, requiring 75 linear feet of drilling to attain an actual depth of 66 feet.

The characteristic surficial, light brown, silty sands appear to be somewhat thinner in this quadrant. They extend to a maximum depth of 15 feet in SB-12, but terminate as early as 3 to 4 feet in SB-15 and SB-1. In both of these latter soil borings, fine to coarse sands appear with fine to medium gravels at 3 to 4 feet, and dominate the lithologic record to approximately 30 feet. The gravels are mostly angular to sub-rounded quartz, quartzite and limestone clasts with a minor feldspar content. There is some variation in the percentage of gravel content (10% to 30%) within this interval, and there is a greater variation in the percentage of fine sands and silt (25% to 80%).

In SB-11, gravels first appear at a greater depth (about 15 feet) and do not constitute a significant a percentage of sediment. The gravel that is present, however, is similar in composition to that described above, in SB-1 and SB-15. At approximately 30 feet these gravels virtually disappear. Caliche blebs and veinlets are much more abundant in SB-11 than any of the borings in the northwest quadrant.

Coarse grains are even less abundant in SB-12, as lithology is dominated by a light brown to reddish tan, fine sand to silty sand, with traces of fine gravel, from 15 to 45 feet. Gravels are generally angular to sub-angular throughout this segment, though occasional rounded to sub-rounded grains are also present.

The gravely sand sequence is interrupted in both SB-1 and SB-15 by a significant cobble and coarse gravel layer which extends from 30 to 35 feet in SB-1, and 32 to 38 feet in SB-15. Cobble sized clasts in this layer are predominantly angular to sub-angular quartzite and gray limestone, similar to other cobble fragments found throughout the site at various depths. This cobble layer is absent in SB-11 and SB-12.

SB-1 and SB-15 continue to exhibit similar lithologies to 65 feet, the termination depth of SB-1. Immediately beneath the previously discussed cobble layer lies a light brown, fine to coarse-grained layer and with little silt or gravel content. SB-15 exhibits finer sediments than SB-1 throughout this segment. However, both borings encounter a gradation to a second cobbley/gravely layer which begins at about 52 feet in SB-1 and 55 feet in SB-15. This layer consists of angular to sub-angular limestone, quartzose and granitic clasts and extends to the bottom (65 feet) of SB-1 and to approximately 78 feet in SB-15. The continuation of SB-15 shows a rapid transformation, from cobbles and coarse gravel to a light brown, medium silty sand with no gravel, within a two foot interval. These finer sediments continue to an approximate depth of 98 feet, where the sediments coarsen to very coarse sands and fine gravels. SB-15 terminates at 100 feet. It is likely this gradation continues into a cobble layer within the 100 to 110 foot interval, since there appears to be a laterally continuous horizon of cobbles at this depth interval over the entire site.

The percentage of coarse sediments found below 50 feet in SB-1 SB-15 is substantially reduced in SB-11, and virtually absent in SB-12. From 30 to 50 feet bgs, lithology in SB-11 is dominated by light brown to whitish brown, very fine sand and silty sand. Between 50 to 60 feet there is a rapid increase in coarse sediment content, mostly medium gravels comprised of sub-angular quartzite and crystalline igneous rocks. At 60 feet there is a sharp return in gradation to fine sand and silty sand, with only traces of fine to medium gravels to a depth of 80 feet, where gravel sized sediments disappear completely. Caliche content is heavy throughout this segment of SB-11. Between 80 to 90 feet, sediments again coarsen from a sandy silt at 80 feet, to medium sands and coarse gravels at 90 feet, total depth of SB-11. This trend may reflect a transition to another cobbley layer at 95 to 100 feet, as previously exhibited in most of the other borings surpassing this depth.

In SB-12, only very fine gravel is present at the 50 foot horizon, and sediments grade back to fine sand and silty sand between 55 to 60 feet bgs. Only traces of fine gravel are present throughout the remaining 20 to 25 feet of the borehole. The predominant material in this final segment is a light brown to reddish tan, very fine sand to silty sand. Traces of caliche are also common throughout the bottom 20 feet of SB-12.

One additional soil boring was drilled at a location approximately 425 feet south of the landfill, to establish local background lithology and soil chemistry. This boring, identified as SB-18, reached a total depth at approximately 150 feet (Figure 4-4).

The surficial, light brown, fine silty sands that were found throughout the MWL site are approximately 7 to 8 feet thick at SB-18. These sands quickly coarsen and become a poorly sorted arrangement of medium to coarse sands, with cobbley fragments appearing as early as 15 feet below ground surface. From 15 to 35 feet, there exists a poorly sorted medium to coarse sand matrix with pebbly gravel and about 5% cobbles. At 35 feet the percentage of cobbles increases to approximately 15%. The coarse, sub-angular to sub-rounded sand remains poorly sorted with angular to sub-angular quartzite and igneous cobbles interspersed. At 42 feet, there is an increase in silt sized particles. Evidence of clay exists between 55 to 60 feet.

The medium to very coarse sand continues, with cobbles disappearing at approximately 75 feet. The silt content remains between 10% and 20% to about 97 feet, then increases to nearly 40%. At this depth, the sand grades to a very fine to silty sand. Cobbles appear between 105 and 113 feet, although the matrix remains a very fine, silty sand. At 120 feet there is a further increase in fines as silt and clay particles constitute 50% of the sediments, producing a borderline of very fine silty sand/sandy silt. At 125 feet the percentage of fines are reduced. Between 127 and 133 feet, a small number of quartz cobbles are interspersed in a matrix of light brown to reddish tan, very fine sand to silty sand. The cobbles are absent below 133 feet, but the matrix material remains relatively unchanged to a depth of 148 feet. At this point there is a rapid increase silt, producing a slightly moist, compacted, reddish tan sandy silt. This layer continues to the bottom of the hole at 150 feet.

Caliche coatings and a high calcareous content are present throughout the first 120 feet of SB-18. The calcium based deposits diminish,

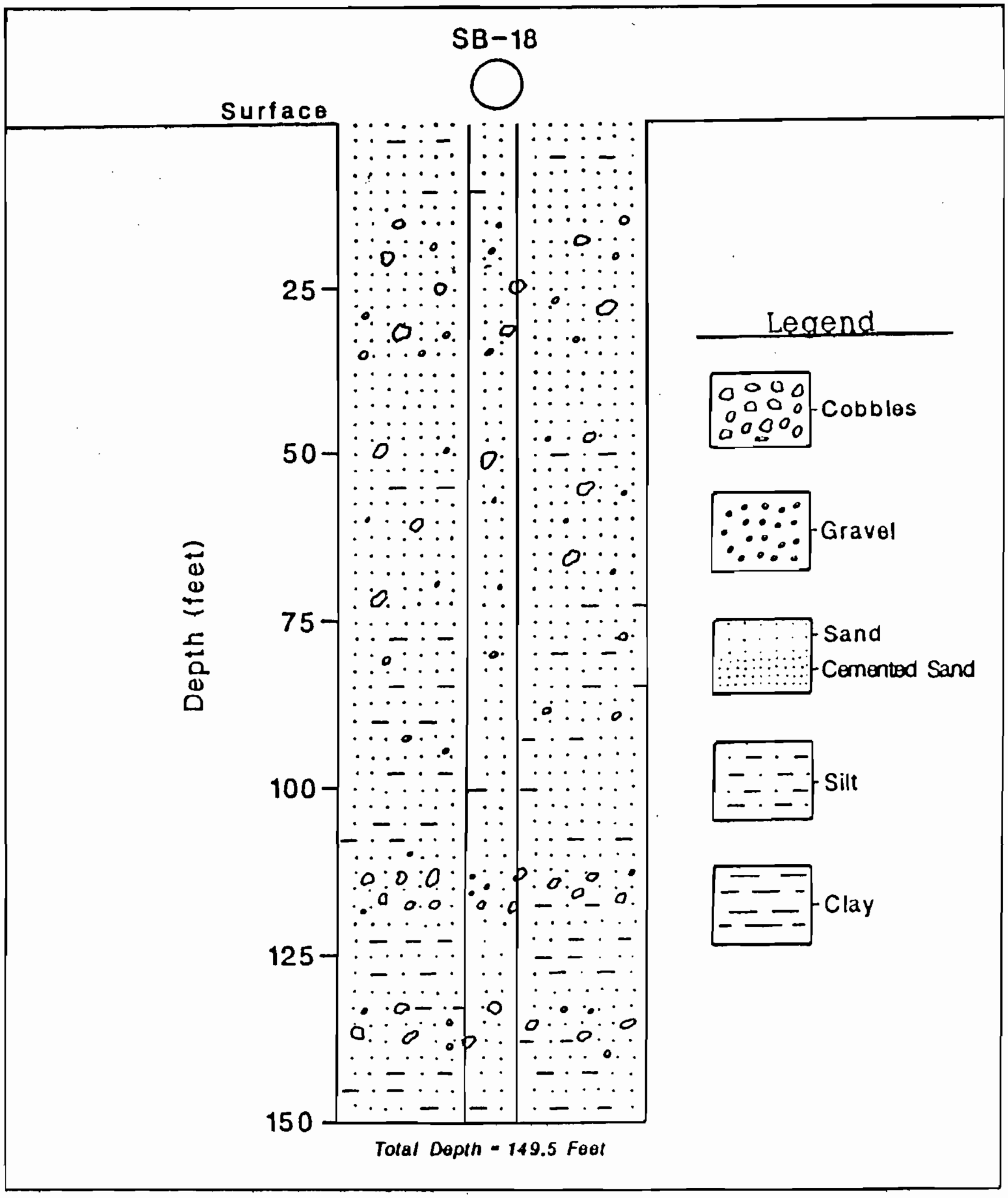


Figure 4.4

Lithologic Cross Section
At Background Soil Boring (SB-18)
Location

Sandia Mixed Waste Landfill

however, with the onset of the reddish tan coloring which occurs between 130 and 150 feet.

4.2 GEOLOGIC INTERPRETATION

Lithologic information obtained from the numerous soil borings was evaluated to identify any significant cross-borehole correlations, which can be used to determine the depositional environment at the mixed waste landfill. These correlations, as well as a general understanding of the lithology, will also prove to be useful in predicting potentials for vertical and horizontal contaminant migration throughout the site.

The first obvious correlation is a surficial cap of aeolian sands which covers the entire site. The thickness of this light brown, silty, fine to medium sand varies across the site, and tends to increase somewhat from southwest to northeast. The significance of this continuous, loosely packed layer, with relation to contaminant migration, is that it may provide a direct route for upward vertical migration of soil vapors originating within 10 to 20 feet of the surface. Below this depth, vapors may reach this layer indirectly via alternative lateral or vertical routes. Aeolian sands vary in thickness over the study area, from about 3 feet in SB-16 (the southern edge of the landfill), to 17 feet in SB-3 at the northeast edge of the landfill.

Two laterally extensive zones with high percentages of cobbles and coarse gravels were identified across the landfill area. The shallowest zone occurs at approximately 50 feet ($\pm$10 feet) bgs throughout most of the site. This zone is most prominent in SB-15, where it is uninterrupted for 23 feet, between 55 and 78 feet on the lithologic record. At the northeast corner of the site, this zone extends nearly 25 feet, between 50 and 75 feet on the lithologic record of SB-3. In SB-3, however, the zone is interrupted by intermittent layers of finer gravels and sands. To the south, at SB-14, this same zone extends from 46 and 70 feet, and is again interrupted by thin, intermittent sands and fine gravels. Further south, at SB-16, and to the extreme south, at SB-18, a discrete cobble zone is absent at this depth. This zone is also virtually absent in SB-12 and SB-5, confining its lateral boundaries to form a northeast-southwest trending belt that diagonally transects the site.

The second zone is deeper, occurring at approximately 100 feet (±10 feet) bgs. This deeper interval appears to have a greater aereal extent, since it is evident in every soil boring which extends to and/or surpasses this depth (with the exception of SB-16). It is possible that the layer occurs at a greater depth at SB-16 since the boring total depth is 105 feet. In fact, many of the borings terminate within or immediately above this layer. Its thickness, therefore, can only be determined from those boreholes which completely penetrate its lower boundary. In SB-9 and SB-14, this layer occurs approximately between 90 and 105 feet. Further east, at SB-5, the cobbley zone is encountered at 98 to 110 feet. To the north, at SB-2, this layer extends from 104 feet to, at least, 125 feet where the boring was completed. There is, however, a thin sand layer at approximately 110 feet interrupting the cobble deposit. To the extreme south, at SB-18, this same apparent layer occurred from 105 to 113 feet.

The cross-borehole associations used to interpret these cobbley zones as laterally continuous layers include elevation comparisons, and lithologic comparisons. In both layers, clast size, degree of weathering, and source materials are laterally consistent, as is the matrix material, but to a somewhat lesser degree. The shallower gravel/cobble zone is dominated by sub-rounded to sub-angular quartzose fragments and sub-angular to angular carbonate clasts in a light-brown, fine to coarse sand matrix with 10% to 20% silt. The silt content varied between boreholes, however, in association with the overall grain size of the sand matrix.

Aside from its larger areal extent, the deeper gravel/cobble layer also varies from the shallower layer in lithologic content. Although the predominant clasts are quartzose and limestone/dolomite, as above, there is a more frequent occurrence of igneous derived material in this lower zone. Cobble sized fragments of feldspar and granite are present, as are gravel sized, miscellaneous crystalline sediments, much of which is believed to be a Precambrian metamorphosed granite derived from a nearby source. Igneous sediments are common at other depths, yet seem particularly abundant within this coarse layer. This layer also appears to have more significant caliche deposits. Most of the deposits are in the form of sediment coatings, though blebs and veinlets are also common. In the northeast portion of the site there is some evidence of cementation within this layer. The matrix material is poorly sorted in this layer, as it is in the one above it, and the matrix generally exhibits the same spectrum of grain sizes and shapes.

The sediments which separate these two zones are also include a fairly continual layer throughout the site. Between 75 and 95 feet bgs there is a consistent occurrence of a light-brown, fine to medium grained sand with a marked absence of gravel. This sand layer varies from 5 to 10 feet in thickness, is slightly to moderately indurated, and is relatively well sorted compared to most of the deposition at this site.

It is unclear whether these laterally continuous layers of sand and gravel/cobbles, and the sediments which lie above them, represent 1) the Ortiz pediment surface (Pleistocene), 2) alluvial fan build-up, or 3) both. It is known that the Mixed Waste Landfill is situated near a boundary of the Ortiz surface, where the Ortiz has been dissected by the Tijeras Arroyo tributary valley. If, in fact, the Ortiz is present here, it most likely will be encountered at a depth much shallower than 50 feet (where the first significant gravels were actually encountered). However, the site is located on the downthrown side of the Sandia Fault, located about 1/2 mile to the east. If any post-Ortiz movement has occurred along this fault, there may be some alluvial fan build-up that has been eroded from the fault scarp, covering the original Ortiz surface. The fact that considerable caliche development is present (a typical characteristic of the Ortiz surface and gravel) throughout the entire lithologic column over most of the site, lends credence to this theory.

Alternatively, the sands and gravels at this site may represent terrace deposits associated with the Tijeras Arroyo. These types of deposits generally form as thin veneers on river-cut surfaces and may be remnants of temporary aggradation processes. Terrace deposits often contain clasts which are foreign to the surrounding gravels (i.e., limestone and dolomite fragments). However, sediments associated with these types of deposits are typically rounded to subrounded. A large percentage of the deeper gravels at this site were more angular. The frequent occurrence of shallow, more pebbly gravel above the first zone of coarse gravels and cobbles, presents the possibility that there is actually a terrace deposit overlying the Ortiz surface. These rounded, pebbly gravels do not, however, form a mappable deposit over the site. The fact that there does not appear to be any mappable deposits, other than the surficial Aeolian sands, within the first 40 to 50 feet suggests that this interval may represent a transitional depositional environment formed by one or more of the processes previously discussed.

It should be noted that the upper 50 feet of SB-18 (located about 425 feet south of the landfill) is significantly different from the other borings. The difference lies in the coarser gravels and cobbles which are encountered at a shallower depth and interspersed, without extensive absence, throughout the 50 feet. These coarse sediments probably do not exhibit sufficient consistency to constitute a discrete layer (such as the Ortiz). However, the sediments may reflect a facies change associated with the dominant depositional force. The abundance of both rounded and angular sediments, and their poorly sorted arrangement, makes it difficult to establish the kind of depositional force. Once again, the situation inherently suggests a combination of depositional environments.

A compacted layer was also discovered in SB-18 just above the termination depth of 150 feet. This layer is essentially a reddish tan silty sand which appears to be compacted rather than cemented. Approximately 170 blow counts were recorded for the first 6 inches, followed by refusal. This layer begins at about 147 feet and continues to the bottom of the hole, approximately 150 feet bgs. This compacted silt is not readily apparent in any other soil boring, though only SB-5 and SB-9 approached this depth.

A close examination of the lithologic information does not indicate the existence of a laterally extensive cemented layer below the MWL. Such a layer would serve to restrict the downward vertical migration of contaminants from the landfill or at a minimum retard the rate of contaminant migration. Some induration does occur sporadically throughout the site, at various depths. The most significant cementation occurs within the two coarse zones described earlier. The most laterally extensive "cemented layer" appears to exist along the eastern edge of the site, within the shallower of these two zones. The logs for SB-7, SB-6, SB-5 and SB-2 indicate that a thin (3 to 5 feet), well indurated, fine sand layer occurs between 65 and 70 feet. This layer begins at about 65 feet in SB-7, SB-6, and SB-5, and at 70 feet in SB-2. The cement is caliche or a calcareous compound. The layer itself is best documented in those holes which utilized continuous sampling (SB-6, SB-5 and SB-2). Unfortunately, the degree of induration is more difficult to assess from split-spoon samples since the continuous driving impact of this tool often alters natural compaction.

5 ANALYTICAL RESULTS

5.1 AIR SAMPLING RADIOLOGICAL RESULTS

Measured concentrations for gross alpha activity, gross beta activity, and tritium in air samples obtained for the background, baseline, ambient air, and personnel breathing zone measurements are presented in Tables 5-1, 5-2, and 5-3. Concentrations having a less than sign (<) are less than the Method Detection Limit (MDL) for that sample. The method for each sample detection limit was calculated based on the background count of the detector and the net activity of the sample.

5.1.1 Gross Alpha Concentrations

Gross alpha concentrations in the background samples (Table 5-1)ranged from $2x10^{-15}$ to $2x10^{-13}$ uCi/ml (it is suspected that the result for sample MWL-P011 may be in error). A confirmatory sample collected at the same location as MWL-P011, but at a later date (sample MWL-P034) is consistent with the other background concentrations of gross alpha activity in airborne particulates. The source of the error is unknown, but may be related to sample contamination and/or counting errors.

The gross alpha concentrations in the baseline air samples at the MWL range from less than the MDL to $1x10^{-13}$ uCi/ml. Sample results from MWL-P012 are notably higher than the other baseline air sample measurements. Sample MWL-P012 was obtained 100 feet west of the MWL, whereas most of othe other air samples were collected within the boundaries of the landfill area. An explanation for the elevated reading at MWL-P012 is lacking.

Six baseline air samples from the MWL exceeded the MDL for gross alpha concentrations. Additionally, all six of these samples significantly exceeded (by greater than 2 standard deviations) the highest

Table 5-1

GROSS ALPHA CONCENTRATIONS FROM BACKGROUND, BASELINE AND PERSONNEL BREATHING ZONE MEASUREMENTS.

Sample ID	Reported Concentration (microcuries/ml)uCi/ml	Two Standard Deviations (microcuries/ml)uCi/mL
Background Samples		
MWL-P008	$4x10^{-15}$	$3x10^{-15}$
MWL-P009	$2x10^{-15}$	$3x10^{-15}$
MWL-P010	$6x10^{-15}$	$3x10^{-15}$
MWL-P011	$2x10^{-13}$	$2x10^{-14}$
MWL-P034	$3x10^{-15}$	$1x10^{-15}$
Baseline Zone Samples		
MWL-P002	$<1x10^{-14}$	$1x10^{-14}$
MWL-P003	$1x10^{-14}$	$2x10^{-14}$
MWL-P004	$<3x10^{-14}$	$2x10^{-14}$
MWL-P005	$<1x10^{-14}$	$1x10^{-14}$
MWL-P006	$2x10^{-14}$	$2x10^{-14}$
MWL-P007	$2x10^{-14}$	$2x10^{-14}$
MWL-P012	$1x10^{-13}$	$5x10^{-14}$
MWL-P014	$<2x10^{-14}$	$2x10^{-14}$
MWL-P015	$2x10^{-14}$	$3x10^{-14}$
MWL-P017	$1x10^{-14}$	$9x10^{-15}$
Breathing Zone Samples		
MWL-P021	$<9x10^{-14}$	$6x10^{-14}$
MWL-P022	$<5x10^{-14}$	$6x10^{-14}$
MWL-P023	$<2x10^{-13}$	$1x10^{-13}$
MWL-P024	$6x10^{-13}$	$2x10^{-13}$
MWL-P025	$<6x10^{-14}$	$6x10^{-14}$
MWL-P026	$<5x10^{-14}$	$6x10^{-14}$
MWL-P027	$<1x10^{-13}$	$1x10^{-13}$
MWL-P028	$<4x10^{-14}$	$4x10^{-14}$
MWL-P029	$5x10^{-13}$	$3x10^{-13}$
MWL-P030	$5x10^{-14}$	$6x10^{-14}$
MWL-P031	$<5x10^{-13}$	$4x10^{-13}$
MWL-P032	$5x10^{-14}$	$6x10^{-14}$
MWL-P036	$<3x10^{-14}$	$4x10^{-14}$
MWL-P038	$<3x10^{-13}$	$2x10^{-13}$
MWL-P039	$<9x10^{-14}$	$1x10^{-13}$
MWL-P040	$2x10^{-13}$	$2x10^{-13}$
MWL-P041	$5x10^{-14}$	$8x10^{-14}$

Table 5-2

GROSS BETA CONCENTRATIONS FROM BACKGROUND, BASELINE AND PERSONNEL BREATHING ZONE MEASUREMENTS.

Sample ID	Reported Concentration (microcuries/ml)uCi/ml	Two Standard Deviations (microcuries/ml)uCi/mL
Background Samples		
MWL-P008	$<5x10^{-14}$	$4x10^{-14}$
MWL-P009	$<3x10^{-14}$	$4x10^{-14}$
MWL-P010	$3x10^{-14}$	$3x10^{-14}$
MWL-P011	$1x10^{-13}$	$6x10^{-14}$
MWL-P034	$1x10^{-14}$	$3x10^{-15}$
Baseline Samples		
MWL-P002	$<2x10^{-13}$	$3x10^{-13}$
MWL-P003	$<2x10^{-13}$	$2x10^{-13}$
MWL-P004	$<3x10^{-13}$	$3x10^{-13}$
MWL-P005	$<2x10^{-13}$	$2x10^{-13}$
MWL-P006	$<3x10^{-13}$	$3x10^{-13}$
MWL-P007	$<2x10^{-13}$	$3x10^{-13}$
MWL-P012	$<4x10^{-13}$	$5x10^{-13}$
MWL-P014	$<4x10^{-13}$	$4x10^{-13}$
MWL-P015	$<3x10^{-13}$	$3x10^{-13}$
MWL-P017	$<3x10^{-14}$	$3x10^{-14}$
Breathing Zone Samples		
MWL-P021	$<2x10^{-13}$	$2x10^{-13}$
MWL-P022	$<2x10^{-13}$	$3x10^{-13}$
MWL-P023	$<8x10^{-13}$	$6x10^{-13}$
MWL-P024	$<5x10^{-13}$	$6x10^{-13}$
MWL-P025	$<3x10^{-13}$	$4x10^{-13}$
MWL-P026	$<2x10^{-13}$	$3x10^{-13}$
MWL-P027	$<5x10^{-13}$	$6x10^{-13}$
MWL-P028	$<2x10^{-13}$	$1x10^{-13}$
MWL-P029	$<9x10^{-13}$	$7x10^{-13}$
MWL-P030	$<2x10^{-13}$	$3x10^{-13}$
MWL-P031	$<1x10^{-12}$	$1x10^{-12}$
MWL-P032	$<2x10^{-13}$	$2x10^{-13}$
MWL-P036	$<2x10^{-13}$	$2x10^{-13}$
MWL-P038	$<1x10^{-12}$	$1x10^{-12}$
MWL-P039	$<5x10^{-13}$	$4x10^{-13}$
MWL-P040	$<1x10^{-12}$	$8x10^{-13}$
MWL-P041	$<3x10^{-13}$	$3x10^{-13}$

Table 5-3

AIRBORNE TRITIUM CONCENTRATIONS FROM BACKGROUND AND BASELINE SAMPLES

Sample ID	Reported Concentrations (microcuries/ml) uCI/ml	Two Standard Deviations (microcuries/ml) uCi/ml
Background Samples		
MWL-T008	$<4x10^{-09}$	$4x10^{-09}$
MWL-T009	$<4x10^{-09}$	$4x10^{-09}$
MWL-T010	$<2x10^{-09}$	$2x10^{-09}$
MWL-T011	$<2x10^{-09}$	$2x10^{-09}$
Baseline Samples		
MWL-T005	$<6x10^{-09}$	$6x10^{-09}$
MWL-T006	$<5x10^{-09}$	$5x10^{-09}$
MWL-T007	$<5x10^{-09}$	$5x10^{-09}$
MWL-T012	$<2x10^{-09}$	$2x10^{-09}$
MWL-T013	$<2x10^{-09}$	$2x10^{-09}$
MWL-T014	$<2x10^{-09}$	$2x10^{-09}$
MWL-T015	$2x10^{-09}$	$2x10^{-09}$
MWL-T016	$<3x10^{-09}$	$3x10^{-09}$
MWL-T017	$<3x10^{-09}$	$3x10^{-09}$

background gross alpha concentration (sample MWL-P010). These elevated readings may be attributable to frequent dust-blown conditions encountered in the general area of the MWL.

Gross alpha concentrations for the air samples collected from personnel breathing zones ranged from less than the MDL to $6x10^{-13}$ uCi/ml. The higher concentrations (compared to background) likely result from dust generated by the drilling and sampling activities during the field investigation.

5.1.2 Gross Beta Concentrations

Gross beta concentrations in the background samples (Table 5-2) ranged from less than the MDL to $1x10^{-13}$ uCi/ml. Similar to the gross alpha concentration for sample MWL-P011, the initial measured concentration for gross beta activity was inconsistent with the other background readings. Sample MWL-P034 showed gross beta concentrations consistent with the other background samples.

Gross beta concentrations in the baseline samples and the personnel breathing zone samples were all less than the MDL.

5.1.3 Tritium Concentrations

Background airborne tritium concentrations (Table 5-3) were all less than the MDL, and only one baseline sample, MWL-T015, showed a tritium concentration above the MDL. However, that measured concentration is within the error margin of background and is consistent with all other background and baseline values (Table 5-3).

Because of the small amount of tritium present in the samples, comparison of the activities on the front and back sections of sorbent for the samples, precluded the accurate determination of collection efficiency to be determined accurately. A conservative collection efficiency (100%) was, therefore, used in calculating airborne concentrations. The actual collection efficiency may be slightly lower.

5.1.4 Comparison of Results with Regulatory Guidelines

The alpha emitter with the most restrictive derived air concentration (DAC) known to have been placed at the MWL is Pu-239, which has a lung clearance time of several years. The DAC listed for Pu-239 (in DOE Order 5480.11) is $6x10^{-12}$ μCi/ml. This concentration is about 250 times greater than the mean long-lived airborne gross alpha concentration measured during the baseline study ($2.5x10^{-14}$ μCi/ml), and at least 35 times greater than the mean alpha concentration measured during the breathing zone study.

Beta-emitting fission products have DAC values ranging upwards from approximately $1x10^{-9}$ μCi/ml. In comparison, the highest airborne gross beta concentration measured during the field investigation is reported as less than $1x10^{-12}$ μCi/ml. As such, the highest airborne gross beta concentration for the field investigation is at least 1000 times less than the DAC for the most restrictive beta emitters likely encountered at the MWL.

The highest airborne tritiated water vapor concentration measured at the MWL is reported as less than $6x10^{-9}$ μCi/ml. Thus, the highest airborne tritiated water vapor concentration measured during the field investigation is at least 3000 times less than the corresponding DAC of $2x10^{-5}$ μCi/ml.

5.2 RADIOLOGICAL RESULTS OF SOIL SAMPLES

Radioanalytical data are presented in Appendix B. The results are discussed in the following subsections and include summarized pertinent data.

5.2.1 Background Concentrations

Subsurface soil background samples were collected from soil boring SB-18. Surface soil background samples were collected from distances of approximately 500 feet north, south, east, and west of MWL.

Radionuclide concentrations from background samples compare favorably with background concentrations reported in literature (DOE, 1987; NCRP, 1987; Berge, 1989) and from previous sampling information obtained during the SNL environmental monitoring program (DOE, 1989). Table 5-4 summarizes the radioanalytical results for the surface and subsurface

Table 5-4

RADIOANALYTICAL RESULTS FOR BACKGROUND SOIL SAMPLES

Radionuclide	Background Sample Type and Location*	Number of Samples	Concentration (pCi/g Except Tritium [pCi/ml of Extracted Water]) Mean	Standard Deviation	Range
Tritium	SB-18	19	<MDL	--	<MDL
	Surface Soil A	4	<MDL	--	<MDL
	Surface Soil B	2	<MDL	--	<MDL
	Surface Soil C	1	3	--	--
Gross Beta	SB-18	19	26	8	10 to 44
	Surface Soil A	4	28	1	26 to 29
	Surface Soil B	2	26	1	25 to 26
	Surface Soil C	1	22	--	--
Gross Alpha	SB-18	19	8	3	<MDL to 15
	Surface Soil A	4	9	4	6 to 14
	Surface Soil B	2	6	1	<MDL to 6
	Surface Soil C	1	14	--	--
Ra-226	SB-18	19	0.7	0.3	0.4 to 1.4
	Surface Soil A**	--	--	--	--
	Surface Soil B	2	0.7	0.2	0.5 to 0.8
	Surface Soil C	1	0.7	--	--
Th-232	SB-18	19	1.0	0.3	<MDL to 1.6
	Surface Soil A**	--	--	--	--
	Surface Soil B	2	1.0	0.1	0.9 to 1.0
	Surface Soil C	1	<MDL	--	--
K-40	SB-18	19	17	4	9 to 25
	Surface Soil A**	--	--	--	--
	Surface Soil B	2	21	3	19 to 23
	Surface Soil C	1	16	--	--
Cs-137	SB-18	19	<MDL	--	<MDL
	Surface Soil A**	--	--	--	--
	Surface Soil B	2	<MDL	--	<MDL
	Surface Soil C	1	<MDL	--	--
U-234	SB-18	6	1.0	0.2	0.8 to 1.5
	Surface Soil A**	--	--	--	--
	Surface Soil B	2	0.7	0.1	0.6 to 0.7
	Surface Soil C**	--	--	--	--
U-235	SB-18	6	<MDL	--	<MDL
	Surface Soil A**	--	--	--	--
	Surface Soil B	2	<MDL	--	<MDL
	Surface Soil C**	--	--	--	--
U-238	SB-18	6	1.0	0.1	0.8 to 1.1
	Surface Soil A**	--	--	--	--
	Surface Soil B	2	0.7	0.1	0.6 to 0.7
	Surface Soil C**	--	--	--	--

[QT]SX3034:D2722, #3461, PM = 25

Table 5-4 (Cont.)

Radionuclide	Background Sample Type and Location*	Number of Samples	Concentration (pCi/g Except Tritium [pCi/ml of Extracted Water]) Mean	Standard Deviation	Range
Pu-238	SB-18	6	<MDL	--	<MDL
	Surface Soil A**	--	--	--	--
	Surface Soil B**	--	--	--	--
	Surface Soil C**	--	--	--	--
Pu-239	SB-18	6	<MDL	--	<MDL
	Surface Soil A**	--	--	--	--
	Surface Soil B**	--	--	--	--
	Surface Soil C**	--	--	--	--

Note: In the calculation of the mean and standard deviation, analytical values less than the MDL were set equal to the MDL when 50% or more of the analytical values exceeded the MDL.

*SB-18: Located 428 feet south of MWL. Samples collected to 140 feet.

Surface Soil A: Samples collected approximately 500 feet to the north, south, east, and west of the MWL.

Surface Soil B: Samples collected off site, near E & E office (Gibson and Girard Boulevards, Albuquerque).

Surface Soil C: Sample collected approximately 300 feet east of the MWL, near the sled track. Sample collected in brass sleeve for analysis with other borehole samples.

**Analysis not performed.

background samples obtained during the MWL field investigation. Table 5-5 provides representative background data from the literature.

5.2.2 Surface Soil Results

Ten surface soil samples were analyzed for tritium, gross alpha and beta radiation, gamma spectrometry (K-40, Ra-226, Th-232, and Cs-137), and isotopic uranium. Results are shown in Table 5-6. Nine of the 10 samples are from within the unclassified area of the MWL, and one sample was obtained from inside the classified area.

Tritium concentrations in the 10 surface soils ranged from 7 to 390 pCi/ml. Tritium concentrations from grid blocks J-8 and O-8 (Figure 3-3) are near background levels (Table 5-4), while the concentrations from the remaining locations (grid blocks A-8, H-3, G-2, B-11, A-7, G-5, E-5, and C-6) are significantly greater than background.

Concentrations of gross alpha and beta radiation, and gamma emitters (K-40, Th-232, Cs-137, and Ra-226) are all within background ranges (Table 5-5).

5.2.3 Subsurface Sample Results

Table summaries of subsurface soil radioanalytical results are presented in Appendix B for gross beta activity (Table B-1), gross alpha activity (Table B-3), Ra-226 (Table B-5), Th-232 (Table B-7), K-40 (Table B-9), and U-234, 238 (Table B-11). Tritium concentrations are presented in Table 5-7. Concentrations for Cs-137, U-235, Pu-238, and Pu-239 are not tabulated, since none of these radioanalytes exceeded the MDL.

Elevated concentrations of tritium, significantly above background, are noted in the soil samples obtained from soil borings SB-3, SB-4, SB-5, SB-6, and SB-17. All of these soil borings are adjacent to the classified area of the MWL (Figure 3-3). Generally, the elevated tritium concentrations are significantly higher from 0-30 feet in depth (Table 5-7). The highest concentration of tritium was found in soil boring SB-3 at 15 feet bgs depth, with a value of 17,000 pCi/ml (of extracted water).

Table 5-5

REPORTED BACKGROUND CONCENTRATIONS FOR SELECTED RADIONUCLIDES IN SOILS

Radionuclide	Mean	Standard Deviation	Concentration (pCi/g Except Tritium [pCi/ml of Extracted Water]) Range
Tritium[1]	2.6	2.3	0.8(0.3) to 8.8(0.9)
Ra-226[2]	0.6	*	0.5 to 1
Th-232[2]	1	*	*
K-40[2]	12	*	*
Cs-137[1]	0.43	0.33	0.00(0.10) to 1.4(0.08)
U-234[1]	0.7	*	0.4 to 1.2
U-235[1]	0.04	*	0.02 to 0.06
U-238[1]	0.8	*	0.4 to 1.3
Pu-238[1]	0.001	0.002	0.005 to 0.010(0.006)
Pu-239[1]	0.007	0.009	0.002(0.010) to 0.052(0.006)

[1]Source: DOE 1987. Analytical uncertainties indicated in parentheses. Results based on data from northern New Mexico soils.

[2]Source: NCRP Report No. 77 (1984) and NCRP Report No. 45 (1975). Results based on data from United States soils.

*Not reported.

Soil borings SB-6 and SB-17, angled borings at the south side of the classifed area, showed tritium concentrations greater than background at all depths sampled (Table 5-7). Maximum concentrations of 5,600 pCi/ml at approximately 29 feet and 5,000 pCi/ml at approximately 30 feet were reported for SB-6 and SB-17, respectively. Tritium concentrations ranged from less than the MDL to 180 pCi/ml in the upper 30 feet of soil borings SB-4 and SB-5. At depths greater than 30 feet for SB-3, SB-4, and SB-5, tritium concentrations were consistent with background ranges reported in Table 5-5.

A tritium concentration of 34 pCi/ml was noted at a depth of 5 feet in SB-13. All other tritium concentrations in samples obtained from SB-13 and for all other borings completed at the MWL were close to background values.

Gross alpha and beta radiation concentrations for all borings completed at the MWL (Table B-1 and B-3) range from 9 to 30 pCi/g for beta emitters and less than MDL to 26 pCi/g for alpha emitters. These concentrations are within background values for these parameters (Table 5-4). Similarly, concentrations of analytes of the gamma radiation scan (K-40, Cs-137, Th-232, Ra-226) from subsoil samples collected at the MWL are within the background levels obtained from soil boring SB-18. A concentration of 50 pCi/g soil for K-40 was assayed for a sample from 10 feet in depth at soil boring SB-12 (Table B-10). This value may fall within normal background limits as the uncertainty of the measured value is 24 pCi/g, and the upper limit of background values is 30 pCi/g.

Analyses for U-234, U-235, and U-238 revealed sample concentrations within background limits (Table 5-4). All values for the uranium isotopes were below 1.0 pCi/g soil. Plutonium isotopes Pu-238 and Pu-239 from samples collected in soil borings SB-13 and SB-18 (from 90 to 140 feet) were all less than the MDL.

5.3 ORGANIC AND INORGANIC ANALYTICAL RESULTS

Only subsurface soil samples from the 18 soil borings were submitted for analyses for volatile organic compounds and semi-volatile organic compounds. In addition, samples from SB-18 (background), SB-4, SB-5, SB-8, SB-10, and SB-17 were submitted for metals analyses (Target Compound List (TCL), USEPA Contract Laboratory Program). Analytical reports for organic and metal analytes are presented in Appendix E.

5.3.1 Background Concentrations

Concentrations for the target organic compounds (both volatile and semi-volatile of the TCL), from all depths of soil boring SB-18 are less than the MDLs for each compound with the exception of those compounds that are common laboratory contaminants (methylene chloride, acetone, and phthalate esters). These compounds were found in comparable concentrations in laboratory QA/QC samples. Tables 5-8a and 5-8b summarize background subsoil results from SB-18 for organic compounds of the target compound list.

Concentrations of metals in the background samples are within normal limits for soils. Table 5-9 summarizes TCL metals concentrations for subsoil samples from SB-18.

5.3.2 Sample Results

Analyses performed for volatile organic compounds and semi-volatile organic compounds indicates the presence of toluene in soil samples obtained from SB-8, SB-10, and SB-17. Toluene was also detected in the field blanks and in one composite sample taken during these final three borings. No organic contamination was identified in any samples taken from the first 15 boreholes. Since toluene was also detected in the field blanks, the data suggest possibility of contaminated sampling apparatus since all method blanks were free of toluene contamination. Also, all the earlier samples collected from the same general areas had no toluene contamination. Tables 5-10a and 5-10b are summaries showing range values for TCL organic compounds. Analyses of the TCL metals show that all samples tested were within background levels (Table 5-11).

Elevated readings for volatile organic compounds were obtained using the HNu Model PS-101 PID from various depths in boreholes SB-1, SB-2, SB-4,SB-5, SB-6, SB-7, and SB-11. The measurements ranged from less than 1 ppm overall to 650 ppm in SB-5 (100 ft depth). Readings in

Table 5-8a

CONCENTRATION RANGES FOR VOLATILE ORGANIC COMPOUNDS (TCL) IN BACKGROUND SUBSOIL SAMPLES

Compound	Concentration Range (mg/kg)
chloromethane	BDL
bromomethane	BDL
vinyl chloride	BDL
chloroethane	BDL
methylene chloride	<0.005-0.007
acetone	0.018-0.303
carbon disulfide	BDL
1,1-dichloroethene	BDL
1,1-dichloroethane	BDL
trans-1,2-dichloroethene	BDL
chloroform	BDL
1,2-dichloroethane	BDL
2-butanone	BDL
1,1,1-trichloroethane	BDL
carbon tetrachloride	BDL
vinyl acetate	BDL
bromodichloromethane	BDL
1,2-dichloropropane	BDL
trans-1,3-dichloropropene	BDL
trichloroethene	BDL
dibromochloromethane	BDL
1,1,2-trichloroethane	BDL
benzene	BDL
cis-1,3-dichloropropene	BDL
2-chloroethylvinyl ether	BDL
bromoform	BDL
4-methyl-2-pentanone	BDL
2-hexanone	BDL
tetrachloroethene	BDL
1,1,2,2-tetrachloroethane	BDL
toluene	BDL
chlorobenzene	<0.005-0.017
ethylbenzene	BDL
styrene	BDL
total xylenes	BDL

BDL - Below Detection Levels

Table 5-8b

CONCENTRATION RANGES FOR SEMI-VOLATILE ORGANIC COMPOUNDS (TCL) IN BACKGROUND SUBSOIL SAMPLES

Compound	Concentration Range (mg/kg)
bis(2-chloroethyl)ether	BDL
1,3-dichlorobenzene	BDL
1,4-dichlorobenzene	BDL
1,2-dichlorobenzene	BDL
bis(2-chlorolsopropyl)ether	BDL
N-nitrosodipropylamine	BDL
hexachloroethane	BDL
nitrobenzene	BDL
Isophorone	BDL
bis(2-chloroethoxy)methane	BDL
1,2,4-trichlorobenzene	BDL
napthalene	BDL
hexachlorobutadiene	BDL
hexachlorocyclopentadiene	BDL
2-chloronaphthalene	BDL
dimethyl phthalate	BDL
acenaphthylene	BDL
fluorene	BDL
acenaphthene	BDL
2,4-dinitrotoluene	BDL
2,6-dinitrotoluene	BDL
diethylphthalate	BDL
4-chlorophenyl phenyl ether	BDL
N-nitrosodiphenylamine	BDL
4-bromophenyl phenyl ether	BDL
hexachlorobenzene	BDL
phenanthrene	BDL
anthracene	BDL
di-n-butyl phthalate	BDL
fluoranthene	BDL
benzidine	BDL
pyrene	BDL
butyl benzyl phthalate	BDL
3,3'-dichlorobenzidine	BDL
benzo(a)anthracene	BDL
bis(2-ethylhexyl)phthalate	<0.330-0.500
chrysene	BDL
di-n-octyl phthalate	BDL
benzo(b)fluoranthene	BDL
benzo(k)fluoranthene	BDL
benzo(a)pyrene	BDL
indeno(1,2,3-cd)pyrene	BDL
dibenzo(a,h)anthracene	BDL
benzo(ghi)perylene	BDL
phenol	BDL
2-chlorophenol	BDL
2-nitrophenol	BDL
2,4-dimethylphenol	BDL
2,4-dichlorophenol	BDL
4-chloro-3-methylphenol	BDL
2,4,6-trichlorophenol	BDL
2,4-dinitrophenol	BDL
4-nitrophenol	BDL
4,6-dinitro-2-methylphenol	BDL
pentachlorophenol	BDL

BDL - Below Detection Levels

Table 5-9

CONCENTRATION RANGES FOR METALS (TCL) IN BACKGROUND SUBSOIL SAMPLES

Parameter	Concentration Range (mg/kg)
Aluminum	2,210 - 9,290
Antimony	< 6.00
Barium	17.4 - 120.0
Beryllium	< 0.200
Cadmium	< 0.500
Chromium	4.48 - 70.4
Cobalt	1.92 - 10.0
Copper	7.61 - 109.0
Iron	4,400 - 17,400
Lead	3.20 - 12.3
Manganese	95.8 - 302.0
Nickel	4.41 - 50.6
Silver	< 1.00
Sodium	103 - 221
Vanadium	7.30 - 20.3
Zinc	25.0 - 128.0

excess of 100 ppm were also obtained in boreholes SB-1 (140 ppm/52 feet) and SB-7 (220 ppm/15 feet). Table 5-12 lists the HNu readings obtained during drilling of the listed boreholes. The laboratory data does not support these findings, however. Soil samples collected at the corresponding locations failed to indicate the presence of organic compounds. HNu readings have wide fluctuations, however, allowing their reliability to be suspect. HNu Model PS-101 PIDs are subject to erroneous meter readings from changes in temperature, moisture conditions, and airborne dust levels.

Continuous HNu monitoring of the open boreholes and samples during the drilling of borings SB-8, SB-10, and SB-17 did not reveal the presence of volatile organic vapors.

5.4 QA/QC RESULTS

Samples were collected during the field investigation for QA/QC as described in section 3.8.5. From these samples, the eight field rinsate blanks collected during subsoil sampling revealed low levels of the common laboratory contaminants including methylene chloride, acetone, phthalate esters, toluene, and 2-butanone. In addition, bromodichloromethane and dibromocloromethane were detected in rinsate samples. These two compounds are common tap water contaminants. They were not, however, detected in any of the soil samples. Low levels of calcium, copper, iron, sodium, and zinc were also detected in the rinsate samples.

One rinsate from the surface soil sampling was analyzed for radiological parameters. Concentrations of tritium, gross beta activity, radium-226, thorium-232, potasium-40, and cesium-137 in this sample were less than the MDL (sample SX3033-471, Appendix D). Uranium, however, exceeded reference background concentrations for both water and soil (USDOE, 1988; NCRP, 1984). The presence of this uranium is not clear, as none of the surface soil samples analyzed showed uranium concentrations above background levels. Thorough decontamination of samples is validated by the lack of tritium in rinsate samples, although tritium was present in elevated concentrations from samples collected at the MWL.

Toluene was detected in the field blanks taken during the final three borings. The (1990) field blanks collected in the course of drilling the first 15 boreholes contained low levels of common laboratory contaminants as previously described above for soil samples. Several samples had low surrogate recoveries for two out of three semi-volatile compound surrogates. The low recoveries are likely due to matrix-masking effects in the soil samples.

Field duplicate results for metals analyses indicate acceptable precision, except for copper with an RPD of 120%. No other qualification of organics or metals results was necessary based on field duplicate results. Radiological results for field duplicates (Appendix Table B-13) have good agreement between duplicate samples. Analytical error for concentrations of gross alpha, radium-226, and thorium-232 are attributable to acceptable variation at low concentrations (near the MDL) for these compounds.

Laboratory matrix spikes and matrix spike duplicates (MS/MSD) results for organics analyses are acceptable. However, the frequency of MS/MSD results for semi-volatile compounds was much less than for volatile organic compounds. Spike and duplicate results for metals analyses indicated the need for qualification of the certain analytes for reasons listed in Table 5-13.

Table 5-13

QUALIFICATIONS BASED ON DATA VALIDATION

Analyte	Laboratory Job File Affected*	Qualifier	Bias	Reason
Antimony	889.011	L	Low	30% Recovery
Copper	889.011	J	Unknown	54.7% RPD
Copper	889.020	J	Unknown	89.7% RPD
Selenium	889.011	R	Extremely Low	0% Recovery
Zinc	889.020	J	Unknown	44.7% RPD

*Positive results for the analyte noted should be qualified in all soil samples of the listed job file. See Appendix E for Laboratory QA data.

Key:

J = Results estimated, bias unknown.
L = Results estimated, biased low.
R = Results rejected as unusable.

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 DISCUSSION

The field work for the Phase 1 RFI at the MWL was completed in June, 1990 following the completion of soil borings SB-8, SB-10, and SB-17. All work performed at the site was completed in accordance with the work plan except for the deviations noted in Section 3.7.

Site lithology is complex and varied, which is typical for alluvial- fluvial depositional environments. Sediments composed primarily of coarse to fine sands and silts dominate the deposited materials. Two distinct layers or lenses of gravelly materials composed of limestone, quartzose, and igneous rock identified occur consistently in the boreholes across the northern half of the site. One layer appears to exist in a northeast to southwest direction across the site and at a depth of approximately 50 feet. This layer consisting of gravel and cobbles is approximately 25 feet in thickness and is prominent in both the lithologic records from the borehole drilling and monitoring well MWL-MW2 (E & E, 1989) located at the northwest corner of the landfill.

A more areally extensive gravel deposit begins from approximately 95 to 100 feet bgs and extends to depths greater than 130 feet bgs. This layer was verified in every borehole across the site. It also is detailed in the lithologic logs for monitoring wells MWL-MW1 and MWL-MW2 (E & E, 1989). However, this layer is absent from the monitoring well MWL-MW3 borehole log.

Such deposition of sands, silts, and gravels, relatively porous in nature, may facilitate vertical and lateral contaminant migration and potential channeling of liquids and vapors. These layers may also impede continuous flow of liquids if abrupt changes in the sediment particle size distribution occurs, for instance where silty sands are underlain by gravel. The presence of caliche layers (ranging in thickness from less than 1 inch to several inches) will also likely retard vertical migration of either liquid or vapor constituents. This caliche may be present as thin veinlets to expansive layers. The extent of each occurrence, however, is unknown and may be difficult to adequately define.

Contaminant flow, whether liquid or vaporous in state, through such a complex, heterogeneous environment would be tortuous at best. The layering of sediments would likely preclude a straight, vertical migration of compounds given the flow barriers of cemented particles (sands, silts) and textural diversity. Accordingly, contaminant migration to the groundwater would be very slow, though at this point, the downward migration of contaminants - or water - cannot be quantified with the present data.

Samples analyzed for radiological analyses for alpha and beta emitters, gamma radiation spectrometry, uranium, and plutonium are below background levels. The background levels were established from actual samples collected during the investigation and from historical data. Radioanalytical results for tritium, however, show elevated tritium contamination in the boreholes immediately adjacent to the classified disposal area, and within 30 feet of the ground surface. Tritium was also detected at points deeper than 30 feet at the south end of the classified area (SB-6 and SB-17) and below the disposal pits. In surface soil samples, tritium was also detected in concentrations greater than background at various locations across the MWL.

Evidence of tritium contamination in the surface and shallow soils, obtained during this investigation, lends support to the 1979 and 1981 studies at the MWL in which tritium was detected in elevated concentrations close to the surface. Similar inferences may be made as the earlier studies, which suggest that lateral migration of tritium is occurring from inactive filled pits and outgassing of tritium from soils can result from an upward movement of the tritium. It is presently unknown if the surficial tritium may be released - or in what magnitude - into the air. Results of the air pathway sampling at one meter above the ground surface show airborne tritium concentrations at the MWL less than or equal to background levels.

6.2 CONCLUSIONS

The analytical data indicate that tritium is the primary contaminant of concern at the MWL. Tritium is, in most circumstances, associated with the movement of water and water vapor in the soil. Because of environmental conditions, movement of water in the unsaturated soil at the MWL is controlled by factors of temperature, salinity gradients, and capillarity, and to a lesser extent, by gravitational forces. Existing shallow soil water will tend to have a dominantly upward flux in response to surface evaporation and evapotranspiration and vapor pressure differentials related to soil temperature gradients (Hillel, 1971), particularly in this geographic region. Tritium may also migrate horizontally and vertically away from the pits by concentration driven diffusion gradients. Since tritium (in soil water) is concentrated in the hydroscopic portion of soil water most closely tied to soil particle surfaces, even in the presence of free water (NCRP, 1979), vertical downward migration with wetting fronts is likely to be limited.

Figure 6-1 presents the conceptual model of current MWL site conditions based on the findings of this Phase 1 investigation. The figure presents the logical flow chart of likely contaminant pathways, resulting ultimately in the possibility of human exposure, including the phase partitioning between soil gas, water, and solids.

The figure also illustrates the probable environmental scenario of tritium migration and the various factors that may affect tritium movement.

6.2.1 Exposure Pathways

Preliminary evaluation of the data suggests the migration of contamination, tritium, from the landfill is limited to the vadose zone immediately surrounding the site. Groundwater monitoring data from the MWL was unavailable as of this report. Therefore a determination could

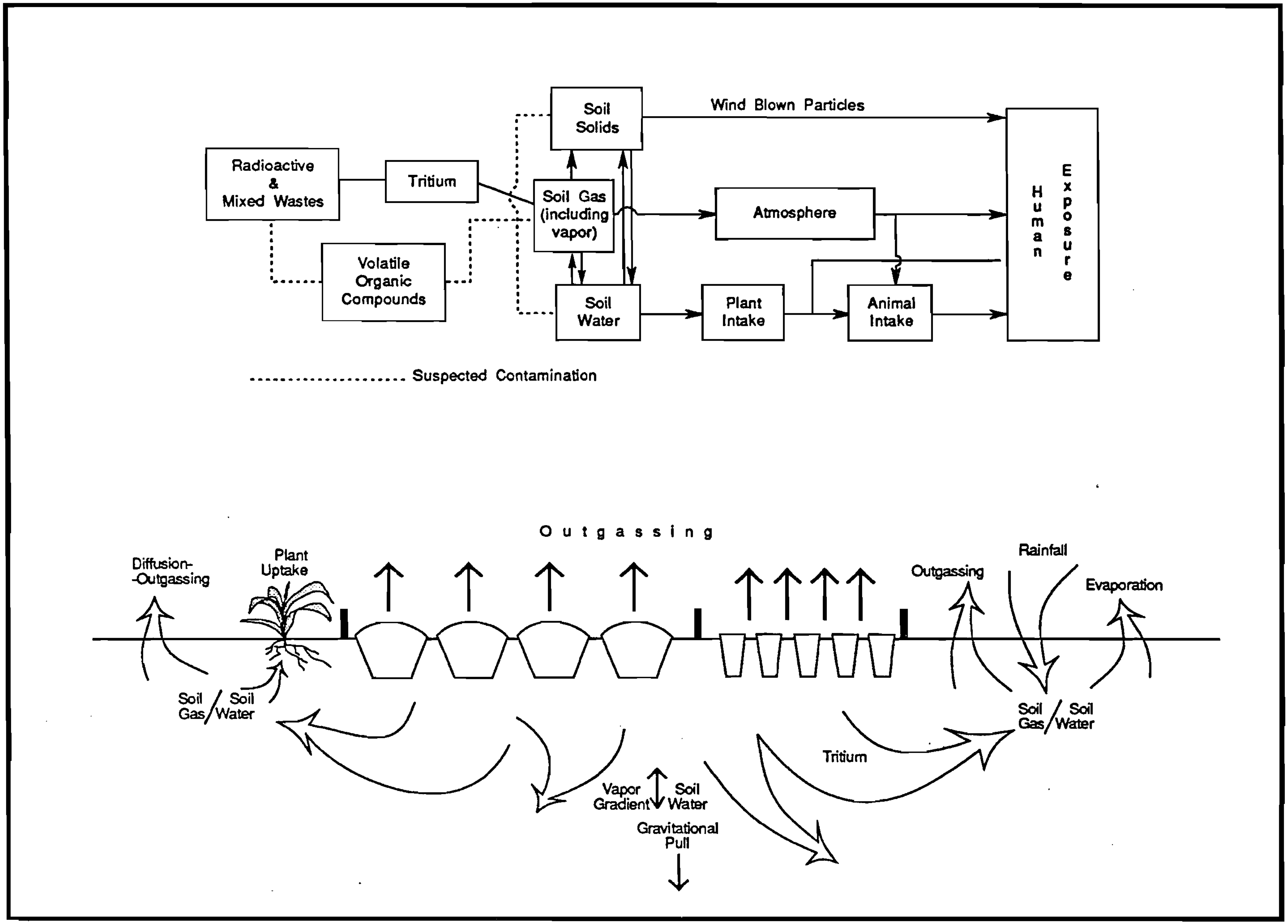


Figure 6-1: Conceptual Model of Current Site Conditions

not be made as to whether or not contamination has reached the groundwater, however the likelihood is low. Furthermore, no measurable release of tritium to the atmosphere has been detected.

Based on the information obtained from this Phase 1 RFI, the most likely contaminant pathway to potential receptors is via the soil. Contact with contaminated soils is the most likely exposure route for humans, however, because the MWL is remotely located and access is restricted by fences, the potential for human exposure to tritium is low.

6.3 RECOMMENDATIONS

To fully characterize the MWL with regard to the potential for existing contaminant releases, as well as a complete evaluation of the physical and chemical environment of the site that may affect future contaminant release and migration, additional data is necessary. Preliminary identification of data gaps to be filled which are necessary for thorough assessment of the MWL include:

- Determine the groundwater flow gradient and determine if additional monitoring wells are needed;
- Obtaining groundwater monitoring data for organic, metals, and radionuclide parameters;
- Sample collection and analysis to determine if a release of radioactive and hazardous contaminants has occurred immediately below the landfill;
- Continued sampling of subsurface soils to verify if a release of volatile organic contaminants has or has not occurred;
- Determination of soil hydraulic characteristics of the vadose zone to provide input for contaminant flow modeling and evaluation;
- Determine soil chemical characteristics that may affect contaminant fate and transport; and
- To the extent possible, more thoroughly define the source term of wastes that may contribute to contamination.

To generate the data required to fill the data gaps, the following technical approaches may be considered and employed.

- Additional angled soil borings·directed under the landfill to obtain subsurface sample collection.
- Soil gas sampling to confirm the presence of volatile organic vapors.
- A bench-scale study of soil hydraulic properties measuring moisture movement in the soil, including an array of soil moisture meters and intact core samples for detailed characterization of intrinsic permeability, effective porosity, moisture content, moisture release characteristics, and other factors.
- Assessment of chemical interactions affecting the mobility of waste migration using current knowledge of processes and modeling.
- Accurately map MWL trench/pit locations and other features, assess topographic features affecting surface migratory pathways, and continue air sampling, if necessary, to monitor for airborne releases of gaseous or other contaminants.

The data obtained from additional investigation of the MWL will be the basis for the record of decision for further action at the site. Further action at the site may include risk assessment, additional corrective action (corrective measures study), or possibly, no further action. The ultimate closure of the landfill with postclosure monitoring will be the ultimate application of data from this process.

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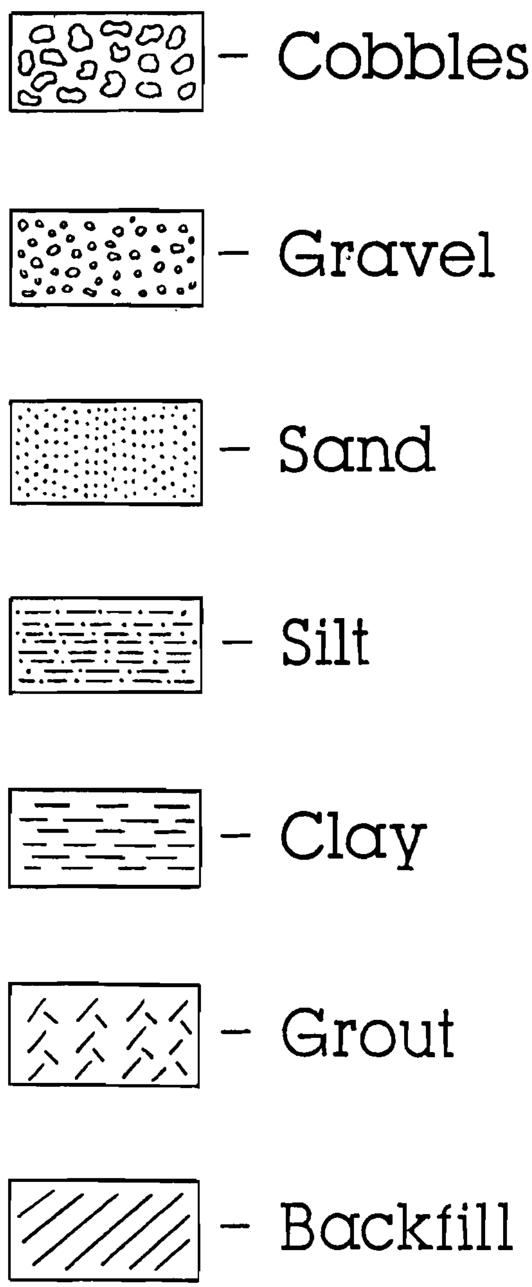
APPENDIX A
BOREHOLE GEOLOGIC LOGS



Key for Soil Boring Logs
(Appendix)

Sandia Mixed Waste Landfill

DRILLING AND SAMPLING LOG

Project: Sandia Mixed Waste Landfill
Boring Contractor: Sergent, Hauskins & Beckwith
Boring Method: 6-5/8" Hollow Stem Auger
Logged By: Ted Faile
Date Completed: 9/25/89 - 9/26/89

Job No.: SX3033
Location: North of Trench A
Surface Elevation: Datum:
Casing Elevation: No Casing Datum:
Total Depth: 75 feet Datum:
Groundwater: Not Encountered

Boring No.: SB-1 (Angle)

Angle Boring: 30° from vertical

Well Details (Actual Depth)	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	0		Light brown, fine grained sand to silty sand; minor caliche; quartzite gravel, sub-angular to angular, sparsely present.			Continuous Sampling; 5' x 2-3/4" Acrylic Tubes. 80% Recovery.
(4.3)	5		Light brown fine to coarse grained sand and gravel; gravel mostly quartz and quartzite pebbles, angular to sub-angular.	964-B-372		65% Recovery
(8.7)	10		Coarse sands and gravels at top; grades to fine grained sand to silty sand (20% silt) near bottom; calcareous throughout.	166-B-767		65% Recovery
(13.0)	15		Light brown, medium to coarse sand mixed with fine to coarse gravel, mostly limestone and quartz; gravel sub-rounded to sub-angular and includes K-spar fragments.	257-B-181		40% Recovery HNu = 1 ppm
(17.3)	20		Light brown, fine to medium grained sand interspersed with fine, angular to sub-angular quartz gravel.	638-B-992		60% Recovery HNu = 1 ppm

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-1 (Angle)

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
(21.7)	25		Light brown, fine to coarse grained sand with some fine to medium gravels. Gravel angular to sub-angular limestone and quartz; limestone particularly sparse.	882-B-302		55% Recovery
(26.0)	30		Light brown to brown fine grained sand grades to coarse sands and fine gravels; calcareous throughout; quartz gravel angular to sub-angular.	299-B-871 + 187-B-098		70% Recovery HNu = 1 ppm
(30.3)	35		Medium to coarse grained sand, to large cobbles; cobbles mostly limestone with lesser quartz and quartzite present; cobbles angular to sub-rounded; calcareous throughout.	850-B-800		25% Recovery HNu = 20 ppm
(34.6)	40		Light brown, fine to coarse grain sand with fine to medium gravels, mostly quartzite; heavily calcareous in localized zones.	572-B-326		50% Recovery
(39.0)	45		Light brown, fine to medium grained sand to silty sand (10% silt); calcareous throughout.	844-B-607		60% Recovery

ecology and environment, inc. **DRILLING AND SAMPLING LOG** Sheet 3 of 3

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-1 (Angle)

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
(43.3)	50		Light brown, fine to medium grained sand to silty sand (10% silt); some quartz gravel sparsely interspersed.	218-B-219		50% Recovery
(47.6)	55		Medium to coarse grained calcareous sand, to medium gravel; gravel sub-angular to sub-rounded; limestone cobbles near bottom.			60% Recovery
(52.0)	60		Calcareous, fine grained sand to silty sand (35% silt) with medium to coarse quartzite and limestone gravel; some cobble size fragments.	701-B-744		40% Recovery HNu = 140 ppm
(56.3)	65		Light brown, fine to coarse grained sand with fine to coarse limestone and quartzite gravel; grades to light brown fine grained sand to silty sand (10% silt); angular limestone gravel mostly sparitic; some small, black cherty gravel also present.			40% Recovery HNu = 70 ppm
(60.6)	70		Heavily calicified (caliche) layer; light brown, fine grained sand to silty sand with fine to coarse gravel and cobbles; coarser materials mostly quartz with some granite and limestone also present; green and red discoloration in some zones.	356-B-313		50% Recovery HNu = 4 ppm
(65.0)	75			114-B-316		

DRILLING AND SAMPLING LOG

Project: Sandia Mixed Waste Landfill
Boring Contractor: Sergent, Hauskins & Beckwith
Boring Method: 6-5/9" O.D. Hollow Stem Auger
Logged By: Ted Faile
Date Completed: 9/18/89 - 9/19/89

Job No.: SX3033
Location: North of Trench D
Surface Elevation:
Casing Elevation: No Casing
Total Depth: 125 feet
Groundwater: Not Encountered

Boring No.: SB-2
Datum:
Datum:
Datum:

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	0		Brown to light brown, fine grained sand to silty sand.			Continuous sampling; 5' x 2-3/4" acrylic tubes. 30% Recovery
	5		Light brown fine grained sand to sandy silt; calcareous throughout.	283-B-888		<10% Recovery
	10		Light brown fine grained sand and silt; fine gravel throughout bottom 12" - 18" of core; calcareous throughout; some organic material appears to be present (graphite from core barrel?).	916-B-971		30% Recovery
	15		Light brown fine grained sand, interspersed with fine to coarse grained quartz gravel; gravels sub-angular to sub-rounded.	710-B-838		<10% Recovery
	20		Light brown, fine grained sand, interspersed with fine to coarse grained quartz gravels; gravel sub-anqular to rounded.	061-B-456		45% Recovery

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-2

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Type	Remarks
	25		Light brown, fine to medium grained sand interspersed with fine to medium size quartz gravel; gravel sub-rounded to rounded.	721-B-961		50% Recovery
	30		Light brown, fine grained sand to silty sand mixed with fine to medium quartz gravels; gravels sub-rounded to rounded; calcareous throughout.	901-B-528		50% Recovery
	35		Light brown fine to medium grained sand mixed with fine to medium quartz gravel; gravel sub-rounded to rounded.	560-B-165		45% Recovery
	40		Light brown, medium to coarse grained sand and fine to medium quartz gravel; calcareous throughout.	606-B-808		55% Recovery
	45		Light brown, medium to coarse grained sands mixed with coarse gravel; small quartz cobbles, sub-rounded to rounded also present throughout.	854-B-381		25% Recovery

Project: Sandia Mixed Waste Landfill | Job No.: SX3033 | Boring No: SB-2

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	50		Light brown, medium to coarse grained sand with small, sub-rounded quartz cobbles and limestone/dolomite fragments; carbonate fragments angular to sub-angular. Mostly sparite with smaller micritic fragments.	376-B-490		50% Recovery
	55		Light brown, medium to coarse grained sand mixed with small, sub-rounded quartz gravel and cobbles; angular to sub-angular limestone/dolomite fragments present throughout.			30% Recovery
	60		Light brown, medium to coarse grained sand with angular to sub-angular limestone/dolomite fragments.	772-B-000		30% Recovery
	65		Light brown, medium to coarse grained sand, grades to finer grained sand and then to a light brown silt.			50% Recovery
	70		Loosely cemented, light brown, fine grained sand, calcareous; grades to a fine to coarse grained sand with small cobbles.	581-B-172		60% Recovery
	75		Cobbles, mostly limestone with minor quartzite.			0% Recovery No sample

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-2

Depth (Feet)	Lithological Description	Sample No.	Remarks
80	Fine to medium grained light brown sand with some fine quartz pebbles interspersed; grades to calcareous, fine to medium grained light brown sand.		65% Recovery Some dark brown to gray discoloration near bottom of core.
85	Fine to medium grained light brown calcareous sand matrix with fine quartz pebbles.		70% Recovery Some dark gray discoloration near bottom of core.
90	Fine to medium grained, light brown sand.	782-B-485	75% Recovery Some dark gray to brown discoloration near bottom of core. HNu = 8 ppm
95	Light brown, fine grained sand to silty sand; some fine grained, sub-rounded gravels interspersed.	371-B-744	60% Recovery No significant discoloration.
100	Next page.		

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-2

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	100		Medium to coarse grained sand, interspersed with medium to coarse gravels; sand coloration much lighter due to increased quartz content; some small cobbles near bottom.	388-B-274		70% Recovery
	105		Coarse gravels and cobbles.			0% Recovery No sample.
	110		Light brown, coarse grained sand, grades to coarse, calcified gravel. Gravel mostly limestone/dolomite fragments, angular to sub-angular, with some subrounded quartz pebbles, and angular to sub-angular quartz fragments. Some cementation evident within gravel layer.	951-B-180		40% Recovery
	115		Coarse gravels and cobbles.			0% Recovery No sample.
	120		Coarse gravel and cobbles; mostly limestone fragments with some quartzite.	900-B-074		Sample collected from ring sampler at 122-123 feet. HNu = 8 ppm HNu - 70 ppm Close hole due to excessive HNu readings.
	125					

DRILLING AND SAMPLING LOG

Project: Sandia Mixed Waste Landfill
Boring contractor: Sergent, Hauskins & Beckwith
Boring Method: 6-5/8" O.D. Hollow Stem Auger
Logged By: Diane Coker
Date Completed: 9/13/89 - 9/14/89

Job No.: SX3033
Boring No.: SB-3
Location: North of Classified Area
Surface Elevation: Datum:
Casing Elevation: No Casing Datum:
Total Depth: 105 feet Datum:
Groundwater: Not Encountered

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks SPT Blows/6"
	0					Split spoon 2' x 2" using two, 6" brass sleeve inserts.
	5		Light brown, sandy silt with caliche present; slightly indurated; fine grained sands 20% - 25%.	630-B-267		9/9/9/10 100% Recovery
	10		Light brown, fine grained sand to silty sand (silt 20%); 5% - 10% clay content, slightly plastic; some moisture present (probably from decontamination).	905-B-719		7/12/10/13 100% Recovery
	15		Light brown, fine grained sand to silty sand (silt 20%); minor clay content; slightly moist.	963-B-271		10/8/9/11 100% Recovery
	20		Light brown, very fine to fine grained sand; minor amount of pebbly gravel present.	673-B-953		12/21/17/15 90% Recovery

ecology and environment, inc. **DRILLING AND SAMPLING LOG** Sheet 2 of 4

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-3

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Type	Remarks
	25		Light brown, fine grained sand to silty sand (10% silt) with some very coarse sand to pebbly gravel; non-indurated to slightly indurated.	462-B-293		12/10/12/13 100% Recovery
	30		Light brown, very fine grained sand to silty sand (30% silt); gravel absent.	373-B-258		10/19/23/20 100% Recovery
	35		Light brown to whitish brown, medium grained sand to silty sand (10% silt); minor amount of cobbles, mostly quartzite; some pebbly gravel; calcareous throughout.	043-B-108		23/28/25/>15 50% Recovery
	40		Light brown, fine to medium grained sand with 10% silt.	367-B-260		44/47/45/>35 100% Recovery
	45		Light brown, fine grained, poorly sorted sand with pebbly gravel and some cobbles near bottom; calcareous throughout.	241-B-315		35/86/180/- 100% Recovery
	50		Next page			

ecology and environment, inc. DRILLING AND SAMPLING LOG

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No. SB-3

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	50		Light brown, fine to medium grained sand with 15% silt; some gravel to cobble size quartzite and limestone fragments; limestone has micritic texture; calcareous throughout.	467-B-557		36/61/62/58 75% Recovery
	55					Significant cobble content between 50 and 60 feet, according to drillers.
	60		Whitish tan, sandy silt; slightly gravelly to cobbly; calcareous throughout.			>100 - 4" 0% Recovery No sample. Lithologic description may be based on slough material.
	65					Intermittent cobble layers between 60 and 70 feet, according to drillers.
	70		Whitish tan, sandy silt, slightly gravelly to cobbly; calcareous throughout.	609-B-244		>150 - 3" 50% Recovery Lithologic description may represent slough material.
	75					

ecology and environment, inc. **DRILLING AND SAMPLING LOG** Sheet 4 of 4

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No : SB-3

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	80		Light brown, fine to medium grained sand with about 5% silt; little or no induration; calcareous throughout. No gravel present.	063-B-011		53/62/80/>20 100% Recovery
	85					Mostly sand between 80 and 90 feet, according to drillers.
	90		Light brown fine to medium grained sand with about 15% silt; some induration; thin (1/4") caliche layers throughout.	312-B-796		83/81/150/- 75% Recovery
	95					
	100		Light brown, fine grained sand to silty sand (20% silt) with some sub-angular pebbles. Pebble material predominantly quartzite with evidence of some igneous material.	537-B-635		75/88/130/>50 100% Recovery
	105					

DRILLING AND SAMPLING LOG

Project: Sandia Mixed Waste Landfill
Boring Contractor: Sergent, Hauskins & Beckwith
Boring Method: 6-5/8" O.D. Hollow Stem Auger
Logged By: Ted Faile
Date Completed: 9/21/89

Job No.: SX3033
Location: East of Classified Area
Surface Elevation:
Casing Elevation: No Casing
Total Depth: 101.5 feet
Groundwater: Not Encountered

Boring No.: SB-4
Datum:
Datum:
Datum:

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks SPT Blows/6"
	0					Split spoon 18" x 2", using two, 6" brass sleeves.
	5		Light brown, medium grained sand with minor silt content.	222-B-606		4/7/13 45% Recovery
	10		Light brown, medium grained sand with fine, well rounded quartz pebbles.	102-B-564		12/14/17 40% Recovery
	15		Light brown, medium grained sand to medium grained, well rounded gravel; loosely packed.			17/17/20 0% Recovery No Sample
	20		Brown, fine to medium grained sand, interspersed with fine quartz gravel, subangular to rounded; some calcareous zones.	801-B-949		22/27/30 40% Recovery

ecology and environment, inc. **DRILLING AND SAMPLING LOG**

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No : SB-4

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Type	Remarks
	25		Light brown, fine grained sand to silty sand matrix with medium to coarse quartz gravel; gravel angular to sub-angular	431-B-209		132/100 - 10" 70% Recovery HNu = 1.8 ppm
	30		Light brown, fine grained sand to silty sand, with some interspersed sub-angular, poorly sorted gravel; loosely compacted.	736-B-647		42/84/82 75% Recovery HNu = 1.0 ppm
	35		Brown, fine to medium grained sand, interspersed with fine to medium quartz gravel; loose.	719-B-440		36/49/53 70% Recovery HNu = 12 ppm
	40		Light brown, fine grained sand mixed with fine, quartz gravel; loosely packed; some calcareous zones.	520-B-012		28/36/48 70% Recovery HNu = 1.5 ppm
	45		Light brown, fine grained sand to silty sand mixed with fine to coarse quartz gravels; loosely packed; calcareous.	109-B-300		24/34/36 70% Recovery HNu = 0.5 ppm

ecology and environment, inc. **DRILLING AND SAMPLING LOG** Sheet 3 of 5

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-4

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	50		Fine to coarse grained sands with limestone and quartz cobbles and fine to coarse gravel. Gravel predominantly quartz, sub-angular to sub-rounded.	881-B-425		150 - 5" 60% Recovery HNu = 2.6 ppm
	55					
	60		Limestone and dolomite cobbles with some calcareous silts, sands and quartz gravel.	913-B-416		200 - 3" 80% Recovery HNu = 2 ppm
	65					
	70		Light brown, medium grained sand to silty sand, grading to coarse sand and gravel. Gravel predominantly quartz pebbles with some limestone fragments.	739-B-330		40/60/100 80% Recovery HNu = 1.0 ppm
	75					

ecology and environment, inc. **DRILLING AND SAMPLING LOG**

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-4

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	75					
	80		Light brown, fine grained sand to silty sand with fine, quartz gravel interspersed.	956-B-962		33/37/35 75% Recovery HNu = 3.5 ppm
	85					
	90		Light brown, fine grained sand; cemented; minor amount of quartz pebbles present; localized calcareous zones; limestone fragments present near bottom.	967-B-472		150 - 6" 70% Recovery HNu = 50 ppm
	95					
	100		Next page.			

ecology and environment, inc. **DRILLING AND SAMPLING LOG** Sheet 5 of 5

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-4

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	100		Light brown, fine grained sand to silty sand matrix with limestone and quartz/ quartzite cobbles present. Some cementation also present.	993-B-835		200 - 6" 50% Recovery HNu = 2 ppm
	105					
	110					
	115					
	120					
	125					

DRILLING AND SAMPLING LOG

Project: Sandia Mixed Waste Landfill
Boring Contractor: Sergent, Hauskins & Beckwith
Boring Method: 6-5/8" O.D. Hollow Stem Auger
Logged By: Diane Coker
Date Completed: 9/20/89 - 9/21/89

Job No.: SX3033
Location: Southwest corner of Classified Area
Surface Elevation:
Casing Elevation: No Casing
Total Depth: 149.5 feet
Groundwater: Not Encountered

Boring No.: SB-5
Datum:
Datum:
Datum:

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	0		Orange brown, medium grained sand to silty sand (10% silt).			Continuous Sampling; 5' x 2-3/4" acrylic tubes. 50% Recovery
	5		Orange brown to light brown, fine grained sand to silty sand (15% silt).	444-B-320		15% Recovery
	10		Light brown to whitish tan, fine grained sand to silty sand (20% silt); calcareous throughout.	131-B-211		15% Recovery
	15		Light brown, medium grained sand to silty sand (10% silt); minor amount of sub-angular fine to medium gravel.	426-B-300		25% Recovery
	20		Light brown, fine to medium grained sand with minor silt content; also minor amount of fine gravel.	541-B-121		10% Recovery

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-5

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	25		Light brown, fine to medium grained sand to silty sand (15% silt).	818-B-784		10% Recovery
	30		Light brown to whitish tan, poorly sorted, fine to medium grained sand to silty sand (20% silt); fine grained pebbly gravel also present, with some larger micritic limestone fragments; calcareous in zones.	541-B-121		15% Recovery
	35		Light brown to whitish brown, medium to coarse grained sand to silty sand (15% silt) with some fine to coarse gravels present; sand matrix heavily calcified with caliche present throughout; gravel clasts sub-angular and primarily igneous.	000-B-003		35% Recovery
	40		Light brown, fine to medium grained sand with minor silt and very fine gravel content; caliche blebs present throughout.	187-B-226		90% Recovery
	45		Light brown, fine to medium grained sand to silty sand (10% silt); slightly moist.	033-B-833		95% Recovery

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-5

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	50		Light brown, fine to medium grained sand to silty sand (10% silt).	954-B-118		90% Recovery HNu = 0.4 ppm
	55		Light brown, fine grained sand to silty sand (10% silt); minor amounts of very coarse sand and fine gravel near bottom; calcareous in zones.			50% Recovery
	60		Light brown fine grained sand to silty sand (10% silt); approximately 1 foot of very coarse sand near middle with hard, indurated sandy silt at bottom; slightly moist.	566-B-212		90% Recovery HNu = 1 ppm
	65		Orange brown, medium grained sand with minor silt content; 6 inch silt or clay layer, dark brown, near middle; evidence of caliche on sides of core.			85% Recovery HNu = 1 ppm
	70		Light brown, medium grained sand grades to a poorly sorted very fine to fine grained sand to silty sand (15% silt); some very coarse sand to fine gravels near bottom; caliche present in upper foot.	800-B-631		70% Recovery
	75					

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-5

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	75		Light brown, very fine to fine grained sand to silty sand (20% silt); grades to coarse to very coarse sand with minor silt content.			90% Recovery HNu = 0.4 ppm
	80		Light brown to whitish brown, very fine to fine grained sand and silty sand (25% silt); sand grains sub-rounded to sub-angular quartz.	929-B-570		60% Recovery HNu = 0.3 ppm
	85		Light tan, very fine to fine grained sand and silty sand (25% silt) grades to a mottled tan then to a darker tan near bottom; some black discoloration near bottom; sand slightly indurated.			50% Recovery HNu = 0.3 ppm
	90		Light tan to light brown, very fine to medium sand with minor silt content; some black discoloration on sides of core, near bottom.	458-B-893		90% Recovery HNu = 0.2 ppm Black discoloration probably graphite.
	95		Light brown, fine grained sand to silty sand (10% silt); grades to uneven layers of dark reddish brown near middle. Bottom is poorly sorted, light brown, very fine sand with fine gravel (15%). Gravel clasts mostly dark gray limestone, quartzite and miscellaneous crystalline material. Caliche blebs present throughout.			70% Recovery
	100		Next page.			

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-5

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	100		Light brown to white, very fine sand to silty sand (15% silt) matrix, with coarse gravel and cobbles. Cobbles predominantly limestone fragments with caliche coating on many.	007-B-949		35% Recovery HNu = 660 ppm Significant cobble content between 100 and 110 feet, according to drillers.
	105		Cobbles; predominantly limestone and quartzite clasts.	126-B-394 + 629-B-036		Sample obtained from ring sampler (109-110 feet) HNu = 230 ppm
	110		Light brown, medium grained sand with minor silt and fine gravel content; caliche interspersed throughout; occasional coarse gravel clast of either quartz or quartzite.	223-B-091		60% Recovery HNu = 0.6 ppm
	115		Light brown, fine to medium grained sand with minor silt content; moist. Occasional large cobbles also encountered.			Sample obtained from ring sampler.
	120		Light brown, fine to medium grained sand with silt (10%) and large pebbles; poorly sorted; moist.	980-B-003		Sample obtained from ring sampler. Intermittent cobble layers, according to drillers.
	125		Next page.			

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-5

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	125		Brown, medium grained sand with minor silt content; moist.			Sample obtained with ring sampler. Intermittent cobble layers, according to drillers.
	130		Orange brown, fine to medium grained sand with 10% silt content; moist.	086-B-111		Sample obtained with ring sampler. HNu = 0.6 ppm
	135		Light brown, very fine to fine grained sand to silty sand (10% silt); caliche blebs in zones; calcareous throughout; moist.			Sample collected with 18" x 2" split spoon. 35/113/285 refusal. HNu = 2 ppm
	140		Orange brown to light brown, fine grained sand to silty sand (15% silt); moist.	108-B-288		Sample obtained from ring sampler. HNu = 1.5 ppm
	145		Orange brown, very fine to medium grained sand to silty sand (10% silt); moist.			Sample obtained from ring sampler. HNu = 1.5 ppm
				698-B-873		

DRILLING AND SAMPLING LOG

Project: Sandia Mixed Waste Landfill
Job No.: SX3033
Boring No.: SB-6 (Angle)
Boring Contractor: Sergent, Hauskins & Beckwith
Location: South of Classified Area
Boring Method: 6-5/8" O.D. Hollow Stem Auger
Surface Elevation:
Datum:
Logged By: Diane Coker
Casing Elevation: No Casing
Datum:
Date Completed: 9/27/89 - 9/28/89
Total Depth: 80 feet
Datum:
Groundwater: Not Encountered

Angle Boring: 30° from vertical

Well Details (Actual Depth)	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	0		Light brown to reddish tan, fine grained sand to silty sand (35% silt); slightly moist; loose.			Continuous Sampling; 5' x 2-3/4" acrylic tubes. 45% Recovery
(4.3)	5		Light brown, fine to very coarse grained sand with 20% silt; some medium gravel (10%); poorly sorted; caliche coating on larger gravel fragments; loose.	147-B-861		50% Recovery
(8.7)	10		Light brown, fine to medium grained sand to silty sand (10% silt), with minor coarse sand content.	335-B-416		90% Recovery
(13.0)	15		Light brown, medium grained sand with minor silt content; grades to very coarse sand and fine gravel; clasts primarily quartz, quartzite, limestone and crystalline igneous material; slightly moist.	959-B-694		40% Recovery
(17.3)	20		Orange brown, fine to medium grained sand to silty sand (15%); caliche veinlets in zones.	079-B-258		50% Recovery

ecology and environment, inc. DRILLING AND SAMPLING LOG

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-6 (Angle)

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
(21.7)	25		Coarse to very coarse gravel; fragments include reddish-purple quartzite and granitic clasts; abundant caliche.	089-B-122		0% Recovery No Sample Gravelly between 25 and 30 feet, according to drilers. Lithologic description based on cuttings
(26.0)	30		Light brown, coarse to very coarse sand with 40% cobbles and cobble fragments; material includes reddish-purple quartzite, dark gray sparitic limestone, and greenish gray, weathered crystalline igneous rock. Also, lesser amount of quartz, feldspar, muscovite and black crystalline mineral.			45% Recovery Due to difficult drilling conditions, SB-6 was moved to a position 15 feet west of its original location. Lithologies from 35 to 80 feet were recorded at the new borehole location
(30.3)	35		Light brown, medium grained sand with minor coarse sand and silt content; slightly moist.	117-B-682		50% Recovery
(34.6)	40		Light brown, medium grained sand with minor coarse sand and silt content; caliche veinlets near bottom; slightly moist; indurated in zones.	873-B-009		60% Recovery HNu = 1 ppm
(39.0)	45		Light brown, medium grained sand to silty sand (15% silt); caliche veinlets throughout; indurated; some orange brown coloring in parts; slightly moist.	135-B-922		65% Recovery

ecology and environment, inc. **DRILLING AND SAMPLING LOG**

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-6 (Angle)

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
(43.3)	50		Light brown, medium to fine grained sand to silty sand (10% silt); very calcareous with caliche veinlets throughout; dry to slightly moist.	370-B-234		40% Recovery HNu = 2.5 ppm
(47.6)	55		Light brown, medium to fine grained sand to silty sand (10% silt) with minor very fine to fine gravel content; calcareous throughout; slightly moist.			65% Recovery
(52.0)	60		White to light brown, poorly sorted sand matrix with silt to cobble size material throughout. Predominantly fine to medium grained sand to silty sand (10% silt) with up to 40% fine to very coarse gravels and 5% cobbles; clasts include pink and white, weathered granitic rocks, quartzite and limestone; caliche throughout; some dark black igneous grains near top.	751-B-		40% Recovery
(56.3)	65		Light brown to orange brown, fine to medium grained sand to silty sand (15% silt); very slightly moist; caliche blebs and veinlets throughout.			65% Recovery
(60.6)	70		Light brown to orange brown, fine to medium grained sand with minor coarse sand and silt content; well indurated; caliche blebs and veinlets throughout; clayey layer near middle; slightly moist.	533-B-976		65% Recovery
	75		Next page.			

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-6 (Angle)

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
(65.0)	75		Light brown, fine to medium grained sand to silty sand (20% silt); calcareous with caliche blebs and veinlets throughout.			75% Recovery
(69.3)	80			052-B-867		
	85					
	90					
	95					
	100					

DRILLING AND SAMPLING LOG

Project: Sandia Mixed Waste Landfill	Job No.: SX3033	Boring No.: SB-7
Boring Contractor: Sergent, Hauskins & Beckwith	Location: East of Trench E	
Boring Method: 6-5/8" O.D. Hollow Stem Auger	Surface Elevation:	Datum:
Logged By: Ted Faile	Casing Elevation: No Casing	Datum:
Date Completed: 9/20/89	Total Depth: 101.5 feet	Datum:
	Groundwater: Not Encountered	

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	0					Split Spoon 18" x 2", using two, 6" brass sleeve inserts.
	5		Light brown, fine grained sand.	579-B-280		17/25/37 100% Recovery
	10		Light brown, fine to medium grained sand.	427-B-014		7/9/14 100% Recovery
	15		Light brown, fine grained sand to silty sand.	406-B-807		12/15/19 100% Recovery HNu = 220 ppm
	20		Light brown, medium grained sand interspersed with minor amount of rounded quartz pebbles.	339-B-865		32/35/40 90% Recovery

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-7

Depth (Feet)	Lithological Description	Sample No.	Remarks
25	Light brown, fine grained to medium grained sand.	437-B-108	17/19/21 100% Recovery HNu = 21 ppm
30	Light brown fine to medium grained sand, loosely cemented; minor amount of fine, well rounded quartz gravel also present.	459-B-234	30/40/72 100% Recovery
35	Light brown, fine grained sand; loosely packed.	531-B-268	19/22/25 90% Recovery
40	Large quartzite and limestone cobbles.		112-6" 0% Recovery No Sample
45	Light brown, medium to coarse grained sand with large, angular to sub-angular quartz fragments; minor amount of fine, well rounded quartz pebbles interspersed throughout.	180-B-740	60/45/50 50% Recovery

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-7

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	50		Light brown, fine to medium grained sand with localized calcareous zones; fine, well rounded gravel pebbles interspersed throughout.	147-B-800		20/39/48 90% Recovery HNu = 10 ppm
	55					
	60		Light brown, fine grained sand to silty sand matrix with coarse quartz gravel; large quartz, limestone and dolomite fragments also present. Gravel rounded to sub-rounded while larger fragments and cobbles generally sub-angular.	746-B-110		160-6" 50% Recovery
	65		Light brown, medium grained sand; well packed.	428-B-199		40/80/120 50% Recovery
	70		Light brown, fine grained sand and silty sand matrix with medium grained, rounded to well-rounded gravel. Sand and silt matrix heavily calcified.	480-B-193		150-6" 40% Recovery
	75		Next page.			

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-7

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	75					
	80		Light brown, medium grained sand with minor amount of poorly sorted quartz gravel.	660-B-869		68/100-8" 75% Recovery HNu = 2 ppm
	85					
	90		Light brown, fine to medium grained sand and silty sand; calcareous cementation throughout.	716-B-933		86/100-10" 80% Recovery HNu = 3 ppm
	95					
	100		Next page.			

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-7

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	100		Light brown, fine to medium grained sand with minor gravel content; slightly cemented. Gravel predominantly fine to medium quartz pebbles with some angular limestone fragments.	570-B-773		150-6" 75% Recovery HNu = 2 ppm
	105					
	110					
	115					
	120					
	125					

DRILLING AND SAMPLE LOG

Project: Sandia Mixed Waste Landfill	**Job No:** SX3033	**Boring No:** SB-8	
Boring Contr.: Sergent, Hauskins & Beckwith	**Location:** Southwest corner of MWL		
Boring Method: 6 5/8" Hollow Stem Auger	**Surface Elev:**	**Datum:**	
Logged by: Jeff Manship	**Casing Elev:** N/A	**Datum:**	
Date Completed: 6/13/90	**Total Depth:** 93.5	**Datum:**	
Angle boring: 15° from vertical	**Groundwater:** Not encountered		

WELL DETAILS (Actual Depth)	DEPTH (Feet)	SYMBOL	LITHOLOGICAL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	REMARKS
	0		Brown fine sand (95%) with a trace of pebbles (2mm), soft			
(4.8)	5		Reddish yellow fine sand with a trace of pebbles, firm	241-B-655		
(9.7)	10			908-B-097 743-B-750		
(14.5)	15		Reddish yellow fine sand (50%) and silt (45%) with pebbles to 10mm, firm	448-B-196 804-B-563		
(19.3)	20			764-B-173 389-B-255		

ecology and environment, inc. — DRILLING AND SAMPLE LOG — Sheet 2 of 5

Project: Sandia Mixed Waste Landfill — Job No: SX3033 — Boring No: SB-8

WELL DETAILS (Actual Depth)	DEPTH (Feet)	SYMBOL	LITHOLOGICAL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	REMARKS
			Fine pink sand (65%) with silt (25%) and trace of quartz pebbles to 45mm. Numerous blebs of caliche, soft.			
(24.1)	25			481-B-930		
			Pinkish coarse gravelly sand (65%). All size of grains, well graded, angular to subangular clasts of granite, soft.	857-B-008		
(29.0)	30			700-B-418 970-B-415		
			Reddish yellow very fine sand (70%) with silt 25% and a trace of gravel, soft.			
(33.8)	35			869-B-318		
			Reddish yellow fine to coarse sand (75%) with silt, pebbles (2-4 mm), firm.	915-B-648		
(38.6)	40			432-B-402		
			Light brown very fine sand (50%) and silt (50%) with a trace of pebbles caliche blebs, soft to firm.			

Project: Sandia Mixed Waste Landfill Job No: SX3033 Boring No: SB-8

WELL DETAILS (Actual Depth)	DEPTH (Feet)	LITHOLOGICAL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	REMARKS
(43.4)	45		331-B-565 505-B-305		
		Large quartz pebbles (25mm) cobbles, no samples collected.			
		Coarse sand and gravel with a trace of silt, angular to subangular.			
(48.3)	50				
		Cobbles, no samples collected.	131-B-433 010-B-254		
		Reddish yellow coarse to fine sand (80%) with silt (20%), firm			
(53.1)	55	Reddish yellow very fine sand and silt, caliche blebs with weak cement, firm.			
(57.9)	60	Reddish yellow silt (70% with very fine sand, firm.	362-B-662 395-B-115		

ecology and environment, inc. DRILLING AND SAMPLE LOG Sheet 4 of 5

Project: Sandia Mixed Waste Landfill Job No: SX3033 Boring No: SB-8

WELL DETAILS (Actual Depth)	DEPTH (Feet)	SYMBOL	LITHOLOGICAL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	REMARKS
(62.8)	65		Quartzite cobbles, 1-3 inch diameter, angular to subangular			
(67.6)	70		Hard cobble layer.	514-B-108 663-B-550		
			Reddish yellow very fine sand (95%) with trace of silt and gravel.			
(72.4)	75		Reddish yellow very fine sand and silt.			
(77.3)	80		Light brown sandy silt	686-B-916 859-B-548 763-B-973		

Project: Sandia Mixed Waste Landfill Job No: SX3033 Boring No: SB-8

WELL DETAILS (Actual Depth)	DEPTH (Feet)	SYMBOL	LITHOLOGICAL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	REMARKS
(82.1)	85		Light brown silty very fine sand (70%), soft.			
			Increase in clay content to 20% at 86 feet bgs.			
(86.9)	90		Reddish yellow gravelly fine sand (60%) with silt, quartz and granite closts to 30mm, angular to subangular.			
				249-B-329		
(90.3)	93.5			078-B-715		

DRILLING AND SAMPLING LOG

Project: Sandia Mixed Waste Landfill	Job No.: SX3033	Boring No.: SB-9	
Boring Contractor: Sergent, Hauskins & Beckwith	Location: West of Trench G		
Boring Method: 6-5/8" O.D. Hollow Stem Auger	Surface Elevation:	Datum:	
Logged By: A. Parolini	Casing Elevation: No Casing	Datum:	
Date Completed: 9/15/89	Total Depth: 133 feet	Datum:	
	Groundwater: Not Encountered		

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
2" PVC Pipe	0					Samples collected with split-barrel sampler (18") to 45 feet depth; CME core sampler (5 feet) used below 45 feet.
	5		Gravelly sand; very fine sand, some fine gravel, minor silt; tan, dry; gravel angular to sub-rounded, quartz and limestone.	673-B-348		32/29/43 Blows 50% Recovery
	10		Silty sand; very fine sand, some silt, trace fine quartz gravel; tan, dry.	789-B-787		28/39/53 50% Recovery
	15		Silty sand; very fine sand, some silt, trace fine gravel; tan, calcareous.	435-B-102		12/14/15 50% Recovery
	20		Gravelly sand; very fine sand, some fine gravel, minor silt, gravel limestone and quartz, angular; tan, dry, calcareous.	422-B-766		16/31/75 100% Recovery

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-9

Depth (Feet)	Lithological Description	Sample No.	Remarks
25	Silty sand; very fine grained sand, some silt, trace fine gravel, quartz and limestone, tan, dry.	911-B-368	28/42/55 100% Recovery
30			No sample recovered.
35	Silty sand; very fine sand, some silt, minor fine to coarse gravel.	298-B-873	45/24/33 25% Recovery
40	Silty sand, very fine sand, some silt, trace fine gravel, quartzite; tan, dry.	865-B-765	110/Refusal 30% Recovery
45	Silty sand, very fine sand, some silt, trace fine gravel, quartz; reddish tan, dry.		CME core 30% Recovery No sample.

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-9

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	50		Silty sand; very fine sand, some silt, trace fine gravel, quartz; reddish tan, dry.	557-B-596		Core interval 50-60 feet, 25% recovery.
	55					
	60		Silty sand; very fine sand, some silt, trace fine gravel; reddish tan.	554-B-791		Core interval 60-65 feet. 100% Recovery
	65		Sandy gravel; fine to coarse gravel, some very fine sand; gravel limestone clasts; trace silt; reddish tan.			Core interval 65-70 feet. Refusal at 66' 1 foot recovered.
	70					
	75		Next page.			

ecology and environment, inc. **DRILLING AND SAMPLING LOG** Sheet 4 of 6

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-9

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	75		Silty sand; very fine to fine sand, some silt, trace fine gravel; reddish tan, calcareous, caliche rinds on gravel; trace moisture at 77.5 feet.	141-B-898		Core interval 75-80 feet. 70% Recovery
	80					Core interval 80-85 feet. Recovery 2.5 feet 82.5 - 85.0 feet
			Silty sand; very fine sand, some silt, minor fine gravel, angular quartz and limestone; caliche rinds, veins.	327-B-192		
	85		Silty sand; very fine sand, some silt, trace fine gravel; reddish tan to light brown; trace caliche, trace moisture.			Core interval 85-90 feet. 100% Recovery
	90		Silty sand; as above.	312-B-736		Core interval 90-93 feet. Refusal at 93 ft. 60% Recovery
			Sandy gravel; fine to coarse gravel, some very fine sand; gravel angular to sub-rounded quartz, granite, limestone.			
	95					
	100		Next page.			

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-9

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Type	Remarks
	100		Gravelly sand; very fine sand, some fine gravel, some silt; tan; gravel angular to sub-rounded.	541-B-997		Sample with split barrel. 54/100/refusal 60% Recovery
	105		Gravelly sand; very fine to fine sand, some fine gravel, minor silt, trace coarse gravel; tan; gravel quartz, limestone.			Core interval 105-110 feet 50% Recovery.
	110		Silty gravelly sand; very fine sand, some silt, minor fine gravel; tan; quartz, limestone gravel clasts.	871-B-465		Core interval 110-115 feet. 100% Recovery.
	115		Silty gravelly sand; as above.			Core interval 115-120 feet. 100% Recovery
	120		Silty gravelly sand; fine sand, some silt, minor fine gravel; calcareous; reddish tan.	384-B-939		Core interval 120-125 feet. 100% Recovery
	125		Next page.			

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-9

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	125		Silty gravelly sand; as above.			Core interval 125-130 feet. 100% Recovery
	130		Silty gravelly sand; as above.	702-B-661		Core interval 130-133 feet. 100% Recovery
	135					
	140					
	145					
	150					

DRILLING AND SAMPLE LOG

Project: Sandia Mixed Waste Landfill **Job No:** SX3033 **Boring No:** SB-10
Boring Contr.: Sergent, Hauskins & Beckwith **Location:** Southend of trench A
Boring Method: 6 5/8" Hollow Stem Auger **Surface Elev:** **Datum:**
Logged by: Jeff Manship **Casing Elev:** N/A **Datum:**
Date Completed: 6/15/90 **Total Depth:** 82 feet **Datum:**
Angle boring: 15° from vertical **Groundwater:** Not encountered

WELL DETAILS (Actual Depth)	DEPTH (Feet)	SYMBOL	LITHOLOGICAL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	REMARKS
	0		Brown fine silty sand (80%) soft.			
			Pinkish fine sand (90%) with silt, few granite pebbles (15mm) soft.	090-B-816		
(4.8)	5					
				357-B-785		
(9.7)	10		Light brown silt (85%) with very sand, firm.	090-B-236		
				409-B-679		
(14.5)	15			310-B-088		
			Reddish yellow silty sand, 6" coarse sand layer, well graded at 19 feet.			
(19.3)	20		Increase silt content to 50%	195-B-178		
				260-B-256		

Project: Sandia Mixed Waste Landfill Job No: SX3033 Boring No: SB-10

WELL DETAILS (Actual Depth)	DEPTH (Feet)	SYMBOL	LITHOLOGICAL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	REMARKS
(24.1)	25		Pinkish coarse sand with fine gravel grading to gravel with sand and silt, angular to subangular clasts of limestone, granite, and quartz, firm.	162-B-570		
(29.0)	30					
(33.8)	35					
(38.6)	40		Light brown coarse sand with fines and gravel, angular to subangular clasts of limestone, granite and quartz			

Project: Sandia Mixed Waste Landfill **Job No:** SX3033 **Boring No:** SB-10

WELL DETAILS (Actual Depth)	DEPTH (Feet)	SYMBOL	LITHOLOGICAL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	REMARKS
(43.4)	45		No recovery, gravel and layered sands.	226-B-582 173-B-132		
(48.3)	50					
(53.1)	55		Light brown coarse sand with pebbles, angular to subangular clasts of limestone, quartz and granite.			
(57.9)	60		No recovery, cobbles with alot of limestone.	826-B-389 137-B-128 836-B-944		

ecology and environment, inc. DRILLING AND SAMPLE LOG

Project: Sandia Mixed Waste Landfill Job No: SX3033 Boring No: SB-10

WELL DETAILS (Actual Depth)	DEPTH (Feet)	SYMBOL	LITHOLOGICAL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	REMARKS
(62.8)	65					
(67.9)	70		Pinkish gray gravel with fine to coarse sand and silt, subangular, most pebbles 15mm, some large cobbles 70mm, limestone, quartz and granite.	307-B-187 123-B-171 253-B-937		
(72.4)	75		No recovery below 72 feet, cuttings 50% fines with large cobbles of limestone and quartz.			
(77.3)	80			002-B-375		
(79.2)	82					

DRILLING AND SAMPLING LOG

Project: Sandia Mixed Waste Landfill
Boring Contractor: Sergent, Hauskins & Beckwith
Boring Method: 6-5/8" O.D. Hollow Stem Auger
Logged By: Diane Coker
Date Completed: 9/19/89

Job No.: SX3033
Location: West of Trench A
Surface Elevation:
Casing Elevation: No Casing
Total Depth: 90 Feet
Groundwater: Not Encountered

Boring No.: SB-11
Datum:
Datum:
Datum:

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
2" Aluminum Pipe	0					Split spoon 18" x 2" using two, 6" brass sleeves
	5		Fine grained, light pinkish brown sand with 10% silt; dry; white caliche flakes throughout.	272-B-199		15/10/9 100% Recovery
	10		Light brown, fine grained sand to silty sand.			14/16/17/12 0% Recovery No Sample. Lithologic description based on cuttings.
	15		Light brown, medium grained sand (5% silt) grades to poorly sorted, fine to coarse grained sand and fine gravel. Gravel material includes quartzite, white igneous rocks and olivine; sub-angular to sub-rounded.	857-B-595		26/37/29/32 100% Recovery
	20		Light brown, medium grained sand with minor silt content. Small blebs of caliche present.	531-B-693		18/19/22/19 100% Recovery

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-11

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Type	Remarks
	25		Poorly sorted, fine grained sand to fine gravel; sub-angular to sub-rounded. Gravel predominantly quartzite with lesser amount of light colored igneous material.	575-B-709		40/20/38/38 100% Recovery HNu = 0.7 ppm
	30		Light brown to whitish brown fine grained sand with about 10% silt; clasts of dark gray limestone and quartzite sparsely interspersed. Heavy caliche content throughout, occurring mostly in thin veinlets. Sand well compacted.	911-B-905		35/43/51/>40 100% Recovery
	35		Orange brown to whitish brown, medium to very fine grained sand to silty sand (20% silt); grains angular to sub-angular; caliche veinlets and blebs present throughout.	930-B-822		37/39/51/>20 50% Recovery
	40		Light brown, fine grained sand to silty sand (20% silt); grains sub-angular to sub-rounded.	751-B-593		24/36/34/35 100% Recovery
	45		Orange brown to light brown, fine grained to very fine grained sand (15% silt). No obvious pebbles, gravel, cobbles, caliche.	189-B-272		14/35/112/Refusal 60% Recovery

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-11

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	50		Whitish tan to pinkish tan, silt to medium gravel (20% silt, 10% gravel); gravel clasts predominantly quartzite and quartz, sub-angular. Some sub-angular white, gray, reddish brown and dark gray crystalline fragments, also present.	702-B-592		>100-4" 50% Recovery Some slough in spoon.
	55					Cobble content increases significantly between 50 and 60 feet, according to drillers.
	60		White to light brown sandy silt with 30% very fine to fine grained sand; minor amount of sub-angular very fine gravel; calcareous.	433-B-242		154/84/64/>20 100% Recovery
	65					
	70		Light brown, fine to medium grained sand with 10% silt and minor amount of medium gravel; poorly sorted. Caliche flakes present throughout with calcareous coatings on larger grains.	074-B-569 + 985-B-623		32/41/54/53 100% Recovery
	75					

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-11

Depth (Feet)	Lithological Description	Sample No.	Remarks
80	Light brown, sandy silt with 40% very fine to fine grained sand; calcareous.	729-B-907	147/112/168/Refusal 100% Recovery HNu = 22 ppm
85			
90	White, very fine to medium grained sand to very coarse gravel; 10% silt with minor amount of very coarse gravel.	483-B-399	180-4" 75% Recovery Some slough in borehole. HNu = 45 ppm
95			
100			

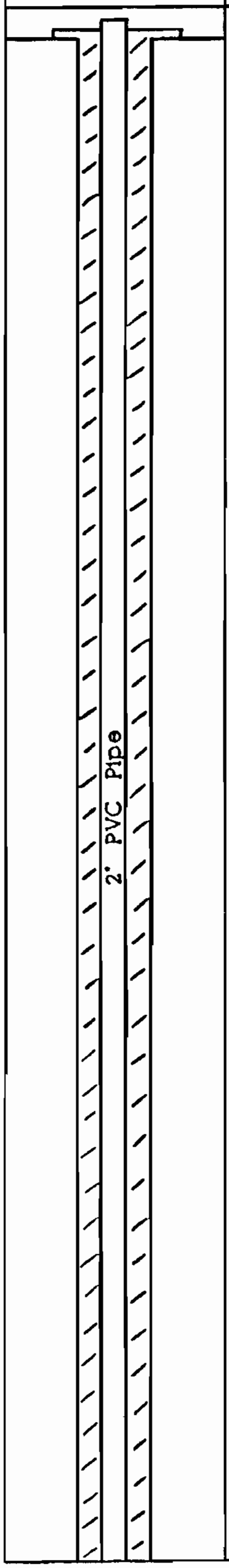
DRILLING AND SAMPLING LOG

Project: Sandia Mixed Waste Landfill
Boring Contractor: Sergent, Hauskins & Beckwith
Boring Method: 6-5/8" O.D. Hollow Stem Auger
Logged By: Alan Parolini
Date Completed: 9/12/89

Job No.: SX3033
Location: Northwest of MWL - approximately 50 feet
Surface Elevation:
Casing Elevation: No Casing
Total Depth: 80 feet
Groundwater: Not Encountered

Boring No.: SB-12
Datum:
Datum:
Datum:

Well Details:



Depth (Feet)	Lithological Description	Sample No.	Sample Type	Remarks
0				Samples collected using 18" split-barrel sampler.
5	Sand; tan, very fine to fine grained, dry.	710-B-578		11/11/8 Blows 100% Recovery
10	Sand and silt; very fine grain, reddish tan, trace fine gravel.	901-B-716		9/10/10 100% Recovery
15	Sand; silty sand, very fine grained, dry, tan, trace fine gravel, angular.	781-B-829		45/25/40 100% Recovery
20	Sand; reddish tan, fine grained, trace silt, dry.	061-B-583		10/11/18 100% Recovery

ecology and environment, inc. **DRILLING AND SAMPLING LOG** Sheet 2 of 4

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-12

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	25		Sand; reddish tan, fine grain, dry, trace fine gravel, some silt. Gravel is angular to sub-rounded.	489-B-437		11/11/15 100% Recovery
	30		Silty sand; reddish tan, dry, friable, trace fine gravel, angular to sub-rounded.	174-B-030		24/22/38 100% Recovery
	35		Silty sand; very fine to fine, reddish tan, trace fine gravel, rounded.	257-B-135		15/14/15 100% Recovery
	40		Silty sand; very fine grain, silty, reddish tan, trace fine gravel, dry.	548-B-156		10/12/15 100% Recovery
	45		Silty sandy gravel; very fine to fine grained sand, fine gravel to 30%; tan, dry.	942-B-210		24/20/30 100% Recovery

ecology and environment, inc. **DRILLING AND SAMPLING LOG**

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-12

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	50		Sand; tan-red fine sand with some silt, fine gravel, 49.5 - 50.0 feet. Sandy gravel, 50 - 50.5 feet; fine, angular, gravel with some silt and sand.	268-B-020		45/40/70; refusal at 50.5 feet. 50% Recovery
	55					
	60		Silty sand; tan-red, very fine grained sand, with some silt, trace fine gravel, dry, some caliche rinds.	543-B-416		10/9/12 100% Recovery
	65					
	70		Silty sand; fine sand, some silt, minor fine gravel, dry, reddish tan.	228-B-633		15/14/25 100% Recovery
	75		Next page.			

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No : SB-12

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	75					
	80		Silty sand, very fine sand, some silt, trace fine gravel with caliche rinds; dry, tannish brown.	766-B-918		24/25/39 100% Recovery
	85					
	90					
	95					
	100					

DRILLING AND SAMPLING LOG

Project: Sandia Mixed Waste Landfill
Boring Contractor: Sergent, Hauskins & Beckwith
Boring Method: 6-5/8" O.D. Hollow Stem Auger
Logged By: Alan Parolini
Date Completed: 9/13/89

Job No.: SX3033
Location: East of Classified Area, MWL, approximately 30 feet
Surface Elevation:
Casing Elevation: No Casing
Total Depth: 100 feet
Groundwater: Not Encountered

Boring No.: SB-13
Datum:
Datum:
Datum:

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
2" PVC Pipe	0					Samples collected using 18" split-barrel sampler.
	5		Gravelly sand; very fine to fine sand, some gravel; tan, dry.	427-B-404		9/19/24 Blows 100% Recovery
	10		Silty sand; very fine sand and silt; tan, dry, calcareous.	133-B-435		7/8/15 100% Recovery
	15		Silty sand; very fine sand and silt, trace fine gravel, angular, quartzite, caliche rind.	040-B-561		21/50/58 100% Recovery
	20		Silty, sandy gravel; fine gravel, some fine sand and silt, trace coarse gravel; calcareous gravel is quartzite, granitic	119-B-374		17/23/25 50% Recovery

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-13

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	25		Silty sand; very fine sand, some silt, trace fine gravel; reddish tan, dry.	710-B-430		14/15/23 100% Recovery
	30		Silty, sandy gravel; fine gravel, some sand, minor silt, trace coarse gravel; gravel clasts limestone and granitic gneiss (?).	647-B-915		80/100/refusal 50% Recovery
	35		Silty sand; fine sand and silt, minor fine gravel; gravel clasts gneissic.	672-B-548		25/25/25 100% Recovery
	40		Silty sand; very fine sand, some silt, minor fine gravel (10%); dry.	243-B-209		16/17/21 100% Recovery
	45		Silty sand; very fine sand, some silt, trace fine gravel; tan, dry.	458-B-253		21/34/47 100% Recovery

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Project: Sandia Mixed Waste Landfill | Job No.: SX3033 | Boring No.: SB-13

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
2" PVC Pipe	50		Gravel (?)			110/refusal No sample recovered. 0% Recovery
	55					
	60		Silty sand; very fine sand, some silt, minor fine gravel, quartz and limestone; tan, dry.	053-B-575		60/46/52 75% Recovery
	65					
	70		Silty sand; fine sand, some silt, minor fine gravel, quartz and limestone with calcareous rinds; tan, dry.	931-B-005		65/50/60 100% Recovery
	75					

ecology and environment, inc. **DRILLING AND SAMPLING LOG** Sheet 4 of 4

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-13

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	80		Silty sand; very fine sand, some silt, trace fine gravel, calcareous rinds; tan, dry.	886-B-407		21/31/40 100% Recovery
	85					
	90		Silty sand; very fine sand, some silt, trace fine gravel; reddish tan, calcareous.	929-B-641		30/38/48 100% Recovery
	95					
	100					No sample recovered.

DRILLING AND SAMPLING LOG

Project: Sandia Mixed Waste Landfill
Boring Contractor: Sergent, Hauskins & Beckwith
Boring Method: 6-5/8" O.D. Hollow Stem Auger
Logged By: D. Coker
Date Completed: 9/12/89

Job No.: SX3033
Location: Approximately 60 ft. W. of MWL fence, near S. edge
Surface Elevation:
Casing Elevation: No Casing
Total Depth: 100 feet
Groundwater: Not Encountered

Boring No.: SB-14
Datum:
Datum:
Datum:

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
2" PVC Pipe	0		Silty sand; very fine sand, minor silt; loose, dry; light tan eolian sand.			Samples collected with a 24" (2 ft) split-barrel sampler.
	5		Silty sand; as above.	646-B-348		8/9/13/20 Blows 100% Recovery
	10		Silty sand; as above.	179-B-068		5/8/7/3 100% Recovery
	15		Silty sand; medium fine sand, some silt, calcareous, light tan.	976-B-544		13/12/15/15 100% Recovery
	20		Silty sand; medium sand, some silt, trace fine gravel; clasts have calcareous rind.	232-B-410		12/19/20/25 100% Recovery

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-14

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	25		Silty, gravelly sand; medium sand, some fine to coarse gravel, minor silt; limestone clasts.	298-B-964		15/16/31/28 100% Recovery
	30		Silty sand; very fine to coarse sand, trace silt, trace fine gravel; dry, tan.	568-B-172		31/76/86/refusal 75% Recovery
	35		Silty, gravelly sand; very fine to coarse sand, some fine to coarse gravel; dry to very slightly moist, tan to dark tan.	929-B-972		70/34/42/36 100% Recovery
	40		Silty sand; very fine to fine sand, some silt, trace fine gravel; tan, dry; clasts to 1/2", caliche rind; some caliche stringers throughout layering.	547-B-358		16/33/50/48 100% Recovery
	45		Gravelly, silty sand; very fine to fine sand, some silt, minor fine gravel; clasts to 1/4", igneous/metamorphic; tan dry.	580-B-242		22/70/130/refusal 75% Recovery
			Gravel; coarse gravel and sand.			Driller description.

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-14

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	50		Silty sand; very fine to medium sand, some silt, trace fine gravel; gravel sub-rounded, igneous; tan.	802-B-577		28/22/27/28 100% Recovery
	55					
	60		Silty sand; fine sand, some silt (10%), trace fine gravel (5%); tan.	109-B-275		23/33/48 Using 18" split-barrel sampler. 50% Recovery.
	65		Gravel; fine to coarse gravel, some sand 66 feet to 70 feet.			Driller description.
	70		Silty, gravelly sand; fine sand, some fine to coarse gravel; refusal on cobbles.	029-B-342		31/refusal 40% Recovery
			Gravel lenses			Driller description.
	75		Next page.			

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-14

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	75					
			Silty sand.			Driller description.
	80		Silty sand; medium sand, some silt; tan, dry.	691-B-871		37/87/147 100% Recovery
	85					
	90		Silty, gravelly sand; medium sand, some silt, some fine gravel, trace coarse gravel.	847-B-052		97/85/110 75% Recovery
	95					
	100		Silty, gravelly sand; fine to medium sand, some silt, minor fine to coarse gravel.	409-B-118		48/60/68 50% Recovery

DRILLING AND SAMPLING LOG

Project: Sandia Mixed Waste Landfill
Boring Contractor: Sergent, Hauskins & Beckwith
Boring Method: 6-5/8" O.D. Hollow Stem Auger
Logged By: D. Coker
Date Completed: 9/12/89 - 9/13/89

Job No.: SX3033
Location: West of Trench A
Surface Elevation:
Casing Elevation: No Casing
Total Depth: 101.5 feet
Groundwater: Not Encountered

Boring No.: SB-15
Datum:
Datum:
Datum:

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
2' PVC Pipe	0		Silty sand.			Sample collected with 18" split-barrel sampler.
			Gravel			Drillers description.
	5		Gravelly, silty sand: fine sand, some silt, minor fine to coarse gravel; light tan.	273-B-228		21/15/13 75% Recovery
	10		Silty sand; fine sand, some silt, trace fine gravel; caliche layers and grain coatings throughout.	823-B-260		14/16/19 30% Recovery
	15		Gravelly, silty sand; fine sand (50%) some silt (30%), some fine gravel (20%); gravel clasts to 1/2".	193-B-997		17/20/27 75% Recovery
	20		Sandy silt; silt, some very fine to fine sand; calcareous, well indurated.	931-B-939		Decide to over-drive sampler (to 2') to increase recovery. 25/36/43/29 90% Recovery

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-15

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	25		Gravelly, silty sand; fine to medium sand, some silt (30%), fine gravel (15%)	952-B-612		19/27/34/40 90% Recovery
	30		Silty sand; fine sand, some silt (15%), minor fine gravel (10%); poorly sorted.	416-B-082		65/62/62/65 100% Recovery
			Gravel; large coarse gravel and fine sand. Gravel fragments to 6".			Drillers description, auger cuttings.
	35		Sandy gravel; fine to coarse gravel (30%), very fine to fine sand, silt; poorly sorted; clasts coated with caliche; gravel angular to sub-angular, limestone and quartzite.	133-B-044		30/25/26/32 100% Recovery
			Gravel; coarse gravel and sand.			Drillers description.
	40		Light brown, fine to very coarse grained sand with some silt and pebbly gravel; gravel primarily quartz, sub-angular to sub-rounded.	252-B-178		55/86/94/>50 100% Recovery
	45		Whitish brown to light brown, fine to medium grained sand, with minor silt content; some gravel (10%) and minor cobbles; caliche coatings on some clasts	869-B-110		36/54/91/125 100% Recovery Sandy gravel between 45 and 50 feet, according to drillers.

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-15

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	50		Light brown, fine to very fine grained sand to silty sand (15% silt), with minor, fine gravel content.	936-B-543		35/37/39/40 100% Recovery Sandy gravel between 50 and 55 feet, according to drillers.
	55					Cobbles between 55 and 60 feet, according to drillers.
	60		Cobbles; some very coarse sand and pebble gravel; primarily limestone and quartzite clasts.	892-B-502		>100/refusal 25% Recovery HNu = 0.4 ppm
	65					Continuation of cobbles down to about 68 feet, according to drillers.
	70		Coarse gravel and cobbles; sub-rounded to sub-angular limestone and quartzite fragments.	915-B-659		160/refusal 50% Recovery
						Continuation of cobbles to about 78 feet, according to drillers.
	75					

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DRILLING AND SAMPLING LOG

Sheet 4 of 4

Project: Sandia Mixed Waste Landfill

Job No.: SX3033

Boring No.: SB-15

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	80		Light brown, fine to medium sand to silty sand (15% silt); gravel absent; slightly moist; indurated.	125-B-161		187/refusal 50% Recovery
	85					
	90		Light brown, very fine to fine grained sand with minor silt content; no gravel; well indurated.	490-B-718		112/280/refusal 50% Recovery
						Cobble layer begins at approximately 93 feet, according to drillers.
	95					
	100		Poorly sorted, medium to very coarse sand; sand sub-angular to sub-rounded quartz; minor feldspar content.	183-B-521		84/74/72/>40 100% Recovery

DRILLING AND SAMPLING LOG

Project: Sandia Mixed Waste Landfill	Job No.: SX3033	Boring No.: SB-16	
Boring Contractor: Sergent, Hauskins & Beckwith	Location: South of Trench F (outside of gate)		
Boring Method: 6-5/8" O.D. Hollow Stem Auger	Surface Elevation:	Datum:	
Logged By: Diane Coker	Casing Elevation: No Casing	Datum:	
Date Completed: 9/14/89 - 9/15/89	Total Depth: 100.5 feet	Datum:	
	Groundwater: Not Encountered		

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
2" Aluminum Pipe	0					Split spoon 18" x 2" using two, 6" brass sleeve inserts.
	5		Light brown, very fine to fine grained sand with 15% silt; loose and dry.	316-B-772		31/43/42 90% Recovery Large boulder or cobbles encountered.
	10		Light brown very fine grained sand to silty sand; slightly indurated; thin caliche layers present throughout.	231-B-657		18/26/32/>20 100% Recovery
	15		Light brown, very fine grained sand to silty sand (20% to 30% silt); slightly indurated; thin, white caliche layers present throughout.	591-B-223		10/17/20/16 100% Recovery
	20		Light brown to whitish brown, very fine grained sand to silty sand (15% silt); significantly indurated in some zones; calcareous throughout; dry to slightly moist.	176-B-331		26/38/35/39 100% Recovery

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-16

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	25		Light brown to whitish brown, very fine to coarse, poorly sorted sand; also 25% sub-angular to sub-rounded pebble gravel. Pebbles primarily quartzite and unidentified igneous material; indurated in parts.	586-B-009		47/93/70/35 75% Recovery
	30		Light brown fine grained sand to silty sand (15% silt).	359-B-138		39/34/20/>25 100% Recovery
	35		Light brown to whitish brown, fine grained sand to silty sand (20% silt); loose to slightly indurated.	736-B-.720 + 757-B-498		31/28/42- 100% Recovery
	40		Light brown, fine to very coarse grained, poorly sorted sand; quartz grains sub-angular to sub-rounded. Sand grades to coarse gravel near bottom; gravel predominantly angular, pink and white igneous rocks, probably feldspar.	838-B-547		35/50/190- 100% Recovery
	45		Multicolored, medium to very coarse grained sand; colors include white, pink, tan to orange tan; white portion with caliche appears significantly weathered; silt content varies from 10% to 20%.	692-B-649		36/42/73/68 100% Recovery

ecology and environment, inc. DRILLING AND SAMPLING LOG

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-16

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	50		Light brown to whitish brown coarse sand to fine gravel; slightly indurated, with caliche pockets. Grades to whitish brown, very fine grained sand, to silty sand (15% silt); dry to slightly moist.	687-B-172		29/27/43/41 100% Recovery
	55					
	60		Light brown, medium to coarse grained sand with minor fine gravel content; sand is quartz while gravel is predominantly quartzite with some igneous fragments; calcareous throughout.	122-B-532		77/115/118- 50% Recovery
	65					Mostly sand or silty sand between 60 and 70 feet, according to drillers.
	70		Light brown, very fine grained sand to silty sand matrix with medium quartzite gravel (up to 30%). Gravel angular to sub-angular. Sand matrix sub-rounded to sub-angular.	309-B-		70/136/>200 65% Recovery
	75		Next page.			

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-16

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	75					
	80		Orange brown, poorly sorted sand, fine to coarse grained with 10% to 15% silt; medium grained gravel up to 10%.	016-B-472		78/>200 40% Recovery HNu = 1.2 ppm Lithologic description may be based partially on slough material.
	85					HNu = 0.8 ppm
	90		Orange brown to whitish tan, very fine to medium grained sand; minor silt content; slightly moist.	100-B-357		73/100/204 65% Recovery
	95					HNu = 1.2 ppm
	100		Light brown, very fine grained sand to silty sand (35% silt).	987-B-831		43/49/67/71 60% Recovery

DRILLING AND SAMPLE LOG

Project: Sandia Mixed Waste Landfill
Job No: SX3033
Boring No: SB-17
Boring Contr.: Sergent, Hauskins & Beckwith
Location: Between Trench Dand the classified area
Boring Method: 6-5/8" Hollow Stem Auger
Surface Elev:
Datum:
Logged by: Jeff Manship
Casing Elev: N/A
Datum:
Date Completed: 6/22/90
Total Depth: 93.5 feet
Datum:
Angle Boring: 26° from vertical
Groundwater: Not encountered

WELL DETAILS	DEPTH (Feet)	SYMBOL	LITHOLOGICAL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	REMARKS
	0					
(4.5)	5		Brown to yellowish brown fine sand with silt and very fine pebbles.	053-B-658		
			Fine Pinkish clean sand.			
(9.0)	10					
			Very fine sand and silt with a trace of clay, reddish yellow to brown.	035-B-242 853-B-620		
(13.5)	15					
				851-B-734		
(18.0)	20					

ecology and environment, inc. DRILLING AND SAMPLE LOG

Project: Sandia Mixed Waste Landfill Job No: SX3033 Boring No: SB-17

WELL DETAILS	DEPTH (Feet)	SYMBOL	LITHOLOGICAL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	REMARKS
			Fine to coarse sand with 15% gravel, reddish yellow clasts of granits and quartz, pebbles 2-4mm.	879-B-289 873-B-961		
(22.5)	25		80% silt with very fine sand, pink, blebs of caliche.	679-B-410 910-B-196		
(27.0)	30		Reddish yellow fine sand with a trace of silt.	382-B-086 812-B-088		
(31.5)	35		Coarse sandy layer, 0.6 feet, soft.	811-B-062		
(36.0)	40		40% silt with 50% fine sand and a trace of pebbles, 15mm.			

ecology and environment, inc. DRILLING AND SAMPLE LOG

Project: Sandia Mixed Waste Landfill Job No: SX3033 Boring No: SB-17

WELL DETAILS	DEPTH (Feet)	SYMBOL	LITHOLOGICAL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	REMARKS
				238-B-193 440-B-162		
(40.4)	45		Light brown fine to very fine sand with a trace of silt and gravel			
				018-B-162 070-B-244		
(45.0)	50		Light brown very find sand			
				831-B-849 057-B-949 792-B-199		
(49.4)	55		40% sand with 50% gravel with approx. 1 foot layers of fine sand and silt. Clasts of granite to 20mm.			
(54.0)	60					
				301-B-646 643-B-593		

ecology and environment, inc. DRILLING AND SAMPLE LOG

Project: Sandia Mixed Waste Landfill Job No: SX3033 Boring No: SB-17

WELL DETAILS	DEPTH (Feet)	SYMBOL	LITHOLOGICAL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	REMARKS
(58.4)	65					
(63.0)	70					
(67.4)	75		Light brown to brown silt and fine sand, few fine pebbles (2-4mm), slight moisture content.			
(72.0)	80			460-B-182		
				098-B-481		

Project: Sandia Mixed Waste Landfill Job No: SX3033 Boring No: SB-17

WELL DETAILS	DEPTH (Feet)	SYMBOL	LITHOLOGICAL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	REMARKS
(76.4)	85		Light brown 80% sand and 15% silt with a trace of gravel (2mm), slight moisture content			
(80.9)	90					
(84.0)	93.5			027-B-643 087-B-465		

DRILLING AND SAMPLING LOG

Project: Sandia Mixed Waste Landfill
Job No.: SX3033
Boring No.: SB-18
Boring Contractor: Sergent, Hauskins & Beckwith
Location: Background boring, south of landfill
Boring Method: 6-5/8" O.D. Hollow Stem Auger
Surface Elevation:
Datum:
Logged By: D. Coker, A. Parolini
Casing Elevation: No Casing
Datum:
Date Completed: Drilled 9/7/89 - 9/8/89
Cemented 9/9/89
Total Depth: 149.5 feet
Datum: Ground Surface
Groundwater: Not Encountered
Rig: CME 55, with modified transmission and gear box

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks SPT Blows/6"
	0					Split spoon 2' x 2" using four, 6" brass sleeve inserts. No sample catcher used.
	5		Sand, fine, tan, silty; moderately well sorted; quartz, sub-angular to sub-rounded; silt 12%. White caliche present; entire sample calcareous; loose, dry.	919-B-338		30/29/21/15 Blows 50% Recovery
	10		Sand, medium to coarse, tan, silty, pebbly, poorly sorted; quartz; calcareous; loose, dry.	251-B-453		37/21/26/13 Blows 75% Recovery
	15		Sand, medium, tan, silty, pebbly, cobbly, poorly sorted. Silt 5%. Larger clasts coated with caliche; entire sample calcareous; loose, dry.	641-B-581		34/43/37/31 Blows 75% Recovery
	20		Sand, as above.	619-B-219		34/43/37/31 Blows 75% Recovery

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-18

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	25		Sand, tan, medium to coarse, pebbly, cobbly. Sand rounded to sub-rounded, frosting evident. Cobbles 5%, pebbles 1%. Color slightly darker than above, due possibly to higher moisture content.	719-B-289		38/27/44/>50 Blows Stopped at 50 on last 6" of drive. 88% Recovery
	30		Sand, tan, fine to medium, cobbly. Sand sub-angular to sub-rounded quartz as above, with 1-3% feldspar and dark accessory minerals. Cobbles sub-angular quartzite, and other very hard igneous crystalline rocks, primarily light-colored.	153-B-886		19/20/13/12 Blows 88% Recovery
	35		Sand, same as above with higher percentage of cobbles.	165-B-237 & 165-B-041		49/44/40/52 Blows 100% Recovery Duplicate samples taken here.
	40		Sand, medium tan, medium to very coarse.	333-B-179		10/12/13/12 Blows 88% Recovery
	45		Sand, tan, medium, silty, cobbly; poorly sorted; silt 10%, very coarse, sand 10%, cobbles 10%. White caliche coating on some cobbles, angular to sub-angular; quartzite and various light colored crystalline igneous rocks. Frosting apparent on sand grains; sample calcareous, very slightly moist.	197-B-449		24/23/21/28 Blows 100% Recovery

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-18

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	50		Sand, reddish tan, medium, silty, cobbly; poorly sorted; silt (clay?) 15%, cobbles 10%. Sample dry to slightly moist; fairly cohesive/indurated; not as loose as above.	482-B-081		5/9/15/17 Blows 100% Recovery
	55		Sand, tan to brown, medium to very coarse, clayey, cobbly. Clay 5%, silt 3%, cobbles 5-10%; white caliche coating on cobbles and in matrix. Slightly moist.			19/85/refusal 50% Recovery No lab sample.
	60		Sand, tan, very coarse, silty, cobbly; silt 10-15%, quartzite cobbles/gravel 5%. Dry to slightly moist; calcareous.	492-B-837		29/50/65/75 Blows 100% Recovery
	65					
	70		Sand, very coarse, tan, pebbly, silty; quartz pebbles/cobbles; calcareous.	864-B-749		100/75/refusal 50% Recovery
	75					

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-18

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	80		Sand, very fine, light brown to tan, silty, calcareous, slightly moist; silt 20%.	555-B-214		23/28/27/39 Blows 100% Recovery
	85					
	90		Sand, medium to very coarse, tan to whitish tan, poorly sorted, gravelly, silty; silt 10%, coarse gravel 5%; frosting on sand grains, white caliche coating on grains of all sizes. Sample slightly moist; calcareous.	511-B-622		22/26/40/>50 Blows 88% Recovery Drilling tight; very slow. 20 gallons water added to hole after driving split spoon.
	95					
	100		Sand, very fine, tan to brown, silty; silt 40%.	720-B-834		22/32/35/37 Blows 100% Recovery Added 10 more gallons of water to hole.

Project: Sandia Mixed Waste Landfill Job No.: SX3033 Boring No.: SB-18

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	105					
	110		Sand, very fine, tan, silty, pebbly, cobbly.	039-B-874		100/>100/refusal 50% Recovery Added 5 more gallons of water.
	115					
	120					
	125		Sand, very fine, light tan to brown, silty, clayey; silt 40%, clay 10%; plastic; slightly moist, calcareous, crumbly.	268-B-755		31/28/28/24 Blows 100% Recovery

Project: Sandia Mixed Waste Landfill   Job No.: SX3033   Boring No.: SB-18

Well Details	Depth (Feet)	Symbol	Lithological Description	Sample No.	Sample Type	Remarks
	130		Sand, very fine, tan to reddish tan, very silty, cobbly; cobbles quartzite; sand very compacted, slightly moist.	950-B-128		100/200/125 Blows 100% Recovery 10 more gallons water added to hole.
	135					
	140			398-B-364		17/34/47/refusal Added 10 more gallons water. 70% Recovery
	145					
	150		Sand, very fine, reddish tan; 60% silt, slightly moist; compacted.			170/refusal No sample. 0% Recovery

APPENDIX B
RADIOANALYTICAL DATA SUMMARIES

Table 5-6

CONCENTRATIONS OF TRITIUM, GROSS BETA, GROSS ALPHA, Ra-226, Th-232, K-40, U-234, AND U-238 IN SURFACE SOIL OF THE MWL*

	Radionuclide							
Grid Block	H-3	Gross Beta	Gross Alpha	Ra-226	Th-232	K-40	U-234	U-238
A-8	100(10)	28(5)	<MDL	0.7(0.2)	1.1(0.4)	14(3)	0.7(0.1)	0.6(0.1)
H-3	390(10)	22(5)	10(6)	1.1(0.2)	1.0(0.4)	13(3)	0.9(0.2)	0.9(0.2)
G-2	95(4)	21(5)	10(5)	0.4(0.2)	0.7(0.5)	13(2)	0.6(0.1)	0.6(0.1)
B-11	48(3)	22(5)	5(5)	0.7(0.2)	0.8(0.4)	24(3)	0.5(0.1)	0.6(0.1)
A-7	69(4)	28(5)	5(5)	0.7(0.2)	0.6(0.3)	18(3)	0.6(0.1)	0.5(0.1)
J-8	15(3)	27(5)	7(5)	0.7(0.2)	1.4(0.4)	23(3)	0.5(0.1)	0.7(0.1)
O-8	7(3)	27(5)	9(6)	1.4(0.2)	1.2(0.5)	18(3)	0.5(0.1)	0.6(0.1)
G-5	63(4)	24(5)	10(5)	0.7(0.2)	1.6(0.4)	26(3)	0.6(0.2)	0.7(0.2)
E-5	240(10)	26(5)	<MDL	0.8(0.2)	0.8(0.3)	25(3)	0.5(0.2)	0.7(0.2)
C-6	79(4)	23(5)	7(5)	0.7(0.2)	0.6(0.3)	22(3)	0.6(0.4)	0.8(0.4)

Note: Analytical uncertainties indicated in parentheses.

*Units are pCi/g except for tritium, which is pCi/ml of extracted water.

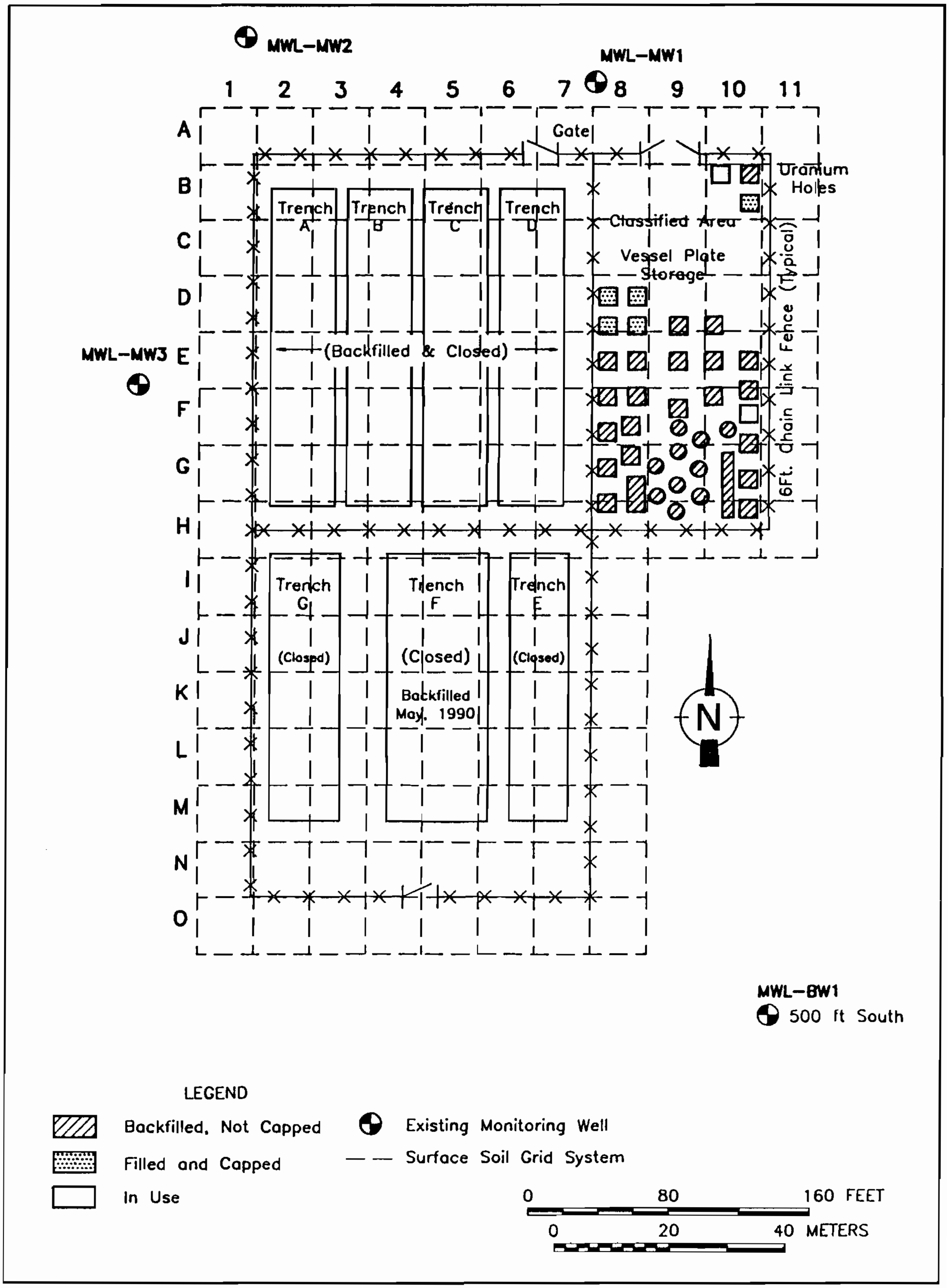

Figure 3-3: SURFACE SOIL SAMPLING AT GRID SYSTEM FOR THE MIXED WASTE LANDFILL

Table 5-7

CONCENTRATIONS OF TRITIUM SAMPLES FROM BOREHOLES

Depth (feet)	Borehole 1	2	3*	4	5	6**
5	<MDL	13(4)	1,500(100)	91(4)	37(3)	24(3)
10	<MDL	13(4)	6,500(100)	61(5)	98(6)	<MDL
15	3(3)	<MDL	17,000(100)	--	180(10)	34(3)
20	4(3)	<MDL	14(2)	49(4)	41(5)	300(10)
25	<MDL	4(4)	29(2)	37(3)	6(3)	1,200(100)
30	<MDL	6(4)	3(2)	22(4)	20(4)	--
35	<MDL	<MDL	3(2)	12(3)	<MDL	5,600(100)
40	<MDL	<MDL	3(2)	11(4)	<MDL	3,300(100)
45	<MDL	<MDL	5(2)	8(3)	<MDL	1,300(100)
50	4(3)	<MDL	4(2)	14(4)	<MDL	93(7)
60	<MDL	<MDL	--	16(4)	<MDL	18(4)
65	--	--	--	--	--	--
70	<MDL	<MDL	5(2)	<MDL	<MDL	11(4)
80	<MDL	--	3(2)	<MDL	10(4)	14(4)
90	--	<MDL	<MDL	4(4)	<MDL	--
95	--	<MDL	--	--	--	--
100	--	<MDL	<MDL	4(4)	<MDL	--
105	--	--	--	--	<MDL	--
110	--	<MDL	--	--	30(4)	--
120	--	<MDL	--	--	<MDL	--
130	--	--	--	--	<MDL	--
140	--	<MDL	--	--	<MDL*	--
150	--	--	--	--	<MDL	--

Analytical uncertainties indicated in parentheses.

NA - Data not available.
-- = No sample.
*Sample from 145 feet.
**Borehole 6 consisted of two angle borings 15 feet apart--one was sampled to 35 linear feet and the other was sampled from 40 to 80 linear feet (see Section 3.5).

Table 5–7 (Cont.)

Depth (feet)	Borehole 7	8	9	10	11	12
5	<MDL	<MDL	<MDL	8(4)	--	<MDL
10	5(4)	<MDL	<MDL	5(4)	--	<MDL
15	<MDL	<MDL	<MDL	<MDL	--	<MDL
20	<MDL	4(4)	<MDL	<MDL	<MDL	<MDL
25	<MDL	<MDL	<MDL	<MDL	--	<MDL
30	<MDL	<MDL	--	--	<MDL	<MDL
35	<MDL	<MDL	2(2)	--	--	<MDL
40	--	<MDL	2(2)	--	<MDL	<MDL
45	NA	<MDL	--	<MDL	--	<MDL
50	<MDL	<MDL	<MDL	--	<MDL	<MDL
60	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
65	<MDL	--	--	--	--	--
70	<MDL	--	2(2)	<MDL	<MDL	<MDL
80	<MDL	--	<MDL	<MDL	<MDL	<MDL
90	<MDL	--	<MDL	--	--	--
95	--	--	--	--	--	--
100	<MDL	--	<MDL	--	--	--
105	--	--	--	--	--	--
110	--	--	<MDL	--	--	--
120	--	--	<MDL	--	--	--
130	--	--	<MDL	--	--	--
140	--	--	--	--	--	--
150	--	--	--	--	--	--

Analytical uncertainties indicated in parentheses.

NA – Data not available.
-- = No sample.

Table 5-7 (Cont.)

Depth (feet)	Borehole 13	14	15	16	17	18
5	34(2)	3(2)	9(2)	<MDL	14(4)	<MDL
10	5(2)	<MDL	<MDL	<MDL	260(10)	<MDL
15	12(2)	<MDL	<MDL	<MDL	1200(100)	<MDL
20	12(2)	<MDL	<MDL	<MDL	3900(100)	<MDL
25	<MDL	<MDL	<MDL	<MDL	4800(100)	<MDL
30	3(2)	<MDL	<MDL	<MDL	5000(100)	<MDL
35	2(2)	<MDL	<MDL	<MDL	3000(100)	<MDL
40	2(2)	<MDL	<MDL	<MDL	1800(100)	<MDL
45	<MDL	<MDL	<MDL	<MDL	660(10)	<MDL
50	--	<MDL	<MDL	<MDL	210(10)	<MDL
60	<MDL	<MDL	<MDL	--	10(2)	<MDL
65	--	--	--	--	--	--
70	<MDL	<MDL	2(2)	<MDL	--	<MDL
80	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
90	<MDL	<MDL	<MDL	<MDL	3(2)	<MDL
95	--	--	--	--	--	--
100	--	<MDL	<MDL	--	--	<MDL
105	--	--	--	--	--	--
110	--	--	--	--	--	<MDL
120	--	--	--	--	--	<MDL
130	--	--	--	--	--	<MDL
140	--	--	--	--	--	<MDL
150		--	--	--	--	-- --

Analytical uncertainties indicated in parentheses.

NA - Data not available.
-- = No sample.

Table 5-10a

CONCENTRATION RANGES FOR VOLATILE ORGANIC COMPOUNDS (TCL) IN SUBSOIL SAMPLES

Compound	Concentration Range (mg/kg)
chloromethane	BDL
bromomethane	BDL
vinyl chloride	BDL
chloroethane	<0.005-0.017
methylene chloride	<0.010-0.280
acetone	BDL
carbon disulfide	BDL
1,1-dichloroethene	BDL
1,1-dichloroethane	BDL
trans-1,2-dichloroethene	BDL
chloroform	BDL
1,2-dichloroethane	BDL
2-butanone	<0.010-0.078
1,1,1-trichloroethane	BDL
carbon tetrachloride	BDL
vinyl acetate	BDL
bromodichloromethane	BDL
1,2-dichloropropane	BDL
trans-1,3-dichloropropene	BDL
trichloroethene	BDL
dibromochloromethane	BDL
1,1,2-trichloroethane	BDL
benzene	BDL
cis-1,3-dichloropropene	BDL
2-chloroethylvinyl ether	BDL
bromoform	BDL
4-methyl-2-pentanone	BDL
2-hexanone	BDL
tetrachloroethene	BDL
1,1,2,2-tetrachloroethane	BDL
toluene	<0.005-0.600
chlorobenzene	BDL
ethylbenzene	BDL
styrene	BDL
total xylenes	BDL

BDL - Below Detection Levels

Table 5-10b

CONCENTRATION RANGES FOR SEMI-VOLATILE ORGANIC COMPOUNDS (TCL) IN SUBSOIL SAMPLES

Compound	Concentration Range (mg/kg)
bis(2-chloroethyl)ether	BDL
1,3-dichlorobezene	BDL
1,4-dichlorobenzene	BDL
1,2-dichlorobenzene	BDL
bis(2-chlorolsopropyl)ether	BDL
N-nitrosodipropylamine	BDL
hexachloroethane	BDL
nitrobenzene	BDL
Isophorone	BDL
bis(2-chloroethoxy)methane	BDL
1,2,4-trichlorobenzene	BDL
napthalene	BDL
hexachlorobutadiene	BDL
hexachlorocyclopentadiene	BDL
2-chloronaphthalene	BDL
dimethyl phthalate	BDL
acenaphthylene	BDL
fluorene	BDL
acenaphthene	BDL
2,4-dinitrotoluene	BDL
2,6-dinitrotoluene	BDL
diethylphthalate	BDL
4-chlorophenyl phenyl ether	BDL
N-nitrosodiphenylamine	BDL
4-bromophenyl phenyl ether	BDL
hexachlorobenzene	BDL
phenanthrene	BDL
anthracene	BDL
di-n-butyl phthalate	<0.330-1.000
fluoranthene	BDL
benzidine	BDL
pyrene	BDL
butyl benzyl phthalate	BDL
3,3'-dichlorobenzidine	BDL
benzo(a)anthracene	BDL
bis(2-ethylhexyl)phthalate	<0.330-1.300
chrysene	BDL
di-n-octyl phthalate	BDL
benzo(b)fluoranthene	BDL
benzo(k)fluoranthene	BDL
benzo(9a)pyrene	BDL
indeno(1,2,3-cd)pyrene	BDL
dibenzo(a,h)anthracene	BDL
benzo(ghi)perylene	BDL
phenol	BDL
2-chlorophenol	BDL
2-nitrophenol	BDL
2,4-dimethylphenol	BDL
2,4-dichlorophenol	BDL
4-chloro-3-methylphenol	BDL
2,4,6-trichlorophenol	BDL
2,4-dinitrophenol	BDL
4-nitrophenol	BDL
4,6-dinitro-2-methylphenol	BDL
pentachlorophenol	BDL

BDL - Below Detection Level

Table 5-11

CONCENTRATION RANGES FOR METALS (TCL) IN SUBSOIL SAMPLES

Parameter	Concentration Range (mg/kg)
Aluminum	1,910-7,790
Antimony	< 6.00
Barium	16-237
Beryllium	0.15-0.70
Cadmium	<0.50-0.97
Chromium	1.27-18.0
Cobalt	1.00-6.80
Copper	6.30-70.0
Iron	3,300-12,400
Lead	2.20-1170
Manganese	69.50-331
Nickel	1.70-21.50
Silver	< 1.00
Sodium	21.00-1,400
Vanadium	5.50-22.20
Zinc	17.60-66.90

Table 5-12

DETECTED VOLATILE ORGANIC VAPOR
CONCENTRATIONS FROM HNu PS-101 PID MONITORING, SEPTEMBER, 1989
(parts per million)

Depth (feet)	Borehole SB-11	SB-1	SB-2	SB-4	SB-5	SB-6	SB-7
0	--	--	--	--	--	--	--
5	--	--	--	--	--	--	--
10	--	--	--	--	--	--	--
15	--	1.0(13 ft)	--	--	--	--	220.0
20	--	1.0(17.3 ft)	--	--	--	--	--
25	0.7	1.0(26 ft)	--	1.8	--	--	21.0
30	--	20.0	--	1.0	--	--	--
35	--	--	--	12.0	--	1.0	--
40	--	--	--	1.5	--	--	--
45	--	--	--	--	--	2.5(43.3 ft)	--
50	--	140.0(52 ft)	--	2.6	0.4	--	10.0
60	--	4.0	--	2.0	1.0	--	--
70	--	--	--	1.0	--	--	--
80	22.0	--	--	3.5	--	--	2.0
90	45.0	--	8.0	50.0	0.2	--	3.0
100	--	--	--	2.0	600.0	--	2.0
110	--	--	--	--	0.6	--	--
120	--	--	8.0	--	--	--	--
125	--	--	70.0	--	--	--	--
130	--	--	--	--	0.6	--	--
135	--	--	--	--	2.0	--	--
140	--	--	--	--	1.5	--	--
150	--	--	--	--	--	--	--

Table B-1

MEAN CONCENTRATIONS[a] OF GROSS BETA IN SOIL SAMPLES FROM BOREHOLES NEAR THE MWL

		Concentration (pCi/g)		
Borehole	Number of Samples	Mean	Standard Deviation	Range
1	13	23	4	16 to 29
2	18	24	3	16 to 29
3	14	21	5	14 to 28
4	14	20	7	9 to 28
5	21	22	4	12 to 27
6	12	22	5	12 to 27
7	14	23	3	19 to 27
8	17	21	3	17 to 29
9	16	21	4	13 to 29
10	12	23	3	17 to 29
11	7	21	2	17 to 23
12	13	24	4	15 to 29
13	13	23	3	18 to 27
14	15	24	3	20 to 30
15	15	21	4	14 to 27
16	13	22	5	14 to 28
17	15	22	4	14 to 27
TOTAL	242			9 to 30

[QTREPORTS]SX3034:D2722, #3406, PM = 31

Table B-2

CONCENTRATIONS OF GROSS BETA IN SOIL SAMPLES FROM BOREHOLES (pCi/g)

Depth (feet)	Borehole 1	2	3	4	5	6**
5	16(5)	26(5)	22(5)	28(5)	26(5)	27(5)
10	20(4)	23(5)	22(5)	25(5)	19(5)	23(5)
15	27(5)	24(5)	15(5)	--	27(5)	26(5)
20	21(4)	16(4)	15(4)	28(5)	26(5)	27(5)
25	24(5)	28(5)	28(5)	28(5)	24(5)	24(5)
30	22(4)	24(4)	25(5)	18(4)	24(5)	--
35	28(5)	24(5)	28(5)	25(5)	24(5)	20(5)
40	22(5)	19(5)	18(4)	17(5)	25(4)	18(4)
45	26(5)	24(5)	14(5)	26(5)	22(5)	26(5)
50	24(5)	23(4)	19(4)	15(4)	25(5)	27(5)
60	25(5)	26(5)	--	19(4)	20(4)	13(6)
65	--	--	--	--	--	--
70	21(5)	19(5)	26(5)	13(4)	21(4)	22(8)
80	29(5)	--	20(5)	12(4)	19(5)	12(6)
90	--	29(5)	22(5)	14(4)	19(5)	--
95	--	26(5)	--	--	--	--
100	--	23(5)	26(5)	9(4)	23(5)	--
105	--	--	--	--	18(5)	--
110	--	26(5)	--	--	12(4)	--
120	--	23(5)	--	--	21(5)	--
130	--	--	--	--	27(5)	--
140	--	23(5)	--	--	20(5)*	--
150	--	--	--	--	27(5)	--

[QT]SX3034:D2722, #3359, PM = 17

Analytical uncertainties indicated in parentheses.

NA = Data not available.
-- = No sample.

*Sample from 145 feet.
**Borehole 6 consisted of two angle borings 15 feet apart--one was sampled to 35 linear feet and the other was sampled from 40 to 80 linear feet (see Section ________).

Table B-2 (Cont.)

Depth (feet)	Borehole 7	8	9	10	11	12
5	26(5)	20(5)	22(5)	22(5)	--	27(5)
10	21(5)	20(5)	24(4)	22(5)	--	21(5)
15	26(5)	26(5)	20(4)	26(5)	--	15(5)
20	19(4)	26(5)	18(4)	29(5)	23(5)	21(5)
25	20(5)	18(5)	13(5)	22(5)	--	26(5)
30	24(5)	NA	--	--	19(4)	24(5)
35	27(5)	20(5)	19(4)	--	--	21(4)
40	--	22(5)	16(4)	--	20(4)	21(5)
45	NA	23(5)	--	23(4)	--	29(5)
50	20(4)	21(5)	22(5)	--	17(5)	24(5)
60	19(4)	21(5)	29(5)	NA	21(5)	27(5)
65	23(5)	--	--	--	--	--
70	22(5)	21(5)	21(4)	19(5)	23(5)	28(5)
80	12(5)	29(5)	25(5)	24(5)	22(5)	28(5)
90	22(5)	17(4)	26(5)	--	--	--
95	--	NA	--	--	--	--
100	25(5)	--	17(5)	--	--	--
105	--	--	--	--	--	--
110	--	--	20(5)	--	--	--
120	--	--	27(5)	--	--	--
130	--	--	19(4)	--	--	--
140	--	--	--	--	--	--
150	--	--	--	--	--	--

[QT]SX3034:D2722, #3359, PM = 17

Analytical uncertainties indicated in parentheses.

NA = Data not available.
-- = No sample.

*Sample from 145 feet.
**Borehole 6 consisted of two angle borings 15 feet apart--one was sampled to 35 linear feet and the other was sampled from 40 to 80 linear feet (see Section ________).

Table B-2 (Cont.)

Depth (feet)	Borehole 13	14	15	16	17	18
5	22(5)	23(5)	27(5)	16(4)	14(4)	23(5)
10	24(4)	22(5)	25(5)	14(5)	26(5)	44(6)
15	22(5)	21(4)	18(4)	17(4)	20(5)	29(5)
20	27(5)	22(4)	14(4)	26(4)	27(5)	13(5)
25	20(5)	20(5)	17(4)	28(5)	27(5)	26(5)
30	18(5)	22(5)	22(5)	22(4)	19(5)	28(5)
35	18(4)	22(5)	26(5)	15(4)	21(5)	25(5)
40	23(4)	24(5)	21(4)	25(5)	25(5)	30(5)
45	24(5)	20(5)	19(3)	16(4)	21(5)	36(6)
50	--	27(5)	14(4)	28(5)	22(5)	25(5)
60	26(5)	24(5)	22(4)	--	NA	29(5)
65	--	--	--	--	--	--
70	24(5)	30(5)	21(4)	22(5)	--	28(5)
80	23(5)	29(5)	22(4)	23(5)	NA	25(5)
90	25(4)	23(5)	21(4)	28(5)	NA	34(5)
95	--	--	--	--	--	--
100	--	26(5)	23(5)	--	--	28(5)
105	--	--	--	--	--	--
110	--	--	--	--	--	11(4)
120	--	--	--	--	--	17(4)
130	--	--	--	--	--	25(5)
140	--	--	--	--	--	10(4)
150	--	--	--	--	--	--

[QT]SX3034:D2722, #3359, PM = 17

Analytical uncertainties indicated in parentheses.

NA = Data not available.
-- = No sample.

*Sample from 145 feet.
**Borehole 6 consisted of two angle borings 15 feet apart--one was sampled to 35 linear feet and the other was sampled from 40 to 80 linear feet (see Section ________).

Table B-3

MEAN CONCENTRATIONS OF GROSS ALPHA IN SOIL SAMPLES FROM BOREHOLES NEAR THE MWL

		Concentration (pCi/g)		
Borehole	Number of Samples	Mean	Standard Deviation	Range
1	10	7	2	<MDL to 11
2	18	11	4	<MDL to 16
3	14	8	3	<MDL to 13
4	10	6	2	<MDL to 12
5	16	7	3	<MDL to 13
6	7	14	7	7 to 26
7	10	8	2	<MDL to 12
8	17	9	4	<MDL to 16
9	16	9	3	5 to 18
10	12	11	4	7 to 18
11	7	6	2	<MDL to 9
12*	--	--	--	--
13	13	10	4	<MDL to 17
14	10	10	3	6 to 15
15	15	8	2	<MDL to 12
16	13	9	4	<MDL to 16
17	15	5	5	<MDL to 15
TOTAL	203			<MDL to 26

[QTREPORTS]SX3034:D2722, #3407, PM = 31

Note: In the calculation of the mean and standard deviation, analytical values less than the MDL were set equal to the MDL when 50% or more of the analytical values exceeded the MDL.

*Analysis not performed.

Table B-4

CONCENTRATIONS OF GROSS ALPHA IN SOIL SAMPLES FROM BOREHOLES (pCi/g)

Depth (feet)	Borehole 1	2	3	4	5	6**
5	***	9(5)	7(6)	***	***	***
10	6(5)	14(7)	8(5)	12(6)	7(5)	10(5)
15	***	13(6)	7(6)	--	***	***
20	<MDL	7(6)	<MDL	8(5)	<MDL	9(5)
25	***	12(6)	8(6)	***	***	***
30	11(6)	10(7)	6(5)	<MDL	13(6)	--
35	5(5)	14(7)	13(7)	***	***	***
40	8(5)	14(7)	13(6)	<MDL	12(6)	9(6)
45	7(5)	11(6)	<MDL	***	***	***
50	7(6)	16(7)	7(6)	5(5)	<MDL	7(5)
60	9(5)	13(6)	--	<MDL	5(5)	20(5)
65	--	--	--	--	--	--
70	7(5)	6(6)	9(6)	<MDL	<MDL	19(5)
80	9(5)	--	8(5)	<MDL	10(6)	26(5)
90	--	14(7)	<MDL	<MDL	<MDL	--
95	--	12(6)	--	--	--	--
100	--	6(5)	10(5)	6(5)	<MDL	--
105	--	--	--	--	<MDL	--
110	--	5(5)	--	--	10(6)	--
120	--	<MDL	--	--	5(4)	--
130	--	--	--	--	<MDL	--
140	--	12(6)	--	--	10(6)*	--
150	--	--	--	--	10(6)	--

[QT]SX3034:D2722, #3360, PM = 17

Analytical uncertainties indicated in parentheses.

NA = Data not available.
-- = No sample.

*Sample from 145 feet.
**Borehole 6 consisted of two angle borings 15 feet apart--one was sampled to 35 linear feet and the other was sampled from 40 to 80 linear feet (see Section ______).
***Analysis not performed.

Table B-4 (Cont.)

Depth (feet)	Borehole 7	8	9	10	11	12
5	***	7(5)	6(5)	7(5)	--	***
10	<MDL	9(6)	11(6)	7(6)	--	***
15	***	11(6)	18(8)	18(6)	--	***
20	7(5)	7(6)	8(6)	16(7)	<MDL	***
25	***	11(6)	12(7)	7(6)	--	***
30	11(6)	NA	--	--	<MDL	***
35	***	9(5)	7(5)	--	--	***
40	--	13(7)	10(6)	--	<MDL	***
45	NA	7(5)	--	13(5)	--	***
50	6(5)	<MDL	11(6)	--	5(4)	***
60	6(6)	6(5)	10(7)	NA	5(4)	***
65	8(6)	--	--	--	--	--
70	7(5)	6(6)	6(6)	13(6)	5(5)	***
80	10(6)	16(7)	7(6)	12(7)	9(5)	***
90	12(6)	12(6)	10(5)	--	--	--
95	--	NA	--	--	--	--
100	10(6)	--	5(4)	--	--	--
105	--	--	--	--	--	--
110	--	--	7(6)	--	--	--
120	--	--	7(5)	--	--	--
130	--	--	6(6)	--	--	--
140	--	--	--	--	--	--
150	--	--	--	--	--	--

[QT]SX3034:D2722, #3360, PM = 17

Analytical uncertainties indicated in parentheses.

NA = Data not available.
-- = No sample.

*Sample from 145 feet.
**Borehole 6 consisted of two angle borings 15 feet apart--one was sampled to 35 linear feet and the other was sampled from 40 to 80 linear feet (see Section ______).
***Analysis not performed.

Table B-4 (Cont.)

Depth (feet)	Borehole 13	14	15	16	17	18
5	8(6)	13(7)	10(5)	<MDL	<MDL	5(5)
10	17(7)	15(7)	10(6)	<MDL	<MDL	11(6)
15	13(7)	11(6)	10(5)	9(5)	15(7)	9(6)
20	16(7)	12(6)	10(7)	<MDL	10(6)	6(5)
25	6(6)	9(6)	6(5)	5(4)	10(6)	<MDL
30	7(5)	6(6)	<MDL	12(7)	<MDL	<MDL
35	11(7)	7(6)	10(6)	<MDL	<MDL	<MDL
40	11(6)	6(5)	7(6)	10(6)	<MDL	15(7)
45	7(6)	10(6)	8(5)	6(5)	8(5)	9(6)
50	--	8(6)	6(6)	15(6)	6(6)	7(6)
60	7(5)	***	5(4)	--	NA	10(6)
65	--	--	--	--	--	--
70	11(6)	***	<MDL	8(6)	--	7(6)
80	<MDL	***	8(6)	10(6)	NA	9(6)
90	12(6)	***	12(6)	16(7)	NA	8(6)
95	--	--	--	--	--	--
100	--	***	9(6)	--	--	7(6)
105	--	--	--	--	--	--
110	--	--	--	--	--	6(5)
120	--	--	--	--	--	6(5)
130	--	--	--	--	--	10(6)
140	--	--	--	--	--	<MDL
150	--	--	--	--	--	--

[QT]SX3034:D2722, #3360, PM = 17

Analytical uncertainties indicated in parentheses.

NA = Data not available.
-- = No sample.

*Sample from 145 feet.
**Borehole 6 consisted of two angle borings 15 feet apart--one was sampled to 35 linear feet and the other was sampled from 40 to 80 linear feet (see Section ______).
***Analysis not performed.

Table B-5

MEAN CONCENTRATIONS OF Ra-226 IN SOIL SAMPLES FROM BOREHOLES NEAR THE MWL

		Concentration (pCi/g)		
Borehole	Number of Samples	Mean	Standard Deviation	Range
1	13	0.8	0.3	0.4 to 1.4
2	18	0.9	0.3	0.4 to 1.5
3	14	0.7	0.2	0.3 to 1.1
4	14	0.9	0.3	0.4 to 1.5
5	21	0.8	0.3	0.4 to 1.8
6	12	0.8	0.2	0.6 to 1.3
7	14	0.8	0.2	0.5 to 1.3
8	17	0.8	0.3	0.6 to 1.4
9	16	0.8	0.3	0.4 to 1.4
10	12	NA	NA	NA
11	7	0.7	0.2	0.5 to 1.0
12	13	0.7	0.3	<MDL to 1.1
13	13	0.8	0.3	<MDL to 1.5
14	15	0.6	0.3	<MDL to 1.3
15	15	0.8	0.2	0.4 to 1.2
16	13	0.7	0.2	0.4 to 1.3
17	15	NA	NA	NA
TOTAL	242			<MDL to 1.8

[QTREPORTS]SX3034:D2722, #3413, PM = 31

Note: In the calculation of the mean and standard deviation, analytical values less than the MDL were set equal to the MDL when 50% or more of the analytical values exceeded the MDL.

NA Data not available.

Table B-6

**CONCENTRATIONS OF Ra-226
IN SOIL SAMPLES FROM BOREHOLES
(pCi/g)**

Depth (feet)	Borehole 1	2	3	4	5	6**
5	0.7(0.2)	0.7(0.4)	1.0(0.4)	1.1(0.2)	0.7(0.2)	0.7(0.1)
10	0.4(0.2)	1.1(0.4)	0.7(0.4)	1.5(0.4)	0.5(0.3)	1.0(0.4)
15	1.4(0.2)	0.9(0.5)	0.6(0.4)	--	0.9(0.1)	0.8(0.2)
20	0.5(0.3)	0.9(0.4)	0.4(0.2)	0.8(0.4)	1.0(0.4)	1.1(0.4)
25	0.6(0.1)	1.1(0.4)	0.6(0.2)	0.4(0.1)	0.9(0.1)	0.6(0.2)
30	0.5(0.4)	1.1(0.3)	0.4(0.2)	0.7(0.3)	0.4(0.4)	--
35	0.9(0.4)	0.9(0.4)	0.3(0.3)	0.7(0.2)	0.6(0.1)	0.8(0.2)
40	0.5(0.3)	1.4(0.6)	0.9(0.3)	1.0(0.4)	0.8(0.3)	0.6(0.3
45	0.7(0.3)	0.6(0.3)	0.6(0.3)	0.7(0.1)	0.8(0.1)	0.7(0.2)
50	1.0(0.3)	0.9(0.4)	0.6(0.3)	0.6(0.3)	1.8(0.5)	0.6(0.3)
60	1.0(0.3)	1.5(0.5)	--	0.6(0.4)	0.9(0.5)	1.0(0.3)
65	--	--	--	--	--	--
70	0.7(0.6)	0.5(0.2)	0.8(0.3)	1.0(0.3)	1.0(0.5)	0.6(0.4)
80	1.0(0.3)	--	0.5(0.2)	1.4(0.4)	0.9(0.4)	1.3(0.6)
90	--	1.0(0.5)	0.8(0.4)	1.0(0.3)	0.6(0.6)	--
95	--	1.0(0.4)	--	--	--	--
100	--	1.0(0.3)	1.1(0.3)	1.0(0.5)	0.7(0.4)	--
105	--	--	--	--	0.9(0.3)	--
110	--	0.4(0.4)	--	--	1.0(0.4)	--
120	--	0.5(0.2)	--	--	0.6(0.4)	--
130	--	--	--	--	0.9(0.3)	--
140	--	1.5(0.5)	--	--	0.6(0.4)*	--
150	--	--	--	--	1.0(0.4)	--

[QT]SX3034:D2722, #3362, PM = 17

Analytical uncertainties indicated in parentheses.

NA = Data not available.
-- = No sample.

*Sample from 145 feet.
**Borehole 6 consisted of two angle borings 15 feet apart--one was sampled to 35 linear feet and the other was sampled from 40 to 80 linear feet (see Section ______).

Table B-6 (Cont.)

Depth (feet)	Borehole 7	8	9	10	11	12
5	0.6(0.2)	0.7(0.2)	0.9(0.2)	NA	--	1.1(0.3)
10	0.8(0.4)	0.9(0.3)	0.6(0.3)	NA	--	<MDL
15	0.8(0.2)	1.4(0.3)	0.5(0.4)	NA	--	0.4(0.3)
20	0.6(0.4)	1.0(0.3)	1.0(0.3)	NA	0.6(0.4)	0.6(0.3)
25	0.6(0.1)	0.8(0.2)	1.0(0.3)	NA	--	<MDL
30	1.3(0.5)	0.6(0.2)	--	--	0.5(0.3)	0.5(0.3)
35	0.9(0.2)	0.6(0.2)	0.4(0.4)	--	--	0.8(0.3)
40	--	0.9(0.2)	0.4(0.3)	--	1.0(0.5)	0.5(0.3)
45	NA	0.7(0.2)	--	NA	--	0.8(0.6)
50	0.7(0.4)	0.7(0.2)	1.0(0.3)	--	0.7(0.3)	0.6(0.3)
60	0.7(0.3)	NA	1.3(0.4)	NA	0.5(0.2)	1.0(0.4)
65	0.5(0.4)	--	--	--	--	--
70	0.7(0.5)	NA	1.4(0.4)	NA	0.7(0.3)	1.1(0.5)
80	1.1(0.4)	NA	1.1(0.3)	NA	0.9(0.5)	0.9(0.4)
90	1.0(0.4)	NA	0.9(0.3)	--	--	--
95	--	NA	--	--	--	--
100	0.9(0.4)	--	0.6(0.3)	--	--	--
105	--	--	--	--	--	--
110	--	--	0.5(0.3)	--	--	--
120	--	--	0.4(0.3)	--	--	--
130	--	--	1.0(0.5)	--	--	--
140	--	--	--	--	--	--
150	--	--	--	--	--	--

[QT]SX3034:D2722, #3362, PM = 17

Analytical uncertainties indicated in parentheses.

NA = Data not available.
-- = No sample.

*Sample from 145 feet.
**Borehole 6 consisted of two angle borings 15 feet apart--one was sampled to 35 linear feet and the other was sampled from 40 to 80 linear feet (see Section ______).

Table B-6 (Cont.)

Depth (feet)	Borehole 13	14	15	16	17	18
5	1.5(0.7)	<MDL	0.5(0.5)	0.6(0.3)	NA	0.7(0.3)
10	0.8(0.4)	<MDL	1.0(0.4)	1.3(0.4)	NA	0.7(0.3)
15	0.7(0.3)	0.5(0.3)	0.8(0.3)	0.6(0.3)	NA	0.4(0.3)
20	1.3(0.3)	0.6(0.3)	0.7(0.4)	0.5(0.4)	NA	1.1(0.3)
25	0.5(0.2)	0.5(0.3)	0.6(0.3)	0.9(0.2)	NA	0.4(0.3)
30	0.6(0.3)	0.7(0.3)	1.0(0.3)	0.6(0.3)	NA	0.5(0.3)
35	0.7(0.3)	<MDL	0.6(0.2)	0.4(0.3)	NA	0.6(0.4)
40	0.7(0.4)	0.5(0.3)	0.8(0.3)	0.8(0.3)	NA	1.4(0.4)
45	0.8(0.3)	0.8(0.3)	0.6(0.2)	0.9(0.4)	NA	0.7(0.4)
50	--	0.5(0.3)	1.2(0.3)	0.8(0.4)	NA	1.3(0.4)
60	<MDL	0.8(0.3)	0.4(0.2)	--	NA	0.6(0.3)
65	--	--	--	--	--	--
70	0.6(0.3)	0.7(0.3)	0.6(0.2)	0.5(0.3)	--	0.5(0.4)
80	0.7(0.3)	0.7(0.4)	1.2(0.3)	0.6(0.3)	NA	0.4(0.3)
90	0.6(0.4)	0.5(0.3)	0.9(0.3)	0.8(0.6)	NA	0.6(0.3)
95	--	--	--	--	--	--
100	--	1.3(0.4)	0.8(0.3)	--	--	0.9(0.4)
105	--	--	--	--	--	--
110	--	--	--	--	--	0.5(0.5)
120	--	--	--	--	--	0.6(0.4)
130	--	--	--	--	--	0.6(0.4)
140	--	--	--	--	--	0.6(0.4)
150	--	--	--	--	--	--

[QT]SX3034:D2722, #3362, PM = 17

Analytical uncertainties indicated in parentheses.

NA = Data not available.
-- = No sample.

*Sample from 145 feet.
**Borehole 6 consisted of two angle borings 15 feet apart--one was sampled to 35 linear feet and the other was sampled from 40 to 80 linear feet (see Section ______).

Table B-7

MEAN CONCENTRATIONS OF Th-232 IN SOIL SAMPLES FROM BOREHOLES NEAR THE MWL

Borehole	Number of Samples	Concentration (pCi/g) Mean	Standard Deviation	Range
1	13	1.2	0.7	<MDL to 2.4
2	18	1.3	0.6	<MDL to 2.2
3	14	0.9	0.5	<MDL to 2.1
4	14	1.1	0.5	<MDL to 1.9
5	21	1.2	0.6	<MDL to 3.0
6	12	1.1	0.4	<MDL to 2.0
7	14	1.1	0.5	<MDL to 2.1
8	17	0.9	0.2	0.6 to 1.4
9	16	1.2	0.5	<MDL to 2.1
10	12	NA	NA	NA
11	7	<MDL*	--	<MDL to 2.2
12	13	1.4	0.6	<MDL to 2.3
13	13	1.2	0.6	<MDL to 2.6
14	15	1.1	0.5	<MDL to 2.1
15	15	1.4	0.8	<MDL to 2.8
16	13	1.0	0.5	<MDL to 2.4
17	15	NA	NA	NA
TOTAL	242			<MDL to 3.0

[QTREPORTS]SX3034:D2722, #3458, PM = 31

Note: In the calculation of the mean and standard deviation, analytical values less than the MDL were set equal to the MDL when 50% or more of the analytical values exceeded the MDL.

*Fewer than 50% of the analytical values exceeded the MDL. See data in Table E.

NA Data not available.

Table B-8

CONCENTRATIONS OF Th-232
IN SOIL SAMPLES FROM BOREHOLES
(pCi/g)

Depth (feet)	Borehole 1	2	3	4	5	6**
5	1.7(0.5)	1.1(0.6)	1.1(0.7)	0.7(0.3)	1.6(0.3)	0.8(0.3)
10	0.9(0.8)	<MDL	<MDL	0.8(0.7)	1.0(0.7)	1.1(0.7)
15	0.7(0.3)	2.2(0.8)	<MDL	--	0.7(0.2)	0.9(0.3)
20	<MDL	<MDL	1.5(0.7)	1.4(0.6)	1.5(0.9)	1.7(0.9)
25	0.4(0.1)	<MDL	1.1(0.7)	1.9(0.4)	0.7(0.2)	1.2(0.5)
30	<MDL	1.5(0.5)	1.6(0.8)	<MDL	3(1)	--
35	<MDL	1.8(0.7)	2.1(0.7)	0.6(0.3)	1.0(0.2)	0.6(0.3)
40	1.9(0.6)	1.9(0.7)	0.5(0.4)	1.9(0.6)	0.9(0.7)	<MDL
45	1.0(0.5)	0.9(0.4)	0.4(0.3)	0.9(0.2)	0.9(0.3)	1.2(0.3)
50	0.4(0.4)	2.2(0.9)	<MDL	1.0(0.5)	<MDL	1.3(0.8)
60	2.2(0.6)	0.8(0.5)	--	1.9(0.6)	1.3(0.7)	1.4(0.9)
65	--	--	--	--	--	--
70	2.4(0.8)	1.3(0.9)	<MDL	0.9(0.6)	0.7(0.6)	2.0(0.9)
80	2.2(0.6)	--	0.6(0.4)	<MDL	<MDL	0.8(0.6)
90	--	2.0(0.8)	<MDL	<MDL	2.0(0.7)	--
95	--	0.5(0.5)	--	--	--	--
100	--	1.7(0.8)	0.6(0.4)	0.9(0.7)	<MDL	--
105	--	--	--	--	1.2(0.5)	--
110	--	1.4(1.1)	--	--	1.8(0.6)	--
120	--	1.0(0.6)	--	--	1.8(0.8)	--
130	--	--	--	--	<MDL	--
140	--	<MDL	--	--	1.8(0.6)*	--
150	--	--	--	--	0.8(0.7)	--

[QT]SX3034:D2722, #3403, PM = 17

Analytical uncertainties indicated in parentheses.

NA = Data not available.
-- = No sample.

*Sample from 145 feet.
**Borehole 6 consisted of two angle borings 15 feet apart--one was sampled to 35 linear feet and the other was sampled from 40 to 80 linear feet (see Section ______).

Table B-8 (Cont.)

Depth (feet)	Borehole 7	8	9	10	11	12
5	0.9(0.2)	0.7(0.3)	1.1(0.4)	NA	--	1.5(0.5)
10	1.7(0.6)	1.1(0.4)	1.9(0.7)	NA	--	<MDL
15	1.3(0.3)	1.4(0.4)	1.8(0.9)	NA	--	<MDL
20	<MDL	0.7(0.3)	1.6(0.4)	NA	<MDL	1.2(0.7)
25	0.8(0.3)	0.8(0.3)	0.8(0.6)	NA	--	1.3(0.6)
30	1.9(0.8)	0.7(0.3)	--	--	2.2(1.0)	2.1(0.9)
35	0.9(0.3)	0.7(0.3)	1.6(0.8)	--	--	0.9(0.7)
40	--	1.0(0.4)	0.8(0.5)	--	<MDL	2.2(0.9)
45	NA	0.9(0.3)	--	NA	--	0.7(0.6)
50	<MDL	0.6(0.2)	<MDL	--	<MDL	1.6(0.7)
60	<MDL	NA	<MDL	NA	1.0(0.6)	1.3(0.5)
65	2.1(0.7)	--	--	--	--	--
70	<MDL	NA	2.1(0.7)	NA	1.1(0.6)	1.4(0.8)
80	<MDL	NA	2.0(0.6)	NA	<MDL	2.3(0.9)
90	<MDL	NA	1.1(0.6)	--	--	--
95	--	NA	--	--	--	--
100	0.9(0.5)	--	1.1(0.5)	--	--	--
105	--	--	--	--	--	--
110	--	--	<MDL	--	--	--
120	--	--	0.7(0.5)	--	--	--
130	--	--	<MDL	--	--	--
140	--	--	--	--	--	--
150	--	--	--	--	--	--

[QT]SX3034:D2722, #3403, PM = 17

Analytical uncertainties indicated in parentheses.

NA = Data not available.
-- = No sample.

*Sample from 145 feet.
**Borehole 6 consisted of two angle borings 15 feet apart--one was sampled to 35 linear feet and the other was sampled from 40 to 80 linear feet (see Section _______).

Table B-8 (Cont.)

Depth (feet)	Borehole 13	14	15	16	17	18
5	1.0(0.5)	2(1)	0.8(0.8)	<MDL	NA	0.7(0.5)
10	<MDL	<MDL	1.2(0.9)	2.4(0.9)	NA	1.1(0.8)
15	1.4(0.6)	<MDL	1.1(0.7)	0.6(0.4)	NA	0.5(0.4)
20	<MDL	<MDL	2.1(1.0)	0.9(0.5)	NA	0.9(0.5)
25	1.5(0.6)	0.8(0.6)	2.7(0.8)	<MDL	NA	0.6(0.4)
30	0.8(0.4)	<MDL	<MDL	0.5(0.4)	NA	0.9(0.6)
35	<MDL	<MDL	<MDL	<MDL	NA	1.3(0.8)
40	<MDL	1.6(0.9)	0.6(0.5)	1.0(0.5)	NA	1.3(0.8)
45	<MDL	1.3(0.6)	<MDL	<MDL	NA	0.6(0.5)
50	--	1.7(0.8)	1.3(0.7)	<MDL	NA	0.9(0.8)
60	2.6(1.0)	1.0(0.8)	1.6(0.6)	--	NA	1.3(0.5)
65	--	--	--	--	--	--
70	1.6(0.4)	<MDL	0.6(0.4)	1.0(0.6)	--	<MDL
80	1.5(0.8)	1.6(0.7)	0.9(0.8)	1.2(0.8)	NA	1.0(0.6)
90	1.2(0.7)	0.9(0.4)	2.6(0.9)	1.4(0.6)	NA	1.2(0.6)
95	--	--	--	--	--	--
100	--	2.1(0.8)	2.8(0.8)	--	--	1.2(0.7)
105	--	--	--	--	--	--
110	--	--	--	--	--	1.6(0.9)
120	--	--	--	--	--	1.2(0.6)
130	--	--	--	--	--	0.9(0.6)
140	--	--	--	--	--	0.6(0.4)
150	--	--	--	--	--	--

[QT]SX3034:D2722, #3403, PM = 17

Analytical uncertainties indicated in parentheses.

NA = Data not available.
-- = No sample.

*Sample from 145 feet.
**Borehole 6 consisted of two angle borings 15 feet apart--one was sampled to 35 linear feet and the other was sampled from 40 to 80 linear feet (see Section ______).

Table B-9

MEAN CONCENTRATIONS OF K-40 IN SOIL SAMPLES FROM BOREHOLES NEAR THE MWL

Borehole	Number of Samples	Concentration (pCi/g) Mean	Standard Deviation	Range
1	13	20	4	14 to 28
2	18	20	3	16 to 27
3	14	19	5	12 to 28
4	14	17	3	9 to 24
5	21	20	4	14 to 28
6	12	20	3	17 to 26
7	14	19	3	14 to 24
8	17	9	1	7 to 12
9	16	20	4	15 to 31
10	12	NA	NA	NA
11	7	23	4	17 to 26
12	13	23	9	10 to 50
13	13	18	4	11 to 24
14	15	18	4	12 to 23
15	15	19	4	10 to 23
16	13	20	5	10 to 26
17	15	NA	NA	NA
TOTAL	242			9 to 50

[QTREPORTS]SX3034:D2722, #3459, PM = 31

NA Data not available.

Table B-10

CONCENTRATIONS OF K-40
IN SOIL SAMPLES FROM BOREHOLES
(pCi/g)

Depth (feet)	Borehole 1	2	3	4	5	6**
5	14(2)	17(6)	25(6)	17(3)	18(2)	19(2)
10	20(7)	18(6)	15(5)	9(5)	23(6)	23(6)
15	20(3)	21(7)	21(6)	--	18(2)	26(3)
20	23(6)	18(6)	26(6)	18(6)	24(7)	20(6)
25	17(2)	17(6)	14(4)	17(2)	16(2)	18(2)
30	20(8)	23(6)	22(6)	24(7)	26(7)	--
35	17(8)	23(7)	12(4)	19(2)	14(2)	23(3)
40	15(8)	18(6)	19(5)	16(6)	23(6)	19(6)
45	15(6)	23(6)	17(5)	16(2)	18(2)	17(2)
50	18(4)	16(6)	14(5)	13(5)	28(7)	17(6)
60	25(7)	23(6)	--	17(5)	20(6)	24(6)
65	--	--	--	--	--	--
70	28(11)	17(7)	28(6)	16(7)	18(6)	18(6)
80	25(7)	--	21(6)	16(7)	20(6)	17(6)
90	--	20(7)	16(5)	21(7)	19(6)	--
95	00	19(6)	--	--	--	--
100	--	21(7)	19(5)	17(6)	22(6)	--
105	--	--	--	--	17(5)	--
110	--	18(6)	--	--	24(6)	--
120	--	25(6)	--	--	19(7)	--
130	--	--	--	--	26(7)	--
140	--	27(7)	--	--	18(6)*	--
150	--	--	--	--	16(7)	--

[QT]SX3034:D2722, #3364, PM = 17

Analytical uncertainties indicated in parentheses.

NA = Data not available.
-- = No sample.

*Sample from 145 feet.
**Borehole 6 consisted of two angle borings 15 feet apart--one was sampled to 35 linear feet and the other was sampled from 40 to 80 linear feet (see Section ______).

Table B-10 (Cont.)

Depth (feet)	Borehole 7	8	9	10	11	12
5	20(2)	11(2)	22(5)	NA	--	21(5)
10	21(6)	9(2)	16(5)	NA	--	50(24)
15	21(2)	10(3)	17(6)	NA	--	23(4)
20	21(6)	10(2)	21(5)	NA	25(6)	19(5)
25	21(2)	8(2)	NA	NA	--	19(6)
30	22(6)	12(2)	--	--	19(6)	10(6)
35	24(2)	9(2)	15(5)	--	--	23(5)
40	--	9(2)	16(4)	--	25(7)	21(5)
45	NA	10(2)	--	NA	--	28(6)
50	20(6)	9(2)	18(5)	--	26(6)	23(5)
60	15(5)	NA	16(5)	NA	25(6)	18(5)
65	14(5)	--	--	--	--	--
70	18(6)	NA	24(6)	NA	17(7)	18(6)
80	15(6)	NA	20(6)	NA	25(7)	25(7)
90	14(6)	NA	16(5)	--	--	--
95	--	NA	--	--	--	--
100	21(6)	--	23(5)	--	--	--
105	--	--	--	--	--	--
110	--	--	17(5)	--	--	--
120	--	--	20(5)	--	--	--
130	--	--	21(5)	--	--	--
140	--	--	--	--	--	--
150	--	--	--	--	--	--

[QT]SX3034:D2722, #3364, PM = 17

Analytical uncertainties indicated in parentheses.

NA = Data not available.
-- = No sample.

*Sample from 145 feet.
**Borehole 6 consisted of two angle borings 15 feet apart--one was sampled to 35 linear feet and the other was sampled from 40 to 80 linear feet (see Section ______).

Table B-10 (Cont.)

Depth (feet)	Borehole 13	14	15	16	17	18
5	16(5)	21(6)	21(7)	18(5)	NA	16(4)
10	24(6)	23(5)	16(5)	13(5)	NA	19(5)
15	18(5)	21(5)	23(5)	24(5)	NA	16(5)
20	11(4)	23(5)	20(5)	16(5)	NA	9(4)
25	16(5)	16(5)	10(3)	24(5)	NA	12(5)
30	14(4)	18(6)	15(4)	22(5)	NA	15(5)
35	16(4)	23(5)	19(4)	21(6)	NA	11(6)
40	23(6)	16(5)	23(5)	26(6)	NA	15(6)
45	19(6)	14(5)	16(4)	20(6)	NA	13(5)
50	--	12(5)	22(5)	20(6)	NA	14(5)
60	19(6)	12(5)	21(5)	--	NA	16(5)
65	--	--	--	--	--	--
70	14(4)	20(4)	23(5)	10(5)	--	21(6)
80	16(5)	20(6)	18(5)	18(6)	NA	16(5)
90	22(6)	20(5)	14(4)	26(7)	NA	16(6)
95	--	--	--	--	--	--
100	--	16(5)	18(5)	--	--	20(5)
105	--	--	--	--	--	--
110	--	--	--	--	--	19(6)
120	--	--	--	--	--	24(6)
130	--	--	--	--	--	17(5)
140	--	--	--	--	--	25(6)
150	--	--	--	--	--	--

[QT]SX3034:D2722, #3364, PM = 17

Analytical uncertainties indicated in parentheses.

NA = Data not available.
-- = No sample.

*Sample from 145 feet.
**Borehole 6 consisted of two angle borings 15 feet apart--one was sampled to 35 linear feet and the other was sampled from 40 to 80 linear feet (see Section _______).

Table B-11

MEAN CONCENTRATIONS OF U-234 AND U-238
IN SOIL SAMPLES FROM SB-3

		Concentration (pCi/g)		
Radio-nuclide	Number of Samples	Mean	Standard Deviation	Range
U-234	14	0.8	0.2	0.5 to 1.0
U-238	14	0.8	0.1	0.5 to 0.9

[QTREPORTS]SX3034:D2722, #3460, PM = 31

Table B-12

**CONCENTRATIONS OF U-234
AND U-238 IN SOIL SAMPLES FROM SB-3 AND SB-18
(pCi/g)**

Depth (feet)	SB-3		SB-17		SB-18	
	U-234	U-238	U-234	U-238	U-234	U-238
5	0.8(0.2)	0.7(0.2)	NA	NA	*	*
10	1.0(0.3)	0.9(0.2)	NA	NA	*	*
15	0.6(0.1)	0.8(0.2)	NA	NA	*	*
20	0.5(0.1)	0.5(0.1)	NA	NA	*	*
25	0.8(0.1)	0.9(0.1)	NA	NA	*	*
30	0.6(0.1)	0.6(0.1)	NA	NA	*	*
35	1.0(0.2)	0.8(0.1)	NA	NA	*	*
40	0.6(0.2)	0.6(0.1)	NA	NA	*	*
45	0.6(0.2)	0.7(0.2)	NA	NA	*	*
50	0.9(0.2)	0.8(0.1)	NA	NA	*	*
60	--	--	NA	NA	*	*
70	0.8(0.2)	0.9(0.2)	--	--	*	*
80	0.9(0.2)	0.7(0.1)	NA	NA	*	*
90	0.8(0.2)	0.9(0.2)	NA	NA	0.8(0.1)	1.0(0.2)
100	1.0(0.2)	0.9(0.2)	--	--	0.9(0.1)	0.9(0.1)
110	--	--	--	--	1.0(0.2)	0.8(0.1)
120	--	--	--	--	1.0(0.2)	1.0(0.2)
130	--	--	--	--	1.0(0.2)	1.1(0.2)
140	--	--	--	--	1.5(0.5)	1.0(0.4)
150	--	--	--	--	--	--

[QT]SX3034:D2722, #3404, PM = 28

Analytical uncertainties indicated in parentheses.
-- = No sample.
*Analysis not performed.

NA Data not available.

Table B-13

RADIOANALYTICAL RESULTS FOR FIELD DUPLICATE SAMPLES

Sample Location	Sample Numbers	Analysis	Concentration (pCi/g except Tritium [pCi/ml of extracted water]) Sample	Sample	% Error
SB-1, 30 feet	299-B-871, 187-B-098	Tritium	<MDL		To come
		Gross beta	22(4)		
		Gross alpha	11(6)		
		Ra-226	0.5(0.4)		
		Th-232	<MDL		
		K-40	20(8)		
		Cs-137	<MDL		
SB-4, 60 feet	913-B-416, 207-B-218	Tritium	16(4)	12(4)	28.6
		Gross beta	19(4)	14(4)	30.3
		Gross alpha	<MDL	<MDL	0
		Ra-226	0.6(0.4)	0.5(0.3)	18.2
		Th-232	1.9(0.6)	1.1(0.6)	53.3
		K-40	17(5)	21(6)	21.1
		Cs-137	<MDL	<MDL	0
SB-5, 105 feet	126-B-394, 629-B-036	Tritium	<MDL	<MDL	0
		Gross beta	18(5)	19(4)	5.4
		Gross alpha*	<MDL	10(6)	66.7
		Ra-226	0.9(0.3)	0.6(0.3)	40.0
		Th-232	1.2(0.5)	1.1(0.5)	8.7
		K-40	17(5)	15(5)	12.5
		Cs-137	<MDL	<MDL	0
SB-6, 60 feet	751-B-984, 719-B-271	Tritium	18(4)	18(4)	0
		Gross beta	13(6)	11(6)	16.7
		Gross alpha	20(5)	21(5)	4.9
		Ra-226	1.0(0.3)	0.6(0.4)	50.0
		Th-232	1.4(0.9)	0.6(0.6)	80.0
		K-40	24(6)	22(6)	8.7
		Cs-137	<MDL	<MDL	0
SB-8, 45 feet	331-B-565, 505-B-305	Tritium	<MDL	<MDL	0
		Gross beta	23(4)	18(4)	24.4
		Gross alpha	6(5)	7(5)	15.4
		Ra-226	0.7(0.2)	0.6(0.3)	15.4
		Th-232	0.7(0.3)	0.9(0.3)	25.0
		K-40	10(2)	7(2)	35.3
		Cs-137	<MDL	<MDL	0
SB-10, 72 feet	307-B-187, 253-B-937	Tritium	<MDL	<MDL	0
		Gross beta	19(5)	17(5)	11.1
		Gross alpha	13(6)	8(6)	47.6
		Ra-226	NA	NA	
		Th-232	NA	NA	
		K-40	NA	NA	
		Cs-137	NA	NA	

[QT]SX3034:D2722, #3463, PM = 19

Note: Analytical uncertainties indicated in parentheses.

*In the calculation of percent error, values less than the MDL were set equal to the MDL when the duplicate value exceeded the MDL.

NA Data not available.

Table B-13 (Cont.)

Sample Location	Sample Numbers	Analysis	Concentration (pCi/g except Tritium [pCi/ml of extracted water]) Sample	Sample	% Error
SB-11, 70 feet	074-B-569, 985-B-623	Tritium*	<MDL	6(4)	66.7
		Gross beta	23(5)	24(5)	4.3
		Gross alpha	5(5)	9(5)	57.1
		Ra-226	0.7(0.3)	0.6(0.4)	15.4
		Th-232	1.1(0.6)	1.0(0.6)	9.5
		K-40	17(7)	19(6)	11.1
		Cs-137	<MDL	<MDL	0
SB-16, 35 feet	736-B-720, 757-B-498	Tritium	<MDL	<MDL	0
		Gross beta	15(4)	18(4)	18.2
		Gross alpha	<MDL	<MDL	0
		Ra-226	0.4(0.3)	0.9(0.3)	76.9
		Th-232*	<MDL	1.0(0.5)	35.3
		K-40	21(6)	14(5)	40.0
		Cs-137	<MDL	<MDL	0
SB-17, 47.5 feet	018-B-162 070-B-244	Tritium	660(10)	730(20)	10.1
		Gross beta	21(5)	22(5)	4.7
		Gross alpha	8(5)	8(5)	0
		Ra-226	NA	NA	
		Th-232	NA	NA	
		K-40	NA	NA	
		Cs-137	NA	NA	
SB-18, 35 feet	165-B-237 165-B-041	Tritium	<MDL	<MDL	0
		Gross beta	25(5)	26(5)	3.9
		Gross alpha*	<MDL	7(6)	33.3
		Ra-226	0.6(0.4)	0.4(0.3)	40.0
		Th-232	1.3(0.8)	0.6(0.4)	73.7
		K-40	11(6)	23(6)	70.6
		Cs-137	<MDL	<MDL	0

[QT]SX3034:D2722, #3463, PM - 19

Note: Analytical uncertainties indicated in parentheses.

*In the calculation of percent error, values less than the MDL were set equal to the MDL when the duplicate value exceeded the MDL.

NA Data not available.