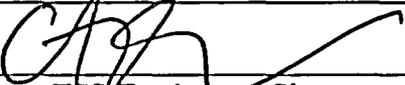


**MAINE YANKEE
FINAL STATUS SURVEY RELEASE RECORD
FR-0200 YARD EAST
SURVEY UNIT 7**

Prepared By:	 FSS Engineer - Signature <u>C.A. Olsen</u> Printed Name	Date: <u>20 June, 2005</u>
Reviewed By:	 FSS Specialist - Signature <u>ROBERT TORZIE</u> Printed Name	Date: <u>6/20/05</u>
Reviewed By:	 Independent Review - Signature <u>G. Madison</u> Printed Name	Date: <u>JUN 20 2005!</u>
Approved By:	 Superintendent FSS - Signature <u>George Hillsberry</u> Printed Name	Date: <u>6/20/05</u>
Approved By:	 FSS, MOP - Signature <u>JAMES R. BAXTER</u> Printed Name	Date: <u>6/20/05</u>

**MAINE YANKEE
FINAL STATUS SURVEY RELEASE RECORD
FR-0200 YARD EAST
SURVEY UNIT 7**

A. SURVEY UNIT DESCRIPTION

FR-0200 Yard East Survey Unit 7 was located in the NE corner of the former industrial area, mostly residing in the footprint of the Administration Building (FB-1200). The 1890 m² area was bordered on the north and east by FR-2900 Survey Unit 2 (South Access Road and Lot C), on the west by FR-0200 Survey Unit 6, and on the south by FR-0200 Survey Unit 8. As shown on map FR0200-7 SITE, this survey unit is approximately centered by the coordinates 624,245E and 407,760N using the Maine State Coordinate System (West Zone) NAD 1927. The location of the survey unit in relation to the Service Building and the surrounding FR-0200 and FR-0111 survey units is shown on map FR0200-7 REF (Attachment 1). The survey unit is located within the expanded Restricted Area boundary.

Survey Unit 7 is an area composed primarily of soil and backfill. As shown on map FR0200-7c, the survey unit is relatively flat with several trenches due to remediation activities, including storm drain and sewer line removal.

B. SURVEY UNIT DESIGN INFORMATION

Survey Unit 7 was originally classified per the LTP Revision 4 as a Class 3 survey unit, but was reclassified to Class 1 given its history during decommissioning activities.

The survey unit design parameters are shown in Table 1. Given a relative shift of 1.5, eighteen direct measurements would be required for the Sign Test, but 40 were prescribed as a conservative measure. Because the measurement locations were based on a systematic square grid with a random start point, the N=40 design led to a survey unit map with 42 locations which are illustrated on map FR0200-7b (Attachment 1). Direct measurements (soil samples) were collected from required locations and analyzed with laboratory gamma spectroscopy instrumentation.

In accordance with the LTP, scans covering 100% of the 1890 m² area were required for the Class 1 survey unit. This was accomplished by use of an *in situ* gamma spectroscopy detector (ISOCS) configured at a 3-meter distance from the surface to obtain overlapping 28-m² fields of view for the 108 shots. The ISOCS detector was positioned perpendicular to the surface. Locations of the 108 survey scans are shown on maps FR0200-7a and 7c (Attachment 1).

The ISOCS scans were configured to ensure 100% scan coverage of all exposed surfaces within Survey Unit 7. The survey instruments used are listed by model and serial number in Attachment 2 (Table 2-1). Scan MDCs are also listed in Attachment 2 (Table 2-2) and are compared to the DCGL, the investigation level, and the DCGL_{EMC}. The scan MDC is less than the scan investigation level, thus providing high confidence (95% or higher) that an elevated area would be detected in the scanning process. Furthermore, since the investigation level was always less than the design DCGL_{EMC}, no EMC sample size adjustment was necessary.

TABLE 1
SURVEY UNIT DESIGN PARAMETERS

Survey Unit	Design Criteria	Basis
Area	1890 m ²	Class 1, < 2,000 m ²
Number of Direct Measurements Required	18 (40 used for design)	Based on an LBGR of 2.1 pCi/g, sigma ¹ of 1.33 pCi/g and a relative shift of 1.5, 18 were required, 42 obtained. Type I = Type II = 0.05
Sample Area	47 m ²	1890 m ² / 40 = 47 m ²
Sample Grid Spacing	6.8 m	(47) ^{1/2}
Scan Grid Area	ISOCS scan at 3 meters	See Section B
Area Factor	1.5	Class 1 Area, LTP Table 6-12
Scan Area	1890 m ²	Class 1 Area – 100%
Scan Investigation Level	1.0 pCi/g Cs-137 0.36 pCi/g Co-60	ISOCS investigation levels (Reference 3)
DCGL	4.2 pCi/g Cs-137 1.52 pCi/g Co-60	DCGL applied to land outside the Restricted Area (Reference 1)
Design DCGL _{EMC}	6.4 pCi/g Cs-137 2.3 pCi/g Co-60	DCGL x Area Factor for Class 1 survey unit, per LTP Section 5.6.3

C. SURVEY RESULTS

A total of 42 direct measurements were performed in Survey Unit 7. Six samples contained detectable Cs-137 with levels of activity greater than the MDA but below the DCGL. Three samples contained detectable Co-60 activity above the MDA but below the DCGL. All other measurements were below the MDA. The results are presented in Table 2. No investigations were necessary as a result of the direct measurements.

ISOCS gamma scans were performed at 108 locations using an investigation level of 1.0 pCi/g Cs-137 and 0.36 pCi/g Co-60. The gamma scans were performed for a sufficient count time to achieve a Minimum Detectable Activity (MDA) of approximately 16% of the DCGL. All identified scan activity levels and MDAs were below the investigation levels. Therefore, no investigation surveys were performed as a result of the scan surveys.

¹ LTP Revision 4, Table 5-1C for RCA Yard West, R0100 (conservative).

TABLE 2
DIRECT MEASUREMENTS

Sample Number	Cs-137 (pCi/g)	Uncertainty (pCi/g)	Co-60 (pCi/g)	Uncertainty (pCi/g)	Unitized Value
FR0200071S001	< 6.57E-02		< 6.00E-02		5.51E-02
FR0200071S002	< 3.93E-02		< 4.70E-02		4.03E-02
FR0200071S003	< 4.61E-02		< 5.11E-02		4.46E-02
FR0200071S004	< 5.85E-02		< 7.41E-02		6.27E-02
FR0200071S005	< 4.08E-02		< 4.42E-02		3.88E-02
FR0200071S006	< 5.60E-02		< 5.93E-02		5.23E-02
FR0200071S007	< 4.25E-02		< 4.13E-02		3.73E-02
FR0200071S008	< 5.16E-02		< 5.37E-02		4.76E-02
FR0200071S009	< 4.64E-02		< 5.07E-02		4.44E-02
FR0200071S010	< 4.57E-02		< 5.18E-02		4.50E-02
FR0200071S011	< 4.29E-02		< 4.64E-02		4.07E-02
FR0200071S012	9.40E-02	3.27E-02	< 5.63E-02		5.94E-02
FR0200071S013	< 4.35E-02		< 5.75E-02		4.82E-02
FR0200071S014	8.56E-02	3.08E-02	< 7.56E-02		7.01E-02
FR0200071S015	< 4.26E-02		< 4.74E-02		4.13E-02
FR0200071S016	< 4.68E-02		< 5.01E-02		4.41E-02
FR0200071S017	< 4.50E-02		< 5.25E-02		4.53E-02
FR0200071S018	9.62E-02	2.58E-02	< 6.36E-02		6.47E-02
FR0200071S019	< 4.71E-02		< 5.65E-02		4.84E-02
FR0200071S020	9.75E-02	2.99E-02	1.34E-01	3.35E-02	1.11E-01
FR0200071S021	< 5.82E-02		< 5.71E-02		5.14E-02
FR0200071S022	< 4.46E-02		< 4.84E-02		4.25E-02
FR0200071S023	< 4.35E-02		< 5.20E-02		4.46E-02
FR0200071S024	< 4.86E-02		< 5.78E-02		4.96E-02
FR0200071S025	< 5.97E-02		< 6.12E-02		5.45E-02
FR0200071S026	< 4.62E-02		< 4.50E-02		4.06E-02
FR0200071S027	< 4.77E-02		< 5.53E-02		4.77E-02
FR0200071S028	< 4.10E-02		< 3.93E-02		3.56E-02
FR0200071S029	< 6.21E-02		< 6.80E-02		5.95E-02
FR0200071S030	1.06E-01	3.45E-02	2.20E-01	3.44E-02	1.70E-01
FR0200071S031	2.29E-01	4.23E-02	4.00E-01	4.08E-02	3.18E-01
FR0200071S032	< 4.08E-02		< 5.29E-02		4.45E-02
FR0200071S033	< 4.70E-02		< 5.09E-02		4.47E-02
FR0200071S034	< 3.96E-02		< 4.32E-02		3.78E-02
FR0200071S035	< 4.74E-02		< 5.26E-02		4.59E-02
FR0200071S036	< 4.47E-02		< 4.45E-02		3.99E-02
FR0200071S037	< 6.77E-02		< 6.44E-02		5.85E-02
FR0200071S038	< 4.49E-02		< 4.99E-02		4.35E-02
FR0200071S039	< 4.05E-02		< 4.55E-02		3.96E-02
FR0200071S040	< 5.00E-02		< 5.77E-02		4.99E-02
FR0200071S041	< 4.44E-02		< 4.57E-02		4.06E-02
FR0200071S042	< 4.81E-02		< 5.65E-02		4.86E-02
Mean	5.80E-02		6.76E-02		5.83E-02
Median	4.69E-02		5.28E-02		4.56E-02
Standard Deviation	3.21E-02		6.02E-02		4.68E-02
Range	3.93E-02 to 2.29E-01		3.93E-02 to 4.00E-01		3.56E-02 to 3.18E-01

“<” indicates MDA value. Bold indicates positive detection value

D. SURVEY UNIT INVESTIGATIONS PERFORMED AND RESULTS

Based on the scan results, no investigations were required.

E. SURVEY UNIT DATA ASSESSMENT

An analysis of the direct sample measurement results, including the mean, median, standard deviation and sample result range, is provided in Table 2. Positively detected values are bolded in the table. Of the 42 soil samples collected, six identified Cs-137 activity below the DCGL value of 4.2 pCi/g and three samples identified Co-60 activity below the DCGL value of 1.52 pCi/g. All other values were below the MDA. Identified sample activities or Minimum Detectable Activities are listed in Table 2. The mean and median activities were less than the DCGLs for Cs-137 and Co-60. The average of the unity measurements was 0.058 indicating that the direct measurements averaged 5.8% of the DCGL limit.

For illustrative purposes, as indicated in LTP Section 5.9.3, a simplified general retrospective dose estimate can be calculated from the average residual contamination level by subtracting the mean fallout Cs-137 value (0.19 pCi/g)² for disturbed soil from the survey unit sample mean activity (0.058 pCi/g). This would equate to an annual dose rate of 0.0 mrem/year. Taking into account the average residual contamination for Co-60, the annual dose rate would equate to 0.45 mrem/yr³. Also, for purposes of demonstrating compliance with the radiological criteria for license termination and the enhanced State of Maine criteria, background activity was not subtracted from the sample analysis activity values.

F. ADDITIONAL DATA EVALUATION

Attachment 4 provides additional data evaluation associated with this Survey Unit, including relevant statistical information. Based on survey unit direct measurement data, this attachment provides the Sign Test Summary, Quantile Plot, Histogram, and Retrospective Power Curve.

1. The Sign Test Summary provides an overall summary of design input (Table 1) and resulting calculated values used to determine the required number (N) of direct measurements (per LTP Section 5.4.2). The Sign Test Summary is a separate statistical analysis that also calculates the mean, median, and standard deviation of the direct measurements.

The critical value and the result of the Sign Test are provided in the Sign Test Summary table, as well as a listing of the key release criteria. The direct measurements clearly pass the Sign Test. The subject release criteria have been satisfied. In addition, the sample standard deviation is smaller than the design sigma; therefore, no additional samples were required.

² See Attachment E to Maine Yankee Procedure PMP 6.7.8 (Reference 2).

³ This annual dose is based on LTP Section 6.7, which shows the contaminated soil contribution (for soils contaminated at the DCGL) to be 10 mrem/y. Therefore, the annual Co-60 dose rate (using the Co-60 DCGL of 1.52 pCi/g outside the RA and the mean Co-60 direct activity value of 0.068 pCi/g) would equate

$$\text{to } \text{Annual Dose Rate} = 10 \times \left(\frac{0.068}{1.52} \right) = 0.45 \text{ mrem / y.}$$

2. The Quantile Plot was generated from the unity data listed in Table 2. The data set and plot are consistent with expectations for a Class 1 survey unit. All of the measurements are below the DCGLs of 4.2 pCi/g (Cs-137) and 1.52 pCi/g (Co-60) for land outside the restricted area.
3. A Histogram Plot was also developed. This plot shows a log-normal distribution with one outlier.
4. A Retrospective Power Curve was constructed, based on FSS results. The curve shows that this survey unit having a mean residual activity at a small fraction of the DCGL has a high probability (“power”) of meeting the release criteria. Thus, it can be concluded that the direct measurement data support rejection of the null hypothesis, providing high confidence that the survey unit satisfied the release criteria and that the data quality objectives were met.

G. CHANGES IN INITIAL SURVEY UNIT ASSUMPTIONS ON EXTENT OF RESIDUAL ACTIVITY

The survey was designed as a Class 1 land survey area; the FSS results were consistent with that classification. The direct measurement sample standard deviation was less than the design sigma. Thus, a sufficient number of sample measurements were taken and no additional measurements were required.

H. LTP CHANGES SUBSEQUENT TO SURVEY UNIT FSS

The FSS of Survey Unit 7 was designed, performed, and evaluated in the June 2005 time frame. The design was performed to the criteria of the LTP Revision 4 (Reference 1). No subsequent LTP changes with potential impact to this survey unit need to be evaluated.

I. CONCLUSION

The FSS of this survey unit was designed based on the designation as a Class 1 area. The survey design parameters are presented in Table 1. The required number of direct measurements was determined for the Sign Test in accordance with the LTP. As presented in Table 2, all direct measurements were less than the DCGLs of 4.2 pCi/g Cs-137 and 1.52 pCi/g Co-60. There were no investigations.

A Sign Test Summary analysis demonstrated that the Sign Test criteria were satisfied. The direct measurement sigma was determined to be less than that used for design, thus indicating that a sufficient number of samples was taken.

The Retrospective Power Curve shown in Attachment 4 confirmed that sufficient samples were taken to support rejection of the null hypothesis, providing high confidence that the survey unit satisfied the release criteria and the data quality objectives were met. Attachment 4 also revealed that direct measurement data represented essentially a log-normal distribution with one outlier.

The scan survey design for this survey unit was developed in accordance with the LTP Revision 4 (Reference 1) with significant aspects of the design discussed in Section B and Table 1. ISOCS scans performed in a systematic grid pattern throughout the survey unit did not identify activity above the scan investigation levels of 1.0 pCi/g Cs-137 and 0.36 pCi/g Co-60. Therefore, no investigations were required as a result of the scan process.

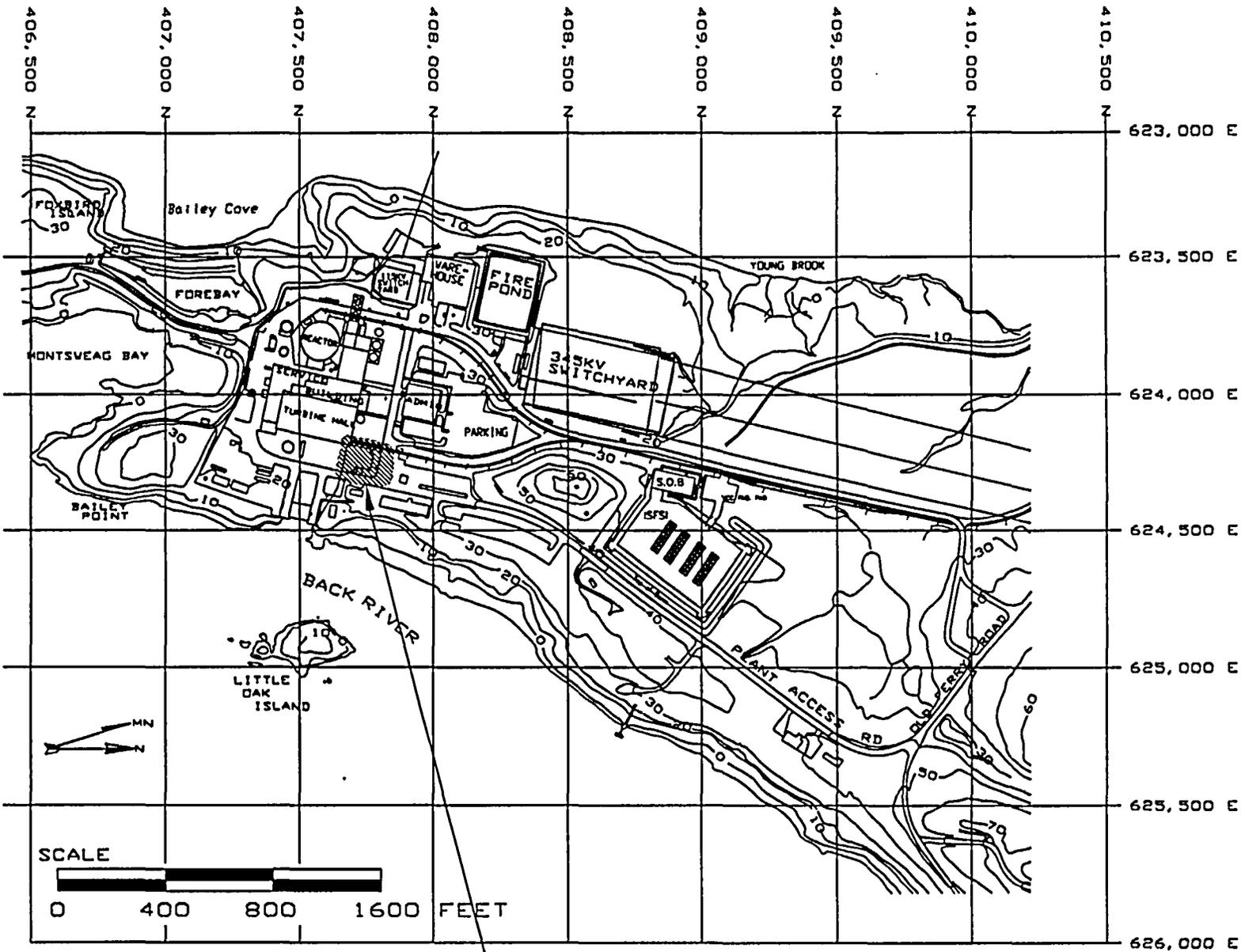
It is concluded that FR-0200 Survey Unit 7 meets the release criteria of 10CFR20.1402 and the State of Maine enhanced criteria.

J. REFERENCES

1. Maine Yankee License Termination Plan, Revision 4, February 28, 2005 provided by Maine Yankee letter to the NRC, MN-05-010
2. Maine Yankee Procedure PMP 6.7.8, FSS Data Processing and Reporting, Attachment E, Approach for Dealing With Background Radioactivity for Maine Yankee Final Status Surveys
3. Maine Yankee Calculation No. EC-003-04, Use of Canberra In Situ Object Counting System (ISOCS) for FSS Surveys

Attachment 1
Survey Unit Maps

Survey Type: Characterization Turnover Final Status Survey Survey Area Name: Yard East

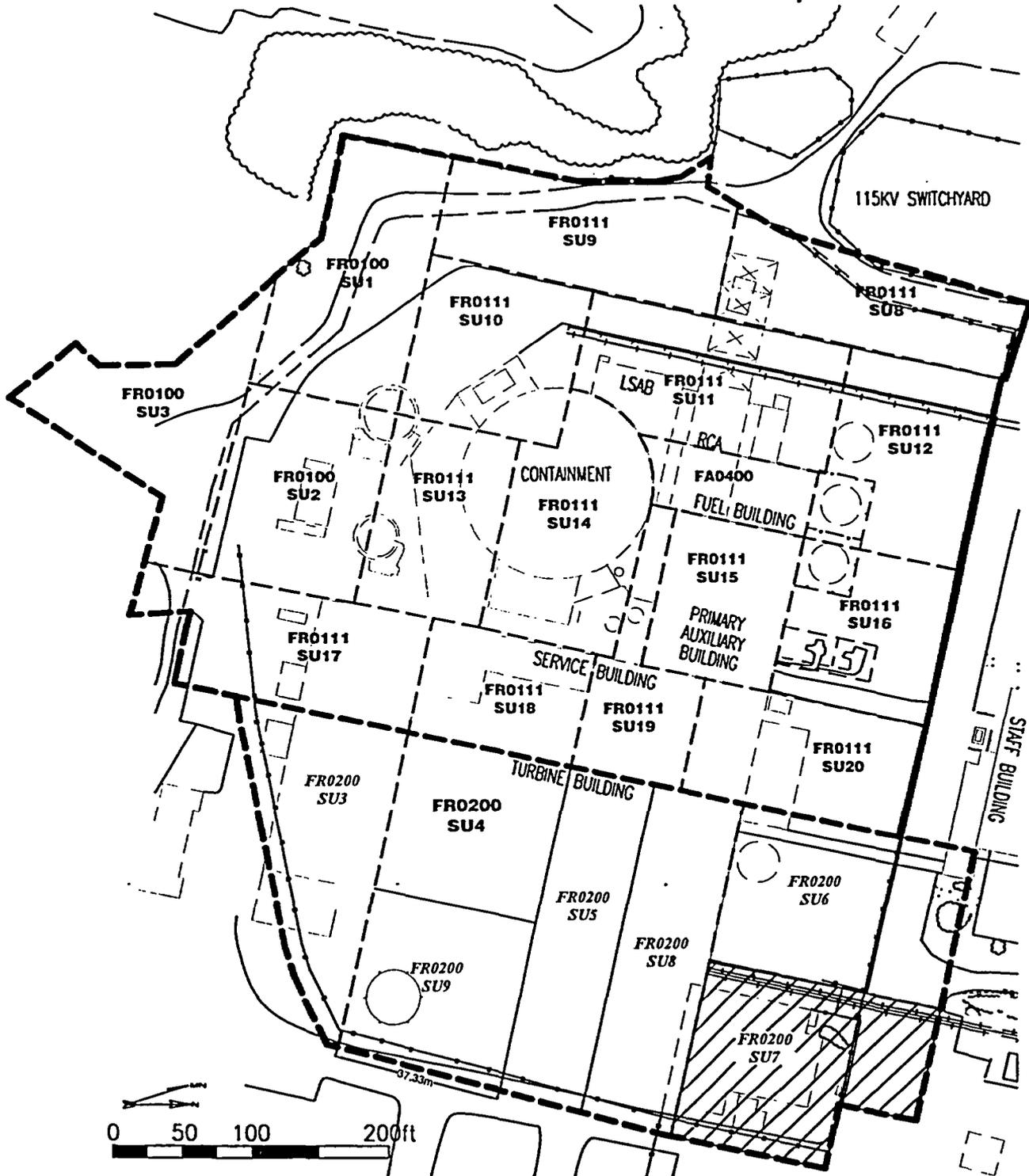


FR0200 SU7

Note: Grid based on Maine State Coordinate System
(West Zone) NAD 1927

Survey Type: Characterization Turnover Final Status Survey | Survey Area Name: Yard East

Final Status Survey FR0200 SU7 Reference Map



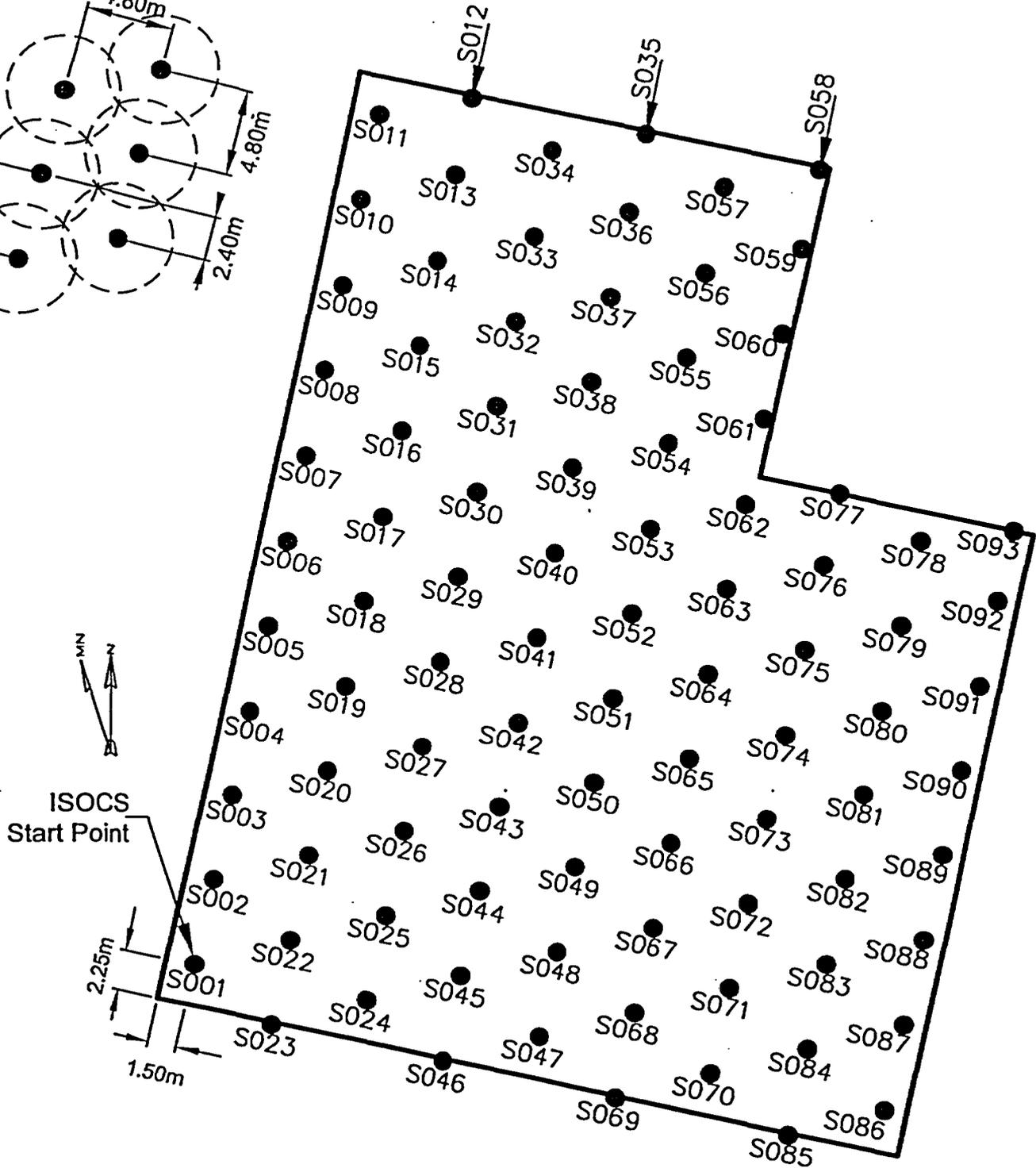
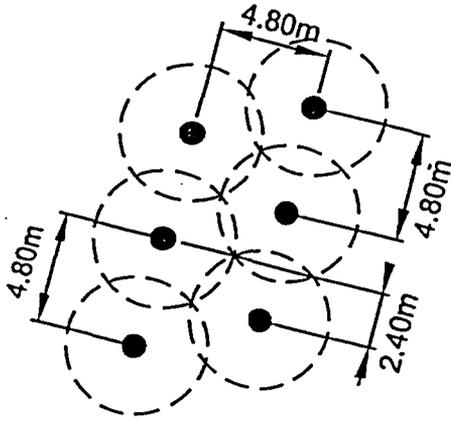
Survey Type: Characterization Turnover Final Status Survey

Survey Area Name: RCA Yard East Soils

Final Status Survey

FR0200 SU7: RCA Yard East Soils

ISOCS Scans S001 - S093

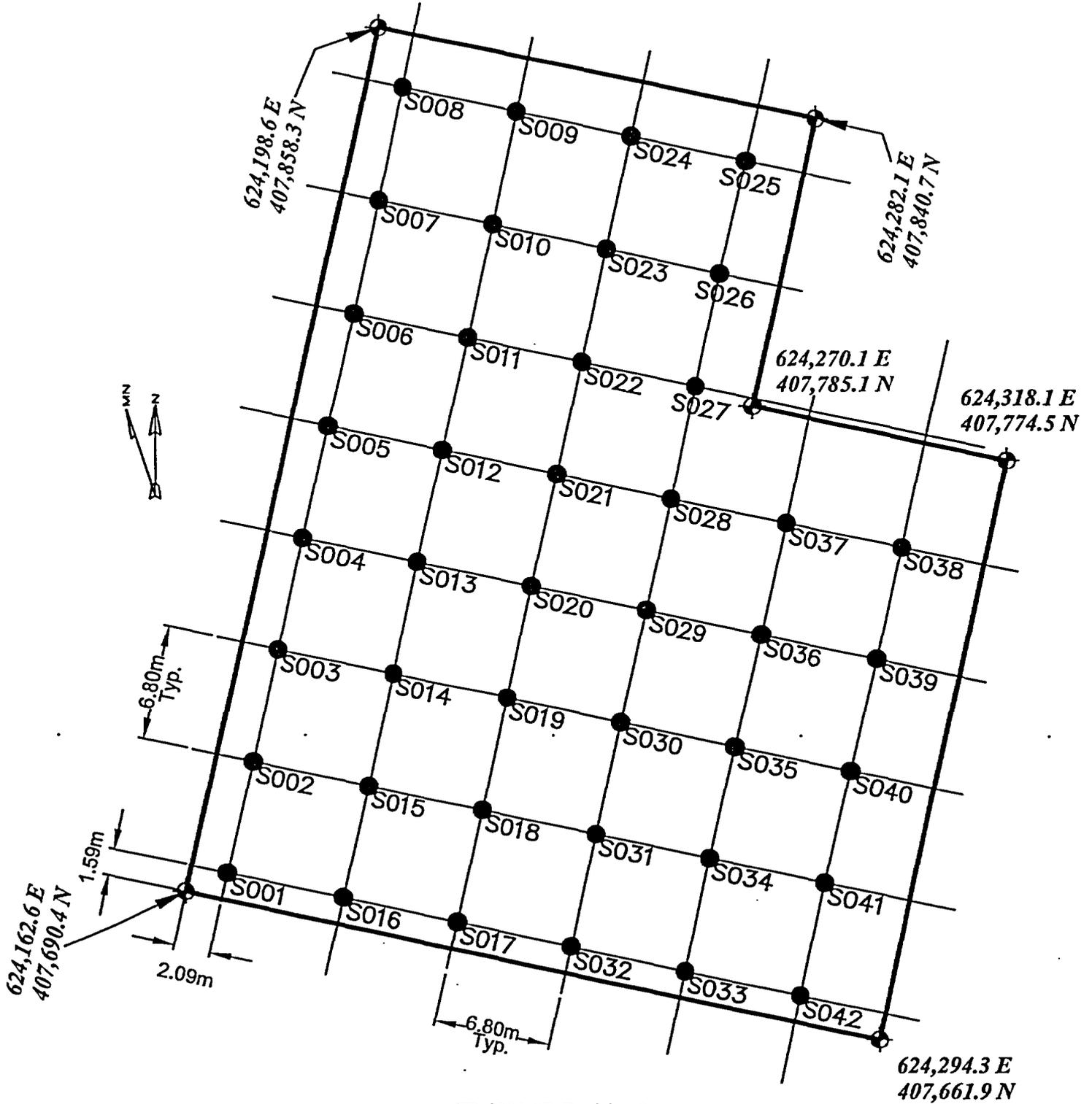


Survey Type: Characterization Turnover Final Status Survey Survey Area Name: RCA Yard East Soils

Final Status Survey

FR0200 SU7: RCA Yard East Soils

Direct Points S001 - S042



Surface Area = 1890 sq-m
N = 40 L = 6.8m

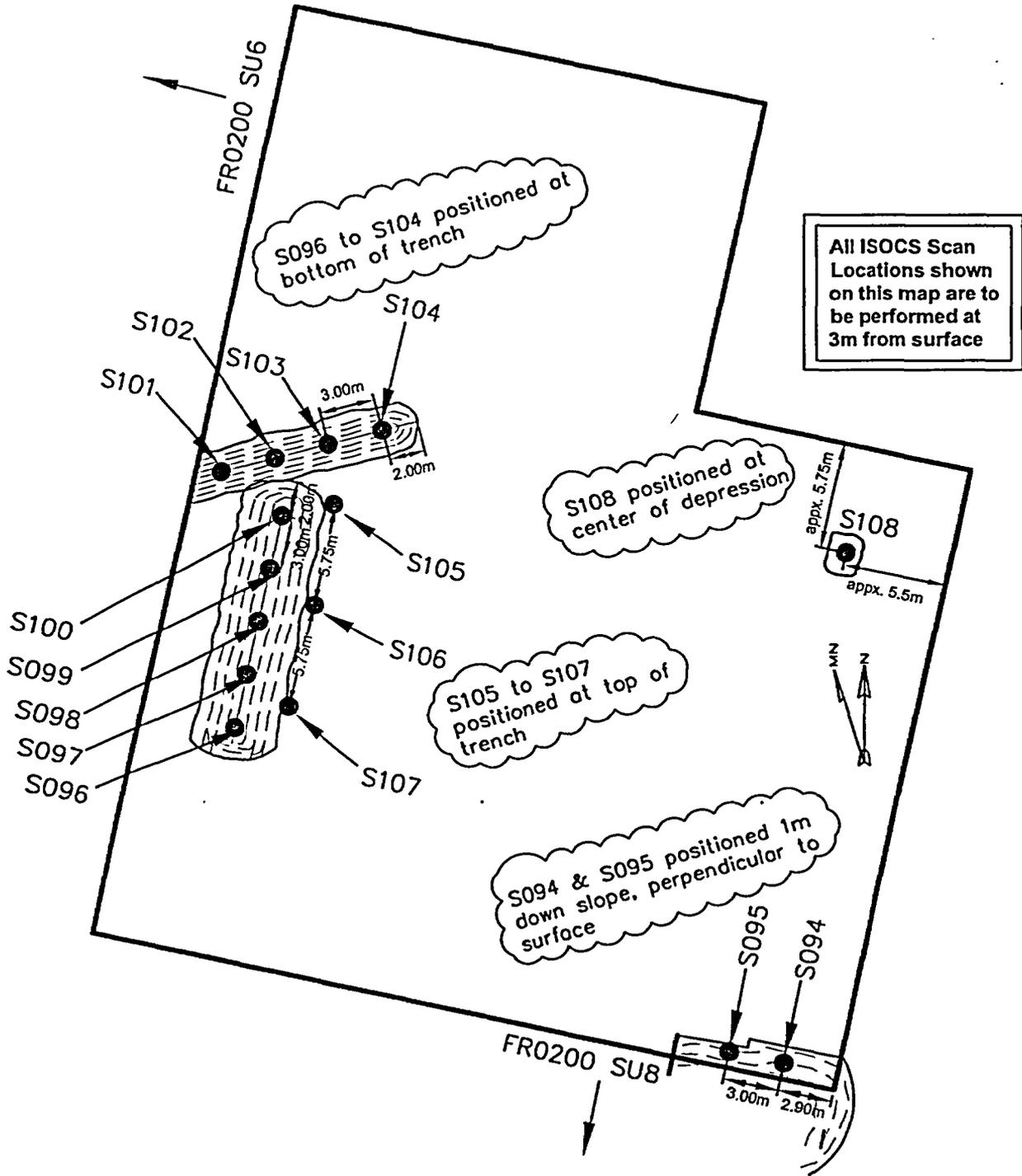
Survey Type: Characterization Turnover Final Status Survey

Survey Area Name: RCA Yard East Soils

Final Status Survey

FR0200 SU7: RCA Yard East Soils

ISOCS Trench Scans S094 - S108



Attachment 2
Survey Unit Instrumentation

TABLE 2-1

INSTRUMENT INFORMATION

ISOCS Detectors (Field Measurements)

Detector No.	MDC (pCi/g)
7605	0.17 to 0.33
7607	0.12 to 0.33
7722	0.11 to 0.32

HPGe Detectors (Laboratory Analysis)

Detector No.	MDC (pCi/g)
FSS1	0.04 to 0.08
FSS2	0.03 to 0.06

TABLE 2-2

**INSTRUMENT SCAN MDC, DCGL,
INVESTIGATION LEVEL AND DCGL_{EMC}**

Parameter	Instrument: ISOCS	Comments
Scan MDC	0.20 to 0.33 pCi/g Cs-137 0.11 to 0.24 pCi/g Co-60	~ 16% DCGL
DCGL	4.2 pCi/g Cs-137 1.52 pCi/g Co-60	Approved DCGL for land areas outside the Restricted Area (Reference 1)
Investigation Level (ISOCS @ 3 m)	1.0 pCi/g Cs-137 0.36 pCi/g Co-60	(Reference 3)
Design DCGL _{EMC}	6.4 pCi/g Cs-137 2.3 pCi/g Co-60	DCGL x Area Factor for Class 1 survey unit, per LTP Section 5.6.3

Attachment 3

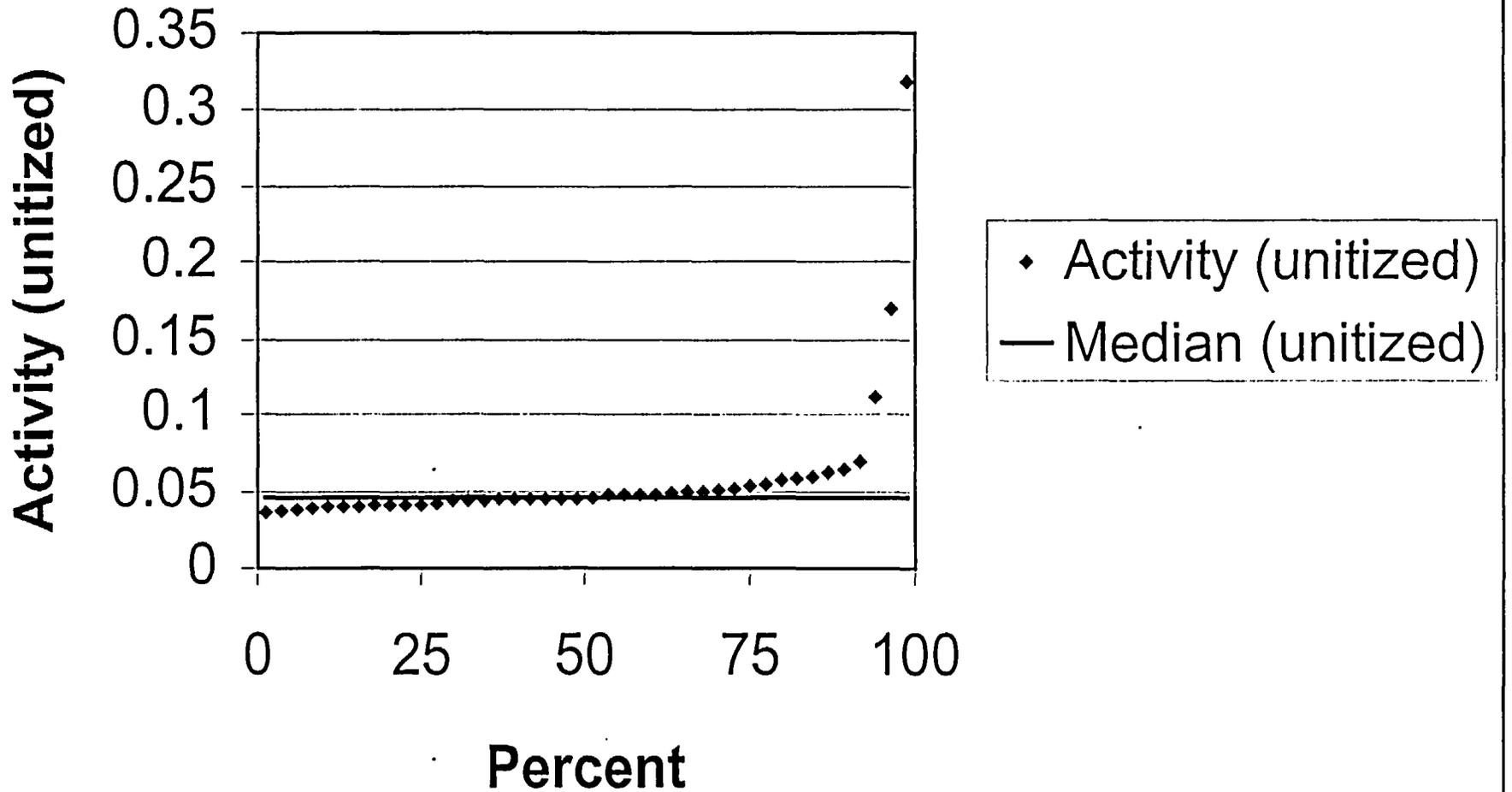
Investigation Table
(No Investigations Required)

Attachment 4
Statistical Data

Survey Package FR0200 Unit 7 UNITY Soil Sign Test Summary

Evaluation Input Values		Comments
Survey Package:	FR0200	
Survey Unit:	07	
Evaluator:	Andy Olsen	
DCGL _w :	1.00E+00	Unity
DCGL _{emc} :	1.50E+00	AF = 1.5
LBGR:	5.00E-01	
Sigma:	3.17E-01	(1.33 pCi/g /4.2 pCi/g)
Type I error:	0.05	
Type II error:	0.05	
Nuclide:	UNITY	
Soil Type:	N/A	
Calculated Values		Comments
Z _{1-α} :	1.645	
Z _{1-β} :	1.645	
Sign p:	0.933193	
Calculated Relative Shift:	1.5	
Relative Shift Used:	1.5	Uses 3.0 if Relative Shift is >3
N-Value:	15	
N-Value+20%:	18	
Sample Data Values		Comments
Number of Samples:	42	
Median:	4.56E-02	
Mean:	5.83E-02	
Net Sample Standard Deviation:	4.68E-02	
Total Standard Deviation:	4.68E-02	Sum of samples and reference
Maximum:	3.18E-01	
Sign Test Results		Comments
Adjusted N Value:	42	
S+ Value:	42	
Critical Value:	26	
Sign test results:	Pass	
Criteria Satisfaction		Comments
Sufficient samples collected:	Pass	
Maximum value <DCGL _w :	Pass	
Median value <DCGL _w :	Pass	
Mean value <DCGL _w :	Pass	
Maximum value <DCGL _{emc} :	Pass	
Total Standard Deviation <=Sigma:	Pass	
Criteria comparison results:	Pass	
Final Status		Comments
The survey unit passes all conditions:	Pass	Survey Unit Passes

FR0200 SU-7 Quantile Plot



One-Sample T-Test Report

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Database

Variable C2

Plots Section

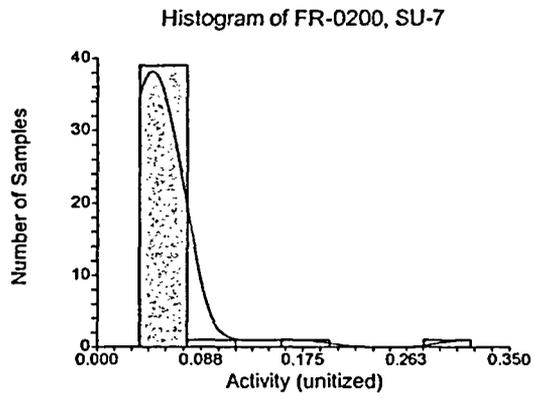


Chart Section

