ORISE
OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

November 18, 2003

Mr. Robert Prince
U.S. Nuclear Regulatory Commission
Region I
475 Allendale Road
King of Prussia, Pennsylvania 19406

SUBJECT: FINAL REPORT–RADIOLOGICAL SCOPING SURVEY OF PORTIONS OF THE SUPERBOLT FACILITY (FORMERLY SUPERIOR STEEL COMPANY), PHASE 2, CARNEGIE, PENNSYLVANIA (RFTA NO: 03-009a)

Dear Mr. Prince:

The Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE) performed radiological scoping survey activities at the Superbolt, Incorporated facility (formerly the Superior Steel Company) in Carnegie, Pennsylvania during the period of August 18 through 20, 2003. Survey activities included document and data reviews; alpha plus beta and gamma surface scans; beta surface activity measurements; exposure rate measurements, soil sampling; and, miscellaneous sampling.

Enclosed are five copies of the subject report with your comments incorporated. If you have any questions or additional comments, please direct them to me at (865) 576-0065 or Tim Vitkus at (865) 576-5073.

Sincerely,

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RADIOLOGICAL SCOPING SURVEY FOR PORTIONS OF THE SUPERBOLT FACILITY (FORMERLY SUPERIOR STEEL COMPANY) PHASE II CARNEGIE, PENNSYLVANIA

W.C. ADAMS

Prepared for the
U.S. Nuclear Regulatory Commission
Region I

Environmental Assessment
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RADIOLOGICAL SCOPING SURVEY FOR PORTIONS OF THE SUPERBOLT FACILITY (FORMERLY SUPERIOR STEEL COMPANY) PHASE 2 CARNEGIE, PENNSYLVANIA

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Region I

FINAL REPORT

NOVEMBER 2003

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RADIOLOGOCAL SCOPING SURVEY
FOR PORTIONS OF THE SUPERBOLT FACILITY
(FORMERLY SUPERIOR STEEL COMPANY)
PHASE 2
CARNEGIE, PENNSYLVANIA
(RFTA NO: 03-009a)

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ABBREVIATIONS AND ACRONYMS

ϵ_i	instrument efficiency
ϵ_s	source efficiency
µrem/h	microrem per hour
µR/h	microroentgens per hour
b_i	background counts in observation interval
AC	The Aerospace Corporation
AEC	Atomic Energy Commission
AHP	Applied Health Physics, Inc.
BKG	background
CCC	Carlucci Construction Company
cm	centimeter
cm^2	square centimeter
cpm	counts per minute
DCGL	derived concentration guideline level
DOE	U.S. Department of Energy
dpm/100 cm^2	disintegrations per minute per 100 square centimeters
EAC	Environmental Assessment Company
EML	Environmental Measurements Laboratory
ESSAP	Environmental Survey and Site Assessment Program
ft	feet
ft^3	cubic feet
ha	hectare
H&S	health & safety
HASL	Health and Safety Laboratory
ITP	Intercomparison Testing Program
kg	kilogram
km	kilometer
m	meter
mm	millimeter
m^2	square meter
m^3	cubic meter
MAPEP	Mixed Analyte Performance Evaluation Program
MDC	minimum detectable concentration
MDCR	minimum detectable count rate
MeV	megaelectron volts
NaI	sodium iodide
NIST	National Institute of Standards and Technology
NRC	U.S. Nuclear Regulatory Commission
NRIP	NIST Radiochemistry Intercomparison Program
ORISE	Oak Ridge Institute for Science and Education
ORNL	Oak Ridge National Laboratory
PADEP	Pennsylvania Department of Environmental Protection
pCi/g	picocuries per gram
SROO	Savannah River Operations Office
SSC	Superior Steel Company

RADIOLOGICAL SCOPING SURVEY
FOR PORTIONS OF THE SUPERBOLT FACILITY
(FORMERLY SUPERIOR STEEL COMPANY)
PHASE 2
CARNEGIE, PENNSYLVANIA

INTRODUCTION AND SITE HISTORY

During the early 1950's, there was a demand for flat, plate-type reactor fuel elements since it was determined that this type of element provided a far greater surface-to-volume ratio than the conventional cylindrical slugs—allowing more efficient use of uranium in reactors. The Atomic Energy Commission (AEC), a predecessor of the U.S. Department of Energy (DOE), therefore solicited contractors for the fabrication of these fuel elements. Superior Steel Corporation (SSC) was successful in their bid for this work.

In the authority review performed by The Aerospace Corporation (AC), the effective date of the AEC contract [Contract No. AT (30-1) – 1412] with SSC was June 27, 1952 and the contract was terminated on September 30, 1957 (AC 1985). According to general correspondence, the work performed by SSC was developmental in nature and limited to the production of flat plates of uranium metal in support of the Savannah River Operations Office (SROO) fuel element development program. With the exception of some special equipment provided by AEC, the facilities and equipment used in support of the contract were owned by SSC. Security inspection records obtained from the SROO indicated SSC initiated the AEC work in March 1953 (AC 1985).

A portion of the former SSC facility, located in Carnegie, Pennsylvania, was used for the handling and milling of uranium metal. Uranium metal processing, depending on the desired final product, consisted of a combination of salt bathing, rolling, brushing, shaping, cutting, stamping, and coiling. The treatment and handling processes generated large quantities of radioactive dust, primarily uranium. Although there was ventilation of this airborne material to varying degrees, the facility system was not adequate to prevent residual contamination of the working areas. This was noted in an AEC Health and Safety Laboratory (HASL) 1955 air monitoring survey in which it was stated "excessive amounts of airborne contamination were

found in all operational areas" (DOE 1995). Historical information indicated that the areas used were cleaned before and after each operation and typically on weekends when the plant was otherwise idle. Cleaning consisted of hosing down the equipment with water until only negligible surface contamination remained (DOE 1995). The HASL report stated that "a significant potential existed for residual contamination at the facility due to the high concentration of dust during the hot rolling operations and the 'wash-down' procedures used to clean the equipment." The HASL report also recommended that additional controls and procedures were needed to monitor the rolling mill during and after operations (AC 1985). According to the authority review by AC, the radiological status of the facility was unknown at the time the AEC contract was terminated. No documents have been found that indicate a final cleanup and radiological survey of the facility was part of the close-out procedures of the contract.

In 1980, the Health and Safety Research Division at Oak Ridge National Laboratory (ORNL) conducted a preliminary radiological survey at the SSC facility. These survey activities indicated that residual uranium contamination above the guidelines in effect in 1980, from former mill operations, existed on building surfaces. Evidence of contamination was found in the former Mill Room, the Rolling Area, and in a storage shed adjacent to the Rolling Area. Gamma radiation exposure rates were measured at up to 500 μR/h in the pits in the former Rolling Area and a soil sample collected from the bottom of the pit had a uranium (U-238) concentration of 5,800 pCi/g. Gamma exposure rates in a nearby storage shed were measured at up to 400 μR/h and a soil sample collected from under the wooden floor contained 1,100 pCi/g of uranium (U-238). The extent of the contamination in these areas could not be determined at that time due to site conditions such as thick coke dust and residue on horizontal and vertical surfaces, heavy equipment and other stored materials on the floor, and rubble in the subfloor pits. It was stated in the cover letter of the ORNL report that "a formal survey of the facility should be carried out ... (that) significant building cleanup is required prior to initiation of any survey effort. This cleanup would consist of removing coke dust from vertical and horizontal surfaces ... and removal of rubble located in subfloor pits to allow for investigation of the lower walls and floors of those pits" (ORNL 1981).

The building that housed the uranium processing areas is now owned by Superbolt, Incorporated, a manufacturer of mechanical stud and bolt tensioners. Superbolt has leased out the areas in question to other businesses for use as storage space and for limited light industrial activities.

Because historical information and previous survey data were limited, Applied Health Physics, Inc. (AHP), was subcontracted through Superbolt's environmental contractor, Environmental Assessment Company (EAC), to perform a preliminary radiological characterization of the site during 1997. AHP survey activities included peripheral screening of areas outside the building e.g., a storm drain on the southeast corner of the Mill Area (which was deemed the outfall for the Mill Area cooling pits), and a gamma scan survey of the property, including the banks of Chartiers Creek. AHP surveys did not identify any elevated radiation levels for the peripheral areas—Mill Area (Area 23A), the Motor Room (Area 23E), or the Rolling Area (Area 23D). However, elevated gamma radiation levels were detected at the southwestern section of the Storage Shed at approximately ten times the natural background levels. The identification of elevated radiation levels near an exterior wall of the Storage Shed led AHP to expand the survey area to include the periphery of the Storage Shed. On two sides of the shed, elevated gamma levels were found in the soil and sample analyses confirmed elevated levels of uranium (AHP 1997a).

In the Fall of 1997, AHP remediated approximately 12 m^3 (400 ft^3) of contaminated soil and concrete from the former Storage Shed Area. Follow-up surveys by a representative of the Pennsylvania Department of Environmental Protection (PADEP) indicated that the Storage Shed Area met the U.S. Nuclear Regulatory Commission (NRC) criteria for release for unrestricted use; however, due to the remaining potential for sub-floor pit contamination within the former Mill Area, as discussed in the 1981 ORNL report, and the finding of two additional areas within the Rolling Area by the PADEP representative, PADEP requested that additional survey activities be performed within the facility. AHP personnel then performed additional remediation activities and the results were reported in a Field Service Report dated December 2, 1997 (AHP 1997b).

At the request of the NRC's Division of Waste Management, the Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE)

performed radiological scoping survey activities on various portions of the Superbolt facility during the period of August 28 through September 1, 2000 (ORISE 2001). These Phase 1 ESSAP survey activities were performed in Superbolt Building 23 Complex areas 23A (ORISE Area A), 23E (ORISE Area B), and 23D (ORISE Area C) and consisted of alpha, beta, and gamma scans; beta surface activity measurements; exposure rate measurements; soil sampling; and miscellaneous sampling. The survey was to also include collection of soil samples from the bottom of excavated trenches; however, this was not possible in all of the trenches since some trenches were filled with water or hazardous debris which were beyond the scope of the ESSAP site-specific health and safety (H&S) plan and ORISE H&S Manual (ORISE 2000a and 2000b). Results of the limited scoping survey activities indicated that significant residual surface contamination remained at the site on the horizontal structural surfaces (floor and overhead structures) within Area 23D (surface activity measurements were not performed in Areas 23A and 23E), and within the soil at various locations throughout the interior and exterior of the surveyed areas (ORISE 2001).

The NRC's Division of Waste Management requested that ESSAP of ORISE perform additional radiological evaluations of portions of the Superbolt facility that were not addressed during Phase 1. The areas that were evaluated included five warehouses (Areas 23A, 23B, 23C, 23D and 23E) that comprise Superbolt Building Complex Number 23. ESSAP also reviewed existing site data and will develop a cost estimate [in conjunction with Carlucci Construction Company (CCC)] associated with further evaluation of the radiological status of the under-floor trench that runs through Areas 23A and 23D.

SITE DESCRIPTION

SSC is located in Carnegie, Pennsylvania and is approximately eight kilometers [km (five miles)] southwest of downtown Pittsburgh (Figure 1). The SSC facility consists of several manufacturing and office buildings occupying approximately ten hectares [ha (25 acres)] of which manufacturing, storage, and support facilities occupy about six ha. The site is bounded on the north, west, and south by Chartiers Creek and on the east by Superior Street.

The portion of the Building 23 Complex where the AEC contract work (uranium milling) was performed was a large steel structure; AEC work was performed in three of the five areas—the former Mill Area (Area 23A), the former Motor Room (Area 23E), and the former Rolling Area (Area 23D) totaling 5,850 m^2 of floor space (Figure 2). The building consists of metal frames and roofs and the siding is corrugated steel. The floor construction varies from area to area and is a combination of poured concrete, brick and bare earth. There are few windows, several garage-type doors, some standard door entrances, and various roof ventilator fans.

Area 23A (2,300 m^2) originally contained the salt bath, roughing mill, brushing station, finishing stands and shear, and was the location where the majority of the uranium metal handling and shaping is believed to have occurred (Figure 3). All machinery involved in the roughing mill process has been previously removed, sold, or scrapped. Subfloor pits, approximately 2.5 m (8 ft) deep, over which the milling equipment was originally located, have been filled-in with rubble and the surfaces concreted over to floor level with a six-inch layer of concrete. This area was reutilized later to rebuild coke oven doors. Currently, Area 23A, is being used as a storage area for equipment that was not part of the uranium milling or coke door rebuilding processes; approximately 20% of the floor space is being used for storage.

Area 23B (1,760 m^2) was not included during the previous ESSAP radiological survey activities. During limited radiological surveys by NRC and PADEP personnel, residual radiological contamination was found embedded at the base of a few structural support columns and in a section of a railroad track within the building. Also, Superbolt had stored radiological waste, generated during the previous AHP remediation work, in containers (55 gallon drums and B25 boxes) within this building. Currently, approximately 50% of the floor space is being used for storage of supplies.

Area 23C (920 m^2) was also not included in the previous ESSAP radiological survey activities. Currently, approximately 10% of the floor space is covered with a small utility/work trailer/office at the north end of the building. No materials or supplies are being stored in this area.

Area 23D (1,250 m^2) originally was the location of the end process of the uranium milling—it was in this area that the metal was rolled for shipping. There were two pits located at the south

end of this area where the bliss downcoiler and upender originally were located. Both pits have been filled with rubble and concreted to floor level. Area 23D is sealed-off from the former Mill Area (Area 23A) by a sheet-metal wall. A small storage shed is attached to the west side of Area 23D. Currently, Area 23D is empty except for the 55 gallon drums and B25 boxes containing remediated waste which are stored in the south end of the area.

Area 23E (1,300 m^2) originally contained the former Motor Room and control panels that powered the mill equipment in Area 23A. During the ORNL surveys, this area was considered the clean side of the mill since the atmosphere was controlled to provide proper operating conditions for the motors and instruments (ORNL 1981). Currently, approximately 20% of Area 23E floor space is being used for storage purposes.

OBJECTIVES

The objectives of these scoping survey activities were to determine if significant contamination remained on other portions of the site and to provide additional survey documentation for previously surveyed areas to further support future remediation of contaminated areas and/or to identify areas that are suitable for unrestricted use. In addition, information was gathered to support the development of the cost estimate associated with the evaluation of the under-floor pits/trenches which will be addressed in Phase 3 of the Superbolt Project.

DOCUMENT REVIEW

ESSAP has previously reviewed the limited site documentation and used the information gathered from that review and the previous ESSAP survey report to plan these scoping survey activities (ORNL 1981, DOE 1995, AHP 1997a and b, and ORISE 2001).

PROCEDURES

During the period of August 18 through 20, 2003, ESSAP performed a limited radiological scoping survey of the SSC facility. The survey activities were conducted in accordance with a site-specific survey plan, submitted to and approved by the NRC, and the ORISE/ESSAP Survey Procedures and Quality Assurance Manuals (ORISE 2003a, b and c).

The areas to be surveyed were to be broken up into survey areas based on contamination potential. Areas with the greatest potential for contamination, such as Areas 23D and 23A along the trench line and Area 23B in the proximity of the railroad tracks where contamination was identified, were to receive the more intensive evaluation. Results, as the survey progressed, indicated that contamination was widespread in Area 23B (in areas other than in the proximity of the railroad tracks) and at the north end of Area 23C; therefore, survey activities were expanded in these areas.

FORMER URANIUM MILLING TRENCHES AND PITS

ESSAP subcontracted with CCC for services necessary to provide a detailed cost estimate associated with evaluating the radiological status of the under-floor pits and trenches which will include: waste removal and disposal of materials from within the trenches, the possible refilling of the trenches with appropriate material/backfill and recapping of the open trenches after the completion of future radiological survey activities. The effort covered by this plan was limited to obtaining physical measurements and above-floor radiological surveys only. Activities during this scoping survey did not include any work involving the excavation or direct access to the pit or trench areas.

REFERENCE SYSTEM

Measurement and sampling locations were referenced on figures prepared by ESSAP (Figures 4 through 9).

SURFACE SCANS

Alpha plus beta and gamma radiation surface scans were performed on approximately 80% of the floor surfaces for Areas 23A and 23E; 90% for Areas 23C and 23D; and, 50% for Area 23B. Alpha plus beta scan coverage was approximately 25% for lower wall areas and 5% for upper surfaces in each area that was surveyed. Particular attention was given to cracks and joints in structural surfaces and on horizontal surfaces where material may have accumulated. Gamma surface scans were performed on approximately 100% of the available exterior area out to two meters from the exterior walls on all sides of the Area 23B and Area 23C facilities (Figure 2). Scans were performed using gas proportional and NaI scintillation detectors coupled to

ratemeters or ratemeter-scalers with audible indicators. Locations of elevated direct radiation detected by surface scans were marked and identified for further investigation.

SURFACE ACTIVITY MEASUREMENTS

During the previous ESSAP survey activities, construction material specific backgrounds were performed in areas of similar construction but without a history of radioactive material use (ORISE 2001). Construction material backgrounds were collected for the following materials: finished and unfinished poured concrete, metal (I-beams), brick and wood surfaces. These measurements were used to correct gross surface activity measurements.

Direct measurements of surface activity were primarily performed at locations of elevated direct radiation identified by surface scans. The direct measurements were performed using gas proportional detectors. All detectors were coupled to ratemeters or ratemeter-scalers with audible indicators. Smear samples, for determining removable gross alpha and gross beta activity levels, were collected at most of the direct measurement locations. Areas of residual activity were brought to the immediate attention of the NRC site representative.

Area 23A

Direct measurements of surface activity were performed at 30 locations within Area 23A—15 of those measurements were from locations of elevated direct radiation identified by surface scans (Figure 4).

Area 23B

Direct measurements of surface activity were performed at 30 locations within Area 23B—24 of those measurements were from locations of elevated direct radiation identified by surface scans (Figure 5).

Area 23C

Direct measurements of surface activity were performed at 34 locations within Area 23C—six of those measurements were from locations of elevated direct radiation identified by surface scans in the northwest corner of the facility (Figure 6).

Area 23D

Direct measurements of surface activity were performed at 29 locations within Area 23D—13 of those measurements were from locations of elevated direct radiation identified by surface scans (Figure 7).

Area 23E

Direct measurements of surface activity were performed at 27 locations within Area 23E—12 of those measurements were from locations of elevated direct radiation identified by surface scans (Figure 8).

EXPOSURE RATES

Exposure rate measurements were performed throughout the facility at a minimum of five locations in each area. Exposure rates were performed at one meter above the surface using a microrem meter (Figure 9).

SOIL SAMPLING

One surface (0 to 15 cm) soil sample was collected from a location of elevated radiation within Area 23B from beneath a brick floor adjacent to a structural steel I-beam footer (Figure 5).

MISCELLANEOUS MEASUREMENTS AND SAMPLING

Five dust/residue samples were collected from the horizontal surfaces of the overhead I-beams; four residue samples were collected from the floor surfaces; and a brick sample (with residue) was collected from a floor surface. These samples were collected from locations of elevated radiation that were identified during surface scans. Miscellaneous sampling locations are shown in Figures 5 through 8.

SAMPLE ANALYSIS AND DATA INTERPRETATION

Samples and data were returned to ORISE's ESSAP laboratory in Oak Ridge, Tennessee for analysis and interpretation. Sample analyses were performed in accordance with the ORISE/ESSAP Laboratory Procedures Manual (ORISE 2003d). Soil and miscellaneous material

samples were analyzed by gamma spectroscopy and the results were reported in units of picocuries per gram (pCi/g). The radionuclides of interest are those associated with natural processed uranium; however, spectra were reviewed for natural thorium and other identifiable total absorption peaks (photopeaks). Smears were analyzed for gross alpha and gross beta activity using a low-background gas proportional counter. Direct measurement data and smear data were converted to units of disintegrations per minute per 100 square centimeters (dpm/100 cm^2). Exposure rates were reported in microroentgens per hour (μR/h). Additional information concerning major instrumentation, sampling equipment, and analytical procedures is provided in Appendices A and B.

FINDINGS AND RESULTS

DOCUMENT REVIEW

Historical data previously submitted for review and the results of previous ORISE survey activities indicated that the soil contamination was associated with the process line trenches and that surface contamination was associated with horizontal surfaces and would most likely be found on overhead structural surfaces. Also, NRC investigative surveys indicated that residual contamination was found on surfaces in areas outside of the Rolling Mill process areas (ORNL 1981, DOE 1995, AHP 1997a and b, and ORISE 2001).

SURFACE SCANS

Interior

Alpha plus beta and gamma surface scans of the interior floors identified areas of elevated radiation above background within each area; areas of residual contamination were located along the floor, lower walls and overhead I-beams with areas of contamination ranging from twice to 450 times background. The majority of the floor surface contamination was on the exposed brick floor surface in Area 23B and in the northwest corner of Area 23C—however; contamination was also present along horizontal upper surfaces in Areas 23B and 23E.

Exterior

Gamma surface scans (out to two meters along the east, west, and south sides of the Area 23B and Area 23C facilities) did not identify any areas of elevated radiation.

SURFACE ACTIVITY LEVELS

Results of the total and removable surface activity levels for Area 23 are presented in Tables 1 through 5. A summary of the direct measurement results for each area is provided below.

Area 23A

Beta surface activity levels in Area 23A ranged from 3 to 8,000 dpm/100 cm^2 for the floor, 0 to 16,000 dpm/100 cm^2 for the lower walls, and 140 to 1,200 dpm/100 cm^2 for the upper surfaces. Removable surface activity levels for all surfaces ranged from 0 to 5 dpm/100 cm^2 for alpha and -4 to 7 dpm/100 cm^2 for beta (Table 1).

Area 23B

Beta surface activity levels in Area 23B ranged from 220 to 130,000 dpm/100 cm^2 for the floor, 360 to 100,000 dpm/100 cm^2 for the lower walls, and 320 to 16,000 dpm/100 cm^2 for the upper surfaces. Removable surface activity levels for all surfaces ranged from 0 to 16 dpm/100 cm^2 for alpha and -3 to 17 dpm/100 cm^2 for beta (Table 2).

Area 23C

Beta surface activity levels in Area 23C ranged from -43 to 140,000 dpm/100 cm^2 for the floor, -79 to 200 dpm/100 cm^2 for the lower walls, and 82 to 3,700 dpm/100 cm^2 for the upper surfaces. Removable surface activity levels for all surfaces ranged from 0 to 3 dpm/100 cm^2 for alpha and -5 to 7 dpm/100 cm^2 for beta (Table 3).

Area 23D

Beta surface activity levels in Area 23D ranged from -24 to 44,000 dpm/100 cm^2 for the floor, -200 to 6,900 dpm/100 cm^2 for the lower walls, and 540 to 15,000 dpm/100 cm^2 for the upper

surfaces. Removable surface activity levels for all surfaces ranged from 0 to 9 dpm/100 cm^2 for alpha and -3 to 24 dpm/100 cm^2 for beta (Table 4).

Area 23E

Beta surface activity levels in Area 23E ranged from 320 to 13,000 dpm/100 cm^2 for the floor, -410 to 12,000 dpm/100 cm^2 for the lower walls, and 330 to 7,200 dpm/100 cm^2 for the upper surfaces. Removable surface activity levels for all surfaces ranged from 0 to 3 dpm/100 cm^2 for alpha and -5 to 9 dpm/100 cm^2 for beta (Table 5).

EXPOSURE RATES

Exposure rates are presented in Table 6. Exposure rates ranged from 8 to 10 µR/h for Area 23A; 6 to 11 µR/h for Area 23B; 6 to 7 µR/h for Area 23C; 6 to 8 µR/h for Area 23D; and, 6 to 9 µR/h for Area 23E.

RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLE

Radionuclide concentrations in the soil sample collected from beneath the brick floor at the base of a footer in Area 23B were 9.2 pCi/g for U-235 and 221 pCi/g for U-238.

RADIONUCLIDE CONCENTRATIONS IN MISCELLANEOUS SAMPLES

Radionuclide concentrations in the residue samples, presented in Table 7, ranged from 5.6 to 138 pCi/g for U-235 and 158 to 3,600 pCi/g for U-238.

COMPARISON OF RESULTS WITH GUIDELINES

The primary contaminant at this site is uranium. The NRC requested that ESSAP compare the survey findings to the former guidelines used for licensees. Therefore, the applicable NRC guidelines for natural uranium surface activity levels on building structural surfaces are as follows (NRC 1987):

Natural Uranium

5,000 α dpm/100 cm^2, averaged over a 1 m^2 area
15,000 α dpm/100 cm^2, total, maximum in a 100 cm^2 area
1,000 α dpm/100 cm^2, removable

These uranium surface activity guidelines specify alpha activity (α); however, because rough, dirty, or porous surfaces may selectively attenuate alpha radiation, beta activity measurements provide a more accurate representation of the residual contamination present. Based on the equivalent alpha to beta decay ratio, beta activity levels may be considered representative of uranium surface activity and are used for guideline comparison. Of the 149 direct measurement locations, 43 exceed the average guideline with thirteen of those locations exceeding the maximum guideline. All of the removable activity measurements were within the removable activity guideline.

All of the miscellaneous samples were collected from locations of elevated direct activity measurement locations. These samples are also indicative of residual activity greater than background levels.

The NRC screening level DCGLs for uranium in soil are as follows (NRC 1999):

Uranium Isotope	DCGL (pCi/g)
U-238	14
U-235	8
U-234	13

Uranium-234 can not be directly quantified from gamma spectroscopy at these DCGL values. Previous alpha spectroscopy results were used to confirm that the isotopic uranium ratios were consistent with processed natural uranium yielding a ratio of 1 to 1 for U-234 to U-238 (ORISE 2001).

Therefore it was decided that U-238 would serve as a surrogate for U-234. This approach requires the calculation of a modified DCGL for the surrogate. The modified U-238 DCGL was calculated as follows:

$$DCGL_{\text{mod},U-238} = DCGL_{U-238} * \frac{DCGL_{U-234}}{\left\{\left[\left(\frac{C_{U-234}}{C_{U-238}}\right) * DCGL_{U-238}\right] + DCGL_{U-234}\right\}}$$

Where $\left(\frac{C_{U-234}}{C_{U238}}\right) = 1$ as determined from alpha spectroscopy results (ORISE 2001,Table 5) and the $DCGL_{\text{mod, U-238}}$ was calculated to be 6.7 pCi/g.

Furthermore, the unity rule (sum-of-ratios) was used to determine whether the sum of each radionuclide concentration (U-235 and U-238) divided by its DCGL was less than or equal to one. Both of the uranium isotopes in the soil sample exceeded their individual DCGLs for the sample.

SUMMARY

During the period of August 18 through 20, 2003, the Environmental Survey and Site Assessment Program of the Oak Ridge Institute for Science and Education performed radiological scoping survey activities at the former Superior Steel Company in Carnegie, Pennsylvania. Survey activities consisted of alpha plus beta and gamma scans; beta surface activity measurements; exposure rate measurements; soil sampling; and miscellaneous sampling.

It was the intent of this survey to determine if significant contamination remained on other portions of the Area 23 Complex and to provide additional survey documentation for previously surveyed areas to further support future remediation activities and identify areas that are suitable for unrestricted use. In addition, information was gathered to support the development of the cost estimate that would be associated with the evaluation of the under-floor pits/trenches that would be addressed in future survey activities.

Survey results indicated that significant contamination, exceeding the guidelines, remains on the floor and lower walls in Area 23B and on the floor in the northwest corner of Area 23C (Figure 10). There were several areas of elevated activity throughout each of the other areas (Areas 23A, 23D, and 23E). A few of these locations have surface activity that exceed the maximum guideline criteria; however, the majority of these elevated surface activity locations are discrete,

small areas that do not exceed the 1 m^2 averaging guideline level. Also, there are several upper surface areas (Areas 23B, 23C, 23D and 23E) where direct measurements on the horizontal upper surface I-beams exceed the average (but not the maximum) total surface activity criteria. Surface activity measurements before and after the dust/residue samples were collected indicated that the majority of the contamination is present or contained within the dusts/residues. The radionuclide concentrations within these samples also indicate that the contamination is removable. The residue samples scraped off the floors in Areas 23B and 23C and the soil sample collected from beneath the red brick in Area 23B also indicate that the contamination is within the residue/soil and is widespread throughout Area 23B and the northwest corner of Area 23C.

FIGURES

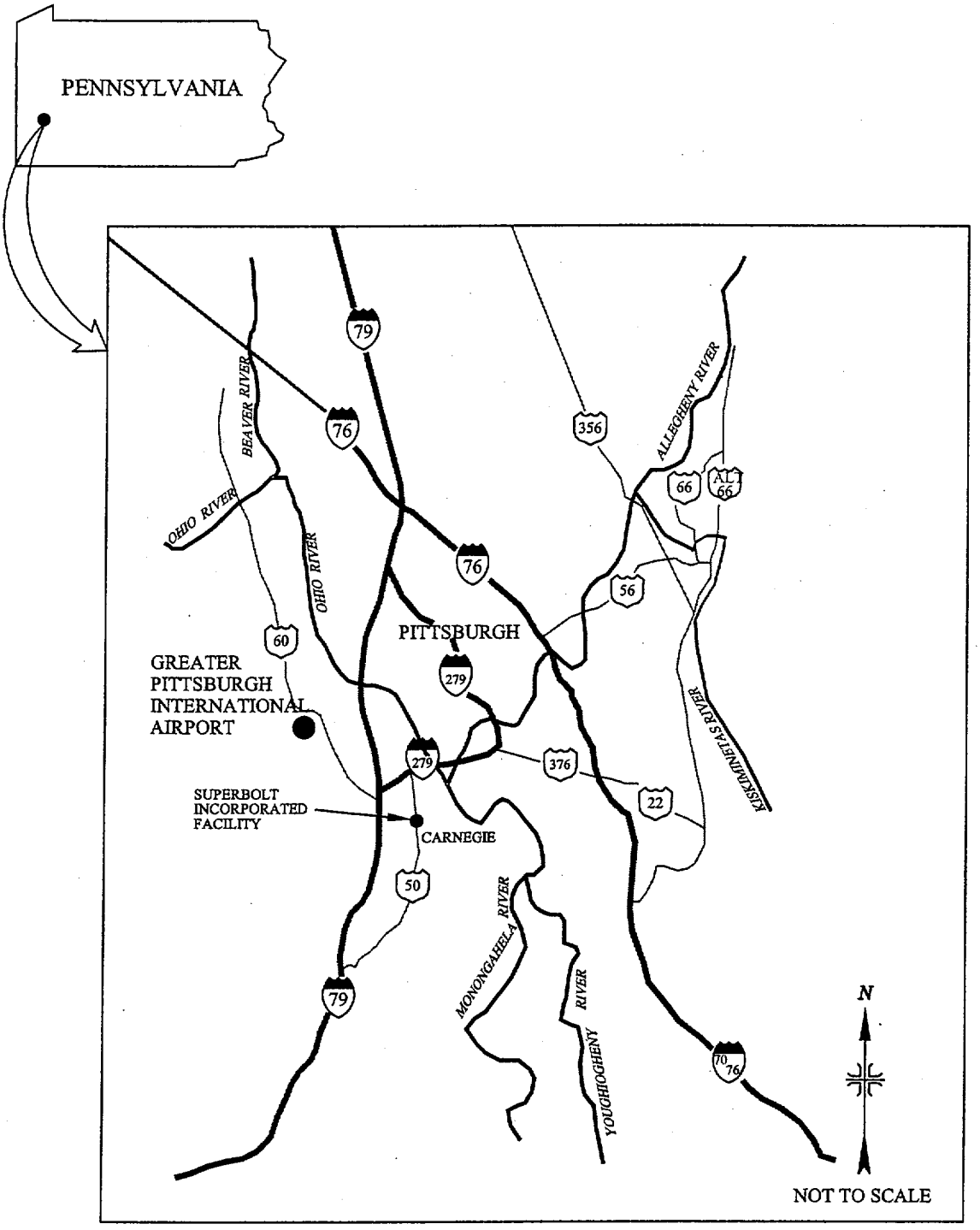


FIGURE 1: Location of the Superbolt, Incorporated Facility - Carnegie, Pennsylvania

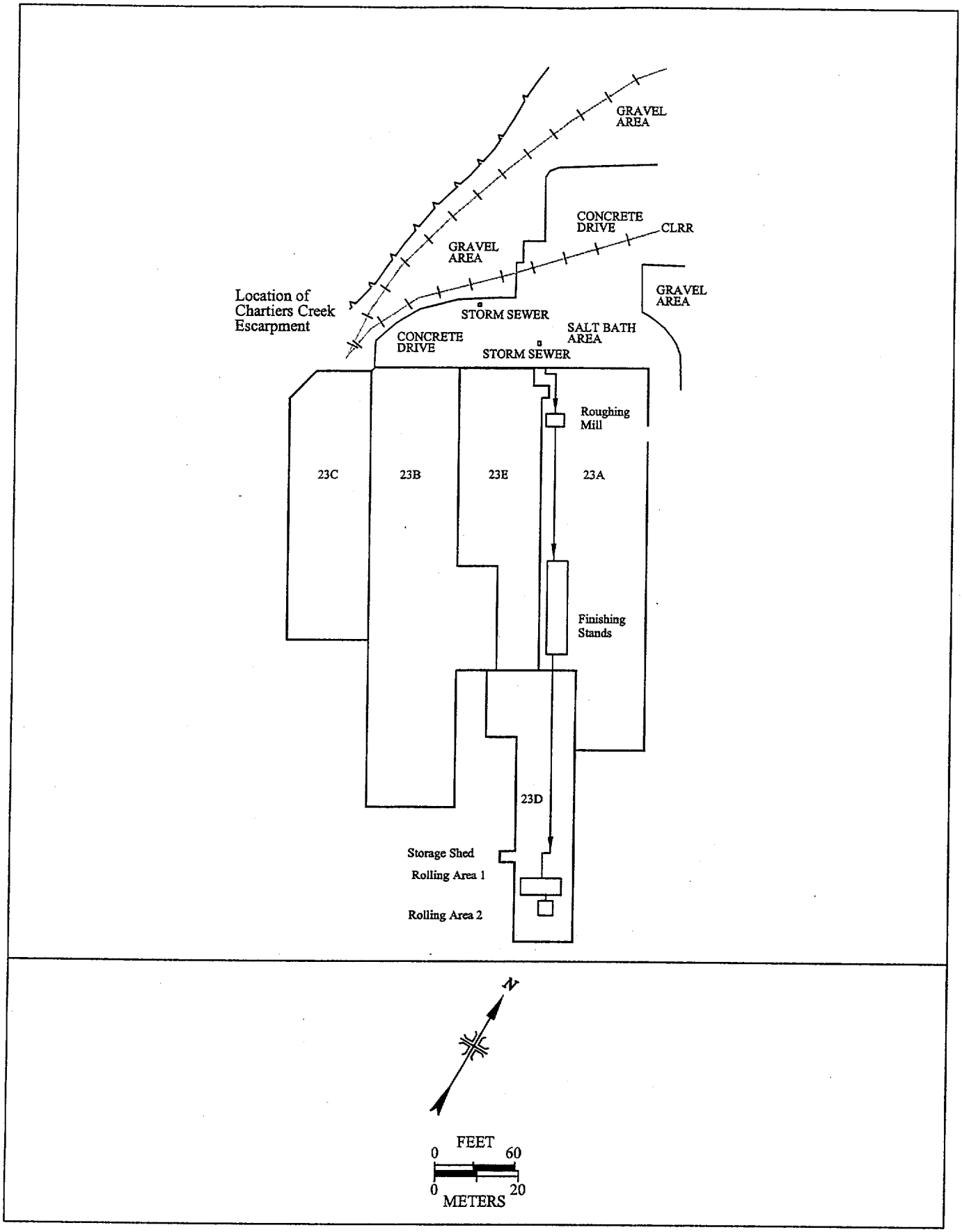
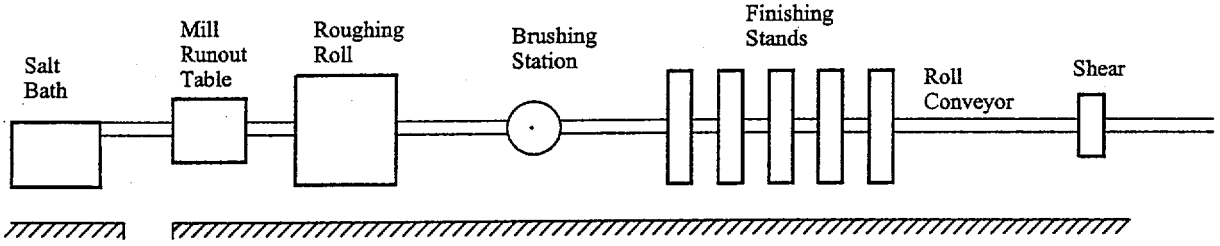
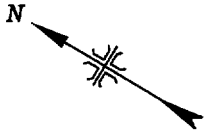


FIGURE 2: Layout of the Building 23 Complex Area Designations and Approximate Locations of Process Line Machinery





NOT TO SCALE

FIGURE 3: Schematic of the Uranium Milling Operation Conducted in 1955 in Area 23A

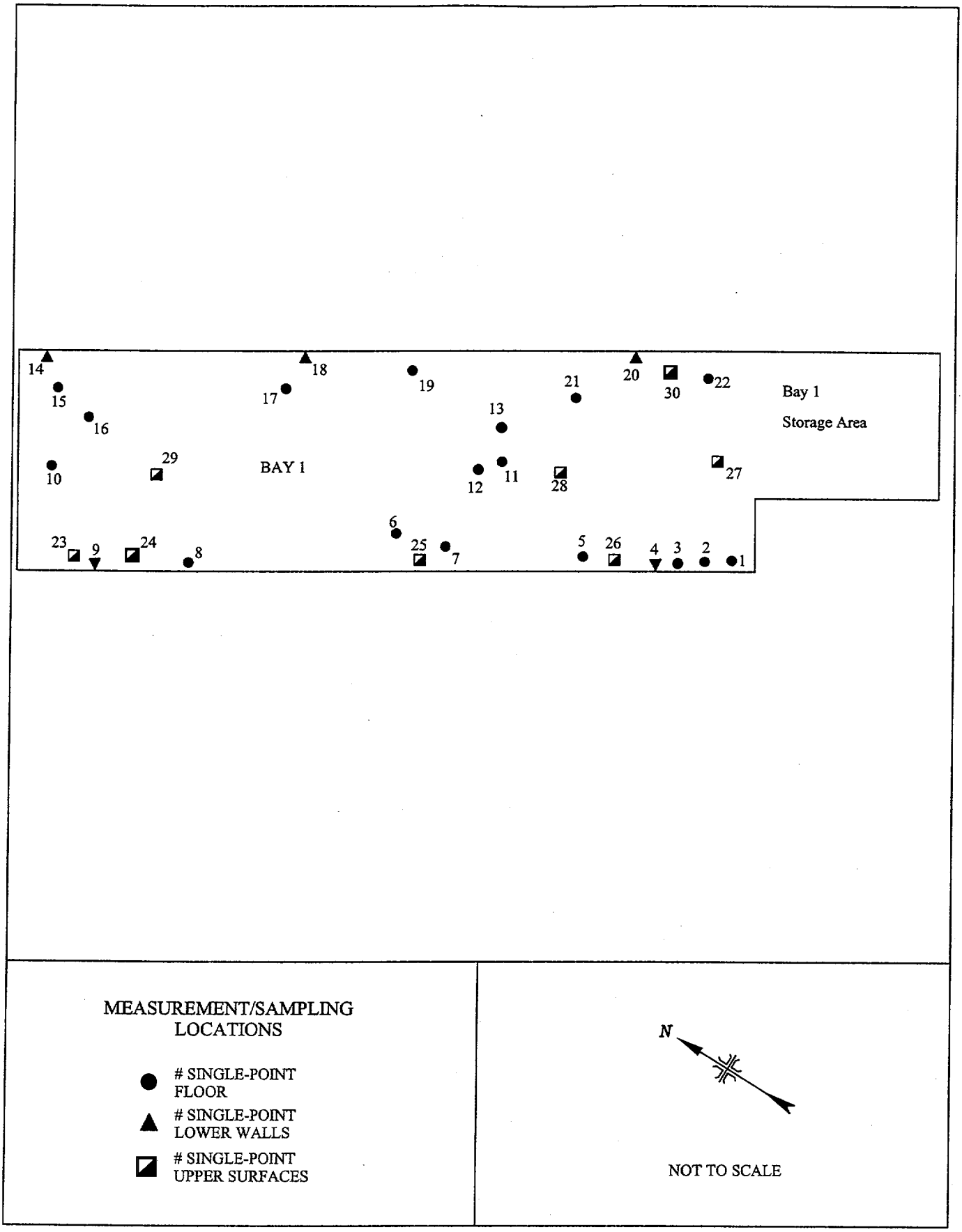


FIGURE 4: Area 23A - Measurement and Sampling Locations

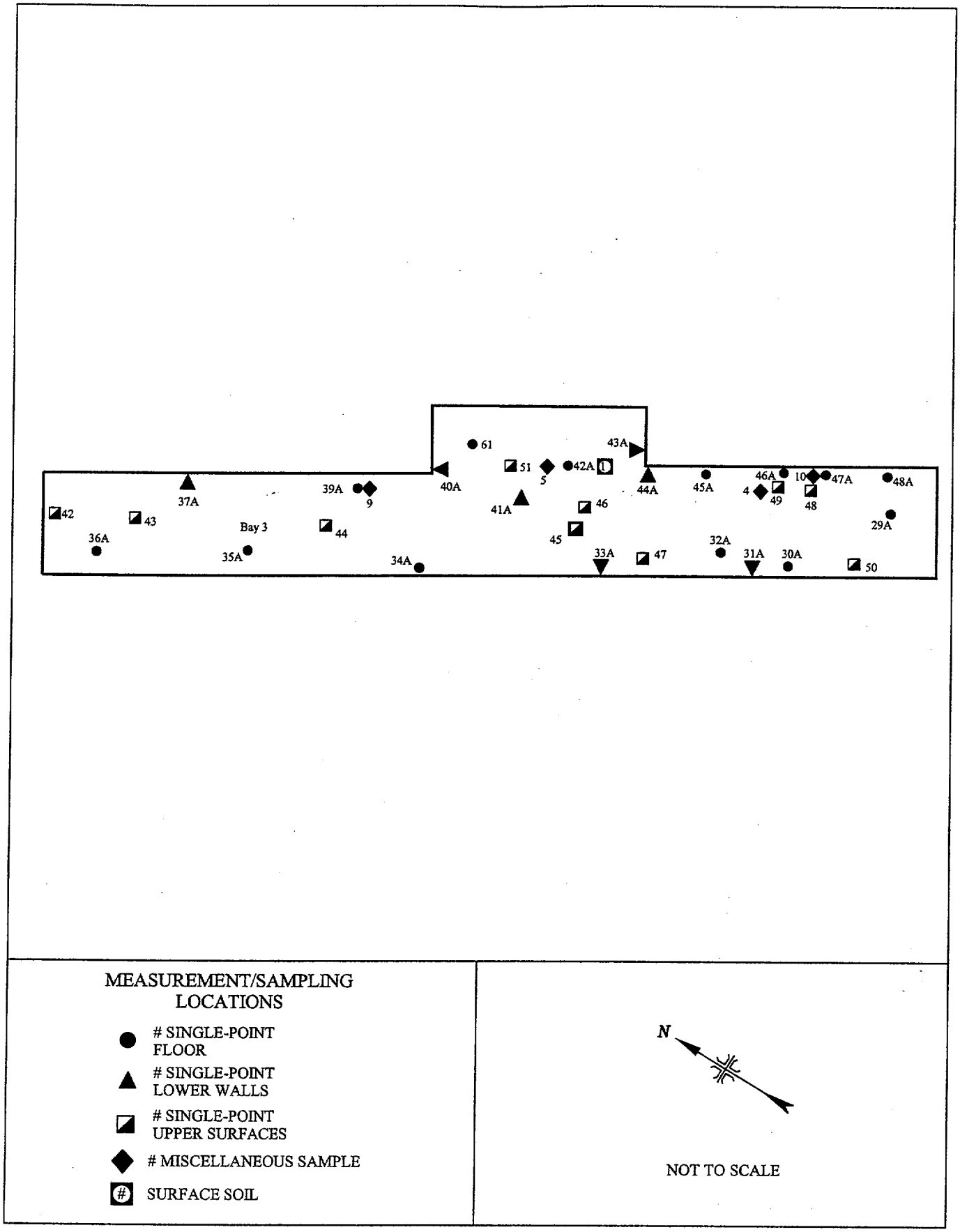


FIGURE 5: Area 23B - Measurement and Sampling Locations

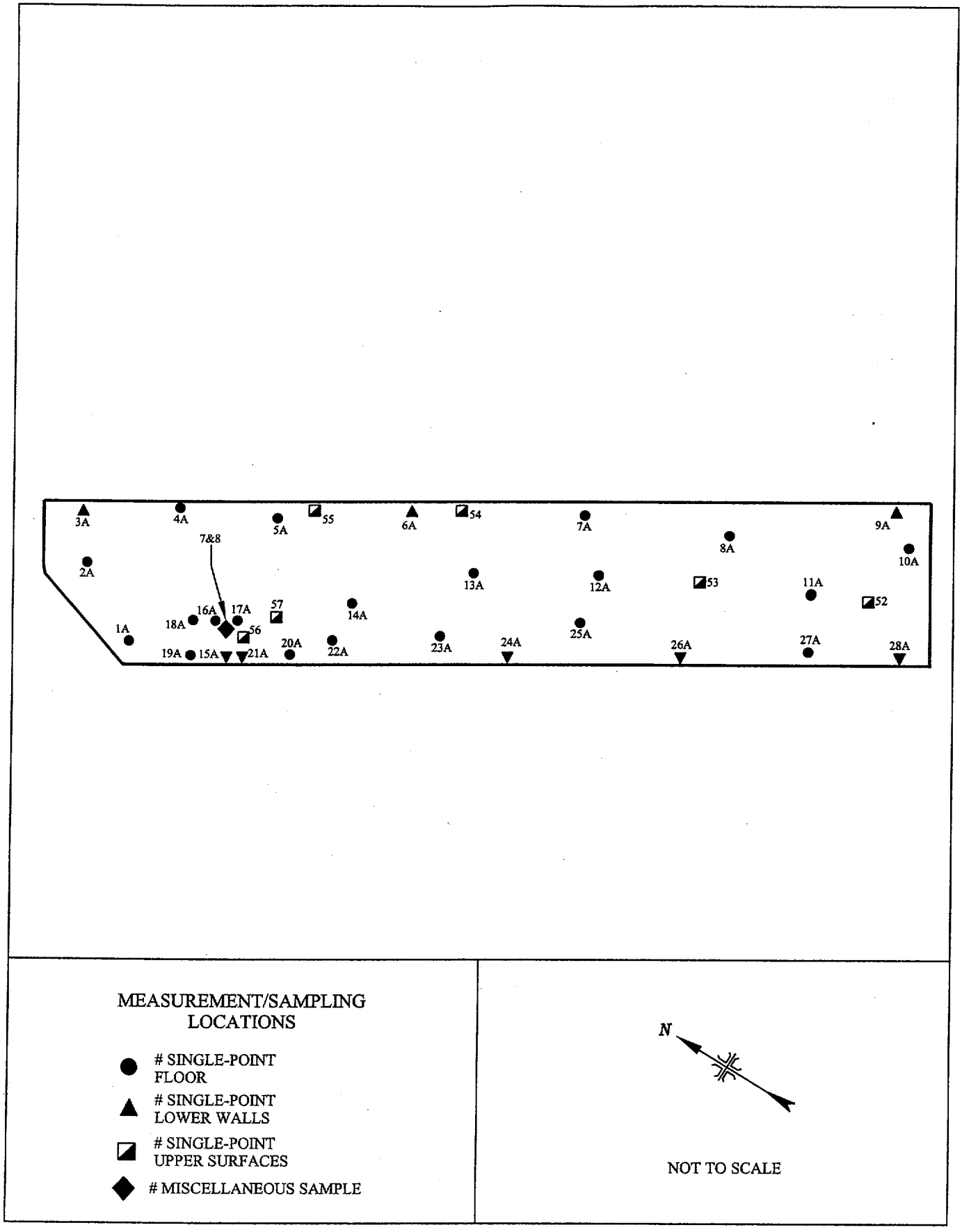


FIGURE 6: Area 23C - Measurement and Sampling Locations

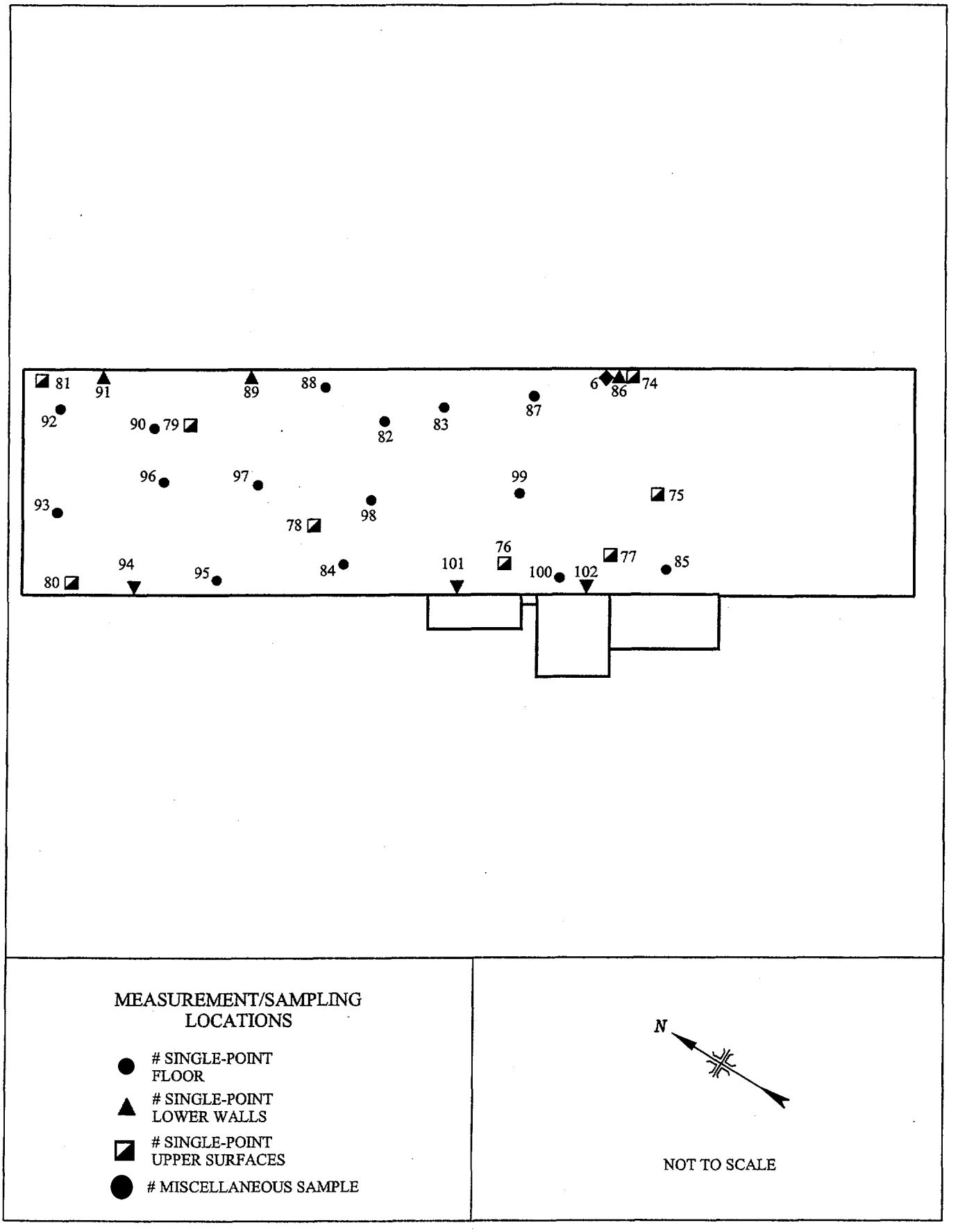
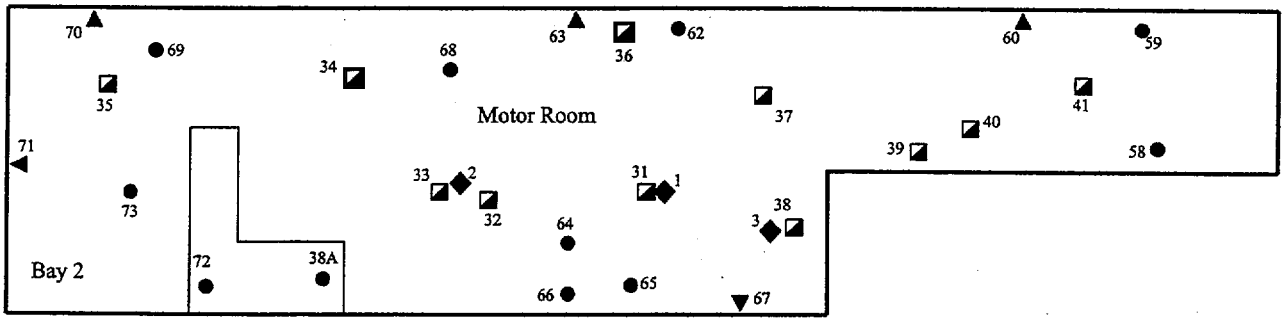


FIGURE 7: Area 23D - Measurement and Sampling Locations



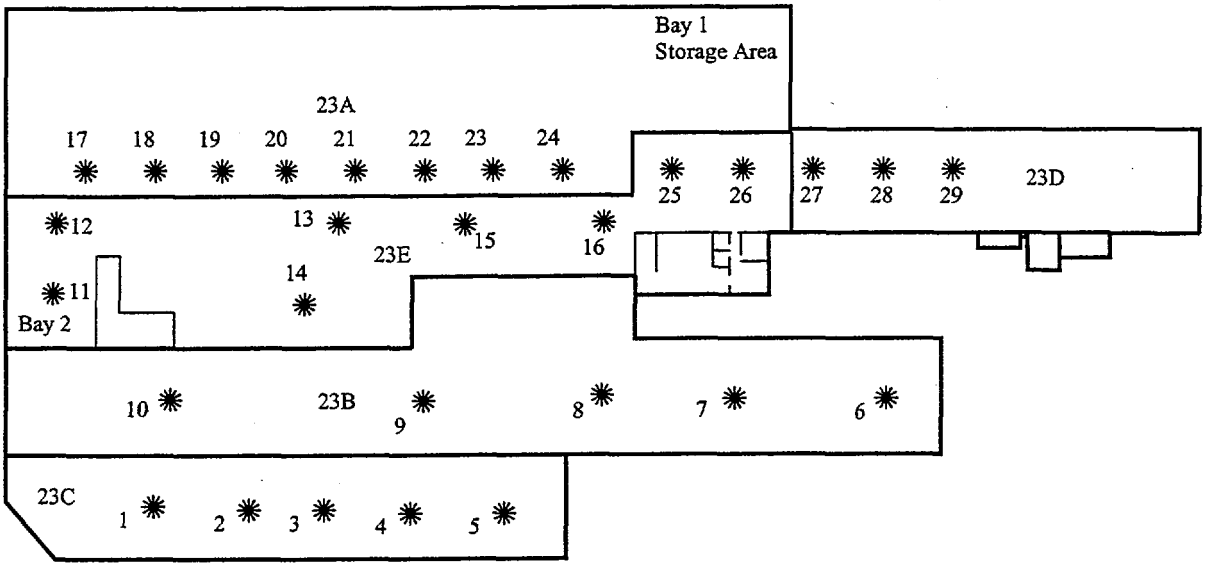
MEASUREMENT/SAMPLING LOCATIONS

- ● # SINGLE-POINT FLOOR
- ▲ # SINGLE-POINT LOWER WALLS
- ◪ # SINGLE-POINT UPPER SURFACES
- ◆ # MISCELLANEOUS SAMPLE

N

NOT TO SCALE

FIGURE 8: Area 23E - Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

EXPOSURE RATE

N

NOT TO SCALE

FIGURE 9: Building 23 Complex - Exposure Rate Measurement Locations

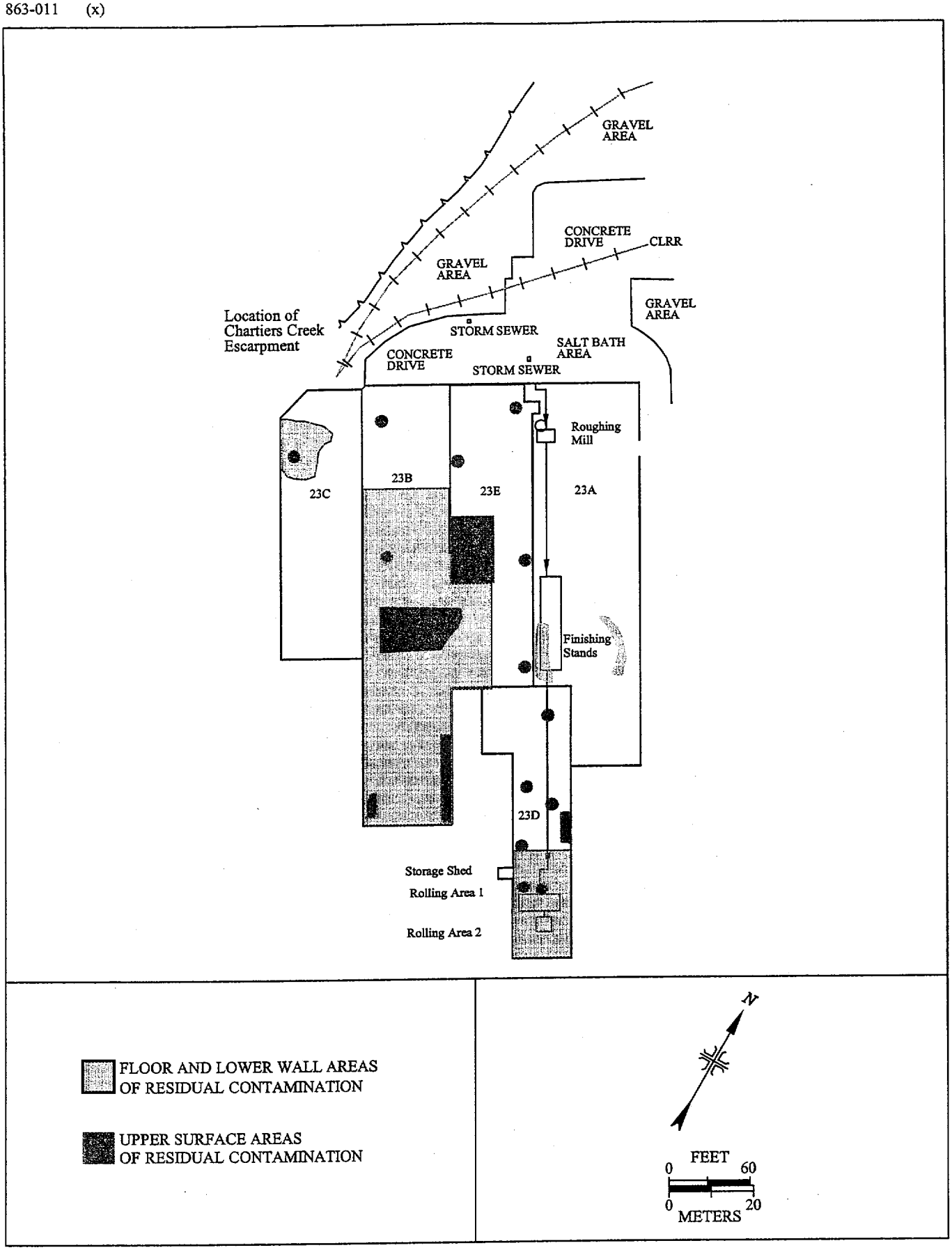


FIGURE 10: Layout of the Building 23 Complex Area Designations and Approximate Locations of Residual Contamination

TABLES

TABLE 1

SURFACE ACTIVITY LEVELS
AREA 23A
SUPERBOLT, INCORPORATED
CARNEGIE, PENNSYLVANIA

Location[a]	Surface[b]	Total Beta Activity (dpm/100 cm^2)	Removable Activity (dpm/100 cm^2)	
			Alpha	Beta
1	F	2,800	3	3
2	F	7,400	1	-3
3	F	950	0	1
4	LW	16,000	1	2
5	F	2,400	0	3
6	F	2,600	3	-2
7	F	1,700	0	-3
8	F	660	0	-3
9	LW	2,700	1	2
10	F	3	0	7
11	F	6,700	0	-1
12	F	8,000	3	5
13	F	2,800	3	-2
14	LW	620	1	1
15	F	230	3	-2
16	F	490	0	3
17	F	220	5	2
18	LW	280	1	-1
19	F	820	0	2
20	LW	0	0	-4
21	F	2,500	0	-1
22	F	4,800	1	-2
23	US	140	5	3
24	US	750	3	3
25	US	180	1	-2
26	US	270	0	-1
27	US	1,200	1	-3
28	US	160	0	-1
29	US	350	5	2
30	US	190	0	1

[a]Refer to Figure 4.
[b]F = floor, LW = lower wall, and US = upper surface.

TABLE 2

SURFACE ACTIVITY LEVELS
AREA 23B
SUPERBOLT, INCORPORATED
CARNEGIE, PENNSYLVANIA

Location[a]	Surface[b]	Total Beta Activity (dpm/100 cm^2)	Removable Activity (dpm/100 cm^2)	
			Alpha	Beta
42	US	320	0	3
43	US	2,600	5	1
44	US	4,000	9	10
45	US	2,000	1	-3
46	US	510	5	5
47	US	570	3	5
48	US	3,100	0	1
49	US	16,000	--	--
50	US	2,300	1	-3
51	US	2,800	0	1
29A	F	4,900	0	-1
30A	F	6,900	1	3
31A	LW	27,000	0	-2
32A	F	17,000	11	12
33A	LW	7,000	1	1
34A	F	2,300	1	3
35A	F	1,500	0	1
36A	F	300	1	2
37A	LW	360	0	-2
39A (Unshielded)	F	63,000	9	3
39A (Shielded)	F	1,000	--	--
40A	LW	5,500	0	-1
41A	LW	100,000	1	1
42A	F	130,000	3	4
43A	LW	7,500	3	11
44A	LW	8,200	0	9
45A	F	3,200	1	-1
46A	F	2,600	1	5
47A	F	22,000	16	17
47A (PS)	F	13,000	--	--
48A	F	31,000	9	16
61	F	220	0	3

[a]Refer to Figure 5. PS = post sample direct measurement.
[b]F = floor, LW = lower wall, and US = upper surface.

TABLE 3

SURFACE ACTIVITY LEVELS
AREA 23C
SUPERBOLT, INCORPORATED
CARNEGIE, PENNSYLVANIA

Location[a]	Surface[b]	Total Beta Activity (dpm/100 cm^2)	Removable Activity (dpm/100 cm^2)	
			Alpha	Beta
1A	F	160	1	2
2A	F	55	0	1
3A	LW	-79	1	2
4A	F	-43	0	-5
5A	F	330	3	-1
6A	LW	24	0	-4
7A	F	420	1	7
8A	F	64	1	-2
9A	LW	27	0	3
10A	F	150	0	-1
11A	F	110	0	-1
12A	F	200	0	-4
13A	F	280	0	1
14A	F	210	1	-3
15A	LW	73	1	-1
16A	F	140,000	0	4
16A (PS)	F	86,000	--	--
17A	F	74,000	1	4
17A (PS)	F	18,000	--	--
18A	F	44,000	0	1
19A	F	8,400	0	3
20A	F	33,000	0	2
21A	LW	46	0	3
22A	F	200	3	-3
23A	F	98	1	2
24A	LW	170	0	-4
25A	F	450	1	2
26A	LW	110	1	-3
27A	F	220	0	2
28A	LW	200	0	-3
52	US	640	0	-5
53	US	680	0	2
54	US	82	0	2
55	US	340	0	-1
56	US	3,700	1	3
57	US	530	0	-1

[a]Refer to Figure 6. PS = post sample direct measurement.

[b]F = floor, LW = lower wall, and US = upper surface.

TABLE 4

SURFACE ACTIVITY LEVELS
AREA 23D
SUPERBOLT, INCORPORATED
CARNEGIE, PENNSYLVANIA

Location[a]	Surface[b]	Total Beta Activity (dpm/100 cm^2)	Removable Activity (dpm/100 cm^2)	
			Alpha	Beta
74	US	9,300	--	--
75	US	6,200	0	3
76	US	4,900	7	24
77	US	11,000	0	14
77 (PS)	US	15,000	--	--
78	US	4,500	9	1
79	US	750	0	-1
80	US	540	0	-1
81	US	1,500	0	-1
82	F	3,300	0	-3
83	F	7,300	0	-2
84	F	6,600	1	-2
85	F	44,000	3	24
86	LW	6,900	0	2
87	F	120	0	-2
88	F	190	0	-2
89	LW	420	0	1
90	F	6,500	0	4
91	LW	-55	0	-1
92	F	170	0	1
93	F	310	0	1
94	LW	-200	0	4
95	F	98	0	-1
96	F	130	0	-1
97	F	-24	0	7
98	F	150	0	3
99	F	140	0	-3
100	F	89	0	-1
101	LW	-130	0	-3
102	LW	4,300	0	-3

[a]Refer to Figure 7. PS = post sample direct measurement.
[b]F = floor, LW = lower wall, and US = upper surface.

TABLE 5

SURFACE ACTIVITY LEVELS
AREA 23E
SUPERBOLT, INCORPORATED
CARNEGIE, PENNSYLVANIA

Location[a]	Surface[b]	Total Beta Activity (dpm/100 cm^2)	Removable Activity (dpm/100 cm^2)	
			Alpha	Beta
31	US	6,800	--	--
31 (PS)	US	2,900	--	--
32	US	6,100	--	--
33	US	7,200	--	--
33 (PS)	US	1,500	--	--
34	US	1,200	0	-1
35	US	500	0	-2
36	US	560	1	-1
37	US	1,200	3	6
38	US	5,500	--	--
38 (PS)	US	470	--	--
39	US	900	1	-2
40	US	800	1	-2
41	US	330	0	3
58	F	320	3	-2
59	F	3,400	0	-1
60	LW	-15	0	2
62	F	3,900	0	3
63	LW	-410	3	1
64	F	6,900	1	3
65	F	9,200	1	-3
66	F	6,100	0	-5
67	LW	12,000	1	1
68	F	330	3	1
69	F	13,000	--	--
70	LW	-37	1	1
71	LW	-100	1	-3
72	F	760	0	1
73	F	350	1	3
38A	F	4,100	1	9

[a]Refer to Figure 8. PS = post sample direct measurement.
[b]F = floor, LW = lower wall, and US = upper surface.

TABLE 6

EXPOSURE RATES
BUILDING 23 COMPLEX
SUPERBOLT, INCORPORATED
CARNEGIE, PENNSYLVANIA

Exposure Rate Measurement Locations[a]	Exposure Rate at 1 m Above Surface (μR/h)
1	7
2	7
3	6
4	7
5	7
6	11
7	9
8	7
9	6
10	7
11	6
12	6
13	9
14	6
15	7
16	7
17	8
18	9
19	8
20	9
21	10
22	8
23	8
24	8
25	8
26	7
27	8
28	6
29	8

[a]Refer to Figure 9.

TABLE 7

RADIONUCLIDE CONCENTRATIONS IN MISCELLANEOUS SAMPLES
BUILDING 23 COMPLEX
SUPERBOLT, INCORPORATED
CARNEGIE, PENNSYLVANIA

Area Sample Location Direct Measurement[a]	Sample Type	Radionuclide Concentration[b] (pCi/g)	
		U-235	U-238
23E 1 DM31[c]	Residue/Dust from upper surface I-beam	9.7 ± 2.3[d]	239 ± 65
23E 2 DM33	Residue/Dust from upper surface I-beam	12.0 ± 2.7	345 ± 96
23E 3 DM38	Residue/Dust from upper surface I-beam	8.7 ± 1.8	181 ± 50
23B 4 DM49	Residue/Dust from upper surface I-beam	15.9 ± 2.2	380 ± 70
23B 5 NA[e]	Brick with residue from the floor	27.6 ± 4.5	590 ± 160
23D 6 DM74	Residue from upper surface	5.6 ± 2.0	158 ± 62
23C 7 DM16A	Residue from floor surface	138 ± 18	3,600 ± 400
23C 8 DM17A	Residue from floor surface	25.2 ± 3.7	573 ± 95
23B 9 DM39A	Residue from floor surface at railroad track	79.7 ± 6.2	2,100 ± 180
23B 10 DM47A	Residue from floor surface	15.6 ± 2.2	323 ± 63

[a]Refer to Figures 5 through 8.
[b]The reported data are qualitative due to geometry considerations.
[c]DM = Direct Measurement Location.
[d]Uncertainties represent the 95% confidence levels based on total propagated uncertainty.
[e]NA = Not Applicable.

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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 his employer.

SCANNING INSTRUMENT/DETECTOR COMBINATIONS

Alpha Plus Beta

Ludlum Floor Monitor Model 239-1
combined with
Ludlum Ratemeter-Scaler Model 2221
coupled to
Ludlum Gas Proportional Detector Model 43-37, Physical Area: 550 cm^2
(Ludlum Measurements, Inc., Sweetwater, TX)

Ludlum Ratemeter-Scaler Model 2221
coupled to
Ludlum Gas Proportional Detector Model 43-68, Physical Area: 126 cm^2
(Ludlum Measurements, Inc., Sweetwater, TX)

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)

DIRECT MEASUREMENT INSTRUMENT/DETECTOR COMBINATIONS

Beta

Ludlum Ratemeter-Scaler Model 2221
coupled to
Ludlum Gas Proportional Detector Model 43-68, Physical Area: 126 cm^2
(Ludlum Measurements, Inc., Sweetwater, TX)

Gamma (Exposure Rate)

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

LABORATORY ANALYTICAL INSTRUMENTATION

High Purity Extended Range Intrinsic Detector
Model No. GMX-45200-5
(EG&G 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 Extended Range Intrinsic Detectors
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)

Low Background Gas Proportional Counter
Model LB-5100-W
(Tennelec/Canberra, Meriden, CT)

APPENDIX B

SURVEY AND ANALYTICAL PROCEDURES

APPENDIX B

SURVEY AND ANALYTICAL PROCEDURES

PROJECT HEALTH AND SAFETY

All survey and laboratory activities were conducted in accordance with ORISE health and safety and radiation protection programs.

CALIBRATION AND QUALITY ASSURANCE

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

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

- Survey Procedures Manual (February 2003)
- Laboratory Procedures Manual (February 2003)
- Quality Assurance Manual (April 2003)

The procedures contained in these manuals were developed to meet the requirements of DOE Order 414.1A 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, ITP, and EML Laboratory Quality Assurance Programs.
- Training and certification of all individuals performing procedures.
- Periodic internal and external audits.

Detectors used for assessing surface activity were calibrated in accordance with ISO-7503[1] recommendations. The total efficiency (ϵ_{total}) was determined for each instrument/detector combination and consisted of the product of the 2π instrument efficiency (ϵ_i) and surface efficiency (ϵ_s): $\epsilon_{total} = \epsilon_i \times \epsilon_s$

The beta calibration ϵ_i ranged from 0.51 - 0.52 for the gas proportional detectors calibrated to Tl-204. The beta calibration source was selected based on the beta energy distribution of the radionuclide. ISO-7503 recommends an ϵ_s of 0.5 for maximum beta energies greater than 0.4 MeV. The total beta efficiency factors ranged from 0.25 to 0.26 for the gas proportional detectors.

SURVEY PROCEDURES

Surface Scans

Surface scans were performed by passing the detectors slowly over the surface; the distance between the detectors and the surface was maintained at a minimum—nominally about 1 cm. A large surface area (550 cm^2), gas proportional floor monitor was used to scan the floors of the surveyed areas. Other surfaces were scanned using small area (126 cm^2) hand-held gas proportional detectors. Identification of elevated levels was based on increases in the audible signal from the recording and/or indicating instrument.

[1] International Standard. ISO 7503-1, Evaluation of Surface Contamination - Part 1: Beta-emitters (maximum beta energy greater than 0.15 MeV) and alpha-emitters. August 1, 1988.

Scan minimum detectable concentrations (MDCs) were estimated using the calculational approach described in NUREG-1507.[2] The scan MDC is a function of many variables, including the background level. Typical beta background levels on floors and walls range from 800 to 1,400 cpm for the large area gas proportional detectors and range from 250 to 450 cpm for the hand-held gas proportional detectors. Additional parameters selected for the calculation of scan MDCs include a one-second observation interval for the gas proportional detectors, a specified level of performance at the first scanning stage of 95% true positive rate and 25% false positive rate, which yields a d' value of 2.32 (NUREG-1507, Table 6.1), and a surveyor efficiency of 0.5. The 2π beta scanning instrument efficiencies (ϵ_i) for the floor monitor and hand-held gas proportional detectors calibrated to Tl-204 were 0.39 and 0.46, respectively. To illustrate an example for the hand-held gas proportional detector, the minimum detectable count rate (MDCR) and scan MDC for beta activity can be calculated as follows:

b_i = (250 cpm)(1 s)(1 min/60 s) = 4.2 counts,
MDCR = (2.32)(4.2 counts)^{½} [(60 s/min)/(1 s)] = 285 cpm,
$MDCR_{surveyor}$ = 285/(0.5)^{½} = 403 cpm

The scan MDC is calculated assuming a source efficiency (ϵ_s) of 0.5 (for Tl-204):

$$ScanMDC = \frac{MDCR_{surveyor}}{(\varepsilon_s)(\varepsilon_i)} dpm/100\,cm^2$$

For the given background range, the estimated scan MDC range for the floor monitor is 3,600 to 4,820 dpm/100 cm^2 and 1,750 to 2,340 dpm/100 cm^2 for the hand-held gas proportional detector.

The scan MDC for the NaI scintillation detector for uranium were obtained directly from NUREG-1507. The scan MDC was 115 pCi/g for total uranium (includes sum of all radionuclides in the uranium decay series).

Surface Activity Measurements

Measurements of total surface activity levels were performed using hand-held gas proportional detectors with portable ratemeter-scalers.

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

Count rates (cpm), which were integrated over one minute with the detector held in a static position, were converted to activity levels (dpm/100 cm^2) by dividing the net rate by the total efficiency ($\epsilon_i \times \epsilon_s$) and correcting for the physical area of the detector.

Because different building materials (poured concrete, brick, wood, steel, etc.) may have different background levels, average background count rates were determined for each material encountered in the surveyed area at a location of similar construction and having no known radiological history. The beta activity background count rates for the gas proportional detectors averaged 357 cpm for concrete, 226 cpm for metal, 617 cpm for brick, and 229 cpm for wood. The beta activity MDCs ranged from 223 to 362 dpm/100 cm^2 for the gas proportional detectors calibrated to Tl-204. The physical area of the gas proportional detectors was 126 cm^2.

Removable Activity Measurements

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

Soil Sampling

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

Residue Sampling

In order to determine if any removable activity was present in the dust/dirt layers on surfaces, residue samples were collected by scrapping the residue into a labeled plastic container with the location and other pertinent information recorded.

Analytical Procedures

Gross Alpha/Beta

Smears were counted for two minutes on a low background gas proportional system for gross alpha and gross beta activity. The MDCs of the procedure were 9 dpm/100 cm^2 for gross alpha and 15 dpm/100 cm^2 for gross beta.

Gamma Spectroscopy

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

Radionuclide	Photopeak	MDC soil (pCi/g)
U-235	0.143 MeV (or 0.186 MeV)	0.06
U-238	0.063 MeV from Th-234*	0.21
	(or 1.001 MeV from Pa-234 m)*	1.74

*Secular equilibrium assumed.

Spectra were also reviewed for other identifiable photopeaks.

UNCERTAINTIES AND DETECTION LIMITS

The uncertainties associated with the analytical data presented in the tables of this report represent the total propagated uncertainties for that data. These uncertainties were calculated based on both the gross sample count levels and the associated background count levels.

Detection limits, referred to as minimum detectable concentration (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.

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

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

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

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

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

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

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

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

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