Electrical Research Section
9th Floor - Edison Building

July 16, 1962

Field Test of Varian M-49 Magnetometer For Locating Buried Cast Iron Pipe Joints

On July 11, 1962, a test was made to determine the feasibility of locating buried cast iron pipe joints with a magnetometer. The instrument used was a Varian model M-49. This device uses the principle of proton free precession to measure the earth's magnetic field extremely accurately. Present were Joseph Connelly, Ballistic Research Laboratory, Aberdeen Proving Ground; Ray Cole, Baltimore Gas & Electric; and Walter Rosengarten and Douglass Fox, both of Philadelphia Electric. Location was Fullerton Heights Avenue, Fullerton, Maryland, a small community north of Baltimore on Route U.S. 1.

The street and adjoining lawns were marked at 1-foot intervals as shown on the sketches. Three traverses were made, two across the street and mains, and one along the gas main. Magnetic field readings are shown on the graphs as is a plot of field differences or gradients. An attempt was made to take another traverse across the road, about 75 feet up the hill from the second traverse. No results were obtained, possibly due to exceptionally strong gradients. The third traverse was also ended because the instrument could not be read. When the magnetic field gradient is steep, different magnetic fields occur at different points in the detector bottle. This results in many precession frequencies occurring across the detector coil as the aligning field is broken. These oscillations are weak, and if they are spread in frequency sufficiently, none will be strong enough to vibrate a reed in the meter. This is a possible reason for the poor results obtained. Another reason might be battery condition or the direction of the earth's field at the points in question. If the field was distorted badly enough, the coil axis might have been parallel to it and no readings would have been possible.

A second problem encountered in this test was the pick-up of stray electromagnetic field radiation. This was believed to be some high harmonic of power line frequency. However, there were no power lines along the street. A single series street light, fed from a rear property pole line, was present. Even with these ideal conditions, at least one reed in the meter vibrated continuously when the aligning field was off.

The gradient obtained from the first traverse seems to correlate well with pipe locations. The 6" gas main, as located by the M-Scope, was only 6" from the low point of the plot. The water main, which is buried much deeper, is about 1-foot from a low point in the left side of the gradient plot. The reason for the other dip next to the water main is not known. Nor is the small dip to the right of the gas main, although it is surmised that the sewer line is located here.

The second traverse shows very little correlation between main locations and gradients. However, the two mains coincide with a maximum and a minimum on the magnetic field intensity plot.

The third traverse, along the gas main, was even less helpful. The magnetometer did not function much of the time. No reading could be obtained over one of the joints. There was also a minimum in the magnetic field and a dip in the gradient over a suspected sewer lateral. There was also a dip in the gradient 1-foot from a joint. Joint locations were taken off Baltimore Gas & Electric maps; thus, a 1-foot error in location is possible.

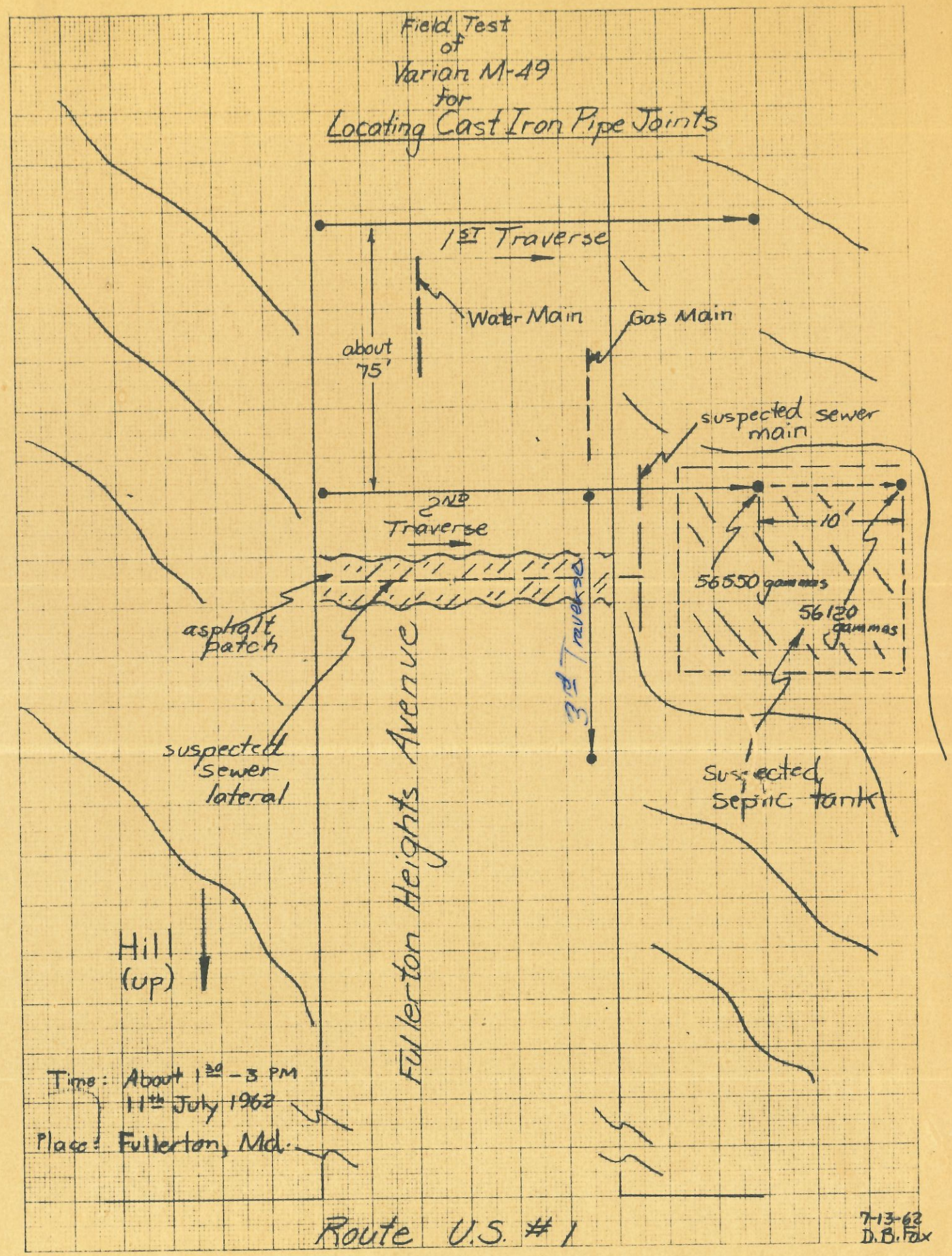
Another test of the magnetometer was attempted at a different location. No results were obtained. The batteries were suspected to be almost completely discharged and tests were discontinued.

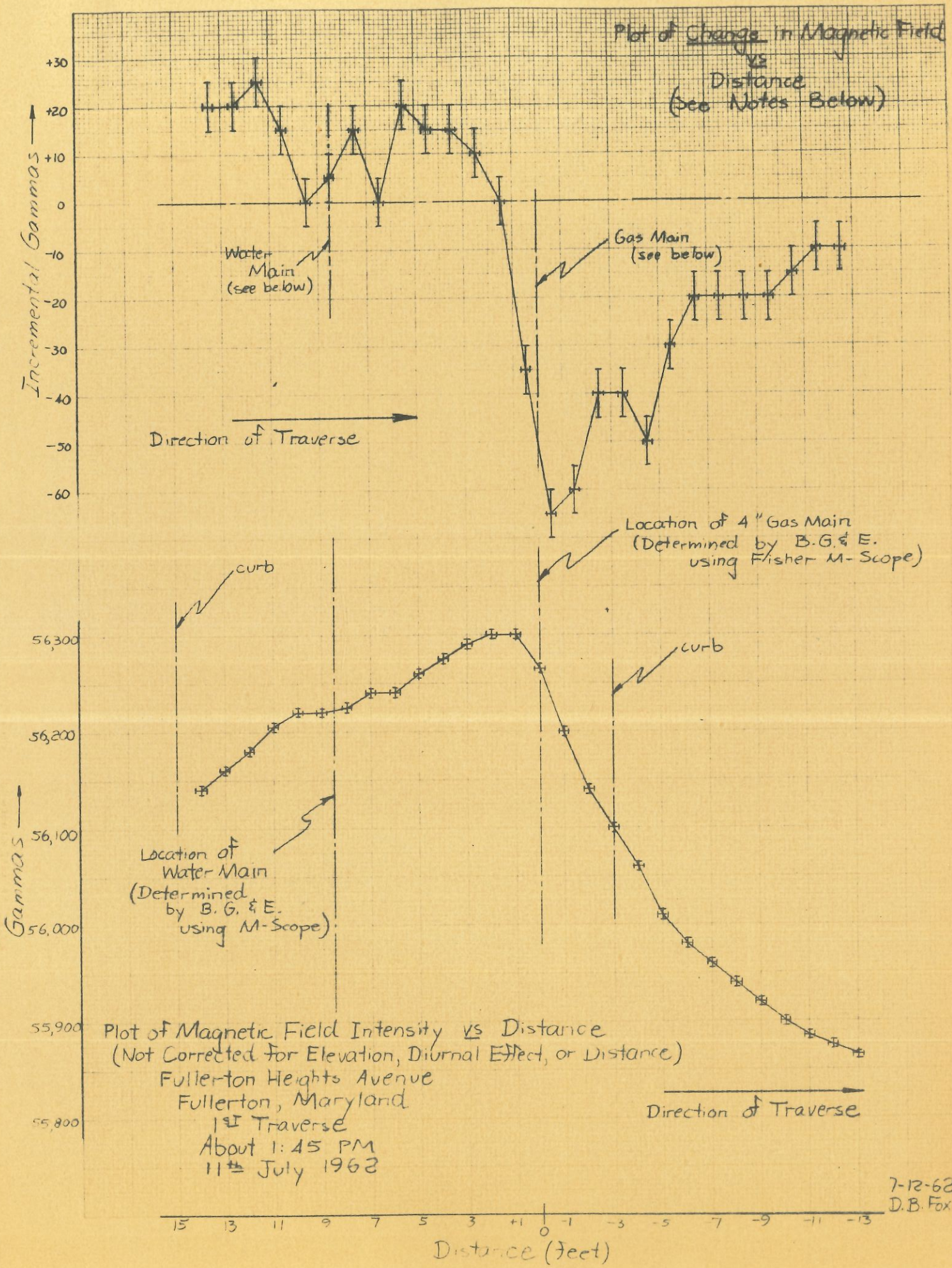
Batteries later tested, found to be OK.

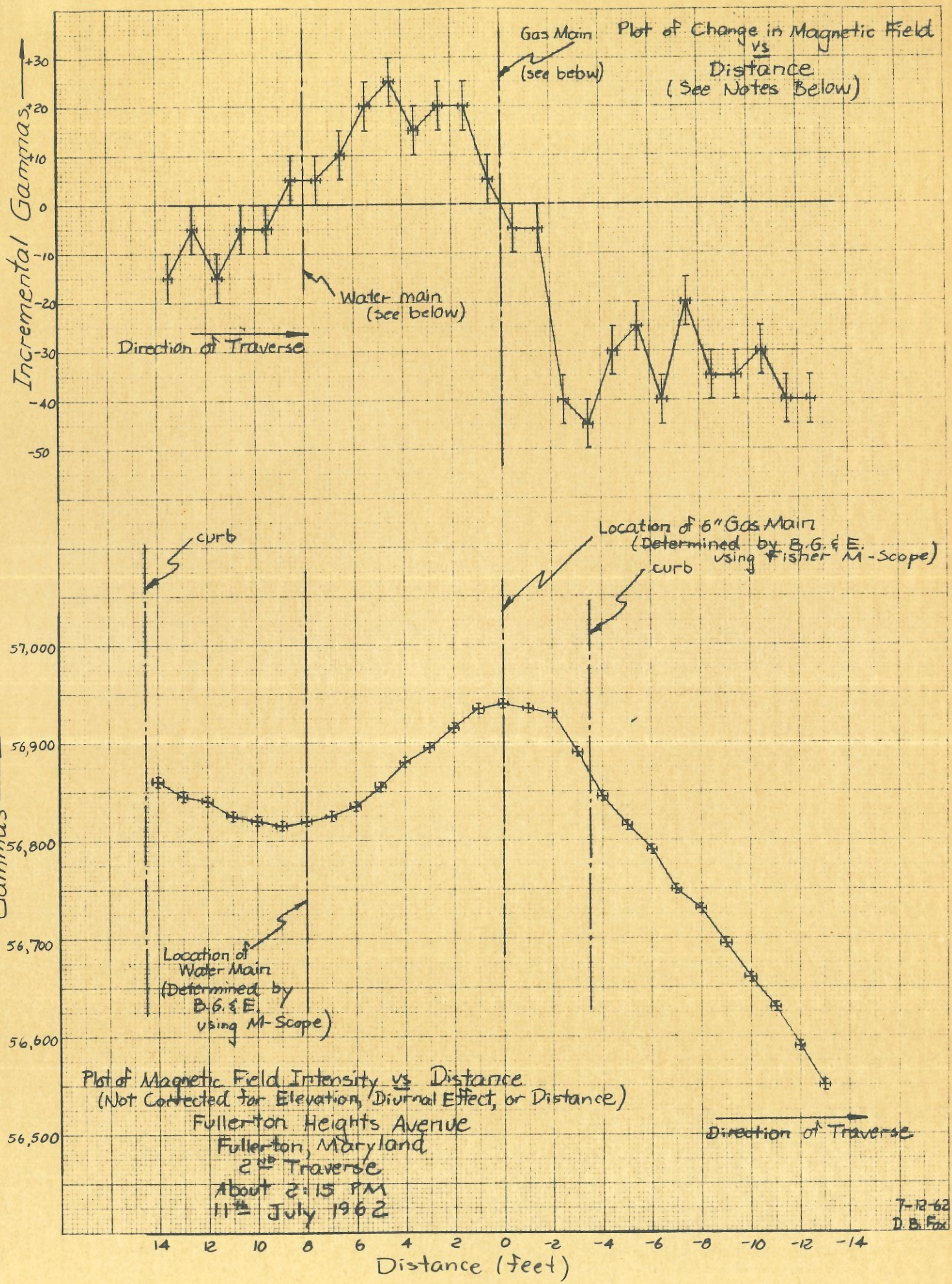
D. B. Fox

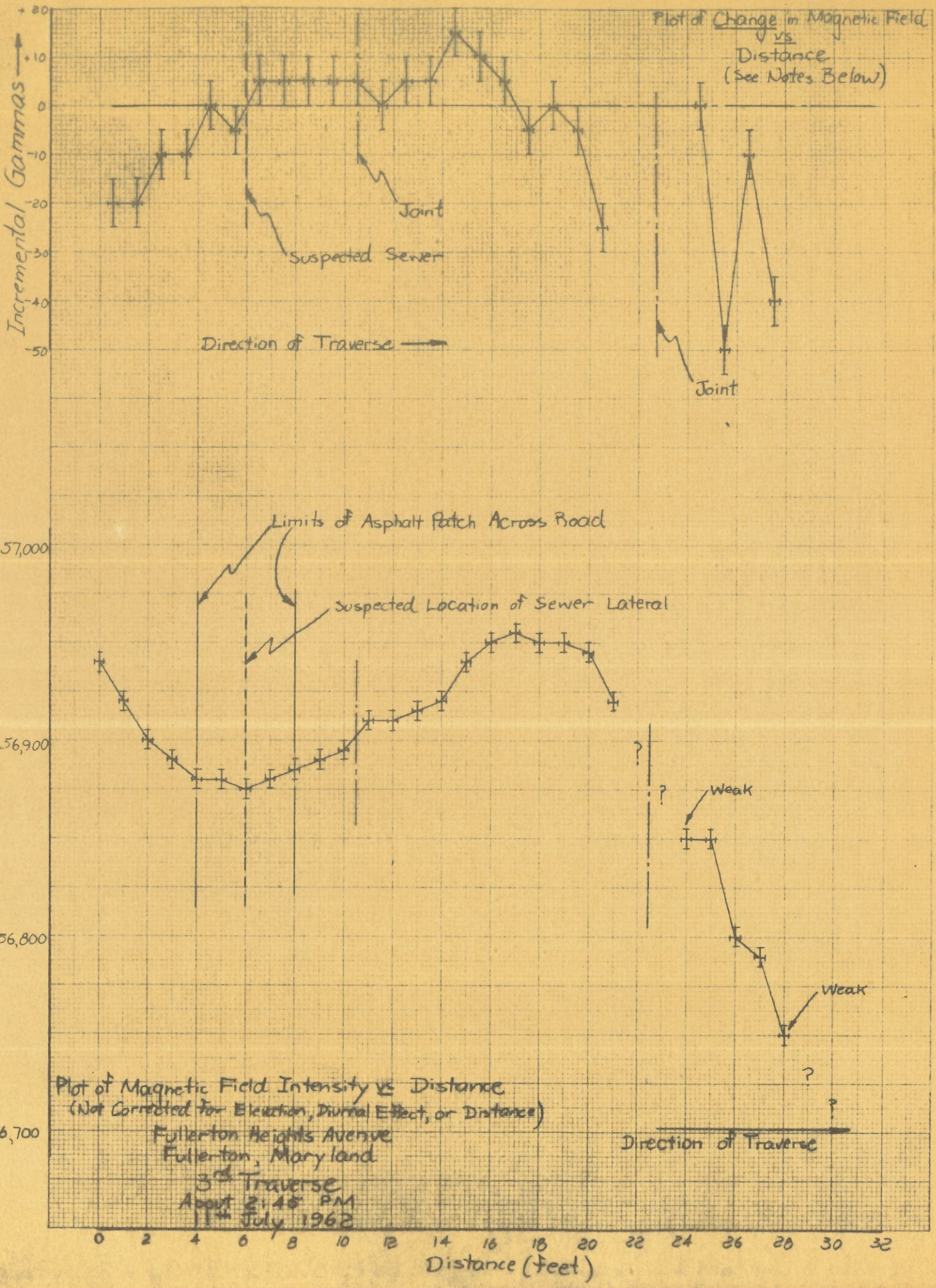
DBF:bh

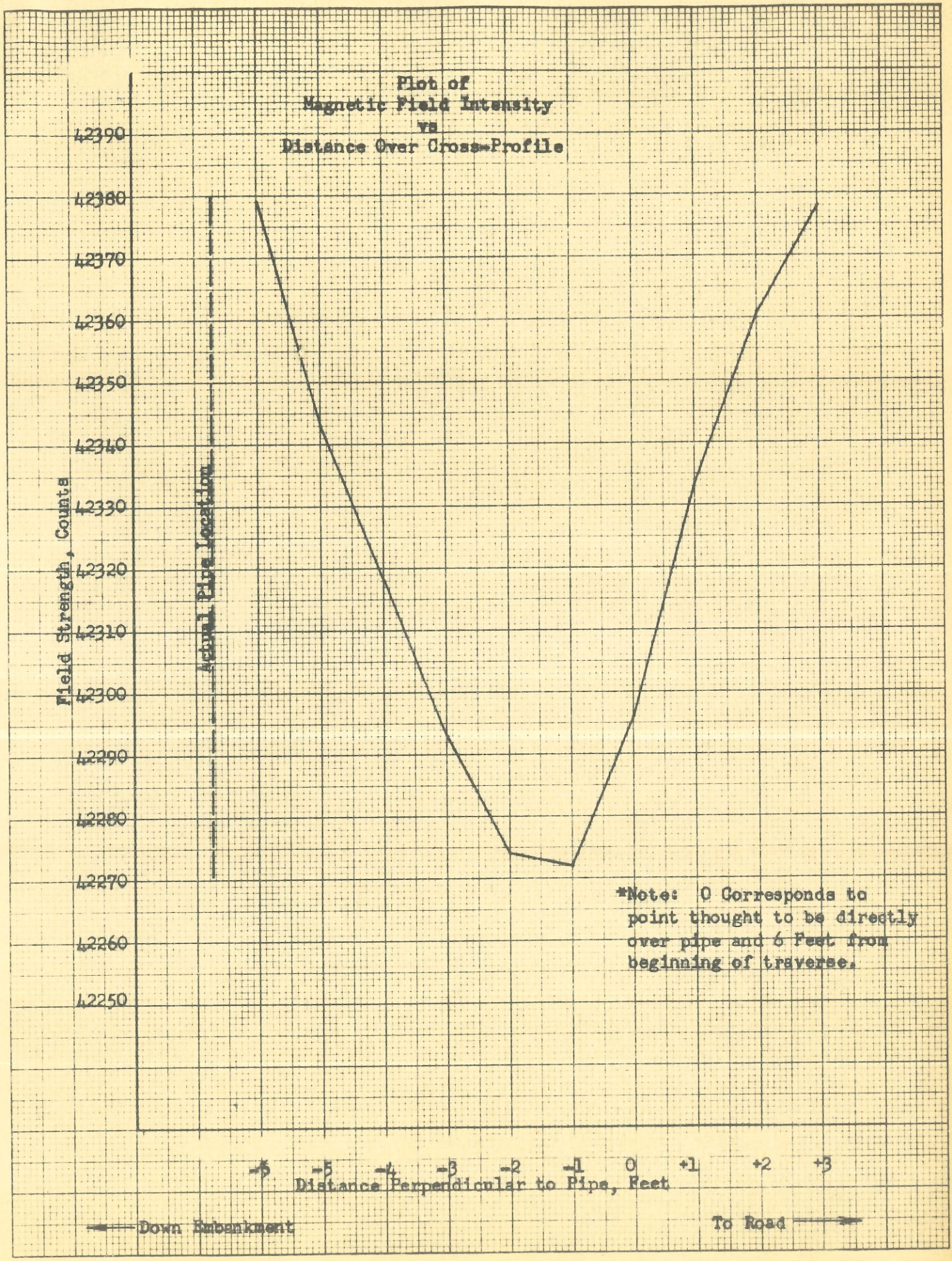
3/27/62 Local soils analysis:
structural parking gravel
" sand
basalt
marble
talc.


Field Test
of
Varian M-49
for
Locating Cast Iron Pipe Joints
1ST Traverse
Water Main
Gas Main
about
75'
suspected sewer
main
2ND
Traverse
10'
56550 gammas
56120
gammas
asphalt
patch
3rd Traverse
suspected
sewer
lateral
Fullerton Heights Avenue
Suspected
Septic tank
Hill
(up)
Time: About 1:30 - 3 PM
11th July 1962
Place: Fullerton, Md.
Route U.S. #1
7-13-62
D.B. Fox

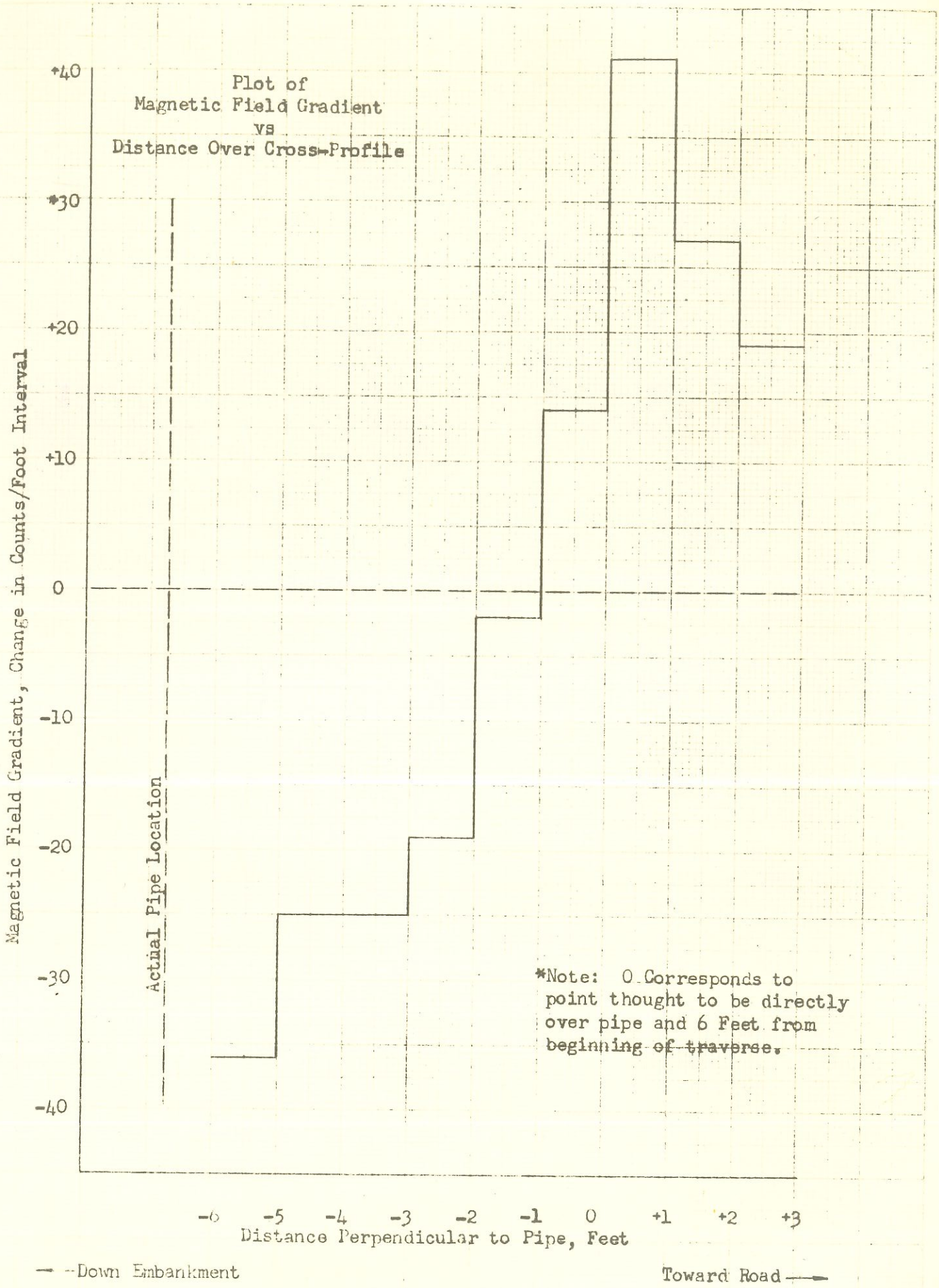

Plot of Change in Magnetic Field
vs
Distance
(See Notes Below)
Incremental Gammas
+30
+20
+10
0
-10
-20
-30
-40
-50
-60
Water Main (see below)
Gas Main (see below)
Direction of Traverse
Location of 4" Gas Main (Determined by B.G.&E. using Fisher M-Scope)
curb
curb
Gammas
56,300
56,200
56,100
56,000
55,900
55,800
Location of Water Main (Determined by B.G.&E. using M-Scope)
Plot of Magnetic Field Intensity vs Distance
(Not Corrected for Elevation, Diurnal Effect, or Distance)
Fullerton Heights Avenue
Fullerton, Maryland
1st Traverse
About 1:45 PM
11th July 1962
Direction of Traverse
7-12-62
D.B. Fox
15 13 11 9 7 5 3 +1 0 -1 -3 -5 -7 -9 -11 -13
Distance (Feet)


Plot of Change in Magnetic Field
vs
Distance
(See Notes Below)
Gas Main
(see below)
Water main
(see below)
Direction of Traverse
Incremental Gammas
+30
+20
+10
0
-10
-20
-30
-40
-50
curb
curb
Location of 6" Gas Main
(Determined by E.G.&E. using Fisher M-Scope)
Location of
Water Main
(Determined by
E.G.&E.
using M-Scope)
Gammas
57,000
56,900
56,800
56,700
56,600
56,500
Plot of Magnetic Field Intensity vs Distance
(Not Corrected for Elevation, Diurnal Effect, or Distance)
Fullerton Heights Avenue
Fullerton, Maryland
2nd Traverse
About 2:15 PM
11th July 1962
Direction of Traverse
7-12-62
D.B.Fox
14 12 10 8 6 4 2 0 -2 -4 -6 -8 -10 -12 -14
Distance (feet)

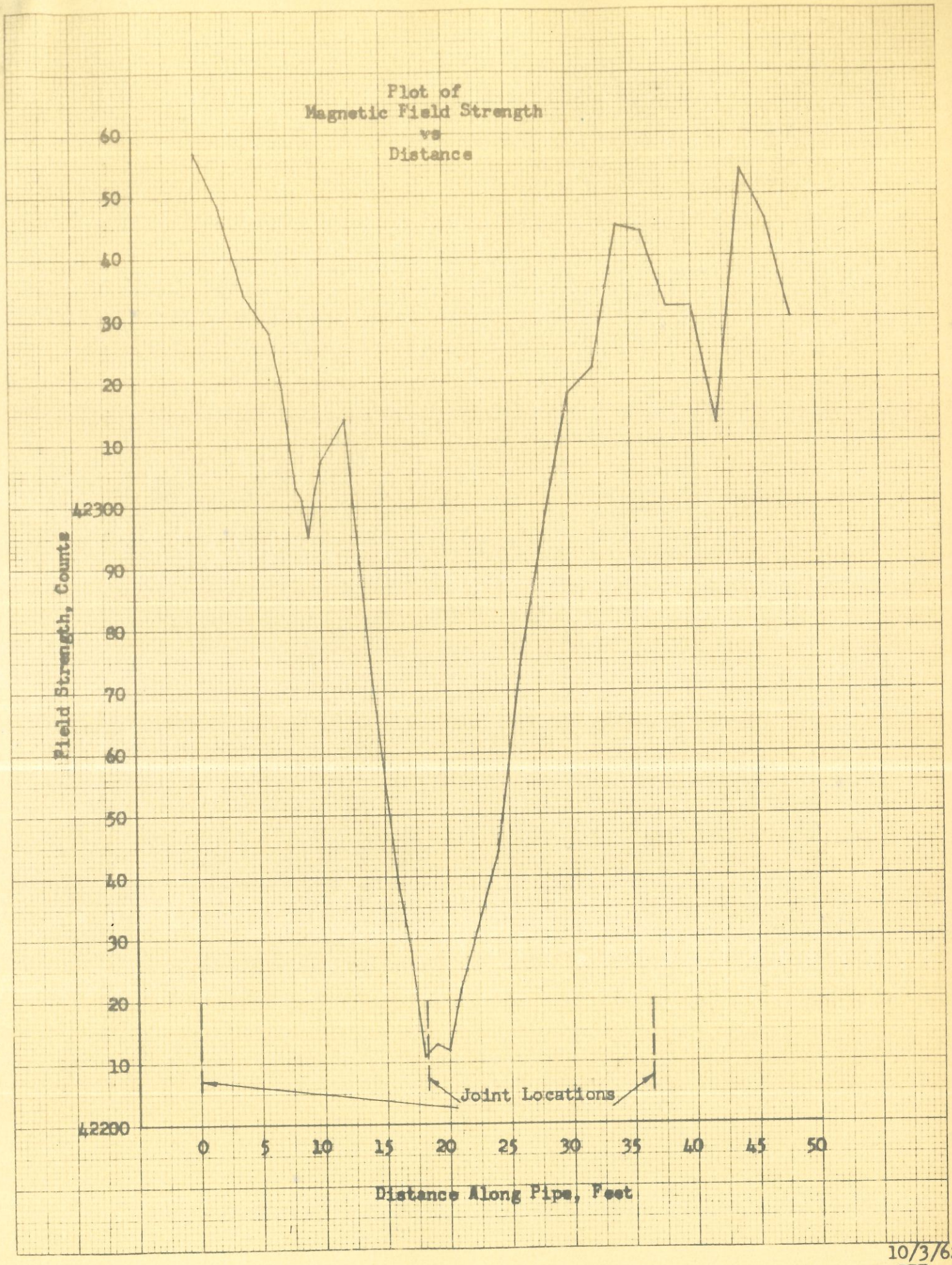

Plot of Change in Magnetic Field vs Distance (See Notes Below)
Incremental Gammas
+20
+10
0
-10
-20
-30
-40
-50
Joint
Suspected Sewer
Direction of Traverse
Joint
Limits of Asphalt Patch Across Road
Suspected Location of Sewer Lateral
57,000
56,900
56,800
56,700
Gammas
?
?
Weak
Weak
?
?
Direction of Traverse
Plot of Magnetic Field Intensity vs Distance
(Not Corrected for Elevation, Diurnal Effect, or Distance)
Fullerton Heights Avenue
Fullerton, Maryland
3rd Traverse
About 2:45 PM
11th July 1962
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32
Distance (feet)


Plot of
Magnetic Field Intensity
vs
Distance Over Cross-Profile
42390
42380
42370
42360
42350
42340
42330
42320
42310
42300
42290
42280
42270
42260
42250
Field Strength, Counts
Actual Pipe Location
*Note: 0 Corresponds to point thought to be directly over pipe and 6 Feet from beginning of traverse.
-6
-5
-4
-3
-2
-1
0
+1
+2
+3
Distance Perpendicular to Pipe, Feet
Down Embankment
To Road

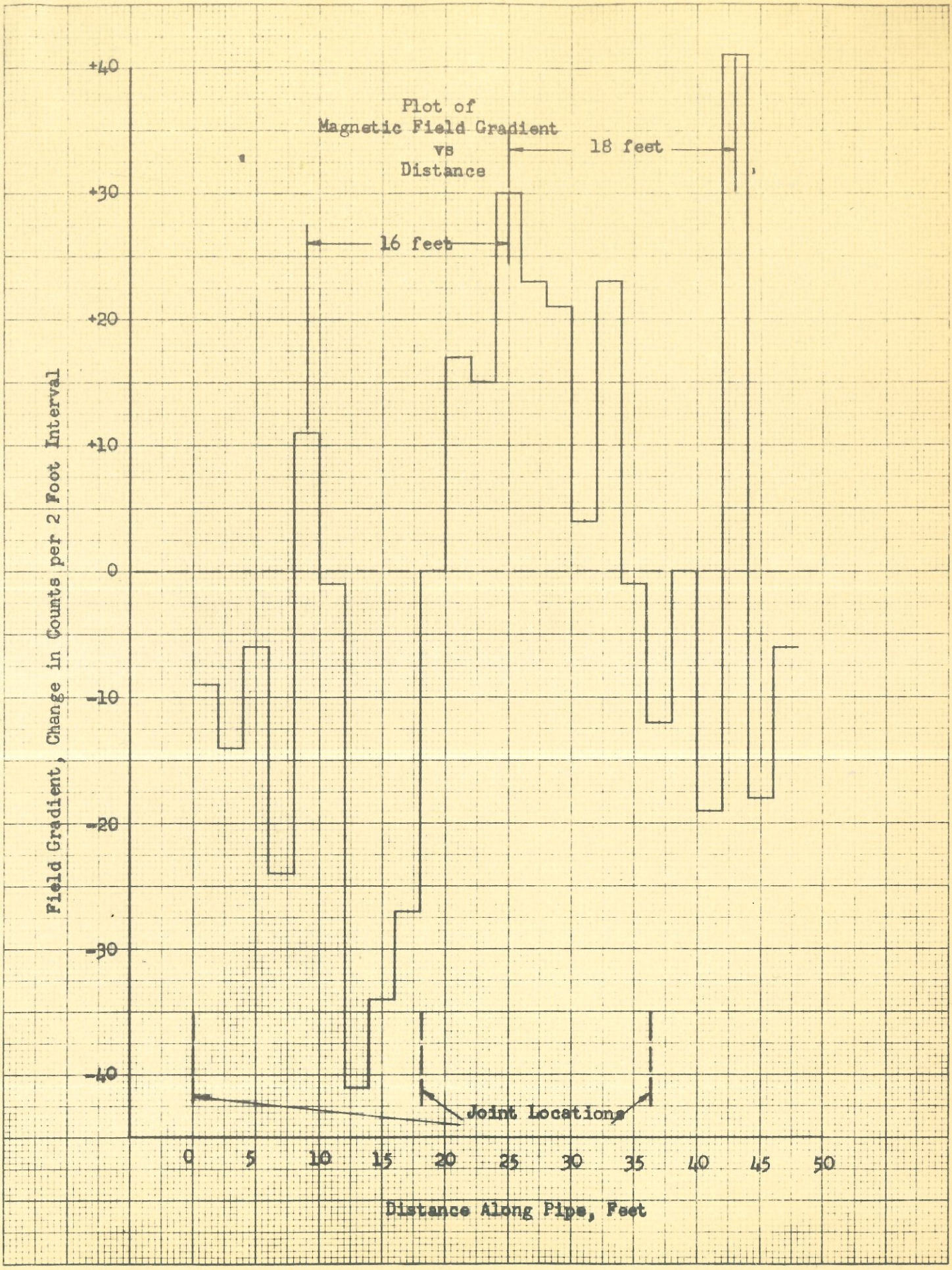
10/24/62


Plot of
Magnetic Field Gradient
vs
Distance Over Cross-Profile
+40
+30
+20
+10
0
-10
-20
-30
-40
Magnetic Field Gradient, Change in Counts/Foot Interval
Actual Pipe Location
*Note: 0 Corresponds to point thought to be directly over pipe and 6 Feet from beginning of traverse.
-6 -5 -4 -3 -2 -1 0 +1 +2 +3
Distance Perpendicular to Pipe, Feet
— --Down Embankment
Toward Road ——

DBF
10/24/62


Plot of
Magnetic Field Strength
vs
Distance
60
50
40
30
20
10
42300
90
80
70
60
50
40
30
20
10
42200
Field Strength, Counts
0
5
10
15
20
25
30
35
40
45
50
Distance Along Pipe, Feet
Joint Locations

10/3/62
DBF



DBF
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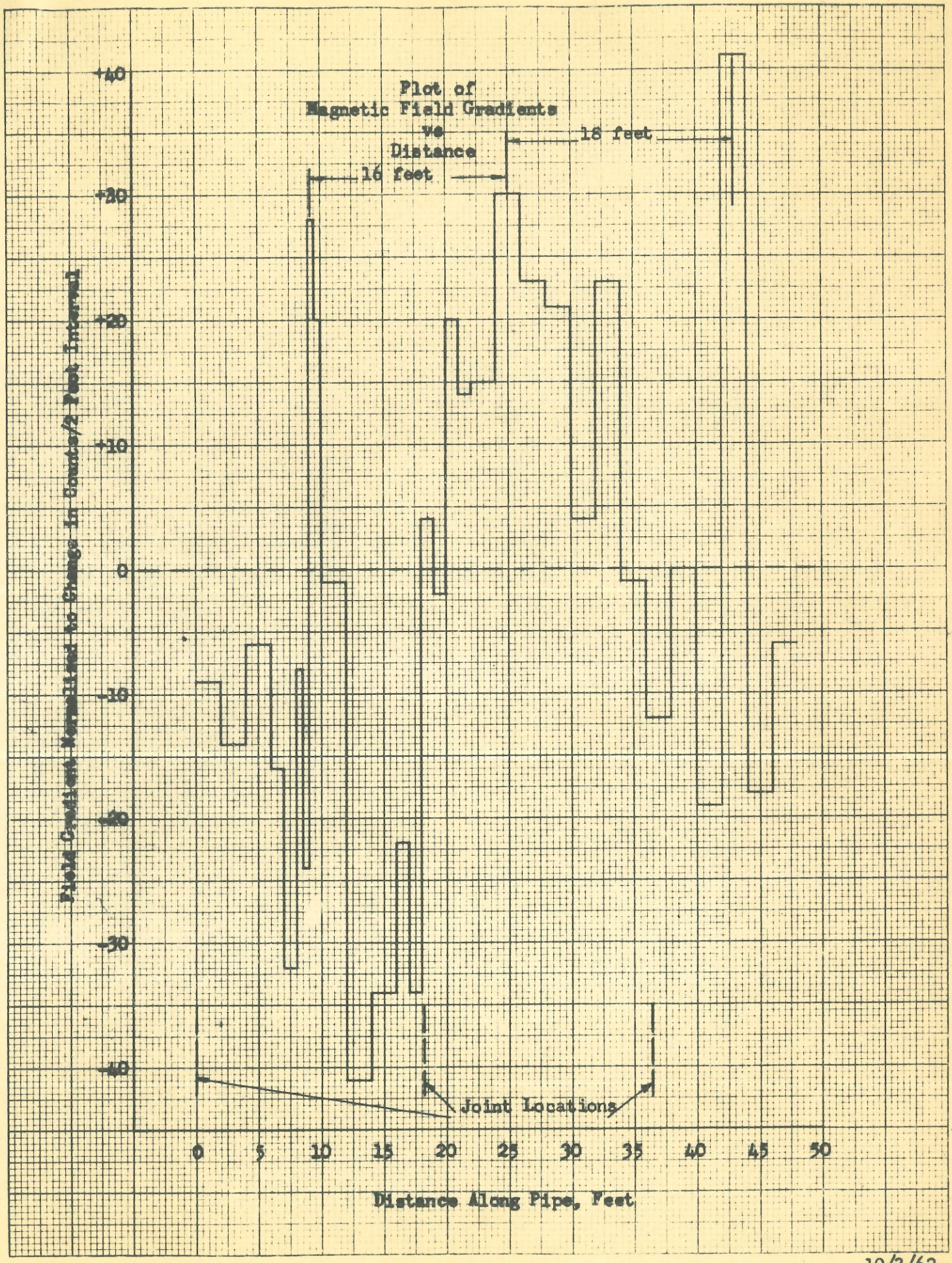

10/3/62
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