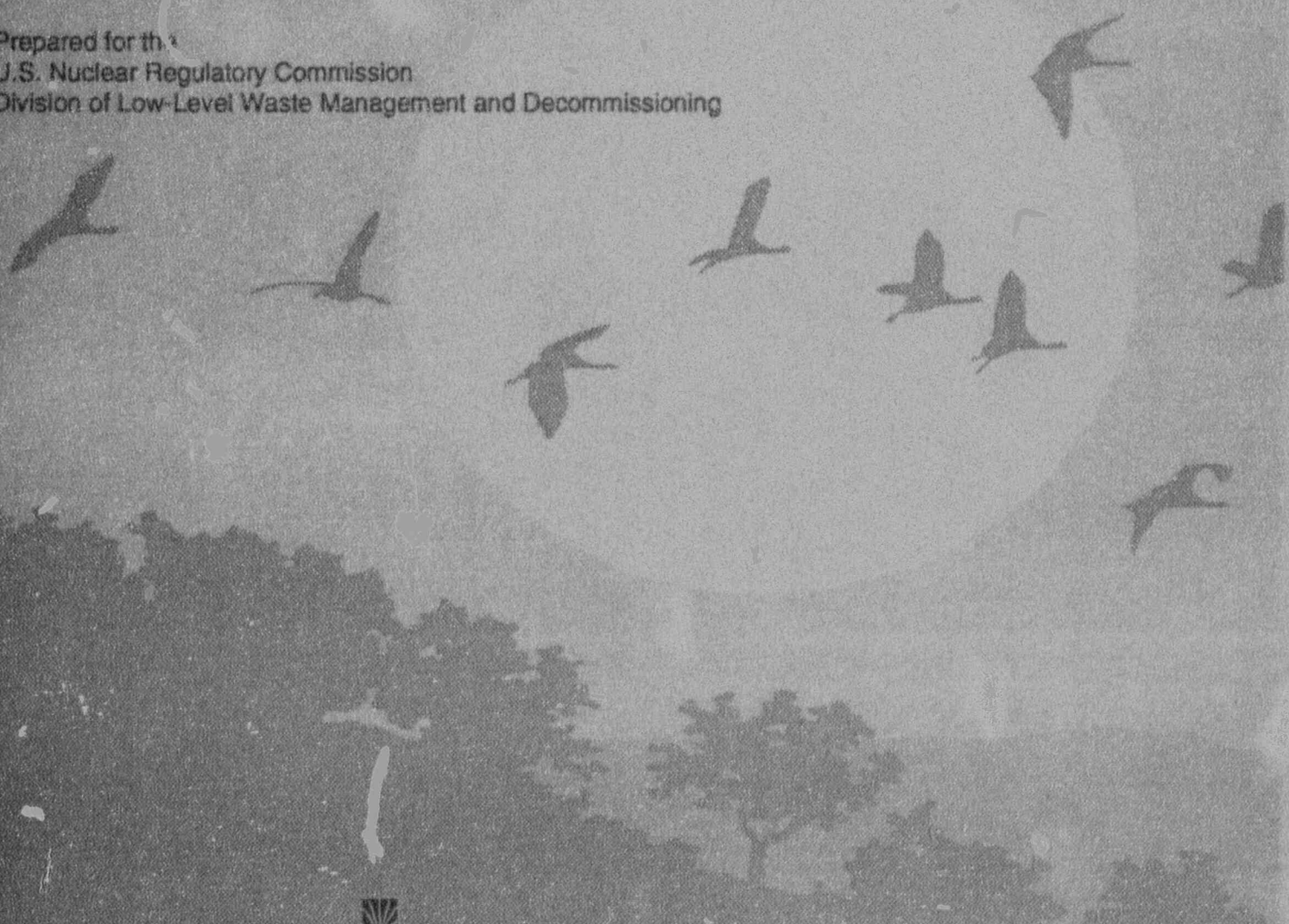
ORISE 93/L-69

CONFIRMATORY SURVEY OF BUILDING B-SOUTH ROOF, BUILDING L SUPPORT AREAS PUMPHOUSE SOUTH AND SEPTIC TANK, AND THE UNAFFECTED OUTDOOR AREAS UNC NAVAL PRODUCTS MONTVILLE, CONNECTICUT

[DOCKET 70-371]

A. J. ANSARI AND K. A. KING

Prepared for the
U.S. Nuclear Regulatory Commission
Division of Low-Level Waste Management and Decommissioning



ORISE
OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION
Environmental Survey and Site Assessment Program
Energy/Environment Systems Division

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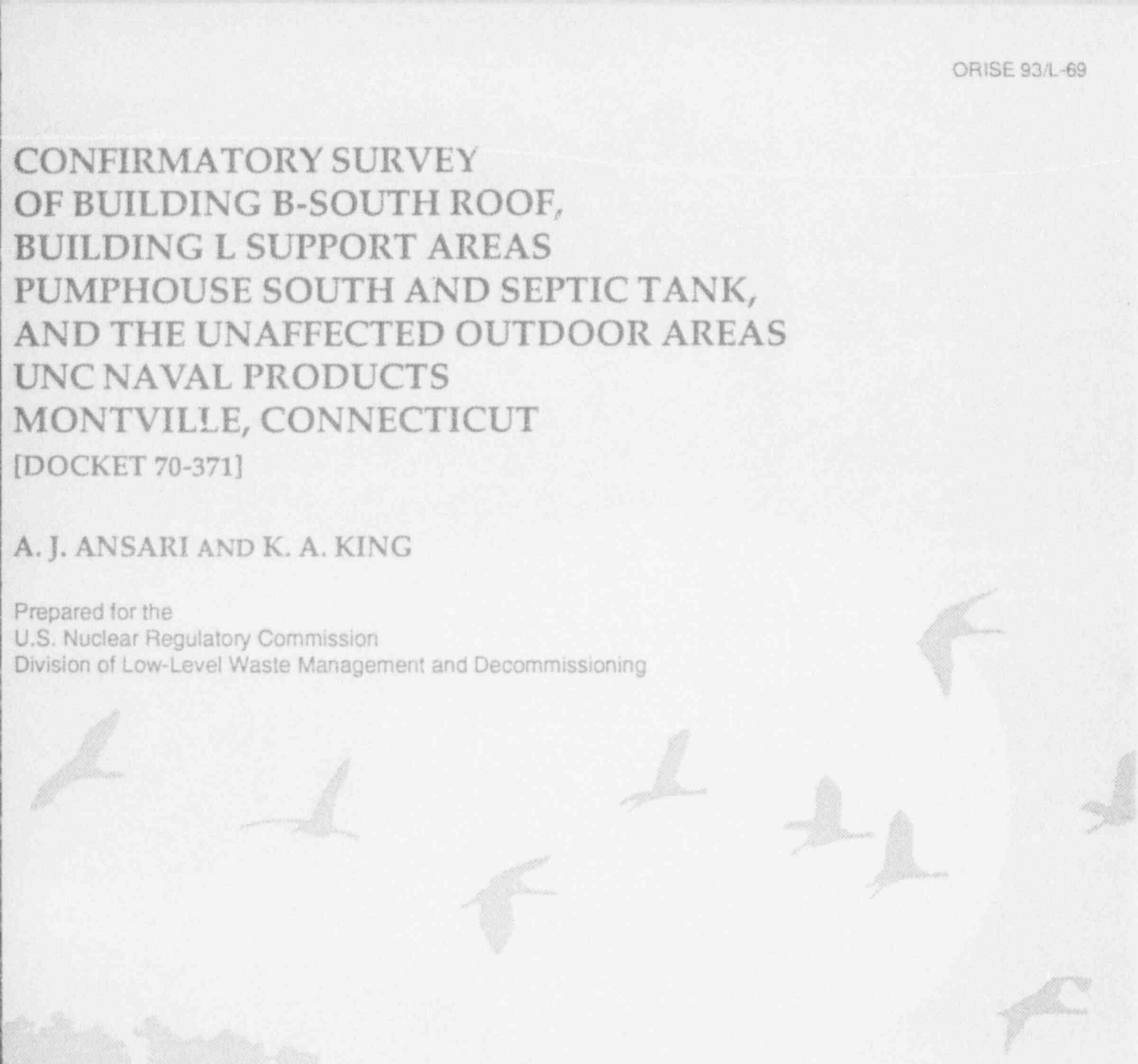

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Division of Low-Level Waste Management and Decommissioning

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FINAL REPORT

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UNC NAVAL PRODUCTS
MONTVILLE, CONNECTICUT

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ABBREVIATIONS AND ACRONYMS

ASME	American Society of Mechanical Engineers
cm	centimeter
cm^2	square centimeter
cpm	counts per minute
dpm/100 cm^2	disintegrations per minute/100 square centimeters
EML	Environmental Measurement Laboratory
EPA	Environmental Protection Agency
ESSAP	Environmental Survey and Site Assessment Program
ft	foot
GM	Geiger-Mueller
km	kilometer
m	meter
m^2	square meter
MDA	minimum detectable activity
NaI	sodium iodide
NIST	National Institute for Standards Technology
NRC	Nuclear Regulatory Commission
ORISE	Oak Ridge Institute for Science and Education
pCi/g	picocurie per gram
PIC	Pressurized Ionization Chamber
μR/h	microroentgen per hour
UNC	United Nuclear Corporation
ZnS	zinc sulfide

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INTRODUCTION AND SITE HISTORY

United Nuclear Corporation (UNC) Naval Products fabricated reactor fuel elements for the Naval Reactors program at the Montville, Connecticut facility under U.S. Nuclear Regulatory Commission (NRC) License SNM-368 [Docket 70 - 371]. The license authorized the fabrication of unclad fuel components, encapsulation of the fuel with corrosion resistant materials, assemblage of these into larger components or into reactor cores, and laboratory activities necessary to support these operations. The radioactive materials utilized were fully enriched, unirradiated uranium and uranium source materials.

The Montville facility was built in 1957-1959, with small additions in 1961 and 1966. A major expansion, Building M, was completed in 1969. All operations were limited to clad fuel. Following authorization by the Atomic Energy Commission (predecessor to the NRC) in 1972, UNC constructed four additional buildings. Building A was completed in early 1973 and operations there were also limited to clad fuel. Building B was completed in September of 1973 and was used for the initial forming and encapsulation of the uranium bearing materials. Building C was completed in May of 1973 and contains the main office and clerical support staff. Buildings D, R, S, and T are used for inspection and bulk storage of non-uranium bearing materials. Construction of Building L was completed in 1990; however, installation of uranium processing equipment was never completed.

In March of 1990, UNC was notified by the U.S. Government that certain contracts were being terminated. As a result of that action, UNC initiated decontamination and decommissioning efforts at the Montville facility in the summer of 1990, while concurrently completing work on existing contracts. The facility was divided into affected and unaffected areas by the licensee, consistent with recommendations of NUREG/CR-5849. In areas designated as unaffected,

unencapsulated fuel had never been used or stored. The licensee's remediation activities and final radiological surveys in support of the license termination have been performed in multiple phases. At the request of the U.S. Nuclear Regulatory Commission (NRC), Region I Office, the Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE) has performed independent confirmatory surveys at this facility. During the period of April 1991 through February 1993, the confirmatory activities for Building B-South Area, Unit 1, Unit 2, Unit 3 Vault, Pack Assembly, the unaffected indoor areas (Buildings B-North, A,M,E,C,D,S,R,T,H), and the affected outdoor areas (Septic Fields 1 and 2, and Incinerator Pad) were completed and the results of those surveys were provided to the NRC.[1-4] In addition, water and/or sludge samples from the city of Montville Waste Water Treatment Plant, the pumping stations, and ground water monitoring wells at the UNC facility were provided to ESSAP for confirmatory analysis. The results of those analyses have been provided to the NRC.[5]

The results of the licensee's final radiological survey of the remainder of the facility, mainly Building B-South roof and the unaffected outdoor areas was submitted to the NRC in March and April of 1993. At the request of the NRC's Region I Office, ESSAP conducted an independent confirmatory survey of Building B-South roof, Building L support areas, pumphouse south and septic tank, and the unaffected outdoor areas, during the period of May 17 through 21, 1993. The procedures and results of that survey are summarized in this report.

SITE DESCRIPTION

The 1,000,000 m^2 UNC site is located in the northeast corner of the town of Montville, New London County, Connecticut (Figure 1). Only a small portion of the site is occupied by the UNC facility. The Central Vermont Railroad has a right-of-way along the Thames River at the eastern edge of the property. The plant is served by a spur from the railroad and has car and truck access from Route 32. The site is bounded on the north by the Thames River, on the east by the railroad and the river, and on the south and west by private property (Figure 2). The plant buildings are set in the side of the valley with the roof line nearly level with the main parking lot. Exterior walls of all buildings are constructed of a combination of concrete block

and insulated metal siding. The building complex was surrounded by a security fence. The licensee has defined the area inside the former security fence as Parcel A (Figure 3) and the area outside the former security fence as Parcel B (Figure 4). The same designation is used in this report for consistency.

OBJECTIVES

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

DOCUMENT REVIEW

The radiological status reports, provided by United Nuclear Corporation Naval Products, were reviewed by ESSAP as part of the confirmatory activities.[6-9] Analytical procedures and methods utilized by the licensee were reviewed for adequacy and appropriateness. The data were reviewed for accuracy, completeness, and compliance with applicable NRC guidelines.

PROCEDURES

During the period from May 17 through May 21, 1993, ESSAP performed confirmatory surveys of Building B-South roof, Building L Support areas, the pumphouse south and septic tank, and the unaffected outdoor areas. The survey was conducted in accordance with a survey plan which was submitted to and approved by the NRC, Region I Office.[10] The survey of outdoor areas included the large and small cooling ponds, the wet area, the main gate road, the incinerator pad road, and a 10 meter perimeter outside the fence which currently surrounds the facility.

SURVEY PROCEDURES: INTERIOR

Reference Grid

A 1 m x 1 m alphanumeric reference grid system was established by UNC on floors, walls and ceilings in pumphouse south and the septic tank. A 2 m x 2 m reference grid was established on all surfaces in Building-L Support areas and on the roof of the Building B-South by UNC. ESSAP measurement and sampling locations were referenced to grids, prominent building features, and/or recorded on appropriate drawings.[5]

Surface Scans

All floor and lower wall surfaces were scanned for alpha, beta, and gamma activity using gas proportional and NaI scintillation detectors. All detectors were coupled to ratemeter-scalers or ratemeters with audible indicators.

Surface Activity Measurements

Measurements for total and removable alpha and beta activity were performed in randomly selected grid blocks on all gridded surfaces in each of the areas surveyed. Measurements were performed in 30 grid blocks on the roof of Building B-South (Figure 5), 49 grid blocks in Building L- Support areas (Figures 6-8), 29 grid blocks in pumphouse south and pipe chase pit (Figures 9 and 10), and 54 grid blocks in the three chambers of the septic tank (Figures 11-16). One direct measurement was performed in the center of each surveyed grid block. At the request of the NRC site representative, in a limited number of grid blocks, measurements were performed at the center and at four points equidistant from the center and grid block corners. These measurements in 4 m^2 grid blocks were limited to a 1 m^2 area such that measurements were performed at the center and at four points one quarter of the distance from the center to the grid block corners. Direct measurements were performed using ZnS scintillation and GM detectors, coupled with ratemeter-scalers. A smear sample for determining removable activity

was obtained at each single-point measurement location and from each set of grid block measurements, at the location corresponding to the highest total alpha activity level. A total of 162 smears were collected. Measurement and sampling locations for total and removable activity are illustrated on Figures 5 through 16.

Exposure Rate Measurements

Background exposure rates for building interiors were previously determined for this site.[4]

Exposure rate measurements were performed at 1 m above the surface at 5 locations using a pressurized ionization chamber (PIC). Measurement locations are shown on Figures 7,8, and 17.

Soil Sampling

A total of 10 soil samples were collected; two samples from the excavations in the Janitor's Closet and the adjoining hallway in Building B-South; one sample from the excavation in the siphon chamber of the septic tank, one sample from underneath the asphalt in the Dog Pen; two samples from the rotoclone platform on the southside of Building B-South; and one sample from each of the four storage bunkers in Building H. Sampling locations are indicated on Figure 17.

Miscellaneous Sampling

Six metal discs, approximately 3 cm in diameter, were collected from the ceiling in Building B-South. Two of these samples were from the Sectioning Area where a previous incident had involved contamination of the ceiling. One sample was collected from the Radioactive Waste Storage Room in the basement, directly underneath a crack on the first floor where a possible contamination was suspected. The three other samples were collected at random locations on the first floor. Sampling locations are indicated on Figure 18.

SURVEY PROCEDURES: EXTERIOR

Reference Grid

A 10 m x 10 m numeric reference grid system was established by UNC in Parcel A (area around facility inside security fence). This grid system was extended by ESSAP into the Incinerator Pad area for sample reference. ESSAP measurement and sampling locations in other areas were referenced to this grid (when possible), prominent site features, and/or recorded on appropriate drawings.

Surface Scans

Surface scans for gamma activity were performed at 1 m intervals in Parcel A and portions of Parcel B (Figures 3 and 4). All scans were performed using NaI scintillation detectors, coupled to ratemeters with audible indicators. Areas of elevated direct radiation, suggesting the presence of surface or near surface contamination, were marked for further investigation.

Exposure Rate Measurements

Background exposure rate measurements were made at 8 off-site locations within 0.5 to 10 km of the site using a PIC. Measurement locations are indicated on Figure 19.

Exposure rate measurements were performed at 1 meter above the surface at 8 locations in Parcel A and 4 locations in Parcel B using a PIC. Measurement locations are indicated on Figure 20.

Soil Sampling

Background soil samples were collected from 8 off-site locations within 0.5 to 10 km of the site. Sampling locations are indicated on Figure 19.

Samples were collected from randomly selected locations and locations of elevated direct radiation identified by surface scans. Thirty-six surface soil samples were collected from Parcel A (Figure 21). Twenty-nine surface soil samples were collected from Parcel B (Figure 22). Twenty surface soil samples were collected from the area surrounding the former Incinerator Pad (Figure 23).

SAMPLE ANALYSIS AND DATA INTERPRETATION

Samples and survey data were returned to the ESSAP Oak Ridge laboratory for analyses and interpretation. Smears and metal discs were analyzed for gross alpha and gross beta activity. Direct measurement, smear and metal disc data were converted to units of disintegrations per minute per 100 cm^2 (dpm/100 cm^2), and exposure rate measurements were reported in microroentgens per hour (μR/h). Soil samples were analyzed by gamma spectrometry. Spectra were reviewed for U-235, U-238, and any other identifiable photopeaks. Soil sample results were reported in units of picocuries per gram (pCi/g). Additional information concerning major instrumentation, sampling equipment, and analytical procedures is provided in Appendices A and B. Results were compared to NRC guidelines which are provided in Appendix C.

FINDINGS AND RESULTS

DOCUMENT REVIEW

ESSAP reviewed the licensee's radiological survey data and comments were provided to the NRC.[11] The licensee provided the NRC with a response to those comments.[12] In ESSAP's opinion, the licensee documents provide an adequate description of the radiological condition of the facility relative to the NRC guidelines for release to unrestricted use.

INTERIOR SURVEY

Surface Scans

Surface scans for alpha, beta, and gamma activity performed on the floors, lower walls, and equipment did not identify any locations of elevated direct radiation.

Surface Activity Levels

Results of total and removable surface activity levels are summarized in Table 1. Total activity measurements ranged from <69 dpm/100 cm^2 to 270 dpm/100 cm^2 for alpha and <1300 dpm/100 cm^2 to 2500 dpm/100 cm^2 for beta. The highest grid block averages were 170 dpm/100 cm^2 and 1600 dpm/100 cm^2 for alpha and beta, respectively. Removable activity was <12 dpm/100 cm^2 for alpha and ranged from <17 dpm/100 cm^2 to 20 dpm/100 cm^2 for beta.

Exposure Rate Measurements

The background exposure rates, previously determined by ESSAP, averaged 12 μR/h. [4]

Exposure rate measurements are summarized in Table 2. The measurements ranged from 11 μR/h to 15 μR/h. The exposure rate of 15 μR/h was measured in a hallway in Building B-South adjoining the Janitor's Closet.

Uranium Concentrations in Soil Samples

Uranium concentrations in soil samples collected from interior locations are presented in Table 3. Concentrations of U-235, U-238, and total uranium ranged from 0.1 to 0.3 pCi/g, 0.8 to 1.9 pCi/g, and 5.0 to 14 pCi/g, respectively. A sample collected from a trench in the siphon chamber of the septic tank contained the highest total uranium concentration at 14 pCi/g.

Miscellaneous Samples

Results of gross alpha and gross beta activity in the 6 ceiling metal disc samples taken in Building B-South ranged from <29 to 2300 dpm/100 cm^2 for alpha and <47 to 180 dpm/100 cm^2 for beta. The data are summarized in Table 4.

EXTERIOR SURVEY

Surface Scans

Surface scans for gamma activity identified one location of elevated direct radiation (approximately 200 cm^2 in size) at grid location 226N, -46W, north of the former Incinerator Pad area (Figure 23). This location was marked for further investigation. Surface scans for gamma activity in Parcel A and Parcel B did not identify any other locations of elevated direct radiation.

Exposure Rate Measurements

Background exposure rates for outdoor areas ranged from 10 to 12 μR/h and averaged 11 μR/h (Table 5).

Exposure rate measurements for on-site outdoor areas are presented in Table 6. On-site exposure rates ranged from 10 to 12 μR/h.

Uranium Concentrations in Soil Samples

Total uranium concentration in background soil samples ranged from 3.2 to 5.6 pCi/g (Table 5).

Uranium concentrations in soil samples collected from the area surrounding the former Incinerator Pad, Parcel A and Parcel B are presented in Table 7. Concentrations of U-235,

U-238, and total uranium in samples collected from the Incinerator Pad area ranged from 0.1 to 12.9 pCi/g, 0.5 to 8.2 pCi/g, and 4.7 to 550 pCi/g, respectively. The sample with the highest concentration was collected at grid location 266N, -46W (Figure 23). The concentrations of U-235, U-238, and total uranium in that sample were 12.9, 8.2, and 550 pCi/g, respectively. Concentrations of U-235, U-238, and total uranium in samples collected from the Parcel A ranged from 0.1 to 0.2 pCi/g, 0.5 to 1.8 pCi/g, and 4.7 to 10 pCi/g, respectively. The uranium concentrations from samples collected in Parcel B (excluding the Incinerator Pad area) ranged from 0.1 to 0.3 pCi/g for U-235, 0.7 to 2.1 pCi/g for U-238, and 4.9 to 14 pCi/g for total uranium.

COMPARISON OF RESULTS WITH GUIDELINES

The NRC guidelines for surface contamination and residual concentrations of radionuclides in soil, established for license termination or release of a facility for unrestricted use are presented in Appendix C. The primary contaminant of concern at this site is enriched uranium. The surface contamination guidelines for uranium are:[13]

Total Activity

5,000 α dpm/100 cm^2, averaged over a 1 m^2 area

15,000 α dpm/100 cm^2, maximum in a 100 cm^2 area

Removable Activity

1,000 α dpm/100 cm^2

Surface activity measurements for total and removable activity in all interior areas surveyed were within these guidelines.

The soil concentration guideline for enriched uranium is 30 pCi/g.[14] With one exception, the uranium concentrations in soil samples collected were within this limit.

The NRC guideline for exposure rate at 1 m above the surface is 5 μR/h above background.[15] All interior and exterior exposure rates were within this limit.

SUMMARY

During the period May 17 through 21, 1993, at the request of the NRC Region I Office, the Environmental Survey and Site Assessment Program of ORISE performed a confirmatory survey of Building B-South roof, Building L Support Areas, pumphouse south and septic tank, and the unaffected outdoor areas at United Nuclear Corporation Naval Products. The interior survey activities consisted of surface scans of the floor and lower wall surfaces for alpha, beta, and gamma activity, measurements of total and removable activity, exposure rate measurements, soil and ceiling metal disc sampling. Exterior survey activities included gamma surface scans, exposure rate measurements, and soil sampling.

Total and removable surface activity measurements were all below the guideline values. Interior and exterior exposure rate measurements were all within the 5 μR/h above background criterion.

Regarding the surface activity and exposure rate guidelines, the results of the ESSAP survey are consistent with the licensee's conclusion that the facility meets the requirements for release for unrestricted use. ESSAP's survey identified only one location (north of the former Incinerator Pad area) at which the total uranium concentration in soil exceeded the guideline value of 30 pCi/g. Total uranium concentration at this location was 550 pCi/g.

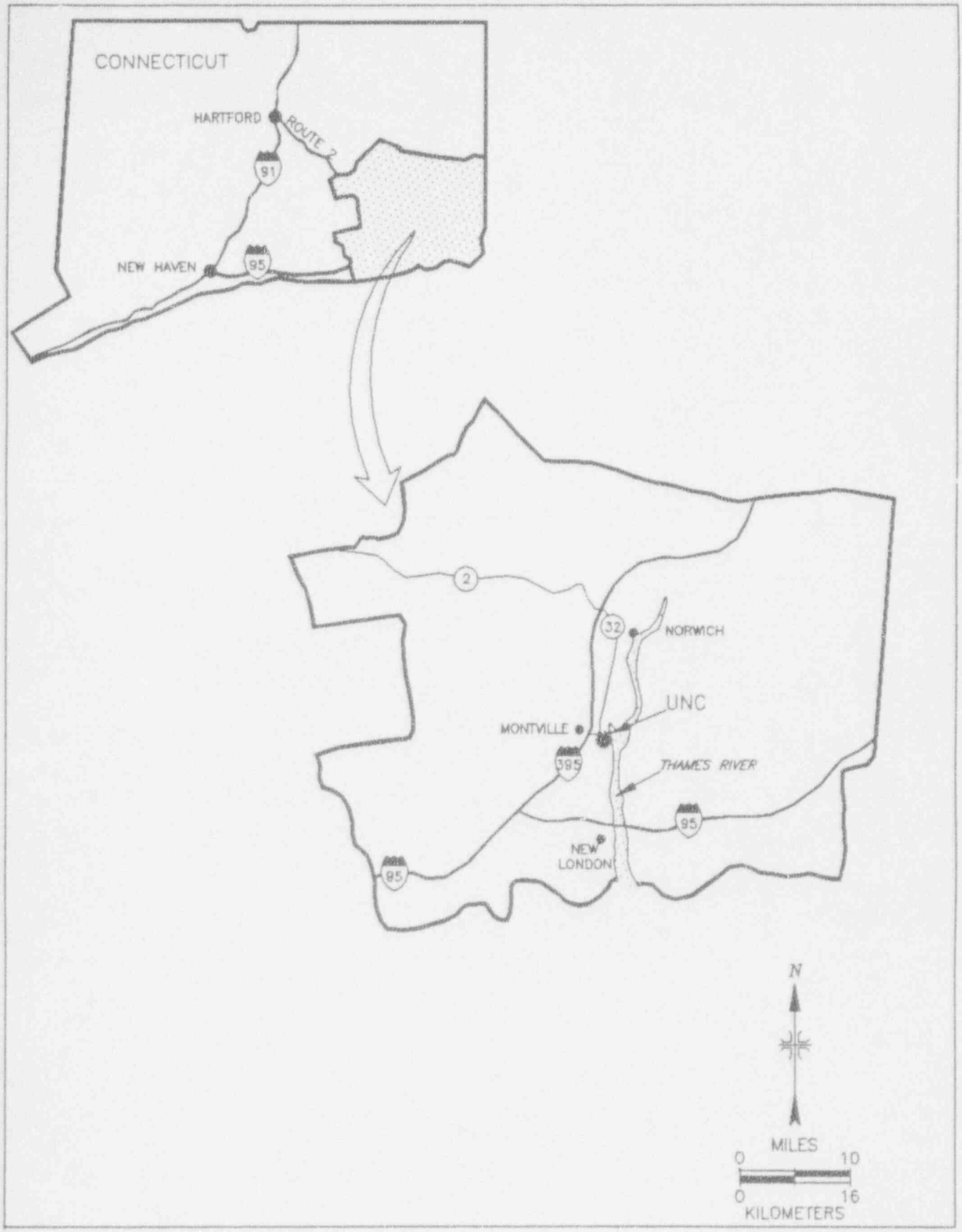


FIGURE 1: Map of New London County, Connecticut, Showing Location of UNC Naval Products Facility

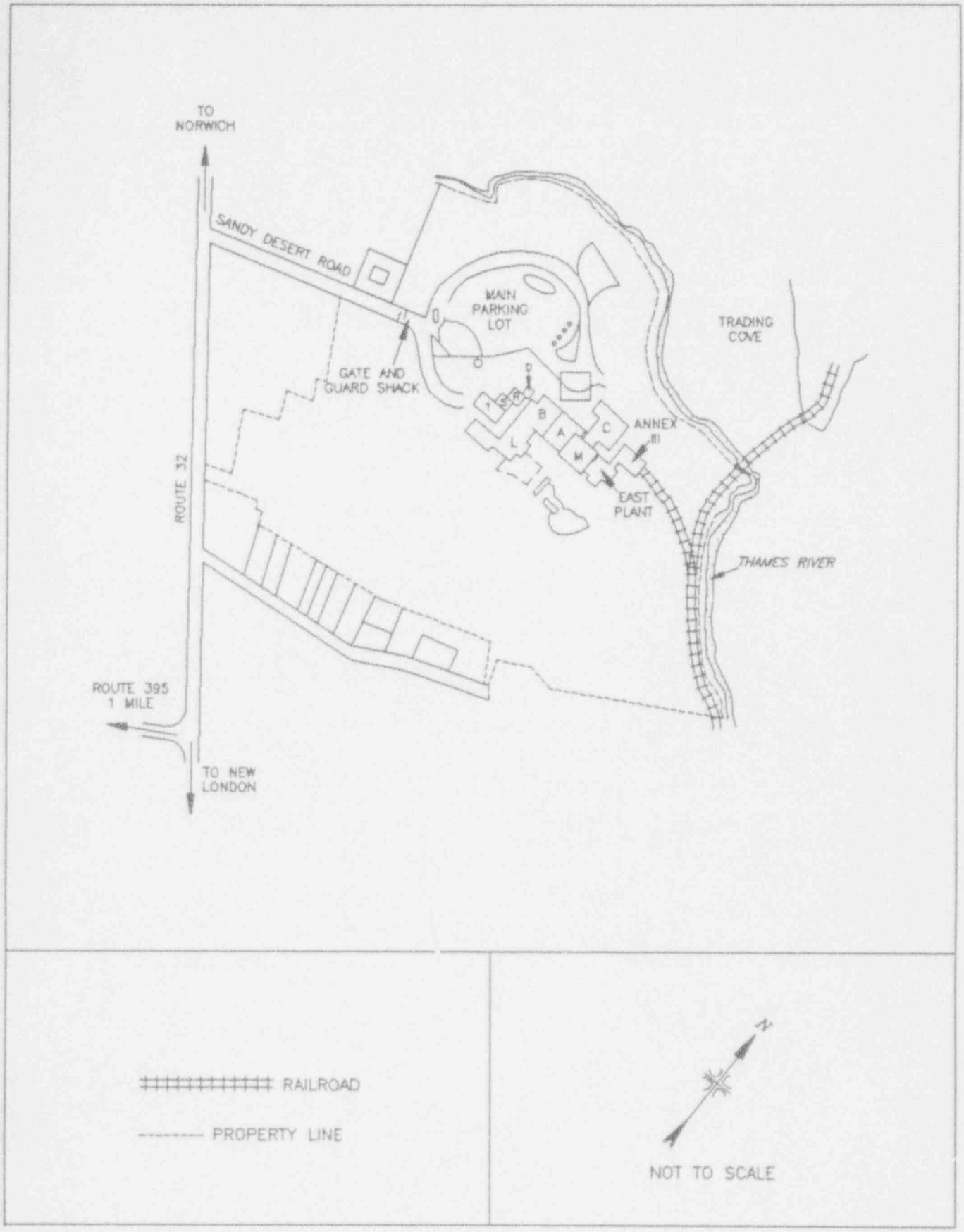


FIGURE 2: Layout of the UNC Naval Products Property

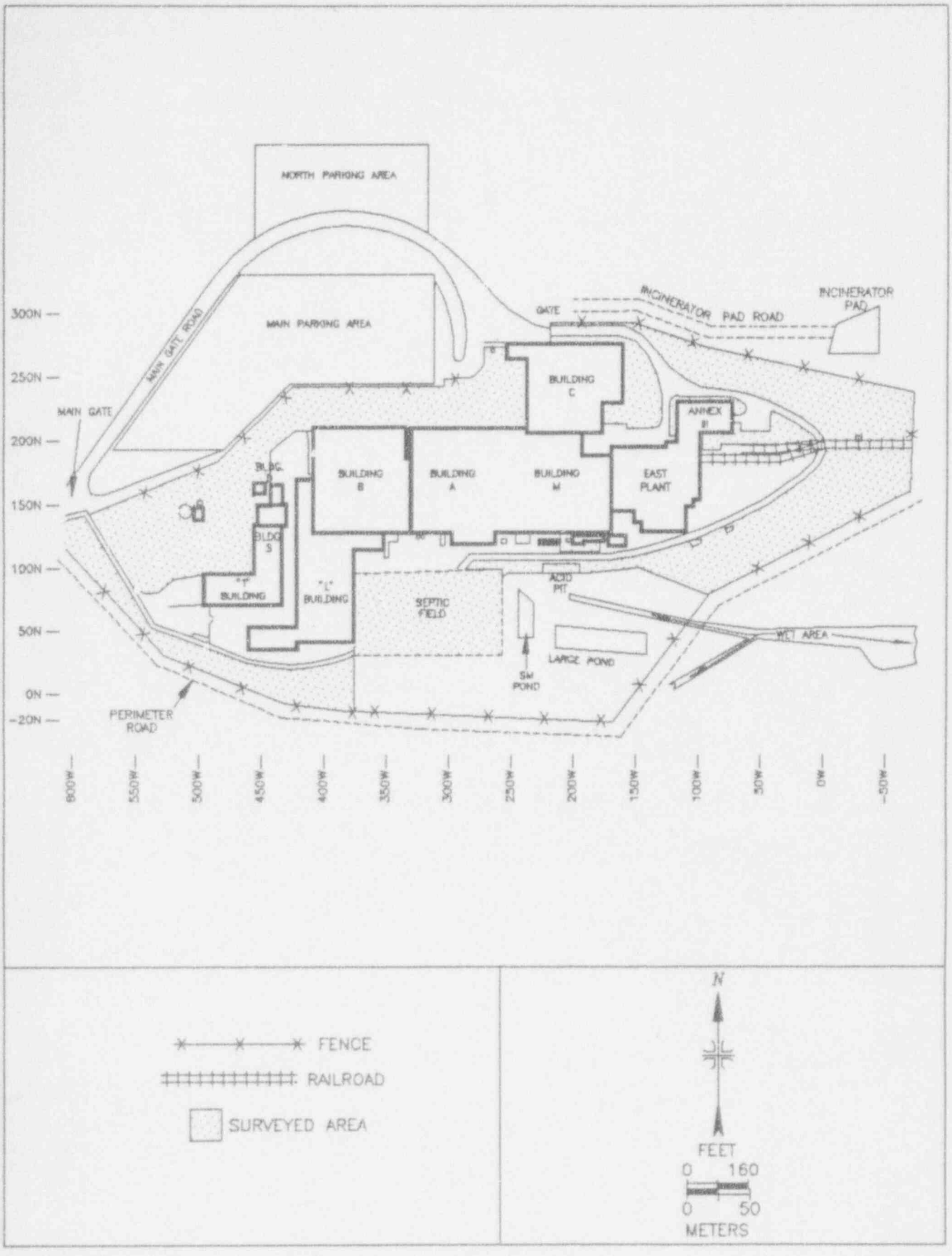


FIGURE 3: Plot Plan of Parcel A

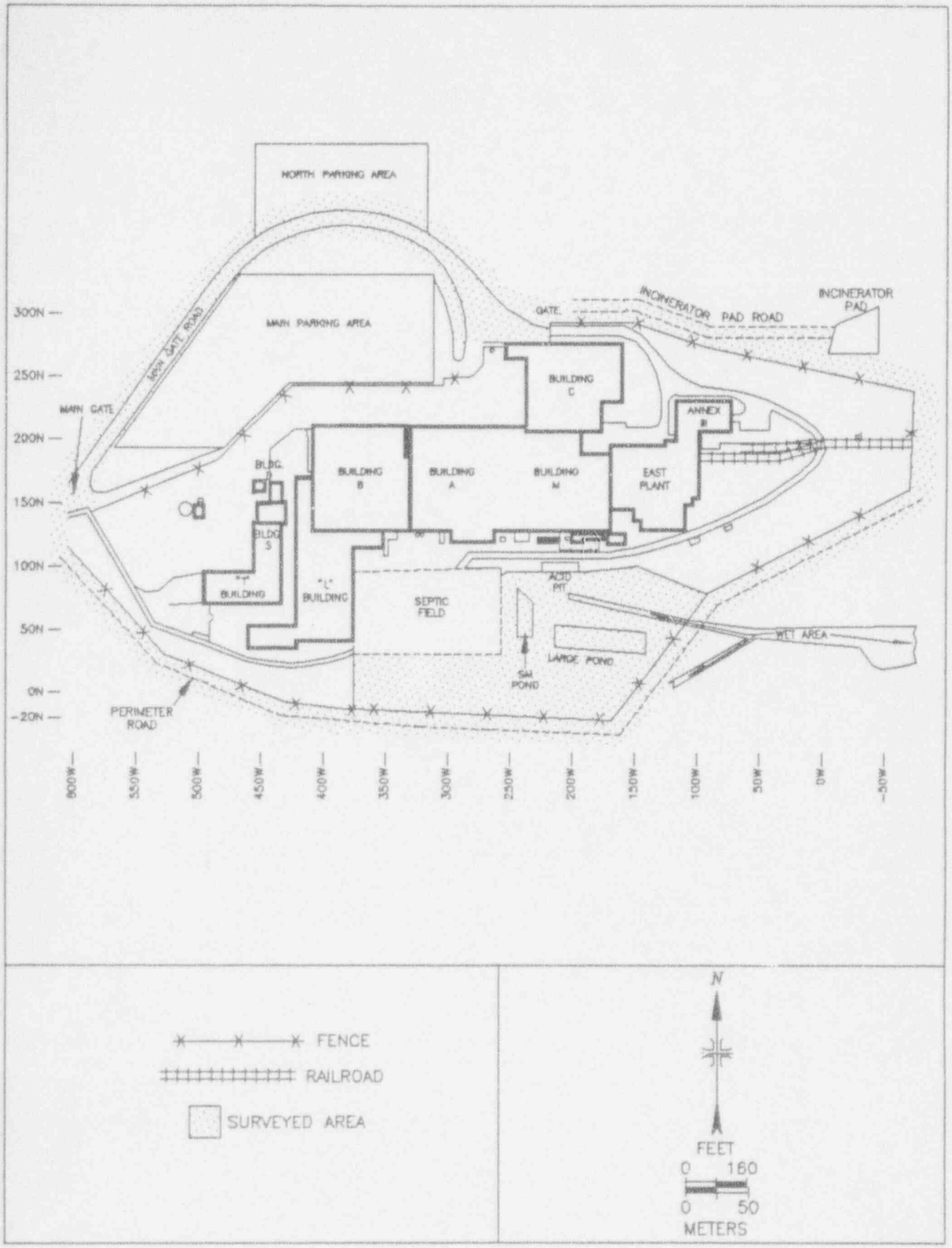


FIGURE 4: Plot Plan of Parcel B

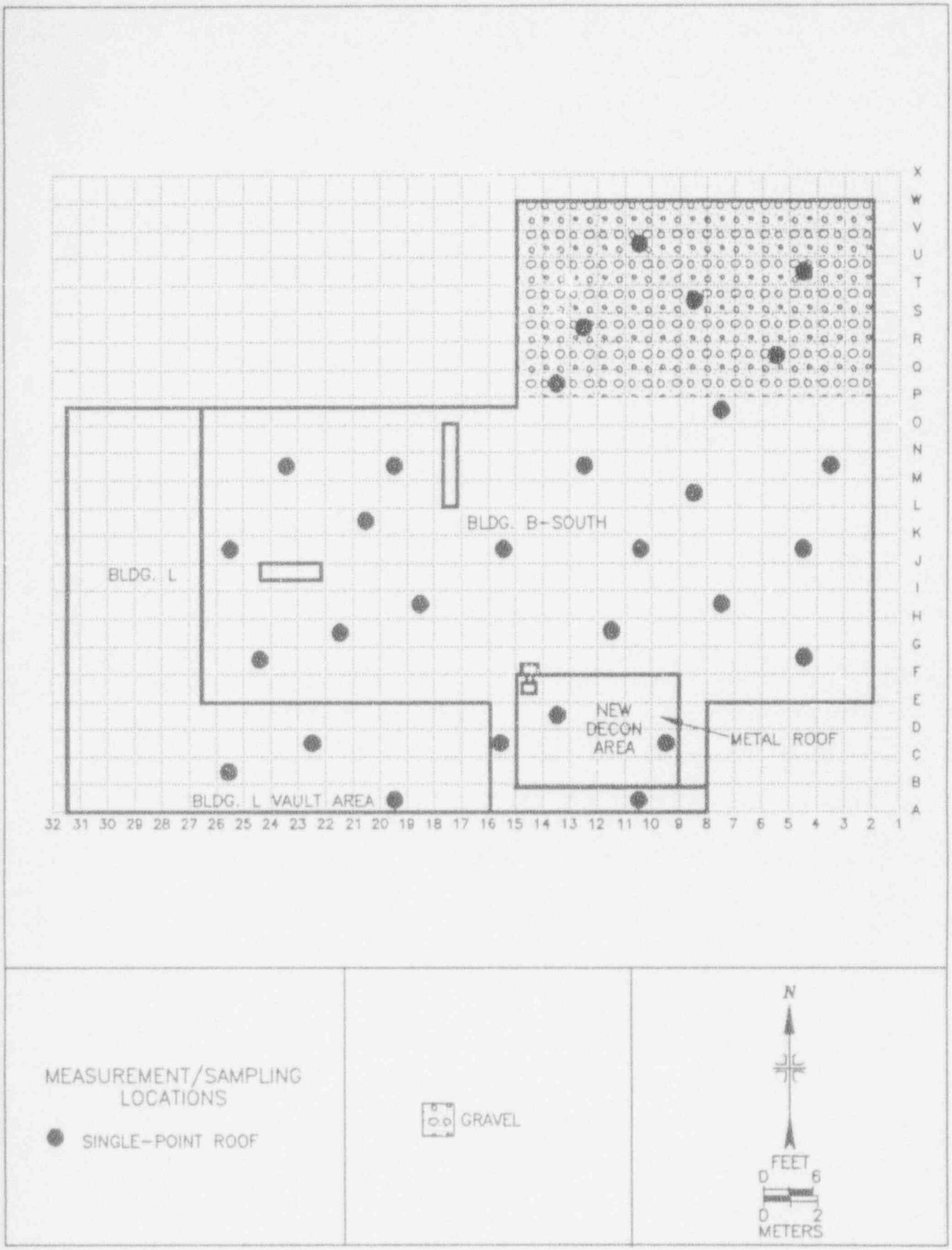


FIGURE 5: Building B-South Roof – Measurement and Sampling Locations

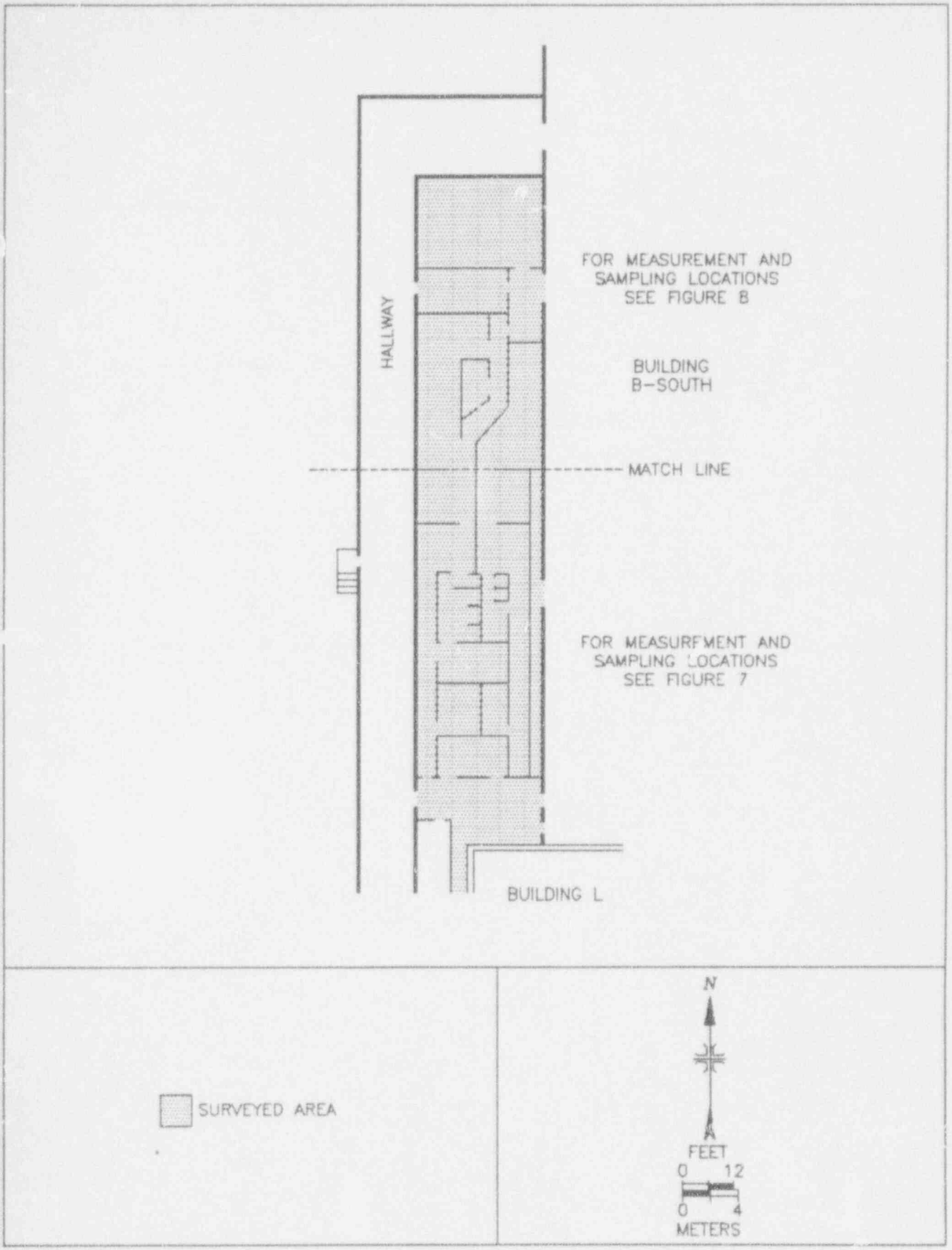


FIGURE 6: Building L Support Areas

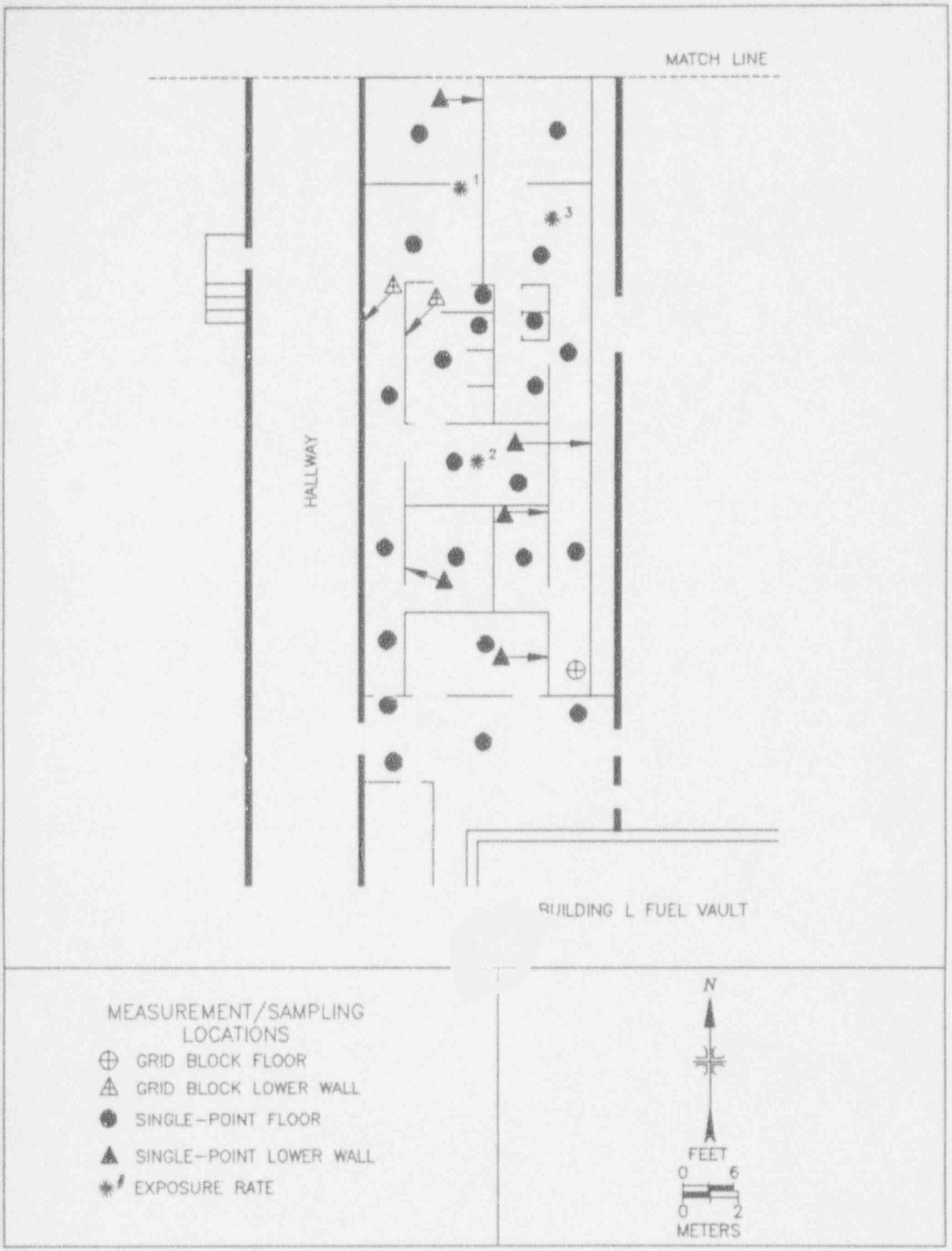


FIGURE 7: Building L Support Areas, South Portion – Measurement and Sampling Locations

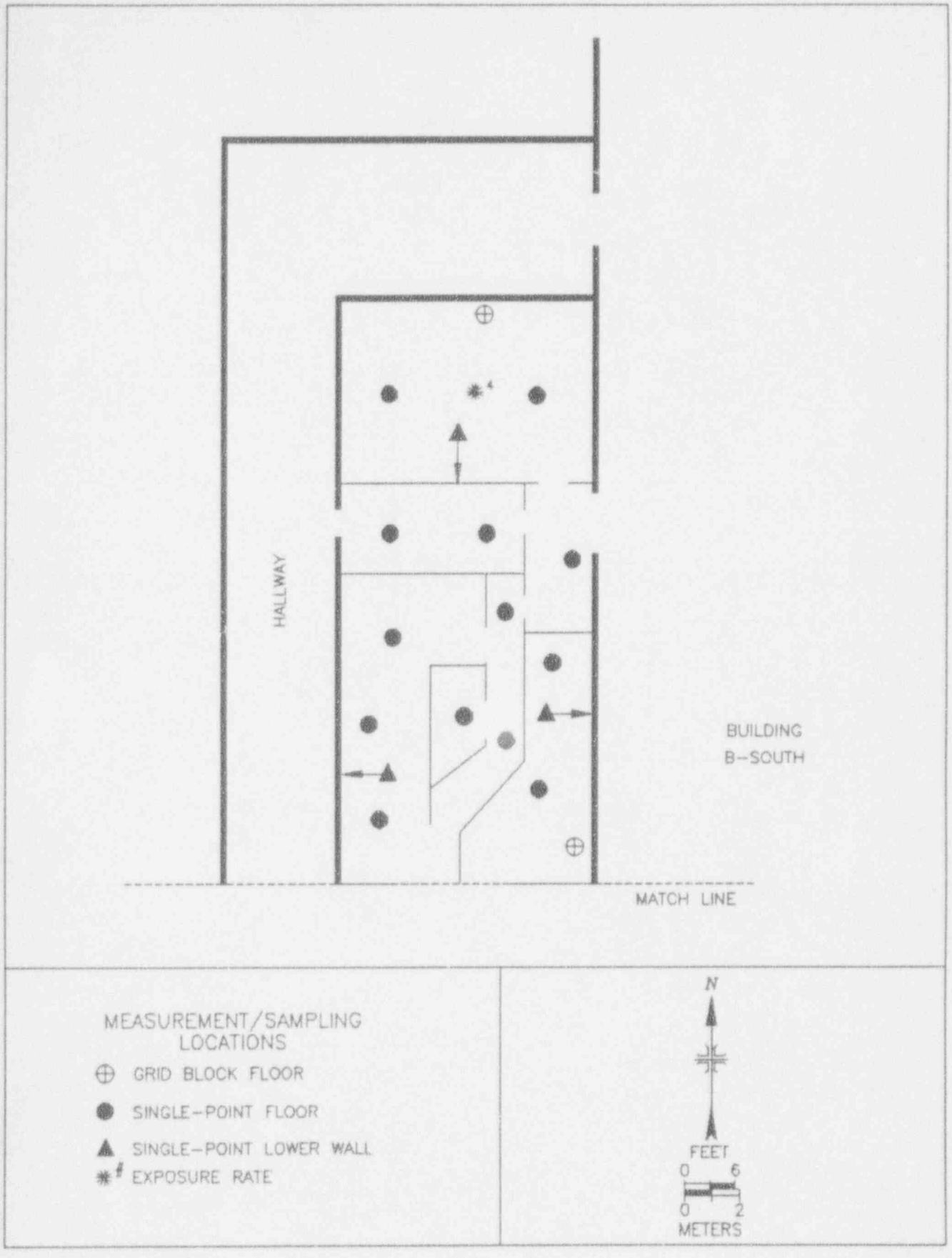
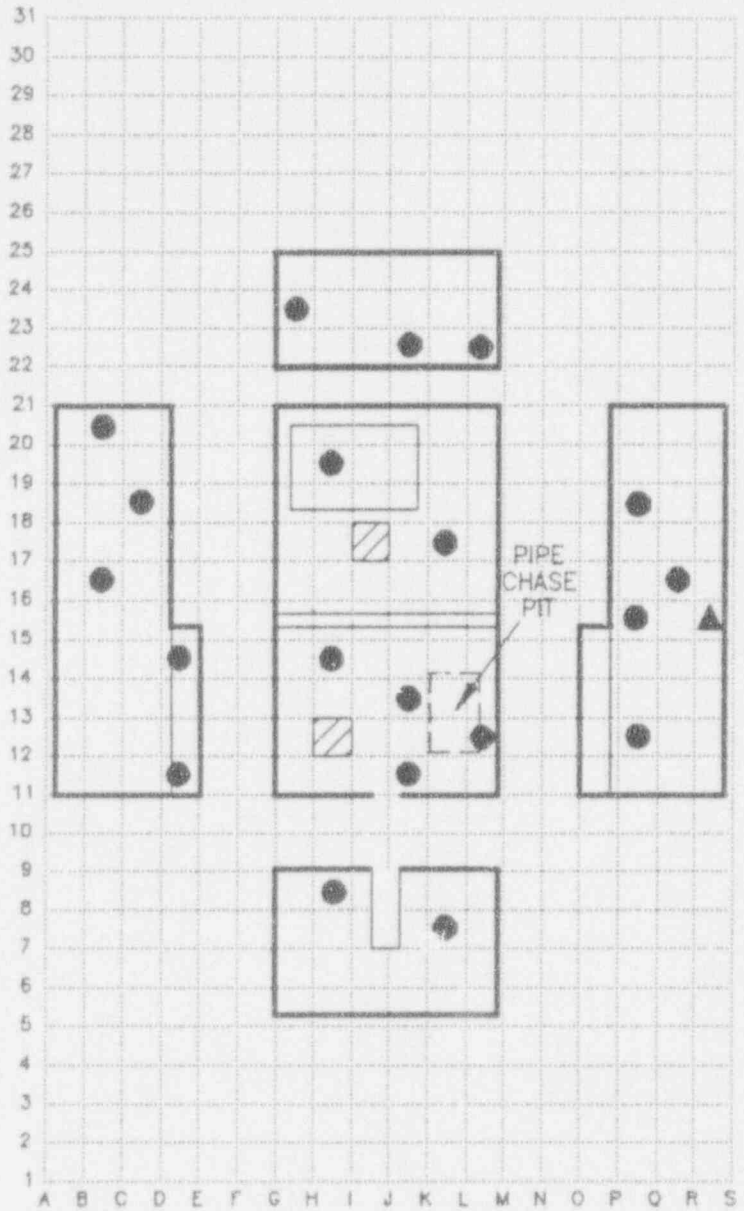


FIGURE 8: Building L Support Areas, North Portion – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

GRID BLOCK

LOWER WALLS AND FLOOR SINGLE-POINT

SINGLE-POINT UPPER WALLS AND CEILING

FIGURE 9: Pumphouse South – Measurement and Sampling Locations

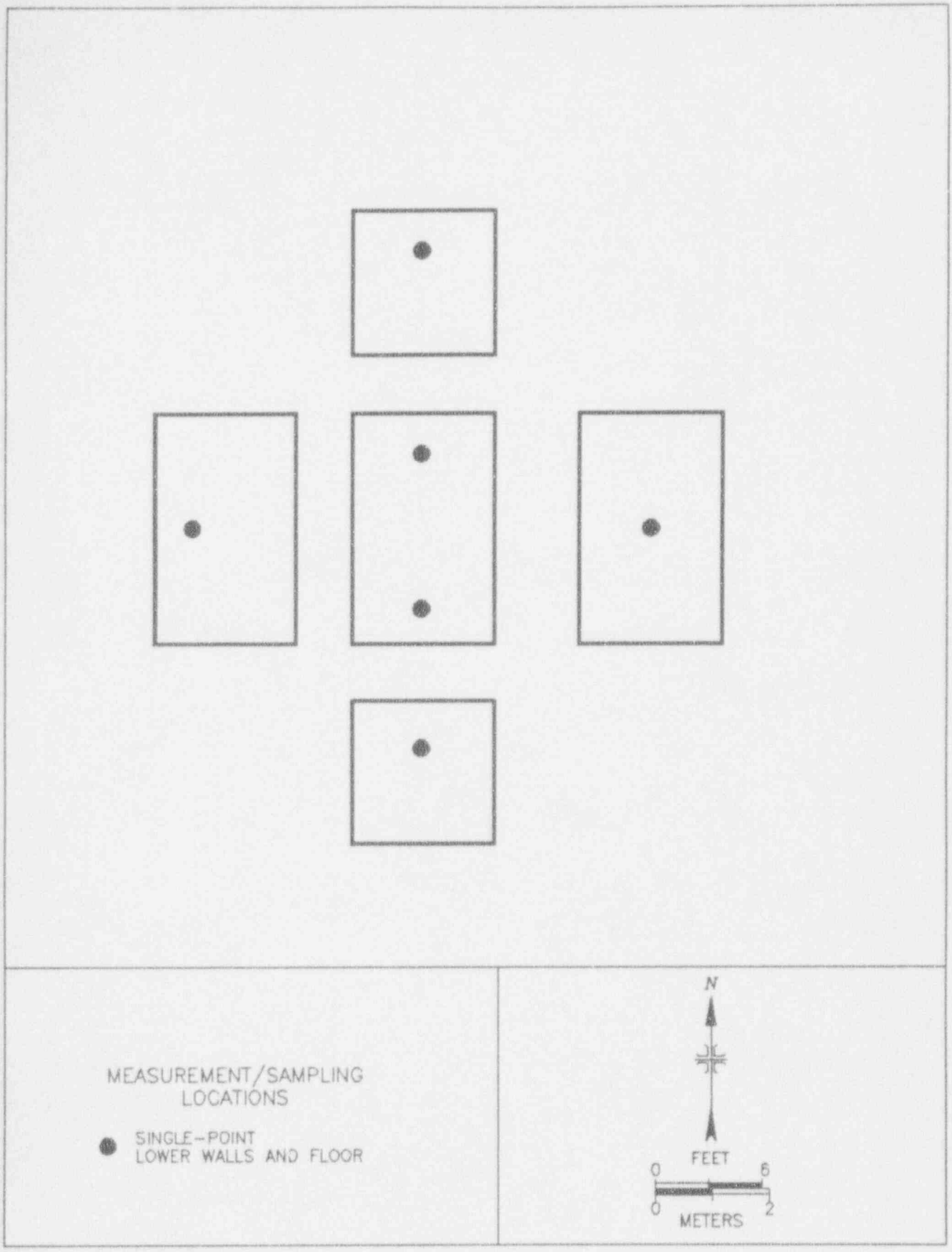


FIGURE 10: Pumphouse South, Pipe Chase Pit – Measurement and Sampling Locations

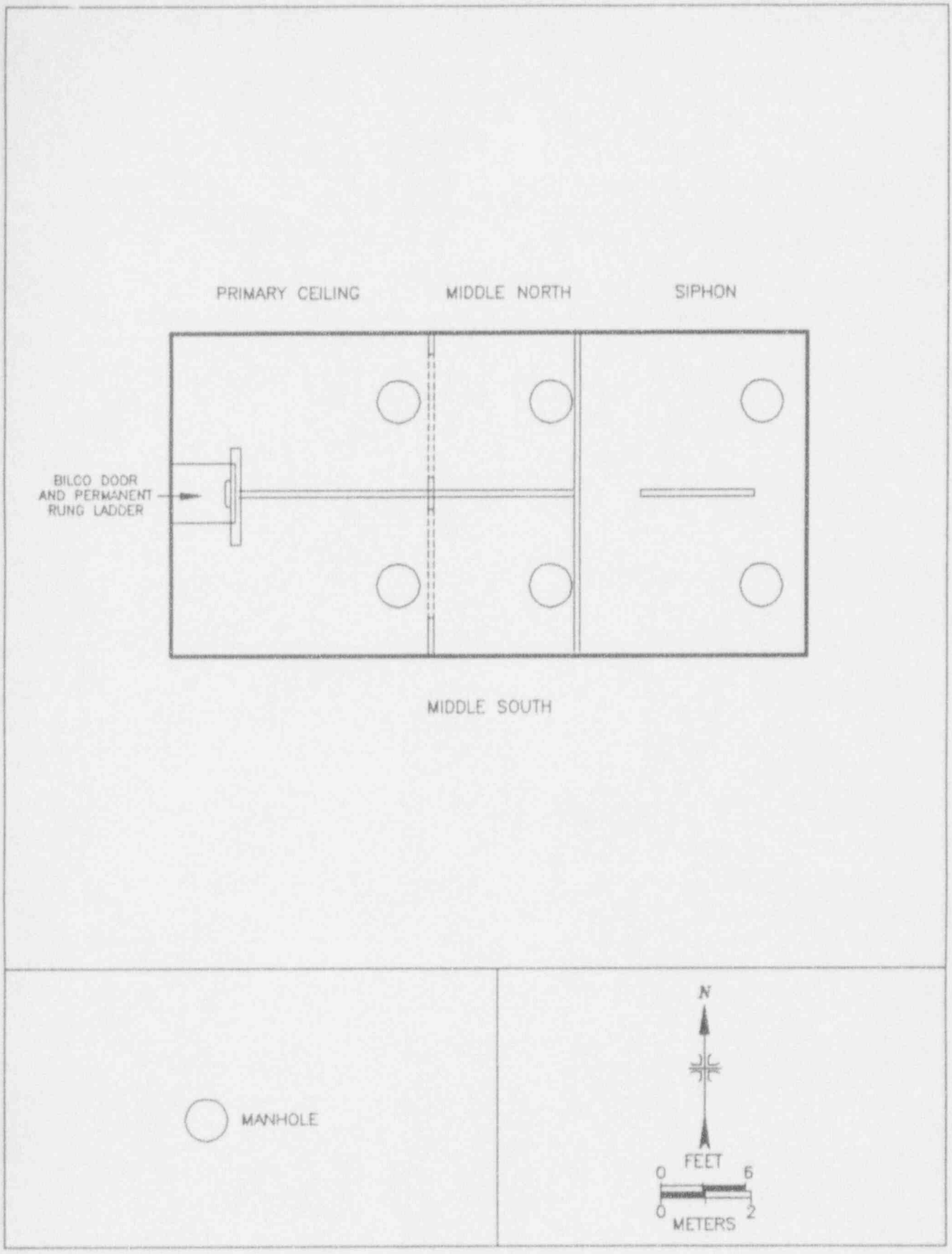


FIGURE 11: Layout of the Septic Tank

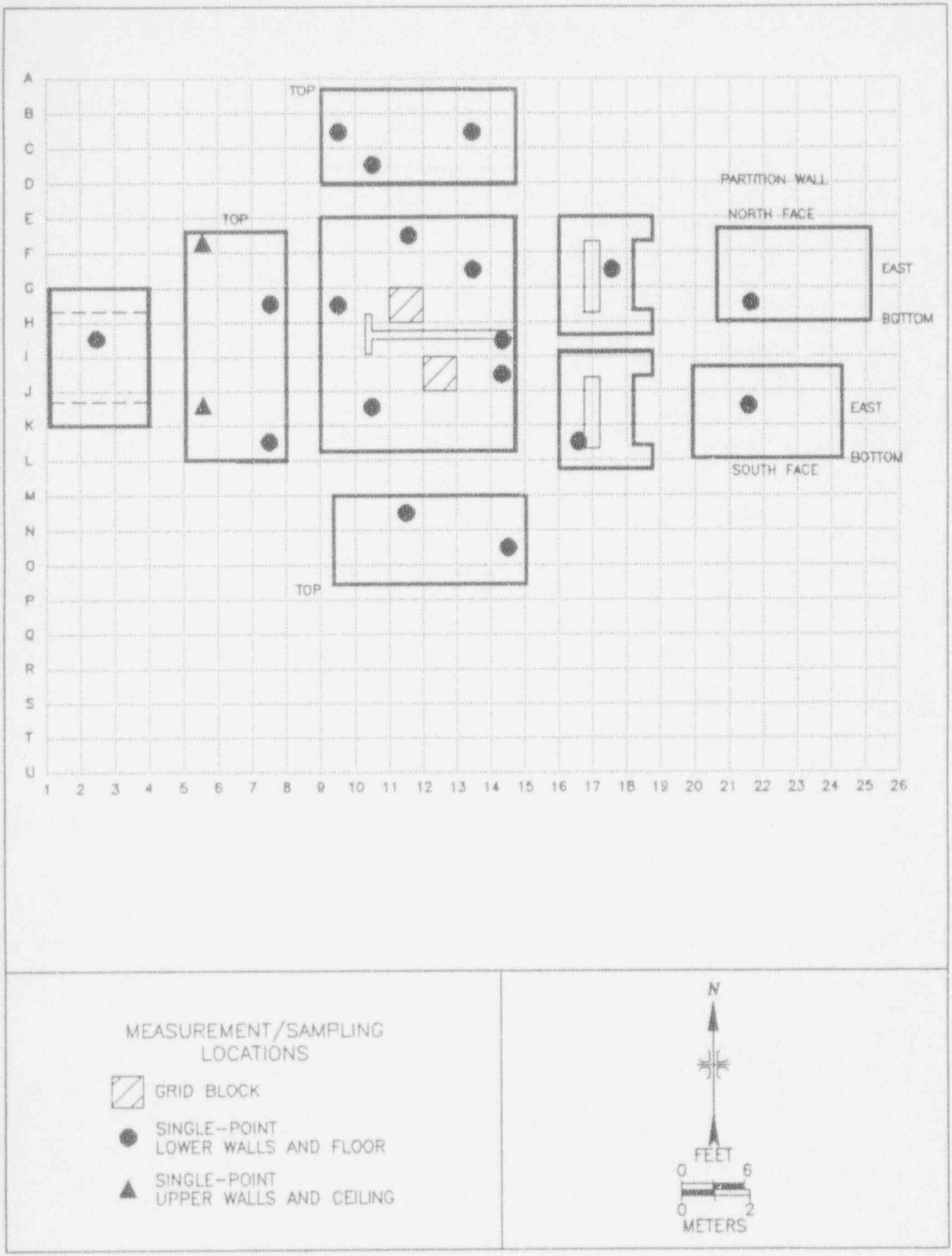
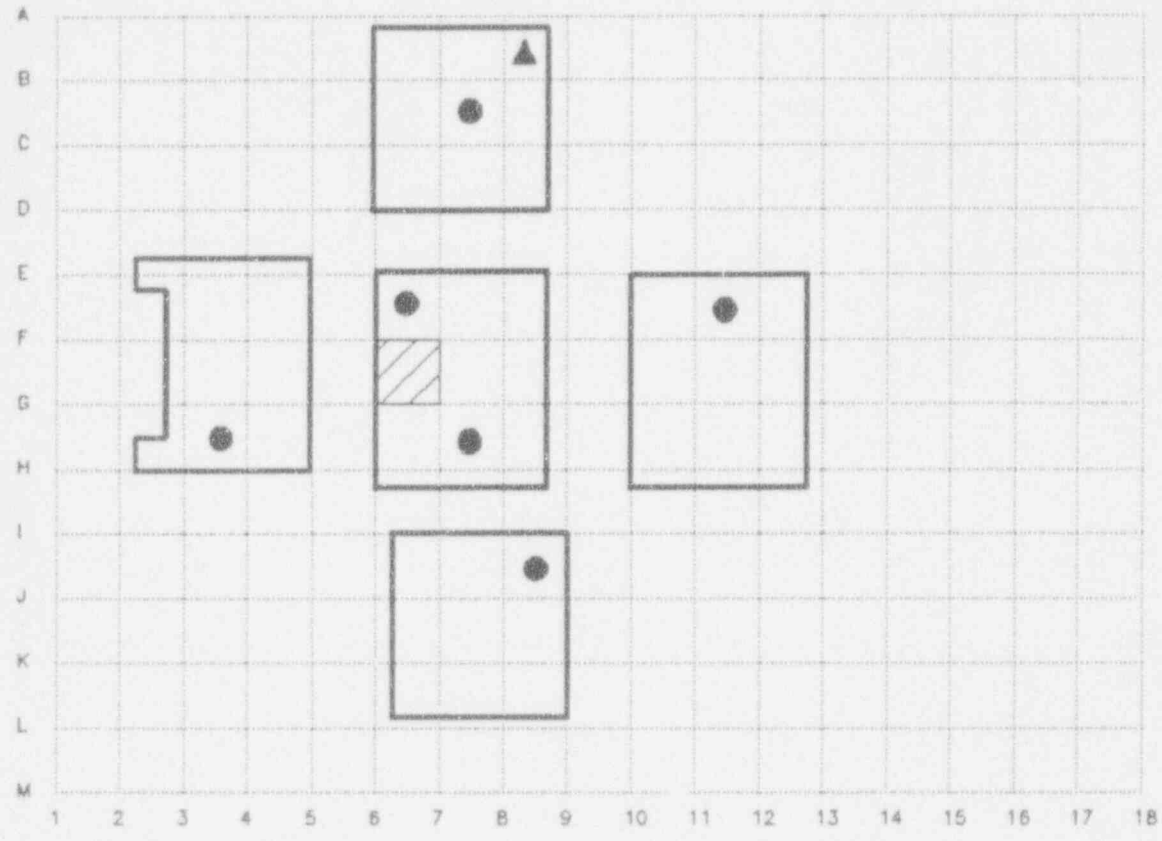


FIGURE 12: Septic Tank Primary Chamber – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

GRID BLOCK

SINGLE-POINT LOWER WALLS AND FLOOR

SINGLE-POINT UPPER WALLS AND CEILING

FIGURE 13: Septic Tank Middle Chamber, North – Measurement and Sampling Locations

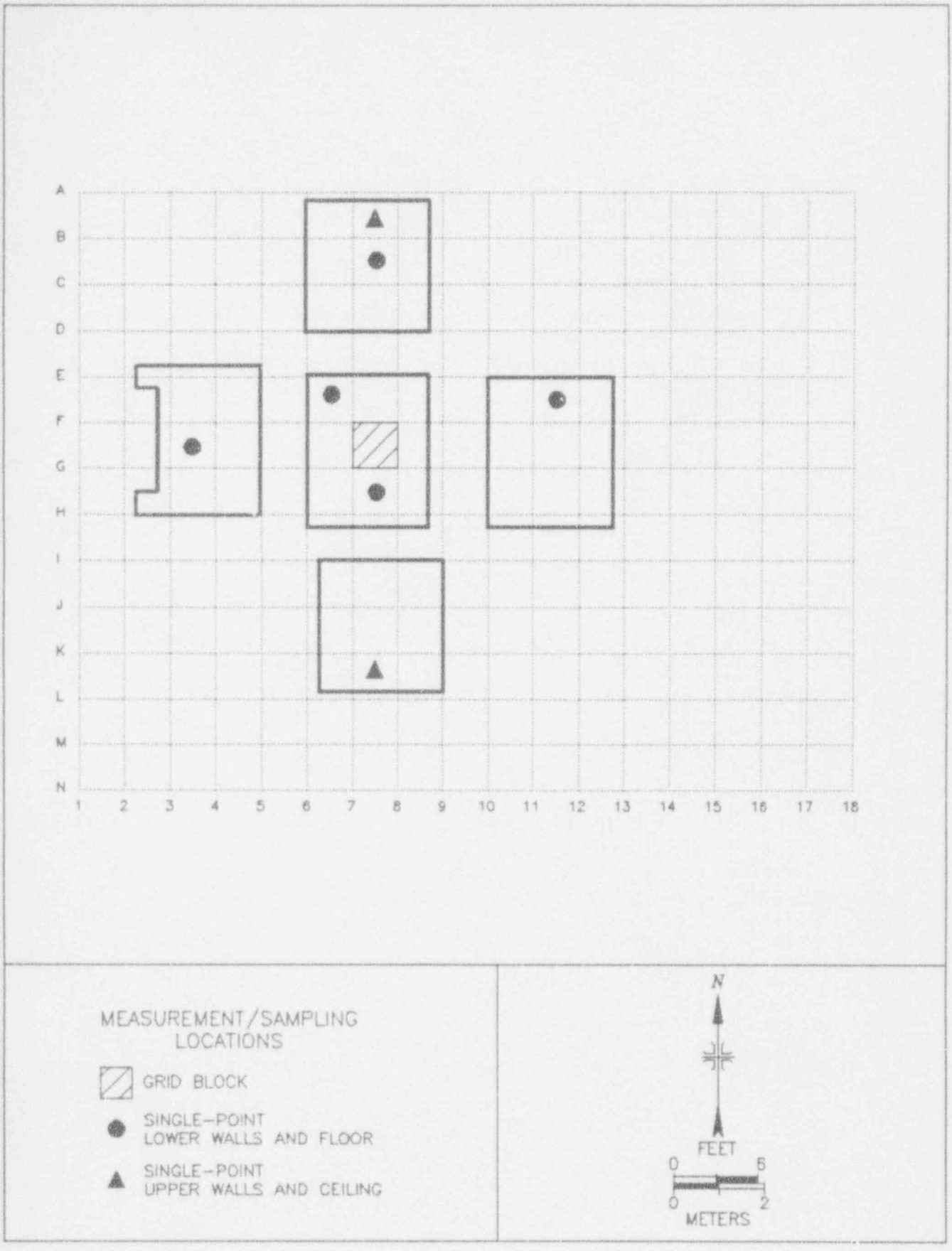


FIGURE 14: Septic Tank Middle Chamber, South – Measurement and Sampling Locations

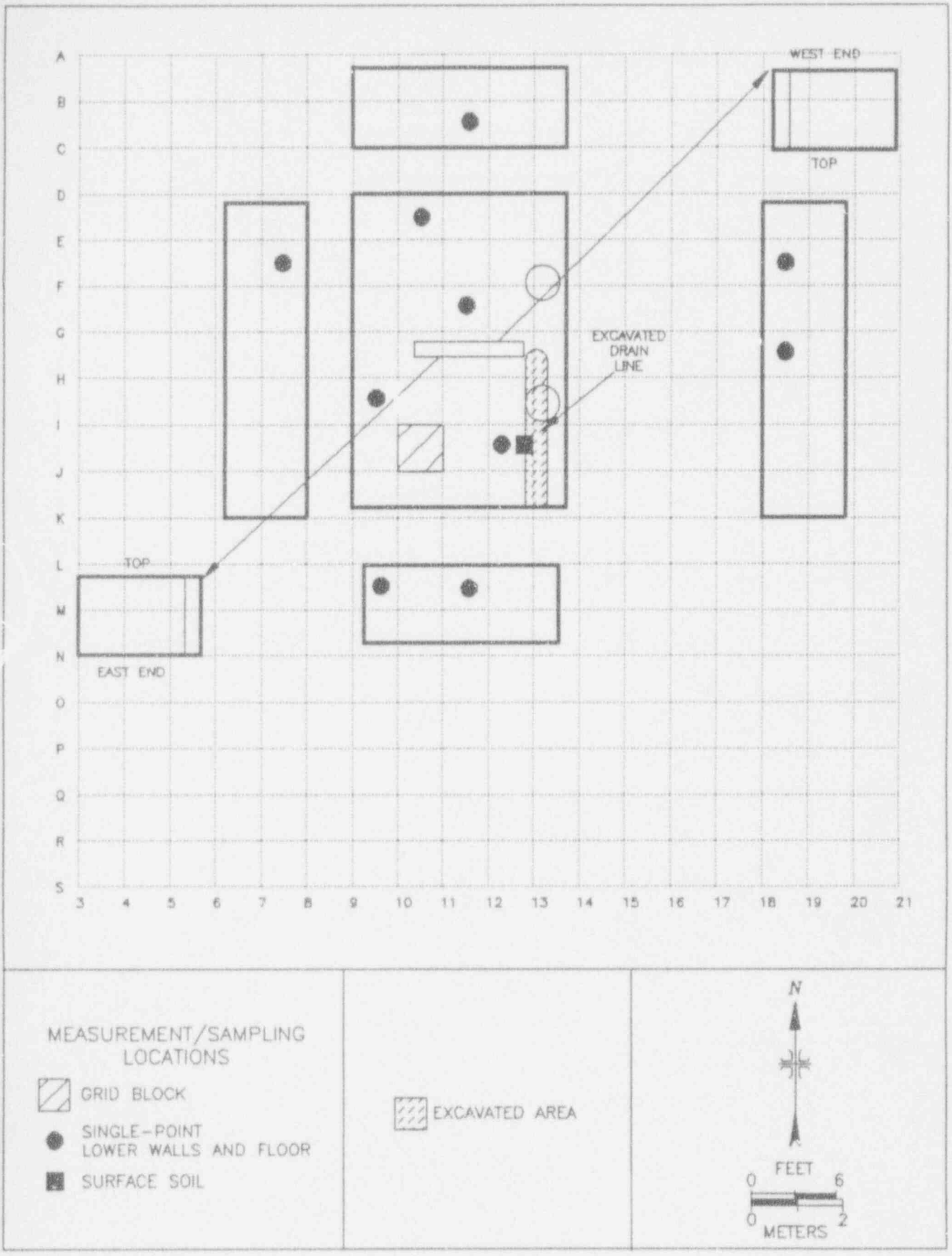
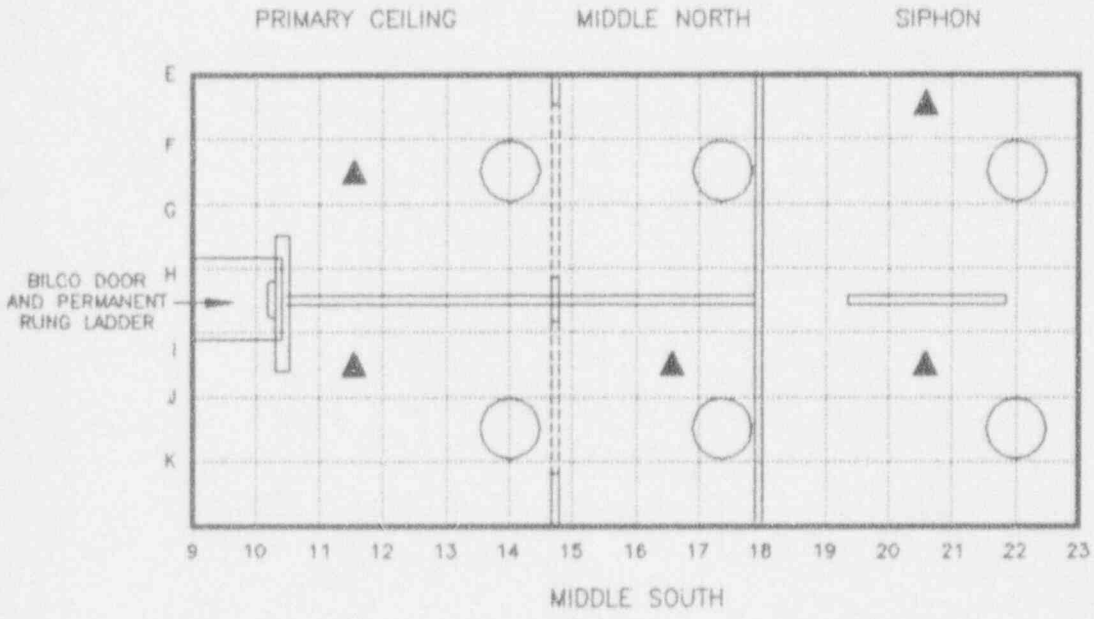


FIGURE 15: Septic Tank Siphon Chamber – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

▲ SINGLE-POINT UPPER WALLS AND CEILING

MANHOLE

N

FEET 0 6

METERS 0 2

FIGURE 16: Septic Tank Ceiling – Measurement and Sampling Locations

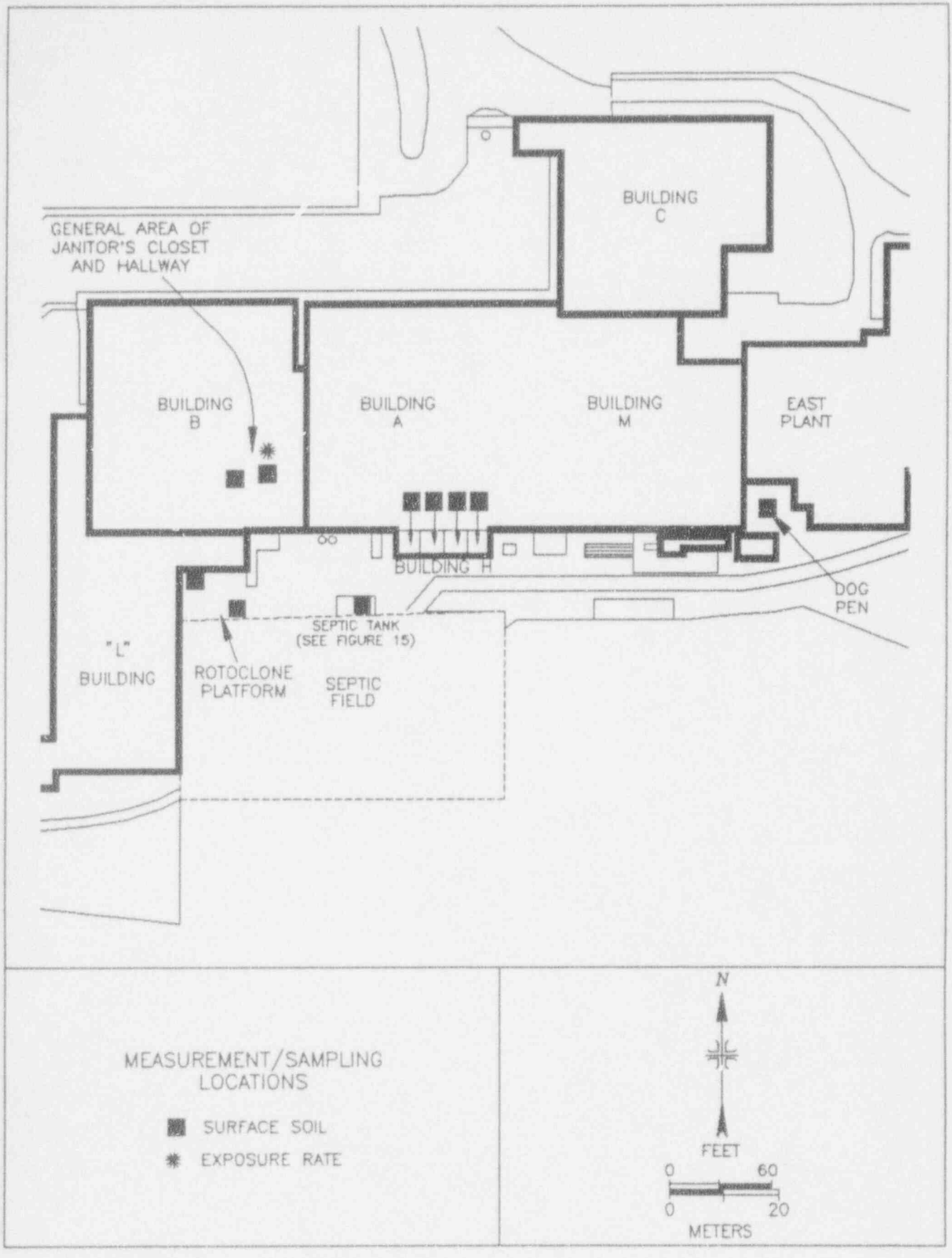


FIGURE 17: Plot Plan of a Portion of the UNC Naval Facility – Measurement and Sampling Locations

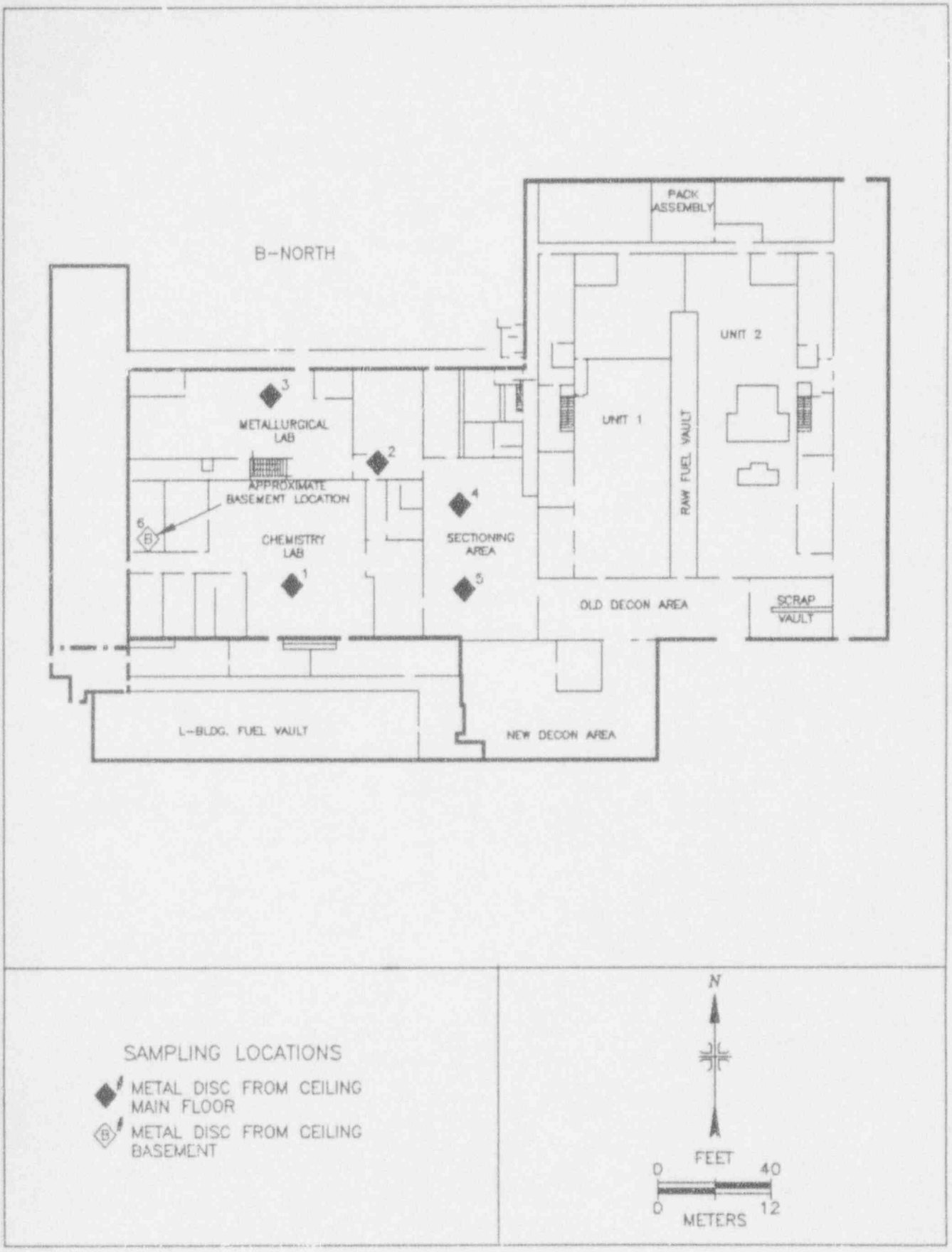


FIGURE 18: Building B-South – Ceiling Metal Disc Sampling Locations

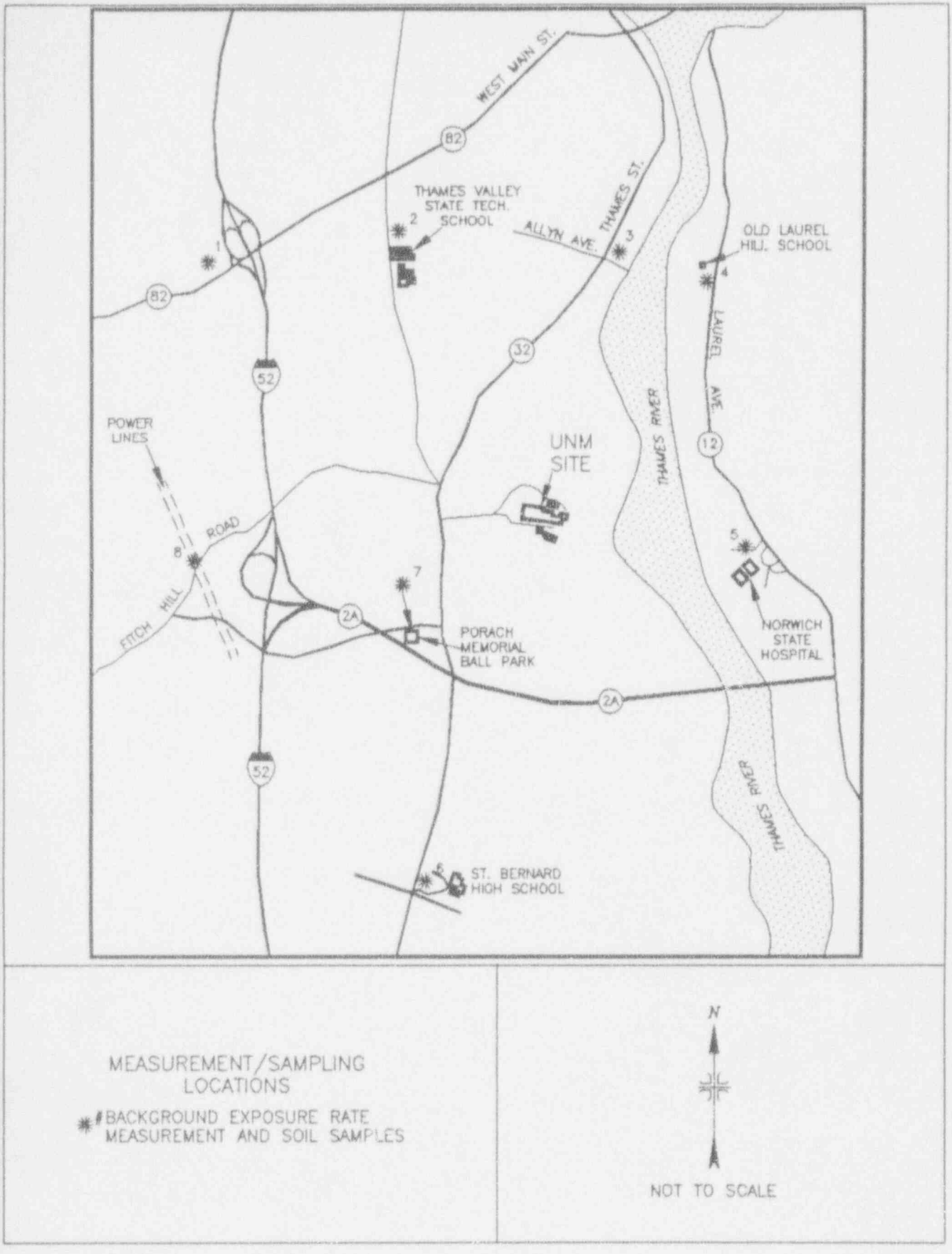


FIGURE 19: Background Exposure Rate Measurement and Soil Sampling Locations

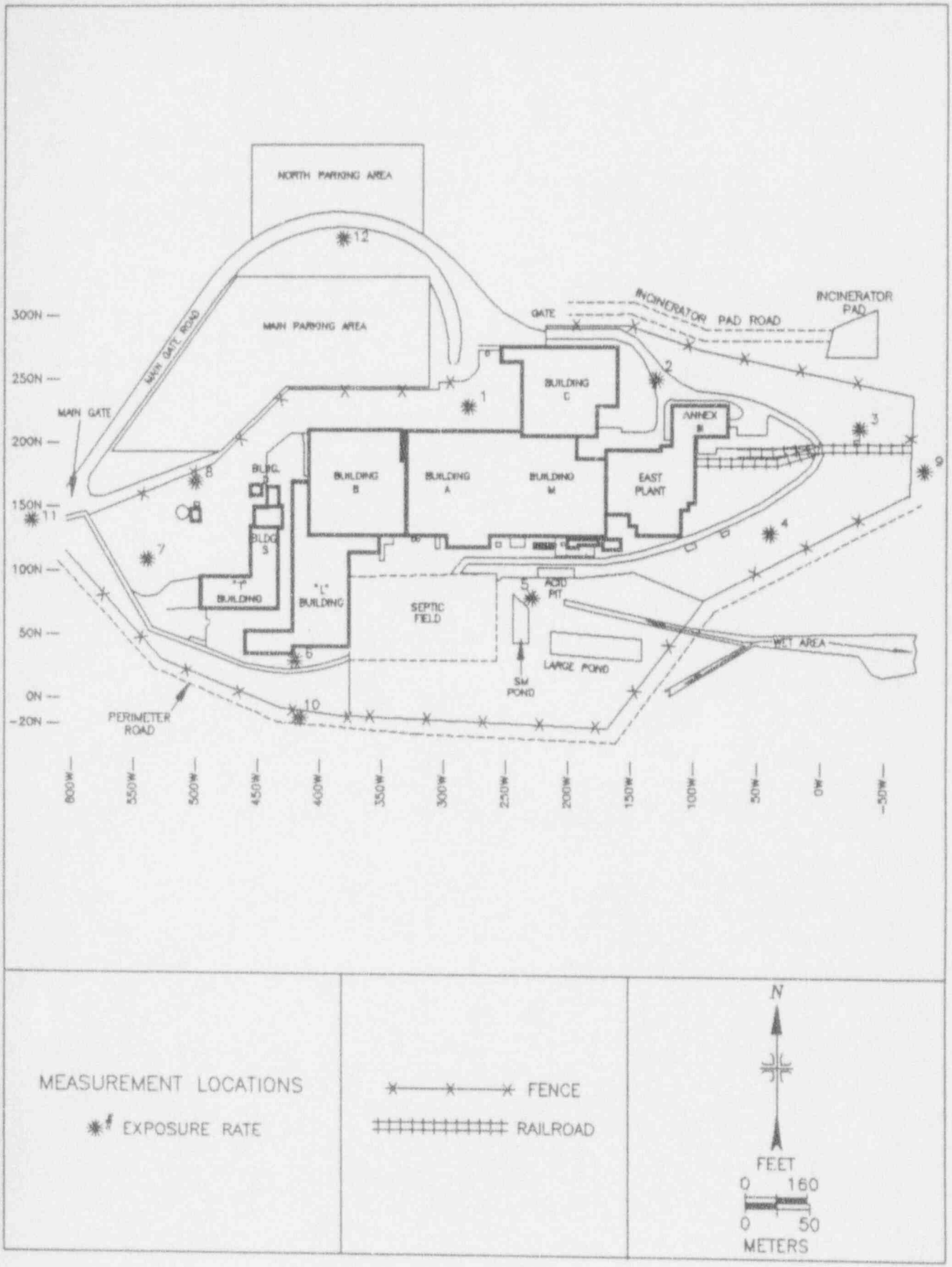


FIGURE 20: Exterior Exposure Rate Measurement Locations

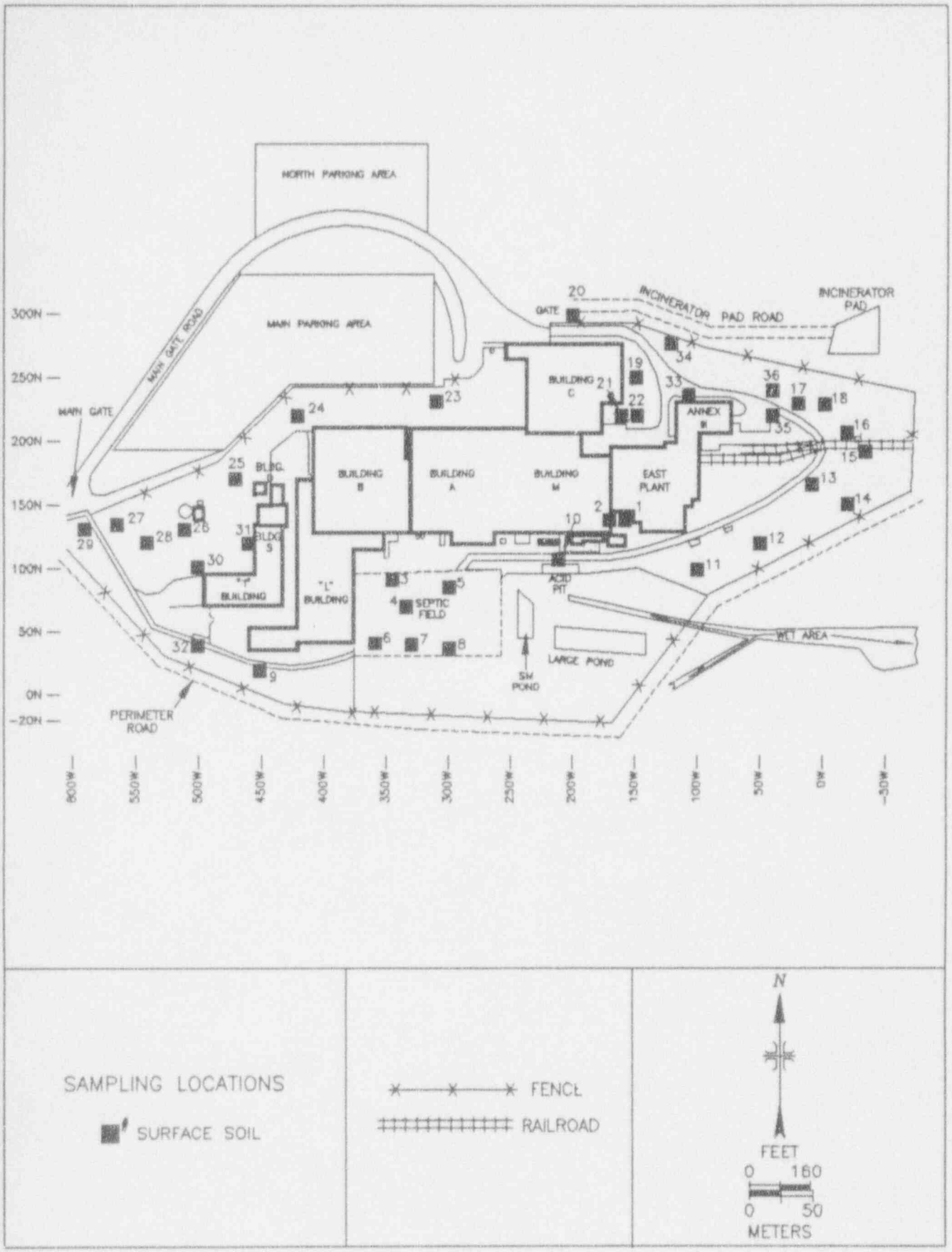


FIGURE 21: Parcel A – Soil Sampling Locations

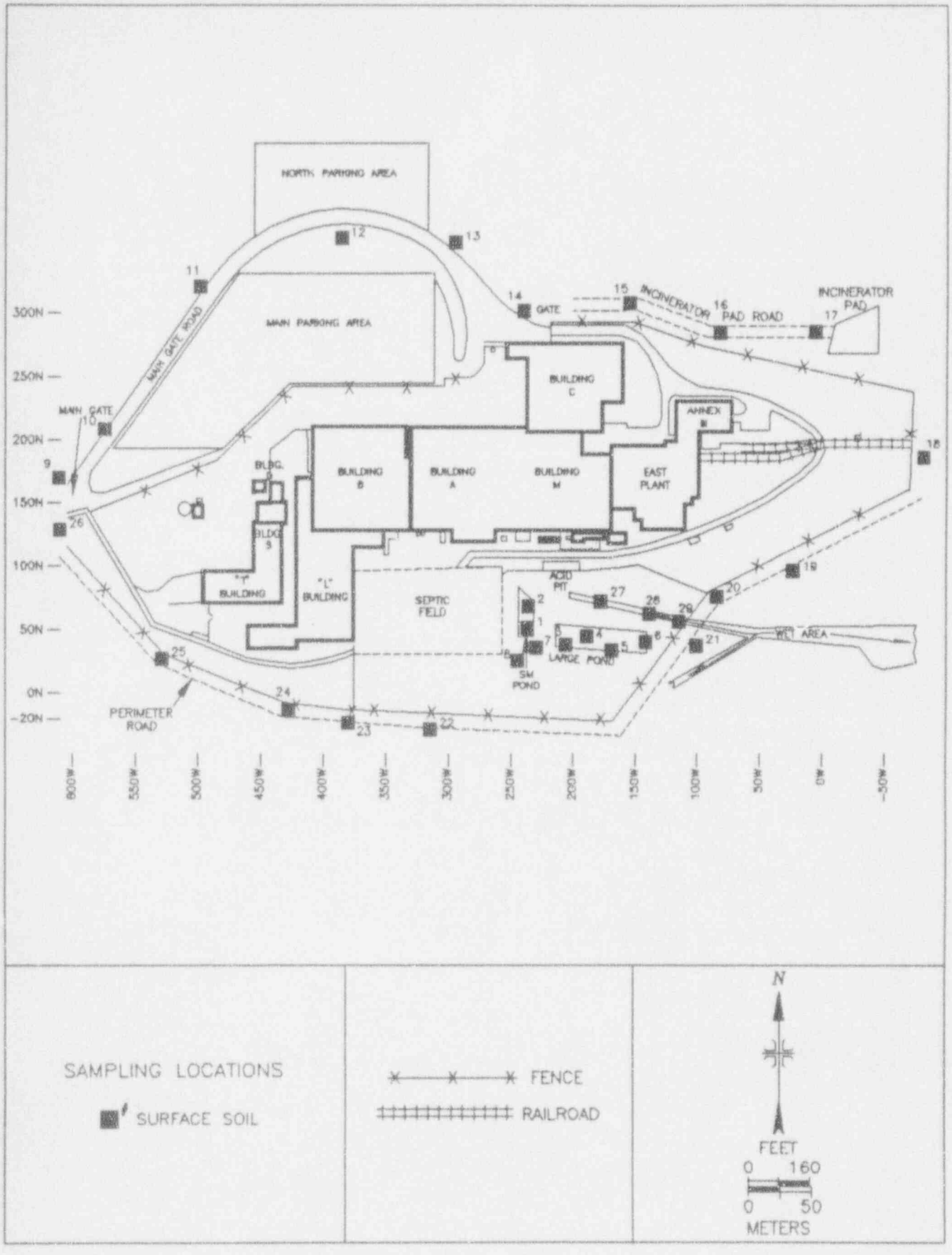


FIGURE 22: Parcel B – Soil Sampling Locations

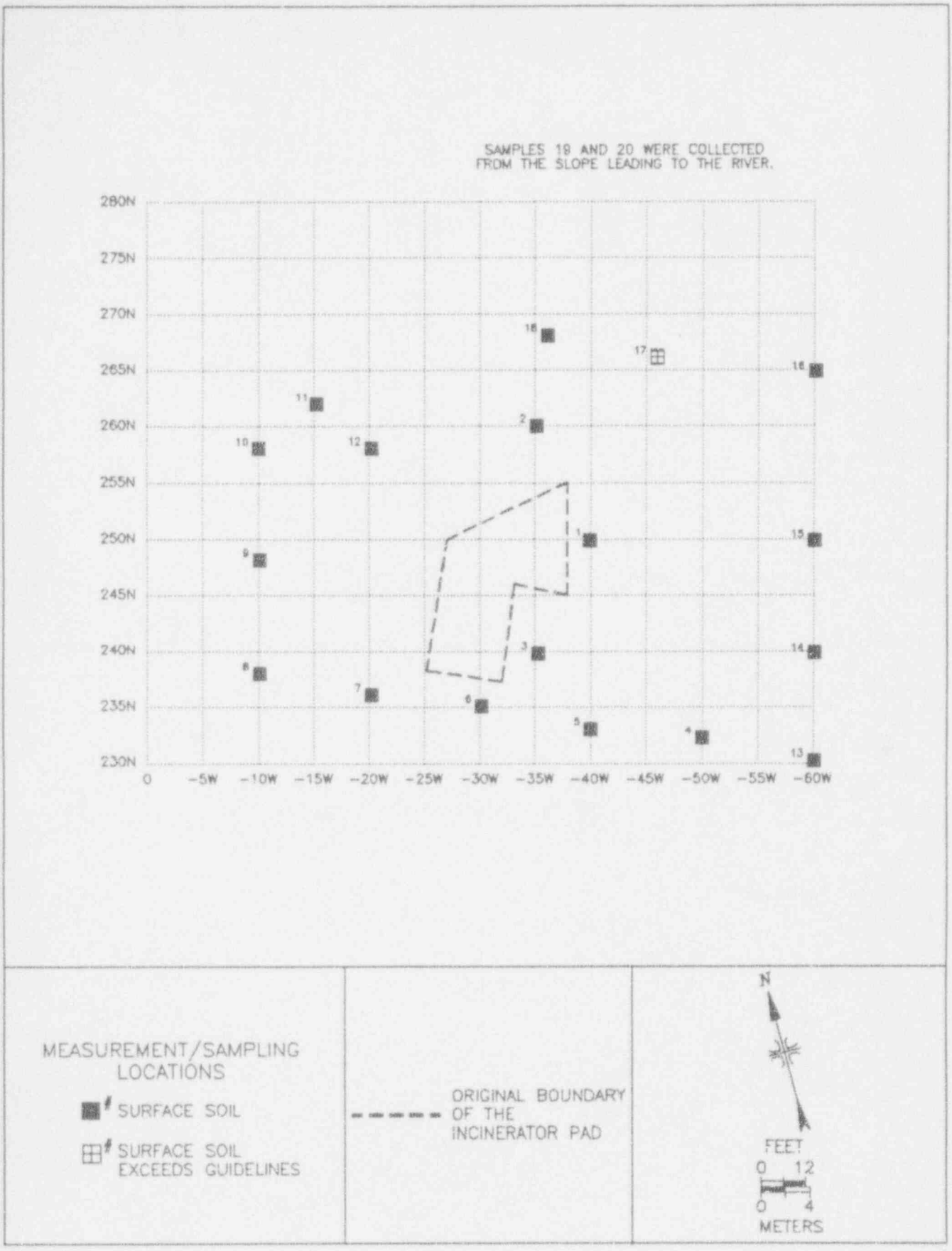


FIGURE 23: Area Surrounding the Former Incinerator Pad – Soil Sampling Locations

TABLE 1

SUMMARY OF SURFACE ACTIVITY MEASUREMENTS
UNITED NUCLEAR CORPORATION
NAVAL PRODUCTS
MONTVILLE, CONNECTICUT

Location	Figure Number	Number of Measurement Locations		Range of Total Activity (dpm/100 cm²)				Range of Removable Activity (dpm/100 cm²)	
				Single Measurement		Grid Block Average			
		Single Pts	Grid Blocks	Alpha	Beta	Alpha	Beta	Alpha	Beta
Building L Support Areas									
Lower Walls and Floor	6-8	44	5	<69	<1300-2500	<69	<1300	<12	<17-20
Building B-South - Roof									
Lower Walls and Floor	5	30	NA[a]	<69-190	<1300-1600	NA	NA	<12	<17-19
Pumphouse South Building									
Pumphouse Room									
Lower Walls and Floor	9	20	2	<69	<1300-1700	<69	<1300	<12	<17
Upper Walls and Ceiling	9	1	NA	<69	<1300	NA	NA	<12	<17
Pipe Chase Pit									
Lower Walls and Floor	10	6	NA	<69	1700-2500	NA	NA	<12	<17

TABLE 1 (Continued)

SUMMARY OF SURFACE ACTIVITY MEASUREMENTS
UNITED NUCLEAR CORPORATION
NAVAL PRODUCTS
MONTVILLE, CONNECTICUT

Location	Figure Number	Number of Measurement Locations		Range of Total Activity (dpm/100 cm²)				Range of Removable Activity (dpm/100 cm²)	
				Single Measurement		Grid Block Average			
		Single Pts	Grid Blocks	Alpha	Beta	Alpha	Beta	Alpha	Beta
Septic Tank									
Primary Chamber									
Lower Walls and Floor	12	18	2	<69-120	<1300-2000	<69	1600	<12	<17
Upper Walls and Ceiling	12,16	4	NA	<69	<1300-2000	NA	NA	<12	<17
Siphon Chamber									
Lower Walls and Floor	15	10	1	<69-270	<1300-2300	170	1400	<12	<17
Upper Walls and Ceiling	15,16	2	NA	<69	<1600-1900	NA	NA	<12	<17
Middle Chamber, South									
Lower Walls and Floor	14	5	1	<69-150	<1300-2300	<69	1400	<12	<17
Upper Walls and Ceiling	14,16	3	NA	<69	1400-1600	NA	NA	<12	<17

TABLE 1 (Continued)

SUMMARY OF SURFACE ACTIVITY MEASUREMENTS
UNITED NUCLEAR CORPORATION
NAVAL PRODUCTS
MONTVILLE, CONNECTICUT

Location	Figure Number	Number of Measurement Locations		Range of Total Activity (dpm/100 cm²)				Range of Removable Activity (dpm/100 cm²)	
				Single Measurement		Grid Block Average			
		Single Pts	Grid Blocks	Alpha	Beta	Alpha	Beta	Alpha	Beta
Middle Chamber, North									
Lower Walls and Floor	13	6	1	<69-220	<1300-1900	<69	1500	<12	<17
Upper Walls and Ceiling	13	1	NA	<69	1300	NA	NA	<12	<17

[a]Grid block averaging was not performed on upper wall and ceiling surfaces.

TABLE 2

INTERIOR EXPOSURE RATE MEASUREMENTS
UNITED NUCLEAR CORPORATION
NAVAL PRODUCTS
MONTVILLE, CONNECTICUT

Location	Exposure Rate (μR/h)
Building L Support Areas	
#1[a]	12
#2[a]	11
#3[a]	11
#4[b]	11
Building B-South	
Janitor's closet adjoining hallway[c]	15

[a]Refer to Figure 7.
[b]Refer to Figure 8.
[c]Refer to Figure 17.

TABLE 3

URANIUM CONCENTRATIONS IN SOIL SAMPLES, INTERIOR LOCATIONS
UNITED NUCLEAR CORPORATION
NAVAL PRODUCTS
MONTVILLE, CONNECTICUT

Location[a]	Uranium Concentration (pCi/g)[b]		
	U-235	U-238	Total Uranium[c]
Building H			
Storage Bunker #1	0.1 ± 0.1	1.6 ± 0.6	5.8
Storage Bunker #2	0.1 ± 0.1	1.2 ± 0.5	5.4
Storage Bunker #3	0.1 ± 0.1	0.8 ± 0.6	5.0
Storage Bunker #4	0.1 ± 0.1	1.1 ± 0.5	5.3
Building B-South Janitor's Closet Excavation			
Janitor's Closet	0.1 ± 0.1	1.0 ± 0.5	5.2
Adjacent Hallway	0.2 ± 0.1	1.2 ± 0.5	9.6
Rotoclone Platform			
Southeast Corner	0.1 ± 0.1	1.9 ± 1.1	6.1
Northwest Corner	0.1 ± 0.1	1.2 ± 0.9	5.4
Miscellaneous			
Dog Pen	0.1 ± 0.1	1.2 ± 0.6	5.4
Siphon Chamber[d]	0.3 ± 0.1	1.5 ± 0.7	14

[a]Refer to Figure 17.
[b]Uncertainties represent the 95 % confidence level, based only on counting statistics.
[c]Total uranium concentrations are calculated based on U-234 to U-235 ratio of 41 to 1 which was established by UNC.
[d]Refer to Figure 15.

TABLE 4

SUMMARY OF SURFACE ACTIVITY MEASUREMENTS
FOR CEILING METAL DISK SAMPLES
BUILDING B-SOUTH
UNITED NUCLEAR CORPORATION
NAVAL PRODUCTS
MONTVILLE, CONNECTICUT

Location[a]	Alpha Activity (dpm/100 cm^2)	Beta Activity (dpm/100 cm^2)
Sample #1, 58-L17[b]	89	<47
Sample #2, 58-F21	<29	<47
Sample #3, 48-CL56	78	<47
Sample #4, 69-N58	1800	78
Sample #5, 69-N51	2300	180
Sample #6, U36	<29	<47

[a]Refer to Figure 18.
[b]Grid location.

TABLE 5

BACKGROUND
EXPOSURE RATES AND
URANIUM CONCENTRATIONS IN SOIL
UNITED NUCLEAR CORPORATION
NAVAL PRODUCTS
MONTVILLE, CONNECTICUT

Measurement Location[a]	Exposure Rate (μR/h) @ 1 m Above Surface	Total Uranium Concentration (pCi/g)[b]
1 Ramada Inn on West Main	12	5.6
2 Thames Valley State Tech School	10	3.8
3 Thames Street and Allyn Avenue	11	3.5
4 Old Laurel Hill School	11	3.2
5 Norwich State Hospital	10	3.6
6 Saint Bernard High School	11	5.6
7 Pomich Memorial Ball Field	11	3.3
8 Fitch Road at Power Lines	12	3.4

[a]Refer to Figure 19.
[b]Total uranium concentrations are calculated based on natural isotopic abundances of U-234 and U-238.

TABLE 6

EXTERIOR EXPOSURE RATE MEASUREMENTS
UNITED NUCLEAR CORPORATION
NAVAL PRODUCTS
MONTVILLE, CONNECTICUT

Location[a]	Exposure Rate at 1 m Above Surface (μR/h)
Parcel A	
1 230 N, 290 W	12
2 250 N, 130 W	12
3 210 N, -30 W	12
4 130 N, 40 W	11
5 80 N, 230 W	10
6 30 N, 420 W	11
7 110 N, 540 W	12
8 170 N, 500 W	11
Parcel B	
9	12
10	12
11	11
12	10

[a]Refer to Figure 20. For Parcel B, locations are approximate.

TABLE 7

URANIUM CONCENTRATIONS IN SOIL SAMPLES
UNITED NUCLEAR CORPORATION
NAVAL PRODUCTS
MONTVILLE, CONNECTICUT

Location		Uranium Concentration (pCi/g)[a]		
		U-235	U-238	Total Uranium[b]
Parcel A[c]				
1	140 N, 172 W	0.2 ± 0.1	1.8 ± 0.8	10
2	140 N, 167 W	0.1 ± 0.1	0.9 ± 0.4	5.1
3	90 N, 338 W	0.1 ± 0.1	1.3 ± 0.7	5.5
4	70 N, 325 W	0.1 ± 0.1	0.9 ± 0.5	5.1
5	85 N, 300 W	0.1 ± 0.1	1.2 ± 0.7	5.4
6	40 N, 350 W	0.1 ± 0.1	0.9 ± 0.6	5.1
7	40 N, 320 W	0.1 ± 0.1	1.6 ± 0.7	5.8
8	30 N, 290 W	0.1 ± 0.1	1.2 ± 0.6	5.4
9	20 N, 450 W	0.2 ± 0.7	1.6 ± 0.6	10
10	110 N, 210 W	0.1 ± 0.1	1.0 ± 0.4	5.2
11	100 N, 100 W	0.1 ± 0.1	0.5 ± 0.4	4.7
12	130 N, 40 W	0.1 ± 0.1	1.4 ± 0.8	5.6
13	170 N, 10 W	0.1 ± 0.1	1.0 ± 0.7	5.2
14	160 N, -20 W	0.1 ± 0.1	0.7 ± 0.6	4.9
15	194 N, -35 W	0.2 ± 0.1	1.3 ± 0.9	9.0
16	210 N, -20 W	0.1 ± 0.1	1.5 ± 0.8	5.7
17	220 N, 20 W	0.1 ± 0.1	1.6 ± 0.6	5.8
18	230 N, 0W	0.1 ± 0.1	1.0 ± 0.7	5.2
19	250 N, 150 W	0.1 ± 0.1	1.0 ± 0.6	5.2
20	300 N, 200 W	0.1 ± 0.1	0.9 ± 0.8	5.1
21	220 N, 150 W	0.2 ± 0.1	1.8 ± 0.9	10
22	200 N, 170 W	0.1 ± 0.1	1.4 ± 0.6	5.6

TABLE 7 (Continued)

URANIUM CONCENTRATIONS IN SOIL SAMPLES
UNITED NUCLEAR CORPORATION
NAVAL PRODUCTS
MONTVILLE, CONNECTICUT

Location		Uranium Concentration (pCi/g)[a]		
		U-235	U-238	Total Uranium[b]
Parcel A[c] (Continued)				
23	230 N, 310 W	0.1 ± 0.1	1.0 ± 0.6	5.2
24	220 N, 420 W	0.1 ± 0.1	<0.9	<5.1
25	160 N, 470 W	0.1 ± 0.1	0.9 ± 0.8	5.1
26	130 N, 510 W	0.2 ± 0.1	1.8 ± 0.8	10
27	135 N, 562 W	0.1 ± 0.1	1.3 ± 0.8	5.5
28	121.5 N, 538 W	0.1 ± 0.1	1.5 ± 0.6	5.7
29	130 N, 590 W	0.1 ± 0.1	1.1 ± 0.7	5.3
30	109 N, 502 W	0.1 ± 0.1	1.2 ± 0.6	5.4
31	120 N, 460 W	0.1 ± 0.1	1.3 ± 0.7	5.5
32	40 N, 500 W	0.1 ± 0.1	0.8 ± 0.5	5.0
33	232 N, 110 W	0.1 ± 0.1	0.9 ± 0.5	5.1
34	280 N, 120 W	0.1 ± 0.1	0.9 ± 0.5	5.1
35	220 N, 40 W	0.2 ± 0.1	0.9 ± 0.6	9.3
36	240 N, 40 W	0.2 ± 0.1	0.7 ± 0.5	9.1
Incinerator Pad[d]				
1	250 N, -40 W	0.1 ± 0.1	1.3 ± 0.8	5.5
2	260 N, -35 W	0.1 ± 0.1	0.8 ± 0.4	5.0
3	240 N, -35 W	0.1 ± 0.1	0.8 ± 0.6	5.0
4	232 N, -50 W	0.1 ± 0.1	0.5 ± 0.5	4.7
5	233 N, -40 W	0.1 ± 0.1	2.1 ± 1.0	6.3
6	235 N, -30 W	0.1 ± 0.1	0.9 ± 0.5	5.1
7	236 N, -20 W	0.2 ± 0.1	1.5 ± 0.6	9.9

TABLE 7 (Continued)

URANIUM CONCENTRATIONS IN SOIL SAMPLES
UNITED NUCLEAR CORPORATION
NAVAL PRODUCTS
MONTVILLE, CONNECTICUT

Location		Uranium Concentration (pCi/g)[a]		
		U-235	U-238	Total Uranium[b]
Incinerator Pad[d] (Continued)				
8	238 N, -10 W	0.1 ± 0.1	1.2 ± 0.6	5.4
9	248 N, -10 W	0.1 ± 0.1	1.1 ± 0.6	5.3
10	258 N, -10 W	0.1 ± 0.1	1.6 ± 0.7	5.8
11	262 N, -15 W	0.2 ± 0.1	0.8 ± 0.9	6.7
12	240 N, -60 W	0.1 ± 0.1	1.0 ± 0.6	5.0
13	258 N, -20 W	0.3 ± 0.1	1.7 ± 0.9	14
14	230 N, -60 W	0.1 ± 0.1	0.8 ± 0.6	5.0
15	250 N, -60 W	0.2 ± 0.1	1.7 ± 0.7	10
16	265 N, -60 W	0.1 ± 0.1	1.0 ± 0.6	5.2
17	266 N, -46 W	12.9 ± 0.9	8.2 ± 2.8	550
18	268 N, -36 W	0.1 ± 0.1	1.3 ± 0.6	5.5
19	North Slope[e]	0.2 ± 0.1	1.5 ± 0.8	9.9
20	North Slope at Discharge[e]	0.3 ± 0.1	1.5 ± 0.8	14
Main Gate Road[f]				
9		0.1 ± 0.1	0.9 ± 0.6	5.1
10		0.1 ± 0.1	2.1 ± 0.9	6.3
11		0.2 ± 0.1	1.1 ± 0.5	9.5
12		0.1 ± 0.1	1.4 ± 0.6	5.6
13		0.1 ± 0.1	0.8 ± 0.7	5.0
14		0.1 ± 0.1	1.1 ± 0.6	5.3

TABLE 7 (Continued)

URANIUM CONCENTRATIONS IN SOIL SAMPLES
UNITED NUCLEAR CORPORATION
NAVAL PRODUCTS
MONTVILLE, CONNECTICUT

Location	Uranium Concentration (pCi/g)[a]		
	U-235	U-238	Total Uranium[b]
Incinerator Pad Road[f]			
15	0.1 ± 0.1	1.2 ± 0.8	5.4
16	0.3 ± 0.1	1.3 ± 1.0	14
17	0.1 ± 0.1	1.1 ± 0.7	5.3
Perimeter Road[f]			
18	0.1 ± 0.1	0.9 ± 0.5	5.1
19	0.1 ± 0.1	0.7 ± 0.4	4.9
20	0.1 ± 0.1	1.5 ± 0.6	5.7
21	0.1 ± 0.1	1.5 ± 0.7	5.7
22	0.1 ± 0.1	1.5 ± 0.6	5.7
23	0.1 ± 0.1	0.9 ± 0.7	5.1
24	0.1 ± 0.1	1.3 ± 0.7	5.5
25	0.1 ± 0.1	2.0 ± 0.7	6.2
26	0.1 ± 0.1	0.8 ± 0.4	5.0
Wet Area[f]			
27	0.1 ± 0.1	1.2 ± 0.6	5.6
28	0.1 ± 0.1	0.7 ± 0.4	4.9
29	0.2 ± 0.2	1.7 ± 1.7	10

[a]Uncertainties represent the 95% confidence level, based only on counting statistics.
[b]Total uranium concentrations are calculated based on a U-234 to U-235 ratio of 41 to 1. For Parcel B, this is more conservative than the ratio of 22 to 1 used by UNC. Refer to reference 12.
[c]Refer to Figure 21.
[d]Refer to Figure 23.
[e]These samples were collected near G3 and E4 markers on the slope leading from the former incinerator pad area to Thames River. Sampling locations are not indicated on Figure 23.
[f]Refer to Figure 22.

REFERENCES

1. Letter from A. Ansari (ORISE) to J. Roth (NRC), Reference: "Preliminary Results of the Confirmatory Radiological Survey of Septic Field 1 and the Incinerator Pad, UNC Naval Products, Montville, Connecticut", December 4, 1992.

2. Letter from A. Ansari (ORISE) to J. Roth (NRC), Reference: "Preliminary data, additional soil samples from Septic Field 1 and the Incinerator Pad, UNC Naval Products, Montville, Connecticut", February 24, 1993.

3. Oak Ridge Institute for Science and Education, "Confirmatory Survey of the Unaffected Indoor Areas and the Electrode Grind Room, UNC Naval Products, Montville, Connecticut", Final Report, December 1993.

4. Oak Ridge Institute for Science and Education, "Confirmatory survey of the B-South Area, Building L, Unit 3 Fuel Vault Area, and Affected Outdoor Areas, UNC Naval Products, Montville, Connecticut", Final Report, December 1993.

5. Letter from A. Ansari (ORISE) to J. Roth (NRC), Reference: "Analysis of Water and Sludge Samples, UNC Naval Products and City of Montville Waste Water Treatment Plant, Montville, Connecticut", June 30, 1993.

6. UNC Naval Products, "Final Site Decontamination Report", March 12, 1993.

7. UNC Naval Products, "B-South Roof Final Decommissioning Survey Report", March 26, 1993.

8. UNC Naval Products, "Final Decontamination and Decommissioning Surveys, Book 5", April 8, 1993.

9. UNC Naval Products, Final Decontamination and Decommissioning Surveys, Book 6", April 30, 1993.

10. Oak Ridge Institute for Science and Education, "Confirmatory Survey Plan for Outdoor Areas, B-South Roof, and L-Building Support Areas, UNC Naval Products, Montville, Connecticut", May 3, 1993.

11. Letter from A. Ansari (ORISE) to J. Roth (NRC), Reference: "UNC Naval Products, Montville, Connecticut, Final Decommissioning Survey Reports, Outdoor Areas, B-South Roof, and L-Building Support Areas", April 26, 1993.

12. Letter from R.J. Gregg (UNC) to J. Roth (NRC), Reference: "UNC Naval Products, Montville, Connecticut, Final Decommissioning Survey Reports, Outdoor Areas, B-South Roof and L Building Support Areas", June 2, 1993.

REFERENCES (Continued)

13. U.S. Nuclear Regulatory Commission, "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source or Special Nuclear Materials", August, 1987.

14. U.S. Nuclear Regulatory Commission, "Disposal or Onsite Storage of Thorium and Uranium Wastes from Past Operations", 46 FR 52061, Washington, D.C., October 23, 1981.

15. U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, "Review Plan: Evaluating Decommissioning Plans for Licenses Under 10 CFR Parts 30, 40, and 70", Washington, D.C., 1991.

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

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

Eberline "Rascal" Ratemeter-Scaler
Model PRS-1
(Eberline, Santa Fe, NM)

Ludlum Floor Monitor
Model 239-1
(Ludlum Measurements Inc.,
Sweetwater, TX)

Ludlum Ratemeter-Scaler
Model 2221
(Ludlum Measurements, Inc.,
Sweetwater, TX)

Detectors

Eberline GM Detector
Model HP-260
Effective Area, 15.5 cm^2
(Eberline, Santa Fe, NM)

Eberline ZnS Scintillation Detector
Model AC-3-7
Effective Area, 59 cm^2
(Eberline, Santa Fe, NM)

Ludlum Gas Proportional Detector
Model 43-37
Effective Area, 550 cm^2
(Ludlum Measurements, Inc.,
Sweetwater, TX)

Ludlum Gas Proportional Detector
Model 43-68
Effective Area, 100 cm^2
(Ludlum Measurements, Inc.,
Sweetwater, TX)

Reuter-Stokes Pressurized Ion Chamber
Model RSS-111
(Reuter-Stokes, Cleveland, OH)

Victoreen NaI Scintillation Detector
Model 489-55
3.2 cm x 3.8 cm Crystal
(Victoreen, Cleveland, OH)

LABORATORY ANALYTICAL INSTRUMENTATION

Alpha Spectrometry System
Tennelec Electronics Model
(Tennelec, Oak Ridge, TN)
Used in conjunction with:
Surface Barrier Detectors
(EG&G ORTEC, Oak Ridge, TN) and
Multichannel Analyzer
3100 Vax Workstation
(Canberra, Meriden,CT)

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)

Low Background Gas Proportional Counter
Model LB-5100-W
(Oxford, Oak Ridge, TN)

APPENDIX B

SURVEY AND ANALYTICAL PROCEDURES

APPENDIX B

SURVEY AND ANALYTICAL PROCEDURES

SURVEY PROCEDURES

Surface Scans

Surface scans were performed by passing the probes slowly over the surface; the distance between the probe and the surface was maintained at a minimum - nominally about 1 cm. A large surface area, gas proportional floor monitor was used to scan the floors of the surveyed areas. Other surfaces were scanned using small area (15.5 cm^2, 59 cm^2, or 100 cm^2) hand-held detectors. 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:

Alpha	-	gas proportional detector with ratemeter-scaler
	-	ZnS scintillation detector with ratemeter-scaler
Beta	-	gas proportional detector with ratemeter-scaler
	-	pancake GM detector with ratemeter-scaler
Gamma	-	NaI scintillation detector with ratemeter

Surface Activity Measurements

Measurements of total alpha and total beta activity levels were primarily performed using ZnS scintillation and GM detectors with ratemeters-scalers.

Count rates (cpm), which were integrated over 1 minute in a static position, were converted to activity levels (dpm/100 cm^2) by dividing the net rate by the 4π efficiency and correcting for the active area of the detector. The alpha activity background countrates for the ZnS scintillation detectors averaged 1 cpm for each detector. Alpha efficiency factors averaged 0.18 for the ZnS scintillation detectors. The beta activity background count rates for the GM detectors averaged 44 cpm. Beta efficiency factors ranged from 0.16 - 0.17 for the GM detector. The effective windows for the ZnS scintillation and GM detectors were 59 cm^2, and 15.5 cm^2, respectively.

Removable Activity Measurements

Removable activity levels were determined using numbered filter paper disks, 47 mm in diameter. Moderate pressure was applied to the smear and approximately 100 cm^2 of the surface was wiped. Smears were placed in labeled envelopes with the location and other pertinent information recorded.

Exposure Rate Measurements

Measurements of gamma exposure rates were performed at 1 m above the surface, using a pressurized ionization chamber (PIC).

Miscellaneous Samples

Soil Samples

Approximately 1 kg of soil was collected at each sample location. Collected samples were placed in a plastic bag, sealed, and labeled in accordance with ESSAP survey procedures.

Ceiling Metal Disc Samples

Metal disc samples (approximately 3 cm in diameter) were cut from the interior sheet metal surface of Building B-South ceiling with a rotary drill and metal hole cutting bit. Collected

samples were placed in a plastic specimen cup, sealed and labeled in accordance with ESSAP survey procedures.

ANALYTICAL PROCEDURES

Gross Alpha/Beta

Smears and metal disc samples were counted on a low background gas proportional system for gross alpha and gross beta activity.

Gamma Spectrometry

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. Energy peaks used for determination of radionuclides of concern were:

U - 235 0.186 MeV

U - 238 0.063 MeV from Th-234*

*Secular equilibrium assumed.

Spectra were also reviewed for other identifiable photopeaks.

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 based only on counting statistics. 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 activity (MDA), were based on 2.71 plus 4.66 times the standard deviation of the background count. When the activity was determined to be less than the MDA of the measurement procedure, the result was reported as less than MDA. Because of variations in background levels, measurement efficiencies, and contributions from other radionuclide 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 NIST, when such standards/sources were available. In cases where they were not available, standards of an industry recognized organization was used. Calibration of pressurized ionization chambers was performed by the manufacturer.

Analytical and field survey activities were conducted in accordance with procedures from the following ESSAP documents:

- Survey Procedures Manual, Revision 7
- Laboratory Procedures Manual, Revision 7
- Quality Assurance Manual, Revision 5

The procedures contained in these manuals were developed to meet the requirements of DOE Order 5700.6C and 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 EPA and EML laboratory Quality Assurance Programs.

- Training and certification of all individuals performing procedures.
- Periodic internal and external audits.

APPENDIX C

GUIDELINES FOR DECONTAMINATION OF FACILITIES AND EQUIPMENT PRIOR TO RELEASE FOR UNRESTRICTED USE OR TERMINATION OF LICENSES FOR BYPRODUCT, SOURCE OR SPECIAL NUCLEAR MATERIALS

AND

GUIDELINES FOR RESIDUAL CONCENTRATIONS OF THORIUM AND URANIUM WASTES IN SOIL

GUIDELINES FOR DECONTAMINATION OF FACILITIES AND EQUIPMENT PRIOR TO RELEASE FOR UNRESTRICTED USE OR TERMINATION OF LICENSES FOR BYPRODUCT, SOURCE, OR SPECIAL NUCLEAR MATERIALS

U.S. Nuclear Regulatory Commission
Division of Fuel Cycle & Material Safety
Washington, D C. 20555

August 1987

The instructions in this guide, in conjunction with Table 1, specify the radionuclides and radiation exposure rate limits which should be used in decontamination and survey of surfaces or premises and equipment prior to abandonment or release for unrestricted use. The limits in Table 1 do not apply to premises, equipment, or scrap containing induced radioactivity for which the radiological considerations pertinent to their use may be different. The release of such facilities or items from regulatory control is considered on a case-by-case basis.

1. The licensee shall make a reasonable effort to eliminate residual contamination.

2. Radioactivity on equipment or surfaces shall not be covered by paint, plating, or other covering material unless contamination levels, as determined by a survey and documented, are below the limits specified in Table 1 prior to the application of the covering. A reasonable effort must be made to minimize the contamination prior to use of any covering.

3. The radioactivity on the interior surfaces of pipes, drain lines, or ductwork shall be determined by making measurements at all traps, and other appropriate access points, provided that contamination at these locations is likely to be representative of contamination on the interior of the pipes, drain lines, or ductwork. Surfaces or premises, equipment, or scrap which are likely to be contaminated, but are such size, construction, or location as to make the surface inaccessible for purposes of measurement, shall be presumed to be contaminated in excess of the limits.

4. Upon request, the Commission may authorize a licensee to relinquish possession or control of premises, equipment, or scrap having surfaces contaminated with materials in excess of the limits specified. This may include, but would not be limited to special circumstances such as razing of buildings, transfer from premises to another organization continuing work with radioactive materials, or conversion of facilities to a long-term storage or standby status. Such requests must:

   a. Provide detailed, specific information describing the premises, equipment or scrap, radioactive contaminants, and the nature, extent, and degree of residual surface contamination.

   b. Provide a detailed health and safety analysis which reflects that the residual amounts of materials on surface areas, together with other considerations such as prospective use of the premises, equipment, or scrap, are unlikely to result in an unreasonable risk to the health and safety of the public.

5. Prior to release of premises for unrestricted use, the licensee shall make a comprehensive radiation survey which establishes that contamination is within the limits specified in Table 1. A copy of the survey report shall be filed with the Division of Fuel Cycle, Medical, Academic, and Commercial Use Safety, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, and also the Administrator of the NRC Regional Office having jurisdiction. The report should be filed at least 30 days prior to the planned date of abandonment. The survey report shall:

a. Identify the premises.

b. Show that reasonable effort has been made to eliminate residual contamination.

c. Describe the scope of the survey and general procedures followed.

d. State the findings of the survey in units specified in the instruction.

Following review of the report, the NRC will consider visiting the facilities to confirm the survey.

TABLE 1
ACCEPTABLE SURFACE CONTAMINATION LEVELS

Nuclides[a]	Average[b,c,f]	Maximum[b,d,f]	Removable[b,e,f]
U-nat, U-235, U-238, and associated decay products	5,000 dpm α/100 cm^2	15,000 dpm α/100 cm^2	1,000 dpm α/100 cm^2
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100 dpm/100 cm^2	300 dpm/100 cm^2	20 dpm/100 cm^2
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1,000 dpm/100 cm^2	3,000 dpm/100 cm^2	200 dpm/100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.	5,000 dpm $\beta\gamma$/100 cm^2	15,000 dpm $\beta\gamma$/100 cm^2	1,000 dpm $\beta\gamma$/100 cm^2

[a]Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should apply independently.

[b]As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[c]Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.

[d]The maximum contamination level applies to an area of not more than 100 cm^2.

[e]The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

[f]The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/h at 1 cm and 1.0 mrad/h at 1 cm, respectively, measured through not more than 7 milligrams per square centimeter of total absorber.

Guidelines for Residual Concentrations of Thorium and Uranium Wastes in Soil

On October 23, 1981, the Nuclear Regulatory Commission published in the Federal register a notice of Branch Technical Position on "Disposal or Onsite Storage of Thorium and Uranium Wastes from Past Operations." This document established guidelines for concentrations of uranium and thorium in soil, that will limit maximum radiation received by the public under various conditions of future land usage. These concentrations are as follows:

Material	Maximum Concentrations (pCi/g) for various options			
	1[a]	2[b]	3[c]	4[d]
Natural Thorium (Th-232 + Th-228) with daughters present and in equilibrium	10	50	--	500
Natural Uranium (U-238 + U-234) with daughters present and in equilibrium	10	--	40	200
Depleted Uranium:				
Soluble	35	100	--	1,000
Insoluble	35	300	--	3,000
Enriched Uranium:				
Soluble	30	100	--	1,000
Insoluble	30	250	--	2,500

[a]Based on EPA cleanup standards which limit radiation to 1 mrad/yr to lung and 3 mrad/yr to bone from ingestion and inhalation and 10 μR/h above background from direct external exposure.
[b]Based on limiting individual dose to 170 mrem/yr.
[c]Based on limiting equivalent exposure to 0.02 working level or less.
[d]Based on limiting individual dose to 500 mrem/yr and in case of natural uranium, limiting exposure to 0.02 working level or less.