DEPARTMENT OF THE ARMY
U.S. ARMY WHITE SANDS MISSILE RANGE
100 Headquarters Avenue
WHITE SANDS MISSILE RANGE, NEW MEXICO 88002-5000

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REPLY TO
ATTENTION OF

Environment and Safety Directorate

Phillip Solano
Project Leader for White Sands Missile Range
Hazardous and Radioactive Materials Bureau
2044 Galisteo
P.O. Box 26110
Santa Fe, New Mexico 87502

SUBJECT: Submittal of RCRA Facility Investigation (RFI) report for the White Sands Former Main Post Landfill 2A

Dear Mr. Solano:

Enclosed is the final RCRA Facility Investigation (RFI) report for the White Sands Former Main Post Landfill 2A dated June 2000. This final report signifies the conclusion of investigative activities at this site.

The Former Main Post Landfill 2A was originally believed to exist below Building 1747 and was thoroughly investigated during the initial White Sands Phase I (1992) and II (1994) RFIs. These investigations indicated that the landfill was not located in the suggested area, and subsequent investigations were directed south of Martin Luther King Avenue near the motor pool area. No evidence of a landfill was ever discovered at either location.

The White Sands intends to petition for No Further Action and submit a Class III Permit Modification Request for this site. Based on the lack of evidence for environmental concerns at this site, long-term groundwater monitoring has been discontinued.

Please contact either Gene Forsythe or Robin Paul at (505) 678-2224 if you have any questions.

Sincerely,

Thomas A. Ladd

Thomas A. Ladd
Director, Environment and Safety Directorate

Enclosure

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MEVATEC

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WS-ES-EC-0036

RCRA FACILITY INVESTIGATION
FORMER MAIN POST LANDFILL 2A
WSMR-40 (SWMU-64)

FOR

June 2000

BY

MEVATEC CORPORATION

US Army, White Sands Missile Range
Environment and Safety Directorate
White Sands Missile Range, New Mexico 88002

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This document details the site characterization for the Main Post Landfill 2A. The report contains findings resulting from performance of non-intrusive geophysical surveys, soil borings, and soil sample collection and analysis at the previously identified landfill areas.

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RCRA FACILITY INVESTIGATION,
FORMER MAIN POST LANDFILL 2A WSMR-40 (SWMU-64)

Submitted to:

U.S. Army
White Sands Missile Range
Directorate of Environment and Safety
White Sands Missile Range, New Mexico 88002-5048

June 2000

Submitted by:

MEVATEC Corporation
Building 126
White Sands Missile Range, New Mexico 88002

EXECUTIVE SUMMARY

Main Post Landfill 2A is identified as Solid Waste Management Unit (SWMU) 64 under the White Sands Missile Range Resource Conservation and Recovery Act (RCRA) Part B Permit Corrective Action Module VIII. In accordance with the requirements of RCRA sections 3004(u) and (v), and under the terms of the Permit, corrective action for this site is required.

The landfill was originally thought to exist below Building 1747 and was thoroughly investigated during the Phase I and II RCRA Facility Investigations (RFIs). These studies indicated that the landfill was not located below the suggested building. Subsequent investigations were directed south of Martin Luther King Avenue near the motor pool area to further explore the possibility of a landfill and characterize buried waste, if found.

Field activities were designed to determine the horizontal and vertical extent of any soil contamination and define the landfill materials. Investigations consisted of geophysical surveys, soil borings, and collection and analysis of depth-specific soil samples. No significant quantities of municipal or industrial waste were found. Identified trenches were most likely due to past borrow activities. All laboratory analyses were well below the stringent Environmental Protection Agency (EPA) Region 9 Media-Specific Human Health Screening Levels.

Although the geophysics failed to identify a landfill, 63 soil borings were completed to verify the absence of buried waste. Depth-specific soil samples were collected from 25 of the 63 borings and analyzed by two laboratories for pesticides, herbicides, PCBs, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), explosives, TPH, and total metals.

The results indicated that Landfill 2A does not exist, nor has this area been used for the disposal of any significant quantity of municipal or industrial waste. Based on the results of the investigation, no further action is required. White Sands will apply for a Class III modification to remove this site from the Permit.

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RCRA FACILITY INVESTIGATION, FORMER MAIN POST LANDFILL 2A WSMR-40 (SWMU-64)

1.0 INTRODUCTION

Landfill 2A was originally referred to as Landfill 2, which was allegedly located in the southeast area of the present site of Building 1747. It is identified in the Resource Conservation Recovery Act (RCRA) Part B Permit Corrective Action Module VIII as Solid Waste Management Unit (SWMU) 64. The exact start up date of the landfill could not be determined, but possibly coincides with the beginning activities on White Sands Missile Range from 1948 to 1965. It was described as a sanitary landfill where only inert materials were disposed. Subsequent investigations were conducted studying historical aerial photographs from 1956, clearly indicating that the landfill was not under Building 1747 (Sverdrup, 1994). As a result of these studies, investigations were directed south of Martin Luther King Drive, near the motor pool storage area, referred to as Landfill 2A.

The investigation was conducted to fully delineate the area, define trenches and buried waste, and to determine if soil contamination has occurred. Field activities to support these objectives consisted of geophysical surveys, soil borings performed in the vicinity, and the collection and analysis of soil samples. Each activity was intended to more fully characterize the area, provide information to determine areas in which further data may be required, and provide data to conduct studies for corrective measures, if warranted. This approach was developed to tier off of the results of the Phase I and II RFIs. All aspects of quality assurance, quality control, data validation and data reporting were conducted in conformance with the Work Plan developed for this effort.

1.1 White Sands Missile Range - Background

1.1.1 Location and Background

Most of White Sands is situated within the Tularosa Basin; with areas along the western and northwestern boundary extending into the Jornada del Muerto Basin. White Sands is located in Doña Ana, Socorro, Lincoln, Otero, and Sierra Counties, New Mexico (NM). The headquarters (Main Post) area of White Sands is located at the southwestern corner of the installation, approximately 43.4 km (27 miles) east-northeast of Las Cruces, NM (Figure 1-1). White Sands' headquarters and most installation support activities are located at the Main Post area. White Sands is the largest land-area military installation in the United States, comprised of nearly 5,631-sq. km (3,200-sq. mi). The installation is approximately 159-km (99 miles) long and 40 to 64-km (25 to 40 miles) wide.

White Sands was established 9 July 1945 as White Sands Proving Ground. In 1958 the name was changed to White Sands Missile Range. The New Mexico desert was selected to be the nations' testing range for several reasons: the desert is sparsely populated, has almost year-round clear weather and unlimited visibility, and as such, affords relatively easy recovery of spent missiles.

White Sands now functions as an outdoor laboratory consisting of a large complex of test ranges, launch sites, impact areas and instrumentation sites required to develop and test tactical and strategic weapons and weapons systems. White Sands is designated as a national range whose mission is the support of missile development and test programs for the Army, Navy, Air Force, National Aeronautics and Space Administration (NASA) and other government agencies.

1.1.2 Regional Geology

White Sands Missile Range lies within the Mexican Highland Section of the Basin and Range Province, characterized by a series of tilted fault blocks forming longitudinal, asymmetric ridges or mountains and broad intervening basins (Figure 1-2). The major portion of White Sands lies within the Tularosa Basin, which is bounded on the west by the Organ, San Augustin, and San Andres Mountains. The eastern limit of the Tularosa Basin lies outside of the Range, and is formed from north to south by the Jicarilla, Sierra Blanca, and Sacramento Mountains (not shown on Figure 1-2).

The Tularosa Basin contains thick sequences of Tertiary and Quaternary age alluvial and bolson fill deposits. These sediments, more than 1,524-m (5,000-ft) thick in some areas, consist mainly of silt, sand, gypsum and clay weathered from the surrounding mountain ranges. The average elevation of the basin floor is 1,219-m (4,000-ft) above mean sea level and surface features consist of flat sandy areas, sand dunes, basalt flows, and playas (dry lakebeds). The average elevation of mountains range from 1,737-m (5,700-ft) at St. Augustin Pass to more than 2,743-m (9,000-ft) at Salinas Peak, the tallest peak at White Sands.

The nature of the bolson-fill deposits varies both laterally and vertically throughout the Main Post Area. Coarse-grained, poorly sorted sediments deposited near mountain fronts grade into fine-grained, well-sorted sediments toward the center of the basin (Kelly, 1973). Sediments further from the mountains also contain a greater percentage of clay and gypsum. Vertically, the sediments are reported to become finer-grained and more consolidated until reaching a laterally continuous clay unit at about 304.8-m (1,000-ft) below ground surface (Kelly and Hearne, 1976).

1.1.3 Regional Hydrology

1.1.3.1 Climatology

The elevation of the White Sands Main Post is approximately 1,219-m (4,000-ft) above mean sea level. Snowfall is infrequent, although heavy snows have occurred. With an average rainfall of only 27.4-cm (10.8-in), mostly occurring during late summer as thunderstorms, often accompanied by hail, the area is considered semi-arid. Intense localized thunderstorms have caused flash flooding in the past. The average summer high temperature is 33.3 °C (92 °F) with lows of about 18.3 °C (65 °F). During the winter months (December, January and February), the average high is 13.9 °C (57 °F), with lows of about 2.2 °C (36 °F). Average annual humidity readings are approximately 37 percent.

1.1.3.2 Surface Water

Very little surface water exists at White Sands due to the low annual precipitation, high evapo-transpiration rates, and high infiltration characteristics of the soils. During the summer season when thunderstorm activity is most common, playas within the basin may contain standing water. Arroyos, which drain the surrounding mountains usually, contain water only following heavy precipitation events.

1.1.3.3 Groundwater

The White Sands Main Post obtains its potable water supply from the aquifer in the upper bolson deposits. The majority of the groundwater recharge to this bolson aquifer occurs through the coarse, unconsolidated Tertiary/Quaternary alluvial fan deposits and arroyos along the eastern flanks of the Organ, San Agustin and San Andres Mountains. This aquifer consists of a wedge-shaped belt of potable water more than 48.3-km (30 miles) long (from north to south), and 4.8 to 8.0-km (3 to 5 miles) east from the mountain front. Groundwater in the vicinity of the Main Post is of sufficient quality (less than 1,000-mg/L total dissolved solids) for human consumption. McClean (1970) reported this freshwater zone extends down to about 549-m (1,800-ft) below ground surface.

Recharge to the regional aquifer is from precipitation falling on the mountain ranges and alluvial fans which border the bolson on the west (White Sands, 1993b). This precipitation infiltrates the unconsolidated, relatively coarse deposits of the alluvial fans, and the resultant groundwater flows toward the center of the Tularosa Basin, generally to the east-southeast. However, groundwater flow direction within the western Tularosa Basin region is presumed to discharge to the south as underflow into the contiguous, northern Hueco Basin of western Texas. No surface expressions of groundwater discharge have been reported within the western Tularosa Basin. Dissolved constituents in groundwater increase with distance eastward from the mountain front, reflecting the increased residence time of groundwater moving from the western bolson margin toward the center of the Tularosa Basin.

1.1.4 Site Specific Lithology and Hydrogeology

The area investigated during for the RFIs was near or beneath the present site of Building 1747, where Landfill 2 was allegedly located. The lithology was recorded using cased-hole geophysical and stratigraphic descriptions made during four monitoring well installations, MW-1, MW-2, MW-9 and MW-10. In general, from the surface down to 108-m (353-ft), the subsurface has numerous alternating thinly to thickly bedded units of unconsolidated sand, silty sand and sandy silt with occasional silt or gravel lenses. The saturated zone is silty, clayey sand and silty sand. The grain size distribution of soils at MW-9 and MW-10 ranged from 6 to 7% gravel and 84 to 90% sand. The hydraulic conductivity estimated from slug test data of MW-1 and MW-2 ranged from 6.6×10^{-4} cm/sec (1.92 ft/day) to 2.0×10^{-3} cm/sec (5.6 ft/day). The hydraulic conductivity was 2.74×10^{-3} cm/sec (7.75 ft/day) for MW-9 and 1.3×10^{-3} cm/sec (3.68 ft/day) for MW-10. Groundwater potentiometric surface data and samples were collected from the upgradient well, (MW-09) and three downgradient wells (MW-01, MW-02, and MW-10).

Table 1-1 illustrates monitoring well location and water level data for the site. It is assume that the geology is the same for Landfill 2A given that it is located in the same vicinity were the geology was characterized.

Table 1-1. Location and Water Level Data for MW-3, MW-6, MW-11, and MW-12.

Well Name	Northing[1]	Easting[1]	Brass Marker Elevation[2]	Top of PVC[4] Elevation[2]	Well Depth[3]	Static Groundwater Elevation[3]
MW-1	3582855.226	361037.952	4222.77	4224.20	352	3884.15
MW-2	3582810.673	361095.058	4227.78	4229.00	345	3893.54
MW-9	3582837.270	360917.316	4229.08	4231.14	350	3907.76
MW-10	3582714.203	361021.444	4222.66	4224.67	353	3883.09

Notes: 1: Universal Transverse Mercator Coordinate Systems, Zone 13, NAD83
2: Elevations are North American Vertical Datum, 1988
3: Measured from brass survey marker.
4: PVC - polyvinyl chloride

1.2 Regulatory Requirements

A RCRA Facility Assessment (RFA) was conducted in August 1988 to identify SWMUs and Areas of Concern (AOC) and existing information on contaminant releases (USEPA, 1988). It also identified releases or suspected releases at sites that require further investigation.

Approximately 138 SWMU sites and AOC were identified during the RFA. Following receipt of the RFA, EPA Region VI, as the lead regulatory agency, provided RCRA permit conditions and recommendations to White Sands. These conditions included performing RCRA Facility Investigations (RFI) at SWMU sites with releases of concern, and implementing corrective measures, if required. Landfill 2 was investigated during the following:

- Phase I RFI performed by IT Corporation (1992)
- Phase II RFI performed by Sverdrup Corporation (1994)

A complete description of each investigation is found in Section 2.2, Previous Investigations.

1.3 Other Regulatory Issues

Based on the results of the investigations, corrective measures will not be required. However, any corrective measures that may have been selected as a result of this investigation would be subject to the requirements of the New Mexico Hazardous Waste Act (NMSA 1978, Chapter 74-4-1 through 14), Title 20 of the New Mexico Administrative Code, Chapter 4.1 (NMED, 1998), and Title 40 of the Code of Federal Regulations (CFR) Part 264 (HSWA). Waste disposal decisions would be based on comparisons of Toxicity Characteristic Leaching Procedure (TCLP) results with regulatory limits listed in 40 CFR 261.24. Any waste excavation and disposal would be subject to requirements of the New Mexico Solid Waste Act (NMSA 1978, chapter 74-9-1 through 42) and Title 20 of the New Mexico Administrative Code, Section 9.1. Site closure

decisions would be based on comparisons of total contaminant concentrations with EPA Region 9 Preliminary Remediation Goals (U.S. EPA, 1998). If required, physical excavation of the waste would be conducted in accordance with Occupational Safety and Health Administration (OSHA) regulations.

2.0 SITE BACKGROUND

2.1 Site Description and History

The Phase I and Phase II RFI investigated what was thought to be Landfill 2 located in the southeast area of the present site of Building 1747 (Figure 2-1). Historical aerial photographs, aerial searches and personnel interviews indicated that the landfill was not under building 1747 and directed further investigations to the south of Martin Luther King Avenue near the motor pool storage area which is referred to as Landfill 2A (Figure 2-1). The area subsequently investigated covers approximately 27.8 hectares (68.8 acres). An exact start-up date could not be determined, but possibly coincides with the beginning activities on White Sands in the early 1940s. Investigations have determined that no landfill exists, either at the site of the original investigation (Bldg 1747) or south of Martin Luther King Drive near the motor pool storage area.

2.2 Previous Investigations

2.2.1 RCRA Facility Assessment

In 1988, A.T. Kearney, Inc. performed a RCRA Facility Assessment at the area referred to as Main Post Landfill 2. The preliminary visual site inspection reported no evidence of a release. The assessment also reported that details were not available on the size, shape, exact location, types of waste which were managed, where the wastes were generated, or the volume of waste that was disposed. No historical information is available on the design, construction and operating procedures used at the purported landfill. No documentation of a release from the unit was identified. The assessment concluded that the potential for contaminant sources to migrate to subsurface waters existed. It was recommended that groundwater sampling be conducted for priority pollutants.

2.2.2 Phase I RCRA Facility Investigation

In 1992, IT Corporation performed a Phase I RFI at the Main Post Landfill 2. The Phase I field investigation included a soil vapor survey (SVS). The SVS detected one occurrence of elevated methane and 1,1,1-trichloroethane. Xylene was detected at low levels at four points. Two monitoring wells, MW-1 and MW-2, were installed and sampled for VOCs, SVOCs, TPH, metals and cyanide. The groundwater analysis detected bis(2-thylhexyl)phthalate, TPH, barium, cadmium, lead, and chromium. Barium was slightly elevated, but below regulatory levels. Cadmium was slightly above MCLs, lead was slightly below MCLs and chromium was detected at potential background levels. It was concluded that the Phase I data did not indicate evidence of a significant contaminant source or release at the site. However, the sample with the elevated occurrence of methane (29,000 ppm), indicated that further investigation should be performed.

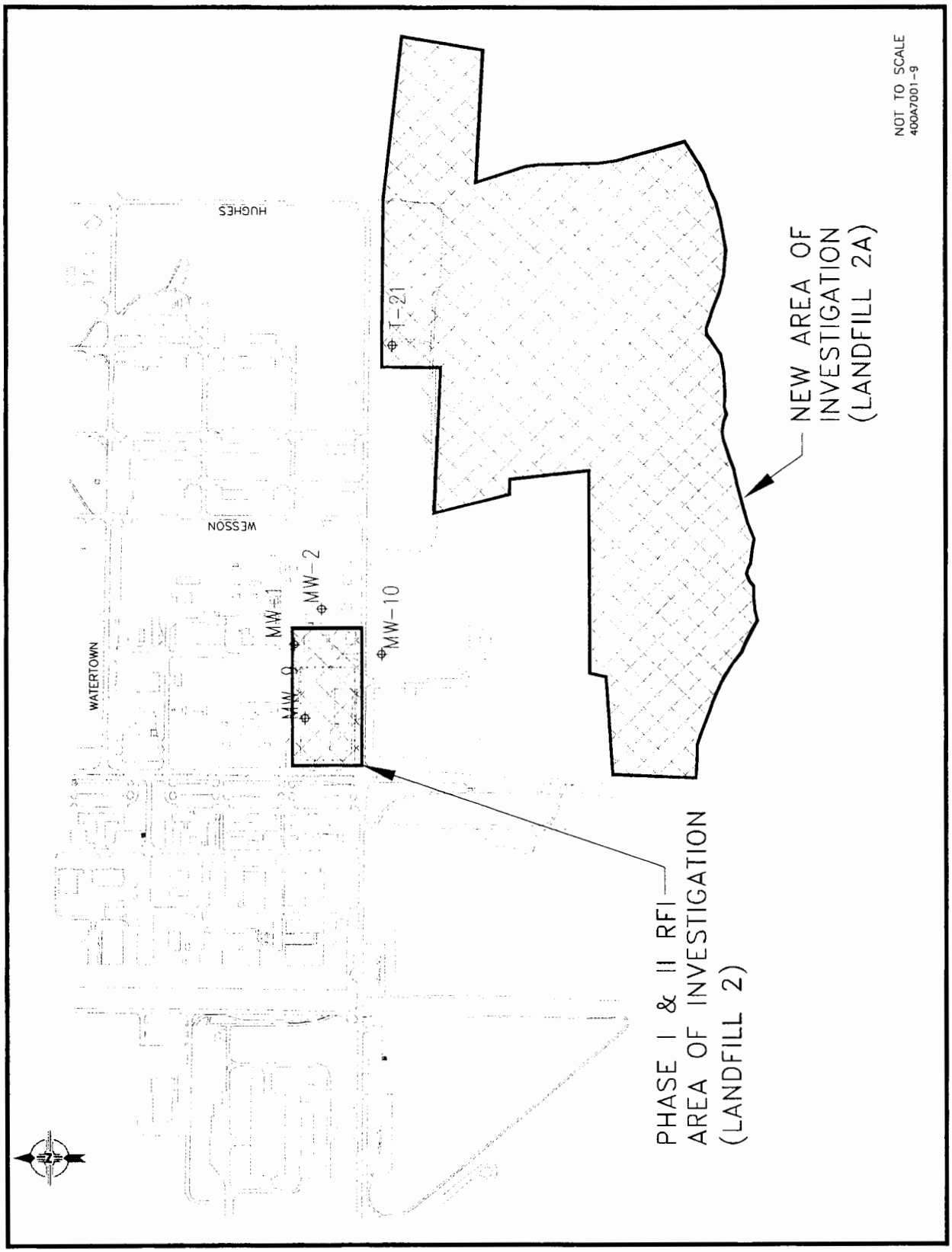

Figure 2-1. Areas of Investigation.

2.2.3 Phase II RCRA Facility Investigation

In 1994, Sverdrup Environmental Incorporated performed a Phase II RFI at Landfill 2. A fifteen-point soil gas survey (SGS) was performed to further evaluate the elevated methane concentration detected in Phase I. Samples were analyzed for methane benzene, toluene, total xylenes, 1,1,1-trichloroethane, tetrachloroethene, and total volatile organics. The SGS did not detect methane or any other constituents above their respective detection limits.

To increase the monitoring coverage of the groundwater, two additional monitoring wells, MW-9 and MW-10 were installed. Groundwater samples were collected from these two wells and the existing Phase I wells. A fifth groundwater sample was collected from USGS Well T21 (TW-2), located southeast of the site. The five groundwater samples were analyzed for VOCs, SVOCs, TPH, metals (total and dissolved), and TDS. VOCs, SVOCs and TPH were not detected in the samples. TW-21 contained the two most substantial concentrations of chromium and lead at 90 and 122 μg/l, respectively. The dissolved chromium and lead were less than 25 and 10 μg/l respectively. The well had an elevated total barium level of 300 μg/l, which was below the action level of 1000 μg/l. Selenium was detected in MW-2 just above its detection limit of 10 μg/l. The Phase II RFI report suggested that further studies be performed to confirm the true location of the landfill.

3.0 CONTINUED SITE INVESTIGATION

During the Phase II investigation, it was found that the former sanitary Landfill 2 might not actually be located under Building 1747 as was initially postulated. Further investigations indicated other possible areas in which the former landfill might be located. Through the study of historical aerial photographs and a helicopter aerial search, possible locations of the site were identified southeast of the Main Post contractor lots, south of Martin Luther King Drive and east of Headquarters Avenue. Further studies were continued to determine if the location of the landfill was in the described area. The following sections describe the activities involved in the investigation effort of the new area.

3.1 Investigative Approach

Field activities provided information to determine if the landfill was located south of Martin Luther King Drive and east of Headquarters Avenue as well as identifying landfill material and horizontal and vertical extent of any soil contamination. Field activities consisted of soil borings and collection and analysis of depth-specific soil samples. Prior to beginning field activities, the locations of buried utilities and other structures were verified. All field activities were directed away from any archeological sites.

Assessment activities for the areas included a non-intrusive geophysical survey that was performed in June and July 1998. The survey was designed to identify and delineate buried waste with particular attention to municipal and/or industrial type waste from past activities. The investigations included a ground conductivity screening survey, with follow–on metal detection and magnetometer surveys. This type of investigation detects buried metal, differential compactions, and non-metallic waste, making it a powerful tool for landfill investigations. The geophysical investigations began with establishing spatial control grids consisting of wooden

lathe on 30.4-m (100-ft) centers (Figure 3-1). The investigation covered was in excess of 24.3 hectares (60 acres). The orientation of the landfill cells and boundaries were established through observations of the surface and aerial photographs. Through these observations, the areas and position of suspected buried wastes were located. The study allowed for concentration on these specific areas of the landfills. Additionally, the observations helped identify other potentially trenched areas, which extended the survey to the northeast corner, increasing the investigation area by 3.72 hectares (9.2 acres) (Figure 3-1).

The geophysical survey allowed for a more comprehensive boring plan to be developed. Sixty-three (63) soil borings were placed directly in areas where the geophysical survey indicated possible buried waste. The final locations of the borings were modified due to subsurface features and observations identified during field investigation activities. The majority of the borings were situated closely following the geophysical survey grid system within the specific areas of investigation. Boring numbers were assigned according to the lathe numbering system. To determine if contamination had migrated in a horizontal direction, 25 borings were randomly sampled for constituents within the perimeter of the areas of investigation. This methodology was based on the results of the geophysical surveys, topographic maps (Figure 3-1) and groundwater elevation data.

3.2 Data Collection and Procedures

The principal operations of the field investigation included soil boring and sampling, management of investigation-derived wastes (IDW), horizontal surveying, and various field measurements. All intrusive activities were preceded by utility and Unexploded Ordinance (UXO) clearance.

3.2.1 Geophysical Survey Methods

The primary geophysical survey was conducted utilizing a Geonics EM-31 ground conductivity meter. This instrument consists of a transmitting antenna, a receiving antenna, associated electronics and a data logger. The transmitting coil generates a time varying magnetic field that penetrates the soil. The strength and phase of these currents are detected by the receiving antenna, and yield two measurements, the soil conductivity, and an In-Phase response. Ground conductivity data reveal lateral changes in electrical properties to approximately 5.48-m (18-ft) deep. EM-31 data were acquired approximately every 0.609-m (2-ft) along the north south traverses. The In-Phase response is primarily an instrument response and is sensitive to nearby metal objects providing a useful quality control indicator for the measured soil conductivity. A follow on survey utilizing a Geonics EM-61 high precision metal locator was conducted as well. This is a time domain electromagnetic instrument specifically designed for mapping buried metal to a depth of approximately 3.05-m (10-ft). It consists of a transmitter coil, two receiver coils, associated electronics and a data logger. The transmitting coil generates a magnetic pulse that penetrates the soil. This pulse induces currents in the subsurface. These currents dissipate rapidly in soil, but persist in buried metal, which possess a very high conductivity. The long-lived eddy currents from metal induce a signal in the receiver coils, which is integrated over the late portion of the time gate between pulses. This signal is proportional to the quantity of buried metal. EM-61 data were acquired every 19.8-cm (7.8-in) along north-south traverse separated by 1.9-m (6.25-ft).

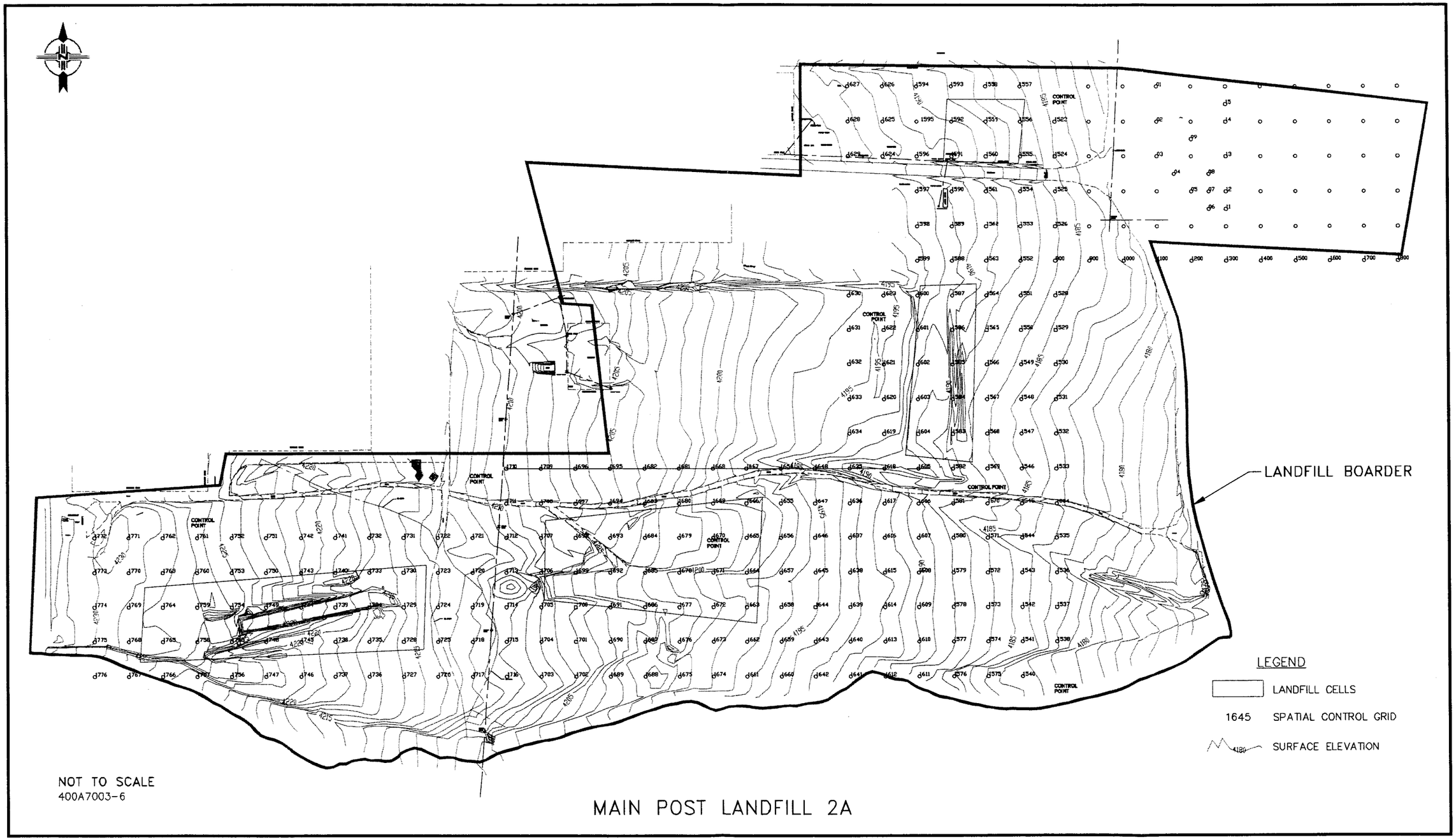

Figure 3-1. Area Spatial Control Grid.

One small area was investigated utilizing a Geometrics G-858 cesium vapor mangnetometer. This instrument measures the strength of the local magnetic field, and detects concentrations of buried iron and steel. (Sunbelt, 1998).

3.2.2 Soil Boring and Sampling Procedures

Soil boring operations were accomplished using dry, continuous-flight, hollow-stem auger drilling methods. This consisted of a truck-mounted drill rig (Photographs 3-1 & 3-2) and continuous-flight augers 1.5-m (5-ft) nominal length and an inside diameter of 10.8-cm (4.25-in).

Photograph 3-1. Truck Mounted Drill Rig.

Photograph 3-2. Truck Mounted Drill Rig.

Sampling was performed using a standard steel 7.6-cm (3-in) outside diameter split-barrel soil sampler. The soil samples were drilled using wire-line method driven over a vertical distance of 0.6-m (2-ft). The maximum depth of the boreholes was 9.1-m (30-ft).

All soil samples were visually classified using the Unified Soil Classification System (USCS) and logged for the entire length of the borehole. (Photographs 3-3 & 3-4, Figure 3-2). Intentions were to adjust the number and total depth of the borings so that the sample collected was below any visual or photo-ionization detection PID evidence of contamination.

Photographs 3-3. Soil Sample Visual Classification.

Photographs 3-4. Soil Sample Visual Classification.

page 1 of 1

Project Number: 400-A7 | Project Name: Landfill 1A + 2A

Boring Number: 2A-1587 | Drilled by: GeoProjects/Benny Hinojosa

Thickness of Overburden: >30' | Total Depth of Hole: 30'

Geologist: Kyle Williams/Benito Avalos | Size and Type of Bit: 8" x 3" HSA

Drilling Method: Hollow Stem Auger | Date Started: 9 June 1999 | Date Completed: 9 June 1999

Depth (ft.)	Time	Classification of Materials	% Rec	Box or Sample No.	Remarks
	14:28	Silty sand, fine- to coarse-grained, poorly sorted, medium dense, slightly moist	100%	0 - 2	15' Hard, Fill
	14:31		100%	2 - 4	
5	14:34		100%	4 - 6	
	14:35		95%	6 - 8	
10	14:38	9' Fine gravel, small amount	100%	8 - 10	Sample
	14:40	Silty sand, with fine gravel, poorly sorted, medium dense, slightly moist	95%	10 - 12	Silty sand
	14:43	Gravelly sand, fine- to coarse-grained, poorly sorted loose, slightly moist	90%	12 - 14	
15	14:46	Silty sand, fine- to coarse-grained, fine gravel, medium dense, slightly moist	95%	14 - 16	
	14:48	Gravelly sand, fine to coarse grained, poorly sorted, loose, slightly moist	95%	16 - 18	
20	14:51	20' Silty sand, medium dense, slightly moist	85%	18 - 20	Sample
	14:54	Sand, fine- to coarse-grained, poorly sorted, loose, moist	95%	20 - 22	
	14:56	23' 24' Silty sand, fine to coarse grained, poorly sorted medium density, moist	80%	22 - 24	
25	14:59	26' Sand to gravel (fine), loose	95%	24 - 26	
	15:03	Sand, fine gravel, poorly sorted, loose, moist	95%	26 - 28	
30	15:07	Gravelly sand, fine to coarse grained, poorly sorted, loose, moist	70%	28 - 30	Sample 29' Hard gravel
		Total Depth Borehole			

Figure 3-2. Soil Boring Log.

When the split-barrel was removed from the boring and opened, any material appearing to be slough was removed. The sample was split in half for each replicate sample. Samples were placed in glass jars with teflon-lined caps and packed so as to have zero headspace. Excess soil around the top of the jars was removed to ensure the cap would have a tight fit. New, disposable gloves were worn by the sampling team members for each sample collected.

3.2.3 Laboratory Test Methods

The laboratory performed all required analyses according to the requirements of "Test Methods for Evaluating Solid Waste" SW-846 (USEPA, 1986) or "Methods for Chemical Analyses of Water and Wastes" USEPA 600 Series (USEPA, 1983). Analyses required by the laboratories were for pesticides, herbicides, polychlorinated biphenyls (PCB), volatile organic compounds (VOC), semi-volatile organic compounds (SVOC), explosives, total petroleum hydrocarbons (TPH), total cyanide and total metals. The test methodologies, sample containers, preservatives, and maximum sample holding times for all chemical parameters and sample matrices are shown in Table 3-1.

Table 3-1. Sample Containers, Test Methodologies and Hold Times for Soils

Analytical Parameter	Analytical Method[1]	Soil	
		Container	Max. Hold Time
Volatile Organic Compounds	SW 846-8260	8-oz. glass jar with teflon-lined cap	14 days
Semi-volatile Organic Compounds	8270B	4-oz glass jar with teflon-lined cap	14 days
Total Metals	SW846-6010	8 -oz. glass with teflon-lined cap	180 days
Explosives	8330	8-oz glass jar with teflon-lined cap	14 days
TPH	8015	N/A	N/A
Pesticides		4-oz glass jar with teflon-lined cap	7 days
Herbicides	8151	4-oz glass jar with teflon-lined cap	7 days
PCBs	8082	20-ml polyethylene	28 days

Notes: 1. Methods referenced are from "Test Methods for Evaluating Solid Waste, "SW-846, 1986
2. NA - Not applicable to this study

3.3 Analytical Results

3.3.1 Geophysical Survey

The study area was divided into three survey sections, designated Landfill 2A West, Landfill 2A East and the extended survey area (Figure 3-3). The EM-31 screening survey for 2A West is depicted in Figure 3-4 showing both the In-Phase response (top) and ground conductivity (bottom) data. The elevated conductivity shown in pink identifies buried waste and metal from 800E to 1300E coincident with negative In-Phase features shown in blue. An area of elevated moisture ("wet spot") was observed downstream from the buried waste. Scattered metallic debris appear as isolated conductivity and In-Phase lows across much of the survey area may be related to debris on the surface. A follow-on survey with the EM-61 was performed verifying the presence of buried metal in the channel and to the north. The results are given in Figure 3-5 with the EM-61 response superimposed on the EM-31 data. (Sunbelt 1998).

Twenty-five (25) boreholes positioned in the areas of concern were sampled for constituents at depths of 2-3 m (8-10 ft), 5-6 m (18-20 ft), and 8-9 m (28-30 ft). In order to ensure sampling equipment was cleaned properly, proper sampling procedures were implemented. Prior to the collection of each sample, all sampling equipment that came in physical contact with the matrix of interest was thoroughly decontaminated (Photograph 3-5).

Photograph 3-5. Equipment Decontamination.

In order to ensure sampling equipment was cleaned properly, proper sampling procedures were implemented. To ensure quality data from the laboratory, several forms of QA/QC samples were collected and analyzed as part of the investigation. QC samples were collected in the field and sent to the same laboratory as the rest of the field samples. QC samples include travel blanks, field blanks, and replicates. QA samples are replicates of field samples and were sent to an independent laboratory for analysis as a check on the performance of the primary laboratory.

All primary and quality control (duplicate) samples were submitted to the following laboratory:

PDP Analytical Services
1680 Lake Front Circle
Suite B
The Woodlands, Texas 77380

Quality assurance samples were submitted to:

Data Chem Laboratories
960 West LeVoy Drive
Salt Lake City, Utah 84123

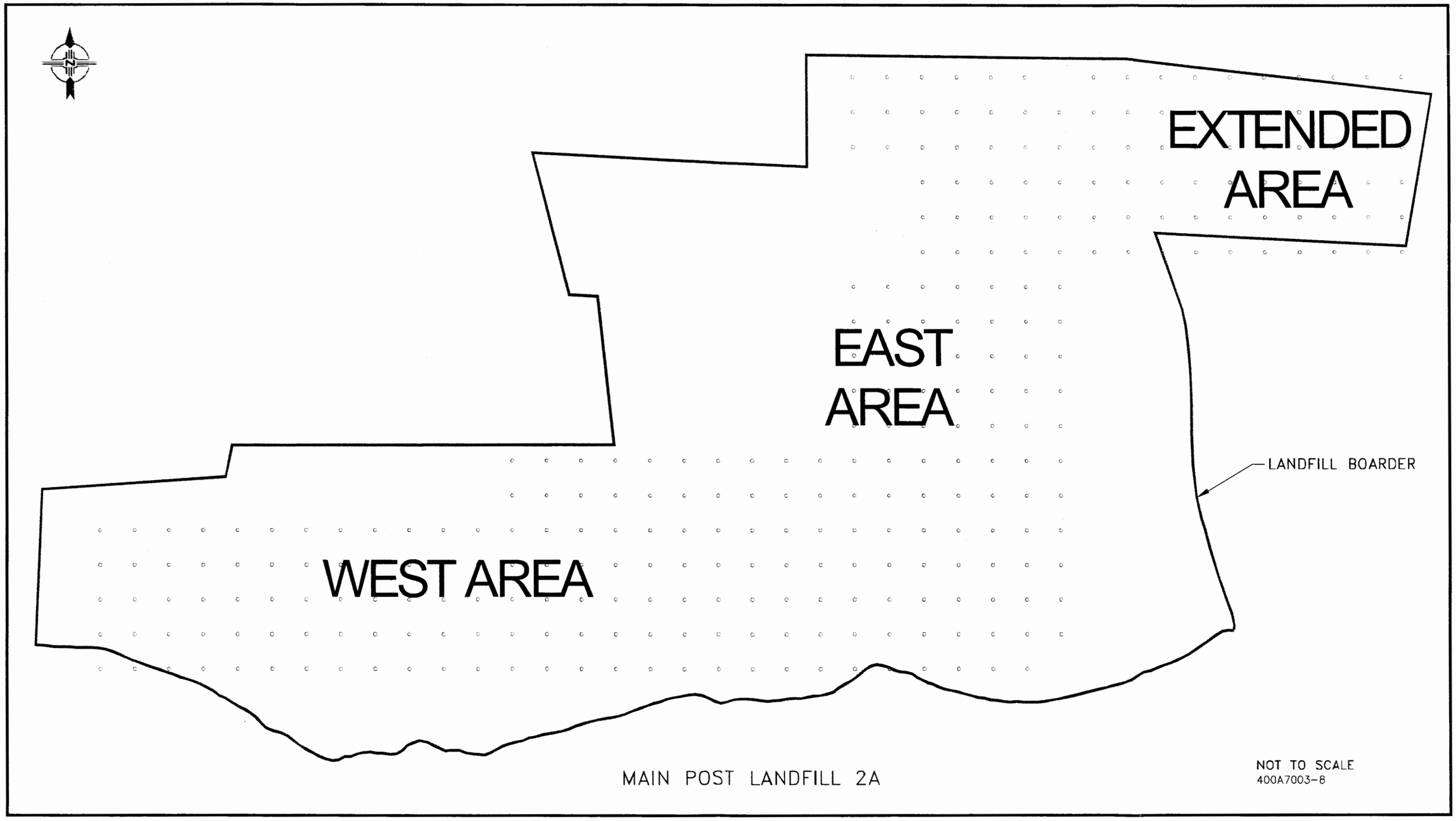

Figure 3-3. Study Area Survey Sections.

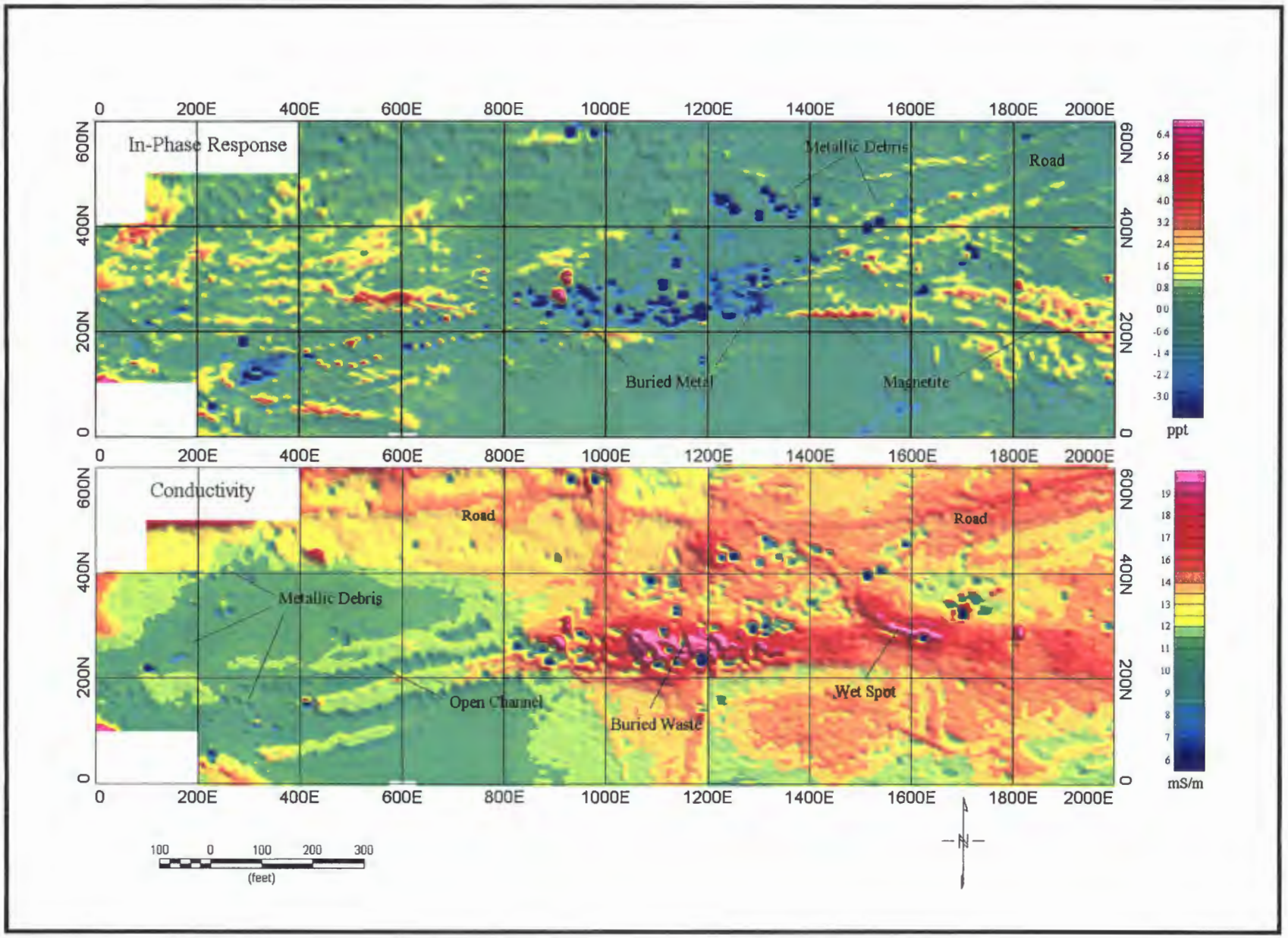

Figure 3-4. Landfill 2A West EM-31 Response.

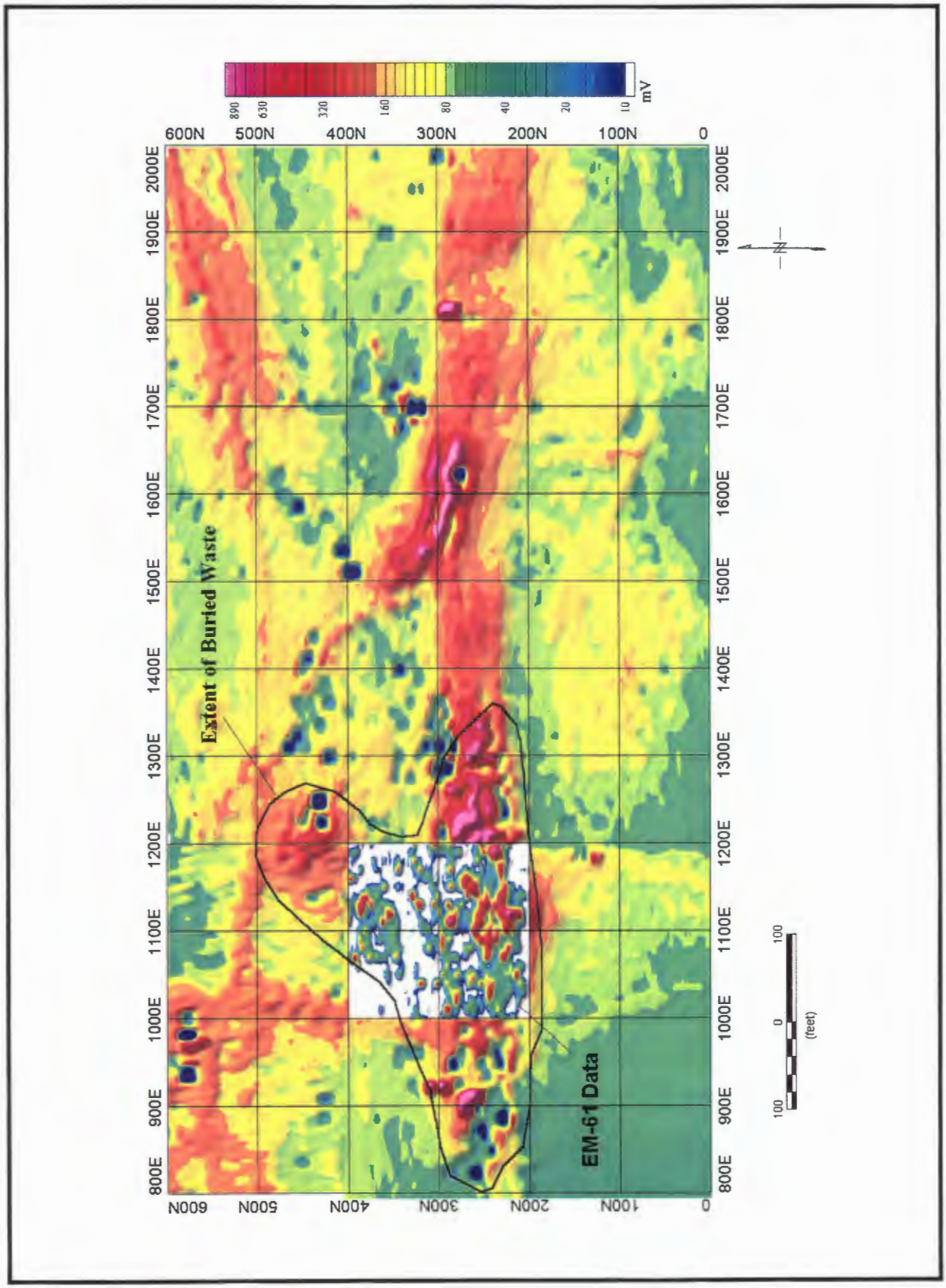

Figure 3-5. Landfill 2A West EM-61 Response Superimposed on EM-31 Response.

The investigation of Landfill 2A East was focused on suspected north-south landfill trenches. The results of the EM-31 survey are presented in Figure 3-6, including both the conductivity data and the In-Phase response. Both data sets display similar results, showing north-south trenches in the northern portion, and only scattered debris in the south. The follow-on investigation is shown in Figure 3-7 with the EM-61 data superimposed on the EM-31 conductivity data. The follow-on survey was designed to establish the northern extent of the landfill trenches. (Sunbelt 1998).

The survey extension was added to the Landfill 2A East grid, which has its origin (0,0) over 304.8-m (1000-ft) to the southwest (Figure 3-8). The EM-31 conductivity data show features like an underground cable and a cast iron water line. A smaller line water line is seen coming in from the southeast. A north-south feature crosses the water line, and is interpreted to be a telephone line. Five trenches to the south of the dirt road were identified in the conductivity data. These trenches were not very robust, indicating only modest concentrations of metallic waste. A sixth trench to the north suggested a heavy concentration of buried metal. (Sunbelt 1999).

The EM-31 In-Phase response mirrors the conductivity results, and identify five of the six suspected waste disposal trenches (Figure 3-9). A few large unknown metallic objects were observed in the area marked "?". An additional buried line is identified which appears to join the water line.

3.3.2 Soil Boring and Sampling

Soil borings were situated with the intent to identify any buried waste and/or depths at which contamination may have occurred in the area. This methodology was based on the geophysical survey interpretations, which anticipated areas and positions of buried wastes. Borings with respect to the conductivity results can be seen on Figures 3-10, 3-11, and 3-12 for the west, east and extended survey areas respectively. Borings with respect to the area of investigation can also be seen in Figure 3-13, situated closely following the grid system within the specific areas of concern designated by the geophysical study. Twenty-five of the sixty-three borings were randomly sampled for constituents within the perimeter of the areas of investigation.

Samples taken at the 25 boreholes were collected to evaluate the presence of VOCs, SVOCs, PCBs, TPH, pesticides, herbicides, explosives, total metals and total cyanide. The results of the soil analysis were well below the Environmental Protection Agency Preliminary Remediation Goals (EPA, 1998). The QA/QC results associated with the data indicate that the data met the required standards and are of known quality and are acceptable for use, with the required qualifications. No sample results were found to be unusable due to quality problems, or were qualified as rejected as a result of the evaluation. QC data demonstrated that the QA mechanisms were effective at ensuring measurement data reliability within expected limits of sampling and analytical error. The sample data are considered representative of actual site conditions at the time of sampling, and are comparable to data sets collected under similar protocols. Complete results of the soil sampling for this investigation are presented in Table 3-2. The sample ID number from the table corresponds to the lathe number. The first number is the SWMU number and the second number is the number of the lathe, which can be referred to in Figure 3-13.

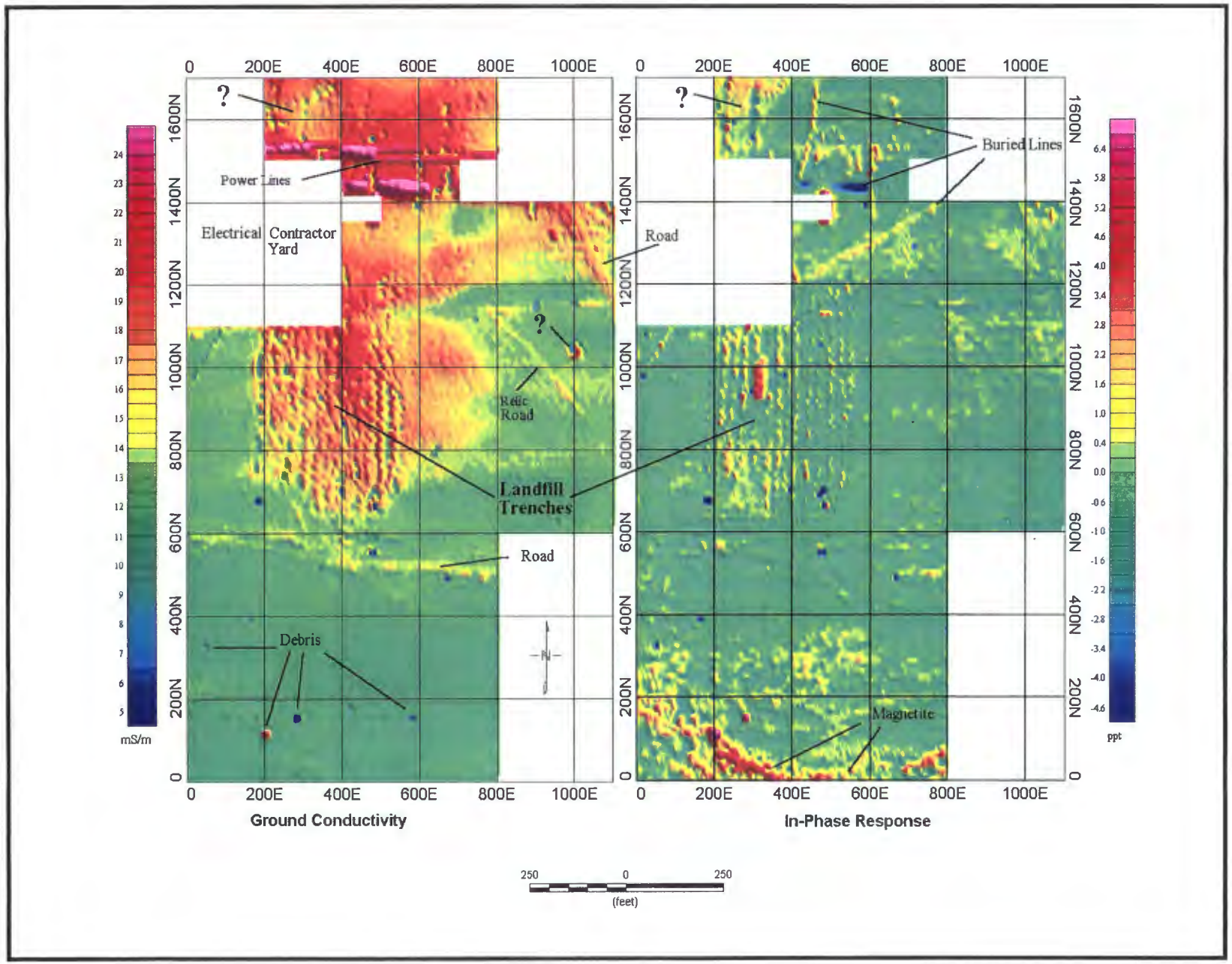

Figure 3-6. Landfill 2A East EM-31 Response.

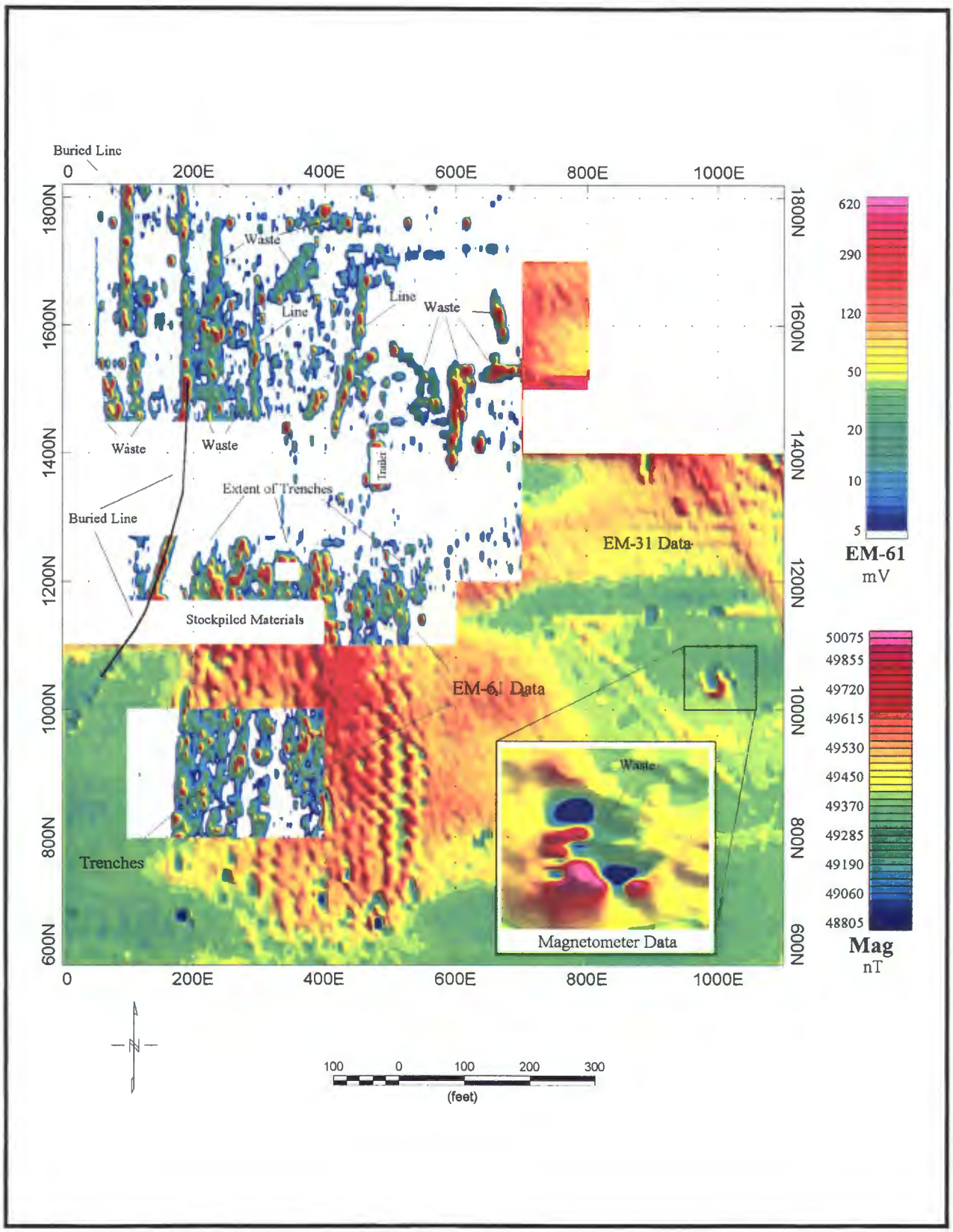

Figure 3-7. Landfill 2A East EM-61 Response Superimposed on EM-31 Response.

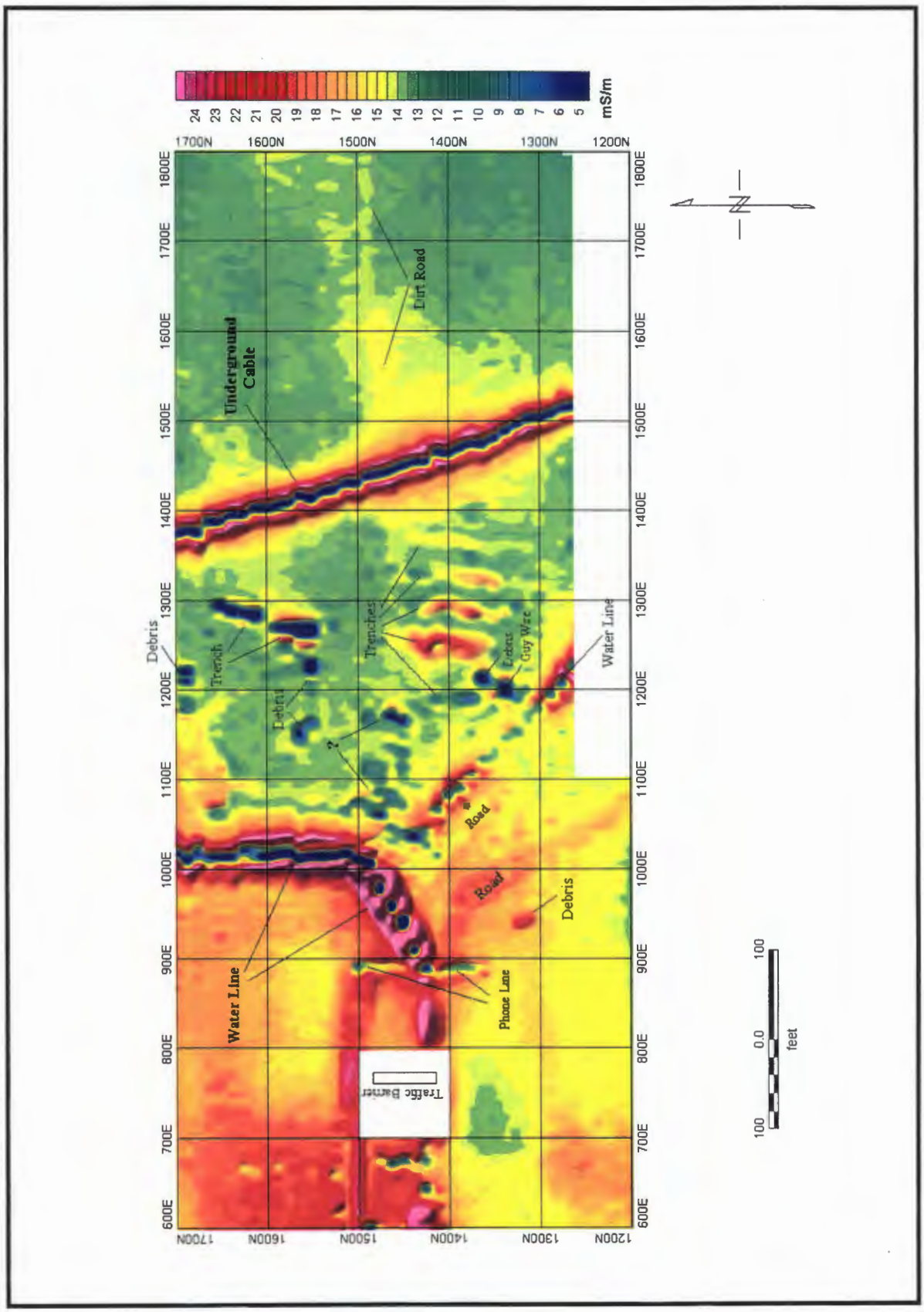

Figure 3-8. Landfill 2A Extension EM-31 Conductivity.

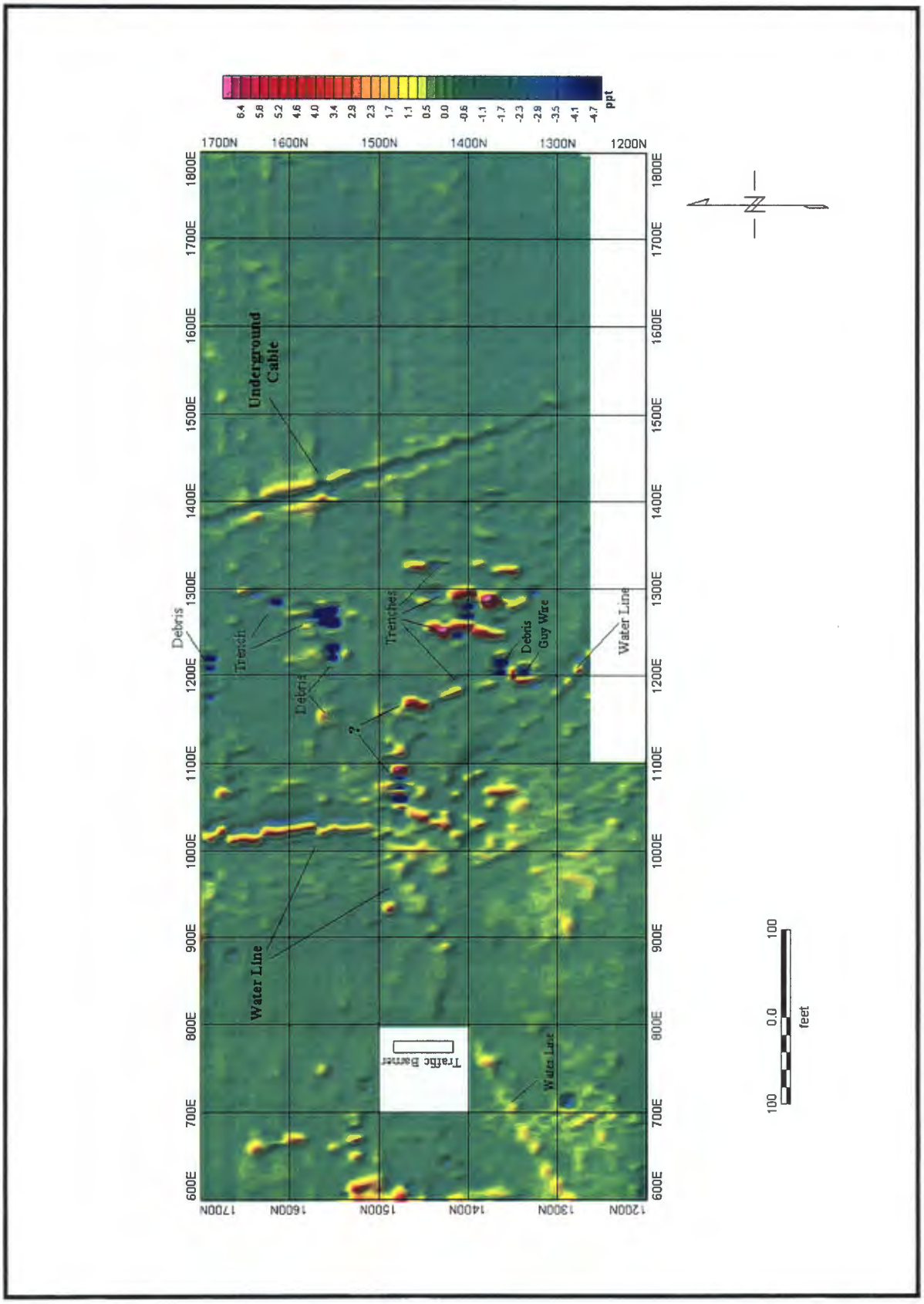

Figure 3-9. Landfill 2A (Extension) EM-31 In-Phase Response.

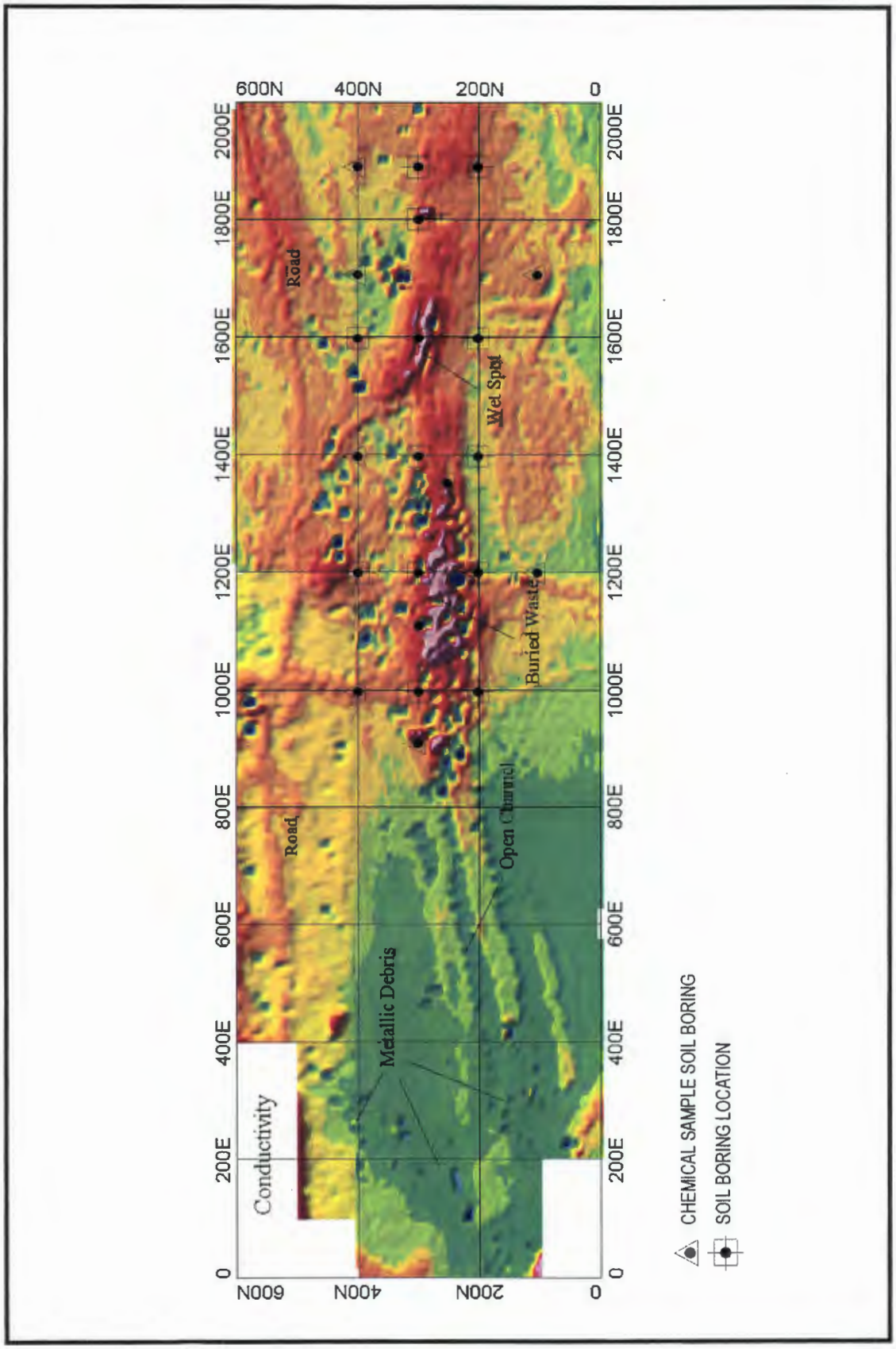

Figure 3-10. Boring Locations on West Geophysical Area.

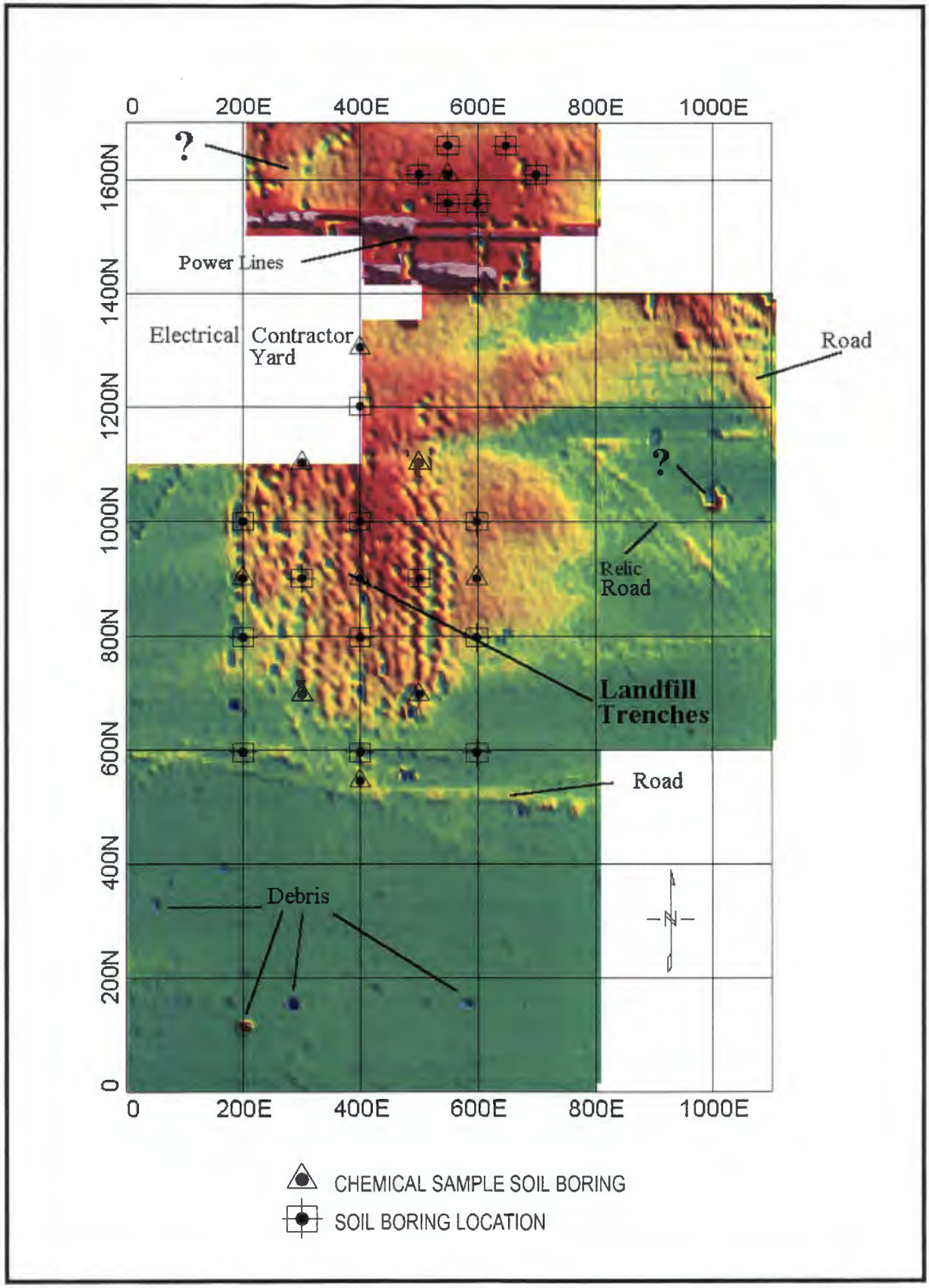

Figure 3-11. Boring Locations on East Geophysical Area.

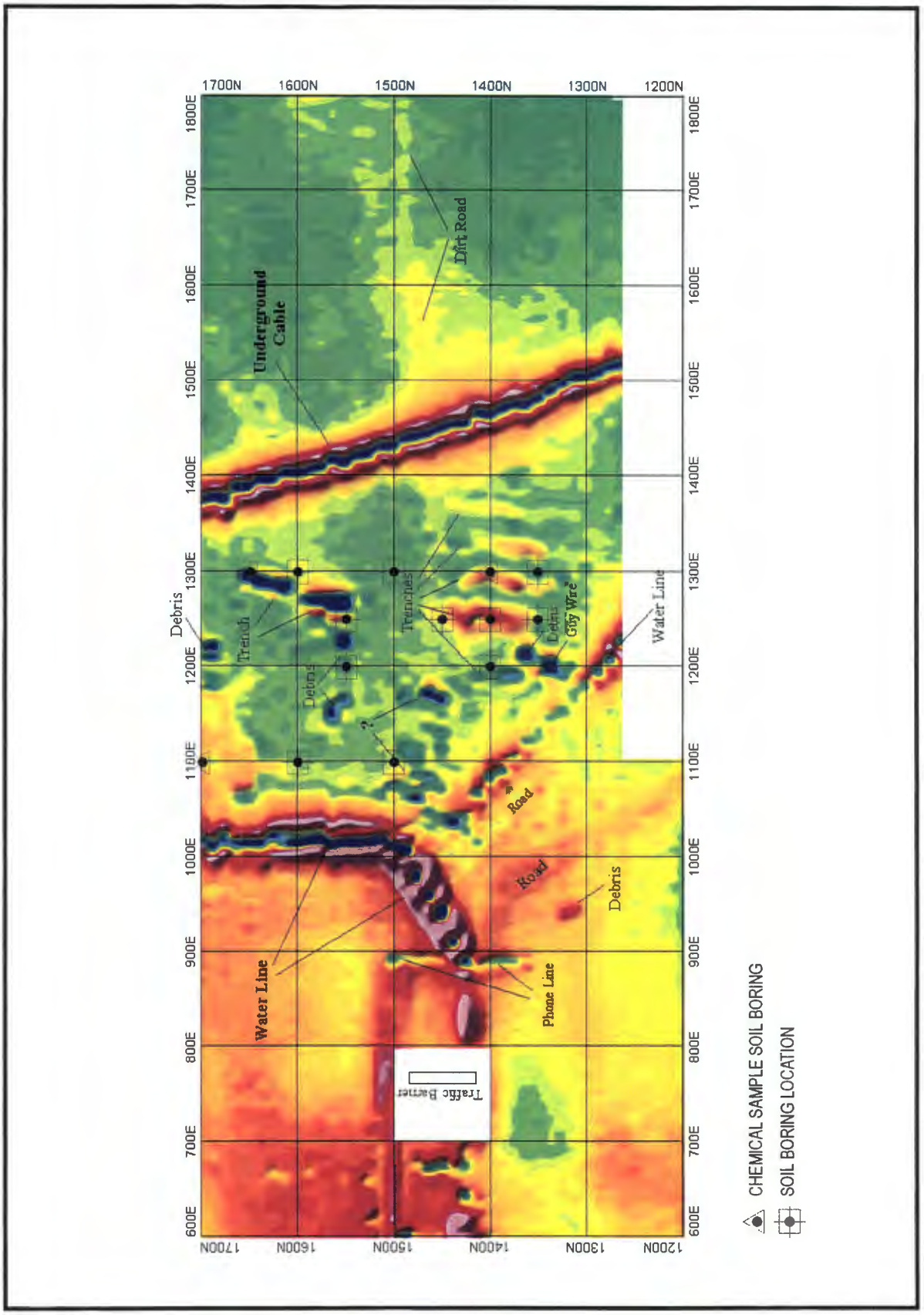

Figure 3-12. Boring Locations on Extended Geophysical Area.

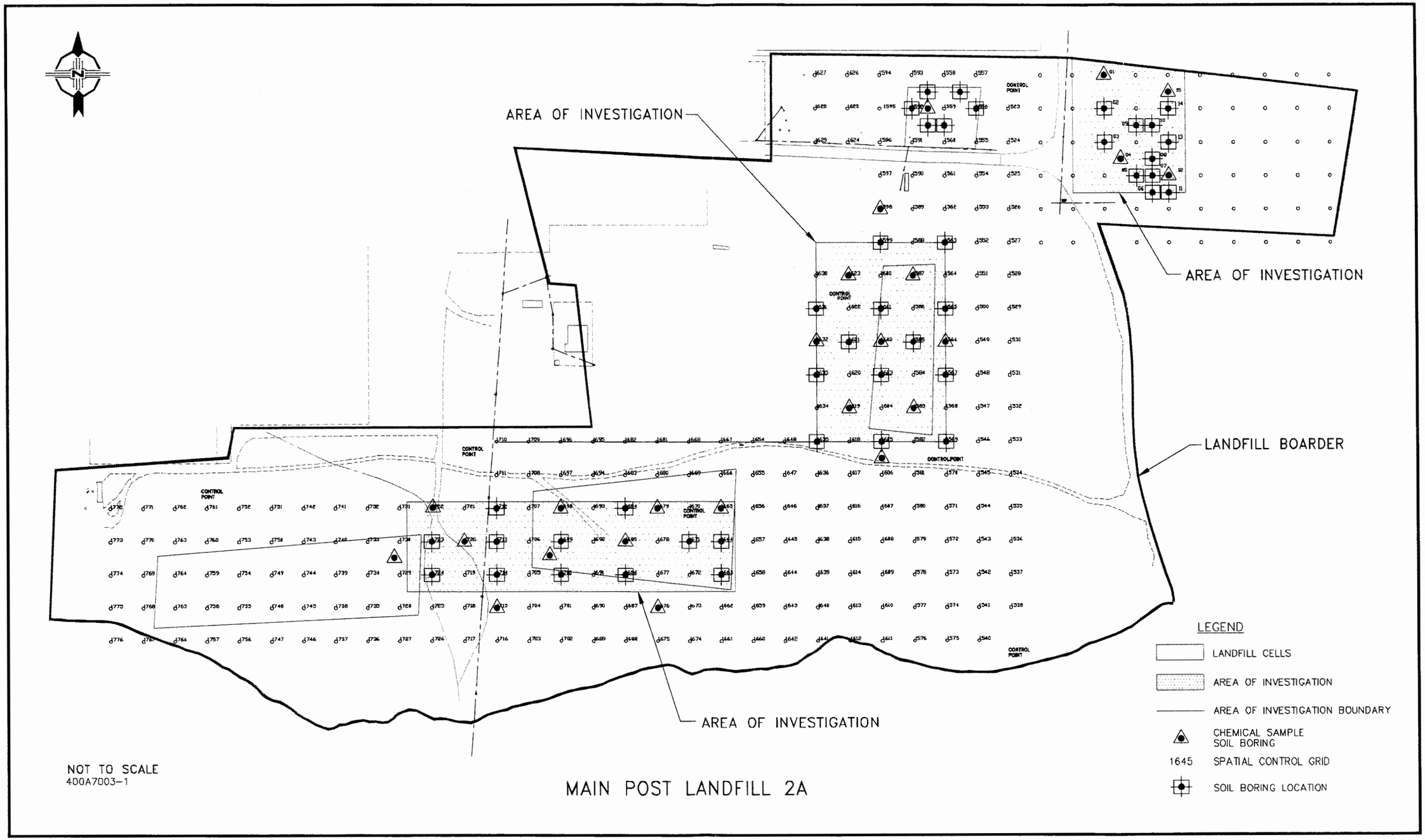

Figure 3-13. Boring Locations with Respect to Grid System.

Table 3-2. Soil Sampling Analytical Results.

	Cyanide	Methylene Chloride VOC	Di-n-butyl-phthalate SVOC	Arsenic Metal	Barium Metal	Chromium Metal	Lead Metal	Mercury Metal	Selenium Metal
	mg/kg	ug/kg	ug/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Detection Limit	**0.51**	**5**	**340**	**0.25**	**0.5**	**0.5**	**0.15**	**0.1**	**0.25**
EPA Screen Level	**1100**	**8.5**	**5500**	**21**	**5200**	**210**	**130**	**22**	**370**
Sample ID									
0063-01									
14-16 ft	ND	ND	ND	0.998	38	5.1	3.22	ND	ND
28-30 ft	ND	ND	ND	1.29	21	1.4	4.27	ND	ND
0063-04									
14-16 ft	ND	ND	ND	1.62	28	2.6	4.5	ND	ND
28-30 ft	ND	ND	ND	2.27	27	2.4	6.37	ND	ND
0063-12									
14-16 ft	ND	ND	ND	1.49	34	1.6	4.43	0.04	ND
28-30 ft	ND	ND	ND	1.69	30	2.3	3.97	0.03	ND
28'-30' QC	ND	ND	ND	1.61	29	1.8	4.28	0.05	ND
0063-15									
14-16 ft	ND	ND	ND	1.58	22	2	4.08	0.1	ND
28-30 ft	ND	ND	ND	1.54	26	2	4.52	0.04	ND
0063-1559									
14-16 ft	ND	ND	ND	1.08	49	0.97	3.49	0.04	ND
28-30 ft	ND	ND	ND	2.11	46	1.8	5.22	0.04	ND
0063-1566									
8-10 ft	ND	ND	ND	1.69	33	2.2	4.04	ND	ND
18-20 ft	ND	ND	ND	2.16	44	2.1	6.22	ND	ND
28-30 ft	1.801	2.8	ND	1.45	30	1.3	4.39	ND	ND
0063-1583									
8-10 ft	ND	2.6	ND	1.71	45	2	5.69	ND	ND
18-20 ft	ND	2.9	ND	1.88	46	2.1	6.61	ND	ND
28-30 ft	ND	2.7	ND	1.51	49	1.9	4.92	ND	ND
0063-1587									
8-10 ft	2.7	ND	ND	2.19	51	3.5	6.83	ND	ND
18-20 ft	ND	ND	ND	1.27	22	1	3.55	ND	ND
28-30 ft	2.7	ND	ND	1.48	30	1.6	4.97	ND	ND
0063-1598									
14-16 ft	ND	3.7	ND	1.52	26	9.2	4.56	ND	ND
28-30 ft	0.9895	3.6	ND	2.1	42	2.8	6.52	ND	ND
0063-1602									
8-10 ft	ND	ND	ND	1.76	47	1.9	5.26	ND	ND
18-20 ft	ND	ND	ND	2.12	53	2.3	7.24	ND	ND
28-30 ft	ND	2.6	ND	1.66	44	5.5	5.39	ND	ND
0063-1605A									
8-10 ft	ND	ND	ND	1.39	24	1.4	3.33	0.17	ND
18-20 ft	0.7188	ND	ND	2.2	60	2.2	6.89	0.17	0.46
28-30 ft	0.8355	ND	ND	1.59	21	1.6	5.04	0.16	0.43
28'-30' QC	ND	ND	ND	1.73	32	1.6	5.39	0.12	0.7

Table 3-2. Soil Sampling Analytical Results (*continued*).

	Cyanide	Methylene Chloride VOC	Di-n-butyl-phthalate SVOC	Arsenic Metal	Barium Metal	Chromium Metal	Lead Metal	Mercury Metal	Selenium Metal
	mg/kg	ug/kg	ug/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Detection Limit	**0.51**	**5**	**340**	**0.25**	**0.5**	**0.5**	**0.15**	**0.1**	**0.25**
EPA Screen Level	**1100**	**8.5**	**5500**	**21**	**5200**	**210**	**130**	**22**	**370**
Sample ID									
0063-1619									
8-10 ft	ND	3.7	ND	2.58	72	3.6	9.57	ND	ND
18-20 ft	ND	2.6	230	2.14	76	2.8	6.56	ND	ND
28-30 ft	ND	3.4	ND	1.88	49	2.2	5.36	ND	ND
0063-1623									
8-10 ft	ND	ND	ND	1.24	27	1	3.19	ND	ND
18-20 ft	ND	3.7	ND	1.26	26	1.5	4.05	ND	ND
28-30 ft	ND	3.9	ND	0.991	31	30	4.33	ND	ND
0063-1632									
18-20 ft	ND	ND	ND	1.07	19	1.3	2.9	ND	ND
28-30 ft	ND	ND	ND	1.49	34	4.9	4.88	0.04	ND
0063-1665									
8-10 ft	ND	ND	ND	2.36	43	4.6	6.87	ND	0.81
18-20 ft	0.729	ND	ND	2.32	70	7.5	7.36	ND	0.59
28-30 ft	ND	ND	ND	1.41	29	2.7	4.11	ND	0.35
0063-1676									
8-10 ft	ND	ND	ND	2.81	56	3	8.3	0.16	0.69
18-20 ft	0.6401	ND	ND	1.67	27	1.6	4.82	0.38	0.71
28-30 ft	ND	ND	ND	1.9	39	3.9	6.33	0.17	0.4
0063-1679									
8-10 ft	ND	ND	ND	1.74	30	1.6	4.44	ND	0.5
18-20 ft	ND	ND	ND	1.32	28	2.6	3.45	ND	0.27
28-30 ft	ND	ND	ND	1.78	39	3.8	4.9	ND	ND
0063-1685									
8-10 ft	ND	ND	ND	1.42	35	1.6	4.11	ND	0.56
18-20 ft	ND	ND	ND	2.21	60	4.6	8.12	0.13	0.63
28-30 ft	ND	ND	ND	2.4	50	6	7.19	ND	0.36
28'-30' QC	ND	ND	ND	1.61	30	1.7	4.35	ND	0.5
0063-1698									
8-10 ft	ND	ND	ND	1.27	23	6.6	3.82	ND	0.32
18-20 ft	ND	ND	ND	1.02	30	1.6	3.03	0.12	ND
28-30 ft	ND	ND	ND	2.1	43	2.9	6.9	0.15	0.54
0063-1699									
8-10 ft	ND	ND	ND	1.65	34	3.2	4.83	ND	ND
18-20 ft	ND	ND	ND	1.92	24	2.3	5.14	ND	0.48
28-30 ft	ND	ND	ND	1.42	23	1.6	4.44	ND	ND
0063-1706									
8-10 ft	ND	ND	ND	1.28	39	21	4.49	ND	0.66
18-20 ft	ND	ND	ND	1.54	23	8.2	5.19	ND	0.44
28-30 ft	ND	ND	ND	1.04	12	3.7	3.05	ND	0.35

Table 3-2. Soil Sampling Analytical Results (*concluded*).

	Cyanide	Methylene Chloride VOC	Di-n-butyl-phthalate SVOC	Arsenic Metal	Barium Metal	Chromium Metal	Lead Metal	Mercury Metal	Selenium Metal
	mg/kg	ug/kg	ug/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Detection Limit	**0.51**	**5**	**340**	**0.25**	**0.5**	**0.5**	**0.15**	**0.1**	**0.25**
EPA Screen Level	**1100**	**8.5**	**5500**	**21**	**5200**	**210**	**130**	**22**	**370**
Sample ID									
0063-1715									
8-10 ft	ND	ND	ND	1.27	34	1.7	3.5	ND	ND
18-20 ft	ND	ND	ND	2.6	65	3.3	5.84	ND	1
28-30 ft	ND	ND	ND	2.5	59	3.8	7.79	ND	0.34
28'-30' QC	ND	ND	ND	2.77	68	3.8	7.86	ND	0.45
0063-1720									
8-10 ft	ND	ND	ND	1.86	38	14	5.91	ND	0.49
18-20 ft	ND	ND	ND	1.14	22	11	3.39	ND	0.52
28-30 ft	ND	ND	ND	1.31	17	5.5	4.32	ND	0.6
28'-30' QC				1.31	19	1.6	4.33	ND	0.34
0063-1722									
8-10 ft	ND	ND	ND	1.28	23	1.6	3.82	ND	ND
18-20 ft	ND	ND	ND	1.32	15	1.4	3.49	ND	0.26
28-30 ft	ND	ND	ND	1.52	20	1.9	5.27	0.12	ND
0063-1730									
8-10 ft	ND	ND	ND	2.25	39	3.4	5.51	ND	0.7
18-20 ft	ND	ND	ND	1.22	21	1.5	2.95	ND	ND
28-30 ft	ND	ND	ND	1.1	16	2	4.25	ND	0.42

4.0 SUMMARY & RECOMMENDATIONS

This investigation was conducted in an effort to identify the location of the landfill reported during the RFA. Studies concluded during the Phase I and Phase II RFIs indicated that the landfill was located elsewhere. Subsequent investigations consisted of aerial searches via helicopter and studying historical aerial photographs. The aerial searches provided useful information to determine possible trench locations due to disruption of soil from earthmoving. This investigation consisted of non-intrusive geophysical studies, soil borings and soil sampling. Non-intrusive geophysical surveys were conducted to pinpoint possible trench locations identified though historical data and to identify signs of buried waste in what was believed to be trenches. The conductivity patterns from the geophysical survey were also coincident with the trenches due to the disruption of the soil from earthmoving.

The geophysical study detected several potential trenches and modest concentrations of suspected buried waste, which in turn narrowed down the search for the landfill. This information allowed for intrusive investigations to be conducted by situating boreholes within the designated areas considering the possible areas of concern. Through visual classification of the boring soil samples, no buried waste was detected. It was concluded these delineated features were consistent with past borrow activities. In addition, soil sampling was analyzed

for selected constituents from 40 CFR Part 261 Appendix VIII that may have been detected in a landfill. Laboratory analysis of the samples collected did not detect any constituents near the regulatory levels. No additional constituent specific confirmatory sampling was needed.

Based upon the data assessment of the investigation survey, no landfill or any sign of buried waste was detected. No further action is required for the remedial investigation/feasibility study at the Former Main Post Sanitary Landfill 1A. White Sands Missile Range will use this determination in conjunction with the Phase I and II RFIs to support a petition for no further action with the State. A Class III permit modification will be submitted to remove the site from the RCRA Part B Permit Corrective Action Module VIII.

LIST OF ACRONYMS

ATEC	Army Test and Evaluation Command
AOC	Area of Concern
CO_2	Carbon Dioxide
CFR	Code of Federal Regulations
cm	centimeter
° C	degrees Celsius
° F	degrees Fahrenheit
EPA	Environmental Protection Agency
ft	feet
kg	kilograms
km	kilometer
m	meter
µg/L	micrograms per liter
mg/L	milligrams per liter
mg/kg	milligrams per kilogram
NMSA	New Mexico Solid Waste Act
NM	New Mexico
NMED	New Mexico Environment Department
OSHA	Occupational Safety and Health Administration
PCB	Polychlorinated Biphenyl
PID	Photo-ionization detection
QA	Quality Assurance
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RPD	Relative percent difference
sec	Second (time)
SB	Soil Boring
SG	Soil Gas
SGS	Soil Gas Survey
sq. km	square kilometer
sq. mi.	square mile
SSHSP	Site Specific Health and Safety Plan
SVOC	Semi-volatile Organic Compound
SVS	soil vapor survey
SWMU	Solid Waste Management Unit
TC	Task Coordinator
TX	Texas
TM	Task Manager
TCLP	Toxicity Characteristics Leaching Procedure
TDS	Total Dissolved Solids
TECOM	Test and Evaluation Command
TW	Test Well

LIST OF ACRONYMS (continued)

USACOE	United States Army Corps of Engineers
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
UXO	Unexploded Ordnance
VOC	Volatile Organic Compounds
White Sands	White Sands Missile Range

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