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

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
Director, Environment and Safety Directorate

Enclosure

Copies Furnished:
Julie Jacobs, DSMOA, NMED
James Bearzi, HRMB, NMED (w/o enclosure)
John E. Kieling, HRMB, NMED (w/o enclosure)
Robert S. (Stu) Dinwiddie, HRMB, NMED (w/o enclosure)
James Harris, EPA Region VI (6PD-N)
CPT Tade, SJA, White Sands Missile Range
Nancy Kosko, CSTE-DTC-IM-E, Developmental Test Command
MEVATEC

WS-ES-EC-0036

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

FOR

BY

MEVATEC CORPORATION

June 2000

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

REPORT DOCUMENTATION PAGE	OMB No. 0704-0188

1. AGENCY USE ONLY (LEAVE BLANK)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	June 2000	Final Report

4. TITLE AND SUBTITLE

RCRA Facility Investigation, Former Main Post Landfill 2A, WSMR-40 (SWMU-64)

5. FUNDING NUMBERS

6. AUTHOR(S)

Benito Avalos, Environmental Engineer/Task Coordinator
Fred Bourger, Engineer/Task Manager

7. PERFORMING ORGANIZATION NAMES(S) AND ADDRESS(ES)

MEVATEC Corporation
Box 399
White Sands, NM 88002

8. PERFORMING ORGANIZATION REPORT NUMBER

400A7/99/001F

9. SPONSORING/MONITORING AGENCY NAMES(S) AND ADDRESS(ES)

Ms. Robin Paul, Technical Inspector
WS-ES-EC
U.S. Army White Sands Missile Range

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

WS-ES-EC-0036

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION AVAILABILITY STATEMENT

D

12b. DISTRIBUTION CODE

13. ABSTRACT (MAXIMUM 200 WORDS)

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.

14. SUBJECT TERMS

Landfill 2A, site investigation, soil borings, geophysical survey, chemical analysis

15. NUMBER OF PAGES

35

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	

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.

TABLE OF CONTENTS

Section **Page**

EXECUTIVE SUMMARY ii

1.0 INTRODUCTION 1
- 1.1 White Sands Missile Range - Background 1
- 1.2 Regulatory Requirements 6
- 1.3 Other Regulatory Issues 6

2.0 SITE BACKGROUND 7
- 2.1 Site Description and Operational History 7
- 2.2 Previous Investigations 7

3.0 CONTINUED SITE INVESTIGATION 9
- 3.1 Investigative Approach 9
- 3.2 Data Collection and Procedures 10
- 3.3 Analytical Results 16

4.0 SUMMARY AND RECOMMENDATIONS 31

LIST OF ACRONYMS 33

REFERENCES 35

List of Figures

1-1 White Sands Missile Range Location 2
1-2 Generalized east-west cross section across the southern part of the Tularosa Basin, North of Highway 70, White Sands Missile Range 4
2-1 Areas of Investigation 8
3-1 Area Spatial Control Grid 11
3-2 Soil Boring Log 14
3-3 Study Area Survey Sections 17
3-4 Landfill 2A West EM-31 Response 18
3-5 Landfill 2A West EM-61 Response Superimposed on EM-31 Response 19
3-6 Landfill 2A East EM-31 Response 21
3-7 Landfill 2A East EM-61 Response Superimposed on EM-31 Response 22
3-8 Landfill 2A Extension EM-31 Conductivity 23
3-9 Landfill 2A Extension EM-31 In-Phase Response 24
3-10 Boring Locations on West Geophysical Area 25
3-11 Boring Locations on East Geophysical Area 26
3-12 Boring Locations on Extended Geophysical Area 27
3-13 Boring Locations with Respect to Grid System 28

TABLE OF CONTENTS (*continued*)

Section **Page**

List of Photographs

3-1 Truck Mounted Drill Rig 12
3-2 Truck Mounted Drill Rig 12
3-3 Soil Sample Visual Classification...13
3-4 Soil Sample Visual Classification...13
3-5 Equipment Decontamination 15

List of Tables

1-1 Location and Water Level Data for MW-3, MW-6, MW-11 and MW-12........................6
3-1 Sample Containers, Test Methodologies and Hold Times for Soils 16
3-2 Soil Sample Analytical Results...29

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.

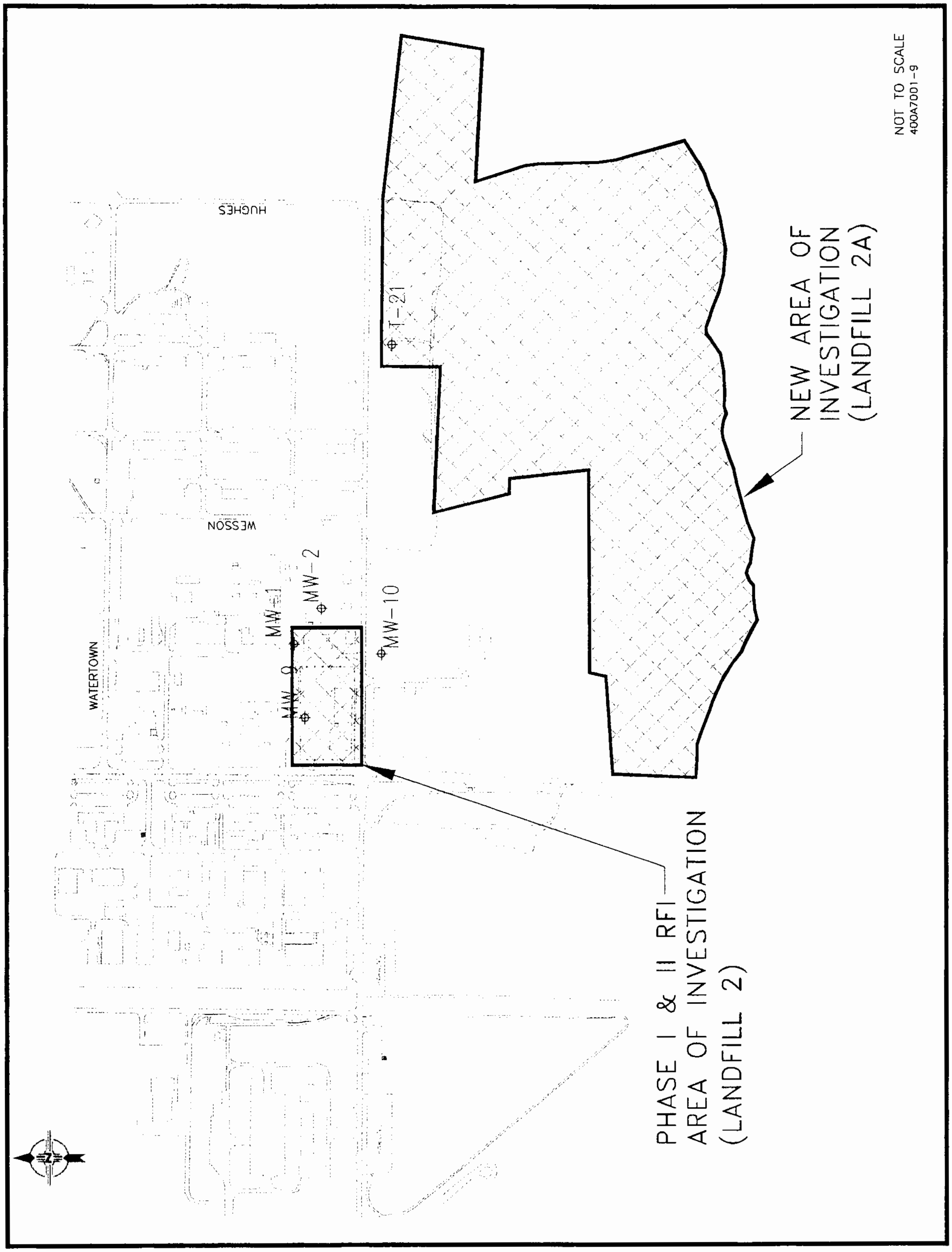

Figure 2-1. Areas of Investigation.

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).

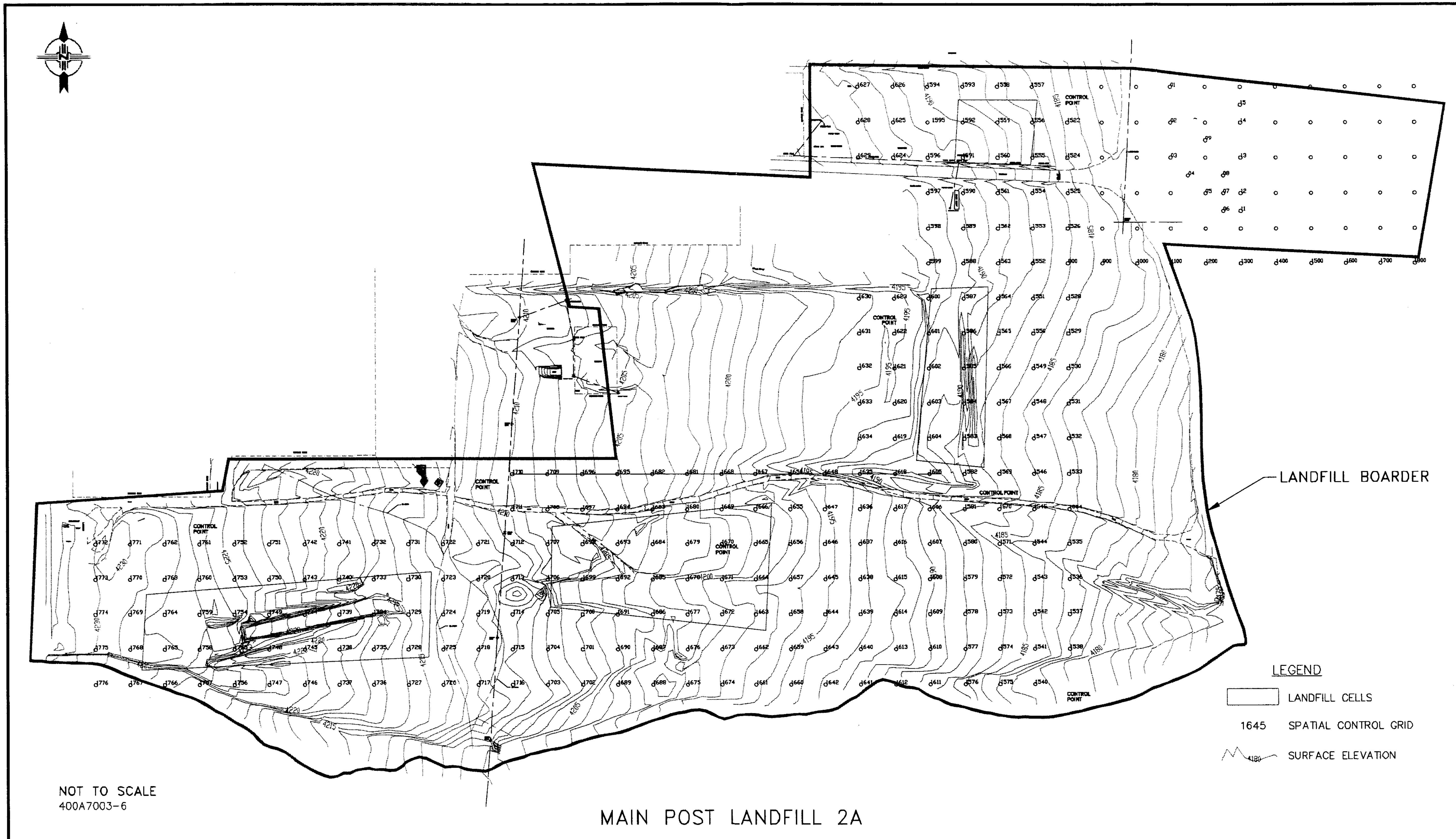

Figure 3-1. Area Spatial Control Grid.