

Route MS-33  
File

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United States Department of Agriculture  
Natural Resources Conservation Service

Chester, PA 19013  
610-490-6042

**Subject:** Ground-Penetrating Radar (GPR)  
Field Assistance; 18-21 September 1995

**Date:** 28 September 1995

**To:** Norman Kalloch  
State Soil Scientist  
USDA-NRCS  
Orono, Maine

**Purpose:**

To provide transect data on the depth to bedrock in various map units in Aroostook County and in the "Big Woods" soil survey areas of Franklin, Oxford and Somerset counties, Maine.

**Participants:**

Jim Doolittle, Research Soil Scientist, NRCS, Chester, PA  
Jonathan Miller, Soil Party Leader, NRCS, Rangeley, ME  
Ron Olson, Soil Resource Specialist, NRCS, Bangor, ME

**Activities:**

Ground-penetrating radar surveys were conducted on the land of the Houlton Band of the Maliseet Indians, Aroostook County on 18 September. Twenty transects (200 observations) were completed. Ground-penetrating radar surveys were conducted in the "Big Woods" area on 19 to 21 September. Over this 2.5-day period, 29 transects, were completed with GPR. These transects provided about 17.2 miles of continuous subsurface data. Along these transects, the depth to bedrock was estimated at 360 observation points.

**Equipment:**

The radar unit used in this study was the Subsurface Interface Radar (SIR) System-2, manufactured by Geophysical Survey Systems, Inc. The SIR System-2 consists of a backpack portable, digital control unit (DC-2) with keypad, VGA video screen, and connector panel. Radar profiles were plotted on a model GS-608P thermal plotter/printer. The system was powered by a 12-VDC battery. The model 3110 (120 MHz) antenna was used in this investigation.

On 18 September, calibration trials were completed in an area of Mapleton soils to determine the velocity of signal propagation through tills, depth scale for radar profiles, and the depth of observation. The depth to bedrock was determined at three observation points. With a scanning time of 70 nanoseconds (ns), the calculated velocity of propagation was

0.116 feet/nanoseconds. With a scanning time of 70 ns, bedrock investigations used a maximum profiling depth of 16.3 feet (195 inches).

### Discussion:

#### Aroostook County -

Radar surveys were conducted in areas of Abrams (loamy, mixed acid, frigid, Lithic Haplorthods), Mapleton (coarse-loamy, mixed, frigid Lithic Haplorthods), and Penquis (coarse-loamy, mixed, frigid Typic Haplorthods) soils. The following is a summary of the results of this survey.

File 1 MhB-Mapleton sil, 0-8% slopes depth (inches)	File 2 MhB-Mapleton sil, 0-8% slopes depth (inches)
21.6	27.6
23.4	43.0
33.3	0.0
32.0	28.0
26.1	25.4
26.9	9.7
35.3	20.1
29.4	21.6
29.4	18.3
30.0	21.0

File 3 PnC-Penquis sil, 8-15% slopes depth (inches)	File 4 PnC-Penquis sil, 8-15% slopes depth (inches)
18.1	22.1
18.1	21.6
20.8	34.6
28.7	16.8
19.0	45.0
23.4	14.2
17.5	24.1
47.2	9.5
62.4	28.3
47.9	19.4

File 5 PnB-Penquis sil, 0-8% slopes depth (inches)	File 6 PnB-Penquis sil, 0-8% slopes depth in
9.1	21.0
8.9	24.3
19.4	49.0
28.9	30.0
18.3	28.3
30.0	36.0
11.5	51.8
26.1	65.1
32.2	30.0
19.4	34.9

File 7 MhC-Mapleton sil, 8-15% slopes  
depth (inches)

11.7  
28.9  
27.6  
23.6  
11.5  
10.6  
34.2  
29.6  
24.1  
22.3

File 8 MhC-Mapleton sil, 8-15% slopes  
depth (inches)

19.7  
28.7  
32.2  
17.0  
26.9  
24.1  
18.1  
9.7  
8.9  
26.1

File 9 PnB-Penquis sil, 0-8% slopes  
depth (inches)

9.1  
17.0  
29.6  
29.4  
18.8  
11.7  
30.0  
32.0  
30.0  
11.5

File 10 PnB-Penquis sil, 0-8% slopes  
depth (inches)

37.5  
28.7  
11.5  
10.8  
13.5  
33.5  
35.5  
32.2  
34.6  
19.0

File 11 MhB-Mapleton sil, 0-8% slopes  
depth (inches)

11.7  
19.0  
29.4  
25.6  
26.7  
26.7  
8.4  
23.6  
19.0  
17.5

File 12 MhB-Mapleton sil, 0-8% slopes  
depth (inches)

18.1  
19.7  
39.3  
34.0  
10.8  
8.6  
7.8  
24.3  
9.7  
26.7

File 13 AbB-Abrams sil, 0-8% slopes  
depth (inches)

9.1  
8.9  
8.2  
24.9  
12.8  
11.1  
22.1  
22.5  
9.1  
8.2

File 14 Xb-Mapleton-Abrams sil, 0-8% slopes  
depth (inches)

10.8  
30.7  
11.5  
9.7  
12.8  
12.2  
18.3  
17.7  
20.3  
20.3

File 15 Xb-Mapleton-Abrams sil, 0-8% slopes depth (inches)      File 16 Xb-Mapleton-Abrams sil, 0-8% slope depth (inches)

24.1  
22.7  
21.0  
15.5  
10.2  
10.4  
15.7  
15.5  
9.5  
28.0

9.1  
18.1  
18.6  
15.7  
16.1  
10.8  
9.7  
11.7  
10.2  
21.6

File 17 MhB-Mapleton sil, 0-8% slopes depth (inches)

9.1  
29.6  
21.0  
19.4  
22.1  
25.4  
14.4  
20.1  
30.2  
23.4

File 18 MhB-Mapleton sil, 0-8% slopes depth (inches)

44.6  
50.5  
29.6  
39.5  
8.9  
8.9  
9.1  
11.5  
20.8  
32.2

File 19 AbB-Abrams sil, 0-8% slopes depth (inches)

10.2  
15.7  
11.7  
10.8  
12.2  
10.8  
16.8  
11.1  
13.5  
18.1

File 20 AbB-Abrams sil, 0-8% slopes depth (inches)

17.5  
12.8  
9.5  
22.3  
8.4  
21.9  
11.7  
12.4  
17.5  
11.1

**Survey Procedures:**

About 17.2 miles of GPR transect were conducted in the "Big Woods." These transects were confined to delineated areas of recognized soil map units. Most transects were conducted along access roads. The vehicles odometer was used to measure distances. On access roads, a 264 foot interval was used between observation points. Though GPR provides a continuous record of subsurface conditions, estimates of the depth to bedrock were restricted to the observation points.

Several transects were conducted along trails. For these transects, the backpack unit was used to transport the SIR-2 System. On these transects, a 100 foot interval was used between observation points.

The following tables summarize observations for each transect according to scanning time to bedrock surface (in nanoseconds) and soil depth (in inches). At each observation site, soil depths were estimated from radar interpretations. Depths were measured from the surface to the bedrock interface.

File 2 - M. U. 94XE  
Lyman-Tunbridge complex 20-60% slopes

Time(ns)	Depth(in)
51.1	32.7
43.0	27.5
36.4	23.3
34.8	22.3
40.3	25.8
37.0	23.7
11.0	7.0
57.4	36.7
51.4	32.9
40.9	26.2
31.2	20.0

File 3 - M. U. 48D  
Marlow-Tunbridge-Dixfield Association, 12-30% slopes

Time(ns)	Depth(in)
42.1	26.9
44.8	28.7
57.1	36.5
33.0	21.1
34.2	21.9
26.7	17.1
59.3	37.9
24.3	15.5
27.9	17.8
57.7	36.9
50.5	32.3

File 4 - M. U. 48D  
 Marlow-Tunbridge-Dixfield Association, 12-30% slopes

Time(ns)	Depth(in)
51.7	33.1
40.3	25.8
59.2	37.9
48.7	31.2
52.0	33.3
55.0	35.2
48.7	31.2
38.8	24.8
49.0	31.3
49.6	31.7
42.1	26.9

File 5 - M. U. 98XE  
 Lyman-Tunbridge complex 20-60% slopes

Time(ns)	Depth(in)
21.0	13.4
18.3	11.7
20.7	13.2
17.7	11.3
24.6	15.7
20.1	12.9
18.0	11.5
19.8	12.7
19.8	12.7
29.1	18.6
32.4	20.7
24.6	15.7

File 6 - M. U. 94XE  
 Lyman-Tunbridge complex 20-60% slopes

Time(ns)	Depth(in)
27.3	17.5
26.4	16.9
23.4	15.0
24.3	15.5
30.9	19.8
28.2	18.0
19.8	12.7
20.4	13.1
24.9	15.9
21.9	14.0
21.0	13.4

File 7 - M. U. 48D  
Marlow-Tunbridge-Dixfield Association, 12-30% slopes

Time(ns)	Depth(in)
50.2	32.1
119.8	76.6
119.6	76.5
45.1	28.9
48.4	31.0
128.3	82.1
62.2	39.8
66.4	42.5
78.4	50.2
140.0	89.6
128.3	82.1
132.2	84.6
101.5	64.9
126.2	80.7
110.9	70.9
127.7	81.7

File 8 - M. U. 40C  
Beckett-Skerry-Tunbridge Association, 5-15% slopes

Time(ns)	Depth(in)
140.0	89.6
97.3	62.2
140.0	89.6
40.3	25.8
61.6	39.4
120.0	76.8
55.9	35.8
43.0	27.5

File 9 - M. U. 48C  
Dixfield-Colonel-Tunbridge Association, 3-15% slopes

Time(ns)	Depth(in)
18.0	11.5
26.1	16.7
27.0	17.3
25.2	16.1
21.0	13.4
35.0	22.4
22.2	14.2
22.8	14.6
22.8	14.6
19.8	12.7

File 10 - M. U. 53C  
 Dixfield-Colonel-Marlow Association, 3-15% slopes

Time(ns)	Depth(in)
51.4	32.9
132.5	84.8
140.0	89.6
140.0	89.6
131.0	83.8
123.5	79.0
80.5	51.5
75.4	48.2
92.8	59.4
91.0	58.2
104.8	67.0
96.1	61.5
51.4	32.9
138.0	88.3
132.2	84.6
70.0	44.8
131.9	84.4
98.8	63.2
119.0	76.1
140.0	89.6
129.8	83.0
112.4	71.9
140.0	89.6

File 11 - M. U. 942C  
 Lyman-Abram complex, 4-25% slopes

Time(ns)	Depth(in)
40.6	26.0
107.6	68.8
33.3	21.3
38.3	24.5
42.7	27.3
37.0	23.7
62.8	40.2
41.2	26.4
44.8	28.7
32.1	20.5
27.6	17.7
41.8	26.7
29.4	18.8
32.7	20.9
55.9	35.8

File 12 - M. U. 942C  
 Lyman-Abram complex, 4-25% slopes

Time(ns)	Depth(in)
40.9	26.2
25.5	16.3
29.4	18.8
32.1	20.5
24.6	15.7
40.3	25.8
22.5	14.4
33.0	21.1
49.9	31.9
46.6	29.8
59.5	38.1
42.7	27.3
43.3	27.7
37.0	23.7
19.2	12.3
34.8	22.3
26.1	16.7
35.0	22.4
36.7	23.5
32.3	20.7
28.8	18.4
37.9	24.2
52.6	33.6
55.3	35.4
63.1	40.4
44.6	28.5

File 13 - M. U. 302D  
 Hermon-Tunbridge-Skerry Association, 12-30% slopes

Time(ns)	Depth(in)
53.5	34.2
53.5	34.2
76.6	49.0
54.7	35.0
40.6	26.0
57.1	36.5
55.0	35.2
51.4	32.9
17.7	11.3
52.6	33.6
56.2	36.0

File 14 - M. U. 302C  
Hermon-Tunbridge-Skerry Association, 5-15% slopes

Time(ns)	Depth(in)
53.8	34.4
64.6	41.3
54.4	34.8
47.2	30.2
42.4	27.1
65.2	41.7
67.3	43.1
57.4	36.7
71.8	45.9
45.4	29.0
49.3	31.5
53.8	34.4
45.7	29.2
52.0	33.3
60.4	38.6
44.8	28.7

File 15 - M. U. 301D  
Hermon-Skerry Association, 12-30% slopes

Time(ns)	Depth(in)
50.5	32.3
63.4	40.6
46.3	29.6
79.9	51.1
69.4	44.4
54.4	34.8
34.8	22.3
48.4	31.0
55.6	35.6
47.5	30.4
54.1	34.6
50.5	32.3
53.3	34.1
61.3	42.0

File 16 - M. U. 302C  
Hermon-Tunbridge-Skerry Association, 5-15% slopes

Time(ns)	Depth(in)
67.6	43.2
64.6	41.3
43.6	27.9
71.2	45.5
41.8	26.7
76.9	49.2
38.2	24.4
31.2	20.0
21.9	14.0
68.2	43.6

File 17 - M. U. 302D  
Hermon-Tunbridge-Skerry Association, 12-30% slopes

Time(ns)	Depth(in)
67.3	43.1
45.4	29.0
55.0	35.2
0.0	0.0
43.3	27.7
25.2	16.1

File 18 - M. U. 48D  
Marlow-Tunbridge-Dixfield Association, 3-15% slopes

Time(ns)	Depth(in)
68.8	44.0
63.4	40.6
63.7	40.8
41.5	26.5
36.4	23.3
47.2	30.2
64.9	41.5
44.8	28.7
68.5	43.8
68.2	43.6

File 19 - M. U. 54C  
Colonel-Dixfield-Brayton Association, 3-15% slopes

Time(ns)	Depth(in)
70.0	44.8
67.9	43.4
48.4	31.0
58.3	37.3
58.9	37.7
60.5	38.7
64.6	41.3
66.1	42.3
43.3	27.7

File 20 - M. U. 48C  
 Dixfield-Colonel-Tunbridge Association, 3-15% slopes

Time(ns)	Depth(in)
61.3	39.2
67.9	43.4
69.4	44.4
64.6	41.3
56.8	36.3
53.2	34.0
64.3	41.1
49.3	31.5
47.8	30.6
51.1	32.7
36.4	23.3
63.1	40.4
68.8	44.0
61.3	39.2
69.4	44.4
74.2	47.5
65.0	41.6
58.6	37.5

File 21 - M. U. 94XC  
 Lyman-Tunbridge Complex, 4-25% slopes

Time(ns)	Depth(in)
35.8	22.9
68.2	43.6
21.0	13.4
29.3	18.7
54.4	34.8
53.2	34.0
56.5	36.1
55.9	35.8
62.8	40.2
26.4	16.9
35.5	22.7
58.0	37.1
20.4	13.1
48.7	31.2
29.4	18.8
47.5	30.4
24.3	15.5
30.3	19.4

File 22-24 - M. U. 76D  
 Chesuncook-Elliottsville-Telos Association, 5-30% slopes

Time(ns)	Depth(in)
35.0	22.4
96.7	61.9
33.9	21.7
53.8	34.4
56.8	36.3
30.3	19.4
33.0	21.1
40.0	25.6
56.8	36.3
23.7	15.2
34.8	22.3
30.9	19.8
66.7	42.7
80.5	51.5
51.7	33.1
65.8	42.1
45.1	28.9
71.2	45.5
57.7	36.9
51.7	33.1
61.3	39.2
76.0	48.6
88.9	56.9
77.9	49.8
41.8	26.7
25.5	16.3
26.4	16.9
33.6	21.5

File 25 - M. U. 89D  
 Elliottsville-Monson Complex, 10-30% slopes

Time(ns)	Depth(in)
140.0	89.6
80.8	51.7
75.4	48.2
95.8	61.3
50.8	32.5
57.1	36.5
38.2	24.4
77.8	49.8
56.8	36.3
61.0	39.0
33.6	21.5
46.9	30.0
41.2	26.4

File 26 - M. U. 94E  
 Monson-Elliottsville-Ricker Complex, 20-65% slopes

Time(ns)	Depth(in)
21.0	13.4
49.6	31.7
18.3	11.7
43.9	28.1
47.8	30.6
44.5	28.5
28.8	18.4

File 27 - M. U. 89D  
 Elliottsville-Monson Complex, 10-30% slopes

Time(ns)	Depth(in)
56.5	36.1
34.8	22.3
42.4	27.1
58.0	37.1
44.0	28.1

File 28 - M. U. 77D  
 Chesuncook-Telos Association, 12-30% slopes

Time(ns)	Depth(in)
21.0	13.4
42.1	26.9
26.1	16.7
47.8	30.6
58.3	37.3
34.3	21.9
36.1	23.1
26.1	16.7
31.0	19.8
39.7	25.4

File 29 - M. U. 89C  
 Elliottsville-Monson Complex, 5-15% slopes

Time(ns)	Depth(in)
28.0	17.9
25.5	16.3
38.2	24.4
19.8	12.7
31.2	20.0
46.3	29.6
20.7	13.2
37.9	24.2
48.9	31.3
51.7	33.1
33.9	21.7
21.3	13.6
42.7	27.3
39.7	25.4
61.6	39.4
26.1	16.7
24.1	15.4
26.7	17.1
40.3	25.8
48.3	30.9
27.0	17.3
30.0	19.2
82.0	52.5
54.7	35.0

File 30 - M. U. 48C  
 Dixfield-Colonel-Tunbridge Association, 3-15% slopes

Time(ns)	Depth(in)
103.0	65.9
94.6	60.5
106.4	68.1
102.1	65.3
99.1	63.4
140.0	89.6
112.1	71.7
114.2	73.1
110.9	70.9
95.2	60.9
64.6	41.3
48.7	31.2
72.4	46.3

File 31 - M. U. 94XC  
 Lyman-Tunbridge Complex, 4-25% slopes

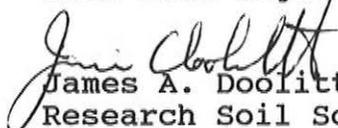
Time(ns)	Depth(in)
95.2	60.9
29.7	19.0
31.5	20.2
20.4	13.1

File 32 - M. U. 53C  
Dixfield-Colonel-Marlow Association, 3-15% slopes

Time(ns)	Depth(in)
96.4	61.7
59.2	37.9
33.3	21.3
50.8	32.5
58.9	37.7
42.1	26.9
58.6	37.5
44.2	28.3
51.7	33.1
88.6	56.7

It was once again my pleasure to work in your state and with members of your fine staff.

With kind regards.

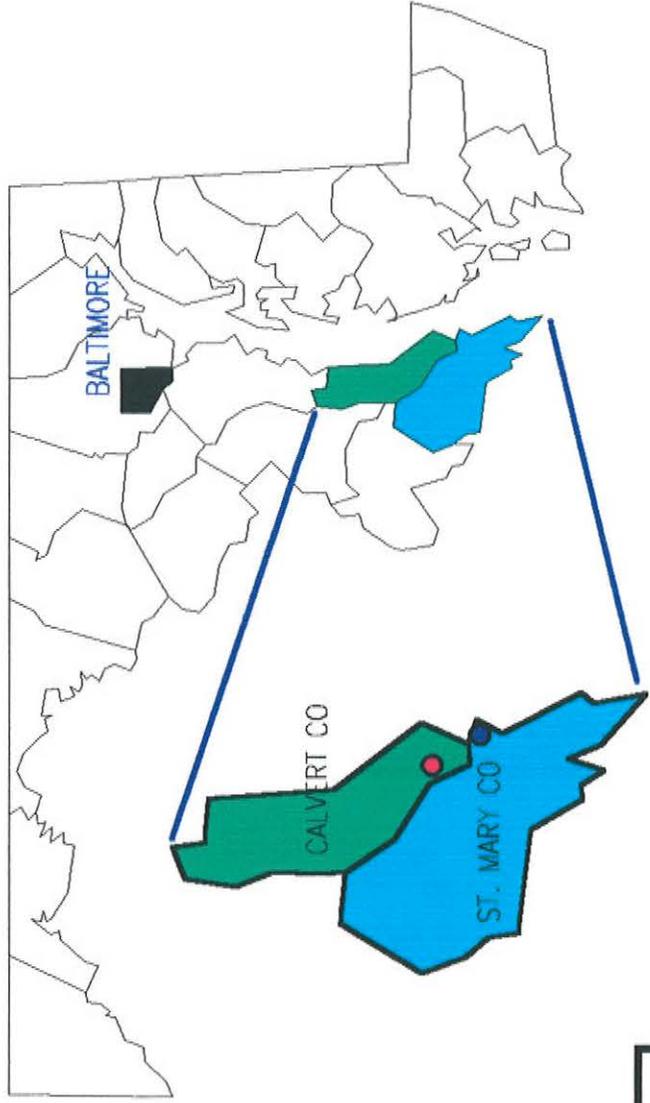
  
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# MARYLAND

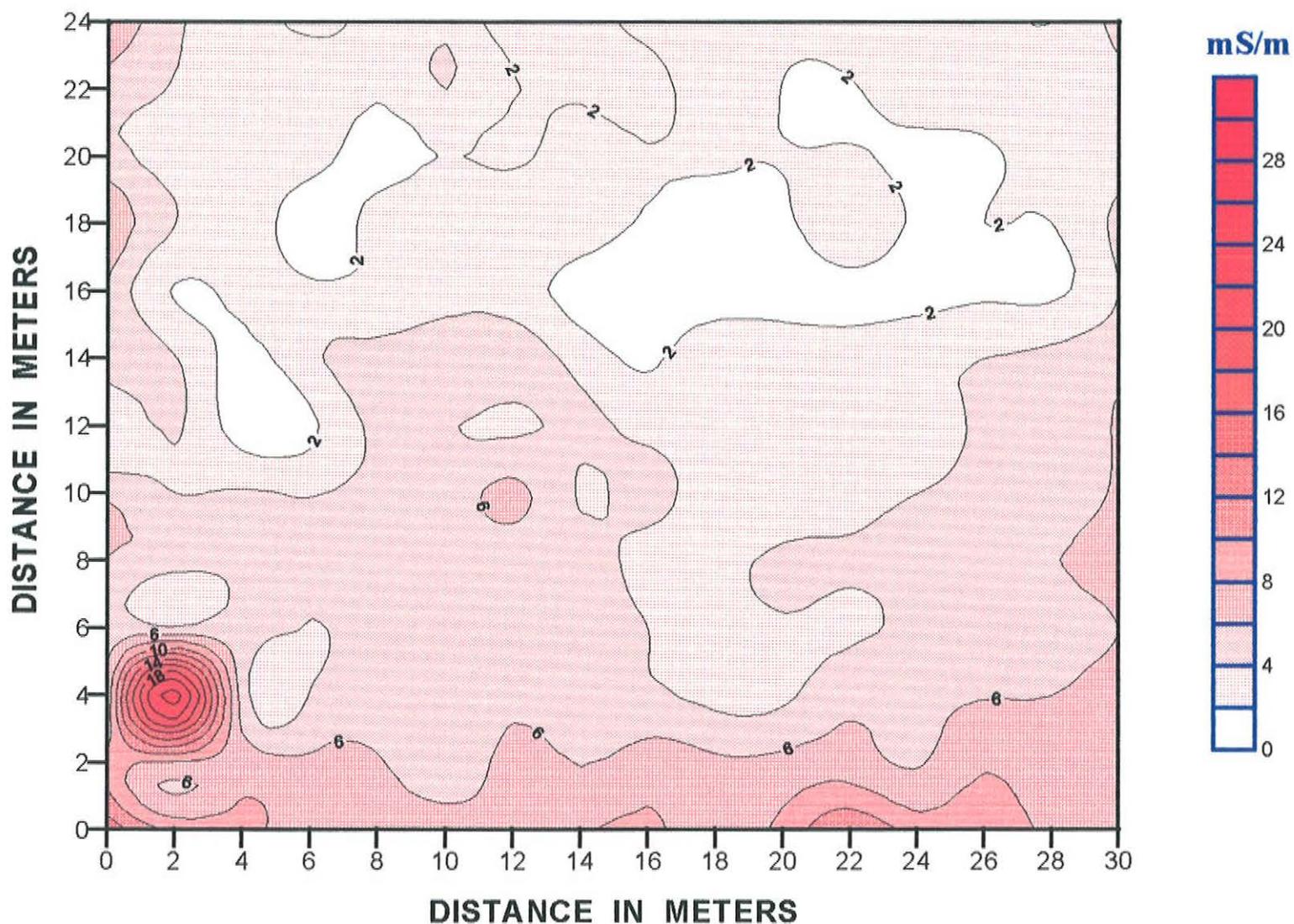


SITES OF ARCHAEOLOGICAL INVESTIGATIONS

- SMITH SITE
- MATTAPANI SITE

# SMITH ARCHAEOLOGICAL SITE JEFFERSON - PATTERSON STATE PARK

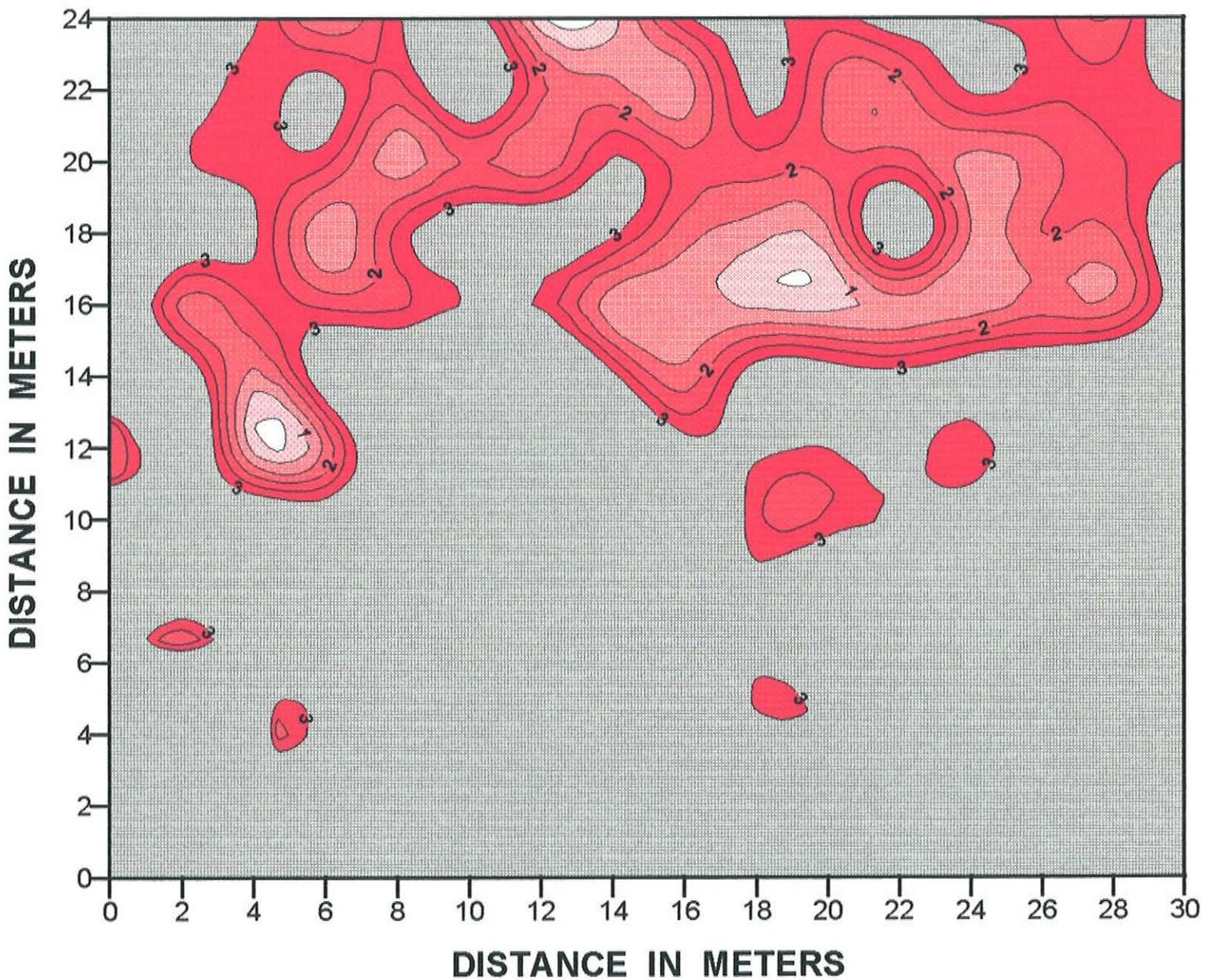
## ELECTROMAGNETIC INDUCTION SURVEY EM38 METER VERTICAL DIPOLE ORIENTATION



N →

# SMITH ARCHAEOLOGICAL SITE JEFFERSON - PATTERSON STATE PARK

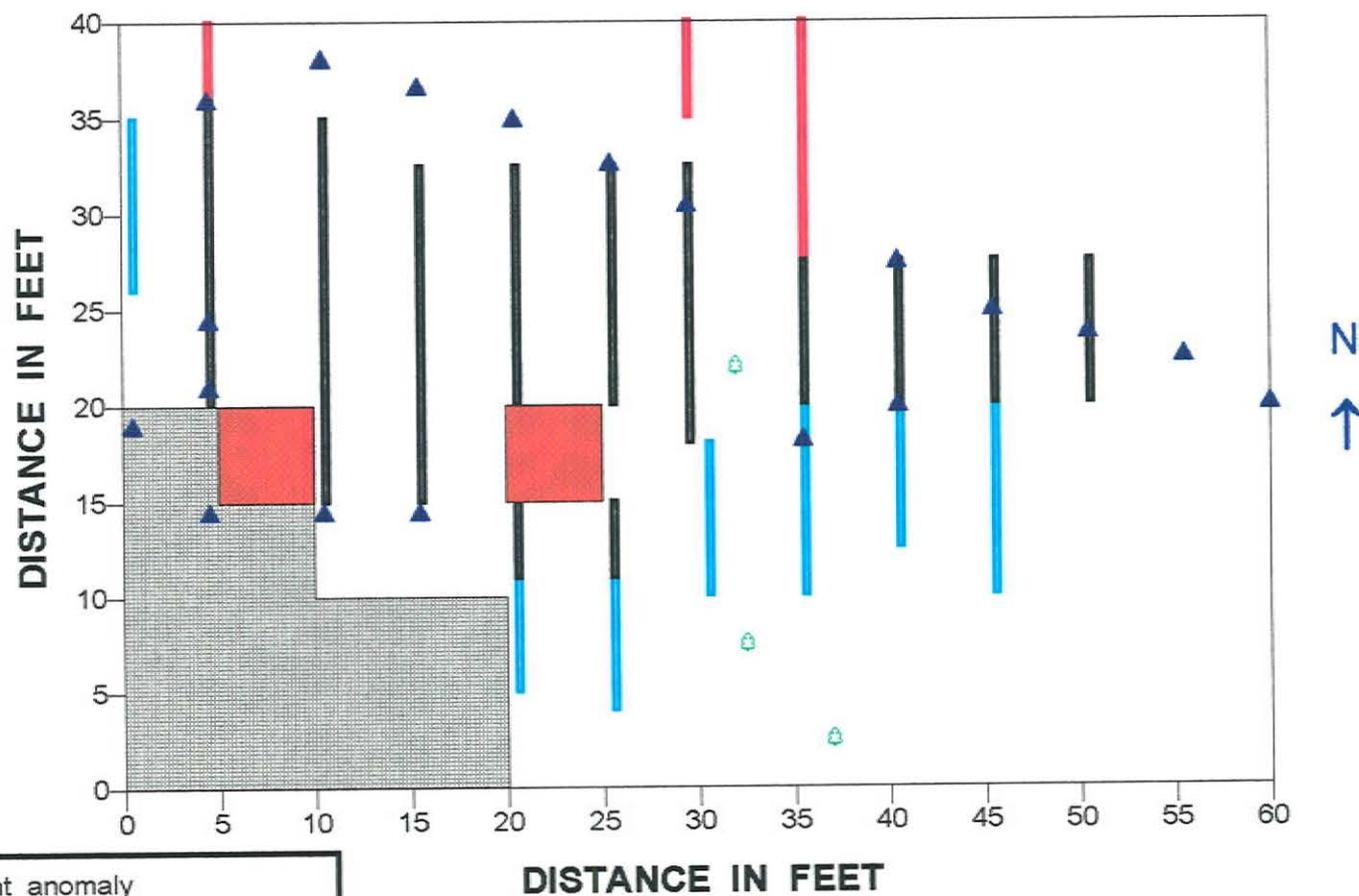
## ELECTROMAGNETIC INDUCTION SURVEY EM38 METER VERTICAL DIPOLE ORIENTATION (AREAS LESS THAN 3ms/m)



N →

# MATTAPANY SITE OF CALVERT'S HOUSE

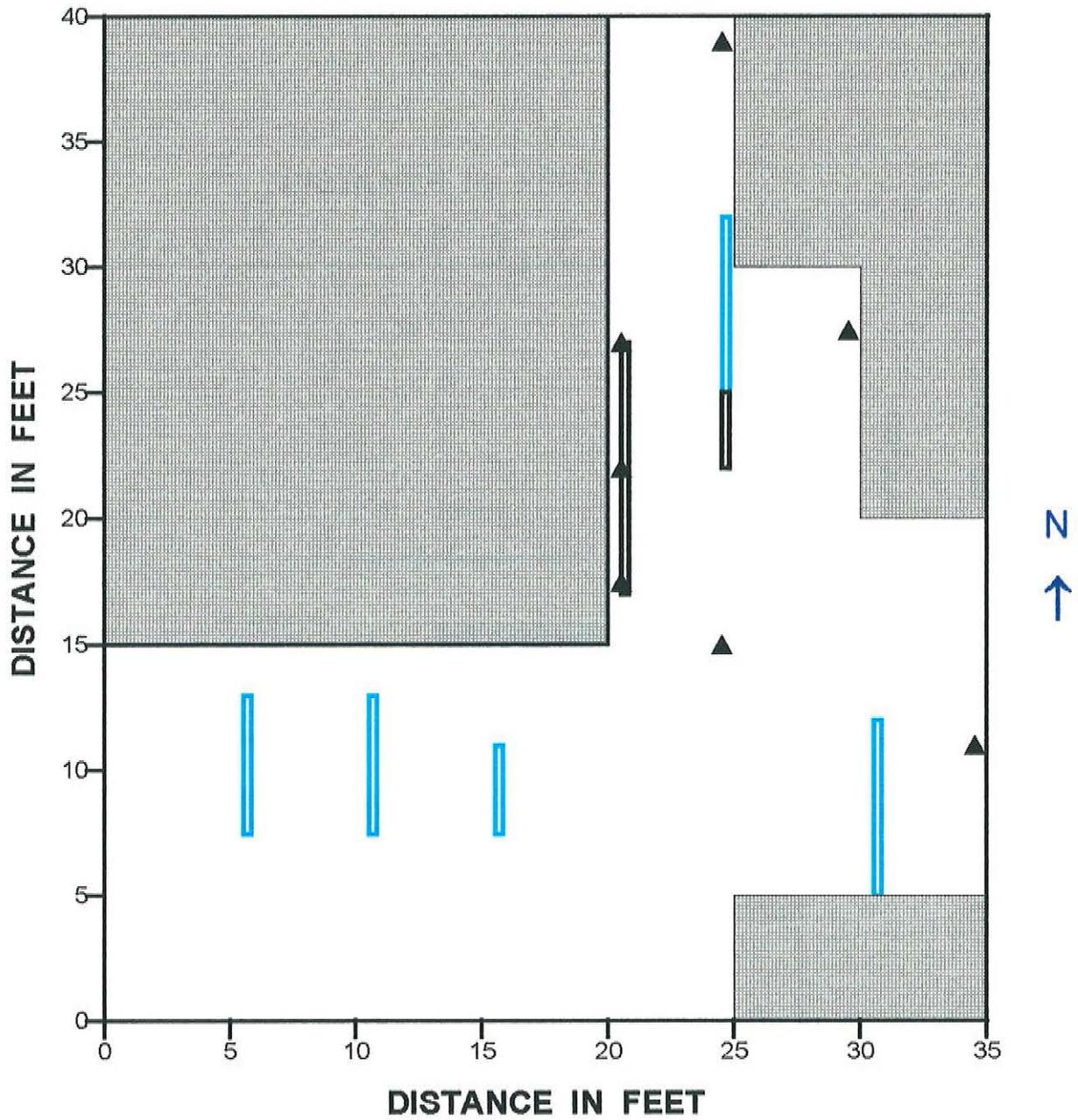
## RESULTS OF GROUND-PENETRATING RADAR SURVEY



- ▲ point anomaly
- ⊗ tree
- soil layer
- fill or cultural layers (strong)
- fill or cultural layers (weak)

# MATTAPANY SITE OF OUT-BUILDING

## RESULTS OF GROUND-PENETRATING RADAR SURVEY



- ▲ point anomaly
- 🌳 tree
- soil layer
- fill or cultural layers (strong)
- fill or cultural layers (weak)