

Commonwealth of Massachusetts
Department of Public Works
W. F. Callahan, Commissioner

U. S. Department of the Interior
Geological Survey
W. E. Mather, Director

[ms. 1013]

Cooperative Geologic Project

Geologic Interpretation of Seismic Data

Route 128 (Northern Circumferential Highway)

Cut, and Hopkins Street Grade Separation

Stations 1-18

in Wakefield, Mass.

by



James E. Maynard, Geologist, U. S. Geological Survey

and

Rev. Daniel Linehan, S. J., Seismologist, Weston College

4 pages of text
3 plates ✓

U. S. GEOLOGICAL SURVEY MASS. DEPT. OF PUBLIC WORKS
COOPERATIVE GEOLOGIC PROGRAM
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Release date:

P.R.

Seismic Series # _____

4/28/50

4/8/49

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General Statement

The completion of a segment of the Northern Circumferential Highway, Route 128, in Wakefield, Mass., requires an underpass bridge at Hopkins Street, Station 5+50. The plan of the project shows approximately 1800 feet of approach cuts between stations 1 and 18. In October 1945 a preliminary seismic study was made of a segment of this cut between stations 6+50 and 13+50. Four profiles were made at this time and a report was submitted by Newton E. Chute and Rev. Daniel Linehan (file report of January 15). This work showed a relatively shallow (in general, 6 to 12 feet in depth) somewhat irregular bedrock surface between stations 6+50 and 13+50. That data indicated that much of this segment of the cut will be in bedrock. In order to obtain more complete data for the preparation of detailed estimates on the amount of bedrock to be excavated for this segment of the cut, and also to obtain sufficient data for the unexplored segment of the cut, 21 additional seismic traverses were made in September 1949. The present report contains only the results obtained from this later work.

The work was performed as a part of a cooperative program of the Massachusetts Department of Public Works and the United States Geological Survey.

Surface Geology

At this location the proposed road will traverse the southeast side of a large bedrock-till hill that is flanked by a sand-gravel kame terrace. The poorly defined boundary of the terrace and the till area crosses the proposed centerline in the vicinity of station 5+70. Numerous outcrops of bedrock occur within 200 feet of the centerline; they are composed of somewhat coarse grained, slightly pink granite, medium-grained dark-colored melanite, or a combination of both of these types of rock. These rocks appear to underlie the entire area of the proposed cut. The till as observed in shallow test pits is loose to moderately loose in texture; in most places it is covered by a layer of fine sand from a few inches to 3 feet in thickness. The surface geology of the site and of the adjacent surrounding area suggests that the till is a rather thin veneer on an irregular bedrock surface. ~~A geologic map with~~ the locations of the center-line and the seismic traverses is shown on sheet 1.

Seismic Traverses

The layout of the seismic traverses is shown on ~~the geologic map~~, sheet 1. The lengths, in feet, of the seismic traverses are as follows:

A'-B', 165	K'-L', 165	D-Q, 220
B'-C', 165	N-O, 220	F-G, 220
A'-D', 110	P-Q, 220	G-H, 220
E'-F', 150	K'-M, 220	H-I, 220
F'-I', 165	A-B, 220	I-J, 220
G'-H', 165	B-C, 220	K-L, 165
H'-J', 180	C-D, 220	L-M, 220

The shot points for the seismic traverses were located as follows:

A',	station	5+30	
B',	"	3+65	
C',	"	2+00	
D',	108 feet to the left (north) of station	5+08	
E',	50 "	" " " " " "	5+38
F',	50 "	" " " " " "	3+88
I',	50 "	" " " " " "	2+23
G',	50 "	" " " right (south) " "	5+30
H',	25 "	" " " " " "	3+65
J',	55 "	" " " " " "	1+85
K',	station	5+95	
M,	15 "	" " " (S.E.) " "	8+14
N,	50 "	" " " " " "	6+07
O,	55 "	" " " " " "	8+20
P,	50 "	" " " left (N.W.) " "	5+82
Q,	54 "	" " " " " "	8+14
A,	32 "	" " " " " "	17+20
B,	53 "	" " " " " "	15+00
C,	57 "	" " " " " "	12+80
D,	55 "	" " " " " "	10+40
F,	station	17+00	
G,	"	14+30	
H,	15 feet to the right (S.E.)	" " "	12+58
I,	18 "	" " " " " "	10+20
J,	4 "	" " " " " "	8+22
K,	42 "	" " " " " "	11+88
L,	63 "	" " " " " "	10+26

Depths to Bedrock

The depths to bedrock at the shot points as calculated from the seismic data are as follows:

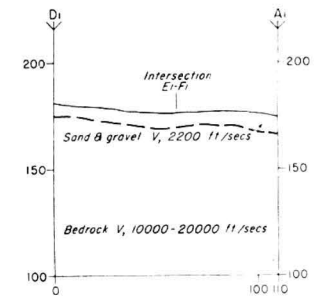
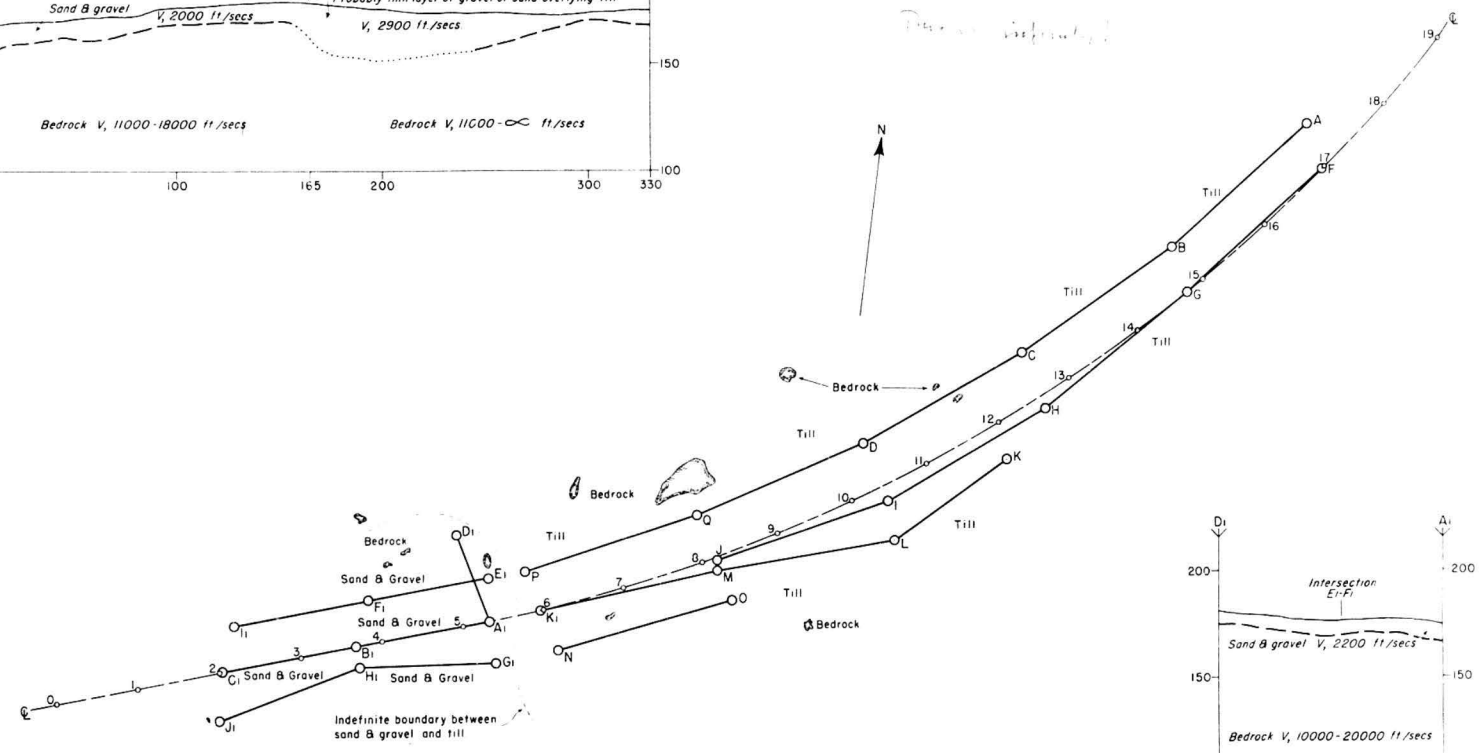
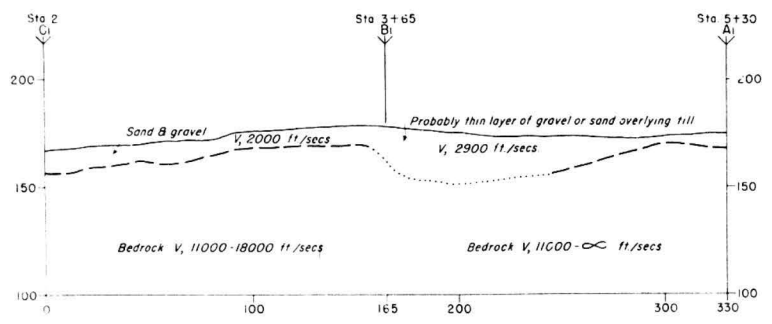
A' - 7 feet	K' - 7 feet	D - 10 feet
B' - 15 " (average)	M - 11 "	F - 10 "
C' - 10 "	N - 9 "	G - 14 "
D' - 7 "	O - 8 "	H - 12 "
E' - 9 "	P - 11 "	I - 15 "
F' - 13 "	Q - 12 "	J - 10 "
I' - 12 "	A - 10 "	K - 8 "
G' - 9 "	B - 8 " (average)	L - 10 "
H' - 13 "	C - 8 "	
J' - 7 "		

Geologic Interpretation of Seismic Data

The geologic sections as interpreted from the seismic data, and the geology of the site are shown on sheets 1, 2, and 3. Although the bedrock surfaces are shown by smooth curves in the sections, it is probable that the actual bedrock surface is much more irregular than these curves suggest, as the detectors were too widely spaced to pick up very small ridges and points. The positions of the bedrock surfaces in the vicinity of shot points B', F', C, and B may be closer to the surface and may differ appreciably in configuration from these forms shown on the sections. Much of the difficulty in interpretation at these places may have been caused by the registration of side refractions instead of vertical refractions when shooting in opposite directions from common shot points. The most logical interpretation from the available seismic data and the geology is shown by the dotted lines. The actual depths to bedrock at shot points A', J', C, A, K, K', O, and N may vary a foot or more from the reported value, for they were calculated from assumed, though reliable, till velocities determined from nearby traverses. The depth to bedrock at shot point F was similarly calculated because the two detectors nearest the shot point failed to register; this value also should be of reasonable accuracy.

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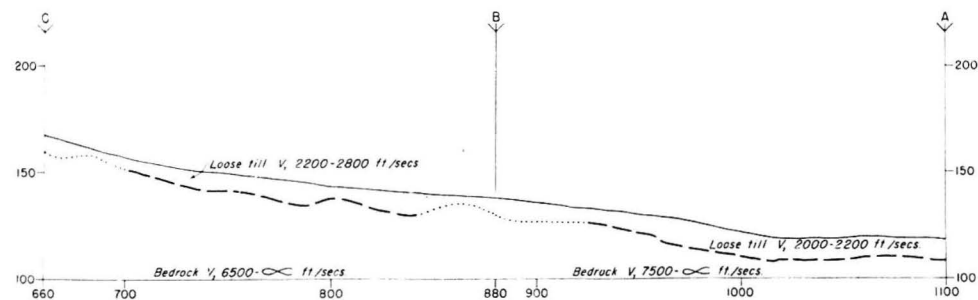
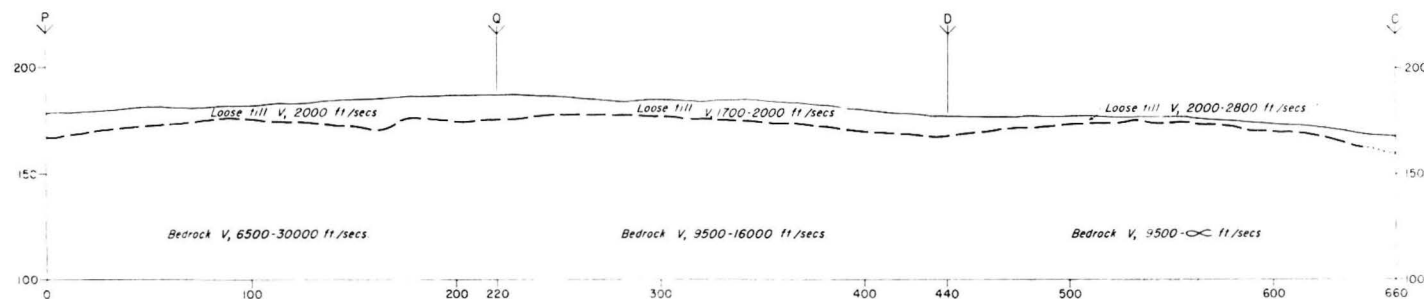
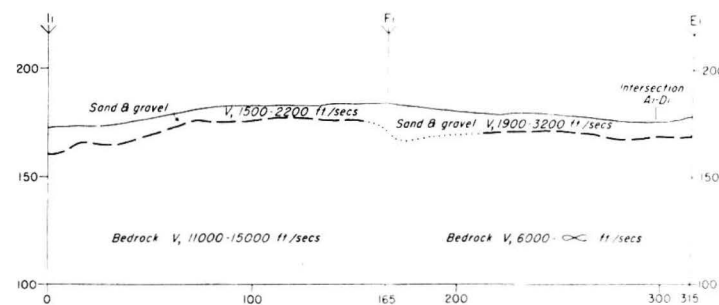
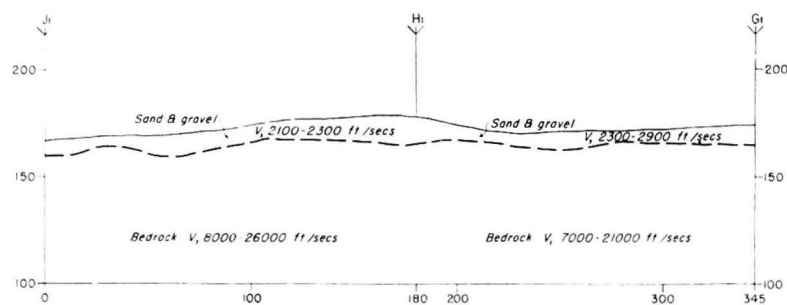


PLAN OF TRAVERSES
SCALE: 1 INCH = 100 FEET
Letters refer to shot points at ends of traverses Numbers refer to D.P.W. stations on centerlines. Indefinite contact

NOTE:
Dotted portions of sections indicate inconclusive seismic data.

INTERPRETATIVE GEOLOGIC SECTIONS ALONG SEISMIC TRAVERSES	
WAKEFIELD	ROUTE NO 128
GRADE SEPARATION-STATION 5+50 CUT, STATIONS 1-18	
SCALE: 1 INCH = 40 FEET	GEOLOGY BY N E CHUTE - J E MAYNARD
Shot point V: Apparent seismic velocity (ies) in feet per second	SEISMIC DATA BY DANIEL LINEHAN, S J
	ENGINEERING BY WILLIAM H STEAD
	DATE SEPTEMBER, 1949 SHEET 1 OF 3

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PLAN OF TRAVERSES

SCALE 1 INCH = 7 FEET

Letters refer to shot points at ends of traverses.

NOTE:
Dotted portions of sections indicate
inconclusive seismic data.

INTERPRETATIVE GEOLOGIC SECTIONS ALONG SEISMIC TRAVERSES

WAKEFIELD

ROUTE NO 128

GRADE SEPARATION STATION 5+50
CUT, STATIONS 1-18

SCALE 1 INCH = 40 FEET

GEOLOGY BY N. E. CHUTE-J. E. MAYNARD

↓ Shot point

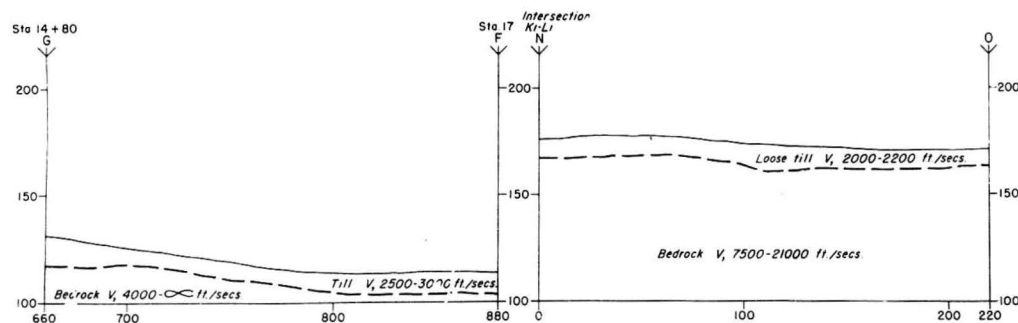
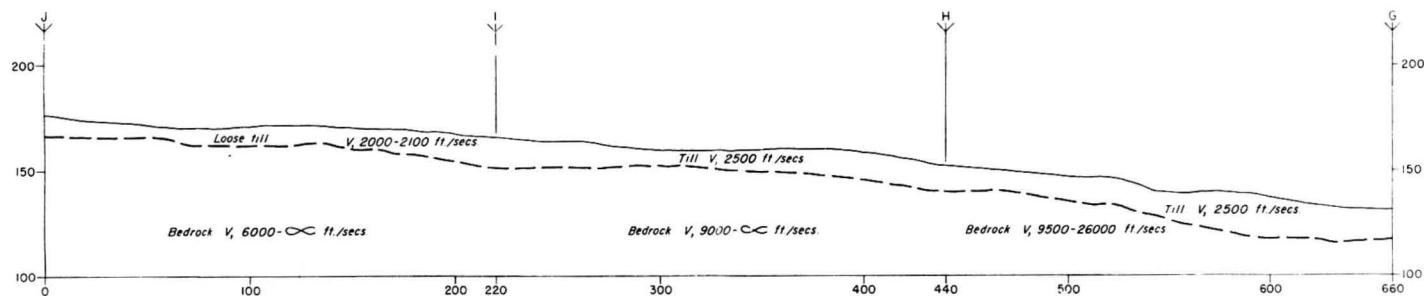
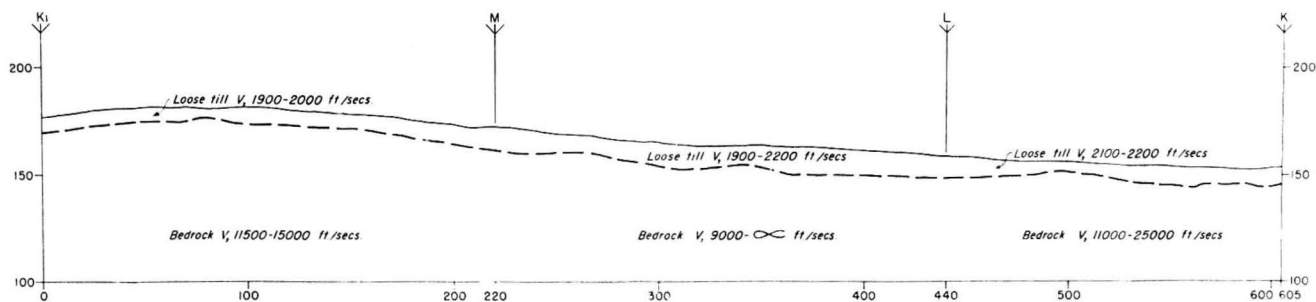
SEISMIC DATA BY DANIEL LINEHAN, S. J.

Vp Apparent seismic velocity (ft/sec)
= feet per second

ENGINEERING BY WILLIAM H. STEAD

DATE SEPT. 1949

SHEET 2 OF 3



PLAN OF TRAVERSES	
SCALE 1 INCH =	FEET
Letters refer to shot points at ends of traverses	

INTERPRETATIVE GEOLOGIC SECTIONS ALONG SEISMIC TRAVERSES	
WAKEFIELD	ROUTE NO 128
GRADE SEPARATION STATION 5+50 CUT, STATIONS 1-18	
SCALE 1 INCH = 40 FEET	GEOLOGY BY N E CHUTE-J E MAYNARD
↓ Shot point	SEISMIC DATA BY DANIEL LINEHAN, S.W.
V. Apparent seismic velocity (ft./sec.)	ENGINEERING BY WILLIAM H. STEAD
DATE SEPT 1949	SHEET 3 OF 3