3505

GEOPHYSICAL REPORT on a
HAMMER REFRACTION SEISMIC SURVEY
of portions of Placer Leases
MPL 1881 to 1886, 1867, 1868 and 1873 to 1876
situated immediately north of Princeton
Similkameen M.D., B.C.

92H/7E, 8W on behalf of Part 1
Dr. A. G. Pentland
(Joy Mining Ltd.)
Field Work-June and July, 1971

Report by:

D. R. Cochrane, P.Eng.,
A. Scott, B.Sc.,
August 16, 1971,
Delta, B.C.

TABLE OF CONTENTS

APPENDIX

I Certificates

II Personnel & Dates Worked

III Instrument Specifications

IV Cost Breakdown

V Computed Layer Thicknesses and Offset Distances

PART A

A - 1 SUMMARY:

Between June 4 and July 8, a field crew employed by D. R. Cochrane, P. Eng., completed some 20 seismic miles (10 line miles) of hammer refraction seismic surveying on Joy Mining's Princeton Placer Mine Leases. The leases straddle Highway No. 5 (Princeton-Merritt highway) immediately north of Princeton, B. C. Figure 2 shows the location of the Placer Mine Leases and of the grid lines surveyed.

A Huntec FS-3 portable facsimile seismograph was utilized on the survey.

The purpose of the survey was to aid in the detection of fossil placer deposits in subsurface material.

This report describes the field procedure, data reduction and interpretation , and tentatively identifies the various velocity ranges encountered, and discusses the results of the survey.

A-2 CONCLUSIONS:

1. Hammer refraction seismic surveying has demonstrated that in the area immediately north of Princeton, the subsurface overburden conditions are quite complex. This includes multiple layering, (velocity) facies changes and a rolling bedrock palaeosurface. The complexity of the colluvium is especially noticeable west of the base line (and Highway #5). This is interpreted as indicative of a complex "post Princeton Series" geological history.

2. Seismic refraction geophysical prospecting investigates the velocities, in feet per second, (f/s) of the various subsurface layers. Statistical analysis of the Princeton area data has identified nine (9) velocity "families". This includes two upper layer groups (v_{1a} and v_{1b}), four second layer groups (v_{2a} to v_{2d} incl.) and three third layer families (v_{3a}, v_{3b}, and v_{3c}).

The profiles which accompany this report show the distribution of these various subsurface velocity families, (profiles at a horizontal and vertical scale of 1 inch:50 feet).

3. The information accumulated from the seismic work is presented mainly in graphic form, and the text of this report is primarily concerned with a description of the field and data processing procedures, and a discussion of "major" subsurface features.

4. The important subsurface features, critical to interpretation, are believed to include:

(a) depressions in the bottom-most layer, which may represent buried (fossil) stream gravel deposits;

(b) the presence of facies changes;

(c) the presence of multiple layering.

The latter two criteria are important in distinguishing unsorted till material from water washed and sorted sand and gravels. Multiple layering is apparent in such areas as in and around 14E:4N, 14W:8N and 18W:12N. These profiles are distinct from the rather homogenous and simple profiles observable in and around 10W on line 4N.

5. An integrated and subsequent portion of the exploration work, is actual physical identification and correlation of the nine velocity families. This is perhaps best done by systematically drilling (or trenching) areas in which "classic" (i.e. modal) subsurface velocity values exist, (see Figure 6, and section D-1 of this report).

6. Seismic velocities are a direct function of compaction, and degree of groundwater saturation as well as the physical nature and composition of the various colluvial layers. Therefore, some overlap of velocity families is expected to exist even within a fairly homogeneous compositional layer. In areas of steep topographic relief an apparent shifting of subsurface velocities and

layer thickness is to be expected, (e.g. disruption of layering due to soil creep and slumping). The profile data is most exact where the ground surface is relatively flat, and there is substantial velocity contrast between the various subsurface layers.

7. What is believed to be an important bedrock depression, including (velocity) facies changes and complex layering, appears to trend slightly west of north and has been tentatively correlated from a point at 29W on line 0, to a center at 34W on line 16N. The linear depression is about 300 feet wide, and in some areas in excess of 30 feet deep. There are indications of minor (associated or subsidiary?) depressions on either side of the main depression. However, due to the fairly large cross line separation, (i.e. 400 feet) intermediate lines at a 200 foot separation, would greatly aid in the definition of this feature.

8. Additional seismic depressional features exist at 55W:line 0, 18W:4N, 7W:8N, 17W:12N, 22W:16N, 35W:24N, 26W:28N, and at 1W:32N.

9. A broad depressional feature was also located on the east portions of lines 0, 4N and 8N. The depression is centered at 28E on these lines and coincides with an existing topographic depression.

10. There is good evidence to suggest that the Princeton series is gently folded and that both limbs of a gentle, regional

anticline are present within the survey area. On line 28N, between 4E and 12W, the deepest layer dips gently to the east. On lines 4 and 8N, in and around 30W, the lower layer dips gently to the west. Differential weathering of the gently dipping Princeton may be expected to produce natural "subsequent" erosional rills, (i.e. parallel to strike) within which aluvial gravels may be expected to collect. These numerous "minor" features are readily observable on the profiles notably in the section west of 4W on line 28N.

11. Investigation of the subsurface features described in section D-2 of this report and the various features discussed in this section is recommended.

Respectfully submitted,

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
D. R. COCHRANE

D. R. Cochrane, P.Eng.,

A. Scott, B.Sc.
August 16, 1971,
Delta, B.C.

PART B

B-1 INTRODUCTION:

During June and the first part of July, 1971, some 20 line miles of reverse shooting, refraction hammer seismic work was completed on Placer Leases situated immediately north of the town of Princeton, in south-central British Columbia. The field and data processing work was conducted by personnel employed by D. R. Cochrane, P. Eng., and work was supervised by Dr. A. Pentland, Joy Mining's consultant.

The purpose of the geophysical work was to map sub-surface velocities, in order to aid in the location of fossil placer deposits. It follows test work conducted in May, 1971, which is described in a report entitled "Resistivity and Hammer Seismic Testing in the Princeton Area", by the present authors, and dated May 30, 1971.

This report describes the field and data processing procedures, and discusses the results obtained. Much of the survey information is presented graphically in seismic profile form.

B-2 LOCATION AND ACCESS:

The Placer Leases straddle Highway #5, (the Princeton-Merritt Highway), immediately north of the town of Princeton. The survey area is bounded in the south by the Princeton Airport, the west by China Creek, and to the east by the Teepee Lakes Road. Facile access to most parts of the Placer leases

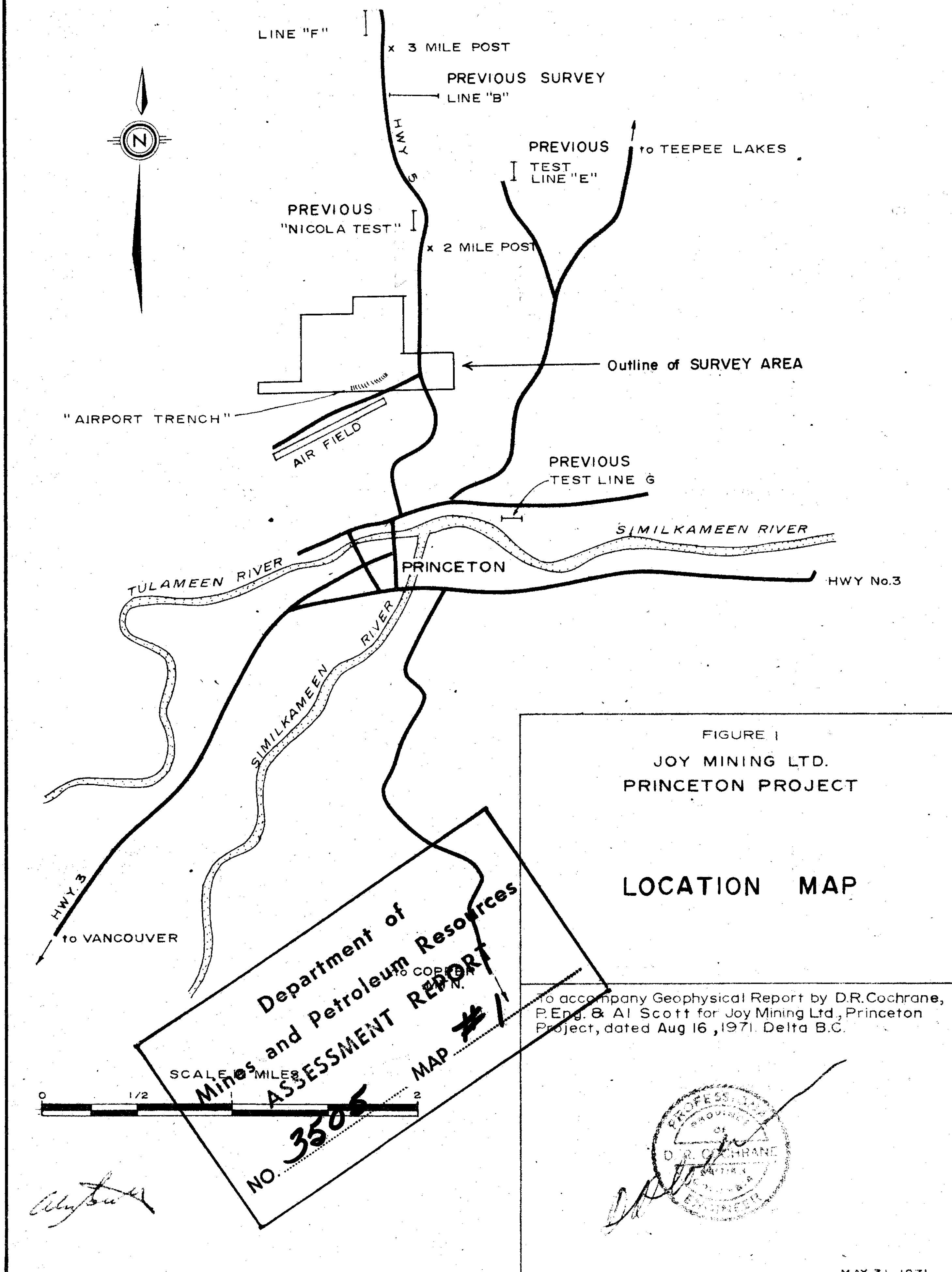


FIGURE I

JOY MINING LTD.
PRINCETON PROJECT

LOCATION MAP

To accompany Geophysical Report by D.R.Cochrane, P.Eng. & Al Scott for Joy Mining Ltd., Princeton Project, dated Aug 16, 1971. Delta B.C.

D. R. COCHRANE PROFESSIONAL ENGINEER

MAY 31, 1971

B-2 LOCATION AND ACCESS cont'd

is provided by various farm roads servicing areas on each side of Highway #5.

A general location map accompanies this report as Figure 1, and Figure 2 is a detailed sketch of the grid area and placer lease outlines.

B-3 LEASES:

The geophysical work was conducted on Placer Leases outlined in Figure 2 (map pocket). Seismic surveying crossed portions of the following leases:

PML 1867, 1868, 1873 to 76, and 1879 to 1886 inclusive. These leases are shown on B. C. Department of Mines Maps 92 H/7E (Placer) and 92 H/8W (Placer).

B-4 SETTING:

Princeton is situated in the Thompson Plateau subdivision of the Interior Plateau Physiographic System of British Columbia. It is characterized by a gently rolling upland surface which varies between just below 2500 feet to just above 6000 feet above mean sea level. The Princeton basin, a relatively flat but wide valley floor, is underlain by a gently dipping series of Miocene sediments (the Princeton Group) overlying the Upper Triassic Nicola Series. The area was ice covered during the Pleistocene epoch, and a moderately thick mantle of drift covers Princeton rocks.

B-4 SETTING cont'd

The Quaternary Period history of the Princeton area is apparently quite complex. The Princeton series is, in places, quite deeply weathered, and in others, scoured clean by erosional agents. There is evidence of fossil river gravels (partly consolidated) overlying weathered Princeton, and several strand lines are evident in the valley. Evidently the area has been alternately lake flooded, and then river drained and glacier inundated during the Quaternary.

B-5 GROUND CONTROL GRID:

Establishment of the grid, and the running of the grid lines was by personnel employed by Joy Mining.

A base line runs true north from line 0 + 00N to line 32N and is designated 0 + 00. Grid lines run true east and west from this base line and are 400 feet apart. Pickets were placed at 100 foot intervals on the base line and grid lines and the line and station number was marked on the pickets. All lines had been chain corrected for slope.

Seismic surveying was standardized so that each set was shot 200 feet and the instrument set up at even numbered stations.

A plan of the grid accompanies this report as Figure 2.

PART C

C-1 FIELD PROCEDURE AND INSTRUMENTATION:

A Huntec FS-3 portable facsimile seismograph was utilized on Joy Mining's Princeton Project. Specifications of the instrument are presented in Appendix III.

Because the depth of interest is limited to primarily the upper 50 to 75 feet, the refraction method was utilized. The method of operation was as follows:

1. The instrument operator placed one geophone in the ground at a selected station on the cross line. The line, station, and shot direction were noted on the chart roll.

2. The hammer man moved up the line impacting an 8" x 8" x 3/4" steel plate (15 lbs. in weight) with a 16 lb. sledge hammer at intervals of 5, 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100, 120, 140, 160, 180 and 200 feet from the stationary geophone.

3. The instrument operator reset the stylus, and turned the chart roll the appropriate amount between each impact. If arrivals were indistinct, he told the hammer man to impact the plate again. When the hammer man was at the 50 foot mark, two geophones were utilized, placed at right angles to the line and 5 feet on either side of the station point.

   (The Huntec unit has a correlator built in that allows only those signals that arrive simultaneously at the two geophones to be recorded. By setting the geophones at right angles to the line, seismic signals from extraneous sources are greatly attenuated, thus improving the signal to noise ratio.)

4. Concurrently with the seismic survey, an inclinometer survey was conducted for topographical control of the seismic profiles.

All lines were shot both in an easterly and a westerly direction as discussed in Section C-2.

C-2 DATA REDUCTION:

(i) General

The raw seismic data is in the form of a time distance plot on electro-sensitive chart paper. The vertical (time axis) scale is 10 milliseconds (m.s.) per centimeter, and the horizontal (distance axis) scale is 50 feet per inch. A series of 2 m.s. vertical dashes mark the postive zero crossings of the shock waves initiated by the sledge hammer blow.

In refraction work, the time between the initiation of the seismic wave and its "final arrival" at the geophone (i.e. the wave which has travelled the minimum time path) is the important feature. In general, the later arrivals represent shear waves, surface waves, reflected waves and reflected refractions.

A series of straight line segments connecting these "first arrivals" is plotted on the record. The line segment that passes through the origin represents the "direct wave", i.e. the one that has travelled directly along the surface from the shot to detector, and further segments represent waves that have travelled along a critically refracting boundary at depth.

In the case of a simple horizontal layering of material, one single profile is adequate for accurate interpretation (to on the order of say 10 percent accuracy). However, in the case of dipping strata or irregular bedrock surface (such as an undulating weathered bedrock surface), "reverse" shooting is necessary for accurate interpretation. In this method, any single grid line

C-2 DATA REDUCTION cont'd

segment must be surveyed in one direction, and then the field array is reversed and the same line segment must be traversed in the opposite direction.

This procedure was followed on Joy Mining's Princeton Project.

Discussions of the hammer seismic refraction method may be found in various texts (such as Dobrin, 1960, Geophysical Prospecting for Oil, McGraw Hill, N.Y.) and in such articles as; Hawkins, L.V., 1961, "The Reciprocal Method of Routine Shallow Seismic Refraction Investigations", Geophysics, Vol. 27, pp. 806 - 819.

(ii) Calculations

Best-fit straight line segments were drawn through the first arrivals for each seismic record. The velocity of each segment was determined, utilizing a clear plastic overlay and the critical distances (distance co-ordinate at points of intersection) were determined.

The velocities and critical distances for both the "forward" and "reversed" profile were noted on standard forms.

The velocities for each layer were normalized from the relation:

$$v = \frac{2}{\frac{1}{v_{fwd.}} + \frac{1}{v_{rev.}}}$$

C-2 DATA REDUCTIONS cont'd

(ii) Calculations

Layer thicknesses and offset distances (the amount the calculated thickness must be shifted towards the critical distance) were calculated from the relations:

$$d_j \simeq \frac{X_{cj}}{2}\sqrt{\frac{V_{j+1} - V_j}{V_{j+1} + V_j}} - \sum_{i=1}^{i=j-1} d_i c_{ji}$$

$$X_m = \sum_{k=1}^{m-1} d_k \tan i_{km} \quad ; \quad \tan i_{km} = \frac{V_k / V_m}{\sqrt{1 - (V_k/V_m)^2}}$$

All calculations were done with a Diehl Algtronic Programmable Calculator.

(iii) Statistics

The arithmetic means and standard deviations of 153 upper layer velocities (v_1), 183 second layer velocities (v_2) and 182 third layer velocites (v_3) were calculated and the data was grouped in histogram form.

C-2 DATA REDUCTIONS cont'd

(iii) Statistics cont'd - -

All of this data was then grouped at 100 foot/second intervals to obtain a total frequency spectrum.

The above was done with the programmable calculator and the results are discussed in Section D.

D-1 CLASSIFICATION OF VELOCITIES:

Two approaches have been utilized to statistically classify the range of velocities encountered on Joy Mining's Princeton Project. The first approach was to group the velocities according to seismic layers (i.e., v_1, v_2, v_3,) and to determine the means and standard deviations. The other approach was to group all the families in small sized classes (100 feet per second groups)and thereby determine modal classes.

Figure 3 is a frequency histogram of 153 upper layer velocities. The distribution is near normal and the mode lies in the 1100 - 1199 foot per second class (encompassing 35 percent of the values). The arithmetic mean is 1100 feet per second and the standard deviation is 104 feet per second.

The frequency distribution of 182 second layer velocities is shown in Figure 4. The distribution is positively skewed and is nearly log-normal in form. The primary mode lies in the 2000 - 2499 foot per second class which encompasses 24 percent of the population. The arithmetic mean is 3030 feet per second and the standard deviation is 1100 feet per second.

The frequency distribution of 183 third layer velocities is shown in Figure 5. The distribution is positively skewed and contains two major modes. The primary mode lies in the 4000 - 4999 foot per second class (encompassing 19 percent of the values) and the secondary mode lies in the 6000 - 6999 foot per second class (encompassing 17 percent of the values). The arithmetic mean is 6430 feet per second and the standard deviation is 2270 feet per second.

D-1 CLASSIFICATION OF VELOCITIES cont'd

A strictly statistical classification of velocity families utilizing standard deviations would be as follows:

Upper layer velocity families		< 1000	
	1000	-	1099
	1100	-	1199
		> 1200	

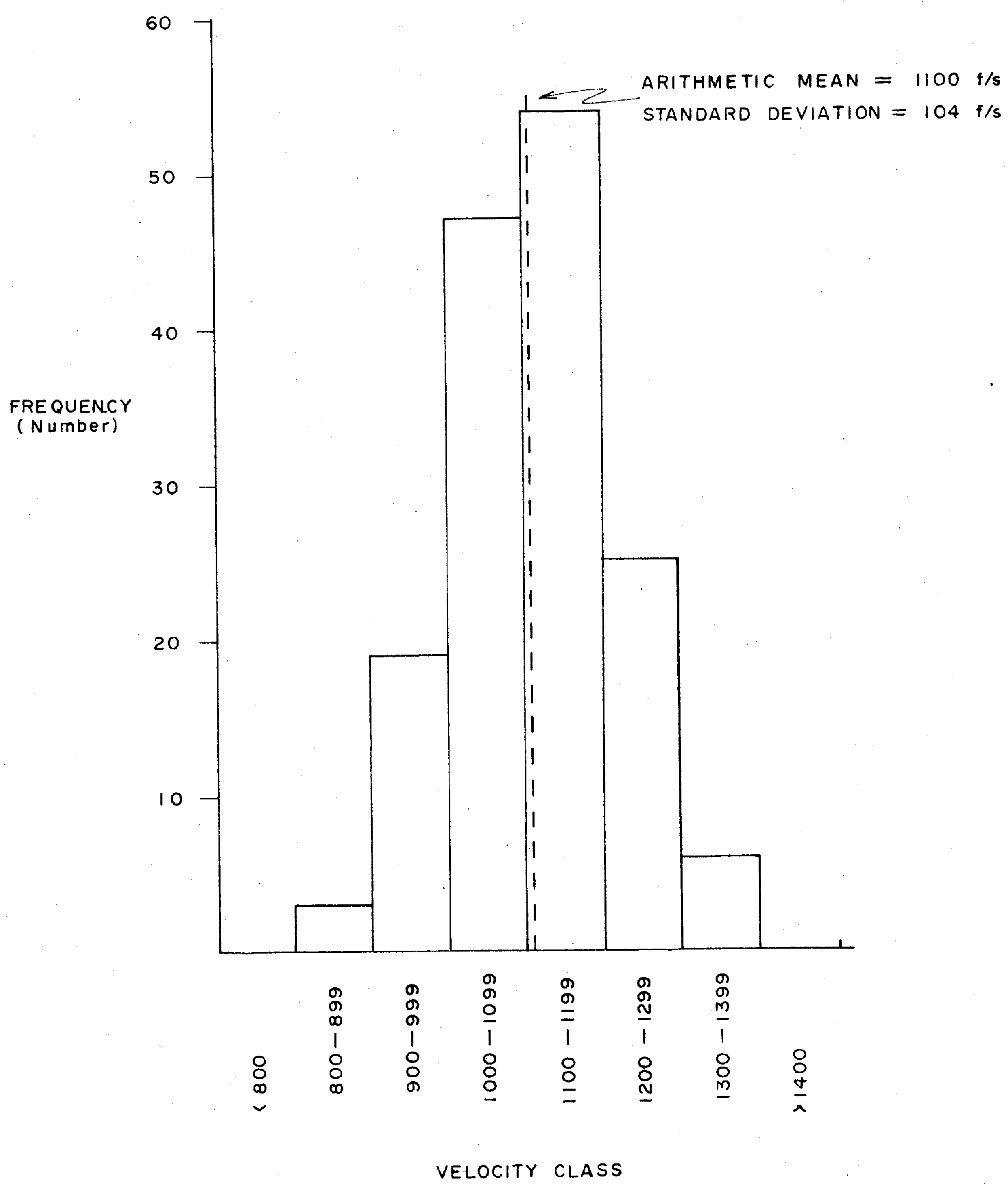
Second layer velocity families		<1900	
	1900	-	2999
	3000	-	4099

Third layer velocity		4100	
	4100	-	6399
	6400	-	8699
		> 8700	

Figure 5 shows the frequency distribution of 153 upper layer, 182 second layer, and 183 third layer velocities in 100 foot per second class intervals.

A number of major breaks in the histogram are evident. These occur at:

1550 feet per second
2650 " " "
4450 " " "
5150 " " "
6250 " " "
~8200 " " "
~9800 " " "



JOY MINING LTD.

PRINCETON PROJECT

FIGURE 3

FIRST LAYER VELOCITY FREQUENCY HISTOGRAM

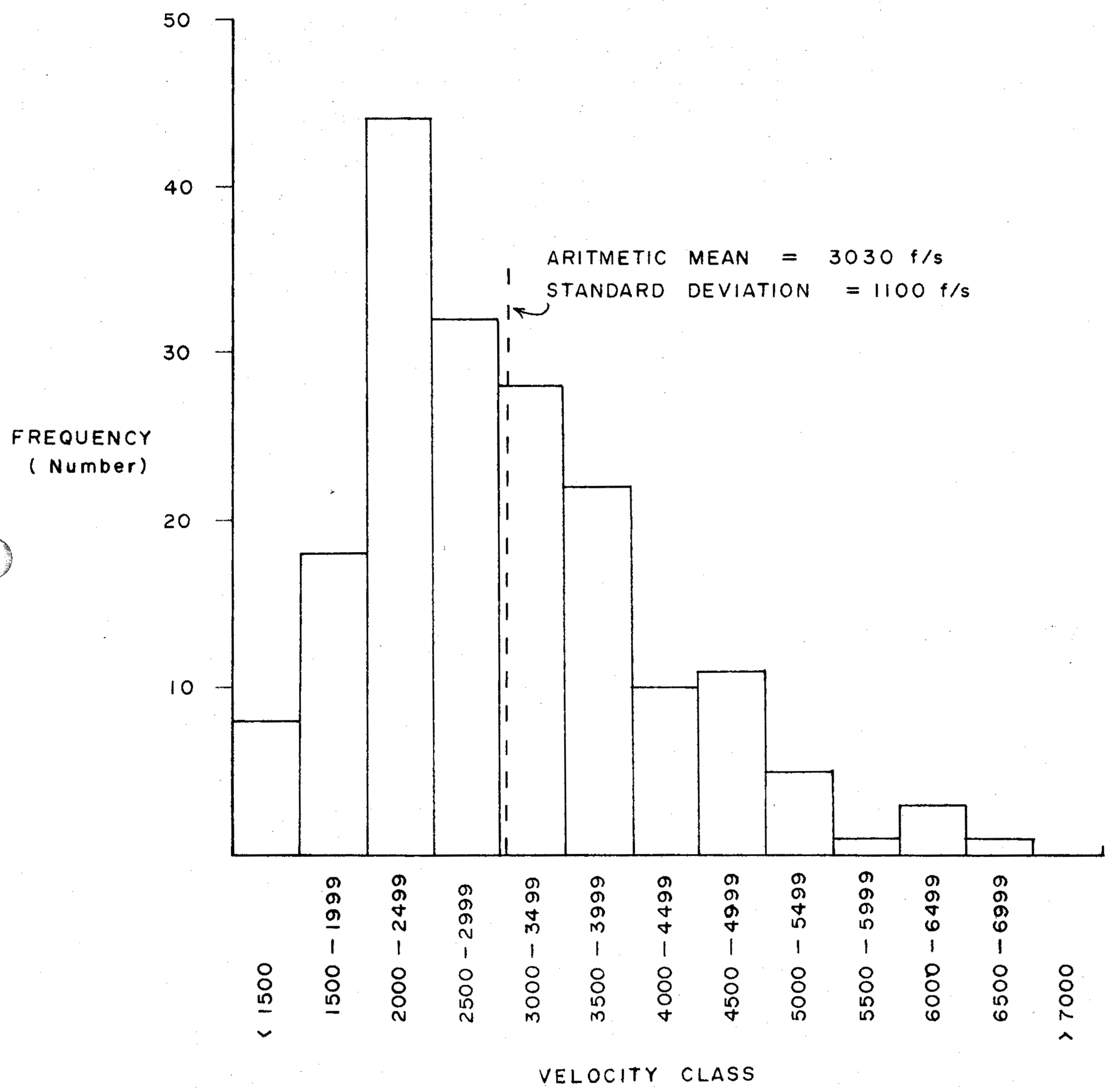


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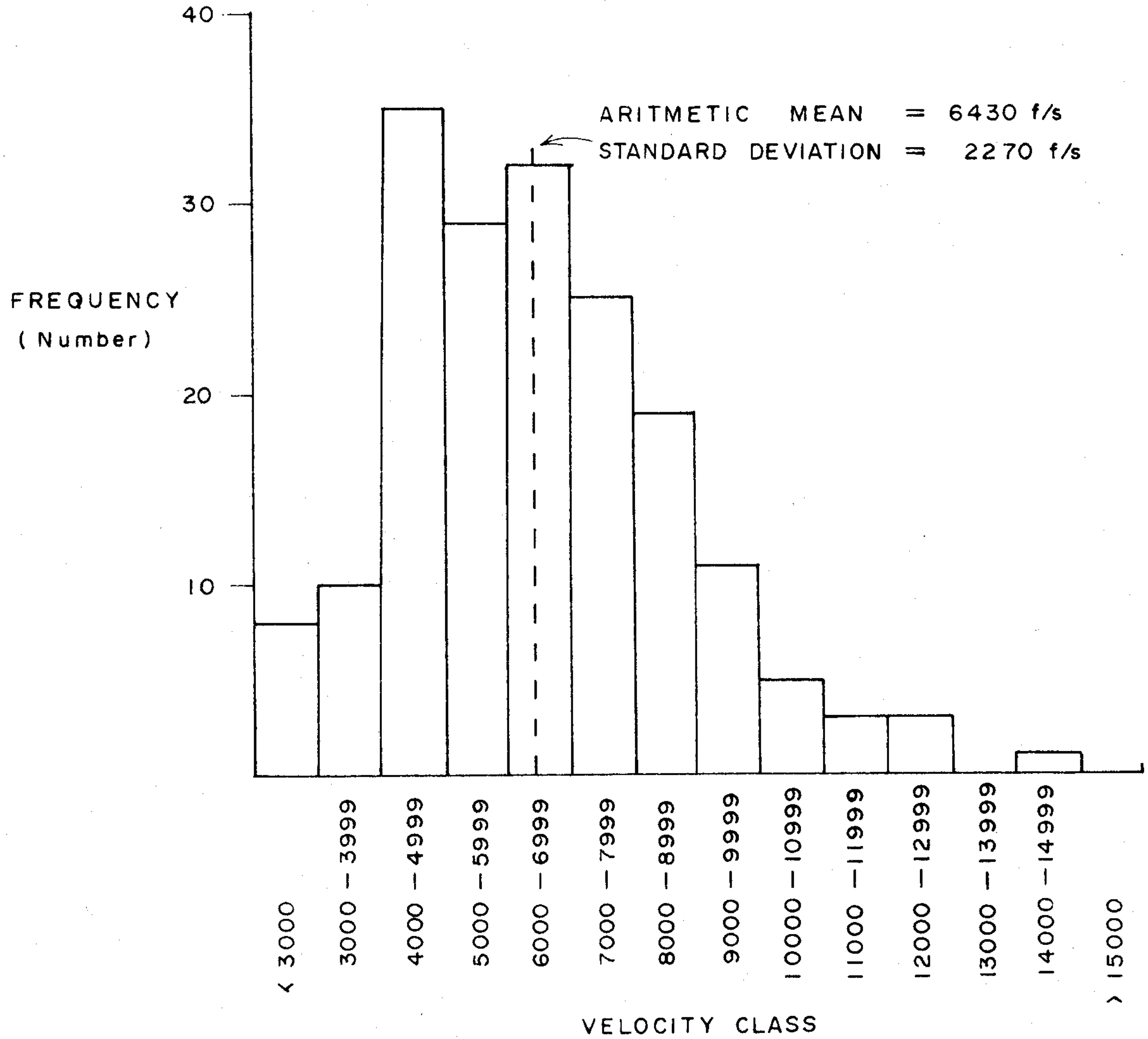
FIGURE 4

SECOND LAYER VELOCITY FREQUENCY HISTOGRAM



JOY MINING LTD.

PRINCETON PROJECT

FIGURE 5

THIRD LAYER VELOCITY FREQUENCY HISTOGRAM

D-1 CLASSIFICATION OF VELOCITIES cont'd

There are a number of secondary breaks between these that have been disregarded for the purposes of this classification.

A general overall classification based on information from both methods is presented below and, has been used in profile preparation and in interpretation.

Velocity Range		Velocity Family
<1099	feet per second	v_{1a}
1100 - 1549	"	v_{1b}
1550 - 2649	"	v_{2a}
2650 - 4449	"	v_{2b}
4450 - 5149	"	v_{2c}
5150 - 6249	"	v_{2d}
6250 - 8199	"	v_{3a}
8200 - 9799	"	v_{3b}
>9800	"	v_{3c}

Prior to this survey, the authors conducted a number of "velocity tests" on Joy Mining's Princeton property. In the report (dated May 30, 1971), the results were discussed and a tentative classification of velocities was arrived at.

This classification is reproduced here on page 21 (Summary of Velocity Tests) and have been used to tentatively identify the velocity families determined above.

Families v_{1a} and v_{1b} are tentatively identified as "uncompacted and undifferentiated surficial deposits", e.g., topsoil, humus, till, loose sediments.

Families v_{3a}, v_{3b}, and v_{3c} are tentatively identified as "bedrock", i.e. Princeton sandstone, argillite, etc. and Nicola

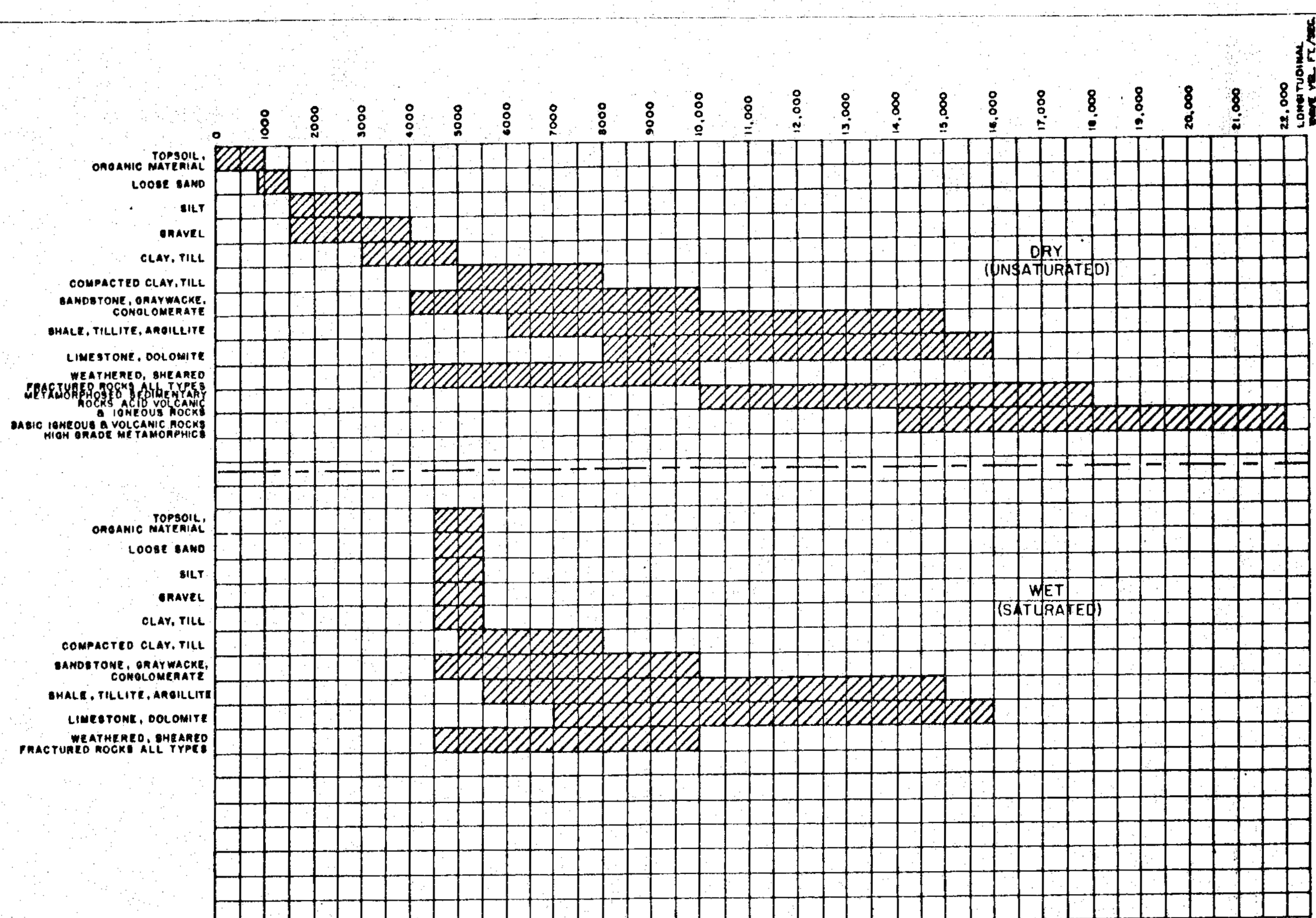
Test	Material \ Velocity	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000	6500	7000	7500	8000	8500	9000
"E"	dry loose fine silty sand	X																
	dry coarse clayey gravel	X																
	saturated clayey gravel										X							
"F"	"topsoil"		XXXX															
	Princeton					(?)XXXXX												
	gravels					X												
"Nicola"	"topsoil with boulders"		X															
	Nicola																XX	
"G"	"topsoil"	X																
	unconsolidated recent gravels			X														
	saturated recent gravels (?)						X											
	sandstone													X				
Airport Trench	uncompacted rusty conglom.			X														
	weathered sandstone						X											

Tentative "dry" classification: ←topsoil→ | ←gravels, conglom. till→ ←Princeton→ ←bedrock (sandstone, Nicola)→ zone of saturation volcanics. A v_3 velocity layer may also, in some cases, represent the water table.

Presumably the higher v_1 velocity families and v_2 set of velocity families will be the families of economic interest. However, they will require physical identification for exploration purposes.

At present, insufficient geological data is available to further distinguish within these velocity interest groups but as physical examination of the ground progresses, a more definite correlation of material to velocity family will be possible.

A standard table correlating velocity to material follows: (Table supplied by Huntec Limited).



CLASSIFICATION OF GEOLOGICAL MATERIALS
BY SEISMIC VELOCITIES

D-2 MAJOR FEATURES OF THE SEISMIC PROFILES:

The seismic profiles accompany this report in the large ledger titled "Joy Mining, Hammer Seismic Profiles, Princeton Placer Project".

The scale is 50 feet to the inch both horizontal and vertical and they are presented as 2,000 foot long sections (0-20W, 20-40W, etc.).

The computed layer thicknesses and offset distances are tabulated as Appendix V.

All lines have been corrected for base line changes in elevation with 0 + 00 on line 0 + 00 N being the "zero" datum.

A brief tabulation of some of the major features is presented below, and they are discussed in the conclusions of this report (Section A).

1. A broad bedrock depression, which apparently trends northerly, has been tentatively correlated between line 0 + 00 and line 16N.

Intersections are:

28W on line 0 + 00 (350 feet wide by 25 feet deep)
31W on line 4N (250 feet wide by 30 feet deep)
30 + 50W on line 8N (200 feet wide by 10 feet deep)
34W on line 12N (unknown width by 20 feet deep (?))
34W on line 16N (approx. 250 feet wide by 30 feet deep)

Layering at this intersection is complex and a facies change is indicated.

2. A topographical depression, which truncates seismic layering, exists at 54 + 50W on line 0 + 00. This may represent a recent stream channel or one which has been recently reoccupied.

3. Centered at 18W on line 4N is a bedrock depression in excess of 300 feet wide and in excess of 30 feet deep. Layering, however, is fairly straightforward and not that which would be expected in a buried stream valley.

4. On line 8N at station 7 + 00W a lens of 6520 f/s to 7000 f/s material lies in a depression roughly 400 feet wide. The lens is 50 feet thick and buried about 30 feet below surface. This velocity is somewhat higher than has been anticipated for unconsolidated gravels.

5. A similar lens is located on line 12N in and around 16 + 00W. Velocities are again in the 6-7000 foot per second range. The lens is some 40 feet thick and comes within 20 feet of the surface.

6. An anomalously high subsurface velocity (20,900 f/s) was encountered between 24W and 26W on line 16N. Immediately to the east is a small bedrock depression underlain by moderately high velocities (13,000 f/s). It is possible that this is a paleotopographic ridge of high density rock (Nicola?).

7. On line 28N at 26 + 50W, a bedrock depression may be present. Within this feature, is a lens of 3000 f/s material

some 400 feet wide with a maximum thickness of 50 feet. It lies within 10 feet of the surface.

8. On line 32N immediately west of the base line, a wedge of 3360 f/s material occupies what appears to be a bedrock depression.

Reinterpretation of many of the profiles may be necessary as physical identification of the subsurface layering progresses.

Respectfully submitted,

A. Scott, B.Sc.

D. R. Cochrane, P.Eng.

August 16, 1971,
Delta, B.C.

APPENDIX I

Certificates

Name: COCHRANE, Donald Robert

Education: B.A.Sc. - University of Toronto
M. Sc. (Eng.) - Queen's University

Professional Associations: Professional Engineer of British Columbia, Ontario and Saskatchewan.
Member of C.I.M.N., G.A.C., M.A.C. - Geological Engineer.

Experience: Engaged in the profession since 1962 while employed with Noranda Exploration Co. Ltd., Quebec Cartier Mines Ltd. and Meridian Exploration Syndicate.

Name: CHASE, William

Education: Grade 12 Diploma

Experience: Employed since September, 1970 and engaged in EM and IP surveying. Previous experience at the Anvil Mine, Y. T., Summer, 1970.

Name: SCOTT, Allan R.

Education: B. Sc. - Geophysicis, University of British Columbia

Experience: Two summers - crew member and operator with Geo-X Surveys Ltd.,
Presently employed with D. R. Cochrane, P. Eng. - Geophysicist

Professional Associations: Member of S.E.G.

Name: ESTACAILLE, Norman

Education: Grade 12 Diploma

Experience: ½ year exploration experience with Huntec presently employed by D. R. Cochrane

APPENDIX I

Certificates

cont'd

Name:	ELLIOTT, David
Education:	Presently - student B.C.I.T. - Computer Technology
Experience:	2 years - Geology - Geophysics - University of British Columbia 5 years - Field work and Geological Drafting

Name:	HUTTON, James
Age:	Twenty-two
Education:	Third year Geophysics, University of British Columbia
Experience:	2 Field Seasons exploration experience with Orequest Explorations.

APPENDIX II

Personnel and Dates Worked

Name	Work Done	Dates
A. Scott	Hammer Seismic Survey and Field Supervision	June 4 - 10, June 18 - 19, July 6 - 8,
	Data Processing, Interpretation & Report Preparation	June 21 - 26, 28 - 30, July 9 - 12, July 23, July 26, July 28 - 31, Aug. 1 & 2, Aug. 7 - 15
N. Estacaille	Hammer Seismic Survey	June 4 - 7, 9 - 24, June 28 to July 8
W. Chase	Hammer Seismic Survey Data Processing	June 11-24, June 28 - July 8 Aug. 10 and 11
J. Hutton	Data Processing	June 24 - 26, June 28 - July 2.
D. Elliott	Draughting	July 14 - 15, Aug. 5,6, and Aug. 9 - 14
D. R. Cochrane	Report Preparation	Aug. 7 - 15

APPENDIX IV

Cost Breakdown

By contract between D. R. Cochrane, P.Eng. and Dr. A. G. Pentland, and dated June 3, 1971 at Vancouver, B.C.

For hammer seismic surveying on placer leases in the Princeton Area,

19.0 seismic line miles at $356.00 per seismic mile ----------------- $ 6,764.00

D. R. Cochrane, P.Eng.

APPENDIX V

SEISMIC CALCULATIONS

Company JOY MINING

Area PRINCETON

Survey by:

D.R. Cochrane, P.Eng.,
4882 - B Delta Street,
Delta, B.C.

Line	Station	Shot Direction	LAYER THICKNESS (d_i) and OFFSET DISTANCES (x_i)								REMARKS
			d_1	x_1	d_2	x_2	d_3	x_3	d_4	x_4	
0 +00	0 + 00	E	10.9	3.6	29.0	12.0					
	1 + 20E	W	7.2	2.4	--	--					
	2 + 60E	E	--	--	--	--					
	4E	W	13.6	4.6	21.1	16.5					
	4E	E	11.1	5.2	15.8	10.4					
	6E	W	6.3	3.0	--	--					
	6E	E	7.1	2.5	33.5	20.5					
	8E	W	7.1	2.5	27.7	17.2					
	8E	E	6.3	1.9	--	--	43.3	19.6			
	10E	W	3.5	2.0	6.4	5.5					
	10E	E	7.8	2.0	39.1	20.5					
	12E	W	3.0	1.6	13.1	9.0					
	16E	E	8.4	5.2	30.0	22.2					
	18E	W	4.5	2.8	--	--					
	18E	E	4.9	3.5	--	--					
	20E	W	7.3	5.1	36.9	23.5					
			--	--	--	--					
	22E	E	12.8	13.5	--	--					
	24E	W	8.0	8.4	--	--					
	24E	E	2.2	1.7	14.1	7.7					
	26E	W	2.7	2.1	23.2	12.4					
	26E	E	25.2	8.4	--	--					
	28E	W	17.3	5.8	--	--					
	28E	E	--	--	--	--					
	30E	W	--	--	--	--					
	30E	E	3.2	1.8	8.8	8.1					
	32E	W	--	--	12.0	9.6	37.5	16.6			
	32E	E	9.0	4.8	--	--					
	34E	W	7.2	3.8	--	--					

where d_i = thickness of i^{th} layer; x_i = offset distance towards shot point for i^{th} layer

SEISMIC CALCULATIONS

Company JOY MINING

Area PRINCETON

Survey by:

D.R. Cochrane, P.Eng.,
4882 - B Delta Street,
Delta, B.C.

Line	Station	Shot Direction	LAYER THICKNESS (d_i) and OFFSET DISTANCES (x_i)								REMARKS
			d_1	x_1	d_2	x_2	d_3	x_3	d_4	x_4	
4N	0 +00	E	4.8	1.9	10.6	5.7					
	2E	W	8.5	3.3	17.6	9.5					
	2E	E	4.7	1.8	10.6	5.7					
	4E	W	12.9	4.8	18.0	13.3					
	4E	E	--	--	--	--					
	6E	W	6.5	2.2							
	6E	E	6.3	2.6	8.8	7.4					
	8E	W	4.3	1.8	19.8	14.4					
	8E	E	3.9	1.8	9.6	10.7	37.2	24.0			
	10E	W	--	--	--	--					
	10E	E	10.5	3.8	12.6	17.0					
	12E	W	11.6	3.0	37.8	24.6					
	12E	E	9.2	4.7	22.0	15.8					
	14E	W	2.5	2.8	12.7	11.0	20.0	17.1			
	14E	E	3.3	1.4							
	16E	W	10.6	4.5	26.6	11.6					
	16E	E	--	--	--	--					
	18E	W	1.8	1.3	5.7	6.4					
	18E	E	--	--	--	--					
	20E	W	1.3	0.9	5.8	6.4					
	20E	E	--	--	--	--					
	22E	W	--	--	--	--					
	22E	E	7.2	5.5	21.6	31.9					
	24E	W	12.4	9.4							
	24E	E	17.4	11.6							
	26E	W	3.5	5.7	16.7	16.7					
	26E	E	9.3	6.3	18.0	25.8					
	28E	W	6.1	4.1	22.0	29.1					
	28E	E	11.0	5.3	9.6	21.6					
	30E	W	11.8	4.8							
	30E	E	--	--	--	--					
	32E	W	2.0	0.8	11.2	11.5					
	32E	E	--	--	--	--					

where d_i = thickness of i^{th} layer; x_i = offset distance towards shot point for i^{th} layer

SEISMIC CALCULATIONS

Company JOY MINING

Area PRINCETON

Survey by:

D.R. Cochrane, P.Eng.,
4882 - B Delta Street,
Delta, B.C.

Line	Station	Shot Direction	d_1	x_1	d_2	x_2	d_3	x_3	d_4	x_4	REMARKS
			LAYER THICKNESS (d_i) and OFFSET DISTANCES (x_i)								
8N	0 + 00	E	14.4	2.9	32.0	24.7					
	2E	W	10.3	2.0	22.0	17.1					
	2E	E	9.8	3.2	18.9	13.9					
	4E	W	9.1	3.0	17.7	13.0					
	4E	E	10.0	2.2							
	6E	W	7.2	1.6							
	6E	E	1.3	0.9	6.6	4.1					
	8E	W	8.1	4.6	20.3	14.9					
	8E	E	9.5	3.4							
	10E	W	15.1	5.4							
	10E	E	9.6	6.1	53.0	13.3					
	12E	W	15.1	9.6	40.4	11.1					
	12E	E	21.8	12.7	30.5	21.4					
	14E	W	20.1	11.7	36.3	24.1					
	14E	E	35.6	8.4							
	16E	W	14.2	11.0	42.2	20.6					
	16E	E	19.3	7.7							
	18E	W	2.4	1.0							
	20E	E	3.1	1.6	22.4	14.3					
	22E	W	6.1	3.1							
	22E	E	2.2	2.9							
	24E	W	12.5	9.4							
	24E	E	19.9	11.2							
	26E	W	9.7	5.4							
	26E	E	10.7	5.5							
	28E	W	5.2	2.7	25.4	24.7					
	28E	E	5.7	3.4	48.2	20.4					
	30E	W	7.1	4.2	57.9	24.6					
	30E	E	5.6	4.4	47.5	18.0					
	32E	W	8.5	6.7	38.7	15.6					

where d_i = thickness of i^{th} layer; x_i = offset distance towards shot point for i^{th} layer

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Company JOY MINING

Area PRINCETON

Line	Station	Shot Direction	LAYER THICKNESS (d_i) and OFFSET DISTANCES (x_i)								REMARKS
			d_1	x_1	d_2	x_2	d_3	x_3	d_4	x_4	
12N	0 + 00	E	13.7	2.1							
	2E	W	6.2	1.6	11.1	9.8					
	2E	E	6.7	1.6							
	4E	W	5.7	3.0	19.6	12.4					
	4E	E	4.8	2.2	8.4	9.7	19.2	25.0			
	6E	W	7.4	2.3	11.8	13.4					

where d_i = thickness of i^{th} layer; x_i = offset distance towards shot point for i^{th} layer

SEISMIC CALCULATIONS

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Area PRINCETON

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Line	Station	Shot Direction	d_1	x_1	d_2	x_2	d_3	x_3	d_4	x_4	REMARKS
			LAYER THICKNESS (d_i) and OFFSET DISTANCES (x_i)								
0 + 00	0 + 00W	W	9.5	2.6	28.2	18.5					
	2W	E	7.6	2.0	21.5	14.1					
	2W	W	6.3	3.0	32.6	10.0					
	4W	E	7.2	3.5	26.3	8.4					
	4W	W	8.2	3.5	24.0	8.6					
	6W	E	7.2	3.1	17.6	6.5					
	6W	W	5.7	2.3	14.7	8.6					
	8W	E	6.0	2.5	12.6	7.6					
	8W	W	4.9	2.1	14.8	6.0					
	10W	E	5.6	2.4	15.8	6.4					
	10W	W	6.1	2.4	15.7	7.2					
	12W	E	6.8	2.7	12.2	5.9					
	12W	W	7.5	2.6	17.0	8.2					
	14W	E	7.5	2.6	16.3	8.0					
	14W	W	7.8	2.0	15.6	10.9					
	16W	E	7.0	1.7	39.7	26.0					
	16W	W	5.7	1.9	29.5	13.6					
	18W	E	4.9	2.7	21.6	10.5					
	18W	W	4.2	2.3	8.5	6.2					
	20W	E	10.5	2.7	39.0	18.1					
	20W	W	14.6	2.7							
	22W	E	11.2	2.1							
	22W	W	12.0	2.7	44.2	25.2					
	24W	E	5.7	2.4	9.3	7.8					
	24W	W	6.0	2.9	14.3	9.2					
	26W	E	5.3	2.6	14.2	9.0					
	26W	W	5.8	2.3	44.3	30.2					
	28W	E	6.1	2.4	23.0	16.3					
	28W	W	3.7	2.2	10.0	9.3	56.2	31.4			
	30W	E	4.8	2.9	12.9	11.9					
	30W	W	6.9	1.8	28.0	21.0					
	32W	E	7.7	2.0							
	32W	W	9.1	2.1							
	34W	E	6.7	1.6	27.0	21.8					
	34W	W	7.5	1.4							
	36W	E	8.4	1.5							
	36W	W	11.1	2.2							
	38W	E	6.3	2.3	13.2	10.2					
	38W	W	4.7	2.6	13.4	6.5					
	40W	E	5.9	3.3	9.1	5.0					
	40W	W	6.7	3.1	11.6	7.8					
	42W	E	5.8	2.7	8.8	6.1					

where d_i = thickness of i^{th} layer; x_i = offset distance towards shot point for i^{th} layer

SEISMIC CALCULATIONS

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Company JOY MINING

Area PRINCETON

Line	Station	Shot Direction	LAYER THICKNESS (d_i) and OFFSET DISTANCES (x_i)								REMARKS
			d_1	x_1	d_2	x_2	d_3	x_3	d_4	x_4	
0 + 00	50W	W	11.3	4.7	24.6	17.9					
	52W	E	9.0	3.8	31.3	21.7					
	52W	W	6.9	2.6	46.3	23.0					
	54W	E	8.3	3.1	19.1	10.3					
	54W	W	14.2	3.8							
	56W	E	5.1	3.7	14.0	8.2					
	56W	W	4.0	3.0	13.1	8.8	31.6	15.5			
	58W	E	6.6	2.1	48.2	20.0					
	58W	W	8.0	2.2							
	60W	E									
	60W	W	8.7	2.1	15.6	11.8					
	62W	E									
	62W	W	13.2	1.7							
	64W	E	5.6	2.4	16.0	6.3					
	64W	W	9.5	2.7							
	66W	E	4.9	1.4							
	66W	W	6.0	3.2	9.4	8.7					
	68W	E	7.3	3.8							
	68W	W	5.7	3.0							
	70W	E	8.2	4.3	14.9	12.7					

where d_i = thickness of i^{th} layer; x_i = offset distance towards shot point for i^{th} layer

SEISMIC CALCULATIONS

Company JOY MINING

Area PRINCETON

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Line	Station	Shot Direction	LAYER THICKNESS (d_i) and OFFSET DISTANCES (x_i)								REMARKS
			d_1	x_1	d_2	x_2	d_3	x_3	d_4	x_4	
4N	0 + 00	W	4.1	1.9	14.0	6.6					
	2W	E	5.7	2.7	10.0	5.2	15.9	15.4			
	2W	W	7.1	2.5	15.2	9.0	29.0	24.0			
	4W	E	8.9	3.1	27.0	15.5					
	4W	W	10.5	3.1	17.5	13.1					
	6W	E	9.0	2.6	20.4	14.7					
	6W	W	9.7	2.5	28.8	19.9					
	8W	E	7.0	1.8	31.3	21.1					
	8W	W	7.5	2.2	28.2	16.4					
	10W	E	6.0	1.8	30.0	17.2					
	10W	W	6.7	2.0							
	12W	E									
	12W	W	7.6	3.9	10.7	7.5					
	14W	E	5.5	2.8	9.5	6.3					
	14W	W	5.9	3.3							
	16W	E	4.4	2.5	6.2	4.5					
	16W	W	6.3	4.0	11.7	6.0	30.2	25.5			
	18W	E	4.1	2.6	23.1	10.2	41.0	35.7			
	18W	W	4.5	2.7	13.5	6.8	38.1	30.3			
	20W	E	5.7	3.4	8.9	5.1	18.6	15.7			
	20W	W	10.5	2.2	26.9	17.6					
	22W	E	9.7	2.1	27.0	17.6					
	22W	W									
	24W	E	6.7	2.7	11.7	11.3	43.5	34.7			
	24W	W	5.1	2.4	10.1	7.3	47.8	25.5			
	26W	E	9.5	4.5	24.2	17.0	49.0	29.8			
	26W	W	9.2	3.2	27.0	20.8					
	28W	E	7.8	2.7	24.1	18.5					
	28W	W	7.8	3.1	11.4	8.0					
	30W	E	6.8	2.7	39.4	23.8					
	32W	E	5.2	1.9	11.9	9.6					
	32W	W	9.8	2.4	16.8	19.4					
	34W	E	8.6	2.1	22.5	25.2					
	34W	W	6.9	1.8	22.7	19.2					
	36W	E	10.0	2.6	32.9	27.8					
	36W	W	4.5	2.4	14.3	7.5					
	38W	E	4.5	2.4	13.4	7.1					
	38W	W	5.5	1.7	12.1	6.1					
	40W	E	7.5	.9							
	40W	W	6.0	1.3	31.8	25.3					
	42W	E	8.8	1.9	26.1	21.3					

where d_i = thickness of i^{th} layer; x_i = offset distance towards shot point for i^{th} layer

SEISMIC CALCULATIONS

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Line	Station	Shot Direction	LAYER THICKNESS (d_i) and OFFSET DISTANCES (x_i)								REMARKS
			d_1	x_1	d_2	x_2	d_3	x_3	d_4	x_4	
8N	0 + 00	W	12.0	3.0	23.7	16.7					
	2W	E	11.7	2.9	26.0	18.1					
	2W	W	11.3	3.9	38.2	15.4					
	4W	E	10.3	3.5	26.9	11.1					
	4W	W	9.3	3.2							
	6W	E	8.6	2.9	16.3	11.5					
	6W	W	8	2.2	25.7	20.8					
	8W	E	6.5	1.7	28.2	22.4	45.2	35.7			
	8W	W	14.3	3.3	51.7	22.3					
	10W	E	9.3	4.6	12.2	9.4	39.3	19.2			
	10W	W	5.9	3.2	9.2	7.8					
	12W	E	5.9	3.2	6.5	6.0					
	12W	W	6.0	3.2	8.5	5.8	27.8	23.5			
	14W	E	4.5	2.4	15.2	9.0	31.4	27.9			
	14W	W	15.1	2.7							
	16W	E	7.1	3.9	10.2	5.2					
	16W	W	7.4	4.1	11.9	5.9					
	18W	E	9.5	5.2	15.8	7.7					
	18W	W									
	20W	E	9.3	2.8	15.9	19.8					
	20W	W	4.6	2.3	11.5	9.8	21.6	20.3			
	22W	E	4.3	2.2	11.6	9.8	21.7	20.3			
	22W	W	6.5	2.9	7.6	5.4	39.1	33.5			
	24W	E	5.9	2.6	19.5	11.9					
	24W	W	4.9	2.2	13.3	12.1					
	26W	E	7.5	3.3	13.0	12.6					
	26W	W	6.1	4.1	6.8	5.7					
	28W	E	6.4	1.9							
	28W	W	6.4	1.5	32.9	16.1					
	30W	E	1.5	.8	5.6	3.4	39.0	19.7			
	30W	W	5.5	1.7							
	32W	E	5.5	1.7							
	32W	W	6	2.0	24	15.3					
	34W	E	7.1	2.5	25.6	16.4					
	34W	W	7.1	2.0	24.5	15.7					
	36W	E	4.5	1.3	38	23.7					
	36W	W	5.5	1.3	22.9	19.8					
	38W	E	6.7	1.6							
	38W	W	9.8	2.3							
	40W	E	7.8	1.9	27.9	20.3					
	40W	W	15.5	3.2							
	42W	E									

where d_i = thickness of i^{th} layer; x_i = offset distance towards shot point for i^{th} layer

SEISMIC CALCULATIONS

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Company JOY MINING

Area PRINCETON

Line	Station	Shot Direction	LAYER THICKNESS (d_i) and OFFSET DISTANCES (x_i)								
			d_1	x_1	d_2	x_2	d_3	x_3	d_4	x_4	REMARKS
8N	42W	W	31.8	5.3							
	44W	E	27.6	4.6							
	44W	W	17.3	3.8							
	46W	E	10.9	2.4							

where d_i = thickness of i^{th} layer; x_i = offset distance towards shot point for i^{th} layer

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Area PRINCETON

Line	Station	Shot Direction	LAYER THICKNESS (d_i) and OFFSET DISTANCES (x_i)								REMARKS
			d_1	x_1	d_2	x_2	d_3	x_3	d_4	x_4	
12N	0 + 00	W	4	2.5	11.5	3.4	21	10			
	2W	E	9	2.0	39	16.6					
	2W	W	9.5	2.5	26.5	10.6					
	4W	E	10	2.7	33	13					
	4W	W	10	2.7	13.5	9.8					
	6W	E	8	2.1	40.5	24.6					
	6W	W	8.4	2.7	20.2	13.2					
	8W	E	9.1	2.9	39.2	24.5					
	8W	W	4	2.6	9.3	6.0	35.0	19.0			
	10W	E	7.7	2.0	35.3	17.6					
	10W	W	8.2	2.0	34.8	12.6					
	12W	E	7.8	1.9	35.5	12.8					
	12W	W	4.9	1.4	29.9	12.3					
	14W	E	7.6	2.1	34.7	14.4					
	14W	W	5.9	2.2	11.3	9.9	16.0	16.7			
	16W	E	4.1	1.6	23.4	9.4					
	16W	W	4.6	1.6	17.6	9.7					
	18W	E	5.3	1.8	31.3	16.7	35.0	38.6			
	18W	W	2	1.7	8.7	4.8	11	10			
	20W	E	3.6	2.9	14.3	4.0	31	17.7			
	20W	W	9.3	3.1	20.1	11.5	27.7	27			
	22W	E	8.9	3.0	23.2	13.0					
	22W	W	5.0	1.7	15.4	7.6	38.8	25.3			
	24W	E	6.0	2.1	12.0	6.2					
	24W	W	7.1	3.2	16.0	8.4					
	26W	E	4.8	2.2	21.6	10.6	39.3	22.9			
	26W	W	6.5	2.1	28.2	16.9					
	28W	E	6.5	2.1	7.7	5.3					
	28W	W	6.7	3.4	5.0	4.2					
	30W	E	7.1	3.6	16.3	7.7					
	30W	W	5.9	2.5							
	32W	E	5.9	2.5	12.9	5.5					
	32W	W	6.0	2.5	6.5	6.1	14.5	14.4			
	34W	E	2.7	1.1	9.7	7.6	33.7	29.8			
	34W	W	5.6	2.1	10.8	7.0					
	36W	E	6.6	2.4	13.6	8.8					
	36W	W	4.9	2.1	15.5	7.4					
	38W	E	4.6	2.0	17.9	8.4	24.0	24.0			
	38W	W	5.6	2.0	33.0	13.8	31.6	12.2			
	40W	E	4.2	1.5	29.8	12.4	55.1	18.3			
	40W	W	5.5	3.5	22.5	9.6					
	42W	E	6.9	4.4	27.3	11.7					
	42W	W	2.8	2.6	30.8	9.8					

where d_i = thickness of i^{th} layer; x_i = offset distance towards shot point for i^{th} layer

SEISMIC CALCULATIONS

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Line	Station	Shot Direction	LAYER THICKNESS (d_i) and OFFSET DISTANCES (x_i)								REMARKS
			d_1	x_1	d_2	x_2	d_3	x_3	d_4	x_4	
12N	44W	E	13.4	12.3	35	13.2					
	44W	W	18.5	9.9	43.0	9.5					
	46W	E	18.5	9.9	50.5	11.0					
	46W	W									
	48W	E	4.8	2.2	19.3	9.2					

where d_i = thickness of i^{th} layer; x_i = offset distance towards shot point for i^{th} layer

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Line	Station	Shot Direction	d_1	x_1	d_2	x_2	d_3	x_3	d_4	x_4	REMARKS
			LAYER THICKNESS (d_i) and OFFSET DISTANCES (x_i)								
16N	0 +00W	W	10.3	2.0	34.6	19.9					
	2W	E	4.4	2.4	12.1	6.0	17.7	12.4			
	2W	W	11.2	2.1	17.1	14.8					
	4W	E	4.3	2.5	10.4	4.9	23.1	21.1			
	4W	W	8.5	3.4	24.5	17.0					
	6W	E	11.6	4.6	17.3	13.1					
	6W	W	12.9	4.8	18.6	15.3					
	8W	E	14.0	5.3	25.6	20.2					
	8W	W	7.0	2.1	14.1	9.5					
	10W	E	8.2	2.5	21.6	14.1					
	10W	W	5.9	2.5	11.9	9.7	55.9	31.7			
	12W	E	11.9	2.7	46.0	24.2					
	12W	W	12.0	2.7	17.5	13.0					
	14W	E	6.0	1.3	45.6	30.8					
	14W	W	7.6	2.1	14.6	11.4					
	16W	E	2.9	3.2	9.5	4.6	23.9	19.2			
	16W	W	9.0	5.5	12.3	8.3	29.1	25.4			
	18W	E	5.0	3.1	19.6	11.0	20.8	20.8			
	18W	W	5.9	4.8	22.6	8.7	28.9	26.1			
	20W	E	5.9	4.8	31.3	11.6	30.6	28.9			
	20W	W	6.4	4.6	18.0	8.9	34.5	21.0			
	22W	E	5.1	3.7	10.0	5.3	56.2	30.4			
	22W	W	5.7	2.7	11.2	8.1	43.2	16.7			
	24W	E	6.4	3.0	13.9	9.8					
	24W	W	16.0	2.8	38.	11.8					
	26W	E	4.0	2.7	11.5	4.4	58.0	18.0			
	26W	W	5.8	2.2	7.3	7.2	38.7	23.6			
	28W	E	3.8	1.4	8.9	8.0	35.4	22.1			
	28W	W	4.5	2.7							
	30W	E	4.3	2.5	13.2	10.8	48.8	20.4			
	30W	W	6.6	4.4	36.9	16.2					
	32W	E	3.9	2.7	17.4	7.8					
	32W	W	7.3	2.3	10.1	13.4					
	34W	E	8.1	2.5	15.5	19.9					
	34W	W	3.0	1.6	12.2	7.8	33.4	26.9			
	36W	E	5.9	1.4	23.9	17.1					
	36W	W	5.1	1.6	11.8	8.1					
	38W	E	4.7	1.5	10.5	7.2					
	38W	W	5.1	2.0							
	40W	E	6.8	2.7							
	40W	W	14.5	6.1	32.6	27.4					
	42W	E	21.8	5.1							

where d_i = thickness of i^{th} layer; x_i = offset distance towards shot point for i^{th} layer

SEISMIC CALCULATIONS

Survey by:

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Company JOY MINING

Area PRINCETON

Line	Station	Shot Direction	d_1	x_1	d_2	x_2	d_3	x_3	d_4	x_4	REMARKS
			LAYER THICKNESS (d_i) and OFFSET DISTANCES (x_i)								
16N	42W	W	11.6	7.9	28.8	9.4					
	44W	E	36.7	5.4							
	44W	W	30.7	5.4							
	46W	E	33.6	5.9							
	46W	W	7.1	8.2	32.8	7.3					
	48W	E	10.5	12.0	28.4	6.9					

where d_i = thickness of i^{th} layer; x_i = offset distance towards shot point for i^{th} layer

SEISMIC CALCULATIONS

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Area PRINCETON

Line	Station	Shot Direction	LAYER THICKNESS (d_i) and OFFSET DISTANCES (x_i)								REMARKS
			d_1	x_1	d_2	x_2	d_3	x_3	d_4	x_4	
20N	0 + 00	W	5.4	2.5	10.8	6.5	19.6	14.9			
	2W	E	4.8	2.2	11.3	6.6	21.8	16.3			
	2W	W	8.1	1.7							
	4W	E	10.2	2.2							
	4W	W	14.2	2.6							
	6W	E	15.8	2.9							
	6W	W	16.6	3.1							
	8W	E	9.1	3.7	14.4	9.8					
	8W	W	13.1	2.6	19.4	23.1					
	10W	E	10.1	4.1	15.1	11.0					
	10W	W	9.4	3.5	26.5	12.5					
	12W	E	6.9	2.6	22.0	10.2	20.0	24.4			
	12W	W	5.4	2.9	7.0	5.8	20.1	12.6			
	14W	E	4.5	2.8	14.1	10.0	26.2	17.3			
	14W	W	9.2	2.8	26.6	12.5					
	16W	E	10.3	3.2	28.4	13.4					
	16W	W	7.3	3.1	29.8	12.5					
	18W	E	9.0	3.8	25.8	11.2					
	18W	W	12.5	4.3	29.3	12.3					
	20W	E	10.0	3.4	37.3	15.0					
	20W	W	13.9	5.2	29.2	11.5					
	22W	E	12.5	4.6	30.1	11.6					
	22W	W	12.9	3.6	26.8	15.9					
	24W	E	12.9	3.6							
	24W	W	12.2	3.4	29.1	13.0					
	26W	E	11.8	3.2	31.5	13.9					
	26W	W	3.5	2.9	13.2	3.9					
	28W	E	9.4	1.5							
	28W	W	11.8	2.8	35.7	20.1					
	30W	E	9.1	4.8	15.1	11.0	34.2	22.7			
	30W	W	6.1	3.1	14.0	12.4					
	32W	E	12.2	6.3	17.5	16.8					
	32W	W	13.1	4.2							
	34W	E	8.4	2.7							
	34W	W	4.5	2.4	16.3	10.4	21.4	25.0			
	36W	E	4.5	2.4	13.4	8.8	20.4	23.2			
	36W	W	3.2	1.5	6.5	4.5					
	38W	E	6.7	3.1	18.1	12.0					
	38W	W	6.6	3.9	11.9	9.5					
	40W	E	16.3	4.6							
	40W	W	13.3	2.9							

where d_i = thickness of i^{th} layer; x_i = offset distance towards shot point for i^{th} layer

SEISMIC CALCULATIONS

Company JOY MINING

Area PRINCETON

Survey by:

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Delta, B.C.

Line	Station	Shot Direction	LAYER THICKNESS (d_i) and OFFSET DISTANCES (x_i)								REMARKS
			d_1	x_1	d_2	x_2	d_3	x_3	d_4	x_4	
20N	42W	E	10.9	2.3							
	42W	W	12.6	3.9							
	44W	E	7.0	2.2							
	44W	W	7.8	1.5	30.0	15.9					
	46W	E	16.5	3.2	26.1	14.6					

where d_i = thickness of i^{th} layer; x_i = offset distance towards shot point for i^{th} layer

SEISMIC CALCULATIONS

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Company JOY MINING

Area PRINCETON

Line	Station	Shot Direction	LAYER THICKNESS (d_i) and OFFSET DISTANCES (x_i)								
			d_1	x_1	d_2	x_2	d_3	x_3	d_4	x_4	REMARKS
24N	0 + 00	W	5.1	1.3	20.4	12.5					
	2W	E	9.8	2.4	24.8	15.6					
	2W	W	8.7	2.0	17.7	13.3					
	4W	E	7.1	1.7	18.4	13.6					
	4W	W	6.5	2.2	28.0	12.8					
	6W	E	9.3	3.2	21.6	10.4					
	6W	W	9.3	3.1	25.1	17.3					
	8W	E	9.0	3.0	21.3	14.9					
	8W	W	6.9	1.8							
	10W	E	7.7	2.0	18.9	14.9					
	10W	W	9.0	3.0	31.7	20.0					
	12W	E	6.5	2.2	19.1	12.1					
	12W	W	4.8	2.9	9.7	6.8	30.3	18.6			
	14W	E	5.8	1.5	29.7	16.1					
	14W	W	4.3	2.2	14.2	9.0					
	16W	E	3.1	1.6	10.4	6.6	20.3	9.9			
	16W	W	9.1	2.1	20.2	14.8					
	18W	E									
	18W	W	15.3	3.8	36.3	20.4					
	20W	E	16.9	4.1	41.6	23.3					
	20W	W	16.6	4.4	31.3	21.6					
	22W	E	9.6	2.5	19.1	13.1					
	22W	W	7.8	5.5	19.8	5.2					
	24W	E	3.4	2.4	21.1	5.0					
	24W	W	10.1	2.2	36.1	18.9					
	26W	E	4.6	2.7	11.6	6.3	23.4	14.3			
	26W	W	7.5	2.2							
	28W	E	18.7	5.5							
	28W	W	9.9	4.2	48.1	12.9					
	30W	E	2.5	1.9	11.3	11.1	49.1	14.3			
	30W	W	7.9	4.4	33.8	12.7					
	32W	E	5.0	2.8	38.2	13.7					
	32W	W	4.7	1.9	30.0	14.4					
	34W	E	6.8	2.7	20.3	10.3					
	34W	W	6.1	3.1	36.6	12.1					
	36W	E	4.0	2.0	26.4	8.7					
	36W	W	6.2	4.1	21.2	10.5	46.2	25.8			
	38W	E	7.5	5.0	14.2	7.8	34.0	19.0			
	38W	W	4.9	3.5	11.3	6.3	26.2	16.8			
	40W	E	1.6	1.1	8.2	4.1					
	40W	W	4.9	1.4	8.8	8.1	33.1	26.9			
	42W	E	4.5	1.3	20.7	17.7					

where d_i = thickness of i^{th} layer; x_i = offset distance towards shot point for i^{th} layer

SEISMIC CALCULATIONS

Company JOY MINING

Area PRINCETON

Survey by:

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Line	Station	Shot Direction	LAYER THICKNESS (d_i) and OFFSET DISTANCES (x_i)								REMARKS
			d_1	x_1	d_2	x_2	d_3	x_3	d_4	x_4	
24N	42W	W	4.0	2.0	15.5	4.7					
	44W	E	3.0	1.6	17.2	5.1					

where d_i = thickness of i^{th} layer; x_i = offset distance towards shot point for i^{th} layer

SEISMIC CALCULATIONS

Company JOY MINING

Area PRINCETON

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Line	Station	Shot Direction	LAYER THICKNESS (d_i) and OFFSET DISTANCES (x_i)								REMARKS
			d_1	x_1	d_2	x_2	d_3	x_3	d_4	x_4	
28N	0 + 00	W	5.8	1.5	23.4	14.8					
	2W	E	9.6	2.6	26.0	16.8					
	2W	W	8.2	1.7							
	4W	E	8.2	1.7							
	4W	W	8.0	1.8	36.4	18.1					
	6W	E	4.6	2.6	11.5	6.8	23.4	14.8			
	6W	W	9.8	3.2	14.1	8.6					
	8W	E	10.9	3.5	28.9	16.4					
	8W	W	7.7	2.1	21.9	13.2					
	10W	E	5.7	1.5	11.0	6.9					
	10W	W	7.0	1.8	27.1	17.6					
	12W	E	9.7	2.5	16.1	11.2					
	12W	W	6.0	3.2	16.0	6.9					
	14W	E	4.5	2.4	18.1	7.4					
	14W	W	9.3	2.0	20.8	14.6					
	16W	E	1.9	1.5	8.5	3.6	23.6	17.2			
	16W	W	5.9	2.2	17.0	8.6					
	18W	E									
	18W	W	6.1	2.1	43.7	13.7					
	20W	E	8.9	3.1	21.6	7.3					
	20W	W	10.5	3.8	32.0	10.3					
	22W	E	9.5	3.4	29.2	9.4					
	22W	W									
	24W	E	2.1	2.0	13.0	4.2	22.3	13.5			
	24W	W	2.1	2.1	7.5	4.4	21.0	6.7			
	26W	E	1.9	1.9	8.5	4.9	51.4	15.1			
	26W	W	3.8	1.4	53.4	19.4					
	28W	E	10.4	3.9	15.2	14.9	38.1	30.0			
	28W	W	7.6	5.2	13.2	10.9	39.7	15.5			
	30W	E	3.9	2.7	9.1	7.2	44.4	15.9			
	30W	W	4.6	2.4	12.7	8.5					
	32W	E	4.3	2.2	14.5	9.5					
	32W	W	6.4	2.6	49.7	27.8					
	34W	E	5.0	2.1	29.0	16.4					
	34W	W	6.2	3.1	39.4	16.5					
	36W	E	12.4	6.1	35.3	15.9					
	36W	W	13.1	3.1							
	38W	E	13.8	3.3							
	38W	W	8.7	4.3	39.2	13.9					
	40W	E	4.7	2.3	35.3	12.1					
	40W	W	3.6	1.2	21.3	13.6					
	42W	E	5.4	1.8							
	42W	W	7.4	3.7	25.2	15.2	25.6	29.3			

where d_i = thickness of i^{th} layer; x_i = offset distance towards shot point for i^{th} layer

SEISMIC CALCULATIONS

Company JOY MINING

Area PRINCETON

Survey by:

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Line	Station	Shot Direction	LAYER THICKNESS (d_i) and OFFSET DISTANCES (x_i)								REMARKS
			d_1	x_1	d_2	x_2	d_3	x_3	d_4	x_4	
28N	44W	E	3.1	3.1	8.0	5.1	14.7	10.1			

where d_i = thickness of i^{th} layer; x_i = offset distance towards shot point for i^{th} layer

SEISMIC CALCULATIONS

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Area PRINCETON

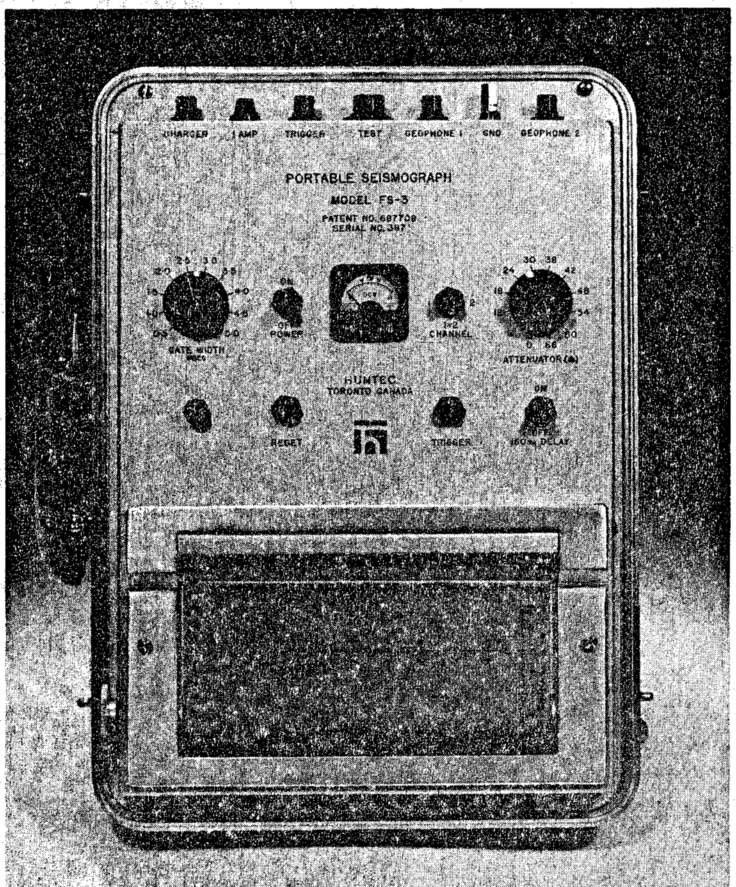
Line	Station	Shot Direction	d_1	x_1	d_2	x_2	d_3	x_3	d_4	x_4	REMARKS
			LAYER THICKNESS (d_i) and OFFSET DISTANCES (x_i)								
32N	0 + 00	W	11.2	3.3	28.8	12.0					
	2W	E	6.0	1.8							
	2W	W	3.2	1.5	11.4	5.6	14.3	21.9			
	4W	E	4.8	2.2	12.1	6.1					
	4W	W	6.8	2.7	10.7	7.0					
	6W	E	7.1	2.9	25.6	15.0					
	6W	W	8.2	2.4	28.7	13.1					
	8W	E	3.0	.9	6.9	3.3					
	8W	W	3.5	1.3	18.3	5.5					
	10W	E	1.8	1.6	3.6	2.8	17.6	5.6			
	10W	W	2.2	1.4	5.7	3.6	15.2	8.1			
	12W	E	7.8	2.0	18.5	9.1					
	12W	W									
	14W	E	5.7	1.6	23.0	9.7					
	14W	W	6.9	1.5	16.7	10.3					
	16W	E	4.4	2.1	8.1	5.5	26.5	17.7			
	16W	W	9.0	1.8	17.3	18.7					
	18W	E	12.3	2.4							
	18W	W	11.9	2.7	25.3	17.9					
	20W	E	8.8	2.0							
	20W	W	5.3	1.9	20.2	11.5					
	22W	E	4.6	1.6	18.2	10.4	34.0	24.0			

where d_i = thickness of i^{th} layer; x_i = offset distance towards shot point for i^{th} layer

APPENDIX III

Instrument Specifications

FS-3 Portable Facsimile Seismograph



FEATURES

Both reflection and refraction modes

Immediate, automatic, permanent record on dry paper

Record in form of accurate time/distance plot

Single unit of rugged, lightweight, weatherproof construction

Noise rejection circuits permit operation in built-up areas

Internal dry or optional Nicad rechargeable batteries

Depths of over 400 feet with hammer source in reflection mode

Greater depth of exploration possible with accessory blasting box

DESCRIPTION

Single-channel refraction seismographs have achieved widespread acceptance since the first commercial unit appeared in 1957. More than 40 earlier FS-2 models are in use in 8 countries on refraction surveys.

A new signal processing technique utilizing two channels of information has been incorporated in the FS-3 seismograph, which enables the instrument to be used for deep penetration, up to 700 feet in some cases, with a hammer source.

The result is a rugged, portable, rapid multi purpose seismograph capable of operating in extremes of climate and in remote areas where dependability is a prime consideration.

APPLICATIONS

1. Depth to bedrock and materials classifications: rock profiles and overburden removal studies ("rippability" etc.) for roads, sewers, foundations and other construction problems.

2. In situ elastic property studies: depth to and elastic properties of subsurface strata for damsite, building, bridge and other foundations applications.

3. Groundwater studies: determination of geological structure; delineation of buried river channels, impervious strata, cemented aquifers, etc.

4. Mineral search: location and delineation of placer deposits of gold, tin and other heavy metals; measurement of quality and extent of non-metallic mineral deposits such as gypsum and limestone.

5. Special purpose studies: archaeological, oceanographic, soil mechanical, geological, civil engineering and meteorological applications of various types.

huntec (70) LIMITED

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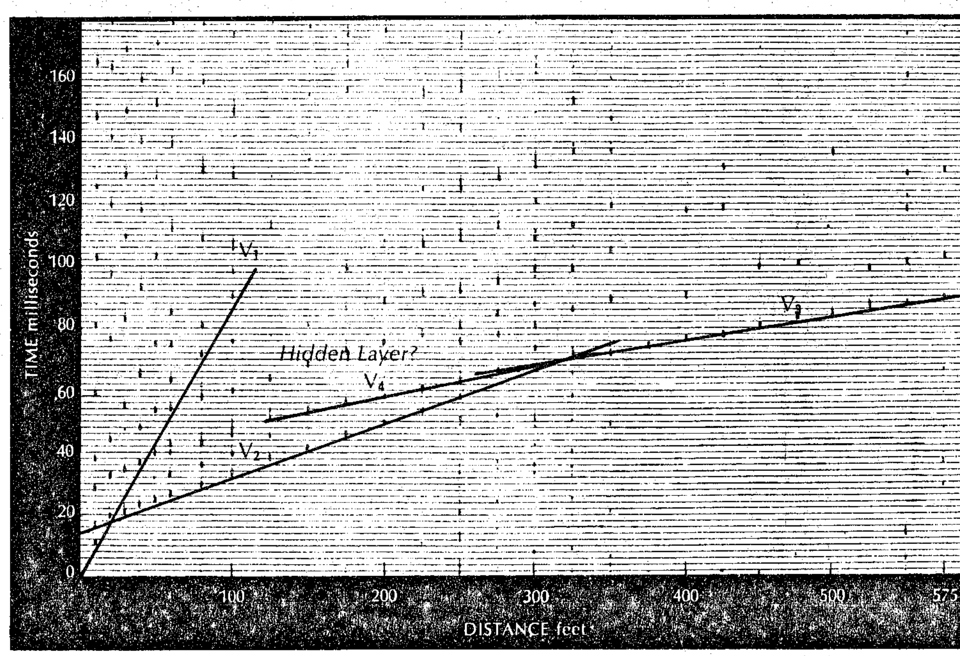
FACSIMILE RECORD

Field data (colour) obtained with a hammer source in a groundwater survey at Malton, Ontario. The record is notable for large source distance obtained, despite the presence of some traffic noise around the 300 foot mark.

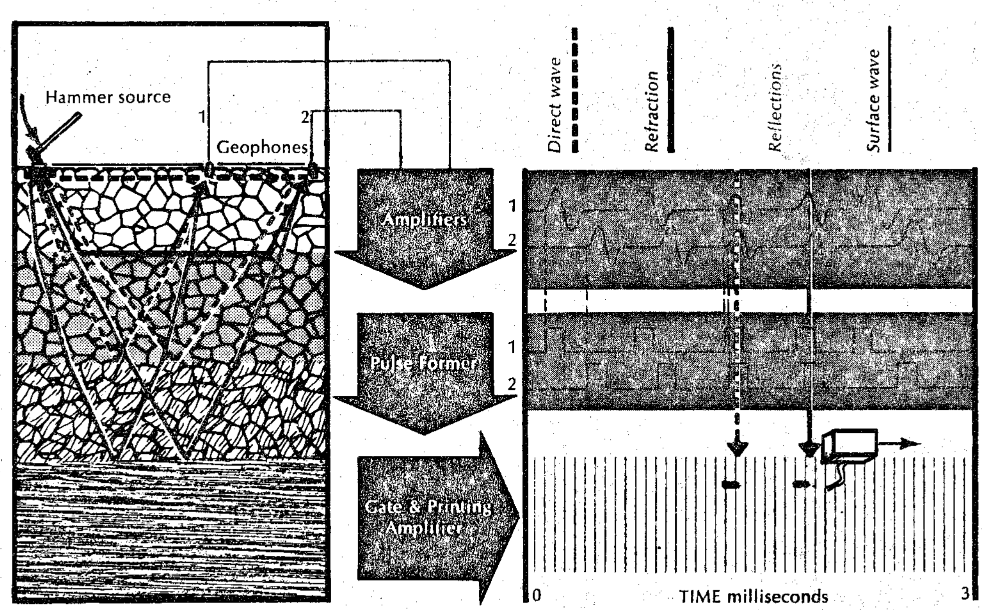
Computation (from slopes and intersections of black lines) gives the following results:

WAVE VELOCITY feet/sec	DEPTH OF LAYER feet
V_1 = 1050	0 - 8
V_2 = 6000	8 - 100 or, 8 - 80 if hidden layer of V_4 = 11,000 is assumed
V_3 = 13,000	>100



REFLECTION MODE

Using the FS-3 and correctly spaced geophones, reflection waves can be separated from other events by velocity filtering. The various waves arriving in turn at the geophones are indicated to the right of the amplifiers. These signals are converted to pulse waves beginning at the positive cycle of the wave train. Pulse width can be varied and only overlapping pulses will print out. In this instance, only the reflected waves with short time delay between the two geophones are recorded.



SPECIFICATIONS

- *Console:* All connectors, switches and wiring conform to Military Specifications. Size: 18" x 14" x 6". Standard Operational Weight 27½ lbs. (32½ lbs. with Nicad batteries and built-in charger pack installed).
- *Recorder Range:* 3 to 180 millisec. 163 to 340 millisec. on delayed range.
- *Temperature Range:* 0° F. to 115° F. (−18° C. to 46° C.)
- *Sweep Accuracy:* ± 1% over temperature range.
- *Calibration:* Against time standard of 160 millisec. Time standard accuracy is ± 2.5% over temperature range.
- *Dual Channel:* Operation can be single channel or double channel for improved signal-noise ratio. Correlator gate range 0.5 to 5 millisec.
- *Geophones:* Velocity sensitive, Hall Sears HS-J Model L1, 280 ohm coil resistance 14 Hz natural frequency.
- *Amplifiers:* Input impedance 700 ohms. Frequency response (3 db) 12-200 Hz. Sensitivity 2uV will print at full gain. Attenuation is adjustable in 6 db steps to 66 db.
- *Power Supply Options:*
  1. Internal battery pack 20 D cells.
  2. Internal rechargeable battery pack with built-in charger.
  3. External 24V battery.
- *Shock Source:* Hammer or Caps.

FIGURE 2

PLAN OF GRID AREA

JOY MINING — PRINCETON PROJECT

SCALE : 1": 400'

To accompany Geophysical Report by D. R. Cochrane and A. Scott on JOY MINING'S Princeton placer project date August 16, 1971, Delta B. C.

3505 M-2