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Congress of the United States
House of Representatives

COMMITTEE ON MERCHANT MARINE AND FISHERIES
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HEALTH AND LONG-TERM CARE
HOUSING AND CONSUMER INTERESTS

December 1, 1992

The Honorable Ivan Selin, Chairman
Nuclear Regulatory Commission
One White Flint North Building
11555 Rockville Pike
Rockville, MD 20852

Dear Mr. Selin:

I am writing with regard to a situation of great concern to the residents and officials of Anne Arundel County.

As you may already know, a parcel of land adjacent to the Curtis Bay Maryland Depot has been found to be contaminated with thorium nitrate. This land, previously owned by the General Services Administration (GSA), was transferred to Anne Arundel County subsequent to its release for unrestricted use.

Since that time, the Nuclear Regulatory Commission (NRC) has revealed that the criteria applied in 1977 may not be adequate to assure public health and safety.

I understand that the NRC is currently reevaluating the status of the property to determine if clean up action is necessary. In light of these somewhat troubling events, I hope you could answer a number of questions I have about the site. I am most concerned about the implications for public health and safety, and what can be done to remedy the current state of uncertainty. Any information you can provide to the following questions will be greatly appreciated:

1. Is the radiation posing an immediate health threat? Does the area need to be fenced off to prevent inadvertent exposure?

2. In what form was the radioactive thorium being stored?

3. I understand that the GSA and the Defense Logistics Agency (DLA) were given until December 4 to come up with a schedule and plan for evaluating and dealing with the contamination. Is that plan still on schedule, and if not, why not?

4. What are both the long and short-term risks to humans of 126 picocuries per gram of soil? 640 pci/g?

5. How many buildings on the site are contaminated?

6. What were the guidelines for radiation contamination in 1977? How have those guidelines changed?

7. Did the NRC have plans, once the criteria for radiation contamination changed, to go back and test sites previously released for unrestricted use?

8. Is there a threat to groundwater posed by the contamination?

9. Within how many feet can one stand of the contaminated site without being in danger?

10. Once cleaned up, where will the radioactive material be disposed?

11. For what is thorium nitrate used?

12. Who is responsible for the remaining thorium nitrate?

13. Are there estimates for the clean-up costs? What are they?

14. Has there been any accounting of what agency will be responsible for clean-up costs?

As you can well understand this problem has caused some alarm to residents in the area, as well as public officials responsible for their health and welfare. I would appreciate whatever timely answers you can provide regarding the Ordnance Road site. I look forward to working with you to see a swift resolution to this problem.

Sincerely,

Wayne T. Gilchrest

Wayne T. Gilchrest
Member of Congress

cc. Richard Cooper, Director Division of Radiation Safety and Safeguards, NRC
Harold Quinn, Director of Planning Staff, GSA
Marilyn S. Barnett, Administrator, DLA

ENCLOSURE 1

QUESTION 1. Is the radiation posing an immediate health threat? Does the area need to be fenced off to prevent inadvertent exposure?

ANSWER.

No. Based on the results of a recently completed survey of the contaminated buildings and adjacent soil by the Oak Ridge Institute for Science and Education, these areas contain contamination that could lead to small doses over an extended period of time. Therefore, these areas do not pose an immediate threat to the public health and safety. At the present time, occupational exposures on the site would be minimal due to the limited use of this property. Also, the estimated radiological exposures at this site are below the Nuclear Regulatory Commission's standards in 10 CFR Part 20 (Standards For Protection Against Radiation) for limits of radiation exposure to individual members of the public. See also response to Question 9.

Fencing is not required since the maximum exposure rates observed at the site are less than the limits that would require fencing i.e., the criteria for restricted areas in 10 CFR 20.105.

Enclosure

QUESTION 2. In what form was the radioactive thorium being stored?

ANSWER.

Based on information in the Nuclear Regulatory Commission docket file, the thorium was stored at the Curtis Bay Depot in the form of thorium nitrate. The thorium nitrate was originally in granular form. Over time, the thorium nitrate absorbed water and degenerated into a liquor that leaked through the storage drums, contaminating the buildings and the soil beneath them.

QUESTION 3. I understand that the General Services Administration and the Defense Logistics Agency were given until December 4 to come up with a schedule and plan for evaluating and dealing with the contamination. Is that plan still on schedule, and if not, why not?

ANSWER.

In a November 4, 1992, letter to the Defense Logistics Agency (DLA) and the General Services Administration (GSA), the Nuclear Regulatory Commission staff requested that, within 30 days, DLA and GSA provide NRC with a schedule and plan for remediating the contamination at the Curtis Bay facility. On November 23, 1992, representatives of GSA and DLA met with NRC staff to determine which agency (DLA or GSA) has responsibility for remediating the site. Based on that meeting, such a determination is expected by the end of January 1993. After this determination is made, plans and schedules for site remediation will be developed. At this point in time, NRC does not object to the pace DLA and GSA have taken to resolve the question as to which agency has responsibility for remediating the site. If unwarranted delays occur in the remediation process, NRC will consider enforcement action.

QUESTION 4. What are the long and short term risks to humans of 126 picocuries per gram of soil? 640 pCi/g?

ANSWER.

The risks associated with such contamination are long-term, small chronic risks associated with protracted exposure to the contaminated material. Exposure to ionizing radiation from any source may cause cancer. However, the contamination at this site is limited to a few areas and the relative risk from the contamination is small.

A 1992 survey by the Oak Ridge Institute for Science and Education, revealed concentrations of total thorium in the soil ranging from background levels up to about 640 pCi/g. This same survey found the maximum exposure rate at the highest soil concentration location was 36 μR/hr at one meter above the soil surface (about 28 μR/hr above background). If an individual worked outside on the site, at the point of maximum exposure, for an entire year (2000 hours), the person would receive about 56 mrem attributable to thorium at the site from past operations, which is below the maximum acceptable public dose limit of 100 mrem/yr contained in Nuclear Regulatory Commission's regulations (10 CFR Part 20). The 36 μR/hr exposure rate, however, was observed at only one location and the areal extent of contamination is limited. Consequently, a more realistic estimate of the dose under current conditions would be expected to be much less than 56 mrem and the public dose limit of 100 mrem/yr. Compliance with this dose limit is mandatory after January 1, 1994.

Occupation of the site for more than the 2000 hours assumed above would result in correspondingly higher doses. NRC generally requires during decommissioning that contamination at sites be reduced to levels sufficiently low to allow the site to be released for unrestricted use. Plausible residence times under this condition could be considerably greater than the 2000 hours typically assumed for an occupational setting, such as if a family lived onsite. Consequently, any materials contaminated with natural thorium causing unacceptable doses would have to be removed or otherwise stabilized to ensure that members of the public would not receive such doses after the site has been released for unrestricted use. For additional discussion of the relative risk to individuals from the contamination present at this site, please see the response to Question 9.

QUESTION 5. How many buildings on the site are contaminated?

ANSWER.

Eight of the nine buildings on the site exhibit some contamination. Four different criteria have been applied in determining the extent of contamination: 1) total surface activity (fixed and removable), 2) removable surface activity, 3) concentration of thorium in soil, and 4) exposure rate. Based on a 1992 survey of warehouses L-411 through L-415 and M-421 through M-424 by the Oak Ridge Institute for Science and Education, total surface activity levels exceeding guidelines were detected on the floors and subfloor beams and joists in 8 of 9 warehouse buildings (all except Bldg. L-411). Removable contamination exceeded guidelines in 2 of the buildings (M-421 and M-422). Thorium concentrations exceeded guidelines in soil samples from 27 locations at 8 of the 9 buildings (all except Bldg. L-411). At 15 of these 27 locations, thorium concentrations also exceeded guidelines in subsurface soil samples. Interior exposure rates were all within the range of background radiation and therefore below the guideline level of 5 μR/ hr above background currently being used by NRC.

QUESTION 6. What were the guidelines for radiation contamination in 1977? How have those guidelines changed?

ANSWER.

In 1977 the Nuclear Regulatory Commission staff used the "Guidelines for Decontamination of Facilities and Equipment Prior to Release For Unrestricted Use or Termination of Licenses For Byproduct, Source, or Special Nuclear Material" dated December 1975 to determine acceptable fixed and removable surface contamination levels for the buildings in question. For thorium, the applicable guideline for fixed contamination is no more than 3,000 disintegrations per minute per 100 square centimeters (dpm/100 cm^2), with the average being no more than 1000 dpm/100 cm^2. The applicable guideline for removable contamination is no more than 200 dpm/100 cm^2. These same criteria are still being used by NRC in accordance with Policy and Guidance Directive FC 83-23: Termination of Byproduct, Source and Special Nuclear Material Licenses (November 4, 1983). In addition, NRC now also applies criteria for an exposure rate at one meter from the surface of five microroentgen per hour (μR/hr) above background.

In 1977, generic soil contamination guidelines for thorium had not yet been established. In 1981, NRC published a Branch Technical Position (BTP) on "Disposal or Onsite Storage of Thorium and Uranium Wastes from Past Operations." This document established concentrations of uranium and thorium in soil that will limit the maximum radiation received by the public under various land uses. NRC staff is currently using the 1981 guidelines for

evaluating whether sites are acceptable for unrestricted release. Under Option 1 of this BTP the maximum concentration for Thorium (Th-232, Th-228 and decay products in secular equilibrium) is 10 pCi/g. Option 2 of the BTP specifies 50 pCi/g, but requires that the thorium be disposed at a depth of at least four feet, that the material be stabilized in a prescribed manner, and that the site exhibit physical characteristics that are acceptable to NRC. The BTP outlined two additional Options in 1981 (Options 3 & 4). However, NRC is currently not allowing on-site disposal using these additional options because they involve the use of land restrictions for the site after license termination.

QUESTION 7. Did the NRC have plans, once the criteria for radiation contamination changed, to go back and test sites previously released for unrestricted use?

ANSWER.

Nuclear Regulatory Commission has conducted several reviews of formerly terminated licenses to determine if any sites previously released for unrestricted use need further remediation. Starting in 1977, Oak Ridge National Laboratory (ORNL), under contract to NRC, conducted a review of 16,230 former materials licenses terminated prior to 1965. In 1990, NRC staff contracted with ORNL to review the files of licenses terminated after 1965. This new ORNL study is ongoing and, based on its results, additional sites may be identified as requiring further remediation. These follow-up studies may include site visits and radiological testing to determine the extent of residual contamination.

QUESTION 8. Is there a threat to groundwater posed by the contamination?

ANSWER.

There is currently no indication of groundwater contamination at this site. However, given the nature of the thorium nitrate and the anticipated shallow depth to groundwater at this site, Nuclear Regulatory Commission will ensure that the potential for groundwater contamination is further evaluated in the characterization that will be performed as part of the site remediation.

QUESTION 9. Within how many feet can one stand of the contaminated site without being in danger?

ANSWER.

The direct radiation exposure from standing on or near the contaminated areas is low compared with existing dose standards in Nuclear Regulatory Commission's radiation protection standards (10 CFR Part 20). A person could stand at the point of maximum exposure on the site for over 2000 hours without receiving a dose that approaches applicable standards.

Currently, the NRC's permissible exposure rate limits for unrestricted areas at licensed facilities is 2 millirem per hour (mrem/hr) for short periods of time or about 2000 μR/hr above background, and the exposure rate criteria for unrestricted use (free release) is 5 μR/hr, above background. Based on the results of a 1992 survey by the Oak Ridge Institute for Science and Education, the maximum exposure rate observed at the site was 36 μR/hr at one meter above the soil surface. NRC's revised 10 CFR Part 20 - Standards For Protection Against Radiation Protection, limits radiation exposure to individual members of the public to 100 mrem per year. Compliance with this dose limit is mandatory after January 1, 1994. If an individual worked on the site, at the point of maximum exposure, for an entire year (2000 hours) the person would receive about 56 mrem in excess of doses attributable to natural background. However, this maximum exposure rate was observed at only one

location and the areal extent of contamination is limited. Consequently, a more realistic estimate of the dose under current conditions would be expected to be much less than the 56 mrem calculated and well within the public dose limit in 10 CFR Part 20 (100 mrem/yr).

QUESTION 10. Once cleaned up, where will the radioactive material be disposed?

ANSWER.

Contaminated building material from this site could be disposed of in a licensed low-level radioactive waste disposal facility. The facility in Barnwell, South Carolina will be available to Maryland generators, assuming the State remains eligible, until June 1994. The radioactive waste could also be disposed of at the Envirocare facility in Clive, Utah, or be transferred to a licensed site. The future disposition of the waste would be established in the decommissioning plan for the site.

QUESTION 11. For what is thorium nitrate used?

ANSWER.

Currently, the most common uses of thorium nitrate are in manufacturing incandescent gas mantles, welding rods, and magnesium-thorium alloys. The thorium at this site was stored by the U.S. Government for potential use in a thorium-cycle nuclear reactor.

QUESTION 12. Who is responsible for the remaining thorium nitrate?

ANSWER.

On November 23, 1992 the Nuclear Regulatory Commission staff met with the staffs of the Defense Logistics Agency (DLA) and the General Services Administration (GSA), the current and former NRC licensees, responsible for the Curtis Bay Depot. GSA and DLA are currently determining which agency is responsible for remediation of the site. Both agencies committed to making a decision by the end of January 1993.

QUESTION 13. Are there estimates for the clean-up costs? What are they?

ANSWER.

At this time, cost estimates for the remediation of the Curtis Bay site have not been established. Cost estimates will be developed by the responsible party in the remediation plan for the site.

QUESTION 14. Has there been any accounting of wha agency will be responsible or c p costs?

ANSWER.

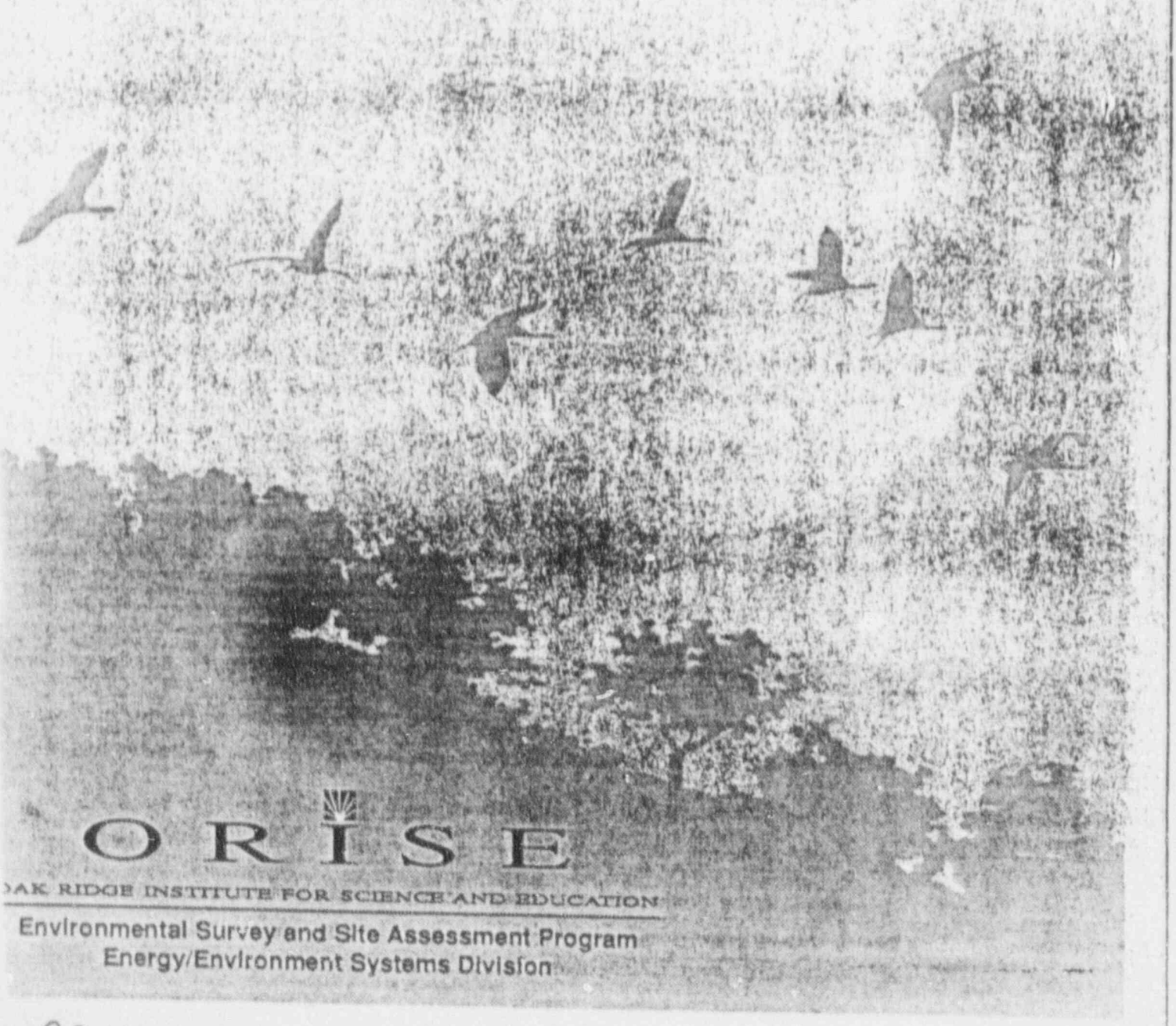
As discussed in the response to Question 12, the Nuclear Regulatory Commission staff is currently working with the staffs of the Defense Logistics Agency and the General Services Administration to determine which of these agencies is responsible for this site.

ENCLOSURE 2

RADIOLOGICAL SURVEY OF PORTIONS OF THE CURTIS BAY DEPOT GENERAL SERVICES ADMINISTRATION BALTIMORE, MARYLAND

W. C. ADAMS AND J. L. PAYNE

Prepared for the Division of Industrial and Medical Nuclear Safety
U.S. Nuclear Regulatory Commission
Region I Office



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

RADIOLOGICAL SURVEY OF PORTIONS OF THE CURTIS BAY DEPOT GENERAL SERVICES ADMINISTRATION BALTIMORE, MARYLAND

Prepared by

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Prepared for
Division of Industrial and Medical Nuclear Safety
U.S. Nuclear Regulatory Commission
Region I Office

FINAL REPORT

SEPTEMBER 1992

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RADIOLOGICAL SURVEY
OF PORTIONS OF THE
CURTIS BAY DEPOT
GENERAL SERVICES ADMINISTRATION
BALTIMORE, MARYLAND

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GENERAL SERVICES ADMINISTRATION
BALTIMORE, MARYLAND

INTRODUCTION AND SITE HISTORY

Prior to 1977, the General Services Administration (GSA) stored thorium nitrate (mantle and reactor grades, average 47% $Th(NO_3)$) in fiber and steel drums in warehouses at the Curtis Bay Depot (CBD) in Curtis Bay, Maryland, under U.S. Nuclear Regulatory Commission (NRC) license STC-133 (Docket No. 40-341). In 1977, GSA notified the NRC Region I Office of its intent to excess empty warehouses as part of a large sale of government land and buildings. Nine of these buildings (M-421 through M-424 and L-411 through L-415) are on land which was transferred to Anne Arundel County, Maryland.

An NRC survey, performed in 1977, identified residual contamination in the wood flooring of several warehouses.[1] Most of the contamination present was located in the tongue and groove joints and was uniformly deposited throughout the buildings. Decommissioning activities were performed by GSA and verified by NRC Region I in the summer and fall of 1977. Results of the NRC confirmatory survey indicated that fixed residual activity levels were less than 1,000 dpm/100 cm^2 for alpha contamination and less than 0.2 mrad/hr for beta-gamma.[2] Smear samples indicated that removable contamination levels were well below NRC guidelines of 200 dpm/100 cm^2. Results from the NRC confirmatory survey were in agreement with GSA's results and the warehouses were released under established guidelines for that period.[3] At that time, there were no soil contamination guidelines for thorium. Soil sample analyses performed in 1977, indicated that radionuclide concentrations above current criteria of 10 pCi/g of total thorium may exist in soil under Buildings L-412, L-413, L-414, M-421, M-422, and M-423.[4]

At the request of the NRC's Region I Offi[illegible]he Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE) conducted a

radiological survey of warehouses L-411 through L-415 and M-421 through M-424, and adjacent land at the Curtis Bay Depot, to evaluate the current radiological status of the site.

SITE DESCRIPTION

Curtis Bay Depot is located at 710 Ordnance Road in Curtis Bay, a suburb of Baltimore, in the northeast corner of Anne Arundel County, Maryland (Figure 1). The facility is in an industrialized area, approximately 8 km (5 miles) northeast of the Baltimore-Washington International Airport (Figure 2). The land and warehouses included in the survey are located on a 2.5 hectare (8 acre) plot of land in the northwest section of the Curtis Bay Depot and separated from the depot property by a chain link security fence (Figures 3 and 4).

The interior surfaces (floors, walls, and ceilings) of the warehouses are of tongue and groove wood construction; exterior walls are covered with corrugated transite siding. Each building contains approximately 300 m^2 (3100 ft^2) of usable floor space. Brick pillars and wooden beams support the warehouses, creating a crawlspace which varies in headroom from 0.6 m (2 ft) to 3 m (9 ft) due to the natural terrain of the area. Concrete loading docks remain along the entire east side of buildings M-421 through M-424, but have been removed from buildings L-411 through L-415 to allow for the placement of the chain link fence which separates the property from the remainder of the Curtis Bay Depot property. Containers of thorium nitrate were unloaded from railcars at the loading docks and transferred into the buildings through one of two bay doors (Figure 5).

The warehouses included in the survey were constructed during World War I, and as a result of weathering, are in advanced stages of structural deterioration. Remediation activities performed in the warehouses, in 1977 by GSA, included the removal of various size areas of the floor and walls, as well as portions of subfloor joists and beams.

The land area around each building (out to 10 m) varied in degree of accessibility due to overgrown vegetation. The land has a varying degree of slope near each building. There are no paved roads within the area that was surveyed.

OBJECTIVE

The objective of the radiological survey was to provide sufficient data to enable the NRC to evaluate the radiological status of the site relative to guidelines.

DOCUMENT REVIEW

As part of the radiological activities, ESSAP reviewed the various documentation associated with the decommissioning.

PROCEDURES

During the period May 4 through May 7, 1992, ESSAP performed a radiological survey of nine warehouses and adjacent land at the Curtis Bay Depot. Survey activities were performed in accordance with a site-specific survey plan, submitted to and approved by the NRC Region I, using procedures and instruments described in the ESSAP Survey Procedures Manual and summarized in Appendices A and B.

SURVEY PROCEDURES - INTERIOR

Reference Grid

Measurement and sampling locations were referenced to building features (Figures 6 - 15).

Surface Scans

Accessible floors and lower walls (up to 2 m) were scanned for alpha, beta, and gamma activity using gas proportional, GM, and NaI scintillation detectors. Particular attention was given to cracks and joints in the floors and walls, ledges, and other locations where material may have

accumulated. All detectors were coupled to ratemeters or ratemeter-scalers with audible indicators. Locations of elevated direct radiation, identified by surface scans, were marked for further investigation.

Surface Activity Measurements

Measurements for beta activity levels, rather than alpha activity, provide a more accurate representation of thorium surface activity, due to conditions of the building surfaces (e.g. dusty, porous, or rough), which may selectively attenuate the alpha activity. Therefore, beta activity levels were used for comparison with the guideline values.

Direct measurements to determine total (fixed and removable) activity were performed in eight of the buildings at a minimum of 22 locations and a maximum of 30 locations, the number being dependent on the total accessible floor and wall surface area. Five direct measurements to determine total activity were performed in Building L-415 using GM detectors. The number of locations in Building L-415 were limited due to the inaccessibility to gas proportional equipment since all floor boards had been removed. A smear sample for determining removable activity was obtained from each direct measurement location.

Exposure Rate Measurements

Background exposure rate measurements at 1 m (3.3 feet) above the floor surface were obtained in 3 buildings of similar construction which did not have a history of radioactive material use. These buildings are located on-site and were identified as buildings K-511, K-611, and K-615 (Figure 6).

Exposure rate measurements were performed at 1 m (3.3 feet) above the floor using a NaI scintillation detector coupled with a ratemeter at 2 locations within each surveyed building (excluding Building L-415).

SURVEY PROCEDURES - EXTERIOR

Reference Grid

Measurement and sampling locations were referenced to site and building features (Figures 16 - 25).

Surface Scans

Surface scans were performed in the crawlspaces and out to 10 m around each building using NaI scintillation detectors coupled to ratemeters with audible indicators. Areas of elevated direct radiation were marked for further investigation.

Exposure Rate Measurements

Background exposure rate measurements were made at 8 locations within 0.5 to 10 km of the site (Figure 16). Exposure rate measurements were also performed at each soil sampling location (Figures 17 - 25). All exposure rate measurements were taken at 1 m (3.3 ft) above the surface with a PIC or with NaI scintillation detectors coupled to ratemeters.

Soil Sampling

Background soil samples (0-15 cm) were collected from 8 locations within 0.5 to 10 km of the site (Figure 16). Surface soil samples (0-15 cm) were collected from 10 locations at each warehouse, 5 from around the exterior of the building and 5 from the crawlspace area. Sampling locations were selected at random and/or at locations of elevated direct radiation identified by surface scans. After surface soil samples were collected, direct radiation levels were monitored with a NaI detector to determine if contamination remained. Subsurface soil samples (depth >15 cm) were then collected at sampling locations where elevated radiation levels indicated possible subsurface residual activity. Surface and subsurface soil sampling locations were referenced to building features (Figures 17 - 25).

SAMPLE ANALYSIS AND DATA INTERPRETATION

All samples and field survey data were returned to ESSAP's Oak Ridge, TN facility for analyses and interpretation. Soil samples were analyzed individually by gamma spectrometry and results reported in pCi/g. Spectra were reviewed for the thorium decay series radionuclides and any other identifiable photopeaks. Smears were analyzed using a low-background gas proportional counter to determine gross alpha and gross beta activity and results were converted to units of dpm/100 cm^2. Direct measurements were converted to units of disintegrations per minute per 100 cm^2 (dpm/100 cm^2), and exposure rate measurements were converted to μR/hr. Appendices A and B describe the analytical instrumentation and procedures utilized. Results were compared to the current NRC guidelines which are provided in Appendix C.

FINDINGS AND RESULTS

DOCUMENT REVIEW

ESSAP's review of the documentation associated with the decommissioning indicated that there were no guidelines established for soil contamination during that period. However, soil analysis results, in the reviewed documentation, indicated that soil contamination above current guidelines remains at the site.[4]

INTERIOR SURVEY

Surface Scans

Surface scans of the floor, lower walls, and exposed subfloor support beams and joists identified locations of elevated direct radiation in 8 of the 9 warehouse buildings. All of the locations were small, isolated spots near edges where floor boards had been removed from previously remediated areas.

Surface Activity Levels

Direct measurements for total and removable surface activity are summarized in Tables 1 and 2. Total beta activity ranged from < 440 to 590,000 dpm/100 cm^2. Removable activity ranged from < 12 to 1,100 dpm/100 cm^2 for gross alpha and from < 15 to 730 dpm/100 cm^2 for gross beta. The location of highest total and removable activity was a subfloor joist in Building M-422.

Exposure Rates

Background exposure rates in buildings of similar construction ranged from 7 to 8 μR/hr (Table 3). Exposure rate measurements for the surveyed buildings ranged from 6 to 10 μR/hr (Table 1).

EXTERIOR SURVEY

Surface Scans

Gamma radiation scans of exterior surfaces identified locations of elevated contact radiation in the crawlspaces of 8 of the 9 buildings, with the exception being Building L-411.

Exposure Rates

Background exposure rates are presented in Table 4 and ranged from 3 to 5 μR/hr. Exposure rates obtained from soil sampling locations ranged from 5 to 36 μR/hr. The results of these measurements are presented in Tables 5-13.

Radionuclide Concentration in Soil Samples

Total thorium (Th-232 + Th-228) concentrations in background soil samples ranged from 0.6 to 1.8 pCi/g. These concentrations are typical of concentrations occurring in environmental soil samples (Table 2).

Concentrations of thorium in surface and subsurface samples taken on site are summarized in Tables 5-13. By comparison of the Th-232 to Th-228 concentrations, a review of the spectra indicated that the thorium decay series radionuclides were in equilibrium. Thorium concentrations from surface samples (0-15 cm) collected around the buildings ranged from 1.0 to 126 pCi/g. The highest soil sample concentration in samples from under the crawlspaces was from a sample collected next to the steps at the north end of the loading dock of Building M-424. Concentrations from surface samples collected from crawlspaces ranged from 0.8 to 640 pCi/g. The highest concentration in samples from under the crawl spaces was from a sample collected under the north end of the loading dock of Building M-421.

Subsurface soil samples (15-30 cm) were collected from 19 locations where direct gamma radiation levels increased at 15 cm depth. Three of these locations were further sampled from 30 to 45 cm due to increased gamma radiation levels at 30 cm depth. Thorium concentrations in subsurface soil samples ranged from 5.6 to 420 pCi/g.

COMPARISON OF RESULTS WITH GUIDELINES

The NRC guidelines for surface contamination, established for license termination or release of a facility for unrestricted use, are presented in Appendix C.[5] The primary surface contaminant of concern for this site is natural thorium.

The acceptable surface contamination levels for natural thorium are:

1,000 dpm/100 cm^2, total, averaged over 1 m^2
3,000 dpm/100 cm^2, total, maximum in 100 cm^2
200 dpm/100 cm^2, removable

As interpreted by the NRC, the average 1,000 dpm/100 cm^2 and maximum 3,000 dpm/100 cm^2 should apply to both alpha and beta measurements independently for surface contamination involving natural thorium.[5] ESSAP's experience has shown that beta measurements typically

provide a more accurate evaluation of thorium contamination on most building surfaces, due to problems inherent in measuring alpha contamination on rough, porous, painted, and/or dusty surfaces. Therefore, all direct measurements were performed for beta activity only.

Surface measurements for total activity identified surface contamination levels exceeding the NRC guideline for maximum activity in 8 of the 9 buildings. In two of the buildings L-414 and M-421, only one measurement exceeded the guideline. In buildings L-412, L-413, L-415, M-422, M-423, and M-424 the number of locations exceeding the guideline were 2, 3, 5, 9, 4, and 2, respectively. Removable activity exceeding 200 dpm/100 cm^2 was found in one location in M-421 and in 2 locations in M-422.

Interior exposure rates were all within the range of background radiation and therefore below the guideline level of 5 μR/h above background currently being used by the NRC for evaluating decommissionings.[7]

Soil concentrations for residual uranium and thorium wastes are presented in the NRC's Branch Technical Position on "Disposal or Onsite Storage of Thorium and Uranium Wastes from Past Operations" (see Appendix C). The applicable soil guidelines are therefore:

natural thorium (Th-232 + Th-228) with daughters present and in equilibrium.	10 pCi/g

The background concentrations for surface soil was determined by averaging the radionuclide concentrations from the background samples that were collected within the vicinity of the facility. The average background for natural thorium in the local vicinity was 1.2 pCi/g.

The NRC guidelines for natural thorium are expressed in terms of concentrations above normal background levels. The results in the data tables that indicate the NRC guidelines have been exceeded are those in excess of:

natural thorium (thorium isotopes plus background)	11.2 pCi/g

All sampling locations exceeding the guideline for thorium were in crawlspace areas or under or near the loading docks. At 27 locations, soil collected from the surface (0-15 cm) exceeded the guideline; at 15 of these locations, soil collected from 15-30 cm exceeded guidelines; and at 3 locations, samples collected from 30-45 cm exceeded 10 pCi/g above background.

SUMMARY

At the request of the Nuclear Regulatory Commission, Region I Office, the Environmental Survey and Site Assessment Program of Oak Ridge Institute for Science and Education performed a radiological survey of warehouses L-411 through L-415 and M-421 through M-424 of the Curtis Bay Depot, located in Baltimore, Maryland from May 4 through May 7, 1992. Building survey activities included alpha, beta, and gamma surface scans on lower wall and floor surfaces; total and removable activity measurements; and exposure rate measurements. Exterior survey activities included gamma surface scans around and under each building; exposure rate measurements; and surface and subsurface soil sampling.

Total surface activity levels exceeding guidelines were detected on the floors and subfloor beams and joists in 8 of the 9 warehouse buildings, with removable contamination exceeding guidelines in 2 of the buildings. Concentrations of thorium, exceeding guidelines, were detected in soil samples from 27 locations at 8 of the 9 buildings. At 15 of these 27 locations, thorium concentrations also exceeded guidelines in subsurface soil samples.

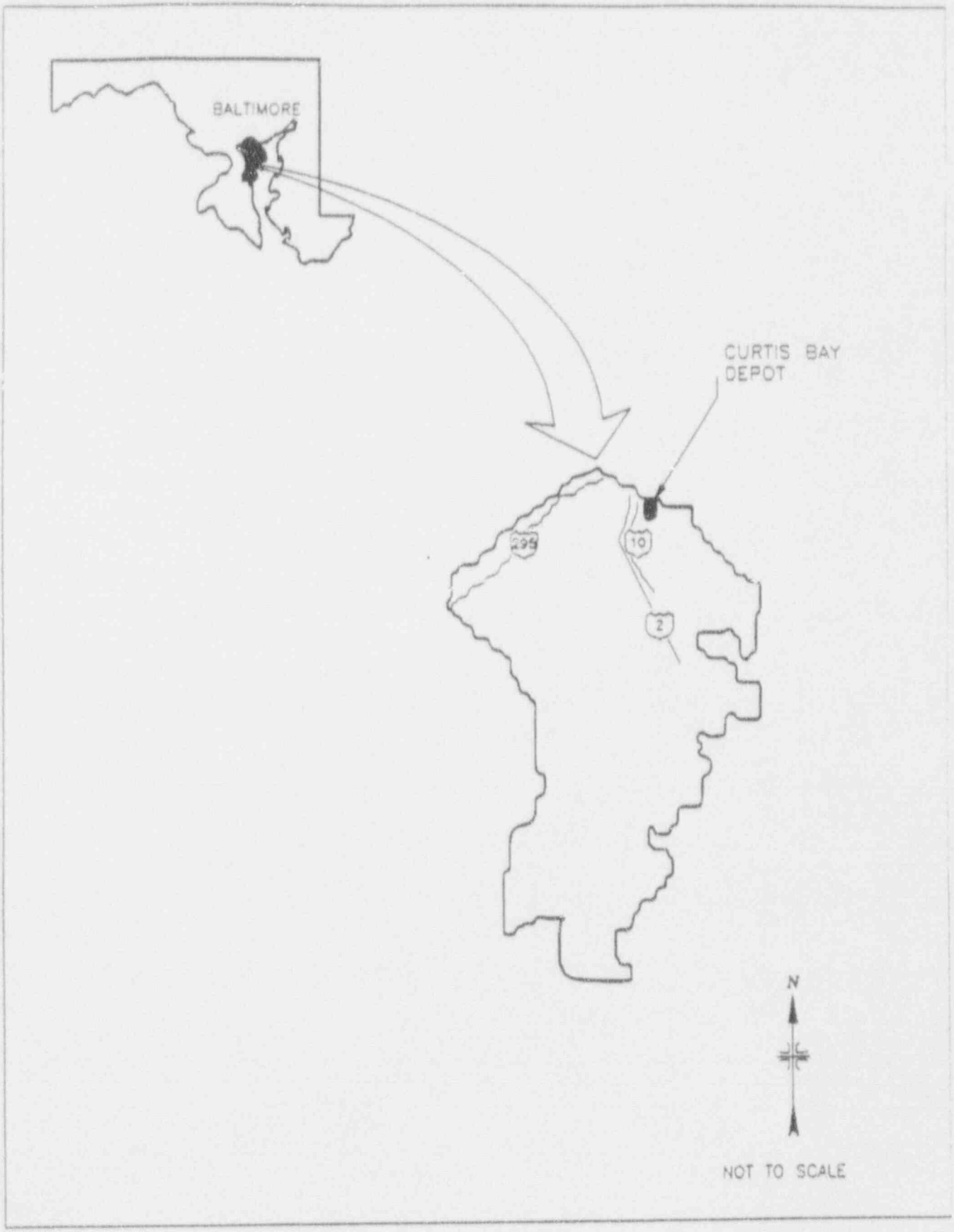

FIGURE 1: Anne Arundel County – Location of Curtis Bay Depot

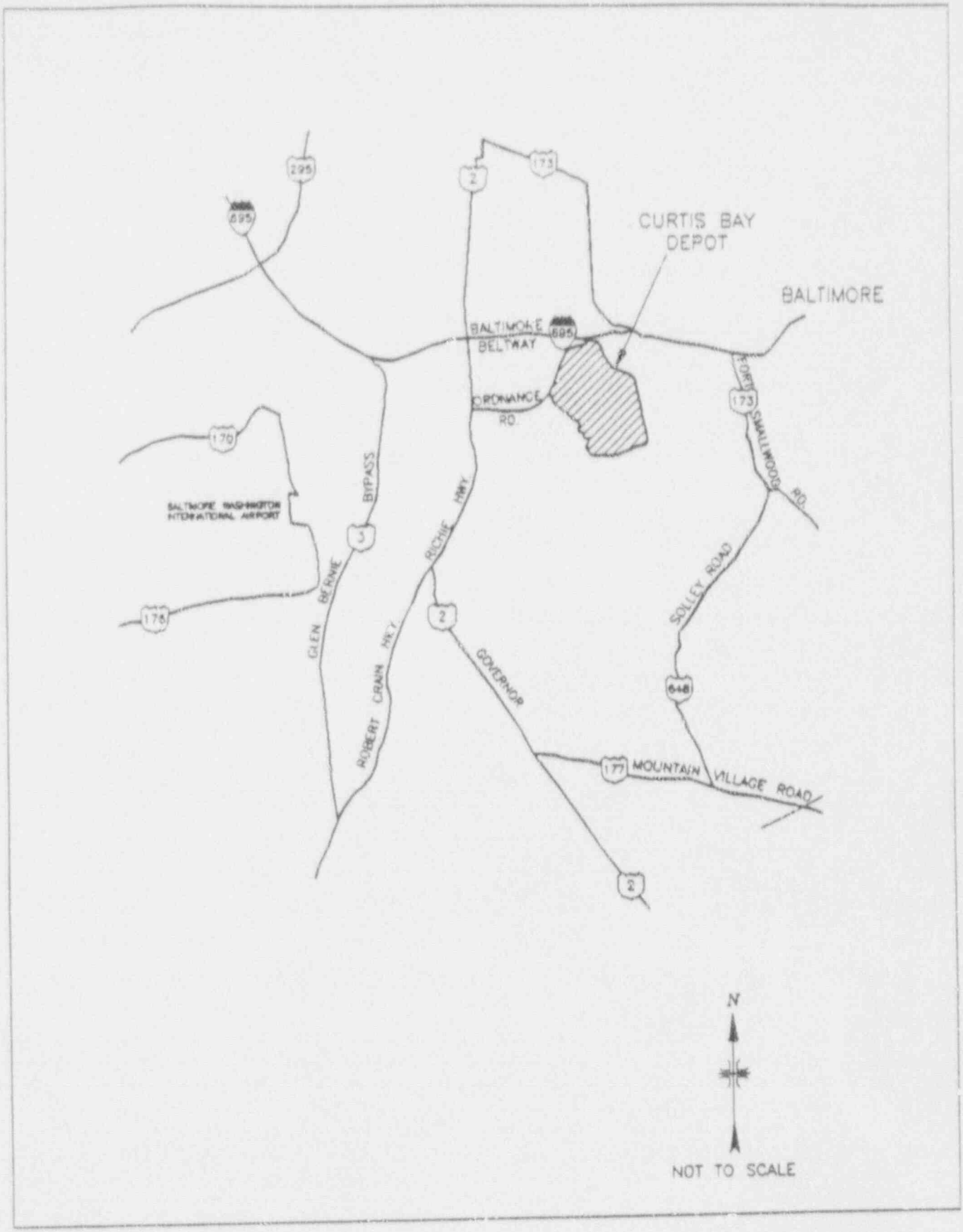

FIGURE 2: Baltimore, Maryland Area Showing Location of Curtis Bay Depot

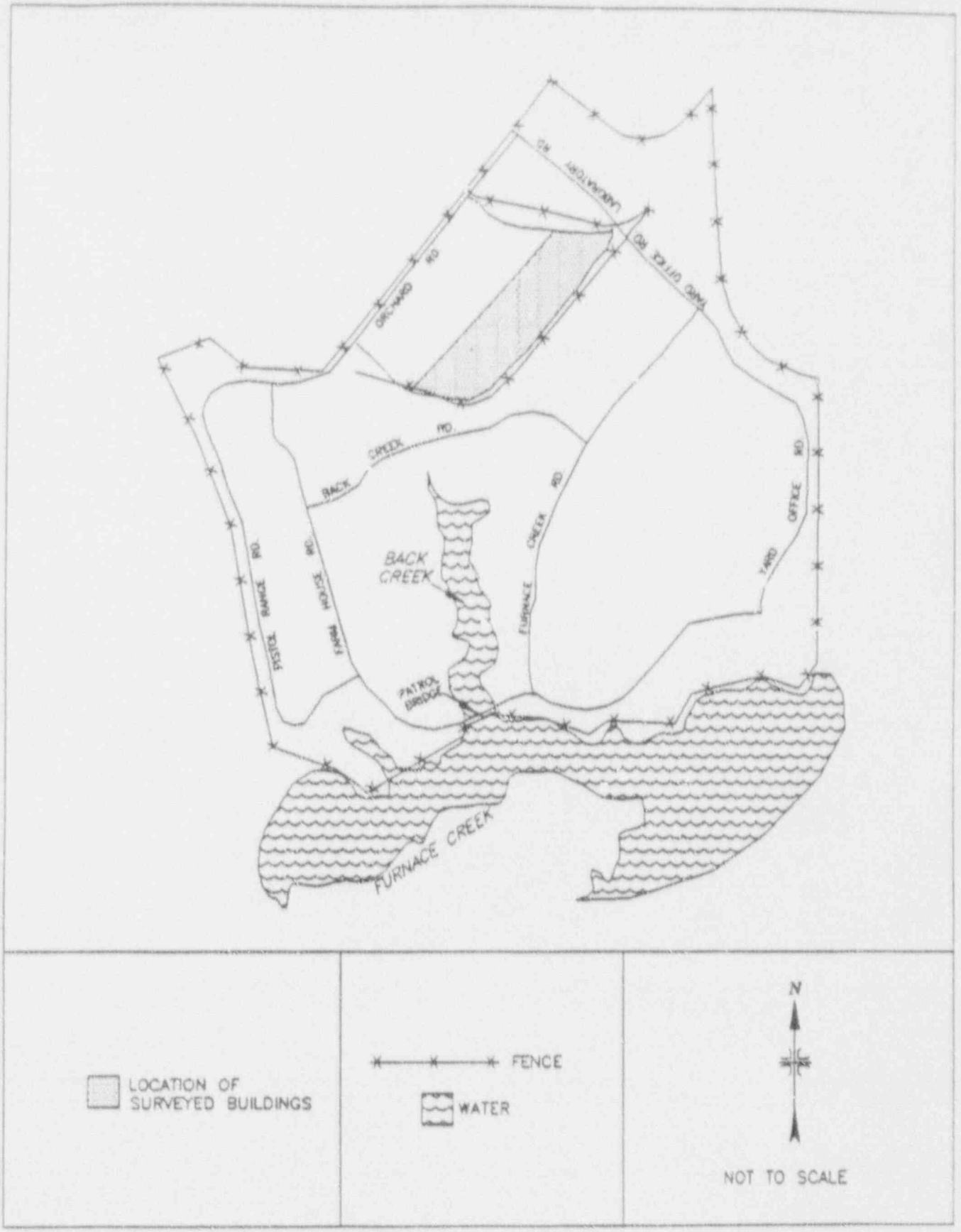

FIGURE 3: Curtis Bay Depot – Location of Surveyed Buildings

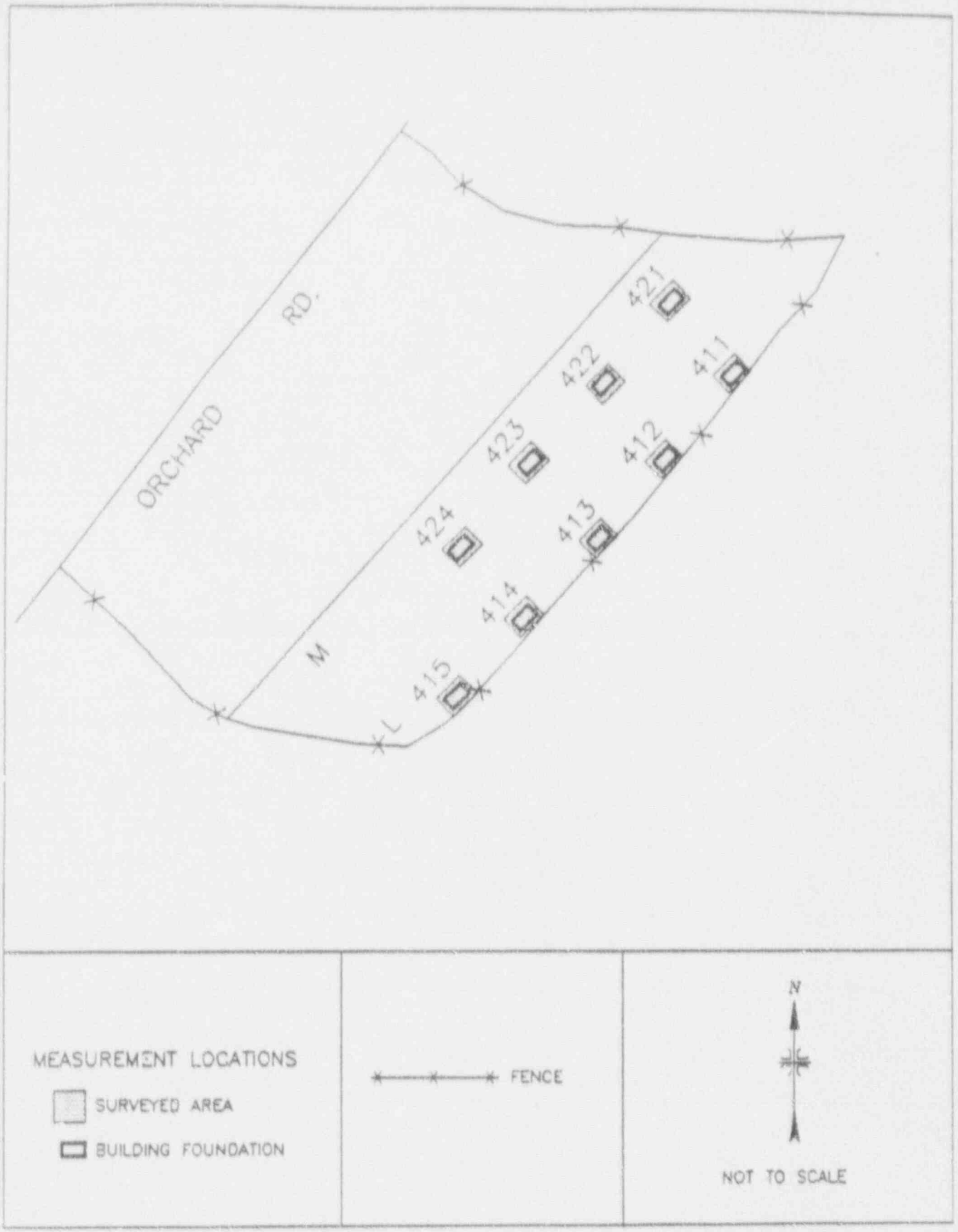

FIGURE 4: Curtis Bay Depot - Surveyed Areas

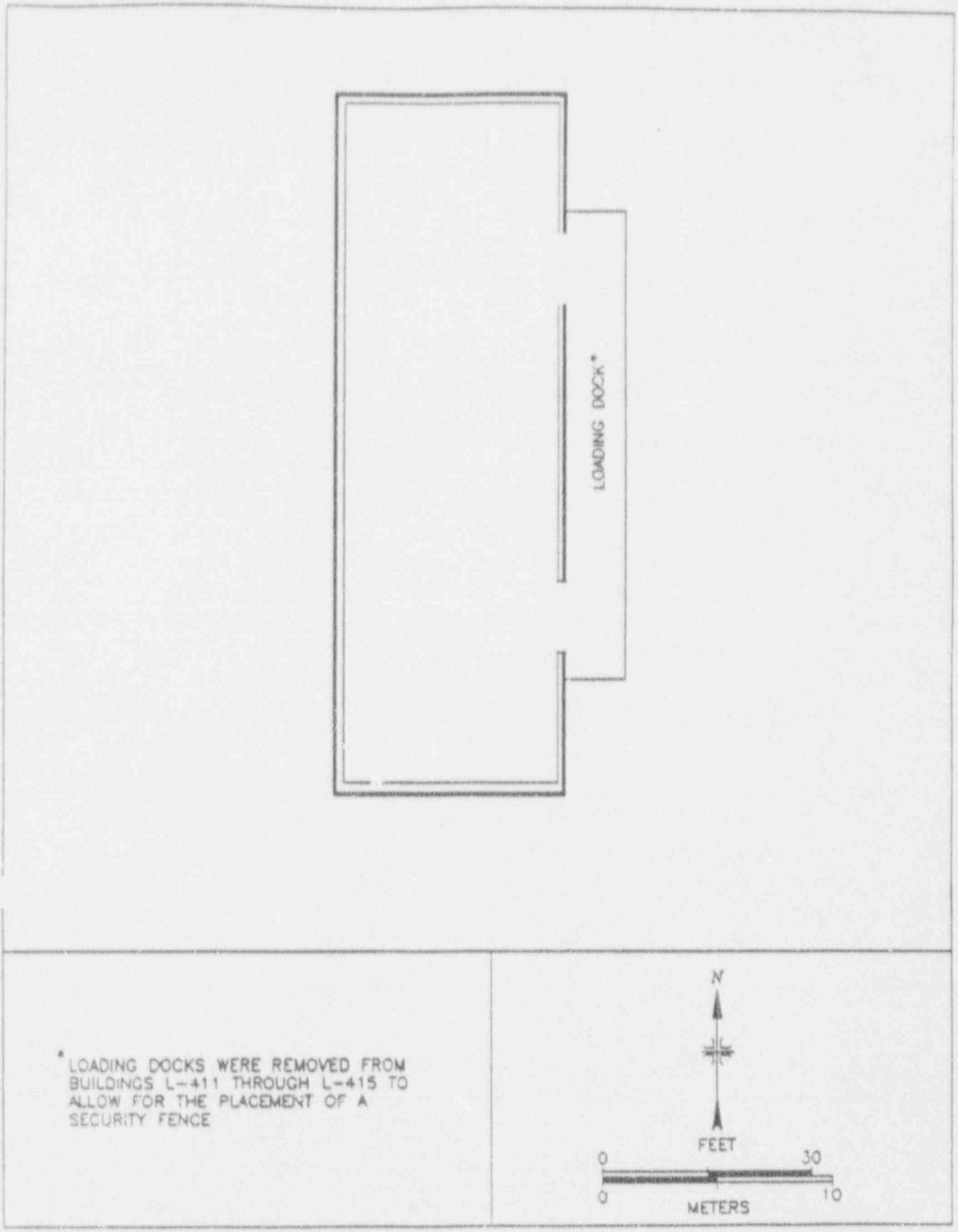

FIGURE 5: Standard Floor Plan of Curtis Bay Depot Warehouses

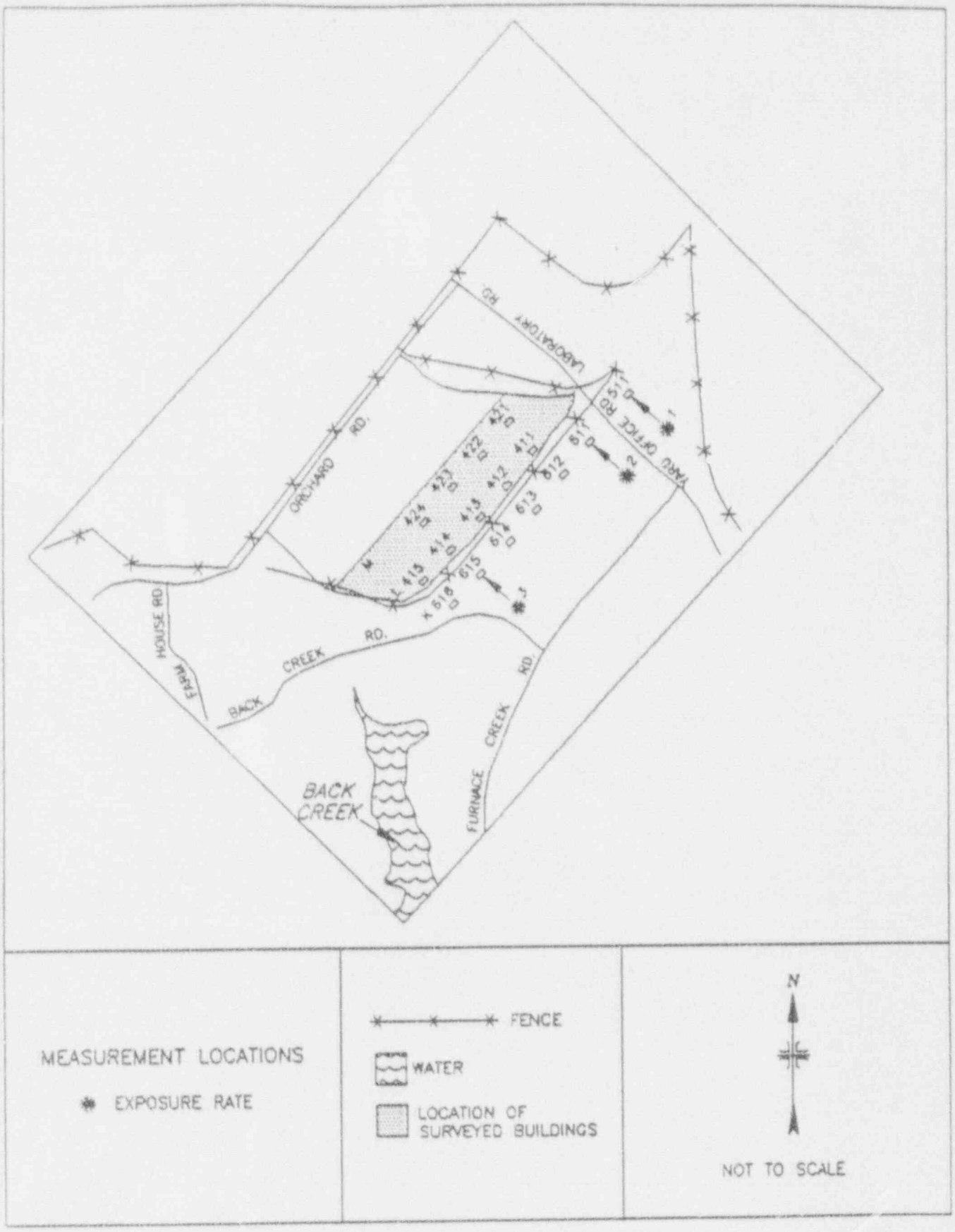

FIGURE 6: Curtis Bay Depot – Interior Background Exposure Rate Measurement Locations

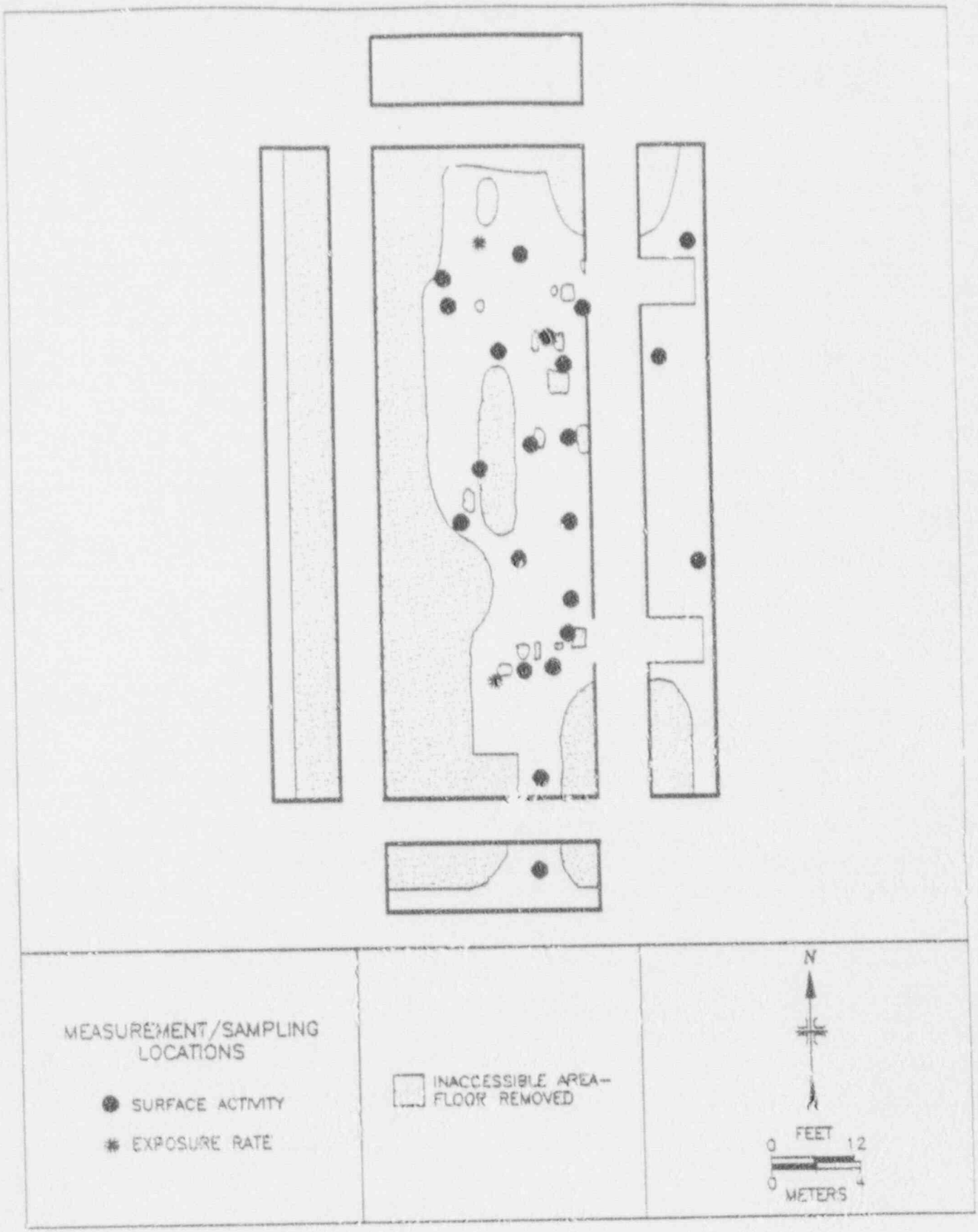

FIGURE 7: Building L-411 – Measurement and Sampling Locations

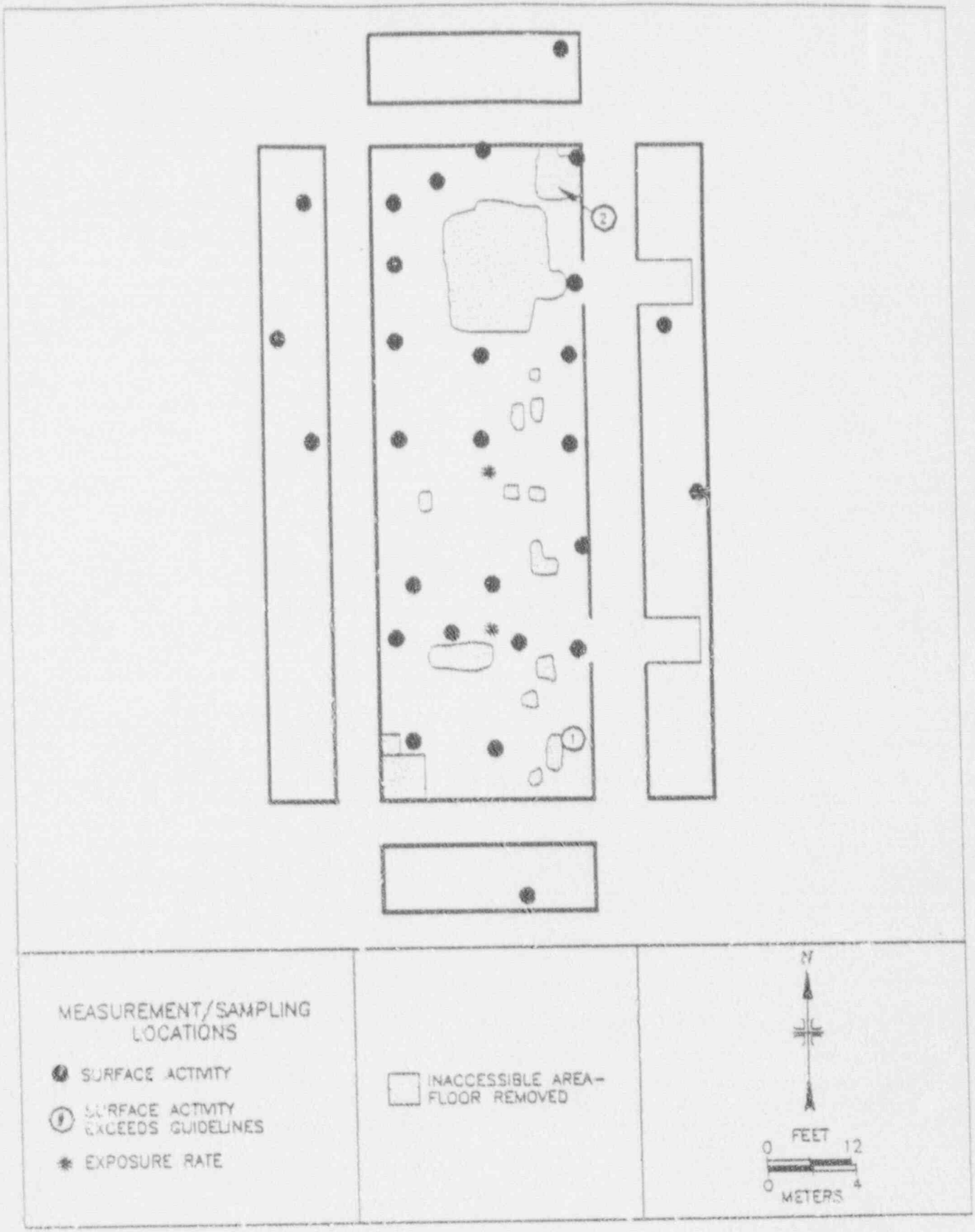

FIGURE 8: Building L-412 -- Measurement and Sampling Locations

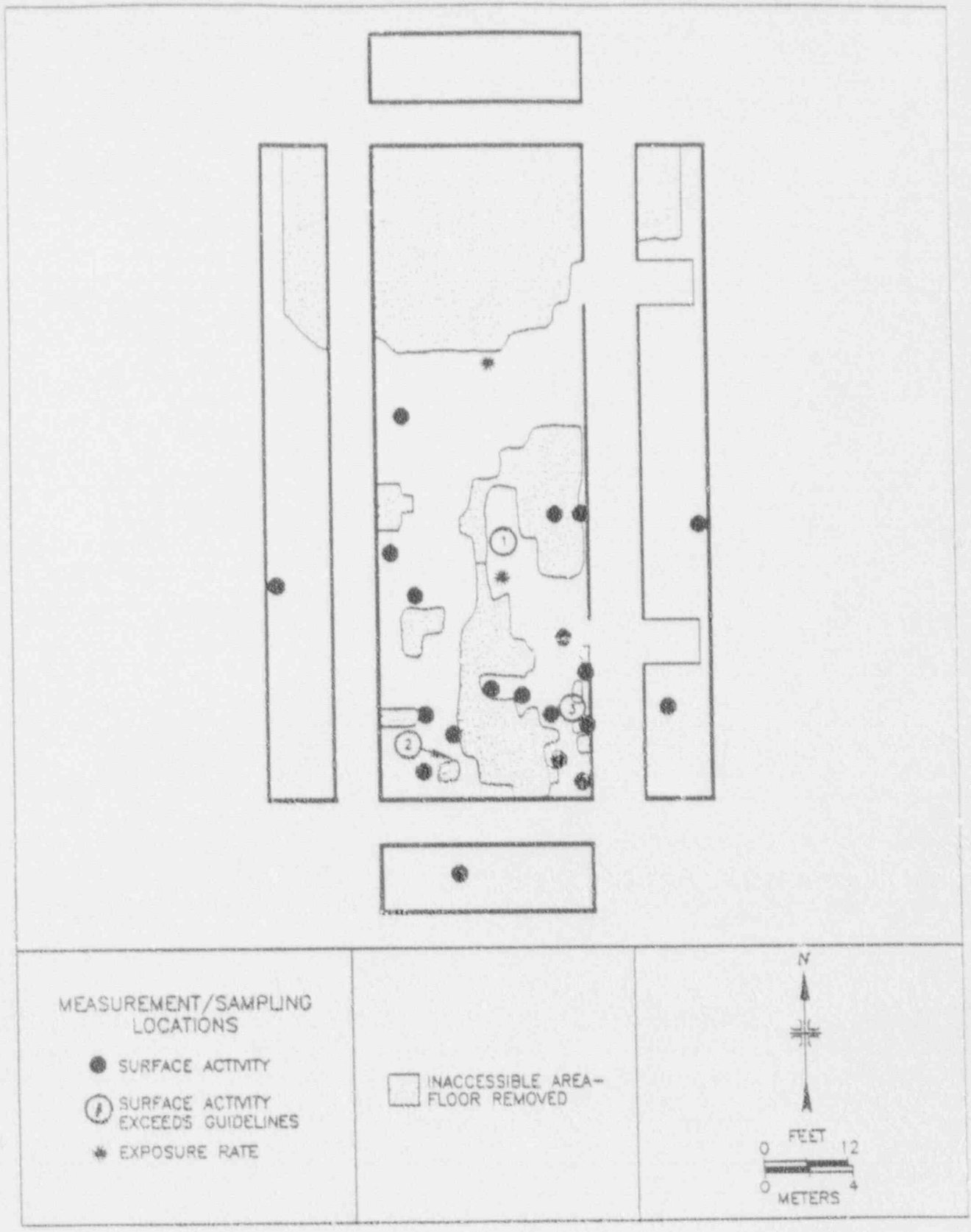

FIGURE 9: Building L-413 - Measurement and Sampling Locations

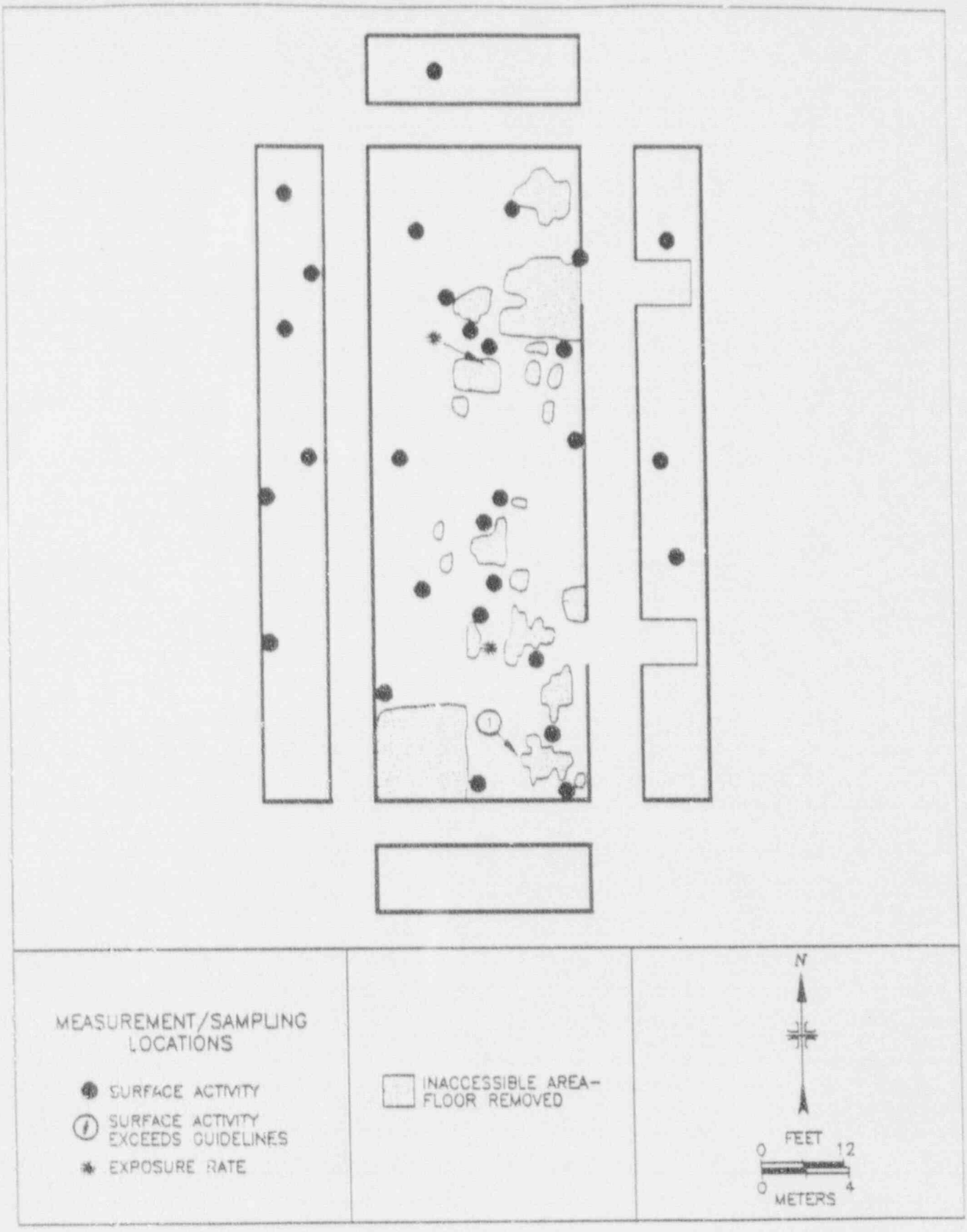

FIGURE 10: Building L-414 - Measurement and Sampling Locations

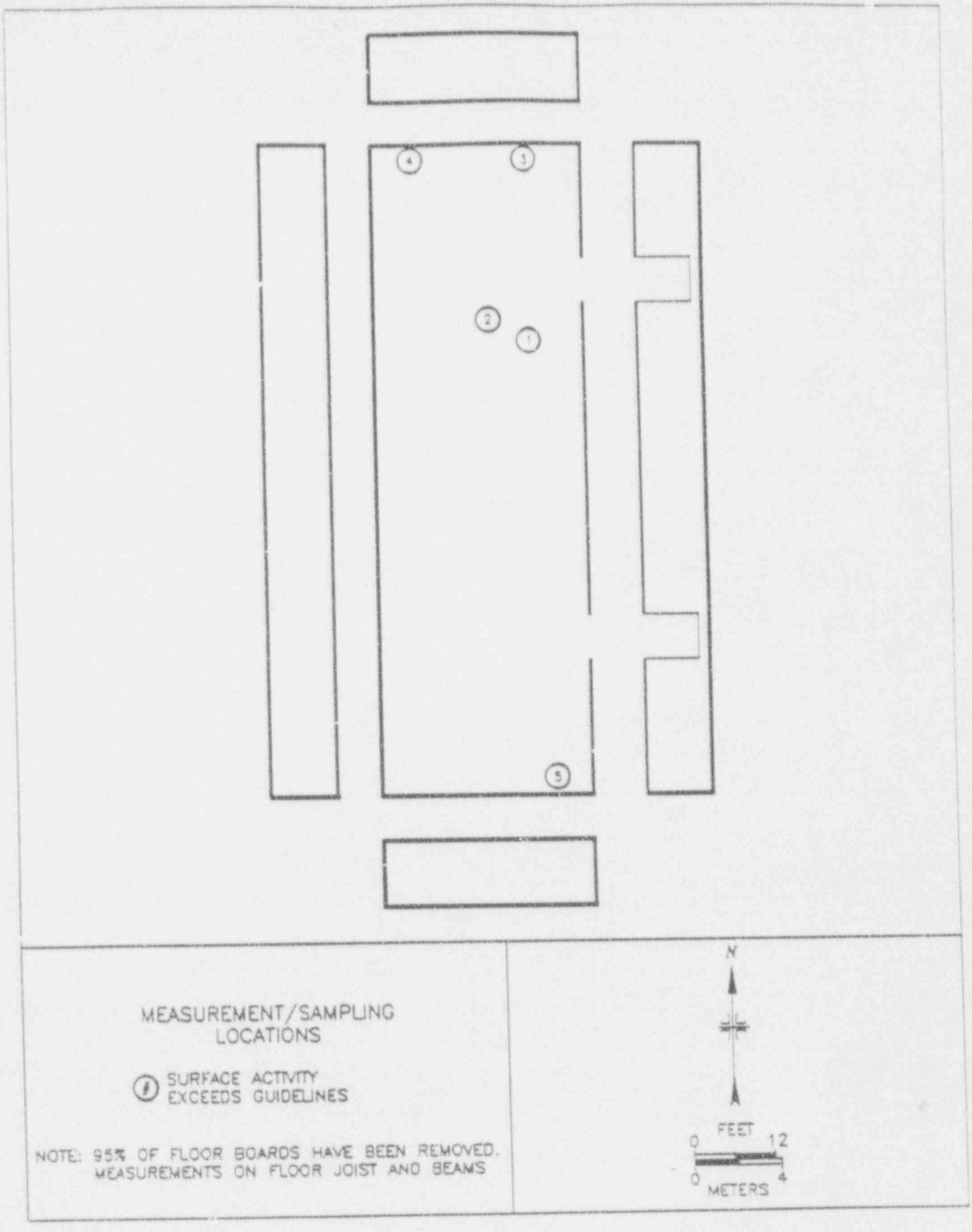

FIGURE 11: Building L-415 - Measurement and Sampling Locations

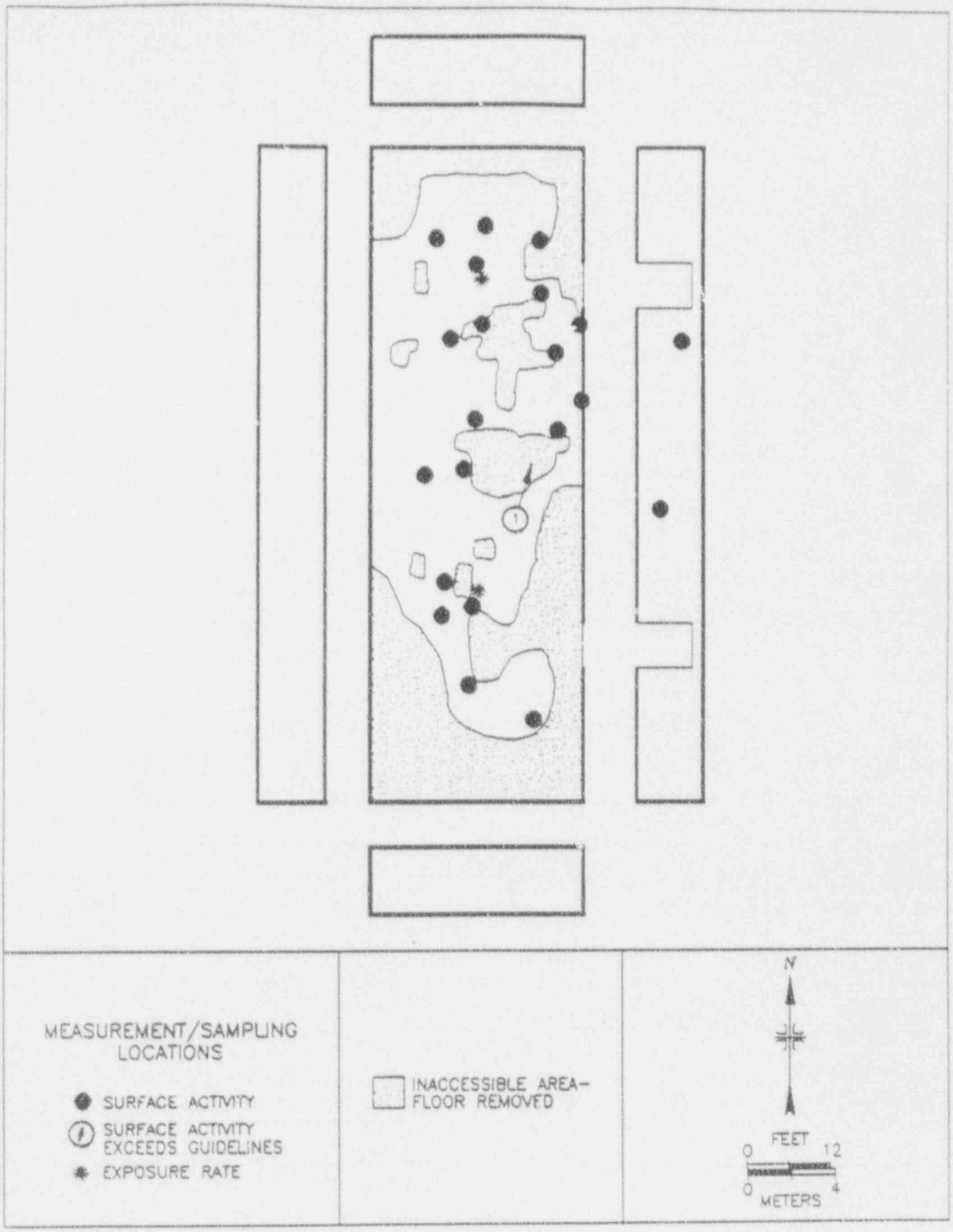

FIGURE 12: Building M-421 - Measurement and Sampling Locations

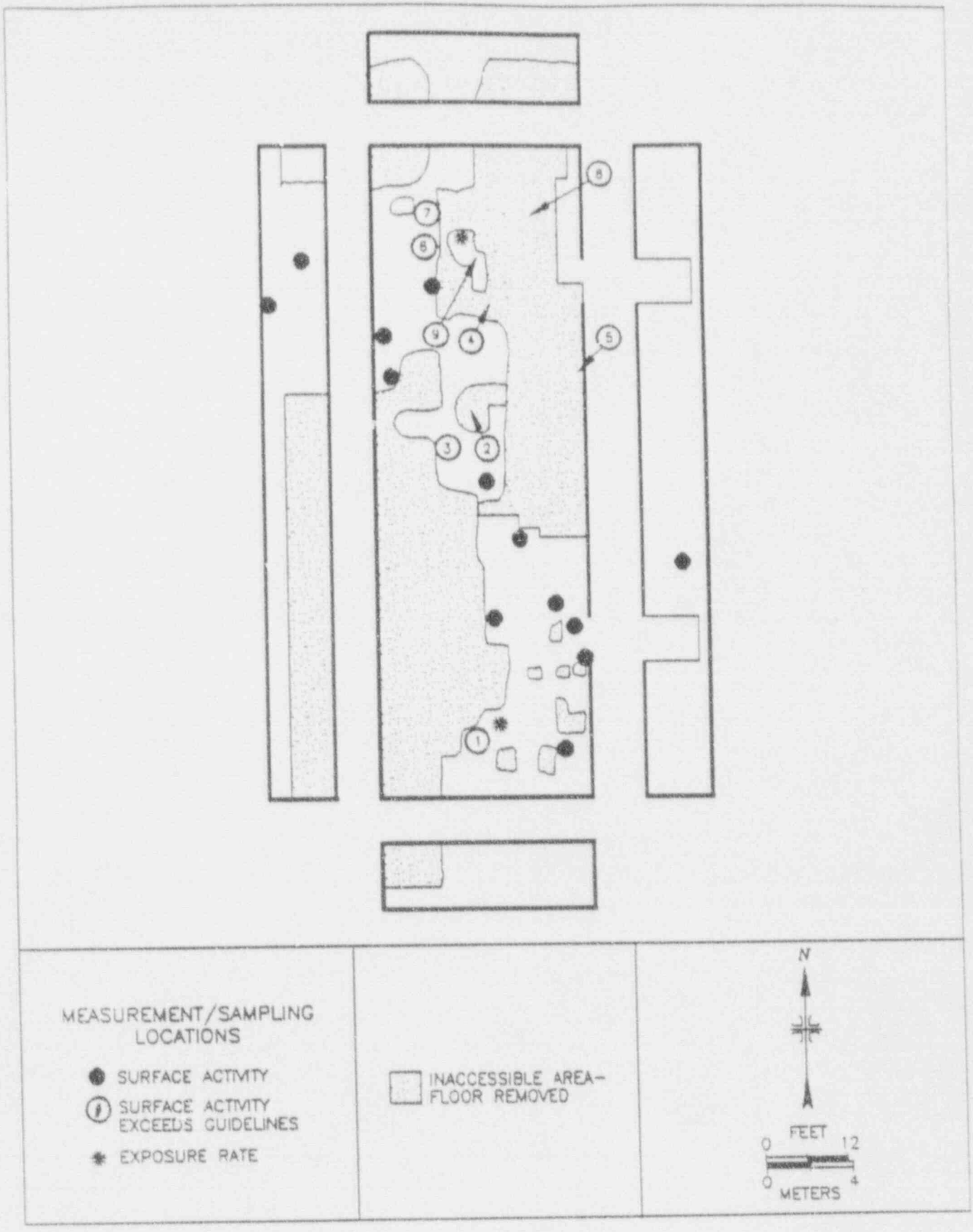

FIGURE 13: Building M-422 - Measurement and Sampling Locations

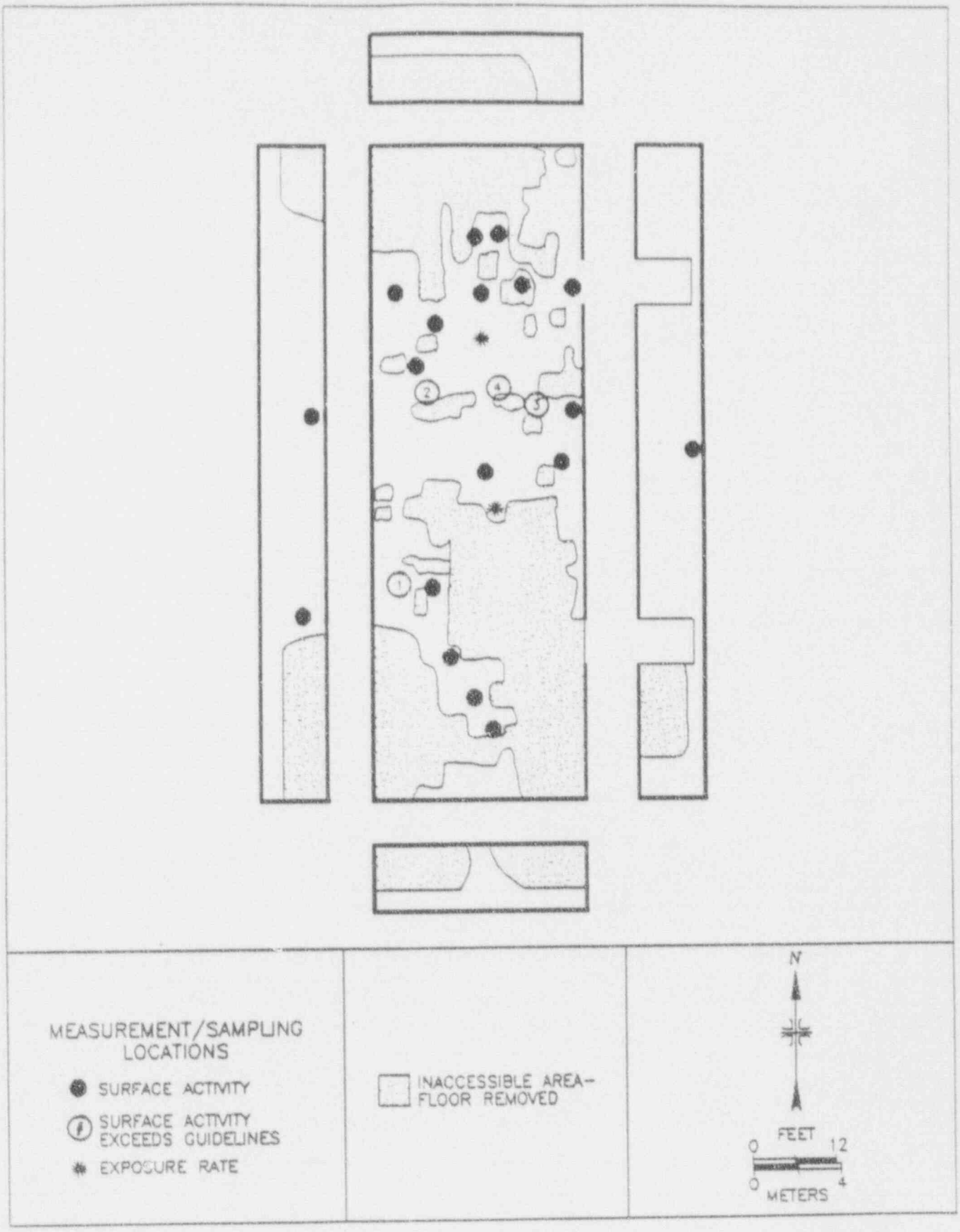

FIGURE 14: Building M-423 - Measurement and Sampling Locations

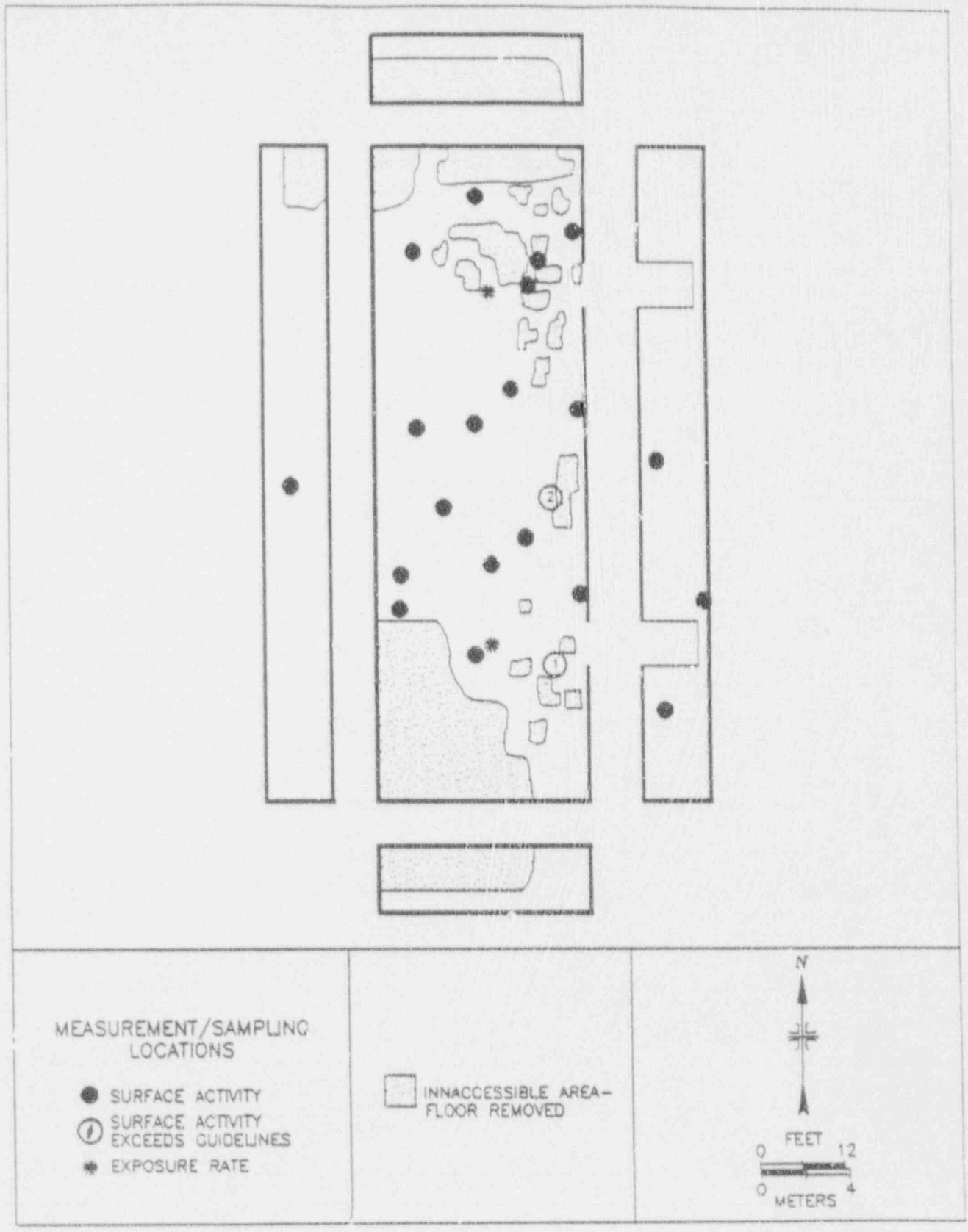

FIGURE 15: Building M-424 - Measurement and Sampling Locations

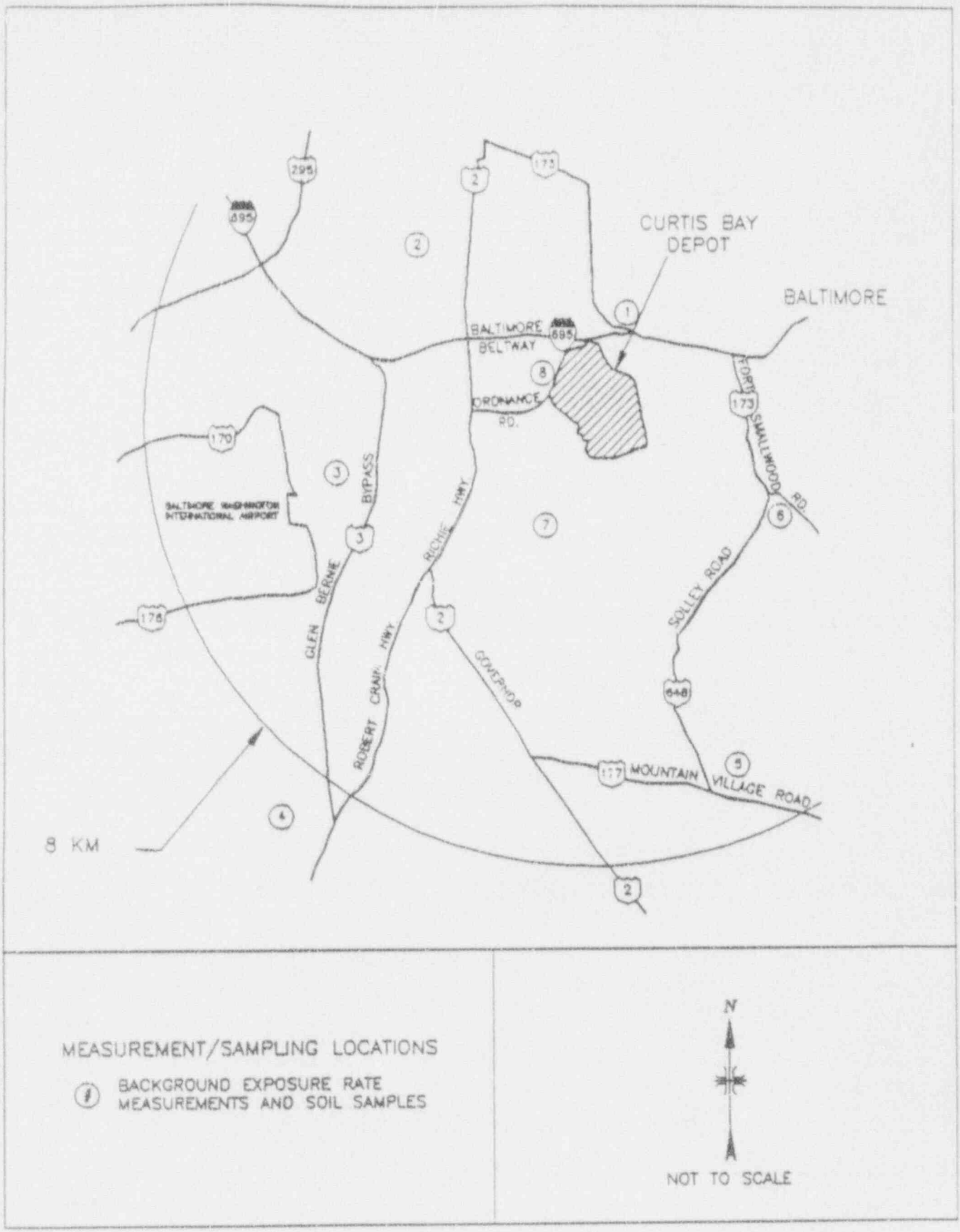

FIGURE 16: Curtis Bay Depot – Exterior Background Exposure Rate Measurement and Soil Sampling Locations

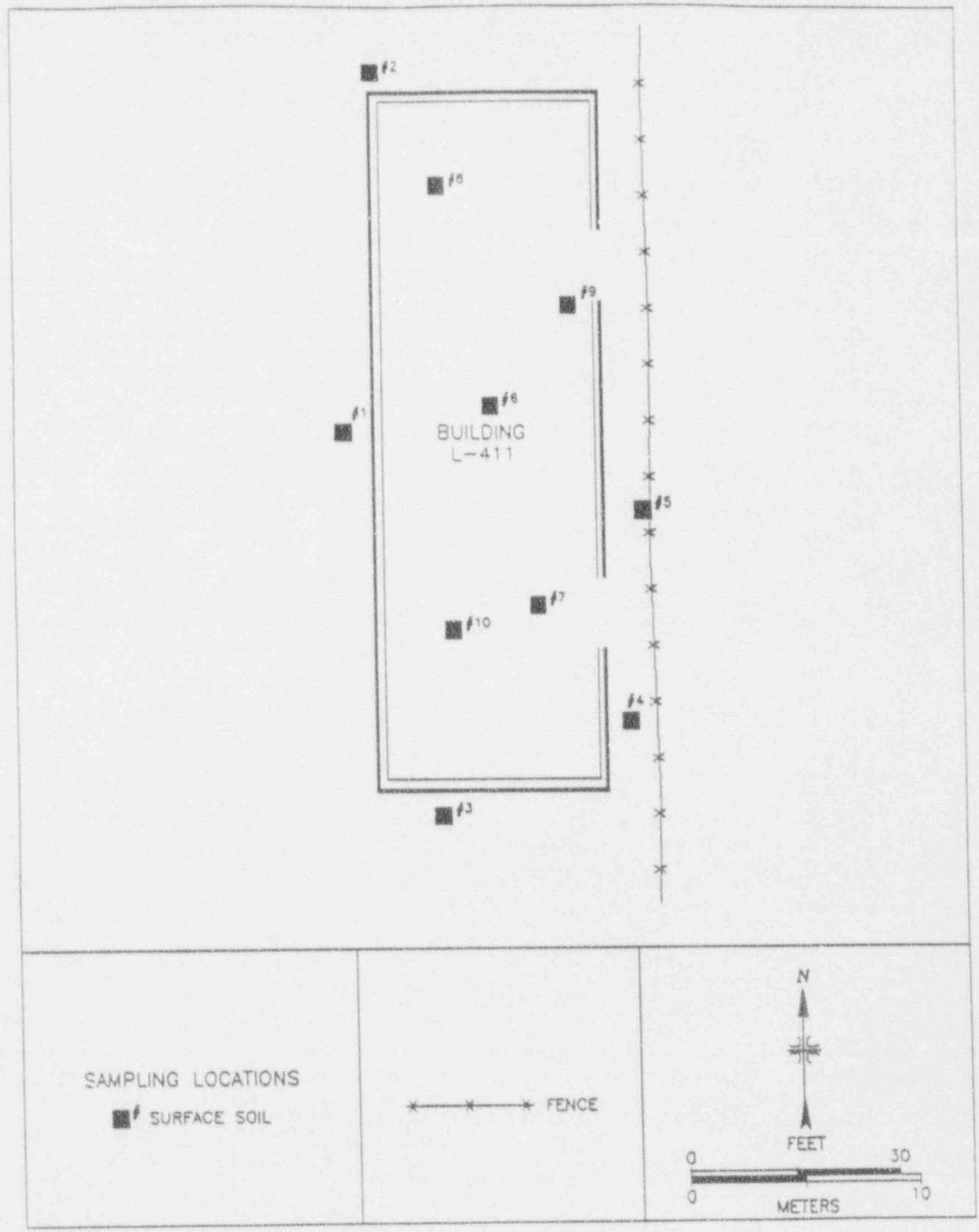

FIGURE 17: Building L-411 - Soil Sampling Locations

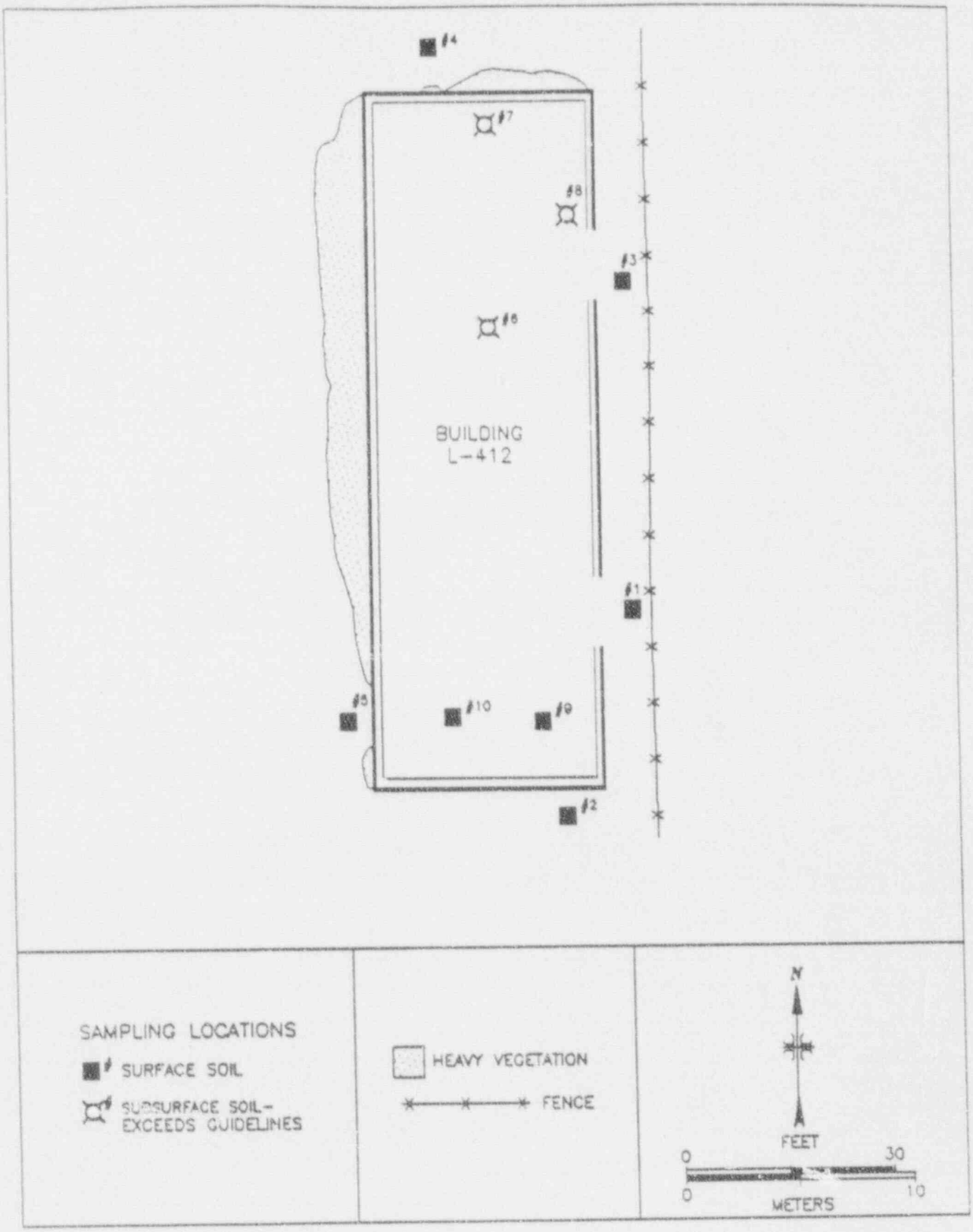

FIGURE 18: Building L-412 - Soil Sampling Locations

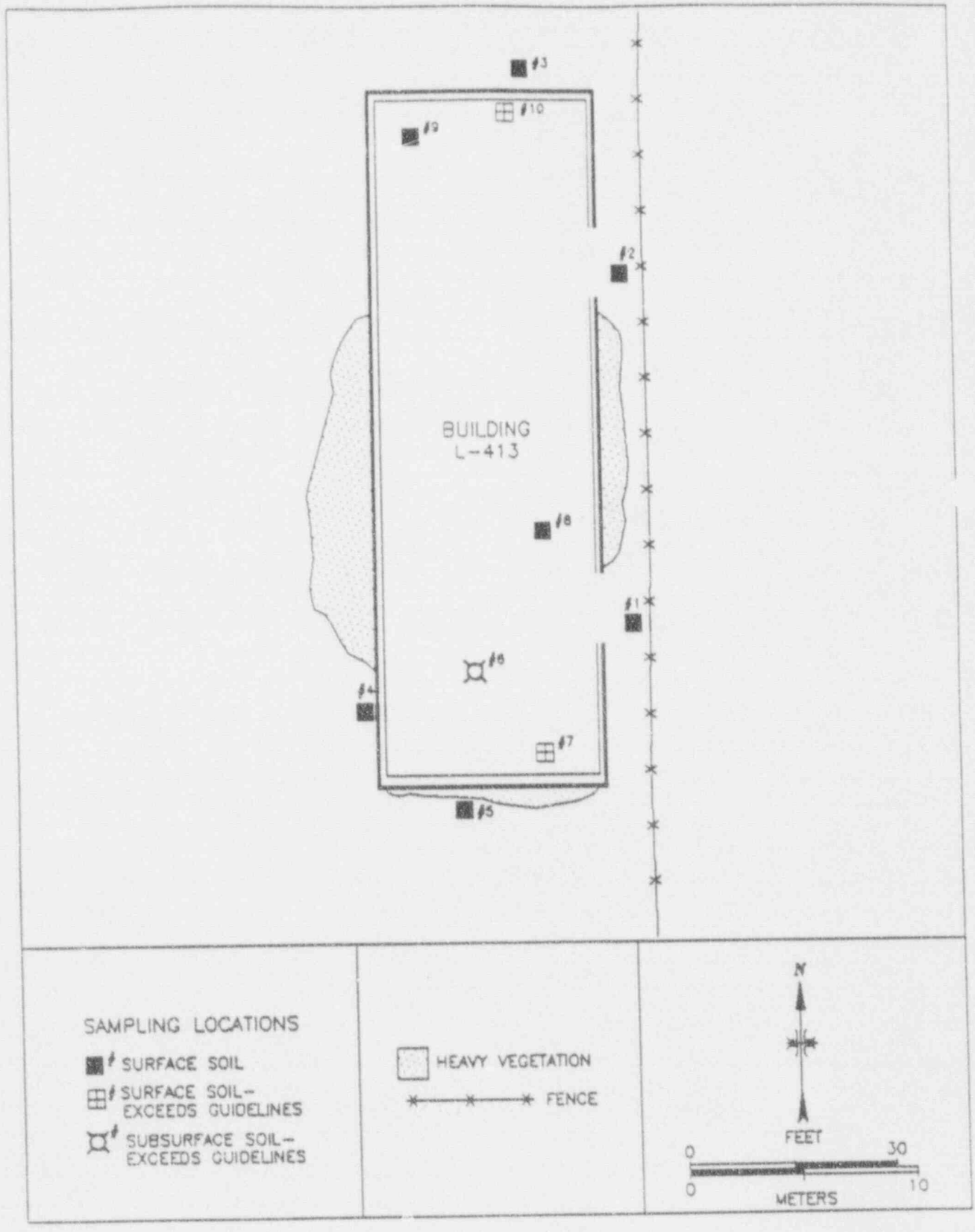

FIGURE 19: Building L-413 - Soil Sampling Locations

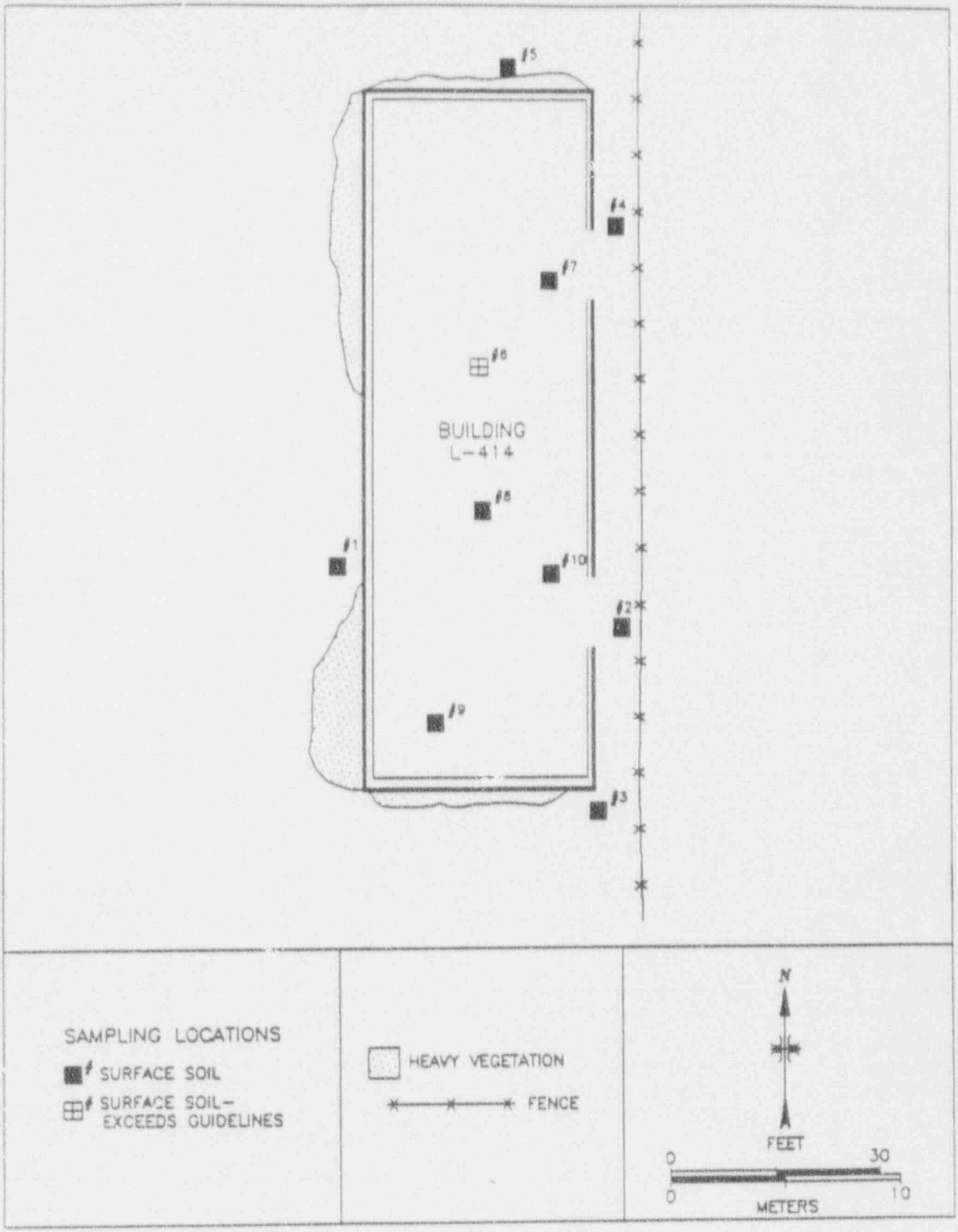

FIGURE 20: Building L-414 - Soil Sampling Locations

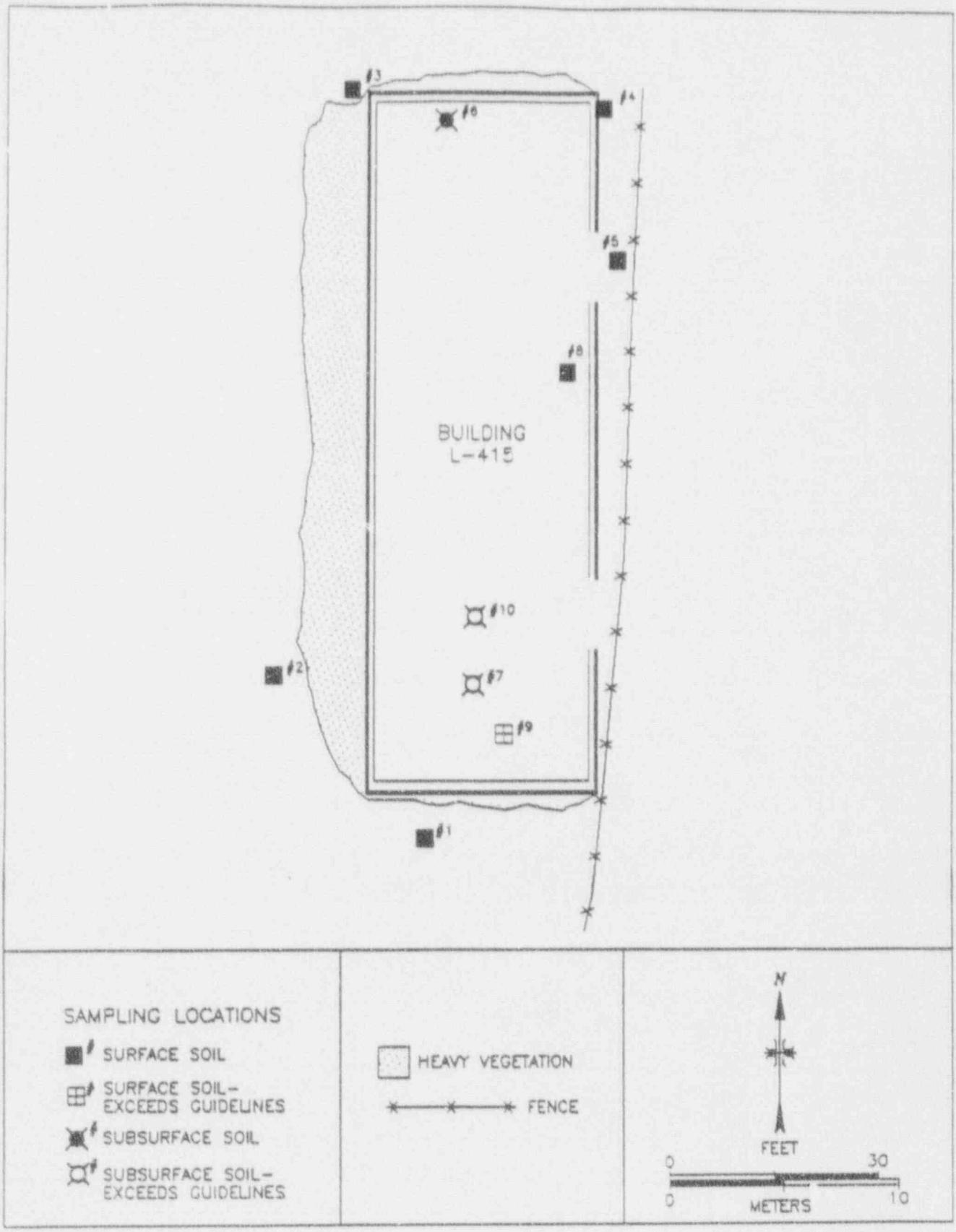

FIGURE 21: Building L-415 - Soil Sampling Locations

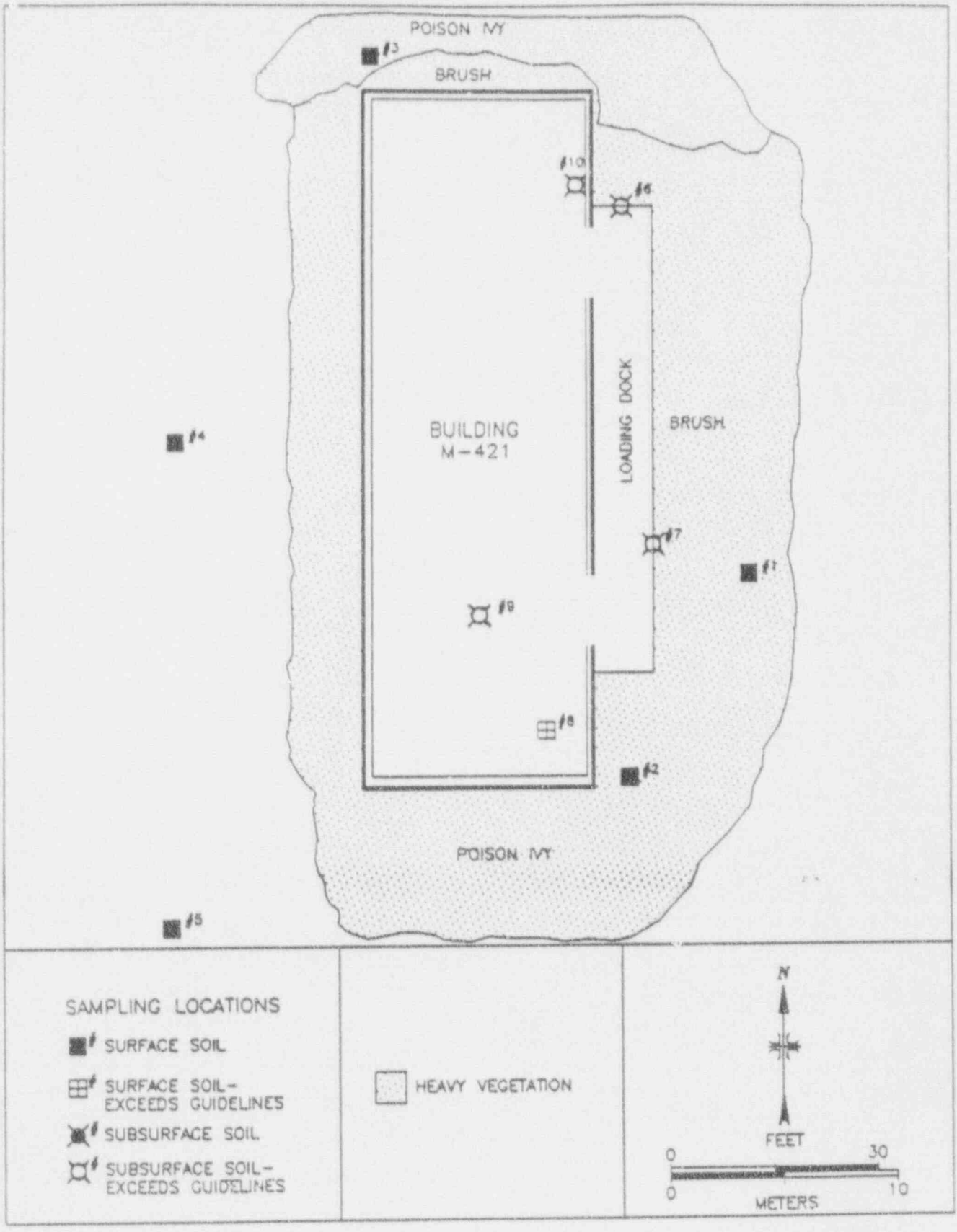

FIGURE 22: Building M-421 - Soil Sampling Locations

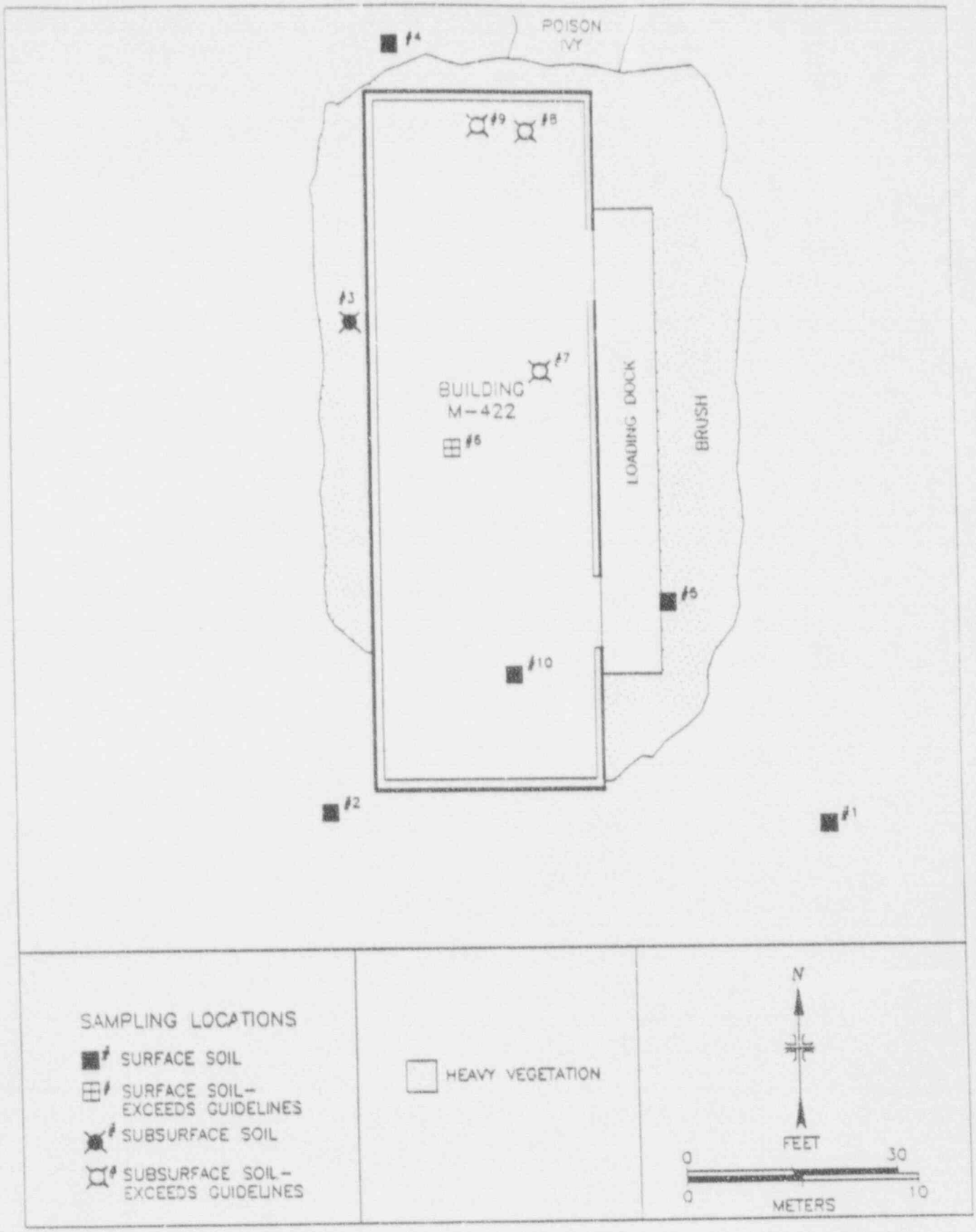

FIGURE 23: Building M-422 - Soil Sampling Locations

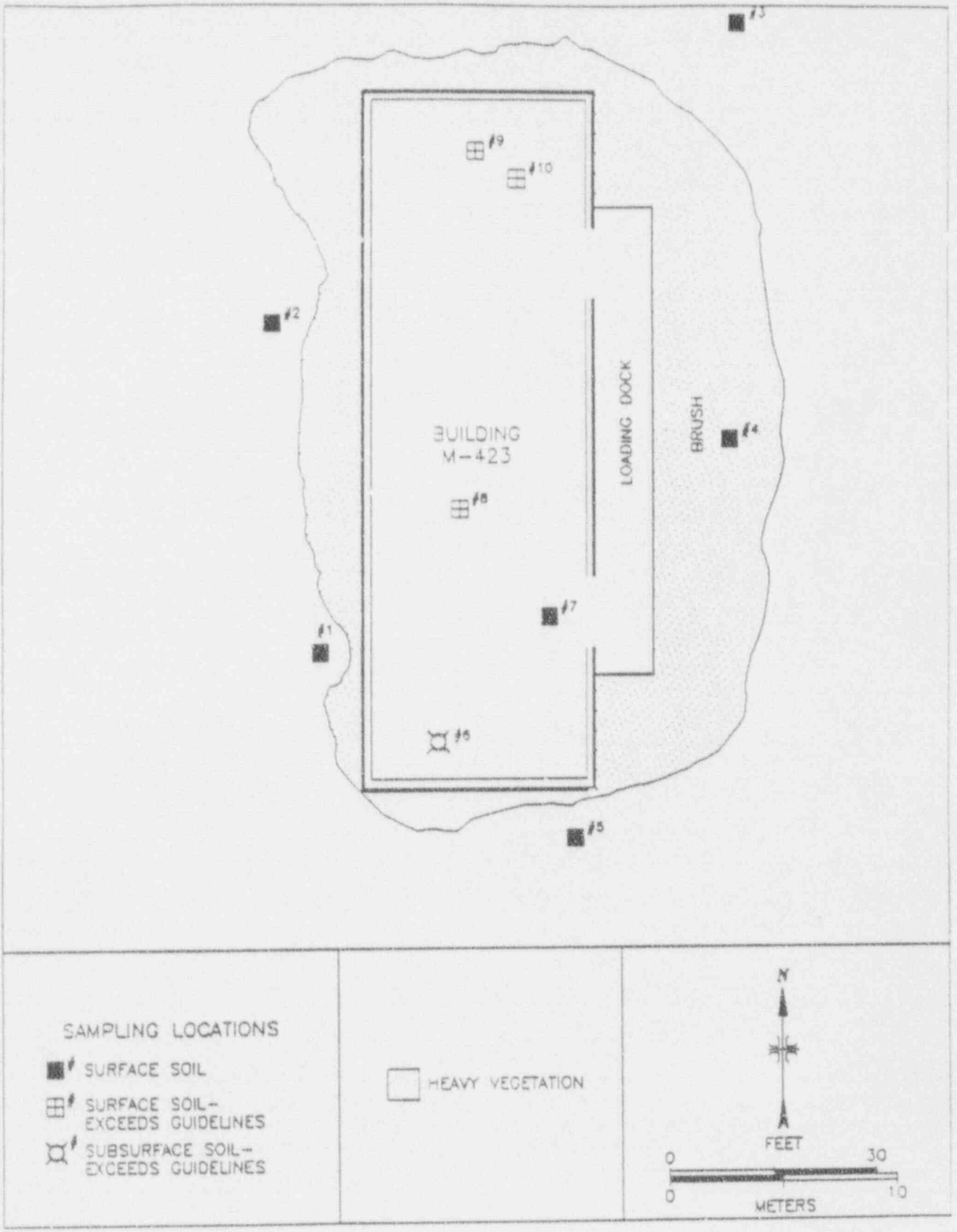

FIGURE 24: Building M-423 - Soil Sampling Locations

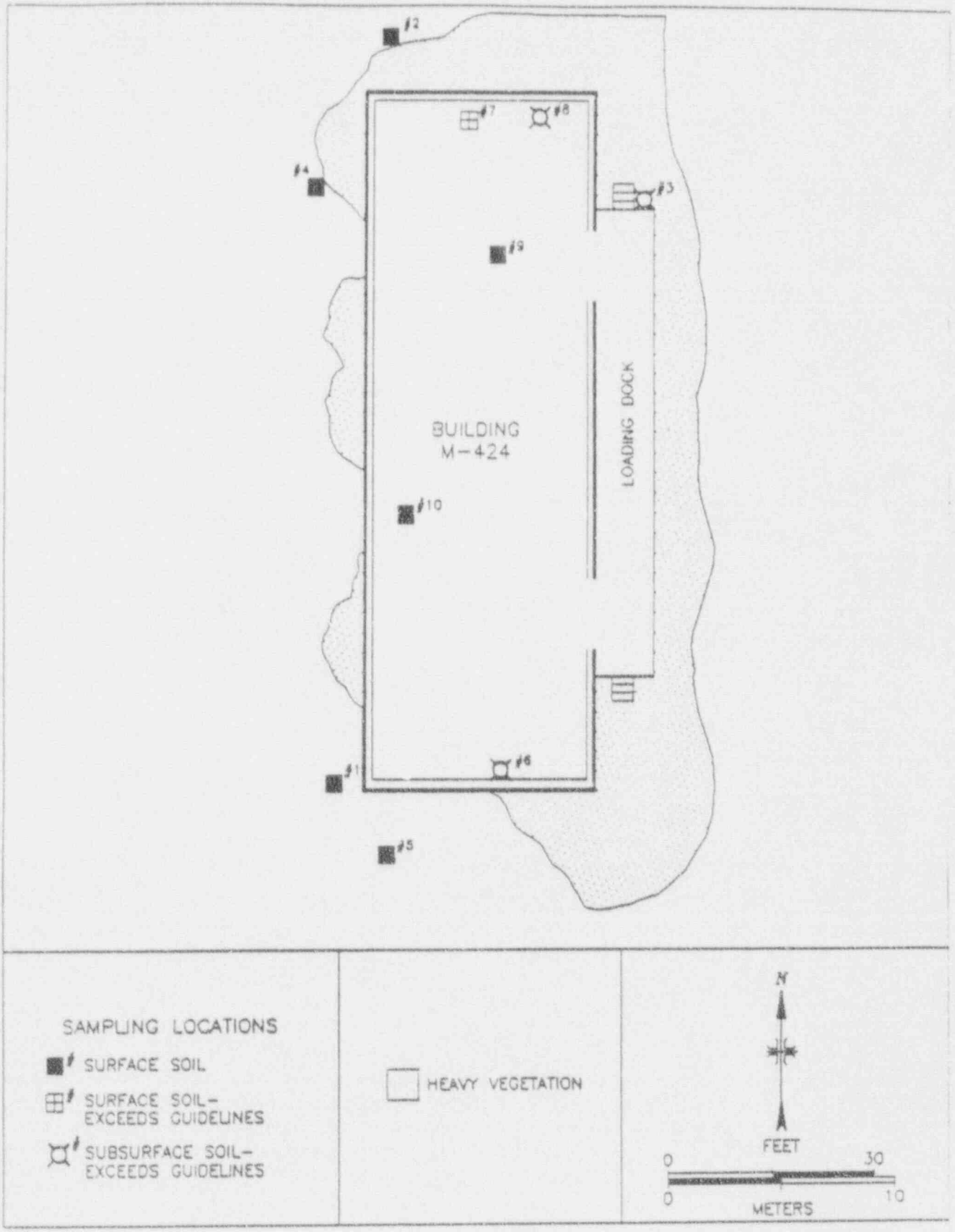

FIGURE 25: Building M-424 - Soil Sampling Locations

TABLE 1

SUMMARY OF SURFACE ACTIVITY AND EXPOSURE RATE MEASUREMENTS
CURTIS BAY DEPOT
BALTIMORE, MARYLAND

Location[a]	Exposure Rate[b] (μR/h) @ 1 m Above Surface	Number of Direct Measurement Locations		Range of Total[d] Activity (dpm/100 cm²)	Locations Exceeding Removable Criteria[e]	Range of Removable Activity (dpm/100 cm²)	
		Total	Exceeding Maximum Criteria[c]	Beta		Alpha	Beta
Building L-411	7	22	0	<440-770	0	<12	<15-15
Building L-412	7	30	2	<440-3,900	0	<12	<15
Building L-413	6-7	23	3	<440-12,000	0	<12	<15-16
Building L-414	6	30	1	<440-14,000	0	<12	<15
Building L-415	---	5	5	12,000-72,000	0	<12-70	<15-30
Building M-421	8-9	22	1	<440-400,000	1	<12-710	<15-470
Building M-422	8-10	22	9	<440-590,000	2	<12-1,100	<15-730
Building M-423	8-9	22	4	<440-12,000	0	<12	<15
Building M-424	7-8	22	2	<440-8,200	0	<12	<15-19

[a]Refer to Figures 7-15.
[b]Dash indicates measurement not performed.
[c]Maximum total contamination level for thorium is 3,000 dpm/100 cm².
[d]Total = fixed plus removable.
[e]Maximum removable contamination level is 200 dpm/100 cm².

TABLE 2

SURFACE ACTIVITY MEASUREMENTS EXCEEDING GUIDELINES
CURTIS BAY DEPOT
BALTIMORE, MARYLAND

Building/Location[a]	Total Beta Activity (dpm/100 cm^2)	Removable Activity[b] (dpm/100 cm^2)	
		Alpha	Beta
L-412 1	3,300	<12	<15
2	3,900	<12	<15
L-413 1	12,000	---	---
2	5,200	<12	<15
3	3,200	<12	<15
L-414 1	14,000	<12	<15
L-415 1	72,000	70	18
2	13,000	39	25
3	65,000	62	30
4	21,000	15	<15
5	12,000	<12	<15
M-421 1	400,000	710	470
M-422 1	14,000	<12	<15
2	590,000	1,100	730
3	4,200	<12	<15
4	73,000	39	21
5	160,000	240	130
6	7,900	15	15
7	11,000	<12	18
8	3,200	<12	<15
9	4,400	<12	<15

TABLE 2 (CONTINUED)

SURFACE ACTIVITY MEASUREMENTS EXCEEDING GUIDELINES
CURTIS BAY DEPOT
BALTIMORE, MARYLAND

Building/Location[a]	Total Beta Activity (dpm/100 cm^2)	Removable Activity[b] (dpm/100 cm^2)	
		Alpha	Beta
M-423 1	11,000	<12	<15
2	3,600	<12	<15
3	12,000	<12	<15
4	4,500	<12	<15
M-424 1	4,500	<12	<15
2	8,200	<12	<15

[a]Refer to Figures 8-15.
[b]Dash indicates measurement not performed.

TABLE 3

INTERIOR BACKGROUND EXPOSURE RATES
CURTIS BAY DEPOT
BALTIMORE, MARYLAND

Measurement Location*	Exposure Rate (μR/h) @ 1 m Above Surface
Building K-511	8
Building K-611	8
Building K-615	7

*Refer to Figure 6.

TABLE 4

EXTERIOR BACKGROUND EXPOSURE RATES AND THORIUM CONCENTRATIONS IN SOIL CURTIS BAY DEPOT BALTIMORE, MARYLAND

Measurement Location[a]		Exposure Rate (μR/h) @ 1 m Above Surface	Total Thorium Concentration (pCi/g)[b]
1	Pennigton Ave at Ordnance Rd	8	1.4 ± 0.8
2	Brooklyn Park #1	7	1.4 ± 0.6
3	Lindale J.H.S.	7	1.8 ± 0.6
4	Randazzo Softball Park	7	1.0 ± 0.4
5	George Fox Middle School	6	0.6 ± 0.6
6	Solly Park	6	0.8 ± 0.4
7	Point Pleasant Elemenatry School	6	0.8 ± 0.4
8	Home Depot Parking Lot	7	1.6 ± 0.6

[a]See Figure 16.
[b]Uncertainties represent the 95% confidence level, based only on counting statistics.

TABLE 5

BUILDING L-411
EXPOSURE RATES AND THORIUM CONCENTRATIONS IN SOIL
CURTIS BAY DEPOT
BALTIMORE, MARYLAND

Location*	Exposure Rate (μR/h) @ 1 m Above Surface	Sample Depth (cm)	Total Thorium Concentration (pCi/g)[b]
1	8	0-15	2.2 ± 0.6
2	8	0-15	3.0 ± 1.0
3	9	0-15	2.8 ± 0.8
4	9	0-15	3.8 ± 1.0
5	9	0-15	3.2 ± 1.0
6	9	0-15	2.0 ± 0.8
7	9	0-15	2.6 ± 1.0
8	8	0-15	2.6 ± 0.8
9	10	0-15	2.4 ± 0.8
10	9	0-15	1.8 ± 0.8

*Refer to Figure 17.
[b]Uncertainties represent the 95% confidence level, based only on counting statistics.

TABLE 6

BUILDING L-412
EXPOSURE RATES AND THORIUM CONCENTRATIONS IN SOIL
CURTIS BAY DEPOT
BALTIMORE, MARYLAND

Location[a]	Exposure Rate (μR/h) @ 1 m Above Surface[b]	Sample Depth (cm)	Total Thorium Concentration (pCi/g)[c]
1	9	0-15	2.2 ± 0.8
2	11	0-15	7.8 ± 1.8
3	9	0-15	3.2 ± 0.8
4	9	0-15	4.6 ± 1.0
5	8	0-15	3.0 ± 1.0
6	16	0-15	56.8 ± 8.6
6	---	15-30	14.8 ± 2.6
7	16	0-15	526 ± 76
7	---	15-30	61.5 ± 9.2
8	16	0-15	66 ± 10
8	---	15-30	87 ± 13
8	---	30-45	18.8 ± 3.4
9	10	0-15	3.8 ± 1.0
10	10	0-15	3.4 ± 1.0

[a]Refer to Figure 18.
[b]Dash indicates measurement not performed.
[c]Uncertainties represent the 95% confidence level, based only on counting statistics.

TABLE 7

BUILDING L-413
EXPOSURE RATES AND THORIUM CONCENTRATIONS IN SOIL
CURTIS BAY DEPOT
BALTIMORE, MARYLAND

Location[a]	Exposure Rate(μR/h) @ 1 m Above Surface[b]	Sample Depth (cm)	Total Thorium Concentration (pCi/g)[c]
1	9	0-15	2.8 ± 0.8
2	9	0-15	2.6 ± 0.8
3	8	0-15	2.6 ± 1.0
4	9	0-15	4.0 ± 1.2
5	9	0-15	3.4 ± 0.8
6	10	0-15	80 ± 12
6	---	15-30	25.6 ± 4.2
7	10	0-15	17.8 ± 3.0
8	10	0-15	5.0 ± 1.2
9	8	0-15	2.0 ± 0.8
10	9	0-15	14.6 ± 2.8

[a]Refer to Figure 19.
[b]Dash indicates measurement not performed.
[c]Uncertainties represent the 95% confidence level, based only on counting statistics.

TABLE 8

BUILDING L-414
EXPOSURE RATES AND THORIUM CONCENTRATIONS IN SOIL
CURTIS BAY DEPOT
BALTIMORE, MARYLAND

Location[a]	Exposure Rate (μR/h) @ 1 m Above Surface	Sample Depth (cm)	Total Thorium Concentration (pCi/g)[b]
1	6	0-15	3.6 ± 1.0
2	7	0-15	1.8 ± 0.6
3	8	0-15	3.4 ± 1.0
4	8	0-15	2.4 ± 0.8
5	8	0-15	3.8 ± 1.0
6	7	0-15	14.0 ± 2.4
7	6	0-15	1.6 ± 0.6
8	6	0-15	0.8 ± 0.6
9	6	0-15	1.2 ± 0.4
10	5	0-15	1.0 ± 0.4

[a]Refer to Figure 26.
[b]Uncertainties represent the 95% confidence level, based only on counting statistics.

TABLE 9

BUILDING L-415
EXPOSURE RATES AND THORIUM CONCENTRATIONS IN SOIL
CURTIS BAY DEPOT
BALTIMORE, MARYLAND

Location[a]	Exposure Rate (μR/h) @ 1 m Above Surface[b]	Sample Depth (cm)	Total Thorium Concentration (pCi/g)[c]
1	8	0-15	3.0 ± 1.0
2	6	0-15	1.8 ± 0.8
3	8	0-15	4.8 ± 1.2
4	9	0-15	4.2 ± 1.0
5	8	0-15	2.6 ± 0.4
6	8	0-15	8.4 ± 1.6
6	---	15-30	6.4 ± 1.2
7	8	0-15	45.4 ± 7.2
7	---	15-30	8.0 ± 1.4
8	6	0-15	5.6 ± 1.2
9	10	0-15	11.2 ± 2.2
10	7	0-15	12.2 ± 2.2
10	---	15-30	20.4 ± 3.4

[a]Refer to Figure 21.
[b]Dash indicates measurement not performed.
[c]Uncertainties represent the 95% confidence level, based only on counting statistics.

TABLE 10

BUILDING M-421
EXPOSURE RATES AND THORIUM CONCENTRATIONS IN SOIL
CURTIS BAY DEPOT
BALTIMORE, MARYLAND

Location[a]	Exposure Rate (μR/h) @ 1 m Above Surface[b]	Sample Depth (cm)	Total Thorium Concentration (pCi/g)[c]
1	9	0-15	1.8 ± 0.6
2	9	0-15	4.6 ± 0.6
3	8	0-15	1.8 ± 1.0
4	7	0-15	1.8 ± 0.8
5	5	0-15	1.6 ± 0.6
6	36	0-15	648 ± 94
6	---	15-30	412 ± 60
7	13	0-15	11.6 ± 2.0
7	---	15-30	6.6 ± 1.4
8	13	0-15	17.4 ± 1.2
9	21	0-15	97 ± 14
9	---	15-30	11.6 ± 2.2
10	16	0-15	73 ± 11
10	---	15-30	43.4 ± 6.8

[a]Refer to Figure 22.
[b]Dash indicates measurements not performed.
[c]Uncertainties represent the 95% confidence level, based only on counting statistics.

TABLE 11

BUILDING M-422
EXPOSURE RATES AND THORIUM CONCENTRATIONS IN SOIL
CURTIS BAY DEPOT
BALTIMORE, MARYLAND

Location[a]	Exposure Rate (μR/h) @ 1 m Above Surface[b]	Sample Depth (cm)	Total Thorium Concentration (pCi/g)[c]
1	13	0-15	4.0 ± 1.2
2	9	0-15	3.6 ± 1.0
3	8	0-15	5.6 ± 1.2
3	---	15-30	4.4 ± 1.0
4	9	0-15	3.8 ± 1.0
5	9	0-15	4.0 ± 1.0
6	13	0-15	12.4 ± 2.2
7	13	0-15	87 ± 13
7	---	15-30	59.2 ± 9.0
8	11	0-15	256 ± 36
8	---	15-30	15.6 ± 2.8
9	13	0-15	626 ± 92
9	---	15-30	130 ± 19
10	8	0-15	1.4 ± 0.6

[a]Refer to Figure 23.
[b]Dash indicates measurement not performed.
[c]Uncertainties represent the 95% confidence level, based only on counting statistics.

TABLE 12

BUILDING M-423
EXPOSURE RATES AND THORIUM CONCENTRATIONS IN SOIL
CURTIS BAY DEPOT
BALTIMORE, MARYLAND

Location[a]	Exposure Rate (μR/h) @ 1 m Above Surface[b]	Sample Depth (cm)	Total Thorium Concentration (pCi/g)[c]
1	9	0-15	3.2 ± 1.0
2	7	0-15	1.8 ± 0.4
3	7	0-15	1.0 ± 0.8
4	10	0-15	3.6 ± 1.2
5	8	0-15	2.4 ± 0.8
6	16	0-15	158 ± 24
6	---	15-30	51.0 ± 8.0
6	---	30-45	18.2 ± 3.2
7	8	0-15	2.0 ± 0.6
8	10	0-15	11.6 ± 2.2
9	7	0-15	142 ± 20
10	8	0-15	35.0 ± 5.6

[a]Refer to Figure 24.
[b]Dash indicates measurement not performed.
[c]Uncertainties represent the 95% confidence level, based only on counting statistics.

TABLE 13

BUILDING M-424
EXPOSURE RATES AND THORIUM CONCENTRATIONS IN SOIL
CURTIS BAY DEPOT
BALTIMORE, MARYLAND

Location[a]	Exposure Rate (μR/h) @ 1 m above Surface[b]	Sample Depth (cm)	Total Thorium Concentration (pCi/g)[c]
1	8	0-15	3.4 ± 1.0
2	8	0-15	5.4 ± 1.2
3	11	0-15	126 ± 19
3	---	15-30	51.4 ± 8.0
4	8	0-15	4.6 ± 1.2
5	7	0-15	2.2 ± 0.6
6	12	0-15	136 ± 20
6	---	15-30	80 ± 12
6	---	30-45	50.4 ± 7.8
7	8	0-15	123 ± 18
8	8	0-15	192 ± 28
8	---	15-30	146 ± 22
9	7	0-15	1.6 ± 0.4
10	8	0-15	1.6 ± 0.6

[a]Refer to Figure 25.
[b]Dash indicates measurement not performed.
[c]Uncertainties represent the 95% confidence level, based only on counting statistics.

REFERENCES

1. Letter from J. O'Reilly (U.S. Nuclear Regulatory Commission, Region I) to C. Brooks (General Services Administration), Reference: "Survey at Curtis Bay Depot," July 13, 1977.

2. Letter from R. McClintock (U.S. Nuclear Regulatory Commission, Region I) to W. Mosrie (General Services Administration), Reference: "Inspection 40-341/77-03," February 8, 1978.

3. "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material," U.S. Nuclear Regulatory Commission, December 1975.

4. "Guidelines for Residual Concentration of Thorium and Uranium Wastes in Soil," U.S. Nuclear Regulatory Commission, October 1981.

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

6. Memorandum from J. Hickey (U.S. Nuclear Regulatory commission, HQ) to D. Collins (U.S. Nuclear Regulatory Commission, Region II), Reference: "Interpretation of Thorium Surface Decontamination Limits", February 20, 1992.

7. "Policy and Guideline FC91-2, Standard Review Plan: Evaluating Decommissioning Plans for Licensees Under 10 CFR Parts 30, 40, and 70," U.S. Nuclear Regulatory Commission, August 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 2220
(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)

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

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)

High-Purity Germanium Coaxial Well Detector
Model GWL-110210-PWS-S, 23% Eff.
(EG&G ORTEC, Oak Ridge, TN)
Used in conjunction with:
Lead Shield Model G-16
(Applied Physical Technology, Atlanta, GA) and
Multichannel Analyzer
3100 Vax Workstation
(Canberra, Meriden, CT)

High-Purity Intrinsic Germanium Detector
Model IGC25, 25% Eff.
(Princeton Gamma-Tech, Princeton, NJ)
Used in conjunction with:
Lead Shield
(Nuclear Data, Schaumburg, IL) and
Multichannel Analyzer
3100 Vax Workstation
(Canberra, Meriden, CT)

Low Background Gas Proportional Counter
Model LB-5110
(Tennelec, 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 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-Beta	-	gas proportional detector with ratemeter-scaler
Beta	-	pancake GM detector with ratemeter-scaler
Gamma	-	NaI scintillation detector with ratemeter

Surface Activity Measurements

Measurements of total beta activity levels were primarily performed using gas proportional detectors, with alpha shields attached, coupled to portable ratemeters-scalers. Beta activity measurements were performed at locations of elevated direct radiation, inaccessible to gas proportional equipment, using 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 4 π efficiency and correcting for the active area of the detector. The background count rates for the proportional and GM detectors averaged approximately 190 and 42 cpm, respectively. Beta efficiency factors ranged from 0.19 to 0.20 for the gas proportional detectors, with alpha absorber covers in place, and 0.24 to 0.26 for the GM detector. The effective area for the gas proportional, and GM detectors were 100 cm^2, and 15.5 cm^2, respectively. The alpha absorber covers consist of 2.0 mg/cm^2 mylar film which is placed in a frame that fits over the effective area of the gas proportional detector.

Removable Activity Measurements

Removable activity levels were determined using numbered filter paper disks, 47 mm in diameter. Moderate pressure was applied to the smear with two or three fingers, 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 using a pressurized ionization chamber (PIC) or NaI scintillation detectors coupled to portable ratemeters. Count rates for the NaI scintillation detectors were converted to exposure rates (μR/h) by cross-comparison with a pressurized ionization chamber (PIC). Gamma scintillation detectors were used for measuring total gamma radiation levels at locations which were difficult to access with the PIC. These detectors were calibrated against the PIC by determining scintillation instrument count rates in exposure rate fields, representative of site conditions. The range of exposure rates encountered at the site was relatively narrow (only differing by a few μR/h). Rather than attempting to develop a calibration curve based on such a limited number of data points, a single calibration factor of 2.6 μR/h per 1,000 counts per minute was determined. This calibration factor was then used to convert gamma scintillation measurements to exposure rates.

Soil Sampling

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.

ANALYTICAL PROCEDURES

Removable Activity

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

Gamma Spectrometry

Soil samples were dried, mixed, and/or crushed then placed in an appropriate container, 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. The energy peaks used for determination of total thorium were:

Th-232	0.911 MeV from Ac-228*
Th-228	0.583 MeV from Tl-208*

*Secular equilibrium assumed

Spectra were also reviewed for other identifiable photopeaks.

A review of gamma spectrometry data indicated that the thorium daughter products were in equilibrium. In secular equilibrium, Th-232 and Th-228 concentrations are equivalent. Therefore, the Th-232 results were doubled to provide total thorium concentrations.

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. When the net sample count was less than the 95% statistical deviation of the background count, the sample concentration was reported as less than the detection limit of the measurement procedures. 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. Additional uncertainties, associated with sampling and measurement procedures, have not been propagated into the data presented in this report.

CALIBRATION AND QUALITY ASSURANCE

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

-Survey Procedures Manual Revision 6 (February 1991)
-Laboratory Procedures Manual Revision 6 (April 1991)
-Quality Assurance Manual Revision 4 (April 1991)

The procedures contained in these manuals were developed to meet the requirements of DOE Order 5700.6B for Quality Assurance and contain measures to assess processes during their performance.

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.

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 MATERIAL

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 MATERIAL

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 of 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,j]	Maximum[b,d,j]	Removable[b,e,j]
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 establishes 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
[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.

CONGRESSIONAL CORRESPONDENCE SYSTEM
DOCUMENT PREPARATION CHECKLIST

This checklist is be submitted with each document (or group of Qs/As) sent for ing into the CCS.

1. BRIEF DESCRIPTION OF DOCUMENT(S) Ltr. to Rep. Gilchrest

2. TYPE OF DOCUMENT ✓ Correspondence ____ Hearings (Qs/As)

3. DOCUMENT CONTROL ____ Sensitive (NRC Only) ✓ Non-Sensitive

4. CONGRESSIONAL COMMITTEE and SUBCOMMITTEES (if applicable)

_____ Congressional Committee

_____ Subcommittee

5. SUBJECT CODES

(a) _____

(b) _____

(c) _____

6. SOURCE OF DOCUMENTS

(a) ____ SECY (document name _____

(b) ✓ Scan- (c) ____ Attachments

(d) ____ Rakey (e) ____ Other _____

7. SYSTEM LOG DATES

(a) 1/12/93 Date OCA sent document to CCS

(b) _____ Date CCS receives document

(c) _____ Date returned to OCA for additional information

(d) _____ Date resubmitted by OCA to CCS

(e) _____ Date entered into CCS by _____

(f) _____ Date OCA notified that document is in CCS

8. COMMENTS 130030

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