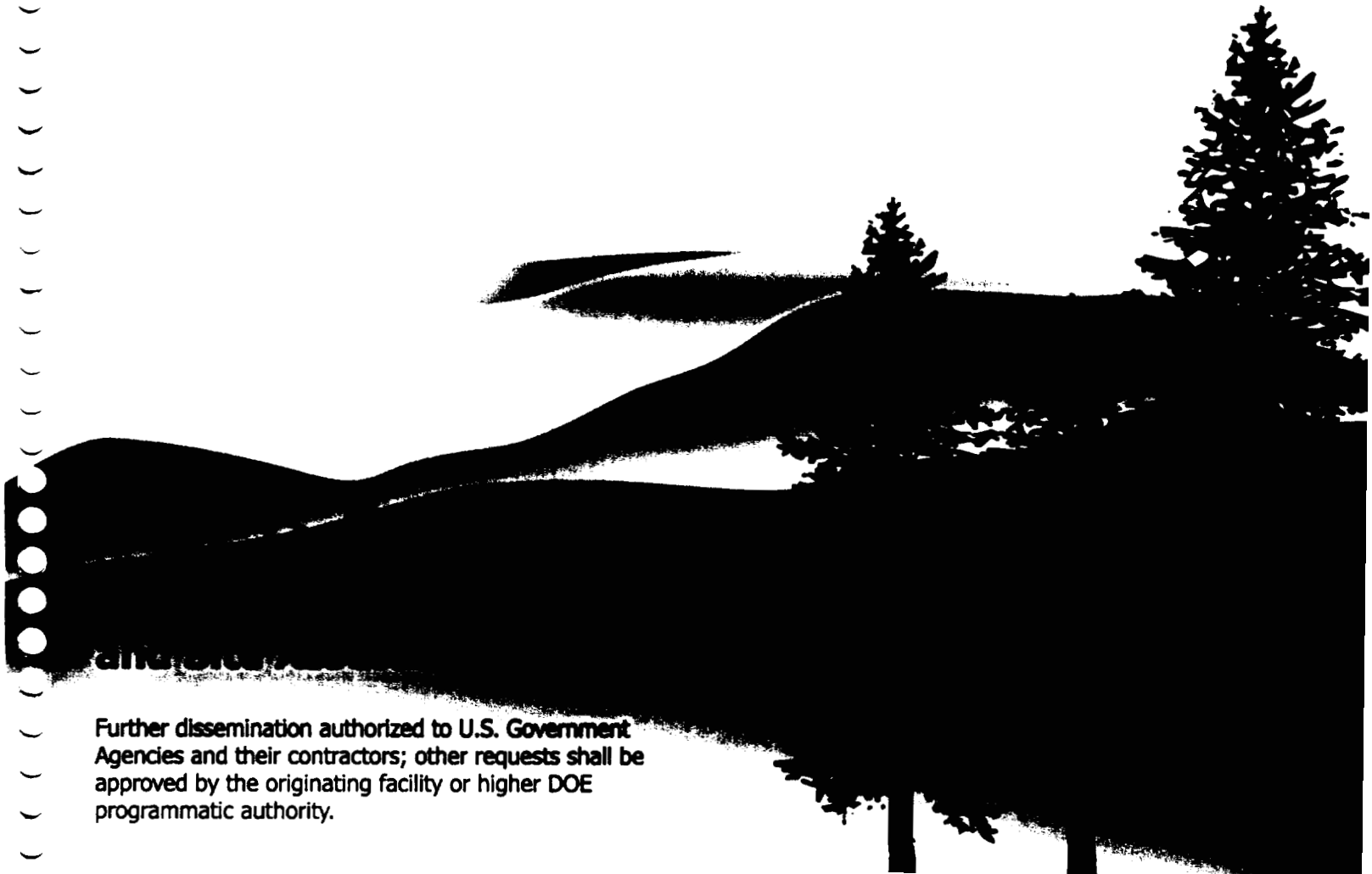
CONFIRMATORY AND IN-PROCESS INSPECTION SURVEYS OF REMAINING LAND AREAS MAINE YANKEE ATOMIC POWER COMPANY WISCASSET, MAINE

T. J. BAUER

Prepared for the
U.S. Nuclear Regulatory Commission



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Prepared by

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Prepared for the

U.S. Nuclear Regulatory Commission

FINAL REPORT

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CONFIRMATORY AND IN-PROCESS INSPECTION SURVEYS
OF REMAINING LAND AREAS
MAINE YANKEE ATOMIC POWER COMPANY
WISCASSET, MAINE

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TABLE OF CONTENTS

PAGE

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS AND ACRONYMS

BKG	background
cm	centimeter
DCGL	derived concentration guideline level
DOE	U.S. Department of Energy
ESSAP	Environmental Survey and Site Assessment Program
FSS	final status surveys
ISM	integrated safety management
ITP	Intercomparison Testing Program
JHA	job hazard analysis
kg	kilogram
kV	kilovolt
LTP	license termination plan
m^2	square meter
MAPEP	Mixed Analyte Performance Evaluation Program
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDC	minimum detectable concentration
MeV	million electron volts
MYAPC	Maine Yankee Atomic Power Company
NaI	sodium iodide
NRC	Nuclear Regulatory Commission
NRIP	NIST Radiochemistry Intercomparison Program
ORISE	Oak Ridge Institute for Science and Education
pCi/g	picocuries per gram
pCi/L	picocuries per liter
SOF	sum-of-fractions
SU	survey unit
TAP	total absorption peak

CONFIRMATORY AND IN-PROCESS INSPECTION SURVEYS OF REMAINING LAND AREAS MAINE YANKEE ATOMIC POWER COMPANY WISCASSET, MAINE

INTRODUCTION AND SITE HISTORY

The Maine Yankee Atomic Power Company (MYAPC) is owned by a consortium of 10 New England electric utilities representing consumers in Maine, New Hampshire, Vermont, Massachusetts, Connecticut, and Rhode Island. The plant began commercial operation in December 1972 under Atomic Energy Commission Docket Number 50-0309, License Number OL-FP DPR36, and permanently ceased operation in December 1996. Over its lifetime, the plant operated for a total of approximately 16 effective full power years based on its rated thermal power. The MYAPC board of directors voted in August 1997 to permanently cease further operation and decommission the plant (MYAPC 2002).

Decontamination and decommissioning activities at MYAPC are nearing an end. Site buildings such as the office building and warehouse have been demolished, with the most notable being the explosive demolition of the 150-foot tall reactor contaminant building on September 7, 2004. Remediation of soil in the plant yard is still ongoing. Final site cleanup is expected to be completed in May 2005. As of April 8, 2005, MYAPC estimated 97% of decommissioning activities at the site are completed (MYAPC 2005).

The U.S. Nuclear Regulatory Commission's (NRC) Headquarters and Region I Offices requested that the Oak Ridge Institute for Science and Education's (ORISE) Environmental Survey and Site Assessment Program (ESSAP) perform confirmatory surveys of selected remaining land areas. Some of the areas intended for the confirmatory surveys were backfilled by MYAPC and therefore inaccessible at the time of the surveys. At the direction of the NRC staff, ESSAP performed the following activities: confirmatory surveys of areas identified as not backfilled, in-process inspection surveys of land areas where remediation was in process, and in-process inspection surveys of other areas where final status surveys (FSS) were in process.

SITE DESCRIPTION

The 820-acre MYAPC site is located at 321 Old Ferry Road in Lincoln County, Wiscasset, Maine. The land areas covered included surface soil survey units (SU) from areas inside and outside the former restricted area, including areas where buildings were demolished. The table below summarizes the surveyed areas.

Survey Type	Survey Area	Survey Unit	Area (m^2)
Confirmatory	FR 0100	3	1,476
	FR 0111	9	1,622
		10	1,332
		17	1,563
	FR 0200	2	2,752
		3	1,687
	FR 0900	2	104
		3	282
In-Process Inspection	FR 0111	19	1,080
	FR 0200	4	1,363
		9	1,400[a]

[a]Area estimated from MYAPC figures.

Collectively, the total area of the SUs covered for confirmatory and in-process inspection surveys was approximately 14,700 m^2.

OBJECTIVES

The objectives of the confirmatory and in-process inspection surveys were to provide independent contractor field data reviews and radiological data for use by the NRC in evaluating the adequacy and accuracy of the licensee's procedures and final status survey results.

DOCUMENT REVIEW

ESSAP reviewed the licensee's FSS release records for adequacy and appropriateness taking into account the License Termination Plan (LTP, MYAPC 2002) and MARSSIM guidance (NRC 2000)—specific records were only reviewed for SUs where confirmatory surveys were performed. Data were evaluated to assure that areas exceeding guidelines were identified and had

undergone remediation. Final status survey results were compared with guidelines to ensure that the data had been interpreted correctly.

PROCEDURES

ESSAP performed confirmatory surveys of the MYAPC open land areas during the periods November 16, 2004, December 8, 2004, and April 25 through 27, 2005. Additional in-process inspection surveys were also performed during the period April 25 through 27, 2005 at the request of the NRC. The surveys were performed in accordance with the site-specific survey plans submitted to and approved by the NRC (ORISE 2004a and b and 2005) and the ORISE/ESSAP Survey Procedures and Quality Assurance Manuals (ORISE 2004c and d). Additional information concerning major instrumentation, sampling equipment, and survey and analytical procedures may be found in Appendices A and B.

REFERENCE GRID

Measurement and sampling locations were noted on figures provided by MYAPC.

SURFACE SCANS

Surface scans of outdoor locations were performed over approximately 10 to 100% of the accessible areas using a NaI scintillation detector coupled to a ratemeter.

SOIL SAMPLING

Surface soil (0-15 cm) samples were collected at five judgmental locations of elevated direct gamma radiation identified by surface scans and from 29 randomly selected locations. Figures 2 through 10 show the soil sampling locations. Additionally, at the request of the NRC, a sediment sample was collected (1644S022) from standing water west of the 115 kV switchyard after water was pumped to the area from the FR 0111 SU 19 excavation.

WATER SAMPLING

While on site during the April 2005 survey, MYAPC pumped water from the FR 0111 SU 19 excavation to an area west of the 115 kV switchyard. At the request of the NRC, two water

samples were collected: one from the water discharge hose (1644W001) and one from the standing water after pumping was completed (1644W002).

SAMPLE ANALYSIS AND DATA INTERPRETATION

Samples and data were returned to ORISE's ESSAP Oak Ridge, Tennessee, facility for analysis and interpretation. Sample analyses were performed in accordance with the ORISE/ESSAP Laboratory Procedures Manual (ORISE 2004e). Soil, water, and sediment samples were analyzed by gamma spectroscopy. Spectra were reviewed for identifiable total absorption peaks. Soil and sediment sample results were reported in units of picocuries per gram (pCi/g). One water sample was analyzed for tritium by distillation. Water sample results were reported in units of picocuries per liter (pCi/L).

Confirmatory and in-process inspection survey data were compared with the appropriate regulatory guidelines for release of the site without radiological restrictions. Soil, water, and sediment samples were analyzed by gamma spectroscopy for the primary gamma emitting radionuclides of concern Cs-137 and Co-60—the data were also reviewed for other fission and activation products. Soil and sediment analytical results were compared to MYAPC's site-specific derived concentration guideline level ($DCGL_W$). The $DCGL_W$ values for SUs within the former restricted area were 2.39 and 0.86 pCi/g for Cs-137 and Co-60, respectively. The $DCGL_W$ values for SUs outside the former restricted area were 4.2 and 1.52 pCi/g for Cs-137 and Co-60, respectively (MYAPC 2002). The sum-of-fractions (SOF) was calculated for each sample for comparison to the unity rule. The NRC will compare water analytical results to the environmental limits specified in MYAPC's Environmental Technical Specifications and Offsite Dose Calculation Manual[1].

[1]Electronic mail correspondence from B. Watson (NRC) on June 15, 2005.

FINDINGS AND RESULTS

DOCUMENT REVIEW

The procedures, methods, and data submitted by MYAPC were considered to be appropriate and adequately documented the radiological status of the SUs where confirmatory surveys were performed.

SURFACE SCANS

Three areas of elevated gamma radiation were noted in FR 0111 SU 9, one area was noted in FR 0111 SU 10, and one area was noted in FR 0900 SU 2. Gamma surface scans of remaining SUs were within the range of ambient background levels.

RADIONUCLIDE CONCENTRATIONS

Soil and Sediment Samples

Table 1 provides the radionuclide concentrations in collected soil and sediment samples. Radionuclide concentrations in soils and sediments collected from SUs within the former restricted area ranged from -0.03 to 1.66 pCi/g for Cs-137 and -0.03 to 0.44 pCi/g for Co-60. The SOF values for these SUs ranged from 0.00 to 0.69. Radionuclide concentrations in soils collected from SUs outside the former restricted area ranged from 0.00 to 0.89 pCi/g for Cs-137 and -0.01 to 0.01 pCi/g for Co-60; the SOF values ranged from 0.01 to 0.22.

Water Samples

Table 2 provides the radionuclide concentrations in collected water samples from FR 0111 SU 19. Radionuclide concentrations ranged from -0.5 to 0.2 pCi/L for Cs-137 and 1.2 to 2.9 pCi/L for Co-60. The H-3 concentration in sample 1644W001 was 750 pCi/L.

COMPARISON OF RESULTS WITH GUIDELINES

Results of the surveys were compared to the applicable guidelines. Confirmatory and in-process inspection results for soil and sediment samples were all less than the applicable $DCGL_W$ values and unity rule.

SUMMARY

At the request of the U.S. Nuclear Regulatory Commission, the Environmental Survey and Site Assessment Program of the Oak Ridge Institute for Science and Education conducted confirmatory and in-process inspection survey activities at the Maine Yankee Atomic Power Company in Wiscasset, Maine. Confirmatory and in-process inspection activities included document and data reviews, and during the periods November 16, 2004, December 8, 2004, and April 25 through 27, 2005, independent surface scans and soil, sediment, and water sampling.

ESSAP's confirmatory and in-process inspection results indicated collected soil and sediment samples did not contain residual contamination in excess of the derived concentration guideline levels for release for unrestricted use and therefore confirm, for areas subject to confirmatory surveys only, final status survey results.

FIGURES

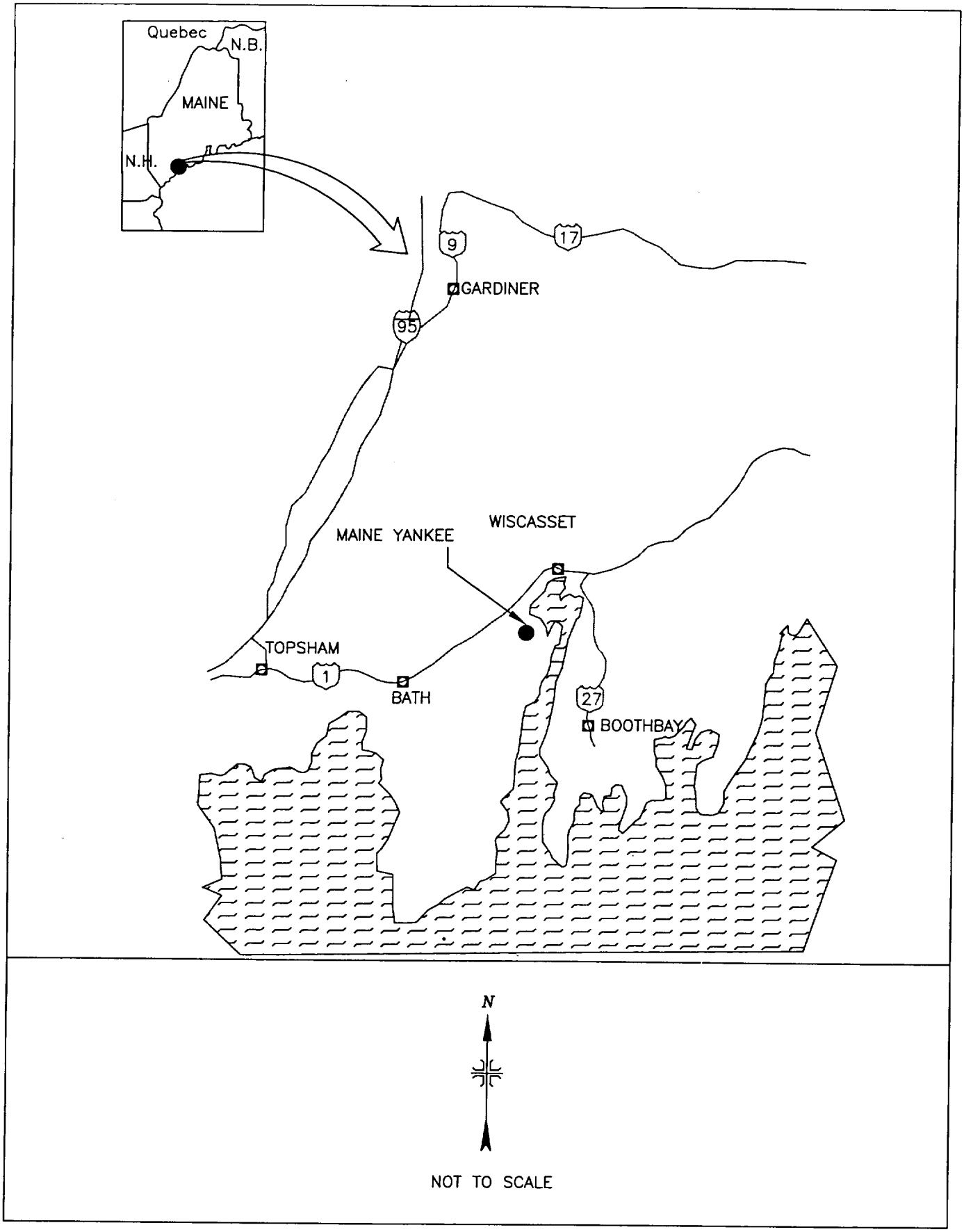


FIGURE 1: Location of the Maine Yankee Atomic Power Plant, Wiscasset, Maine

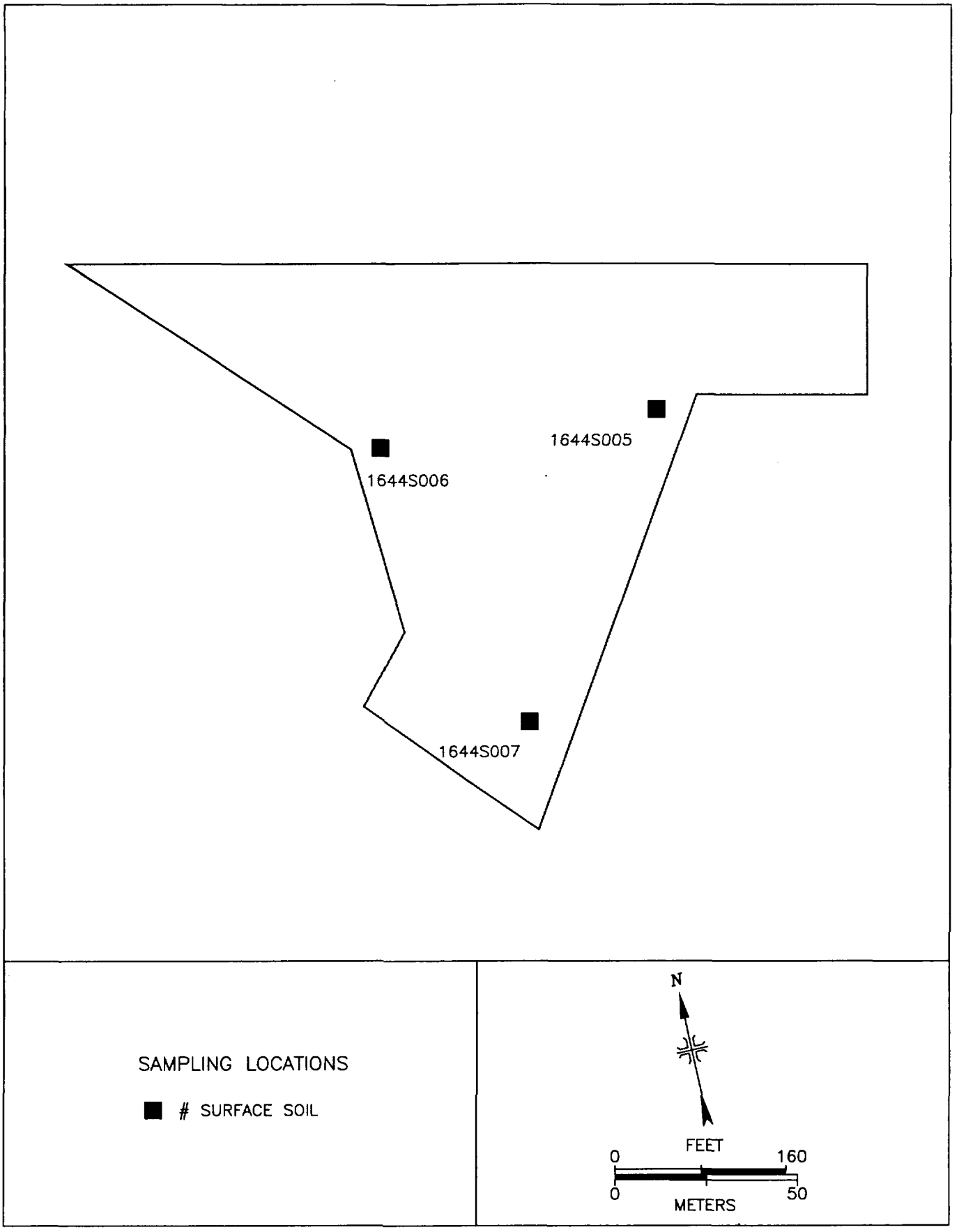


FIGURE 2: FR 0100, Survey Unit 3 – Sampling Locations

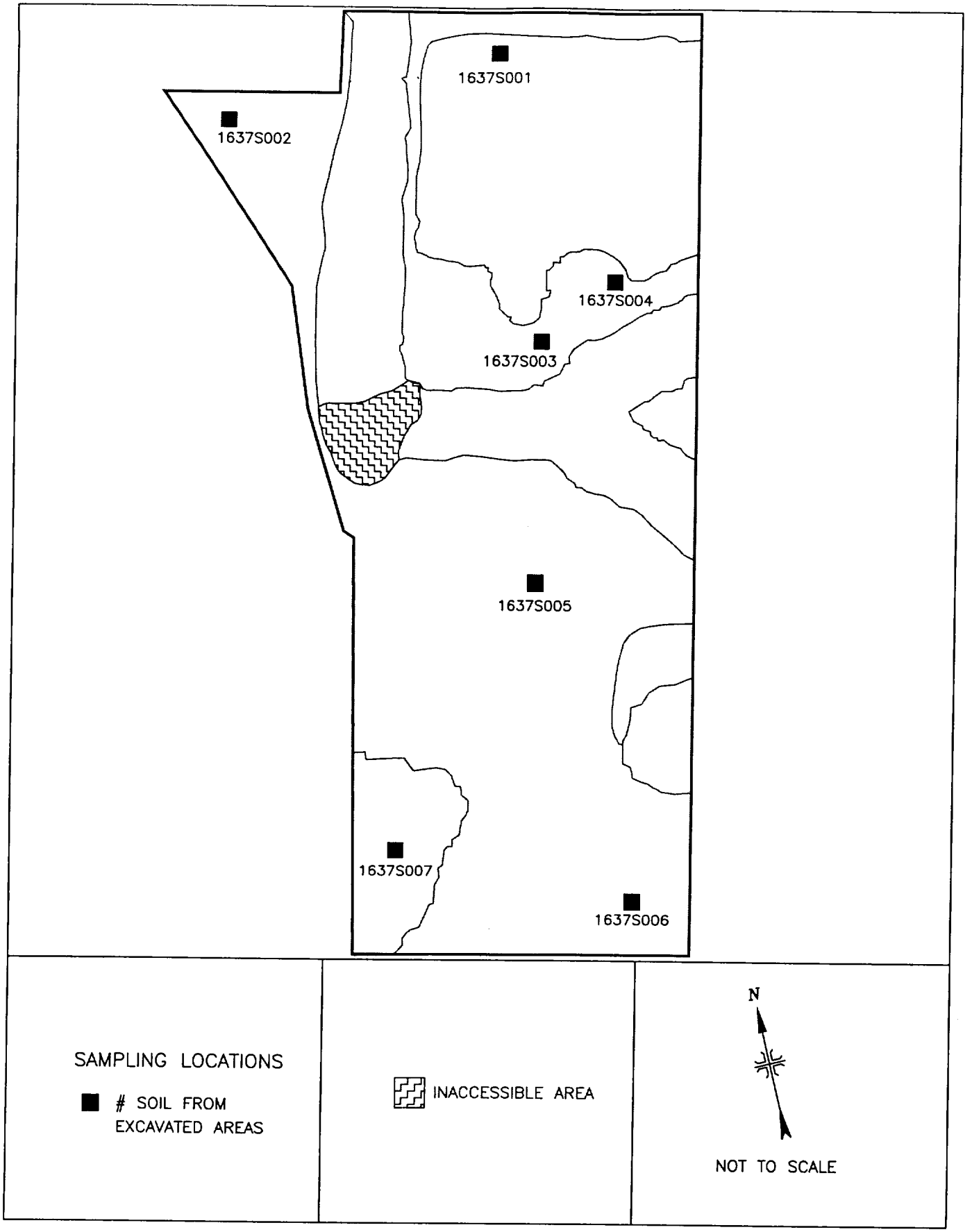


FIGURE 3: FR 0111, Survey Unit 9 – Sampling Locations

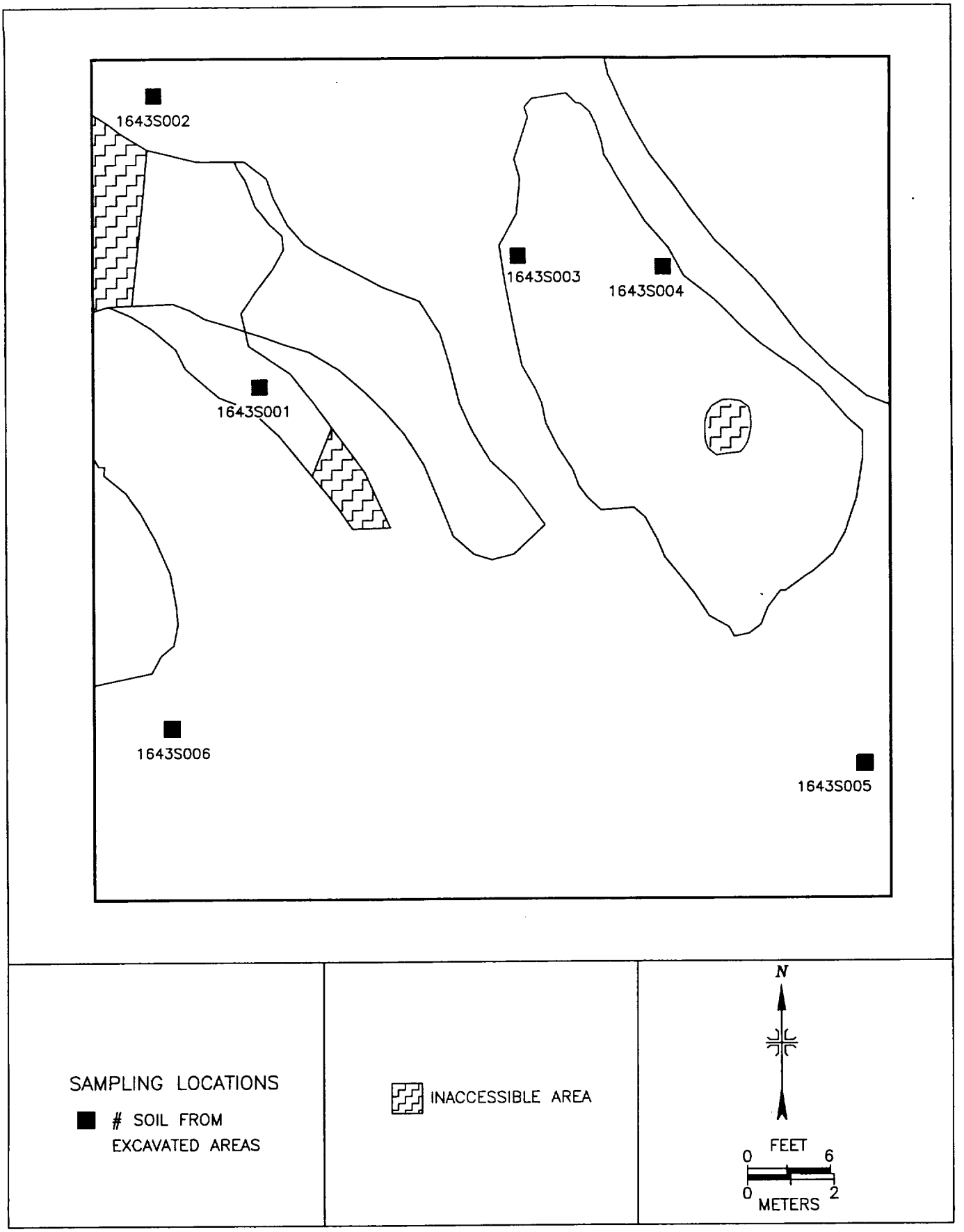


FIGURE 4: FR 0111, Survey Unit 10 – Sampling Locations

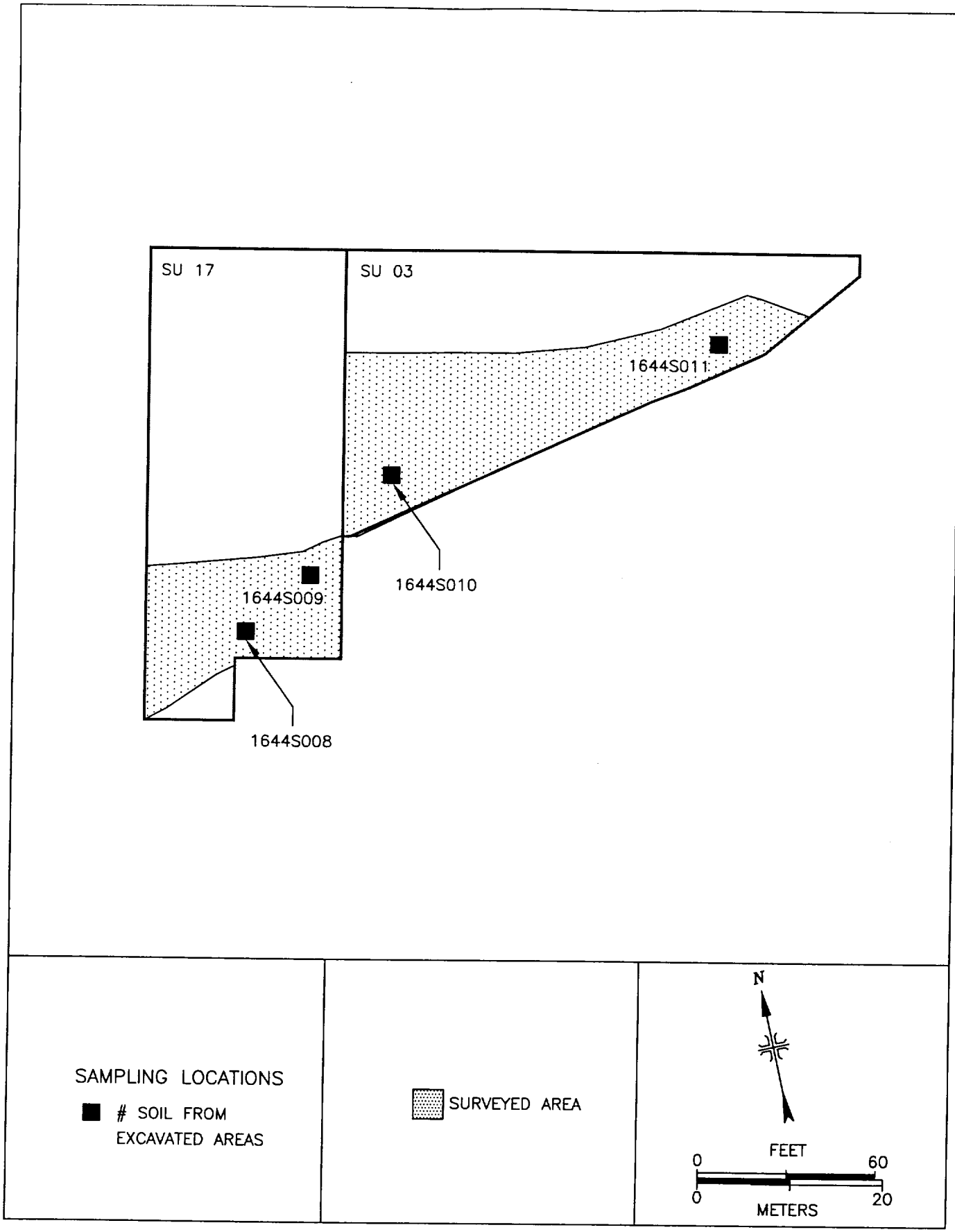


FIGURE 5: FR 0111, Survey Unit 17 and FR 0200, Survey Unit 3 – Sampling Locations

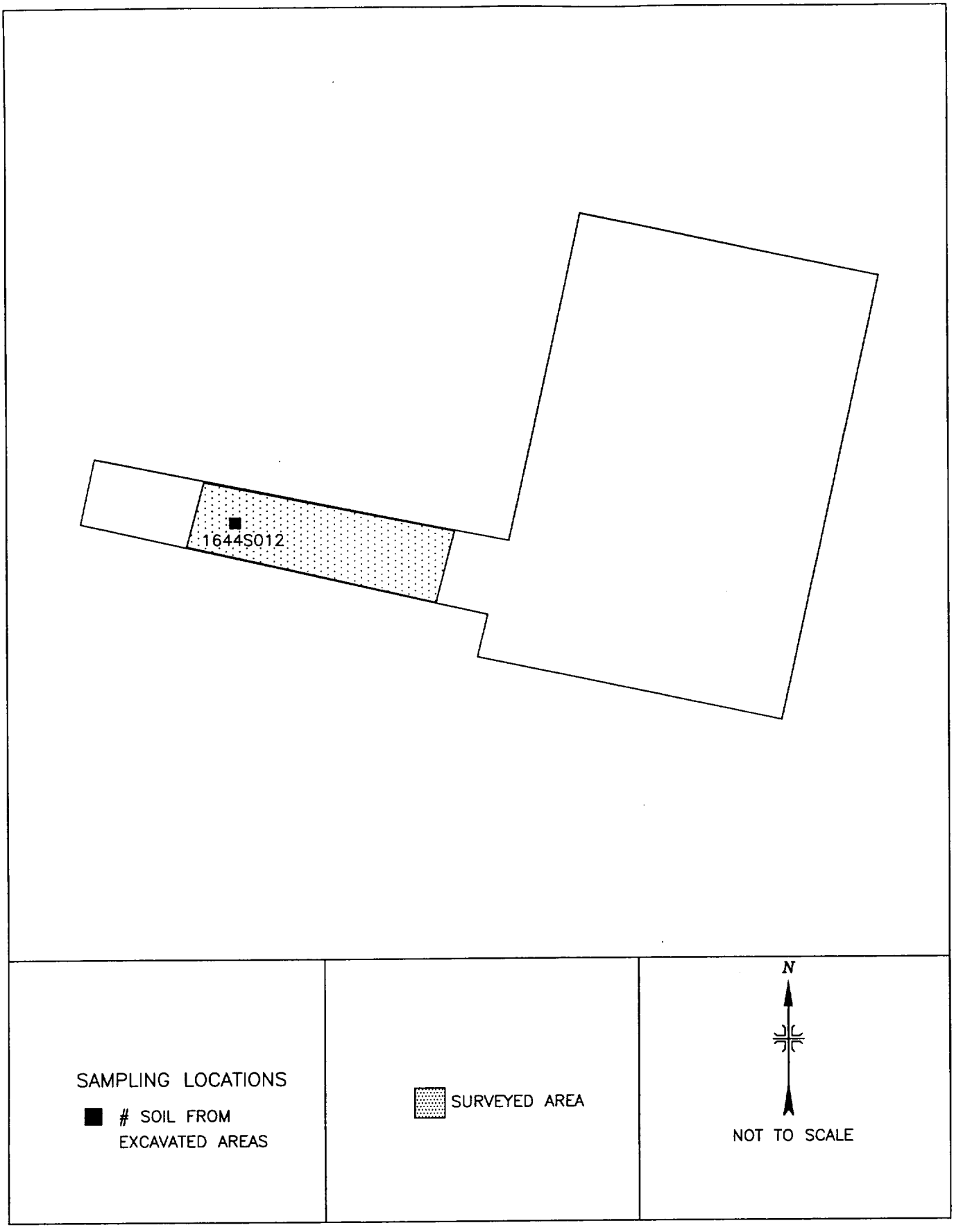


FIGURE 6: FR 0111, Survey Unit 19 – Sampling Locations

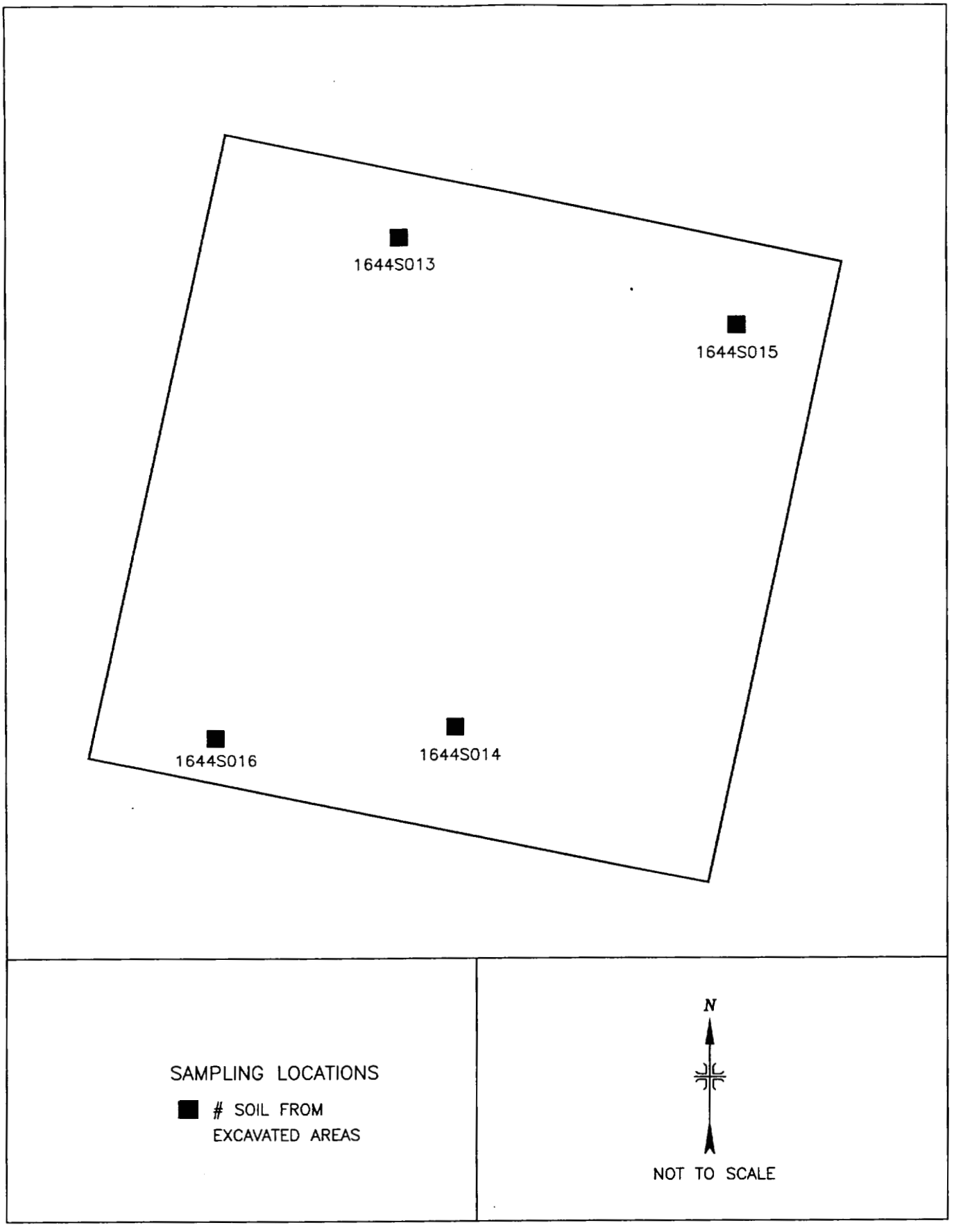
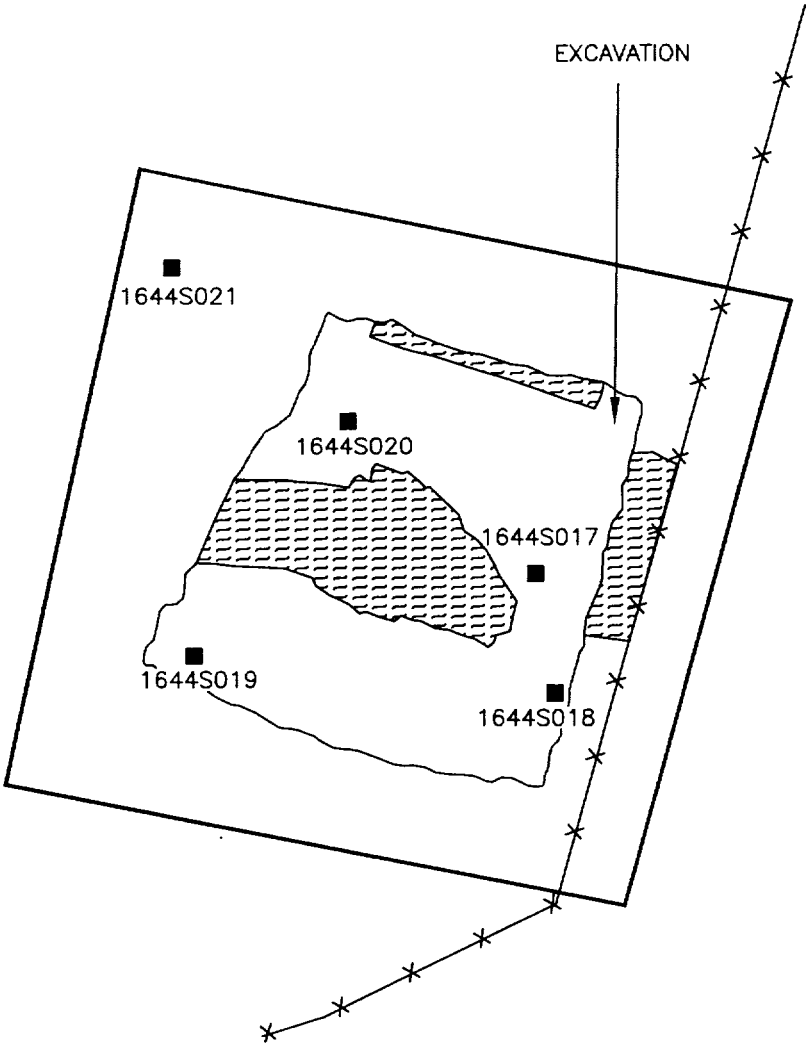


FIGURE 7: FR 0200, Survey Unit 4 – Sampling Locations



SAMPLING LOCATIONS

■ # SOIL FROM EXCAVATED AREAS

FENCE

WATER

N

NOT TO SCALE

FIGURE 8: FR 0200, Survey Unit 9 – Sampling Locations

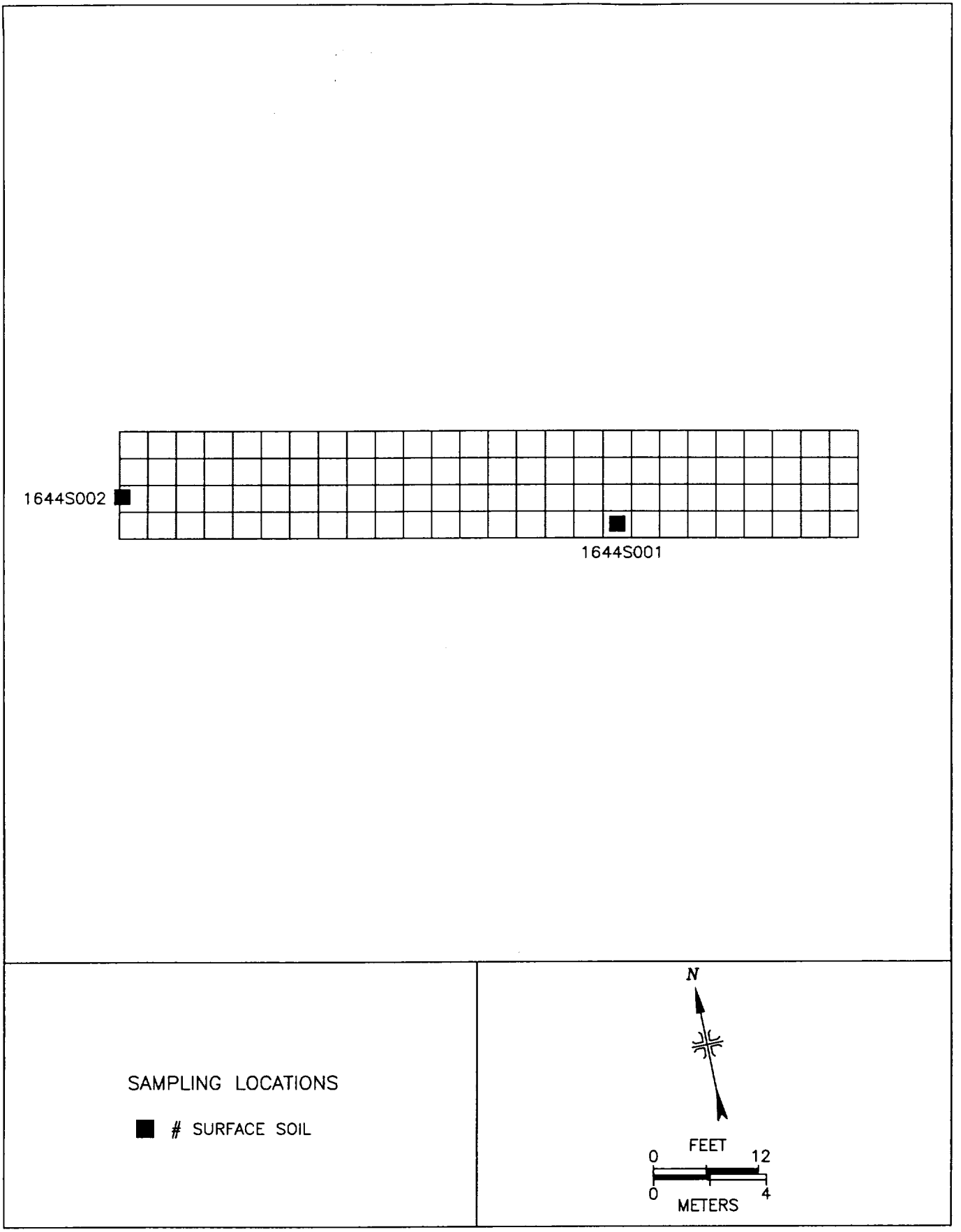


FIGURE 9: FR 0900, Survey Unit 2 – Sampling Locations

1644-005 (1)

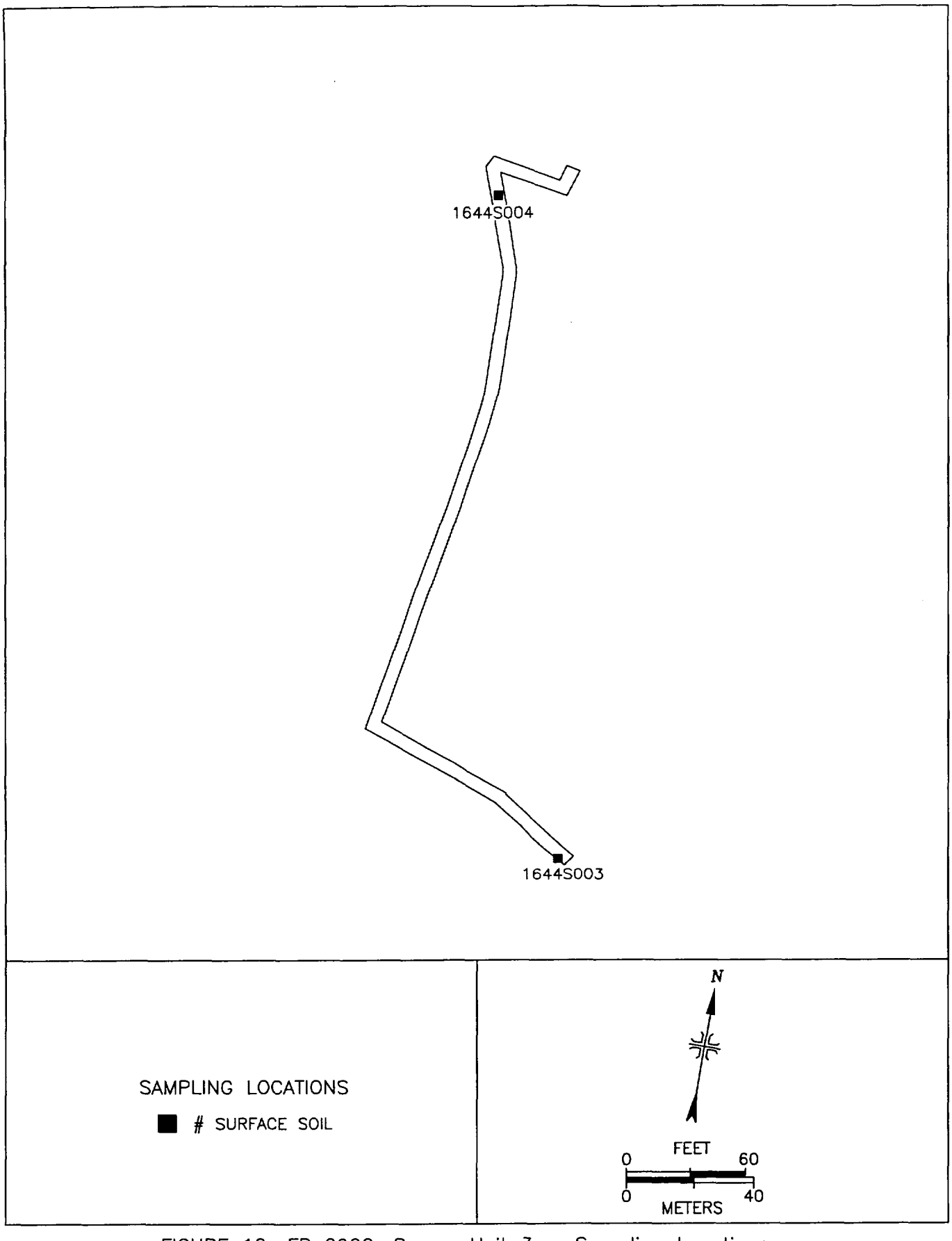


FIGURE 10: FR 0900, Survey Unit 3 – Sampling Locations

TABLES

TABLE 1

RADIONUCLIDE CONCENTRATIONS IN SOILS AND SEDIMENTS REMAINING LAND AREAS MAINE YANKEE ATOMIC POWER COMPANY WISCASSET, MAINE

Sample[a]	Radionuclide Concentrations (pCi/g)		Sum-of-Fractions[b]
	Cs-137	Co-60	
Survey Units Within the Former Restricted Area[c]			
FR 0100 SU 3			
1644S005	0.07 ± 0.04[d]	-0.01 ± 0.03	0.03
1644S006	0.01 ± 0.02	-0.03 ± 0.03	0.00
1644S007	0.09 ± 0.03	0.03 ± 0.03	0.07
FR 0111 SU 9			
1637S001	-0.03 ± 0.03	-0.01 ± 0.04	0.00
1637S002	0.56 ± 0.05	0.27 ± 0.05	0.55
1637S003	0.02 ± 0.03	0.03 ± 0.04	0.04
1637S004	0.05 ± 0.02	0.00[e] ± 0.03	0.02
1637S005	0.02 ± 0.02	0.00 ± 0.03	0.01
1637S006	0.04 ± 0.02	0.01 ± 0.02	0.03
1637S007	0.04 ± 0.03	0.01 ± 0.03	0.03
FR 0111 SU 10			
1643S001	0.06 ± 0.03	0.00 ± 0.03	0.03
1643S002	0.00 ± 0.01	-0.01 ± 0.02	0.00
1643S003	0.02 ± 0.02	0.00 ± 0.02	0.01
1643S004	0.02 ± 0.02	-0.01 ± 0.04	0.01
1643S005	0.00 ± 0.02	0.00 ± 0.03	0.00
1643S006	0.01 ± 0.02	0.01 ± 0.02	0.02
FR 0111 SU 17			
1644S008	1.66 ± 0.09	0.00 ± 0.03	0.69
1644S009	0.04 ± 0.02	0.01 ± 0.03	0.03
FR 0111 SU 19			
1644S012	0.02 ± 0.02	0.05 ± 0.04	0.07
1644S022[f]	0.05 ± 0.03	0.15 ± 0.05	0.20
FR 0200 SU 3			
1644S010	0.02 ± 0.03	0.00 ± 0.03	0.01
1644S011	-0.01 ± 0.02	0.04 ± 0.04	0.05
FR 0200 SU 9			
1644S017	0.14 ± 0.04	0.44 ± 0.07	0.57
1644S018	0.04 ± 0.03	-0.01 ± 0.03	0.02
1644S019	-0.01 ± 0.01	0.01 ± 0.03	0.01
1644S020	0.00 ± 0.02	-0.01 ± 0.03	0.00

TABLE 1 (CONTINUED)

RADIONUCLIDE CONCENTRATIONS IN SOILS AND SEDIMENTS
REMAINING LAND AREAS
MAINE YANKEE ATOMIC POWER COMPANY
WISCASSET, MAINE

Sample[a]	Radionuclide Concentrations (pCi/g)		Sum-of-Fractions[b]
	Cs-137	Co-60	
FR 0200 SU 9 (continued)			
1644S021	0.00 ± 0.02	0.01 ± 0.03	0.01
Survey Units Outside the Former Restricted Area[g]			
FR 0200 SU 4			
1644S0013	0.07 ± 0.03	0.01 ± 0.03	0.02
1644S0014	0.03 ± 0.02	0.00 ± 0.03	0.01
1644S0015	0.00 ± 0.01	0.01 ± 0.02	0.01
1644S0016	0.02 ± 0.02	0.01 ±0.03	0.01
FR 0900 SU 2			
1644S001	0.04 ± 0.02	-0.01 ± 0.02	0.01
1644S002	0.02 ± 0.02	0.01 ± 0.03	0.01
FR 0900 SU 3			
1644S003	0.89 ± 0.07	0.01 ± 0.03	0.22
1644S004	0.18 ± 0.03	0.00 ± 0.03	0.04

[a]Refer to Figures 2 through 10.
[b]Calculated using the sum-of-fractions (SOF) to compare to the unity rule, as discussed in Section 4.3.3 of MARSSIM (NRC 2000). Note: A value of zero was used in the SOF calculation when a radionuclide concentration result was negative.
[c]DCGLs are 2.39 and 0.86 pCi/g for Cs-137 and Co-60, respectively, for survey units within the former restricted area.
[d]Uncertainties represent the 95% confidence level based on total propagated uncertainties.
[e]Zero values due to rounding.
[f]Sediment sample collected from standing water west of the 115 kV switchyard after water was pumped to the area from the FR 0111 SU 19 excavation.
[g]DCGLs are 4.2 and 1.52 pCi/g for Cs-137 and Co-60, respectively, for survey units outside the former restricted area.

TABLE 2

RADIONUCLIDE CONCENTRATIONS IN FR 0111 SU 19 WATER
REMAINING LAND AREAS
MAINE YANKEE ATOMIC POWER COMPANY
WISCASSET, MAINE

Sample	Radionuclide Concentrations (pCi/L)		
	Tritium (H-3)	Cs-137	Co-60
1644W001	750 ± 260[a]	-0.5 ± 2.0	1.2 ± 2.2
1644W002	--[b]	0.2 ± 1.6	2.9 ± 2.9

[a]Uncertainties represent the 95% confidence level based on total propagated uncertainties.
[b]Analysis not performed.

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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 author or employer.

SCANNING INSTRUMENT/DETECTOR COMBINATIONS

Gamma

Eberline Pulse Ratemeter Model PRM-6
(Eberline, Santa Fe, NM)
coupled to
Victoreen NaI Scintillation Detector Model 489-55, Crystal: 3.2 cm x 3.8 cm
(Victoreen, Cleveland, OH)

Ludlum Model 12
(Ludlum Measurements, Inc., Sweetwater, TX)
coupled to
Victoreen NaI Scintillation Detector Model 489-55, Crystal: 3.2 cm x 3.8 cm
(Victoreen, Cleveland, OH)

LABORATORY ANALYTICAL INSTRUMENTATION

Tri-Carb Liquid Scintillation Analyzer
Model 3100
(Packard Instrument Co., Meriden, CT)

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

High Purity Extended Range Intrinsic Detector
Model No. GMX-45200-5
(AMETEK/ORTEC, Oak Ridge, TN)
used in conjunction with:
Lead Shield Model SPG-16-K8
(Nuclear Data)
Multichannel Analyzer
DEC ALPHA Workstation
(Canberra, Meriden, CT)

High-Purity Germanium Detector
Model GMX-30-P4, 30% Eff.
(AMETEK/ORTEC, Oak Ridge, TN)
Used in conjunction with:
Lead Shield Model G-16
(Gamma Products, Palos Hills, IL) and
Multichannel Analyzer
DEC ALPHA Workstation
(Canberra, Meriden, CT)

APPENDIX B

SURVEY AND ANALYTICAL PROCEDURES

APPENDIX B
SURVEY AND ANALYTICAL PROCEDURES

PROJECT HEALTH AND SAFETY

The proposed survey and sampling procedures were evaluated to ensure that any hazards inherent to the procedures themselves were addressed in current job hazard analyses (JHAs). All survey and laboratory activities were conducted in accordance with ORISE health and safety and radiation protection procedures.

A walkdown of the survey areas was performed in order to evaluate and identify potential health and safety issues. MYAPC provided general site-specific safety awareness. Survey work was performed per the ORISE generic health and safety plans and a site-specific integrated safety management (ISM) pre-job hazard checklist.

QUALITY ASSURANCE

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

- Survey Procedures Manual (September 2004)
- Laboratory Procedures Manual (August 2004)
- Quality Assurance Manual (August 2004)

The procedures contained in these manuals were developed to meet the requirements of Department of Energy (DOE) Order 414.1B and the U.S. Nuclear Regulatory Commission *Quality Assurance Manual for the Office of Nuclear Material Safety and Safeguards* 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 MAPEP, NRIP, and ITP Laboratory Quality Assurance Programs.

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

SURVEY PROCEDURES

Surface Scans

Surface scans were performed by passing the detectors slowly over the surface; the distance between the detector and the surface was maintained at a minimum—nominally about 1 cm. Identification of elevated levels was based on increases in the audible signal from the recording and/or indicating instrument. Scans were performed using NaI detectors coupled to ratemeters.

The scan MDCs for the NaI scintillation detector for the contaminants of concern in surface soil were obtained directly from NUREG-1507[1] when available. The scan minimum detectable concentrations (MDC) provided in NUREG-1507 were 10.4 and 5.8 pCi/g, respectively, for Cs-137 and Co-60.

Soil and Sediment Sampling

Approximately 1 kilogram (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 one liter of water was collected from each sample location. The samples were sealed and labeled in accordance with ESSAP survey procedures.

RADIOLOGICAL ANALYSIS

Gamma Spectroscopy

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

[1]NUREG-1507. Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions. US Nuclear Regulatory Commission. Washington, DC; June 1998.

acidified. Net material weights were determined and the samples counted using intrinsic germanium detectors coupled to a pulse height analyzer system. Background and Compton stripping, peak search, peak identification, and concentration calculations were performed using the computer capabilities inherent in the analyzer system. All total absorption peaks (TAP) associated with the radionuclides of concern were reviewed for consistency of activity. Total absorption peaks used for determining the activities of radionuclides of concern and the typical associated MDCs for a one-hour count time were:

Radionuclide	TAP (MeV)	MDC Soil (pCi/g)	MDC Water (pCi/L)
Cs-137	0.662	0.05	3.3
Co-60	1.173	0.05	3.9

Spectra were also reviewed for other identifiable TAPs.

Liquid Scintillation

Water analysis for tritium (H-3) was performed by distillation and placing a representative portion of the distilled sample into a scintillation cocktail and counting on a liquid scintillation counter. The typical MDC of the procedure is 400 pCi/L.

DETECTION LIMITS

Detection limits, referred to as MDC, were based on 3 plus 4.65 times the standard deviation of the background count [$3 + (4.65\sqrt{BKG})$]. 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.