COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

PETROLEUM SEARCH SUBSIDY ACTS

Publication No. 32

MUTTABURRA SEISMIC SURVEY, QUEENSLAND, 1959

BY

ARTESIAN BASIN OIL COMPANY PROPRIETARY LIMITED

Issued under the Authority of Senator the Hon. W. H. Spooner,
Minister for National Development

1962

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

Minister: SENATOR THE HON. W. H. SPOONER, M.M.
Secretary: H. G. RAGGATT, C.B.E.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

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FOREWORD

In 1959 the Commonwealth Government enacted the Petroleum Search Subsidy Act 1959, under which companies proposing to drill for new stratigraphic information or to carry out either geophysical or bore-hole surveys in search of petroleum could be subsidised for the cost of drilling or of survey operations approved by the Minister for National Development.

The Bureau of Mineral Resources, Geology and Geophysics is required, on behalf of the Department of National Development, to examine the applications, maintain surveillance of the operations and in due course publish the results.

A seismic survey was carried out under the Petroleum Search Subsidy Act 1959 in the Muttaburra area of Queensland by Artesian Basin Oil Company Proprietary Limited. This Publication deals with that survey and contains the information furnished by Artesian Basin Oil Company Proprietary Limited and edited in the Geophysical Branch of the Bureau of Mineral Resources. The final report was written by E.R. Denton, Geophysicist, and R.G. Dennison, Review Seismologist, under the supervision of R.C. Sprigg, Managing Director, all of Geoseismic (Australia) Limited. The methods of carrying out the seismic survey and the results obtained are presented in detail.

CONTENTS

ILLUSTRATIONS

ILLUSTRATIONS (Cntd.)

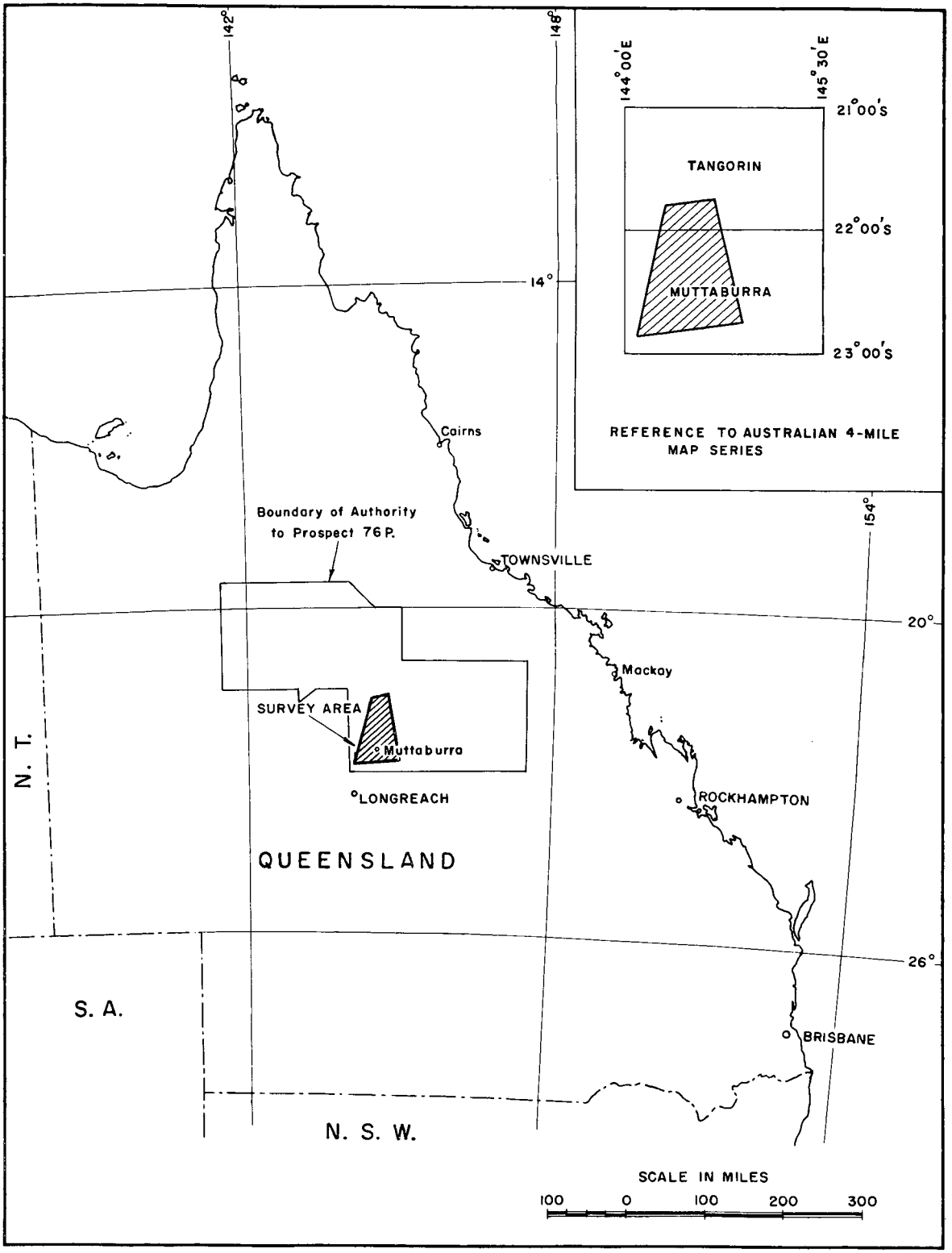

Fig. I. LOCALITY MAP

ABSTRACT

This report refers to a seismic reflection survey conducted near the town of Muttaburra in Queensland, between 16th October and 12th December, 1959, by Geoseismic (Australia) Ltd, for the Artesian Basin Oil Company Pty Ltd.

The purpose of the survey was to determine the nature of any structures present and the thickness of the sedimentary rocks. A number of isolated reconnaissance lines were laid and the shot-points were placed at one or two mile intervals. The records were computed by jump correlation. One structural feature found as a result of the reconnaissance traverses was investigated by more detailed work.

A northerly plunging anticline, with easterly dip contrary to the regional westerly dip was delineated on two reflecting horizons. The relief due to the easterly dip is approximately 250 feet on the deeper horizon and 200 feet on the shallower horizon.

To investigate the area fully, it would be necessary to carry out a further seismic reflection survey using the continuous profiling method of recording and computing.

1. INTRODUCTION

A seismic reflection survey was conducted near the town of Muttaburra, Cumberland County, Queensland, between 16th October and 12th December, 1959, by Geoseismic (Australia) Ltd, for the Artesian Basin Oil Company Pty Ltd. The survey area (see Figure 1) was located in Authority to Prospect No. 76P held by the Company. Muttaburra is situated in the plains of Central Queensland, and is 70 miles north of the nearest rail and airline services at Longreach.

The purpose of the survey was to determine the thickness of the sedimentary rocks and the nature of any structures present. The assignment was specified by the Artesian Basin Oil Company Pty Ltd and consisted of a number of isolated reconnaissance lines in which the shot-points were one or two miles apart and the records were computed by jump correlation. Usually, subsurface structures underlie the topographic "highs". The positions of the seismic lines were selected by determining these topographic "highs" from aerial photomaps and the drainage patterns of the surface.

One structural feature found as a result of the reconnaissance traverses was investigated by more detailed work.

The climate of the area is semi-arid with rainfall limited to a wet season which occurs between December and February. When the survey was conducted, the area was suffering an acute drought, which had persisted for a period of three years. The only water available was from artesian bores.

Drainage is to the south by the Thompson River, which flows only during the wet season. Timber cover is confined to river and creek channels and consists of several varieties of stunted eucalypts. Elsewhere, the plains are covered with Mitchell grass.

2. GEOLOGY

The area is part of the Great Artesian Basin. The surface is predominantly brown clay of the Tambo Formation - a marine deposit of Cretaceous age. These beds and the geology of the Artesian Basin have been described by Whitehouse (1954). A number of bores have been drilled in the area for artesian water. These bores were bottomed in the Blythesdale aquifer, which is a paralic sandstone formation of Cretaceous age. The depth of the Veraston bore on the Muttaburra Prospect is 3,214 feet. A driller's log is available and the rocks are mainly marine blue shale above the sandstone aquifers.

The only outcrops observed in the survey area were of laterite, or duricrust, which forms the cap rock of a number of mesas to the south of the Veraston bore. These mesas comprise the "Alma" Range depicted on map 4M64 of the Queensland "four mile" series. The beds are horizontal or almost horizontal.

Palaeozoic rocks crop out on the eastern rim of the Artesian Basin some 140 miles east of Muttaburra. It is considered likely that in the Muttaburra area they underlie the Mesozoic beds.

Very little is known of the rocks in the immediate Muttaburra area below the horizon of the Blythesdale aquifer. In fact, the nature and age of the pre-Mesozoic rocks over several tens of thousands of square miles in this vicinity is practically unknown. Fortunately, several regional tendencies can be observed that permit some inference. These, in turn, fit most of the geophysical evidence obtained from the survey.

The main regional geological features, according to Sprigg (1958), are as follows:

(i) East of Longreach, the Mesozoic sedimentary rocks several thousand feet thick overlie a basement ridge of granite and metamorphic rocks. The trend of the ridge is believed to be more or less north-south.

(ii) East of this basement ridge, a Permian trough extends more or less north-north-west to south-south-east, underlying the marginal developments of the Mesozoic rocks.

(iii) Permian sedimentary rocks crop out along the eastern margin of the Artesian Basin in Queensland and New South Wales. In general, nonconformities between the various ages of post-Permian sedimentary rocks are minor except where affected by faulting. A tendency to unconformity develops farther to the east and intensifies in the Roma-Springsure and Bowen Basin zones in the approaches to the Hunter-Bowen thrust zone. Fold axes appear to be coincident throughout in spite of the intensification of folding in the underlying Permian sedimentary rocks.

(iv) Carboniferous-Devonian beds of the Drummond Ranges crop out immediately east of the basin in this vicinity and are folded more strongly than the Permian sedimentary rocks.

Applying this basic information to the area covered by the seismic survey, the Muttaburra Prospect may straddle the junction of the Longreach basement ridge and the Permian trough on the east.

It is believed that this survey is the first geophysical survey conducted in the vicinity of Muttaburra.

3. FIELD PROCEDURE

All traverses were run along gravel roads, stock routes, or boundary fences. Five reconnaissance lines were shot in which the shot-points were spaced at one or two mile intervals; the records were computed by jump correlation.

Lines are identified in this report according to their location:

(1) Muttaburra Lines
(2) Inverness Line
(3) Tangorin Line
(4) Arranmore Line
(5) Aramac Line

The location of lines and shot-points is shown on the location map and the contour maps (see Plates 1-4 incl.)

A significant structural anomaly was found on the Muttaburra Line and further lines of both correlation shooting and continuous profiling were run to investigate the anomaly more fully. This programme of shooting is known as the Muttaburra Prospect.

Shot-points were located and levelled by stadia survey using a Wild T-1 theodolite. Elevations were tied to benchmarks established by the Queensland Main Roads Department, and were referred to as the Queensland State Datum. All geophone spreads were chained.

One shot-hole was drilled at each shot-point with a Mayhew-1000 drill. Water was used as a drilling fluid and the short supply of water in the area limited the field production. The usual formations encountered by the drill were, from the surface downwards, clay, brown shale, grey shale, and blue shale. Stringers of sandstone occurred in many holes. The depth to the blue shale varied between 60 and 120 feet on the Muttaburra Prospect. On most of the other reconnaissance lines, the blue shale was not reached until the drill had penetrated 200 feet or more.

The shots were placed at the centre of straddle spreads, the spread lengths being 1,320 feet. At least two shots were recorded from each hole so that both single and mixed records were available at each shot-point. Record quality was fair to good where the shots were fired in the blue shale. The Tangorin, Arranmore, and Aramac Lines were abandoned when this shale became too deep to allow the drill to reach it in a reasonable time. The normal charge of dynamite used throughout the survey was 25 lb.

4. RESULTS OF THE SURVEY

Methods of Computation

Corrections for elevation and weathering were made by the normal up-hole method using an elevation velocity of 7,000 ft/sec. This velocity was computed from an up-hole survey at Shot-point No. 2 of the Muttaburra Prospect. It was checked by refraction plots. A weathering velocity of 4,000 ft/sec was calculated also. Shots fired above the blue shale were invariably in the weathered layer.

Reflections were picked, corrected for the effects of weathering and elevation, and plotted on the cross-sections in two-way travel time. Reflections were graded with respect to their certainty by principles described by Gaby (1947).

On the records obtained for the reconnaissance lines, the reflections were correlated by character and interval. On the records obtained by continuous profiling, the reflections were correlated at interlocking shot-points by datum-to-datum times corrected for weathering and elevation.

All dips observed were quite gentle and migrated sections were not prepared. Correlation was facilitated by the presence of an extremely strong and persistent reflection which appeared on nearly all of the records. This reflector is identified as the "P" horizon in

this report. Character changes and phasing prevented the early leg of this reflection being recorded at many shot-points, and thus a later, more prominent leg was used for control on this horizon.

A second reflecting horizon, tentatively identified as the Blythesdale Formation, was also continuous over the Muttaburra Prospect.

Presentation of Results

Contour maps of the "P" horizon and the Blythesdale horizon were constructed for the Muttaburra Prospect. An average velocity of 8,000 ft/sec was assumed for the area so that data could be presented in depth. These maps, together with a contour map of the isopach between them, and three sample cross-sections, are printed as Plates 2 - 7 inclusive.

The cross-sections for the four reconnaissance lines are printed as Plates 8 - 14 inclusive. No contour maps were constructed for these lines. The following information has been filed with the Bureau of Mineral Resources, Geology and Geophysics, and is available for future reference :-

(i) A complete set of record sections
(ii) A complete set of cross-sections
(iii) Results of an up-hole velocity survey.

5. DISCUSSION OF RESULTS

A long northerly plunging anticline is shown on the "P" horizon with its axis bearing almost north-south. On the eastern limb of the anticline there is a narrow synclinal feature. On the Blythesdale horizon, this syncline appears to be wider and shallower, and several possible structural closures are shown on the anticlinal axis.

Dips on both horizons are very gentle, except those located near Shot-points 10 and 11, where an easterly dip of approximately seven degrees contrary to the regional westerly dip was found on the "P" horizon, and similar dips of five to six degrees on the Blythesdale horizon.

It is possible that there is faulting at the location of the interpreted syncline. There is no definite information and the faulting is not mapped because seismic control east of this area is limited, the shot-points being at one mile intervals.

The isopach map shows gentle thickening over the syncline and a thinning over the anticlinal axis. The map shows indications of the contours closing in several isolated areas.

The horizons mapped are relatively shallow, the deepest point on the "P" horizon being about 3,500 feet below the surface. Deeper reflections than the "P" horizon appeared on some of the records, principally in the eastern part of the area investigated. They indicated that the depth of sedimentary rocks may extend locally down to a two-way reflection of time about 1.200 sec, or approximately 5,000 feet. These reflections rarely tied between shot-points. However, correlations that could be made indicated that the deeper reflections were conformable with the shallow horizons.

The Arranmore Line is a line trending south-east, located approximately 20 miles south-west of the Muttaburra Prospect. Dip is gentle, and all reflectors appear to be conformable. No deep reflections were observed on records shot along the south-eastern portion of the line. The deepest reflector in the area has a two-way time of approximately 0.870 sec, which would place its depth in the vicinity of 3,500 feet.

The Aramac Line is located approximately 4 miles south-east of the town of Muttaburra. It traverses approximately 21 miles in a south-westerly direction. Gentle north-westerly dip was observed except between Shot-points 3 and 4, where approximately 0.025 sec of south-easterly dip appears on the deep reflectors. The depth of sedimentary rocks on the north-western portion of the line appears to be the same as that on the Arranmore Line. Some isolated deeper reflections, down to 1.090 sec (4,000 feet), were observed on records taken along the south-eastern portion of the line.

The Inverness Line is located immediately to the north-east of the Muttaburra Prospect. Deep, random reflections are present, but the deepest continuous reflections, probably from the "P" reflector, were approximately 3,500 feet below the surface. An anticlinal feature was observed showing 0.040 sec of easterly dip from Shot-point 71 to Shot-point 75. This represents approximately 160 feet of dip over a distance of 7 1/2 miles when referred to the contrary regional dip. This reversal is the projection of the plunging anticline mapped on the Muttaburra Prospect.

The Tangorin Line was shot in a general easterly directon approximately 32 miles north of the Inverness Line. An apparent anticlinal structure is shown on the deeper "P" horizon but record quality did not permit weaker shallow reflections to be plotted with any accuracy. The "P" horizon shows an easterly dip of 0.019 sec between Shot-points 9 and 11 and a northerly dip of 0.200 sec to Shot-point 12. Shallow reflections, where plotted, are apparently conformable.

6. GEOLOGICAL INTERPRETATION OF RESULTS.

As noted under "Geology", it is considered that the Muttaburra Prospect may straddle the junction of the Longreach basement ridge with the Permian trough on the east.

West of the depression line of the observed minor syncline, practically no reflections that could be correlated were recorded below the "P" horizon. The "P" horizon is gently undulating at a position somewhat less than 3,500 feet below sea level. To the east, however, almost horizontal reflectors were recorded to depths of almost 5,000 feet. In this eastern area, a strong degree of conformity is apparent, which is in keeping with the general relations of Permian rocks with the Mesozoic rocks where they crop out in the immediate east. It appears reasonable that these deeper sedimentary rocks are Permian in age.

The strong and relatively abrupt change in contour of the "P" horizon across the previously mentioned central syncline is believed to be significant. The smoother contour is

to the east, as one might expect in the absence of any significant time (and erosional) break between two sedimentary formations. To the west, however, the undulating contour of the "P" horizon is quite typical of a more sculptured erosional surface developed in hard basement rocks.(1).

It is predicted, therefore, that the eastern part of the prospect overlies a buried Permian trough, whereas to the west, Mesozoic rocks lie directly upon irregular basement "highs", which probably include granites. This irregular erosion surface has influenced the thickness of the pre-marine Cretaceous-Mesozoic rocks so that the isopachous contours exhibit thinning over the "highs" and thickening in the troughs. In the Mesozoic blanketing sedimentary rocks there are some structural peculiarities which require explanation. The narrow syncline, coinciding with the junction of the presumed Permian bedrock, does not appear to be a normal "fold" feature. It is possible that it is a fossil valley eroded along a former line of weakness and preserved throughout early mid-Mesozoic times by continuing sedimentary compaction. On the other hand, the feature is relatively straight and narrow and consequently control by faulting seems more probable. Possibly a reversal of fault movement produced such a feature. Such movements usually develop anomalous "valleys" of this type along the line of weakness. If this is so in this case, it would indicate a fault contact in the western margin of the predicted Permian sedimentary basin and suggests the tectonic pattern of a half-graben for the Permian basin in this area. The nature of the pre-(?) Permian rocks in this easterly zone cannot be gauged and, if folded Carboniferous-Devonian sedimentary rocks are present, and this is probable, continuous profiling methods of recording and computing are more likely to provide reliable indication of their structure than records taken at shot-points at one or two mile intervals.

7. RECOMMENDATIONS AND CONCLUSIONS

The Muttaburra Prospect has delineated a northerly plunging anticline showing up to 250 feet of relief on the "P" horizon, and 200 feet of relief on the Blythesdale horizon due to reverse easterly dip. Although the evidence indicates bedrock at 3,200 feet on this structure, the predicted favourable relation to deeper Palaeozoic sedimentary rocks to the east, and possibly also to the west, makes it of definite interest in the search for oil. Several other possibilities exist such as Palaeozoic wedgeouts against the presumed basement ridge from the east. To investigate the area in more detail it would be necessary to conduct further seismic traverses using continuous profiling methods of recording and computation.

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(1) Footnote by the Bureau of Mineral Resources:
The difference in character of the "P" horizon contours on either side of the central syncline could also be due to the relatively close spacing of traverses and shot-points west of the syncline as compared with the generally wider spacing of traverses and shot-points east of the syncline.

REFERENCES

GABY, P.P 1947 Grading system for seismic reflections and correlations. Geophysics. 12, 590-617.

SPRIGG, R.C. 1958 Petroleum prospects of western parts of Great Australian Artesian Basin. Bull. Amer. Ass. Petrol. Geol. 42, 2465-2491.

WHITEHOUSE, F.W. 1954 The geology of the Queensland portion of the Great Australian Artesian Basin, ARTESIAN WATER SUPPLIES IN QUEENSLAND, Appendix G. Dept. of the Co-ordinator-General of Public Works, Queensland.

APPENDIX I

COMPUTATION AND INTERPRETATION METHODS

Weathering and Elevation Correction	Normal up-hole
Elevation Datum	+600 ft above sea level
Weathering Velocity Vw	4,000 ft/sec
Elevation Velocity Ve	7,000 ft/sec
Correlation Method	Character and Interval
Interlock Ties (Continuous profiling)	Datum to datum time ties
Horizons Mapped	Tentative Blythesdale
	Tentative "P" Horizon
	Isopach Blythesdale to "P" Horizon

APPENDIX II

FIELD PROCEDURE

Type Traverse	1 and 2 mile correlation. Also some continuous profiling
Spread Length	1,320 ft
Station Interval	110 ft
Type Geophones Used	SIE Type S-16
Number per Trace	4
Connection	Series - parallel
Spacing in Group	20 ft
Type Amplifier	Century 501A
Number of Channels	24
Filter Setting	39 - 66 c/s
Mixing	Single and mixed record obtained from each shot-point. Mix 50% unidirectional.
Galvanometers	Century G-14

APPENDIX III

STATISTICS

Field work commenced	16th October 1959
Field work completed	12th December 1959
Field recording hours	243.75 hr
Recorder drive hours	73.50 hr
Miles traversed	142.3 miles
Holes shot	166
Records shot	375
Dynamite used	9,602.5 lb
Caps used	462
Average shot depth	100 ft
Average charge size	25 lb
Number of drills	1

APPENDIX III (Contd.)

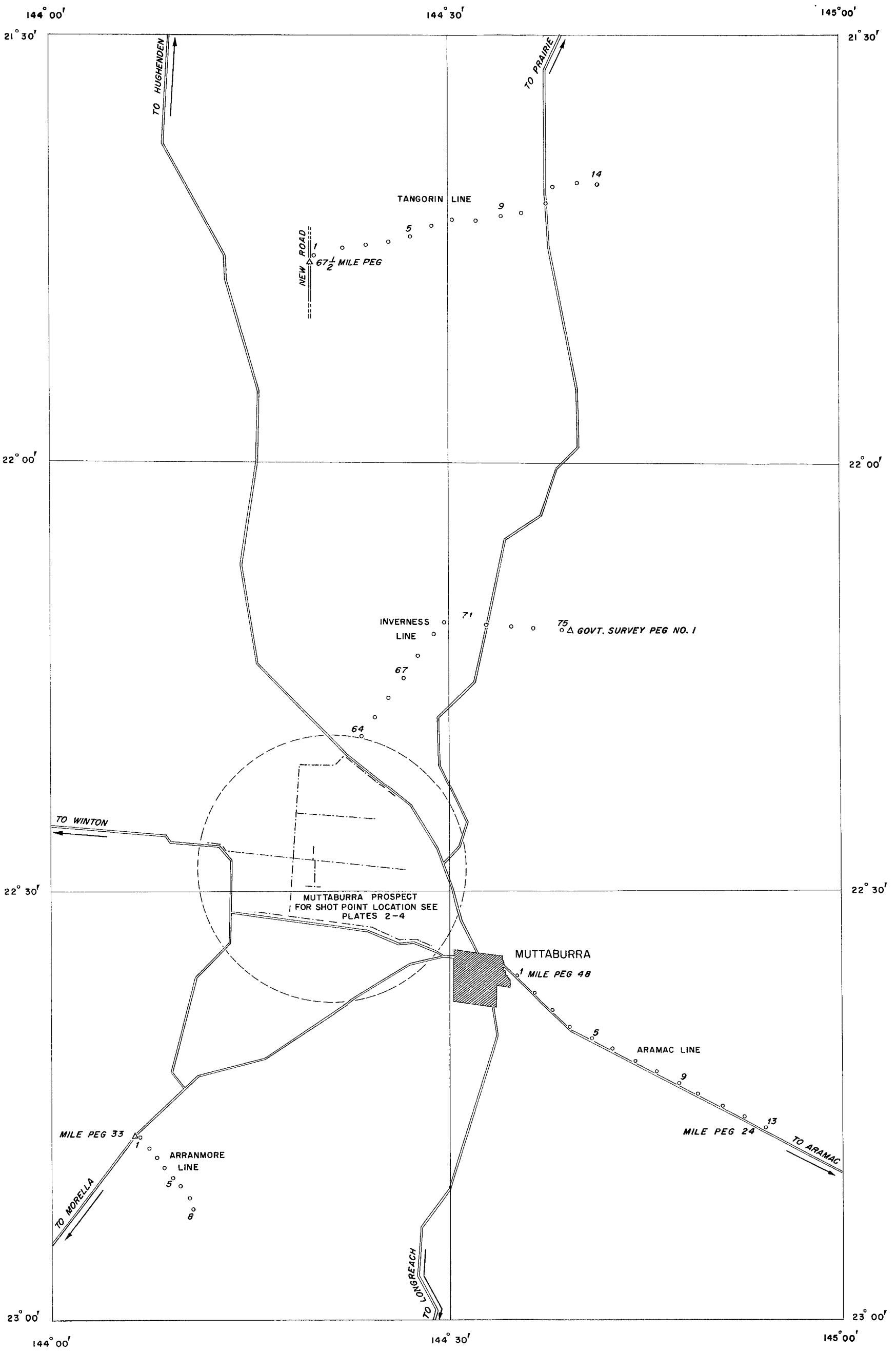
Type of drill	Mayhew-1000
Drilling hours	273.25 hr
Drill drive hours	77.75 hr
Holes drilled	166
Footage drilled	16,443 ft
Bits used	
Hawthorne AC 4 1/4" Rockcutter Blades	9 sets
Rock Bits 4 1/4" Tricone	1
Drilling mud	450 lb
Bran	1,200 lb

APPENDIX IV

LOCATION AND PERSONNEL

Crew Headquarters	Muttaburra, Queensland
Party Chief	E. R. Denton
Computer	C. N. Strong
Observer	L. Read
Junior Observer	D. Jones
Surveyor	H. R. Ridge
Driller	C. Davies
Review Seismologist	R. G. Dennison

PLATE 1



REFLECTION SEISMIC SURVEY

PROSPECT LOCATION MAP

FOR

ARTESIAN BASIN OIL COMPANY PTY.LTD.

BY

GEOSURVEYS AUST. LTD.

REFERENCE

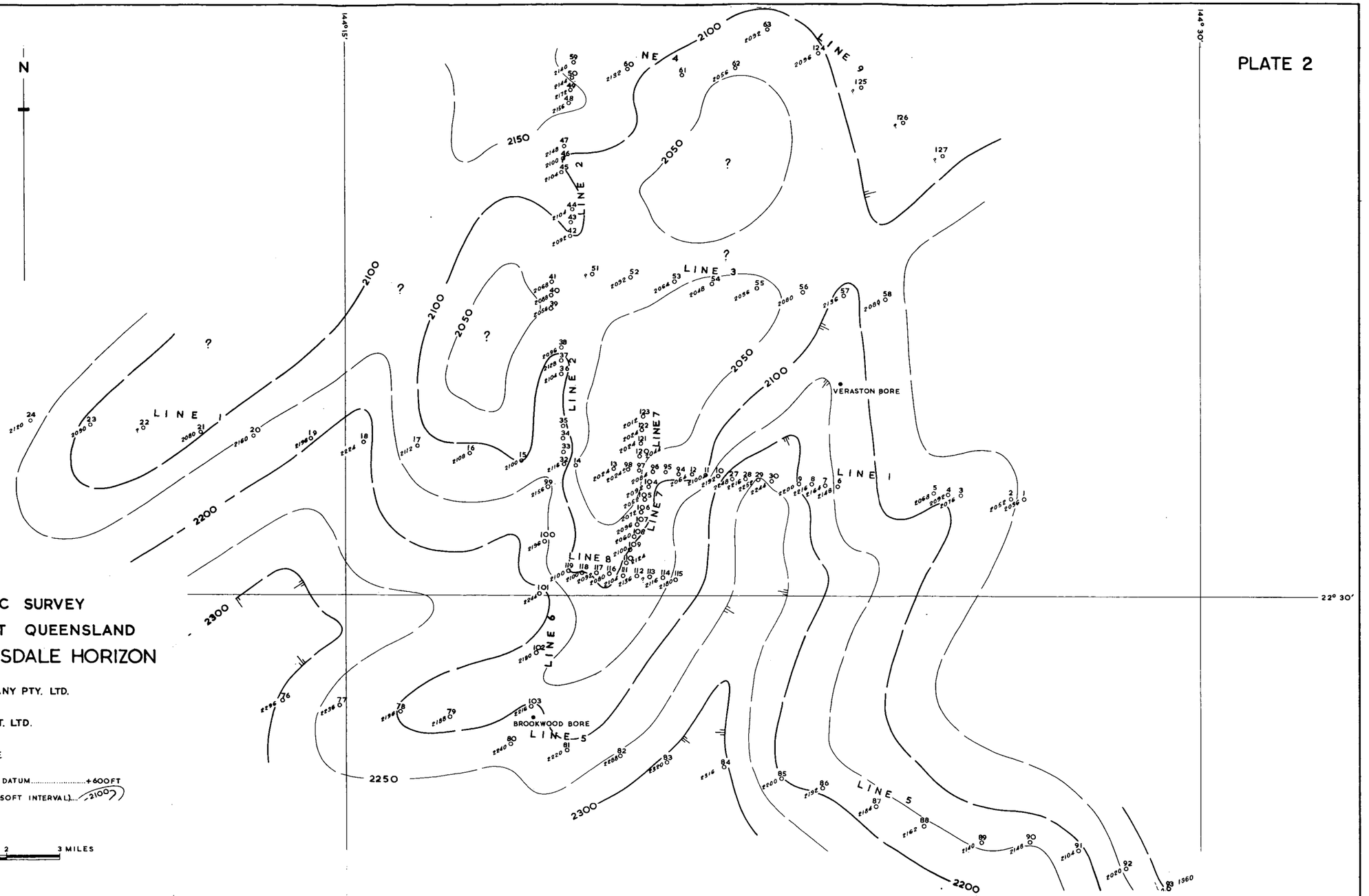
ROAD ..... SEISMIC TRAVERSE.....

SHOT POINT.....65

SCALE

MILES 8 0 8 16 24 MILES

PLATE 2



REFLECTION SEISMIC SURVEY
MUTTABURRA PROSPECT QUEENSLAND
CONTROL FOR BLYTHESDALE HORIZON

FOR

ARTESIAN BASIN OIL COMPANY PTY. LTD.

BY

GEOSURVEYS AUST. LTD.

REFERENCE

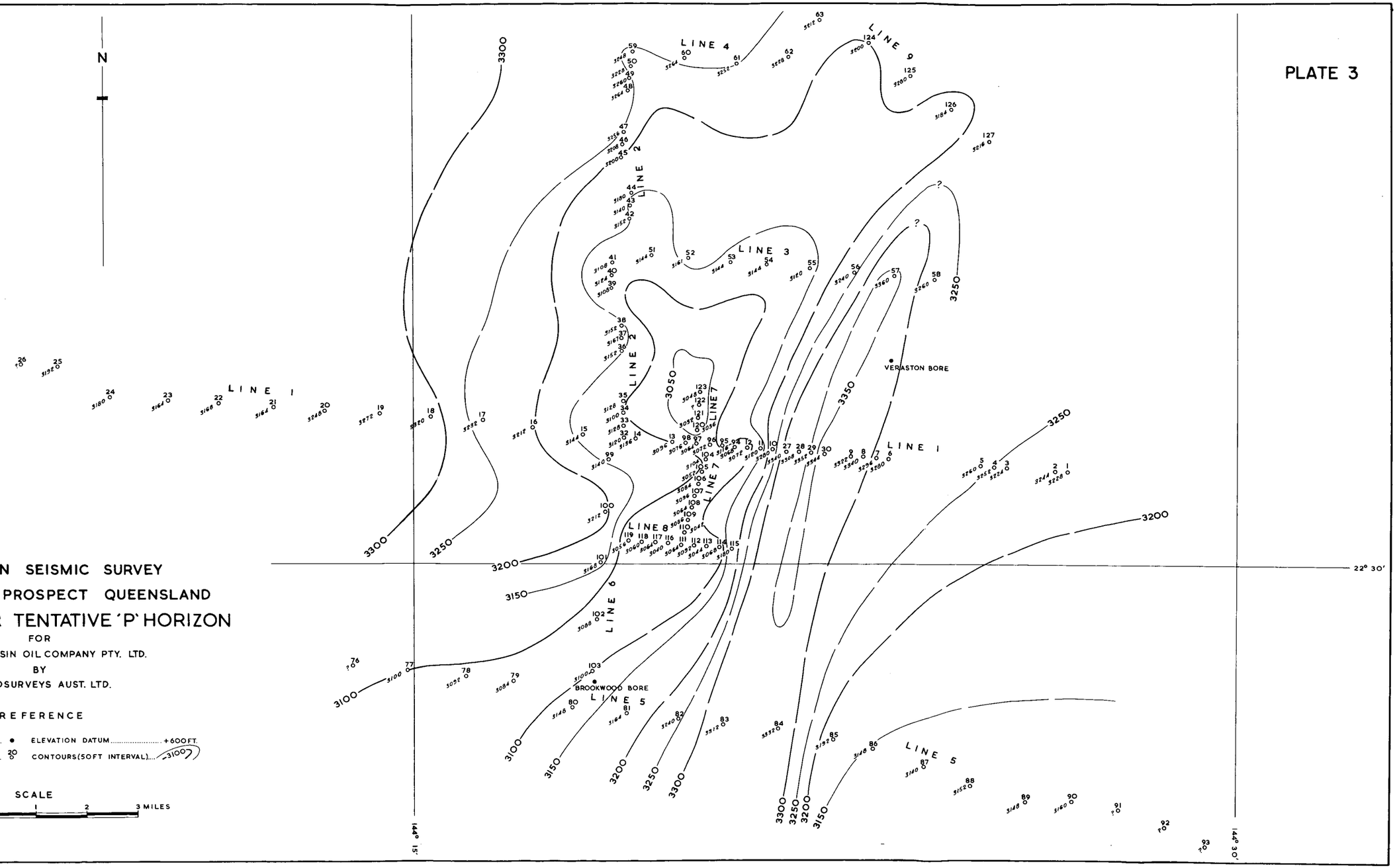
BORE ..... • ELEVATION DATUM ..... +600FT

SHOT HOLE ..... 20 ○ CONTOURS (SOFT INTERVAL) ..... -2100

SCALE

CHAINS 80 0 1 2 3 MILES

PLATE 3



REFLECTION SEISMIC SURVEY
MUTTABURRA PROSPECT QUEENSLAND
CONTROL FOR TENTATIVE 'P' HORIZON

FOR

ARTESIAN BASIN OIL COMPANY PTY. LTD.

BY

GEOSURVEYS AUST. LTD.

REFERENCE

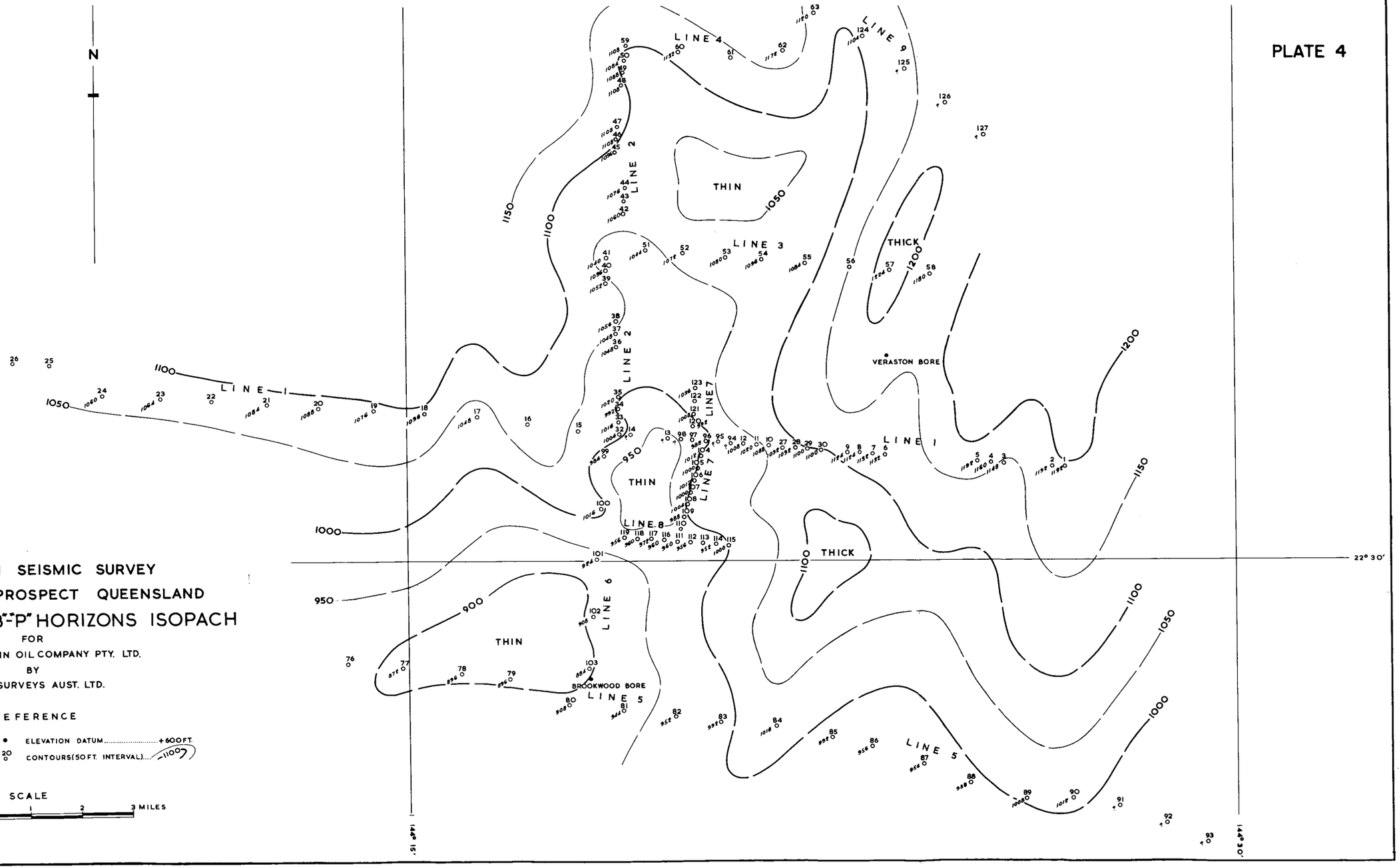
BORE ..... ● ELEVATION DATUM ..... +600FT.

SHOT HOLE ..... 20 ○ CONTOURS (50FT INTERVAL) ..... -3100?

SCALE

CHAINS 80 0 1 2 3 MILES

PLATE 4



REFLECTION SEISMIC SURVEY

MUTTABURRA PROSPECT QUEENSLAND

CONTROL FOR "B"-"P" HORIZONS ISOPACH

FOR

ARTESIAN BASIN OIL COMPANY PTY. LTD.

BY

GEOSURVEYS AUST. LTD.

REFERENCE

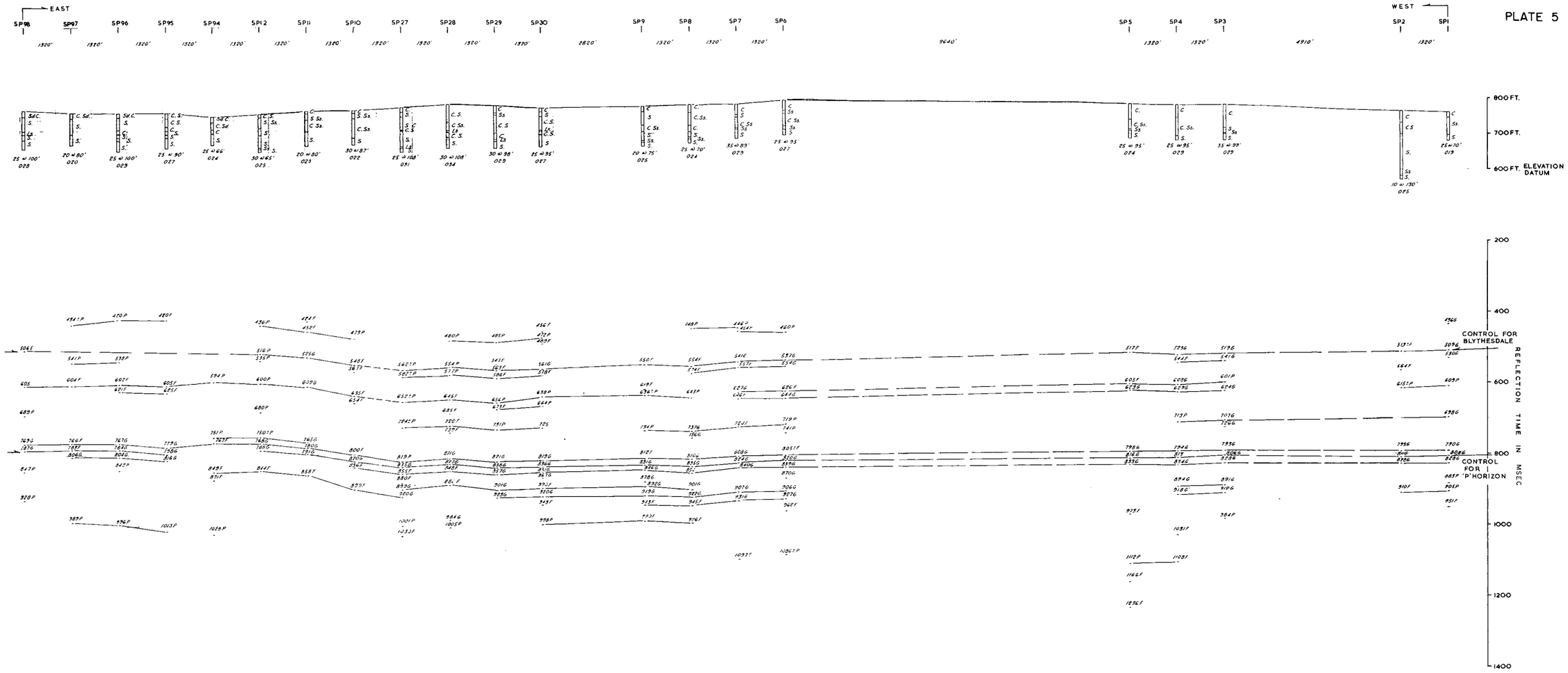
BORE ..... • ELEVATION DATUM ..... +600FT.

SHOT HOLE ..... 20 CONTOURS(50FT. INTERVAL) 1100

SCALE

CHAINS 80 0 1 2 3 MILES

PLATE 5



MUTTABURRA PROSPECT
LINE 1
FOR
ARTESIAN BASIN OIL COMPANY PTY. LTD.
BY
GEOSURVEYS AUST. LTD.

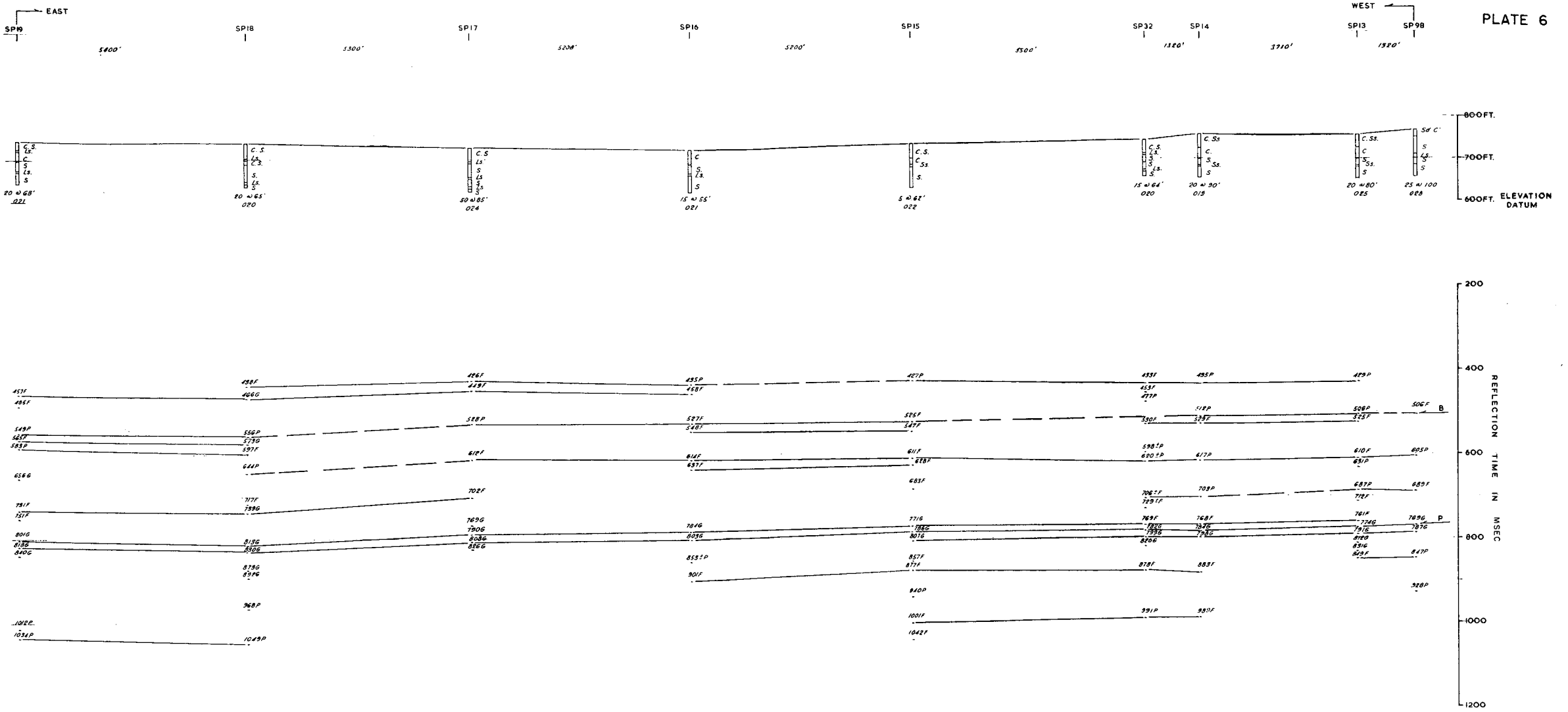
HORIZONTAL SCALE
FEET 1000 0 1000 2000 3000 FEET

LEGEND

6.....RELIABILITY GOOD
F..... " FAIR
P..... " POOR
?..... " QUESTIONABLE
E.....ESTIMATED VALUE

C.....CLAY
S.....SHALE
Ls.....LIMESTONE
Ss.....SANDSTONE
Sd.....SAND

PLATE 6



LEGEND

G.....RELIABILITY GOOD	———	CLAY.....C
F..... " FAIR	— —	SHALE.....S
P..... " POOR	— — —	LIMESTONE.....Ls
?..... " QUESTIONABLE	- - - - -	SANDSTONE.....Ss
E.....ESTIMATED VALUE		SAND.....Sd

MUTTABURRA PROSPECT
LINE 1

FOR

ARTESIAN BASIN OIL COMPANY LTD.

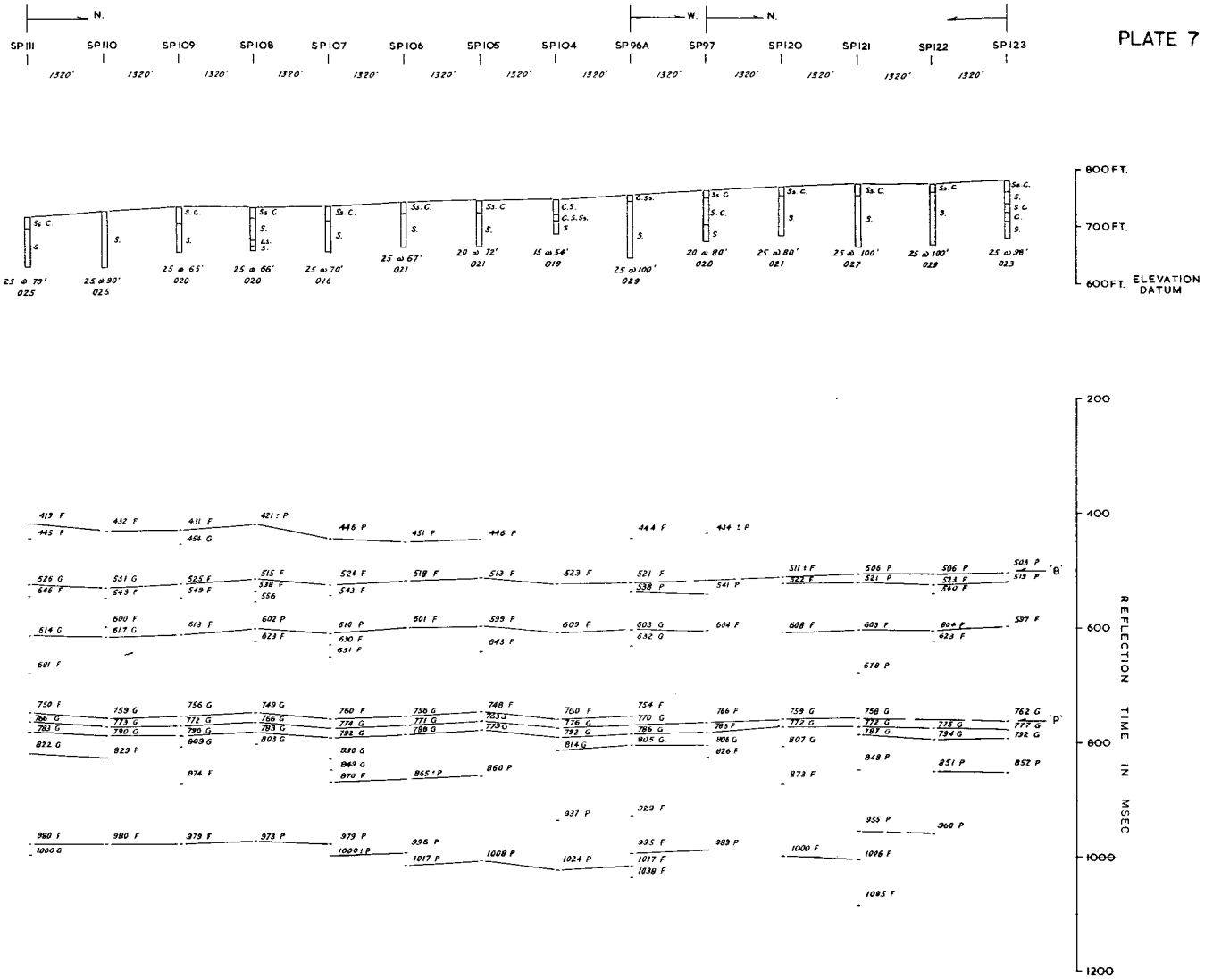
BY

GEOSURVEYS AUST. LTD.

HORIZONTAL SCALE

FEET 1000 0 1000 2000 3000 FEET

PLATE 7



LEGEND

6..... RELIABILITY GOOD	———	CLAY.....	C
F..... " FAIR	— — —	SHALE.....	S
P..... " POOR	— — — —	LIMESTONE.....	Ls
?..... " QUESTIONABLE	- - - - -	SANDSTONE.....	Ss
E..... ESTIMATED VALUE		SAND.....	Sd

MUTTABURRA PROSPECT

LINE 7

FOR

ARTESIAN BASIN OIL COMPANY PTY. LTD.

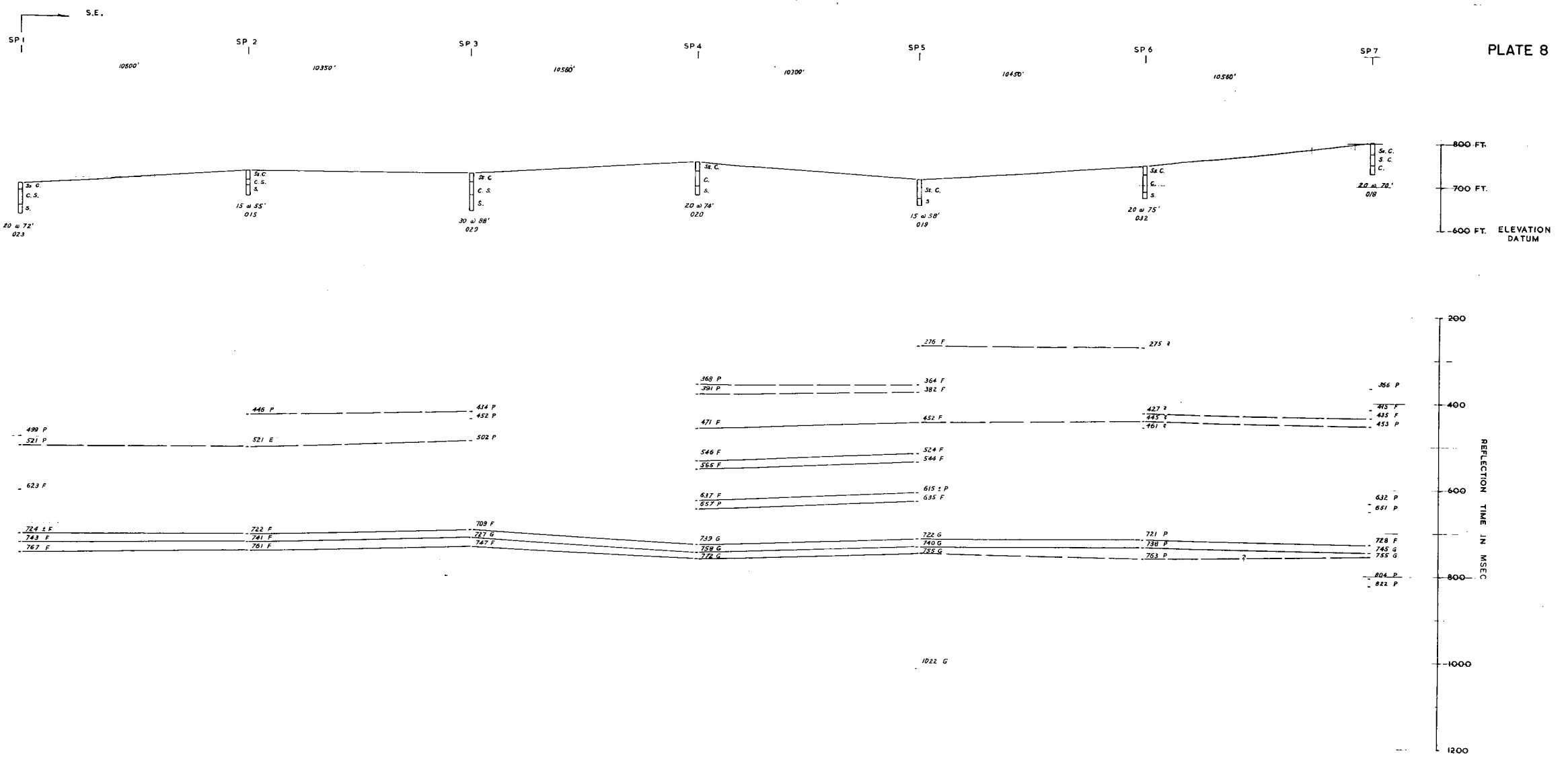
BY

GEOSURVEYS AUST. LTD.

HORIZONTAL SCALE

FEET 1000 0 1000 2000 3000 FEET

PLATE 8



LEGEND

6	RELIABILITY GOOD	———
F	" FAIR	— —
P	" POOR	— — —
?	" QUESTIONABLE	- - - - -
E	ESTIMATED VALUE	

CLAY	C
SHALE	S
LIMESTONE	Ls
SANDSTONE	Ss
SAND	Sd

ARAMAC LINE

FOR

ARTESIAN BASIN OIL COMPANY PTY. LTD.

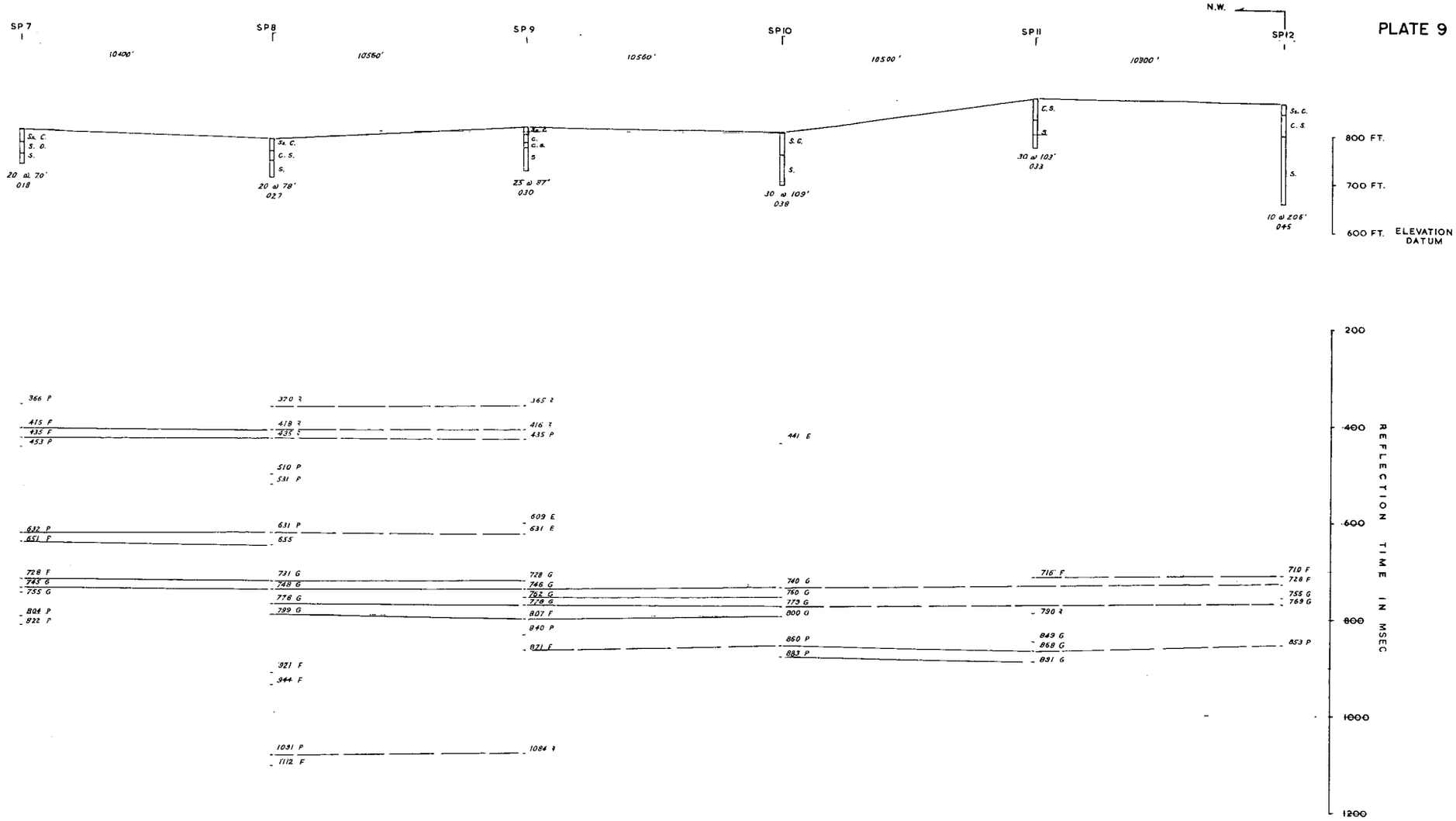
BY

GEOSURVEYS AUST. LTD.

HORIZONTAL SCALE

FEET 2000 0 2000 4000 6000 FEET

PLATE 9



LEGEND

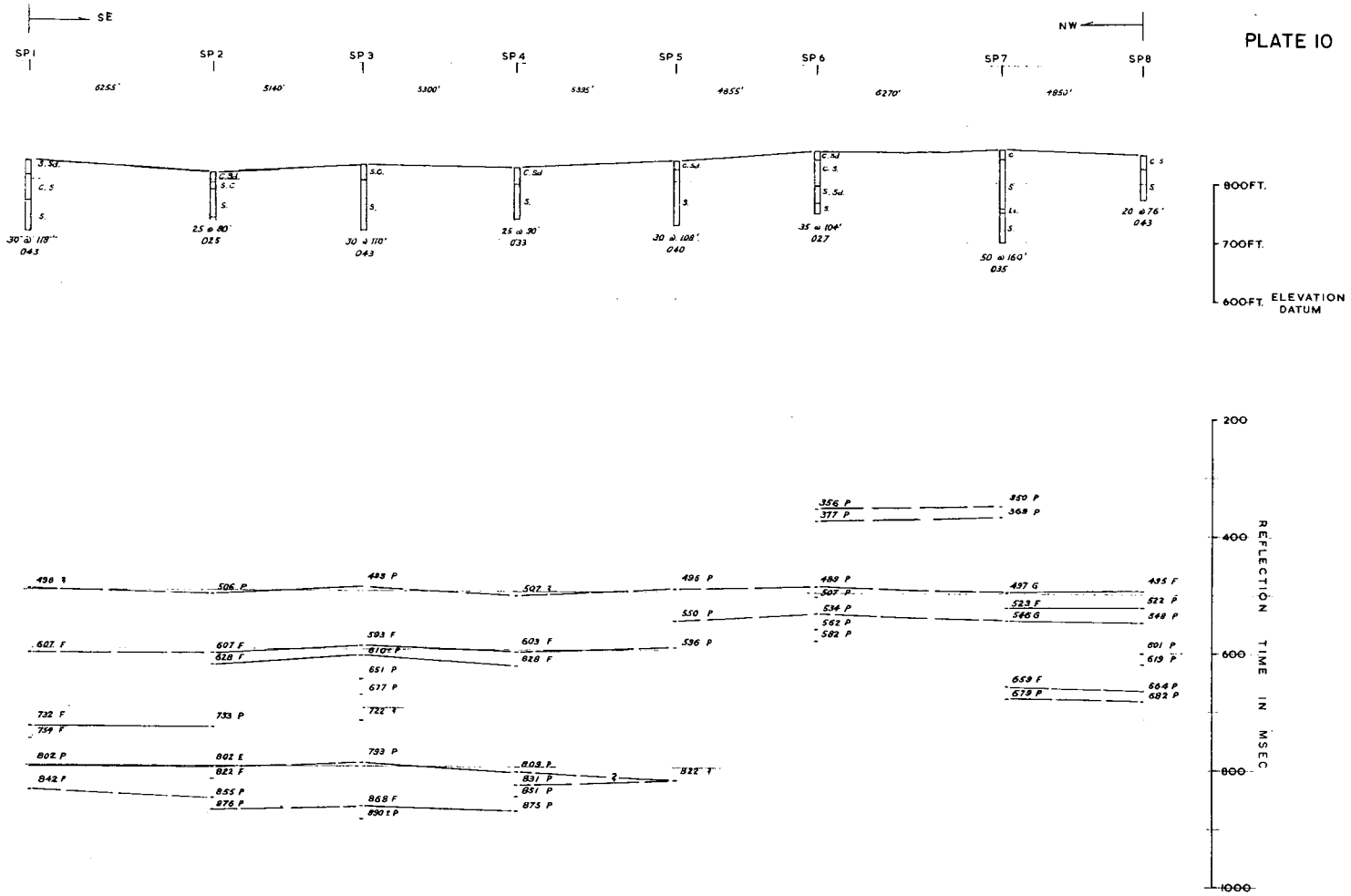
G.....RELIABILITY GOOD ———
F..... " FAIR — — —
P..... " POOR — — — —
?..... " QUESTIONABLE -----
E.....ESTIMATED VALUE

CLAY.....C
SHALE.....S
LIMESTONE.....Ls
SANDSTONE.....Ss
SAND.....Sd

ARAMAC LINE
FOR
ARTESIAN BASIN OIL COMPANY PTY. LTD.
BY
GEOSURVEYS AUST. LTD.

HORIZONTAL SCALE
FEET 2000 0 2000 4000 6000 FEET

PLATE 10



LEGEND

G.....RELIABILITY GOOD	———	CLAY.....C
F..... " FAIR	— — —	SHALE.....S
P..... " POOR	— — — —	LIMESTONE.....Ls
?..... " QUESTIONABLE	-----	SANDSTONE.....Ss
E.....ESTIMATED VALUE		SAND.....Sd

ARRANMORE LINE

FOR

ARTESIAN BASIN OIL COMPANY PTY. LTD.

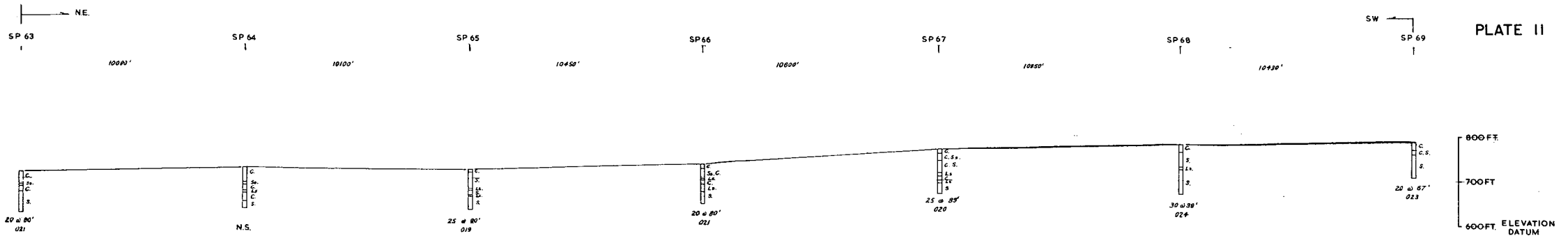
BY

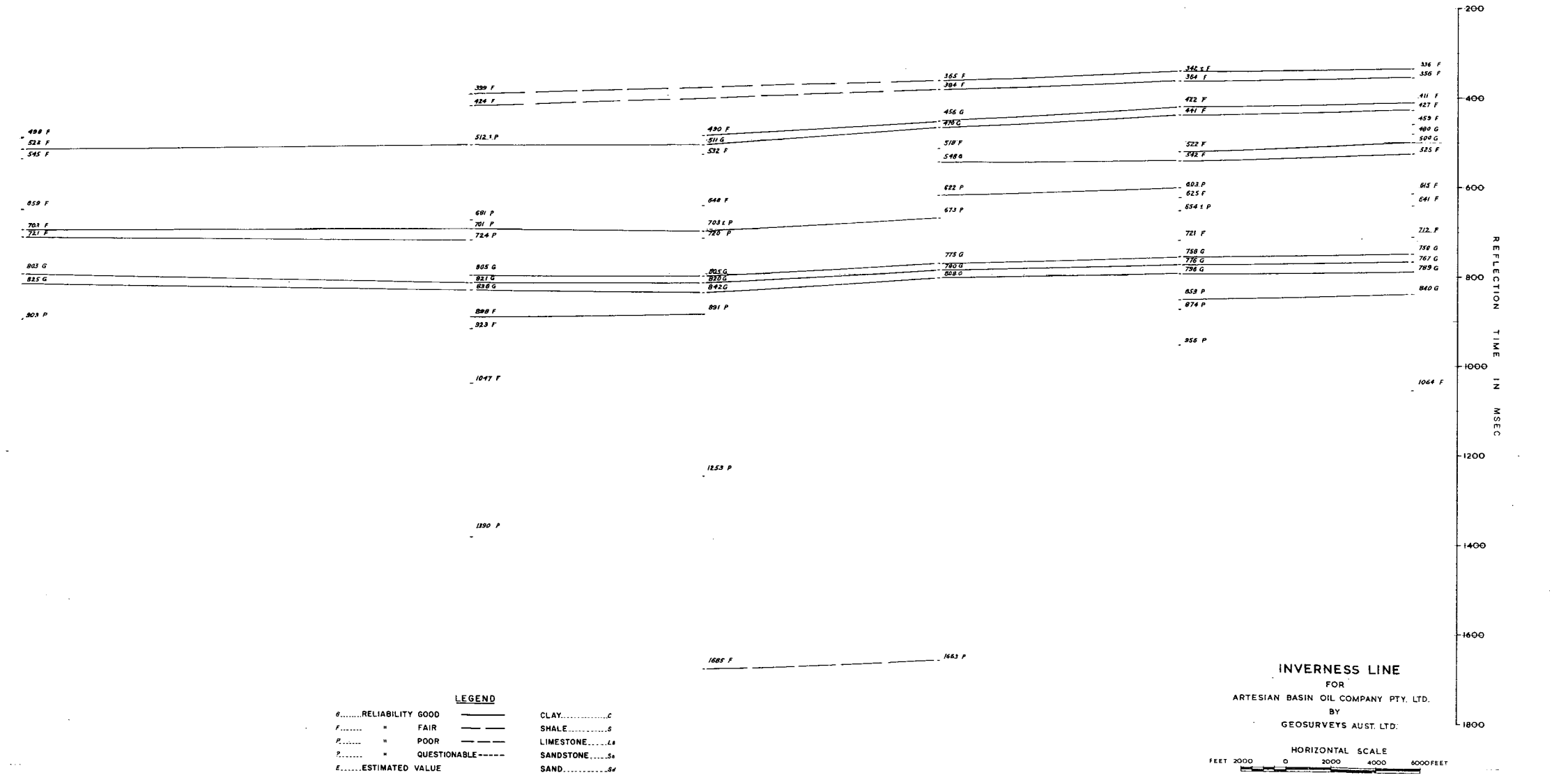
GEOSURVEYS AUST. LTD.

HORIZONTAL SCALE

FEET 2000 0 2000 4000 6000 FEET

PLATE II





LEGEND

G.....RELIABILITY GOOD	———	CLAY.....	C
F..... " FAIR	— — —	SHALE.....	S
P..... " POOR	— — — —	LIMESTONE.....	Ls
?..... " QUESTIONABLE	-----	SANDSTONE.....	Ss
E.....ESTIMATED VALUE		SAND.....	Sd

INVERNESS LINE

FOR

ARTESIAN BASIN OIL COMPANY PTY. LTD.

BY

GEOSURVEYS AUST. LTD.

HORIZONTAL SCALE

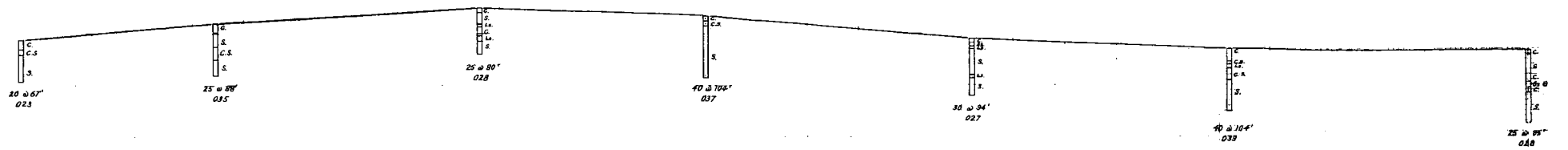
FEET 2000 0 2000 4000 6000 FEET

PLATE 12

SOUTH WEST ← → EAST

WEST ←

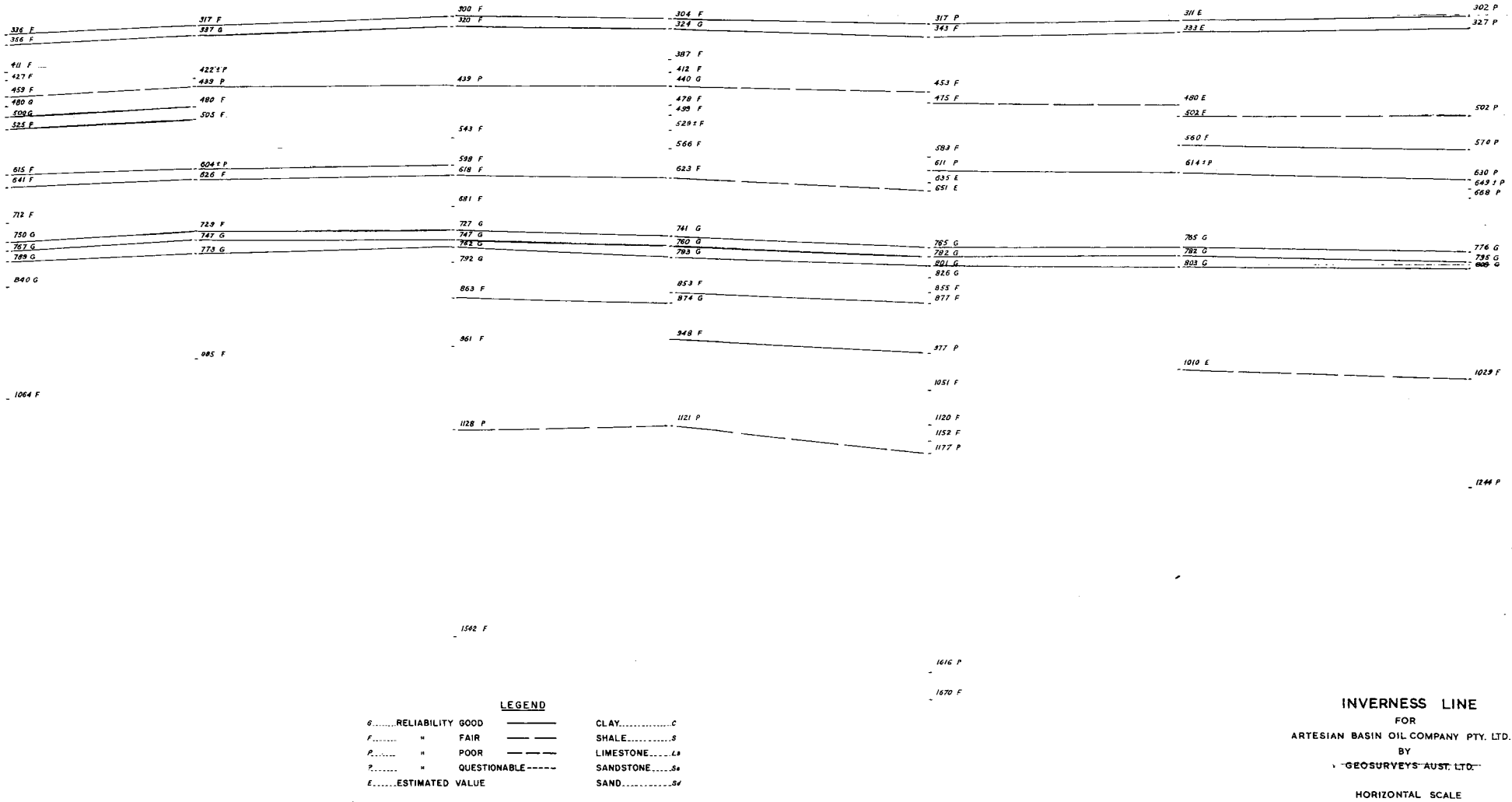
SP 69 | SP 70 | SP 71 | SP 72 | SP 73 | SP 74 | SP 75



800 FT.

700 FT.

600 FT. ELEVATION DATUM.



200

400

600

800

1000

1200

1400

1600

1800

REFLECTION TIME IN MSEC

LEGEND

G.....RELIABILITY GOOD	———	CLAY.....C
F..... " FAIR	— —	SHALE.....S
P..... " POOR	— — —	LIMESTONE.....Ls
?..... " QUESTIONABLE	- - - - -	SANDSTONE.....Ss
E.....ESTIMATED VALUE		SAND.....Sd

INVERNESS LINE

FOR

ARTESIAN BASIN OIL COMPANY PTY. LTD.

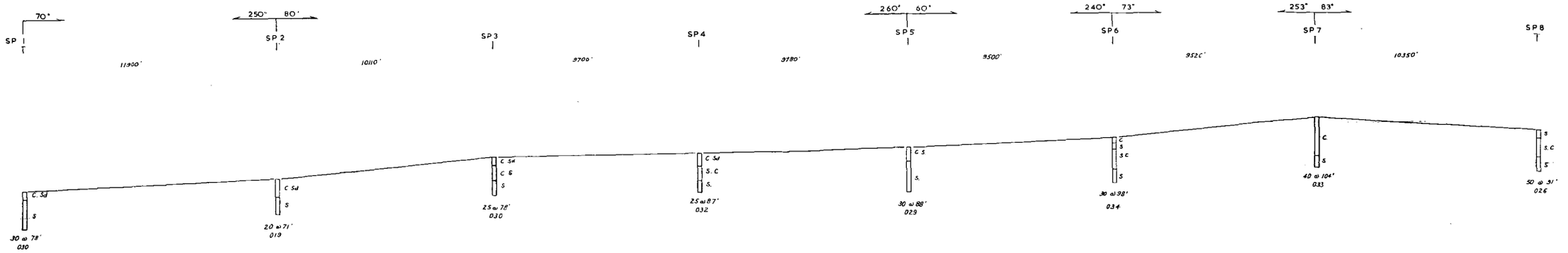
BY

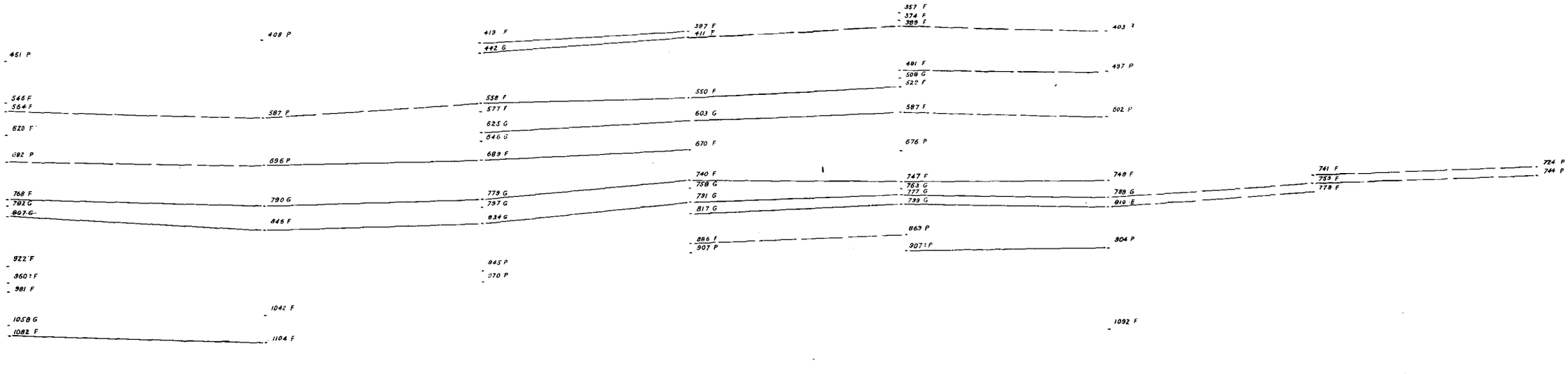
GEOSURVEYS AUST. LTD.

HORIZONTAL SCALE

FEET 2000 0 2000 4000 6000 FEET

PLATE 13





LEGEND

G.....RELIABILITY GOOD	———	CLAY.....C
F..... " FAIR	— — —	SHALE.....S
P..... " POOR	— — — —	LIMESTONE.....Ls
?..... " QUESTIONABLE	- - - - -	SANDSTONE.....Ss
E.....ESTIMATED VALUE		SAND.....Sd

TANGORIN LINE

FOR

ARTESIAN BASIN OIL COMPANY PTY. LTD.

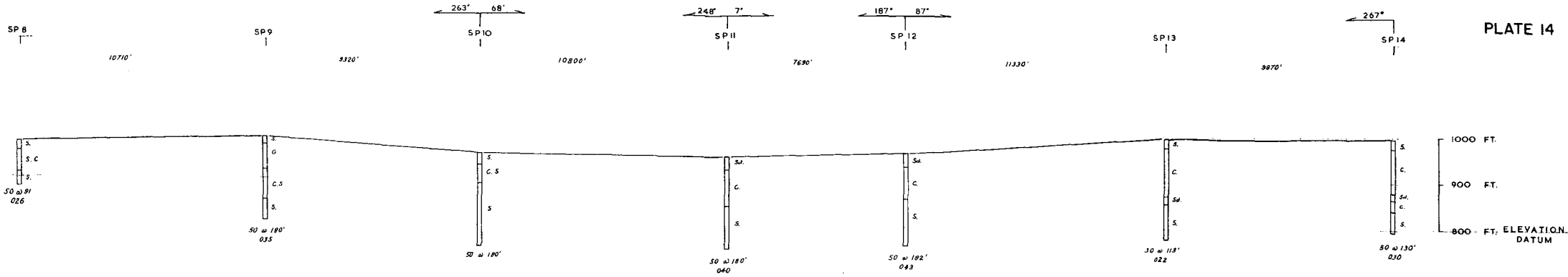
BY

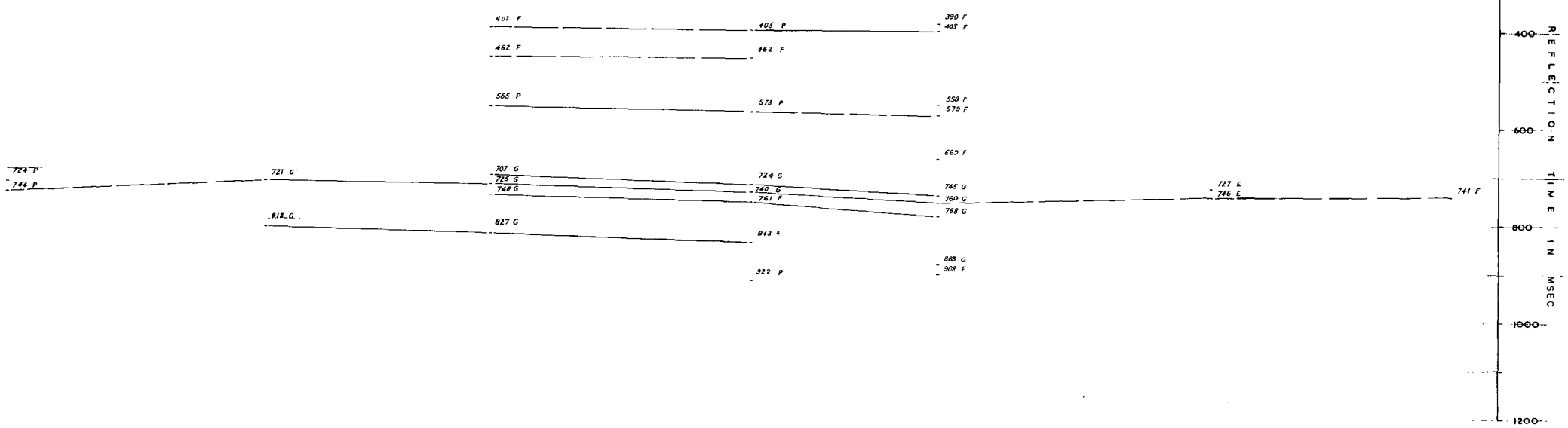
GEOSURVEYS AUST. LTD.

HORIZONTAL SCALE

FEET 2000 0 2000 4000 6000 FEET

PLATE 14





LEGEND

G.....RELIABILITY GOOD	———	CLAY.....C
F..... " FAIR	—— ——	SHALE.....S
P..... " POOR	— — —	LIMESTONE.....Ls
?..... " QUESTIONABLE	- - - - -	SANDSTONE.....Sa
E.....ESTIMATED VALUE		SAND.....Sd

TANGORIN LINE

FOR

ARTESIAN BASIN OIL COMPANY PTY. LTD.

BY

~~GEOSURVEYS AUST. LTD.~~

HORIZONTAL SCALE

FEET 2000 0 2000 4000 6000 FEET