RECORD OF DECISION
FOR THE
LEE ACRES LANDFILL SUPERFUND SITE,
FARMINGTON, NEW MEXICO

U.S. Environment Protection Agency
Region 6 Superfund Division

MAY 2004

LEE ACRES LANDFILL SUPERFUND SITE
RECORD OF DECISION

CONCURRENCE

Petra Sanchez
Remedial Project Manager

Don Williams, Team Leader
New Mexico/ Technical Section

Wren Stenger, Branch Chief
Louisiana / New Mexico/Oklahoma Branch

Michael C. Barra
Site Attorney, Office of Regional Counsel

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CONCURRENCE

Mark A. Peycke, Chief Superfund Branch
Office of Regional Counsel

Pam Phillips
Deputy Director, Superfund Division

The United States Department of the Interior

Bureau of Land Management

Lee Acres Landfill
Farmington, New Mexico

Record of Decision

June 2004

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Declaration

Site Name and Location

This decision document presents the selected remedy for the Lee Acres Landfill National Priorities List (NPL) Site near Farmington, New Mexico, which comprises 60 acres owned by the United States, and is commonly known as the Lee Acres Landfill. The site is approximately 4.5 miles east of Farmington, New Mexico. Lee Acres is listed in the Environmental Protection Agency's (EPA) National Superfund Database, identification number NMD980750020.

Statement of Basis and Purpose

This decision document presents the selected remedy for the Lee Acres Landfill near Farmington, New Mexico, which was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. § 9601, et seq., as amended by the Superfund Amendments and Reauthorization Act (SARA), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR Part 300. This decision is based on the Administrative Record file for this site.

EPA and the State of New Mexico Environmental Department (NMED) have reviewed the Administrative Record for the Lee Acres Landfill and concur with the selected remedy. The Department of the Interior, Bureau of Land Management (BLM), is the lead agency for response action at the Lee Acres Landfill.

The selected remedy is protective of human health and the environment, and complies with Federal and State requirements that are legally applicable or relevant and appropriate requirements (ARARs) for the remedial action. The selected remedy also is cost effective.

Assessment of the Site

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in the ROD, may present an imminent and substantial endangerment to public health and the environment.

Description of Selected Remedy

The selected remedy will consist of closure and capping of landfill soils to prevent leachate using a capillary barrier design provided by the Department of Energy's Sandia National Laboratory. Surface water run-on and run-off controls will be constructed to divert run-on and maximize run-off. Because contaminant concentrations, for which clean-up levels are listed in Table 2, have been decreasing, and the plume is not migrating, the selected remedy for ground water is monitored natural attenuation. Institutional controls will ensure the long-term effectiveness of the remedy. This response action is comprehensive, and will address all actual or potential risk at the site. No additional response actions are anticipated.

BLM will continue to monitor ground water to ensure the effectiveness of the capillary barrier cap and natural attenuation remedy. If monitoring data indicate a long-term (i.e., two years) trend of significantly increasing contaminant concentrations (for contaminants listed in Table 2), then an evaluation of the remedy performance will be conducted to determine the cause, and appropriate corrective actions will be taken, if needed. Specific monitoring well locations outside the landfill (waste containment) boundary will be determined during remedy design for the purpose of monitoring compliance with applicable or relevant and appropriate requirements (ARARs). Monitoring well locations within the landfill boundary also will be determined during remedy design for the purpose of monitoring cap performance. This approach was selected to ensure that any contaminant increases that may occur are in fact a long-term trend rather than a short-term event.

Institutional controls will be utilized to prevent access to contaminated ground water and to hazardous substances encapsulated in the landfill. An area of 134.68 acres of public land, which includes the Lee Acres Landfill and a buffer area around it, was withdrawn by BLM from surface entry and mining for a period of 50 years (see 62 FR 2177, Public Land Order No. 7234). The effect of the withdrawal is to prohibit all potential uses of this public land that BLM is unable to prohibit on a discretionary basis due to statutory requirements. The withdrawal does not prohibit all activities on the withdrawn land. The activities not prohibited by the withdrawal, however, are at BLM's discretion, and BLM may choose whether or not to authorize these activities and may dictate the circumstances under which they may occur. BLM will exercise its discretion to prohibit any activities that could disturb the integrity of the containment system, and to prohibit the drilling of ground-water wells for any purpose other than monitoring connected with the remedial action at the Lee Acres Landfill site.

The landfill contents at the former Lee Acres Landfill are the source materials at this site, and are not considered principal threat wastes (i.e., highly toxic or highly mobile waste that generally cannot be reliably contained). The landfill contents consist of common household waste, various types of construction debris, and industrial wastes such as paint thinners, grease and oil strippers and cleaners, pesticides, and general cleaning chemicals. The lagoons, which formerly contained liquid waste, were drained and covered with clean soil in 1986. In addition, the contaminated ground water is not considered a principal threat waste because it is not considered a source of contamination. The selected remedy will significantly reduce the mobility of remaining sources in the former landfill; however, the selected remedy will not actively reduce the existing toxicity and volume. Light non-aqueous phase liquids (LNAPLS) and dense non-aqueous phase liquids (DNAPLS) were not found in concentrations that exceed EPA action levels during the Remedial Investigation (RI), and therefore were not considered further in the RI/FS process. The same reasoning was used for landfill gases, which were not measured in elevated concentrations during the RI.

The major components of the selected remedy are:

- landfill cover (capillary barrier cover) with lysimeters;
- surface water run-on and run-off controls;
- monitored natural attenuation of ground water; and

- institutional controls, in the form of withdrawal of site by BLM, and implemented through the District Resource Management Plan/Final Environmental Impact Statement.

Statutory Determination

The selected remedy is protective of human health and the environment. The selected remedy for the soil pathway will attain State and Federal ARARs. The selected remedy for the ground-water pathway will attain ARARs within a reasonable time frame not to exceed the ground-water monitoring period of 30 years.

The selected remedy does not satisfy the statutory preference for treatment as a principle element of the remedy because the landfill waste is high-volume, low-risk waste that can be reliably contained, and would not be cost-effective to treat. The selected remedy is cost-effective, and utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable.

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted no less often than each five years after the initiation of the remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

Data Certification Checklist

The following information has been included in the ROD.

- The chemicals of concern (COCs) and their respective concentrations.
- Baseline risk represented by the COCs.
- Current and future land and ground water assumptions used in the baseline risk assessment and ROD.
- Land and ground-water use that will be available at the site as a result of the selected remedy.

- Estimated capital, operation and maintenance (O&M), and total present worth costs; discount rate and number of years over which cost estimates are projected.
- Factors that led to selecting the remedy.
- Clean-up levels established for COCs and the basis for these levels.
- How source materials constituting principal threats are addressed.

Authorizing Signatures

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Assistant Secretary — Date
Policy, Management and Budget
Department of the Interior

[signature] — 6/24/04

Director, Superfund Division — Date
Region 6
U.S. Environmental Protection Agency

- Estimated capital, operation and maintenance (O&M), and total present worth costs; discount rate and number of years over which cost estimates are projected.
- Factors that led to selecting the remedy.
- Clean-up levels established for COCs and the basis for these levels.
- How source materials constituting principal threats are addressed.

Authorizing Signatures

7/22/04

Assistant Secretary
Policy, Management and Budget
Department of the Interior

Date

Director, Superfund Division
Region 6
U.S. Environmental Protection Agency

Date

1.0 INTRODUCTION

This Record of Decision presents the selected remedy for the remediation of soil and ground-water contamination at the Lee Acres Landfill Superfund Site. In an effort to promote technology advancement, the Bureau of Land Management (BLM), the Environmental Protection Agency (EPA), and the New Mexico Environment Department (NMED) have worked together to select a comprehensive remedy that is appropriate for the climate conditions at the site. The remedy selection is based on the potential risk presented by the site, the most current data available, ease of implementation, public support, and cost effectiveness. Data collected subsequent to the finalization of the Proposed Plan (PP) up through November 1999, have been incorporated into and evaluated for the remedy selection in this ROD.

The technology selected for the closure and capping of the landfill soils is a capillary barrier cover designed by the Department of Energy's (DOE) Sandia National Laboratory in Albuquerque NM, the University of New Mexico, and BLM's Farmington Field Office. Both EPA and NMED have been involved in the development of the plan, and have received copies of the September 1998, January 1999, March 1999, and June 2000 pilot study reports from UNM in order to review the results of the project collected to date. The results of the data collected during the pilot project monitoring period were interpreted by the designers at Sandia and UNM. Success of the pilot was defined as "no measurable infiltration at the bottom of the cap; failure of the cap would have been the detection of measurable infiltration at the bottom of the cap". The results have shown that the capillary barrier performed as originally expected. However, there was an unexpected increase, followed by decreases, in some VOCs in two monitoring wells within the landfill boundary, BLM 56 and 57. It is suspected that the increases in concentrations were temporary spikes caused by the installation of the pilot project. In order to more closely monitor this situation, sampling frequency was increased to quarterly for wells BLM 57, 56, and 49.

Because the contaminant concentrations have been decreasing in all wells located outside the landfill cells, and the plume has not been moving, the selected remedy for the contaminated ground water is monitored natural attenuation. BLM will continue to monitor ground water to ensure the continued effectiveness of the monitored natural attenuation remedy. If monitoring data indicate a long-term (i.e., two years) trend of significantly increasing contaminant concentrations (for contaminants listed in Table 2), then an evaluation of remedy performance will be conducted to determine the cause, and appropriate corrective actions will be taken, if needed. Specific monitoring well locations outside the landfill (waste containment) boundary will be determined during remedy design for the purpose of monitoring compliance with ARARs. Monitoring well locations within the landfill boundary also will be determined during remedy design for the purpose of monitoring cap performance.

The total estimated cost of the preferred alternatives for soil and ground water is $2.2 million. The total future cost for remediation of the Lee Acres Landfill is not expected to exceed $3.5 million over 30 years.

2.0 SITE LOCATION AND DESCRIPTION

The Lee Acres Landfill is located approximately 4.5 miles east of Farmington, New Mexico (Figure 1), on federal land managed by the BLM. In May 1962, San Juan County leased 20 acres (W1/2NW1/4SW1/4 of Section 22, T29N, R12W). Another 40 acres was leased in 1980 (S1/2SW1/4NW1/4; NW1/4NE1/4SW1/4; and NE14NW1/4SW1/4 of Section 22, T29N, R12W) (BLM 1981). All 60 acres are contained in a fenced area as one site (see Figure 1).

3.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

The Lee Acres Landfill was operated by San Juan County through leases dating from 1962 until April 1993. The original lease was approved by BLM in 1962 for use of the property as a municipal solid waste landfill. In 1980, San Juan County, with the knowledge of both the State and BLM, expanded the use of the landfill to allow the disposal of liquid waste. Containment berms were built, and lagoons were established in the northwest and southwest quadrants of the landfill. These are referred to as the "northern lagoon" and "southern lagoon" respectively. Figures 2 through 4, based on photogrammetric data, illustrate landfill use and development history. Section 16 presents a chronological summary of the regulatory events at the landfill.

In 1985, the berm of the northern lagoon was breached during routine maintenance activities, releasing both the liquid contents and hydrogen sulfide gas. A resident that was present at the landfill, and several emergency response team members were hospitalized due to inhalation of the gas. New Mexico Environmental Improvement Division (NMEID), the predecessor of the NMED, responded to the release, aerated the lagoon, and treated the lagoon contents with ferric chloride to neutralize the hydrogen sulfide and stabilize other chemicals that might be present in the liquid contents of the lagoon. The landfill was closed to liquid waste disposal in 1985 and was closed to solid waste disposal in 1986. It was covered with 4 to 15 feet of clean soil in 1986. A Preliminary Investigation was performed by BLM in 1988. The Lee Acres Landfill was placed on the National Priorities List (NPL) by the Environmental Protection Agency (EPA) in 1990.

During the period of operation of the landfill, the Giant-Bloomfield Refinery (GBR), located immediately south of the landfill, was also in full operation, refining mainly diesel and unleaded gasoline. It has been discovered that the refinery lost approximately 45,000 barrels of refined product into the soils and ground water from about 1975 to 1984. In their efforts to recover the product and remediate the contaminated ground water, GBR installed numerous recovery wells and an air stripping system under the regulatory authority of New Mexico Oil and Gas Division.

In 1986, volatile organic compounds (VOCs) were found at concentrations greater than the associated maximum contaminant levels (MCLs) in samples collected from three domestic water supply wells in the Lee Acres subdivision located down-gradient from the landfill and refinery. The BLM agreed to connect the 13 residents in the subdivision who were using private drinking water wells to a municipal water supply. During the construction of the connections, BLM provided those residents with at least 8,700 gallons of bottled water. The hookups were completed in 1987.

In January 1993, EPA, NMED, and BLM entered into a technical Memorandum of Understanding (MOU) that developed a technical working group to complete the Remedial

Investigation (RI), the Feasibility Study (FS), and the Proposed Plan (PP). The RI was approved by EPA and NMED in May 1995, and the FS was approved by the two agencies in May 1996. Subsequently, the PP was approved by the EPA and NMED in September 1996. The public review and response period was completed in November 1996 with no comments received.

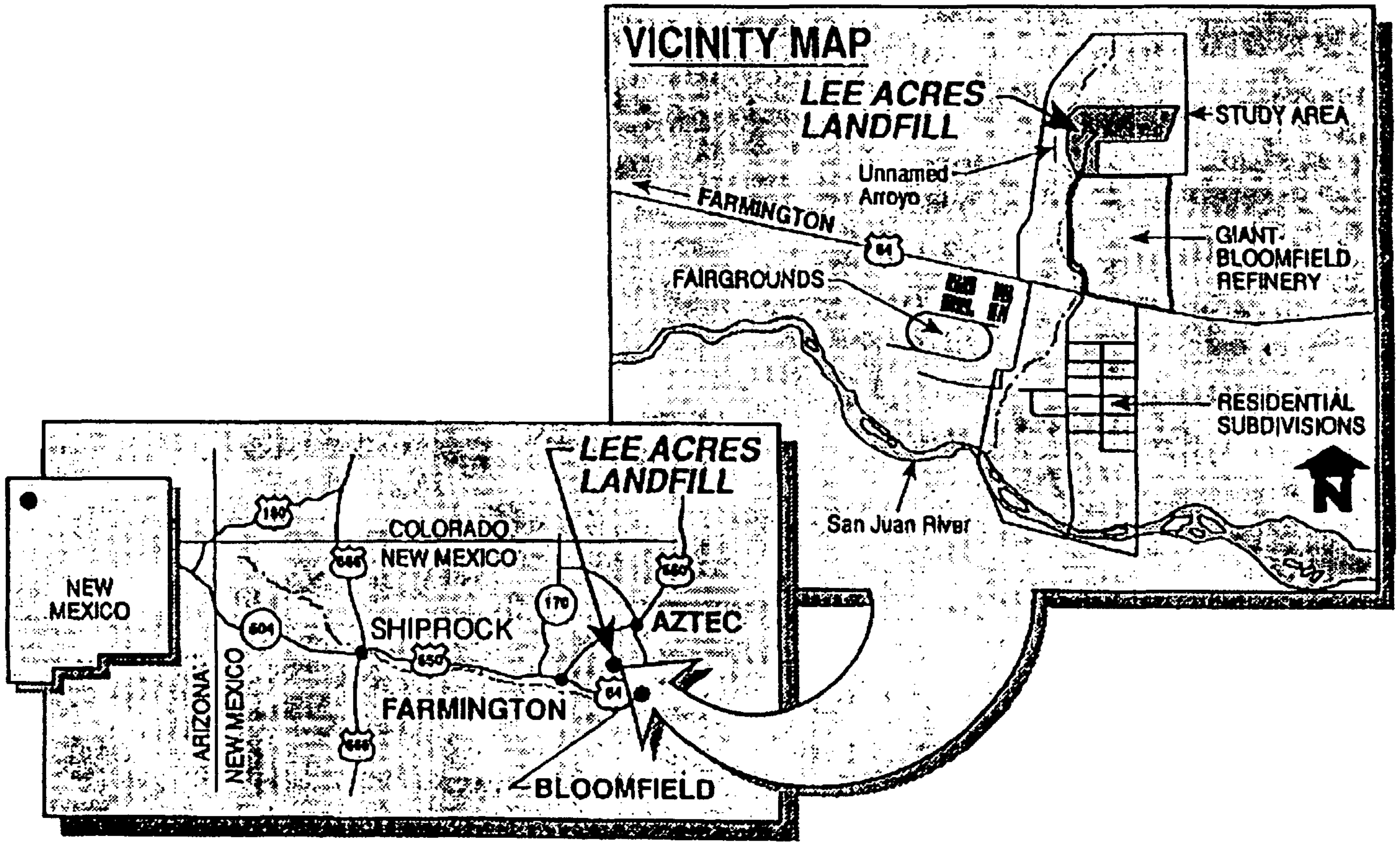

Figure 1 Lee Acres Landfill Location

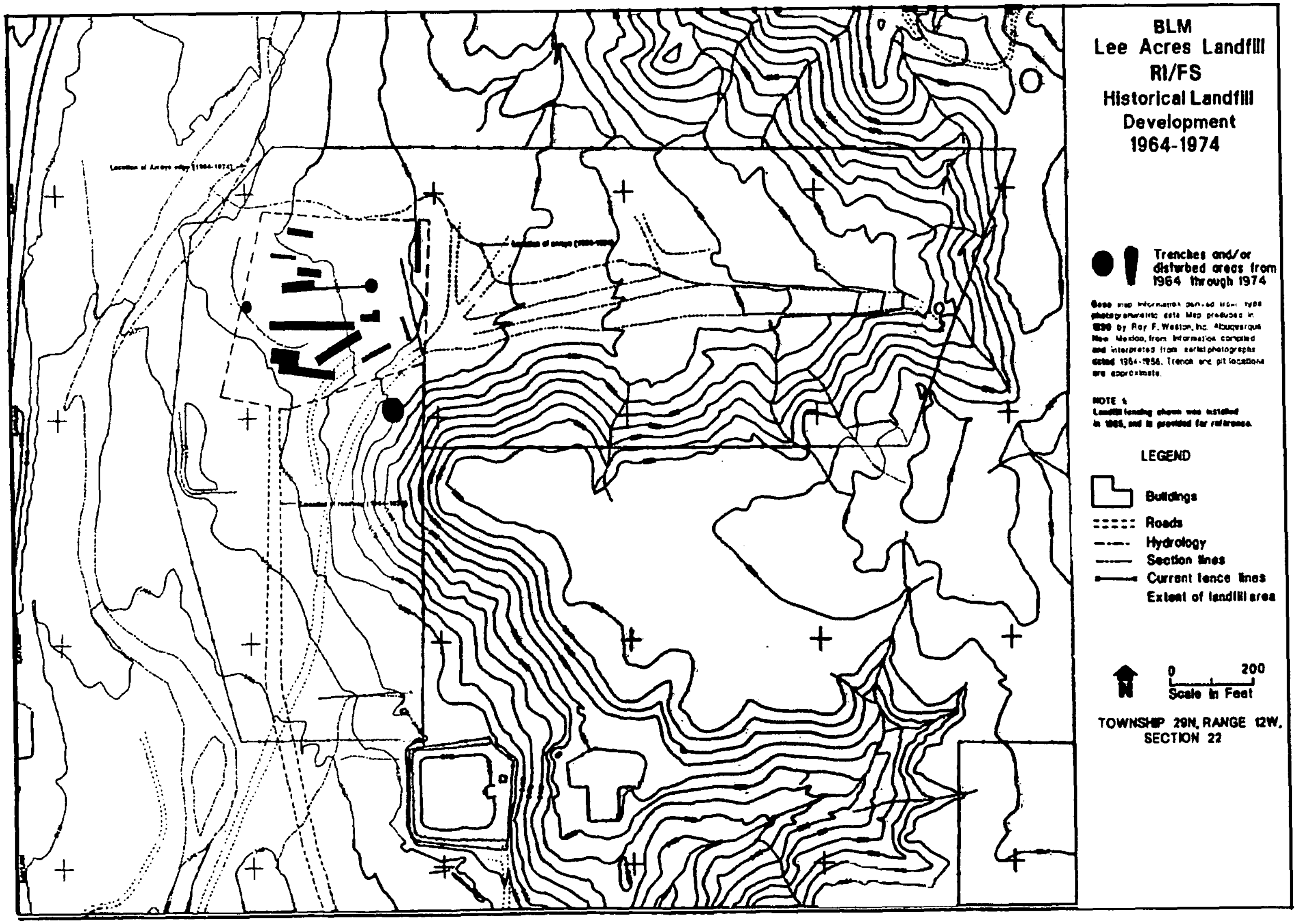

Figure 2 Historical Landfill Development, 1964-1974

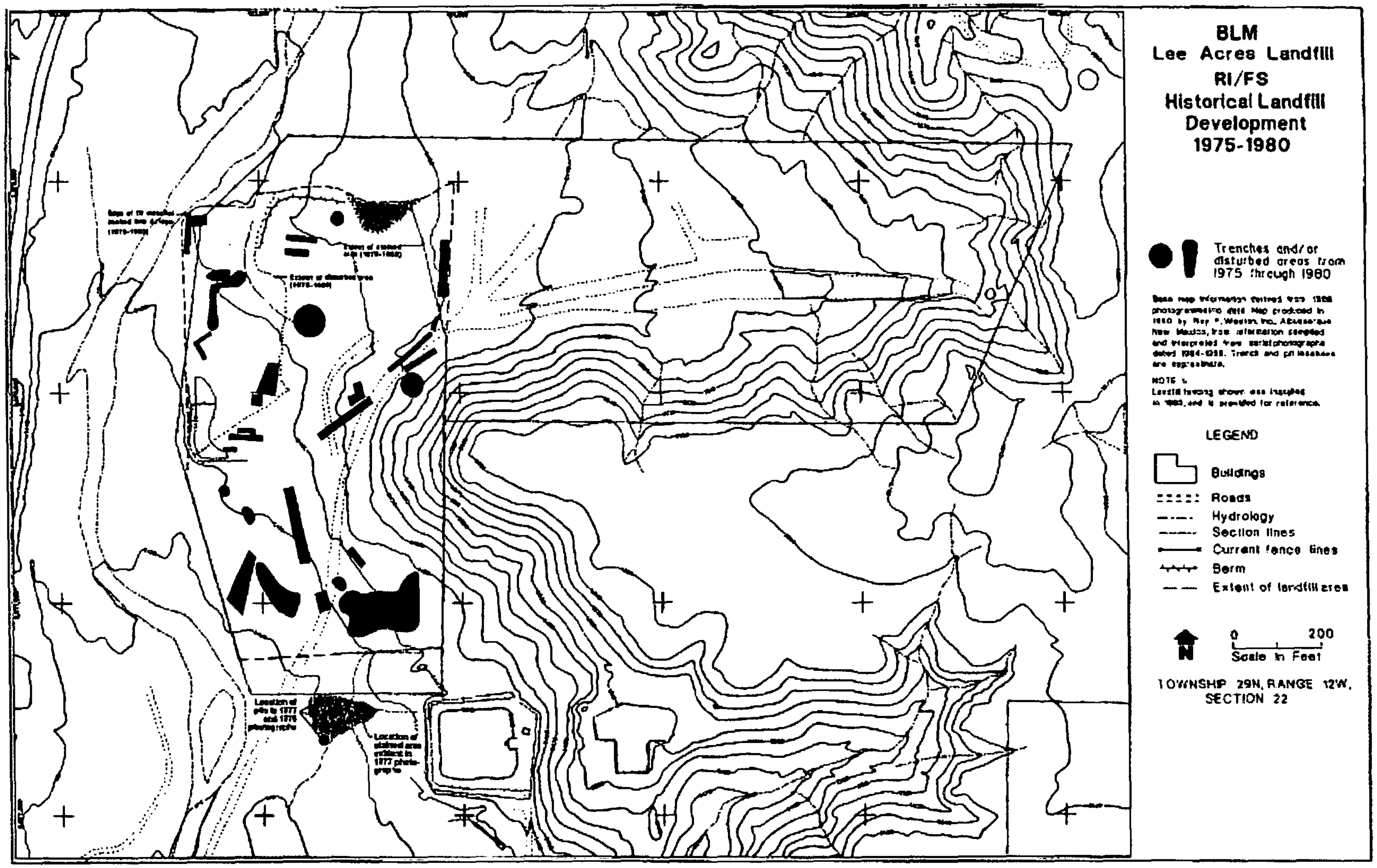

Figure 3 Historical Landfill Development, 1975-1980

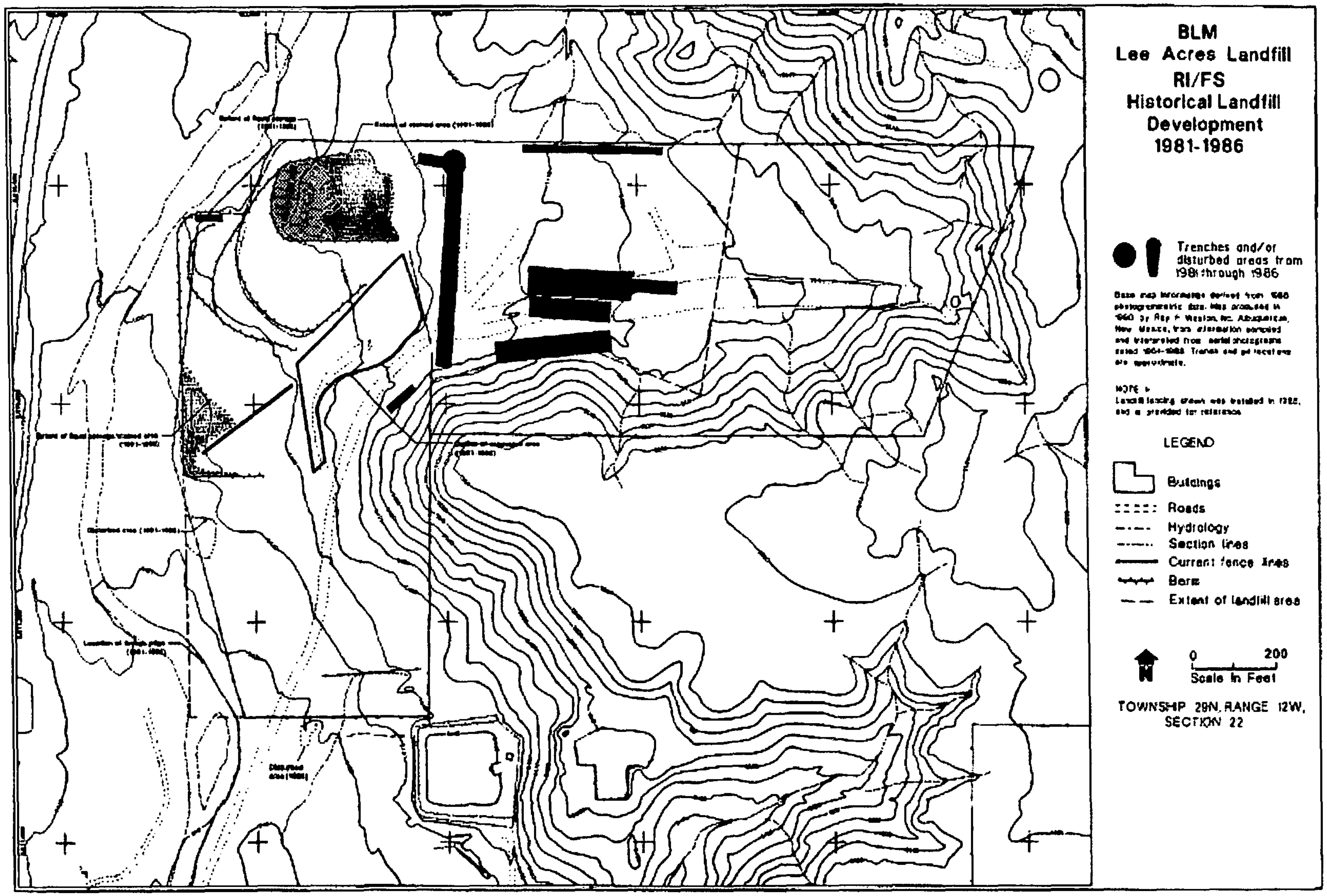

Figure 4 Historical Landfill Development, 1981-1986

4.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION

BLM began a public participation program in 1990 regarding the Lee Acres Landfill, in fulfillment of the public participation requirements in CERCLA and section 300.430(f)(3) of the NCP. Scoping meetings were held in Santa Fe, Albuquerque and Farmington. Two Open Houses were held in 1993 and 1994 at the Farmington District Office. Fact Sheets and newsletters were published periodically during the RI/FS process as well. No comments, input or public response were received during these outreach efforts.

Responsiveness Summary

The RI/FS Report and the PP for the Lee Acres Landfill were released to the public on September 16, 1996. These documents were made available to the public in both the Administrative Record and the information repositories listed in Table 1. The notice of availability of the documents was published in the Farmington Times, Durango Herald, and the Albuquerque Journal. A public comment period was held from September 16, 1996 through November 16, 1996. In addition, a public meeting was held at San Juan College in Farmington, New Mexico on September 26, 1996. At this meeting, representatives of the BLM, EPA Region VI, NMED, Sandia National Laboratory and Department of Energy (DOE) were present to answer questions from the public. No members of the public attended the meeting, and no comments were received on the RI/FS and PP during the public comment period. The public response is part of the Administrative Record. The decisions in the ROD are based on the data included in the Administrative Record.

Lee Acres Landfill RI/FS Information Repositories

Bureau Of Land Management Contact: Mr. Joel Farrell 1235 La Plata Highway Farmington, New Mexico 87401 505-599-6311
Alturian Public Library Contact: Ms. Suzy Horvath 201 W. Chaco Aztec, New Mexico 87410 505-334-9456
New Mexico Environment Department Ground Water Protection and Remediation Bureau Contact: Ms. Robin Brown 1190 St. Francis Drive Santa Fe, New Mexico 87503 505-827-2434
Environmental Protection Agency Library Contact: Mr. Sairam Appaji 1445 Ross Avenue Dallas, Texas 75202 214-665-3126
Farmington Public Library Contact: Ms. Nancy Gorman 100 W. Broadway Farmington, New Mexico 87401 505-599-1270

Table 1 Administrative Record Repository Locations

5.0 SCOPE AND ROLE OF OPERABLE UNITS

Two environmental media are being addressed by this ROD for the Lee Acres Landfill: soil within and beneath the landfill, and contaminated shallow alluvia ground water beneath and south of the landfill. With this remedy, all potential risk from the site is being addressed. No additional response actions are anticipated.

The primary concern for remediation of the soils within the landfill is the potential for the leaching of the residual contamination from the landfill soils into the ground water. This ROD presents alternatives designed to prevent future leaching of contaminants by percolation of surface moisture into the ground water through the contaminated trash layers and the lagoon sediments that are still in place in the landfill. Although contaminated soils exist within the landfill, the most highly contaminated soils have been covered with clean soil. This reduction of percolation and natural degradation of the contaminants has been occurring within the soil since the landfill's closure.

The primary concern for the ground-water pathway is potential ingestion of manganese, nickel, and chlorinated volatile organic compounds (VOCs) that are present in the ground water. These contaminants pose a potential risk to human health because the EPA's Hazard Index (HI) for noncarcinogenic risk is exceeded, and the concentrations of some chlorinated VOCs exceed ARARs.

Ground-water contamination forms a plume in the alluvial aquifer. The plume extends from the landfill south onto the adjacent property owned by GBR. Three concentrated areas of ground-water contamination remain. Two of the concentrated areas correspond to the locations of the former liquid waste lagoons at the landfill. The third concentrated area of ground-water contamination is south of the landfill located near wells GBR-32, GBR-48, and GBR-49. The source of the third center of contamination has not been identified. Identifying the source of the third center of contamination is not necessary because long-term ground-water monitoring data (March 1990 to November 1999) demonstrate that the ground-water contamination levels are decreasing and the contaminant plume is receding. The decrease in the contaminant concentrations and plume size is attributed to closing the liquid waste lagoons to use, allowing the contents to evaporate, backfilling the lagoons with clean soil, and closing the landfill. Under favorable conditions, natural physical, chemical, or biological processes can act to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil or ground water. These processes include biodegradation; dispersion; dilution; sorption; volatilization; and chemical or biological stabilization, transformation, or destruction of contaminants. (Monitored Natural Attenuation of Chlorinated Solvents, U.S. EPA Remedial Technology Fact Sheet).

To protect public health, welfare, and the environment from hazardous substances that will remain at the landfill following the completion of remedial action, BLM has withdrawn 134.68 acres of public land, within which the landfill is located, from settlement, sale, location, and entry, as described in Public Land Order No. 7234 (62 Fed. Reg. 2177, January 15, 1997). In light of this withdrawal, the current and reasonably foreseeable future uses of the withdrawn land, including the ground water beneath the land, will not include any use that will result in an unacceptable risk to human health or the environment due to exposure to hazardous substances remaining at the landfill. Pursuant to the authority vested in the Secretary of the Interior by Section 104 of CERCLA, 42 U.S.C. 9604, and Section 204 of the Federal Land Policy and Management Act, 43 U.S.C. 1714, this withdrawal, and the resulting restriction on use, will remain in effect until January 15, 2047, unless the Secretary determines that the withdrawal should be extended.

6.0 SUMMARY OF SITE CHARACTERISTICS

The Lee Acres Landfill is in the eastern portion of San Juan County, a dissected high plateau within the Navajo Section of the Colorado Plateau physiographic province. This high plateau is dissected by the San Juan and Animas Rivers that originate in the San Juan Mountains of southern Colorado, coalesce near Farmington, and flow west to the Colorado River. The landfill is located in the southern drainage basin of the interfluvial ridge between the two rivers. The intermittent surficial waters from the area drain through an unnamed arroyo system that joins the San Juan River south of the Lee Acres subdivision.

In this part of San Juan County, much of the land is publicly owned, open rangeland. Several governmental agencies, industries, developers, and private citizens own or lease land within the original study area for the site (Figure 5). The original study area (circa 1986) was significantly larger than the site is now. It was re-defined in 1993 for the RI. No Indian reservations, tribal lands, or railroad land grants are within the study area. Residential, commercial, and industrial developments are concentrated in the incorporated municipalities of Aztec, Bloomfield, and Farmington, and adjacent to the transportation corridors between these towns. The majority of the residential development in the area is considered low income housing. The major vehicular transportation route in the vicinity of the former landfill is U.S. Highway 64, also known as the Bloomfield Highway. The highway is located approximately ½ mile south of the landfill boundary.

Figure 5 is a general land use map of the study area prepared on the basis of 1988 aerial photographs and surface reconnaissance. Land use has not changed significantly since 1988.

The land in the region of the study area is used predominantly as open rangeland for livestock and wildlife. It is also used for: 1) industrial purposes by the Giant-Bloomfield Refinery (GBR), and by the El Paso Natural Gas Substation, which is north of the study area; 2) residential purposes south of the study area and north of the San Juan River; and 3) public recreational purposes at the San Juan County Fairgrounds southwest of the study area.

The rangeland vegetation in the area is not well suited to supporting large numbers of livestock; approximately 12 acres are required to feed one mature cow and calf for one month (one animal-unit-month). Oil and natural gas wells are present near the landfill. A north to south trending natural gas pipeline is located approximately 500 feet west of the landfill site. No public schools, prisons, or hospitals are within three miles of the site. The nearest educational facility is a private school operated by the Mennonite community approximately one mile north of the landfill. Future use of this area is expected to remain much the same as it is now, with the exception of a possible county road expansion.

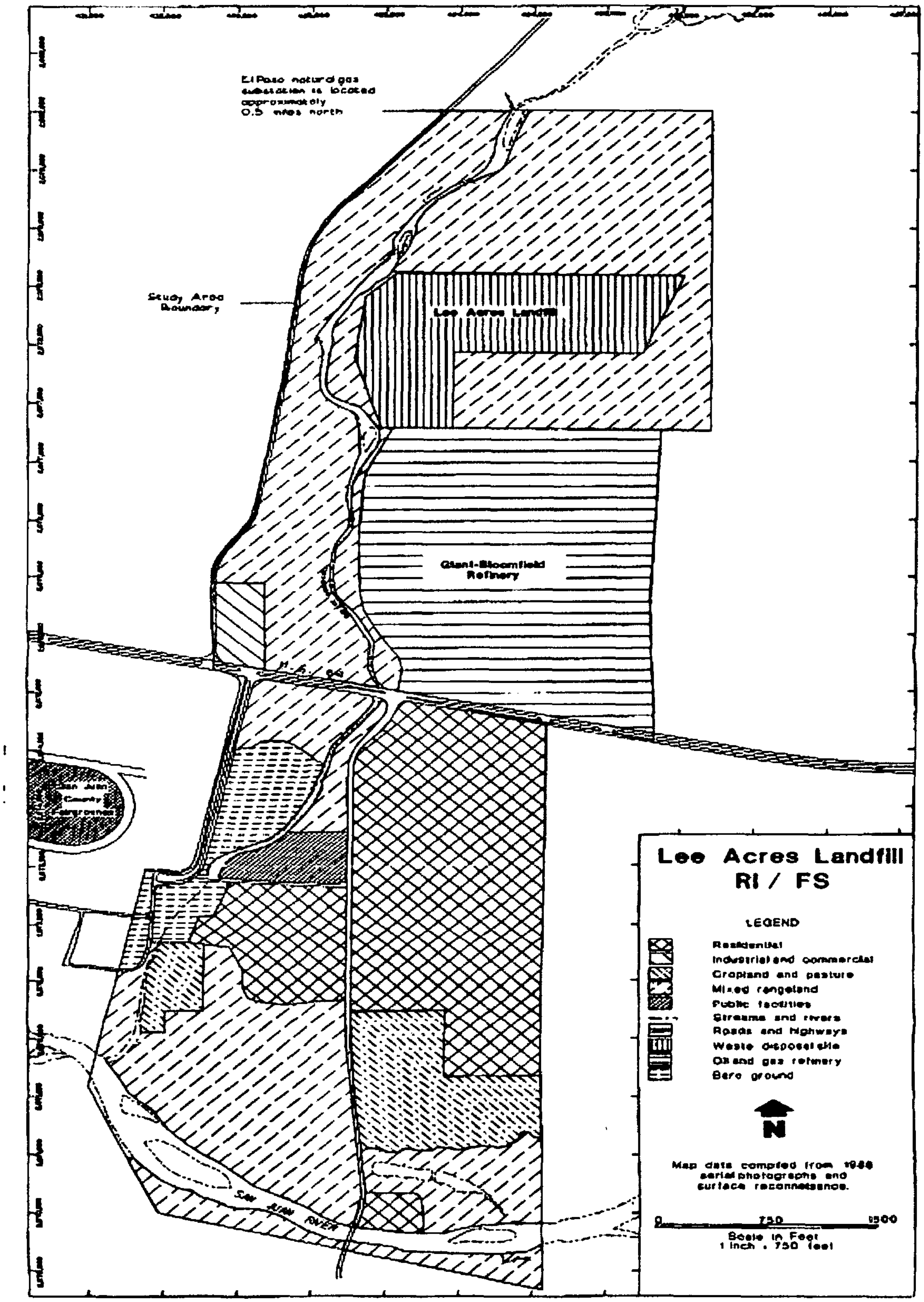

Figure 5 Lee Acres Landfill Vicinity Land Use Map

The 60-acre landfill can be divided into two portions. The eastern 40 acres is sublain by tertiary Nacimiento Formation claystone/siltstone facies interfingered with Nacimiento sandstone facies that forms the low permeable barrier to bedrock aquifers. This portion of the landfill was generally used for solid waste disposal and dead animal pits. The western 20 acres of the landfill is underlain by quaternary alluvium classified as unconsolidated silty sand to sandy gravel. The thickness of the alluvium, from ground surface to bedrock, is up to 60 feet near the center of the channel and the depth to water is 34 to 47 feet. Alluvial ground water is present beneath approximately 8 acres along the western edge of the landfill (Figure 6), but not the eastern portion of the landfill.

The western edge of the landfill is underlain by an unconfined alluvial aquifer. The aquifer is bound on both sides by the margins of an incised bedrock channel which is approximately 600 feet wide in the area near the landfill. Ground water in the alluvial aquifer moves southward at a rate of approximately 0.17 feet per day (62 feet/year), based on the hydraulic data collected in 1993. Farther south, the saturated alluvium interfingers with the San Juan River deposits and is not bound by the bedrock channel. The alluvium is comprised of poor to moderately sorted, fine to medium sands with some gravel and cobbles. Unconsolidated silt and clay lenses are common. The underlying regional bedrock aquifer is unaffected by the contamination from the Lee Acres Landfill site.

Based on historical records and field sampling, soil investigations at the landfill identified four major areas that are either known or potential contaminant source areas that pose a threat to ground water. The former northern and southern liquid waste lagoons have been identified as known contaminant source areas.

The areas of the site identified as potential sources, based on analytical results, include the southern region of the landfill, which may have been either a lagoon area or solid waste disposal area, and an area south of the landfill fence that includes the GBR firewater storage ponds.

The landfill is surrounded on the north, east and west by undeveloped property. GBR is located south of the landfill, and the GBR property is bounded on the south by Highway 64. South of Highway 64, there is a residential area, the Lee Acres Subdivision, which extends to the San Juan

River. The San Juan River is about one mile south of the Lee Acres Landfill. It was this subdivision that required the domestic water supply in 1986, due to contamination from sources that were not specifically identified. Ground water in the study area is not currently used for municipal, domestic, or agricultural water supplies. The landfill has been withdrawn from public use until at least 2047.

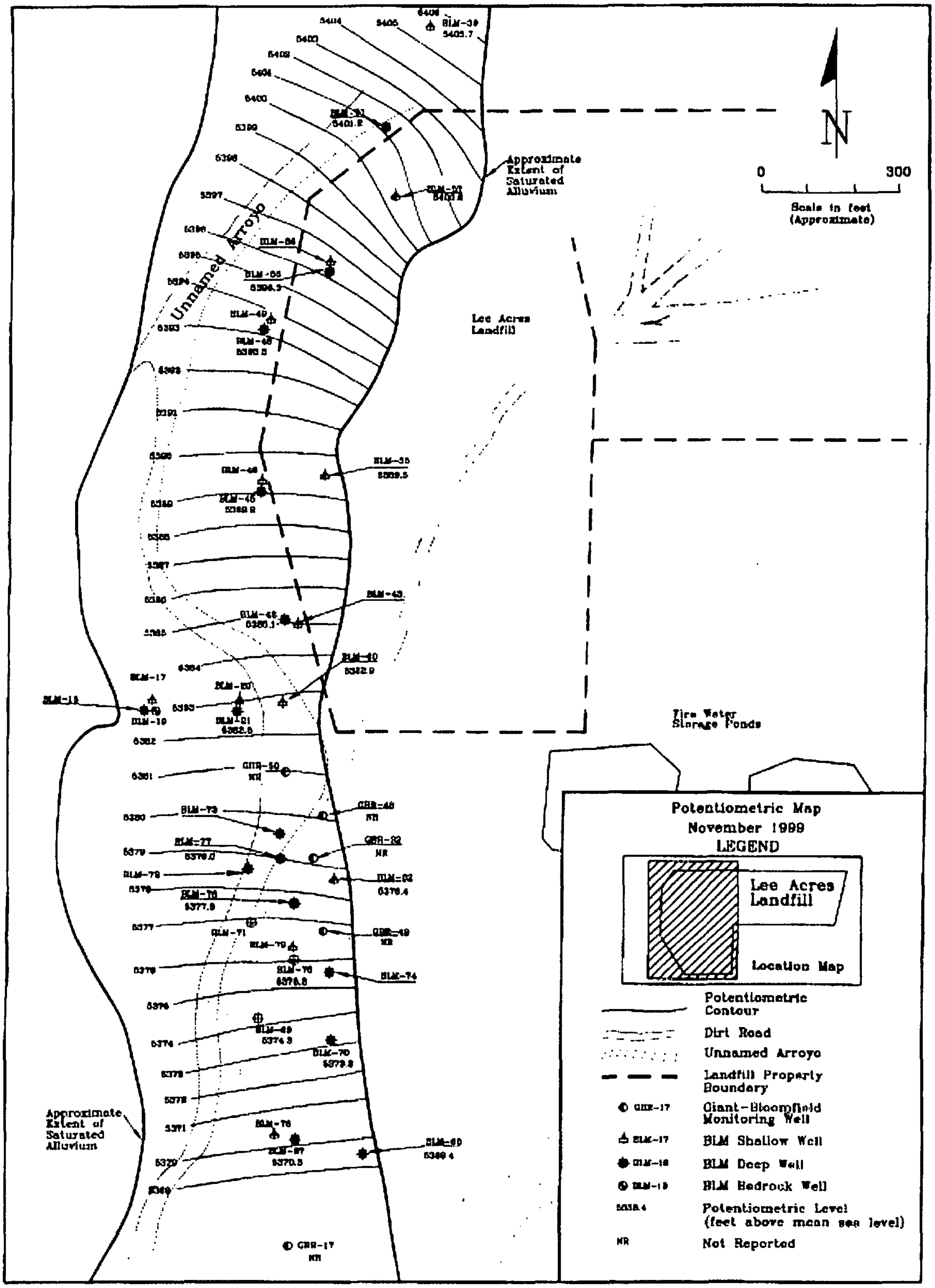

Figure 6 Saturated Alluvium Extent and Potentiometric Surface Map, November 1999

6.1 Field Investigation and Data Collection Activities

Following the lagoon treatment by NMEID in 1985, AEPCO, a BLM contractor, completed a site inspection at the landfill in 1986.

In February 1987 under agreement with BLM, the United States Geological Survey (USGS) installed 12 ground-water monitoring wells/piezometers in the adjacent arroyo. Several geophysical surveys were conducted.

In March 1987, GBR announced the implementation of ground-water remediation to remove petroleum products.

During the fall of 1988, DOI held RI scoping meetings in Farmington, Santa Fe and Albuquerque, New Mexico to initiate public involvement in the project and to begin to collect historical data.

In September 1993, field data collection for use in the RI Report was completed and USGS took over the semi-annual monitoring program at Lee Acres Landfill. This monitoring program is ongoing. The data used in the FS and PP to determine appropriate actions on the site were current through the date of the release of those documents (from 1993 through May 1996). Data collected through November 1999 are presented and discussed in this ROD.

6.2 Nature and Extent of Soil Contamination, Lee Acres Study Area

Soil samples were collected from both the vadose and saturated zones during the initial stage of the RI. Details of the soil sampling programs are found in the RI. The landfill is estimated to contain approximately 800,000 cubic yards of contaminated soil and waste. Waste types encountered within the landfill consist of common household waste and various types of construction debris. Typical types of household and industrial wastes that contain many of the chemicals listed below include paint thinners, grease and oil strippers and cleaners, pesticides, general cleaning chemicals, dry cleaning chemicals, carburetor cleaners, used oil from automotive and heavy equipment, kitchen and restaurant cleaners and grease, oil field wastes, spent copier and toner cartridges, and many other types of materials. It is probable that many of these products or their containers were placed in both lagoons, as well as other parts of the landfill during the period from 1974 through 1986.

The following methods for soil testing at the Lee Acres Landfill were used during the RI in 1993 and earlier. Samples were collected during borehole installation and from well installation. Soil samples from boreholes BH 01 through BH 39 and wells BLM 39 through BLM 66 were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides/PCBs and metals using EPA methods 8010, 8020, 8270, 8080 and TCLP. Soil samples from boreholes BH 40 through BH 53 and well bores BLM 67 through BLM 79 were analyzed for VOCs, metals, chloride, and sulfate.

Soil samples collected for the RI in 1990 identified chlorinated and non-chlorinated VOCs, SVOCs, and pesticides in the subsurface above the method detection limits (MDLs). Chlorinated VOCs, common in solvents, were found in soil samples including 1,2-*trans*-dichloroethene (1,2-*trans*-DCE), tetrachloroethane (PCE), trichloroethene (TCE), trichloromethane, dichloromethane, and other constituents in very low concentrations. During the 1990 sampling event, 1,2-*trans*-DCE was detected in one soil sample collected in the landfill and in two samples collected off-site. Other VOC contaminants detected in vadose zone soils on and south of the landfill included TCE, PCE, and petroleum, gasoline, and oil field wastes such as benzene, toluene, ethylene and xylene (BTEX) compounds. On the site, the highest concentrations of BTEX were found in the region of the former northern liquid waste lagoon and east of the northern lagoon. The majority of the VOC compounds are indicative of solvent and stripper well wastes, while the BTEX compounds are related to petroleum hydrocarbon wastes. Chlorinated VOCs were found in relatively low concentrations (<10 μg/kg) in the landfill. The highest concentration (252,600μg/kg) was found in the northern lagoon. Areas outside the lagoon, but adjacent to it ranged in concentration from 30 to 51 μg/kg.

Pesticide concentrations ranged from 5.7 μg/kg to 405 μg/kg. These sites were very localized in the borehole grid, predominantly in the southwestern portion of the landfill. SVOCs, predominantly *bis*(2-ethylhexyl)phthalate and dichlorobenzene were detected in landfill soils in concentrations at or near MDLs. The highest concentrations of SVOCs in the soils were found just inside the south landfill entrance, near the former southern liquid waste lagoon, and in the eastern 40-acre portion of the landfill. The highest concentrations of pesticides were at or near MDLs. They were located in soil samples from the eastern and southern portions of the landfill.

The soil investigations within the landfill boundary identified four areas that are either known or potential contaminant source areas. The former lagoons are considered to have acted as a source of manganese found in ground water, because manganese concentrations in ground water samples collected from beneath the former lagoons were the highest measured, and the lysimeter samples collected from beneath the former lagoons reveal remnants of past leachate migration. The southern region of the landfill has been identified as a potential source area based on analytical results from soils in the region near BH 13.

6.3 Nature and Extent of Ground Water Contamination, Lee Acres Study Area

Quaternary alluvium forms an unconfined aquifer. It is poorly to moderately sorted, fine-grained to coarse-grained sands, with some gravels and cobbles. Unconsolidated silt and clay lenses are common south of U.S. 64 , where the unnamed arroyo channel alluvium mixes with San Juan River deposits. The extent of the saturated alluvium at the site is demonstrated in Figure 6. The unconfined aquifer was defined during the RI because it is bounded on the east by bedrock and the saturated zone ends with no confining feature on the west or above the ground water. This type of configuration is, by geologic definition, an unconfined aquifer. There are no known beneficial uses of this aquifer; however, it is a potential drinking water source. Pursuant to Section 7.28 of the Rules and Regulations Governing Drilling of Wells and Appropriation and Use of Ground Water in New Mexico, the unconfined alluvial aquifer is part of the San Juan Underground Water Basin. The New Mexico Water Quality Control Commission Regulations 3101.A classify all ground water with an existing total dissolved solids concentration less than 10,000 milligrams per liter as protected.

Ground water in the unnamed arroyo alluvial aquifer flows from north to south toward the San Juan River within a paleochannel in the bedrock. South of U.S. 64, ground water is no longer contained within the incised unnamed arroyo bedrock channel where the alluvium interfingers with San Juan River terrace and flood plain deposits. In this area, ground water from the unnamed arroyo alluvium discharges and mixes with the ground water of the San Juan River Valley. Most of the domestic, municipal, and agricultural water in the San Juan Basin comes from wells completed in the Quaternary surficial valley deposits or underlying sandstones. Recharge is derived from upstream alluvial aquifer flow and infiltration from meteoric precipitation. Infiltration from the fire water storage ponds southeast of the landfill and the landfill liquid waste lagoons contributed to alluvial aquifer recharge in the past. These sources were later drained, and no longer impact the alluvial aquifer.

Horizontal gradients in the alluvial aquifer range from 0.004 feet per foot (feet/ft) to 0.014 feet/ft. The gradients are steeper in the northern portion of the study area and generally decrease toward the south, the direction of the ground water movement as shown in Figure 6.

The method for determining the background manganese concentrations was developed and agreed upon by EPA, NMED and BLM. The concentration of 346 $\mu g/l$ manganese was determined by averaging data collected during the RI from three wells located up-gradient of the landfill that were determined to be unaffected by activities at the landfill.

Manganese above the background concentration forms a plume in the alluvial aquifer extending from beneath the Lee Acres Landfill to the south. Figure 7 shows the extent of the manganese plume as of May 1994. Figure 8 shows the extent of the manganese plume as of November 1999. The highest concentrations of manganese are found in BLM-57, located beneath the northern liquid waste disposal lagoon, with an initial concentration in 1990 of 7880 $\mu g/l$, and 7100 $\mu g/l$ in November 1999.

In BLM-55, located beneath the southern lagoon, the initial concentration in 1990 was 3560 $\mu g/l$ and was reported as below detection limits in November of 1999. Also in November 1999, the alluvial aquifer manganese concentrations measured in 9 of the 13 wells sampled south of the landfill were below the average background concentration of 346 $\mu g/l$ (Figure 8). The total volume of the manganese plume was approximately 5.3 million gallons. The manganese in the ground water is attributed to either past disposal of liquid in the former liquid waste lagoons or the interaction between the native soils and reducing agents in the lagoons. Since the cessation of activity in the landfill, the migration of the manganese plume appears to have halted. Figures 7 through 10 demonstrate the halting of plume migration, as well as declining concentrations over time.

Nickel is also identified as a contaminant of concern (COC) based on New Mexico Water Quality Control Commission (NMWQCC) criteria. Currently, there is no Federal MCLG or MCL for nickel. In February 1995, EPA remanded the MCLG and MCL for nickel, and has not identified a new value. The State of New Mexico's promulgated standard of 200 μg/L is the clean-up level for the Lee Acres Landfill. With the exception of GBR-48, nickel concentrations have been and continue to be below the ARAR of 200 μg/l (Figure 9).

Figure 7, based on May 1994 data, shows that the VOC plume concentrations detected beneath the landfill are below ARARs but were above ARARs in the portion of the plume south of the landfill and west of the firewater ponds. Since May 1994, the 1,2-*cis*-DCE levels have decreased and are equal to or less than the MCL for 1,2-*cis*-DCE, (i.e., 70 μg/l). For example GBR 49 has gone from 90 μg/l to 19 μg /l in November 1999. The highest 1,2-*cis*-DCE concentration in November 1999 was 19 μg/l, in well GBR 49.

As shown in Figure 7, the highest concentrations of VOCs are found centered in the area around wells GBR 32, GBR-48 and BLM 68. The VOC plume, consisting mainly of 1,2-DCE, is about 300-feet long and 60-feet wide. In 1999, the estimated volume of VOC contaminated ground water was 600,000 gallons. The 1,2-DCE concentration in this plume ranges from below Method Detection Limit (MDL) up to 19 μg/l as of November 1999. PCE and TCE also exist within the VOC plume, with concentrations ranging from below MDL to 7.9 μg/l (PCE) and below MDL to 3.5 μg/l (TCE). Figures 10 through 12 show 1,2-DCE, TCE, and PCE aerial distribution in the aquifer. Figures 13 through 15 show concentration trends versus time for three representative wells (GBR-48, GBR-32, and BLM-68) in the chlorinated VOC plume. Overall, the chlorinated VOCs in these wells all show generally stable or declining concentrations for each constituent over time. As of November 1999, only two ground-water samples collected from monitoring wells at the site contained VOC concentrations greater than the associated clean-up levels listed in Table 2. The concentration of PCE measured in a water sample collected from well BLM-68 was 5.3 μg/l and the clean-up level is 5.0 μg/l. The concentration of vinyl chloride measured in a sample collected from well BLM-57 contained 2.6 μg/l and the associated clean-up level is 1.0 μg/l.

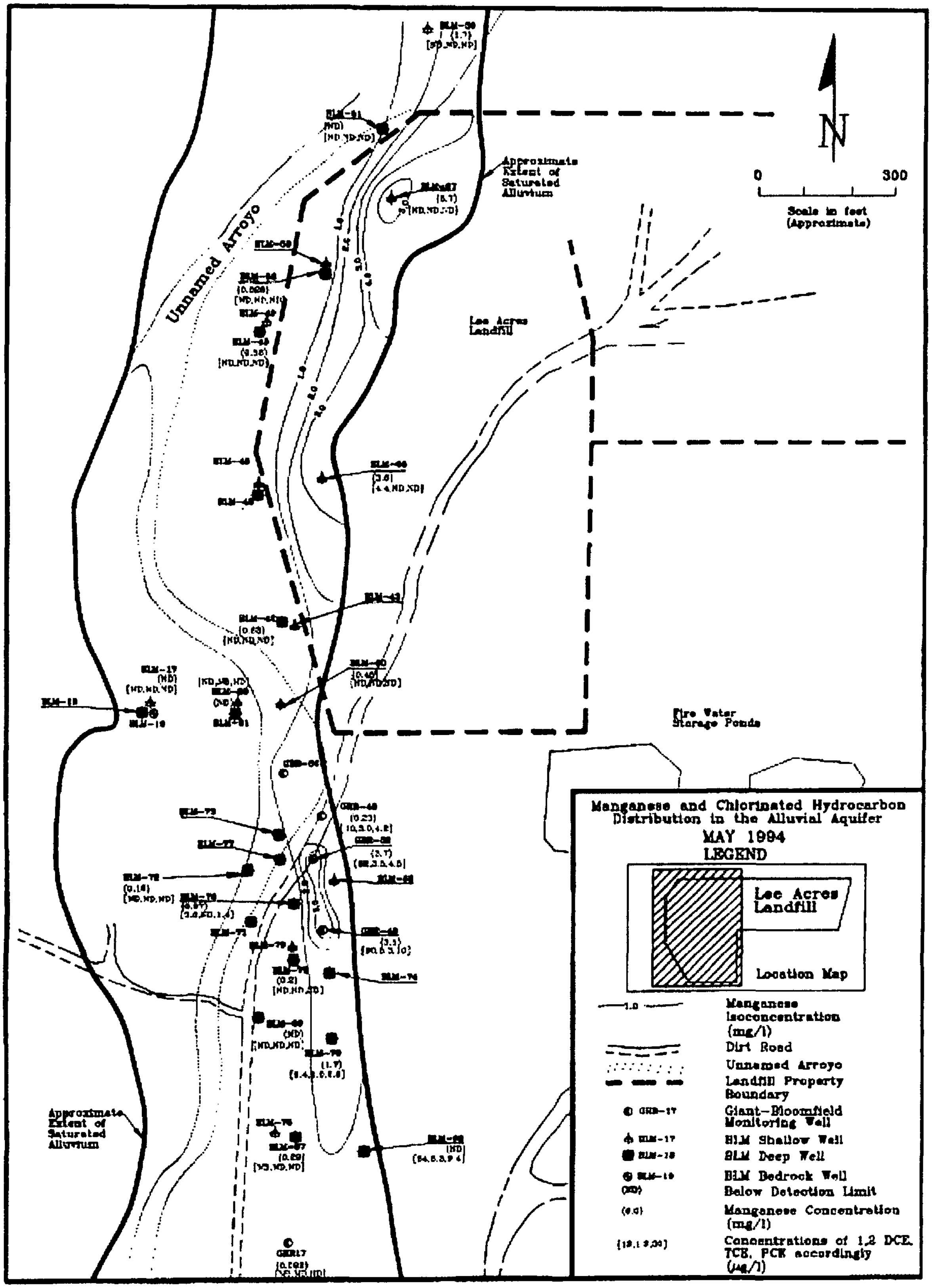

Figure 7 Multi-contaminant Map, May 1994

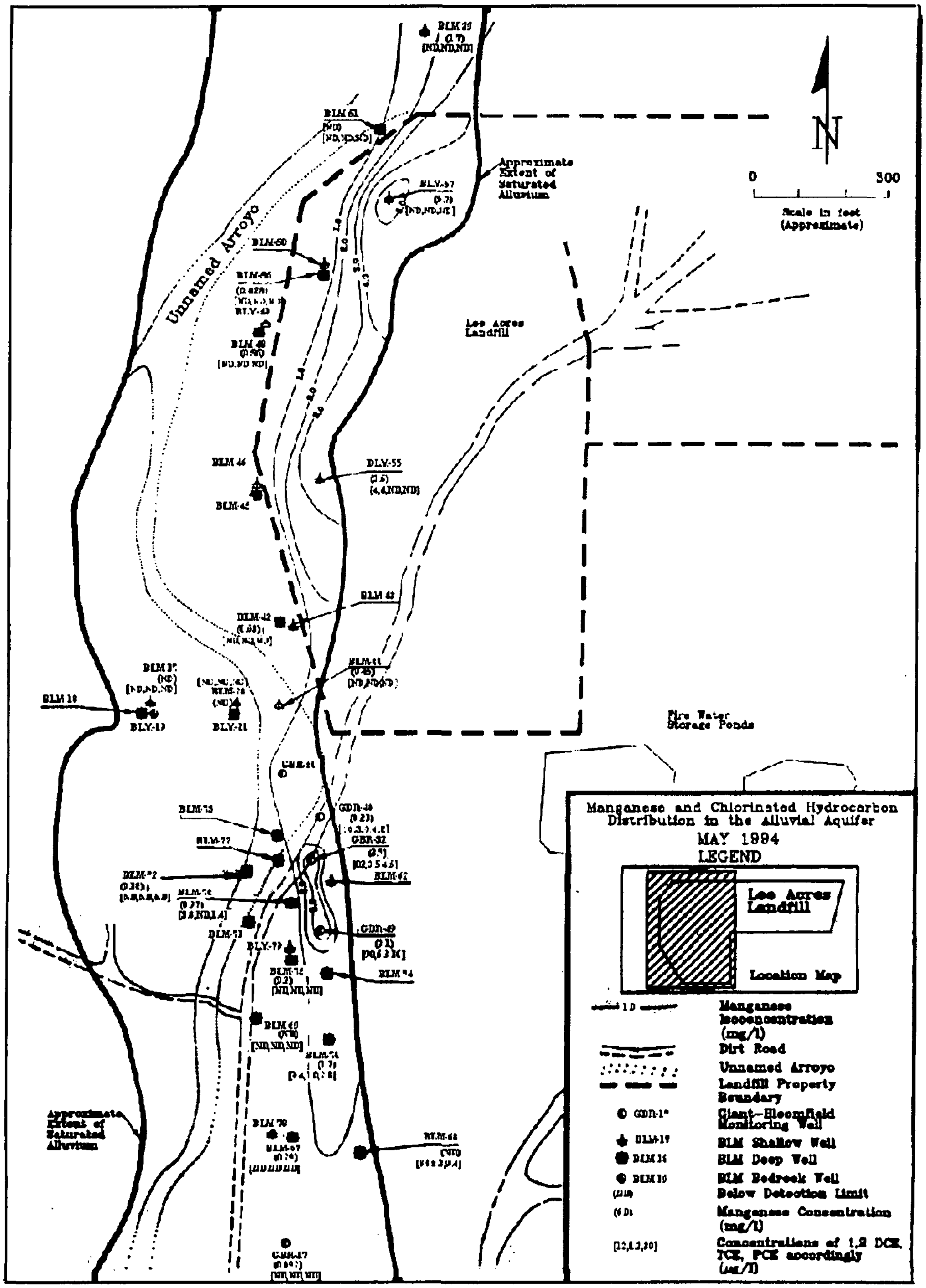

Figure 8 Manganese Distribution Map - November 1999

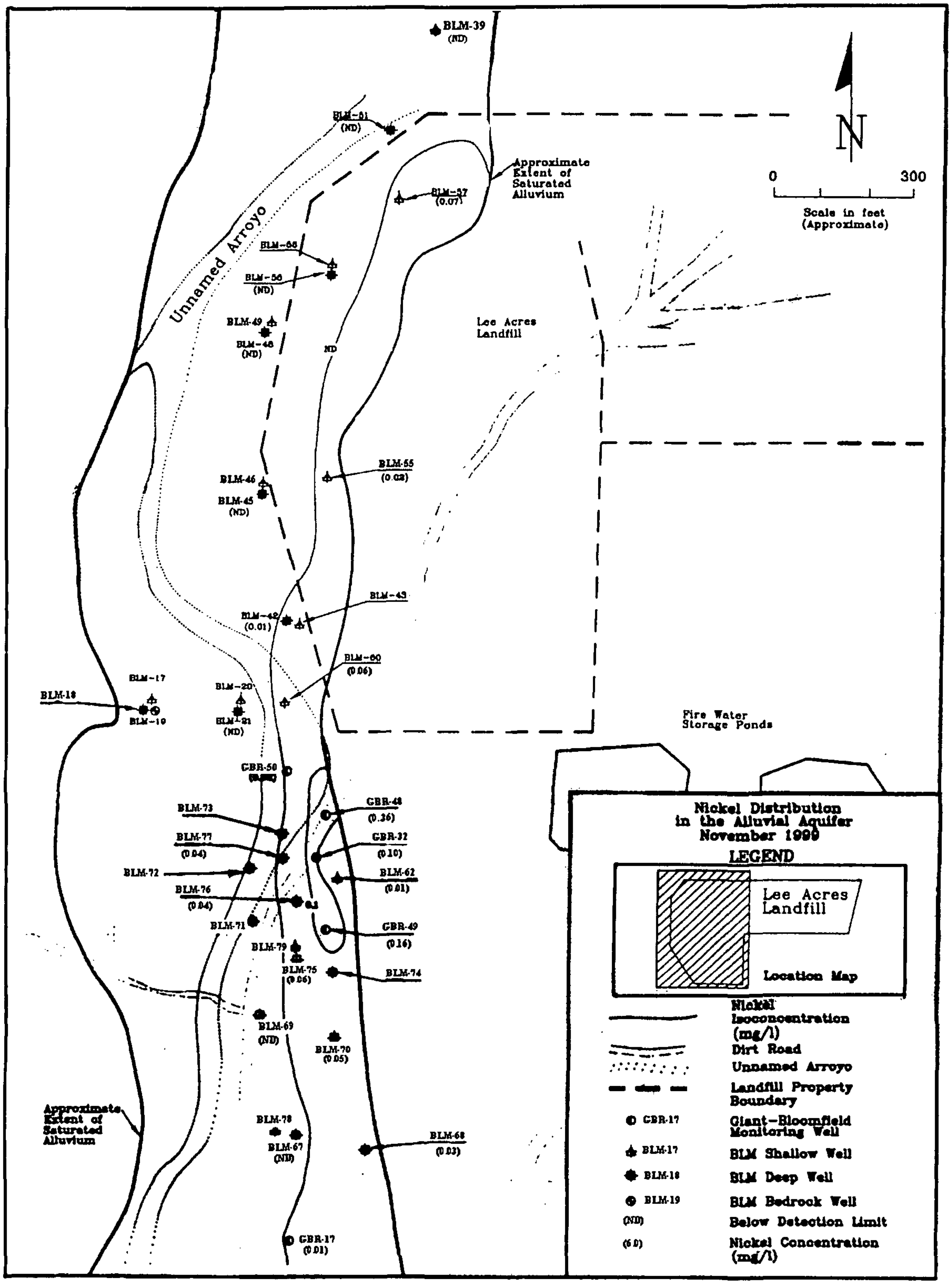

Figure 9 Nickel Distribution Map - November 1999

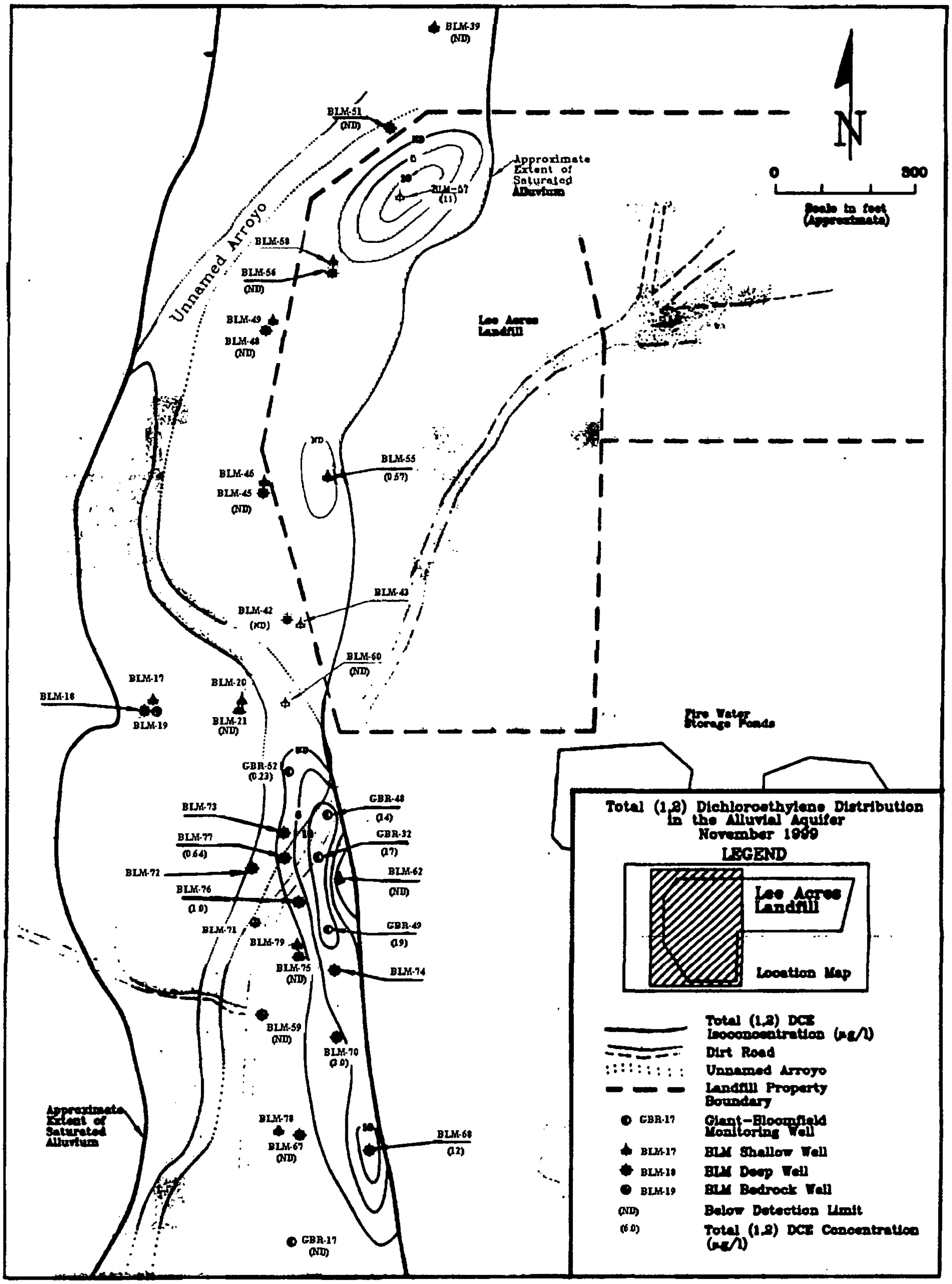

Figure 10 1,2-DCE Distribution Map - November 1999

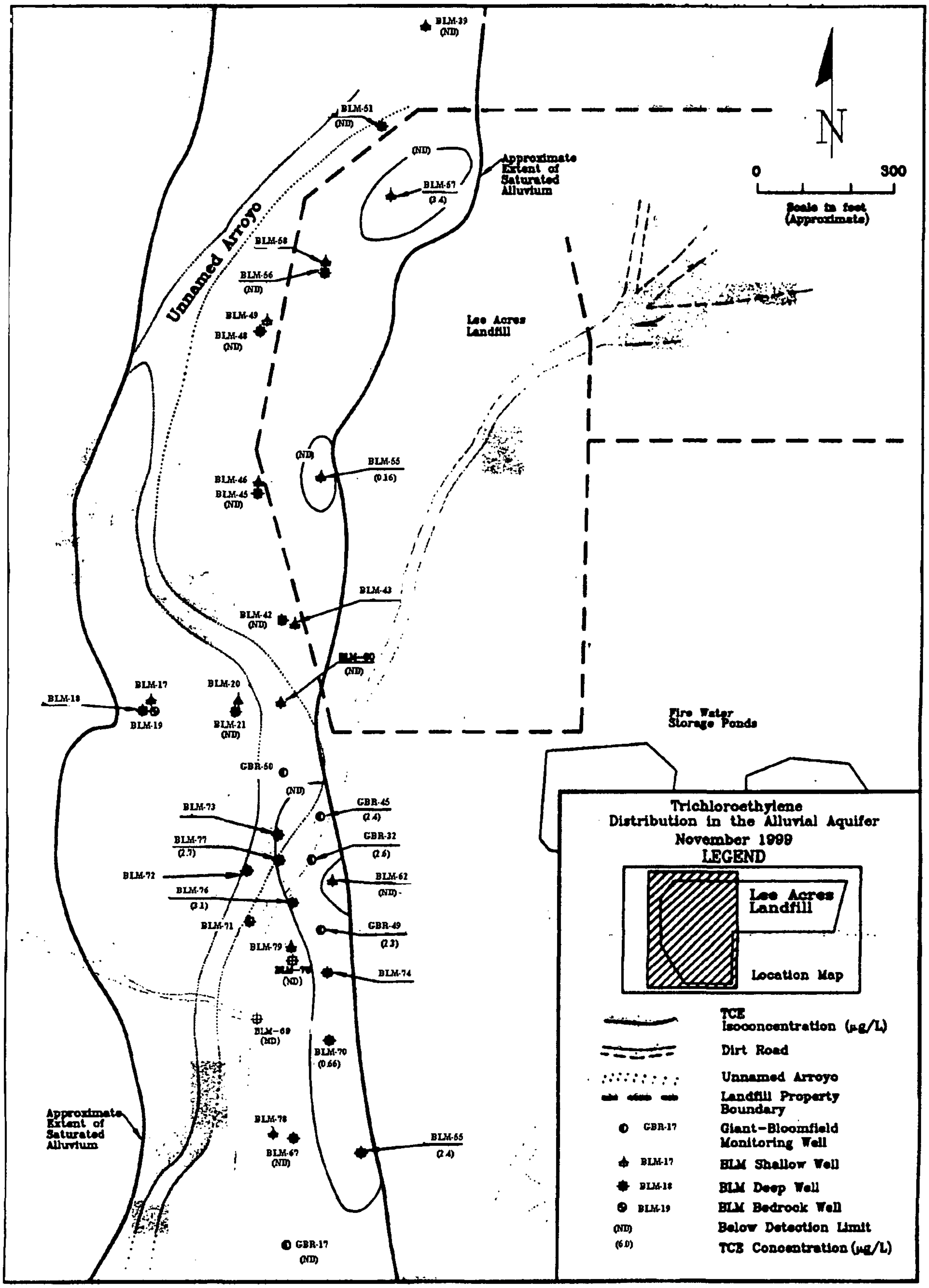

Figure 11 TCE Distribution Map - November 1999

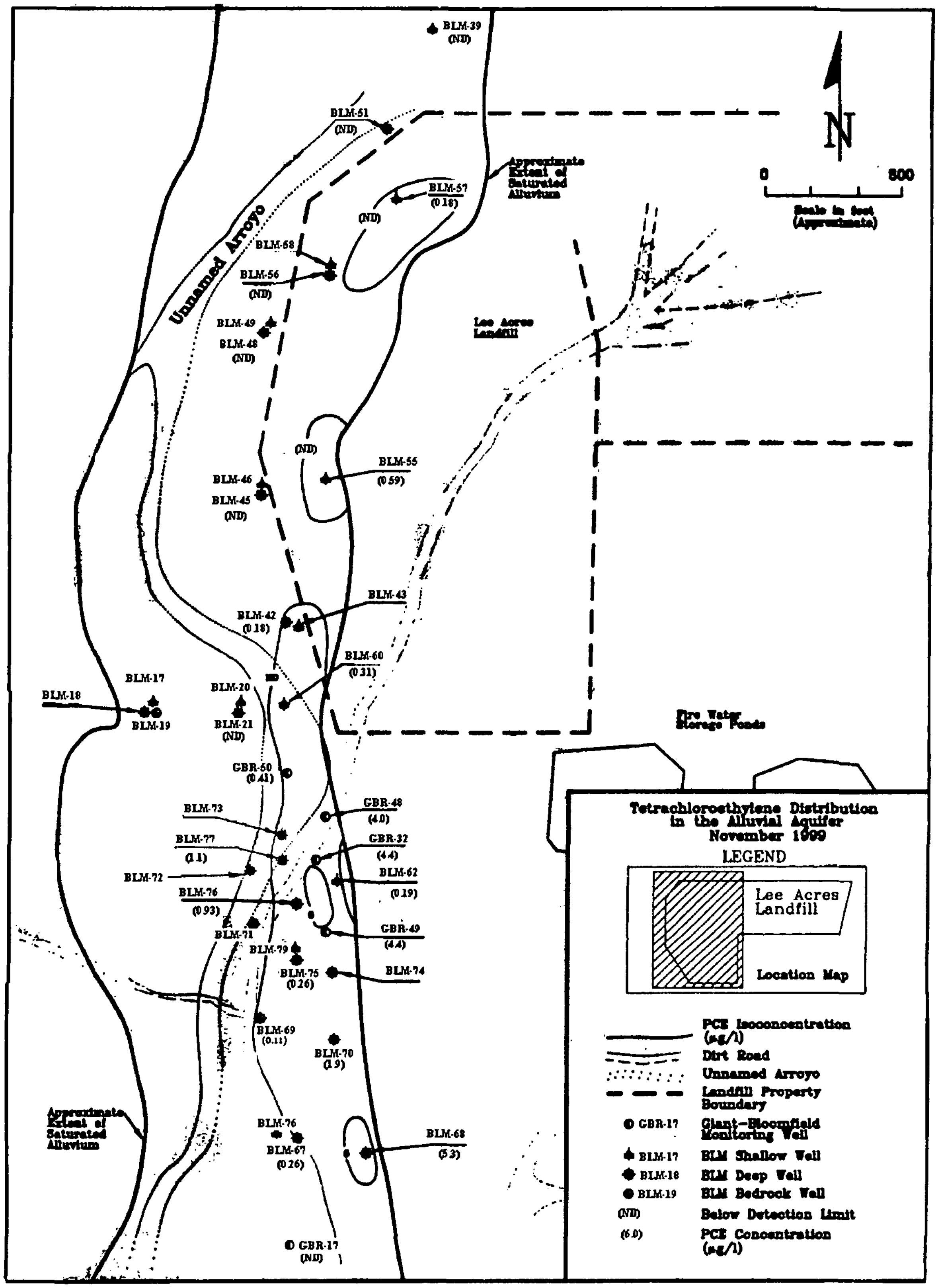

Figure 12 PCE Distribution Map - November 1999

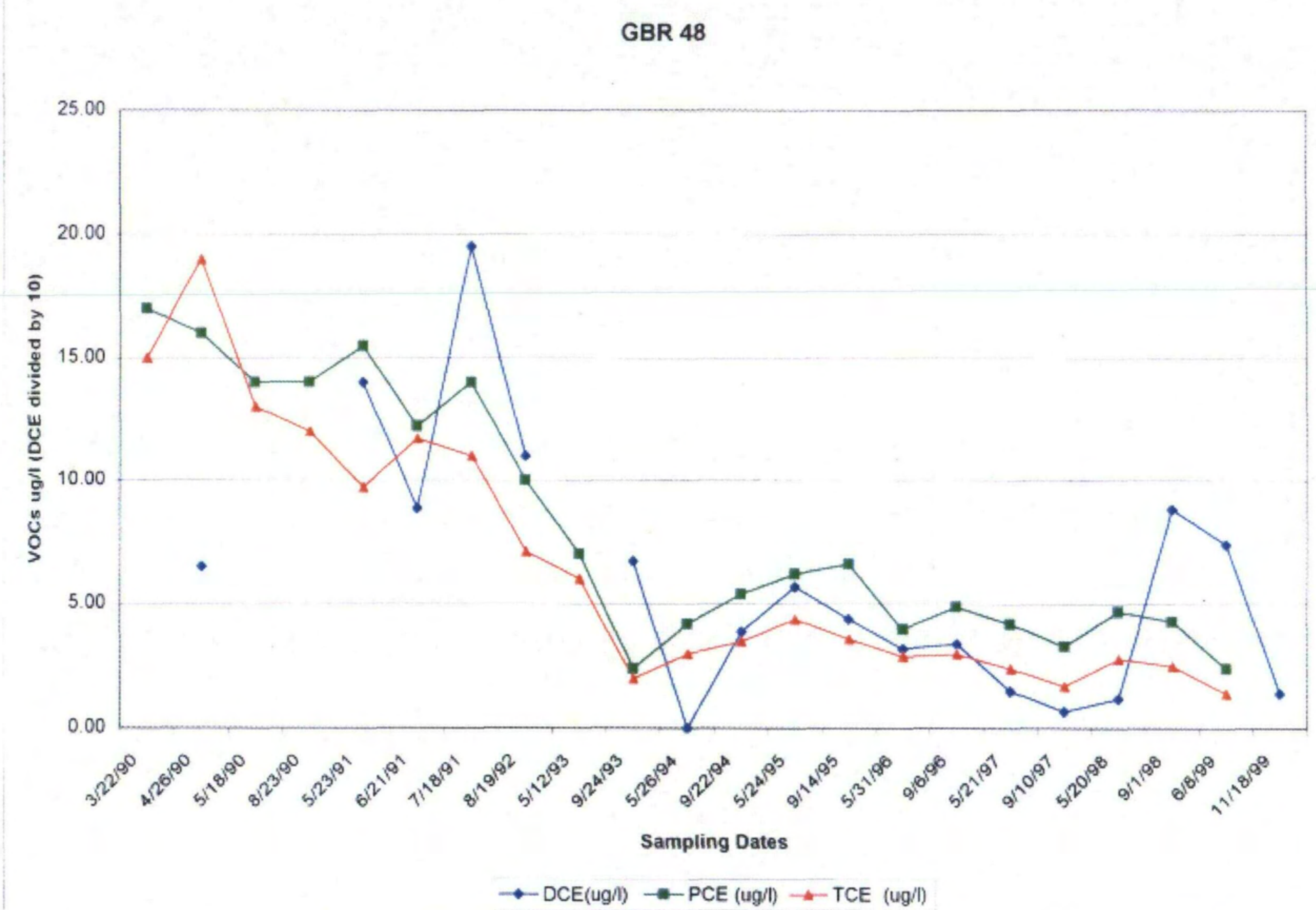

Figure 13 1,2-DCE, PCE and TCE Concentrations vs. Time, GBR-48

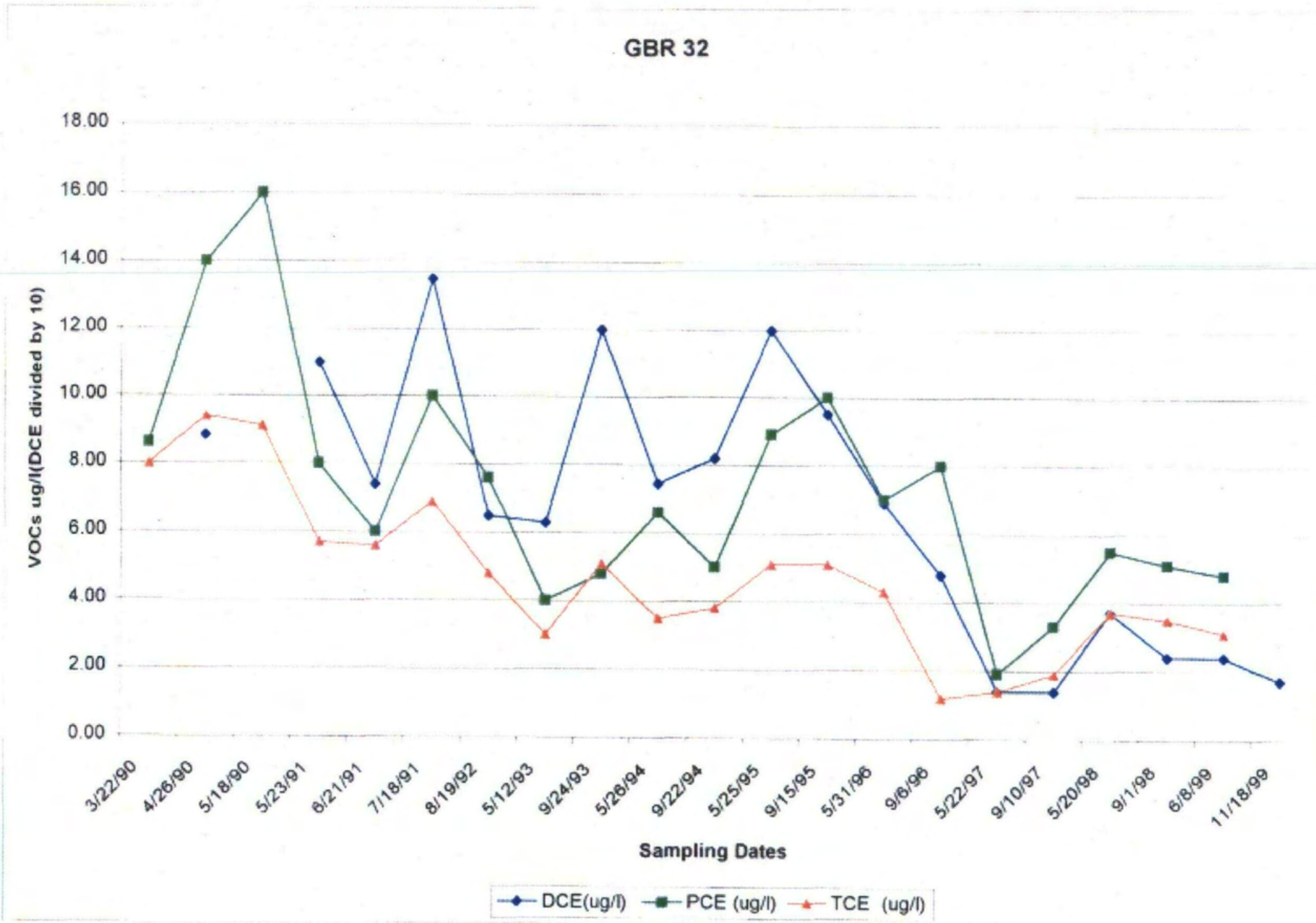

Figure 14 1,2-DCE, PCE and TCE Concentrations vs. Time, GBR-32

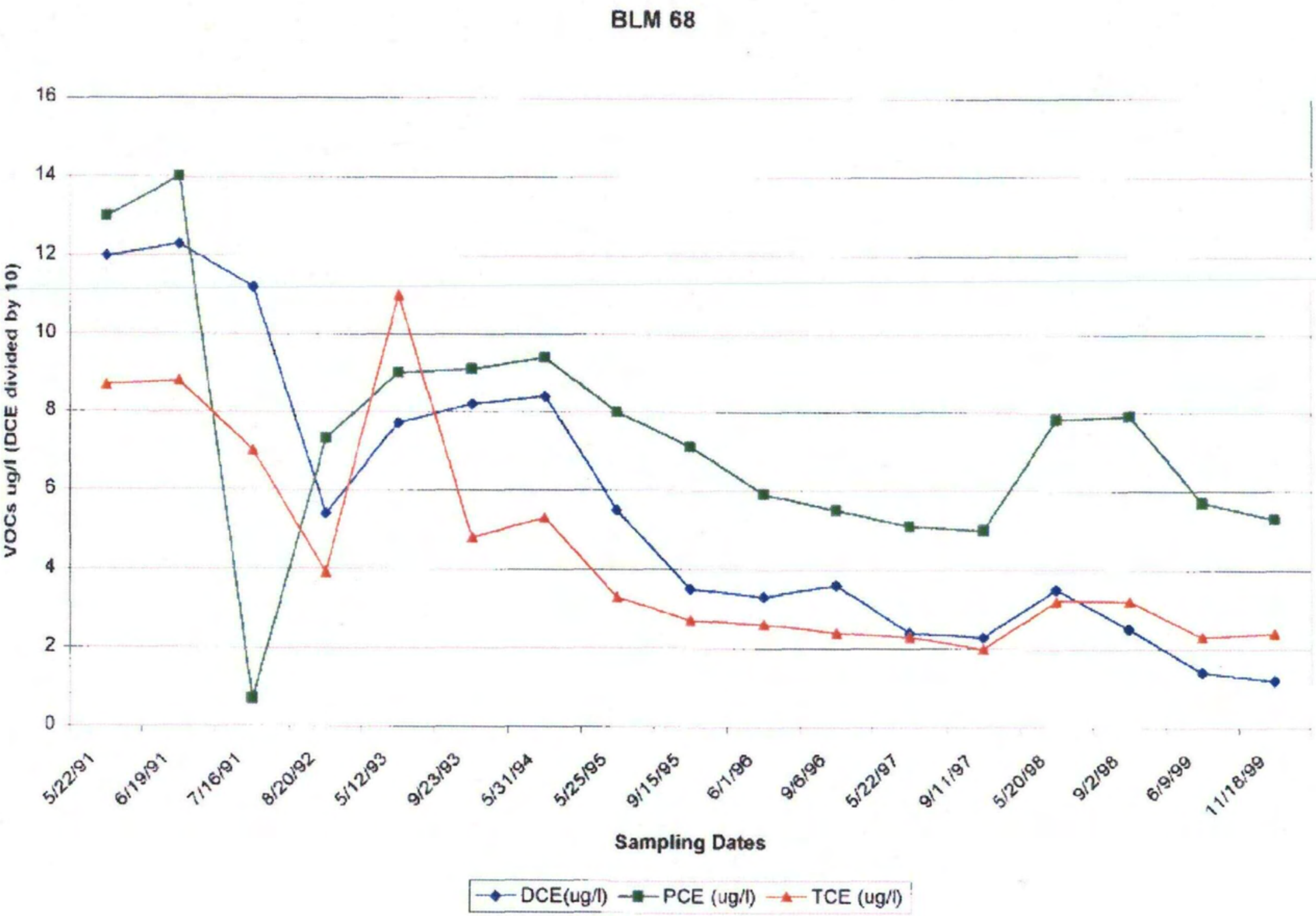

Figure 15 1,2-DCE, PCE and TCE Concentrations vs. Time, BLM 68

7.0 SUMMARY OF SITE RISKS

7.1 Human Health Risk Assessment Summary

The human health and ecological risk assessments were completed in September 1994. The Contaminants of Potential Concern (COPCs) are defined as those chemicals present within the former Lee Acres Landfill resulting from past activities, and include only those chemicals above reportable limits or at concentrations above naturally occurring levels that have been determined not to be sampling or laboratory artifacts. (Weston RIR 1995).

The Contaminants of Concern (COCs) are a subset of the COPCs, and were derived from the COPCs. COCs include contaminants contributing to the risk, and contaminants that exceed State or Federal ARARs. Clean-up levels for the COCs are listed in Table 2.

Manganese was found to be the only non-carcinogenic COC with a Hazard Index (HI) exceeding the EPA non-carcinogenic target of 1. On-site resident drinking water ingestion was the only ingestion pathway evaluated because preliminary findings showed that risk scenario to be an order of magnitude higher than any others during the preliminary risk assessment.

The risk assessment was for a child living on the site, weighing 16 kg for 6 years (350 days per year) drinking 1 liter per day of water containing 6,340 μg/l Manganese. The child would have to be living this scenario for 2,190 days before any toxic effects would occur. Toxic effects of manganese include: delusions, hallucinations, insomnia, depression and some symptoms of Parkinson's Disease.

No landfill gases were recorded during the RI, and therefore are not included in the risk assessment.

The primary pathways of concern at the Lee Acres Landfill are:

- potential future leaching of contaminants through the vadose zone to the alluvial aquifer; and
- ingestion of manganese and VOC-contaminated ground water.

The RI eliminates ingestion, inhalation, and contact with contaminated soil or waste within the former landfill as a pathway of concern because the fill material is covered with an average of 4.5-feet of clean soil. Information collected during the RI also indicated that liquid in the former liquid waste lagoons created a hydraulic head and provided the moisture needed to push the contaminated liquid downward and forced the leachate of the lagoon contaminants into the alluvial ground-water aquifer. The landfill and adjoining public lands have been withdrawn by the BLM (Federal Register, December 9, 1995), and the lagoons will never be re-activated. Also, the lagoons were drained and covered with clean soil in 1986. These actions have impacted the leachate pathway and mitigated much of the possibility of future contamination from the lagoon sediments due to leaching.

Ground-water data obtained between August 1992 and September 1993 were used in the development of the contaminants of potential concern (COPCs). COPCs were developed with two methods: 1) frequency of detection analysis; and 2) statistical comparison of data to study area background data the Shapiro-Wilks "goodness-of-fit" test, D'Agostino's "goodness-of-fit" test, and the Coefficient-of-Variation Test.

The following are the COPCs identified in the human health risk assessment:

1,1,1-trichloroethane (1,1,1-TCA)
1,1-dichloroethane (1,1-DCA)
1,1-dichloroethene (1,1-DCE)
1,2-*trans*-dichloroethene (1,2-*trans*-DCE)
1,2-*cis*-dichloroethene (1,2-*cis*-DCE)
carbon disulfide,
dichloromethane
tetrachloroethene (PCE)
trichloroethene (TCE)
vinyl chloride (VC)

chloride

cobalt

manganese

molybdenum

nickel

Although chloride is identified as a COPC, it is not a CERCLA hazardous substance and has no toxicity factors. Therefore, the risks associated with chloride in the alluvial aquifer were not quantitatively assessed.

The COCs are those contaminants contributing to the risk, which are listed in Table 2 with clean-up levels identified. The COCs for the Lee Acres Landfill are:

manganese;

nickel;

1,2-*cis*-dichoroethene (1,2-*cis*-DCE);

1,2-*trans*-dichloroethene (1,2-*trans*-DCE);

tetrachloroethylene (PCE);

trichloroethylene (TCE), and

vinyl chloride.

For purposes of consideration, the human health risk calculation is based on the scenario of a hypothetical on-site resident. This assumption was used to assess the potential exposures to materials containing COCs. Exposure pathways considered included inhalation and dermal exposure, as well as ingestion. Inhalation and dermal exposure pathways were discounted because the landfill has been covered with clean soil. The scenario for ingestion used was that of an on-site resident who uses the ground water from the most highly contaminated well within the landfill as the primary drinking water supply. This scenario provides the worst case human health exposure potential. The carcinogenic health risk calculation is less that one in 100,000. This places the carcinogenic risk factor within the NMED and EPA acceptable risk ranges. The actual carcinogenic risk is much lower and is not further considered.

Manganese contamination in the alluvial aquifer poses the most significant non-carcinogenic risk with Hazard Index values (HI) ranging from 20 to 40 based on ground-water concentrations in wells beneath the landfill cells. An HI ranking of greater than one (1) indicates that there is the potential for non-carcinogenic health effects from exposure. Exposure to manganese contamination in ground water may result in adverse health effects, including delusions, hallucinations, insomnia, depression, and some symptoms of Parkinson's Disease.

7.2 Ecological Risk Assessment Summary

The study area addressed by the ecological risk assessment is somewhat unique because the waste cells and lagoons associated with landfilling and disposal activities have been covered by an average of 4.5 ft of clean material. Consequently, a majority of the chemicals detected in the RI are associated with deep subsurface soil and ground water and do not pose a risk to biological receptors either incidentally or routinely inhabiting the former Lee Acres Landfill.

By virtue of their presence in the upper 5 ft of soil (before it was covered with 4.5 ft of clean soil) and their relative hazard, dieldrin and DDT were identified as COPCs. The effects of both occur most strongly at upper trophic levels through alteration of biochemical pathways and impairment of reproductive potential. Most common effects in mammals such as mice, vole and rats, are hyperactivity and increased liver mass. In birds, thinning of the egg shell walls impairs reproductivity.

The estimated exposure dosages were compared to the toxicological endpoint dosages for dieldrin and DDT as well as for a simultaneous exposure to both chemicals. The results suggest that there is no risk to biological indicators associated with the former Lee Acres Landfill and additional concern is not warranted.

A screening-level ecological risk assessment was conducted to evaluate the potential threat to the environment posed by existing levels of contamination in soil at the Lee Acres Landfill. The risk characterization is an integration of the exposure and toxicity assessment results. Relative toxicity of individual COPCs and cumulative toxicity were determined. Ecological receptors were identified and an uncertainty analysis performed.

Data indicated that there was no ecological risk to the flora in the vicinity of the Lee Acres Landfill. The San Juan River is located 1.5 miles south of the site, and its fauna and flora were not impacted.

Dieldrin and DDT were identified through the selection process outlined in the RI Section 9.2. (Weston 1995). The risk assessment focused on the movement of COPCs detected in the upper soil layers through a food chain consisting of:

- vegetation, exposure from soil;
- soil macro invertebrates, exposure from soil;
- kangaroo rat, exposure from ingestion of vegetation and invertebrates; and
- red-tailed hawk, exposure from ingestion of small mammals.

Results of the exposure assessment suggest that very low concentrations of dieldrin and DDT are accumulated by receptors. The toxicity assessment identified numerous laboratory studies that exposed mice, rats and various avian species to dieldrin and DDT. The estimated exposure concentrations were compared to the toxicological endpoint concentrations for dieldrin and DDT, as well as for a simultaneous exposure to both chemicals. The results suggest that adverse effects for biological receptors associated with the landfill are unlikely.

8.0 REMEDIAL ACTION OBJECTIVES (RAOs)

8.1 Development of Remedial Action Objectives for the Soil Pathway

At present, the landfill site contains heterogeneous solid waste and variably contaminated soils. The liquid waste lagoons have been abandoned and covered with soil. Contaminants and their concentrations were described earlier in this ROD.

The RAOs for the potential soil pathway are:

> -Reduce or eliminate the potential for future leaching of contaminants from the landfill to ground water by preventing moisture infiltration.

-Reduce or eliminate the potential for future direct exposure to contaminated soil and waste.

-Reduce or eliminate the potential for future migration of contaminants through storm water run-off or erosion.

The potential migration and exposure pathways from the landfill soil source areas include the production of leachate, human or ecological direct contact exposure, and migration of soil contaminants through storm water run-off or erosion. However, none of these pathways is currently contributing contamination. The potential for direct exposure to contaminated soil was dismissed in the RI because waste cells and landfill trenches are covered with an average of 4.5 feet of clean soil, the landfill would not be able to sustain a house or industrial structure because of the uneven settling that is characteristic of landfills (Davis and Cornwell 1991), and the post-closure care of landfills does not permit disturbance of the soil cap (40 CFR 258 Subpart D). Furthermore, BLM has withdrawn the Lee Acres Landfill from public use to ensure that the site will never be sold, leased, or used for public purposes for a minimum of 50 years, and to restrict access to contaminated ground water.

The possible activation of the leaching pathway is a potential threat at the Lee Acres Landfill. The leachate would result primarily from infiltration of meteoric water from the former liquid waste disposal lagoons or contaminated subsurface soils. The lagoon sediments, which are contaminated with BTEX compounds, present the highest potential for leachate production at the site. Therefore, elimination or reduction of the potential leachate pathway is considered as an RAO.

The possible leaching of contaminants from the landfill soils will be resolved by placing a cap over the western portion of the landfill. The selected capping alternative has been tested and demonstrated to be effective through a pilot project, directed by Sandia National Laboratory, DOE, and BLM, which lasted two years. The pilot project involved development and testing of an arid climate-specific capillary barrier on a portion of the landfill. The success of the pilot project was determined by no infiltration of surface water through the lowest layer in the cap and thus the trash layer of the landfill. Based on the final pilot project report results, the capillary barrier cap will be expanded to include the balance of the western portion of the landfill. If the installed capillary barrier does not continue to perform as expected, an evaluation will be performed to determine the cause, and appropriate corrective actions will be taken, if needed. As previously stated, the RAOs are designed to prevent exposure to landfill soils, to prevent leachate production, and to contain/remediate contaminated ground water.

8.2 Development of Remedial Action Objectives for the Ground Water Pathway

Infiltration of meteoric water into the subsurface has caused movement of some contaminants into the ground-water system. Although there is no current domestic ground-water use downgradient from the landfill or upgradient of the refinery, installation of new domestic/industrial ground-water wells in the future could result in unacceptable risk due to manganese exposure.

The RAOs for ground water are:

- Elimination or significant reduction of the risk posed by elevated manganese levels in ground water by eliminating access to the ground water.

- Reduction of levels of manganese, nickel, 1,2-DCE, PCE, TCE, and VC to comply with ARARs.

Table 2 presents the clean-up levels for the COCs which were detected with concentration levels in excess of acceptable risk levels or ARARs, and which also exceeded site background concentrations within alluvial ground-water wells. The ARARs presented in Table 3 consist of maximum contaminant levels (MCLs) set by the Federal Safe Drinking Water Act (SDWA) and the ground-water standards listed in the NMWQCC Regulations.

For most of the COCs (1,2-DCE, PCE, and TCE), the chemical-specific ARARs, which are the Federal SDWA MCLs, are the clean-up levels for the alluvial aquifer. For nickel, the clean-up level is the New Mexico Water Quality Control Commission (NMWQCC) standard. For manganese, the elevated background level of manganese indicates that ground water at the landfill is unsuitable for drinking water. As a consequence, the federal MCL for manganese is neither relevant nor appropriate for purposes of establishing cleanup levels at the landfill. New Mexico Water Quality Control Commission (NMWQCC) Regulations, section 4101 (B), provide that if background levels of any water contaminant exceed state standards established pursuant to section 4103 of the NMWQCC Regulations, then cleanup standards for such pollution shall be the background concentration. Accordingly, the clean-up level for manganese contamination in the ground water at the site is the state ARAR, or the background concentration, which is 346μg/L. This background concentration was determined by averaging data collected in three background wells, BLM 14, 15 and BLM 39 during the RI. The clean-up level for vinyl chloride (1 μg/L) is based on NMWQCC Section 4101(B) standards. This clean-up level is more stringent than the Federal MCL of 2μg/L, and so is the ARAR since it is a more stringent promulgated standard.

The remedial action objectives for the Lee Acres Landfill are to prevent further contamination of ground water from leaching of contaminants that may exist in the landfill soils, and to eliminate all possibility of human and ecological exposure to contaminated soils and ground water emanating from the landfill while utilizing the most cost-effective remedial technologies available.

To prevent human exposure to contaminated soils and ground water, BLM has withdrawn 134.68 acres of public land, within which the landfill is located, from settlement, sale, location, and entry, as described in Public Land Order No. 7234 (62 Fed. Reg. 2177, January 15, 1997). As a result of this withdrawal, ground water beneath the landfill will not be used as a drinking water source for the 50 year duration of the withdrawal. In the event that potential exposure to hazardous substances in such ground water poses an unacceptable risk to human health at the end of this period, BLM may extend the withdrawal, take other necessary steps, or fulfill all requirements of section 120(h) of CERCLA, as appropriate, to ensure that public health and the environment is protected from contaminated soils and ground water at and beneath the landfill.

Table 2 Remedial Goals (Clean-up Levels)

Constituent	Site Historic Maximum Concentration (µg/L)	Risk-Based Preliminary Remediation Goal (µg/L)	SDWA MCL (µg/L)	NMWQCC Standards (µg/L)	Site Background Mean[a] (µg/L)	Cleanup Levels (µg/L)
Manganese	6,335	176	50[b]	200[c]	346	346[d]
Nickel	578[e]	NA	NA	200[f]	7.75	200
1,2-*cis*-Dichloroethene	77	NA	70	per part 101z.z[g]	NA	70
1,2-*trans*-Dichloroethene	120	NA	100	per part 101z.z[g]	NA	100
Tetrachloroethylene (PCE)	10	NA	5	20	NA	5
Trichloroethylene (TCE)	11	NA	5	100	NA	5
Vinyl Chloride	3.1	NA	2	1	NA	1

a Mean concentration value of upgradient area located north of the former Lee Acres Landfill
b Secondary Maximum Contaminant Level (SMCL)
c Standard for domestic supply.
d NMWQCC regulation Part 3-101.2 does not require cleanup level below site background level.
e Highest value of 12,500 µg/L occurred during the May 1993 sampling period and was determined to be a statistical anomaly for the purposes of this table, the next highest value is specified.
f Standard for irrigation use.
g No NMWQCC specific to 1,2-DCE exists, therefore Part 101.z.z. is referenced for State ARAR
NA - not applicable.
NOTE: Dichloromethene was detected once in 95 samples at a concentration level of 27 µg/L; however, this concentration was considered a statistical anomaly and is not presented

Table 3 State Applicable or Relevant and Appropriate Requirements (ARARs)

State Chemical-Specific ARARs for Lee Acres Landfill Groundwater Contaminants of Potential Concern

Chemical	Citation	Requirement	Maximum Concentration Detected (µg/L)	Status	Comments
METALS					
Manganese	NMAC 20.6.2.4101(b)	Water quality standard = background Below 1 x 10^{-5} risk	6,335	ARAR	Average background concentration for manganese (346 µg/L) is the ARAR
Nickel	NMAC 20.6.2.4103(b)	Water quality standard = 200 µg/L Below 1 x 10^{-5} risk	12,500	ARAR	12,500 µg/L was one time occurrence and was determined to be a statistical anomaly. Next highest value is 578 µg/L.
ORGANICS					
1,2-*cis*-Dichloroethylene 1,2-*cis* DCE	NMAC 20.6.2.4103(b)	Below 1 x 10^{-5} risk	77	ARAR	New Mexico has established health-based numerical groundwater standard applicable to all water containing less than 10,000 mg/L total dissolved solids which apply to all groundwater, whether used for domestic, commercial, or agricultural purposes. Groundwater of quality better than the standards is allowed to deteriorate to the standards. Groundwater of worse quality than the standards may not be degraded further.
1,2-*trans*-Dichloroethylene 1,2-*trans* DCE	NMAC 20.6.2.4103(b)	Below 1 x 10^{-5} risk	120	ARAR	
Tetrachloroethylene (PCE)	NMAC 20.6.2.4103(b)	Water quality standard = 20 µg/L Below 1 x 10^{-5} risk	10	ARAR	
Trichloroethylene (TCE)	NMAC 20.6.2.4103(b)	Water quality standard = 100 µg/L Below 1 x 10^{-5} risk	11	ARAR	
Vinyl Chloride (VC)	NMAC 20.6.2.4103(b)	Water quality standard = 1 µg/L Below 1 x 10^{-5} risk	3.1	ARAR	

Table 3a Federal Applicable or Relevant and Appropriate Requirements (ARARs)

Federal Chemical Specific ARARs for Lee Acres Landfill Groundwater Contaminants of Potential Concern

Chemical	Citation	Requirement	Maximum Concentration Detected (µg/L)	Status	Comments
METALS					
Nickel		NONE	12,500	ARAR	12,500 (µg/L) was one time occurrence, and was determined to be a statistical anomaly. Next highest value is 578 µg/L
ORGANICS					
1,2-*cis*-Dichloroethylene 1,2-*cis* DCE	SDWA	Water quality standard = 70 µg/L	77	ARAR	Groundwater remedial actions will need to ensure that drinking water quality water supplies do not exceed ARAR concentrations
1,2-*trans*-Dichloroethylene 1,2-*trans* DCE	SDWA	Water quality standard = 100 µg/L	120	ARAR	
Tetrachloroethylene (PCE)	SDWA	Water quality standard = 5 µg/L	10	ARAR	
Trichloroethylene (TCE)	SDWA	Water quality standard = 5 µg/L Below 1 x 10^{-5}	11	ARAR	
Vinyl Chloride (VC)	SDWA	Water quality standard = 2 µg/L	3.1	ARAR	

ARAR - applicable or relevant and appropriate requirements

µg/L - micrograms per Liter

SDWA - Safe Drinking Water Act

9.0 DISCUSSION OF EVALUATED ALTERNATIVES AND BALANCING CRITERIA

After an initial screening of 34 different soil remedial options and 50 ground-water options, five soil and five ground-water technologies and process options were evaluated in greater detail with respect to effectiveness, implementability and approximate cost. The technologies and process options were then combined into remedial alternatives.

These alternatives were screened against the two threshold criteria and five balancing criteria identified in CERCLA. The final remedies selected for the ground-water and soil pathways are Alternatives S-5(a) and G-2(a), which are modified versions of Alternatives S-5 and G-2. Selection of the alternatives was based on a comparative analysis of the alternatives with respect to the threshold and balancing criteria and two modifying criteria (i.e., State acceptance and community acceptance). These two criteria were evaluated based on comments to the RI/FS, responses to the PP, and participation in public meetings/hearings. The nine criteria are defined as follows:

The two threshold criteria are:

Overall Protection of Human Health and the Environment–Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment, and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled, through treatment, engineering controls, and/or institutional controls. The RAOs were developed, using the results of the risk assessment, to be protective of human health and the environment. The initial screening of alternatives retained only those options and technologies that were either required by the National Contingency Plan (NCP) or were determined to be effective in meeting the RAOs.

Compliance with ARARs–Section 121(d) of CERCLA and NCP Section 300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations which are collectively referred to as "ARARs," unless such ARARs are waived under CERCLA section 121(d)(4).

ARARs were considered in the development of the RAOs, and include chemical-specific, location-specific, and action-specific ARARs. The ARARs for ground water were used to develop the remediation goals, or clean-up levels, which are the concentration levels that the proposed alternatives must meet. RAOs for soil require reducing the potential for exposure to contaminated soils and migration of contaminants through the surface water pathway.

The five balancing criteria are:

Long-Term Effectiveness and Permanence--Under this criterion, an alternative is assessed in terms of its long-term effectiveness in maintaining protection of human health and the environment after response objectives have been met. The magnitude of residual risk and adequacy and reliability of controls are taken into consideration, as well as comparison of effectiveness to similar technologies.

Short-Term Effectiveness--Under this criterion, an alternative is assessed in terms of its effectiveness in protecting human health and the environment during the construction and implementation of a remedy before response objectives have been met. The time until the response objectives have been met is also factored into this criterion.

Implementability--Under this criterion, an alternative is assessed in terms of its technical and administrative feasibility and the availability of required goods and services. Also considered is the reliability of the technology, the ability to monitor the effectiveness of the remedy, ease of undertaking additional remedial actions (if necessary), need for regulatory permits, and availability of land to implement the option.

Reduction of toxicity, mobility, or volume (TMV)--Under this criterion, an alternative is assessed in terms of the anticipated performance of the specific treatment technologies it employs. Factors such as the volume of materials destroyed or treated, the degree of expected reduction, the degree to which treatment is irreversible, and the type and quantity of remaining residuals are taken into consideration.

Cost--Under this criterion, an alternative is assessed in terms of its present worth, capital, and operation and maintenance (O&M) costs, and these costs relative to similar technologies.

The two modifying criteria are:

State Acceptance- Under this criterion, an alternative is evaluated in terms of the technical and administrative issues and concerns the state may have. Frequently, state acceptance is closely related to compliance with state ARARs.

Community Acceptance - Under this criterion, an alternative is evaluated in terms of the issues and concerns the public may have had.

10.0 SOIL PATHWAY ALTERNATIVES

The five alternatives considered for soil remediation were:

- S-1 No Action
- S-2 Institutional and Surface Controls
- S-3 Institutional and Surface Controls and Capping with Flexible Membrane Liner (FML)
- S-4 Institutional and Surface Controls, Hot Spot Bioremediation, and Capping with Low Permeability Cap
- S-5 Institutional and Surface Controls, Hot Spot Bioremediation, and Engineered Low Permeability Soil Cap on the West Half of the Landfill, Installation of Lysimeters to Monitor Possible Leachate Generation

All of the proposed alternatives for the soil pathway (except for the No Action Alternative) would require long-term monitoring and maintenance to ensure that the remedial action continues to be effective, and the use of institutional controls as described in Alternative S-2.

Alternative S-1 - No Action

No cost is associated with this alternative.

Years to Implement: 0

Under this alternative, no further action would be taken at the site. The current fence would not be maintained, and there would be no sampling or monitoring to evaluate the level of leachate production. Consideration of this alternative is required by the NCP.

Alternative S-2 - Institutional and Surface Controls

Total Capital Cost: $80,400

Total Operation & Maintenance (O & M) Cost: $0

Additional Cost: $21,200

Additional costs include remedial design ($4,300), inflation escalation, 5% contingency, and 3% internal project management.

Total Alternative S-2 Cost: $101,600

Years to Implement: 0.8

Under this alternative, surface water run-on and run-off control structures would be constructed to divert run-on and maximize run-off. This would help to reduce leachate production by limiting the amount of infiltration, and would limit the potential for contaminant migration through storm water run-off or erosion. Specific surface water controls will be identified in the remedial design. This alternative would include restricting access to the site by maintaining the current fencing.

In addition, an area of 135 acres of public land, which includes the Lee Acres Landfill and a buffer area around it, was withdrawn by BLM from surface entry and mining for a period of 50 years (see 62 FR 2177, Public Land Order No. 7234). The effect of the withdrawal is to prohibit all potential uses of this public land that BLM is unable to prohibit on a discretionary basis due to statutory requirements. The withdrawal does not prohibit all activities on the withdrawn land. The activities not prohibited by the withdrawal, however, are at BLM's discretion, and BLM may choose whether or not to authorize these activities, and may dictate the circumstances under which they may occur. BLM will exercise its discretion to prohibit any activities that could disturb the integrity of the containment system, and to prohibit the drilling of ground-water wells for any purpose other than monitoring connected with the remedial action at the Lee Acres Landfill Site. Discretionary restrictions on the use of the land at the Lee Acres Landfill site that are in compliance with the current withdrawal will be implemented in accordance with BLM's current resource management plan. The prevailing management plan for the Lee Acres Landfill Site is the 1991 Albuquerque District Resource Management Plan/Final Environmental Impact Statement for Oil and Gas Leasing and Development. The Farmington Field Office is currently revising the Plan, which is expected to be finalized in May 2003. In addition, long-term ground-water monitoring would be used to determine whether contaminant leaching from the landfill material to the ground water is occurring.

Alternative S-3 - Institutional and Surface Controls and Capping with Flexible Membrane Liner (FML)

Total Capital Cost: $9,568,700

Total O & M Cost: $176,800

Additional costs include remedial design ($360,600), inflation escalation, 5% contingency, and 3% internal project management.

Additional Costs: $2,519,000

Total Alternative S-3 Cost: $12,264,500

Years to Implement 1.5

Under this alternative, surface water run-on and run-off control structures would be constructed to divert run-on and maximize run-off. This would help to reduce leachate production by limiting the amount of infiltration, and would limit the potential for contaminant migration through storm water run-off or erosion. The amount of infiltration would be further reduced by placing an FML cap over the entire landfill (an estimated 60 acres), including the lagoons and all solid waste disposal areas. This alternative would include restricting access to the site by maintaining the current fencing and placing an administrative withdrawal on the property as discussed in Alternative S-2. Long-term ground-water monitoring would be used to determine if additional contaminants were leaching from the landfill material and contributing to the existing ground-water contamination.

Alternative S-4 - Institutional and Surface Controls, Hot Spot Bioremediation, and Capping with Engineered, Low Permeability Cap

Total Capital Cost: $4,923,800

Total O&M Cost: $300,000

Additional costs include remedial design ($0.2 million), inflation escalation, 5% contingency, and 3% internal project management

Additional Costs: $1,367,300

Total Alternative S-4 Cost: $6,588,400

Years to Implement: 1.0

Under this alternative, surface water run-on and run-off control structures would be constructed to divert run-on and maximize run-off. This would help to reduce leachate production by limiting the amount of infiltration and would limit the potential for contaminant migration through storm water run-off or erosion. The amount of infiltration would be further reduced by placing a low permeability cap over the western portion of the landfill (an estimated 20-30 acres), including the lagoons and all solid waste disposal areas. Two types of caps were considered: a conventional compacted clay cap; and an innovative capillary barrier cap developed by Sandia National Laboratory (FS, Appendix G-2, BLM, 1996). This alternative would include restricting access to the site by maintaining the current fencing and continuing the administrative withdrawal on the property as discussed in Alternative S-2. Long-term ground-water monitoring would be used to determine if additional contaminants were leaching from the landfill material and contributing to the existing ground-water contamination.

The effectiveness of the low permeability soil cap would be increased by treating or excavating the BTEX-contaminated lagoon area sediments, which are expected to be the contaminants most likely to produce leachate. For purposes of analysis of this alternative, the proposed method for reducing BTEX contamination is *in-situ* bioremediation. If determined to be ineffective during the remedial design phase, pilot-scale studies, or through evaluation of the implemented alternative, the method will be adjusted to reduce BTEX concentrations through excavation and *ex-situ* treatment, which may include on-site bioremediation (landfarming) or shipment to an off-site facility. Also, further sampling may prove that the BTEX compounds are being naturally degraded, which would eliminate the necessity for bioremediation.

Alternative S-5 - Institutional and Surface Controls, Hot Spot Remediation, and Engineered Low Permeability Soil Cap on the West Half of the Landfill, Installation of Lysimeters to Monitor Possible Leachate Generation

Total Capital Cost (approximate): $1.9 million for a conventional clay cap, or approximately $1.2 million for the capillary barrier.
Total O&M Cost: $300,000
Additional costs include remedial design ($0.2 million), inflation escalation, 5% contingency and 3% internal project management
Additional Costs: $1.4 million
Total Alternative S-5 Cost (approximate): $3.6 million
Years to Implement: 1

Under this alternative, surface water run-on and run-off control structures would be constructed to divert run-on and maximize run-off. This would help to reduce leachate production from the west half of the landfill by limiting the amount of infiltration and would limit the potential for contaminant migration through storm water run-off or erosion. The amount of infiltration would be further reduced by placing a capillary barrier cap over the western half of the landfill (an estimated 25 acres), including the lagoons and most of the solid waste disposal areas. Two types of caps were considered: a conventional compacted clay cap; and an innovative capillary barrier cap being developed by Sandia National Laboratory. A system of lysimeters would be installed in the landfill to monitor leachate generation (see Figure 17). If leachate does occur, a collection system could be installed or the area could be capped at a later time. This alternative would also include restricting access to the site by maintaining the current fencing and placing an administrative withdrawal on the property, as discussed in Alternative S-2. Long-term ground-water monitoring would be used to determine if additional contaminants were leaching from the landfill material and contributing to the existing ground-water contamination.

The effectiveness of the low permeability soil cap would be increased by treating or excavating the BTEX-contaminated lagoon area sediments, which are expected to be the contaminants most likely to produce leachate. For purposes of analysis of this alternative, the proposed method for reducing BTEX contamination is *in-situ* bioremediation. If this is determined to be ineffective during the remedial design phase, pilot-scale studies, or through evaluation of the implemented alternative, the method can be adjusted to reduce BTEX concentrations through excavation and *ex-situ* treatment, which may include on-site bioremediation (landfarming) or shipment to an off-site facility. Also, further sampling may prove that the BTEX compounds are being naturally degraded, which would eliminate the necessity for bioremediation.

Selected Soil Pathway Alternative

Based on the results of the pilot study conducted at the Lee Acres Landfill, EPA, BLM, and the State of New Mexico concluded that the cap is performing as expected, and that hot spot bioremediation of the lagoon area sediments is not necessary to improve the long-term performance of the remedy. Accordingly, Alternative S-5 was modified by eliminating the hot spot treatment, and is presented below as Alternative S-5(a). Alternative S-5(a) is the selected alternative based on the successful outcome of the pilot project results.

Alternative S-5(a) - Institutional and Surface Controls, Capping with Capillary Barrier Cover on the Western Portion of the Landfill, and Installation of Lysimeters to Monitor Possible Leachate Generation

Total Capital Cost (approximately): $1.2 million for the capillary barrier
Total O&M Cost: $300,000
Additional costs include remedial design ($0.2 million), inflation escalation, 5% contingency and 3% internal project management
Additional Costs: $0.5 million
Total Alternative S-5 Cost (approximate): $1.9 million
Years to Implement: 1

This alternative is a modified version of Alternative S-5. Alternative S-5(a) does not include the hot spot bioremediation of BTEX-contaminated lagoon sediments included in Alternative S-5.

The purpose of the hot spot remediation included in Alternative S-5 was to increase the effectiveness of the low permeability cap. However, based on the results of the pilot study conducted at the Lee Acres Landfill, EPA, BLM, and the State of New Mexico concluded that the cap is performing as expected, and that hot spot bioremediation of the lagoon area sediments is not necessary to improve the performance of the remedy. The performance of the cap will be monitored, and if monitoring data indicate that the cap is not performing as anticipated, an evaluation of the remedy performance will be conducted to determine the cause, and appropriate corrective actions will be taken if needed.

Overall Protection of Human Health and the Environment

Alternative S-5(a) will protect human health and the environment by limiting access to the contaminated soils, by using surface water run-on and run-off controls to limit the amount of run-on infiltration and protect the landfill from erosion, and by capping with low permeability soil to eliminate other infiltration.

Compliance with ARARs

This alternative will include an engineered low permeability cap that will meet the minimum requirements of 40 CFR Part 258, to comply with ARARs. Although there is slight risk of leachate production, the entire site has been fenced and withdrawn from use. There is no risk to human health or the environment from the east half of the landfill. Lysimeter installation and monitoring will further ensure that no risk develops from this area. The performance of the cap will be monitored, and if monitoring data indicate that the cap is not performing as anticipated, an evaluation of the remedy performance will be conducted to determine the cause, and appropriate corrective actions will be taken if needed.

Long-Term Effectiveness and Permanence

The long-term effectiveness of this alternative depends on continued maintenance of the low permeability cap and surface controls, and no leachate occurring beneath the eastern portion of the landfill. The permanence and level of residual risk for this alternative will be the same as S-4, and the residual risk will be lower than that for alternatives S-1, S-2, and S-3. Lysimeter installation and ground-water monitoring will provide information regarding leachate generation and contaminant characteristics throughout the entire landfill. The number and placement of lysimeters will be determined in the design phase.

Short-Term Effectiveness

The short-term effectiveness for this alternative is the same as that for S-4. The possibility of a release during installation of the lysimeters also exists, making the risk the same as S-4. Therefore, this alternative is expected to present a greater level of short-term risk to workers and residents during overall implementation than S-1, S-2 and S-3.

Implementability

None of the soil pathway alternatives would require permits, and none would require the use of additional property that is not controlled by BLM. This makes the administrative implementability of these alternatives equal. Alternative S-5(a) would be easily implemented with readily available materials and technology and is expected to be reliable in meeting its objective of elimination of the production of leachate by both limiting infiltration and reducing leachable contaminant concentrations. The installation of the low permeability cap will be much easier to implement than the FML cap. Installation of lysimeters in the landfill will be easily implementable, and will monitor for possible leachate production. These activities make this alternative more difficult to implement than Alternatives S-1 and S-2 but easier to implement than Alternative S-3. In addition, because the low permeability cap requires only compaction, this alternative is expected to be more flexible in allowing additional soil or ground-water remedial actions than Alternative S-3, which would require re-welding of the FML. Overall, this alternative is expected to be much more easily implemented than Alternative S-3, and slightly less easily than Alternative S-4.

Reduction of Toxicity, Mobility, or Volume of Contaminants

Overall, this alternative provides a greater reduction of mobility than Alternatives S-1 and S-2 and the same reduction as Alternatives S-3 and S-4. Installation of the low-permeability cap, lysimeters and site monitoring will not actively reduce contaminant toxicity or volume, but it will reduce the mobility of the contamination. In addition, reduction of ground-water contaminant concentrations through natural attenuation is expected to continue, thereby reducing toxicity and volume of contaminants in ground water. Lysimeters will be used to monitor the effectiveness and integrity of the cap.

Cost

The estimated cost for this alternative is $1.9 million of which about half ($1.2 million) is the capital cost for installing the low permeability cap. The cost for the cap assumes a 25-acre low permeability cap covered with soil and vegetated, and 30-year O&M period. It is expected that a minimum of six lysimeters will need to be installed and checked quarterly. The lysimeters are expected to cost approximately $34,000. The overall cost is more than the cost of Alternatives S-1 and S-2, but less than the cost of Alternatives S-3 and S-4.

11.0 GROUND-WATER PATHWAY ALTERNATIVES

The five alternatives considered for ground-water remediation were:

- G-1 No Action
- G-2 Institutional Controls and Monitoring
- G-3 Extraction Well System, Sheet Piling Containment, Precipitation/Flocculation Treatment, and Subsurface Disposal
- G-4 Permeable Treatment Wall using Sheet Piling Containment
- G-5 Permeable Treatment Wall using Sheet Piling Containment and Extraction and Reinjection of Manganese Hot Spots

Alternative G-1 - No Action

There is no cost associated with this alternative.

Years to Implement: 0

Under this alternative, no further action would be taken at the site. Ground-water contaminant levels would not be monitored, and no institutional actions would be taken to ensure that residents do not become exposed to contaminated ground water resulting from landfill operations. Retention of this alternative is required by the NCP.

Alternative G-2 - Institutional Controls and Monitoring

Total Capital Cost: $ 40,000

Total O&M Cost: $235,000

Additional Costs: $32,000

Total Alternative G-2 Cost: $ 307,000

Years to Implement: 0.5

This alternative would include restricted access to, and long-term monitoring of, areas with ground-water contamination exceeding clean-up levels. Access would be restricted by fencing and withdrawal of the landfill site from public uses to limit future use of the property as discussed in Soil Alternative S-2. In order to implement monitoring of ground-water contamination south of the landfill, BLM will seek the cooperation of Giant Industries (Giant) in allowing access for installing and taking samples from wells on Giant Property. Absent such cooperation, BLM will exercise its authorities under CERCLA to obtain access to Giant property for the purpose of taking samples and otherwise implementing this response action. Ground water would be monitored on the south of the landfill to evaluate changes in the plume geometry and contaminant concentrations. For purposes of cost analysis, it is assumed that a minimum of 18 wells would be monitored. Five new wells would be sampled quarterly for three years, semi-annually for two years, and then annually for 25 years. The existing wells would be monitored semi-annually for five years and annually for 25 years, as required by CERCLA. The wells would be monitored for the COCs identified in Table 2.

Alternative G-3 - Extraction Well System, Sheet Piling Containment, Precipitation/Flocculation Treatment and On-site Subsurface Disposal

Total Capital Cost: $552,200

Total O&M Cost: $899,000

Additional costs include remedial design ($72,600), inflation escalation, 5% contingency, and 10% internal project management.

Additional Costs: $859,200

Total Alternative G-3 Cost: $2,310,400

Years to Implement: 1.5

This alternative would meet the RAOs by withdrawing the contaminated ground water through an extraction well system, removing the contaminants in an on-site treatment system, and reinjecting the treated ground water into the subsurface. Based on the capture zone modeling presented in Appendix E of the Feasibility Study Report (FS, BLM, 1996), it is assumed that a total of 26 extraction wells would be required, oriented north-south, to capture the entire manganese plume. This alternative includes the installation of sheet piling along the western side of the plume. This containment structure is expected to increase the effectiveness of the extraction well system and decrease the remediation time by limiting the volume of uncontaminated ground water extracted. The withdrawn ground water would be treated in an on-site precipitation and flocculation system. The treated ground water would be returned to the aquifer through one of two subsurface disposal options, either an infiltration gallery or shallow injection wells. A specific treatment option for VOCs is not included because the VOC clean-up levels are expected to have been met through degradation in the aquifer, extraction, and handling on the surface. Influent concentrations would be monitored to verify that VOC concentrations remain below clean-up levels. If it is determined that VOC clean-up levels are not met by this system, a specific VOC treatment option can be added to the manganese treatment train. The exact number and locations of the extraction wells and disposal wells or infiltration gallery would be determined during the remedial design phase. However, the subsurface disposal locations must be designed to return ground water to the aquifer in locations that would not adversely affect the extraction system on GBR property south of the landfill. Metal-bearing sludge produced in the precipitation and flocculation system would be sent off-site for recovery or for disposal in a RCRA-permitted facility. For purposes of cost analysis, it is assumed that five wells, all currently in place, would be monitored quarterly for five years, semi-annually for five years, and then annually for the remainder of the 30-year O&M period to verify the effectiveness of the system. The monitoring frequency may be changed as necessary if EPA, BLM, and the State concur that site conditions have changed sufficiently to warrant a change in monitoring frequency. These frequencies are the expected level of activity at the site and thus were used for cost estimation purposes for the ROD. The wells would be monitored for VOCs, manganese, nickel, and general chemistry.

Alternative G-4 - Permeable Treatment Wall using Sheet Piling Containment

Total Capital Cost: $788,000

Total O&M Cost: $493,600

Additional costs include remedial design ($31,300), inflation escalation, 5% contingency, and 10% internal project management,

Additional Costs: $552,200

Total Alternative G-4 Cost: $1,833,800

Years to Implement: 1.5

This alternative would meet the RAOs by treating both VOCs and manganese in a "funnel and gate" system. The "gate" or treatment wall would be located at the down-gradient end of the plume. The containment walls, the "funnel," would be constructed of sealable sheet piling. The type of reactive material in the treatment wall (iron-based material or limestone) would be chosen during the design phase and would require further testing of both the iron-based material and the limestone (FS, Appendix G-1, BLM, 1996). A pilot test of this technology using iron as the reactive media resulted in a 99% reduction in VOCs and an 86% reduction in manganese. This system would not require removal of water from the aquifer or disposal of treated water and, therefore, would have no adverse affect on GBR's remedial efforts. However, it would require periodic replacement of the reactive material in the gate, and the spent material would be shipped off-site for either regeneration or disposal. The efficiency of the system would be monitored by wells placed down-gradient of the reactive wall. For purposes of cost analysis, it is assumed that five wells (two newly installed down-gradient of the treatment wall) would be monitored quarterly for five years, semi-annually for five years, and then annually for the remainder of the 30 year O&M period to verify the effectiveness of the system. The monitoring frequency may be changed as necessary if EPA, BLM, and the State concur that site conditions have changed sufficiently to warrant a change in monitoring frequency. These frequencies are the expected level of activity at the site and thus were used for cost estimation purposes for the ROD. The wells would be monitored for VOCs, manganese, nickel and general chemistry.

Alternative G-5 - Permeable Treatment Wall using Sheet Piling Containment and Extraction-and -Reinjection of Ground Water in Manganese Hot Spots

Total Capital Cost: $891,000

Total O&M Cost: $524,300

Additional costs include remedial design ($42,500), inflation escalation, 5% contingency, and 10% internal project management.

Additional Costs: $611,500

Total Alternative G-5 Cost: $2,026,900

Years to Implement: 1.5

This alternative would meet the RAOs by treating both VOCs and manganese in a funnel and reactive wall system. The manganese concentrations in the northern and southern lagoon hot spots would also be reduced by limited extraction and reinjection of ground water within those two areas. The extracted water would be reinjected in front of the treatment wall and would then pass through the treatment system. The wall's hydraulic conductivity would be engineered to accommodate the additional hydraulic head without interrupting the natural hydraulic gradient of the system. The treatment wall would be located at the down-gradient end of the plume. The containment walls would be constructed of sealable sheet piling. The type of reactive material in the reactive wall (iron-based material or limestone) would be chosen during the design phase and would require further testing of both the iron-based material and the limestone (FS, Appendix G-1, BLM, 1996). This system would not require net removal of water from the aquifer or disposal of treated water and therefore would have no adverse affect on GBR's remediation effort. However, it would require periodic replacement of the reactive material in the wall. Spent material would be shipped off-site for regeneration or disposal. The extraction and reinjection portion of the alternative would include a withdrawal well located in each lagoon area. The exact number and location of wells would be determined during the remedial design phase. The withdrawn ground water would be transported over the surface to the treatment reactive wall, and reinjected upgradient of the reactive wall so the water would be treated as it flows through the reactive wall. This would combine the advantages of short-term reduction of hot spot concentrations with the advantages of *in-situ* treatment, eliminating the need for surface treatment and subsurface disposal facilities. For purposes of cost analysis, it is assumed that five wells (two newly installed down-gradient of the wall) would be monitored quarterly for five years, semi-annually for five years, and then annually for the remainder of the 30-year O&M period to verify the effectiveness of the system. The monitoring frequency may be changed as necessary if EPA, BLM, and the State concur that site conditions have changed sufficiently to warrant a change in monitoring frequency. These frequencies are the expected level of activity at the site and thus were used for cost estimation purposes for the ROD. The wells would be monitored for VOCs, manganese, nickel and general chemistry.

Selected Ground-Water Pathway Alternatives

Long-term ground-water monitoring data collected at the Lee Acres Landfill from March 1990 to November 1999 indicate that ground-water contamination levels are decreasing and the contaminant plume is receding. The decrease in the contaminant concentrations and plume size likely is attributable to closing the liquid waste lagoons to use, to closing the landfill, and to the process of natural attenuation of contaminants in the ground water. Due to the decreasing ground-water contamination levels, Alternative G-2 was modified by adding monitored natural attenuation as an element of the alternative, which is presented as Alternative G-2(a). Alternative G-2(a) is the selected remedy for the ground-water pathway.

Alternative G-2(a) - Institutional Controls, Natural Attenuation and Monitoring

Total Capital Cost: $0.00
Total O&M Cost: $235,000
Additional Costs: $32,000
Total Alternative G-2(a) Cost: $267,000
Years to Implement: 0.5

This alternative would include restricted access to, and long-term monitoring of, areas with ground-water contamination exceeding clean-up levels identified in Table 2. Reduction in concentration levels of COCs would be achieved through natural attenuation. Data indicate that natural attenuation is occurring for all COCs at the site, and MCLs have been met in most ground-water monitoring wells located outside the landfill cells area. Access would be restricted by fencing and deed restrictions to limit future use of the property. To implement monitoring of ground-water contamination south of the landfill, BLM will seek the cooperation of Giant Industries (Giant) in allowing access for installing and taking samples from wells on Giant property. Absent such cooperation, BLM will exercise its authorities under CERCLA to obtain access to Giant property for the purpose of taking samples and otherwise implementing this response action. Ground-water monitoring on and south of the landfill would be conducted to evaluate changes in the plume geometry and contaminant concentrations. For purposes of cost analysis, it is assumed that a minimum of 14 wells would be monitored. The wells would be monitored for VOCs, manganese, nickel and general chemistry. Monitoring frequency will be determined during the remedy design.

If monitoring data indicate a long-term (i.e., two years) trend of significantly increasing contaminant concentrations (for contaminants listed in Table 2), then an evaluation of the remedy performance will be conducted to determine the cause, and appropriate corrective actions will be taken, if needed. Specific monitoring well locations outside the landfill (waste containment) boundary will be determined during remedy design for the purpose of monitoring compliance with ARARs. Monitoring well locations within the landfill boundary also will be determined during remedy design for the purpose of monitoring cap performance. This approach was selected to ensure that any contaminant increases that may occur are in fact a long-term trend rather than a short-term event.

Overall Protection of Human Health and the Environment

Alternative G-2(a) will protect human health and the environment by limiting access to contaminated ground water. Evaluation of current data (post 1993) indicates that the VOC plume concentrations are decreasing. For almost all sampling locations, the results are below MCLs for VOCs. The manganese plume has decreased in concentration, with the exception of BLM 57 in September 1997, which is under the landfill cells. No migration has been detected since 1993. BLM will continue to monitor ground water to ensure the continued effectiveness of the monitored natural attenuation remedy. BLM cannot limit access to ground water south of the landfill. However, it is expected that the GBR remedial project will be continuing. Since the VOC and manganese plumes have stopped moving, long-term monitoring would enable action to be taken if migration occurs. This alternative would be protective of human health and the environment as long as contaminants continue to be attenuated in the subsurface.

Compliance with ARARs

VOC concentrations are expected to decrease below ARARs through the process of natural attenuation. Based on data collected through November 1999, it appears that the migration of manganese and nickel has halted and concentrations of manganese and nickel are also expected to decrease below ARARs through natural attenuation. Clean-up levels will be achieved in monitoring wells, the locations of which will be determined during remedy design.

Long-Term Effectiveness and Permanence

This alternative would maintain protection of human health after the remedial objectives have been met. This alternative would have less residual risk than Alternative G-1, because potential migration will be monitored. Natural attenuation will occur under either alternative. The other ground-water alternatives (G-3, G-4, and G-5) would actively decrease contaminant concentrations and may result in less residual risk than this alternative.

Short-Term Effectiveness

Implementation of this alternative would include no construction requiring exposure to contaminated media. Some of the monitoring wells required to continue to monitor the ground water are already in place, but additional monitoring wells may be required. Because this alternative relies on natural attenuation rather than treatment to reduce ground-water contamination, it may be less effective in the short-term than other alternatives.

Implementability

Additional monitoring wells on property adjacent to the landfill will require the cooperation of the adjacent property owner, or access pursuant to CERCLA authorities. The need to obtain such cooperation or access is not expected to limit the implementability of this alternative. This alternative would not preclude the undertaking of additional remedial actions at a later time. This alternative is expected to be more easily implemented than Alternatives G-3, G-4, and G-5.

Reduction of Toxicity, Mobility, or Volume of Contaminants

There would be no active reduction of TMV by this alternative, although the TMV of the VOCs and manganese is expected to continue to decrease due to natural attenuation. Based on data collected through November 1999, ground-water monitoring indicates that overall, manganese concentrations are declining, indicating that it is being naturally attenuated. Alternatives G-3 through G-5 will actively treat the contaminants and will reduce the TMV of all of the contaminants more than Alternatives G-1 or G-2.

Cost

The cost associated with this alternative is $267,000 almost all due to O&M costs associated with monitoring wells for 30 years. The total cost is much less than the costs associated with Alternatives G-3 through G-5.

12.0 SELECTED REMEDIAL ALTERNATIVES

12.1 Selected Soil Alternative

The selection of the remedy for the soil pathway was based on the five balancing, two threshold and two modifying criteria. Table 4 presents each alternative in relation to each criterion.

The selected alternative for landfill soil remediation is Alternative S-5(a) - Institutional and Surface Controls, Engineered Low Permeability Cap (Capillary Barrier) on the Western Portion of the Landfill, and Installation of Lysimeters to Monitor Possible Leachate Generation. The cap will minimize leaching of contamination from the soil by reducing or eliminating water infiltration. The effectiveness of the system in minimizing leachate will be monitored by lysimeters. Institutional and surface controls will be used to protect the integrity of the cap and monitoring system, and to prevent exposure to contamination. This alternative provides long-term protection of human health and the environment with a cost-effective remedy that was selected on the basis of site-specific, long-term monitoring data.

The engineered low permeability cap was developed at Sandia National Laboratories (Appendix G-2, BLM FS, 1996) and tested on-site in a pilot plot. It is an innovative technology consisting of a capillary barrier specifically designed for arid climate landfills. An 18-month large-scale test of the capping technology was conducted at the northern lagoon at the Lee Acres Landfill. The results of the test demonstrated that the cap should be effective at the Lee Acres Landfill Site. The EPA and NMED, by their concurrence in this ROD, approve installation of the capillary barrier cap at the Lee Acres Landfill.

BLM will continue to monitor ground water to ensure the effectiveness of the capillary barrier cap and natural attenuation remedy. If monitoring data indicate a long-term (i.e., two years) trend of significantly increasing contaminant concentrations (for contaminants listed in Table 2), then an evaluation of the remedy performance will be conducted to determine the cause, and appropriate corrective actions will be taken, if needed. Specific monitoring well locations outside the landfill (waste containment) boundary will be determined during remedy design for the purpose of monitoring compliance with ARARs. Monitoring well locations within the landfill boundary also will be determined during remedy design for the purpose of monitoring cap performance. Figures 16, 17 and 18 illustrate the location of the pilot project and the recommended cap location.

Surface water run-on and run-off control structures will be constructed to divert run-on and maximize run-off. Specific surface water control features will be determined during remedy design, and their ongoing performance ensured through long-term monitoring and maintenance.

An area of 134.68 acres of public land, which includes the Lee Acres Landfill and a buffer area around it, was withdrawn by BLM from surface entry and mining for a period of 50 years (see 62 FR 2177, Public Land Order No. 7234). At the end of the 50 year period of the withdrawal, if hazardous substances remain at the Lee Acres Landfill above levels that prevent unrestricted use, the withdrawal will be extended or other controls will be implemented.

The area withdrawn is described as follows (see Figure 19 for a map of the withdrawn area):

New Mexico Principal Meridian
T. 29N., R. 12W.,
Sec. 21, lots 6 and 7 (everything southeast of County Road No. 5569);
Sec. 22, lot 5 (everything southeast of County Road No. 5569);
lot 6 W\1/2\, lot 11 W\1/2\, and lot 12;
Sec. 28, lot 2.

The effect of the withdrawal is to prohibit all potential uses of this public land that BLM is unable to prohibit on a discretionary basis due to statutory requirements. The withdrawal does not prohibit all activities on the withdrawn land. The activities not prohibited by the withdrawal, however, are at BLM's discretion, and BLM may choose whether or not to authorize these activities and may dictate the circumstances under which they may occur. BLM will exercise its discretion to prohibit any activities that could disturb the integrity of the containment system, and to prohibit the drilling of ground-water wells for any purpose other than monitoring connected with the remedial action at the Lee Acres Landfill Site.

Discretionary restrictions on the use of the land at the Lee Acres Landfill Site that are in compliance with the current withdrawal, will be implemented in accordance with BLM's current resource management plan. Resource management plans enable BLM to manage public lands and resources in a balanced manner, as directed by the Federal Land Policy and Management Act (FLPMA) of 1976. Resource management plans also allow BLM to analyze impacts to public lands, as prescribed under the National Environmental Policy Act (NEPA) of 1969.

The prevailing resource management plan for the Lee Acres Landfill Site is the Farmington Resource Management Plan and Final Environmental Impact Statement, dated September 2003. The Final RMP/EIS does not contain any changes to current management of the established Lee Acres withdrawal. The restrictions of this withdrawal will remain to protect public health, welfare and the environment from the hazardous materials that remain onsite, for a period of fifty years. At the end of the 50 year period of the withdrawal, if hazardous substances remain at the Lee Acres Landfill above levels that prevent unrestricted use, the withdrawal will be extended or other controls will be implemented.

All future proposals for Lee Acres Landfill Site will have to be in accordance with the current withdrawal as well as the current resource management plan. Any person or entity proposing an activity within the Lee Acres Landfill site would do so through an application to the Farmington Field Office. This application would be reviewed for conformance with the withdrawal and the current resource management plan, which refers to this Record of Decision. Only those applications that are in conformance with the provisions of these documents will be subject to further NEPA review and analysis. Final determination on any future proposed actions at the Lee Acres Landfill Site will be made by the Farmington Field Office, following a proposal-specific NEPA analysis that will include consultation with the appropriate governmental entities.

BLM is responsible for implementing, maintaining, and monitoring of the surface and institutional controls for the duration of the remedies selected in the ROD and for as long as hazardous substances remain on site above levels that prevent unrestricted use. BLM will submit to EPA a monitoring report on the status of the surface and institutional controls at least annually. The report, at a minimum, will contain an evaluation of whether all of the surface and institutional controls requirements of the ROD are being met, including the results of a visual field inspection of all areas subject to surface and institutional controls, and a description of any deficiencies in the surface and institutional controls and measures that have been or will be taken to correct the deficiencies. BLM will notify EPA in writing within 72 hours of discovery of any activity that is inconsistent with the surface or institutional control objectives or use restrictions, exposure assumptions, or any action that may disrupt the effectiveness of the remedial action. BLM will notify EPA in writing at least 45 days in advance of any proposals for major land use changes inconsistent with the surface or institutional control objectives or use restrictions, exposure assumptions, or any action that may disrupt the effectiveness of the remedial action. BLM will notify EPA in writing at least six months prior to any transfer, sale, or lease of any property subject to surface or institutional controls under the terms of this ROD and consult with EPA on specific wording for property transfer or lease documents. BLM will notify EPA of any activities that violate the restrictions in the land use plan described above, the effect of the activities on the protectiveness of the remedy, and any proposed actions to address the violation of the restrictions. BLM also will consult with EPA prior to proposing any changes in the restrictions in the land use plan described above.

12.2 Selected Ground Water Alternative

Selection of the remedy for the ground-water pathway was based on the five balancing, two threshold and two modifying criteria. Table 5 presents each alternative in relation to the nine criteria.

The selected remedial alternative for ground water is G-2(a) - Institutional Controls, Natural Attenuation with Monitoring. Natural attenuation will be relied upon to achieve clean-up levels for ground water. Ground water will be monitored to document that natural attenuation is occurring. Institutional controls will be used to prevent exposure to ground-water contamination until cleanup levels are achieved. The institutional controls include the withdrawal discussed in Section 12.1 above, which will be implemented in accordance with the finalized Resource Management Plan/Final Environmental Impact Statement, expected to be finalized in May 2003.

Monitored natural attenuation was selected for the Lee Acres Landfill based on ground-water monitoring data collected from 1993 through 1999. These data indicate that the VOC plume concentrations are decreasing. For almost all sampling locations, the results are below MCLs for VOCs. The manganese plume has decreased in concentration, with the exception of BLM 57 in September 1997, which is under the landfill cells. No migration has been detected since 1993. BLM will continue to monitor ground water to ensure the continued effectiveness of the monitored natural attenuation remedy. Monitoring frequency will be determined during the remedy design.

13.0 STATUTORY DETERMINATION

Under CERCLA Section 121, BLM and EPA must select remedies that are protective of human health and the environment, comply with applicable or relevant and appropriate requirements (unless a statutory waiver is justified), are cost-effective, utilize permanent solutions, and use alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element.

The selected remedies protect human health and the environment through capping the landfill to prevent leachate production from the soils, and monitoring future movement or chemical changes in the ground water.

The selected remedies of capping and monitored natural attenuation will comply with all applicable or relevant and appropriate requirements (ARARs). The ARARs are presented in Table 3, and clean-up levels are presented in Table 2.

The selected remedy is cost-effective in terms of its long-term effectiveness and permanence, reduction in toxicity and mobility, and short-term effectiveness. The selected remedy is consistent with EPA's presumptive remedy for landfills (i.e., containment), and the cover design takes into consideration the expected performance of landfill covers in an arid climate such as the area in which the site is located. In addition, based on years of ground-water monitoring data, natural attenuation of the ground-water contamination is expected to continue, and clean-up levels achieved within a reasonable timeframe.

The selected remedy provides the best balance of trade-offs with respect to the balancing criteria set out in section 300.436(f)(1) of the NCP, such that it represents the maximum extent to which permanence and treatment can be utilized at this site. While treatment is not being utilized at the site, the containment remedy provides permanent reduction of low-level risk from the landfill contents. Monitored natural attenuation will provide a permanent reduction in risk from the ground-water pathway. The contaminant source at the Lee Acres Landfill is not considered principal threat waste, but rather is high-volume, low-risk waste such as is discussed in the NCP as appropriate for engineering controls (see section 300.430(a)(1)(iii)(B) of the NCP, which states, that...."EPA expects to use engineering controls, such as containment, for waste that poses a relatively low long-term threat or where treatment is impracticable.")
Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will

be conducted no less often than each five years after the initiation of the remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

14.0 DOCUMENTATION OF SIGNIFICANT CHANGES

In the Proposed Plan, Soil Alternatives S-4 and S-5 included a provision for hot spot bioremediation of BTEX-contaminated lagoon sediments in the event it was needed to increase the effectiveness of the low-permeability cap. Based on the results of the capillary barrier pilot study conducted by the Department of Energy's Sandia National Laboratory, EPA, BLM, and the State of New Mexico concluded that the cap is performing as expected, and that hot spot bioremediation of the lagoon area sediments is not necessary. Accordingly, Alternative S-5 was modified by eliminating the hot spot bioremediation element, and presented as Alternative S-5(a), which is the selected remedy for the soil pathway.

As a result of the ground-water monitoring data, Alternative G-2 from the Proposed Plan also was modified by adding monitored natural attenuation as an element of the remedy, and is presented as Alternative G-2(a) in this Record of Decision. Data collected through November 1999 support the conclusion that contamination levels are continuing to decline through natural attenuation, with the exception of BLM 57, which is located directly beneath the landfill cell. The concentrations of 1,2-DCE increased through May 1999, and the November 1999 sampling indicates reduction in concentrations. A report being prepared by UNM will evaluate these conditions. It is suspected that these data are related to the installation of the capillary barrier pilot cap. Because of the increase in concentrations, monitoring frequency has been increased to quarterly and piezometers have been installed and sampled until trends can be verified.

BLM and EPA believe that these changes to the alternatives outlined in the Proposed Plan could have been reasonably anticipated by the public from the time the Proposed Plan and RI/FS Report were released for public comment to the final selection of the remedy. For the soil alternative, the Proposed Plan stated that "...further sampling may prove that the BTEX compounds are being naturally degraded, which would eliminate the necessity for bioremediation." The possibility that bioremediation might not be implemented was noted in the Proposed Plan, and sampling data confirm that the treatment option is not needed.

For the ground-water pathway, Alternative G-2(a) includes a monitored natural attenuation element rather than ground-water monitoring only (Alternative G-2), which was the preferred alternative in the Proposed Plan. By identifying monitored natural attenuation as a remedial action for the ground-water, clean-up levels are identified and must be attained. While inclusion of monitored natural attenuation in the remedy does not change in any way the technical approach to cleaning up the ground water, it does result in the identification of site-specific remediation objectives within a specified timeframe. BLM and EPA believe that identifying clean-up levels for ground-water contaminants provides a more comprehensive remedy than Alternative G-2, but, from a technical standpoint, it does not significantly differ from the preferred alternative identified in the Proposed Plan.

Finally, in the proposed plan, Alternative S-5 was described to cover 62 acres. Upon further study, BLM, EPA and NMED have agreed that the cap size for Alternative S-5(a) will be reduced from 62 acres to about 25 acres. This cap size reduction necessitates the installation of lysimeters to monitor for potential leachate production.

Table 4 Alternative Criteria Evaluation Comparison Table for Soil Page 1

Alternative	Long-term effective-ness	Short-term effective-ness	Implementability	Reduction of TMV	Cost	Overall Protection of Human Health and the Environment	Compliance with ARARs	State Acceptance	Public Acceptance
S-1 No Action	Not Effective	Not Effective	Easily implemented	Will not reduce TMV	$0.00	Does not eliminate the potential for leaching so will not be protective of human health and the environment	Does not comply with ARARs		
S-2 Institutional and Surface controls	Not Effective	Not Effective	Easily implemented	Will not reduce TMV	$0.1 million	Will limit access, but not eliminate the potential for leaching, therefore is not completely protective of human health and the environment	Does not comply with ARARs		
S-3 Institutional and Surface Controls and Capping with Flexible Membrane Liner	Expected to be fully effective for the long-term	Fully effective	Installation and maintenance is more complicated than the other alternatives, however managerial implementation is similar to the other capping options	Fully complies	$12.26 million	Expected to be fully protective of human health and the environment	Fully complies with ARARs for soil		
S-4 Institutional and Surface Controls, and Capping with an Engineered, Low Permeability Cap(as defined in the New Mexico Solid Waste Regulations) over the Western Portion of the Landfill, with Lysimeters to Monitor Possible Leachate Production	Expected to be fully effective for the long-term	Fully effective	Easily implemented, moderate level of difficulty in installation and maintenance	Fully complies	$2.7 million	Expected to be fully protective of human health and the environment	Fully complies with ARARs for soil		

S-5 Institutional and Surface Controls, and Capping with Engineered Low Permeability Cap (Capillary Barrier Cap) on the Western Portion of Landfill, Lysimeters to Monitor Possible Leachate Production	Expected to l e fully effective for the long-term	Fully	Easily implemented	Fully complies	$1.9 million	Expected to be fully protective of human health and the environment	Fully complies with ARARs for -oil		

Table 4 Alternative Criteria Evaluation Comparison Table for Soil Page 2

Table 5 Alternative Criteria Evaluation Comparison Table for Ground Water

Alternative	Long-term effectiveness	Short-term effectivenes s	Implementability	Reduction of TMV	Cost	Overall Protection of Human Health and the Environment	Compliance with ARARs	State Acceptance	Public Acceptance
G-1 No Action	Not Effective	Not Effective	Easily Implementable	Does not reduce TMV	$0.00	Not protective of human health or the environment	Does not comply with ARARs		
G-2 Institutional Controls, Natural Attenuation with Monitoring	Effective as long as site ground water conditions do not change	Effective as long as site ground water conditions do not change	Land ownership may present some difficulty in obtaining agreements	Does not actively reduce TMV, but will passively reduce TMV	$0.31 million	Protective of human health and the environment providing no site ground water conditions change	Expected to fully comply		
G-3 Extraction Well System, Sheet Piling Containment, Precipitation/ Flocculation Treatment and On-site Subsurface Disposal	Fully effective, however will dewater alluvial aquifer, potentially affecting down-gradient recovery program	Fully effective	Land ownership may present some difficulty in obtaining agreements	Actively reduces TMV	$2.3 million	Protective of human health and the environment	Expected to fully comply with ARARs		
G-4 Permeable Treatment Wall using Sheet Piling Containment	Full effective, will not dewater alluvial ground water	Fully effective	Land ownership may present some difficulty in obtaining agreements	Actively reduces TMV	$1.8 million	Protective of human health and the environment	Expected to fully comply with ARARs		
G-5 Permeable Treatment Wall using Sheet Piling Containment and Extraction-and-Re-injection of Ground water in Manganese Hot Spots	Fully effective, however will dewater alluvial aquifer, potentially affecting down-gradient recovery program	Fully effective	Land ownership may present some difficulty in obtaining agreements	Actively reduces TMV	$2.0 million	Protective of human health and the environment	Expected to fully comply with ARARs		

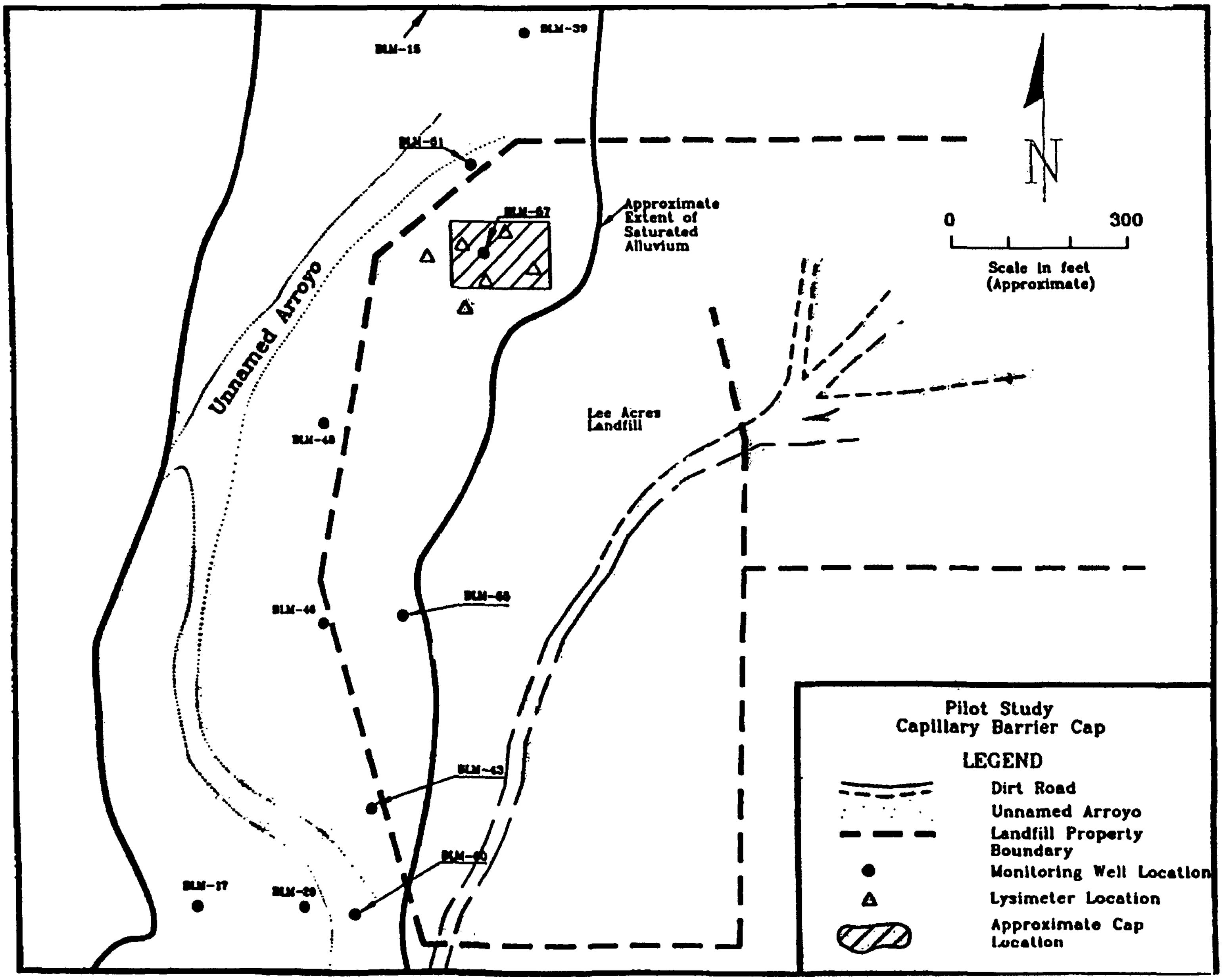

Figure 16 Location of Capillary Barrier Pilot Project

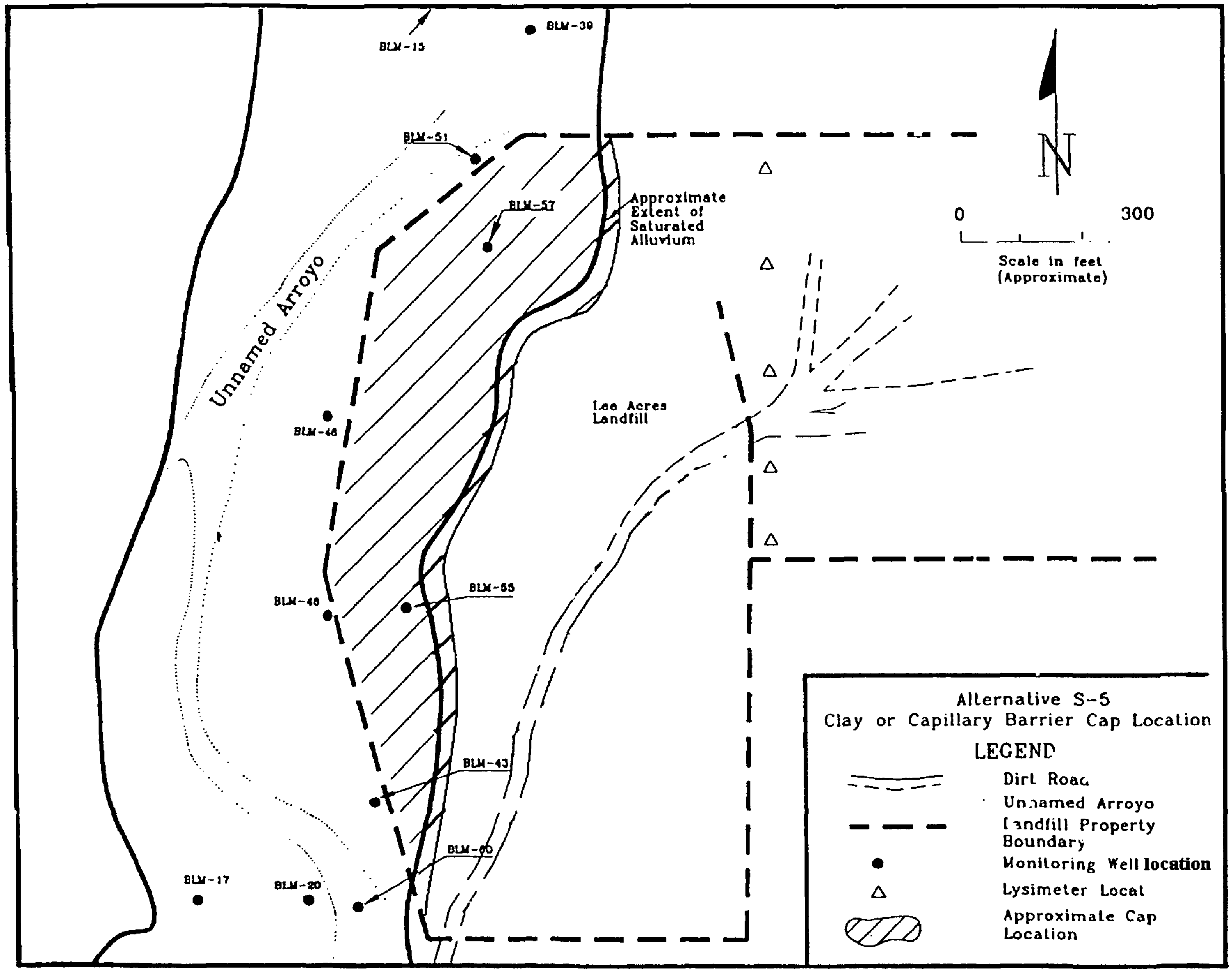

Figure 17 Landfill Cap and Possible Lysimeter Location Alternative

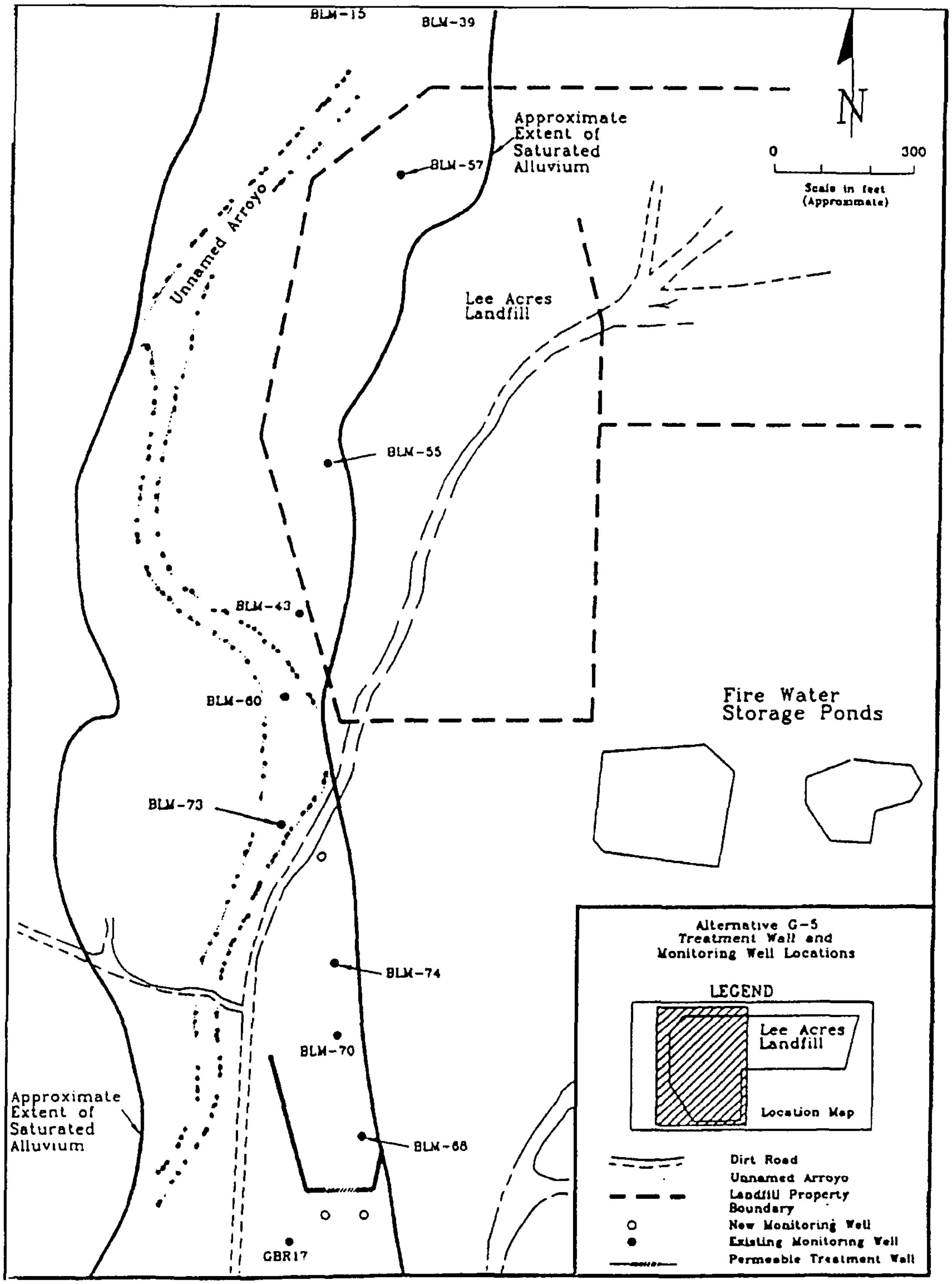

Figure 18 Alternative G-5, Sheet Piling and Reactive Wall Location

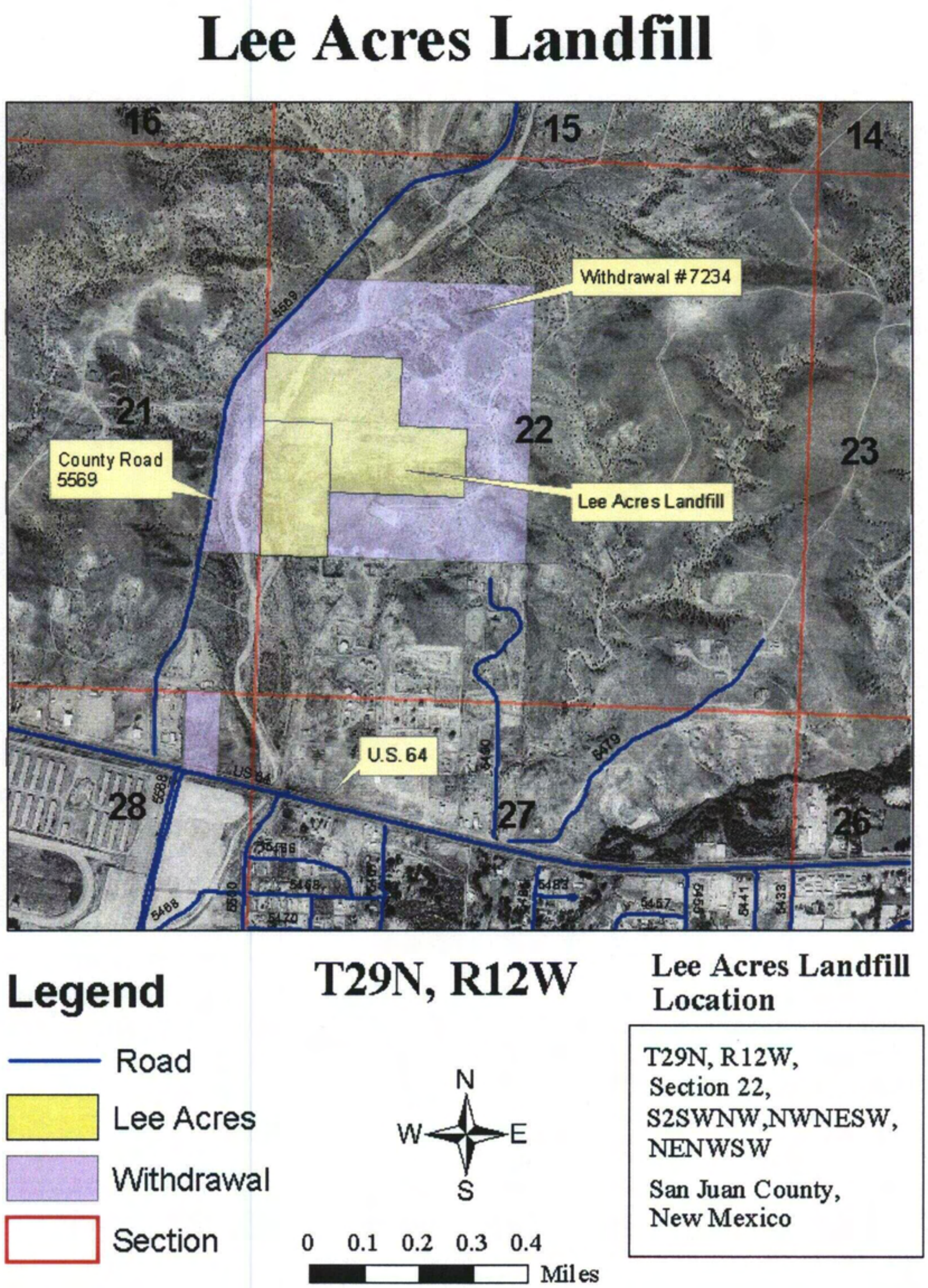

Figure 19 Lee Acres Landfill and Land Withdrawal Location

To obtain further information regarding the Lee Acres Landfill, please contact:

Joel Farrell, Assistant Field Manager for Resources
Bureau of Land Management, Farmington District
1235 La Plata Highway
Farmington, NM
970-385-1353

Sairam Appaji, Project Manager
Environmental Protection Agency, Region VI
1445 Ross Ave
Dallas TX 75202
214-665-3126

Robin Brown, Project Manager
New Mexico Environment Department
P.O. Box 26110
Santa Fe, NM 87502
505-827-2434

15.0 GLOSSARY OF TERMS

ARARS..Applicable or Relevant and Appropriate Requirements
BH..Borehole
BLM..Bureau of Land Management
BTEX...Benzene, Toluene, Ethyl benzene, Xylene
CERCLA .... Comprehensive Environmental Response, Compensation, and Liability Act
COC...Contaminants of Concern
COPC..Contaminants of Potential Concern
DCE...Dichloroethene
DOI...Department of the Interior
EPA.. Environmental Protection Agency
ES...Executive Summary
FML..Flexible Membrane Liner
FS ....Feasibility Study
GBR..Giant Bloomfield Refinery
MCL..Maximum Contaminant Level
MDL...Minimum Detection Level
mg/l...Milligrams per liter (parts per million)
MOU... Memorandum of Understanding
NCP...National Contingency Plan
NMED... New Mexico Environment Department
NMEID...New Mexico Environmental Improvement Department
NMOCD...New Mexico Oil Conservation Department
NMWQCC..New Mexico Water Quality Control Commission
NPL..National Priorities List
O & M..Operation and Maintenance
PCE..Tetrachloroethene
PRG...Preliminary Remediation Goals
RAO...Remedial Action Objectives
RI.. Remedial Investigation
RIR..Remedial Investigation Report
SARA..Superfund Amendments and Reauthorization Act
SDWA...Safe Drinking Water Act
SVOC ....Semi-volatile Organic Compounds
TCE..Trichloroethene

TMV..Toxicity, Mobility, and Volume

:g/l...micrograms per liter (parts per billions)

VOC..Volatile Organic Compounds

16.0 LEE ACRES REGULATORY CHRONOLOGY

Date	Event
May 1, 1962	Lee Acres officially opened
Apr. 25, 1980	San Juan County Development Plan for landfill includes provisions for combined sludge and dead animal pit.
Nov. 10, 1980	NMEID found refuse pit almost full and not compacted or covered at required frequency. Suggested either additional land for expansion or new location.
Aug. 24, 1981	NMEID submits to EPA Potential Hazardous Waste Site Inspection Report, reporting surface impoundment with liquids, sludge, oily wastes, drilling fluids and drilling muds.
Sept. 9, 1981	NMEID reported noncompliance regarding required 2 feet of final cover over original landfill area.
Apr. 18, 1985	Lagoon breach and vapor release incident occurred. Eleven people treated for hydrogen sulfide poisoning.
May 8, 1985	BLM compliance exam reported sludge pit was fenced and a "No Dumping" sign posted.
Jan. 14, 1986	NMEID inspection reported the liquid waste lagoon was 96 to 97% evaporated
Apr. 24, 1986	NMEID inspection reported the liquid waste lagoon was completely covered with soil.
Apr. 25, 1986	Lee Acres Landfill officially closed by BLM suspending leases, except for a 5 acre transfer station.
Oct. 21, 1986	NMEID Administrative Order issued for BLM to provide water to residents, and prepare plans to investigate, cleanup, and monitor ground water.
Nov. 5, 1986	BLM begins bottled water delivery to 13 identified residents.
Dec. 1986	BLM fenced landfill to prevent direct contact.
Dec. 24, 1986	BLM and Lee Acres Water Users Assoc. enter agreement to permanently hook up Lee Acres residents to the community supply system.
1987	Lee Acres residents hooked up to community water system.
March 1989	BLM conducts preliminary investigation.

Dec. 19, 1989	Clean Water Act Sec. 404 nationwide permit received for arroyo erosion control construction.
Aug. 28, 1990	Lee Acres Landfill placed on the National Priorities List by EPA.
Sept. 13, 1991	CERCLA 107 letters issued by EPA to BLM, San Juan County and Giant Bloomfield Refinery.
Jan. 1993	BLM, EPA and NMED enter into a technical MOU for completion of the Remedial Investigation.
Sept. 1993	Final Remedial Investigation Report.
May 19, 1995	EPA and NMED approve Remedial Investigation.
May 8, 1996	EPA and NMED approve Feasibility Study.
Sept. 1996	EPA and NMED approve Proposed Plan
Nov. 16, 1996	Public review and comment period completed.