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FINAL TASK SPECIFIC PLAN FOR THE BUILDING 9 REMEDIAL ACTION SUPPORT SURVEY AND FINAL STATUS SURVEY NAS BRUNSWICK ME

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TETRA TECH EC INC

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FINAL
TASK SPECIFIC PLAN FOR THE BUILDING 9 REMEDIAL ACTION SUPPORT SURVEY AND FINAL STATUS SURVEY FORMER NAVAL AIR STATION BRUNSWICK BRUNSWICK, MAINE

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ACRONYMS AND ABBREVIATIONS

APP	Accident Prevention Plan
cm^2	square centimeter
cm/s	Centimeters per Second
cpm	counts per minute
Cs-137	Cesium-137
CTO	Contract Task Order
DAC	Derived Air Concentration
DFW	Definable Features of Work
DoD	Department of Defense
dpm	disintegrations per minute
DQO	Data Quality Objectives
FSS	Final Status Survey
H-3	Tritium
HEPA	High Efficiency Particulate Air
HRA	Historical Radiological Assessment
LBGR	Lower Boundary of the Gray Region
LLRW	low-level radioactive waste
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDC	Minimum Detectable Concentration
MDCR	Minimum Detectable Count Rate
MDL	Minimum Detection Limit
NASB	Naval Air Station Brunswick
NAVFAC	Naval Facilities Engineering Command
NAVSEA	Naval Sea Systems Command
Ra-226	Radium-226
RASO	Radiological Affairs Support Office
RASS	Remedial Action Support Survey
RWP	Radiation Work Permit
SOP	Standard Operating Procedure
SSHP	Site Safety and Health Plan
SU	Survey Unit
Th-232	Thorium-232
TtEC	Tetra Tech EC, Inc.
TSP	Task Specific Plan
U-238	Uranium-238

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1.0 INTRODUCTION

Tetra Tech EC, Inc. (TtEC) has prepared this Task Specific Plan (TSP) for the Remedial Action Support Survey (RASS) and Final Status Survey (FSS) of Building 9 at the former Naval Air Station Brunswick (NASB), Brunswick, Maine for the United States Department of the Navy (Navy), Naval Facilities Engineering Command (NAVFAC), Atlantic under a Removal Action Contract, N62470-13-D-8007, Contract Task Order (CTO) WE09. The survey will be conducted in accordance with the general approach and methodologies provided in the Basewide Radiological Management Plan (TtEC, 2014a) and Standard Operating Procedures (SOPs) provided in Attachment 3 to the Basewide Radiological Management Plan. The surveys will conform to the requirements of the Accident Prevention Plan (APP)/Site Safety and Health Plan (SSHP) (TtEC, 2014b) and the Radiation Protection Plan, Attachment 2 to the Basewide Radiological Management Plan, prepared for the survey program. No exceptions to the Basewide Radiological Management Plan, SOPs, or APP/SSHP are noted.

1.1 Site Description and Historical Summary

Building 9 is a one story wooden structure covering approximately 8,888 square feet and was constructed in 1943. The building had several uses over the years including a Laundry Building (1940s), Electronic and Ordnance Shop (1950s to 1960s), Patrol Squadron Special Unit (VPU) (1970s to 1980s), and the Morale, Welfare, and Recreation (MWR) Chief Petty Officer (CPO) Wardroom, a lounge and mess facility for non-commissioned officers and as the NASB housing office from 2006 to until base closure in 2011. The location of Building 9 within NASB is shown on Figure A-1.

Public Works drawings showing the configuration of the building as the Laundry Building, the 1984 remodel plans, 1985 as-built drawing, and the building in its current configuration are provided in Appendix B. From review of the drawings, all of the original interior partitions and walls have either been removed or stripped, the exterior walls were stripped to the surface of the concrete masonry or bare studs, all floor finishes (carpet and vinyl tiles) were removed, and all windows including the original clerestory windows, louvers, and roofing have been removed. The drawings show that the western half of the building contained administrative functions and the central and eastern half were storage/warehouse locations. Currently, the building is vacant and the walls and floors have been stripped down to the original surfaces.

Building 9 has no current radiological use; however, as a former Electronics and Ordnance Shop, this building was used in the maintenance and repair of electronic components. Although the specific nature of the work performed in this building is unknown, electronics are known to include items with radioactive material. The building was later used by the VPU. VP squadrons flew P-2 Neptune and P-3 Orion aircraft. The Orion replaced the Neptune 1966 because it was larger, more versatile, and could deliver a more powerful weapon. The VPU likely used this building to house Advanced Undersea Weapons/Anti-Submarine Underwater Warfare components and for torpedo maintenance and overhaul. Examples of radioactive materials potentially used in this building would be aircraft components, electronics, and instrumentation

(NAVSEA, 2012). Per the Historical Radiological Assessment (HRA), the radionuclides of concern (ROCs) for Building 9 are Cesium-137 (Cs-137), Radium-126 (Ra-226), Thorium-232 (Th-232), Tritium (H-3), and Uranium-238 (U-238) (NAVSEA, 2012).

1.2 Previous Characterization Survey

In July 2012, Tetra Tech, Inc. conducted a scoping survey in accordance with their TSP (Tetra Tech, Inc., 2012). This survey plan was developed so that if no contamination levels above the release criteria were identified, the survey results would serve as FSS results. Building 9 was surveyed as a Class 3 area resulting in 25 percent of the floor and walls up to 6 feet being surveyed. One survey unit (SU 1) was established for this Class 3 survey. The survey results indicated that one area (approximately 300 square centimeters [cm^2] in size) on the floor in the room just east of the entry had alpha activity at 3,985 disintegrations per minute (dpm)/100 cm^2 and beta activity at 39,118 dpm/100 cm^2. All other scan surveys, direct measurements, removable contamination surveys, and gamma walkover surveys provided data that was indicative of background values. The analytical results of the wet smears showed that all 17 smears were less than the Minimum Detection Limit (MDL) for tritium. A copy of Tetra Tech, Inc's Scoping Survey Report is provided as Appendix C to this TSP. The location of the elevated area is provided in Figure A-1. The contaminated area is currently posted as a Radioactive Material Area and access is controlled.

Remedial action will be undertaken to address the contamination identified during the scoping survey. RASSs will then be conducted in accordance with this TSP to verify the removal of fixed contamination in the affected area.

In accordance with the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) (DoD et al., 2000), as contamination was identified during the scoping survey, the room with the elevated location within Building 9 will be reclassified as a Class 1 area and a Class 1 survey of the floor and approximately 2 meters up the walls that were present when potential radioactive material was in use will be performed. This Class 1 survey will be bounded by a Class 2 survey between 2 and 4 meters along the walls that were present when potential radioactive material was in use. The remainder of the floor surfaces within Building 9 will be reclassified as a Class 1 area. The remainder of the walls within Building 9 that were present when potential radioactive material was in use will be reclassified as a Class 2 area and a Class 2 survey from the floor to approximately 2 meters up the walls will be performed. If other locations of contamination are identified during performance of the Class 1 survey, these areas will be remediated and subsequent RASSs will be performed until the release criteria for the ROCs are achieved. If other locations of contamination are identified during performance of the Class 2 survey, these areas will be reclassified as Class 1 areas and Class 1 surveys will be performed and these areas will be remediated and subsequent RASSs will be performed until the release criteria for the ROCs are achieved. The remedial actions and subsequent RASSs will be designed to achieve results that can be used as FSSs to provide a complete FSS report for Building 9. This report will demonstrate that no fixed or removable contamination remains at levels exceeding the release criteria.

2.0 PREPARATION AND REMEDIAL ACTION SUPPORT SURVEYS

Any miscellaneous trash and debris present inside Building 9 will be removed and surveyed as materials and equipment in accordance with SOP 003, Release of Materials and Equipment from Radiologically Controlled Areas, before the remediation activities are begun. Any remaining carpeting or vinyl tiles still present in the building will also be removed to expose the original concrete surface and surveyed as materials and equipment. Materials identified as having contamination present above the levels specified in Table 2-1 will be packaged for subsequent decontamination or storage and disposal.

The one area of elevated activity, as identified by the Tetra Tech, Inc. survey data, will be remediated to remove any fixed contamination exceeding the release criteria. This will be accomplished by removing a thin layer of the surface material (concrete flooring). It is important to note that fixed contamination methods can result in the creation of removable surface contamination. This creates a condition that may generate airborne radioactive material. Removal activities will be controlled in such a manner that generation of airborne radioactivity is greatly reduced. Air sampling will be performed to monitor and properly evaluate any resultant airborne radioactivity.

Remediation will be performed in accordance with the requirements of a Tetra Tech EC, Inc. Radiation Work Permit (RWP) and SOP 007, Decontamination of Equipment and Tools. Personnel performing the remediation will be required to wear protective coveralls, shoe covers, and gloves. A step-off pad with 55-gallon drums with plastic liners for waste shall be placed at each entry point. To mitigate potential airborne contamination, a water surfactant will be sprayed on the affected areas prior to remediation. Air monitoring will be performed during remediation using a low-volume continuous air monitor in accordance with SOP 009, Air Sampling and Sample Analysis. Air samples will be collected for the entire time that airborne causing remediation occurs, and for a minimum of 2 hours, to ensure that the minimum detectable concentration for 10 percent of the derived air concentration (DAC) for Th-232 is met during air sampling. During the course of work, if an airborne concentration exceeds 10 percent of the DAC for one of the ROCs, ongoing activities will cease. The affected location will then be posted as an Airborne Radioactivity Area until the source of the airborne concentration is eliminated and levels are confirmed to be below 10 percent of the DAC, or increased controls are established in the applicable RWP.

The residual radioactivity on the concrete floor surface will be removed by mechanically abrading the surface of the affected area. During the abrading, a high efficiency particulate air (HEPA) vacuum will be used to provide ventilation over the remediation area. To mitigate potential airborne contamination, a water surfactant will be sprayed on the affected area prior to remediation. During the removal, a HEPA vacuum will also be used to provide ventilation over the remediation area.

The progress of remedial actions will be checked periodically by a Radiological Control Technician scanning the area with a Ludlum Model 2360 survey meter with a Ludlum Model 43-68 gas-flow proportional detector and a Ludlum Model 2350 survey meter with a Ludlum

Model 44-10 sodium iodide scintillation detector. Large area wipes will also be collected throughout the remediation process to ensure removable contamination is contained.

Remediation activities will continue until the survey indicates that the residual fixed radioactivity is less than 100 dpm/100 square centimeters (cm^2) alpha and removable radioactivity is less than 20 dpm/100 cm^2 alpha as specified in Table 2-1. When the survey indicates that the remediation is complete, the area will be cleaned with a HEPA vacuum to remove any loose material. Any herculite or plastic sheeting used to protect against the spread of contamination to adjacent SUs will be disposed of as low-level radioactive waste (LLRW).

3.0 FINAL STATUS SURVEY DESCRIPTION

The FSS is being performed to assess whether residual activity has been removed to levels below the release criteria defined in Table 2-1. The intent of the Building 9 FSS is to achieve unrestricted release for the building. As the Class 3 survey indicated an area of elevated activity, the surveys will involve resurveying 100 percent of all floor surfaces and up to 2 meters of the wall surfaces in the room that had the elevated location (Class 1 survey), 50 percent of the wall surfaces between 2 and 4 meters above the Class 1 area in the room that had the elevated location (Class 2 survey), 100 percent survey of the remaining floor surfaces within the building (Class 1 survey), and 50 percent of the remaining wall surfaces up to 2 meters within Building 9 that would have been present during the use of radioactive material (Class 2 survey).

3.1 Release Criteria

The release criterion for building surfaces is 5,000 dpm/100 cm^2 for Cs-137, 100 dpm/100 cm^2 for Ra-226, 1,000 dpm/100 cm^2 for Th-232, and 5,000 dpm/100 cm^2 for U-238. The release criteria for H-3 is 5,000 dpm/100 cm^2 total surface activity; however, due to the low energy beta emitted by H-3, detection with surface monitoring is not practical and these samples will be sent off-site for analysis for H-3. The removable contamination release criterion is one-fifth of the total activity criteria. The limits for the specific RCOs to be addressed in Building 9 are provided in Table 2-1.

3.2 Reference Area

Building 53 will initially be used as the reference area for this survey. If similar material types are not available within Building 53, radiologically non-impacted portions of Buildings 200 and 250 may also be used as reference areas, with the selected areas being reviewed and approved by RASO. These buildings appear to have similar building materials as in Building 9. The concrete surface within Building 250 and not Building 292 will be used as the reference area for the concrete floor in Building 9 as the surface beta emission rate was found to be much higher than many of the impacted surfaces during the scoping survey. The hallway in Building 250 adjacent to the former “GEEDUNK” area is similar in material to the concrete surface within Building 9. The reference area survey data will be obtained prior to final recording of surveys within Building 9 and will be included in the Building 9 FSS report. Reference areas for surveys performed to determine compliance with Ra-226 criteria are not required due to the application of particle detection theory, which does not subtract reference values. The locations Location of

Buildings 53, 200, and 250 are shown on Figure A-2 in Appendix A. Additional reference areas may be chosen by the Radiation Safety Officer Representative (RSOR), in consultation with the Radiological Affairs Support Office (RASO).

3.3 Investigation Level

The investigation level for alpha surveys will be areas identified by two or more alpha counts over the predetermined scan interval followed by two or more alpha counts after pausing over the same area when using a large area detector. When using a handheld detector that has a background count rate of one or fewer counts per minute (cpm) for alpha surveys, the investigation level will be one or more alpha counts over the predetermined scan interval followed by one or more alpha counts after pausing over the same area. The investigation level for beta surveys will be 4,500 dpm/100 cm^2 beta (at 90 percent of the release criteria). The investigation levels for removable contamination are 20 dpm/100 cm^2 alpha and 200 dpm/100 cm^2 beta. These levels are consistent with the release criteria presented in Table 2-1. For gamma surveys, the investigation level will be established at the reference area mean plus 3-sigma (σ), where σ is the standard deviation of the gamma readings in the reference area.

3.4 Survey Units

SU 1 is considered to be a Class 1 area that requires 100 percent scan survey of the floor and walls up to approximately 2 meters as recommended in MARSSIM guidance (DoD et al. 2000) Section 8.5.3. SUs 2 through 7 are considered to be Class 1 areas that require 100 percent scan survey of the floors. SU 8 is considered to be a Class 2 area that requires 50 percent survey of the walls in SU 1 between 2 and 4 meters from the floor surface and 50 percent survey of the walls up to 2 meters from the floor in SU 2. Only those walls that would have been present when radiological activities would have occurred will be surveyed. As noted in NAVFAC Drawing 2066032 provided in Appendix B, the only interior walls that were not removed or stripped during the remodel process in 1984/1985 are present in the southeastern portion of the building as shown in Figure A-3. The locations of the seven Class 1 survey units within Building 9 are provided on Figure A-3. The SU layouts are shown on Figures A-4 through A-11 in Appendix A.

Each SU will contain systematic data collection locations. At each systematic sample location, a direct surface measurement, gamma exposure rate, and swipe survey will be obtained. Swipe surveys will be analyzed in accordance with the SOPs. The number of systematic locations has been determined in Section 3.5 to be a minimum of 16. Using a random start point, the systematic data collection locations have been laid out in a triangular grid pattern for each SU using the computer process provided by Visual Sample Plan (Matzke et al., 2010). Locations for the systematic data collection are shown on Figures A-4 through A-11 in Appendix A.

3.5 Establishing the Number of Measurements

Since the contaminants may be present in the background, N is calculated in the manner specified for the Wilcoxon Rank-Sum test (Equation 5-2 from the Basewide Radiological Management Plan):

Equation 5-2 from the Basewide Radiological Management Plan (TtEC, 2014a)

$$N = \left\{ \frac{\left(Z_{1-\alpha} + Z_{1-\beta}\right)^2}{3\left(P_r - 0.5\right)^2} \right\} (1.2)$$

Where:

- $Z_{1-\alpha}$ = Type I decision error level as determined from MARSSIM (1.645)
- $Z_{1-\beta}$ = Type II decision error level as determined from MARSSIM (1.645)
- P_r = random measurement probability, which is based on relative shift discussed in Section 2.6.3
- 1.2 = factor for over-sampling to account for missing or unusable data

The second term in the equation increases the number of data points by 20 percent. The value of 20 percent was selected to account for a reasonable amount of uncertainty in the parameters used to calculate *N* and still allow flexibility to account for some lost or unusable data. While this 20 percent factor assists in meeting all data quality objectives (DQOs) as stated in Table 3-1, it is not required during the data quality assessment to demonstrate compliance with the stated objectives of the statistical tests. The actual number of measurements required for each survey unit will be calculated for the final report.

P_r in Equation 5-2 from the Basewide Radiological Management Plan is based on the relative shift. The relative shift is equal to Δ/σ, where Δ is equal to [derived concentration guideline level (DCGL) – lower boundary of the gray region (LBGR)], and σ is an estimate of the standard deviation of the measured values in a survey unit. In cases where the unity rule is used, the DCGL is set at 1.

3.5.1 LBGR Determination

The LBGR is the net median concentration of the contaminant in the survey unit. Since this value is unknown, MARSSIM (DoD et al., 2000) suggests using a value for the LBGR of ½ DCGL during planning purposes. However, once the median concentration activity in the survey unit is established (as expressed in a gross alpha and gross beta measurement), this value will be used as a ratio to the lowest DCGL for the decay method to determine the LBGR. Equation 6-7 from the Basewide Radiological Management Plan gives the method used to determine the LBGR:

Equation 6-7 from the Basewide Radiological Management Plan (TtEC, 2014a)

$$LBGR = \frac{C_1}{DCGL_1} + \frac{C_2}{DCGL_2} + \frac{C_3}{DCGL_3} + \ldots + \frac{C_i}{DCGL_i} \leq 1$$

Where:

C_i = concentration of radionuclide "i"
$DCGL_i$ = DCGL of radionuclide "i"

For planning purposes, the LBGR will administratively be set to ½ the DCGL, or at a value of 0.5.

3.5.2 Standard Deviation

There is also no estimate of the standard deviation of the contaminant in the survey unit, especially if no contaminant is initially expected. Therefore, σ will be assigned the value of the standard deviation of the adjusted measurement values in the survey unit as shown in Equation 6-8 from the Basewide Radiological Management Plan:

Equation 6-8 from the Basewide Radiological Management Plan (TtEC, 2014a)

$$\sigma = \sqrt{\left(\frac{\sigma_{C1}}{DCGL_1}\right)^2 + \left(\frac{\sigma_{C2}}{DCGL_2}\right)^2 + \ldots + \left(\frac{\sigma_{Ci}}{DCGL_i}\right)^2}$$

Where:

σ_{Ci} = standard deviation from radionuclide "i"
$DCGL_i$ = DCGL of radionuclide "i"

For planning purposes, as σ is unknown, per MARSSIM recommendations, it will be estimated as 0.3.

3.5.3 Relative Shift

The relative shift is equal to Δ/σ, where Δ is equal to [wide-area DCGL ($DCGL_W$) − LBGR] and σ is an estimate of the standard deviation of the measured values in a survey unit (or for planning purposes from the background area). As stated previously, in cases where the unity rule is used, the DCGL is set to 1. The relative shift can be calculated as shown in Equation 5-1 from the Basewide Radiological Management Plan:

Equation 5-1 from the Basewide Radiological Management Plan (TtEC, 2014a)

$$\frac{\Delta}{\sigma} = \frac{DCGL_W - LBGR}{\sigma} = \frac{1 - 0.5}{0.3} = 1.67$$

Using this Δ/σ value of 1.67, from Table 5.1 of MARSSIM, P_r was determined to be 0.871014.

3.5.4 Unity Rule

As stated in Section 4.3.3 and Appendix I.11 of MARSSIM, the unity rule was used since multiple radionuclides (with different decay methods, with unknown ratios, and with unrelated radionuclide concentrations) were present. As stated in Appendix I.11.1, the DCGL is set at 1.0. Therefore, *N* is calculated using Equation 5-2 from the Basewide Radiological Management Plan as follows:

Equation 5-2 from the Basewide Radiological Management Plan (TtEC, 2014a)

Where:

Type I decision error level (MARSSIM Table 5.2): 1.645
Type II decision error level (MARSSIM Table 5.2): 1.645
Random measurement probability (MARSSIM Table 5.1): 0.871014

$$31.45 = \left\{ \frac{(1.645+1.645)^2}{3(0.871014-0.5)^2} \right\}(1.2)$$

N for surveys is calculated as a minimum of 31.45 total data collection locations. Rounding this number up to an even number would equate to 16 from each survey unit and 16 from the reference area, for a total of 32. Figures A-4 through A-11 indicate the approximate systematic measurement locations.

The survey is not initially designated as an FSS, but was designed so that if no radioactive contamination was found above the established release criteria, this survey could be used as an FSS, in accordance with MARSSIM (DoD et al., 2000). To maintain the potential for an FSS, data will be continuously analyzed to determine the relationship between each survey unit and the reference area.

3.6 Alpha and Beta Scan Measurements

Scan measurements are performed to identify areas of radioactivity that exceed an action level within the SU. Alpha (α) scans will be effective for identifying elevated concentrations of Ra-226, Th-232, and U-238. Beta (β) scans will be effective in identifying elevated concentrations of Cs-137. One hundred percent of accessible surface areas in the Class 1 SUs will be scanned with the Ludlum Model 43-37, 43-37-1, or 43-68 gas flow proportional detectors coupled to a Ludlum 2360 or 2221 survey meter.

3.6.1 Alpha Scan Measurements

3.6.1.1 Large Area Detectors (Model 43-37, 43-37-1, or equivalent)

The alpha count rate on various surfaces within Building 9 typically averages less than 10 cpm with a Model 43-37 or 43-37-1 (or equivalent) detector. Therefore, alpha scan speeds will be determined using Equation 7-4 from the Basewide Radiological Management Plan (TtEC, 2014a).

Equation 7-4 from the Basewide Radiological Management Plan (TtEC, 2014a)

$$P(n \geq 2) = 1 - \left[1 + \frac{(GE + B)t}{60}\right]\left[e^{\frac{-(GE+B)t}{60}}\right]$$

Where:

$P(n \geq 2)$	=	probability of getting two or more counts during the time interval t(%)
t	=	time interval (seconds) = 4
G	=	DCGLw x area factor (dpm) = 300
E	=	detector efficiency (4π) = 0.10
B	=	observed background count rate (cpm) = 10
$P(n \geq 2)$	=	74.52 percent at a scan speed of 4 centimeters per second (cm/s)

The scan surveys will be performed using a Ludlum Model 43-37 (or equivalent) detector. The detector position will be adjusted so that the detector window is approximately one-quarter inch from the building surfaces. The surveyor will move the detector at a scan speed of 4 cm/s while maintaining audio and visual observation of the instrument response. If the surveyor observes two or more counts during a scan interval (approximately 4 seconds), the surveyor will pause the detector movement for 4 seconds to obtain additional data. If no additional counts are noticed during the 4-second observation, the surveyor can continue the scan survey. Conversely, if additional counts are noticed during the 4-second observation, the surveyor will mark the area for further investigation and subsequent biased measurements using a 126-cm^2 or smaller detector to locate and properly quantify any areas of elevated activity.

3.6.1.2 Small Area Detectors (Model 43-68 or equivalent)

The alpha count rate on various surfaces in Building 9 typically averages less than 2 cpm with a Model 43-68 detector. When using a 126-cm^2 or smaller detector, scanning for alpha emitters differs in that the expected background response of most alpha detectors is very close to zero. Since the amount of time a contaminated area is under the probe varies, and the background count rate of some alpha instruments is less than 1 cpm, it is not reasonable to determine a fixed minimum detectable concentration (MDC) for scanning. Instead, it is more practical to determine the probability of detecting an area of contamination at a predetermined derived concentration guideline level for given scan rates.

For alpha survey instrumentation with backgrounds ranging from less than 1 to 3 cpm, a single count provides a surveyor sufficient cause to stop and investigate further. Assuming this to be true, the probability of detecting given levels of alpha surface contamination can be calculated by use of Poisson summation statistics.

Given a known scan rate and a surface contamination release limit, the probability of getting a second count from a 300 dpm source is calculated using Equation 7-2 from the Basewide Radiological Management Plan (TtEC, 2014a):

Equation 7-2 from the Basewide Radiological Management Plan (TtEC, 2014a)

$$P(n \geq 1) = 1 - e^{\frac{-GEd}{60v}}$$

Where:

$P(n \geq 1)$	=	probability of observing a single count = 83.5 percent
G	=	contamination activity dpm = 300
E	=	detector efficiency (4π) = 0.10
d	=	width of detector in direction of scan (centimeters) = 14.4
v	=	scan speed (cm/s) = 4

Once a count is recorded and the guideline level of contamination is present, the surveyor will stop and wait until the probability of getting another count is at least 90 percent. This time interval can be calculated using Equation 7-3 from the Basewide Radiological Management Plan (TtEC, 2014a):

Equation 7-3 from the Basewide Radiological Work Plan (TtEC, 2014a)

$$t = \frac{13,800}{CAE}$$

Where:

t	=	time period for static count(s) = 3.65
C	=	contamination guideline (dpm/100 cm^2) = 300
A	=	physical probe area (cm^2) = 126
E	=	detector efficiency (4π) = 0.10

Using the above equations from the Basewide Radiological Management Plan and Chapter 6 of MARSSIM (DoD et al., 2000), the probability of detecting 300 dpm/100 cm^2 alpha at a scan speed of 4 cm/s with a time period of 4 seconds for a static count is 83.5 percent.

Scan speeds may be adjusted based on the specific parameters for instruments in use, provided that the probability does not fall below 68 percent.

3.6.2 Beta Scan Measurements

3.6.2.1 Large Area Detectors (Model 43-37, 43-37-1, or equivalent)

The minimum number of net source counts in the scan interval can be arrived at by multiplying the square root of the number of background counts (in the scan interval) by the detectability value associated with the desired performance (as reflected in *d′*) as shown in Equation 7-5 from the Basewide Radiological Management Plan (TtEC, 2014a):

Equation 7-5 from the Basewide Radiological Management Plan (TtEC, 2014a)

$$MDCR = d' \sqrt{b_i} \left(\frac{60}{i} \right)$$

Where:

d' = index of sensitivity (α and β errors [performance criteria])
b_i = number of background counts in scan time interval (count)
i = scan or observation interval (seconds)

For beta scans:

d' = 3.28
b_i = 33.3 counts (based on a background of 500 cpm)
i = 15.90 cm / 4 cm/s = 4 seconds

Beta scan minimum detectable count rate (MDCR) = 283.91 cpm at a scan speed of 4 cm/s.
The scan MDC is determined from the MDCR by applying conversion factors that account for detector and surface characteristics and surveyor efficiency. As discussed below, the MDCR accounts for the background level, performance criteria (*d′*), and observation interval. The observation interval during scanning is the actual time that the detector can respond to the contamination source. This interval depends on the scan speed, detector size in the direction of the scan, and area of elevated activity. The scan MDC for structure surfaces is calculated using Equation 7-6 from the Basewide Radiological Management Plan (TtEC, 2014a):

Equation 7-6 from the Basewide Radiological Management Plan (TtEC, 2014a)

$$Scan\ MDC = \frac{MDCR}{\sqrt{p}\ \varepsilon_i \varepsilon_s \frac{W_A}{100\ cm^2}}$$

Where:

MDCR is discussed above
p = surveyor efficiency factor
ε_i = instrument efficiency (count per particle)
ε_s = contaminated surface efficiency (particle per disintegration)
W_A = area of the detector window (cm^2)

For beta scans:

$MDCR$ = 283.91
p = 0.50
ε_i = 0.4084
ε_s = 0.25
W_A = 821

Beta scan MDC = 478.77 dpm/100 cm^2 at a scan speed of 4 cm/s.

3.7 Alpha and Beta Static Measurements

Alpha and beta static measurements will be obtained from the locations identified in Appendix A. Additional measurements may be collected if radiation readings exceeding the investigation level are identified while performing the scan surveys. Ludlum Model 43-68 gas-flow proportional detectors coupled to Ludlum Model 2221 or 2360 data loggers will be used to perform alpha and beta static measurements. Note that all alpha and beta static measurements exceeding investigation levels should have corresponding notes on the survey sheets annotating the investigative action taken (sample taken, surveyed with different instrument type, etc.).

3.7.1 Alpha Static Measurements

The MDC for alpha measurements is calculated using Equation 7-7 from the Basewide Radiological Management Plan (TtEC, 2014a):

Equation 7-7 from the Basewide Radiological Management Plan (TtEC, 2014a)

$$MDC = \frac{3 + 4.65\sqrt{R_B T_B}}{\varepsilon_s \varepsilon_i \frac{W_A}{100} T_B}$$

Where:

3 + 4.65 = constant factor provided in MARSSIM
R_B = background count rate = 1 cpm
T_B = background count time = 2 minutes
ε_i = instrument efficiency = 0.4
ε_s = surface efficiency factor = 0.25
W_A = probe area size = 126 cm^2

The calculated MDC (based on preliminary measurements) for alpha contamination is 37.99 dpm/100 cm^2, using a 2-minute static counting time. Counting time may be increased as necessary to provide a sufficient static MDC for any ROC below the release criteria (Table 2-1).

The specified count times are based on the MDC formula, Equation 7-7 from the Basewide Radiological Management Plan (TtEC, 2014a). The count times are useful in determining an instrument's ability to meet the required MDC. However, empirically derived values will provide a more accurate assessment of the MDC for a specified count time as recommended by MARSSIM (DoD et al., 2000). Empirical values will be determined at NASB in conjunction with reference area measurements. With concurrence of the Navy RASO, count times determined based on empirical data will be used for static survey measurements.

3.7.2 Beta Static Measurements

For the Ludlum 43-68 surveying for Cs-137, the MDC equation becomes:

$$MDC = \frac{3 + 4.65\sqrt{R_B T_B}}{\varepsilon_s \varepsilon_i \frac{W_A}{100} T_B}$$

3 + 4.65	=	constant factor provided in MARSSIM
R_B	=	background count rate = 500 cpm
T_B	=	background count time = 2 minutes
ε_i	=	instrument efficiency = 0.4
ε_s	=	surface efficiency factor = 0.25
W_A	=	probe area size = 126 cm^2

The calculated MDC (based on preliminary measurements) for beta contamination is 595.4 dpm/100 cm^2, using a 2-minute static counting time. Counting time may be increased as necessary to maintain the MDC below the Table 2-1 limits.

Alpha and beta measurements are recorded at the same time with a Ludlum 2360 data logger. Therefore, the count time for Cs-137 with the Ludlum 43-68 detector in the static mode will be 2 min.

The specified count times are based on the MDC formula, Equation 7-7 from the Basewide Radiological Management Plan (TtEC, 2014a). The count times are useful in determining an instrument's ability to meet the required MDC. However, empirically derived values will provide a more accurate assessment of the MDC for a specified count time as recommended by MARSSIM (DoD et al., 2000). Empirical values will be determined at NASB in conjunction with reference area measurements. With concurrence of the RASO, count times determined based on empirical data will be used for static survey measurements.

3.8 Exposure/Dose Rate Measurements

Gamma exposure/dose rate measurements will be collected from the specified systematic locations in each of the SUs. Ludlum Model 19, or equivalent, scintillation detectors will be used to perform the measurements. The measurements will be conducted with the instrument at 1 meter from the floor.

3.9 Media Samples

Removable contamination will be assessed using Masslinn® cloths and monitoring the cloths with a Ludlum 43-68 detector coupled to a Ludlum 2360 or 2221 survey meter. The detector will be operated on the alpha plus beta plateau. Areas with a Masslinn® cloth indicating any increase in activity will be rewiped with another Masslinn® cloth to determine the specific area that contains the removable contamination. Swipe surveys will be collected at each of the specified systematic locations for each survey unit. Additional samples may also be collected based on scan survey results exceeding the investigation level. All swipe surveys will be screened using a Ludlum 2929 or 3030 scaler rate meter with a Ludlum 43-10-1 detector (or equivalent). Swipe surveys will be performed and documented in accordance with SOP 001, Radiation and Contamination Surveys.

In addition to swipes to determine the presence of alpha and beta emitting radionuclides, swipes will be taken at the systematic data collection points for the presence of H-3. The swipes will be wetted with distilled water prior to survey. Tritium swipes will be sent to an off-site laboratory for analysis using liquid scintillation methods.

3.10 Dose Modeling in Support for Unrestricted Release

The intent of the Building 9 FSS is to achieve unrestricted release for the building. To accomplish this goal, it is necessary to provide a means for calculating residual dose to the critical group; the residential scenario in RESRAD-BUILD was selected. The modifications to the default scenario presented in RESRAD-BUILD will be to use the net mean concentrations for Cs-137, Ra-226, Th-232, and U-238 above background, use the actual surface area for the SU, and change the removable fraction to 20 percent.

After the residual dose is determined, the Navy will also determine the excess lifetime cancer risk to the critical group. These values will be provided in the final report.

4.0 QUALITY CONTROL

The DQOs for the survey are provided in 3-1.

Definable features of work (DFWs) establish the measures required to verify both the quality of work performed and compliance with project requirements. The DFW for this task is radiological surveys. Description of this DFW and the associated phases of quality control are presented in Table 4-1.

5.0 ENVIRONMENTAL PROTECTION

The environmental protection-driven requirements have been addressed in the Environmental Protection Plan (TtEC, 2014c). No additional requirements are necessary.

6.0 REFERENCES

DoD (Department of Defense), Department of Energy, Nuclear Regulatory Commission, and U.S. Environmental Protection Agency. 2000. Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), NUREG-1575, Revision 1. August.

Matzke et al. 2010. Visual Sample Plan. Upgrade version 6.0 released June 2010. Pacific Northwest National Laboratory. June.

NAVSEA (Naval Sea Systems Command.). 2014. Final Historical Radiological Assessment, History of the Use of General Radioactive Materials from 1943 to 2011 NAS Brunswick ME. March

TtEC (Tetra Tech EC, Inc.). 2014a. Basewide Radiological Management Plan, Former Naval Air Station Brunswick, Brunswick, Maine. In Progress.

TtEC. 2014b. Accident Prevention Plan/Site Safety and Health Plan, Former Naval Air Station Brunswick, Brunswick, Maine. In Progress

TtEC. 2014c. Environmental Protection Plan, Former Naval Air Station Brunswick, Brunswick, Maine. In Progress.

Tetra Tech, Inc. 2013. Scoping Survey Report Building 9, Naval Air Station Brunswick, Brunswick, Maine. March.

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TABLES

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TABLE 2-1
BUILDING 9
PRIMARY RADIATION PROPERTIES AND RELEASE CRITERIA
FOR RADIONUCLIDES OF CONCERN

Radionuclide	Primary Radiation Properties		Release Criteria			
			Materials & Equipment		Building Surfaces	
	Half-Life	Type	Total Surface Activity	Removable Activity	Total Surface Activity	Removable Activity
Cs-137	3.01E01 years	Beta	5,000	1,000	5,000	1,000
H-3	1.23E01 years	Beta	5,000	1,000	5,000	1,000
Ra-226	1.6E03 years	Alpha	100	20	100	20
Th-232	1.41E10 years	Alpha	1,000	200	1,000	200
U-238	4.47E09 years	Alpha/Beta	5,000	1,000	5,000	1,000

Notes:
[a] Units are disintegrations per minute per 100 square centimeters.

Abbreviations and Acronyms:
Cs-137 – Cesium-137
H-3 - Tritium
Ra-226 – Radium-226
Th-232 – Thorium-232
U-238 – Uranium-238

TABLE 3-1
SUMMARY OF DATA QUALITY OBJECTIVES

STEP 1	STEP 2	STEP 3	STEP 4	STEP 5	STEP 6	STEP 7
State the Problem	**Identify the Goal of the Study**	**Identify Information Inputs**	**Define the Boundaries of the Study**	**Develop the Analytical Approach**	**Specify Performance or Acceptance Criteria**	**Develop the Plan for Obtaining Data**
Building 9 is listed in the HRA as an area impacted by radiological activities. The radionuclides of concern are Cs-137, H-3, Ra-226, Th-232, and U-238. It must be determined if the site-specific release criteria for these radionuclides have been met or if remediation is warranted.	The primary use of the data expected to result from completion of this TSP is to support the Final Status Survey of Building 9. Therefore, the decision to be made can be stated as "Do the results of the survey meet the release criteria?"	Radiological surveys required to support the Final Status Survey of Building 9 will include: • 100 percent scan surveys of Class 1 areas • 50 percent scan surveys of Class 2 areas • A minimum of 16 systematic static measurements in Class 1 and Class 2 areas • One swipe survey at each systematic sample location • Static and swipe survey measurements at biased locations	The lateral and vertical spatial boundaries for this survey effort are confined to the interior of Building 9 as shown on the figures in Appendix A.	If the concentration of radioactivity on building surfaces is less than the release criteria, then no further measurements are required. If the results of the survey exceed the release criteria, then the building will be further investigated.	Limits on decision errors are set at 5 percent as specified in the Basewide Radiological Management Plan (TtEC, 2014a).	Operation details for the radiological survey process have been developed. The theoretical assumptions are based on guidelines contained in MARSSIM (DoD et al., 2000). Specific assumptions regarding types of radiation measurements, instrument detection capabilities, quantities and locations of data to be collected, and investigation levels are contained in this TSP and the Basewide Radiological Management Plan (TtEC, 2014a).

Abbreviations and Acronyms:

H-3 - Tritium
HRA – Historical Radiological Assessment
MARSSIM – Multi-Agency Radiation Survey and Site Investigation Manual
Ra-226 – Radium-226
SU – survey unit
Th-232 – Thorium-232
TSP – Task-specific Plan
U-238 – Uranium-238

TABLE 4-1
DEFINABLE FEATURES OF WORK FOR RADIOLOGICAL SURVEYS

ACTIVITY	PREPARATORY (Prior to initiating survey activity)	DONE	INITIAL (At outset of survey activity)	DONE	FOLLOW-UP (Ongoing during survey activity)	DONE
Radiological surveys and sampling	• Verify that an approved TSP is in place. • Verify that the Remedial Project Manager, Navy Technical Representative, and the Caretaker Site Office are notified about mobilization. • Verify that an approved RWP, if required, is available and has been read and signed by assigned personnel. • Verify that the Basewide Radiological Management Plan (TtEC, 2014a), APP/SSHP (TtEC, 2014b), and TSP have been reviewed. • Verify that personnel assigned are trained and qualified. • Verify that personnel have been given an emergency notification procedure. • Verify that workers assigned dosimetry have completed NRC Form 4. • Verify that relevant SOPs and/or manufacturers' instructions are available and have been reviewed for equipment to be used. • Verify that equipment is on site and in working order (initial daily check).		• Verify that radiological instruments are as specified in the Basewide Radiological Management Plan (TtEC, 2014a) and TSP. • Inspect Training Records. • Verify that a qualified RCT and SSHO are present in the active work areas. • Verify that reference area measurements have been obtained in accordance with the Basewide Radiological Management Plan (TtEC, 2014a) and this TSP. The same survey methodology and instruments used to collect the background data will be used to perform measurements within survey units. • Verify that daily checks were performed on all survey instruments. • Verify that instrument calibration and setup are current. • Verify that required dosimetry is being worn. • Verify that field logbooks, chain-of-custody documents, and proper forms are in use. • Verify that samples and measurements are being collected in accordance with the TSP, Basewide Radiological Management Plan (TtEC 2014a), and applicable SOPs. • Verify the sample handling is in accordance with the Basewide Radiological Management Plan (TtEC, 2014a) and applicable SOPs.		• Verify that the site is properly posted and secured, if necessary. • Conduct ongoing inspections of material and equipment. • Verify that a qualified RCT and SSHO are present at active work areas. • Verify that daily instrument checks were obtained and documented. • Verify the survey results were documented. • Verify that personnel have read and signed the revised RWP, if revision is required. • Inspect chain-of-custody and survey logs for completeness. • Verify the survey activities conform to the TSP. • Verify that survey instruments are recalibrated after repairs or modifications. • Verify that site activities are being photographed. • Verify that survey documentation is reviewed by the RSOR.	

Abbreviations and Acronyms:

APP – Accident Prevention Plan
NRC – Nuclear Regulatory Commission
RCT – Radiation Control Technician
RSOR – Radiation Safety Officer Representative
RWP – Radiation Work Permit
SOP – Standard Operating Procedure
SSHO – Site Safety and Health Officer
SSHP – Site Safety and Health Plan
TSP – Task Specific Plan

APPENDIX A

FIGURES FOR BUILDING 9 SURVEYS

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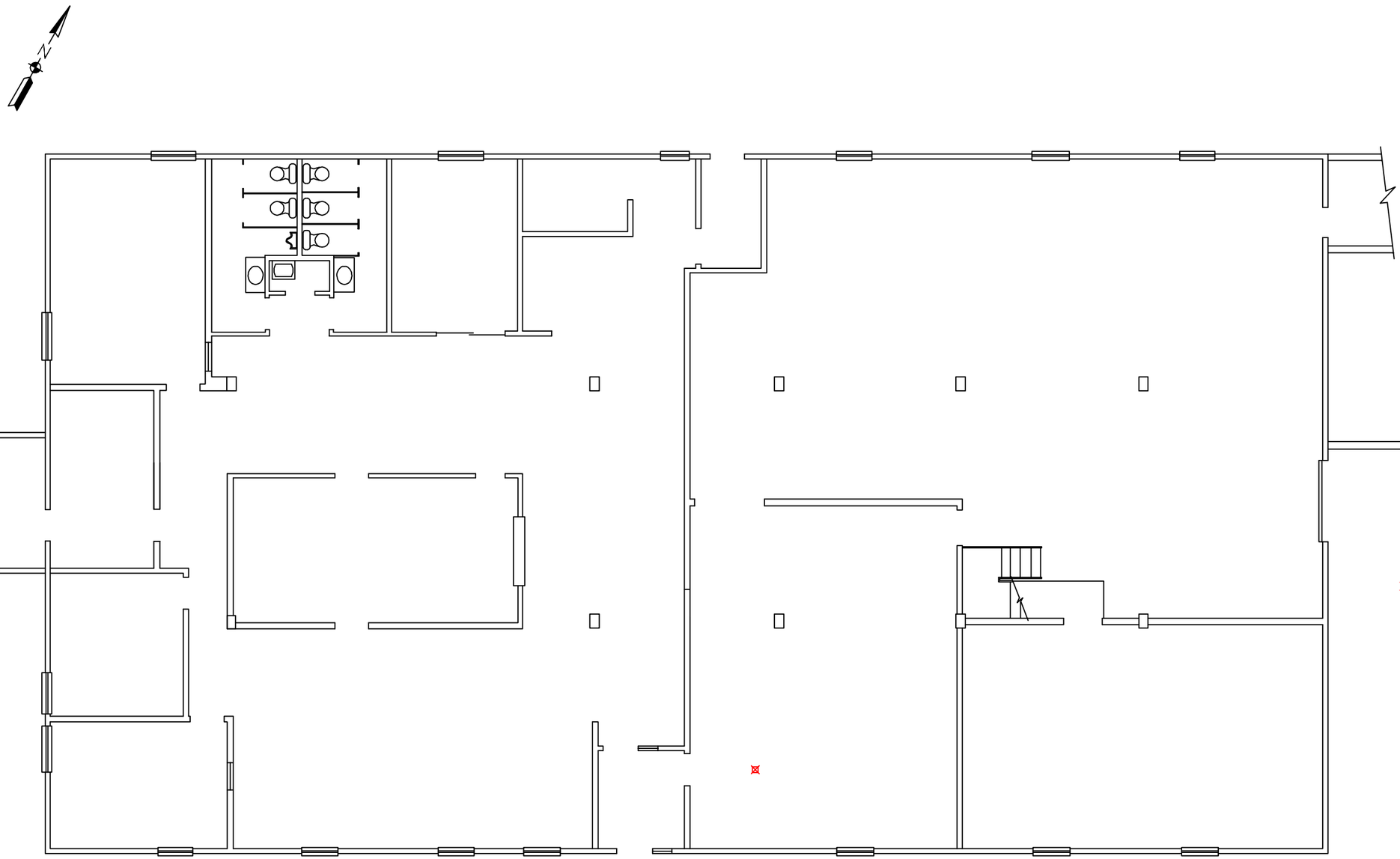

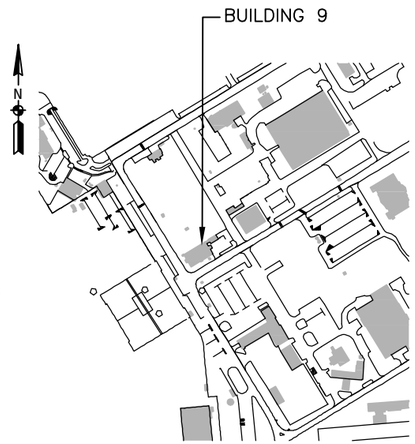

KEYPLAN

LEGEND

APPROXIMATE POINT LOCATION OF ELEVATED READING

5 0 5 10

(feet)

TASK SPECIFIC PLAN FOR BUILDING 9 REMEDIAL ACTION SUPPORT SURVEY AND FINAL STATUS SURVEY

FIGURE A-1

BUILDING 9

FORMER NAVAL AIR STATION, BRUNSWICK, MAINE

REVISION: –
AUTHOR: A.CRABTREE
PROJECT NO:
FILE: SEE BELOW

TETRA TECH EC, INC.

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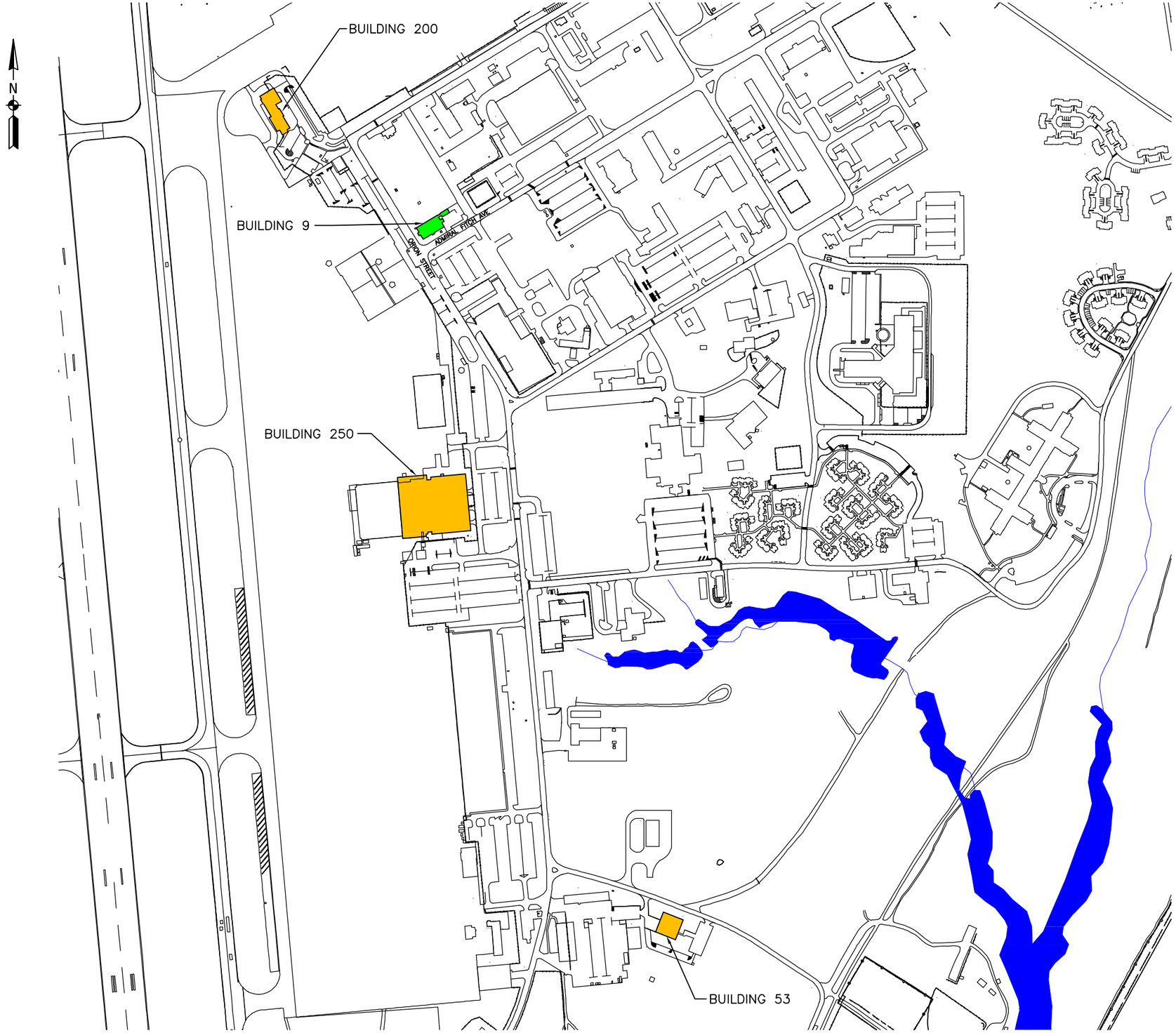

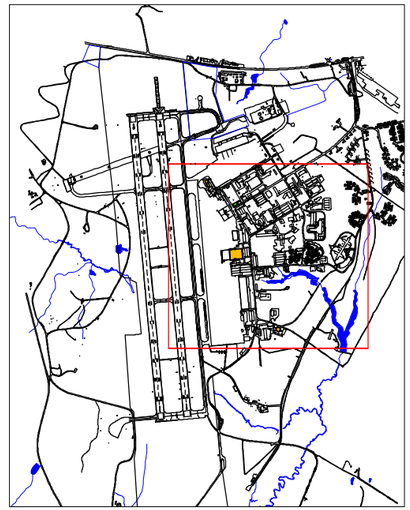

KEYPLAN

LEGEND

- BUILDING 9
- BUILDINGS 53, 200, AND 250
- WATER

250 0 250 500

(feet)

TASK SPECIFIC PLAN FOR BUILDING 9 REMEDIAL ACTION SUPPORT SURVEY AND FINAL STATUS SURVEY

FIGURE A-2

BUILDING 9 AND BACKGROUND REFERENCE AREAS

FORMER NAVAL AIR STATION, BRUNSWICK, MAINE

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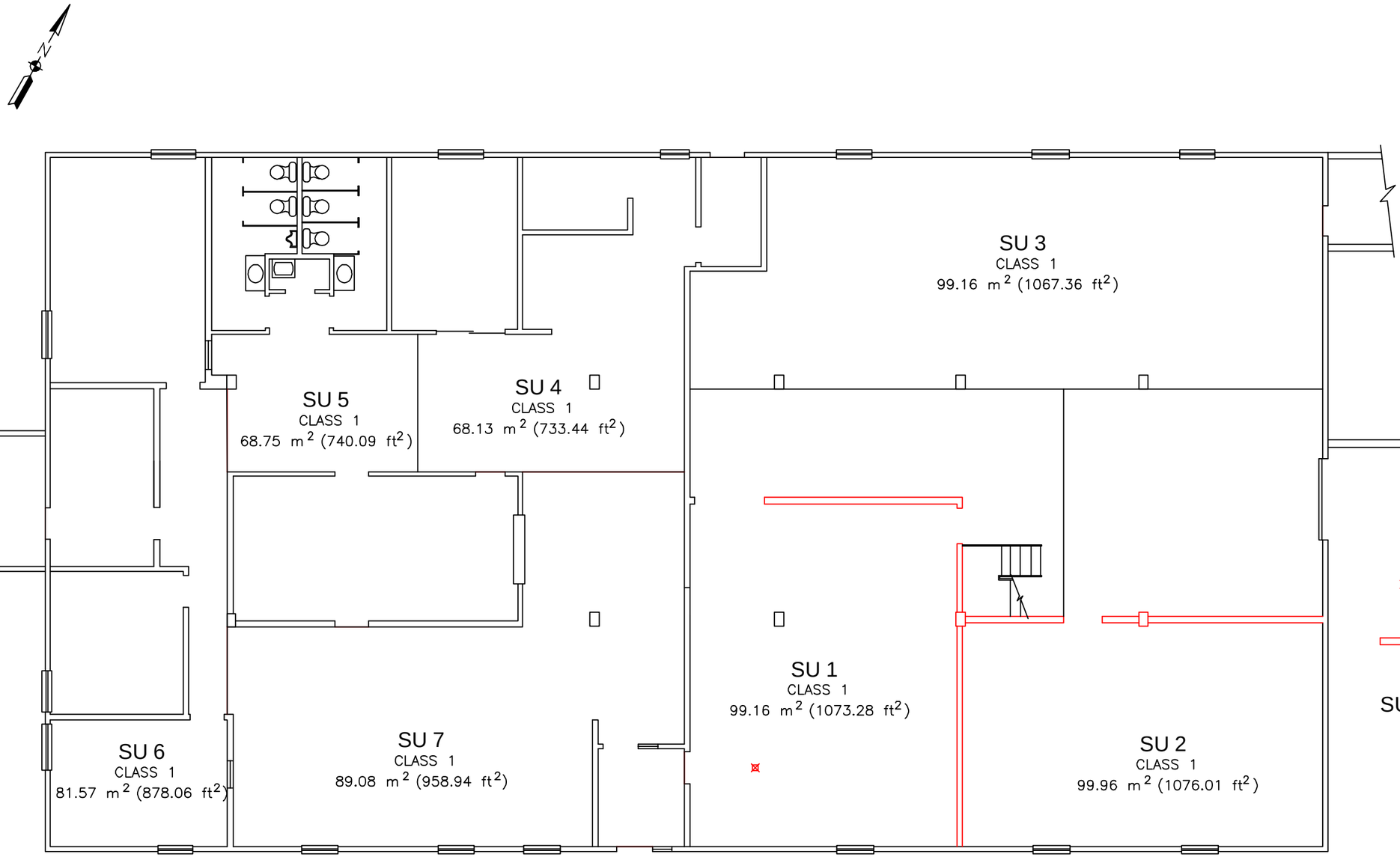

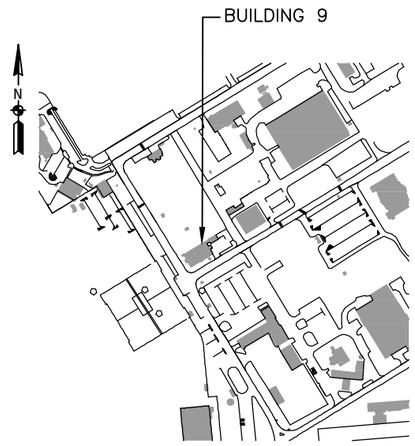

KEYPLAN

LEGEND

- APPROXIMATE POINT LOCATION OF ELEVATED READING
- WALLS PRESENT WHEN POTENTIAL RADIOACTIVE MATERIAL IN USE
- SU 1 SURVEY UNIT DESIGNATION

5 0 5 10

(feet)

TASK SPECIFIC PLAN FOR BUILDING 9 REMEDIAL ACTION SUPPORT SURVEY AND FINAL STATUS SURVEY

FIGURE A-3

BUILDING 9 CLASS 1 SURVEY UNITS

FORMER NAVAL AIR STATION, BRUNSWICK, MAINE

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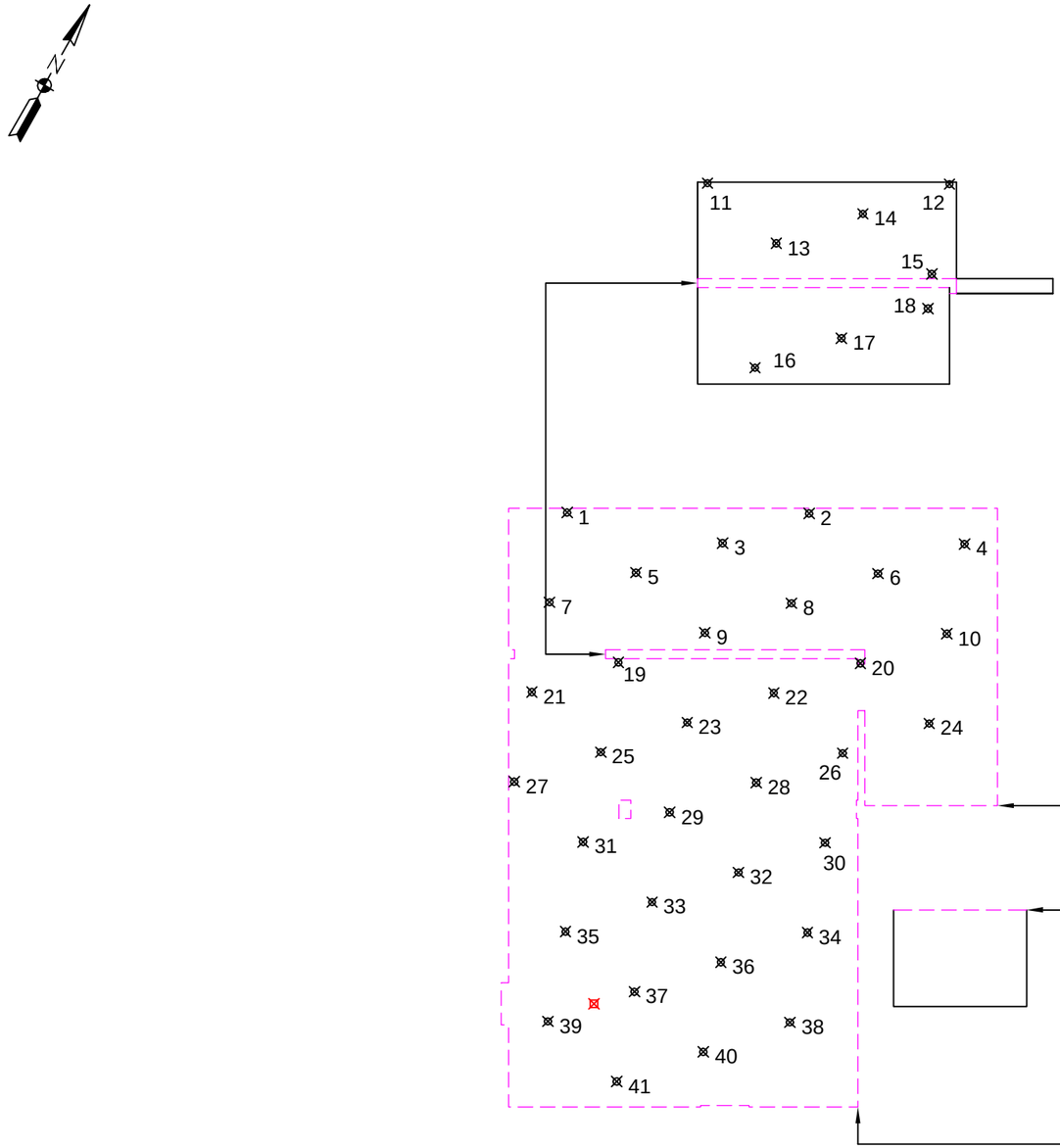
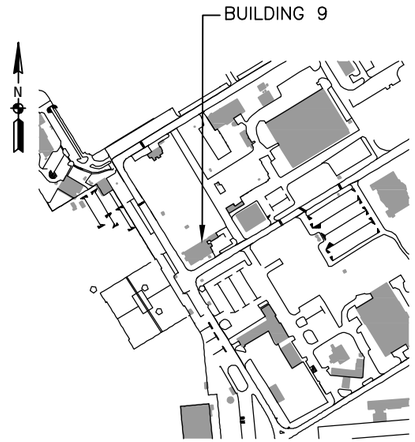


SU 1
CLASS 1
99.16 m^2 (1073.28 ft^2)

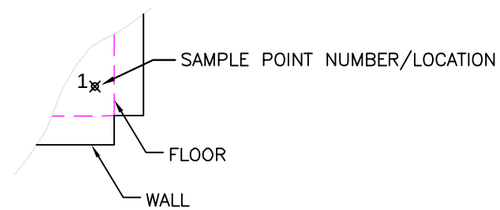


KEYPLAN

LEGEND

APPROXIMATE POINT LOCATION OF ELEVATED READING

SU 1 SURVEY UNIT DESIGNATION



NOTE: SURVEY IN STAIRWELL TO BE LIMITED TO FLOOR SURFACE AND ADJOINING WALL SURFACE UP 2 METERS; STAIRWELL NOT INCLUDED IN SURVEY ACTIVITIES.

5 0 5 10
(feet)

TASK SPECIFIC PLAN FOR BUILDING 9 REMEDIAL ACTION SUPPORT SURVEY AND FINAL STATUS SURVEY

FIGURE A-4

BUILDING 9 SURVEY UNIT 1

FORMER NAVAL AIR STATION, BRUNSWICK, MAINE

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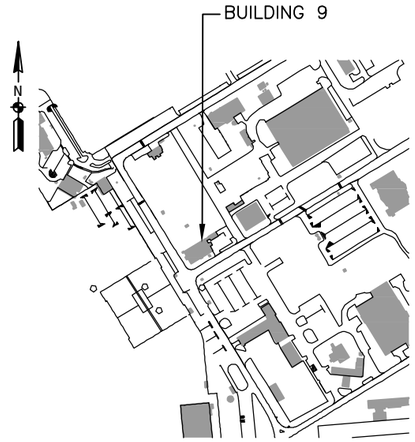
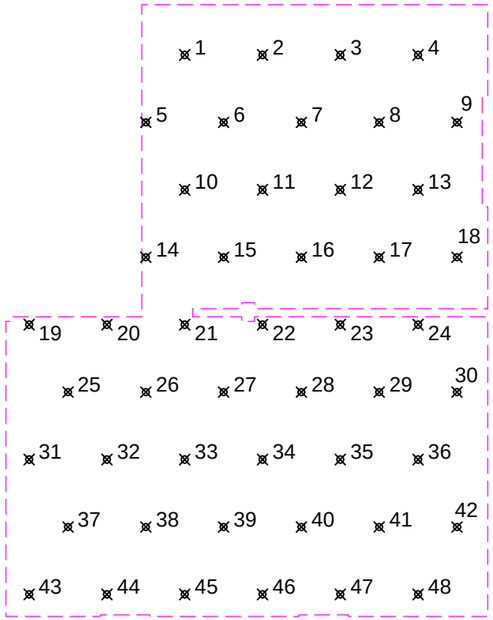


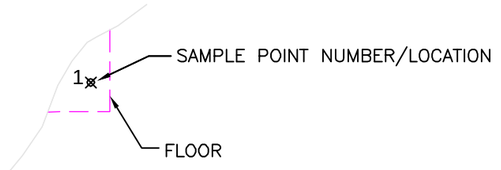
KEYPLAN

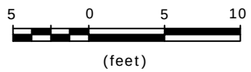


SU 2
CLASS 1
99.96 m^2 (1076.01 ft^2)

LEGEND

SU 2 SURVEY UNIT DESIGNATION





TASK SPECIFIC PLAN FOR BUILDING 9 REMEDIAL ACTION SUPPORT SURVEY AND FINAL STATUS SURVEY

FIGURE A-5

BUILDING 9 SURVEY UNIT 2

FORMER NAVAL AIR STATION, BRUNSWICK, MAINE

REVISION: –
AUTHOR: A.CRABTREE
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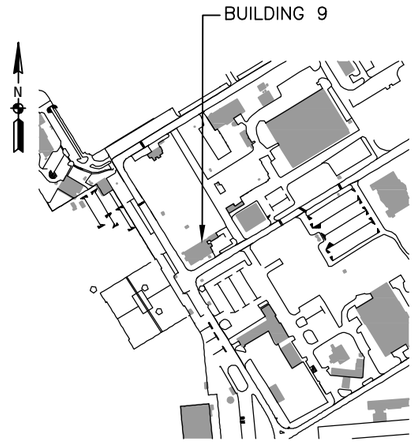

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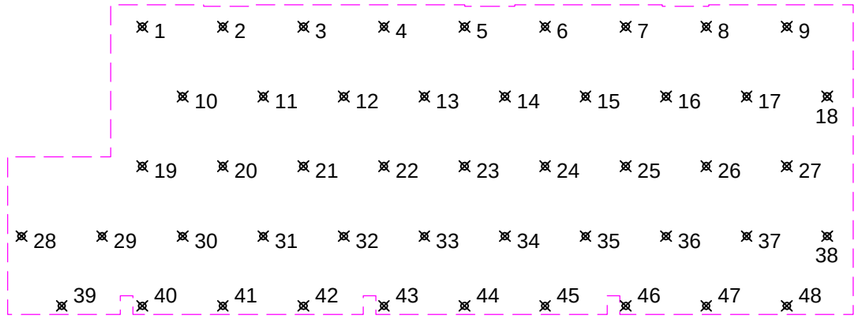
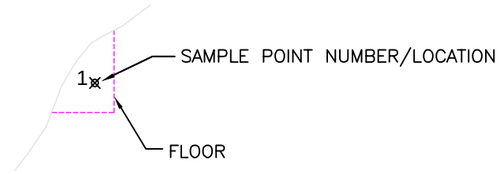
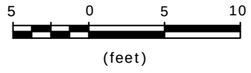


SU 3
CLASS 1
99.16 m^2 (1067.36 ft^2)

LEGEND

SU 3 SURVEY UNIT DESIGNATION





TASK SPECIFIC PLAN FOR BUILDING 9 REMEDIAL ACTION SUPPORT SURVEY AND FINAL STATUS SURVEY

FIGURE A-6

BUILDING 9 SURVEY UNIT 3

FORMER NAVAL AIR STATION, BRUNSWICK, MAINE

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AUTHOR: A.CRABTREE
PROJECT NO:
FILE: SEE BELOW

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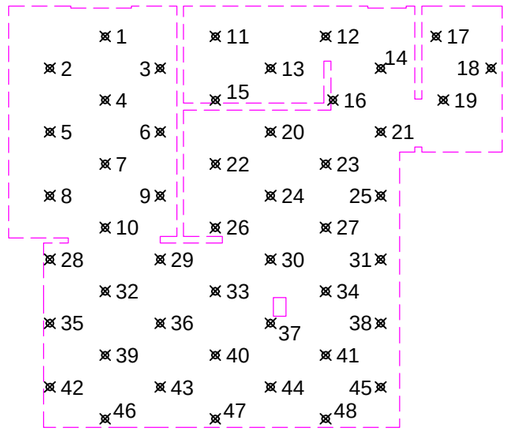
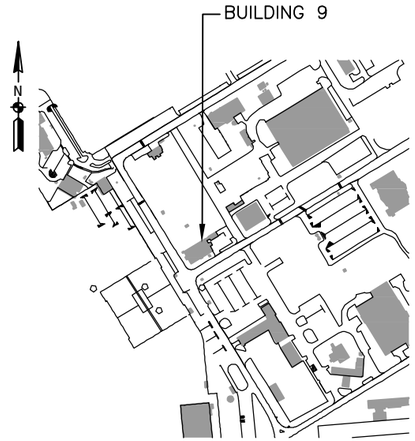


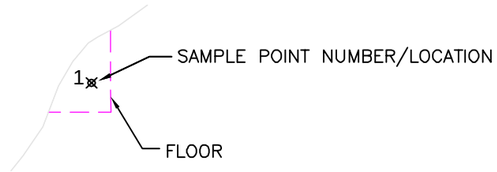
SU 4
CLASS 1
68.13 m^2 (733.44 ft^2)



KEYPLAN

LEGEND

SU 4 SURVEY UNIT DESIGNATION



5 0 5 10
(feet)

TASK SPECIFIC PLAN FOR BUILDING 9 REMEDIAL ACTION SUPPORT SURVEY AND FINAL STATUS SURVEY

FIGURE A-7

BUILDING 9 SURVEY UNIT 4

FORMER NAVAL AIR STATION, BRUNSWICK, MAINE

REVISION: –
AUTHOR: A.CRABTREE
PROJECT NO:
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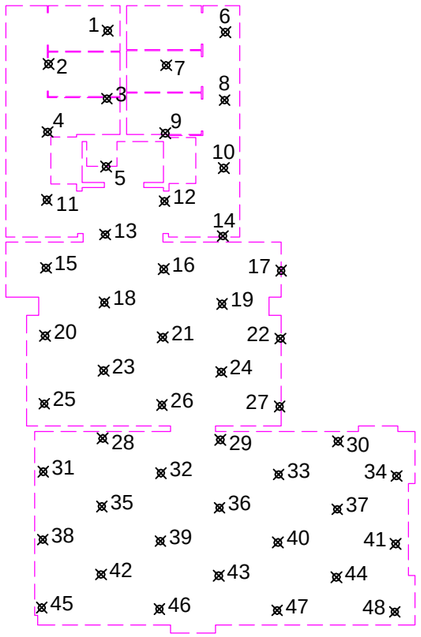
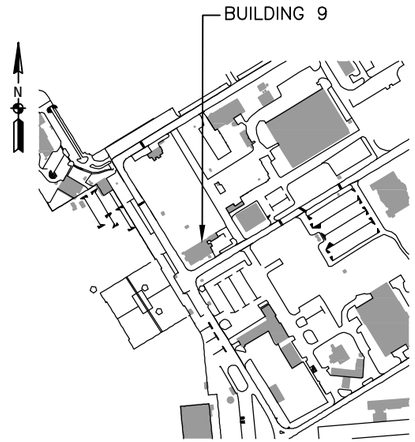


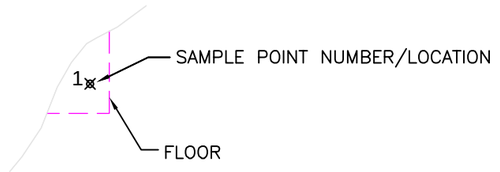
SU 5
CLASS 1
68.75 m^2 (740.09 ft^2)



KEYPLAN

LEGEND

SU 5 SURVEY UNIT DESIGNATION



TASK SPECIFIC PLAN FOR BUILDING 9 REMEDIAL ACTION SUPPORT SURVEY AND FINAL STATUS SURVEY

FIGURE A-8

BUILDING 9 SURVEY UNIT 5

FORMER NAVAL AIR STATION, BRUNSWICK, MAINE

REVISION: –
AUTHOR: A.CRABTREE
PROJECT NO:
FILE: SEE BELOW

TETRA TECH EC, INC.

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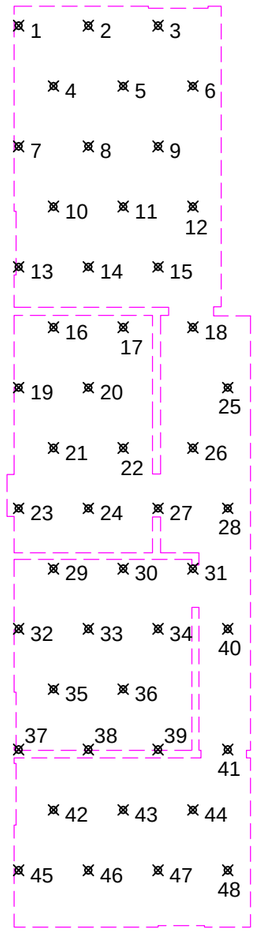
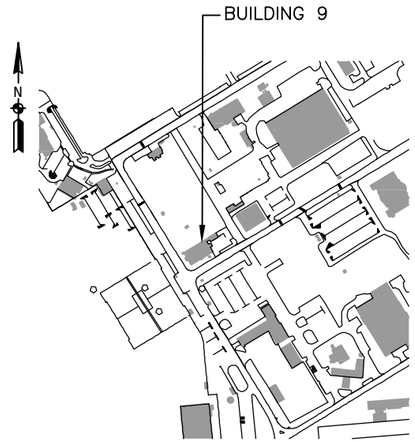


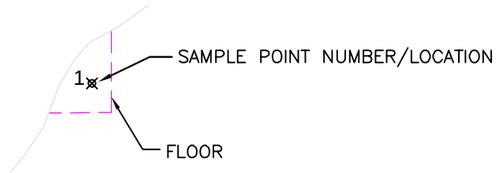
SU 6
CLASS 1
81.57 m^2 (878.06 ft^2)



KEYPLAN

LEGEND

SU 6 SURVEY UNIT DESIGNATION



TASK SPECIFIC PLAN FOR BUILDING 9 REMEDIAL ACTION SUPPORT SURVEY AND FINAL STATUS SURVEY

FIGURE A-9

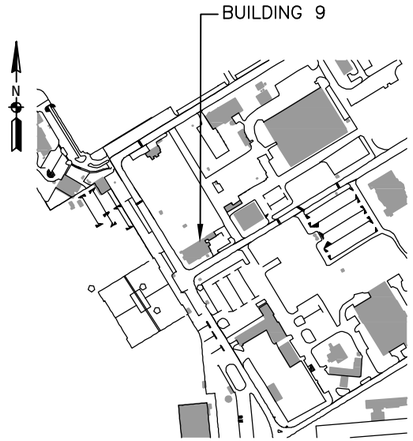
BUILDING 9 SURVEY UNIT 6

FORMER NAVAL AIR STATION, BRUNSWICK, MAINE

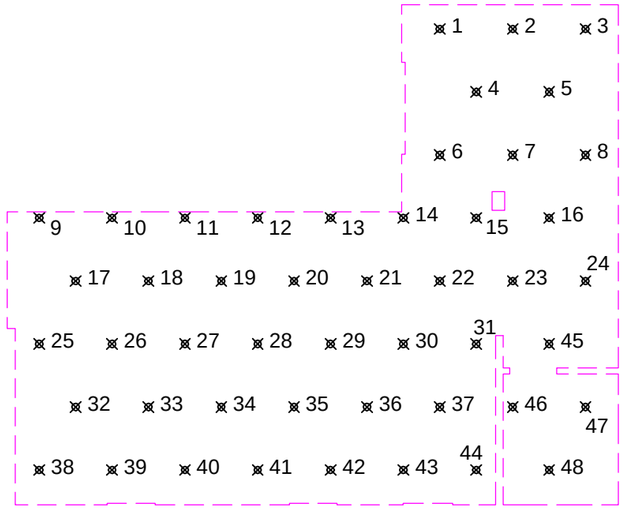
REVISION: –
AUTHOR: A.CRABTREE
PROJECT NO:
FILE: SEE BELOW

TETRA TECH EC, INC.

P:\CAD Project Files\NAS Brunswick\DWG Files\Brunswick_bldg 9 Figure A-9_02-06-14.dwg



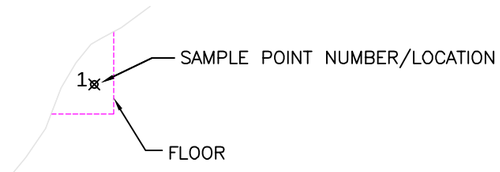
KEYPLAN

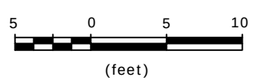


SU 7
CLASS 1
89.08 m^2 (958.94 ft^2)

LEGEND

SU 3 SURVEY UNIT DESIGNATION





TASK SPECIFIC PLAN FOR BUILDING 9 REMEDIAL ACTION SUPPORT SURVEY AND FINAL STATUS SURVEY

FIGURE A-10

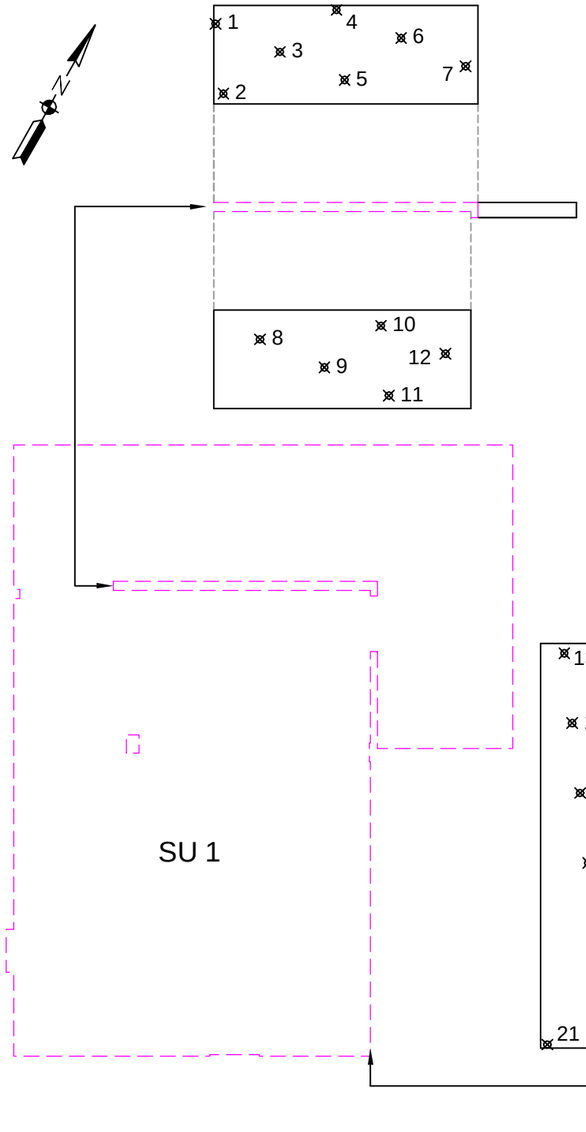
BUILDING 9 SURVEY UNIT 7

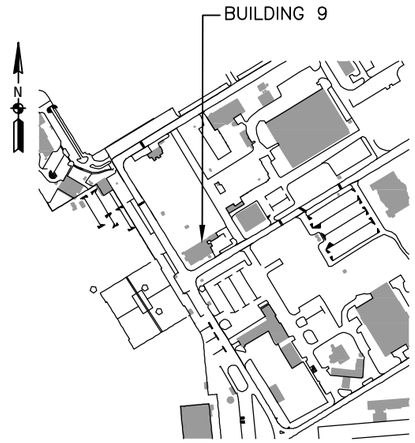
FORMER NAVAL AIR STATION, BRUNSWICK, MAINE

REVISION: –
AUTHOR: A.CRABTREE
PROJECT NO:
FILE: SEE BELOW

TETRA TECH EC, INC.

P:\CAD Project Files\NAS Brunswick\DWG Files\Brunswick_bldg 9 Figure A-10_02-06-14.dwg

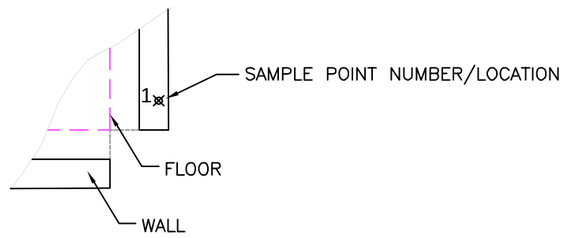




KEYPLAN

LEGEND

SU 8 SURVEY UNIT DESIGNATION



SU 8
CLASS 2
83.19 m^2 (895.52 ft^2)

5 0 5 10
(feet)

TASK SPECIFIC PLAN FOR BUILDING 9 REMEDIAL ACTION SUPPORT SURVEY AND FINAL STATUS SURVEY

FIGURE A-11

BUILDING 9 SURVEY UNIT 8

FORMER NAVAL AIR STATION, BRUNSWICK, MAINE

REVISION: –
AUTHOR: A.CRABTREE
PROJECT NO:
FILE: SEE BELOW

TETRA TECH EC, INC.

P:\CAD Project Files\NAS Brunswick\DWG Files\Brunswick_bldg 9 Figure A-11_02-06-14.dwg

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APPENDIX B

PUBLIC WORK DRAWINGS

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REAR ELEVATION

FRONT ELEVATION

SECTION "A-A"

RIGHT SIDE ELEVATION

LEFT SIDE ELEVATION

DETAIL - WOOD LOUVRE (For Tumbler Lock Door)

TYP. D.H. WINDOW DETAILS

Note: Stock Frames, Architraves & Sill

TYP. DOOR FRAME.

TYP. INT. DOOR FRAMS, ETC.

MONITOR WINDOW DETAILS

HEAD (Jamb Sim.)

HEAD SECT. (Jamb Sim.)

MULLION SECT.

SILL

SECTION

PLAN

MONITOR LOUVRE DET.

TYP. HEAD SECT. 4

TYP. TRANSOM SECT. 5

TYP. THR. SECT. 6

EXTERIOR DR. & FRAME DETAILS

PART ELEV. DR.

½ ELEV. DOOR

ELEVS. - DRS. D1 & D2

TYP. WALL SECT.

HEAD SECT. 10

SILL SECT. 11

SECT. 8

MULL. SECT. 9

CURB SECT. 7

DELIVERY RM. INT. WINDOW DET'S.

ELEVATION TOWARD DELIVERY RM.

ELEV. TOWARD OFFICE

SECT. - RAIL (Compressor Space)

EXT. & INT. DOORS.

INTERMEDIATE & END PARTN. - WOMENS TOILET -

PART ELEV. FRONT

MENS TOILET STALL & SHOWER

FIRST FLOOR PLAN

SECT. 12-12

LAUNDERING SPACE

All floors monolithic cement topping finish

COMPRESSOR SPACE

SORTING & MENDING

DELIVERY & RECEIVING

PLATFORM

VESTIBULE

COND. ROOM

WOMEN

MEN

H&C REF OFF.

4" SAN-SEWER

Laundry Trays

REFERENCE DRAWINGS			NUMBER
BU. Y&D DWG. - CEDAR POINT, MD.		(PLANS & INT. DETAILS)	211,211
BU. Y&D DWG. -	DO.	(ELEVS. & DETAILS)	211,212
BU. Y&D. DWG.	DO.	(EXT. DETAILS)	211,213

NO.	DATE	REVISIONS	BY	CHK'D	SUP'R	DEPT HEAD	APP'D
1	2-21-46	As Built Delivery & Receiving Room	CAJ				
2	4-1-80	SANITARY SEWER LINE ADDED	CW			W.B.	

ENGINEER CONTRACT NO. Y-3807

CONSTRUCTION CONTRACT NO. 5354

Drawn By: C.A.J. 11-20-45

Checked By: A.O.D. 11-21-45

Chief Draftsman:

Supervisor: C.H.G. 12/1/45

Dept. Head: 12/1/45

RECORD NO. 3784

SCALE: As Noted

Y&D DWG NO. 232,792.

U.S. NAVAL AIR STATION · BRUNSWICK, MAINE ·

LAUNDRY BUILDING ·

· PLAN, ELEVATIONS & DETAILS ·

PLUS 4" SAN-SEWER LOCATION

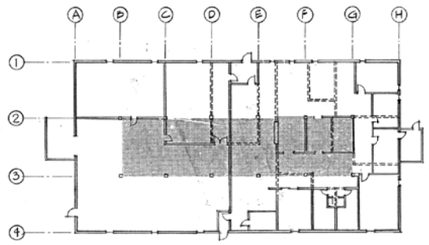
SUBMITTED Walter JACKSON & MORELAND ENGINEERS.

APPROVED [redacted]

By C.H. Cameron

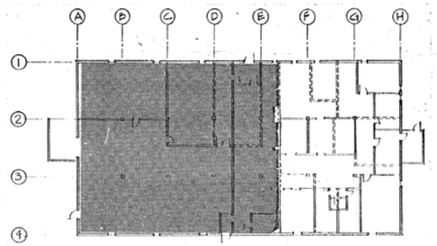
By [redacted] PUBLIC WORKS OFFICER

9 S



PHASE 1 (SHOWN SHADED)
GENERAL DESCRIPTION OF WORK

1. REMOVE CLERESTORY WINDOWS, LOUVERS, ROOFING & ROOF SHEATHING.
2. REMOVE CLERESTORY RAFTERS & SAVE FOR RE-USE.
3. CUT WOOD COLUMNS & LOWER THE WOOD TRUSSES (2 TRUSSES).
4. INSTALL BEAMS & SALVAGED RAFTERS, NEW SHEATHING & ROOFING FLUSH W/EXISTING ROOF.



PHASE 2 (SHOWN SHADED)
GENERAL DESCRIPTION OF WORK

1. REMOVE EXISTING WINDOWS ON THE GROUND FLOOR AND FRAME-IN AND INSTALL NEW WINDOW
2. MOVE STAIRS TO NEW LOCATION
3. STRIP INTERIOR WALLS & INSTALL INSULATION
4. REMOVE INTERIOR PARTITIONS WHERE INDICATED
5. INSTALL NEW FULL HEIGHT FIRE RATED PARTITION, NEW ENTRIES & THE NEW MECHANICAL ROOM
6. INSTALL HEATING & ELECTRICAL WORK.
7. SHADED AREA SHOULD BE COMPLETE EXCEPT FOR FINAL FINISHES.

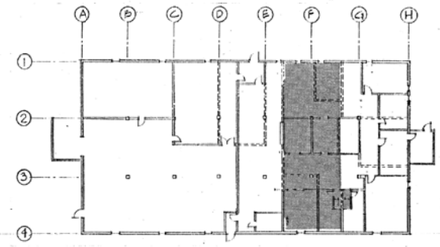
DEPARTMENT OF THE NAVY

NAVAL FACILITIES ENGINEERING COMMAND

REPAIRS & IMPROVEMENTS TO HOUSING OFFICE, BUILDING 9

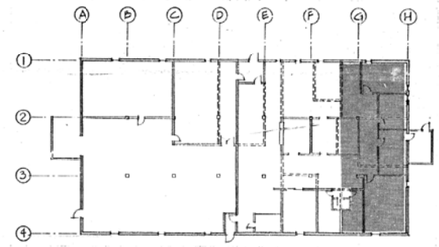
CONSTRUCTION CONTRACT NO. N62472-84-C-2563

NAVAL AIR STATION
BRUNSWICK, MAINE



PHASE 3 (SHOWN SHADED)
GENERAL DESCRIPTION OF WORK

1. INSTALL TEMPORARY SEPARATION PARTITION.
2. REMOVE WINDOWS, BLOCK-UP & FRAME-IN NEW WINDOWS.
3. STRIP, INSULATE & SHEETROCK EXTERIOR WALLS.
4. REMOVE CEILING FRAMING & PARTITIONS INDICATED INCLUDING THE LIGHTING, WIRING AND HEATING SYSTEMS.
5. REWORK THE WOMEN'S TOILET, INSTALL JANITOR'S CLOSET. (MAINTAIN THE USE OF THE MEN'S TOILET)
6. INSTALL NEW PARTITIONS, CEILING, LIGHTING, WIRING & HEATING SYSTEMS.
7. FINAL FINISH THIS AREA TO THE FULL HEIGHT RATED PARTITION INCLUDING CARPET, TILE & PAINT.
8. TENANTS MOVE INTO FINISHED AREA AND GO TO PHASE 4.



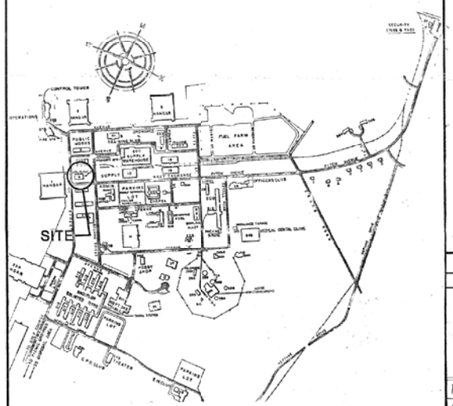
PHASE 4 (SHOWN SHADED)
GENERAL DESCRIPTION OF WORK

1. REMOVE WINDOWS, BLOCK-UP & FRAME IN NEW WINDOWS.
2. STRIP, INSULATE AND SHEETROCK EXTERIOR WALLS.
3. REMOVE CEILING FRAMING & PARTITIONS INDICATED INCLUDING THE REMAINING LIGHTING, WIRING & HEATING SYSTEM.
4. REWORK THE MEN'S TOILET (ALLOW FOR THE USE OF THE WOMENS TOILET)
5. INSTALL NEW CEILING, PARTITIONS, ETC.
6. FINAL FINISH THIS AREA.
7. REMOVE TEMPORARY PARTITION AND TIE FINISH WORK IN TOGETHER.

LIST OF DRAWINGS

LOCUS MAP

SITE PLAN



GRAPHIC SCALES
CHECK GRAPHIC SCALES BEFORE USING

FIRE CHIEF: R.R.W.
SAFETY OFF: C.J.M.

SATISFACTORY TO _____ DATE 4/7/84

CLEVERDON, VARNEY & PIKE
Consulting Engineers & Architects
Boston, Mass.
DSGN JDM DR RRR CHK WEM
SUBY CH ENGR
SUBMITTED BY William H. Pike - President
TEL DIV NO SIGN 9/21/84
DIR OF ENG _____
SATISFACTORY TO _____
APPROVED _____ DATE _____
PUBLIC WORKS OFFICER

DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND
NAVAL AIR STATION BRUNSWICK, MAINE
REPAIRS & IMPROVEMENTS TO HOUSING OFFICE, BUILDING 9
TITLE SHEET

SIZE	CODE IDENT NO.	NAVFAC DRAWING NO.
F	80091	2066031

CONST CONTR NO. N62472-84-C-2563
SCALE SPEC 04-84-2563 SHEET 1 OF 13

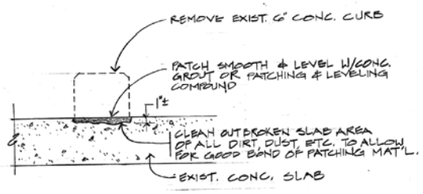
AS BUILT

PENDING BLDG 9

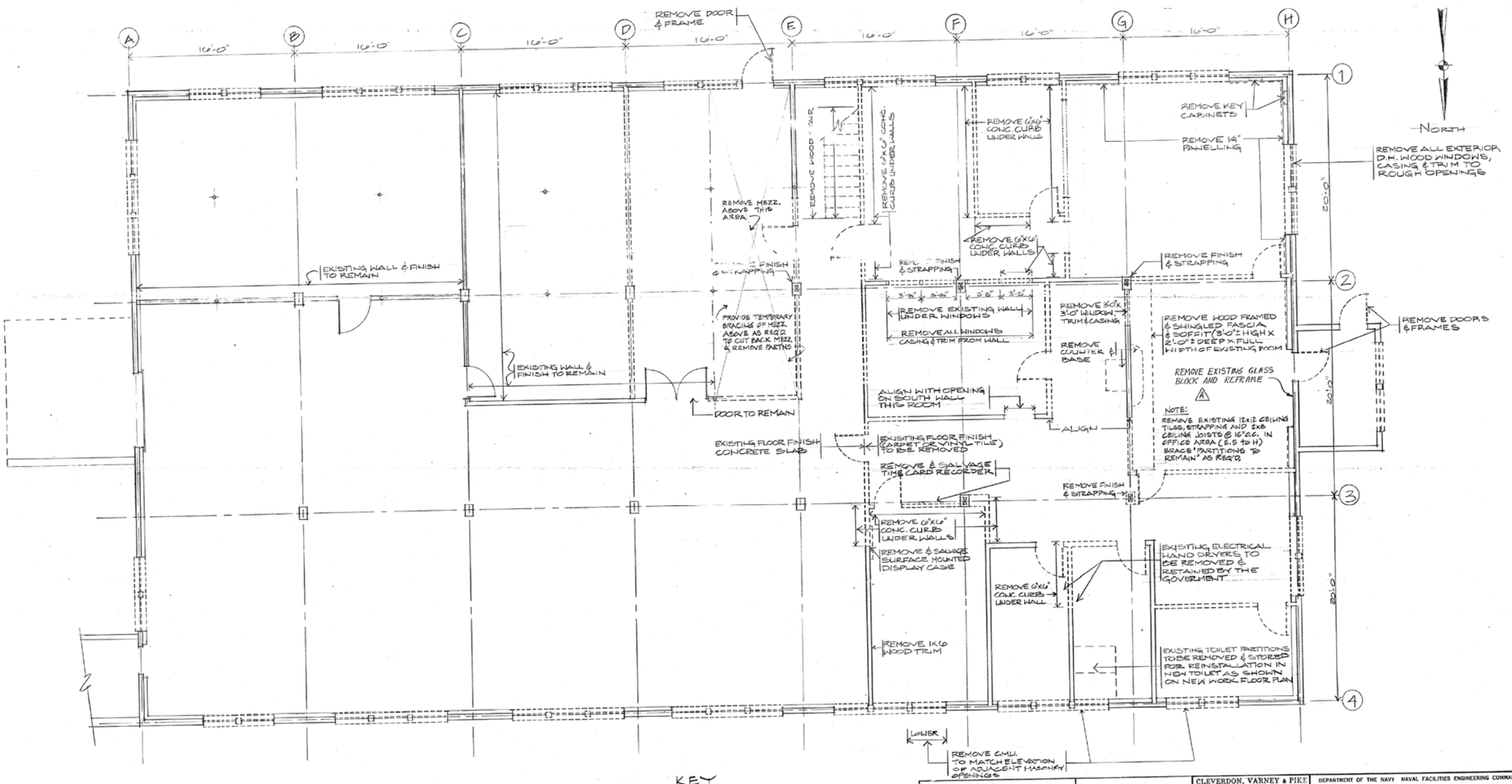
REVISION				
SYM	DESCRIPTION	PREP'D. BY	DATE	APPROVED
A	AS BUILT	D.B.R.	5-6-85	DK

GENERAL DEMOLITION NOTES:

1. REMOVE ALL EXISTING FLOOR FINISHES (CARPET OR VINYL TILE)
2. REMOVE ALL 1/4" PANELLING FROM FACE OF INTERIOR WALLS. EXTERIOR WALLS SHALL HAVE ALL FINISH MATERIAL REMOVED TO SURFACE OF CONCRETE MASONRY (TO 48"± A.F.F.) OR BARE STUDS (48" A.F.F. AND ABOVE)
3. REMOVE ALL EXISTING INTERIOR WALL FINISHES TO BARE STUDS EXCEPT WHERE IS INDICATED OTHERWISE.



TYPICAL FLOOR PATCH DETAIL
SCALE: 1½" = 1'-0"



EXISTING FLOOR PLAN
SCALE 1/4" = 1'-0"

KEY
- STUD PARTITIONS TO REMAIN WITH FINISH REMOVED
- ITEMS & PARTITIONS TO BE REMOVED

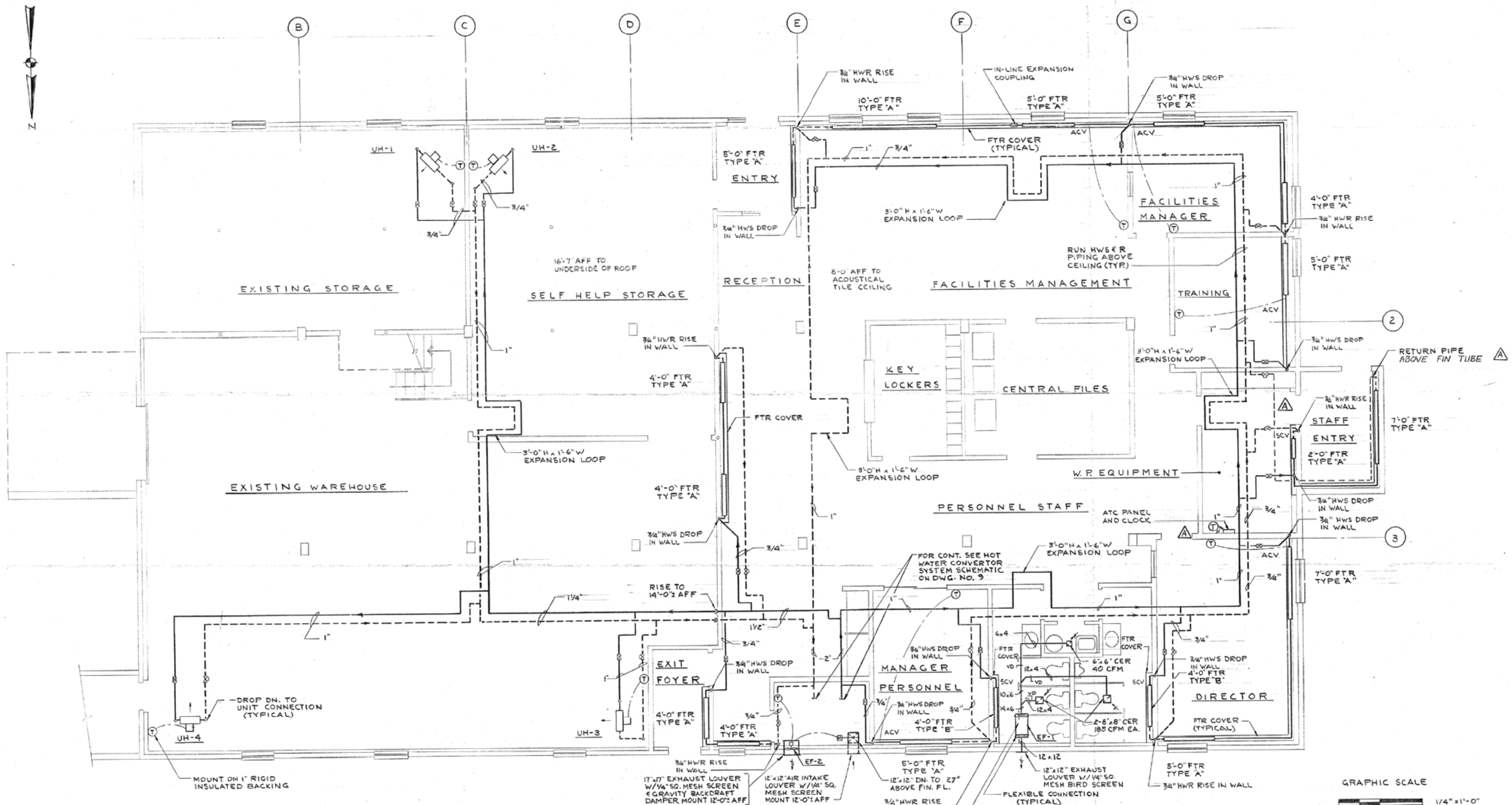
GRAPHIC SCALES
CHECK GRAPHIC SCALES BEFORE USING
SCALE 1/4"=1'-0"
0 1' 2' 3' 4' 5' 10'

SATISFACTORY TO _____ DATE 6/1/84

CLEVERDON, VARNEY & PIKE
Cons. Mtg Engineers & Architects
Boston, Mass.
DRGN JDM DR RRR CHK WEM
SUPV ON ENGR
SUBMITTED BY William H. Pike President (TITLE)
FIRM MEMBER
TEL DIV
DIR OF ENG
SATISFACTORY TO
APPROVED DATE
PUBLIC WORKS OFFICER

DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND
NAVAL AIR STATION BRUNSWICK, MAINE
REPAIRS & IMPROVEMENTS TO HOUSING OFFICE, BUILDING NO. 9
DEMOLITION/ EXISTING FLOOR PLAN
SIZE F | CODE IDENT NO. 80091 | NAVFAC DRAWING NO. 2066032
CONST CONTR NO. N62472-84-C-2563
SCALE | SPEC 04-84-8563 | SHEET 5 OF 13

SYM	DESCRIPTION	PREP'D. BY	DATE	APPROVED
A	AS BUILT	DBR	5-3-85	DR



HEATING & PLUMBING NEW WORK PLAN MAIN LEVEL

SCALE: 1/4" = 1'-0"

GRAPHIC SCALE: CHECK GRAPHIC SCALES BEFORE USING

STATE OF MAINE — WILLIAM H. PINEO 3979 — REGISTERED PROFESSIONAL ENGINEER

DATE 6/7/84

CLEVERDON, VARNEY & PIKE
Consulting Engineers / Architects
Boston, Mass.

SUBMITTED: William Pineo, President

TEL DIV

DIR OF ENG

SATISFACTORY TO

APPROVED DATE

PUBLIC WORKS OFFICER

DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND

NAVAL AIR STATION BRUNSWICK, MAINE

REPAIRS & IMPROVEMENTS TO HOUSING OFFICE, BUILDING NO. 9

HEATING & PLUMBING NEW WORK

SIZE	CODE IDENT NO.	NAVFAC DRAWING NO.
F	80091	2066840
		CONST CONTR NO. N62472-84-C-2563
SCALE	SPEC 04-84-2563	SHEET 10 OF 13

APPENDIX C

SCOPING SURVEY REPORT

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N60087.PF.003156
NAS BRUNSWICK
5090.3b

FINAL SCOPING SURVEY REPORT BUILDING 9 NAS BRUNSWICK ME

3/1/2013

TETRA TECH

Final

Scoping Survey Report
Building 9

Naval Air Station Brunswick
Brunswick, Maine

March 2013

Prepared for:
Department of the Navy
Base Realignment and Closure
Program Management Office Northeast
Philadelphia, Pennsylvania

Prepared by:
Tetra Tech, Inc.
661 Anderson Drive, Suite 5
Pittsburgh, Pennsylvania

Prepared under:
Naval Facilities Engineering Command
Contract Number: N62470-08-D-1001
Task Order: WE03

FINAL

SCOPING SURVEY REPORT
Building 9

Naval Air Station Brunswick
Brunswick, Maine

March 2013

Contract Task Order WE03

Prepared for:
Department of the Navy
Base Realignment and Closure
Program Management Office Northeast
Philadelphia, Pennsylvania

REVIEW AND APPROVAL

Lawson Bailey
Project Manager

Paul Burgio
BRAC Environmental Coordinator

EXECUTIVE SUMMARY

At Naval Air Station Brunswick (NASB), Building 9 was originally constructed in 1943 as a laundry facility. Its area is approximately 8,888 square feet. During the 1950s and 1960s, Building 9 housed the Electronic and Ordnance Shop, and later, 1970s and 1980s, the Patrol Squadron Special Unit (VPU). More recent use of Building 9 was as the Morale, Welfare and Recreation (MWR) facility, Chief Petty Officer (CPO) Wardroom, a lounge and mess facility for non-commissioned officers. Most recent use of the building was as the base housing office. As an Electronics and Ordnance Shop, Building 9 was used in the maintenance and repair of electronic components. Electronic components are known to include items with radioactive material. The building was later used by the VPU. VP squadrons flew P-2 Neptune and P-3 Orion aircraft. The Neptune replaced the Orion in 1966 because it was larger, more versatile, and could deliver a more powerful weapon. The VPU likely used this building to house AUW components and for torpedo maintenance and overhaul. Examples of radioactive materials potentially used in this building would be aircraft components, electronics, and instrumentation. The Historical Radiological Assessment (HRA) (TetraTech 2012c) identified the specific isotopes of concern in Building 9 to be tritium (H-3), cesium 137 (Cs-137), radium 226 (Ra-226), thorium 232 (Th-232) and uranium 238 (U-238). A Task Specific Plan was developed to define the type and amount of surveys to be conducted in the potentially impacted areas. The Task Specific Plan ware designed to serve as a Final Status Survey if no contamination was found. Surveys of the potentially impacted areas of Building 9 were performed in July of 2012 with the results contained in this report.

All scan surveys, direct measurements, removable contamination surveys and gamma walkover surveys provided data that was indicative background values with a single exception found by the SCM. A localized spot, no greater than 300 cm^2 was found with maximum alpha activity of 3,985 dpm/100 cm^2 and maximum beta activity of 39,118 dpm/100 cm^2. The area of high activity is located on the south side of Building 9, inside and to the right of the exterior door on the south wall.

Based on the results of all surveys within the potentially impacted areas of Building 9 indicating radioactive material in one location based on a survey of 25% of the floor and lower wall area, further evaluation, remediation and surveys must be considered. Building 9 is not recommended for unrestricted use.

TABLE OF CONTENTS

FIGURES

TABLES

APPENDICES

ACRONYMS AND ABBREVIATIONS

µR/hr	Microroentgens per hour
α	Alpha
β	Beta
ε_i	Instrument efficiency
Cs-137	Cesium 137
CFD	Cumulative frequency distribution
cm	Centimeter
cm^2	Square centimeter
cpm	Count per minute
CPO	Chief Petty Officer
DQO	Data quality objective
dpm	Disintegration per minute
DU	Depleted uranium
EPA	U.S. Environmental Protection Agency
ft^2	Square feet
H-3	Tritium
HRA	Historical radiological assessment
LBGR	Lower Bound of the Gray Region
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MWR	Morale, Welfare and Recreation
MSI	Millennium Services, Inc.
NAS	Naval Air Station
NIST	National Institute of Standards and Technology
NRC	Nuclear Regulatory Commission
PSPC	Position sensitive proportional counter
RASO	Radiological Affairs Support Office
Ra-226	Radium 226
ROC	Radionuclide of concern
RSOR	Radiation Safety Officer Representative

SCM	Surface contamination monitor
SIMS	Survey information management systems
Sr-90	Strontium 90
SU	Survey unit
Th-232	Thorium 232
TSP	Task specific plan
U-238	Uranium 238
VPU	Patrol Squadron Special Unit
VSP	Visual sample plan

1.0 SITE DESCRIPTION

Naval Air Station Brunswick (NASB) was originally constructed in the early 1940s on the site of a small municipal airport. The original mission during World War II of the NASB was to train and form-up squadrons of Royal Canadian Air Force and Royal Navy pilots. NASB was deactivated in October 1946, 14 months after the end of WWII. In 1951, the station was selected by the Navy as a prime center for development. During the development period, the Navy signed an agreement with the Air Force authorizing the construction of an Air Force Control and Warning Facility, as a part of the continental circumferential radar screen. On March 15, 1951, the inactive station was recommissioned as a Naval Air Facility. The established mission was to support three land-plane patrol squadrons and one fleet aircraft service squadron. Its future mission was to be a master jet air station that conducted anti-submarine warfare off the Atlantic Coast. On December 1, 1951 the station's designation was officially elevated to a Naval Air Station.

Approximately 222 structures and buildings were constructed during the 1950's, including a large portion of the existing housing, the ordnance magazine area south of the runways and the communications and navigational aids west of the runways. Building 9 was completed in 1943. NAS Brunswick continued to support anti-submarine warfare until base closure in 2011.

1.1 BUILDING LOCATION AND DESCRIPTION

Building 9 was originally constructed in 1943 as a laundry facility. Its area is approximately 8,888 square feet. During the 1950s and 1960s, Building 9 housed Electronic and Ordnance Shop, and later, 1970s and 1980s, the Patrol Squadron Special Unit (VPU). More recent use of Building 9 was as the Morale, Welfare and Recreation (MWR) facility, Chief Petty Officer (CPO) Wardroom, a lounge and mess facility for non-commissioned officers. Most recent use of the building was as the base housing office. The location of Building 9 at BNAS is shown in Figure 1.

1.2 PRIOR HISTORICAL USE

As an Electronics and Ordnance Shop, Building 9 was used in the maintenance and repair of electronic components. Although the specific nature of the work performed in this building is unknown, electronics are known to include items with radioactive material. The building was later used by the VPU. VP squadrons flew P-2 Neptune and P-3 Orion aircraft. The Neptune replaced the Orion in 1966 because it was larger, more versatile, and could deliver a more powerful weapon. The VPU likely used this building to house AUW components and for torpedo maintenance and overhaul. Examples of radioactive materials potentially used in this building would be aircraft components, electronics, and instrumentation. The Historical Radiological Assessment (HRA) (TetraTech 2012c) identified the specific isotopes of concern in Building 9 to be tritium (H-3), cesium 137 (Cs-137), radium 226 (Ra-226), thorium 232 (Th-232) and uranium 238 (U-238).

1.3 CURRENT AND FUTURE BUILDING OR LAND USE

Building 9 is currently vacant. No potential use of the facility is known.

1.4 REPORT OBJECTIVES

This report details the procedures and results of the surveys performed to facilitate unrestricted release of Building 9.

2.0 HISTORICAL RADIOLOGICAL ASSESSMENT

The history of Building 9 identifies the use of a portions of the structure as an Electronics and Ordinance Shop. The maintenance of electronic components is likely to have included items with radioactive material. The electronic components were identified in a site-wide evaluation of historical base operations performed by the Navy (TetraTech 2012c), also referred to as a Historical Radiological Assessment (HRA). Additional information was reported in the Task Specific Plan (TSP), attached as Appendix A. These documents are the references for the information presented in this section.

2.1 OPERATING HISTORY

As stated above, portions of Building 9 was used as an Electronics and Ordinance Shop during the 1950s and 1960s. During the 1970s and 1980s, the building housed VPU. The VPU likely used this building to house AUW components and for torpedo maintenance and overhaul. More recent use of Building 9 was as the MWR CPO Wardroom, a lounge and mess facility for non-commissioned officers. Finally, Building 9 housed the base housing office until base closure.

2.2 MULTI-AGENCY RADIATION SURVEY AND SITE INVESTIGATION MANUAL CLASSIFICATION

Building 9 is classified as a Class 3 area per Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) classifications (Nuclear Regulatory Commission [NRC] 2000). Although radioactive material was present in the areas, there is no record of area or equipment contamination occurring with Building 9. The classification is summarized in Table 1 and more detail is presented in Section 4.2.

2.3 RADIONUCLIDES OF CONCERN

As identified in the HRA (TetraTech, 2012c), the isotopes of concern in Building 9 are H-3, Cs-137, Ra-226, Th-232, and U-238.

3.0 RELEASE CRITERIA

Limits on residual contamination for the radionuclides of concern are discussed below. These limits, or release criteria, refer to meeting standards for release of Building 9 radiological controls, allowing unrestricted use.

3.1 UNRESTRICTED RELEASE CRITERIA

The release criterion for building surfaces (floors and walls) is 100 alpha disintegrations per minute (dpm) per 100 square centimeters (cm^2) for Ra-226. The criterion for Th-232 is 1,000 alpha dpm/100 cm^2. The criterion for Cs-137 is 5,000 beta dpm/100 cm^2 and criterion for U-238 is 5,000 alpha dpm/100 cm^2. The limits for the specific radionuclides to be addressed in Building 9 are provided in Table 2. The removable contamination limit is one fifth of the total activity criteria. H-3 limits are 5,000 dpm/100 cm^2 total surface activity, however due to the low energy beta emitted by H-3, detection with surface monitoring is not practical. Smears were obtained and analyzed at an off-site laboratory for H-3. The removable contamination release criteria for H-3 is one fifth of the total activity criteria (TetraTech 2012a).

3.2 INVESTIGATION LEVELS

Investigation levels for the alpha and beta surveys were equal to 75 percent of the release criteria for the isotope of concern in each area surveyed.

4.0 SURVEY DESIGN

The survey consisted of alpha and beta scanning and direct measurements at defined and random locations of alpha, beta, and gamma radiations and removable alpha and beta radioactivity. Details of the survey method are provided in the TSP, attached as Appendix A.

4.1 OBJECTIVE OF SURVEYS

The objective of the surveys was to demonstrate that potential residual radioactivity levels from historical Navy activities in the building are less than the predetermined release criteria. In demonstrating that the objective has been met, the null hypothesis was tested for residual contamination that exceeded the release criterion. The alternative hypothesis was then tested for residual contamination that meets the release criterion.

4.2 SURVEY UNITS

Building 9 was surveyed as Class 3 area, requiring a 25 percent survey of floor and walls up to 6 feet. Using a random start point, systematic data collection locations (N) were laid out in a triangular grid pattern for the survey units using the computer process provided by Visual

Sample Plan (VSP) (DOE 2012). Locations for data collection are provided in Appendix D as well as field data sheets provided with the results of surveys from the survey unit.

4.3 REFERENCE AREAS

A reference area for Building 9 was initially identified as the fire station, Building 292. The specific material of construction that is applicable to Building 9 is concrete. Building 292 has no history of radioactive material use (TetraTech 2012c). Reference survey method descriptions and documentation are provided in Appendix B (Millennium Services Inc. [MSI] 2012). Subsequent to the initial surveys at the Brunswick Naval Air Station, it became apparent that the surface beta emission rate from the reference area was much higher than many of the impacted area surfaces. Other areas were considered for a reference area, with the area most likely to be similar being a hallway in the non-impacted area of Building 250. The area chosen was adjacent to the former "GEEDUNK" area. The area was surveyed with the SCM and was determined to show a normal distribution with no outliers, and an average instrument response more in line with other impacted areas. Application of reference area data was impacted greatly by the atmospheric conditions both within the buildings as well as local weather conditions as described in Appendix B. See Figure 1 for locations of background reference areas.

4.4 STATISTICAL TESTS

Since the release criteria are based on individual spot limits, normal statistical tests such as Sign Test, or Wilcoxon Rank Sum Test have no meaning. Also, the alpha limits for Ra-226, 100 dpm/100 cm^2, and the methods used to determine compliance with the SCM coincidence logic on two separate detectors results in a low range of counts per survey interval. Again, statistical tests do not provide any additional insight to the data. Beta surveys performed with the SCM will generate a cumulative frequency distribution plot (CFD) which provides information related to the average, standard deviation and distribution of data collected in a survey area. CFDs of surfaces that exhibit normally distributed activity will display a straight line, the slope of the line related to the standard deviation of the data. Therefore, natural radioactivity found in reference area surveys will produce a straight line on a CFD. Points that deviate from the straight line often indicate levels elevated above background. Building 9 SCM CFD plots were reviewed in this way, and if a data point deviated from the expected straight line, it would have been investigated as an outlier (and possible contamination). The CFDs are also evaluated to ensure that the high end of the plot is less than the release criteria when the 50^{th} percentile of the background subtracted data adjusted to zero. The high end of the CFD plot represents the Minimum Detectable Concentration (MDC) of the SCM as applied to a given survey.

4.5 DETERMINING THE NUMBER OF DIRECT MEASUREMENTS

To determine the number of measurements, N, to be taken per survey unit when the contaminant is not present in background, Equation 5-3 of the management plan (TetraTech 2012a) is used:

Equation 5-3 from the management plan (TetraTech 2012a)

$$N = \left(\frac{(Z_{1-\alpha} + Z_{1-\beta})^2}{4(Sign\rho - 0.5)^2} \right)(1.2)$$

Where:

N = Number of data points

$Z_{1-\alpha}$ = Type I decision error level, 1.645

$Z_{1-\beta}$ = Type II decision error level, 1.645

Sign ρ = random measurement probability, 0.945201

1.2 = 20 percent increase in number of samples over the minimum

The values used in the calculation were from MARSSIM guidance (NRC 2000) and were based on a recommended value for the relative shift of 1.6. Type I and Type II decision errors were based on 0.05 false negative and 0.05 false positive rates. The associated *Z* values were obtained from MARSSIM Table 5.2 (NRC 2000). The random measurement probability, Sign ρ, is from MARSSIM Table 5.4 (NRC 2000).

The calculation results in a value of N = 16.38. Therefore, a minimum of 17 direct measurements were obtained in each survey unit. The scan MDCs, discussed in Section 6.6 and presented in Table 2 are below the release criteria. Therefore, recalculation of the value of N is not required in accordance with MARSSIM guidance, Chapter 5, Figure 5-3.

5.0 FIELD ACTIVITIES

In addition to the radiological surveys, other field activities were completed during the course of this work. These activities include quality control, health and safety clearance and asbestos abatement. All activities are discussed in this section.

5.1 MOBILIZATION

Mobilization for the Building 9 survey occurred on June 4, 2012 by Millennium Services, Inc. (MSI), the survey contractor. The final TSP for the survey, provided in Appendix A, was reviewed by survey staff during the initial training. Training on the safety plans was also conducted, as was a briefing by the project Radiation Safety Officer Representative (RSOR), who provided dosimetry to survey staff.

5.2 INITIAL CLEARANCE AND SURVEY UNIT MARK OUT

Work began with a building walkthrough conducted by health and safety personnel. The walkthrough was performed to ensure personnel working inside the building would not

encounter any unsafe situations and to estimate the amount of trash and debris to be removed for proper disposal. Building surveys, including a walkover gamma survey using a sodium-iodide (NaI) based microR meter, and large area wipes, were performed to verify that work areas were clear of loose radioactive contamination and elevated radiation levels, and that no radiation work permits were necessary. The gamma walkover surveys identified areas showing exposure rate values of 11 to 13 microR/hr in Building. Finally, SUs were identified, marked and gridded.

Using a random start point identified in the TSP, the systematic data collection fixed-point locations were laid out in a triangular grid pattern for the SUs, using the computer process provided by VSP (DOE 2012).

5.3 ASBESTOS ABATEMENT ACTIVITIES

An asbestos abatement contractor was mobilized to remove asbestos-containing materials in the building that impeded the survey of original surfaces. The floor of the Building 9 had been covered with tile flooring and carpeting, covering the original concrete. The materials, were disposed of as assumed low-level radioactive waste. No ventilation ducts or drains were found that required preparation for survey.

5.4 SURVEY ACTIVITIES

The survey consisted of alpha and beta scan measurement with the SCM of Class 3 SUs. The required surveys were performed with scan coverage of at least 25 percent for Class 3.

Surveys were performed at predetermined locations and made for:

- Direct measurements of alpha and beta radiations
- Removable alpha or beta radioactivity
- Exposure rate measurement
- Tritium smears

Gamma walkover surveys of both SUs were conducted with a 2" x 2" NaI detector with a data logging instrument, Ludlum 2241-2 attached to a field computer.

6.0 SURVEY INSTRUMENTATION

Instruments selected for this survey were appropriate for the physical and environmental site conditions as described in the final TSP. The instruments and selected measurement methods used were able to detect the stated radionuclide(s) of concern (ROC) or radiation type of interest, and were, in relation to the survey or analytical technique, capable of measuring levels equal to or less than the release criteria.

6.1 INSTRUMENT CALIBRATION

Initial calibrations of hand-held survey instruments to NIST-traceable sources were performed by the instrument vendor. Ludlum instruments were calibrated by Ludlum within a year prior to this survey. After calibration by Ludlum, these instruments underwent an efficiency determination performed by MSI personnel on site, specific to the radionuclides of concern. Calibration of the SCMs to NIST-traceable sources was also performed on site. The SCMs were calibrated at the start of the project using MSI's approved calibration procedures.

6.2 INSTRUMENT OPERATIONAL CHECKS AND QUALITY ASSURANCE PROCEDURES

Radiation detection instruments used in the survey were maintained and calibrated to operate within manufacturer specifications so that the required sensitivity and precision were maintained. Survey instruments were source-checked daily before each day's survey. Procedures were followed for all field instrumentation to verify that the instruments were operating properly and that the data were valid with instrument calibrations that were NIST-traceable. These procedures included functional operational checks, routine maintenance, calibration procedures, and operational instructions. The operational checks ensured that the instruments were within the ±20 percent acceptance criteria established when their baseline information was set up. When the instruments did not meet the criteria, they were removed from service, tested, repaired or replaced, and recalibrated.

The SCMs were checked in each configuration prior to use in accordance with SCM quality control procedures. Following an initial source check, the SCM operations were verified with a Performance Based Check (PBC). The PBCs test all aspects of SCM operations. Results of the PBC checks are applied to a control chart to allow review of performance each day and to note any trends that may be occurring. Surveys conducted that do not have successful PBC results before and after completion are rejected and need to be performed following SCM maintenance and successful PBC performance.

6.3 INSTRUMENTS FOR THE MEASUREMENT OF ALPHA AND BETA SURFACE ACTIVITY

Various gas-filled detectors were used to measure alpha and beta surface activities. Details are provided in the following sub-sections.

6.3.1 Instruments for the Static Measurement of Alpha and Beta Surface Activity

SU fixed point locations were measured with the Ludlum 43-68 gas flow proportional detectors coupled to a Ludlum 2221 ratemeter. The counting gas used was P-10 gas.

6.3.2 Instruments for the Scan Measurement of Alpha and Beta Surface Activity

Survey units were scanned with the SCM. The SCM utilizes a gas flow position-sensitive proportional counter (PSPC). The PSPC functions using P-10 as the counting gas. As in any proportional counter, voltage plateaus are established for the detection of alpha or alpha plus beta particles. High voltage appropriate for the type of particles to be detected is applied to the single anode wire that runs the length of the detector. The SCM computer compares the pulse heights of pulses sensed at each end of the anode wire and establishes the location on the anode wire where the nuclear particle was sensed. Although the available resolution is greater than 2,000 locations on the anode wire, the SCM computer will "bin" the data in 5-centimeter (cm)-wide increments along the length of the wire.

The SCM was operated in both a dynamic or "rolling" mode or a static or "corner" mode. In the dynamic mode, the system uses a direct current-powered drive motor affixed to a cart that contains all electronics and computer hardware, and the detector assembly is mounted to the front of the cart. The SCM's design focuses on eliminating human performance issues associated with surveys of large areas. The system is designed such that surveys are performed at constant speed, the detector is held at a set distance from the surface being surveyed, and survey data are recorded automatically. In the dynamic mode, a precision wheel encoder is mounted to the cart axle to measure the distance traveled by the cart. The encoder can measure to a small fraction of a cm and is used to trigger the computer to capture data for every 5 cm of travel of the SCM cart. The result is count data (counts) for every 5 cm "bin" for every 5 cm of travel, or a matrix of 25 cm^2 "pixels" of data. In the static mode, a preset time is applied to the collection of data from a stationary detector. Data are binned in a manner similar to the dynamic mode.

Data are transferred from the SCM to a processing station that contains the Survey Information Management Systems (SIMS) software via removable media. SIMS software is used to "stitch" the individual blocks of data together to create a single survey of the entire area. The data collected in 25 cm^2 pixels is summed with adjacent pixels in a manner that will result in the evaluation of every possible 100 cm^2 area. In measuring activity, each 25 cm^2 pixel is 25 percent of four overlapping 100 cm^2 areas. This process ensures that small areas of activity above limits are not missed through grid registration errors.

The SCM in the dynamic mode is operated with a recount detector for alpha surveys with low investigation levels. A second detector is hard mounted behind the first at a constant distance. Both detectors perform complete surveys as discussed above. SIMS will generate a survey for each detector. The individual detector surveys will display activity from a source if present, but also counts that result from background activity. SIMS applies "coincidence logic" to the two surveys to avoid false positives caused by background radioactivity. The recount detector survey is superimposed on the primary detector survey. Each 100 cm^2 area is evaluated against a threshold number of counts. If both detectors are above the threshold value, the results are averaged and the activity is evaluated against the investigation levels. If either the primary or

recount detector is below the threshold, the counts are considered to be from background, and a null value is incorporated in the coincidence logic report.

In the static mode, a second count is obtained at each static measurement location. The second count is considered the recount survey. The SIMS coincidence logic described above is applied to determine if activity is present or if the observed counts are caused by background. The coincidence logic applied within the SIMS software is described in Appendix J of MARSSIM (NRC 2000) and is designed to reduce the large number of false positives typically obtained when the investigation levels are low, as in alpha surveys.

6.3.3 Determination of Instrument Efficiency for Alpha and Beta Surface Activity Measurements

Instrument efficiency (ε_i) is defined as the ratio between the net count rate (in counts per minute [cpm]) of the instrument and the surface emission rate of the calibration source for a specified geometry. Instrument efficiency was calculated by obtaining static counts from a detector positioned over a calibration source that features a NIST-traceable surface emission rate.

Additional considerations that control overall instrument efficiencies include the following:

- Calibration Sources: Selected calibration sources feature alpha and beta emitter energies similar to those expected from contaminants in the field (the same or similar to ROCs). An adjustment for radiations per disintegration may be applied.
- Source Geometry Factors: Geometry factors may be applied based on a calibration source area greater than the area of the probe.
- Source-to-Detector Distances: Calibration is performed at a "source-to-detector" distance consistent with the "detector-to-surface" distance used in the field.
- Window Density Thickness: Calibration is performed using a detector window density thickness identical to that used in the field.
- Detector-Related Factors: The SCM is able to increase efficiency by using a 10-cm deep detector to survey a 5-cm bin (see Section 6.3.2 above). This detector geometry allows the 5-cm section to be passed over twice and increases the instrument efficiency by a factor of two.

6.4 INSTRUMENT FOR THE MEASUREMENT OF EXPOSURE RATES

The Ludlum Model 19 instrument, which contains a sodium iodide detector, was used to measure ambient gamma exposure rates. Sodium iodide scintillation detectors are sensitive to photon gamma radiation. The instrument output is calibrated to read in microR/hr.

6.5 INSTRUMENT FOR GAMMA WALKOVER SURVEYS

The Ludlum Model 43-10-1 NaI detector is coupled to a Ludlum 2241-2 ratemeter/data logger. The detector is a 2" x 2" NaI, sensitive to photon gamma radiation and is ideal for locating higher than usual radiation levels in survey areas.

6.6 INSTRUMENT FOR MEASURING SWIPE SAMPLES

Swipe samples were collected for the analysis of removable contaminants. Swipe samples, also referred to as smear samples, were obtained at the discrete surveillance points in the survey units. All samples were processed using a Ludlum Model 2929 low-background, alpha/beta counter. This counter uses a dual phosphor scintillation detector.

6.7 DETECTION SENSITIVITIES

The final TSP (Appendix A) provides a detailed discussion and presentation of detection sensitivities of the detectors. Table 2 summarizes the results of sensitivity calculations. Some have been recalculated where actual field parameters differ from the TSP assumptions. These are noted in Table 2. Resulting instrument sensitivities for the Building 9 surveys are more than sufficient to detect the applicable release criteria.

7.0 SURVEY PROCEDURES

This section provides a review of the survey procedure and how the procedure met project data quality objectives (DQO). This section includes site-specific discussions of techniques for scanning, direct radiation, and removable contamination surveys of Building 9.

7.1 REVIEW OF DATA QUALITY OBJECTIVES

DQOs are qualitative and quantitative statements developed to define the purpose of the data collection effort, clarify what the data should represent to satisfy this purpose, and specify the performance requirements for the quality of information to be obtained from the data. These outputs are used to develop a data collection design that meets all performance criteria and other design requirements and constraints. The U.S. Environmental Protection Agency (EPA) has developed a seven-step process to develop DQOs.

Step One – State the Problem

The problem can be stated as, "Can Building 9 be released from radiological controls or is further action required?"

Step Two – Identify the Goal of the Study

The primary use of the data from this survey is to support the release from radiological controls of Building 9. Therefore, the decision to be made can be stated as, "Do the results of the survey meet the release criteria for the site-specific radiological nuclides of concern?"

Step Three – Inputs to the Decisions

Radiological surveys designed to support the decision included:

- 25 percent alpha and beta scan surveys of Class 3 areas
- A minimum of 17 systematic, static alpha and beta measurements in the SU.
- A minimum of 17 swipe surveys for removable alpha and beta activity in the SU.
- A minimum of 17 tritium smears in the SU.
- A gamma walkover survey of the SU

Step Four – Identify the Boundaries of the Study

The lateral and vertical spatial boundaries for this survey effort include the interior of Building 9 Interior walls of Building 9 are excluded from the survey since they were constructed during the buildings use as a MWR CPO Wardroom and housing office.

Step Five – Identify the Decision Rules

If the presence of the site-specific radiological nuclides of concern on building surfaces, or in sediment samples is less than the release criteria, then no further measurements are required. If the results of the survey exceed the release criteria, then the data will be used to characterize the site-specific radiological nuclides of concern with the intent to design and implement remediation in the future.

Step Six – Set Limits on Decision Errors

Limits on decision errors are set at 5 percent, as specified in the Management Plan (TetraTech 2012a).

Step Seven – Optimize the Study Design

Operational details for the radiological survey process have been developed. The theoretical assumptions meet or exceed guidelines in MARSSIM (NRC 2000). Specific assumptions regarding types of radiation measurements, instrument detection capabilities, quantities and locations of data to be collected, and investigation levels are contained in the TSP and the management plan (TetraTech 2012a). The TSP was reviewed and approved by the Navy, both BRAC and RASO.

7.2 SCAN MEASUREMENT TECHNIQUE

Scanning assessments were conducted using the SCM in conjunction with an automated information management system. This arrangement allowed computer analysis of large volumes of survey measurements acquired in relatively short time periods, resulting in easily interpretable graphical displays of survey results. The survey technology was employed for both scanning and static measurements. The scanning mode was used to survey open areas, and the static mode was used to monitor biased areas on walls or doors.

The SCM system uses a patented PSPC that is capable of establishing where along the detector a decay event occurs. This capability allows a long detector to be divided electronically into a continuous array of small, virtual detectors that are similar in efficiency to other counters, but that have backgrounds associated with small area detectors. This division results in improved sensitively, because of the low background- and specific identification of the location of the radioactivity. In scanning mode, the SCM logged information in 25 cm^2 bins by logging data for each 5-cm width of the PSPC and for every 5 cm of forward travel. Scan speed is motor-controlled and the distance the SCM travels is measured by a precision wheel encoder. Data were recorded in 25 cm^2 pixels over the entire surface surveyed; thus, the SCM records 400 measurements for every square meter it traverses. Controlling the survey speed and automatically logging the location of the data obtained using a wheel encoder eliminates typical errors and uncertainties associated with hand-held detectors.

7.3 DIRECT MEASUREMENT TECHNIQUE

Direct measurement locations were first selected using VSP software. Locations generated by VSP are presented in Appendix A. After these locations had been found and marked, the following measurements were performed:

- 2-minute alpha count with the Model 43-68 detector;
- 1-minute beta count with the Model 43-68 detector.

7.4 SMEAR MEASUREMENT TECHNIQUE

Smear surveys were obtained at each of the locations identified for static measurements. Smears covered 100 cm^2 areas. Smears were returned to an onsite counting facility and were counted in a Ludlum 2929 with a 43-10-1 dual phosphor detector. The smears were counted simultaneously for alpha and beta. Count time for each smear was 2 minutes.

7.5 GAMMA EXPOSURE RATE MEASUREMENT

Gamma exposure rate was recorded at each of the pre-determined measurement locations using a Ludlum Model 19 microR meter. Exposure rates were taken at approximately 3 feet above the floor surface.

7.6 GAMMA WALKOVER SURVEY

A gamma walkover survey was performed in each survey unit. The walkover survey was performed using a Ludlum 44-10, 2" x 2" NaI detector coupled to a Ludlum 2241-2 operating in the data logging mode, and feeding a field computer. The survey was performed by slowly walking (approximately 0.5 meters/second) the entire survey unit while maintaining the detector at a height of approximately 4 inches above the floor while moving the detector in a serpentine pattern.

8.0 RESULTS AND ANALYSIS

This section presents the results of the scanning measurements on floors and walls, direct measurements at pre-determined locations, smear survey and gamma survey results at fixed locations, gamma walkover survey results and tritium smear results.

The results from all measurement techniques have been organized and are reported for each survey unit in Appendix D. The appendix contains:

- alpha and beta SCM scan results;
- SCM field maps;
- alpha and beta direct survey results at each pre-determined survey location;
- Direct measurement field data sheets;
- Smear results, both alpha and beta and gamma exposure rate at each pre-determined location;
- Smear and gamma exposure rate field data sheets;
- Gamma walkover data sheet;
- Laboratory analytical results.

The results of the surveys are discussed in the following paragraphs.

8.1 SURVEY UNIT #1

SU-1 is the interior of Building 9. SU-1 survey data and supporting documentation is presented in Appendix D.

8.1.1 SU-1 SCM Scans

The SCM alpha survey reports for SU-1 are labeled FB0101A, FB0101B and FB0101J. The initial survey performed with the SCM in the dynamic mode with a 180 cm detector identified a

small area of elevated activity well above the release criteria. The original SCM survey was labeled FB0101J. The maximum value measured in FB0101J is 3,985 dpm/100 cm^2. The area is located in strip 22 on the SCM map. Photographs of the spot are included in Figure 3. Photo 1 shows the extent of the area with elevated activity. Photo 2 shows the area as left, with a radioactive materials sign placed over the spot.

To more clearly evaluate the remainder of the building, strip 22 was removed from the processed survey, and the resulting survey was labeled FB0101A. Survey FB0101A, which has excluded the area above the release criteria in strip 22, identified five spots that exceed the threshold value for both the primary and recount detectors, ranging from 21 dpm/100 cm^2 to 78 dpm/100 cm^2. One spot exceeded the investigation level. The maximum value is an isolated spot with no other indications in the surrounding 100 cm^2 areas. The value of 78 dpm represents 5 to 6 counts in the survey interval of both the primary and recount detectors, a count rate found throughout the area surveyed. However, application of the coincidence mode eliminates the vast majority of the those background counts. Periodic alignment of the higher counts in both the primary and recount detectors due to background is rare but expected a small percentage of the time. No indications of patterns, indicative of contamination are present on the 2-dimensional displays for the primary or recount detectors. The area indicating 78 dpm/100 cm^2 on the coincidence display, when viewed on the primary and recount detectors, appears consistent with the rest of the survey data display. Therefore, the 78 dpm/100 cm^2 area is consistent with the background for this survey. No field investigation of that spot is determined to be necessary.

SCM alpha survey FB0101B was performed with the SCM in the static mode with a 180 cm detector. The survey was performed within a concrete drain trough in the northeast portion of Building 9. No 100 cm^2 areas of FB0101B exceeded the threshold value in both the primary and recount detectors, indicating that all areas surveyed within the drain trough exhibit activity associated with natural background.

SCM beta survey reports for Building 9 are labeled FB0102A, FB0102B and FB0102J. The labeling is similar to the alpha survey reports discussed above. FB0102J shows the single area with a maximum value of 39,118 dpm/100 cm^2. The area is the identical area discussed above and shown in Figure 3. Survey report FB0102A is the same report as FB0102J with strip 22 redacted. Removing strip 22 allows for an assessment of the remainder of the floor surveys in Building 9.

Survey FB0102A shows a CFD plot that is straight lines with no outliers, indicative of a normal distribution of radioactivity as found in background. The background applied shows that the area used for reference area surveys is similar to the Building 9, SU-1 concrete floors. The maximum value of the CFD is below the release criteria. The straight line CFD indicates no activity that is distinguishable from the distribution associated with background radioactivity.

Survey FB0102B was performed with the SCM operating in the static mode, with a 180 cm detector. The survey was performed within a concrete drain trough in the northeast section of Building 9. The CFD shows a straight line with a slight turn at the high end. The slight turn may be from different concrete or from materials covering a small portion of the trough and

containing radon progeny. The increase is also noted in the 2-dimensional display. There are no outliers in the data and all measurements are well below the release criteria

Survey maps, drawn by field technicians, are included in Appendix D. Maps indicate the location, orientation and number of each strip within the survey area. Strips have been marked in the field with chalk lines as well as tape in the corners of each strip. The maps apply to both alpha and beta surveys.

8.1.2 SU-1 Direct Measurements.

Alpha and beta measurement results obtained at the pre-determined locations are presented in Appendix D. 17 locations were specified on the floors. No significant results were noted in the data. All locations showed activity levels well below the release criteria with average values close to that of the background reference area. The maximum background subtracted values recorded are 3.78 dpm/ 100 cm^2 for alpha measurements and 1172 dpm/100 cm^2 for beta measurements. The data sheets for all direct measurements are included in Appendix D. The data sheets provide the raw data recorded by the technician, maps of all the locations, and grid coordinates for each location.

Field data sheets for all direct measurements are included in Appendix D. The data sheets provide the raw data recorded by the technician, a map of the 17 locations, and grid coordinates for each location.

8.1.3 SU-1 Removable Contamination Measurements

Removable contamination surveys were performed at the 17 pre-determined locations. Smears from each location were returned to an on-site counting facility and analyzed for both alpha and beta activity. All smears were at or near background values for both alpha and beta activity. Results of the removable contamination survey are included in Appendix D. Field data sheets for removable contamination are also included in Appendix D. The data sheets provide the raw data recorded by the technician, a map of the 17 locations, and grid coordinates for each location.

8.1.4 Gamma Walkover Survey

A gamma walkover survey of each quadrant was performed with an unshielded 2" x 2" NaI detector coupled to a ratemeter operating in a data logging mode. The data logger was connected to a field computer to record readings. Readings were obtained for 2 second intervals, and then down loaded. The down load process required 2 seconds. Results of the data collection and analysis of the data, including mean and standard deviation are presented in Appendix D. The data was compared to a maximum value of the mean plus 3 sigma (3σ). Any readings above the mean plus 3σ value were investigated. The 3σ of the survey unit data set investigation criteria was chosen since any reference area that may be used would have great variability based on the materials of construction and weather conditions affecting radon and its progeny as discussed in Appendix B.

All reading in Building 9, SU-1, were below the mean plus 3 sigma criteria.

8.1.5 Tritium Smears

Wet smears were obtained at each of the 17 pre-determined sample locations in SU-1. The wet smear technique is used to determine if concentrations of tritium are present on the surface. The smears were placed in sealable plastic bags and sent to an off-site laboratory for analysis using liquid scintillation counting methods. Analytical results of smears showed all 17 smears less than the reported Minimum Detection Limit (MDL) of the analytical method. The MDL of the method is in the range of 2.22 to 6.66 dpm/100 cm^2. A duplicate sample was obtained at sample location 10. Analytical result for the duplicate sample, 009-SWI-010D, is less than the MDL.

9.0 CONCLUSION

All scan surveys, direct measurements, removable contamination surveys and gamma walkover surveys provided data that was indicative of background values with a single exception found by the SCM. A localized spot, no greater than 300 cm^2 was found with maximum alpha activity of 3,985 dpm/100 cm^2 and maximum beta activity of 39,118 dpm/100 cm^2. The area of high activity is located on the south side of Building 9, inside and to the right of the exterior door on the south wall.

Based on the results of all surveys within the potentially impacted areas of Building 9 indicating radioactive material in one location based on a survey of 25 percent of the floor and lower wall area, further evaluation, remediation and surveys must be considered. Building 9 is not recommended for unrestricted use.

10.0 REFERENCES

Department of Energy (DOE). 2012. *Visual Sample Plan.* Upgrade version 6.2 released February, 2009. Pacific Northwest National Laboratory.

Millennium Services, Inc. (MSI). 2012. *Basewide Radiological Management Plan Naval Air Station Brunswick Reference Area Survey Results*, July.

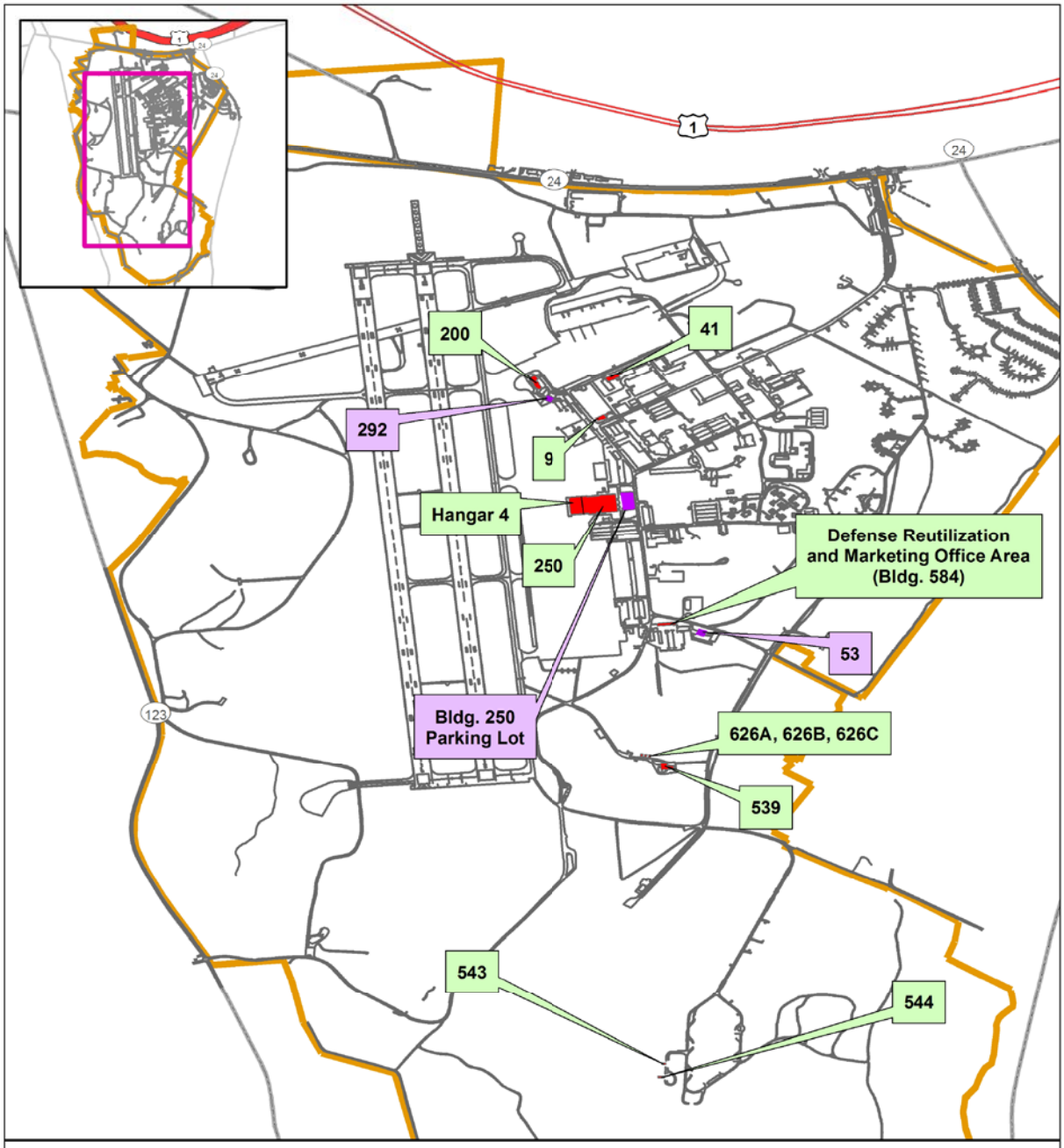
Nuclear Regulatory Commission. 2000. NUREG-1575, *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM), Rev. 1.

Tetra Tech, Inc. (TetraTech) 2012a. *Basewide Radiological Management Plan, Naval Air Station Brunswick, Brunswick, Maine.* April.

Tetra Tech, Inc. (TetraTech) 2012b. *Health and Safety Plan for Basewide Radiological Surveys, Naval Air Station, Brunswick, Maine.* April.

Tetra Tech, Inc. (TetraTech) 2012c. *Historical Radiological Assessment, Naval Air Station Brunswick, History of the Use of General Radioactive Materials, 1943-2011.* April.

FIGURES


1
24
200
41
292
9
Hangar 4
250
Defense Reutilization and Marketing Office Area (Bldg. 584)
53
123
Bldg. 250 Parking Lot
626A, 626B, 626C
539
543
544
Legend
Impacted Buildings
Background Reference Areas*
Major Roads
Limited Access
Highways
Secondary Roads
NAS Brunswick
*Background reference area measurements were also taken in Buildings 200 and 250 and outside of Building 41.
N
0 500 1,000 2,000
Feet
Naval Air Station Brunswick, Maine
Basewide Radiological Surveys
Figure 1: Base Map Showing Impacted Buildings & Background Reference Areas

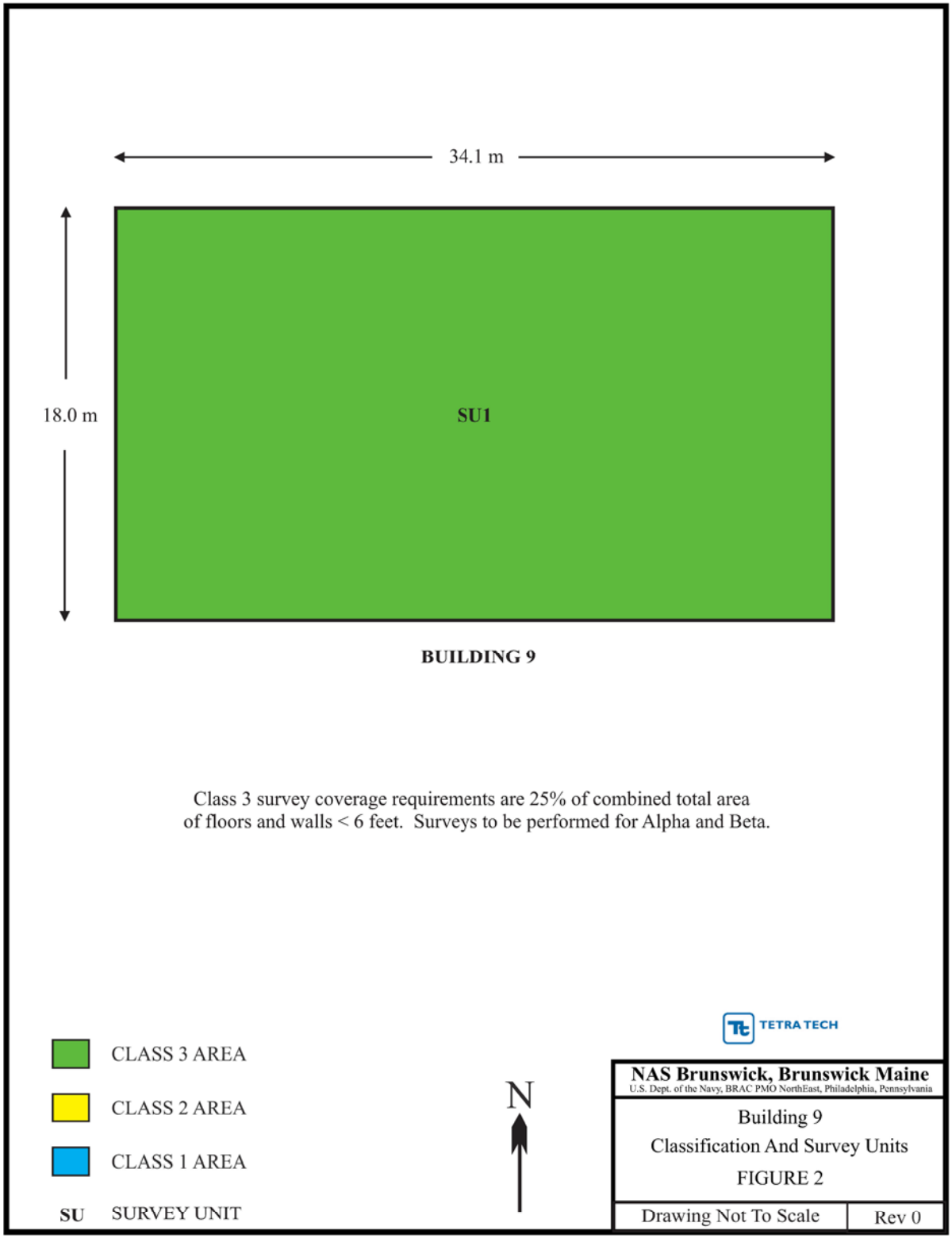

34.1 m
18.0 m
SU1
BUILDING 9
Class 3 survey coverage requirements are 25% of combined total area
of floors and walls < 6 feet. Surveys to be performed for Alpha and Beta.
CLASS 3 AREA
CLASS 2 AREA
CLASS 1 AREA
SU SURVEY UNIT
N
TETRA TECH
NAS Brunswick, Brunswick Maine
U.S. Dept. of the Navy, BRAC PMO NorthEast, Philadelphia, Pennsylvania
Building 9
Classification And Survey Units
FIGURE 2
Drawing Not To Scale
Rev 0

Figure 3 Photographs of area of elevated activity in Building 9

Area of elevated activity bounded by black line

Area elevated activity posted as radioactive material area

TABLES

TABLE 1: AREA CLASSIFICATIONS

Survey Units	Area or Rooms	Class	Area	ROC
SU - 1	Entire Building 9	3	Floors and walls up to 6 feet	H-3, Cs-137, Ra-226, Th-232, U-238

TABLE 2: DETECTION SENSITIVITIES

Survey Type	Detector	Sensitivity *a priori, unless noted* (dpm/100cm^2)	TSP Section
Alpha Scan	SCM	99.5% probability of seeing >=100 dpm/100cm^2	2.7.1
	43-68	96.9% probability of seeing >=1 count in 8 seconds	
Beta Scan	SCM	364 *(for Sr-90)*	2.7.2
	43-68	729 (for Sr-90)	
Alpha Static	SCM	98.3% probability of seeing >=100 dpm/100cm^2	2.8.1
	43-68	64.8	
Beta Static	SCM	529 *(for Sr-90)*	2.8.2
	43-68	545 *(for Sr-90)*	

cm^2	Centimeter squared
dpm	Disintegrations per minute
SCM	Surface Contamination Monitor
Sr-90	Strontium 90
TSP	Task Specific Plan

APPENDIX A
TASK SPECIFIC PLAN

Final

Task Specific Plan
Building 9 Scoping Survey

Naval Air Station Brunswick
Brunswick, Maine

July 2012

Prepared for:
Department of the Navy
Base Realignment and Closure
Program Management Office Northeast
Philadelphia, Pennsylvania

Prepared by:
Tetra Tech, Inc.
661 Anderson Drive, Suite 5
Pittsburgh, Pennsylvania

Prepared under:
Naval Facilities Engineering Command
Contract Number: N62470-08-D-1001
Task Order: WE03

FINAL

TASK SPECIFIC PLAN
BUILDING 9 SCOPING SURVEY

NAVAL AIR STATION BRUNSWICK
BRUNSWICK, MAINE

July 2012

Contract Task Order WE03

Prepared for:
Department of the Navy
Base Realignment and Closure
Program Management Office Northeast
Philadelphia, Pennsylvania

REVIEW AND APPROVAL

Lawson Bailey
Project Manager

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BRAC Environmental Coordinator

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ACRONYMS AND ABBREVIATIONS

α	Alpha
β	Beta
ε_i	Instrument efficiency
ε_s	Contaminated surface efficiency
B	Background count rate
b_i	Number of background counts in scan time interval
d'	Index of sensitivity
E	Detector efficiency
G	Source activity
i	Scan or observation interval
ρ or P	Probability
p	Surveyor efficiency factor
R_B	Background count rate
t	Time interval of detector over source
T_B	Background counting time
T_{S+B}	Sample counting time
W_A	Area of the detector window
$Z_{1-\alpha}$	Type I decision error level
$Z_{1-\beta}$	Type II decision error level
AUW	Advanced Undersea Weapons/Anti-Submarine Underwater Warfare
cm	Centimeter
cm^2	Square centimeter
cm/sec	Centimeter per second
cpm	Count per minute
Cs-137	Cesium 137
dpm	Disintegration per minute
DFW	Definable features of work
ft^2	Square feet
HASP	Health and Safety Plan
HRA	Historical radiological assessment
H-3	Tritium
inch/sec	Inch per second
LBGR	Lower bound of the gray region

MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDC	Minimum detectable concentration
MDCR	Minimum detectable count rate
min	Minute
N	Number of data points
NAS	Naval Air Station
NRC	Nuclear Regulatory Commission
PSPC	Position sensitive proportional counter
RASO	Radiological Affairs Support Office
Ra-226	Radium 226
SCM	Surface contamination monitor
sec	Second
SIMS	Survey Information Management System
SOP	Standard operating procedure
TSP	Task specific plan
Th-232	Thorium 232
U-238	Uranium 238
VP	Patrol Squadron
VPU	Patrol Squadron Special Unit

1.0 INTRODUCTION

This task specific plan (TSP) provides task-specific details for the scoping survey at Building 9 at the Naval Air Station Brunswick (NASB) in Brunswick, Maine. The survey will be conducted in accordance with the general approach and methodologies that are given in the Basewide Radiological Management Plan at Naval Air Station Brunswick (TetraTech 2012a) and standard operating procedures (SOP). The surveys will conform to the requirements of the Health and Safety Plan (HASP) (TetraTech 2012b) prepared for the survey program. No exceptions to the management plan, SOPs, and HASP are noted.

1.1 SITE DESCRIPTION AND HISTORICAL SUMMARY

The MWR CPO Wardroom (Building 9) was used from 2006 to 2011 as a lounge and mess facility for non-commissioned officers. This building was originally built as a laundry facility and later housed the Electronic and Ordnance Shop (1950s - 1960s) and the Patrol Squadron Special Unit (VPU) (1970s-1980s). The building was constructed in 1943 and its area is approximately 8,888 ft2. Historical floor plans for this building were reviewed to determine the locations of operational activities within the building.

This building has no current radiological use; however, as an Electronics and Ordnance Shop, this building was used in the maintenance and repair of electronic components. Although the specific nature of the work performed in this building is unknown, electronics are known to include items with radioactive material. The building was later used by the VPU. VP squadrons flew P-2 Neptune and P-3 Orion aircraft. The Neptune replaced the Orion in 1966 because it was larger, more versatile, and could deliver a more powerful weapon. The VPU likely used this building to house AUW components and for torpedo maintenance and overhaul. Examples of radioactive materials potentially used in this building would be aircraft components, electronics, and instrumentation. Building 9 is currently vacant.

Examples of radioactive material used in Building 9 are those associated with aircraft electronics components and AUW. The specific isotopes of concern identified in the HRA (TetraTech 2012c) are tritium (H-3), cesium 137 (Cs-137), radium 226 (Ra-226), thorium 232 (Th-232) and uranium 238 (U-238).

2.0 SURVEY DESCRIPTION

This survey is being performed to assess if residual activity is above the established release criteria, as defined in Table 6-1 of the management plan (TetraTech 2012a). Surveys of the facility will be performed to determine the existence of isotopes associated with the maintenance of aircraft and weapons instrumentation. Surveys will be performed for the presence of H-3, Cs-137, Ra-226, Th-232 and U-238. Alpha surveys will be performed to determine compliance with release criteria for Ra-226, Th-232 and U-238. Due to the extremely low number of counts in the SCM survey interval associated with the release criteria, positive indications for alpha surveys will be based on exceeding a threshold value in both a primary and recount detector in a

100 cm^2 area. Areas that exceed the investigation criteria based on the activity level determined by the SCM will be investigated.

Beta surveys will be performed to determine compliance with the release criteria for Cs-137. Due to the low energy beta emitted by H-3, compliance with H-3 release criteria will be determined through smears taken at predetermined locations and off site analysis by liquid scintillation methods.

2.1 SURVEY PREPARATION AND REMEDIATION ACTIVITIES

Areas within Building 9 that have flooring material that has been installed since the possible use of radioactive materials will have the flooring removed to expose the concrete surface to conduct the required scan and fixed measurement surveys. Materials containing asbestos will be removed by a certified asbestos abatement contractor. Materials (tile, carpet, cabinets, shelving) will be surveyed for release in accordance with SOP-012, *Release of Materials and Equipment* (see Appendix B of the management plan [TetraTech 2012a]). Materials with radioactivity above the limits specified in Table 6-1 of the management plan will be packaged for storage and subsequent disposal. Materials that cannot be surveyed due to physical size or porosity will be considered potentially radioactive and will be packaged for storage and subsequent evaluation.

Interior walls that have been recently constructed in support of Building 9 function as a lounge and mess area for non-commissioned officers will not be included in the areas to be surveyed.

Survey area preparation activities will be performed under radiological controls established in the SOPs. A listing of applicable SOPs for both preparation and survey activities is provided in Table 1. Surveys conducted in support of area preparation activities can provide input into final reports, but will not be used to demonstrate compliance with the release criteria or determination for additional survey requirements.

2.2 RELEASE CRITERIA

The building surface release criteria for Ra-226 is 100 disintegrations per minute (dpm) per 100 square centimeters (cm^2) total activity, and for Cs-137 is 5,000 dpm/100 cm^2 (TetraTech 2012a). The removable contamination release criteria is one-fifth of the total activity limits (TetraTech 2012a). The limits for the specific radionuclides to be addressed in Building 9 are provided in Table 2. Alpha surveys will be performed to meet the more restrictive criteria for Ra-226. Beta surveys will be performed to meet the release criteria of Cs-137. H-3 limits are 5,000 dpm/100 cm^2 total surface activity, however due to the low energy beta emitted by H-3, detection with surface monitoring is not practical. Smears will be obtained and analyzed at an off-site laboratory for H-3. The release criteria for H-3 will be one fifth of the total activity criteria

2.3 REFERENCE AREA

The reference area will be selected with the concurrence of Navy Radiological Affairs Support Office (RASO). The reference areas for the Building 9 survey will consist of concrete floors and asphalt surfaces. The reference materials will be identified in on-site buildings that have no history of containing radioactive material. The reference area survey data will be obtained prior to final recording of surveys within Building 9 and will be included in the Building 9 survey report.

2.4 INVESTIGATION LEVELS

Investigation levels for the alpha and beta surveys will be equal to 75 percent of the release criteria for the more restrictive isotope of concern in each area to be surveyed.

2.5 SURVEY UNITS AND CLASSIFICATION

Building 9 will be surveyed as Class 3, requiring a 25 percent survey of floor and walls up to 6 feet. The total floor area of the impacted areas of the building is 8,888 square feet or 826 square meters. The building will be surveyed as a single survey unit. A layout drawing indicating building dimensions is provided as Figure 1. Figure 2 provides locations for pre-established direct measurements, removable contamination surveys and gamma dose rate measurements. Since not all carpet and tile was removed to expose original flooring, the process of identifying those locations was limited to original concrete floors. Using a random start point, systematic data collection locations (N) have been laid out in a triangular grid pattern for the survey units using the computer process provided by Visual Sample Plan (Gilbert et al. 2001). The pattern has been adjusted by the computer process so that carpeted and tiled areas are not included. In some cases, the number of data collection locations may exceed N. Locations for data collection are provided in Figures 2. Additional biased surveys will be performed and samples will be collected at accessible points of ventilation systems and drain entrances within the building.

2.6 ESTABLISHING THE NUMBER OF MEASUREMENTS

To determine the number of measurements, N, to be taken per survey unit when the contaminant is not present in background, Equation 5-3 of the management plan (TetraTech 2012a) is used:

Equation 5-3 from the Management Plan (TetraTech 2012a)

$$N = \left(\frac{(Z_{1-\alpha} + Z_{1-\beta})^2}{4(Sign\rho - 0.5)^2} \right)(1.2)$$

Where:

N = Number of data points

$Z_{1-\alpha}$ = Type I decision error level, 1.645

$Z_{1-\beta}$ = Type II decision error level, 1.645

Sign ρ = random measurement probability, 0.945201

1.2 = 20 percent increase in number of samples over the minimum

The values used in the calculation are from Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) guidance (Nuclear Regulatory Commission [NRC] 2000) and are based on a recommended value for the relative shift (Δ/σ) of 1.6 as discussed in Section 5.5.2.2 of MARSSIM (NRC 2000). Type I and Type II decision errors are based on 0.05 false negative and 0.05 false positive rates. The associated Z values are obtained from MARSSIM Table 5.2 (NRC 2000). The random measurement probability, Sign ρ, is from MARSSIM Table 5.4 (NRC 2000).

Using the defined values, the equation becomes:

$$N = \left(\frac{(1.645 + 1.645)^2}{4(0.945201 - 0.5)^2} \right)(1.2)$$

The calculation results in a value of N = 16.38328. Therefore, a minimum of 17 measurements will be obtained in each survey unit.

2.7 ALPHA AND BETA SCAN MEASUREMENTS

Scan measurements are performed to identify elevated areas of radioactivity within the survey unit. Alpha scans will be effective for identifying elevated concentrations of Ra-226, Th-232 and U-238. Beta scans will be effective for identifying elevated concentrations of Cs-137. Twenty five percent of floor and wall surfaces the Class 3 survey units will be scanned with the SCM or the Ludlum 43-68 gas flow proportional detectors coupled to a Ludlum 2221 or 2241. Based on the identified ROCs, the survey unit within Building 9 will be surveyed for alpha and beta activity. All scan surveys will be performed using the Surface Contamination Monitor (SCM).

The SCM utilizes a gas flow position sensitive proportional counter (PSPC). The PSPC functions as any gas flow proportional counter, using P-10 as the counting gas. As in any proportional counter, voltage plateaus are established for the detection of alpha or alpha plus beta particles. High voltage appropriate for the type of particles to be detected is applied to the single anode wire which runs the length of the detector. The SCM computer compares the pulse heights of pulses sensed at each end of the anode wire and establishes the location on the anode wire where the pulsed was sensed. Although the available resolution is greater than 2,000 locations on the anode wire, the SCM computer will "bin" the data in 5 centimeters (cm) wide increments along the length of the wire.

The SCM can be operated in both a dynamic or "rolling" mode or a static or "corner" mode. In the dynamic mode, the system uses a direct current powered drive motor affixed to a cart which

contains all electronics and computer hardware, and a detector (or two) is mounted to the front of the cart. The SCM's design focuses on the elimination of human issues associated with performing surveys of large areas. The system is designed such that surveys are performed at constant speed, the detector held at a set distance from the surface being surveyed, and survey data recorded automatically. In the dynamic mode, a precision wheel encoder is mounted to the cart axle to determine distance traveled by the cart. The encoder can measure to a small fraction of a centimeter and is used to trigger the computer to capture data for every 5 cm of travel of the SCM cart. The result is count data (counts) for every 5 cm "bin" for every 5 cm of travel, or a matrix of 25 cm^2 "pixels" of data. In the static mode, a preset time is applied to the collection of data from a stationary detector. Data is binned in a manner similar to the dynamic mode.

Data is transferred from the SCM to a processing station containing the Survey Information Management Systems (SIMS) software via removable media. SIMS software is used to "stitch" the individual strips of data to create a single survey of an entire area. The data collected in 25 cm^2 "pixels" is summed with adjacent "pixels" in a manner that will result in the evaluation of every possible 100 cm^2 area. When determining activity, each 25 cm^2 "pixel" is 25 percent of four overlapping 100 cm^2 areas. This process ensures that small areas of activity above limits are not missed through grid registration errors.

2.7.1 Alpha Scan Measurements

The limiting alpha emitting ROC is Ra-226. To achieve the sensitivity to detect at the release criteria for Ra-226, the SCM will be used in the recount mode, using two detectors hard mounted to each other at a set distance. The system will be operated at a target speed of 0.5 inch per second (inch/sec) with detection probability of greater than 95 percent at the release criteria value for Ra-226 of 100 dpm/100 cm^2 (TetraTech 2012a). The probability of detecting two counts due to a source is given by Equation 7-4 from the Management Plan (TetraTech 2012a) below.

Equation 7-4 from the Management Plan (TetraTech 2012a)

$$P(n \geq 2) = 1 - \left(1 + \frac{(GE + B)t}{60}\right) e^{\frac{-(GE+B)t}{60}}$$

Where:

$P(n \geq 2)$ = probability of getting two or more counts during the time interval t

t = time interval of detector over source (second [sec])

G = source activity (dpm)

E = detector efficiency (4π)

B = background count rate (count per minute [cpm])

60 = conversion factor, seconds to minutes

Since the detectors associated with the SCM are manufactured to the same specifications, the efficiency of each detector is similar. Therefore, the probability of obtaining two or more counts on each detector as they traverse the same 100 dpm source is the square of the probability for a single detector.

Typical background values observed with the SCM are less than 1 cpm/100 cm^2. Efficiency (4π) of the SCM for alpha emitters has been measured at 25 percent or greater. The efficiency for a point source would be 50 percent. The detector width is 12 cm. Survey speed for alpha emitters is 1.25 centimeter per second (cm/sec) (0.5 inch/sec). Using these parameters, equation 7-5 from the Management Plan (TetraTech 2012a) becomes:

$$P(n \geq 2) = 1 - \left(1 + \frac{(100 * 0.5 + 1)9.6}{60}\right) e^{\frac{-(100*0.5+1)9.6}{60}}$$

Where:

$P(n \geq 2)$ = probability of getting two or more counts during the time interval t

t = 9.6 sec

G = 100 dpm

E = 0.5

B = 1 cpm

Therefore:

$$P(n \geq 2) = 0.9974 \text{ or } 99.74\%$$

The probability of both detectors responding with two or more counts from a point source of 100 dpm at a speed of 1.25 cm/sec (0.5 inch/sec) would be the square of a single detector, or:

$$P(\text{n} \geq 2)_{\text{2 det}} = 99.48\%$$

For areas that are not surveyed with the SCM due to physical constraints, areas will be scanned with the Ludlum 43-68 gas flow detector and a Ludlum 2221or 2241 count rate meter. The surveyor will move the detector at a scan speed of 1.25 cm/sec (0.5 inch/sec) at a height of ¼ to ½ inch above the surface while maintaining audio observation of the instrument. A single count will cause the surveyor to pause and observe the area for an additional eight seconds. The probability of getting a second count from a 100 dpm source if given by MARSSIM equation J-5 (NRC 2000):

MARSSIM Equation J-5 (NRC 2000)

$$P(n \geq 1) = 1 - e^{\frac{-(GE+B)t}{60}}$$

Where:

$P(n \geq 1)$ = probability of getting one or more counts during the time interval t

t = time interval of detector over source (sec)

G = source activity (dpm)

E = detector efficiency (4π)

B = background count rate (cpm)

60 = conversion factor seconds to minutes

Or:

$$P(n \geq 1) = 1 - e^{\frac{-(100*0.25+1)15.2}{60}}$$

Where:

$P(n \geq 1)$ = probability of getting one or more counts during the time interval t

t = 15.2 sec (based on the initial scan interval of 7.2 seconds plus the 8 second recount)

G = 100 dpm

E = 0.25 (4π)

B = 1 cpm

Therefore:

$$P(n \geq 1) = 0.999 = 99.9\%$$

If the surveyor does not observe a second count in the eight second window, the surveyor can continue the scan survey. If a second count is observed during the eight second window, the surveyor will obtain a 60 second count at that location and record the data with the direct measurement surveys for the survey unit.

2.7.2 Beta Scan Measurements

Beta scan surveys will be performed in Building 9. For these beta surveys, the SCM will be the primary instrument. The limiting isotope of concern in the Class 3 area is Cs-137. In Class 3 areas, the SCM will be operated at a target speed of 2 inch/sec (5 cm/sec). For SCM scans for Cs-137 in Class 3 areas, the MDCR from Equation 7-5 of the Management Plan (TetraTech 2012a) is:

$$MDCR = 3.28\sqrt{16.67}\left(\frac{60}{2}\right) = 401\ cpm$$

Where: d' = 3.28

b_i = 16.67 counts (based on 500 cpm background and a 2 sec count interval)

i = 2 sec (based on a scan speed of 5 cm/sec and a detector width of 10 cm.)

and the scan MDC from Equation 7-6 of the Management Plan (TetraTech 2012a) is:

$$Scan\ MDC = \frac{401}{\sqrt{1} * .66 * .5 * \left(\frac{100}{100}\right)} = 1215\ cpm$$

Where: $p = 1$
$\varepsilon_i = .66$
$\varepsilon_s = 0.5$
$W_A = 100\ cm^2$

If necessary, for areas that are not surveyed for Cs-137 with the SCM due to physical constraints, areas will be scanned with the Ludlum 43-68 gas flow detector and a Ludlum 2221 or 2241count rate meter. The detector will be operated on the alpha plus beta plateau. The surveyor will move the detector at a scan speed of 0.5 inch/sec (1.25 cm/sec) at a height of ¼ to ½ inch above the surface while maintaining audio observation of the instrument. The response of the Ludlum 43-68 detector to the beta emissions from Cs-137 is approximately ½ that of the SCM. Background values are similar. The surveyor efficiency factor is 0.5, detector width is approximately 9 centimeters and the active area of the detector is 126 cm^2. For the Ludlum 43-68 detector scans for Cs-137 in Class 3 areas the MDCR and Scan MDC are:

$$MDCR = 3.28\sqrt{24} * \left(\frac{60}{7.2}\right) = 134\ cpm$$

Where: d' = 3.28
b_i = 24 counts (based on 500 cpm background and a 7.2 sec count interval)
i =7.2 sec (based on a scan speed of 1.25 cm/sec and a detector width of 9 cm)

and:

$$Scan\ MDC = \frac{134}{\sqrt{.5} * .33 * 0.5 * (\frac{100}{100})} = 1149\ cpm$$

Where: $p = 0.5$
$\varepsilon_i = .33$
$\varepsilon_s = 0.5$
$W_A = 126\ cm^2$ (areas greater than 100 cm^2 default to 100 cm^2)

2.8 ALPHA AND BETA STATIC MEASUREMENTS

Alpha and beta static measurements will be obtained with both the SCM and the Ludlum 43-68 detector coupled to the Ludlum 2221or 2241 rate meter. The SCM static measurements will supplement the surveys performed in the dynamic or rolling mode when the rolling mode cannot get into areas such as on floors against the wall, or on walls where interferences make rolling surveys impractical. The Ludlum 43-68 detector will be used to obtain fixed measurements at the number of locations identified in Section 2.5.

2.8.1 Alpha Static Measurements

The limiting alpha emitting ROC is Ra-226. Static counts for alpha emitting Ra-226 obtained with the SCM will utilize the detection probability approach similar to that for the SCM in the dynamic or scan method described in Section 2.7. The SCM will use a single detector; however, 2 data acquisitions of 8 seconds each will be obtained at each location. The surveyor will place the detector against the surface to be surveyed and hold it steady for two 8 second counts. Data will be processed by creating 2 separate surveys of an area, the first 8 second count of each static measurement comprising the first data set and the second 8 second count, the second data set. The second data set will be over-laid on the first, and both sets evaluated for each 100 cm^2 area. Those areas in which both sets show a positive value above a prescribed threshold, will be indicative of an area in excess of the release criteria. The process assures that areas greater than the release criteria are detected with greater than 95 percent probability while suppressing false positives due to background. The approach is consistent with that of the SCM in the dynamic mode.

The probability of detecting two counts due to a source is given by Equation 7-4 from the management plan (TetraTech 2012a) below.

Equation 7-4 from the Management Plan (TetraTech 2012a)

$$P(n \geq 2) = 1 - \left(1 + \frac{(GE + B)t}{60}\right) e^{\frac{-(GE+B)t}{60}}$$

Where:

$P(n \geq 2)$ = probability of getting two or more counts during the time interval t

t = time interval of detector over source (sec)

G = source activity (dpm)

E = detector efficiency (4π)

B = background count rate (cpm)

60 = conversion factor, seconds to minutes

Since the same detector will be used to acquire data at each location, all factors are equal for the 2 data sets. Typical background values observed with the SCM are less than 1 cpm/100 cm^2. Efficiency (4π) of the SCM for alpha emitters has been measured at 25 percent or greater. The efficiency for a point source would be 50 percent. The time interval will be 8 seconds. Using these parameters, equation 7-5 from the management plan (TetraTech 2012a) becomes:

$$P(n \geq 2) = 1 - \left(1 + \frac{(100 * 0.5 + 1)8}{60}\right) e^{\frac{-(100*0.5+1)8}{60}}$$

Where:

$P(n \geq 2)$ = probability of getting two or more counts during the time interval t

t = 8 sec

G = 100 dpm

E = 0.5

B = 1 cpm

Therefore:

$$P(n \geq 2) = \ 0.9913 \ \text{ or } \ 99.13\%$$

The probability of both detectors responding with two or more counts from a point source of 100 dpm with a count time of 8 seconds would be the square of a single detector, or:

$$P(\text{n} \geq 2)_{\ 2\ \text{det}} = 98.27\%$$

Therefore, the count time for the SCM in the static mode will be 8 seconds.

Static measurements for alpha emissions in Building 9 area will require a 2 minute count time for the Ludlum 43-68 based on Ra-226. The MDC calculation for the specified count time from Equation 7-8 of the management plan (TetraTech 2012a):

Equation 7-9 from Management Plan (TetraTech 2012a)

$$MDC = \frac{3 + 3.29\sqrt{1 * 2 * \left(1 + \frac{2}{10}\right)}}{0.25 * 0.25 * \frac{100}{100 cm^2} * 2}$$

MDC = 64.8 dpm

Where:

R_B = 1 cpm

T_B = 600 sec or 10 min

T_{S+B} = 120 sec or 2 min

ε_i = 0.25

ε_s = 0.25

W_A = 126 cm^2 (areas greater than 100 cm^2 default to 100 cm^2)

2.8.2 Beta Static Measurements

Static measurement count times for the beta from the limiting ROC, Cs-137, will be 8 seconds for the SCM and 30 seconds for the Ludlum 43-68 with the 2221 or 2241 rate meter. For the SCM surveying for Cs-137, the MDC equation becomes:

$$MDC = \frac{3 + 3.29\sqrt{500 * .133 * (1 + \frac{.133}{.133})}}{.66 * .5 * \left(\frac{100}{100}\right) * .133} = 932\ dpm$$

Where: R_b = 500 cpm

T_{s+b} = 8 sec. or .133 min

T_b = 8 sec. or .133 min

ε_i = 0.66

ε_s = 0.5

W_A = 126 cm^2 (areas greater than 100 cm^2 default to 100 cm^2

For the Ludlum 43-68 surveying for Cs-137, the equation becomes:

$$MDC = \frac{3 + 3.29\sqrt{200 * .5 * (1 + \frac{.5}{.5})}}{.33 * .5 * \left(\frac{100}{100}\right) * .5} = 600\ dpm$$

2.9 GAMMA WALKOVER SURVEYS

Gamma walkover surveys will be conducted in each survey unit with a 2" by 2" sodium iodide detector and a Ludlum 2241 ratemeter. Gamma readings will be obtained in accordance with Section 8.2.2 of the Basewide Radiological Management Plan (TetraTech 2012a).

2.10 REMOVABLE CONTAMINATION SURVEYS

Removable contamination will be assessed by swiping a Masslin cloth on a suspect area and monitoring the swiped cloth with a Ludlum 43-68 detector coupled to a Ludlum 2221 or 2241 detector. Since both alpha and beta emitting nuclides are present, detectors will be operated on the both the alpha plateau then on the alpha plus beta plateau. Areas in which the first swipe of the Masslin cloth indicates any increase in activity will be re-wiped with the Masslin cloth to determine the specific area that contains removable contamination. Swipe surveys will be conducted at any area indicating activity above background. Swipe surveys will also be conducted in at least one location within each 1,000 square feet (ft^2) in a Class 3 survey unit, and at each floor and sink drain. Swipe surveys will also be performed at each of the systematic data collection locations. All swipe surveys will be counted using a Ludlum 2929 detector. Swipe surveys will be performed and documented in accordance with SOP-006, *Radiation and Contamination Surveys* (see Appendix B of the management plan [TetraTech 2012a]).

In addition to swipes to determine the presence of alpha and beta emitting radionuclides, swipes will be taken at the systematic data collection points and drains in Building 9 for the presence of H-3. The swipes will be wetted with distilled water prior to survey. Tritium swipes will be sent to an off-site laboratory for analysis using liquid scintillation methods.

2.11 MEDIA SAMPLES

Samples will be collected if sediment is found in sumps, floor drains, and sink drains to support evaluation of compliance with release criteria and to determine specific nuclides as necessary. Sampling may also be performed as an integral part of investigations to determine the cause of elevated measurements. Samples will be collected in accordance with SOP-009, *Sampling Procedures for Radiological Surveys* (see Appendix B of the management plan [TetraTech 2012a]), and submitted to an off-site laboratory for radiological analysis. One sediment sample per drain will be collected if sediment is present. Analysis of results will be evaluated against soil criteria identified in Table 2.

Media samples will also be obtained at any accessible building outfall locations that would contain liquid runoff from Building 9.

3.0 SITE RESTORATION

Site restoration work is not required at the conclusion of surveying in Building 9.

4.0 BUILDING 9 REPORT

Results of the survey that demonstrate that no single measurement indicating activity greater than the release criteria, and the resultant risk based dose as calculated, will be presented in a survey report. Any conclusion other than a recommendation for unrestricted release will be presented in a Characterization Report.

5.0 QUALITY CONTROL

The data quality objectives for the survey are provided in Table 3.

Definable features of work (DFW) establish the measures required to verify both the quality of work performed and compliance with project requirements. The DFW for this task is radiological surveys. Description of this DFW and the associated phases of quality control are presented in Table 4.

6.0 ENVIRONMENTAL PROTECTION

Environmental protection requirements are addressed in the management plan (TetraTech 2012a).

7.0 REFERENCES

Department of Energy (DOE). 2012. *Visual Sample Plan.* Upgrade version 6.2 released February, 2009. Pacific Northwest National Laboratory.

Gilbert, R., and others. 2001. Visual Sample Plan. Upgrade version 5.9 released October 29, 2009. Pacific Northwest National Laboratory. Principal authors of Version 5.9 Pulsipher, Wilson, and others.

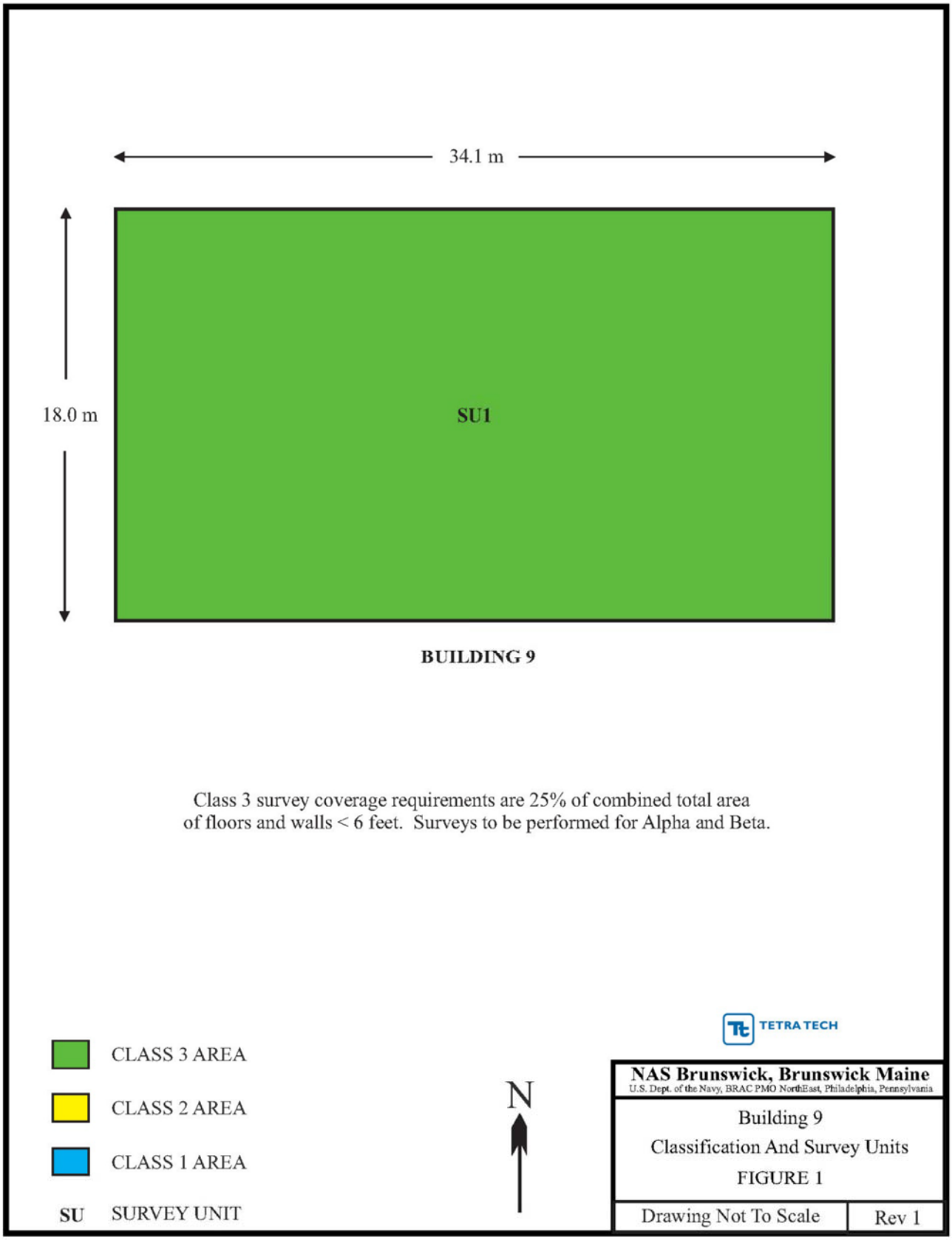
Nuclear Regulatory Commission (NRC). 2000. NUREG-1575, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM),* Rev. 1.

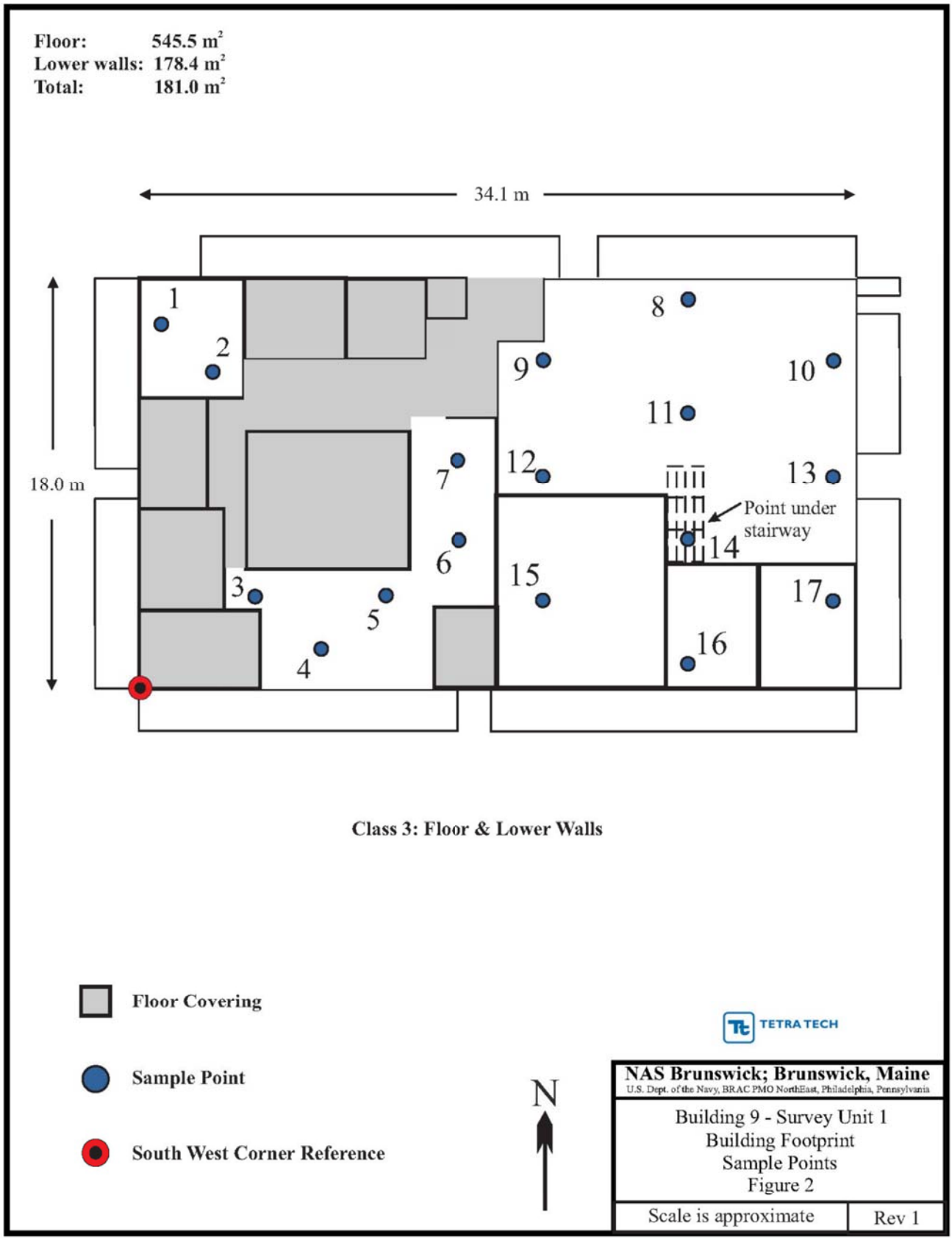
Tetra Tech, Inc. (TetraTech) 2012a. *Basewide Radiological Management Plan, Naval Air Station Brunswick, Brunswick, Maine.* April.

Tetra Tech, Inc. (TetraTech) 2012b. *Health and Safety Plan for Basewide Radiological Surveys, Naval Air Station, Brunswick, Maine.* April.

Tetra Tech, Inc. (TetraTech) 2012c. *Historical Radiological Assessment, Naval Air Station Brunswick, History of the Use of General Radioactive Materials, 1943-2011.* April.

FIGURES


34.1 m
18.0 m
SU1
BUILDING 9
Class 3 survey coverage requirements are 25% of combined total area of floors and walls < 6 feet. Surveys to be performed for Alpha and Beta.
CLASS 3 AREA
CLASS 2 AREA
CLASS 1 AREA
SU SURVEY UNIT
N
TETRA TECH
NAS Brunswick, Brunswick Maine
U.S. Dept. of the Navy, BRAC PMO NorthEast, Philadelphia, Pennsylvania
Building 9
Classification And Survey Units
FIGURE 1
Drawing Not To Scale
Rev 1


Floor: 545.5 m²
Lower walls: 178.4 m²
Total: 181.0 m²
34.1 m
18.0 m
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
Point under stairway
Class 3: Floor & Lower Walls
Floor Covering
Sample Point
South West Corner Reference
N
TETRA TECH
NAS Brunswick; Brunswick, Maine
U.S. Dept. of the Navy, BRAC PMO NorthEast, Philadelphia, Pennsylvania
Building 9 - Survey Unit 1
Building Footprint
Sample Points
Figure 2
Scale is approximate
Rev 1

TABLES

TABLE 1 BUILDING 9 APPLICABLE STANDARD OPERATING PROCEDURES

Procedure	Title	Rev
SOP 002	Radiation Work Permits	0
SOP 004	Project Dosimetry	0
SOP 006	Radiation and Contamination Surveys	1
SOP 007	Preparation of Portable Radiation and Contamination Survey Meters for Field Use	0
SOP 008	Air Sampling and Sample Analysis	0
SOP 009	Sampling Procedures for Radiological Surveys	0
SOP 010	RCA Posting and Access Control	0
SOP 011	Control of Radioactive Materials	0
SOP 012	Release of Materials and Equipment	0
SOP 016	Decontamination of Equipment and Tools	0
SOP 022	Radiological Clothing Selection, Monitoring and Decontamination	0
SOP 023	Source Control	0
SOP 024	Occurrence Reporting	0
RP-OP-017	Operation of the Ludlum Model 2929 Dual Scaler	0
RP-OP-025	Operation of the Ludlum Model 2221	0
RP-OP-026	Operation of the Ludlum Model 19	0
SCM-OPS-01	Position Sensitive Proportional Counters Purging	0
SCM-OPS-02	Position Sensitive Proportional Counters Plateau Determination	0
SCM-OPS-03	Position Sensitive Proportional Counters Position Calibration	1
SCM-OPS-04	Encoder Calibration	0
SCM-OPS-05	Position Sensitive Proportional Counters Efficiency Calibration	0
SCM-OPS-06	Position Sensitive Proportional Counters Quality Assurance	1
SCM-SETUP-01	Position Sensitive Proportional Counters Repair	0
SCM-SETUP-02	Hardware Setup	0
SCM-SETUP-03	Quality Assurance Testing of SCM	0

TABLE 2 BUILDING 9 PRIMARY RADIATION PROPERTIES AND RELEASE CRITERIA FOR RADIONUCLIDES OF CONCERN

Radionuclide	Primary Radiation Properties		Release Criteria[a]				
			Materials & Equipment		Building Surfaces		Soil[b]
	Half-Life	Type	Total Surface Activity	Removable Activity	Total Surface Activity	Removable Activity	Activity (pCi/g)
H-3	1.23E01 years	Beta	5,000	1,000	5,000	1,000	66
Cs-137	3.01E01 Years	Beta	5,000	1,000	5,000	1,000	6.6
Ra-226	1.60E03 years	Alpha	100	20	100	20	1
Th-232	1.41E10 years	Alpha	1,000	200	1,000	200	0.66
U-238	4.47E09 years	Alpha/Beta	5,000	1,000	5,000	1,000	8.4

Notes:

a Units are disintegrations per minute per 100 square centimeters, unless otherwise specified.
b Criteria is above background for those radionuclides found in background soils.

Cs-137 Cesium 137
H-3 Tritium
Ra-226 Radium 226
Th-232 Thorium 232
U-238 Uranium 238

Source: TetraTech 2012a. Basewide Radiological Management Plan, Naval Air Station Brunswick, Brunswick, Maine. April.

TABLE 3 SUMMARY OF DATA QUALITY OBJECTIVES

STEP 1 Statement of Problem	STEP 2 Decisions	STEP 3 Inputs to the Decisions	STEP 4 Boundaries of Study	STEP 5 Decision Rules	STEP 6 Limits on Decision Errors	STEP 7 Optimizing the Sampling Design
Building 9 is listed in the HRA as an area impacted by radiological activities. The isotopes of concern are H-3, Cs-137, Ra-226, Th-232, and U-238. It must be determined if the site-specific release criteria for these isotopes have been met or if remediation or further survey is warranted.	The primary use of the data expected to result from completion of this TSP is to support the Scoping Survey of Building 9. Therefore the decision to be made can be stated as "Do the results of the survey indicate activity above background or meet the release criteria?"	Radiological surveys required to support the Final Status Survey of Building 9 will include: • 25 percent scan surveys of Class 3 areas • A minimum of 17 systematic static measurements will be performed in Class 3 areas • One swipe per 1,000 square feet in Class 3 survey units • One sediment sample will be collected from each drain if available. • One swipe at each systematic sample location • One tritium swipe at each systematic location in Building 9.	The lateral and vertical spatial boundaries for this survey effort are confined to the interior portions of Building 9.	If the concentration of radioactivity on building surfaces, paved areas, or in sediment samples is less than the release criteria, then no further measurements are required. If the results of the survey exceed the release criteria, then the building will be investigated further.	Limits on decision errors are set at 5 percent as specified in the management plan (TetraTech 2012a).	Operational details for the radiological survey process have been developed. The theoretical assumptions are based on guidelines contained in MARSSIM (NRC 2000). Specific assumptions regarding types of radiation measurements, instrument detection capabilities, quantities and locations of data to be collected, and investigation levels are contained in this TSP and the management plan (TetraTech 2012a)

Notes:

Cs-137	Cesium 137	Ra-226	Radium 226
H-3	Tritium	Th-232	Thorium 232
HRA	Historical Radiological Assessment	TSP	Task Specific Plan
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual	U-238	Uranium 238
NRC	Nuclear Regulatory Commission		

TABLE 4 DEFINABLE FEATURES OF WORK FOR RADIOLOGICAL SURVEYS

ACTIVITY	PREPARATORY (Prior to initiating survey activity)	DONE	INITIAL (At onset of survey activities)	DONE	FOLLOW-UP (Ongoing during survey activities)	DONE
Radiological Surveys	• Verify that an approved TSP is in place. • Verify that the Remedial Project Manager and the Caretaker Site Office are notified about mobilization. • Verify that an approved Radiation Work Permit, if required, is available and has been read and signed by assigned personnel. • Verify that the management plan, HASP and TSP, have been reviewed. • Verify that personnel assigned are trained and qualified. • Verify that personnel have been given an emergency notification procedure. • Verify that workers assigned dosimeter have completed NRC Form 4. • Verify that relevant SOPs are available and have been reviewed for equipment to be used. • Verify that equipment is on site and in working order (initial daily check).		• Verify that radiological instruments are as specified in the management plan (TetraTech 2012a) and TSP. • Inspect Training Records. • Verify that reference area measurements have been obtained in accordance with the management plan (TetraTech 2012a). • Verify that daily checks were performed on all survey instruments. • Verify that instrument calibration and setup are current. • Verify that required dosimeter is being worn. • Verify that field logbooks and proper forms are in use. • Verify that samples and measurements are being collected in accordance with the TSP, management plan and applicable SOPs. • Verify the sample handling is in accordance with the management plan (TetraTech 2012a) and applicable SOPs.		• Verify that the site is properly posted and secured. • Conduct ongoing inspections of material and equipment. • Verify that daily instrument checks were obtained and documented. • Verify that survey results were documented. • Inspect chain-of-custody and survey logs for completeness. • Verify that survey activities conform to the TSP. • Verify that survey instruments are recalibrated after repairs or modifications.	

Notes:

HASP Health and Safety Plan
NRC Nuclear Regulatory Commission
SOP Standard Operating Procedure
TSP Task Specific Plan

APPENDIX B
REFERENCE AREA REPORT

Basewide Radiological Management Plan
Naval Air Station Brunswick
Reference Area Survey Results

July 2012

Prepared By:

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222 Creekstone Ridge
Woodstock, GA 30188

1.0 Introduction

This report of reference area survey results (RASR) provides site- and material-specific details used to establish reference point survey values (background) for the final status survey (FSS) at each area surveyed at the former Brunswick Naval Air Station (NASB). The reference surveys were conducted in accordance with the general approach and methodologies that are given in the management plan for basewide radiological surveys at NASB (TetraTech 2012a) and in the standard operating procedures (SOP). The surveys conformed to the requirements of the site health and safety plan (HASP) (TetraTech 2012b) prepared for the basewide survey program. No exceptions to the management plan, SOPs or HASP are noted.

2.0 Discussion

Release criteria for the survey sites at NASB are established in the approved management plan (TetraTech 2012a)) and the individual task specific plans (TSP). Applicable release criteria for each site surveyed are applied to observations of radioactive activity levels to determine a site's acceptability for free release. Observed activity values are based on activity levels in excess of background radioactivity. To establish background values, a reference area must be identified that consists of construction materials similar to those in the facilities surveyed, but with no potential for contamination from use or storage of radioactive material.

Reference areas are typically chosen as locations that contain the same materials of construction as those that will be encountered at the areas to be surveyed for release and that have no history that would indicate use of radioactive materials. Data are collected in the reference areas using the same instrumentation that will be used in the impacted areas. Building or outdoor paved surfaces are surveyed with alpha- or beta-sensitive instruments to achieve the required sensitivity to show compliance with release criteria. Survey instruments will respond to several inputs during the reference area surveys. First, and of most concern, is the natural radioactivity in the surface material. Second is cosmic and terrestrial radiation. Although instruments may be operated so as to have minimal response to gamma or X-ray radiations, the response is not zero. Finally, radon and radon progeny may affect surface measurements inconsistently based on location and weather-related parameters. Although cosmic and terrestrial radiations and the impact of radon and its progeny must always be considered, the variability of natural activity in the construction material provides the greatest challenge in establishing reference area data.

NASB presents a challenge in defining a reference background for the survey of the potentially impacted buildings. The amount of natural activity, the decay chain of natural uranium and natural thorium due to the amount of uranium bearing granite in the rock structure of Maine is significantly higher than that found in other parts of the United States. Initial set up of equipment to be used in performance of the surveys indicated higher background exposure rates than found at similar surveys performed recently. Specifically, exposure rate measurements in the range of 14 to 15 μR/hr were noted in areas external to Buildings 200 and 250. Readings as high as 17 to 18 μR/hr were noted on the concrete taxiways adjacent to the NASB runways, extending to the hangar facilities. The higher readings appear to be due to the high density concrete used in the taxiways. In comparison, exposure rates of 5 to 7 μR/hr were observed during at a recent survey at a former naval air station in California.

The presence of higher levels of natural uranium and its progeny present several issues in determining a reference area background value to apply to surveys intended to determine compliance with release criteria. The first issue is related to the amount of beta or alpha particles emitted per unit time from the surface of the material. Concrete or asphalt surface emission rates will be dependent on the source of the aggregate used and the surface treatment. For example, painted or sealed concrete will display a lower emission rate than bare concrete. Since concrete foundations, even for those facilities constructed at the same time, can be supplied with aggregate from different locations and the surface emission rate can vary greatly. Similarly, non-impacted asphalt surfaces can present great variability in background emission rate. Other materials of construction, such as wood, steel, and drywall do not contain natural radioactivity and therefore are not affected by material surface emission rate.

The second issue affecting the determination and use of a reference area background value is related to the radon gas generated within the uranium decay chain. Radon is a radioactive inert gas. Because it is inert, it will migrate out of the uranium bearing materials of construction, either concrete or asphalt. Within buildings, the radon gas and its progeny, both alpha and beta emitting nuclides, will build up to high concentrations. Radon will stay in the atmosphere, however the progeny, existing as particulates, will tend to fall out on surfaces. Both radon in the atmosphere and the progeny on the surfaces will impact the response of survey instrumentation. Ventilation of buildings, or rooms within buildings, will reduce the impact of the radon. However, the amount of impact will vary based on the how well areas can be ventilated. As an example, large hangar areas are not well ventilated by floor fans, but rely on opening large hangar bay doors and outside weather conditions. On clear, windy days, the ventilation process can be effective. However, on calm, overcast days with little air movement, and a possible atmospheric inversion, the ventilation effort can have a minimal effect. Removal of radon progeny from surfaces will also vary greatly based on the ventilation method and the porosity of the surface material. For example, forced air flow with large fans on hard surfaces will remove most of the radioactive progeny. However, little is removed from porous material such as acoustic ceiling tile.

The issues discussed above result in a challenge to establish reference area background values to be applied to each of the materials of construction involved in the potentially impacted areas at NASB. High emission rates from materials of construction such as concrete or asphalt alone could be addressed and would result in longer count times or slower scan speeds to achieve the required Minimum Detectable Concentrations. The variability resulting from the existence of both radon gas in the atmosphere and radon progeny on surfaces creates a unique circumstance that has been addressed through applications available through the use of the Surface Contamination Monitor/Survey Information Management System (SCM/SIMS).

Surveys at the former NASB consist of alpha and beta surface surveys and gamma walkover surveys. Alpha and beta surface surveys were performed using gas proportional counters, consisting of both the Surface Contamination Counter (SCM), which uses large Position Sensitive Proportional Counters (PSPC), and the Ludlum 43-68, 126 square-centimeter (cm^2) probe attached to a Ludlum 2221 rate meter. The gamma walkover surveys were performed using an unshielded 2" x 2" sodium iodide (NaI) detector coupled to a Ludlum 2241-2 data logger.

For alpha and beta surface surveys, the SCM is designed to record a large number of measurements, 400 measurements per square meter. The number of measurements allows for detailed analysis of a survey area with specific view of the distribution of radioactive measurements and identification of outliers. The use of SCM/SIMS to determine the distribution of beta emission from a surface is discussed in the following.

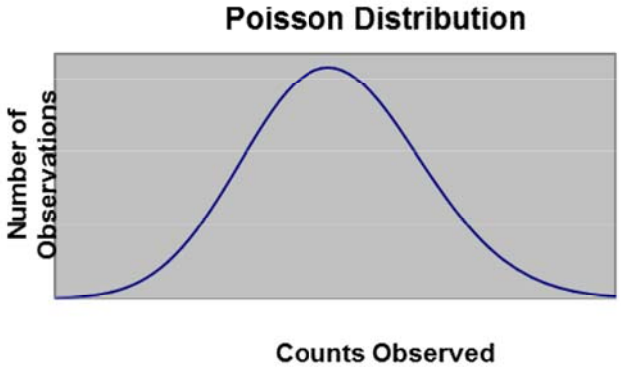
Beta Surveys – SCM/SIMS

Several key issues must be recognized to understand the process used by SCM/SIMS for beta surveys. First, the process of radioactive decay follows well-defined statistics, Poisson statistics, represented by the following equation:

$$P(x;\mu) = e^{-\mu} \mu^{x} / x!$$

Where P represents the probability of observing x counts when the average number expected is μ. As an example, if the surface emission detected by an instrument was 600 counts per minute (cpm), the average counts per second would be 10. A 4-second count would be expected to yield an average of 40 counts. Graphically, the data can be displayed as shown in the Figure 1. The x axis represents the number of counts observed during a 4-second interval, and the y axis represents the number of times those counts are observed. The peak, representing the average value, is 40 counts. The graph appears in several references, including the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM).

Figure 1



The data can also be displayed as a cumulative frequency distribution (CFD). The CFD plots can be generated using several available math programs. CFD generation is included in the SIMS software. In Figure 2, representing the same data as displayed in Figure 1, the x-axis represents counts obtained, and the y axis is a log scale percentage of measurements that equal or exceed each value on the x axis.

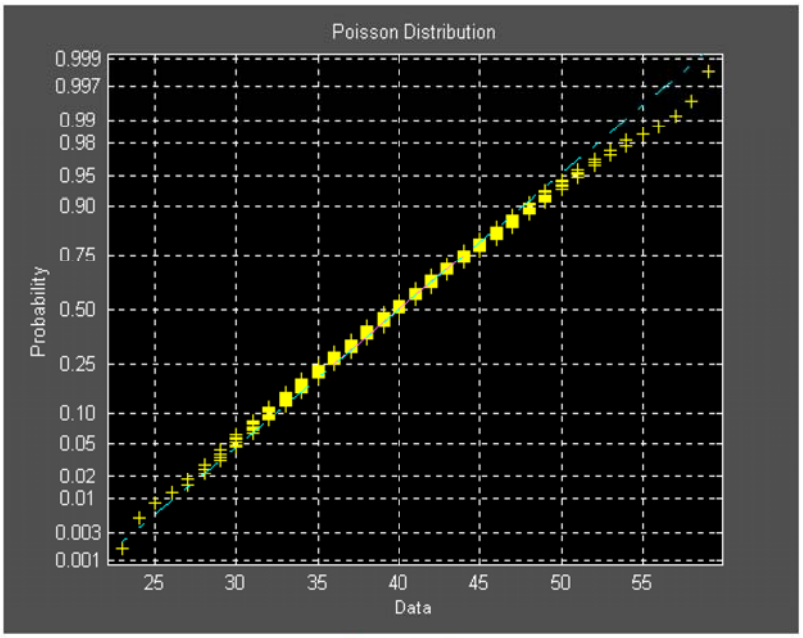


Figure 2

The graph shows a straight line function with a slight shoulder at the upper values, representing a normal distribution function (Poisson distribution). If a surface consisted of material that was homogenous and contained a uniform distribution of radioactivity, random spatial measurements would yield a similar result. A large number of short measurements at random locations on the surface would result in data showing a straight line function on a cumulative frequency plot (with a slight shoulder at the upper values). The mean value from the plot (50 percent value) would represent the average value associated with measurement data. One standard deviation can be read from the graph at the probability values of 16 and 84. The standard deviation for this data set is ±6 counts.

The CFD process is designed to evaluate whether a data set is distributed normally and if there are any outliers. The numerical value of the mean will differ from building to building, and even within buildings that are not associated with a single continuous pour. The standard deviation of a series of measurement will be affected by the magnitude of the count rate. A section of concrete surveyed with a detector residence time of 8 seconds will have greater counts than if it were surveyed with a 4-second residence time. The higher counts obtained will result in a smaller standard deviation, in turn resulting in a higher slope (more upright) to the CFD. The normal distribution will again be represented by a straight line with a slight shoulder at the upper end.

Concrete and asphalt undergo a mixing process before they are poured that greatly homogenizes the material. The initial pour will uniformly distribute the components, sand and aggregate. SCM surveys, performed in even small areas, will produce a large number of measurements. The SCM survey process produces 400 measurements per square meter, so that surveys of even a few square meters will produce thousands of measurements. The large number of measurements provides the necessary input to create meaningful CFDs, assessing the normalcy of the

distribution and identifying outliers if present. A normal CFD defines background radioactivity. The only constant regarding non-contaminated concrete or asphalt is that there will be a normal distribution of surface activity measurements with no outliers. That is the definition of background.

Alpha Surveys – SCM Surveys

Alpha surveys are particularly difficult because of the small count rate associated with the release criteria of most alpha-emitting radionuclides. A few counts above background will frequently challenge the criteria. Alpha background, as with beta background described above, is not a constant, but varies with Poisson statistics. The primary challenge to any alpha survey with any instrumentation is the suppression of false positives created by background variability. False positives require further investigation with longer count times, resulting in prolonged survey time and costs.

False positives caused by background become prevalent and are the critical factor with which to contend in alpha surveys with low release criteria. Surveys for alpha-emitting radionuclides at NASB are performed with the SCM using a dual survey process that incorporates a second recount detector in the dynamic mode and a second data acquisition in the static mode. SIMS processing of the data is focused on suppressing false positives while providing a high degree of confidence that a source at the activity of the release criteria will be identified. Background subtraction is not incorporated in the SCM/SIMS process.

The sensitivity of any system to detect low concentrations of alpha-emitting radionuclides is expressed in probability of detection based on particle detection theory. The process is described in Section 6.7.2.2 of MARSSIM with additional discussion in Appendix J. SCM surveys for alpha-emitting radionuclides are performed in the detector recount mode, as stated earlier. The increase in alpha background count rates at the NASB facilities necessitates increasing the threshold to 3 counts (3 or more counts). The probability of detecting a source by obtaining three or more counts in a 100 cm^2 area from a source is given by:

$$P(\geq 3) = 1 - [e^{\frac{-(GE+B)t}{60}} * (1 + \frac{(GE+B)t}{60} + \left(\frac{(GE+B)t}{60}\right)^2/2)]$$

Where:

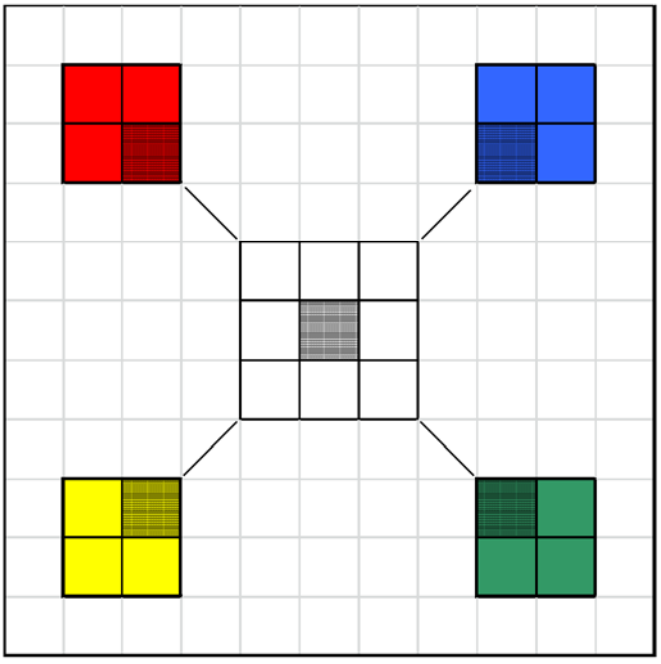
$P(n\geq3)$ =	Probability of getting three or more counts in the survey time interval
G =	Source activity in dpm
E =	Detector efficiency (4π)
B =	Background in cpm
t =	Time over source in seconds

Using the release limits and radionuclides of concern (ROCs) at NASB, the source activity for alpha (G) is 100 dpm. The detector efficiency E is based on a point source. Point source

geometry is appropriate since the physical size of 100 dpm of radium 226 (Ra-226) is minute. The specific activity of Ra-226 is 1 Curie per gram. Therefore, 100 dpm of Ra-226 is equal to 4.5×10^{-12} grams, and the mass equivalent of 100 dpm of Ra-226 would be best represented by a point source.

A point source would be under the detector for two data acquisitions (each occurring during 5 cm of detector travel) according to the process the SCM uses to record data; hence, the SCM will "double count" the source. SCM processing will then add the two adjacent pixels as shown below in Figure 3. The SCM provides data to SIMS in areas of 25 cm^2. SIMS sums each 25 cm^2 "pixel" of data with each combination of adjacent 25 cm^2 areas to create all possible 100 cm^2 areas within the area surveyed. Figure 3 show the process employed by SIMS.

Figure 3



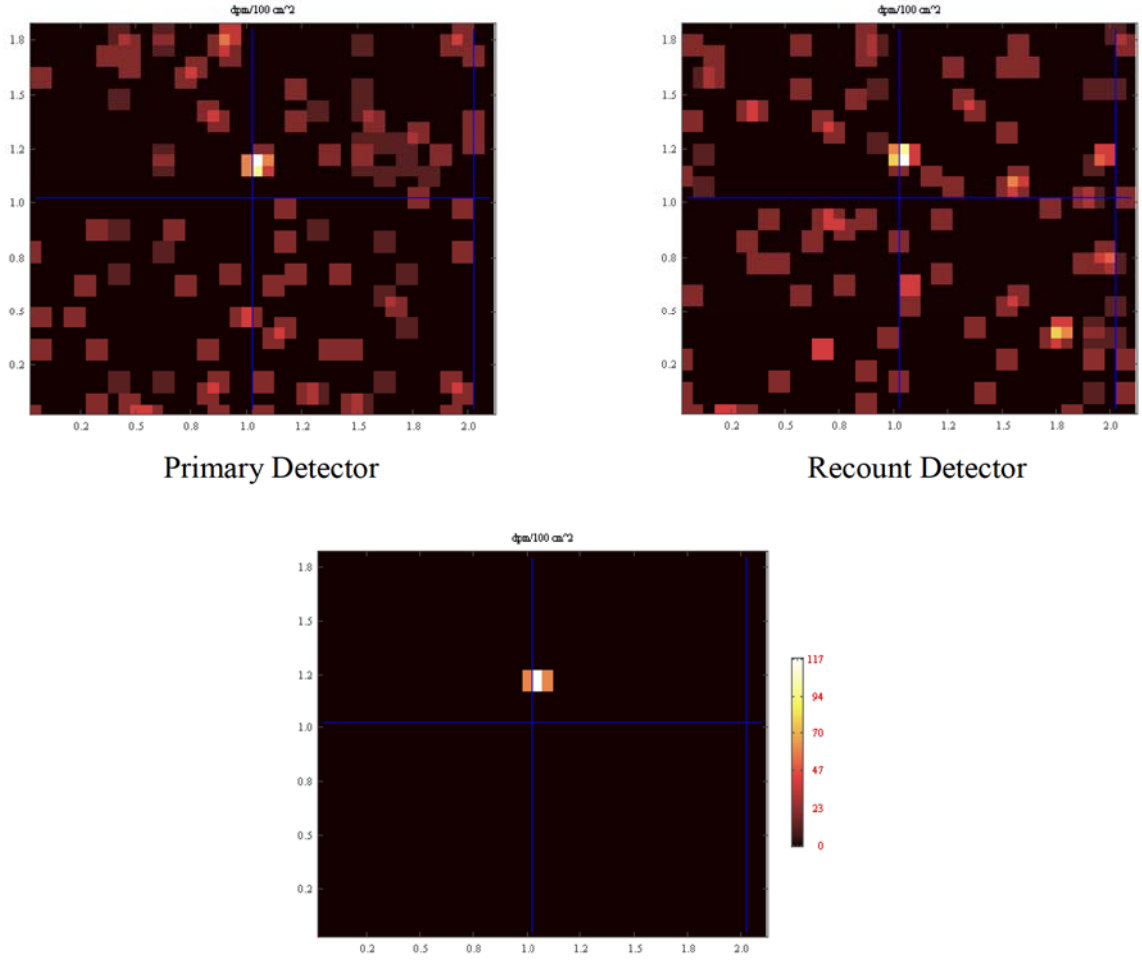
When determining maximum activity, each 25 cm^2 pixel is actually 25 percent of four overlapping 100 cm^2 areas. The result of the SCM/SIMS process is that the efficiency will be doubled for a point source. Typical 4π alpha efficiency for distributed sources for the SCM is approximately 25 percent. The effective efficiency for a point source would be approximately 50 percent. All SCM efficiencies for both the dynamic and static modes determined at NASB exceeded 50 percent. A conservative value of 50 percent has been applied throughout the NASB survey.

Although typical alpha background that has been recorded with the SCM at locations throughout the United States at approximately 1.0 cpm/100 cm^2, measurements at NASB were in the range of 4 to 5 cpm/100 cm^2. The time over the source will be the equivalent of two acquisition cycles of 5 centimeters (cm) each. At 1.25 cm/second (cm/sec) survey speed, the time over the source would be 8 seconds, for 10 cm / 1.25 cm/sec.

Based on the probability equation above, a single detector will record at least three counts while traversing a 100 dpm Ra-226 source 97.7 percent of the time. Both detectors will record at least three counts 95.5 percent of the time (square of a single detector probability). Figure 4 contains 2-dimensional color graphic display of an SCM survey of a source of approximately 100 dpm. Background is not subtracted from the primary or recount detector. Background counts are observed as randomly distributed throughout the survey area. Since the two detectors are hard mounted with a known offset, the two images can be superimposed so each represents the same area surveyed. The coincidence logic applied by the SIMS computer process evaluates each 100 cm^2 area of each detector. Those in which the number of counts does not exceed the threshold

value in both detectors have a null value in the associated area in the coincidence survey. Calculations are performed for those that exceed the threshold value in both detectors based on the total counts from both detectors and the total time of survey from both detectors. The detector efficiency is then applied to determine the activity within that 100 cm^2 area. The survey area is approximately 4 square meters with a total of 1,600 individual measurements.

Figure 4



Primary Detector

Recount Detector

Coincidence Logic

SIMS evaluation of the survey identified a source of 118 dpm at the location shown (X= 105 cm, Y= 120 cm from the southwest corner of the survey area). More critical is the elimination of false positives through use of "two out of two" logic. Elimination of false positives due to elevated background is the critical aspect of alpha surveys expected to locate areas of radioactivity as low as 100 dpm/100 cm^2.

Using the probability of detection equation above, setting the source value to zero, maintaining the background at 5 cpm, and holding the efficiency at 50 percent and maintaining a survey speed at 0.5 inch per second (t = 8 seconds), a single detector will record at least three counts from background 3 percent of the time. Both detectors recording at least three counts in the

same 100 cm^2 area as a result of background will occur 0.009 percent of the time. This low false positive rate allows for efficient surveys with a limited number of resultant investigations. Use of larger area detectors without position sensitivity or the ability to apply the coincidence logic will result in a large increase in the false positive rate. For example, alpha scans of an area with a 582 cm^2 detector on a surface with an average background count rate of 5 cpm/100 cm^2 will result in more than 2 counts per detector interval of 78 percent. A false positive that requires an investigation will occur almost every detector width scanned. The primary issue in scanning surfaces for low level alpha contamination is the elimination of false positives.

Gamma Walkover – NaI Surveys

The variability of gamma exposure rate from the various surfaces at NASB is discussed in Section 2. The variability is amplified by changes in the weather conditions as well as the ability to ventilate indoor areas that have been closed up for long periods. The normal approach would be to determine an area similar to those areas that are potentially impacted and perform a walkover survey of that area. Evaluation of the reference area data to determine mean value and standard deviation would allow for the determination of an investigation criteria. That criteria is typically the mean plus 3 standard deviations (3σ). However, the variability from area to area and even from day to day in the same area due to the high and variable concentration of the natural uranium in concrete aggregate, radon gas and radon progeny does not allow for establishment of a single reference area and investigation criteria for the NASB surveys.

Therefore, a more practical approach of applying the mean plus 3σ investigation criteria to the data set developed within each survey unit was determined to be the most reasonable approach. The approach will meet the objectives of determining if there are any locations within a survey unit that may have gamma emitting nuclides either subsurface, behind walls or in pipe and cable chases that may not be detected by surface alpha and beta surveys.

3.0 Methodology

The process of establishing reference areas for both alpha and beta background values on various materials of construction followed the general principals defined in MARSSIM, with additional confirmation of the suitability of the area with the SCM. Initial efforts included the determination of the various surfaces that would require survey. The materials include bare concrete, painted concrete, painted concrete block, drywall, wood, steel, floor tile, and instrument maintenance countertops. With surveys commencing in Hangar 4 and Building 250, a building that was constructed at the same time containing many of the materials was identified as the fire station, Building 292. Appendix A contains photographs of the building and the interior areas used for the various materials of construction. Materials not available in Building 292 included tile floors and drywall. Since neither material contains natural radioactivity, the specific time of construction of a reference area was not important. The Public Works Building, Building 53, was chosen for tile flooring and drywall. The interior areas of Building 53 used for reference surveys are shown in Appendix A. In each location and for each material of construction, a SCM survey for beta emitting nuclides was performed. Surveys were performed at the same survey speed and source to detector distance as those used to perform potentially impacted area surveys. The processed survey results from each surface material were evaluated to ensure that the CFD represented a normal distribution with no outliers. The areas were marked for identification as background determination areas.

Once an area was established as containing normally distributed radioactivity, hand held instrument measurements were performed within the bounds of the areas surveyed by the SCM. For each hand held instrument, a series of 10 one minute counts at various locations were obtained for each material of construction.

Since alpha surveys with the SCM do not subtract background, but rather address background through the coincidence logic approach, alpha surveys were not performed in the reference areas. Hand held instrument alpha measurements were performed within the area used for beta measurements. Each instrument performed a single 10 minute count to obtain better statistics.

In all applications, SCM and hand held instrumentation, the reference area measurements result in a single value, in cpm/100 cm^2 that will be applied to the measurements taken in potentially impacted areas. For SCM reference area beta surveys, the 50^{th} percentile of the data becomes the background value for each material of construction. Similarly for reference area beta surveys with hand held instruments, the average of the 10 one minute measurements becomes the background value. Since alpha surveys with the SCM do not subtract background, no background values are determined. For alpha surveys with hand held instruments, the cpm value obtained from the 10 minute count has been applied. In all cases, the background values consist of the surface emission rate from the material of construction plus impacts due to radon in the atmosphere, radon progeny on the surface of the material, and external gamma radiation from the natural activity in the taxiways, concrete structures and other natural uranium bearing materials at NASB.

For subsequent alpha and beta surveys in potentially impacted areas with both the SCM and hand held instrumentation, the application of the background has been continuously evaluated. With the constantly changing impact of sources on the detectors other than the surface emission rate of the material, rarely would a reference area value be aligned with the potentially impacted area. For beta surveys, the use of the CFD plots generated by SCM/SIMS allows an assessment of an area to determine if the radioactivity is normally distributed and if any outliers exist. Also, subtracting a single, 50^{th} percentile, value would result in the 50^{th} percentile value of the potentially impacted area survey to be near zero, if all factors impacting the surveys were identical. Any offset in the 50^{th} percentile value from zero would indicate the amount of difference in background and whether the reference area value was conservative or non-conservative. The evaluation of the reference area data to the potentially impacted area from SCM data can be applied to hand held instrumentation results if necessary. Similarly, alpha surveys performed with the SCM can show increased count rates on both the primary and recount detector, indicating higher than usual background that may still be excluded by the coincidence logic. SIMS computer evaluation of the primary and recount detectors can quantify the activity levels. The evaluation of SCM generated data can be used to access the adequacy of the hand held background data.

During the survey of potentially impacted areas, the need for additional reference areas was noted. The fire station, Building 292, background reference for concrete, both painted and unpainted concrete, appeared high. The high, non-conservative, values resulted in very low readings in the Hangar 4 survey units. Additionally, the tile flooring in Building 53 was non-conservative relative to the tile floors in Building 250. A second location within Building 250, but not within the impacted area was identified. The area, outside the store identified as the "Geedunk" was surveyed as a reference area for both concrete and tile flooring. Photos of the "Geedunk" area are included in Appendix A. The remainder of the survey of potentially

impacted areas showed the need for additional reference areas that are pictured in Appendix A. In each case, the reference area values were closer to the data established by surveys in the potentially impacted area but could not duplicate the variations induced by constantly changing radon levels in the atmosphere and radon progeny on surfaces.

In all cases, reference area data was confirmed by SCM/SIMS to be normally distributed and without outliers. Application of reference area beta activity values attempted to establish a 50^{th} percentile of the CFD of the potentially impacted area as close to zero as practical with the high end of the CFD below the acceptance criteria when the CFD was adjusted to set the 50^{th} percentile to zero. Alpha background is not subtracted from surveys performed with the SCM. When extreme alpha emission rates were noted in one potentially impacted area, a new reference area on a nearby exposed concrete pad was determined for the hand held instrumentation.

4.0 Results

The results of the reference area surveys for both the SCM and the Ludlum 43-68 detectors with the Ludlum 2221 rate meter are provided as Tables 1 through 5. The SCM results are reported for beta emission rate only in Table 1, since the SCM survey process for low level alpha activity does not subtract background. The SCM results are presented for both dynamic and static modes as indicated in the table.

Three hand-held instruments were used during the performance of surveys at NASB. Table 2 provides the summary data for each instrument and the average value across all three instruments. Tables 3, 4, and 5 provide the field data that supports the summary table.

During surveys in Building 200, higher than expected readings were obtained on concrete block, metal, and ceiling tile surfaces. In all three cases, SCM surveys had not identified areas that did not show normal distributions and were without outliers. Building 200 did exhibit higher than usual gamma background and was much harder to ventilate than other buildings due to the small size of the rooms. To address the issue, similar materials were identified within Building 200, but at the far south end of the second floor, away from the potentially impacted areas. A single hand held detector, instrument number 148426, was used for all direct measurement surveys within Building 200.

The Task Specific Plan for Building 41 required a survey of an exterior concrete slab at the east end of the building. Again, higher than expected activity was recognized during the SCM survey and while obtaining fixed point measurements with the hand held instrument. The SCM beta survey identified a normal distribution with no outliers, while the alpha surveys indicated higher activity, randomly disbursed and no areas exceeding the release criteria. A similar concrete pad that was not included in the potentially impacted areas was used to establish reference area values for the concrete pad. A single hand held detector, instrument number 148426, was used for all direct measurement surveys on the Building 41 pad. Results of the concrete pad reference area survey are included in the summary table as well as the detailed data sheet for detector 148426.

No reference area based investigation criteria for gamma walkover surveys is applied to potentially impacted area surveys due to the variability of gamma exposure rates throughout NASB and as impacted by local weather conditions. Investigation criteria is applied to the data set developed within individual survey units, analyzing the data for the potential of extreme values.

Table 1

SCM Reference Area Results
Beta

Survey Name	Detector Type	Material Type	Mean (cpm)
FR1102B	T-180 Dynamic	Painted Concrete	838
FR1202B	T-180 Dynamic	Concrete	1401
FR1602B	T-180 Dynamic	Tile Floor	1177
FR1702B	T-180 Dynamic	Drywall	565
FR1202C	R-180 Dynamic	"Geedunk" Concrete	904
FR1602C	R-180 Dynamic	"Geedunk" Tile	496
FR1802A	R-180 Dynamic	Asphalt	1434
FR5602B	C-90 Static	Tile Floor	672
FR5702B	C-90 Static	Drywall	508
FR5502B	C-90 Static	Concrete Block	906
FR5102B	C-90 Static	Painted Concrete	823
FR5202B	C-90 Static	Concrete	1343
FR5302B	C-90 Static	Steel	560
FR5402B	C-90 Static	Wood	647
FR4102B	C-180 Static	Painted Concrete	838
FR4202B	C-180 Static	Concrete	1262
FR4302B	C-180 Static	Steel	498
FR4402B	C-180 Static	Wood	658
FR4502B	C-180 Static	Concrete Block	1034
FR4602B	C-180 Static	Tile Floor	698
FR4702B	C-180 Static	Drywall	521
FR4902B	C-180 Static	Countertop	797

The survey name represents the SCM/SIMS file name. The C-90 detector is the 90 cm detector used for static counts, The C-180 is the 180 cm detector used for static counts.

Table 2

Hand Held Instrument Reference Area Data

	AVERAGE BETA											
	Painted Concrete	Concrete	Wood	*Concrete Block*	*Steel*	Tile	Drywall	Bldg 250 Tile	Bldg 250 Concrete	Bldg 250 Counter top	Asphalt	Bldg 250 Drawer
190181	177.30	291.90	170.80	259.90	135.10	145.30	147.70	221.80	306.00	246.80	547.90	268.80
148451	251.20	408.90	258.40	362.20	189.50	230.50	207.30	290.60	447.30	296.40	263.10	281.90
148426	184.60	311.50	174.60	272.10	158.30	145.90	143.90	163.90	230.60	202.90	313.00	172.90
Sum	613.1	1012.3	603.8	894.2	482.9	521.7	498.9	676.3	983.9	746.1	1124	723.6
Avg cpm	204.37	337.43	201.27	298.07	160.97	173.90	166.30	225.43	327.97	248.70	374.67	241.20

	AVERAGE ALPHA											
	Painted Concrete	Concrete	Wood	Concrete Block	Steel	Tile	Drywall	Bldg 250 Tile	Bldg 250 Concrete	Bldg 250 Counter top	Asphalt	Bldg 250 Drawer
190181	4.80	6.40	2.80	1.70	3.70	3.00	3.20	4.00	3.60	2.20	10.80	3.50
148451	4.40	8.00	2.40	3.50	4.10	2.80	3.40	5.20	5.60	5.50	13.60	4.80
148426	5.00	9.10	4.90	3.80	5.30	3.90	4.10	5.10	4.40	4.10	11.30	3.70
Sum	14.20	23.50	10.10	9.00	13.10	9.70	10.70	14.30	13.60	11.80	35.70	12.00
Avg cpm	4.73	7.83	3.37	3.00	4.37	3.23	3.57	4.77	4.53	3.93	11.90	4.00

Table 2 (Continued)

Hand Held Instrument Reference Area Data
Building 200 and Building 41

	INSTRUMENT 148426 AVERAGE BETA		
	Bldg 200 Metal	Bldg 200 Ceiling Tile	Bldg 41 Concrete
Avg cpm	202.70	271.50	417.40

	INSTRUMENT 148426 AVERAGE ALPHA			
	Bldg 200 Concrete Block	Bldg 200 Metal	Bldg 200 Ceiling Tile	Bldg 41 Concrete
Avg cpm	4.30	6.20	7.30	18.20

Table 3

	Instrument #190181 Beta											
	Painted Concrete	Concrete	Wood	Concrete Block	Steel	Tile	Drywall	Bldg 250 Tile	Bldg 250 Concrete	Bldg 250 Countertop	Asphalt	Bldg 250 Drawer
1 min	188	303	170	252	115	146	142	242	332	257	503	290
Counts	195	278	167	262	145	140	146	244	279	268	538	255
	193	296	184	303	159	148	136	216	306	253	526	256
	184	272	183	266	152	155	145	233	287	268	516	248
	189	287	174	267	142	142	122	233	297	232	542	282
	163	292	160	247	125	157	157	239	296	252	568	286
	169	275	161	250	127	139	161	176	322	219	583	280
	177	333	170	227	141	147	147	213	301	232	560	274
	161	298	159	252	125	135	158	216	308	233	574	250
	154	285	180	273	120	144	163	206	332	254	569	267
Sum	1773	2919	1708	2599	1351	1453	1477	2218	3060	2468	5479	2688
Avg cpm	177.30	291.90	170.80	259.90	135.10	145.30	147.70	221.80	306.00	246.80	547.90	268.80

	Instrument #190181Alpha											
	Painted Concrete	Concrete	Wood	Concrete Block	Steel	Tile	Drywall	Bldg 250 Tile	Bldg 250 Concrete	Bldg 250 Countertop	Asphalt	Bldg 250 Drawer
10 min	48	64	28	17	37	30	32	40	36	22	108	35
cpm	4.80	6.40	2.80	1.70	3.70	3.00	3.20	4.00	3.60	2.20	10.80	3.50

Table 4

	Instrument #148451 Beta											
	Painted Concrete	Concrete	Wood	Concrete Block	Steel	Tile	Drywall	Bldg 250 Tile	Bldg 250 Concrete	Bldg 250 Countertop	Asphalt	Bldg 250 Drawer
1 min	272	364	265	391	187	238	213	304	471	308	290	278
Counts	258	399	251	360	186	239	190	323	438	302	251	295
	219	427	275	348	190	224	226	285	448	298	260	270
	247	388	267	345	200	206	206	289	457	289	245	281
	229	432	226	374	169	253	202	295	427	276	268	276
	278	422	256	379	164	224	209	273	444	315	259	281
	269	408	240	340	204	230	195	285	438	293	265	293
	229	406	273	359	180	200	223	291	462	299	258	278
	253	426	267	361	209	247	203	278	451	288	272	280
	258	417	264	365	206	244	206	283	437	296	263	287
Sum	2512	4089	2584	3622	1895	2305	2073	2906	4473	2964	2631	2819
Avg cpm	251.20	408.90	258.40	362.20	189.50	230.50	207.30	290.60	447.30	296.40	263.10	281.90

	Instrument #148451 Alpha											
	Painted Concrete	Concrete	Wood	Concrete Block	Steel	Tile	Drywall	Bldg 250 Tile	Bldg 250 Concrete	Bldg 250 Countertop	Asphalt	Bldg 250 Drawer
10 min	44	80	24	35	41	28	34	52	56	55	136	48
cpm	4.40	8.00	2.40	3.50	4.10	2.80	3.40	5.20	5.60	5.50	13.60	4.80

Table 5

	Instrument 148426 Beta											
	Painted Concrete	Concrete	Wood	Concrete Block	Steel	Tile	Drywall	Bldg 250 Tile	Bldg 250 Concrete	Bldg 250 Countertop	Asphalt	Bldg 250 Drawer
1 min	198	271	155	284	169	138	136	172	217	202	310	169
Counts	192	282	172	263	157	142	139	178	221	191	300	174
	171	321	182	265	156	140	146	154	240	176	302	167
	153	339	184	316	152	135	142	171	269	220	310	185
	193	323	167	274	166	150	168	162	252	237	308	171
	166	304	180	250	138	152	129	163	210	207	341	185
	180	307	202	275	162	163	148	169	212	212	319	172
	180	323	170	283	163	160	152	151	230	187	316	153
	210	326	161	251	152	132	132	143	208	200	321	179
	203	319	173	260	168	147	147	176	247	197	303	174
Sum	1846	3115	1746	2721	1583	1459	1439	1639	2306	2029	3130	1729
Avg cpm	184.60	311.50	174.60	272.10	158.30	145.90	143.90	163.90	230.60	202.90	313.00	172.90

	Instrument 148426 Alpha										
	Painted Concrete	Concrete	Wood	Concrete Block	Steel	Tile	Drywall	Bldg 250 Tile	Bldg 250 Concrete	Bldg 250 Countertop	Asphalt
10 min	50	91	49	38	53	39	41	51	44	41	113
cpm	5.00	9.10	4.90	3.80	5.30	3.90	4.10	5.10	4.40	4.10	11.30

Table 5 (Continued)

	Instrument 148426 Beta		
	Bldg 200 Metal	Bldg 200 Ceiling Tile	Bldg 41 Concrete
I min	207	254	406
Counts	196	273	432
	226	279	419
	206	278	409
	193	297	417
	186	290	415
	191	260	497
	185	259	398
	214	249	434
	223	276	347
Sum	2027	2715	4174
Avg Cpm	202.70	271.50	417.40

	Instrument 148426 Alpha			
	Bldg 200 Concrete Block	Bldg 200 Metal	Bldg 200 Ceiling Tile	Bldg 41 Concrete
10 min	43	62	73	182
cpm	4.30	6.20	7.30	18.20

Appendix A

Brunswick NAS
Background Reference Material

Backgrounds on reference materials were taken in Building 292 (Fire Station), Building 53 (Public Works Building). Additional material backgrounds were performed in Building 200, Building 250 and the north concrete pad on the east side of Building 41. All material locations are identified with the following label:

MILLENNIUM SERVICES BACKGROUND REFERENCE MATERIAL

Figure 1 Building 292

Building 292 was selected for performing reference backgrounds on the following materials

- Steel
- Concrete
- Painted concrete
- Wood
- Concrete block

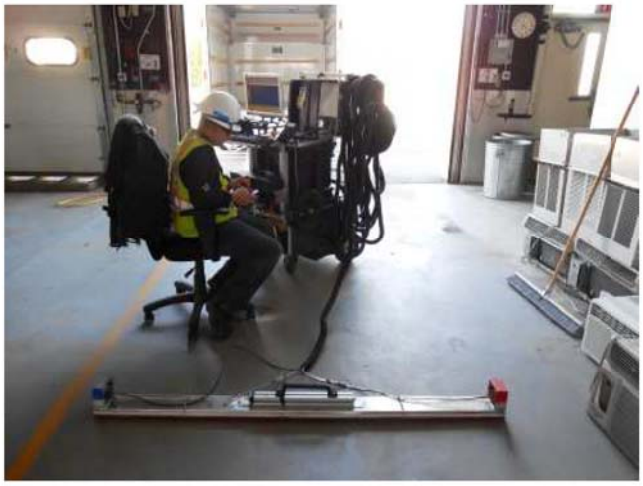


Figure 2 Painted Concrete

Figure 3 Unpainted concrete

Figure 4 Concrete block

Figure 5 Wood

Figure 6 Steel

Reference backgrounds were performed in Building 53 inside the Public Works office hallway on floor tile and drywall.

Figure 7 Building 53

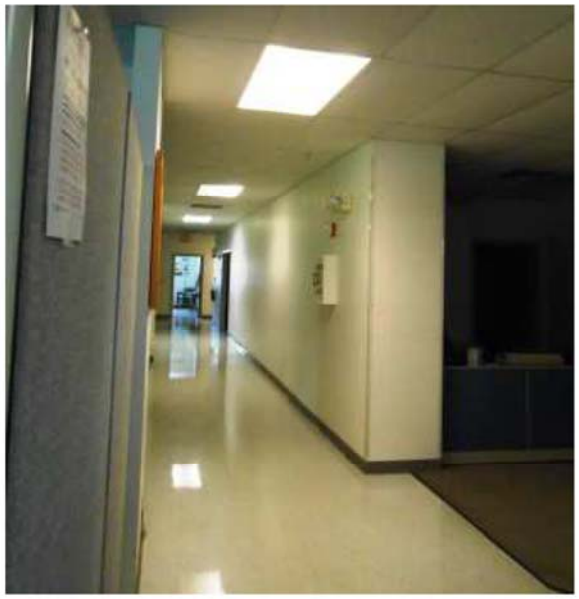


Figure 8 Floor tile and drywall

Material backgrounds were performed in Building 250 outside of the GEEDUNK area for painted concrete and in the hallway for tile. Also in Rm 101 backgrounds were taken on countertops and drawers. In addition, the asphalt in the parking lot of 250 was used as a reference area.

Figure 9 Building 250 and asphalt

Figure 10 Geedunk painted concrete

Figure 11 Geedunk tile

Figure 12 Rm 101 Countertop and drawers

Reference backgrounds were needed in Building 200 on ceiling tile and metal (door to the right). Additional reference backgrounds were taken on concrete block. All these backgrounds were taken in the 2nd floor hallway of the building.

Figure 13 Building 200 hallway (concrete block, metal and ceiling tile.

The concrete pad on the northeast side of Building 41 was used as the reference for the impacted pad.

Figure 14 NE pad outside of Building 41

APPENDIX C
INSTRUMENT INFORMATION

Appendix C

Instrumentation Calibration and Efficiencies

Surface Contamination Monitor

Alpha and Beta Efficiency Determination

ATTACHMENT A

PSPC EFFICIENCY WORKSHEET RA-226– SCM MODEL III

Equipment Configuration

SCM III S/N:	1	**Computer S/N:**	TLSYS81800063
Electronics S/N:	SRA E009	**HV Pre-amp S/N:**	17
LV Pre-amp S/N:	21	**A/B LLD Settings (mV):**	23/23
Operating Voltage (V):	1300	**PSPC Type (e.g. T180):**	T180
Mylar Thickness (mg/cm^2):	0.8	**Speed (in./sec) or Count Time (msec):**	0.5 inch/sec
Recount Method (circle):	Average / Gamma Subtraction / NA		

Calibration Source(s) Information

Serial Number	Isotope	Emission Type	Half Life (years)	Assay Date	$q_{2\pi}$ Emission (particles/min)	Active Area (cm^2)	Decay Corrected $q_{2\pi}$ Emission*
1451-97	Th-230	Alpha	75400	2-1-11	24066	.20	24066

* To calculate the decay corrected $q_{2\pi}$ emission rate in particle/sec/100 cm^2:

$$\text{Decay Corrected } q_{2\pi} = \left[q_{2\pi} \cdot e^{\frac{-(\ln 2)t}{T_{1/2}}} \right] \cdot \left[\frac{100}{A} \right], \text{ where}$$

t = time, in years, between assay date and calibration date
$T_{1/2}$ = half life, in years
A = active area (cm^2)
NOTE: The 100/A factor is only used when the area of the calibration source is larger than the width of the PSPC.

Data File Information

Filename	Number of Strips
G1TH230A	30

Efficiency Calculation

Average (cpm/100 cm^2)	Subtotal Efficiency (ε_t)
13236	0.55

Data Review

Data Review	Name	Date	Signature
Data Processor	Jeff Vassett	6/4/12	
Project Manager	R. W. Dubiel	6/4/12	R.W. Dubiel

ATTACHMENT A

PSPC EFFICIENCY WORKSHEET RA-226– SCM MODEL III

Equipment Configuration

SCM III S/N:	1	**Computer S/N:**	TLSYS81800063
Electronics S/N:	SRA E009	**HV Pre-amp S/N:**	17
LV Pre-amp S/N:	21	**A/B LLD Settings (mV):**	23/23
Operating Voltage (V):	1300	**PSPC Type (e.g. T180):**	C180
Mylar Thickness (mg/cm^2):	0.8	**Speed (in./sec) or Count Time (msec):**	8000 msec
Recount Method (circle):	Average / Gamma Subtraction / NA		

Calibration Source(s) Information

Serial Number	Isotope	Emission Type	Half Life (years)	Assay Date	$q_{2\pi}$ Emission (particles/min)	Active Area (cm^2)	Decay Corrected $q_{2\pi}$ Emission*
1451-97	Th-230	Alpha	75400	2-1-11	24066	.20	24066

* To calculate the decay corrected $q_{2\pi}$ emission rate in particle/sec/100 cm^2:

$$\text{Decay Corrected } q_{2\pi} = \left[q_{2\pi} \cdot e^{\frac{-(\ln 2)t}{T_{1/2}}} \right] \cdot \left[\frac{100}{A} \right], \text{ where}$$

t = time, in years, between assay date and calibration date
$T_{1/2}$ = half life, in years
A = active area (cm^2)
NOTE: The 100/A factor is only used when the area of the calibration source is larger than the width of the PSPC.

Data File Information

Filename	Number of Strips
G1TH230B	30

Efficiency Calculation

Average (cpm/100 cm^2)	Subtotal Efficiency (ε_t)
13496	0.56

Data Review

Data Review	Name	Date	Signature
Data Processor	Jeff Vassett	6/4/12	
Project Manager	R. W. Dubiel	6/4/12	R. W. Dubiel

ATTACHMENT A

PSPC EFFICIENCY WORKSHEET – SCM MODEL III

Equipment Configuration

SCM III S/N:	1	**Computer S/N:**	TLSYS81800063
Electronics S/N:	SRA E009	**HV Pre-amp S/N:**	17
LV Pre-amp S/N:	21	**A/B LLD Settings (mV):**	23/23
Operating Voltage (V):	1915	**PSPC Type (e.g. T180):**	C180
Mylar Thickness (mg/cm^2):	0.8	**Speed (in./sec) or Count Time (msec):**	8000 msec
Recount Method (circle):	Average / Gamma Subtraction / NA		

Calibration Source(s) Information

	Serial Number	Isotope	Emission Type	Half Life (years)	Assay Date	$q_{2\pi}$ Emission (particles/min)	Active Area (cm^2)	Decay Corrected $q_{2\pi}$ Emission*
1	FY-865	Cs-137	Beta	3.017E1	3/26/98	90000	100	67464
2								
3								
4								
5								

* To calculate the decay corrected $q_{2\pi}$ emission rate in particle/sec/100 cm^2:

$$\text{Decay Corrected } q_{2\pi} = \left[q_{2\pi} \cdot e^{\frac{-(\ln 2)t}{T_{1/2}}} \right] \cdot \left[\frac{100}{A} \right], \text{ where}$$

t = time, in years, between assay date and calibration date
$T_{1/2}$ = half life, in years
A = active area (cm^2)
NOTE: The 100/A factor is only used when the area of the calibration source is larger than the width of the PSPC.

Data File Information

	Filename	Number of Strips
1	G1Cs137B	30
2		
3		
4		
5		

ATTACHMENT A (cont'd)

Efficiency Calculation

	Average (cpm/100 cm^2)	Instrument Efficiency (ε_i)	Surface Efficiency (ε_s)	Fraction (f)	Subtotal Efficiency (ε_t)
1	26311	0.39	0.5	1	0.195
2					
3					
4					
5					
				Total Efficiency (ε_T):	.470

Data Review

Data Review	Name	Date	Signature
Data Processor	Jeff Vassett	7/4/12	
Project Manager	R. W. Dubiel	7/4/12	R. W. Dubiel

ATTACHMENT A

PSPC EFFICIENCY WORKSHEET – SCM MODEL III

Equipment Configuration

SCM III S/N:	6	**Computer S/N:**	TLSYS81802517
Electronics S/N:	SRA E007	**HV Pre-amp S/N:**	18
LV Pre-amp S/N:	20	**A/B LLD Settings (mV):**	23/23
Operating Voltage (V):	1915	**PSPC Type (e.g. T180):**	T180
Mylar Thickness (mg/cm^2):	0.8	**Speed (in./sec) or Count Time (msec):**	2 inch/sec
Recount Method (circle):	Average / Gamma Subtraction / NA		

Calibration Source(s) Information

	Serial Number	Isotope	Emission Type	Half Life (years)	Assay Date	$q_{2\pi}$ Emission (particles/min)	Active Area (cm^2)	Decay Corrected $q_{2\pi}$ Emission*
1	FY-865	Cs-137	Beta	3.017E1	3/26/98	90000	100	67464
2								
3								
4								
5								

* To calculate the decay corrected $q_{2\pi}$ emission rate in particle/min/100 cm^2:

$$\text{Decay Corrected } q_{2\pi} = \left[q_{2\pi} \cdot e^{\frac{-(\ln 2)t}{T_{1/2}}} \right] \cdot \left[\frac{100}{A} \right], \text{ where}$$

t = time, in years, between assay date and calibration date
$T_{1/2}$ = half life, in years
A = active area (cm^2)
NOTE: The 100/A factor is only used when the area of the calibration source is larger than the width of the PSPC.

Data File Information

	Filename	Number of Strips
1	G6Cs137A	30
2		
3		
4		
5		

ATTACHMENT A (cont'd)

Efficiency Calculation

	Average (cpm/100 cm^2)	Instrument Efficiency (ε_i)	Surface Efficiency (ε_s)	Fraction (f)	Subtotal Efficiency (ε_t)
1	42096	0.624	0.5	1	0.312
2					
3					
4					
5					
				Total Efficiency (ε_T):	0.312

Data Review

Data Review	Name	Date	Signature
Data Processor	Jeff Vassett	7/4/12	
Project Manager	R. W. Dubiel	7/4/12	R. W. Dubiel

Hand Held Instrumentation

Calibration and Efficiency

Ludlum Model 2221 Ratemeter Serial Number 148451

Ludlum Model 43-68 Probe Serial Number PR177646

Alpha Efficiency

	1	2	3	4	5
Isotope	Th-230	C-14	Tc-99	Tl-204	Sr-90
Serial Number	D7-928	D7-934	A7-132	A7-134	A7-135
Emission Type	Alpha	Beta	Beta	Beta	Beta
Half Life	75000	5730	213000	3.78	28.5
Assay Date	10/18/2006	12/1/2006	8/15/2002	8/7/2002	8/7/2002
$q_{2\pi}$ Emission Rate	37490	52040	28170	24870	53150
Decay Corrected q2π Emission Rate	37489	52016	28169	5554	43566
Probe Coverage Percent	88%	88%	88%	88%	88%
Adjusted Emission Rate	32990	45774	24789	4888	38338
Measurement 1	7585.2				
Measurement 2	7557.2				
Measurement 3	7378.2				
Measurement 4	7622.2				
Measurement 5	7466.2				
Measurement 6	7539.2				
Measurement 7	7542.2				
Measurement 8	7434.2				
Measurement 9	7485.2				
Measurement 10	7523.2				
Measurement 11	7487.2				
Measurement 12	7463.2				
Measurement 13	7454.2				
Measurement 14	7459.2				
Measurement 15	7590.2				
Measurement 16	7498.2				
Measurement 17	7568.2				
Measurement 18	7528.2				
Measurement 19	7564.2				
Measurement 20	7455.2				
Mean of Measurements	7508.05	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Efficiency	23%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Ludlum Model 2221 Ratemeter Serial Number 148451

Ludlum Model 43-68 Probe Serial Number PR177646

Beta Efficiency

	1	2	3	4	5
Isotope	Th-230	Cs-137	Tc-99	Tl-204	Sr-90
Serial Number	1451-97	FY-865	D7-932	A7-134	A7-135
Emission Type	Alpha	Beta	Beta	Beta	Beta
Half Life	75000	30.17	213000	3.78	28.5
Assay Date	12/1/2006	3/26/1998	10/11/2006	8/7/2002	8/7/2002
$q_{2\pi}$ Emission Rate	12110	90000	315700	24870	53150
Decay Corrected q2π Emission Rate	12110	67464	315696	5554	43566
Probe Coverage Percent	88%	88%	88%	88%	88%
Adjusted Emission Rate	10656	59368	277812	4888	38338
Measurement 1		15075	93729		
Measurement 2		15215	93725		
Measurement 3		15235	94673		
Measurement 4		15257	94112		
Measurement 5		15099	93964		
Measurement 6		15027	94292		
Measurement 7		14918	94070		
Measurement 8		14950	94145		
Measurement 9		15109	94382		
Measurement 10		14956	94259		
Measurement 11		15150	94194		
Measurement 12		15403	94071		
Measurement 13		15041	93797		
Measurement 14		14931	94083		
Measurement 15		15528	93878		
Measurement 16		14966	94481		
Measurement 17		15008	93719		
Measurement 18		15078	93548		
Measurement 19		15144	93736		
Measurement 20		15262	93795		
Mean of Measurements	#DIV/0!	14980.6	93895.65	#DIV/0!	#DIV/0!
Efficiency	#DIV/0!	25%	34%	#DIV/0!	#DIV/0!

Scientific and Industrial Instruments

POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CERTIFICATE OF CALIBRATION

CUSTOMER MILLENNIUM SERVICES ORDER NO. 20189532/371143

Mfg. Ludlum Measurements, Inc. Model 2221 Serial No. 148451

Mfg. Ludlum Measurements, Inc. Model 43-68 Serial No. PR177646

I. Date 19-Dec-11 Cal Due Date 19-Dec-12 Cal. Interval 1 Year Meterface 202-159

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 36 % Alt 701.8 mm Hg

☐ New Instrument Instrument Received ☑ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical ck. ☑ Meter Zeroed ☐ Background Subtract ☑ Input Sens. Linearity
☑ F/S Resp. ck ☑ Reset ck. ☑ Window Operation ☑ Geotropism
☑ Audio ck. ☐ Alarm Setting ck. ☑ Batt. ck. (Min. Volt) 4.4 VDC

☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set Comments V Input Sens. Comments mV Det. Oper. Comments V at Comments mV Threshold Dial Ratio 100 = 10 mV

☑ HV Readout (2 points) Ref./Inst. 500 / 502 V Ref./Inst. 2000 / 2003 V

COMMENTS:

```
                    44-9        43-68          Model 2221 currently set for 44-9 operation.
      High Voltage: 900         1100 (Alpha)
                                1575 (Beta)    Firmware: 261010
    Threshold dial: 600(60mv)   5(50mv)        Cal'd with 39" cable.
44-9: Tc99 SN:5280 Size:93200dpm, Counts:21867cpm, Background:55cpm, 4pi Eff:23.40%
      Pu239 SN:5283 Size:24600dpm, Counts:3852cpm, Background:55cpm, 4pi Eff:15.43%
      SrY90 SN:5281 Size:99870dpm, Counts:40572cpm, Background:55cpm, 4pi Eff:40.56%
43-68: Tc99 SN:5280 Size:93200dpm, Counts:34443cpm, Background:321cpm, 4pi Eff:36.61%
       SrY90 SN:5281 Size:99870dpm, Counts:37875cpm, Background:321cpm, 4pi Eff:37.60%
       Pu239 SN:5283 Size:24600dpm, Counts:5627cpm, Background:4cpm, 4pi Eff:22.85%
```

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
x1K	400kcpm	400	400
x1K	100kcpm	100	100
x100	40kcpm	400	400
x100	10kcpm	100	100
x10	4kcpm	400	400
x10	1kcpm	100	100
x1	400cpm	400	400
x1	100cpm	100	100

*Uncertainty within ± 10% C.F. within ± 20%

ALL **Range(s) Calibrated Electronically**

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout	400kcpm	39976 (0)	39976 (0)
	40kcpm	3998	3998
	4kcpm	400	400
	400cpm	40	40
	40cpm	4	4

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Log Scale	500kcpm	500 kcpm	500 kcpm
	50kcpm	50	50
	5kcpm	5	5
	500cpm	500 cpm	500 cpm
	50cpm	50	50

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978 State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: ☐ 73410 ☐ ~~1131~~ ☑ 781 ☐ 059 ☐ 280 ☐ 60646 ☐ 70897 ☐ Ra-226 S/N Y982

Cs-137 Gamma S/N ☐ 1162 ☐ G112 ☐ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☑ Alpha S/N Pu239 SN:5280 ☑ Beta S/N Tc99 SN:5283 SrY90 ☐ Other

☑ m 500 S/N 190566 ☐ Oscilloscope S/N ☑ Multimeter S/N 86250390

Calibrated By: [signature] Date 19 Dec 11

Reviewed By: [signature] Date 20 Dec 11

AC Inst. Only ☐ Passed Dielectric (Hi-Pot) and Continuity Test ☐ Failed:

Designer and Manufacturer
of
Scientific and Industrial
Instruments

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

Bench Test Data

Detector 43-68 Serial No. PR 177646 Order #. 20189532/371143

Customer MILLENNIUM SERVICES

Counter 2221 Serial No. 148451 Counter Input Sensitivity 5 mV

Count Time 1 min Distance Source to Detector Surface

Other

High Voltage	Background	Isotope Pu239 Size 24600dpm	Isotope Tc99 Size 93200dpm	Isotope Size	Isotope Size
1000	0	4823			
1050	2	5711			
1100	4	5627			
1150	4	5731			
1200	4	5784			
1525	160		29730		
1550	254		32332		
1575	321		34443		
1600	348		35573		
1625	392		35120		

☐ Gas proportional detector count rate decreased ≤ 10% after 15 hour static test using 39" cable.

Signature [signature] Date 19-Dec-11

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

of Scientific and Industrial Instruments

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501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CERTIFICATE OF CALIBRATION

CUSTOMER MILLENNIUM SERVICES ORDER NO. 20189743

Mfg. Ludlum Measurements, Inc. Model 2241-2 Serial No. 270478

Mfg. Ludlum Measurements, Inc. Model 43-68 Serial No. PR 314511

Date 17-Feb-12 Cal Due Date 17-Feb-13 Cal. Interval 1 Year Meterface digital

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 75 °F RH 26 % Alt 704.8 mm Hg

☑ New Instrument Instrument Received ☐ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical ck. ☐ Meter Zeroed ☐ Background Subtract ☐ Input Sens. Linearity

☑ F/S Resp. ck ☑ Reset ck. ☐ Window Operation

☑ Audio ck. ☑ Alarm Setting ck. ☑ Batt. ck. (Min. Volt) 2.2 VDC

☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set Comments V Input Sens. Comment mV Det. Oper. Comments V at Comment mV Threshold Dial Ratio = mV

COMMENTS:

	Det.1(cpm)	Det.2(cpm)
Detector & Color:	43-68(red)	44-10(yellow)
Deadtime Correction:	0µSec	9µSec
Calibration Constant:	100e-2	100e-2
Ratemeter alarm:	50.0kcpm	50.0kcpm
Ratemeter alert:	20.0kcpm	20.0kcpm
High voltage:	1650 v	1050 v
Millivoltage:	4mv	10mv

Overload checked but not set.

DET.1(43-68) HIGH VOLTAGE SET FOR BETA OPERATION.
SEE ATTACHMENT 1 FOR EFFICIENCIES.

FIRMWARE#: P-09-23

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
Dig.rate			
Dig.rate			

*Uncertainty within ± 10% C.F. within ± 20%

Range(s) Calibrated Electronically

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Ratemeter Readout	800K cpm		799 kc/m
	200K cpm		199 kc/m
	80K cpm		79.9 kc/m
	20K cpm		19.9 kc/m
	8K cpm		7.99 kc/m
	2K cpm		1.99 kc/m
	800 cpm		799 c/m
	200 cpm		199 c/m

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Scaler Readout	800K cpm		79962 (0)
	200K cpm		19948 (0)
	80K cpm		7996 (0)
	20K cpm		1994 (0)
	8K cpm		800 (0)
	2K cpm		200 (0)
	800 cpm		80 (0)
	200 cpm		20 (0)

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Reference Instruments and/or Sources: ☐ 73410 ☐ 1131 ☐ 781 ☐ 059 ☐ 280 ☐ 60646 ☐ 70897 ☐ Ra-226 S/N Y982

Cs-137 Gamma S/N ☐ 1162 ☐ G112 ☐ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☑ Alpha S/N Pu239 #4337, ☑ Beta S/N Tc99 #635/83, Sr90y90 #918 ☑ Other Am241 = 0.76 µCi

☑ m 500 S/N 38120 ☐ Oscilloscope S/N ☑ Multimeter S/N 84260131

Calibrated By: Lemuel Ortega Date 17-Feb-12

Reviewed By: Diana DeLeon Date 20 Feb 12

Designer and Manufacturer
of
Scientific and Industrial
Instruments

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

Bench Test Data For Detector

Detector 44-10 Serial No. AR312986

Customer MILLENNIUM SERVICES Order #. 20189743

Counter 2241-2 Serial No. 270478 Counter Input Sensitivity 3 10 mV

Count Time 6 seconds Distance Source to Detector Surface

Other

High Voltage	Background	Isotope Am241 Size ~ 0.76μCi	Isotope Size	Isotope Size	Isotope Size
800	623	10036			
850	637	10646			
900	620	12084			
950	622	12134			
1000	615	12184			
✓ 1050	634	12221			
1100	635	12238			
1150	621	12353			
1200	664	12279			
1250	738	12605			
1300	854	12724			
1350	934	12745			

Signature Lemm Ortega Date 17-Feb-12

Ludlum Model 19

Calibration Certificate

Scientific and Industrial Instruments

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CERTIFICATE OF CALIBRATION

CUSTOMER MILLENNIUM SERVICES ORDER NO. 20189530/371142

Mfg. Ludlum Measurements, Inc. Model 19 Serial No. 142858

Mfg. _____ Model _____ Serial No. _____

Cal. Date 5-Dec-11 Cal Due Date 5-Dec-12 Cal. Interval 1 Year Meterface 202-016

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 34 % Alt 694.8 mm Hg

☐ New Instrument Instrument Received ☑ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical ck. ☑ Meter Zeroed ☑ Background Subtract ☐ Input Sens. Linearity
☑ F/S Resp. ck ☑ Reset ck. ☐ Window Operation ☑ Geotropism
☑ Audio ck. ☐ Alarm Setting ck. ☑ Batt. ck. (Min. Volt) 2.2 VDC

☐ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☑ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set 600 V Input Sens. 37 mV Det. Oper. _____ V at _____ mV Threshold Dial Ratio _____ = _____ mV

☐ HV Readout (2 points) Ref./Inst. _____ / _____ V Ref./Inst. _____ / _____ V

COMMENTS:

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
5000	4000 uR/hr	3600	4000
5000	1000 uR/hr	900	1000
500	400 uR/hr = 74600 cpm	380	400
500	100 uR/hr	95	100
250	200 uR/hr = 37800 cpm	205	200
250	100 uR/hr	102	100
50	7460 cpm	40	40
50	1860 cpm	10	10
25	3780 cpm	20.5	20
25	945 cpm	5	5

*Uncertainty within ± 10% C.F. within ± 20%

50, 25 **Range(s) Calibrated Electronically**

Digital Readout	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*

Log Scale	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*

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Reference Instruments and/or Sources: ☐ 73410 ☐ 1131 ☐ 781 ☐ 059 ☐ 280 ☐ 60646 ☐ 70897 ☐ Ra-226 S/N Y982
Cs-137 Gamma S/N ☐ 1162 ☐ G112 ☑ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N _____ ☐ Beta S/N _____ ☐ Other _____

☑ m 500 S/N 190566 ☐ Oscilloscope S/N _____ ☑ Multimeter S/N 86250390

Calibrated By: _____ Date 5-Dec-11

Reviewed By: _____ Date 7 Dec 11

AC Inst. Only ☐ Passed Dielectric (Hi-Pot) and Continuity Test ☐ Failed: _____

Ludlum 2929 with 43-10-1 Detector

Calibration Certificate

Scientific and Industrial Instruments

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CERTIFICATE OF CALIBRATION

CUSTOMER MILLENNIUM SERVICES ORDER NO. 20189530/371142

Mfg. Ludlum Measurements, Inc. Model 2929 Serial No. 163817

Mfg. Ludlum Measurements, Inc. Model 43-10-1 Serial No. PR167232

Cal. Date 5-Dec-11 Cal Due Date 5-Dec-12 Cal. Interval 1 Year Meterface 202-014

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 34 % Alt 694.8 mm Hg

☐ New Instrument Instrument Received ☑ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical ck. ☑ Window Operation

☑ Audio ck.

☑ Meter Zeroed Alpha Sensitivity 175 mV Beta Sensitivity 4 mV Beta Window 50 mV

☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set 725 V = 2.94 on High Voltage dial. High Voltage set with detector connected.

☑ HV Readout (2 points) Ref./Inst. 500 / 502 V Ref./Inst. 2000 / 1998 V

COMMENTS:

Tc99 SN:5280 Size:93200dpm, Counts:26084cpm, Background:60cpm, 4pi Eff:27.92%
Pu239 SN:7053 Size:24900dpm, Counts:10458cpm, Background:1cpm, 4pi Eff:41.99%
SrY90 SN:5281 Size:102085dpm, Counts:45368cpm, Background:60cpm, 4pi Eff:44.38%

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

	REFERENCE CAL POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Alpha Channel Digital Readout	400K cpm	39972 (0)	39972 (0)
	40K cpm	3997	3997
	4K cpm	399	399
	400 cpm	40	40
	40 cpm	4	4
Beta/Gamma Channel Digital Readout	400K cpm	39968 (0)	39968 (0)
	40K cpm	3997	3997
	4K cpm	399	399
	400 cpm	40	40
	40 cpm	4	4

*Uncertainty within ± 10% C.F. within ± 20%

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: ☐ 73410 ☐ 1131 ☐ 781 ☐ 059 ☐ 280 ☐ 60646 ☐ 70897 ☐ Ra-226 S/N Y982

Cs-137 Gamma S/N ☐ 1162 ☐ G112 ☐ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N ☐ Beta S/N ☐ Other

☑ m 500 S/N 190566 ☐ Oscilloscope S/N ☑ Multimeter S/N 86250390

Calibrated By: Jason Fl Date 5-Dec-11

Reviewed By: Rhonda Hi Date 6 Dec 11

AC Inst. Only ☐ Passed Dielectric (Hi-Pot) and Continuity Test ☐ Failed:

Designer and Manufacturer
of
Scientific and Industrial
Instruments

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

Bench Test Data For Detector

Detector 43-10-1 Serial No. PR167232 Order #. 20189530/371142

Customer MILLENNIUM SERVICES Alpha Input Sensitivity 175 mV

Counter 2929 Serial No. 163817 Beta Input Sensitivity 4 mV

Count Time 1Minute Beta Window 50 mV

Other _____ Distance Source to Detector TRAY

High Voltage	Background		Isotope Pu239 Size 24900dpm		Isotope Tc99 Size 93200dpm		Isotope SrY90 Size 102085dpm	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta
700	0	56	10330	253	37	23553	4	44487
725	1	60	10458	259	40	26084	4	45368
750	2	66	10395	273	45	29271	22	44197

☐ Gas Proportional detector count rate decreased ≤ 10% after 15 hour static test using 39" cable.

☐ Gas proportional detector count rate decreased ≤ 10% after 5 hour static test using 39" cable and alpha/beta counter.

Signature Jason Fleming Date 5-Dec-11

LUDLUM MEASUREMENTS, INC.
501 Oak St.
P.O. Box 810
Sweetwater, Texas 79556
Phone: 325-235-5494 / 800-622-0828 (USA)
Fax: 325-235-4672
e-mail: ludlum@ludlums.com
Website: http://www.ludlums.com

Designer and Manufacturer
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ATTACHMENT 1

Efficiencies as stated are 4pi (dpm), taken at surface level less background. Efficiencies as follows:

Efficiencies for 43-68:

Source:	Tc99	~~*~~ Pu239 ~~*~~	Sr90y90
Source Count:	8306 cpm	8524 cpm	23072 cpm
Background:	218 cpm	218 cpm	218 cpm
Efficiency:	≈ 35.3 % 4pi net	≈ 26.9 % 4pi net	≈ 35.3 %4pi net
Source Size:	22,900dpm	30900dpm	61870dpm
Source SN:	#635/83	#4337	#918

~~2423~~ 60 * Pa239 efficiency taken at beta voltage

Source Certificates

Eckert & Ziegler
Isotope Products

24937 Avenue Tibbitts
Valencia, California 91355

Tel 661•309•1010
Fax 661•257•8303

CERTIFICATE OF CALIBRATION
ALPHA STANDARD SOURCE

Radionuclide:	Th-230	**Customer:**	MILLENNIUM SERVICES, INC.
Half-life:	(7.54 ± 0.03)E+04 years	**P.O. No.:**	2010-002
Catalog No.:	AF-230-A1	**Reference Date:**	1-Feb-11 12:00 PST
Source No.:	1451-97	**Contained Radioactivity:**	10.84 **nCi** 401.1 **Bq**

Physical Description:

A. Capsule type:	A-1
B. Nature of active deposit:	Electrodeposited and diffusion bonded oxide
C. Active diameter/volume:	5 mm
D. Backing:	Platinum
E. Cover:	None

CAUTION!
DELICATE SURFACE
DO NOT WIPE
ACTIVE AREA

Radioimpurities:

None detected

Method of Calibration:

This source was assayed using a windowless internal gas flow proportional counter.

Uncertainty of Measurement:

A. Type A (random) uncertainty:	± 0.5 %
B. Type B (systematic) uncertainty:	± 3.0 %
C. Uncertainty in aliquot weighing:	± 0.0 %
D. Total uncertainty at the 99% confidence level:	± 3.0 %

Notes:

- See reverse side for leak test(s) performed on this source.
- EZIP participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (as in NRC Regulatory Guide 4.15).
- Nuclear data was taken from "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had a surface emission rate of 12110 α/min in 2π on 17-Jan-11.

Daniel James Van Dalsem
Quality Control

17-Jan-11
Date

EZIP Ref. No.: 1451-97

Isotope Products Laboratories
An Eckert & Ziegler Company

24937 Avenue Tibbitts
Valencia, California 91355

Tel 661·309·1010
Fax 661·257·8303

CERTIFICATE OF CALIBRATION
ALPHA STANDARD SOURCE

Radionuclide:	Th-230	**Customer:**	SHONKA RESEARCH ASSOCIATES
Half-life:	(7.54 ± 0.03)E+04 years	**P.O. No.:**	1727
Catalog No.:	LDS-230-100MM	**Reference Date:**	1-Dec-06 12:00 PST
Source No.:	D7-928	**Contained Radioactivity: (Total alpha)**	34.12 nCi 1262 Bq

Physical Description:

A. Capsule type:	LDS (121 mm x 121 mm)
B. Nature of active deposit:	Electrodeposited oxide
C. Active area:	100 mm x 100 mm
D. Backing:	Stainless steel
E. Cover:	None

CAUTION!
DELICATE SURFACE
DO NOT WIPE
ACTIVE AREA

Radioimpurities:

Am-241 = 0.152%; Ra-226 = 0.0143% on 1-Dec-06

Method of Calibration:

This source was assayed using a windowless internal gas flow proportional counter.

Uncertainty of Measurement:

A. Type A (random) uncertainty:	± 0.5 %
B. Type B (systematic) uncertainty:	± 3.0 %
C. Uncertainty in aliquot weighing:	± 0.0 %
D. Total uncertainty at the 99% confidence level:	± 3.0 %

Notes:

- See reverse side for leak test(s) performed on this source.
- IPL participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (as in NRC Regulatory Guide 4.15).
- Nuclear data was taken from "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had a total alpha surface emission rate of 37490 α/min in 2π on 18 Oct 06.

Daniel James Van Dalsen — Quality Control

23-OCT-06 — Date

IPL Ref. No.: 1116-79

Nycomed Amersham

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CERTIFICATE

No. 100337

for a Sealed Radioactive Source

Source Type: Beta Wide Area Reference Source

Product code	CDR06031
Drawing	VZ-626/1
Dimensions of active surface	100 mm x 100 mm
Overall dimensions	120 mm x 120 mm x 3 mm
Source no.	FY 865
Nuclide	Caesium-137

Measurement Data

Activity	2.47 kBq
Overall uncertainty*	6 %
Beta surface emission rate	1.50E03 s^{-1} in 2 π steradian
Overall uncertainty* of beta surface emission rate	6 %
Reference date	26 March 1998
Traceability*	Defined on page 2

Leakage and Contamination Test/s

Test method/s*	I
Test/s passed on	31 March 1998

Additional Information

ISO classification*	
Remark	

* see page 2 for explanation

Amersham Buchler GmbH & Co KG

i. A.

(Production Manager)

APPENDIX D
SURVEY UNIT #1 SURVEY RESULTS

Surface Contamination Monitor Auto-Generated Survey Report Description

This Appendix contains the auto-generated reports for surveys performed with the Surface Contamination Monitor (SCM). The reports are generated using copyrighted software Survey Information Management System (SIMS). The basic design of the software is to eliminate human errors in the creation of survey reports. Errors such as transcription errors are eliminated by limiting inputs to the report to direct inputs from other computer processes or files within SIMS. The following is a description of the SCM Auto-Generated Reports that follow in this Appendix.

A separate report is generated for each SCM survey. There are many survey units (SU) within a building or area survey. Each SU may have multiple SCM surveys. As an example, a SU may have a floor survey, a lower wall survey, an upper wall and ceiling survey. Surveys are limited to 100 square meters if they are Class 1 area surveys. To control the data for a large project, an alpha-numeric survey file name, limited to 8 digits, is assigned to each SCM survey. File names for surveys performed at the Brunswick Naval Air Station Alameda contain 7 digits. The file nomenclature is as follows;

Alpha Numeric Digit	Description	Example
1	Type of Survey	F – Final Status P – Performance Based Check T – Test
2	Building or Area	A - Hangar 4 B – Building 9 C – Building 41 D – Building 200 E – Building 250 F - Building 539 G – Bunkers 626, A,B,C H – Bunkers 543 and 544
3, 4	Survey Unit Number	01 - SU-1 02 – SU-2 03 – SU-3, etc.
5,6	Building Surface and Type of Survey	01 – Floor Survey, alpha 02 – Floor Survey, beta 11 – Lower Walls, alpha 12 – Lower Walls, beta 21 – Upper Walls, alpha 22 – Upper walls, beta 31 – Ceilings, alpha 32 – Ceilings, beta
7	Incremental Survey Number	A – First Survey B – Second Survey, etc

As an example, Survey File Name FD0101A, is the final status survey performed in Building 200, in survey unit SU 1, on the floor, surveying for alpha activity. It is the first survey at that surface location

Survey Report Table: The first 5 lines items of the table are drawn from the SCM performing the survey. The information is input into the on-board SCM computer by the SCM operator, or is known by the computer. The operator will input the survey file name, his/her name (multiple names if more than one operator involved), and select the type of survey configuration (dynamic mode, static mode, recount assembly or single detector and size of detector). A detector listing of R180 is a dynamic mode recount assembly with a 180 centimeter (cm) detector. A detector listing of C180 is a static mode with a 180 cm detector. The survey date and the SCM number are known by the on-board computer.

Each page of a survey report is date and time stamped at the time of processing and successively numbered..

The "Criteria" section, are drawn from information pre-established in the SIMS computer. Release criteria for each type of survey and radionuclide of concern (ROC) are input into the computer prior to SIMS processing. The SIMS processor simply selects the ROC. The survey report will use the appropriate criteria in evaluating the data. The release criteria will be listed on the first page.

The "System Information" section provides the computer system information. Two key parameters are input into SIMS prior to survey processing. They are background values associated with the various surface materials to be surveyed and SCM efficiency by radionuclide and system configuration. Alpha surveys are performed without background subtraction. Beta surveys will use a single value listed in counts per minute (cpm). That value will be subtracted for every 100 cm^2 value prior to calculating the disintegrations per minute (dpm) value. The SIMS and SCM versions are inherent in the two computers.

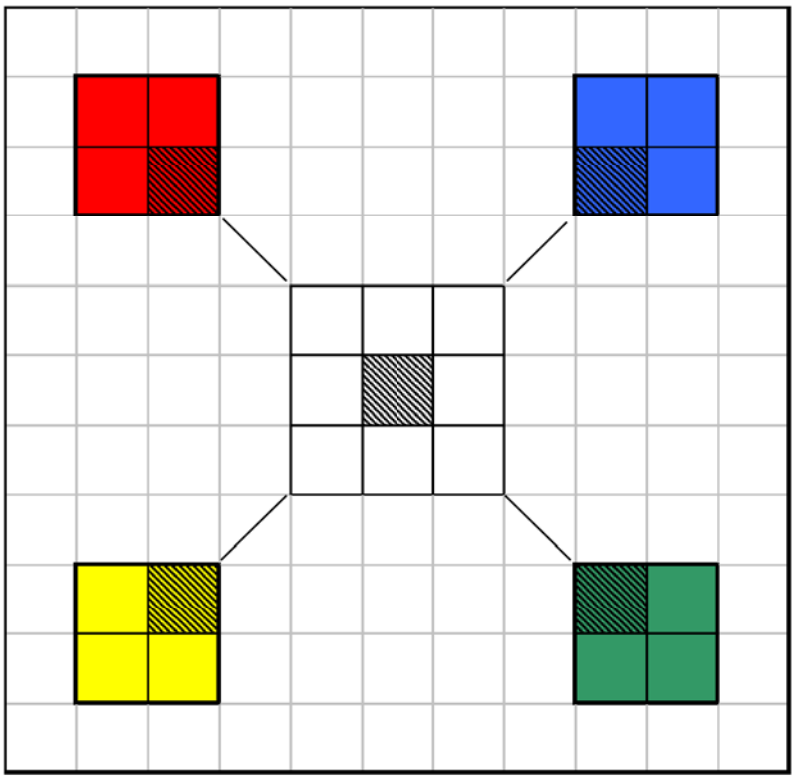
The "Survey Results" section is a result of the data processing. Within SIMS, the SIMS processor can select "Below Criteria" if no value exceeds the criteria stated above. Another option is to record the highest 100 cm^2 area value for the survey.

Below the survey report table, a statement is made to express whether the survey image is spatially correlated by the statement "The lower left corner of all images corresponds to the southwest corner of the survey". Surveys that are not spatially correlated will have that statement below the table "This survey is not position correlated."

Two-Dimensional Color Graphic Images: SCM systems collect data in 25 cm^2 "pixels of data. The survey data is "stitched" by the SIMS processor. During the stitching process, the operator does not see data, but rectangular blocks that can be aligned. The blocks coincide with data strips obtained by the SCM operator. For dynamic surveys, the data strip will have the dimensions of the detector width by the length of distance rolled. For static surveys the blocks will be 180 cm by 10 cm. Each strip is numbered by the SCM computer. To "stitch" the survey data, the processor aligns the strips as indicated by maps drawn by the technicians while obtaining the data. For static surveys, the

individual strips are aligned side by side. SIMS will then correlate all data in 25 cm^2 "pixels, then evaluate all possible combinations of 4 "pixels" or 100 cm^2. The following demonstrates the process.

Each 25 cm^2 "pixel" of data is combined with 4 combinations of adjacent "pixels". The summed value is then placed in the lower left "pixel", resulting in each new "pixel" representing activity in a 100 cm^2 area. Four hundred 100 cm^2 areas will result in a one square meter area.



The two-dimension display provides an image of the activity with increasing activity level being depicted by a more intense light image. Each two-dimensional display has a computer applied 1 square meter grid (blue lines) to provide the viewer with perspective on the size of the survey area and assist in locating any hot spots that may appear. The horizontal and vertical scales of the two dimensional display are in meters. The color scale can be adjusted but is typically set for a maximum "white" image of 3 times the release criteria.

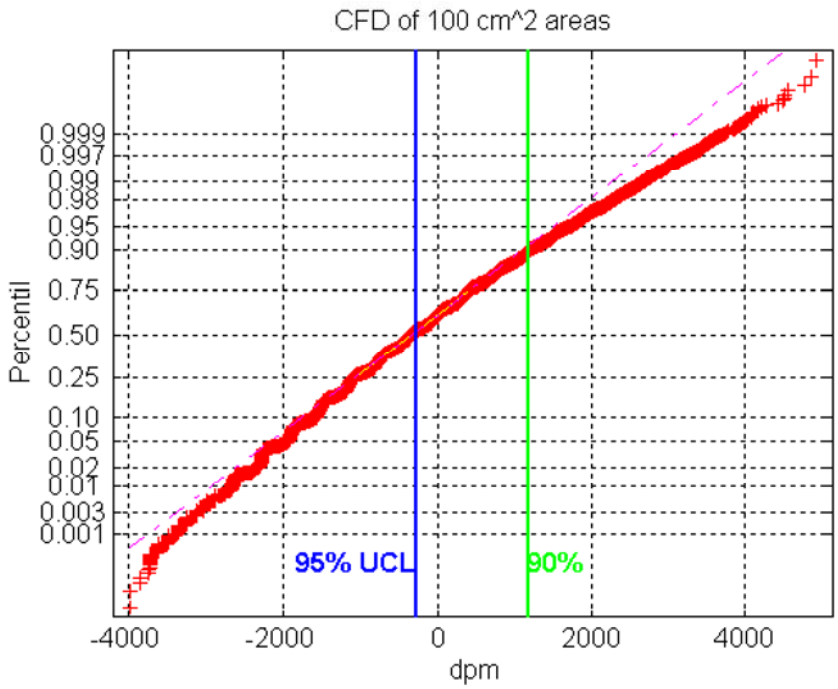
Alpha Surveys: Alpha surveys are conducted using a recount detector assembly. The survey process is described in the Work Plan and the Task Specific Plan for surveys performed at the Brunswick Naval Air Station Alameda and implements the process described in MARSSIM, Appendix J. The detectors are a fixed distance apart. SIMS software will process each of the detector data independently. The images from both the primary and recount detector are displayed in Figures 1 and 2 to demonstrate to the randomness of background and low level counting performed by the SCM. Since the critical issue in low level alpha counting is to minimize the impact of false positives due to background, a "coincidence logic" evaluation is performed by SIMS (Figure 3). The data from the recount detector is superimposed on the primary detector. Since the

detectors are hard mounted together in a recount assembly, the offset distance is a known constant. A threshold value is incorporated in the SIMS software. The threshold value is chosen to assure that a source at any location, equal to the release criteria, will be above the threshold on both detectors greater than 95% of the time. If either detector has a result less than the threshold value, a zero value is placed in that "pixel" on the coincidence display. Those areas will appear black, indicating no detectable activity above background. The process greatly reduces the number of false positives typically experienced in low level alpha surveys.

Beta Surveys: Beta background values are significantly higher than alpha background values, eliminating the "coincidence" counting approach used in alpha surveys. A single two-dimensional display is included in the beta survey reports. Within SIMS, the process for developing the data image is identical to that described above.

An additional feature of beta surveys is the inclusion of a cumulative frequency distribution (CFD) plot. The scale at the bottom of the plot is a liner scale in activity units, dpm/100 cm^2. The vertical scale the percentage of total measurements obtained. Each point on the curve represents the percent of total measurements at or below the value on the horizontal scale. The vertical scale is a statistical scale based the standard deviation of normally distributed data. A straight line would be indicative of normally distributed data. The slope of the line is related to the standard deviation. A more vertical line would indicate a small standard deviation. A lower slope, more horizontal line would represent a larger standard deviation. Contamination would be identified by data points that depart from the curve at the high end, i.e. outliers. Those data points would not fall within the normal distribution of background.

An example CFD plot is presented below:



The blue vertical line represents the 95% upper confidence level (UCL) of the data. With the large number of measurements obtained in each survey, the 95% UCL is close to the

mean of the data. The green vertical line represents the 90th percentile of the data. Ninety percent of the data fall at or below the green line. Since beta surveys have a background value subtracted, a non-contaminated area would have approximately 50% of the data as negative values and 50 % positive. A 50 % value at or near zero is indicative of a valid reference area for the area surveyed.

Meter Grid Table: The grid table provides numerical information for every square meter identified on Figure 1. The blue lined grid in Figure 1 is computer applied based on the out dimensions of the stitched pattern. The grid table identifies each grid by an X and Y coordinate. Within that grid, the numerical information is presented as mean or average value, the maximum value, the minimum value and the standard deviation. All values are in dpm per 100 cm^2. A final column provides the number of 100 cm^2 areas are within that grid. Only areas within the grid that have data are included in the numerical data. If a grid has less than the 100, 100 cm^2 areas, the actual number of 100 cm^2 areas is shown.

Exception Report: Surveys that include areas in excess of the release criteria will contain an addition survey report section that includes both a color-graphic display similar to those discussed above, with red spots indicating areas above the release criteria on a green background. An investigation table is also included that lists in order of descending activity, the activity level, location from the southwest corner of the survey (X,Y) coordinates, and the location from the SW of the strip (X,Y). Since strip numbers are marked in the field, the investigation allows for ease in locating the elevated activity.

SCM Results

Survey Report

Survey File Name:	FB0101A
Survey Date:	July 5, 2012
Survey Equipment:	SCM1
Detector(s):	R180
Surveyor(s):	THROWER
Criteria	
Any 100 cm^2 Measurement:	100 net dpm/100 cm^2
Average Over Any 1 m^2:	100 net dpm/100 cm^2
System Information	
Background:	Background not Subtracted
Efficiency (100 cm^2):	R180: 50.0%
SIMS Version:	V5.3m
SCM Version:	V3.4d
Survey Results	
Maximum 100 cm^2:	Below Criteria
Maximum m^2 Average:	Below Criteria
Area Exceeding 100 cm^2 Levels:	0.00 m^2

The lower left corner of all images corresponds to the south west corner of the survey.

Primary Detector:

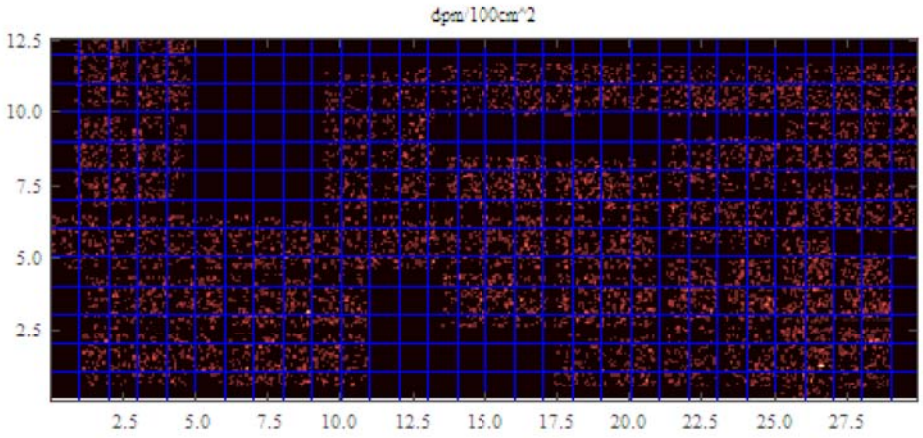


Figure 1: Meter Grid overlaid onto image plot of 100cm^2 areas..

Recount Detector:

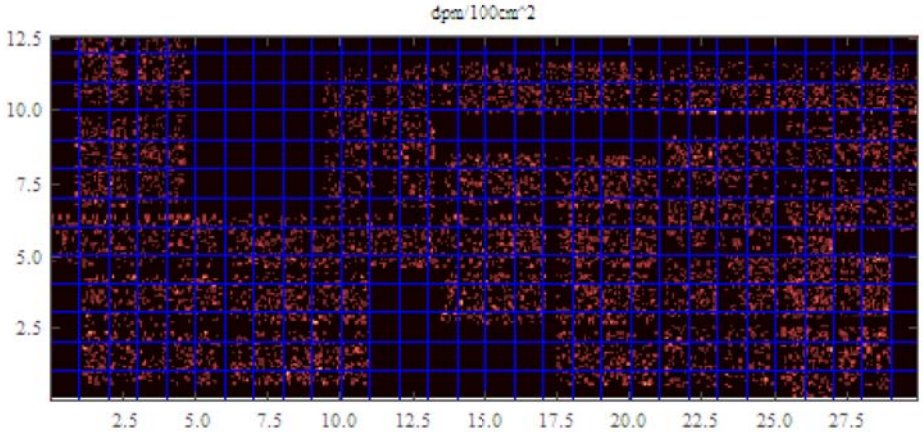


Figure 2: Meter Grid overlaid onto image plot of 100cm^2 areas..

Coincidence Logic:

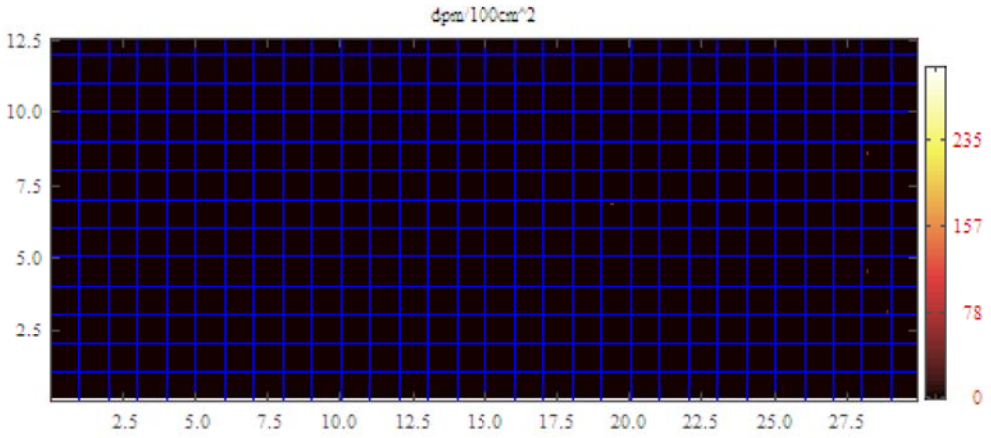


Figure 3: Meter Grid overlaid onto image plot of 100cm^2 areas. The color scale is in dpm per 100cm^2.

Meter Grid Summary Table

X	Y	Mean dpm/100cm^2	Max dpm/100cm^2	Min dpm/100cm^2	Std dpm/100cm^2	100cm^2 Areas
1	1	N/A	N/A	N/A	N/A	0
1	2	N/A	N/A	N/A	N/A	0
1	3	N/A	N/A	N/A	N/A	0
1	4	N/A	N/A	N/A	N/A	0
1	5	0	0	0	0	40
1	6	0	0	0	0	100
1	7	0	0	0	0	33
1	8	0	0	0	0	10
1	9	0	0	0	0	10
1	10	0	0	0	0	7
1	11	0	0	0	0	9
1	12	0	0	0	0	10
1	13	0	0	0	0	5
2	1	0	0	0	0	32
2	2	0	0	0	0	80
2	3	0	0	0	0	64
2	4	0	0	0	0	80
2	5	0	0	0	0	64
2	6	0	0	0	0	100
2	7	0	0	0	0	60
2	8	0	0	0	0	100
2	9	0	0	0	0	100
2	10	0	0	0	0	70
2	11	0	0	0	0	90
2	12	0	0	0	0	100
2	13	0	0	0	0	50
3	1	0	0	0	0	40
3	2	0	0	0	0	100
3	3	0	0	0	0	80
3	4	0	0	0	0	100
3	5	0	0	0	0	70
3	6	0	0	0	0	100
3	7	0	0	0	0	50
3	8	0	0	0	0	70
3	9	0	0	0	0	70
3	10	0	0	0	0	50

3	11	0	0	0	0	54
3	12	0	0	0	0	60
3	13	0	0	0	0	30
4	1	0	0	0	0	40
4	2	0	0	0	0	100
4	3	0	0	0	0	80
4	4	0	0	0	0	100
4	5	0	0	0	0	70
4	6	0	0	0	0	100
4	7	0	0	0	0	50
4	8	0	0	0	0	100
4	9	0	0	0	0	100
4	10	0	0	0	0	80
4	11	0	0	0	0	100
4	12	0	0	0	0	100
4	13	0	0	0	0	40
5	1	0	0	0	0	40
5	2	0	0	0	0	100
5	3	0	0	0	0	80
5	4	0	0	0	0	100
5	5	0	0	0	0	70
5	6	0	0	0	0	100
5	7	0	0	0	0	42
5	8	0	0	0	0	60
5	9	0	0	0	0	60
5	10	0	0	0	0	48
5	11	0	0	0	0	70
5	12	0	0	0	0	70
5	13	0	0	0	0	28
6	1	0	0	0	0	32
6	2	0	0	0	0	80
6	3	0	0	0	0	69
6	4	0	0	0	0	90
6	5	0	0	0	0	63
6	6	0	0	0	0	90
6	7	0	0	0	0	27
6	8	N/A	N/A	N/A	N/A	0
6	9	N/A	N/A	N/A	N/A	0

6	10	N/A	N/A	N/A	N/A	0
6	11	N/A	N/A	N/A	N/A	0
6	12	N/A	N/A	N/A	N/A	0
6	13	N/A	N/A	N/A	N/A	0
7	1	0	0	0	0	32
7	2	0	0	0	0	80
7	3	0	0	0	0	56
7	4	0	0	0	0	80
7	5	0	0	0	0	68
7	6	0	0	0	0	90
7	7	0	0	0	0	27
7	8	N/A	N/A	N/A	N/A	0
7	9	N/A	N/A	N/A	N/A	0
7	10	N/A	N/A	N/A	N/A	0
7	11	N/A	N/A	N/A	N/A	0
7	12	N/A	N/A	N/A	N/A	0
7	13	N/A	N/A	N/A	N/A	0
8	1	0	0	0	0	40
8	2	0	0	0	0	100
8	3	0	0	0	0	70
8	4	0	0	0	0	100
8	5	0	0	0	0	80
8	6	0	0	0	0	100
8	7	0	0	0	0	30
8	8	N/A	N/A	N/A	N/A	0
8	9	N/A	N/A	N/A	N/A	0
8	10	N/A	N/A	N/A	N/A	0
8	11	N/A	N/A	N/A	N/A	0
8	12	N/A	N/A	N/A	N/A	0
8	13	N/A	N/A	N/A	N/A	0
9	1	0	0	0	0	40
9	2	0	0	0	0	100
9	3	0	0	0	0	70
9	4	0	0	0	0	100
9	5	0	0	0	0	80
9	6	0	0	0	0	100
9	7	0	0	0	0	30
9	8	N/A	N/A	N/A	N/A	0

9	9	N/A	N/A	N/A	N/A	0
9	10	N/A	N/A	N/A	N/A	0
9	11	N/A	N/A	N/A	N/A	0
9	12	N/A	N/A	N/A	N/A	0
9	13	N/A	N/A	N/A	N/A	0
10	1	0	0	0	0	40
10	2	0	0	0	0	100
10	3	0	0	0	0	70
10	4	0	0	0	0	100
10	5	0	0	0	0	80
10	6	0	0	0	0	100
10	7	0	0	0	0	60
10	8	0	0	0	0	60
10	9	0	0	0	0	60
10	10	0	0	0	0	60
10	11	0	0	0	0	60
10	12	0	0	0	0	18
10	13	N/A	N/A	N/A	N/A	0
11	1	0	0	0	0	36
11	2	0	21	0	2	90
11	3	0	0	0	0	59
11	4	0	0	0	0	80
11	5	0	0	0	0	72
11	6	0	0	0	0	100
11	7	0	0	0	0	80
11	8	0	0	0	0	100
11	9	0	0	0	0	100
11	10	0	0	0	0	100
11	11	0	0	0	0	100
11	12	0	0	0	0	30
11	13	N/A	N/A	N/A	N/A	0
12	1	N/A	N/A	N/A	N/A	0
12	2	N/A	N/A	N/A	N/A	0
12	3	N/A	N/A	N/A	N/A	0
12	4	N/A	N/A	N/A	N/A	0
12	5	0	0	0	0	40
12	6	0	0	0	0	100
12	7	0	0	0	0	70

12	8	0	0	0	0	80
12	9	0	0	0	0	80
12	10	0	0	0	0	80
12	11	0	0	0	0	80
12	12	0	0	0	0	30
12	13	N/A	N/A	N/A	N/A	0
13	1	N/A	N/A	N/A	N/A	0
13	2	N/A	N/A	N/A	N/A	0
13	3	N/A	N/A	N/A	N/A	0
13	4	N/A	N/A	N/A	N/A	0
13	5	0	0	0	0	40
13	6	0	0	0	0	100
13	7	0	0	0	0	80
13	8	0	0	0	0	100
13	9	0	0	0	0	100
13	10	0	0	0	0	100
13	11	0	0	0	0	100
13	12	0	0	0	0	40
13	13	N/A	N/A	N/A	N/A	0
14	1	N/A	N/A	N/A	N/A	0
14	2	N/A	N/A	N/A	N/A	0
14	3	0	0	0	0	20
14	4	0	0	0	0	50
14	5	0	0	0	0	52
14	6	0	0	0	0	80
14	7	0	0	0	0	46
14	8	0	0	0	0	60
14	9	0	0	0	0	36
14	10	0	0	0	0	32
14	11	0	0	0	0	80
14	12	0	0	0	0	44
14	13	N/A	N/A	N/A	N/A	0
15	1	N/A	N/A	N/A	N/A	0
15	2	N/A	N/A	N/A	N/A	0
15	3	0	0	0	0	40
15	4	0	0	0	0	100
15	5	0	0	0	0	80
15	6	0	0	0	0	100

15	7	0	0	0	0	60
15	8	0	0	0	0	100
15	9	0	0	0	0	40
15	10	0	0	0	0	20
15	11	0	0	0	0	100
15	12	0	0	0	0	60
15	13	N/A	N/A	N/A	N/A	0
16	1	N/A	N/A	N/A	N/A	0
16	2	N/A	N/A	N/A	N/A	0
16	3	0	0	0	0	40
16	4	0	0	0	0	100
16	5	0	0	0	0	80
16	6	0	0	0	0	100
16	7	0	0	0	0	60
16	8	0	0	0	0	100
16	9	0	0	0	0	40
16	10	0	0	0	0	20
16	11	0	0	0	0	100
16	12	0	0	0	0	60
16	13	N/A	N/A	N/A	N/A	0
17	1	N/A	N/A	N/A	N/A	0
17	2	N/A	N/A	N/A	N/A	0
17	3	0	0	0	0	40
17	4	0	0	0	0	100
17	5	0	0	0	0	80
17	6	0	0	0	0	100
17	7	0	0	0	0	60
17	8	0	0	0	0	100
17	9	0	0	0	0	40
17	10	0	0	0	0	20
17	11	0	0	0	0	100
17	12	0	0	0	0	60
17	13	N/A	N/A	N/A	N/A	0
18	1	0	0	0	0	30
18	2	0	0	0	0	60
18	3	0	0	0	0	46
18	4	0	0	0	0	70
18	5	0	0	0	0	56

18	6	0	0	0	0	70
18	7	0	0	0	0	54
18	8	0	0	0	0	70
18	9	0	0	0	0	22
18	10	0	0	0	0	20
18	11	0	0	0	0	100
18	12	0	0	0	0	60
18	13	N/A	N/A	N/A	N/A	0
19	1	0	0	0	0	50
19	2	0	0	0	0	100
19	3	0	0	0	0	70
19	4	0	0	0	0	100
19	5	0	0	0	0	80
19	6	0	0	0	0	100
19	7	0	0	0	0	80
19	8	0	0	0	0	100
19	9	0	0	0	0	30
19	10	0	0	0	0	20
19	11	0	0	0	0	100
19	12	0	0	0	0	60
19	13	N/A	N/A	N/A	N/A	0
20	1	0	0	0	0	50
20	2	0	0	0	0	100
20	3	0	0	0	0	70
20	4	0	0	0	0	100
20	5	0	0	0	0	80
20	6	0	0	0	0	100
20	7	1	78	0	9	80
20	8	0	0	0	0	100
20	9	0	0	0	0	30
20	10	0	0	0	0	20
20	11	0	0	0	0	100
20	12	0	0	0	0	60
20	13	N/A	N/A	N/A	N/A	0
21	1	0	0	0	0	40
21	2	0	0	0	0	80
21	3	0	0	0	0	56
21	4	0	0	0	0	80

21	5	0	0	0	0	60
21	6	0	0	0	0	70
21	7	0	0	0	0	64
21	8	0	0	0	0	90
21	9	0	0	0	0	27
21	10	0	0	0	0	16
21	11	0	0	0	0	80
21	12	0	0	0	0	48
21	13	N/A	N/A	N/A	N/A	0
22	1	0	0	0	0	40
22	2	0	0	0	0	80
22	3	0	0	0	0	64
22	4	0	0	0	0	80
22	5	0	0	0	0	64
22	6	0	0	0	0	56
22	7	0	0	0	0	70
22	8	0	0	0	0	49
22	9	0	0	0	0	70
22	10	0	0	0	0	20
22	11	0	0	0	0	100
22	12	0	0	0	0	60
22	13	N/A	N/A	N/A	N/A	0
23	1	0	0	0	0	45
23	2	0	0	0	0	90
23	3	0	0	0	0	72
23	4	0	0	0	0	90
23	5	0	0	0	0	72
23	6	0	0	0	0	80
23	7	0	0	0	0	100
23	8	0	0	0	0	70
23	9	0	0	0	0	100
23	10	0	0	0	0	20
23	11	0	0	0	0	100
23	12	0	0	0	0	60
23	13	N/A	N/A	N/A	N/A	0
24	1	0	0	0	0	40
24	2	0	0	0	0	80
24	3	0	0	0	0	64

24	4	0	0	0	0	80
24	5	0	0	0	0	72
24	6	0	0	0	0	80
24	7	0	0	0	0	100
24	8	0	0	0	0	70
24	9	0	0	0	0	100
24	10	0	0	0	0	20
24	11	0	0	0	0	100
24	12	0	0	0	0	60
24	13	N/A	N/A	N/A	N/A	0
25	1	0	0	0	0	50
25	2	0	0	0	0	100
25	3	0	0	0	0	80
25	4	0	0	0	0	100
25	5	0	0	0	0	90
25	6	0	0	0	0	80
25	7	0	0	0	0	100
25	8	0	0	0	0	70
25	9	0	0	0	0	100
25	10	0	0	0	0	20
25	11	0	0	0	0	100
25	12	0	0	0	0	60
25	13	N/A	N/A	N/A	N/A	0
26	1	0	0	0	0	72
26	2	0	0	0	0	80
26	3	0	0	0	0	64
26	4	0	0	0	0	80
26	5	0	0	0	0	80
26	6	0	0	0	0	64
26	7	0	0	0	0	80
26	8	0	0	0	0	55
26	9	0	0	0	0	70
26	10	0	0	0	0	62
26	11	0	0	0	0	100
26	12	0	0	0	0	60
26	13	N/A	N/A	N/A	N/A	0
27	1	0	0	0	0	81
27	2	0	0	0	0	90

27	3	0	0	0	0	74
27	4	0	0	0	0	100
27	5	0	0	0	0	100
27	6	0	0	0	0	80
27	7	0	0	0	0	100
27	8	0	0	0	0	70
27	9	0	0	0	0	100
27	10	0	0	0	0	80
27	11	0	0	0	0	100
27	12	0	0	0	0	60
27	13	N/A	N/A	N/A	N/A	0
28	1	0	0	0	0	45
28	2	0	0	0	0	90
28	3	0	0	0	0	70
28	4	0	0	0	0	80
28	5	0	0	0	0	80
28	6	0	0	0	0	20
28	7	0	0	0	0	100
28	8	0	0	0	0	70
28	9	0	0	0	0	100
28	10	0	0	0	0	80
28	11	0	0	0	0	100
28	12	0	0	0	0	60
28	13	N/A	N/A	N/A	N/A	0
29	1	0	0	0	0	45
29	2	0	0	0	0	90
29	3	0	0	0	0	72
29	4	0	39	0	4	90
29	5	0	39	0	4	90
29	6	0	0	0	0	20
29	7	0	0	0	0	100
29	8	0	0	0	0	70
29	9	1	59	0	6	100
29	10	0	0	0	0	80
29	11	0	0	0	0	100
29	12	0	0	0	0	60
29	13	N/A	N/A	N/A	N/A	0
30	1	N/A	N/A	N/A	N/A	0

30	2	N/A	N/A	N/A	N/A	0
30	3	N/A	N/A	N/A	N/A	0
30	4	N/A	N/A	N/A	N/A	0
30	5	N/A	N/A	N/A	N/A	0
30	6	0	0	0	0	14
30	7	0	0	0	0	70
30	8	0	0	0	0	50
30	9	0	0	0	0	80
30	10	0	0	0	0	64
30	11	0	0	0	0	80
30	12	0	0	0	0	48
30	13	N/A	N/A	N/A	N/A	0

The X and Y columns reference the grids of Figures 1 and 2. Bold text denotes grids which exceed the investigation criteria. When '100' is indicated in the 'Areas' column, the grid is a full square meter. The mean is the average of all measurements in the grid. The standard deviation is calculated from pixels that contain data. All units (i.e. mean, max, and standard deviation) are in dpm per 100cm^2. Meters with no recorded data are not displayed.

Survey Report

Survey File Name:	FB0101B
Survey Date:	July 10, 2012
Survey Equipment:	SCM1
Detector(s):	C180
Surveyor(s):	THROWER
Criteria	
Any 100 cm^2 Measurement:	100 net dpm/100 cm^2
Average Over Any 1 m^2:	100 net dpm/100 cm^2
System Information	
Background:	Background not Subtracted
Efficiency (100 cm^2):	C180: 50.0%
SIMS Version:	V5.3m
SCM Version:	V3.4a
Survey Results	
Maximum 100 cm^2:	Below Criteria
Maximum m^2 Average:	Below Criteria
Area Exceeding 100 cm^2 Levels:	0.00 m^2

This survey is not position correlated.

Primary Detector:

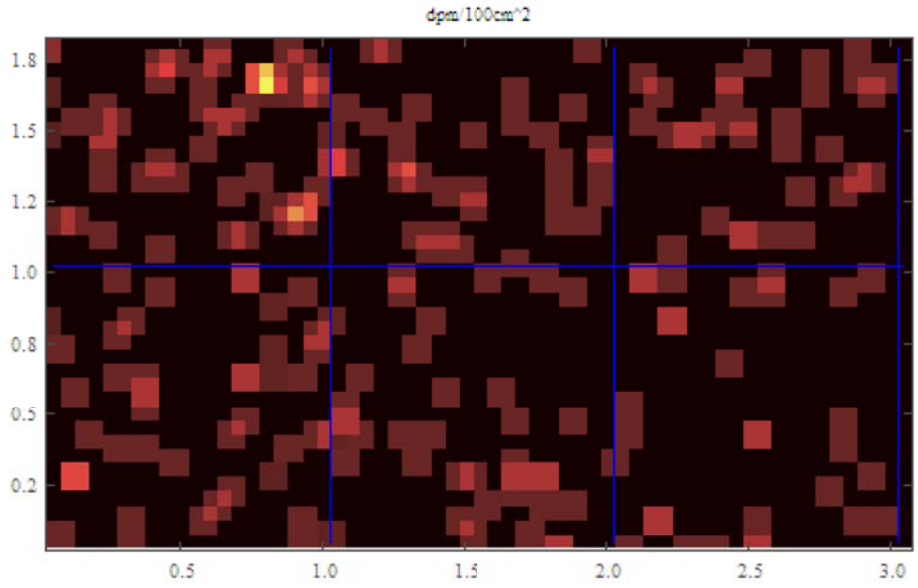


Figure 1: Meter Grid overlaid onto image plot of 100cm^2 areas..

Recount Detector:

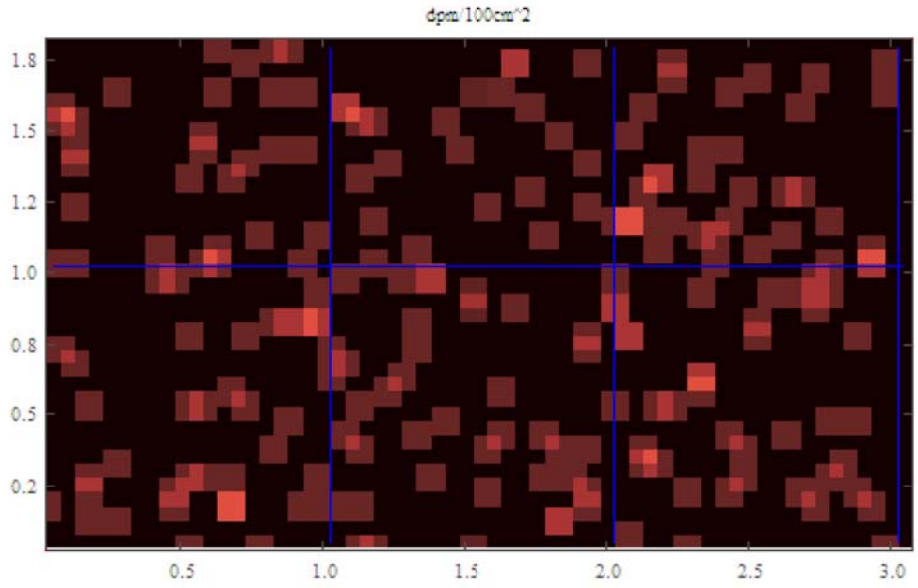


Figure 2: Meter Grid overlaid onto image plot of 100cm^2 areas..

Coincidence Logic:

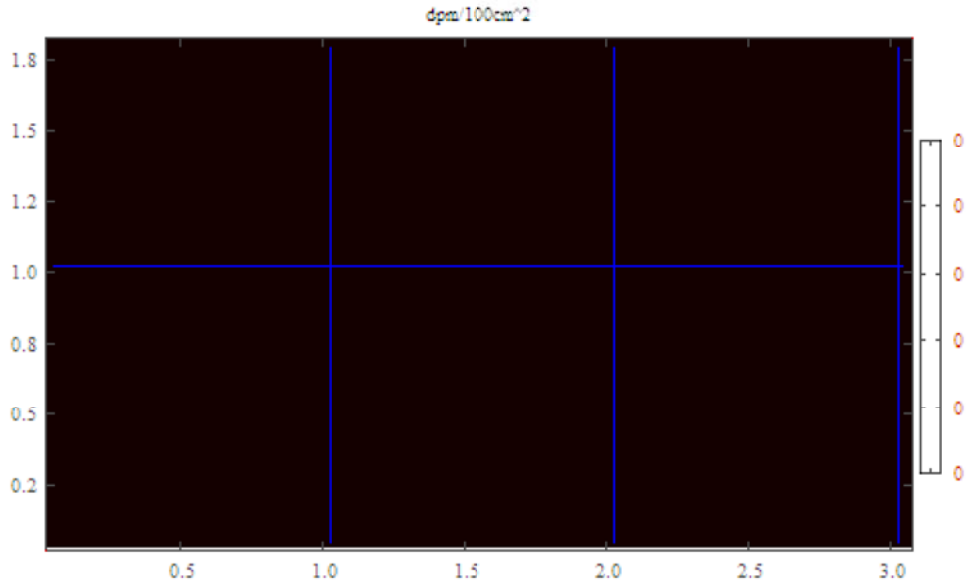


Figure 3: Meter Grid overlaid onto image plot of 100cm^2 areas. The color scale is in dpm per 100cm^2.

Meter Grid Summary Table

X	Y	Mean dpm/100cm^2	Max dpm/100cm^2	Min dpm/100cm^2	Std dpm/100cm^2	100cm^2 Areas
1	1	0	0	0	0	100
1	2	0	0	0	0	80
2	1	0	0	0	0	100
2	2	0	0	0	0	80
3	1	0	0	0	0	100
3	2	0	0	0	0	80

The X and Y columns reference the grids of Figures 1 and 2. Bold text denotes grids which exceed the investigation criteria. When '100' is indicated in the 'Areas' column, the grid is a full square meter. The mean is the average of all measurements in the grid. The standard deviation is calculated from pixels that contain data. All units (i.e. mean, max, and standard deviation) are in dpm per 100cm^2. Meters with no recorded data are not displayed.

Survey Report

Survey File Name:	FB0101J
Survey Date:	July 5, 2012
Survey Equipment:	SCM1
Detector(s):	R180
Surveyor(s):	THROWER
Criteria	
Any 100 cm^2 Measurement:	100 net dpm/100 cm^2
Average Over Any 1 m^2:	100 net dpm/100 cm^2
System Information	
Background:	Background not Subtracted
Efficiency (100 cm^2):	R180: 50.0%
SIMS Version:	V5.3m
SCM Version:	V3.4d
Survey Results	
Maximum 100 cm^2:	**3,985 dpm/100 cm^2**
Maximum m^2 Average:	Below Criteria
Area Exceeding 100 cm^2 Levels:	0.11 m^2

The lower left corner of all images corresponds to the south west corner of the survey.

Primary Detector:

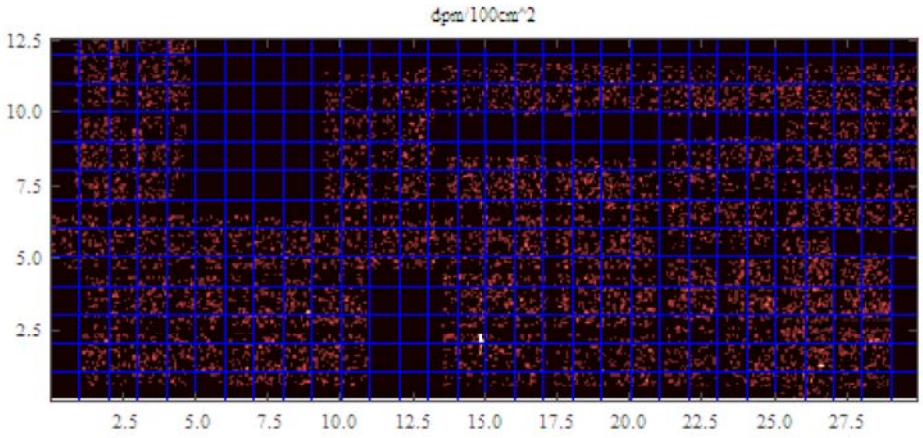


Figure 1: Meter Grid overlaid onto image plot of 100cm^2 areas..

Recount Detector:

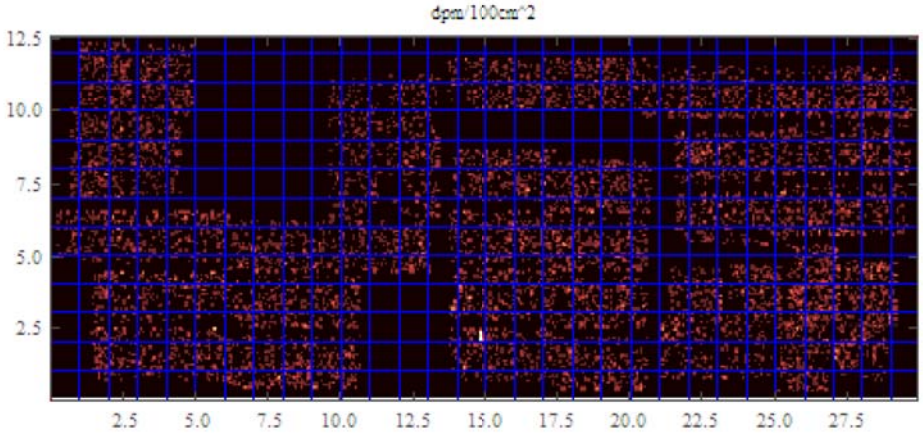


Figure 2: Meter Grid overlaid onto image plot of 100cm^2 areas..

Coincidence Logic:

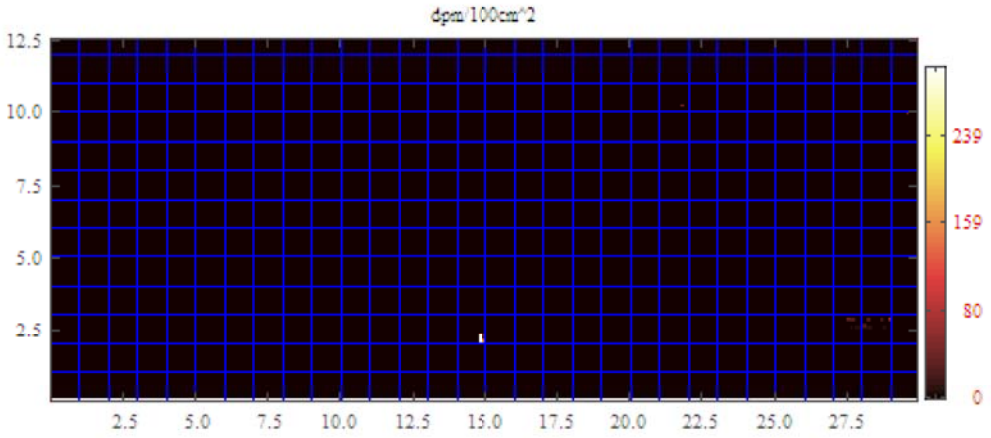


Figure 3: Meter Grid overlaid onto image plot of 100cm^2 areas. The color scale is in dpm per 100cm^2.

Meter Grid Summary Table

X	Y	Mean dpm/100cm^2	Max dpm/100cm^2	Min dpm/100cm^2	Std dpm/100cm^2	100cm^2 Areas
1	1	N/A	N/A	N/A	N/A	0
1	2	N/A	N/A	N/A	N/A	0
1	3	N/A	N/A	N/A	N/A	0
1	4	N/A	N/A	N/A	N/A	0
1	5	0	0	0	0	40
1	6	0	0	0	0	100
1	7	0	0	0	0	33
1	8	0	0	0	0	10
1	9	0	0	0	0	10
1	10	0	0	0	0	7
1	11	0	0	0	0	9
1	12	0	0	0	0	10
1	13	0	0	0	0	5
2	1	0	0	0	0	32
2	2	1	42	0	5	80
2	3	0	0	0	0	64
2	4	0	0	0	0	80
2	5	0	0	0	0	64
2	6	0	0	0	0	100
2	7	0	0	0	0	60
2	8	0	0	0	0	100
2	9	0	0	0	0	100
2	10	0	0	0	0	70
2	11	0	0	0	0	90
2	12	0	0	0	0	100
2	13	0	0	0	0	50
3	1	0	0	0	0	40
3	2	0	0	0	0	100
3	3	0	0	0	0	80
3	4	0	0	0	0	100
3	5	0	0	0	0	70
3	6	0	0	0	0	100
3	7	0	0	0	0	50
3	8	0	0	0	0	70
3	9	0	0	0	0	70
3	10	0	0	0	0	50

3	11	0	0	0	0	54
3	12	0	0	0	0	60
3	13	0	0	0	0	30
4	1	0	0	0	0	40
4	2	0	0	0	0	100
4	3	0	0	0	0	80
4	4	0	0	0	0	100
4	5	0	0	0	0	70
4	6	0	0	0	0	100
4	7	0	0	0	0	50
4	8	0	0	0	0	100
4	9	0	0	0	0	100
4	10	0	0	0	0	80
4	11	0	0	0	0	100
4	12	0	0	0	0	100
4	13	0	0	0	0	40
5	1	0	0	0	0	40
5	2	0	0	0	0	100
5	3	0	0	0	0	80
5	4	0	0	0	0	100
5	5	0	0	0	0	70
5	6	0	0	0	0	100
5	7	0	0	0	0	42
5	8	0	0	0	0	60
5	9	0	0	0	0	60
5	10	0	0	0	0	48
5	11	0	0	0	0	70
5	12	0	0	0	0	70
5	13	0	0	0	0	28
6	1	0	0	0	0	32
6	2	0	0	0	0	80
6	3	0	0	0	0	69
6	4	0	0	0	0	90
6	5	0	0	0	0	63
6	6	0	0	0	0	90
6	7	0	0	0	0	27
6	8	N/A	N/A	N/A	N/A	0
6	9	N/A	N/A	N/A	N/A	0

6	10	N/A	N/A	N/A	N/A	0
6	11	N/A	N/A	N/A	N/A	0
6	12	N/A	N/A	N/A	N/A	0
6	13	N/A	N/A	N/A	N/A	0
7	1	0	0	0	0	32
7	2	0	0	0	0	80
7	3	0	0	0	0	56
7	4	0	0	0	0	80
7	5	0	0	0	0	68
7	6	0	0	0	0	90
7	7	0	0	0	0	27
7	8	N/A	N/A	N/A	N/A	0
7	9	N/A	N/A	N/A	N/A	0
7	10	N/A	N/A	N/A	N/A	0
7	11	N/A	N/A	N/A	N/A	0
7	12	N/A	N/A	N/A	N/A	0
7	13	N/A	N/A	N/A	N/A	0
8	1	0	0	0	0	40
8	2	0	0	0	0	100
8	3	0	0	0	0	70
8	4	0	0	0	0	100
8	5	0	0	0	0	80
8	6	0	0	0	0	100
8	7	0	0	0	0	30
8	8	N/A	N/A	N/A	N/A	0
8	9	N/A	N/A	N/A	N/A	0
8	10	N/A	N/A	N/A	N/A	0
8	11	N/A	N/A	N/A	N/A	0
8	12	N/A	N/A	N/A	N/A	0
8	13	N/A	N/A	N/A	N/A	0
9	1	0	0	0	0	40
9	2	0	0	0	0	100
9	3	0	0	0	0	70
9	4	0	0	0	0	100
9	5	0	0	0	0	80
9	6	0	0	0	0	100
9	7	0	0	0	0	30
9	8	N/A	N/A	N/A	N/A	0

9	9	N/A	N/A	N/A	N/A	0
9	10	N/A	N/A	N/A	N/A	0
9	11	N/A	N/A	N/A	N/A	0
9	12	N/A	N/A	N/A	N/A	0
9	13	N/A	N/A	N/A	N/A	0
10	1	0	0	0	0	40
10	2	0	0	0	0	100
10	3	0	0	0	0	70
10	4	0	0	0	0	100
10	5	0	0	0	0	80
10	6	0	0	0	0	100
10	7	0	0	0	0	60
10	8	0	0	0	0	60
10	9	0	0	0	0	60
10	10	0	0	0	0	60
10	11	0	0	0	0	60
10	12	0	0	0	0	18
10	13	N/A	N/A	N/A	N/A	0
11	1	0	0	0	0	36
11	2	0	0	0	0	90
11	3	0	0	0	0	59
11	4	0	0	0	0	80
11	5	0	0	0	0	72
11	6	0	0	0	0	100
11	7	0	0	0	0	80
11	8	0	0	0	0	100
11	9	0	0	0	0	100
11	10	0	0	0	0	100
11	11	0	0	0	0	100
11	12	0	0	0	0	30
11	13	N/A	N/A	N/A	N/A	0
12	1	N/A	N/A	N/A	N/A	0
12	2	N/A	N/A	N/A	N/A	0
12	3	N/A	N/A	N/A	N/A	0
12	4	N/A	N/A	N/A	N/A	0
12	5	0	0	0	0	40
12	6	0	0	0	0	100
12	7	0	0	0	0	70

12	8	0	0	0	0	80
12	9	0	0	0	0	80
12	10	0	0	0	0	80
12	11	0	0	0	0	80
12	12	0	0	0	0	30
12	13	N/A	N/A	N/A	N/A	0
13	1	N/A	N/A	N/A	N/A	0
13	2	N/A	N/A	N/A	N/A	0
13	3	N/A	N/A	N/A	N/A	0
13	4	N/A	N/A	N/A	N/A	0
13	5	0	0	0	0	40
13	6	0	0	0	0	100
13	7	0	0	0	0	80
13	8	0	0	0	0	100
13	9	0	0	0	0	100
13	10	0	0	0	0	100
13	11	0	0	0	0	100
13	12	0	0	0	0	40
13	13	N/A	N/A	N/A	N/A	0
14	1	0	0	0	0	25
14	2	0	0	0	0	50
14	3	0	0	0	0	35
14	4	0	0	0	0	50
14	5	0	0	0	0	52
14	6	0	0	0	0	80
14	7	0	0	0	0	46
14	8	0	0	0	0	60
14	9	0	0	0	0	36
14	10	0	0	0	0	32
14	11	0	0	0	0	80
14	12	0	0	0	0	44
14	13	N/A	N/A	N/A	N/A	0
15	1	0	0	0	0	50
15	**2**	**3**	**1,147**	**0**	**22**	**100**
15	**3**	**94**	**3,985**	**0**	**355**	**70**
15	4	0	0	0	0	100
15	5	0	0	0	0	80
15	6	0	0	0	0	100

15	7	0	0	0	0	60
15	8	0	0	0	0	100
15	9	0	0	0	0	40
15	10	0	0	0	0	20
15	11	0	0	0	0	100
15	12	0	0	0	0	60
15	13	N/A	N/A	N/A	N/A	0
16	1	0	0	0	0	50
16	2	0	0	0	0	100
16	3	0	0	0	0	70
16	4	0	0	0	0	100
16	5	0	0	0	0	80
16	6	0	0	0	0	100
16	7	0	0	0	0	60
16	8	0	0	0	0	100
16	9	0	0	0	0	40
16	10	0	0	0	0	20
16	11	0	0	0	0	100
16	12	0	0	0	0	60
16	13	N/A	N/A	N/A	N/A	0
17	1	0	0	0	0	50
17	2	0	0	0	0	100
17	3	0	0	0	0	70
17	4	0	0	0	0	100
17	5	0	0	0	0	80
17	6	0	0	0	0	100
17	7	0	0	0	0	60
17	8	0	0	0	0	100
17	9	0	0	0	0	40
17	10	0	0	0	0	20
17	11	0	0	0	0	100
17	12	0	0	0	0	60
17	13	N/A	N/A	N/A	N/A	0
18	1	0	0	0	0	35
18	2	0	0	0	0	70
18	3	0	0	0	0	49
18	4	0	0	0	0	70
18	5	0	0	0	0	56

18	6	0	0	0	0	70
18	7	0	0	0	0	54
18	8	0	0	0	0	70
18	9	0	0	0	0	22
18	10	0	0	0	0	20
18	11	0	0	0	0	100
18	12	0	0	0	0	60
18	13	N/A	N/A	N/A	N/A	0
19	1	0	0	0	0	50
19	2	0	0	0	0	100
19	3	0	0	0	0	70
19	4	0	0	0	0	100
19	5	0	0	0	0	80
19	6	0	0	0	0	100
19	7	0	0	0	0	80
19	8	0	0	0	0	100
19	9	0	0	0	0	30
19	10	0	0	0	0	20
19	11	0	0	0	0	100
19	12	0	0	0	0	60
19	13	N/A	N/A	N/A	N/A	0
20	1	0	0	0	0	50
20	2	0	0	0	0	100
20	3	0	0	0	0	70
20	4	0	0	0	0	100
20	5	0	0	0	0	80
20	6	0	0	0	0	100
20	7	0	0	0	0	80
20	8	0	0	0	0	100
20	9	0	0	0	0	30
20	10	0	0	0	0	20
20	11	0	0	0	0	100
20	12	0	0	0	0	60
20	13	N/A	N/A	N/A	N/A	0
21	1	0	0	0	0	40
21	2	0	0	0	0	80
21	3	0	0	0	0	56
21	4	0	0	0	0	80

21	5	0	0	0	0	60
21	6	0	0	0	0	70
21	7	0	0	0	0	64
21	8	0	0	0	0	90
21	9	0	0	0	0	27
21	10	0	0	0	0	16
21	11	0	0	0	0	80
21	12	0	0	0	0	48
21	13	N/A	N/A	N/A	N/A	0
22	1	0	0	0	0	40
22	2	0	0	0	0	80
22	3	0	0	0	0	64
22	4	0	0	0	0	80
22	5	0	0	0	0	64
22	6	0	0	0	0	56
22	7	0	0	0	0	70
22	8	0	0	0	0	49
22	9	0	0	0	0	70
22	10	0	0	0	0	20
22	11	0	39	0	4	100
22	12	0	0	0	0	60
22	13	N/A	N/A	N/A	N/A	0
23	1	0	0	0	0	45
23	2	0	0	0	0	90
23	3	0	0	0	0	72
23	4	0	0	0	0	90
23	5	0	0	0	0	72
23	6	0	0	0	0	80
23	7	0	0	0	0	100
23	8	0	0	0	0	70
23	9	0	0	0	0	100
23	10	0	0	0	0	20
23	11	0	0	0	0	100
23	12	0	0	0	0	60
23	13	N/A	N/A	N/A	N/A	0
24	1	0	0	0	0	40
24	2	0	0	0	0	80
24	3	0	0	0	0	64

24	4	0	0	0	0	80
24	5	0	0	0	0	72
24	6	0	0	0	0	80
24	7	0	0	0	0	100
24	8	0	0	0	0	70
24	9	0	0	0	0	100
24	10	0	0	0	0	20
24	11	0	0	0	0	100
24	12	0	0	0	0	60
24	13	N/A	N/A	N/A	N/A	0
25	1	0	0	0	0	50
25	2	0	0	0	0	100
25	3	0	0	0	0	80
25	4	0	0	0	0	100
25	5	0	0	0	0	90
25	6	0	0	0	0	80
25	7	0	0	0	0	100
25	8	0	0	0	0	70
25	9	0	0	0	0	100
25	10	0	0	0	0	20
25	11	0	0	0	0	100
25	12	0	0	0	0	60
25	13	N/A	N/A	N/A	N/A	0
26	1	0	0	0	0	72
26	2	0	0	0	0	80
26	3	0	0	0	0	64
26	4	0	0	0	0	80
26	5	0	0	0	0	80
26	6	0	0	0	0	64
26	7	0	0	0	0	80
26	8	0	0	0	0	55
26	9	0	0	0	0	70
26	10	0	0	0	0	62
26	11	0	0	0	0	100
26	12	0	0	0	0	60
26	13	N/A	N/A	N/A	N/A	0
27	1	0	0	0	0	81
27	2	0	0	0	0	90

27	3	0	0	0	0	74
27	4	0	0	0	0	100
27	5	0	0	0	0	100
27	6	0	0	0	0	80
27	7	0	0	0	0	100
27	8	0	0	0	0	70
27	9	0	0	0	0	100
27	10	0	0	0	0	80
27	11	0	0	0	0	100
27	12	0	0	0	0	60
27	13	N/A	N/A	N/A	N/A	0
28	1	0	0	0	0	45
28	2	0	0	0	0	90
28	3	1	40	0	5	70
28	4	0	0	0	0	80
28	5	0	0	0	0	80
28	6	0	0	0	0	20
28	7	0	0	0	0	100
28	8	0	0	0	0	70
28	9	0	0	0	0	100
28	10	0	0	0	0	80
28	11	0	0	0	0	100
28	12	0	0	0	0	60
28	13	N/A	N/A	N/A	N/A	0
29	1	0	0	0	0	45
29	2	0	0	0	0	90
29	3	2	83	0	10	72
29	4	0	0	0	0	90
29	5	0	0	0	0	90
29	6	0	0	0	0	20
29	7	0	0	0	0	100
29	8	0	0	0	0	70
29	9	0	0	0	0	100
29	10	0	0	0	0	80
29	11	0	0	0	0	100
29	12	0	0	0	0	60
29	13	N/A	N/A	N/A	N/A	0
30	1	N/A	N/A	N/A	N/A	0

30	2	N/A	N/A	N/A	N/A	0
30	3	N/A	N/A	N/A	N/A	0
30	4	N/A	N/A	N/A	N/A	0
30	5	N/A	N/A	N/A	N/A	0
30	6	0	0	0	0	14
30	7	0	0	0	0	70
30	8	0	0	0	0	50
30	9	0	0	0	0	80
30	10	1	41	0	5	64
30	11	0	0	0	0	80
30	12	0	0	0	0	48
30	13	N/A	N/A	N/A	N/A	0

The X and Y columns reference the grids of Figures 1 and 2. Bold text denotes grids which exceed the investigation criteria. When '100' is indicated in the 'Areas' column, the grid is a full square meter. The mean is the average of all measurements in the grid. The standard deviation is calculated from pixels that contain data. All units (i.e. mean, max, and standard deviation) are in dpm per 100cm^2. Meters with no recorded data are not displayed.

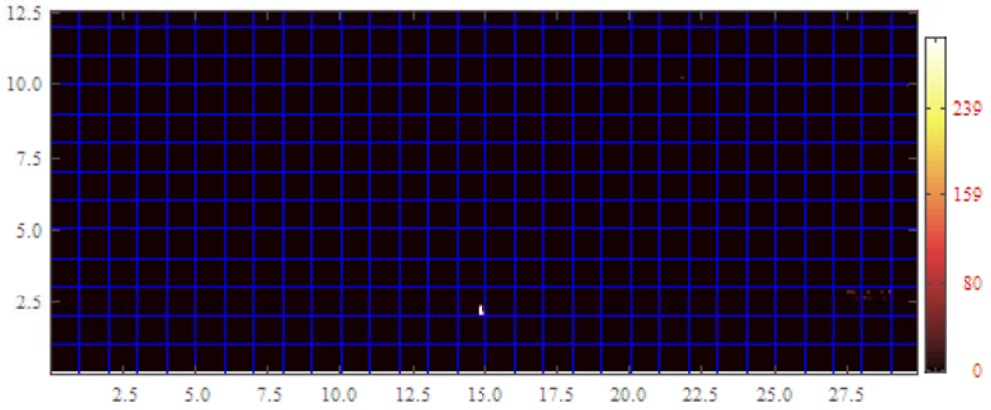


Figure 4: Yellow denotes meter grids that exceed criteria , while red corresponds to 100cm^2 areas exceeding criteria.

Investigation Table

Type	Value	Strip	Location From SW of Survey (X,Y)cm	Location From SW of Strip (X,Y)cm	Grid (X,Y)	Inv (Counts)	Count Time
Spot	3985	22	(1480,210)	(130,155)	N/A		
Spot	504	22	(1480,225)	(130,170)	N/A		
Spot	241	22	(1480,195)	(130,140)	N/A		

This table details the location of values that exceed criteria. In the case to 100 cm^2 (spot) alarms both the SCM strip number and the location relative to the south west corner of the survey. In the case of square meter (Average) alarms the meter grid coordinates are given.

Survey Report

Survey File Name:	FB0102A
Survey Date:	July 5, 2012
Survey Equipment:	SCM6
Detector(s):	R180
Surveyor(s):	THROWER
Criteria	
Any 100 cm^2 Measurement:	5,000 net dpm/100 cm^2
Average Over Any 1 m^2:	5,000 net dpm/100 cm^2
System Information	
Background:	R180: 904 cpm
Efficiency (100 cm^2):	R180: 31.2%
SIMS Version:	V5.3m
SCM Version:	V3.4d
Survey Results	
Maximum 100 cm^2:	Below Criteria
Maximum m^2 Average:	Below Criteria
Area Exceeding 100 cm^2 Levels:	0.00 m^2

The lower left corner of all images corresponds to the south west corner of the survey.

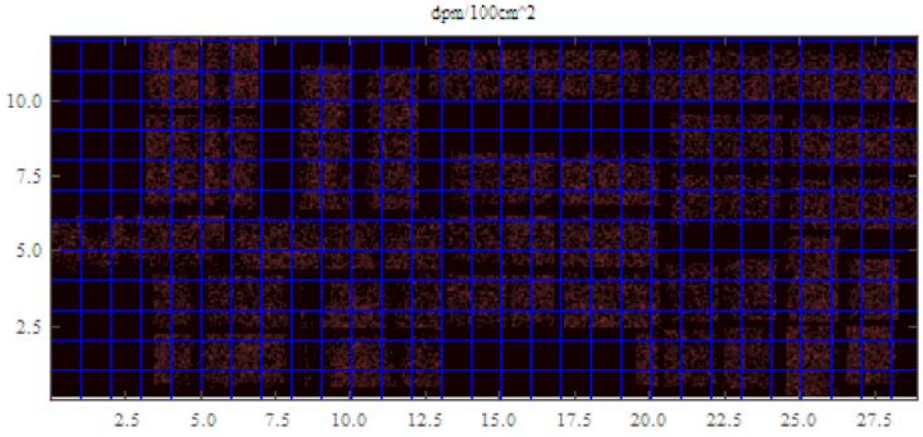


Figure 1: Meter Grid overlaid onto image plot of 100cm² areas. The color scale is in dpm per 100cm².

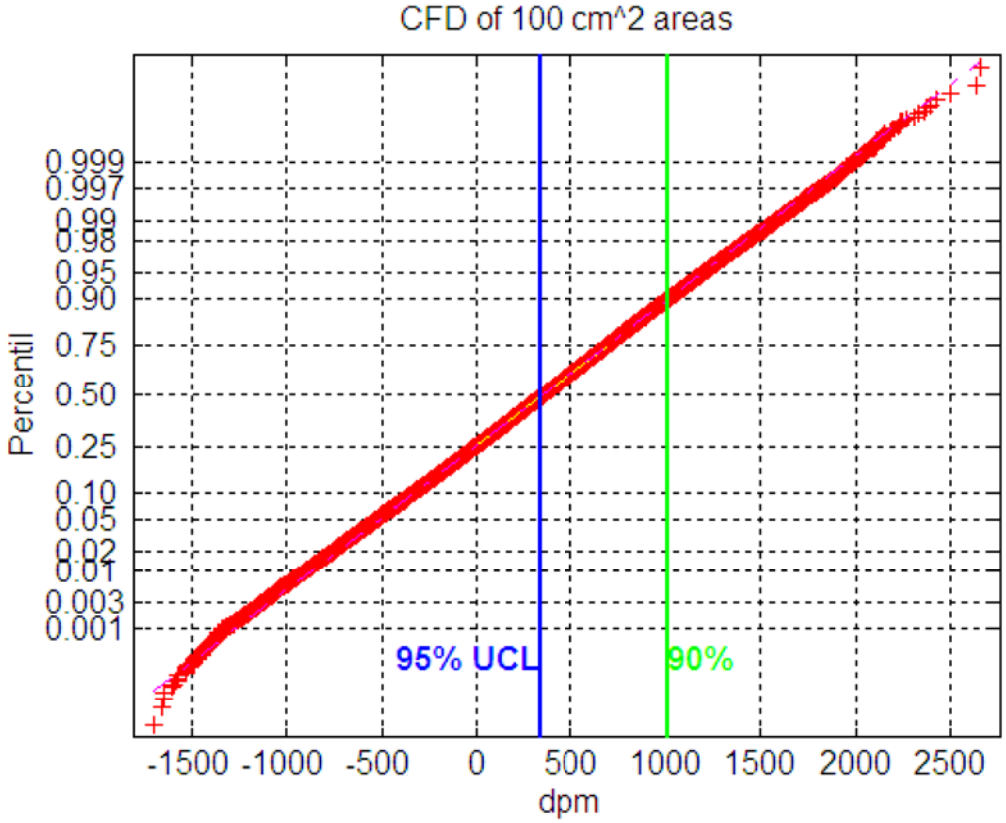


Figure 2: CFD of surface activity in 100cm² areas. The horizontal scale is in dpm per 100cm².

Meter Grid Summary Table

X	Y	Mean dpm/100cm^2	Max dpm/100cm^2	Min dpm/100cm^2	Std dpm/100cm^2	100cm^2 Areas
1	1	N/A	N/A	N/A	N/A	0
1	2	N/A	N/A	N/A	N/A	0
1	3	N/A	N/A	N/A	N/A	0
1	4	N/A	N/A	N/A	N/A	0
1	5	102	1,245	-1,160	452	70
1	6	298	1,840	-604	510	100
1	7	-73	711	-1,047	573	10
1	8	N/A	N/A	N/A	N/A	0
1	9	N/A	N/A	N/A	N/A	0
1	10	N/A	N/A	N/A	N/A	0
1	11	N/A	N/A	N/A	N/A	0
1	12	N/A	N/A	N/A	N/A	0
1	13	N/A	N/A	N/A	N/A	0
2	1	N/A	N/A	N/A	N/A	0
2	2	N/A	N/A	N/A	N/A	0
2	3	N/A	N/A	N/A	N/A	0
2	4	N/A	N/A	N/A	N/A	0
2	5	205	1,765	-808	456	70
2	6	31	1,764	-1,358	571	100
2	7	-34	698	-683	515	10
2	8	N/A	N/A	N/A	N/A	0
2	9	N/A	N/A	N/A	N/A	0
2	10	N/A	N/A	N/A	N/A	0
2	11	N/A	N/A	N/A	N/A	0
2	12	N/A	N/A	N/A	N/A	0
2	13	N/A	N/A	N/A	N/A	0
3	1	N/A	N/A	N/A	N/A	0
3	2	N/A	N/A	N/A	N/A	0
3	3	N/A	N/A	N/A	N/A	0
3	4	N/A	N/A	N/A	N/A	0
3	5	-84	1,449	-1,164	595	70
3	6	330	1,730	-643	503	100
3	7	603	1,642	-416	654	10
3	8	N/A	N/A	N/A	N/A	0
3	9	N/A	N/A	N/A	N/A	0
3	10	N/A	N/A	N/A	N/A	0

3	11	N/A	N/A	N/A	N/A	0
3	12	N/A	N/A	N/A	N/A	0
3	13	N/A	N/A	N/A	N/A	0
4	1	353	1,536	-1,068	651	30
4	2	637	1,826	-290	428	50
4	3	376	1,691	-377	401	46
4	4	451	1,815	-526	405	60
4	5	103	1,289	-1,031	524	76
4	6	412	1,712	-790	405	100
4	7	525	1,855	-376	404	50
4	8	569	2,246	-291	440	80
4	9	588	1,833	-291	433	80
4	10	353	2,135	-694	472	64
4	11	601	1,902	-702	512	80
4	12	702	2,121	-646	466	80
4	13	722	1,471	327	356	8
5	1	-126	1,147	-1,436	483	60
5	2	210	1,612	-1,312	570	100
5	3	74	1,582	-1,362	618	80
5	4	23	1,343	-1,274	593	100
5	5	100	2,113	-892	570	80
5	6	389	1,798	-668	469	100
5	7	508	2,378	-689	530	55
5	8	435	1,716	-987	519	90
5	9	429	1,558	-694	442	90
5	10	563	2,059	-508	442	72
5	11	733	1,840	-375	497	90
5	12	755	1,962	-248	442	90
5	13	760	2,181	-432	745	9
6	1	234	1,872	-1,092	571	60
6	2	319	1,830	-899	499	100
6	3	112	1,576	-1,073	578	80
6	4	100	1,594	-1,086	500	100
6	5	-119	1,294	-1,262	548	66
6	6	421	1,579	-586	417	80
6	7	420	2,656	-1,295	693	62
6	8	462	2,362	-1,044	646	90
6	9	459	1,898	-726	562	90

6	10	89	1,682	-985	418	72
6	11	255	1,591	-777	509	90
6	12	341	1,697	-748	501	90
6	13	357	1,569	-316	497	9
7	1	335	1,673	-601	464	60
7	2	590	2,226	-790	485	100
7	3	435	1,671	-471	459	80
7	4	293	1,746	-719	450	100
7	5	375	1,740	-875	490	80
7	6	318	1,977	-892	477	100
7	7	331	2,049	-876	579	64
7	8	442	1,695	-814	513	90
7	9	348	1,979	-938	525	90
7	10	461	1,800	-709	493	72
7	11	715	2,121	-380	539	90
7	12	762	2,184	-495	521	90
7	13	763	1,305	128	378	9
8	1	124	1,975	-1,520	679	60
8	2	260	1,712	-984	600	100
8	3	290	2,021	-908	516	80
8	4	137	1,809	-1,431	572	100
8	5	649	1,944	-742	483	80
8	6	342	1,502	-738	434	100
8	7	-184	467	-848	398	10
8	8	N/A	N/A	N/A	N/A	0
8	9	N/A	N/A	N/A	N/A	0
8	10	N/A	N/A	N/A	N/A	0
8	11	N/A	N/A	N/A	N/A	0
8	12	N/A	N/A	N/A	N/A	0
8	13	N/A	N/A	N/A	N/A	0
9	1	-151	1,287	-1,122	478	36
9	2	-393	638	-1,398	504	60
9	3	-342	1,291	-1,175	510	54
9	4	-496	782	-1,262	355	70
9	5	411	2,400	-1,387	623	77
9	6	298	1,685	-799	421	100
9	7	335	1,972	-1,110	569	66
9	8	410	1,723	-687	501	80

9	9	394	2,111	-703	519	80
9	10	391	1,872	-705	490	80
9	11	415	1,725	-844	580	80
9	12	529	1,006	-195	408	8
9	13	N/A	N/A	N/A	N/A	0
10	1	373	1,670	-861	597	60
10	2	293	1,818	-1,085	571	100
10	3	404	1,956	-1,274	625	80
10	4	228	1,569	-970	524	100
10	5	229	1,809	-1,030	525	80
10	6	166	1,465	-825	482	100
10	7	369	1,867	-1,030	542	80
10	8	398	1,691	-713	525	100
10	9	426	1,759	-642	428	100
10	10	480	2,065	-774	493	100
10	11	639	1,937	-374	438	100
10	12	541	1,117	18	389	10
10	13	N/A	N/A	N/A	N/A	0
11	1	581	1,892	-378	462	60
11	2	575	1,915	-285	415	100
11	3	494	2,112	-767	513	80
11	4	337	2,329	-848	523	100
11	5	263	1,948	-983	534	80
11	6	200	1,352	-780	439	100
11	7	73	1,203	-1,228	583	45
11	8	311	1,468	-602	398	50
11	9	208	1,752	-715	453	50
11	10	263	1,688	-915	451	50
11	11	296	1,494	-475	450	50
11	12	N/A	N/A	N/A	N/A	0
11	13	N/A	N/A	N/A	N/A	0
12	1	177	1,496	-1,133	520	60
12	2	13	2,127	-1,095	554	100
12	3	-22	1,460	-1,270	550	80
12	4	-46	1,140	-1,240	455	100
12	5	329	1,802	-923	567	80
12	6	128	1,312	-1,138	504	100
12	7	215	1,530	-1,115	554	80

12	8	406	2,024	-642	466	100
12	9	413	1,936	-1,000	484	100
12	10	580	1,963	-317	413	100
12	11	502	1,796	-506	499	100
12	12	N/A	N/A	N/A	N/A	0
12	13	N/A	N/A	N/A	N/A	0
13	1	439	2,152	-294	421	60
13	2	315	1,945	-768	461	100
13	3	281	2,016	-748	504	74
13	4	273	1,459	-685	433	90
13	5	437	1,733	-760	401	79
13	6	321	1,843	-662	457	100
13	7	211	1,446	-649	482	24
13	8	451	2,023	-629	537	20
13	9	583	1,761	-422	477	20
13	10	429	1,844	-544	528	24
13	11	297	1,506	-690	430	60
13	12	514	2,026	-289	604	24
13	13	N/A	N/A	N/A	N/A	0
14	1	N/A	N/A	N/A	N/A	0
14	2	N/A	N/A	N/A	N/A	0
14	3	139	1,173	-764	391	48
14	4	444	1,787	-780	458	80
14	5	-35	1,258	-1,032	441	56
14	6	170	1,893	-924	465	80
14	7	111	1,369	-1,224	553	50
14	8	317	2,000	-1,020	500	70
14	9	437	1,565	-513	443	14
14	10	-118	915	-851	478	10
14	11	295	1,648	-908	443	100
14	12	469	1,697	-786	432	60
14	13	N/A	N/A	N/A	N/A	0
15	1	N/A	N/A	N/A	N/A	0
15	2	N/A	N/A	N/A	N/A	0
15	3	186	1,482	-1,105	575	60
15	4	365	1,744	-570	421	100
15	5	142	1,570	-709	496	70
15	6	248	1,414	-1,437	491	100

15	7	75	1,313	-840	426	70
15	8	307	1,658	-899	395	100
15	9	398	2,040	-833	609	20
15	10	-254	1,019	-742	421	10
15	11	310	1,990	-563	448	100
15	12	398	1,746	-574	482	60
15	13	N/A	N/A	N/A	N/A	0
16	1	N/A	N/A	N/A	N/A	0
16	2	N/A	N/A	N/A	N/A	0
16	3	195	1,685	-942	442	60
16	4	383	1,638	-1,019	480	100
16	5	238	1,868	-1,166	543	70
16	6	456	1,749	-761	458	100
16	7	272	1,457	-827	555	70
16	8	412	2,499	-717	462	100
16	9	493	1,486	-224	422	20
16	10	-300	898	-838	403	10
16	11	301	1,630	-982	515	100
16	12	502	1,957	-842	557	60
16	13	N/A	N/A	N/A	N/A	0
17	1	N/A	N/A	N/A	N/A	0
17	2	N/A	N/A	N/A	N/A	0
17	3	253	1,504	-719	490	48
17	4	592	1,828	-276	402	80
17	5	464	1,644	-597	508	50
17	6	497	2,064	-673	486	70
17	7	375	1,555	-473	520	55
17	8	504	1,881	-503	481	80
17	9	486	1,925	-659	579	16
17	10	-383	535	-1,464	516	10
17	11	337	1,708	-610	476	100
17	12	479	1,829	-388	457	60
17	13	N/A	N/A	N/A	N/A	0
18	1	N/A	N/A	N/A	N/A	0
18	2	N/A	N/A	N/A	N/A	0
18	3	568	1,760	-591	454	54
18	4	385	1,874	-648	449	90
18	5	381	1,991	-842	516	78

18	6	459	1,870	-550	425	100
18	7	467	2,103	-853	530	70
18	8	498	2,005	-449	485	100
18	9	-167	892	-1,185	502	20
18	10	-123	1,149	-536	355	10
18	11	333	2,080	-870	492	100
18	12	457	2,004	-433	461	60
18	13	N/A	N/A	N/A	N/A	0
19	1	N/A	N/A	N/A	N/A	0
19	2	N/A	N/A	N/A	N/A	0
19	3	620	2,236	-488	547	60
19	4	423	1,857	-689	460	100
19	5	507	2,640	-1,291	644	80
19	6	407	1,727	-665	499	100
19	7	366	1,710	-910	540	70
19	8	451	1,916	-717	566	100
19	9	-75	923	-789	462	20
19	10	-11	1,136	-260	216	10
19	11	313	1,613	-858	433	100
19	12	439	1,765	-638	456	60
19	13	N/A	N/A	N/A	N/A	0
20	1	725	1,577	-92	433	25
20	2	628	1,595	-367	420	50
20	3	525	1,909	-399	501	70
20	4	447	2,046	-773	478	100
20	5	411	2,039	-821	535	80
20	6	424	2,114	-579	450	100
20	7	549	2,013	-467	530	70
20	8	433	2,114	-654	485	100
20	9	-180	1,090	-1,384	641	20
20	10	-161	1,686	-763	512	8
20	11	271	1,747	-972	480	80
20	12	432	1,295	-365	410	48
20	13	N/A	N/A	N/A	N/A	0
21	1	288	1,428	-535	387	35
21	2	393	1,932	-878	480	70
21	3	230	1,845	-745	598	56
21	4	145	1,814	-1,572	575	80

21	5	169	1,437	-777	527	46
21	6	291	1,579	-531	531	29
21	7	357	2,311	-1,063	665	44
21	8	294	1,725	-949	508	41
21	9	249	1,384	-904	474	34
21	10	291	1,396	-771	479	22
21	11	357	1,700	-1,035	475	100
21	12	254	1,373	-762	465	60
21	13	N/A	N/A	N/A	N/A	0
22	1	252	1,600	-800	438	50
22	2	229	1,665	-519	372	100
22	3	266	1,740	-1,046	456	70
22	4	180	1,446	-807	471	100
22	5	293	1,504	-775	454	50
22	6	-76	1,006	-780	367	30
22	7	225	1,617	-847	433	100
22	8	244	2,157	-1,274	596	70
22	9	298	1,741	-921	457	100
22	10	394	1,602	-409	494	50
22	11	457	1,715	-589	460	100
22	12	301	1,941	-837	534	60
22	13	N/A	N/A	N/A	N/A	0
23	1	381	1,933	-731	521	46
23	2	315	1,526	-1,106	462	80
23	3	193	1,515	-838	516	56
23	4	242	1,713	-647	486	80
23	5	254	1,342	-887	487	46
23	6	-26	1,210	-712	399	30
23	7	234	1,428	-921	455	100
23	8	156	1,731	-820	511	70
23	9	232	1,894	-971	468	100
23	10	355	1,562	-890	476	50
23	11	433	2,027	-604	424	100
23	12	279	1,355	-674	476	60
23	13	N/A	N/A	N/A	N/A	0
24	1	275	1,896	-674	439	60
24	2	232	1,315	-810	407	100
24	3	265	1,855	-679	496	70

24	4	315	1,700	-508	484	100
24	5	377	1,639	-1,113	521	60
24	6	-178	911	-916	374	30
24	7	224	1,614	-570	413	100
24	8	74	1,490	-1,064	486	70
24	9	309	2,124	-878	452	100
24	10	422	1,954	-860	490	50
24	11	503	1,926	-963	495	100
24	12	204	1,850	-751	493	60
24	13	N/A	N/A	N/A	N/A	0
25	1	551	1,796	-975	525	60
25	2	519	2,114	-927	549	70
25	3	465	1,660	-889	606	61
25	4	293	1,891	-913	516	70
25	5	256	2,136	-1,254	614	66
25	6	328	1,599	-926	459	45
25	7	298	1,611	-742	476	70
25	8	249	1,605	-1,117	470	49
25	9	384	1,587	-388	435	70
25	10	208	1,459	-1,354	511	38
25	11	385	1,635	-582	488	100
25	12	154	1,428	-1,106	464	60
25	13	N/A	N/A	N/A	N/A	0
26	1	496	1,630	-538	436	90
26	2	600	2,431	-809	505	100
26	3	511	2,237	-388	409	90
26	4	609	2,128	-762	476	100
26	5	530	1,697	-359	446	100
26	6	465	1,869	-618	503	70
26	7	406	1,818	-365	437	100
26	8	263	1,531	-808	481	70
26	9	475	1,938	-813	546	100
26	10	186	1,440	-475	401	50
26	11	499	1,824	-421	466	100
26	12	255	1,285	-1,056	532	60
26	13	N/A	N/A	N/A	N/A	0
27	1	266	1,506	-1,126	616	48
27	2	431	1,773	-836	495	80

27	3	377	1,938	-1,096	640	66
27	4	280	1,862	-1,038	561	80
27	5	400	1,905	-1,020	528	56
27	6	554	1,929	-590	611	38
27	7	417	1,640	-542	447	100
27	8	330	1,740	-591	469	70
27	9	448	1,819	-724	412	100
27	10	303	1,917	-472	448	50
27	11	507	1,918	-488	487	100
27	12	256	1,525	-725	489	60
27	13	N/A	N/A	N/A	N/A	0
28	1	370	2,021	-767	522	50
28	2	559	1,588	-488	430	100
28	3	640	2,190	-271	448	80
28	4	558	1,946	-870	467	100
28	5	659	2,151	-813	509	60
28	6	536	1,464	-363	431	30
28	7	349	1,576	-815	430	100
28	8	235	1,354	-1,171	403	70
28	9	465	2,155	-779	543	100
28	10	285	1,891	-869	546	50
28	11	576	2,067	-555	545	100
28	12	310	1,634	-1,027	525	60
28	13	N/A	N/A	N/A	N/A	0
29	1	174	877	-901	535	10
29	2	43	1,202	-1,204	520	20
29	3	300	1,617	-1,165	789	16
29	4	699	1,649	-184	459	20
29	5	710	1,947	-189	521	12
29	6	422	1,905	-643	529	27
29	7	387	1,528	-865	471	90
29	8	219	1,352	-1,077	493	60
29	9	472	1,875	-488	423	80
29	10	261	1,970	-855	568	40
29	11	651	1,935	-615	495	80
29	12	463	2,035	-713	533	48
29	13	N/A	N/A	N/A	N/A	0

The X and Y columns reference the grids of Figures 1 and 2. Bold text denotes grids which exceed the investigation criteria. When '100' is indicated in the 'Areas' column, the grid is a full square meter. The mean is the average of all measurements in the grid. The standard deviation is calculated from pixels that contain data. All units (i.e. mean, max, and standard deviation) are in dpm per 100cm^2. Meters with no recorded data are not displayed.

Survey Report

Survey File Name:	FB0102B
Survey Date:	July 10, 2012
Survey Equipment:	SCM1
Detector(s):	C180
Surveyor(s):	THROWER
Criteria	
Any 100 cm^2 Measurement:	5,000 net dpm/100 cm^2
Average Over Any 1 m^2:	5,000 net dpm/100 cm^2
System Information	
Background:	C180: 1,262 cpm
Efficiency (100 cm^2):	C180: 19.5%
SIMS Version:	V5.3m
SCM Version:	V3.4a
Survey Results	
Maximum 100 cm^2:	Below Criteria
Maximum m^2 Average:	Below Criteria
Area Exceeding 100 cm^2 Levels:	0.00 m^2

This survey is not position correlated.

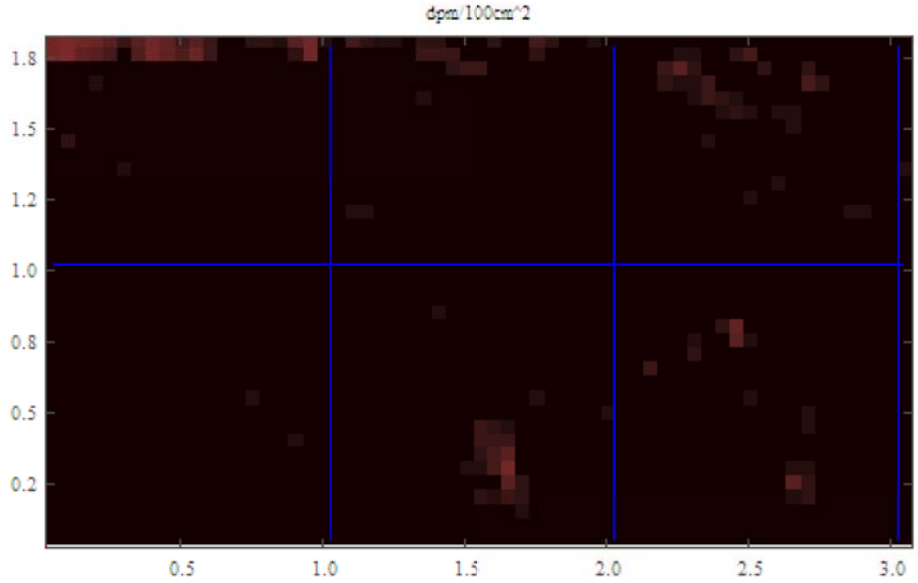


Figure 1: Meter Grid overlaid onto image plot of 100cm² areas. The color scale is in dpm per 100cm².

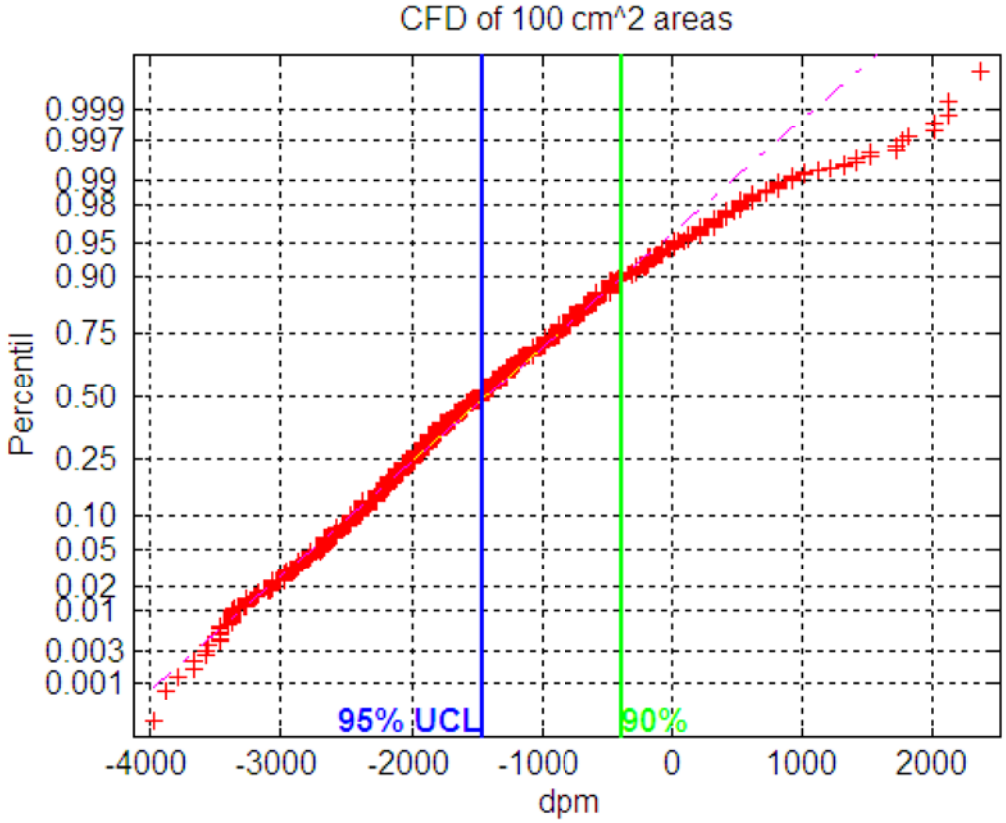


Figure 2: CFD of surface activity in 100cm² areas. The horizontal scale is in dpm per 100cm².

Meter Grid Summary Table

X	Y	Mean dpm/100cm^2	Max dpm/100cm^2	Min dpm/100cm^2	Std dpm/100cm^2	100cm^2 Areas
1	1	-1,767	128	-3,972	737	100
1	2	-1,337	2,430	-3,192	1,112	80
2	1	-1,476	2,128	-3,885	961	100
2	2	-1,317	864	-3,372	743	80
3	1	-1,459	1,729	-3,672	874	100
3	2	-1,303	1,328	-3,272	883	80

The X and Y columns reference the grids of Figures 1 and 2. Bold text denotes grids which exceed the investigation criteria. When '100' is indicated in the 'Areas' column, the grid is a full square meter. The mean is the average of all measurements in the grid. The standard deviation is calculated from pixels that contain data. All units (i.e. mean, max, and standard deviation) are in dpm per 100cm^2. Meters with no recorded data are not displayed.

Survey Report

Survey File Name:	FB0102J
Survey Date:	July 5, 2012
Survey Equipment:	SCM6
Detector(s):	R180
Surveyor(s):	THROWER
Criteria	
Any 100 cm^2 Measurement:	5,000 net dpm/100 cm^2
Average Over Any 1 m^2:	5,000 net dpm/100 cm^2
System Information	
Background:	R180: 904 cpm
Efficiency (100 cm^2):	R180: 31.2%
SIMS Version:	V5.3m
SCM Version:	V3.4d
Survey Results	
Maximum 100 cm^2:	**39,118 dpm/100 cm^2**
Maximum m^2 Average:	Below Criteria
Area Exceeding 100 cm^2 Levels:	0.07 m^2

The lower left corner of all images corresponds to the south west corner of the survey.

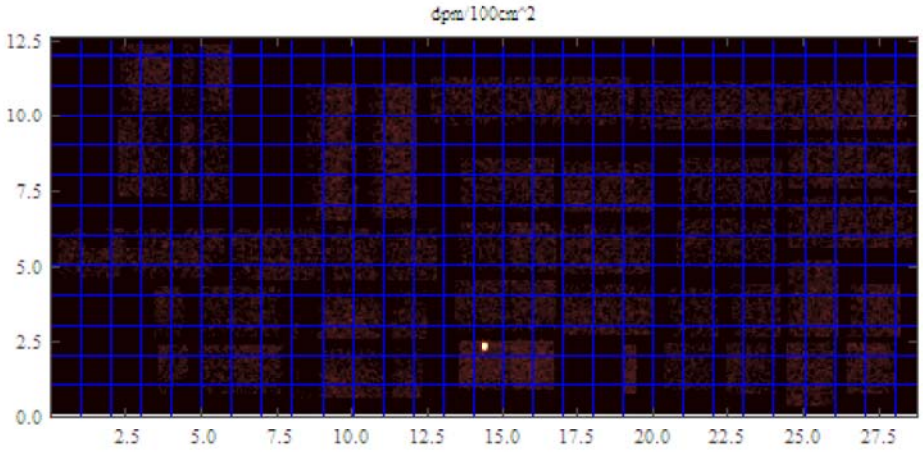


Figure 1: Meter Grid overlaid onto image plot of 100cm² areas. The color scale is in dpm per 100cm².

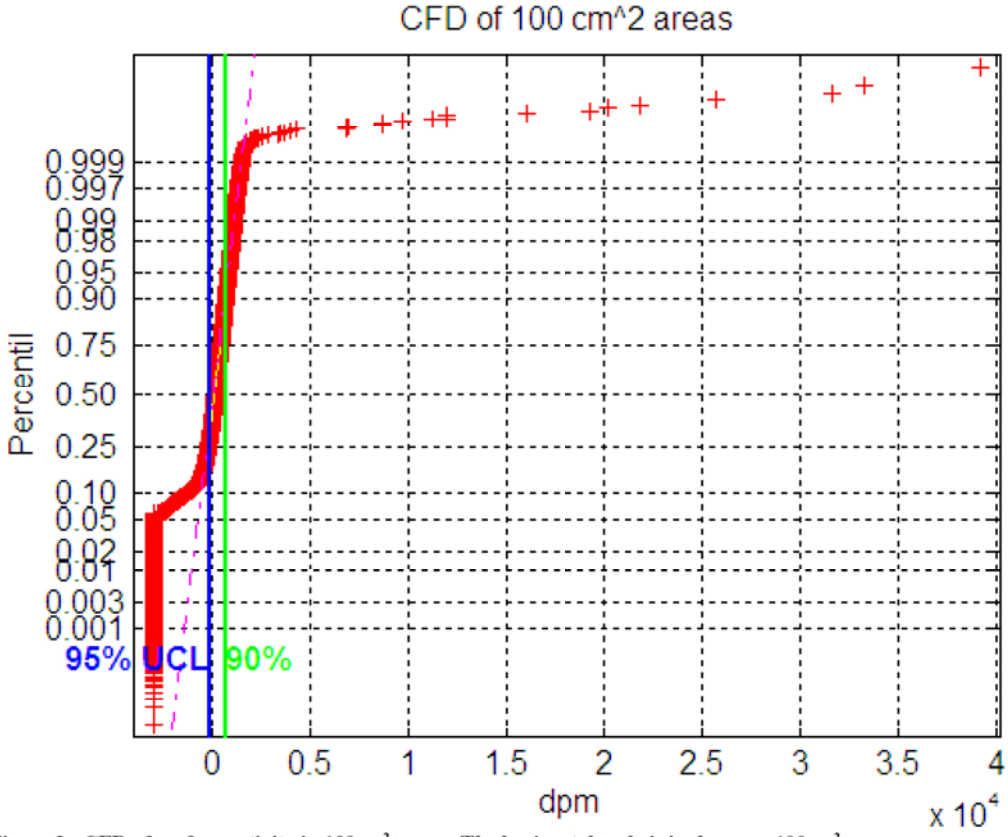


Figure 2: CFD of surface activity in 100cm² areas. The horizontal scale is in dpm per 100cm².

Meter Grid Summary Table

X	Y	Mean dpm/100cm^2	Max dpm/100cm^2	Min dpm/100cm^2	Std dpm/100cm^2	100cm^2 Areas
1	1	N/A	N/A	N/A	N/A	0
1	2	N/A	N/A	N/A	N/A	0
1	3	N/A	N/A	N/A	N/A	0
1	4	N/A	N/A	N/A	N/A	0
1	5	-889	1,131	-2,897	1,248	50
1	6	-509	1,693	-2,897	1,341	100
1	7	-852	456	-2,897	1,174	20
1	8	N/A	N/A	N/A	N/A	0
1	9	N/A	N/A	N/A	N/A	0
1	10	N/A	N/A	N/A	N/A	0
1	11	N/A	N/A	N/A	N/A	0
1	12	N/A	N/A	N/A	N/A	0
1	13	N/A	N/A	N/A	N/A	0
2	1	N/A	N/A	N/A	N/A	0
2	2	N/A	N/A	N/A	N/A	0
2	3	N/A	N/A	N/A	N/A	0
2	4	N/A	N/A	N/A	N/A	0
2	5	-168	806	-1,813	712	50
2	6	60	1,215	-1,121	491	100
2	7	-319	648	-809	388	20
2	8	N/A	N/A	N/A	N/A	0
2	9	N/A	N/A	N/A	N/A	0
2	10	N/A	N/A	N/A	N/A	0
2	11	N/A	N/A	N/A	N/A	0
2	12	N/A	N/A	N/A	N/A	0
2	13	N/A	N/A	N/A	N/A	0
3	1	N/A	N/A	N/A	N/A	0
3	2	N/A	N/A	N/A	N/A	0
3	3	N/A	N/A	N/A	N/A	0
3	4	N/A	N/A	N/A	N/A	0
3	5	-463	1,083	-2,034	770	50
3	6	206	1,242	-839	448	100
3	7	162	1,201	-682	480	20
3	8	-270	1,566	-2,897	1,354	80
3	9	353	1,132	-255	293	80
3	10	330	1,343	-259	319	72

3	11	-166	1,170	-2,897	1,011	72
3	12	-82	1,171	-2,897	1,122	80
3	13	-576	1,004	-2,897	1,509	40
4	1	-1,501	766	-2,897	1,383	28
4	2	-877	1,130	-2,897	1,413	70
4	3	-867	1,407	-2,897	1,394	60
4	4	-524	1,034	-2,897	1,406	80
4	5	-284	1,395	-2,897	1,064	74
4	6	319	1,394	-339	309	100
4	7	175	662	-223	281	20
4	8	-618	1,171	-2,897	1,331	100
4	9	-63	1,324	-2,515	766	100
4	10	-113	970	-2,319	704	90
4	11	423	1,401	-424	334	90
4	12	542	1,483	-179	330	100
4	13	-58	1,273	-2,897	1,499	50
5	1	-1,014	313	-2,897	1,136	40
5	2	-141	978	-1,046	474	100
5	3	-397	1,089	-2,043	711	80
5	4	-225	989	-1,360	475	100
5	5	-157	1,113	-1,726	634	80
5	6	333	1,488	-607	314	100
5	7	-718	1,737	-2,897	1,365	27
5	8	-55	1,439	-2,897	1,032	70
5	9	197	1,444	-784	437	70
5	10	203	1,405	-688	391	63
5	11	-318	936	-1,620	567	63
5	12	-241	720	-1,583	571	70
5	13	-675	684	-2,897	1,268	35
6	1	-676	726	-2,897	1,326	40
6	2	184	1,285	-532	344	100
6	3	-66	1,167	-1,772	668	80
6	4	125	1,055	-511	318	100
6	5	-92	1,007	-1,866	684	70
6	6	252	1,223	-799	330	80
6	7	-824	1,132	-2,897	1,688	26
6	8	-180	1,056	-2,897	995	100
6	9	-16	1,066	-1,331	411	100

6	10	-31	1,081	-1,018	416	90
6	11	323	1,567	-487	400	90
6	12	406	1,477	-544	351	100
6	13	-126	1,287	-2,897	1,506	50
7	1	-733	961	-2,897	1,294	40
7	2	353	1,241	-363	301	100
7	3	106	1,166	-1,782	699	80
7	4	239	1,301	-521	287	100
7	5	168	1,344	-692	347	80
7	6	235	1,456	-518	352	100
7	7	-556	1,046	-2,427	1,139	30
7	8	N/A	N/A	N/A	N/A	0
7	9	N/A	N/A	N/A	N/A	0
7	10	N/A	N/A	N/A	N/A	0
7	11	N/A	N/A	N/A	N/A	0
7	12	N/A	N/A	N/A	N/A	0
7	13	N/A	N/A	N/A	N/A	0
8	1	-779	1,024	-2,897	1,236	32
8	2	52	998	-1,216	457	80
8	3	-22	1,164	-2,007	750	64
8	4	-73	1,063	-1,033	469	80
8	5	302	1,377	-898	409	74
8	6	314	1,407	-357	333	100
8	7	-555	1,030	-2,338	1,203	30
8	8	N/A	N/A	N/A	N/A	0
8	9	N/A	N/A	N/A	N/A	0
8	10	N/A	N/A	N/A	N/A	0
8	11	N/A	N/A	N/A	N/A	0
8	12	N/A	N/A	N/A	N/A	0
8	13	N/A	N/A	N/A	N/A	0
9	1	-244	629	-824	317	40
9	2	-469	619	-1,212	375	100
9	3	-601	812	-2,492	739	80
9	4	-391	725	-1,241	333	100
9	5	-117	1,208	-1,689	653	80
9	6	248	1,221	-486	324	100
9	7	-265	1,005	-2,252	779	60
9	8	-282	1,093	-1,808	709	60

9	9	-294	817	-1,976	667	60
9	10	-169	912	-1,625	676	60
9	11	-201	737	-1,685	636	60
9	12	-2,484	0	-2,897	456	12
9	13	N/A	N/A	N/A	N/A	0
10	1	574	1,478	-151	281	40
10	2	447	1,490	-230	349	100
10	3	52	1,420	-2,483	924	80
10	4	431	1,764	-574	412	100
10	5	-64	1,024	-1,356	491	80
10	6	170	1,169	-487	331	100
10	7	314	1,626	-642	443	80
10	8	457	1,693	-728	405	100
10	9	465	1,613	-469	349	100
10	10	443	1,570	-559	404	100
10	11	521	1,553	-694	350	100
10	12	-2,423	0	-2,897	500	20
10	13	N/A	N/A	N/A	N/A	0
11	1	427	1,332	-109	290	40
11	2	218	1,318	-813	413	100
11	3	-103	1,299	-2,415	918	80
11	4	243	1,658	-787	401	100
11	5	-86	1,463	-1,277	516	80
11	6	166	1,143	-1,022	357	100
11	7	-245	922	-2,897	965	70
11	8	-272	1,248	-2,897	1,062	80
11	9	-274	1,449	-2,897	1,081	80
11	10	-324	1,271	-2,897	1,055	80
11	11	-257	1,214	-2,897	1,087	80
11	12	-2,550	0	-2,897	416	16
11	13	N/A	N/A	N/A	N/A	0
12	1	216	1,064	-1,033	435	40
12	2	-31	1,250	-1,005	483	100
12	3	-345	1,224	-2,522	862	80
12	4	-68	1,287	-1,028	437	100
12	5	-180	1,099	-1,309	553	80
12	6	164	1,216	-557	356	100
12	7	127	1,259	-1,264	572	80

12	8	507	1,445	-145	308	100
12	9	504	1,584	-97	342	100
12	10	635	1,599	-79	332	100
12	11	543	1,584	-246	340	100
12	12	-2,482	0	-2,897	441	20
12	13	N/A	N/A	N/A	N/A	0
13	1	-813	1,087	-2,897	1,558	24
13	2	-986	901	-2,897	1,398	60
13	3	-1,070	1,161	-2,897	1,408	52
13	4	-786	1,198	-2,897	1,400	70
13	5	-672	1,113	-2,897	1,272	71
13	6	-384	1,247	-2,897	1,311	100
13	7	-789	1,162	-2,897	1,345	35
13	8	715	1,658	229	367	10
13	9	510	875	43	271	10
13	10	-779	1,325	-2,897	1,541	52
13	11	-546	1,339	-2,897	1,404	80
13	12	-782	1,320	-2,897	1,583	16
13	13	N/A	N/A	N/A	N/A	0
14	1	-1,295	1,194	-2,897	1,283	16
14	2	-376	1,725	-2,897	1,597	80
14	3	-859	1,566	-2,897	1,610	67
14	4	-613	1,000	-2,897	1,340	90
14	5	-886	1,019	-2,897	1,317	69
14	6	-904	953	-2,897	1,283	80
14	7	-1,060	1,467	-2,897	1,481	53
14	8	-696	1,169	-2,897	1,425	70
14	9	-640	915	-2,897	1,475	35
14	10	-419	901	-2,897	1,161	60
14	11	313	1,283	-580	316	100
14	12	350	1,024	-166	338	20
14	13	N/A	N/A	N/A	N/A	0
15	1	-526	1,105	-1,688	987	20
15	2	659	1,663	-23	271	100
15	**3**	**1,056**	**39,118**	**-2,897**	**4,947**	**80**
15	4	278	1,236	-460	291	100
15	5	-56	1,152	-1,834	683	80
15	6	142	938	-524	284	100

15	7	-318	1,041	-2,897	1,109	70
15	8	115	1,101	-685	351	100
15	9	285	1,101	-263	320	50
15	10	-425	1,303	-2,897	1,171	60
15	11	190	1,376	-527	329	100
15	12	374	1,015	-136	327	20
15	13	N/A	N/A	N/A	N/A	0
16	1	-427	1,293	-1,586	954	20
16	2	760	1,794	-39	371	100
16	3	113	1,695	-2,897	1,228	80
16	4	250	1,156	-370	314	100
16	5	40	1,388	-1,666	658	80
16	6	251	1,438	-532	367	100
16	7	-166	1,376	-2,897	1,172	70
16	8	288	1,330	-486	353	100
16	9	298	1,369	-478	295	50
16	10	-508	1,306	-2,897	1,123	60
16	11	282	1,318	-524	315	100
16	12	323	1,343	-228	363	20
16	13	N/A	N/A	N/A	N/A	0
17	1	-370	950	-1,382	843	14
17	2	779	1,798	56	333	70
17	3	99	1,981	-2,897	1,232	56
17	4	420	1,299	-523	316	70
17	5	195	1,181	-1,751	675	59
17	6	374	1,279	-311	359	80
17	7	-53	1,473	-2,897	1,072	56
17	8	328	1,212	-377	320	80
17	9	396	1,241	-924	379	40
17	10	-339	1,009	-2,897	1,193	60
17	11	338	1,366	-354	335	100
17	12	295	1,025	-331	369	20
17	13	N/A	N/A	N/A	N/A	0
18	1	N/A	N/A	N/A	N/A	0
18	2	N/A	N/A	N/A	N/A	0
18	3	424	1,160	-275	364	30
18	4	375	1,233	-480	320	100
18	5	-78	1,088	-2,437	848	80

18	6	355	1,226	-272	328	100
18	7	141	1,258	-1,206	559	70
18	8	423	1,333	-170	283	100
18	9	-242	1,296	-2,445	1,046	50
18	10	-352	1,059	-2,897	1,192	60
18	11	292	1,183	-585	307	100
18	12	359	935	-296	293	20
18	13	N/A	N/A	N/A	N/A	0
19	1	N/A	1,132	N/A	N/A	0
19	2	N/A	1,137	N/A	N/A	0
19	3	415	1,254	-314	374	30
19	4	352	1,461	-369	344	100
19	5	25	1,595	-2,479	964	80
19	6	364	1,416	-280	349	100
19	7	48	1,138	-1,152	505	70
19	8	344	1,324	-404	340	100
19	9	-292	909	-2,439	1,023	50
19	10	-394	1,200	-2,897	1,167	60
19	11	223	966	-506	312	100
19	12	290	1,070	-357	327	20
19	13	N/A	N/A	N/A	N/A	0
20	1	-249	1,400	-2,897	1,636	18
20	2	-299	1,540	-2,897	1,542	60
20	3	-267	1,478	-2,897	1,393	60
20	4	102	1,462	-2,260	748	100
20	5	-321	1,231	-2,897	1,093	80
20	6	-85	1,062	-2,897	1,008	100
20	7	-60	1,150	-2,897	891	70
20	8	380	1,348	-311	312	100
20	9	-286	1,146	-2,571	1,043	50
20	10	51	1,031	-2,897	740	48
20	11	266	1,136	-513	330	80
20	12	-567	616	-2,366	1,043	16
20	13	N/A	N/A	N/A	N/A	0
21	1	-1,732	687	-2,897	1,331	28
21	2	160	1,078	-551	283	70
21	3	-88	939	-2,897	878	66
21	4	-712	1,035	-2,897	1,301	80

21	5	-1,707	1,045	-2,897	1,372	55
21	6	-1,387	915	-2,897	1,408	70
21	7	-1,599	810	-2,897	1,404	55
21	8	-1,707	862	-2,897	1,265	70
21	9	-1,673	822	-2,897	1,382	35
21	10	266	1,252	-590	301	60
21	11	224	1,124	-490	329	100
21	12	-1,140	520	-2,578	1,205	20
21	13	N/A	N/A	N/A	N/A	0
22	1	-1,752	783	-2,897	1,298	40
22	2	126	935	-518	259	100
22	3	93	1,019	-550	295	90
22	4	97	1,001	-561	309	100
22	5	-1,085	833	-2,897	1,324	70
22	6	114	1,013	-647	329	100
22	7	-225	1,208	-2,897	1,060	80
22	8	133	1,012	-892	326	100
22	9	216	863	-323	279	50
22	10	272	1,158	-241	329	60
22	11	283	1,059	-360	290	100
22	12	-1,032	660	-2,334	1,233	20
22	13	N/A	N/A	N/A	N/A	0
23	1	-1,463	911	-2,897	1,445	34
23	2	-4	1,143	-2,430	945	70
23	3	-26	853	-2,348	732	57
23	4	-117	807	-1,852	645	70
23	5	-917	698	-2,897	1,131	61
23	6	55	925	-561	294	100
23	7	-287	1,278	-2,897	1,055	80
23	8	98	1,093	-698	331	100
23	9	167	994	-537	304	50
23	10	405	1,122	-498	355	60
23	11	254	1,215	-531	337	100
23	12	-1,154	656	-2,518	1,206	20
23	13	N/A	N/A	N/A	N/A	0
24	1	-1,356	1,246	-2,897	1,406	50
24	2	118	942	-597	284	100
24	3	190	1,255	-560	324	80

24	4	202	951	-505	323	100
24	5	-673	938	-2,897	1,268	80
24	6	66	1,167	-598	315	100
24	7	-269	1,142	-2,897	1,044	80
24	8	170	1,103	-564	342	100
24	9	213	902	-431	264	50
24	10	390	1,443	-317	335	60
24	11	296	1,300	-551	336	100
24	12	-1,113	413	-2,564	1,176	20
24	13	N/A	N/A	N/A	N/A	0
25	1	-375	1,229	-2,897	1,483	68
25	2	302	1,545	-1,213	544	80
25	3	244	1,449	-2,897	732	71
25	4	-64	1,374	-2,897	1,116	80
25	5	-215	1,476	-2,897	1,143	76
25	6	-724	990	-2,897	1,409	52
25	7	96	1,081	-2,897	558	66
25	8	110	1,025	-933	421	68
25	9	283	996	-325	307	70
25	10	9	1,219	-2,458	711	78
25	11	265	1,204	-513	333	100
25	12	-1,111	626	-2,502	1,221	20
25	13	N/A	N/A	N/A	N/A	0
26	1	-378	1,200	-2,897	1,384	90
26	2	388	1,314	-508	334	100
26	3	436	1,310	-368	335	90
26	4	544	1,563	-357	316	100
26	5	454	1,596	-360	332	100
26	6	-572	1,068	-2,897	1,396	80
26	7	270	1,245	-660	295	100
26	8	179	1,157	-1,310	505	80
26	9	309	1,416	-463	309	100
26	10	78	1,468	-2,401	855	90
26	11	348	1,466	-719	348	100
26	12	-1,137	528	-2,518	1,165	20
26	13	N/A	N/A	N/A	N/A	0
27	1	-1,494	930	-2,897	1,457	44
27	2	101	1,226	-2,427	932	80

27	3	142	1,566	-2,897	889	65
27	4	-89	1,108	-2,897	1,111	80
27	5	-711	1,239	-2,897	1,437	52
27	6	174	1,412	-2,897	789	44
27	7	298	1,172	-569	307	100
27	8	167	1,300	-1,324	483	80
27	9	354	1,247	-705	343	100
27	10	88	1,260	-2,405	873	90
27	11	331	1,333	-613	374	100
27	12	-1,076	693	-2,452	1,189	20
27	13	N/A	N/A	N/A	N/A	0
28	1	-1,294	1,141	-2,897	1,456	50
28	2	408	1,297	-356	310	100
28	3	478	1,310	-352	326	80
28	4	477	1,642	-231	306	100
28	5	-448	1,616	-2,897	1,489	60
28	6	360	1,104	-532	324	40
28	7	269	1,134	-577	341	100
28	8	144	1,052	-1,046	437	80
28	9	288	1,159	-385	320	100
28	10	95	1,368	-2,371	888	90
28	11	399	1,420	-256	353	100
28	12	-985	1,117	-2,646	1,307	20
28	13	N/A	N/A	N/A	N/A	0
29	1	-1,652	0	-2,897	394	5
29	2	-339	0	-2,467	153	10
29	3	70	1,538	-2,562	1,748	8
29	4	435	761	-196	279	10
29	5	-383	1,133	-2,897	1,697	6
29	6	-208	1,148	-2,897	1,386	28
29	7	-308	1,024	-2,897	1,285	70
29	8	-586	919	-2,897	1,290	56
29	9	-372	1,153	-2,897	1,443	70
29	10	-598	1,660	-2,897	1,478	51
29	11	-300	1,389	-2,897	1,493	50
29	12	-1,322	543	-2,897	1,330	10
29	13	N/A	N/A	N/A	N/A	0

The X and Y columns reference the grids of Figures 1 and 2. Bold text denotes grids which exceed the investigation criteria. When '100' is indicated in the 'Areas' column, the grid is a full square meter. The mean is the average of all measurements in the grid. The standard deviation is calculated from pixels that contain data. All units (i.e. mean, max, and standard deviation) are in dpm per 100cm^2. Meters with no recorded data are not displayed.

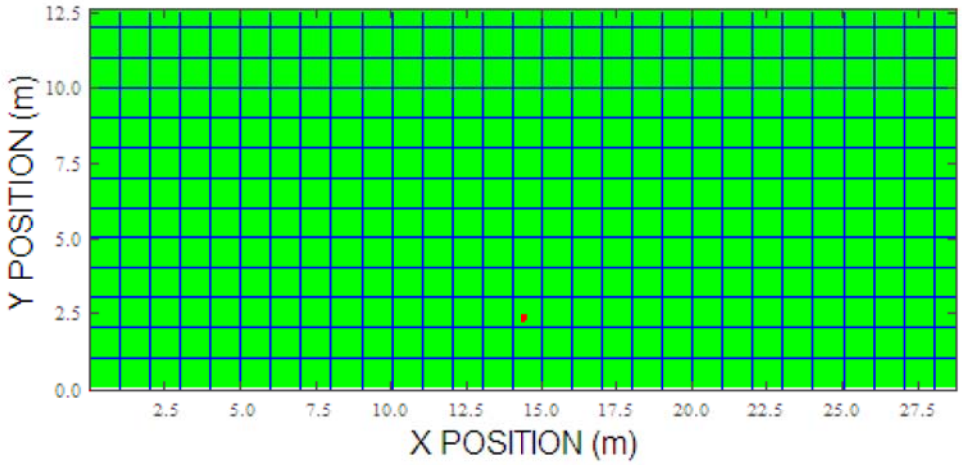


Figure 3: Yellow denotes meter grids that exceed criteria , while red corresponds to 100cm^2 areas exceeding criteria.

Investigation Table

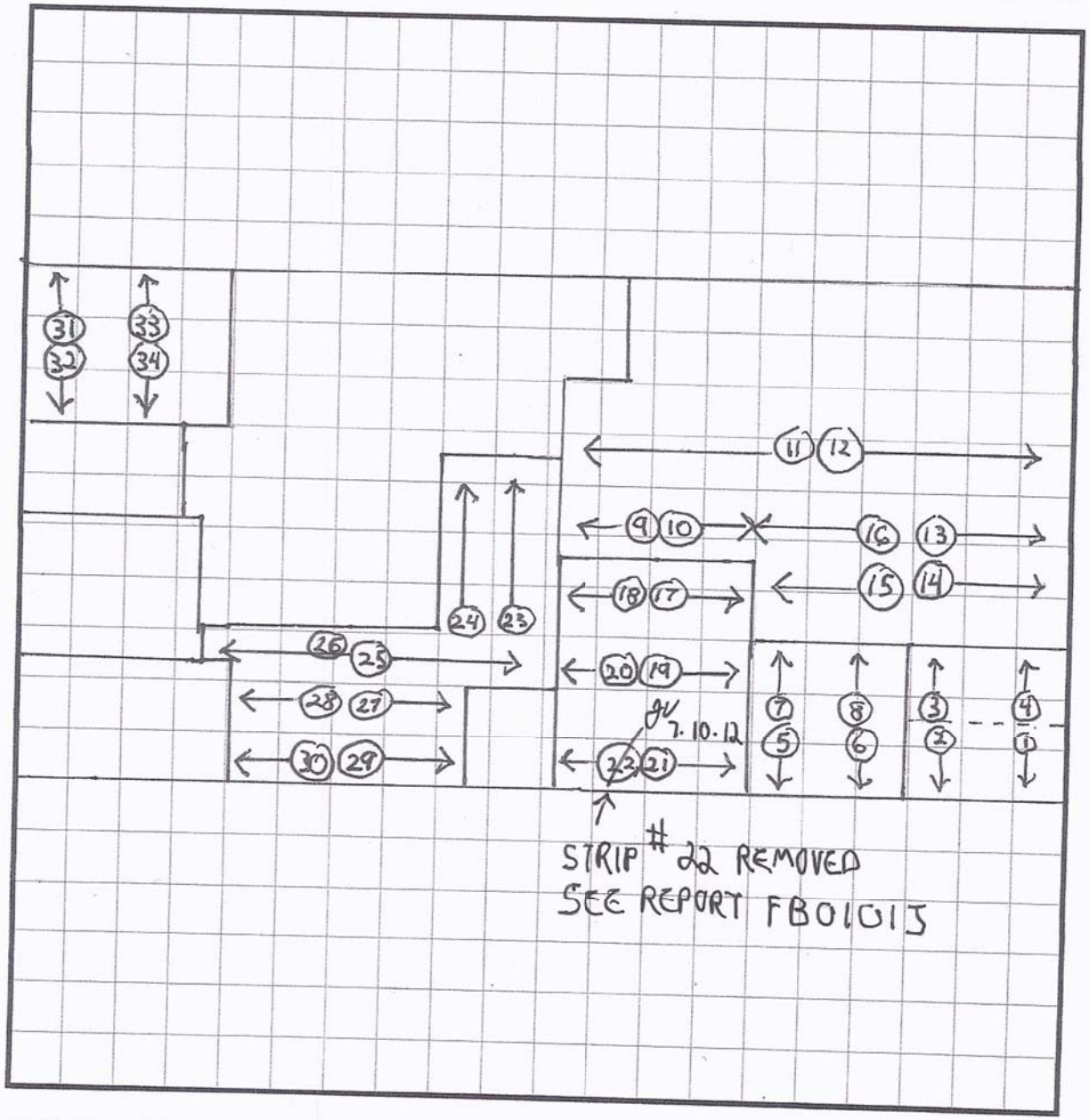
Type	Value	Strip	Location From SW of Survey (X,Y)cm	Location From SW of Strip (X,Y)cm	Grid (X,Y)	Inv (Counts)	Count Time
Spot	39118	22	(1435,235)	(110,155)	N/A		

This table details the location of values that exceed criteria. In the case to 100 cm^2 (spot) alarms both the SCM strip number and the location relative to the south west corner of the survey. In the case of square meter (Average) alarms the meter grid coordinates are given.

SCM Maps

NASB SCM Survey Form

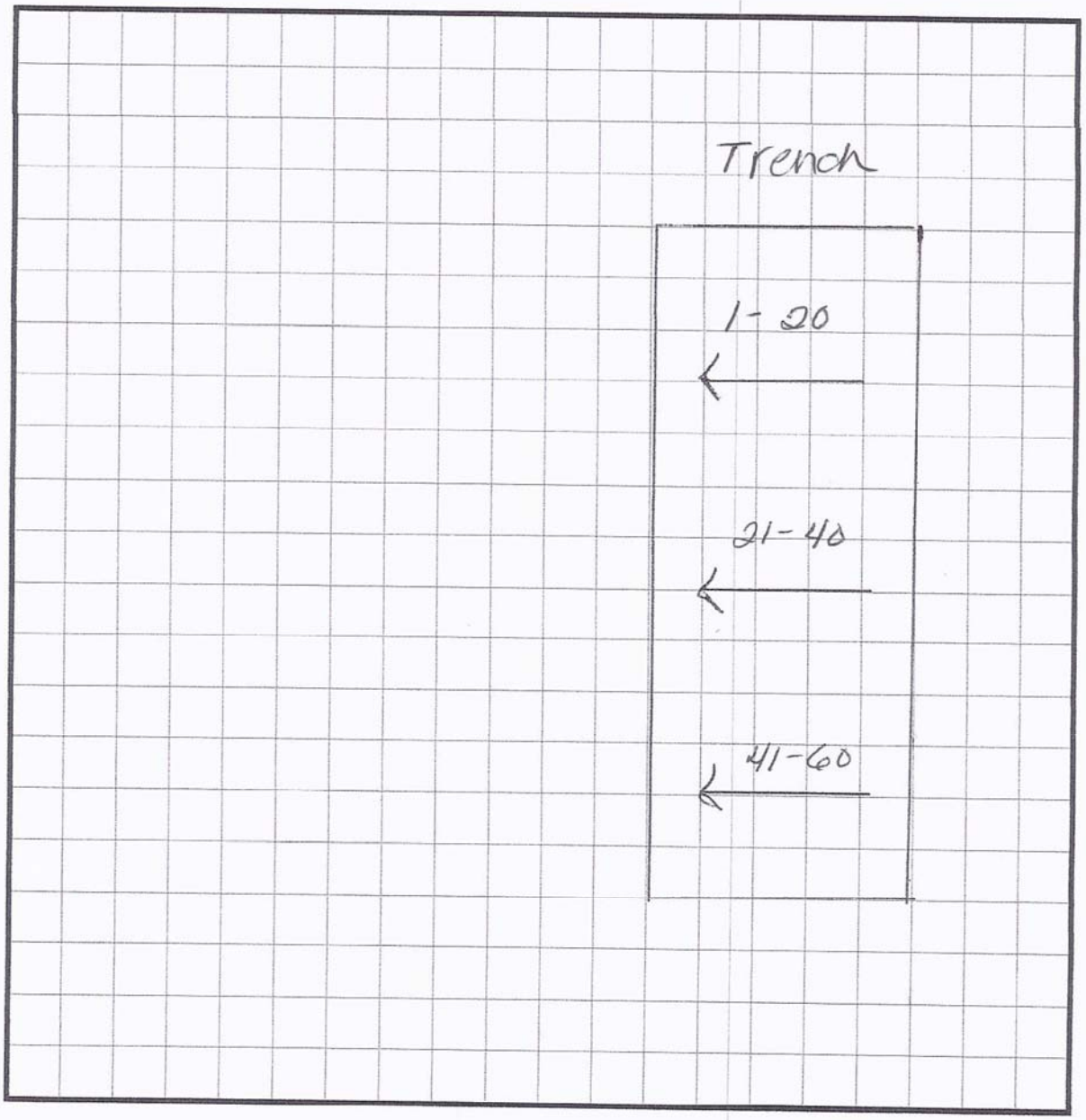
Survey File Name:	FB0101A		
Building:	9	**Survey Unit:**	1
SCM Number:	1	**Detector Type** (Circle One):	C90 C180 T90 (T180)
Surface (Circle One):	(Floors) Walls < 6' Walls > 6' Ceiling		
Material Type (Circle One):	Asphalt Cinder Block (Concrete) Drywall Steel Wood		
Survey Type (Circle One):	(Alpha) Beta		



Data Review	Name	Date	Signature
Operator	Brandon Thrower	7-5-12	Brandon Thrower
Operator			
Data Processor	JEFF VASSETT	7.10.12	
Project Mgr.	R.W. Dubiel	7-10-12	R.W. Dubiel

NASB SCM Survey Form

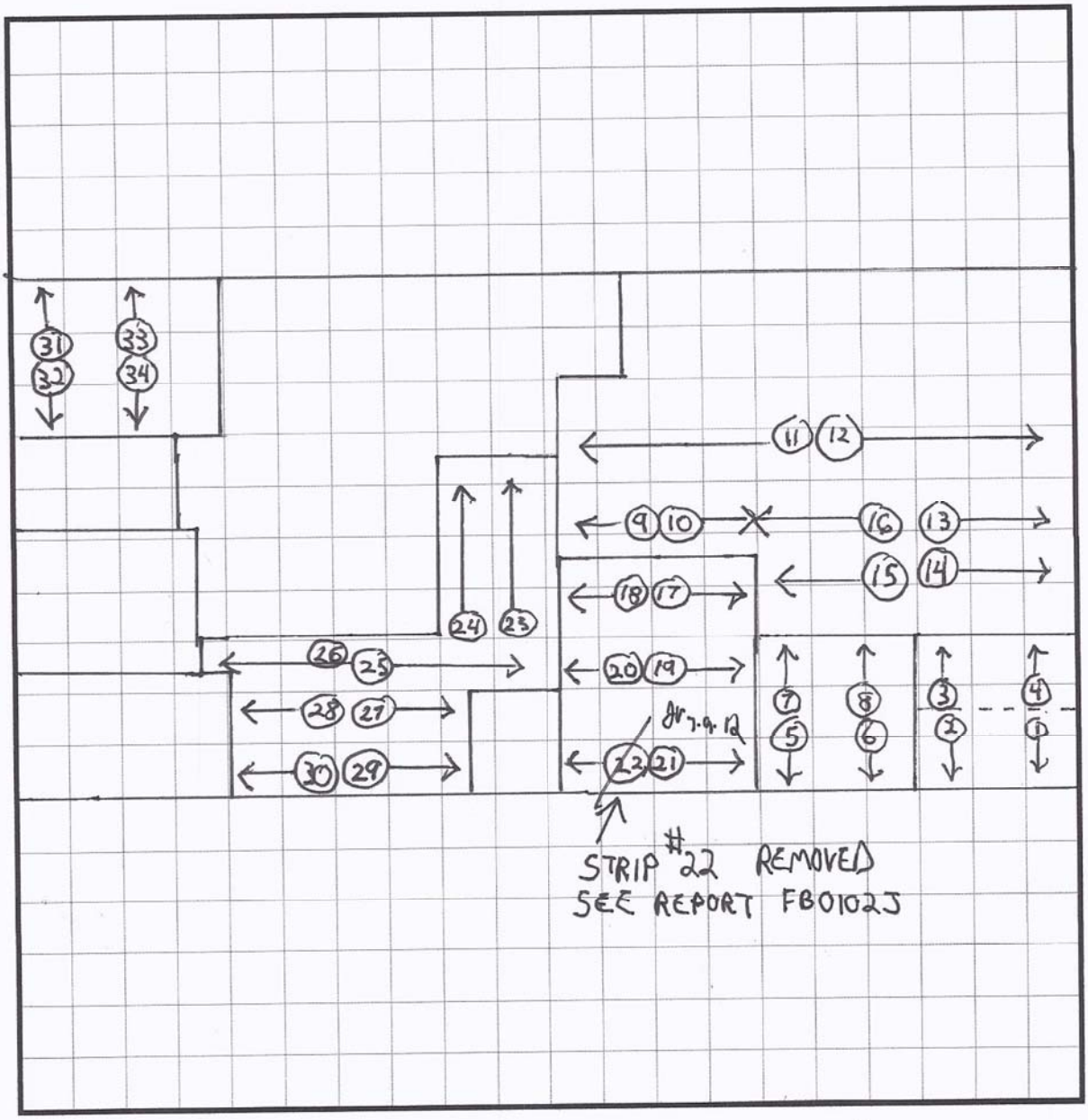
Survey File Name:	7-10-12 FB0101 B		
Building:	9	**Survey Unit:**	SU1
SCM Number:	1	**Detector Type** (Circle One):	C90 (C180) T90 T180
Surface (Circle One):	(Floors) Walls < 6' Walls > 6' Ceiling		
Material Type (Circle One):	Asphalt Cinder Block (Concrete) Drywall Steel Wood		
Survey Type (Circle One):	(Alpha) Beta		



Data Review	Name	Date	Signature
Operator	Vicki Patrick	7-10-12	Vicki Patrick
Operator			
Data Processor	JEFF VASSETT	7-10-12	
Project Mgr.	R.W. Dubiel	7-10-12	R.W. Dubiel

NASB SCM Survey Form

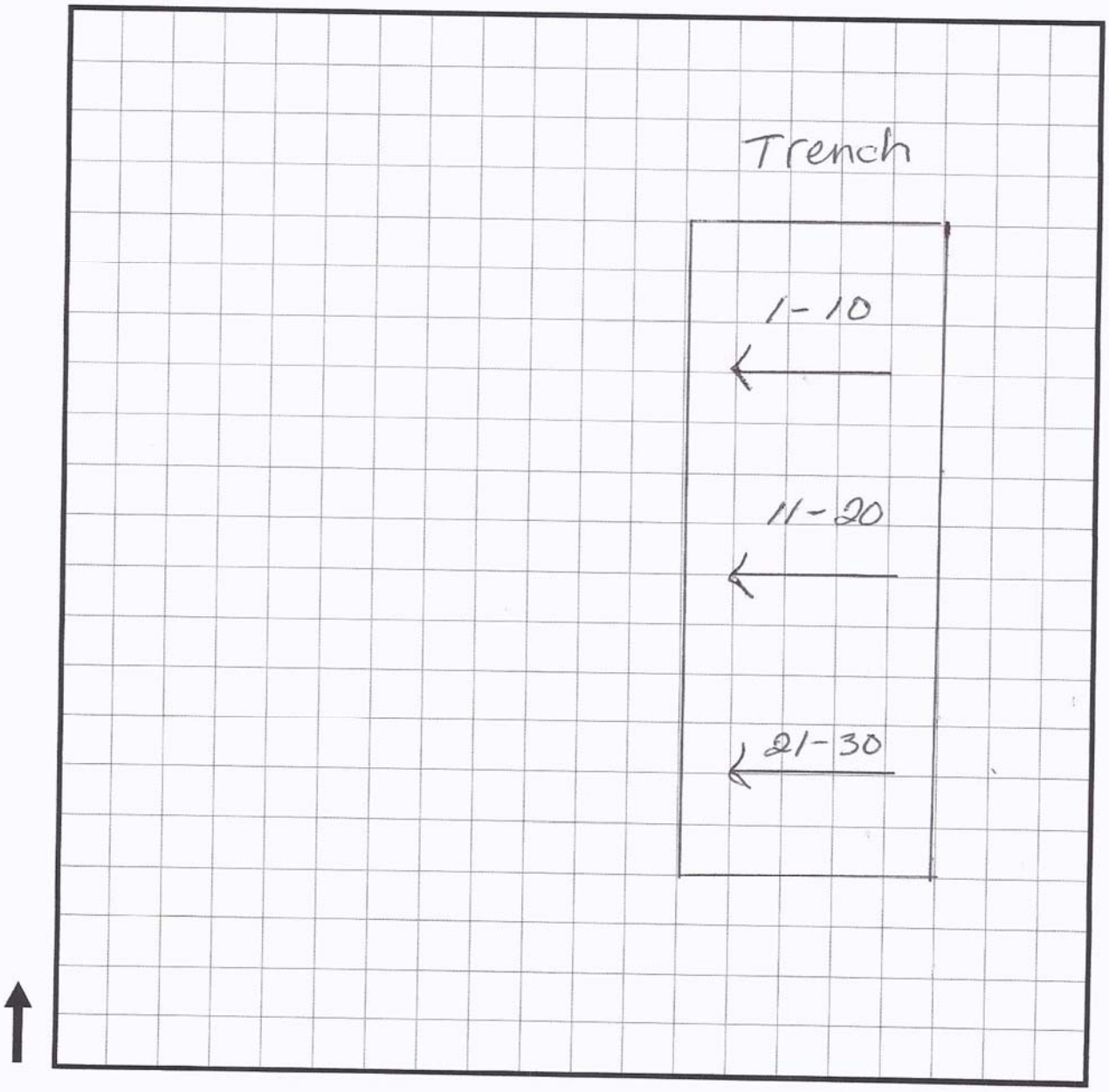
Survey File Name:	FB0102A		
Building:	9	**Survey Unit:**	1
SCM Number:	6	**Detector Type** (Circle One):	C90 C180 T90 (T180)
Surface (Circle One):	(Floors) Walls < 6' Walls > 6' Ceiling		
Material Type (Circle One):	Asphalt Cinder Block (Concrete) Drywall Steel Wood		
Survey Type (Circle One):	Alpha (Beta)		



Data Review	Name	Date	Signature
Operator	James Kirby	7-5-12	
Operator			
Data Processor	JEFF VASSETT	7-8-12	
Project Mgr.	R.W. Dubiel	7-8-12	R.W. Dubiel

NASB SCM Survey Form

Survey File Name:	7.11.12 FB0102B		
Building:	~~4~~ 9	**Survey Unit:**	SU1
SCM Number:	1	**Detector Type** (Circle One):	C90 (C180) T90 T180
Surface (Circle One):	(Floors) Walls < 6' Walls > 6' Ceiling		
Material Type (Circle One):	Asphalt Cinder Block (Concrete) Drywall Steel Wood		
Survey Type (Circle One):	Alpha (Beta)		



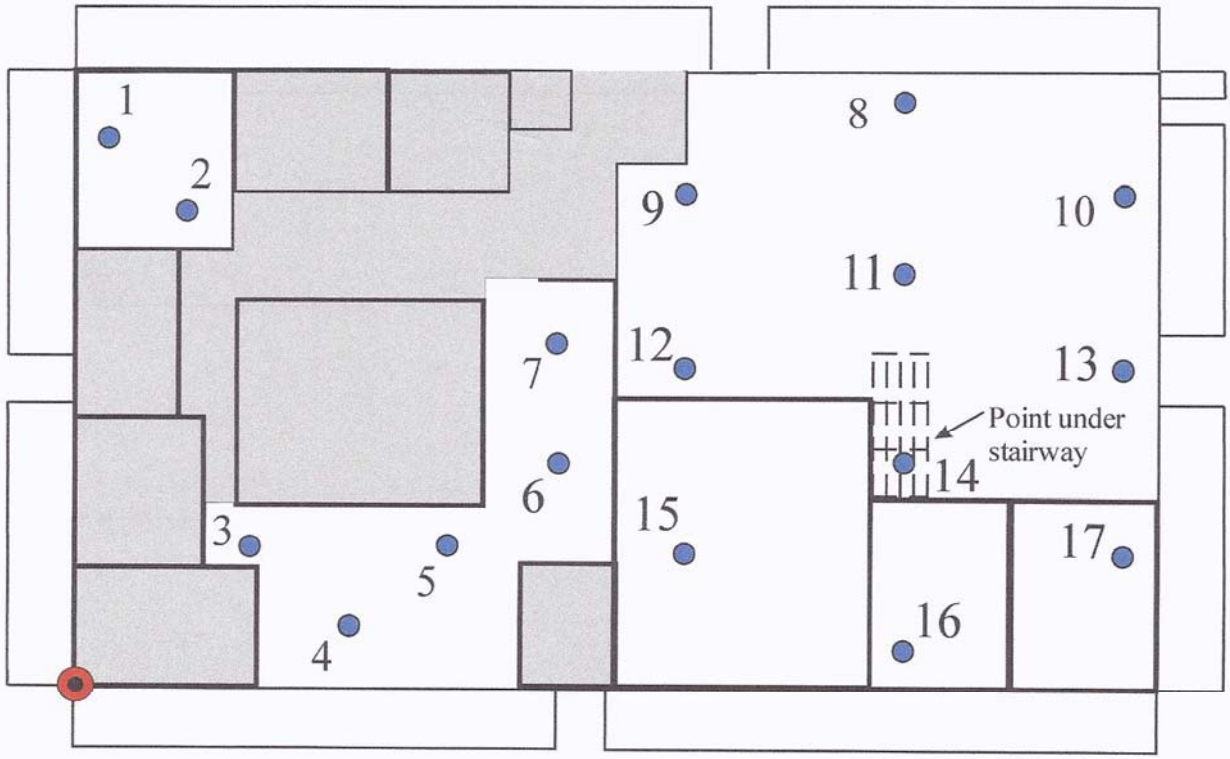
Data Review	Name	Date	Signature
Operator	Viki Patrick	7-10-12	Viki Patrick
Operator			
Data Processor	JEFF VASSETT	7.10.12	
Project Mgr.	R.W. Dubiel	7-10-12	R.W. Dubiel

Directs

Building	Bldg 9											
Survey Unit	1											
Class	3		**Measurement No.**	**Material**	**Ref. Background (cpm)**		**Static Counts (cpm)**		**Static Results (dpm/100 cm^2)**		**Action**	**Action**
Model 2221	148451				**α**	**β**	**α**	**β**	**α**	**β**	**α**	**β**
Detector 43-68	PR-177646		1	Concrete	7.83	337.43	6.00	316.00	-40.67	-171.44	Pass	Pass
Date	7/2/2012		2	Concrete	7.83	337.43	6.00	343.00	-40.67	44.56	Pass	Pass
Static Count Time (min)	2.0		3	Concrete	7.83	337.43	5.00	409.00	-62.89	572.56	Pass	Pass
Background Count Time (min)	1.0		4	Concrete	7.83	337.43	3.00	312.00	-107.33	-203.44	Pass	Pass
α Efficiency- Instrument	0.180		5	Concrete	7.83	337.43	5.00	360.00	-62.89	180.56	Pass	Pass
α Efficiency- Surface	0.25		6	Concrete	7.83	337.43	6.00	386.00	-40.67	388.56	Pass	Pass
β Efficiency- Instrument	0.250		7	Concrete	7.83	337.43	6.00	412.00	-40.67	596.56	Pass	Pass
β Efficiency- Surface	0.50		8	Concrete	7.83	337.43	8.00	411.00	3.78	588.56	Pass	Pass
Area Correction Factor	1.00		9	Concrete	7.83	337.43	5.00	425.00	-62.89	700.56	Pass	Pass
			10	Concrete	7.83	337.43	7.00	484.00	-18.44	1172.56	Pass	Pass
			11	Concrete	7.83	337.43	5.00	443.00	-62.89	844.56	Pass	Pass
			12	Concrete	7.83	337.43	5.00	408.00	-62.89	564.56	Pass	Pass
			13	Concrete	7.83	337.43	4.00	413.00	-85.11	604.56	Pass	Pass
			14	Concrete	7.83	337.43	3.00	426.00	-107.33	708.56	Pass	Pass
			15	Concrete	7.83	337.43	8.00	416.00	3.78	628.56	Pass	Pass
			16	Concrete	7.83	337.43	7.00	426.00	-18.44	708.56	Pass	Pass
			17	Concrete	7.83	337.43	6.00	457.00	-40.67	956.56	Pass	Pass
							Action Level		100.00	5000		
							Average		-49.82	522.68		
							Standard Deviation		32.45	372.46		
Based on the initial survey the following points were investigated by performing a 5 minute static count			N/A						0.00	0.00	Pass	Pass
			N/A						0.00	0.00	Pass	Pass
			N/A						0.00	0.00	Pass	Pass
			N/A						0.00	0.00	Pass	Pass
			N/A						0.00	0.00	Pass	Pass

NASB Direct Survey Form

Building:	Building 9	**Survey Unit:**	1 Floors
Instrument Model Number:	2221	**Serial Number:**	148451
Probe Model Number:	4368	**Serial Number:**	177646
Survey Type (Circle One):	(Alpha) (Beta)	Building 9 Footprint	



#	Surface	Material Type	X (m)	Y (m)	Counts α (cpm) β	#	Surface	Material Type	X (m)	Y (m)	Counts (cpm)
1	Floor	2	0.7	16.9	6 · 316	10	Floor	2	16.0	14.0	7 · 484
2	Floor		2.7	14.5	6 · 343	11	Floor		22.5	12.0	5 · 443
3	Floor		5.0	3.5	5 · 409	12	Floor		24.5	9.1	5 · 408
4	Floor		6.9	1.0	3 · 312	13	Floor		16.0	10.5	4 · 413
5	Floor		12.5	2.8	5 · 360	14	Floor		22.5	8.1	3 · 426
6	Floor		10.9	5.4	6 · 386	15	Floor		24.5	2.6	8 · 416
7	Floor		10.9	9.4	6 · 412	16	Floor		22.5	2.2	7 · 426
8	Floor		22.5	16.7	8 · 411	17	Floor		16.0	20	6 · 457
9	Floor		24.5	14.0	5 · 425						

Material:	**Painted concrete-1**	**Concrete-2**	**Steel-3**	**Wood-4**	**Cinder Blk-5**	**Tile-6**	**Drywall-7**

Data Review	**Name**	**Date**	**Signature**
Technician	James Kirby	~~6~~ JK 7-2-12	
Technician			
Data Processor	R GAULT	7/3/12	
Project Manager	R.W. Dubiel	7/3/12	R.W. Dubiel

Gamma and Smears

Bldg 9 SU1 - Smear/Gamma

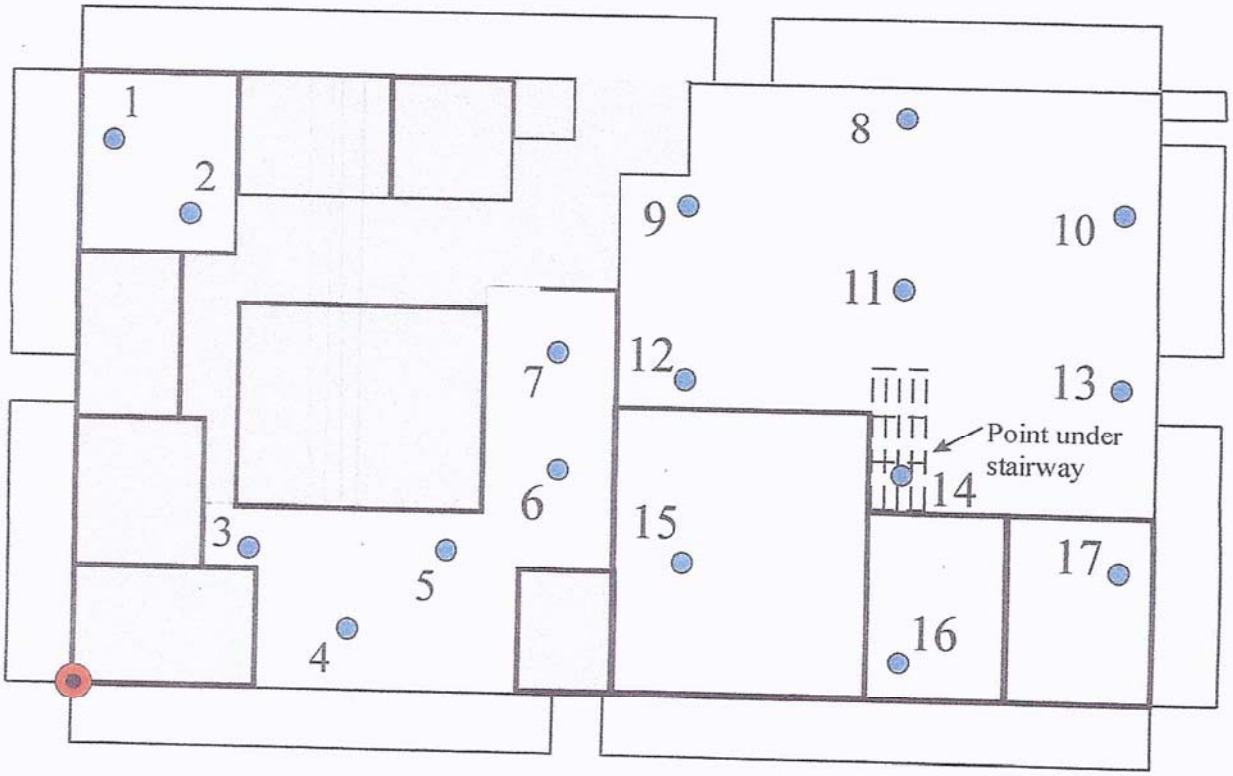
Point	Material	Direct µR	Smear					
		µR	Total CPM α	Net CPM α	Total CPM β	Net CPM β	α dpm	β dpm
1	2	12	0	-0.20	63	-7	-0.48	-25.09
2	2	11	0	-0.20	64	-6	-0.48	-21.51
3	2	12	0	-0.20	54	-16	-0.48	-57.35
4	2	12	0	-0.20	75	5	-0.48	17.92
5	2	11	1	0.80	64	-6	1.91	-21.51
6	2	11	0	-0.20	74	4	-0.48	14.34
7	2	11	0	-0.20	70	0	-0.48	0.00
8	2	11	0	-0.20	68	-2	-0.48	-7.17
9	2	11	1	0.80	80	10	1.91	35.84
10	2	12	0	-0.20	54	-16	-0.48	-57.35
11	2	13	0	-0.20	61	-9	-0.48	-32.26
12	2	12	0	-0.20	63	-7	-0.48	-25.09
13	2	12	0	-0.20	67	-3	-0.48	-10.75
14	2	12	0	-0.20	70	0	-0.48	0.00
15	2	12	0	-0.20	67	-3	-0.48	-10.75
16	2	12	0	-0.20	75	5	-0.48	17.92
17	2	13	0	-0.20	68	-2	-0.48	-7.17

Material	
Painted concrete	1
Concrete	2
Steel	3
Wood	4
Cinder block	5
Tile	6
Dtywall	7
Asphalt	8
Countertop	9

2929 Bkg	
α	0.2
β	70

NASB Smear / Gamma Survey Form

Building:	Building ~~250~~ 9	**Survey Unit:**	1 Floors
Instrument Model Number:	2929	**Serial Number:**	168817
Instrument Model Number:	Model 19	**Serial Number:**	142858
Survey Type (~~Circle One~~):	(Alpha) Beta	Building 9 Footprint	



#	Area	Material	X (m)	Y (m)	uR/hr	Smear A (cpm) B
1	Floor	2	0.7	16.9	12	0 \63
2	Floor		2.7	14.5	11	0 \64
3	Floor		5.0	3.5	12	0 \54
4	Floor		6.9	1.0	12	0 \75
5	Floor		12.5	2.8	11	1 \64
6	Floor		10.9	5.4	11	0 \74
7	Floor		10.9	9.4	11	0 \70
8	Floor		22.5	~~16.1~~ 7.9	11	0 \68
9	Floor		24.5	14.0	11	1 \80
10	Floor	2	16.0	14.0	12	0 \54
11	Floor		22.5	12.0	13	0 \61
12	Floor		24.5	9.1	12	0 \63
13	Floor		16.0	10.5	12	0 \67
14	Floor		22.5	8.1	12	0 \70
15	Floor		24.5	2.6	12	0 \67
16	Floor		22.5	2.2	12	0 \75
17	Floor		16.0	2.0	13	0 \68

Material: Painted concrete-1 | Concrete-2 | Steel-3 | Wood-4 | Cinder Blk-5 | Tile-6 | Drywall-7

Data Review	Name	Date	Signature
Technician	James Kirby	7-2-12	
Technician			
Data Processor	R Gault	7/3/12	
Project Manager	R.W. Dubiel	7/3/12	

Gamma Walkover

Building 9 SU-1

Number	Date	Time	Ratemeter	Units	Scaler	Count Time	CT Units
1	7/5/2012	11:22:59	11239	cpm	390	2	sec(s)
2	7/5/2012	11:23:03	11234	cpm	366	2	sec(s)
3	7/5/2012	11:23:07	10935	cpm	349	2	sec(s)
4	7/5/2012	11:23:11	11070	cpm	360	2	sec(s)
5	7/5/2012	11:23:15	11023	cpm	378	2	sec(s)
6	7/5/2012	11:23:19	10963	cpm	371	2	sec(s)
7	7/5/2012	11:23:23	10555	cpm	352	2	sec(s)
8	7/5/2012	11:23:27	10965	cpm	365	2	sec(s)
9	7/5/2012	11:23:31	10643	cpm	360	2	sec(s)
10	7/5/2012	11:23:35	11066	cpm	380	2	sec(s)
11	7/5/2012	11:23:39	10663	cpm	359	2	sec(s)
12	7/5/2012	11:23:43	11044	cpm	357	2	sec(s)
13	7/5/2012	11:23:47	11191	cpm	358	2	sec(s)
14	7/5/2012	11:23:51	10895	cpm	368	2	sec(s)
15	7/5/2012	11:23:55	10982	cpm	373	2	sec(s)
16	7/5/2012	11:23:59	9821	cpm	316	2	sec(s)
17	7/5/2012	11:24:03	10369	cpm	363	2	sec(s)
18	7/5/2012	11:24:07	10056	cpm	328	2	sec(s)
19	7/5/2012	11:24:11	10191	cpm	360	2	sec(s)
20	7/5/2012	11:24:15	11169	cpm	382	2	sec(s)
21	7/5/2012	11:24:19	10306	cpm	375	2	sec(s)
22	7/5/2012	11:24:23	10527	cpm	377	2	sec(s)
23	7/5/2012	11:25:53	11178	cpm	358	2	sec(s)
24	7/5/2012	11:25:57	10628	cpm	332	2	sec(s)
25	7/5/2012	11:26:01	10433	cpm	346	2	sec(s)
26	7/5/2012	11:26:05	10669	cpm	348	2	sec(s)
27	7/5/2012	11:26:09	10594	cpm	333	2	sec(s)
28	7/5/2012	11:26:13	10086	cpm	333	2	sec(s)
29	7/5/2012	11:26:17	10546	cpm	380	2	sec(s)
30	7/5/2012	11:26:21	10287	cpm	364	2	sec(s)
31	7/5/2012	11:26:25	10012	cpm	345	2	sec(s)
32	7/5/2012	11:26:29	10276	cpm	375	2	sec(s)
33	7/5/2012	11:26:33	10701	cpm	354	2	sec(s)
34	7/5/2012	11:26:37	10726	cpm	334	2	sec(s)
35	7/5/2012	11:26:41	10762	cpm	347	2	sec(s)
36	7/5/2012	11:26:45	10735	cpm	357	2	sec(s)
37	7/5/2012	11:26:49	11065	cpm	384	2	sec(s)
38	7/5/2012	11:26:53	11073	cpm	374	2	sec(s)
39	7/5/2012	11:26:57	11265	cpm	361	2	sec(s)
40	7/5/2012	11:27:01	11934	cpm	389	2	sec(s)
41	7/5/2012	11:27:05	12459	cpm	404	2	sec(s)
42	7/5/2012	11:27:09	12263	cpm	413	2	sec(s)
43	7/5/2012	11:27:13	11727	cpm	404	2	sec(s)

44	7/5/2012	11:27:17	12045 cpm	395	2 sec(s)
45	7/5/2012	11:27:21	11484 cpm	376	2 sec(s)
46	7/5/2012	11:27:25	11672 cpm	405	2 sec(s)
47	7/5/2012	11:27:29	10761 cpm	347	2 sec(s)
48	7/5/2012	11:27:33	10656 cpm	346	2 sec(s)
49	7/5/2012	11:27:37	10391 cpm	351	2 sec(s)
50	7/5/2012	11:27:41	11368 cpm	368	2 sec(s)
51	7/5/2012	11:27:45	10982 cpm	337	2 sec(s)
52	7/5/2012	11:27:49	10821 cpm	345	2 sec(s)
53	7/5/2012	11:27:53	11443 cpm	400	2 sec(s)
54	7/5/2012	11:27:57	10703 cpm	357	2 sec(s)
55	7/5/2012	11:28:01	11076 cpm	369	2 sec(s)
56	7/5/2012	11:28:05	11362 cpm	383	2 sec(s)
57	7/5/2012	11:28:09	10866 cpm	348	2 sec(s)
58	7/5/2012	11:28:13	11571 cpm	380	2 sec(s)
59	7/5/2012	11:28:17	10561 cpm	359	2 sec(s)
60	7/5/2012	11:28:21	10681 cpm	345	2 sec(s)
61	7/5/2012	11:28:25	11351 cpm	400	2 sec(s)
62	7/5/2012	11:28:29	10807 cpm	364	2 sec(s)
63	7/5/2012	11:28:33	11244 cpm	358	2 sec(s)
64	7/5/2012	11:28:37	11209 cpm	361	2 sec(s)
65	7/5/2012	11:28:41	12378 cpm	396	2 sec(s)
66	7/5/2012	11:28:45	11940 cpm	386	2 sec(s)
67	7/5/2012	11:28:49	12314 cpm	395	2 sec(s)
68	7/5/2012	11:28:53	11577 cpm	360	2 sec(s)
69	7/5/2012	11:28:57	11805 cpm	394	2 sec(s)
70	7/5/2012	11:29:01	12169 cpm	418	2 sec(s)
71	7/5/2012	11:29:05	12304 cpm	388	2 sec(s)
72	7/5/2012	11:29:09	12448 cpm	420	2 sec(s)
73	7/5/2012	11:29:13	12364 cpm	432	2 sec(s)
74	7/5/2012	11:29:17	11139 cpm	377	2 sec(s)
75	7/5/2012	11:29:21	11457 cpm	397	2 sec(s)
76	7/5/2012	11:29:25	11524 cpm	392	2 sec(s)
77	7/5/2012	11:29:29	11370 cpm	368	2 sec(s)
78	7/5/2012	11:29:33	11127 cpm	389	2 sec(s)
79	7/5/2012	11:29:37	10986 cpm	382	2 sec(s)
80	7/5/2012	11:29:41	10864 cpm	365	2 sec(s)
81	7/5/2012	11:30:33	11251 cpm	387	2 sec(s)
82	7/5/2012	11:30:37	10782 cpm	366	2 sec(s)
83	7/5/2012	11:30:41	10950 cpm	345	2 sec(s)
84	7/5/2012	11:30:45	11653 cpm	397	2 sec(s)
85	7/5/2012	11:30:49	10919 cpm	361	2 sec(s)
86	7/5/2012	11:30:53	10613 cpm	344	2 sec(s)
87	7/5/2012	11:30:57	10781 cpm	356	2 sec(s)
88	7/5/2012	11:31:01	10973 cpm	340	2 sec(s)
89	7/5/2012	11:31:05	10732 cpm	369	2 sec(s)
90	7/5/2012	11:31:09	10899 cpm	378	2 sec(s)

91	7/5/2012	11:35:03	11348 cpm	382	2 sec(s)
92	7/5/2012	11:35:07	11514 cpm	385	2 sec(s)
93	7/5/2012	11:35:11	11376 cpm	365	2 sec(s)
94	7/5/2012	11:35:15	11916 cpm	404	2 sec(s)
95	7/5/2012	11:35:19	10710 cpm	355	2 sec(s)
96	7/5/2012	11:35:23	11295 cpm	408	2 sec(s)
97	7/5/2012	11:35:27	10780 cpm	324	2 sec(s)
98	7/5/2012	11:35:31	11856 cpm	386	2 sec(s)
99	7/5/2012	11:35:35	11040 cpm	389	2 sec(s)
100	7/5/2012	11:35:39	11030 cpm	351	2 sec(s)
101	7/5/2012	11:35:43	10935 cpm	365	2 sec(s)
102	7/5/2012	11:35:47	11226 cpm	367	2 sec(s)
103	7/5/2012	11:35:51	11133 cpm	392	2 sec(s)
104	7/5/2012	11:35:55	11073 cpm	375	2 sec(s)
105	7/5/2012	11:35:59	11810 cpm	401	2 sec(s)

Average	11102.3 cpm
Std. Dev	569.9509 cpm
Std Dev * 3	1709.853 cpm
Avg + Std Dev * 3	12812.15 cpm
Max. Value	12459 cpm

Laboratory Analytical Results

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Laboratories, Inc.

ANALYTICAL REPORT

PROJECT NO. CTO WE03

NAS Brunswick, ME

Lot #: F2G170497

Lawson Bailey

Tetra Tech, Inc.
900 Trail Ridge Road
Aiken, SC 29803

TESTAMERICA LABORATORIES, INC.

Erika Starman
Project Manager

August 10, 2012

13715 Rider Trail North Earth City, MO 63045 **tel** 314.298.8566 **fax** 314.298.8757 **www.testamericainc.com**

Case Narrative
LOT NUMBER: F2G170497

This report contains the analytical results for the 18 samples received under chain of custody by TestAmerica St. Louis on July 14, 2012. These samples are associated with your NAS Brunswick, ME project.

The analytical results included in this report meet all applicable quality control procedure requirements except as noted on the following page.

The test results in this report meet all NELAP requirements for parameters in which accreditations are held by TestAmerica St. Louis. Any exceptions to NELAP requirements are noted in the case narrative. **TestAmerica St. Louis' Florida certification number is E87689.** The case narrative is an integral part of this report.

This report shall not be reproduced, except in full, without the written approval of the laboratory.

All chemical analysis results are based upon sample as received, wet weight, unless noted otherwise. All radiochemistry results are based upon sample as dried and ground with the exception of tritium, unless requested wet weight by the client.

Observations/Nonconformances
Reference the chain of custody and condition upon receipt report for any variations on receipt conditions and temperature of samples on receipt.

Manual integrations were performed only when necessary and are in compliance with the laboratory's standard operating procedure. Detailed information can be found in the raw data section of the level IV report.

The following clean-up methods for Organic analyses may have been used on samples in this data set. Specific methods employed are documented on the batch extraction logs.

Method 3600C: Cleanup
Method 3620C: Florisil Cleanup
Method 3630C: Silica Gel Cleanup
Method 3640A: Gel-Permeation Cleanup
Method 3650B: Acid-Base Partition Cleanup
Method 3660B: Sulfur Cleanup
Method 3665A: Sulfuric Acid/Permanganate Cleanup

H-3 by Distillation & LSC (EPA 906.0 MOD)

While the sample quench parameter (tSIE) actually was within the quench curve, the sample exhibited zero efficiency. This is assumed to be due, in part, to the amount of quench as well as the low count rate of the sample ROI. As the sample count rate is below the background count rate, the result reported is negative. In order to calculate uncertainty and detection limit, the efficiency was manually calculated from the laboratory's quench verification curve.

Affected Samples:
F2G170497 (11): 009-SWI-010D
F2G170497 (13): 009-SWI-012
F2G170497 (15): 009-SWI-014

Due to interference (color/chemical quenching) in the sample (from dirt/debris/etc. on the swipe) the sample exhibited quench (tSIE) slightly off the lower end of the quench curve. Results calculated using the efficiency projected from the curve should be considered estimated. Due to the nature of the sample (single swipe sample), there is not additional aliquot available and reanalysis is not possible.

Affected Samples:
F2G170497 (3): 009-SWI-003
F2G170497 (4): 009-SWI-004
F2G170497 (6): 009-SWI-006
F2G170497 (9): 009-SWI-009
F2G170497 (10): 009-SWI-010
F2G170497 (11): 009-SWI-010D
F2G170497 (12): 009-SWI-011
F2G170497 (13): 009-SWI-012
F2G170497 (14): 009-SWI-013
F2G170497 (15): 009-SWI-014
F2G170497 (16): 009-SWI-015
F2G170497 (18): 009-SWI-017

There were no other nonconformances or observations noted with any analysis on this lot.

METHODS SUMMARY

F2G170497

PARAMETER	ANALYTICAL METHOD	PREPARATION METHOD
H-3 by Distillation & LSC	EPA 906.0 MOD	

References:

EPA "EASTERN ENVIRONMENTAL RADIATION FACILITY RADIOCHEMISTRY PROCEDURES MANUAL" US EPA EPA 520/5-84-006 AUGUST 1984

SAMPLE SUMMARY

F2G170497

WO #	SAMPLE#	CLIENT SAMPLE ID	SAMPLED DATE	SAMP TIME
MVML9	001	009-SWI-001	07/03/12	11:25
MVMMA	002	009-SWI-002	07/03/12	11:25
MVMMC	003	009-SWI-003	07/03/12	11:25
MVMMD	004	009-SWI-004	07/03/12	11:25
MVMME	005	009-SWI-005	07/03/12	11:30
MVMMF	006	009-SWI-006	07/03/12	11:30
MVMMG	007	009-SWI-007	07/03/12	11:30
MVMMH	008	009-SWI-008	07/03/12	11:35
MVMMJ	009	009-SWI-009	07/03/12	11:35
MVMMK	010	009-SWI-010	07/03/12	11:35
MVMML	011	009-SWI-010D	07/03/12	11:35
MVMMM	012	009-SWI-011	07/03/12	11:35
MVMMN	013	009-SWI-012	07/03/12	11:35
MVMMQ	014	009-SWI-013	07/03/12	11:40
MVMMR	015	009-SWI-014	07/03/12	11:40
MVMMT	016	009-SWI-015	07/03/12	11:40
MVMMV	017	009-SWI-016	07/03/12	11:45
MVMMW	018	009-SWI-017	07/03/12	11:45

NOTE(S):

- The analytical results of the samples listed above are presented on the following pages.
- All calculations are performed before rounding to avoid round-off errors in calculated results.
- Results noted as "ND" were not detected at or above the stated limit.
- This report must not be reproduced, except in full, without the written approval of the laboratory.
- Results for the following parameters are never reported on a dry weight basis: color, corrosivity, density, flashpoint, ignitability, layers, odor, paint filter test, pH, porosity pressure, reactivity, redox potential, specific gravity, spot tests, solids, solubility, temperature, viscosity, and weight.

Tetra Tech, Inc.

Client Sample ID: 009-SWI-001

Radiochemistry

Lab Sample ID: F2G170497-001
Work Order: MVML9
Matrix: SOLID

Date Collected: 07/03/12 1125
Date Received: 07/14/12 0915

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDL	Count Time	Prep Date	Analysis Date
TRITIUM (Distill) by EPA 906.0 MOD				**pCi/sample**		**Batch # 2213059**		**Yld %**
Tritium	-0.918	U	1.48	10.0	1.53	30	07/31/12	07/31/12

NOTE(S)

Data are incomplete without the case narrative.
Bold results are greater than the MDL.

U Result is less than the sample detection limit.

The MDL is an estimate of the measured activity at which there is a 99% confidence that a given analyte is present in a given sample matrix. This is functionally analogous to the "critical value" or the "limit of detection".

Ra-226 results analyzed by EPA 901.1 MOD were calculated and reported from the 46.09 percent abundant 609.31 KeV line of Bi-214.

Tetra Tech, Inc.

Client Sample ID: 009-SWI-002

Radiochemistry

Lab Sample ID: F2G170497-002
Work Order: MVMMA
Matrix: SOLID

Date Collected: 07/03/12 1125
Date Received: 07/14/12 0915

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDL	Count Time	Prep Date	Analysis Date
TRITIUM (Distill) by EPA 906.0 MOD				**pCi/sample**		**Batch # 2213059**		**Yld %**
Tritium	-1.14	U	1.22	10.0	1.26	30	07/31/12	07/31/12

NOTE(S)

Data are incomplete without the case narrative.
Bold results are greater than the MDL.

U Result is less than the sample detection limit.

The MDL is an estimate of the measured activity at which there is a 99% confidence that a given analyte is present in a given sample matrix. This is functionally analogous to the "critical value" or the "limit of detection".

Ra-226 results analyzed by EPA 901.1 MOD were calculated and reported from the 46.09 percent abundant 609.31 KeV line of Bi-214.

Tetra Tech, Inc.

Client Sample ID: 009-SWI-003

Radiochemistry

Lab Sample ID: F2G170497-003
Work Order: MVMMC
Matrix: SOLID

Date Collected: 07/03/12 1125
Date Received: 07/14/12 0915

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDL	Count Time	Prep Date	Analysis Date
TRITIUM (Distill) by EPA 906.0 MOD				**pCi/sample**		**Batch # 2213059**		**Yld %**
Tritium	-1.07	U	2.28	10.0	2.48	30	07/31/12	07/31/12

NOTE(S)

Data are incomplete without the case narrative.
Bold results are greater than the MDL.

U Result is less than the sample detection limit.

The MDL is an estimate of the measured activity at which there is a 99% confidence that a given analyte is present in a given sample matrix. This is functionally analogous to the "critical value" or the "limit of detection".

Ra-226 results analyzed by EPA 901.1 MOD were calculated and reported from the 46.09 percent abundant 609.31 KeV line of Bi-214.

Tetra Tech, Inc.

Client Sample ID: 009-SWI-004

Radiochemistry

Lab Sample ID: F2G170497-004
Work Order: MVMMD
Matrix: SOLID

Date Collected: 07/03/12 1125
Date Received: 07/14/12 0915

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDL	Count Time	Prep Date	Analysis Date
TRITIUM (Distill) by EPA 906.0 MOD				**pCi/sample**		**Batch # 2213059**		**Yld %**
Tritium	-0.991	U	2.24	10.0	2.42	30	07/31/12	07/31/12

NOTE(S)

Data are incomplete without the case narrative.
Bold results are greater than the MDL.

U Result is less than the sample detection limit.

The MDL is an estimate of the measured activity at which there is a 99% confidence that a given analyte is present in a given sample matrix. This is functionally analogous to the "critical value" or the "limit of detection".

Ra-226 results analyzed by EPA 901.1 MOD were calculated and reported from the 46.09 percent abundant 609.31 KeV line of Bi-214.

Tetra Tech, Inc.

Client Sample ID: 009-SWI-005

Radiochemistry

Lab Sample ID: F2G170497-005
Work Order: MVMME
Matrix: SOLID

Date Collected: 07/03/12 1130
Date Received: 07/14/12 0915

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDL	Count Time	Prep Date	Analysis Date
TRITIUM (Distill) by EPA 906.0 MOD				**pCi/sample**		**Batch # 2213059**		**Yld %**
Tritium	-1.43	U	1.59	10.0	1.74	30	07/31/12	07/31/12

NOTE(S)

Data are incomplete without the case narrative.
Bold results are greater than the MDL.

U Result is less than the sample detection limit.

The MDL is an estimate of the measured activity at which there is a 99% confidence that a given analyte is present in a given sample matrix. This is functionally analogous to the "critical value" or the "limit of detection".

Ra-226 results analyzed by EPA 901.1 MOD were calculated and reported from the 46.09 percent abundant 609.31 KeV line of Bi-214.

Tetra Tech, Inc.

Client Sample ID: 009-SWI-006

Radiochemistry

Lab Sample ID: F2G170497-006
Work Order: MVMMF
Matrix: SOLID

Date Collected: 07/03/12 1130
Date Received: 07/14/12 0915

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDL	Count Time	Prep Date	Analysis Date
TRITIUM (Distill) by EPA 906.0 MOD				**pCi/sample**		**Batch # 2213059**		**Yld %**
Tritium	0.568	U	2.12	10.0	2.01	30	07/31/12	07/31/12

NOTE(S)

Data are incomplete without the case narrative.
Bold results are greater than the MDL.

U Result is less than the sample detection limit.

The MDL is an estimate of the measured activity at which there is a 99% confidence that a given analyte is present in a given sample matrix. This is functionally analogous to the "critical value" or the "limit of detection".

Ra-226 results analyzed by EPA 901.1 MOD were calculated and reported from the 46.09 percent abundant 609.31 KeV line of Bi-214.

Tetra Tech, Inc.

Client Sample ID: 009-SWI-007

Radiochemistry

Lab Sample ID: F2G170497-007
Work Order: MVMMG
Matrix: SOLID

Date Collected: 07/03/12 1130
Date Received: 07/14/12 0915

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDL	Count Time	Prep Date	Analysis Date
TRITIUM (Distill) by EPA 906.0 MOD				**pCi/sample**		**Batch # 2213059**		**Yld %**
Tritium	-1.15	U	1.25	10.0	1.30	30	07/31/12	07/31/12

NOTE(S)

Data are incomplete without the case narrative.
Bold results are greater than the MDL.

U Result is less than the sample detection limit.

The MDL is an estimate of the measured activity at which there is a 99% confidence that a given analyte is present in a given sample matrix. This is functionally analogous to the "critical value" or the "limit of detection".

Ra-226 results analyzed by EPA 901.1 MOD were calculated and reported from the 46.09 percent abundant 609.31 KeV line of Bi-214.

Tetra Tech, Inc.

Client Sample ID: 009-SWI-008

Radiochemistry

Lab Sample ID: F2G170497-008
Work Order: MVMMH
Matrix: SOLID

Date Collected: 07/03/12 1135
Date Received: 07/14/12 0915

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDL	Count Time	Prep Date	Analysis Date
TRITIUM (Distill) by EPA 906.0 MOD				**pCi/sample**		**Batch # 2213059**		**Yld %**
Tritium	-1.22	U	1.74	10.0	1.88	30	07/31/12	07/31/12

NOTE(S)

Data are incomplete without the case narrative.
Bold results are greater than the MDL.

U Result is less than the sample detection limit.

The MDL is an estimate of the measured activity at which there is a 99% confidence that a given analyte is present in a given sample matrix. This is functionally analogous to the "critical value" or the "limit of detection".

Ra-226 results analyzed by EPA 901.1 MOD were calculated and reported from the 46.09 percent abundant 609.31 KeV line of Bi-214.

Tetra Tech, Inc.

Client Sample ID: 009-SWI-009

Radiochemistry

Lab Sample ID: F2G170497-009
Work Order: MVMMJ
Matrix: SOLID

Date Collected: 07/03/12 1135
Date Received: 07/14/12 0915

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDL	Count Time	Prep Date	Analysis Date
TRITIUM (Distill) by EPA 906.0 MOD				**pCi/sample**		**Batch # 2213059**		**Yld %**
Tritium	-0.856	U	2.40	10.0	2.57	30	07/31/12	07/31/12

NOTE(S)

Data are incomplete without the case narrative.
Bold results are greater than the MDL.

U Result is less than the sample detection limit.

The MDL is an estimate of the measured activity at which there is a 99% confidence that a given analyte is present in a given sample matrix. This is functionally analogous to the "critical value" or the "limit of detection".

Ra-226 results analyzed by EPA 901.1 MOD were calculated and reported from the 46.09 percent abundant 609.31 KeV line of Bi-214.

Tetra Tech, Inc.

Client Sample ID: 009-SWI-010

Radiochemistry

Lab Sample ID: F2G170497-010
Work Order: MVMMK
Matrix: SOLID

Date Collected: 07/03/12 1135
Date Received: 07/14/12 0915

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDL	Count Time	Prep Date	Analysis Date
TRITIUM (Distill) by EPA 906.0 MOD				pCi/sample		Batch # 2213059		Yld %
Tritium	-0.833	U	2.22	10.0	2.36	30	07/31/12	07/31/12

NOTE(S)

Data are incomplete without the case narrative.
Bold results are greater than the MDL.

U Result is less than the sample detection limit.

The MDL is an estimate of the measured activity at which there is a 99% confidence that a given analyte is present in a given sample matrix. This is functionally analogous to the "critical value" or the "limit of detection".

Ra-226 results analyzed by EPA 901.1 MOD were calculated and reported from the 46.09 percent abundant 609.31 KeV line of Bi-214.

Tetra Tech, Inc.

Client Sample ID: 009-SWI-010D

Radiochemistry

Lab Sample ID: F2G170497-011
Work Order: MVMML
Matrix: SOLID

Date Collected: 07/03/12 1135
Date Received: 07/14/12 0915

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDL	Count Time	Prep Date	Analysis Date
TRITIUM (Distill) by EPA 906.0 MOD				**pCi/sample**		**Batch # 2213059**		**Yld %**
Tritium	-1.20	U	1.59	10.0	1.85	30	07/31/12	08/02/12

NOTE(S)

Data are incomplete without the case narrative.
Bold results are greater than the MDL.

U Result is less than the sample detection limit.

The MDL is an estimate of the measured activity at which there is a 99% confidence that a given analyte is present in a given sample matrix. This is functionally analogous to the "critical value" or the "limit of detection".

Ra-226 results analyzed by EPA 901.1 MOD were calculated and reported from the 46.09 percent abundant 609.31 KeV line of Bi-214.

Tetra Tech, Inc.

Client Sample ID: 009-SWI-011

Radiochemistry

Lab Sample ID: F2G170497-012
Work Order: MVMMM
Matrix: SOLID

Date Collected: 07/03/12 1135
Date Received: 07/14/12 0915

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDL	Count Time	Prep Date	Analysis Date
TRITIUM (Distill) by EPA 906.0 MOD				**pCi/sample**		**Batch # 2213059**		**Yld %**
Tritium	-0.824	U	2.27	10.0	2.42	30	07/31/12	07/31/12

NOTE(S)

Data are incomplete without the case narrative.
Bold results are greater than the MDL.

U Result is less than the sample detection limit.

The MDL is an estimate of the measured activity at which there is a 99% confidence that a given analyte is present in a given sample matrix. This is functionally analogous to the "critical value" or the "limit of detection".

Ra-226 results analyzed by EPA 901.1 MOD were calculated and reported from the 46.09 percent abundant 609.31 KeV line of Bi-214.

Tetra Tech, Inc.

Client Sample ID: 009-SWI-012

Radiochemistry

Lab Sample ID: F2G170497-013
Work Order: MVMMN
Matrix: SOLID

Date Collected: 07/03/12 1135
Date Received: 07/14/12 0915

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDL	Count Time	Prep Date	Analysis Date
TRITIUM (Distill) by EPA 906.0 MOD				**pCi/sample**		**Batch # 2213059**		**Yld %**
Tritium	-1.20	U	1.64	10.0	1.90	30	07/31/12	08/02/12

NOTE(S)

Data are incomplete without the case narrative.
Bold results are greater than the MDL.

U Result is less than the sample detection limit.

The MDL is an estimate of the measured activity at which there is a 99% confidence that a given analyte is present in a given sample matrix. This is functionally analogous to the "critical value" or the "limit of detection".

Ra-226 results analyzed by EPA 901.1 MOD were calculated and reported from the 46.09 percent abundant 609.31 KeV line of Bi-214.

Tetra Tech, Inc.

Client Sample ID: 009-SWI-013

Radiochemistry

Lab Sample ID: F2G170497-014
Work Order: MVMMQ
Matrix: SOLID

Date Collected: 07/03/12 1140
Date Received: 07/14/12 0915

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDL	Count Time	Prep Date	Analysis Date
TRITIUM (Distill) by EPA 906.0 MOD				**pCi/sample**		**Batch # 2213059**		**Yld %**
Tritium	-1.06	U	1.87	10.0	2.13	30	07/31/12	08/02/12

NOTE(S)

Data are incomplete without the case narrative.
Bold results are greater than the MDL.

U Result is less than the sample detection limit.

The MDL is an estimate of the measured activity at which there is a 99% confidence that a given analyte is present in a given sample matrix. This is functionally analogous to the "critical value" or the "limit of detection".

Ra-226 results analyzed by EPA 901.1 MOD were calculated and reported from the 46.09 percent abundant 609.31 KeV line of Bi-214.

Tetra Tech, Inc.

Client Sample ID: 009-SWI-014

Radiochemistry

Lab Sample ID: F2G170497-015
Work Order: MVMMR
Matrix: SOLID

Date Collected: 07/03/12 1140
Date Received: 07/14/12 0915

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDL	Count Time	Prep Date	Analysis Date
TRITIUM (Distill) by EPA 906.0 MOD				**pCi/sample**		**Batch # 2213059**		**Yld %**
Tritium	-1.20	U	2.19	10.0	2.54	30	07/31/12	08/02/12

NOTE(S)

Data are incomplete without the case narrative.
Bold results are greater than the MDL.

U Result is less than the sample detection limit.

The MDL is an estimate of the measured activity at which there is a 99% confidence that a given analyte is present in a given sample matrix. This is functionally analogous to the "critical value" or the "limit of detection".

Ra-226 results analyzed by EPA 901.1 MOD were calculated and reported from the 46.09 percent abundant 609.31 KeV line of Bi-214.

Tetra Tech, Inc.

Client Sample ID: 009-SWI-015

Radiochemistry

Lab Sample ID: F2G170497-016
Work Order: MVMMT
Matrix: SOLID

Date Collected: 07/03/12 1140
Date Received: 07/14/12 0915

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDL	Count Time	Prep Date	Analysis Date
TRITIUM (Distill) by EPA 906.0 MOD				**pCi/sample**		**Batch # 2213059**		**Yld %**
Tritium	-1.24	U	2.09	10.0	2.29	30	07/31/12	08/01/12

NOTE(S)

Data are incomplete without the case narrative.
Bold results are greater than the MDL.

U Result is less than the sample detection limit.

The MDL is an estimate of the measured activity at which there is a 99% confidence that a given analyte is present in a given sample matrix. This is functionally analogous to the "critical value" or the "limit of detection".

Ra-226 results analyzed by EPA 901.1 MOD were calculated and reported from the 46.09 percent abundant 609.31 KeV line of Bi-214.

Tetra Tech, Inc.

Client Sample ID: 009-SWI-016

Radiochemistry

Lab Sample ID: F2G170497-017
Work Order: MVMMV
Matrix: SOLID

Date Collected: 07/03/12 1145
Date Received: 07/14/12 0915

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDL	Count Time	Prep Date	Analysis Date
TRITIUM (Distill) by EPA 906.0 MOD				**pCi/sample**		**Batch # 2213059**		**Yld %**
Tritium	-0.378	U	1.87	10.0	1.88	30	07/31/12	08/01/12

NOTE(S)

Data are incomplete without the case narrative.
Bold results are greater than the MDL.

U Result is less than the sample detection limit.

The MDL is an estimate of the measured activity at which there is a 99% confidence that a given analyte is present in a given sample matrix. This is functionally analogous to the "critical value" or the "limit of detection".

Ra-226 results analyzed by EPA 901.1 MOD were calculated and reported from the 46.09 percent abundant 609.31 KeV line of Bi-214.

Tetra Tech, Inc.

Client Sample ID: 009-SWI-017

Radiochemistry

Lab Sample ID: F2G170497-018
Work Order: MVMMW
Matrix: SOLID

Date Collected: 07/03/12 1145
Date Received: 07/14/12 0915

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDL	Count Time	Prep Date	Analysis Date
TRITIUM (Distill) by EPA 906.0 MOD				**pCi/sample**		**Batch # 2213059**		**Yld %**
Tritium	-0.126	U	2.43	10.0	2.48	30	07/31/12	08/01/12

NOTE(S)

Data are incomplete without the case narrative.
Bold results are greater than the MDL.

U Result is less than the sample detection limit.

The MDL is an estimate of the measured activity at which there is a 99% confidence that a given analyte is present in a given sample matrix. This is functionally analogous to the "critical value" or the "limit of detection".

Ra-226 results analyzed by EPA 901.1 MOD were calculated and reported from the 46.09 percent abundant 609.31 KeV line of Bi-214.

METHOD BLANK REPORT

Radiochemistry

Client Lot ID: F2G170497
Matrix: SOLID

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDL	Count Time	Prep Date	Lab Sample ID / Analysis Date
TRITIUM (Distill) by EPA 906.0 MOD			pCi/sample	Batch # 2213059		Yld %		F2G310000-059B
Tritium	-0.320	U	0.950	10.0	0.827	30	07/31/12	07/31/12

NOTE(S)

Data are incomplete without the case narrative.
Bold results are greater than the MDL

U Result is less than the sample detection limit.

The MDL is an estimate of the measured activity at which there is a 99% confidence that a given analyte is present in a given sample matrix. This is functionally analogous to the "critical value" or the "limit of detection".

Ra-226 results analyzed by EPA 901.1 MOD were calculated and reported from the 46.09 percent abundant 609.31 KeV line of Bi-214.

F2G170497

CLIENT ANALYSIS SUMMARY

TestAmerica St. Louis
Storage Loc: SC

Project Manager: EKS
Quote #: 90665
SDG:
Date Received: 2012-07-14

Project: CTO WE03
NAS Brunswick, ME
Analytical Due Date: 2012-08-10

PO#:
Report to: Lawson Bailey
Report Due Date: 2012-08-11

Client: 1443231 Tetra Tech, Inc.
#SMPS in LOT: 18
Report Type: D Expanded Deliverable
EDD Code: 00

Follow DOD QSM 4.2 Project uses MLCC for RAD

SAMPLE #	CLIENT SAMPLE ID	Site ID	Client Matrix	DATE/TIME SAMPLED	WORKORDER	A
1	009-SWI-001			2012-07-03 / 1125	MVML9	SOLID

SAMPLE COMMENTS:

XX ZC	EPA 906.0 MOD	WIPE, 906.0 MOD, TRITIUM	G8	Distillation and Suspended in LSC Cocktail	01	STANDARD TEST SET	PROT: A	WRK LOC	06	

SAMPLE #	CLIENT SAMPLE ID	Site ID	Client Matrix	DATE/TIME SAMPLED	WORKORDER	A
2	009-SWI-002			2012-07-03 / 1125	MVMMA	SOLID

SAMPLE COMMENTS:

XX ZC	EPA 906.0 MOD	WIPE, 906.0 MOD, TRITIUM	G8	Distillation and Suspended in LSC Cocktail	01	STANDARD TEST SET	PROT: A	WRK LOC	06	

SAMPLE #	CLIENT SAMPLE ID	Site ID	Client Matrix	DATE/TIME SAMPLED	WORKORDER	A
3	009-SWI-003			2012-07-03 / 1125	MVMMC	SOLID

SAMPLE COMMENTS:

XX ZC	EPA 906.0 MOD	WIPE, 906.0 MOD, TRITIUM	G8	Distillation and Suspended in LSC Cocktail	01	STANDARD TEST SET	PROT: A	WRK LOC	06	

SAMPLE #	CLIENT SAMPLE ID	Site ID	Client Matrix	DATE/TIME SAMPLED	WORKORDER	A
4	009-SWI-004			2012-07-03 / 1125	MVMMD	SOLID

SAMPLE COMMENTS:

XX ZC	EPA 906.0 MOD	WIPE, 906.0 MOD, TRITIUM	G8	Distillation and Suspended in LSC Cocktail	01	STANDARD TEST SET	PROT: A	WRK LOC	06	

SAMPLE #	CLIENT SAMPLE ID	Site ID	Client Matrix	DATE/TIME SAMPLED	WORKORDER	A
5	009-SWI-005			2012-07-03 / 1130	MVMME	SOLID

SAMPLE COMMENTS:

XX ZC	EPA 906.0 MOD	WIPE, 906.0 MOD, TRITIUM	G8	Distillation and Suspended in LSC Cocktail	01	STANDARD TEST SET	PROT: A	WRK LOC	06	

SAMPLE #	CLIENT SAMPLE ID	Site ID	Client Matrix	DATE/TIME SAMPLED	WORKORDER	A
6	009-SWI-006			2012-07-03 / 1130	MVMMF	SOLID

SAMPLE COMMENTS:

XX ZC	EPA 906.0 MOD	WIPE, 906.0 MOD, TRITIUM	G8	Distillation and Suspended in LSC Cocktail	01	STANDARD TEST SET	PROT: A	WRK LOC	06	

SAMPLE #	CLIENT SAMPLE ID	Site ID	Client Matrix	DATE/TIME SAMPLED	WORKORDER	A
7	009-SWI-007			2012-07-03 / 1130	MVMMG	SOLID

SAMPLE COMMENTS:

XX ZC	EPA 906.0 MOD	WIPE, 906.0 MOD, TRITIUM	G8	Distillation and Suspended in LSC Cocktail	01	STANDARD TEST SET	PROT: A	WRK LOC	06	

SAMPLE #	CLIENT SAMPLE ID	Site ID	Client Matrix	DATE/TIME SAMPLED	WORKORDER	A
8	009-SWI-008			2012-07-03 / 1135	MVMMH	SOLID

SAMPLE COMMENTS:

XX ZC	EPA 906.0 MOD	WIPE, 906.0 MOD, TRITIUM	G8	Distillation and Suspended in LSC Cocktail	01	STANDARD TEST SET	PROT: A	WRK LOC	06	

SAMPLE #	CLIENT SAMPLE ID	Site ID	Client Matrix	DATE/TIME SAMPLED	WORKORDER	A
9	009-SWI-009			2012-07-03 / 1135	MVMMJ	SOLID

SAMPLE COMMENTS:

CLIENT ANALYSIS SUMMARY

Storage Loc: TestAmerica St. Louis SC

Project Manager: EKS | Quote #: 90665 | SDG:

Project: CTO WE03 | NAS Brunswick, ME

PO#: | Report to: Lawson Balley

Client: 1443231 Tetra Tech, Inc.

Date Received: 2012-07-14

Analytical Due Date: 2012-08-10

Report Due Date: 2012-08-11

Report Type: D Expanded Deliverable

#SMPS in LOT: 18 EDD Code: 00

Follow DOD QSM 4.2 Project uses MLCC for RAD

XX ZC EPA 906.0 MOD WIPE, 906.0 MOD, TRITIUM G8 Distillation and Suspended in LSC Cocktail 01 STANDARD TEST SET PROT: A WRK LOC 06

SAMPLE #	CLIENT SAMPLE ID	Site ID	Client Matrix	DATE/TIME SAMPLED	WORKORDER	A
10	009-SWI-010			2012-07-03 / 1135	MVMMK	SOLID

SAMPLE COMMENTS:

XX ZC EPA 906.0 MOD WIPE, 906.0 MOD, TRITIUM G8 Distillation and Suspended in LSC Cocktail 01 STANDARD TEST SET PROT: A WRK LOC 06

SAMPLE #	CLIENT SAMPLE ID	Site ID	Client Matrix	DATE/TIME SAMPLED	WORKORDER	A
11	009-SWI-010D			2012-07-03 / 1135	MVMML	SOLID

SAMPLE COMMENTS:

XX ZC EPA 906.0 MOD WIPE, 906.0 MOD, TRITIUM G8 Distillation and Suspended in LSC Cocktail 01 STANDARD TEST SET PROT: A WRK LOC 06

SAMPLE #	CLIENT SAMPLE ID	Site ID	Client Matrix	DATE/TIME SAMPLED	WORKORDER	A
12	009-SWI-011			2012-07-03 / 1135	MVMMM	SOLID

SAMPLE COMMENTS:

XX ZC EPA 906.0 MOD WIPE, 906.0 MOD, TRITIUM G8 Distillation and Suspended in LSC Cocktail 01 STANDARD TEST SET PROT: A WRK LOC 06

SAMPLE #	CLIENT SAMPLE ID	Site ID	Client Matrix	DATE/TIME SAMPLED	WORKORDER	A
13	009-SWI-012			2012-07-03 / 1135	MVMMN	SOLID

SAMPLE COMMENTS:

XX ZC EPA 906.0 MOD WIPE, 906.0 MOD, TRITIUM G8 Distillation and Suspended in LSC Cocktail 01 STANDARD TEST SET PROT: A WRK LOC 06

SAMPLE #	CLIENT SAMPLE ID	Site ID	Client Matrix	DATE/TIME SAMPLED	WORKORDER	A
14	009-SWI-013			2012-07-03 / 1140	MVMMQ	SOLID

SAMPLE COMMENTS:

XX ZC EPA 906.0 MOD WIPE, 906.0 MOD, TRITIUM G8 Distillation and Suspended in LSC Cocktail 01 STANDARD TEST SET PROT: A WRK LOC 06

SAMPLE #	CLIENT SAMPLE ID	Site ID	Client Matrix	DATE/TIME SAMPLED	WORKORDER	A
15	009-SWI-014			2012-07-03 / 1140	MVMMR	SOLID

SAMPLE COMMENTS:

XX ZC EPA 906.0 MOD WIPE, 906.0 MOD, TRITIUM G8 Distillation and Suspended in LSC Cocktail 01 STANDARD TEST SET PROT: A WRK LOC 06

SAMPLE #	CLIENT SAMPLE ID	Site ID	Client Matrix	DATE/TIME SAMPLED	WORKORDER	A
16	009-SWI-015			2012-07-03 / 1140	MVMMT	SOLID

SAMPLE COMMENTS:

XX ZC EPA 906.0 MOD WIPE, 906.0 MOD, TRITIUM G8 Distillation and Suspended in LSC Cocktail 01 STANDARD TEST SET PROT: A WRK LOC 06

SAMPLE #	CLIENT SAMPLE ID	Site ID	Client Matrix	DATE/TIME SAMPLED	WORKORDER	A
17	009-SWI-016			2012-07-03 / 1145	MVMMV	SOLID

SAMPLE COMMENTS:

XX ZC EPA 906.0 MOD WIPE, 906.0 MOD, TRITIUM G8 Distillation and Suspended in LSC Cocktail 01 STANDARD TEST SET PROT: A WRK LOC 06

SAMPLE #	CLIENT SAMPLE ID	Site ID	Client Matrix	DATE/TIME SAMPLED	WORKORDER	A

F2G170497

CLIENT ANALYSIS SUMMARY

TestAmerica St. Louis
Storage Loc: SC

Project Manager: EKS
Quote #: 90665 SDG:
Date Received: 2012-07-14

Project: CTO WE03
NAS Brunswick, ME
Analytical Due Date: 2012-08-10

PO#:
Report to: Lawson Bailey
Report Due Date: 2012-08-11

Client: 1443231 Tetra Tech, Inc.
Report Type: D Expanded Deliverable
#SMPS in LOT: 18
EDD Code: 00

Follow DOD QSM 4.2 Project uses MLCC for RAD

18	009-SWI-017	2012-07-03 / 1145	MVMMW	SOLID

SAMPLE COMMENTS:

XX	ZC	EPA	906.0 MOD	WIPE, 906.0 MOD, TRITIUM	G8	Distillation and Suspended in LSC Cocktail	01	STANDARD TEST SET	PROT: A	WRK LOC	06

TestAmerica St. Louis Chain-of-Custody Record

13715 Rider Trial North
Earth City, MO 63045
Phone: 314-298-8566 Fax: 314-298-8757

Customer Information		Project Information		Analyses / Method Requested
Project Name	Brunswick NAS	Purchase Order	1065666	A. Tritium analysis
PM/ Quote#		Master Agreement #		B.
Company	Tetratech	Bill To		C.
Send Report To:	Lawson Baily	Invoice Attn		D.
Address:	900 Trail Ridge Rd	Address:		E.
				F.
City/State/Zip	Aiken, SC 29803	City/State/Zip		G.
Phone	803-641-6326	Phone		H.
Fax		Fax		I.

Sx No.	Sample Description	Sample Date	Sample Time	Sample Matrix	Container Type	Preservative	No. of Bottles	A.	B	C	D	E	F	G	H	I	Comments
1	009-SWI-001	7/3/2012	1125	H^3 swipe	ziploc			x									SU1
2	009-SWI-002	7/3/2012	1125	H^3 swipe	ziploc			x									
3	009-SWI-003	7/3/2012	1125	H^3 swipe	ziploc			x									
4	009-SWI-004	7/3/2012	1125	H^3 swipe	ziploc			x									
5	009-SWI-005	7/3/2012	1130	H^3 swipe	ziploc			x									
6	009-SWI-006	7/3/2012	1130	H^3 swipe	ziploc			x									
7	009-SWI-007	7/3/2012	1130	H^3 swipe	ziploc			x									
8	009-SWI-008	7/3/2012	1135	H^3 swipe	ziploc			x									
9	009-SWI-009	7/3/2012	1135	H^3 swipe	ziploc			x									
10	009-SWI-010	7/3/2012	1135	H^3 swipe	ziploc			x									
10d	009-SWI-010d	7/3/2012	1135	H^3 swipe	ziploc			x									
11	009-SWI-011	7/3/2012	1135	H^3 swipe	ziploc			x									
12	009-SWI-012	7/3/2012	1135	H^3 swipe	ziploc			x									

Shipment Method: FED EX

Airbill No.:

Required Turnaround: 21 days

Relinquished by:	Date	Relinquished by:	Date	Relinquished by:	Date
Company Name: MSI	Time 0830	Company Name:	Time	Company Name:	Time
Received by:	Date 7/10/12	Received by:	Date	Received by:	Date
Company Name: TA	Time 0915	Company Name:	Time	Company Name:	Time

TestAmerica St. Louis Chain-of-Custody Record

13715 Rider Trial North
Earth City, MO 63045
Phone: 314-298-8566 Fax: 314-298-8757

Customer Information		Project Information		Analyses / Method Requested
Project Name	Brunswick NAS	Purchase Order	1065666	A. Tritium analysis
PM/ Quote#		Master Agreement #		B.
Company	Tetratech	Bill To		C.
Send Report To:	Lawson Baily	Invoice Attn		D.
Address:	900 Trail Ridge Rd	Address:		E.
				F.
City/State/Zip	Aiken, SC 29803	City/State/Zip		G.
Phone	803-641-6326	Phone		H.
Fax		Fax		I.

Sx No.	Sample Description	Sample Date	Sample Time	Sample Matrix	Container Type	Preservative	No. of Bottles	A.	B	C	D	E	F	G	H	I	Comments
1	009-SWI-013	7/3/2012	1140	H^3 swipe	ziploc			x									SU1
2	009-SWI-014	7/3/2012	1140	H^3 swipe	ziploc			x									
3	009-SWI-015	7/3/2012	1140	H^3 swipe	ziploc			x									
4	009-SWI-016	7/3/2012	1145	H^3 swipe	ziploc			x									
5	009-SWI-017	7/3/2012	1145	H^3 swipe	ziploc			x									

Shipment Method: FED EX | Airbill No.: | Required Turnaround: 21 days

Relinquished by:	Date	Relinquished by:	Date	Relinquished by:	Date
Company Name: MSI	Time 0830	Company Name:	Time	Company Name:	Time
Received by:	Date 7/13/12	Received by:	Date	Received by:	Date
Company Name: TA	Time 0915	Company Name:	Time	Company Name:	Time

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

CUR Form #: 0 8 8

Lot #(s): F2G170474, 479 488 (508) TestAmerica St. Louis
475 481 490 503
476, 484 494 504
477 485 498 (497)
478, 487, 500

CONDITION UPON RECEIPT FORM

Client: Tetra Tech
Quote No: 90465
COC/RFA No: N/A
Initiated By: [illegible] Date: 7/13/12 Time: 0915

Shipping Information

Shipper: (FedEx) UPS DHL Courier Client Other: _____ Multiple Packages: Y (N)

Shipping # (s):*

1. 7937 8052 3177
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

Sample Temperature (s):**

1. Ambient
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

*Numbered shipping lines correspond to Numbered Sample Temp lines

**Sample must be received at 4°C ± 2°C- If not, note contents below. Temperature variance does NOT affect the following: Metals-Liquid; Rad tests- Liquid or Solids; Perchlorate

Condition (Circle "Y" for yes, "N" for no and "N/A" for not applicable):

1.	(Y) N	Are there custody seals present on the cooler?	8.	Y (N)	Are there custody seals present on bottles?
2.	Y (N) N/A	Do custody seals on cooler appear to be tampered with?	9.	Y N (N/A)	Do custody seals on bottles appear to be tampered with?
3.	(Y) N	Were contents of cooler frisked after opening, but before unpacking?	10.	Y N (N/A)	Was sample received with proper pH[1]? (If not, make note below)
4.	(Y) N	Sample received with Chain of Custody?	11.	Y N (N/A)	Containers for C-14, H-3 & I-129/131 marked with "Do Not Preserve" label?
5.	(Y) N N/A	Does the Chain of Custody match sample ID's on the container(s)?	12.	(Y) N	Sample received in proper containers?
6.	Y (N)	Was sample received broken?	13.	Y N (N/A)	Headspace in VOA or TOX liquid samples? (If Yes, note sample ID's below)
7.	(Y) N	Is sample volume sufficient for analysis?	14.	Y N (N/A)	Was Internal COC/Workshare received?

[1] For DOE-AL (Pantex, LANL, Sandia) sites, pH of ALL containers received must be verified, EXCEPT VOA, TOX, Oil & Grease and soils.

Notes: * Sample 543-SW1-543 has 543-SW1-009 on bag.
Sample 544-SW1-544 has 544-SW1-009 on bag
Sample 041-SW1-041 has 041-SW1-009 on bag

Use bag ID's per KS.

Corrective Action:
☐ Client Contact Name: _____ Informed by: _____
☐ Sample(s) processed "as is"
☐ Sample(s) on hold until: _____ If released, notify: _____
Project Management Review: EVS Date: 8/10/12

THIS FORM MUST BE COMPLETED AT THE TIME THE ITEMS ARE BEING CHECKED IN. IF ANY ITEM IS COMPLETED BY SOMEONE OTHER THAN THE INITIATOR, THEN THAT PERSON IS REQUIRED TO APPLY THEIR INITIAL AND THE DATE NEXT TO THAT ITEM.

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