# Characterization Survey Report
# American Ordnance Milan DU Facilities

August 2022

Clark Barton, CHP, CSP
Christopher Royce, CHP, CSP
Christi Wilson, MHP

Prepared for:
American Ordnance, LLC
Milan Army Ammunition Plant
Milan, TN 38358

N|V|5

1835 Terminal Drive
Suite 200
Richland, WA 99354

100614-RPT-20220829

## LIMITATIONS

NV5/Dade Moeller has prepared this survey report based on historical documents and drawings supplied by the current American Ordnance Milan (AOM) project team, and information received from the current AOM project team regarding historical work with radioactive material at the facility. Our work is based on information available at the time of publication. Information provided in this report by NV5/Dade Moeller is intended exclusively for the use of the AOM project team. The characterization survey plan requirements discussed in this report are based on the information provided, and our current understanding and interpretation of regulatory agency regulations, guidance, and policies. The professional services have been performed in accordance with practices generally accepted by other health physicists practicing in this field. No other warranty, either expressed or implied, is made.

# EXECUTIVE SUMMARY

This characterization survey report of the AOM DU Munitions facilities at the Milan Army Ammunition Plant (MLAAP) documents the results of the survey and provides the basis for the release of the facilities from control as a radiologically impacted area. This survey was designed such that if all of the results were below the release limits, the survey will suffice as the final status survey. In addition to all results being below the release limits, all were below the Action Level set at 75% of the release limits, and all results were below the minimum detectable activity for both direct alpha and for removable alpha. This data should be sufficient to support the termination of the radioactive material license for the AOM DU facilities.

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# RECORD OF REVISIONS

| Revision Number | Description | Date |
|---|---|---|
| 0 | New Document issued by Clark Barton | 08/03/2022 |

# 1.0 INTRODUCTION

The survey plan (NV5/DM, 2022b) was used to perform a characterization survey of the American Ordnance Milan (AOM) DU facilities at the Milan Army Ammunition Plant (MLAAP) on August 22–24, 2022. The AOM facilities surveyed were a dock at the E-67 area, and parts of four buildings in the X Line: X-14, X-18, X-26, and X-27. All of the areas were pre-classified as Class 3 due to the type and nature of the licensed radioactive materials used at the facilities.

A Historical Site Assessment (HSA) (NV5/DM, 2022a) for AOM shows that the indicated areas in Figures 1 through 5 are the only areas with radioactive material work. Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)-like Class 3 surveys were conducted for both alpha and beta-emitting materials in these five areas.

A gamma survey was also performed in each area to eliminate the possibility of bulk materials being present and to identify any gross contamination. Additionally, 20 locations had 1 square meter areas surveyed, with direct, static, and removable contamination measurements performed. There were no areas of elevated activity found during the gamma scans or during the 1 square meter alpha/beta scans. The locations were randomly selected on the spot, with emphasis placed on stains, damaged areas, and cracks. There were no floor drains found.

# 2.0 CHARACTERIZATION SURVEY REQUIREMENTS

For this survey the appropriate release criteria will be average total alpha contamination below 265 dpm/100 $cm^2$ with removable contamination not to exceed 10% (26 dpm/100 $cm^2$). Additionally, the data collected for this survey will be designed such that it could be used as all or part of a final status survey.

## 2.1 MINIMUM DETECTABLE ACTIVITY DETERMINATION

Minimum Detectable Activity (MDA) will be calculated to verify that the chosen survey instruments and methods are adequately sensitive to meet the survey criteria. A Decision Level (DL), also the Derived Concentration Guideline Level (DCGL), will be set to the release limits and used to determine whether a survey point meets the criteria. An Action Level (AL) will be calculated based on the background study. The AL will be set to 75% of the release limits.

In order to calculate the MDA, an acceptable false positive and false negative rate must be determined. For purposes of this survey, it is assumed that a 5% false positive ($\alpha$) and a 5% false negative ($\beta$) rate will be acceptable. The number of standard deviations above zero on the standard normal distribution to have a probability of $\alpha$ or $\beta$ being higher is the standard normal deviate, $k\alpha$ or $k\beta$. From Table 5.2 of the MARSSIM (NRC, 2000), values of $k\alpha$ and $k\beta$ are set at 1.645 when $\alpha$ and $\beta$ are equal to 0.05 (5%).

Direct measurements are taken by placing a detector as near as possible to the surface measured. A discrete measurement is then performed for a pre-determined time interval and the reading recorded. Direct measurements are collected using data-logging instruments such as the Ludlum 2360 in combination with the Ludlum 43-93 detector. The instruments are calibrated with radionuclides of similar energies to the radionuclides of concern as discussed in Section 3.0.

Direct measurement MDAs for alpha and beta-gamma-emitting radionuclides are calculated using the following expanded equation based on MARSSIM Equation 6-7 (NRC, 2000):

$$MDA_{static} = \frac{3 + 2k\sqrt{R_b t_g (1 + {}^{t_g}/_{t_b})}}{t_g \cdot E_{total} \cdot \frac{A}{100}}$$

where:

| | |
|---|---|
| $MDA_{static}$ | = MDA level in dpm/100cm$^2$ |
| $R_b$ | = background count rate in cpm |
| $t_b$ | = background counting time |
| $t_g$ | = sample counting time |
| $E_{total}$ | = total detector efficiency for radionuclide emission of interest (includes combination of instrument efficiency and surface efficiency*) |
| $A$ | = physical detector area in cm$^2$ |

*Surface efficiency applied is in accordance with the recommended values of 0.25 for alpha and beta emitters <400 keV max and 0.5 for all others as described in MARSSIM (NRC, 2000).

Wipe samples are performed to determine the presence of removable residual radioactivity at each location for which a direct measurement is made. A wipe is performed by wiping a standard wipe (47 mm-diameter, paper or absorbent cloth) over an area of 100 cm$^2$ using moderate pressure. Wipes are collected from each direct measurement location. Analysis for gross beta-gamma and alpha radioactivity are performed on site by NV5/Dade Moeller.

The MDAs for wipe samples are determined using the same equation specified for direct measurements, with a surface efficiency of 1.0. The counting times used for background counts and sample counts may be changed to meet the required MDA.

## 2.2 BUILDING AND MATERIAL SPECIFIC BACKGROUND

Building-specific background will be established using a survey of a non-impacted building/area of the same build era and materials. Since there is no evidence of any contamination, it is reasonable to use an area close to the Class 3 areas to establish background levels for the materials. The non-impacted area of X-18 was selected as the background area.

## 2.3 RADIONUCLIDES OF CONCERN

The Historical Site Assessment (HAS) (NV5/DM, 2022a) and referenced documents establish the only radionuclide of concern for the AOM as depleted uranium, which is 99% U-238. Uranium-238 and progeny have alpha, beta, and gamma emissions. Alpha contamination will be the primary concern and will be the main monitored emission; however, beta and gamma emissions will also be monitored due to the potential for alpha absorption from other materials on the surface.

## 2.4 ACTION LEVELS

The action levels for AOM was established at a level that is 75% of the release criteria. The AL was not exceeded at any survey location.

## 2.5 DEVIATIONS FROM THE SAMPLE DESIGN

Since no areas of elevated activity were discovered during the gamma scans, the 20 sample locations for each survey were selected on the spot. As there were no floor drains identified, some bias survey points were selected where there were cracks, discolorations, or damage on the floor. There were no deviations from the survey plan.

## 2.6 SURVEY UNIT DEFINITION

The Class 3 areas are shown in Figures 1 through 5. Previous experience with Visual Sample Plan (VSP) (PNNL, 2017) for the type of survey equipment used shows that 15 to 17 locations are usually sufficient to meet the MARSSIM criteria. For Class 3 area random point selection is the default in MARSSIM. The gamma scan measurements, physical attributes, and surveyor experience will be used to select the random locations for 20 locations at each Class 3 area, with a bias to any areas identified with elevated activity, floor drains, and cracks/crevices. This should ensure that all decisions based on this data are conservative.

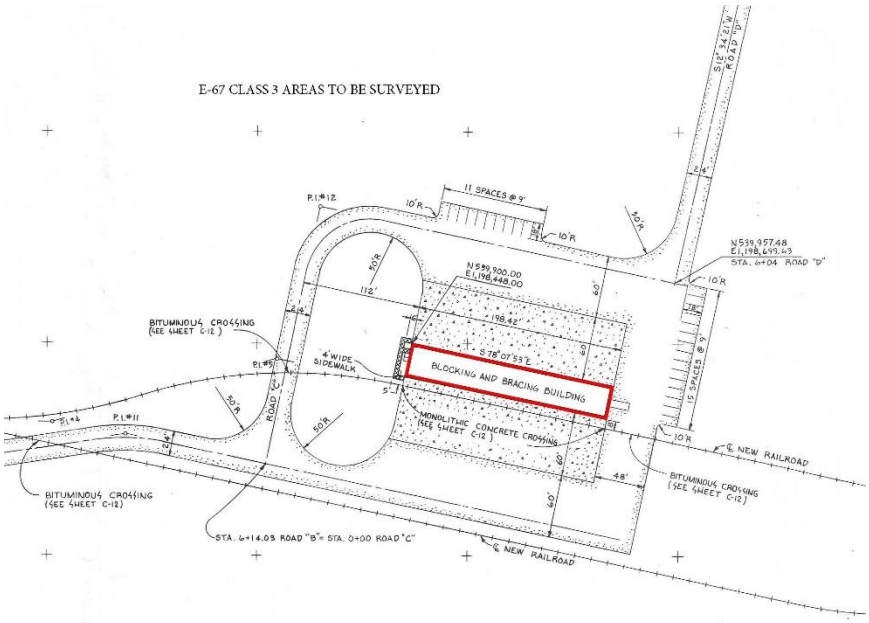


*Figure 1 – E-67 Class 3 Area*

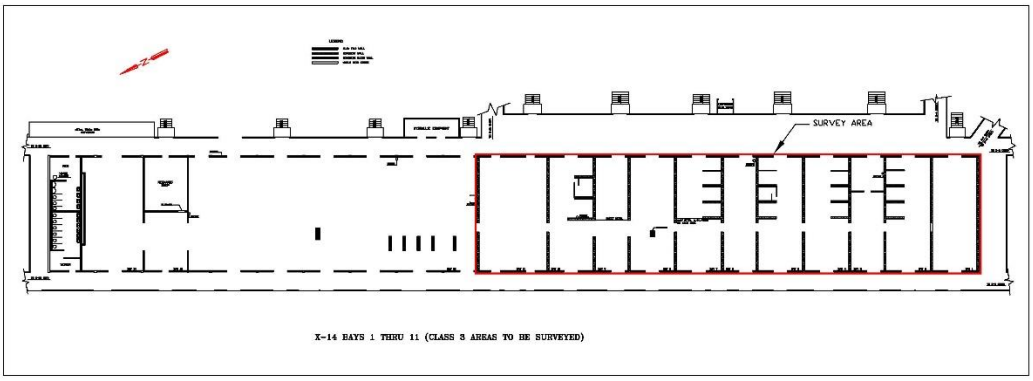


*Figure 2 – X-14 Class 3 Area*

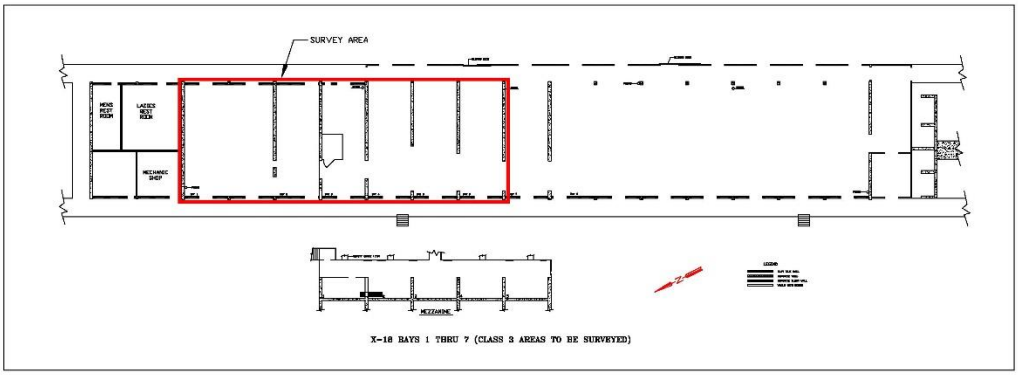


*Figure 3 – X-18 Class 3 Area*

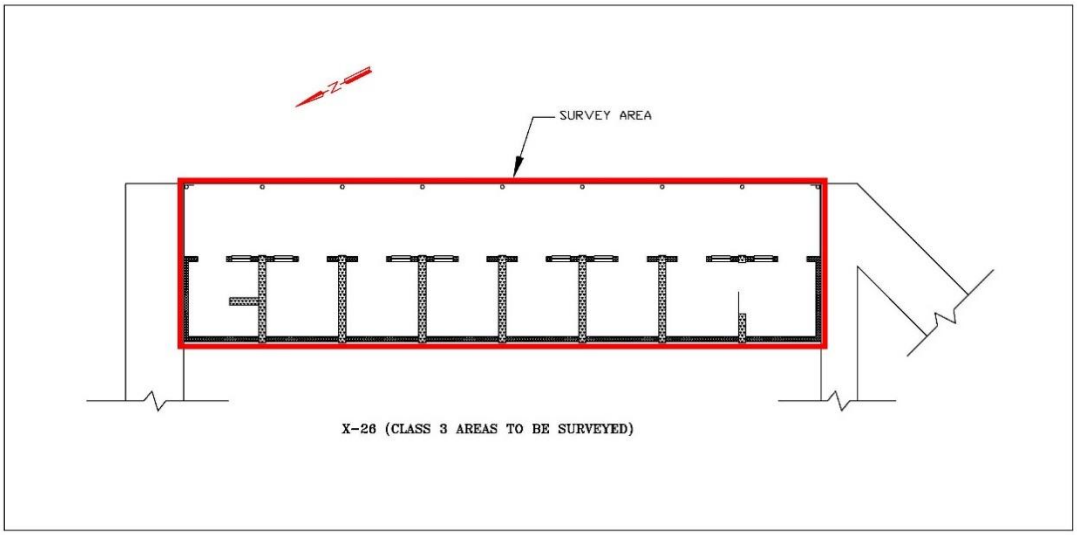


*Figure 4 – X-26 Class 3 Area*

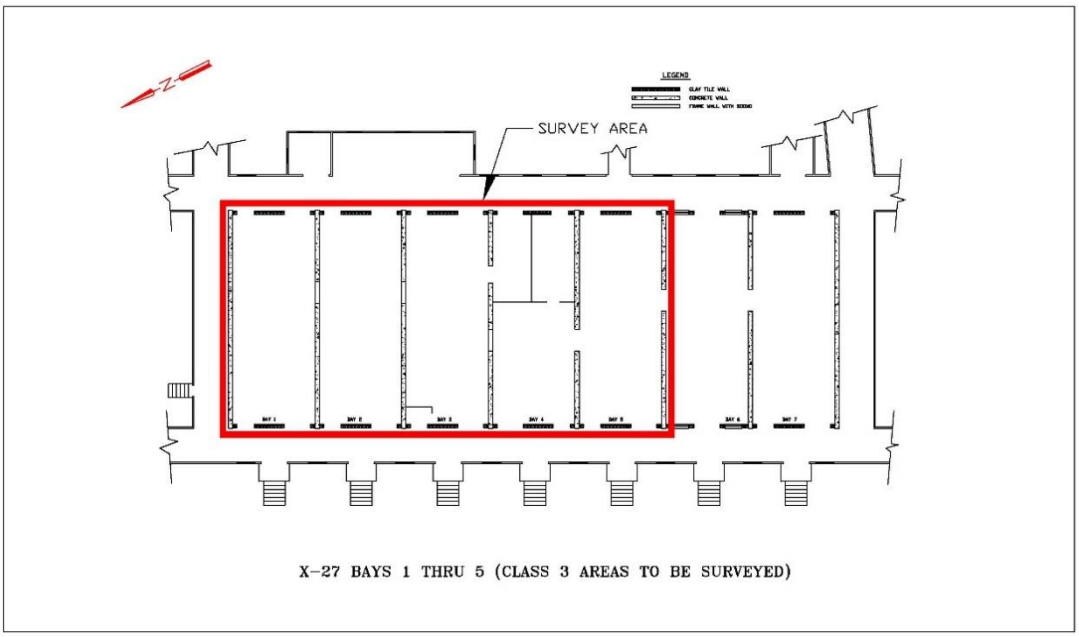


*Figure 5 – X-27 Class 3 Area*

## 2.7 SURVEY INSTRUMENTATION

The survey instrumentation for this survey plan includes:

- Ludlum Model 43-93, Dual Phosphor Scintillator, used for direct and scan measurements for alpha and beta residual radioactivity. This detector is commonly paired with a Ludlum 2360 meter.
- Ludlum Model 43-10-1, Dual Phosphor Scintillator, used to analyze wipe samples for alpha and beta removable residual radioactivity. This detector is paired with a Ludlum 2929 bench counter.
- Exploranium Model GR-135 Plus, used to perform gamma scanning surveys.

Based on the potential radionuclides assumed to be present and their associated radiations, the detection sensitivities of various instruments and techniques were evaluated for use at AOM. Instruments are selected for use during direct measurements and analysis of removable residual radioactivity wipes. The instruments were selected to meet the MDA goals. Instrument selection criteria include the capability of the instrument to detect the radiation types emitted by the radionuclides of concern, sufficient efficiency factors, and estimates of background radiation values.

Instruments are calibrated with radionuclides of similar energies to the radionuclides of concern and are traceable to the National Institute of Standards and Technology (NIST). Since the release limits are lower for removable residual radioactivity, the wipes will be counted on equipment that is more sensitive than the field instruments used for the direct measurements. Table 2-1 shows survey instrumentation. Calibration certificates for all instruments are included in Attachment A.

*Table 1: Proposed Instrumentation*

| Detector Model | Detector Type | Detector Area | Instrument Model | Window Thickness | Total Efficiency[1] |
|---|---|---|---|---|---|
| Ludlum 43-93 | Dual Phosphor Scintillation | 100 $cm^2$ | Ludlum 2360 | 1.2 $mg/cm^2$ | 13.6% - Beta<br>19.9% - Alpha |
| Ludlum 43-10-1 | Dual Phosphor Scintillation | 40.3 $cm^2$ | Ludlum 2929 | 0.8 $mg/cm^2$ | 33.8% – Beta<br>19.0% – Alpha |

*Table 2: Example Instrument Operating Parameters and Sensitivities*

| Measurement Type | Detector Model | Instrument Model | Count Time | Background[1] (cpm) | MDA (dpm/ 100 $cm^2$) |
|---|---|---|---|---|---|
| Total Surface Activity | Ludlum 43-93 | Ludlum 2360 | 2 min. sample<br>10 min. bkg. | 175 – Beta<br>2.6 – Alpha | 745 – Beta<br>177 – Alpha |
| Removable Activity (Alpha/Beta) | Ludlum 43-10-1 | Ludlum 2929 | 2 min. sample<br>10 min. bkg. | 32 – Beta<br>0.22 - Alpha | 34 – Beta<br>12 – Alpha |

[1] Background count rates are taken from a recent survey of concrete using these model instruments.

The MDAs displayed in Table 2-2 are using actual background measurements and efficiency factors obtained and tested during performance of the background study.

Daily response checks are performed and documented on control charts in accordance and are used to demonstrate that radiological instrumentation is operating correctly. Initial values and daily source checks, as well as the MDA Calculation sheets, are shown in Attachment B.

# 3.0 SURVEY INSTRUCTIONS

Direct and scan surveys and wipe samples were performed at each survey point. Each survey point was approximately 1 square meter (1 meter on each side). All results were logged on a data sheet. All data sheets are included in Attachment C. The following methods were used for the surveys.

## 3.1 PRESURVEY REQUIREMENTS

1. Verify the survey instrument is within the calibration due date.
2. Perform a 10-minute background check on the Ludlum 43-93/2360 for both alpha and beta. Record these results on the log sheet. Alpha and beta background must be ±20% of the original background. Background readings exceeding this level must be evaluated by the NV5/Dade Moeller Project Manager prior to proceeding with the survey.
3. Perform a source check on the Ludlum 43-93/2360 for both alpha and beta. Acceptance criteria are ±20% of the source value. Perform a check of both alpha and beta. Record on the log sheet and plot the point on the graph. If the instrument response is outside the acceptance criteria, check the instrument for loose cables and holes in the window. Repeat source check. If it fails again, tag the instrument out of service and obtain another instrument.
4. Perform a background count with the Sodium Iodide (NaI) detector and record the value. Background must be ±20% of the original background. Background readings exceeding this

level must be evaluated by the NV5/Dade Moeller Project Manager prior to proceeding with the survey.

5. Perform a source check of the NaI detector. Acceptance criteria are ±20% of the source value. Record on the log sheet and plot the point on the graph. If the instrument response is outside the acceptance criteria, repeat source check. If it fails again, tag the instrument out of service and obtain another instrument.
6. Take a 10-minute background on the Ludlum 43-10-1/2929 for both alpha and beta. Record on the log sheet. Background must be ±20% of the original background. Background readings exceeding this level must be evaluated by the NV5/Dade Moeller Project Manager prior to proceeding with the survey.
7. Perform a source check of the Ludlum 43-10-1/2929 for both alpha and beta. Record and plot results. Acceptance criteria are ±20% of the source value. Record on the log sheet and plot the point on the graph. If the instrument response is outside the acceptance criteria, repeat source check. If it fails again, tag the instrument out of service and obtain another instrument.
8. Obtain sufficient wipes and wipe envelopes for the number of survey points. Label envelopes with survey point designation.

## 3.2 ALPHA/BETA SCAN SURVEYS

1. Scan the area at 4 inches per second with the detector held at a distance from the surface of 1/4 inch for beta/gamma and 1/8 inch for alpha.
2. If elevated readings (approximately twice background) are noted, stop and mark elevated area for additional static measurements as directed in section 3.4.
3. Note locations of scan readings, elevated counts, and actions taken.

## 3.3 GAMMA SCAN SURVEYS

1. Survey each survey unit with the NaI meter.
2. Meter should be held at approximately 6 inches from the floor.
3. Use a serpentine pattern to survey the area.
4. Note any elevated readings and mark elevated area.
5. Investigate any reading greater than two times background.

## 3.4 DIRECT SURVEYS

1. Locate any elevated areas identified in section 3.3, and any floor drains, stains, and cracks/crevices in the survey area. Locate one of the 20 survey locations at the points.
2. Randomly selected additional locations to total 20.
3. Scan a 1 square meter area surrounding each location and mark any elevated area.
4. Perform direct measurement readings for gross alpha and gross beta at each location, using either the center of the scanned area or the highest elevated area identified during the scan. Take a count at each survey location for the duration selected to meet the MDA requirements. Document each reading.
5. If any reading exceeds the action level, repeat the reading. If the reading is still above the action level, flag the location and notify the AOM Radiation Safety Officer.

## 3.5 WIPE SURVEYS

1. Use a dry smear and wipe a 100 $cm^2$ area using moderate pressure. 100 $cm^2$ is accomplished using a 2-inch filter paper wiped over an approximately 8-inch long "S."
2. Place wipe in a labeled wipe envelope, or self wrapper.
3. Count the wipes on the Ludlum 2929 for the time required to meet the desired MDA and record the results.
4. If any wipe samples exceed the action level, obtain a wipe sample adjacent to the earlier one. If the second wipe also exceeds the action level, flag the area and notify the PNPF Radiation Safety Officer.

## 3.6 DOCUMENTATION

1. Record actual sample locations where surveys and wipes were obtained. As noted, movement of locations due to obstructions is approved.
2. Record all direct survey results.
3. Record wipe sample results.
4. Sign and date records and send to NV5/Dade Moeller Project Manager for review.

## 3.7 SURVEY REPORT

The survey reports for each individual survey area include a narrative of actions taken and results achieved; however, no areas of detectable activity were identified, and, therefore, there are no narratives. Direct survey results are reported for each survey point, and all have been converted into units of dpm/100$cm^2$ for direct comparison to the MDA, AL, and release limit for the direct measurements and the wipe samples.

Since no areas of detectable activity were found, there is no high, low, or average readings, other than background. All results are below the MDA, which is below the AL, which is below the release criteria. Since all individual results are below the release criteria, and all results are below the MDA, no statistical analysis is meaningful, other than to state that all results are indistinguishable from background.

The instrumentation, survey methods, and data quality methods utilized for this survey were identical to methods routinely used on final status surveys to support license termination decisions. The data collected, and methods used, show that the initial classification of Class 3 areas is sufficient, and that the quantity and quality of data collected for this characterization survey is sufficient to support a decision of termination of the radioactive material license for this facility.

## REFERENCES


NV5/DM, 2022a. 100614-RPT-20220729, *Radiological Historical Site Assessment, American Ordnance Milan*. NV5/Dade Moeller, Richland, WA.

NV5/DM, 2022b. 100614-RPT-20220803, *Characterization Survey Plan, American Ordinance Milan DU Facilities.* NV5/Dade Moeller, Richland, WA.

NRC, 1999. *Residual Radioactive Contamination from Decommissioning, Parameter Analysis*. NUREG/CR-5512, Vol. 3. Sandia National Laboratories, October 1999

NRC, 2000. *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*. NUREG-1575, Revision 1, Government Printing Office, Washington, D.C.

NRC, 2001. *Residual Radioactive Contamination: User Manual – DandD Version 2.1.* NUREG/CR-5512, Vol. 2. Sandia National Laboratories, April 2001

PNNL, 2017. *Visual Sample Plan (VSP)*. Pacific Northwest National laboratory, Richland, WA

## ATTACHMENT A

Environmental Restoration Group, Inc.
8809 Washington NE, Suite #150
Albuquerque, NM 87113

office: (505) 298-4224
fax: (505) 797-1404
web: www.ERGOffice.com

# EQUIPMENT PACKING SLIP

***Company Name:*** NV5/Dade Moller
***Order Number:*** 5147
***Contact Name:***
***P.O. or Reference Number:***
***Contact Telephone:***

***Date Ordered:*** 8/9/2022
***Shipping Method:*** n/a
***Date Shipped:*** 8/17/2022
***Shipping Number:*** 4374-3886-2
***Date of Delivery:*** 8/18/2022

***Ship To Information:***

NV5/Dade Moller

***Billing Address:***

NV5/Dade Moller
Accounts Payable
1835 Terminal Dr
Ste 200
Richland, WA 99354

***Equipment Enclosed:***

| *Instrument* | *Serial Number* | *Tested* |
|---|---|---|
| Ludlum 2360 | 184951 | ☐ |
| Ludlum 2360 | 184965 | ☐ |
| Ludlum 2929 & 43-10-1 | 129566 & PR132720 | ☐ |
| Ludlum 2929 & 43-10-1 | 185277 & PR194726 | ☐ |
| Ludlum 3 & 44-2 | 275513 & PR306257 | ☐ |
| Ludlum 43-93 | PR400158 | ☐ |
| Ludlum 43-93 | PR399442 | ☐ |

***Special Instructions:***

(2) EXTRA MYLARS AND 39" CABLES INCLUDED.Clark Barton
124 Hidden Hills Trail
Wartburg, TN 37887

***Note:***
***(a) By accepting and using ERG rental equipment, the Renter indemnifies and holds harmless ERG against any and all claims, actions, proceedings, costs, expenses, damages, and liabilities (including attorney's fees and costs) arising out of Renter's use of equipment.***

***Page 1 of 1***

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# Certificate of Calibration

Calibration and Voltage Plateau

Environmental Restoration Group, Inc.
8809 Washington St NE, Suite #150
Albuquerque, NM 87113
(505) 298-4224
www.ERGoffice.com

Meter/Detector: Manufacturer: Ludlum Model Number: 2929 & 43-10-1 Serial Number: 185277 & PR194726

- [x] Mechanical Check
- [ ] F/S Response Check
- [ ] Geotropism
- [ ] Meter Zeroed
- [x] THR/WIN Operation
- [ ] Reset Check
- [x] Audio Check
- [ ] Battery Check

HV Check (+/- 2.5%): [x] 500 V [x] 1000 V [x] 1500 V

Cable Length: [x] 39-inch [ ] 72-inch [ ] Other:

Alpha Threshold: 170 mV Barometric Pressure: 24.78 inches Hg

Source Distance: [ ] Contact [ ] 6 inches [x] Other: In Planchet Beta Threshold: Temperature: 76 °F

Source Geometry: [ ] Side [ ] Below [x] Other: In Planchet Beta Window: Relative Humidity: 24 %

Pulser Ludlum 500-1 sn 347243 Multimeter n/a Instrument found within tolerance: [x] Yes [ ] No

| Range/Multiplier | Reference Setting | Integrated 1-Min. Count "As Found" α | Integrated 1-Min. Count "As Found" β | Integrated 1-Min. Count "Reading" α | Integrated 1-Min. Count "Reading" β |
|---|---|---|---|---|---|
| x 1000 | 400 Kcpm | 400144 | 400131 | 400144 | 400131 |
| x 100 | 40 Kcpm | 40014 | 40014 | 40014 | 40014 |
| x 10 | 4 Kcpm | 4002 | 4002 | 4002 | 4002 |
| x 1 | 400 cpm | 400 | 401 | 400 | 401 |

Count Time (min) 1.0

| High Voltage | Pot. Setting | Background Counts α | Background Counts β | Alpha Source Counts Gross α | Alpha Source Counts Gross β | Alpha Source Counts Net α | Alpha Source Counts Net β | Beta Source Counts Gross α | Beta Source Counts Gross β | Beta Source Counts Net α | Beta Source Counts Net β | Other Source Counts Gross α | Other Source Counts Gross β | Other Source Counts Net α | Other Source Counts Net β |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 750 | 3.00 | 2 | 23 | 4364 | 387 | 4362 | 364 | 0 | 1549 | -2 | 1526 | | | | |
| 800 | 3.30 | 2 | 53 | 6260 | 271 | 6258 | 218 | 4 | 2762 | 2 | 2709 | | | | |
| 850 | 3.50 | 2 | 64 | 6600 | 394 | 6598 | 330 | 1 | 3397 | -1 | 3333 | | | | |
| 900 | 3.70 | 4 | 90 | 6854 | 755 | 6850 | 665 | 1 | 4044 | -3 | 3954 | | | | |

Recommended HV (VDC) 850 Pot. Setting 3.50

Additional Comments:

Alpha Source: Th-230 sn:U9-059 18,759dpm/9,474cpm (4/8/22) 47mm disk Total Efficiency: 0.174 4π Efficiency: 0.352

Beta Source: Tc-99 sn:U9-060 16,817dpm/9,250cpm (4/11/22) 47mm disk Total Efficiency: 0.090 4π Efficiency: 0.198

Other Source: Total Efficiency: n/a 4π Efficiency: n/a

NOTE: The total efficiency provided is calculated per ISO-7503/NUREG 1575 (MARSSIM): Total Efficiency = Instrument Efficiency × Source Efficiency; where Instrument Efficiency is calculated as net counts ÷ source 2π emission rate. The 4π efficiency is calculated as net counts ÷ source 4π activity. The provided efficiencies are radionuclide specific and are calculated using source counts and background counts at the recommended operating HV. The provided efficiencies are for general information purposes only and are not intended to replace user efficiency calculation method or results.

Calibrated By: Calibration Date 8/8/22 Calibration Due: 8/8/23

Reviewed By: T. Date: Aug-08, 2022

**ERG Form ITC. 101.D**

*This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997*

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# Certificate of Calibration

Calibration and Voltage Plateau

Environmental Restoration Group, Inc.
8809 Washington St NE, Suite #150
Albuquerque, NM 87113
(505) 298-4224
www.ERGoffice.com

Meter/Detector: Manufacturer: Ludlum Model Number: 2929 & 43-10-1 Serial Number: 129566 & PR132720

- [x] Mechanical Check
- [ ] F/S Response Check
- [ ] Geotropism
- [ ] Meter Zeroed
- [x] THR/WIN Operation
- [ ] Reset Check
- [x] Audio Check
- [ ] Battery Check

HV Check (+/- 2.5%): [x] 500 V [x] 1000 V [x] 1500 V

Cable Length: [x] 39-inch [ ] 72-inch [ ] Other:

Alpha Threshold: 170 mV Barometric Pressure: 24.63 inches Hg

Source Distance: [ ] Contact [ ] 6 inches [x] Other: In Planchet Beta Threshold: 4 mV Temperature: 73 °F

Source Geometry: [ ] Side [ ] Below [x] Other: In Planchet Beta Window: 46 mV Relative Humidity: 20 %

Pulser Ludlum 500-1 sn 347243 Multimeter n/a Instrument found within tolerance: [x] Yes [ ] No

| Range/Multiplier | Reference Setting | Integrated 1-Min. Count "As Found" α | Integrated 1-Min. Count "As Found" β | Integrated 1-Min. Count "Reading" α | Integrated 1-Min. Count "Reading" β |
|---|---|---|---|---|---|
| x 1000 | 400 Kcpm | 398671 | 398750 | 398671 | 398750 |
| x 100 | 40 Kcpm | 39888 | 39872 | 39888 | 39872 |
| x 10 | 4 Kcpm | 3991 | 3990 | 3991 | 3990 |
| x 1 | 400 cpm | 399 | 399 | 399 | 399 |

Count Time (min) 1.0

| High Voltage | Pot. Setting | Background Counts α | Background Counts β | Alpha Source Counts Gross α | Alpha Source Counts Gross β | Alpha Source Counts Net α | Alpha Source Counts Net β | Beta Source Counts Gross α | Beta Source Counts Gross β | Beta Source Counts Net α | Beta Source Counts Net β | Other Source Counts Gross α | Other Source Counts Gross β | Other Source Counts Net α | Other Source Counts Net β |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 550 | 2.40 | 0 | 16 | 4407 | 408 | 4407 | 392 | 0 | 1338 | 0 | 1322 | | | | |
| 600 | 2.60 | 1 | 31 | 5884 | 299 | 5883 | 268 | 0 | 2475 | -1 | 2444 | | | | |
| 650 | 2.80 | 0 | 69 | 6346 | 404 | 6346 | 335 | 0 | 3272 | 0 | 3203 | | | | |
| 700 | 3.00 | 0 | 56 | 6534 | 735 | 6534 | 679 | 0 | 4029 | 0 | 3973 | | | | |

Recommended HV (VDC) 650 Pot. Setting 2.80

Additional Comments:

Alpha Source: Th-230 sn:U9-059 18,759dpm/9,474cpm (4/8/22) 47mm disk Total Efficiency: 0.167 4π Efficiency: 0.338

Beta Source: Tc-99 sn:U9-060 16,817dpm/9,250cpm (4/11/22) 47mm disk Total Efficiency: 0.087 4π Efficiency: 0.190

Other Source: Total Efficiency: n/a 4π Efficiency: n/a

NOTE: The total efficiency provided is calculated per ISO-7503/NUREG 1575 (MARSSIM): Total Efficiency = Instrument Efficiency × Source Efficiency; where Instrument Efficiency is calculated as net counts ÷ source 2π emission rate. The 4π efficiency is calculated as net counts ÷ source 4π activity. The provided efficiencies are radionuclide specific and are calculated using source counts and background counts at the recommended operating HV. The provided efficiencies are for general information purposes only and are not intended to replace user efficiency calculation method or results.

Calibrated By: Calibration Date 7/27/22 Calibration Due: 7/27/23

Reviewed By: T. Date: Aug-01, 2022

**ERG Form ITC. 101.D**

*This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997*

ERG

# Certificate of Calibration

Calibration and Voltage Plateau

Environmental Restoration Group, Inc.
8809 Washington St NE, Suite #150
Albuquerque, NM 87113
(505) 298-4224
www.ERGoffice.com

| | | | | | | |
|---|---|---|---|---|---|---|
| Meter: | Manufacturer: | Ludlum | Model Number: | 2360 | Serial Number: | 184951 |
| Detector: | Manufacturer: | Ludlum | Model Number: | 43-93 | Serial Number: | PR400158 |

☑ Mechanical Check ☑ THR/WIN Operation HV Check (+/- 2.5%): ☑ 500 V ☑ 1000 V ☑ 1500 V
☐ F/S Response Check ☑ Reset Check Cable Length: ☑ 39-inch ☐ 60-inch ☐ Other:
☑ Geotropism ☑ Audio Check
☑ Meter Zeroed ☑ Battery Check

Alpha Threshold: 120 mV Barometric Pressure: 24.43 inches Hg
Beta Threshold: 4 Temperature: 72 °F
Beta Window: 30 mV Relative Humidity 20 %

Source Distance: ☑ Contact ☐ 6 inches ☐ Other:
Source Geometry: ☐ Side ☑ Below ☐ Other:

Pulser: Ludlum 500-1 sn 201932 Multimeter: Fluke 110 PLUS Instrument found within tolerance: ☑ Yes ☐ No

| Range/Multiplier | Reference Setting | "As Found Reading" | Meter Reading | Integrated 1-Min. Count α | Integrated 1-Min. Count β |
|---|---|---|---|---|---|
| x 1000 | 400 Kcpm | 400 | 400 | 400367 | 400447 |
| x 1000 | 100 Kcpm | 100 | 100 | | |
| x 100 | 40 Kcpm | 400 | 400 | 40057 | 40047 |
| x 100 | 10 Kcpm | 100 | 100 | | |
| x 10 | 4 Kcpm | 400 | 400 | 4008 | 4008 |
| x 10 | 1 Kcpm | 100 | 100 | | |
| x 1 | 400 cpm | 400 | 400 | 400 | 401 |
| x 1 | 100 cpm | 100 | 100 | | |

Count Time (min) 1.0

| High Voltage | Pot. Setting | Background Counts α | Background Counts β | Alpha Source Counts Gross α | Alpha Source Counts Gross β | Alpha Source Counts Net α | Alpha Source Counts Net β | Beta Source Counts Gross α | Beta Source Counts Gross β | Beta Source Counts Net α | Beta Source Counts Net β | Other Source Counts Gross α | Other Source Counts Gross β | Other Source Counts Net α | Other Source Counts Net β |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 550 | | 0 | 67 | 2461 | 349 | 2461 | 282 | 2 | 549 | 2 | 482 | | | | |
| 575 | | 2 | 112 | 3182 | 404 | 3180 | 292 | 14 | 1353 | 12 | 1241 | | | | |
| 600 | | 1 | 190 | 3570 | 470 | 3569 | 280 | 13 | 1916 | 12 | 1726 | | | | |
| 625 | | 1 | 270 | 3867 | 598 | 3866 | 328 | 21 | 2553 | 20 | 2283 | | | | |
| 650 | | 3 | 335 | 4097 | 806 | 4094 | 471 | 26 | 3230 | 23 | 2895 | | | | |

Recommended HV (VDC) 625 Pot. Setting

Additional Comments:

| | | | | | |
|---|---|---|---|---|---|
| Alpha Source: | Th-230 sn:U9-059 18,759dpm/9,474cpm (4/8/22) 47mm disk | Total Efficiency: | 0.102 | 4π Efficiency: | 0.206 |
| Beta Source: | Tc-99 sn:U9-060 16,817dpm/9,250cpm (4/11/22) 47mm disk | Total Efficiency: | 0.062 | 4π Efficiency: | 0.136 |
| Other Source: | | Total Efficiency: | n/a | 4π Efficiency: | n/a |

NOTE: The total efficiency provided is calculated per ISO-7503/NUREG 1575 (MARSSIM): Total Efficiency = Instrument Efficiency × Source Efficiency; where Instrument Efficiency is calculated as net counts ÷ source 2π emission rate. The 4π efficiency is calculated as net counts ÷ source 4π activity. The provided efficiencies are radionuclide specific and are calculated using source counts and background counts at the recommended operating HV. The provided efficiencies are for general information purposes only and are not intended to replace user efficiency calculation method or results.

Calibrated By: Ryan Smith Calibration Date: 8/3/22 Calibration Due: 8/3/23

Reviewed By: Date: 8/3/22

**ERG Form ITC. 101.C**

*This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997*

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Calibration and Voltage Plateau

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(505) 298-4224
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| | | | | | | |
|---|---|---|---|---|---|---|
| Meter: | Manufacturer: | Ludlum | Model Number: | 2360 | Serial Number: | 184965 |
| Detector: | Manufacturer: | Ludlum | Model Number: | 43-93 | Serial Number: | PR399442 |

☑ Mechanical Check ☑ THR/WIN Operation HV Check (+/- 2.5%): ☑ 500 V ☑ 1000 V ☑ 1500 V
☐ F/S Response Check ☑ Reset Check Cable Length: ☑ 39-inch ☐ 60-inch ☐ Other:
☑ Geotropism ☑ Audio Check
☑ Meter Zeroed ☑ Battery Check

Alpha Threshold: 120 mV Barometric Pressure: 24.57 inches Hg
Beta Threshold: 4 Temperature: °F
Beta Window: 40 mV Relative Humidity 20 %

Source Distance: ☑ Contact ☐ 6 inches ☐ Other:
Source Geometry: ☐ Side ☑ Below ☐ Other:

Pulser Ludlum 500-1 sn 347243 Multimeter Fluke 112 sn 87490128 Instrument found within tolerance: ☑ Yes ☐ No

| Range/Multiplier | Reference Setting | "As Found Reading" | Meter Reading | Integrated 1-Min. Count α | Integrated 1-Min. Count β |
|---|---|---|---|---|---|
| x 1000 | 400 Kcpm | 400 | 400 | 399830 | 399827 |
| x 1000 | 100 Kcpm | 100 | 100 | | |
| x 100 | 40 Kcpm | 400 | 400 | 39986 | 39987 |
| x 100 | 10 Kcpm | 100 | 100 | | |
| x 10 | 4 Kcpm | 400 | 400 | 3999 | 3999 |
| x 10 | 1 Kcpm | 100 | 100 | | |
| x 1 | 400 cpm | 400 | 400 | 400 | 400 |
| x 1 | 100 cpm | 100 | 100 | | |

Count Time (min) 1.0

| High Voltage | Pot. Setting | Background Counts α | Background Counts β | Alpha Source Counts Gross α | Alpha Source Counts Gross β | Alpha Source Counts Net α | Alpha Source Counts Net β | Beta Source Counts Gross α | Beta Source Counts Gross β | Beta Source Counts Net α | Beta Source Counts Net β | Other Source Counts Gross α | Other Source Counts Gross β | Other Source Counts Net α | Other Source Counts Net β |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 525 | | 1 | 97 | 2944 | 386 | 2943 | 289 | 92 | 1117 | 91 | 1020 | | | | |
| 550 | | 1 | 185 | 3620 | 448 | 3619 | 263 | 83 | 1954 | 82 | 1769 | | | | |
| 575 | | 3 | 237 | 3742 | 541 | 3739 | 304 | 90 | 2612 | 87 | 2375 | | | | |
| 600 | | 4 | 344 | 4060 | 820 | 4056 | 476 | 111 | 3068 | 107 | 2724 | | | | |

Recommended HV (VDC) 575 Pot. Setting

Additional Comments:

| | | | | | |
|---|---|---|---|---|---|
| Alpha Source: | Th-230 sn:U9-059 18,759dpm/9,474cpm (4/8/22) 47mm disk | Total Efficiency: | 0.099 | 4π Efficiency: | 0.199 |
| Beta Source: | Tc-99 sn:U9-060 16,817dpm/9,250cpm (4/11/22) 47mm disk | Total Efficiency: | 0.064 | 4π Efficiency: | 0.141 |
| Other Source: | | Total Efficiency: | n/a | 4π Efficiency: | n/a |

NOTE: The total efficiency provided is calculated per ISO-7503/NUREG 1575 (MARSSIM): Total Efficiency = Instrument Efficiency × Source Efficiency; where Instrument Efficiency is calculated as net counts ÷ source 2π emission rate. The 4π efficiency is calculated as net counts ÷ source 4π activity. The provided efficiencies are radionuclide specific and are calculated using source counts and background counts at the recommended operating HV. The provided efficiencies are for general information purposes only and are not intended to replace user efficiency calculation method or results.

Calibrated By: Calibration Date 8/3/22 Calibration Due: 8/3/23

Reviewed By: T. Date: Aug-04, 2022

**ERG Form ITC. 101.C**

*This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997*

Designer and Manufacturer of Scientific and Industrial Instruments

www.ludlums.com

# CERTIFICATE OF CALIBRATION

**LUDLUM MEASUREMENTS, INC.**
501 Oak Street
325-235-5494
Sweetwater, TX 79556, U.S.A.

ACCREDITED
CERT # 4084.01

Customer ENVIRONMENTAL RESTORATION GROUP ORDER NO. 20424560/525477

Mfg. Ludlum Measurements, Inc. Model 3 Serial No. 275513

Mfg. Ludlum Measurements, Inc. Model 44-2 Serial No. PR306257

Cal. Date 3-Jun-22 Cal Due Date 3-Jun-23 Cal. Interval 1 Year Meterface 202-666

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 52 % Alt 705.2 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.

☐ Calibrated in accordance with LMI SOP 14.8 ☑ Calibrated in accordance with LMI SOP 14.9

Instrument Volt Set 800 V Input Sens. 29 mV Det. Oper. 800 V at 29 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.
Multimeter uncertainty within 1.3% of reading, Gamma uncertainty within 5.0% of reading, Neutron uncertainty within 7.0% of reading, Count rate uncertainty within 5.4% of reading

| RANGE/MULTIPLIER | REFERENCE CAL. POINT | INSTRUMENT REC'D "AS FOUND READING" | INSTRUMENT METER READING |
|---|---|---|---|
| X100 | 4000 µR/hr | 38 µR/hr | 40 µR/hr |
| X100 | 1000 µR/hr | 8 | 10 |
| x10 | 400 µR/hr = 67900 cpm | 38 | 40 |
| x10 | 100 µR/hr | 8 | 10 |
| X1 | 6790 cpm | 38 | 40 |
| X1 | 1697 cpm | 8 | 10 |
| X0.1 | 679 cpm | 38 | 40 |
| X0.1 | 169 cpm | 8 | 10 |

X 1, 0.1 **Range(s) Calibrated Electronically**

| Digital Readout | REFERENCE CAL. POINT | INSTRUMENT RECEIVED | INSTRUMENT METER READING |
|---|---|---|---|
| | | | |

| Log Scale | REFERENCE CAL. POINT | INSTRUMENT RECEIVED | INSTRUMENT METER READING |
|---|---|---|---|
| | | | |

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.
All pass/fail determinations are based on the manufacturer's specifications without considering uncertainty factors.
Measurement results represent expanded uncertainties expressed at approximately the 95% level of confidence, using a coverage factor of k=2.
The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323AB-2013

ISO/IEC 17025:2017(E)
State of Texas Calibration License No. LO-1963

**Reference Instruments and/or Sources:** Cs-137 S/N: ☐ 059 ☐ 2171CP ☐ 2261CP ☐ 720 ☐ 734 ☐ 781 ☐ 1131 ☐ 1616 ☐ 1696 ☐ 1909 ☐ 1916CP ☐ 2324/2521 ☐ 5717CO ☐ 5719CO ☐ 60646 ☐ 70897 ☐ 73410 ☐ E552 ☐ G112 ☑ 2168CP ☐ S-394 ☐ S-1054 ☐ T10081 ☐ T10082 Neutron Am-241 Be ☐ T-304 Ra-226 ☐ Y982 ☐ E551 ☐ 5105 ☐ CSV280

☐ Alpha S/N ☐ Beta S/N ☐ Other

☑ m 500 S/N 352881 ☐ Oscilloscope S/N ☑ Multimeter S/N 53950165

Calibrator Rene Araguz Title Calibrator Date 3-June-22

QC'd By Title Final QC Date 6 Jun 22

This certificate shall not be reproduced except in full without the written approval of Ludlum Measurements, Inc.
FORM C22A 01/07/2020 Page 1 of 2

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

www.ludlums.com

Designer and Manufacturer
of
Scientific and Industrial
Instruments

**LUDLUM MEASUREMENTS, INC.**
501 Oak Street
325-235-5494
Sweetwater, TX 79556, U.S.A.

## Bench Test Data For Detector

Detector 44-2 Serial No. PR306257

Customer ENVIRONMENTAL RESTORATION GROUP ORDER NO. 20424560/525477

Counter 2200 Serial No. 255396 Counter Input Sensitivity 29 mV

Count Time 6 Sec Distance Source to Detector Surface

Other

| High Voltage | Background | Isotope Am241 Size ~0.89uCi | Isotope Size | Isotope Size | Isotope Size |
|---|---|---|---|---|---|
| 650 | 97 | 9091 | | | |
| 700 | 106 | 10810 | | | |
| 750 | 113 | 11015 | | | |
| 800 | 113 | 11057 | | | |
| 850 | 114 | 11165 | | | |
| 900 | 124 | 11239 | | | |
| 950 | 170 | 11760 | | | |
| 1000 | 379 | 14066 | | | |

Signature Rene Araguz Date 3-June-22

FORM C4A 01/22/2020 Page 2 of 2 • Serving The Nuclear Industry Since 1962 •

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ERG
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SUITE 150
ALBUQUERQUE, NM 87113
UNITED STATES US

SHIP DATE: 16AUG22
ACTWGT: 20.00 LB
CAD: 5044249/INET4490
DIMS: 16x16x13 IN

BILL SENDER

TO **CLARK BARTON**
**NV5**
**124 HIDDEN HILLS TRAIL**

**WARTBURG TN 37887**
(509) 528-1628
INV:
PO:
REF: ERG #5147
DEPT:

581J2/F39D/FE4A

J2220220412O1uv

FedEx Express

1 of 4

TRK# 0201 **7776 1065 1277**

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Mstr# **7776 1065 1277**

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DIMS: 12x12x12 IN
BILL SENDER

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## ATTACHMENT B

MDCR

| Instrument | beta bkg counts total counts | alpha bkg counts total counts | Critical Value Beta | Critial Value Alpha | Beta $S_D$ | Alpha $S_D$ | Beta Bkg+5D rate cpm | Alpha Bkg+5D rate cpm | Beta MDA dpm | Alpha MDA dpm | limit | 0.75 limit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| bench 129566 | 315 | 2.2 | 14.8 | 1.8 | 31.9 | 5.5 | 47.4 | 3.0 | 34.4 | 12.3 | 26 | 19.5 |
| bench 185277 | 365 | 8.9 | 15.9 | 2.9 | 34.0 | 8.1 | 53.5 | 4.9 | 36.6 | 16.8 | | |
| | | | | | | | | | | | | |
| handheld PR400158 | 1920 | 25.0 | 35.3 | 4.6 | 73.3 | 11.3 | 228.7 | 8.2 | 778.5 | 174.8 | 265 | 198.8 |
| handheld PR399442 | 1750 | 26.0 | 33.7 | 4.6 | 70.1 | 11.5 | 210.1 | 8.3 | 745.2 | 177.1 | | |

| | uR/hr bkg | Critical value Gamma | gamma MDCR | gamma critical |
|---|---|---|---|---|
| NaI dose | 8 | 6 | 15 | 23 |
| NaI item scans | | 0 | 3 | 3 |
| | | | | |
| NaI Outside | | 0 | 3 | 3 |

Formula used depends on count rate, <100 uses Stapleton, >100 uses Poisson, both use alpha and beta error 0.05. Stapleton parameter set to 0.4 for columns D to I
alpha background should be put in as average if <1 count, which should only occur for < 5 minutes.

| | Bench | Handheld | | Efficiencies | Bench | Handheld |
|---|---|---|---|---|---|---|
| Count times | minutes | | | Beta | 0.338 | 0.136 |
| background | 10 | | 10 | Alpha | 0.190 | 0.199 |
| samples | 2 | | 2 | Size | 100 | 100 |
| | | | | | smeared area size | |

This version of the spreadsheet used the MDAstatic calcuation from MARSSIM equation 6-7 for columns J and K

bench counter 129566

| Instrument | Beta | Alpha |
|---|---|---|
| | 347 | 3 |
| | 329 | 0 |
| | 305 | 2 |
| | 316 | 2 |
| | 311 | 0 |
| | 299 | 6 |
| | 328 | 1 |
| | 332 | 1 |
| | 333 | 2 |
| | 318 | 3 |
| | 310 | 4 |
| | 293 | 2 |
| | 326 | 2 |
| | 335 | 4 |
| | 309 | 4 |
| | 278 | 0 |
| | 316 | 1 |
| | 311 | 2 |
| | 290 | 2 |
| | 321 | 2 |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

| Surface | eta averag | b 2SD | alpha avg | a 2SD |
|---|---|---|---|---|
| | 315 | 33 | 2.2 | 3 |

bench counter 185277

| Instrument | Beta | Alpha |
|---|---|---|
| | 358 | 12 |
| | 347 | 8 |
| | 364 | 4 |
| | 396 | 15 |
| | 375 | 5 |
| | 396 | 14 |
| | 365 | 9 |
| | 380 | 9 |
| | 357 | 5 |
| | 336 | 7 |
| | 349 | 9 |
| | 342 | 9 |
| | 367 | 12 |
| | 357 | 19 |
| | 367 | 8 |
| | 364 | 1 |
| | 355 | 9 |
| | 394 | 6 |
| | 369 | 10 |
| | 371 | 7 |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

| Surface | eta averag | b 2SD | alpha avg | a 2SD |
|---|---|---|---|---|
| | 365 | 33 | 8.9 | 8 |

handheld ab PR400158

| Instrument | Beta | Alpha |
|---|---|---|
| | 150 | 1 |
| | 199 | 2 |
| | 213 | 1 |
| | 155 | 2 |
| | 206 | 4 |
| | 175 | 2 |
| | 209 | 5 |
| | 176 | 5 |
| | 164 | 3 |
| | 190 | 4 |
| | 218 | 3 |
| | 188 | 0 |
| | 201 | 2 |
| | 199 | 2 |
| | 200 | 1 |
| | 206 | 6 |
| | 209 | 0 |
| | 199 | 2 |
| | 193 | 3 |
| | 188 | 2 |

| Instrument | beta averag | b 2SD | alpha avg | a 2SD |
|---|---|---|---|---|
| all | 192 | 37 | 2.5 | 3 |

handheld ab PR399442

| Instrument | Beta | Alpha |
|---|---|---|
| | 141 | 3 |
| | 141 | 2 |
| | 175 | 1 |
| | 163 | 1 |
| | 194 | 3 |
| | 139 | 4 |
| | 163 | 0 |
| | 150 | 3 |
| | 153 | 2 |
| | 198 | 0 |
| | 175 | 4 |
| | 165 | 3 |
| | 196 | 6 |
| | 203 | 4 |
| | 207 | 2 |
| | 167 | 3 |
| | 228 | 3 |
| | 185 | 1 |
| | 183 | 4 |
| | 178 | 3 |

| Instrument | beta averag | b 2SD | alpha avg | a 2SD |
|---|---|---|---|---|
| all | 175 | 48 | 2.6 | 3 |

# Meter/Detector Response - BKG and Source

| | | | | |
|---|---|---|---|---|
| Date | 8/18/2022 | Performed by (sign/date) | Clark Barton | |
| | Model | Serial Number | 8/18/2022 | |
| Meter | 2929 | 129566 | | |
| Probe | 43-10-1 | PR132720 | Isotope | Quantity |
| Source | Nucleus | exempt | I-129 | .05 uCi |
| 2nd Source | The Source | exempt | Th-230 | 0.001 uCi |

Location:

Notes:

| | 10 minute | | 10 minute | |
|---|---|---|---|---|
| | gross | beta | gross | Alpha |
| Reading number | Source Counts | Background Counts | 2nd Source | Background Counts |
| 1 | 137 | 563 | 719 | 3 |
| 2 | 136 | 552 | 651 | 0 |
| 3 | 138 | 533 | 647 | 3 |
| 4 | 141 | 605 | 659 | 1 |
| 5 | 133 | 634 | 729 | 1 |
| 6 | 148 | 603 | 636 | 3 |
| 7 | 140 | 573 | 683 | 1 |
| 8 | 145 | 576 | 686 | 1 |
| 9 | 153 | 632 | 674 | 0 |
| 10 | 147 | 622 | 680 | 1 |
| | | | | |
| average | 141.8 | 589.3 | 676.4 | 1.4 |
| avg - 2SD | 129.3 | 519.3 | 616.1 | -0.9 |
| avg +2SD | 154.3 | 659.3 | 736.7 | 3.7 |

# Daily Source Check Data Sheet

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Date | | 8/18/2022 | Initiated by (sign/date) | | Clark Barton | | | | |
| | Model | Serial | | | 8/22/2022 | | | | |
| Meter | 2929 | 129566 | | | | | | | |
| Probe | 43-10-1 | PR132720 | LCL | HCL | Listed Eff | | | | |
| Source | I-129 | exempt | 129.3 | 154.3 | 0.19 | Tc-99 | | | |
| 2nd Source | Th-230 | exempt | 616.1 | 736.7 | 0.338 | Th-230 | | | |
| alpha bkg | | | -0.9 | 3.7 | | | | | |
| beta bkg | | | 519.3 | 659.3 | | | | | |
| Location: | beta background lower at location | | | | | | | | |
| | Background | | | | | | | | |
| Date | alpha | beta | Source1 CPM | Source2 CPM | Initials | | time | | |
| 8/22/2022 | 2 | 334 | 143 | 713 | cbb | | 1430 | | |
| 8/23/2022 | 1 | 335 | 122 | 722 | cbb | | 1703 | | |
| 8/23/2022 | | | 148 | | cbb | | 1705 | beta recount | |
| 8/24/2022 | 4 | 338 | 147 | 654 | cbb | | 1500 | | |

# Meter/Detector Response - BKG and Source

| | | | | |
|---|---|---|---|---|
| Date | 8/18/2022 | Performed by (sign/date) | Clark Barton | |
| | Model | Serial Number | 8/18/2022 | |
| Meter | 2360 | 184965 | | |
| Probe | 43-93 | PR399442 | Isotope | Quantity |
| Source | Nucleus | exempt | I-129 | .05 uCi |
| 2nd Source | The Source | exempt | Th-230 | 0.001 uCi |

Location:

Notes:

| Reading number | Source Counts | beta Background Counts | 2nd Source | Alpha Background Counts |
|---|---|---|---|---|
| 1 | 261 | 197 | 435 | 0 |
| 2 | 242 | 194 | 420 | 0 |
| 3 | 265 | 196 | 435 | 0 |
| 4 | 232 | 227 | 440 | 1 |
| 5 | 243 | 193 | 432 | 0 |
| 6 | 250 | 198 | 444 | 0 |
| 7 | 245 | 203 | 458 | 0 |
| 8 | 226 | 174 | 469 | 0 |
| 9 | 227 | 176 | 422 | 0 |
| 10 | 223 | 177 | 453 | 1 |
| | | | | |
| average | 241.4 | 193.5 | 440.8 | 0.2 |
| avg - 2SD | 212.3 | 162.2 | 409.7 | -0.6 |
| avg +2SD | 270.5 | 224.8 | 471.9 | 1.0 |

# Daily Source Check Data Sheet

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Date | | 8/18/2022 | Initiated by (sign/date) | | Clark Barton | | | | |
| | Model | Serial | | | 8/22/2022 | | | | |
| Meter | 2360 | 184965 | | | | | | | |
| Probe | 43-93 | PR399442 | LCL | HCL | Listed Eff | | | | |
| Source | I-129 | exempt | 212.3 | 270.5 | 0.141 | Tc-99 | | | |
| 2nd Source | Th-230 | exempt | 409.7 | 471.9 | 0.199 | Th-230 | | | |
| alpha bkg | | | -0.6 | 1.0 | | | | | |
| beta bkg | | | 162.2 | 224.8 | | | | | |
| Location: | at AOM beta background is 50-75 cpm lower, so is beta source | | | | | | | | |
| | Background | | | | | | | | |
| Date | alpha | beta | Source1 CPM | Source2 CPM | Initials | | time | | |
| 8/22/2022 | 0 | 134 | 193 | 444 | cbb | | 920 | background lower on s | |
| 8/23/2022 | 2 | 1344 | 209 | 421 | cbb | | 845 | 10 minute background | |
| 8/23/2022 | 4 | 1562 | 214 | 448 | cbb | | 1135 | 10 minute background | |
| 8/23/2022 | | | 218 | 468 | cbb | | 1318 | no background taken | |
| 8/24/2022 | 1 | 1529 | 239 | 444 | cbb | | 800 | 10 minute background | |
| 8/24/2022 | 29 | 1527 | 219 | 486 | cbb | | 945 | 10 minute background | |
| 8/24/2022 | 9 | 1119 | 214 | 415 | cbb | | 1134 | 10 minute background | |
| 8/24/2022 | 12 | 1390 | 212 | 423 | cbb | | 1253 | 10 minute background | |

# Meter/Detector Response - BKG and Source

| | | | | |
|---|---|---|---|---|
| Date | 8/18/2022 | Performed by (sign/date) | Clark Barton | |
| | Model | Serial Number | 8/18/2022 | |
| Meter | 3 | 275513 | | |
| Probe | 44-2 | PR306257 | Isotope | Quantity |
| Source | Cs-137 | check button | Cs-137 | 1 uCi |

Location:

Notes:

| Reading number | uR/hr Source Counts | uR/hr Background Counts |
|---|---|---|
| 1 | 650 | 12 |
| 2 | 600 | 13 |
| 3 | 600 | 14 |
| 4 | 650 | 11 |
| 5 | 500 | 12 |
| 6 | 650 | 12 |
| 7 | 600 | 13 |
| 8 | 550 | 12 |
| 9 | 600 | 11 |
| 10 | 550 | 12 |
| | | |
| average | 595 | 12.2 |
| avg - 2 SD | 495.5571074 | 10.36212683 |
| avg + 2SD | 694.4428926 | 14.03787317 |

# Daily Source Check Data Sheet

| | | | | | |
|---|---|---|---|---|---|
| Date | 8/18/2022 | Initiated by (sign/date) | | Clark Barton | |
| | Model | Serial Number | | 8/22/2022 | |
| Meter | 3 | 275513 | | | |
| Probe | 44-2 | PR306257 | | LCL | HCL |
| Source | Cs-137 | check button | | 495.557107 | 694.4428926 |
| Background | | | | 10.3621268 | 14.03787317 |
| Location: | | | | | |
| | | | | | |
| Date | Background uR/hr | Source1 uR/hr | Initials | | time |
| 8/22/2022 | 6 | 650 | cbb | | 830 |
| 8/23/2022 | 6 | 600 | cbb | | 820 |
| 8/23/2022 | 7 | 700 | cbb | | 1055 |
| 8/23/2022 | 5.5 | 650 | cbb | | 1345 |

| | | | | |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

## ATTACHMENT C

NV5 DADE MOELLER

# Radiological Survey Report

Area Description: X-18 non impacted

Purpose of Survey: Background

Date: 8/22/22

Performed by

Print: Clark Barton/Lorinda Finch

Sign:

Sketch of Area:

See attached

Survey Results - Instrument 1

| Location Number | Alpha cpm | Beta cpm | Alpha dpm/100cm² | Beta dpm/100cm² |
|---|---|---|---|---|
| See attached | | | | |

Legend: # - General Area Dose Rate; #_ - Contact Dose Rate; (#) - Smear/Direct Location

Indicate LAW and scanning using lines representing area covered.

Instrumentation

| Model | Serial | α eff | β eff. | ~~α bkg~~ | ~~β bkg~~ | ~~size cm²~~ |
|---|---|---|---|---|---|---|
| 44-2 | PR306257 | N/A | N/A | 5uR/hr | N/A | N/A |

Source Check (pre/post)

| Isotope | reading | unit |
|---|---|---|
| Cs137 | 650 | uR/hr |

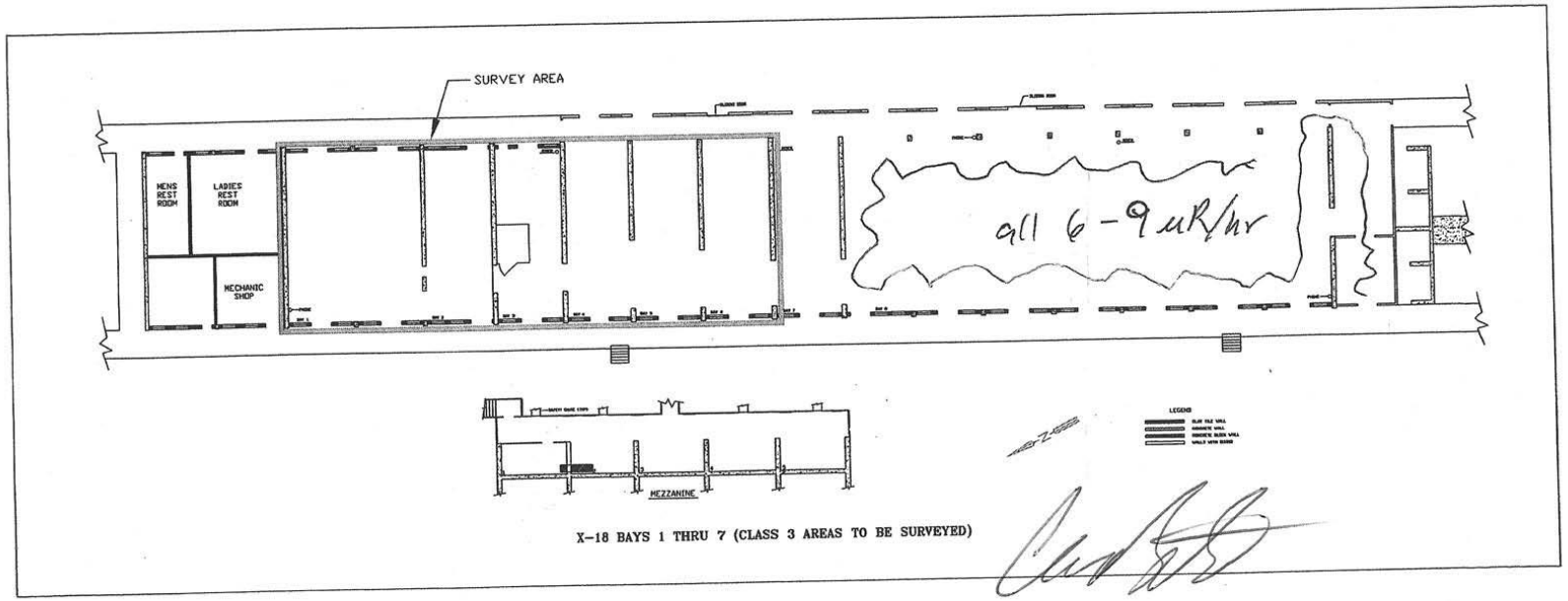
Comments:

NV5/ DADE MOELLER

PAGE 1 OF 1

FRM-RP-002 REV. AB FSS_00

NaI Scanned 8/22/22




X-18 BAYS 1 THRU 7 (CLASS 3 AREAS TO BE SURVEYED)

NV5 DADE MOELLER

# Radiological Survey Report

| | | |
|---|---|---|
| Area Description: X-18 Non-impacted | Date | 8/22/2022 |
| Purpose of Survey: Background | Performed by | |
| | Print: | Clark Barton / Lorinda Finch |
| | Sign: | CHP, CSP |

Sketch of Area: See Attached all survey points had approx. 1 square meter scan surveyed, no elevated areas identified.

Survey Results - Instrument 1

| Location Number | Alpha cpm | Beta cpm | Alpha dpm/100cm$^2$ | Beta dpm/100cm$^2$ |
|---|---|---|---|---|
| 1 | 1 | 150 | 5 | 0 |
| 2 | 2 | 199 | 10 | 360 |
| 3 | 1 | 213 | 5 | 463 |
| 4 | 2 | 155 | 10 | 37 |
| 5 | 4 | 206 | 19 | 412 |
| 6 | 2 | 175 | 10 | 184 |
| 7 | 5 | 209 | 24 | 434 |
| 8 | 5 | 176 | 24 | 191 |
| 9 | 3 | 164 | 15 | 103 |
| 10 | 4 | 190 | 19 | 294 |
| 11 | 3 | 218 | 15 | 500 |
| 12 | 0 | 188 | 0 | 279 |
| 13 | 2 | 201 | 10 | 375 |
| 14 | 2 | 199 | 10 | 360 |
| 15 | 1 | 200 | 5 | 368 |
| 16 | 6 | 206 | 29 | 412 |
| 17 | 0 | 209 | 0 | 434 |
| 18 | 2 | 199 | 10 | 360 |
| 19 | 3 | 193 | 15 | 316 |
| 20 | 2 | 188 | 10 | 279 |

Legend: # - General Area Dose Rate # - Contact Dose Rate
(#) - Smear Location LAW # - Large Area Wipe
D # - Direct Survey Location
Indicate LAW and scanning using lines representing area covered.

Instrumentation

| Model | Serial | α eff | β eff. | α bkg | β bkg | size cm$^2$ |
|---|---|---|---|---|---|---|
| 43-93 | PR400158 | 0.206 | 0.136 | 0 | 150 | 100 |

Source Check (pre/post)

| Isotope | reading | unit |
|---|---|---|
| I-129 | 223 | cpm |
| Th-230 | 467 | cpm |

Comments: Alpha AL = 198 dpm/100cm$^2$ , MDA = 175 dpm/100cm2

NV5 DADE MOELLER

# Radiological Survey Report

| | | |
|---|---|---|
| Area Description: X-18 Non-impacted | Date | 8/22/2022 |
| Purpose of Survey: Background | Performed by | |
| | Print: | Clark Barton / Lorinda Finch |
| | Sign: | CHP, CSP |

Sketch of Area: See Attached
all survey points had approx. 1 square meter scan surveyed, no elevated areas identified.

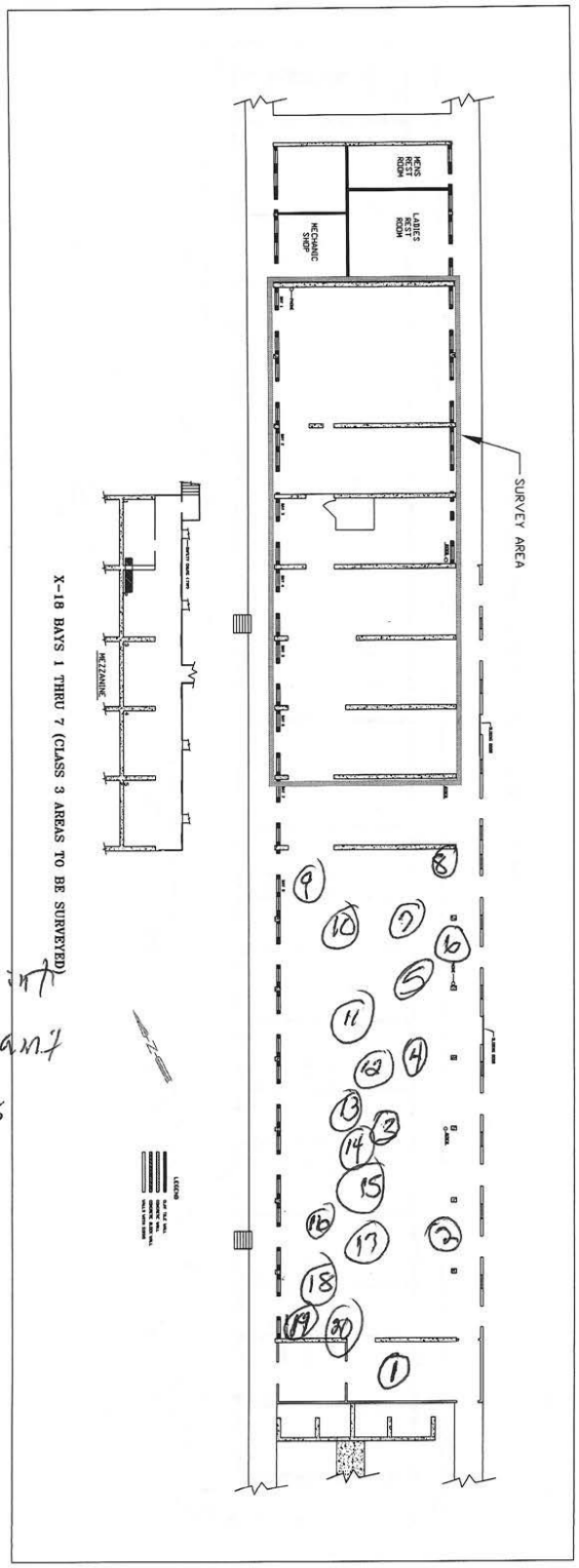
Survey Results - Instrument 1

| Location Number | Alpha cpm | Beta cpm | Alpha dpm/100cm$^2$ | Beta dpm/100cm$^2$ |
|---|---|---|---|---|
| 1 | 3 | 141 | 15 | 50 |
| 2 | 2 | 141 | 10 | 50 |
| 3 | 1 | 175 | 5 | 291 |
| 4 | 1 | 163 | 5 | 206 |
| 5 | 3 | 194 | 15 | 426 |
| 6 | 4 | 139 | 20 | 35 |
| 7 | 0 | 163 | 0 | 206 |
| 8 | 3 | 150 | 15 | 113 |
| 9 | 2 | 153 | 10 | 135 |
| 10 | 0 | 198 | 0 | 454 |
| 11 | 4 | 175 | 20 | 291 |
| 12 | 3 | 165 | 15 | 220 |
| 13 | 6 | 196 | 30 | 440 |
| 14 | 4 | 203 | 20 | 489 |
| 15 | 2 | 207 | 10 | 518 |
| 16 | 3 | 167 | 15 | 234 |
| 17 | 3 | 228 | 15 | 667 |
| 18 | 1 | 185 | 5 | 362 |
| 19 | 4 | 183 | 20 | 348 |
| 20 | 3 | 178 | 15 | 312 |

Legend: # - General Area Dose Rate # - Contact Dose Rate
(#) - Smear Location LAW # - Large Area Wipe
D # - Direct Survey Location
Indicate LAW and scanning using lines representing area covered.

| Instrumentation | | | | | | | Source Check (pre/post) | | |
|---|---|---|---|---|---|---|---|---|---|
| Model | Serial | α eff | β eff. | α bkg | β bkg | size cm$^2$ | Isotope | reading | unit |
| 43-93 | PR399442 | 0.199 | 0.141 | 0 | 134 | 100 | I-129 | 193 | cpm |
| | | | | | | | Th-230 | 444 | cpm |

Comments: alpha AL=199 dpm/100cm$^2$, MDA = 177




7- on paint
14- on paint
17- holes
20- Paint

NV5 DADE MOELLER

## Bench Counter Worksheet

| | | | |
|---|---|---|---|
| Area Description: X18 Nonimpacted | | Date | 8/22/2022 |
| Purpose of Survey: Background | | Performed by | |
| | | Print: | Clark Barton |

| Survey Results - Instrument 1 | | | | | Survey Results - Instrument 2 | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Location Number | Alpha 10 min | Beta 10 min | Alpha dpm/100cm$^2$ | Beta dpm/100cm$^2$ | Location Number | Alpha cpm | Beta cpm | Alpha dpm/100cm$^2$ | Beta dpm/100cm$^2$ |
| Background | 2 | 334 | 0 | 2 | | | | | |
| Background | 0 | 329 | 0 | -1 | | | | | |
| 1 | 3 | 347 | 1 | 8 | | | | | |
| 2 | 0 | 329 | 0 | -1 | | | | | |
| 3 | 2 | 305 | 0 | -14 | | | | | |
| 4 | 2 | 316 | 0 | -8 | | | | | |
| 5 | 0 | 311 | 0 | -11 | | | | | |
| 6 | 6 | 299 | 1 | -17 | | | | | |
| 7 | 1 | 328 | 0 | -2 | | | | | |
| 8 | 1 | 332 | 0 | 1 | | | | | |
| 9 | 2 | 333 | 0 | 1 | | | | | |
| 10 | 3 | 318 | 1 | -7 | | | | | |
| 11 | 4 | 310 | 1 | -11 | | | | | |
| 12 | 2 | 293 | 0 | -20 | | | | | |
| 13 | 2 | 326 | 0 | -3 | | | | | |
| 14 | 4 | 335 | 1 | 2 | | | | | |
| 15 | 4 | 309 | 1 | -12 | | | | | |
| 16 | 0 | 278 | 0 | -28 | | | | | |
| 17 | 1 | 316 | 0 | -8 | | | | | |
| 18 | 2 | 311 | 0 | -11 | | | | | |
| 19 | 2 | 290 | 0 | -22 | | | | | |
| 20 | 2 | 321 | 0 | -5 | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

| Instrumentation | | | | | | | Source Check (pre/post) | | |
|---|---|---|---|---|---|---|---|---|---|
| Model | Serial | α eff | β eff. | α bkg | β bkg | size cm$^2$ | Isotope | reading | unit |
| 2929 | 129566 | 0.338 | 0.19 | 1 | 331 | 100 | Th-230 | 713 | cpm |
| | | | | | | | I-129 | 143 | cpm |

Comments: alpha AL = 19 dpm/100cm$^2$, MDA = 12 dpm/100cm2

**Performed by (Signature):** CHP, CSP **Date:8/22/22**

**Reviewed by (Signataure):** **Date:**

NV5/ DADE MOELLER PAGE 1 OF 1 FRM-RP-009 REV_00

NV5 DADE MOELLER

## Bench Counter Worksheet

| | | | |
|---|---|---|---|
| Area Description: X18 Nonimpacted | | Date | 8/22/2022 |
| Purpose of Survey: Background | | Performed by | |
| | | Print: | Clark Barton |

| Survey Results - Instrument 1 | | | | | Survey Results - Instrument 2 | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Location Number | Alpha 10 min | Beta 10 min | Alpha dpm/100cm$^2$ | Beta dpm/100cm$^2$ | Location Number | Alpha cpm | Beta cpm | Alpha dpm/100cm$^2$ | Beta dpm/100cm$^2$ |
| Background | 6 | 372 | 1 | 11 | | | | | |
| Background | 10 | 358 | 2 | 4 | | | | | |
| 1 | 12 | 358 | 2 | 4 | | | | | |
| 2 | 8 | 347 | 1 | -2 | | | | | |
| 3 | 4 | 364 | 0 | 7 | | | | | |
| 4 | 15 | 396 | 3 | 23 | | | | | |
| 5 | 5 | 375 | 0 | 13 | | | | | |
| 6 | 14 | 396 | 3 | 23 | | | | | |
| 7 | 9 | 365 | 1 | 8 | | | | | |
| 8 | 9 | 380 | 1 | 15 | | | | | |
| 9 | 5 | 357 | 0 | 4 | | | | | |
| 10 | 7 | 336 | 1 | -7 | | | | | |
| 11 | 9 | 349 | 1 | -1 | | | | | |
| 12 | 9 | 342 | 1 | -4 | | | | | |
| 13 | 12 | 367 | 2 | 9 | | | | | |
| 14 | 19 | 357 | 4 | 4 | | | | | |
| 15 | 8 | 367 | 1 | 9 | | | | | |
| 16 | 1 | 364 | -1 | 7 | | | | | |
| 17 | 9 | 355 | 1 | 3 | | | | | |
| 18 | 6 | 394 | 1 | 22 | | | | | |
| 19 | 10 | 369 | 2 | 10 | | | | | |
| 20 | 7 | 371 | 1 | 11 | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

| Instrumentation | | | | | | | Source Check (pre/post) | | |
|---|---|---|---|---|---|---|---|---|---|
| Model | Serial | α eff | β eff. | α bkg | β bkg | size cm$^2$ | Isotope | reading | unit |
| 2929 | 185277 | 0.352 | 0.198 | 4 | 350 | 100 | Th-230 | 720 | cpm |
| | | | | | | | I-129 | 146 | cpm |

Comments: alpha AL = 19 dpm/100cm$^2$, MDA = 17 dpm/100cm2

**Performed by (Signature):** Clark Barton, CHP, CSP **Date:8/22/22**

**Reviewed by (Signataure):** **Date:**

NV5/ DADE MOELLER PAGE 1 OF 1 FRM-RP-009 REV_00

NV5 DADE MOELLER

# Radiological Survey Report

| | | |
|---|---|---|
| Area Description: E-67 Class 3 | Date | 8/23/2022 |
| Purpose of Survey: Characterization Survey | Performed by | |
| | Print: | Clark Barton / Lorinda Finch |
| | Sign: | CHP, CSP |

Sketch of Area: See Attached all survey points had approx. 1 square meter scan surveyed, no elevated areas identified.

Survey Results - Instrument 1

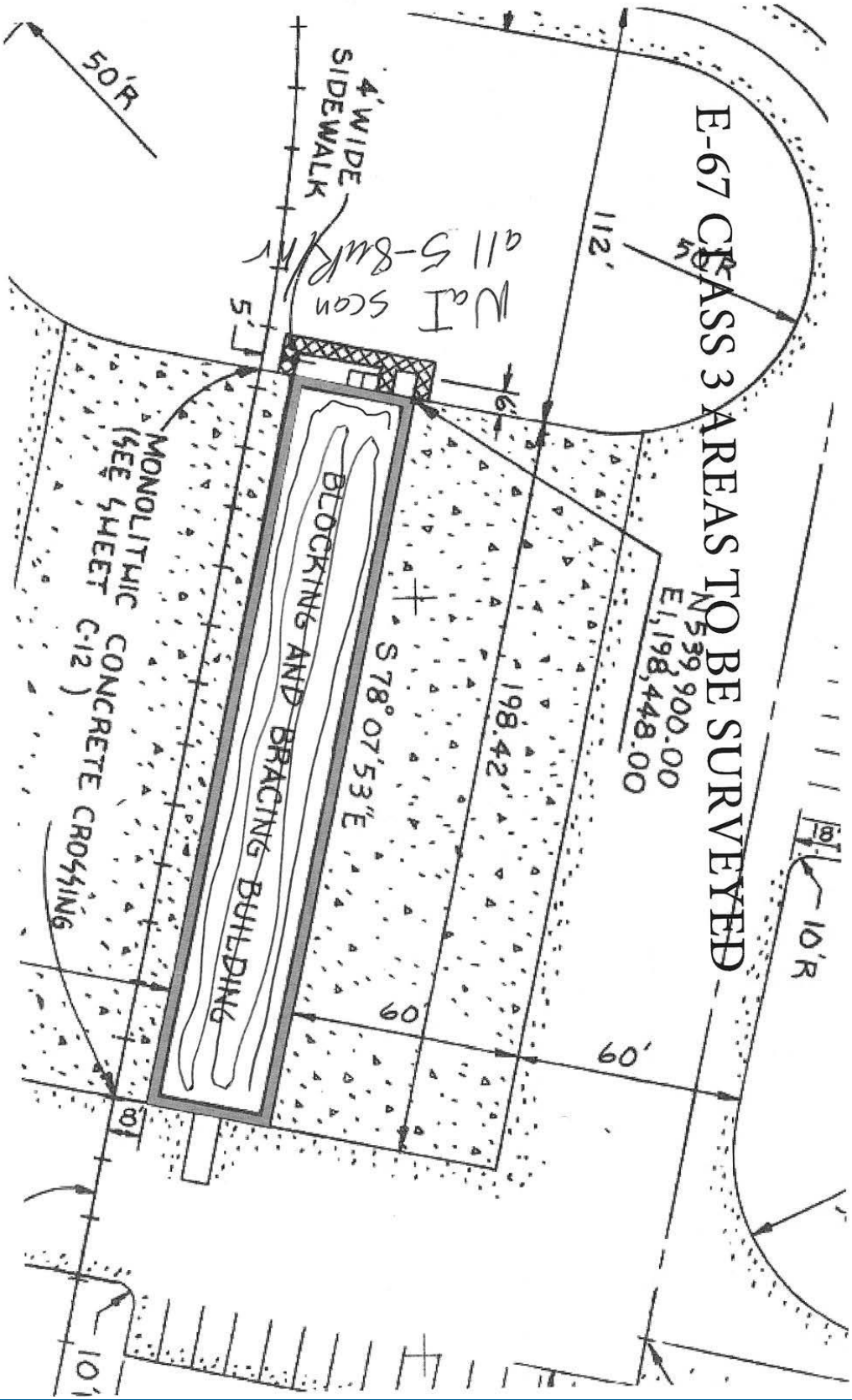
| Location Number | Alpha 2 min cts | Beta 2 min cts | Alpha dpm/100cm$^2$ | Beta dpm/100cm$^2$ |
|---|---|---|---|---|
| 1 | 7 | 318 | 5 | -113 |
| 2 | 18 | 319 | 32 | -110 |
| 3 | 15 | 378 | 25 | 99 |
| 4 | 32 | 383 | 67 | 117 |
| 5 | 17 | 334 | 30 | -57 |
| 6 | 14 | 296 | 22 | -191 |
| 7 | 14 | 371 | 22 | 74 |
| 8 | 11 | 312 | 15 | -135 |
| 9 | 21 | 350 | 40 | 0 |
| 10 | 19 | 350 | 35 | 0 |
| 11 | 26 | 401 | 52 | 181 |
| 12 | 21 | 377 | 40 | 96 |
| 13 | 17 | 337 | 30 | -46 |
| 14 | 7 | 368 | 5 | 64 |
| 15 | 20 | 323 | 37 | -96 |
| 16 | 15 | 372 | 25 | 78 |
| 17 | 15 | 364 | 25 | 50 |
| 18 | 12 | 343 | 17 | -25 |
| 19 | 24 | 316 | 47 | -121 |
| 20 | 19 | 353 | 35 | 11 |
| 4R | 25 | 389 | 50 | 138 |

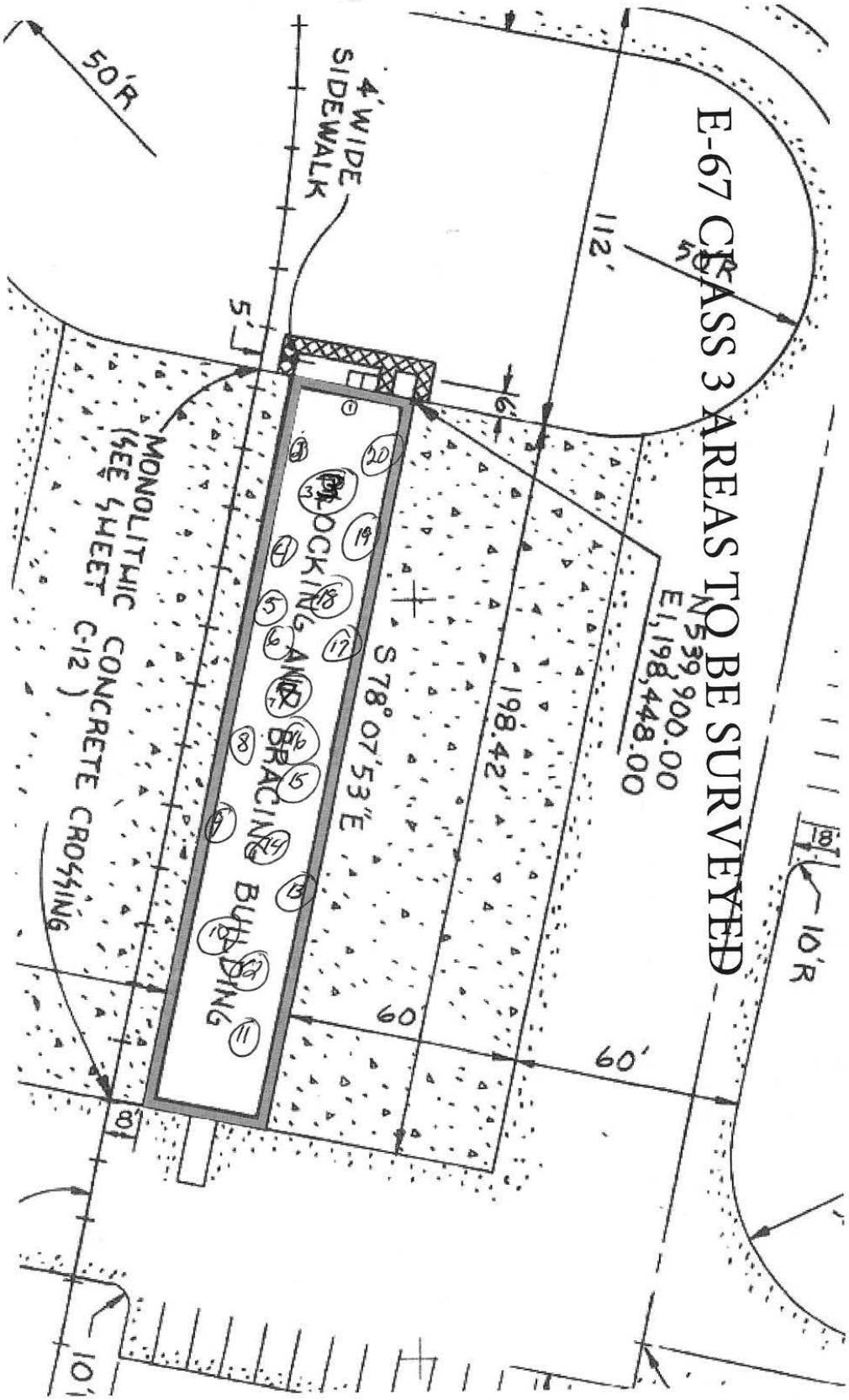
Legend: # - General Area Dose Rate # - Contact Dose Rate
(#) - Smear Location LAW # - Large Area Wipe
D # - Direct Survey Location
Indicate LAW and scanning using lines representing area covered.

| Instrumentation | | | | | | | Source Check (pre/post) | | |
|---|---|---|---|---|---|---|---|---|---|
| Model | Serial | α eff | β eff. | α bkg 10 mi | β bkg 10 m | size cm$^2$ | Isotope | reading | unit |
| 43-93 | PR399442 | 0.199 | 0.141 | 26 | 1750 | 100 | I-129 | 209 | cpm |
| | | | | | | | Th-230 | 421 | cpm |
| 44-2 | PR306257 | n/a | n/a | n/a | 6-9 uR/hr | n/a | Cs-137 | 600 | uR/hr |

Comments: alpha AL = 199 dpm/100cm$^2$, MDA = 177 dpm/100cm$^2$

NV5/ DADE MOELLER PAGE 1 OF 1 FRM-RP-002 REV. AlpaBeta_00


E-67 CLASS 3 AREAS TO BE SURVEYED
N 539,900.00
E 1,198,448.00
10'R
60'
60
198.42'
S 78° 07' 53" E
BLOCKING AND BRACING BUILDING
112'
6'
5'
4' WIDE SIDEWALK
50'R
MONOLITHIC (SEE SHEET C-12)
CONCRETE CROSSING
8'
10'


E-67 CLASS 3 AREAS TO BE SURVEYED
N 539,900.00
E 1,198,448.00
198.42'
S 78° 07' 53" E
BLOCKING AND BRACING
BUILDING
112'
60'
60'
10'R
50'R
4' WIDE SIDEWALK
MONOLITHIC (SEE SHEET C-12)
CONCRETE CROSSING
5'
6'
8'
10'

NV5 DADE MOELLER

# Bench Counter Worksheet

| | | | |
|---|---|---|---|
| Area Description: E67 Class 3 | | Date | 8/23/2022 |
| Purpose of Survey: Characterization Survey | | Performed by | |
| | | Print: | Clark Barton |

| Survey Results - Instrument 1 | | | | | Survey Results - Instrument 2 | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Location Number | Alpha 2 min cts | Beta 2 min cts | Alpha dpm/100cm$^2$ | Beta dpm/100cm$^2$ | Location Number | Alpha cpm | Beta cpm | Alpha dpm/100cm$^2$ | Beta dpm/100cm$^2$ |
| Background 10 | 0 | 367 | -1 | 27 | | | | | |
| Background 10 | 1 | 335 | 0 | 11 | | | | | |
| 1 | 2 | 65 | 2 | 5 | | | | | |
| 2 | 0 | 67 | -1 | 11 | | | | | |
| 3 | 0 | 61 | -1 | -5 | | | | | |
| 4 | 1 | 72 | 1 | 24 | | | | | |
| 5 | 0 | 61 | -1 | -5 | | | | | |
| 6 | 0 | 72 | -1 | 24 | | | | | |
| 7 | 0 | 76 | -1 | 34 | | | | | |
| 8 | 0 | 57 | -1 | -16 | | | | | |
| 9 | 0 | 61 | -1 | -5 | | | | | |
| 10 | 0 | 64 | -1 | 3 | | | | | |
| 11 | 0 | 67 | -1 | 11 | | | | | |
| 12 | 2 | 65 | 2 | 5 | | | | | |
| 13 | 0 | 66 | -1 | 8 | | | | | |
| 14 | 0 | 65 | -1 | 5 | | | | | |
| 15 | 1 | 59 | 1 | -11 | | | | | |
| 16 | 0 | 81 | -1 | 47 | | | | | |
| 17 | 0 | 62 | -1 | -3 | | | | | |
| 18 | 0 | 68 | -1 | 13 | | | | | |
| 19 | 0 | 73 | -1 | 26 | | | | | |
| 20 | 0 | 76 | -1 | 34 | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

| Instrumentation | | | | | | | Source Check (pre/post) | | |
|---|---|---|---|---|---|---|---|---|---|
| Model | Serial | α eff | β eff. | α bkg | β bkg | size cm$^2$ | Isotope | reading | unit |
| 2929 | 129566 | 0.338 | 0.19 | 2.2 | 315 | 100 | Th-230 | 722 | cpm |
| | | | | | | | I-129 | 148 | cpm |

Comments: Alpha AL = 19 dpm/100cm$^2$, MDA = 12 dpm/100cm$^2$

**Performed by (Signature):** CHP, CSP **Date:8/23/22**

**Reviewed by (Signataure):** **Date:**

NV5/ DADE MOELLER PAGE 1 OF 1 FRM-RP-009 REV_00

NV5 DADE MOELLER

# Radiological Survey Report

| | | |
|---|---|---|
| Area Description: X-18 Class 3 | Date | 8/23/2022 |
| Purpose of Survey: Characterization Survey | Performed by | |
| | Print: | Clark Barton / Lorinda Finch |
| | Sign: | CHP, CSP |

Sketch of Area: See Attached all survey points had approx. 1 square meter scan surveyed, no elevated areas identified. 3, 5, 8, 10, 20 on paint, rest on bare concrete

Survey Results - Instrument 1

| Location Number | Alpha 2 min cts | Beta 2 min cts | Alpha dpm/100cm$^2$ | Beta dpm/100cm$^2$ |
|---|---|---|---|---|
| 1 | 9 | 354 | 10 | 14 |
| 2 | 4 | 391 | -3 | 145 |
| 3 | 2 | 376 | -8 | 92 |
| 4 | 8 | 455 | 7 | 372 |
| 5 | 4 | 385 | -3 | 124 |
| 6 | 4 | 383 | -3 | 117 |
| 7 | 3 | 341 | -6 | -32 |
| 8 | 3 | 342 | -6 | -28 |
| 9 | 5 | 412 | -1 | 220 |
| 10 | 6 | 381 | 2 | 110 |
| 11 | 7 | 392 | 5 | 149 |
| 12 | 6 | 367 | 2 | 60 |
| 13 | 5 | 369 | -1 | 67 |
| 14 | 9 | 364 | 10 | 50 |
| 15 | 8 | 409 | 7 | 209 |
| 16 | 16 | 377 | 27 | 96 |
| 17 | 12 | 412 | 17 | 220 |
| 18 | 37 | 405 | 80 | 195 |
| 19 | 8 | 355 | 7 | 18 |
| 20 | 1 | 383 | -11 | 117 |

Legend: # - General Area Dose Rate # - Contact Dose Rate
(#) - Smear Location LAW # - Large Area Wipe
D # - Direct Survey Location
Indicate LAW and scanning using lines representing area covered.

Instrumentation

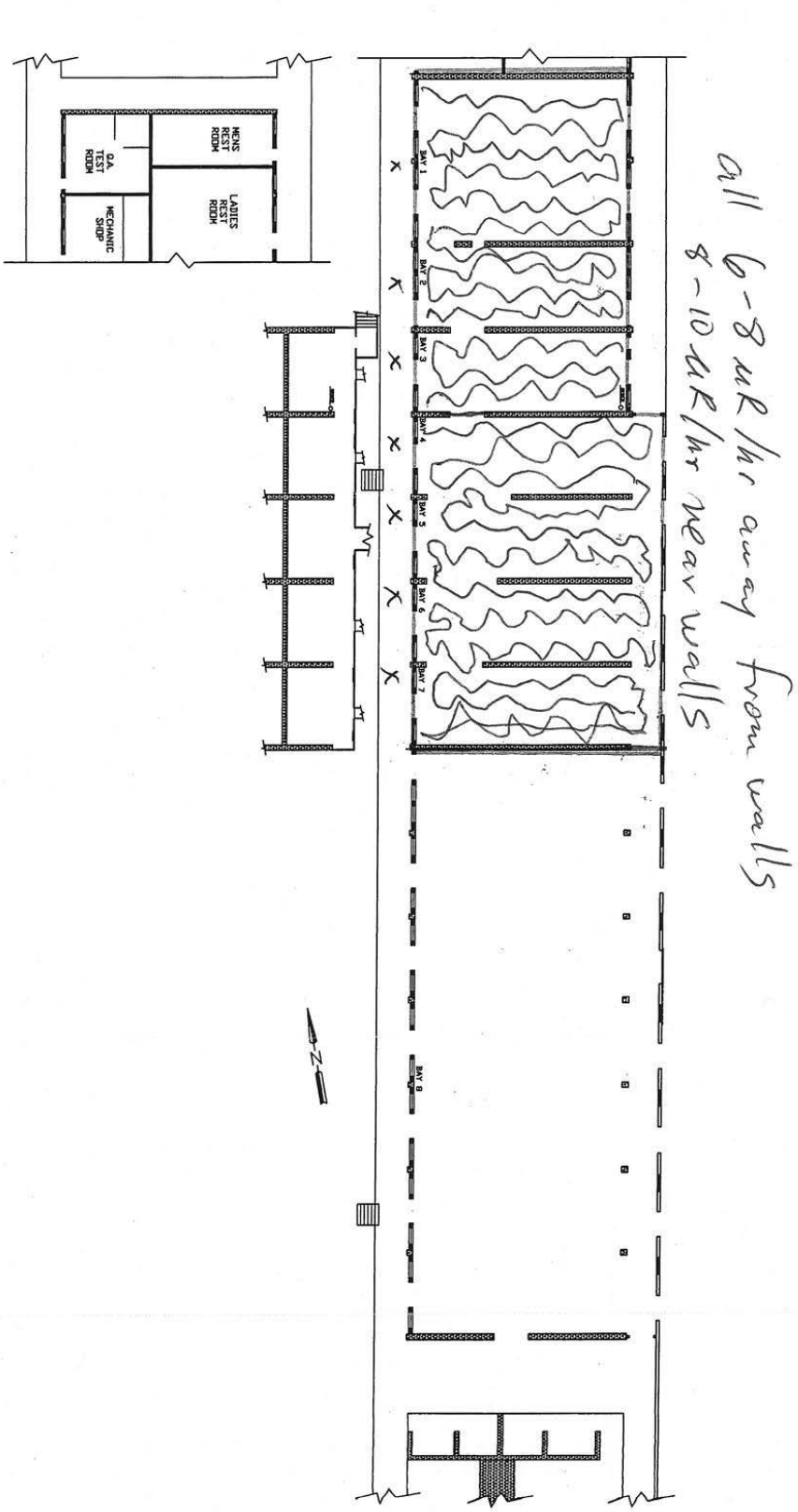
| Model | Serial | α eff | β eff. | α bkg 10 mi | β bkg 10 m | size cm$^2$ |
|---|---|---|---|---|---|---|
| 43-93 | PR399442 | 0.199 | 0.141 | 26 | 1750 | 100 |
| | | | | | | |
| 44-2 | PR306257 | n/a | n/a | n/a | 6-9 uR/hr | n/a |

Source Check (pre/post)

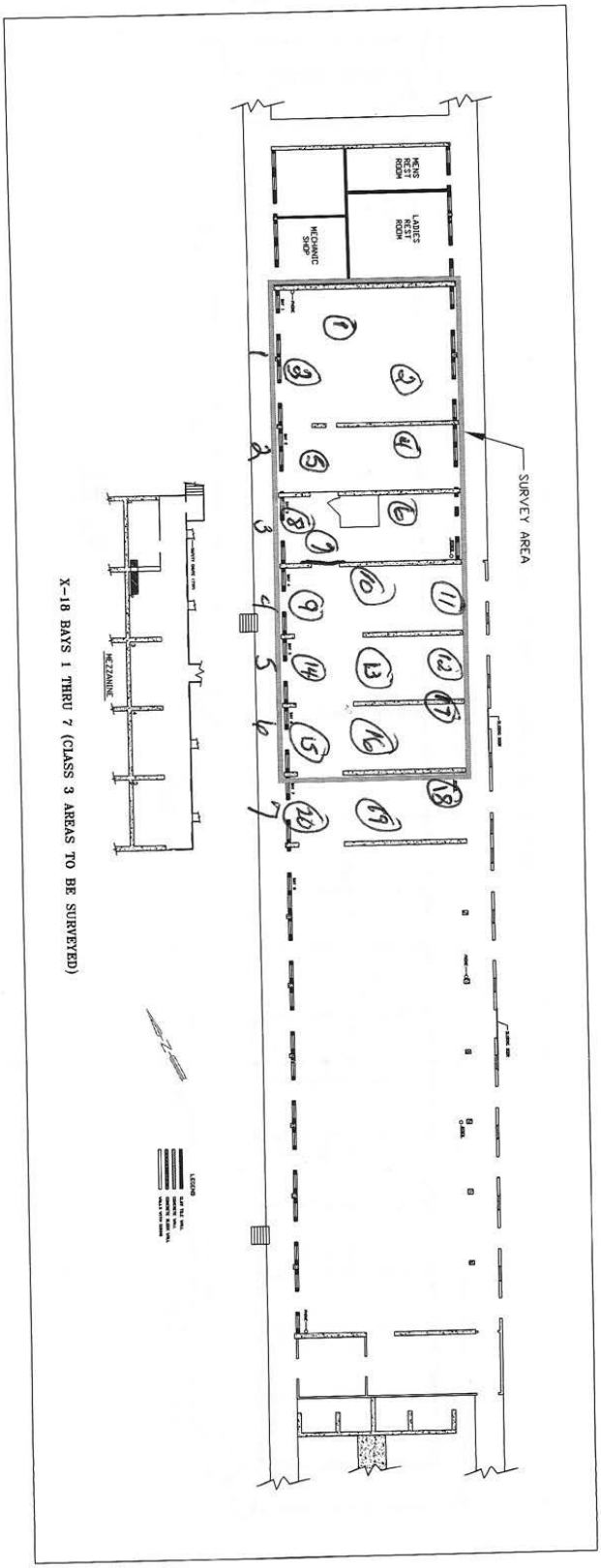
| Isotope | reading | unit |
|---|---|---|
| I-129 | 214 | cpm |
| Th-230 | 448 | cpm |
| Cs-137 | 700 | uR/hr |

Comments: alpha AL = 199 dpm/100cm$^2$, MDA = 177 dpm/100cm$^2$

NV5/ DADE MOELLER PAGE 1 OF 1 FRM-RP-002 REV. AlpaBeta_00


X-18
- 9,028 sq.ft Bays 1-7
all 6-8 uR/hr away from walls
8-10 uR/hr near walls
BAY 1
BAY 2
BAY 3
BAY 4
BAY 5
BAY 6
BAY 7
BAY 8
MENS REST ROOM
LADIES REST ROOM
Q.A. TEST ROOM
MECHANIC SHOP
N

Bays 1-7




X-18 BAYS 1 THRU 7 (CLASS 3 AREAS TO BE SURVEYED)

NV5 DADE MOELLER

## Bench Counter Worksheet

| | | | |
|---|---|---|---|
| Area Description: X-18 Class 3 | | Date | 8/23/2022 |
| Purpose of Survey: Characterization Survey | | Performed by | |
| | | Print: | Clark Barton |

| Survey Results - Instrument 1 | | | | | Survey Results - Instrument 2 | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Location Number | Alpha 2 min cts | Beta 2 min cts | Alpha dpm/100cm$^2$ | Beta dpm/100cm$^2$ | Location Number | Alpha cpm | Beta cpm | Alpha dpm/100cm$^2$ | Beta dpm/100cm$^2$ |
| Background 10 | 0 | 367 | -1 | 27 | | | | | |
| Background 10 | 1 | 335 | 0 | 11 | | | | | |
| 1 | 1 | 67 | 1 | 11 | | | | | |
| 2 | 1 | 66 | 1 | 8 | | | | | |
| 3 | 1 | 78 | 1 | 39 | | | | | |
| 4 | 0 | 67 | -1 | 11 | | | | | |
| 5 | 1 | 68 | 1 | 13 | | | | | |
| 6 | 0 | 51 | -1 | -32 | | | | | |
| 7 | 0 | 74 | -1 | 29 | | | | | |
| 8 | 0 | 60 | -1 | -8 | | | | | |
| 9 | 0 | 65 | -1 | 5 | | | | | |
| 10 | 0 | 60 | -1 | -8 | | | | | |
| 11 | 0 | 59 | -1 | -11 | | | | | |
| 12 | 0 | 78 | -1 | 39 | | | | | |
| 13 | 0 | 65 | -1 | 5 | | | | | |
| 14 | 1 | 60 | 1 | -8 | | | | | |
| 15 | 0 | 45 | -1 | -47 | | | | | |
| 16 | 0 | 75 | -1 | 32 | | | | | |
| 17 | 0 | 69 | -1 | 16 | | | | | |
| 18 | 0 | 56 | -1 | -18 | | | | | |
| 19 | 0 | 91 | -1 | 74 | | | | | |
| 20 | 0 | 70 | -1 | 18 | | | | | |
| 19R | 1 | 72 | 1 | 24 | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

| Instrumentation | | | | | | | Source Check (pre/post) | | |
|---|---|---|---|---|---|---|---|---|---|
| Model | Serial | α eff | β eff. | α bkg | β bkg | size cm$^2$ | Isotope | reading | unit |
| 2929 | 129566 | 0.338 | 0.19 | 2.2 | 315 | 100 | Th-230 | 722 | cpm |
| | | | | | | | I-129 | 148 | cpm |

Comments: alpha AL = 19 dpm/100cm$^2$, MDA = 12 dpm/100cm$^2$

**Performed by (Signature):** Clark Barton, CHP, CSP **Date:8/23/22**

**Reviewed by (Signataure):** **Date:**

NV5/ DADE MOELLER PAGE 1 OF 1 FRM-RP-009 REV_00

NV5
DADE MOELLER

# Radiological Survey Report

Area Description: X-26, X-27, X-14

Date: 8/23/22

Purpose of Survey: Impacted Class 3 Nat

Performed by
Print: Clark Barton / Lorinda Finch
Sign:

Sketch of Area:

See attached maps

Survey Results - Instrument 1

| Location Number | Alpha cpm | Beta cpm | Alpha dpm/100cm² | Beta dpm/100cm² |
|---|---|---|---|---|
| on | maps | | | |

Legend: # - General Area Dose Rate; #- Contact Dose Rate; (#) - Smear/Direct Location

Indicate LAW and scanning using lines representing area covered.

Instrumentation

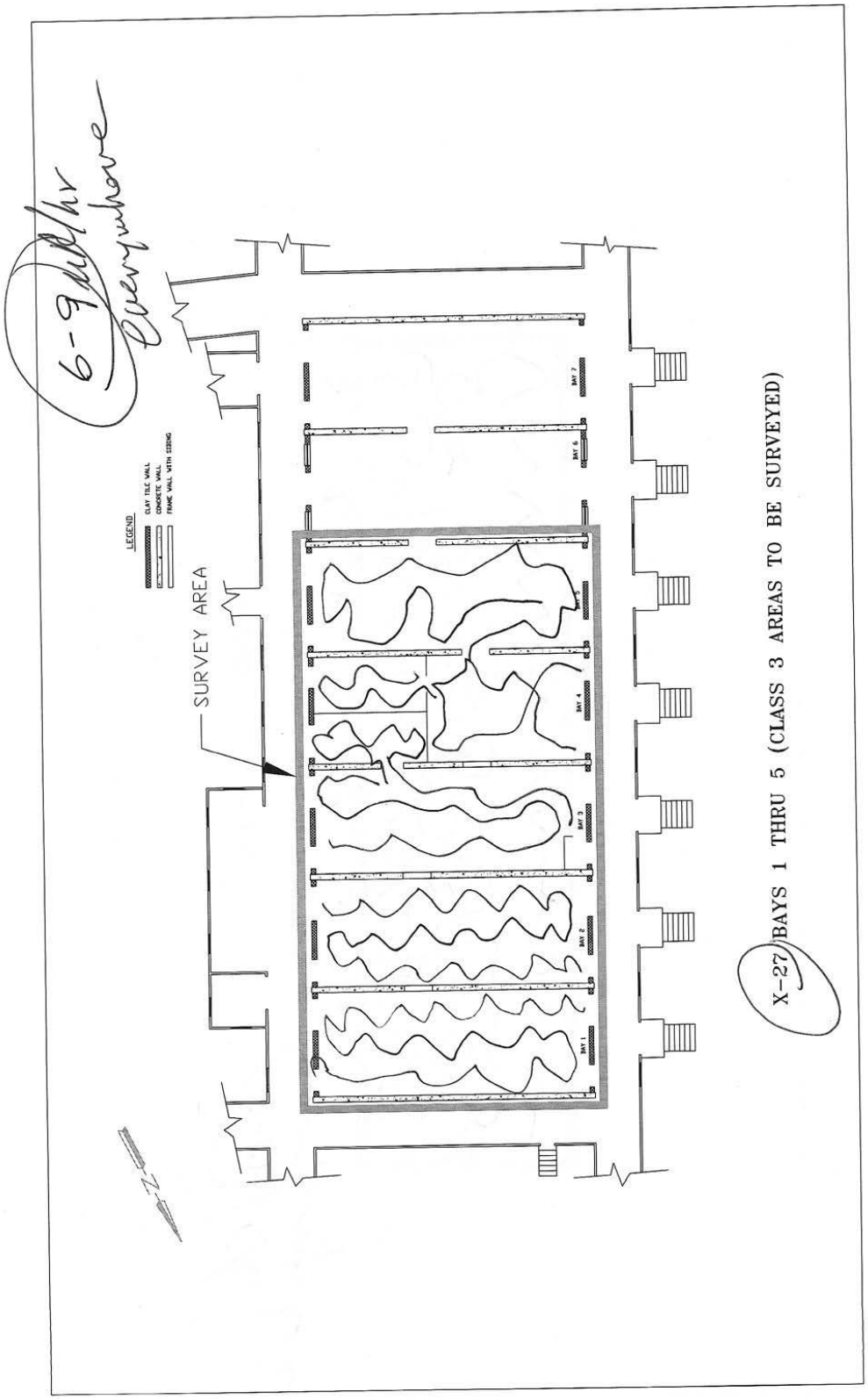
| Model | Serial | α eff | β eff. | α bkg | β bkg | size cm² | Source Check (pre/post) Isotope | reading | unit |
|---|---|---|---|---|---|---|---|---|---|
| 44-2 | PR306257 | N/A | N/A | N/A | 5.5uR/hr | N/A | Cs137 | 650uR/hr | |

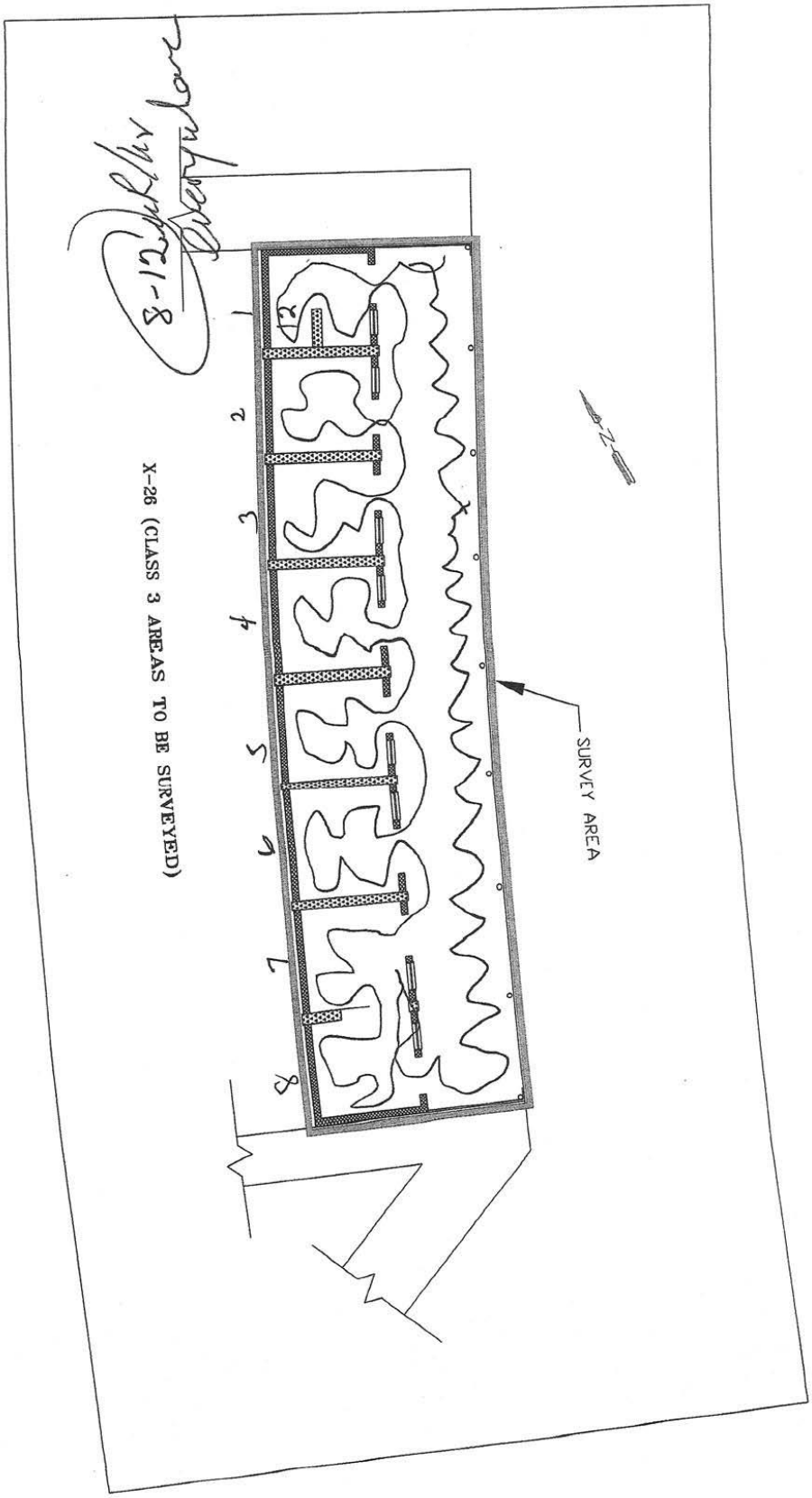
Comments: All areas scanned as per maps, no elevated areas found.

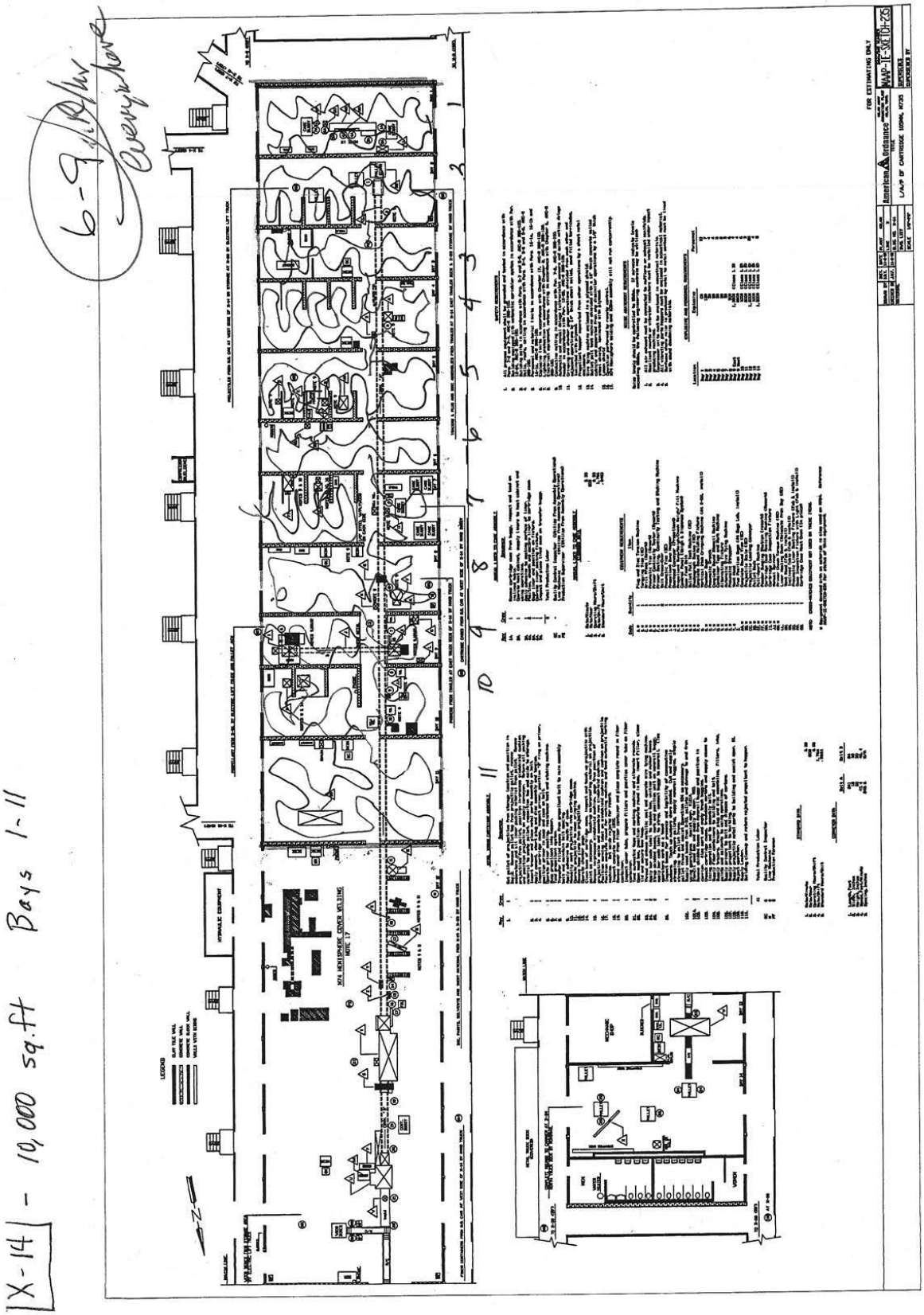
NV5/ DADE MOELLER

PAGE 1 OF 1

FRM-RP-002 REV. AB FSS_00


6-9 hr
Overnighters
LEGEND
CLAY TILE WALL
CONCRETE WALL
FRAME WALL WITH SIDING
SURVEY AREA
BAY 1
BAY 2
BAY 3
BAY 4
BAY 5
BAY 6
BAY 7
X-27 BAYS 1 THRU 5 (CLASS 3 AREAS TO BE SURVEYED)


SURVEY AREA
1
2
3
4
5
6
7
8
12
X-26 (CLASS 3 AREAS TO BE SURVEYED)
8-12-21


6-9
Bays 1-11
10,000 sq.ft
X-14
FOR ESTIMATING ONLY
American Ordnance
MAP-TE-SK101-X5
LAYOUT OF CARTRIDGE 105MM, M720
HYDRAULIC COMPRESSOR
LEGEND

NV5 DADE MOELLER

# Radiological Survey Report

| | | |
|---|---|---|
| Area Description: X-14 Class 3 | Date | 8/24/2022 |
| Purpose of Survey: Characterization Survey | Performed by | |
| | Print: | Clark Barton / Lorinda Finch |
| | Sign: | CHP, CSP |

Sketch of Area: See Attached
all survey points had approx. 1 square meter scan surveyed, no elevated areas identified.

Survey Results - Instrument 1

| Location Number | Alpha 2 min cts | Beta 2 min cts | Alpha dpm/100cm$^2$ | Beta dpm/100cm$^2$ |
|---|---|---|---|---|
| 1 | 5 | 332 | -1 | -64 |
| 2 | 4 | 355 | -3 | 18 |
| 3 | 4 | 366 | -3 | 57 |
| 4 | 2 | 351 | -8 | 4 |
| 5 | 11 | 351 | 15 | 4 |
| 6 | 7 | 375 | 5 | 89 |
| 7 | 6 | 329 | 2 | -74 |
| 8 | 4 | 342 | -3 | -28 |
| 9 | 4 | 263 | -3 | -309 |
| 10 | 6 | 377 | 2 | 96 |
| 11 | 6 | 325 | 2 | -89 |
| 12 | 3 | 341 | -6 | -32 |
| 13 | 5 | 348 | -1 | -7 |
| 14 | 5 | 350 | -1 | 0 |
| 15 | 7 | 340 | 5 | -35 |
| 16 | 10 | 317 | 12 | -117 |
| 17 | 8 | 380 | 7 | 106 |
| 18 | 7 | 408 | 5 | 206 |
| 19 | 5 | 383 | -1 | 117 |
| 20 | 4 | 364 | -3 | 50 |

Legend: # - General Area Dose Rate # - Contact Dose Rate
(#) - Smear Location LAW # - Large Area Wipe
D # - Direct Survey Location
Indicate LAW and scanning using lines representing area covered.

Instrumentation

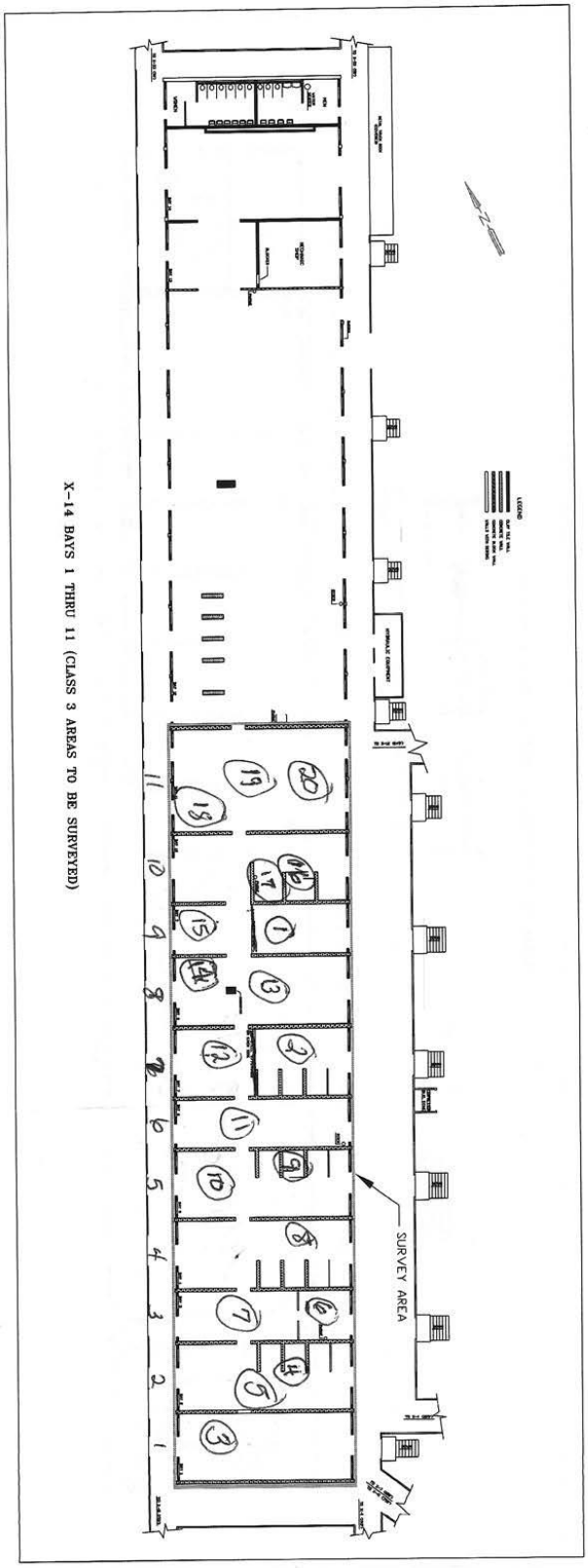
| Model | Serial | α eff | β eff. | α bkg 10 mi | β bkg 10 m | size cm$^2$ |
|---|---|---|---|---|---|---|
| 43-93 | PR399442 | 0.199 | 0.141 | 26 | 1750 | 100 |

Source Check (pre/post)

| Isotope | reading | unit |
|---|---|---|
| I-129 | 239 | cpm |
| Th-230 | 444 | cpm |

Comments:alpha AL = 199 dpm/100cm$^2$, MDA = 177 dpm/100cm$^2$

NV5/ DADE MOELLER PAGE 1 OF 1 FRM-RP-002 REV. AlpaBeta_00




X-14 BAYS 1 THRU 11 (CLASS 3 AREAS TO BE SURVEYED)

NV5 DADE MOELLER

## Bench Counter Worksheet

| | | | |
|---|---|---|---|
| Area Description: X-14 Class 3 | | Date | 8/24/2022 |
| Purpose of Survey: Characterization Survey | | Performed by | |
| | | Print: | Clark Barton |

| Survey Results - Instrument 1 | | | | | Survey Results - Instrument 2 | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Location Number | Alpha 2 min cts | Beta 2 min cts | Alpha dpm/100cm$^2$ | Beta dpm/100cm$^2$ | Location Number | Alpha cpm | Beta cpm | Alpha dpm/100cm$^2$ | Beta dpm/100cm$^2$ |
| Background 10 | 4 | 338 | 1 | 12 | | | | | |
| Background 10 | 0 | 325 | -1 | 5 | | | | | |
| 1 | 0 | 81 | -1 | 47 | | | | | |
| 2 | 1 | 60 | 1 | -8 | | | | | |
| 3 | 1 | 85 | 1 | 58 | | | | | |
| 4 | 1 | 79 | 1 | 42 | | | | | |
| 5 | 0 | 66 | -1 | 8 | | | | | |
| 6 | 1 | 62 | 1 | -3 | | | | | |
| 7 | 0 | 71 | -1 | 21 | | | | | |
| 8 | 0 | 73 | -1 | 26 | | | | | |
| 9 | 1 | 67 | 1 | 11 | | | | | |
| 10 | 1 | 73 | 1 | 26 | | | | | |
| 11 | 0 | 70 | -1 | 18 | | | | | |
| 12 | 0 | 67 | -1 | 11 | | | | | |
| 13 | 1 | 71 | 1 | 21 | | | | | |
| 14 | 0 | 73 | -1 | 26 | | | | | |
| 15 | 0 | 64 | -1 | 3 | | | | | |
| 16 | 1 | 61 | 1 | -5 | | | | | |
| 17 | 0 | 59 | -1 | -11 | | | | | |
| 18 | 1 | 54 | 1 | -24 | | | | | |
| 19 | 0 | 70 | -1 | 18 | | | | | |
| 20 | 0 | 62 | -1 | -3 | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

| Instrumentation | | | | | | | Source Check (pre/post) | | |
|---|---|---|---|---|---|---|---|---|---|
| Model | Serial | α eff | β eff. | α bkg | β bkg | size cm$^2$ | Isotope | reading | unit |
| 2929 | 129566 | 0.338 | 0.19 | 2.2 | 315 | 100 | Th-230 | 654 | cpm |
| | | | | | | | I-129 | 147 | cpm |

Comments: alpha AL - 19 dpm/100cm$^2$, MDA = 12 dpm/100cm$^2$

**Performed by (Signature):** CHP, CSP **Date:8/24/22**

**Reviewed by (Signataure):** **Date:**

NV5/ DADE MOELLER PAGE 1 OF 1 FRM-RP-009 REV_00

NV5 DADE MOELLER

# Radiological Survey Report

| | | |
|---|---|---|
| Area Description: X-26 Class 3 | Date | 8/24/2022 |
| Purpose of Survey: Characterization Survey | Performed by | |
| | Print: | Clark Barton / Lorinda Finch |
| | Sign: | CHP, CSP |

Sketch of Area: See Attached
High moisture in all rooms
Rubber liner on floor rooms 1, 2, 1/2 of 3, 4, 5, 6, 1/2 of 7, 1/3 of hallway. all survey points had approx. 1 square meter scan surveyed, no elevated areas identified.

Survey Results - Instrument 1

| Location Number | Alpha 2 min cts | Beta 2 min cts | Alpha dpm/100cm$^2$ | Beta dpm/100cm$^2$ |
|---|---|---|---|---|
| 1 | 5 | 352 | -1 | 7 |
| 2 | 6 | 387 | 2 | 131 |
| 3 | 9 | 398 | 10 | 170 |
| 4 | 6 | 306 | 2 | -156 |
| 5 | 8 | 320 | 7 | -106 |
| 6 | 6 | 360 | 2 | 35 |
| 7 | 7 | 397 | 5 | 167 |
| 8 | 12 | 424 | 17 | 262 |
| 9 | 8 | 394 | 7 | 156 |
| 10 | 7 | 384 | 5 | 121 |
| 11 | 9 | 397 | 10 | 167 |
| 12 | 5 | 407 | -1 | 202 |
| 13 | 8 | 412 | 7 | 220 |
| 14 | 12 | 380 | 17 | 106 |
| 15 | 20 | 409 | 37 | 209 |
| 16 | 8 | 374 | 7 | 85 |
| 17 | 8 | 380 | 7 | 106 |
| 18 | 7 | 424 | 5 | 262 |
| 19 | 6 | 359 | 2 | 32 |
| 20 | 3 | 384 | -6 | 121 |

Legend: # - General Area Dose Rate # - Contact Dose Rate
(#) - Smear Location LAW # - Large Area Wipe
D # - Direct Survey Location
Indicate LAW and scanning using lines representing area covered.

Instrumentation

| Model | Serial | α eff | β eff. | α bkg 10 mi | β bkg 10 m | size cm$^2$ |
|---|---|---|---|---|---|---|
| 43-93 | PR399442 | 0.199 | 0.141 | 26 | 1750 | 100 |

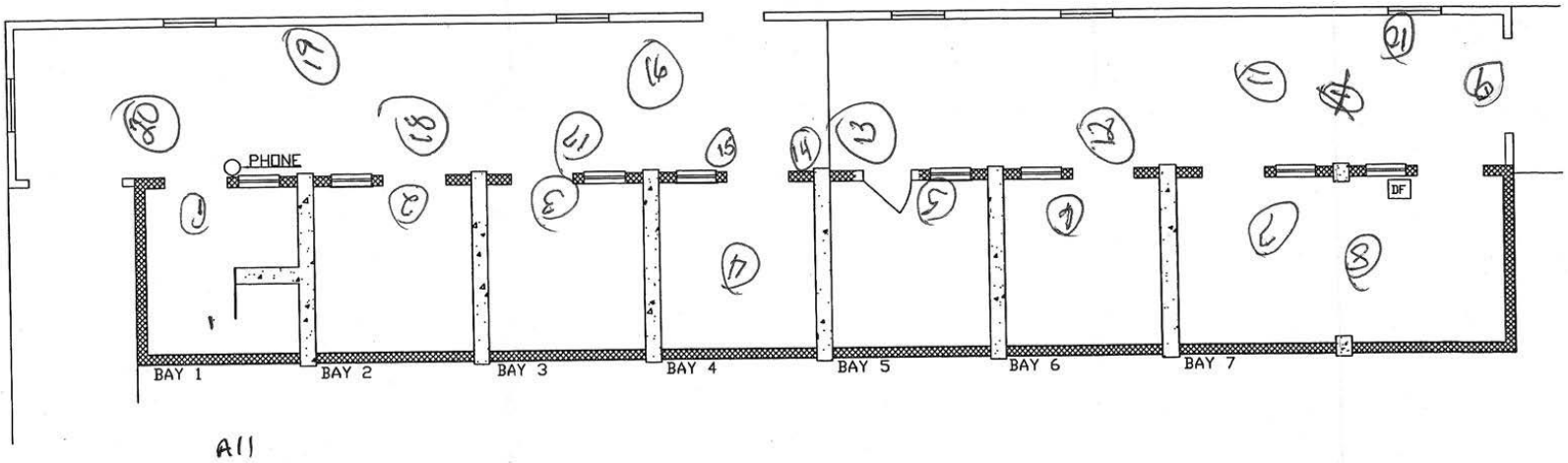
Source Check (pre/post)

| Isotope | reading | unit |
|---|---|---|
| I-129 | 219 | cpm |
| Th-230 | 486 | cpm |

Comments: alpha AL = 199 dpm/100cm$^2$, MDA = 177dpm/100cm$^2$

NV5/ DADE MOELLER PAGE 1 OF 1 FRM-RP-002 REV. AlpaBeta_00

X-26 - 2,123 sq. ft. Rewark




All

NV5 DADE MOELLER

# Bench Counter Worksheet

| | | | |
|---|---|---|---|
| Area Description: X-26 Class 3 | | Date | 8/24/2022 |
| Purpose of Survey: Characterization Survey | | Performed by | |
| | | Print: | Clark Barton |

| Survey Results - Instrument 1 | | | | | Survey Results - Instrument 2 | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Location Number | Alpha 2 min cts | Beta 2 min cts | Alpha dpm/100cm$^2$ | Beta dpm/100cm$^2$ | Location Number | Alpha cpm | Beta cpm | Alpha dpm/100cm$^2$ | Beta dpm/100cm$^2$ |
| Background 10 | 4 | 338 | 1 | 12 | | | | | |
| Background 10 | 0 | 325 | -1 | 5 | | | | | |
| 1 | 1 | 62 | 1 | -3 | | | | | |
| 2 | 0 | 59 | -1 | -11 | | | | | |
| 3 | 0 | 60 | -1 | -8 | | | | | |
| 4 | 2 | 74 | 2 | 29 | | | | | |
| 5 | 0 | 67 | -1 | 11 | | | | | |
| 6 | 0 | 71 | -1 | 21 | | | | | |
| 7 | 1 | 58 | 1 | -13 | | | | | |
| 8 | 1 | 66 | 1 | 8 | | | | | |
| 9 | 0 | 67 | -1 | 11 | | | | | |
| 10 | 0 | 70 | -1 | 18 | | | | | |
| 11 | 0 | 71 | -1 | 21 | | | | | |
| 12 | 0 | 62 | -1 | -3 | | | | | |
| 13 | 0 | 68 | -1 | 13 | | | | | |
| 14 | 1 | 66 | 1 | 8 | | | | | |
| 15 | 0 | 78 | -1 | 39 | | | | | |
| 16 | 0 | 51 | -1 | -32 | | | | | |
| 17 | 0 | 73 | -1 | 26 | | | | | |
| 18 | 0 | 66 | -1 | 8 | | | | | |
| 19 | 1 | 72 | 1 | 24 | | | | | |
| 20 | 0 | 58 | -1 | -13 | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

| Instrumentation | | | | | | | Source Check (pre/post) | | |
|---|---|---|---|---|---|---|---|---|---|
| Model | Serial | α eff | β eff. | α bkg | β bkg | size cm$^2$ | Isotope | reading | unit |
| 2929 | 129566 | 0.338 | 0.19 | 2.2 | 315 | 100 | Th-230 | 654 | cpm |
| | | | | | | | I-129 | 147 | cpm |

Comments: alpha AL = 19 dpm/100cm$^2$, MDA 177 dpm/100cm$^2$

**Performed by (Signature):** CHP, CSP **Date:8/24/22**

**Reviewed by (Signataure):** **Date:**

NV5/ DADE MOELLER PAGE 1 OF 1 FRM-RP-009 REV_00

NV5 DADE MOELLER

# Radiological Survey Report

| | | |
|---|---|---|
| Area Description: X-27 Class 3 | Date | 8/24/2022 |
| Purpose of Survey: Characterization Survey | Performed by | |
| | Print: | Clark Barton / Lorinda Finch |
| | Sign: | CHP, CSP |

Sketch of Area: See Attached
all survey points had approx. 1 square meter scan surveyed, no elevated areas identified.

Survey Results - Instrument 1

| Location Number | Alpha 2 min cts | Beta 2 min cts | Alpha dpm/100cm$^2$ | Beta dpm/100cm$^2$ |
|---|---|---|---|---|
| 1 | 5 | 390 | -1 | 142 |
| 2 | 8 | 328 | 7 | -78 |
| 3 | 3 | 359 | -6 | 32 |
| 4 | 6 | 420 | 2 | 248 |
| 5 | 5 | 420 | -1 | 248 |
| 6 | 6 | 363 | 2 | 46 |
| 7 | 5 | 388 | -1 | 135 |
| 8 | 3 | 410 | -6 | 213 |
| 9 | 4 | 359 | -3 | 32 |
| 10 | 4 | 369 | -3 | 67 |
| 11 | 6 | 380 | 2 | 106 |
| 12 | 7 | 364 | 5 | 50 |
| 13 | 3 | 280 | -6 | -248 |
| 14 | 5 | 394 | -1 | 156 |
| 15 | 5 | 422 | -1 | 255 |
| 16 | 5 | 377 | -1 | 96 |
| 17 | 5 | 398 | -1 | 170 |
| 18 | 10 | 399 | 12 | 174 |
| 19 | 7 | 376 | 5 | 92 |
| 20 | 4 | 399 | -3 | 174 |

Legend: # - General Area Dose Rate # - Contact Dose Rate
(#) - Smear Location LAW # - Large Area Wipe
D # - Direct Survey Location
Indicate LAW and scanning using lines representing area covered.

Instrumentation

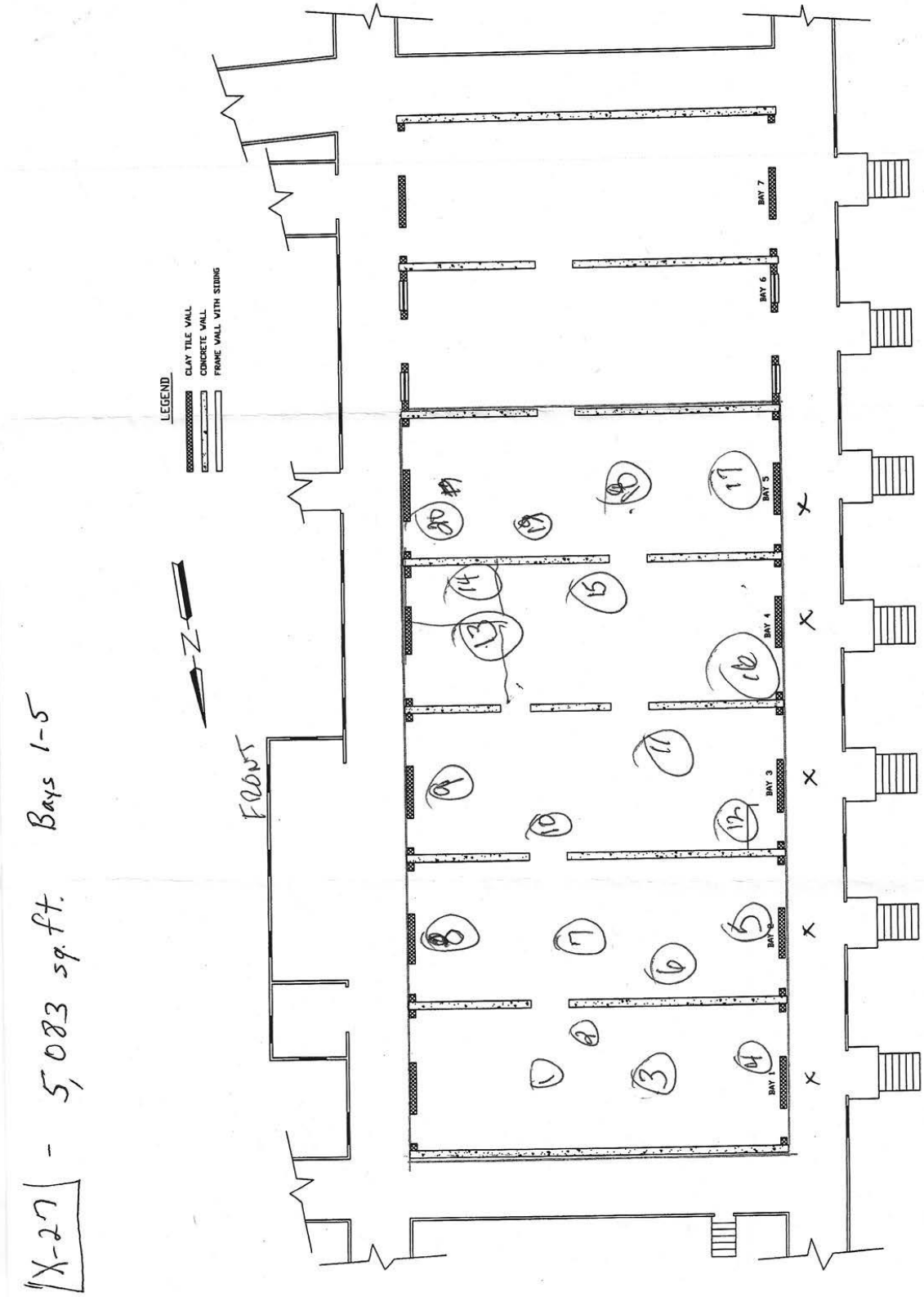
| Model | Serial | α eff | β eff. | α bkg 10 mi | β bkg 10 m | size cm$^2$ |
|---|---|---|---|---|---|---|
| 43-93 | PR399442 | 0.199 | 0.141 | 26 | 1750 | 100 |

Source Check (pre/post)

| Isotope | reading | unit |
|---|---|---|
| I-129 | 214 | cpm |
| Th-230 | 415 | cpm |

Comments:alpha AL = 199 dpm/100cm$^2$, MDA = 177 dpm/100cm$^2$

NV5/ DADE MOELLER PAGE 1 OF 1 FRM-RP-002 REV. AlpaBeta_00




X-27 - 5,083 sq. ft. Bays 1-5

NV5 DADE MOELLER

## Bench Counter Worksheet

| | | | |
|---|---|---|---|
| Area Description: X-27 Class 3 | | Date | 8/24/2022 |
| Purpose of Survey: Characterization Survey | | Performed by | |
| | | Print: | Clark Barton |

| Survey Results - Instrument 1 | | | | | Survey Results - Instrument 2 | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Location Number | Alpha 2 min cts | Beta 2 min cts | Alpha dpm/100cm$^2$ | Beta dpm/100cm$^2$ | Location Number | Alpha cpm | Beta cpm | Alpha dpm/100cm$^2$ | Beta dpm/100cm$^2$ |
| Background 10 | 4 | 338 | 1 | 12 | | | | | |
| Background 10 | 0 | 325 | -1 | 5 | | | | | |
| 1 | 0 | 75 | -1 | 32 | | | | | |
| 2 | 0 | 43 | -1 | -53 | | | | | |
| 3 | 0 | 68 | -1 | 13 | | | | | |
| 4 | 0 | 74 | -1 | 29 | | | | | |
| 5 | 0 | 50 | -1 | -34 | | | | | |
| 6 | 0 | 76 | -1 | 34 | | | | | |
| 7 | 0 | 64 | -1 | 3 | | | | | |
| 8 | 0 | 46 | -1 | -45 | | | | | |
| 9 | 0 | 67 | -1 | 11 | | | | | |
| 10 | 0 | 77 | -1 | 37 | | | | | |
| 11 | 0 | 70 | -1 | 18 | | | | | |
| 12 | 1 | 77 | 1 | 37 | | | | | |
| 13 | 1 | 56 | 1 | -18 | | | | | |
| 14 | 0 | 55 | -1 | -21 | | | | | |
| 15 | 1 | 57 | 1 | -16 | | | | | |
| 16 | 0 | 70 | -1 | 18 | | | | | |
| 17 | 0 | 58 | -1 | -13 | | | | | |
| 18 | 0 | 66 | -1 | 8 | | | | | |
| 19 | 1 | 64 | 1 | 3 | | | | | |
| 20 | 0 | 72 | -1 | 24 | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

| Instrumentation | | | | | | | Source Check (pre/post) | | |
|---|---|---|---|---|---|---|---|---|---|
| Model | Serial | α eff | β eff. | α bkg | β bkg | size cm$^2$ | Isotope | reading | unit |
| 2929 | 129566 | 0.338 | 0.19 | 2.2 | 315 | 100 | Th-230 | 654 | cpm |
| | | | | | | | I-129 | 147 | cpm |

Comments: alpha AL = 19 dpm/100cm$^2$, MDA = 177 dpm/100cm$^2$

**Performed by (Signature):** CHP, CSP **Date:8/24/22**

**Reviewed by (Signataure):** **Date:**

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