COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD No. 1964/191

EXPERIMENTAL "VIBROSEIS" SURVEY. HAWKESBURY SANDSTONE. NSW 1964

FINAL PROGRESS REPORT

ON AN

EXPERIMENTAL "VIBROSEIS" * SEISMIC SURVEY

CONDUCTED IN

THE KULNURA AND GRASSY HILL AREAS

OF THE SYDNEY BASIN

FOR THE

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

BY

SEISMOGRAPH SERVICE LIMITED

DURING

AUGUST - SEPTEMBER 1964.

* A Trademark of Continental Oil Company.

C O N T E N T S

SYNOPSIS

An Experimental "Vibroseis" Seismic Survey was conducted in the Kulnura and Grassy Hill Areas of the Sydney Basin in New South Wales by Seismograph Service Limited, Party 243 on behalf of the Bureau of Mineral Resources, Geology and Geophysics; the survey occupied 27½ working days during the period from 24th August to 26th September, 1964.

The broad objective of the Hawkesbury Sandstone Project was to assess the "Vibroseis" method in areas of exposed Hawkesbury Sandstone where previous conventional seismic surveys have experienced difficulty in obtaining reliable reflection quality, particularly from the deeper section.

The survey was confined to two areas, one in the vicinity of Kulnura No. 1 Bore and the other about 30 miles to the west, on and adjacent to the main road connecting Windsor and Singleton approximately 4 miles north-east of Grassy Hill.

The Vibroseis results were fair to good; in both areas reliable data was obtained down to the depths of approximately 12,000 feet.

The Final Progress Report is based on a preliminary study of the results; a final interpretative report will be submitted upon the completion of the entire experimental

survey of which this project forms a part.

The results of the survey are presented in variable area cross-sectional form for this report. The Progress Reports which were submitted during the course of the Hawkesbury Sandstone Project are available at the office of the Bureau of Mineral Resources and the enclosures to these reports are listed in Appendix "A" to this Final Progress Report.

GEOLOGY AND PREVIOUS GEOPHYSICS

GEOLOGY

The Sydney Basin consists of Permian and Triassic sediments deposited unconformably upon Devonian and Silurian rocks which are often found to be metamorphosed in exposures around the edges of the basin. The limits of the basin are bounded by the Permian rocks which are covered in turn by a blanket of continental Triassic formations. Minor Tertiary intrusions occur sporadically throughout the basin.

The most prominent uplift in the area is the Lochinvar Anticline whose axis trends approximately north-south and possibly runs into the more gently folded Kulnura Anticline. Several other folds have their axes parallel to this major trend. In general in the central part of the basin, Permian structure is reflected by less intense structure in the overlying Triassic Sediments.

The Permian series show evidence of two marine transgressions each followed by continental coal measure periods. The thickness of the system varies from 16,000 feet in the north, to 5,000 feet in the south, but is unknown in the central area. The Triassic Rocks are the the most widely exposed and have an average thickness of 4,000 feet. They are divided into three main groups of which the basal Narrabeen, a quartz sandstone with shales and conglomerates, is the thickest. Above this lies the

Hawkesbury Sandstone which is a massive, course sandstone with some conglomerates and shaly lenses. The uppermost formation is the Wianamatta Group, which consists largely of freshwater shales, and occurs mainly as small exposures on the Hawkesbury Sandstone plateaux. It is developed more extensively to the south-east.

The Permian dark shales and siltstones are the main possible source beds, particularly those in the Upper Marine. However, few good reservoirs have been penetrated so far and even the thin sands in the base of the Triassic and the top of the Permian lack good permeability.

PREVIOUS GEOPHYSICS

(1) Aeromagnetic. The Australian Oil and Gas Corporation Ltd. (A.O.G.) has made an extensive aeromagnetic coverage of the Sydney Basin. The magnetic method has proved to be useful for reconnaissance in determining the structure of the Sydney Basin. However the presence of Volcanics within the Marine sequence is known to have produced a false impression of the magnetic basement depth and as a consequence, it is difficult to clearly define other than major structures in the sedimentary section using this method.

(2) Gravity. Little interpretational work has been carried out on the gravity results obtained in the Sydney Basin, however from the BMR's initial work on a Bouguer Anomaly map, integrating all gravity work to date, two

salient features emerge. Firstly a gravity low associated with the southern extension of the Kulnura Anticline and secondly a high in the Lapstone Monocline area. The low in the structurally high area suggests a granitic basement here and the high over the Lapstone Monocline is probably associated with Volcanics.

From the above it appears that a reverse gravity correlation exists in at least part of the Central Sydney Basin.

(3) Seismic. The Bureau of Mineral Resources conducted an experimental seismic survey in the Sydney Basin in 1957. The applicability of the seismic method in areas with various outcropping formations was tested but no complex methods were attempted. Shooting was carried out on the Upper Triassic Wianamatta Shale and Hawkesbury Sandstone in the central part of the basin.

Fair results were obtained on the Wianamatta shale but only poor results were obtained in test areas on the Hawkesbury Sandstone.

Since 1957 a considerable amount of seismic work has been carried out throughout the basin. This work has generally been confined to areas with little or no Hawkesbury Sandstone on the surface. In regions away from exposed Hawkesbury Sandstone generally fair quality

results have been obtained and where poor results occur in these areas, the reason has been attributed to disturbed subsurface conditions.

Seismic work on A.O.G.'s Line AJ on exposed Hawkesbury Sandstone produced fair to poor results from the shallow part of the section, but no continuous reflections were recorded at depths greater than 4,000 to 5,000 feet below the surface. On Line L, situated approximately 3 miles to the north of Line AJ, on more rugged Hawkesbury Sandstone in the vicinity of Kulnura No. 1 Bore, very poor results were obtained and no reflections are evident on the section.

The rugged terrain and dense bush had imposed severe limitations on the conventional experimental variations on Line L. The only effective variables tried were the charge depths and sizes. These were varied between 160 and 100 feet and 15 to 25 lbs. respectively in single holes. The best depth was between 100 and 135 feet. Eight geophones per trace were used, spaced at 15 feet along the line of traverse.

OBJECTIVES

The Hawkesbury Sandstone is a hard quartzitic sandstone which is exposed over a large part of the Central Sydney Basin. Conventional seismic results on this formation have been generally poor especially at depth and previous seismic work in the Sydney Basin has largely been restricted to areas which have no Triassic Hawkesbury Sandstone on the surface. Access problems exist due to the extremely rugged topography of the Hawkesbury Sandstone Areas, and shot hole drilling is difficult and expensive due to the hard and abrasive nature of the sandstone.

The objective of the Vibroseis Survey was to assess the capabilities of the method by experimentation on two traverses located on exposed Hawkesbury Sandstone in the vicinity of Kulnura No. 1 Bore, where previous conventional results were available for comparison purposes and then to apply the techniques developed during these experiments along traverses located on the Sandstone in a different part of the basin.

PROGRAMME

The locations of the two traverses, H.S.1 and H.S.2 comprising the survey in the Kulnura Area are shown on the Locality Map (Enclosure No.1). Both traverses lie on exposed Hawkesbury Sandstone.

The H.S.1 traverse was situated along the road from Wiseman's Ferry to Gosford within the Shire of Gosford. The line straddles the village of Mangrove Mountain and coincides with the Australian Oil and Gas Corporation Limited, Singleton-Camden, Seismic Survey, Line AJ, Shot Points 7-16.

H.S.2 traverse was located approximately five miles to the north of the H.S.1 traverse on the road from Kulnura to Wyong and is partly within the Shire of Gosford and partly within the Shire of Wyong. The traverse coincides with A.O.G. Line L.

The Kulnura No. 1 Bore is sited approximately ½ mile to the South-West of V.P. 1485, on the H.S.2 traverse.

A total of 22 days were worked on the two traverses, 8½ days on production recording using a transposed method and 13½ days on experimental work.

The location of the second area surveyed which comprises the H.S.3 and H.S.4 traverses is also shown on the Locality Map. The H.S.3 traverse lies along the

road from Windsor to Singleton 4 miles to the north-east of Grassy Hill. The H.S.4 traverse extends to the east from the northern end of the H.S.3 line and was sited along a forestry track which followed the crest of the Womerah Range. Both traverses lie within the Shire of Colo.

On H.S.3 traverse, a swampy surface layer of recent alluvium covers the Hawkesbury Sandstone from the south end of the line as far as V.P. 1605; along the H.S.4 traverse the elevations rise and the Sandstone is exposed along the entire line except for the region between V.P.'s 1701 and 1703 which is located on the Upper Triassic, Wianamatta Shale. These geological boundries are shown on the V.P. location map, enclosure No. 3.

The recording on the H.S.3 and H.S.4 traverses occupied $5\frac{1}{2}$ days and no detailed experimentation was carried out.

RESULTS

HAWKESBURY SANDSTONE 1. (H.S.1)

The initial recording on this traverse was made without extensive experimentation to provide a first appraisal of the Vibroseis method and to compare the results with those obtained from the previous conventional work on the coincident A.O.G. Line AJ.

The transposed field technique was as follows:-

Geophone pattern - 360 geophones in a rectangular pattern of length 600 feet and width 200 feet.
Vibrator pattern - 3 vibrators spaced at 200 ft. intervals over a length of 600 feet.
No. of sweeps - 10 per trace.
Trace interval - 132 feet.
Offset distance - 1320 - 2640 feet.
Sweep frequency - 10 - 40 cycles per second.

The traverse was later completed using this technique and the results are shown in Variable Area Section form on enclosure No. 4.

Further experimentation was then conducted with the objective of improving the data depth, and consisted essentially of comparisons between various pattern lengths and spread offsets. The best technique for improving the deep information was shown to be one employing 20 sweeps per trace and 1,000 feet geophones and vibrator pattern lengths with a 3 spread offset of 3960 - 5280 feet;

however, with this extremely large offset, the shallower reflections at 0.5-0.7 seconds were severely attentuated due to normal move out cancellation across the length of the patterns. The results obtained using this technique are shown on enclosure No. 5 and a comparison with enclosure No. 4 clearly indicates the enhancement of the deep reflection at 1.8 seconds between V.P.'s 1406 and 1409. This part of the line was again repeated using a two spread offset method with 20 sweeps per trace, the results of which are shown as enclosure No. 6. This section represents a compromise between the two methods described previously and shows a reduction in the amplitude of the deep event at 1.8 seconds, but allows the continuity of a shallow event at 0.7 seconds to be discernable. It is therefore considered to be the optimum technique for this area.

The strong band of reflections within the range of 0.5-0.7 seconds on enclosure No. 4, is practically flat across the section. A weak alignment is evident at a time of 1.8 seconds between V.P.'s 1406 and 1409. On enclosure No. 5 this deep horizon exhibits south dip.

H. S. 2.

Firstly the one spread offset method was used on the eastern part of this traverse. The previous conventional results were extremely poor and because of the difference in the results between A.O.G.'s AJ and L lines it was thought that different problems existed. The first records obtained on H.S. 2 traverse showed that although

the quality of the shallow reflection was not as high as on H.S. 1, the Vibroseis results did not differ so radically as the conventional sections indicated. At this stage the experimental work was continued on the H.S. 1 traverse and, after completion there, the two spread offset method was used on H.S. 2 traverse wherever the operational hazards permitted, firstly to fill in whatever gaps existed in the one spread offset coverage and secondly to extend the line further to the west.

The results are shown on three enclosures. Firstly enclosure 7 shows the eastern part of the line using a one and two spread offset.

The technique is listed below:-

Geophone pattern - 360 geophones in a rectangular pattern of length 600 ft. and width 200 ft.
Vibrator pattern - 3 vibrators spaced at 200 feet intervals over a length of 600 feet.
No. of sweeps - 10 per trace.
Trace interval - 132 feet.
Offset distances - 1320-2640 and 2640-3960 feet.
Sweep Frequency - 10-40 cycles per second.

This section is presented uncomposited on playback.

Secondly enclosure No. 8 shows the entire traverse with the eastern part, between V.P.'s 1494 and 1499, as a repeat of enclosure No. 7 but with a 3/2 composite on playback. For the western part of this section the field technique used was that obtained as the optimum during the experimental work on traverse H.S. 1. Those profiles

which could not be vibrated using a two spread offset method are designated one spread offset (1 o.s.) at the bottom of the section.

The third section for the H.S. 2 traverse is shown on enclosure No. 9. The technique was the same as that used for the one spread offset section of H.S. 1 enclosure No. 4, except that the vibrator and geophone pattern lengths were increased to 1,000 feet. The objective was to more closely delineate the structure in the shallow part of the section by revibrating the part of the traverse nearest to the Kulnura Bore (V.P. 1485) using the optimum technique for shallow information.

The results show several horizons between 0.5 and 1.5 seconds; the shallowest strong horizon, at 0.5 seconds at the extreme eastern end of the H.S. 2 traverse, can be character correlated reasonably well with the strong event at about 0.55 seconds on the H.S. 1 traverse. At V.P. 1498 a distinct change in this horizon occurs and further to the west the reflection loses both its distinctive character and its relatively high amplitude. At the nearest point to the Kulnura No. 1 Bore, V.P. 1485, this horizon is at a reflection time of 0.5 seconds which corresponds to a depth of 3,200 feet below the seismic datum (sea-level plus 800 ft.) and probably represents a bed within the Upper Coal Measures which lie at the top of the Upper Permian section. This horizon shows an overall gentle south east dip with an anticlinal reversal centred between V.P.'s 1486 and 1487.

The deepest continuous horizon on this traverse occurs between 1.4 and 1.5 seconds and shows similar structural relief; this reflection time corresponds to a depth of about 11,000 feet. The Kulnura No. 1 Bore did not penetrate to this depth.

This traverse coincides with the conventional A.O.G. Line L. The Vibroseis section shows a major improvement in the record quality at all depths compared to the conventional section which is of very poor quality.

H. S. 3.

No experimentation was carried out on this traverse. The technique was selected primarily for simplicity in order to obtain as much production in the first day's work as possible. A secondary consideration in the adoption of this technique was that the Sydney Basin is thought to be shallower in this region than in that of the two previous traverses. The geometry of the field recording method was therefore designed to accomodate the expected thinner section.

The field technique was as follows:-

Geophone pattern - 360 geophones in a rectangular pattern 600 feet long and 200 feet wide.
Vibrator pattern - 3 Vibrators in line over a pattern length of 600 feet.
No. of sweeps - 10 per trace.
Trace interval - 132 feet.
Offset distance - 1320 - 2640 feet.

Sweep frequency - 10 - 40 cycles per second.

The results are shown in Variable Area section form on enclosure No. 10. Four good horizons exist at approximate times of 0.5, 0.6, 0.8 and 1.0 seconds. All of these horizons are conformable and show no dip. A deeper horizon with poor continuity is evident at 1.4 seconds which shows 20 milliseconds of north dip across the section.

This line is situated entirely in an area where the Hawkesbury Sandstone is overlaid by a recent swampy alluvium.

No conventional results are available for comparison purposes in this area of the Sydney Basin.

H. S. 4.

The same technique was used on this traverse as H.S. 3 except that, due to a deterioration in the record quality, the number of sweep was increased from 10 to 20 from V.P. 1704 to the east.

At the western end of this section, enclosure No. 11, a good correlation can be made with the four horizons between 0.5 and 1.0 seconds from the adjacent H.S. 3 traverse. These horizons display a good continuity as far east as V.P. 1703, but from this point continuity can only be established with difficulty. The clearest horizon is at a time of 0.620 seconds at V.P. 1699 and shows about

40 milliseconds of east dip to V.P. 1705. From V.P. 1706 west dip is assumed and the horizon emerges at the eastern end of the section at a time of 0.630 seconds.

This line is situated on exposed Hawkesbury Sandstone except for the region between V.P.'s 1701 and 1703 where a cover of Upper Triassic Wianamatta Shale obscures the Sandstone. From the section it can be seen that this surface cover has little effect on the record quality.

The deterioration in quality from V.P. 1704 to the east is thought to be due largely to the occurrance of coherent noise events having a high apparent velocity. These events may be due to reflected refractions from the steep sides of the spur on which the line is situated.

CONCLUSIONS

The quality of the Vibroseis results range from fair to good and shallow information can be readily obtained at a quality equal to or better than that produced to date by conventional methods. In addition, by the use of long offsets, penetration can be achieved to depths of 11,000-12,000 feet.

It is considered that the lack of penetration obtained by previous conventional surveys may be due in part to a generation problem associated with poor coupling between the charge and the Hawkesbury Sandstone. The extent of this problem is difficult to establish but it is supported by the improvement in quality which occurs when the charge is placed in the overlying Wianamatta Shale. This implies that the Hawkesbury Sandstone does not attenuate the seismic energy at an abnormally high rate, but that it may not be a good medium for energy generation from a dynamite charge. In contrast it appears that the Vibroseis results are not appreciably affected by the surface formations.

The production on the H.S. 2 traverse using the two spread offset, 20 sweeps per trace method developed for the deep and shallow information was at a rate of $\frac{3}{4}$ of a mile per day. On the H.S. 3 traverse, using a method employing 10 sweeps per trace, a rate of $1\frac{1}{2}$ miles per day was achieved.

ACKNOWLEDGEMENTS

The information in the section on 'Geology and Previous Geophysical Work' has been abstracted from the 'Geophysical Preview Report on the Experimental 'Vibroseis' Survey in the Otway and Sydney Basins' by F. J. Moss. This Preview Report is an internal, unpublished document of the Bureau of Mineral Resources, Geology and Geophysics.

The geological demarkations on the V.P. location map of the H.S.3 and H.S.4 traverses were obtained from the office of Australian Oil and Gas Corporation Limited.

DISTRIBUTION

Bureau of Mineral Resources, Melbourne.	8 copies
Seismograph Service Limited, London.	1 copy
Seismograph Service Limited, Melbourne.	1 copy
Party 243	1 copy

November, 1964.

T. L. Kendall.
Party Chief,
Party 243,
Seismograph Service Limited.

APPENDIX A

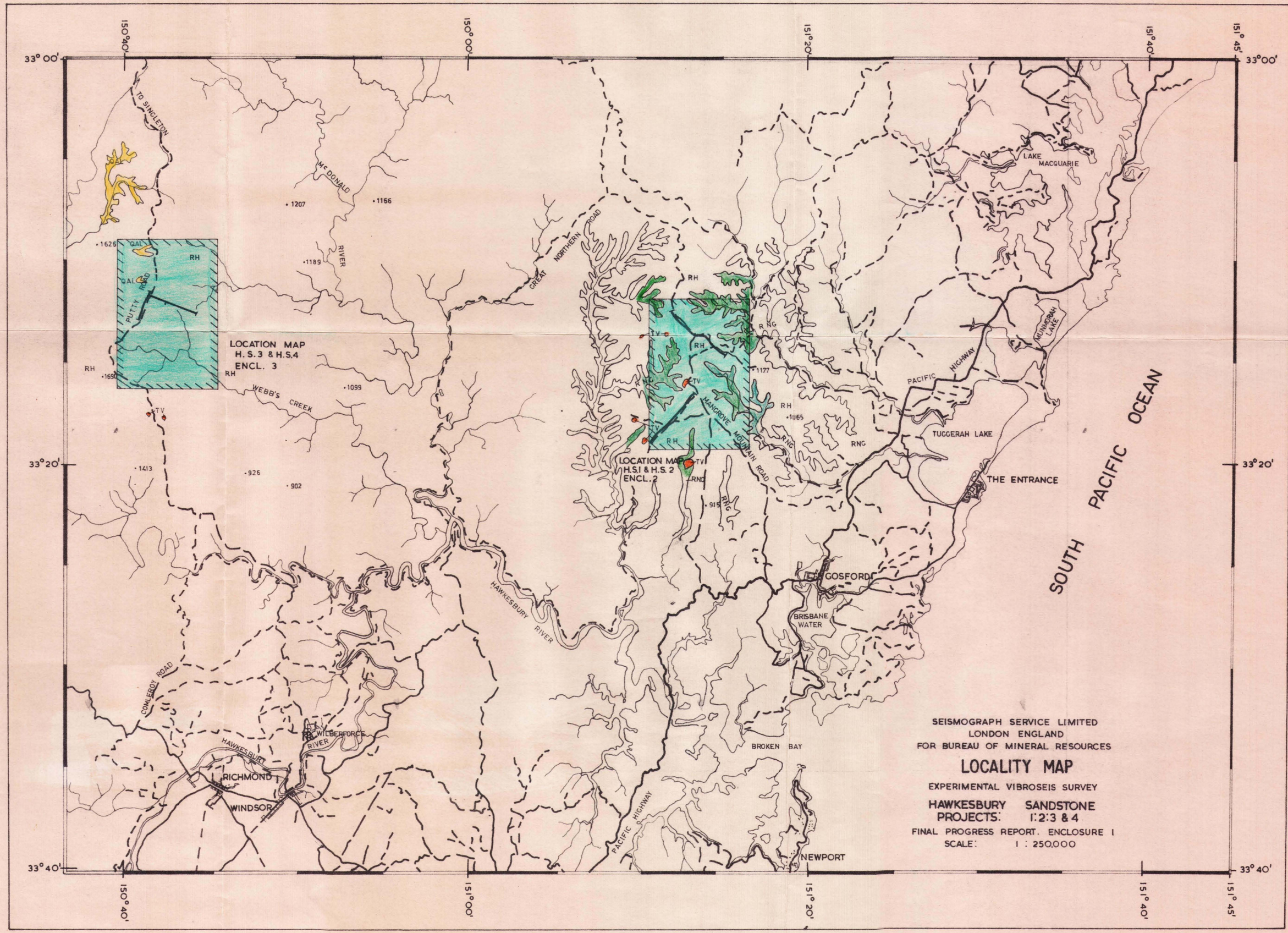
List of Progress Report enclosures available at the Bureau of Mineral Resources.

Time - Distance Plot — Noise Spread — H.S. 1
Amplitude - Wave number
Amplitude - Frequency
and
Frequency - Wave number plots — Noise Spread — H.S. 1
Time - Depth and Velocity - Depth plots of velocity function Vi - 1200 - 0.6z

Variable Area Section H.S. 1 V.P.'s 1406-1414
Variable Area Section H.S. 1 V.P.'s 1402-1406 (3 spread offset)
Variable Area Section H.S. 1 V.P.'s 1402-1406 (1 spread offset)
Variable Area Section H.S. 1 V.P. 1406 (3 spread offset)
Variable Area Section H.S. 2 V.P.'s 1494-1499 (1 and 2 spread offset)
Variable Area Section H.S. 1 V.P.'s 1407-1409 (1 and 2 spread offset 600 ft. patterns)
Variable Area Section H.S. 1 V.P.'s 1407-1409 (2 spread offset 600ft. patterns)
Variable Area Section H.S. 1 V.P.'s 1407-1409 (3 spread offset 600ft. patterns)
Variable Area Section H.S. 1 V.P.'s 1407-1409 (2 spread offset 1000ft.patterns)
Variable Area Section H.S. 1 V.P.'s 1407-1409 (3 spread offset 1000ft.patterns)
Variable Area Section H.S. 1 Noise Spread (400 ft. - 4380 ft.)
Map showing traverse of H.S. 4.
Tables of Experimental field techniques.

LIST OF ENCLOSURES

No. 1	Locality Map	H.S. 1, 2, 3 and 4.
No. 2	V.P. Location Map	H.S. 1 and 2 traverses.
No. 3	V.P. Location Map	H.S. 3 and 4 traverses.
No. 4	Variable Area Section	H.S. 1 V.P.'s 1402-1414
No. 5	Variable Area Section	H.S. 1 V.P.'s 1407-1409 (3 spread offset)
No. 6	Variable Area Section	H.S. 1 V.P.'s 1407-1409 (2 spread offset)
No. 7	Variable Area Section	H.S. 2 V.P.'s 1494-1499
No. 8	Variable Area Section	H.S. 2 V.P.'s 1483-1499
No. 9	Variable Area Section	H.S. 2 V.P.'s 1484-1487
No.10	Variable Area Section	H.S. 3 V.P.'s 1601-1606
No.11	Variable Area Section	H.S. 4 V.P.'s 1699-1708



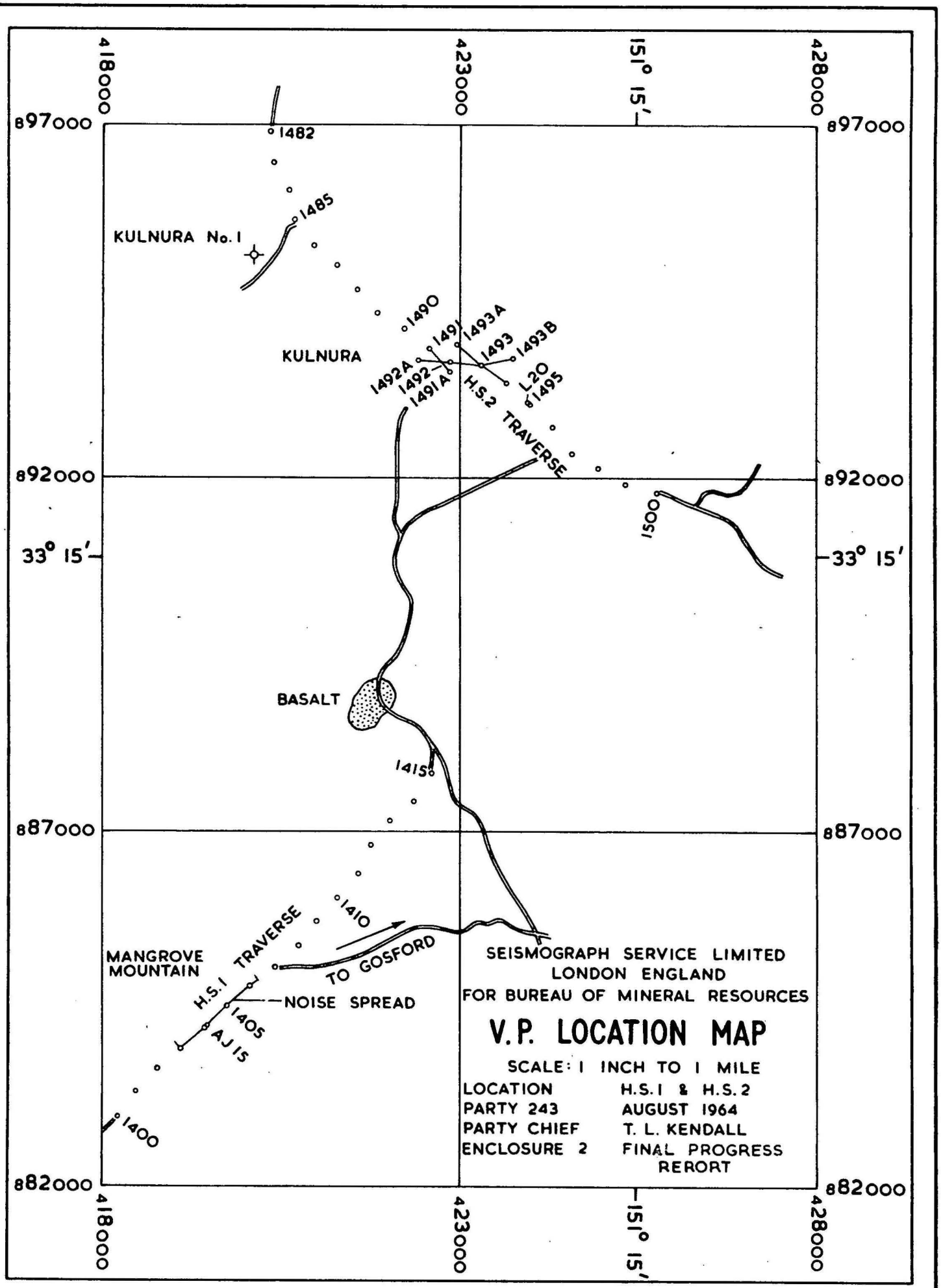
THE GEOLOGICAL DEMARKATIONS SHOWN ON THIS MAP HAVE BEEN ABSTRACTED FROM GEOLOGICAL SURVEY OF N.S.W. SYDNEY SHEET SI 56-5

RH HAWKESBURY SANDSTONE

RNG NARRABEEN GROUP GOSFORD FORMATION

TV BASALT

QAL ALLUVIUM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423000
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897000
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33° 15'
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882000
1482
1485
KULNURA No. 1
1490
KULNURA
1491
1493A
1493
1493B
1492A
1492
1491A
H.S.2
L20
1495
TRAVERSE
1500
BASALT
1415
1410
MANGROVE MOUNTAIN
H.S.1 TRAVERSE
TO GOSFORD
NOISE SPREAD
1405
AJ 15
1400
SEISMOGRAPH SERVICE LIMITED
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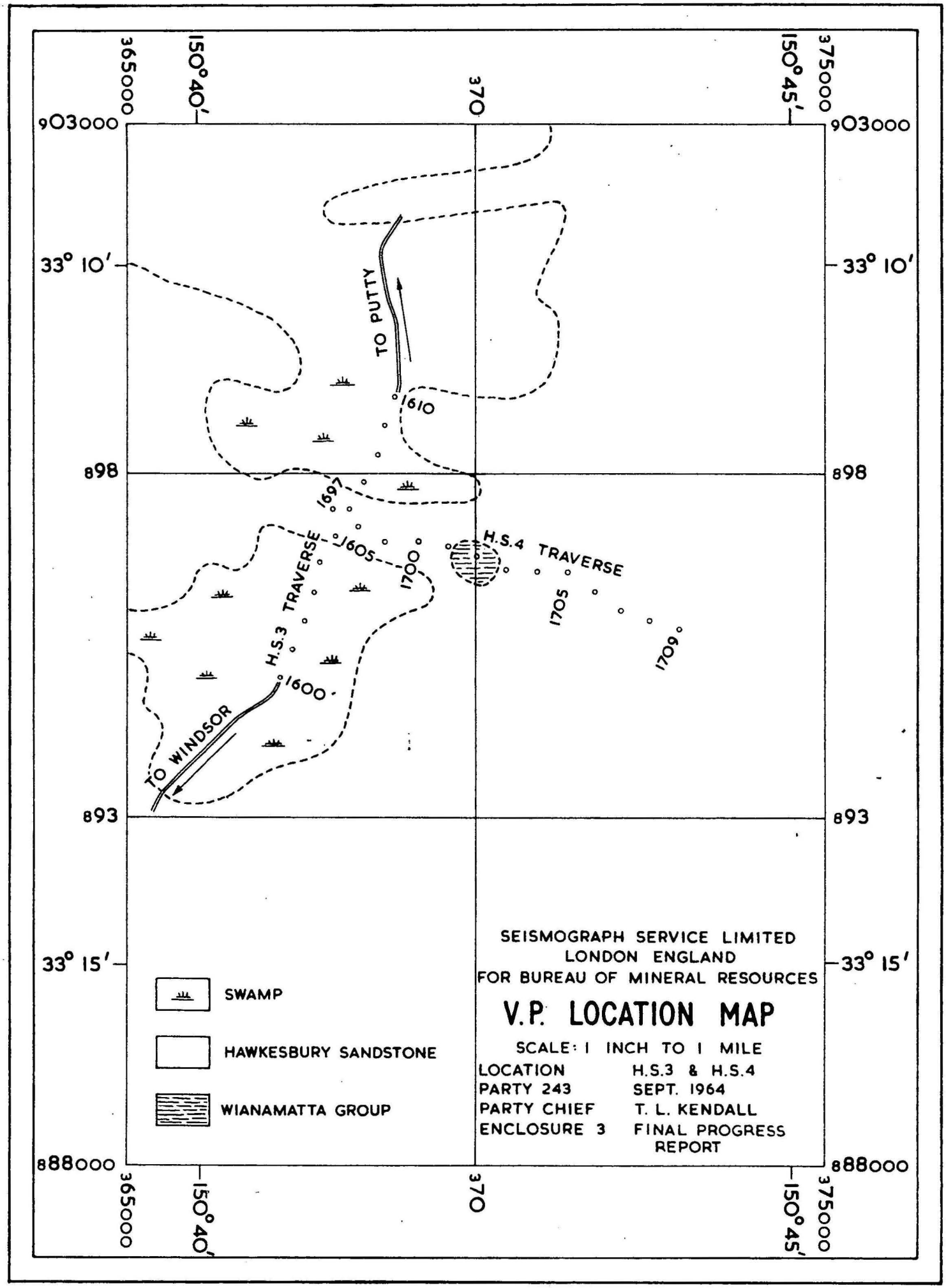
FOR BUREAU OF MINERAL RESOURCES
V.P. LOCATION MAP
SCALE: 1 INCH TO 1 MILE
LOCATION H.S.1 & H.S.2
PARTY 243 AUGUST 1964
PARTY CHIEF T. L. KENDALL
ENCLOSURE 2 FINAL PROGRESS REPORT


365000
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370
150°45'
375000
903000
33° 10'
898
33° 15'
893
888000
TO PUTTY
1610
1697
1605
1700
H.S.4 TRAVERSE
1705
1709
H.S.3 TRAVERSE
1600
TO WINDSOR
SWAMP
HAWKESBURY SANDSTONE
WIANAMATTA GROUP
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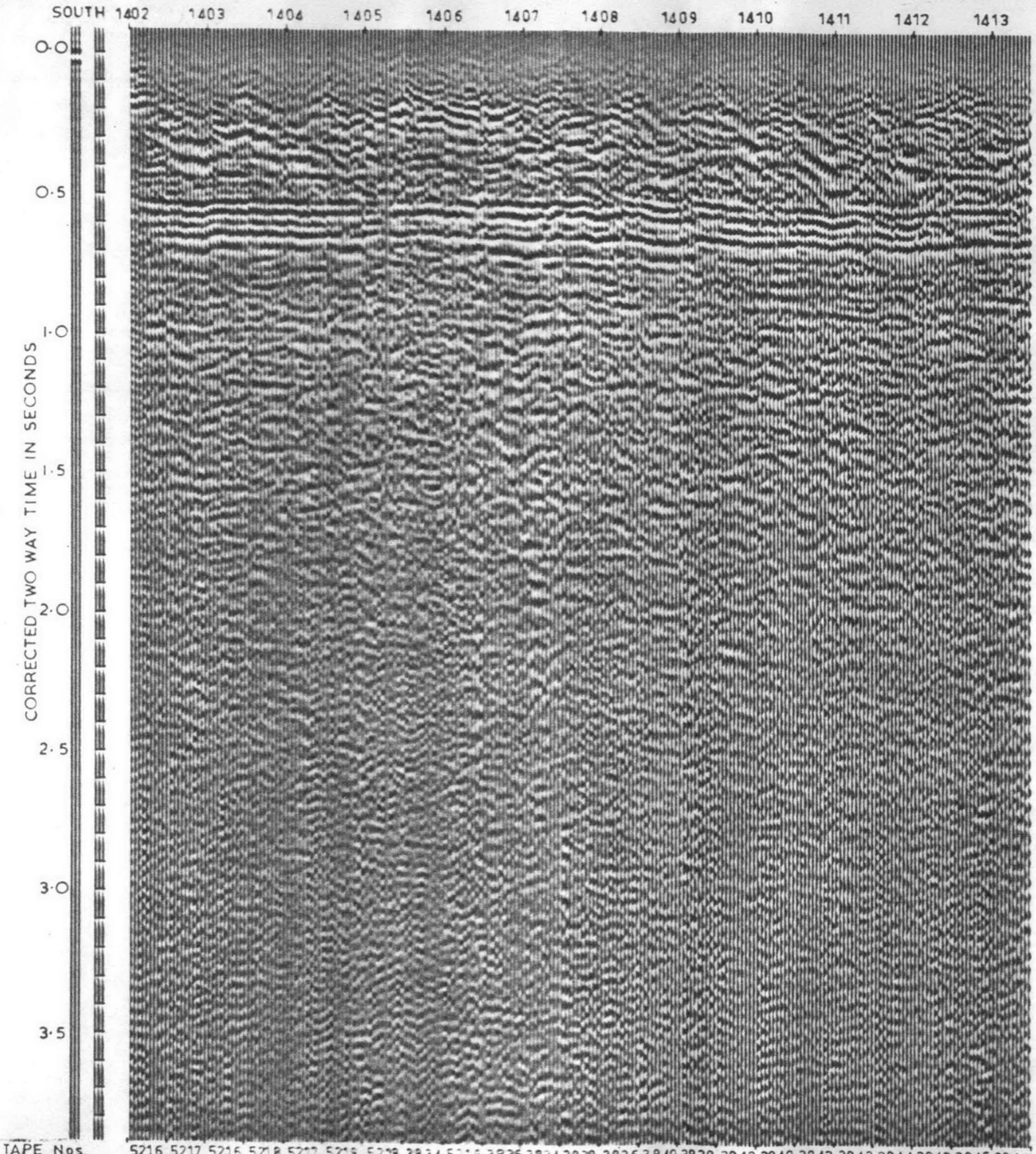
FOR BUREAU OF MINERAL RESOURCES
V.P. LOCATION MAP
SCALE: 1 INCH TO 1 MILE
LOCATION H.S.3 & H.S.4
PARTY 243 SEPT. 1964
PARTY CHIEF T. L. KENDALL
ENCLOSURE 3 FINAL PROGRESS REPORT

LINE H.S.1



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VARIABLE AREA CROSS-SECTION
VIBROSEIS®
FOR BUREAU OF MINERAL RESOURCES

HAWKESBURY SANDSTONE 1

LINE H.S.1 S.P.'S. 1402 – 1414

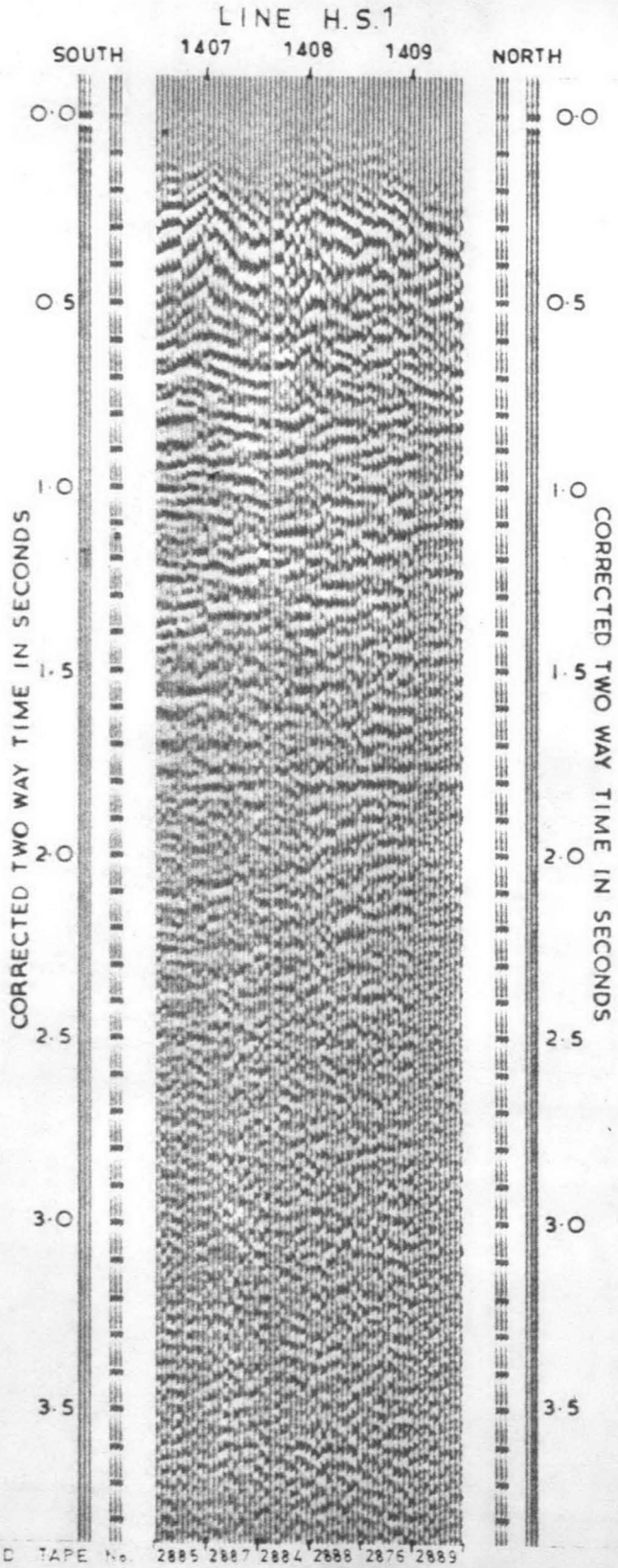
VELOCITY DISTRIBUTION	Vi=12000+.6z
WEATHERING VELOCITY (Vw)	3000 FT/SEC
HORIZONTAL VELOCITY (Vh)	–
ELEVATION VELOCITY (Ve)	10000 FT./SEC.
WEATHERING METHOD	–
HORIZONTAL SCALE 1" 2400'	DATUM M.S.L.
TYPE OF PROFILING	TRANSPOSED
TRACE INTERVAL	132'
OFFSET DISTANCE	1386' - 2574'
No. AND TYPE OF VIBRATORS	3
SWEEP FREQUENCY 10 - 40	No. OF SWEEPS 10
PLAYBACK FILTER	OUT - 42
MIXING	–

VIBRATOR PATTERN:
600' IN LINE

GEOPHONE PATTERN:
600'X200' RECTANGLE OF 360 GEOPHONES

PARTY 243	DATE OCTOBER - 1964
ENCLOSURE No. 4	FINAL PROGRESS REPORT

SSL 94A. ®A TRADE MARK CONTINENTAL OIL CO.



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VARIABLE AREA CROSS-SECTION
VIBROSEIS®
FOR BUREAU OF MINERAL RESOURCES

HAWKESBURY SANDSTONE 1

LINE H.S. 1 S.P.'S 1407 – 1409

VELOCITY DISTRIBUTION	Vi = 12000 + · 6z
WEATHERING VELOCITY (Vw)	3000 F/SEC.
HORIZONTAL VELOCITY (V_h)	–
ELEVATION VELOCITY (V_e)	10000 F/SEC.
WEATHERING METHOD	–
HORIZONTAL SCALE 1" : 2400'	DATUM M.S.L. + 800'
TYPE OF PROFILING	TRANSPOSED
TRACE INTERVAL	132'
OFFSET DISTANCE	4026' – 5214'
No. AND TYPE OF VIBRATORS	3
SWEEP FREQUENCY 10 – 40	No. OF SWEEPS 20
PLAYBACK FILTER	OUT – 42
MIXING	–

VIBRATOR PATTERN:

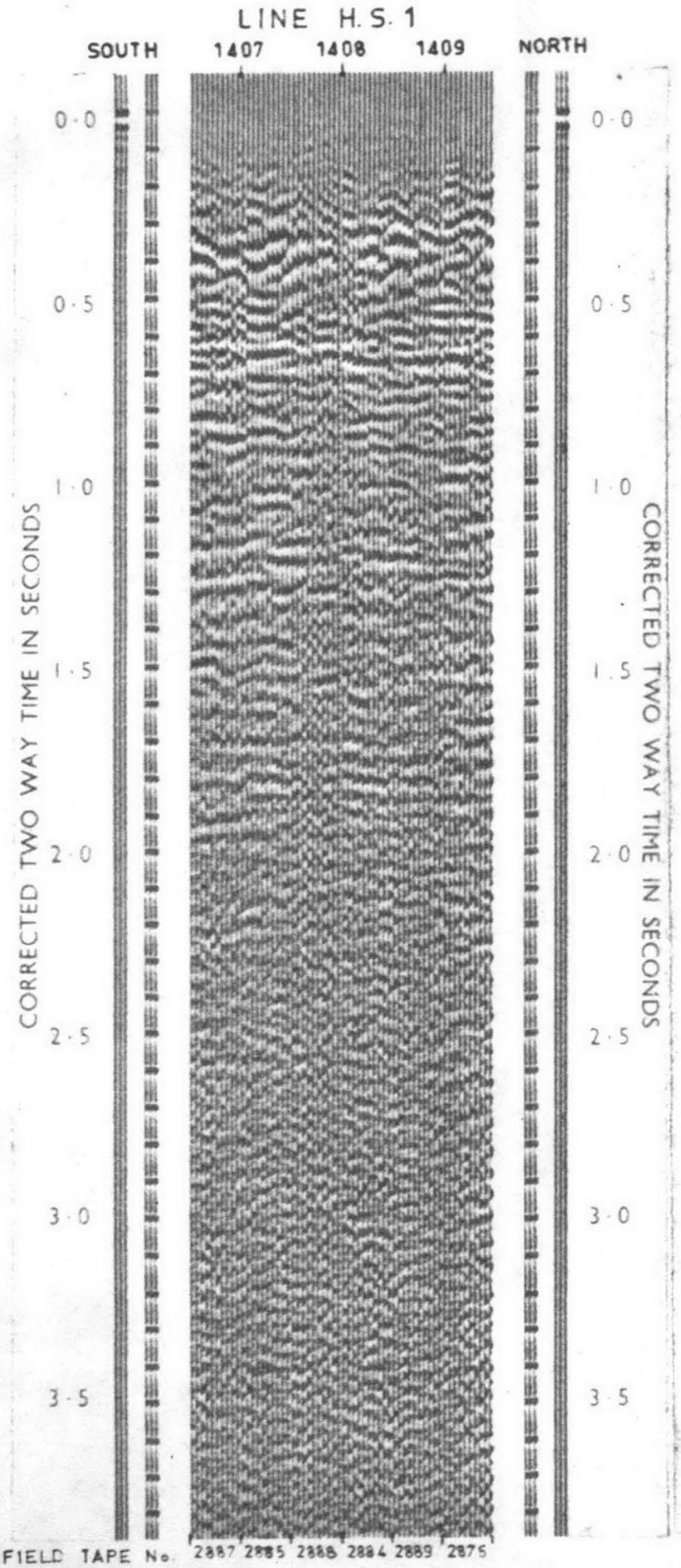
1000' IN LINE

GEOPHONE PATTERN:

1000' X 200' RECTANGLE OF 360 GEOPHONES

PARTY 243	DATE OCTOBER, 1964
ENCLOSURE 5	FINAL PROGRESS REPORT

SSL 94A. ®A TRADE MARK CONTINENTAL OIL CO.



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VARIABLE AREA CROSS-SECTION
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HAWKESBURY SANDSTONE 1

LINE H.S.1 S.P.'S. 1407 – 1409

VELOCITY DISTRIBUTION	Vi = 12000 +- 6%
WEATHERING VELOCITY (Vw)	3000 F/SEC.
HORIZONTAL VELOCITY (V_h)	–
ELEVATION VELOCITY (V_e)	10000 F/SEC.
WEATHERING METHOD	–
HORIZONTAL SCALE 1:2400	DATUM M.S.L.+ 800'
TYPE OF PROFILING	TRANSPOSED
TRACE INTERVAL	132'
OFFSET DISTANCE	2705' – 3894'
No. AND TYPE OF VIBRATORS	3
SWEEP FREQUENCY 10-40	No. OF SWEEPS 20
PLAYBACK FILTER	OUT – 42
MIXING	–

VIBRATOR PATTERN:

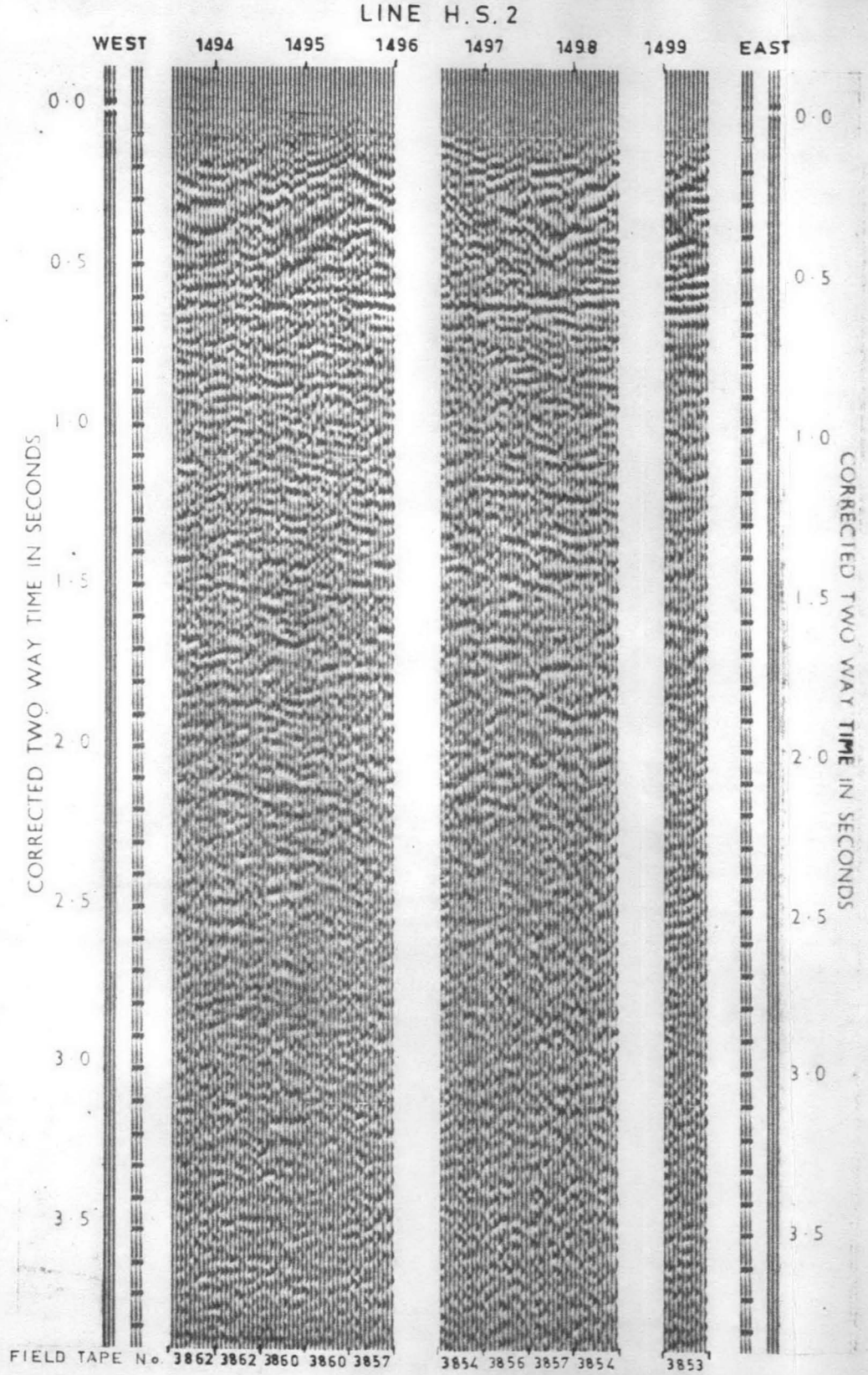
1000' IN LINE

GEOPHONE PATTERN:

1000'X 200' RECTANGLE OF 360 GEOPHONES

PARTY 243	DATE OCTOBER-1964
ENCLOSURE 6	FINAL PROGRESS REPORT

SSL 94A. ®A TRADE MARK CONTINENTAL OIL CO.



SEISMOGRAPH SERVICE LIMITED
LONDON ENGLAND

VARIABLE AREA CROSS-SECTION
VIBROSEIS®
FOR BUREAU OF MINERAL RESOURCES

HAWKESBURY SANDSTONE 2

LINE H.S.2 S.P.'S. 1494 – 1499	
VELOCITY DISTRIBUTION	Vi = 12000 + 6z
WEATHERING VELOCITY (Vw)	3000 F/SEC.
HORIZONTAL VELOCITY (Vh)	–
ELEVATION VELOCITY (Ve)	10000 F/SEC.
WEATHERING METHOD	–
HORIZONTAL SCALE 1" : 2400'	DATUM M.S.L. + 800
TYPE OF PROFILING	TRANSPOSED
TRACE INTERVAL	132'
OFFSET DISTANCE	1386'-2574' & 2706'-3894'
No. AND TYPE OF VIBRATORS	3
SWEEP FREQUENCY 10 – 40	No. OF SWEEPS 10
PLAYBACK FILTER	OUT – 42
MIXING	–

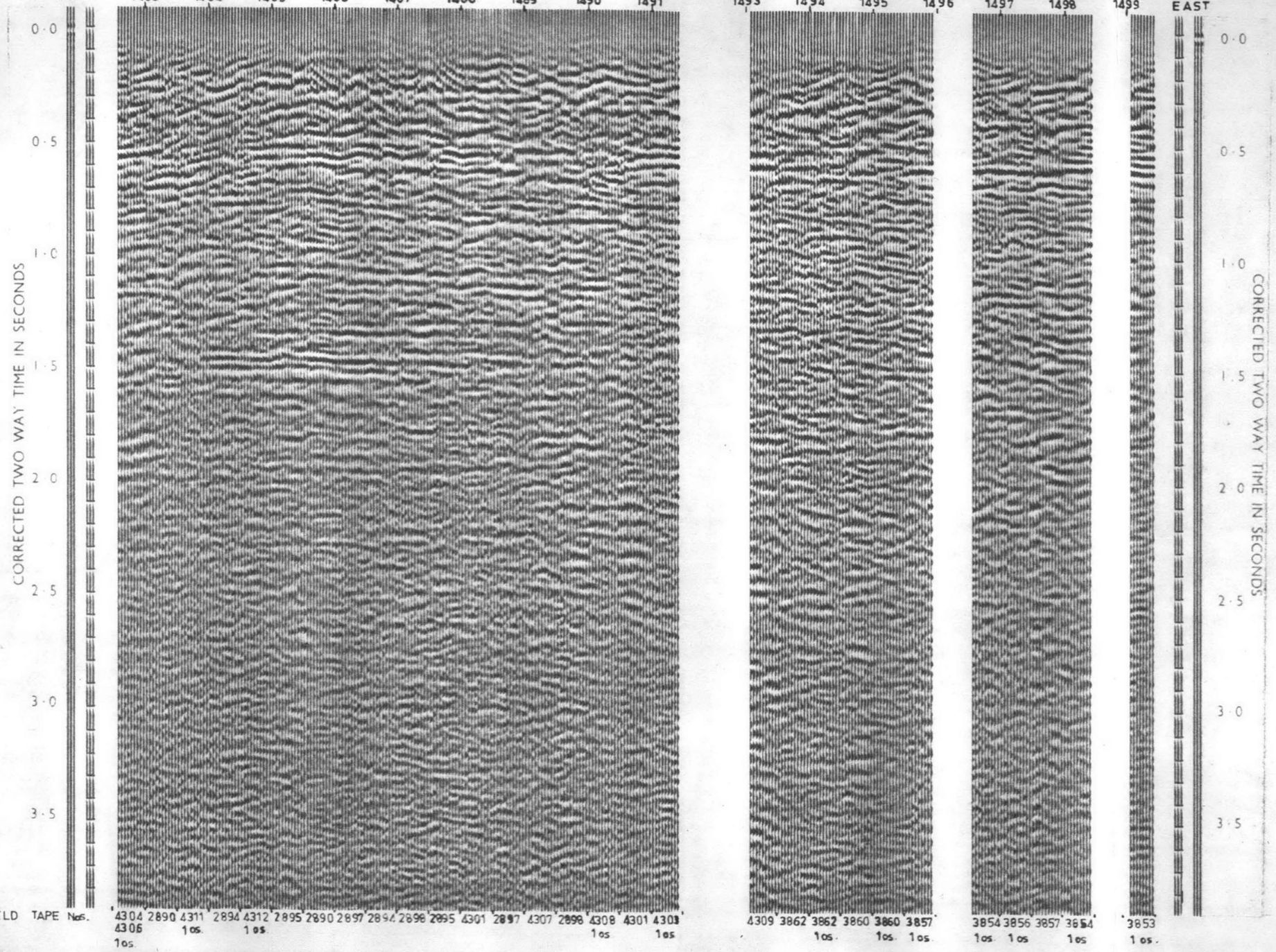
VIBRATOR PATTERN:
600' IN LINE

GEOPHONE PATTERN:
500' X 200' RECTANGLE OF 360 GEOPHONES

PARTY 243	DATE OCTOBER, 1964
ENCLOSURE No. 7	FINAL PROGRESS REPORT

SSL 044 ®A TRADE MARK CONTINENTAL OIL CO.

LINE H.S. 2



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HAWKESBURY SANDSTONE 2

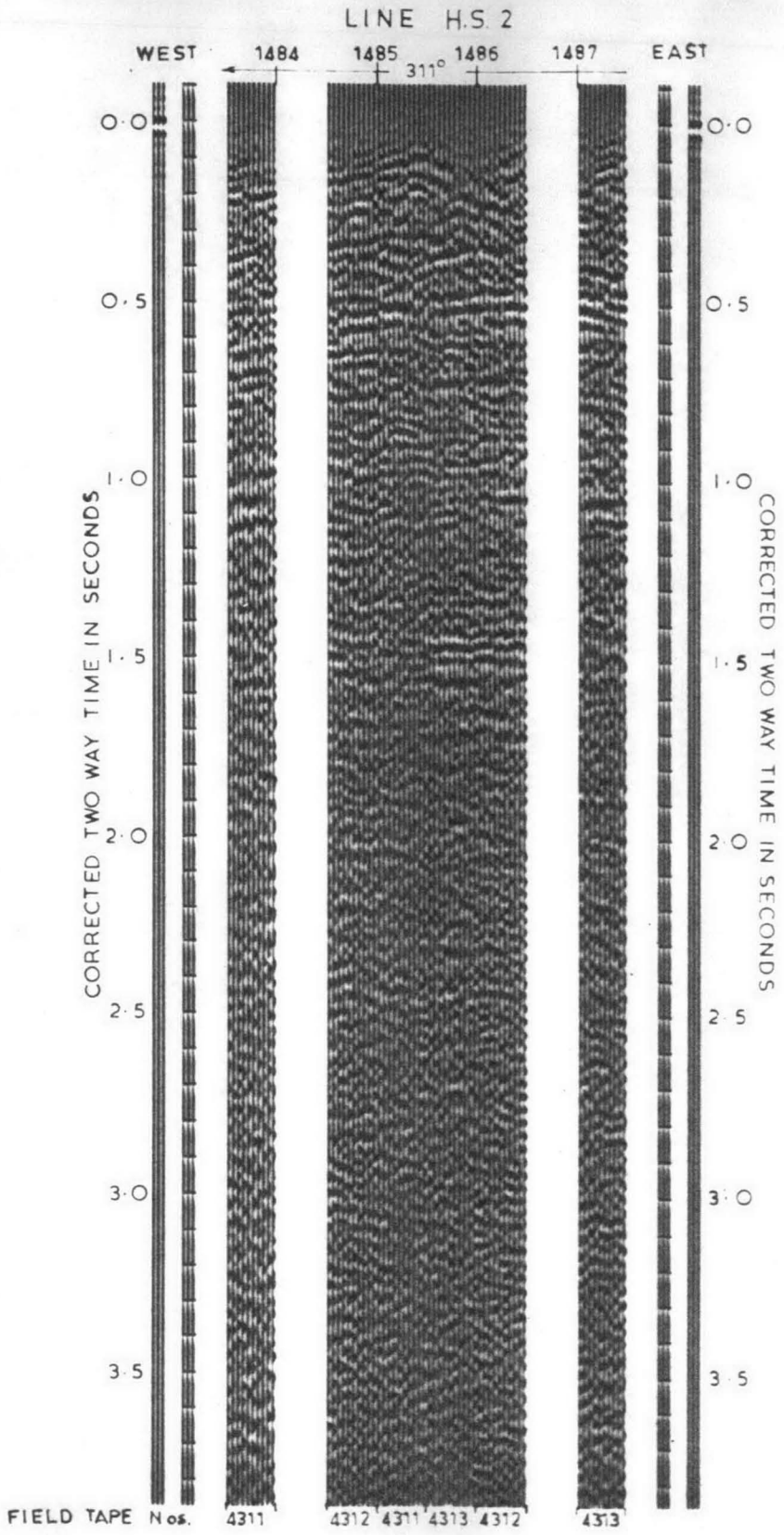
LINE H.S. 2 S.P.'S. 1483 – 1499	
VELOCITY DISTRIBUTION	Vi = 12000+·6z
WEATHERING VELOCITY (Vw)	3000 F/SEC.
HORIZONTAL VELOCITY (V_h)	–
ELEVATION VELOCITY (V_e)	10000 F/SEC
WEATHERING METHOD	–
HORIZONTAL SCALE 1" : 2400'	DATUM M.S.L. + 800'
TYPE OF PROFILING	TRANSPOSED
TRACE INTERVAL	132'
OFFSET DISTANCE	1386'-2574' & 2706'-3894'
No. AND TYPE OF VIBRATORS	2 & 3
SWEEP FREQUENCY 10 – 40	No. OF SWEEPS 10-20
PLAYBACK FILTER	OUT – 42
MIXING	3/2 COMPOSITED

VIBRATOR PATTERN:
1000' IN LINE

GEOPHONE PATTERN:
1000'X 200' RECTANGLE OF 360 GEOPHONES

PARTY 243	DATE OCTOBER-1964
ENCLOSURE No. 8	FINAL PROGRESS REPORT

SSL 94A. ®A TRADE MARK CONTINENTAL OIL CO.



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HAWKESBURY SANDSTONE 2

LINE H.S. 2 S.P.'S. 1484 – 1487

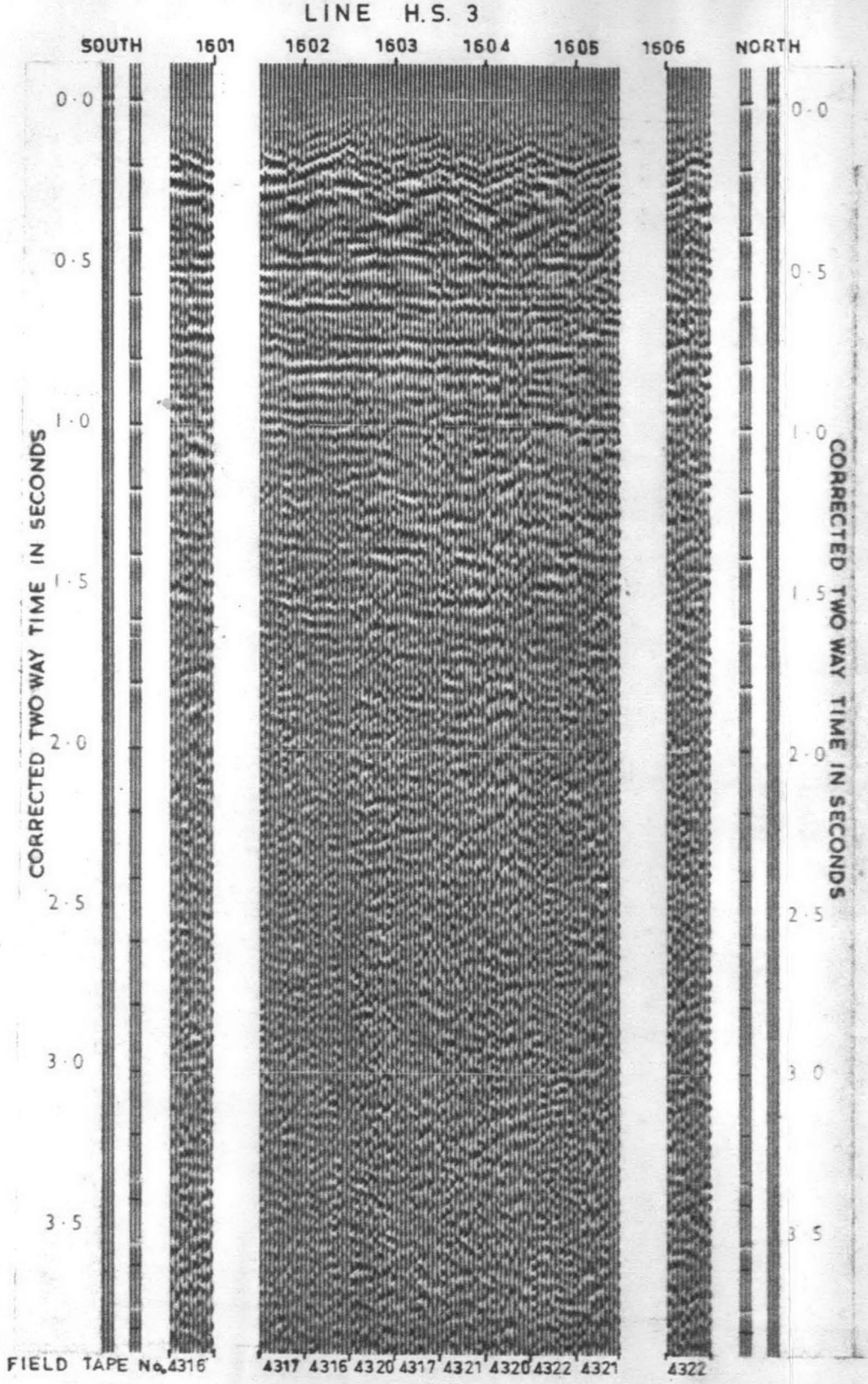
VELOCITY DISTRIBUTION	Vi = 12000 + ·6z
WEATHERING VELOCITY (V_w)	3000 F/SEC.
HORIZONTAL VELOCITY (V_h)	–
ELEVATION VELOCITY (V_e)	10000 F/SEC.
WEATHERING METHOD	–
HORIZONTAL SCALE 1" : 2400'	DATUM M.S.L. + 800'
TYPE OF PROFILING	TRANSPOSED
TRACE INTERVAL	132'
OFFSET DISTANCE	1386' – 2574'
No. AND TYPE OF VIBRATORS	3
SWEEP FREQUENCY 10 – 40	No. OF SWEEPS 10:20
PLAYBACK FILTER	OUT – 42
MIXING	–

VIBRATOR PATTERN:
1000' IN LINE

GEOPHONE PATTERN:
1000'X 200' RECTANGLE OF 360 GEOPHONES

PARTY 243	DATE OCTOBER, 1964
ENCLOSURE 9	FINAL PROGRESS REPORT

SS-54A. ®A TRADE MARK CONTINENTAL OIL CO



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HAWKESBURY SANDSTONE 3

LINE H.S. 3 S.P.'S. 1601 – 1606

VELOCITY DISTRIBUTION	Vi = 12000 + 6z
WEATHERING VELOCITY (Vw)	3000 F/SEC.
HORIZONTAL VELOCITY (Vh)	–
ELEVATION VELOCITY (Ve)	10000 F/SEC.
WEATHERING METHOD	–
HORIZONTAL SCALE 1" : 2400'	DATUM M.S.L. + 1000'
TYPE OF PROFILING	TRANSPOSED
TRACE INTERVAL	132'
OFFSET DISTANCE	1386' – 2574'
No. AND TYPE OF VIBRATORS	2 & 3
SWEEP FREQUENCY 10 – 40	No. OF SWEEPS 10
PLAYBACK FILTER	OUT-42
MIXING	–

VIBRATOR PATTERN:

600' IN LINE

GEOPHONE PATTERN:

600' X 200' RECTANGLE OF 360 GEOPHONES

PARTY 243	DATE OCTOBER, 1964
ENCLOSURE No. 10	FINAL PROGRESS REPORT

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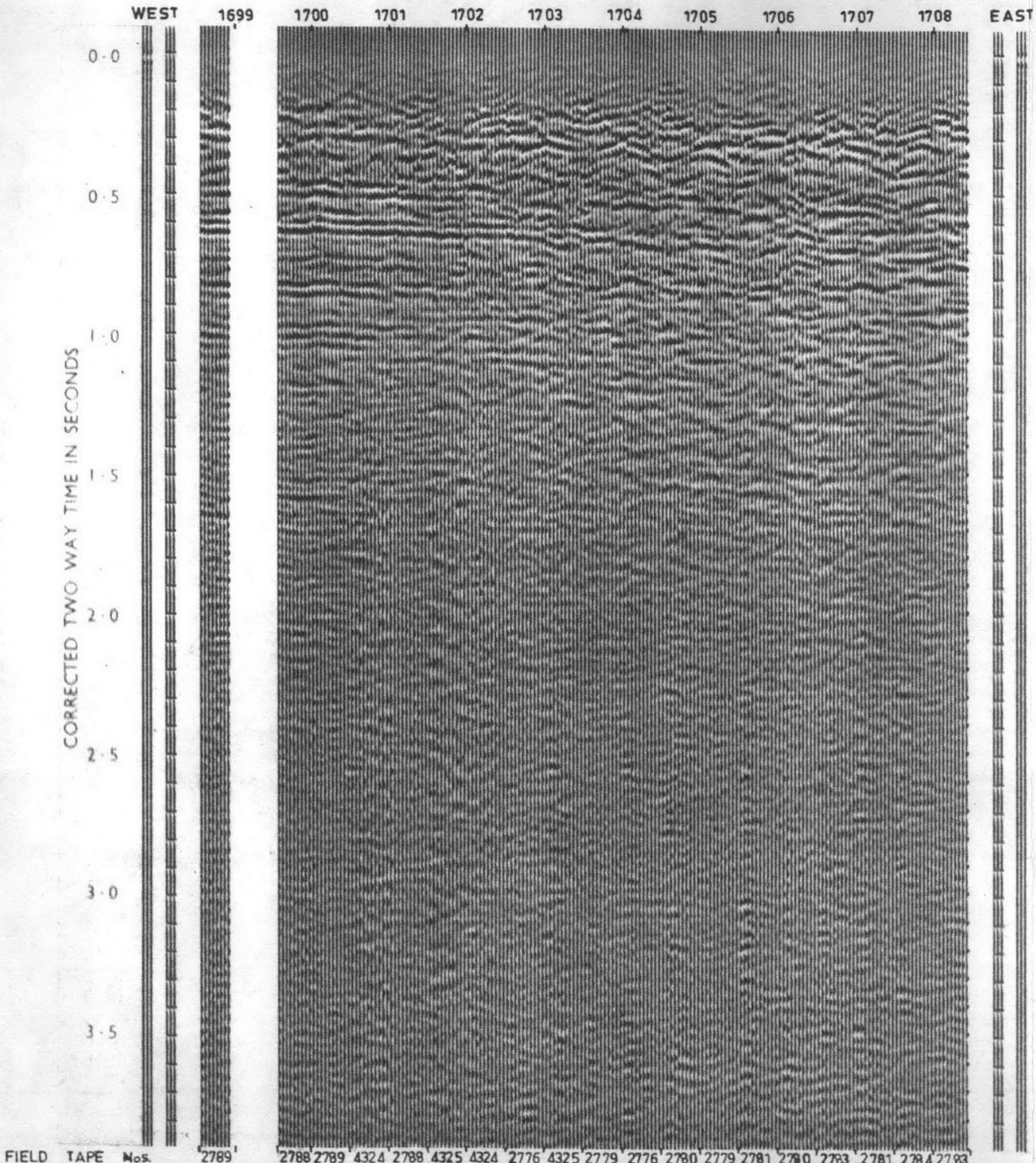
LINE H.S.4



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HAWKESBURY SANDSTONE 4

LINE H.S.4 S.P.'S 1699 - 1709	
VELOCITY DISTRIBUTION	Vi = 12000 + .6z
WEATHERING VELOCITY (Vw)	3000 F/SEC
HORIZONTAL VELOCITY (V_h)	–
ELEVATION VELOCITY (V_e)	10000 F/SEC
WEATHERING METHOD	–
HORIZONTAL SCALE 1" : 2400'	DATUM MSL + 1000'
TYPE OF PROFILING	TRANSPOSED
TRACE INTERVAL	132'
OFFSET DISTANCE	1386' - 2574'
No. AND TYPE OF VIBRATORS	2 & 3
SWEEP FREQUENCY 10 - 40	No. OF SWEEPS 10, 20
PLAYBACK FILTER	OUT - 42
MIXING	3/2 COMPOSITED

VIBRATOR PATTERN:
600' IN LINE

GEOPHONE PATTERN:
600 X 200' RECTANGLE OF 360 GEOPHONES

PARTY 243	DATE OCTOBER-1964
ENCLOSURE No. 11	FINAL PROGRESS REPORT

SSL 94A. ®A TRADE MARK CONTINENTAL OIL CO.