



April 5, 2002  
CAL/696-3451

**VIA EXPRESS DELIVERY SERVICE**

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**Subject: Radioactive Materials License No. 0145-37: Request to Release Certain Portions of General Atomics' Facility to Unrestricted Use and Delete them from its License: Namely, Building 27-1 (EA-1 Bunker) Land Area**

and

Ms. Mary Adams  
Licensing Section 1/Licensing Branch  
Division of Fuel Cycle Safety  
and Safeguards, NMSS  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555

**Subject: Docket No. 70-734; SNM-696: Request to Release Certain Portions of General Atomics' Facility to Unrestricted Use and Delete them from its License: Namely, Building 27-1 (EA-1 Bunker) Land Area**

Dear Ms. Adams and Ms. Kwok:

As you are aware, General Atomics (GA) is continuing its efforts to decontaminate, as appropriate, and obtain the release to unrestricted use of selected facilities and land areas on its site. GA recently completed an extensive decommissioning project which it started a few years ago. This project, which is the subject of this request, involved surveying, remediating where necessary, and dismantling portions of a bunker situated on what is referred to as "GA's former Building 27-1 Bunker Land Area."

The Building 27-1 Bunker Land Area includes the location where the former Building 27-1 Bunker Facility, also known as the "EA-1 Bunker", was located. This building was dismantled almost in its entirety and disposed of as low level radioactive waste. Only certain retaining walls and stairs remain. The retaining walls protect the nearby Building 27 from a potential landslide. The Building 27-1 Bunker Land Area also includes the land that surrounded the Building 27-1 Bunker Building; including the land area where an underground vaulted radioactive liquid waste storage tank was located. The tank and the vault in which it was located were removed during decommissioning activities; leaving a large excavation pit. Additionally, a trench remains that was formed during removal of the drain line that ran from the former Building 27-1 facility to the tank. There also remains a large excavation pit located in an area where an array of underground storage wells were previously located in the building. The storage wells (12 all) were all excavated and disposed of as low level radioactive waste.

*NMSSol  
Public*  
*Add: Mary Adams  
Paper Copy*

During the operating history of Building 27-1 facility, the laboratories were used for various projects including U.S. Department of Energy sponsored gas cooled reactor advanced nuclear fuel studies and commercial radio-pharmaceutical production of Y-90. The nuclear fuel studies involved the use of special nuclear material (primarily enriched uranium), thorium, depleted uranium and irradiated fuel (with its associated mixed fission products).

Enclosed is a report titled "General Atomics' Final Radiological Survey Report for Building 27-1 (EA-1 Bunker) Land Area," dated April 2002. This report documents the results of GA's radiological measurements, surveys, and soil sampling and analysis which demonstrate that this land area and remnant of Building 27-1 meet the State- and NRC- approved criteria for release to unrestricted use.

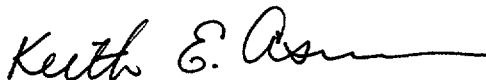
Accordingly, GA hereby requests both the State of California Department of Health Services' Radiologic Health Branch (State) and the U.S. Nuclear Regulatory Commission (NRC) to release the Building 27-1 Bunker Land Area and building remnant thereon, as described in the enclosed final survey report, to unrestricted use.

The total land area to be released to unrestricted use, including the footprint of the retaining wall, is approximately 15,300 ft<sup>2</sup> (~1,420 m<sup>2</sup>). The total surface area of the retaining wall (remaining portions of Building 27-1) is approximately 1,422 ft<sup>2</sup> (~132 m<sup>2</sup>).

It is GA's understanding that the State has the lead in reviewing this report and conducting confirmatory surveys as they are deemed appropriate; the results of which will be made available to the NRC.

If you should have any questions regarding this request or the enclosed report, please contact Ms. Laura Q. Gonzales at (858) 455-2758, or me at (858) 455-2823. Your assistance in responding to this request is very much appreciated.

Very truly yours,



Keith E. Asmussen, Ph.D., Director  
Licensing, Safety and Nuclear Compliance

Enclosure: GA report titled: "General Atomics' Final Radiological Survey Report for the Building 27-1 (EA-1 Bunker) Land Area," dated April 2002.

cc: Dr. D. Blair Spitzberg, Chief, NMSS Branch 3, Region IV  
Mr. Wayne L. Britz, Fuel Cycle Inspector, NRC Region IV  
Ms. Kathleen Henner, State of CA, Brea, CA  
Dr. Mina Goeders, State of CA, Sacramento

**GENERAL ATOMICS'**  
**FINAL RADIOLOGICAL SURVEY REPORT**  
**for**  
**Building 27-1 (EA-1 Bunker) Site**

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April 2002



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## Introduction

General Atomics (GA) is continuing its efforts directed at decontaminating, as appropriate, and obtaining the release to unrestricted use of selected facilities and land areas at its site.

GA has recently completed the Final Radiological Survey of the Building 27-1 ( a.k.a. Building EA-1) Bunker Land Area. This area includes the location where the former Building 27-1 Bunker Facility, also known as the "EA-1 Bunker", was located. This building was dismantled almost in its entirety and disposed of as low level radioactive waste. Only retaining walls and stairs remain. The retaining walls protect the nearby Building 27 from a potential landslide. The EA-1 Bunker Land Area also includes the land that surrounded the EA-1 Bunker Building; including the land area where an underground vaulted radioactive liquid waste storage tank was located. The tank and the vault in which it was located were removed during decommissioning activities. A large excavation pit and a trench formed after removal of the drain line from the former Building 27-1 facility to the tank remain. There is also a large pit area located in what used to be an underground storage pit previously located in the building. The storage pits (12 of them in all) were all excavated and disposed of as low level radioactive waste.

The total land area to be released to unrestricted use, including the footprint of the retaining wall, is approximately 15,300 ft<sup>2</sup> (~1,420 m<sup>2</sup>). The total surface area of the retaining wall (remaining portions of Building 27-1) is approximately 1,422 ft<sup>2</sup> (~132 m<sup>2</sup>).

GA is requesting both the U.S. Nuclear Regulatory Commission (NRC) and the State of California (DOHS/RHB) to release the EA-1 Bunker Land Area to unrestricted use.

This report documents the results of GA's radiological measurements and soil sampling and analysis completed on the EA-1 Bunker Land Area. The results of these surveys, measurements, and analyses demonstrate that this land area and remnant of Building 27-1 (EA-1) meet the NRC and State approved criteria for release to unrestricted use.

## Site Description

A plan view of the GA Site is shown in Figure 1A. The location of the EA-1 Bunker Land Area in relation to other facilities on GA's Main Site is shown in Figure 1B. The land area boundary to be released is shown in Figure 1C. The remaining portion of Building 27-1 is shown in Figure 2. There are no sewer systems that traverse this parcel of land.



TEXT



## History and Classification

### History

Building 27-1 (also known as the EA-1 Bunker Facility) was originally constructed in 1965. This facility was a single level, heavily shielded, concrete block structure situated north of, and adjacent to, Building 27. The building, which covered approximately 1,255 ft<sup>2</sup>, was divided into 3 laboratories which were joined by a common hallway. The laboratory spaces were identified as Room A (west), Room B (east), and Room C (center). The bulkheads and ceiling of Rooms A and B and the hallways were constructed of 12 inch thick concrete. The ceiling of Room C was constructed of corrugated steel capped with concrete. The south and west walls of the building were back filled with an earthen fill. There was a sub floor beneath the main floor. The space between these floors was earthen filled.

Room C, which was added in 1973, contained 12 below ground cylindrical storage wells previously used for storage of high level radioactive material. Each well was approximately 10 inches in diameter and 12 feet deep.

Building 27-1 was surrounded by a fenced-in service yard that is approximately 15,300 ft<sup>2</sup>. This service yard contained a bermed radioactive waste storage area, a small metal shed, and a below ground vaulted liquid waste holding tank.

During the operating history of this facility, the laboratories were used for several projects including; DOE sponsored HTGR advanced nuclear fuel studies and commercial radio-pharmaceutical production of Y-90. The nuclear fuel studies involved the use of special nuclear material (mainly uranium enriched to various percentages of U-235), thorium, depleted uranium and irradiated fuel (with it's associated mixed fission and mixed activation products).

### Site Conditions at Time of Final Survey

All equipment, service lines and supporting fixtures were removed from the restricted areas, decontaminated as appropriate, surveyed and released to unrestricted use or disposed of as low level radioactive waste. The walls, floors and ceilings of Rooms A, B, & C and portions of the connecting hallway with fixed levels of contamination were coated with a Polymeric Barrier, (a "fixative"), to ensure the activity would remain fixed (to avoid the possibility of airborne radioactivity during dismantlement). The floors, walls, and ceilings were then cut into sections for easier handling and disposed of as low level radioactive waste. The soil backfill was removed from the external walls, surveyed, sampled, analyzed and disposed of as clean waste in a local land fill or as low level radioactive waste in accordance with the surveys and sampling and analyses results. The floors, walls, and ceilings of the building were removed; except for the

south stairwell and enclosing walls which remained as retaining walls. The high level storage wells in Room C were filled with concrete and an absorbent material, then welded shut. The wells were then removed in one large piece and disposed as low level radioactive waste. The remaining interior portions of the facility that had localized spots of fixed contamination (identified during the Characterization Survey) were decontaminated. The piping for the Liquid Waste Tank was excavated, cut up, and disposed of as low level radioactive waste. The Liquid Waste Tank which was within a secondary concrete vault was excavated along with the vault and disposed of as low level radioactive waste. During the excavation of the Tank Vault, a drain line, apparently installed to protect the Tank Vault from a build up of ground water, was discovered. This line was excavated to the Controlled Area fence, cut off at that point, surveyed, and disposed of as clean waste. The remaining portion of this drain line, which is open ended at the steep hillside approximately 100 ft from the Controlled Area fence, was surveyed, found to be clean and left in-place. The Final Survey for the Waste Tank Vault and associated drain line excavation pit was completed prior to the completion of the Final Survey on the open land area and retaining wall due to safety considerations and the availability of equipment to support this survey. The detailed Final survey results for this excavation pit are enclosed as Appendix B.

All floor drains and utility lines encountered during building demolition were removed, surveyed, and released or disposed of as low level radioactive waste based on survey results. There is one (1) piece of cast iron drain line between the upper and lower floors of the remaining structure that was apparently an abandoned drain for the sub-floor. The pipe could not be removed because additional excavation would jeopardize the integrity of Building- 27, so it was surveyed in-place and found to be clean.

During the performance of the Final Survey, two (2) drainage lines were discovered at the northerly and westerly boundary fence line. One (1) of these lines had detectable levels of radioactivity but below the approved release criteria. The drainage line was excavated, the soil contained in the line was disposed of as low level radioactive waste, the empty line was surveyed and no activity above background was detected. This line was disposed of as non-radioactive waste. In a second line, found at the westerly boundary, samples of the contents contained no activity above natural background levels, however, due to the inability to survey 100% of the pipe internal surfaces, this line was excavated and disposed of as low level radioactive waste.

#### Classification

The **non-suspect affected areas** of the site include (1) the remaining portions of the building as shown in Figure 2, and (2) the asphalt as shown in Figure 1C.

The **suspect affected areas** of the site includes (1) the footprint of the portion of the building that was demolished (including the Room C Pit), (2) the Waste Tank Pit and drain line trench and (3) the hillside northwest of these areas, as shown in Figure 1C.

### Criteria for Release to Unrestricted Use

Based on process knowledge, characterization surveys, and post decontamination surveys, the primary radionuclides of concern for this land area are Strontium-90 (Sr-90) and Cesium-137 (Cs-137). Cobalt-60 (Co-60) was identified in trace concentrations in a few of the soil samples.

#### Facilities and Equipment (and Asphalt or Concrete Surfaces)

The U.S. NRC's and the State of California's criteria for releasing facilities and equipment to unrestricted use are shown in Tables 1 and 2, respectively. The applicable guidelines for the most restrictive isotope used at the facility, Sr-90, is as follows:

1,000 dpm/100 cm<sup>2</sup>, averaged over 1 m<sup>2</sup> area  
3,000 dpm/100 cm<sup>2</sup>, maximum in a 100 cm<sup>2</sup> area  
200 dpm/100 cm<sup>2</sup>, removable activity

The criteria for beta/gamma emitters (including Cs-137 and Co-60), the next most predominant radionuclides, is as follows:

5,000 dpm/100 cm<sup>2</sup>, averaged over 1 m<sup>2</sup> area  
15,000 dpm/100 cm<sup>2</sup>, maximum in a 100 cm<sup>2</sup> area  
1,000 dpm/100 cm<sup>2</sup>, removable activity

#### Release Criteria for Soils

The approved release criteria in pCi/g (above natural background concentrations) for Sr-90 and other radionuclides found on the GA site are provided as follows:

Enriched Uranium (U-234 + U-235)	30 pCi/g
Thorium (Th-228 + Th-232)	10 pCi/g
Depleted Uranium	35 pCi/g
Cs-137	15 pCi/g
Co-60	8 pCi/g
Sr-90	1800 pCi/g

If more than one radionuclide exists, the sum of the fractions of the concentrations is calculated as follows:

$$\sum_{i=1}^n \frac{C_i}{L_i} = <1$$

Where:

$C_i$  = The average concentration levels of radionuclide  $i$  in the sample (above background).

$L_i$  = The release criteria for radionuclide  $i$ .

The sum of the fractions must be less than or equal to one (1).

#### Exposure Rate Guideline

Exposure rates measured at 1 m above the surface are not to exceed 10  $\mu$ R/hr above natural background levels.

### **Instrumentation and Background Measurements**

A list of instruments used during the radiological surveys is shown in Table 3. The table includes: (1) a description of the instrument, model number and its serial number, (2) a description of the detector (if applicable) and its serial number, (3) instrument ranges, (4) calibration due dates, (5) typical background readings and (6) calibration efficiencies (if applicable). All of the instruments used were calibrated semiannually and after repair, except for exposure rate meters which were calibrated quarterly.

#### Background Measurements for Instruments/Detectors

Building 13 on GA's main site was used for conducting background measurements with instruments used for the final survey because: (1) there is no history involving radioactive materials or storage of radioactive materials in Building 13, and (2) the various surfaces and construction materials found at the EA-1 Bunker Land Area could also be found within and outside of Building 13. Background information, where appropriate, is included in Table 3.

Table 3 also includes minimum detectable activities (MDA's) for instruments used for fixed measurements, for each type of surface. The MDA's were calculated using equation (5-2) from the NUREG/CR-5849 as shown

below:

Equation (5-2)

$$MDA = \frac{2.71 + 4.65\sqrt{B_R \times t}}{t \times E \times \frac{A}{100}} \text{ (dpm/100cm}^2\text{)}$$

Where:

$B_R$  = background rate (cpm)

t = count time (min)

E = efficiency

A = area of the detector (cm<sup>2</sup>)

### Background Soil Concentrations of Concern

Typical soil background concentrations measured by gamma spectroscopy in soil near the GA site have been established and are provided in Table 4 along with the locations where these samples were taken.

### Exposure Rate Background

Typical exposure rate background for GA's site using a Ludlum Model 19 micro R meter is 12-18  $\mu\text{R/hr}$  measured at 1 m from the surface of soil. This range of exposure rates can be measured south of Building 15 (an office building on the eastern portion of the GA site). Measurements taken offsite in 10 different locations (9 offsite and 1 onsite at a non-impacted area near Building 15) over a period of 15 months also averaged  $\sim 15 \mu\text{R/hr}$  (measured at 1 m from the surface). The range of 12-18  $\mu\text{R/hr}$  is typical at the GA site for the external dose rates measured at 1 meter from the surface. Background measurements at 1 m above an asphalt surface are generally higher due to the higher concentrations of naturally occurring radioactive material (NORM). This background fluctuates depending upon the asphalt batch used and the date applied. This background, (measured at 1 m from the surface) ranges from 22-30  $\mu\text{R/hr}$ . Due to survey geometry differences and soil substrata composition differences, natural background levels are higher in excavation pits than on soil surfaces. Background levels obtained in a pit excavated in a Non-Impacted area are provided in Figure 3.

## Final Surveys Performed

### Objectives and Responsibilities

The objectives of the final survey plans were: (1) to demonstrate that the average surface contamination levels for each survey unit were below the approved release criteria, (2) to show that the maximum residual activity did not exceed three times the approved release criteria for an average surface contamination value in an area up to 100 cm<sup>2</sup>, (3) to demonstrate that the results of soil sample analyses were well below GA's approved release criteria for unrestricted use, and, (4) that the exposure rate measurements taken in these areas, measured at 1 meter above the surface, were less than 10  $\mu\text{R/hr}$  above background.

### Survey Plans

Final Survey Plans were developed based on the previous history of the adjacent buildings, the EA-1 Bunker Land Area site, the radionuclides of concern for this area, the potential for contamination, the various types of surfaces encountered and the classification of the various areas.

Surveys were conducted in accordance with an approved survey plan(s) by qualified Health Physics Technicians having a minimum of three years health physics experience. Soil samples were counted in GA's Health Physics Laboratory which maintains an effective QA program.

Every survey taken was documented on a daily basis to a worksheet/drawing showing the approximate locations surveyed/sampled. The documentation included the results of the measurements (including units), the technician's signature, date, instrument(s) used (including the model and serial number of both the ratemeter and detector), calibration due date, % efficiency, background readings (if applicable) and any other pertinent information.

The Final Survey Plan(s) for the EA-1 Bunker Land Area are provided in Appendix A.

### Soil Sampling

Soil samples were collected in approximate locations as indicated on Figure 43. Each soil sample collected was properly logged, sealed, labeled, packaged and tracked. About 1 kilogram of soil was collected per sample. All debris (i.e., grass, rocks, sticks, asphalt and foreign objects) was removed from each sample. Each soil sample was individually crushed to reduce large lumps, dried, placed into tared 0.5 liter marinelli beakers (filled to the top), weighed, sealed and transported to GA's Health Physics Laboratory. Sample locations were documented on a drawing.

Soil samples were analyzed in GA's Health Physics Laboratory with a Canberra Low Sensitivity Gamma Spectroscopy MCA System using a high purity germanium detector. The system is calibrated using NIST traceable standards and performance checked daily. Soil samples were counted for a minimum of 30 minutes each. A 30 minute count was sufficient to detect the radionuclides of concern at levels well below GA's approved soil release criteria.

### Sr-90 and Plutonium Analyses

In September 2001, ten (10) soil samples were sent to an offsite laboratory (Severn Trent Laboratories) for Sr-90 analysis, because Sr-90 is a pure beta emitter and cannot be detected by gamma spectroscopy and Sr-90 was used in the Building 27-1 bunker facility.



In December 2001, an additional twelve (12) soil samples were sent to the laboratory for Sr-90, gamma spectroscopy and plutonium analysis. Gamma spectroscopy was requested in order to compare the offsite lab's results with those of the GA HP laboratory, and plutonium analysis was requested in order to demonstrate that plutonium is not a contaminant in the soil at the EA-1 Bunker Land Area.

#### Steep Slope on North Side of Land Area

The steep slopes surrounding the Vaulted Waste Tank pit were not originally included in the Final Survey due to safety concerns. During the performance of the GA Confirmatory survey, a hot particle was discovered at the Northeastern fence line shared with the TRIGA<sup>®</sup> Reactor site. This area was remediated, and the final survey was expanded to include surveys of the sloped areas.

#### Liquid Waste Vaulted Tank Excavation Pit

The Liquid Waste Vaulted Tank excavation pit and associated drain line trench were surveyed separately from the rest of the site because of safety concerns and the availability of equipment to support the survey in the excavations. For this reason, the survey plan and the results of this survey are provided in Appendix B.

### Survey Summary

Comparisons of the Site Decommissioning Plan requirements with the Final Surveys performed in relation to the percentage of surface area scanned, number of measurements (i.e., number of fixed radiation measurements), exposure rate measurements ( $\mu\text{R/hr}$ ), and soil samples taken are provided as follows:





**Comparisons of Site Decommissioning Plan Requirements with  
Final Surveys Performed on the EA-1 Bunker Land Area**

Survey Area <sup>(1)</sup>	Gridding	# of Direct Measurements <sup>(2)</sup>	Exposure Rate Scanning and Fixed Measurements (μR/hr)	Surface Scans on asphalt or concrete	# of Soil Samples Taken and Analyzed
D-Plan <sup>(3)</sup> Requirements, Non-Suspect Affected Area →	Not Required	1 per 20 m <sup>2</sup> or, 1 every 4.5 m	1 per 10 m <sup>2</sup> , or, 1 every 3 m at 1 m from the surface	10% of accessible floors and walls below 2 m	4 per 10m x 10 m grid
Surveys performed in Non-Suspect Affected Areas →	Yes, 10m x 10m grids on land areas & 1m x 1m on structure surfaces	Measurements taken at least 1 every 2m  <u>Walls and stairs:</u> 131 fixed α, 131 fixed β, and 128 wipes  <u>Asphalt:</u> 10 fixed β and 10 wipes.  Total = 390 measurements	Measurements taken 1 every 2 m  <u>Walls and Stairs:</u> 179 fixed measurements at contact, 179 fixed measurements at 1 m from the surface, and 100% scan at the surface.  <u>Asphalt:</u> 10 fixed at contact, 10 fixed at 1m, and 100% surface scan.  <u>Land Area:</u> 1 every 2 m contact and at 1 m from the surface and 100% scan	<u>Walls, Floor and Stairs:</u> 100% beta scan on floor, stairs and lower 1-2 m of walls  10% beta scan on rest of walls  10% alpha scan of all walls, floor and stairs  <u>Asphalt:</u> 100% α scan, 100% β scan.	≥ 4 per 10m x 10m grid  Total of 46 surface (0-6") samples.
D-Plan <sup>(3)</sup> Requirements, Suspect Affected Area →	Yes	1 per 4 m <sup>2</sup> , or, 1 every 2 m	1 per 4 m <sup>2</sup> or 1 every 2 m	100% of floors and walls 2 m	4 per 10 m x 10 m grid (~21 total)
Surveys performed in Suspect Affected Areas →	Yes 10m x 10m grids (land) 1m x 1m (structure)	Not Applicable (no applicable surfaces)	Measurements taken 1 every 2 m (at surface and at 1 m)	Not Applicable (No applicable surfaces)	≥ 4 per 10m x 10m grid 28 surface (0-6") 14 sub-surface (6"-12")

<sup>(1)</sup> The total land area to be released to unrestricted use, including the footprint of the retaining wall, is approximately 15,300 ft<sup>2</sup> (~1,420 m<sup>2</sup>).

<sup>(2)</sup> Fixed α, β, or Wipes on concrete or asphalt

<sup>(3)</sup> D-Plan = GA Site Decommissioning Plan

## Results of the Final Surveys

### Alpha and Beta Scanning

1. *Floors, Walls and Stairs (non-suspect affected areas)* - The results for both the beta and alpha scans are shown in Figure 5 (for Wall A), Figure 9 (for Wall B), Figure 13 (for the external portions of Wall C), Figure 17 (for the internal portions of Wall C), Figure 21 (for Walls D, E and H), Figure 25 (for Wall F), Figure 29 (for Wall G), Figure 33 (for Figure I), and Figure 36A (for the stairs).

Approximately 100% of the floor, stairs and lower walls (~1-2 m) and 10% of the rest of the walls were scanned for beta activity using a 15 cm<sup>2</sup> pancake GM probe, with the exception of Wall F which received a 10% beta and 10% alpha scan due to the fact that this wall was above Wall I and was accessible with crane support only. The radiation levels for all of the beta scans were not discernable from normal background activity.

Approximately 10% of all floor and wall surfaces as well as the stairs were scanned for alpha contamination using a 50 cm<sup>2</sup> alpha hand held detector. The radiation levels were not discernable from normal background activity.

2. *Asphalt Surfaces (non-suspect affected area)*: Approximately 100% of the asphalt surfaces were scanned for alpha and beta activity using a gas flow proportional 434 cm<sup>2</sup> detector and ratemeter (floor monitors); as shown in Figure 40 (beta scan) and Figure 44 (alpha scan).

The highest beta scan result was 3500 cpm. Fixed one minute measurements using the 100 cm<sup>2</sup> gas flow proportional detector and ratemeter were taken in all elevated areas to determine activity levels. All of the results were < 508 dpm/100 cm<sup>2</sup> (the MDA), which is well below the Sr-90 average limit of 1,000 dpm/100 cm<sup>2</sup> and below the maximum limit (for a 100 cm<sup>2</sup> area) of 3,000 dpm/100 cm<sup>2</sup>. See Figure 40.

All alpha scan results were 0-20 cpm (not discernable from normal background levels on asphalt). See Figure 44.

### Fixed Alpha and Beta Measurements

1. *Floors, Walls and Stairs (non-suspect affected areas)* - A total of 131 fixed  $\alpha$  and 131 fixed  $\beta$  measurements were taken on the remaining portions of the building as shown in Figure 4 (for Wall A), Figure 8 (for Wall B), Figure 12 (for the external Wall C), Figure 16 (for the internal Wall C), Figure 20 (for Walls D, E and H), Figure 24 (for Wall F), Figure 28 (for Wall G), Figure 32 (for Wall I), and Figure 36 (for the stairs).

All alpha measurements were not discernable from normal background readings (< 20 cpm) and all were below the MDA (< 244 dpm/100 cm<sup>2</sup>). The highest beta measurement was 446 dpm/100 cm<sup>2</sup> on the stairs as shown in Figure 36.

2. *Asphalt (non-suspect affected area)*: A total of 10 one minute fixed beta measurements were taken. All measurements were < MDA (< 508 dpm/100 cm<sup>2</sup>) as shown in Figure 39.

All measurements were well below the approved release criteria for fixed alpha and fixed beta activity.

#### Removable Contamination Surveys

Removable contamination surveys were performed on all remaining portions of the building and the asphalt by wiping (i.e., smearing) an ~100 cm<sup>2</sup> area using a 47 mm filter paper. The locations of the 138 total smears collected are shown in Figure 6 (for Wall A), Figure 10 (for Wall B), Figures 14 and 18 (for Wall C), Figure 22 (for Wall D), Figure 26 (for Wall F), Figure 30 (for Wall G), Figure 22 (for Wall H), Figure 34 (for Wall I), Figure 37 (for the stairs), and Figure 41 (for the asphalt)

The results are provided in Table 5. All alpha results were <10 dpm/100 cm<sup>2</sup>. The highest beta result was 29 dpm/100 cm<sup>2</sup>.

All results were well below the approved release criteria for removable activity (< 200 dpm/100 cm<sup>2</sup> for Sr-90).

#### Exposure Rate Surveys (Scans and Fixed Measurements)

1. *Walls and Stairs*: Fixed exposure rate measurements were taken in a total of 179 locations at contact and at 1 meter from the surface at approximate locations shown in Figure 7 (for Wall A), Figure 11 (for Wall B), Figure 15 (for Wall C), Figure 19 (for Wall C), Figure 23 (for Walls D, E and H), Figure 27 (for Wall F), Figure 31 (for Wall G), Figure 35 (for Wall I), for Figure 38 (for the stairs). The highest contact exposure rate reading was 24  $\mu$ R/hr at contact and 26  $\mu$ R/hr at 1 m from the surface.
2. *Asphalt Surfaces* - Approximately 100% of the asphalt surface was scanned using a microR meter (see Figure 45). Readings ranged from 20-23  $\mu$ R/hr (background for asphalt surfaces). In addition, 10 fixed exposure rate measurements were taken at 1 m from the asphalt surface. The highest reading was 20  $\mu$ R/hr (see Figure 45).



3. *Non-Suspect Affected and Suspect Affected Land Areas:* Approximately 100% of the Non-Suspect Affected Area and Suspect Affected Area land area surfaces were scanned with a NaI(Tl) detector held approximately 1" from the surface. The exposure rate ranged from 18-21  $\mu\text{R/hr}$  as shown in Figure 42.

Fixed exposure rate measurements at 1 m from the surface were also conducted every 2 m.. The maximum readings in every 10x10 m grid were provided in Figure 42. The highest reading was 23  $\mu\text{R/hr}$ .

4. *Suspect Affected Land Areas:* Fixed exposure rate measurements were taken in 29 locations at 1 meter from the surface. The maximum exposure rate measurement was 23  $\mu\text{R/hr}$ . See Figure 42 for locations and results.

These measurements are all below the approved release criteria of 10  $\mu\text{R/hr}$  above the natural background range of 15-18  $\mu\text{R/hr}$  at GA.

#### Exposure Rate Measurements at Soil Sampling Locations

Fixed exposure rate measurements were taken at contact and at 1 m from the surface at 74 soil sample locations. The highest measurement was 26  $\mu\text{R/hr}$  at contact and 24  $\mu\text{R/hr}$  at 1 m. The results are provided in Table 6.

#### Soil Samples

A total of 107 soil samples were collected from the Building 27-1 (EA-1 Bunker) Site as follows:

1. 30 surface (0-6") soil samples were collected in the suspect affected areas at the approximate locations shown in Figure 43.
2. 14 subsurface (6"-12") soil samples were collected in the suspect affected areas, at the approximate locations shown in Figure 43.
3. 46 surface (0-6") soil samples were collected in the non-suspect affected areas at the approximate locations shown in Figure 43, and
4. 13 soil samples (D-1 through D-13 on Figure 43) were collected near drainage areas.
5. 4 soil samples (P-1 through P-4 on Figure 43) were collected for plutonium analysis. (Other samples were also sent offsite for plutonium analysis).

All 107 soil samples were analyzed by gamma spectroscopy. The results are provided in Table 6. A summary of the results is provided as follows:



# of Samples= 107	Radionuclide Concentration (pCi/g) <i>(Background not subtracted)</i>				
	<sup>137</sup> Cs	<sup>60</sup> Co	<sup>238</sup> U	<sup>235</sup> U	Total Thorium
High	1.41 ± 0.15	0.16 ± 0.11	3.33 ± 1.23	0.43 ± 0.09	4.99
Low	ND	ND	ND	ND	1.56
Average n = 107	0.23	0.11	1.68	0.18	3.24

Notes:

1. All results were far less than the approved release criteria.
2. The sum of fractions for any sample was far less than 1.0.
3. ND = Not detected, <0.1 pCi/g Cs-137, <0.1 pCi/g Co-60, <3.0 pCi/g U-238, <0.3 pCi/g U-235.
4. The average was calculated using 107 soil sample results (n=107). ND results were included in the average as follows: For Cs-137 ND = 0.1 pCi/g, for Co-60 ND=0.1 pCi/g, for U-235 ND = 0.3 pCi/g and U-238 ND = 3.0 pCi/g. NOTE: This average is conservative because it assumes that the ND values are positive when zero could be assumed.
5. Soil background values not subtracted.

Cs-137 was detected in 75 out of 107 soil samples. The highest activity level was 1.41 ± 0.15 pCi/g, which is far below the approved release limit of 15 pCi/g.

Co-60 was detected in five (5) soil samples. The highest result was 0.16 ± 0.11 pCi/g which is far below the approved GA release limit of 8 pCi/g.

Uranium (U-238 and U-235) was at, or near, nominal background levels and well below the approved release limits.

Thorium contamination was not present (as determined by process knowledge and gamma spectroscopy analyses of soil samples). All thorium results were at, or near, background levels and well below the release limit of 10 pCi/g.

Sr-90 and Plutonium Analysis

A total of 22 soil samples (samples S-20, S-21, S-22, S-23, S-24, SSA-25 (subsurface sample), S-29, S-34, S-38 and S-63) were sent to an offsite laboratory STL (Severn Trent Laboratories) Laboratories for Sr-90 analysis. Samples were selected based on those which had the highest activity, areas with the most potential for Sr-90 contamination and soil samples from both the Room C pit and the waste tank vault pit. The approximate locations are shown in Figure 43.

The results are summarized in Table 7. Sr-90 was detected in 4 of 22 soil samples analyzed. The highest concentration was  $4.19 \pm 0.96$  pCi/g, which is far below the approved release criteria of 1800 pCi/g.

In addition, a total of 12 soil samples (P-1 through P-4, S-3, S-4, S-19, SA-26, S-39, S-53, S-60 and S-69 (called S-64 by STL) were also analyzed by STL Laboratories for Plutonium (Pu-238, Pu-239/240). Samples were selected based on those which had the highest activity, areas with the most potential for Sr-90 contamination and soil samples from both the Room C pit and the waste tank vault pit. The approximate locations are shown in Figure 43. Plutonium was not detected in any of the soil samples. The results are summarized in Table 7.

The Final Survey Plan indicated that gross alpha/gross beta analysis would be conducted in selected soil samples from the site. This was planned in order to demonstrate that the Sr-90 levels were below the release criteria (i.e., the gross beta was  $< 1800$  pCi/g which is the release criteria for Sr-90 in soil). However, instead, GA decided to submit soil samples to an offsite laboratory for Sr-90 analysis.

### **Waste Tank Excavation Pit and Drain Line Trench Survey**

The Vaulted Liquid Waste Tank excavation pit and associated drain line trench were surveyed separately from the rest of the site because of safety concerns and the availability of equipment to support the survey in the excavations. For this reason, the survey plan and the results of this survey are provided in Appendix B.

### **GA Internal Confirmatory Survey**

#### **Description**

Following the completion of the EA-1 Bunker Land Area Final Survey, a Confirmatory Survey was performed in accordance with an approved survey plan. The purpose of this survey was to confirm that the Final Survey was effective in defining the radiological conditions of the area.

The confirmatory survey did not include a survey of the remaining portions of the building since no contamination was found on any surfaces during the Final Survey. The confirmatory survey concentrated on surveying the suspect affected land areas having the highest potential for contamination.



### Survey Plan

1. Scan all surface area using microR measurements. Alert level = 25  $\mu\text{R/hr}$
2. Take exposure rate measurements using microR meter in every 10x10 meter grid (about 15 measurements) at 1 m from the surface. Alert level = 20  $\mu\text{R/hr}$
3. Collect, process and analyze (by gamma spec) 20 soil samples in the suspect affected area as shown in the attached figure (~4 per grid evenly spaced).
4. Collect, process and analyze (by gamma spec) 10 soil samples in the non-suspect affected area as shown in the attached figure (~1 per grid evenly spaced).
5. Collect soil samples in all areas where elevated readings are identified and in areas where readings are higher than in the surrounding soil.

Alert levels for soil sample results: > 50% of the soil criteria limits.

### Survey Performed and Summary of Results

#### Gamma Scan

The gamma scan consisted of scanning ~100% of the surface using a 2" x 2" NaI(Tl) detector held ~1" from the surface. During the performance of this survey, an area with elevated exposure rate readings (> 500  $\mu\text{R/hr}$ ) was discovered on a steep slope at the boundary between the adjacent TRIGA<sup>®</sup> complex and EA-1 Bunker Land Area. The elevated measurement was investigated and a hot particle was found, which, when isolated, read 20 mR/hr at contact (see Figure 46 for the approximate location of the hot particle). Five additional soil samples were collected (F-2 HP-1 through F-2 HP-5 shown in Figure 47); the results are provided in Table 8. This area was excavated and disposed of as low level radioactive waste.

After remediation of this area, the exposure rate surface scan was completed. The results ranged from 15 to 26  $\mu\text{R/hr}$  on the open surface land areas and 26 to 32  $\mu\text{R/hr}$  in the Waste Tank Excavation Pit. See Figure 50 for approximate locations and results. Note: The exposure rate release criteria is 10  $\mu\text{R/hr}$  at 1 m from the surface; there is no surface exposure rate criteria. Typical background surface exposure rate measurements inside pits and trenches are 25-27  $\mu\text{R/hr}$  (see Figure 3).

#### Soil Samples

A total of 53 soil samples were collected during the confirmatory survey as follows:

1. 5 surface (0-6") soil samples were collected in the elevated area prior to decontamination (as discussed above).
2. 5 surface (0-6") soil samples were collected after decontamination of the elevated area (see post decontamination locations in Figure 47 and Table 9 for results).
3. 13 surface (0-6") soil samples on the steep slopes surrounding the Waste Tank Vault Pit.  
 Following the discovery of this "Hot Particle", the confirmatory survey was expanded to include a final survey on all of the steep slopes surrounding the Waste Tank Vault excavation pit and associated drain pipe trench using remote surveying techniques. *The steep slopes were excluded from the original final survey plan due to safety concerns. Proper equipment was obtained and the slopes were surveyed.* These final survey soil sample locations (C1 through C13) are illustrated on Figure 48. The results are included in Table 9.
4. 18 surface (0-6") soil samples in the Suspect Affected Area (see Figure 49 for approximate locations and Table 9 for results).
5. 12 surface (0-6") soil samples in the Non-Suspect Affected Area (see Figure 49 for approximate locations and Table 9 for results).

A summary of the 48 soil sample results (provided in Table 9) is as follows:

	Radionuclide Concentration (pCi/g) (Background <u>not</u> subtracted)				
	Cs-137	Co-60	U-238	U-235	Total Thorium
High	1.74 ± 0.14	0.56 ± 0.13	2.61 ± 1.05	0.41 ± 0.30	4.76 ± 0.57
Low	ND	ND	0.81 ± 0.34	ND	2.32 ± 0.48
Average n=48	0.35	0.12	1.55	0.20	3.15

Notes:

1. All results were far less than the approved release criteria.
2. The sum of fractions for any sample was far less than 1.0.
3. ND = Not detected, <0.1 pCi/g Cs-137, <0.1 pCi/g Co-60, <3.0 pCi/g U-238, <0.3 pCi/g U-235.
4. The average was calculated using 48 results (the 5 soil samples collected prior to decontamination were not included in the average but the 5 soil samples post decontamination were included in the average). ND results were included in the average as follows: For Cs-137 ND = 0.1 pCi/g, for Co-60 ND=0.1 pCi/g, for U-235 ND = 0.3 pCi/g. NOTE: This average is conservative because it assumes that the ND values are positive when zero could be assumed.
5. Soil background values not subtracted





### Exposure Rate Measurements

Exposure rate measurements at 1 meter from the surface were taken every 2 m over the entire site. The maximum readings in each 10m x 10m grid was recorded as shown in Figure 51.

Exposure rate measurements at 1 meter from the surface were also taken at the 19 locations in and around the Waste Tank Vault excavation pit (as shown in Figure 52). The maximum measurement in the excavation pit was 26  $\mu\text{R/hr}$ ; the lowest was 15  $\mu\text{R/hr}$ . These measurements were below the approved release criteria of 10  $\mu\text{R/hr}$  above a typical background level of 20  $\mu\text{R/hr}$  at 1 m (see Figure 3).

### Conclusion

All of GA's Confirmatory Survey results (after remediation of the one elevated area found during the survey) confirm that radioactivity levels on the Building 27 (EA-1 Bunker) Land Area are below the approved release criteria.

### Conclusion

Final contamination and radiation surveys, as well as the results of analyses of soil samples, as documented in this report, collected during the Final Survey and during GA's internal Confirmatory Survey, demonstrate that the EA-1 Bunker Land Area (and building remnant thereon) meets the approved criteria for release to unrestricted use.

# TABLES

**TABLE 1: USNRC'S ACCEPTABLE SURFACE CONTAMINATION LEVELS <sup>1</sup>**

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

- a Where surface contamination by both alpha- and beta/gamma-emitting nuclides exists, the limits established for alpha- and beta/gamma-emitting nuclides should apply independently.
- b As used in this table dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, an geometric factors associated with the instrumentation.
- c Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.
- d The maximum contamination level applies to an area of not more than 100 cm<sup>2</sup>.
- e The amount of removable radioactive material per 100 cm<sup>2</sup> of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, then pertinent levels should be reduced proportionally and the entire surface should be wiped.
- f The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mRad/hr at 1 cm<sup>2</sup> and 1.0 mRad/hr at 1 cm<sup>2</sup>, respectively, measured through not more than 7 milligrams per square centimeter of total absorber.

TABLE 2: STATE OF CA ACCEPTABLE SURFACE CONTAMINATION LEVELS <sup>1</sup>			
Nuclides <sup>a</sup>	Average <sup>b,c,f</sup> (dpm/100cm <sup>2</sup> )	Maximum <sup>b,d,f</sup> (dpm/100cm <sup>2</sup> )	Removable <sup>b,e,f</sup> (dpm/100cm <sup>2</sup> )
U-nat, <sup>235</sup> U, <sup>238</sup> U, & associated decay products	5,000	15,000	1,000
Transuranics, <sup>226</sup> Ra, <sup>228</sup> Ra, <sup>230</sup> Th, <sup>228</sup> Th, <sup>231</sup> Pa, <sup>227</sup> Ac, <sup>125</sup> I, <sup>129</sup> I	100	300	20
Th-nat, <sup>232</sup> Th, <sup>90</sup> Sr, <sup>223</sup> Ra, <sup>224</sup> Ra, <sup>232</sup> U, <sup>126</sup> I, <sup>133</sup> I, <sup>131</sup> I	1,000	3,000	200
Beta/gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except <sup>90</sup> Sr and other noted above	5,000	15,000	1,000
<p>a Where surface contamination by both alpha- and beta/gamma-emitting nuclides exists, the limits established for alpha- and beta/gamma-emitting nuclides should apply independently.</p> <p>b As used in this table dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, an geometric factors associated with the instrumentation.</p> <p>c Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.</p> <p>d The maximum contamination level applies to an area of not more than 100 cm<sup>2</sup>.</p> <p>e The amount of removable radioactive material per 100 cm<sup>2</sup> of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, then pertinent levels should be reduced proportionally and the entire surface should be wiped.</p> <p>f The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/hr at 1 cm<sup>2</sup> and 1.0 mrad/hr at 1 cm<sup>2</sup>, respectively, measured through not more than 7 milligrams per square centimeter of total absorber.</p>			

<sup>1</sup> Guidelines For Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses For byproduct, Source, or Special Nuclear Material, also known as "Decon-1" incorporated into GA's State of CA Radioactive Materials License.

**TABLE 3: BUILDING 27-1 (EA-1 BUNKER) SITE - LIST OF INSTRUMENTS**

Instrument	Detector	Range	Calibration Due Date	Efficiency	Background	Description
					MDA (100cm <sup>2</sup> β & 50cm <sup>2</sup> α detectors only)	
Ludlum Model 2221 S/N 148445	Ludlum Model 43-37 gas (434cm <sup>2</sup> ) proportional <b>Alpha detector</b> S/N 147966	Four Linear Ranges 0-500,000 & one Log 50-500,000 (CPM)	10-25-01	21.18%	10 - 40 cpm (asphalt)	Active Probe Area = 434 cm <sup>2</sup> . The detector and rate meter are combined and mounted on a roll around cart. The instrument features a static-flow system, quick connects, a portable gas bottle and a means to adjust the height of the detector from the floor for optimum performance.
Ludlum Model 2221 S/N 84459	Ludlum Model 43-37 gas (434cm <sup>2</sup> ) proportional <b>Beta detector</b> S/N 086215	Four Linear Ranges 0-500,000 & one Log 50-500,000 (CPM)	11-15-01	22.11%	2400-2900 cpm (asphalt)	Active Probe Area = 434 cm <sup>2</sup> . The detector and rate meter are combined and mounted on a roll around cart. The instrument features a static-flow system, quick connects, a portable gas bottle and a means to adjust the height of the detector from the floor for optimum performance.
Ludlum Model 2221 S/N 84423	Ludlum Model 43-68 100 cm <sup>2</sup> proportional <b>Beta detector</b> S/N 119444	Four Linear Ranges 0-500,000 & one Log 50-500,000 (CPM)	09-26-01	24.13%	682 ± 40 cpm (asphalt)  MDA = 508 dpn/100cm <sup>2</sup>	100 cm <sup>2</sup> gas flow proportional counter
Ludlum Model 3 S/N 147819	Ludlum Model 44-10 NaI (TI) Scintillator <b>Gamma Detector</b> S/N 153765	Four Ranges 0-500 μR/hr	09-04-01	NA	18-19 μR/hr (asphalt) 11-13 μR/hr (soil)	2 inch x 2 inch NaI (TI) scintillator. Used for measuring external dose rates on the surface and at one meter.
Ludlum Model 3 S/N 153590	Ludlum Model 44-10 NaI (TI) Scintillator <b>Gamma Detector</b> S/N 155190	Four Ranges 0-500 μR/hr	9-07-01 12-01-01	NA	19-21 μR/hr (asphalt) 11-13 μR/hr (soil)	2 inch x 2 inch NaI (TI) scintillator. Used for measuring external dose rates on the surface and at one meter.
Ludlum Model 19 S/N 158881	RCA Model 6199 <b>Gamma Detector</b>	0-5 mR/hr	11-16-01	NA	19-21 μr/hr (asphalt) 11-13 μr/hr (soil)	Used for exposure rate scanning and fixed exposure rate measurements

**TABLE 3: BUILDING 27-1 (EA-1 BUNKER) SITE - LIST OF INSTRUMENTS**

Instrument	Detector	Range	Calibration Due Date	Efficiency	Background	Description
					MDA (100cm <sup>2</sup> β & 50cm <sup>2</sup> α detectors only)	
Ludlum Model 3 S/N 153551	Ludlum Model 44-10 NaI (TI) Scintillator Gamma Detector S/N155109	Four Ranges 0-500 μR/hr	07-04-01 10-18-01	NA	17-20 μR/hr (asphalt) 11-13 μR/hr (soil)	2 inch x 2 inch NaI (TI) scintillator. Used for measuring external dose rates on the surface and at one meter.
Ludlum Model 12 S/N 138738	Ludlum Model 43-64 Alpha Scintillator ZnS (Ag) S/N 148349	Four Ranges 0-500,000cpm	08-31-01 01-10-02	21.58% 21.58%	Typical Background = 10 cpm Count Time ~ 0.5 min  MDA = 244 dpm/100 cm <sup>2</sup>	Active Probe Area =50cm <sup>2</sup> Used for Alpha surveying
Ludlum Model 3 S/N 138880	Ludlum Model 44-9 15cm <sup>2</sup> beta/gamma probe S/N 145962	Four Ranges 0-500,000 cpm	08-09-01	21.35%	100-140 (concrete) 80-100 (asphalt)	Active Probe Area = 15cm <sup>2</sup> Used for beta/gamma surveying
Ludlum Model 2221 S/N 148436	Ludlum Model 43-68 100 cm <sup>2</sup> proportional Beta detector S/N 120477	Four Linear Ranges 0-500,000 & one Log 50-500,000 (CPM)	06-02-02	28.6%	621 ± 31 cp2m (asphalt)  MDA = 207 dpm/100cm <sup>2</sup>	100 cm <sup>2</sup> gas flow proportional counter
Canberra Low Level α/β Counter Model 2404	Gas Flow Proportional Detector	N/A	As needed	~26-30%	Varies with Sample	Canberra Model 2404 Low Level α/β gas proportional counting system used to count wipes for removable contamination. Results are usually reported as dpm/100cm <sup>2</sup> .
Canberra Gamma Spectroscopy System	High Purity Germanium Detector	N/A	As needed	Varies with Sample	Varies with Sample	Gamma Spectroscopy MCA system using a high purity Germanium detector.

<b>TABLE 4: GAMMA SPECTROSCOPY RESULTS OF BACKGROUND SOIL (SURFACE) SAMPLES</b>							
Sample ID	<i>Radionuclide Concentrations (<math>\rho</math>Ci/gm) - Results <math>\pm 2\sigma</math> - 30 Minute Counts</i>						
	<sup>137</sup> Cs 661.6 keV peak	<sup>60</sup> Co 1173 keV peak	<sup>228</sup> Th 238 keV peak	<sup>228</sup> Ra ( <sup>232</sup> Th) 911 keV peak	Total Thorium <sup>228</sup> Th + <sup>232</sup> Th	<sup>238</sup> U 63.3 (92.7) keV peak	<sup>235</sup> U 144 (186) keV peak
X-1	ND	ND	0.71 $\pm$ 0.07	0.97 $\pm$ 0.25	1.68	1.17 $\pm$ 0.77	(0.13 $\pm$ 0.06)
X-2	ND	ND	0.90 $\pm$ 0.13	1.49 $\pm$ 0.31	2.39	1.91 $\pm$ 1.18	(0.13 $\pm$ 0.08)
X-3	0.06 $\pm$ 0.04	ND	1.49 $\pm$ 0.10	1.56 $\pm$ 0.25	3.05	1.45 $\pm$ 0.80	(0.23 $\pm$ 0.09)
X-4	ND	ND	1.52 $\pm$ 0.23	3.22 $\pm$ 0.61	4.74	3.74 $\pm$ 2.18	(0.28 $\pm$ 0.17)
X-5	ND	ND	1.92 $\pm$ 0.17	2.41 $\pm$ 0.53	4.33	(4.49 $\pm$ 1.64)	(0.32 $\pm$ 0.16)
X-6	ND	ND	1.02 $\pm$ 0.08	0.96 $\pm$ 0.23	1.98	1.31 $\pm$ 0.80	(0.14 $\pm$ 0.06)
X-7	0.13 $\pm$ 0.08	ND	1.59 $\pm$ 0.14	2.40 $\pm$ 0.38	3.99	2.16 $\pm$ 1.48	(0.18 $\pm$ 0.10)
X-8	ND	ND	1.44 $\pm$ 0.28	1.40 $\pm$ 0.28	2.84	2.30 $\pm$ 1.16	(0.14 $\pm$ 0.09)
X-9	0.09 $\pm$ 0.08	ND	0.89 $\pm$ 0.10	1.27 $\pm$ 0.31	2.16	1.59 $\pm$ 1.05	(0.10 $\pm$ 0.08)
X-10	ND	ND	1.29 $\pm$ 0.11	1.52 $\pm$ 0.36	2.81	1.10 $\pm$ 0.96	(0.16 $\pm$ 0.08)

**Notes:**

1. Surface (0-6") soil samples were collected on 06/05/00 and 06/06/00 by Ed Rudgers off GA's site but close to GA.
2. Samples were counted 7/20/00 through 7/24/00 for 30 minutes (same count as the soil samples).
3. ND means: < 0.1 pCi/g for Cs-137, < 0.1 pCi/g for Co-60
4. The numbers in parenthesis indicate that the peak in parenthesis was used rather than the preferred peak shown because the preferred peak was not identified.

**Sample Locations:**

- X1 Sorrento Valley Road near sample location ST65 on the hillside ~1 mile from Building 37.
- X2 Sorrento Valley Road near Carmel Mountain Road junction on steep cliff.
- X3 Sorrento Valley Road in Los Penasquitos Preserve ~2 miles from Building 37.
- X4 Sorrento Valley Court at the end of the road in the field.
- X5 Roselle Street, East of sample location ST64 ~ ½ mile from Building 37 (collected on the hillside)
- X6 Roselle Street, East of sample location ST64 ~1 ½ mile from Building 37 (collected on hillside).
- X7 Lusk Boulevard, from the hillside ~ 1 ½ miles from Building 37 (collected on the hillside).
- X8 Vista Sorrento Parkway, ~ ½ mile from Building 37 (collected on the hillside).
- X9 Callahan Road, ~ ½ mile from Building 37 (collected on the hillside).
- X10 Eastgate Mall road, ~3 miles from Building 37 (collected in a field).

<b>TABLE 5: BUILDING 27-1 (EA-1 BUNKER) LAND AREA SMEAR SURVEY RESULTS</b>			
Smear ID #	Note: Numbers are not in order; there are no #'s 33-36	Gross $\alpha$ in dpm/100 cm <sup>2</sup>	Gross $\beta$ in dpm/100 cm <sup>2</sup>
<b>Wall-A Internal (see Figure 6)</b>			
15		<10	<10
16		<10	<10
17		<10	11
18		<10	<10
19		<10	29
20		<10	<10
21		<10	<10
<b>Wall-A External (see Figure 6)</b>			
22		<10	<10
23		<10	<10
24		<10	<10
25		<10	<10
26		<10	<10
27		<10	<10
28		<10	<10
29		<10	<10
30		<10	<10
31		<10	<10
32		<10	<10
<b>Wall-B (External) - See Figure 10</b>			
1		<10	<10
2		<10	<10
3		<10	<10
4		<10	<10
5		<10	<10



<b>TABLE 5: BUILDING 27-1 (EA-1 BUNKER) LAND AREA SMEAR SURVEY RESULTS</b>			
Smear ID #	Note: Numbers are not in order; there are no #'s 33-36	Gross $\alpha$ in dpm/100 cm <sup>2</sup>	Gross $\beta$ in dpm/100 cm <sup>2</sup>
<b>Wall-B (Internal) - See Figure 10</b>			
6		<10	<10
7		<10	<10
8		<10	<10
9		<10	<10
<b>Wall-C Internal (See Figure 18)</b>			
37		<10	<10
38		<10	<10
39		<10	14
40		<10	<10
41		<10	<10
42		<10	<10
43		<10	<10
44		<10	<10
45		<10	<10
46		<10	<10
47		<10	<10
48		<10	<10
49		<10	<10
50		<10	<10
<b>Wall-C External (See Figure 14)</b>			
1		<10	<10
2		<10	<10
3		<10	<10
4		<10	<10
5		<10	<10
6		<10	<10

<b>TABLE 5: BUILDING 27-1 (EA-1 BUNKER) LAND AREA SMEAR SURVEY RESULTS</b>			
Smear ID #	Note: Numbers are not in order; there are no #'s 33-36	Gross $\alpha$ in dpm/100 cm <sup>2</sup>	Gross $\beta$ in dpm/100 cm <sup>2</sup>
<b>Wall-D Internal (See Figure 22)</b>			
1		<10	<10
2		<10	<10
3		<10	<10
4		<10	<10
5		<10	<10
6		<10	<10
<b>Wall-H Internal (See Figure 22)</b>			
7		<10	<10
8		<10	<10
9		<10	<10
10		<10	<10
11		<10	<10
<b>Wall-D External (See Figure 22)</b>			
1		<10	<10
2		<10	<10
3		<10	<10
4		<10	<10
5		<10	<10
6		<10	<10
7		<10	<10
8		<10	<10
9		<10	<10
<b>Wall D External (See Figure 22)</b>			
10		<10	<10
11		<10	<10
12		<10	<10

**TABLE 5: BUILDING 27-1 (EA-1 BUNKER) LAND AREA SMEAR SURVEY RESULTS**

Smear ID #	Note: Numbers are not in order; there are no #'s 33-36	Gross $\alpha$ in dpm/100 cm <sup>2</sup>	Gross $\beta$ in dpm/100 cm <sup>2</sup>
13		<10	<10
14		<10	<10
<b>Wall F Internal (See Figure 26)</b>			
1		<10	<10
2		<10	<10
3		<10	<10
4		<10	<10
5		<10	<10
6		<10	<10
7		<10	<10
8		<10	<10
9		<10	<10
10		<10	<10
11		<10	<10
<b>Wall F External (See Figure 26)</b>			
1		<10	<10
2		<10	<10
3		<10	<10
4		<10	11
5		<10	<10
6		<10	<10
7		<10	<10
8		<10	<10
9		<10	<10
10		<10	<10
11		<10	<10

<b>TABLE 5: BUILDING 27-1 (EA-1 BUNKER) LAND AREA SMEAR SURVEY RESULTS</b>			
Smear ID #	Note: Numbers are not in order; there are no #'s 33-36	Gross $\alpha$ in dpm/100 cm <sup>2</sup>	Gross $\beta$ in dpm/100 cm <sup>2</sup>
<b>Wall G External (See Figure 30)</b>			
1		<10	<10
2		<10	<10
3		<10	<10
4		<10	<10
<b>Wall G Internal (See Figure 30)</b>			
5		<10	<10
6		<10	<10
<b>Wall I External (See Figure 34)</b>			
1		<10	<10
2		<10	<10
3		<10	<10
4		<10	<10
5		<10	<10
6		<10	<10
7		<10	<10
<b>Wall I Internal (See Figure 34)</b>			
1		<10	<10
2		<10	<10
3		<10	<10
4		<10	<10
5		<10	<10
6		<10	<10
7		<10	<10
<b>Bunker Land Asphalt/Concrete (See Figure 41)</b>			
1		<10	<10
2		<10	<10

**TABLE 5: BUILDING 27-1 (EA-1 BUNKER) LAND AREA SMEAR SURVEY RESULTS**

Smear ID #	Note: Numbers are not in order; there are no #'s 33-36	Gross $\alpha$ in dpm/100 cm <sup>2</sup>	Gross $\beta$ in dpm/100 cm <sup>2</sup>
3		<10	<10
4		<10	<10
5		<10	<10
6		<10	<10
7		<10	<10
8		<10	<10
9		<10	<10
10		<10	<10
<b>Bunker Stairs and Landing (See Figure 37)</b>			
1		<10	<10
2		<10	<10
3		<10	<10
4		<10	<10
5		<10	<10
6		<10	<10
7		<10	<10
8		<10	<10
9		<10	<10
10		<10	<10
11		<10	<10
12		<10	<10
13		<10	<10
14		<10	<10

**TABLE 6: BUILDING 27-1 (EA-1 BUNKER) LAND AREA FINAL SOIL SAMPLE RESULTS**

#	Sample ID	Radionuclide Concentrations (pCi/g) <i>Background Not Subtracted, 30 min. count (except as noted)</i>					Exposure Rate ( $\mu$ R/hr)	
		U-238 63 keV, 93 keV used when 63 keV not present	U-235 144 keV, 186 keV used when 144 keV not present)	Cs-137 662 keV	Co-60 1170 and 1330 keV peaks averaged	Total Thorium Th-228 (238 keV) plus Th-232 (911 keV)	Contact at Soil Location	@ 1m at Soil Location
1	S-2	1.38 ± 1.02	0.21 ± 0.10	0.55 ± 0.12	ND	2.90 ± 0.57	22	20
2	S-3	1.69 ± 1.28	0.22 ± 0.10	1.32 ± 0.13	ND	3.32 ± 0.39	25	22
3	S-4	2.03 ± 1.22	0.17 ± 0.10	0.31 ± 0.07	ND	3.02 ± 0.53	22	20
4	SS-4 (2hr)	ND	ND	0.25 ± 0.06	ND	3.22 ± 0.34	-	-
5	SA-5	1.46 ± 1.03	0.20 ± 0.11	0.09 ± 0.07	ND	3.34 ± 0.54	22	20
6	S-6	0.90 ± 0.78	0.11 ± 0.06	0.14 ± 0.07	ND	1.89 ± 0.40	23	21
7	SA-S6	ND	0.10 ± 0.11	0.18 ± 0.11	ND	2.67 ± 0.48	-	-
8	S-7	1.58 ± 0.63	0.14 ± 0.08	1.21 ± 0.11	ND	2.25 ± 0.41	26	24
9	SA-8	0.96 ± 1.16	0.11 ± 0.07	ND	ND	3.01 ± 0.38	24	23
10	SA-9	0.95 ± 0.79	0.08 ± 0.07	ND	ND	2.72 ± 0.40	25	23
11	SA-10	1.54 ± 0.69	0.13 ± 0.07	0.23 ± 0.09	ND	2.45 ± 0.39	23	23
12	SA-11	1.41 ± 1.11	0.12 ± 0.08	ND	ND	2.82 ± 0.43	21	21
13	S-12	2.10 ± 0.68	0.20 ± 0.07	ND	ND	3.11 ± 0.39	20	19
14	S-13	1.20 ± 0.73	0.12 ± 0.07	ND	ND	2.80 ± 0.38	20	20
15	S-14	1.26 ± 1.16	0.20 ± 0.11	ND	ND	3.84 ± 0.52	19	19
16	S-15	1.04 ± 0.77	0.13 ± 0.07	ND	ND	3.04 ± 0.46	18	17

**TABLE 6: BUILDING 27-1 (EA-1 BUNKER) LAND AREA FINAL SOIL SAMPLE RESULTS**

#	Sample ID	Radionuclide Concentrations (pCi/g)					Exposure Rate (µR/hr)	
		<i>Background Not Subtracted, 30 min. count (except as noted)</i>					Contact at Soil Location	@ 1m at Soil Location
		U-238 63 keV, 93 keV used when 63 keV not present	U-235 144 keV, 186 keV used when 144 keV not present)	Cs-137 662 keV	Co-60 1170 and 1330 keV peaks averaged	Total Thorium Th-228 (238 keV) plus Th-232 (911 keV)		
17	S-16	1.80 ± 0.69	0.14 ± 0.08	ND	ND	3.09 ± 0.41	18	18
18	S-17	1.49 ± 0.75	0.15 ± 0.08	0.11 ± 0.10	ND	2.86 ± 0.44	20	19
19	S-18	0.90 ± 0.89	0.13 ± 0.07	0.05 ± 0.06	ND	3.06 ± 0.43	22	19
20	S-19	1.32 ± 0.62	0.17 ± 0.07	0.37 ± 0.07	ND	2.82 ± 0.40	20	18
21	S-20	1.04 ± 0.71	0.18 ± 0.07	0.11 ± 0.07	ND	2.78 ± 0.35	21	19
22	S-21	1.36 ± 1.08	0.17 ± 0.09	0.15 ± 0.07	ND	2.27 ± 0.41	21	19
23	S-22	1.19 ± 1.23	0.15 ± 0.10	0.16 ± 0.07	ND	2.80 ± 0.51	19	18
24	S-23	0.80 ± 0.77	0.11 ± 0.06	0.32 ± 0.24	ND	2.53 ± 0.36	24	22
25	S-24	1.62 ± 1.17	0.15 ± 0.09	0.24 ± 0.10	ND	3.20 ± 0.49	24	23
26	SA-25	1.48 ± 1.15	0.20 ± 0.08	0.15 ± 0.10	ND	4.09 ± 0.51	23	21
27	SSA-25	1.48 ± 0.96	0.17 ± 0.08	0.15 ± 0.08	ND	3.31 ± 0.49	-	-
28	SA-26	1.28 ± 1.16	0.19 ± 0.09	0.07 ± 0.04	ND	3.43 ± 0.46	23	22
29	SA-27	1.68 ± 1.16	0.16 ± 0.07	0.19 ± 0.08	ND	3.21 ± 0.42	22	22
30	SSA-27	1.38 ± 1.00	0.17 ± 0.08	0.12 ± 0.06	ND	3.47 ± 0.43	-	-
31	SA-28	1.29 ± 0.91	0.20 ± 0.08	ND	ND	2.99 ± 0.40	22	21
32	S-29	1.68 ± 1.17	0.26 ± 0.11	ND	ND	3.57 ± 0.47	25	22

**TABLE 6: BUILDING 27-1 (EA-1 BUNKER) LAND AREA FINAL SOIL SAMPLE RESULTS**

#	Sample ID	Radionuclide Concentrations (pCi/g)					Exposure Rate (μR/hr)	
		<i>Background Not Subtracted, 30 min. count (except as noted)</i>					Contact at Soil Location	@ 1m at Soil Location
		U-238 63 keV, 93 keV used when 63 keV not present	U-235 144 keV, 186 keV used when 144 keV not present)	Cs-137 662 keV	Co-60 1170 and 1330 keV peaks averaged	Total Thorium Th-228 (238 keV) plus Th-232 (911 keV)		
33	S-30	2.03 ± 1.16	0.16 ± 0.08	0.10 ± 0.08	ND	3.98 ± 0.48	25	24
34	S-31	2.51 ± 1.56	0.21 ± 0.10	0.10 ± 0.08	ND	3.61 ± 0.50	25	22
35	S-32 (2hr)	1.78 ± 1.10	0.22 ± 0.06	0.18 ± 0.04	ND	3.83 ± 0.46	24	22
36	S-33	1.09 ± 1.13	0.21 ± 0.09	0.18 ± 0.09	ND	3.74 ± 0.49	22	21
37	S-34	2.17 ± 0.69	0.15 ± 0.08	0.34 ± 0.09	ND	2.92 ± 0.45	22	21
38	S-35	1.30 ± 1.00	0.13 ± 0.08	0.12 ± 0.06	ND	2.88 ± 0.40	22	21
39	S-36	2.43 ± 1.58	0.26 ± 0.10	0.39 ± 0.08	ND	3.89 ± 0.53	24	21
40	S-37	1.80 ± 1.21	0.15 ± 0.07	0.12 ± 0.06	ND	2.87 ± 0.39	23	21
41	S-38	1.62 ± 1.24	0.19 ± 0.11	0.48 ± 0.13	ND	4.99 ± 0.55	23	21
42	SS-38	2.14 ± 1.29	0.28 ± 0.13	0.17 ± 0.08	ND	3.82 ± 0.59	-	--
43	S-39	1.17 ± 1.38	0.22 ± 0.12	0.39 ± 0.11	ND	4.85 ± 0.60	23	21
44	SS-39	2.63 ± 1.41	0.27 ± 0.09	0.18 ± 0.09	ND	4.12 ± 0.54	-	--
45	S-40	1.29 ± 1.11	0.23 ± 0.09	0.15 ± 0.07	ND	3.76 ± 0.57	25	22
46	S-41	1.57 ± 1.04	0.12 ± 0.10	0.07 ± 0.06	ND	3.05 ± 0.42	26	23
47	S-42	2.10 ± 1.26	0.13 ± 0.07	0.04 ± 0.05	ND	3.34 ± 0.50	18	17
48	S-43	0.93 ± 1.00	0.21 ± 0.10	0.11 ± 0.07	ND	3.07 ± 0.48	18	17



**TABLE 6: BUILDING 27-1 (EA-1 BUNKER) LAND AREA FINAL SOIL SAMPLE RESULTS**

#	Sample ID	Radionuclide Concentrations (pCi/g)					Exposure Rate (μR/hr)	
		<i>Background Not Subtracted, 30 min. count (except as noted)</i>					Contact at Soil Location	@ 1m at Soil Location
		U-238 63 keV, 93 keV used when 63 keV not present	U-235 144 keV, 186 keV used when 144 keV not present)	Cs-137 662 keV	Co-60 1170 and 1330 keV peaks averaged	Total Thorium Th-228 (238 keV) plus Th-232 (911 keV)		
49	S-44	0.99 ± 1.04	0.11 ± 0.11	0.47 ± 0.08	0.16 ± 0.11	3.30 ± 0.52	18	17
50	S-45	1.20 ± 0.61	0.12 ± 0.07	0.13 ± 0.07	ND	2.80 ± 0.44	18	17
51	S-46	1.58 ± 1.48	0.13 ± 0.09	0.40 ± 0.11	ND	2.82 ± 0.54	19	18
52	S-47	0.96 ± 0.99	0.11 ± 0.08	0.31 ± 0.09	ND	2.66 ± 0.49	18	17
53	S-48	1.39 ± 1.30	0.20 ± 0.12	0.35 ± 0.10	ND	3.11 ± 0.55	17	17
54	S-49	0.92 ± 1.13	0.15 ± 0.09	0.26 ± 0.10	ND	2.81 ± 0.50	17	17
55	S-50	0.69 ± 0.84	0.16 ± 0.11	0.31 ± 0.13	ND	2.60 ± 0.70	17	17
56	S-51	1.37 ± 1.30	ND	0.49 ± 0.11	ND	3.38 ± 0.58	17	17
57	S-52	0.78 ± 0.91	0.14 ± 0.10	0.17 ± 0.10	ND	3.65 ± 0.47	18	17
58	S-53	1.40 ± 1.36	0.21 ± 0.12	0.26 ± 0.09	ND	3.96 ± 0.66	17	17
59	S-54	ND	0.10 ± 0.12	0.38 ± 0.14	ND	3.90 ± 0.65	18	17
60	S-55	2.32 ± 0.81	0.15 ± 0.10	0.52 ± 0.11	ND	3.07 ± 0.58	19	18
61	S-56	2.28 ± 1.00	0.16 ± 0.11	0.39 ± 0.12	ND	3.39 ± 0.53	19	18
62	S-57	0.88 ± 0.81	0.20 ± 0.10	0.14 ± 0.10	ND	2.47 ± 0.41	19	18
63	S-58	1.47 ± 0.80	0.19 ± 0.12	0.47 ± 0.10	ND	1.56 ± 0.18	19	19
64	S-59	2.24 ± 1.26	0.13 ± 0.09	0.95 ± 0.13	0.15 ± 0.11	3.40 ± 0.55	20	19

**TABLE 6: BUILDING 27-1 (EA-1 BUNKER) LAND AREA FINAL SOIL SAMPLE RESULTS**

#	Sample ID	Radionuclide Concentrations (pCi/g)					Exposure Rate (µR/hr)	
		<i>Background Not Subtracted, 30 min. count (except as noted)</i>					Contact at Soil Location	@ 1m at Soil Location
		U-238 63 keV, 93 keV used when 63 keV not present	U-235 144 keV, 186 keV used when 144 keV not present)	Cs-137 662 keV	Co-60 1170 and 1330 keV peaks averaged	Total Thorium Th-228 (238 keV) plus Th-232 (911 keV)		
65	S-60	0.90 ± 0.73	0.23 ± 0.08	0.10 ± 0.05	ND	2.59 ± 0.38	21	19
66	S-61	1.29 ± 0.96	0.12 ± 0.07	0.09 ± 0.08	ND	2.87 ± 0.47	22	20
67	S-62	1.64 ± 1.11	0.10 ± 0.08	0.18 ± 0.07	ND	2.75 ± 0.41	22	20
68	S-63	0.89 ± 0.99	0.18 ± 0.09	1.04 ± 0.12	0.05 ± 0.06	2.72 ± 0.54	20	19
69	S-64	1.85 ± 1.44	0.22 ± 0.10	0.18 ± 0.09	ND	3.01 ± 0.56	20	19
70	S-65	1.69 ± 1.19	0.18 ± 0.09	0.47 ± 0.09	ND	3.15 ± 0.46	19	18
71	S-66	1.11 ± 0.93	0.22 ± 0.11	0.29 ± 0.09	ND	3.06 ± 0.57	18	17
72	S-67	0.98 ± 0.89	0.21 ± 0.08	0.45 ± 0.10	0.07 ± 0.09	3.24 ± 0.47	18	17
73	S-68	0.91 ± 1.13	0.13 ± 0.13	0.73 ± 0.15	0.13 ± 0.09	3.12 ± 0.62	18	17
74	S-69	1.17 ± 1.37	0.18 ± 0.09	1.41 ± 0.15	ND	3.37 ± 0.60	18	17
75	S-70	1.77 ± 1.28	0.12 ± 0.10	0.34 ± 0.12	ND	3.87 ± 0.56	18	17
76	S-1 (pipe)	1.27 ± 1.00	0.12 ± 0.07	0.26 ± 0.07	ND	2.11 ± 0.44	22	20
77	Bunker 38-	2.49 ± 1.50	0.29 ± 0.08	ND	ND	4.74 ± 0.60	--	--
78	Bunker 38-	2.13 ± 1.24	0.26 ± 0.04	ND	ND	3.60 ± 0.46	--	--
79	Bunker 38-	3.33 ± 1.23	0.26 ± 0.12	ND	ND	4.11 ± 0.53	--	--
80	Bunker 38-	3.29 ± 0.92	0.24 ± 0.10	ND	ND	3.82 ± 0.54	--	--

**TABLE 6: BUILDING 27-1 (EA-1 BUNKER) LAND AREA FINAL SOIL SAMPLE RESULTS**

#	Sample ID	Radionuclide Concentrations (pCi/g) <i>Background Not Subtracted, 30 min. count (except as noted)</i>					Exposure Rate ( $\mu$ R/hr)	
		U-238 63 keV, 93 keV used when 63 keV not present	U-235 144 keV, 186 keV used when 144 keV not present)	Cs-137 662 keV	Co-60 1170 and 1330 keV peaks averaged	Total Thorium Th-228 (238 keV) plus Th-232 (911 keV)	Contact at Soil Location	@ 1m at Soil Location
81	Bunker 39-	2.47 ± 1.48	0.29 ± 0.26	0.02 ± 0.04	ND	4.46 ± 0.57	-	--
82	Bunker 39-	2.90 ± 1.27	0.34 ± 0.12	ND	ND	4.26 ± 0.60	-	--
83	Bunker 39-	3.22 ± 1.83	0.43 ± 0.09	ND	ND	4.55 ± 3.83	-	--
84	Bunker 39-	2.25 ± 1.31	0.31 ± 0.18	ND	ND	3.46 ± 0.45	-	--
85	S-71	2.78 ± 1.32	0.22 ± 0.08	ND	ND	3.52 ± 0.45	22	21
86	S-72	2.94 ± 1.40	0.26 ± 0.09	ND	ND	3.39 ± 0.34	22	20
87	S-73 (2hr)	2.38 ± 1.40	0.26 ± 0.06	ND	ND	4.00 ± 0.54	22	21
88	S-74	2.02 ± 1.15	0.24 ± 0.10	ND	ND	3.46 ± 0.54	20	19
89	S-75 (2hr)	3.01 ± 1.69	0.21 ± 0.22	0.06 ± 0.02	ND	3.82 ± 0.49	-	--
90	S-76	1.90 ± 0.99	0.21 ± 0.09	ND	ND	3.29 ± 0.39	-	--
91	D-1	1.30 ± 1.14	0.17 ± 0.11	0.28 ± 0.10	ND	3.14 ± 0.54	--	--
92	D-2	1.14 ± 1.01	0.16 ± 0.09	0.23 ± 0.09	ND	2.94 ± 0.50	--	--
93	D-3	1.25 ± 0.69	0.11 ± 0.08	ND	ND	3.02 ± 0.45	--	--
94	D-4	1.37 ± 0.96	0.18 ± 0.09	ND	ND	2.79 ± 0.40	--	--
95	D-5	1.74 ± 0.71	0.15 ± 0.10	ND	ND	4.27 ± 0.52	--	--
96	D-6	1.98 ± 0.89	0.17 ± 0.10	ND	ND	3.08 ± 0.44	--	--

**TABLE 6: BUILDING 27-1 (EA-1 BUNKER) LAND AREA FINAL SOIL SAMPLE RESULTS**

#	Sample ID	Radionuclide Concentrations (pCi/g) <i>Background Not Subtracted, 30 min. count (except as noted)</i>					Exposure Rate ( $\mu$ R/hr)	
		U-238 63 keV, 93 keV used when 63 keV not present	U-235 144 keV, 186 keV used when 144 keV not present)	Cs-137 662 keV	Co-60 1170 and 1330 keV peaks averaged	Total Thorium Th-228 (238 keV) plus Th-232 (911 keV)	Contact at Soil Location	@ 1m at Soil Location
97	D-7	1.01 $\pm$ 0.88	0.17 $\pm$ 0.07	0.10 $\pm$ 0.06	ND	2.90 $\pm$ 0.41	--	--
98	D-8	1.54 $\pm$ 1.07	0.08 $\pm$ 0.08	0.09 $\pm$ 0.07	ND	2.98 $\pm$ 0.47	--	--
99	D-9	0.94 $\pm$ 0.93	0.07 $\pm$ 0.07	ND	ND	3.26 $\pm$ 0.54	--	--
100	D-10	0.78 $\pm$ 0.65	0.15 $\pm$ 0.08	0.05 $\pm$ 0.05	ND	2.20 $\pm$ 0.36	--	--
101	D-11	1.14 $\pm$ 0.91	0.21 $\pm$ 0.09	ND	ND	3.11 $\pm$ 0.44	--	--
102	D-12	1.83 $\pm$ 1.14	0.10 $\pm$ 0.07	ND	ND	2.79 $\pm$ 0.43	--	--
103	D-13	1.67 $\pm$ 1.22	0.14 $\pm$ 0.09	ND	ND	2.98 $\pm$ 0.47	--	--
104	P-1	ND	0.15 $\pm$ 0.08	0.24 $\pm$ 0.10	ND	2.96 $\pm$ 0.62	--	--
105	P-2	ND	0.15 $\pm$ 0.11	0.10 $\pm$ 0.07	ND	3.69 $\pm$ 0.78	--	--
106	P-3	ND	0.13 $\pm$ 0.06	ND	ND	3.12 $\pm$ 0.86	--	--
107	P-4	ND	0.16 $\pm$ 0.10	ND	ND	3.28 $\pm$ 0.86	--	--

Notes:

1. Shaded entries indicate sub-surface samples.
2. ND = Not detected, <0.1 pCi/g Cs-137, <0.1 pCi/g Co-60, <3.0 pCi/g U-238, <0.3 pCi/g U-235.
3. Samples D-1 through D-13 were taken in drain pipes, P-1 through P-4 were taken for Plutonium analysis.

**TABLE 7: BUILDING 27-1 (EA-1 BUNKER) STRONTIUM-90 AND PLUTONIUM SOIL SAMPLE RESULTS**

Sample ID	Sr-90		Pu-238		Pu-239/Pu-240	
	Results	MDC	Results	MDC	Results	MDC
P-1	-0.05 ± 0.36	0.62	0.125 ± 0.095	0.14	-0.031 ± 0.055	0.12
P-2	0.02 ± 0.31	0.54	0.076 ± 0.065	0.094	0.027 ± 0.029	0.040
P-3	-0.03 ± 0.33	0.58	0.068 ± 0.049	0.069	-0.027 ± 0.026	0.062
P-4	-0.07 ± 0.28	0.49	0.021 ± 0.027	0.044	0.003 ± 0.013	0.027
S-3	0.03 ± 0.31	0.54	-0.006 ± 0.038	0.073	0.0000004±0.013	0.029
S-4	0.48 ± 0.34	0.53	0.008 ± 0.024	0.044	0.003 ± 0.012	0.024
S-19	0.12 ± 0.32	0.55	-0.033 ± 0.032	0.069	0.0000004±0.012	0.028
SA-26	0.69 ± 0.38	0.58	-0.007 ± 0.041	0.078	0.007 ± 0.017	0.032
S-39	0.32 ± 0.34	0.56	0.053 ± 0.043	0.061	0.008 ± 0.020	0.038
S-53	0.01 ± 0.30	0.53	0.017 ± 0.035	0.062	0.012 ± 0.028	0.050
S-60	0.50 ± 0.34	0.53	0.023 ± 0.024	0.035	0.007 ± 0.016	0.031
S-69	0.02 ± 0.32	0.55	0.028 ± 0.023	0.031	0.010 ± 0.015	0.024
S-20	0.37 ± 0.33	0.53	--	--	--	--
S-21	0.19 ± 0.30	0.50	--	--	--	--
S-22	0.92 ± 0.40	0.55	--	--	--	--
S-23	0.48 ± 0.35	0.55	--	--	--	--

**TABLE 7: BUILDING 27-1 (EA-1 BUNKER) STRONTIUM-90 AND PLUTONIUM SOIL SAMPLE RESULTS**

Sample ID	Sr-90		Pu-238		Pu-239/Pu-240	
	Results	MDC	Results	MDC	Results	MDC
S-24	0.53 ± 0.34	0.52	--	--	--	--
SSA-25	-0.003 ± 0.34	0.59	--	--	--	--
S-29	0.037 ± 0.31	0.54	--	--	--	--
S-34	0.049 ± 0.29	0.50	--	--	--	--
S-38	0.37 ± 0.35	0.56	--	--	--	--
S-63	4.19 ± 0.96	0.57	--	--	--	--

Notes:

1. Soil samples analyzed by Severn Trent Laboratories, Inc. St. Louis, 13715 Rider Trail North, Earth City, MO 63045. Report dated October 15, 2001 (Lot #: F1I200261) and report dated January 21, 2002 (Lot #: F1L170110).
2. Sample sent to Severn-Trent Laboratories was sample S-69. When the sample was sent, the sample number S-64 was incorrectly recorded on the shipping papers.
3. Shaded results are above the minimum detectable concentration (MDC).
4. GA conclusions: Plutonium contamination is not present in the soil. Sr-90 was detected in only 4 out of 22 samples.

**TABLE 8: BUILDING 27 (EA-1 BUNKER) LAND AREA CONFIRMATORY SURVEY  
INITIAL SOIL SAMPLE RESULTS**

#	Sample ID	Radionuclide Concentrations (pCi/g) <i>Background Not Subtracted, 30 min. count (except as noted)</i>				
		U-238 (63keV, 93 keV used when 63 not present)	U-235 (144keV, 186 keV used when 144 not present)	Cs-137 (662 keV)	Co-60 {(1170 keV+1330 keV) /2}	Total Thorium Th-228 (238 keV), plus Th-232 (911 keV)
44	F2 HP-1	0.94 ± 0.64	ND	1.64 ± 0.13	0.11 ± 0.10	3.10 ± 0.46
45	F2-HP-2	1.00 ± 0.75	0.07 ± 0.08	0.32 ± 0.08	ND	2.74 ± 0.44
46	F2-HP-3	0.81 ± 0.85	0.13 ± 0.08	1.20 ± 0.11	0.29 ± 0.08	2.35 ± 0.42
47	F2-HP-4	1.18 ± 1.20	0.20 ± 0.11	10.35 ± 0.30	0.14 ± 0.10	2.97 ± 0.50
48	F2-HP-5	1.12 ± 1.22	0.06 ± 0.06	0.47 ± 0.09	0.08 ± 0.06	2.73 ± 0.38

Note:

ND = Not detected, <0.1 pCi/g Cs-137, <0.1 pCi/g Co-60, <3.0 pCi/g U-238, <0.3 pCi/g U-235

**TABLE 9: BUILDING 27 (EA-1 BUNKER) LAND AREA CONFIRMATORY SURVEY FINAL  
SOIL SAMPLE RESULTS**

#	Sample ID	Radionuclide Concentrations (pCi/g)				
		<i>Background Not Subtracted, 30 min. count (except as noted)</i>				
		U-238 (63keV, 93 keV used when 63 not present)	U-235 (144keV,186 keV used when 144 not present)	Cs-137 (662 keV)	Co-60 {(1170 keV+1330 keV)/2}	Total Thorium Th-228 (238 keV), plus Th-232 (911 keV)
pCi/g	pCi/g	pCi/g	pCi/g	pCi/g		
1	NSSA-1	1.15 ± 1.11	0.14 ± 0.08	0.08 ± 0.07	ND	3.07 ± 0.45
2	NSSA-2	1.01 ± 1.00	ND	0.50 ± 0.15	ND	4.28 ± 0.90
3	NSSA-3	1.27 ± 1.07	0.10 ± 0.08	0.23 ± 0.09	ND	3.37 ± 0.48
4	NSSA-4	1.23 ± 1.00	0.12 ± 0.07	0.10 ± 0.06	ND	3.39 ± 0.44
5	NSSA-5	1.52 ± 1.08	0.41 ± 0.44	0.60 ± 0.12	ND	3.25 ± 0.53
6	NSSA-6	1.89 ± 1.08	0.12 ± 0.07	ND	ND	2.84 ± 0.35
7	NSSA-7	1.64 ± 1.08	0.22 ± 0.08	ND	ND	3.07 ± 0.40
8	NSSA-8	1.61 ± 1.06	0.08 ± 0.08	0.13 ± 0.07	ND	3.62 ± 0.48
9	NSSA-9	1.41 ± 1.34	0.18 ± 0.09	ND	ND	3.78 ± 0.54
10	NSSA-10	1.60 ± 1.32	0.19 ± 0.11	0.82 ± 0.11	ND	3.19 ± 0.46
11	NSSA-11	0.70 ± 0.77	0.18 ± 0.08	0.59 ± 0.09	ND	2.95 ± 0.47
12	NSSA-12	1.56 ± 1.23	0.18 ± 0.09	1.25 ± 0.15	ND	2.86 ± 0.56
13	SSA-1	1.15 ± 1.15	0.16 ± 0.10	0.14 ± 0.07	ND	3.10 ± 0.52
14	SSA-2	1.24 ± 1.07	0.19 ± 0.11	ND	ND	3.48 ± 0.44
15	SSA-3	1.76 ± 0.89	0.27 ± 0.14	0.44 ± 0.12	ND	4.14 ± 0.53
16	SSA-4	2.14 ± 0.83	0.20 ± 0.10	0.30 ± 0.12	ND	3.83 ± 0.58
17	SSA-5	1.79 ± 1.50	0.23 ± 0.10	0.39 ± 0.08	ND	4.34 ± 0.48
18	SSA-6	2.05 ± 1.43	0.23 ± 0.10	0.34 ± 0.10	ND	4.76 ± 0.57
19	SSA-7	1.26 ± 1.13	0.23 ± 0.10	0.16 ± 0.07	ND	3.62 ± 0.42
20	SSA-8	1.49 ± 0.84	0.18 ± 0.09	0.91 ± 0.12	ND	3.06 ± 0.48
21	SSA-9	1.63 ± 1.08	0.21 ± 0.08	ND	ND	3.48 ± 0.46
22	SSA-10	1.93 ± 1.02	0.29 ± 0.09	ND	ND	3.47 ± 0.62



**TABLE 9: BUILDING 27 (EA-1 BUNKER) LAND AREA CONFIRMATORY SURVEY FINAL  
SOIL SAMPLE RESULTS**

#	Sample ID	Radionuclide Concentrations (pCi/g)				
		<i>Background Not Subtracted, 30 min. count (except as noted)</i>				
		U-238 (63keV, 93 keV used when 63 not present)	U-235 (144keV,186 keV used when 144 not present)	Cs-137 (662 keV)	Co-60 {(1170 keV+1330 keV)/2}	Total Thorium Th-228 (238 keV), plus Th-232 (911 keV)
pCi/g	pCi/g	pCi/g	pCi/g	pCi/g		
23	SSA-11	2.24 ± 0.90	0.16 ± 0.09	0.34 ± 0.11	ND	4.03 ± 0.56
24	SSA-12	1.95 ± 0.74	0.20 ± 0.08	0.25 ± 0.07	ND	2.52 ± 0.39
25	SSA-13	1.62 ± 0.77	0.23 ± 0.10	ND	ND	3.11 ± 0.13
26	SSA-14	1.26 ± 0.95	0.17 ± 0.09	ND	ND	3.13 ± 0.57
27	SSA-15	1.96 ± 1.47	0.13 ± 0.11	0.22 ± 0.09	ND	3.34 ± 0.60
28	SSA-16	2.61 ± 1.05	0.15 ± 0.10	0.25 ± 0.09	ND	3.07 ± 0.62
29	SSA-17	0.81 ± 0.34	0.22 ± 0.12	ND	ND	3.10 ± 0.12
30	SSA-18	1.31 ± 0.88	0.21 ± 0.13	0.20 ± 0.08	ND	3.22 ± 0.50
31	C-1	1.66 ± 1.23	0.41 ± 0.30	0.08 ± 0.08	ND	2.77 ± 0.46
32	C-2	2.47 ± 1.24	0.29 ± 0.09	0.09 ± 0.09	ND	3.21 ± 0.50
33	C-3	1.55 ± 0.98	0.29 ± 0.08	0.24 ± 0.09	ND	3.19 ± 0.11
34	C-4	1.94 ± 1.04	0.14 ± 0.08	ND	ND	3.08 ± 0.46
35	C-5	1.59 ± 0.66	0.18 ± 0.09	ND	ND	2.63 ± 0.40
36	C-6	1.74 ± 0.63	0.23 ± 0.13	0.15 ± 0.07	ND	2.99 ± 0.44
37	C-7	1.11 ± 1.10	0.18 ± 0.10	0.23 ± 0.10	0.24 ± 0.10	2.82 ± 0.47
38	C-8	1.59 ± 0.67	0.15 ± 0.08	0.40 ± 0.08	ND	3.15 ± 0.44
39	C-9	1.98 ± 1.16	0.17 ± 0.10	1.26 ± 0.14	0.15 ± 0.07	2.94 ± 0.55
40	C-10	1.19 ± 1.00	ND	1.74 ± 0.14	0.54 ± 0.11	2.94 ± 0.49
41	C-11	1.20 ± 0.94	0.13 ± 0.07	1.24 ± 0.12	0.10 ± 0.07	2.32 ± 0.48
42	C-12	1.12 ± 0.89	0.16 ± 0.09	0.11 ± 0.08	ND	2.47 ± 0.41
43	C-13	1.31 ± 1.08	0.14 ± 0.08	0.12 ± 0.07	ND	2.41 ± 0.91
44	Post Decon-1	1.52 ± 0.66	0.16 ± 0.09	0.29 ± 0.09	ND	2.36 ± 0.37

**TABLE 9: BUILDING 27 (EA-1 BUNKER) LAND AREA CONFIRMATORY SURVEY FINAL  
SOIL SAMPLE RESULTS**

#	Sample ID	Radionuclide Concentrations (pCi/g)				
		<i>Background Not Subtracted, 30 min. count (except as noted)</i>				
		U-238 (63keV, 93 keV used when 63 not present)	U-235 (144keV,186 keV used when 144 not present)	Cs-137 (662 keV)	Co-60 {(1170 keV+1330 keV) /2}	Total Thorium <b>Th-228</b> (238 keV), plus <b>Th-232</b> (911 keV)
pCi/g	pCi/g	pCi/g	pCi/g	pCi/g		
45	Post Decon-2	1.50 ± 0.55	0.17 ± 0.09	0.35 ± 0.07	ND	2.36 ± 0.40
46	Post Decon-3	1.42 ± 0.67	0.14 ± 0.09	0.51 ± 0.08	0.56 ± 0.13	2.76 ± 0.42
47	Post Decon-4	1.23 ± 0.56	0.12 ± 0.09	0.39 ± 0.10	0.05 ± 0.05	2.79 ± 0.40
48	Post Decon-5	1.92 ± 1.23	0.15 ± 0.08	0.35 ± 0.10	0.06 ± 0.07	2.73 ± 0.37

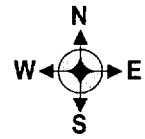
Note:

ND = Not detected, <0.1 pCi/g Cs-137, <0.1 pCi/g Co-60, <3.0 pCi/g U-238, <0.3 pCi/g U-235

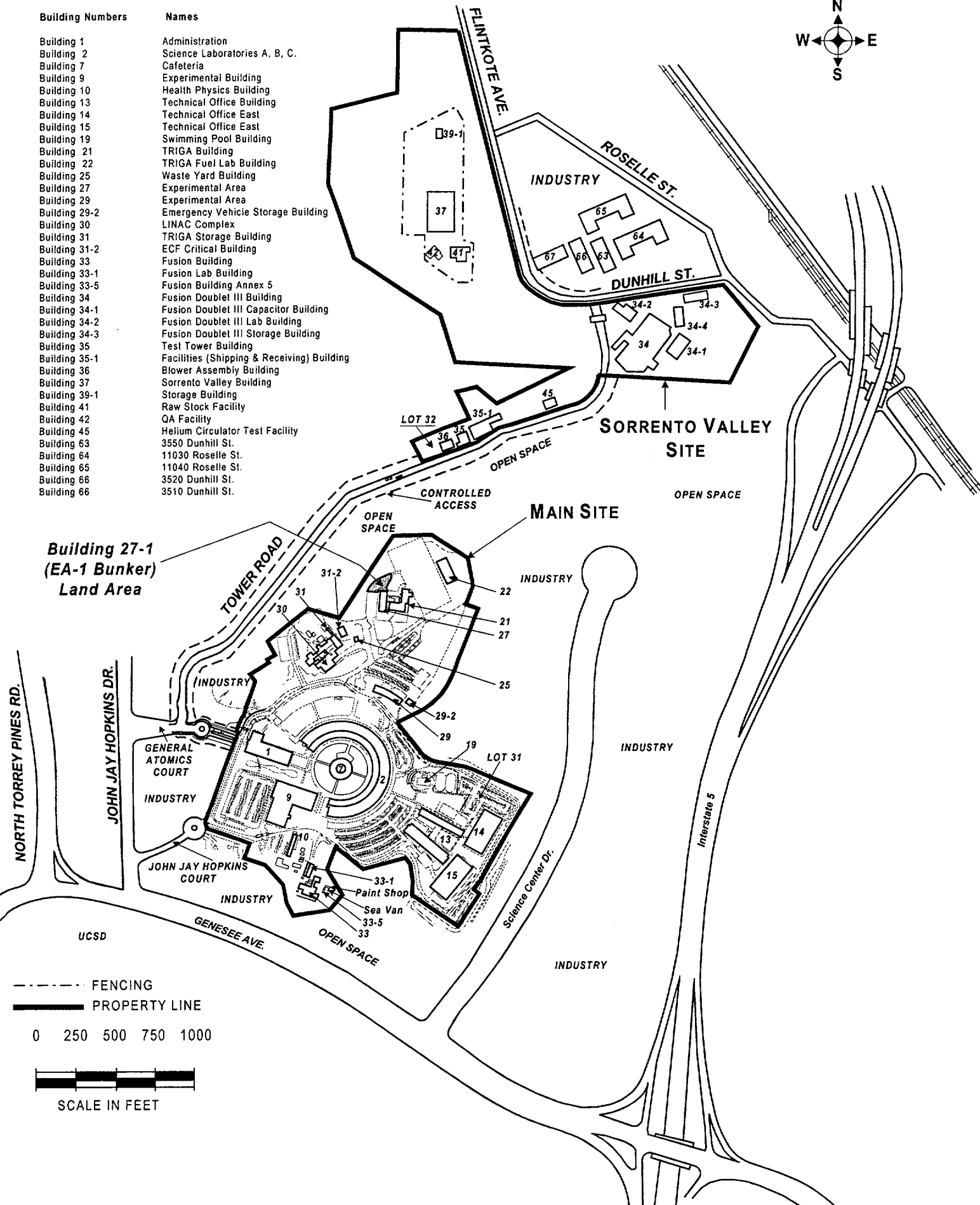
# FIGURES

Figure 1A: Main Site and Sorrento Valley Site

April 2002



Building Numbers	Names
Building 1	Administration
Building 2	Science Laboratories A, B, C.
Building 7	Cafeteria
Building 9	Experimental Building
Building 10	Health Physics Building
Building 13	Technical Office Building
Building 14	Technical Office East
Building 15	Technical Office East
Building 19	Swimming Pool Building
Building 21	TRIGA Building
Building 22	TRIGA Fuel Lab Building
Building 25	Waste Yard Building
Building 27	Experimental Area
Building 29	Experimental Area
Building 29-2	Emergency Vehicle Storage Building
Building 30	LINAC Complex
Building 31	TRIGA Storage Building
Building 31-2	ECF Critical Building
Building 33	Fusion Building
Building 33-1	Fusion Lab Building
Building 33-5	Fusion Building Annex 5
Building 34	Fusion Doublet III Building
Building 34-1	Fusion Doublet III Capacitor Building
Building 34-2	Fusion Doublet III Lab Building
Building 34-3	Fusion Doublet III Storage Building
Building 35	Test Tower Building
Building 35-1	Facilities (Shipping & Receiving) Building
Building 36	Blower Assembly Building
Building 37	Sorrento Valley Building
Building 39-1	Storage Building
Building 41	Raw Stock Facility
Building 42	QA Facility
Building 45	Helium Circulator Test Facility
Building 63	3550 Dunhill St.
Building 64	11030 Roselle St.
Building 65	11040 Roselle St.
Building 66	3520 Dunhill St.
Building 66	3510 Dunhill St.



**Building 27-1  
(EA-1 Bunker)  
Land Area**

**MAIN SITE**

**SORRENTO VALLEY SITE**

NORTH TORREY PINES RD.

JOHN JAY HOPKINS DR.

UCSD

GENERAL ATOMICS COURT

JOHN JAY HOPKINS COURT

TOWER ROAD

INDUSTRY

INDUSTRY

INDUSTRY

GENESEE AVE.

Science Center Dr.

INDUSTRY

INDUSTRY

INDUSTRY

Interstate 5

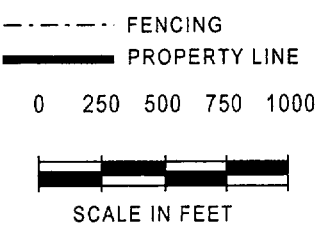


Figure 1B: Building 27-1 (EA-1 Bunker) Site in Relationship to Surrounding Area

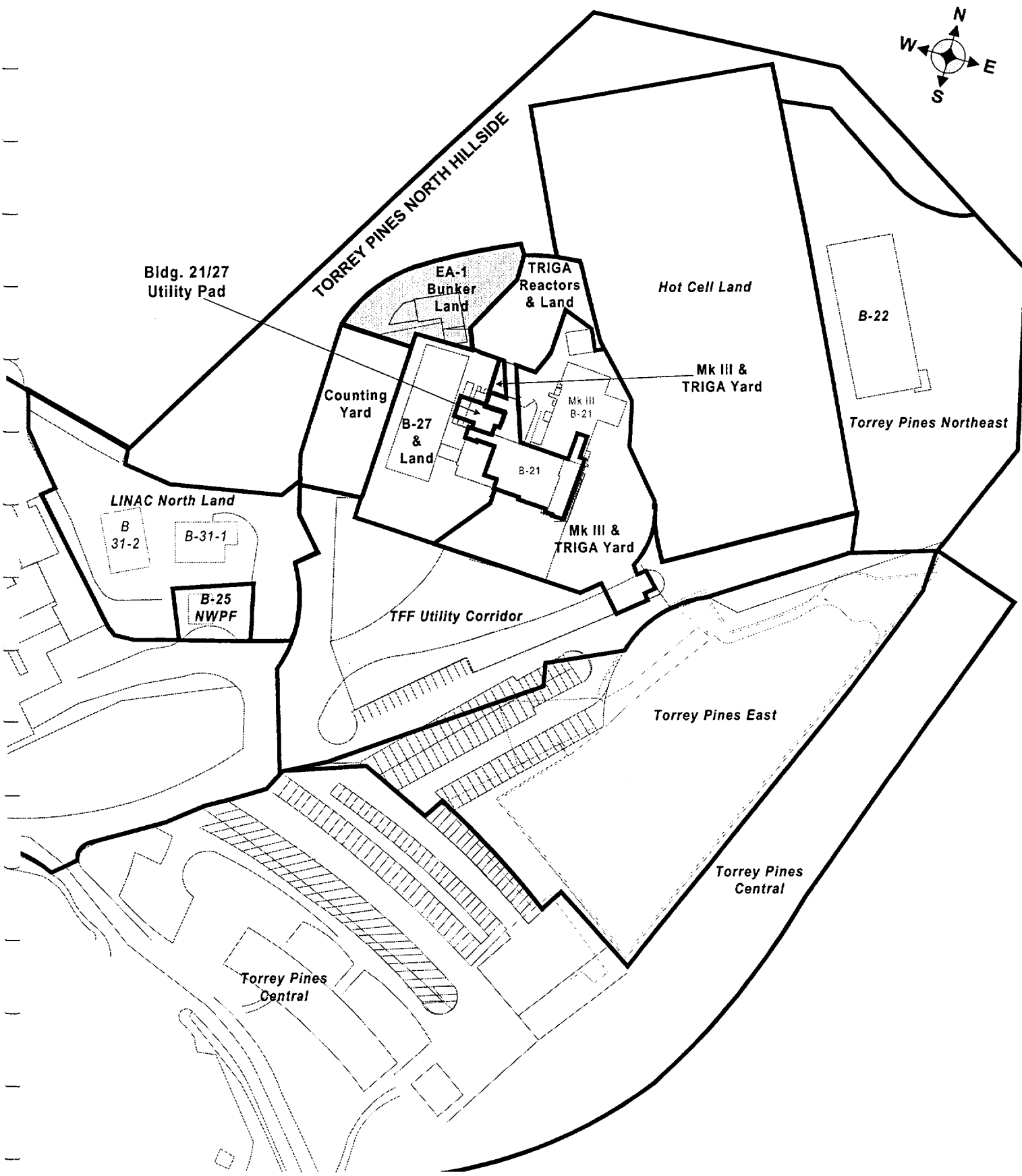


Figure 1C: Building 27-1 (EA-1 Bunker) Site Boundary Area

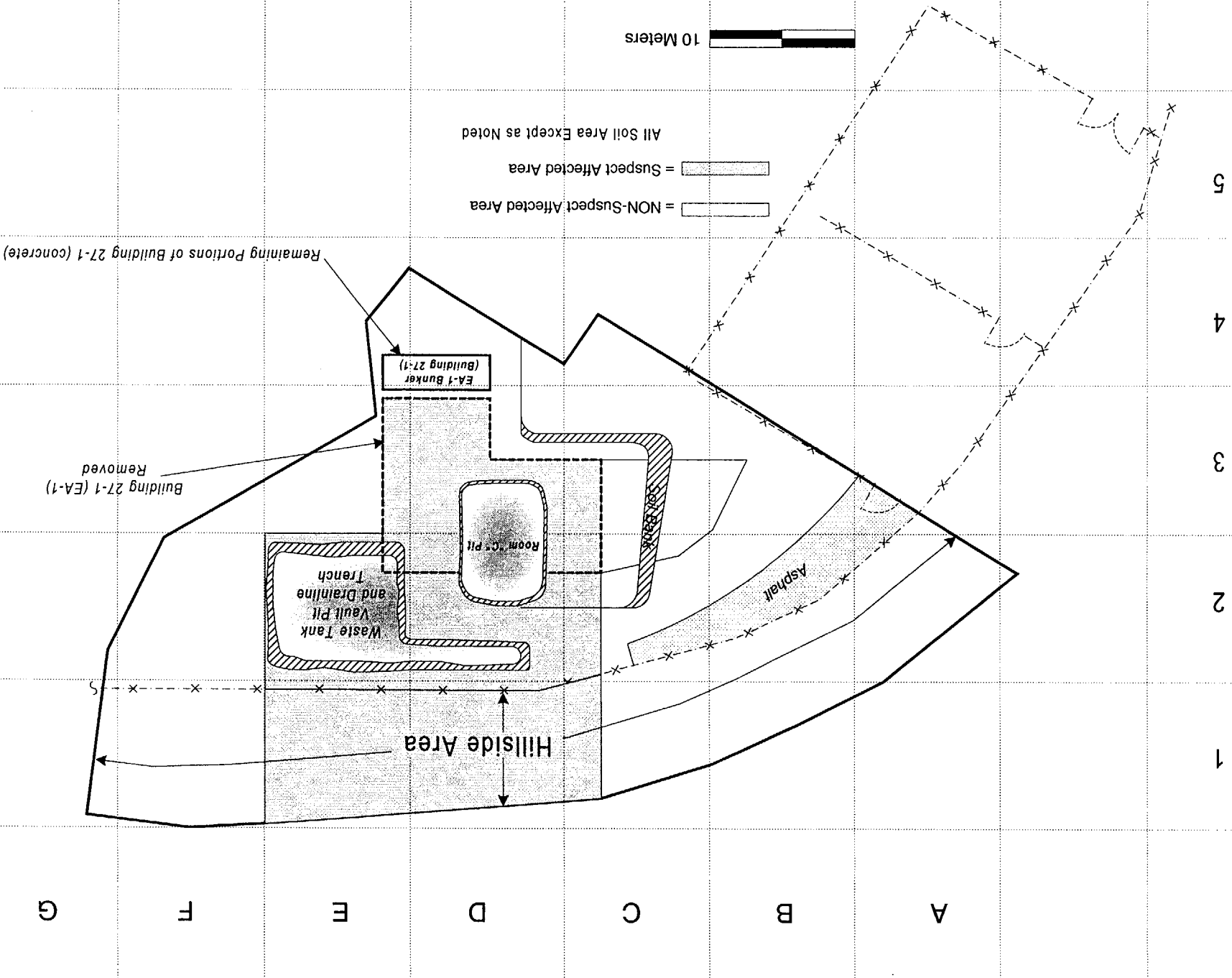
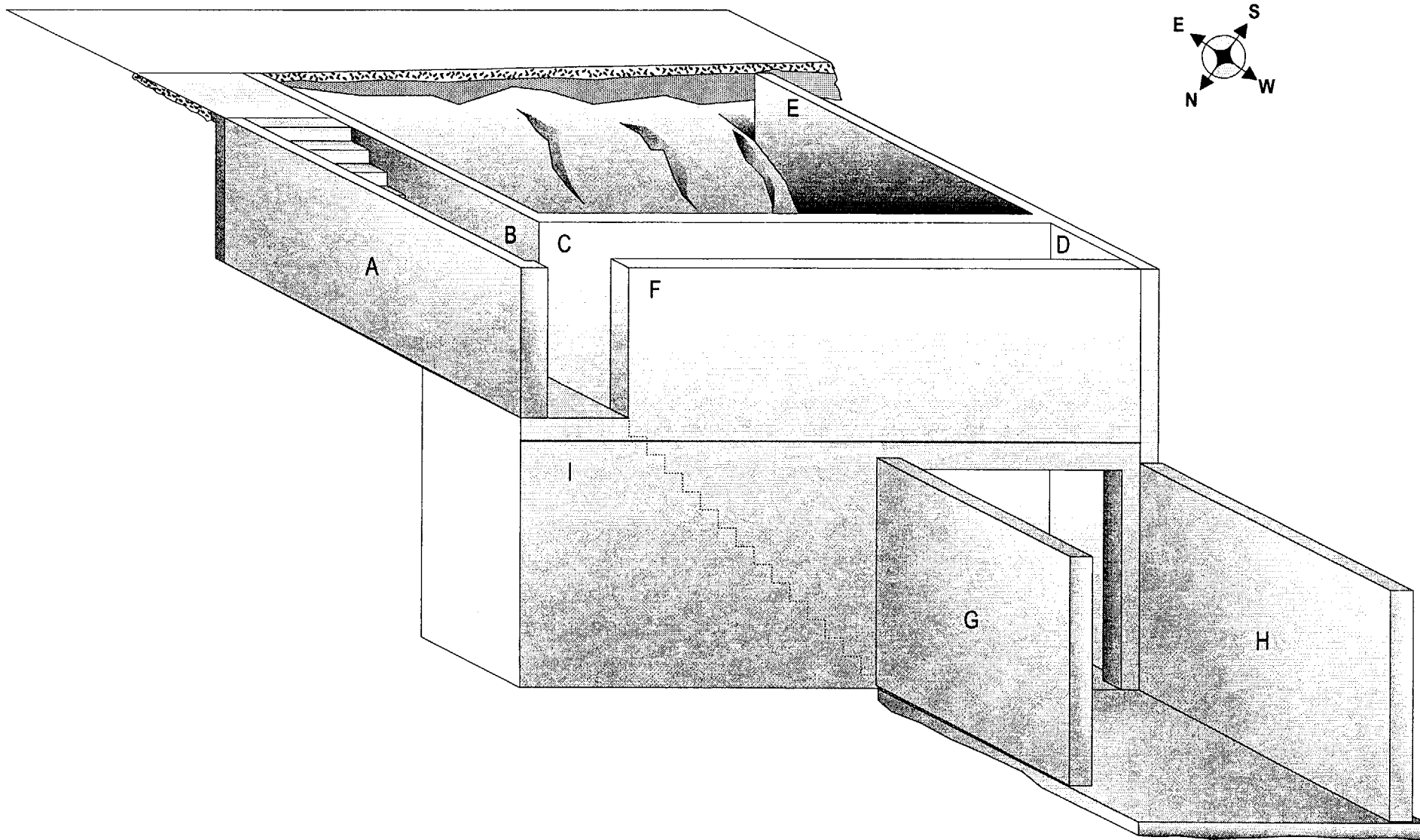


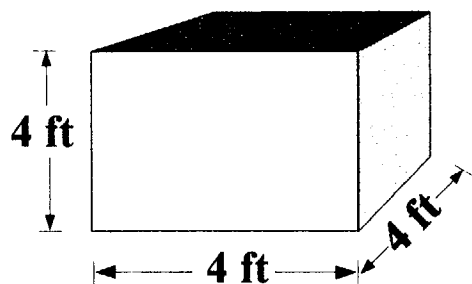
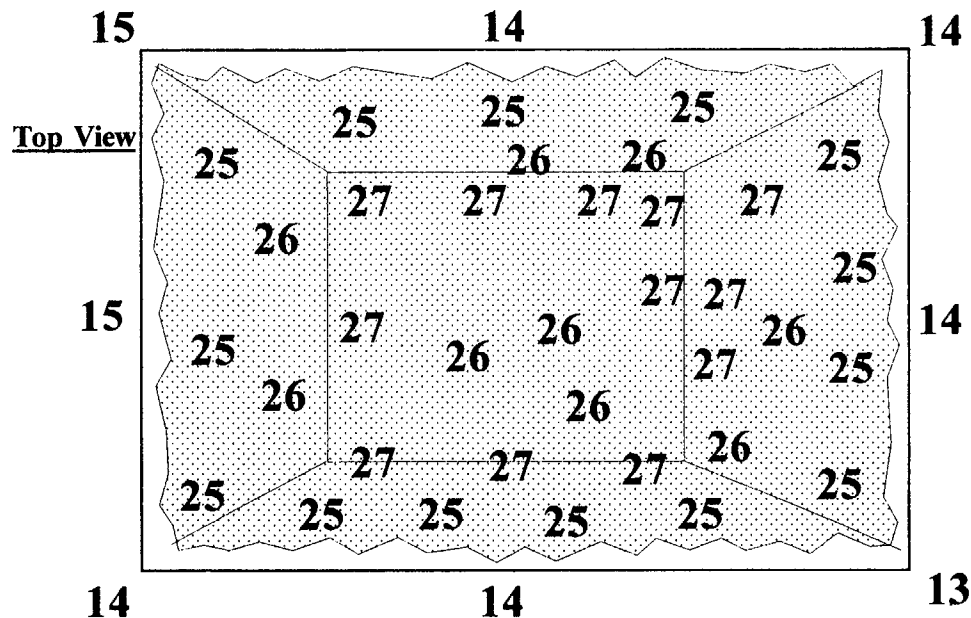
Figure 2: Remaining Portions of Building 27-1



### Figure 3: Background Pit Results

LUDLUM MODEL 3 with 2"x 2" NaI (TI) Detector ( $\mu\text{R/hr}$ )

BACKGROUND PIT

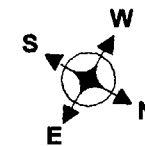


All readings recorded in  $\mu\text{R/hr}$  (on surface of soil)  
 \*4ft deep pit dug in clay-type soil in Torrey Pines  
 West land area.

### Pipe Backgrounds

LUDLUM MODEL-3 with 2"x 2"  
 NaI (TI) Detector ( $\mu\text{R/hr}$ )

Pipe Diameter 6 inches

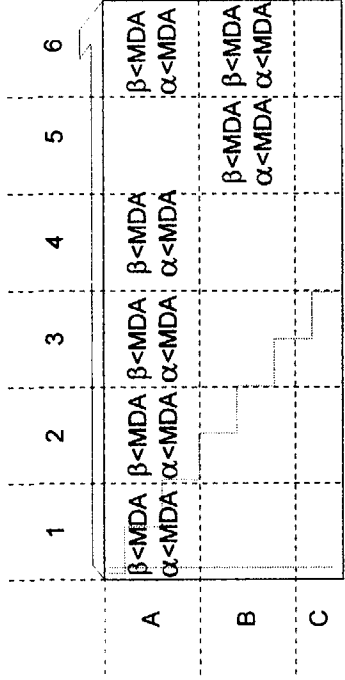


	Steel	PVC	Aluminum	
Ground	8	12	13	1'6"
	10	13	13	
1'	19	22	24	6'
2'	21	28	27	
3'	24	29	29	
4'	24	31	30	
5'	23	29	30	
6'	22	29	29	

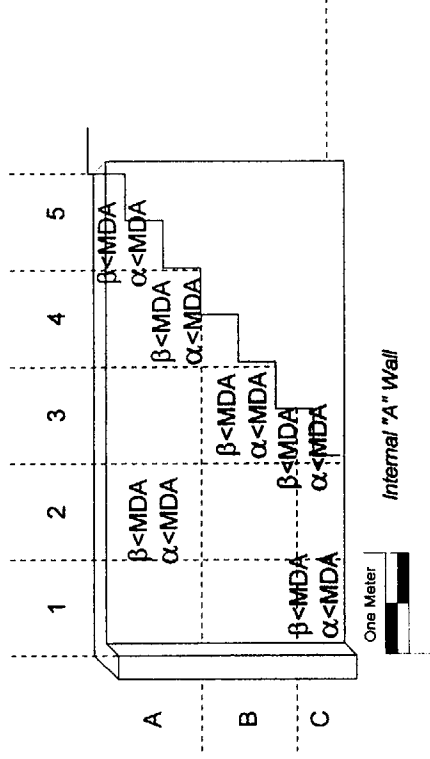
Location	Background Pit Survey			
Instrument(s)	Model-3	N/A	N/A	N/A
Serial Number	147819	N/A	N/A	N/A
Calibration Due	08/09/2000	N/A	N/A	N/A
Efficiency	N/A	N/A	N/A	N/A
$\alpha$ $\beta$ $\gamma$	$\gamma$	N/A	N/A	N/A
Probe Number	153765	N/A	N/A	N/A
Probe Size	44-10	N/A	N/A	N/A
Comments: All readings recorded in Micro-R per hr				
Signature: <u>C. Stanley B. Hunter</u> Date: <u>02/18/2000 - 02/25/2000</u>				



Figure 4: EA-1 Bunker Internal and External Retaining Wall A Alpha and Beta Fixed Measurement Locations and Results.



External "A" Wall



$\beta = 2$  Minute Fixed Beta Results in dpm/100cm<sup>2</sup>

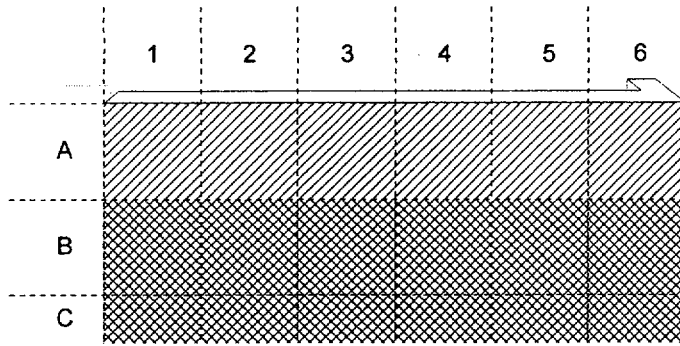
$\alpha =$  Fixed Alpha Results in dpm/100cm<sup>2</sup>

$\beta$  MDA = 207 dpm/100cm<sup>2</sup>

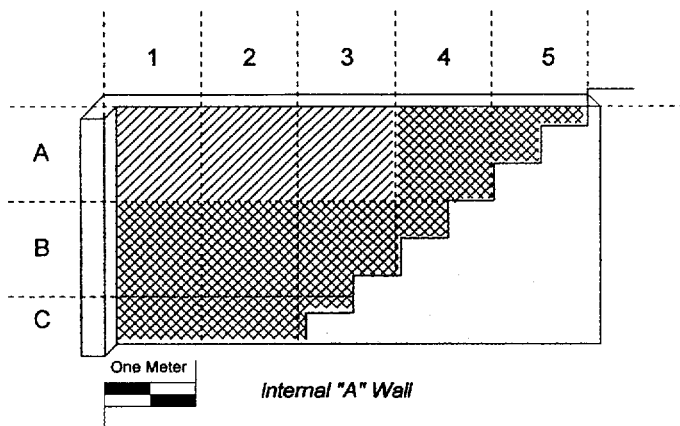
$\alpha$  MDA = 244 dpm/100cm<sup>2</sup>

Instrument		
Model	Ludlum 2221	Ludlum M-12
Serial #	148436	138738
Cal Due Date	04/29/02	01/10/02

Figure 5: EA-1 Bunker Internal and External Retaining Wall A  
Alpha and Beta Scan Locations and Results



External "A" Wall







Internal "A" Wall

Survey Results= All Readings  $\leq$  Background

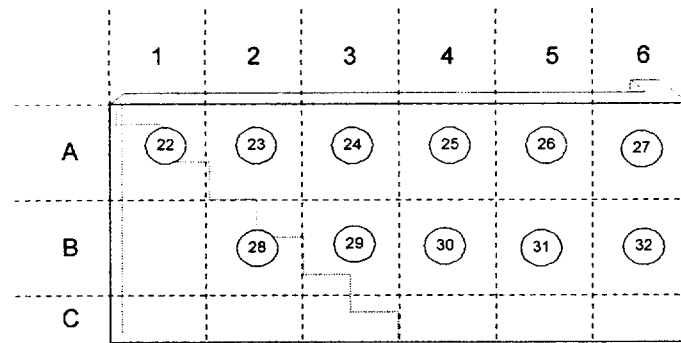
Beta background = 100-140 cpm

Alpha background = 0-20 cpm

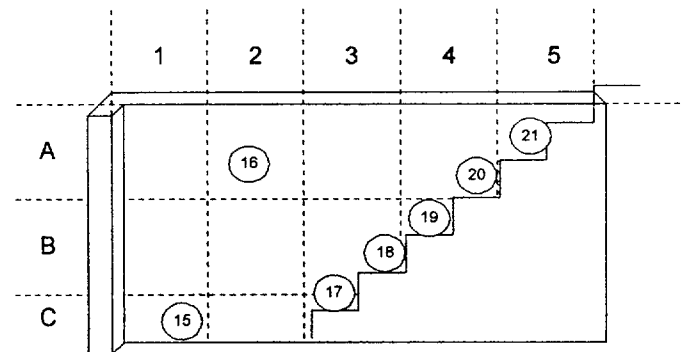
-  = Denotes 10% Beta 15cm<sup>2</sup> Direct Scan
-  = Denotes 10% Alpha 50cm<sup>2</sup> Direct Scan
-  = Denotes 100% Beta 15cm<sup>2</sup> Direct Scan
-  = Denotes 10% Alpha 50cm<sup>2</sup> Direct Scan

Instrument		
Model	Ludlum M-3	Ludlum M-12
Serial #	138880	138738
Cal Due Date	08/09/01	08/31/01

Figure 6: EA-1 Bunker Internal and External Retaining Wall A  
 Wipe Sample Locations  
 (See Table 5 for results)



External "A" Wall



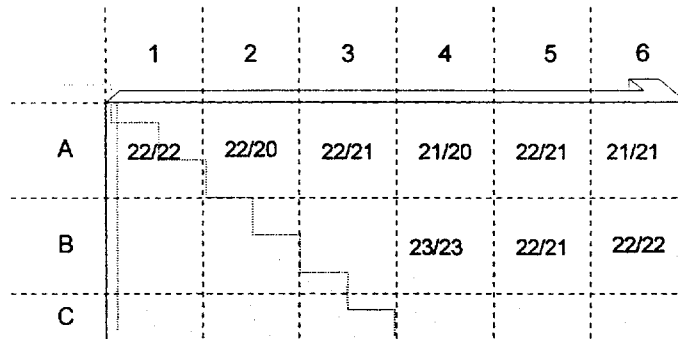
Internal "A" Wall



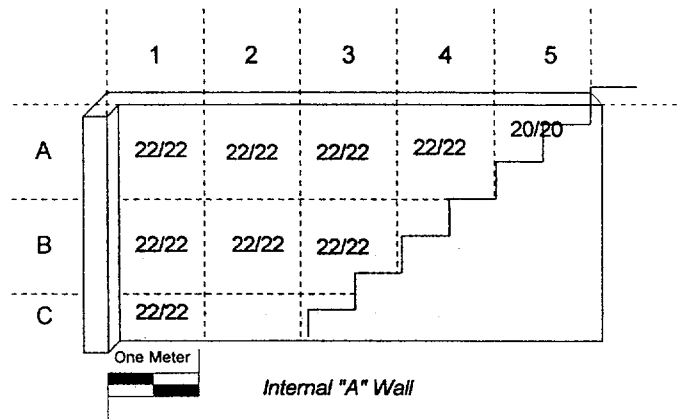
# Wipe Location

Technicians: Barbara Lyons and Will Schuck 06/04/01

Figure 7: EA-1 Bunker Internal and External Retaining Wall A Contact and 1 Meter Exposure Rate Locations and Results



External "A" Wall



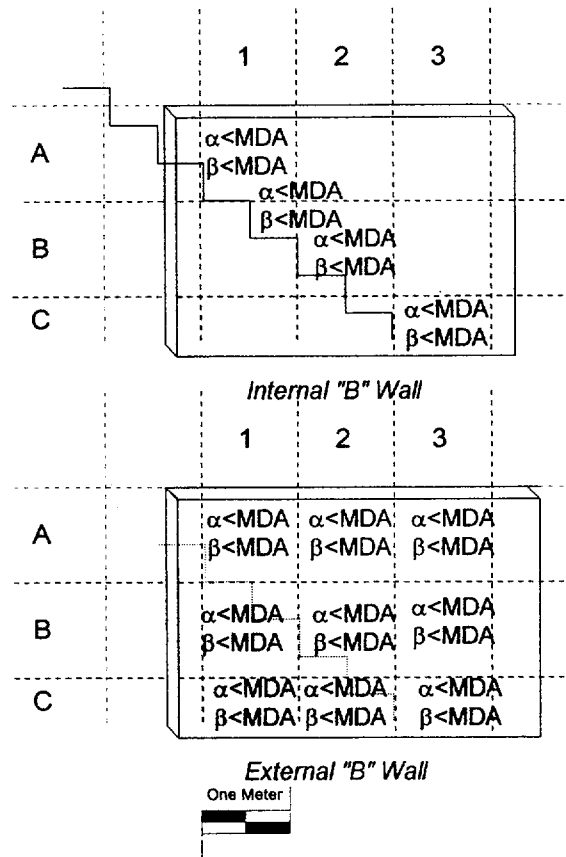
Internal "A" Wall

## Denotes Contact and 1 Meter readings in  $\mu\text{R/hr}$

Instrument		
Model	Ludlum M-3	N/A
Serial #	153590	N/A
Cal Due Date	09/07/01	N/A

Technicians: Barbara Lyons and Will Schuck 6/14/01

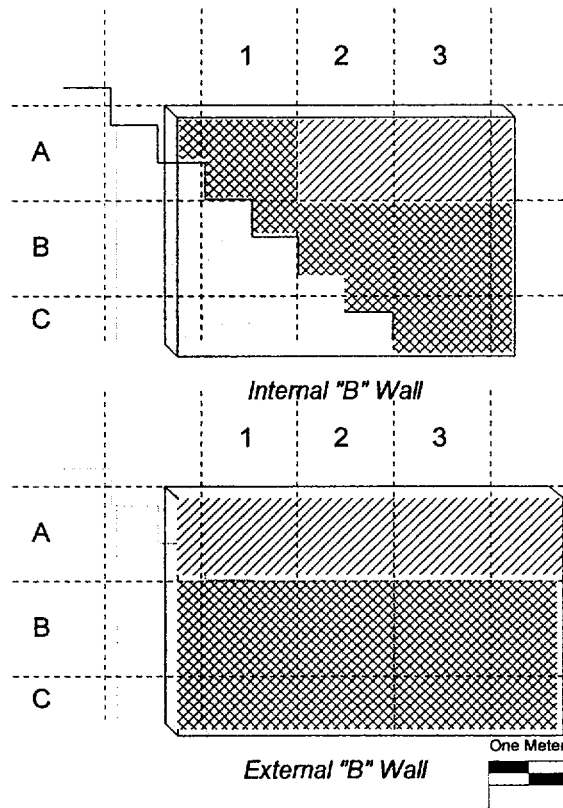
Figure 8 : EA-1 Bunker Internal and External Retaining Wall B  
Alpha and Beta Fixed Measurement Locations and Results.



β = 2 minute Fixed Beta Results in dpm/100cm<sup>2</sup>  
 α = Fixed Alpha Results in dpm/100cm<sup>2</sup>  
 β MDA = 207 dpm/100cm<sup>2</sup>  
 α MDA = 244 dpm/100cm<sup>2</sup>

Instrument		
Model	Ludlum 2221	Ludlum M-12
Serial #	148436	138738
Cal Due Date	04/29/02	01/10/02



Figure 9: EA-1 Bunker Internal and External Retaining Wall B  
Alpha and Beta Scan Locations and Results



Survey Results= All Readings  $\leq$  Background

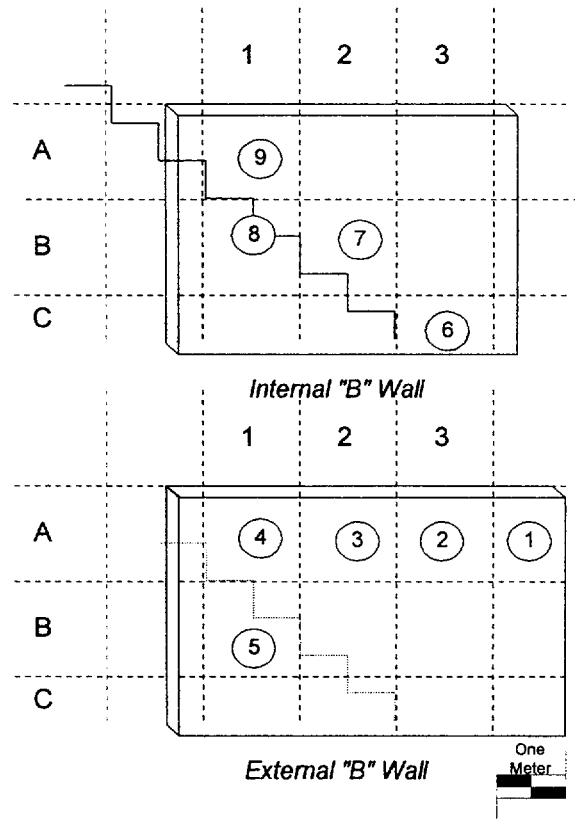
15cm<sup>2</sup> Beta background = 100-140 cpm

50cm<sup>2</sup> Alpha background = 0-20 cpm

-  = Denotes 10% Beta 15cm<sup>2</sup> Direct Scan  
Denotes 10% Alpha 50cm<sup>2</sup> Direct Scan
-  = Denotes 100% Beta 15cm<sup>2</sup> Direct Scan  
Denotes 10% Alpha 50cm<sup>2</sup> Direct Scan

Instrument		
Model	Ludlum M-3	Ludlum M-12
Serial #	138880	138738
Cal Due Date	08/09/01	08/31/01

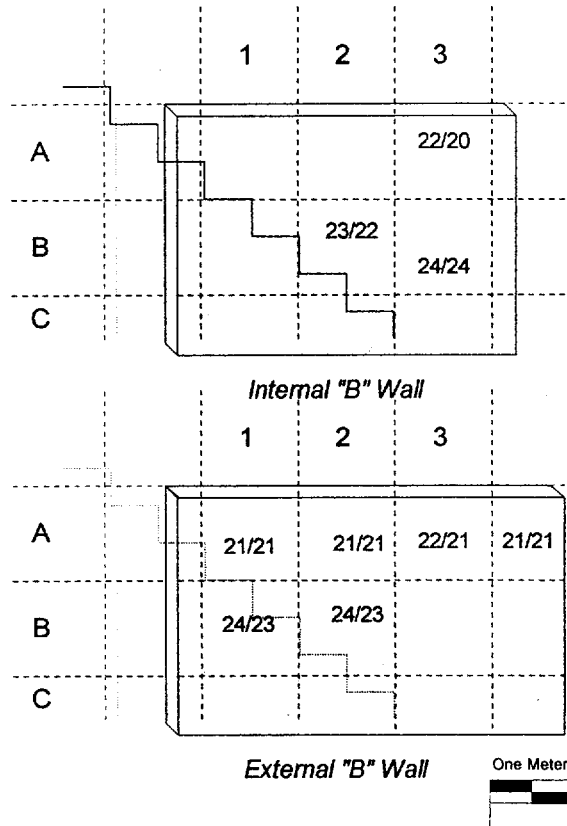
Figure 10: EA-1 Bunker Internal and External Retaining Wall B  
 Wipe Sample Locations  
 (See Table 5 for results)



Ⓝ Denotes Wipe Location

Technicians: Barbara Lyons and Will Schuck 06/19/01

Figure 11: EA-1 Bunker Internal and External Retaining Wall B Contact and 1 Meter Exposure Rate Locations and Results



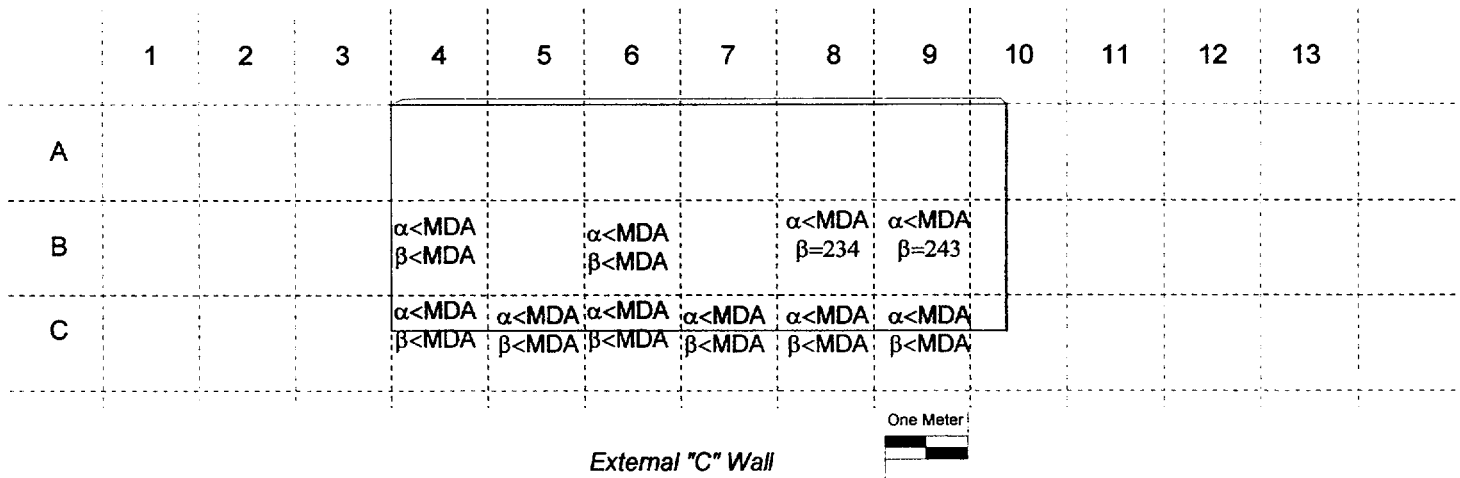
## Denotes Contact and 1 Meter Readings in  $\mu\text{R/hr}$

Instrument		
Model	Ludlum M-3	N/A
Serial #	147819	N/A
Cal Due Date	09/04/01	N/A

Technicians: Barbara Lyons and Will Schuck 06/15/01



Figure 12: EA-1 Bunker External Retaining Wall C  
Alpha and Beta Fixed Measurement Locations and Results

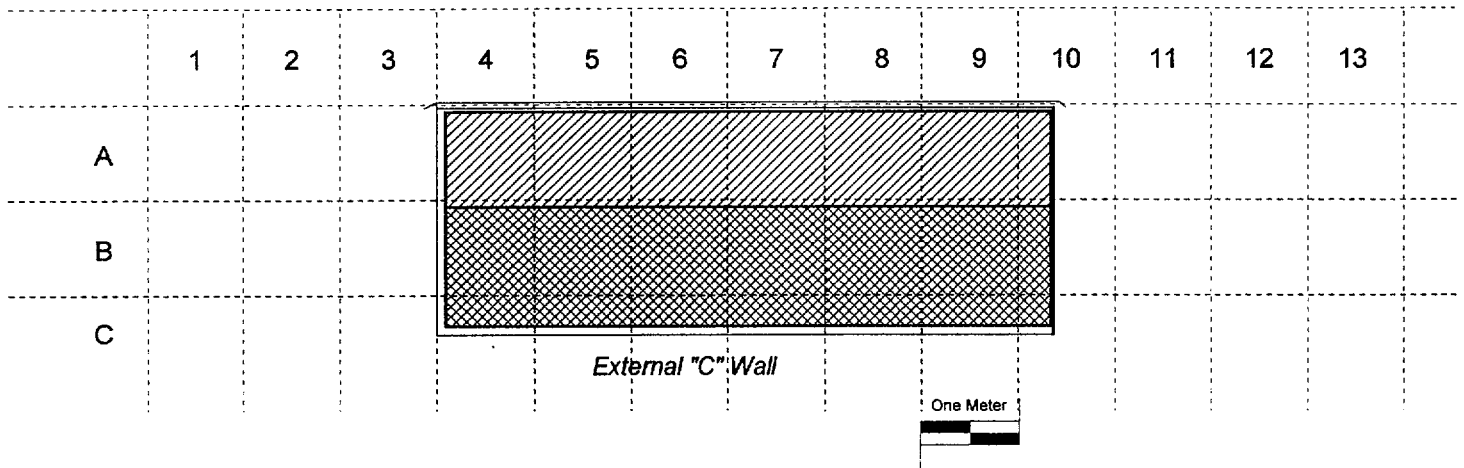


$\beta$  = 2 Minute Fixed Beta results in dpm/100cm<sup>2</sup>  
 $\alpha$  = Alpha Fixed results in dpm/100cm<sup>2</sup>  
 $\beta$  MDA = 207dpm/100cm<sup>2</sup>  
 $\alpha$  MDA = 244 dpm/100cm<sup>2</sup>

Instrument		
Model	Ludlum 2221	Ludlum M-12
Serial #	148436	138738
Cal Due Date	04/29/02	01/10/02

Technicians: Barbara and Joe Sullivan 12/08/01



Figure 13: EA-1 Bunker External Retaining Wall C  
Alpha and Beta Scan Locations and Results



Survey Results= All Readings  $\leq$  Background

15cm<sup>2</sup> Beta background = 100-140 cpm

50cm<sup>2</sup> Alpha background = 0-20 cpm

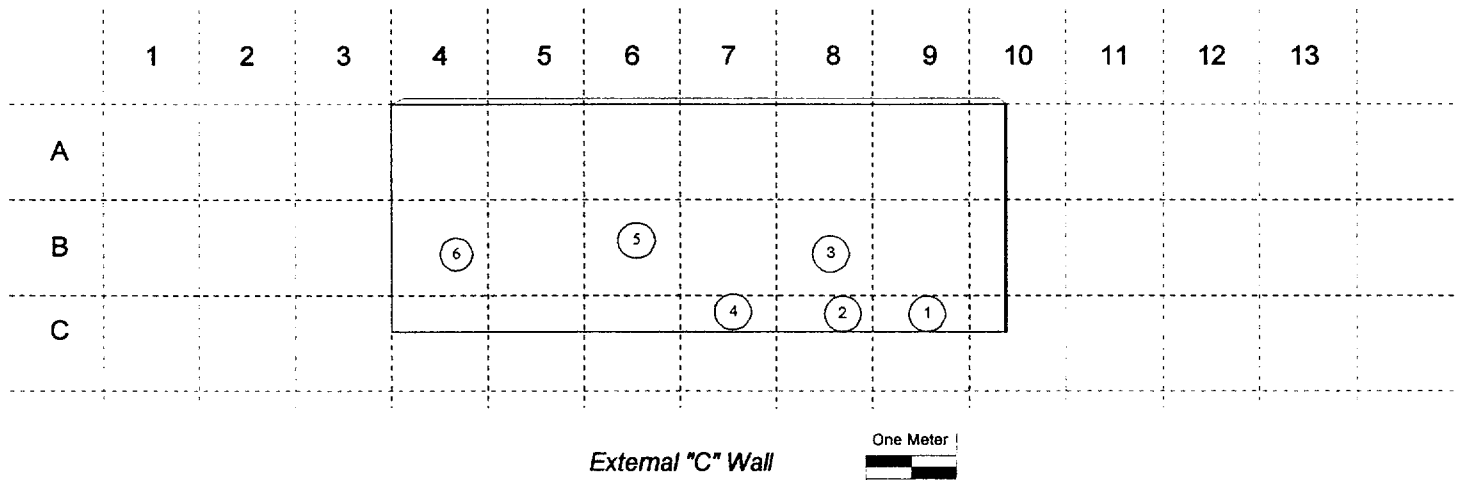
-  = Denotes 10% Beta 15cm<sup>2</sup> Direct Scan  
Denotes 10% Alpha 50cm<sup>2</sup> Direct Scan
-  = Denotes 100% Beta 15cm<sup>2</sup> Direct Scan  
Denotes 10% Alpha 50cm<sup>2</sup> Direct Scan

Instrument		
Model	Ludlum M-3	Ludlum M-12
Serial #	138880	138738
Cal. Due Date	08/09/01	08/31/01

Technicians: Barbara Lyons and Will Schuck 07/02/01

Figure 14: EA-1 Bunker External Retaining Wall C Wipe Sample Locations

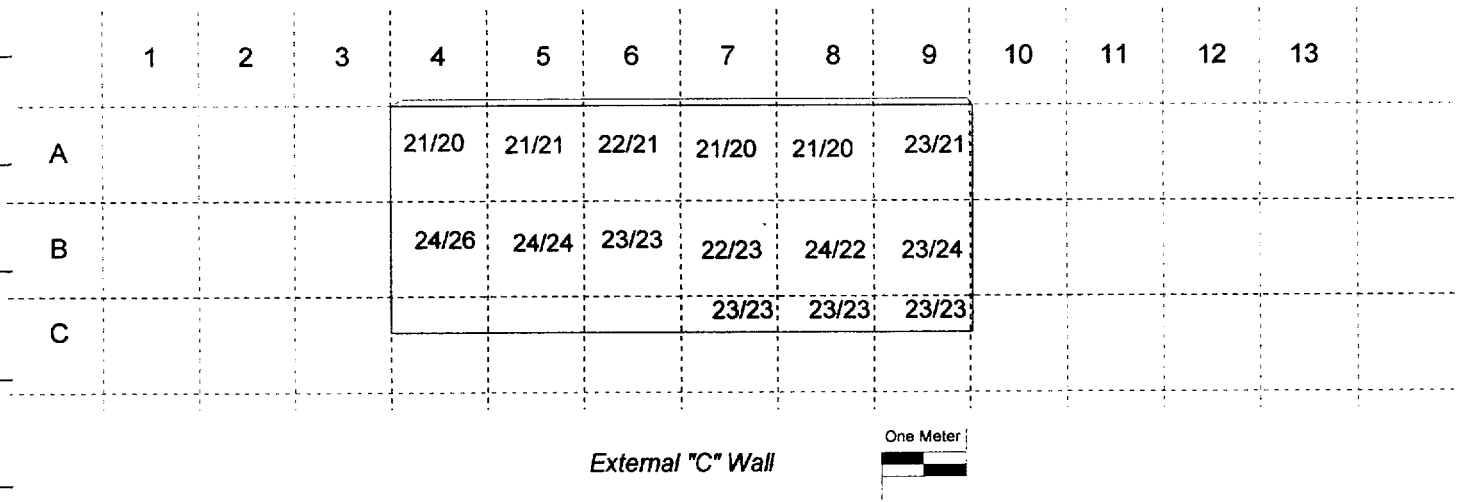
(See Table 5 for results)



⊕ Wipe Location

Technicians: Barbara Lyons and Will Schuck 06/12/01

Figure 15: EA-1 Bunker External Retaining Wall C  
 Contact and 1 Meter Expose Rate Locations and Results

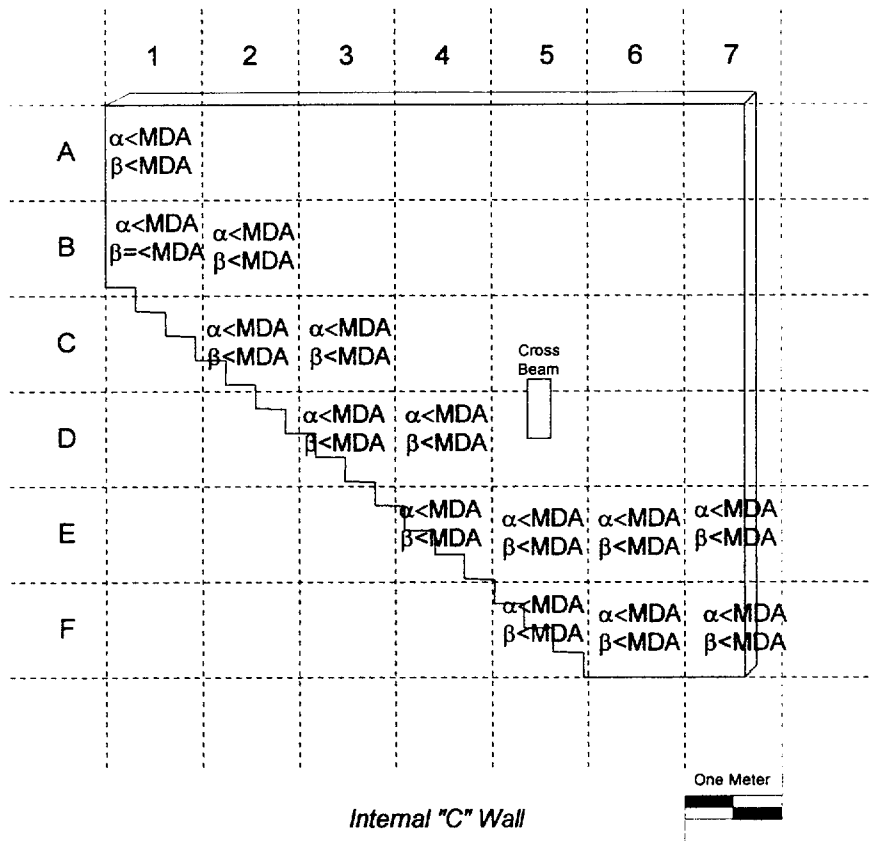


## denotes readings at contact and 1 meter readings in  $\mu\text{R/hr}$

Instrument		
Model	Ludlum M-3	N/A
Serial #	147819	N/A
Cal Due Date	09/04/01	N/A

Technicians: Barbara Lyons and Will Schuck 06/11/01

Figure 16: EA-1 Bunker Internal Retaining Wall C  
Alpha and Beta Fixed Measurement Locations and Results.



$\beta$  = 2 Minute Fixed Beta Results in dpm/100cm<sup>2</sup>

$\alpha$  = Fixed Alpha Results in dpm/100cm<sup>2</sup>

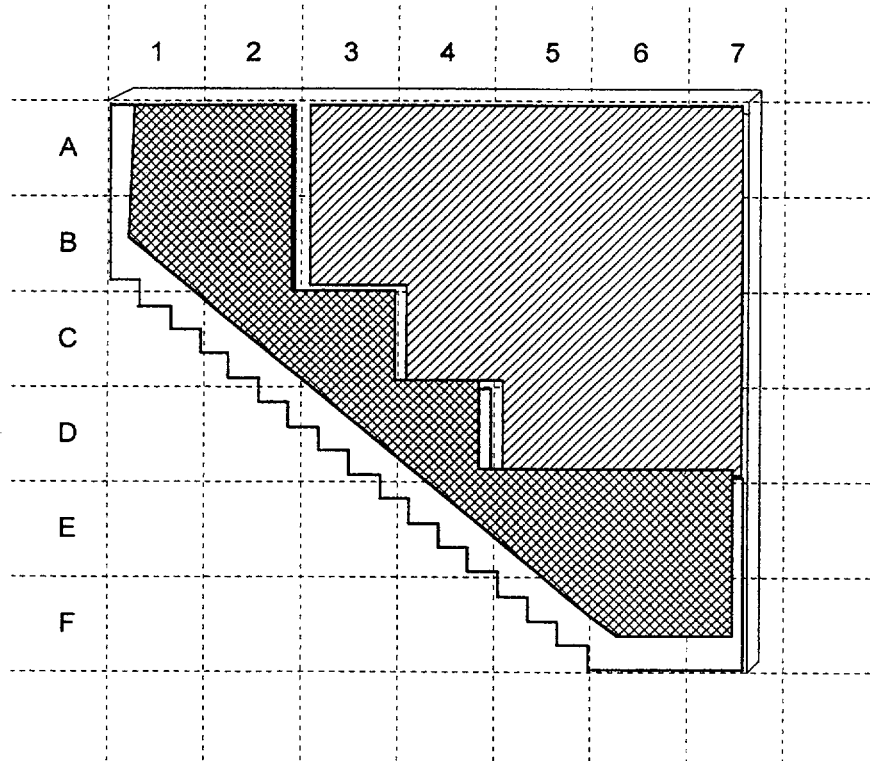
$\beta$  MDA = 207 dpm/100cm<sup>2</sup>

$\alpha$  MDA = 244 dpm/100cm<sup>2</sup>

Instrument		
Model	Ludlum 2221	Ludlum M-12
Serial #	148436	138738
Cal Due Date	04/29/02	01/10/02

Technicians: Barbara Lyons and Will Schuck 12/07/01

Figure 17: EA-1 Bunker Internal Retaining Wall C  
Alpha and Beta Scan Locations and Results





Internal "C" Wall

Survey Results= All Readings  $\leq$  Background

15cm<sup>2</sup> Beta background = 100-140 cpm

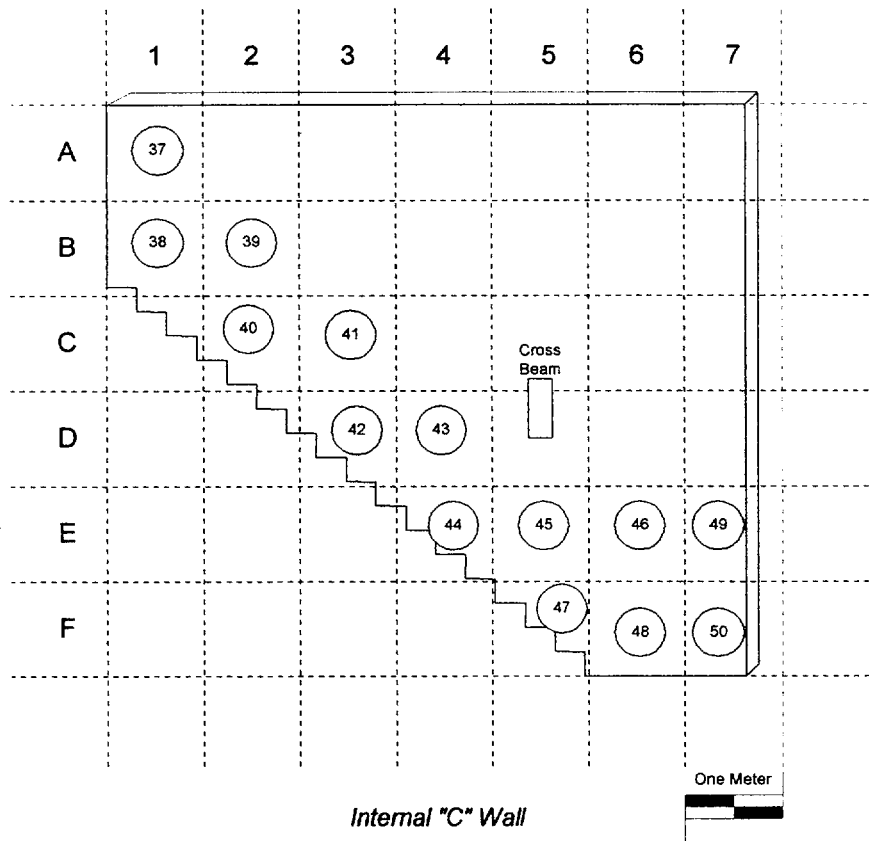
50cm<sup>2</sup> Alpha background = 0-20 cpm

-  = Denotes 10% Beta 15cm<sup>2</sup> Direct Scan  
Denotes 10% Alpha 50cm<sup>2</sup> Direct Scan
-  = Denotes 100% Beta 15cm<sup>2</sup> Direct Scan  
Denotes 10% Alpha 50cm<sup>2</sup> Direct Scan

Instrument		
Model	Ludlum M-3	Ludlum M-12
Serial #	138880	138738
Cal Due Date	08/09/01	08/31/01

Technicians: Barbara Lyons and Will Schuck 06/27/01

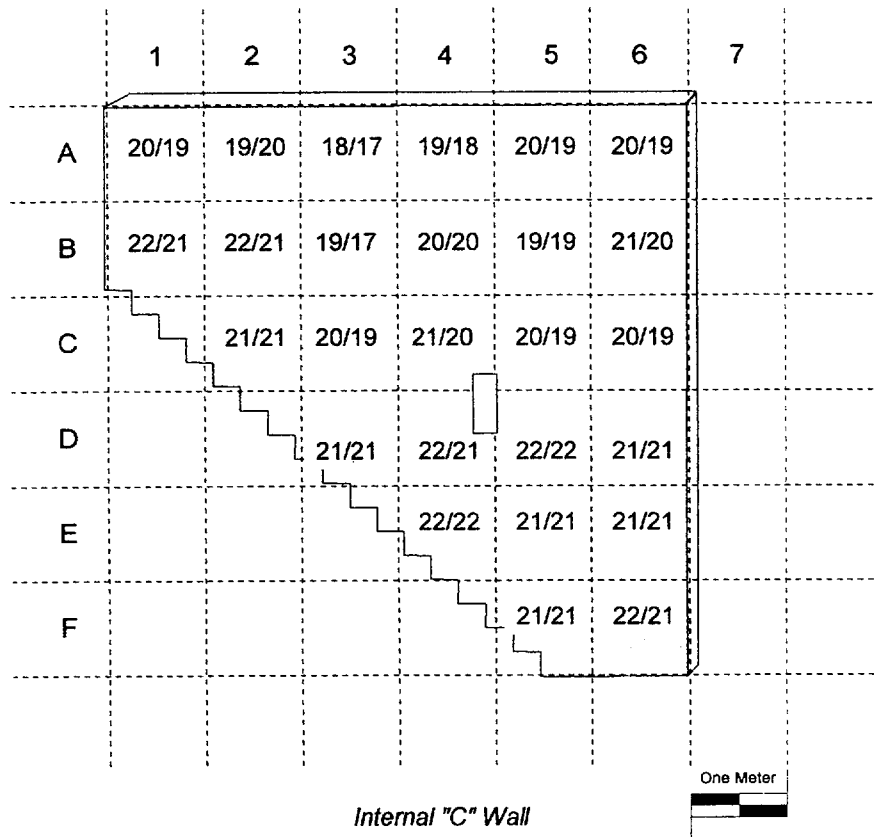
Figure 18: EA-1 Bunker Internal Retaining Wall C  
 Wipe Sample Locations.  
 (See Table 5 for results)



# Wipe Location

Technicians: Barbara Lyons and Will Schuck 06/04/01

Figure 19: EA-1 Bunker Internal Retaining Wall C Contact and 1 Meter Exposure Rate Locations and Results



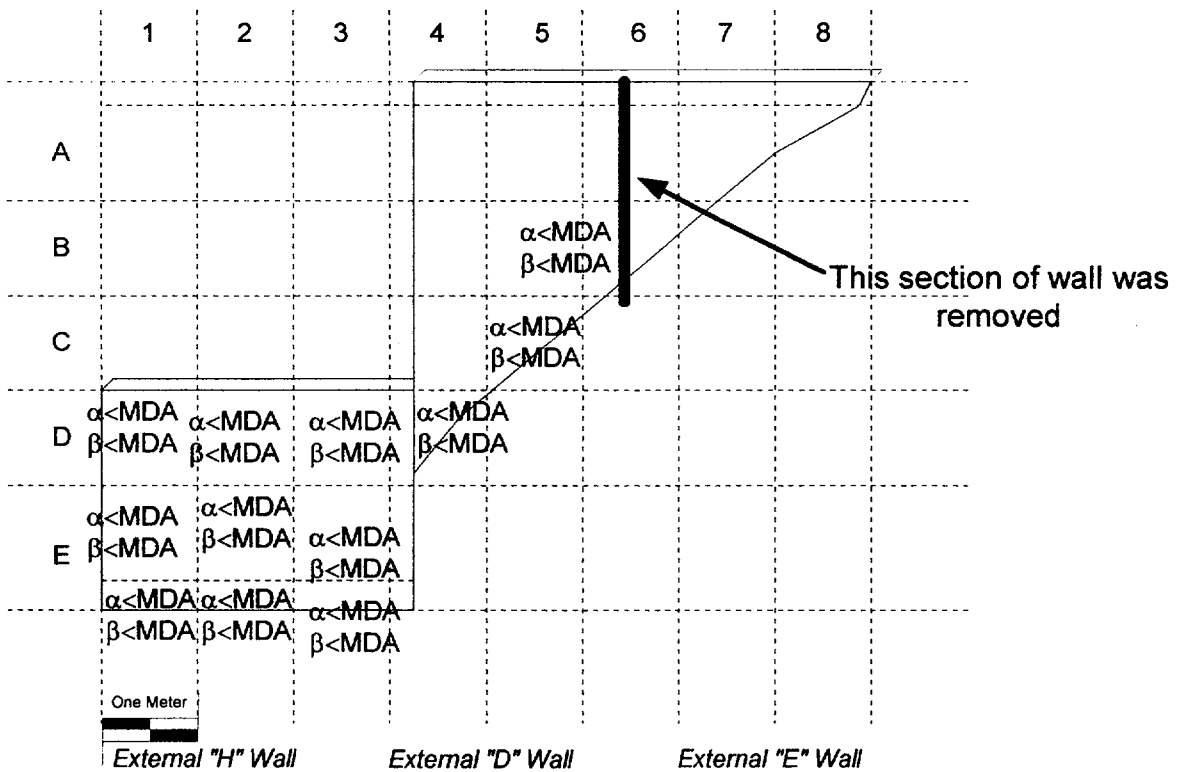
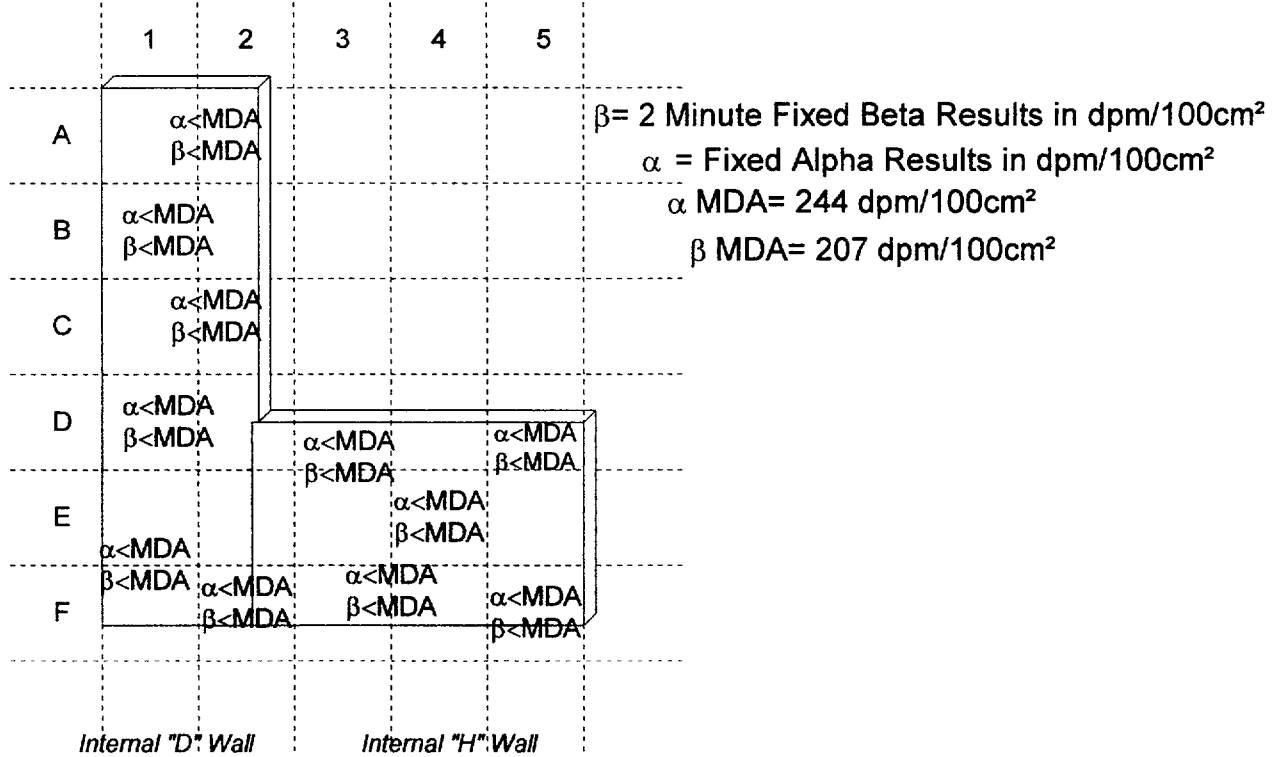
## denotes contact reading and 1 meter reading in  $\mu\text{R/hr}$

Instrument		
Model	Ludlum M-3	N/A
Serial #	153590	N/A
Cal Due Date	09/07/01	N/A

Technicians: B. Lyons and W. Schuck 06/07/01



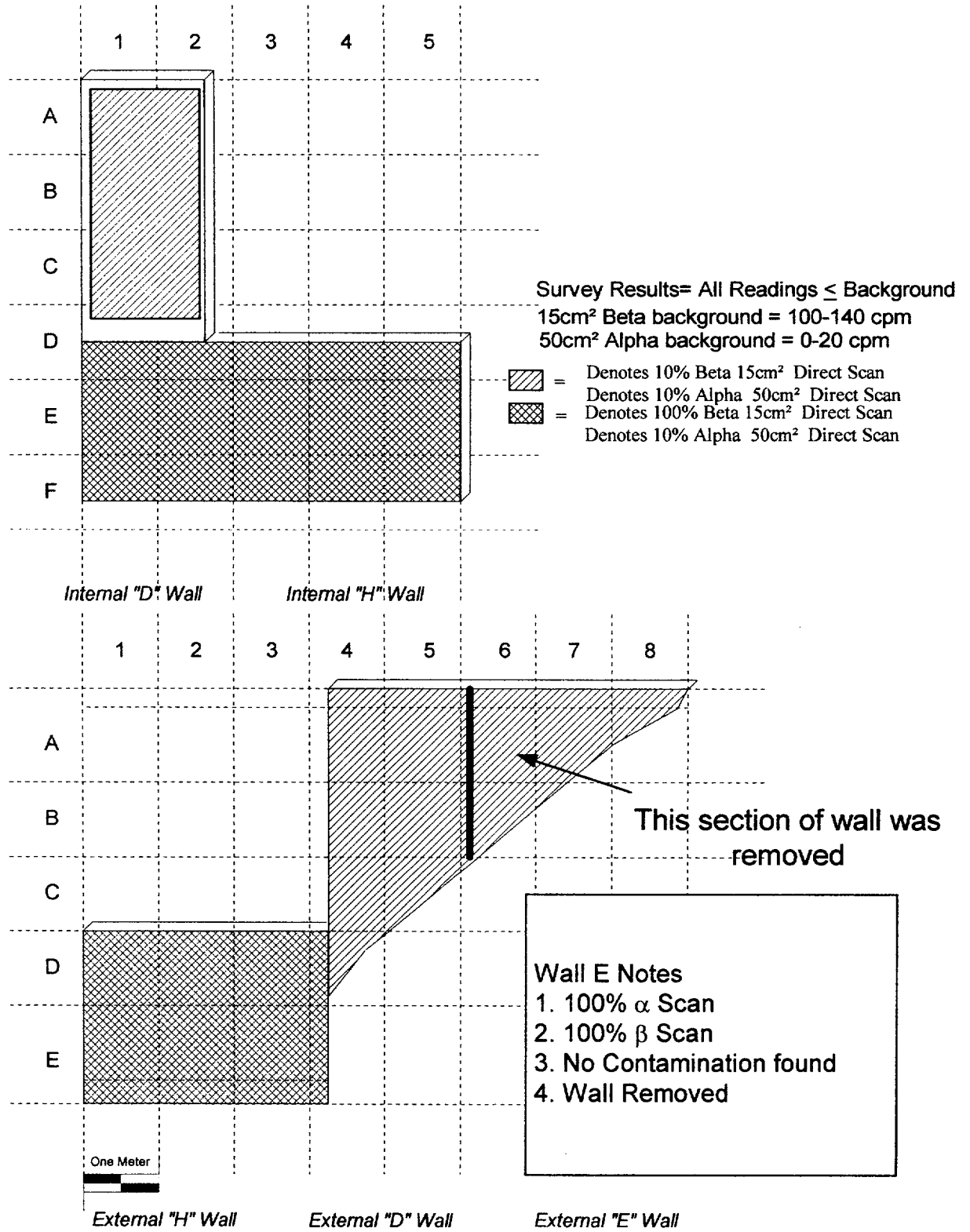
Figure 20 : EA-1 Bunker Internal and External Retaining Walls D, E, & H  
Alpha and Beta Fixed Measurement Locations and Results.



Instrument		
Model	Ludlum 2221	Ludlum M-12
Serial #	148436	138738
Cal Due Date	04/29/02	01/10/02

Technicians: B. Lyons and  
J. Sullivan 12/08/01

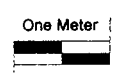
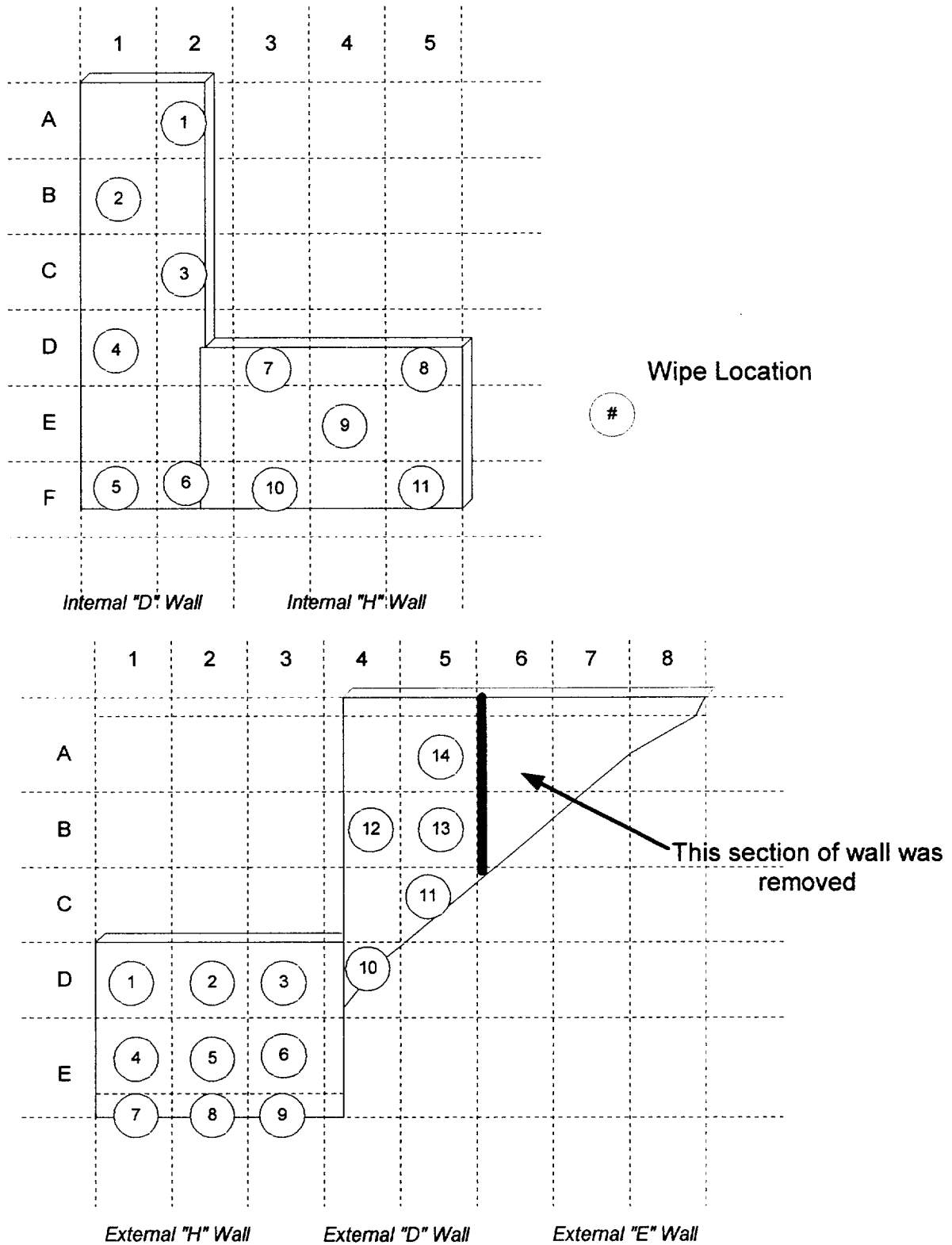
Figure 21: EA-1 Bunker Internal and External Retaining Wall D, E & H  
Alpha and Beta Scan Locations and Results



Instrument		
Model	Ludlum M-3	Ludlum M-12
Serial #	138880	138738
Cal Due Date	08/09/01	08/31/01

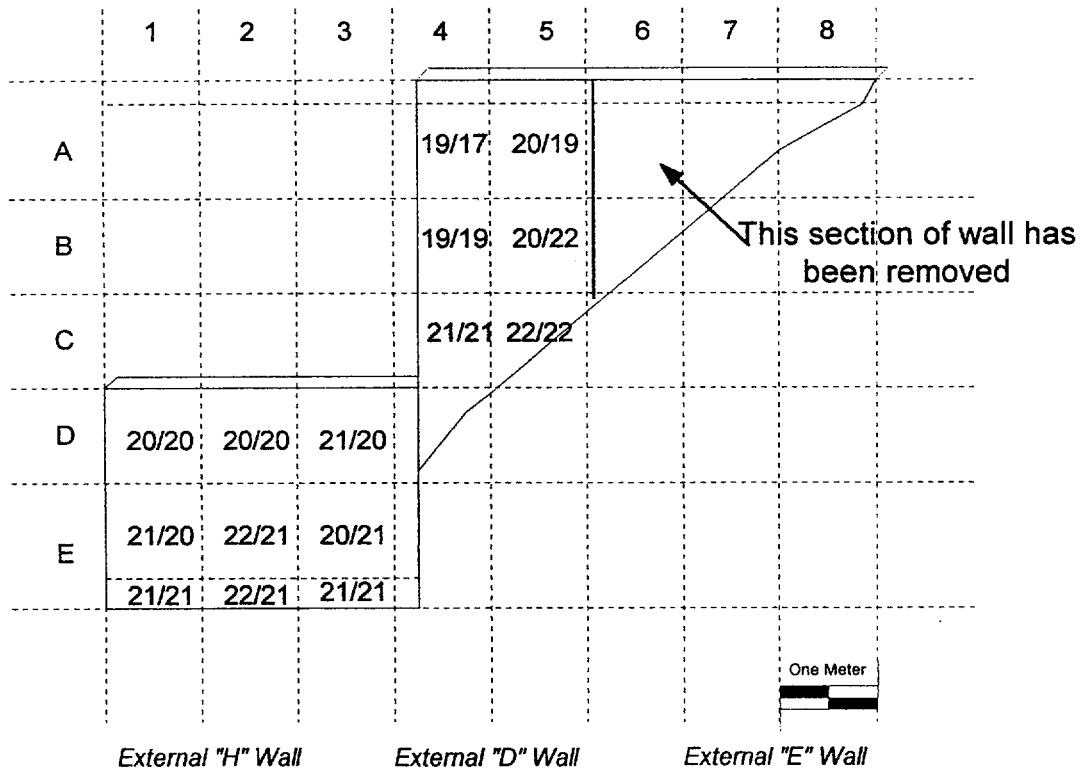
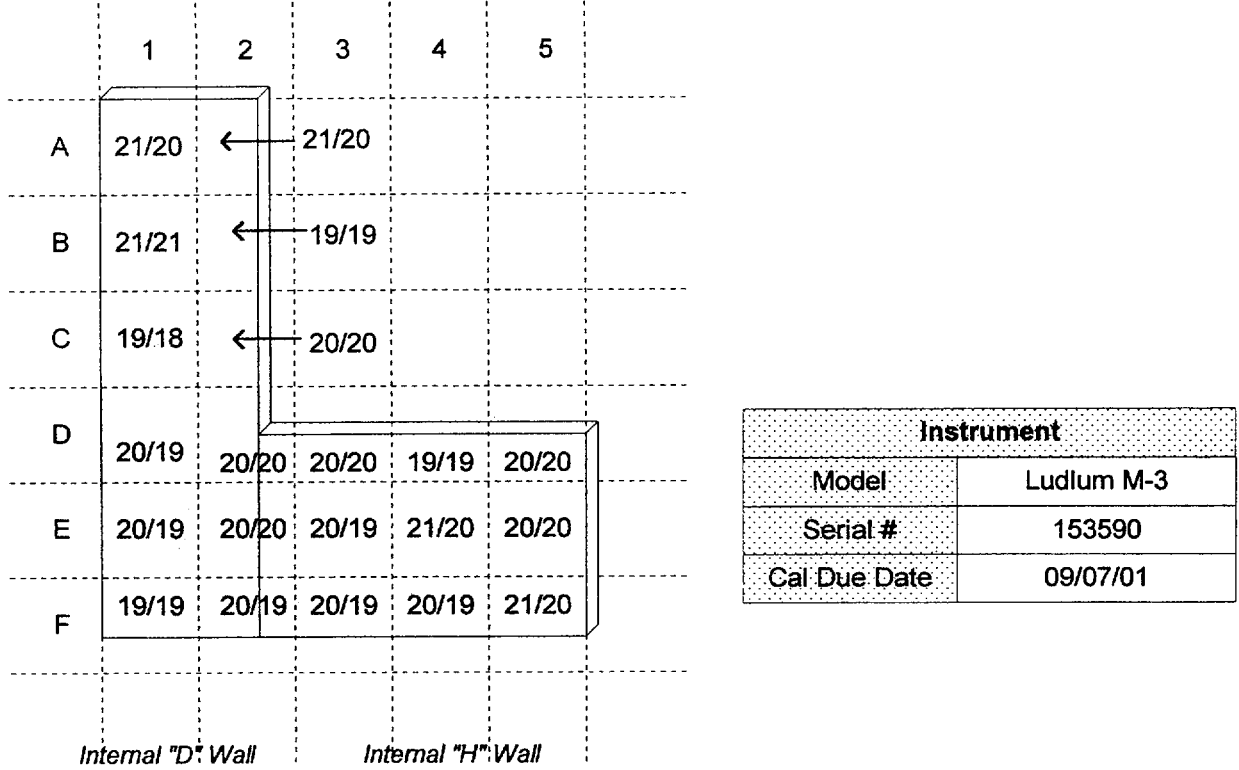
Technicians: B. Lyons and  
W. Schuck 06/27/01

Figure 22: EA-1 Bunker Internal and External Retaining Walls D, E, & H  
 Wipe Sample Locations  
 (See Table 5 for results)



Technicians: B. Lyons and W. Schuck 06/27/01

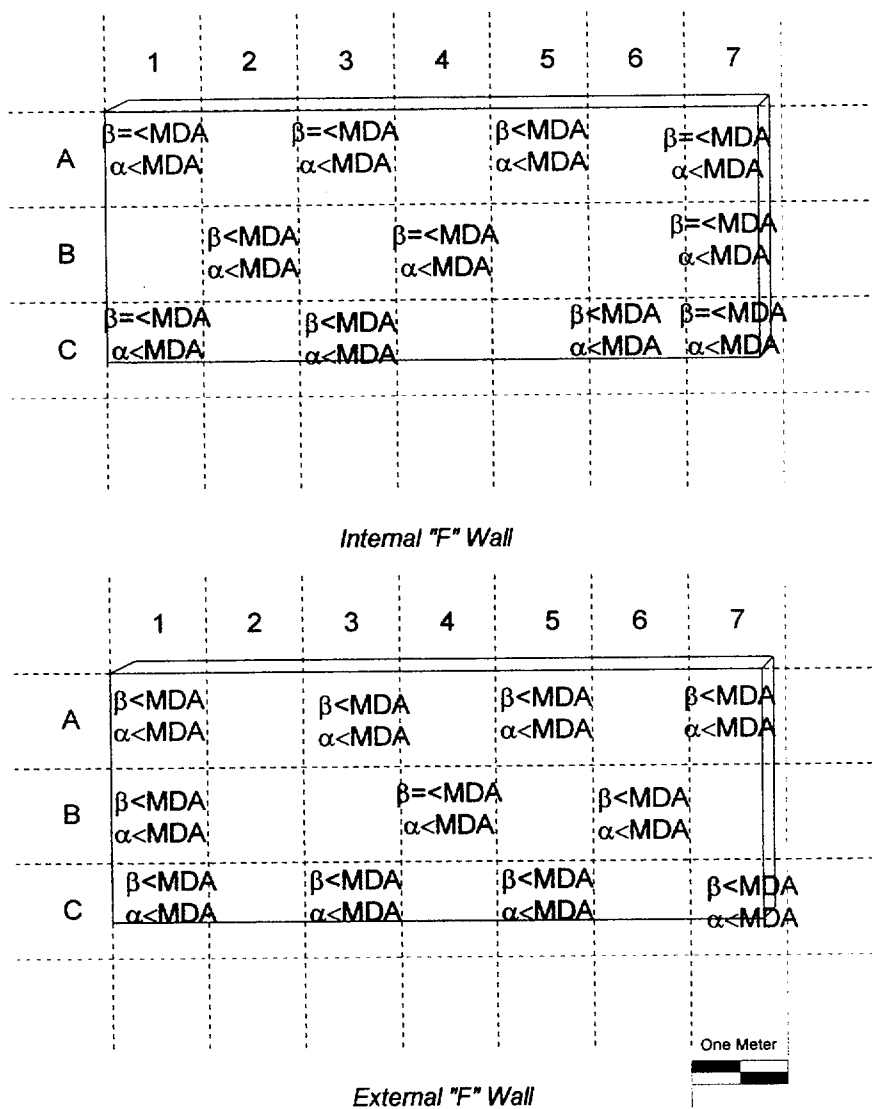
Figure 23: EA-1 Bunker Internal and External Retaining Walls D, E, & H Contact and 1 Meter Exposure Rate Locations and Results



## denotes contact and 1 meter readings in  $\mu\text{R/hr}$

Technicians: B. Lyons and W. Schuck 06/27/01

Figure 24: EA-1 Bunker Internal and External Retaining Wall F Alpha and Beta Fixed Measurement Locations and Results.



$\beta$  = 2 Minute Fixed Results in dpm/100cm<sup>2</sup>

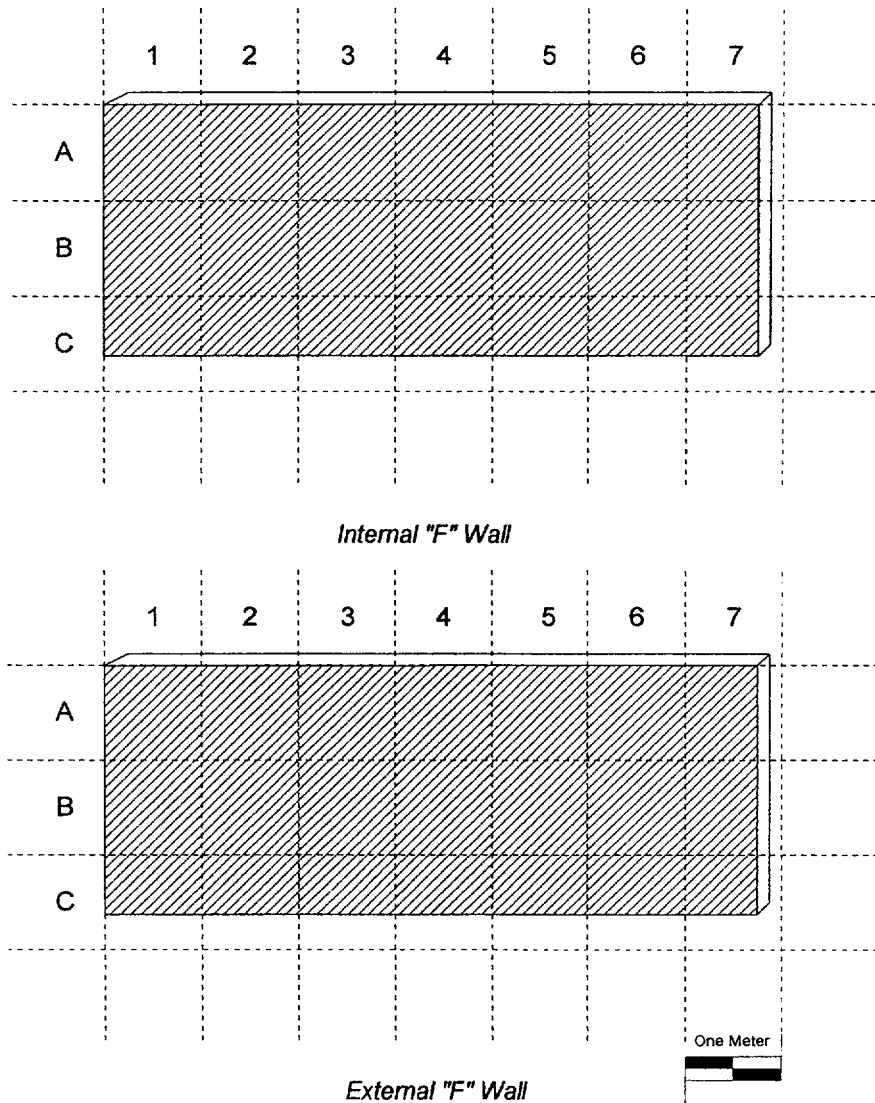
$\alpha$  = Fixed Alpha Results in dpm/100cm<sup>2</sup>

$\beta$  MDA = 207 dpm/100cm<sup>2</sup>

$\alpha$  MDA = 244 dpm/100cm<sup>2</sup>

Instrument		
Model	Ludlum 2221	Ludlum M-12
Serial #	148436	138738
Cal Due Date	04/29/02	01/10/02

Figure 25: EA-1 Bunker Internal and External Retaining Wall F  
Alpha and Beta Scan Locations and Results



Survey Results= All Readings  $\leq$  Background

15cm<sup>2</sup> Beta background = 100-140 cpm

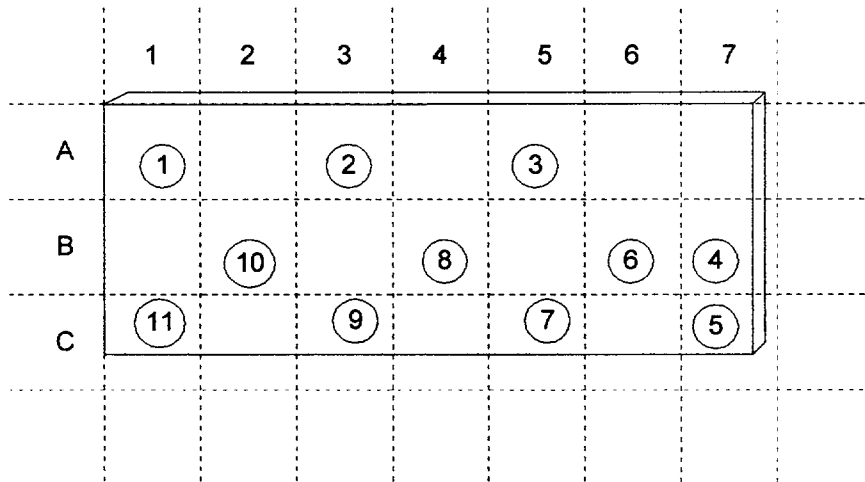
50cm<sup>2</sup> Alpha background = 0-20 cpm

= Denotes 10% Beta 15cm<sup>2</sup> Direct Scan  
Denotes 10% Alpha 50cm<sup>2</sup> Direct Scan

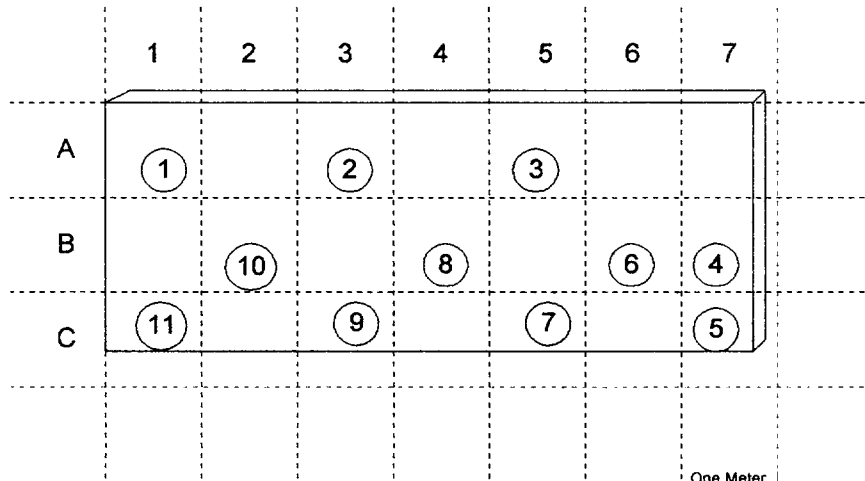
Instrument		
Model	Ludlum M-3	Ludlum M-12
Serial #	138880	138738
Cal Due Date	08/09/01	08/31/01

Technicians: B. Lyons and W. Schuck 06/27/01

Figure 26: EA-1 Bunker Internal and External Retaining Wall F  
 Wipe Sample Locations  
 (See Table 5 for results)



Internal "F" Wall



External "F" Wall

One Meter



# Wipe Location

Technicians: B. Lyons and W. Schuck 06/27/01

Figure 27: EA-1 Bunker Internal and External Retaining Wall F Contact and 1 Meter Exposure Rate Locations and Results

	1	2	3	4	5	6	7
A	19/19	19/19	20/18	20/19	19/19	18/19	20/19
B	20/19	18/19	18/19	19/19	18/19	18/19	19/19
C	22/20	19/18	21/20	21/20	20/18	19/19	21/20

Internal "F" Wall

	1	2	3	4	5	6	7
A	20/20	19/18	18/17	18/18	19/18	18/17	18/18
B	19/19	18/18	18/18	21/19	17/17	18/18	18/18
C	19/19	18/19	19/18	18/18	19/18	18/18	18/18



External "F" Wall

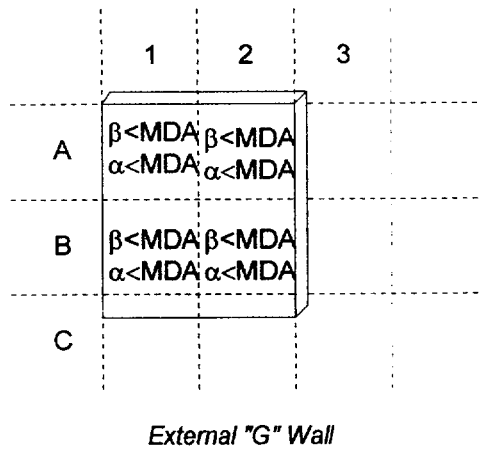
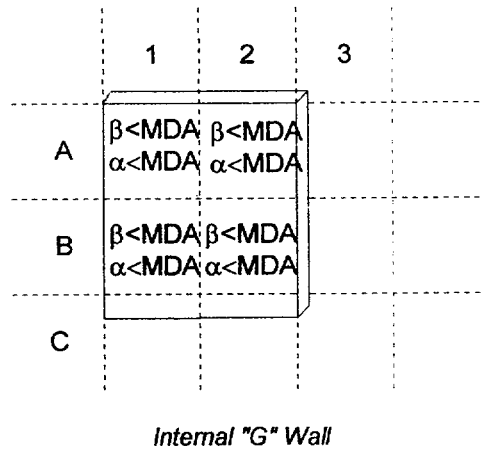
#/# denotes  $\mu\text{R/hr}$  readings at contact and 1 meter

Instrument		
Model	Ludlum M-3	N/A
Serial #	153590	N/A
Cal Due Date	09/07/01	N/A

Technicians: B. Lyons and W. Schuck 06/27/01



Figure 28: EA-1 Bunker Internal and External Retaining Wall G Alpha and Beta Fixed Measurement Locations and Results.

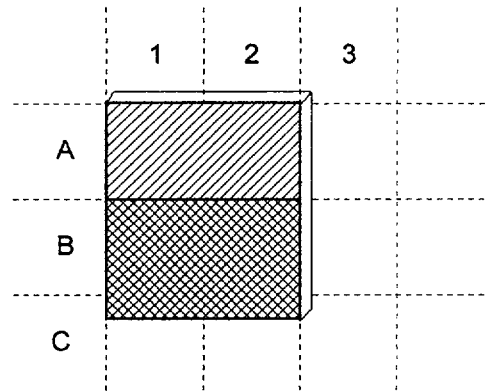


$\beta$  = 2 Minute Fixed Beta results in dpm/100cm<sup>2</sup>  
 $\alpha$  = Alpha results in dpm/100cm<sup>2</sup>  
 $\beta$  MDA = 207dpm/100cm<sup>2</sup>  
 $\alpha$  MDA = 244 dpm/100cm<sup>2</sup>

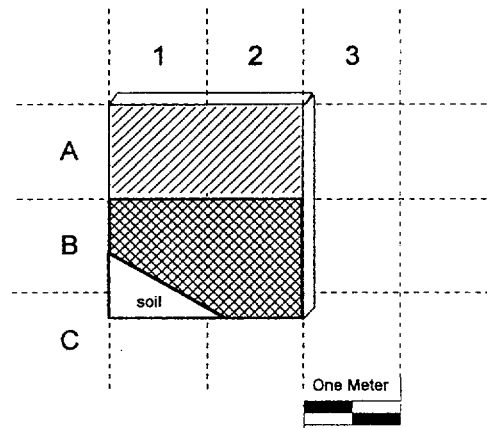
Instrument		
Model	Ludlum 2221	Ludlum M-12
Serial #	148436	138738
Cal Due Date	04/29/02	01/10/02

Technicians: B. Lyons and W. Schuck 12/07/01

Figure 29: EA-1 Bunker Internal and External Retaining Wall G  
Alpha and Beta Scan Locations and Results



Internal "G" Wall





External "G" Wall

Survey Results= All Readings  $\leq$  Background

15cm<sup>2</sup> Beta background = 100-140 cpm

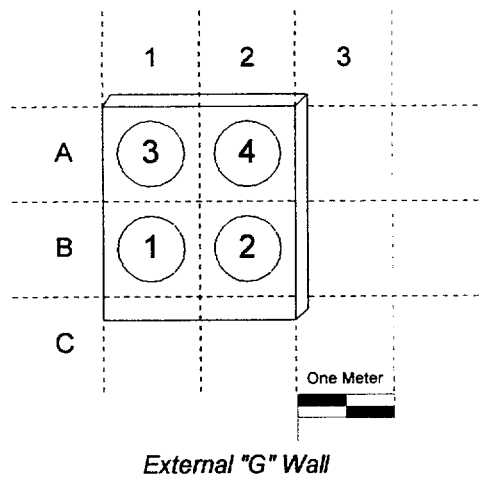
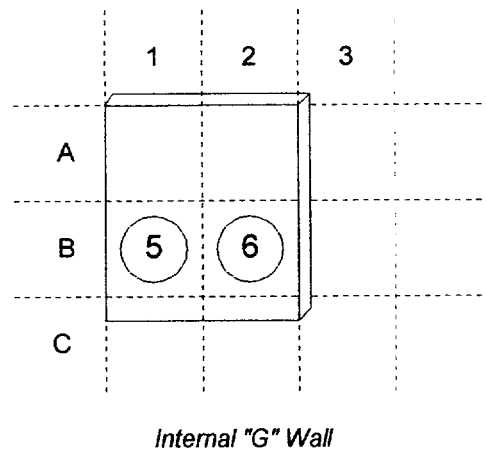
50cm<sup>2</sup> Alpha background = 0-20 cpm

-  = Denotes 10% Beta 15cm<sup>2</sup> Direct Scan  
Denotes 10% Alpha 50cm<sup>2</sup> Direct Scan
-  = Denotes 100% Beta 15cm<sup>2</sup> Direct Scan  
Denotes 10% Alpha 50cm<sup>2</sup> Direct Scan

Instrument		
Model	Ludlum M-3	Ludlum M-12
Serial #	138880	138738
Cal Due Date	08/09/01	08/31/01

Technicians: B. Lyons and W. Schuck 06/19/01

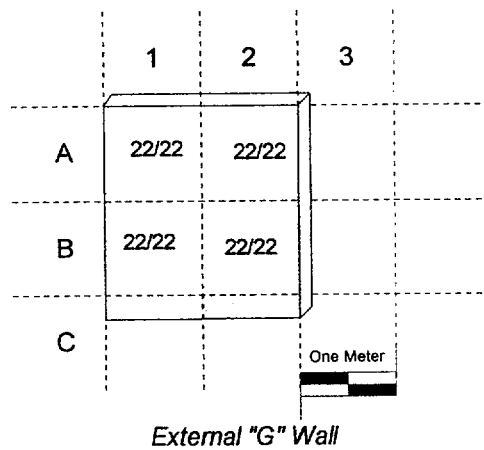
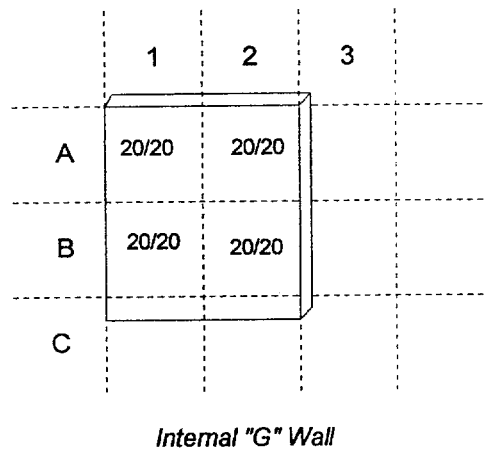
Figure 30: EA-1 Bunker Internal and External Retaining Wall G  
 Wipe Sample Locations  
 (See Table 5 for results)



# Wipe Location

Technicians: B. Lyons and W. Schuck 06/19/01

Figure 31: EA-1 Bunker Internal and External Retaining Wall G Contact and 1 Meter Exposure Rate Locations and Results

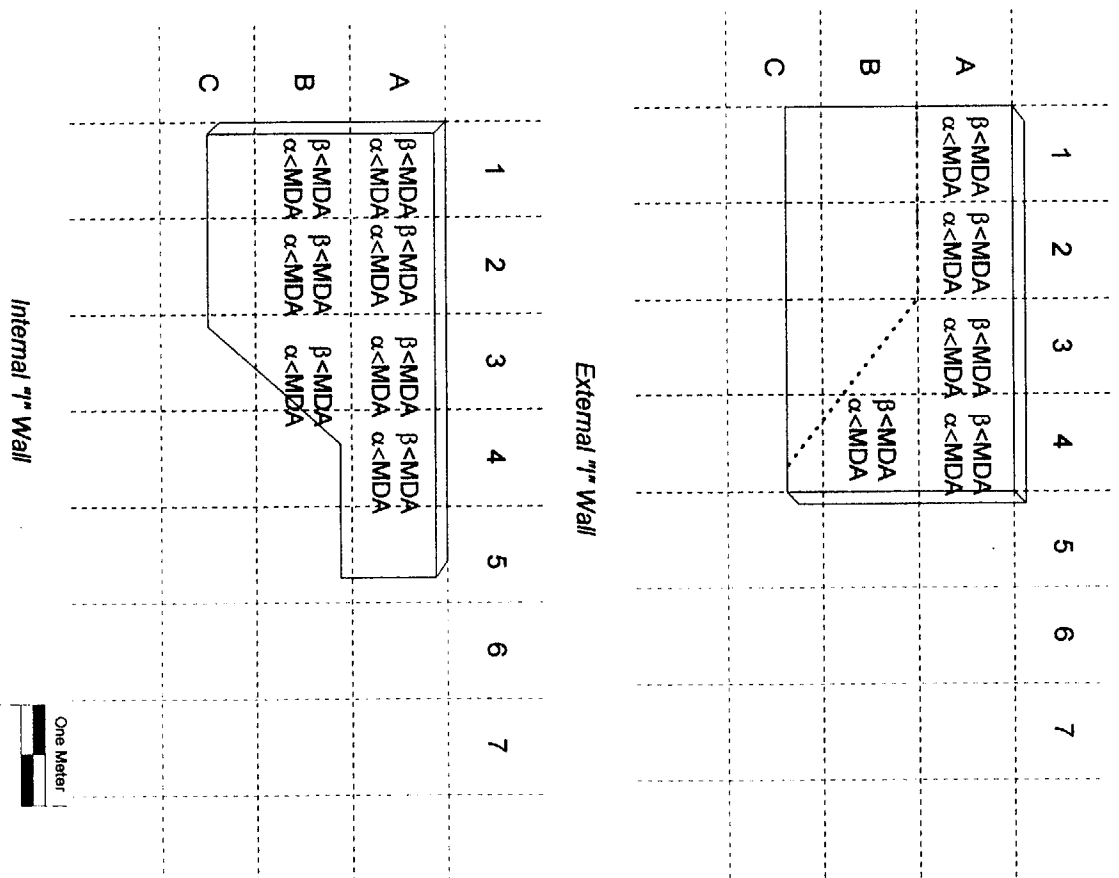


#/# Denotes contact and 1 meter reading in  $\mu\text{R/hr}$

Instrument		
Model	Ludlum M-3	N/A
Serial #	153590	N/A
Cal Due Date	09/07/01	N/A

Technicians: B. Lyons and W. Schuck 06/19/01

Figure 32: EA-1 Bunker Internal and External Retaining Wall I  
Alpha and Beta Fixed Measurement Locations and Results.

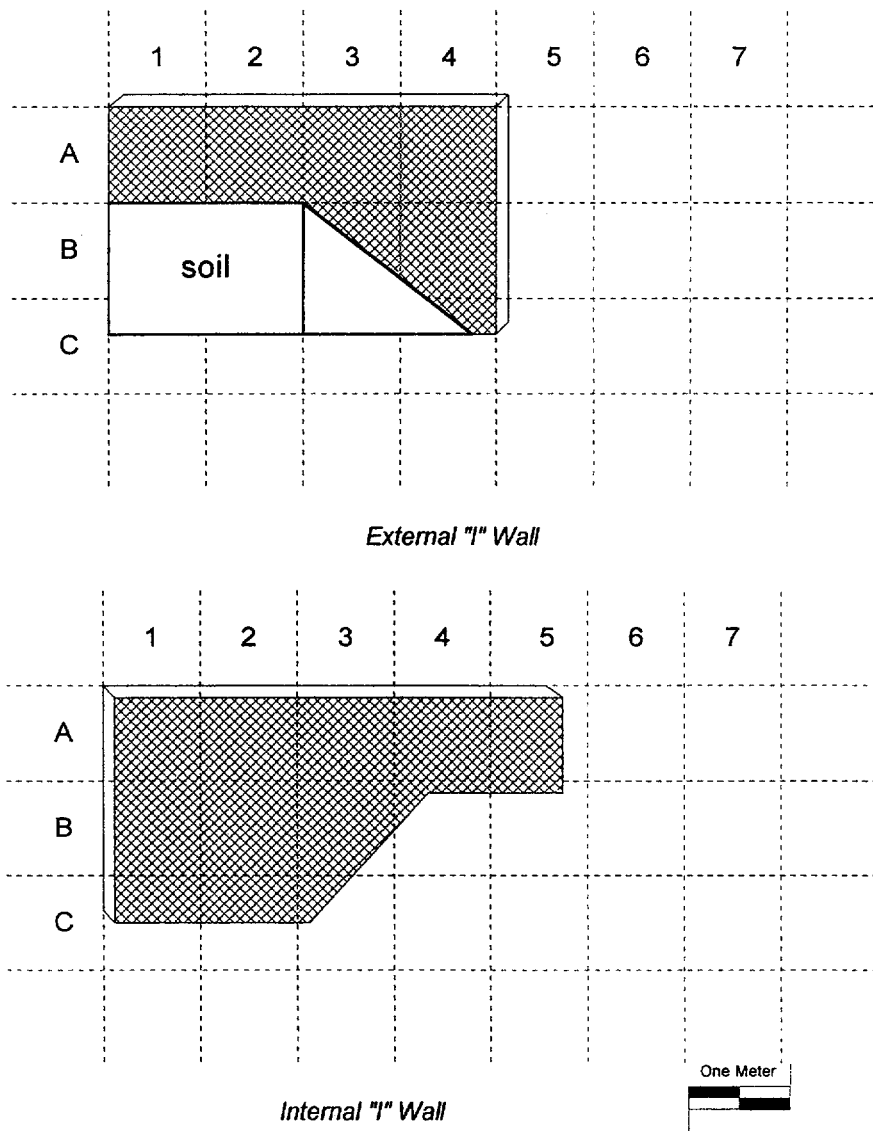


β = 2 minute fixed beta results in dpm/100cm<sup>2</sup>  
 α = Alpha Fixed results in dpm/100cm<sup>2</sup>  
 Beta MDA= 207 dpm/100cm<sup>2</sup>  
 Alpha MDA= 323 dpm/100cm<sup>2</sup>

Instrument		
Model	Ludlum 2221	Ludlum M-12
Serial #	148436	138738
Cal Due Date	04/29/02	01/10/02

Technicians: B. Lyons and J. Sullivan 07/02/01

Figure 33: EA-1 Bunker Internal and External Retaining Wall I  
Alpha and Beta Scan Locations and Results



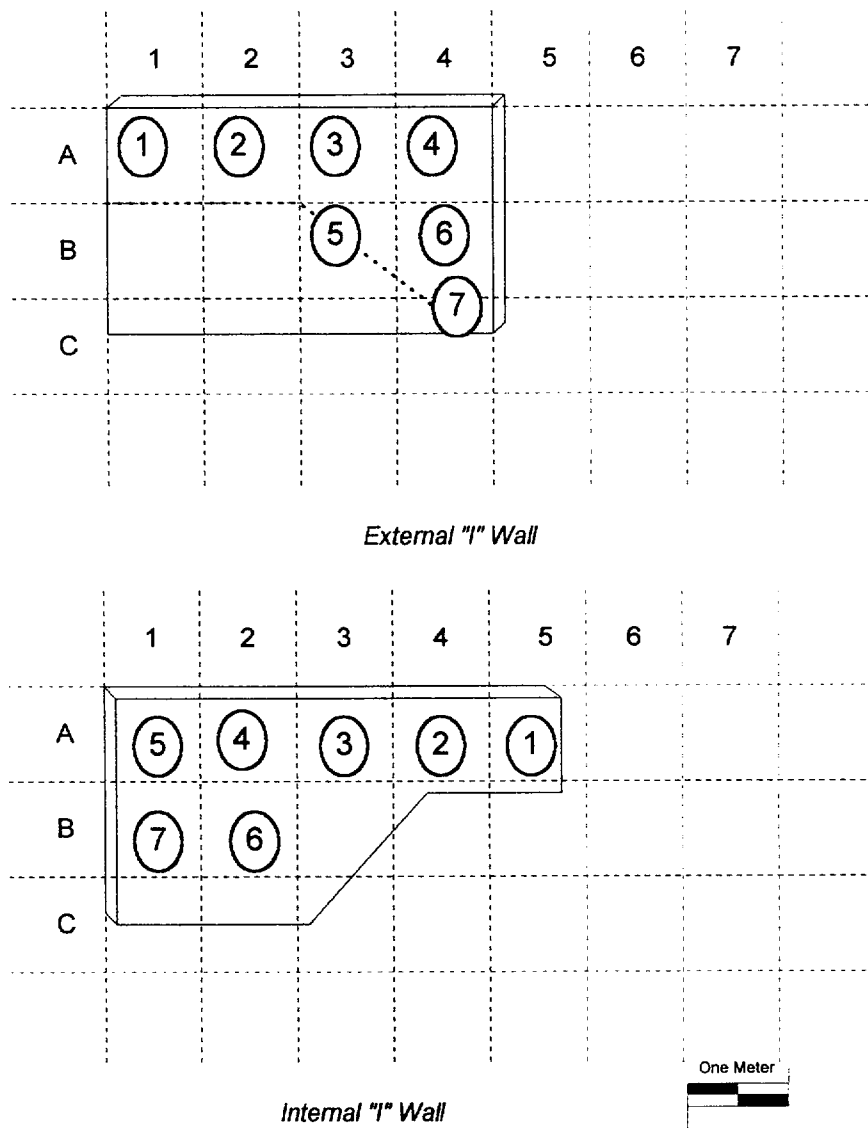
Survey results= All readings  $\leq$  background  
 [Cross-hatched] = denotes 100% Beta Scan and 10% Alpha Scan

15cm<sup>2</sup> Beta Background = 100-140 cpm  
 50cm<sup>2</sup> Alpha Background = 0-20 cpm

Instrument		
Model	Ludlum M-3	Ludlum M-12
Serial #	138880	138738
Cal Due Date	08/09/01	08/31/01

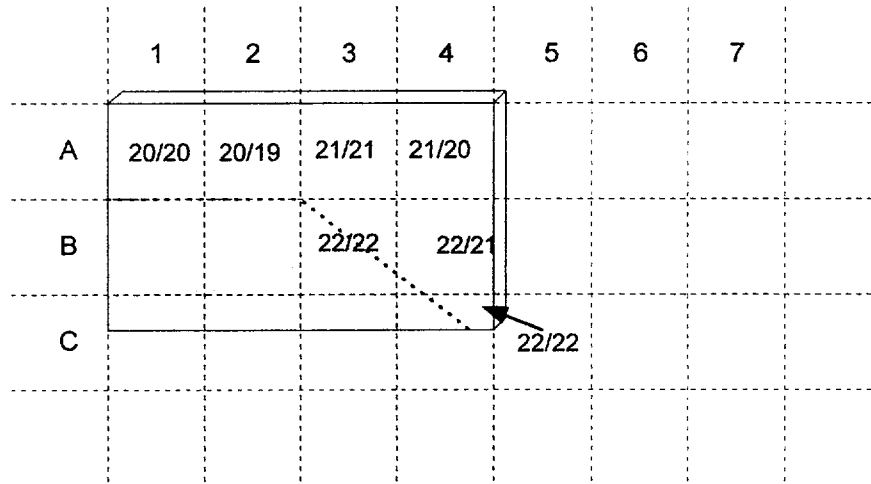
Technicians: B. Lyons and W. Schuck 07/02/01

Figure 34: EA-1 Bunker Internal and External Retaining Wall I  
 Wipe Sample Locations  
 (See Table 5 for results)

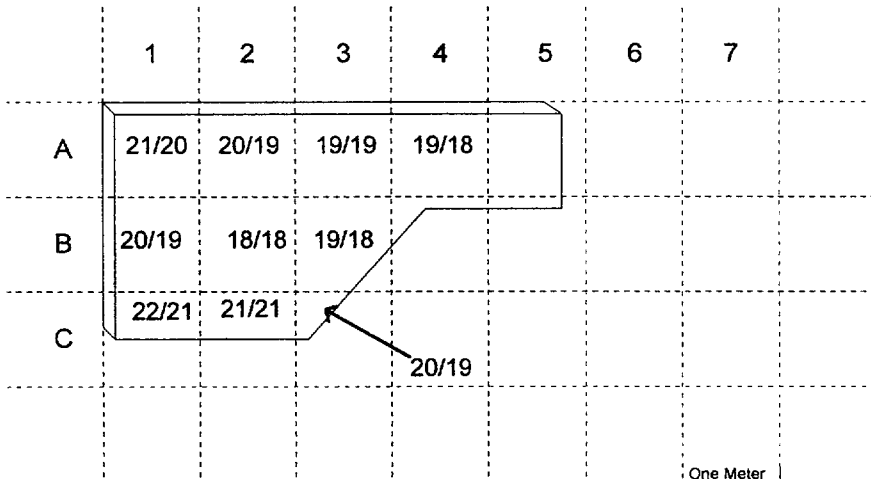


(n) Denotes Wipe Location

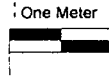
Figure 35: EA-1 Bunker Internal and External Retaining Wall I Contact and 1 Meter Exposure Rate Locations and Results



External "I" Wall



Internal "I" Wall



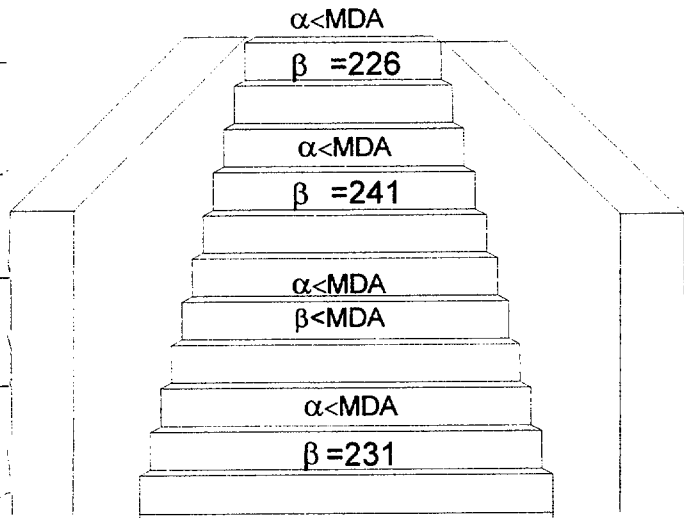
##/#= denotes contact and 1 meter readings in  $\mu\text{R/hr}$

Instrument		
Model	Ludlum M-3	N/A
Serial #	153590	N/A
Cal Due Date	09/07/01	N/A

Technicians: B. Lyons and W. Schuck 07/02/01

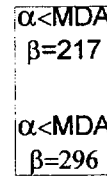


Figure 36: Bunker Retaining Wall Stairwell  
Alpha and Beta Fixed Measurement Locations and Results.

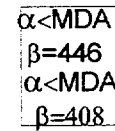


$\alpha$  denotes alpha results in dpm/100cm<sup>2</sup>  
 $\beta$  denotes Beta results in dpm/100cm<sup>2</sup>  
 $\beta$  MDA = 207 dpm/100cm<sup>2</sup>  
 $\alpha$  MDA = 244 dpm/100cm<sup>2</sup>

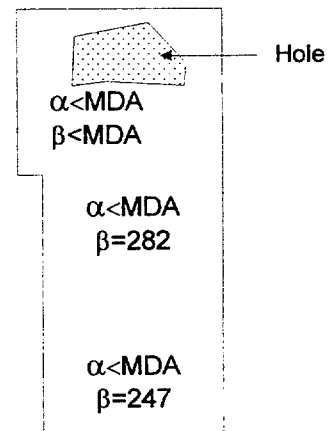
Upper Landing



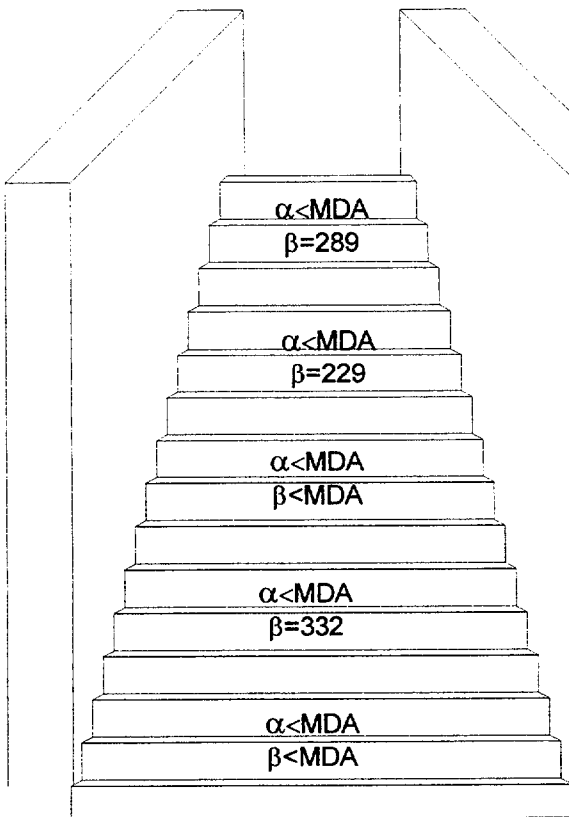
Middle Landing



Lower Landing



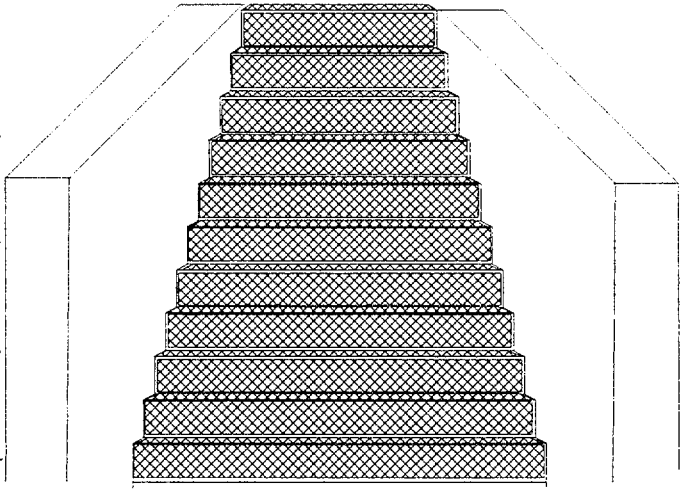
Lower Stairs




Instrument		
Model	Ludlum 2221	Ludlum M-12
Serial #	148436	138738
Cal Due Date	04/29/02	01/10/02

Technicians: B. Lyons and J. Sullivan 12/08/01

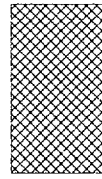
Figure 36A: Bunker Retaining Wall Stairwell  
Alpha and Beta Scan Locations and Results.



 = 100% Beta and 10% Alpha Scan  
 Survey Results= All Readings  $\leq$  Background  
 Beta Background = 100 to 140 cpm  
 Alpha Background = 0 to 20 cpm

Upper Stairs

Upper Landing

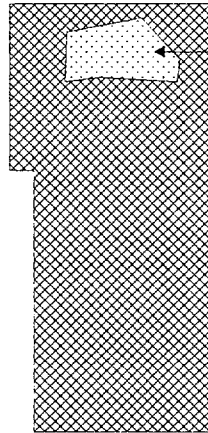


Middle Landing

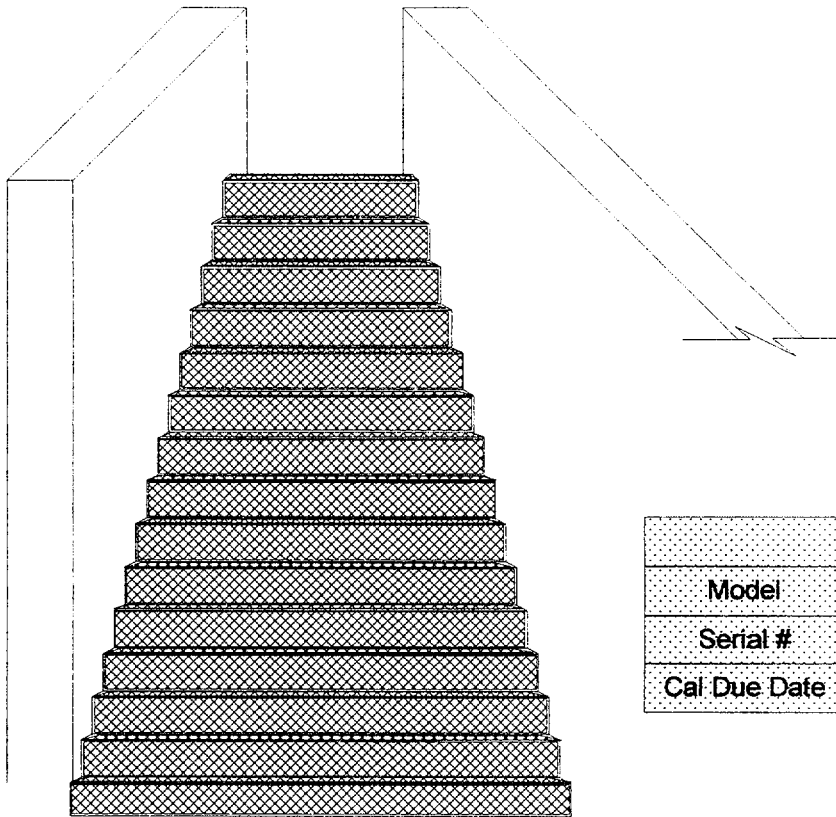


Lower Stairs

Lower Landing



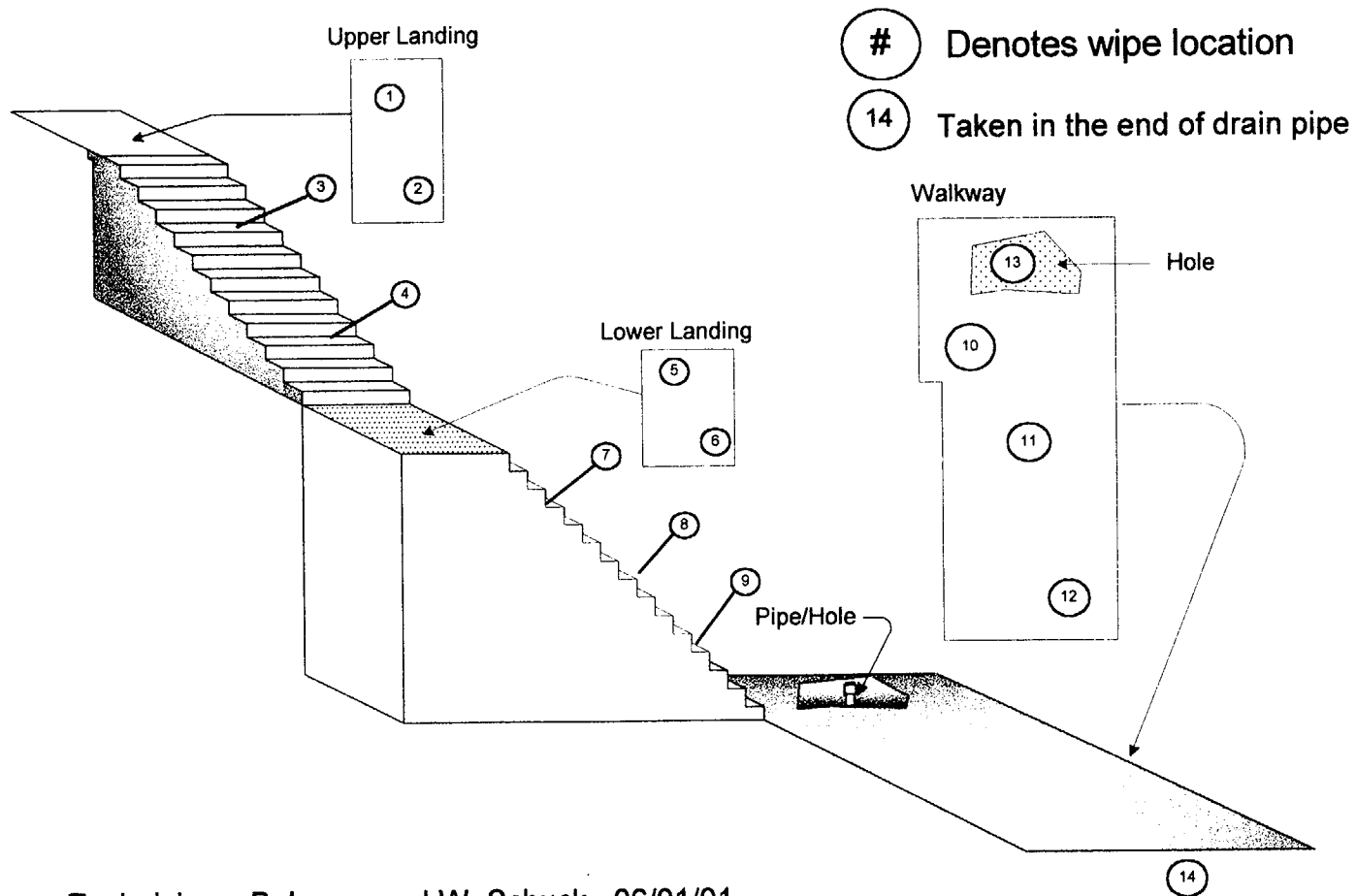
Hole



Instrument		
Model	Ludlum M-3	Ludlum M-12
Serial #	138880	138738
Cal Due Date	08/09/01	08/31/01

Barbara Lyons  
 Will Schuck  
 06-14-01

Figure 37: EA-1 Bunker Retaining Wall Stairwell  
Wipe Sample Locations  
(See Table 5 for results)

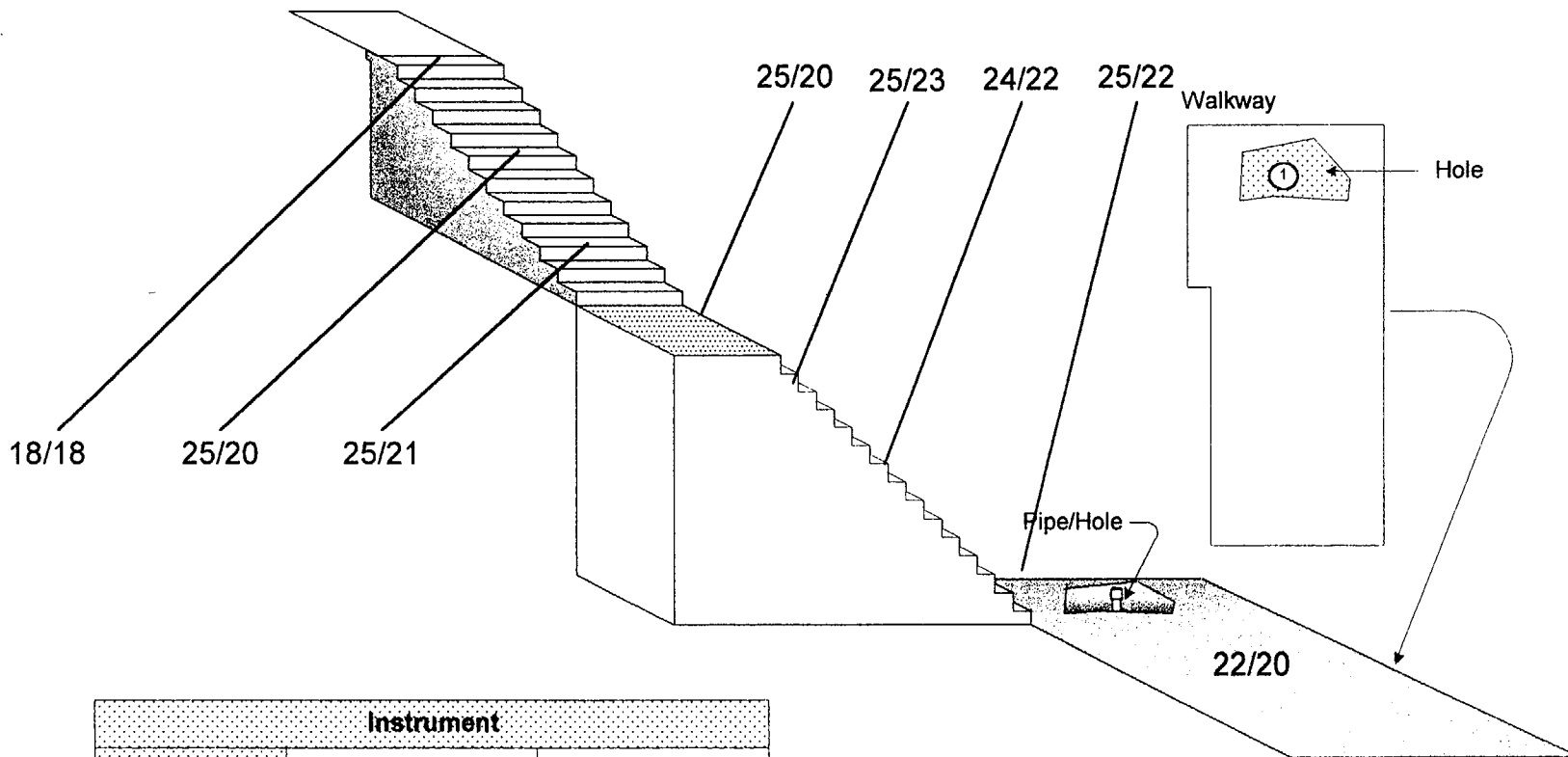


Technicians: B. Lyons and W. Schuck 06/01/01

Figure 38: EA-1 Bunker Retaining Wall Stairwell  
 Contact and 1 Meter Exposure Rate Measurement Locations and Results

## denotes Contact and 1 Meter readings in  $\mu\text{R/hr}$

① Soil Sample S-1





Instrument		
Model	Ludlum M-3	N/A
Serial #	147819	N/A
Cal Due Date	09/04/01	N/A

Technicians: B. Lyons and W. Schuck 06/05/01

Figure 39: EA-1 Bunker Land Area Fixed Beta Measurement Locations and Results



 = Denotes Suspect Affected area  
 = Denotes Non-Suspect Affected area

1

2

3

4

5

A

B

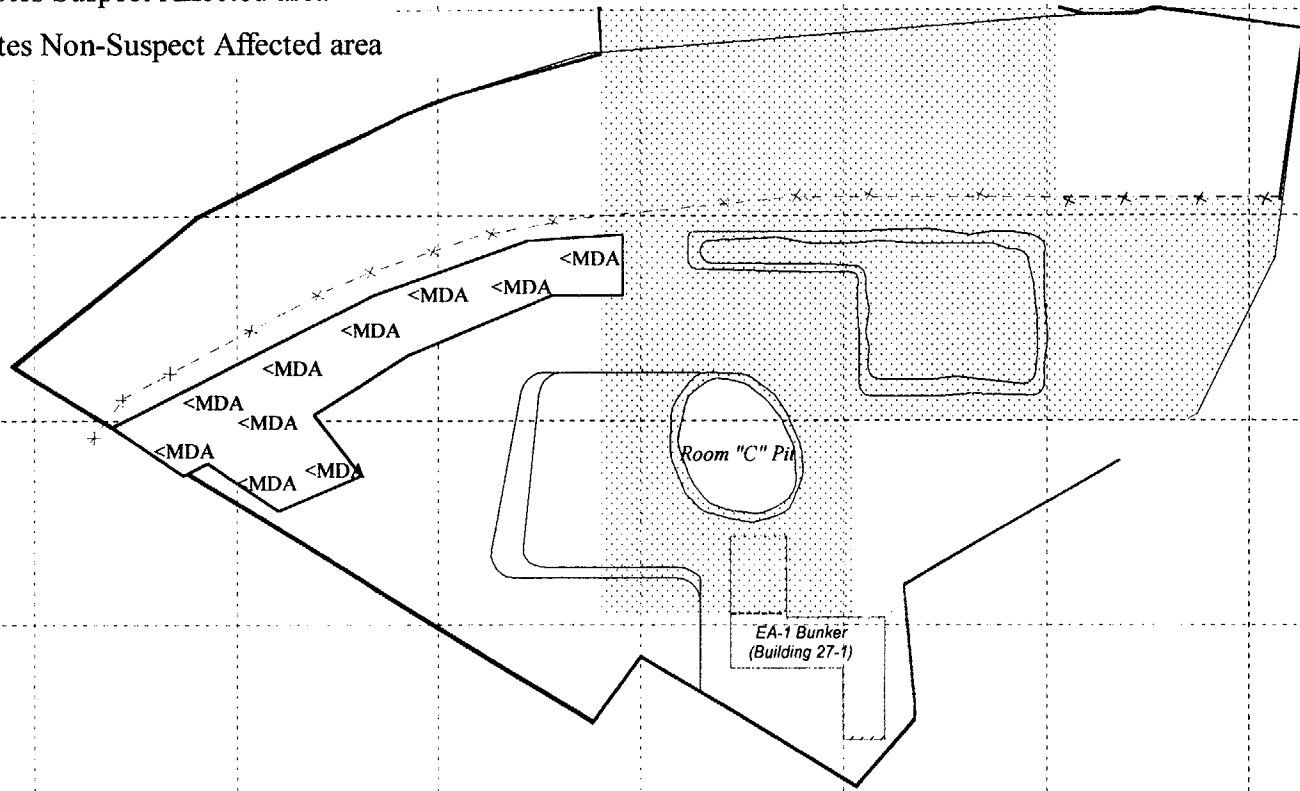
C

D

E

F

G



Instrument		
Model	Ludlum 2221	N/A
Serial #	84423	N/A
Cal Due Date	09/26/01	N/A



MDA= 508 dpm/100cm<sup>2</sup>  
 1 Minute Fixed Beta counts

Technicians: B. Lyons and W. Schuck 06/12/01

 10 Meters

Figure 40: EA-1 Bunker Land Area Beta Scan Locations and Results



 = Denotes Suspect Affected area  
 = Denotes Non-Suspect Affected area

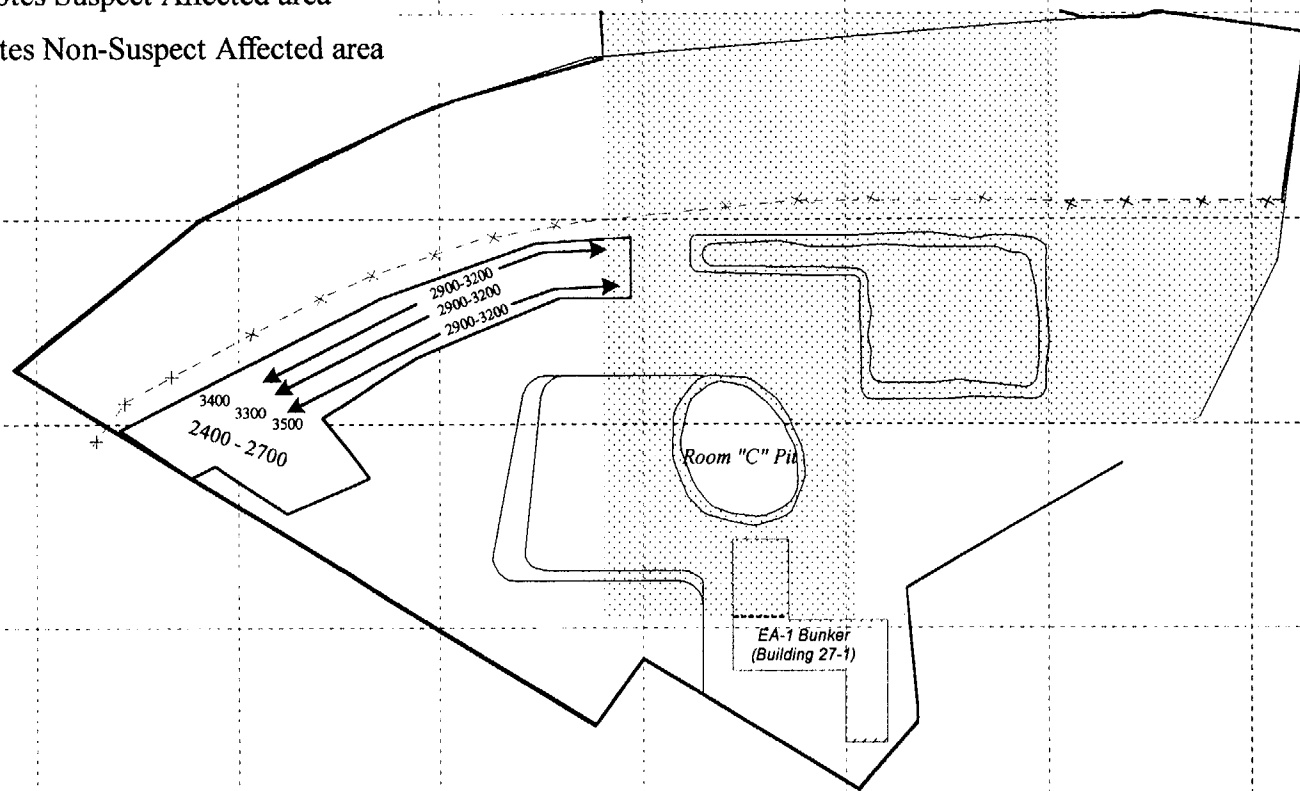
1

2

3

4

5



Instrument		
Model	Ludlum 2221	N/A
Serial #	84459	N/A
Cal Due Date	11/15/01	N/A

One Minute fixed Beta measurements were taken at the highest beta scan locations. The maximum result was <MDA, (508 dpm/100cm<sup>2</sup>) as shown on Figure 39.



Technicians: B. Lyons and W. Schuck 06/12/01

Background = 2450 to 2780 cpm



Figure 41: EA-1 Bunker Land Area Removable Contamination Survey Locations  
 (See Table 5 for results)



 = Denotes Suspect Affected area  
 = Denotes Non-Suspect Affected area

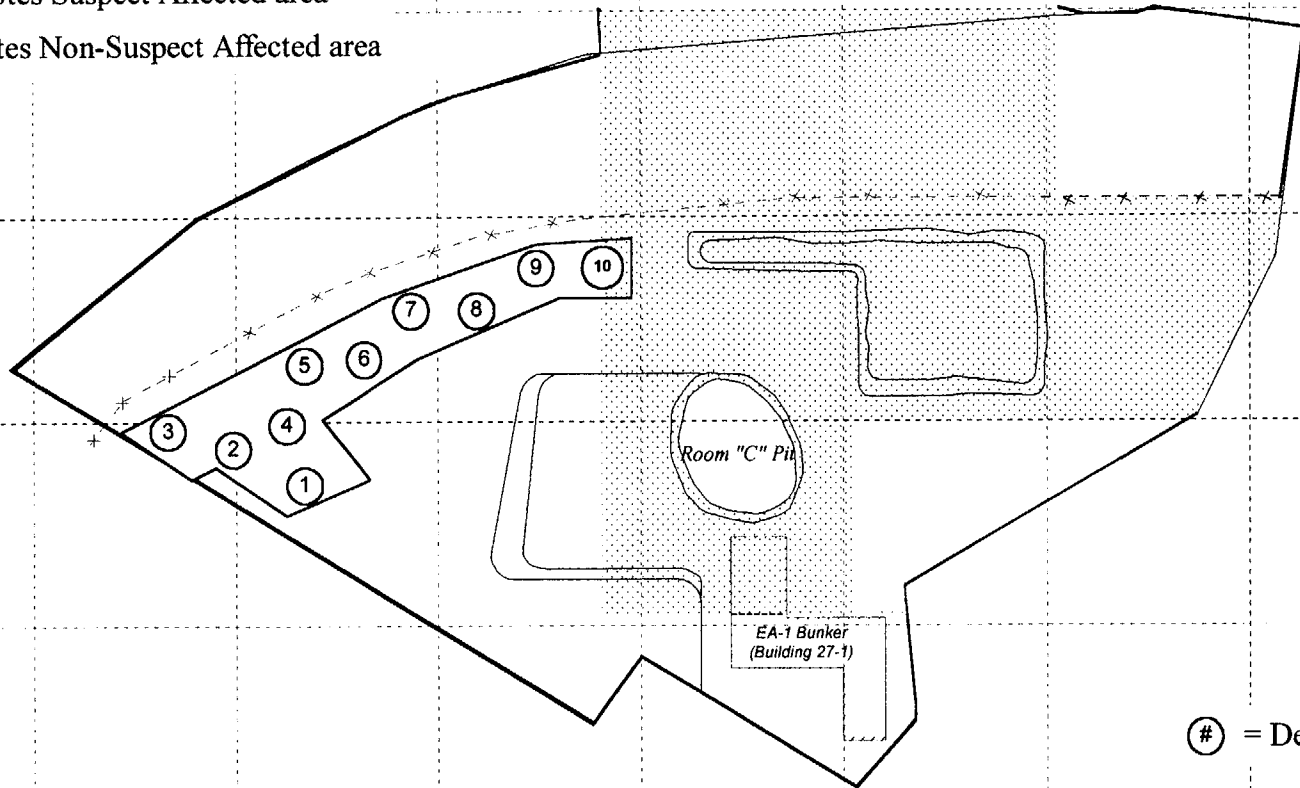
1

2

3

4

5



⊙ = Denotes Wipe location




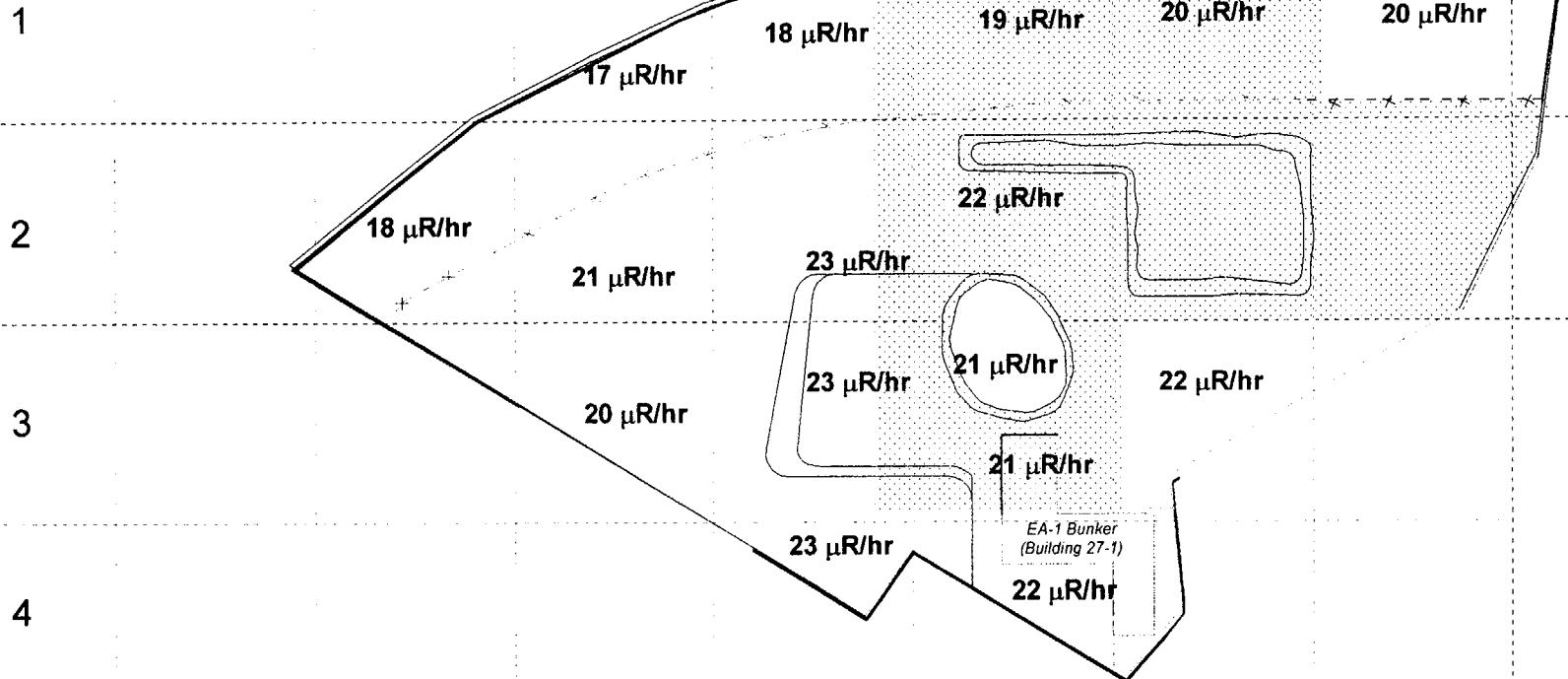
 10 Meters

Figure 42: EA-1 Bunker Land Area Exposure Rate Measurements and Results.



 = Denotes Suspect Affected area  
 = Denotes Non-Suspect Affected area



1. 100% of surface scanned. Results of scan ranged from 18 to 21mR/hr
2. Exposore Rate Fixed Measurements conducted every 2 meters at 1 meter above the surface. The highest reading in each 10 x 10 meter grid shown.

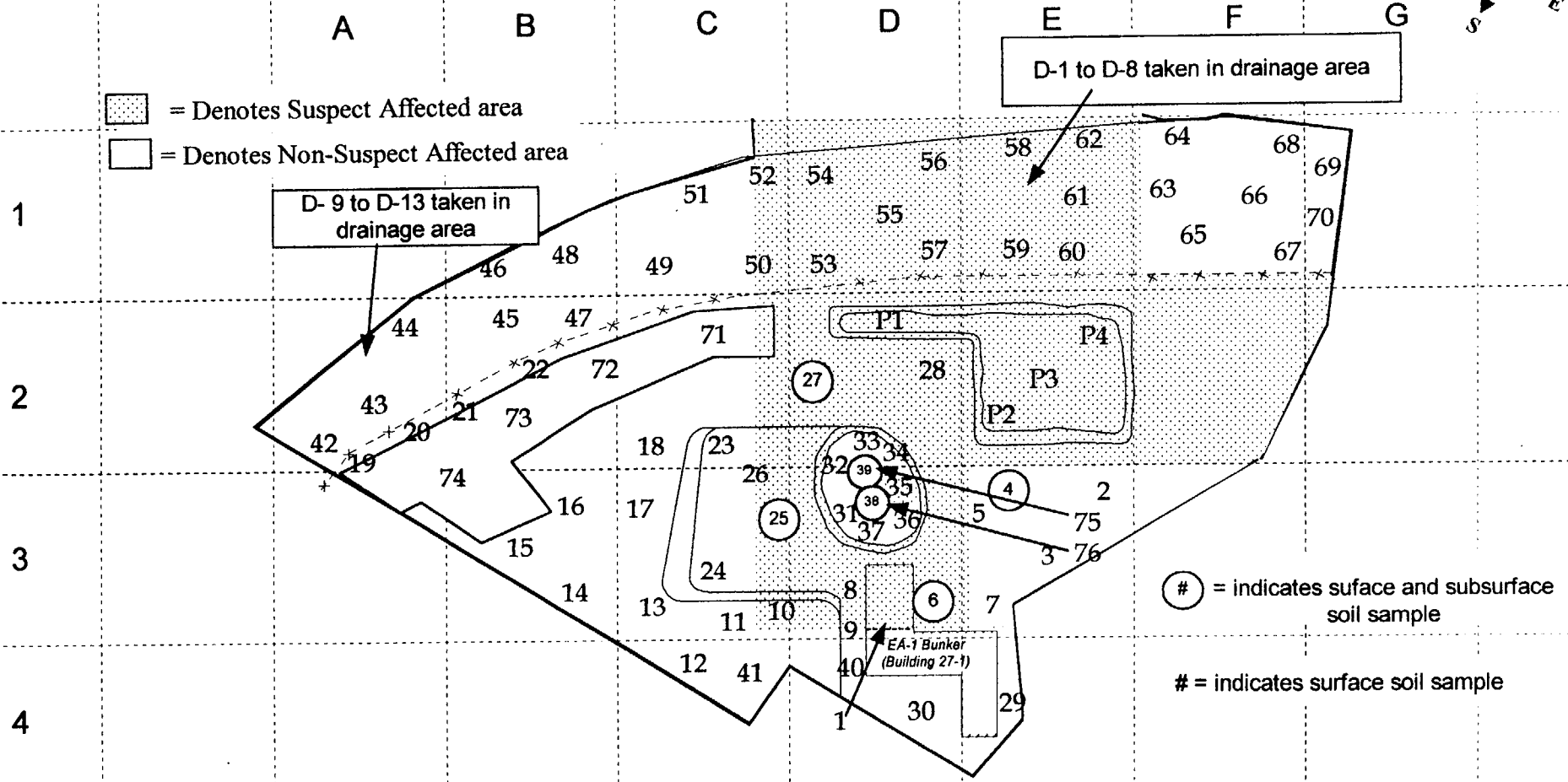
Instrument		
Model	Ludlum M-3	Ludlum M-3
Serial #	153590	153551
Cal Due Date	09/07/01	10/08/01

Technicians: B. Lyons and W. Schuck 06/12/01

 10 Meters



# Figure 43: EA-1 Bunker Land Area Soil Sample Locations

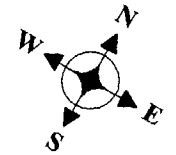




Samples # 38-1, 38-2, 38-3, 38-4,  
39-1, 39-2, 39-3, 39-4  
Were taken in 6" increments at  
location # 38 and #39

B. Lyons  
W. Schuck 06/08/2001

10 Meters

Figure 44: EA-1 Bunker Land Area Asphalt Surface Alpha Scan



 = Denotes Suspect Affected area  
 = Denotes Non-Suspect Affected area

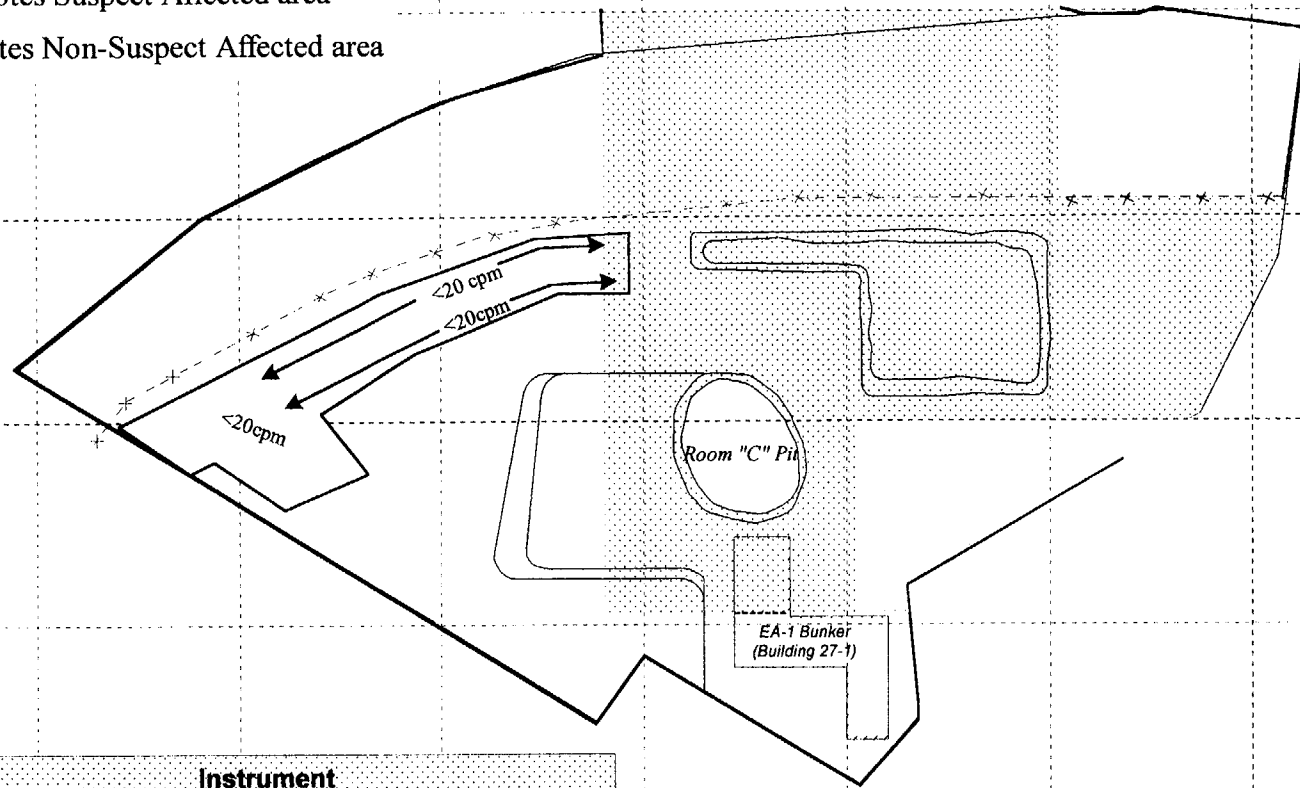
1

2

3

4

5



Instrument		
Model	Ludlum 2221	N/A
Serial #	148445	N/A
Cal Due Date	10/25/01	N/A



Technicians: B. Lyons and W. Schuck 06/12/01

Background= 0-32 cpm



Figure 45: EA-1 Bunker Land Area Asphalt Surface Exposure Rates and Fixed Measurements.



 = Denotes Suspect Affected area  
 = Denotes Non-Suspect Affected area

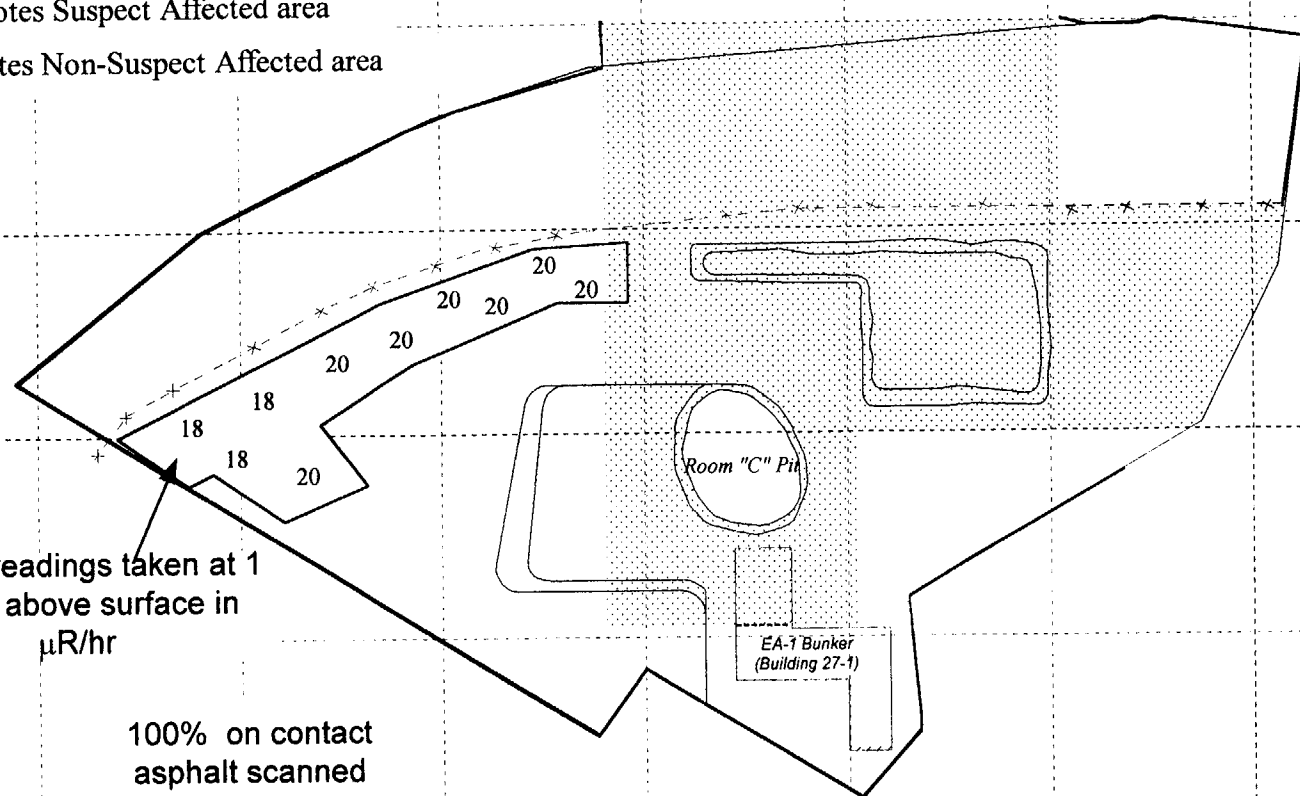
1

2

3

4

5



These readings taken at 1 meter above surface in  $\mu\text{R/hr}$

100% on contact asphalt scanned readings 20-23  $\mu\text{R/hr}$

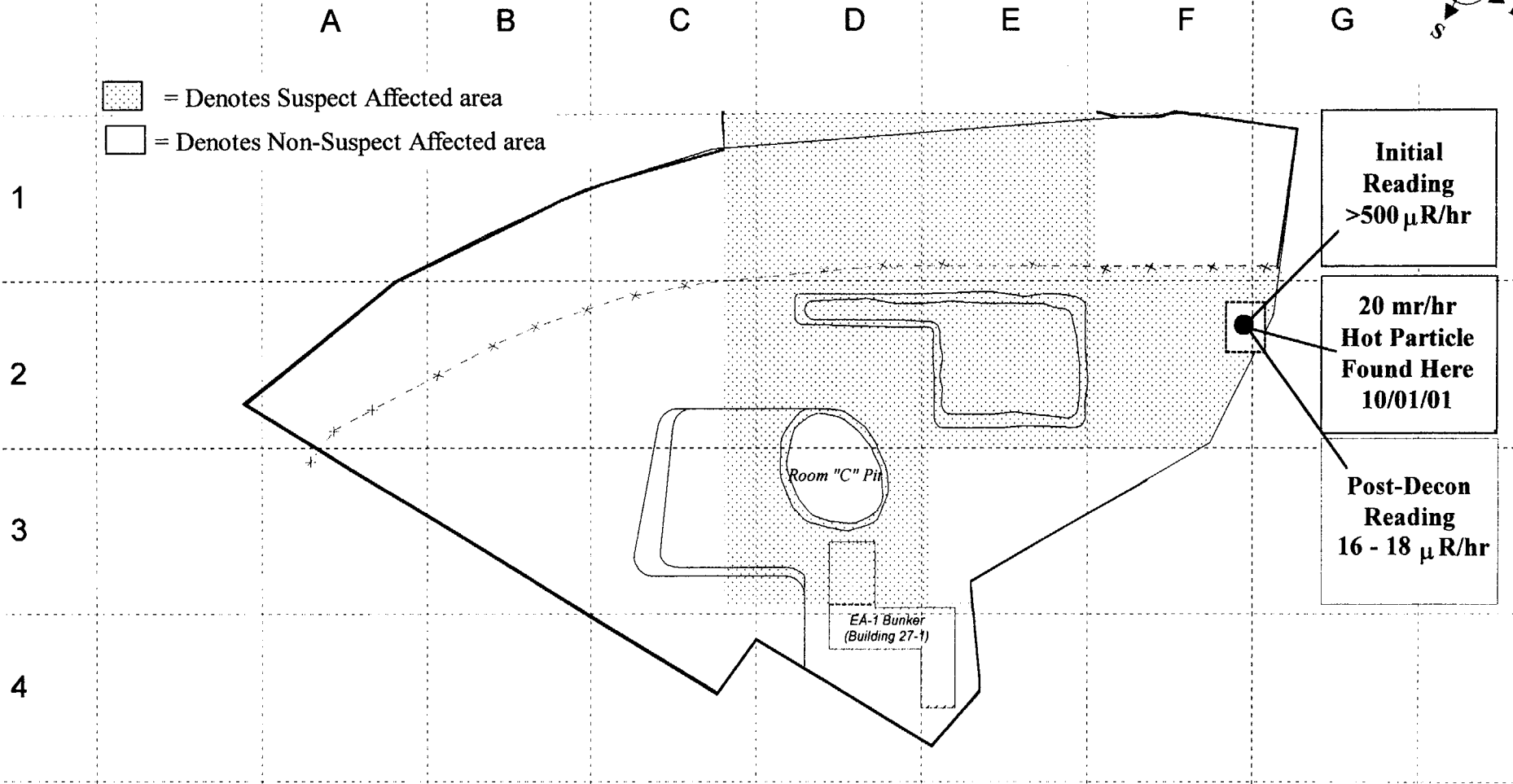
Instrument		
Model	Ludlum M-3	N/A
Serial #	153590	N/A
Cal Due Date	06/13/01	N/A

Technicians: B. Lyons and W. Schuck 06/01/01



**Figure 46: EA-1 Bunker Hot Particle Location**

10/01/2001





EA-1 Bunker				
<b>Instruments</b>	Model-3	N/A	N/A	N/A
<b>Serial Number</b>	153590	N/A	N/A	N/A
<b>Calibration Due</b>	12/11/2001	N/A	N/A	N/A
<b>Efficiency</b>	N/A	N/A	N/A	N/A
$\alpha$	$\beta$	$\gamma$		
			N/A	N/A
<b>Probe Number</b>	155190	N/A	N/A	N/A
<b>Probe Size</b>	2" x 2"	N/A	N/A	N/A
Comments: Hot Particle				
Signature: <u>C. Stanley J. Sullivan</u>				
Date: 10/01/2001				



Figure 47: EA-1 Bunker Hot Particle Area, Post Decontamination Soil Sample Locations

10/10/2001



 = Denotes Suspect Affected area  
 = Denotes Non-Suspect Affected area

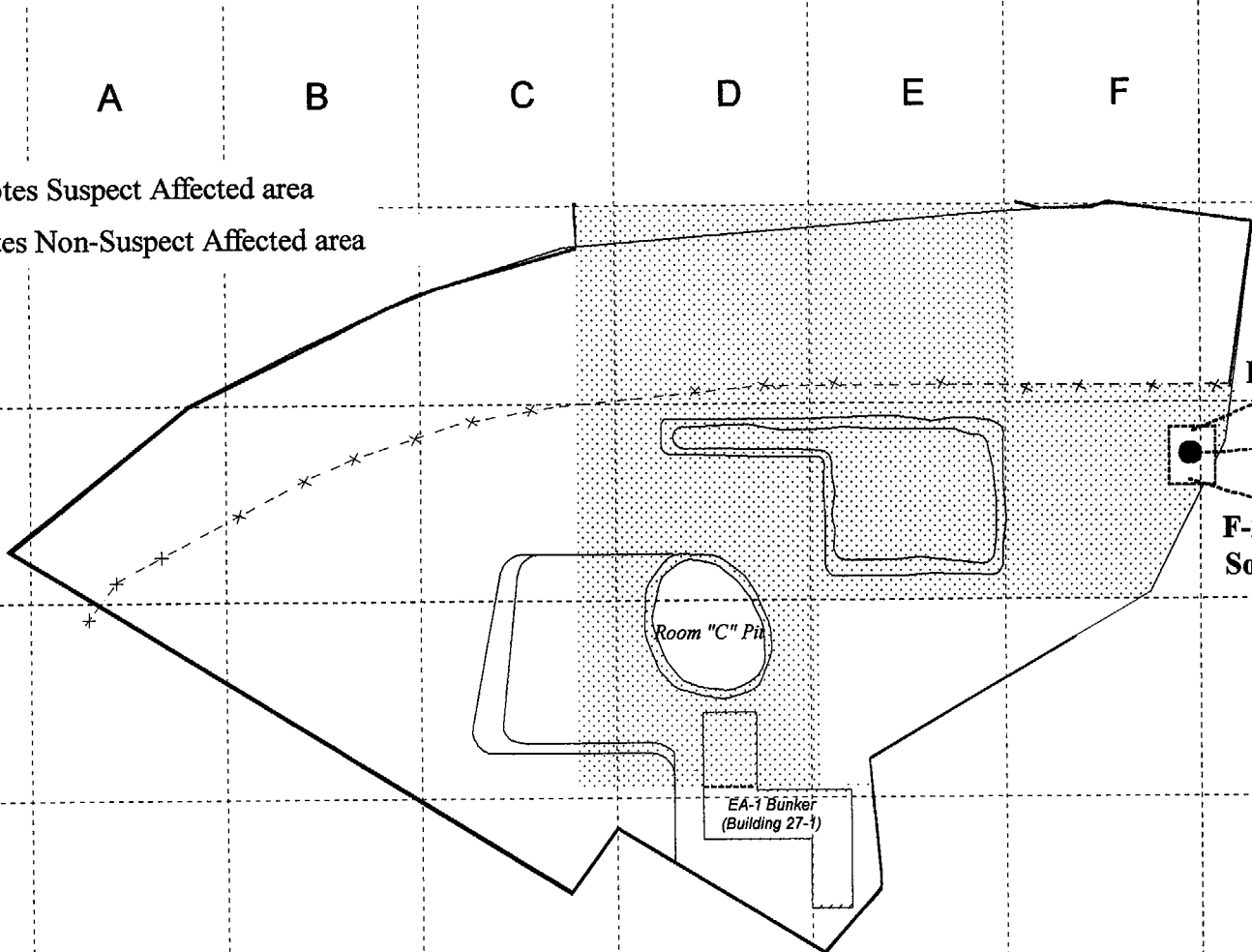
1

2

3

4

5



Location	EA-1 Bunker			
Instruments	N/A	N/A	N/A	N/A
Serial Number	N/A	N/A	N/A	N/A
Calibration Due	N/A	N/A	N/A	N/A
Efficiency	N/A	N/A	N/A	N/A
$\alpha$ / $\beta$ / $\gamma$	N/A	N/A	N/A	N/A
Probe Number	N/A	N/A	N/A	N/A
Probe Size	N/A	N/A	N/A	N/A

Comments: Post Decon Soil Samples.

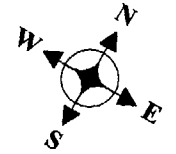
Signature: C. Stanley J. Sullivan

Date: 10/10/2001

 10 Meters

**Figure 48: EA-1 Bunker Soil Sample Locations and Exposure Rates at 1 meter for Areas Previously Excluded**

10/15/2001



= Denotes Suspect Affected area  
 = Denotes Non-Suspect Affected area

1

2

3

4

5

A

B

C

D

E

F

G

**C#** = Soil Sample Locations

C1	17 $\mu$ R/hr
C2	17 $\mu$ R/hr
C3	18 $\mu$ R/hr
C4	18 $\mu$ R/hr
C5	17 $\mu$ R/hr
C6	17 $\mu$ R/hr
C7	16 $\mu$ R/hr
C8	17 $\mu$ R/hr
C9	15 $\mu$ R/hr
C10	15 $\mu$ R/hr
C11	16 $\mu$ R/hr
C12	16 $\mu$ R/hr
C13	16 $\mu$ R/hr

Room "C" Pit

EA-1 Bunker  
(Building 27-1)

EA-1 Bunker				
Instruments	Model-19	N/A	N/A	N/A
Serial Number	158881	N/A	N/A	N/A
Calibration Due	11/16/2001	N/A	N/A	N/A
Efficiency	N/A	N/A	N/A	N/A
$\alpha$	$\beta$	$\gamma$	N/A	N/A
Probe Number	N/A	N/A	N/A	N/A
Probe Size	N/A	N/A	N/A	N/A

Comments: Soil Samples and 1 meter readings.

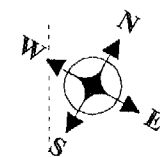
Signature: C. Stanley J. Sullivan



Date: 10/10/2001 - 10/15/2001



10 Meters

Figure 49: EA-1 Bunker Confirmatory Soil Sample Locations

09/26/2001



 = Denotes Suspect Affected area  
 = Denotes Non-Suspect Affected area

 = Denotes Suspect Affected area  
 Soil Sample Location  
 = Denotes Non-Suspect Affected area  
 Soil Sample Location

Location	EA-1 Bunker			
Instruments	N/A	N/A	N/A	N/A
Serial Number	N/A	N/A	N/A	N/A
Calibration Due	N/A	N/A	N/A	N/A
Efficiency	N/A	N/A	N/A	N/A
α	N/A	N/A	N/A	N/A
β	N/A	N/A	N/A	N/A
γ	N/A	N/A	N/A	N/A
Probe Number	N/A	N/A	N/A	N/A
Probe Size	N/A	N/A	N/A	N/A

Comments: Confirmatory Soil Samples

Signature: C. Stanley J. Sullivan Date: 09/26/2001

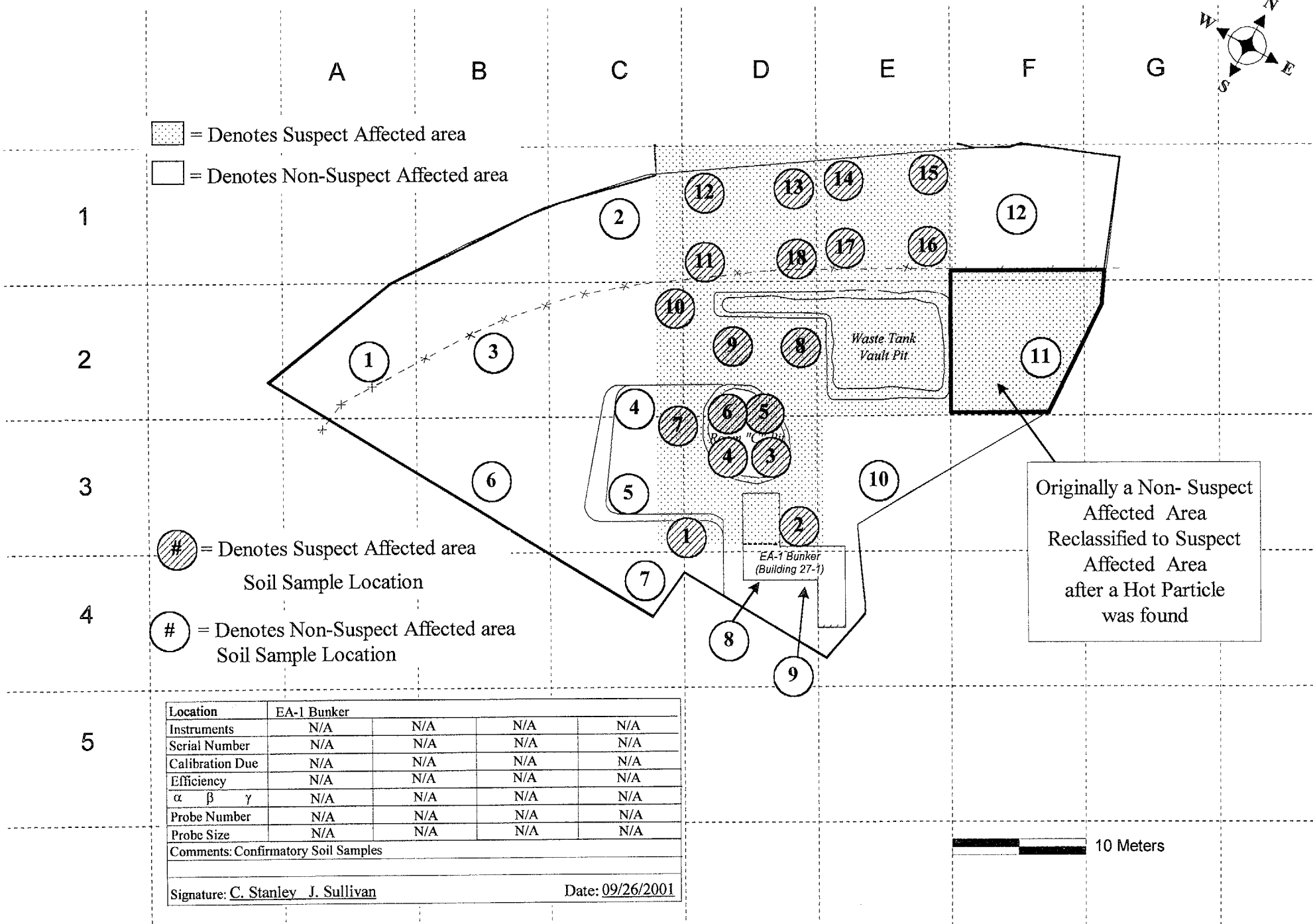


Figure 50: EA-1 Bunker Confirmatory Survey Exposure Rate Scan Measurement Locations



A B C D E F G

1

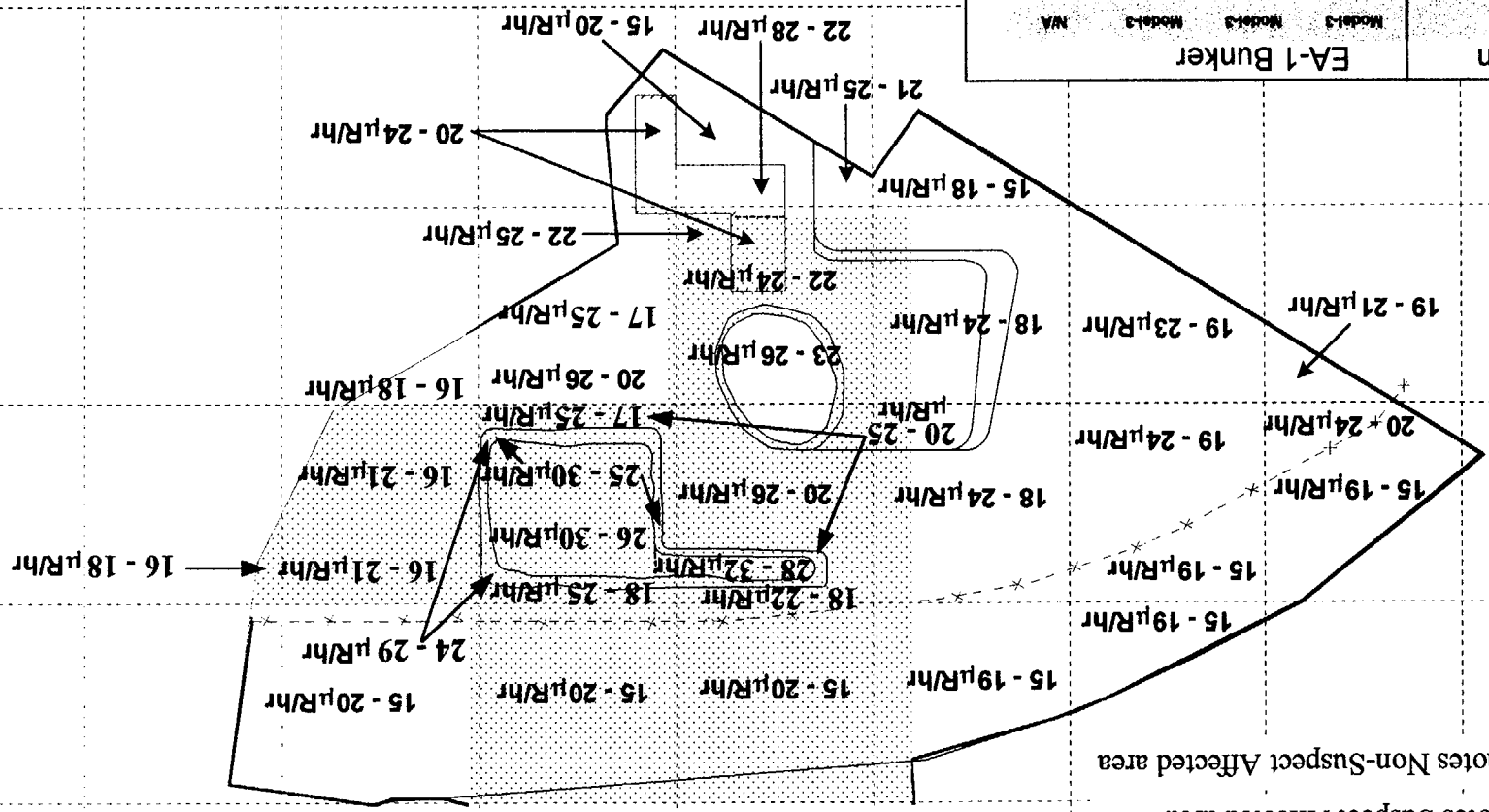
2

3

4

5

□ = Denotes Non-Suspect Affected area  
 ■ = Denotes Suspect Affected area

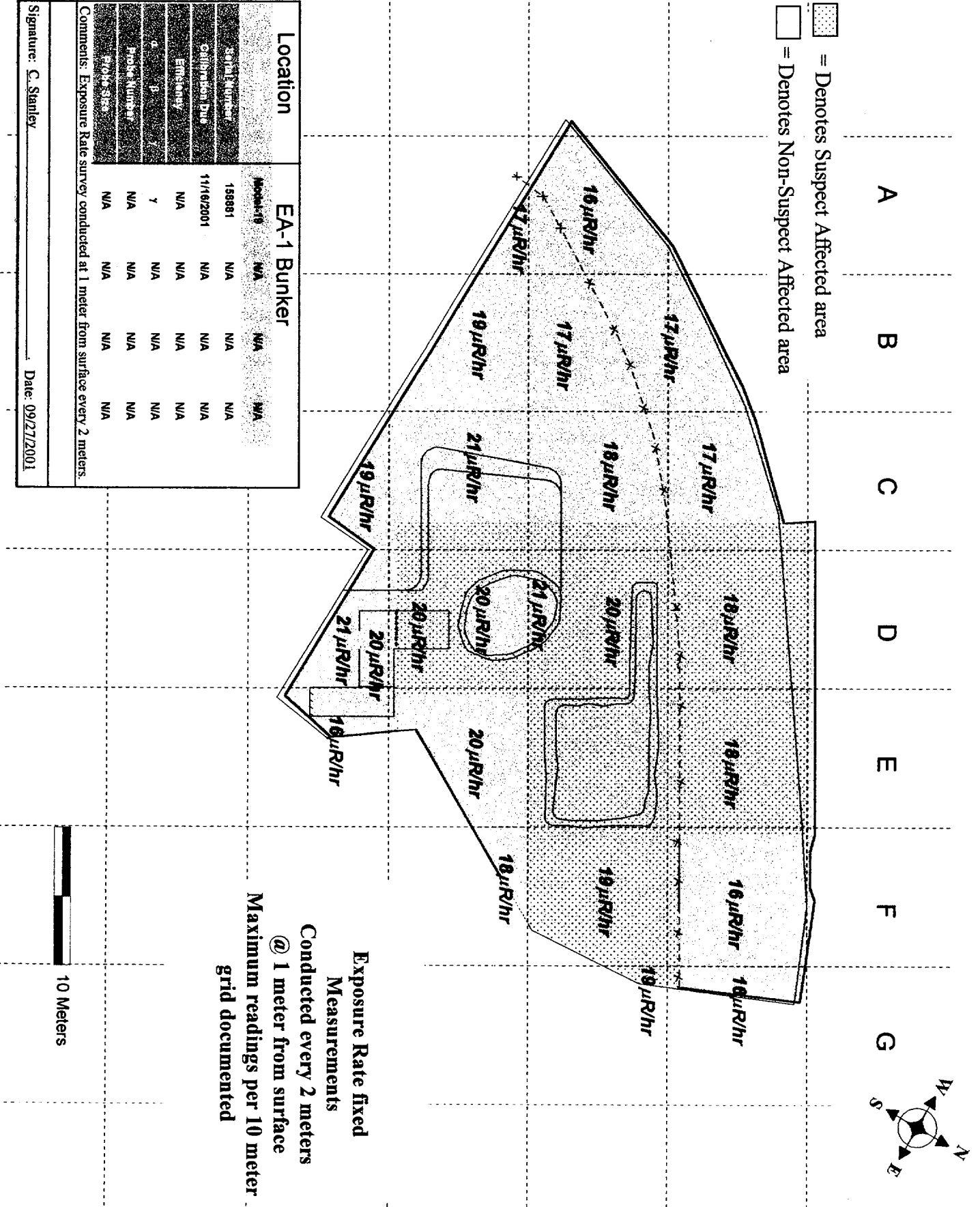


Location		EA-1 Bunker		
Model-3	Model-3	Model-3	Model-3	Model-3
153551	15348	153590	N/A	N/A
10/18/2001	11/16/2001	12/11/2001	N/A	N/A
N/A	N/A	N/A	N/A	N/A
155109	154618	155190	N/A	N/A
2" x 2"	2" x 2"	2" x 2"	2" x 2"	2" x 2"
Comments: Exposure Rate Survey conducted at ~ one inch from surface.				
100% Scan at ~ one inch from surface.				
Signature: C. Stanley, J. Sullivan, B. Lyons, W. Schuck Date: 10/1/01 - 10/12/01				

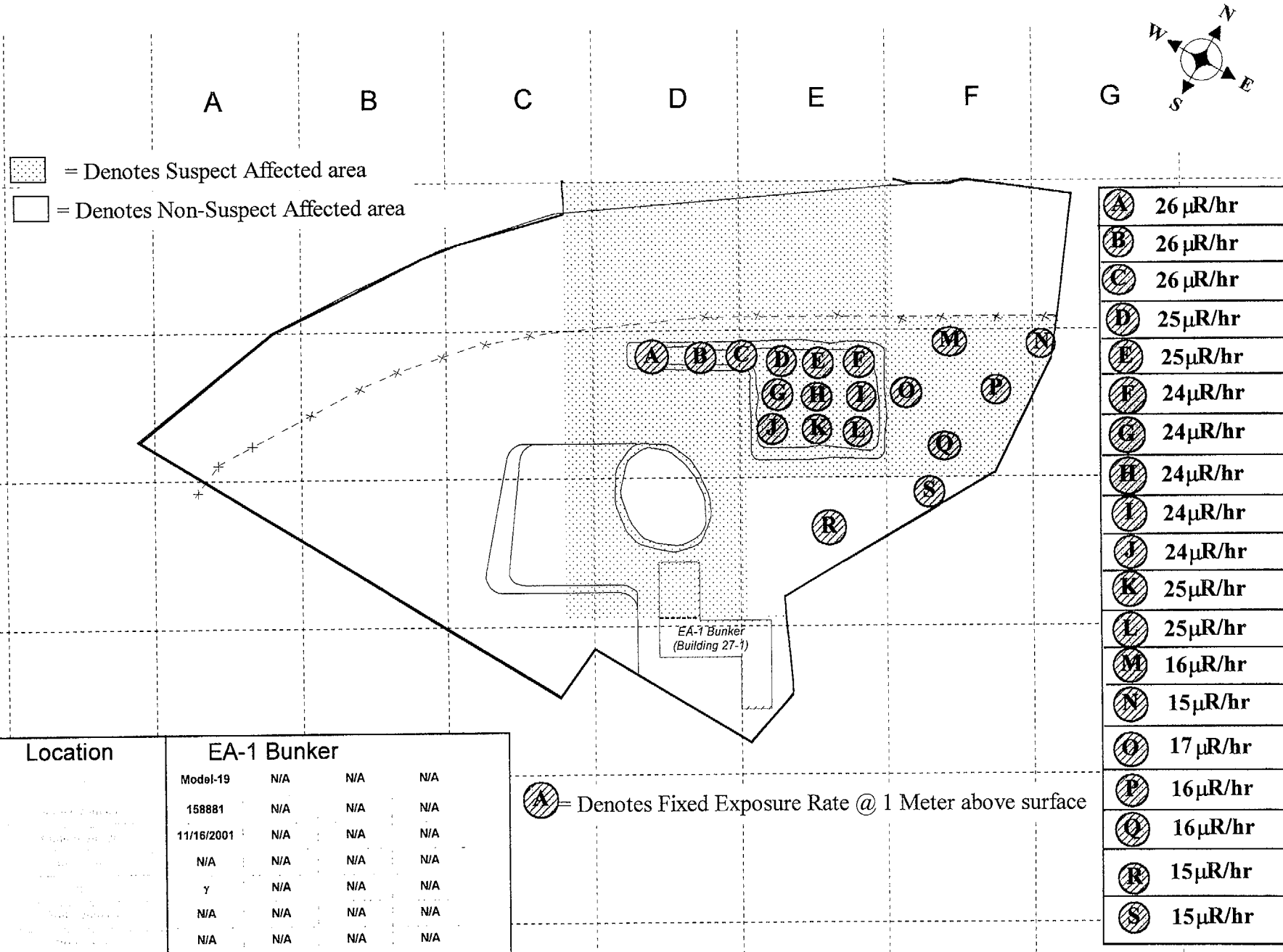


Figure 51: EA-1 Bunker Confirmatory Fixed Exposure Rate Measurement Locations and Results

09/27/2001



**Figure 52: EA-1 Bunker Confirmatory Fixed Exposure Rate Measurement Locations and Results for Waste Tank Pit and Areas Previously Excluded**



Location	EA-1 Bunker			
Model-19	N/A	N/A	N/A	N/A
158881	N/A	N/A	N/A	N/A
11/16/2001	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A
y	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A

Comments: Exposure Rate survey conducted at 1 meter from surface .

Signature: C. Stanley J. Sullivan Date: 10/10/2001

APPENDIX A  
"FINAL SURVEY PLANS

DATED FEBRUARY 11, 2000 AND APRIL 11, 2001"

TO

GA'S FINAL RADIOLOGICAL SURVEY REPORT FOR THE  
BUILDING 27-1 (EA-1 BUNKER) SITE

February 11, 2000

Prepared by: W. LaBonte *W. LaBonte*

Approved by: *Laura Q. Gonzales* Date: *2/11/00*  
L. Q. Gonzales

**Final Survey Plan for EA1 Bunker (Building 27-1)**

This survey plan is for EA1 Bunker (Building 27-1) surfaces that remained as a retaining wall for Building 27 following the EA-1 Bunker building demolition. This survey plan also addresses the surrounding soil and areas excavated during the dismantling of the building. Prior to implementing this plan, a Final Survey for the Waste Tank Vault excavation pit, and associated drain line excavation trench, was conducted in accordance with an approved Final Survey Plan.

This survey plan is for the building surfaces that remained following demolition of Rooms A, B & C and portions of the connecting hallway. The portions of the EA-1 Bunker that were found to be contaminated during the Characterization Survey were dismantled and packaged as Radioactive waste for disposal off site. Portions of the building that were not contaminated were surveyed and disposed of in a local landfill facility.

This plan also includes the surrounding soil surfaces, asphalt roadways, and areas excavated during the building and storage well dismantling. The soil surfaces to be included in this plan are the areas illustrated in Figure 1, EA-1 Bunker (Building 27-1) Affected Area Classification.

**Background and Classification**

**Background Information**

Building 27-1 (the EA1 Bunker) was originally constructed by General Atomics, Division of General Dynamics, in 1965. This facility was a single level, heavily shielded, concrete block structure situated North of, and adjacent to, Building 27 (EA1). The building, which covered approximately 1255 ft<sup>2</sup>, was divided into 3 laboratories which were joined by a common hallway. The laboratory spaces were identified as Room A (West), Room B (East), and Room C (Center). The bulkheads and ceiling of Rooms A and B and the hallways were constructed of 12 inch thick concrete. The ceiling of Room C was constructed of corrugated steel capped with concrete. The South and West walls of the building were back filled with an earthen fill. There is a sub floor beneath the main floor. The space between these floors was earthen filled.

Room C, which was added in 1973, contained 12 below ground cylindrical storage wells previously used for storage of high level radioactive material. Each well was approximately 10 inches in diameter and 12 feet deep.

Building 27-1 was surrounded by a fenced-in service yard that is approximately 15,300 ft<sup>2</sup>.

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This service yard contained a bermed radioactive waste storage area, a small metal shed, and a below ground liquid waste holding tank.

During the operating history of this facility, the laboratories were used for several projects including; DOE sponsored HTGR advanced fuel studies and commercial radiopharmaceutical production of  $^{90}\text{Y}$ .

### Classification

The entire building is classified as an **Affected Area**. Rooms A, B, and C, and the connecting hallways are classified as **Suspect Affected Areas** and the stair well is classified as **Non-Suspect Affected Area**. See Figure 1, EA-1 Bunker (Building 27-1) Affected Area Classification.

### Survey Objectives and Responsibility

The purpose of performing a final survey is to demonstrate that the radiological conditions satisfy the NRC and State of California guidelines for release to unrestricted use. The objectives include (1) to show that the average surface contamination levels for each survey unit are within the authorized value, (2) to show that the maximum residual activity ("hot spot" area) does not exceed three times the average value in an area up to  $100\text{ cm}^2$ , (3) that a reasonable effort has been made to clean removable contamination and fixed contamination and (4) that the exposure rates in occupiable locations are less than  $10\text{ }\mu\text{R/hr}$  above background measured at 1 meter above the surface. Samples will be taken by qualified Health Physics technicians having a minimum of 3 years Health Physics Technician experience following approved Health Physics procedures and this plan. The survey and final report documenting the survey will be performed by GA's Health Physics group.

### Release Criteria (per GA Site Decommissioning Plan)

#### Facility Structure Criteria

Characterization surveys performed in this building included gamma spectroscopy analysis and  $^{90}\text{Sr}$  analysis (performed by a contracted laboratory). Many of the samples taken indicated the presence of  $^{90}\text{Sr}$ . This factor combined with knowledge of facility use in the past concludes that  $^{90}\text{Sr}$  is the most likely Radionuclide.

The applicable release criteria for internal building surfaces, based on  $^{90}\text{Sr}$ , are:

**1,000 dpm/100  $\text{cm}^2$ , averaged over 1  $\text{m}^2$  area**  
**3,000 dpm/100  $\text{cm}^2$ , maximum in a 100  $\text{cm}^2$  area**  
**200 dpm/100  $\text{cm}^2$ , removable activity**

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Alpha contamination was not detected on any of the Characterization surveys and alpha emitters were not detected in any of the samples analyzed by gamma spectroscopy.

### Exposure Rate Measurements

The guideline value for exposure rates measured at 1 m above the surface is 10  $\mu$ R/hr above background.

### Soil Criteria (soil limits apply to roof gravel, concrete rubble and asphalt rubble)

The release criteria for soil are specified in the Site Decommissioning Plan and summarized below. The values presented below are above background levels. **Note: Soil, asphalt and concrete rubble must remain on-site until specific approval to move it off-site is granted by the NRC and the State of California.**

Cs-137	15 pCi/g
Co-60	8 pCi/g
Enriched Uranium (U-234 plus U-235)	30 pCi/g
Thorium (Th-232 plus Th-228)	10 pCi/g
Sr-90	1800 pCi/g

If multiple nuclides are present, the sum of the ratios of the concentration of each Radionuclide to its respective guideline must not exceed 1. **If other nuclides are encountered, notify HP Management for release criteria.**

**Gross alpha/beta results are required for a representative number of soil samples (to have an upper bound for the maximum Sr-90 which could be in the soil). Sr-90 analysis may also be required.**

### Alert Levels

If the following "alert levels" are exceeded, notify HP Management so an evaluation can be performed to determine if increased survey coverage or decontamination is required.

### On Concrete or Asphalt Surfaces

**Note: The Alert levels provided below are based on the background cpm plus the meter cpm value taking into account the instrument efficiency and probe surface area. The alert level for each instrument used must be determined prior to performing surveys. The**

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**background determination must be performed in building 13 or other HP management approved area.**

#### Alpha Monitoring

>100 cpm alpha using the large area (434 cm<sup>2</sup>) probe. If >100 cpm, check with a hand held alpha meter.

>60 cpm using a hand held alpha probe, notify Health Physics Management.

#### Beta Scanning using 434 cm<sup>2</sup> probe

> ~1900 cpm beta using the large area (434 cm<sup>2</sup>) probe (#84459)

> ~2300 cpm beta using the large area (434 cm<sup>2</sup>) probe (#73701)

> ~300 cpm above background using any other 434 cm<sup>2</sup> probe

**Exceeding the Alert Level:** To determine if additional decontamination is necessary in areas where the Alert Level has been exceeded, the following should be performed:

At the 10, 1m grid locations which had the highest floor monitor readings, scan the 1m grid using the 100 cm<sup>2</sup> probe (for each instrument). If readings are >650 cpm, decontamination may be required; notify HP Management. If readings are <650 cpm, no further decontamination is needed; this represents ~200 cpm above background (400 counts for a 2 minute count)

#### Beta Measurement Using the 100 cm<sup>2</sup> probe

> ~1300 counts in 2 minutes using the beta 100 cm<sup>2</sup> gas flow proportional counter (s/n 84423)

> ~1150 counts in 2 minutes using the beta 100 cm<sup>2</sup> gas flow proportional counter (s/n 86332)

> ~200 cpm (400 counts in 2 minutes) above background for other beta 100 cm<sup>2</sup> gas flow proportional counter or if probe calibration has changed or if other changes to the meter have been made. **Ensure the background determination has been completed at building 13 (or other HP Management approved location).**

#### Beta measurement Using the Pancake GM probe

> 150 cpm

**Decontamination Required-** when (1) Pancake GM measurement > 150 cpm or (2) values greater than those provided above using the 100 cm<sup>2</sup> probe.

### Exposure Rate Measurement

Exposure rate measurements at contact (1-2" above the surface) and at 1m above the surface: 20  $\mu$ R/hr.

### Soil, Gravel, Asphalt Rubble, Concrete Rubble Samples

Any Radionuclide above natural background levels (see HP-40 for background levels). All soil sample results must be reviewed by Laura Gonzales, Paul Maschka, or Bill LaBonte.

### Site Conditions at Time of Final Survey

All equipment, service lines and supporting fixtures were removed from the restricted areas, decontaminated as appropriate, surveyed and released or disposed of as radioactive waste. The walls, floor and ceiling of Room A, B, &C and portions of the connecting hallway with fixed levels of contamination were coated with a Polymeric Barrier to ensure the activity would remain fixed. The soil backfill has been removed from the external walls. The floor, walls, and ceiling of the building have been removed except for the South stairwell and enclosing walls which will be used as a retaining wall. The high level storage wells in Room C were filled with concrete and an absorbent material, then welded closed. The wells were removed in 1 piece and prepared for disposal as radioactive waste off-site. The remaining interior portions of the facility that had localized spots of fixed contamination (identified on the Characterization survey) were decontaminated. The piping for the Liquid Waste Tank was excavated, cut up, and packaged for disposal as radioactive waste. The Liquid Waste Tank and its concrete vault were excavated and packaged for disposal as radioactive waste. The Final Survey for the Waste Tank Vault and associated drain line has been completed.

All floor drains and utility lines encountered during building demolition were removed, surveyed, and dispositioned based on survey results. There is 1 piece of cast iron drain line between the upper and lower floors of the remaining structure that was apparently an abandoned floor drain for the sub-floor. This item could not be removed because additional excavation would jeopardize the integrity of Building 27.

A Post D&D Survey was performed on the remaining building portions and soil surfaces to provide reasonable assurances that no additional remediation was required.



### Final Survey Requirements

The minimum survey requirements for this final survey are outlined in Table-1, Planned Surveys for Building 27-1, (EA-1 Bunker). The minimum number of survey points and locations is identified in Enclosure -1, EA-1 Bunker, (Building 27-1), Final Survey Grid Maps.

Soil and asphalt sampling/surveys will be performed in accordance with Figure - 2, EA-1 Bunker (Building 27-1) Soil Sampling Plan.

### Documentation

**Every** survey conducted must be documented on a **daily basis** on a drawing showing the approximate locations surveyed. Include the results (including units), the technicians' signature, date, instrument(s) used, efficiency, background readings (if applicable) and any other applicable information.

Figure 1: EA-1 Bunker (Building 27-1) Affected Area Classification

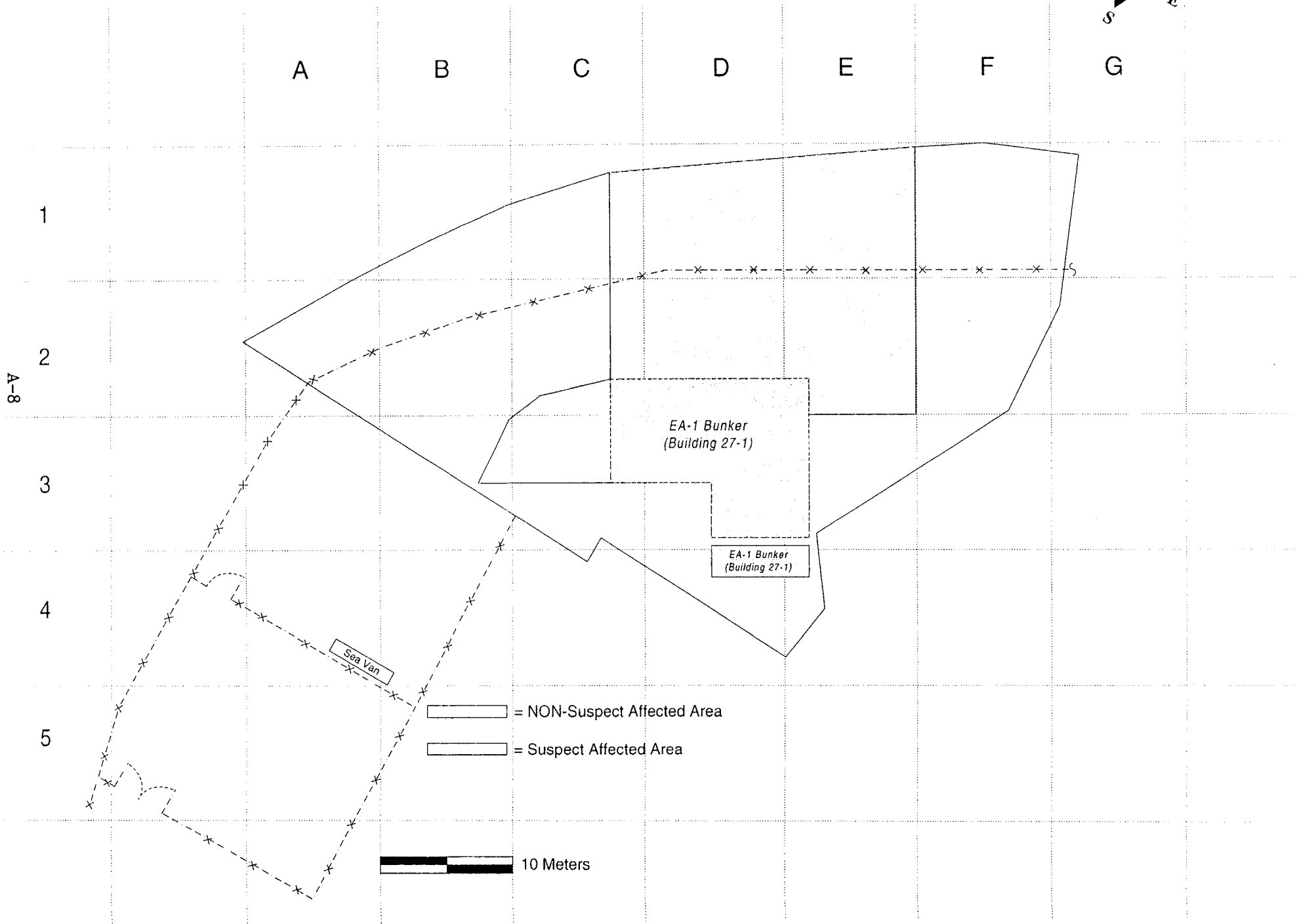
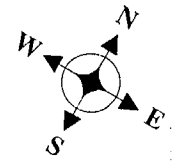
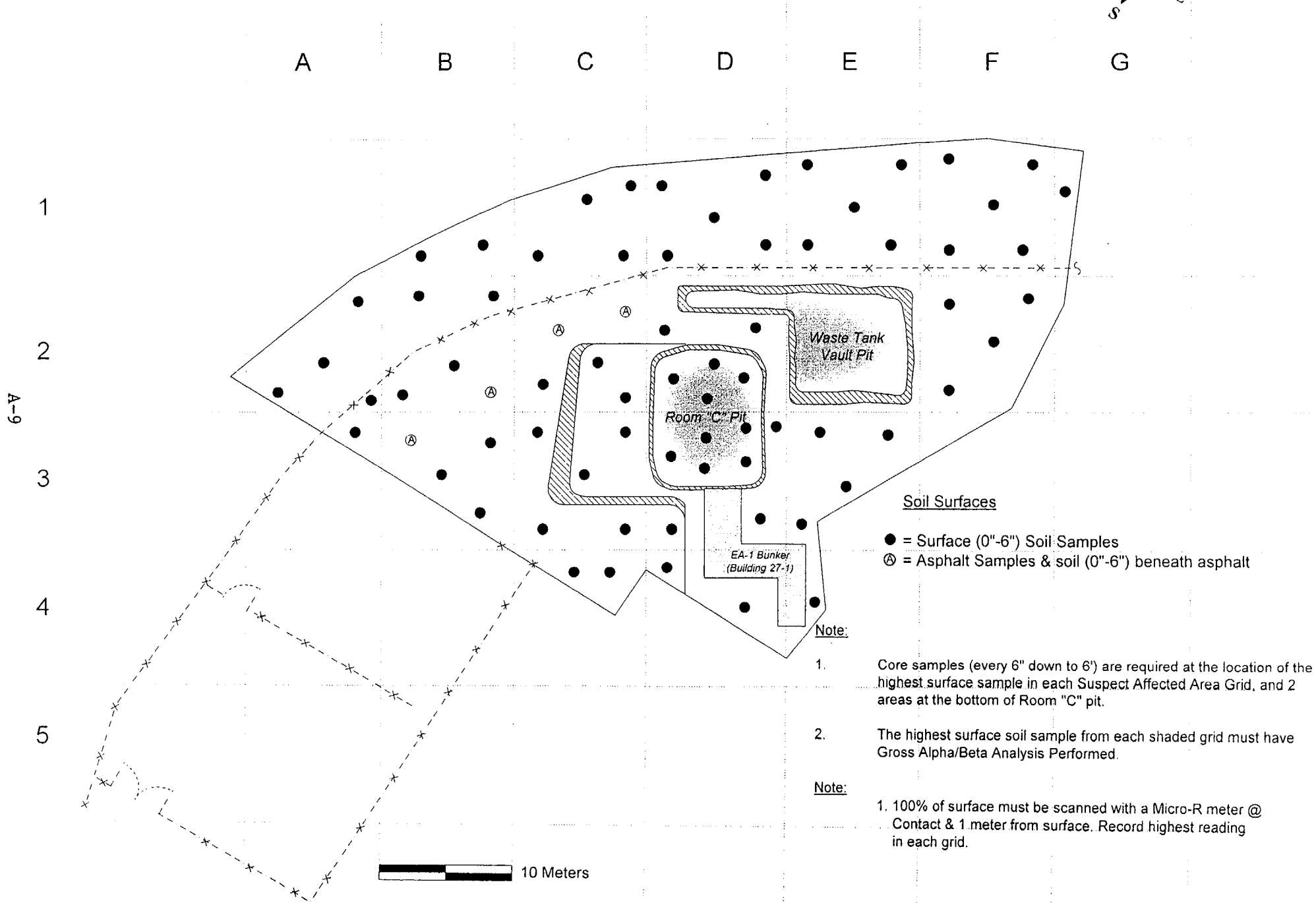
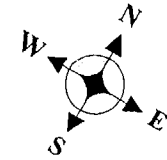


Figure 2: EA-1 Bunker (Building 27-1) Soil Sampling Plan



**Table - 1, Planned Surveys for Building 27-1 (EA1 Bunker)**

<b>Type of Survey</b>	<b>Corridor</b>	<b>Stairwells</b>	<b>External Walls</b>	<b>Land Areas<sup>(1)</sup></b>
<b>Smears (100 cm<sup>2</sup>)</b>	loacations identified in enclosure-1, 100% β,γ, 10% α	locations identified in enclosure-1, 100% β,γ, 10% α	locations identified in enclosure-1, 100% β,γ, 10% α	NA
<b>Masslinn Wipes</b>	100%, β,γ	100%, β,γ	100%, β,γ	NO
<b>Direct α,β Scans<sup>(3)</sup></b>	See below	See below	See below	100% β, 10% α on Asphalt & Concrete
<i>Floors</i>	100% β, 10% α	100% β, 10% α	100% β, 10% α	NA
<i>Walls below 2m</i>	100% β, 10% α	100% β, 10% α	100% β, 10% α	NA
<i>Walls above 2m</i>	10% β, 10% α	10% β, 10% α	10% β, 10% α	NA
<i>Other</i>	NA	Steps & Handrail 100% β, 10% α	NA	NA
<b>Direct γ Scans<sup>(2)</sup></b>	See below	See below	See below	100% scan at @ contact and @ 1m from surface
<i>Floors</i>	μR readings every 1 m. See Enclosure 1	μR readings every 1 m. See Enclosure 1	NA	NA
<i>Walls</i>	μR readings every 1 m. See Enclosure 1	μR readings every 1 m. See Enclosure 1	μR readings every 1 m. See Enclosure 1	NA
<i>Other</i>	NA	1 μR reading every 1 m on steps.	NA	NA
<b>Samples</b>	See below	See below	See below	See below
<i>Asphalt</i>	NA	NA	NA	As identified in Figure-2, Soil Sampling Plan
<i>Concrete</i>	NO	NO	NO	NA
<i>Soil</i>	NA	NA	NA	As identified in Figure-2, Soil Sampling Plan

(1) All readings to be taken with a μR meter using a 1" X 1" or 2" x 2" NaI detector.

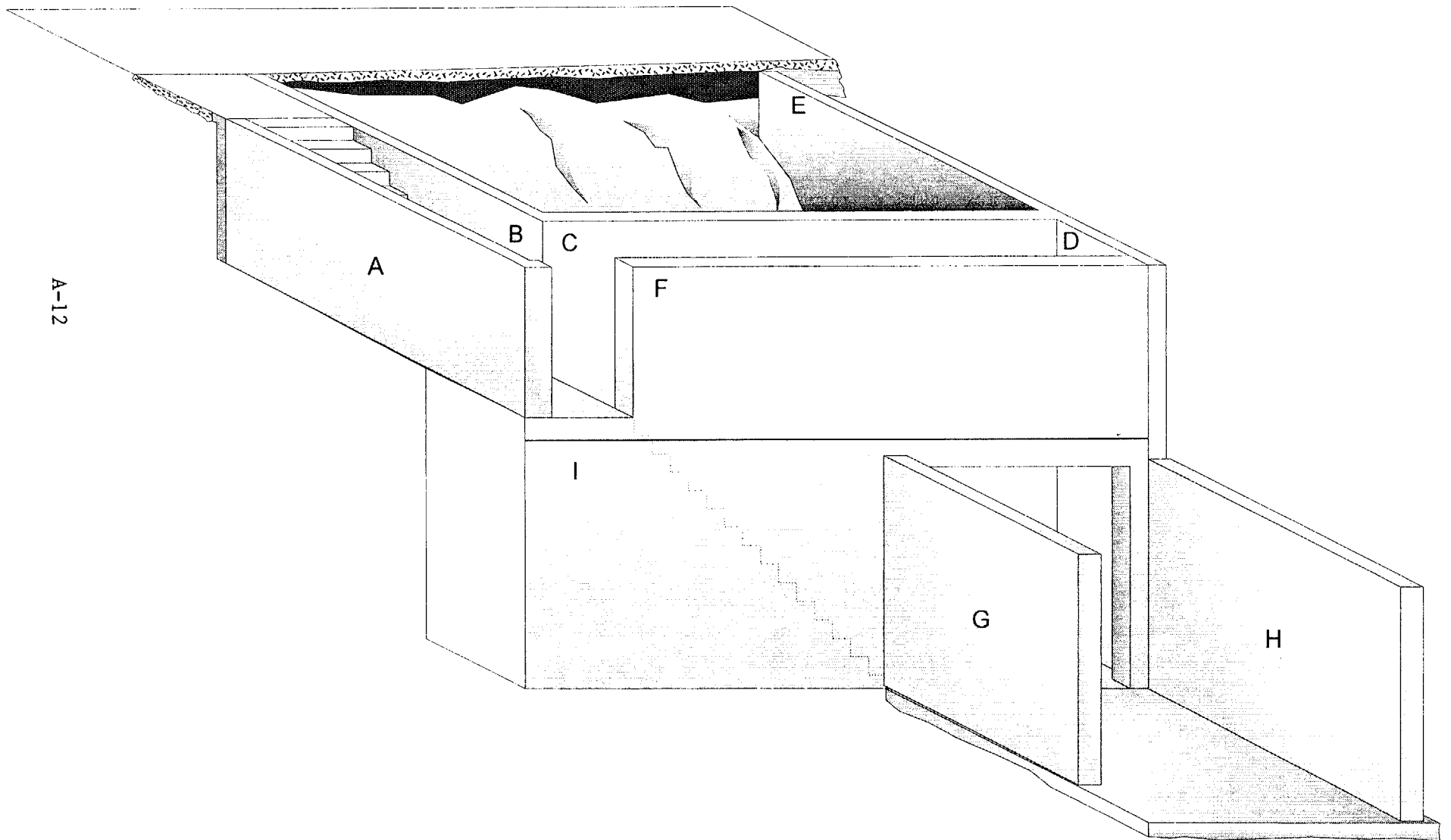
(2) Flat/smooth surfaces should be scanned using a Model 2221 ratemeter with a 434 cm<sup>2</sup> probe (preferably), or with a 100 cm<sup>2</sup> probe. Rough surfaces or small items should be scanned with a pancake GM detector.

**Enclosure - 1**

**EA - 1 Bunker (Building 27-1)**

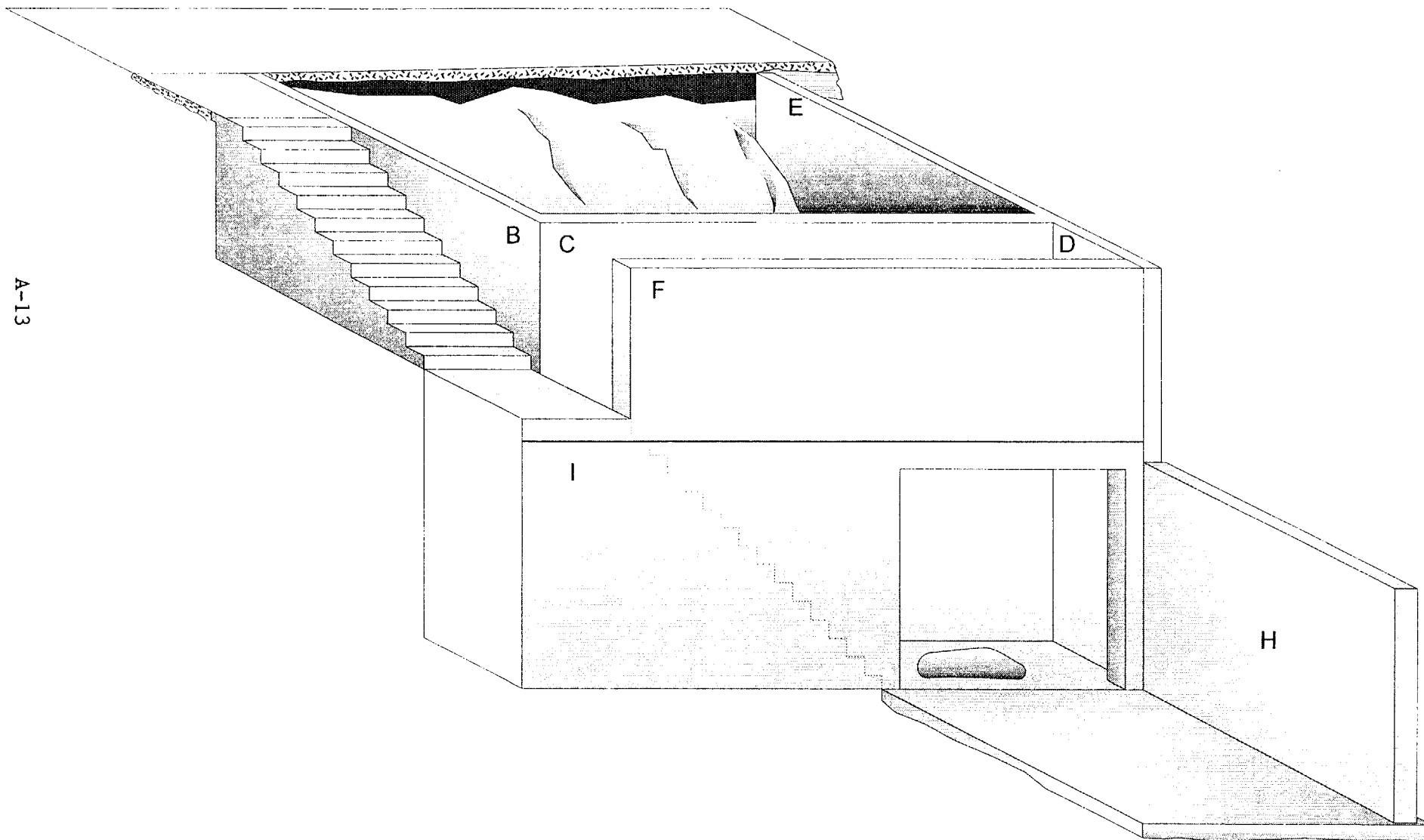
**Final Survey Grid Maps**

Enclosure - 1, EA-1 Bunker (Building 27-1), Final Survey Grid Maps

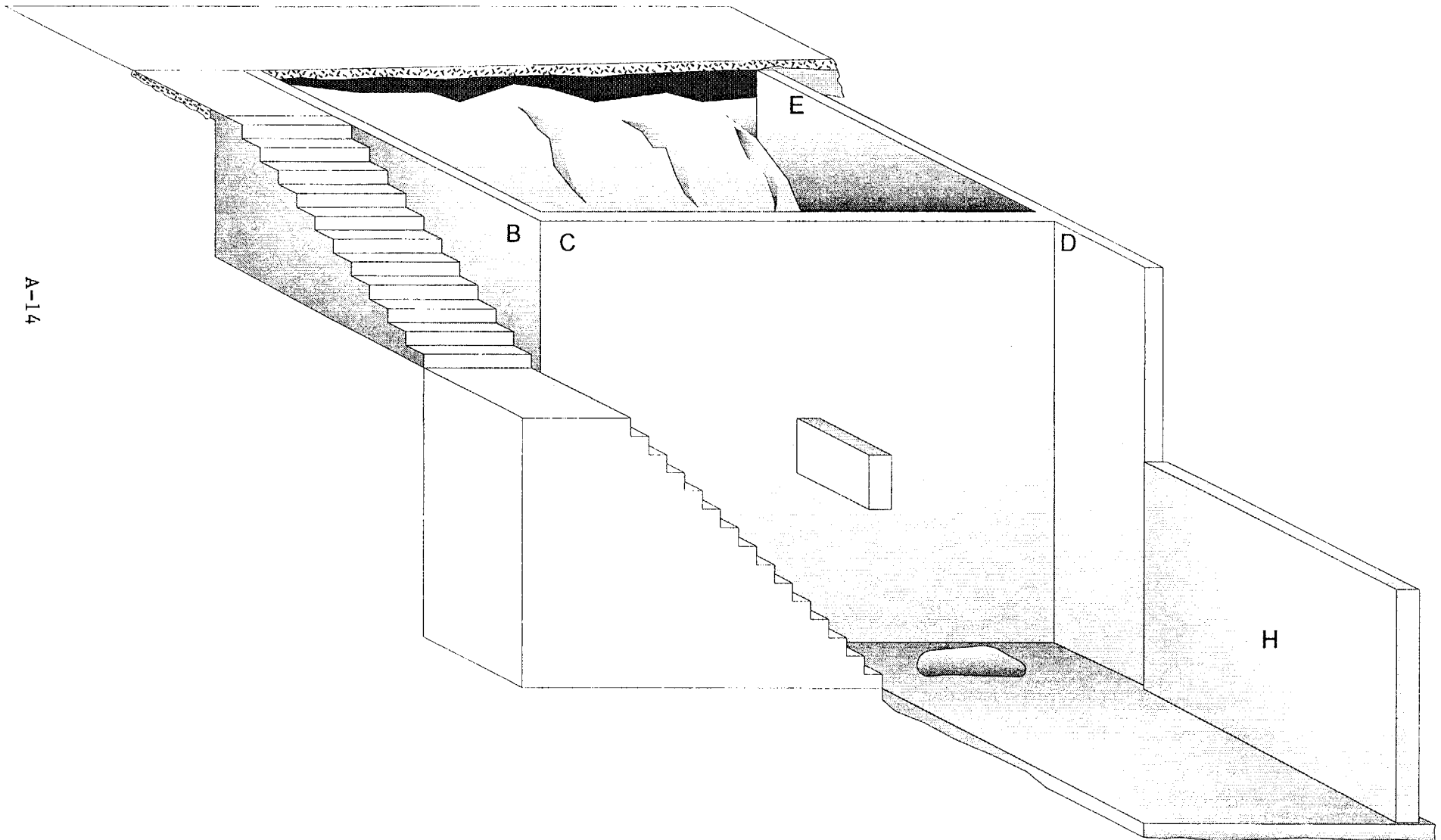


A-12

Enclosure - 1, EA-1 Bunker (Building 27-1), Final Survey Grid Maps



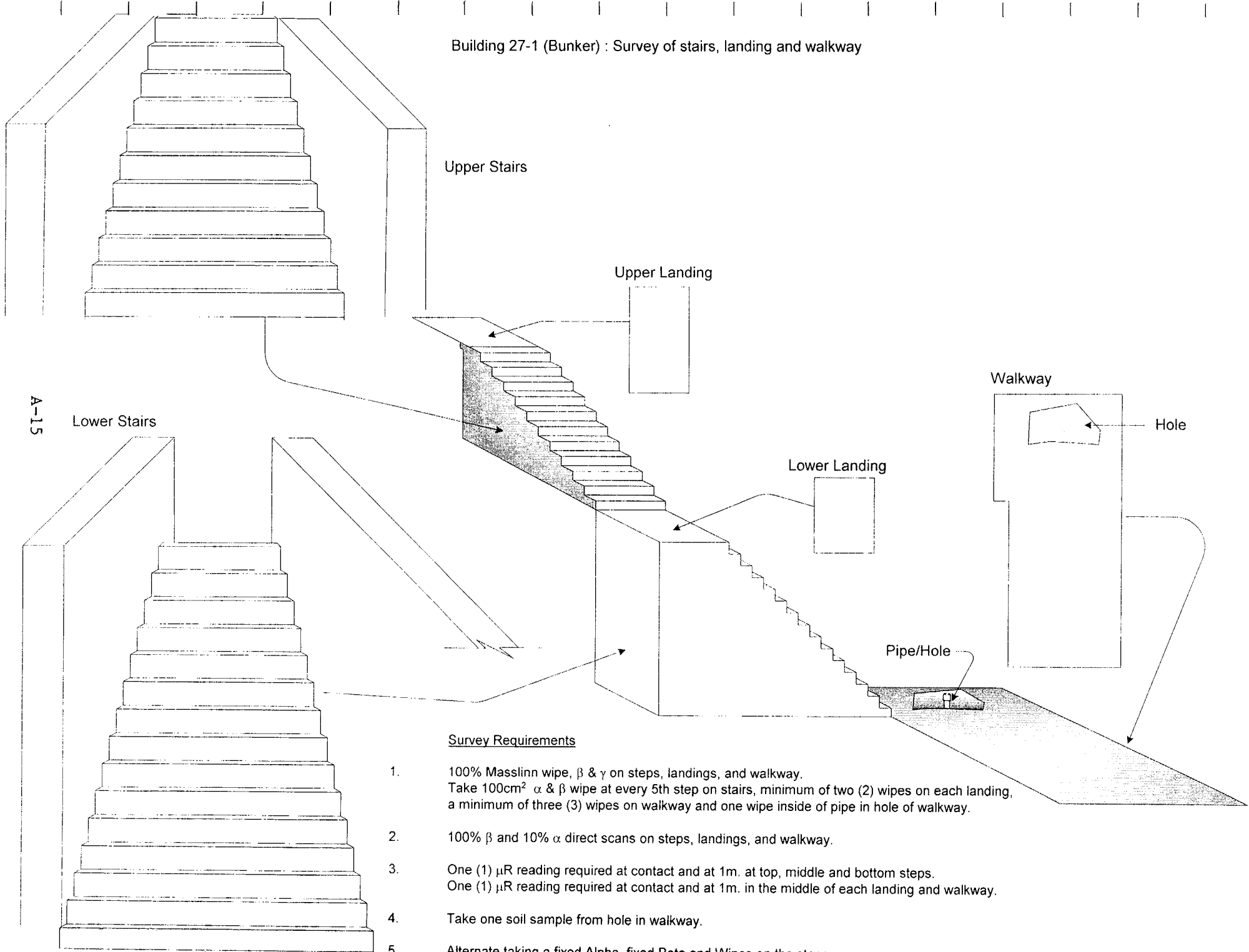
Enclosure - 1, EA-1 Bunker (Building 27-1), Final Survey Grid Maps



A-14



Building 27-1 (Bunker) : Survey of stairs, landing and walkway

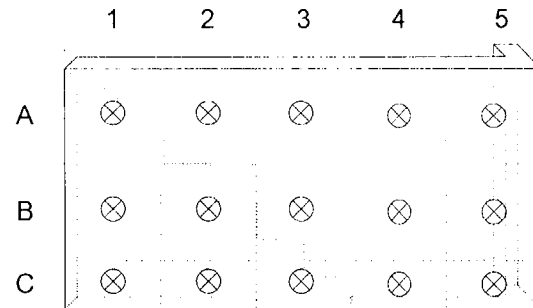


Survey Requirements

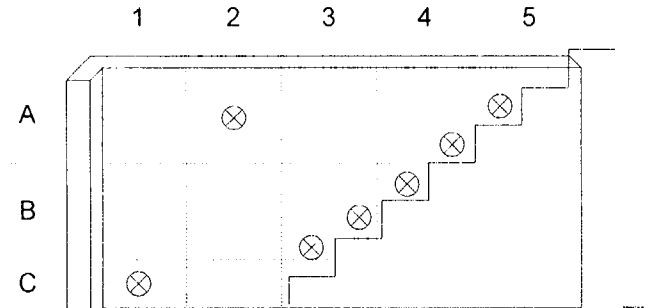
1. 100% Masslinn wipe,  $\beta$  &  $\gamma$  on steps, landings, and walkway.  
Take 100cm<sup>2</sup>  $\alpha$  &  $\beta$  wipe at every 5th step on stairs, minimum of two (2) wipes on each landing, a minimum of three (3) wipes on walkway and one wipe inside of pipe in hole of walkway.
2. 100%  $\beta$  and 10%  $\alpha$  direct scans on steps, landings, and walkway.
3. One (1)  $\mu$ R reading required at contact and at 1m. at top, middle and bottom steps.  
One (1)  $\mu$ R reading required at contact and at 1m. in the middle of each landing and walkway.
4. Take one soil sample from hole in walkway.
5. Alternate taking a fixed Alpha, fixed Beta and Wipes on the steps.

Enclosure - 1, EA-1 Bunker (Building 27-1), Final Survey Grid Maps

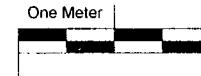
Wall "A": Internal and External



External "A" Wall



Internal "A" Wall



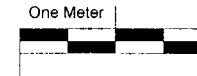
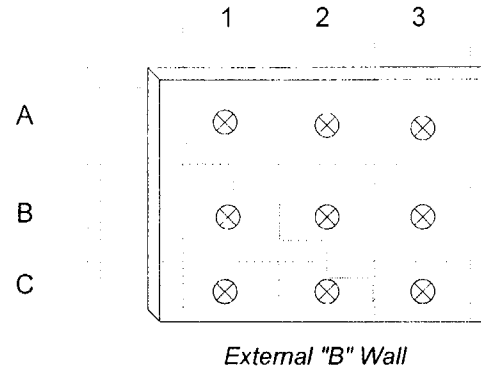
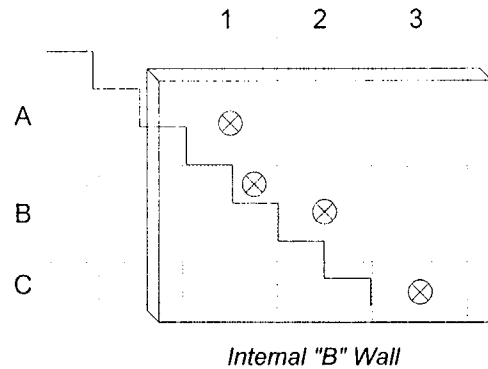
A-16

Survey Requirements

1. The circled X<sup>s</sup> are approximate locations of wipes to be taken. These must be counted for gross  $\alpha$ ,  $\beta$ . In addition, Fixed Alpha and Fixed Beta measurements will be taken at approximate locations.
2. 100% Masslinn wipe,  $\beta, \gamma$ , required.
3. 100%  $\beta$  and 10%  $\alpha$  Direct Scans in B & C rows/grids, (plus A-4 and A-5 on internal wall).
4. 10%  $\beta$  and 10%  $\alpha$  Direct Scans in A grids (row A).
5. One (1)  $\mu$ R reading required, contact and at One (1) meter in each grid.
6. 100%  $\beta$  and  $\alpha$  direct scans required on steps and handrails, if present.

Enclosure - 1, EA-1 Bunker (Building 27-1), Final Survey Grid Maps

Wall "B": Internal and External



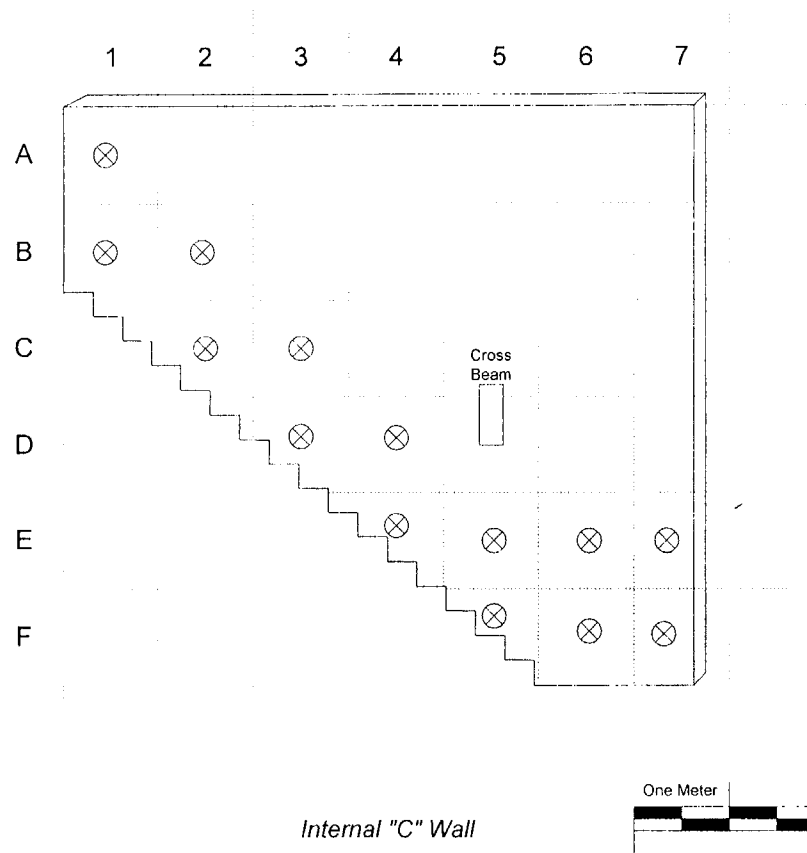
A-17

Survey Requirements

1. The circled X's are approximate locations of wipes to be taken. These must be counted for gross  $\alpha$ ,  $\beta$ . In addition, Fixed Alpha and Fixed Beta measurements will be taken at approximate locations.
2. 100% Masslinn wipe,  $\beta, \gamma$ , required.
3. 100%  $\beta$  and 10%  $\alpha$  Direct Scans in B & C rows/grids, (plus A-1 on internal wall).
4. 10%  $\beta$  and 10%  $\alpha$  Direct Scans in A grids (row A).
5. One (1)  $\mu R$  reading required, contact and at One (1) meter in each grid.
6. 100%  $\beta$  and  $\alpha$  direct scans required on steps and handrails, if present.

Enclosure - 1, EA-1 Bunker (Building 27-1), Final Survey Grid Maps

Wall "C": Internal



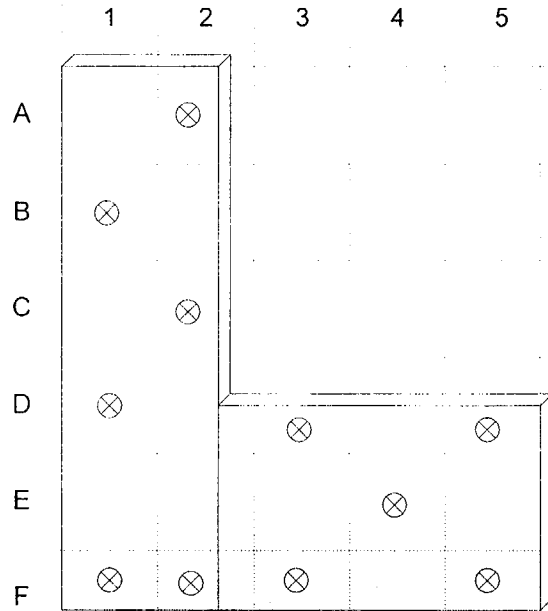
Survey Requirements

1. The circled X's are approximate locations of wipes to be taken. These must be counted for gross  $\alpha$ ,  $\beta$ . In addition, Fixed Alpha and Fixed Beta measurements will be taken at approximate locations.
2. 100% Masslinn wipe,  $\beta, \gamma$ , required.
3. 100%  $\beta$  and 10%  $\alpha$  Direct Scans in; F-5,6 & 7, E-4, 5, 6 & 7, D-3 & 4, C-1, 2 & 3, B-1 & 2, A-1 & 2.
4. 10%  $\beta$  and 10%  $\alpha$  Direct Scans in grids not listed in 3 above.
5. One (1)  $\mu$ R reading required, contact and at One (1) meter in each grid.
6. 100%  $\beta$  and  $\alpha$  direct scans required on steps and handrails, if present.

Enclosure - 1, EA-1 Bunker (Building 27-1), Final Survey Grid Maps

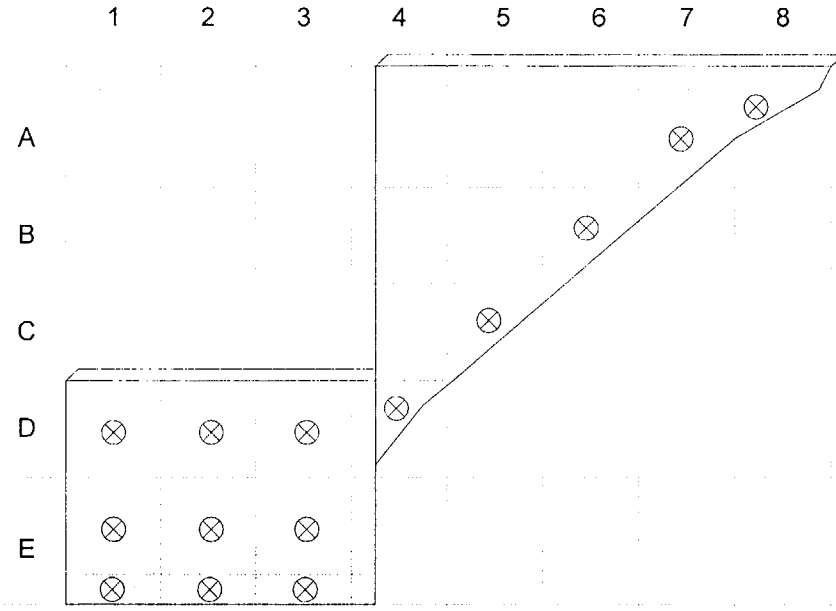
Wall "D": "E" and "H" Internal and External

A-19



Internal "D" Wall

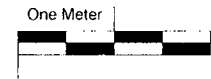
Internal "H" Wall



External "H" Wall

External "D" Wall

External "E" Wall

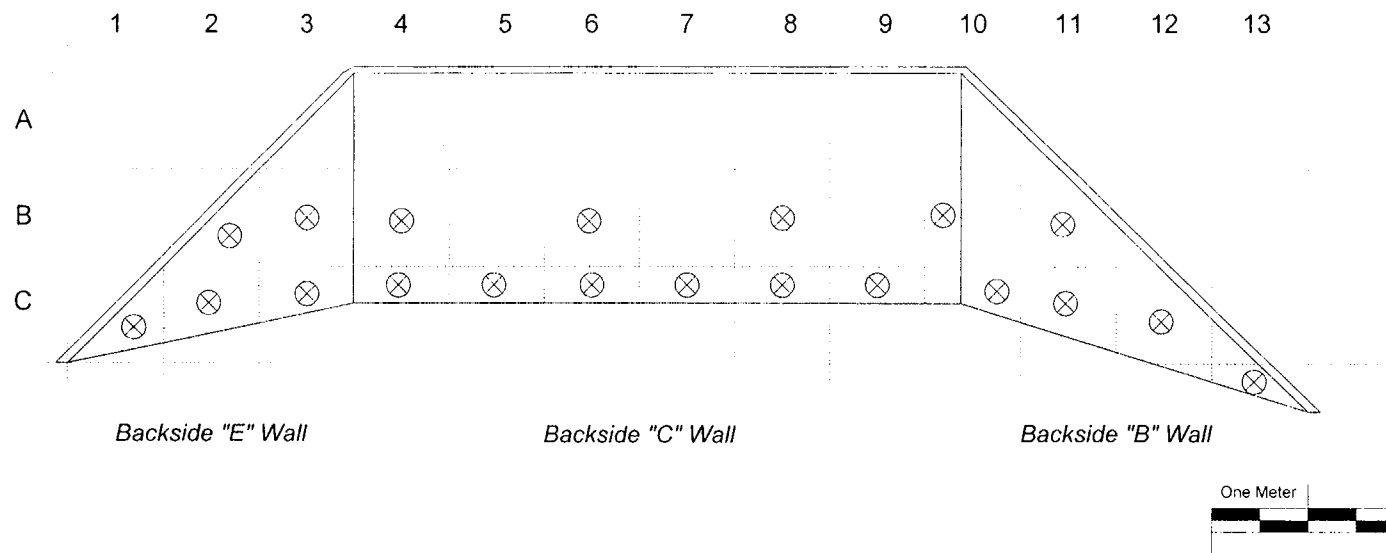


Survey Requirements

1. The circled X's are approximate locations of wipes to be taken. These must be counted for gross  $\alpha$ ,  $\beta$ . In addition, Fixed Alpha and Fixed Beta measurements will be taken at approximate locations.
2. 100% Masslinn wipe,  $\beta, \gamma$ , required.
3. 100%  $\beta$  and 10%  $\alpha$  Direct Scans in D, E & F rows/grids.
4. 10%  $\beta$  and 10%  $\alpha$  direct scans in A, B & C grids (rows A, B & C).
5. One (1)  $\mu$ R reading required, Contact and at One (1) meter in each grid.
6. 100%  $\beta$  and  $\alpha$  direct scans required on steps and handrails, if present.

Enclosure - 1, EA-1 Bunker (Building 27-1), Final Survey Grid Maps

Backside "E": "C" and "B" Wall



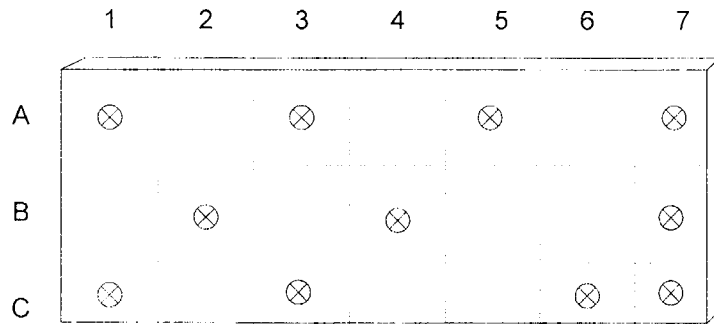
A-20

Survey Requirements

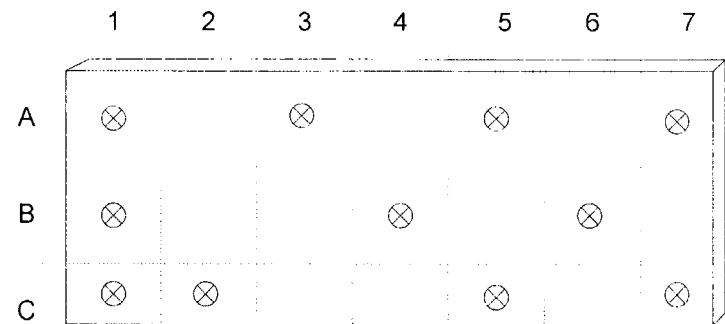
1. The circled X's are approximate locations of wipes to be taken. These must be counted for gross  $\alpha$ ,  $\beta$ . In addition, Fixed Alpha and Fixed Beta measurements will be taken at approximate locations.
2. 100% Masslinn wipe,  $\beta, \gamma$ , required.
3. 100%  $\beta$  and 10%  $\alpha$  Direct Scans in B & C rows/grids.
4. 10%  $\beta$  and 10%  $\alpha$  Direct Scans in A grids (row A).
5. One (1)  $\mu$ R reading required, contact and at One (1) meter in each grid.

Enclosure - 1, EA-1 Bunker (Building 27-1), Final Survey Grid Maps

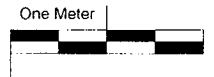
Wall "F": Internal and External



Internal "F" Wall



External "F" Wall



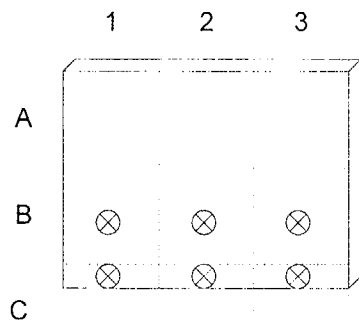
A-21

Survey Requirements

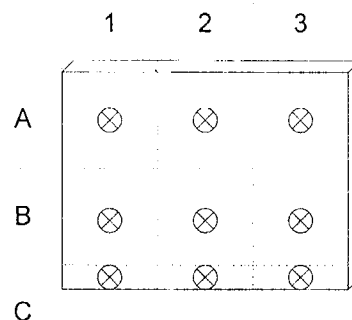
1. The circled X's are approximate locations of wipes to be taken. These must be counted for gross  $\alpha$ ,  $\beta$ . In addition, Fixed Alpha and Fixed Beta measurements will be taken at approximate locations.
2. 100% Masslinn wipe,  $\beta, \gamma$ , required.
3. 10%  $\beta$  and 10%  $\alpha$  Direct Scans Required.
4. One (1)  $\mu$ R reading required, contact and at One (1) meter in each grid.
5. 100%  $\beta$  and  $\alpha$  direct scans required on steps and handrails, if present.

Enclosure - 1, EA-1 Bunker (Building 27-1), Final Survey Grid Maps

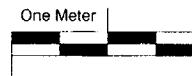
Wall "G": Internal and External



Internal "G" Wall



External "G" Wall



A-22

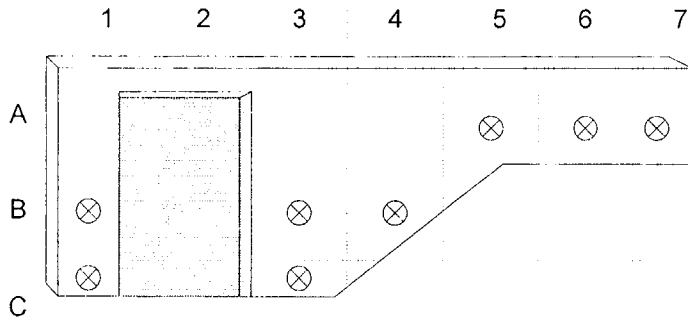
Survey Requirements

1. The circled X<sup>s</sup> are approximate locations of wipes to be taken. These must be counted for gross  $\alpha$ ,  $\beta$ . In addition, Fixed Alpha and Fixed Beta measurements will be taken at approximate locations.
2. 100% Masslinn wipe,  $\beta, \gamma$ , required.
3. 100%  $\beta$  and 10%  $\alpha$  Direct Scans in B & C rows/grids.
4. 10%  $\beta$  and 10%  $\alpha$  Direct Scans in A grids (row A).
5. One (1)  $\mu$ R reading required, contact and at One (1) meter in each grid.

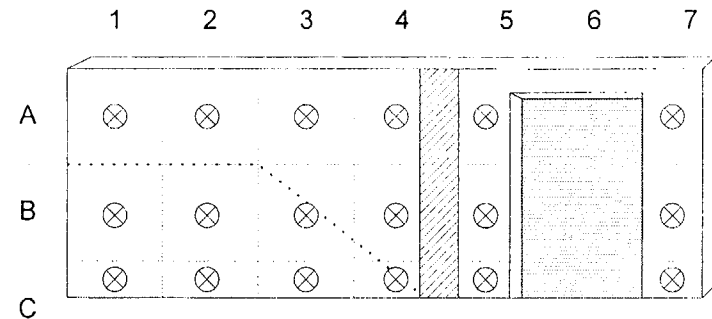


Enclosure - 1, EA-1 Bunker (Building 27-1), Final Survey Grid Maps

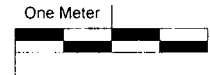
Wall "I": Internal and External



Internal "I" Wall



External "I" Wall



A-23

Survey Requirements

1. The circled X's are approximate locations of wipes to be taken. These must be counted for gross  $\alpha$ ,  $\beta$ . In addition, Fixed Alpha and Fixed Beta measurements will be taken at approximate locations.
2. 100% Masslinn wipe,  $\beta, \gamma$ , required.
3. 100%  $\beta$  and 10%  $\alpha$  Direct Scans Required.
4. One (1)  $\mu$ R reading required, contact and at One (1) meter in each grid.
5. 100%  $\beta$  and  $\alpha$  direct scans required on steps and handrails, if present.

April 11, 2001

Prepared by: W. LaBonte *W LaBonte*

Approved by: *Laura Gonzales* Date: *April 11, 2001*  
L. Q. Gonzales

**Final Survey Plan for EA1 Bunker (Building 27-1) Rev. 1**

This survey plan is for EA1 Bunker (Building 27-1) surfaces that remained as a retaining wall for Building 27 following the EA-1 Bunker building demolition and the surrounding land areas., including excavation pits.

This plan revises the Final Survey Plan Issued on February 11, 2000.

Within this land area there are excavation pits which resulted from the excavation and removal of the Waste Tank, associated piping and the Room C Storage Wells. This land contains a small section of the asphalt access road, the remainder of this land is soil.

This survey plan is for the building surfaces that remained following demolition of Rooms A, B & C and portions of the connecting hallway. The portions of the EA-1 Bunker that were found to be contaminated during the Characterization Survey were dismantled and packaged as Radioactive waste for disposal off site. Portions of the building that were not contaminated were surveyed and disposed of in a local landfill facility.

This plan also includes the surrounding soil surfaces, asphalt roadways, and areas excavated during the building, storage well, and Waste Tank dismantling. The soil/asphalt surfaces to be included in this plan are the areas illustrated in Figure 1, EA-1 Bunker (Building 27-1) Affected Area Classification.

**Background and Classification**

**Background Information**

Building 27-1 (the EA1 Bunker) was originally constructed by General Atomics, Division of General Dynamics, in 1965. This facility was a single level, heavily shielded, concrete block structure situated North of, and adjacent to, Building 27 (EA1). The building, which covered approximately 1255 ft<sup>2</sup>, was divided into 3 laboratories which were joined by a common hallway. The laboratory spaces were identified as Room A (West), Room B (East), and Room C (Center). The bulkheads and ceiling of Rooms A and B and the hallways were constructed of 12 inch thick concrete. The ceiling of Room C was constructed of corrugated steel capped with concrete. The South and West walls of the building were back filled with an earthen fill. There is a sub floor beneath the main floor. The space between these floors was earthen filled.

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Room C, which was added in 1973, contained 12 below ground cylindrical storage wells previously used for storage of high level radioactive material. Each well was approximately 10 inches in diameter and 12 feet deep.

Building 27-1 was surrounded by a fenced-in service yard that is approximately 15,300 ft<sup>2</sup>.

This service yard contained a bermed radioactive waste storage area, a small metal shed, and a below ground liquid waste holding tank.

During the operating history of this facility, the laboratories were used for several projects including; DOE sponsored HTGR advanced fuel studies and commercial radio-pharmaceutical production of <sup>90</sup>Y.

### **Site Conditions at Time of Final Survey**

All equipment, service lines and supporting fixtures were removed from the restricted areas, decontaminated as appropriate, surveyed and released or disposed of as radioactive waste. The walls, floor and ceiling of Room A, B, & C and portions of the connecting hallway with fixed levels of contamination were coated with a Polymeric Barrier to ensure the activity would remain fixed. The soil backfill has been removed from the external walls. The floor, walls, and ceiling of the building have been removed except for the South stairwell and enclosing walls which will be used as a retaining wall. The high level storage wells in Room C were filled with concrete and an absorbent material, then welded closed. The wells were removed in 1 piece and prepared for disposal as radioactive waste off-site. The remaining interior portions of the facility that had localized spots of fixed contamination (identified on the Characterization survey) were decontaminated. The piping for the Liquid Waste Tank was excavated, cut up, and packaged for disposal as radioactive waste. The Liquid Waste Tank and its concrete vault were excavated and packaged for disposal as radioactive waste. The Final Survey for the Waste Tank Vault and associated drain line has been completed.

All floor drains and utility lines encountered during building demolition were removed, surveyed, and dispositioned based on survey results. There is 1 piece of cast iron drain line between the upper and lower floors of the remaining structure that was apparently an abandoned floor drain for the sub-floor. This item could not be removed because additional excavation would jeopardize the integrity of Building 27.

A Post D&D Survey was performed on the remaining building portions and soil surfaces to provide reasonable assurances that no additional remediation was required.

### **Classification**

The remaining portions of the building are classified as **Non-Suspect Affected Areas**. The footprint of the portion of the building that was demolished is classified as a **Suspect Affected**

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**Areas.** The Waste Tank Pit and Drain Line Trench are classified as a **Suspect Affected Area**. The potential drainage area Northwest of the former building is classified as a **Suspect Affected Area**. See Figure 1, EA-1 Bunker (Building 27-1) Affected Area Classification for details. All Suspect Affected Areas are shown as shaded areas on Figure-1.

### Survey Objectives and Responsibility

The purpose of performing a final survey is to demonstrate that the radiological conditions satisfy the NRC and State of California guidelines for release to unrestricted use. The objectives include (1) to show that the average surface contamination levels for each survey unit are within the authorized value, (2) to show that the maximum residual activity ("hot spot" area) does not exceed three times the average value in an area up to 100 cm<sup>2</sup>, (3) that a reasonable effort has been made to clean removable contamination and fixed contamination and (4) that the exposure rates in occupiable locations are less than 10 µR/hr above background measured at 1 meter above the surface. Samples will be taken by qualified Health Physics technicians having a minimum of 3 years Health Physics Technician experience following approved Health Physics procedures and this plan. The survey and final report documenting the survey will be performed by GA's Health Physics group.

### Release Criteria (per GA Site Decommissioning Plan)

#### Facility Structure Criteria

Characterization surveys performed in this building included gamma spectroscopy analysis and <sup>90</sup>Sr analysis (performed by a contracted laboratory). Many of the samples taken indicated the presence of <sup>90</sup>Sr. This factor combined with knowledge of facility use in the past concludes that <sup>90</sup>Sr is the most likely Radionuclide.

The applicable release criteria for internal building surfaces, based on <sup>90</sup>Sr, are:

**1,000 dpm/100 cm<sup>2</sup>, averaged over 1 m<sup>2</sup> area**  
**3,000 dpm/100 cm<sup>2</sup>, maximum in a 100 cm<sup>2</sup> area**  
**200 dpm/100 cm<sup>2</sup>, removable activity**

Alpha contamination was not detected on any of the Characterization surveys and alpha emitters were not detected in any of the samples analyzed by gamma spectroscopy.

#### Exposure Rate Measurements

The guideline value for exposure rates measured at 1 m above the surface is 10 µR/hr above background.

**Soil Criteria (soil limits apply to roof gravel, concrete rubble and asphalt rubble)**

The release criteria for soil are specified in the Site Decommissioning Plan and summarized below. The values presented below are above background levels. **Note: Soil, asphalt and concrete rubble must remain on-site until specific approval to move it off-site is granted by the NRC and the State of California.**

Cs-137	15 pCi/g
Co-60	8 pCi/g
Enriched Uranium (U-234 plus U-235)	30 pCi/g
Thorium (Th-232 plus Th-228)	10 pCi/g
Sr-90	1800 pCi/g

If multiple nuclides are present, the sum of the ratios of the concentration of each Radionuclide to its respective guideline must not exceed 1. **If other nuclides are encountered, notify HP Management for release criteria.**

**Gross alpha/beta results are required for a representative number of soil samples (to have an upper bound for the maximum Sr-90 which could be in the soil). Sr-90 analysis may also be required.**

**Alert Levels**

If the following “alert levels” are exceeded, notify HP Management so an evaluation can be performed to determine if increased survey coverage or decontamination is required.

**On Concrete or Asphalt Surfaces**

**Note: The Alert levels provided below are based on the background cpm plus the meter cpm value taking into account the instrument efficiency and probe surface area. The alert level for each instrument used must be determined prior to performing surveys. The**

**background determination must be performed in building 13 or other HP management approved area.**

**Alpha Monitoring**

>100 cpm alpha using the large area (434 cm<sup>2</sup>) probe. If >100 cpm, check with a hand held alpha meter.

>60 cpm using a hand held alpha probe, notify Health Physics Management.

### Beta Scanning using 434 cm<sup>2</sup> probe

- > ~1900 cpm beta using the large area (434 cm<sup>2</sup>) probe (#84459)
- > ~2300 cpm beta using the large area (434 cm<sup>2</sup>) probe (#73701)
- > ~300 cpm above background using any other 434 cm<sup>2</sup> probe

**Exceeding the Alert Level:** To determine if additional decontamination is necessary in areas where the Alert Level has been exceeded, the following should be performed:

At the 10, 1m grid locations which had the highest floor monitor readings, scan the 1m grid using the 100 cm<sup>2</sup> probe (for each instrument). If readings are >650 cpm, decontamination may be required; notify HP Management. If readings are <650 cpm, no further decontamination is needed; this represents ~200 cpm above background (400 counts for a 2 minute count)

### Beta Measurement Using the 100 cm<sup>2</sup> probe

- > ~1300 counts in 2 minutes using the beta 100 cm<sup>2</sup> gas flow proportional counter (s/n 84423)
- > ~1150 counts in 2 minutes using the beta 100 cm<sup>2</sup> gas flow proportional counter (s/n 86332)
- > ~200 cpm (400 counts in 2 minutes) above background for other beta 100 cm<sup>2</sup> gas flow proportional counter **or** if probe calibration has changed **or** if other changes to the meter have been made. **Ensure the background determination has been completed at building 13 (or other HP Management approved location).**

### Beta measurement Using the Pancake GM probe

> 80 cpm

**Decontamination Required-** when (1) Pancake GM measurement > 100 cpm **or** (2) values greater than those provided above using the 100 cm<sup>2</sup> probe.

### Exposure Rate Measurement

Exposure rate measurements at contact (1-2" above the surface) and at 1m above the surface: 20 μR/hr.

### Soil, Gravel, Asphalt Rubble, Concrete Rubble Samples

All soil sample results must be reviewed by Laura Gonzales, Paul Maschka, or Bill LaBonte.

W:\bunker\271fsp.wpd

### Final Survey Requirements

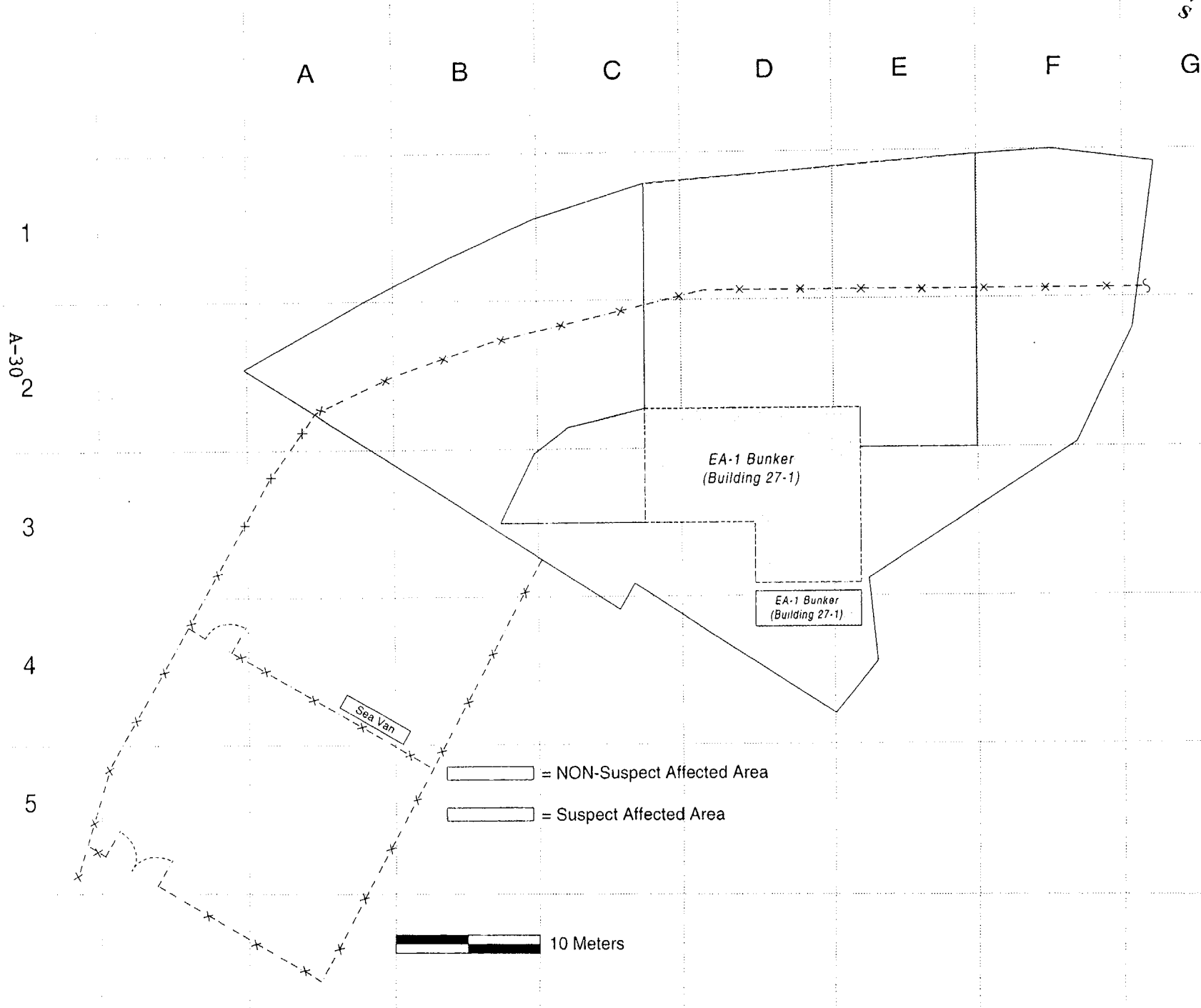
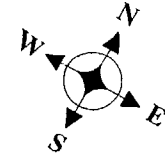
The minimum survey requirements for this final survey are outlined in Table-1, Planned Surveys for Building 27-1, (EA-1 Bunker). The minimum number of survey points and locations is identified in Figure-1, Soil Sampling Plan, Enclosure -1, EA-1 Bunker, (Building 27-1), Final Survey Grid Maps and Enclosure-2, EA-1 Bunker Waste tank Pit and Trench.

Soil and asphalt sampling/surveys will be performed in accordance with Figure - 2, EA-1 Bunker (Building 27-1) Soil Sampling Plan.

### Documentation

**Every** survey conducted must be documented on a **daily basis** on a drawing showing the approximate locations surveyed. Include the results (including units), the technicians' signature, date, instrument(s) used, efficiency, background readings (if applicable) and any other applicable information.

Figure 1: EA-1 Bunker (Building 27-1) Affected Area Classification



A-30

1

2

3

4

5

A

B

C

D

E

F

G

EA-1 Bunker  
(Building 27-1)

EA-1 Bunker  
(Building 27-1)

Sea Van

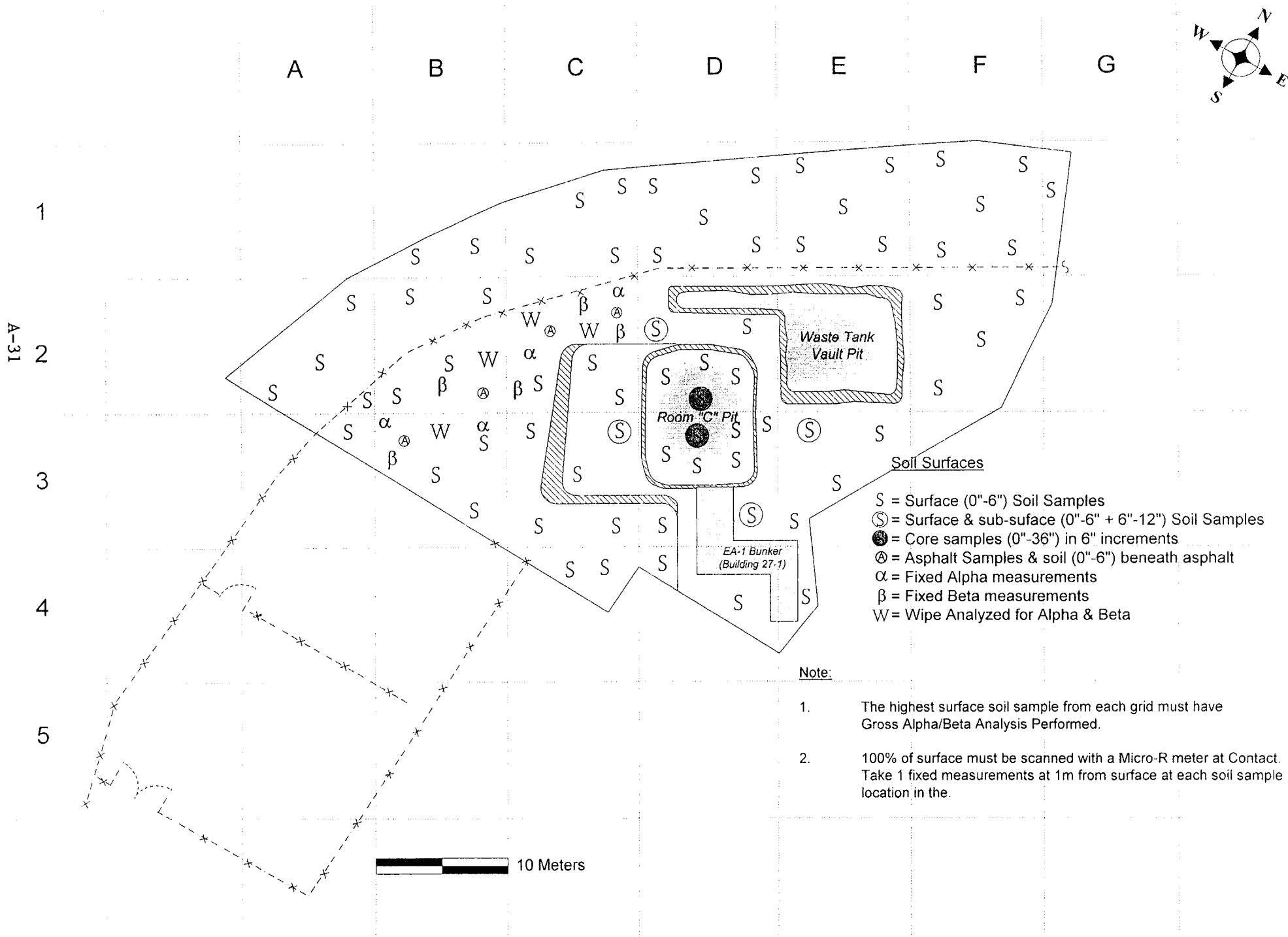
☐ = NON-Suspect Affected Area

☐ = Suspect Affected Area

10 Meters



**Figure 2: EA-1 Bunker (Building 27-1) Waste Tank Vault Pipe Trench Soil Sample Locations**



## Comparisons of Site Decommissioning Plan Requirements with Planned Final Surveys on the EA-1 Bunker

Survey Area	Gridding	# of Direct Measurements Fixed $\alpha$ , $\beta$ , or swipes on concrete or asphalt	# of Exposure Rate Measurements ( $\mu\text{R/hr}$ )	Surface Scans on asphalt or concrete	# of Soil Samples Taken and Analyzed
GA Site Decommissioning Plan Non-Suspect Affected Area	Not Required	A minimum of 30 or 1 per 50 m <sup>2</sup> or 1 every ~ 7m. for a total of 30	1 per 10 m <sup>2</sup> or 1 per ~ 3 m Total $\approx$ 19	10% of Surface Areas below 2 m (asphalt and concrete)	Not Required
Final Surveys Non-Suspect Affected Areas	Yes 1 m x 1 m grids	Fixed $\alpha$ = 173, Fixed $\beta$ = 174, Swipes = 161 See Figure 2 and Enclosure 1 for details.	1 per 10 m <sup>2</sup> or 1 per ~ 3 m Total = 180 readings plus 100% scan See Figure 2 and Enclosure 1 for details.	100% of accessible concrete and asphalt surfaces below 2m, 10 % above 2m See Figure 2 and Enclosure 1	41 surface (0-6") samples and 5 sub surface @ 6-12"
GA Site Decommissioning Plan Suspect Affected Area	Yes	1 per 4m <sup>2</sup> or 1 every 2m. There is ~ 3m <sup>2</sup> of asphalt, for a total of 2 measurements	1 per 4 m <sup>2</sup> or 1 every 2m. Total = 40	100 % of asphalt and concrete	25 based on a 5m triangular grid system.
Final Surveys Suspect Affected Areas	Yes 10 m x 10 m grids on open land, 1 m x 1 m on waste tank pit and trench	# total, 1 fixed $\alpha$ , 1 fixed $\beta$ , and 1 wipe. See Figure 2 for details.	140 fixed measurements plus 100% scan. See Figure 2 and Enclosure 2 for details.	Approximately 100% of 3 m <sup>2</sup> . must be scanned, see Figure 2	88 surface samples (0-6"), 6 sub surface (6- 12"), and 4 core samples (0-36") in 6" increments. See Figure 2 and Enclosures 1 & 2 for locations.

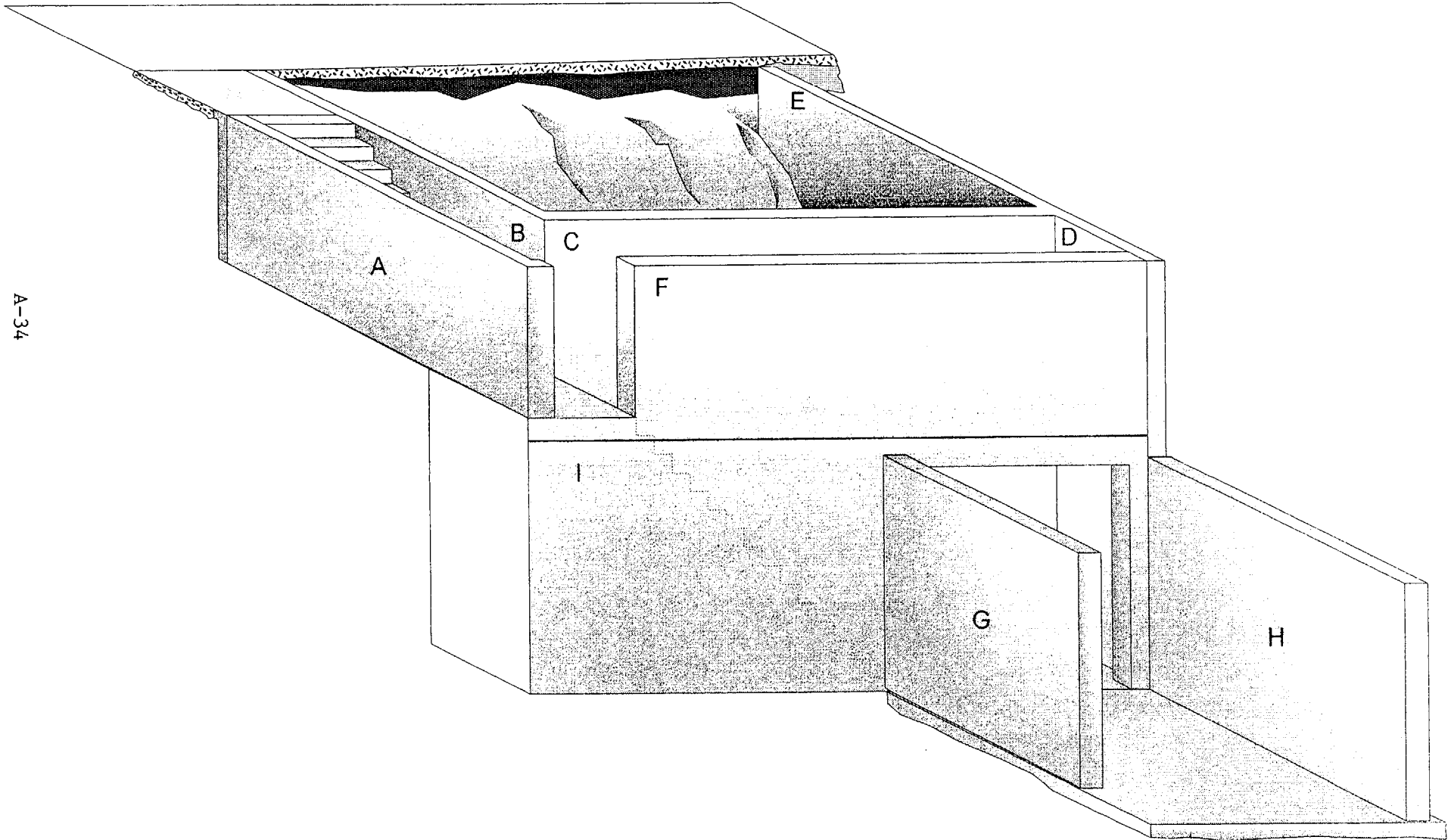
Note The Non-Suspect Affected Area contains 700 m<sup>2</sup> of soil, 70 m<sup>2</sup> of asphalt pavement, and 185 m<sup>2</sup> of building remnant surfaces. The Suspect Affected Area consists of 450 m<sup>2</sup> of soil surfaces, 3 m<sup>2</sup> of asphalt pavement, and 160 m<sup>2</sup> waste tank pit and trench surfaces.

**Enclosure - 1**

**EA - 1 Bunker (Building 27-1)**

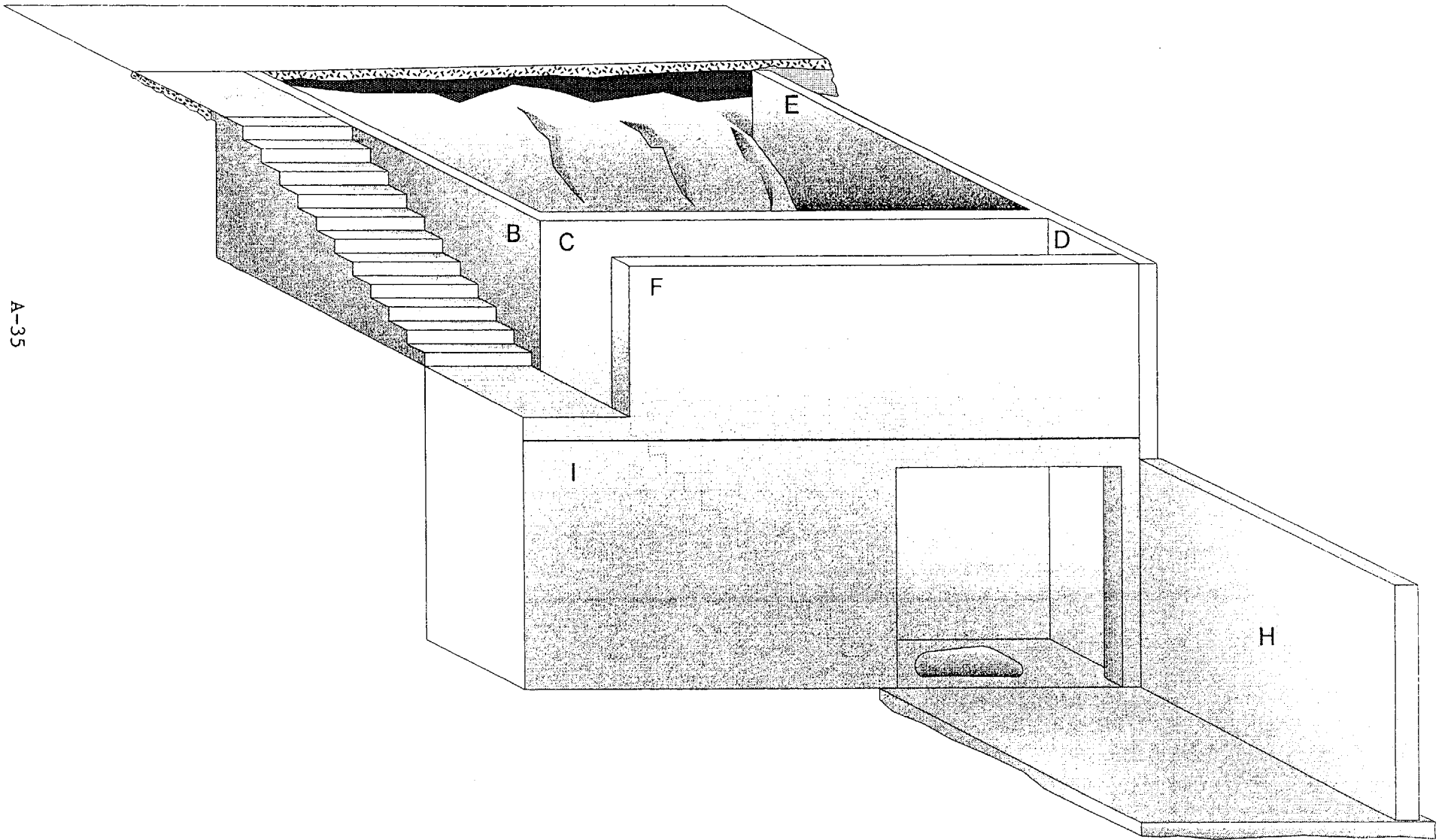
**Final Survey Grid Maps**

Enclosure - 1, EA-1 Bunker (Building 27-1), Final Survey Grid Maps



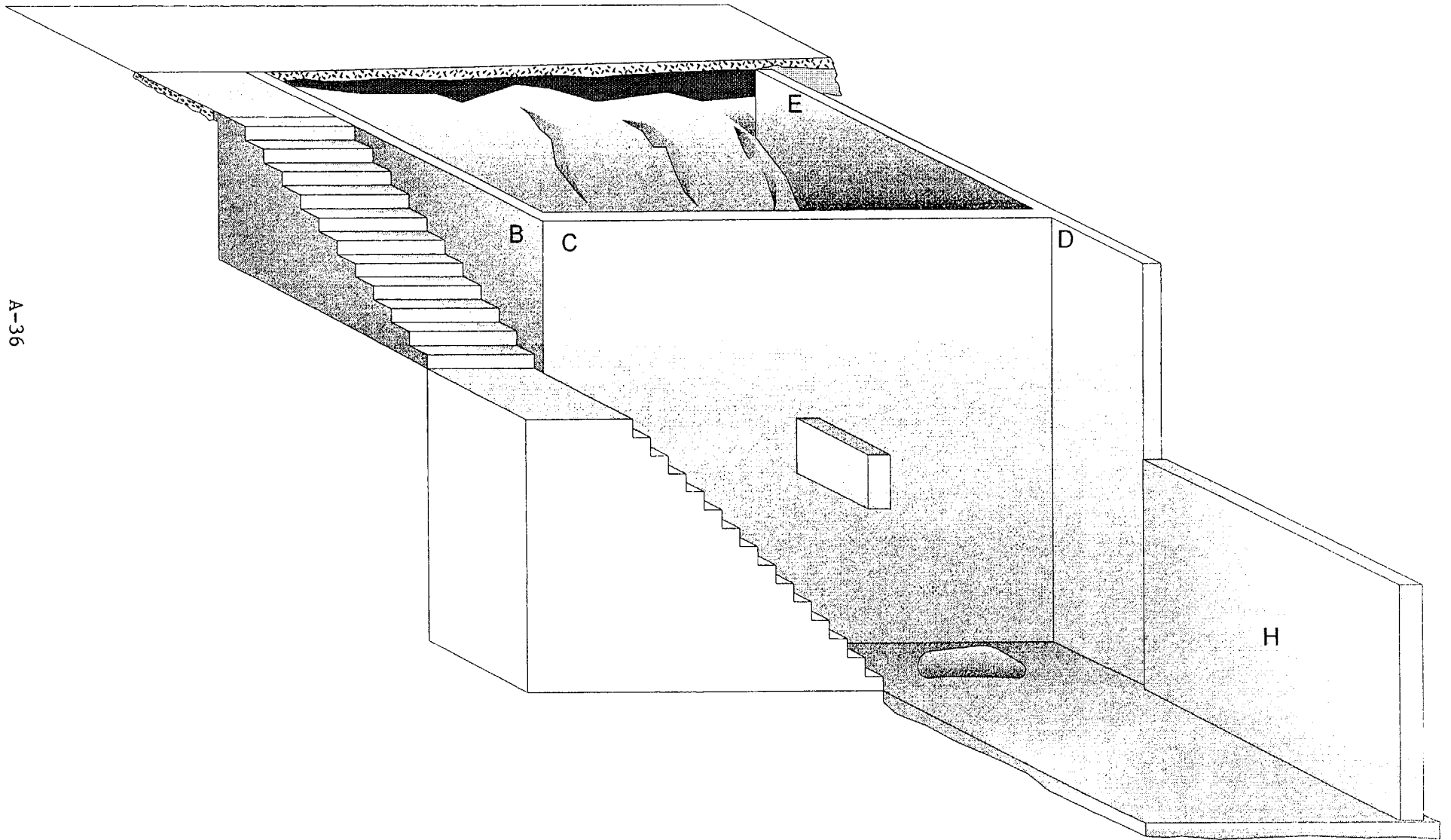
A-34

Enclosure - 1, EA-1 Bunker (Building 27-1), Final Survey Grid Maps



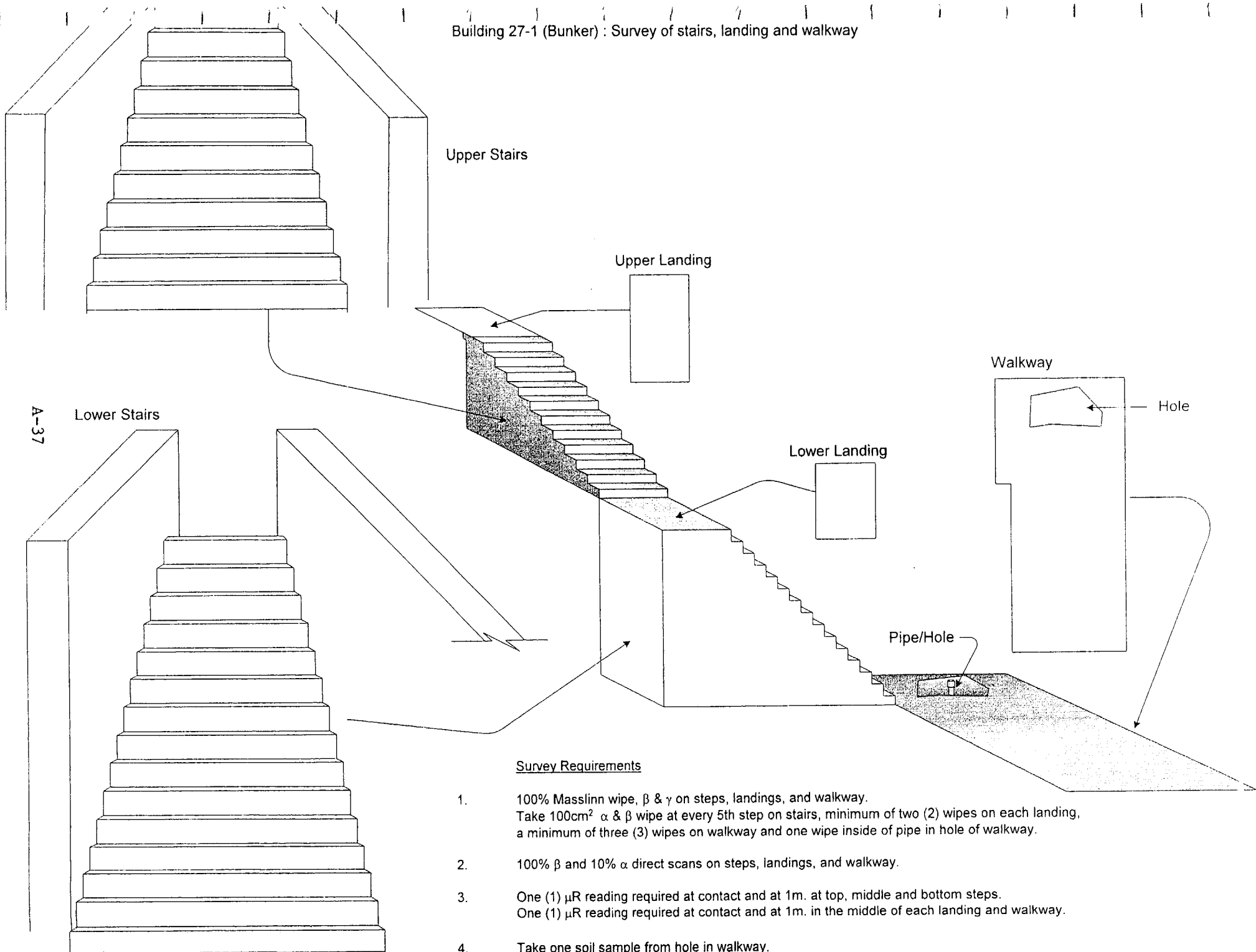
A-35

Enclosure - 1, EA-1 Bunker (Building 27-1), Final Survey Grid Maps



A-36

Building 27-1 (Bunker) : Survey of stairs, landing and walkway

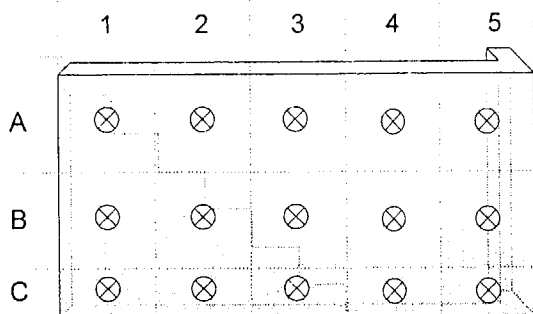


Survey Requirements

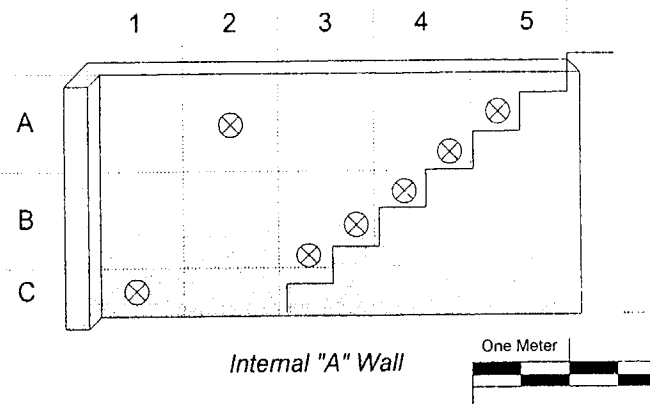
1. 100% Masslinn wipe,  $\beta$  &  $\gamma$  on steps, landings, and walkway.  
Take 100cm<sup>2</sup>  $\alpha$  &  $\beta$  wipe at every 5th step on stairs, minimum of two (2) wipes on each landing, a minimum of three (3) wipes on walkway and one wipe inside of pipe in hole of walkway.
2. 100%  $\beta$  and 10%  $\alpha$  direct scans on steps, landings, and walkway.
3. One (1)  $\mu$ R reading required at contact and at 1m. at top, middle and bottom steps.  
One (1)  $\mu$ R reading required at contact and at 1m. in the middle of each landing and walkway.
4. Take one soil sample from hole in walkway.

Enclosure - 1, EA-1 Bunker (Building 27-1), Final Survey Grid Maps

Wall "A": Internal and External



External "A" Wall



Internal "A" Wall

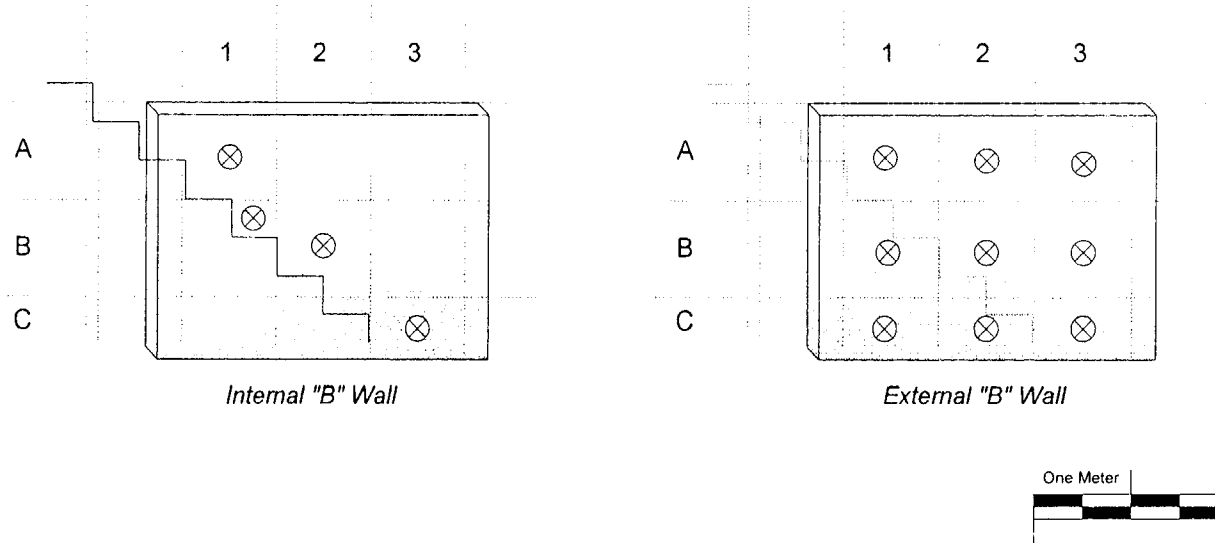
Survey Requirements

1. The circled X's are approximate locations of wipes to be taken. These must be counted for gross  $\alpha$ ,  $\beta$ .
2. 100% Masslinn wipe,  $\beta, \gamma$ , required.
3. 100%  $\beta$  and 10%  $\alpha$  Direct Scans in B & C rows/grids, (plus A-4 and A-5 on internal wall).
4. 10%  $\beta$  and 10%  $\alpha$  Direct Scans in A grids (row A).
5. One (1)  $\mu R$  reading required, contact and at One (1) meter in each grid.
6. 100%  $\beta$  and  $\alpha$  direct scans required on steps and handrails, if present.



Enclosure - 1, EA-1 Bunker (Building 27-1), Final Survey Grid Maps

Wall "B": Internal and External

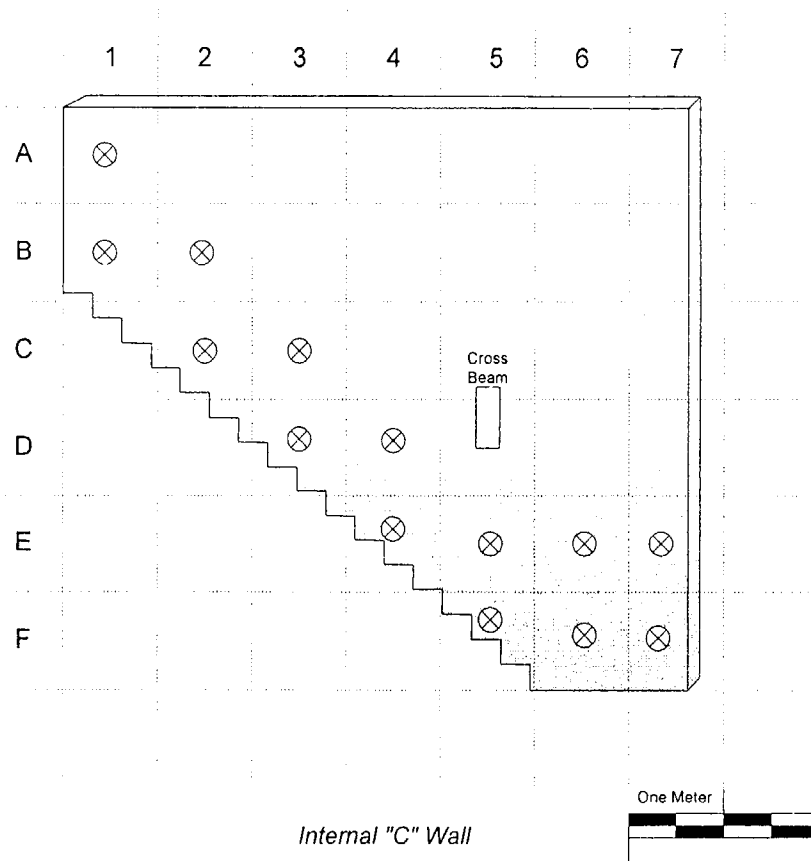


A-39

Survey Requirements

1. The circled X's are approximate locations of wipes to be taken. These must be counted for gross  $\alpha$ ,  $\beta$ .
2. 100% Masslinn wipe,  $\beta, \gamma$ , required.
3. 100%  $\beta$  and 10%  $\alpha$  Direct Scans in B & C rows/grids, (plus A-1 on internal wall).
4. 10%  $\beta$  and 10%  $\alpha$  Direct Scans in A grids (row A).
5. One (1)  $\mu$ R reading required, contact and at One (1) meter in each grid.
6. 100%  $\beta$  and  $\alpha$  direct scans required on steps and handrails, if present.

Wall "C": Internal



A-40

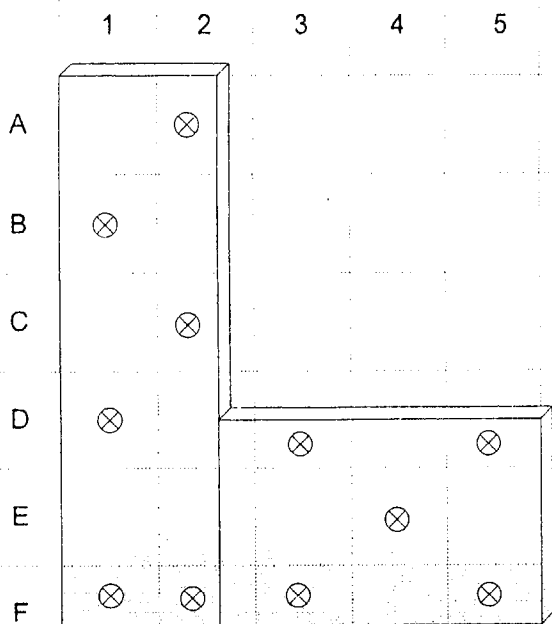
Internal "C" Wall

Survey Requirements

1. The circled X's are approximate locations of wipes to be taken. These must be counted for gross  $\alpha$ ,  $\beta$ .
2. 100% Masslinn wipe,  $\beta, \gamma$ , required.
3. 100%  $\beta$  and 10%  $\alpha$  Direct Scans in; F-5, 6 & 7, E-4, 5, 6 & 7, D-3 & 4, C-1, 2 & 3, B-1 & 2, A-1 & 2.
4. 10%  $\beta$  and 10%  $\alpha$  Direct Scans in grids not listed in 3 above.
5. One (1)  $\mu$ R reading required, contact and at One (1) meter in each grid.
6. 100%  $\beta$  and  $\alpha$  direct scans required on steps and handrails, if present.

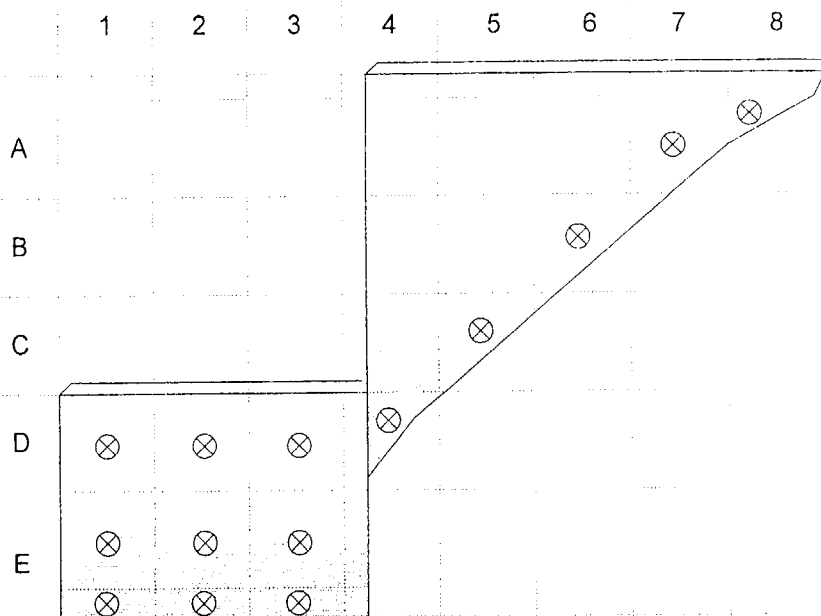
Wall "D": "E" and "H" Internal and External

A-41



Internal "D" Wall

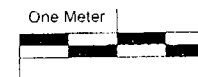
Internal "H" Wall



External "H" Wall

External "D" Wall

External "E" Wall

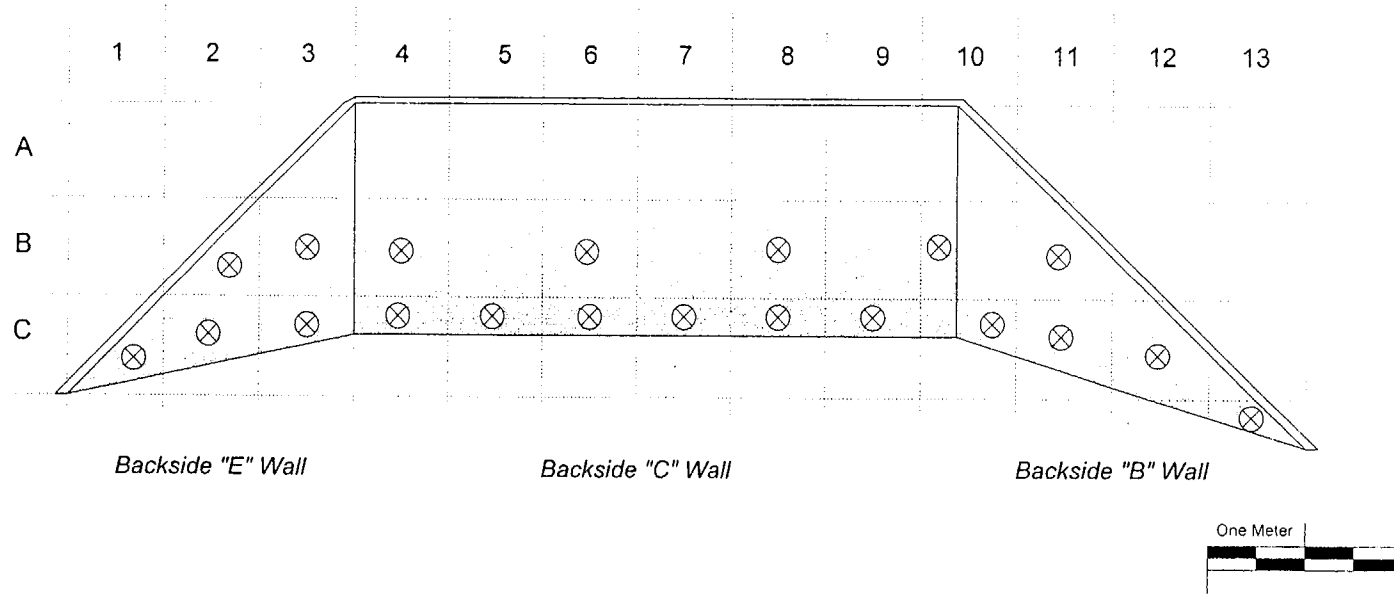


Survey Requirements

1. The circled X's are approximate locations of wipes to be taken. These must be counted for gross  $\alpha$ ,  $\beta$ .
2. 100% Masslinn wipe,  $\beta, \gamma$ , required.
3. 100%  $\beta$  and 10%  $\alpha$  Direct Scans in D, E & F rows/grids.
4. 10%  $\beta$  and 10%  $\alpha$  direct scans in A, B & C grids (rows A, B & C).
5. One (1)  $\mu R$  reading required, Contact and at One (1) meter in each grid.
6. 100%  $\beta$  and  $\alpha$  direct scans required on steps and handrails, if present.

Enclosure - 1, EA-1 Bunker (Building 27-1), Final Survey Grid Maps

**Backside "E": "C" and "B" Wall**



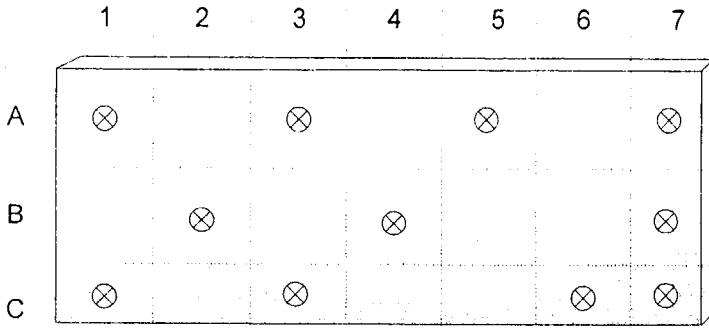
A-42

Survey Requirements

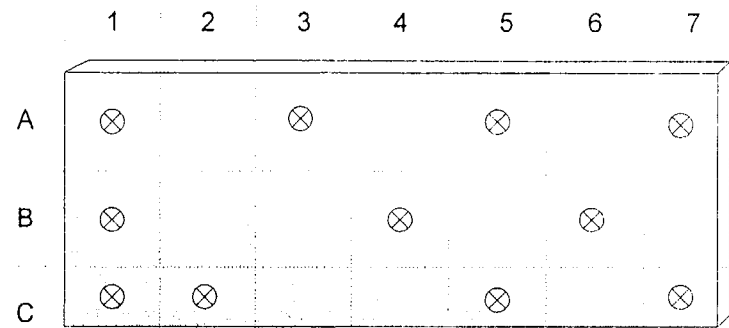
1. The circled X's are approximate locations of wipes to be taken. These must be counted for gross  $\alpha$ ,  $\beta$ .
2. 100% Masslinn wipe,  $\beta, \gamma$ , required.
3. 100%  $\beta$  and 10%  $\alpha$  Direct Scans in B & C rows/grids.
4. 10%  $\beta$  and 10%  $\alpha$  Direct Scans in A grids (row A).
5. One (1)  $\mu$ R reading required, contact and at One (1) meter in each grid.

Enclosure - 1, EA-1 Bunker (Building 27-1), Final Survey Grid Maps

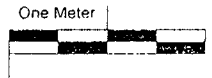
Wall "F": Internal and External



Internal "F" Wall



External "F" Wall



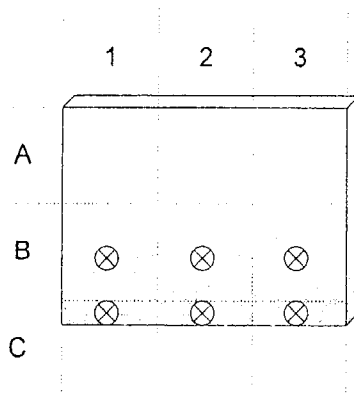
A-43

Survey Requirements

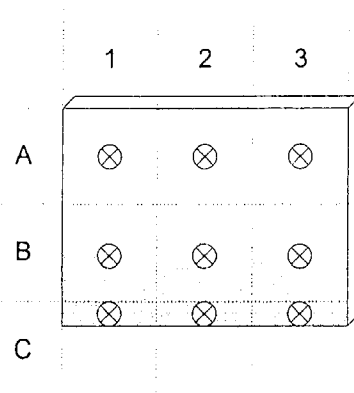
1. The circled X's are approximate locations of wipes to be taken. These must be counted for gross  $\alpha$ ,  $\beta$ .
2. 100% Masslinn wipe,  $\beta$ ,  $\gamma$ , required.
3. 10%  $\beta$  and 10%  $\alpha$  Direct Scans Required.
4. One (1)  $\mu$ R reading required, contact and at One (1) meter in each grid.
5. 100%  $\beta$  and  $\alpha$  direct scans required on steps and handrails, if present.

Enclosure - 1, EA-1 Bunker (Building 27-1), Final Survey Grid Maps

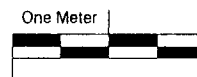
Wall "G": Internal and External



Internal "G" Wall



External "G" Wall



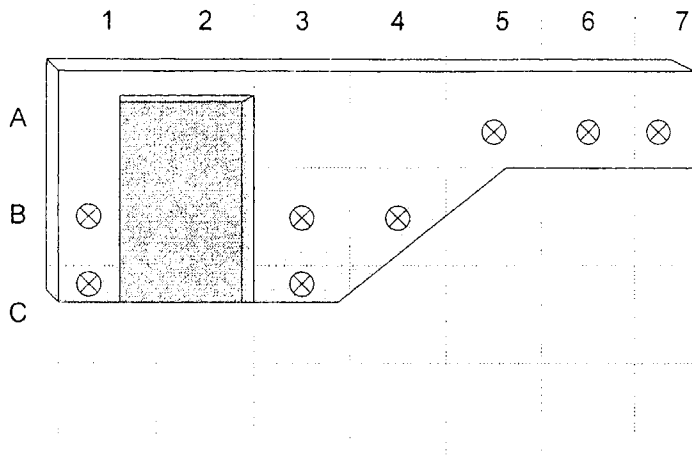
A-44

Survey Requirements

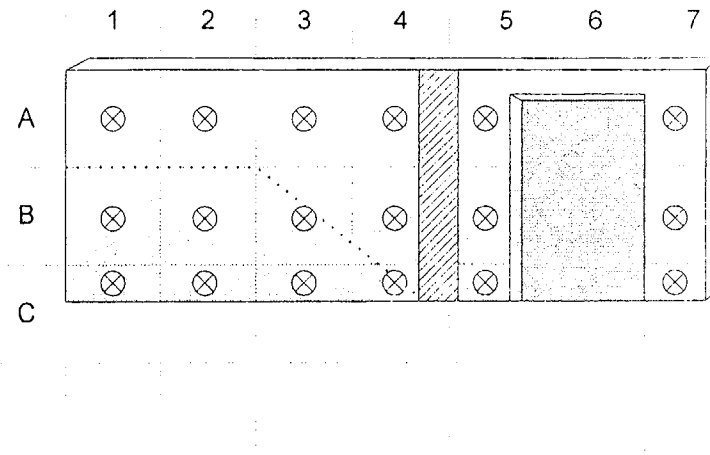
1. The circled X's are approximate locations of wipes to be taken. These must be counted for gross  $\alpha$ ,  $\beta$ .
2. 100% Masslinn wipe,  $\beta, \gamma$ , required.
3. 100%  $\beta$  and 10%  $\alpha$  Direct Scans in B & C rows/grids.
4. 10%  $\beta$  and 10%  $\alpha$  Direct Scans in A grids (row A).
5. One (1)  $\mu$ R reading required, contact and at One (1) meter in each grid.

Enclosure - 1, EA-1 Bunker (Building 27-1), Final Survey Grid Maps

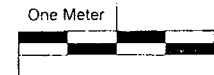
Wall "I": Internal and External



Internal "I" Wall



External "I" Wall



A-45

Survey Requirements

1. The circled X<sup>ts</sup> are approximate locations of wipes to be taken. These must be counted for gross  $\alpha$ ,  $\beta$ .
2. 100% Masslinn wipe,  $\beta, \gamma$ , required.
3. 100%  $\beta$  and 10%  $\alpha$  Direct Scans Required.
4. One (1)  $\mu$ R reading required, contact and at One (1) meter in each grid.
5. 100%  $\beta$  and  $\alpha$  direct scans required on steps and handrails, if present.

**Enclosure - 2**

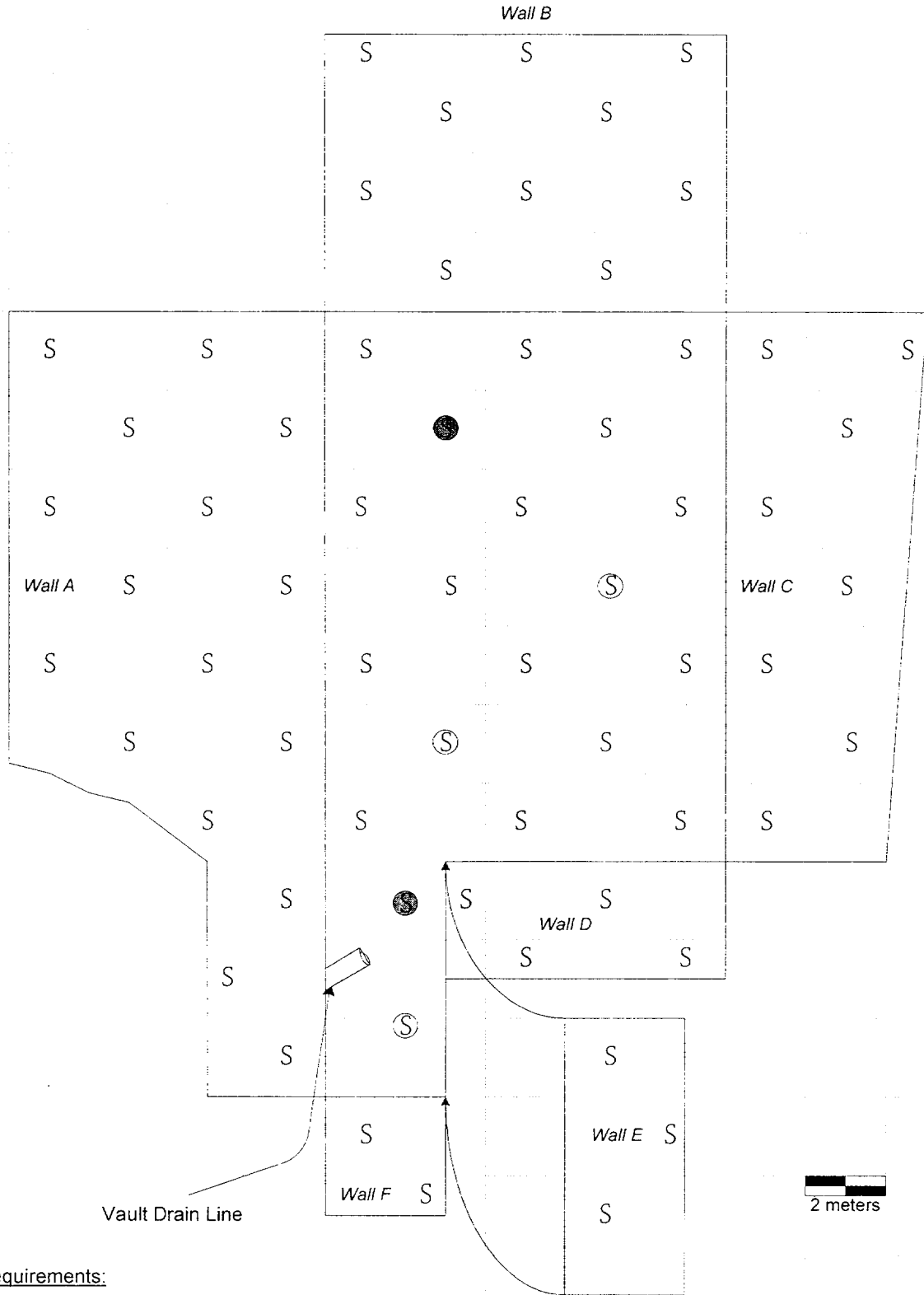
**EA-1 Bunker (Building 27-1)**

**Waste tank and Pit**

**Final Survey Requirements**



Enclosure - 2, EA-1 Bunker Waste Tank Vault Pit and Drain Line Trench



Survey Requirements:

1. Take a contact and 1m Exposure rate measurement in each grid.
2. Take soil samples at 0-6" in each location indicated with an "S".
3. Take soil samples at 0"-6" + 6"-12" in locations identified with a (S).
4. Take Soil Samples at 6" increments down to 36" (S)
5. Take large area wipes and  $\mu\text{R/hr}$  readings the entire length of the pipe.



APPENDIX B  
“ SURVEY REPORT FOR THE BUILDING 27-1  
WASTE TANK VAULT PIT”

TO

GA'S FINAL RADIOLOGICAL SURVEY REPORT FOR THE  
BUILDING 27-1 (EA-1 BUNKER) SITE

**Building 27 (EA-1 Bunker) Waste Tank Vault Pit and Drain Line Trench**

**Final Radiological Survey Report**

Prepared By: W. LaBonte and Laura Gonzales

Illustrated By: Stephen Finchum and Cornelius Stanley

Survey Technicians: Mark Kraft and Scott Cowan

**April 2002**

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## **Introduction**

This Appendix describes the Final Radiological Survey performed in the Building 27-1 (EA-1 Bunker) Waste Tank and Drain Line Excavation Pit completed in November 1999. (Additional surveys were performed in this area in 2001; those surveys are described in the main body of this report).

The excavation pit was created as a result of the removal of the Underground Liquid Radioactive Waste Tank which was within a concrete vault. Both the tank and the concrete vault were disposed of as radioactive waste. The drain line trench was created after the removal of the associated drain line that provided for the drainage of groundwater accumulated on the outside of the concrete vault.

This report documents the results of the radiological measurements and soil sampling completed on this open pit, trench and associated drain line, and demonstrates that this area meets the approved criteria for release to unrestricted use.

## **Site Description**

The waste tank vault pit and drain line trench are shown in Figure 1. All surfaces are soil. The large waste tank vault pit and drain line trench resulted from the excavation of the waste tank and its associated concrete vault and drain line. The floor area of the pit is ~52 m<sup>2</sup> (pit and trench floor area). The total wall surface area is ~126 m<sup>2</sup>. The total surface area (floor and walls) is 178 m<sup>2</sup>. The dimensions of the main pit are shown in Figure 2.

## **History of Use and Classification**

The waste tank, which has been removed and packaged for disposal as radioactive waste, collected liquid wastes from Building 27 and the EA-1 Bunker (Building 27-1). This tank was enclosed inside a concrete vault which was also removed and packaged as low level radioactive waste. Both the Tank and its associated vault were installed below the ground to provide shielding. A drain line was installed on the outside of the vault to provide drainage for accumulated groundwater. A video camera was run inside the pipe to verify its end point and to determine if any additional lines tied into this pipe underground. There were no additional pipes connected to this line. This drain line is 4" in diameter and ran 100 feet from the vault to the canyon wall approximately 15 feet below the surface.

This excavation pit and pipe trench were classified as a “**suspect affected area**” due to the fact that the tank was used to contain radioactive liquid waste and because localized areas of contamination were identified.

### **Criteria for Release to Unrestricted Use**

See main body of report for the approved criteria for release to unrestricted use.

### **Instrumentation & Background Measurements**

A list of instruments used during the radiological surveys is shown in Table 1. The table includes: (1) a description of the instrument, model number and its serial number, (2) a description of the detector (if applicable) and its serial number, (3) instrument ranges, (4) calibration due dates, (5) typical background readings and (6) calibration efficiencies (if applicable). All of the instruments used were calibrated semiannually and after repair, except for exposure rate meters which were calibrated quarterly.

#### **Background Soil Concentrations and Exposure Rates**

See main body of report for information on background soil samples and background exposure rates.

### **Decontamination**

The waste tank and the concrete vault were removed and packaged for disposal as low level radioactive waste. The drain line installed on the outside of the vault to provide drainage for accumulated groundwater is about 4" in diameter and ran about 100' from the vault to the canyon wall approximately 15' below the surface. Approximately 29 feet of the drain line was uncovered and removed. The remaining portion, which is buried, was surveyed in-place (it was found to be clean). A video camera was run inside the pipe to verify it's end point and to determine if any additional lines tied into this pipe underground; no additional pipes were found.

### **Final Surveys Performed**

#### **Objectives and Responsibilities**

The objectives of the final survey plans were: (1) to demonstrate that the average surface contamination levels for each survey unit were below the approved release criteria, (2) to show that the maximum residual activity did not exceed three times the average value in an area up to

100 cm<sup>2</sup>, (3) to demonstrate that the soil sample results were well below GA's approved release criteria for unrestricted use, (4) that the exposure rate measurements taken in this area measured at 1 meter above the surface were less than 10  $\mu$ R/hr above background.

Surveys were taken in accordance with an approved survey plan only by qualified Health Physics Technicians having a minimum of three years health physics experience. Soil samples were counted in GA's Health Physics Laboratory which maintains an effective QA program. Wipes (100 cm<sup>2</sup>) were counted on portable wipe counters (SAC-4 and BC-4).

Every survey taken was documented on a daily basis to a worksheet/drawing showing the approximate locations surveyed/sampled. The documentation included the results of the measurements (including units), the technician's signature, date, instrument(s) used (including the model and serial number of both the ratemeter and detector), calibration due date, % efficiency, background readings (if applicable) and any other pertinent information.

Each soil sample collected was properly logged, labeled, packaged and tracked and the sampling locations were documented on a drawing.

#### Survey Plan

A Final Survey Plan was developed based on the previous history of the Waste Tank, adjacent buildings, the radionuclides of concern for this area, the potential for contamination, the various types of surfaces encountered and the classification of the area (suspect affected). The entire pit and trench was "gridded" into 2m x 2m squares.

The surveys/sampling conducted within this pit, pipe trench and drain line remnant, located to the North to Northeast of Building 27-1 were completed in accordance with an approved written survey plan. A copy of the final survey plan is provided in Attachment 1 as follows: "Final Survey Plan for EA1 Bunker (Building 27-1) Waste Tank Vault Pit and Drain Line Trench."

#### Soil Sampling

Shallow soil samples were collected at a depth of 15 cm (0-6") using manual equipment (i.e., long handled spades). The locations selected were in accordance with the 2m x 2m grid sampling plan identified in the Final Sampling Plan.

Subsurface soil samples were not taken because the surfaces sampled were far below the original natural surface grade and because surface soil sample results and exposure rate measurements were below the release criteria.



Each of the soil samples taken was approximately 1 kilogram in mass. The samples were properly logged, labeled, tracked and packaged into plastic bags. All debris (i.e., grass, rocks, sticks, asphalt and foreign objects) was removed from each sample. Each soil sample was individually crushed to reduce large lumps, dried, placed into a tared marrinelli beaker (filled to the top), weighed, sealed and transported to GA's Health Physics Laboratory.

Soil samples were analyzed in GA's Health Physics Laboratory with a Canberra Low Sensitivity Gamma Spectroscopy MCA System using a high purity Germanium Detector. The system is calibrated using NIST traceable standards and performance checked daily.

Soil samples were counted for a minimum of 30 minutes each. A 30 minute count was sufficient to detect the radionuclides of concern at levels well below GA's approved soil release criteria.

Due to the possible Sr-90 contamination, which can not be detected by gamma spectroscopy, soil samples were sent to an offsite laboratory (Severn Trent Laboratories, Inc. for Sr-90 analysis. The results (which were all no detectable Sr-90 present) were provided in the main report.

In addition, a few samples from the pit were analyzed by the offsite laboratory (Severn Trent Laboratories, Inc) for plutonium. (No plutonium was detected in any of the soil samples, see main body of the report for these results).

### **Survey Summary**

Comparisons of the site Decommissioning Plan requirements with the Final Surveys in relation to the percentage of surface area scanned, number of measurements (i.e., number of fixed radiation measurements and 100 cm<sup>2</sup> wipes), exposure rate measurements ( $\mu$ R/hr) and soil samples taken are provided as follows:

Comparisons of Site Decommissioning Plan Requirements with the Final Surveys of the Tank Vault Pit Surfaces		
Survey	# of Exposure Rate Measurements (μR/hr)	# of Soil Samples Taken and Analyzed
Site Decommissioning Plan Requirements →	1 per 4 m <sup>2</sup> at 1 m from the surface  52 m <sup>2</sup> (floor area)/4 = 13 measurements	4 per 10m x 10m grid  178 m <sup>2</sup> total surface area therefore, ~8 soil samples
Final Surveys Conducted →	65 measurements at 1 m for the each soil surface  and 65 measurements at contact for each soil surface	52

Notes:

1. The total surface area of the pit and pipe trench to be released to unrestricted use is ~ 178 m<sup>2</sup>. The surface area of the pit and trench floor is approximately 52 m<sup>2</sup>.
2. In addition, during the final and/or confirmatory survey, soil samples from the pit were sent offsite for Sr-90 and plutonium analysis, none of either was detected, (see main body of report for results).

**Results of the Final Drain Pipe Surveys**

Survey Performed

1. Gamma scan of the entire inside of the 71 foot drain line.
2. Beta scan of the outside and 6" into the inside of the pipe (both ends of drain pipe).
3. Alpha scan of the outside and 6" into the inside of the pipe (both ends of drain pipe).
4. Large area masslinn cloth "smear" of the entire inside of the drain pipe.
5. Four 100 cm<sup>2</sup> smears (2 inside the pipe and 2 outside of the pipe) were counted on both the SAC-4 wipe counter (for gross alpha activity) and on the BC-4 wipe counter (for gross beta activity).

Exposure Rate Scan

The entire internal surface of the drain line pipe (~71' long) made of PVC was scanned with a 2

X 2" NaI (Tl) detector. The detector was dragged along the bottom of the 4" diameter pipe.

Exposure rate measurements ranged from 23-36  $\mu\text{R/hr}$  (see Figure 4 for approximate locations and results). Background measurements taken inside various pipes buried in a Non-Impacted area (to determine natural background levels), ranged from 12-31  $\mu\text{R/hr}$  (for the PVC pipe) as shown in Figure 3 of the main part of the report.

#### Fixed Measurements

100% of the drain line external pipe ends and approximately 6" into each end were scanned for beta/gamma activity using a 15cm<sup>2</sup> hand-held detector. No discernible activity above background identified. Background readings were 80-100 cpm (See Figure 4).

100% of the drain line external pipe ends and approximately 6" into each end were scanned for alpha activity using a 50 cm<sup>2</sup>  $\alpha$  hand-held detector. No discernible activity above background identified. Background readings were 0-20 cpm; readings were <20 cpm (See Figure 4).

#### Removable Contamination Surveys

A large area wipe (Maslinn Cloth) was pulled through the entire length (71') of the pipe internals and checked with a 15 cm<sup>2</sup>  $\beta/\gamma$  geiger counter. No discernible activity above background identified. Background readings were 80-100 cpm; masslin readings were 80-100 cpm.. See Figure 4.

Two (2) 100 cm<sup>2</sup> wipes were taken on the external surfaces of the drain pipe and two (2) 100 cm<sup>2</sup> wipes were taken on the inside (up to 6") of the drain pipe. The wipes consisted of using a Whatman Filter Paper (4.7 cm<sup>2</sup> diameter) and wiping an area of ~ 100 cm<sup>2</sup>. The wipes were counted using a low level portable wipe counters (SAC 4's for alpha contamination and BC-4's for beta contamination). The locations where wipe samples were collected and the results are provided in Figure 4. The wipe results were < 14 dpm/100 cm<sup>2</sup> alpha (MDA for the SAC-4) <107 dpm/100 cm<sup>2</sup> beta (MDA for the BC-4).

### Results of the Soil Surface Final Surveys

#### Exposure Rate Scanning and Measurements

The entire soil surface of the vault pit and trench was scanned using a 2 X 2" NaI (Tl) detector held at contact (approximately 1-2" from the surface). In addition, exposure rate measurements both at contact and at 1 m every 2 m. These measurements are provided in Figure 3. The

instruments used for this survey are provided in Table 1. The highest reading inside the pit was 30  $\mu\text{R/hr}$  contact and 28  $\mu\text{R/hr}$  at 1 m. These measurement are less than the approved release criteria of 10  $\mu\text{R/hr}$  above a typical surface background of 25-27  $\mu\text{R/hr}$  and a reading of 20  $\mu\text{R/hr}$  at 1 m from bottom for pits).

Soil Samples

A total of 52 soil samples were collected from the Building 27-1 Bunker Waste Tank Vault Pit and Trench. These soil samples locations are identified in Figure 5 . Gamma spectroscopy results are provided for these samples in Table 2. A summary of the isotopic results is as follows:

No of Soil Samples = 52	Radionuclide Concentration (pCi/g) (Background Not Subtracted)			
	<sup>137</sup> Cs	<sup>60</sup> Co	<sup>235</sup> U	<sup>238</sup> U
High	2.57 ± 0.14	0.24 ± 0.09	0.34 ± 0.09	3.60 ± 0.72
Low	ND	ND	ND	ND
Average	0.26	0.12	0.26	2.90

Notes:

1. All results were far less than the approved release criteria.
2. The sum of fractions for any sample was far less than 1.0.
3. ND = Not detected, <0.1 pCi/g Cs-137, <0.1 pCi/g Co-60, <3.0 pCi/g U-238, <0.3 pCi/g U-235.
4. The average was calculated using 48 results (the 5 soil samples collected prior to decontamination were not included in the average but the 5 soil samples post decontamination were included in the average). ND results were included in the average as follows: For Cs-137 ND = 0.1 pCi/g, for Co-60 ND=0.1 pCi/g, for U-235 ND = 0.3 pCi/g. NOTE: This average is conservative because it assumes that the ND values are positive when zero could be assumed.
5. Soil background values not subtracted.

Cs-137 was detected in 32 of the 52 soil samples. The highest concentration was 2.57 ± 0.14 pCi/g, which is far below the approved release criteria of 15 pCi/g.

Co-60 was detected, in low concentrations, in 6 out of 52 samples. The highest concentration was 0.24 ± 0.09 pCi/g which is far below the approved release criteria is 8 pCi/g.

U-235 and U-238 concentrations were at, or near, typical background concentrations.

Thorium concentrations were at, or near, typical background concentrations. Thorium was not a contaminant in the soil at the Building 27-1 (EA-1) bunker site.

Soil samples from the pit were sent to an offsite laboratory for Sr-90 and Plutonium analyses. The results of these are provided in the main report (none of either was detected).

### **Conclusion**

Final contamination and radiation surveys, as well as soil sample results provided in this report demonstrate that the Waste Tank Vault Pit, Drain Line Trench, and Drain Line associated with Building 27-1 meets the approved criteria for release to unrestricted use.

**Table 1: List of Instruments for the EA-1 Bunker Waste Tank Vault Pit and Drain Line Trench**

Instrument	Detector	Range	Calibration Due Date	Efficiency	Background	Description
Ludlum Model 3 S/N 153311	Ludlum Model 44-10 NaI (TI) Scintillator Gamma Detector S/N 155594	Four Ranges 0-500 $\mu$ R/hr	12-03-99	NA	15-18 $\mu$ R/hr (higher in pits and trenches)	2 inch x 2 inch NaI (TI) scintillator. Used for measuring external dose rates on the surface and at one meter.
Ludlum Model 3 S/N 153551	Ludlum Model 44-10 NaI (TI) Scintillator Gamma Detector S/N 155109	Four Ranges 0-500 $\mu$ R/hr	12-03-99	NA	15-18 $\mu$ R/hr (higher in pits and trenches)	2 inch x 2 inch NaI (TI) scintillator. Used for measuring external dose rates on the surface and at one meter.
Ludlum Model 3 S/N 4687	Ludlum Model 44-9 15 cm <sup>2</sup> Beta/Gamma S/N 117851	Four Ranges 0-100,000 cpm	05-02-00	22.05%	~80-100 cpm	The instrument is used for beta/gamma surveying. The detector has an active probe area of 15 cm <sup>2</sup> .
Ludlum Model 177 S/N 73599	Ludlum Model 43-65 50 cm <sup>2</sup> ZnS(Ag) Alpha Scintillator S/N 092188	4 Ranges 0-50,000 cpm	02-07-00	21.58%	0 -20 cpm	This instrument is used for $\alpha$ surveying. The detector has an active probe area of 50 cm <sup>2</sup> .
Eberline BC-4 S/N 30362	Scaler with GM Tube	0-999,999 counts	02-03-00	21.65%	~35 cpm	Used for counting wipe and air samples for $\beta/\gamma$ activity.
Eberline SAC-4 S/N 1153	Scaler with Scintillation / PM Tube	0-999,999 counts	03-24-00	29.78%	~0.2 cpm	Used for counting wipe and air samples for $\alpha$ activity.
Canberra Gamma Spectroscopy System	High Purity Germanium Detector	N/A	As needed	Varies with Sample	Varies with Sample	Gamma Spectroscopy MCA system using a high purity Germanium detector.

**Table 2: EA-1 Bunker Waste Tank Vault Pit and Trench Final Survey Soil Sample Gamma Spectroscopy Results**

#	Sample ID	Radionuclide Concentrations (pCi/g)			
		U-238 (93 keV)	U-235 (144keV,186 keV used when 144 not present)	Cs-137 (662 keV)	Co-60 {(1170 keV+1330 keV) /2}
1	27-1s-99-1000	ND	ND	ND	ND
2	27-1s-99-1001	ND	ND	ND	ND
3	27-1s-99-1002	ND	ND	ND	ND
4	27-1s-99-1003	ND	0.19 ± 0.08	ND	ND
5	27-1s-99-1004	2.54 ± 0.64	0.20 ± 0.07	0.13 ± 0.04	ND
6	27-1s-99-1005	2.34 ± 0.77	0.23 ± 0.10	ND	ND
7	27-1s-99-1006	ND	0.21 ± 0.09	ND	ND
8	27-1s-99-1007	3.50 ± 1.00	0.29 ± 0.12	ND	ND
9	27-1s-99-1008	ND	0.23 ± 0.08	ND	ND
10	27-1s-99-1009	ND	ND	ND	ND
11	27-1s-99-1010	ND	ND	ND	ND
12	27-1s-99-1011	ND	0.24 ± 0.10	ND	ND
13	27-1s-99-1012	3.60 ± 0.72	0.26 ± 0.09	ND	ND
14	27-1s-99-1013	ND	0.27 ± 0.19	ND	ND
15	27-1s-99-1014	ND	0.30 ± 0.09	ND	ND
16	27-1s-99-1015	2.89 ± 0.70	0.28 ± 0.08	0.29 ± 0.07	ND
17	27-1s-99-1016	2.34 ± 0.59	0.31 ± 0.07	ND	ND
18	27-1s-99-1017	ND	ND	0.40 ± 0.06	0.07 ± 0.04
19	27-1s-99-1018	ND	0.22 ± 0.06	0.14 ± 0.06	ND
20	27-1s-99-1019	ND	ND	0.09 ± 0.09	ND
21	27-1s-99-1020	ND	ND	0.34 ± 0.08	ND
22	27-1s-99-1021	2.30 ± 0.92	0.19 ± 0.08	0.20 ± 0.09	0.24 ± 0.09
23	27-1s-99-1022	ND	0.20 ± 0.07	0.23 ± 0.07	ND
24	27-1s-99-1023	ND	0.21 ± 0.06	0.11 ± 0.06	ND
25	27-1s-99-1024	ND	ND	0.29 ± 0.05	ND
26	27-1s-99-1025	ND	ND	0.22 ± 0.09	ND
27	27-1s-99-1026	3.06 ± 0.73	0.29 ± 0.10	0.19 ± 0.06	ND

**Table 2: EA-1 Bunker Waste Tank Vault Pit and Trench Final Survey Soil Sample Gamma Spectroscopy Results**

#	Sample ID	Radionuclide Concentrations (pCi/g) <i>Background Not Subtracted, 30 min. count (except as noted)</i>			
		U-238 (93 keV)	U-235 (144keV,186 keV used when 144 not present)	Cs-137 (662 keV)	Co-60 {(1170 keV+1330 keV) /2}
28	27-1s-99-1027	ND	0.19 ± 0.08	1.27 ± 0.13	ND
29	27-1s-99-1028	ND	0.27 ± 0.08	0.23 ± 0.07	ND
30	27-1s-99-1029	ND	0.21 ± 0.06	0.91 ± 0.10	ND
31	27-1s-99-1030	3.00 ± 0.73	ND	0.28 ± 0.05	0.04 ± 0.03
32	27-1s-99-1031	ND	0.25 ± 0.11	0.14 ± 0.12	ND
33	27-1s-99-1032	ND	ND	ND	ND
34	27-1s-99-1033	ND	ND	0.16 ± 0.07	0.06 ± 0.05
35	27-1s-99-1034	2.50 ± 0.69	0.26 ± 0.07	ND	ND
36	27-1s-99-1035	2.54 ± 0.81	0.18 ± 0.09	0.36 ± 0.09	0.09 ± 0.07
37	27-1s-99-1036	2.83 ± 0.78	0.34 ± 0.09	0.39 ± 0.07	ND
38	27-1s-99-1037	2.74 ± 0.90	0.25 ± 0.09	ND	ND
39	27-1s-99-1038	2.60 ± 0.62	0.21 ± 0.06	0.08 ± 0.06	ND
40	27-1s-99-1039	2.32 ± 0.84	0.22 ± 0.11	0.39 ± 0.09	ND
41	27-1s-99-1040	2.89 ± 0.84	ND	0.23 ± 0.06	ND
42	27-1s-99-1041	ND	0.21 ± 0.12	ND	ND
43	27-1s-99-1042	ND	ND	2.57 ± 0.14	0.14 ± 0.06
44	27-1s-99-1043	ND	0.17 ± 0.11	0.40 ± 0.10	ND
45	27-1s-99-1044	ND	0.31 ± 0.11	0.12 ± 0.05	ND
46	27-1s-99-1045	2.49 ± 0.70	0.25 ± 0.09	0.10 ± 0.07	ND
47	27-1s-99-1046	2.91 ± 0.68	0.27 ± 0.06	0.18 ± 0.05	ND
48	27-1s-99-1047	ND	ND	ND	ND
49	27-1s-99-1048	ND	0.28 ± 0.08	0.31 ± 0.06	ND
50	27-1s-99-1049	ND	0.31 ± 0.11	0.13 ± 0.07	ND
51	27-1s-99-1050	2.62 ± 0.60	0.24 ± 0.07	0.18 ± 0.08	ND
52	27-1s-99-1051	ND	0.24 ± 0.12	0.30 ± 0.09	ND

**Notes:**

1. ND = Not detected, <0.1 pCi/g Cs-137, <0.1 pCi/g Co-60, <3.0 pCi/g U-238, <0.3 pCi/g U-235.
2. Thorium was not discernible from natural background activity levels.



**Figure 1: Building 27-1 Bunker: Waste Tank Vault Pit & Drain Line Trench**

B-16

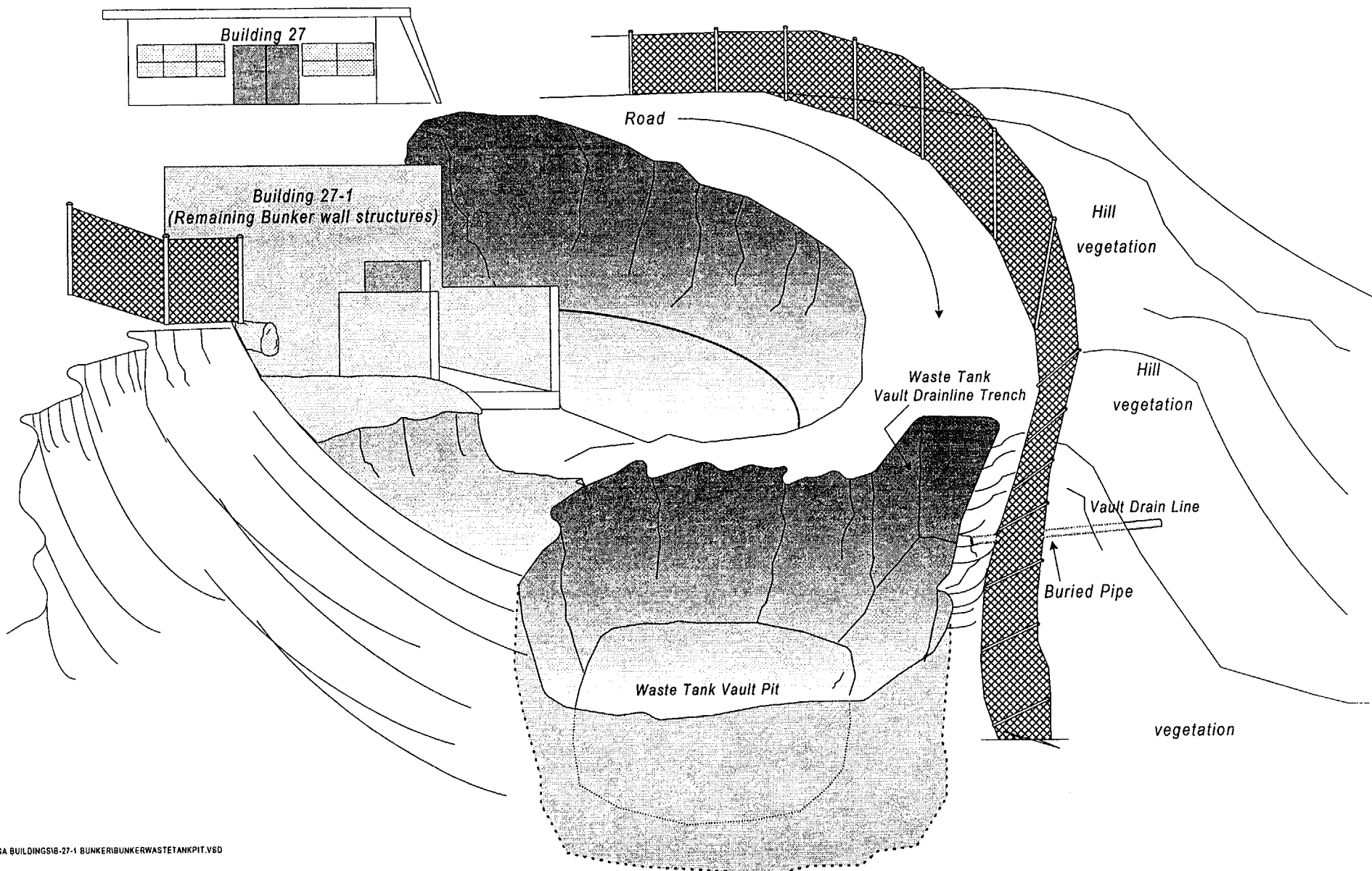
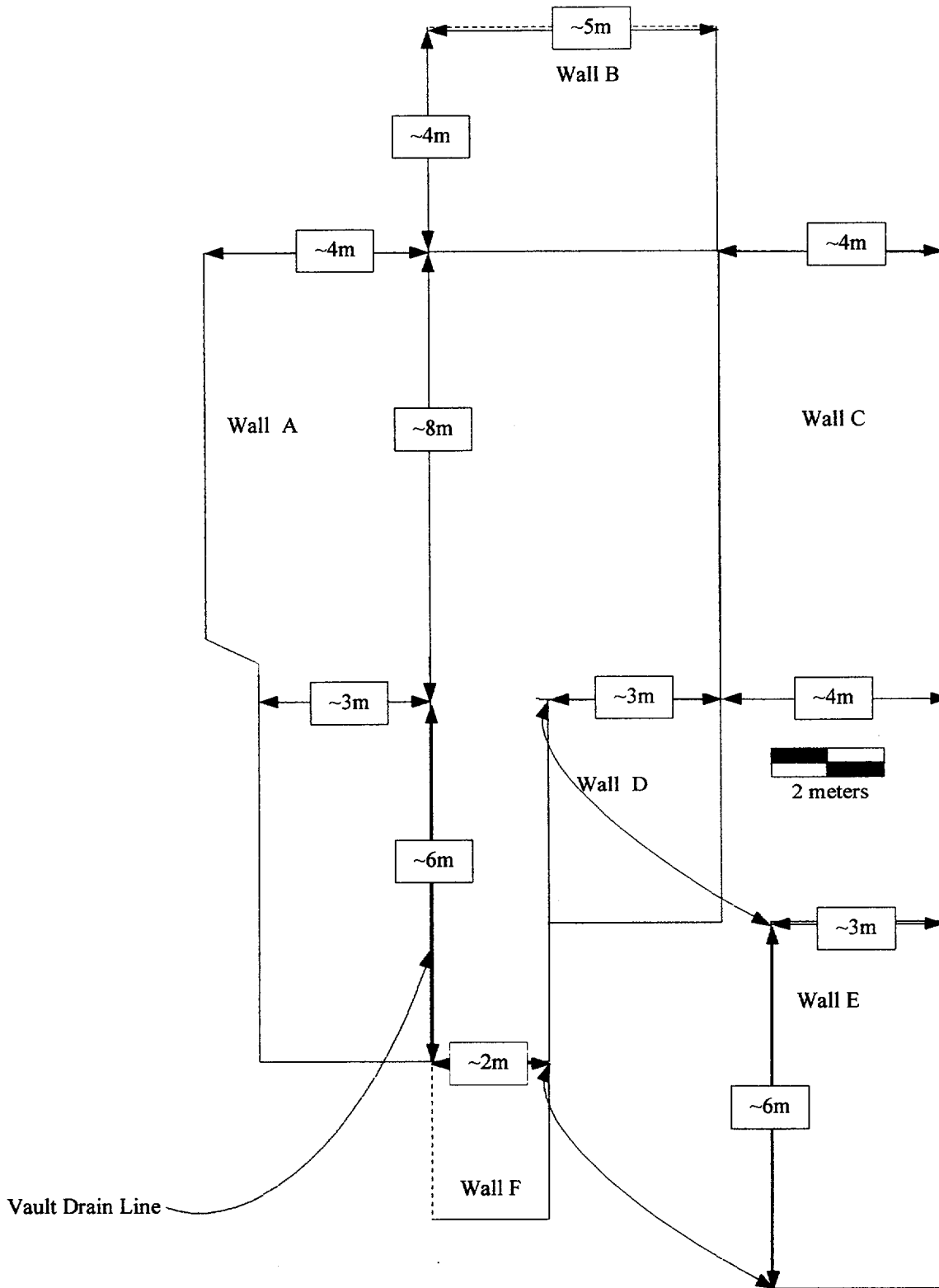
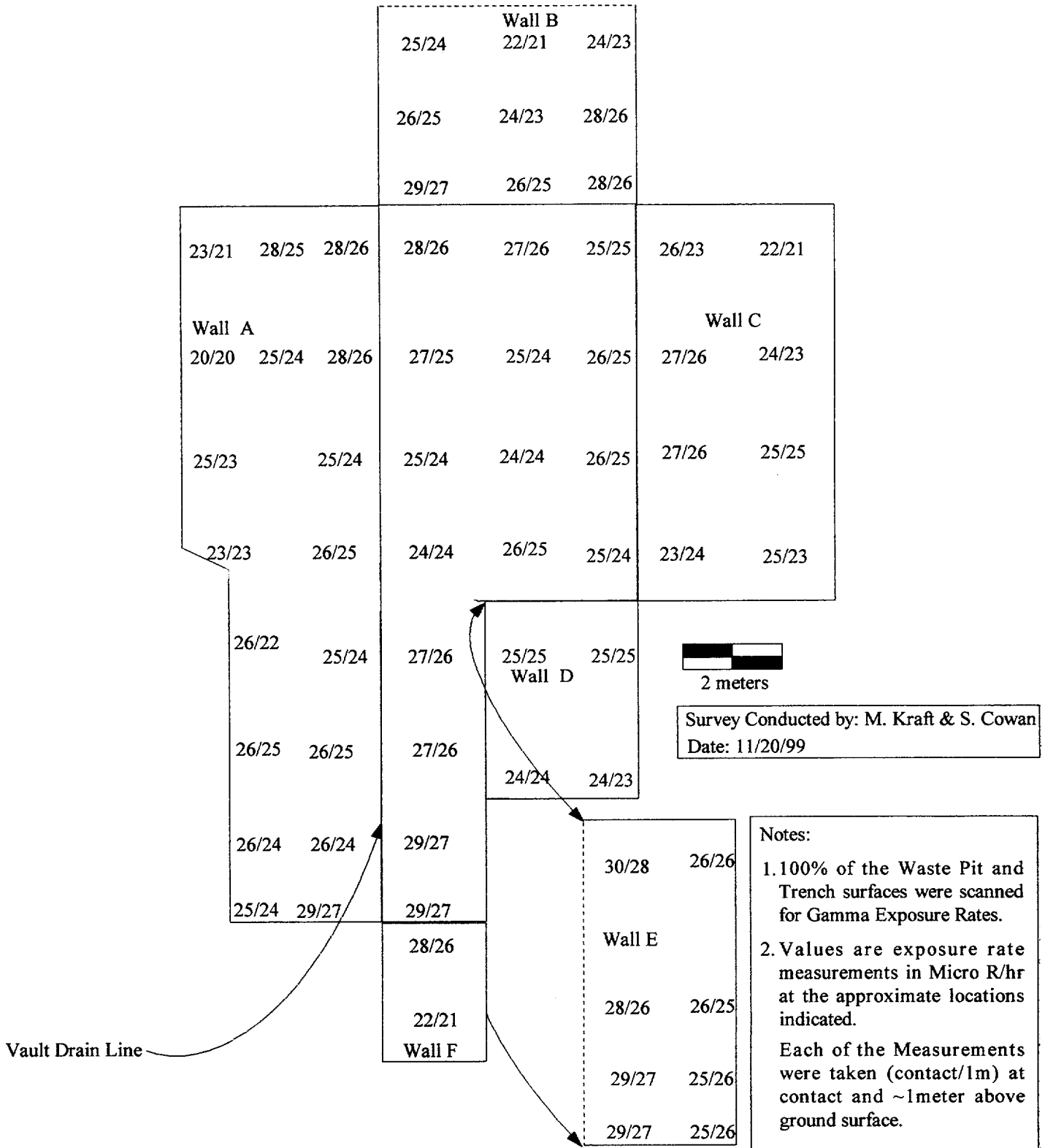


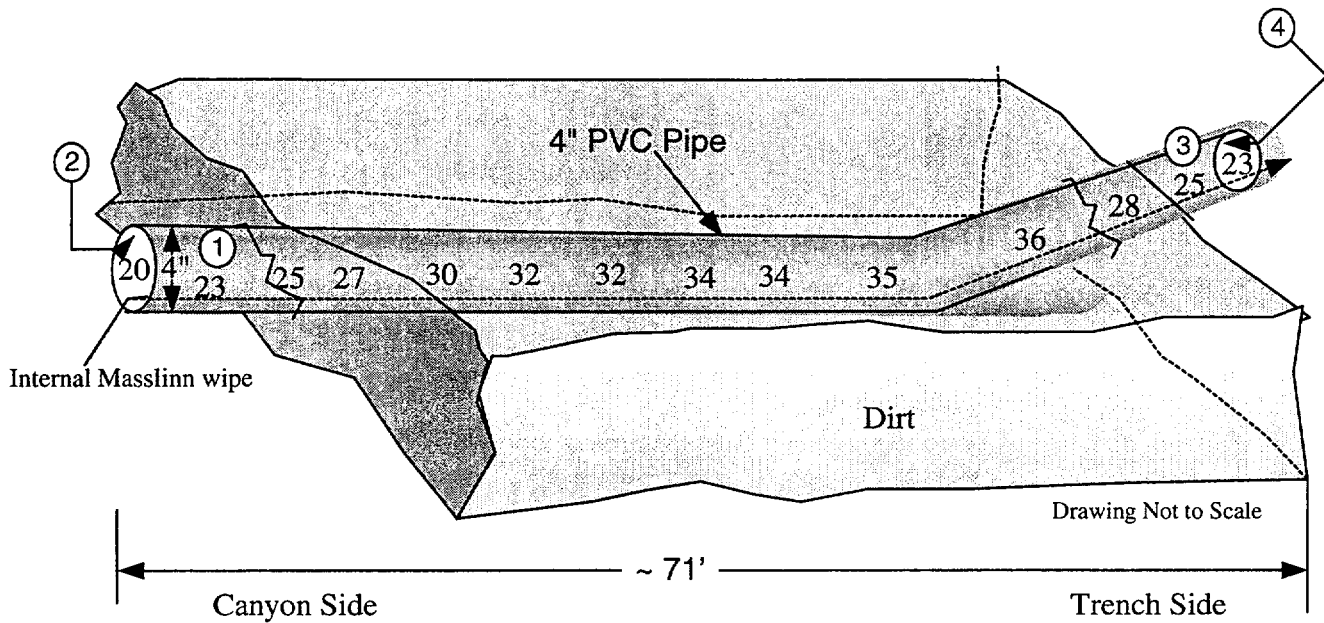
Figure 2: Dimensions: Waste Tank Vault Pit and Trench



**Figure 3: Waste Tank Vault Pit and Trench Gamma Scan Locations and Results of Exposure Rate Measurements**



**Figure 4: EA-1 Bunker Waste Tank Vault Drain Line  
Locations and Results of Radiological Survey Measurements**

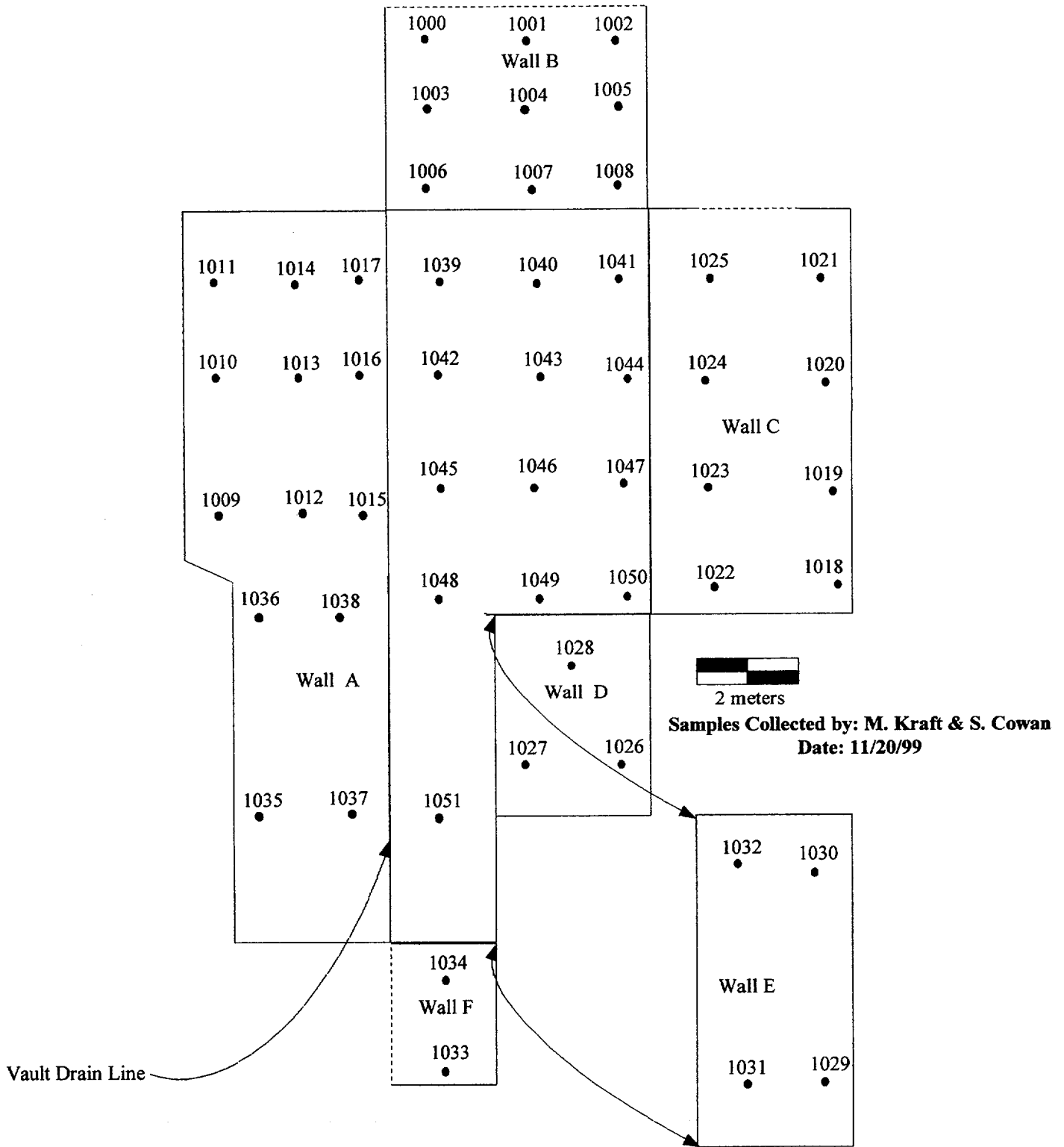


Survey Conducted by: M. Kraft and S. Cowan  
Date: 11-20-99

Notes:

1. Exposure rate measurements were taken internally the entire length of the pipe and are shown in  $\mu\text{R/hr}$ . Results ranged from 20 to 36  $\mu\text{R/hr}$ .
2. The exposed ends of the pipe and ~6" inside were scanned for beta/gamma and alpha activity. No discernible activity above background (80-100 cpm beta/gamma and 0-20 cpm alpha) was found.
3. A large area Masslinn wipe was taken the inside the entire length of the pipe and checked with a 15  $\text{cm}^2$  beta/gamma Geiger counter. No discernible activity above background (80 - 100 cpm) was found.
4. (#) Denotes wipe number and location. Wipes were taken internally and externally at both ends. Maximum wipe results were <107 dpm/100  $\text{cm}^2$  beta and <14 dpm/100  $\text{cm}^2$  alpha.
5. Instruments used for this survey are listed in Table 1.

Figure 5: Waste Tank Vault Pit and Trench Numbered Soil Sample Locations



**Attachment 1**

**“Final Survey Plan for EA-1 Bunker (Building 27-1) Waste Tank Vault Pit and  
Drain Line Trench ,” dated November 19, 1999**

Attachment 1 to Appendix B

November 19, 1999

Prepared by: W. LaBonte *W LaBonte 11/19/99*

Approved by: *Laura Gonzales* Date: 11/19/99  
L. Q. Gonzales

Final Survey Plan for EA1 Bunker (Building 27-1)  
Waste Tank Vault Pit and Drain Line Trench

This survey plan is for EA1 Bunker (Building 27-1) Waste tank Vault pit and excavation trench created during the removal of the Vault drain. This survey addresses soil surface scans and soil samples to be taken from inside the pit and from the drain line trench. It also addresses the survey of the remaining drain line which is located at the bottom of the trench and runs underground and ends at the canyon slope.

The soil surfaces to be included in this plan are the areas illustrated in figure 1, EA-1 Bunker Waste Tank Vault Pit & Drain Line Trench Location, and figure2, Dimensions, Waste Tank Vault Pit.

Background and Classification

Background Information

A plastic Waste Tank which was contained in a concrete vault was connected to Building 27 (Radiochemistry) and Building 27-1(EA-1 Bunker) to collect radioactive liquid wastes. During decommissioning operations, the waste tank and it's concrete vault were excavated and disposed of as radioactive waste. During excavation, a drain line was discovered approximately 12 feet below the surface. This drain line provided an open drain path for the external surfaces of the concrete vault to Sorrento Valley canyon slope. Approximately 20 feet of this line was excavated and removed. The remaining portion of the line, the portion that runs from the Controlled Area fence into the canyon, will be left in place because it is not radiologically contaminated.

Classification

The Waste Tank Vault pit and Vault Drain line Trench areas are classified as a **Suspect Affected Area**. The Waste Tank Vault Drain line is classified as **Non-Suspect Affected Area**.

## Survey Objectives and Responsibility

The purpose of performing a final survey is to demonstrate that the radiological conditions satisfy the NRC and State of California guidelines for release to unrestricted use. The objectives include (1) that the exposure rates in occupiable locations are less than 10  $\mu\text{R/hr}$  above background measured at 1 meter above the surface, (2) that soil activity concentrations are below the release criteria identified in the GA Site D&D Plan, (3) that the loose surface activity inside the abandoned Drain line is less than the release criteria identified below, and (4) the direct radiation levels inside of the Drain line are less than 10  $\mu\text{R/hr}$  above background. Samples will be taken by qualified Health Physics technicians having a minimum of 3 years Health Physics Technician experience following approved Health Physics procedures and this plan. The survey and final report documenting the survey will be performed by GA's Health Physics group.

## Release Criteria (per GA Site Decommissioning Plan)

### Waste Tank Vault Drain Line Criteria

Characterization surveys performed in Building 27-1 included gamma spectroscopy analysis and  $^{90}\text{Sr}$  analysis (performed by a contracted laboratory). Many of the samples taken indicated the presence of  $^{90}\text{Sr}$  as well as  $^{137}\text{Cs}$  and  $^{60}\text{Co}$ . This fact combined with knowledge of the use of the facility in the past concludes that  $^{90}\text{Sr}$ ,  $^{137}\text{Cs}$ , and  $^{60}\text{Co}$  are the most likely Radionuclides.

The applicable release criteria, based on  $^{90}\text{Sr}$ , which is the strictest nuclide, is:

**1,000 dpm/100 cm<sup>2</sup>, averaged over 1 m<sup>2</sup> area**  
**3,000 dpm/100 cm<sup>2</sup>, maximum in a 100 cm<sup>2</sup> area**  
**200 dpm/100 cm<sup>2</sup>, removable activity**

Alpha contamination was not detected on any of the Characterization surveys and alpha emitters were not detected in any of the samples analyzed by gamma spectroscopy.

### Exposure Rate Measurements

The guideline value for exposure rates measured at 1 m above the surface is 10  $\mu\text{R/hr}$  above background.

### Soil Criteria

The release criteria for soil is specified in the Site Decommissioning Plan and summarized below. The values presented below are above background levels. **Note: Soil, asphalt and concrete rubble from affected areas must remain on site until specific approval to move it off site is granted by the NRC and the State of California.**



Cs-137	15 pCi/g
Co-60	8 pCi/g
Enriched Uranium (U-234 plus U-235)	30 pCi/g
Thorium (Th-232 plus Th-228)	10 pCi/g
Sr-90	1800 pCi/g

If multiple nuclides are present, the sum of the ratios of the concentration of each Radionuclide to its respective guideline must not exceed 1. **If other nuclides are encountered, notify HP Management for release criteria.**

**Gross alpha/beta results are required for a representative number of soil samples (to have an upper bound for the maximum Sr-90 which could be in the soil). Sr-90 analysis may also be required.**

### Alert Levels

If the following "alert levels" are exceeded, notify HP Management so an evaluation can be performed to determine if increased survey coverage or decontamination is required.

#### Alpha Monitoring

>60 cpm using a hand held alpha probe, notify Health Physics Management.

**Exceeding the Alert Level:** To determine if additional decontamination is necessary in areas where the Alert Level has been exceeded, the following should be performed:

#### Beta measurement Using the Pancake GM probe

> 150 cpm

**Decontamination Required-** when (1) Pancake GM measurement > 150 cpm,

#### Exposure Rate Measurement

Exposure rate measurements at 1 m above the surface: 5  $\mu$ R/hr above background or above 20  $\mu$ R/hr, which ever is less.

Exposure rate measurements on contact (within 2" from the surface): 25  $\mu$ R/hr.

#### Soil, Gravel, Asphalt Rubble, Concrete Rubble Samples

Any Radionuclide above natural background levels (see HP-40 for background levels). All soil sample results must be reviewed by Laura Gonzales, Paul Maschka, or Bill LaBonte.

## Final Survey Requirements

### Pit and Trench Surfaces

Scan the entire surface with a 2" X 2" NaI detector held within 2" of the surface.

Perform a scan with a 2" X 2" NaI detector held 1 meter from the surface at each soil sample location.

Take a surface Soil sample (0-6" depth) at each location identified in Figure - 3, Soil Sample Locations. Gamma Scan each sample and perform a gross Alpha/Beta count on the highest sample from each wall.

### Vault Drain Line

Perform a smear survey at each end of the drain line. Analyze for  $\alpha$  and  $\beta$  contamination.

Perform a direct scan with portable Alpha and Beta instruments at each pipe end.

Pull a large area wipe through the entire internal surface of the Drain line. Analyze for  $\alpha$  and  $\beta$  contamination.

Using a NaI detector, perform a radiation survey on the pipe internal surface by pushing the probe into each end of the pipe. 100 % of the surface should be surveyed.

## Documentation

**Every** survey conducted must be documented on a **daily basis** on a drawing showing the approximate locations surveyed. Include the results (including units), the technician signature, date, instrument(s) used, efficiency, background readings (if applicable) and any other applicable information.

Figure 1: EA-1 Bunker Waste Tank Vault Pit & Drain Line Trench Location

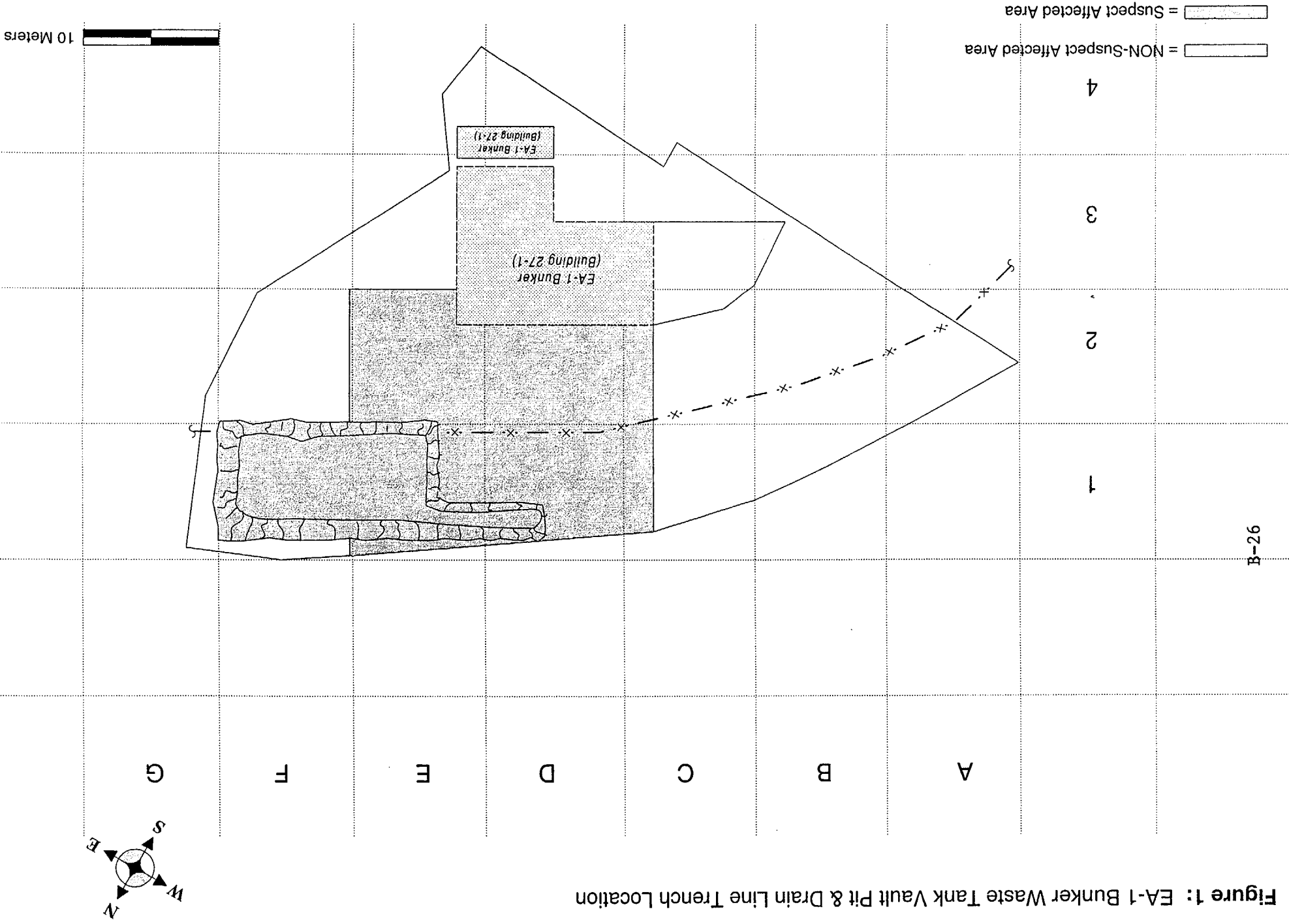


Figure 2: Dimensions: Waste Tank Vault Pit and Trench

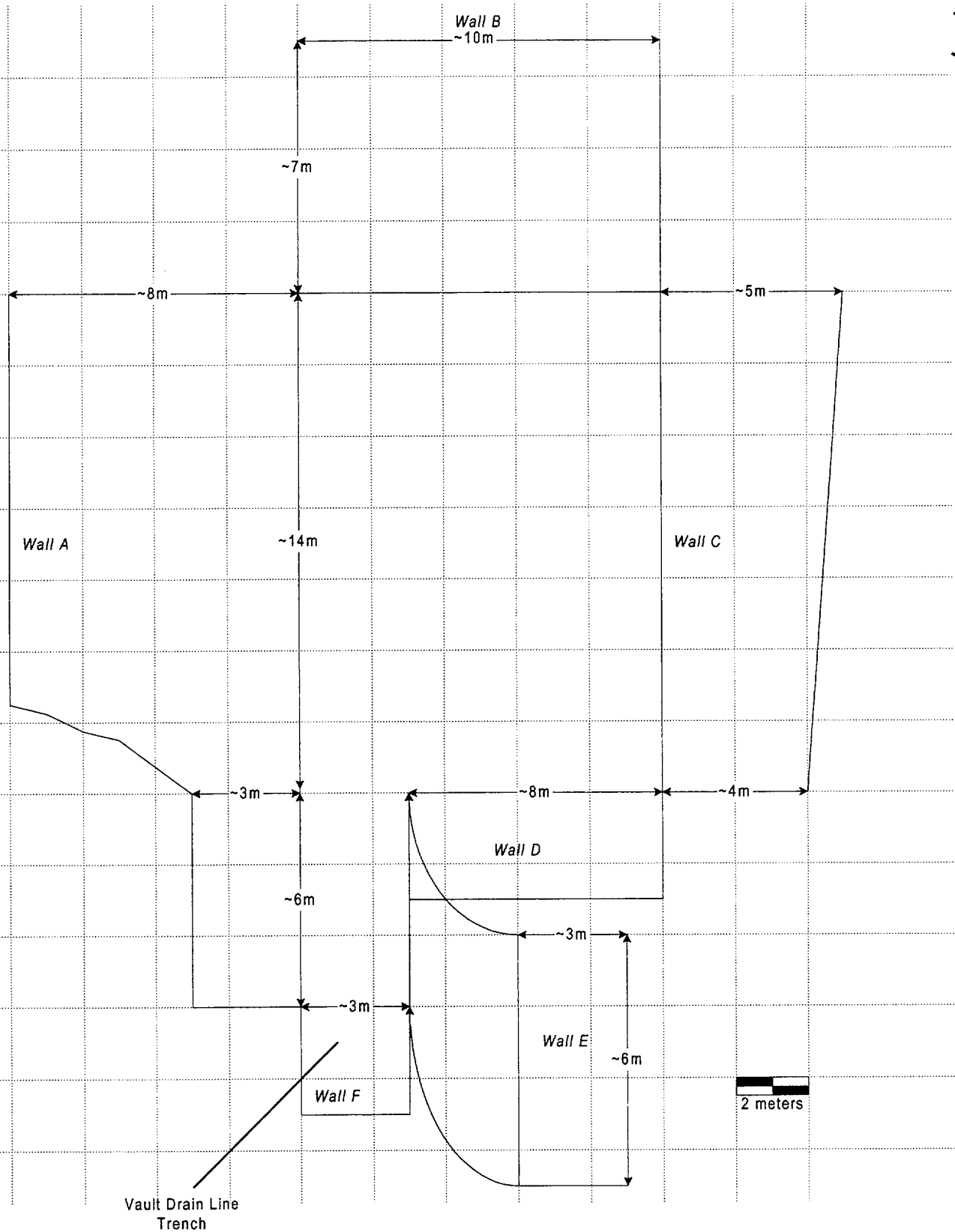
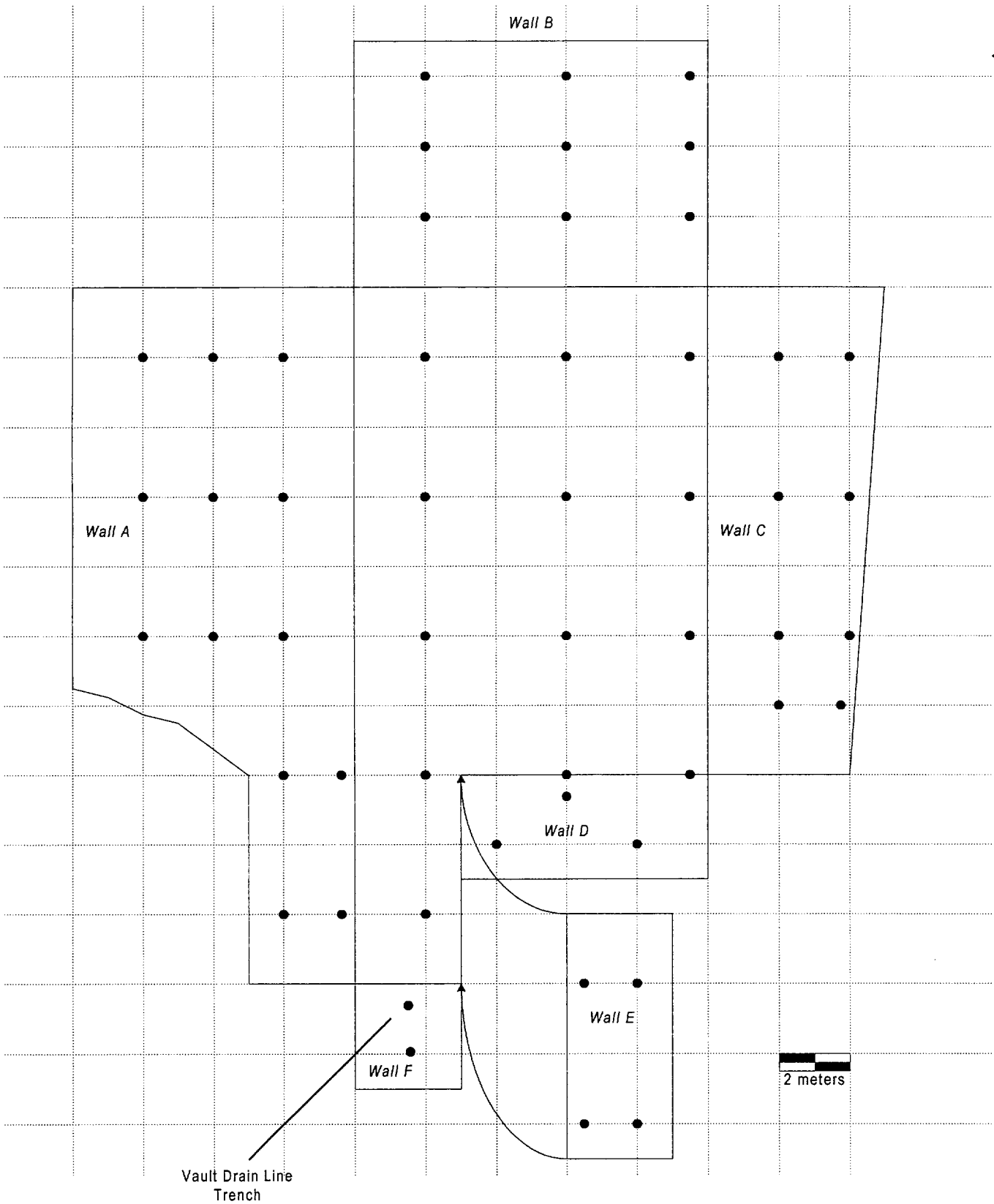


Figure 3: Soil Sample Locations  
Waste Tank Vault Pit



● = Denotes Soil Sample Location