COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record No. 1968 / 129

CSIRO Headquarters Site Seismic Refraction Survey,

Canberra 1968

by

G. Hart

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ILLUSTRATIONS

SUMMARY

Four seismic refraction traverses were surveyed as a test for foundation conditions at a proposed building site for the Commonwealth Scientific and Industrial Research Organisation Headquarters at Campbell in the A.C.T. The results indicate good and fairly uniform foundation conditions over the entire site, except for the north-west corner of the site, where the overburden thickness increases to about 35 ft.

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1. INTRODUCTION

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) is proposing to construct its headquarters on a site at Campbell in the A.C.T. (see Plate 1). At the request of the National Capital Development Commission, the Bureau of Mineral Resources, Geology and Geophysics, carried out a site investigation for foundation conditions. Surface geological mapping was done by G.A.N. Henderson (pers. comm.) of the Bureau's Geological Branch. The Geophysical Branch was requested to carry out shallow seismic refraction coverage of the area. Four spreads, with a total spread length of 2175 feet, were completed between 29th May and 3rd June 1968 by G. Hart (geophysicist), D. Tarlinton (field assistant), and two field-hands.

2. GEOLOGY

The geology of the Canberra city area is given by Öpik (1958). Detailed surface mapping of the site, carried out by Henderson (pers. comm.), is shown in Plate 1. Dacite tuff of the Mount Ainslie Volcanics, of Lower Devonian age, is the only petrological type cropping out on the site and in the nearby area. The rock is coarsely jointed and massively bedded. The material is rather resistant to weathering as evidenced by the nearby mountain (Mount Ainslie), which is composed of similar material, and also by the exposure of massive boulders of fresh dacite on about 20 percent of the site. The remainder of the exposed material consists of dacite at all stages of weathering and is covered by grass.

3. METHOD AND EQUIPMENT

The seismic refraction method that was used to obtain depths to unweathered bedrock was based on the "method of differences" (Heiland, 1946). Knowledge of the depth to unweathered bedrock along the spread makes interpolation between shot-points of the depth to the partially weathered bedrock more reliable, and it is this layer that is of prime importance for the support of building foundations.

To give the necessary resolution of the shallower layers, a geophone spacing of 25 ft was used, resulting in a coverage of 550 ft per spread. Shots from the ends of the spreads were fired at distances of 10, 20, 30, 50, and 100 ft. Shots were also fired near the centre of the spread and between the sixth and seventh geophones from each end. The layout of the four traverses is shown in Plate 1.

Owing to the proximity of various public and private buildings and a main road, gelignite charges were restricted to 5 oz. A high level of 50-Hz pickup occurred and some background seismic noise was present. As a result of these factors, average record quality was only fair.

The equipment used consisted of a 24-channel refraction seismograph manufactured by South-western Industrial Electronics Co. and 20-Hz geophones made by Texas Instruments Co.

4. RESULTS

The results in the form of seismic cross-sections are shown in Plates 2 and 3. The dashed line in the cross-sections is the interpolated position of the top of the 7000 to 8000-ft/s layer. The depth to this layer ranges from about 15 to 35 feet. Contours of unweathered bedrock are shown in Plate 4; the shaded zones are zones where the depth to partially weathered bedrock exceeds 20 feet.

Owing to the fact that no topographic survey of the geophone stations had been carried out, the surface elevations as given in Plates 2 and 3 were interpolated from the topographic contours given in Plate 1. The accuracy of these surface elevations is estimated at ± 2 feet.

The accuracy of the depth to bedrock determined by the seismic refraction method is usually estimated at within ± 20 percent of the depth. Depth estimates to the various layers have been made not only at geophone positions, but also at the long offset shot-points, e.g. at station A27.

Table 1 shows the rock types that are expected to correspond to the longitudinal wave velocities as marked in Plates 2 and 3.

TABLE 1

Longitudinal wave velocity, ft/s	Rock type
700 - 1200	Soil
3200 - 6000	Very weathered dacite
7000 - 8000	Partially weathered dacite with open joints (partially weathered bedrock)
12,000 - 16,500	Unweathered dacite, joints slightly open to tight.

5. CONCLUSIONS

The results indicate that the thickness of overburden is about 20 feet except in the north-west corner of the site, where the thickness increases to about 35 feet. To check the seismic results, drill holes are recommended at C17 and at the intersection of Traverses A and B.

A geological report being prepared by the Geological Branch of this Bureau ("Geological Investigation of Proposed CSIRO site, Campbell, A.C.T. 1968", by G.A.M. Henderson) states that weathering along individual joints may extend to considerable depth, particularly in the vicinity of rock outcrops. Such weathering, of erratic depth and small horizontal extent, would probably not be detected by the seismic method.

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6. REFERENCES

HEILAND, C.A. 1946 GEOPHYSICAL EXPLORATION, New York, Prentice-Hall Inc.

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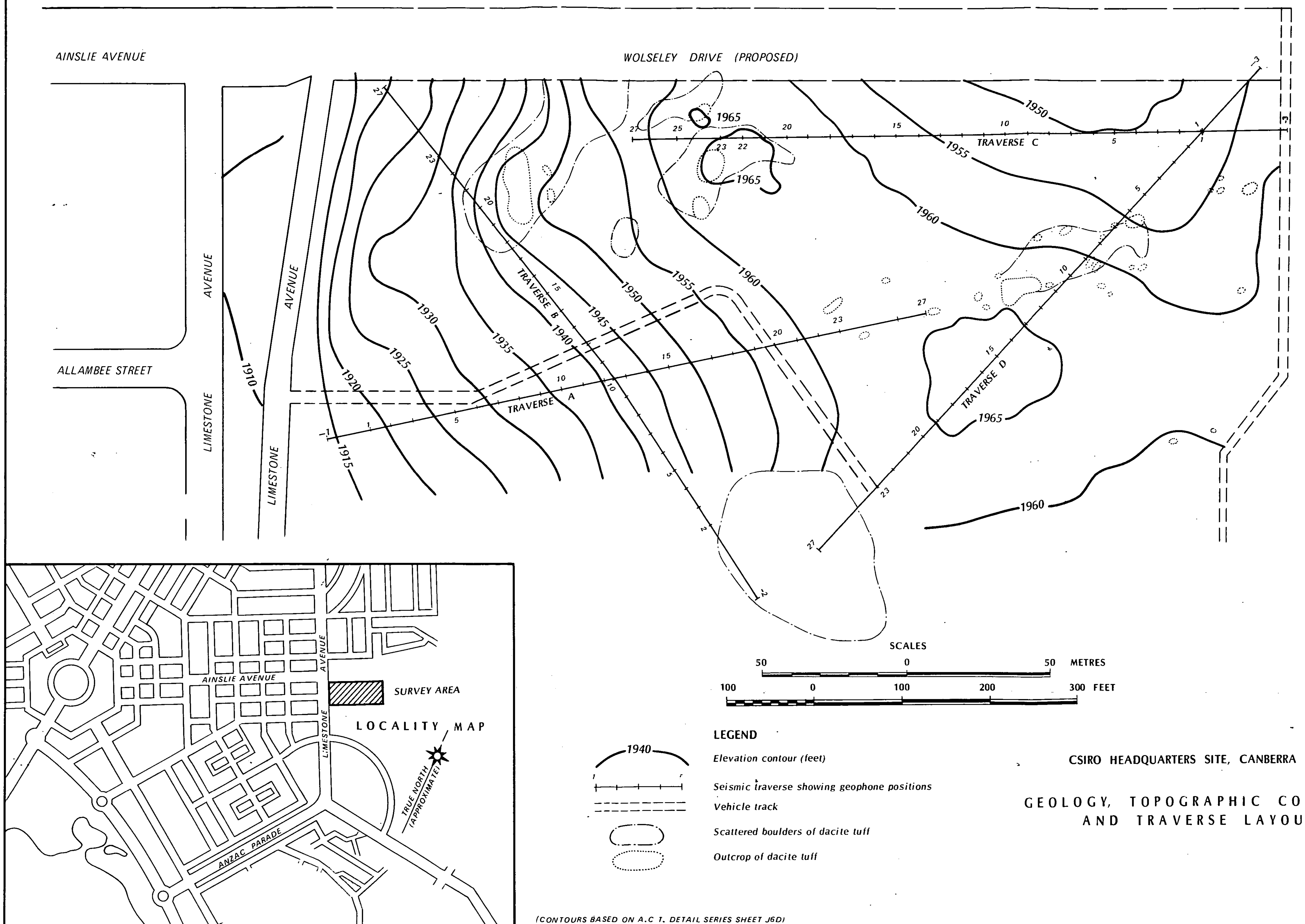
OPIK, A.A. 1958 The Geology of the Canberra City District, Bur. Min. Resour. Aust. Bull. 32.



CSIRO HEADQUARTERS SITE, CANBERRA 1968

GEOLOGY, TOPOGRAPHIC CONTOURS AND TRAVERSE LAYOUT

(CONTOURS BASED ON A.C.T. DETAIL SERIES SHEET J6D)

(TOPOGRAPHY BASED ON PLANE TABLE SURVEY BY T.J.PALLETT & W.E.READ)

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PLATE 2

SEISMIC CROSS-SECTIONS
TRAVERSES A & B

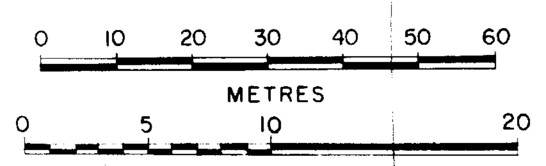
LEGEND

(7000) Seismic velocity (ft/s) in formation

I.Pt TRAV Traverse intersection point

Unweathered bedrock boundary

HORIZONTAL AND VERTICAL SCALE IN FEET



TRAVERSE A

STATION NUMBER		-1	1				5					10					15					20			23	27
SURFACE ELEVATION		1914	1918	1921	1923	1925	1927	1929	1931	1933	1934	1936	1938	1940	1942	1945	1947	1950	1952	1954	1955	1957	1959	1960	1962	1964
UNWEATHERED ROCK	DEPTH	51	47	—	53	55	55	55	54	52	50	52	—	52	52	52	55	—	57	63	62	53	54	46	53	53
	ELEVATION	1863	1871	—	1870	1870	1872	1874	1877	1881	1884	1884	—	1888	1890	1893	1892	—	1895	1891	1893	1904	1905	1914	1909	1911

TRAVERSE B

STATION NUMBER		-2	2			5					10					15					20			23	27
SURFACE ELEVATION		1950	1946	1945	1944	1943	1943	1942	1942	1942	1942	1942	1941	1942	1942	1943	1943	1943	1944	1944	1942	1939	1934	1930	1920
UNWEATHERED ROCK	DEPTH	55	46	46	41	37	43	62	59	49	58	45	48	55	53	59	52	59	70	71	71	—	—	57	66
	ELEVATION	1895	1900	1899	1903	1906	1900	1880	1883	1893	1884	1897	1893	1887	1889	1884	1891	1884	1874	1873	1871	—	—	1873	1854

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PLATE 3

SEISMIC CROSS-SECTIONS
TRAVERSES C & D

STATION NUMBER	-3	1				5					10					15					20				25	27
SURFACE ELEVATION	1960	1953	1952	1951	1950	1950	1950	1950	1951	1952	1953	1954	1954	1955	1955	1957	1958	1959	1961	1962	1964	1965	1966	1965	1963	1958
UNWEATHERED ROCK DEPTH	41	31	36	40	38	37	42	45	—	53	59	58	57	59	58	54	64	60	58	64	55	48	47	46	43	43
UNWEATHERED ROCK ELEVATION	1919	1922	1916	1911	1912	1913	1908	1905	—	1899	1894	1896	1897	1896	1897	1903	1894	1899	1903	1898	1909	1917	1919	1919	1920	1915

STATION NUMBER	-3	1				5					10					15					20				27
SURFACE ELEVATION	1955	1953	1953	1953	1953	1954	1955	1957	1959	1960	1962	1963	1964	1965	1966	1967	1967	1967	1966	1965	1964	1964	1963	1963	1960
UNWEATHERED ROCK DEPTH	40	44	—	32	25	24	23	33	34	40	33	44	46	44	45	45	55	61	51	60	54	41	—	52	35
UNWEATHERED ROCK ELEVATION	1915	1909	—	1921	1928	1930	1932	1924	1925	1920	1929	1919	1918	1921	1921	1922	1912	1906	1915	1905	1910	1923	—	1911	1925

LEGEND

(7000) Seismic velocity (ft/s) in formation

I.Pt TRAV Traverse intersection point

Unweathered bedrock boundary

HORIZONTAL AND VERTICAL SCALE IN FEET

0 10 20 30 40 50 60

METRES

0 5 10 20

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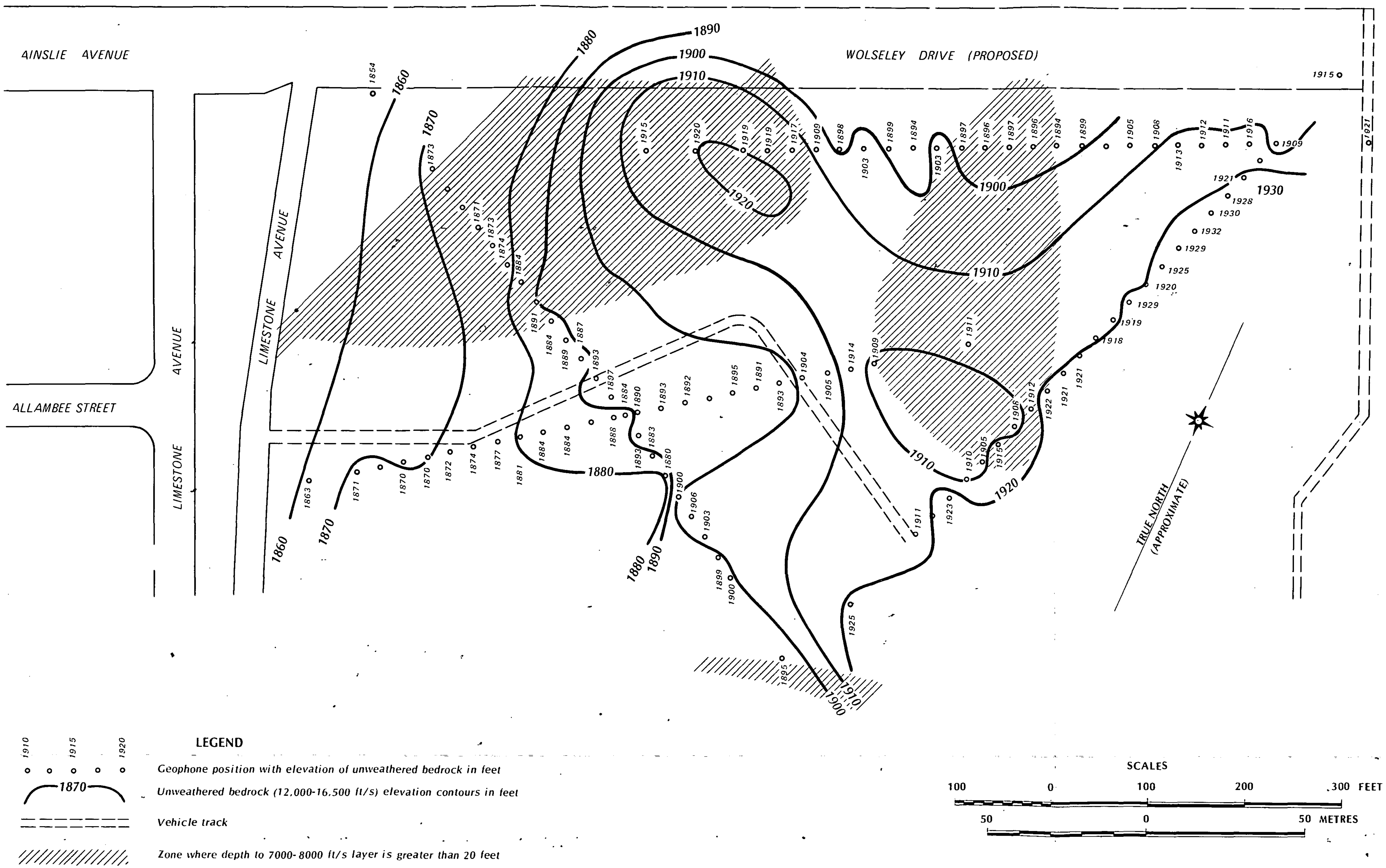

CONTOURS OF UNWEATHERED BEDROCK

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