MATERIALS LICENSE

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974 (Public Law 93-438), and Title 10, Code of Federal Regulations, Chapter I, Parts 30, 31, 32, 33, 34, 35, 36, 39, 40, and 70, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, possess, and transfer byproduct, source, and special nuclear material designated below; to use such material for the purpose(s) and at the place(s) designated below; to deliver or transfer such material to persons authorized to receive it in accordance with the regulations of the applicable Part(s). This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, as amended, and is subject to all applicable rules, regulations, and orders of the Nuclear Regulatory Commission now or hereafter in effect and to any conditions specified below.

Licensee		
1. Kerr-McGee Corporation	3. License Number	SNM-1999
2. Kerr-McGee Center Oklahoma City, OK 73125	4. Expiration Date	January 1, 1997
	5. Docket or Reference No.	70-3073 Amendment No. 5

6. Byproduct, Source, and/or Special Nuclear Material	7. Chemical and/or Physical Form	8. Maximum Amount that Licensee May Possess at Any One Time Under This License
A. Uranium Enriched in U-235	A. Contaminated soil, sludge, sediment, trash, building rubble, structures, and any other contaminated material.	A. All residual contamination which currently exists at the former Cushing Refinery Site.
B. Thorium	B. Contaminated soil, sludge, sediment, trash, building rubble, structures, and any other contaminated material	B. All residual contamination which currently exists at the former Cushing Refinery Site.
C. Natural Uranium and Depleted Uranium	C. Contaminated soil, sludge, sediment, trash, building rubble, structures, and any other contaminated material.	C. All residual contamination which currently exists at the former Cushing Refinery Site.
D. U-235	D. Calibration and reference radioactive sources containing U-235	D. No calibration or reference radioactive source containing U-235, shall exceed 0.1 microCurie per source.

9. Authorized Use: Licensed material shall be possessed and used in remediation activities leading to the decommissioning of the Cushing Site.

10. Authorized Place of Use: The existing facilities of Kerr-McGee Corporation, Environmental Operations, Technology and Engineering Division, P.O. Box 89, Cushing, OK 74023. Location: Two miles North - State Highway 18, 1/2 mile East - Deep Rock Road.

MATERIALS LICENSE
SUPPLEMENTARY SHEET

License Number
SNM-1999

Docket or Reference Number
70-3073

Amendment No. 5

11. Conditions:

A. Kerr-McGee shall submit by license amendment request, before May 1, 1994, a Proposed Decommissioning Plan for the Cushing Site meeting the requirements of 10 CFR 70.38(c)(2)(iii).

B. Kerr-McGee shall submit, by separate license amendment requests, or as a part of the Proposed Decommissioning Plan, detailed descriptions of the methods for performing the following activities, prior to beginning the activities:

1. Prior to transferring contaminated material to any of the three temporary storage areas provide an analysis of the ability of the three temporary storage areas to effectively resist erosion by wind and water, and describe the measurement procedures to be used to control the sorting of the contaminated material to be transferred to the temporary storage areas.

2. Prior to neutralizing the acidic contaminated sludge in Pit 4, describe the methods to be used.

3. Prior to demolishing potentially contaminated structures, provide a description of the methods to be used.

C. Both the 8 hour and 2 to 3 hour Health and Safety indoctrinations described in Item 8 of the application shall include all of the topics described in 10 CFR 19.12.

D. Deleted.

E. Notwithstanding statements in the application, the limits listed in "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material," Policy and Guidance Directive 83-23, August 1987, shall be used as the criteria for the unrestricted release of equipment, material, and personnel.

F. All radiation protection program procedures shall, at a minimum, be approved by the Radiation Safety Officer and either the Vice President, Environmental Operations, or the Vice President, Environmental & Health Management.

G. All work in radioactive materials areas or restricted areas, or work with licensed material not located in radioactive materials or restricted areas, shall be in accordance with an approved radiation safety procedure. Work may be performed in the haul road corridor area,* except in fenced radioactive materials areas located within the haul road corridor area, without implementing a radiation safety procedure.

---

* The haul road corridor area is considered to be defined as the aggregate of the 33 survey units addressed in Kerr-McGee's letter to the NRC dated May 30, 1996.

MATERIALS LICENSE
SUPPLEMENTARY SHEET

License Number
SNM-1999

Docket or Reference Number
70-3073

Amendment No. 5

H. Wastes disposed offsite shall be classified and meet waste form requirements of 10 CFR Part 61, meet applicable disposal site license conditions, and meet Department of Transportation and 10 CFR Part 71 transportation requirements.

I. The Radiation Safety Officer for this license is Mr. Terence Moore.

J. Licensee is exempt from the physical protection requirements of 10 CFR Part 73 and the criticality accident requirements of 10 CFR 70.24.

K. Except as specifically provided otherwise in this license, the licensee shall conduct its program in accordance with statements, representations, and conditions contained in letter dated September 25, 1992, as supplemented on December 18, 1992, January 14, 1993, February 23, 1993, August 26, 1993, and January 5, 1994.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

Date: January 7, 1997

By: John W.N. Hickey

John W.N. Hickey, Chief
Low-Level Waste and Decommissioning
Projects Branch
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards

SNM-1999
70-3073
Amendment No. 5

H. Wastes disposed offsite shall be classified and meet waste form requirements of 10 CFR Part 61 meet applicable disposal site license conditions, and meet Department of Transportation and 10 CFR Part 71 transportation requirements.

I. The Radiation Safety Officer for this license is Mr. Terence Moore.

J. Licensee is exempt from the physical protection requirements of 10 CFR Part 73 and the criticality accident requirements of 10 CFR 70.24.

K. Except as specifically provided otherwise in this license, the licensee shall conduct its program in accordance with statements, representations, and conditions contained in letter dated September 25, 1992, as supplemented on December 18, 1992, January 14, 1993, February 23, 1993, August 26, 1993, and January 5, 1994.

FOR THE NUCLEAR REGULATORY COMMISSION
[Original signed by]

Date: January 7, 1997

By: [Original signed by]
John W.N. Hickey, Chief
Low-Level Waste and Decommissioning
Projects Branch
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards

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ENCLOSURE 2

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS

RELATED TO AMENDMENT NO. 5 TO MATERIALS LICENSE NO. SNM-1999

KERR-McGEE CORPORATION

CUSHING REFINERY SITE

DOCKET NO. 70-3073

1.0 INTRODUCTION

Kerr-McGee Corporation (the licensee) in its letter dated February 16, 1996, identified a need to construct an all weather haul road on its Cushing Refinery site. Under the terms of license condition 11.G, the licensee would be required to implement a radiation safety procedure while work is being performed in the haul road corridor area.

2.0 BACKGROUND

On April 6, 1993, U.S. Nuclear Regulatory Commission (NRC) issued Materials License SNM-1999 authorizing possession of contaminated soil, sludge, sediment, trash, building rubble, and any other contaminated material, at the licensee's Cushing site. Condition 11.G of Materials License SNM-1999, states that "[A]ll work in materials areas or restricted areas, or work with licensed material not located in radioactive materials or restricted areas, shall be in accordance with an approved radiation safety procedure." However, License Condition 11.G does not include a radiation limit below which the licensee would not have to implement a radiation safety procedure while either working in materials areas or restricted areas, or working with licensed material. Thus, the licensee in its February 16, 1996, letter proposed establishing a radiation limit below which a radiation safety procedure would not have to implemented while working in the haul road corridor area.

3.0 EVALUATION

The licensee in its letter dated February 16, 1996, proposed establishing a radiation limit below which a radiation safety procedure would not have to be implemented while either working in a materials areas or restricted areas, or working with licensed material. The licensee by letter dated May 30, 1996, submitted the "Final Radiation Survey of Haul Road Corridor" (Final Survey Report) to support its proposal. In addition, the licensee requested that NRC release the haul road corridor area for unrestricted use. The licensee's request for release of this area for unrestricted release is still under review. The Final Survey Report provided data that indicated that the haul road corridor area meets NRC criteria for unrestricted release. The licensee supplemented the Final Survey Report by letter dated August 30, 1996.

In that letter, the licensee addressed NRC's concerns related to potential subsurface contamination in the haul road corridor area. Subsurface contamination could result from either migration of contaminated material from the surface or buried contaminated material. The licensee's effort to determine if migration of contaminated material had occurred in this area was to collect soil samples from the three locations of highest concentration of licensed material on the surface. The samples were taken from depths of 15 centimeters to one meter. The licensee noted that all of the soil samples yielded results indicating only background concentrations of uranium, thorium, and radium. The licensee in its letter dated November 25, 1996, submitted the results of this subsurface sampling effort. With respect to buried contaminated material, the licensee stated that there is only one location in this haul road corridor area where contaminated material is buried. This on-site burial will be assessed during NRC's evaluation of the licensee's request to have the haul road corridor area released from its license.

At the request of NRC, its contractor, the Oak Ridge Institute for Science and Education (ORISE), performed a confirmatory survey of the haul road corridor during the period of August 26 through 29, 1996. The results of that ORISE confirmatory survey were provided to NRC in the "Confirmatory Survey of the Haul Road Corridor at the Oklahoma Refinery site," dated December 1996. ORISE performed scan surveys of between 50 to 100 percent of the surface area of each selected survey unit. In addition, ORISE collected over 60 surface soil samples and three subsurface soil samples. The soil samples yielded results indicating only background or slightly above background concentrations of uranium and thorium. These results of the subsurface samples provided no definitive indication of subsurface contamination due to surface migration. There were nine samples that yielded results indicating elevated levels of radium. The elevated levels of radium ranged from 1.1 to 73.7 picocuries per gram. ORISE noted that these levels have been previously documented as being the result of past oil refinery operations which tended to concentrate radium within pipe scale. Radium is considered a naturally occurring radioactive material, and thus, regulated by states rather than NRC. ORISE's results support the licensee's position that the haul road corridor area meets NRC's unrestricted use criteria.

Therefore, NRC finds that activities may be conducted in the haul road corridor area without the implementation of a radiation safety procedure based on the licensee's Final Survey Report and ORISE's draft confirmatory survey results. This NRC finding does not include the several radioactive materials areas located within the haul road corridor area.

4.0 STATE CONSULTATION

The Oklahoma State official was notified of the proposed issuance of the amendment. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendment deletes an administrative requirement to implement a radiation safety procedure while either working in materials areas or restricted areas, or working with licensed material. Accordingly, the amendment meets the

criteria for categorical exclusion set forth in 10 CFR 51.22(c)(10). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

6.0 CONCLUSION

NRC has concluded, based on the considerations discussed above, that issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

Principal Contributor: S. Brown

Date: January 7, 1997

ENCLOSURE 3

CONFIRMATORY SURVEY OF THE HAUL ROAD CORRIDOR AT THE OKLAHOMA REFINERY SITE KERR-McGEE CORPORATION CUSHING, OKLAHOMA

[DOCKET NO. 70-3073]

D. R. QUAYLE AND T. J. VITKUS

Prepared for the
Division of Waste Management
U.S. Nuclear Regulatory Commission

ORISE

OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

Environmental Survey and Site Assessment Program
Environmental and Health Sciences Division

The **Oak Ridge Institute for Science and Education** (ORISE) was established by the U.S. Department of Energy to undertake national and international programs in science and engineering education, training and management systems, energy and environment systems, and medical sciences. ORISE and its programs are operated by Oak Ridge Associated Universities (ORAU) through a management and operating contract with the U.S. Department of Energy. Established in 1946, ORAU is a consortium of 89 colleges and universities.

CONFIRMATORY SURVEY
OF THE HAUL ROAD CORRIDOR AT THE
OKLAHOMA REFINERY SITE
KERR-McGEE CORPORATION
CUSHING, OKLAHOMA

Prepared by: _____ Date: 12/16/96
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A. T. Payne, Administrative Services Manager,
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ACKNOWLEDGMENTS

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CONFIRMATORY SURVEY OF THE HAUL ROAD CORRIDOR AT THE OKLAHOMA REFINERY SITE KERR-McGEE CORPORATION CUSHING, OKLAHOMA

Prepared by

D. R. Quayle and T. J. Vitkus

Environmental Survey and Site Assessment Program
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Prepared for

Division of Waste Management
U.S. Nuclear Regulatory Commission

FINAL REPORT

DECEMBER 1996

This report is based on work performed under an Interagency Agreement (NRC Fin. No. A-9076) between the U.S. Nuclear Regulatory Commission and the U.S. Department of Energy. Oak Ridge Institute for Science and Education performs complementary work under contract number DE-AC-05-76OR00033 with the U.S. Department of Energy.

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ABBREVIATIONS AND ACRONYMS

µR/h	microroentgens per hour
µrem/h	microrem per hour
AEC	Atomic Energy Commission
ASME	American Society of Mechanical Engineers
BKG	background
cm	centimeter
cm^2	square centimeter
cpm	counts per minute
BTP	Branch Technical Position
EML	Environmental Measurements Laboratory
EPA	Environmental Protection Agency
ESSAP	Environmental Survey and Site Assessment Program
kg	kilogram
KMC	Kerr-McGee Corporation
m	meter
m^2	square meter
m^3	cubic meter
MDC	minimum detectable concentration
MeV	mega electron volts
NaI	sodium iodide
NIST	National Institute of Science and Technology
NRC	Nuclear Regulatory Commission
ORAU	Oak Ridge Associated Universities
ORISE	Oak Ridge Institute for Science and Education
pCi/g	picocuries per gram
RMA	radioactive materials area
UA	unaffected area
UF_4	uranium tetrafluoride
UF_6	uranium hexafluoride

CONFIRMATORY SURVEY
OF THE HAUL ROAD CORRIDOR AT THE
OKLAHOMA REFINERY SITE
KERR-McGEE CORPORATION
CUSHING, OKLAHOMA

INTRODUCTION AND SITE HISTORY

The Cushing Refinery Site is located two miles north of the City of Cushing in Payne County, Oklahoma and was operated from 1915 to 1972. Kerr-McGee Corporation (KMC) purchased the Cushing site from General American Oil Company of Texas in 1956 and operated an oil refinery there from 1956 to 1972. From 1962 to 1966, KMC used part of the Cushing refinery site to process natural thorium and natural, depleted, and enriched uranium under two Atomic Energy Commission (AEC) licenses, SMB-664 and SNM-695.

AEC license SMB-664 was issued to KMC on November 7, 1962 and authorized unlimited quantities of uranium and thorium in a variety of chemical forms. The bulk of uranium material received was UF_6 (uranium hexafluoride). Typical products were oxides, carbides, fluorides, nitrates, metal, etc. Thorium material was received in the form of concentrates. Typical products were oxides or carbides or combinations of uranium and thorium compounds at various ratios of thorium to uranium.

AEC license SNM-695 was issued to KMC on April 23, 1963 and authorized possession of any enriched uranium in any form, except metal, including scrap recovery, not to exceed 1000 kilograms (kg) of uranium-235. The uranium was received in the form of UF_6 and other chemical compounds and was converted to other compounds of uranium suitable for nuclear fuels. AEC license SNM-695 was amended to permit reduction of high enriched UF_4 (uranium tetraflouride) to uranium metal buttons.

Enriched uranium was processed at Cushing from early 1963 until September 1965 and thorium processing was performed from December 1964 until February 1966. In April 1966, KMC reported to the AEC that as of April 26, 1966, all special nuclear material had been transferred from the Cushing site to KMC's new Cimarron facility in Crescent, Oklahoma and that all Cushing buildings in which licensed activities had been performed were cleaned and decontaminated. The AEC conducted a close-out survey of the Cushing facility on July 6, 1966. On the basis of this survey, and in response to KMC's request for authorization to release the facility for unrestricted use, licenses SMB-664 and SNM-695 were terminated on July 25, 1966.

During cleanup activities, some radioactively contaminated materials were placed in burial trenches, old petroleum storage tank dike areas, and part of a hydrocarbon waste impoundment (Pit 4) on the site. Materials placed in trenches and the waste impoundment were covered with native soil. An October 1989 radiological survey conducted by Oak Ridge Associated Universities (ORAU) confirmed the presence of general low-level radioactive material in the northeast corner of the site around and in Pit 4.

The remediation and restoration of the former refinery site by KMC has identified localized areas of contamination from former processing and waste management activities. About 5600 cubic meters (m^3) of soil and other materials contaminated with licensed uranium or thorium in excess of the limits specified in Nuclear Regulatory Commission (NRC) Branch Technical Position (BTP) Option 2 or 4 are estimated to remain on site. About 1375 m^3 of material at Option 1 concentrations is buried on-site in trenches. On April 6, 1993, the NRC issued license SNM-1999 to KMC for decommissioning the site for release for unrestricted use.

KMC is scheduled to begin acid sludge remediation at the site and intends to construct haul roads for transporting treated sludge to on-site disposal cells. The roads will run through portions of the site that were used for petroleum refining during the years that nuclear material processing was performed. Most of the roads will be within the north tank farm which was used for crude oil and refined oil storage. Thorium-contaminated wastewater was dumped in various tank dikes and also sprayed in the northeast corner of the tank farm. KMC has petitioned the NRC for release for unrestricted use of the corridor where the haul roads will be constructed in order to permit construction activities without the requirements for radiation safety training and monitoring. In support of this petition, KMC performed a radiological survey of the haul road corridor land areas and provided the results in a final status survey report (KMC 1996). The results of that survey indicated that the NRC's guidelines for residual concentrations of uranium and thorium in soil were satisfied, with the exception of two areas that will be maintained as radioactive materials areas (RMA). Portions of the roads also will be established in areas unaffected by radioactive material use that KMC previously surveyed. The Oak Ridge Institute for Science and Education (ORISE) performed a confirmatory survey of those areas in September 1995 (ORISE 1996a). At the request of the NRC's Division of Waste Management, the Environmental Survey and Site Assessment Program (ESSAP) of ORISE performed a confirmatory survey of the affected portions of the haul road corridor. This report describes the procedures and results of this survey.

SITE DESCRIPTION

The KMC Cushing site is located in Payne County, Oklahoma, two miles north of the City of Cushing (Figure 1). Cushing lies about midway between Tulsa and Oklahoma City. The terrain of the region is rolling, oil-producing pasture land. Several oil fields were developed in the immediate area. The elevation of the refinery site ranges from 250 to 280 meters above sea level. The entire Cushing site encompasses approximately 178 hectares. The haul road corridor is located in the north-central portion of the plant. KMC has divided the corridor into 33 survey units, with each survey unit containing approximately 10,000 square meters (1 hectare) of land area (Figure 2).

OBJECTIVES

The objectives of the confirmatory survey were to provide independent document reviews and radiological data for use by the NRC in evaluating the adequacy and accuracy of the licensee's final status survey report relative to established NRC guidelines.

DOCUMENT REVIEW

ESSAP reviewed the licensee's documentation associated with the final status survey of the haul road corridors and analytical procedures and methods used by the licensee were reviewed for adequacy and appropriateness. The data were reviewed for accuracy, completeness, and compliance with applicable NRC guidelines.

PROCEDURES

ESSAP performed a confirmatory survey of the proposed haul road corridors at the Cushing Refinery Site during the period August 26 through August 29, 1996. The survey was in accordance with a site-specific survey plan dated August 15, 1996 which was submitted to and approved by NRC and in accordance with the ORISE/ESSAP Survey Procedures and Quality Assurance Manuals (ORISE 1996b, 1995a and b). A total of ten survey units were selected, investigating eight that were adjoining established RMA's and two that were randomly selected (Figure 2).

Reference Grid

ESSAP used the existing 100 meter × 100 meter survey unit established by KMC for survey data reference.

Surface Scans

Surface scans for gamma activity were performed over approximately 50 to 100 percent of each selected survey unit using NaI scintillation detectors coupled to portable ratemeters and ratemeter-scalers with audible indicators. Areas of elevated direct radiation identified by scans were marked for further investigation.

Exposure Rate Measurements

Exposure rate measurements were performed at a minimum of five systematic locations within each survey unit and at locations of elevated direct gamma radiation detected by surface scans. Exposure rates were measured at 1 meter above the surface using a microrem meter. Measurement locations are shown in Figures 3 through 13. Background exposure rate measurements were obtained during a previous survey at the Cushing Refinery Site (ORISE 1996a).

Soil Sampling

The analytical results of background soil samples, collected during a previous ORISE survey at the Cushing Refinery Site were used for comparison (ORISE 1996a). A total of sixty-three surface soil samples were collected from the selected survey units, in which six were composite samples and three were borehole samples. Sampling locations are shown in Figures 3 through 13.

SAMPLE ANALYSIS AND DATA INTERPRETATION

Samples and survey data were returned to the ORISE/ESSAP laboratory in Oak Ridge, TN for analyses and interpretation. Sample analysis was in accordance with the ORISE/ESSAP Laboratory Procedures Manual (ORISE 1995c). Soil samples were analyzed by solid-state gamma spectrometry and the spectra were reviewed for radionuclides of interest; U-235, U-238, Th-232, Th-228 and any other identifiable photopeaks. Soil samples results were reported in units of picocuries per gram (pCi/g). Exposure rate measurements were reported in microroentgens per hour (μR/h). Results were compared with the licensee's documentation and NRC guidelines for release for unrestricted use. Additional information concerning major instrumentation, sampling equipment, and analytical procedures are provided in Appendices A and B.

FINDINGS AND RESULTS

SURFACE SCANS

Surface scans for gamma activity within the haul road corridor identified seven locations of elevated direct gamma radiation in survey unit 40A, one location of elevated direct gamma radiation in survey unit 32A, and one location of elevated direct gamma radiation in survey unit 54A. Surface scans for gamma activity within the remaining surveyed areas did not identify any locations of elevated direct radiation.

EXPOSURE RATES

Exposure rates at 1 meter above the surface ranged from 9 to 15 μR/h (Table 1). Background exposure rates ranged from 4 to 5 μR/h (ORISE 1996a).

RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES

Radionuclide concentrations in background soil samples were less than 0.1 pCi/g for U-235, 1.0 to 1.6 pCi/g for U-238, 0.5 to 1.0 pCi/g for Th-228, 0.6 to 0.9 pCi/g for Th-232, and 0.6 to 0.9 pCi/g for Ra-226 (ORISE 1996a).

Concentrations of radionuclides in confirmatory soil samples from the selected haul road corridor survey units are summarized in Table 1. Concentration ranges were as follows: U-235, less than 0.8 pCi/g; U-238, less than 2.9 pCi/g; Th-228, 0.5 to 2.9 pCi/g; Th-232, less than 0.4 to 2.8 pCi/g. Elevated levels of Ra-226, ranging from 1.1 to 73.7 pCi/g, were detected in nine soil samples which corresponded to the locations of elevated direct radiation previously discussed. These levels have been previously documented as being the result of past oil refinery operations which tend to concentrate Ra-226 within pipe scale (ORISE 1996a). Ra-226 concentrations in all remaining soil samples ranged from 0.5 to 1.0 pCi/g.

COMPARISON OF RESULTS WITH GUIDELINES

The primary contaminants of concern for this site are enriched uranium and natural thorium. The generic guidelines for residual concentrations of uranium in soil are provided in the NRC Branch Technical Position on "Disposal or Onsite Storage of Thorium and Uranium Wastes from Past Operations" (NRC 1981). Specifically, the Option 1 average soil guidelines for enriched uranium and thorium are 30 pCi/g and 10 pCi/g, respectively.

Soil samples collected from the haul road corridors were generally consistent with natural background levels of uranium and thorium and therefore all soil samples were within the Option 1 soil guideline for enriched uranium and natural thorium.

The exposure rate guideline, measured at 1 m from the surface, is 10 μR/h above background (NRC 1981). Exposure rates measured in the haul road corridors were all within this guideline.

SUMMARY

ESSAP performed confirmatory survey activities of the haul road corridors located at the Kerr-McGee Cushing Refinery Site in Cushing, Oklahoma during the period of August 26 through 29, 1996. Survey activities included surface scans, exposure rate measurements, and soil sampling. The ESSAP confirmatory measurements support the licensee's conclusion that residual radioactivity within the specified haul road corridors at the Cushing Refinery Site satisfies NRC guidelines for release for unrestricted use.

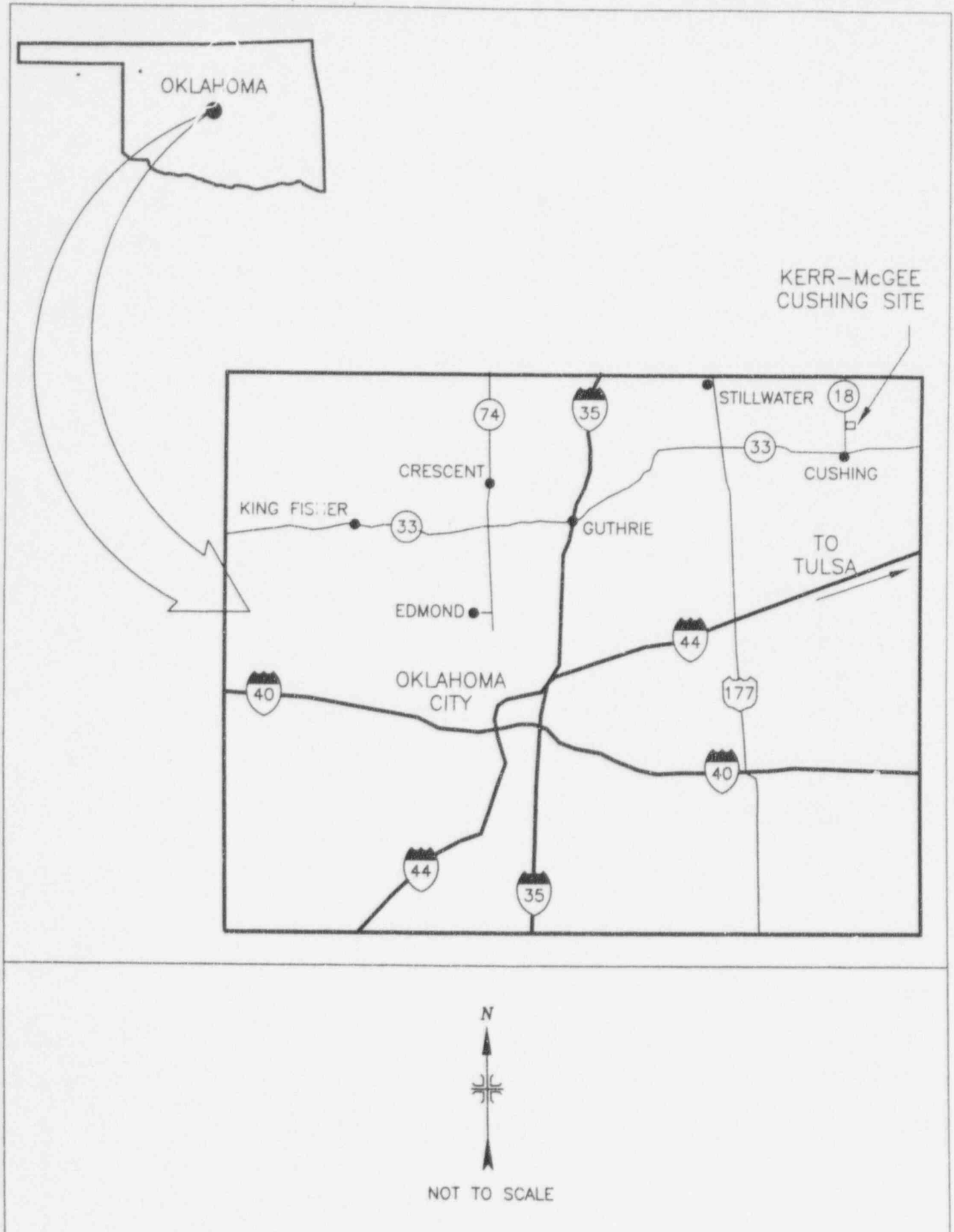


FIGURE 1: Location of the Kerr-McGee Corporation Site, Cushing, Oklahoma

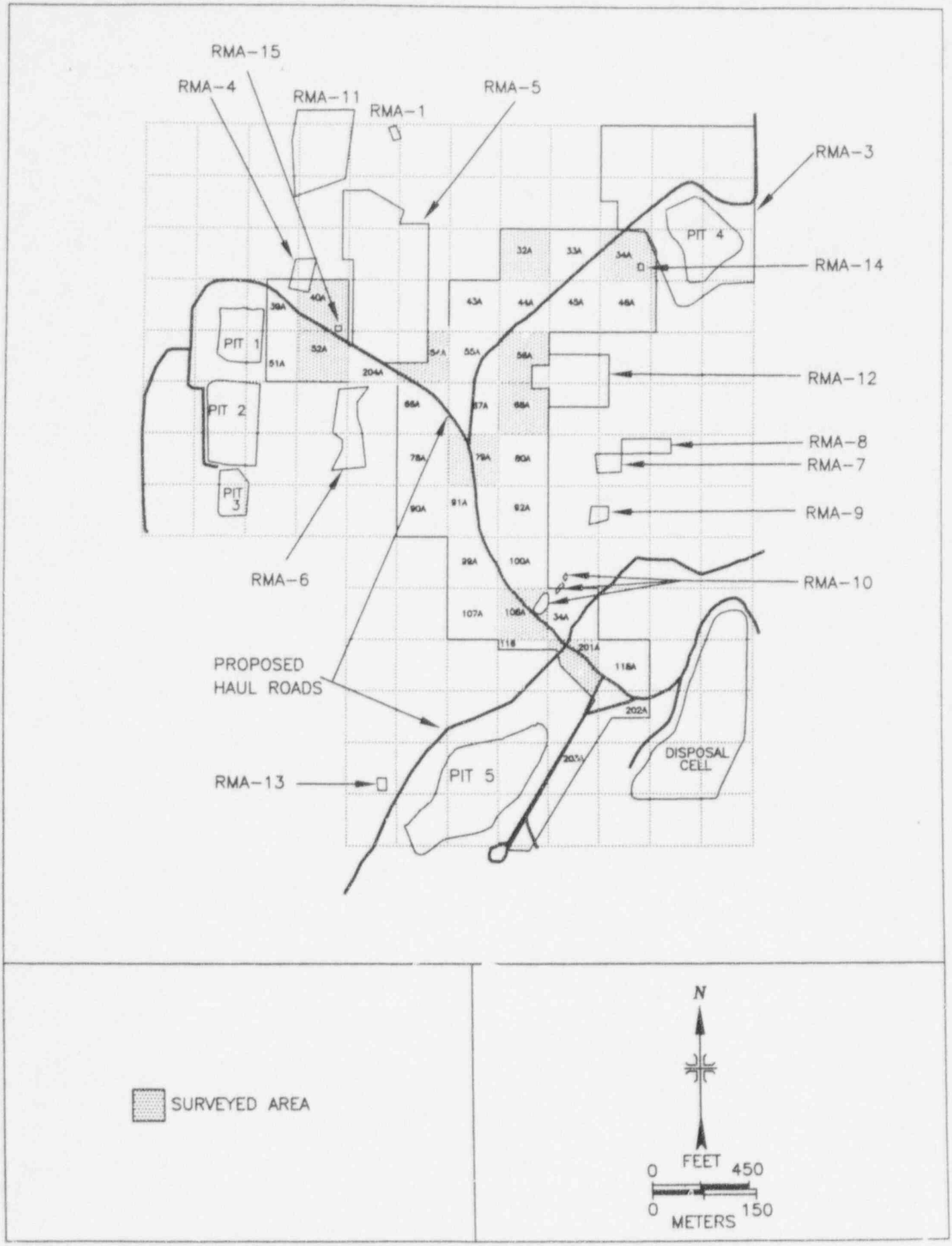


FIGURE 2: Haul Road Corridor, Kerr-McGee Corporation – Survey Unit Locations and Areas Surveyed

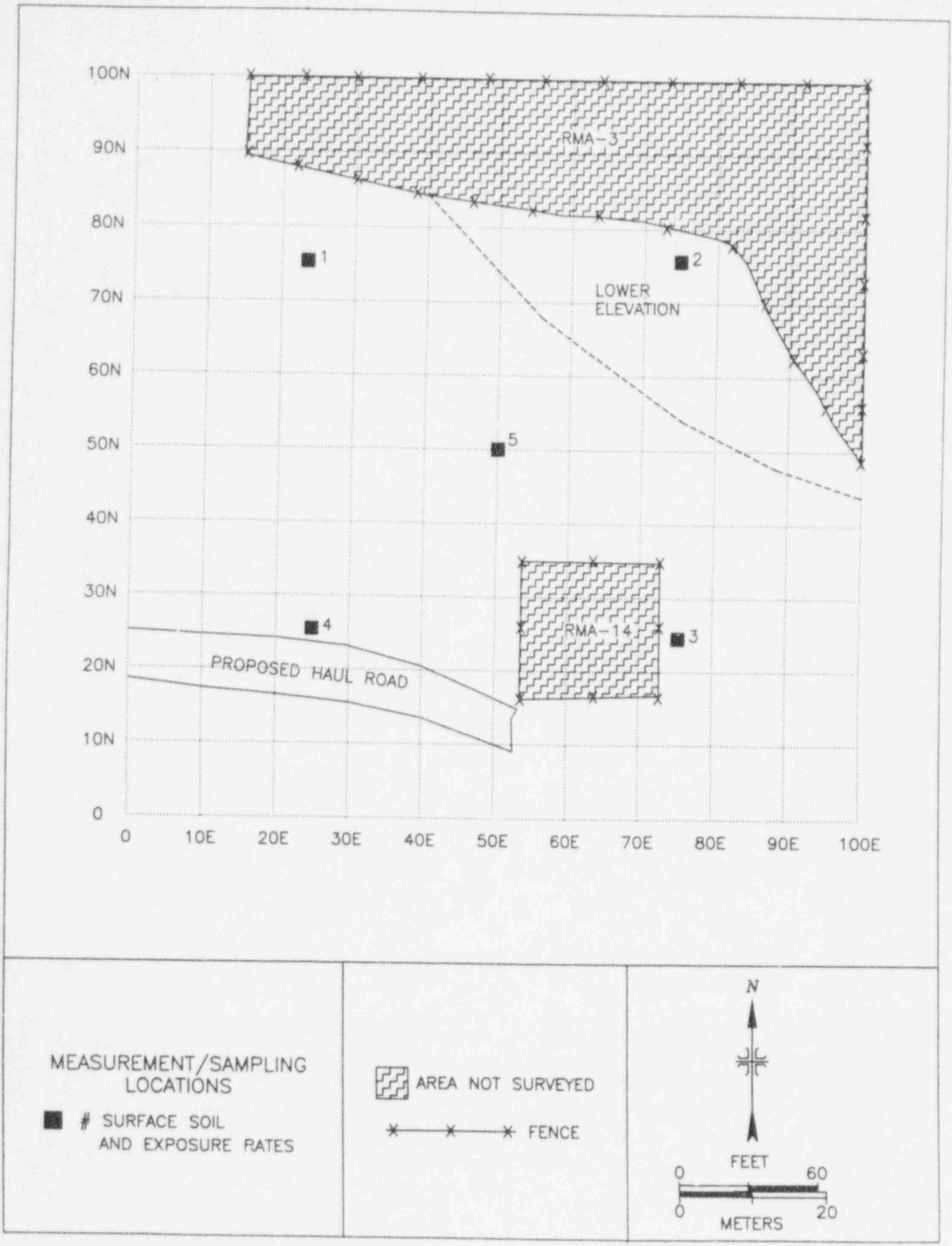


FIGURE 3: Survey Unit 34A – Measurement and Sampling Locations

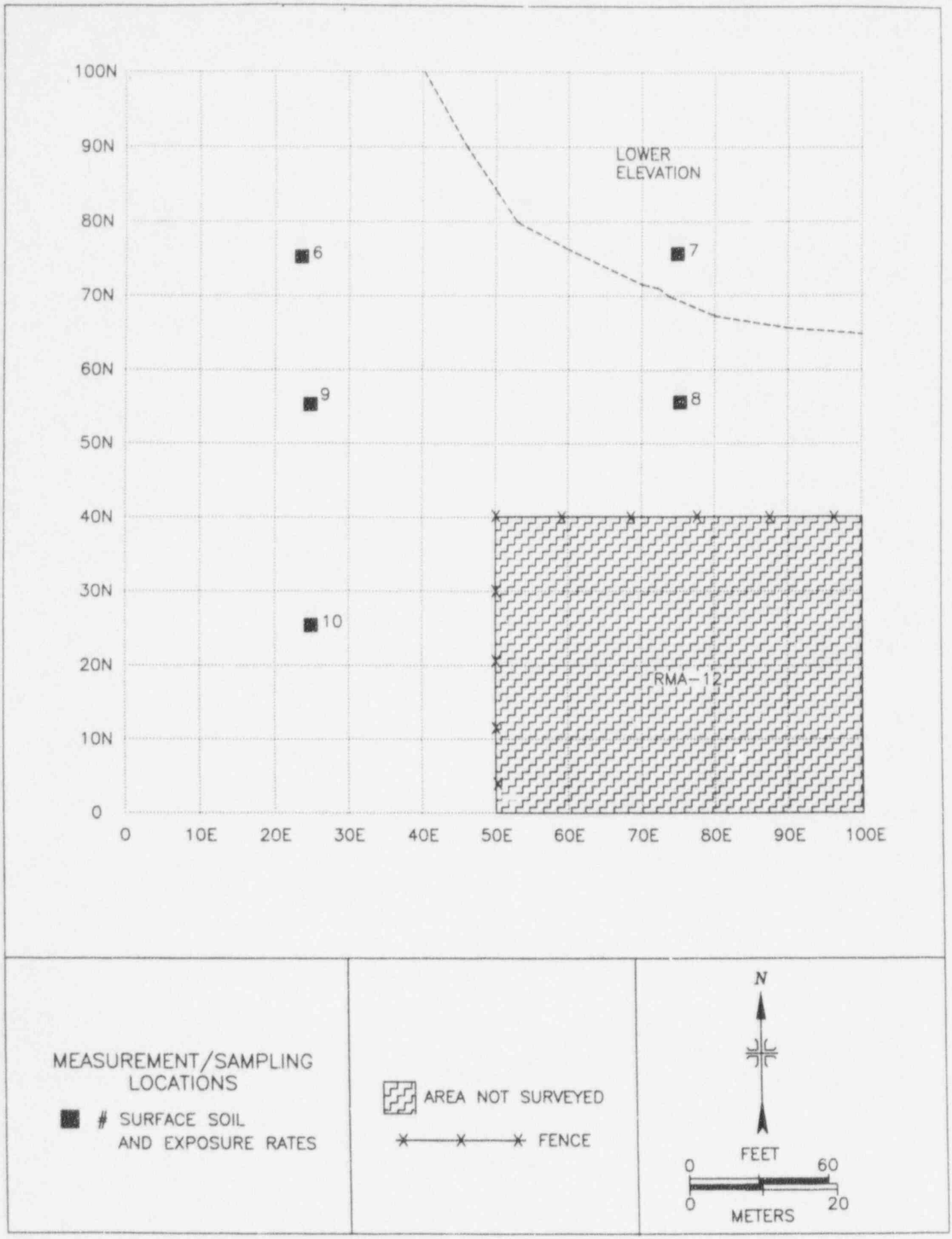


FIGURE 4: Survey Unit 56A – Measurement and Sampling Locations

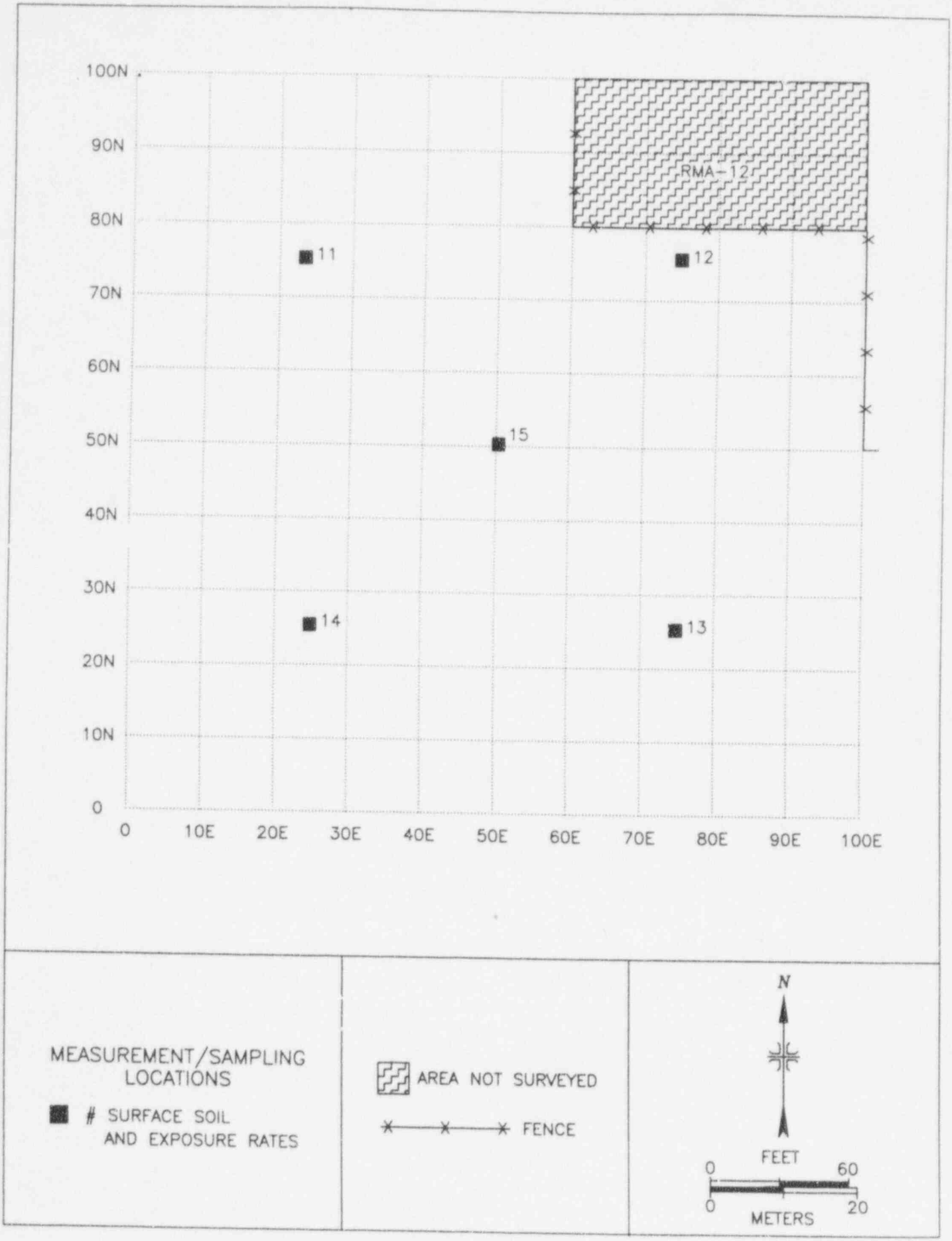


FIGURE 5: Survey Unit 68A – Measurement and Sampling Locations

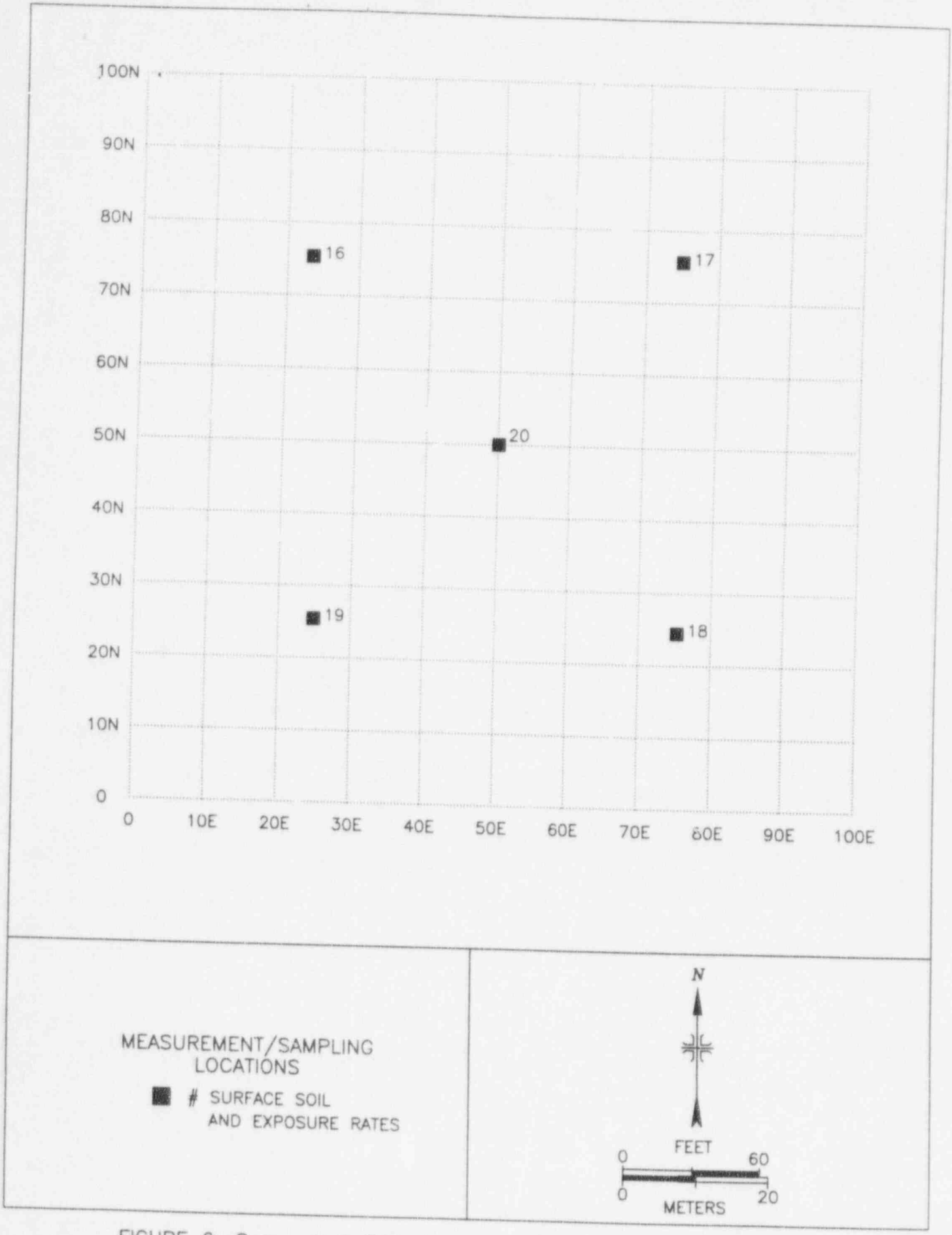
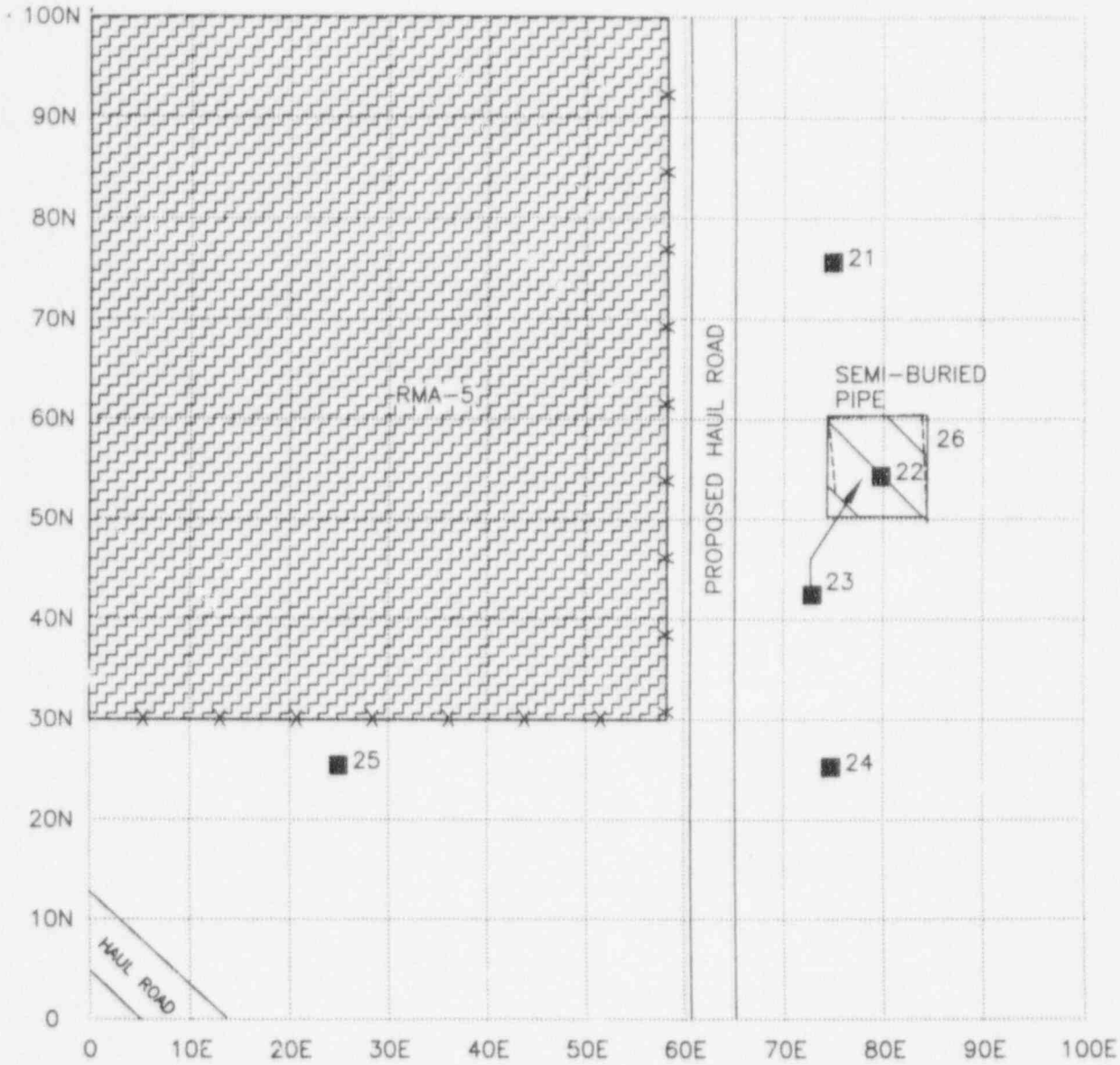


FIGURE 6: Survey Unit 79A – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

■ # SURFACE SOIL AND EXPOSURE RATES

4-POINT COMPOSITE

AREA NOT SURVEYED

FENCE

N

FEET

0 60

0 20

METERS

FIGURE 7: Survey Unit 54A – Measurement and Sampling Locations

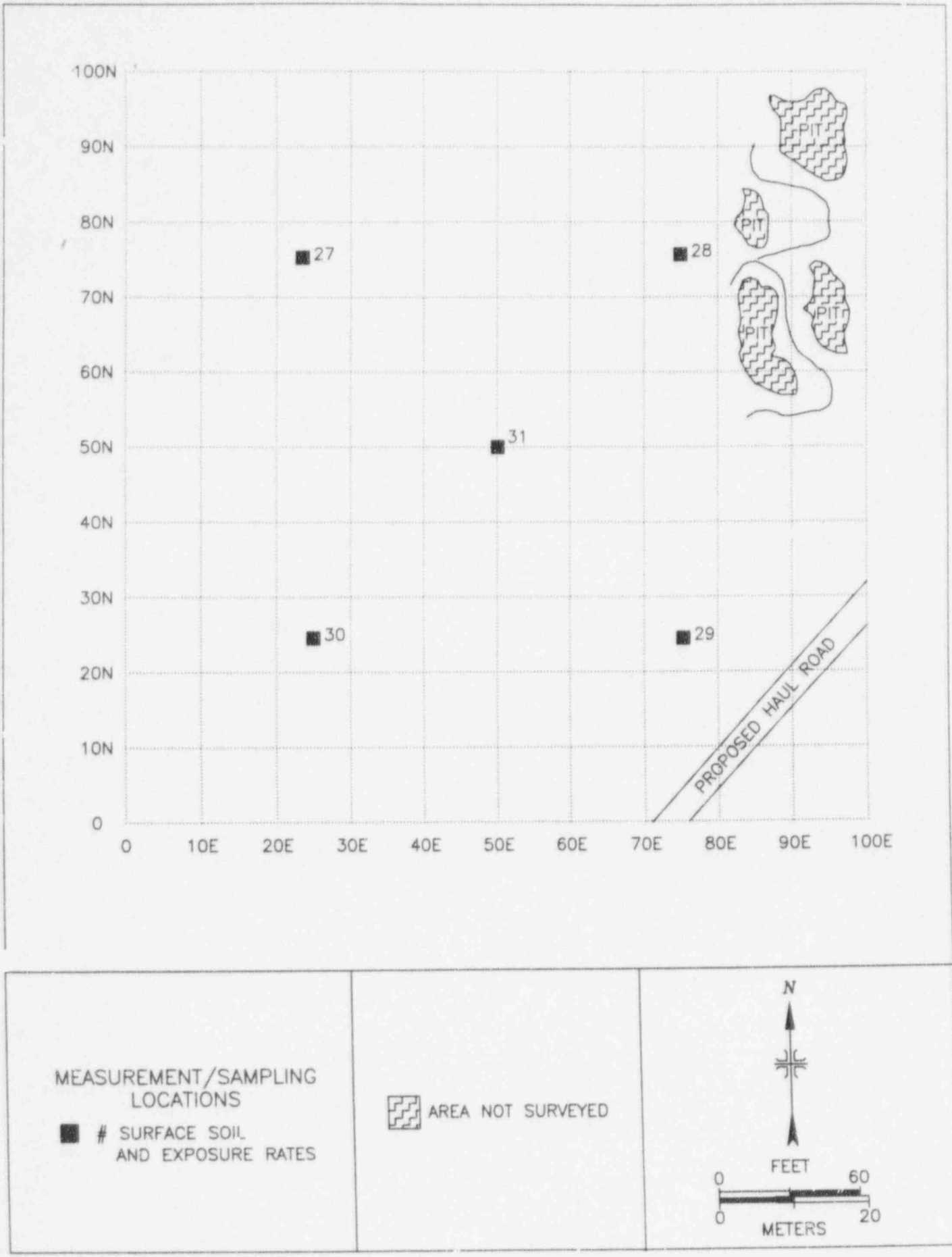


FIGURE 8: Survey Unit 32A – Measurement and Sampling Locations

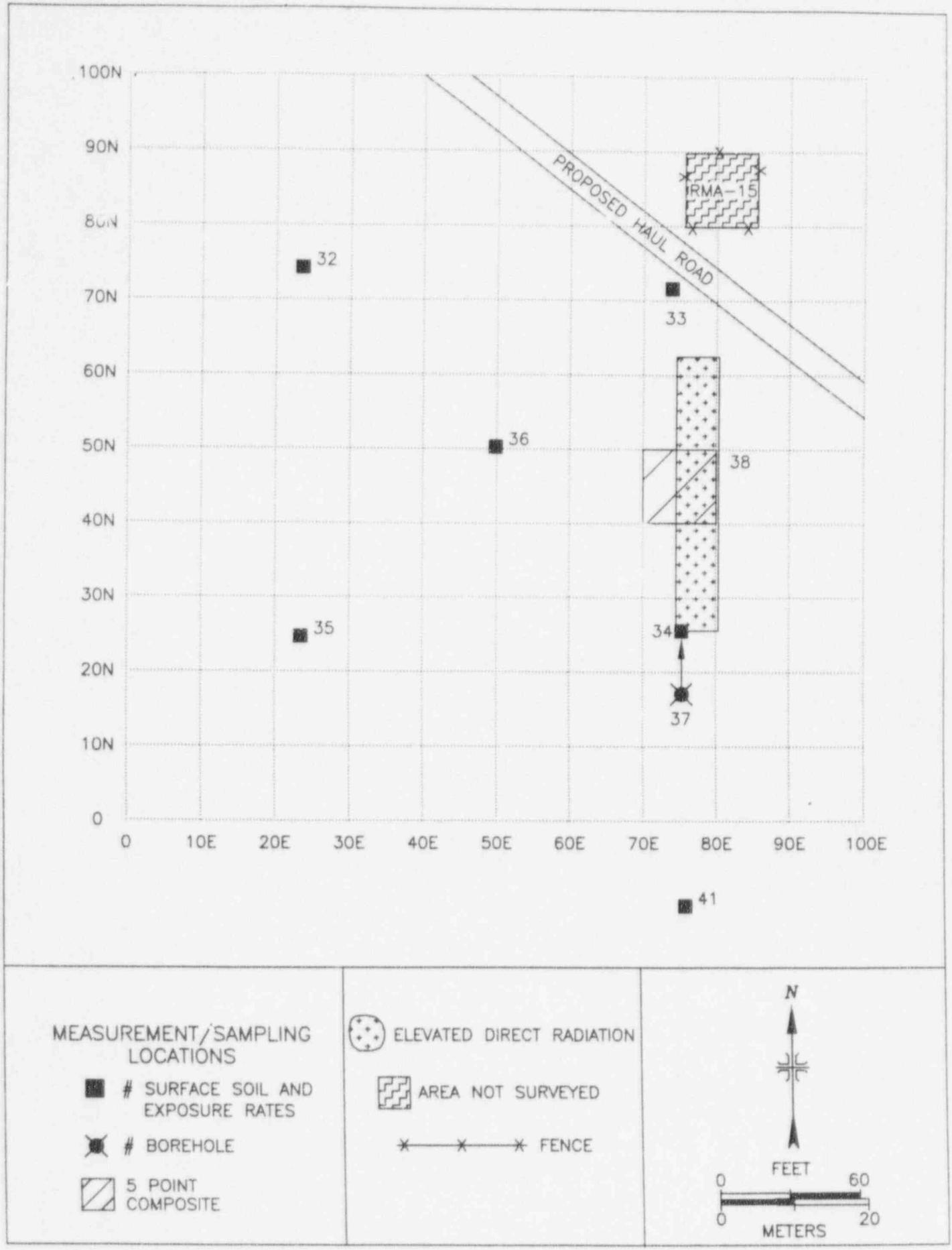


FIGURE 9: Survey Unit 52A – Measurement and Sampling Locations

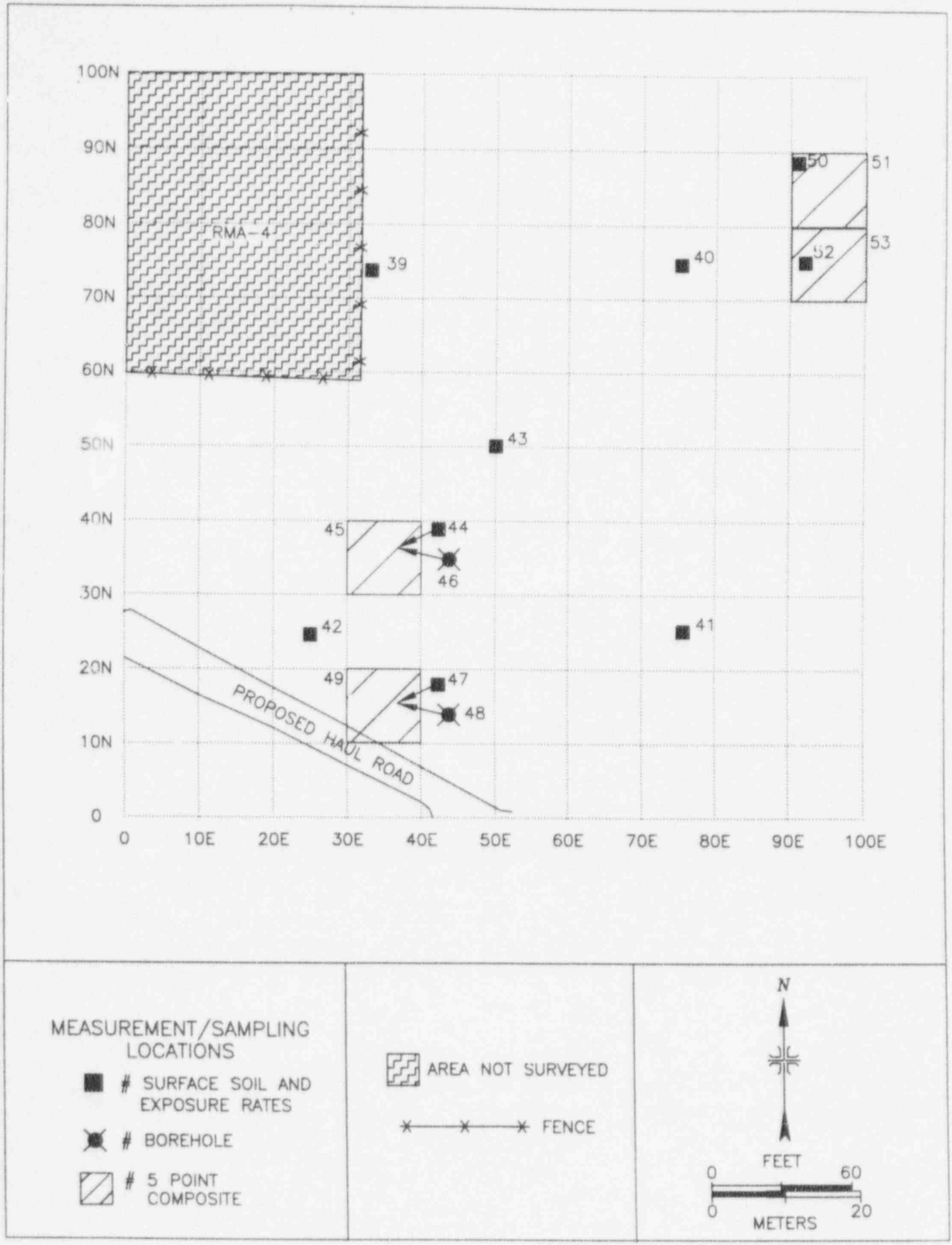


FIGURE 10: Survey Unit 40A – Measurement and Sampling Locations

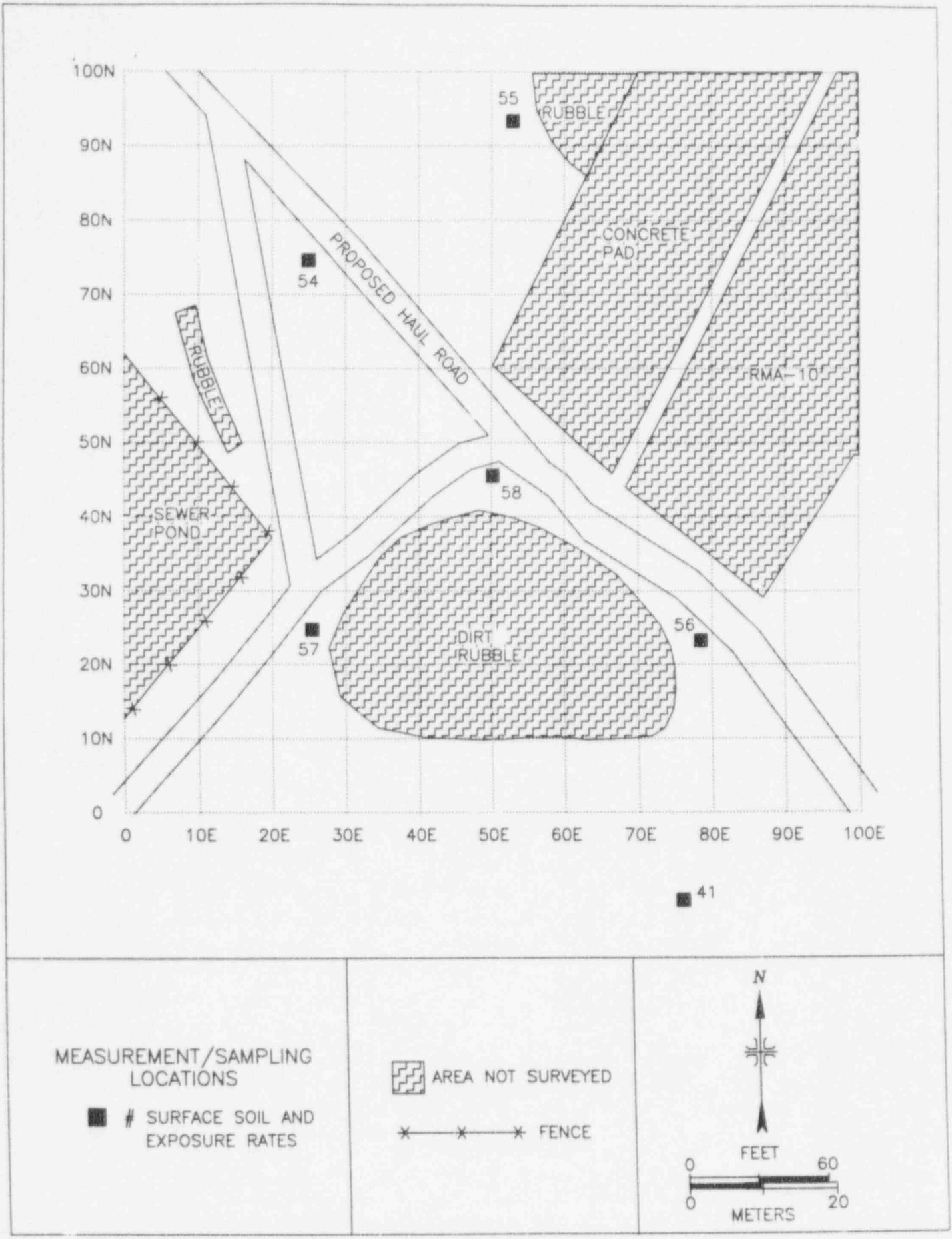


FIGURE 11: Survey Unit 108A – Measurement and Sampling Locations

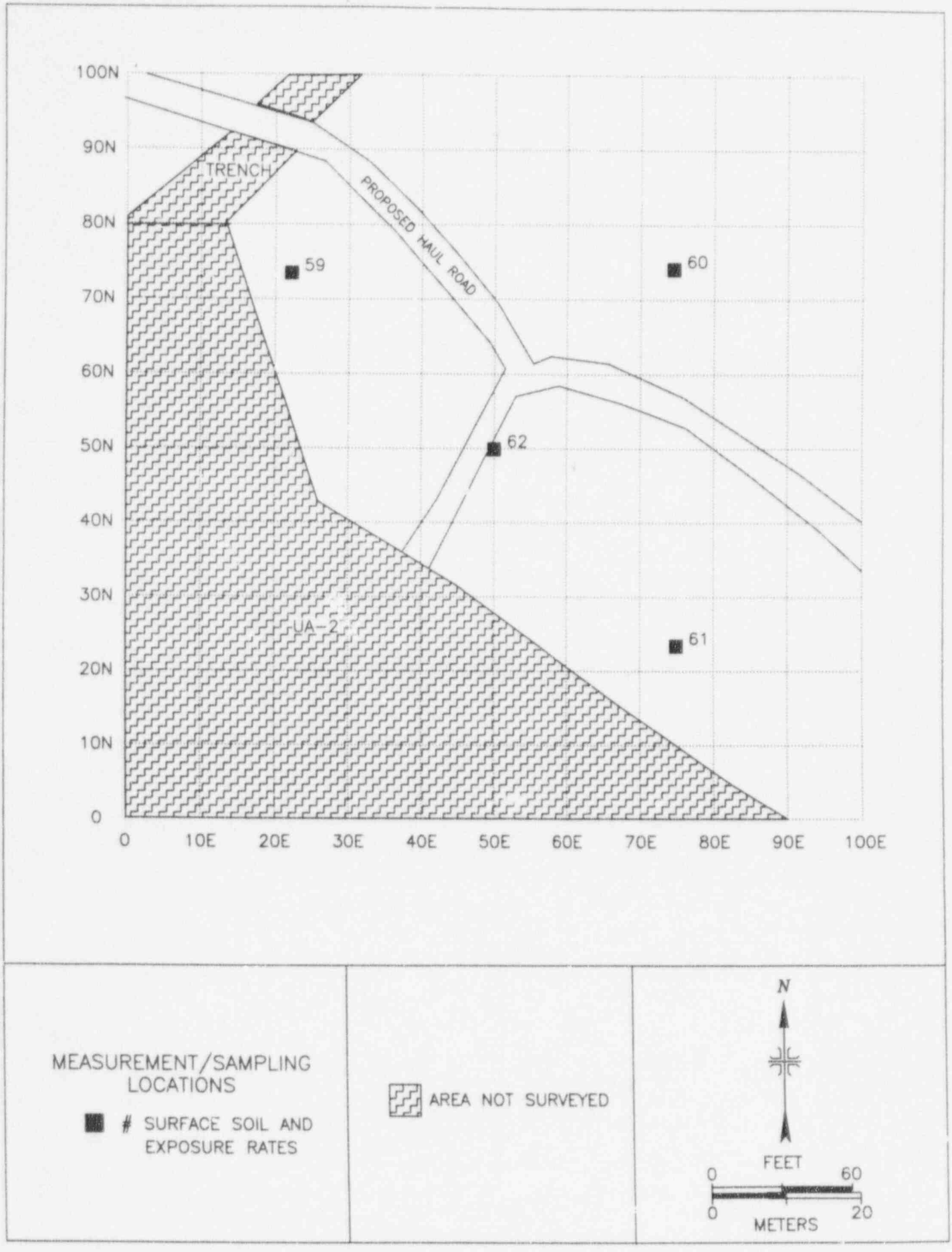


FIGURE 12: Survey Unit 201A, Part A – Measurement and Sampling Locations

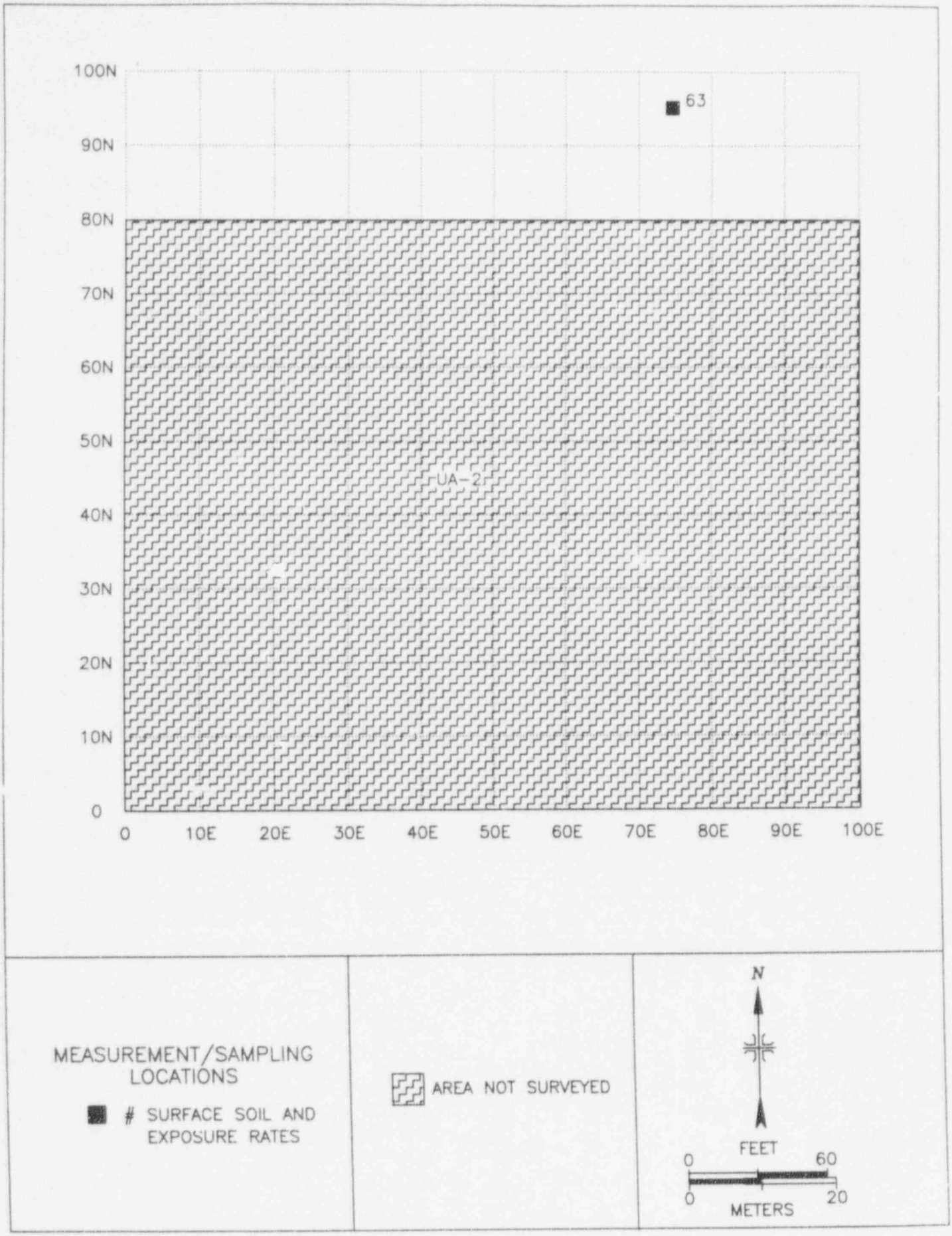


FIGURE 13: Survey Unit 201A, Part B – Measurement and Sampling Locations

TABLE 1

EXPOSURE RATES AND RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES
OKLAHOMA REFINERY SITE
KERR-McGEE CORPORATION
CUSHING, OKLAHOMA

ESSAP Sample ID	Survey Unit[a]	Exposure Rates (μR/h)	Radionuclide Concentration (pCi/g)				
			U-238	U-235	Ra-226	Th-232	Th-228
1	34A	9	0.8 ± 0.6[b]	0.2 ± 0.2	0.8 ± 0.1	1.1 ± 0.2	1.2 ± 1.1
2	34A	10	0.7 ± 0.4	<0.1	0.6 ± 0.1	0.8 ± 0.1	0.7 ± 0.1
3	34A	12	1.4 ± 0.6	0.1 ± 0.1	1.0 ± 0.1	1.1 ± 0.2	1.1 ± 0.1
4	34A	10	1.3 ± 0.6	<0.2	1.0 ± 0.1	1.1 ± 0.2	1.1 ± 0.1
5	34A	11	1.2 ± 0.5	<0.2	0.8 ± 0.1	1.0 ± 0.2	1.1 ± 0.1
6	56A	10	0.8 ± 0.6	<0.2	0.9 ± 0.1	0.9 ± 0.2	0.9 ± 0.1
7	56A	10	0.9 ± 0.7	<0.2	0.7 ± 0.1	1.0 ± 0.2	0.9 ± 0.1
8	56A	10	0.8 ± 0.7	<0.2	0.7 ± 0.1	0.9 ± 0.2	0.9 ± 0.1
9	56A	11	1.2 ± 0.7	<0.2	0.8 ± 0.1	1.0 ± 0.2	0.9 ± 0.1
10	56A	13	1.1 ± 0.6	<0.2	0.8 ± 0.1	1.0 ± 0.2	1.0 ± 0.1
11	68A	9	1.1 ± 0.5	<0.2	0.7 ± 0.1	0.9 ± 0.1	1.0 ± 0.1
12	68A	10	1.1 ± 0.6	<0.2	0.7 ± 0.1	1.0 ± 0.2	1.0 ± 0.1
13	68A	11	0.8 ± 0.6	<0.2	0.8 ± 0.1	0.9 ± 0.2	1.0 ± 0.1
14	68A	11	0.8 ± 0.6	<0.2	0.7 ± 0.1	0.9 ± 0.2	1.0 ± 0.1
15	68A	10	0.7 ± 0.5	<0.2	0.8 ± 0.1	1.0 ± 0.2	1.1 ± 0.1

TABLE 1 (Continued)

EXPOSURE RATES AND RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES
OKLAHOMA REFINERY SITE
KERR-McGEE CORPORATION
CUSHING, OKLAHOMA

ESSAP Sample ID	Survey Unit[a]	Exposure Rates (µR/h)	Radionuclide Concentration (pCi/g)				
			U-238	U-235	Ra-226	Th-232	Th-228
16	79A	11	0.6 ± 0.5	<0.2	0.9 ± 0.1	1.0 ± 0.2	1.1 ± 0.1
17	79A	11	1.7 ± 0.6	<0.2	0.8 ± 0.1	0.9 ± 0.2	1.0 ± 0.1
18	79A	10	1.1 ± 0.7	<0.2	0.8 ± 0.1	0.8 ± 0.2	1.0 ± 0.1
19	79A	11	1.0 ± 0.5	<0.2	1.0 ± 0.1	1.0 ± 0.2	1.1 ± 0.1
20	79A	12	2.0 ± 0.8	<0.2	0.9 ± 0.1	1.0 ± 0.2	1.0 ± 0.1
21	54A	9	0.9 ± 0.6	<0.2	0.9 ± 0.1	1.0 ± 0.2	1.0 ± 0.1
22	54A	14	1.4 ± 0.6	<0.2	1.0 ± 0.1	1.0 ± 0.2	1.0 ± 0.1
23	54A	13	<2.9	<0.8	73.7 ± 0.7	1.6 ± 0.7	1.1 ± 0.2
24	54A	11	1.4 ± 0.6	<0.3	0.9 ± 0.1	1.1 ± 0.2	1.1 ± 0.1
25	54A	9	1.0 ± 0.5	<0.2	0.9 ± 0.1	1.1 ± 0.2	1.0 ± 0.1
26[c]	54A	---[d]	1.4 ± 0.6	<0.2	0.9 ± 0.1	0.9 ± 0.2	1.0 ± 0.1
27	32A	11	0.6 ± 0.5	<0.2	0.8 ± 0.1	1.0 ± 0.2	1.0 ± 0.1
28	32A	12	1.1 ± 0.7	<0.2	0.9 ± 0.1	1.1 ± 0.2	1.2 ± 0.1
29	32A	12	1.2 ± 0.6	<0.3	1.1 ± 0.1	1.3 ± 0.2	1.3 ± 0.1
30	32A	12	1.1 ± 0.6	<0.2	1.0 ± 0.1	<0.4	1.2 ± 0.1

TABLE 1 (Continued)

EXPOSURE RATES AND RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES
OKLAHOMA REFINERY SITE
KERR-McGEE CORPORATION
CUSHING, OKLAHOMA

ESSAP Sample ID	Survey Unit[a]	Exposure Rates (μR/h)	Radionuclide Concentration (pCi/g)				
			U-238	U-235	Ra-226	Th-232	Th-228
31	32A	12	0.9 ± 0.6	<0.2	1.0 ± 0.1	1.2 ± 0.2	1.1 ± 0.1
32	52A	13	1.4 ± 0.6	<0.2	1.0 ± 0.1	1.2 ± 0.2	1.2 ± 0.1
33	52A	12	0.9 ± 0.5	<0.1	0.8 ± 0.1	0.9 ± 0.1	0.9 ± 0.1
34	52A	13	1.0 ± 0.5	<0.2	0.9 ± 0.1	1.8 ± 0.2	1.9 ± 0.1
35	52A	12	1.1 ± 0.6	0.1 ± 0.1	1.0 ± 0.1	1.3 ± 0.2	1.1 ± 0.1
36	52A	12	1.3 ± 0.7	<0.2	1.0 ± 0.1	1.0 ± 0.2	1.1 ± 0.1
37[c]	52A	---[d]	0.7 ± 0.6	<0.2	0.9 ± 0.1	1.8 ± 0.2	1.8 ± 0.1
38[c]	52A	15	0.9 ± 0.6	<0.3	0.9 ± 0.1	2.5 ± 0.2	2.5 ± 0.1
39	40A	12	0.9 ± 0.5	<0.2	1.0 ± 0.1	1.2 ± 0.2	1.2 ± 0.1
40	40A	13	1.2 ± 0.7	<0.2	1.1 ± 0.1	1.1 ± 0.2	1.3 ± 0.1
41	40A	12	1.6 ± 0.8	<0.2	0.9 ± 0.1	1.2 ± 0.2	1.1 ± 0.1
42	40A	10	1.1 ± 0.6	<0.2	1.0 ± 0.1	1.2 ± 0.2	1.0 ± 0.1
43	40A	12	0.9 ± 0.6	0.1 ± 0.1	1.0 ± 0.1	1.2 ± 0.2	1.2 ± 0.1
44	40A	15	1.0 ± 0.7	<0.2	2.3 ± 0.1	1.3 ± 0.2	1.4 ± 0.1
45[c]	40A	15	1.4 ± 0.6	<0.3	1.1 ± 0.1	1.3 ± 0.2	1.2 ± 0.1

TABLE 1 (Continued)

EXPOSURE RATES AND RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES
OKLAHOMA REFINERY SITE
KERR-McGEE CORPORATION
CUSHING, OKLAHOMA

ESSAP Sample ID	Survey Unit[a]	Exposure Rates (μR/h)	Radionuclide Concentration (pCi/g)				
			U-238	U-235	Ra-226	Th-23[b]	Th-228
46[c]	40A	---[d]	<1.9	<0.5	9.0 ± .04	1.4 ± 0.3	1.3 ± 0.1
47	40A	14	0.8 ± 0.6	<0.3	5.6 ± 0.2	1.4 ± 0.2	1.4 ± 0.1
48[c]	40A	---[d]	<1.7	<0.4	9.1 ± 0.3	1.3 ± 0.3	1.7 ± 0.1
49[c]	40A	12	1.1 ± 0.6	<0.3	2.0 ± 0.1	1.1 ± 0.2	1.1 ± 0.1
50	40A	11	<1.7	<0.4	1.0 ± 0.2	2.3 ± 0.5	2.5 ± 0.2
51[c]	40A	11	1.5 ± 0.8	<0.3	1.0 ± 0.1	1.7 ± 0.2	1.7 ± 0.1
52	40A	11	0.9 ± 0.6	<0.2	1.0 ± 0.1	2.8 ± 0.2	2.9 ± 0.1
53[c]	40A	11	1.2 ± 0.7	<0.2	1.0 ± 0.1	1.4 ± 0.2	1.7 ± 0.1
54	108A	9	0.7 ± 0.5	<0.1	0.5 ± 0.1	0.5 ± 0.1	0.5 ± 0.1
55	108A	10	0.7 ± 0.6	<0.2	0.6 ± 0.1	0.5 ± 0.1	0.6 ± 0.1
56	108A	9	0.4 ± 0.4	<0.1	0.8 ± 0.1	0.8 ± 0.1	0.7 ± 0.1
57	108A	12	0.6 ± 0.5	<0.2	0.7 ± 0.1	0.8 ± 0.2	1.0 ± 0.1
58	108A	10	1.3 ± 0.6	<0.2	0.9 ± 0.1	0.8 ± 0.2	0.9 ± 0.1
59	201A	10	0.7 ± 0.6	<0.2	0.9 ± 0.1	1.0 ± 0.2	1.0 ± 0.1
60	201A	9	0.7 ± 0.4	<0.2	0.7 ± 0.1	0.9 ± 0.2	0.9 ± 0.1

TABLE 1 (Continued)

EXPOSURE RATES AND RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES
OKLAHOMA REFINERY SITE
KERR-McGEE CORPORATION
CUSHING, OKLAHOMA

ESSAP Sample ID	Survey Unit[a]	Exposure Rates (μR/h)	Radionuclide Concentration (pCi/g)				
			U-238	U-235	Ra-226	Th-232	Th-228
61	201A	10	1.1 ± 0.5	<0.2	0.8 ± 0.1	1.0 ± 0.2	1.0 ± 0.1
62	201A	9	1.2 ± 0.6	<0.1	0.9 ± 0.1	0.8 ± 0.1	0.8 ± 0.1
63	201A	11	0.9 ± 0.4	<0.2	0.8 ± 0.1	0.9 ± 0.2	0.7 ± 0.1

[a]Refer to Figures 3 through 13.
[b]Uncertainties represent the 95% confidence level, based only on counting statistics.
[c]Composite sample.
[d]Exposure rate not taken.
[e]Borehole sample.

REFERENCES

Kerr-McGee Corporation. Final Radiation Survey of Haul Road Corridor. Cushing, OK; May 1996.

Oak Ridge Institute for Science and Education (ORISE). Survey Procedures Manual for the Energy/Environment Systems Division, Environmental Survey and Site Assessment Program, Revision 9. Oak Ridge, TN; April 30, 1995a.

Oak Ridge Institute for Science and Education. Quality Assurance Manual for the Energy/Environment Systems Division, Environmental Survey and Site Assessment Program, Revision 7. Oak Ridge, TN; January 31, 1995b.

Oak Ridge Institute for Science and Education. Laboratory Procedures Manual for the Energy/Environment Systems Division, Environmental Survey and Site Assessment Program, Revision 9. Oak Ridge, TN; January 31, 1995c.

Oak Ridge Institute for Science and Education. Confirmatory survey for the four unaffected areas of the Cushing Refinery Site, Kerr-McGee Corporation, Cushing, OK (Docket No. 70-3073). Oak Ridge, TN; May 1996a.

Oak Ridge Institute for Science and Education. Proposed confirmatory survey plan for the haul road corridor of the Cushing Refinery Site, Kerr-McGee Corporation, Cushing, OK. Oak Ridge, TN; August 1996b.

U.S. Nuclear Regulatory Commission (NRC). Disposal or onsite storage of thorium and uranium wastes from past operations. Washington, DC: Federal Register 46 (205):52061-52063; October 1981.

APPENDIX A

MAJOR INSTRUMENTATION

APPENDIX A

MAJOR INSTRUMENTATION

The display of a specific product is not to be construed as an endorsement of the product or its manufacturer by the authors or their employers

DIRECT RADIATION MEASUREMENT

Instruments

Bicron Micro-Rem Meter
(Bicron Corporation, Newburg, OH)

Eberline Pulse Ratemeter
Model PRM-6
(Eberline, Santa Fe, NM)

Ludlum Ratemeter-Scaler
Model 12
(Ludlum Measurements, Inc.,
Sweetwater, TX)

Detectors

Victoreen N[illegible]tillation Detector
Model 489-5[illegible]
3.2 cm x 3.8 cm Crystal
(Victoreen, Cleveland, OH)

Laboratory Analytical Instrumentation

High Purity Extended Range Intrinsic Detectors
Model No: ERVDS30-25195
(Tennelec, Oak Ridge, TN)
Used in conjunction with:
Lead Shield Model G-11
(Nuclear Lead, Oak Ridge, TN) and
Multichannel Analyzer
3100 Vax Workstation
(Canberra, Meriden, CT)

High-Purity Germanium Detector
Model GMX-23195-S, 23% Eff.
(EG&G ORTEC, Oak Ridge, TN)
Used in conjunction with:
Lead Shield Model G-16
(Gamma Products, Palos Hills, IL) and
Multichannel Analyzer
3100 Vax Workstation
(Canberra, Meriden, CT)

APPENDIX B

SURVEY AND ANALYTICAL PROCEDURES

APPENDIX B

SURVEY AND ANALYTICAL PROCEDURES

SURVEY PROCEDURES

Surface Scans

Surface scans for gamma activity were performed by passing the detector slowly over the surface maintaining the distance between the detector and the surface at a minimum. Identification of elevated levels was based on increases in the audible signal from the recording and/or indicating instrument. Combinations of detectors and instruments used for the scans were:

Gamma - NaI scintillation detector with ratemeter and/or ratemeter-scaler

Exposure Rate Measurements

Measurements of dose equivalent rates (μrem/h) were performed at 1 m above the surface using a Bicron microrem meter. Although the instrument displays data in μrem/h, the μrem/h to μR/h conversion is essentially unity.

Soil Sampling

Approximately 1 kg of soil was collected at each sample location. Collected samples were placed in a double plastic bags, sealed, and labeled in accordance with ESSAP survey procedures. Surface soil samples were collected at a depth of 0-15 cm, while subsurface soil samples were collected at a depth of 15-30 cm.

ANALYTICAL PROCEDURES

Gamma Spectroscopy

Samples of soil were dried, mixed, crushed, and/or homogenized as necessary, and a portion sealed in 0.5-liter Marinelli beaker or other appropriate container. The quantity placed in the beaker was chosen to reproduce the calibrated counting geometry. Net material weights were determined and

the samples counted using intrinsic germanium detectors coupled to a pulse height analyzer system. Background and Compton stripping, peak search, peak identification, and concentration calculations were performed using the computer capabilities inherent in the analyzer system. All photopeaks associated with the radionuclides of concern were reviewed for consistency of activity. Energy peaks used for determining the activities of radionuclides of concerns were:

U-238	0.063 MeV from Th-234*
U-235	0.143 MeV
Th-232	0.911 MeV from Ac-228*
Th-228	0.239 MeV from Pb-212*
Ra-226	0.352 MeV from Pb-214*

*Secular equilibrium assumed

Spectra were also reviewed for other identifiable total absorption peaks

Uncertainties and Detection Limits

The uncertainties associated with the analytical data presented in the tables of this report represent the 95% confidence level for that data. These uncertainties were calculated based on both the gross sample count levels and the associated background count levels. Additional uncertainties, associated with sampling and measurement procedures, have not been propagated into the data presented in this report.

Detection limits, referred to as minimum detectable concentration (MDC), were based on 2.71 plus 4.65 times the standard deviation of the background count [$2.71 + (4.65\sqrt{BKG})$]. When the activity was determined to be less than the MDC of the measurement procedure, the result was reported as less than MDC. Because of variations in background levels, measurement efficiencies, and contributions from other radionuclides in samples, the detection limits differ from sample to sample and instrument to instrument.

Calibration and Quality Assurance

Calibration of all field and laboratory instrumentation was based on standards/sources, traceable to National Institute of Science and Technology (NIST), when such standards/sources were available. In cases where they were not available, standards of an industry recognized organization were used.

Analytical and field survey activities were conducted in accordance with procedures from the following documents of the Environmental Survey and Site Assessment Program.

- Survey Procedures Manual, Revision 9 (April 1995)
- Laboratory Procedures Manual, Revision 9 (January 1995)
- Quality Assurance Manual, Revision 7 (January 1995)

The procedures contained in these manuals were developed to meet the requirements of DOE Order 5700.6C and American Society of Mechanical Engineers (ASME) NQA-1 for Quality Assurance and contain measures to assess processes during their performance.

Quality control procedures include:

- Daily instrument background and check-source measurements to confirm that equipment operation is within acceptable statistical fluctuations.
- Participation in Environmental Protection Agency (EPA) and Environmental Measurements Laboratory (EML) Quality Assurance Programs.
- Training and certification of all individuals performing procedures.
- Periodic internal and external audits.