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ORISE

OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

March 20, 1995

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U.S. Department of Energy
Washington, DC 20585-0002

SUBJECT: FINAL REPORT-RADIOLOGICAL SURVEY OF THE FORMER AMERICAN MANUFACTURING COMPANY OF TEXAS, FORT WORTH, TEXAS

Dear Dr. Williams:

The Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE) conducted radiological survey activities at the former American Manufacturing Company of Texas Site in Fort Worth, Texas during the period October 3 through 5, 1994. The survey activities consisted of document review, surface scans, surface activity measurements, smears for removable activity, exposure rate measurements, and soil and miscellaneous sampling.

Enclosed are five copies of the subject document. Please do not hesitate to contact me at (615) 576-0065 or William L. (Jack) Beck at (615) 576-5031 should you have any questions.

Sincerely,

Wade C. Adams

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Project Leader/Health Physicist
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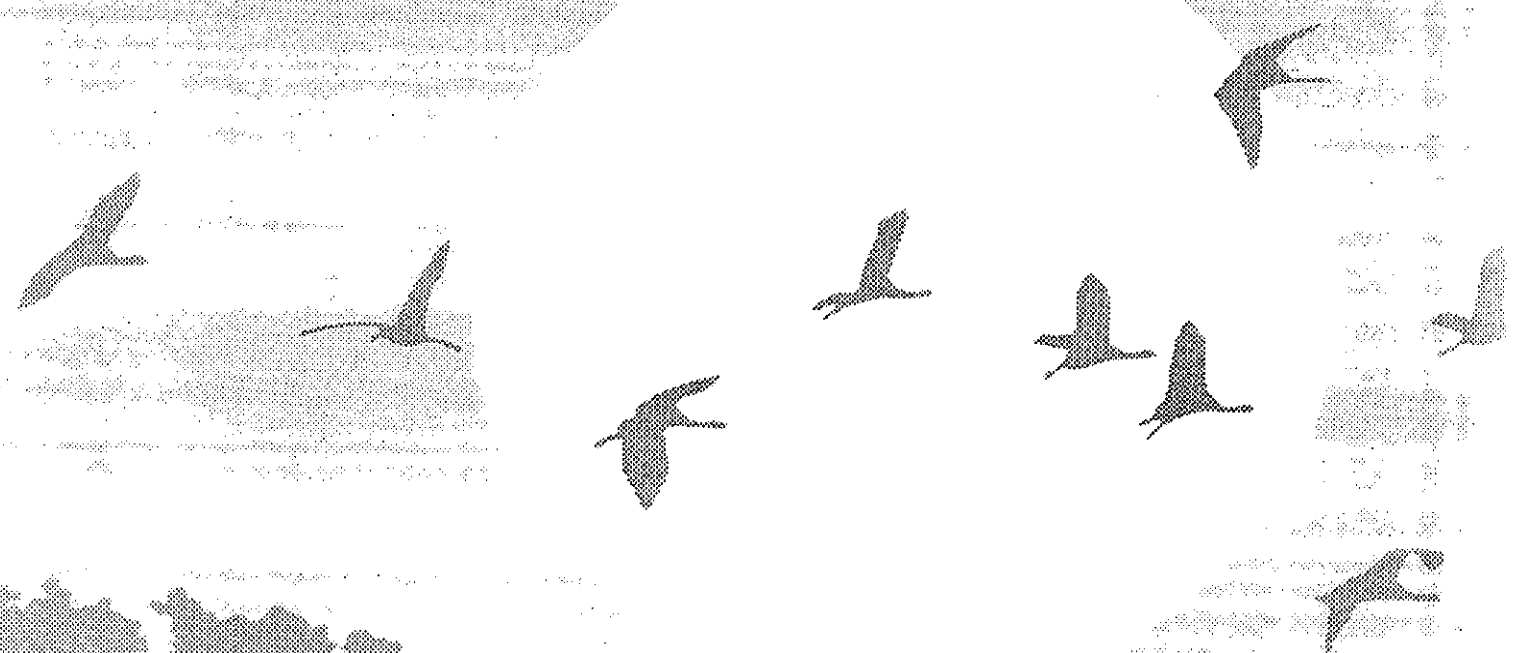
File 371

RADIOLOGICAL SURVEY OF THE FORMER AMERICAN MANUFACTURING COMPANY OF TEXAS FORT WORTH, TEXAS

W.C. ADAMS AND J.R. MORTON

Prepared for the
Office of Environmental Restoration
U.S. Department of Energy



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

ORISE 95/B-82

RADIOLOGICAL SURVEY OF THE FORMER AMERICAN MANUFACTURING COMPANY OF TEXAS FORT WORTH, TEXAS

Prepared by

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Prepared for the

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U.S. Department of Energy

FINAL REPORT

FEBRUARY 1995

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RADIOLOGICAL SURVEY
OF THE
FORMER AMERICAN MANUFACTURING COMPANY OF TEXAS
FORT WORTH, TEXAS

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS AND ACRONYMS

AEC	Atomic Energy Commission
AMCOT	American Manufacturing Company of Texas
ASME	American Society of Mechanical Engineers
cm	centimeter
cm^2	square centimeter
cpm	counts per minute
DCG	derived concentration guides
DOE	U.S. Department of Energy
dpm/100 cm^2	disintegrations per minute per 100 square centimeters
EML	Environmental Measurements Laboratory
EPA	U.S. Environmental Protection Agency
ESSAP	Environmental Survey and Site Assessment Program
ft	feet
ft^2	square feet
FUSRAP	Formerly Utilized Sites Remedial Action Program
GM	Geiger-Mueller
kg	kilograms
km	kilometer
lbs	pounds
m	meter
m^2	square meter
mrem/yr	millirem per year
μCi/ml	microcurie per milliliter
μrem/h	microrem per hour
μR/h	microroentgens per hour
MDA	minimum detectable activity
mi	mile
NaI	sodium iodide
NIST	National Institute of Standards and Technology
NLO	National Lead of Ohio
ORISE	Oak Ridge Institute for Science and Education
pCi/g	picocuries per gram
pCi/l	picocuries per liter
QA	Quality Assurance
ZnS	zinc sulfide

DESIGNATION RADIOLOGICAL SURVEY
OF THE
FORMER AMERICAN MANUFACTURING COMPANY OF TEXAS
FORT WORTH, TEXAS

INTRODUCTION AND SITE HISTORY

In 1960 and 1961, AMCOT was subcontracted by National Lead of Ohio (NLO) to conduct specialized tube elongation and billet piercing tests on uranium metal for the Atomic Energy Commission (AEC), a predecessor of the U.S. Department of Energy (DOE). A series of tests were performed using AMCOT's Number 1 Witter Mill in a fenced-off area of the plant. According to information obtained from NLO accountability reports, approximately 30 tons of uranium was used during the elongation and piercing tests. NLO controlled most aspects of the work including the handling and storing of the uranium, health and safety, industrial hygiene, and the post-test decontamination efforts. The site records indicate that NLO exercised considerable effort to minimize contamination during the testing process, and to the decontamination efforts as well. There are no records to indicate that uranium was used in any other capacity or in any other area of the site. Previous owners have indicated that the testing area had not been altered significantly, and that the equipment used by NLO for the tests was present on the site.

There were three documented decontamination efforts; one each year in 1961, 1962, and 1963.[1] The first two decontamination efforts emphasized the removal of gross contamination; the last effort indicated that the entire site was decontaminated. However, the decontamination reports did not discuss cleanup criteria or residual contamination levels. Due to this uncertainty, it was unknown if residual contamination, in excess of DOE guidelines, remained at the site. Therefore, further radiological evaluation was needed to determine whether residual uranium contamination was present in excess of DOE guidelines.

DOE reviewed available historical documentation describing previous AEC activities conducted at the AMCOT site. Based on this information, the DOE determined that a designation survey should be performed to determine if there was radiological contamination on the property for

which DOE has authority to require remedial action under the Formerly Utilized Sites Remedial Action Program (FUSRAP). DOE requested that the Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE) perform a radiological survey of the area used during the uranium tests to determine the radiological status of the area relative to the current DOE guidelines.

SITE DESCRIPTION

The former American Manufacturing Company of Texas (AMCOT), currently owned by PRR, Inc., is located in the Haltom City section of Fort Worth, Texas and is approximately 25 km (16 miles) southwest of the Dallas-Fort Worth International Airport (Figure 1). Interstate 820 runs to the north and Interstate 35W to the west. The site occupies most of the 3300 block of North Sylvania Avenue (Figure 2).

Buildings are constructed primarily of sheet-metal with steel foundations and frames; flooring consists of concrete and dirt covered brick. Equipment in the area of concern occupies approximately 60% of the available floor space; the equipment includes the Number 1 Witter Mill, a rotary furnace, feed tables, a hydraulic press, and various other pieces of equipment. The ceiling height at the apex is approximately 18 m (60 ft); vent openings are along the apex of the ceiling. The remainder of the buildings are of similar construction.

OBJECTIVE

The objective of this survey was to obtain sufficient data on the current radiological status of those portions of the AMCOT site, used for AEC activities, to enable a determination by DOE as to the need for further actions under FUSRAP.

DOCUMENT REVIEW

ESSAP reviewed the radiological data provided by the DOE[1]. A review of the data assisted ESSAP in the determination of survey equipment and analysis procedures that were used to prepare the ESSAP survey plan which was approved by DOE.[2]

PROCEDURES

A survey team from ESSAP visited the AMCOT site during the period of October 3 through 5, 1994 and performed visual inspections and radiological measurement and sampling. Survey activities included surface scans for beta and gamma activity, direct measurements for beta activity, smears for removable activity, exposure rate measurements, and soil and miscellaneous sampling. Areas of concern were floors, equipment, trenches, pits, and roof purlin surfaces. Survey activities were conducted in accordance with current procedures in the ORISE/ESSAP Survey Procedures and Quality Assurance Manuals and with a survey plan which was submitted to and approved by the DOE.[2] This report summarizes the procedures and results of the survey.

SURVEY PROCEDURES

Reference Grid

Available site data and maps were used as a guide in the selection of measurement and sampling locations. Measurement and sampling locations were referenced to prominent building features or existing landmarks and recorded on appropriate drawings. The areas that were surveyed are identified in Figures 3 through 17.

Surface Scans

Interior surfaces were scanned for residual gamma and beta activity using NaI scintillation, large area gas proportional, and GM detectors. Gamma scans were performed along the roof driplines with NaI scintillation detectors. All detectors were coupled to ratemeters or ratemeter-scalers

with audible indicators. Particular attention was given to cracks and joints in the floor and walls, ledges, ducts, drains, and other locations where material may have settled or accumulated.

Surface Activity Measurements

Direct measurements for beta activity were performed using GM detectors coupled to ratemeter-scalers at 39 locations on floor and lower wall surfaces in the suspect area. Direct measurements were obtained from 64 equipment surfaces and 42 overhead surfaces. Two additional measurements were performed on brick surfaces inside the furnaces. Smears for removable contamination were taken at each direct measurement location. Measurements and sampling locations for total and removable activity are illustrated on Figures 4 through 12, and 16.

Exposure Rate Measurements

Background exposure rate measurements were determined for the building interiors at 8 locations of similar construction, but without a history of radioactive materials use. Exposure rates were measured at 20 locations within the suspect area including locations along the roof drip lines. All exposure rates were performed at 1 m above the surface using a micro-rem meter. Measurement locations are indicated on Figures 13 and 14.

Soil Sampling

Background soil samples were collected at 8 locations on the exterior and interior grounds of the site. Surface soil samples (0-15 cm) were collected at 11 locations within the suspect area and at 6 locations along the roof drip lines. Sampling locations are indicated on Figures 15 and 16.

Miscellaneous Sampling

Two residue samples were collected from overhead framework. A firebrick sample was collected from each of the two furnaces and liquid/sludge/sediment samples were collected from 5 of the various pits, trenches, and a storm drain. Sampling locations are indicated on Figures 7, 9, 16, and 17.

SAMPLE ANALYSIS AND DATA INTERPRETATION

Samples and survey data were returned to the ESSAP Oak Ridge, Tennessee laboratory for analysis and interpretation. Smears were analyzed for gross alpha and gross beta activity using a low background gas proportional counter. Direct measurement and smear data were converted to units of disintegrations per minute per 100 cm^2 (dpm/100 cm^2). Exposure rates were converted from μrem/h to μR/h. Soil and miscellaneous solid samples were analyzed by solid state gamma spectrometry; spectra were reviewed for U-238 and U-235 and any other identifiable photopeaks with results reported in pCi/g. Liquid samples were analyzed for gross alpha and gross beta activity using a low background gas proportional counter with results reported in pCi/l. Additional information concerning major instrumentation, sampling equipment, and analytical procedures is provided in Appendices A and B. Results were compared to DOE guidelines which are provided in Appendix C.

FINDINGS AND RESULTS

SURFACE SCANS

Gamma scans in the suspect area did not identify any locations of elevated direct radiation. Gamma scans did identify a brick wall to the south of the area with elevated activity due to natural building material. Beta surface scans of the floors, lower walls (up to 2 m), equipment, and overhead areas did not identify any locations of elevated direct radiation.

SURFACE ACTIVITY LEVELS

The contaminant of concern is processed natural uranium, i.e. uranium separated from its long lived daughter products, but in its naturally occurring isotopic abundances. Processed natural uranium emits both alpha and beta radiation in approximately equal proportions; either beta activity levels or alpha activity levels may, therefore, be measured for determining uranium surface activity levels. Measurements of beta activity levels, rather than alpha activity levels, provide a more accurate representation of uranium surface activity, due to conditions of the building surfaces (e.g. dusty, porous, or rough), which may selectively attenuate the alpha radiation. Therefore, beta measurement results were used for comparison with the guideline values.

Direct measurements for total and removable surface activity are summarized in Table 1. Background direct measurements were performed at locations which were not suspected of having radioactive materials use (Appendix B). Total activity levels for single measurements ranged from less than 880 to 4600 dpm/100 cm^2 for beta. Removable activity levels were less than 12 dpm/100 cm^2 for alpha and were less than or equal to 16 dpm/100 cm^2 for beta.

EXPOSURE RATES

Background exposure rates ranged from 4 to 8 μR/h (Table 2). With one exception, individual exposure rates within the suspect area ranged from 4 to 8 μR/h. The one exception was an exposure rate of 16 μR/h which was performed near a brick wall containing naturally occurring radioactive materials. Results of exposure rate measurements within the suspect area are presented in Table 3.

RADIONUCLIDE CONCENTRATIONS IN SOILS

Background radionuclide concentrations in soils are summarized in Table 4. Concentration ranges were as follows: U-235, 0.1 to 0.2 pCi/g; U-238, <1.4 to 2.6 pCi/g; Th-228, 0.2 to 0.6; Th-232, 0.2 to 0.7 pCi/g. Total uranium and total thorium concentrations in the

soil samples ranged from <3.0 to 5.3 pCi/g and 0.4 to 1.2 pCi/g, respectively. Radionuclide concentrations in Building 800A are summarized in Table 5 and were: U-235, <0.1 to 0.5 pCi/g; U-238, <1.3 to 3.3 pCi/g; Th-228, <0.1 to 1.0 pCi/g; and, Th-232, <0.2 to 1.2 pCi/g. Total uranium and total thorium concentrations ranged from <2.7 to 7.1 pCi/g and <0.3 to 2.2 pCi/g, respectively.

RADIONUCLIDE CONCENTRATIONS IN MISCELLANEOUS SAMPLES

Radionuclide concentrations in the miscellaneous samples are summarized in Table 6. Concentration ranges were as follows: U-235, <0.2 to 0.5 pCi/g; U-238, 1.1 to 3.7 pCi/g; Th-228, <0.3 to 3.4 pCi/g; and, Th-232, <0.7 to 3.4 pCi/g. Total uranium and total thorium concentrations in the miscellaneous samples ranged from <2.4 to 7.9 pCi/g and <1.1 to 6.8 pCi/g, respectively.

RADIONUCLIDE CONCENTRATIONS IN WATER SAMPLES

Radionuclide concentrations in water samples are summarized in Table 7. Concentrations were as follows: U-235, <7.7 E-9 μCi/ml; U-238, <7.3 E-8 μCi/ml; Th-228, <7.1 E-9 μCi/ml; and, Th-232, <2.0 E-8 μCi/ml.

COMPARISON OF RESULTS WITH GUIDELINES

A summary of the DOE guidelines for residual radioactive material are included as Appendix C. The radionuclide of concern at the former American Manufacturing Company of Texas is processed natural uranium. The surface contamination guidelines for natural uranium are as follows:

Total Activity

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

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

Removable Activity

1,000 α dpm/100 cm^2

As rough, porous, or dirty surfaces attenuate alpha radiation, the beta activity was considered to be most representative of surface activity and was used for comparison to guideline levels since processed natural uranium emits both alpha and beta radiations in a 1:1 ratio. The applicable exposure rate guideline is 20 μR/h above background levels.

All direct measurements performed by ESSAP indicated that surface activity levels were within guidelines.

A site specific uranium guideline for soil contamination was not developed for this site; however, the soil sample results within the suspect area were comparable to the results for the background samples.

The water sample results were compared to the ingested water derived concentration guides (DCG) listed in DOE Order 5400.5.[3] The DCG's for the radionuclides listed in Table 7 of this report are as follows: U-235, 6E-7 μCi/ml; U-238, 6E-7 μCi/ml; Th-228, 4E-7 μCi/ml; and, Th-232, 5E-8 μCi/ml; all water sample results were within the DCG values. These DCG values for internal exposure are based on a committed effective dose equivalent of 100 mrem/yr for the ingested radionuclide.

SUMMARY

At the request of the U.S. Department of Energy, the Oak Ridge Institute for Science and Education's Environmental Survey and Site Assessment Program conducted a radiological survey of the suspect area of Building 800A at the Former American Manufacturing Company of Texas in Fort Worth, Texas. Designation survey activities included document reviews, surface scans, surface activity measurements, smears for removable activity, exposure rate measurements, and soil and miscellaneous sampling.

Direct measurements and smears of the floors, equipment and overhead surfaces were compared to the DOE surface contamination guidelines for uranium (Appendix C). The ESSAP survey results indicate that surface activity levels were within the DOE surface contamination guidelines. All exposure rate measurements were within the guideline value of 20 μR/h above background levels. The soil sample results within the suspect area were comparable to the background soil sample results; and the water sample results were within the derived concentration guide values for ingested water listed in DOE Order 5400.5.

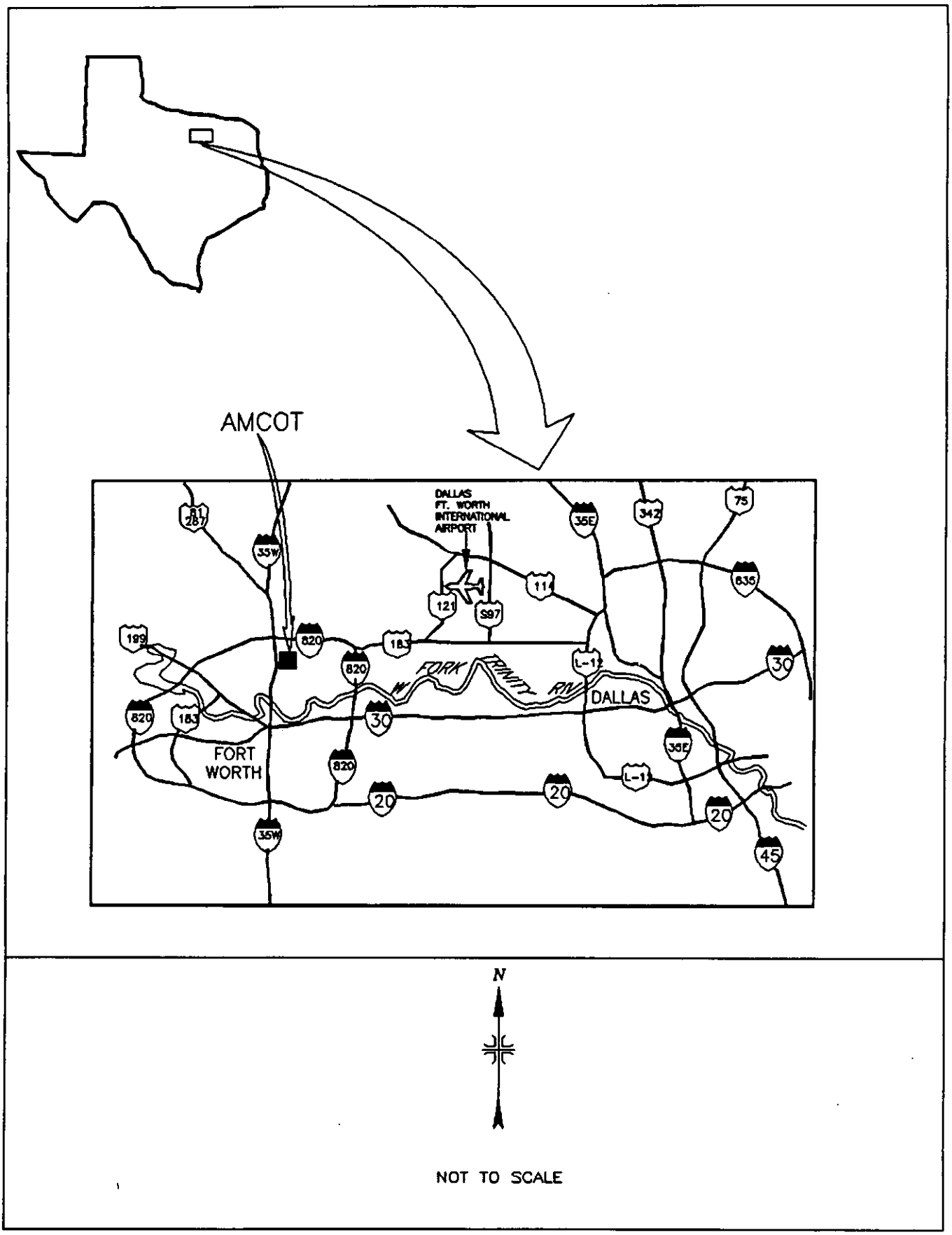


FIGURE 1: Location of the Former American Manufacturing Company of Texas

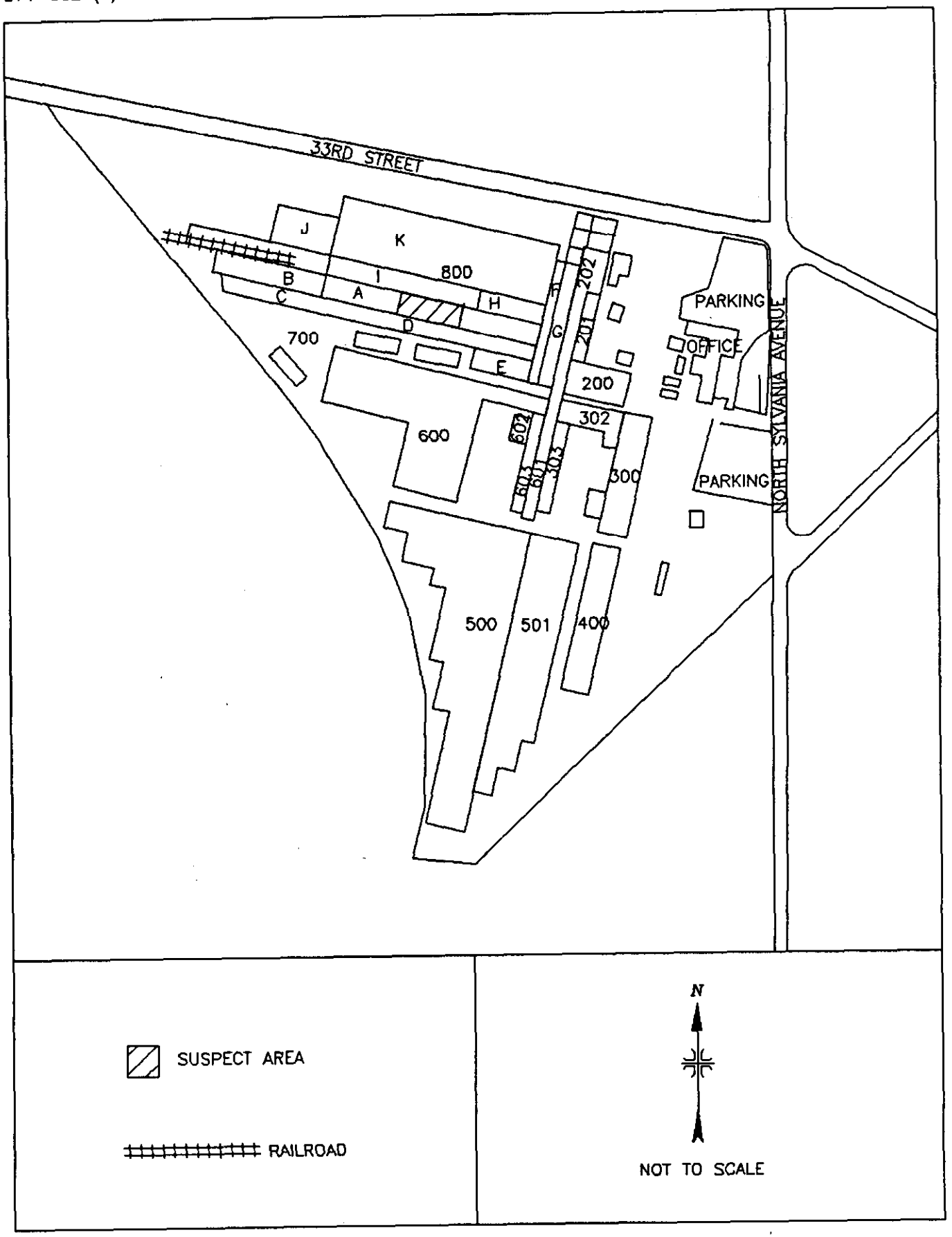


FIGURE 2: Plot Plan of the Former American Manufacturing Company of Texas

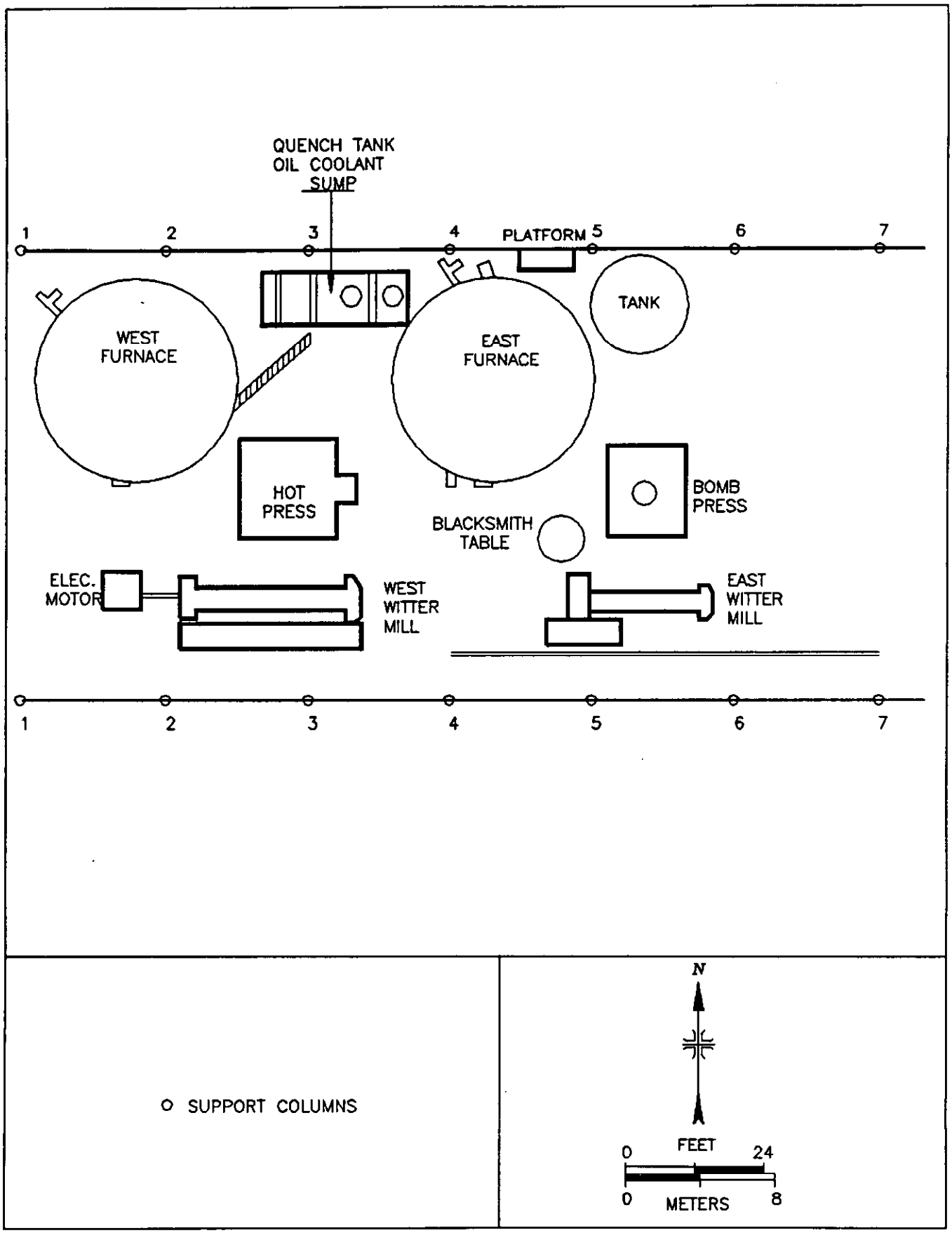


FIGURE 3: Plot Plan of Building 800A, Suspect Area

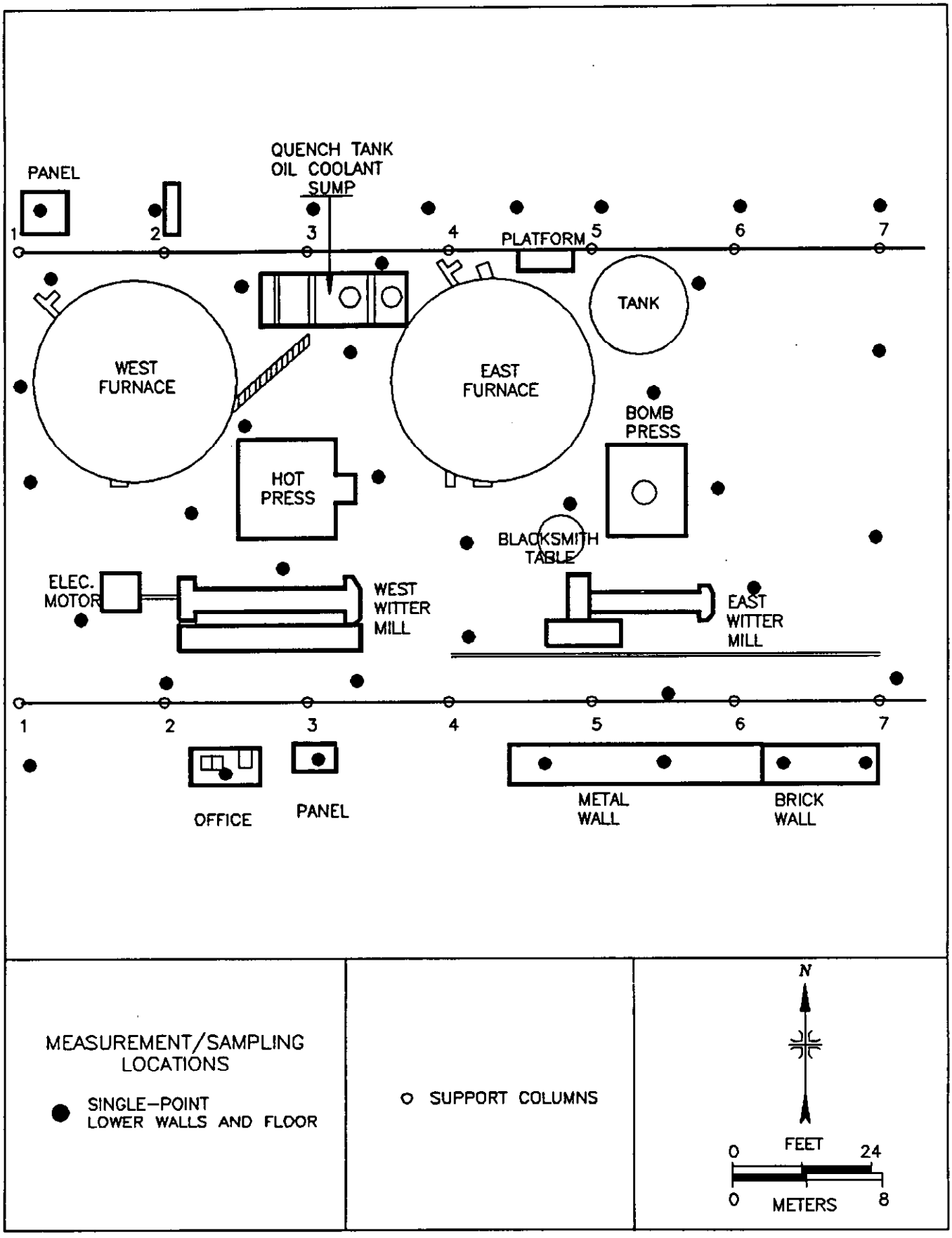


FIGURE 4: Building 800A, Suspect Area, Lower Walls and Floor – Measurement and Sampling Locations

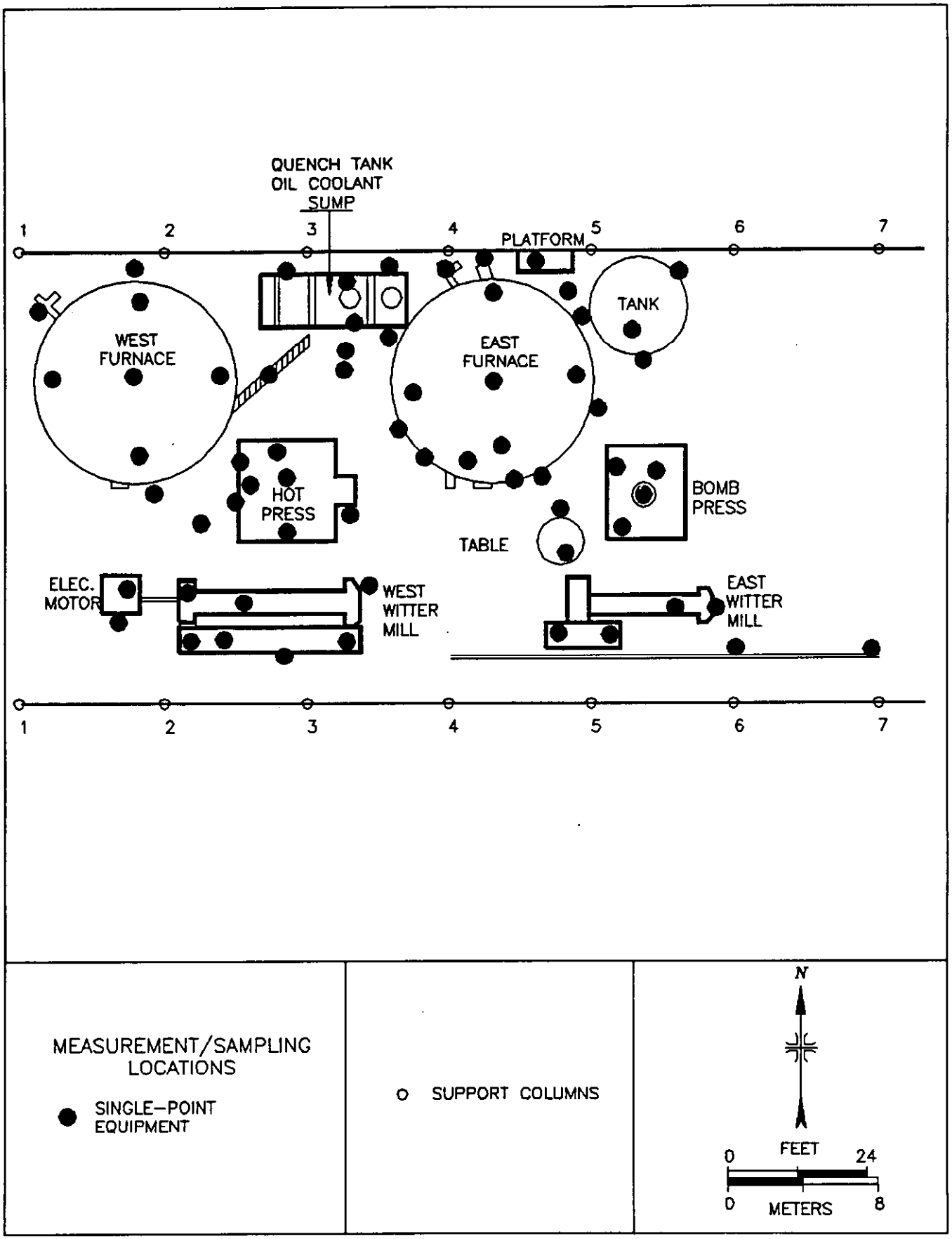


FIGURE 5: Building 800A, Suspect Area, Equipment – Measurement and Sampling Locations

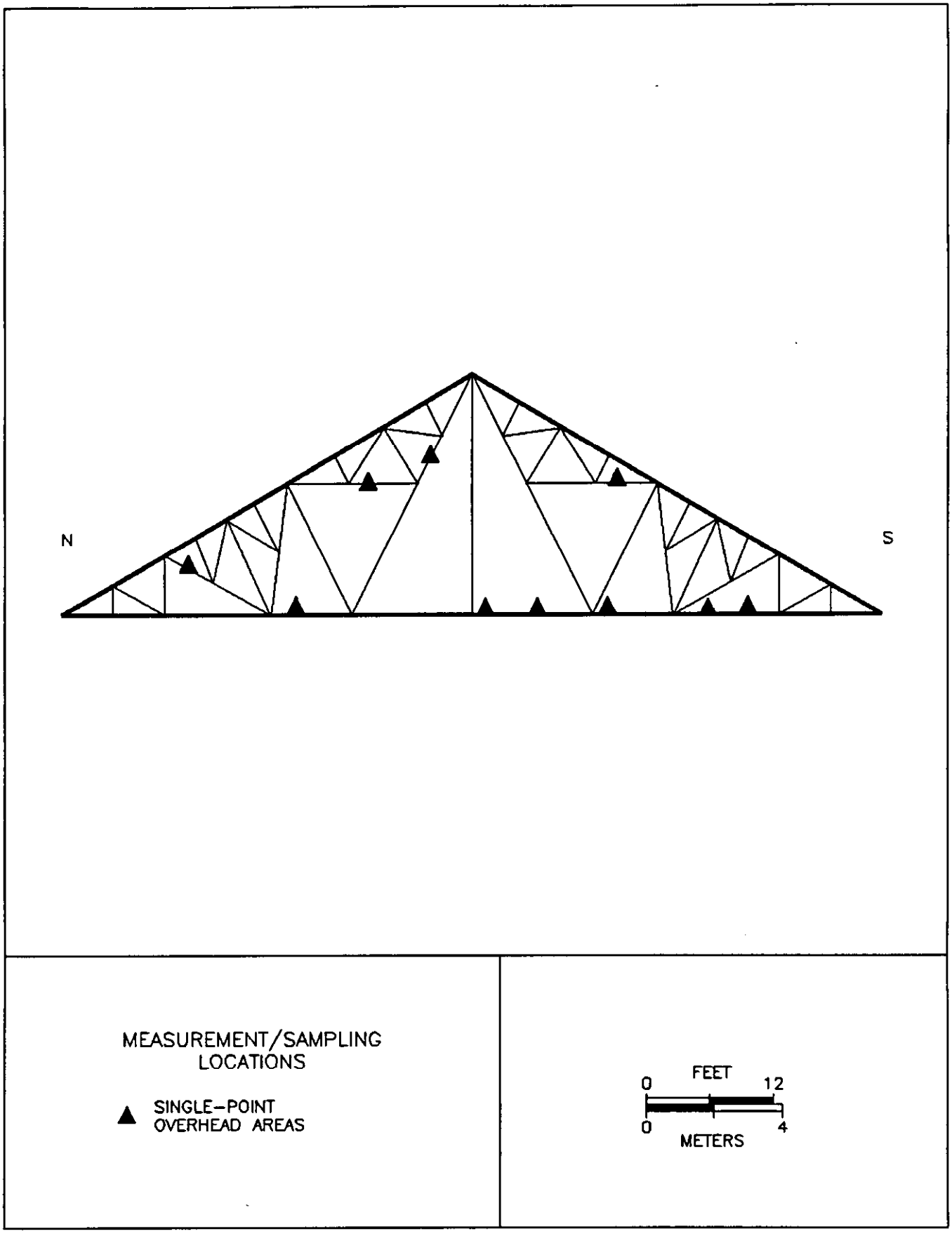
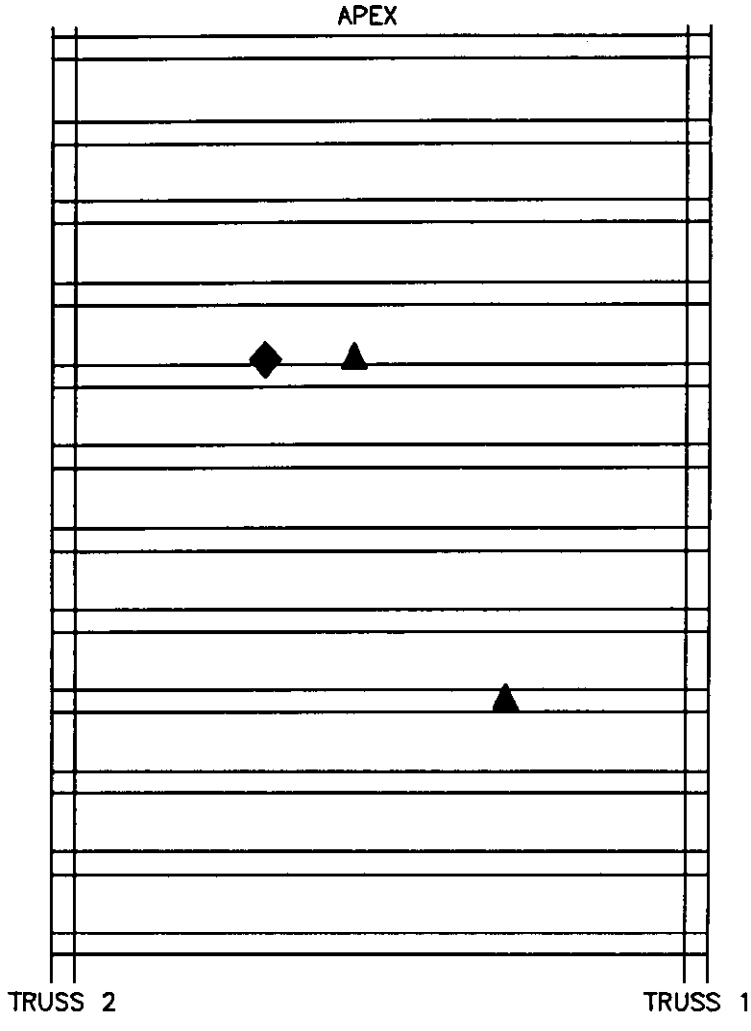


FIGURE 6: Truss #1 – Measurement and Sampling Locations



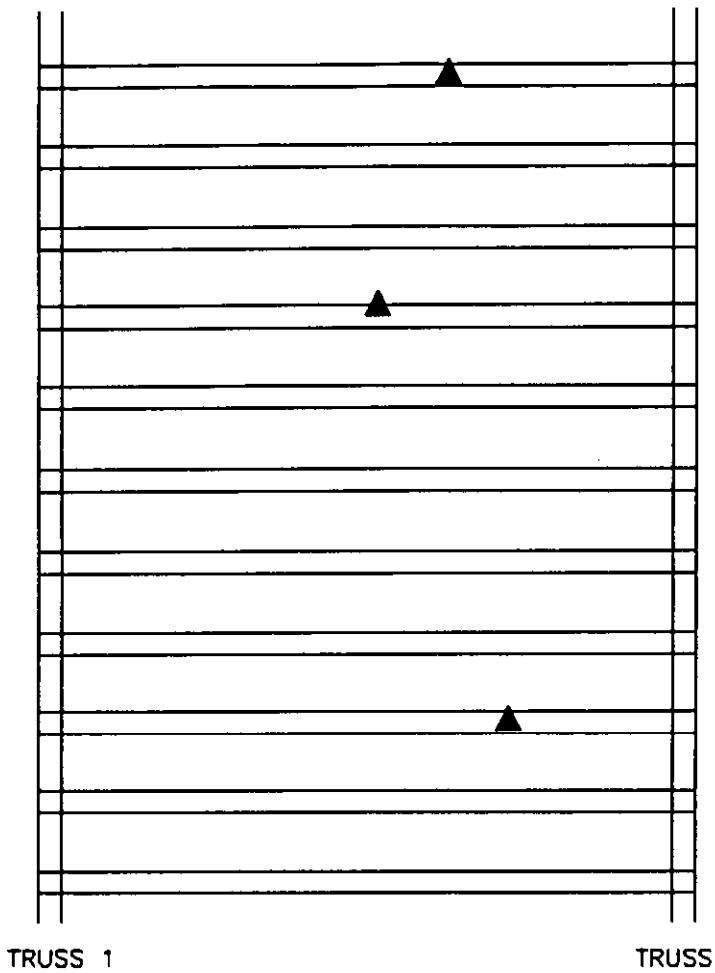
MEASUREMENT/SAMPLING LOCATIONS

▲ SINGLE-POINT OVERHEAD AREAS

◆ RESIDUE SAMPLE

FEET
0 6
0 2
METERS

FIGURE 7: Bay 1, North Purlins – Measurement and Sampling Locations

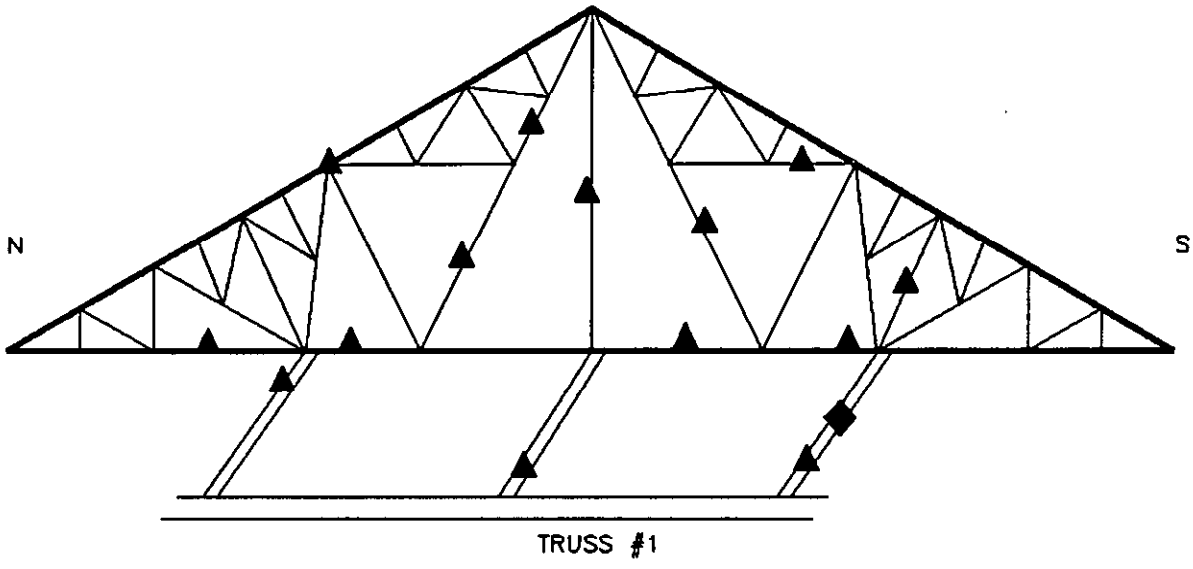


MEASUREMENT/SAMPLING LOCATIONS

▲ SINGLE-POINT OVERHEAD AREAS

FEET
0 6
0 2
METERS

FIGURE 8: Bay 1, South Purlins – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

▲ SINGLE-POINT OVERHEAD AREAS

◆ RESIDUE SAMPLE

FEET
0 12
0 4
METERS

FIGURE 9: Truss #2 – Measurement and Sampling Locations

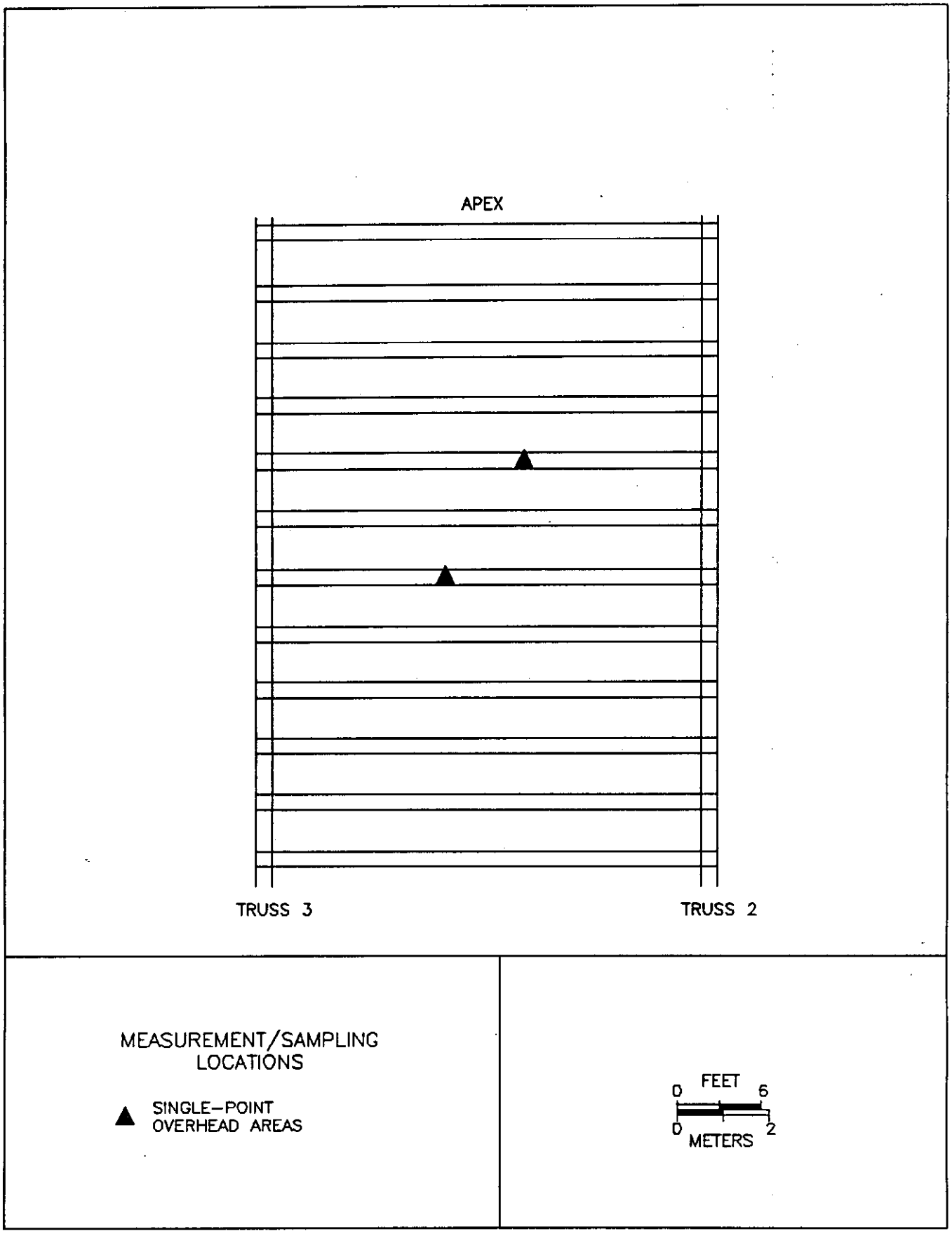
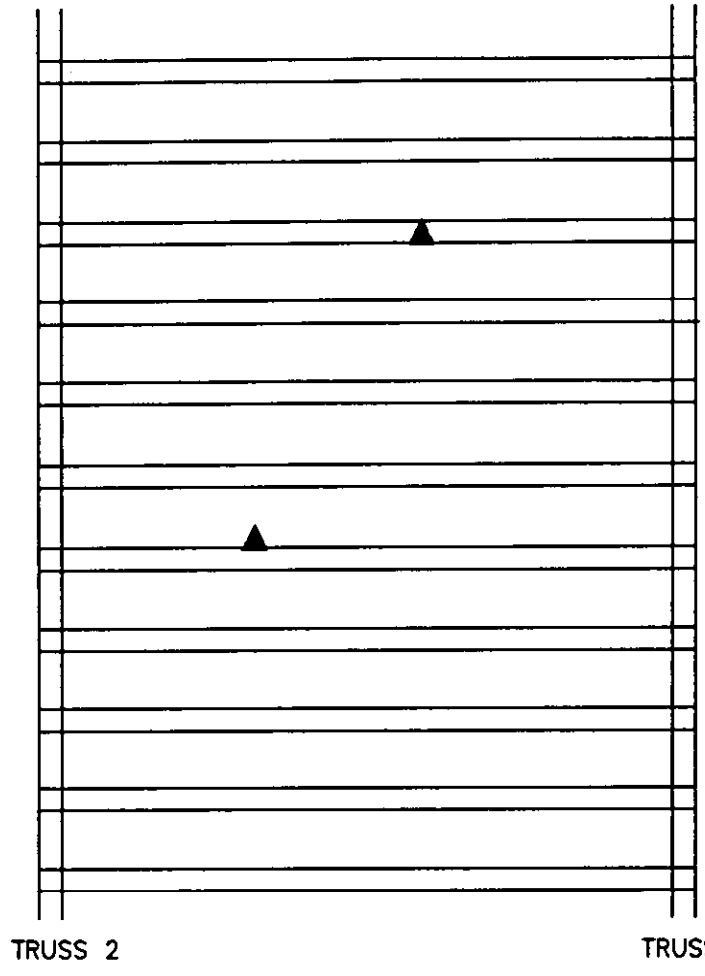


FIGURE 10: Bay 2, North Purlins – Measurement and Sampling Locations

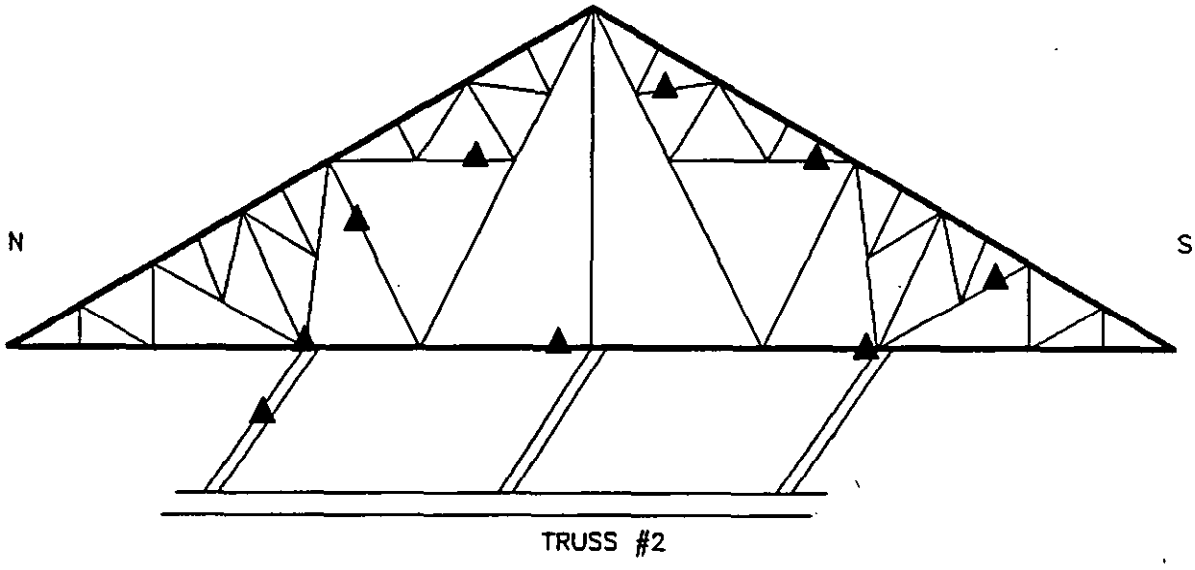


MEASUREMENT/SAMPLING LOCATIONS

▲ SINGLE-POINT OVERHEAD AREAS

FEET
0 6
0 2
METERS

FIGURE 11: Bay 2, South Purlins – Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

▲ SINGLE-POINT OVERHEAD AREAS

FEET
0 12
0 4
METERS

FIGURE 12: Truss #3 – Measurement and Sampling Locations

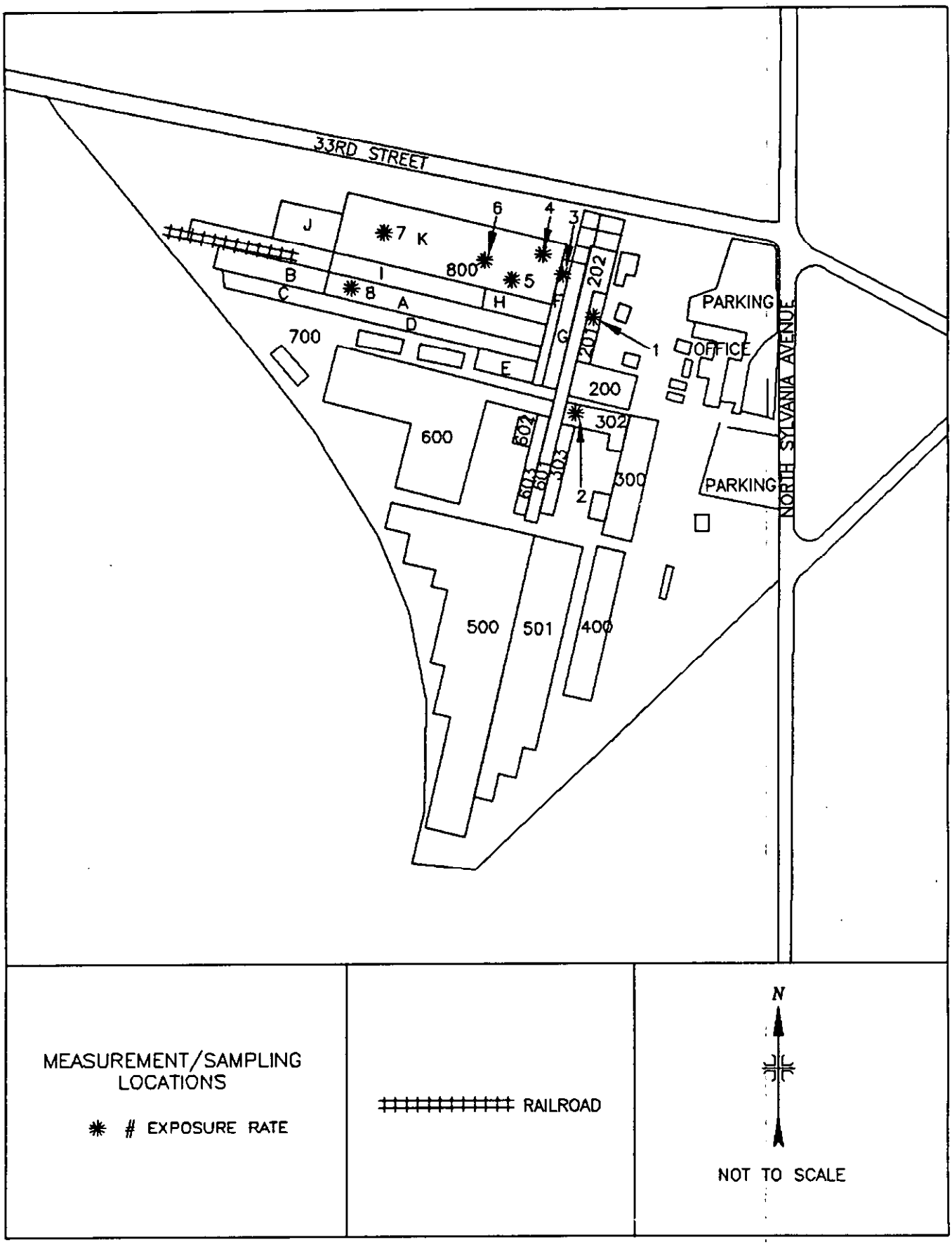


FIGURE 13: Background Exposure Rate Measurement Locations

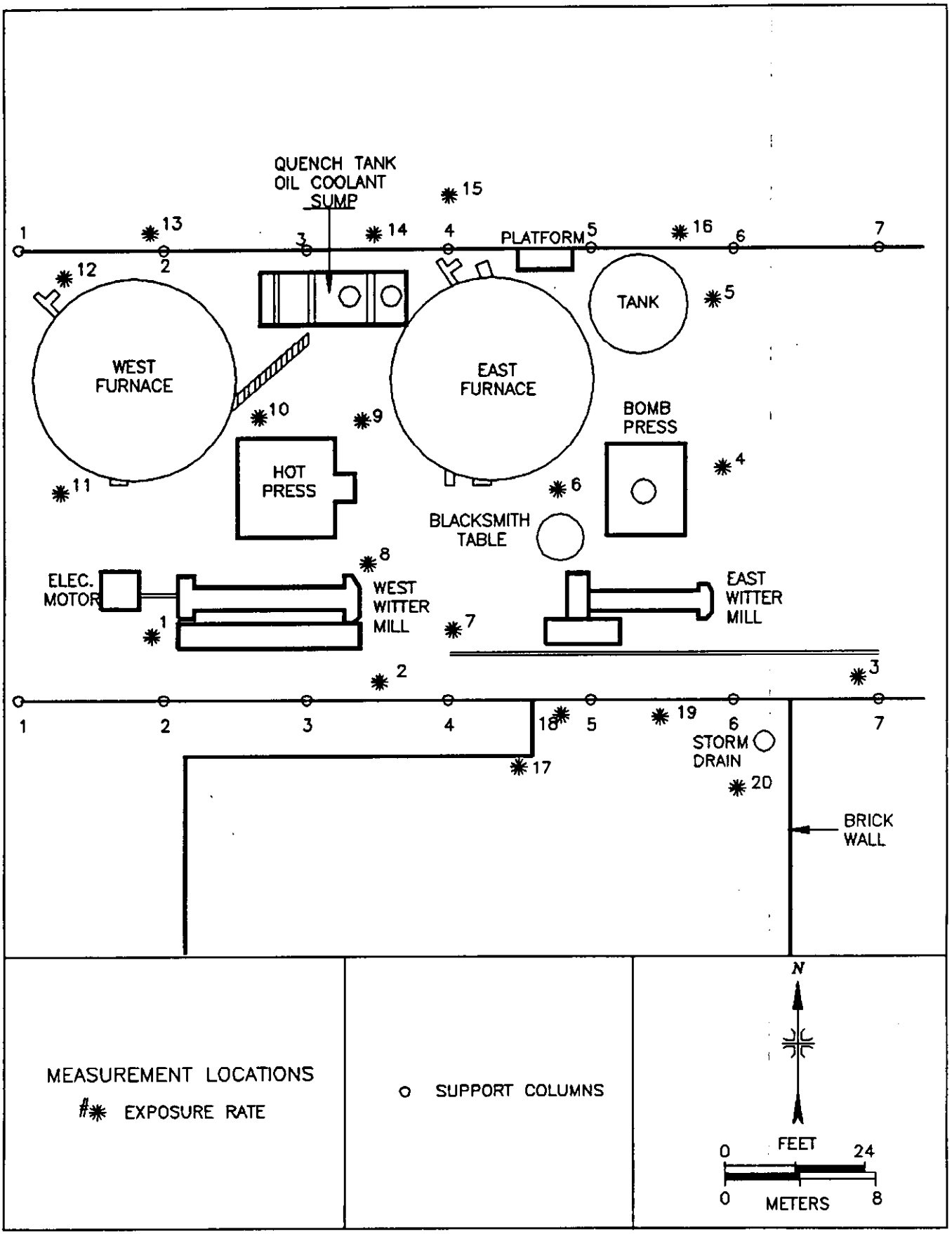


FIGURE 14: Building 800A, Suspect Area – Exposure Rate Measurement Locations

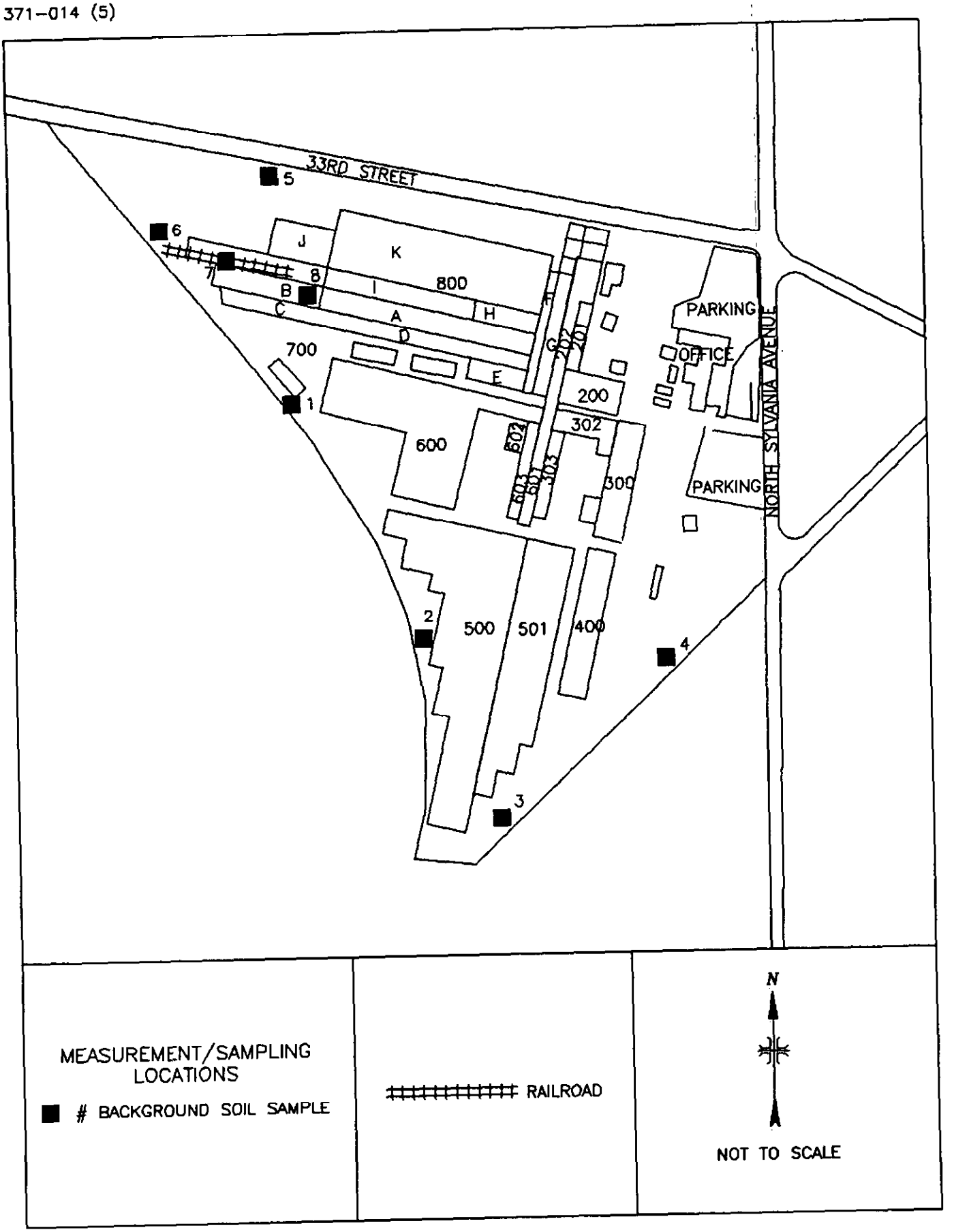


FIGURE 15: Background Soil Sampling Locations

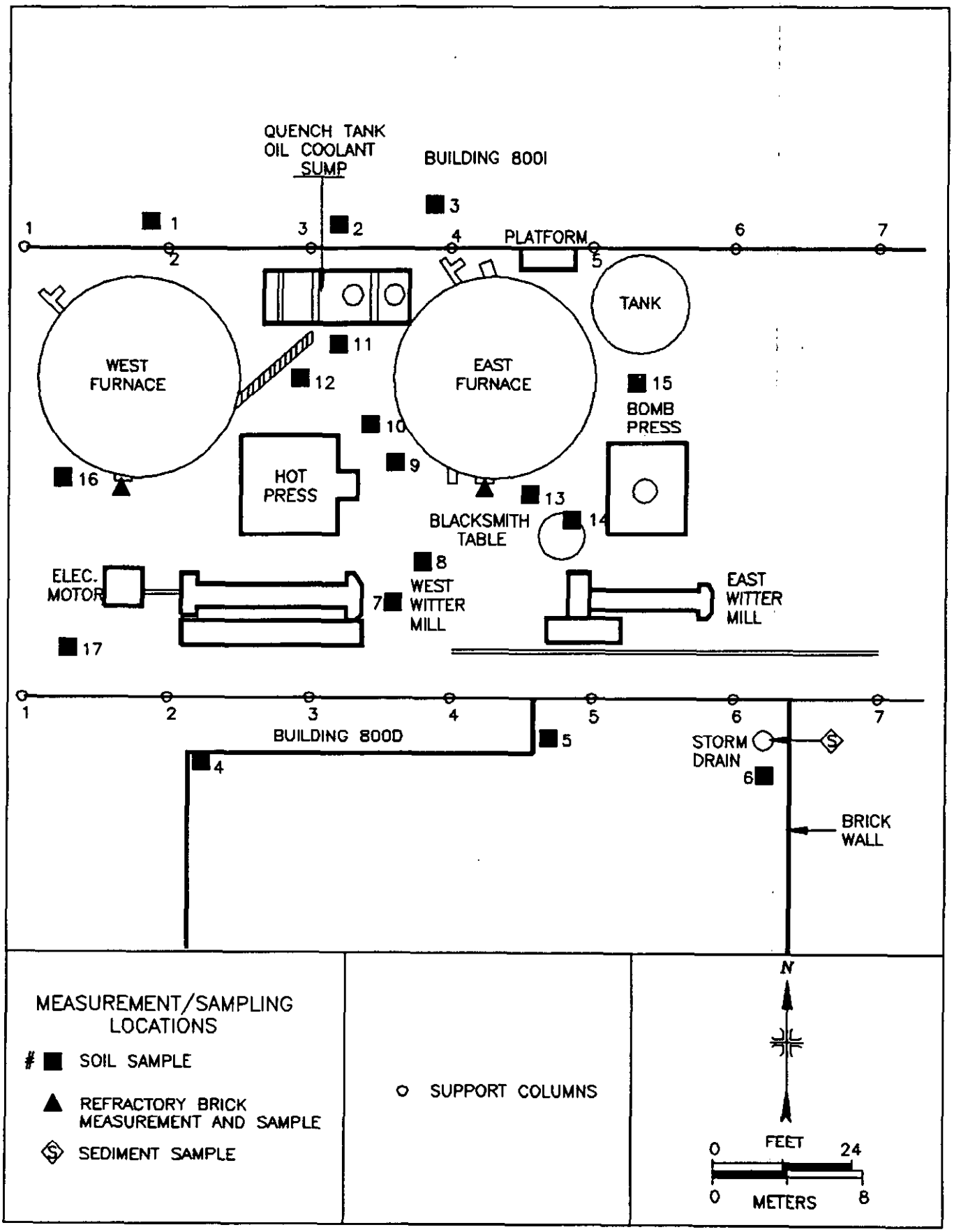


FIGURE 16: Building 800A, Suspect Area – Measurement and Sampling Locations

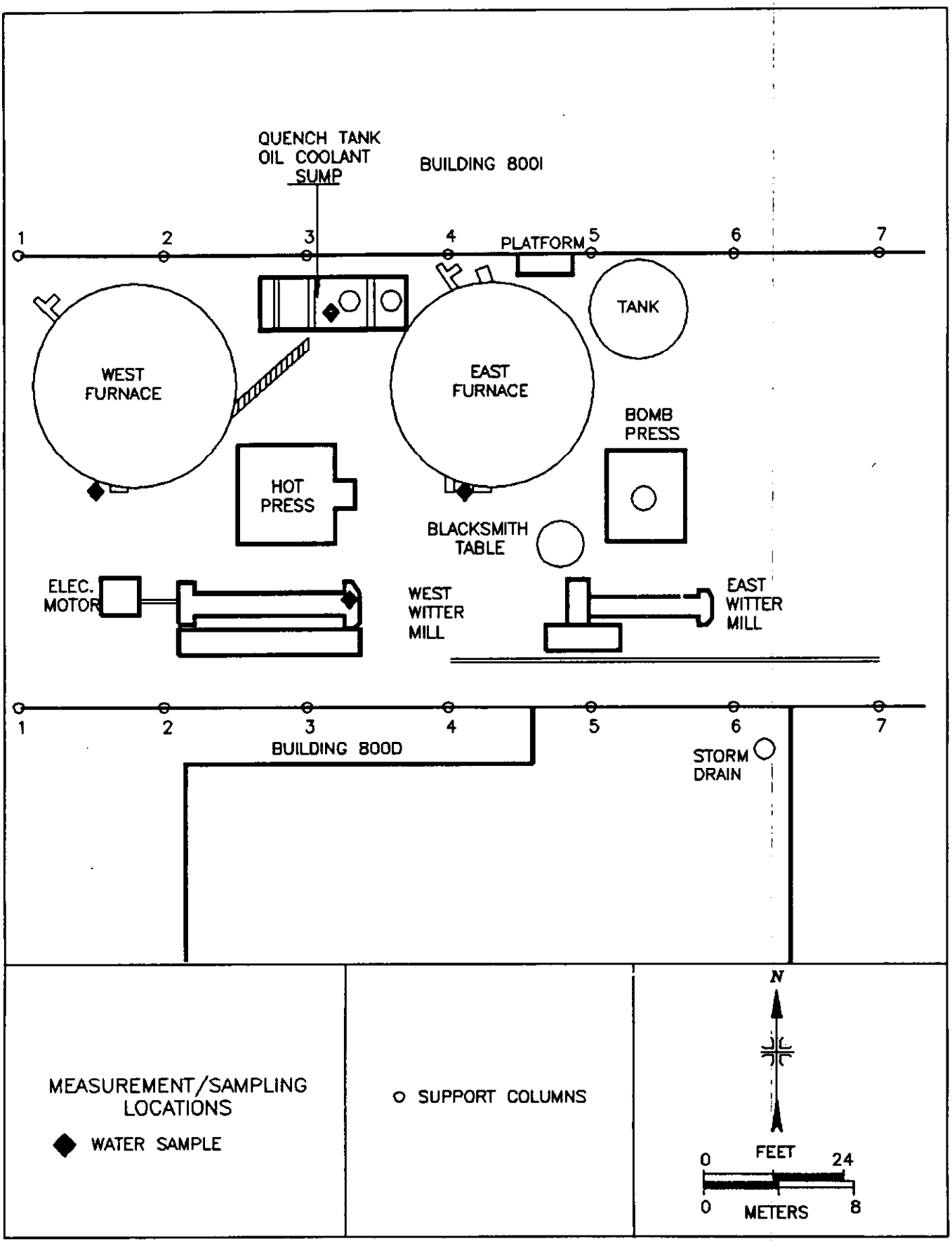


FIGURE 17: Building 800A, Suspect Area – Water Sampling Locations

TABLE 1

SUMMARY OF SURFACE ACTIVITY LEVELS
FORMER AMERICAN MANUFACTURING COMPANY OF TEXAS SITE
BUILDING 800A
FORT WORTH, TEXAS

Location[a]	Number of Single Point Measurements	Total Activity Range (dpm/100 cm^2)	Removable Activity Range (dpm/100 cm^2)	
		Beta	Alpha	Beta
Floor	24	< 880	< 12	< 16
Lower Walls	15	< 880-1900	< 12	< 16
Equipment	62	< 880-3000	< 12	≤ 16
Overheads	42	< 800	< 12	< 16
Refractory Brick	2	2700-4600	< 12	< 16

[a]Refer to Figures 4-12 and 16.

TABLE 2

BACKGROUND EXPOSURE RATES
FORMER AMERICAN MANUFACTURING COMPANY OF TEXAS
BUILDING 800A
FORT WORTH, TEXAS

Location[a]	Exposure Rate at 1 m (μR/h)
Building 201	5
Building 302	5
Building 800F	6
Building 800K	4
Building 800K	5
Building 800K	5
Building 800K	6
Building 800A	8

[a]Refer to Figure 13.

TABLE 3

EXPOSURE RATES
FORMER AMERICAN MANUFACTURING COMPANY OF TEXAS
BUILDING 800A
FORT WORTH, TEXAS

Location[a]	Exposure Rate at 1 m (μR/h)
1	7
2	6
3	6
4	4
5	5
6	6
7	5
8	5
9	4
10	6
11	6
12	8
13	7
14	5
15	5
16	5
17	6
18	8
19	6
20	16[b]

[a]Refer to Figure 14.
[b]Elevated exposure rate due to naturally occurring radioactive materials in the brick wall.

TABLE 4

RADIONUCLIDE CONCENTRATIONS IN BACKGROUND SOIL SAMPLES FORMER AMERICAN MANUFACTURING COMPANY OF TEXAS SITE FORT WORTH, TEXAS

Location[a]	Radionuclide Concentrations (pCi/g)					
	U-235	U-238	Total Uranium[b]	Th-228	Th-232	Total Thorium[c]
1	0.1 ± 0.1[d]	0.9 ± 0.5	1.9	0.3 ± 0.1	0.4 ± 0.2	0.7
2	0.1 ± 0.1	0.7 ± 0.6	1.5	0.3 ± 0.1	0.4 ± 0.2	0.7
3	0.1 ± 0.1	0.5 ± 0.4	1.1	0.2 ± 0.1	0.2 ± 0.1	0.4
4	0.1 ± 0.1	<0.7	<1.5	0.4 ± 0.1	0.4 ± 0.2	0.8
5	0.1 ± 0.1	0.8 ± 0.5	1.7	0.4 ± 0.1	0.5 ± 0.2	0.9
6	0.2 ± 0.1	<1.4	<3.0	0.5 ± 0.1	0.7 ± 0.2	1.2
7	0.1 ± 0.1	2.6 ± 2.0	5.3	0.6 ± 0.1	0.6 ± 0.2	1.2
8	0.1 ± 0.1	1.3 ± 0.7	2.7	0.4 ± 0.1	0.5 ± 0.2	0.9

[a]Refer to Figure 15.
[b]Total uranium concentrations are calculated based on a U-234 to U-238 activity ratio of 1:1.
[c]Total thorium concentrations are calculated based on the sum of Th-228 and Th-232.
[d]Uncertainties represent the 95% confidence level, based only on counting statistics.

TABLE 5

RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES
FORMER AMERICAN MANUFACTURING COMPANY OF TEXAS
BUILDING 800A
FORT WORTH, TEXAS

Location[a]	Radionuclide Concentrations (pCi/g)					
	U-235	U-238	Total Uranium[b]	Th-228	Th-232	Total Thorium[c]
1	0.5 ± 0.1[d]	3.3 ± 1.6	7.1	1.0 ± 0.1	1.2 ± 0.3	2.2
2	<0.1	0.4 ± 0.3	<0.9	0.1 ± 0.1	0.1 ± 0.1	0.2
3	0.1 ± 0.1	0.8 ± 0.5	1.7	0.4 ± 0.1	0.3 ± 0.2	0.7
4	0.1 ± 0.1	<1.3	<2.7	0.3 ± 0.1	0.3 ± 0.2	0.6
5	0.1 ± 0.1	0.7 ± 0.5	1.5	0.4 ± 0.1	0.5 ± 0.2	0.9
6	0.1 ± 0.1	<1.1	<2.3	0.4 ± 0.1	0.4 ± 0.2	0.8
7	0.1 ± 0.1	<0.3	<0.7	0.1 ± 0.1	<0.2	<0.3
8	0.1 ± 0.1	<0.3	<0.7	0.1 ± 0.1	0.1 ± 0.1	0.2
9	0.1 ± 0.1	0.1 ± 0.1	0.3	0.1 ± 0.1	<0.1	<0.2
10	<0.1	0.2 ± 0.2	<0.5	0.1 ± 0.1	<0.1	<0.2
11	0.1 ± 0.1	0.3 ± 0.3	0.7	0.1 ± 0.1	0.1 ± 0.1	0.2
12	0.1 ± 0.1	<0.3	<0.7	<0.1	<0.1	<0.2
13	<0.1	<0.4	<0.9	0.1 ± 0.1	<0.1	<0.2
14	<0.1	<0.3	<0.7	0.1 ± 0.1	<0.1	<0.2
15	<0.1	<0.5	<1.1	0.1 ± 0.1	<0.2	<0.3
16	<0.1	<0.4	<0.9	<0.1	<0.1	<0.2
17	<0.1	<0.2	<0.5	0.1 ± 0.1	<0.1	<0.2

[a]Refer to Figure 16.
[b]Total uranium concentrations are calculated based on a U-234 to U-238 activity ratio of 1:1. Background total uranium concentrations, which average 2.0 pCi/g, have not been subtracted.
[c]Total thorium concentrations are calculated based on the sum of Th-228 and Th-232. Background total thorium concentrations, which average 0.9 pCi/g, have not been subtracted.
[d]Uncertainties represent the 95% confidence level, based only on counting statistics.

TABLE 6

RADIONUCLIDE CONCENTRATIONS IN MISCELLANEOUS SAMPLES FORMER AMERICAN MANUFACTURING COMPANY OF TEXAS SITE BUILDING 800A FORT WORTH, TEXAS

Location[a]	Radionuclide Concentrations (pCi/g)					
	U-235	U-238	Total U[b]	Th-228	Th-232	Total Th[c]
Residue						
Bay 1, South Cross Beam	<0.2	1.2 ± 1.2[d]	<2.6	0.5 ± 0.3	<1.0	<1.5
Bay 1, North Purlin	<0.2	1.1 ± 1.1	<2.4	0.4 ± 0.2	<0.7	<1.1
Refractory Brick						
West Furnace	<0.2	3.6 ± 2.0	<7.4	3.2 ± 0.2	3.2 ± 0.6	6.4
East Furnace	0.5 ± 0.1	3.7 ± 1.4	7.9	3.4 ± 0.1	3.4 ± 0.3	6.8
Sediment						
Storm Drain	<0.2	<2.8	<3.0	<0.3	<1.1	<1.4

[a]Refer to Figure 7, 9, and 16.
[b]Total uranium concentrations are calculated based on a U-234 to U-238 activity ratio of 1:1. Background total uranium concentrations, which average 2.0 pCi/g, have not been subtracted.
[c]Total thorium concentrations are calculated based on the sum of Th-228 and Th-232. Background total thorium concentrations, which average 0.9 pCi/g, have not been subtracted.
[d]Uncertainties represent the 95% confidence level, based only on counting statistics.

TABLE 7

RADIONUCLIDE CONCENTRATIONS IN WATER SAMPLES
FORMER AMERICAN MANUFACTURING COMPANY OF TEXAS SITE
BUILDING 800A
FORT WORTH, TEXAS

Location[a]	Radionuclide Concentrations (μCi/ml)			
	U-235	U-238	Th-228	Th-232
West Furnace Pit	<5.2 E-9	<7.1 E-8	<5.8 E-9	<1.8 E-8
East Furnace Pit	<4.4 E-9	<7.2 E-8	<5.0 E-9	<1.5 E-8
Quench Tank	<5.3 E-9	<7.2 E-8	<7.1 E-9	<2.0 E-8
West Witter Mill	<7.7 E-9	<7.3 E-8	<3.5 E-9	<1.5 E-8

[a]Refer to Figure 17.

REFERENCES

1. Enclosures with letter to J. Whitney (Project Director, Sylvania Project Development) from A. Williams (U.S. DOE, Office of Environmental Restoration), August 19, 1994.

2. Oak Ridge Institute for Science and Education, "Designation Survey Plan for the Former American Manufacturing Company of Texas Site, Fort Worth, Texas," September 20, 1994.

3. "Radiation Protection of the Public and the Environment," DOE Order 5400.5, U.S. Department of Energy, February 8, 1990.

APPENDIX A

MAJOR INSTRUMENTATION

APPENDIX A

MAJOR INSTRUMENTATION

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

DIRECT RADIATION MEASUREMENT

Instruments

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

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

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)

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

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)

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) 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:

Beta	—	gas proportional detector with ratemeter-scaler
	—	GM detector with ratemeter-scaler
Gamma	—	NaI scintillation detector with ratemeter

Surface Activity Measurements

Beta activity measurements were performed on floors, lower walls, overhead surfaces, equipment, and at locations of elevated direct radiation 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 beta activity background count rates for the GM detectors were determined on site and averaged approximately 47 cpm. Beta efficiency factors ranged

from 0.21 to 0.22 for the GM detectors. The effective window area for the GM detectors were 15.5 cm^2.

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 using a micro-rem meter. A calibration curve was developed and the μrem/h rates were converted to exposure rates (μR/h).

Miscellaneous Sampling

Approximately 40 g of residue was collected at two locations in the overhead area and approximately 200 g of refractory brick from each of the two furnaces. The samples were placed in specimen cups, sealed, and labeled in accordance with ESSAP survey procedures.

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.

Water Sampling

Approximately 3.8 liters of water was collected from each sample location. The samples were transferred to a plastic container, sealed, and labeled in accordance with ESSAP survey procedures.

ANALYTICAL PROCEDURES

Removable Activity

Gross Alpha/Beta

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

Miscellaneous Samples

Gamma Spectrometry

Solid Samples. Samples of solid materials (soil, sludge, residues, and construction material) 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:

Th-228	0.583 MeV from T1-208
Th-232	0.911 MeV from Ac-228*
U-235	0.143 MeV (or 0.186 MeV)
U-238	0.063 MeV (or 0.093 MeV) from Th-234* (or 1.001 MeV from Pa-234 m)*

*Secular equilibrium assumed.

Spectra were also reviewed for other identifiable photopeaks.

Liquid Samples

Liquid samples with a high solid content were dried, mixed, and a portion sealed in 0.5 liter Marinelli beaker. Those with a low solid content were placed in 0.5 liter containers without processing. The samples were then treated as a solid sample.

UNCERTAINTIES AND DETECTION LIMITS

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

Detection limits, referred to as minimum detectable activity (MDA), were based on 2.71 plus 4.66 times the standard deviation of the background count:

$$2.71 + (4.66 \sqrt{BKG})$$

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 radionuclides in samples, the detection limits differ from sample to sample and instrument to instrument.

CALIBRATION AND QUALITY ASSURANCE

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

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

- Survey Procedures Manual, Revision 8 (December 1993)
- Laboratory Procedures Manual, Revision 8 (August 1993)
- Quality Assurance Manual, Revision 6 (July 1993)

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

SUMMARY OF DEPARTMENT OF ENERGY RESIDUAL RADIOACTIVE MATERIAL GUIDELINES[1]

APPENDIX C

SUMMARY OF DEPARTMENT OF ENERGY RESIDUAL RADIOACTIVE MATERIAL GUIDELINES[1]

BASIC DOSE LIMITS

The basic dose limit for the annual radiation dose (excluding radon) received by an individual member of the general public is 100 mrem/yr.[2] In implementing this limit, DOE applies as low as reasonably achievable principles to set site-specific guidelines.

EXTERNAL GAMMA RADIATION

The average level of gamma radiation inside a building or habitable structure on a site that has no radiological restriction on its use shall not exceed the background level by more than 20 μR/h and will comply with the basic dose limits when an appropriate-use scenario is considered.

SURFACE CONTAMINATION GUIDELINES

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

[a] 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 measured by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

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

[c] Measurements of average contamination should not be averaged over an area of more than 1 m^2. For objects of less surface area, the average should be derived for each such object.

[d] The average and maximum dose rates 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.

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

[f] The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping an area of that size with dry filter or soft absorbent paper, applying moderate pressure, and measuring the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of surface area less than 100 cm^2 is determined, the activity per unit area should be based on the actual area and the entire surface should be wiped. The numbers in this column are maximum amounts.

REFERENCES

1. "Guidelines for Residual Radioactive Material at Formerly Utilized Sites Remedial Action Program and Remote Surplus Facilities Management Program Sites," U.S. Department of Energy, Revision 2, March 1987.

2. "Radiation Protection of the Public and the Environment," DOE Order 5400.5, U.S. Department of Energy, February 8, 1990.