UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
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Subject: GPR - Archaeological Survey
Yarmouth, Massachusetts.
April 30, 1992
Trip Report.

Date: 06-04-1992

To: Don Liptack
District Conservationist
Barnstable, MA.

Background:

On April 30, 1992 a Ground-penetrating radar (GPR) survey and a soil investigation was conducted on Great Island in Yarmouth, Massachusetts (see appendix A for location map). An archaeological team from UMASS uncovered a Late Prehistoric/Early Historic Period Native American cornfield under a half meter of windblown dune sand. The radar was used to determine the full extent of the field and to locate individual corn mounds and other cultural features, prior to this summers field work. A soil investigation was conducted to estimate the age and origin of the wind blown deposits that lie over the field.

In Attendance:

Jim Doolittle, Soil Specialist (GPR), Northeast NTC, Chester PA.
Pete Fletcher, Project Leader, Plymouth County Soil Survey
Don Liptack, District Conservationist, Barnstable County, MA.
Steve Mrozowski, Assistant Professor, UMASS, Boston.
Joanne Provost, Volunteer, USDA-Soil Conservation Service.
Richard Scanu, State Soil Scientist, USDA-SCS, Amherst, MA.
Steve Spear, Soil Conservationist, Barnstable County, MA.
UMASS Graduate Students.

GPR Equipment:

The GPR unit used at this site was a SIR (Subsurface Interface Radar) System-8. A 300 and 500 MHz antenna were tested at the site. The 500 MHz antenna worked best for the shallow investigation and was used for the investigation. The system is powered by a 12 volt battery.

The GPR is a broad bandwidth, pulse modulated radar system that has been specifically designed to penetrate earthen materials. Relatively high frequency, short duration pulses of energy are transmitted into the ground from a coupled antenna. When a pulse strikes an interface (boundary) separating layers of differing electromagnetic properties, a portion of the pulse's energy is reflected back to the receiving antenna. The reflected pulse is

received, amplified, sampled and converted into a similarly shaped waveform in the audio frequency range. The processed reflected signal is displayed on graph paper for further analysis. The graphic profile obtained consists of a horizontal scale which represents distance traveled along the transect line and a vertical scale which is a time scale which can be converted to a depth scale if velocity of signal propagation is known.

Procedure:

Once all members arrived at the site an overview of the project was discussed and the survey crew began to establish a grid for the area. Trial runs were made with the radar to determine optimal settings and antenna selection. A log of the soil profile was described by the soil scientists.

A 25 x 30 meter grid was laid out for the study site. Observation stations were located at one meter intervals throughout the grid. Transects with the radar were run in a south to north direction. The distance between transects was one meter. Ground elevations were recorded for the grid area (see figure two). Detailed elevations were recorded for the area of the buried cornfield.

Results:

Soil Investigations:

Appendix B is a copy of the soil log taken from the pit area. In general the area has a wind blown deposit of medium sand textures approximately two feet thick. Buried beneath the wind blown deposit is the original soil surface. The buried soil profile had developed in glacial outwash deposits.

The buried surface layer (Apb horizon) within the area of the cornfield differed from adjacent non cultivated areas in that: 1. the surface layer was thicker, 2. darker in color - interpreted to be a higher organic matter content, and 3. felt more compact when digging through and handling clods. The change in density and mineral composition for the buried plow layer was recorded as an interface by the radar. Where the strong interface occurred on the radar profiles, the buried field was interpreted to be present below the windblown deposit.

GPR Survey: (NOTE: all radar profiles are on file at the Middleboro Field Office)

A total of 15 transects were made with the radar. Transects continued until the interface for the buried plow layer was no longer recorded. Figure one is a copy of the radar profile from transect four (starting coordinate X=4, Y=0 to X=4, Y=20). On figure 1 the interface for the buried agricultural field is evident in the center of the profile from station 11 through 19. The dark wavy interface is 29 to 34 inches below the surface. The corn mounds are interpreted on figure 1 as the tops of the wavy interface (for example station 13.5 and 16 on figure 1).

Two point objects are located on figure 1, a point object is an isolated hyperbolic interface which is usually an anomaly in the soil such as a boulder or man made object. A good example of a point object signature is located on figure 1 between stations 7 and 8. This point object is located approximately 22 inches below the surface. The multiple reflections on each side of the hyperbolic signal indicate that a trench may have been dug around the point object and it may possibly be a well or cistern, however ground truthing is required to confirm this interpretation.

Figure 2 is a contour elevation map of the site (note: all contours are in feet). The area of detail was the area where elevations were recorded at each one meter station.

Figure 3 is a map showing the boundary of the buried field delineated with the radar, the field boundary coordinates are located on the right. Limit of survey means the field may continue beyond that coordinate but was not investigated with the radar.

Figure 4 is a detailed map of the field area, showing the location of the mounds (red asterisk) and the location of point objects (blue triangles) interpreted from the radar profiles.

Jim Turenne

James Turenne
Soil Scientist (GPR)
USDA-Soil Conservation Service

cc:
Rudy Chlanda, Geologist/Cultural Resource Specialist, USDA-SCS Amherst, MA.
Jim Doolittle, Soil Specialist (GPR), Northeast NTC, Chester PA.
Pete Fletcher, Project Leader, Plymouth County Soil Survey
Steve Mrozowski, Assistant Professor, UMASS, Boston.

APPENDIX A: Great Island Location Map
Hyannis Quadrangle

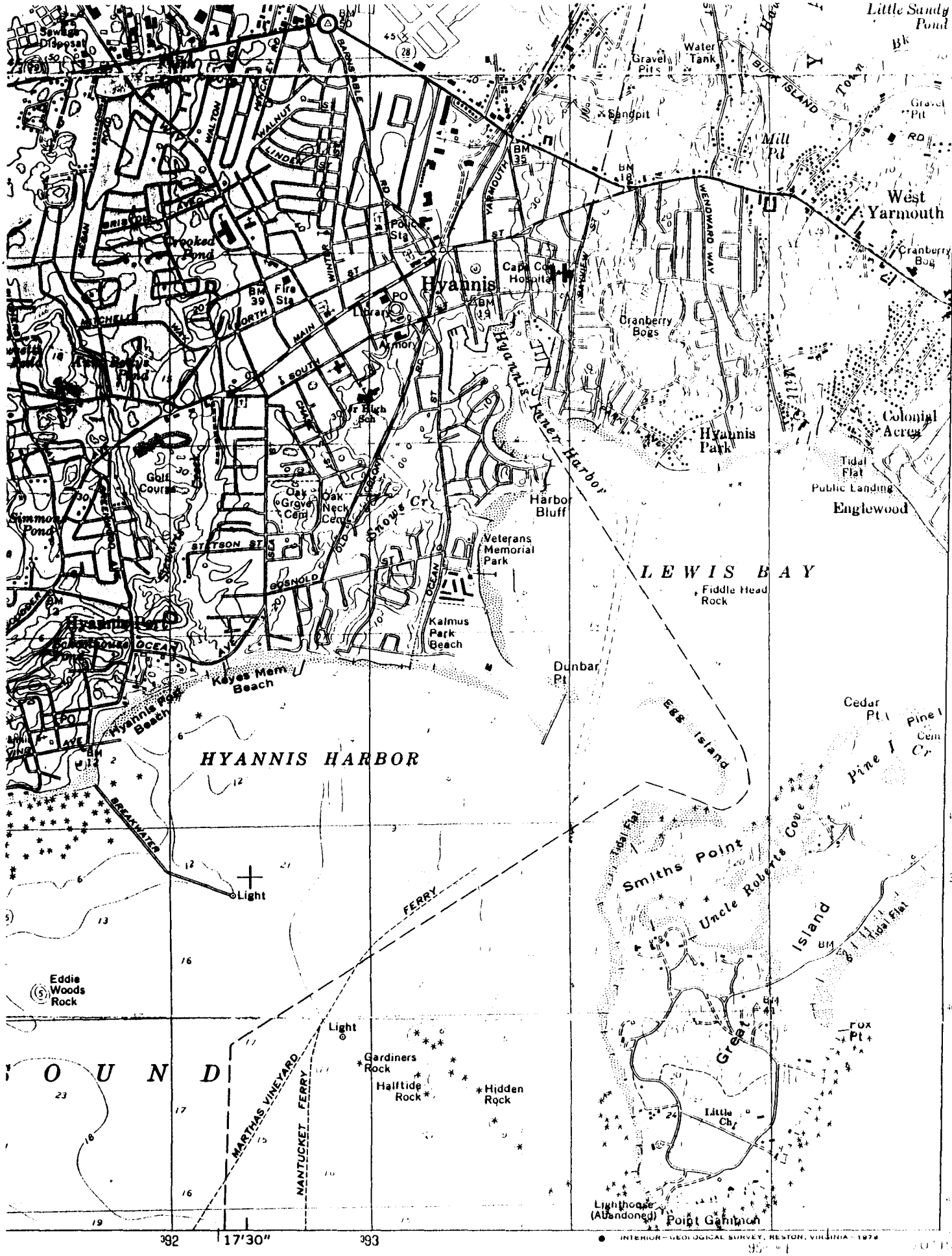


Figure ONE: GPR Profile from Transect 4 (30 nanoseconds)

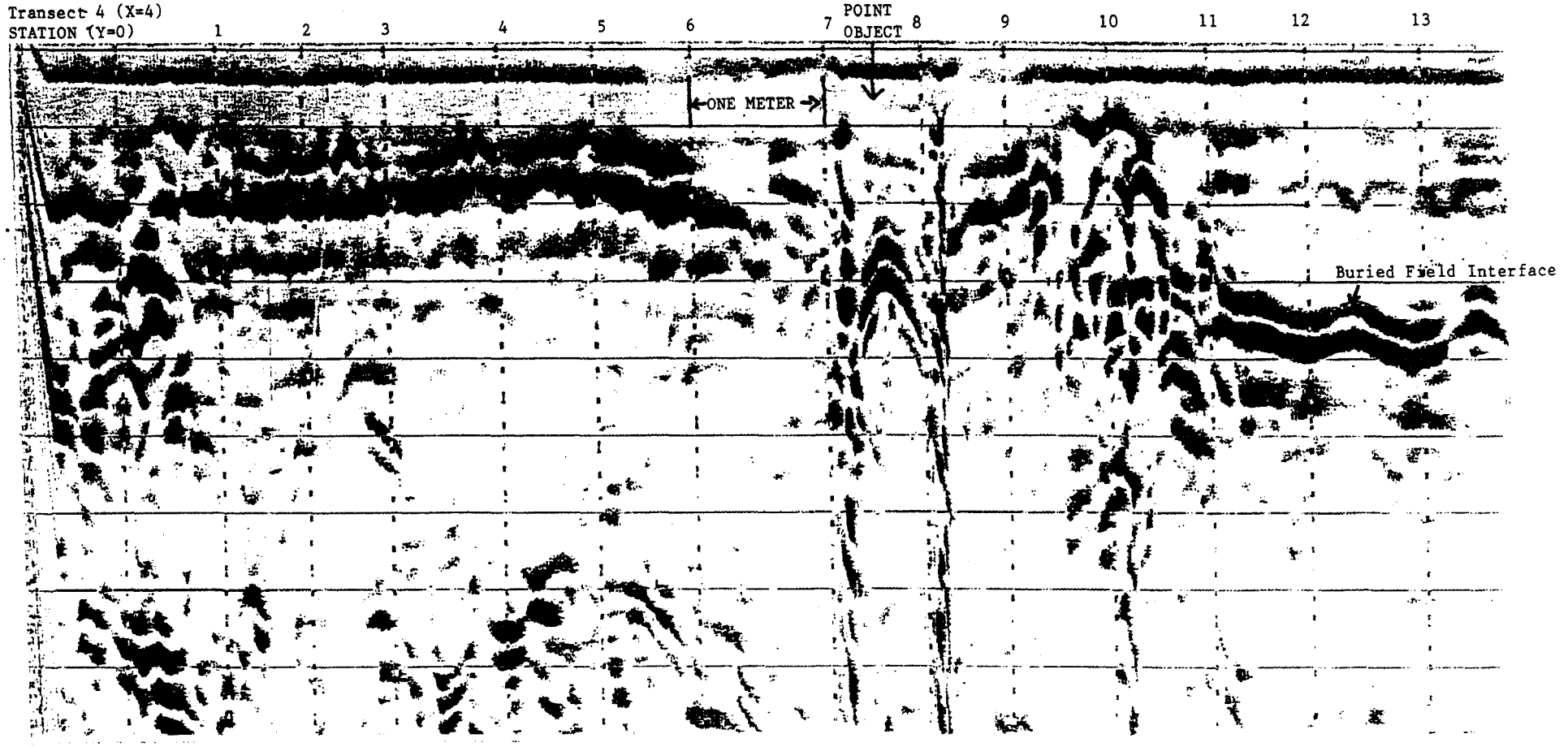
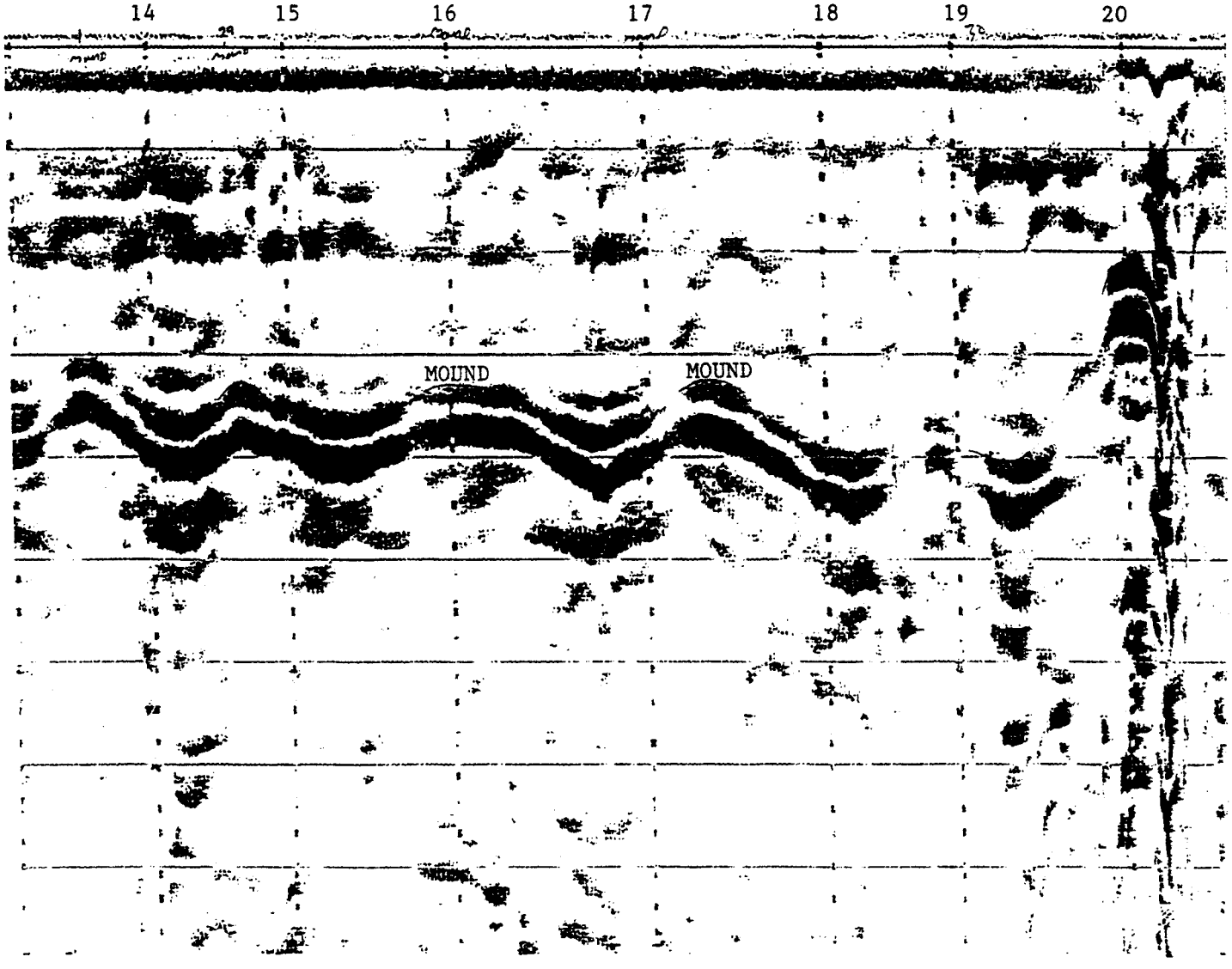
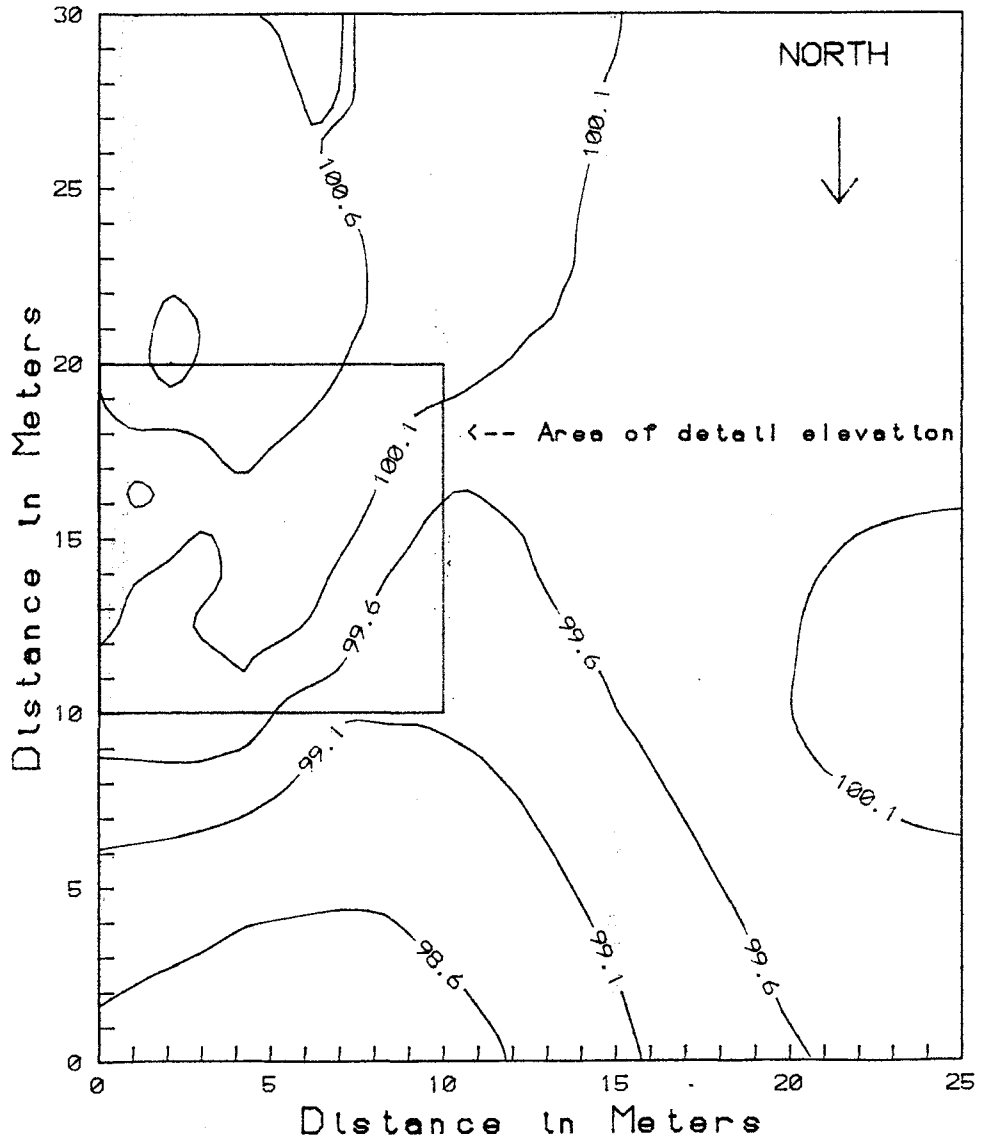


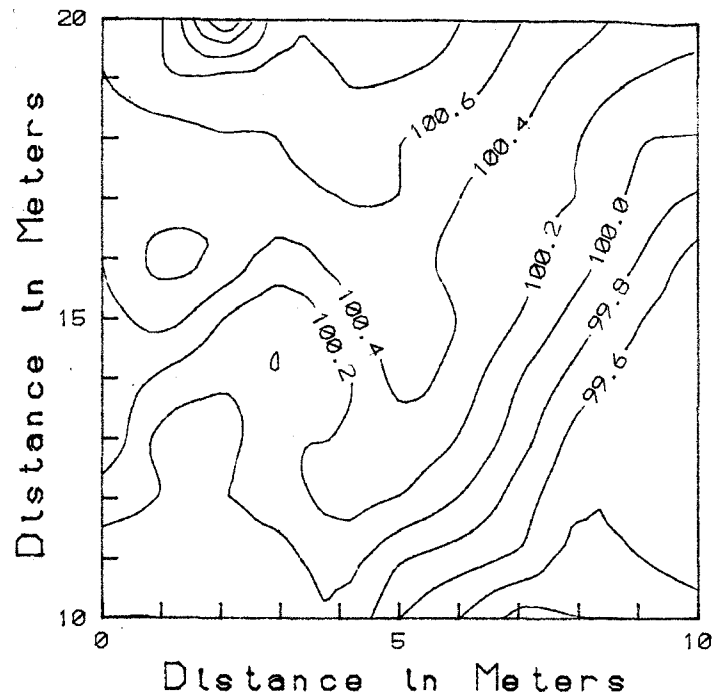
Figure ONE: (continued)



Yarmouth Site, Elevation Contour Map



Area of Detail Elevation

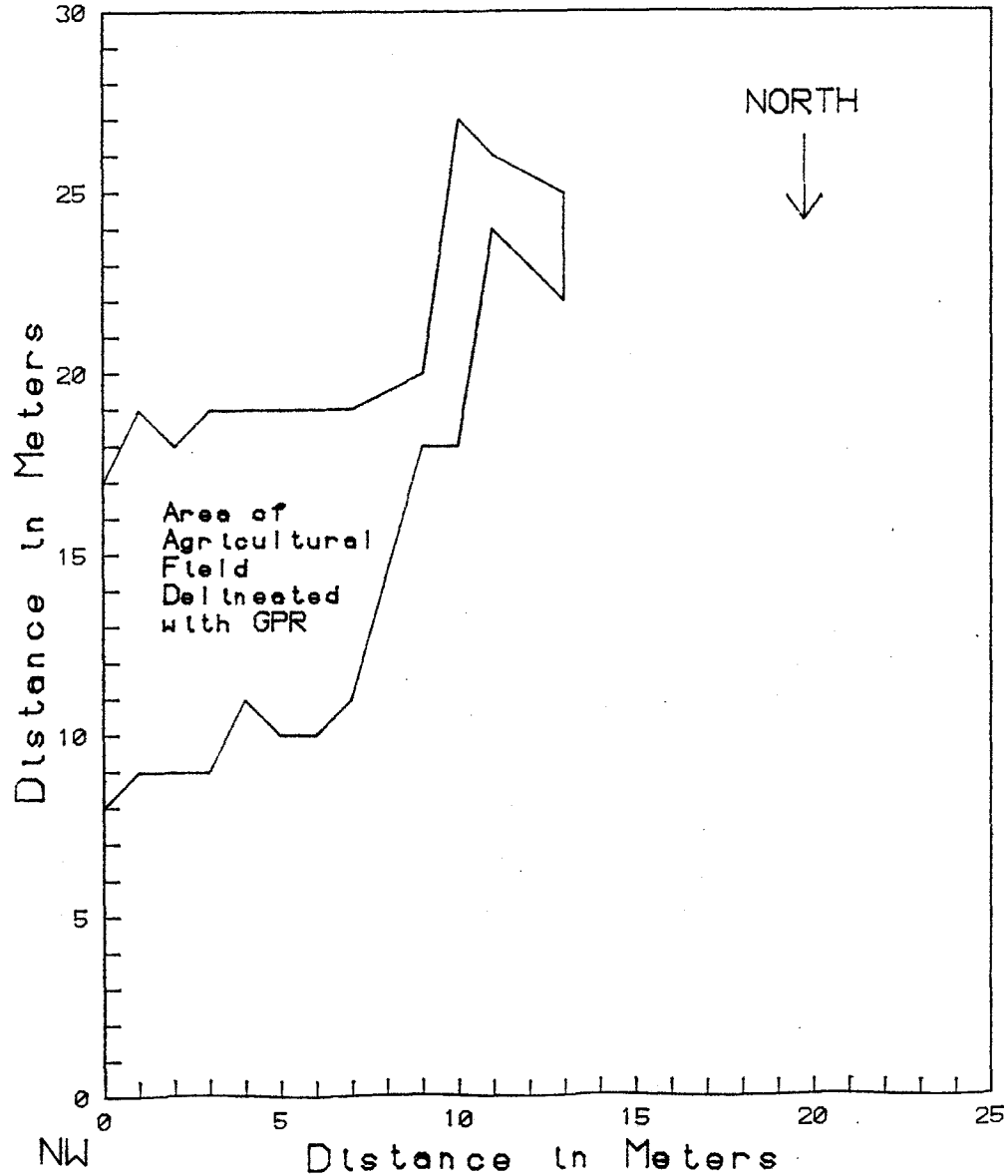


Conto
(al

Contour Interval = .5 feet
(all contours in feet)
TBM (100 feet base elevation)
- orange paint on large
boulder, southwest of site.

Fig
2

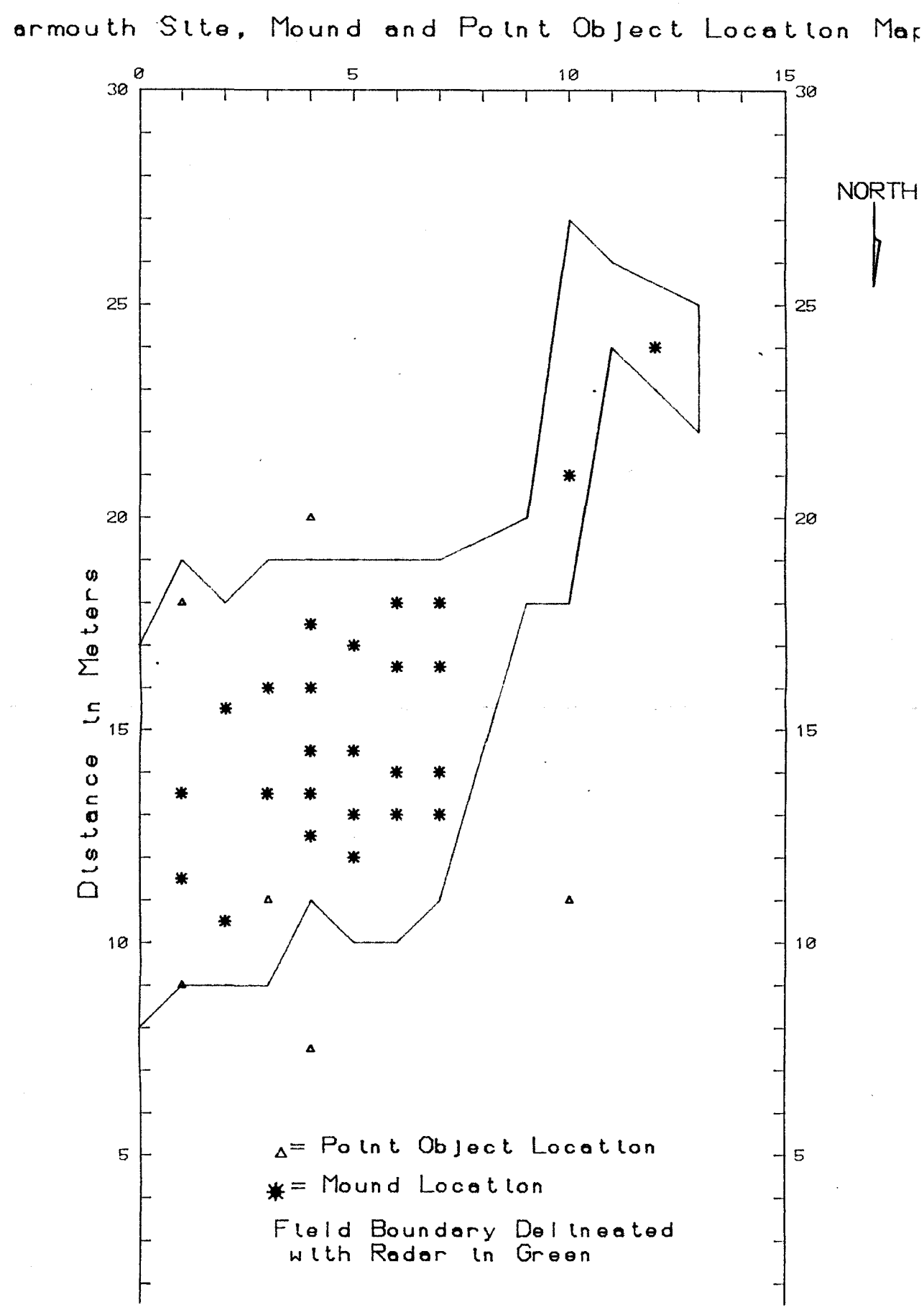
Figure 3



Field Boundary Coordinates
(delineated with GPR)

X-axis	Y-axis	Notes
0	8	
0	17	limit of survey
1	9	
1	19	
2	9	
2	18	
3	9	
3	19	
4	11	
4	19	
5	10	
5	19	
6	10	
6	19	
7	11	
7	19	
9	18	
9	20	
10	18	
10	27	limit of survey
11	24	
11	26	limit of survey
12	23	
12	26	limit of survey

FIGURE FOUR


armouth Site, Mound and Point Object Location Map
0
5
10
15
30
25
20
15
10
5
Distance in Meters
NORTH
△= Point Object Location
✱= Mound Location
Field Boundary Delineated
with Radar in Green

APPENDIX B

SOIL INVESTIGATIONS / FIELD NOTES

DESCRIBED BY: Pete Fletcher, Soil Survey Project Leader

REQUESTED BY: UMASS-Boston, Archaeology

SITE LOCATION: Great Island, Yarmouth, MA.

DATE April 30, 1992	TIME 12pm	WEATHER sunny, 50F
LAND USE Forested	LANDFORM	SLOPE nearly level
VEGETATION Red & White Oak, Red Cedar		STONINESS Isolated Boulder

SOIL TYPE Carver

SOIL CLASSIFICATION

PARENT MATERIAL eolian sand over glaciofluvial	DEPTH BEDROCK N/A
DRAINAGE CLASS excessively drained	HYDRIC SOIL no
DEPTH MOTTLES	DEPTH WATER TABLE greater than 6 feet

SOIL PROFILE DESCRIPTION

SOIL HORIZON	DEPTH INCHES	COLOR DRY/MOIST	SOIL TEXTURE	~~SOIL MOTTLING~~ Horizon Boundary	CONSISTANCY	
Oi	1.5-0		FIBRIC			NON Decomposed Leaves & Twigs
Oe	0-1.5	2.5YR 3/2	HEMIC	ABRUPT WAVY		PARTIALLY & WELL Decomposed Leaves & TWIGS. MANY VERY FINE & FINE ROOTS
E	1.5-2.75	10YR 4/1	SAND	ABRUPT WAVY	loose	SOME LIGHTER AREAS 10YR 5/1 UNCOATED QUARTZ SAND GRAINS COMMON VERY FINE & FINE ROOTS
Bh	2.75-3.75	10YR 4/2	SAND	ABRUPT SMOOTH	loose	COMMON VERY FINE & FINE ROOT FEW MEDIUM ROOTS
C1	3.75-7.75	10YR 4/3	SAND	CLEAR WAVY	loose	FEW VERY FINE TO MEDIUM ROOTS
C2	7.75-13.5	10YR 4/2	SAND	MICRO BOUNDARY POCKETS & CHANNELS INTERMIX, POSS WORM CHANNELS AW	loose	FEW VERY FINE-MEDIUM ROOTS
2Ab	13.5-19.5	① 10YR 2/1	② SANDY LOAM	CLEAR WAVY INTERMIXING	FRIABLE	COMMON VERY FINE-COARSE SHELLS & SHELL FRAGMENTS-COMMON
2B/Ab	19.5-26	B 10YR 4/3 Ab 10YR 3/1	LOAMY SAND SOME FINE & COARSE	CLEAR WAVY INTERMIXING	VERY FRIABLE	COMMON VERY FINE & FEW FINE & MEDIUM ROOTS
2B-C	26-40	10YR 5/5	LOAMY SAND SOME FINE & COARSE GRAINED		VERY FRIABLE	FEW VERY FINE & FINE

NOTES: 1) pockets of lighter material-blotchy appearance in some areas

2) Question whether fineness is due to organic carbon-question how stable is organic carbon in the soil?