HARDY ASSOCIATES (1978) LTD.
CONSULTING ENGINEERING & PROFESSIONAL SERVICES

RESISTIVITY/INDUCED POLARIZATION SURVEY

KENOGAMING TOWNSHIP, ONTARIO

1984

Prepared for
BEARCAT EXPLORATIONS LTD.

By
HARDY ASSOCIATES (1978) LTD.
Calgary, Alberta

April 1984

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1.0 INTRODUCTION

From March 11th to March 31, 1984, Hardy Associates (1978) Ltd. carried out a resistivity/induced polarization (IP) survey for Bearcat Explorations Ltd. Table 1 gives the detail of the work done during that period. The survey area was located approximately 75 kilometres southwest of the town of Timmins in Kenogaming Township, Porcupine Mining District, Ontario (Figure 1). The survey was performed by C. Galopin and W.R. Hemstock of Hardy Associates (1978) Ltd, with the assistance of J. Dallaire of Timmins. The field crew stayed in Timmins and drove daily to the site. Due to bad snow conditions on the road leading from Regan Road to the site, the survey area was accessed by snowmobiles during the last week of survey. A total of 16 line kilometres was surveyed. The purpose of the survey was to detect disseminated sulphide mineralization associated with structures which could contain gold.

The geology of the area is described in a report by Brereton dated Dec 1983 (1).

2.0 EQUIPMENT

The resistivity/IP measurements were made with a gradient array with a potential electrode separation of 25 metres and a current electrode separation of about 3 kilometres. The measurements were made in the time-domain with a Scintrex IPR-10A receiver. The source current was supplied by a Scintrex TSQ-3 3 kVA transmitter. A full description of the resistivity/IP system and the instruments used is given in Appendix A.

Measurements were made with a 4-second period and a duty cycle of 50%, to produce timing of 1 second on, 1 second off, 1 second on (reversed polarity), and 1 second off. Chargeability was measured over three successive windows of 260 milliseconds width, after a delay of 65 milliseconds.

TABLE 1

Day		Crew Members	Comments
March 11 to March 12	Mobilization	W.J. Scott C. Galopin W.R. Hemstock	
March 13 to March 27	Geophysical Survey	C. Galopin W.R. Hemstock J.G. Dallaire	
March 28 to March 29	Repeat survey on lines 0,1,2,3	C. Galopin W.R. Hemstock J.G. Dallaire	NO CHARGE
March 30 to March 31	Demobilization	C. Galopin W.R. Hemstock	

3.0 FIELD PROCEDURE

The field procedure involved establishing the current electrodes at the selected points and then carrying out the survey measurements on the survey lines. Figure 1 shows the entire survey area.

The current electrodes were positioned 3 kilometres apart on line 6, with the northern electrode 1980 metres from the base line and the southern electrode 1020 metres from the baseline.

The potential electrodes (stainless-steel stakes) were then moved along 17 north-south lines. Voltage and chargeability readings were taken at stations spaced every 25 metres. The current was read on the transmitter every 10 minutes. The lines were flagged every 100 metres.

4.0 DATA PROCESSING

Each evening the resistivity values were calculated using the formula developed in Appendix A. The chargeability values M were calculated using the formula:

$M = (1.47 \times M_{31}) + M_{32} + (0.81 \times M_{33})$ where M_{31}, M_{32}, M_{33} are the 3 chargeability readings taken on the instrument. The values are approximately 3 times larger than Newmont Standard values.

In the office, profiles of resistivity and chargeability were produced (Plate 3). Resistivity values were contoured at logarithmic intervals. (Plate 2). The chargeability values were contoured at a 10 millivolts/volt (mV/V) interval. (Plate 1). Plate 4 shows an interpretation prepared from pre-existing VLF-EM survey results (4). Anomalous areas were identified on the chargeability contour map (Plate 1). The areas of anomalies were then reproduced on Plates 2,3 and 4. Information taken from previous work was also used for the interpretation.

5.0 SURVEY RESULTS

This interpretation is based on the observations of apparent resistivity and apparent chargeability measured on the survey grid. Reference has been made also the regional geologic map

(5), the detailed geology of Brereton (1), airborne geophysical results (2), VLF EM results from Filo (4),and ground magnetic surveys,from assessment files, performed in 1966 (6) and 1980 (3). The earlier magnetic survey is considerably more detailed, and appears to show also the locations of holes drilled on the Jonsmith and other zones. Neither magnetic map, however, can be tied exactly to the present survey, as boundaries of the earlier claims do not coincide with the present ones. Furthermore the outline of Akweskwa Lake appears to have altered with time, so that keying of locations to the shoreline is not reliable. To tie the 1966 survey, reference was made to the centre of the pond at 7+00E, O+00N. In this report, the magnetic correlations are based primarily on the 1966 survey results.

In general, contours of high apparent resistivity outline the areas of outcrop or thin cover. Low resistivity areas probably indicate primarily areas with bedrock depressions filled with overburden. The apparent chargeability contours, on the other hand, reflect the metallic mineral content (sulphides and magnetite) of the rocks.

In the northern part of the survey area, background chargeabilities were from 20 to 25 mV/V. South of an east-west line through 2+50S, backgrounds are generally lower, at about 10 to 15 mV/V. This change in background may reflect a difference in rock type or sulphide content, although none is shown on the geological map (1), or it may reflect an increased thickness of overburden on the southern part of the grid.

Several strong anomalies associated with high chargeability and low resistivity values were identified. These are numbered 1 through 9 on Plates 1,2,3 and 4. Most of the anomalies trend roughly northwest-southeast.

5.1 ANOMALY 1

Anomaly 1 (south of the base line) has chargeability magnitudes ranging from 30 to 90 mV/V. This zone is localised and is associated with a strong magnetic anomaly (3,6); it is probably due to the presence of magnetite in serpentinite. The VLF results show a response trending west-northwest which is strong to the west but dies away under Anomaly 1. The VLF response is probably due to localised shearing in the serpentinite.

5.2 ANOMALY 2

Anomaly 2 coincides with the main gold-zinc showing. Previous work done in this area (mapping, backhoe and rock trenching, sampling, (1) resulted in the discovery of numerous sheared and mineralized zones with pyrite and sericite. The maximum chargeabilities vary from 40 to 60 mV/V. This anomalous zone trends in a northwest-southeast direction, and is associated with a weak VLF response. The anomalous area outlined by the IP is somewhat larger than that shown on the geological map (1). The central third of Anomaly 2 appears to have been evaluated by previous drilling and trenching. Strong IP responses exist both northwest and southeast of this central third. High apparent resistivities observed over this zone are caused by a high proportion of outcrop.

5.3 ANOMALIES 3 AND 4

Two anomalous areas 3 and 4 may be part of a single structure. Maximum chargeabilities range from 40 to 90 mV/V on Anomaly 3 and from 40 to 70 mV/V on Anomaly 4. Neither area is strongly reflected in the apparent resistivity data, although resistivity values are somewhat lower on Anomaly 4. There is a weak VLF anomaly coincident with Anomaly 3, bot none apparently related directly to Anomaly 4. There are no strong magnetic correlations with either zone.

From the geologic map (1), it appears that a diabase dyke cuts the east end of Anomaly 3; near this diabase there is outcrop with pyrite. The geology of this zone is similar to that of the main zone, and the responses are somewhat stronger. No outcrop is shown near Anomaly 4, although two old drill holes are shown on the magnetic map (6). The broader shape suggests that the source of Anomaly 4 lies under considerable overburden.

5.4 ANOMALIES 5 AND 7

Anomalous area 5 is the strongest zone on the property with the highest IP responses. The northwest ends of Anomalies 5 and 7 coincide with diabase dykes and are located in swamps. The chargeability values vary from 40 to 120 mV/V on 5 and from 40 to 100 mV/V on 7. Tentatively, Anomalies 5 and 7 have been identified as being part of the same structure. A strong VLF anomaly from 200 m west of Anomaly 5 passes through it and extends into Anomaly 7. The apparent resistivity contours imply a bedrock depression linking 5 and 7, roughly along the trend of the VLF anomaly. The coincident VLF and resistivity features suggest that the bedrock depression is structurally controlled, and thus that Anomaly 5 and Anomaly 7 are parts of the same structure.

Because of the uncertainty in location, it is difficult to make exact correlations between the magnetics and Anomalies 5 and 7. However, it appears that both zones are just north of a 2500 gamma linear feature with a weak VLF expression. Neither the regional nor the local geologic maps indicate serpentinite in this area, and the only nearby outcrop (8+00E,1+60N) is shown on the geologic map (1) to be siliceous tuffs. It is unusual, however, to have such a strong magnetic response without the presence of magnetite in ultramafics.

Anomaly 5, which is just south of the Jonsmith Au Zone, should receive high priority in further investigations, while work on Anomaly 7 should probably await evaluation of 5.

5.5 ANOMALY 6

The northwest-southeast anomalous trend called 6 is located under a swamp. Anomaly 6 is associated with a diabase dyke. The chargeabilities vary from 40 to 100 mV/V in 6A and from 50 to 60 mV/V in 6B. The airborne magnetic and VLF-EM results (2) show high responses in this area. The ground VLF survey showed also a medium conductor on the southern edge of anomaly 6.

There is no strong feature in the 1966 magnetic results which appears to correlate with this zone. From this map the positions of seven holes near the Jonsmith zone have been transferred to Plate 1. If the drill hole locations are correct, then the area the holes were testing shows no anomalous induced polarization results. The holes appear to be midway between two weak VLF conductors.

Because of its proximity to the Jonsmith Zone, Anomaly 6 would be of considerable interest if economic mineralization were found in Anomaly 5.

5.7 ANOMALIES 8 AND 9

Anomalies 8 and 9 are in a zone which is shown on the 1966 magnetic results (6) to be magnetically anomalous. This zone is shown on the regional geologic map(s) as serpentinites. The local geologic map, however, shows no serpentinites in the north-east part of the grid.

If these two IP anomalies are in serpentinites, then they probably arise from magnetite concentrations. The 1966 report describes horizontal loop EM work in the north-east part of the grid which found no conductors. It is thus unlikely that the IP responses are from strong concentrations of nickel-bearing sulphides.

5.8 SOUTHEAST SHORE OF AKWESKWA LAKE

Old records cited by Brereton (1) refer to mineralized shear zones in the region of 10+00E, 4+00S. In the southeast some apparent chargeabilities range up to 30 mV/V but no anomalous responses were found comparable to those on the west side of the lake.

6.0 SUMMARY, DISCUSSION AND RECOMMENDATIONS

From March 11th to March 31, 1984, a resistivity/induced polarization (IP) survey was conducted in Kenogaming township, for Bearcat Explorations Ltd. The measurements were made with a gradient array, and 25 m spacing between receiver electrodes.

Background chargeabilities ranged from 10 mV/V over the southern part of the grid to 20 over the northern part.

A chargeability anomaly of more than 60 mV/V was observed over the main Au-Zn zone. This response (Anomaly 2) is coincident with the area already investigated by trenching and drilling, and extends somewhat beyond the known part to the northwest and southeast.

Higher apparent chargeabilities were observed in Anomalies 1 and 3 through 9. Anomaly 1 appears to be associated with strongly magnetic serpentinites shown on the geologic map (1). Anomalies 8 and 9 are in magnetic areas and are probably from serpentinites as well. Anomalies 3,4,5,6 and 7 are in favourable geology, and should be investigated.

The highest priority anomalies for further work are 3 and 5. Anomaly 3 could be trenched or drilled on Line 6E. Anomaly 5 is in swamp and probably could not be investigated by trenching. A drill hole is recommended to intersect this zone at about 7+00E, 2+55N. Because of the nature of gradient IP measurements no reliable estimates of dip or depths can be given.

Anomaly 6A should be investigated by stripping and possibly by drilling, but is rated lower in priority than Anomalies 3 or 5.

Before much effort is expended on the responses in the northeast part of the grid, a magnetic survey should be carried out to clarify the geological framework. This survey should be carried out on lines at 50 metre spacing, with readings at 10 metre intervals.

Respectfully Submitted,
HARDY ASSOCIATES (1978) LTD.

Per: Anthony Kay M.Sc. P.Geoph.
for C. Galopin, Geophysicist

Per:
W.J. Scott, Ph.D., P.Eng.
Chief Geophysicist

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APPENDIX "A"

RESISTIVITY/IP SYSTEM

TECHNICAL DESCRIPTION OF IPR-10A AND TSQ-3

1.0 INTRODUCTION

Figure 1 shows the resistivity/IP electrode configuration for a gradient array. This arrangement permits exploration on parallel lines from a fixed position of the current electrodes, by movement of the potential electrodes.

Lateral exploration by resistivity measurements is best suited to detection of vertical contacts such as faults, dykes, shear zones and steeply dipping veins, and to a lesser extent to detection of massive sulphides of anomalous conductivity. Most sulphides, such as chalcopyrite, bornite, chalcolite, pyrite, pyrrhotite, arsenopyrite and molybdenite, as well as graphite and certain of the clay minerals, produce IP effects.

The measurements are made in the time-domain with waveforms as shown in Figure 2(a). The source current is supplied by a Scintrex TSQ-3 3 KVA transmitter, offering a constant current output regulation of 0.1%.

The Scintrex Digital Time-Domain Induced Polarization Receiver IPR-10A is used as the receiver system.

2.0 DATA ACQUISITION AND REDUCTION

Induced polarization effects are produced by interrupting the current abruptly. The voltage across the potential electrodes generally does not drop to zero instantaneously, but decays rather slowly, after an initial large decrease from the original steady state value. Electrical measurements were made with a four second period and 50% duty cycle, so that the current was on for 1 second, off for 1 second, on again in the opposite direction for 1 second and off for 1 second (Figure 2 a).

a) Apparent Resistivity

The peak voltage, Vp, is obtained by choosing a resistivity "window" on the measured waveform, illustrated in Figure 2(b). This allows one to avoid the turn-on transient, thus yielding a more accurate value of the peak voltage. In the Scintrex IPR-10A, the peak voltage is integrated for 40% of the current on time, from 450 to 850 milliseconds.

Resistivities are calculated from the formula:

$$\rho a = G \frac{Vp}{I}$$

where ρa = apparent resistivity

Vp = voltage measured across the potential electrodes P_1 and P_2

I = current injected through the current electrodes C_1 and C_2

$$G = \frac{2\pi}{\left(\frac{1}{r_1} - \frac{1}{r_2}\right) - \left(\frac{1}{r_3} - \frac{1}{r_4}\right)}$$

where r_1, r_2, r_3 and r_4 are the distances between each potential electrode and the current electrodes (Figure 1)

b) Chargeability

In the time-domain IP method, a measure of the IP effect can be obtained by calculating a chargeability M from the measured data. The chargeability is obtained by choosing a chargeability "window" on the decay curve, illustrated in Figure 2(c). For the survey, a measuring programme was selected on the IPR-10A, such that the area under the decay curve was integrated in 3 slices. The delay time was set at 65 milliseconds. The first chargeability M_{31} was integrated from 65 to 325 milliseconds, the second chargeability M_{32} from 325 to 585 milliseconds and the third chargeability from 585 to 845 milliseconds.

A chargeability reading is defined by the formula:

$$M = \frac{Vs}{Vp} \text{ in millivolts/volt}$$

$$V_s = \frac{1}{t_r} \int_{t1}^{t2} V_s \, dt + Vx$$

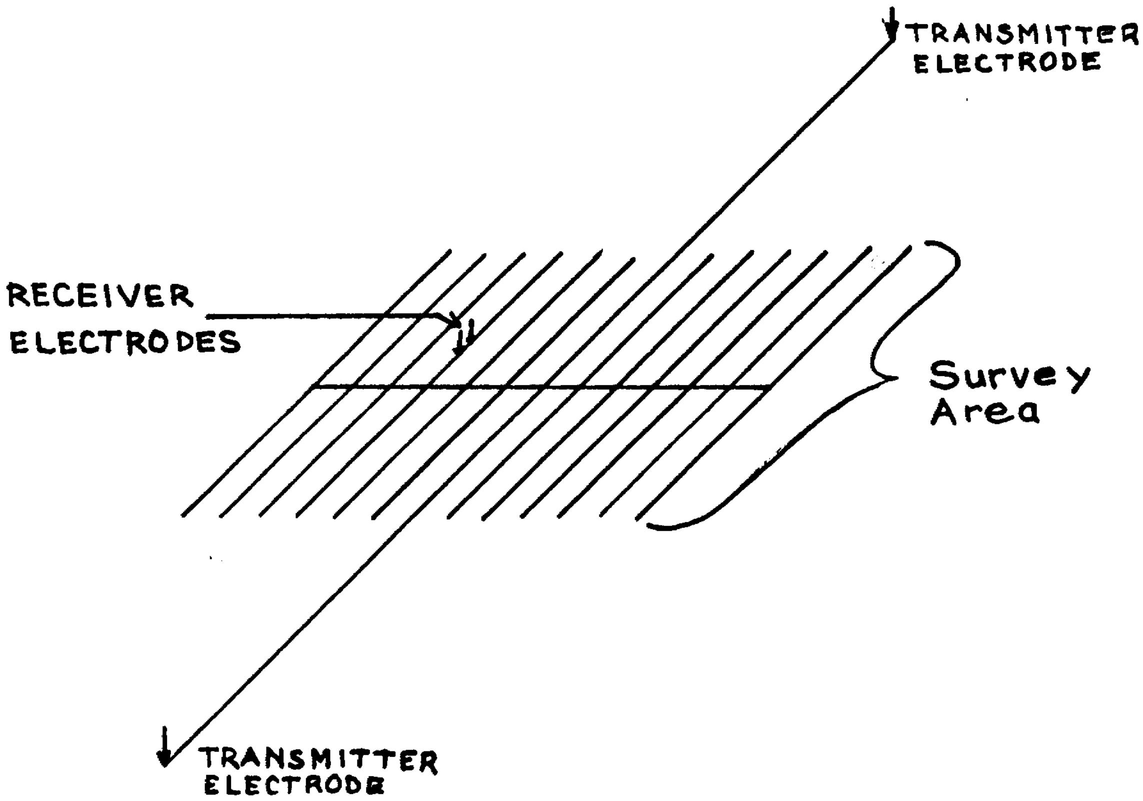
where t_1 = time at beginning of slice

t_2 = time at end of slice

V_x = residual transient voltage at the end of the automatic self potential correction

$t_r = t_2 - t_1$, i.e. the integrating period

V_p = primary voltage



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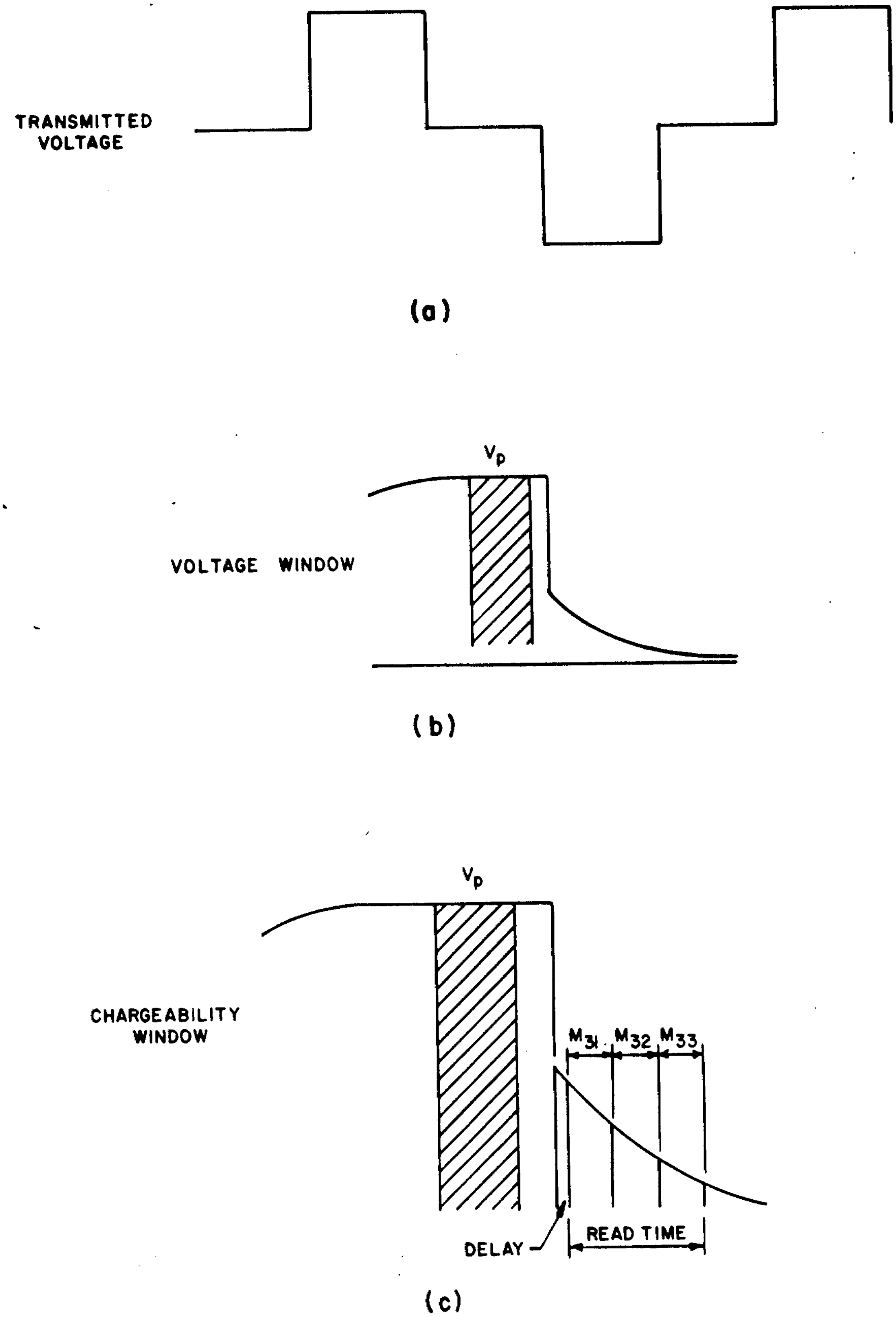
RESISTIVITY/IP ELECTRODE CONFIGURATION

GRADIENT ARRAY

FIGURE 1

HT84-82/03



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WAVE FORMS USED FOR
IP/RESISTIVITY CALCULATIONS

FIGURE 2

HT83-82/03

SCINTREX TSQ-3 3000 W

Time and Frequency Domain IP and Resistivity Transmitter

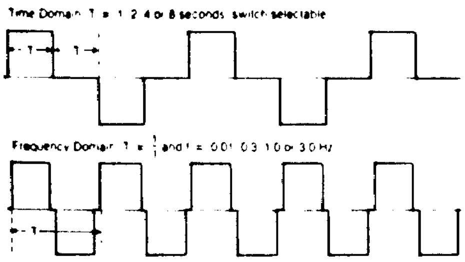
Function

The TSQ-3 is a multi-frequency, square wave transmitter suitable for induced polarization and resistivity measurements in either the time or frequency domain. The unit is powered by a separate motor-generator.

The favourable power/weight ratio and compact design of this system make it portable and highly versatile for use with a wide variety of electrode arrays. The medium range power rating is sufficient for use under most geophysical conditions.

The TSQ-3 has been designed primarily for use with the Scintrex Time Domain and Frequency Domain Receivers, for combined induced polarization and resistivity measurements, although it is compatible with most standard time domain and frequency domain receivers. It is also compatible with the Scintrex Commutated DC Resistivity Receivers for resistivity surveying. The TSQ-3 may also be used as a very low frequency electromagnetic transmitter.

Basically the transmitter functions as follows. The motor turns the generator (alternator) which produces 800 Hz, three phase, 230 V AC. This energy is transformed upwards according to a front panel voltage setting by a large transformer housed in the TSQ-3. The resulting AC is then rectified in a rectifier bridge. Commutator switches then control the DC voltage output according to the waveform and frequency selected. Excellent output current stability is ensured by a unique, highly efficient technique based on control of the phase angle of the three phase input power.



Waveforms output by the TSQ-3

Features

Current outputs up to 10 amperes, voltage outputs up to 1500 volts, maximum power 3000 VA.

Solid state design for both power switching and electronic timing control circuits.

Circuit boards are removable for easy servicing.

Switch selectable wave forms: square wave continuous for frequency domain and square wave interrupted with automatic polarity change for time domain.

Switch selectable frequencies and pulse times.

Overload, underload and thermal protection for maximum safety.

Digital readout of output current.

Programmer is crystal controlled for very high stability.

Low loss, solid state output current regulation over broad range of load and input voltage variations.

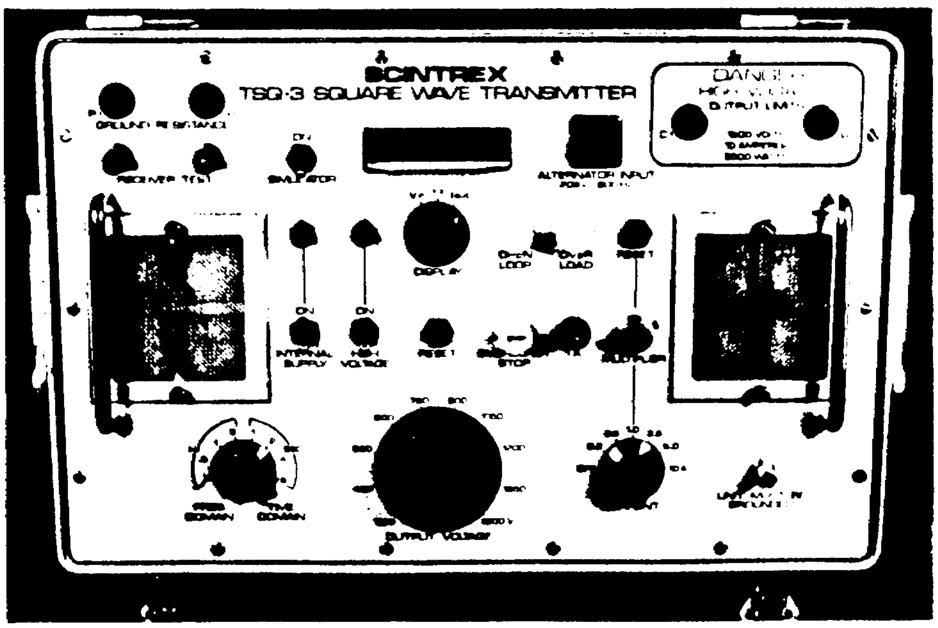
Rectifier circuit is protected against transients.

Excellent power/weight ratio and efficiency.

Designed for field portability; motor-generator is installed on a convenient frame and is easily man-portable. The transmitter is housed in an aluminum case.

The motor-generator consists of a reliable Briggs and Stratton four stroke engine coupled to a brushless permanent magnet alternator.

New motor-generator design eliminates need for time domain dummy load.



Technical Description of TSQ-3/3000W Time and Frequency Domain IP and Resistivity Transmitter

TSQ-3 transmitter with portable motor generator unit

Transmitter Console	
Output Power	3000 VA maximum
Output Voltages	300, 400, 500, 600, 750, 900, 1050, 1200, 1350 and 1500 volts, switch selectable
Output Current	10 amperes maximum
Output Current Stability	Automatically controlled to within ± 0.1% for up to 20% external load variation or up to ± 10% input voltage variation
Digital Display	Light emitting diodes permit display up to 1999 with variable decimal point; switch selectable to read input voltage, output current, external circuit resistance. Dual current range, switch selectable
Absolute Accuracy	± 3% of full range
Current Reading Resolution	10 mA on coarse range (0-10A) 1 mA on fine range (0-2A)
Frequency Domain Waveform	Square wave, continuous with approximately 6% off time at polarity change
Frequency Domain Frequencies	Standard: 0.1, 0.3, 1.0 and 3.0 Hz, switch selectable Optional: any number of frequencies in range 0 to 5 Hz.
Time Domain Cycle Timing	t:t:t:t;on:off:on:off;automatic
Time Domain Polarity Change	each 2t; automatic
Time Domain Pulse Durations	Standard: t = 1, 2, 4 or 8 seconds Optional: any other timings
Time and Frequency Stability	Crystal controlled to better than .01%
Efficiency	.78
Operating Temperature Range	− 30°C to + 50°C
Overload Protection	Automatic shut-off at 3300 VA
Underload Protection	Automatic shut-off at current below 75mA
Thermal Protection	Automatic shut-off at internal temperature of + 85°C
Dimensions	350 mm x 530 mm x 320 mm
Weight	25.0 kg.
Power Source	
Type	Motor flexibly coupled to alternator and installed on a frame with carrying handles.
Motor	Briggs and Stratton, four stroke, 8 H.P.
Alternator	Permanent magnet type, 800 Hz, three phase 230 V AC
Output Power	3500 VA maximum
Dimensions	520 mm x 715 mm x 560 mm
Weight	72.5 kg
Total System	
Shipping Weight	150 kg includes transmitter console, motor generator, connecting cables and re-usable wooden crates

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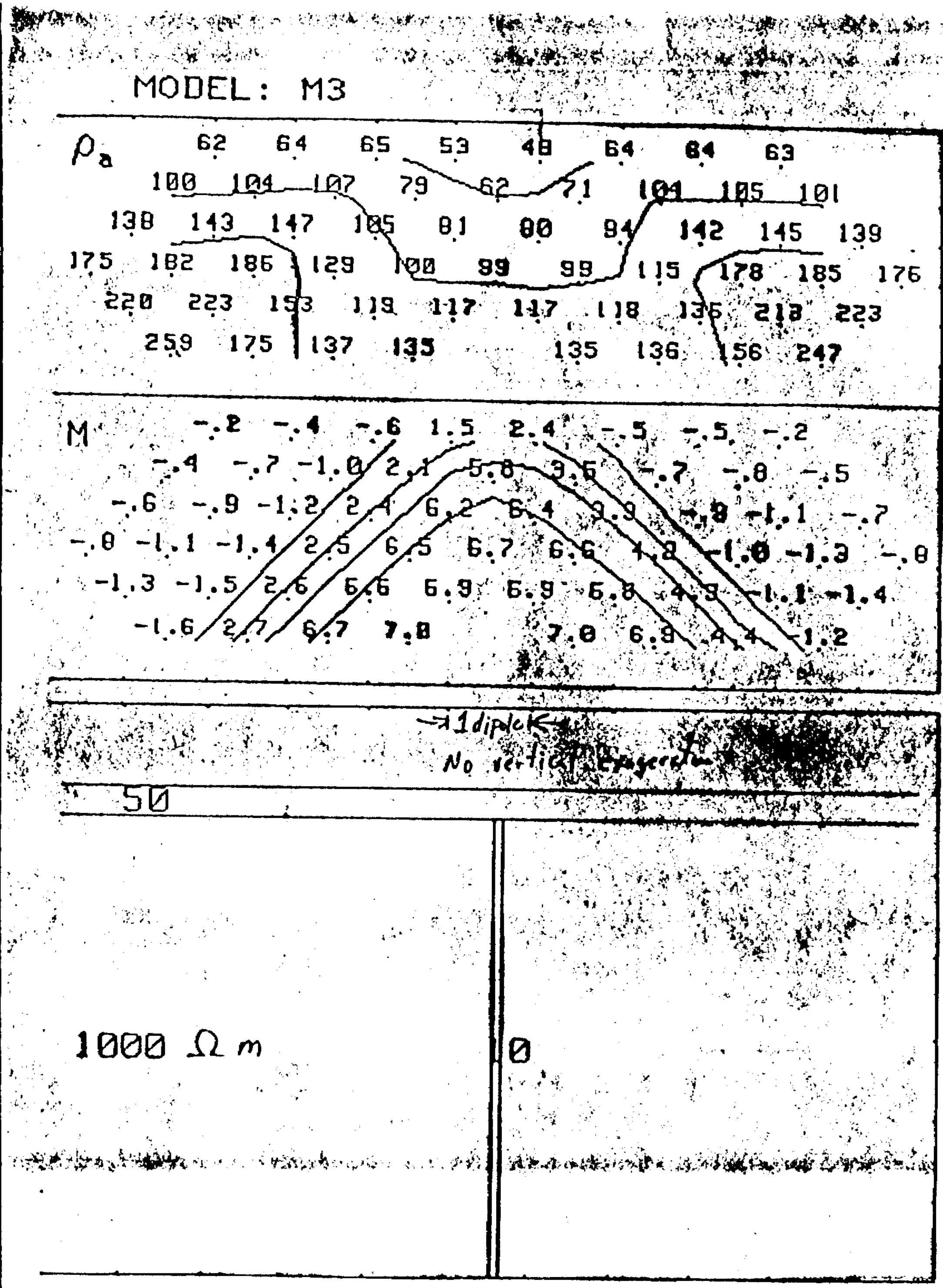
Geophysical and Geochemical Instrumentation and Services



MODEL: M3
ρa
62 64 65 53 48 64 64 63
100 104 107 79 62 71 104 105 101
138 143 147 105 81 80 94 142 145 139
175 182 186 129 100 99 99 115 178 185 176
220 223 153 119 117 117 118 135 213 223
259 175 137 135 135 136 156 247
M
-.2 -.4 -.6 1.5 2.4 -.5 -.5 -.2
-.4 -.7 -1.0 2.1 5.8 3.6 -.7 -.8 -.5
-.6 -.9 -1.2 2.4 6.2 6.4 3.9 -.8 -1.1 -.7
-.8 -1.1 -1.4 2.5 6.5 6.7 6.6 4.8 -1.0 -1.3 -.8
-1.3 -1.5 2.6 6.6 6.9 6.9 6.8 4.9 -1.1 -1.4
-1.6 2.7 6.7 7.8 7.0 6.8 4.4 -1.2
1 dipole
No vertical
50
1000 Ω m
0

SCINTREX IPR-10A Digital Time Domain Induced Polarization Receiver

Function

Scintrex has improved the successful IPR-10 Digital Time Domain Receiver to give new advantages to the explorationist and researcher alike. The new IPR-10A includes all the features of the IPR-10 plus: 1) an analogue output for recording on a chart recorder, 2) an expanded programme allowing for pulses of up to 8 seconds, twice as long as with the IPR-10 and 3) a longer integrating time for Vp, totalling 40 percent of the current on (pulse) time.

Packaged in a lightweight, portable format, this reliable receiver allows a new ease of operation due to the semi-automatic primary voltage (Vp) ranging, the digital display and the continuous averaging of Vp and IP transient values. An analogue meter has been retained so that the operator still has visual confirmation that signal levels are adequate and that the transmitter is operating properly.

The IPC-10A is principally used in electrical (EIP) and magnetic (MIP) induced polarization surveys for disseminated base metal occurrences such as porphyry copper in acidic intrusives and lead-zinc deposits in carbonate rocks. In addition, the IPR-10A receiver can be used in high accuracy resistivity surveying where its automatic commutated DC resistivity measurement, automatic SP buckout and digital read-out offer distinct advantages over other techniques. Also, it is often useful to measure induced polarization in addition to resistivity as a second physical parameter for interpretation. It often happens that geological materials have IP contrasts when resistivity contrasts are absent.

Advantages

Digital display. Battery voltage (V_{BAT}), self potential (SP), primary voltage (Vp) and chargeability (M) values are read out on a high legibility digital display in volts, millivolts, microvolts or millivolts/volt.

A low power consumption Liquid Crystal display is standard while a Light Emitting Diode display is optional for cold weather operation.

Continuous averaging. Vp and M values are continuously averaged and the display is automatically updated for each pulse pair.

Full operator control. Reading may be terminated at any time that the operator feels that the values have adequately converged. The instrument will then automatically bring the average to a pulse pair. It will automatically shut off at a pulse pair after a maximum of 31 cycles.

Multiple channel selection. Forty standard switch selectable IP integration channels with either 1, 3 or 6 channels integrated simultaneously.

Vp integration. The Vp is integrated for 40% of the current on time, enough to average out random noise but sufficiently removed from the on and off parts of the pulse which may be distorted by coupling or IP effects.

Analogue recorder output. While the digital averaging is usually sufficient to yield convergence to a noise free reading, in areas of very low signal or for research purposes, the entire curve form can be recorded on an analogue chart recorder for later analysis.

Reading recall. Any value can be called up repeatedly at any time after a reading has been completed simply by manipulating a function switch. The values are only erased when a new reading is begun or when the receiver is turned off.

Semi-automatic Vp ranging. The semi-automatic primary voltage ranging means that the operator need only select the appropriate one of twelve Vp ranges for inputs between 30 microvolts and 30 volts. There is no manual fine adjustment for Vp.

Normalized chargeability readout. M is read directly in Vs/Vp, normalized for the integration time. The multiple channel M readouts are normalized for standard decay curve shape, providing immediate field indication of anomalous curve shape.

Continuous Vp monitor. An analogue meter is used for continuous operator monitoring of transmitted signal as well as for the external circuit resistance.

Positive self triggering. Synchronous gating and a restriction on triggering to

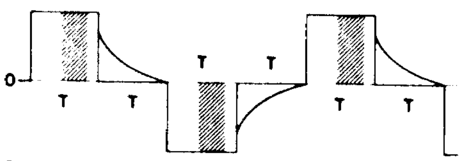
IPR-10A Digital Time Domain Induced Polarization Receiver

the final 2.5% of the current on time reduce the possibility of mistriggering by noise provided that the transmitter and receiver timings are equal.

Expanded self potential tracking. Automatic self potential tracking down to 30μV Vp with a range up to 20 x Vp.

Versatile. Useable with any time domain transmitter.

Plus. External circuit ohmmeter, high input impedance, excellent power line noise rejection, CMOS circuitry, long life from only four dry cells, lightweight, robust construction.



Time domain wave form. The shaded area represents the Vp integration time. For each current pulse, integration starts at .45T and ends at .85T so that 40% of the area of the pulse is averaged. The Vp values are normalized for time. T can be 1, 2, 4 or 8 seconds.

Operation

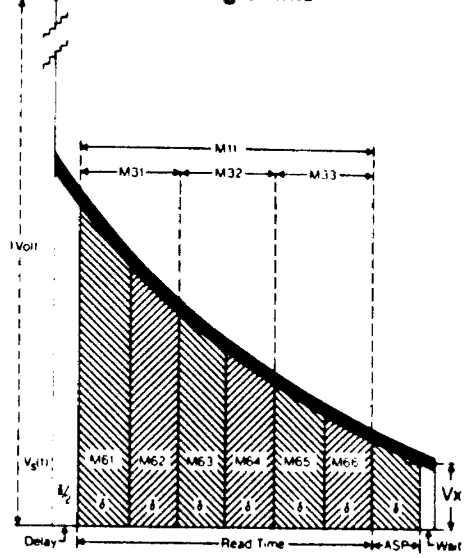
The IPR-10A is simple to operate. First, the operator selects the measuring programme desired, that is whether the area under the decay curve is to be integrated in one, three or six slices and whether the value of δ (shown in the IPR-10A programme diagram) is 130, 260, 520 or 1040 milliseconds. The potential circuit resistance may be checked using the built-in ohmmeter.

Both the Transmitter and Receiver are then turned on. The SP control and Vp range switch are adjusted for symmetrical deflection, within an indicated range on the analogue meter. The SP can then be read on the digital display in millivolts. The polarity depends on the position of a toggle switch.

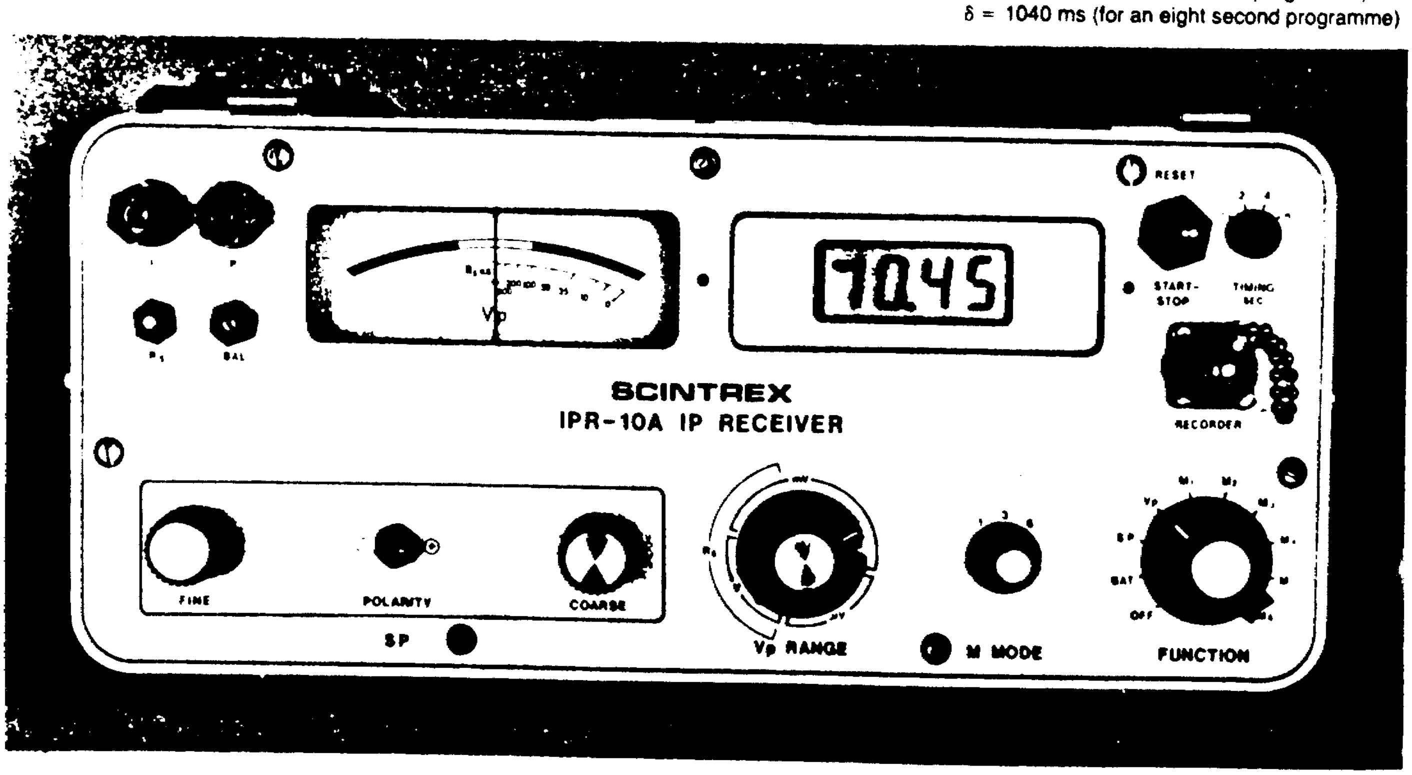
After the integration is initiated, the values of the primary voltage (Vp) and the chargeability (M) are averaged and updated after each pulse pair (i.e. cycle). Depending on the position of the Function Switch, the current average of: Vp, M_{11}, M_{31}, or M_{61} (see programme diagram), is displayed on the digital display, while the values of the additional M slices are stored in the memory for recall when the reading is complete. The M values are in millivolts/volt, i.e. they are normalized for Vp, slice width, number of pulses and curve shape.

The curve shape normalization is to a standard decay form. All six channel outputs should be approximately equal provided that there is no electromagnetic

IPR-10A Programme



δ = 130 ms (for a one second programme)
δ = 260 ms (for a two second programme)
δ = 520 ms (for a four second programme)
δ = 1040 ms (for an eight second programme)



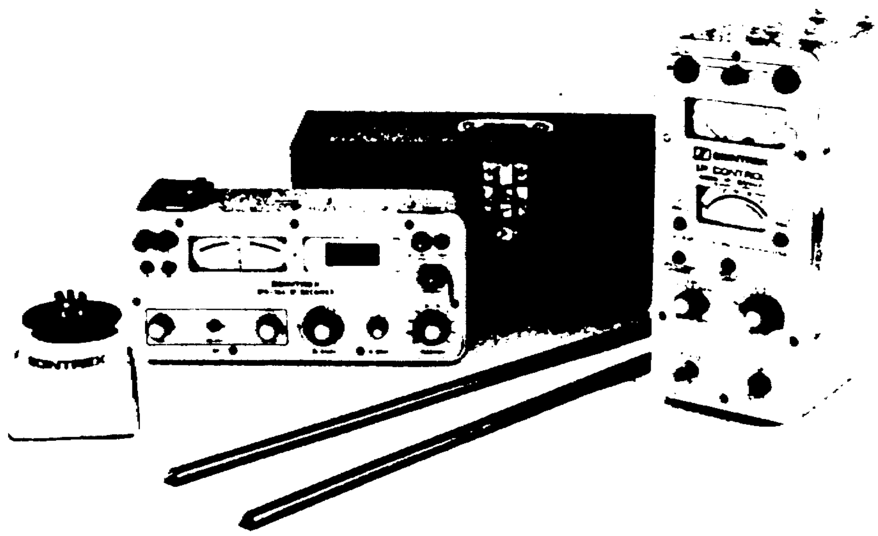
IPR-10A Digital Time Domain Induced Polarization Receiver

coupling or IP effects with anomalous decay time constants. This allows the operator to attack coupling problems immediately, for example, by changing the electrode array. The actual curve shape can be restored, if desired, using the normalizing constants given in the manual.

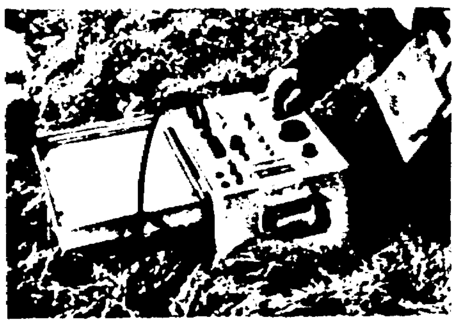
Digital Displays

The IPR-10A is available with either a standard Liquid Crystal (LCD) or an optional Light Emitting Diode (LED) display. The LCD display has much lower power consumption than the LED and far superior readability in high ambient light. This display has been programmed to continuously read out the V_{BAT}, Sp, Vp or M values according to the Function Switch setting. To conserve battery power, the LED option is programmed to display these values for .2 seconds per cycle during measurement and for 2 seconds during read-out. The display is then shut off until the Function Switch is moved to a new position.

Both displays offer good legibility, even in direct sunlight. While Scintrex employs the best available low-temperature specification LCD's, these displays become sluggish at temperatures below 0°C so that the use of this display is recommended down to − 10°C only. For lower temperature operation, the LED option is recommended. If the standard LCD display is purchased initially, a conversion to LED's can be made at a later date, if it becomes desirable to use the IPR-10A in a sub-zero environment.

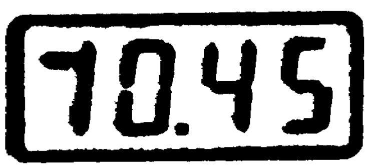


IPR-10A Time Domain Receiver and battery powered 250 watt IPC-8 / 250 Transmitter.



The TSQ-3 Time and Frequency Domain, 3000 W, IP and Resistivity Transmitter, one of five different Scintrex Transmitters compatible with the IPR-10A.

Actual size of LCD digital display.



A chargeability reading is defined by the following formula:

$$M = \frac{Vs \cdot 1000}{Vp} \text{ in mV/V}$$

$$Vs = \frac{1}{t_r}\int_{t_1}^{t_2} Vs\, dt + Vx$$

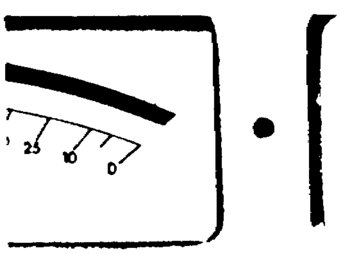
t_1 = time at beginning of slice.

t_2 = time at end of slice.

Vx = residual transient voltage at the end of the automatic self potential correction.

$t_r = t_2 - t_1$, i.e. the integrating period.

Vp = primary voltage.



SCINTREX
IPR-10A IP RECEIVER

Technical Description of the IPR-10A Digital Time Domain Induced Polarization Receiver

Input Impedance	3.0 megohms.
50 or 60 Hz Powerline Rejection	− 50 db (300x). Client should specify power line frequency in area of application so proper filter can be installed.
Primary Voltage Range	30 microvolts to 30 volts in 12 ranges.
Accuracy of Vp Measurement	±3% full scale; 0.1% resolution.
Vs/Vp Range	100 mV/V (100‰) full scale.
Vs/Vp Accuracy	3% of full scale, 0.1 mV/V resolution.
SP Accuracy	1%.
SP Resolution	1 mV.
Primary SP Buckout Range	±1 V.
Automatic SP Tracking Range	20 x Vp, maximum ± 1 V, minimum 30μV.
External Circuit Ohmmeter	0 to 500 K ohms.
Analogue Recorder Output	±4V Full Scale. 1 KΩ source resistance.
Digital Display	Liquid Crystal (LCD) is standard, Light Emitting Diode (LED) is optional. 3½ digits in both cases. LCD display stays on continuously. LED display displays for .2 seconds each cycle during measurement and for 2 seconds during readout then shuts off to conserve power. The LED display is recommended mainly for operation below −10°C.
Required Stability of Transmitter Timing	Need only exceed measuring programme selected (1, 2, 4 or 8 second programme, see diagram) however, deviation from nominal time may affect the accuracy of measurement.
Operating Temperature Range	For standard LCD model; −10° to +60 °C. For optional LED model; −30° to +60 °C.
Storage Temperature Range	For standard LCD model; −20° to +75°C. For optional LED model; −60° to +75°C.
Dimensions	310 mm x 150 mm x 170 mm.
Weight, Complete with Lid and Batteries	3.6 kg.
Power Supply	4 D cells; estimated battery life 1 month intermittent duty at 25°C with LCD display, 1 week with LED display plus 1 Alkaline cell, Eveready E91 or equivalent; estimated life, 1 year.

SCINTREX

222 Snidercroft Road
Concord Ontario Canada
L4K 1B5

Telephone: (416) 669-2280
Cable: Geoscint Toronto
Telex: 06-964570

Geophysical and Geochemical
Instrumentation and Services

HARDY ASSOCIATES (1978) LTD.
CONSULTING ENGINEERING & PROFESSIONAL SERVICES

STATEMENT OF QUALIFICATIONS

I, William J. Scott, of Calgary, Alberta, do hereby certify that:

1. I am Chief Geophysicist of Hardy Associates (1978) Ltd., with an office at 221-18 St S.E., Calgary, Alberta, T2E 6J5.

2. I graduated in Engineering Physics (Geophysics Option) from the University of Toronto in 1962. I obtained an M.A. in Geophysics from the University of Toronto in 1965, and a PhD in Applied Geophysics from McGill University in 1982.

3. I have practised my profession continuously since graduation, and have been with Hardy Associates since 1980.

4. I am a registered Professional Engineer in Ontario.

5. I have no interest in Bearcat Explorations nor in Carl Creek Resources or the Kenogaming Property nor do I expect to receive or acquire any such interest in the future.

6. I supervised the performance of this survey, in person at the outset, and nightly by telephone thereafter.

W.J. Scott, Ph.D, P.Eng.

Ministry of Natural Resources
Ontario

Report of Work
(Geophysical, Geological, Geochemical and Expenditures)

W8406.447 #5

42A04NW0132 2.7342 KENOGAMING

Mining Act — Do not use shaded areas

900

Type of Survey(s): GEOPHYSICAL - INDUCED POLARIZATION	Township or Area: KENOGAMING TWP
Claim Holder(s): INGEMAR EXPLORATIONS LTD	Prospector's Licence No.: T-836
Address: CEDARHILL ONTARIO	
Survey Company: HARDY ASSOCIATES (1978) LTD.	Date of Survey (from & to): 11 03 84 (Day Mo. Yr.) – 31 03 84 (Day Mo. Yr.) — Total Miles of line Cut: --
Name and Address of Author (of Geo-Technical report): W.J. SCOTT, 221-18 STREET S.E. CALGARY, ALBERTA T2E 6J5	

Credits Requested per Each Claim in Columns at right

Special Provisions		Days per Claim
For first survey: Enter 40 days. (This includes line cutting)	Geophysical - Electromagnetic	
	- Magnetometer	
For each additional survey: using the same grid: Enter 20 days (for each)	- Radiometric	
	- Other	
	Geological	
	Geochemical	
Man Days		**Days per Claim**
Complete reverse side and enter total(s) here	Geophysical - Electromagnetic	
	- Magnetometer	
	- Radiometric	
	- Other IP	~~53~~ 120 maximum reached
	Geological	
	Geochemical	
Airborne Credits		**Days per Claim**
Note: Special provisions credits do not apply to Airborne Surveys.	Electromagnetic	
	Magnetometer	
	Radiometric	

Mining Claims Traversed (List in numerical sequence)

Prefix	Number	Expend. Days Cr.
P	652688	
	652689	
	652690	
	652691	
	652692	
	652800	
	653241	
	653242	

PORCUPINE MINING DIVISION
RECEIVED
OCT 22 1984
A.M. 7 8 9 10 11 12 1 2 3 4 5 6 P.M.

RECORDED
OCT 22 1984
Receipt No. 4

Total number of mining claims covered by this report of work: 8

Expenditures (excludes power stripping)

Type of Work Performed:

Performed on Claim(s):

Calculation of Expenditure Days Credits

Total Expenditures $ ÷ 15 = Total Days Credits

Instructions: Total Days Credits may be apportioned at the claim holder's choice. Enter number of days credits per claim selected in columns at right.

Date	Recorded Holder or Agent (Signature)

For Office Use Only

Total Days Cr. Recorded	Date Recorded	Mining Recorder
160	Oct. 22/84	[signature]
	Date Approved as Recorded: Nov 7/84	Branch Director: [signature]

Certification Verifying Report of Work

I hereby certify that I have a personal and intimate knowledge of the facts set forth in the Report of Work annexed hereto, having performed the work or witnessed same during and/or after its completion and the annexed report is true.

Name and Postal Address of Person Certifying:
W.J. SCOTT HARDY ASSOCIATES (1978) LTD
221-18 ST S.E. CALGARY, ALBERTA T2E 6J5

Date Certified: 18 Oct 84 — Certified by (Signature): [signature]

1362 (81/9)

Assessment Work Breakdown

Man Days are based on eight (8) hour Technical or Line-cutting days. Technical days include work performed by consultants, draftsmen, etc..

Type of Survey: INDUCED POLARIZATION

Technical Days				Technical Days Credits		Line-cutting Days		Total Credits		No. of Claims		Days per Claim
	X	7	=		+		=		÷		=	

Type of Survey:

Technical Days				Technical Days Credits		Line-cutting Days		Total Credits		No. of Claims		Days per Claim
	X	7	=		+		=		÷		=	

Type of Survey:

Technical Days				Technical Days Credits		Line-cutting Days		Total Credits		No. of Claims		Days per Claim
	X	7	=		+		=		÷		=	

Type of Survey:

Technical Days				Technical Days Credits		Line-cutting Days		Total Credits		No. of Claims		Days per Claim
	X	7	=		+		=		÷		=	

Field:	Scott	2
	Galopin	17
	Hemstock	17
	D allaire	15
		51 days

Office:	Scott	2
	Galopin	5
	Drafting	2
		9

Total technical days: 60

Ontario

File

Ministry of Natural Resources

GEOPHYSICAL – GEOLOGICAL – GEOCHEMICAL TECHNICAL DATA STATEMENT

TO BE ATTACHED AS AN APPENDIX TO TECHNICAL REPORT
FACTS SHOWN HERE NEED NOT BE REPEATED IN REPORT
TECHNICAL REPORT MUST CONTAIN INTERPRETATION, CONCLUSIONS ETC.

Type of Survey(s) INDUCED POLARIZATION
Township or Area KENOGAMING
Claim Holder(s)

Survey Company HARDY ASSOCIATES (1978) LTD
Author of Report W.J. SCOTT
Address of Author 221-18 STREET S.E. CALGARY ALBERTA T2E 6J5
Covering Dates of Survey 11 MARCH-15 APRIL 84
(linecutting to office)
Total Miles of Line Cut -

SPECIAL PROVISIONS CREDITS REQUESTED

ENTER 40 days (includes line cutting) for first survey.

ENTER 20 days for each additional survey using same grid.

	DAYS per claim
Geophysical	
–Electromagnetic	
–Magnetometer	
–Radiometric	
–Other	
Geological	
Geochemical	

AIRBORNE CREDITS (Special provision credits do not apply to airborne surveys)

Magnetometer ______ Electromagnetic ______ Radiometric ______
(enter days per claim)

DATE: 18 Oct 84 SIGNATURE: W. Scott
Author of Report or Agent

Res. Geol. ______ Qualifications 2 6345

Previous Surveys

File No.	Type	Date	Claim Holder

MINING CLAIMS TRAVERSED
List numerically

(prefix)	(number)
P65	2688
	2689
	2690
	2691
	2692
	2800
	3241
	3242

If space insufficient, attach list

TOTAL CLAIMS ______

837 (5/79)

GEOPHYSICAL TECHNICAL DATA

GROUND SURVEYS - If more than one survey, specify data for each type of survey

Number of Stations 629 Number of Readings 1252

Station interval 25m Line spacing 100 m and 50 m

Profile scale

Contour interval Chargeability 10 milliseconds

Resistivity 1,5,10,50,100,500,1000,5000,10000 ohm-metres

MAGNETIC

Instrument

Accuracy – Scale constant

Diurnal correction method

Base Station check-in interval (hours)

Base Station location and value

ELECTROMAGNETIC

Instrument

Coil configuration

Coil separation

Accuracy

Method: ☐ Fixed transmitter ☐ Shoot back ☐ In line ☐ Parallel line

Frequency

(specify V.L.F. station)

Parameters measured

GRAVITY

Instrument

Scale constant

Corrections made

Base station value and location

Elevation accuracy

INDUCED POLARIZATION RESISTIVITY

Instrument TX: Scintrex TSQ3 RX: Scintrex IPR 10A

Method ☒ Time Domain ☐ Frequency Domain

Parameters – On time 1 second Frequency

– Off time 1 second Range

– Delay time 65 milliseconds

– Integration time 780 milliseconds

Power 3 KVA

Electrode array Gradient

Electrode spacing RX: 25 m TX: 3000 M

Type of electrode RX: Stainless Steel Rods. TX: Aluminum foil with steel rods

SELF POTENTIAL

Instrument ________________ Range ________________

Survey Method ________________

____

Corrections made ________________

____

RADIOMETRIC

Instrument ________________

Values measured ________________

Energy windows (levels) ________________

Height of instrument ________________ Background Count ________________

Size of detector ________________

Overburden ________________

(type, depth – include outcrop map)

OTHERS (SEISMIC, DRILL WELL LOGGING ETC.)

Type of survey ________________

Instrument ________________

Accuracy ________________

Parameters measured ________________

____

Additional information (for understanding results) ________________

____

____

AIRBORNE SURVEYS

Type of survey(s) ________________

Instrument(s) ________________

(specify for each type of survey)

Accuracy ________________

(specify for each type of survey)

Aircraft used ________________

Sensor altitude ________________

Navigation and flight path recovery method ________________

____

Aircraft altitude ________________ Line Spacing ________________

Miles flown over total area ________________ Over claims only ________________

GEOCHEMICAL SURVEY – PROCEDURE RECORD

Numbers of claims from which samples taken ______

______

______

Total Number of Samples ______

Type of Sample ______
(Nature of Material)

Average Sample Weight ______

Method of Collection ______

______

Soil Horizon Sampled ______

Horizon Development ______

Sample Depth ______

Terrain ______

______

Drainage Development ______

Estimated Range of Overburden Thickness ______

______

______

SAMPLE PREPARATION

(Includes drying, screening, crushing, ashing)

Mesh size of fraction used for analysis ______

______

______

______

General ______

______

______

______

______

______

______

______

______

______

ANALYTICAL METHODS

Values expressed in: per cent ☐ p. p. m. ☐ p. p. b. ☐

Cu, Pb, Zn, Ni, Co, Ag, Mo, As,-(circle)

Others ______

Field Analysis (______ tests)

Extraction Method ______

Analytical Method ______

Reagents Used ______

Field Laboratory Analysis

No. (______ tests)

Extraction Method ______

Analytical Method ______

Reagents Used ______

Commercial Laboratory (______ tests)

Name of Laboratory ______

Extraction Method ______

Analytical Method ______

Reagents Used ______

General ______

______

______

______

______

______

______

______

______

______

Our File: 2.7342

October 26, 1984

Mining Recorder
Ministry of Natural Resources
60 Wilson Avenue
Timmins, Ontario
P4N 2S7

Dear Sir:

We received reports and maps on October 24, 1984 for a Geophysical (Induced Polarization) Survey submitted on Mining Claims P-652688 et al in the Township of Kenogaming.

This material will be examined and assessed and a statement of assessment work credits will be issued.

We do not have a copy of the report of work which is normally filed with you prior to the submission of this technical data. Please forward a copy as soon as possible.

Yours sincerely,

S.E. Yundt
Director
Land Management Branch

Whitney Block, Room 6643
Queen's Park
Toronto, Ontario
M7A 1W3
Phone: (416)965-4888

S. Hurst:ig

cc: Ingamar Exploration
Cedar Hill
Connaught, Ontario
P0N 1A0.

cc: Hardy Associates (1978) Ltd.
221-18 Street S.E.
Calgary, Alberta
T2E 6J5

Attn: W.J. Scott

Ministry of Natural Resources
Ontario

Report of Work
(Geophysical, Geological, Geochemical and Expenditures)

COPY

Mining Act

Instructions: – Please type or print.
– If number of mining claims traversed exceeds space on this form, attach a list.
Note: – Only days credits calculated in the "Expenditures" section may be entered in the "Expend. Days Cr." columns.
– Do not use shaded areas below.

Type of Survey(s)	Township or Area
GEOPHYSICAL - INDUCED POLARIZATION	KENOGAMING TWP

Claim Holder(s)	Prospector's Licence No.
INGEMAR EXPLORATIONS LTD	T-836

Address: CEDARHILL ONTARIO

Survey Company	Date of Survey (from & to)	Total Miles of line Cut
HARDY ASSOCIATES (1978) LTD.	11 (Day) 03 (Mo.) 84 (Yr.) – 31 (Day) 03 (Mo.) 84 (Yr.)	--

Name and Address of Author (of Geo-Technical report): W.J. SCOTT, 221-18 STREET S.E. CALGARY, ALBERTA T2E 6J5

Credits Requested per Each Claim in Columns at right

Special Provisions		Days per Claim
For first survey: Enter 40 days. (This includes line cutting)	Geophysical	
	- Electromagnetic	
	- Magnetometer	
For each additional survey: using the same grid: Enter 20 days (for each)	- Radiometric	
	- Other	
	Geological	
	Geochemical	

Man Days		Days per Claim
Complete reverse side and enter total(s) here	Geophysical	
	- Electromagnetic	
	- Magnetometer	
	- Radiometric	
	- Other IP	~~53~~ 120 maximum reached
	Geological	
	Geochemical	

Airborne Credits		Days per Claim
Note: Special provisions credits do not apply to Airborne Surveys.	Electromagnetic	
	Magnetometer	
	Radiometric	

Mining Claims Traversed (List in numerical sequence)

Mining Claim Prefix	Mining Claim Number	Expend. Days Cr.
P	652688	
	652689	
	652690	
	652691	
	652692	
	652800	
	653241	
	653242	

PORCUPINE MINING DIVISION
RECEIVED
[illegible] 1984
A.M. 7 8 9 10 11 12 1 2 3 4 5 6 P.M.

Expenditures (excludes power stripping)

Type of Work Performed

Performed on Claim(s)

Calculation of Expenditure Days Credits

Total Expenditures				Total Days Credits
$	÷	15	=	

Instructions
Total Days Credits may be apportioned at the claim holder's choice. Enter number of days credits per claim selected in columns at right.

Total number of mining claims covered by this report of work.

For Office Use Only		
Total Days Cr. Recorded	Date Recorded	Mining Recorder
	Date Approved as Recorded	Branch Director

Date	Recorded Holder or Agent (Signature)

Certification Verifying Report of Work

I hereby certify that I have a personal and intimate knowledge of the facts set forth in the Report of Work annexed hereto, having performed the work or witnessed same during and/or after its completion and the annexed report is true.

Name and Postal Address of Person Certifying
W.J. SCOTT HARDY ASSOCIATES (1978) LTD
221-18 ST S.E. CALGARY, ALBERTA T2E 6J5

Date Certified: 18 Oct 84
Certified by (Signature): W Scott

Assessment Work Breakdown

Man Days are based on eight (8) hour Technical or Line-cutting days. Technical days include work performed by consultants, draftsmen, etc..

Type of Survey
INDUCED POLARIZATION

Technical Days				Technical Days Credits		Line-cutting Days		Total Credits		No. of Claims		Days per Claim
	X	7	=		+		=		÷		=	

Type of Survey

Technical Days				Technical Days Credits		Line-cutting Days		Total Credits		No. of Claims		Days per Claim
	X	7	=		+		=		÷		=	

Type of Survey

Technical Days				Technical Days Credits		Line-cutting Days		Total Credits		No. of Claims		Days per Claim
	X	7	=		+		=		÷		=	

Type of Survey

Technical Days				Technical Days Credits		Line-cutting Days		Total Credits		No. of Claims		Days per Claim
	X	7	=		+		=		÷		=	

Field:	Scott	2
	Galopin	17
	Hemstock	17
	D allaire	15
		51 days

Office:	Scott	2
	Galopin	5
	Drafting	2
		9

Total technical days: 60

Mining Lands Section — File No 2.7342

Control Sheet

TYPE OF SURVEY
- ✓ GEOPHYSICAL
- ___ GEOLOGICAL
- ___ GEOCHEMICAL
- ___ EXPENDITURE

MINING LANDS COMMENTS:

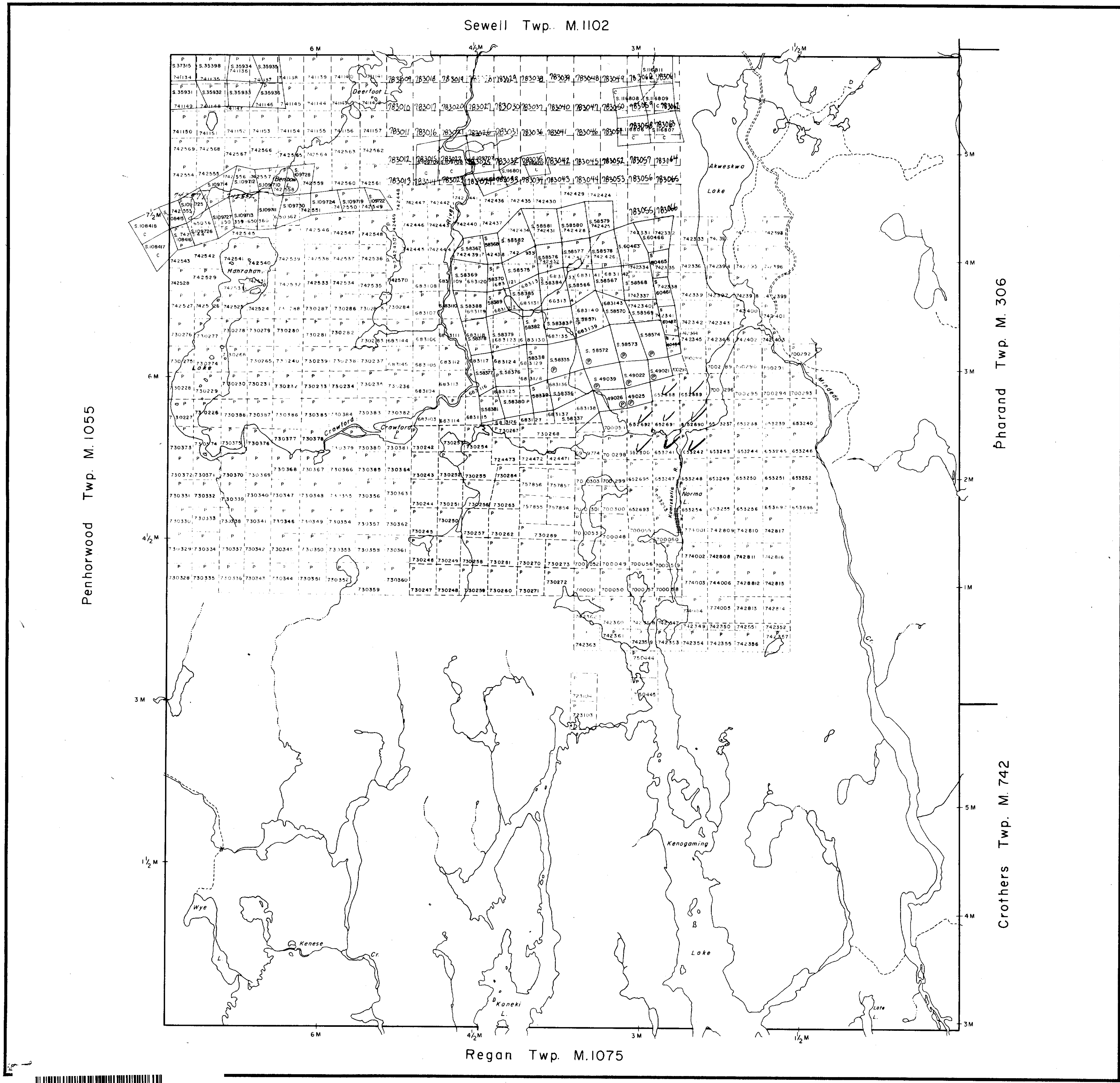
Lgl. L.D.

Denis K.

Signature of Assessor

Nov. 5/84

Date



THE TOWNSHIP OF

KENOGAMING

DISTRICT OF SUDBURY

PORCUPINE MINING DIVISION

SCALE: 1-INCH = 40 CHAINS

LEGEND

PATENTED LAND	● or Ⓟ
CROWN LAND SALE	C.S.
LEASES	Ⓛ
LOCATED LAND	Loc.
LICENSE OF OCCUPATION	L.O.
MINING RIGHTS ONLY	M.R.O.
SURFACE RIGHTS ONLY	S.R.O.
ROADS	
IMPROVED ROADS	
KING'S HIGHWAYS	
RAILWAYS	
POWER LINES	
MARSH OR MUSKEG	
MINES	
CANCELLED	C
PATENTED S.R.O.	

NOTES

400' Surface Rights reservation along the shores of all lakes and rivers.

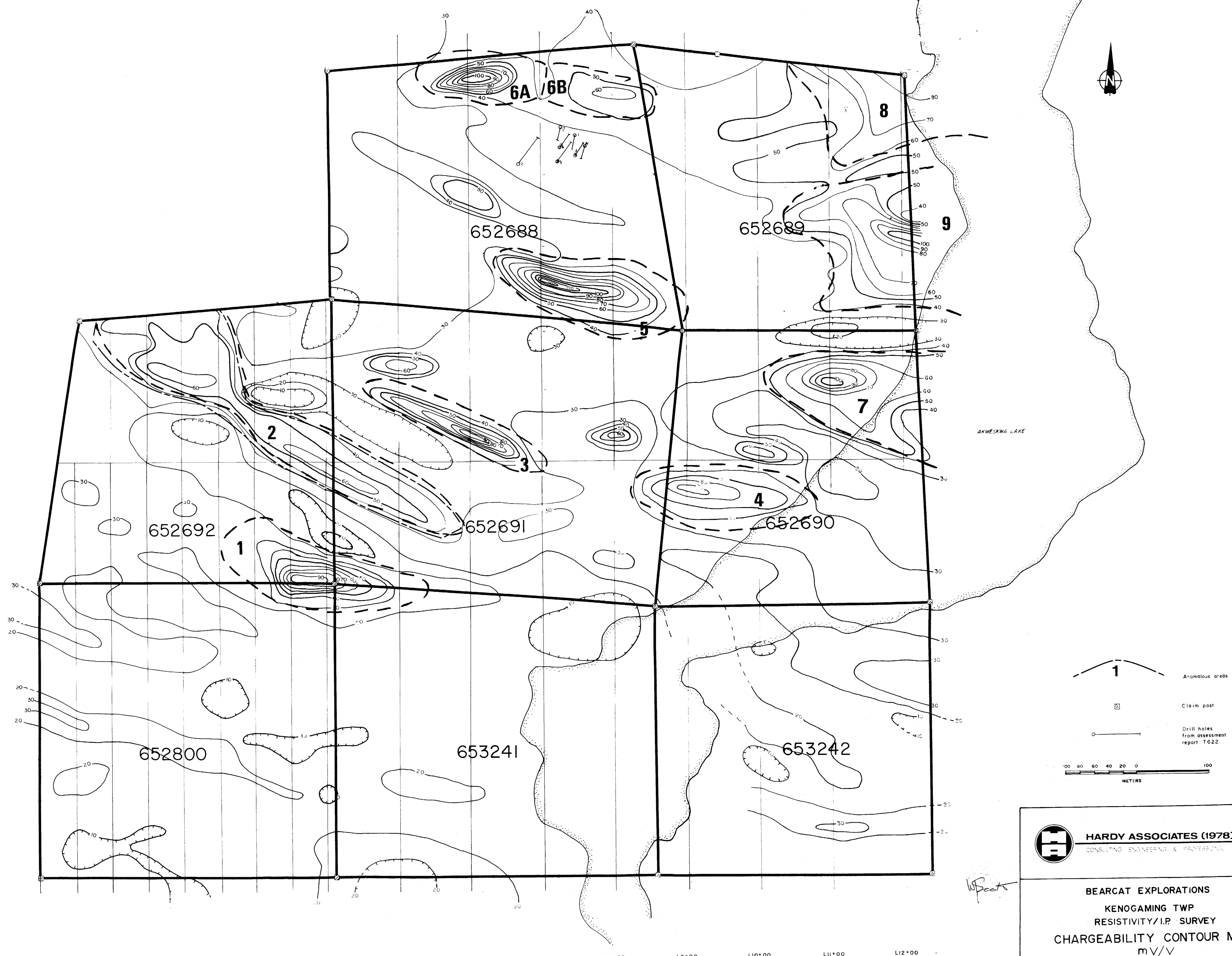
DATE OF ISSUE
Ministry of Natural Resources TORONTO

PLAN NO.- M.967

ONTARIO
MINISTRY OF NATURAL RESOURCES
SURVEYS AND MAPPING BRANCH

42A04NW0132 2.7342 KENOGAMING

200



1 Anomalous areas

Claim post

Drill holes from assessment report T622

100 80 60 40 20 0 100
METERS

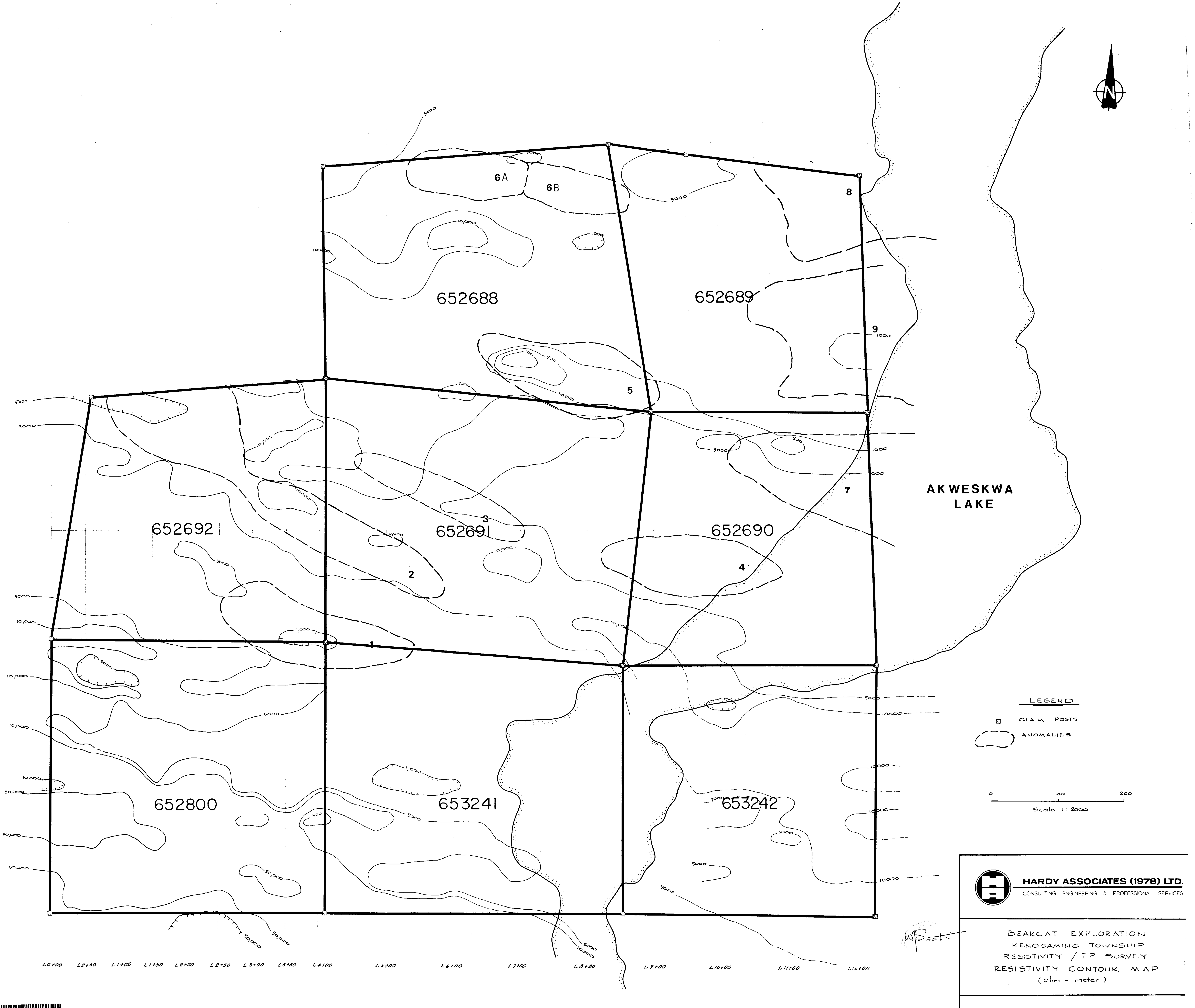
HARDY ASSOCIATES (1978) LTD.
CONSULTING ENGINEERING & PROFESSIONAL SERVICES

BEARCAT EXPLORATIONS

KENOGAMING TWP
RESISTIVITY/I.P. SURVEY

CHARGEABILITY CONTOUR MAP
mV/V

Scale: 1:2000		Date: April, 1984	
Project No. CG12046		By: C. Galopin	Plate 1

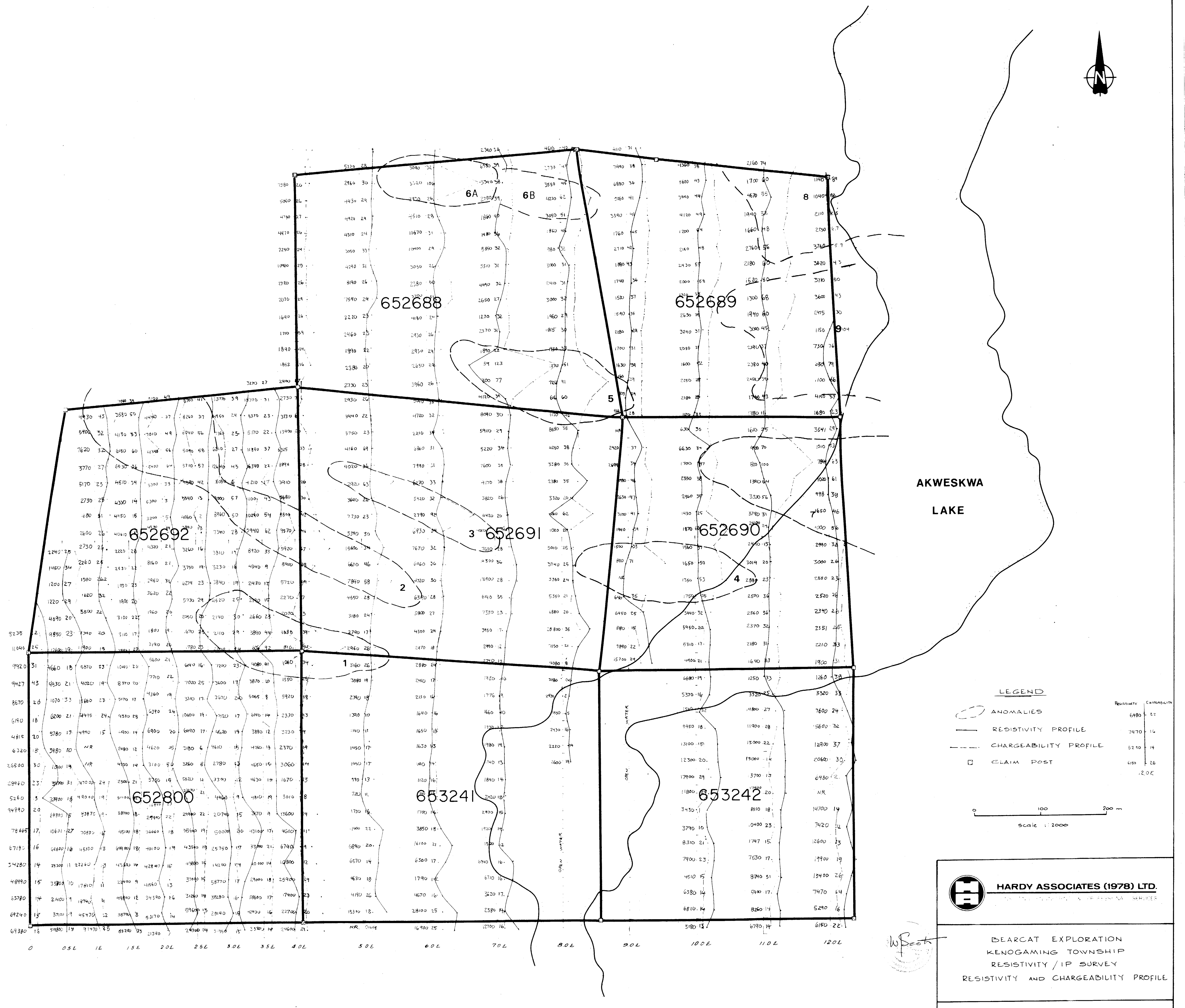


HARDY ASSOCIATES (1978) LTD.
CONSULTING ENGINEERING & PROFESSIONAL SERVICES

BEARCAT EXPLORATION
KENOGAMING TOWNSHIP
RESISTIVITY / IP SURVEY
RESISTIVITY CONTOUR MAP
(ohm - meter)

CG 12046 | 27342 | PLATE 2

220



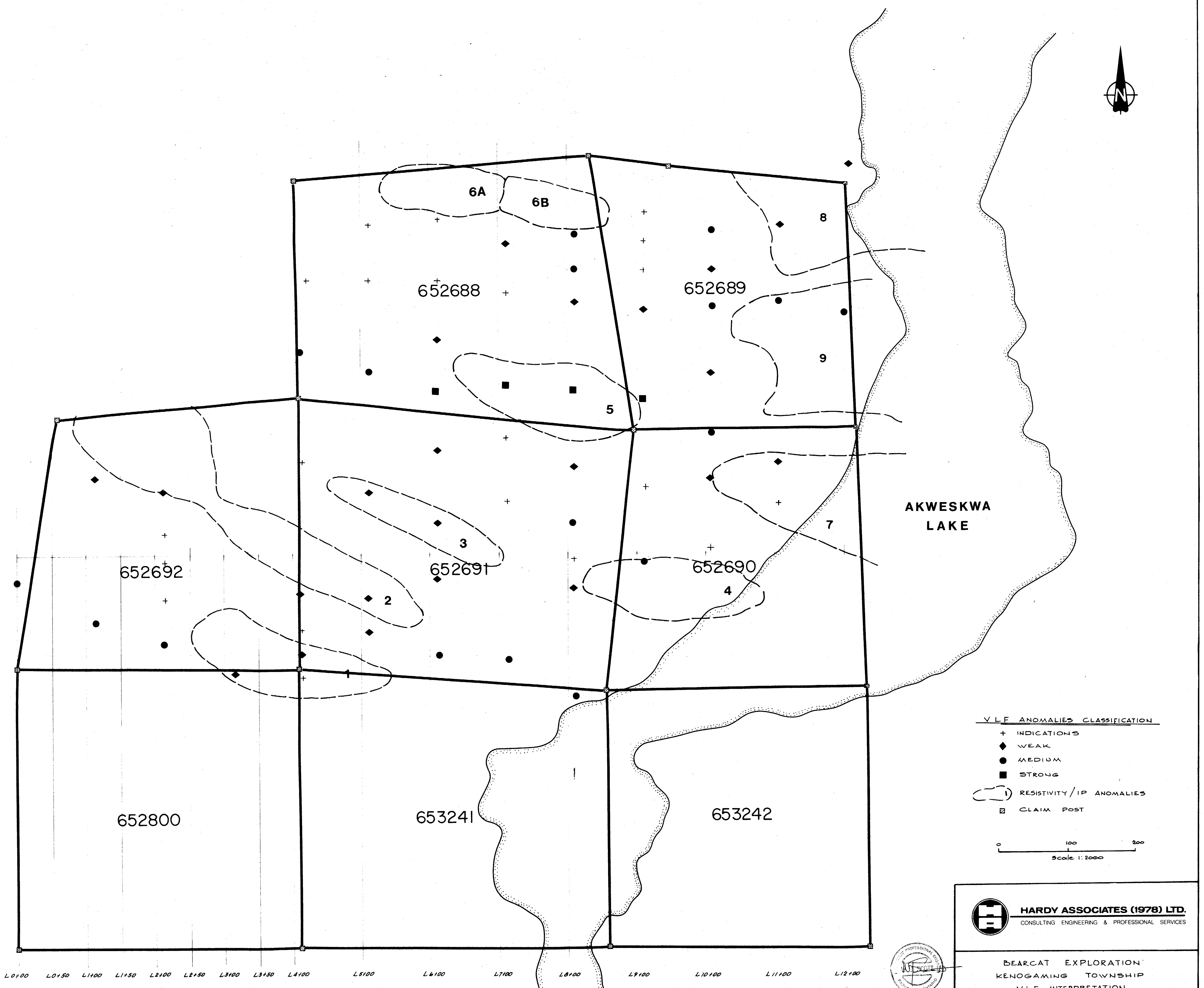
HARDY ASSOCIATES (1978) LTD.

BEARCAT EXPLORATION
KENOGAMING TOWNSHIP
RESISTIVITY / IP SURVEY
RESISTIVITY AND CHARGEABILITY PROFILE

CG 12046

PLATE 3

230



HARDY ASSOCIATES (1978) LTD.
CONSULTING ENGINEERING & PROFESSIONAL SERVICES

BEARCAT EXPLORATION
KENOGAMING TOWNSHIP
VLF INTERPRETATION
FIELD DATA FROM FILO (4)

CG 12046 | 2.7342 | PLATE 4

240