A GEOPHYSICAL SURVEY

AT THE CARROLL HOUSE

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A Geophysical Survey at the Carroll House

This survey detected a possible well or other type of refilled pit on the south side of the house. Several likely paths, now buried, were delineated. See Figure 1.

Many areas of fill soil were mapped. There appears to be a buried earth layer, possibly a garden bed or pavement, extending east-west across the site; this interface can be partly traced beneath a recently-constructed cemetery terrace.

Concentrations of debris underground were also located. While some could be lenses of trash, others could help define lost structures. This geophysical survey did not detect anything of the tavern which might have formerly been at the east side of this site.

The Site

The Charles Carroll House is located on the south side of historic Annapolis, where the Duke of Gloucester Street meets Spa Creek. Charles Carroll, the house builder's son, was one of the signers of the Declaration of Independence. The house is a part of the property for St. Mary's Roman Catholic Church and plans are being made for the historical renovation of the house and garden.

In about 1948, extensive earthwork was done on the property; within the area of survey it appears that fill is more likely than earth removal. On the eastern side, an earlier terrace was extended for a small cemetery.

The relief at the site is about 25 ft, with high ground on the north and west. Adjacent to Spa Creek, the surface is only a few feet above the tidal water.

The site is covered by mown lawn grass with a moderate number of trees and bushes. The soil is somewhat sandy and appears to contain few stones.

Buried water pipes, drains, and electric wires are known to be on the property. The surrounding land is residential or commercial, with no industries or electric train lines in the vicinity. The Carroll House is built of brick.

A grid was set up along the line of the principal waterfront retaining wall, with a bend in this wall as a reference point.

While not parallel to the house, this alignment allowed the survey to be easily done down the line of bushes in the garden. Baseline offsets, extended up the hill from the waterfront, have an east-west error of as much as 5 ft due to the fact that bushes and topography block the line of sight. After the survey, Paul Shackel nailed metal jar lids at 50 ft multiple points on the geophysical grid to aid its relocation (W140 is the only irregular line).

The surficial information of Figure 1 is derived from a site map made by Bill Roulette and Eileen Williams, with supplementary measurements by Bill Helton, and by comparison with the at-surface indications on the radar profiles. The radar's location of walkways provides independent evidence of the lines of traverse.

The Survey

A SIR System-7 ground-penetrating radar, manufactured by Geophysical Survey Systems, profiled a length of 18,630 ft (3.53 miles). A model 3105 (180 MHz) antenna was found to be the most suitable at this site. A high resolution antenna, model 3102 (315 MHz), was tested but had too shallow a profiling depth; the soil resistivity here is about 60 ohm-m and geophysics indicates that the soil gets less sandy with increasing depth.

The depth scale of the radar profiles was estimated by a geometrical analysis of some echoes; from the information in Figure 3, an average pulse velocity of 0.35 ft/nanosecond provided this calibration.

The radar traverse speed was 5/8 ft per second and traverses were usually made toward the east and spaced by 5 ft. Bill Helton aided this survey.

Two additional geophysical instruments supplemented the investigation of some areas. A total of 221 measurements were made with a proton magnetometer (the average field was 54,500 nanotesla) and 210 readings were made of the electrical resistance of the earth. These surveys were done in collaboration with Eileen Williams, Mark Woods, Barbara Little, and Paul Shackel.

This field work was done over the period March 17-21, 1987. The weather was mostly sunny and warm then and there was no rainfall.

Survey Results

Figure 1 summarizes the major findings of the geophysical survey. The results there are derived from the detailed map of radar echoes, Figure 2. The depths indicated in Figure 2 are more likely to be overestimates than underestimates.

The right hand side of Figure 4 shows a reverberating echo of the radar pulse at a concrete sidewalk; there is evidentally an abrupt change in the earth below the walk, causing the radar pulse to resonate in the surface layer.

The deep echo toward the left side of the profile is more interesting. The fact that rather different echoes are vertically-aligned suggests that a deep refilled pit or similar feature could be here; a well or privy could cause this type of echo. The feature is less than 5 ft wide and extends to a depth of over 7 ft. It was also detected on parallel lines $2\frac{1}{2}$ ft either side of this line. The resistivity data in Figure 5 indicate that the earth has anomalously high electrical resistivity at the location of the deep radar echo; rubble or sand could cause this.

The echoes at E35-40 in Figure 4 are seen in Figure 2 to form a band; a buried path is likely. Figure 5 suggests that this likely path has low resistivity, suggesting an entrenched path or possibly construction with cinders rather than gravel. Several other possible paths are indicated in Figure 1; they are marked with a stippled pattern.

The earliest part of the Carroll House is on the east side, but historical records indicate a now-demolished extension even farther east. The radar profile of Figure 6 crosses this area and reveals a flat surface about 2 ft below ground with a more complex soil strata on the east (right). The radar also found many metal objects below the sidewalk on the south side of the house; Figure 7 shows the zone. A fluxgate magnetometer detected magnetic materials in this same zone.

Along line N110, a buried interface was detected which gives an unusually strong radar echo. It is mapped in Figure 1 between E85 and E320. Figure 8 gives an illustration. Fill earth for the extension of the cemetery terrace appears to have been placed over this stratum, for Figures 8 and 9 show it beneath the fill.

The material of this radar-reflecting stratum is not known, but it could be soil more loamy or more sandy than the other soils in the area. While about 3 ft below the present surface, this layer is somewhat deeper on the uphill side.

The radar also detected more complex strata in some areas. The area of irregular soil strata just south of the house, shown in Figure 1, could be at the location of a cow stable which is indicated on a map from about 1900. Other regions of irregular soil strata are shown in Figures 1 and 2. An illustration is given as Figure 10. These radar echoes could be caused by now-buried earthworkings or excavations, lenses of rubble or debris, or similar moderately complex soil features.

Cross-hatched patterns in Figure 1 map some of the areas where fill earth was detected. While the downhill half of the cemetery is also fill, it is not mapped here because geophysics did not reliably indicate it. The area of irregular soil strata around N140W50 may also be caused by fill soil. While these areas of fill can mask or mimic archaeological features, they might also preserve them.

A rather deep feature was found near the south end of the property. It is shown in Figure 11 and is more likely to be a natural earth contrast than a cultural feature. Figure 12 is the map of a magnetic survey done in the area; anchor rods from the wooden sea wall cause the strong magnetic low on the east (these rods also cause the radar echoes at a 10 ft spacing on line N10). A magnetic object near S105W130 at a depth of less than about 2 ft causes a distinct magnetic anomaly and also appears to have caused the reverberating echo of Figure 13. This is probably an iron object weighing less than 5 lb.

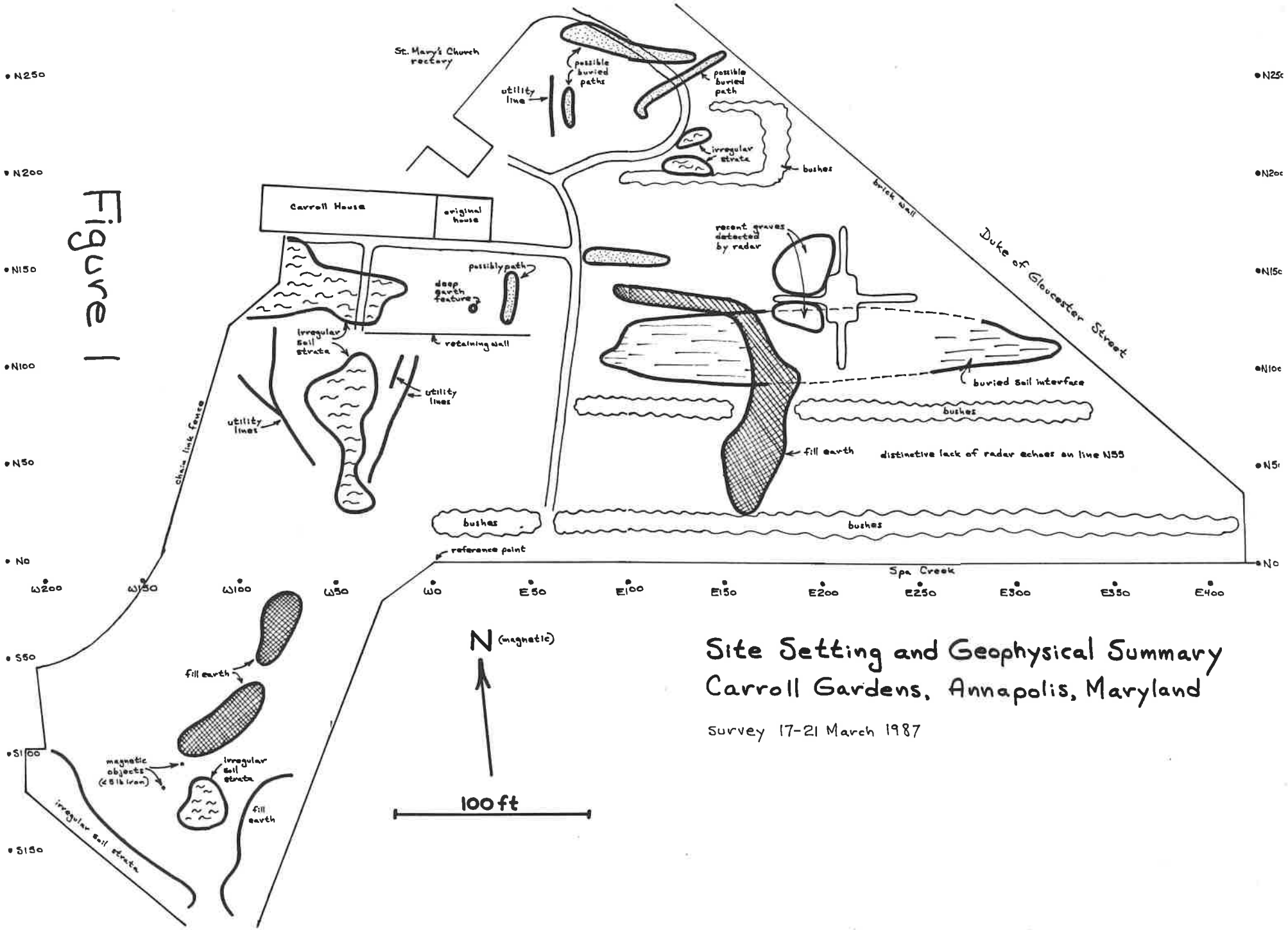
Line N55 is unusual. For a band probably less than 10 ft wide, there is almost a complete lack of radar echoes going east-west across the width of the site. Figure 14 shows the sharp contrast with 5 ft away. While a path or similar feature could be here, it was not directly detected by the radar.

It is possible that several summer houses were once somewhat offset from that line. Two resistivity profiles were measured along line N40. The sawtooth pattern predominant on the left side of Figure 15 is caused by unresolved earth features less

than 2 ft deep and spaced by 4-8 ft; this could be the result of cultivation of the soil. The span E300-310 shows a modest anomaly, although the radar profile of Figure 16 indicates only a small contrast there.

The two radar antennas were compared in a profile across the cemetery, Figure 17. Echoes from recent graves, on the left, are very shallow and the cause is not known. There is little detection of the seven reburials from moved 19th century graves.

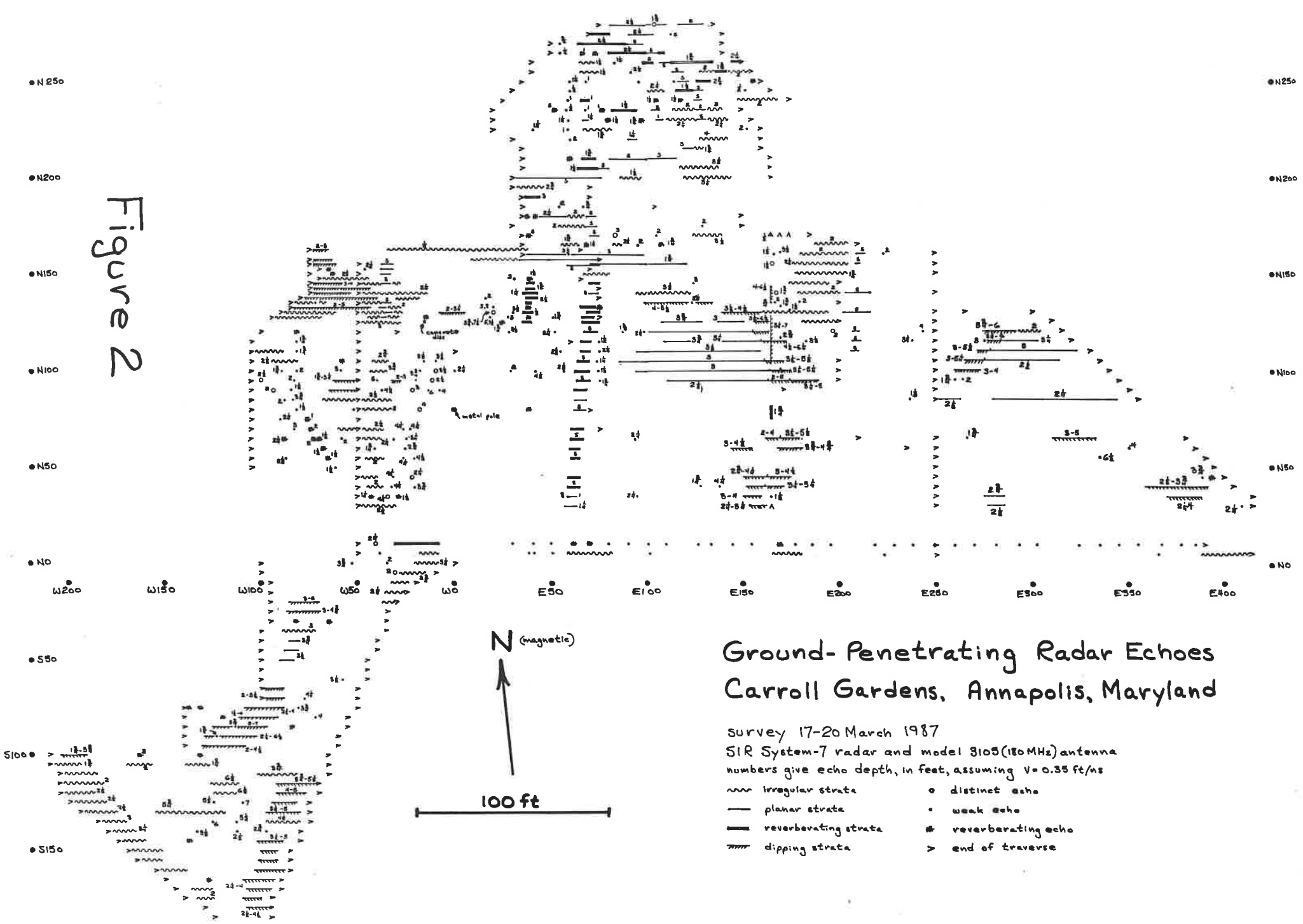
Figure 1



Site Setting and Geophysical Summary
Carroll Gardens, Annapolis, Maryland

Survey 17-21 March 1987

Figure 2



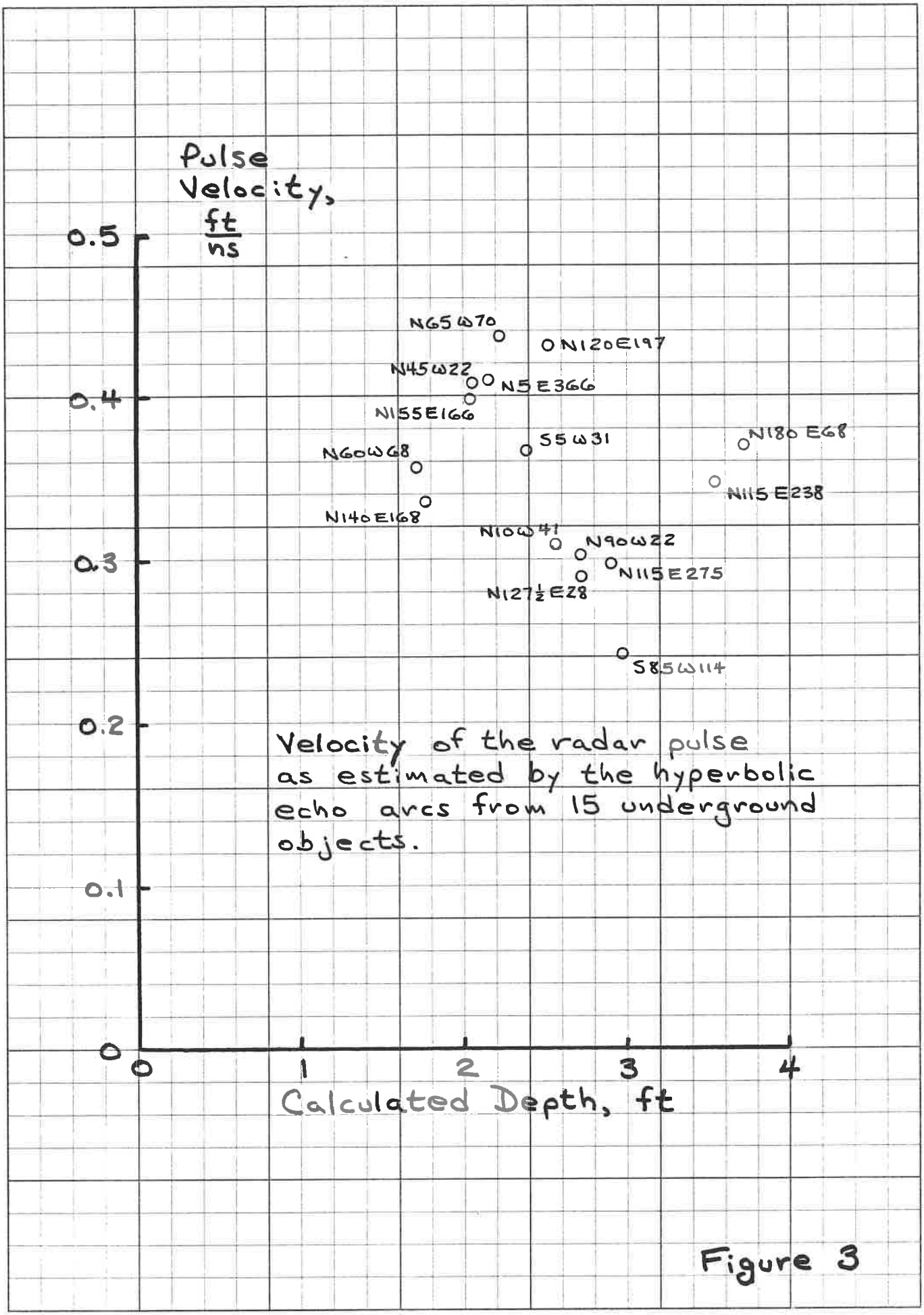
Ground-Penetrating Radar Echoes
Carroll Gardens, Annapolis, Maryland

Survey 17-20 March 1987

SIR System-7 radar and model 3105 (150 MHz) antenna

numbers give echo depth, in feet, assuming V = 0.35 ft/ns

~~ irregular strata	o distinct echo
—— planar strata	· weak echo
═══ reverberating strata	# reverberating echo
≈≈≈ dipping strata	> end of traverse



Velocity of the radar pulse as estimated by the hyperbolic echo arcs from 15 underground objects.

Figure 3

line N130
markers at 5 ft intervals
model 3105 (180 MHz) antenna
survey 18 Mar 87

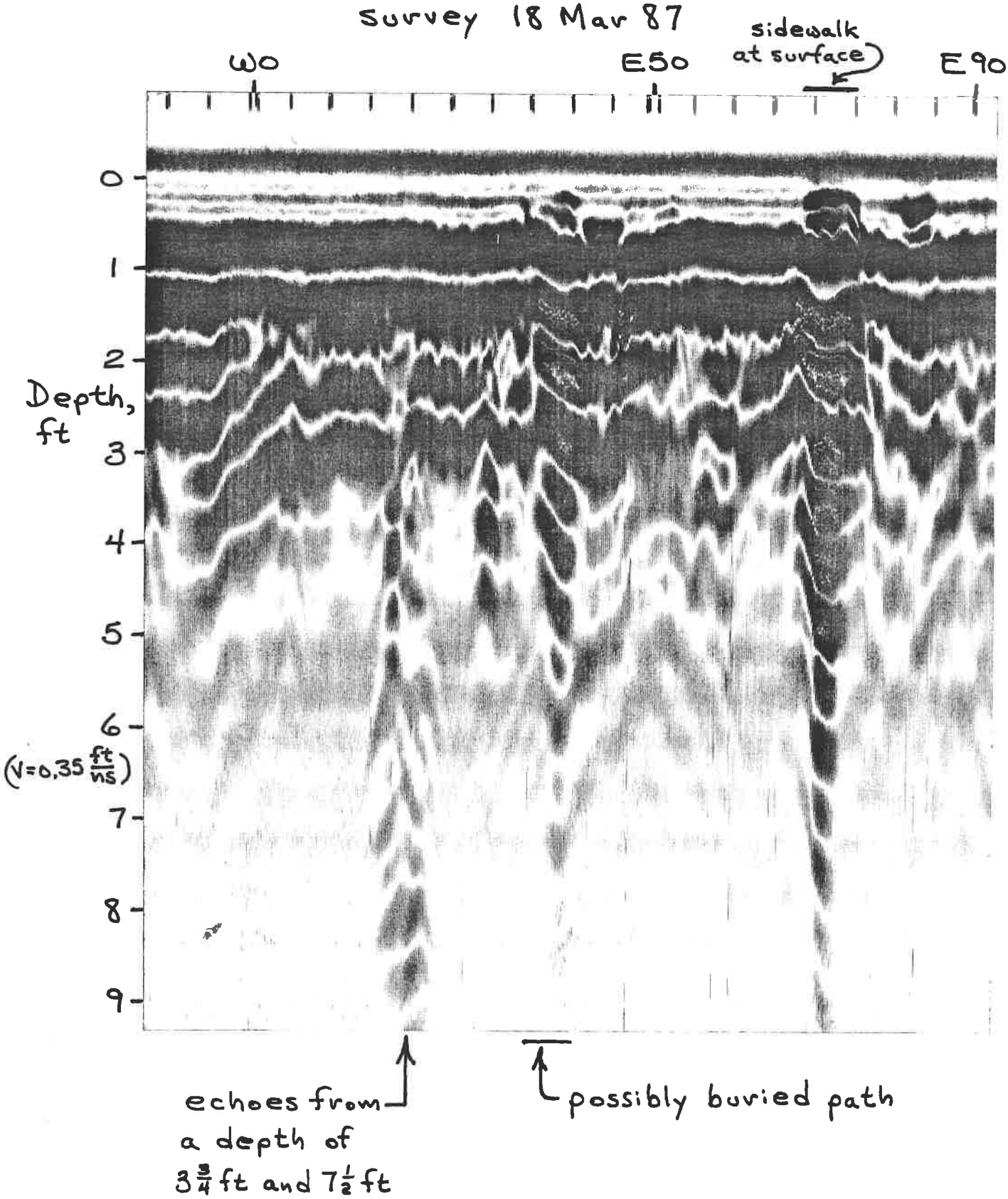


Figure 4

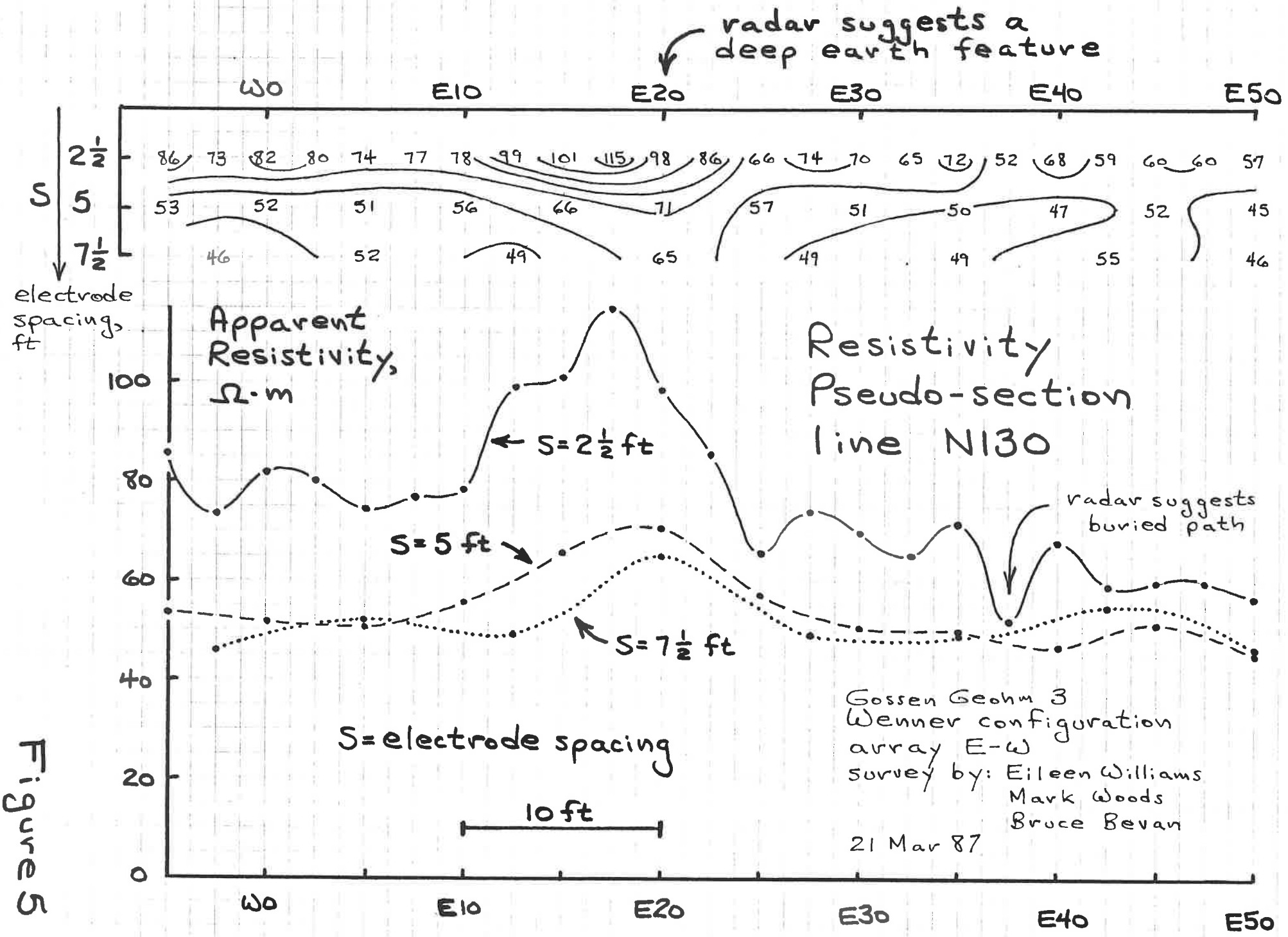

radar suggests a deep earth feature
W0
E10
E20
E30
E40
E50
S
2½
5
7½
86 73 82 80 74 77 78 99 101 115 98 86 66 74 70 65 72 52 68 59 60 60 57
53 52 51 56 66 71 57 51 50 47 52 45
46 52 49 65 49 49 55 46
electrode spacing, ft
Apparent Resistivity, Ω·m
100
80
60
40
20
0
S=2½ ft
S=5 ft
S=7½ ft
Resistivity Pseudo-section line N130
radar suggests buried path
S=electrode spacing
10 ft
Gossen Geohm 3
Wenner configuration
array E-W
survey by: Eileen Williams
Mark Woods
Bruce Bevan
21 Mar 87

Figure 5

line N180
markers at 5 ft intervals
model 3105 (180 MHz) antenna
survey 18 Mar 87

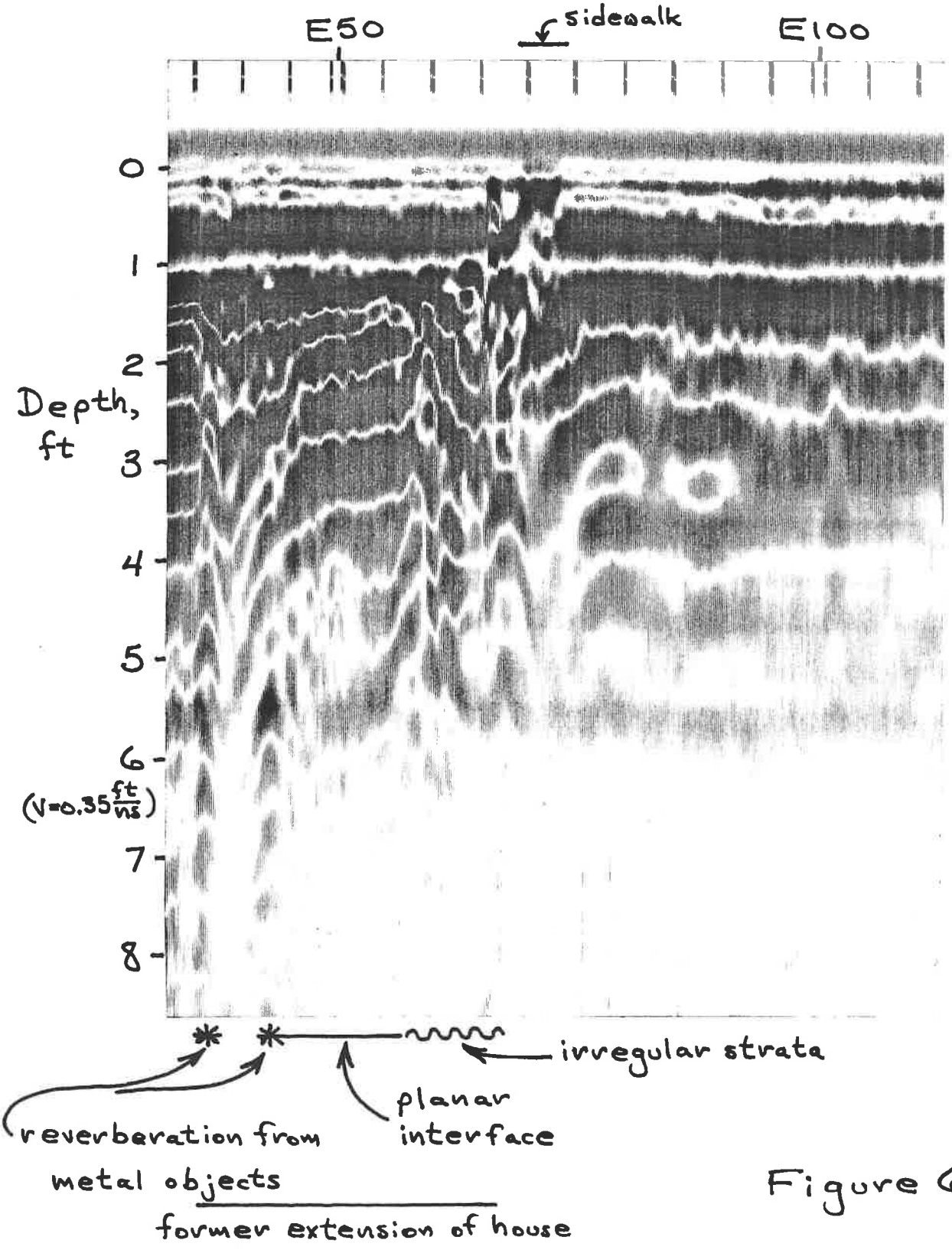


Figure 6

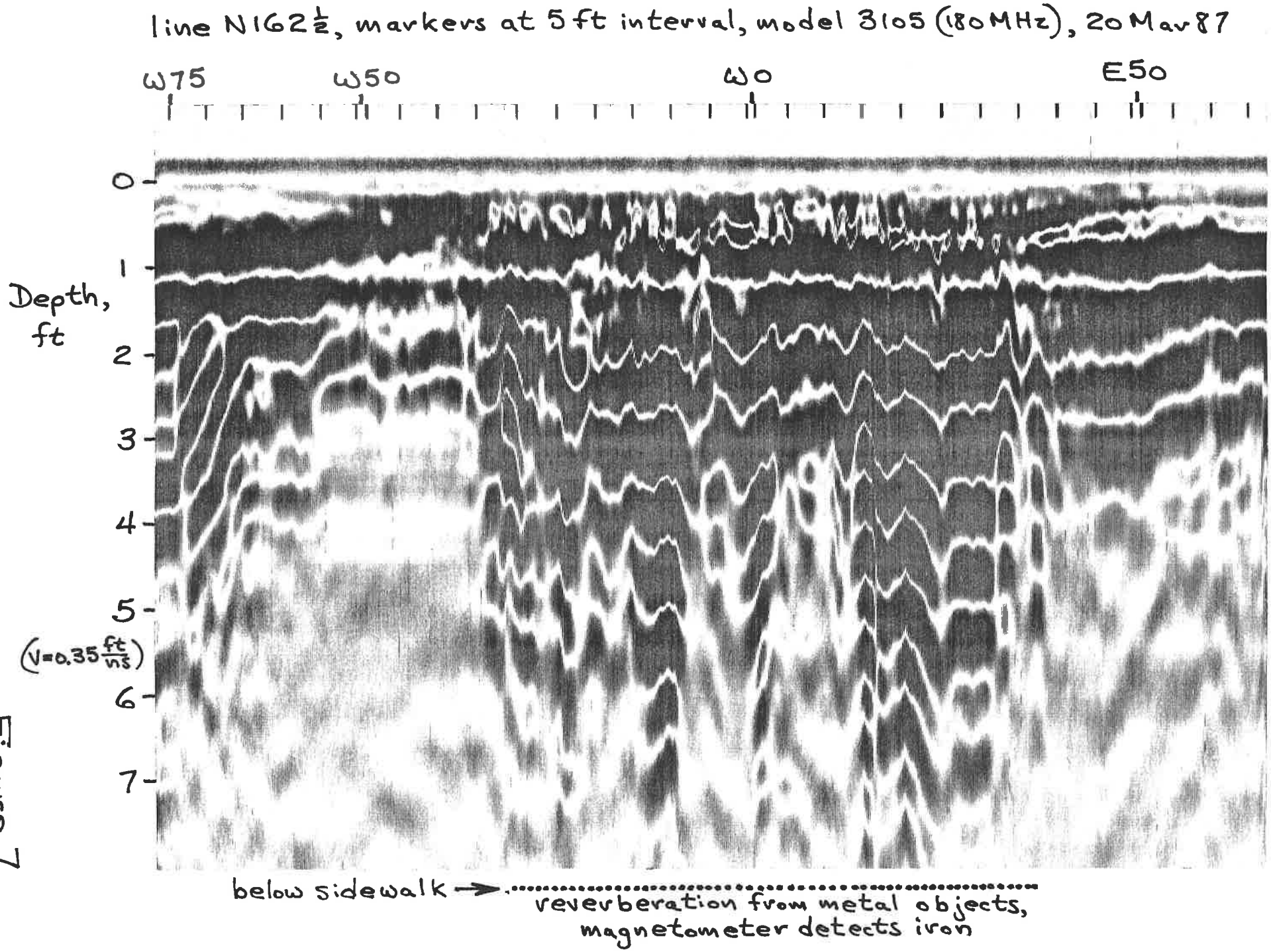

line N162½, markers at 5 ft interval, model 3105 (180 MHz), 20 May 87
W75
W50
W0
E50
0
1
2
3
4
5
6
7
Depth, ft
(V=0.35 ft/ns)
below sidewalk →
reverberation from metal objects, magnetometer detects iron

Figure 7

line N110
markers at 5 ft intervals
model 3105 (180 MHz) antenna
survey 19 Mar 87

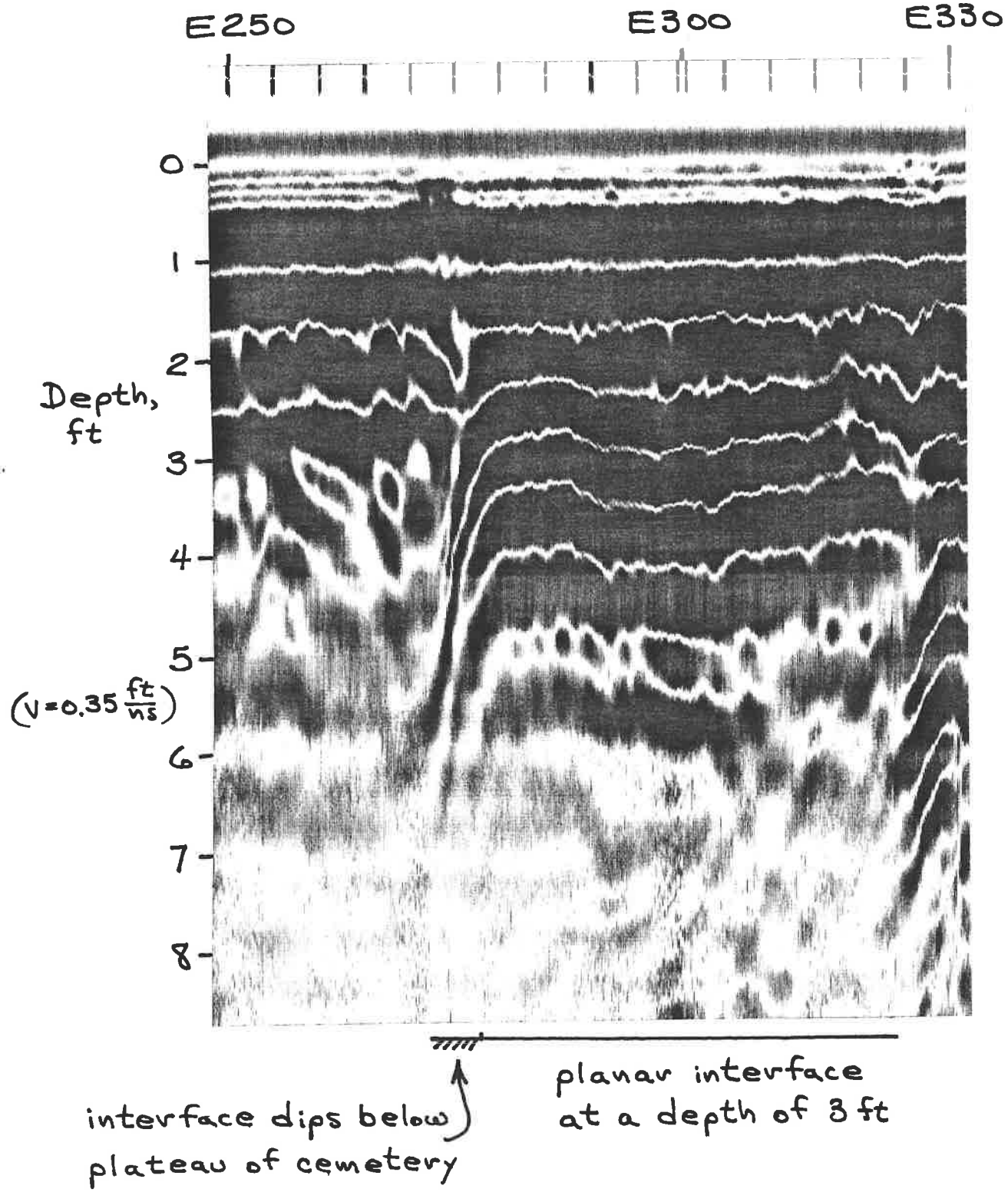


Figure 8

line E165
markers at 5 ft intervals
model 3105 (180 MHz) antenna
survey 20 Mar 87

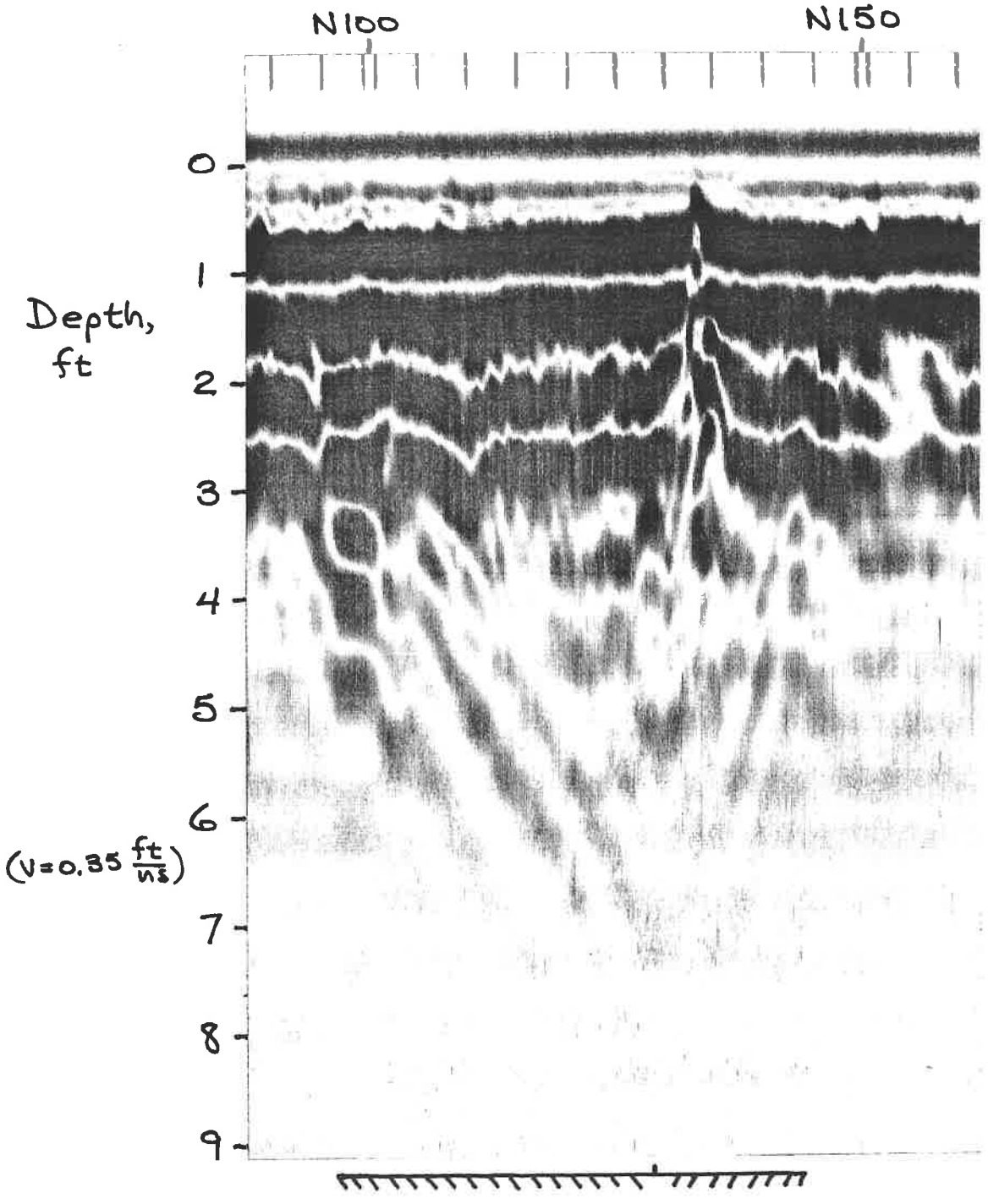
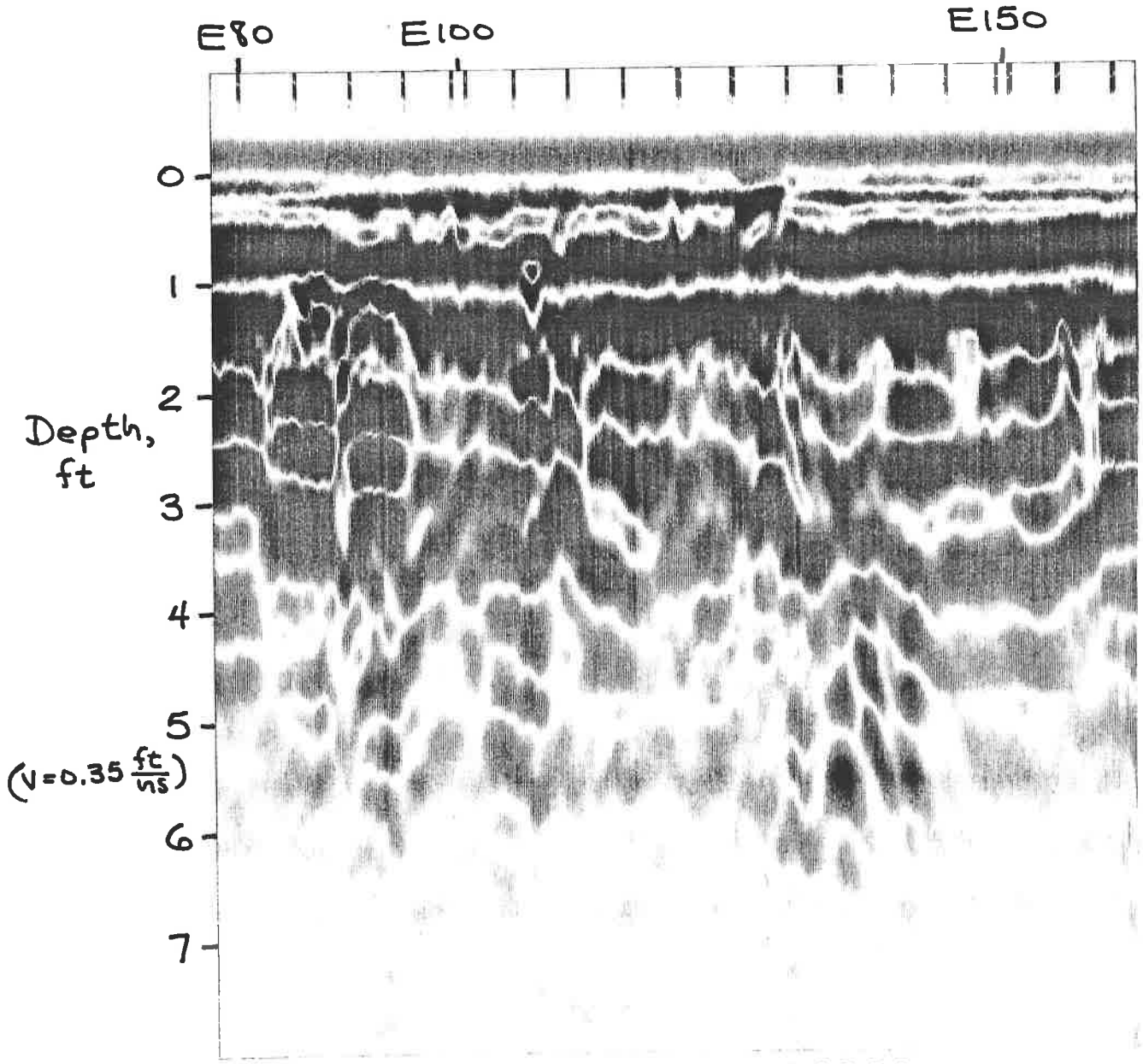


Figure 9

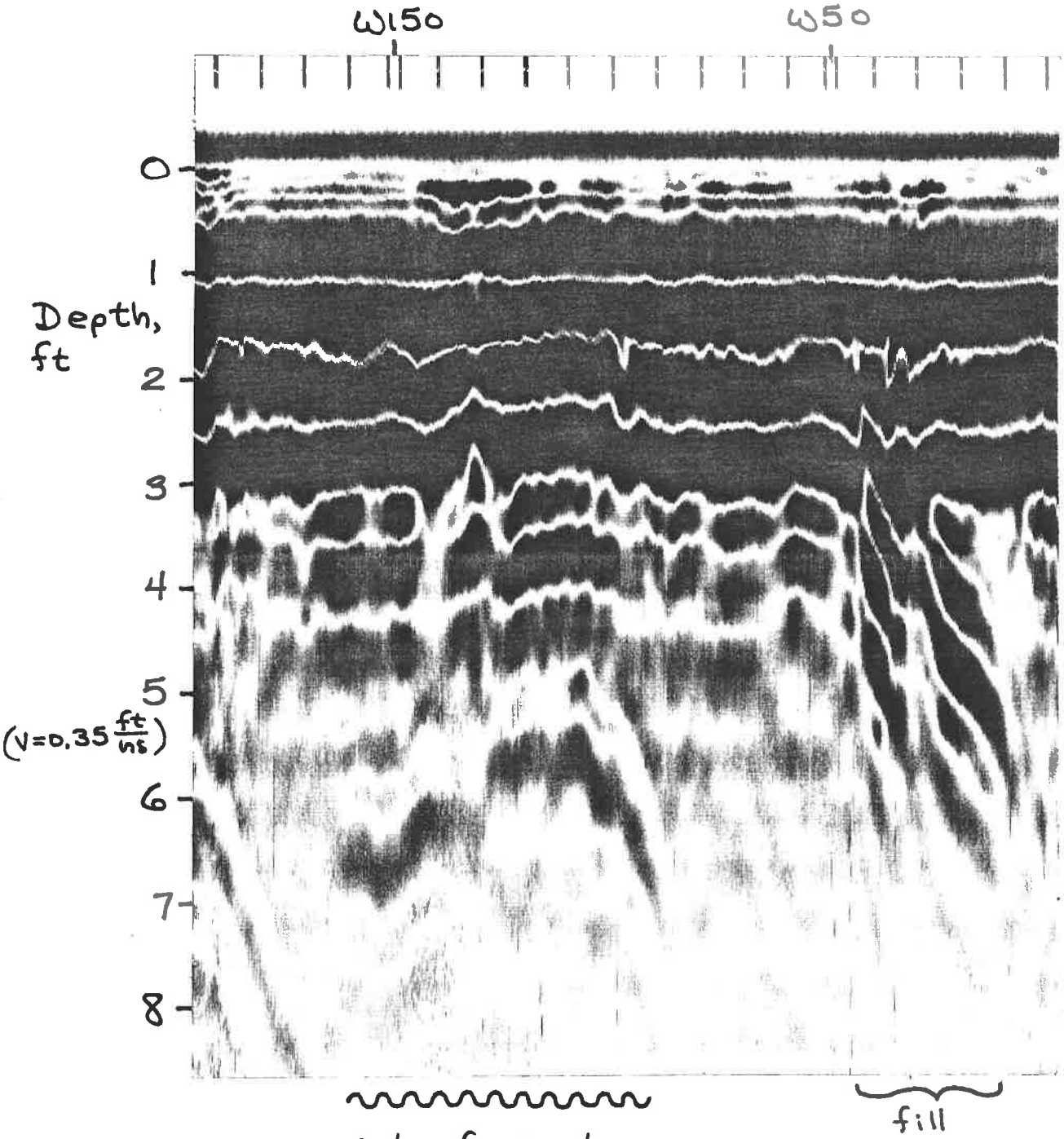
line N220
markers at 5 ft intervals
model 3105 (180 MHz) antenna
survey 17 Mar 87



irregular strata at a depth of 4 ft

Figure 10

line 5130
markers at 5 ft intervals
model 3105 (180 MHz) antenna
survey 20 Mar 87



interface at
an apparent depth
of 5¾ ft

(depths are overestimated where below water table)

Figure 11

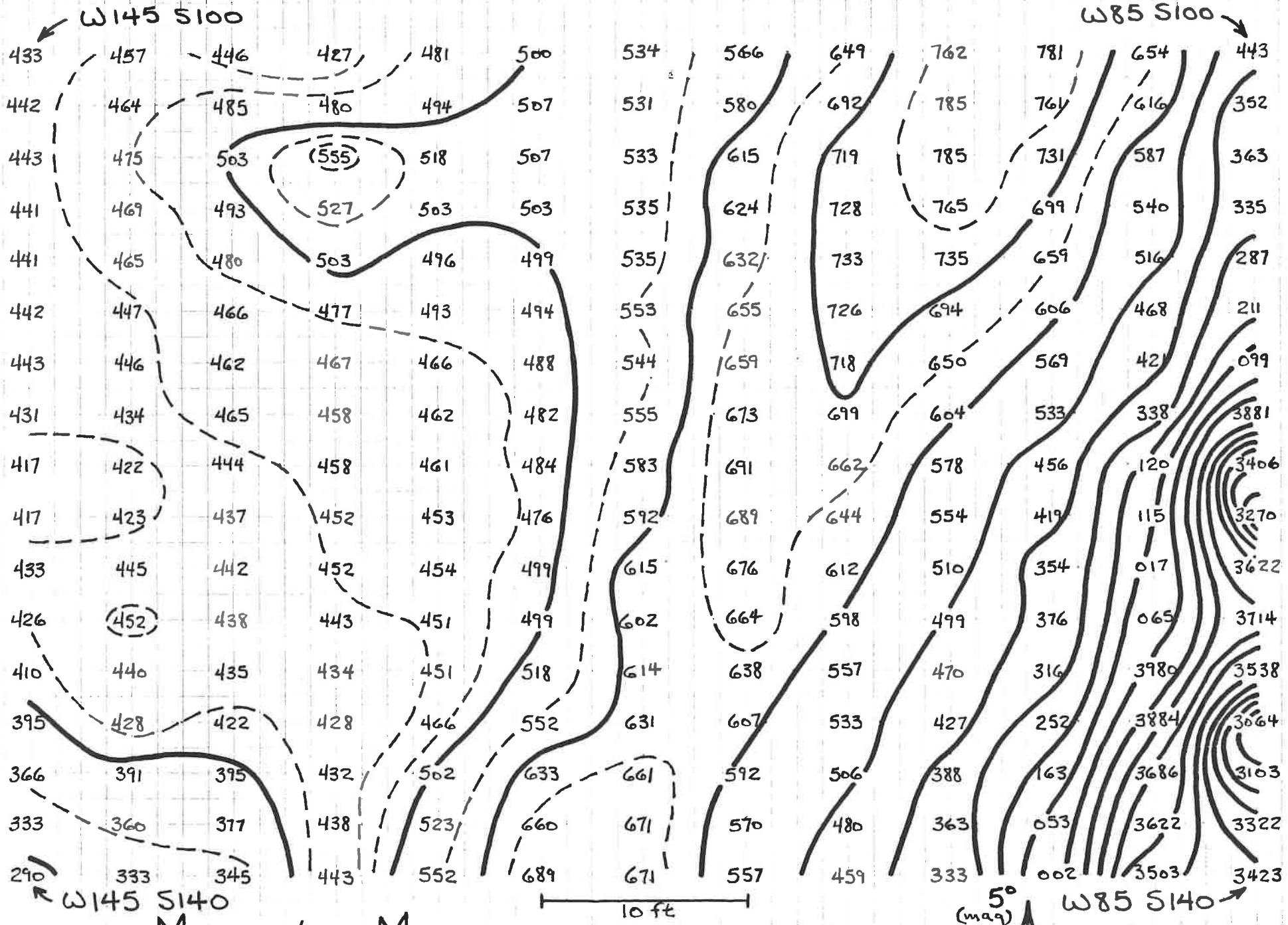


Figure 12

Magnetic Map, contour interval = 100 nT — 25 or 50 nT ---

total flux density
survey 21 Mar 87
no temporal correction
A (Fred.) = 19

sensor height = 3 ft
digits are XYZ in 54,XYZ nT
Scintrex MP-2 proton magnetometer

survey by:
Eileen Williams
Mark Woods
Bruce Bevan

line 5105
markers at 5 ft intervals
model 3105 (180 MHz) antenna
survey 20 Mar 87

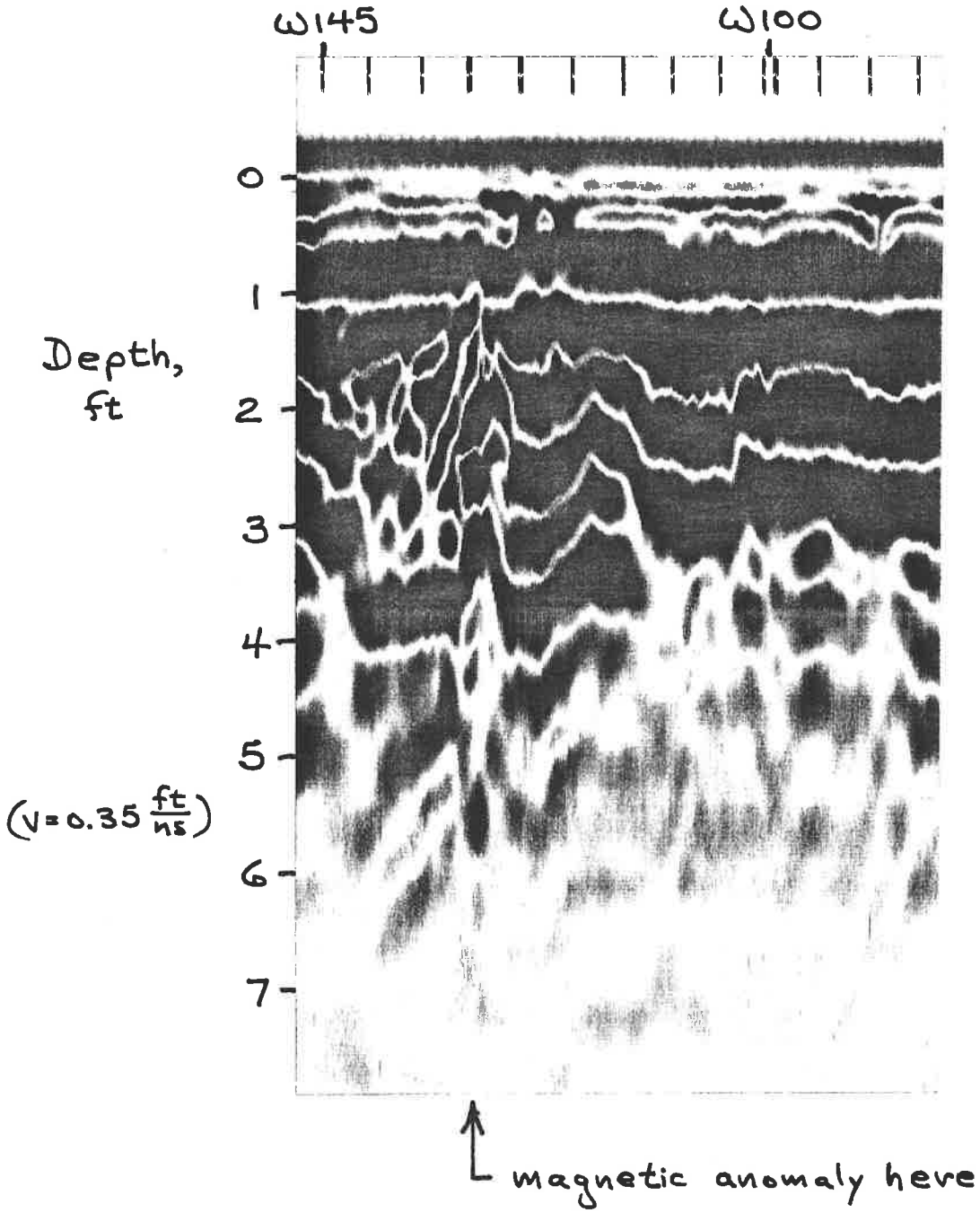


Figure 13