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A REPORT ON

AN ELECTRICAL INDUCED POLARIZATION POLE-DIPOLE SURVEY

OVER THE EAST HEEMSKIRK GRID

NEAR ZEEHAN, WEST COAST TASMANIA

ON BEHALF OF

RENISON LIMITED

VOLUME I

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PRIVATE AND CONFIDENTIAL

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NEAR ZEEHAN, WEST COAST TASMANIA
ON BEHALF OF
RENISON LIMITED

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SYDNEY, N.S.W.

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SUMMARY

A pole-dipole induced polarization survey executed over the 12 lines of the East Heemskirk grid has delineated a series of single and multiple chargeable zones. For the most part these are considered to be due to disseminated sources within host rocks which either are less resistive than, or show no resistive contrast with the enclosing rocks types.

There is only limited interline correlation, which infers either "dislocation" between lines or more likely, facies change along strike. It is concluded that the area would be more effectively surveyed using a gradient array in spite of the substantial interline spacing of 400 metres.

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INTRODUCTION

At the request of Mr. L.A. Newnham, Chief Geologist for Renison Limited, Scintrex Pty. Ltd. executed electrical induced polarization surveys over the East Heemskirk grid, Trial Harbour Road, near Zeehan Tasmania on 21 double operator days, between the 4th and 31st January, 1978. The field party was variously under Mr. G. Street BSc., and Mr. R. Lindberg with Mr. R.A. Bennett assisting during the latter part of the survey.

On site geological direction and supervision was carried out by Mr. P. Stevenson while the Author provided such geophysical direction as was required.

The grid consisted of some 12 lines 400 metres apart, in total, about 16 kilometres of line. The method chosen was pole-dipole at n = 1 to 4 with an a spacing of 25 metres, using two operators reading on line. In all some 2560 data points were recorded using Scintrex IPR-8 receivers with three decay slices.

METHOD

Some brief comments on the method will assist in understanding the nature of the data acquired and its interpretation principles.

Figure 1 shows in diagrammatic form the acquisition of the resistivity data with a pole-dipole array. C_1 injects current into the ground, the second electrode C_2 being at an effectively infinite distance. The current moves out as shown by the solid arrows. The potential electrode pairs, P_1P_2, P_2P_3, P_3P_4 and P_4P_5 tap off volumes of rock being the volume contained between two hemispheres between the potential electrodes. As can be seen, the larger n values will sample a greater volume of material to depth. The resistivity measured is the resistivity of the volume of material *between* the two potential electrodes but is *biased by* the current electrode. The resultant data is plotted midway between the current electrode C_1, and the closest potential to the electrode. As each potential dipole and current dipole pass over a resistivity feature or chargeable sequence, a response will occur for $n \times a$ values greater than the depth to source. This will produce a "double peak" anomaly as shown in Figure 2. A similar situation will arise for chargeability.

Figure 2 shows the anomaly forms for a single source at various ratios of spacing to depth α, where $\alpha = a$ (array spacing) divided by d (the depth to source). Note that when the depth is equal to or less than the spacing, a single peak occurs, while for spacings larger than the depth, double peaks will occur. (In the case of

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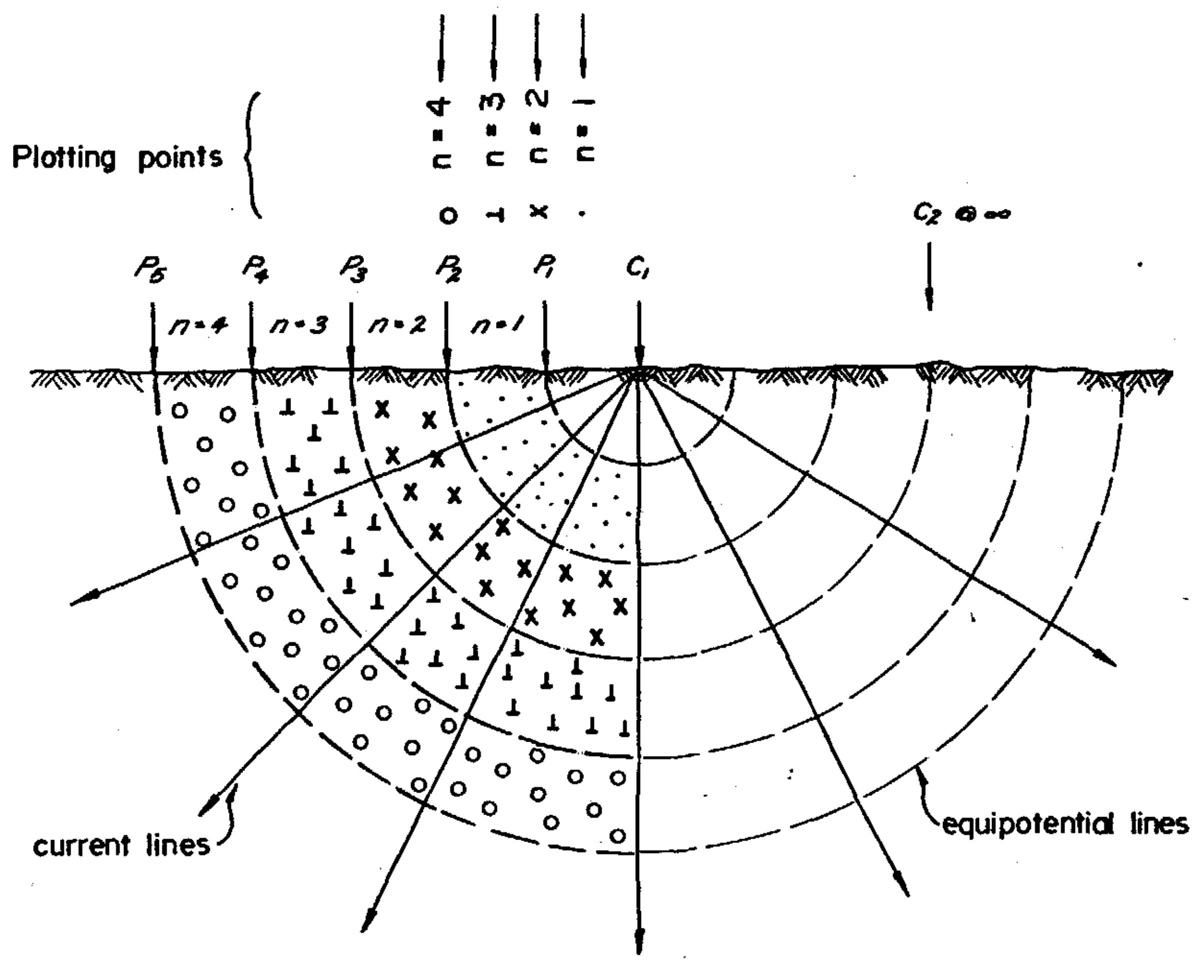
EQUIPOTENTIAL DIAGRAM

POLE-DIPOLE ARRAY



SCALE, 1"=200 ft.

5 cm

FIGURE 1

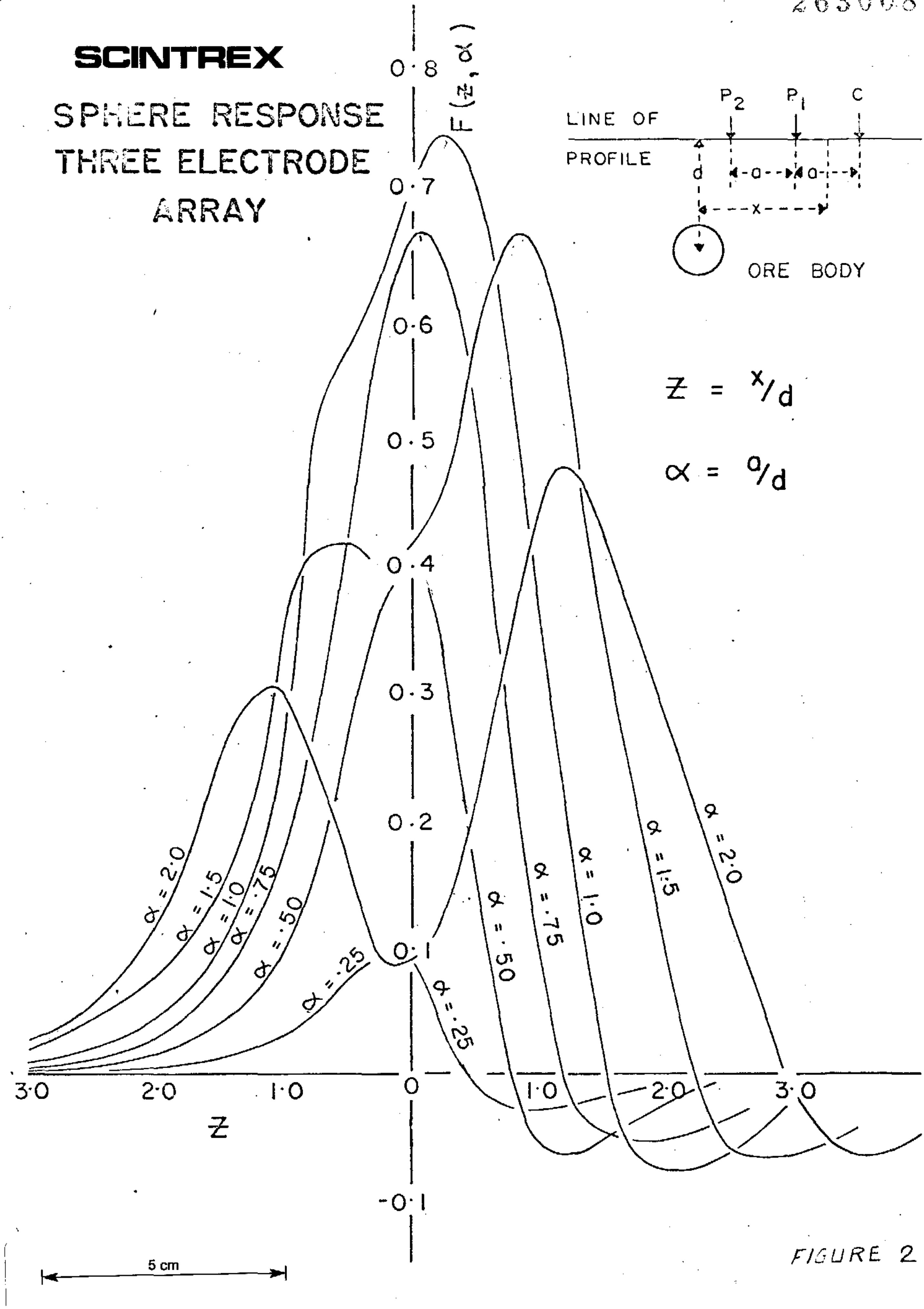

SCINTREX
SPHERE RESPONSE
THREE ELECTRODE
ARRAY
F (z, α)
0·8
0·7
0·6
0·5
0·4
0·3
0·2
0·1
0
-0·1
3·0
2·0
1·0
1·0
2·0
3·0
Z
α = 2·0
α = 1·5
α = 1·0
α = ·75
α = ·50
α = ·25
LINE OF
PROFILE
P2
P1
C
d
a
a
x
ORE BODY
Z = x/d
α = a/d
5 cm

FIGURE 2

pole-dipole, *a* in the diagram is equal to *n* × *a*).

When a single isolated source is located, the position and depth to source can be accurately located, however for multiple sources within the resolution of the array, multiple "double peaks" will occur which can make the interpretation of individual sources difficult or impossible. This occurs on almost all lines in the present survey.

The gradient array is superior in isolating individual events as the *resolution* of the array is determined by the potential dipole, while the depth of penetration is determined by the *distance between* C_1 *and* C_2 which is always large. With pole-dipole this is also so, but depth of penetration always results in a lesser resolution.

EQUIPMENT

The ground was energised by a Scintrex 2.5 kilowatt time domain transmitter powered by an 8HP Briggs & Stratton generator. The resultant primary (resistivity) and secondary (chargeability) fields were investigated using two Scintrex IPR-8 receivers reading three slices under the decay curve.

DATA PRESENTATION

As requested, the data has been drafted onto the Renison standard sheets at the horizontal scale of 1:2500 and vertical scales of 1 centimetre = 4 millivolts/volt for chargeability and a 5 centimetre log scale for the resistivity and expressed in ohm-metres.

DISCUSSION OF RESULTS

Each of the anomalies on each line is discussed separately and correlation between adjacent lines suggested. Where relevant, the decay forms are mentioned, and the magnetic field data commented on.

At this stage the data does not warrant a contour interpretation as it is dependent on depth of overburden/oxidation.

LINE 5000N ...... A significant chargeability anomaly of some 75 millivolts/volt was recorded at about 2340E which also shows a significant depression in the resistivity data of 75% to 350 ohm-metres on the $n = 1$ spacing. The maximum depth to source is estimated to be less than 20 to 25 metres.

Between about 1700E and 2300E, background resistivities remain at ± 30% of about 1000 ohm-metres on all four electrode spacings. However, the chargeability data shows a significant increase in background from 16 millivolts/volt on the $n = 1$ spacing to 28 millivolts/volt on the $n = 4$ spacing. This indicates a variable depth of alluvium cover having a bulk chargeability of the order of 12 millivolts/volt and a depth less than the potential dipole employed, namely 25 metres.

Within these steady conditions, a small but perhaps significant chargeability anomaly was located at about 1920E, the maximum depth of which is about 25 to 40 metres. The anomaly is more significant on the greater spacings. The decay form indicated is *fast*, inferring either a fine grained source or an inefficient chargeable source such as magnetite. As significant increases in magnetic field were noted between 1900E and 2000E, magnetite is considered the source. The host rock is less resistive to weathering, at least near surface, as evidenced by the n = 1 resistivity of 1600 ohm-metres as against n = 4 resistivity of 400 ohm-metres.

A significant resistivity low was noted at about 1620E of about 50 ohm-metres (on all spacings) as against resistivities 7 to 10 times as great 50 to 75 metres to both east and west. This response is accompanied by 70 millivolts/volt induced polarization, and the maximum depth is less than 20 metres. A slightly slower than normal decay form infers a coarse grain size to the causative material, while higher than normal magnetic fields were noted at 1650E. The source is conductive chargeable material of coarse grain size containing magnetite or pyrrhotite. The latter would fit the observed geophysical characteristics.

A further broad resistivity low of less than 100 ohm-metres was noted at 1420E on all four spacings and this is accompanied by 66 millivolts/volt chargeabilities on the n = 1 spacing and much reduced values on other spacings. A second smaller maximum of 64 millivolts/volt was noted at 1460E, also within the broad resistivity low. The sources are considered to be less than the 25 metres dipole deep, and relatively narrow, as n = 2 to 4 values show much reduced responses.

The variable nature of the chargeability data infers interference from multiple narrow sources over these anomalies.

West of about 1400E the resistivity increases dramatically to 1000± ohm-metres on the *n* = 4 spacing, and on all spacings west of 1300E. Between 1400E and 1300E increasing relatively conductive cover is probably present. West of 1400E the bedrock must outcrop or be under shallow cover. The background chargeability falls west of 1300E. Both these characteristics are considered to be typical of granites which are interpreted to subcrop west of 1300E.

LINE 4600N ...... A substantial 76 millivolts/volt induced polarization response was recorded on *n* = 1 at 2412E (with correspondingly large values for *n* = 2 to 4). This is accompanied by a massive 85% reduction in apparent resistivity to 100 ohm-metres. The decay form is *fast*, and therefore either a fine grained source and/or an inefficient chargeable source such as magnetite is the source. The maximum depth is less than the dipole (25 metres) used. This anomaly corresponds to a similar response on line 5000N at 2340E.

A 40 millivolts/volt response was recorded at about 2340E whose maximum depth is less than 20 metres. Lower resistivities again infer a somewhat less resistive host to the mineralisation. The larger spacings show higher chargeabilities, which infer the chargeable source increases in importance with depth. Significant distortions in the magnetic field occur, inferring a contribution of magnetite and/or pyrrhotite to the source. A slightly faster than normal decay form infers the former. This response may correlate with a less significant feature some 40 metres under cover at about 2170E on line 5000N.

An interpretation of the profile form infers a chargeable source at about 1940E. The 60 millivolts/volt chargeabilities on the $n = 1$ are less on subsequent spacings which are displaced to the east, inferring a dip to the source in that direction. As there is no material change in the 600 to 800 ohm-metres resistivities, a disseminated chargeable source at less than 20 metres depth is the interpreted source.

Increasingly significant chargeability responses of 36 millivolts/volt, 44 millivolts/volt, 56 millivolts/volt and 61 millivolts/volt were noted at about 1780E and to the east. The source is considered to have a maximum depth of 25 to 50 metres, and increases in importance with depth. Generally lower than background resistivities of 200 ohm-metres were recorded over this zone. Disseminated chargeable material within a broad less resistive host, or weakly interconnected chargeable material, is the interpreted source. This anomaly is considered to be related to a significant response of 72 millivolts/volt recorded at 1620E on line 5000N.

A broad zone of higher than background chargeability was recorded centred at about 1520E. The width of the zone may be as great as 50 metres while the maximum depth indicated is about 25 metres or so. At depth, resistivities increase, inferring a near surface conductive zone. The source is considered to be disseminated sulphides and/or graphite within a less resistive host rock.

Higher apparent resistivities (1000+ ohm-metres) were recorded between about 1560E and 1660E, and also west of about 1450E. Over these zones the chargeability reaches a low 16 millivolts/volt background. These zones are probably underlain by granites which have these characteristics.

LINE 4200N ...... East of about 2250E the background chargeability remains a low 12 millivolts/volt while the apparent resistivity is about 400 ohm-metres. The data infers a "thin" surface cover of less resistive and less chargeable material over this unit.

Two major induced polarization sources were defined at about 2150E and 2180E (which may in fact represent edge effects of a solid source between these two anomalies.) Both chargeability maxima are accompanied by extremely low 20 ohm-metres and 40 ohm-metres apparent resistivities against n = 4 backgrounds of 300 to 400 ohm-metres outside this zone. The maximum depth to source is estimated at about 25 to 30 metres. Normal decay forms were recorded in both cases. Significant distortions in the magnetic field over these anomalies infer the presence of pyrrhotite and/or magnetite within the source, although the latter could not alone be the source. This zone *may?* be the correlative of that recorded on line 4600N at 1940E.

A moderate chargeability high of 30 millivolts/volt on n = 1 was recorded at 1980E with an indication of a double peak on *n* = 2. *n* = 1 resistivities are high, but significantly the *higher* spacings give *lower* apparent resistivities, inferring a more conductive source at depth, with a resistive near surface cover. This zone may be a correlative of that seen at 1825E on line 4600N.

Between about 1550E and 1850E apparent resistivities remain a relatively low 100 ohm-metres ±50% while background chargeabilities remain a low 12 ±4 millivolts/volt. The underlying rock type must be low in mafic minerals and be relatively conductive. Sandstones and shales *could* fit these characteristics.

A significant chargeability anomaly of 37 millivolts/volt at 1580E and also at 1640E of 26 millivolts/volt may represent either individual sources or a solid source between the two. The more substantial 37 millivolts/volt response is associated with a 70 ohm-metres low, flanked to the west by a substantial rise to 8000 ohm-metres. The source is interpreted as sulphides, either interconnected or within a less resistive host on the eastern contact of a granite whose contact is as 1560E ± 10 metres. The maximum depth to source is 25 metres.

West of about 1560E ±10 metres, apparent resistivity rises to reach over 6000 ohm-metres between 1550E and 1400E. Lower 16 ±2 millivolts/volt chargeability background indicates the presence of granite.

LINE 3800N ...... This line shows similar features to those recorded on line 4200N. However, the events are further apart along the line, and show material changes in relative amplitude, indicating significant along strike changes.

An *n* = 1 16 millivolts/volt above 20 millivolts/volt background response was recorded at about 2325E coincident with a material 80% fall in apparent resistivity to 50 ohm-metres. The *n* = 2 value shows a double peak effect and is much greater in amplitude for chargeability but shows lower apparent resistivities of 25 ohm-metres. The interpretation of this zone is of moderately interconnected chargeable material within a less resistive host rock whose maximum depth to source is about 25 metres at 2325E. The decay form is normal, inferring average grain size to the source, while significant distortions in the total magnetic field infer magnetite and/or pyrrhotite to contribute to the source. Magnetite would be required to account for the amplitude of the magnetic field distortion.

A more significant 40 millivolts/volt above background (16 millivolts/volt) response was recorded from a source whose width is greater than the 25 metres potential dipole at about 2240E. The *n* = 2 spacing shows a double peak but is smaller in amplitude which infers a reduced importance with depth. The 95% fall in *n* = 4 resistivity to 15 ohm-metres infers massive conduction within the source which is considered to be at a depth of 25 metres. Slow decay forms infer a slightly coarser than normal grain size within the source. Substantial magnetic field distortions to 5000 gamma infer magnetite to be present, however it alone could not be responsible for the chargeability observed, for that, sulphides, graphite or serpentinite would be required.

The two anomalies described above at 2325E and 2240E are probably along strike correlatives of the substantial anomalies recorded at 2180E and 2150E on line 4200N.

Within generally low apparent resistivities ranging between 80 and 300 ohm-metres, and low background chargeabilities of 16 ± 4 millivolts/volt, east of 1550E, a number of discrete resistivity maxima of over 1000 ohm-metres were noted at 1850E and 1950E which at depth show slightly higher chargeability backgrounds. Over the entire zone between 1500E and 2200E, higher chargeabilities on the higher *n* values infer a less chargeable alluvium cover less than 20 metres deep.

A substantial increase in resistivity was recorded from about 1700E from 50 to 100 ohm-metres to 7000 to 10,000 ohm-metres between 1150E and 1300E. The gradual nature of this increase infers a systematic change in physical characteristics.

Within the above zone, two substantial chargeability responses were noted at about 1360E and 1425E of 40 to 45 millivolts/volt above the 12 millivolts/volt background. If anything, the resistivity is slightly *larger* on the higher spacings. The sources therefore consist of disseminated chargeable material within a 2000 ohm-metres resistive host. The sources also contain magnetite as significant increases in magnetic field were noted coincident with the chargeability maxima. However, magnetite *alone* is not considered the source. Slower than normal decay forms also infer a predominantly sulphide source. The maximum depth to source is about 20 to 30 metres. The dip of the source *may* be to the east. These anomalies could be related to 1580E and 1640E observed on line 4200N.

West of 1300E chargeabilities fall dramatically to background of about 12 millivolts/volt while resistivities remain between 3000 to 10,000 ohm-metres. These values are typical of granites, while the chargeability anomalies interpreted as being due to disseminated sulphides and magnetite at 1425E and 1360E, probably represent a "halo" near the edge of the granite, a feature recorded elsewhere.

LINE 3400N ...... A marked change in both chargeability and apparent resistivity data profiles is evident between lines 3400N and 3800N, which infers much changed geology between lines. The gradual rise in apparent resistivities to 10,000 ohm-metres on the western flank of line 3800N is not seen on this line. This infers that either the resistive (granite) section terminates between lines, or is deeply buried (150+ metres) below the line, as no sign of higher resistivities is seen on the larger *n* values. A further possibility is that the granite changes its physical properties across this line, but is dismissed as not possible.

East of 1850E the surface material has significantly lower chargeability of 10 to 12 millivolts/volt and a slightly lower resistivity than the underlying bedrock. The depth of the cover (weathering?) is guesstimated as 15 to 20 metres.

East of 1700E resistivity backgrounds appear to be about 200 to 400 ohm-metres. At 1800E ± 30 metres, an increase to 700 ohm-metres was noted which coincides with a highly significant 60 millivolts/volt induced polarization response at about 1800E. As a material 7000 to 8000 gamma distortion in the total magnetic field was located at this site, the source is considered to contain (but not be wholly caused by) magnetite. Faster than normal decay forms (M_1 = 82 millivolts/volt versus M_5 = 76 millivolts/volt), infer either a fine grained or inefficient source such as magnetite. The maximum depth to source is considered to be less than 30 metres. This zone may correlate with the distinct resistivity high of 2000 to 3000 ohm-metres recorded at 1850E on line 3800N which does not however, have high associated chargeabilities.

The dominant feature on this traverse is a zone of high chargeabilities extending from approximately 1250E to 1630E. The sources are "multiple" within this zone and give an apparent high background of about 52 ±4 millivolts/volt. However, multiple individual sources which the array canot differentiate, could well be the source. Within this background a number of individual maxima were differentiated. At about 1580E an 80 millivolts/volt response was recorded from a source interpreted to be slightly less resistive than the enclosing rocks. "Double peak" anomalies are seen on the *n* = 2 to 4 spacings which show an apparent progressively easterly displacement, which infers an east dip. Maximum depth to source is about 25 metres. The apparent resistivity is of the order of 200 to 300 ohm-metres.

The second significant chargeability maximum was 76 millivolts/volt at 1500E. The source is wide, perhaps 25 to 40 metres, while the maximum depth indicated is again of the order of 25 metres. The associated resistivity appears to be slightly higher than background at 500 ohm-metres, while the magnetic field shows a coincident 4000 gamma increase over this anomaly. The decay form is slightly longer than normal. The source is considered to be disseminated magnetite and sulphides within a host slightly more resistive than background.

The western flank of the high background is marked by a wide (50 +? metres) chargeable zone which reaches 67 millivolts/volt at 1320E. The resistivity shows no major change over this zone, while a slightly higher magnetic field of up to 2500 gamma was recorded at *about* 1300E. The source is interpreted as sulphides and magnetite within a host which shows little resistive contrast with the enclosing material.

LINE 3000N ...... The resistivity on this line can be related to line 3400N. The main features are two major changes in apparent resistivity. The most easterly occurs at 1580E with resistivities to the east being as high as 7000 to 9000 ohm-metres at 1650E, and 400 ohm-metres immediately west of the contact. This *may?* be related to a much lower amplitude change at about 1770E on line 3400N.

The second feature is a similar proportional change at about 1130E with resistivity being 1500 ohm-metres immediately to the east of the contact and as low as 20 ohm-metres immediately to the west of the contact. This "contact" may also be related to a similar but lesser feature on line 3400N at about 1150E.

Both the above resistivity features represent rock type changes.

Deeper alluvial cover as indicated by lower $n = 1$ resistivities was recorded between about 1300E to 1570E. At about 1470E a 30 metres cover is estimated, while between 1575E and 1725E outcrop (or sub-crop) is expected.

There are no significant chargeability anomalies east of about 1150E. Between 1025E and 1130E a substantial chargeability anomaly of 40 millivolts/volt above the 16 millivolts/volt background was recorded. This is interpreted as a "wide" (25 metres) source centred at 1060E, whose maximum depth is less than 25 metres. This zone appears to be of greater chargeability with depth and the interpreted easterly displacement of the "double peak" anomaly infers an east dip. The depression in the apparent resistivity data at this point to as low as 20 ohm-metres, infers conduction within the source. The decay form is slower than normal, while the magnetic field shows a 6000 gamma distortion at this point. The source is considered to be magnetite/pyrrhotite and sulphides, either interconnected or within a conductive host rock.

A 40 millivolts/volt chargeability response at 860E was superimposed on a 30 millivolts/volt background. The source is interpreted as being about 25 metres deep and slightly less resistive than the enclosing rocks. The source is probably "wide".

An *n* = 1 "double peak" anomaly is inferred centred at 680E. A westerly dip to the source is inferred. The background resistivities are about 300 ± ohm-metres and no distortion in them was noted. Thus the source is considered to be disseminated chargeable material at a depth of 20 metres or less.

LINE 2600N ...... East of 1450E the chargeability background remains at about 14 ±4 millivolts/volt to the end of the line at 2100E. The larger effective spacings show higher resistivities and higher chargeabilities indicating a surface material of lesser resistivity and chargeability than the bedrock beneath.

East of 1800E apparent resistivities within the bedrock were of the order of 600 to 1000 ohm-metres and at about 1875E and 2000E a thicker conductive, lower chargeability cover/oxidation to 25+ metres is inferred.

The most easterly induced polarization anomaly was recorded between 1275E and 1400E. The source is centred at about 1325E and is wide (≈ 40 metres?). A series of "double peak" anomalies infer a 25± metres depth to source and perhaps an east dip. The apparent resistivity over the zone remains a relatively high 1000 ohm-metres, while the magnetic field shows sharp 5000-6000 gamma and 3000+ gamma maxima at 1375E and 1325E respectively. The sources therefore must contain magnetite *and* sulphides in disseminated or electrically discontinuous form.

Between about 600E and 1275E the background chargeability is about 28 millivolts/volt on the *n* = 4 spacing, but only about 16 millivolts/volt on the *n* = 1 spacing. The apparent resistivity is about 300 to 700 ohm-metres at *n* = 4, while at *n* = 1 it averages about 300 ohm-metres. This infers a cover which is more conductive (to 200 ohm-metres) and less chargeable (to 12 millivolts/volt) varying about the 22± metres depth (assuming a simple two layer case).

Within the above zone a chargeability anomaly was defined whose source is interpreted to be at about 775E. The apparent resistivity showed a fall of 60% to 100 ohm-metres which infers a less resistive host to the causative sulphides/graphite. The maximum depth is estimated at 25 metres, while a small 200 gamma "dipole" type distortion in the magnetic field *may* indicate the presence of minor magnetite or pyrrhotite within the source.

A chargeability response to 40 millivolts/volt was recorded between 480E and 610E with two maxima at about 520E and 570E. This is interpreted as a "double peak" anomaly whose source is at 540E, and whose width is about 40 metres. The apparent resistivity decreases to a significant 35 ohm-metres over the source compared to 600± ohm-metres either side. The magnetic field shows a 7000 gamma increase at and to the immediate east of the interpreted source. The decay form is very slightly slower than normal. The source is interpreted as magnetite and sulphides (or serpentinites) interconnected, or if not, within a host rock which is less resistive than the enclosing rocks.

The most westerly feature observed was a single peak of 40 millivolts/volt on the n = 2 spacing at 450E, which on n = 3 and n = 4 have inferred double peaks. Thus the depth to source is between 25 and 50 metres. The resistivity remains a high 800 to 1000 ohm-metres, however, the magnetic field shows a distortion at, or to the east of this point. The source is interpreted as being disseminated magnetite and sulphides within a resistive host.

LINE 2200N ...... The general form of both the apparent resistivity data and chargeability data is similar to line 2600N and infers a continuity along strike.

A broad zone of higher chargeabilities was recorded between about 1250E and 1600E which *may* correlate with a less prominent zone on line 2600N between about 1125E and 1500E. Four separate chargeability maxima were recorded within the zone which are considered significant, and the "interference pattern" between them for larger n values, may well be responsible for the "higher background" observed over the whole zone.

At 1615E a 20 millivolts/volt response was recorded from 600 to 1000 ohm-metres material. The depth to source is considered to be less than 25 metres. A significant 7000 gamma magnetic field increase was logged just west of the interpreted source. The source is considered to be disseminated sulphides/magnetite within a host showing no appreciable resistivity contrast with the enclosing rocks.

The second 30 millivolts/volt above background response was centred at 1540E and lies immediately to the east of a 4000 ohm-metres resistivity unit which separates this anomaly from one at 1450E (see below). The apparent resistivity within the source could be as low as 300 ohm-metres. A substantial *decrease* in magnetic field of 8000 gamma lies in close proximity to this source ("noise" or "remnant magnetism"?) The source is considered to be disseminated or weakly interconnected magnetite and/or sulphides within a host less resistive than the enclosing rocks. The maximum depth is 30 metres.

At 1450E a significant induced polarization response of about 50 millivolts/volt above background on n = 1 and 2 was recorded just west of a 4000 ohm-metres resistive unit. The 80% fall in coincidental apparent resistivity to 250 ohm-metres infers the host to the chargeable sources to be less resistive than the enclosing rocks. The maximum depth appears to be 25 to 30 metres.

The last source appears to be either a broad single unit between about 1260E and 1340E, or two separate "wide" zones at these points.

The maximum depth to source on the western margin looks to be about 25 metres, however, on the eastern margin (or source) the depth appears to be greater at 40 to 50 metres. As the resistivities remain a high 500 to 700 ohm-metres, the source to the chargeability is considered to be disseminated in nature. A distinct magnetic field maxima of about 2500 gamma at 1320E infers magnetite within the eastern portion of the source.

The next group of significant chargeability responses was recorded between 825E and 980E. The most easterly zone was a broad 28 to 30 millivolts/volt response above background centred at 950E. The source is interpreted to be disseminated chargeable material, probably sulphides, within a resistive (700± ohm-metres) source.

The most substantial response on this line was recorded at 860E and is 60 millivolts/volt above the 20 millivolt/volt background. The decay form is slightly slower than normal. The apparent resistivity shows a decline to 300 to 400 ohm-metres, while the magnetic field shows a 5000 gamma increase. The source therefore is considered to be coarse grained magnetite, or sulphides, within a host just a little less resistive than the enclosing rocks. The maximum depth to source is less than 25 metres deep.

The most westerly chargeability anomaly was recorded between 480E and 680E and consists of multiple sources at 500E?, 550E? and certainly at 650E. The resultant interference pattern between them is difficult, if not impossible, to uniquely resolve.

The two chargeability maxima of 68 millivolts/volt at 615E and 52 millivolts/volt at 660E represent either two separate "wide" sources or a single source between the two. The resistivity shows a marked decline to 30 ohm-metres from 1000 ohm-metres to the immediate east and west, while the magnetic field shows some distortion. The source therefore is sulphides and/or graphite with some magnetite. The conduction is probably due to interconnection of the sulphides/ graphite, but may, although less likely, be due to the host rock. A maximum depth to source of 20 metres or less is estimated.

LINE 1800N ...... The chargeability on this line shows a general correlation with that seen on line 2200N, but there are material changes in characteristics along strike.

Between 1200E and 1475E, a series of chargeable sources were recorded which probably correlate with a similar series on line 2200N between 1230E and 1650E.

The most easterly significant chargeability anomaly was recorded centred at about 1440E. This 40 millivolts/volt chargeability response occurs within resistive 1000 ohm-metres source rocks. The source is interpreted to be disseminated sulphides/graphite with some contribution from magnetite, and is at a maximum depth of 25 metres. Two 30 millivolts/volt chargeability responses on the *n* = 1 spacing were recorded at 1340E and 1385E. The multiple nature of the sources is difficult to resolve, but each is considered to be due to a *separate* source at *about* that co-ordinate, rather than a single source *between* the two maxima. The source has a maximum depth of the order of 25 metres and again a disseminated sulphide/graphite and magnetite source is suggested.

A significant 30 millivolts/volt response centred at 1230E is also considered to have a disseminated source within a resistive 1000 to 2000 ohm-metres host. The maximum depth is about 25 metres, while the width of the source is also judged to be of the order of 20 metres.

Between 1060E and 1130E, centred at 1085E, a 40 to 50 millivolts/volt response was logged from material which shows no significant change in the 1500 ±500 ohm-metres background. The maximum depth to source is 25 metres, while the source itself is considered to be disseminated sulphides (or graphite). This anomaly may relate to a broad low amplitude chargeability (not described) on line 2200N between 1050E and 1150E.

A relatively minor 10 to 20 millivolts/volt anomaly at 760E (under conductive cover) probably relates to more substantial responses recorded on line 2200N at 860E.

A chargeability response interpreted as a double peak at 585E and 630E of 40 and 20 millivolts/volt, has an interpreted source centred at 610E and is interpreted as being due to a "wide" source. This anomaly is very similar to one recorded on line 2200N at 640E, but is more subdued. The source is disseminated sulphides or graphite within a host which shows no contrast with the 400 to 500 ohm-metres background.

LINE 1400N ...... East of 650E the background resistivity is very much higher at 2500 to 7500 ohm-metres than observed on previous lines. The background chargeability is also significantly lower.

A significant chargeability response of 20 millivolts/volt was recorded centred at 1440E. The source is considered to be "wide" (20+ metres) centred at or slightly west of 1435E, and is more significant with depth. The apparent resistivity shows a 70% reduction in background to about 1000 ohm-metres, while the magnetic field over this anomaly is quiet. Thus, the source is interpreted to be disseminated sulphides or graphite within a host less resistive than the enclosing material.

A signficant decrease in apparent resistivity from 3000 to 4000 ohm-metres to less than 250 ohm-metres was recorded between 1160E and 1230E. This feature is accompanied by an increase in chargeability to 30 millivolts/volt (from 12 millivolts/volt $n = 1$, and 20 millivolts/volt $n = 4$). The magnetic field shows a 3000 gamma increase centred at 1200E also. The interpreted source is sulphides and magnetite within a host less resistive than the enclosing material and is at a depth of the order of 20 to 30 metres. To the immediate east and west of this anomaly, a less chargeable and less resistive cover is inferred.

The next significant increase in chargeability was logged between 750E and 840E where chargeability rises to 40 millivolts/volt from 20 millivolts/volt. The associated apparent resistivities are a high 4000 ohm-metres ± while there is no material change in the magnetic field. Therefore the source is attributed to disseminated sulphides (or graphite) at a depth of 25 metres or so.

Between 275E and 675E significantly higher chargeabilities of 50 millivolts/volt were recorded as against inferred backgrounds of 16 to 20 millivolts/volt to the immediate east and west. The apparent resistivities show an apparent *decline* to the 800 to 1000 ohm-metres level, inferring a less resistive unit. Induced polarization maxima at 320E, 468E, 550E and 625E are considered to be variations only within the larger unit. This unit is also characterised by sharp changes to ± 8000 gamma from background in magnetic field. As "Dolerite float" was recorded to the west of this unit, (but not over it) it may in fact be the underlying source, for such characteristics are often seen over dolerites and basalts. The maximum depths to source over the above listed maxima are 25 to 30 metres.

LINE 1200N ...... A substantial and significant 40 millivolts/volt induced polarization response was defined at 1480E on the *n* = 1 spacing, with double peak responses on *n* = 2 to 4. The associated resistivity data shows a 70% decline to about 800 ohm-metres. As there is no material change in the magnetic field, the source must be sulphides (or less likely, graphite) within a host less resistive than the enclosing rocks. The maximum depth to source is 25 metres.

A smaller, but still significant response of 20 millivolts/volt was defined at 1300E from a 1500 ohm-metres host rock. Again the maximum depth is about 25 metres.

On this line a broad zone of increased chargeability was noted between 300E and 700E where the background level rises to 40 millivolts/volt within this higher background unit which is considered to be a rock unit. The magnetic field shows positive and negative variations from background to 4000 gamma. These characteristics are idential to those recorded on line 1400N between 275E and 700E to which they are related. Within this zone a significant increase in chargeability was defined at 560E by a double peak which shows the source to be 15 to 20 metres below that point. This anomaly marks the contact between a rock unit whose resistivity ranges about 500 ohm-metres to the west, and over 10 times more resistive to the east. The unit to the east has low magnetic relief while the western unit has high magnetic relief. The source is disseminated sulphides with *perhaps* minor magnetite.

The most westerly chargeability anomaly was defined at 185E where a 20 millivolts/volt anomaly was noted from within 1000 ohm-metres apparent resistivities. Again, disseminated sulphides at a depth of 20 to 25 metres are the suspected source.

LINE 1000N ...... East of about 950E the chargeability background is at about 24 ±4 millivolts/volt while the resistivity remains at about 2000 ohm-metres for n = 4 and 1000 ohm-metres for n = 1. This area is overlain be a less resistive, less chargeable surface layer which is estimated to be of the order of 30 metres thick, while the intrinsic "bulk" resistivity is considered to be 500 ohm-metres, and the chargebility about 12 to 16 millivolts/volt.

West of 775E the chargeabilities rise significantly from the relatively low 24 millivolts/volt ± level to the east, to 60 millivolts/volt to the west. Within this zone several significant chargeability maxima were recorded which are described below. In addition, the 675E station marks the boundary between relatively quiet magnetic fields to the east, and high relief (to ±3000 gamma) to the west.

The most easterly of the chargeability maxima was recorded centred at 750E where the n = 1 value reaches some 44 millivolts/volt, the n = 2 value reaches 60 millivolts/volt, and the n = 3 shows a double peak effect of 64 millivolts/volt. The depth to source is considered to be about 30 to 50 metres at this point. The resistivity remains a high 1000 to 3000 ohm-metres over the anomaly, inferring a disseminated sulphide (or graphite) source.

A major double peak 70 millivolts/volt response was recorded centred at 640E, again from within 1000 ohm-metres resistivities. The magnetic field shows significant changes to east and west of this zone, inferring the source to be disseminated sulphides and/or graphite carrying some magnetite. The maximum depth to source is 20 metres or less.

The most westerly anomaly of significance was recorded at 550E and is considered to represent a more chargeable and less resistive variant within this rock unit.

SUMMARY OF PHYSICAL PROPERTIES

As the data does not permit a meaningful contour interpretation, a summary of the main features observed has been made on Plate 1 accompanying this report.

Interline correlations have been presented, and due to the "dilution" of properties due to differential overburden (and oxidation??), allowance has been made for these layers when drawing in boundaries.

CONCLUSIONS

1 - A contour interpretation of the data is not presented due to the dilution factor of a variable thickness of cover. The various properties have, however, been compiled on Plate 1. This shows a marked discontinuity along strike between lines 3000N and 3400N. North and south of this boundary, the strike appears discontinuous but north south.

2 - In the northern block (above and including lines 3400N), the chargeability anomalies in the east are divided from those in the west by a zone of low background chargeability and resistivity.

Anomalies in the east often show *fast* decay forms (fine grained or inefficient source), while those is the west show *slower* decay forms characteristic of *coarser* grained sources.

In the south, no such simple generalisation was observed.

3 - The induced polarization responses observed in this survey were substantial (to 100 millivolts/volt) and are rarely considered to be due to truly conductive sources. Most are disseminated in nature.

4 - Maximum depths to 50 to 60 metres have been estimated, but most sources outcrop or sub-crop.

5 - While magnetite undoubtedly contributes to some of the chargeability anomalies located, the absence of chargeability anomalies over some significant magnetic field distortions shows that magnetite is not always chargeable to a significant degree in this area.

6 - It is not possible to determine the possible economic merit of any of the chargeability anomalies in the present survey as amplitude, associated resistivity and magnetic field alone will not assist. Each of the anomalies is discussed in detail in the main body of the report and the source and characteristics described. Geochemical and geological data will be required to differentiate the zones of interest.

7 - Should any of the "multiple source" zones prove to be of possible economic interest, it is strongly recommended that gradient array be run over them prior to any drilling to precisely isolate the source. With "single sources" this of course will not be necessary.

8 - In zones of interest, it is recommended that intermediate 200 metre lines be surveyed with gradient array *together with* the adjacent lines. This will show a precise delineation of targets *and* a precise determination of depth (maximum and minimum).

9 - The twelve lines of the East Heemskirk grid were surveyed with pole-dipole at $a = 25$ *metres* and $n = 1$ *to* 4 in 21 double operator days. In all some 16 kilometres and 2560 readings were involved.

10 - With the wisdom of hindsight it is considered that the East Heemskirk grid should have been surveyed using a gradient array in spite of the substantial 400 metres interline spacing and the difficulties in positioning current dipoles. The field crew estimates that the task could have beem performed in half the time. Further, pole or dipole-dipole detail could have then been performed on critical areas.

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

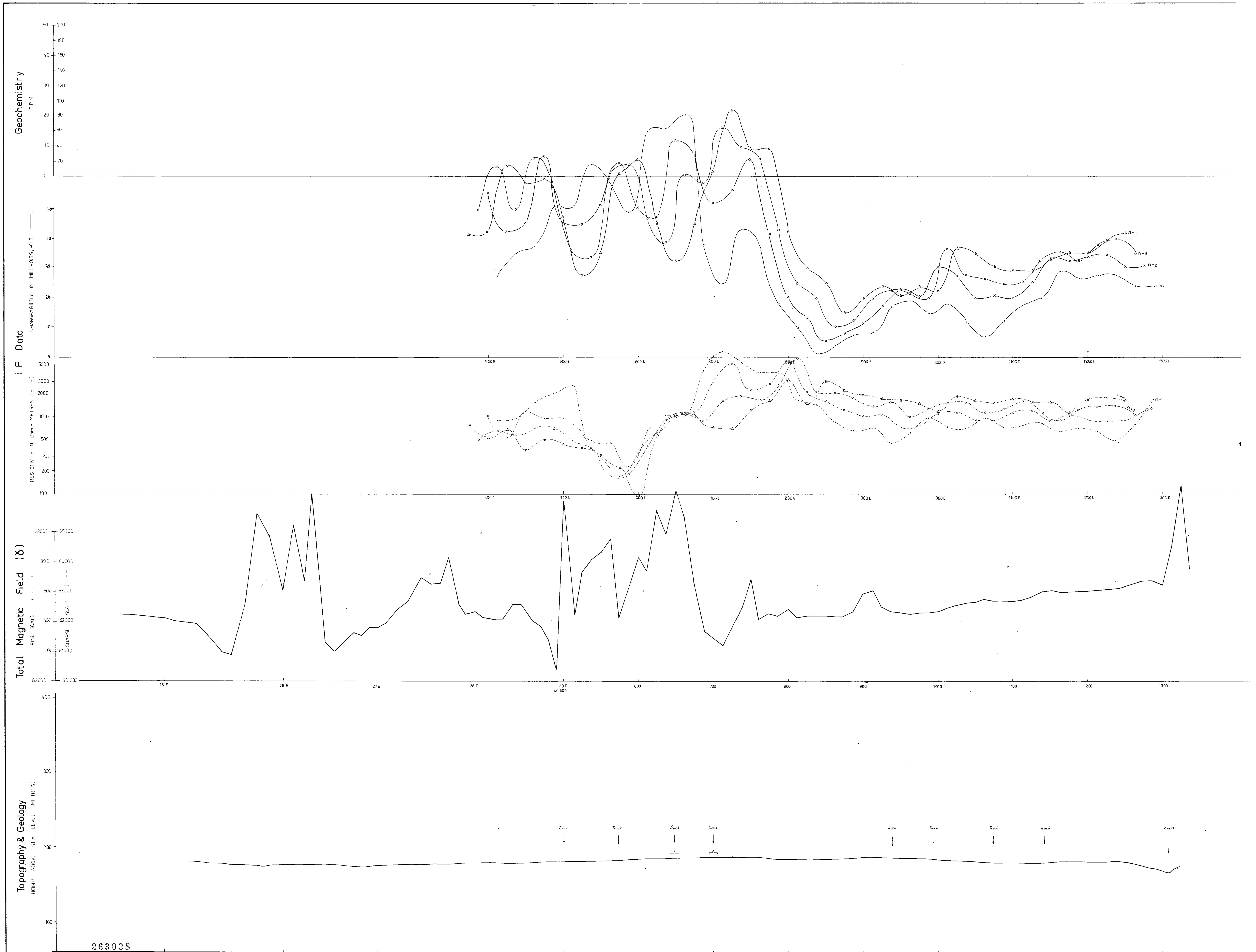
Respectfully submitted on behalf of:

SCINTREX PTY. LTD.

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

GEOPHYSICIST


BASELINE
5000 N
4600N
4200 N
3800 N
3400N
3000N
2600 N
2200 N
1800N
1400 N
1200 N
1000N
high resistivity
low chargeability
low background resistivity
low background chargeability
high resistivity
low chargeability
high resistivity
high chargeability
high resistivity
low chargeability
moderate resistivity
high chargeability
low background resistivity
low background chargeability
high resistivity
low chargeability
high/moderate resistivity
low chargeability
high resistivity
low chargeability
high chargeability
moderate/high resistivity
moderate resistivity
moderate resistivity
high resistivity
low background chargeability
SILVER STREAM (KYNANCE)
Legend
Resistivity low
Resistivity high
I.P. Anomalies
Probable and possible boundaries
Dislocation
263037
RENISON LIMITED
EAST HEEMSKIRK GRID
ELECTRICAL INDUCED POLARIZATION - POLE DI-POLE SURVEY
N.B. TRAVERSE LINES NOT SURVEYED
GEOLOGIST : P.R. Stephenson
DRAUGHTSMAN : F.A. Colson
DATE Dec. '77
SCALE 1:5,000 METRES
100 0 100 200
REVISIONS
SURVEYED & COMPILED BY
SCINTREX
JAN. 1978
DRAWING No.
1165
78-1263 Vol. 1 | 2
5 cm



263038

RENISON LIMITED	DRAWN	P R S
EAST HEEMSKIRK GRID S.P.L.129	TRACED	J M M
LINE 1000 N	DATE	2 3 78
SECTION LOOKING N W 1166	SCALE	1 2000
SCALE. 1: 2000 METRES (40 0 40 80 120)	DRAWING No.	TH 67

I P DATA
Pole - Dipole

CHARGEABILITY — RESISTIVITY
n=1, n=2, n=3, n=4

SCINTREX PTY, LTD, 1978

MAGNETICS
5000 Scale
1000 Scale

GEOCHEMISTRY
Sn
Cu
Pb
Zn
As
W

GEOLOGY
Qra Quaternary alluvium, fluvioglacials
UЄc Upper Crimson Creek Formation
LЄc Lower Crimson Creek Formation (Mine sequence equivalent)
Єsc Success Creek Group

* Erratic magnetometer reading

5 cm

78-1263 Vol 2/2

263039

RENISON LIMITED		DRAWN	P R S
EAST HEEMSKIRK GRID S.P.L. 129		TRACED	J M M
LINE 1200 N		DATE	2 3 78
SECTION LOOKING N W	1167	SCALE	1 2000
SCALE. 1: 2000 METRES		DRAWING No.	TH 68

I P DATA
Pole - Dipole

CHARGEABILITY — n=1, n=2, n=3, n=4
RESISTIVITY — n=1, n=2, n=3, n=4

SCINTREX PTY, LTD, 1978

MAGNETICS
5000 Scale
1000 Scale

GEOCHEMISTRY

GEOLOGY

- Qra — Quaternary alluvium, fluvioglacials
- UЄc — Upper Crimson Creek Formation
- LЄc — Lower Crimson Creek Formation (Mine sequence equivalent)
- Єsc — Success Creek Group

* Erratic magnetometer reading

5 cm

78-1263 Vol 2/2

263040

RENISON LIMITED	DRAWN: P R S
EAST HEEMSKIRK GRID S.P.L. 129	TRACED: J M M
LINE 1400 N	DATE: 2 3 78
SECTION LOOKING N W 1168	SCALE: 1 : 2000
SCALE. 1: 2000 METRES	DRAWING No. TH 69

I.P. DATA
Pole - Dipole
CHARGEABILITY RESISTIVITY
n=1 n=1
n=2 n=2
n=3 n=3
n=4 n=4

MAGNETICS

GEOCHEMISTRY

GEOLOGY
Quaternary alluvium, fluvioglacials
Upper Crimson Creek Formation
Lower Crimson Creek Formation (Mine sequence equivalent)
Success Creek Group

* Erratic magnetometer reading

5 cm

SCINTREX PTY., LTD., 1978

78- 1263 Vol. 2/2

RENISON LIMITED	DRAWN	P R S
EAST HEEMSKIRK GRID S.P.L. 129	TRACED	J M M
LINE 1800 N	DATE	14-2-78
SECTION LOOKING N W 1169	SCALE	1 2000
SCALE. 1: 2000 METRES (40 0 40 80 120)	DRAWING No.	TH 70

78-1263 Vol. 2/2.

I P DATA
Pole - Dipole
CHARGEABILITY RESISTIVITY
n=1, n=2, n=3, n=4

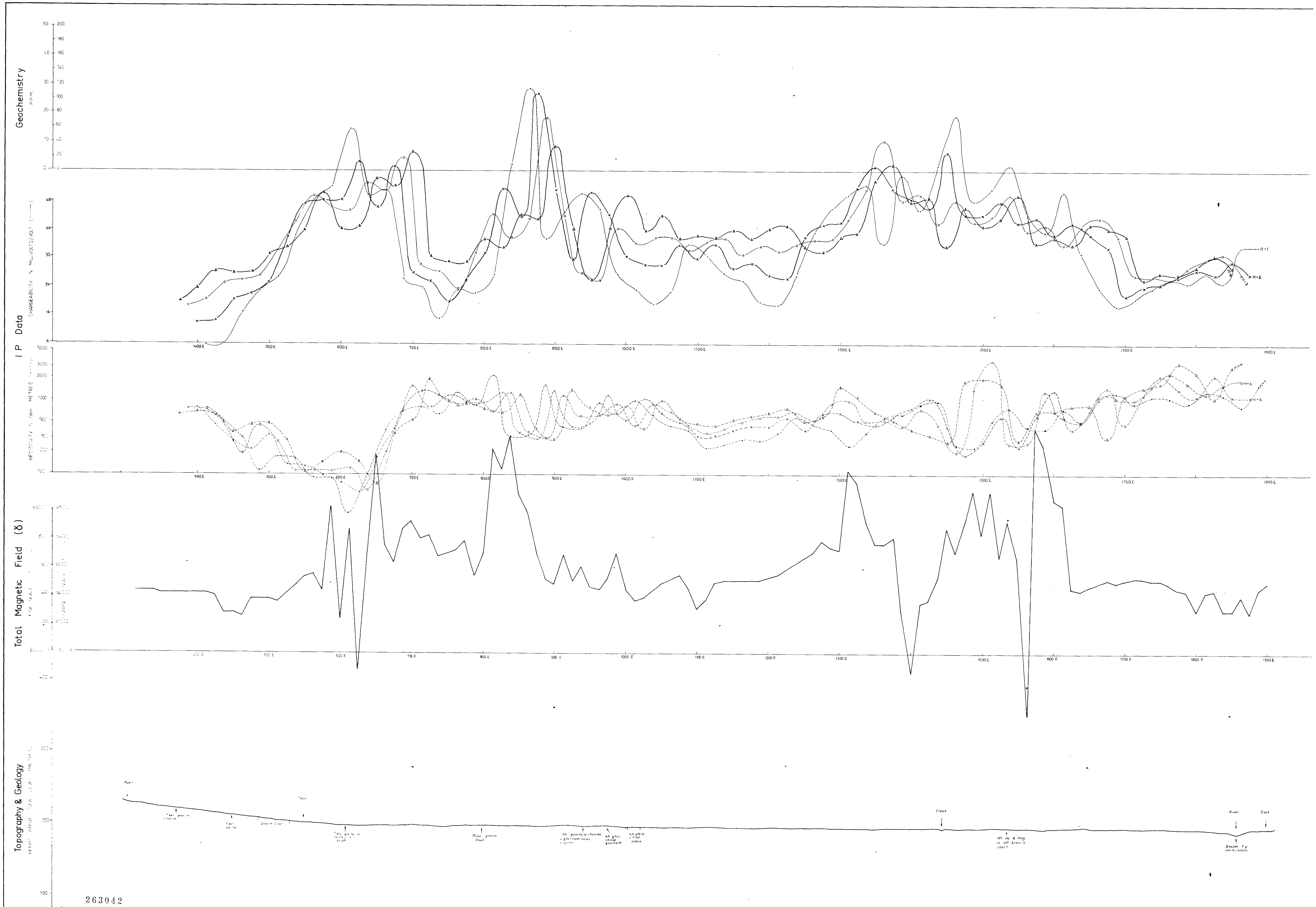
SCINTREX PTY, LTD., 1978

MAGNETICS
5000 Scale
1000 Scale

GEOCHEMISTRY
Sn
Cu
Pb
Zn
As
W

GEOLOGY
Qra Quaternary alluvium, fluvioglacials
uЄc Upper Crimson Creek Formation
lЄc Lower Crimson Creek Formation (Mine sequence equivalent)
Єsc Success Creek Group

5 cm



RENISON LIMITED	DRAWN	P R S
EAST HEEMSKIRK GRID SP L. 129	TRACED	J M M
LINE 2200 N	DATE	15-2-78
SECTION LOOKING N W 1170	SCALE	1:2000
SCALE. 1: 2000 METRES	DRAWING No.	TH 71

I P DATA
Pole - Dipole

n=1 n=2 n=3 n=4

MAGNETICS

GEOCHEMISTRY

GEOLOGY

SCINTREX PTY, LTD, 1978

* Erratic magnetometer readings

78 - 1263 Vol. 2/2

RENISON LIMITED	DRAWN	P.R.S.
EAST HEEMSKIRK GRID S.P.L. 129	TRACED	J. M. M.
LINE 2600 N 1171	DATE	15-2-78
SECTION LOOKING N.W.	SCALE	1:2000
SCALE. 1: 2000 METRES (40 0 40 80 120)	DRAWING No.	TH 72

I.P. DATA
Pole - Dipole
CHARGEABILITY RESISTIVITY
n=1 n=1
n=2 n=2
n=3 n=3
n=4 n=4
SCINTREX PTY., LTD., 1978

MAGNETICS
5000 Scale
1000 Scale

GEOCHEMISTRY
Sn
Cu
Pb
Zn
As
W

GEOLOGY
Qrc Quaternary alluvium, fluvioglacials
U€c Upper Crimson Creek Formation
L€c Lower Crimson Creek Formation (Mine sequence equivalent)
€sc Success Creek Group

* Erratic magnetometer reading

5 cm

78 - 1263 Vol. 2/2.

263044

RENISON LIMITED	DRAWN	P R S
EAST HEEMSKIRK GRID S.P.L. 129	TRACED	J M M
LINE 3000 N	DATE	15-2-78
SECTION LOOKING N W	SCALE	1:2000
1172	DRAWING No.	TH 73
SCALE. 1: 2000 METRES (40 0 40 80 120)		

I P DATA
Pole - Dipole
CHARGEABILITY RESISTIVITY
n=1, n=2, n=3, n=4

SCINTREX PTY., LTD., 1978

MAGNETICS
5000 Scale
1000 Scale

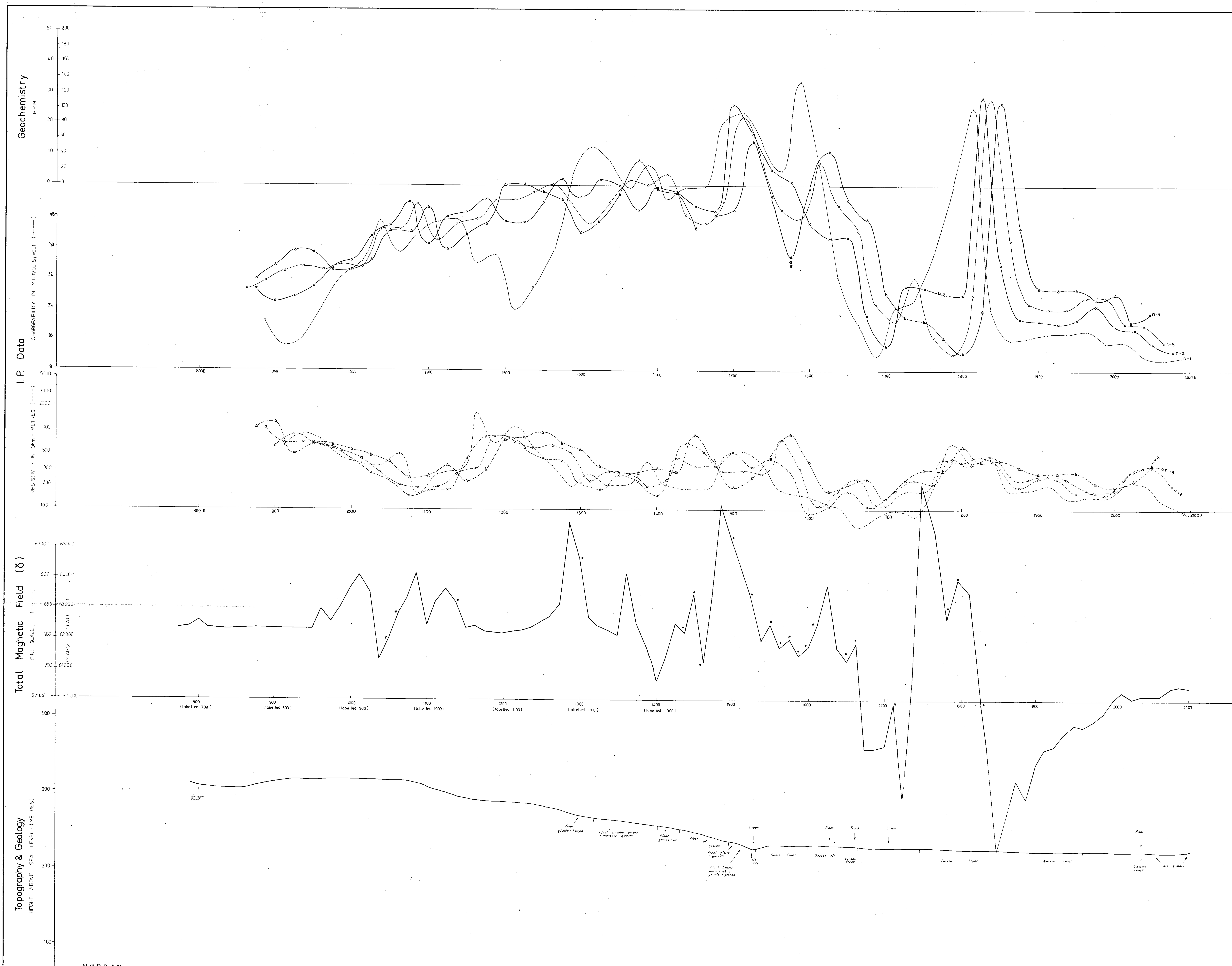
GEOCHEMISTRY
Cu, Pb, Zn, As, W

GEOLOGY
Qra Quaternary alluvium, fluvioglacials
UEc Upper Crimson Creek Formation
LEc Lower Crimson Creek Formation (Mine sequence equivalent)
Esc Success Creek Group

* Erratic magnetometer reading

5 cm

78-1263 Vol. 2/2.



263045

RENISON LIMITED	
EAST HEEMSKIRK GRID S.P.L. 129	DRAWN: P. R. S.
LINE 3400 N	TRACED: J. M. M.
1173	DATE: 27 · 2 · 78
SECTION LOOKING N W	SCALE: 1: 2000
SCALE. 1: 2000 METRES (40 0 40 80 120)	DRAWING No. TH 74

I.P. DATA Pole-Dipole
CHARGEABILITY — RESISTIVITY: n=1, n=2, n=3, n=4

MAGNETICS
5000 Scale
1000 Scale

GEOCHEMISTRY
Sn
Cu
Pb
Zn
As
W

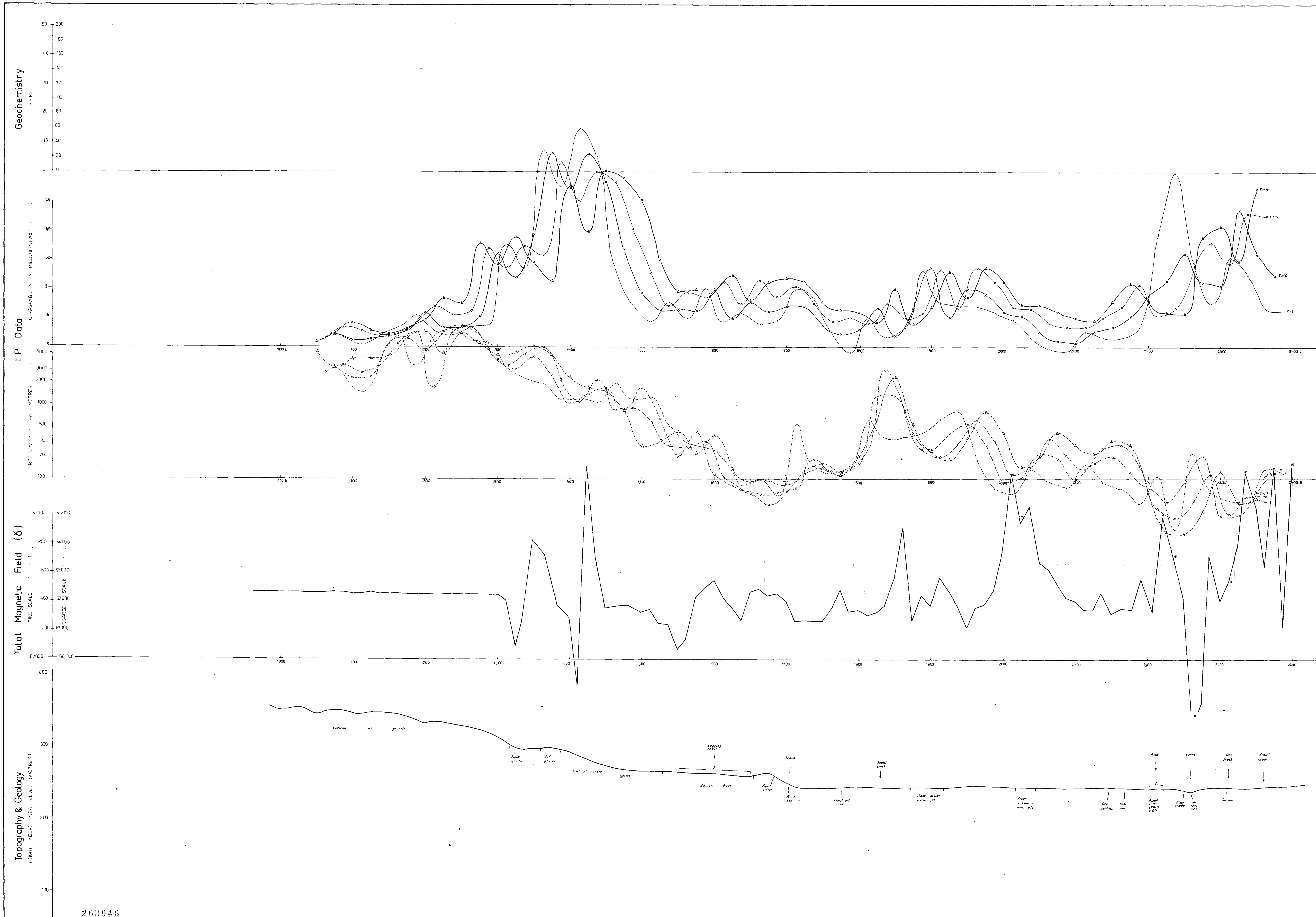
GEOLOGY
Qra Quaternary alluvium, fluvioglacials
UЄc Upper Crimson Creek Formation
LЄc Lower Crimson Creek Formation (Mine sequence equivalent)
Єsc Success Creek Group

* Erratic magnetometer readings

5 cm

SCINTREX PTY., LTD., 1978

78-1263 Vol. 2/2



RENISON LIMITED	DRAWN	P R S
EAST HEEMSKIRK GRID S.P.L. 129	TRACED	J M M
LINE 3800 N	DATE	2 '3 78
SECTION LOOKING N.W. 1174	SCALE	1 : 2000
SCALE. 1: 2000 METRES (40 0 40 80 120)	DRAWING No.	TH 75

I.P. DATA
Pole-Dipole
CHARGEABILITY / RESISTIVITY
n=1, n=2, n=3, n=4

MAGNETICS
5000 Scale
1000 Scale

GEOCHEMISTRY
Sn
Cu
Pb
Zn
As
W

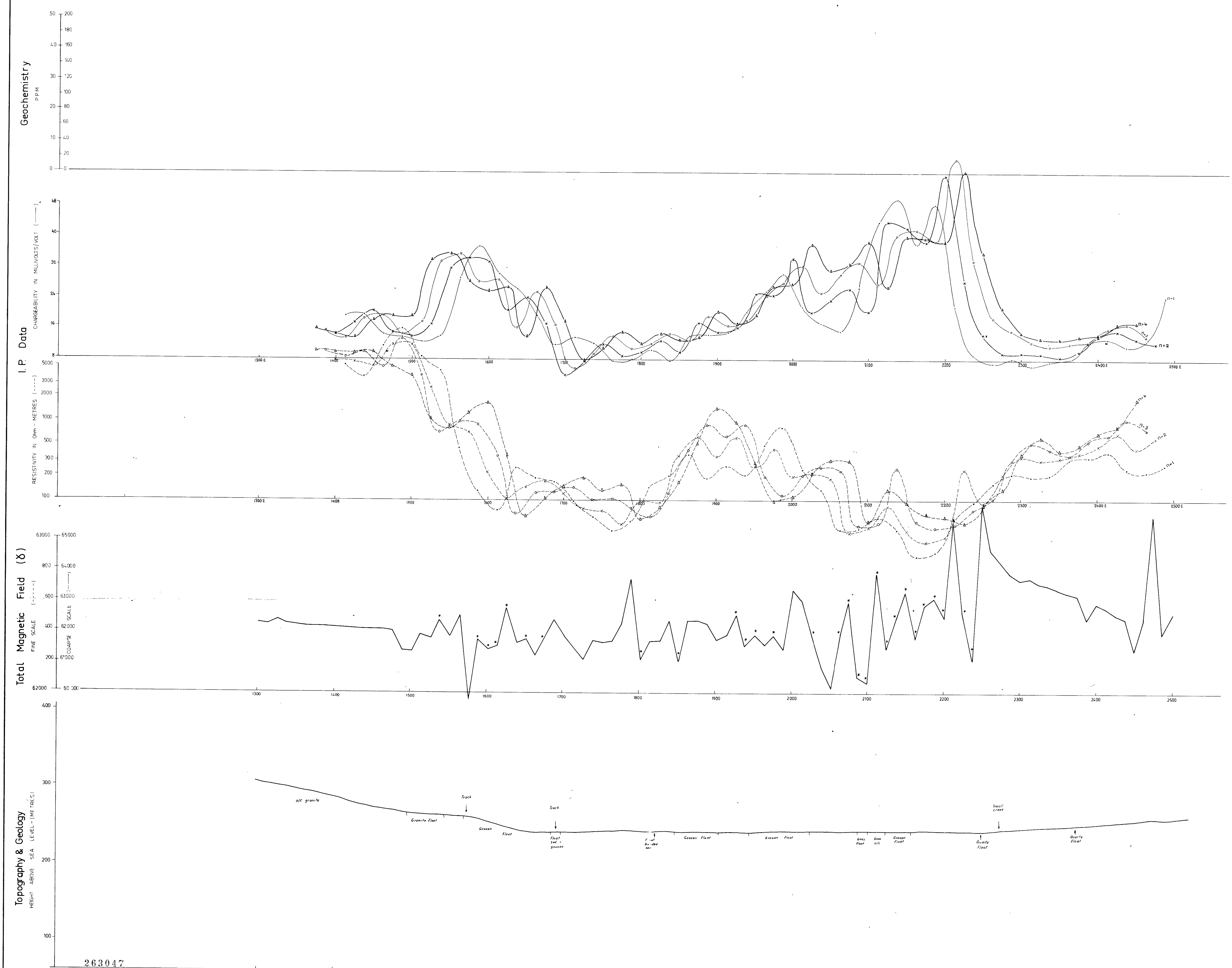
GEOLOGY
Qra Quaternary alluvium, fluvioglacials
UEc Upper Crimson Creek Formation
LEc Lower Crimson Creek Formation (Mine sequence equivalent)
Esc Success Creek Group

* Erratic magnetometer reading

5 cm

SCINTREX PTY., LTD., 1978

78-1263 Vd 2/2



RENISON LIMITED		DRAWN	P R S
EAST HEEMSKIRK GRID S.P.L. 129		TRACED	J M M
LINE 4200 N	1175	DATE	23 2 78
SECTION LOOKING N W		SCALE	1: 2000
SCALE. 1: 2000 METRES		DRAWING No.	TH 76

I P DATA
Pole - Dipole

MAGNETICS

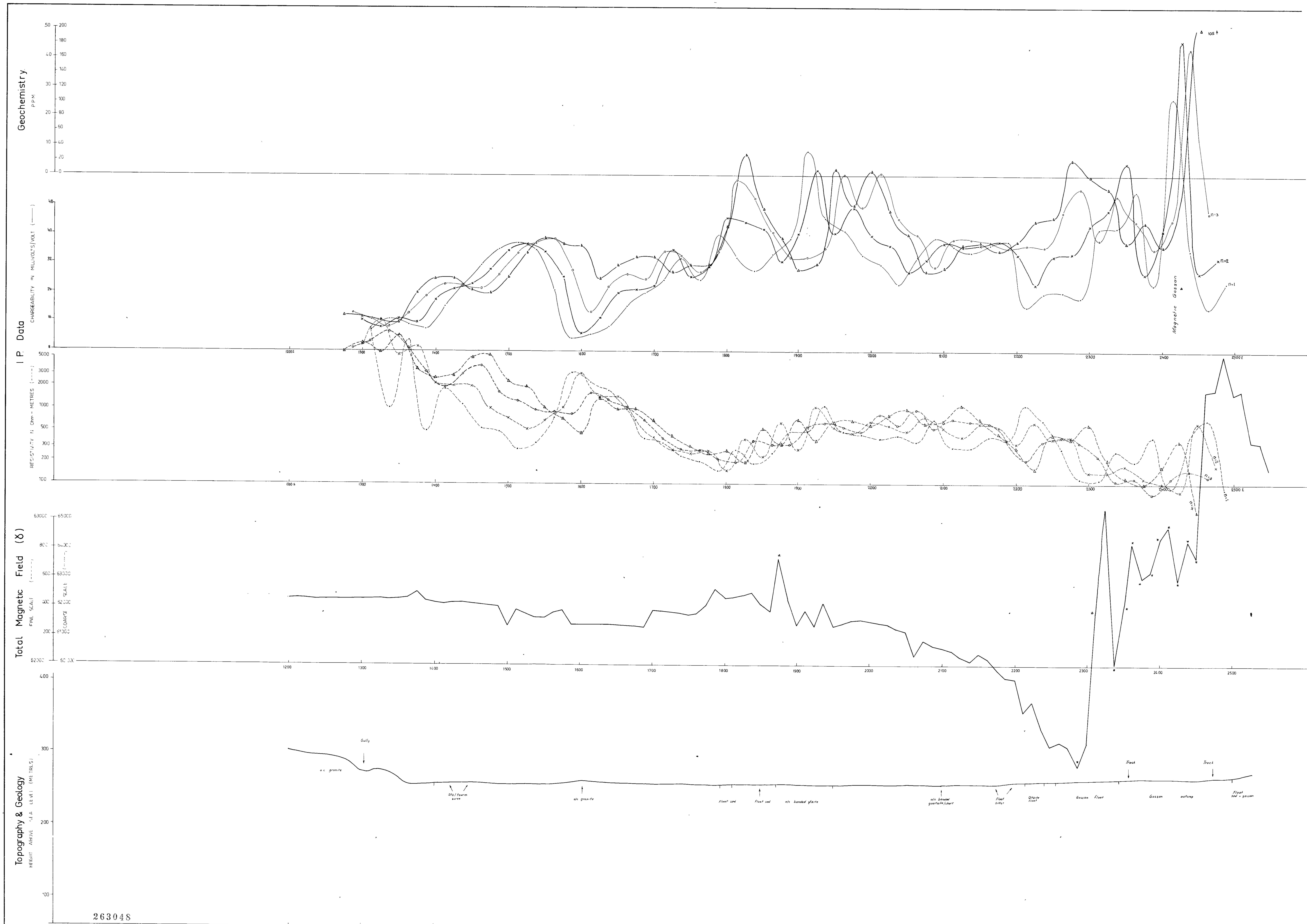
GEOCHEMISTRY

GEOLOGY

SCINTREX PTY, LTD, 1978

* Erratic magnetometer readings

78-1263 Vol 2/2



263048

RENISON LIMITED		DRAWN	P.R.S.
EAST HEEMSKIRK GRID	S.P.L. 129	TRACED	J.M.M.
LINE 4600 N		DATE	1.3.78
SECTION LOOKING N.W.	1176	SCALE	1:2000
SCALE. 1: 2000 METRES		DRAWING No.	TH 77

I.P. DATA
Pole - Dipole
CHARGEABILITY RESISTIVITY
n=1
n=2
n=3
n=4
SCINTREX PTY. LTD. 1978

MAGNETICS
5000 Scale
1000 Scale

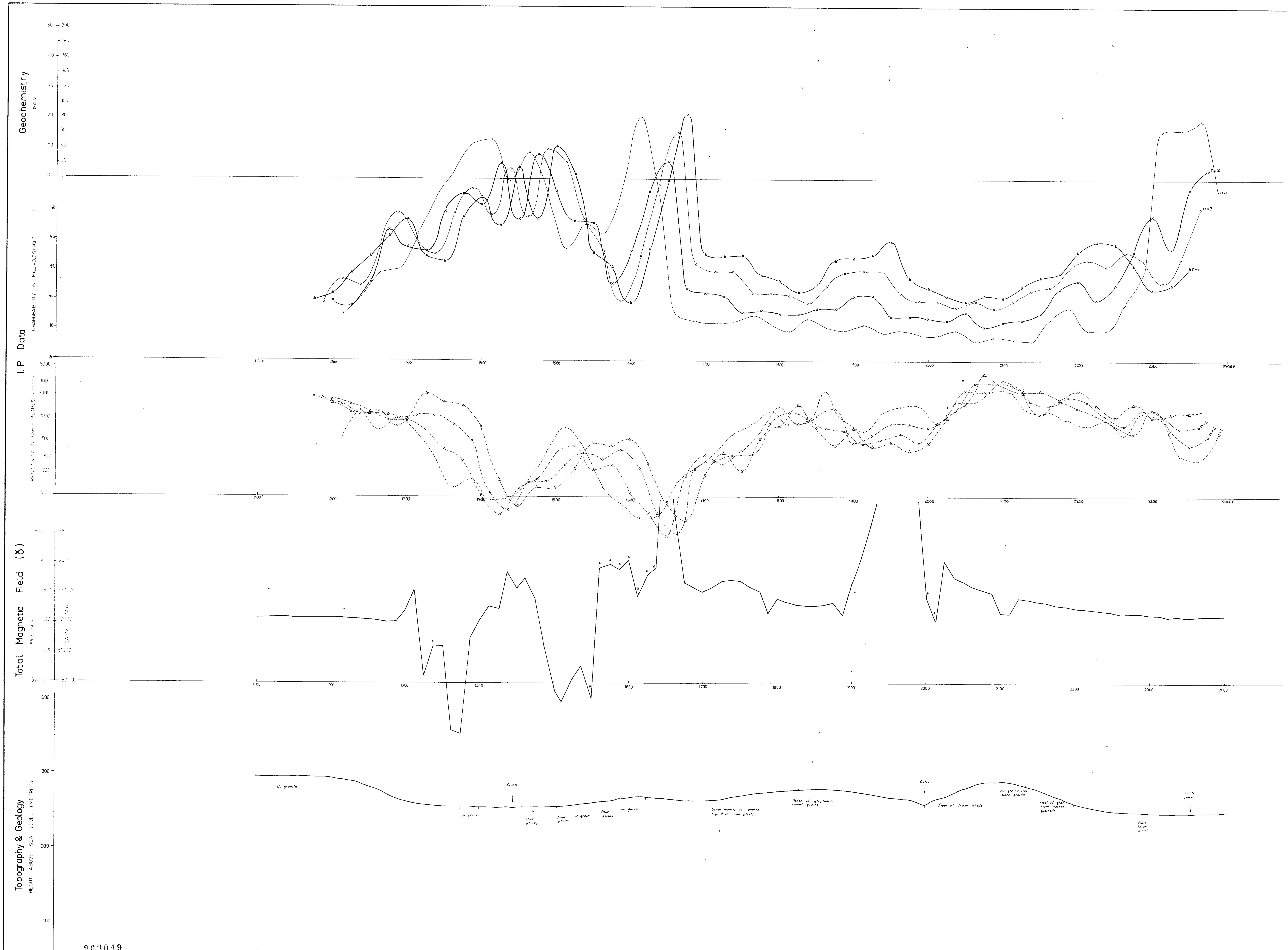
GEOCHEMISTRY
Cu
Pb
Zn
As

GEOLOGY
Qra Quaternary alluvium, fluvioglacials
UЄc Upper Crimson Creek Formation
LЄc Lower Crimson Creek Formation (Mine sequence equivalent)
Єsc Success Creek Group

* Erratic magnetometer reading

5 cm

78-1263 Vol. 2/2.



RENISON LIMITED	DRAWN	P R S
EAST HEEMSKIRK GRID S.P.L. 129	TRACED	J M M
LINE 5000 N	DATE	27 2 78
SECTION LOOKING N W 1177	SCALE	1: 2000
SCALE. 1: 2000 METRES	DRAWING No.	TH 78

I P DATA
Pole - Dipole
CHARGEABILITY RESISTIVITY
n-1 n-1
n=2 n-2
n=3 n=3
n=4 n=4

MAGNETICS
5000 Scale
1000 Scale

GEOCHEMISTRY
Cu
Pb
Zn
As
W

GEOLOGY
Qrc Quaternary alluvium, fluvioglacials
uЄ Upper Crimson Creek Formation
lЄc Lower Crimson Creek Formation (Mine sequence equivalent)
Єsc Success Creek Group

* Erratic magnetometer readings

5 cm

SCINTREX PTY LTD - 1978

78-1263 Vol. 2/2.