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A REPORT ON

A GRADIENT ARRAY EIP SURVEY

OVER THE FEDERATION GRID

TRIAL HARBOUR ROAD, NEAR ZEEHAN, TASMANIA

ON BEHALF OF

RENISON LIMITED

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A REPORT ON
A GRADIENT ARRAY ELECTRICAL INDUCED POLARIZATION SURVEY
OVER THE FEDERATION GRID
TRIAL HARBOUR ROAD, NEAR ZEEHAN, TASMANIA
ON BEHALF OF
RENISON LIMITED

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GEOPHYSICAL CONSULTANTS AND CONTRACTORS

SUMMARY

A detailed gradient array electrical induced polarization survey consisting of 2500 individual stations at 10 metre intervals on 100 metre line spacing over the 34 kilometres of the Federation Grid, Trial Harbour Road near Zeehan, located some twenty zones of anomalous induced polarization with respect to background.

Some six sections of the zones defined were considered of prime geophysical interest based on the similarity of the characteristics to those located at Sweeney's Mine.

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INTRODUCTION

At the request of Mr. L.A. Newnham, Chief Geologist for Renison Limited, Scintrex Pty. Ltd. executed a gradient array survey over the 34 line kilometres of the Federation grid. The work was carried out by a two operator crew on 18½ double and four single operator days between 19th November, and 17th December, 1977. About 6½ days were lost to bad weather. The crew leader was Mr. G. Street, B.Sc., assisted by Mr. O Saeck. In all, about 3500 stations were surveyed.

The object of the survey was to locate and define zones of anomalous induced polarization within the region mapped as granite.

EQUIPMENT AND SURVEY METHOD

The equipment consisted of a 2½/3 kilowatt Scintrex induced polarization transmitter powered by a 10HP Briggs and Stratton motor generator to energise the field, with Scintrex IPR-8 time domain induced polarization receivers to investigate the primary and secondary potential fields (apparent resistivity and chargeability

respectively). The energisation wave form was a 2 second on and 2 second off and reverse, while the receiver programme was 2 seconds operated in Mode 2, while three decay curve slices M_1, M_3 and M_5 were separately recorded.

The method chosen was gradient array which has excellent depth penetration due to the *large* current dipoles employed, and excellent resolution due to the *small* potential dipole employed. In the present case they were 1600 metres and 10 metres respectively.

In order to appreciate the volume from which observed data originates, some brief comments are made on the method. The characteristic of the gradient array is that the current poles are distant from the potential dipole. Figure 1 displays the salient features of the primary current flow and primary equipotential field generated during energisation, and, in exaggerated form, shows the influence of terrain on the current paths. From this diagram it can be seen that the *apparent resistivity* measurement is a summation of the volume of material normal to local slope beneath the surface and at right angles to the line.

The apparent resistivity will be *biased by* the influence of each current electrode, but the *relative* values of *adjacent* readings can be considered *reliable*. As each electrode is approached, the readings become *increasingly biased by* that electrode.

Each in-line (i.e. along strike) gradient block will show a similar

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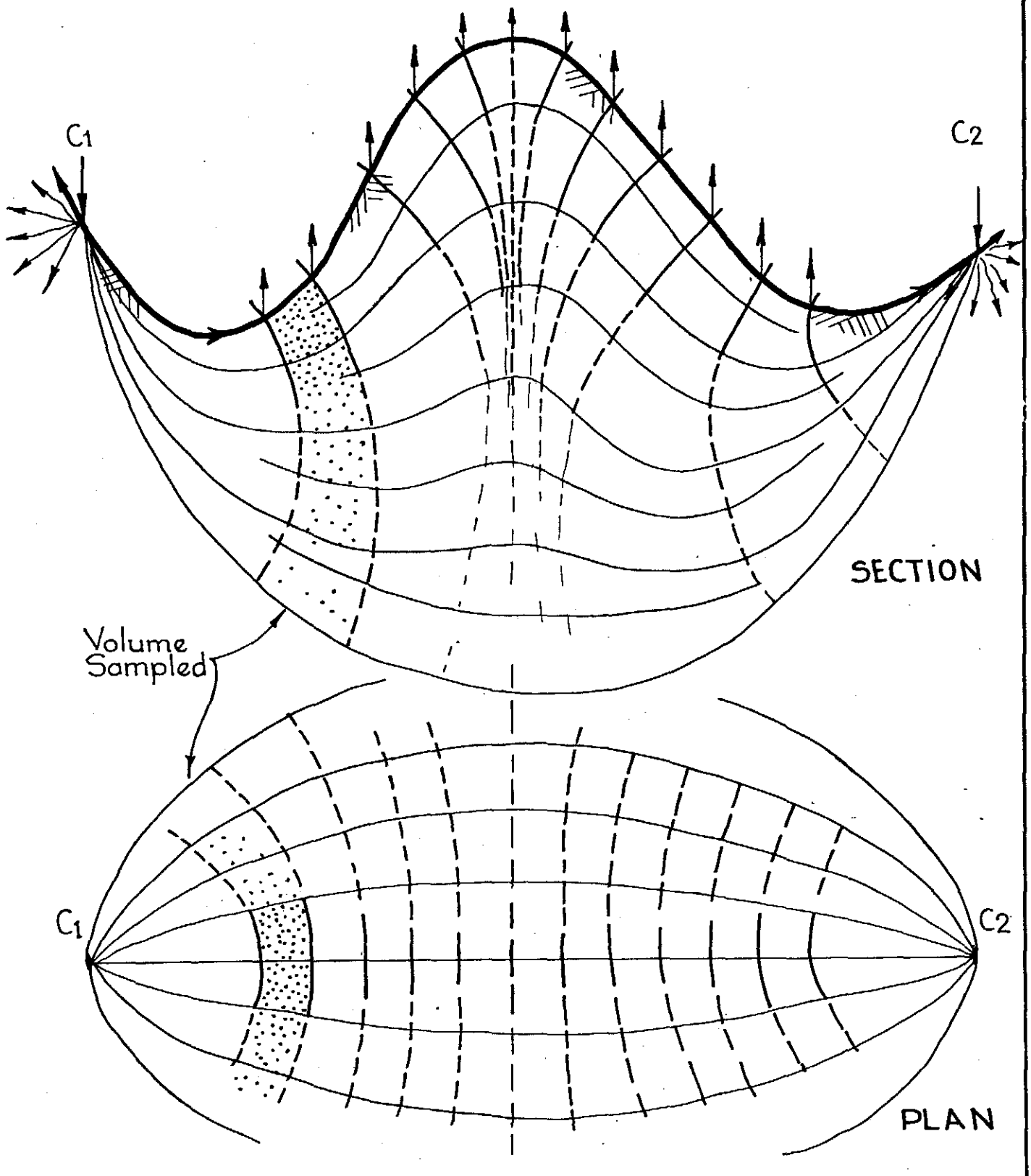


Diagrammatic Representation of Primary Current and Potential Field in Steep Topography.

FIGURE 1

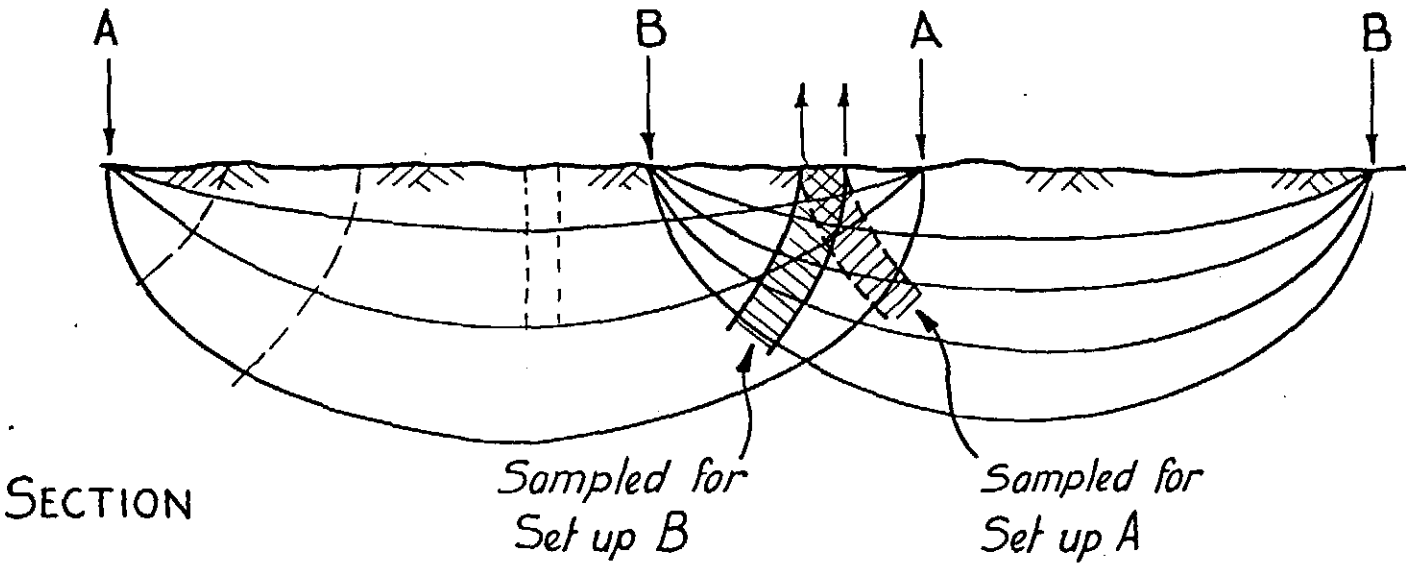
anomaly form, however, end-on gradient blocks (i.e. adjacent) *may* show material differences as the overlapping potential dipole will not necessarily be sampling the same volume of material. This is increasingly true as the current pole is approached. Figure 2A illustrates this situation diagrammatically.

Distortion can also occur at the extremeties of the array as shown in Figure 2B. This is due to the angle of the primary energising current to the reading potential. If there is a *conductive* unit at, near, or at right angles, to the line, the current will run at right angles to the line, and thus the equipotentials will be parallel to the reading dipole. Therefore readings in the "zone of distortion" should be regarded with caution.

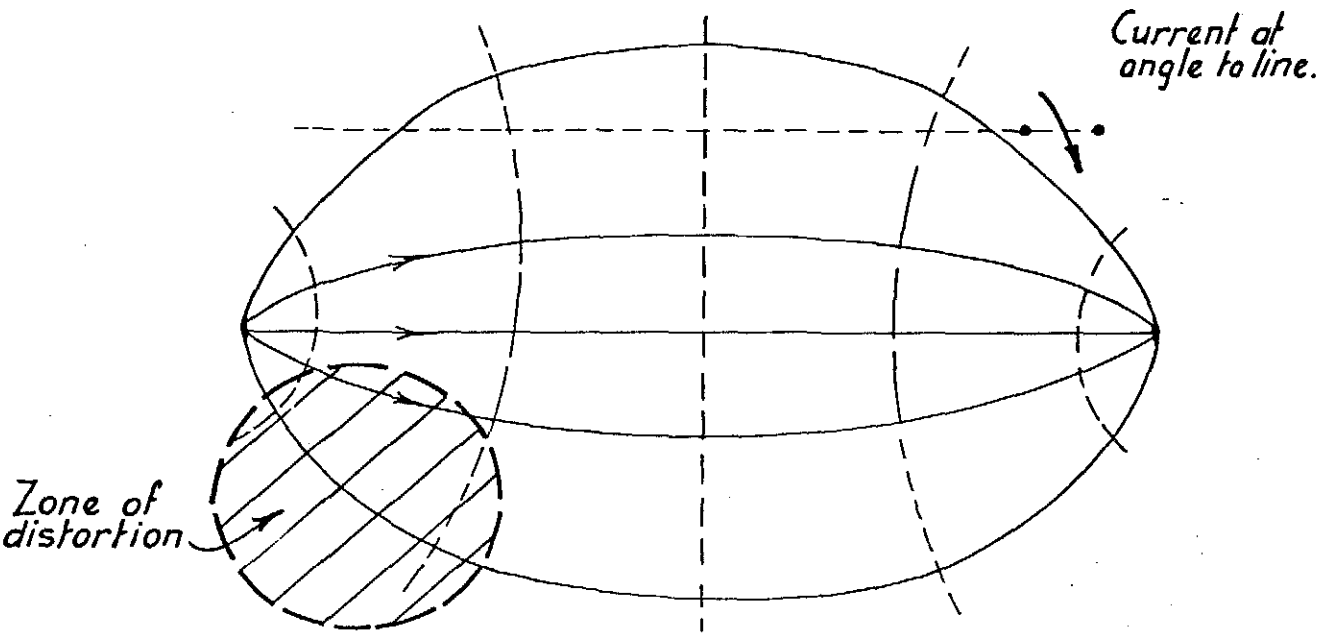
Note particularly that the *source volume* is *normal to local slope* and not vertically beneath the potential dipoles.

Note also that the volume of material *closest* to the potential electrodes will influence the data most. It is difficult to easily quantify the complex relationship between the volume of material sampled and its distance from the potential dipole.

Figure 3 displays the secondary current pattern generated from the decay of induced polarization effect *within* a chargeable sulphide source, together with the equipotential field generated by that decay. Note that due to the necessarily curved nature of the current flow outside the body, the on-surface manifestation is *wider than*



2(a) Explanation of difference in ρ_a measurements for "end-on" arrays.



2(b) Explanation of exaggeration at edges of array.

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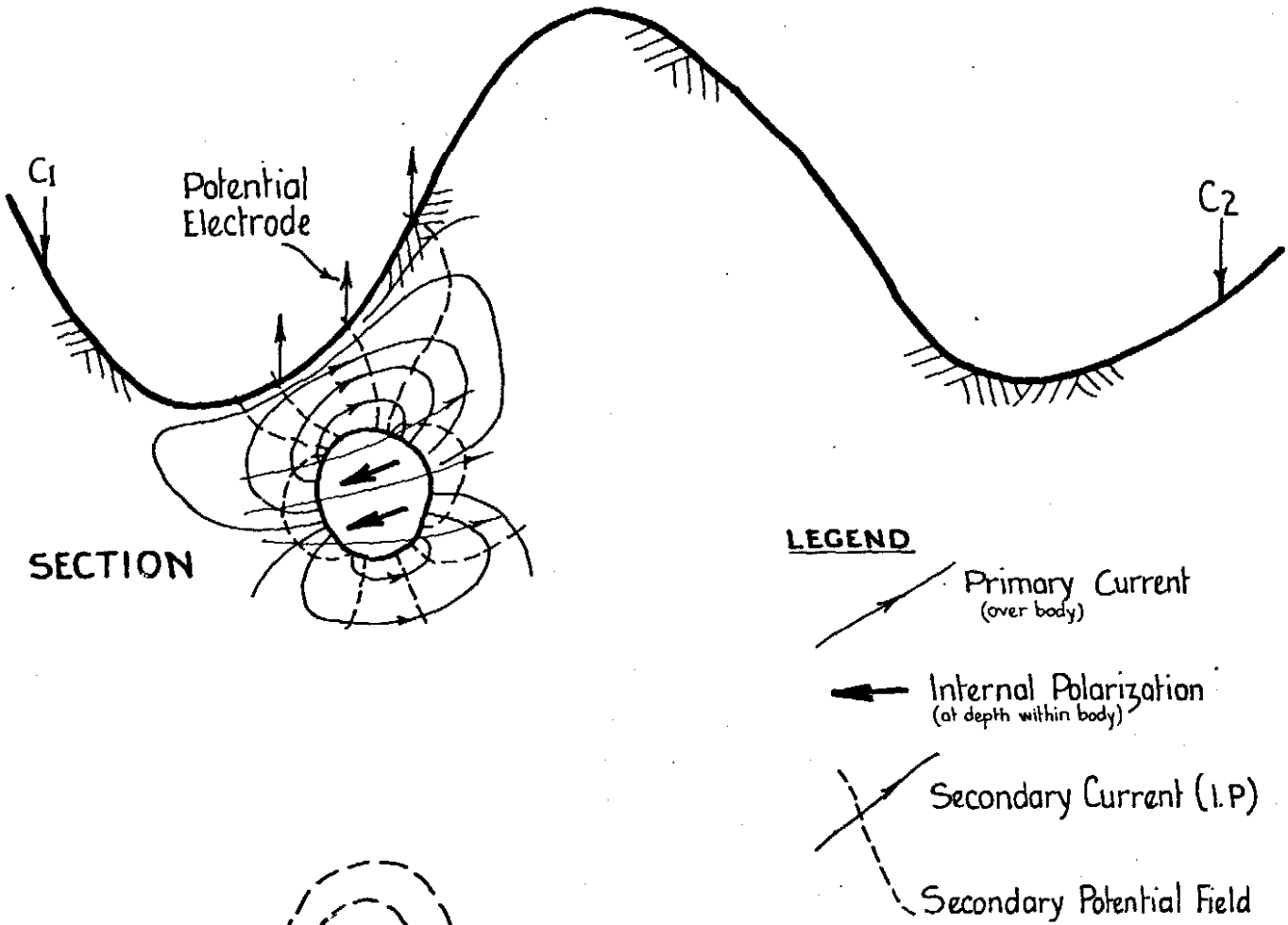
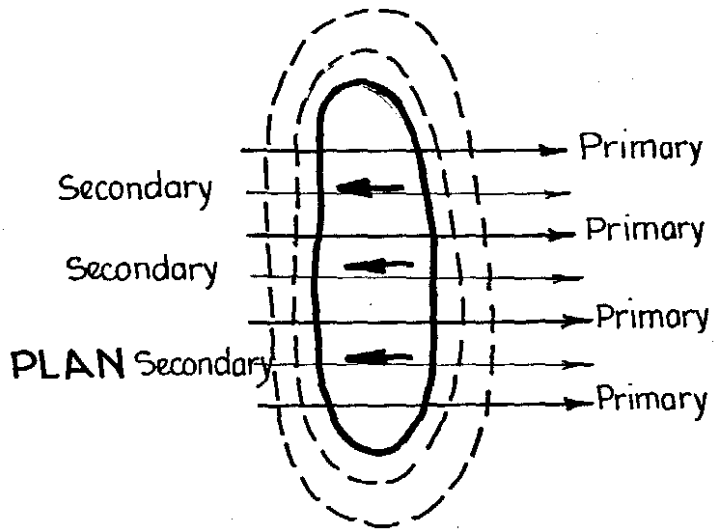




Diagrammatic representation of secondary current (I.P. effect) and secondary potential field in steep terrain.

FIGURE 3

the *source width.* Note also that the volume sampled in the primary potential field (apparent resistivity ρ*a*) is not necessarily the same volume as is the secondary potential field (apparent chargeability *Ma*). This is of course true for *any* array).

Both the apparent chargeability and apparent resistivity are plotted midway between the potential electrodes.

THE EXPECTED GEOPHYSICAL SIGNATURE

From the work carried out over the "Type Deposit" at Sweeney's Mine, the folowing geophysical characteristics are expected:-

1.... The enclosing granites at Sweeney's had high 5000 to 20,000 ohm-metres resistivities and extremely low, 4± millivolts/volt chargeability backgrounds.

2.... The body itself, when it consisted mainly of pyrite was extremely chargeable (to 100+ millivolts/volt), but had resistivities of between 400 and 500 ohm-metres, even within the "massive" sulphides. Late stage alteration between the pyrite crystals probably caused the whole mineral assemblage to be electrically discontinuous.

3.... The pyrrhotite bearing sections of the body would be expected to be very much more conductive, as pyrrhotite acts to join individual pyrite crystals in electrical continuity in most deposits it occurs in. Thus conductive bodies could also be expected, although their conductivity would not necessarily show a sympathetic relationship

to chargeability.

4.... The dimensions of the Sweeney's body necessitated a close grid line spacing of 100 metres, while the requirement for resolution required a small 10 metres potential dipole. The depth penetration was achieved by using large current dipoles. Additional interline spacings were employed where necessary to further refine any chargeability anomalies located.

DATA PRESENTATION AND DISCUSSION OF RESULTS

The data profiles are presented at the horizontal scale of 1:2500, with the contour interpretations of resistivity and chargeability at the scale of 1:2000 (The latter scale was chosen in consultation with Renison Limited. This scale was chosen in preference to the standard 1:5000 scale due to the complexity of the data, with a view to subsequent photoreduction). The anomaly designations are on both profiles and contour maps for easy identification.

Although three decay slices, M_1, M_3 and M_5 were acquired, only M_3 has been plotted and contoured. The vertical scales for chargeability and resistivity were 1 centimetre = 2 millivolts/volt and a 10 centimetre log cycle expressed in ohm-metres, respectively.

The background resistivities range between 500 and 3000 ohm-metres, but a range of 300 to 7000 ohm-metres was recorded. The strike of the most prominent resistivity features appears to be grid east - west. However, north of 200N on all lines, there is some evidence

of a north-south trend by *apparent* level changes between lines. These features are *real* and not a function of array position or geometry.

The chargeability data also shows a grid east-west trend for significant high and low features, even north of 200N on all lines, suggesting two different trends in the area. The background is about 10 millivolts/volt (6 milliseconds), which although higher than the Sweeney's granites, is still low for freshrocks.

Each of the significant induced polarization anomalies is described separately below.

ZONE 'A' ..... was recorded as an 18 millivolts/volt response on line 12E centred at 750S. The resistivity over the chargeability maximum is 1000 ohm-metres, as against 2500 ohm-metres to the east and west. A 20 millivolts/volt anomaly on line 11E at 705S is again associated with lower resistivities of 1500 ohm-metres as against 2700 ohm-metres to the east and west.

ZONE 'B' ..... 6 millivolts/volt chargeabilities were recorded on 12E between 540S and 605S with distinct maxima at 545S, 575S and 590S all of which infer sources at these points. The anomaly is associated with lower than background resistivities of 400 and 500 ohm-metres. This response "lenses out" to the west and is open to the east. The maximum depth to source at 595S is 10 metres and at 545S, 20 metres.

ZONE 'C' ..... A single line anomaly of 8 millivolts/volt above background was recorded at 625S on line 11E. A minor but significant fall in the changing resistivity background infers some conduction within the source. The maximum depth is less than 10 metres at 625S. It may form an extension of Zone 'B' described above.

ZONE 'D' ..... On the northern ends of lines 12E, 11E and 10E, distinct chargeability responses of 3 millivolts/volt, 6 millivolts/volt and 8 millivolts/volt were recorded from 500 ohm-metres material. The maximum depth to source in all cases is 10 metres.

ZONE 'E' ..... Within the backgrounds of about 12 millivolts/volt, a significant 10 millivolts/volt response was recorded at 205N on line 7E in close proximity to a significant change in resistivity background from 2000 ohm-metres in the south to 900 ohm-metres to to the north. The anomaly itself shows a minor depression in this level. The depth to source is not greater than 20 metres. The anomaly is open to the east, and to the west may continue as a sharp 6 to 8 millivolts/volt above background response at 225N on line 6E. Here the maximum depth is less than 10 metres, and the source wholly disseminated.

ZONE 'F' ..... An 8 millivolts/volt response above the 12 millivolts/volt background was recorded at 080N on line 7E coincident with a sharp increase in resistivity to 3500 ohm-metres from 1500 ohm-metres The source is interpreted as being due to disseminated sulphides within a relatively resistive host. On line 6E a 6 millivolts/volt

response at 045N may be related. The maximum depth to source on each line is 20 metres.

ZONE 'G' ..... A significant 10 millivolts/volt response was recorded on line 6E at 030S from within resistivities of about 1000 ohm-metres. At 00, no chargeability readings were obtained, however, the resistivity falls by about 50% to 500 ohm-metres. These low resistivities were recorded over a swamp area, but are not due to that, but to the underlying rocks. *Both* the chargeability highs and resistivity lows are of interest in this case. The maximum depth to source at 030S is 20 metres.

ZONE 'H' ..... This zone is one of the most substantial recorded in the area. On line 3E the anomaly extends from 690S to 750S with individual maxima inferring individual sources at 730S, 715S and 690S of 34, 39 and 24 millivolts/volt respectively. The apparent resistivity shows considerable variation over the anomaly, being 2000 ohm-metres at 735S and 400 ohm-metres at 685S. The maximum depths to source are estimated to be of the order of 20 metres. To the east, a single anomaly of 14 to 15 millivolts/volt above background centred at 715S on line 4E from 1000 ohm-metres resistivities, it interpreted as the eastern extension of the maximum observed on line 3E. (Unfortunately the lake crosses the extensions to the east). The maximum depth is estimated again at 20 metres.

To the west, a broad 10 millivolts/volt above background response was noted between 655S and 700S on line 2E, with an 18 to 20

millivolts/volt peak centred at 665S. Further to the west, this zone crosses line 1E at 655S where a 14 millivolts/volt response was recorded from relatively low resistivities of 600 ohm-metres as against 1000+ ohm-metres to both north and south. On both the above lines, the maximum depth of the source is estimated to be between 10 and 20 metres. On line 00 an 8 millivolts/volt above background response coincident with relatively high 3000 ohm-metres resistivities, was defined at 640S.

ZONE 'I' ..... A significant anomaly of 12 millivolts/volt on line 2E between 380N and 450N is accompanied by a significant depression in background resistivity from 1000 ohm-metres to 1500 ohm-metres to 230 to 400 ohm-metres. This anomaly occurs over old workings, and is therefore presumably due to sulphides. Two distinct peaks at 385N and between 405N and 450N with inferred individual sources at 415N and about 445N, were located associated with distinct resistivity lows. The source is weakly interconnected sulphides at a maximum depth of 10 to 15 metres. To the east on line 2.5E, a higher than background response was defined between 375N and 470N. On the southern flank of this response a substantial 15 to 30 millivolts/volt anomaly was recorded centred at 385N and is associated with a fall in resistivity to 400 ohm-metres from 1000 ohm-metres background. This is obviously a southerly extension of the peak at 385N on line 2E. The maximum depth is 20 metres.

On line 1E, two distinct and substantial above background chargeability responses of 25 millivolts/volt were recorded at 395N and 435N.

The former is associated with 325 ohm-metres resistivities, while the latter is associated with 800 ohm-metres resistivities. Background to north and south is about 900 ohm-metres. The maximum depth to source in both cases is about 20 metres. The sources are disseminated or weakly interconnected sulphides within a host less resistive than the enclosing rocks. 50 metres west on line 050E, higher chargeabilities of 6 to 10 millivolts/volt above background were recorded between 350N and 475N. The associated resistivities are a low 300 ohm-metres overall. Individual sulphide segregations are inferred at 365N, 405N, 425N and 462N. In all cases, the maximum depths to the disseminated or weakly interconnected sulphide source is about 20 metres.

ZONE 'J' ..... On line 00, 8 to 10 millivolts/volt above background chargeabilities were recorded between 550N and 655N within relatively high 1200 ohm-metres resistivities. Wholly disseminated sulphides are considered the source and are at a depth of about 20 metres below surface. To the east, two significant maxima of 16 to 18 millivolts/volt at 695N and 8 and 15 millivolts/volt at 580N and 605N on line 1E are considered to be related responses (Jn and Js respectively). The source is again considered to be disseminated sulphides.

To the west the anomaly was seen on line 0.5W between 590N and 675N with distinct maxima of 19 and 17 millivolts/volt at 600N and 660N. As on line 00, the apparent resistivities remain a relatively high 1000 ohm-metres, and thus a wholly disseminated source is

suggested. The maximum depth to source is 20 metres and 30 metres respectively.

ZONE 'K' ..... This zone may be a continuation of Zone 'H'. The most significant development of the anomaly was on intermediate line 2.5W, where the response was recorded between 575S and 625S, with distinct maxima of 8 millivolts/volt at 615S and 22 millivolts/volt above background at 585S. The latter is associated with 1300 ohm-metres resistivities, while the former is associated with 1000 ohm-metres resistivities. In both cases, the maximum depth to the disseminated source is estimated to be 20 metres. On line 2W an 11 millivolts/volt single peak at about 590S was located offset at 605S by a local 40% decrease in resistivity to 800 ohm-metres. The maximum depth to source may be as great as 30 metres at this point. On line 1W, 6 to 8 millivolts/volt chargeabilities were noted between 590S and 640S from 800 to 1000 ohm-metres material. Two maxima, at 600S and 625S are inferred, the maximum depths of which are about 20 metres. To the east, along strike, Zone 'H' occurs.

To the west on line 3W, higher chargeabilities of over 20 millivolts/volt were recorded between 375S and 620S, the southern section between 550S and 625S being considered Zone 'K'. Two distinct maxima of 12 to 14 millivolts/volt above the 10 millivolts/volt background to the south, were noted at 570S and 605S. The resistivities remain a high 1800 ohm-metres, so the source must be disseminated material at a depth of 20 metres below surface. Only relatively minor responses were recorded on line 4W of 6 millivolts/volt above background at

595S and 615S from disseminated sources within a resistive 2000 ohm-metres host.

ZONE 'L' ..... A series of anomalies sub-parallel to Zone 'K' are collectively termed Zone 'L'. On the most easterly line, 2W, a 12 millivolts/volt response located at 480S, was associated with 2500 ohm-metres resistivities. The source therefore is disseminated at a maximum depth of 20 metres. On line 2.5W the response consists of two maxima of 6 to 8 millivolts/volt above background at 510S and 450S within higher than background 2200 ohm-metres resistivities. Again the source is disseminated. On line 3W, Zone 'L' consists of higher 20 millivolts/volt chargeabilities between 375S and 490S with maxima at 385S, 435S and 475S, all clearly associated with higher background resistivities of 2500 to 3000 ohm-metres. On line 4W within higher chargeabilities between 425S and 530S, two distinct maxima of 16 to 18 millivolts/volt at 430S and 505S were defined from 2000 ohm-metres material. The maximum depth to the source of each is about 10 to 15 metres. On line 4.5W, generally higher chargeabilities were recorded between 370S and 535S. (This zone is equivalent to 350S to 530S on line 4W). The southern maximum on line 4W at 505S is much reduced at about 20 millivolts/volt, while that at 435S on line 4W was seen as a 28 millivolts/volt anomaly at 445S. At 375S and 350S, 12 and 13 millivolts/volt responses were recorded, which are equivalent to the section between 350S and 380S on line 4W. Maximum depth to source seems a shallow 15 metres. On line 5W, three distinct zones were recorded. At 510S a 10 millivolts/volt response within high 2000 ohm-metres resistivities was located,

the depth to which is estimated at 20 metres. Between 390S and 470S, 10 to 14 millivolts/volt responses were located, showing sources at 415S and 455S. Again, disseminated sources at 20 metres depths are indicated. Between 340S and 377S, 12 millivolts/volt maxima were recorded at 355S and 375S from disseminated sources at maximum depths of 20 metres and 15 metres respectively. This zone is not really seen as a major response on line 5.5W.

ZONE 'M' ..... A significant increase of 10 millivolts/volt above background (8 millivolts/volt) was noted between 650N and 725N on line 3W. Individual sources are inferred at 655N, 685N and 715N, all within generally lower apparent resistivities of 500 ohm-metres as against 1000 ohm-metres to the north and south. The maximum depth at 655N is 15 metres and at 715N, 25 metres. The source is either disseminated material within a more conductive host, or weakly interconnected sulphide material. Within a 400 ohm-metres resistivity low as against 900 ohm-metres background, two 5 millivolts/volt responses above 8 millivolts/volt were recorded on line 3.5W. This is the most westerly extension of this zone. Maximum depth is again about 20 metres. On line 2.5W to the east, a minor chargeability response of 3 millivolts/volt and a moderate one of 7 millivolts/volt were recorded at 675N and 720N within 600 ohm-metres resistivities. Maximum depths to source are about 20 metres. A moderate 7 millivolts/volt response at 705N on line 2W was the most easterly manifestation of this zone.

ZONE 'N' ..... An old mine shaft was recorded on lines 3W and 4W at about 375N and 325N coincident with a sharp rise in apparent resistivity

in each case from about 500 ohm-metres to 1500 ohm-metres. On line 4W no chargeability readings were obtainable due to high noise levels, while no appreciable chargeability response was recorded on line 3W. To the east, on line 2W, great difficulty in obtaining meaningful data over this section was encountered. This difficulty was independent of both array position and reading unit. Both the original "noisy" data and the "normal" non-noise data are shown. The "normal" data shows a small 5 millivolts/volt response at 305N and at 325N.

ZONE 'O' ..... A series of induced polarization highs of 8 to 10 millivolts/volt were recorded between 162S and 315S on 6W, with individual maxima at 175S, 225S, 260S and 305S. The central highs above are associated with 1300 ohm-metres resistivities, while the outside highs are associated with 2000 ohm-metres resistivities. Resistive sources at maximum depths of up to 20 metres are the interpreted sources. To the east on line 5W, single anomalies at 235S, 285S and 315S *may* be related *either* to Zone 'O' or 'L'. On line 7W, generally higher chargeabilities were recorded between 160S and 330S. Individual maxima of 7 millivolts/volt at 320S, 225S, 195S and 175S were related to 3000, 1200, 1300 and 1300 ohm-metre resistivities respectively. The depths to source are inferred to be between 15 and 20 metres at most. Disseminated sulphides within a less resistive unit, or perhaps showing weak interconnection are the likely source. On line 8W, two minor sources at 170S and 205S *may* represent the most westerly manifestation of this zone.

ZONE 'P' ..... A very sharp change in resistivity from a low of

500 ohm-metres at 795S to 3000 ohm-metres at 775S were recorded on line 1E. A sharp local 10 to 12 millivolts/volt chargeability high was noted at this site. On line 2E a similar resistivity low was noted at 815S with an 8 millivolts/volt anomaly located at 795S. On line 00 a small 6 to 7 millivolts/volt above background chargeability response was located in close proximity to a resistivity low of 400 ohm-metres centred at 835S as against a background of 1600 ohm-metres. On line 1W a chargeability of 6 millivolts/volt at 812S is associated with lower than background resistivities, while on line 2W the 7 to 8 millivolts/volt response at 790S is associated with higher resistivities. The depths to source are all about 15 to 20 metres and the source itself probably shows some interconnection on lines 1E, 00 and 1W, and is wholly disseminated on the other lines.

ZONE 'Q' ..... A substantial chargeability response of up to 28 millivolts/volt on line 4E at or north of 580S is within resistivities of about 1000 ohm-metres. On line 3E a 23 millivolts/volt response (15 millivolts/volt above background) was observed at 565S within 600 to 700 ohm-metres resistivities. This response is due to disseminated sulphides within a host only sightly less resistive than the enclosing rocks. The maximum depth at 565S is 18 metres.

ZONE 'R' ..... was located on lines 1E and 2E at 450S and 475S (subsidiary) and 450S and 475S respectively, and on line 00 at 500S. As the associated resistivities are a high 800 to 1200 ohm-metres, the source is considered disseminated sulphides. The indicated depth is about 15 to 20 metres in all cases.

ZONE 'S' ..... This zone was seen as a 22 millivolts/volt response at about 365S on line 2E, with a 21 millivolts/volt response at 405S on line 3E. Both maxima are individual "closed" anomalies, and are associated with *higher* local resistivities, and have maximum depths to source of 20 metres. Disseminated sulphides within a *resistive* source is the interpreted cause.

CONCLUSIONS AND RECOMMENDATIONS

1 - Clearly, the trend of significant chargeability features is approximately grid east-west for the most part. It is understood that this parallels the prominent joint system within the underlying granites.

2 - The resistivity data shows the general grid east-west trend, but superimposed on it is a distinct change in background resistivity level about an arc (see resistivity contour plan) which separates higher resistivities to the south, south-west and central western areas, and lower background resistivities to the north-east. The background resistivity in the former is 1500 ohm-metres to 2000 ohm-metres, and in the latter 1000± ohm-metres. The chargeability background *overall* remains about the same on both sides of the boundary. However, the *form* shows some variation.

3 - It may be significant that a substantial number of significant anomalies occur south-west of, or in close proximity to this boundary (e.g. 'H', 'L', 'K' and 'O'). The strike of the

anomalism is still east-west, and to the south-west of this "zone of high chargeability", the backgrounds are more *uniformly* low at 12 ±2 millivolts/volt than those to the north-east of that contact where an *average* 12 ±2 millivolts/volt background shows a greater *variation*. It is considered that the postulated boundary is a boundary between granites of different composition.

4 - When the magnetic data is contoured it will probably assist in the evaluation of different granite units and may be able to shed some light on which group of chargeability anomalies are significant.

5 - The chargeability anomalies located are of three main types, (a) single line maxima e.g. 'G', (b) zones showing continuity over hundreds of metres. e.g. 'H', and (c) "multiple" zones with little continuity between lines e.g. 'L'. The possible implication of these various "types" is not known, but it must show a slightly different origin.

6 - For the most part, decay forms observed were normal, inferring an "average" grain size distribution for the causative sources. Distortion in decay form proved an excellent and sensitive monitor of the validity of readings during moisture and cable leakage problems.

7 - Each of the anomalies is discussed and categorised below, mainly on similarity of characteristics to Sweeney's, and on amplitude

although the latter may not be a good basis for assessment.

Zone 'A' ... located as twice background on line 12E and 750S and on 11E at 705S at 18 millivolts/volt, and as a smaller response on line 10E at 685S. The zone is associated with falls in apparent resistivity to 1000 to 1500 ohm-metres.

The source is disseminated chargeable material with a less resistive host at a maximum depth of 10 metres. On lines 11E at 705S and 12E at 750S the response is of *SECONDARY* interest.

Zone 'B' ... is really seen only on line 12E between 540S and 605S, with three sources inferred at 545S, 575S and 590S. Low associated resistivities occur. Maximum depth to source is 10 metres at 590S. Of *SECONDARY* interest on this line. The anomaly is open to the east.

Zone 'C' ... A sharp 8 millivolts/volt above background response at 625S on line 11E is coincident with a *relative* fall in resistivity to 900 ohm-metres and is interpreted as coming from a partially conductive source at a maximum depth of 10 metres, and is considered of *SECONDARY* interest.

Zone 'D' ... A sharp response of 3 to 8 millivolts/volt on lines 12E to 10E at 500S is interpreted as being due to disseminated chargeable material at a maximum depth of 10 metres. Of *SECONDARY* interest on line 10E.

Zone 'E' ... On line 7E at 205N, a significant 10 millivolts/volt above background anomaly was located, and whose source is disseminated and lies at a maximum depth of 20 metres. This zone *may* continue across line 6E at 225N. Of *SECONDARY* to *PRIMARY* interest on line 7E.

Zone 'F' ... An 8 millivolts/volt anomaly at 080N on line 7E is interpreted as being from disseminated sulphides within a resistive source at a maximum depth of 20 metres, and is considered of *SECONDARY/TERTIARY* interest.

Zone 'G' ... A significant 10 millivolts/volt maximum at 030S and a 500 ohm-metres low at 010S, are considered of *SECONDARY* to *PRIMARY* interest. Maximum depth to source at 030S is 20 metres.

Zone 'H' ... This most significant induced polarization zone was recorded on line 00 at 640S, line 1E at 655S, line 2E at 665S, line 3E between 680S and 750S and finally on line 4E at 715S. The maximum depth to source is considered to be 20 metres, and the interest on lines 00, 1E, 2E and 3E is *SECONDARY*, and on line 4E is *PRIMARY*. The source shows a great variation of resistivity within it, similar to that observed over Sweeney's.

Zone 'I' ... Substantial 25 millivolts/volt above background responses were observed at 395N and 435N on line 1E, 12 millivolts/volt at 385N, 415N and 445N on line 2E, and 25 millivolts/volt

at 385N on line 2.5E. All are considered to come from disseminated or weakly interconnected sulphides within a less resistive than background host, and are at a depth of 20 metres. This response is considered of *PRIMARY* interest. The response extends up through line 0.5E in reduced form.

Zone 'J' ... 6 to 8 millivolts/volt chargeabilities over 1000 ohm-metres material were noted on lines 00 and 0.5W between 550N and 655N, and between 580N and 680N, the maximum depth to the disseminated material being about 20 to 30 metres. On line 1E the zone splits into two discrete zones, Js of 9 millivolts/volt at 580N and 15 millivolts/volt at 605N and Jn of 18 millivolts/volt above background at 695N. The maximum depths of these responses are 20 metres, 10 metres and 20 metres respectively. The anomaly on lines 0.5W and 00 are of *SECONDARY* interest, and on line 1E is of *PRIMARY* interest.

Zone 'K' ... Significant chargeability responses on line 2W at 590S, on line 2.5W at 585S and on line 3W at 575S and 605S are considered of *SECONDARY*, *PRIMARY* and *SECONDARY* interest respectively. The sources become progressively more resistive to the west at 800 ohm-metres, 1000 ohm-metres and 2000 ohm-metres respectively. The sources are considered to be disseminated chargeable material at depths of about 20 metres.

Zone 'L' ... A significant *series* of anomalies on lines 2W to 5W between about 350S and 525S make up this zone. A series of

"lenses" of chargeable material are inferred, as each individual event cannot be traced as a major feature over any adjacent line. The resistivities are such as to always infer the sources to be disseminated, while depths to source range from 10 to 30 metres, with most being about 20 metres. The responses on lines 5W, 4.5W, 4W and 2W are considered of *SECONDARY* to *PRIMARY* interest, with the remainder being of *SECONDARY* interest. (For position and depth details see text, page 12).

Zone 'M' ... This zone was recorded on line 3W at 665N, 685N and 715N where 8 to 10 millivolts/volt above background responses were located within relatively low 500 ohm-metres resistivities. This anomaly is considered of better than *SECONDARY* importance. To east and west, much reduced responses on lines 2.5W, 2W and 3.5W were recorded, and are considered of *SECONDARY* to *TERTIARY* interest only.

Zone 'N' ... Little or no anomalism was observed over mine workings at 375N and 325N on 3W and 4W. 4 to 6 millivolts/volt anomalies at 310N and 325N on line 2W *may?* be on strike extensions. However, they would be rated of *TERTIARY* geophysical interest. It is considered that little or no sulphide is now present.

Zone 'O' ... This zone was best defined on 6W at 162S and 315S and on line 7W at about the same co-ordinates. The anomalies lie in a 1200 ohm-metres zone *within* 3000 ohm-metres resistivities on both lines. The maxima are at 175S, 220S, 260S and 305S on

line 6W, and at 175S, 195S and 225S on line 7W, and are considered of *SECONDARY* to *PRIMARY* interest. Maximum depths range to 20 metres.

Zone 'P' ... A series of *relative* resistivity lows on 2E, 1E, 00 and 1W at 815S, 795S, 835S and 785S are accompanied by increased chargeabilities in the vicinity. The source is considered to be weakly interconneted to disseminated chargeable material at maximum depths of up to 20 metres. These anomalies are considered of *SECONDARY* interest at best.

Zone 'Q' ... Anomalies of 10 to 15 millivolts/volt above background were noted at or north of 580S on line 4E and at 565S on line 3E within 1000 and 600 to 700 ohm-metre resistivities respectively. The maximum depths are between 15 and 20 metres in both cases. The zone is of *SECONDARY* interest.

Zone 'R' ... Anomalies of about 6 to 8 millivolts/volt above background on line 00 at 500S and at 450S and 475S on 1E and 2E are interpreted as emanating from disseminated sulphides at a maximum depth of about 15 to 20 metres. These anomalies are considered of *SECONDARY* interest on line 1E and *TERTIARY* interest on the other lines.

Zone 'S' ... Two individual anomalies at 365S on line 2E and 405S on line 3E of about 21 millivolts/volt (8 millivolts/volt above background), are interpreted as coming from disseminated sulphide sources within a relatively *resistive* source at 20

metre depths. These anomalies are of *TERTIARY* to *SECONDARY* interest only.

The author looks forward to discussing these results with Renison Limited in the near future.

Respectfully submitted on behalf of:

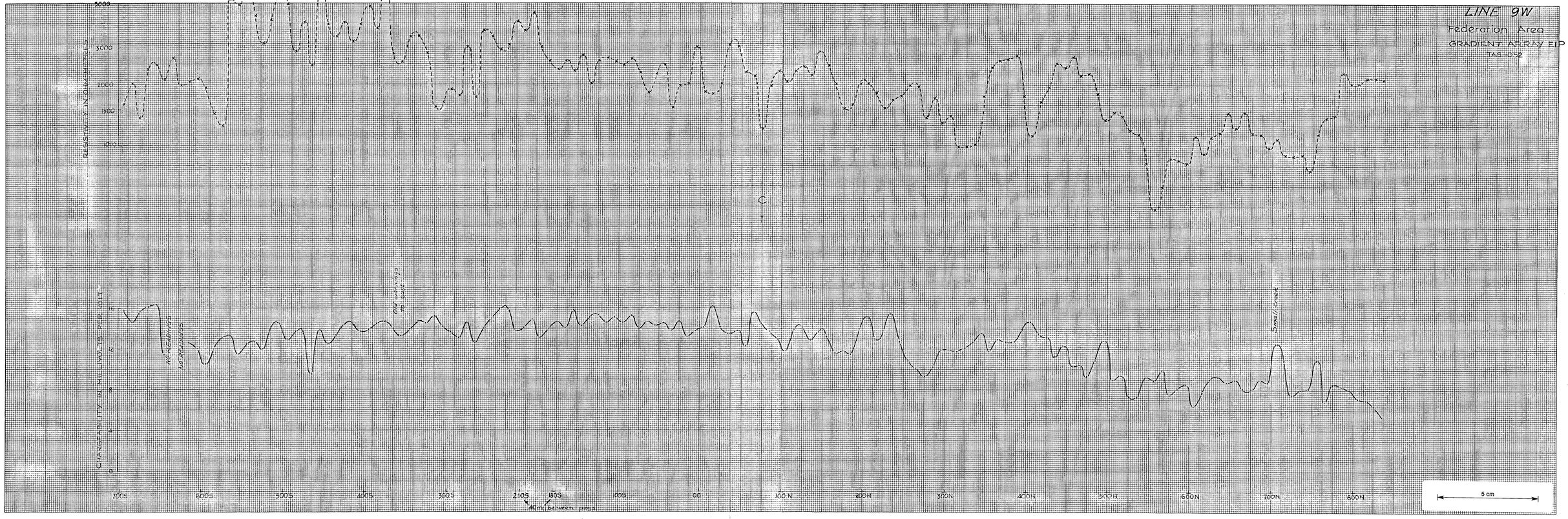
SCINTREX PTY. LTD.

A.W. HOWLAND-ROSE, MSc, DIC, AMAusIMM, FGS.

GEOPHYSICIST

029

256031



47 1517

K+E 10 X 10 TO THE CENTIMETER 46 1320 X 25 CM.
KEUFFEL & ESSER CO. MADE IN U.S.A.

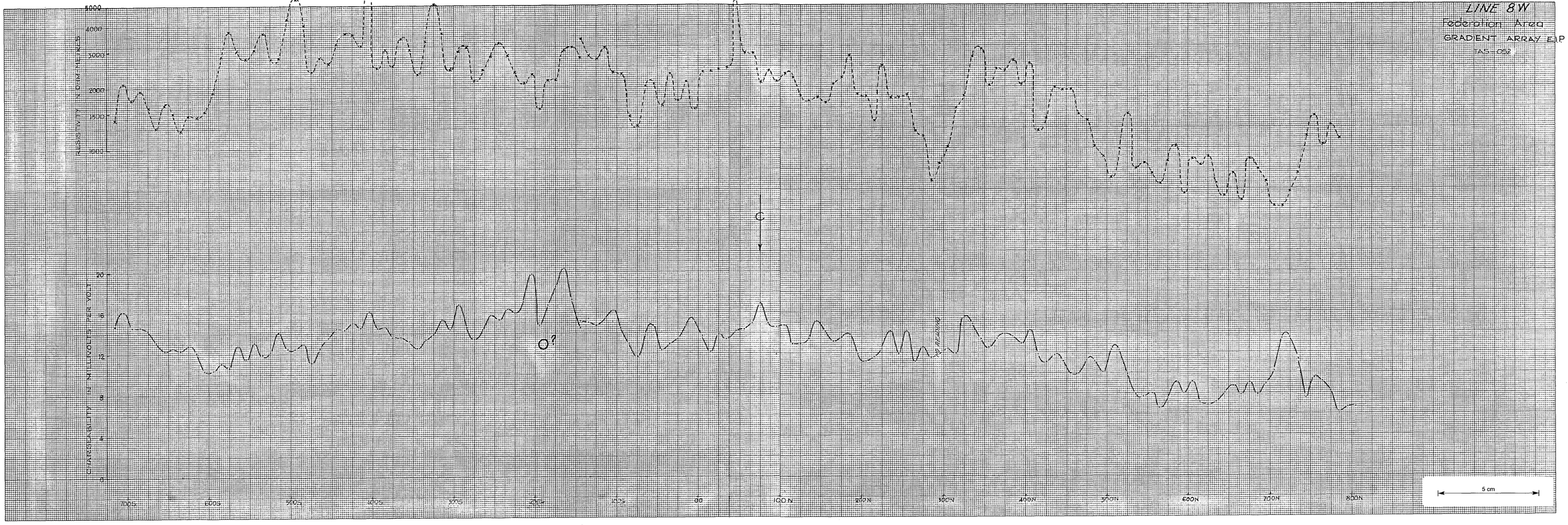
030

256032

47 1517

K+E
10 X 10 TO THE CENTIMETER 25 X 38 CM.
KEUFFEL & ESSER CO. MADE IN U.S.A.

LINE 8W
Federation Area
GRADIENT ARRAY E1P
AS-052



031

47 1517

K&E 10 X 10 TO THE CENTIMETER • 20 X 30 CM
KEUFFEL & ESSER CO. MADE IN U.S.A.

5 cm

256033

LINE 7W

Federation Area

GRADIENT ARRAY EIP

TAS 052

RESISTIVITY IN OHM-METRES

5000
3000
2000
1000

CHARGEABILITY IN MILLIVOLTS PER VOLT

20
16
12
8
4
0

N OF CREEKLINE

W OF BASELINE

C

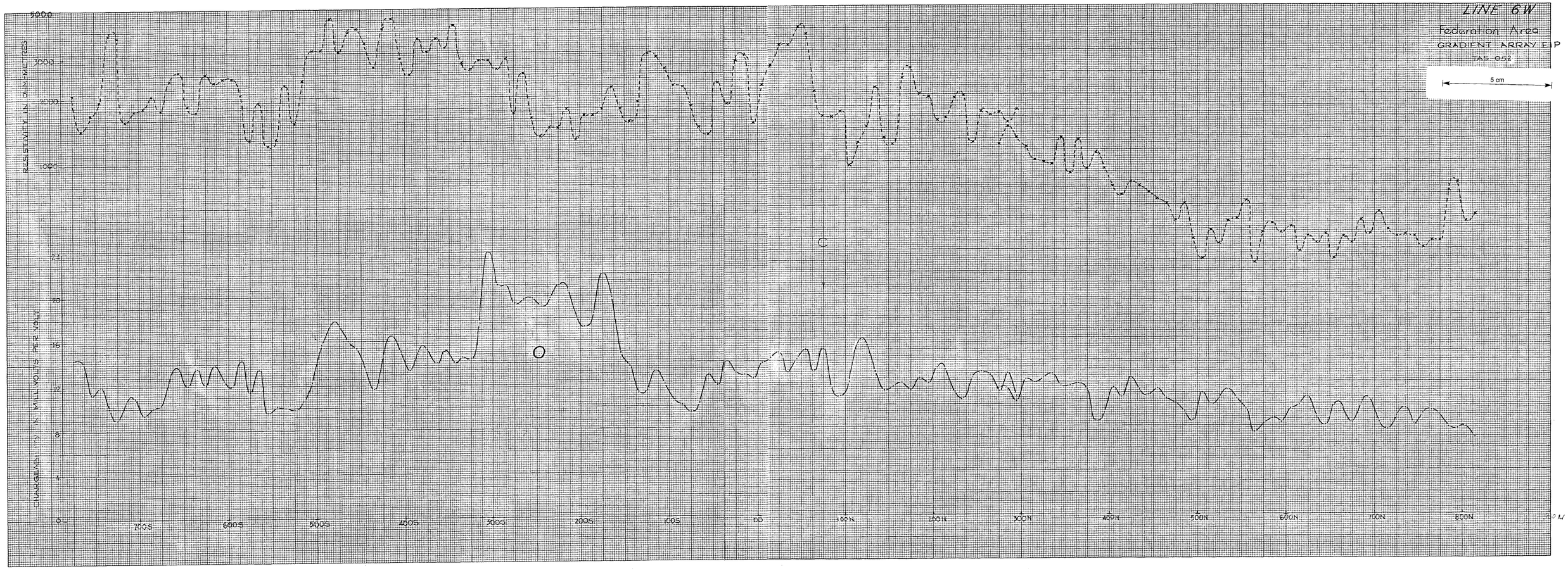
600S 500S 400S 300S 200S 100S 0D 100N 200N 300N 400N 500N 600N 700N 800N 900N

256034

022

47 1517

K&E 10 X 10 TO THE CENTIMETER • 25 X 38 CM.
KEUFFEL & ESSER CO. MADE IN U.S.A.



K&E 10 X 10 TO THE CENTIMETER • 25 X 38 CM.
KEUFFEL & ESSER CO. MADE IN U.S.A.

47 1517

033

256035

47 1517

K&E 10 X 10 TO THE CENTIMETER • 25 X 38 CM.
KEUFFEL & ESSER CO. MADE IN U.S.A.

LINE 55 W

Federeration Area

GRADIENT ARRAY E.I.P

TAS -052

5 cm

RESISTIVITY IN OHM-METRES

6000
4000
3000
2000
1000

24

CHARGEABILITY IN MILLIVOLTS PER VOLT

20
16
12
8
4
0

6005
5005
4005
3005
2005

C

L

034

47 1517
K+E 10 X 10 TO 2 CENTIMETER • 25 X 38 CM.
10 X 10 TO 2 INCH • 25 X 38 CM.

LINE 5W

Federation Area

GRADIENT ARRAY IP

IAS 0512

035

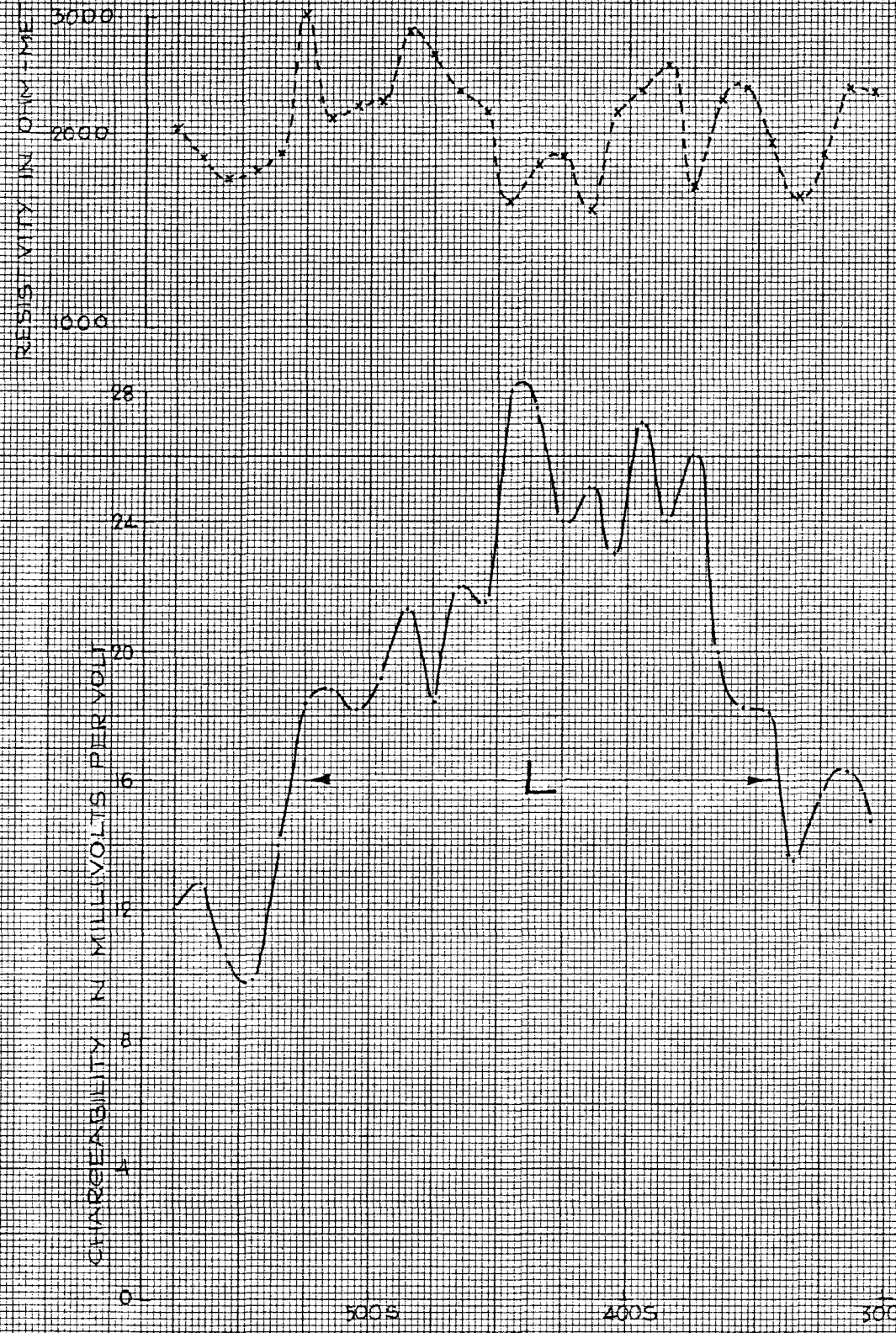
256037

LINE 4.5 W

Federation Area

GRADIENT ARRAY E.I.P

FAS 052



47 1517

K&E 10 X 10 TO THE CENTIMETER • 25 X 38 CM.
KEUFFEL & ESSER CO. MADE IN U.S.A.

5 cm

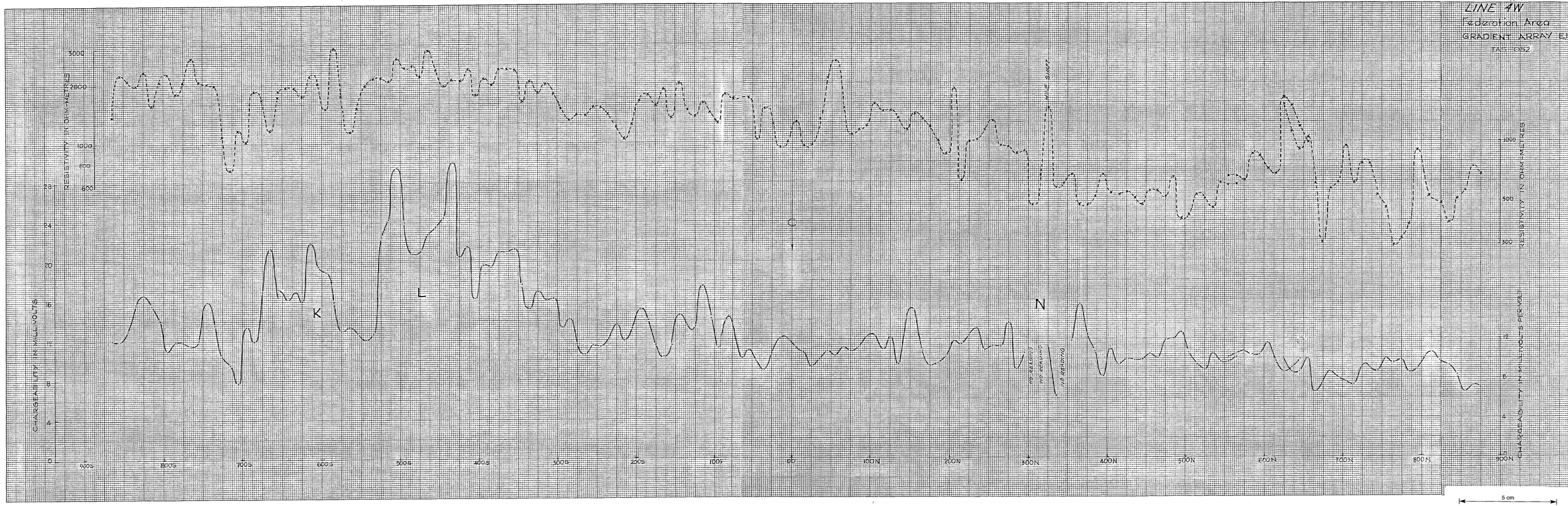
036

256038

47 1517

K+E
KEUFFEL & ESSER CO. MADE IN U.S.A.
10 X 10 TO THE CENTIMETER 25 X 38 CM.

LINE 4W
Federation Area
GRADIENT ARRAY EIP
TAS 1952



037

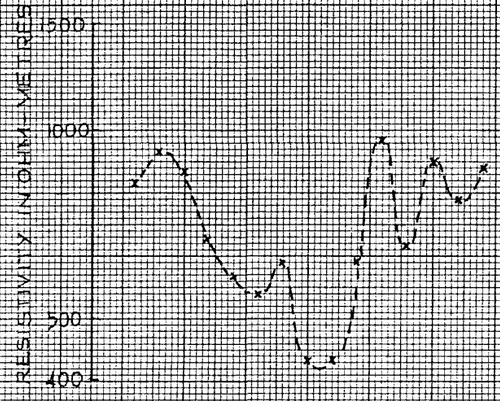
256039

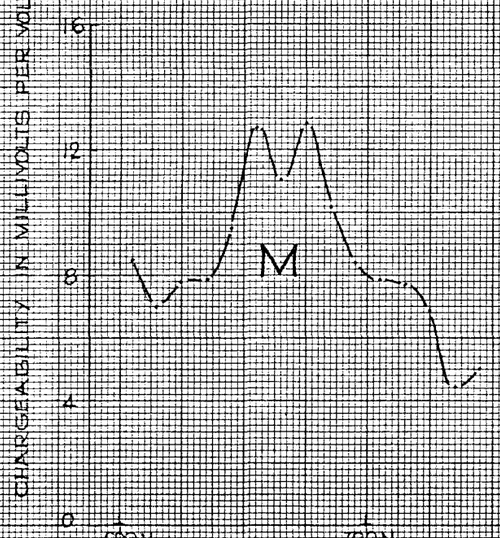
LINE 3.5W

Federation Area

GRADIENT ARRAY E.I.P.

TAS-052





600N

700N

800N

5 cm

47 1517

KE 10 X 10 TO THE CENTIMETER • 25 X 38 CM. KEUFFEL & ESSER CO. MADE IN U.S.A.

038

256040

47 1517
K&E
10 X 10 TO THE CENTIMETER 46 1320
KEUFFEL & ESSER CO. MADE IN U.S.A.

033

256041

LINE 2.5 W

Federation Area

GRADIENT ARRAY EIP

TAS-052

47 1517

K&E 10 X 10 TO THE CENTIMETER • 25 X 38 CM.
KEUFFEL & ESSER CO. MADE IN U.S.A.

RESISTIVITY IN OHM-METRES

1000
900
800
700
600
500
400

CHARGEABILITY IN MILLIVOLTS PER VOLT

16
12
8
4
0

M

600 N
700 N
800N

5 cm

040

256042

LINE 25W

Federation Area

GRADIENT ARRAY E.I.P

TAS-052

RESISTIVITY IN OHM-METRES

3000

2000

1000

36

32

28

24

20

16

12

8

4

0

CHARGEABILITY IN MILLIVOLTS PER VOLT

K

L

7000S

6000S

5000S

4000S

5 cm

47 1517

K&E 10 X 10 TO THE CENTIMETER • 25 X 38 CM.
KEUFFEL & ESSER CO. MADE IN U.S.A.

041

256043

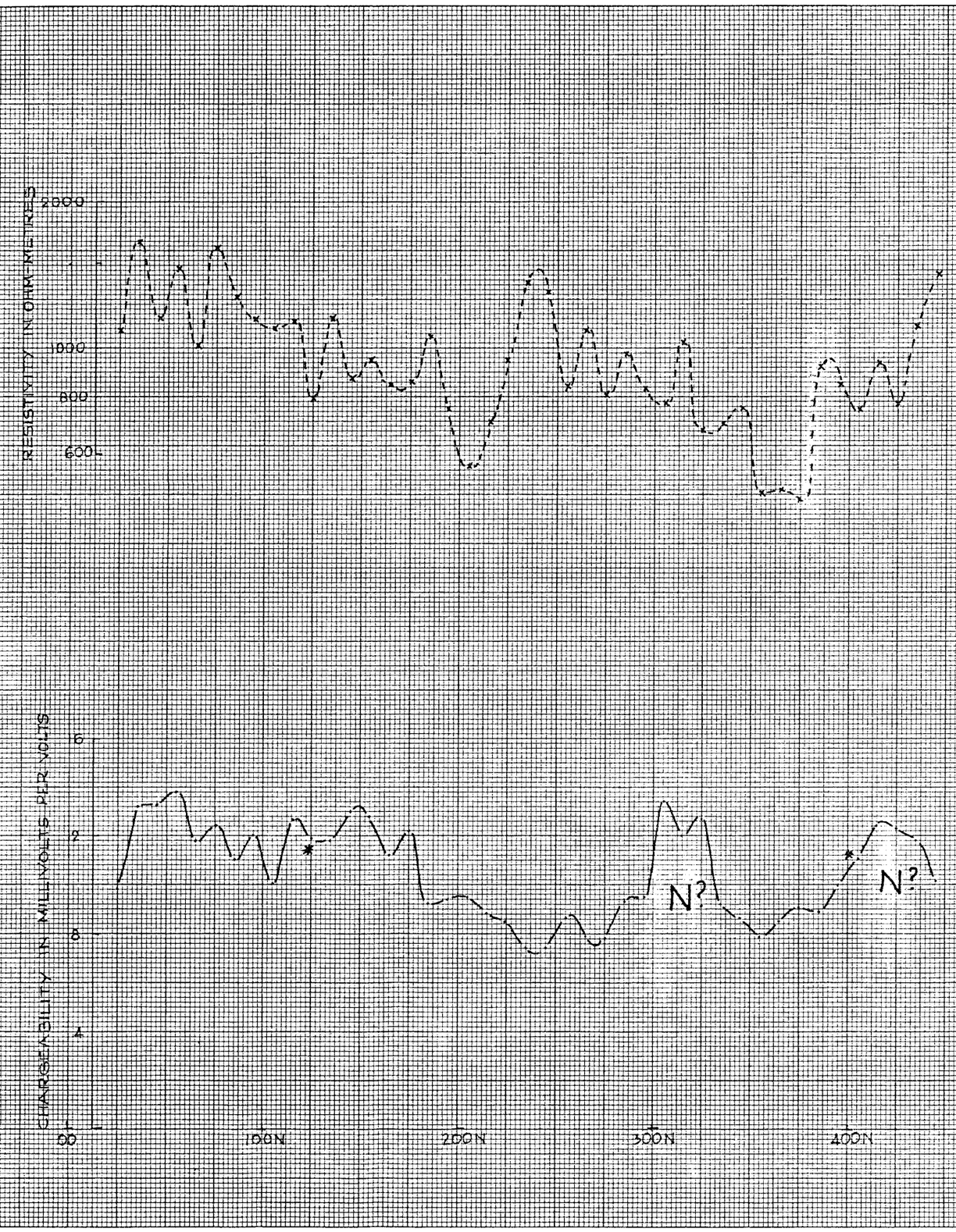
LINE 2W

Federation Area

GRADIENT ARRAY E.I.P.

TAS 052

(RE-READ)



5 cm

47 1517

K&E 10 X 10 TO THE CENTIMETER • 25 X 38 CM.
KEUFFEL & ESSER CO. MADE IN U.S.A.

042

256044

47 1517

KOKE
KEUFFEL & ESSER CO.
MADE IN U.S.A.

256045

043

LINE 1W

Federation Area

GRADIENT ARRAY E.I.P.

TAS-052

RESISTIVITY IN OHM-METRES

CHARGEABILITY IN MILLIVOLTS PER VOLT

47 1517

K&E 10 X 10 TO THE CENTIMETER 25 X 25 CM.
KEUFFEL & ESSER CO. MADE IN U.S.A.

P

H/K

C

900S 800S 700S 600S 500S 400S 300S 200S 100S 0 100N 200N 300N 400N 500N 600N 700N 800N 900N

5 cm

044

256046

LINE 0·5 W

Federeration Area

GRADIENT ARRAY E.I.P

IAS-052

5 cm

47 1517

K&E 10 X 10 TO THE CENTIMETER • 25 X 38 CM.
KEUFFEL & ESSER CO. MADE IN U.S.A.

045

256047

47 1517

K+E 10 X 10 TO THE CENTIMETER 25 X 38 CM.
KEUFFEL & ESSER CO. MADE IN U.S.A.

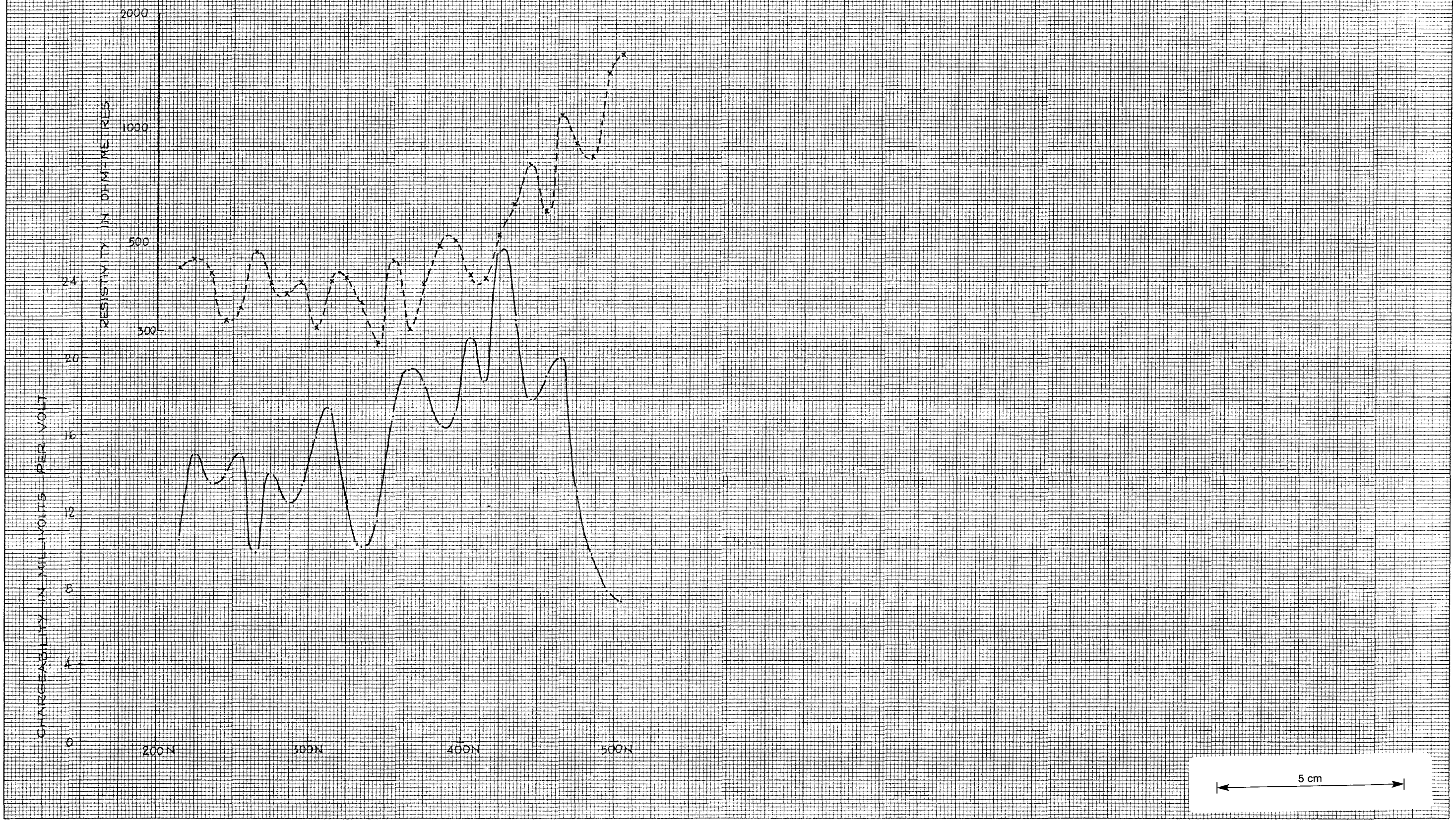
256048

LINE 0.5E

Federation Area

GRADIENT ARRAY E.I.P.

TAS-052



047

47 1517

K&E 10 X 10 TO THE CENTIMETER • 25 X 38 CM.
KEUFFEL & ESSER CO. MADE IN U.S.A.

047

256049

47 1517

KOE KEUFFEL & ESSER CO. MADE IN U.S.A. 10 X 10 TO THE CENTIMETER 25 X 25 CM

048

256050

LINE 2E

Federation Area

GRADIENT ARRAY E/P

TAS 252

47 1517

K+E 10 X 10 TO THE CENTIMETER 25 X 38 CM
KEUFFEL & ESSER CO. MADE IN U.S.A.

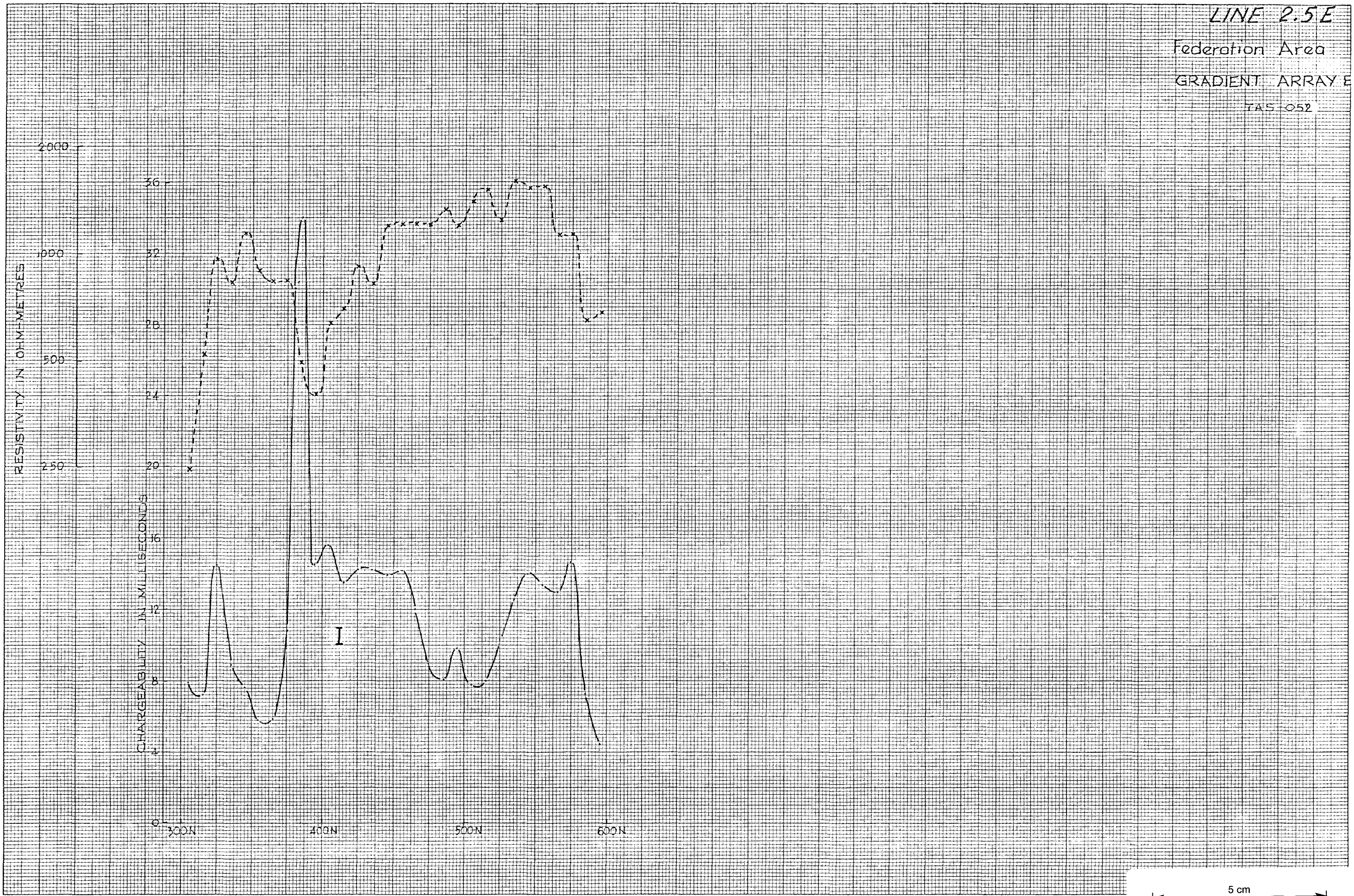
256051

LINE 2.5E

Federation Area

GRADIENT ARRAY EIP

TAS-052



047

47 1517

K&E 10 X 10 TO THE CENTIMETER • 25 X 38 CM.
KEUFFEL & ESSER CO. MADE IN U.S.A.

5 cm

050

256052

47 1517

KEUFFEL & ESSER CO.
MADE IN U.S.A.

LINE 3E

Federation Area

GRADIENT ARRAY E.I.P.

JAS-052

RESISTIVITY IN OHM-METRES

CHARGEABILITY IN MILLIVOLTS PER VOLT

H

Q

S

C

LAKE ERIE

LAKE ERIE

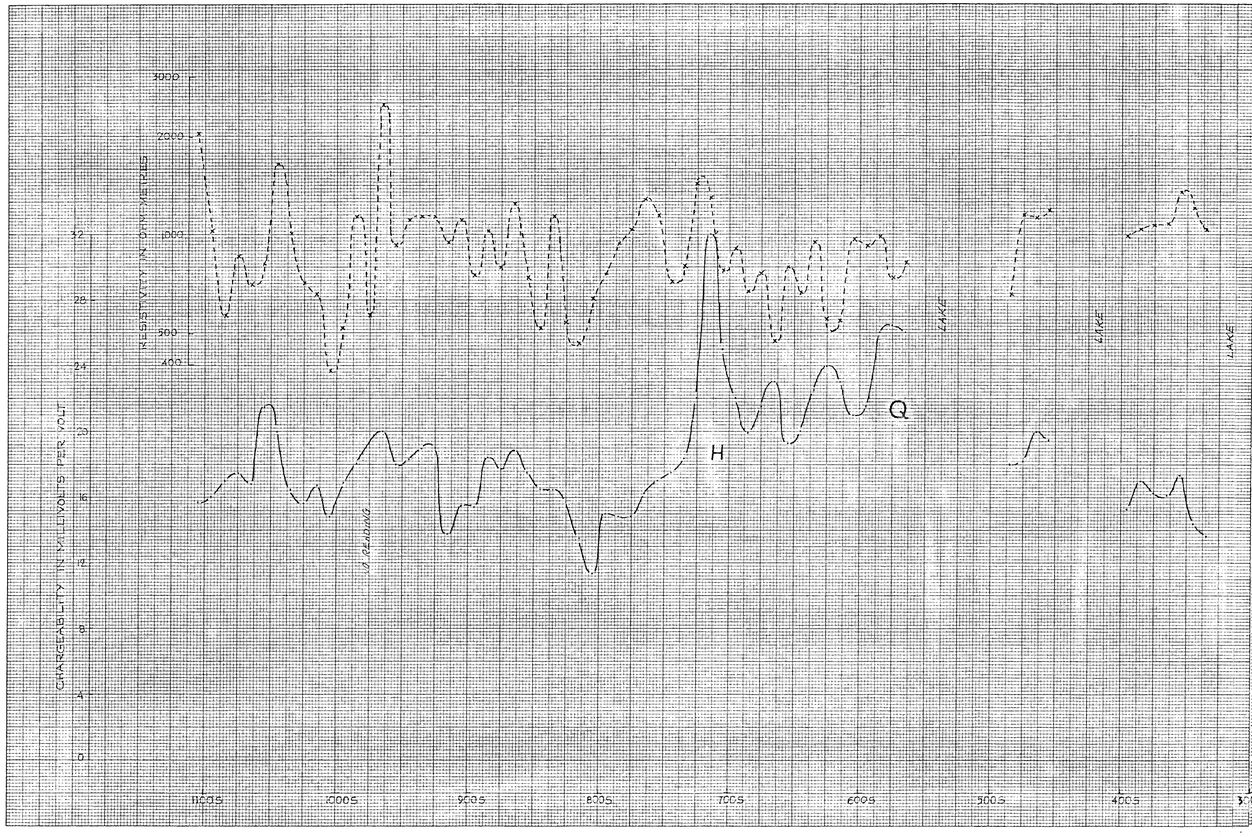
1000S 900S 800S 700S 600S 500S 400S 300S 200S 100S 0 100N 200N 300N 400N 500N 600N 700N

5 cm

051

256053

47 1517



052

256054

LINE 5E

Federation Area

GRADIENT ARRAY E.T.P.

TAS-052

5 cm

47 1517

KODAK TRI-X PAN 2415 CENTIMETER 25 X 38 CM.

053

256055

47 1517

K&E MADE IN U.S.A. 10 X 10 TO THE CENTIMETER • 25 X 38 CM.

LINE 6E

Federation Area

GRADIENT ARRAY E.I.P.

A5-052

CHARGEABILITY IN MILLIVOLTS PER VOLT

RESISTIVITY IN OHM-METRES

LAKE

LAKE

CREEK

CREEK

E

F

G

1100S 1000S 900S 800S 700S 600S 500S 400S 300S 200S 100S 00 100N 200N 300N 400N 500N

5 cm

054

256056

47 1517

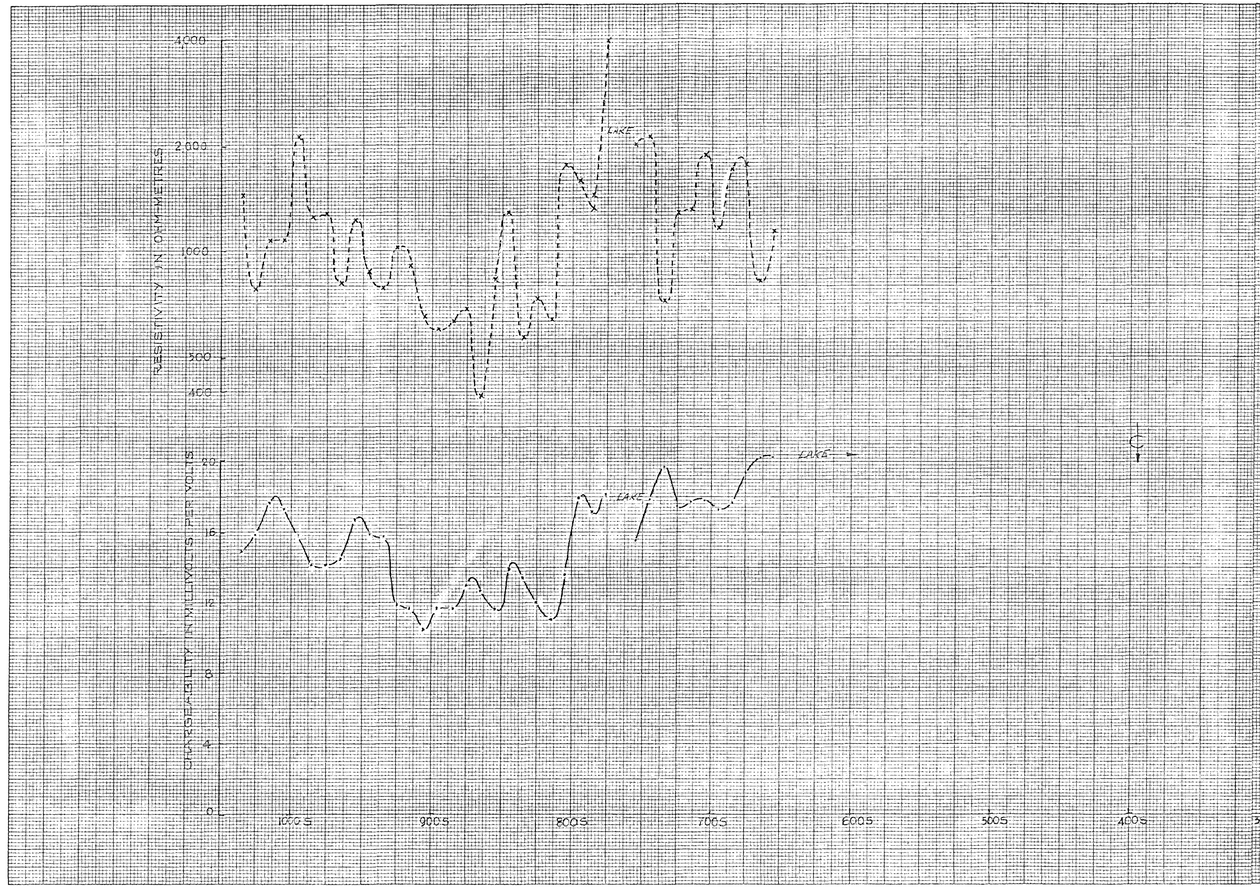
10 X 10 TO THE CENTIMETER • 25 X 38 CM
KEUFFEL & ESSER CO. MADE IN U.S.A.

LINE 7E

Federation Area

GRADIENT ARRAY E.M.P.

TAS-052



5 cm

055

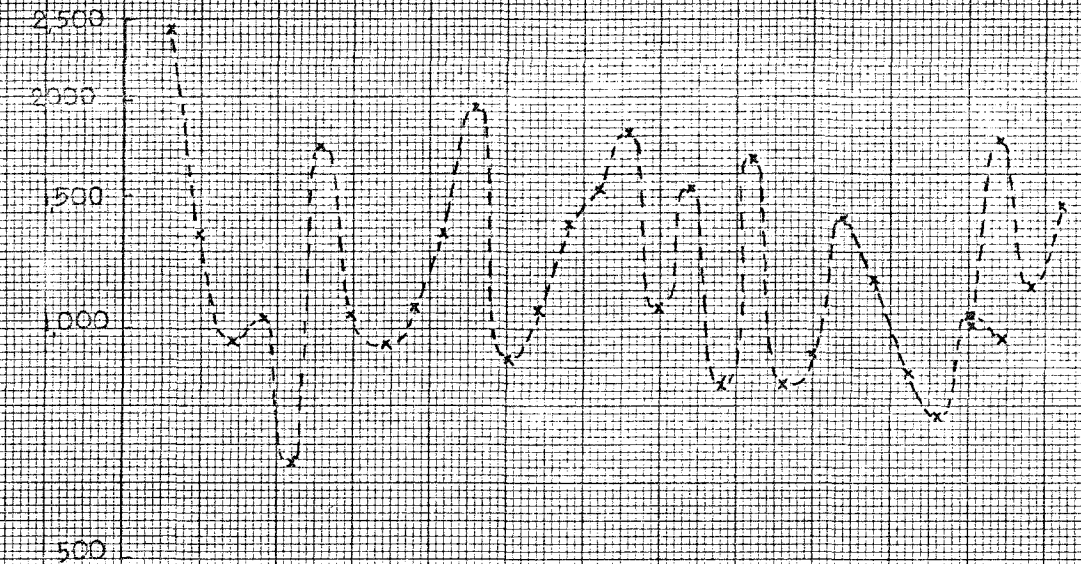
256057

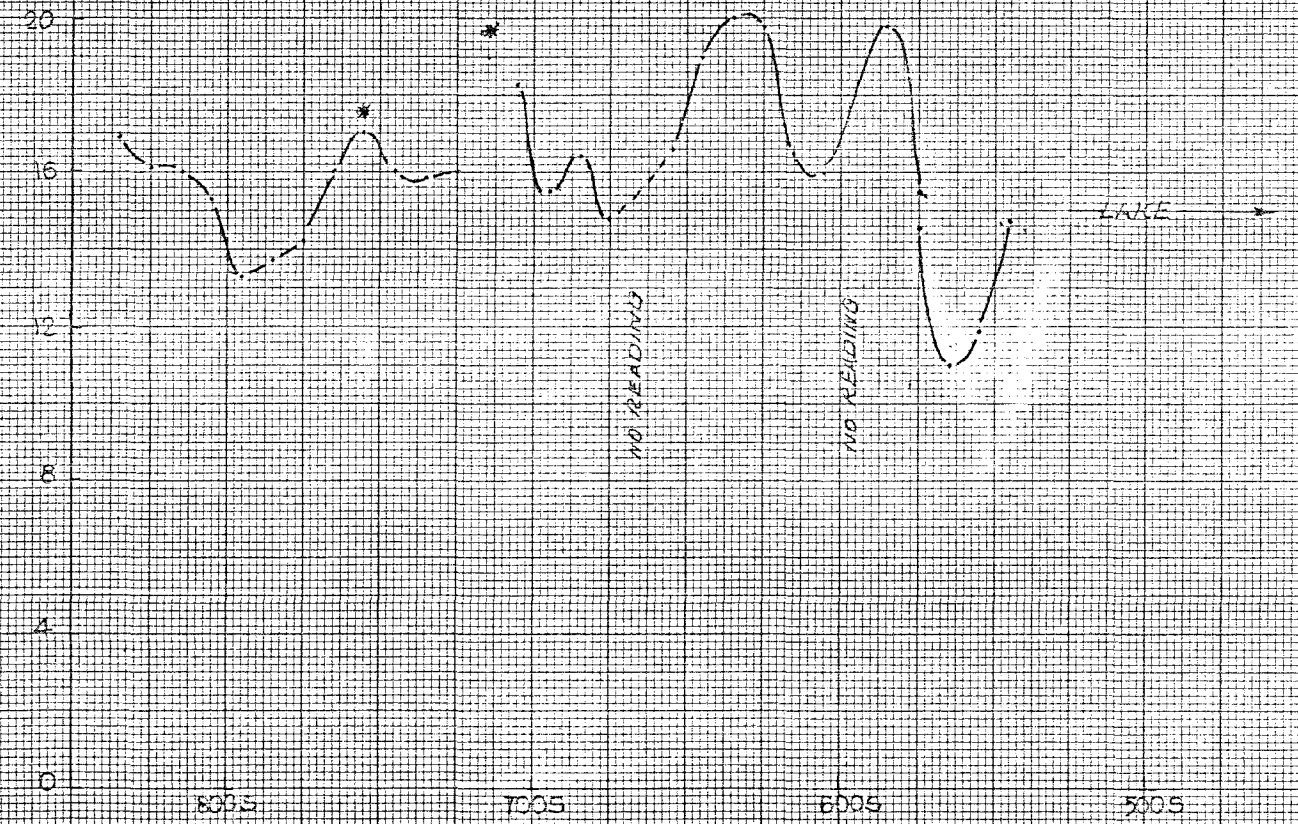
LINE 8E

Federation Area

GRADIENT ARRAY EIP

TAS-052





5 cm

47 1517

10 X 10 TO THE CENTIMETER • 25 X 38 CM.
KEUFFEL & ESSER CO. MADE IN U.S.A.

256058

LINE 9E

Federation Area

GRADIENT ARRAY EIP

TAS 052

5 cm

10 X 10 TO THE CENTIMETER • 25 X 38 CM.
KEUFFEL & ESSER CO. MADE IN U.S.A.
47 1517

057

256059

LINE 10E

Federation Area

GRADIENT ARRAY EIP

TAS-052

5 cm

47 1517

10 X 10 TO THE CENTIMETER • 25 X 38 CM.
KEUFFEL & ESSER CO. MADE IN U.S.A.

256060

053

LINE 11E

Federation Area

GRADIENT ARRAY E1P

TAS-052

5 cm

47 1517

K&E 10 X 10 TO THE CENTIMETER • 25 X 38 CM. KEUFFEL & ESSER CO. MADE IN U.S.A.

059

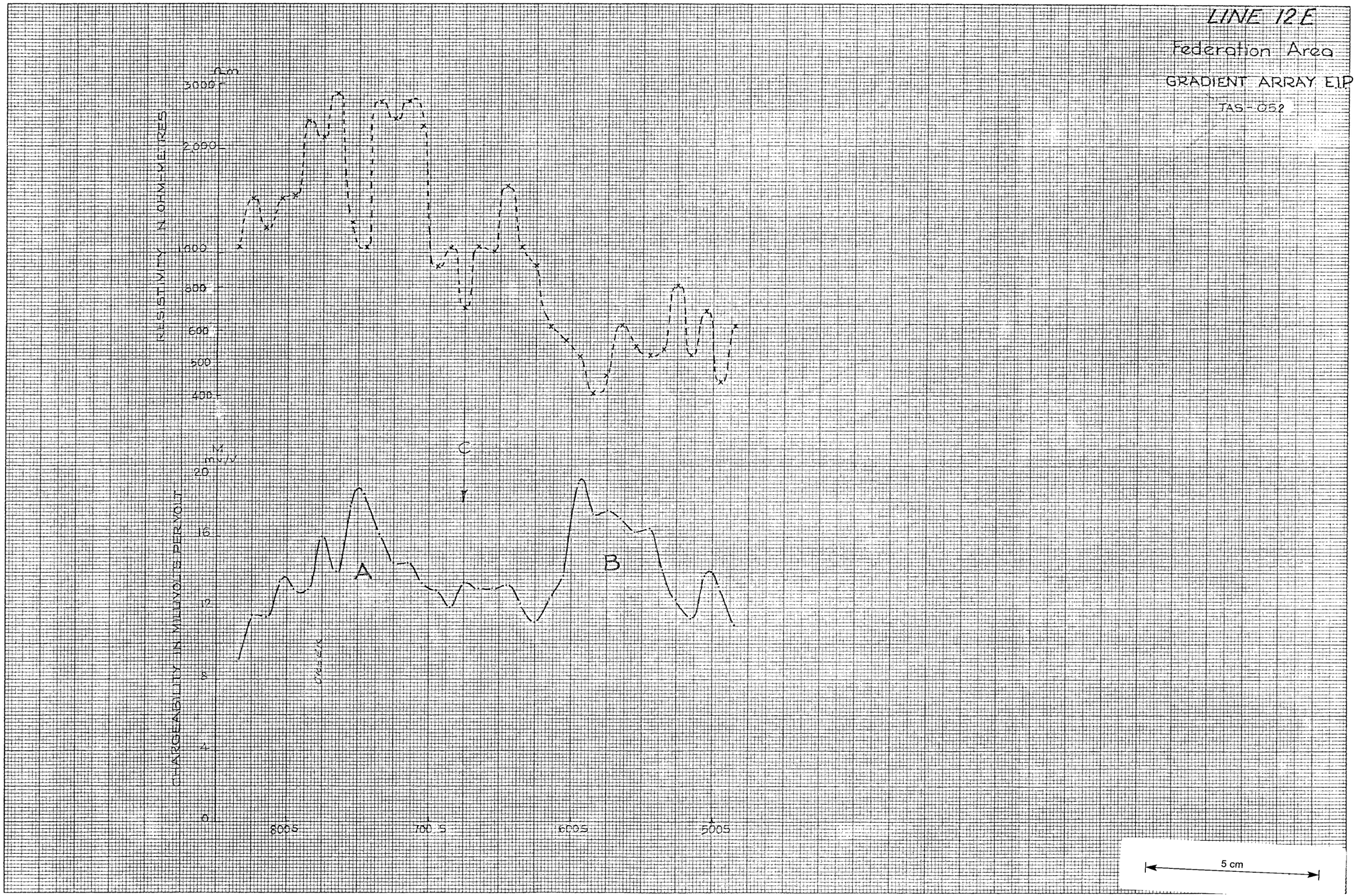
256061

LINE 12E

Federation Area

GRADIENT ARRAY E.I.P

TAS-052



47 1517

KE 10 X 10 TO THE CENTIMETER • 25 X 38 CM.
KEUFFEL & ESSER CO. MADE IN U.S.A.

Line 9W
Line 8W
Line 7W
Line 6W
Line 5.5W
Line 5W
Line 4.5W
Line 4W
Line 3W
Line 2.5W
Line 2W
Line 1W
Line 00
Line 1E
Line 2E
Line 3E
Line 4E
Line 5E
Line 6E
Line 7E
Line 8E
Line 9E
Line 10E
Line 11E
Line 12E

Baseline

5000 N

5000 S

Sub-base Line 8400 S

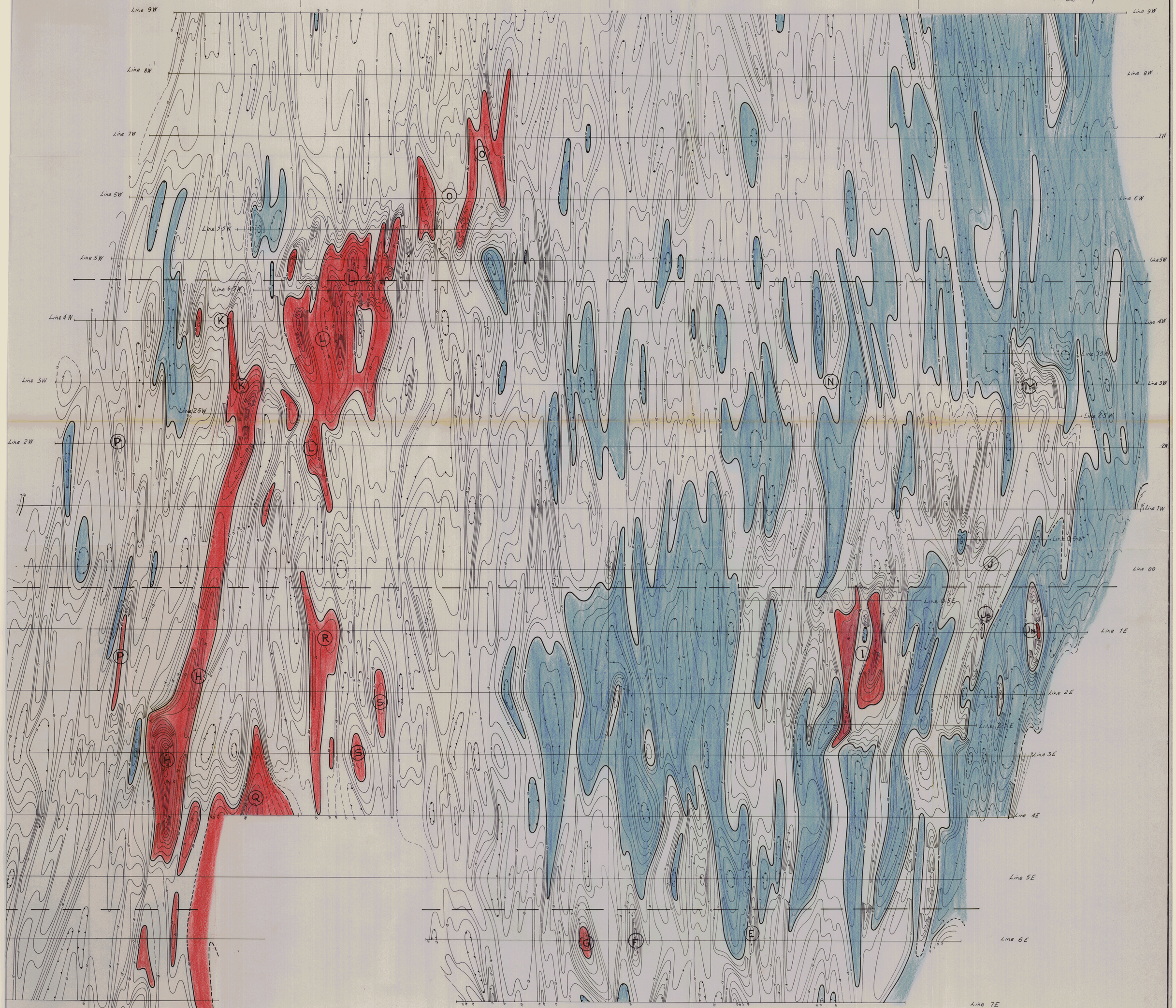
5 cm

W
S
N
E

Gradient Block Boundary shown thus:- — — — —

Significant Zone of Induced Polarization (Q)

1214



Gradient Block Boundary shown thus :- — — — —

Significant Zone of Induced Polarization (Q)

RENISON LIMITED

FEDERATION GRID

NEAR ZEEHAN - TASMANIA

GRADIENT ARRAY
ELECTRICAL INDUCED POLARIZATION

CHARGEABILITY CONTOUR PLAN

SURVEYED & COMPILED BY
SCINTREX
NOVEMBER - DECEMBER, 1977

5 cm
SCALE 1:2000 metres

Job. Nº TAS-052 Sht 1 of 1 PLATE 1.

78-1270 1214

Line 9W

Line 8W

Line 7W

Line 6W

Line 5·5W

Line 5W

Line 4·5W

Line 4W

Line 3W

Line 2·5W

Line 2W

Line 1W

Line 00

Line 1E

Line 2E

Line 3E

Line 4E

Line 6E

Line 7E

Line 8E

Line 9E

Line 10E

Line 11E

Line 12E

Sub base Line 8 to S

5 cm

Gradient Block Boundary shown thus :-

Significant Change in Resistivity Level

1215

Line 9W
Line 8W
Line 7W
Line 6W
Line 5W
Line 4W
Line 3W
Line 2W
Line 1W
Line 0
Line 1E
Line 2E
Line 3E
Line 4E
Line 5E
Line 6E
Line 7E
Line 8E
Line 9E
Line 10E
Line 11E
Line 12E

Line 5·5W
Line 4·5W
Line 2·5W
Line 3·5W
Line 0·5W
Line 0·5E
Line 2·5E

Sub base Line 840 S

5 cm

Gradient Block Boundary shown thus:- — — — —
Significant Change in Resistivity Level

RENISON LIMITED

FEDERATION GRID

NEAR ZEEHAN - TASMANIA

GRADIENT ARRAY
ELECTRICAL INDUCED POLARIZATION

RESISTIVITY CONTOUR PLAN

SURVEYED & COMPILED BY
SCINTREX

NOVEMBER - DECEMBER 1977

5 cm

SCALE 1:2000 metres

256063

Job. N° TAS-052 Sht. 1 of 1 PLATE 2.

78-1270 . 1215.