
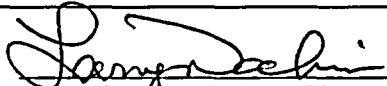

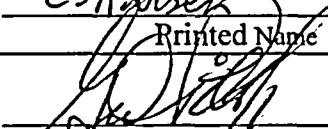



**MAINE YANKEE
FINAL STATUS SURVEY RELEASE RECORD
FR-2900 ROADS / RAILROAD
SURVEY UNIT 3**

Prepared By:	 _____ FSS Engineer - Signature <u>G. Madison</u> _____ Printed Name	Date: <u>JUN 09 2005</u>
Reviewed By:	 _____ FSS Specialist - Signature <u>Larry Dockins</u> _____ Printed Name	Date: <u>6/9/05</u>
Reviewed By:	 _____ Independent Review - Signature <u>C. A. Olsen</u> _____ Printed Name	Date: <u>11. June, 2005</u>
Approved By:	 _____ Superintendent FSS - Signature <u>George Pillsbury</u> _____ Printed Name	Date: <u>6/15/05</u>
Approved By:	 _____ FSS, MOP - Signature <u>JAMES R. PACKER</u> _____ Printed Name	Date: <u>6/15/05</u>

**MAINE YANKEE
FINAL STATUS SURVEY RELEASE RECORD
FR-2900 ROADS / RAILROAD
SURVEY UNIT 3**

A. SURVEY UNIT DESCRIPTION

Survey Unit 3 is located in Survey Area FR-2900, the footprint of the remaining site railroads and beds, and includes railroads from Gate 2 (Protected Area) to Old Ferry Road, with the exclusion of almost 200 meters of rails within the ISFSI boundary. As shown on map FR2900-3Site (Attachment 1), the railroads are located North of the Protected Area and the survey area is approximately centered at coordinates 409,750 N and 624,400 E using the Maine State Coordinate System (West Zone) NAD 1927.

The rails served as the shipping route for a majority of the site's decommissioning activities. As a result, radioactive materials generated in the Restricted Area were routinely transferred along the route. Post FSS use of the rails included the movement of material from the expanded Restricted Area (Gate 2) to the ISFSI soil/debris pile staging area for future railcar loading operations for offsite transfer/disposal. The 6,370 m² survey design area encompassed a survey unit width of 6 meters centered on the rails.

The rails are shown in relation to other major site structures in map FR2900-3Site. All maps referenced in this release record are provided in Attachment 1 unless otherwise noted. Due to a Maine Yankee commitment, *in situ* gamma re-scans were performed on 13 selected grid locations inside adjacent FR-1800 Survey Units 1 and 2. This area was not included in the original survey design area calculation. As a result, an additional 2,125 m² of soils received gamma re-scans outside of the original survey design.

B. SURVEY UNIT DESIGN INFORMATION

The area was designated a Class 3 land survey unit per the LTP (Table 5-1C, R2900, Roads/Rails Final Verification). There was no remediation of the rail bed surfaces performed prior to the Final Status Survey; however, a small portion of pavement surface was removed (between the rails and immediately adjacent on either side) where the west access road crosses the tracks north of the ISFSI prior to FSS.

The survey unit design parameters are shown in Table 1. Given an adjusted relative shift of 3.0, 14 direct measurements were required for the Sign Test. Fourteen direct measurements were actually performed. The 14 direct measurements (soil samples) collected from the required locations were analyzed by laboratory gamma spectroscopy instrumentation. Measurement locations were randomly determined and are illustrated on maps FR2900-3 DP REF and FR2900-3a through FR2900-3c.

Additionally, 13 (biased) sediment samples were obtained in areas with higher contamination potential at low points of trenches/ditches where water existed based on professional judgment. The biased sediment samples provide additional confidence that no areas of elevated activity were present that could not be reliably detected using the scan process. Biased sediment sample locations S016-S028 are illustrated on maps FR2900-3d through FR2900-3f and FR2900-3h through FR2900-3j.

Process history indicated that water leaking from railcars could have impacted the survey unit. The scan survey was designed with the assumption that the highest potential for plant-derived materials existed near the center of the railroad tracks. Thus for optimum efficiency for detecting plant-derived materials, the ISOCS detector was centered over the railroad tracks. The scan requirement for a Class 3 area is 1-10% coverage, but 100% of FR-2900 Survey Unit 3 was scanned although a small percentage of the area was covered with water. The scan survey design included 200 overlapping scans, each of approximately 78.5 m² area. The scan locations are shown on maps FR2900-3 REF and FR2900-3d through FR2900-3m. The High Purity Germanium (HPGe) In Situ Object Characterization System (ISOCS) scan investigation level was conservatively set at approximately 25% of the DCGL, as shown in Table 2-2 (Attachment 2). The survey design called for an open collimation configuration which allows a broader field of view (10 meter diameter), and better efficiency for detection of an elevated area since the detector face was positioned 1 meter perpendicular from the surface centered between the tracks. The survey design also called for investigation of any verified positive detection of Co-60 greater than the MDA.

The instruments used in this survey 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 and the investigation level. As shown in this table, the scan MDC is less than the scan investigation level in all cases, thus providing high confidence (95% or higher) that an elevated area would be detected in the scanning process.

TABLE 1
SURVEY UNIT DESIGN PARAMETERS

Survey Unit	Design Criteria	Basis
Area	6,370 m ²	Class 3 Unlimited
Number of Direct Measurements Required	14	Based on an adjusted LBGR of 3.5 pCi/g, Cs-137 sigma ¹ of 0.23 pCi/g and a relative shift of 3.0. Type I = Type II = 0.05
Sample Area	NA	Class 3 Area
Sample Grid Spacing	NA	Class 3 Area
Scan Grid Area	ISOCS scan at 1 meter height for 78.5 m ² field of view	See Section B
Area Factor	NA	Only required for Class 1 areas
Scan Survey Area	6,370 m ²	Class 3 – 1-10%
Scan Investigation Level	0.36 pCi/g Co-60 1.0 pCi/g Cs-137	EC 003-004 (Reference 3)
DCGL	1.52 pCi/g Co-60 4.2 pCi/g Cs-137	LTP, Rev. 4 Section 6-7 for Land Areas outside the RA
DCGL _{EMC}	NA	Class 3 Area

¹ Design sigma is based on characterization data, listed in LTP Table 5-1C Bailey House Land Area, R1800, (LTP, Rev. 4).

C. SURVEY RESULTS

Fourteen direct measurements were made in Survey Unit 3. All direct measurements were less than 50% of the DCGL, therefore, no investigations were required as a result of the direct measurements. The resulting data are presented in Table 2 below. All direct measurement results were less than MDA for Co-60 and Cs-137.

Additionally, 13 biased sediment samples were performed in low-lying areas (trenches or ditches where water could not be completely removed) to provide high confidence that small pockets of activity were not present exceeding the investigation levels. All sediment sample results were less than 50% of the DCGL, therefore, no investigations were required as a result of the biased samples. Of the biased sediment samples obtained, only two samples identified Cs-137 greater than MDA with a maximum value of 0.145 pCi/g. All other sediment sample results were less than MDA for Co-60 and Cs-137. No Co-60 was identified in any biased sample.

ISOCS Scans were performed at 200 locations using investigation levels of 0.36 pCi/g Co-60 and 1.0 pCi/g Cs-137. The gamma scans were designed for an MDA of approximately 10% of the DCGL. The survey design also specified investigation of any scan location with positive Co-60 activity identified greater than MDA. Since all the measurement results were less than the investigation levels, no investigations were required as a result of the scans. Of the 200 scans obtained, only one location positively identified Cs-137 at 2% of the DCGL. No Co-60 was identified for any scan location.

TABLE 2
DIRECT MEASUREMENTS

Sample Location	Cs-137 pCi/g	
FR2900-03-3-S001-VS	<	5.80E-02
FR2900-03-3-S002-VS	<	6.00E-02
FR2900-03-3-S003-VS	<	6.34E-02
FR2900-03-3-S004-VS	<	5.57E-02
FR2900-03-3-S005-VS	<	5.35E-02
FR2900-03-3-S006-VS	<	5.62E-02
FR2900-03-3-S007-VS	<	5.04E-02
FR2900-03-3-S008-VS	<	5.90E-02
FR2900-03-3-S009-VS	<	5.17E-02
FR2900-03-3-S010-VS	<	4.08E-02
FR2900-03-3-S011-VS	<	4.93E-02
FR2900-03-3-S012-VS	<	5.59E-02
FR2900-03-3-S013-VS	<	5.22E-02
FR2900-03-3-S014-VS	<	5.47E-02
Mean	5.43E-02	
Median	5.52E-02	
Standard Deviation	5.50E-03	
Sample Range	4.08E-02 to 6.34E-02	

“<” indicates MDA value. No Co-60 was detected above MDA.

D. SURVEY UNIT INVESTIGATIONS PERFORMED AND RESULTS

Since all direct sample results were less than 50% of the DCGL, no investigations were required. 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, are provided in Table 2. All direct measurement results were below the DCGL. No Cs-137 or Co-60 above MDA was identified in any of the 14 direct samples.

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 $(0.19 \text{ pCi/g})^2$ for disturbed soil from the survey unit sample mean activity (0.05 pCi/g) . The result is a net value of -0.14 pCi/g . This would equate to an annual dose rate of 0.0 mrem/y . However, for purposes of demonstrating compliance with the radiological criteria for license termination and the enhanced State criteria, background activity was not subtracted from the soil sample analysis activity values.

F. ADDITIONAL DATA EVALUATION

Attachment 4 provides additional data evaluation associated with Survey Unit 3, 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. As is shown in the table, all of the key release criteria were clearly satisfied for the FSS of this survey unit.

2. The Quantile Plot was generated from direct measurement data listed in Table 2 and indicates general symmetry about the median. The data set and plot are consistent with expectations for a Class 3 survey unit. There is no reason to conclude that the data set represents other than random variations in a Class 3 surface survey unit.

² See Attachment E to Maine Yankee Procedure PMP 6.7.8 (Reference 4)

3. A Histogram Plot was also developed based on the direct measurement values. This plot shows that the direct data were essentially a log normal distribution.
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 3 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.

H. LTP CHANGES SUBSEQUENT TO SURVEY UNIT FSS

The FSS of Survey Unit 3 was designed, performed, and evaluated in the April 2005-June 2005 time frame using 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 LTP designation as a Class 3 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 DCGL of 4.2 pCi/g Cs-137.

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 variance consistent with expectations for a Class 3 survey unit.

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 at a height of 1 meter in a systematic grid pattern throughout the survey unit failed to identify any areas exceeding the scan investigation levels of 0.36 pCi/g Co-60 and 1.0 pCi/g Cs-137; therefore, no investigations were required.

It is concluded that FR-2900 Survey Unit 3 meets the release criteria of 10CFR20.1402 and the State of Maine enhanced criteria.

J. REFERENCES

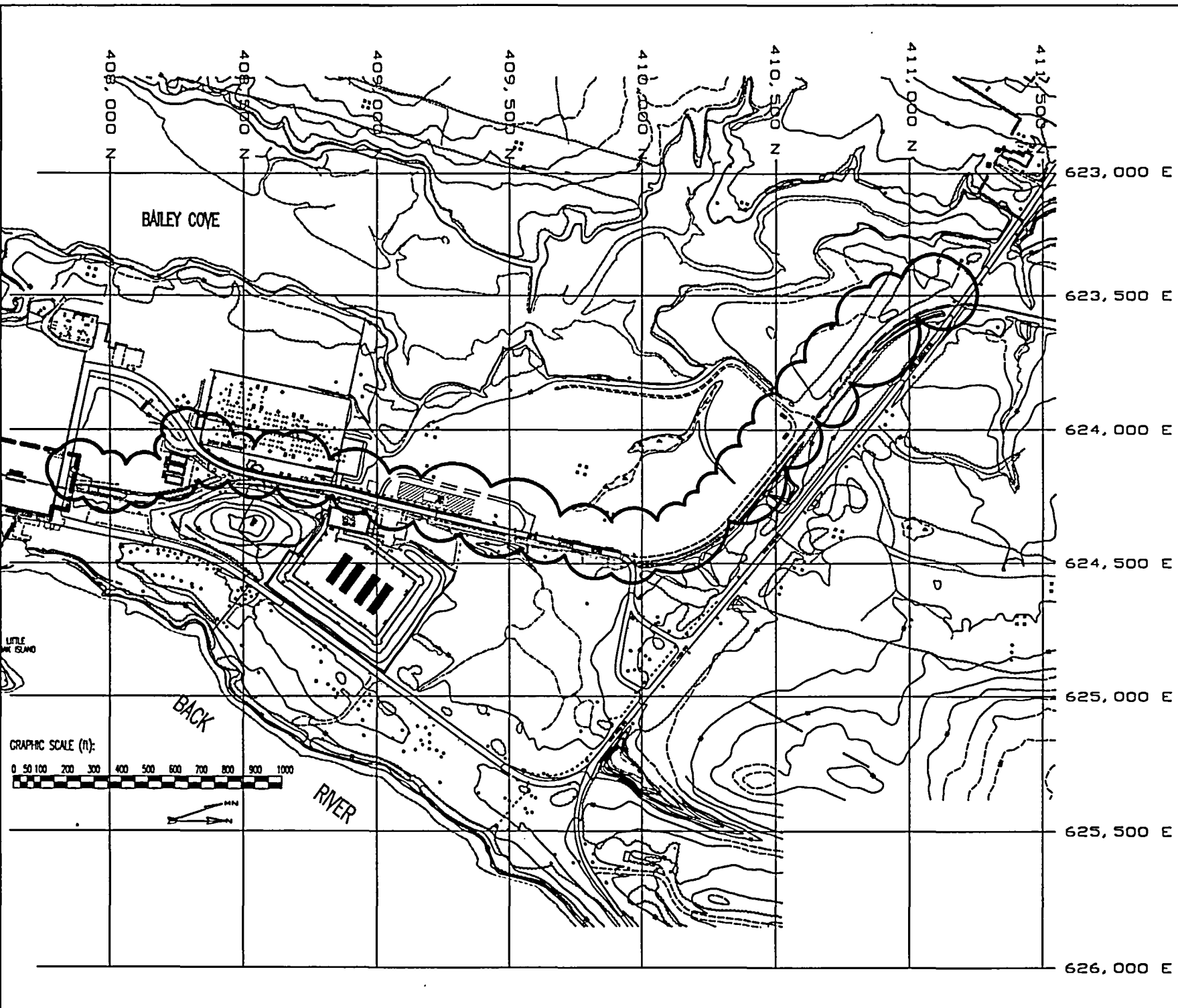
1. Maine Yankee License Termination Plan, Revision 4, February 28, 2005
2. Form 11 of Maine Yankee Procedure PMP 6.7.4, FSS Survey Unit and Release Record Reconciliation Form for FR 1800 Survey Units 1 and 2, completed April 27, 2004
3. Maine Yankee Calculation No. EC-003-04, Use of Canberra In Situ Object Counting System (ISOCS) for FSS Surveys
4. 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.

Attachment 1

Survey Unit Maps

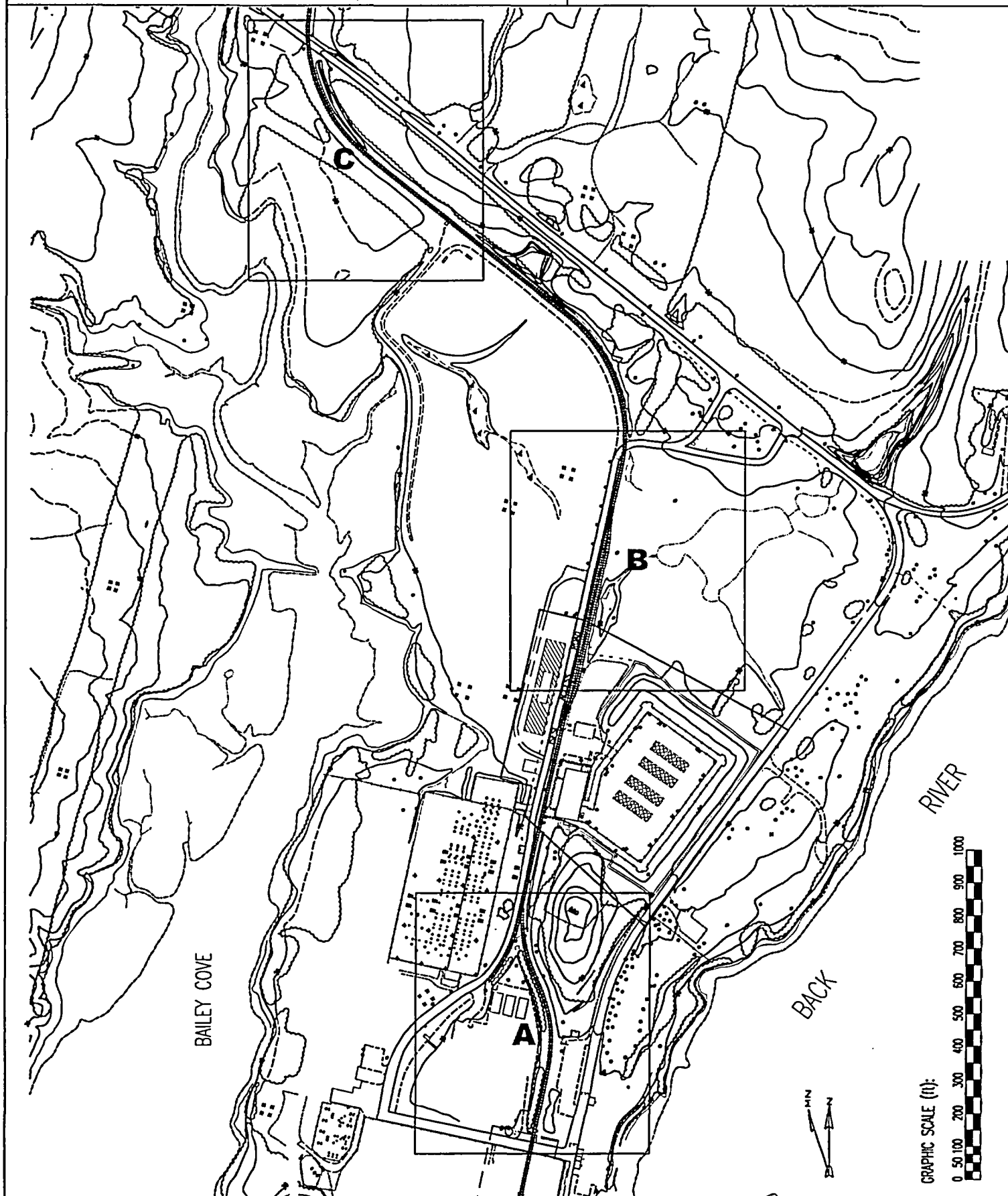
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Survey Area Name: Roads and Rails



Survey Type: ☐ Characterization ☐ Turnover ☒ Final Status Survey

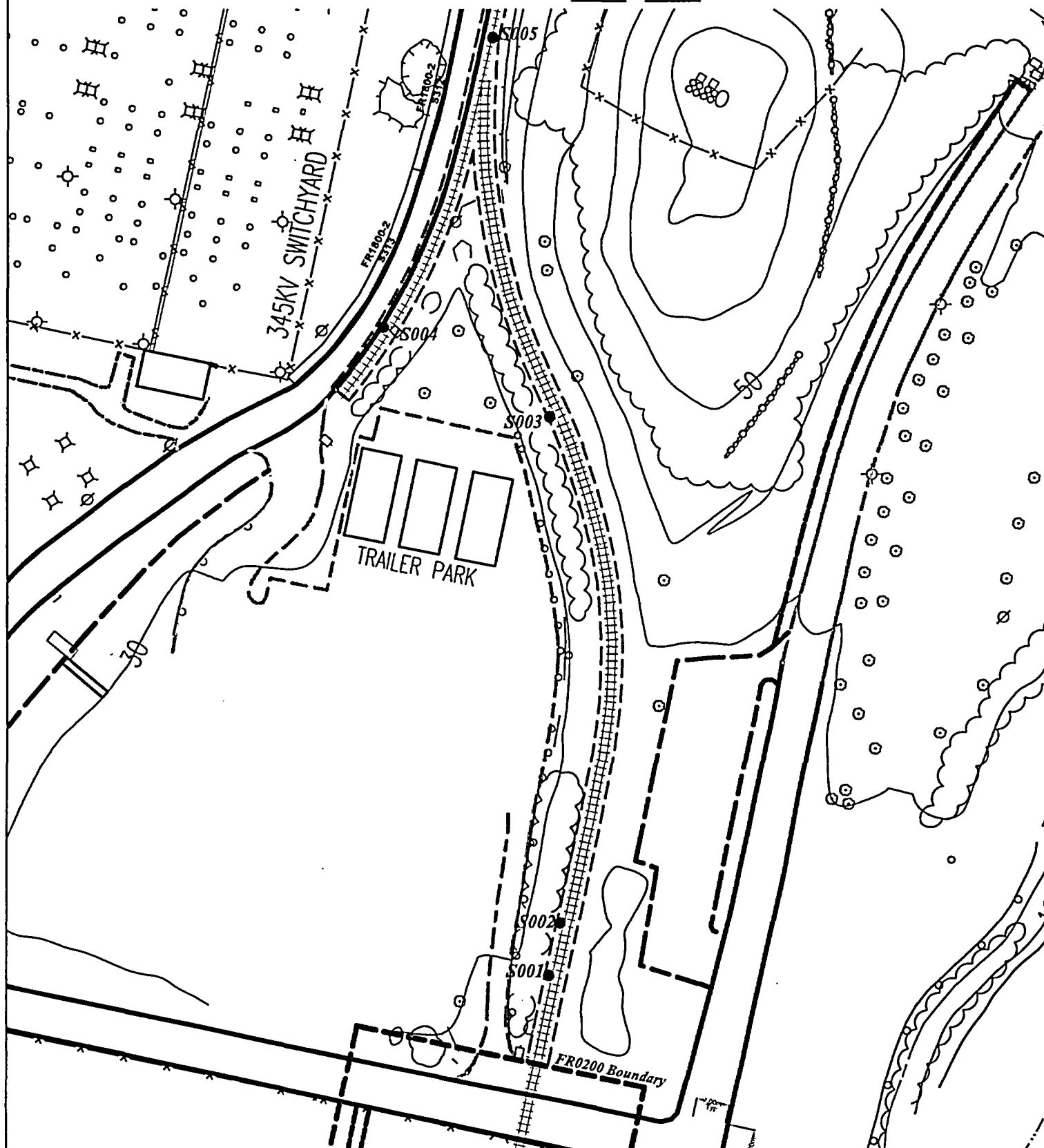
Survey Area Name: Roads and Rails



Survey Type: ☐ Characterization ☐ Turnover ☒ Final Status Survey

Survey Area Name: Roads and Rails

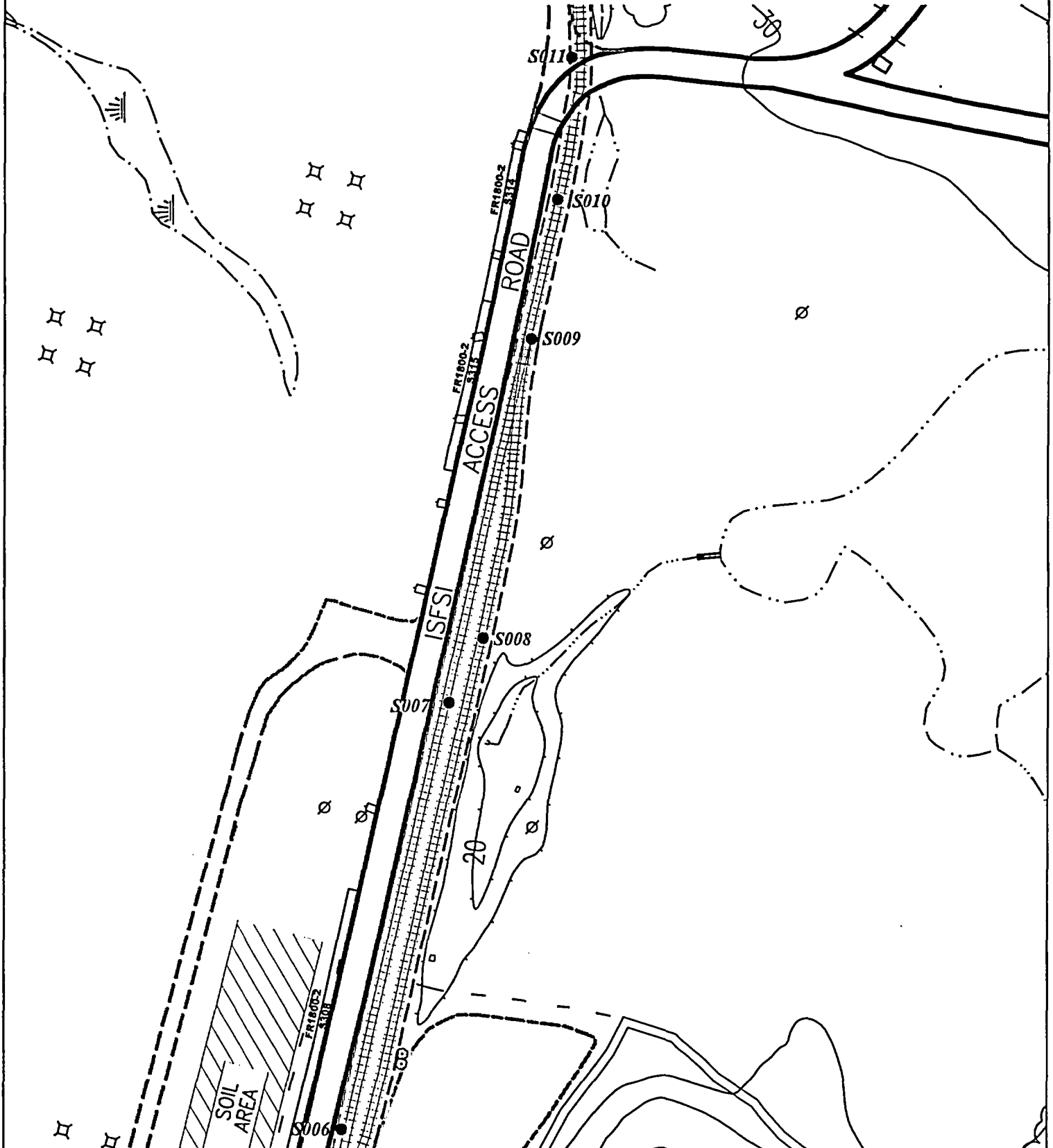
FR2900 SU3: Direct Points, Map A
Direct Point Locations S001 - S005



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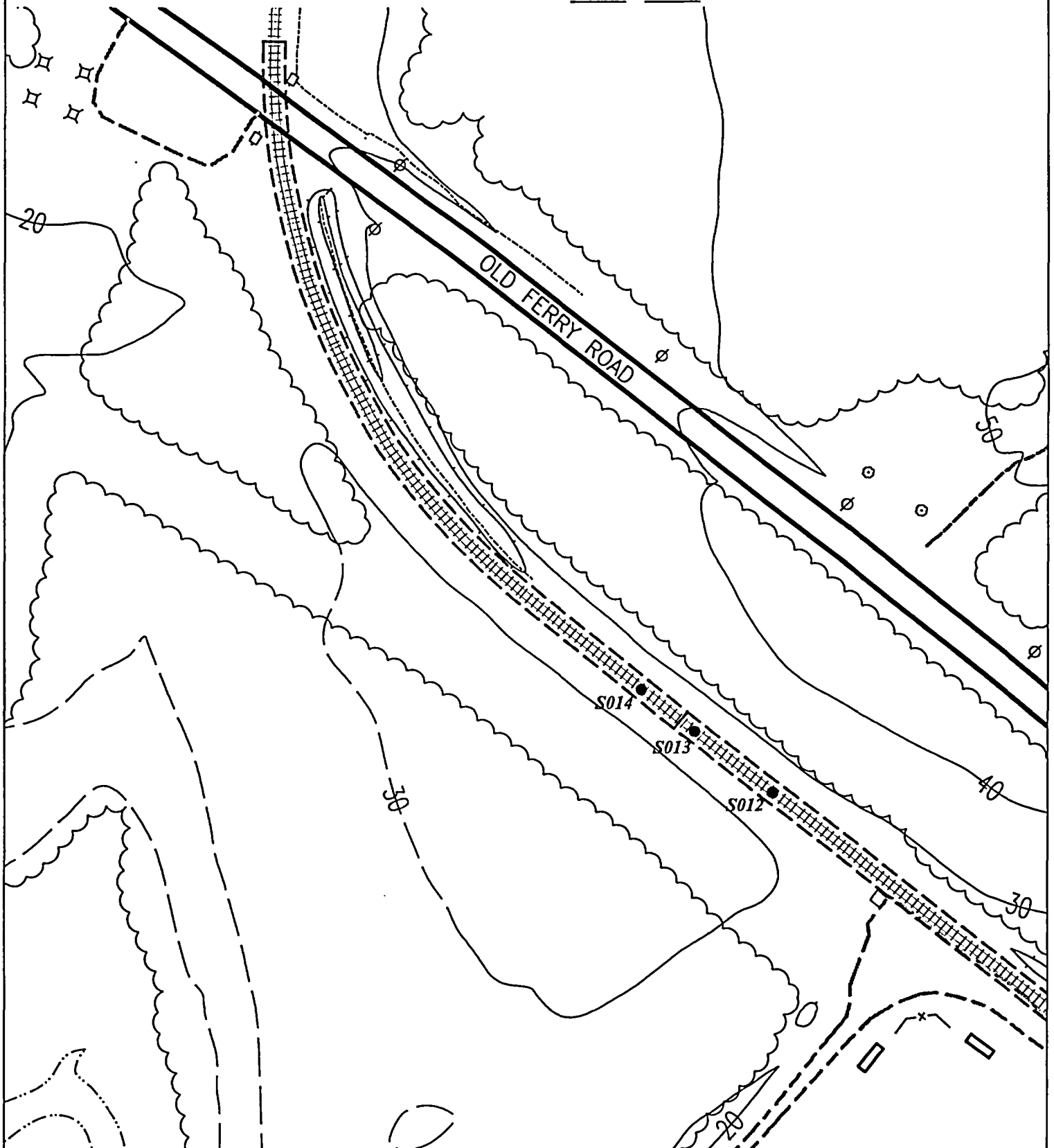
Survey Area Name: Roads and Rails

FR2900 SU3: Direct Points, Map B
Direct Point Locations S006 - S011



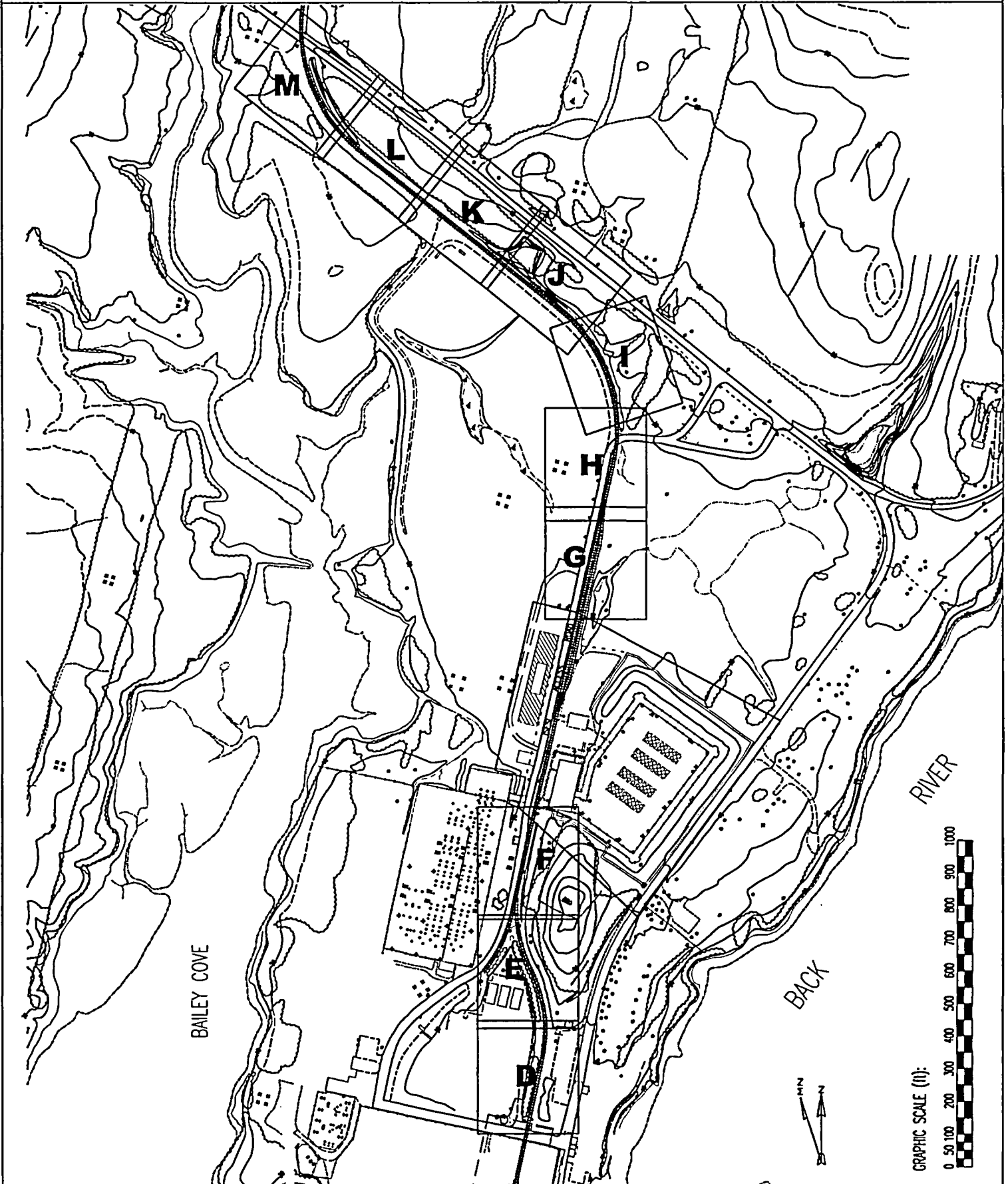
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FR2900 SU3: Direct Points, Map C
Direct Point Locations S012 - S014



Survey Type: ☐ Characterization ☐ Turnover ☐ Final Status Survey

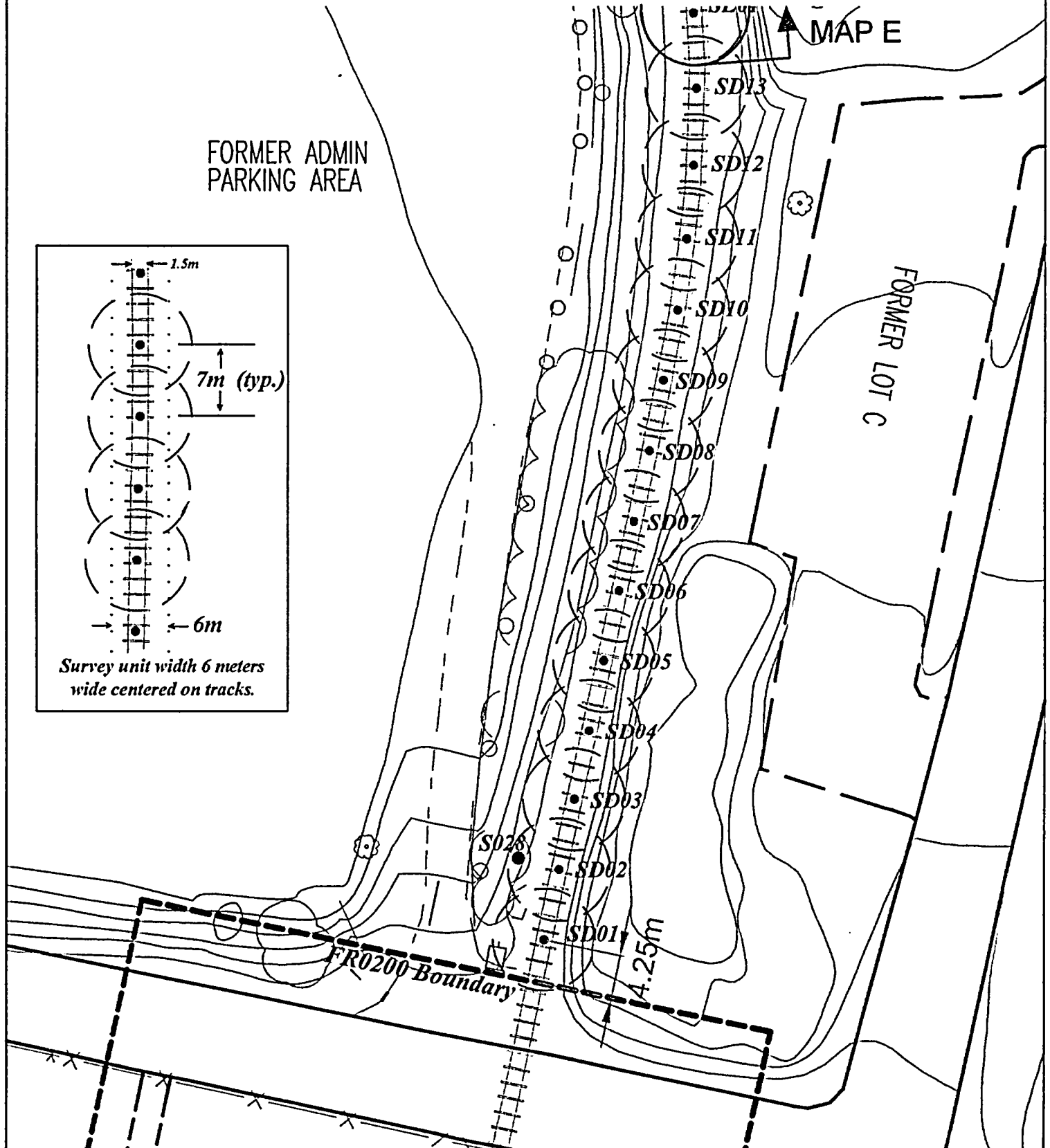
Survey Area Name: Roads and Rails



Survey Type: ☐ Characterization ☐ Turnover ☒ Final Status Survey

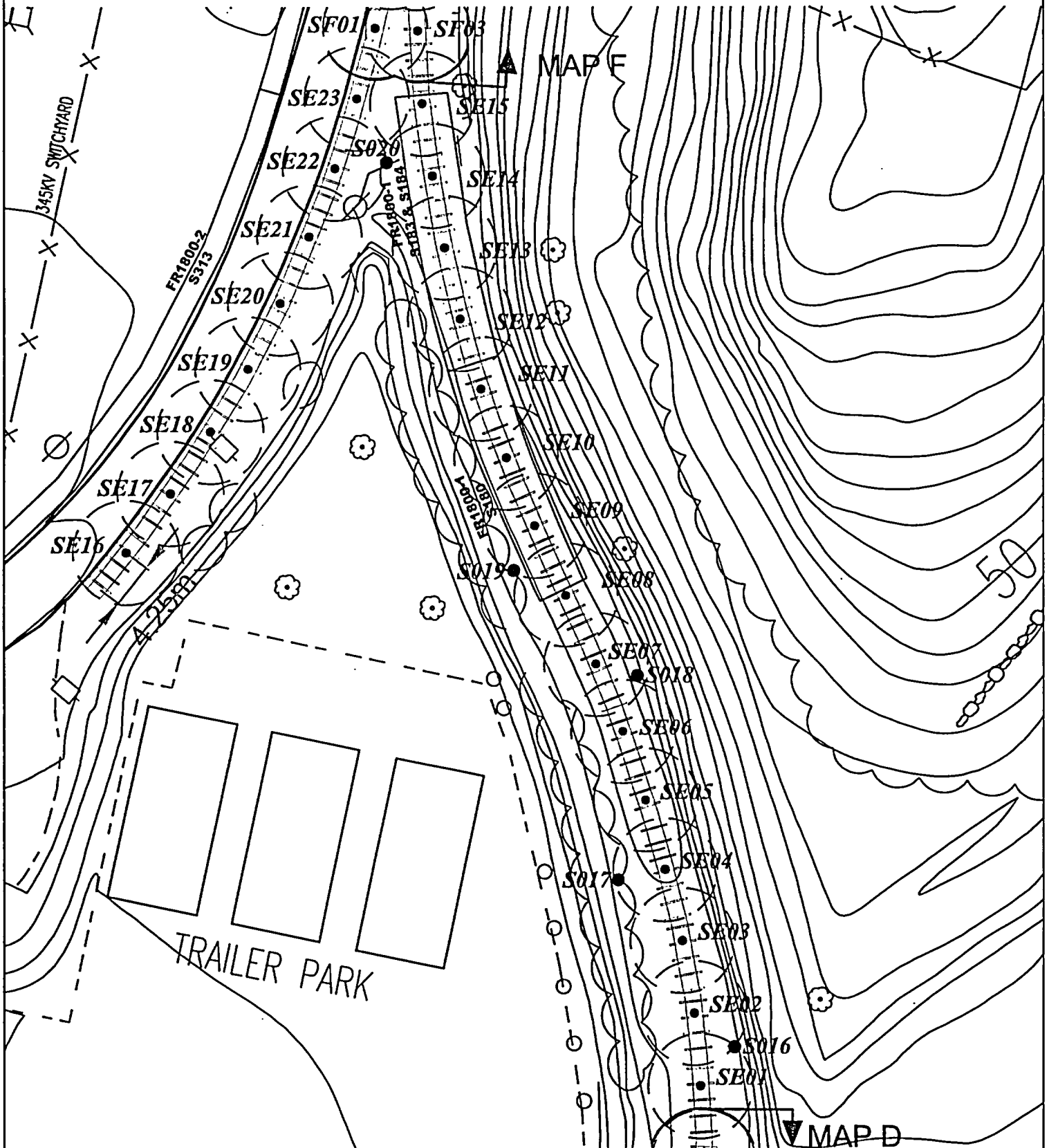
Survey Area Name: Roads and Rails

FR2900 SU3: ISOCS Surveys, Map D
Survey Locations SD01 - SD13 & S028



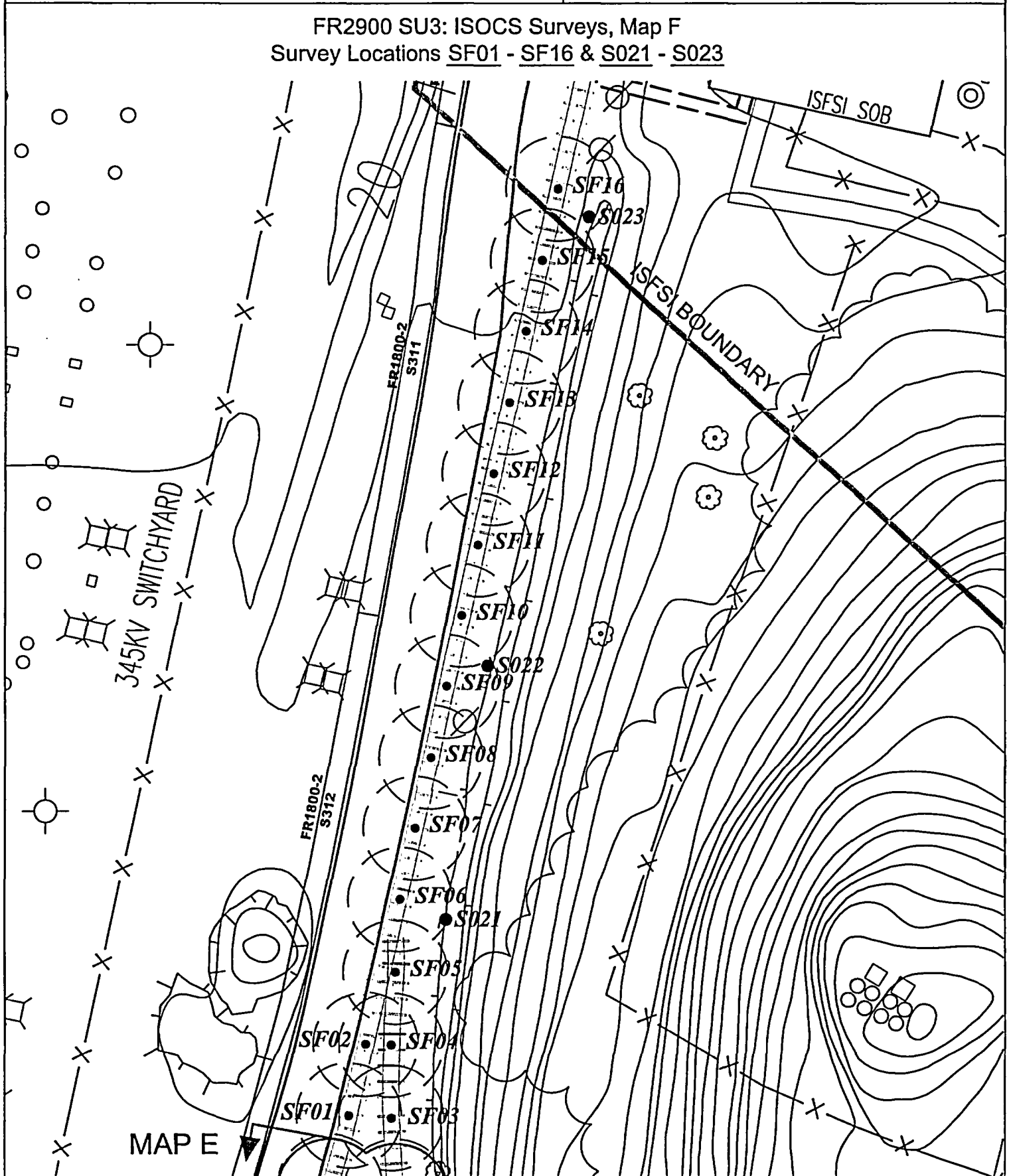
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FR2900 SU3: ISOCs Surveys, Map E
Survey Locations SE01 - SE23 & S016 - S020



Survey Type: ☐ Characterization ☐ Turnover ☒ Final Status Survey

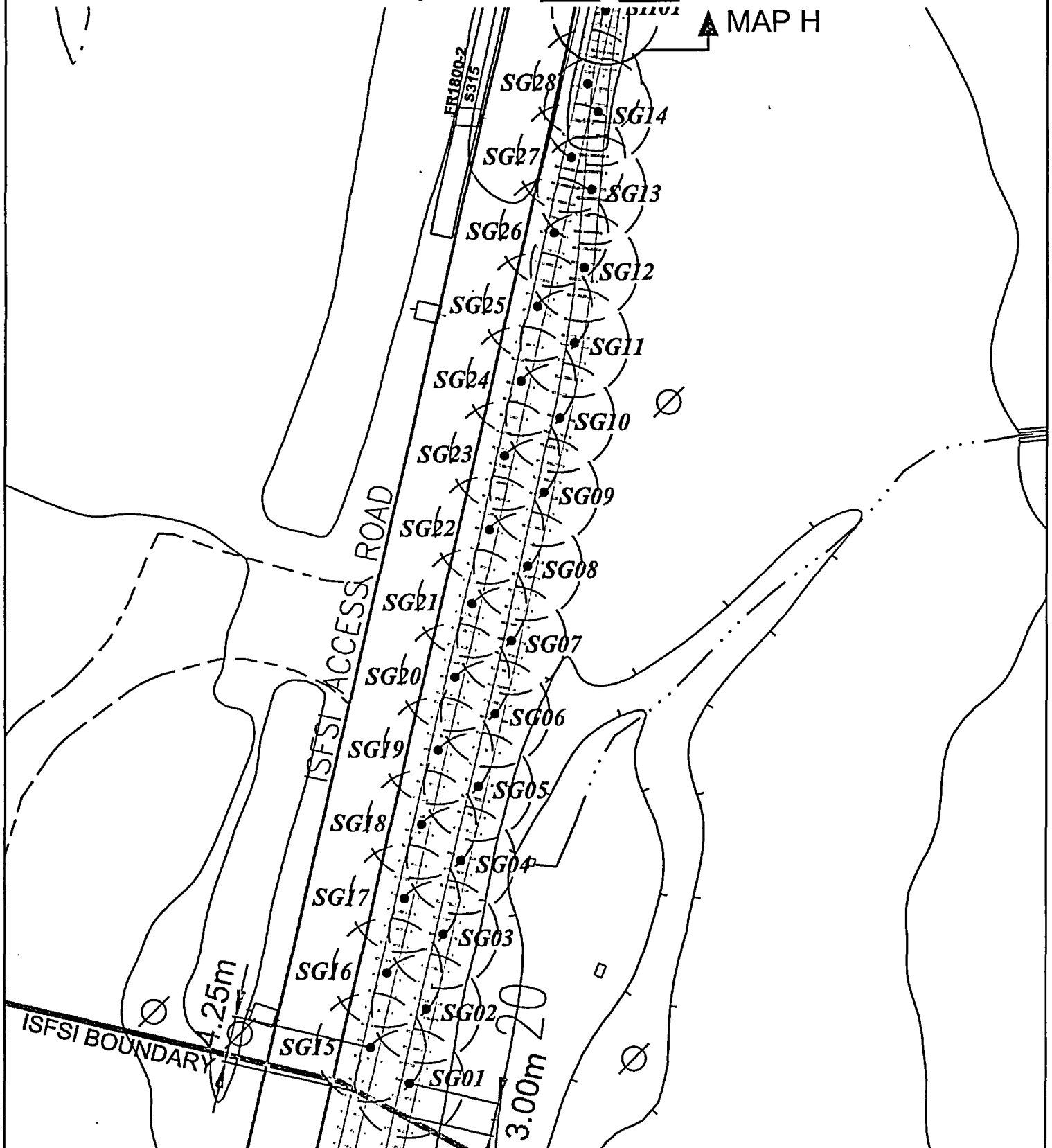
Survey Area Name: Roads and Rails



Survey Type: ☐ Characterization ☐ Turnover ☒ Final Status Survey Survey Area Name: Roads and Rails

FR2900 SU3: ISOCS Surveys, Map G

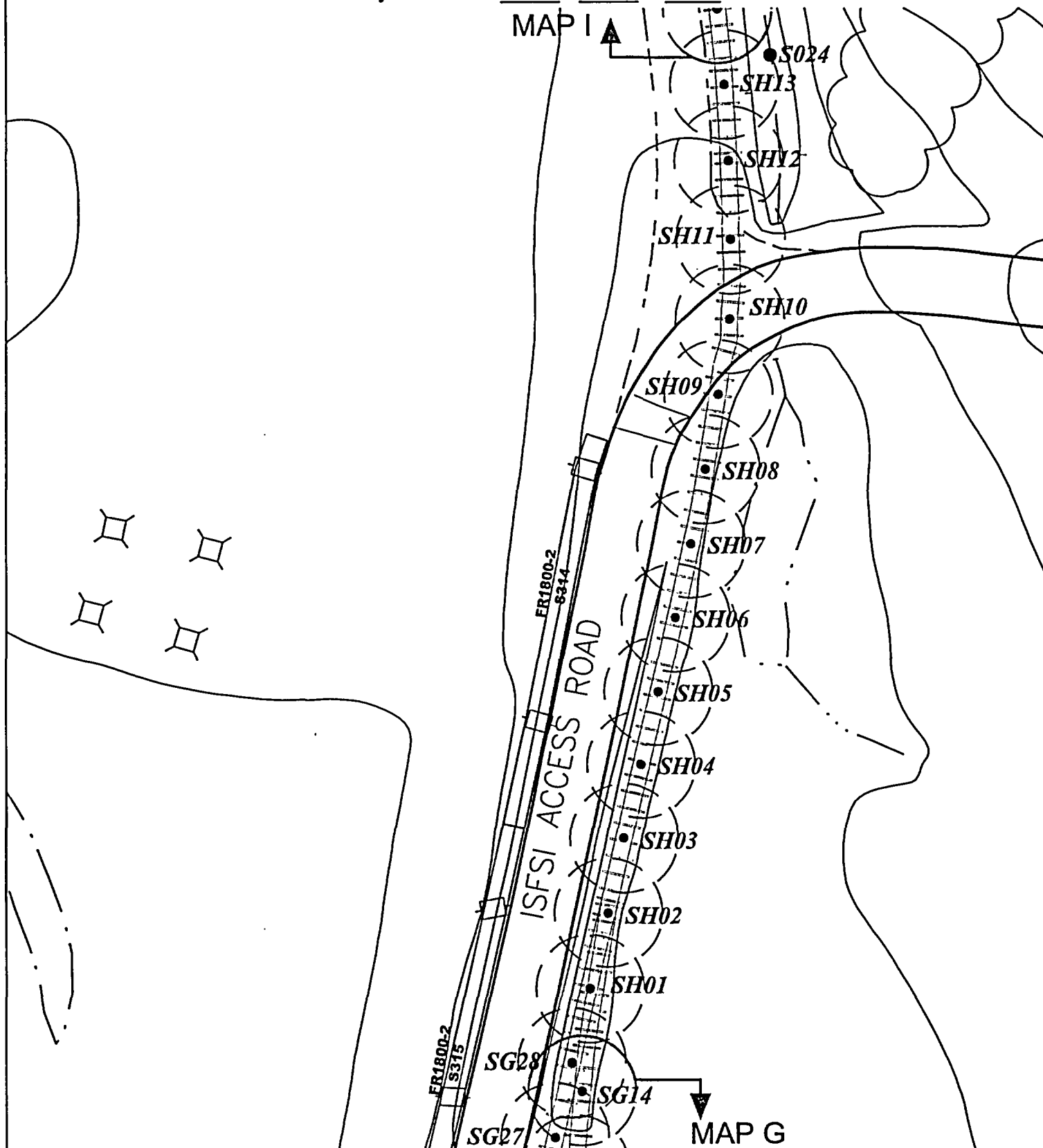
Survey Locations SG01 - SG28



Survey Type: ☐ Characterization ☐ Turnover ☒ Final Status Survey

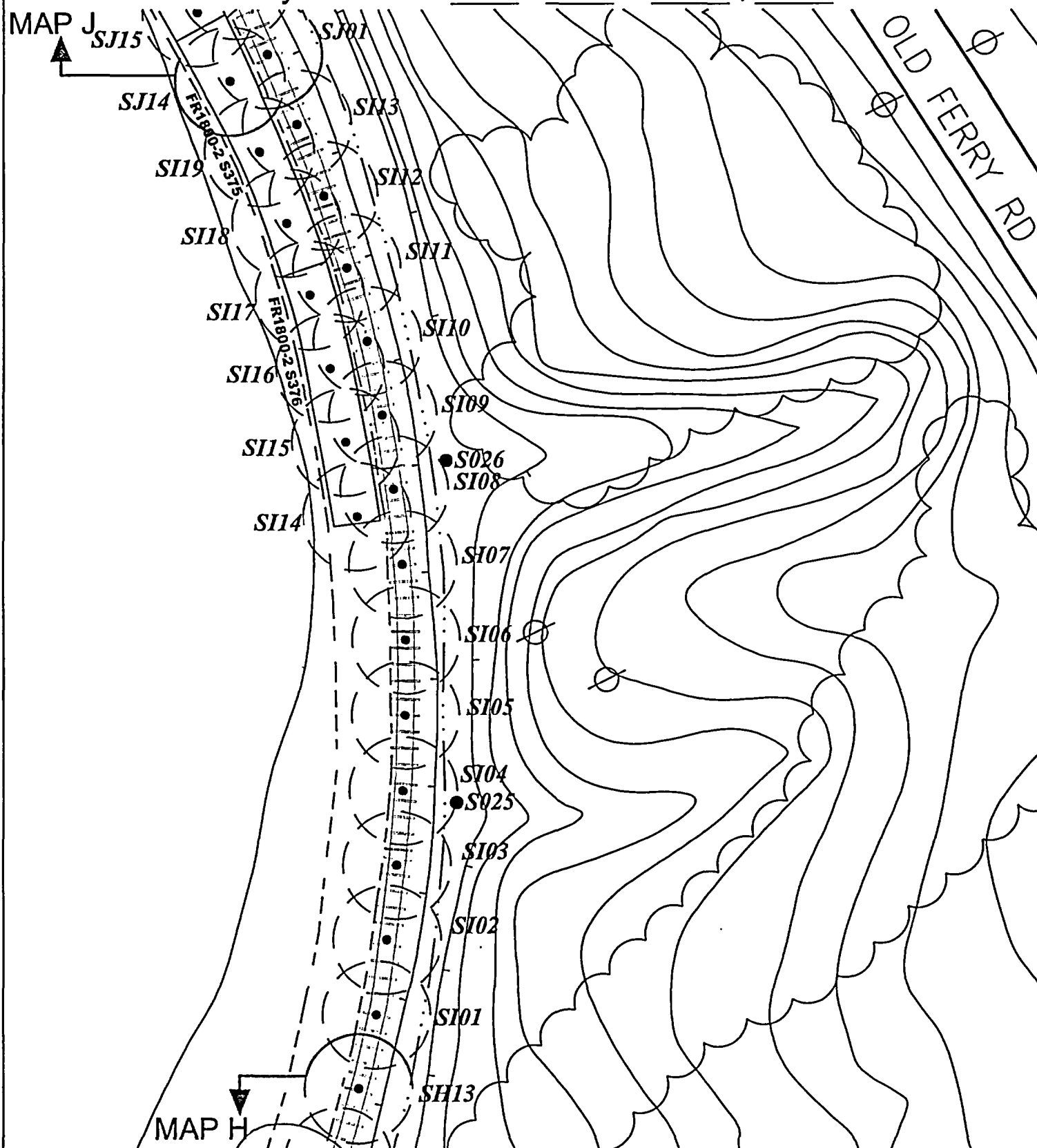
Survey Area Name: Roads and Rails

FR2900 SU3: ISOCS Surveys, Map H
Survey Locations SH01 - SH13 & S024



Survey Type: ☐ Characterization ☐ Turnover ☒ Final Status Survey Survey Area Name: Roads and Rails

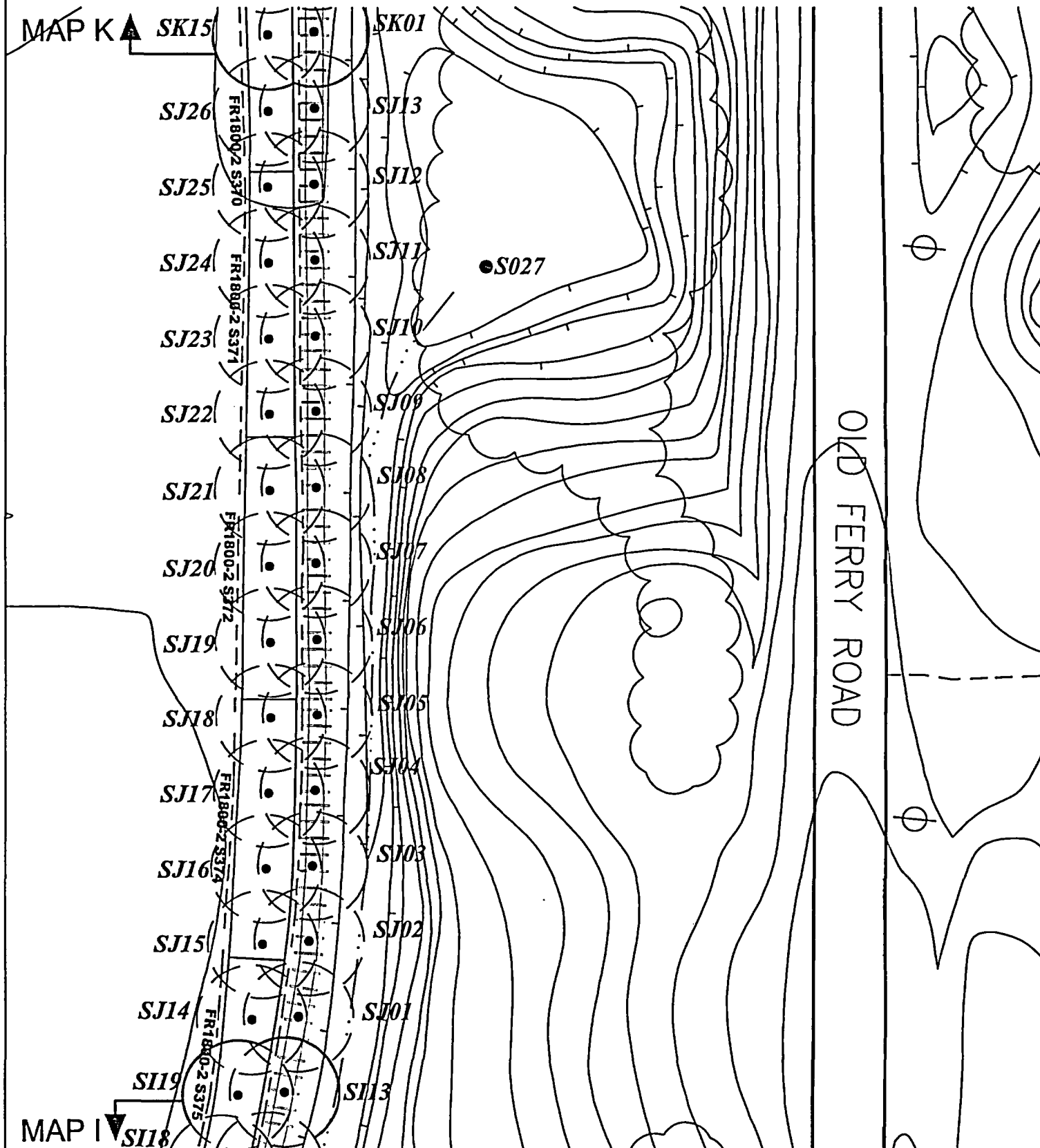
FR2900 SU3: ISOCS Surveys, Map I
Survey Locations SI01 - SI19 & S025 , S026



Survey Type: ☐ Characterization ☐ Turnover ☒ Final Status Survey

Survey Area Name: Roads and Rails

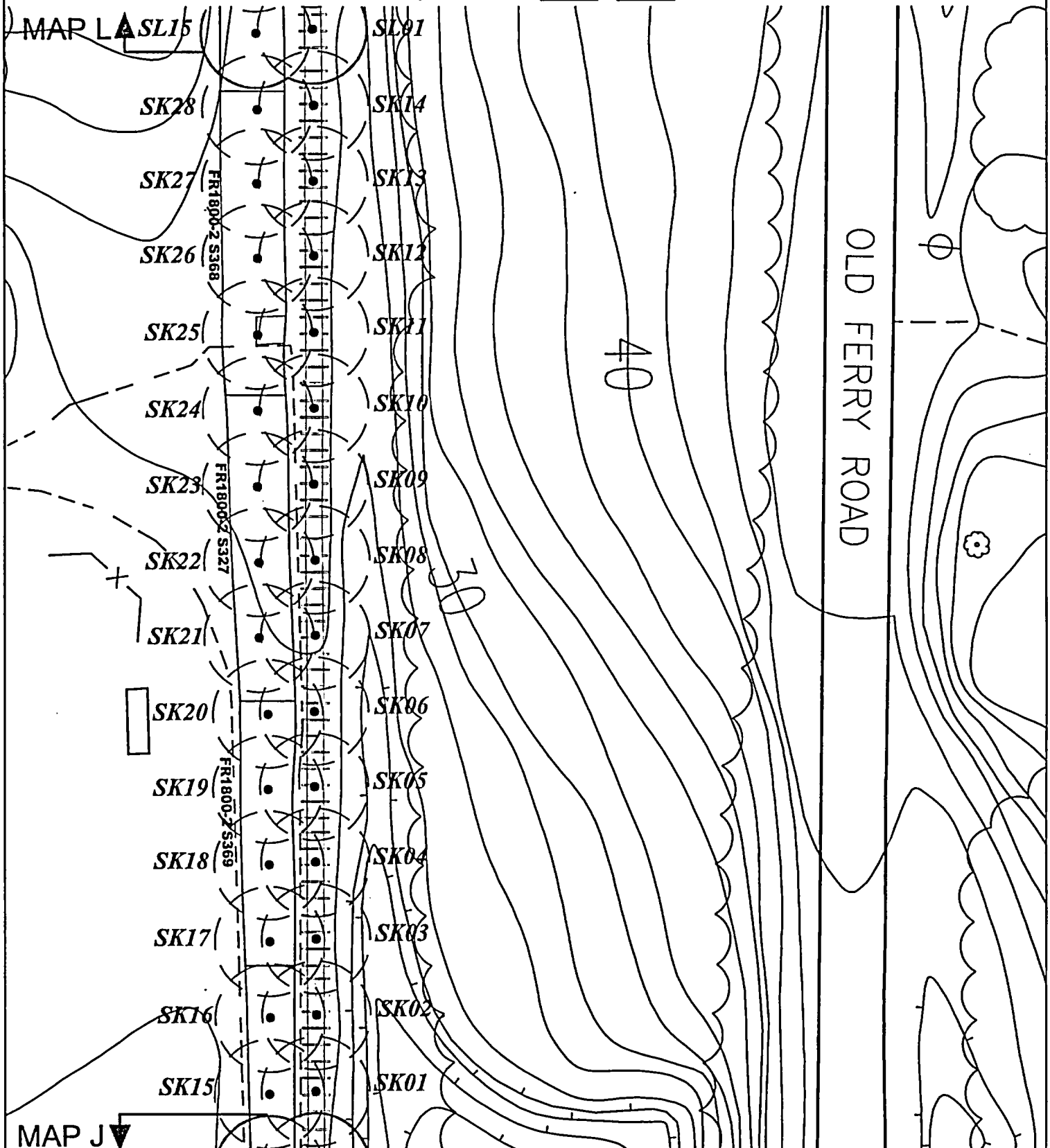
FR2900 SU3: ISOCS Surveys, Map J
Survey Locations SJ01 - SJ26 & S027



Survey Type: ☐ Characterization ☐ Turnover ☒ Final Status Survey

Survey Area Name: Roads and Rails

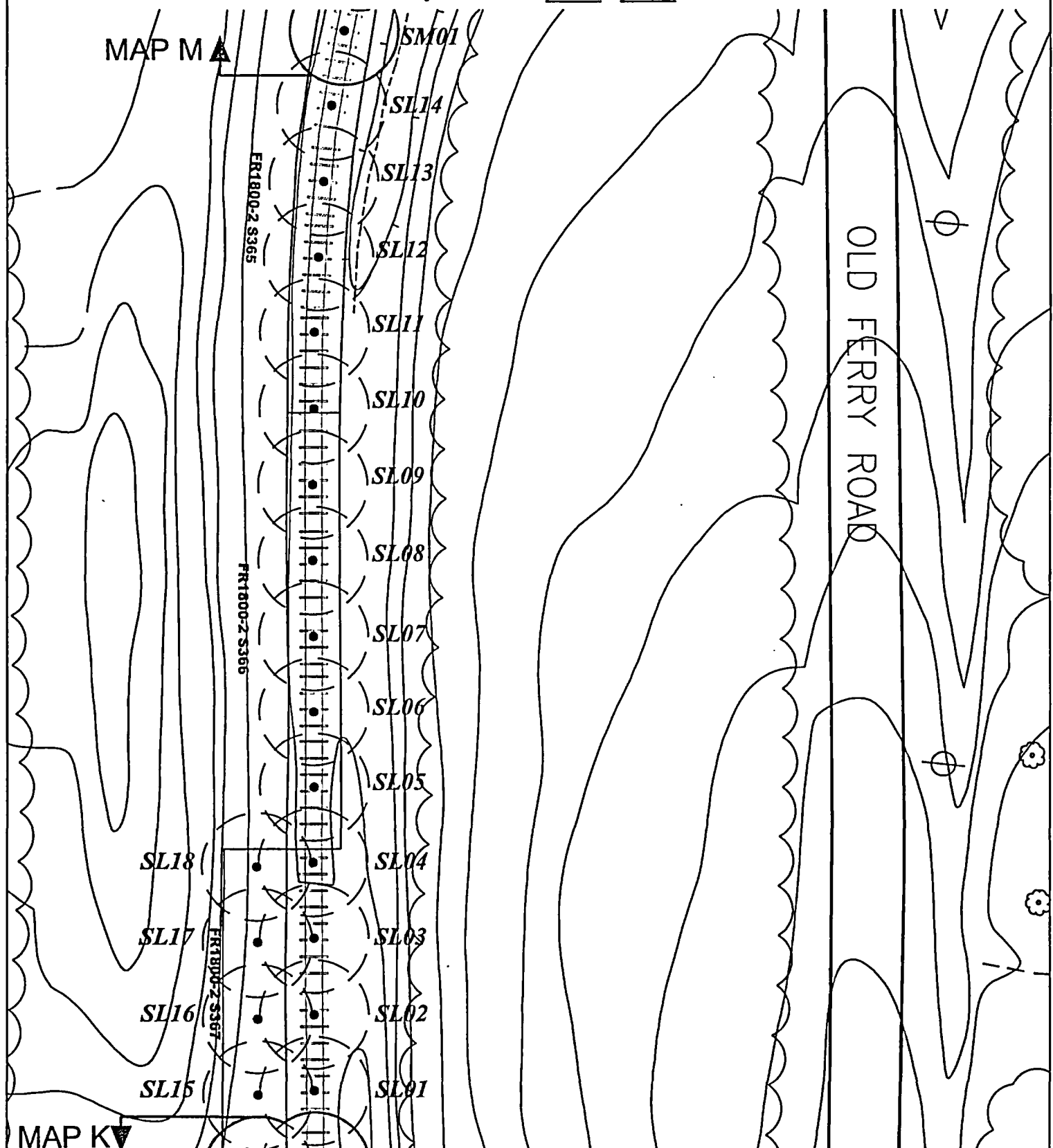
FR2900 SU3: ISOCS Surveys, Map K
Survey Locations SK01 - SK28



Survey Type: ☐ Characterization ☐ Turnover ☒ Final Status Survey

Survey Area Name: Roads and Rails

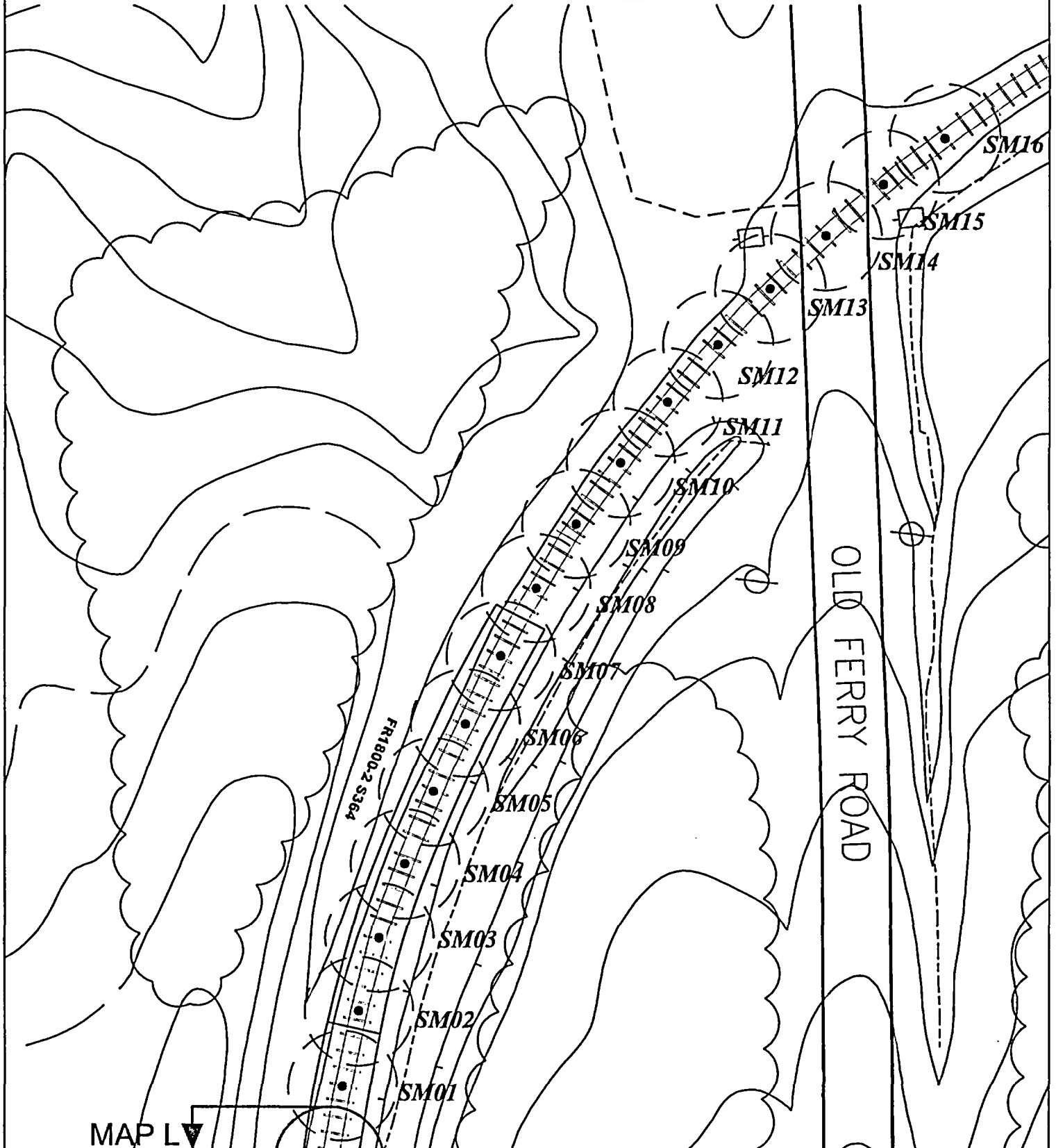
FR2900 SU3: ISOCS Surveys, Map L
Survey Locations SL01 - SL18



Survey Type: ☐ Characterization ☐ Turnover ☒ Final Status Survey

Survey Area Name: Roads and Rails

FR2900 SU3: ISOCS Surveys, Map M
Survey Locations SM01 - SM16



Attachment 2

Survey Unit Instrumentation

TABLE 2-1

INSTRUMENT INFORMATION

HPGe Detectors (Laboratory Sample Analysis)

Detector No.	MDC
FSS1	0.05 to 0.11 pCi/g
FSS2	0.04 to 0.10 pCi/g

ISOCS Detectors (Field Measurements)

Detector No.	MDC
7605	0.05 to 0.18 pCi/g

TABLE 2-2

**INSTRUMENT SCAN MDC, DCGL,
AND INVESTIGATION LEVEL**

Parameter	Instrument: ISOCS	Comments
Scan MDC	0.06 to 0.13 pCi/g Co-60 0.05 to 0.18 pCi/g Cs-137	Design MDC specified to be ~10% of the DCGL
DCGL	1.52 pCi/g Co-60 4.2 pCi/g Cs-137	LTP Rev 4 Section 6.7 (Reference 1)
Investigation Level (ISOCS @ 1m)	0.36 pCi/g Co-60 1.0 pCi/g Cs-137	Reference 3

Attachment 3

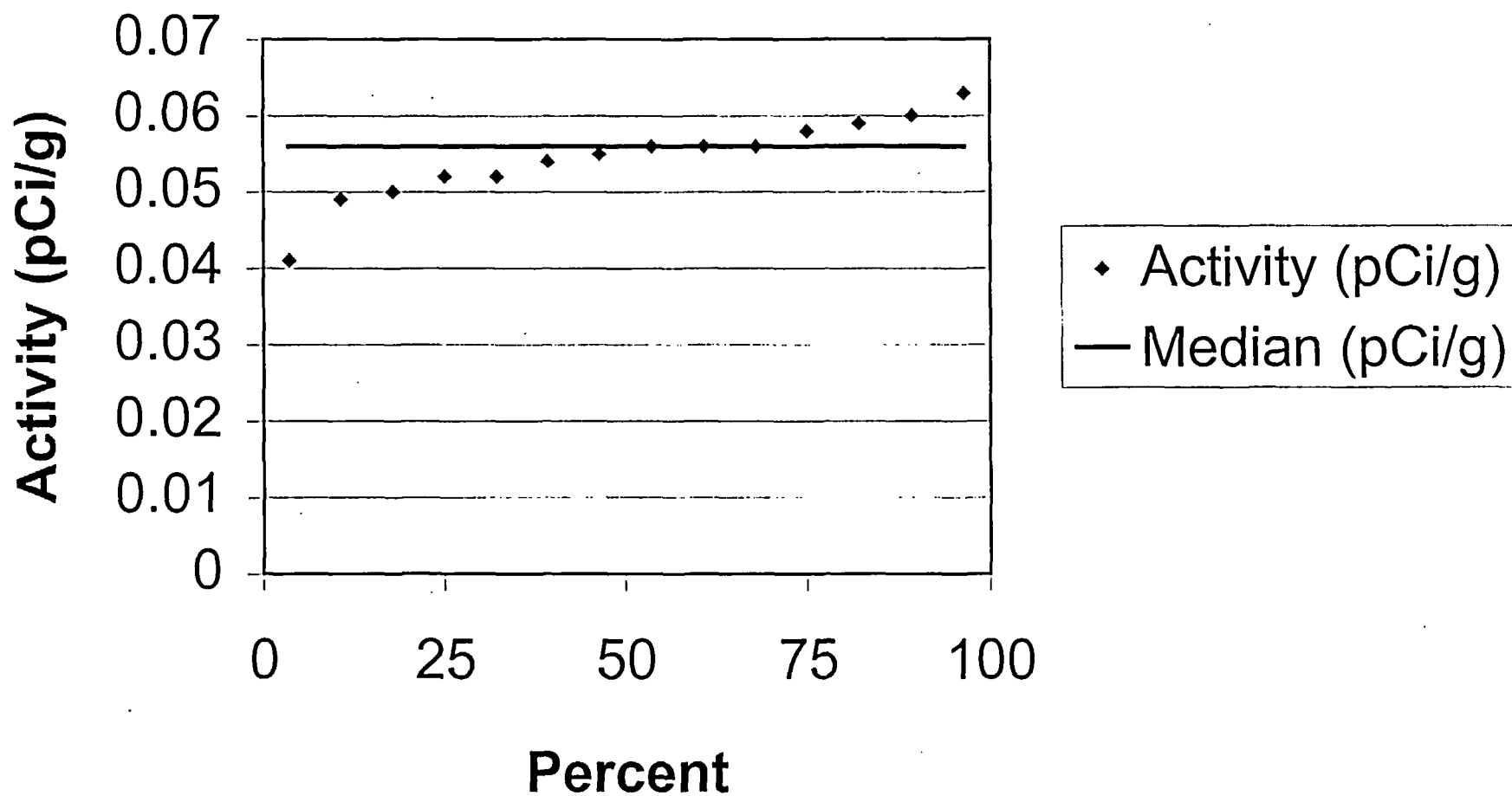
Investigation Table (None Required)

Attachment 4
Statistical Data

Survey Package FR2900 Unit 3 CS-137 Soil Sign Test Summary

Evaluation Input Values		Comments
Survey Package:	FR2900	Rails
Survey Unit:	03	
Evaluator:	G. Madison	
DCGL _w :	4.20E+00	Cs-137 DCGL
DCGL _{emc} :	4.20E+00	
LBGR:	2.10E+00	50% of DCGL
Sigma:	2.30E-01	LTP Rev 4, Table 5-1C for R1800
Type I error:	0.05	
Type II error:	0.05	
Nuclide:	CS-137	
Soil Type:	N/A	
Calculated Values		Comments
Z _{1-α} :	1.645	
Z _{1-β} :	1.645	
Sign p:	0.99865	
Calculated Relative Shift:	9.1	
Relative Shift Used:	3.0	Uses 3.0 if Relative Shift is >3
N-Value:	11	
N-Value+20%:	14	
Sample Data Values		Comments
Number of Samples:	14	
Median:	5.52E-02	
Mean:	5.43E-02	
Net Sample Standard Deviation:	5.50E-03	
Total Standard Deviation:	5.50E-03	
Maximum:	6.34E-02	
Sign Test Results		Comments
Adjusted N Value:	14	
S+ Value:	14	
Critical Value:	10	
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	N/A for Class 3
Total Standard Deviation <=Sigma:	Pass	
Criteria comparison results:	Pass	
Final Status		Comments
The survey unit passes all conditions:	Pass	Survey Unit Passes

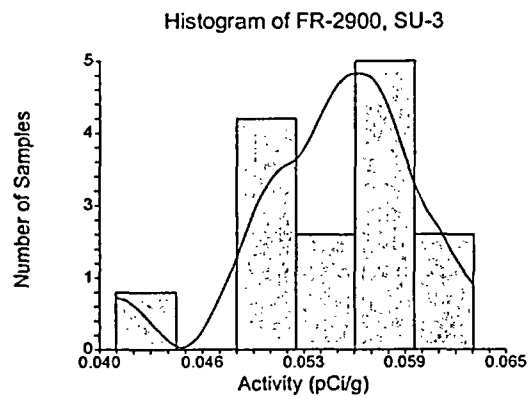
FR2900 SU-3 Quantile Plot



One-Sample T-Test Report

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Database
Variable C2

Plots Section



One-Sample T-Test Power Analysis

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Chart Section

