REPORT ON THE
INDUCED POLARIZATION
AND RESISTIVITY SURVEY
ON THE 104G/10W
IN AND C CLAIM GROUPS,
SCHAFT CREEK AREA,
LIARD MINING DIVISION, B.C.
FOR
HECLA OPERATING COMPANY

To accompany reports by
E. Ostensoe and
P.I. Conley, P. Eng.
for Hecla Operating Company
October 26, 1972.

3983

REPORT ON THE
INDUCED POLARIZATION
AND RESISTIVITY SURVEY
ON THE 104G/10W
IN AND C CLAIM GROUPS,
SCHAFT CREEK AREA,
LIARD MINING DIVISION, B.C.
FOR
HECLA OPERATING COMPANY

BY

PHILIP G. HALLOF, Ph.D.

AND

MARION A. GOUDIE, B.Sc.

NAME ~~AND LOCATION OF PROPERTY:~~

IN AND C CLAIM GROUPS, SCHAFT CREEK AREA
LIARD MINING DIVISION, B.C. 57°33'N, 130°55'W

DATE STARTED - IN CLAIM: JULY 25, 1972
DATE FINISHED - IN CLAIM: AUGUST 6, 1972

DATE STARTED - C CLAIM: JULY 17, 1972
DATE FINISHED - C CLAIM: AUGUST 9, 1972

TABLE OF CONTENTS

McPHAR GEOPHYSICS

NOTES ON THE THEORY, METHOD OF FIELD OPERATION AND PRESENTATION OF DATA FOR THE INDUCED POLARIZATION METHOD

Induced Polarization as a geophysical measurement refers to the blocking action or polarization of metallic or electronic conductors in a medium of ionic solution conduction.

This electro-chemical phenomenon occurs wherever electrical current is passed through an area which contains metallic minerals such as base metal sulphides. Normally, when current is passed through the ground, as in resistivity measurements, all of the conduction takes place through ions present in the water content of the rock, or soil, i.e. by ionic conduction. This is because almost all minerals have a much higher specific resistivity than ground water. The group of minerals commonly described as "metallic", however, have specific resistivities much lower than ground waters. The induced polarization effect takes place at those interfaces where the mode of conduction changes from ionic in the solutions filling the interstices of the rock to electronic in the metallic minerals present in the rock.

The blocking action or induced polarization mentioned above, which depends upon the chemical energies necessary to allow the ions to give up or receive electrons from the metallic surface, increases with the time that a d. c. current is allowed to flow through the rock; i. e. as ions pile up against the metallic interface the resistance to current flow increases. Eventually, there is enough polarization in the form of excess ions at the interfaces, to appreciably reduce the amount of current flow through the metallic particle. This polarization takes place at each of the infinite number of solution-metal interfaces in a mineralized rock.

When the d. c. voltage used to create this d. c. current flow is cut off, the Coulomb forces between the charged ions forming the polarization cause them to return to their normal position. This movement of charge creates a small current flow which can be measured on the surface of the ground as a decaying potential difference.

From an alternate viewpoint it can be seen that if the direction of the current through the system is reversed repeatedly before the polarization occurs, the effective resistivity of the system as a whole will change as the frequency of the switching is changed. This is a consequence of the fact that the amount of current flowing through each metallic interface depends upon the length of time that current has been passing through it in one direction.

The values of the per cent frequency effect or F. E. are a measurement of the polarization in the rock mass. However, since the measurement of the degree of polarization is related to the apparent resistivity of the rock mass it is found that the metal factor values or M. F. are the most useful values in determining the amount of polarization present in the rock mass. The MF values are obtained by normalizing the F. E. values for varying resistivities.

The induced polarization measurement is perhaps the most powerful geophysical method for the direct detection of metallic sulphide mineralization, even when this mineralization is of very low concentration. The lower limit of volume per cent sulphide necessary to produce a recognizable IP anomaly will vary with the geometry and geologic environment of the source, and the method of executing the survey. However, sulphide mineralization of less than one per cent by volume has been detected by the IP method under proper geological conditions.

The greatest application of the IP method has been in the search for disseminated metallic sulphides of less than 20% by volume. However, it has also been used successfully in the search for massive sulphides in situations where, due to source geometry, depth of source, or low resistivity of surface layer, the EM method can not be successfully applied. The ability to differentiate ionic conductors, such as water filled shear zones, makes the IP method a useful tool in checking EM anomalies which are suspected of being due to these causes.

In normal field applications the IP method does not differentiate between the economically important metallic minerals such as chalcopyrite, chalcocite, molybdenite, galena, etc., and the other metallic minerals such as pyrite. The induced polarization effect is due to the total of all electronic conducting minerals in the rock mass. Other electronic conducting materials which can produce an IP response are magnetite, pyrolusite, graphite, and some forms of hematite.

In the field procedure, measurements on the surface are made in a way that allows the effects of lateral changes in the properties of the ground to be separated from the effects of vertical changes in the properties. Current is applied to the ground at two points in distance (X) apart. The potentials are measured at two other points (X) feet apart, in line with the current electrodes is an integer number (n) times the basic distance (X).

The measurements are made along a surveyed line, with a constant distance (nX) between the nearest current and potential electrodes. In most surveys, several traverses are made with various values of (n); i.e. (n) = 1, 2, 3, 4, etc. The kind of survey required (detailed or reconnaissance) decides the number of values of (n) used.

In plotting the results, the values of the apparent resistivity, apparent per cent frequency effect, and the apparent metal factor measured for each set of electrode positions are plotted at the intersection of grid lines, one from the center point of the current electrodes and the other from the center point of the potential electrodes. (See Figure A.) The resistivity values are plotted above the line as a mirror image of the metal factor values below. On a second line, below the metal factor values, are plotted the values of the per cent frequency effect. In some cases the values of per cent frequency effect are plotted as superscripts of the metal factor value. In this second case the frequency effect values are not contoured. The lateral displacement of a given value is determined by the location along the survey line of the center point between the current and potential electrodes. The distance of the value from the line is determined by the distance (nX) between the current and potential electrodes when the measurement was made.

The separation between sender and receiver electrodes is only one factor which determines the depth to which the ground is being sampled in any particular measurement. The plots then, when contoured, are not section maps of the electrical properties of the ground under the survey line. The interpretation of the results from any given survey must be carried out using the combined experience gained from field results, model study results and theoretical investigations. The position of the electrodes when anomalous values are measured is important in the interpretation.

In the field procedure, the interval over which the potential differences are measured is the same as the interval over which the electrodes are moved after a series of potential readings has been made. One of the advantages of the induced polarization method is that the same equipment can be used for both detailed and reconnaissance surveys merely by changing the distance (X) over which the electrodes are moved each time. In the past, intervals have been used ranging from 25 feet to 2000 feet for (X). In each case, the decision as to the distance (X) and the values of (n) to be used is largely determined by the expected size of the mineral deposit being sought, the size of the expected anomaly and the speed with which it is desired to progress.

The diagram in Figure A demonstrates the method used in plotting the results. Each value of the apparent resistivity, apparent metal factor, and apparent per cent frequency effect is plotted and identified by the position of the four electrodes when the measurement was made. It can be seen that the values measured for the larger values of (n) are plotted farther from the line indicating that the thickness of the layer of the earth that is being tested is greater than for the smaller values of (n); i.e. the depth of the measurement is increased. When the F.E. values are plotted as superscripts to the MF values the third section of data values is not presented and the F.E. values are not contoured.

The actual data plots included with the report are prepared utilizing an IBM 360/75 Computer and a Calcomp 770/763 Incremental Plotting System. The data values are calculated, plotted, and contoured according to a programme developed by McPhar Geophysics. Certain symbols have been incorporated into the programme to explain various situations in recording the data in the field.

The IP measurement is basically obtained by measuring the difference in potential or voltage (ΔV) obtained at two operating frequencies. The voltage is the product of the current through the ground and the apparent resistivity of the ground. Therefore in field situations where the current is very low due to poor electrode contact, or the apparent resistivity is very low, or a combination of the two effects; the value of (ΔV) the change in potential will be too small to be measurable. The symbol "TL" on the data plots indicates this situation.

In some situations spurious noise, either man made or natural, will render it impossible to obtain a reading. The symbol "N" on the data plots indicates a station at which it is too noisey to record a reading. If a reading can be obtained, but for reasons of noise there is some doubt as to its accuracy, the reading is bracketed in the data plot ( ).

In certain situations negative values of Apparent Frequency Effect are recorded. This may be due to the geologic environment or spurious electrical effects. The actual negative frequency effect value recorded is indicated on the data plot, however the symbol "NEG" is indicated for the corresponding value of Apparent Metal Factor. In contouring negative values the contour lines are indicated to the nearest positive value in the immediate vicinity of the negative value.

The symbol "NR" indicates that for some reason the operator did not attempt to record a reading although normal survey procedures would suggest that one was required. This may be due to inaccessible topography or other similar reasons. Any symbol other than those discussed above is unique to a particular situation and is described within the body of the report.

METHOD USED IN PLOTTING DIPOLE-DIPOLE INDUCED POLARIZATION AND RESISTIVITY RESULTS

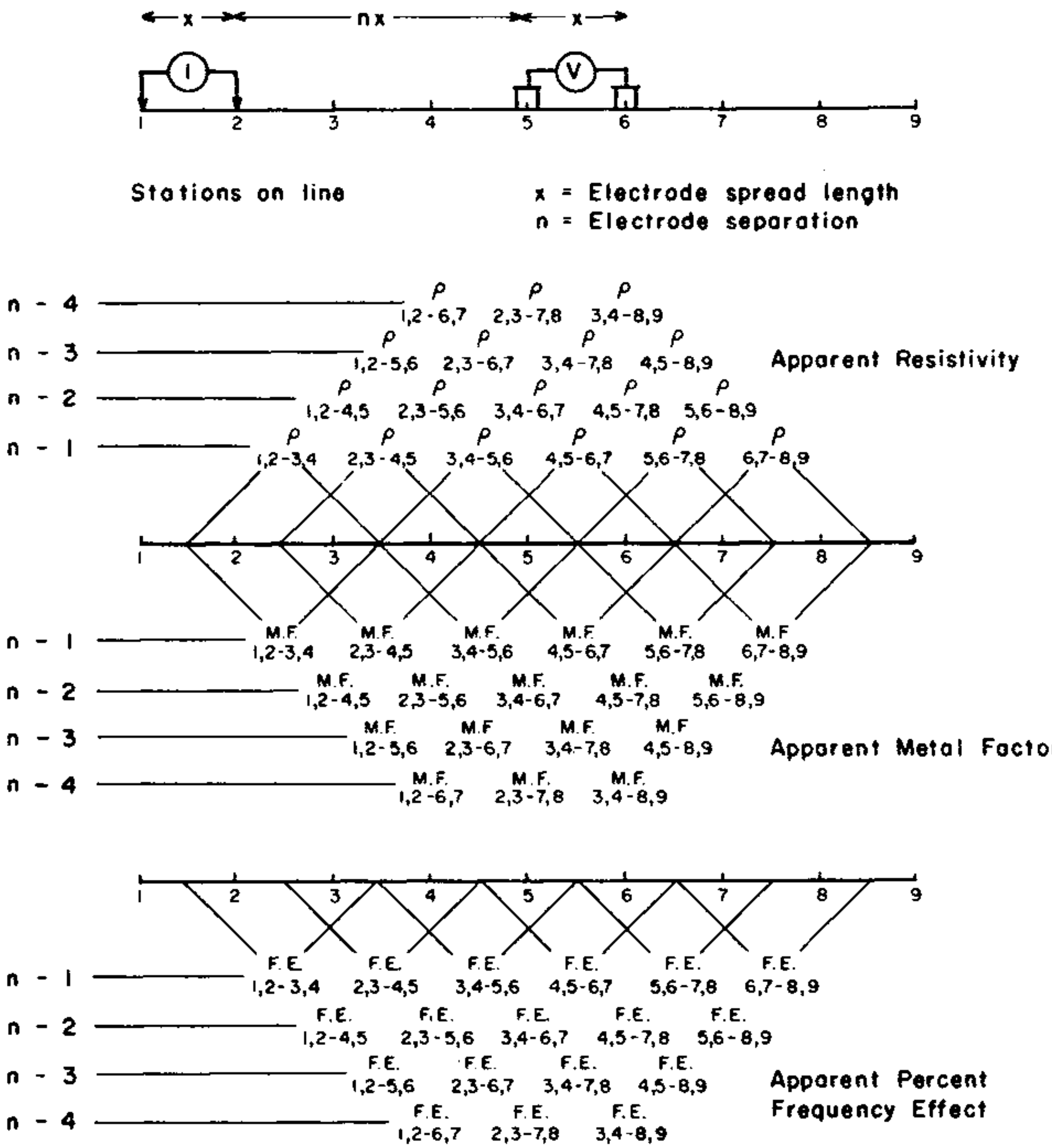

Fig. A

McPHAR GEOPHYSICS LIMITED

REPORT ON THE INDUCED POLARIZATION AND RESISTIVITY SURVEY ON THE IN AND C CLAIM GROUPS, SCHAFT CREEK AREA, LIARD MINING DIVISION, B.C. FOR HECLA OPERATING COMPANY

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1. INTRODUCTION

At the request of the client, we have completed an Induced Polarization and Resistivity survey on the IN and C Claim Groups, Schaft Creek area, Liard Mining Division, B.C. for Hecla Operating Company. The claim groups are situated at 57°33' north latitude and 130°55' west longitude.

The geology of the grid area itself is not available at the time this report is written. However, to the immediate west, green andesites flank the Hickman batholith and it is believed that the geology of the two areas is similar. Diorite and porphyry intrusives are known; copper minerals and some pyrite have been located in the volcanics.

The IP survey was carried out to locate any deposits of metallic mineralization which might be of economic value. The work was completed in July and August, 1972, using a McPhar P660 high power variable frequency IP unit operating at 0.3 and 5.0 cps over the following claims:

IN	-	1, 2, 3, 4, 27, 28, 29, 30, 35, 36, 53, 54, 55, 56, 61, 62, 75, 76, 77, 78, 83, 84, 101, 102, 103, 104, 109, 110, 127, 128, 129, 130, 135, 136.
C	-	10, 11, 12, 13, 14, 16, 33, 34, 35, 36, 37, 38, 59, 61, 62.

These claims are assumed to be owned or held under option by Hecla Operating Company.

2. PRESENTATION OF RESULTS

The Induced Polarization and Resistivity results are shown on the following data plots in the manner described in the notes preceding this report.

Line		Electrode Intervals	Dwg. No.
C Claim Group			
24000N		200 feet	IP 5991-1
23500N		200 feet	IP 5991-2
23000N		200 feet	IP 5991-3
22000N		200 feet	IP 5991-4
21000N		200 feet	IP 5991-5
IN Claim Group			
1500S	(West Part)	200 feet	IP 5990-1
1500S	(Central Part)	200 feet	IP 5990-2
1500S	(East Part)	200 feet	IP 5990-3
7000S	(West Part)	200 feet	IP 5990-4
7000S	(East Part)	200 feet	IP 5990-5

Also enclosed with this report are Dwgs. I.P.P. 3547 and I.P.P. 4864, plan maps of the C and IN Claim Grids at a scale of 1" = 400' and 500' respectively. The definite, probable and possible Induced Polarization anomalies are indicated by bars, in the manner shown on the legend, on these plan maps as well as on the data plots. These bars represent the surface projection of the anomalous zones as interpreted from the location of the transmitter and receiver electrodes when the anomalous values were measured.

Since the Induced Polarization measurement is essentially an averaging process, as are all potential methods, it is frequently difficult to exactly pinpoint the source of an anomaly. Certainly, no anomaly can be located with more accuracy than the electrode interval length; i.e. when using 200' electrode intervals the position of a narrow sulphide body can only be determined to lie between two stations 200' apart. In order to definitely locate, and fully evaluate, a narrow, shallow source it is necessary to use shorter electrode intervals. In order to locate sources at some depth, larger electrode intervals must be used, with a corresponding increase in the uncertainties of location. Therefore, while the centre of the indicated anomaly probably corresponds fairly well with source, the length of the indicated anomaly along the line should not be taken to represent the exact edges of the anomalous material.

The claim information shown on Dwgs. I.P.P. 3547 and I.P.P. 4864 has been taken from maps made available by the staff of Hecla Operating Company.

3. DISCUSSION OF RESULTS

The IP results as plotted on Dwg. I.P.P. 4864 are only approximate in position, as the base map which was provided by the client is not true to scale.

The geology of the grid area is not known, but the mineralisation in the area to the immediate west is associated with high resistivities and it seems probable from these results that this is true, in part at least, of this survey area. Because of this, if and where it is true, the metal factors will be low in magnitude and may not be indicative of the true situation. Therefore the survey results are discussed with regard to both metal factor and frequency effect anomalies.

The resistivities are variable across the width of the survey lines, but the lines are too far apart to make reliable correlations between high and low resistivity contacts. As an example, this contact on Line 24000N lies at 22W; on Line 23500N it lies at 24W and the high resistivity zone ceases at 12W; on Line 23000N the zone has narrowed drastically, the western contact being at 26W and the eastern contact at 20W. The high resistivities probably reflect a specific rock type, but more data are needed to be certain. With sufficient data, the changing resistivities would be a good guide in geological mapping.

C Claim Group

Five lines were surveyed over the northern portion of the grid and are discussed below in detail. In the discussion, unless an anomaly is specified as being metal factor or frequency effect, it reflects anomalous values for both.

Line 24000N

A probable anomaly from 36W to 38W is shallow, with the top of the source at less than 100'. Some depth extent is indicated.

A weak, shallow anomaly from 22W to 24W reflects decreased resistivities, but the frequency effects, which are three to four times over background, show this increase from 14W to 30W. The resistivities indicate a change in rock type at 22W. One possible interpretation is that weakly disseminated mineralisation is present from 14W to 30W in more than one type of host rock.

This may also be true further to the east, where there is a very weak metal factor anomaly from 2W to 4W, but the frequency effects are moderately anomalous from 8W to the end of the line, where the anomaly is incomplete.

Line 23500N

A definite, shallow anomaly extends from 40W to 42W; the top of the source is less than 100' deep. This anomaly is on strike with probable anomalies to the north and south and with them is designated Zone A. During the IP survey, a self potential effect of 3 mv was measured with the P660 receiver from 40W to 42W. Ground geology might possibly locate outcropping mineralization over this anomaly; if not, the source should be checked by drilling. The drill hole should be located to test the source at a vertical depth of 150' below 41W.

A probable to possible shallow anomaly extends from 28W to 34W and is correlated with anomalies to the north and south to form Zone B. Two weak anomalies extend from 14W to 18W and 6W to 10W. The frequency effect anomalies are much more extensive and of greater magnitude (see Dwg. I.P. 5991-2). It is recommended that drilling be initiated to; a) test the source of the Zone B anomaly at a vertical depth of 150' under 31W and b) to test the source of the weak metal factor anomaly, but strong frequency effect anomaly, from 14W to 18W at a vertical depth of 150' under 16W.

Line 23000N

A possible anomaly from 48W to the western end of the line, where it is incomplete, shows some depth extent; the top of the source is less than 100' in depth.

A probable anomaly (Zone A) extends from 42W to 44W. The magnitude of the anomaly increases with depth. A very weak anomaly from 34W to 36W is near 200' deep - this is the Zone B anomaly. The frequency effects are anomalous in varying magnitude from 44W to 18W; from 12W to 2W; from 4E to 28E and from 35E to 37E. There are coincident metal factor anomalies as follows:

6E to 8E	-	possible with the top at a depth near 100'.
14E to 18E	-	definite - the magnitude increases with depth. This is the northern anomaly of Zone C.
32E to 41E	-	possible to probable. This anomaly is suspect except from 35E to 37E as the frequency effects are very near background.

It is recommended that the anomaly from 14E to 18E be drilled to check the source at a vertical depth of 150' under 16E.

Line 22000N

Anomalous frequency effects are much more extensive than metal factor anomalies, varying in depth and magnitude (see Dwg. IP 5991-4). There are coincident metal factor anomalies from 4E to 6E (definite and shallow), Zone C, and from 12E to 14E (possible and relatively deep, circa 200').

The probable frequency effect anomaly from 0 to 4E, where there is no metal factor anomaly, could be checked at a depth of 100' below 1E.

Line 21000N

A definite, shallow anomaly was located from 0 to 6W. The pattern of the anomaly suggests a source dipping at about 45° to the east. This anomaly is correlated with anomalies to the north into Zone C.

A very weak anomaly extends from 10E to 14E.

The anomalous frequency effects are slightly more extensive.

IN Claim Group

Two widely separated lines were surveyed.

Line 1500S

Weak anomalies were located as follows: 33W to 31W; 29W to 27W; 23W to 15W; 2E to 4E; 6E to 8E; 12E to 14E; 27E to 104AE and 96AE to 90AE. A probable anomaly extends from 25E to 27E. An incomplete definite anomaly extends east from 4AE. The frequency effect anomalies are much more extensive and they are greater in magnitude, in general. It will be necessary at some place on the grid to test the source of both a metal factor anomaly and a frequency effect anomaly in order to determine which is more representative of the mineralization. Recommendations for that purpose have been made for C Claim Group; the results should be applied to the interpretation of this grid.

Line 7000S

A narrow, weak, metal factor anomaly from 12E to 14E may be a resistivity low, but a weak frequency effect anomaly is offset to the east by one electrode interval and the two may be related.

A definite to probable anomaly extends from 22E to 30E where there is an interval of 200', then the anomaly continues from 32E to 40E. The anomalous frequency effects vary somewhat in magnitude and extend beyond the metal factor anomaly to 56E. It is recommended that the definite portion of the anomaly be checked at a vertical depth of 150' to 200' below 25E by drilling. The eastern flank of the anomaly could be similarly tested below 37E.

Weak frequency effect anomalies were located from 61E to 63E; 64E to 66E; 68E to 70E and 84E to 86E.

A broad anomaly extends from 94E to 114E, varying in magnitude from possible to definite. Background resistivities are moderately high as are the frequency effects. The top of the source of the definite portion from 101E to 107E is at a depth near 100' and the source from 110E to 112E reaches its highest magnitude near 200'. Three drill holes are recommended here as follows:

1) to test the anomaly at a vertical depth of 100' below 97E.
2) to test the anomaly at a vertical depth of 150' below 106E.
3) to test the anomaly at a vertical depth of 200' below 111E.

The frequency effects are moderately anomalous from 114E to 126E. At 124E, the resistivities decrease sharply; at 126E the frequency effects decrease. It seems probable that there is a change in rock type at 124E. The metal factor anomaly from 118E to the end of the line, where it is incomplete, is coincident with a frequency effect anomaly at 118E to 126E. From there east, the decrease in frequency effects makes the definite metal factor anomaly seem less significant. However, the anomaly could be checked at a vertical depth of 100' below 129E.

4. CONCLUSIONS

C Claim Group

Three narrow zones of anomalous IP effects were outlined by the survey. However, frequency effect anomalies were much broader in extent. The resistivities of the country rock are high and would thus result in low metal factors, masking all but the strongest metal factor results. It is therefore important to establish which of the two readings is the better criterion for interpretation. Drilling recommendations were made with that in mind.

IN Claim Group

The same comments apply to this grid. If the drilling is carried out and the results are encouraging, intermediate parallel lines should be surveyed.

McPHAR GEOPHYSICS LIMITED

Philip G. Hallof,
Geophysicist.

Marion A. Goudie,
Geologist.

Dated: September 28, 1972

ASSESSMENT DETAILS

PROPERTY: "IN" Group		MINING DIVISION: Liard
SPONSOR: Hecla Operating Company		PROVINCE: British Columbia
LOCATION: Schaft Creek Area		
TYPE OF SURVEY: Induced Polarization		
OPERATING MAN DAYS:	38	DATE STARTED: July 25, 1972
EQUIVALENT 8 HR. MAN DAYS:	57	DATE FINISHED: August 6, 1972
CONSULTING MAN DAYS:	1	NUMBER OF STATIONS: 169
DRAUGHTING MAN DAYS:	5	NUMBER OF READINGS: 1404
TOTAL MAN DAYS	63	MILES OF LINE SURVEYED: 6.29

CONSULTANTS:
Philip G. Hallof, 15 Barnwood Court, Don Mills, Ontario.
Marion A. Goudie, 739 Military Trail, West Hill, Ontario.

FIELD TECHNICIANS:
Alex B. Walcer, 112 Rutherford Road North, Brampton, Ontario.
S. Dunbar, 4687 Langara Ave., Vancouver, B.C.
Plus 2 Helpers:
L. Bingham, 7989 Patterson Ave., Burnaby, B.C.
K. Matheson, 3760 Marine Drive, Burnaby, B.C.

DRAUGHTSMEN:
F.R. Peer, 38 Torrens Avenue, Toronto 6, Ontario.
N. Lade, 299 Jasper Avenue, Oshawa, Ontario.
V. Young, 703 Cortez Avenue, Bay Ridges, Ontario.

McPHAR GEOPHYSICS LIMITED

Philip G. Hallof,
Geophysicist

Dated: September 28, 1972

STATEMENT OF COST

Hecla Mining Company
"IN" Group
Schaft Creek Area, B.C.

Crew: A. Walcer - S. Dunbar

9½ days Operating:

7-3/4 days Operating		@ $265.00/day	$2,053.75
1-3/4 days Operating			N.C.
2¼ days Bad Weather)	3 days	@ $100.00/day	300.00
¾ day Preparation)			
½ day Breakdown			N.C.

Expenses prorated 7-3/4/15

Air fare	22.73	
Air lift to survey	338.16	
Taxis	20.36	
Meals	43.04	
Freight and Brokerage	99.40	
Telephone and Telegraph	2.07	
	525.76	
+ 10%	52.58	
		578.34

Extra labour (prorated)	351.47	
+ 20%	70.29	
		421.76
		$3,353.85

McPHAR GEOPHYSICS LIMITED

Philip G. Hallof,
Geophysicist

Dated: September 28, 1972

ASSESSMENT DETAILS

PROPERTY: "C" Group		MINING DIVISION: Liard	
SPONSOR: Hecla Operating Company		PROVINCE: British Columbia	
LOCATION: Schaft Creek Area			
TYPE OF SURVEY: Induced Polarization			
OPERATING MAN DAYS:	29	DATE STARTED:	July 17, 1972
EQUIVALENT 8 HR. MAN DAYS:	43½	DATE FINISHED:	August 9, 1972
CONSULTING MAN DAYS:	1	NUMBER OF STATIONS:	165
DRAUGHTING MAN DAYS:	5	NUMBER OF READINGS:	1308
TOTAL MAN DAYS:	49½	MILES OF LINE SURVEYED:	6.1

CONSULTANTS:
Philip G. Hallof, 15 Barnwood Court, Don Mills, Ontario.
Marion A. Goudie, 739 Military Trail, West Hill, Ontario.

FIELD TECHNICIANS:
Alex B. Walcer, 112 Rutherford Road North, Brampton, Ontario.
S. Dunbar, 4687 Langara Ave., Vancouver, B.C.
Plus 2 Helpers:
L. Bingham, 7989 Patterson Ave., Burnaby, B.C.
K. Matheson, 3760 Marine Drive, Burnaby, B.C.

DRAUGHTSMEN:
F.R. Peer, 38 Torrens Avenue, Toronto 6, Ontario.
N. Lade, 299 Jasper Avenue, Oshawa, Ontario.
V. Young, 703 Cortez Avenue, Bay Ridges, Ontario.

McPHAR GEOPHYSICS LIMITED

Philip G. Hallof
Philip G. Hallof,
Geophysicist

Dated: September 28, 1972

STATEMENT OF COST

Hecla Mining Company
"C" Group
Schaft Creek Area, B. C.

Crew: A. Walcer - S. Dunbar

$7\frac{1}{4}$ days Operating		@ $265.00/day	$1,921.25
$2\frac{1}{2}$ days Travel) 3/4 day Preparation)	$3\frac{1}{4}$ days	@ $100.00/day	325.00
$\frac{1}{2}$ day Off			N. C.

Expenses prorated $7\frac{1}{4}/15$

Air fare	21.27	
Air lift to survey	316.24	
Taxis	19.04	
Meals	40.26	
Freight and Brokerage	92.97	
Telephone and Telegraph	1.92	
	491.80	
+ 10%	49.18	
		540.98

Extra labour (prorated)	328.80	
+ 20%	65.76	
		394.56
		$3,181.79

McPHAR GEOPHYSICS LIMITED

Philip G. Hallof,
Geophysicist

Dated: September 28, 1972

CERTIFICATE

I, Philip George Hallof, of the City of Toronto, Province of Ontario, do hereby certify that:

1. I am a geophysicist residing at 15 Barnwood Court, Don Mills, Ontario.

2. I am a graduate of the Massachusetts Institute of Technology with a B.Sc. Degree (1952) in Geology and Geophysics, and a Ph. D. Degree (1957) in Geophysics.

3. I am a member of the Society of Exploration Geophysicists and the European Association of the Exploration Geophysicists.

4. I am a Professional Geophysicist, registered in the Province of Ontario, the Province of British Columbia and the State of Arizona.

5. I have no direct or indirect interest, nor do I expect to receive any interest directly or indirectly, in the property or securities of Hecla Mining Company or any affiliate.

6. The statements made in this report are based on a study of published geological literature and unpublished private reports.

7. Permission is granted to use in whole ir in part for assessment and qualification requirements but not for advertising purposes.

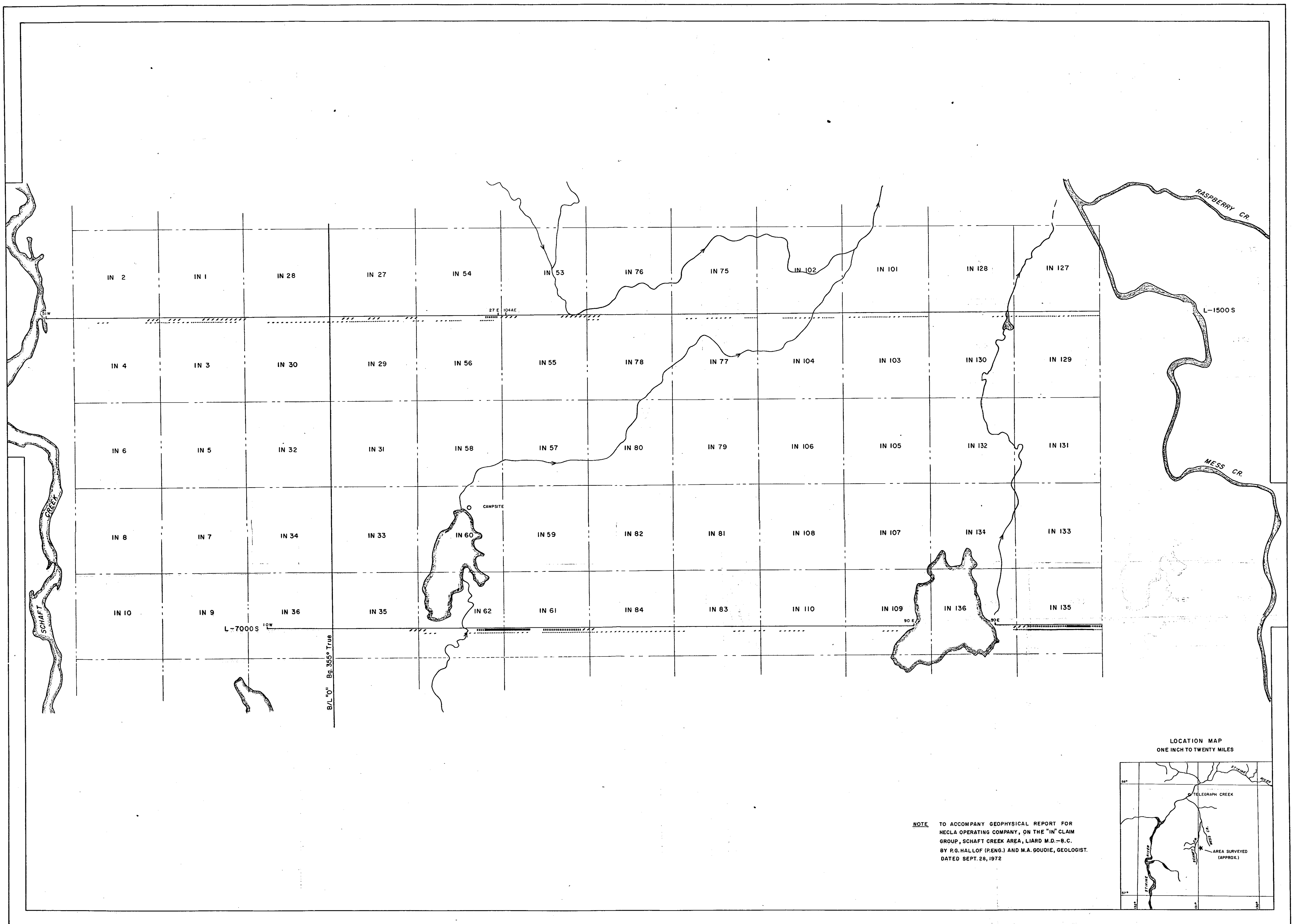
Dated at Toronto

This 28th day of Sept ember, 1972

Philip G. Hallof, Ph. D.

DWG. I.P.P. 4864

McPHAR GEOPHYSICS
INDUCED POLARIZATION AND RESISTIVITY SURVEY
PLAN MAP



NOTE TO ACCOMPANY GEOPHYSICAL REPORT FOR HECLA OPERATING COMPANY, ON THE "IN" CLAIM GROUP, SCHAFT CREEK AREA, LIARD M.D.–B.C. BY P.G. HALLOF (P.ENG.) AND M.A. GOUDIE, GEOLOGIST. DATED SEPT. 28, 1972

SURFACE PROJECTION OF ANOMALOUS ZONES

	(METAL FACTOR)	(FREQUENCY EFFECT)
DEFINITE	▬▬▬	———
PROBABLE	:::::::::	-----------
POSSIBLE	\\\\\\\	- - - - -

Number at the end of anomaly indicates spread used.

NOTE POSITION OF ANOMALIES HAS BEEN ADJUSTED TO COMPENSATE FOR SCALE INACCURACY OF PLAN. FOR EXACT LOCATION OF ANOMALIES, CONSULT DATA STRIPS.

HECLA OPERATING COMPANY
"IN" GROUP – SCHAFT CREEK AREA
LIARD M. D., BRITISH COLUMBIA

SCALE
One inch = 500 feet
(Approx.)

3983 M-2

Department of Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 3983 MAP #2

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
PHILIP G. HALLOF
9/28/72
Expiry Date: February 25, 1973

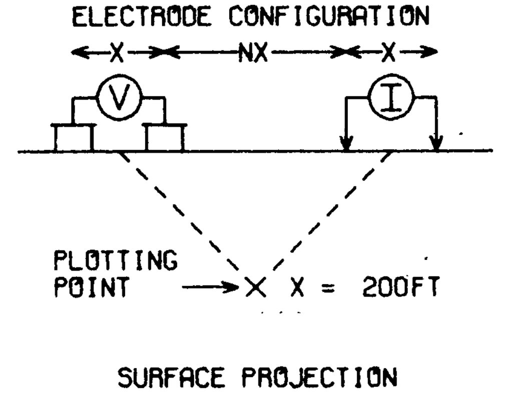
DWG. I.P.P.-4864

DWG. NO.- I.P.-5990-2

HECLA OPERATING COMPANY

IN GROUP, SCHAFT CREEK AREA,
LIARD M.D., B.C.

LINE NO.- 1500S (CENTRAL PART)



SURFACE PROJECTION OF ANOMALOUS ZONES
DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: AUG 1972

APPROVED:

DATE: 9/20/72

NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

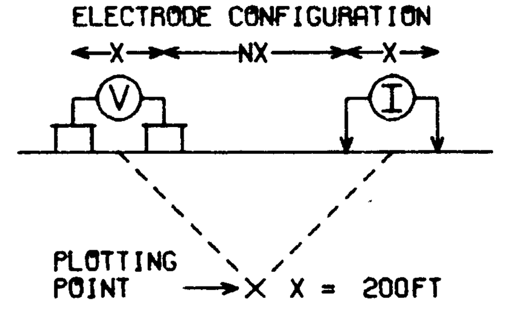
NOTE: THIS PLOT WAS PRODUCED BY McPHAR COMPUTER DIVISION

DWG. NO.- I.P.-5990-3

HECLA OPERATING COMPANY

IN GROUP, SCHAFT CREEK AREA,
LIARD M.D., B.C.

LINE NO.- 1500S (EAST PART)



SURFACE PROJECTION OF ANOMALOUS ZONES
DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: AUG 1972

APPROVED:

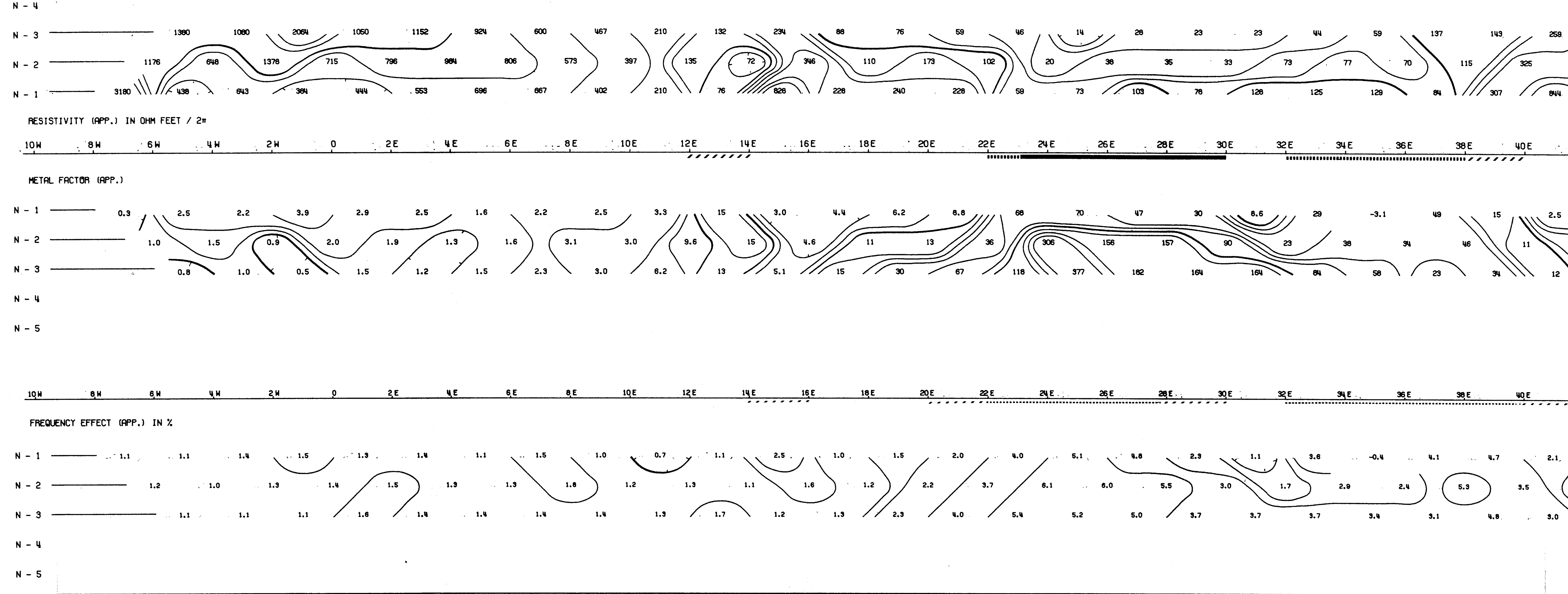
DATE: 9/28/72

NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED BY McPHAR COMPUTER DIVISION

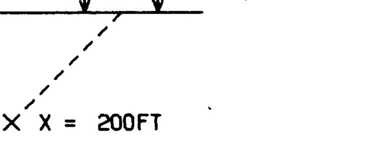


DWG. NO.- I.P.- 5990-4

HECLA OPERATING COMPANY

IN GROUP, SCHAFT CREEK AREA
LIARD M.D., B.C.

LINE NO.- 7000S (WEST PART)



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE ▬▬▬
PROBABLE ▮▮▮▮▮▮
POSSIBLE / / / / /

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: JUL 1972

APPROVED:

DATE: 9/28/72

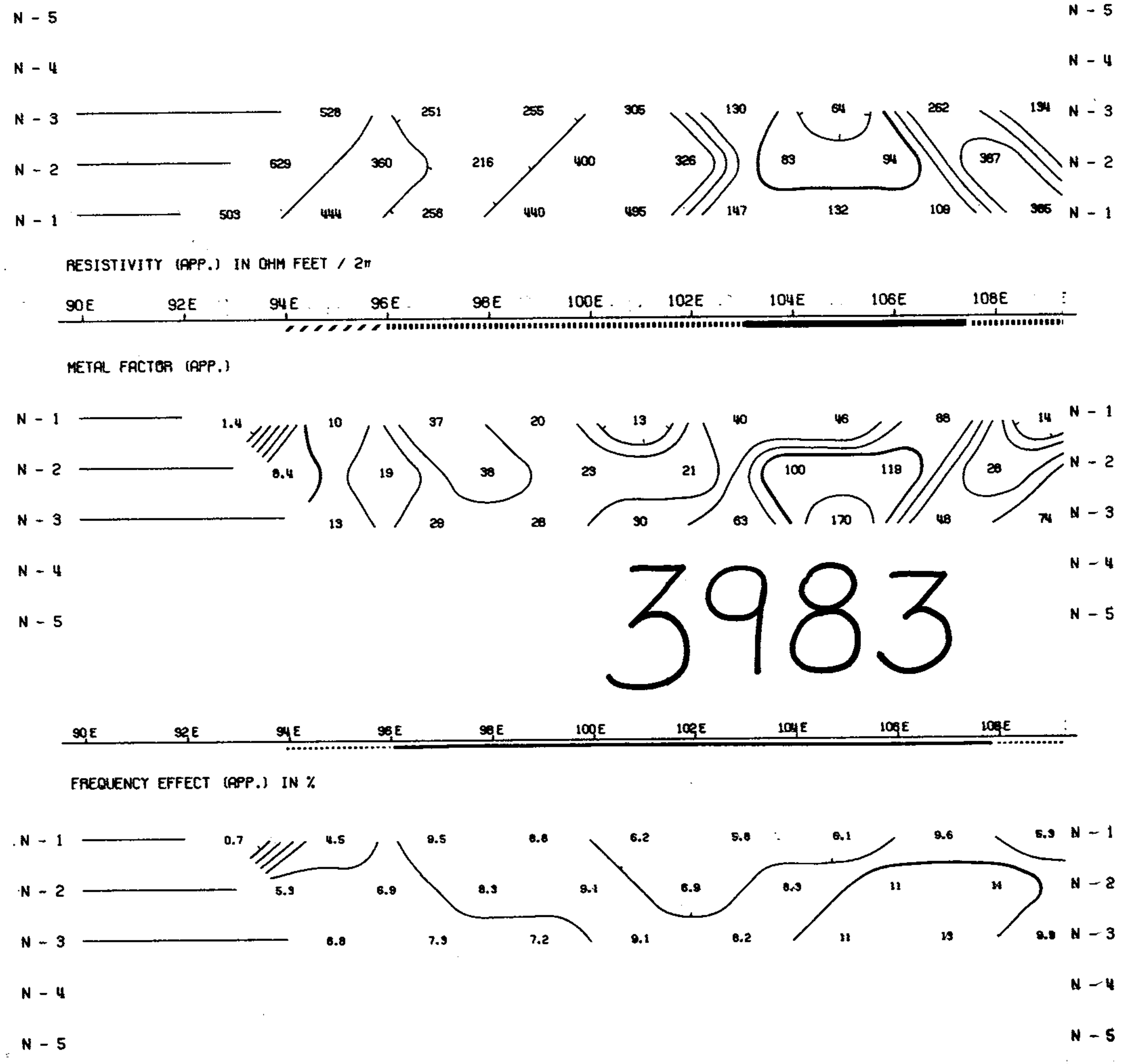
NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1,-1.5-2,-3,-5,-7.5-10

Expiry Date: February ... 1973

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED BY McPHAR COMPUTER DIVISION



DWG. NO.- I.P.-5990-5

HECLA OPERATING COMPANY

IN GROUP, SCHAFT CREEK AREA
LIARD M.D., B.C.

LINE NO.- 7000S (EAST PART)

ELECTRODE CONFIGURATION

PLOTTING POINT X = 200FT

SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: JUL. 1972

APPROVED: P. G. Hallof

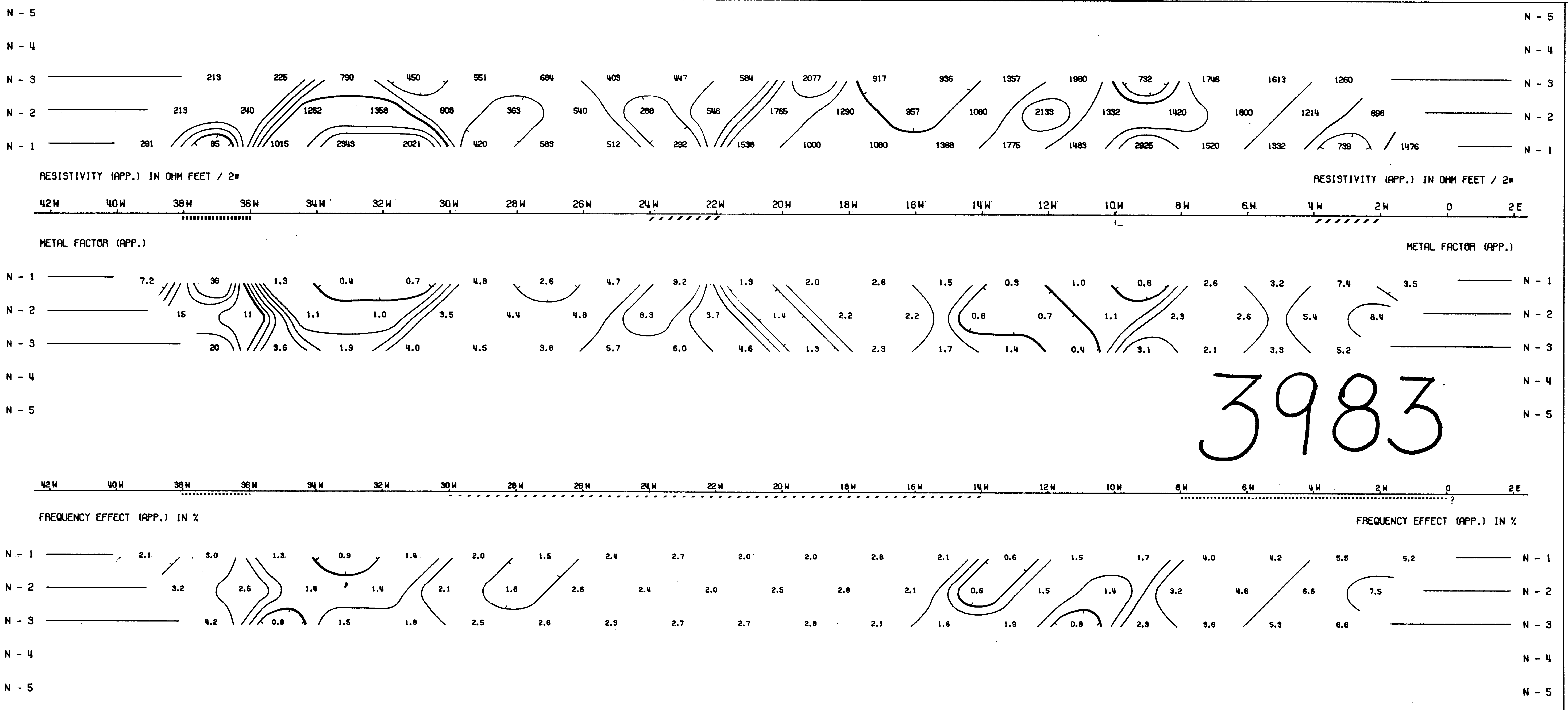
DATE: 9/28/72

NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED BY MCPHAR COMPUTER DIVISION



DWG. NO.- I.P.-5991-1

HECLA OPERATING COMPANY

C GROUP, SCHAFT CREEK AREA

LIARD M.D., B.C.

LINE NO.- 24000N

ELECTRODE CONFIGURATION

X = 200FT

PLOTTING POINT

SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE

PROBABLE

POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: JUL 1972

APPROVED:

DATE:

NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA

Expiry Date: February 25 1973

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED BY McPHAR COMPUTER DIVISION

DWG. NO.- I.P.-5991-2

HECLA OPERATING COMPANY

C GROUP, SCHAFT CREEK AREA
LIARD M.D., B.C.

LINE NO.- 23500N

ELECTRODE CONFIGURATION

PLOTTING POINT → X   X = 200FT

SURFACE PROJECTION OF ANOMALOUS ZONES
DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: JUL 1972

APPROVED:

DATE: 9/28/72

NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED BY MCPHAR COMPUTER DIVISION

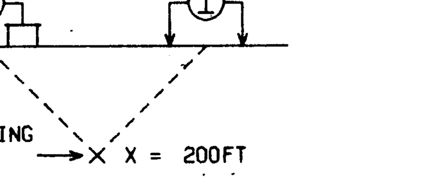
DWG. NO.- I.P.-5991-3

HECLA OPERATING COMPANY

C GROUP, SCHAFT CREEK AREA
LIARD M.D., B.C.

LINE NO.- 23000N

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: AUG 1972

APPROVED:

DATE: 9/28/72

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA

NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED BY MCPHAR COMPUTER DIVISION

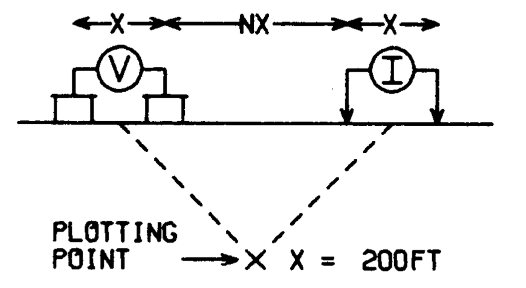
DWG. NO.- I.P.-5991-4

HECLA OPERATING COMPANY

C GROUP, SCHAFT CREEK AREA
LIARD M.D., B.C.

LINE NO.- 22000N

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES
DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: AUG 1972

APPROVED:

NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

DATE: 9/28/72

McPHAR GEOPHYSICS

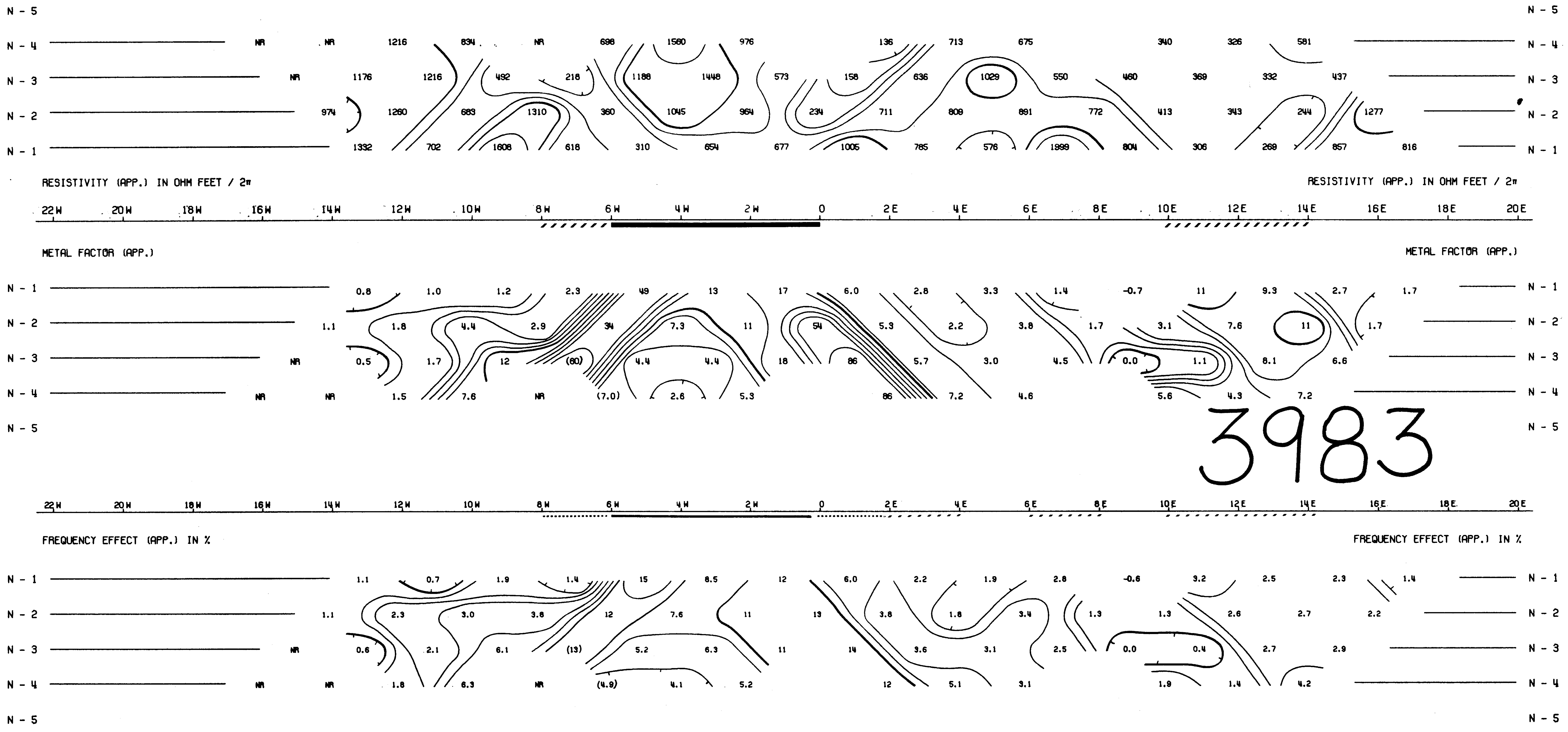
INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED BY MCPHAR COMPUTER DIVISION

DWG. NO.- I.P.-5991-5

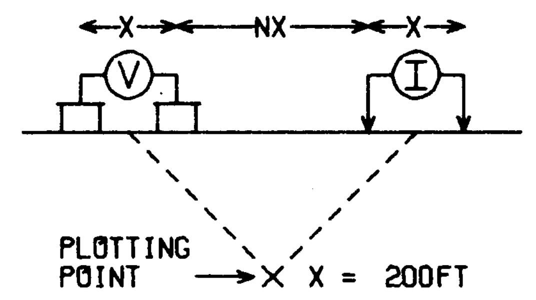
HECLA OPERATING COMPANY

C GROUP, SCHAFT CREEK AREA
LIARD M.D., B.C.



LINE NO.- 21000N

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: [illegible] 1972

APPROVED:

DATE: 9/28/72

NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

PROFESSIONAL ENGINEER

Expiry Date: February 2[illegible] 1973

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

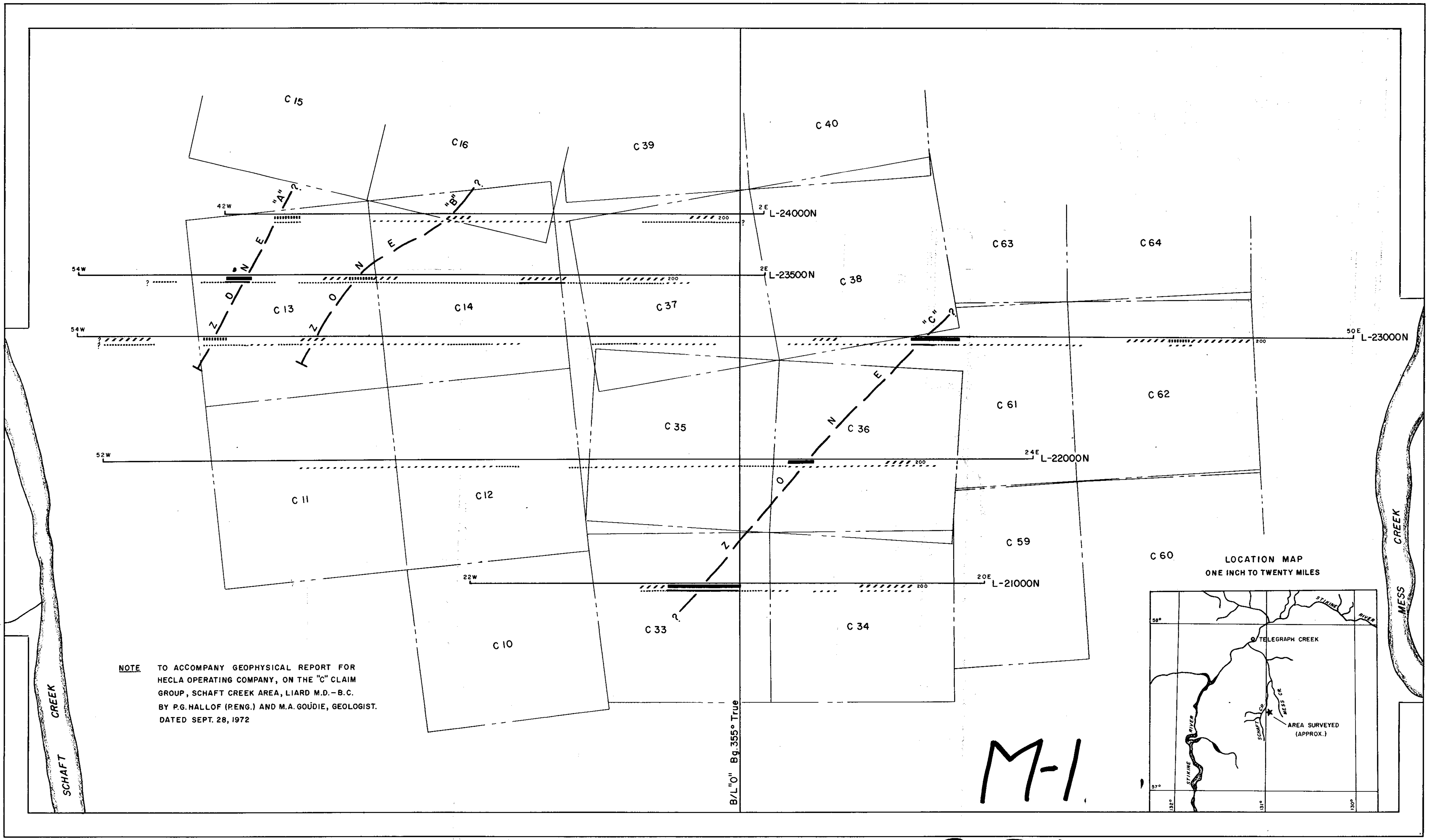
NOTE: THIS PLOT WAS PRODUCED BY MCPHAR COMPUTER DIVISION

DWG. I.P.P.-3547

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

PLAN MAP



SURFACE PROJECTION OF ANOMALOUS ZONES

	(METAL FACTOR)	(FREQUENCY EFFECT)
DEFINITE		
PROBABLE		
POSSIBLE		

Number at the end of anomaly indicates electrode interval

AXIS OF ANOMALOUS I.P. ZONE

HECLA OPERATING COMPANY

"C" GROUP – SCHAFT CREEK AREA

LIARD M. D., BRITISH COLUMBIA

SCALE

One inch = 400 feet

3983

Department of Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 3983 MAP #1

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — PHILIP G. HALLOF

Expiry Date: February 28, 1973

DWG. I.P.P.-3547

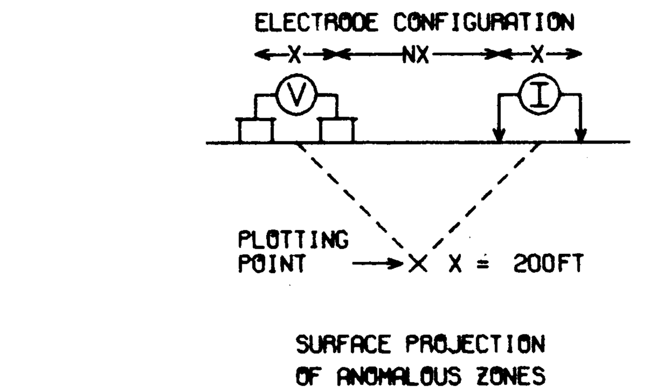
DWG. NO.- I.P.-5990-1

HECLA OPERATING COMPANY

IN GROUP, SCHAFT CREEK AREA
LIARD M.D., B.C.

LINE NO.- 1500S (WEST PART)

ELECTRODE CONFIGURATION



X = 200FT

SURFACE PROJECTION OF ANOMALOUS ZONES
DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: AUG 1972

NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

APPROVED

DATE: 9/28/72

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED BY MCPHAR COMPUTER DIVISION

CERTIFICATE

I, Marion A. Goudie, of the City of Toronto, Province of Ontario, do hereby certify that:

1. I am a geologist residing at 739 Military Trail, West Hill, Ontario.

2. I am a graduate of the University of Western Ontario with a B.Sc. Degree (1950) in Honours Geology.

3. I am a member of the Geological Society of America.

4. I have been practising my profession for 23 years.

5. I have no direct or indirect interest, nor do I expect to receive any interest directly or indirectly, in the property or securities of Hecla Mining Company or any affiliate.

6. The statements made in this report are based on a study of published geological literature and unpublished private reports.

7. Permission is granted to use in whole or in part for assessment and qualification requirements but not for advertising purposes.

Dated at Toronto

This 28th day of September, 1972

Marion A. Goudie

Marion A. Goudie, B.Sc.