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Formerly Utilized Sites Remedial Action Program (FUSRAP)
Contract No. DACW45-98-D-0028

Post-Remedial Action Report for the Remedial Action at the Ventron Site

Beverly, Massachusetts

March 2003

POST-REMEDIAL ACTION REPORT

FOR THE

REMEDIAL ACTION AT THE VENTRON SITE

BEVERLY, MASSACHUSETTS

March 2003

Prepared for

United States Department of Energy

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By

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ACRONYMS

AEC	U.S. Atomic Energy Commission
BNI	Bechtel National, Inc.
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
DCG	derived concentration guide
DOE	U.S. Department of Energy
FIDLER	field instrument for the detection of low-energy radiation
FUSRAP	Formerly Utilized Sites Remedial Action Program
IVC	independent verification contractor
MARSSIM	Multi-Agency Radiation Survey Site Investigation Manual
MED	Manhattan Engineer District
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety and Health Administration
PIC	pressurized ionization chamber
PPE	personal protective equipment
PMC	project management contractor
SAIC	Science Applications International Corporation

UNITS OF MEASURE

µCi	microcurie
µR	microroentgen
cm	centimeter
cpm	counts per minute
dpm	disintegrations per minute
ft	foot
h	hour
ha	hectare
in.	inch
km	kilometer
m	meter
mL	milliliter
mrem	millirem
pCi	picocurie
y	year

1.0 INTRODUCTION

1.1 BACKGROUND

This report documents the remedial action conducted by the Department of Energy (DOE) at the former Ventron Corporation site in Beverly, Massachusetts (see Figures 1-1 and 1-2). The site is located on Massachusetts Bay at the confluence of the Bass and Danvers rivers, approximately 24 km (15 miles) northeast of Boston. DOE cleanup activities documented by this report include initial remediation of site tidal flats (harbor) in September 1995 and remediation of the remainder of the site from May 1996 to March 1997.

Remedial action at Ventron was conducted under the Formerly Utilized Sites Remedial Action Program (FUSRAP). FUSRAP was established in 1974 by the U.S. Atomic Energy Commission (AEC) under the Atomic Energy Act of 1954, as amended. Its mission is to identify and clean up or otherwise control sites where residual radioactive contamination (exceeding current federal guidelines) remains from contract work for the Manhattan Engineer District (MED) or AEC.

FUSRAP's objectives at the Ventron site were to

- identify and evaluate areas formerly used to support MED/AEC nuclear development activities;
- remove or otherwise control radioactive contamination above current federal guidelines;
- achieve and maintain compliance with applicable criteria for the protection of human health and the environment; and
- certify the site, to the extent possible, for use without radiological restrictions after remediation.

Bechtel National, Inc. (BNI), the FUSRAP project management contractor, assisted in planning, management, and implementation of the DOE remedial action at the Ventron site. Science Applications International Corporation (SAIC) was the environmental studies contractor. Oak Ridge National Laboratory (ORNL) conducted designation surveys for the site, and Oak Ridge Institute for Science and Education (ORISE) served as the independent verification contractor (IVC) for final remediation. Health physics and laboratory functions were provided by Thermo NUtech Services and Safety and Ecology Corporation, the radiological support subcontractors. The owner of the Ventron site during the time of DOE remediation was Morton International, Inc. (Morton).

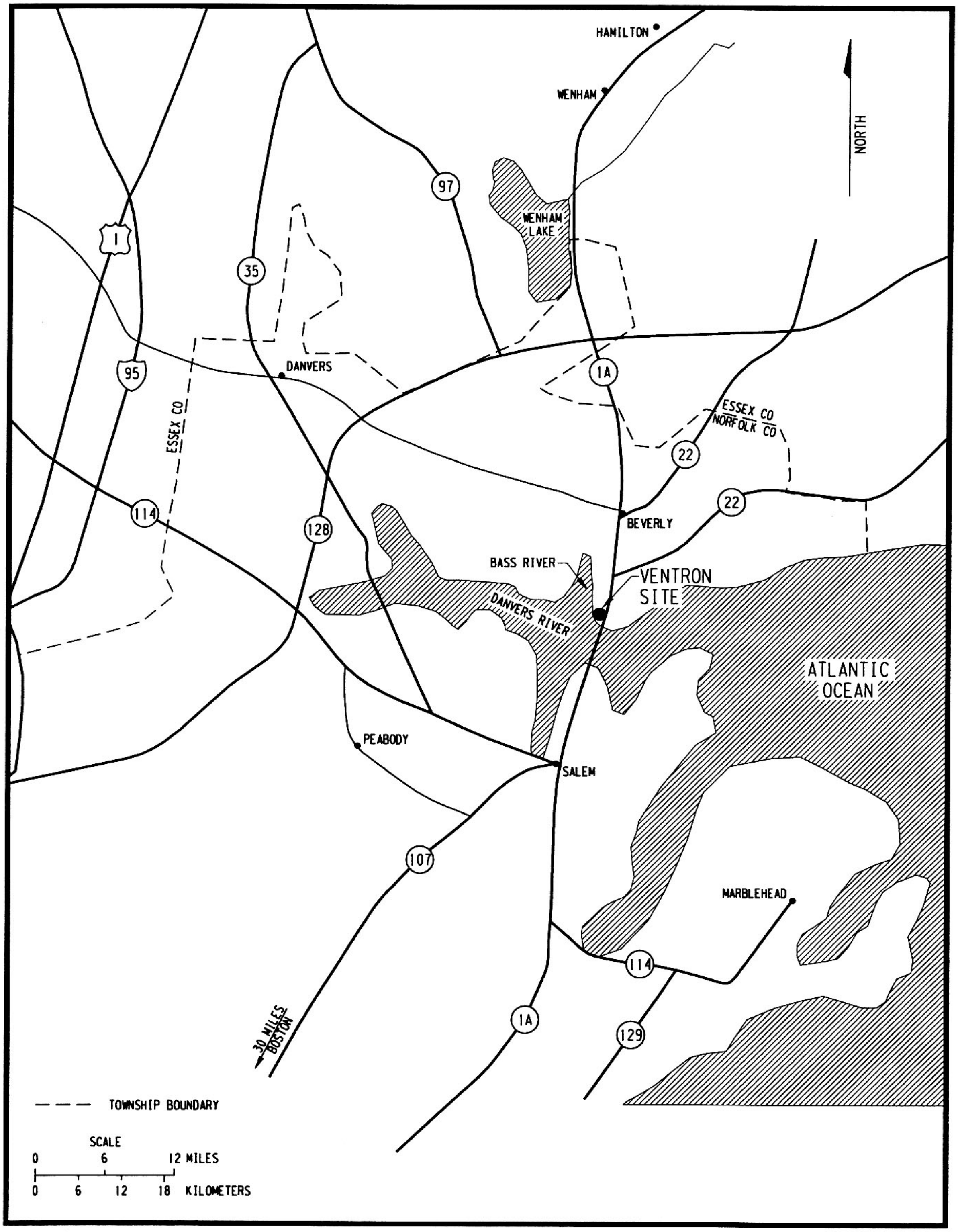

Figure 1-1
Location of the Ventron Site
Beverly, MA

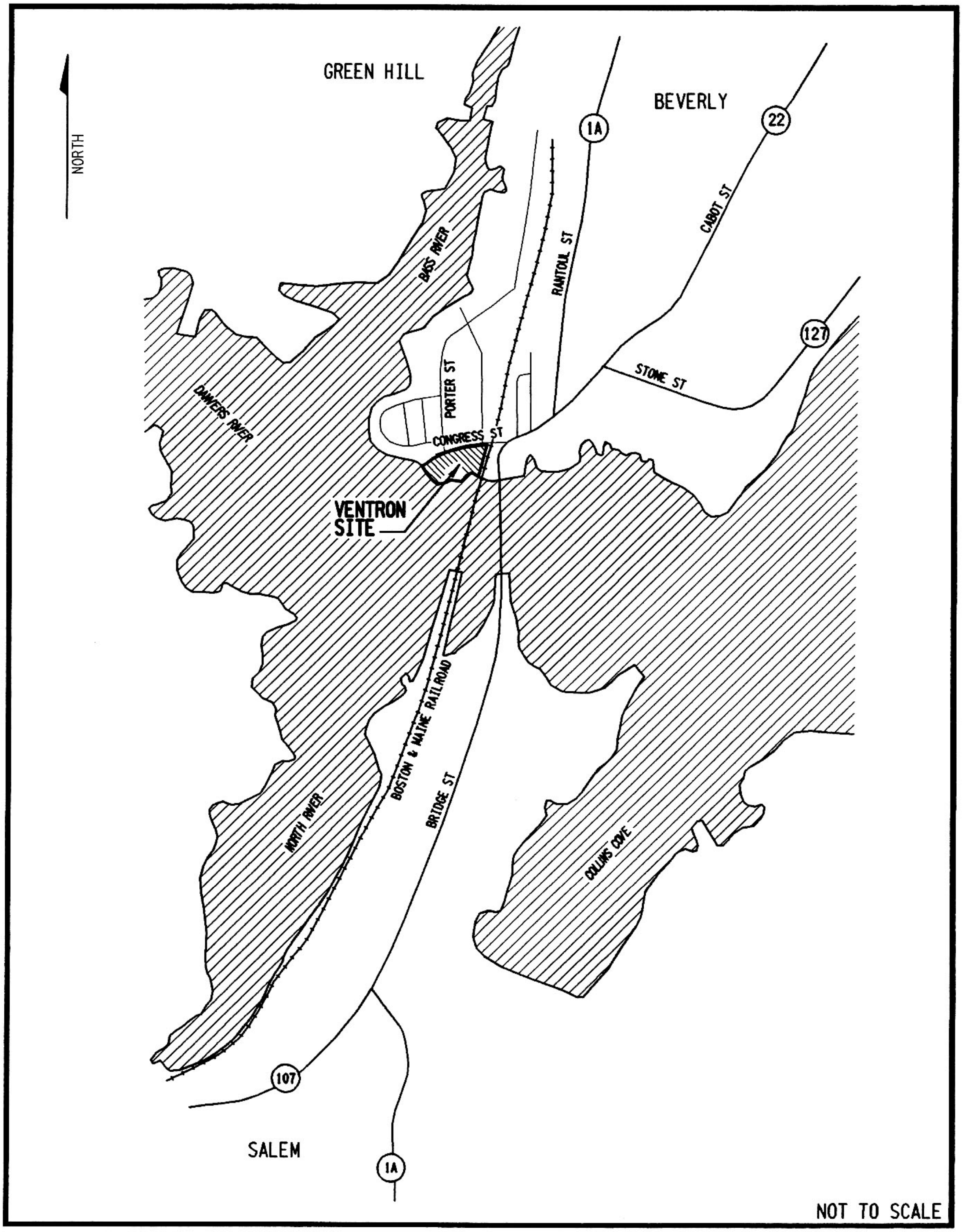

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Figure 1-2
Ventron Site Vicinity Map
Beverly, MA

1.2 REGULATORY COMPLIANCE

FUSRAP cleanup activities at the Ventron site were conducted in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Remediation in the harbor area during 1995 was conducted as a time-critical removal action to support other required site remediation activities. Excavation activities during the sitewide cleanup effort in 1996-1997 followed CERCLA requirements for non-time-critical removal actions. The engineering evaluation/cost analysis prepared for site activities was issued for public comment on February 12, 1996, and was finalized with responses to public comments in April 1996 (DOE 1996b). An Administrative Record was established and made available at the City of Beverly Library on November 6, 1995.

Environmental assessments required by the National Environmental Policy Act were incorporated in CERCLA documentation prepared for the site. An investigation was conducted in accordance with 10 CFR 1022, and floodplains, wetlands, and coastal tidal areas were determined to be present; however, proposed activities were determined to have minimal short-term and positive long-term environmental effects. Consultations with regulators regarding natural resources and endangered and threatened species determined that proposed activities would have no negative effect on these resources. Consultations with historic preservation officials determined that no protected historical or archaeological resources would be adversely affected by cleanup activities.

Cleanup activities were conducted in full compliance with federal and state waste management and transportation requirements.

1.3 HISTORY

From 1942 to 1948, the Metal Hydrides Corporation (predecessor of the Ventron Corporation), conducted uranium processing operations under contract to the MED and its successor agency, the AEC. MED/AEC contract operations at the Ventron site involved conversion of uranium oxide to uranium metal powder using calcium hydride (DOE 1995). In a process used later at the facility, uranium oxide was reacted with hydrogen fluoride to produce uranium tetrafluoride, which was mixed with magnesium and heated to produce uranium metal (ORNL 1988). Other operations at the site included recovery of uranium from scrap and turnings resulting from operations at a fuel fabrication plant in Hanford, Washington. MED/AEC contract work at Ventron involved only natural uranium; no depleted or enriched uranium was processed.

Two of the four original buildings used for MED/AEC work were demolished between 1948 and 1950 (after completion of AEC surveying and decommissioning), and two other buildings (Buildings B and F) were erected at these locations. The remaining original buildings (Buildings A and A-1) contained furnaces, leaching facilities, a mixing room, a drying room, and analytical laboratories. The Alfa Building (Building J) was used in later non-MED-related thorium operations, reportedly involving purification of thorium compounds.[1] The primary radioactive contaminant resulting from this work was thorium-232.

Radiological surveys of the land and buildings were conducted by ORNL in 1977 and in 1980 to 1982. In 1986, the Ventron site was designated for inclusion in FUSRAP. Additional radiological surveys of the site were performed by ORNL in 1987 to 1988, and in 1991, surveys were performed of properties in the vicinity of the site to determine if radiological contamination from plant operations had migrated offsite. Further characterization of radiological and chemical conditions at the site was performed by BNI for DOE in 1992.

In 1976, the Ventron Corporation was acquired by the Thiokol Corporation, which became a division of Morton Thiokol, Inc., in 1980, and was subsequently renamed Morton International in 1990. In 1994, Morton production activity at the Ventron site ceased. In 1996, DOE and Morton International finalized a Memorandum of Agreement (MOA) regarding the allocation of cleanup responsibilities between the parties at the site (see Appendix A). DOE radiological decontamination of the site concluded in 1997.

1.4 SITE DESCRIPTION

The Ventron site is located in Beverly, Massachusetts. The site occupies 1.2 ha (3 acres) on Massachusetts Bay, at the confluence of the Bass and Danvers rivers. The property is bordered by Congress Street on the north, the Boston and Maine Railroad on the east, the Bass River on the west, and the Danvers River on the south. A seawall composed primarily of granite boulders surrounds the property along its boundaries with the Danvers and Bass rivers. The western and southern boundaries of the property extend beyond the seawall to the low tide mark of the adjacent harbor.

Before remedial action began, the site was a fully operational chemical manufacturing facility comprised of three groups of buildings: the A buildings (A and A-1); the B buildings

[1] Designation of the Alfa Building as Building J is as it is identified in the 1996 DOE/Morton Memorandum of Agreement (MOA), provided as Appendix A of this report.

(B-1, B-2, and B-3; and the C buildings (C-1, C-2, C-3, and C-4). In addition, buildings E and F; the Alfa Building (Building J, the former Alfa Laboratory); and the Biocides Building[2] also existed onsite (see Figure 1-3).

Buildings A and A-1 were the original buildings used by the MED for uranium oxide storage during processing. A concrete loading pad adjacent to Building A-1 is thought to have been used for uranium oxide storage and transfer activities. Elevated levels of radioactivity were detected on interior building surfaces, on MED-related equipment, on the roof, in retort tunnels beneath Building A, and in soil beneath Building A-1. A contaminated portion of the roof was removed and replaced by DOE in 1987.

Buildings B-1, B-2, and B-3 were adjoining buildings and faced the harbor to the south. Buildings B-1 and B-2 were erected over the location of a machine shop used during MED operations. The machine shop was demolished between 1948 and 1950 after being surveyed and decommissioned according to standards in effect at that time. No residual radioactivity was detected within the B buildings; however, soil beneath the buildings was radioactively contaminated.

Buildings C-1, C-2, C-3, and C-4 were joined and faced the harbor to the west. During MED operations, two subsurface waste pits reportedly were active in the vicinity of these buildings. No residual radioactivity was detected within the buildings. Soil beneath and adjacent to the buildings was contaminated.

The Biocides Building and Building E were constructed after MED operations were completed. No MED activities were conducted in or on the site of these two buildings. The Biocides Building was in use as company offices and Building E was in use as a storage warehouse.

Building F was constructed after MED operations were completed. The foundry, which it replaced, was active during MED-related activities.

[2] Designation of the Biocides Building is as it is identified in the 1996 DOE/Morton MOA, provided as Appendix A. In contractor documents, the Biocides Building is identified as either Building D (SAIC) or J (BNI).

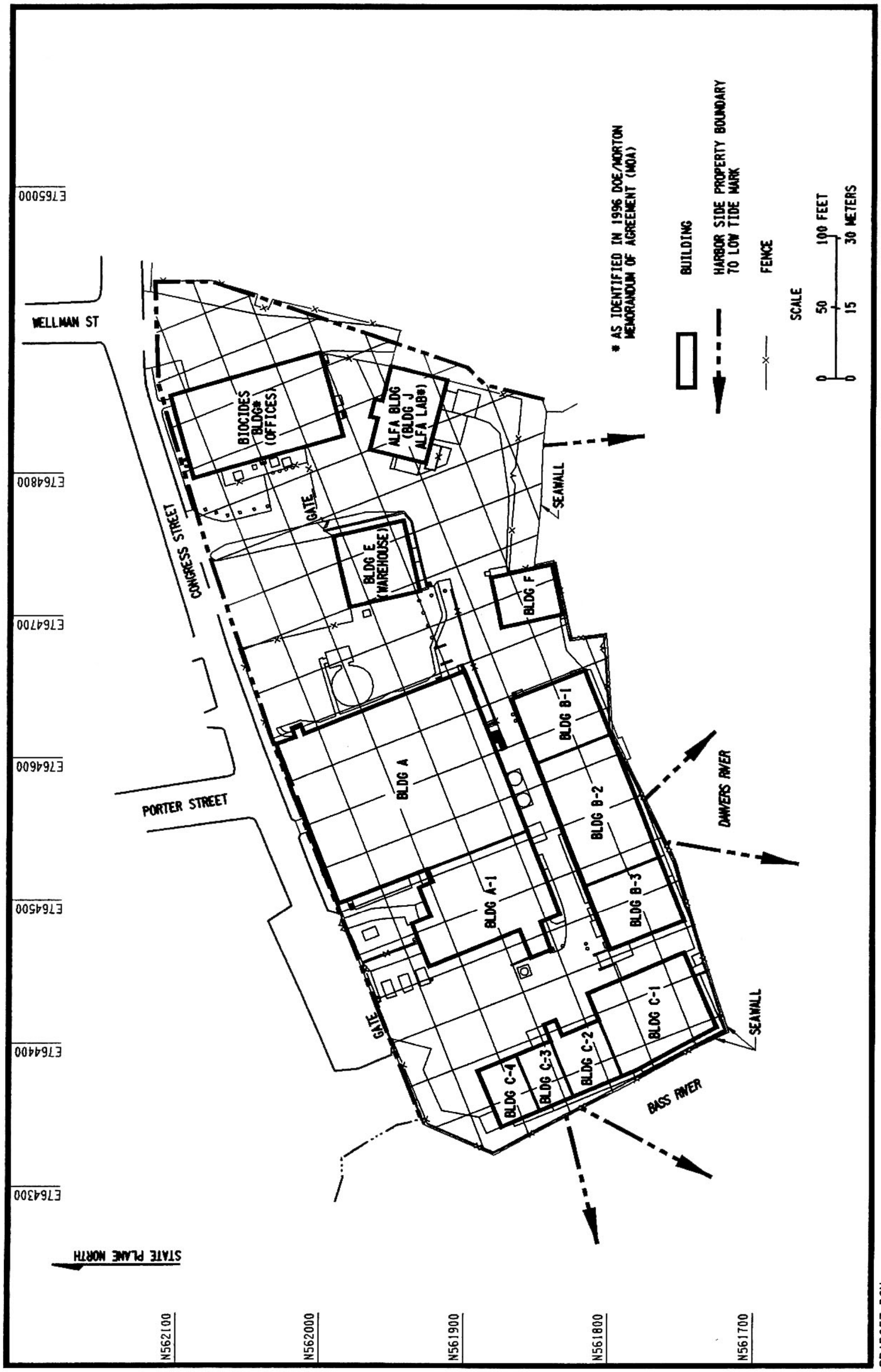

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Figure 1-3
Ventron Site Plan

2.0 REMEDIAL ACTION GUIDELINES

DOE criteria for radionuclides are provided in DOE Order 5400.5, "Radiation Protection of the Public and Environment" (DOE 1990). Chapter IV of the Order addresses release criteria for surfaces and soil contaminated with residual radioactivity. Established release criteria exists for different types of radiation and some radionuclides. Criteria for radionuclides without established concentrations are developed on a site-specific basis, in accordance with procedures established in the Order. Established criteria also may be modified, or supplemented, when conditions delineated in the Order are met.

Radioactive contaminants of concern at the Ventron site were uranium-238, thorium-232, and radium-226. Uranium-238 was identified as the primary radioactive contaminant associated with MED/AEC activities (DOE 1995). Table 2-1 summarizes DOE criteria applicable to the Ventron site.

For indoor and outdoor structural surfaces, remedial action guidelines for alpha activity from natural uranium, uranium-235, uranium-238, and associated decay products are 5,000 dpm/100 cm^2 averaged over the entire surface area; 15,000 dpm/100 cm^2 (maximum); and 1,000 dpm/100 cm^2 (removable). Guidelines for thorium-232 and associated decay products on indoor and outdoor structural surfaces are 1,000 dpm/100 cm^2 averaged over the entire surface area; 3,000 dpm/100 cm^2 (maximum); and 200 dpm/100 cm^2 (removable). Guidelines for radium-226 and associated decay products on indoor and outdoor structural surfaces are 500 dpm/100 cm^2 averaged over the entire surface area; 1,500 dpm/100 cm^2 (maximum); and 20 dpm/100 cm^2 (removable). At the Ventron site, this criteria was applicable to radioactively contaminated equipment and undemolished surfaces such as building slabs.

In addition, because Buildings A and A-1 were planned to be demolished by Morton, supplemental standards were approved by DOE for use on demolition rubble from these buildings, in lieu of established surface guidelines for structural surfaces (DOE 1996d). The rationale for supplemental limits was that established surface criteria would not be applicable to the resulting rubble/debris and that the rubble would more appropriately be compared with volumetric criteria. The approved supplemental standards for masonry rubble, metal surfaces, and other material comprising building rubble are provided in Table 2-1. The DOE approach to building rubble was provided to state regulators (DOE 1996a; MDEP 1996a and b).

Table 2-1
Summary of DOE Guidelines for Residual Radioactive Contamination at the Ventron Site

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Basic Dose Limits

Basic dose limit of 100 mrem/y (excluding radon) for member of the general public. In implementing this limit, DOE applies as-low-as- reasonably-achievable principles to set site-specific guidelines where necessary.

Site-Specific Soil Guidelines

Uranium[1]	100 pCi/g above background for total uranium; 50 pCi/g above background for uranium-238
Thorium-232	5 pCi/g above background averaged over the surface 15-cm (6-in.) layer Radium-226 of soil, and 15 pCi/g above background averaged over any 15-cm (6-in.) -thick layer of soil (below the 6-in. surface layer) regardless of depth

Building Rubble[2]

Uranium 100 pCi/g for total uranium; 50 pCi/g for uranium-238
Thorium-232 15 pCi/g
Radium-226 15 pci/g

Indoor/Outdoor Structural Surface Contamination

Residual contamination guidelines for fixed and transferable radioactive contamination (dpm/100 cm^2) (DOE Order 5400.5):

Radionuclide	Average	Maximum	Removable
Natural uranium, U--235, U-238, and associated decay products	5,000 (alpha)	15,000 (alpha)	1,000 (alpha)
Beta/gamma emitters (radionuclides with decay modes other than alpha emissions)	5,000 (beta/gamma)	15,000 (beta/gamma)	1,000 (beta/gamma)
Thorium-232	1,000	3,000	200
Radium-226	500	1,500	20

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[1]DOE 1993.
[2]DOE 1996c, 1996d.

Because no established criteria exist for uranium in soil, a DOE site-specific criterion was developed and presented to regulators (DOE 1993; DOE 1996a). The DOE site-specific criterion for residual radioactive material in soil at Ventron was 100 pCi/g above background for total uranium and 50 pCi/g above background for uranium-238, regardless of depth. Generic soil guidelines for thorium-232 and radium-226 contained in the Order were applied. The criteria for thorium-232 and radium-226 are 5 pCi/g for residual radioactive material in the first 15 cm (6 in.) of soil and 15 pCi/g for depths greater than 15 cm (6 in.).

To establish the levels of naturally occurring background radioactivity in soils near the site, samples were taken at three offsite locations. Establishment of background levels is important because cleanup guidelines are based on concentrations of radionuclides above background. Background data serve as a frame of reference for evaluating site data because they represent conditions typical of the areas unaffected by activities at the site. During remedial action, soil samples were obtained from three remote background locations in the general area of the Ventron site. Background sampling locations were selected on the basis of their proximity to the site, relative independence from potential site influence, and representativeness of area land uses.

Background sampling locations are shown in Figure 2-1. Samples from these locations were analyzed for radium-226, thorium-232, and uranium-238. Background external gamma exposure rates were also measured at these three locations using a pressurized ionization chamber (PIC). The average background concentration for uranium-238 was 2.3 pCi/g, with a range of 1.3 to 3.6 pCi/g. The average concentration of thorium-232 in background samples was 0.86 pCi/g, with a range of 0.51 to 1.2 pCi/g. The average background concentration of radium-226 was 0.59 pCi/g, with a range of 0.37 to 0.89 pCi/g. The average background external gamma exposure rate was determined to be 9.0 µR/h.

Asbestos-containing material found in retort tunnels beneath Building A was the only nonradioactive constituent mingled with residual radioactive materials at concentrations requiring remedial action. The asbestos-containing material was contaminated with radium-226 at concentrations greater than 5 pCi/g. All asbestos materials containing residual radioactive material were removed from the site and transported to Envirocare of Utah, a facility licensed for the disposal of radioactively contaminated asbestos. Although mercury was present in the harbor tidal flats, it was not commingled with residual radioactive materials at concentrations requiring remedial action.

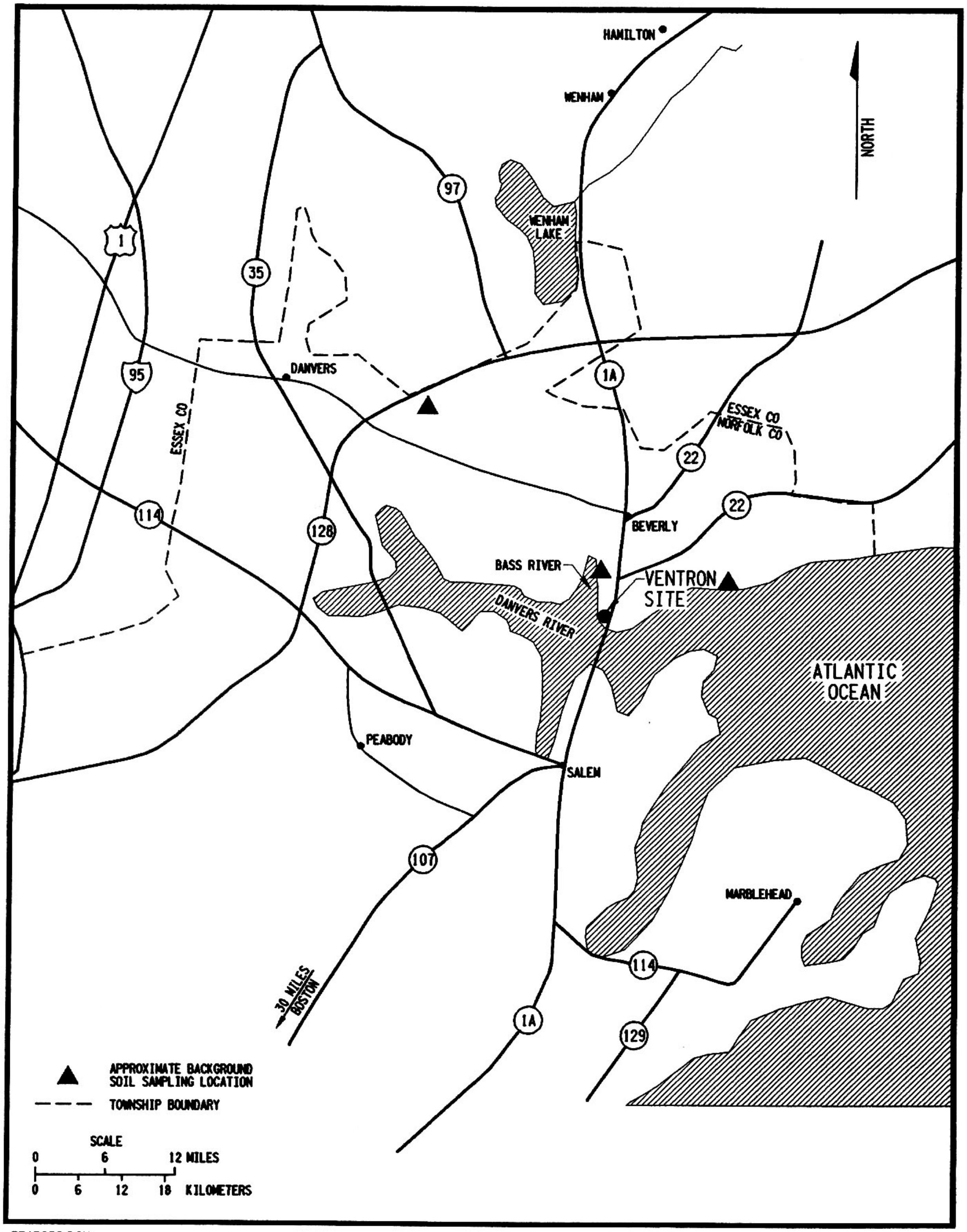

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Figure 2-1
Ventron Site
Background Sampling Locations

3.0 REMEDIAL ACTION

3.1 OVERVIEW

Radiological decontamination of the Ventron site by the DOE occurred in two phases: in September 1995 and from May 1996 to March 1997. Supplemental sampling of the site to verify the adequacy of radiological remediation was performed in July 1997 (see Section 5.0).

In September 1995, the first phase of DOE remediation of site tidal flats (harbor) adjacent to the seawall began to ensure that radioactive material was removed from the area before Morton began its harbor remedial activities. During this first phase of remediation, a walkover was performed over the entire harbor down to the low-tide mark, and areas with readings above 20,000 cpm were targeted for remediation. Elevated readings were found in three areas. Excavations were completed in grids 15 and 32, and post-remedial action samples were collected. Excavation was halted in the third area (grids 28 and 29) because contamination in that area was too extensive to be removed by manual methods. Post-remedial action sampling was performed on all grids except 20, 28, 29, 30, 44, 45, and 46, which were remediated during the second phase of the remedial action. Included as Appendix B is the report on this first phase of cleanup activities.

Pursuant to the MOA between the parties, onsite buildings A, A-1, B-1, B-2, B-3, C-1, C-2, C-3, C-4, and F were demolished by Morton before the second phase of DOE remediation began. Crushed rubble from the demolition of Buildings A and A-1 was sampled. Rubble meeting DOE criteria was stockpiled and used as backfill along the seawall. As excavation progressed, demolition of the Alfa Building (Building J) became necessary in order to access and remove contaminated soil beneath the building. Material from the Alfa Building was sampled to characterize its radiological content. Building slabs were surveyed and either decontaminated and left in place or removed and disposed of with other contaminated material.

Excavation of contaminated materials was the primary remedial action technique used at the Ventron site. Eleven discrete areas of the site were excavated and verified for compliance with radiological cleanup criteria. Excavations occurred beneath demolished buildings, in the northwest corner of the site, and in harbor grids 20, 28, and 29. To prevent failure of the seawall, areas within 4 m (12 ft) of the wall were excavated and sampled separately from the surrounding excavation. Residual radioactivity within the seawall was not remediated because of its stability. The average activity of total uranium in the seawall, if reduced to rubble, was estimated to be 0.72 pCi/g (BNI 1997).

Walkover scans were conducted during remedial action to direct the excavation. As remediation was completed, exposure rate measurements were taken with a PIC to confirm that radiation levels were in compliance with applicable guidelines, and soil samples were collected and analyzed to establish that residual radioactive material exceeding applicable criteria had been removed (see Section 4.0 for a presentation of sampling results). Sampling of soil beneath the slab of Building A also was performed to demonstrate that the majority of the area beneath the slab was uncontaminated.

Figure 3-1 shows the expected areas of contamination for the site. Figure 3-2 shows the actual areas of excavation, depth of excavation, and the location of the retort tunnels where material within the tunnels was removed.

Following remedial action, areas were restored to the condition agreed upon by the property owner. Restoration primarily involved placement of sufficient buttress in adjacent areas of the seawall to maintain seawall integrity. Backfilling of the open excavations was the responsibility of Morton, as specified in the MOA (see Appendix A).

Neither of the two structures remaining onsite (the Biocides Building and Building E) was involved in work with radiological materials. However, interior gamma radiation exposure rates were taken of these structures at a frequency of approximately one per 100 m2 of floor area, or one per room, whichever yielded a greater frequency.

3.2 CONTAMINATION CONTROL DURING THE CLEANUP

During remedial action, engineering controls, administrative controls, and monitoring were used to protect remediation workers and members of the general public from potential exposure to radiation above applicable standards. These controls are outlined in the health and safety instructions for the site.

All personnel working in radioactively contaminated areas were required to wear disposable coveralls, booties, gloves, safety glasses, and hard hats. When conditions warranted, additional protective clothing and personal protective equipment (PPE) such as hoods, face shields, and respirators were required, as specified in the health and safety instructions.

Workers exiting radioactively contaminated work areas were subjected to a whole-body scan (frisked) at the control point with a hand-held radiation detection instrument by personnel who had received Radiological Worker II training; the scan ensured that protective clothing was not contaminated and prevented spread of contamination to clean areas. Workers were resurveyed (boots and hands) after removing PPE to ensure that no material was transferred to

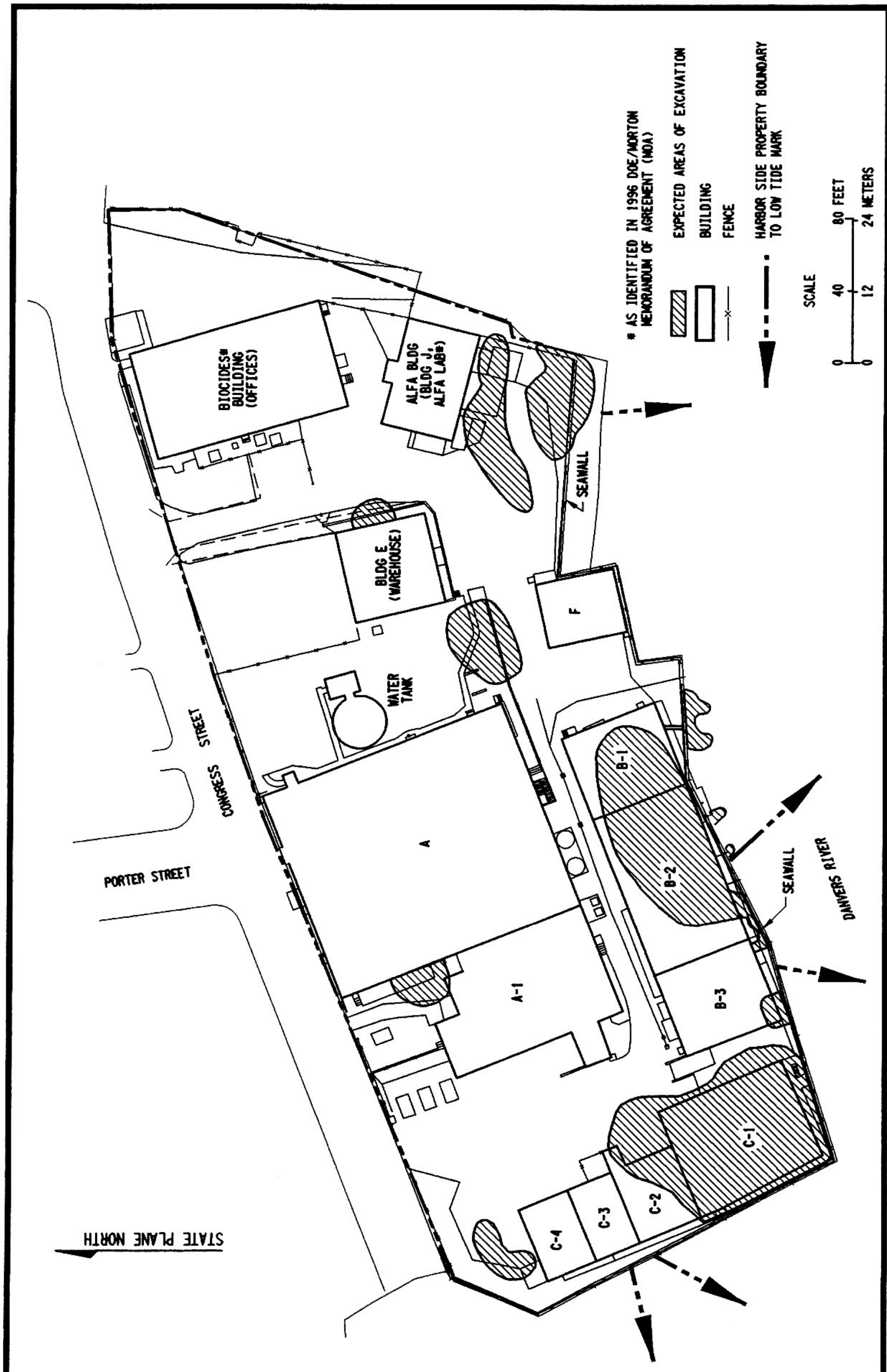

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Figure 3-1
Ventron Site
Expected Areas of Excavation

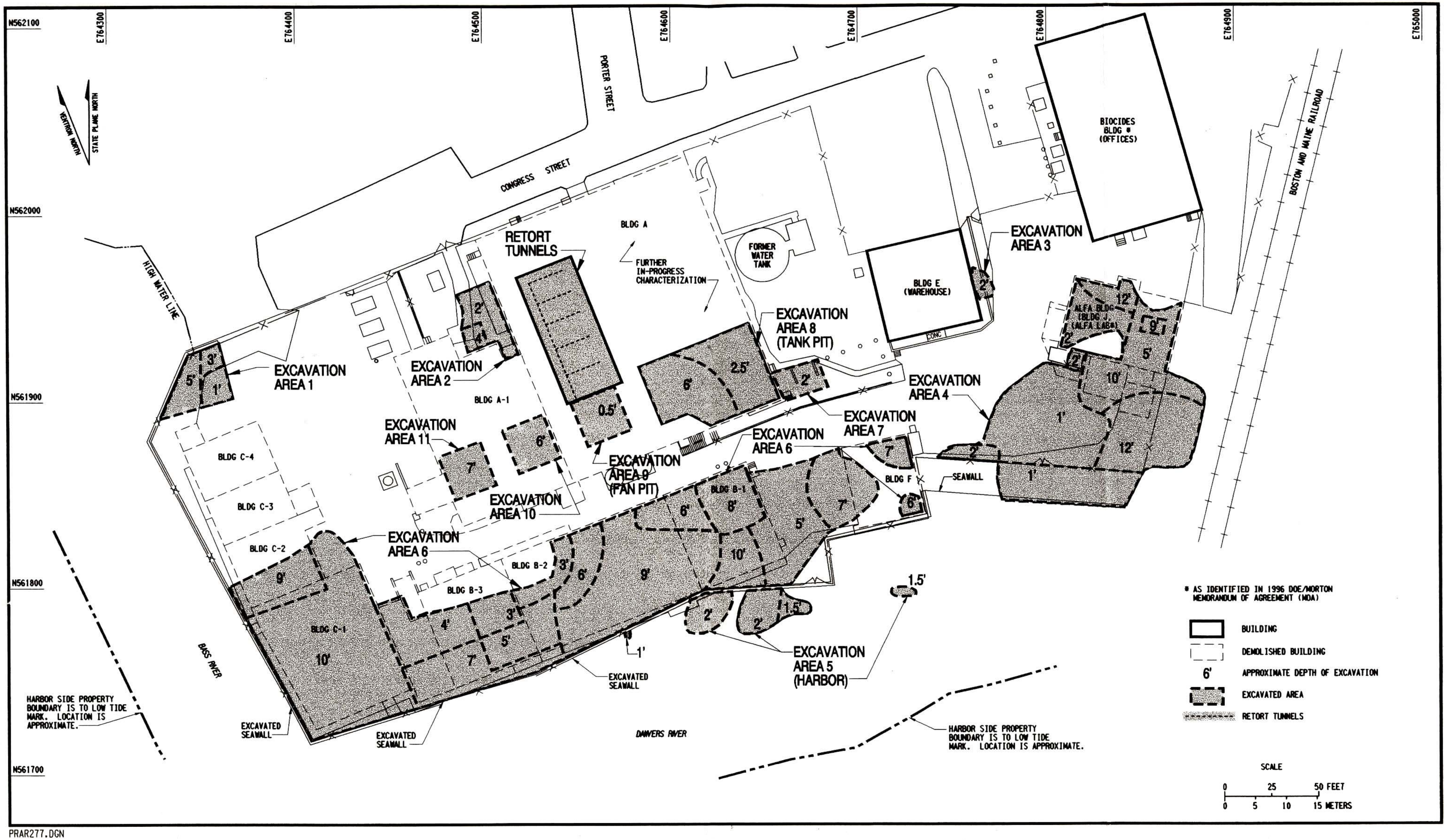

Figure 3-2
Ventron Site
Areas of Remediation and Further Characterization

personal clothing or skin. Contaminated PPE was placed in containers and shipped for disposal as low-level radioactive waste. Uncontaminated PPE was disposed of as solid waste.

The primary potential pathways by which persons onsite and offsite could be exposed to radioactive material generated at the site during removal activities are inhalation and ingestion of radioactively contaminated airborne dust generated during excavation. During remedial action, the spread of contamination and personnel exposure were minimized by the following measures:

- A fine water mist was sprayed as needed to control dust during soil removal and transport.
- Trucks hauling contaminated materials were fitted with liners, and the loads were covered to prevent loss of the contents.
- Silt fences were placed around excavated areas to prevent runoff of potentially contaminated sediment until sampling results confirmed that contamination had been removed.

Perimeter air particulate sampling adjacent to areas being remediated was conducted to ensure that no member of the general public was exposed to radioactivity above applicable guidelines (DOE 1990). The derived concentration guide (DCG) for air represents the concentration of a particular radionuclide that would yield a committed effective dose equivalent of 100 mrem/y (the DOE basic dose limit) to an individual continuously exposed to the radionuclide by inhalation for an entire year. This guideline was established to protect members of the general public against undue risk from radiation. High-volume air samplers were used to collect air samples for calculation of the air particulate concentration. The samples were collected and counted daily after sufficient time was allowed for radon progeny decay. Concentrations of uranium-238 measured by area particulate air samplers ranged from 5.38×10^{-15} µCi/mL (2.0×10^{-6} pCi/L) to 9.87×10^{-13} µCi/ML (0.001 pCi/L). The DCG for uranium-238 is 2.0×10^{-12} µCi/mL (0.002 pCi/L), which is 2.0 times greater than any activity detected at the site.

3.3 POST-REMEDIAL ACTION ACTIVITIES

3.3.1 Overview

Following remediation, samples and surveys were done by the project management contractor (PMC) to verify compliance with radiological cleanup criteria. Samples and surveys were also done by ORISE, the independent verification contractor (IVC), to verify compliance with criteria in effect at the time of remediation (ORISE 2003). The following section provides a discussion of PMC verification procedures. A discussion of IVC procedures is provided in Section 6.

3.3.2 Survey Techniques

After the material was excavated, the site was subdivided into 100^{-m2} grids (10 m by 10 m). In some areas, the grids were smaller because of physical limitations of the site. A gamma walkover survey was performed in each grid using an Eberline SPA-3 gamma scintillation detector or a field instrument for detection of low-energy radiation (FIDLER). After survey results indicated that remediation was complete, post-remedial action samples were collected from the excavated area in accordance with the post-remedial action survey plan (BNI 1996).

Radiological walkovers were performed in each survey grid to detect the emission of high and low energy gamma radiation. The low energy gamma radiation was detected with a Bicron FIDLER equipped with a 5-in.-diameter by 0.063-in.-thick sodium iodide crystal. The high-energy gamma radiation was detected with the Eberline SPA-3 equipped with a 2-in by 2-in. sodium iodide crystal. Table 6-7, page 6-47 in the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), Revision 1 (DoD et al 2000), lists the scan MDCs for the SPA-3 as: 2.8 pCi/g (104 Bq/kg) Ra-226,1.8 pCi/g (677 Bq/kg) Th-232, and 80 pCi/g (2,960 Bq/kg) total uranium. Each 10-m by 10-m grid was divided into approximately ten 1-m-wide transects which were walked over, with the instruments being moved from side to side covering approximately a 1-m-wide swath with each stride.

Normal verification sampling was conducted by collecting 25 evenly spaced samples per 100-^{m2}. These 25 samples were then composited into a single sample. For grids of less than 100^{-m2}, the composite sample was generated at the proportionally reduced ratio equivalent to 25 samples per 100^{-m2} or a minimum of four samples per area composited. Locations next to the sea wall (see Figure D-2) were all less than 100^{-m2} and were treated in this manner.

In general, discrete samples were taken using one of three different methods. The first method was to take a sample from the portion of the grid with the highest SPA-3 readings ("Highest Area"). The second method, used primarily in Phase II of the Alfa Building excavation, is to take evenly spaced discrete samples from the entire excavation. The third method, used primarily in the Harbor excavation, is to take five discrete samples in an X pattern from each survey grid.

The soil samples were analyzed on a lead-shielded FIDLER and then sent to either the ThermoNUtech laboratory in Oak Ridge, Tennessee, or the field laboratory at the Wayne Interim Storage Site in Wayne, New Jersey, for gamma spectral analysis to ensure that all soil above cleanup criteria had been removed. If the analysis (or the lead-shielded FIDLER readings) indicated residual radioactive material above criteria, additional excavation was performed, and additional post-remedial action samples were collected and analyzed. The rationale for the sampling program and analytical results are presented in Section 4.

4.0 POST-REMEDIAL ACTION MEASUREMENTS

The following section presents the results of post-remedial action measurements taken by BNI following demolition of radioactively contaminated buildings or the completion of areas of excavation to demonstrate compliance with radiological criteria in effect at the conclusion of remediation. IVC post-remediation measurements and conclusions are provided in a separate report.

Data presented in this section are gross sampling results, without the subtraction of background concentrations. Tables referenced in this section are provided in Appendix D.

4.1 BUILDINGS

Before soil excavation began, buildings A, A-1, B-1, B-2, B-3, C-1, C-2, C-3, C-4, and F were demolished by Morton. The debris from buildings B (B-1, B-2, B-3), C (C-1, C-2, C-3, C-4), and F was shipped to a Class II industrial landfill for disposal. Debris from buildings A and A-1 was crushed, sampled, and stockpiled for use as backfill (see Table D-1). The building debris was sampled by creating a pile of the material crushed each day and taking several composite samples from the pile. Data for the crushed debris from buildings A and A-1 indicated that the concentrations of uranium-238, thorium-232, and radium-226 were below supplemental limit criteria. Uranium-238 concentrations ranged from 0.23 to <4.2 pCi/g (average 2.36 pCi/g). Concentrations of thorium-232 ranged from <0.23 to <1.3 pCi/g (average 0.72 pCi/g), and radium-226 concentrations ranged from <0.16 to 1.2 pCi/g (average 0.60 pCi/g).

As soil remediation progressed, demolition of the Alfa Building (Building J) became necessary in order to access and remove contaminated soil beneath the building. Data from the building material are presented in Table D-2. Uranium-238 concentrations ranged from 0.57 to <9.70 pCi/g (average 3.84 pCi/g). Concentrations of thorium-232 ranged from <0.53 to <2.7 pCi/g (average 1.24 pCi/g), and radium-226 concentrations ranged from <0.37 to <1.60 pCi/g (average 0.97 pCi/g).

4.2 EXCAVATIONS

The northwest corner of the site was the first area to be excavated. The actual area of Excavation 1 shown in Figure 4-1 did not vary significantly from the area expected to be excavated. As shown in Table D-3, post-remedial action concentrations of uranium-238 in composite soil samples from Excavation 1 ranged from 6.8 to 8.8 pCi/g (average 7.8 pCi/g). Post-remedial action uranium-23 8 concentrations in discrete samples collected from the portion

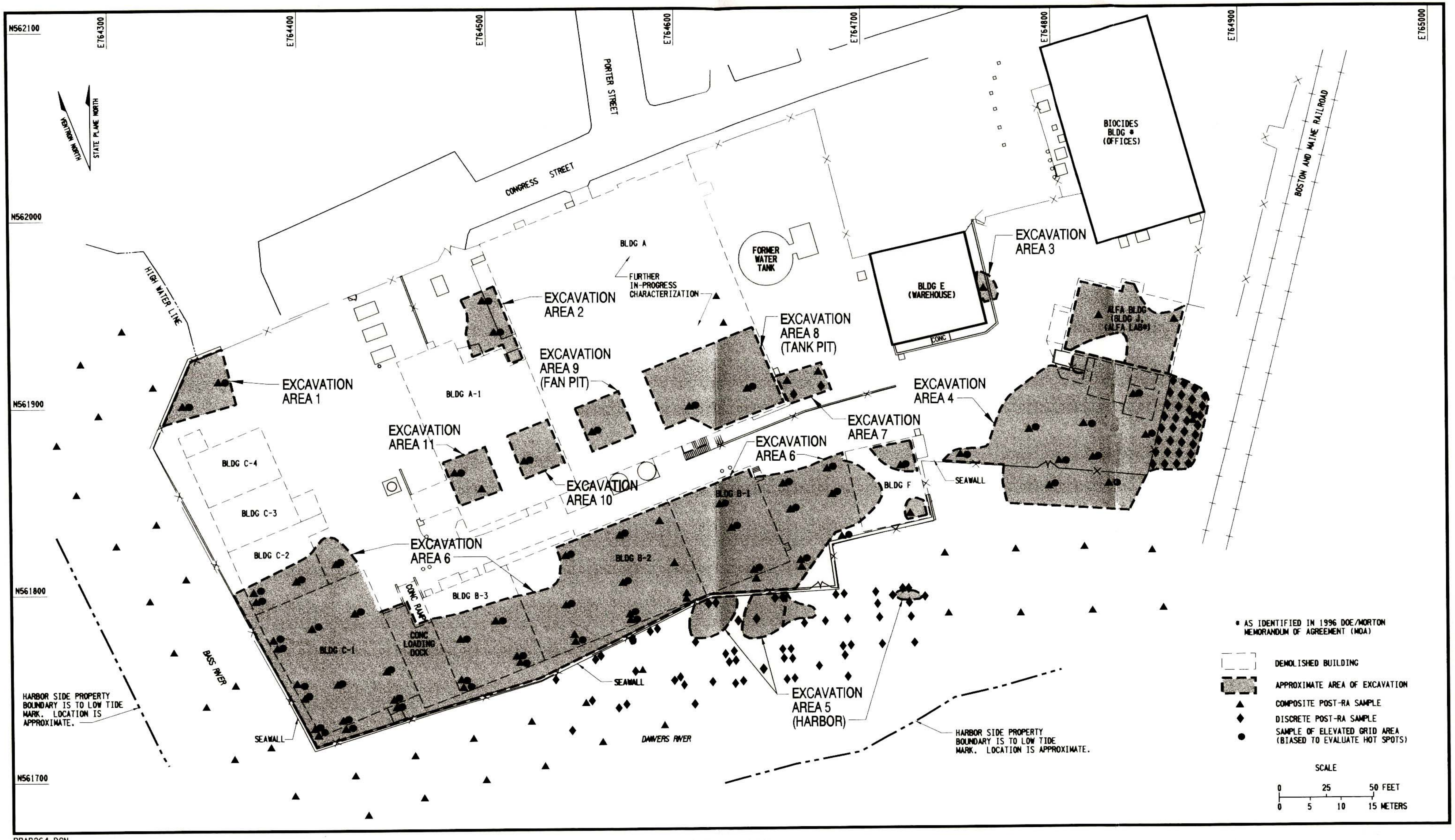

Figure 4-1
Ventron Site
Areas of Excavation and Post-Remedial Sampling Locations

of the survey grids showing the highest readings during the walkover ranged from 6.6 to 12.7 pCi/g (average 9.7 pCi/g). Post-remedial action concentrations of thorium-232 ranged from 0.79 to 0.92 pCi/g (average 0.86 pCi/g) in composite soil samples and from 0.43 to 1.7 pCi/g (average 1.07 pCi/g) in discrete samples from the portion of the survey grids with the highest walkover survey readings. Post-remedial action concentrations of radium-226 ranged from 0.64 to 1.0 pCi/g (average 0.82 pCi/g) in composite soil samples and from 0.44 to 1.3 pCi/g (average 0.87 pCi/g) in discrete samples from the portion of the survey grids with the highest walkover survey readings. The gamma exposure rate for Excavation 1 ranged from 10.7 to 11.5 µR/h (Table D-11).

Excavation 2 (Figure 4-1) was adjacent to Buildings A and A-1. The excavated area did not vary significantly from the expected area of excavation and did not overlap the contamination from Building A or Building A-1. As shown in Table D-3, post-remedial action concentrations of uranium-238 ranged from 9.9 to 15.8 pCi/g (average 12.9 pCi/g) in composite soil samples and from 14.1 to 34.1 pCi/g (average 24.1 pCi/g) in discrete samples taken from the portion of the survey grids with the highest readings during the walkover. Post-remedial action concentrations of thorium-232 ranged from 0.89 to 1.2 pCi/g (average 1.05 pCi/g) in composite soil samples and from 0.7 to 1.3 pCi/g (average 0.67 pCi/g) in discrete samples from the portion of the survey grids with the highest readings during the walkover. Post-remedial action concentrations of radium-226 ranged from 0.6 to 0.88 pCi/g (average 0.74 pCi/g) in composite soil samples and from 0.65 to 1.0 pCi/g (average 0.83 pCi/g) in discrete samples from the portion of the survey grids with the highest readings during the walkover. The gamma exposure rate for Excavation 2 ranged from 10.7 to 11.5 µR/h (Table D-11).

Excavation 3 (Figure 4-1) was adjacent to Building E (warehouse). During characterization, above-criteria concentrations of uranium-238 (50 pCi/g) were detected in one sample from Excavation 3; however, no above-criteria concentrations of uranium-238 were detected during remediation. It is likely that the contamination was removed during characterization. As shown in Table D-3, post-remedial action radionuclide concentrations in composite soil samples from Excavation 3 were 2.9 pCi/g for uranium-238, <0.81 pCi/g for thorium-232, and 0.6 pCi/g for radium-226. The gamma exposure rate for Excavation 3 was 9.0 µR/h (Table D-11).

Excavation 4 (Figure 4-1) consisted of an area adjacent to the Alfa Building (Phase I), a small area that extended onto the railroad property (Phase II), and the area beneath the Alfa Building (Phase III). The excavated area was larger than expected because additional contamination was discovered as the excavation proceeded. Removal of the additional contamination required the unplanned demolition of the Alfa Building and excavation onto the adjacent railroad property. Although these areas were contiguous, the excavation was conducted in separate phases and the post-remedial action results are treated separately in the following discussion.

As shown in Table D-4, post-remedial action concentrations of uranium-238 in composite soil samples from Excavation 4 Phase I, area south of Alfa Building, ranged from <2.9 to 36.3 pCi/g (average 12.53 pCi/g). Post-remedial action concentrations of uranium-238 in discrete samples from Excavation 4 (Phase I), taken from the portion of the survey grids with the highest readings during the walkover, ranged from <1.9 to 32.6 pCi/g (average 11.8 pCi/g). The post-remedial action concentrations of thorium-232 in composite soil samples from Excavation 4 (Phase I) ranged from <0.66 to 2.1 pCi/g (average 1.23 pCi/g). Post-remedial action concentrations of thorium-232 in discrete samples for the Alfa Building and adjacent area, which were taken from the portion of the survey grids with the highest readings during the walkover, ranged from <0.56 to 7.74 pCi/g (average 2.5 pCi/g). The sample with the highest reading (7.74 pCi/g) was taken from an area of one square meter; this reading is well below the 50 pCi/g criterion for areas of radiological anomaly. The post-remedial action concentrations of radium-226 in composite soil samples for the Alfa Building (Phase I) ranged from 0.49 pCi/g to 1.1 pCi/g (average 0.72 pCi/g). Post-remedial action concentrations of radium-226 in discrete samples for the Alfa Building (Phase I) taken from the portion of the survey grids with the highest readings during the walkover, ranged from <0.3 to 1.15 pCi/g (average 0.67 pCi/g). The gamma exposure rate for Excavation 4 ranged from 10.3 to 14.6 µR/h (Table D-11).

Because remedial action progressed offsite onto an adjacent property used by an active rail line, the schedule for completion of this excavation was closely coordinated with the railroad property owners. To avoid having to access the area more than once for sampling, discrete samples were collected and analyzed along with one composite sample and four samples from the elevated areas. As shown in Table D-4, post-remedial action radionuclide concentrations in the composite sample from the railroad excavation were 16.96 pCi/g for uranium-238, 0.92 pCi/g for thorium-232, and 0.89 pCi/g for radium-226. Post-remedial action concentrations in discrete soil samples from the railroad property (Alfa Building Phase II) ranged from 0.15 to 39.49 pCi/g (average 12.17 pCi/g) for uranium-238; from 0.48 pCi/g to 2.00 pCi/g (average 0.95 pCi/g) for thorium-232; and from 0.45 to 1.46 pCi/g (average 0.81 pCi/g) for radium-226. Post-remedial action concentrations in discrete samples from the portion of the survey grids with the highest readings during the walkover ranged from 24.87 to 46.63 pCi/g (average 36.48 pCi/g) for uranium-238; from 0.98 to 1.4 pCi/g (average 1.18 pCi/g) for thorium-232; and from 0.72 to 0.88 pCi/g (average 0.84 pCi/g) for radium-226.

Excavation 4 Phase III consisted of the area under the Alfa Building (Figure 4-1). As shown in Table D-4 (Phase III), post-remedial action concentrations of uranium-238 in composite soil samples ranged from 7.42 to 35.08 pCi/g (average 20.76 pCi/g). The post-remedial action concentrations of thorium-232 in composite soil samples from Excavation 4 (Phase III) ranged from 0.78 to 0.91 pCi/g (average 0.84 pCi/g). The post-remedial action concentrations of radium-226 in composite soil samples for the Alfa Building (Phase III) ranged from 0.61 pCi/g to 0.81 pCi/g (average 0.70 pCi/g). No discrete samples were taken during Phase III of Excavation 4.

Excavation 5 (Figure 4-1) consisted of the harbor area. During September 1995 (Phase I), most of the harbor area was excavated and surveyed. Post-remedial action data indicated that grids 1 through 19, 21 through 27, and 31 through 43 (Appendix E, Figure D-1) met radiological release criteria. The remaining grids (20, 28 through 30, and 44 through 46) were remediated and surveyed during the remedial action conducted from May 1996 through March 1997 (Phase II). Grids 20, 28, 29, and 30 required excavation; grids 44, 45, and 46 were surveyed and found to meet radiological release criteria. As shown in Table D-5, post-remedial action concentrations of uranium-238 in soil samples (composite) for grids (1-19, 21-27, and 31-43) ranged from 0.37 to 21.5 pCi/g (average 3.86 pCi/g). Post-remedial action concentrations of thorium-232 in composite soil samples for Phase I grids ranged from 0.26 to 3.60 pCi/g (average 0.65 pCi/g). Post-remedial action concentrations of radium-226 in composite soil samples for Phase I grids ranged from 0.29 to 1.00 pCi/g (average 0.50 pCi/g). The gamma exposure rate for Excavation 5 Phase I ranged from 8.0 to 12.0 ~R/h (Table D-11).

Post-remedial action concentrations of uranium-238 in Phase II samples (grids 20, 21, 28 through 32, and 44 through 46) ranged from 1.1 to 37.6 pCi/g (average 5.42 pCi/g). Post-remedial action concentrations of thorium-232 in Phase II samples ranged from 0.35 to 2.00 pCi/g (average 0.69 pCi/g). Post-remedial action concentrations of radium-226 in Phase II samples ranged from 0.26 to 1.3 pCi/g (average 0.62 pCi/g). The gamma exposure rate for Excavation 5 Phase II ranged from 8.0 to 10.0 µR/h (Table D-11).

Excavation 6 (Figure 4-1) was comprised of two discrete areas: the area within 12 ft of the seawall and the area extending from the Building C slab, across the Building B slab, to the Building F slab. The excavation area was flooded except during periods of low tide, during which time excavation could proceed.

Before work began in Excavation 6, the area within approximately 4 m (12 ft) of the seawall was excavated, verified, and backfilled. Engineering constraints imposed by the instability of the seawall required that no more than a 3-m- (10-ft) -wide section of the wall be exposed at any given time during excavation in the vicinity of the seawall. Additionally, the exposed section was to be backfilled within 24 hours of the excavation. To facilitate backfilling, a lead-shielded FIDLER was used to screen samples. The FIDLER was calibrated by taking readings from samples that had been analyzed at an offsite laboratory, and a control chart was developed using the laboratory results for those samples. The use of the lead-shielded FIDLER resulted in substantial cost savings for the project by reducing stand-down time while still meeting remedial action guidelines.

As shown in Table D-6, post-remedial action concentrations of uranium-238 ranged from 3.78 to 38.1 pCi/g (average 18.71 pCi/g) in composite soil samples and from 2.2 to 29.6 pCi/g (average 12.44 pCi/g) in discrete samples from the portion of the survey grids with the highest reading during the walkover. Post-remedial action concentrations of thorium-232 ranged from 0.52 to 1.6 pCi/g (average 0.83 pCi/g) in composite soil samples and from 0.42 to 2.59 pCi/g (average 0.90 pCi/g) in discrete samples from the portion of the survey grids with the highest reading during the walkover. Post- remedial action concentrations of radium-226 ranged from 0.34 to 1.9 pCi/g (average 0.71 pCi/g) in composite soil samples and from 0.34 to 2.24 pCi/g (average 0.73 pCi/g) in discrete samples from the portion of the survey grids with the highest reading during the walkover.

With regards to the remainder of Excavation 6, the excavated area was much larger than expected because additional contamination was discovered as the excavation proceeded. As shown in Table D-7, post-remedial action concentrations of uranium-238 ranged from 4.17 to 45.79 pCi/g (average 22.41 pCi/g) in composite soil samples and from <4.03 to 48.50 pCi/g (average 21.0 pCi/g) in discrete samples from the portion of the survey grids with the highest readings during the walkover. Post-remedial action concentrations of thorium-232 ranged from 0.45 to 1.18 pCi/g (average 0.80 pCi/g) in composite soil samples and from 0.55 to 2.55 pCi/g (average 0.93 pCi/g) in discrete samples from the portion of the survey grids with the highest readings during the walkover. Post-remedial action concentrations of radium-226 ranged from 0.45 to 1.08 pCi/g (average 0.70 pCi/g) in composite soil samples and from 0.38 to 2.24 pCi/g (average 0.74 pCi/g) in discrete samples from the portion of the survey grids with the highest readings during the walkover. The gamma exposure rate for Excavation 6 ranged from 9.0 to 12.0 µR/h (Table D-11).

Excavation 7 (Figure 4-1) consisted of an area between Buildings A and E. Characterization data indicated above-criteria concentrations of uranium-238 (57 pCi/g and 97 pCi/g) in two samples from this area; however, no uranium-238 concentrations above criteria were detected during remediation. It is likely that the contamination was removed during characterization. As shown in Table D-8, post-remedial action concentrations of uranium-238 ranged from <4.52 to <4.63 pCi/g (average 4.56 pCi/g) in composite soil samples and from <3.82 to 10.89 pCi/g (average 7.36 pCi/g) in discrete samples from the portion of the survey grids with the highest reading during the walkover. Post-remedial action concentrations of thorium-232 ranged from 0.67 to 0.94 pCi/g (average 0.81 pCi/g) in composite soil samples and from 0.69 to 0.84 pCi/g (average 0.77 pCi/g) in discrete samples from the portion of the survey grids with the highest reading during the walkover. Post-remedial action concentrations of radium-226 ranged from 0.56 to 0.68 pCi/g (average 0.62 pCi/g) in composite soil samples and from 0.6 to 0.7 pCi/g (average 0.65 pCi/g) in discrete samples from the portion of the survey grids with the highest reading during the walkover. Only one gamma exposure rate measurement was made for Excavation 7 with a value of 11.0 µR/h (Table D-11).

Excavation 8 entailed the removal of material beneath the leach tank pit in Building A (Figure 4-1). The leach tank pit was an area that contained a tank used in the batch process leaching of ores during MED/AEC activities. Contaminated soils and pipes were discovered below the concrete floor of the pit, necessitating the excavation of this area. As shown in Table D-9, post-remedial action concentrations of radionuclides in the composite soil sample were 8.3 8 pCi/g for uranium-238, 1.03 pCi/g for thorium-232, and 0.71 pCi/g for radium-226.

Excavation 9 was the area beneath the fan pit. The fan pit contained a fan used to exhaust the retort ovens in Building A (Figure 4-1). Soil beneath the concrete floor of the fan pit was found to be contaminated and required excavation. As shown in Table D-9, post-remedial concentrations of uranium-238 were 6.72 pCi/g in the composite soil sample and 13.75 pCi/g in the discrete sample from the portion of the survey grid with the highest reading during the walkover. Post-remedial action concentrations of thorium-232 were 0.51 pCi/g in the composite soil sample and 1.42 pCi/g in the discrete sample from the portion of the survey grid with the highest reading during the walkover. Post-remedial action concentrations of radium-226 were 0.42 pCi/g in the composite soil sample and 1.16 pCi/g in the discrete sample from the portion of the survey grid with the highest reading during the walkover.

Excavation 10 was an area of soil contamination beneath Building A-1 adjacent to Building A. During site remediation the Building A-1 slab was broken up, walked over with scanning instruments, and subslab contaminated soil was discovered (Figure 4-1). This area was excavated to a depth of approximately six feet. Due to the small size of this excavation (smaller than a survey grid) one composite sample and one discrete sample (from the area of highest walkover instrument reading) were taken. As shown in Table D-9, the post-remedial action concentration of uranium-238 was 4.18 pCi/g in the composite soil sample and 1.52 pCi/g in the discrete soil sample. The post-remedial action concentration of thorium-232 was 1.08 pCi/g in the composite soil sample and 2.2 pCi/g in the discrete soil sample. The post-remedial action concentration of radium-226 was 1.03 pCi/g in the composite sample and 2.62 pCi/g in the discrete sample.

Excavation 11 was an area of soil contamination beneath Building A-1 that was not contiguous with Excavation 10. During site remediation, contaminated soil was discovered here (Figure 4-1) and was excavated to a depth of approximately seven ft. Due to the small size of this excavation (smaller than a survey grid) one composite sample and one discrete sample (from the area of highest walkover instrument reading) were taken. As shown in Table D-9, the post-remedial action concentration of uranium-238 was 3.89 pCi/g in the composite soil sample and 22.51 pCi/g in the discrete soil sample. The post-remedial action concentration of thorium-232 was 2.46 pCi/g in the composite soil sample and 0.90 pCi/g in the discrete soil sample. The post-remedial action concentration of radium-226 was 2.69 pCi/g in the composite sample and 1.01 pCi/g in the discrete sample.

4.3 OTHER AREAS OF REMEDIATION

Several other areas of the site were addressed during remediation as follows.

To demonstrate that the soil beneath the majority of Building A slab was uncontaminated, 21 discrete samples were taken from various locations (see Figure 3-2). Uranium-238 concentrations in these soil samples ranged from 2.40 to 10.20 pCi/g (average 3.88 pCi/g). Concentrations of thorium-232 ranged from 0.60 to 2.50 pCi/g (average 1.50 pCi/g), and radium-226 concentrations ranged from 0.48 to 2.70 pCi/g (average 1.83 pCi/g) (see Table D-10).

The bank of retort ovens in Building A exhausted into a tunnel directly beneath the building (Figure 3-2). The tunnel contained radioactively contaminated material that was also contaminated with asbestos. The asbestos-contaminated material was removed by Morton from the retort tunnel, bagged, packaged in accordance with 49 CFR 173.1050 and Occupational Safety and Health Administration (OSHA) regulations in 29 CFR 1926.1101, and shipped for disposal as low-level radioactive waste at a commercial disposal facility. All asbestos work was performed in accordance with applicable OSHA and Massachusetts State standards to protect workers from inadvertent exposure to the asbestos material.

The seawall at the Ventron site is on the order of 100 years old and is composed primarily of granite boulders stacked one on another to a height of approximately 12 ft. The seawall is roughly 640 ft long and forms the western and southern boundaries of the site. The thickness of the wall varies from about four feet at the base to about two feet at the top and is estimated to be 20 percent void space.

Residual contamination within the seawall could not be remediated because of its stability and safety concerns. To estimate potential concentrations of total uranium in the rubble if the seawall were demolished, a calculation was performed using data obtained during remedial action. The total activity on the outer surfaces of the rocks was assumed to be dispersed throughout the rubble. The calculation results indicated that the total uranium concentration in the rubble (0.72 pCi/g total uranium) would be less than 1 percent of the volumetric soil guideline of 100 pCi/g established for the Ventron site (BNI 1997). Based on results of the calculation, total uranium concentrations for the seawall are below applicable guidelines, and the seawall required no further action.

5.0 SUPPLEMENTAL SAMPLING TO CONFIRM DATA SUFFICIENCY

Because of concerns about the final radiological status of the Ventron site, additional sampling was performed during July 1997. Seven onsite boreholes and three boreholes in the harbor were drilled and sampled (see Figure 5-1 and Table 5-1). Samples were collected from each 1-ft increment until refusal for the onsite boreholes. The majority of the samples in the harbor were collected in 6-in. increments, with one sample being collected from a 1-ft increment. All samples were analyzed for uranium-238, radium-226, and thorium-232.

Uranium-238 concentrations in the onsite soil samples ranged from 1.14 to 24.57 pCi/g (average 6.24 pCi/g). Concentrations of thorium-232 ranged from 0.50 to 1.77 pCi/g (average 0.82 pCi/g), and radium-226 concentrations ranged from 0.51 to 2.09 pCi/g (average 0.73 pCi/g).

Uranium-238 concentrations in the harbor soil samples ranged from 2.3 9 to 13.17 pCi/g (average 5.30 pCi/g). Concentrations of thorium-232 ranged from 0.38 to 0.60 pCi/g (average 0.49 pCi/g), and radium-226 concentrations ranged from 0.36 to 0.59 pCi/g (average 0.43 pCi/g).

All supplemental sample results were well below the cleanup criteria of 50 pCi/g U-238; 5 pCi/g thorium-232; and 5 pCi/g radium-226. This supplemental post-remedial action data addresses the issues concerning the sufficiency of the data to demonstrate site-wide compliance with the cleanup criteria. The report on this activity is provided as Appendix C.

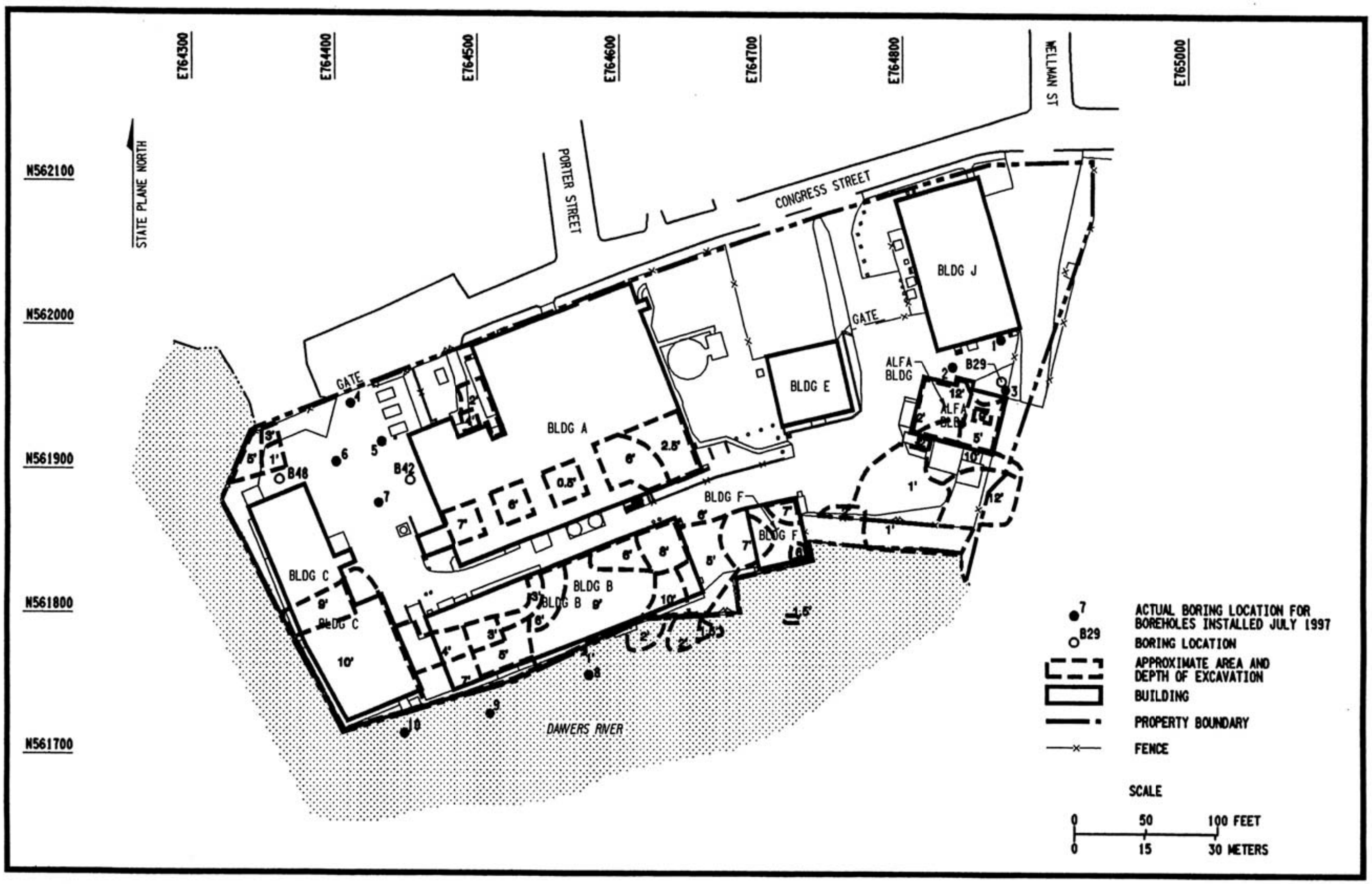

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Figure 5-1
Supplemental Sampling Locations at Ventron

Table 5-1
Post-Remedial Action Data, July 1997 Supplemental Sampling

Borehole	Sample ID	Depth (ft)	U-238 (pCi/g)	Th-232 (pCi/g)	Ra-226 (pCi/g)
Onsite					
1 (Alfa Building)	127-RS-0800	0 – 1	<2.55	0.6 +/- 0.06	0.55 +/- 0.04
1 (Alfa Building)	127-RS-0801	1 – 2	4.30 +/- 1.36	0.78 +/- 0.07	0.64 +/- 0.05
1 (Alfa Building)	127-RS-0802	2 – 3	6.61 +/- 1.28	0.51 +/- 0.06	0.65 +/- 0.04
1 (Alfa Building)	127-RS-0803	3 – 4	3.31 +/- 1.00	0.65 +/- 0.06	0.65 +/- 0.04
1 (Alfa Building)	127-RS-0805	4 – 5	1.98 +/- 1.06	0.61 +/- 0.07	0.06 +/- 0.05
1 (Alfa Building)	127-RS-0806	5 – 5.5	2.27 +/- 1.13	0.61 +/- 0.07	0.51 +/- 0.05
2 (Alfa Building)	127-RS-0806	0 – 1	4.15 +/- 0.93	0.55 +/- 0.06	0.52 +/- 0.04
2 (Alfa Building)	127-RS-0807	1 – 2	8.57 +/- 1.18	0.72 +/- 0.06	0.55 +/- 0.04
2 (Alfa Building)	127-RS-0808	2 – 3	16.29 +/- 1.67	0.61 +/-0.06	0.61 +/- 0.04
2 (Alfa Building)	127-RS-0814	3 – 3.75	12.42 +/- 1.49	0.74 +/- 0.06	0.55 +/- 0.04
3 (Alfa Building)	127-RS-0809	0 – 1	11.70 +/- 1.49	0.71 +/- 0.07	0.66 +/- 0.04
3 (Alfa Building)	127-RS-0810	1 – 2	24.57 +/- 1.24	0.67 +/- 0.06	0.63 +/- 0.04
3 (Alfa Building)	127-RS-0811	2 – 3	13.11 +/- 1.31	0.61 +/- 0.06	0.60 +/- 0.04
3 (Alfa Building)	127-RS-0812	3 – 4	17.33 +/- 1.73	0.73 +/- 0.07	0.61 +/- 0.04
3 (Alfa Building)	127-RS-0813	4 – 5	14.35 +/- 1.59	0.66 +/- 0.07	0.06 +/- 0.04
4 (Building A/C Area)	127-RS-0815	0 – 1	2.24 +/- 1.04	1.16 +/- 0.07	1.39 +/- 0.06
4 (Building A/C Area)	127-RS-0816	1 – 2	<4.08	1.77 +/- 0.10	2.09 +/- 0.08
4 (Building A/C Area)	127-RS-0817	2 – 3	4.71 +/- 1.22	0.97 +/- 0.08	1.08 +/- 0.05
4 (Building A/C Area)	127-RS-0818	3 – 4	2.94 +/- 1.39	1.59 +/- 0.09	1.35 +/- 0.06
5 (Building A/C Area)	127-RS-0819	0 – 1	<2.95	0.50 +/- 0.05	0.55 +/- 0.04
5 (Building A/C Area)	127-RS-0820	1 – 2	2.98 +/- 1.37	0.71 +/- 0.06	0.74 +/- 0.05
5 (Building A/C Area)	127-RS-0821	2 – 3	4.28 +/- 1.09	0.68 +/- 0.06	0.73 +/- 0.05
5 (Building A/C Area)	127-RS-0822	3 – 4	5.10 +/- 1.13	0.81 +/- 0.07	0.78 +/- 0.05
6 (Building A/C Area)	127-RS-0823	0 – 1	<3.17	0.56 +/- 0.06	0.65 +/- 0.04
6 (Building A/C Area)	127-RS-0824	1 – 2	1.14 +/- 0.96	0.57 +/- 0.06	0.62 +/- 0.04
6 (Building A/C Area)	127-RS-0825	2 – 3	1.77 +/- 0.94	0.78 +/- 0.06	0.69 +/- 0.04
6 (Building A/C Area)	127-RS-0826	3 – 4	4.19 +/- 1.24	0.90 +/- 0.07	0.64 +/- 0.04
6 (Building A/C Area)	127-RS-0827	4 – 5	2.77 +/- 1.19	0.74 +/- 0.07	0.71 +/- 0.04
7 (Building A/C Area)	127-RS-0828	0 – 1	3.72 +/- 1.01	0.69 +/- 0.06	0.51 +/- 0.04
7 (Building A/C Area)	127-RS-0829	1 – 2	3.90 +/- 1.25	0.67 +/- 0.07	0.66 +/- 0.04
7 (Building A/C Area)	127-RS-0830	2 – 3	<3.37	0.84 +/- 0.07	0.56 +/- 0.05
7 (Building A/C Area)	127-RS-0831	3 – 4	2.79 +/- 1.14	0.86 +/- 0.07	0.72 +/- 0.05

Table 5-1 (continued)

Borehole	Sample ID	Depth (ft)	U-238 (pCi/g)	Th-232 (pCi/g)	Ra-226 (pCi/g)
Onsite					
8 (Grid 31)	127-RS-0832	2 – 3	<2.55	0.6 +/- 0.06	0.43 +/- 0.04
8 (Grid 31)	127-RS-0833	3 – 3.5	<2.39	0.44 +/- 0.05	0.37 +/- 0.04
9 (Grid 33)	127-RS-0834	2 – 2.5	<2.72	0.53 +/- 0.06	0.59 +/- 0.04
10 (Grid 16)	127-RS-0835	2 – 2.5	13.17 +/- 1.26	0.52 +/- 0.06	0.39 +/- 0.04
10 (Grid 16)	127-RS-0836	2.5 – 3	5.68 +/- 0.96	0.38 +/- 0.06	0.36 +/- 0.03

6.0 POST-REMEDIAL ACTION STATUS

Analytical results of post-remedial action surveys indicate that the levels of radioactivity in the remediated areas are in compliance with applicable cleanup guidelines for radioactive contamination. The IVC reviewed the post-remedial action survey methods and results to determine whether the radiological measurements confirm that the remediated areas comply with the guidelines established for the site.

The IVC is responsible for preparing a plan outlining the procedures used in conducting verification activities. These procedures specify a verification process requiring two methods of review (Types A and B). Type A verification consists of reviewing the post-remedial action survey results and collecting and analyzing additional samples as required. The Type B verification review consists of an independent site survey by the IVC including direct radiological measurements, review of post-remedial action survey methods and results, sampling, and laboratory analysis of separate soil samples. The IVC conducted both types of review, in full conformance with the approved verification plan.

After completing the verification study, the IVC will report its findings and recommendations to DOE. DOE will review the report to verify that the remedial action was successful. The IVC's published verification report will then become part of the CERCLA Administrative Record file for the Ventron site.

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DOD, DOE, EPA, NRC, 2000. Table 6.7, "NaI (TI) Scintillation Detector Scan MDCs for Common Radiological Contaminants," Multi Agency Radiation Survey and Site Investigation Manual, Revision 1, p. 6-47 (August).

MDEP (Massachusetts Department of Environmental Protection), 1996a. Letter from L. Alexander (MDEP) to J. Kopotic (DOE-FSRD), "Demolition of Building A & A-1; Risk Characterization Report," CCN 143797, June 21.

MDPH (Massachusetts Department of Public Health), 1996b. Letter from T. O'Connell to J. Koptic (DOE), "Approval of Remediation Approach," CNN 143840, June 21.

ORNL (Oak Ridge National Laboratory), 1988. "Results of the Radiological Survey at the Ventron Site, Beverly, Massachusetts," ORNL/TM-10053, Oak Ridge, Tenn. (May).

ORISE (Oak Ridge Institute for Science and Education), 2003. "Verification Survey of the Ventron Site, Beverly, Massachusetts," ORISE 03-0321, Oak Ridge, Tenn. (March).

GLOSSARY

Alpha-emitting - See Radiation.

Ambient Background Radiation - Ambient background radiation refers to naturally occurring radiation emitted from either cosmic (i.e., from the sun) or terrestrial (i.e., from the earth) sources. Exposure to this type of radiation is unavoidable, and its level varies greatly depending on geographic location. For example, New Jersey typically receives 100 mrem/y, Colorado receives about 115 mrem/y, and some areas in South America receive up to 7,000 mrem/y. Naturally occurring terrestrial radionuclides include uranium, radium, potassium, and thorium (see **Radionuclide**). The dose levels do not include the concentrations of naturally occurring radon inside buildings.

Beta/gamma-emitting - See **Radiation.**

Centimeter - A centimeter (cm) is a metric unit of measure for length; l in is equal to 2.54 cm; 1 ft is equal to approximately 30 cm.

Contamination - The term "contamination" is used generally to mean a concentration of one or more radioactive materials that exceeds naturally occurring levels. Contamination may or may not exceed the DOE cleanup guidelines.

Disintegrations per minute - Disintegrations per minute (dprn) is the measurement indicating the amount of radiation being released from a substance per minute.

Dose - As used in this report, dose is actually dose equivalent and is used to relate absorbed dose (mrad) to an effect on the body. Dose is measured in millirems (mrern). For comparison, a dose of 500,000 mrem to the whole body within a sort time causes death in 50 percent of the people who receive it; a dose of 5,000,000 mrem may be delivered to a cancerous tumor during radiation treatment; normal background radiation at or near sea level results in an annual dose of about 100 mrem; DOE radiation protection standards limit the dose that may be received by members of the general public to 100 mrem/y above background levels; living in a brick house typically results in a dose of about 75 mrem/y above the background level.

Exposure Rate - Exposure rate is the rate at which radiation imparts energy to the air. Exposure is typically measured in microroentgens (µR), and exposure rate is typically expressed as µR/h. The dose to the whole body can be approximated by multiplying the exposure rate by the number of hours of exposure. For example, if an individual were exposed to gamma radiation at a rate of

20 μR/h for 168 h/week (continuous exposure) for 52 weeks/y, the whole-body dose would be approximately 175 mrem/y.

Gamma Radiation - See **Radiation**.

Meter - A meter (m) is a metric unit of length; l m is equal to approximately 39 in.

Microroentgen - A microroentgen (~R) is a unit used to measure radiation exposure. For further information, see Exposure Rate.

Millirem - The millirem (mrem) is the unit used to measure radiation dose to man. The DOE dose limit is 100 mrem above background radiation levels within any 1-year period for members of the general public. Naturally occurring radioactive substances in the ground result in a yearly exposure of about 100 mrem to each member of the population. To date, no difference can be detected between the health of population groups exposed to 100 mrem/y above background and the health of groups who are not exposed.

Natural Background Radiation - Natural background radiation refers to radiation emitted from the naturally occurring radionuclides found in manmade materials. The concentrations of the radionuclide, and thus the radiation, will vary widely because of variations in the composition of the materials.

Radiation - There are three primary types of radiation: alpha, beta, and gamma. Alpha radiation travels less than an inch in air before it stops, and it cannot penetrate the outer layers of human skin. Beta radiation can penetrate the outer layers of skin but cannot reach the internal organs. Gamma radiation, the most penetrating type, can usually reach the internal organs.

Radionuclide - Radioactive elements are also referred to as radionuclides. For example, uranium-235 is a radionuclide, uranium-238 is another, thorium-232 is another, and so on.

Remedial Action - Remedial action is a general term used to mean "cleanup of contamination that exceeds DOE guidelines." It refers to any action required so that a property may be certified as being in compliance with guidelines and may therefore be released for future use. Remedial action also includes restoring remediated properties to their original conditions as far as possible.

Uranium - Uranium is a naturally occurring radioactive element. The principal use of refined uranium is for the production of fuel for nuclear reactors. Uranium in its natural form is not suitable for use as a fuel source.

Appendix A

DOE/MORTON MEMORANDUM OF AGREEMENT

Department of Energy

Oak Ridge Operations Office
P.O. Box 2001
Oak Ridge, Tennessee 37831 — 8123
May 9, 1996

James J. Fuerholzer
President, Morton Adhesives and Chemical Specialties
Morton International, Inc.
100 North Riverside Plaza
Chicago, Illinois 60606-1598

Dear Mr. Fuerholzer:

VENTRON SITE - MEMORANDUM OF AGREEMENT

Enclosed is the final signed Memorandum of Agreement (MOA) supporting upcoming remediation activities at the Ventron Site. I appreciate you and your staff's efforts in developing this mutually beneficial document which also supports the acceleration of the Department of Energy's (DOE) planned rernediation activities at the site. DOE is currently planning on mobilizing to the site by mid-June 1996, following Morton's completion of the building demolition effort, with a planned completion in Fall 1996.

On March 27, 1996, a meting was held at the site with state personnel to tour the site and discuss planned rernediation activities. Representatives included Morton International, Massachusetts Departments of Environmental Protection and Radiation Control, and DOE. State personnel were in agreement with the planned remediation approach, but requested additional monitoring which DOE agreed to do.

Again, I appreciate Morton's efforts in helping to develop the MOA, and I look forward to working with your staff toward the successful remediation of the site. It has been a pleasure working with Alicia Raddatz of your staff, and I will continue to coordinate all aspects of DOE's remediation activities, at the site with her. Because the MOA addresses joint DOE and Morton responsibilities, I want to stress the importance of close coordination. Between Morton and DOE to ensure we keep State and Federal officials/agencies, public, and other stakeholders accurately informed of our activities and progress at the site.

If you have any questions regarding the MOA or DOE's remediation plans at the site I can be reach at (423) 576-9441.

Sincerely,

D. Kopotic, Site Manager Former
Sites Restoration Division

Enclosure
cc w/enclosure:
A. S. Johnson, EM-421, CL

MEMORANDUM OF AGREEMENT

MORTON INTERNATIONAL, INC. (the "Owner") owns certain real property located in Beverly, Massachusetts, identified as Parcel No. l shown on City of Beverly Property No. l and filed in Deed Book 10091, page 339 in the records of Essex County, Massachusetts, and shown on the attached Exhibit "Premises").

The Department of Energy (the "DOE") is conducting remedial action at sites, including the Premises, used by contractors and/or subcontractors to the Manhattan Engineer District and the Atomic Energy Commission, as part of the Formerly Utilized Sites Remedial Action Program ("FUSRAP").

DOE has previously defined the extent of contamination of the Premises. The following is an agreement reached between the parties of some of the actions to be undertaken by the parties in order that the remediation of the Premises can be accomplished:

1. The Owner will demolish and remove at its expense Buildings B and C (as shown in Exhibit 1) and any equipment located therein, and disconnect power service to the buildings and remove associated service lines and poles. These buildings are not contaminated with radioactive materials. However, the soils underneath Buildings B and C are contaminated, and the DOE will remediate radioactively contaminated soil. The owner expects that the demolition and removal of Buildings B and C will be completed by the end of May 1996. DOE expects to initiate soil remediation activities within 4 weeks after Buildings B and C have been demolished and removed.

2. As necessary, DOE will decontaminate radioactive interior portions of Buildings A, A-1, and J (former Alfa Laboratory, as shown in Exhibit 1) and any radioactive equipment located therein. Upon completion of such decontamination the Owner will demolish and remove Buildings A, A-1, J and the equipment located therein. After Buildings A, A-1, and J have been demolished and removed, DOE will initiate remediation of radioactive soils beneath or surrounding Buildings A, A-1, and J. DOE will dispose of radioactive residues resulting from the decontamination of Buildings A, A-I, and J.

3. Any buildings to be demolished by the Owner will be taken down to the basement floor slab, including any support structures. DOE will have responsibility for decontaminating (or otherwise remediating) the radiological component of building foundations and subsurface utilities and structures and for disposing of any such foundations and subsurface utilities and structures that remain radioactive above the clean-up criteria agreed to by DOE and the Commonwealth of Massachusetts Departments of Environmental Protection and Public Health, Radiation Control Program (hereinafter "clean-up criteria"). DOE will remove any building foundations and subsurface utilities or structures that it needs in order to get to radioactive contamination. If such removed foundations and

subsurface utilities and structures are not radioactive contaminated above clean-up criteria their ultimate disposition will be the responsibility of the Owner.

4. DOE will be responsible for the remediation, decontamination, and disposition of radiological contamination above clean-up criteria and any non-radiological contaminants that are mixed with such radiological contamination, whether located in or under Buildings A, A-1, B, C, or J, or elsewhere on the Premises.

5. DOE's responsibilities under this agreement will be limited to remediation, decontamination, and disposition of radiological contamination above clean-up criteria and any non-radiological contaminants that are mixed with such radiological contamination, and the owner will be responsible for the disposition of any materials remediated or decontaminated in accordance with the clean-up criteria.

6. Upon completion of the work by DOE, the Owner will, where necessary, back-fill, grade and seed the site. DOE expects to notify the Owner in writing, based on existing data, that the Premises meet applicable cleanup criteria, within 6 months of completion of the remediation work.

7. DOE expects to begin its remediation activities in May 1996 with a tentative remediation time of 6 to 8 months. DOE expects to provide a copy of the Post Remedial Action Report to the Owner within 18 months after completion of all remediation activities.

8. The Owner has appointed Alicia Raddatz as the person on site to be contacted by the DOE for matters pertaining to the remediation work. The DOE has appointed Jim Kopofic as the person to be contacted by the Owner and its contractors for matters pertaining to the remediation work.

9. Obligations of the DOE under this agreement are subject to the Anti-Deficiency Act, 31 USC Section 1341, as amended, and to the availability of funds appropriated by Congress which DOE may legally spend for such purposes and nothing in this agreement implies that Congress shall appropriate such funds.

10. Access to the Premises and the work to be performed by the DOE and/or its contractors is governed by Real Estate License No. 7-95-0160, as amended, signed by the Owner on 3/20/96.

11. Each party reserves the right to renegotiate this Agreement in the event of significant changes in scope, cost, or discovery of unknown factors. If the Parties, in good faith, are unable to agree to revisions of this Agreement in order to address such events, either Party may terminate this Agreement; by providing 3 0 days prior written notice to the other Party.

12. DOE's responsibilities under this agreement shall terminate when DOE issues the Federal Register notice and certification docket for the Premises.

T'he parties hereto have executed the Memorandum of Agreement this 18th of March 1996.

THE UNITED STATES OF AMERICA
DEPARTMENT OF ENERGY

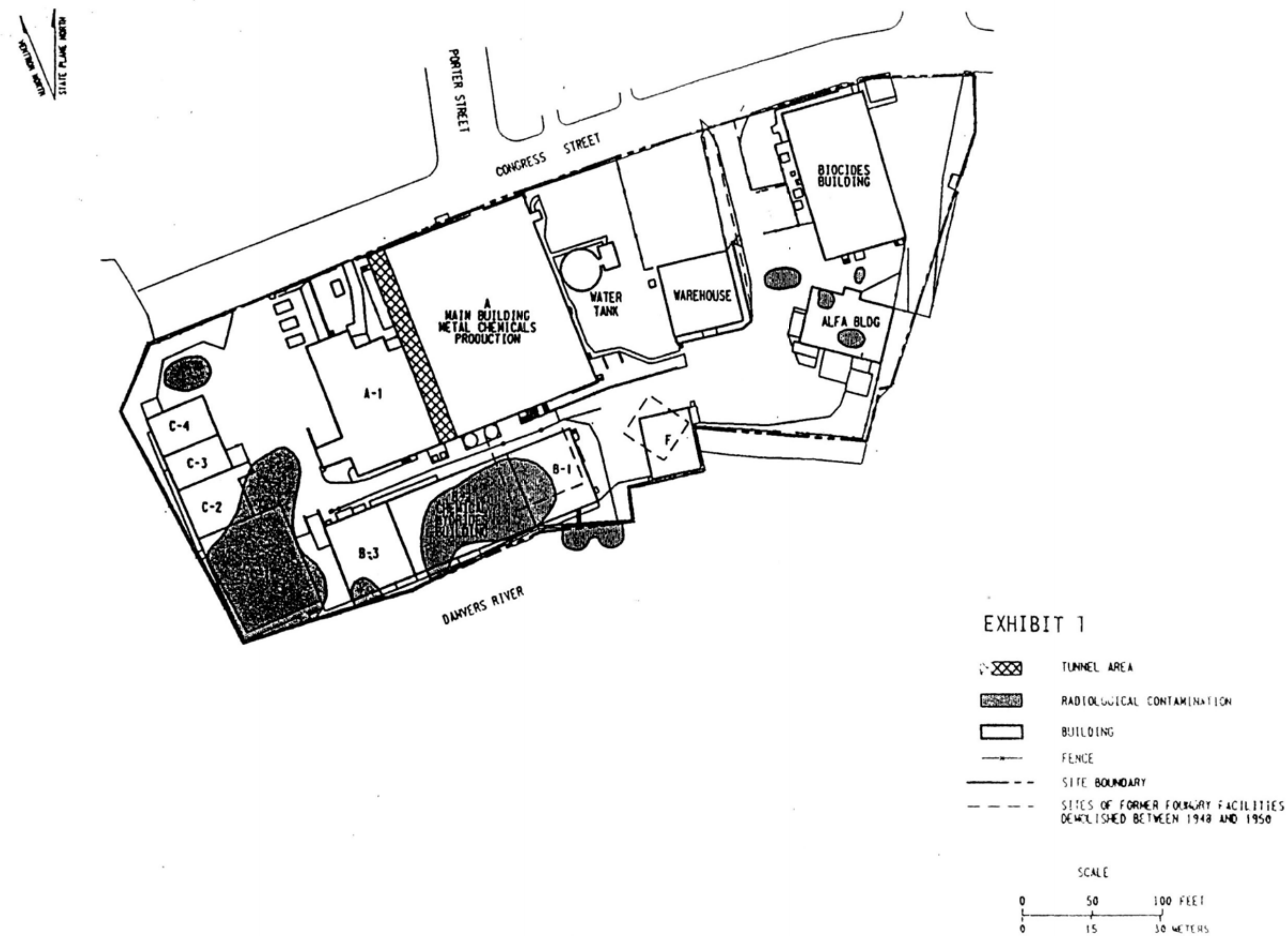
By: ______________________

Title: Director, Former Sites Restoration Div.

MORTON INTERNATIONAL, INC. By:

By: ______________________

Title: Group Vice President


STATE PLANE NORTH
VENTRON NORTH
PORTER STREET
CONGRESS STREET
BIOCIDES BUILDING
ALFA BLDG
WAREHOUSE
WATER TANK
A
MAIN BUILDING
METAL CHEMICALS
PRODUCTION
A-1
C-4
C-3
C-2
B-1
B-3
F
DANVERS RIVER
EXHIBIT 1
TUNNEL AREA
RADIOLOGICAL CONTAMINATION
BUILDING
FENCE
SITE BOUNDARY
SITES OF FORMER FOUNDRY FACILITIES
DEMOLISHED BETWEEN 1948 AND 1950
SCALE
0 50 100 FEET
0 15 30 METERS

Appendix B

1995 HARBOR REMEDIAL ACTION REPORT

FUSRAP Project
Job 14501

127-96-002
NO. ______ REV. NO. 0
DATE: 01-02-96

FUSRAP TECHNICAL BULLETIN

Prepared by	Team Lead Approval	Project Engineer Approval	Project Manager Approval
Tim King	Andrew George for Melissa Cuevra	[signature]	[signature]

Introduction

Purpose

This technical bulletin presents information obtained during remedial action at the Ventron Site in Beverly, Massachusetts. The remedial action was limited to the harbor adjacent to the seawall that surrounds the site.

Selection of Sampling Points

A grid was established in the harbor in an attempt to establish as many 10 meter by 10 meter grids as possible since post remedial action sampling is performed in areas of 100 m2 or less. The grid established is shown in Figure 1. One 25 plug composite sample was collected from each grid following FUSRAP protocol (191-IG-032). In addition to post remedial action samples, characterization samples were collected to assist in the control of the remedial action. The cleanup guideline for the Ventron Site is 50 pCi/g for U-238 (CCN 136542).

Methodology

Field Methods

Field methods are outlined in Work Instruction #95-156 and Post-Remedial Action Survey Plan for the Ventron Harbor (CCN 133125). The first activity was to establish a correlation between the FIDLER readings and pCi/g Based on these samples and background levels for the FIDLER a count rate of 20,000 cpm was used as guidance in the field. The pre-remedial action walkover data is attached in Appendix I. After the walkover was completed areas above 20,000 cpm were targeted for excavation. Three areas were determined to be elevated and are shown on figure l. Excavations were completed in grids 15 and 32 and post-remedial action samples were collected. The third area in grids 29 and 28 (Figure 1) was to extensive to be removed by manual methods so excavation was halted. This area will be addressed when the onsite remedial action is initiated. Since contamination remains in grids 28 and 29 the adjacent grids (30, 44, 45, 46, and 20) were not released for independent verification. Post-remedial action sampling was performed on all of the remaining grids. For each grid 25 plugs per 100 m^2 were collected and composited into one sample. For grids less than 100 m^2 the plugs were reduced proportionally and composited. Soil samples were sent to a dedicated gamma spectroscopy lab at the Wayne site. The Wayne lab provided a quick turn around time to assist decisions made in the field. Splits of the post-remedial action samples were sent to the Oak Ridge Thermo NuTech Laboratory for final analysis. Along with the composite post-remedial action samples boreholes were installed in areas where ORNL had previously detected subsurface contamination and in random locations. The borehole locations are shown in Figure 2. In addition to sampling, gamma exposure rate measurements were taken in each grid.

Quality Control

Quality control measures implemented during this effort include a Quality Assessment (QAA-127G0-01).

Results

A summary of the composite sample results are shown in Table l and borehole data is shown in Table 2. Gamma exposure rate measurements are shown in Table 3. As can be seen in Tables l and 2 all soil results are below the U-238 guideline of 50 pCi/g. Table 4 lists the data package "D" numbers that were generated during this effort

Summary and Conclusions

The port-remedial action data, indicates that all grids (1-19, 21-27, 31-43) meet the radiological release criteria for unrestricted use. Although the post-remedial action data for grid 20 was below criteria the IVC detected some elevated areas in the grid. These areas will be addressed during the site remedial action.

Table 1
Ventron Harbor Post-Remedial Action Sample Results

Sample #	Grid #	Radionuclide Concentration (pCi/g) U-238	Ra-226	Th-232
12795006	1	0.37 +/- 0.46	0.60 +/- 0.09	0.46 +/- 0.10
12795007	2	<1.90	0.47 +/- 0.07	<0.58
12795008	3	<1.70	0.44 +/- 0.10	0.48 +/- 0.11
12795009	4	<1.80	0.52 +/- 0.12	0.36 +/- 0.19
12795010	5	<1.70	0.36 +/- 0.09	<0.53
12795011	6	<1.90	0.45 +/- 0.07	0.27 +/- 0.10
12795012	7	<1.50	0.39 +/- 0.08	0.41 +/- 0.11
12795013	8	1.70 +/- 0.67	0.61 +/- 0.11	0.26 +/- 0.13
12795014	9	2.70 +/- 0.87	0.52 +/- 0.10	0.47 +/- 0.07
12795015	10	2.10 +/- 0.81	0.39 +/- 0.08	0.33 +/- 0.16
12795016	11	8.10 +/- 2.20	0.29 +/- 0.09	0.58 +/- 0.09
12795017	12	<2.70	0.45 +/- 0.11	0.54 +/- 0.11
12795018	13	1.30 +/- 0.65	0.51 +/- 0.10	0.65 +/- 0.13
12795036	14	<3.10	0.40 +/- 0.15	<0.86
12793019	15	5.60 +/- 1.60	0.50 +/- 0.10	0.59 +/- 0.11
12795020	16	13.30 +/- 1.70	0.43 +/- 0.12	0.38 +/- 0.11
12795031	17	9.50 +/- 2.60	0.56 +/- 0.08	0.34 +/- 0.11
12795021	18	21.50 +/- 4.40	0.57 +/- 0.11	0.60 +/- 0.08
12795022	19	3.00 +/- 0.98	0.43 +/- 0.11	0.71 +/- 0.??
12795023	20	7.70 +/- 2.20	0.49 +/- 0.14	0.93 +/- 0.14
12795024	21	6.10 +/-1.70	0.70 +/- 0.13	0.77 +/- 0.12
12795025	22	<2.20	0.37 +/- 0.07	0.61 +/- 0.11
12795026	23	3.60 +/- 1.10	0.53 +/- 0.10	0.39 +/- 0.08
12795027	24	<2.00	0.39 +/- 0.07	0.55 +/- 0.13
12795028	25	<2.10	0.38 +/- 0.08	0.78 +/- 0.13
12795029	26	<1.90	0.56 +/- 0.09	0.38 +/- 0.08
12795030	27	1.80 +/- 0.73	0.45 +/- 0.10	0.35 +/- 0.08
12795032	31	9.80 +/- 2.90	0.47 +/- 0.18	3.60 +/- 0.67
12795033	33	4.20 +/- 1.30	0.52 +/- 0.10	<0.59
12795041	34	<2.40	0.44 +/- 0.13	0.59 +/- 0.15
12795042	35	0.74 +/- 0.70	0.43 +/- 0.13	0.67 +/- 0.11
12795043	36	1.10 +/- 0.65	0.48 +/- 0.12	<0.62
12795044	37	1.80 +/- 0.79	0.46 +/- 0.13	<0.64
12795037	38	<4.10	0.51 +/- 0.13	0.36 +/- 0.13
12795038	39	<3.10	0.51 +/- 0.18	0.56 +/- 0.20
12795039	40	<4.00	0.61 +/- 0.13	0.84 +/- 0.19
12795040	41	<4.40	1.00 +/- 0.28	0.60 +/- 0.37
12795034	42	<4.40	0.52 +/- 0.21	<1.50
12795035	43	1.30 +/- 1.10	0.83 +/- 0.17	0.91 +/- 0.19

Note: Data in this table can be found in data packages D-23003, D-23034, D-23045, and D-23073
All post-remedial action samples were analyzed at the Oak Ridge Laboratory

Table 2
Ventron Harbor Borehole Sample Results

			Radionuclide Concentration (pCi/g)		
Sample #	**Borehole #**	**Depth (ft)**	**U-238**	**Ra-226**	**Th-232**
12795045	45	1-1.5	19.10 +/- 2.30	0.44 +/- 0.10	<0.78
12795046	46	1-1.5	24.00 +/- 2.50	0.39 +/- 0.11	0.57 +/- 0.09
12795047	47	1-1.5	33.40 +/- 3.40	0.74 +/- 0.14	0.99 +/- 0.12
12795048	48	1-1.5	18.10 +/- 1.90	0.34 +/- 0.09	0.44 +/- 0.07
12795049	49	1-1.5	6.30 +/- 1.70	0.38 +/- 0.08	0.43 +/- 0.07
12795050	50	1-1.5	4.00 +/- 1.20	0.36 +/- 0.09	<0.40
12795051	51	1-1.5	31.10 +/- 3.10	0.38 +/- 0.08	0.84 +/- 0.13
12795052	52	1-1.5	14.40 +/- 3.90	<0.42	0.56 +/- 0.15
12795053	53	1-1.5	16.20 +/- 1.80	0.32 +/- 0.08	0.47 +/- 0.12
12795060AB	60	0-0.50	8.29 +/- 1.76	0.44 +/- 0.08	<0.54
12795060BC	60	0.5-1.0	12.13 +/- 2.28	0.41 +/- 0.09	<0.50
12795060CD	60	1.0-1.5	5.02 +/- 1.35	0.38 +/- 0.09	<0.47
12795060DE	60	1.5-2.0	5.24 +/- 1.38	0.34 +/- 0.09	<0.55
12795060EF	60	2.0-2.5	3.04 +/- 1.13	0.25 +/- 0.84	<0.52
12795061AB	61	0-0.5	23.09 +/- 3.79	0.83 +/- 0.09	0.82 +/- 0.14
12795061BC	61	0.5-1.0	26.23 +/- 4.29	0.55 +/- 0.10	0.97 +/- 0.16
12795061CD	61	1.0-1.5	28.44 +/- 4.61	0.63 +/- 0.11	0.77 +/- 0.16
12795061DE	61	1.5-2.0	12.18 +/- 2.26	0.39 +/- 0.09	0.55 +/- 0.12
12795061EF	61	2.0-2.5	19.88 +/- 3.41	0.55 +/- 0.09	<0.57
12795063AB	63	0-0.5	6.88 +/- 1.60	0.36 +/- 0.08	0.80 +/- 0.14
12795063BC	63	0.5-1.0	22.77 +/-5.55	0.46 +/- 0.10	0.93 +/- 0.16
12795063CD	63	1.0-1.5	6.84 +/- 1.60	0.50 +/- 0.09	0.54 +/- 0.14
12795063DE	63	1.5-2.0	<0.32	0.36 +/- 0.08	<0.54
12795063EF	63	2.0-2.5	1.49 +/- 1.07	0.41 +/- 0.09	0.69 +/- 0.14

Note: Data in this table can be found in data packages D-23242, D-23046, D-23431, and D-23432

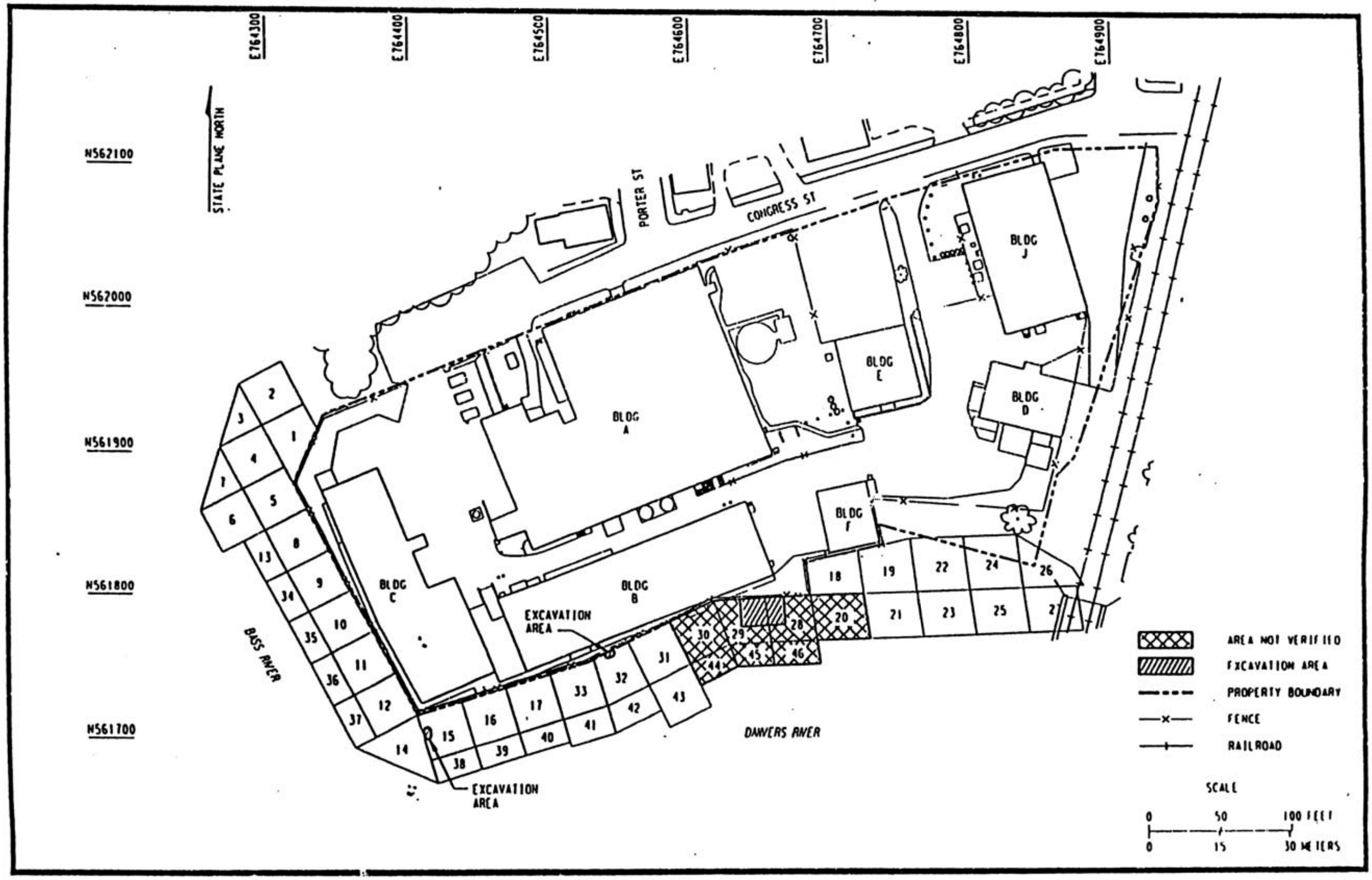
Table 3
Gamma Exposure Rate Measurements

Grid #	µR/hr	Grid #	µR/hr
1	12	21	9
1	11	21	10
2	12	22	9
2	12	22	9
3	11	23	9
4	11	23	9
4	11	24	8
5	11	24	9
5	10	25	8
6	12	25	8
7	12	26	10
8	10	27	10
8	10	27	10
9	8	30	12
9	9	30	9
10	9	31	10
10	9	31	9
11	8	32	10
11	8	32	10
12	8	33	9
12	8	33	9
13	10	34	9
14	10	35	9
15	10	36	8
15	8	37	8
16	9	36	8
16	8	39	9
17	10	40	8
17	9	41	8
18	9	42	10
16	8	43	9
19	9	44	10
19	10	45	10
20	10	46	9
20	10		

Note: Data in this table can be found in data packages D-22685

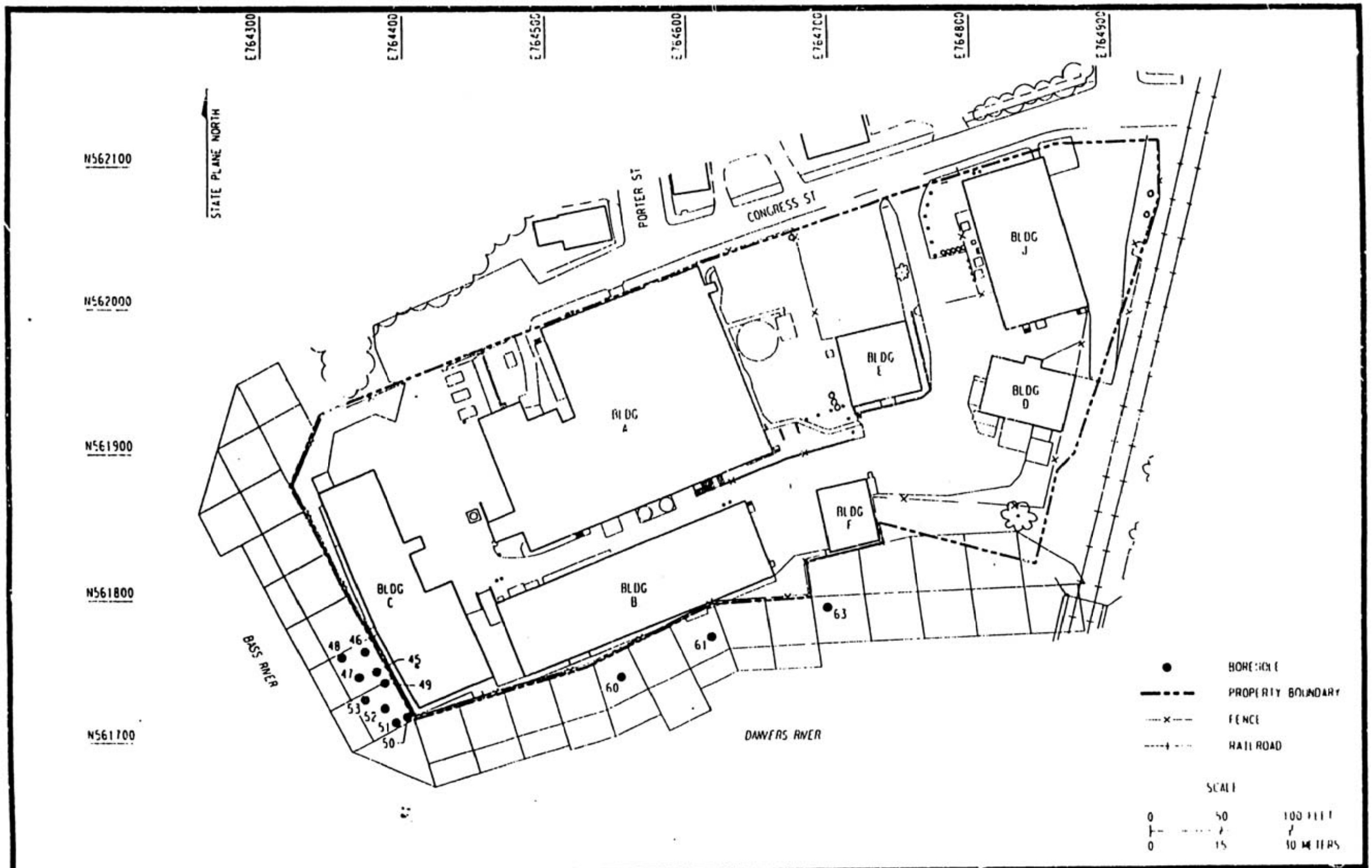
Table 4
Data Packages Generated During The Ventron Harbor Remedial Action

D-23003
D-23034
D-23045
D-23046
D-23073
D-23242
D-23431
D-23432
D-22865



127F026.DGN

Figure 1
Ventron Site
Verification Grid



127F026.DGN

Figure 2
Ventron Site
Borehole Locations

Appendix C

JULY 1997 SUPPLEMENT SAMPLING REPORT

FUSRAP Project
Job 14501

127-97-001
NO. ______ REV. NO. 0
DATE: 8-5-97

FUSRAP TECHNICAL BULLETIN

Prepared by	Team Lead Approval	Project Engineer Approval	Project Manager Approval
[signature]	[signature]	[signature] 8/5/97	[signature] for S.G. Wilkinson 8/5/97

Introduction

This technical bulletin presents the data obtained from additional sampling performed during July 1997 at the Ventron site in Beverly. Massachusetts. This sampling was performed, based on direction from DOE-HQ (Ref. 1), to close issues concerning the sufficiency of data to demonstrate site-wide compliance with the cleanup criteria. A sampling plan was agreed upon by BNI, FSRD. DOE-HQ, and ORISE prior to the initiation of sampling (Ref. 2). Other data collected to document the post remedial action status of the site can be found in the draft Post Remedial Action Report (Ref. 3) for the site.

Description

Seven onsite boreholes and three boreholes in the harbor were drilled and sampled. The borehole locations are shown on Figure 1. Samples were collected from every one f foot increment until refusal for the onsite boreholes. The majority of' the samples in the harbor were collected in 6-inch increments with one sample being collected from a one foot increment. All samples were analyzed for U-238, Ra-226, and Th-232. Sample analyses results and depths are shown in Table 1.

Harbor

3 boreholes (8.9.11)) were sampled. Sampling begun below the backfill that was placed in the harbor by Morton following their mercury removal action. The purpose of this sampling was to ensure that contamination was not present at depth due to sediment deposition resulting from normal tidal cycles. Data for U-238. the primary contaminant ranged from <2.39 to 13.17 pCi/g.

ALFA Building Area

3 boreholes (1.2.3) were sampled. Samples were collected and analyzed from surface to refusal. This area was investigated due to an elevated sample from characterization borehole 1329. Results for U-238 ranged from 1.98 to 24.57 pCi/g.

Building A/C Area

4 boreholes (4.5.6.7) were sampled. Samples were collected and analyzed from surface to borehole refusal. This area was sampled due to a lack of data density in the area as well as elevated results from characterization boreholes B42 and 1348. Results for U-238 ranged from 1.14 to 5.10 pCi/g.

Conclusion

As shown by the data presented in Table 1. All sample results are well below the cleanup criteria of 100 pCi/g total U (50 pCi/g U-238). With the collection of this data all areas of the site including the 3 areas in question have been addressed and compliance with the site cleanup criteria has been demonstrated. Figure 2 shows a compilation of all "clean data" (characterization and remedial action) collected from the Ventron site which illustrates the sufficiency of data for the site to be released without radiological restrictions.

References:

1) Bechtel National, Inc. Ventron Sampling Plan. July 1997

2) Bechtel National, Inc. Pest-Remedial Action Report for the Remedial Action at the Ventron Site (1st draft). May 1997

3) Johnson. Albert S. to Seay, W. Resolution of Open Issues at Ventron Site. Beverly, Massachusetts. June 1997

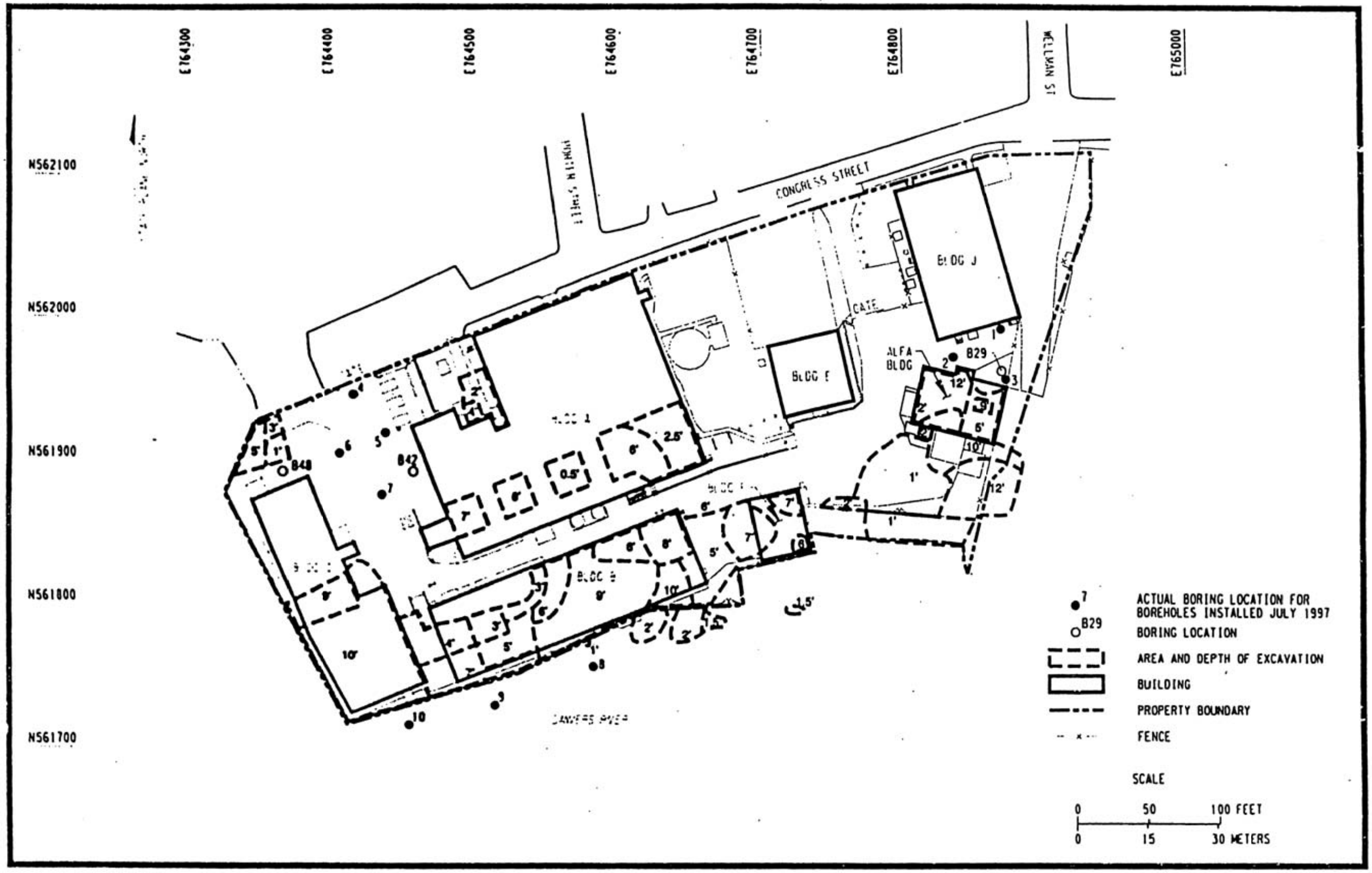


Figure 1
Additional Sampling Locations at
Ventron

Table 1
Sample Results From July 1997

Borehole #	Sample ID	Depth (ft)	Ra-226	Th-232	U-238
Onsite – 1	127RS0800	0-1	0.55 +/- 0.04	0.60 +/- 0.06	<2.55
	127RS0801	1-2	0.64 +/- 0.05	0.78 +/- 0.07	4.30 +/- 1.36
	127RS0802	2-3	0.65 +/- 0.04	0.51 +/- 0.06	6.61 +/- 1.28
	127RS0803	3-4	0.65 +/- 0.04	0.65 +/- 0.06	3.31 +/- 1.00
	127RS0804	4-5	0.65 +/- 0.05	0.61 +/- 0.07	1.98 +/- 1.06
	127RS0805	5-5.5	0.51 +/- 0.05	0.61 +/- 0.07	2.27 +/- 1.13
2	127RS0806	0-1	0.52 +/- 0.04	0.55 +/- 0.06	4.15 +/- 0.93
	127RS0807	1-2	0.55 +/- 0.04	0.72 +/- 0.06	8.57 +/- 1.18
	127RS0808	2-3	0.61 +/- 0.04	0.61 +/- 0.06	16.29 +/- 1.67
	127RS0814	3-3.75	0.55 +/- 0.04	0.74 +/- 0.06	12.42 +/- 1.49
3	127RS0809	0-1	0.66 +/- 0.04	0.71 +/- 0.07	11.70+/- 1.49
	127RS0810	1-2	0.63 +/- 0.04	0.67 +/ 0.06	24.57 +/- 1.24
	127RS0811	2-3	0.60 +/- 0.04	0.61 +/ 0.06	13.11 +/- 1.31
	127RS0812	3-4	0.61 +/- 0.04	0.73 +/ 0.07	17.22 +/- 1.73
	127RS0813	4-5	0.61 +/- 0.04	0.66 +/- 0.07	14.35 +/- 1.59
4	127RS0815	0-1	1.39 +/- 0.06	1.16 +/- 0.07	2.24 +/- 1.04
	127RS0816	1-2	2.09 +/- 0.08	1.77 +/- 0.10	<4.08
	127RS0817	2-3	1.08 +/- 0.05	0.97 +/- 0.08	4.71 +/- 1.22
	127RS0818	3-4	1.35 +/- 0.06	1.59 +/- 0.09	24.94 +/- 1.39
5	127RS0819	0-1	0.55 +/- 0.04	0.50 +/- 0.05	<2.95
	127RS0820	1-2	0.74 +/- 0.05	0.71 +/- 0.06	2.98 +/-1.37
	127RS0821	2-3	0.73 +/- 0.05	0.68 +/- 0.06	4.28 +/- 1.09
	127RS0822	3-4	0.78 +/- 0.05	0.81 +/- 0.07	5.10 +/- 1.13
6	127RS0823	0-1	0.65 +/- 0.04	0.56 +/- 0.06	<3.17
	127RS0824	1-2	0.62 +/- 0.04	0.57 +/- 0.06	1.14 +/- 0.96
	127RS0825	2-3	0.69 +/- 0.04	0.78 +/- 0.06	1.77 +/- 0.94
	127RS0826	3-4	0.64 +/- 0.04	0.90 +/- 0.07	4.19 +/- 1.24
	127RS0827	4-5	0.71 +/- 0.04	0.74 +/- 0.07	2.77 +/- 1.19
7	127RS0828	0-1	0.51 +/- 0.04	0.69 +/- 0.06	3.72 +/- 1.01
	127RS0829	1-2	0.66 +/- 0.04	0.67 +/- 0.07	3.90 +/- 1.25
	127RS0830	2-3	0.56 +/- 0.05	0.84 +/- 0.07	<3.37
	127RS0831	3-4	0.72 +/- 0.05	0.86 +/- 0.07	2.79 +/- 1.14
Harbor – 8	127RS0832	2-3	0.43 +/- 0.04	0.60 +/- 0.06	<2.55
	127RS0833	3-3.5	0.37 +/- 0.04	0.44 +/- 0.05	<2.39
9	127RS0834	2-2.5	0.59 +/- 0.04	0.53 +/- 0.06	<2.72
10	127RS0835	2-2.5	0.39 +/- 0.04	0.52 +/- 0.06	13.17+/- 1.26
	127RS0836	2-3.3	0.36 +/- 0.03	0.38 +/- 0.06	5.68 +/- 0.96

Appendix D

POST-REMEDIAL ACTION SAMPLING DATA

Figures

Tables (Gross Results Presented)

Table D-1 Buildings A and A-1 Demolition Data

Sample ID	Pile Location	U-238 (pCi/g)	Th-232 (pCi/g)	RA-226 (pCi/g)
127-RS-097	Quadrant A	<2.00	<0.57	0.45 +/- 0.06
127-RS-098	Quadrant A	<1.50	0.57 +/- 0.08	0.43 +/- 0.05
127-RS-099	Quadrant A	<1.30	0.53 +/- 0.08	0.43 +/- 0.04
127-RS-100	Quadrant A	<1.30	0.70 +/- 0.10	0.36 +/- 0.05
127-RS-101	Quadrant A	<2.10	0.63 +/- 0.13	0.59 +/- 0.06
127-RS-102	Quadrant A	1.20 +/- 0.53	0.75 +/- 0.10	0.44 +/- 0.05
127-RS-103	Quadrant A	<2.00	0.59 +/- 0.09	0.47 +/- 0.06
127-RS-104	Quadrant A	<2.50	0.63 +/- 0.14	0.61 +/- 0.08
127-RS-105	Quadrant A	<2.30	0.49 +/- 0.12	0.62 +/- 0.06
127-RS-106	Quadrant B	<2.30	0.65 +/- 0.14	0.62 +/- 0.07
127-RS-107	Quadrant B	<3.20	<0.89	0.61 +/- 0.10
127-RS-108	Quadrant B	3.60 +/- 1.30	<0.98	0.95 +/- 0.14
127-RS-109	Quadrant B	3.10 +/- 1.60	<1.30	1.20 +/- 0.15
127-RS-110	Quadrant B	<2.60	0.95 +/- 0.14	0.90 +/- 0.08
127-RS-111	Quadrant B	<3.70	1.10 +/- 0.16	0.78 +/- 0.11
127-RS-112	Quadrant B	1.30 +/- 1.00	1.10 +/- 0.16	1.00 +/- 0.10
127-RS-113	Quadrant B	<3.40	0.88 +/- 0.18	0.67 +/- 0.09
127-RS-114	Quadrant B	<3.20	0.71 +/- 0.14	0.82 +/- 0.09
127-RS-115	Quadrant C	0.40 +/- 0.46	<0.48	0.39 +/- 0.05
127-RS-116	Quadrant C	<3.70	0.78 +/- 0.18	0.55 +/- 0.10
127-RS-117	Quadrant C	<3.20	<0.79	0.59 +/- 0.08
127-RS-118	Quadrant C	<2.40	0.85 +/- 0.15	0.62 +/- 0.07
127-RS-119	Quadrant C	<2.70	0.82 +/- 0.15	0.57 +/- 0.08
127-RS-120	Quadrant C	<1.90	0.71 +/- 0.12	0.55 +/- 0.06
127-RS-121	Quadrant C	2.80 +/- 1.30	0.89 +/- 0.19	0.76 +/- 0.13
127-RS-122	Quadrant C	1.70 +/- 0.89	<0.75	0.73 +/- 0.09
127-RS-123	Quadrant C	<3.60	0.94 +/- 0.20	0.74 +/- 0.10
127-RS-124	Quadrant D	<3.50	0.91 +/- 0.24	0.98 +/- 0.13
127-RS-125	Quadrant D	<4.20	<1.10	<0.76
127-RS-126	Quadrant D	<2.20	<0.58	0.45 +/- 0.07
127-RS-127	Quadrant D	<2.40	<0.61	0.63 +/- 0.08
127-RS-128	Quadrant D	<3.00	<0.76	0.42 +/- 0.09
127-RS-129	Quadrant D	<2.10	<0.53	0.38 +/- 0.07
127-RS-130	Quadrant D	1.20 +/- 0.87	<0.78	<0.51
127-RS-131	Quadrant D	<3.50	<0.95	<0.60
127-RS-132	Quadrant D	<3.20	0.50 +/- 0.16	0.54 +/- 0.10
127-RS-133	Quadrant D	<0.90	<0.23	<0.16
127-RS-134	Quadrant D	<0.84	<0.24	<0.16
127-RS-135	Pile Grab	<2.20	0.69 +/- 0.12	1.20 +/- 0.08
127-RS-142	Quadrant E	<1.90	0.55 +/- 0.10	0.58 +/- 0.06
127-RS-143	Quadrant E	<2.40	0.43 +/- 0.11	<0.37

Table D-1 (continued)

Sample ID	Pile Location	U-238 (pCi/g)	Th-232 (pCi/g)	RA-226 (pCi/g)
127-RS-144	Quadrant E	<2.70	0.90 +/- 0.13	0.61 +/- 0.07
127-RS-145	Quadrant E	1.60 +/- 0.76	0.76 +/- 0.10	0.60 +/- 0.06
127-RS-146	Quadrant E	0.23 +/- 0.69	<0.76	0.52 +/- 0.08
127-RS-147	Quadrant E	2.40 +/- 077	<0.46	0.30 +/- 0.06
127-RS-148	Quadrant E	<2.80	0.54 +/- 0.12	0.46 +/- 0.07
127-RS-149	Quadrant E	3.20 +/- 0.97	0.61 +/- 0.10	0.61 +/- 0.06
127-RS-150	Quadrant E	1.70 +/- 0.80	<0.52	0.42 +/- 0.06

Table D-2 Alfa Building (Building J) Demolition Data

Sample ID	Material	U-238 (pCi/g)	Th-232 (pCi/g)	RA-226 (pCi/g)
127-RS-610	Metal	0.57 +/- 0.74	<0.53	<0.37
127-RS-611	Roofing	<3.00	<1.10	<0.62
127-RS-612	Concrete	<2.10	0.64 +/- 0.10	1.30 +/- 0.08
127-RS-613	Wood	<9.70	<2.60	<1.60

Table D-3
Post-Remedial Action Data, Excavations 1, 2, and 3

Excavation 1 (NW Corner of Site)

Grid Location	Sample ID	Sample Type	U-238 (pCi/g)	Th-232 (pCi/g)	RA-226 (pCi/g)
S0 - E0	127-RS-088	Composite	8.8 +/- 2.3	0.92 +/- 0.12	1.0 +/- 0.80
S3 - E9	127-RS-136	Highest Area	6.6 +/- 1.8	0.43 +/- 0.10	0.44 +/- 0.06
S9 - E10	127-RS-091	Composite	6.8 +/- 1.80	0.79 +/- 0.10	0.64 +/- 0.06
S2 - 314	127-RS-137	Highest Area	12.7 +/- 3.30	1.7 +/- 0.16	1.3 +/- 0.11

Excavation 2 (Near Buildings A and A-1 Slabs)

Grid Location	Sample ID	Sample Type	U-238 (pCi/g)	Th-232 (pCi/g)	RA-226 (pCi/g)
S0 - E50	127-RS-092	Composite	9.9 +/- 2.70	0.89 +/- 0.16	0.88 +/- 0.11
S0 - E50	127-RS-093	Highest Area	14.1 +/- 3.60	0.7 +/- 0.12	0.65 +/- 0.07
S10 - E50	127-RS-094	Composite	15.8 +/- 4.10	1.2 +/- 0.21	0.6 +/- 0.10
S10 - E50	127-RS-095	Highest Area	34.1 +/- 2.50	1.3 +/- 0.15	1 +/- 0.09

Excavation 3 (Near Building E)

Grid Location	Sample ID	Sample Type	U-238 (pCi/g)	Th-232 (pCi/g)	RA-226 (pCi/g)
S0 – E130	127-RS-096	Composite	2.9 +/- 1.10	<0.81	0.6 +/- 0.09

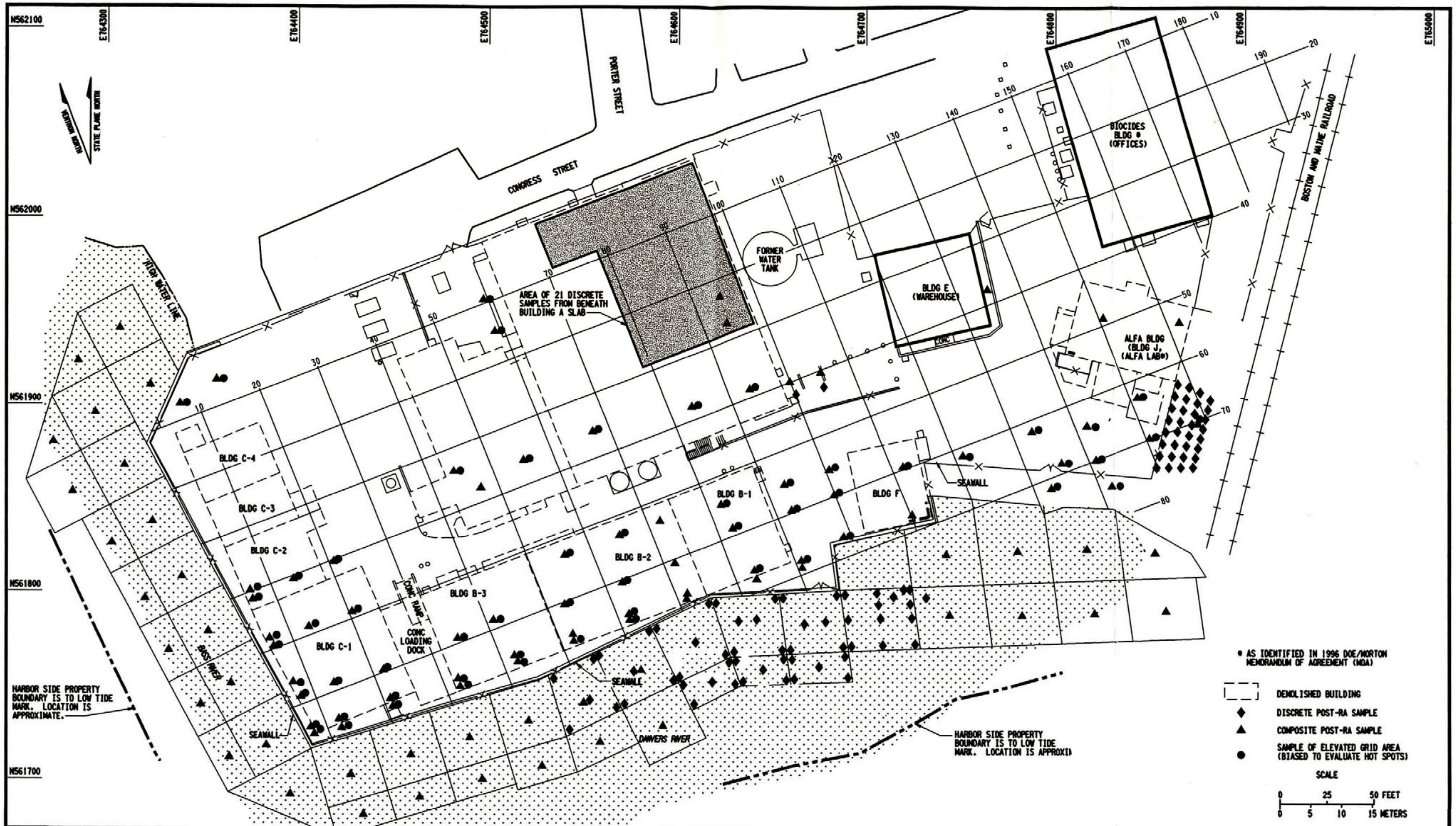


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Figure D-1
Ventron Site
Verification Grids and Post-Remedial Action Sampling Locations

Table D-4
Post-Remedial Action Data, Excavation 4
Alfa Building (Building J)

Grid Location	Sample ID	Sample Type	U-238 (pCi/g)	Th-232 (pCi/g)	RA-226 (pCi/g)
S60 - E150	127-RS-232	Highest Area	36.3 +/- 4.9	<0.66	0.66 +/- 0.08
S60 - E150	127-RS-231	Composite	32.6 +/- 2.00	1.2 +/- 0.15	0.62 +/- 0.08
S70 - E140	127-RS-228	Highest Area	<2.9	1.4 +/- 0.13	0.49 +/- 0.07
S70 - E140	127-RS-227	Composite	5.4 +/- 1.6	<0.56	0.67 +/- 0.07
S50 - E150	127-RS-230	Highest Area	11.4 +/- 3.3	1.3 +/- 0.19	0.76 +/- 0.11
S50 - E150	127-RS-229	Composite	20.6 +/- 1.6	1.5 +/- 0.17	1 +/- 0.09
S70 - E130	127-RS-222	Highest Area	<3.2	1.6 +/- 0.15	0.63 +/- 0.08
S70 - E130	127-RS-221	Composite	<3.1	3 +/- 0.2	<0.45
S60 - E140	127-RS-226	Highest Area	8.3 +/- 2.3	1.5 +/- 0.15	0.67 +/- 0.09
S60 - E140	127-RS-225	Composite	<2.90	2.6 +/- 0.15	0.41 +/- 0.07
S60 - E130	127-RS-220	Highest Area	<3.90	2.1 +/- 0.19	1.1 +/- 0.11
S60 - E130	127-RS-289	Composite	<4.95	7.74 +/- 0.36	1.15 +/- 0.15
S50 - E140	127-RS-224	Highest Area	7.2 +/- 2.0	1.3 +/- 0.13	0.63 +/- 0.08
S50 - E140	127-RS-223	Composite	<1.9	0.8 +/- 0.12	<0.3
S50 - E130	127-RS-287	Highest Area	7.7 +/- 0.83	1.4 +/- 0.12	0.74 +/- 0.06
S50 - E130	127-RS-288	Highest Area	23.1 +/- 5.8	1.75 +/- 0.13	0.07 +/- 0.11
S50/60 - E130/140	127-RS-290	Composite	4.84 +/-1.36	1.75 +/- 0.13	0.83 +/- 0.07
Phase II – Railroad Excavation (uses special grid)					
0E - 0S	127-RS-527	Discrete	10.83 +/- 2.65	1.-11 +/- 0.09	0.81 +/- 0.06
0E - 2S	127-RS-528	Discrete	16.82 +/- 2.77	1.26 +/- 0.11	1 +/- 0.06
0E - 4S	127-RS-529	Discrete	22.9 +/- 2.75	0.83 +/- 0.09	0.97+/- 0.06
0E - 6S	127-RS-530	Discrete	25.0 +/- 3.16	1.17 +/- 0.10	0.89 +/- 0.06
0E - 8S	127-RS-531	Discrete	8.63 +/- 2.21	0.64 +/- 0.09	0.84 +/- 0.06
0E - 10S	127-RS-532	Discrete	39.49 +/- 3.72	1.10 +/- 0.11	0.95 +/- 0.07
0E - 12S	127-RS-533	Discrete	1.87 +/- 2.26	0.76 +/- 0.10	0.91 +/- 0.07
2E - 0S	127-RS-534	Discrete	25.57 +/- 3.43	1.44 +/- 0.12	1.46 +/- 0.08
2E - 2S	127-RS-535	Discrete	21.75 +/- 3.06	2.00 +/- 0.12	1.04 +/- 0.06
2E - 4S	127-RS-536	Discrete	15.11 +/ - 2.86	1.13 +/- 0.11	0.82 +/- 0.07
2E - 6S	127-RS-537	Discrete	21.3 +/- 3.04	1.12 +/- 0.11	0.89 +/- 0.07
2E - 8S	127-RS-538	Discrete	7.52 +/- 2.42	0.83 +/- 0.09	0.79 +/- 0.06
2E - l0S	127-RS-539	Discrete	12.05 +/-1.96	0.77 +/- 0.09	0.77 +/- 0.06
2E -12S	127-RS-540	Discrete	9.96 +/- 2.05	0.88 +/- 0.09	0.77 +/- 0.06

Table D-4 (continued)

Grid Location	Sample ID	Sample Type	U-238 (pCi/g)	Th-232 (pCi/g)	RA-226 (pCi/g)
4E - 0S	127-RS-541	Discrete	3.60 +/-1.64	0.48 +/- 0.08	0.50 +/- 0.05
4E - 2S	127-RS-542	Discrete	34.92 +/- 3.66	1.17 +/ 0.10	0.91 +/ 0.07
4E - 4S	127-RS-543	Discrete	24.38 +/- 3.47	1.38 +/ 0.12	1.20 +/ 0.08
4E - 6S	127-RS-544	Discrete	6.69 +/- 2.60	0.89 +/ 0.11	0.78 +/ 0.06
4E - 8S	127-RS-545	Discrete	11.47 +/- 2.39	0.88 +/ 0.10	0.72 +/ 0.06
4E - 10S	127-RS-546	Discrete	7.66 +/ -1.93	0.82 +/ 0.08	0.65 +/ 0.05
4E -12S	127-RS-547	Discrete	0.74 +/ 41.90	0.55 +/ 0.08	0.68 +/- 0.05
4E -14S	127-RS-548	Discrete	3.47 +/- 1.93	0.79 +/- 0.09	0.71 +/- 0.05
6E - 0S	127-RS-549	Discrete	0.58 +/- 2.06	0.81 +/ 0.08	0.76 +/ 0.05
6E - 2S	127-RS-550	Discrete	<3.03	0.66 +/ 0.08	0.51 +/ 0.04
6E - 4S	127-RS-551	Discrete	0.65 +/- 1.94	0.70 +/ 0.07	0.49 +/ 0.04
6E - 6S	127-RS-552	Discrete	<3.03	0.64 +/ 0.07	0.45 +/ 0.04
6E - 8S	127-RS-553	Discrete	19.72 +/- 2.83	0.80 +/ 0.10	0.88 +/ 0.06
6E - 10S	127-RS-554	Discrete	2.70 +/- 1.83	0.73 +/ 0.09	0.60 +/ 0.05
6E - 128	127-RS-555	Discrete	0.15 +/- 2.35	1.13 +/ 0.09	0.75 +/ 0.05
6E - 145	127-RS-556	Discrete	3.56 +/- 1.72	0.98 +/ 0.09	0.75 +/ 0.06
Area Comp.	127-RS-557	Composite	16.96 +/ 2.67	0.92 +/ 0.10	0.89 +/ 0.07
Highest Area	127-RS-558	Discrete	38.15 +/ - 3.60	1.24 +/ 0.10	0.73 +/ 0.06
Highest Area	127-RS-559	Discrete	43.81 +/- 3.95	1.15 +/- 0.10	0.96 +/- 0.07
3E - 4S	127-RS-568	Highest Area	27.36 +/- 3.06	1.27 +/ 0.10	0.72 +/ 0.06
3E - 4S	127-RS-569	Highest Area	46.63 +/- 3.43	0.98 +/ 0.09	0.86 +/ 0.06
1E - 5S	127-RS-570	Highest Area	38.08 +/- 3.48	1.4 +/- 0.10	0.88 +/- 0.06
1E - 5S	127-RS-571	Highest Area	24.87 +/- 2.99	1.04 +/- 0.09	0.88 +/- 0.06
Phase III – Under Alfa Building					
1501140E - 40/40S	127-RS-633	Composite	26.67 +/- 2.17	0.9 +/- 0.06	0.81 +/- 0.04
150E - 508	127-RS-632	Composite	21.1 +/-1.86	0.91 +/- 0.06	0.68 +/- 0.03
160E - 50S	127-RS-630	Composite	13.51 +/-1.94	0.79 +/- 0.07	0.7 +/- 0.04
160E - 608	127-RS-631	Composite	7.42 +/-1.40	0.78 +/- 0.06	0.71 +/- 0.04
Alfa Pit (150E - 508) Bottom	127-RS-646	Composite	35.08 +/- 3.18	0.84 +/- 0.08	0.61 +/- 0.05

Table D-5
Post-Remedial Action Data, Excavation 5 (Harbor)

Phase I					
Grid Location	**Sample ID**	**Sample Type**	**U-238 (pCi/g)**	**Th-232 (pCi/g)**	**Ra 226 (pCi/g)**
Grid 1	12795006	Composite	0.37 +/- 0.46	0.46 +/- 0.10	0.60 +/- 0.09
Grid 2	12795007	Composite	<1.90	<0.58	0.47 +/- 0.07
Grid 3	12795008	Composite	<1.70	0.48 +/- 0.11	0.44 +/- 0.10
Grid 4	12795009	Composite	<1.80	0.36 +/- 0.19	0.52 +/- 0.12
Grid 5	12795010	Composite	<1.70	<0.53	0.36 +/- 0.09
Grid 6	12795011	Composite	<1.90	0.27 +/- 0.10	0.45 +/- 0.07
Grid 7	12795012	Composite	<1.50	0.41 +/- 0.11	0.39 +/- 0.08
Grid 8	12795013	Composite	1.70 +/- 0.67	0.26 +/- 0.13	0.6 +/- 0.11
Grid 9	12795014	Composite	2.70 +/- 0.87	0.47 +/- 0.07	0.52 +/- 0.10
Grid 10	12795015	Composite	2.10 +/- 0.81	0.33 +/- 0.16	0.39 +/- 0.08
Grid 11	12795016	Composite	8.10 +/- 2.20	0.58 +/- 0.09	0.29 +/- 0.09
Grid 12	12795017	Composite	<2.70	0.54 +/- 0.11	0.45 +/- 0.11
Grid 13	12795018	Composite	1.30 +/- 0.65	0.65 +/- 0.13	0.51 +/- 0.10
Grid 14	12795036	Composite	<3.10	<0.86	0.40 +/- 0.15
Grid 15	12795019	Composite	5.60 +/-1.60	0.59 +/- 0.11	0.50 +/- 0.10
Grid 16	12795020	Composite	13.30 +/-1.70	0.38 +/- 0.11	0.43 +/- 0.12
Grid 17	12795031	Composite	9.50 +/- 2.60	0.34 +/- 0.11	0.56 +/- 0.08
Grid 18	12795021	Composite	21.50 +/- 4.40	0.60 +/- 0.08	0.57 +/- 0.11
Grid 19	12795022	Composite	3.00 +/- 0.98	0.71 +/- 0.16	0.43 +/- 0.11
Grid 21	12795024	Composite	6.10 +/-1.70	0.77 +/- 0.12	0.70 +/- 0.13
Grid 22	12795025	Composite	<2.20	0.61 +/- 0.11	0.37 +/- 0.07
Grid 23	12795026	Composite	3.60 +/-1.10	0.39 +/- 0.08	0.53 +/- 0.10
Grid 24	12795027	Composite	<2.00	0.55 +/- 0.13	0.39 +/- 0.07
Grid 25	12795028	Composite	<2.10	0.78 +/- 0.13	0.38 +/- 0.08
Grid 26	12795029	Composite	<1.90	0.38 +/- 0.08	0.56 +/- 0.09
Grid 27	12795030	Composite	1.80 +/- 0.73	0.35 +/- 0.08	0.45 +/- 0.10
Grid 31	12795032	Composite	9.80 +/- 2.90	3.60 +/- 0.67	0.47 +/- 0.18
Grid 33	12795033	Composite	4.20 +/-1.30	<0.59	0.52 +/- 0.10
Grid 34	12795041	Composite	<2.40	0.59 +/- 0.15	0.44 +/- 0.13
Grid 35	12795042	Composite	0.74 +/- 0.70	0.67 +/- 0.11	0.43 +/- 0.13
Grid 36	12795043	Composite	1.10 +/- 0.65	<0.62	0.48 +/- 0.12
Grid 37	12795044	Composite	1.80 +/- 0.79	<0.64	0.46 +/- 0.13
Grid 38	12795037	Composite	<4.10	0.36 +/- 0.13	0.51 +/- 0.13
Grid 39	12795038	Composite	<3.10	0.56 +/- 0.20	0.51 +/- 0.18
Grid 40	12795039	Composite	<4.00	0.84 +/- 0.19	0.61 +/- 0.13

Table D-5 (continued)

Grid Location	Sample ID	Phase I Sample Type	U-238 (pCi/g)	Th-232 (pCi/g)	Ra-226 (pCi/g)
Grid 41	12795040	Composite	<4.40	0.60 +/- 0.37	1.00 +/- 0.28
Grid 42	12795034	Composite	<4.40	<1.50	0.52 +/- 0.21
Grid 43	12795035	Composite	1.30 +/-1.10	0.91 +/- 0.19	0.83 +/- 0.17
Phase II					
Grid 20	127-RS-151	Discrete	13.0 +/- l.1	1 +/- 0.12	0.47 +/- 0.07
Grid 20	127-RS-152	Discrete	8.6 +/- 0.83	1 +/- 0.09	0.57 +/- 0.05
Grid 20	127-RS-153	Discrete	2.1 +/- 0.70	0.57 +/- 0.09	0.47 +/- 0.05
Grid 20	127-RS-154	Discrete	2.4 +/- 0.83	0.46 +/- 0.10	0.33 +/- 0.06
Grid 20	127-RS-155	Discrete	4.3 +/- 1.30	0.7 +/- 0.11	0.88 +/- 0.07
Grid 20	127-RS-156	Discrete	6.6 +/ -1.80	0.61 +/- 0:11	0.69 +/- 0.06
Grid 20	127-RS-157	Discrete	12.9 +/- 1.2	0.77 +/- 0.13	0.51 +/- 0.08
Grid 20	127-RS-158 `	Discrete	6.7 +/- 0.83	0.98 +/- 0.13	0.47 +/- 0.06
Grid 20	127-RS-159	Discrete	<3.3	0.64 +/- 0.15	0.55 +/- 0.10
Grid 20	127-RS-160	Discrete	17.3 +/- 4.3	0.75 +/- 0.11	0.48 +/- 0.08
Grid 21	127-RS-639	Composite	37.6 +/- 2.95	0.91 +/- 0.08	0.59 +/- 0.04
Grid 21	127-RS-647	Discrete	11.0 +/- 2.46	0.79 +/ 0.11	0.62 +/- 0.06
Grid 21	127-RS-650	Discrete	18.1 +/- 2.60	1.50 +/- 0.11	0.64 +/- 0.05
Grid 21	127-RS-651	Discrete	12.3 +/- 3.01	0.85 +/- 0.12	0.74 +/- 0.07
Grid 28	127-RS-172	Discrete	<2.4	<0.6	0.84 +/- 0.08
Grid 28	127-RS-175	Discrete	1.1 +/- 0.53	0.39 +/- 0.08	0.37 +/- 0.05
Grid 28	127-RS-181	Discrete	3.3 +/- 0.93	0.49 +/- 0.08	0.27 +/- 0.04
Grid 28	127-RS-182	Discrete	5.6 +/- 1.5	0.64 +/- 0.10	0.43 +/- 0.06
Grid 28	127-RS-183	Discrete	2.9 +/- 0.92	<0.51	0.55 +/- 0.06
Grid 29	127-RS-171	Discrete	7.4 +/- 2.0	0.83 +/- 0.12	0.36 +/- 0.07
Grid 29	127-RS-173	Discrete	1.2 +/- 0.57	0.5 +/- 0.08	0.58 +/- 0.05
Grid 29	127-RS-174	Discrete	8.8 +/- 1.0	0.7 5+/- 0.11	0.53 +/- 0.07
Grid 29	127-RS-176	Discrete	3.4 +/- 0.10	0.59 +/- 0.09	<0.3
Grid 29	127-RS-177	Discrete	7.8 +/- 2.00	0.65 +/- 0.09	0.56 +/- 0.06
Grid 29	127-RS-178	Discrete	6.7 +/- 1.8	1.1 +/- 0.14	0.7 +/- 0.07
Grid 29	127-RS-179	Discrete	8.5 +/- 2.2	<0.39	0.26 +/- 0.04
Grid 29	127-RS-180	Discrete	16.5 +/- 1.2	0.37 +/- 0.10	<0.29
Grid 30	127-RS-166	Discrete	1.3 +/- 0.61	0.59 +/- 0.10	0.88 +/- 0.06
Grid 30	127-RS-167	Discrete	<2.3	0.63 +/- 0.11	1.3 +/- 0.07
Grid 30	127-RS-168	Discrete	11.4 +/- 2.9	0.93 +/- 0.12	0.69 +/- 0.07
Grid 30	127-RS-169	Discrete	9.3 +/- 0.94	0.44 +/- 0.10	0.97 +/- 0.07
Grid 30	127-RS-170	Discrete	1.6 +/- 0.65	0.61 +/- 0.11	0.77 +/- 0.06

Table D-5 (continued)

Grid Location	Sample ID	Phase I Sample Type	U-238 (pCi/g)	Th-232 (pCi/g)	Ra-226 (pCi/g)
Phase II					
Grid 31	127-RS-161	Discrete	<2.8	<0.64	1.1 +/- 0.08
Grid 31	127-RS-162	Discrete	2.9 +/- 0.89	0.58 +/- 0.09	0.87 +/- 0.06
Grid 31	127-RS-163	Discrete	3 +/- 1.0	0.84 +/- 0.10	0.7 +/- 0.07
Grid 31	127-RS-164	Discrete	2.9 +/- 0.90	0.76 +/- 0.09	1.1 +/- 0.07
Grid 31	127-RS-165	Discrete	<2.1	0.68 +/- 0.11	0.92 +/- 0.07
Grid 32	127-RS-197	Discrete	<1.81	<0.42	<0.33
Grid 32	127-RS-198	Discrete	<2.25	0.73 +/- 0.13	1.1 +/- 0.07
Grid 32	127-RS-199	Discrete	<2.17	0.57 +/- 0.11	0.83 +/- 0.07
Grid 32	127-RS-200	Discrete	5.76 +/-1.64	0.89 +/- 0.14	0.9 +/- 0.08
Grid 32	127-RS-201	Discrete	<1.93	0.67 +/- 0.12	0.81 +/- 0.06
Grid 44	127-RS-202	Discrete	<2.43	0.51 +/- 0.12	0.86 +/- 0.08
Grid 44	127-RS-203	Discrete	<1.86	0.74 +/- 0.11	1.14 +/- 0.07
Grid 44	127-RS-204	Discrete	2.72 +/- 0.96	0.51 +/- 0.16	0.53 +/- 0.08
Grid 44	127-RS-205 (	Discrete	<1.54	<0.43	0.85 +/- 0.06
Grid 44	127-RS-206	Discrete	<3.19	<0.55	<0.35
Grid 45	127-RS-212	Discrete	<2.3	0.62 +/- 0.10	0.58 +/- 0.07
Grid 45	127-RS-213	Discrete	2.9+/-I.1	0.96 +/- 0.19	0.75 +/- 0.11
Grid 45	127-RS-214	Discrete	2.3 +/- 0.84	0.7 +/- 0.11	0.48 +/- 0.06
Grid 45	127-RS-215	Discrete	2.9 +/- 0.99	<0.68	0.5 +/- 0.07
Grid 45	127-RS-216	Discrete	1.5 +/- 0.66	0.62 +/- 0.09	0.43 +/- 0.05
Grid 46	127-RS-207	Discrete	<2.33	0.77 0.13	0.5 +/- 0.07
Grid 46	127-RS-208	Discrete	<2.5	<0.63	0.38 +/- 0.07
Grid 46	127-RS-209	Discrete	<2.9	2 +/- 0.15	0.44 +/- 0.08
Grid 46	127-RS-210	Discrete	<2.0	0.35 +/- 0.10	0.55 +/- 0.06
Grid 46	127-RS-211	Discrete	1.8 +/- 0.81	0.67 +/.- 0.15	0.41 +/- 0.08
Grid 29/30 HS Removal	127-RS-253	Discrete	3.4 +/- 0.10	0.64 +/- 0.10	0.51 +/- 0.05
Grid 29/30 HS Removal	127-RS-254	Discrete	2.7 +/- 0.98	0.52 +/- 0.08	0.38 +/- 0.05
Grid 29/30 HS Removal	127-RS-255	Discrete	<1.9	0.55 +/- 0.08	0.3 +/- 0.05
Grid 29/30 HS Removal	127-RS-256	Discrete	<1.9	0.5 +/- 0.09	0.4 +/- 0.05

Table D-6
Post-Remedial Action Data, Excavation 6
Samples Near Vicinity of Seawall

Seawall Proximity Location	Sample ID	Sample Type	U- 238 (pCi/g)	Th-232 (pCi/g)	Ra-226 (pCi/g)
Location 1	127-RS-285	Composite	12.3 +/- 3.10	0.79 +/- 0.08	0.40 +/- 0.05
	127-RS-286	Highest Area	15.1 +/- 3.80	1.1 +/- 0.14	0.47 +/- 0. 08
Location 2	127-RS-296	Composite	25.89 +/- 1.93	1.16 +/- 0.15	0.86 +/- 0.08
	127-RS-297	Composite	18.1 +/- 4.51	0.77 +/- 0.13	0.69 +/- 0.07
	127-RS-298	Highest Area	5.3 +/- 1.39	0.42 +/- 0.07	0.42 +/- 0.06
Location 3	127-RS-295	Composite	21.16 +/- 1.52	0.69 +/- 0.69	0.34 +/- 0.07
	127-RS-294	Composite	29.31 +/- 2.07	0.59 +/- 0.10	0.52 +/- 0.06
	127-RS-293	Highest Area	16.73 +/- 4.28	<0.94	0.52 +/- 0.11
Location 4	127-RS-299	Composite	22.7 +/- 1.90	1.6 +/- 0.17	1.6 +/- 0.11
	127-RS-300	Composite	24.9 +/- 6.20	<0.96	1.3 +/- 0.11
	127-RS-301	Highest Area	26.1 +/- 6.40	0.86 +/- 0.17	1.3 +/- 0.10
Location 5	127-RS-302	Composite '	8.4 +/- 2.20	0.61 +/- 0.11	0.6 +/- 0.06
	127-RS-303	Composite '	15.6 +/- 4.00	0.84 +/- 0.14	0.77 +/- 0.10
	127-RS-304	Highest Area	11.3 +/- 1.00	0.71 +/- 0.11	0.61 +/- 0.07
Location 6	127-RS-305	Composite	8.3 +/- 2.40	1.2 +/- 0.19	0.97 +/- 0.12
	127-RS-306	Composite	27.6 +/- 6.90	<1.1	1.9 +/- 0.15
	127-RS-307	Highest Area	19.0 +/- 1.7	1.7 +/- 0.18	1.3 +/- 0.11
Location 7	127-RS-308	Composite	14.8 +/- 1.2	0.72 +/- 0.11	0.57 +/- 0.06
	127-RS-309	Composite	38.1 +/- 2.50	<0.94	0.77 +/- 0.10
	127-RS-310	Highest Area	7.2 +/- 1.90	<0.61	<0.35
Location 8	127-RS-311	Composite	16 +/- 1.40	1 +/- 0.14	1.2 +/- 0.09
	127-RS-312	Composite	18.7 +/- 4.80	<1.2	<0.77
	127-RS-313	Highest Area	8.8 +/- 0.89	0.57 +/- 0.12	0.86 +/- 0.07
Location 9	127-RS-314	Composite	20.7 +/- 1.50	0.59 +/- 0.08	0.50 +/- 0.05
	127-RS-315	Composite	23.6 +/- 1.60	0.55 +/- 0.12	0.45 +/- 0.07
	127-RS-316	Highest Area	29.6 +/- 1.70	0.61 +/- 0.12	<0.35
Location 10	127-RS-317	Composite	15 +/- 1.20	0.61 +/- 0.09	0.55 +/- 0.05
	127-RS-318	Composite	11.5 +/- 3.00	<0.62	0.58 +/- 0.07
	127-RS-319	Highest Area	8.1 +/- 2.10	0.92 +/- 0.09	0.61 +/- 0.06
Location 11	127-RS-320	Composite	12.8 +/- 3.20	0.72 +/- 0.12	0.45 +/- 0.07
	127-RS-321	Composite	12.5 +/- 3.10	1.1 +/- 0.10	0.52 +/- 0.05
	127-RS-322	Highest Area	3.7 +/- 1.10	0.43 +/- 0.09	0.34 +/- 0.05
Location 12	127-RS-323	Composite	16.5 +/- 1.30	0.78 +/- 0.09	0.56 +/- 0.06
	127-RS-324	Composite	25.9 +/- 6.4	<0.64	0.5 +/- 0.08
	127-RS-325	Highest Area I	2.2 +/- 0.83	<035	0.81 +/- 0.08
Location 13	127-RS-326	Composite	11.6 +/- 1.20	<0.58	0.42 +/ 0.07
	127-RS-327	Composite	24.2 +/- 1.80	0.65 +/- 0.10	0.42 +/- 0.05

Table D-6 Continued

Seawall Proximity Location	Sample ID	Sample Type	U-238 (pCi/g)	Th-232 (pCi/g)	Ra-226 (pCi/g)
	127-RS-328	Highest Area	5.7 +/- 1.50	0.54 +/- 0.09	0.37 +/- 0.06
Location 14	127-RS-414	Composite	36.88 +/- 3.42	0.75 +/- 0.08	0.53 +/- 0. 05
	127-RS-415	Highest Area	21.79 +/- 2.47	1.17 +/- 0.10	0.75 +/- 0.07
Location 15	127-RS-336	Composite	28.9 +/- 3.02	0.97 +/- 0.09	0.64 +/- 0.06
	127-RS-337	Highest Area	<2.76	0.51 +/- 0.07	0.45 +/- 0.04
Location 16	127-RS-334	Composite	25.5 +/- 2.49	0.9 +/- 0.10	0.89 +/- 0.06
	127-RS-335	Highest Area	12.98 +/- 2.32	2.59 +/- 0.18	2.24 +/- 0.12
Location 17	127-RS-460	Composite	4.75 +/- 1.268	0.52 +/- 0.06	0.59 +/- 0.04
Location 18	127-RS-464	Composite	18.8 +/- 2.46	0.76 +/- 0.07	0.57 +/- 0.04
Location 19	127-RS-477	Composite	3.78 +/- 1.63	0.73 +/- 0.08	0.54 +/- 0.05
Location 20	127-RS-518	Composite	6.98 +/- 1.59	0.88 +/- 0.12	0.64 +/- 0.07
	127-RS-522	Highest Area	15.13 +/- 1.86	0.93 +/- 0.14	0.7 +/- 0.08

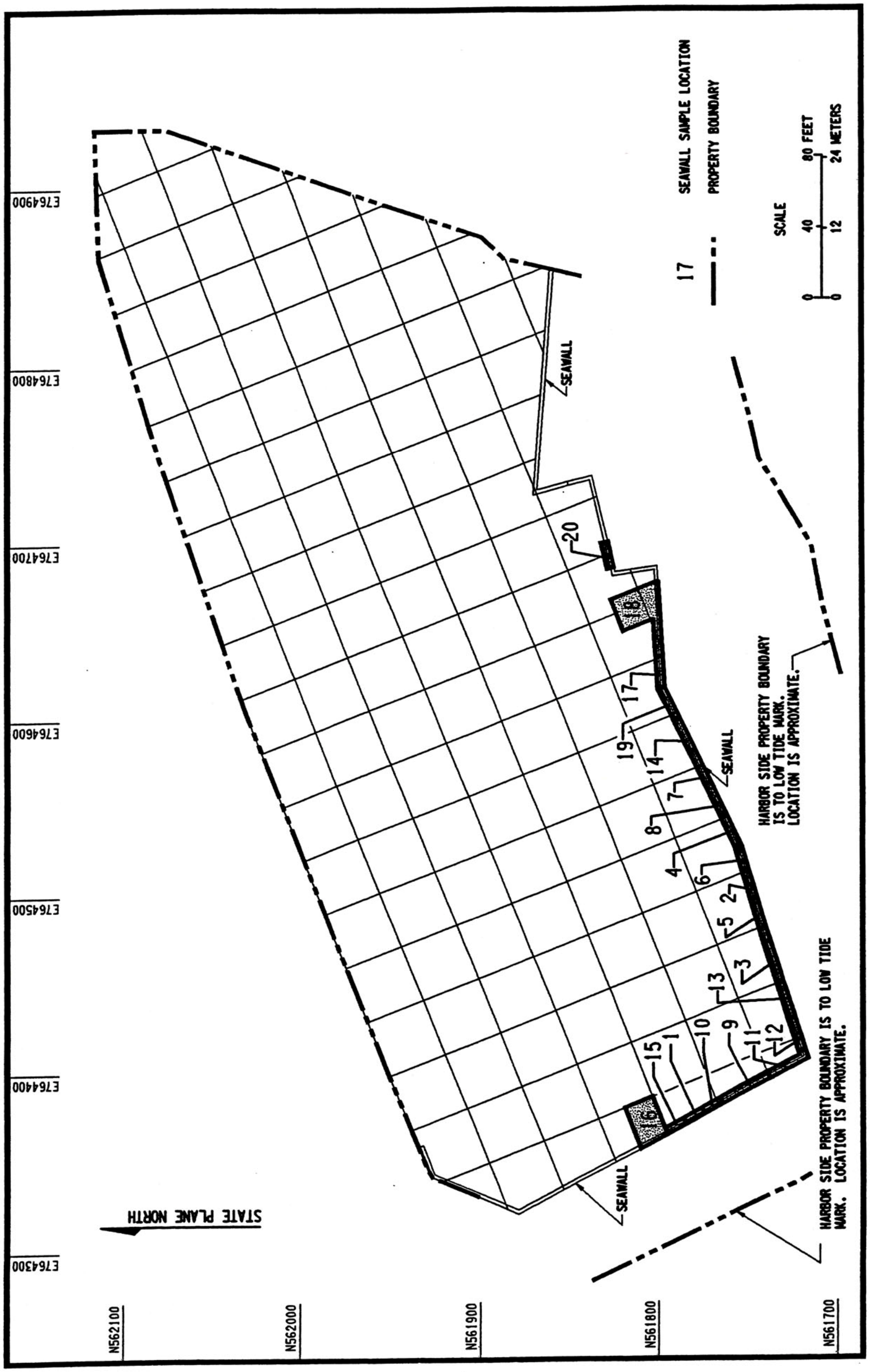

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Figure D-2
Ventron Site
Location of Samples Taken Near the Seawall

Table D-7
Post-Remedial Action Data, Excavation 6
(From Building C Slab, Across Building B Slab, to Building F Slab)

Grid Location	Sample ID	Sample Type	U-238 (pC g)	Th-232 (pCi/g)	Ra-226 (pCi/g)
S30 - E0	127-RS-334	Composite	22.5 +/- 2.49	0.9 +/- 0.10	0.89 +/- 0.06
S30 - E0	127-RS-335	Highest Area	12.98 +/- 2.32	2.55 +/- 0.18	2.24 +/- 0.12
S30 - E10	127-RS-338	Composite	7.36 +/-1.32	1.11 +/- 0.11	0.94 +/- 0.06
S30 - E10	127-RS-339	Highest Area	19.8 +/- 2.44	1.39 +/- 0.12	1.13 +/- 0.08
S30 - E20	127-RS-340	Composite	5.31 +/-1.13	0.87 +/- 0.09	0.86 +/- 0.06
S30 - E20	127-RS-341	Highest Area	<6.23	1.67 +/- 0.14	1.96 +/- 0.10
S40 - E0	127-RS-342	Composite	44.3 +/- 3.87	1.18 +/- 0.10	0.9 +/- 0.06
S40 - E0	127-RS-343	Highest Area	37.5 +/- 3.57	1.06 +/- 0.10	1.13 +/- 0.07
S40 - E10	127-RS-344	Composite	22.4 +/- 2.37	0.81 +/- 0.08	0.78 +/- 0.05
S40 - E10	127-RS-345	Highest Area	29.5 +/- 3.18	0.85 +/- 0.09	0.6 +/- 0.06
S40 - E20	127-RS-347	Composite	9.84 +/-1.39	0.69 +/- 0.08	0.58 +/- 0.05
S40 - E20	127-RS-348	Highest Area	7.63 +/-1.25	0.58 +/- 0.08	0.58 +/- 0.05
S50 - E0	127-RS-465	Composite	8.87 +/- 2.17	0.83 +/- 0.08	0.82 /- 0.06
S50 - E0	127-RS-356	Highest Area	45.03 +/- 4.51	1.22 +/- 0.11	0.78 +/- 0.07
S50 - E10	127-RS-357	Composite	41.89 +/- 3.61	1.13 +/- 0.09	0.79 +/- 0.06
S50 - E10	127-RS-358	Highest Area	35.26 +/- 3.18	0.55 +/- 0.08	0.38 +/- 0.05
S50 - E20	127-RS-373	Composite	20.7 +/- 2.29	0.63 +/- 0.08	0.51 +/- 0.05
S50 - E20	127-RS-374	Highest Area	17.94+/- 2.12	0.78 +/- 0.10	0.56 +/- 0.05
S60 - E0	127-RS-359	Composite	45.79 +/- 3.66	0.85 +/- 0.08	0.72 +/- 0.05
S60 - E0	127-RS-360	Highest Area	30.34 +/- 2.93	0.76 +/- 0.08	0.58 +/- 0.05
S60 - E10	127-RS-361	Composite	21.08 +/- 2.23	0.59 +/- 0.07	0.54 +/- 0.05
S60 - E10	127-RS-362	Highest Area	7.51 +/-1.29	0.65 +/- 0.09	0.45 +/- 0.05
S60 -E20	127-RS-370	Composite	23.05 +/- 2.35	0.45 +/- 0.06	0.45 +/- 0.04
S60 - E20	127-RS-371	Highest Area	<4.03	0.67 +/- 0.08	0.43 +/- 0.05
S50 - E30	127-RS-380	Composite	44.7 +/- 4.02	0.89 +/- 0.09	0.85 +/- 0.06
S50 - E30	127-RS-439	Highest Area	48.50 +/- 4.79	0.93 +/- 0.10	0.80 +/- 0.06
S60 - E30	127-RS-364	Composite	32.87 +/- 3.17	0.79 +/- 0.10	0.61 +/- 0.05
S60 -E30	127-RS-365	Highest Area	13.82 +/-1.83	0.73 +/- 0.09	0.62 +/- 0.05
S50 - E40	127-RS-382	Composite	26.92 +/- 2.81	0.65 +/- 0.08	0.76 +/- 0.06
S50 - E40	127-RS-383	Highest Area	23.34 +/- 2.60	0.77 +/- 0.10	0.77 +/- 0.06
S60 - E40	127-RS-366	Composite	40.38 +/- 3.96	0.9 +/- 0.10	1.08 +/- 0.07
S60 - E40	127-RS-379	Highest Area	<13.6	<2.12	<1.14
S50 - E50	127-RS-399	Composite	31.67 +/- 2.97	0.68 +/- 0.08	0.64 +/- 0.05
S50 - E50	127-RS-431	Highest Area	18.15 +/- 2.45	0.56 +/- 0.07	0.48 +/- 0.04
S60 - E50	127-RS-430	Composite	34.8 +/- 4.23	0.91 +/- 0.10	0.61 +/- 0.06
S40 - E60	127-RS-412	Composite	42.05 +/- 3.70	0.73 +/- 0.08	0.6 +/- 0.05
S40 - E60	127-RS-413	Highest Area	40.16 +/- 3.47	0.58 +/- 0.08	0.59 +/- 0.05
S50 - E60	127-RS-441	Composite	38.3 +/- 4.61	1.09 +/- 0.10	1.04 +/- 0.07

Table D-7 (continued)

Grid Location	Sample ID	Sample Type	U-238 (pC g)	Th-232 (pCi/g)	Ra-226 (pCi/g)
S50 - E60	127-RS-440	Highest Area	40.59 +/- 4.05	0.77 +/- 0.09	0.74+/-0.06
S60 - E60	127-RS-458	Composite	12.8 +/-1.96	0.64 +/- 0.07	0.78 +/- 0.05
S60 - E60	127-RS-415	Highest Area	21.79 +/- 2.47	1.17 +/- 0.10	0.75 +/- 0.07
S40 - E70	127-RS-463	Composite	8.0 +/- 1.76	0.79 +/- 0.07	0.69 +/- 0.04
S50 - E70	127-RS-462	Composite	17.21 +/- 2.29	0.96 +/- 0.08	0.68 +/- 0.05
S60 - E70	127-RS-461	Composite	16.43 +/- 2.11	0.73 +/- 0.07	0.49 +/- 0.04
S40 - E80	127-RS-510	Composite	12.46 +/-1.88	0.74 +/- 0.10	0.69 +/- 0.07
S40 - E80	127-RS-511	Highest Area	11.31 +/-1.40	0.82 +/- 0.13	0.69 +/- 0.07
S50 - E80	127-RS-512	Composite	35.43 +/- 4.25	0.78 +/- 0.10	0.68 +/- 0.07
S50 - E80	127-RS-513	Highest Area	31.47 +/- 2.95	0.85 +/- 0.14	0.64 +/- 0.07
S60 - E80	127-RS-514	Composite	34.97 +/- 3.99	0.66 +/- 0.10	0.62 +/- 0.06
S60 - E80	127-RS-515	Highest Area	32.15 +/- 3.11	0.68 +/- 0.12	0.65 +/- 0.07
S40 - E90	127-RS-580	Composite	14.1 +/- 2.58	0.70 +/- 0.08	0.62 +/- 0.05
S40 - E90	127-RS-581	Highest Area	16.22 +/- 2.61	0.76 +/- 0.08	0.60 +/- 0.05
S50 - E90	127-RS-582	Composite	11.76 +/-1.91	0.62 +/- 0.07	0.53 +/- 0.04
S50 - E90	127-RS-583	Highest Area	10.27 +/-1.87	0.69 +/- 0.07	0.50 +/- 0.04
S60 - E90	127-RS-584	Composite	5.59 +/-1.97	0.68 +/- 0.07	0.60 +/- 0.04
S60 - E90	127-RS-585	Highest Area	8.55 +/-1.71	0.59 +/- 0.07	0.49 +/- 0.04
S70 - E90	127-RS-586	Composite	4.43 +/-1.86	0.81 +/- 0.09	0.63 +/- 0.05
S40 - E100	127-RS-587	Composite	14.64 +/- 2.02	0.71 +/- 0.07	0.59 +/- 0.05
S40 - E100	127-RS-588	Highest Area	13.58 +/- 2.15	0.74 +/- 0.08	0.58 +/- 0.05
S50 - E100	127-RS-589	Composite	22.8 +/- 2.77	0.91 +/- 0.09	0.62 +/- 0.05
S50 - E100	127-RS-590	Highest Area	20.6 +/- 2.57	0.91 +/- 0.09	0.59 +/- 0.05
S60 - E100	127-RS-591	Composite	18.44 +/- 2.57	0.84 +/- 0.09	0.64 +/- 0.05
S60 - E100	127-RS-592	Highest Area	18.23 +/- 2.65	0.80 +/- 0.08	0.49 +/- 0.05
S60 - El 10	127-RS-595	Composite	4.17 +/- 2.36	0.71 +/- 0.09	0.59 +/- 0.05
S60 - El 10	127-RS-596	Highest Area	6.78 +/- 2.54	0.76 +/- 0.10	0.54 +/- 0.06
S50 - El 10	127-RS-593	Composite	8.92 +/- 2.12	0.86 +/- 0.09	0.61 +/- 0.05
S50-E110	127-RS-594	Highest Area	18.08 +/- 2.24	0.79 +/- 0.09	0.60 +/- 0. 05

Table D-8 Post-Remedial Action Data, Excavation 7
(Between Building A Slab and Building E)

Grid Location	Sample ID	Sample Type	U-238 (pC g)	Th-232 (pCi/g)	Ra-226 (pCi/g)
S30 – E100	127-RS-349	Composite	<4.63	0.67 +/- 0.10	0.56+/-0.06
S30 – E100	127-RS-350	Highest Area	<3.82	0.69 +/- 0.11	0.7 +/- 0.07
S30 – E110	127-RS-352	Composite	<4.52	0.94 +/- 0.94	0.68 +/- 0.06
S30 – E110	127-RS-353	Highest Area	10.89 +/- 1.77	0.84 +/- 0.11	0.6 +/- 0.08

Table D-9
Post-Remedial Action Data, Excavations 8, 9, 10, and 11
Excavation 8 (Building A Leach Tank Pit)

Excavation 8 (Building A Leach Tank Pit)

Grid Location	Sample ID	Sample Type	U-238 (pC g)	Th-232 (pCi/g)	Ra-226 (pCi/g)
S30 – E80	127-RS-438	Composite	8.38 +/- 2.46	1.03 +/- 0.09	0.71+/-0.06

Excavation 9 (Building A Fan Pit)

Grid Location	Sample ID	Sample Type	U-238 (pC g)	Th-232 (pCi/g)	Ra-226 (pCi/g)
S30 – E66	127-RS-454	Composite	6.72 +/- 1.492	0.51 +/- 0.07	0.42+/-0.04
S30 – E66	127-RS-455	Highest Area	13.75 +/- 2.62	1.42 +/- 0.12	1.16+/-0.08

Excavation 10

Grid Location	Sample ID	Sample Type	U-238 (pC g)	Th-232 (pCi/g)	Ra-226 (pCi/g)
S30 – E50	127-RS-442	Composite	4.14 +/- 1.92	1.08 +/- 0.10	1.03+/-0.07
S30 – E50	127-RS-441A	Highest Area	1.52 +/- 3.36	2.2 +/- 0.17	2.62 +/- 0.12

Excavation 11

Grid Location	Sample ID	Sample Type	U-238 (pC g)	Th-232 (pCi/g)	Ra-226 (pCi/g)
S20 - E40	127-RS-438A	Composite	3.89+/-3.00	2.46 +/- 0.17	2.69+/-0.12
S20 - E40	127-RS-439A	Highest Area	22.51+/-3.37	0.90 +/- 0.10	1.01 +/- 0.07

Table D-10
Building A Soil Beneath Slab Samples

Building A Subslab Samples

Sample Number	Sample ID	Sample Type	U-238 (pCi/g)	Th-232 (pCi/g)	Ra-226 (pCi/g)
1	127-RS-257	Discrete	<4.40	1.70 +/- 0.25	2.20 +/- 0.14
2	127-RS-258	Discrete	<3.60	2.50 +/- 0.20	2.60 +/- 0.14
3	127-RS-259	Discrete	<2.90	1.70 +/- 0.15	1.70 +/- 0.10
4	127-RS-260	Discrete	10.20 +/- 2.80	<1.40	2.50 +/- 0.16
5	127-RS-261	Discrete	<3.50	2.20 +/- 0.21	2.20 +/- 0.13
6	127-RS-262	Discrete	<4.30	<1.20	2.10 +/- 0.14
7	127-RS-263	Discrete	2.90	2.20 +/- 0.22	2.00 +/- 0.12
8	127-RS-264	Discrete	<4.10	<1.20	2.20 +/- 0.14
9	127-RS-265	Discrete	2.60	1.40 +/- 0.15	1.70 +/- 0.09
10	127-RS-266	Discrete	<2.50	0.81 +/- 0.15	0.93 +/- 0.08
11	127-RS-267	Discrete	4.20	1.80 +/- 0.16	1.80 +/- 0.10
12	127-RS-268	Discrete	<3.40	1.80 +/- 0.20	2.70 +/- 0.14
13	127-RS-269	Discrete	<4.70	2.10 +/- 0.25	2.40 +/- 0.17
14	127-RS-270	Discrete	<3.7	1.3 +/- 0.22	1.8 +/- 0.12
15	127-RS-271	Discrete	<3.3	0.9 +/- 0.17	1.3 +/- 0.11
16	127-RS-272	Discrete	<2.60	1.50 +/- 0.16	1.40 +/- 0.09
17	127-RS-273	Discrete	<2.40	<0.73	0.47 +/- 0.08
18	127-RS-274	Discrete	<2.50	<0.79	1.60 +/- 0.10
19	127-RS-422	Discrete	<5.49	1.93 +/- 0.16	2.33 +/- 0.11
20	127-RS-423	Discrete	<5.74	1.68 +/- 0.17	2.09 +/- 0.12
21	127-RS-426	Discrete	<2.59	0.60 +/- 0.07	0.48 +/- 0. 04

Table D-11
Gamma Exposure Rate Survey Data

Excavation	Grid Location	µR/h
Excavation 1	S0 – E0	11.5
Excavation 1	S0 - E10	10.7
Excavation 2	S0 - E50	10.7
Excavation 2	S10 - E50	11.5
Excavation 3	S30 - E130	9.0
Excavation 4	S50 - E130	10.5
Excavation 4	S50 - E140	10.6
Excavation 4	S50 - E150	13.1
Excavation 4	S60 - E140	10.6
Excavation 4	S60 - E150	14.6
Excavation 4	S70 - E130	10.75
Excavation 4	S70 - E140	10.3
Excavation 4	S50 - E140	13.0
Excavation 4	S50 - E150	14.0
Excavation 4	S50 - E160	12.0
Excavation 5	Harbor Grid 1	12.0
Excavation 5	Harbor Grid 2	12.0
Excavation 5	Harbor Grid 3	11.0
Excavation 5	Harbor Grid 4	11.0
Excavation 5	Harbor Grid 5	11.0
Excavation 5	Harbor Grid 6	12.0
Excavation 5	Harbor Grid 7	12.0
Excavation 5	Harbor Grid 8	10.0
Excavation 5	Harbor Grid 9	8.0
Excavation 5	Harbor Grid 10	9.0
Excavation 5	Harbor Grid 11	8.0
Excavation 5	Harbor Grid 12	8.0
Excavation 5	Harbor Grid 13	10.0
Excavation 5	Harbor Grid 14	10.0
Excavation 5	Harbor Grid 15	10.0
Excavation 5	Harbor Grid 16	9.0
Excavation 5	Harbor Grid 17	10.0
Excavation 5	Harbor Grid 18	9.0
Excavation 5	Harbor Grid 19	9.0
Excavation 5	Harbor Grid 20	8.0
Excavation 5	Harbor Grid 21	9.0
Excavation 5	Harbor Grid 22	9.0
Excavation 5	Harbor Grid 23	9.0
Excavation 5	Harbor Grid 24	9.0
Excavation 5	Harbor Grid 25	8.0

Table D-11 (continued)

Excavation	Grid Location	µR/h
Excavation 5	Harbor Grid 26	10.0
Excavation 5	Harbor Grid 27	10.0
Excavation 5	Harbor Grid 28	10.0
Excavation 5	Harbor Grid 29	8.0
Excavation 5	Harbor Grid 30	10.0
Excavation 5	Harbor Grid 31	10.0
Excavation 5	Harbor Grid 32	10.0
Excavation 5	Harbor Grid 33	9.0.
Excavation 5	Harbor Grid 34	9.0
Excavation 5	Harbor Grid 35	9.0
Excavation 5	Harbor Grid 36	8.0
Excavation 5	Harbor Grid 37	8.0
Excavation 5	Harbor Grid 38	8.0
Excavation 5	Harbor Grid 39	9.0
Excavation 5	Harbor Grid 40	8.0
Excavation 5	Harbor Grid 41	8.0
Excavation 5	Harbor Grid 42	10.0
Excavation 5	Harbor Grid 43	9.0
Excavation 5	Harbor Grid 44	10.0
Excavation 5	Harbor Grid 45	10.0
Excavation 5	Harbor Grid 46	8.0
Excavation 6	S30 – E0	9.0
Excavation 6	S40 – E0	9.0
Excavation 6	S50 – E0	10.0
Excavation 6	S60 – E0	10.0
Excavation 6	S30 - E10	9.0
Excavation 6	S40 – E10	10.0
Excavation 6	S50 – E10	9.0
Excavation 6	S60 – E10	9.0
Excavation 6	S30 - E10	10.0
Excavation 6	S40 - E20	11.0
Excavation 6	S50 - E20	11.0
Excavation 6	S60 - E20	10.0
Excavation 6	S50 - E30	9.0
Excavation 6	S60 - E30	9.0
Excavation 6	S50 - E40	9.0
Excavation 6	S60 - E40	9.0
Excavation 6	S50 - E50	10.0
Excavation 6	S50 - E70	10.0
Excavation 6	S50 - E80	9.0
Excavation 6	S50 - E90	10.0

Table D-11 (continued)

Excavation	Grid Location	µR/h
Excavation 6	S50 - E100	10.0
Excavation 6	S50 - E110	10.0
Excavation 6	S60 - E50	11.0
Excavation 6	S60 - E60	10.0
Excavation 6	S60 - E70	10.0
Excavation 6	S60 - E80	10.0
Excavation 6	S60 - E90	10.0
Excavation 6	S60 - E100	10.0
Excavation 6	S60 - E110	12.0
Excavation 7	S30 - E-100	11.0