

THE MOTHERLODE
AND **812214**
GREYHOUND PROPERTIES
OF
CUMBERLAND MINING CO. LTD. N.P.L.
GREENWOOD, B.C.

BY

ALLEN GEOLOGICAL ENGINEERING LTD.

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Vancouver 2, B.C.

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A B S T R A C T

The Motherlode and Greyhound properties of Cumberland Mining Company are in the Greenwood area of south central British Columbia. All physical conditions are conducive to all-year open pit mining at moderate cost.

The Motherlode was a well known producer and for many years supplied the smelter at Greenwood with ore bearing copper, silver and gold. The economics of mining have changed sufficiently to warrant bringing the Motherlode and nearby Greyhound deposits back into production.

Ore reserves are estimated as follows:

	<u>Motherlode</u> Tons	<u>Greyhound</u> Tons
Drill Proven	616,000	748,225
Indicated	720,000	-
Inferred	1,000,000	-
Totals	<u>2,336,000</u>	<u>748,225</u>

The estimated life of the operation is five years.

The operating profit, on the basis of data used in the report, is estimated as follows, using copper at 40 cents per pound, Canadian Funds:

<u>Motherlode</u>	<u>Greyhound</u>
<u>\$4,718,720</u>	<u>\$1,870,812.50</u>

The capital requirements to bring the operation to the production stage are estimated at \$550,000.00.

It is recommended that plans be completed at the earliest possible date to proceed with the project.

CONTENTS

	<u>Page</u>
<u>ABSTRACT</u>	
<u>MAPS AND SECTIONS</u>	
A. <u>INTRODUCTION</u>	1
B. <u>MOTHERLODE AND GREYHOUND PROPERTIES</u>	3
a) Location, Accessibility and Facilities	3
b) History	4
c) Titles	5
d) Geology	6
e) Water	8
f) Power	9
g) Tailings Disposal	9
h) Waste Disposal	9
C. <u>ORE RESERVE ESTIMATES</u>	10
D. <u>MINING</u>	13
E. <u>CONCENTRATING</u>	15
F. <u>SHIPPING AND SMELTING</u>	16
G. <u>ECONOMIC CONSIDERATIONS</u>	17
a) Ore - Estimated Value	17
b) Capital Cost Estimates	19
c) Estimated Operating Cost	20
d) Estimated Operating Profit	28
H. <u>SUMMARY AND CONCLUSIONS</u>	29
I. <u>RECOMMENDATIONS</u>	30
REFERENCES	
APPENDIX	

M A P S

M.1	Plan of Present & Proposed Pit Outlines, Motherlode Mine				
M.2	Cross-Section A, Motherlode Mine				
M.3	"	"	B,	"	"
M.4	"	"	C,	"	"
M.5	"	"	D,	"	"
M.6	"	"	E,	"	"
M.7	"	"	F,	"	"
M.8	"	"	G,	"	"
M.9	"	"	H,	"	"
M.10	"	"	I,	"	"
M.11	"	"	J,	"	"
G.1	Horizontal Section, El. 2800' - 2850', Greyhound Mine				
G.2	"	"	El. 2750' - 2800',	"	"
G.3	"	"	El. 2700' - 2750',	"	"
G.4	"	"	El. 2650' - 2700',	"	"
G.5	"	"	El. 2600' - 2650',	"	"

MOTHERLODE AND GREYHOUND

PROPERTIES

CUMBERLAND MINING CO. LTD. N.P.L.

GREENWOOD, B.C.

A. INTRODUCTION

The Motherlode and Greyhound copper-silver-gold deposits are located 3 miles westerly from Greenwood, B.C. The Motherlode was in production from 1901 to 1918 and accounted for 68 million pounds of copper, 620 thousand ounces of silver and 150 thousand ounces of gold. From 1957 until 1962 when production was resumed on an open pit basis an additional 5-1/2 million pounds of copper, 50 thousand ounces of silver and 12-1/2 thousand ounces of gold was acquired from the old workings. Detailed information is, therefore, available but, since this report is concerned primarily with the economics of the proposed 2,000 ton-per-day new operation, brief references only are made regarding the general characteristics, geology and physical features of the area; and emphasis is placed upon the methods and costs of acquiring the sizeable amounts of copper, silver and gold still available from both deposits, and the estimated profit therefrom.

In some categories final decisions have not been made but allowing for this, and with reservations for changes and improvements to be made at a later date, the economics of moving the concentrator from Mount Washington,

Vancouver Island to its former location on the Motherlode property near Greenwood, and enlarging it to treat 2,000 tons per 24 hours, are herein outlined. Data pertaining to concentrator design and enlargement and contract mining, are included in the Appendix.

B. MOTHERLODE AND GREYHOUND PROPERTIES

The Greyhound deposit is geologically similar and one mile from the Motherlode Mine. The descriptive data herein is minimal but a list of available reports and maps is included under "Reference".

a) Location, Accessibility and Facilities

The Motherlode and Greyhound properties are located 3 miles north-westerly by road from Greenwood, B.C., at West longitude $118^{\circ}44'$ and North latitude $49^{\circ}06'$.

Greenwood is on the Southern Trans Canada Highway and the Canadian Pacific Railway about 7-1/2 miles north of the Canadian-U.S. border.

Power supply is available from the West Kootenay Power and Light Company.

Water is available from Motherlode and Deadwood Creeks and if necessary from Boundary Creek. Deadwoods flats are going to be test drilled for a possible water supply.

Timber and lumber is available from local sawmills.

The properties are about 3,000 feet above sea level, and the weather is amenable for all-year open-pit operations.

b) History

The Greenwood-Grand Forks area was actively prospected during the 1890-1898 period. From 1898 to 1908 the ore from the Motherlode Mine was treated at the smelter at Greenwood. In 1957 the property was placed into production on the basis of 600 tons per day. Production History is as follows:

Period	Total Mined Tons	Copper lbs.	Silver oz.	Gold oz.
First, 1901-1918	3,772,575	67,827,575	619,772	158,912
Second, Mar. to Aug. 1957	101,274	1,100,000	-	-
Third, June 1959 to May 1962	543,985	5,354,205	43,359	11,489

The Greyhound deposit was diamond drilled by the British Columbia Copper Company in 1912. Ventures did additional drilling in 1948 and Attwood Copper Company continued the drilling in the early 1950's. In 1955 and 1956 Salamet Mines completed an additional 70 diamond drill holes. In the early years one shaft and a short adit tunnel were driven to explore the near surface mineralization on the property.

Motherlode production was first acquired from two open pits and extensive underground workings down to the 500 level. Most of the ore came from the pit and above the 400-foot level on the main Motherlode deposit. Subsequent production has been small and from the Motherlode and Sunset

d) Geology

The area is underlain by metamorphosed sedimentary and volcanic rocks, chiefly skarn, quartzite, chert, marble and chloritic schist, into which have been intruded a large body of granodiorite and numerous dykes, sills and irregular masses of monzonite, pulaskite and quartz porphyry.

General Table of Formation

Tertiary - Miocene (?) -	Pulaskite porphyry (alkali syenite porphyry) Dykes and sills
	Monzonite porphyry Dykes and sills
	Augite porphyrite Dykes
	Olivine basalt Dykes
Mesozoic -	Hornblende porphyrite Dykes and masses
Jurassic (?) -	Granodiorite
(?) -	Quartz porphyrite
Palaeozoic - Carboniferous (?)	Attwood series, Brooklyn formation Crystalline limestone
	Knob Hill group Tuff and ash rock more or less silicified, chert, jasperoid Small lenses of argillite and limestone Group in part is silicified limestone of the Brooklyn formation.

The ore bodies lie adjacent to a granodiorite intrusion in altered sedimentary and volcanic rocks. The mineralized zone is semi-circular and outcrops for a length of 1,200 feet and a width of about 200 feet. It has been explored by underground workings to a depth of 500 feet, but most of the mining was above the 400-foot level.

The ore is composed of chalcopyrite and magnetite, chalcopyrite and pyrite, and only chalcopyrite. The gangue is chiefly skarn, composed mostly of garnet, epidote, actinolite and other lime silicates. Some zones may be highly altered fine-grained intrusive material, and others are cherty. Where mineralization is strongest alteration is most complete.

There are many lenses, pods and irregular zones of mineralization, some containing much magnetite. These are not uniform and barren or low-grade zones are present throughout the deposit.

The main deposit from which most of the ore has been acquired is the Motherlode. Two nearby small roof-pendant-type deposits are the Sunset and Crown Silver, which lie on the east side of the Motherlode.

From the 400-foot level to the surface most of the better grade ore has been removed. Pillars and sills remain, along with blocks that were not amenable to smelting in the first operation, or were too low grade. Also, the zone has not been bottomed at the 400-foot depth and mineralization has been encountered to and below the 500-foot level. About 600 feet southeast of the Motherlode shaft a zone estimated to contain about 217,000 tons of ore has been indicated by diamond drilling.

On the Motherlode the ore reserves were estimated by Francis H. Frederick, Mining Geologist of San Francisco in 1951. Revised estimates were made by C.W.S. Tremaine in 1960. After examinations of all data and the property, these reserves have been accepted as satisfactory for production planning.

The Greyhound deposit is similar to the Motherlode except for less magnetite in the mineralized zones. The deposit is roughly tabular, extending from the surface at the north end to a depth of 285 feet on the southern extremity. The chalcopyrite-pyrite is in skarn near a granodiorite contact. Low epidote, high actinolite skarn appears to be the most favorable host rock.

The estimated average grade is 0.65% copper for the Motherlode and 0.79% copper for the Greyhound. The estimated recoverable gold and silver is valued at \$1.40 per ton for both deposits.

e) Water

The supply of water for the operation may be acquired from Deadwood Creek, which at this date (September 15, 1967) is estimated to flow at 100 g.p.m.; or Boundary Creek which has a considerably larger flow. The latter would, if used, necessitate over two miles of pipeline against a head of 990 feet. Motherlode Creek is a nearby source, but is of intermittent flow during a dry summer season. It is estimated that in excess of 800 g.p.m. will be required for the concentrator and the provision should be arranged to acquire 1000 g.p.m., with adequate local

storage facilities.

f) Power

Power may be acquired from the West Kootenay Power and Light service. A contract similar to the 1957-62 operation may be arranged. The power line and other facilities were removed when the operation was last shut down, but these may be re-installed, and additional power acquired for the new concentrator.

The West Kootenay Power and Light Company will arrange for all necessary electrical lines and hook-up. A deposit of \$30,000.00 will be required, but this will be a prepayment for up to 4 years of service.

g) Tailings Disposal

The same area will be used for tailings disposal as that used during the Motherlode operation. Only minor repairs and alterations will be required.

On the Greyhound property there is ample space near the pit location for waste disposal.

h) Waste Disposal

There is space near both pit locations for waste disposal. Preparation and maintenance of the area will be nominal.

C. ORE RESERVE ESTIMATES

Motherlode

Francis H. Frederick, Mining Geologist of San Francisco, submitted a report dated August 30, 1951, in which he detailed the reserves of ore in the Motherlode mine. Before the last operation, in a report dated June 12, 1959, C. W. S. Tremaine revised the Frederick estimates, and it is these, after allowing for the ore mined subsequent to that date that are accepted and considered conservative by the writer. These are as follows:

	<u>Assured</u>	<u>Indicated</u>	<u>Inferred</u>
Main Block, West Part	616,000	--	--
Main Block, East Part	--	520,000	900,000
North Area, Highline	--	100,000	100,000
Below 200 Level and Dumps	--	100,000	--
	<hr/>	<hr/>	<hr/>
Total Estimates	616,000 Tons	720,000 Tons	1,000,000 Tons

The total Assured, Indicated and Inferred is 2,336,000 tons. The estimated grade of the above reserves averaged 0.8% copper. A study of the data from the last operation, June 1959 to May 1962, however, indicated an average run-of-mine grade of 0.65% copper, and it is the latter grade used in the calculations for this report.

From the Frederick data and preliminary pit design the waste that will be removed is estimated to be 2,617,000 tons.

Greyhound

All available diamond drill data was mapped. Horizontal sections were made through the ore zone at 50-foot intervals. The available drill indicated ore was calculated to be as follows:

<u>Section</u>	<u>Tons</u>	<u>Average Grade % Copper</u>
Surface 2,850 elevation to 2,800	25,564	0.55
" 2,800 "	175,687	0.80
" 2,750 "	141,692	0.75
" 2,700 "	48,420	0.90
Total	563,655 Tons	
Weighted Average		0.787%

These sections are shown on the accompanying horizontal section through the Greyhound mineralized zone.

To facilitate pit design, vertical sections were drawn at 50-foot intervals, first in a north-south direction and then in an east-west direction. Reserves were re-calculated on the basis of the vertical sections. It was concluded that the east-west vertical sections produced more practicable results from the drill data available and, until some additional drilling can be completed, these are used for the calculations in this report. They are as follows:

<u>Section</u>	<u>Waste Tons</u>	<u>Ore Tons</u>
13100-13160N	6,120 43,375	4,325
13050-13100N	91,500	24,300
13000-13050N	150,900	46,500
12950-13000N	187,500	52,200
12900-12950N	135,900	87,600
12850-12900N	135,200	125,800
12800-12850N	509,700	127,300
12700-12800N	236,400	202,800
12600-12700N	36,600	77,400
12500-12600N	720	-
	<u>1,532,915</u>	<u>748,225</u>

The grade is estimated at 0.79% copper.

A resume of the calculated ore and waste tonnages for the proposed two pits is as follows:

<u>Pit</u>	<u>Ore Tons</u>	<u>Waste Tons</u>	<u>Approximate Ore: Waste</u>
Motherlode	2,336,000	2,617,000	1:1
Greyhound	748,225	1,532,915	1:2
Totals	<u>3,084,225</u>	<u>4,149,915</u>	<u>1:1.34</u>

D. MINING

The ore and waste may be mined and delivered to the concentrator stockpile and waste disposal by the company, or it may be done by a contractor who supplies equipment, men and materials for an agreed amount per ton of rock handled.

Since only one preliminary bid has been received from an experienced contractor to date, the following estimates are for the company doing the mining on a 2-shift, 5-day per week basis. The estimated rock handled will be 162,000 tons per month on the Greyhound and 108,000 tons per month on the Motherlode, assuming that mining is carried on for 260 days per year. This amounts to about 7,500 tons per working day from the Greyhound and 5,000 tons per working day from the Motherlode.

The rock is competent and breaks well. Preliminary pit design has been on the basis of 35-foot rises and 30-foot berms for the walls of both pits. Final design may result in changes when sufficient data is available to lay out roadways and waste storage. The overall wall slope under this arrangement is just over 50 degrees.

On the basis of preliminary pit design, and planned production figures as noted above, the following is a preliminary production schedule:

PRELIMINARY PRODUCTION SCHEDULE

Month	Waste Tons	Total Waste	Ore Month	Ore Total	Milled Total	Stock-piled
	<u>Greyhound</u>					
1.	150,000	150,000	12,000	12,000	-	12,000
2.	130,000	280,000	32,000	44,000	-	44,000
3.	110,000	390,000	52,000	96,000	54,000	42,000
4.	102,000	492,000	60,000	156,000	108,000	48,000
5.	102,000	594,000	60,000	216,000	162,000	54,000
6.	108,000	702,000	54,000	270,000	216,000	54,000
7.	108,000	810,000	54,000	324,000	270,000	54,000
8.	108,000	918,000	54,000	378,000	324,000	54,000
9.	108,000	1,026,000	54,000	432,000	378,000	54,000
10.	108,000	1,134,000	54,000	486,000	432,000	54,000
11.	108,000	1,242,000	54,000	540,000	486,000	54,000
12.	108,000	1,350,000	54,000	594,000	540,000	54,000
13.	102,000	1,452,000	60,000	654,000	594,000	60,000
14.	102,000	1,554,000	60,000	714,000	648,000	66,000
	<u>Motherlode</u>					
15.	52,000	1,646,000	36,000	750,000	702,000	48,000
16.	92,000	1,698,000	6,000	756,000	756,000	-
17.	54,000	1,752,000	54,000	810,000	810,000	-
18.	54,000	1,806,000	54,000	864,000	864,000	-
19.	48,000	1,854,000	60,000	924,000	918,000	6,000
20.	48,000	1,902,000	60,000	984,000	972,000	12,000
21.	48,000	1,950,000	60,000	1,044,000	1,026,000	18,000
22.	48,000	1,998,000	60,000	1,104,000	1,080,000	24,000
23.	48,000	2,046,000	60,000	1,164,000	1,134,000	30,000
24.	48,000	2,094,000	60,000	1,224,000	1,188,000	36,000
48.	1,296,000	3,390,000	1,296,000	2,520,000	2,484,000	36,000
58.	540,000	3,930,000	540,000	3,060,000	3,024,000	36,000
59.	90,000	4,020,000	18,000	3,078,000	3,078,000	-
60.	97,000	4,117,000	8,000	3,086,000	3,086,000	-

If the mining is contracted, all the equipment would be supplied except possibly the two small service trucks.

E. CONCENTRATING

It is planned to dismantle and relocate the concentrator now at the Mount Washington property on the old site at the Motherlode property.

Metallurgical tests were made in 1956 by Franklin H. Sharp on the Motherlode ore, and currently testing is underway at Britton Research Ltd., Vancouver, on this ore.

A 90% recovery producing a 25% copper concentrate is indicated by the work to date and experience gained from the former operation.

Crushing will be on a 2-shift, 5-day week basis, but the concentrator will operate 7 days a week, 24 hours a day. Allowing for necessary shut-downs it is estimated that the plant will operate 320 days and treat 640,000 tons per year.

Present plans, and cost calculations in this report are based upon shipping the concentrate to Tacoma for smelting and refining.

Mr. F. E. Worthington of Vancouver, B.C. has designed a preliminary flow sheet and made cost estimates for moving the concentrator, relocating and enlarging it to a capacity of 2,000 tons per 24 hours. Mr. Worthington's data is included with this report in the Appendix.

F. SHIPPING AND SMELTING

For the purposes of this report it has been assumed that the concentrate will be shipped by rail to the A.S.&R. smelter at Tacoma, Washington, U.S.A.

The former Motherlode operation provided much data for the present transportation and smelting costing. When metallurgical tests are completed, however, some changes may be required. Consideration is being given to trucking the concentrate rather than rail transportation and this investigation is proceeding.

G. ECONOMIC CONSIDERATIONS

The following calculations are based upon economic conditions at the time of writing, September 25th, 1967. It is assumed that the company will do all the mining and the concentrate will be sold to the American Mining and Smelting Company at Tacoma, Washington.

a) ESTIMATED VALUE OF THE ORE

1. The Motherlode Ore

Estimated Grade	0.65% Copper
Allowing for Mining Dilution @ 10%	0.585% Copper
Estimated Metal Values, Can.\$	Cu \$0.40/lb.
	Ag \$1.70/ounce
	Au \$37.80/ounce
Concentrator Loss @ 10% - Copper paid for 10.53 lbs./T	
Copper Value	\$ 4.21/T
Silver & Gold, Est.	1.10/T
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Total	\$ 5.31/T
Less Transportation, Smelting and Refining, including Penalties and Losses: All Est. @ 20% of Total Metals Value	1.06/T
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Net Estimated Value	\$ 4.25/T
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2. The Greyhound Ore

Estimated Grade	0.79% Copper
Allowance for Mining Dilution @ 10%	0.711% Copper
Metal Values Same as above	
Concentrator Loss @ 10% - Copper paid for	12.79 lbs./T
Copper Value	\$ 5.12/T
Gold & Silver, Est.	1.10/T
	<hr/>
Total Value	6.22/T
Less Transportation, Smelting and Refining, including Penalties and Losses: All Estimated @ 20% of Total Metal Value	1.24/T
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	4.98/T
Less Royalties	0.25
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Net Estimated Value	\$ 4.73/T
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The above calculations are based on Copper @ 40 cents per pound Canadian funds.

If the price increases the adjusted net is shown below:

Property	Net Value of Ore per Ton Copper Price, ¢/lb. Can.Funds		
	40	45	50
Motherlode	\$4.25	\$4.77	\$5.30
Greyhound	\$4.73	\$5.30	\$5.88

b) CAPITAL COST ESTIMATES

1. Dismantle, move and erect Concentrator on Motherlode	\$100,000.00
2. Addition of New and Used Units	163,000.00
3. New and Additional Buildings, Foundations and Alterations	50,000.00
4. Pumps and Water Line, Tailings Flume, Water Impounding	32,000.00
5. Miscellaneous New Construction and Alterations, Electrical, Piping, Launderers, Sumps, etc.	20,000.00
6. Power, Prepayment of hook-up and 4-year supply	30,000.00
7. Mining and Transportation Equipment, Used, on Purchase-Rental Agreements	100,000.00
8. Pits Preparation and Roadways	5,000.00
9. Tailings and Waste Disposal Areas	5,000.00
10. Office, Warehouse, Assaying	15,000.00
11. Working Capital	30,000.00
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TOTAL ESTIMATE	\$550,000.00
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NOTES

1. Mr. Worthington's Estimates, Items 1-5 inclusive, are of necessity preliminary, until metallurgical tests can be completed and additional costing data acquired.
2. Power, Item 6, is a prepayment, and should be incorporated in part with the operating cost estimated at \$16.86 cents per ton of ore

treated, but insufficient data pertaining to the final West Kootenay Contract and other items are at this time not available.

c) OPERATING COST ESTIMATES

I. ADMINISTRATION

a) Personnel, per month

1 Manager	\$1,750.00
1 Accountant	800.00
1 Bookkeeper, warehouse, first aid	700.00
1 Stenographer, warehouse clerk	450.00
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Total	\$3,700.00
Plus all Benefits @ 25%	925.00
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Total Personnel	<u><u>\$4,625.00</u></u>

b) Services, per month

Insurance	1,500.00
Property Taxes, etc.	500.00
Office and First Aid supplies	200.00
Heat, Light and Maintenance	100.00
Legal and Audit	300.00
Telephone, Telegraph, etc.	100.00
Vancouver Office	3,200.00
Travel	300.00

Local Contributions and General	\$ 300.00
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Total	\$11,125.00
Contingencies @ 10%	1,112.50
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Total Estimate	\$12,237.50
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Cost per ton of Ore Concentrated on the basis of 54,000 tons per month -	\$0.2266

2. GENERAL SERVICES, LABOUR

1 Surface Superintendent	(per month)	\$ 800.00
1 General Foreman		600.00
3 Mechanics		1,500.00
1 Electrician		500.00
1 Electrician's Helper		400.00
1 Carpenter		500.00
1 Plumber		500.00
1 Machinist		500.00
3 Laborers		1,200.00
1 Janitor		350.00
1 Truck Driver		400.00
1 Assayer		650.00
1 Assayer's Helper		400.00
		<hr/>
Total		\$ 8,700.00

Total Forwarded	\$ 8,700.00
Plus all benefits @ 25%	2,175.00
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Total Estimate, Services, Labour	\$10,875.00
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<u>ESTIMATE FOR MINING 35%</u>	<u>\$ 3,806.25 per month</u>
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<u>ESTIMATE FOR CONCENTRATING 65%</u>	<u>\$ 7,068.75 per month</u>
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3. MINING

a) General Services, Labour, as above	\$ 3,806.25
b) Mining Labour, per month	
1 Mine Superintendent	\$ 1,400.00
2 Shift Bosses	1,400.00
1 Geologist	900.00
1 Chief Engineer	900.00
1 Surveyor	700.00
1 Surveyor's and Geologist's Assistant	500.00
1 Sampler and Geologist's Assistant	400.00
4 Truck Drivers	2,000.00
4 Shovel Operators	2,200.00
2 Drillers	900.00
2 Blasters	850.00
2 Oilers	800.00

General Services, Labour Forwarded		\$ 3,806.25
Mining Labour, per month - cont'd.		
1 Miner	\$ 450.00	
2 Service Truck Drivers	800.00	
1 Grader Operator	450.00	
2 Bulldozer Operators	1,000.00	
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Total	\$15,650.00	
All Benefits @ 25%	3,912.50	
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	19,562.50	
Contingencies @ 10%	1,956.25	
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Total Estimate	<u>\$21,518.75</u>	<u>21,518.75</u> per month
Plus General Services, as 1 above		<u>\$25,324.00</u> per month
Labour, Cost per Ton of Ore Concentrated		<u>\$0.4690</u>

c) Mining Supplies

4 35-Ton Truck Shifts @ \$5/hr.	\$160.00
4 Shovel Shifts @ \$6/hr.	192.00
2 Drill Shifts @ \$8/hr.	128.00
1 Jack Leg Shift @ \$2/hr.	16.00
2 Fuel and Service Truck Shifts @ \$3/hr.	48.00
1 Grader Shift @ \$3/hr.	24.00
2 Bulldozer Shifts @ \$4/hr.	64.00
Explosives and Blasting Supplies	300.00
Mining Supplies and Tools	25.00
	<hr/>
Total	\$957.00

Total Forward	\$ 957.00
Contingencies @ 10%	<u>95.70</u>
Total Estimate	<u><u>\$1,052.70 per day</u></u>
Supplies, Cost per Ton of Ore Concentrated	<u>\$0.5264</u>
TOTAL MINING COSTS PER TON OF CONCENTRATED	<u><u>\$0.9954</u></u>

A preliminary estimate has been received from an experienced and reliable contractor as follows:

<u>Greyhound:</u>	Ore	\$0.98	per ton
	Waste	0.72	" "
<u>Motherlode:</u>	Ore	0.72	" "
	Waste	0.72	" "
AVERAGE		0.75	per ton of rock

An approximate comparison of the total estimated cost of the entire operation is as follows:

From both pits:	Total Ore	3,084,225
	Total Waste	<u>4,149,915 Tons</u>
	Total Rock	7,234,140 Tons
Contractor, Total Cost		\$5,425,600.00
Company, Total Cost		<u>3,070,100.00</u>
Difference in Company saving		<u><u>\$2,355,500.00</u></u>

It is evident, therefore, that plans should include all mining to be done by the company.

4. CONCENTRATING AT 2,000 TONS/DAY

1. General Services, Labour, per month		\$ 7,068.75
2. Concentrating, Labour, per month		
1 Concentrator Superintendent	\$ 1,000.00	
1 Metallurgist	800.00	
1 Assayer	800.00	
1 Mill Foreman	750.00	
2 Shift Bosses	1,500.00	
1 Mechanic, Repairman	500.00	
2 Primary Crushermen	900.00	
2 Secondary Crushermen	900.00	
3 Flotation Men	1,200.00	
3 Grinding Mill Operators	1,200.00	
3 Filter and Dryer Operators	1,200.00	
3 Labourers	1,125.00	
	<hr/>	
Total	\$11,875.00	
All Benefits @ 25%	2,968.70	
	<hr/>	
Total	\$14,843.70	<u>\$14,843.70</u>
Total		\$21,912.45
Contingencies @ 10%		<u>2,191.25</u>
Total Concentrating, Labour		<u>\$24,103.70</u>
Cost per ton, Labour, of Ore Concentrated		<u><u>\$0.4464</u></u>

3. Power	<u>Connected HP</u>	<u>KWH Per Week</u>
Jaw Crusher	250	14,810
Gyratory Crusher	200	11,940
Pan Feeder	20	2,500
3 Ball Mills	750	93,900
1 Rods Mill	350	43,800
Flotation Circuit	210	26,300
Thickening	20	2,500
Filtering	10	1,250
All Conveyors	120	15,000
All Pumps	80	10,000
Water Supply	150	18,750
Tailings Disposal	75	9,375
Vibrating Feeders	20	2,500
Vacuum Pumps	80	10,000
Heating	20	2,500
Shop and Assay Office	50	6,000
Lighting	40	5,000
Safety Factor	<u>155</u>	<u>19,400</u>
	2,600	295,525
80% Demand Factor @ 1¢ per KWH		<u><u>\$2,364.00</u></u>
Cost per ton of Ore Concentrated		\$0.1688

Carried Forward	\$0.1688
4 Rods and and Balls @ 2 lbs./Ton @ 10¢/lb.	0.2000
5 Liners	0.0500
6 Miscellaneous Supplies	0.0250
7 Reagents	0.0120
8 Heating and Drying	0.0400
9 Maintenance	<u>0.0070</u>
Total	<u><u>\$0.4988</u></u>

TOTAL ESTIMATED COSTS OF CONCENTRATING

Labour	\$0.4464 per Ton
Power & Supplies	<u>0.4988 per Ton</u>
TOTAL	<u><u>\$0.9452 per Ton</u></u>

5. CONCENTRATE HANDLING AND DEVELOPMENT

The cost of transporting concentrate from the concentrator at the Motherlode to the railway cars at Greenwood, is estimated at \$0.040 per ton of ore concentrated. Diamond drilling and other development costs are estimated at \$0.020 per ton of ore concentrated. The estimated total for these two categories is \$0.060 per ton of ore concentrated.

Transportation of the concentrate from Greenwood to the smelter at Tacoma, Washington is included in the calculations for the value of the ore along with estimated smelting costs.

c) ESTIMATED OPERATING COST

1. Administration	\$0.2266 per ton of ore
2. Mining	0.9954 " " " "
3. Concentrating	0.9452 " " " "
4. Concentrate Handling and Development	<u>0.0600 " " " "</u>
	<u>\$2.2272 per ton of ore</u>

d) ESTIMATED OPERATING PROFIT

Motherlode

Estimated net value of the ore	\$4.25 per ton
Estimated Operating Cost	<u>2.23 " "</u>
Estimated Net Operating Profit	<u>\$2.02 per ton</u>

For 2,336,000 tons \$4,716,720.00

Greyhound

Estimated net value of the ore	\$4.73 per ton
Estimated Operating Cost	<u>2.23 " "</u>
Estimated Net Operating Profit	<u>\$2.50 per ton</u>

For 748,325 tons \$1,870,812.50

Total estimated operating profit \$6,589,532.50

NOTE: The above Ore Copper @ 40 cents per pound, Canadian Funds.

H. SUMMARY AND CONCLUSIONS

The Motherlode mine contains a sizeable tonnage of copper-silver-gold ore because of the changing economics of the mining industry. The prices of copper and silver have increased substantially since the deposit was last mined. In conjunction with the Greyhound deposit which is geologically similar, but smaller and higher grade, an open pit operation may be undertaken to advantage. The concentrator may be moved back onto the same foundations it occupied in 1962, and enlarged to treat 2,000 tons of ore per twenty-four hours.

The Motherlode is estimated to have available 2,336,000 tons of ore grading 0.65% copper and the Greyhound 748,325 tons grading 0.79% copper, with each deposit containing estimated recoverable silver and gold amounting to \$1.10 per ton.

As the basis of a 2,000 ton per-24-hour operation the estimated operating profit is \$2.50 per ton from the Greyhound pit and \$2.02 from the Motherlode, with copper at 40 cents per pound, Canadian Funds.

On the basis of a 5-year operation, if no new ore is developed, the estimated operating profit from the Motherlode is \$4,718,720 and \$1,870,812.50 on the Greyhound.

The estimated capital cost of placing the property into production is \$550,000.00.

It is concluded that an operating profit in excess of \$1,000,000.00 per year may be won from the Motherlode and Greyhound copper, silver, gold deposits if placed into production in accordance with the data contained in this report, for a period of 5 years.

RECOMMENDATIONS-

It is herewith recommended that plans be started as soon as possible to acquire the necessary detailed data to finalize concentrator and open pit designs. It is further recommended that the machinery markets be researched for suitable used equipment for the concentrating and mining purposes in order that final cost figures may be acquired. Lastly, it is recommended that financial arrangements be completed in order that the proposed project may be brought on stream before the month or six weeks of cold weather expected some time around the end of the year.

Respectfully submitted,

 P.Eng.
ALLEN GEOLOGICAL ENGINEERING LTD.

1115 United Kingdom Building
409 Granville Street
Vancouver 2, B.C.
September 25, 1967

R E F E R E N C E S

1. Report on Motherlode Sunset Mine - F. H. Frederick
August, 1951.
2. Salamet Mines Limited, Interim Report - J. M. Cormie
October, 1956.
3. Report on the Greyhound Property of Salmo Prince
Mines Ltd. - A. R. Allen
January, 1956.
4. Report on the Holdings of Cumberland Mining Company
Ltd. - Allen Geological Engineering Ltd.
November, 1966.
5. LeRoy, O.E. G.S.C. Memoir 19.
Geology of Motherlode and Sunset Mines, 1913.
6. Reports of Minister of Mines of British Columbia.
1894 - 1919.

F. E. WORTHINGTON AND ASSOCIATES LTD.

Structural and Mechanical Designers

TELEPHONE ~~684-0987~~ 277-3907

~~STOCK EXCHANGE BUILDING - 475 HOWE STREET~~
~~VANCOUVER 1, CANADA~~

814 Lucas

Richmond, B. C.

September 21, 1967

Cumberland Mining Co. Ltd.,
569 Howe Street,
Vancouver 1, B. C.

Gentlemen:

Attached our preliminary estimate of the cost of moving and re-assembling your existing flotation plant and also for increasing the capacity from 1,000 T./24 hrs. to 2,000 T./24 hrs.

Also accompanying this estimate is our preliminary Flow Sheet of your proposed plant.

We wish to point out that we have not had sufficient time for a thorough study and also that due to the mill tests not being completed, which are now in progress, the attached flow sheet may require some minor changes and also on this account we are unable to size the additional thickening and flotation units.

The crushing plant and fine ore storage has been sized based on two assumptions, (a) that mining will be at the rate of five days per week and milling seven days per week, (b) that the Company informs us the Jaw and Gyratory crushers are available at a reasonable price.

The Company also informs us that the 9' x 13' Rod Mill is available at a reasonable price; our estimate for some of the additional equipment required is based on cost of new units.

All the mill pump circuits are not shown on the attached flow sheet.

- 2 -

Cumberland Mining Co. Ltd.,

September 21, 1967

Mining and crushing on a five day basis requires 5,400 tons draw to feed the mill on the week end, allowing for some safety factor. (4:00 P.M. Friday to 8:00 A.M. Monday = $2\frac{2}{3}$, $2.66 \times 2,000 = 5,320$). One alternative to this would be a mine run stock pile and operate the crushing plant six or seven days per week.

Final metallurgical tests may show the feasibility of a regrind mill in the flotation circuit.

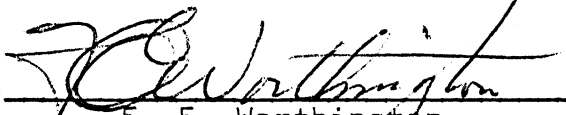
The location of your proposed plant near Greenwood, B. C. is such that construction costs would be somewhat higher during the winter months.

Should you require additional information please call on us.

Yours very truly,

F. E. WORTHINGTON & ASSOCIATES LTD.

PER:


F. E. Worthington

September 21, 1967

PRELIMINARY ESTIMATE

FOR

2800 TON PER 8 HRS. CRUSHING PLANT

AND

2000 TON PER 24 HRS. FLOTATION PLANT

CUMBERLAND MINING COMPANY LIMITED

AT GREENWOOD, BRITISH COLUMBIA

Dismantle and move from about Courtenay,
V.I., B.C., and erect and install at about
Greenwood, B.C. \$100,000.00

Additional new and/or used units, e.g.
Crushers, Pan Feeder, Rod Mill, Cyclones,
Thickener, Flotation Cells and Conveyors 163,000.00

New and additional construction, e.g.
Truck Dump Hopper, Crushing Plant found-
ations and buildings, Fine Ore storage
and re-claim, Rod Mill, Flotation and
Thickener foundations, Conveyors and
Shuttle alterations, Concentrate stor-
age and handling alterations 50,000.00

Pumps and mill water line, tailings
flume, water impounding and contin-
gencies 32,000.00

Miscellaneous new construction and
alterations, electrical, piping,
launders, sumps, etc. 20,000.00

\$365,000.00



FLOODS MINING & AGGREGATE CO. LTD.

HOPE, BRITISH COLUMBIA

Box 1030,
Hope, B.C.
September 27, 1967

Allen Geological Engineering Ltd.,
1115 - 409 Granville St.,
Vancouver, B.C.

Attention: Mr. Alfred Allen

Dear Sir:

Further to our telephone conversation, our preliminary estimate of costs for work at Greyhound and Motherlode Pits of Cumberland Mining Co. Ltd. is:-

	<u>Greyhound</u>	<u>Motherlode</u>
Ore	98¢/Ton	72¢/Ton
Waste	72¢/Ton	72¢/Ton

This estimate is based on a limited examination of the site and without a complete outline of the pits and methods of operation. These figures are not firm but should be within a reasonable range for a feasibility study.

Our estimate is based on the use of a 10' by 10' drill pattern with 3" diameter holes, ammonium nitrate-fuel oil blasting agent and one rubber-tired excavator. If additional loaders or shovels were required, or changes were necessary in the drilling and blasting pattern, the estimated prices would be increased.

....2



- 2 -

FLOODS MINING & AGGREGATE CO. LTD.

HOPE, BRITISH COLUMBIA

September 27, 1967

Allen Geological Engineering Ltd.

Please contact us if we can be of further service in this matter.

Yours truly,

FLOODS MINING & AGGREGATE CO. LTD.

R.G. ROSSE

RGR:rt

Cumberland Mining Company Limited

204 - 849 HOWE STREET

TELEPHONE: 681-8861

VANCOUVER 1, B. C.

January 4, 1968

Mr. D. A. Chapman,
D.A.Chapman & Associates Limited
Suite 2 - 515 Granville Street,
VANCOUVER 2, B. C.

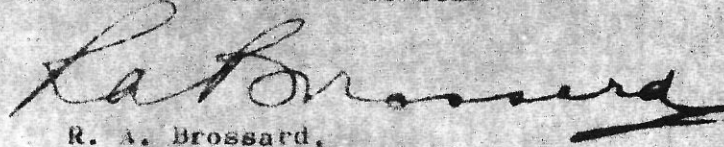
Dear Mr. Chapman:

Furukawa Mining Co. Ltd hold a First Mortgage on the Cumberland mill, which with interest would amount to approximately \$350,000.00. While Second, Third and Fourth Mortgages have been registered against the mill, tentative arrangements have been made to retire these from proceeds of the sale of stock of a subsidiary of this company. I would suggest that if your clients are interested in using the Cumberland mill, they simply acquire the First Mortgage from Furukawa Mining Company, arrangements for which I have already made with that company, which would fully protect your clients during the period in which we are liquidating the remaining indebtedness.

The funds required to expand the mill to 2000 tons per day, to acquire the necessary mining machinery and get the operation under way, are as estimated on page 18 of the Allen Report, \$550,000.00. Included in this figure is \$100,000.00 for mining machinery. We can make arrangements to acquire the necessary machinery on a lease purchase agreement, paying for it out of production. We also feel that either through certain items already acquired by the company, or through the elimination of certain costs included in the Allen Report, a possible further \$50,000.00 of the cash requirements can be eliminated. In other words, we believe the property can be put into production with \$400,000.00 of cash, or that total cash requirements, including acquisition of the First Mortgage, would be \$750,000.00.

Yours very truly,

CUMBERLAND MINING COMPANY LIMITED



R. A. Brossard,
President

RAB:rw

Cumberland Mining Company Limited

204 - 869 HOWE STREET

TELEPHONE: 681-8861

VANCOUVER 1, B. C.

January 5, 1968

Mr. D. A. Chapman,
D. A. Chapman & Associates Limited
Suite 2 - 515 Granville Street,
VANCOUVER 2, B. C.

Dear Mr. Chapman:

With reference to our telephone conversation regarding this company's Motherlode and adjacent claims, which are being put into a Pool together with the holdings of San Jacinto, we agree that Cumberland will be responsible from its share of the proceeds of the Pool for any claims against these properties arising from Cumberland's creditors.

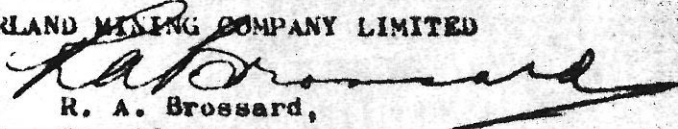
This will confirm our advice to you that this company's mineral claims are now held in the name of an associate company, H & A Holdings Ltd for the account of the Pool. The properties had been lodged some years ago as security to two of the mortgages on the Cumberland mill, of which you were advised in our letter of yesterday's date: Discharges were obtained from the holders of the mortgages and registration was effected prior to the transfer.

In the case of Furukawa's debenture, this debenture is specific only against Cumberland's milling equipment and provides that Cumberland may deal with any other assets in its normal course of business. The transferring of these claims to an associate company for development purposes, for shares of said company would constitute normal course of business.

With regard to your enquiry as to the relationship of this company with Bio Metals Limited, we would advise that there is no involvement with Bio Metals Limited in the above mineral claims, Bio Metals were simply retained by this company to do a Feasibility Study on the "leaching" aspects of the Motherlode ore, that company has no interest in the leases.

Yours very truly,

CUMBERLAND MINING COMPANY LIMITED


R. A. Brossard,
President.

RAB:rw

N 74° W

ELEV. 3600'

60 LEVEL

1962 PIT FLOOR

115 LEVEL

200 LEVEL

ELEV. 3270'

300 LEVEL

400 LEVEL

D.D.H. No 68

PROBABLE POSITION OF
MINERALIZED ZONE

ELEV. 3000'

REFERENCE LINE

CUMBERLAND MINING CO. LTD.

CROSS-SECTION A

(PROJECTION)

MOTHER LODE MINE

VANCOUVER, B.C.

DRAWN BY

R. R.

DATE

25/9/67

SCALE

1 inch = 100 feet

DWG. No.

M 2

ALLEN GEOLOGICAL
ENGINEERING LTD.

Alfred Allen

N 74° W

ELEV. 3600'

60 LEVEL

1962 PIT FLOOR

200 LEVEL

ELEV 3270'

MAG STOPE

300 LEVEL

MAGNETITE STOPE

400 LEVEL

POSSIBLE MINERALIZED ZONE

ELEV 3000'

REFERENCE LINE

CUMBERLAND MINING CO. LTD.

CROSS-SECTION B (PROJECTION)

MOTHER LODE MINE VANCOUVER, B.C.

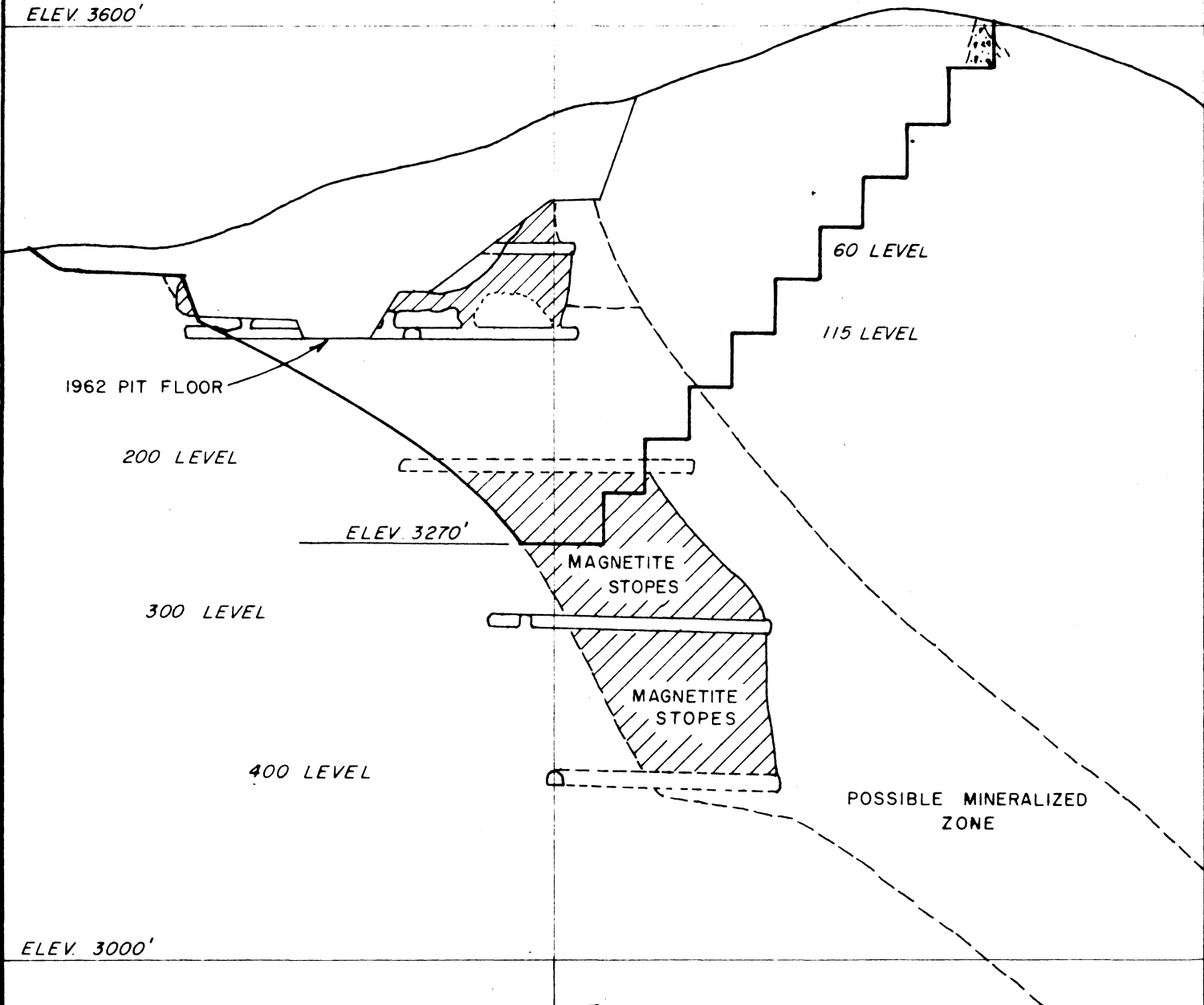
DRAWN BY	DATE
R. R.	25/9/67
SCALE	DWG. No.
1 inch = 100 feet	M 3

ALLEN GEOLOGICAL
ENGINEERING LTD.

Richard H. Allen

N 74° W

ELEV. 3600'



CUMBERLAND MINING CO. LTD.

CROSS-SECTION C
(PROJECTION)

MOTHER LODE MINE
VANCOUVER, B.C.

DRAWN BY R. R. DATE 25/9/67

SCALE 1 inch = 100 feet DWG. No. M 4

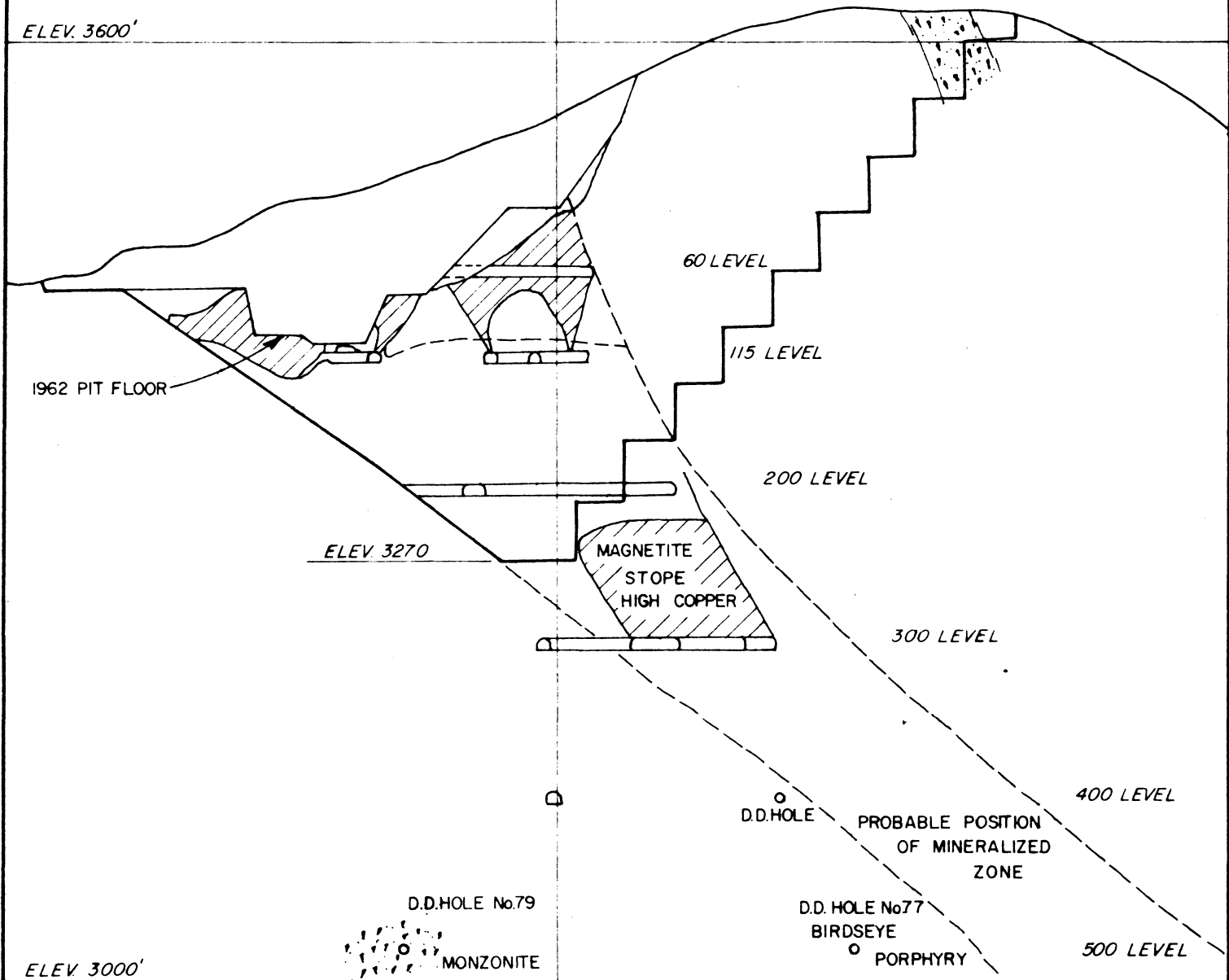
ALLEN GEOLOGICAL
ENGINEERING LTD.

Clarence R. Allen

REFERENCE LINE

N 74° W

ELEV. 3600'



CUMBERLAND MINING CO. LTD.

CROSS-SECTION D (PROJECTION)

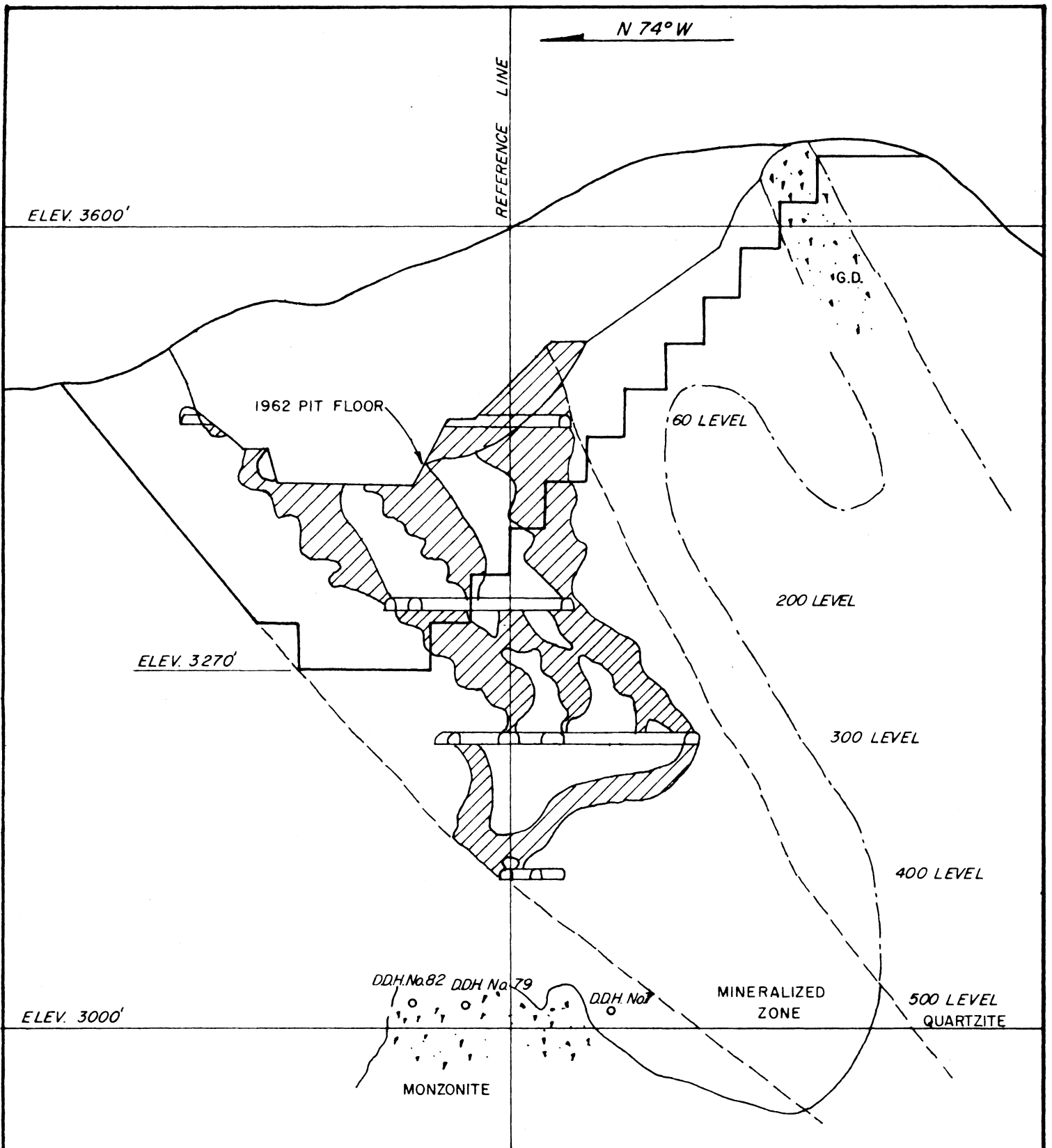
MOTHER LODE MINE
VANCOUVER, B.C.

DRAWN BY	DATE
R.R.	25/9/67
SCALE	DWG. No.
1 inch = 100 feet	M 5

ALLEN GEOLOGICAL
ENGINEERING LTD.

Alfred R. Allen

REFERENCE LINE

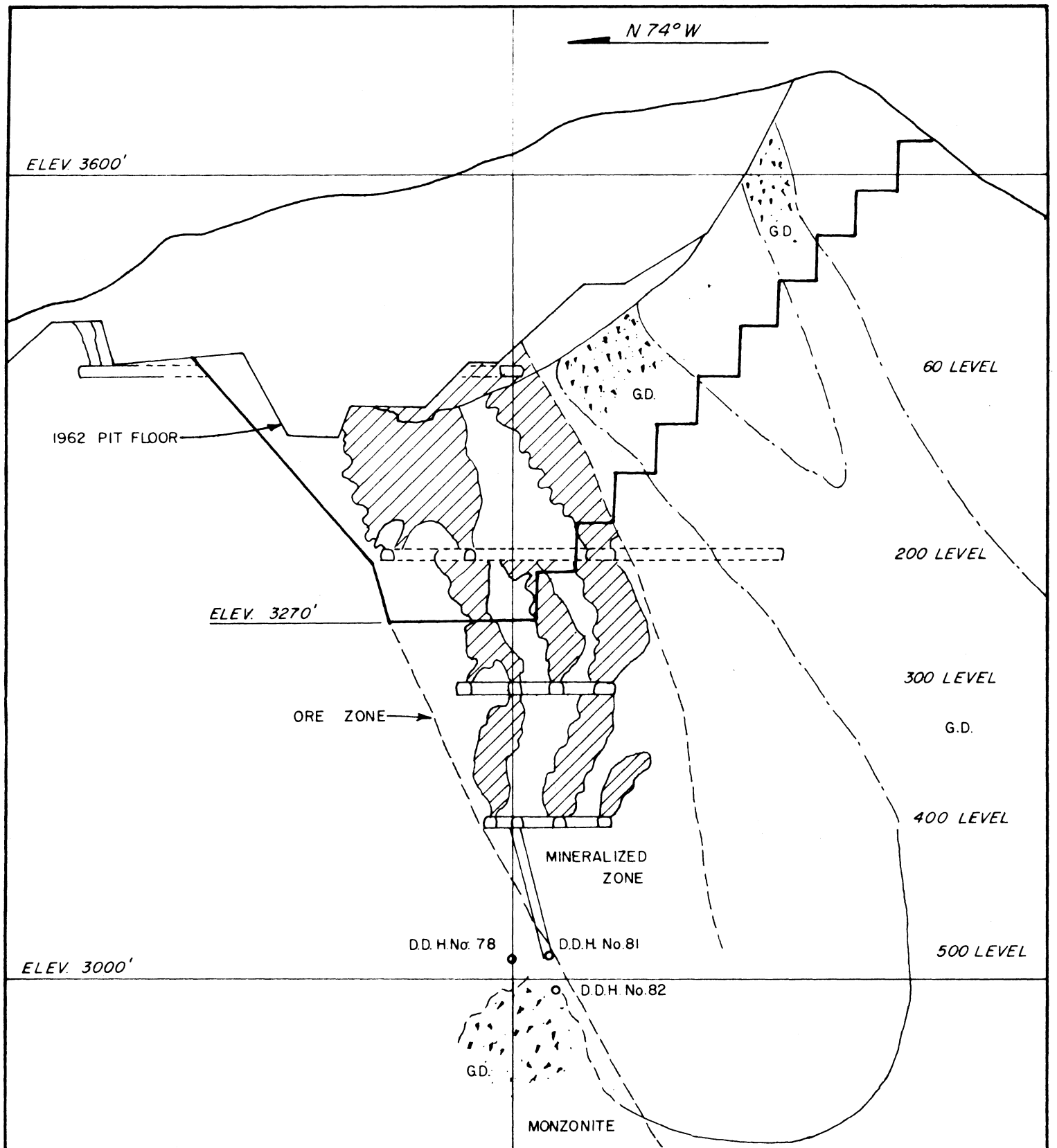


CUMBERLAND MINING CO. LTD.

**CROSS-SECTION E
(PROJECTION)**

**MOTHER LODE MINE
VANCOUVER, B.C.**

DRAWN BY <i>R. R.</i>	DATE <i>25/9/67</i>	ALLEN GEOLOGICAL ENGINEERING LTD. <i>Alfred R. Allen</i>
SCALE 1 inch = 100 feet	DWG. No. <i>M 6</i>	



CUMBERLAND MINING CO. LTD.

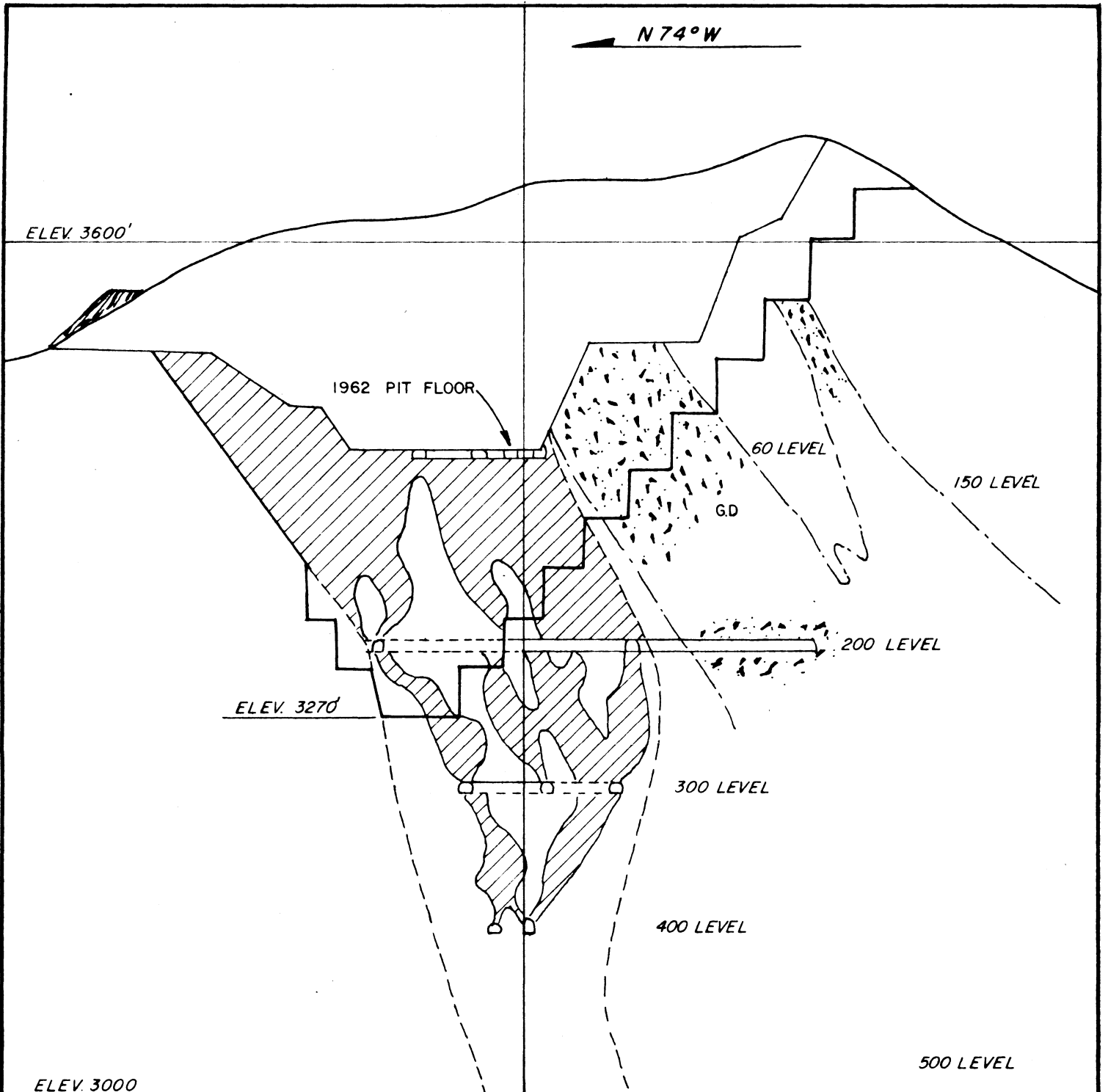
CROSS - SECTION F
(PROJECTION)

MOTHER LODE MINE
VANCOUVER, B.C.

REFERENCE LINE

DRAWN BY R. R.	DATE 25/9/67
SCALE 1 inch = 100 feet	DWG. No. M 7

ALLEN GEOLOGICAL
ENGINEERING LTD.
Alfred R. Allen



MINERALIZED ZONE

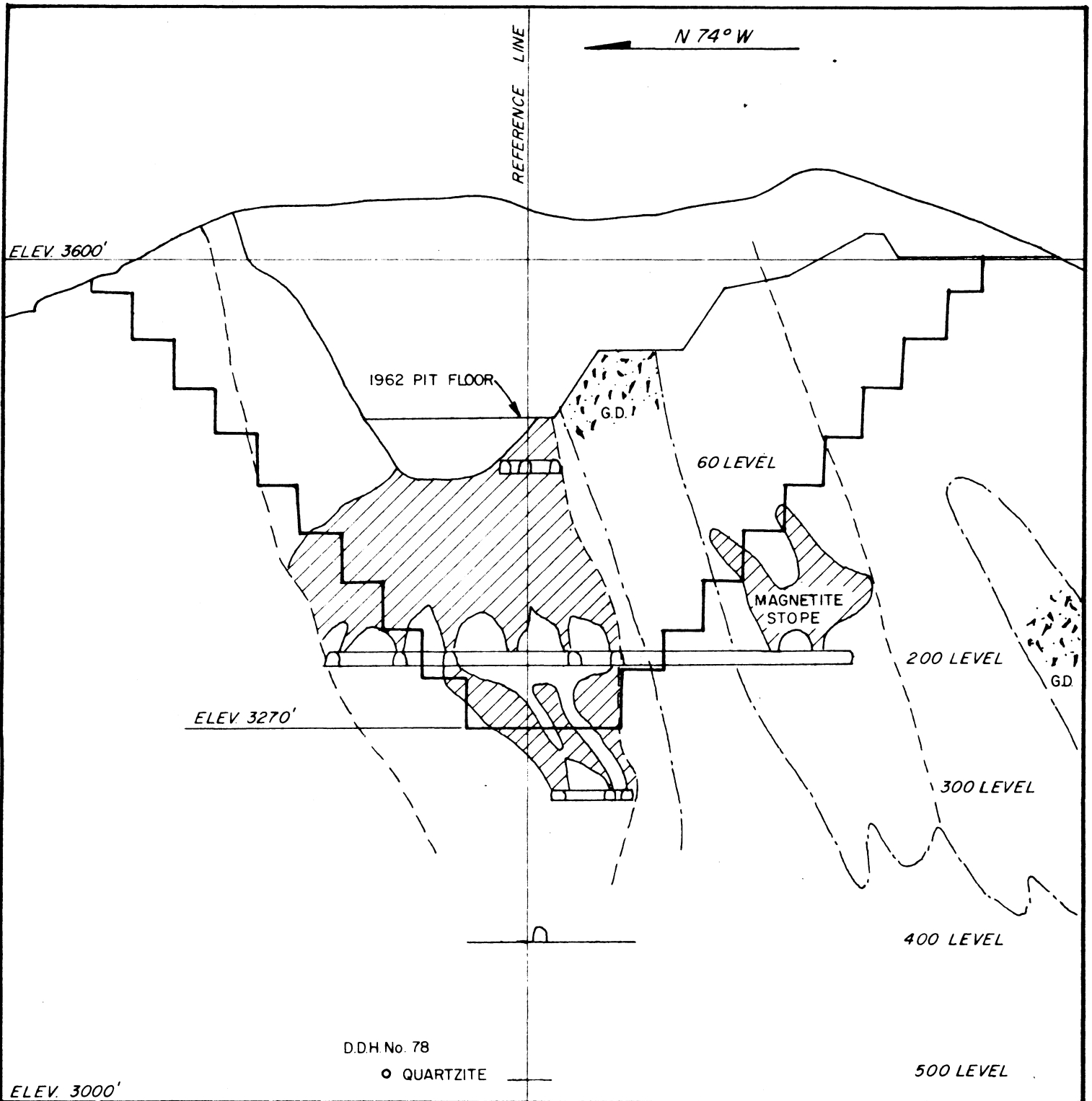
REFERENCE LINE

CUMBERLAND MINING CO. LTD.

**CROSS-SECTION G
(PROJECTION)**

**MOTHER LODGE MINE
VANCOUVER, B.C.**

DRAWN BY	DATE	ALLEN GEOLOGICAL ENGINEERING LTD. <i>Alfred K. Allen</i>
R.R.	25/9/67	
SCALE	DWG. No.	
1 inch = 100 feet	M 8	

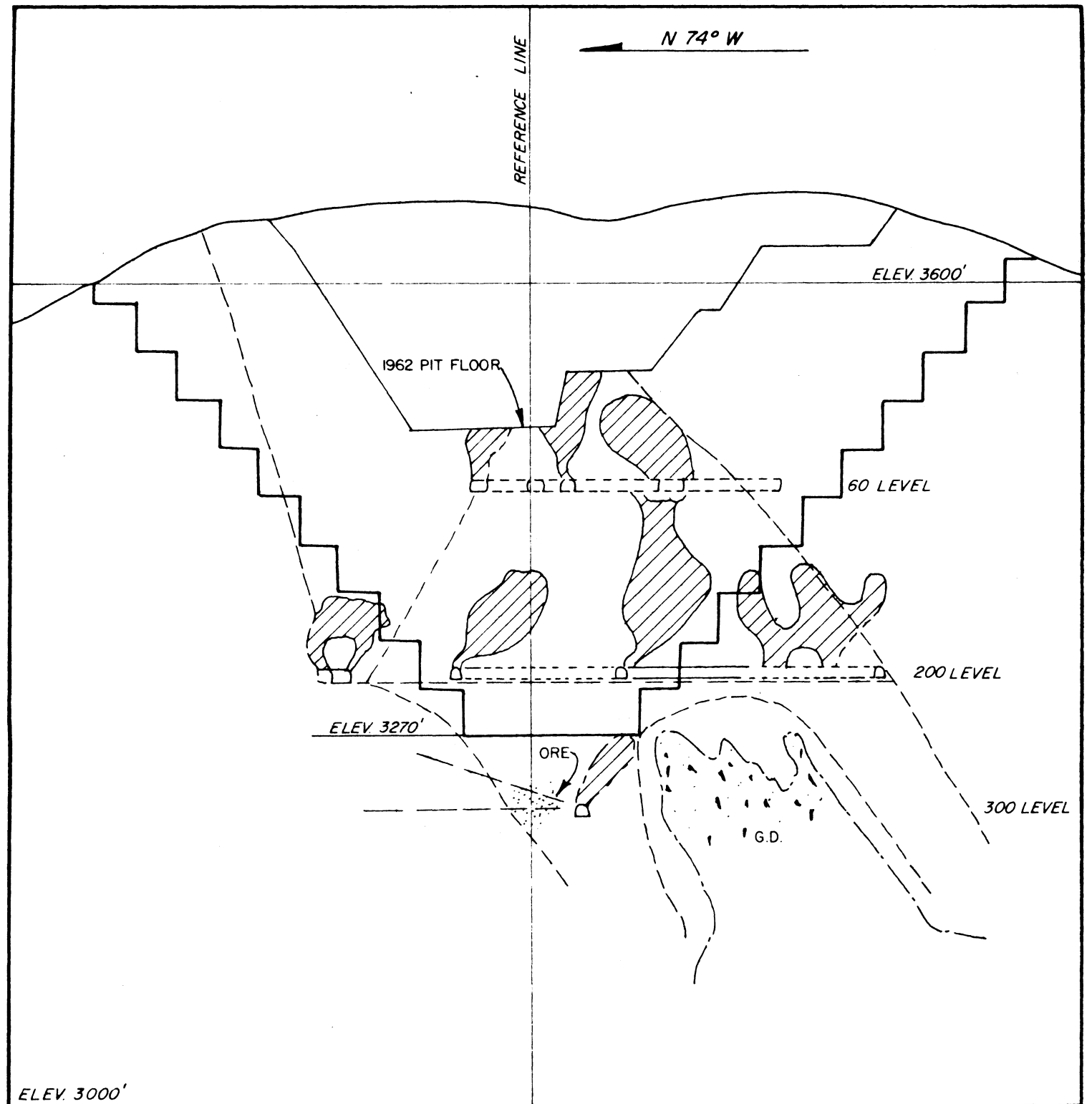


CUMBERLAND MINING CO. LTD.

**CROSS-SECTION H
(PROJECTION)**

**MOTHER LODE MINE
VANCOUVER, B.C.**

DRAWN BY R.R.	DATE 25/9/67	ALLEN GEOLOGICAL ENGINEERING LTD. <i>Alfred R. Allen</i>
SCALE 1 inch = 100 feet	DWG. No. M 9	



CUMBERLAND MINING CO. LTD.

CROSS-SECTION I
(PROJECTION)

MOTHER LODGE MINE
VANCOUVER, B.C.

DRAWN BY R. R.	DATE 25/9/67	ALLEN GEOLOGICAL ENGINEERING LTD. <i>Alfred H. Allen</i>
SCALE 1 inch = 100 feet	DWG. No. M 10	

N 74° W

ELEV 3600'

1962 PIT FLOOR

60 LEVEL

200 LEVEL

ELEV 3270'

REFERENCE LINE

ELEV 3000'

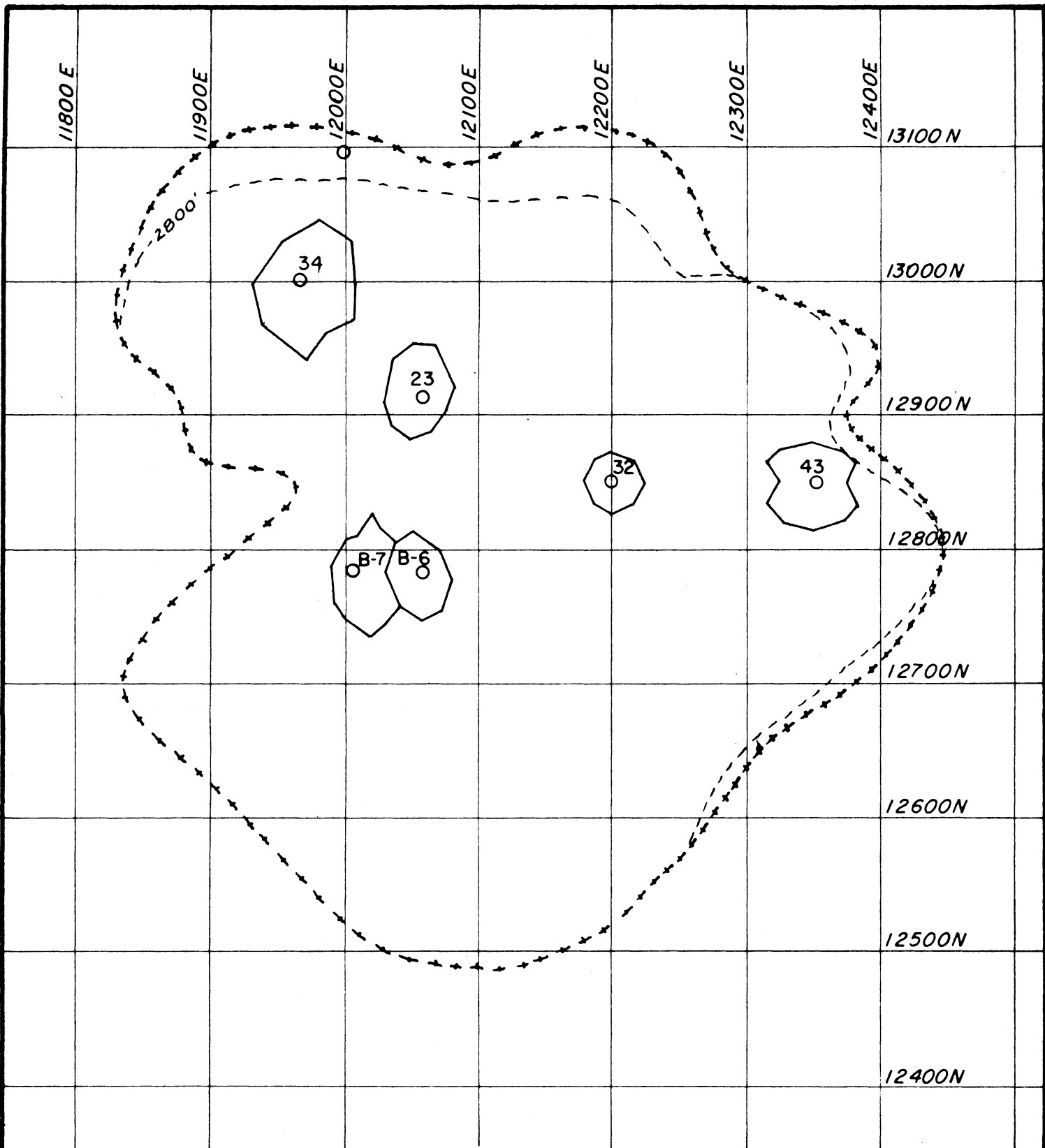
CUMBERLAND MINING CO. LTD.

CROSS-SECTION J
(PROJECTION)

MOTHER LODE MINE
VANCOUVER, B.C.

DRAWN BY	DATE
R. R.	25/9/67
SCALE	DWG. No.
1 inch = 100 feet	M 11

ALLEN GEOLOGICAL
ENGINEERING LTD.
Alfred K. Allen



DRILL INDICATED ORE
 25,564 TONS
 GRADE: 0.55% Cu.

Probable Final Pit Contour ---
 " " " Rim +++
 O.D.D.H.

CUMBERLAND MINING CO. LTD.

HORIZONTAL SECTION

EL. 2800'-2850'

GREYHOUND MINE

VANCOUVER, B.C.

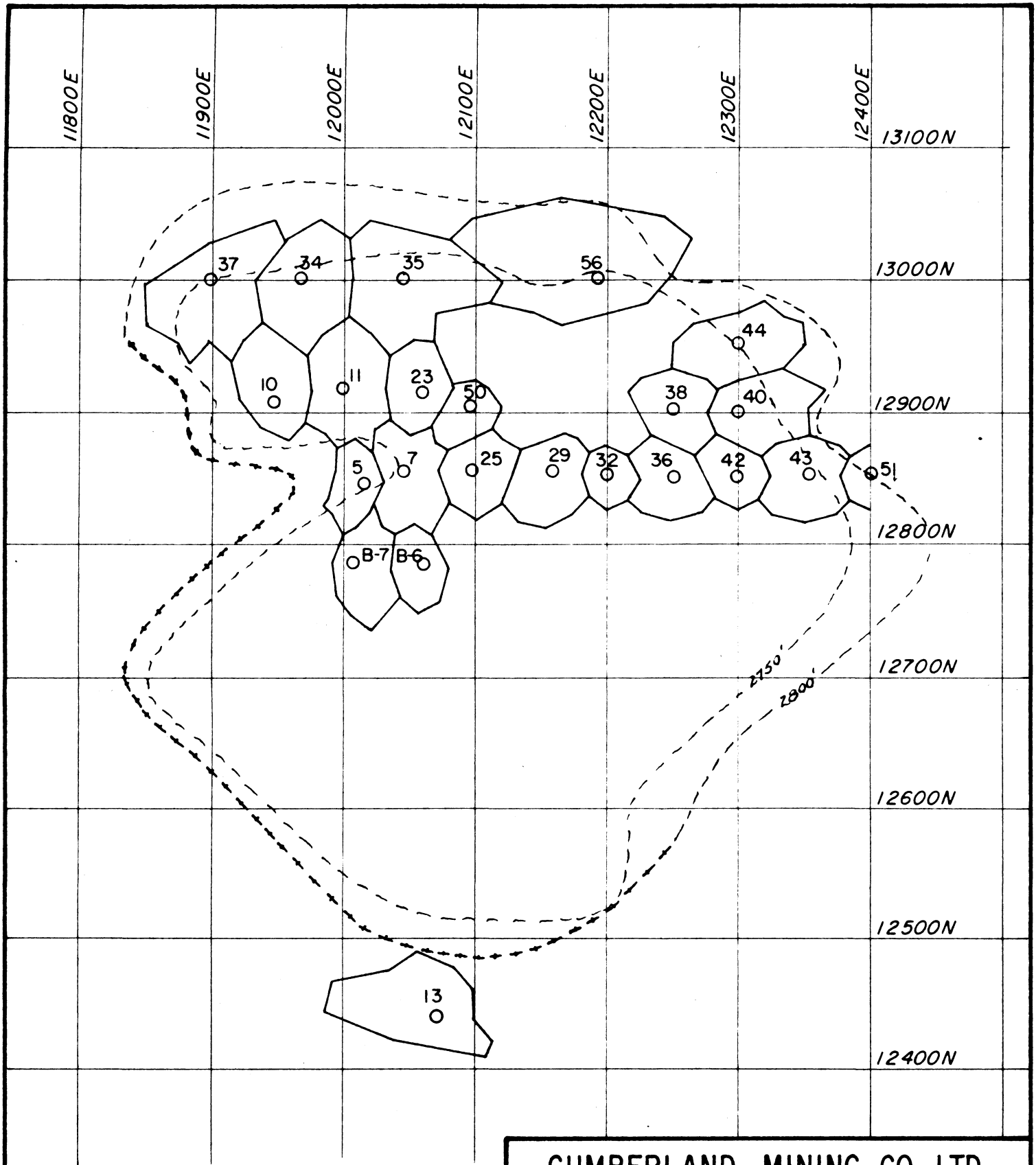
DRAWN BY :	DATE
R.R.	25/9/67

ALLEN GEOLOGICAL
 ENGINEERING LTD.

SCALE
 1 inch = 100 ft.

DWG. NO.
 G 1

Alfred R. Allen



DRILL INDICATED ORE
 175,687 TONS
 GRADE: 0.80% Cu.

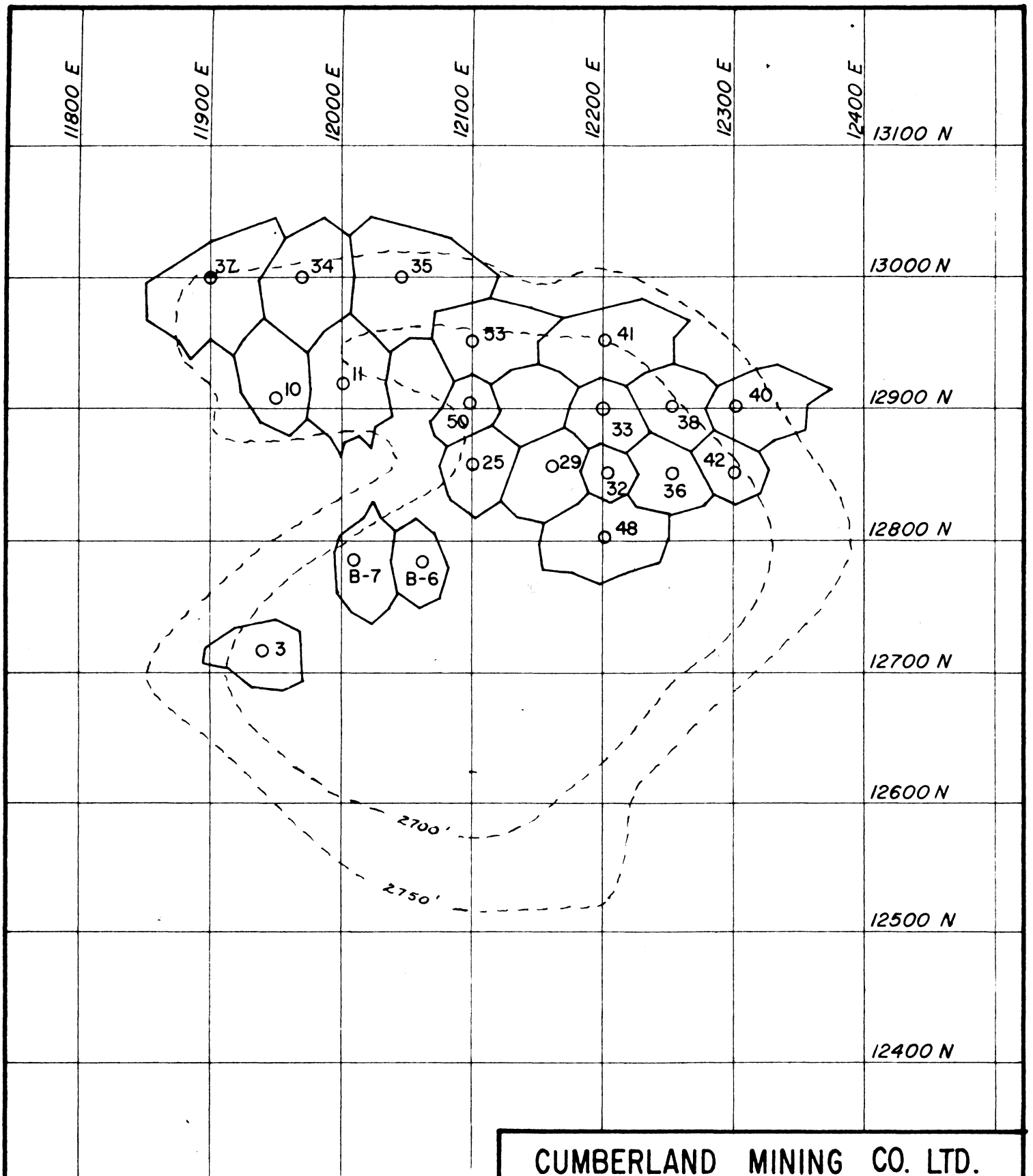
Probable Final Pit Contour ---
 " " " Rim -.-
 O D. D. H.

CUMBERLAND MINING CO. LTD.

HORIZONTAL SECTION
 EL. 2750' - 2800'
GREYHOUND MINE
 VANCOUVER, B.C.

DRAWN BY:	DATE
R. R.	25/9/67
SCALE	DWG. NO.
1 inch = 100 ft.	G 2

ALLEN GEOLOGICAL ENGINEERING LTD.
Alfred K. Allen



DRILL INDICATED ORE
 141.692 TONS
 GRADE : 0.75 % Cu.

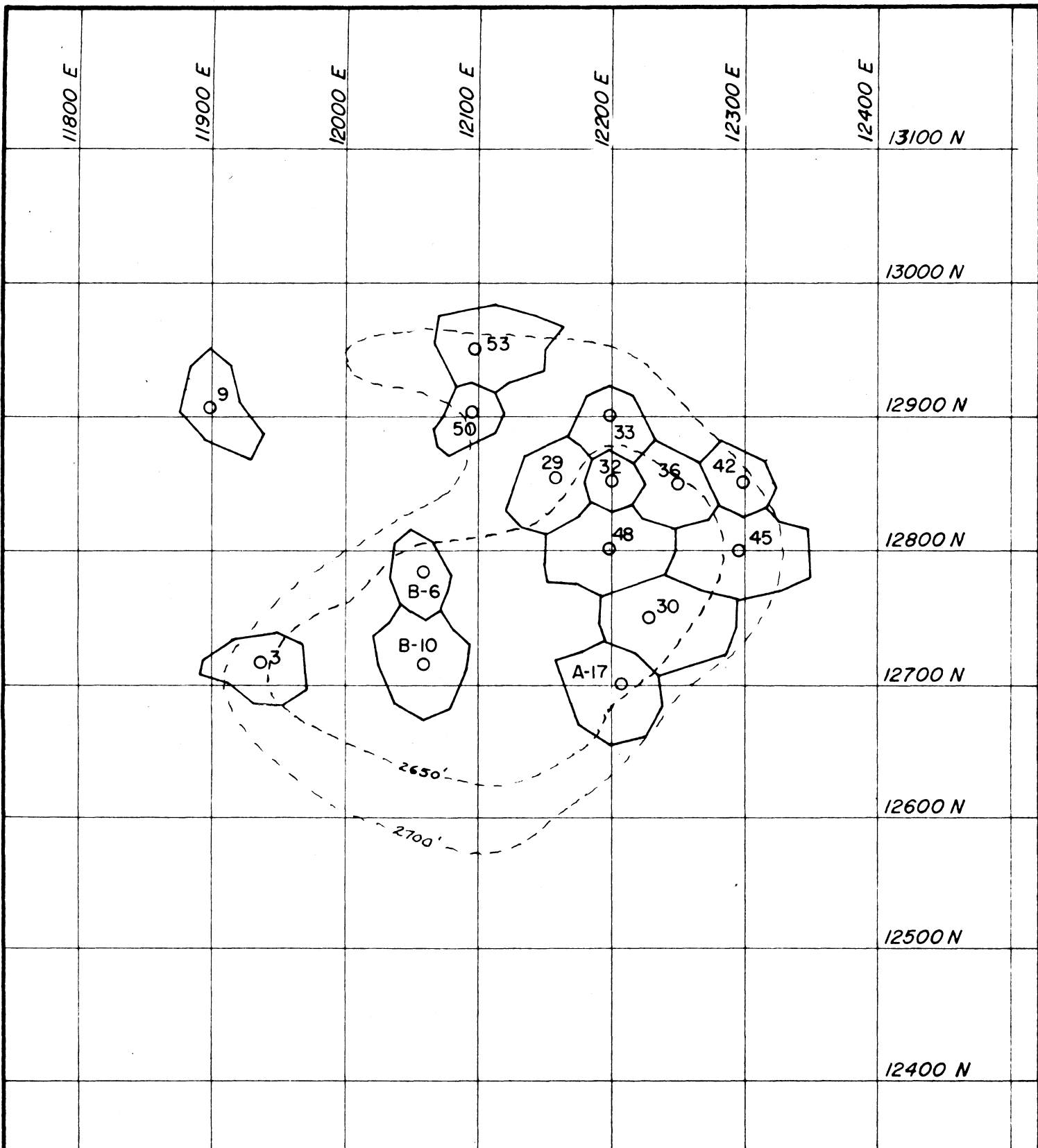
Probable Final Pit Contour ---
 ○ D.D.H.

CUMBERLAND MINING CO. LTD.

HORIZONTAL SECTION
EL. 2700' - 2750'
GREYHOUND MINE
 VANCOUVER, B.C.

DRAWN BY: R.R.	DATE 25/9/67
SCALE 1 inch = 100 ft.	DWG. NO. G 3

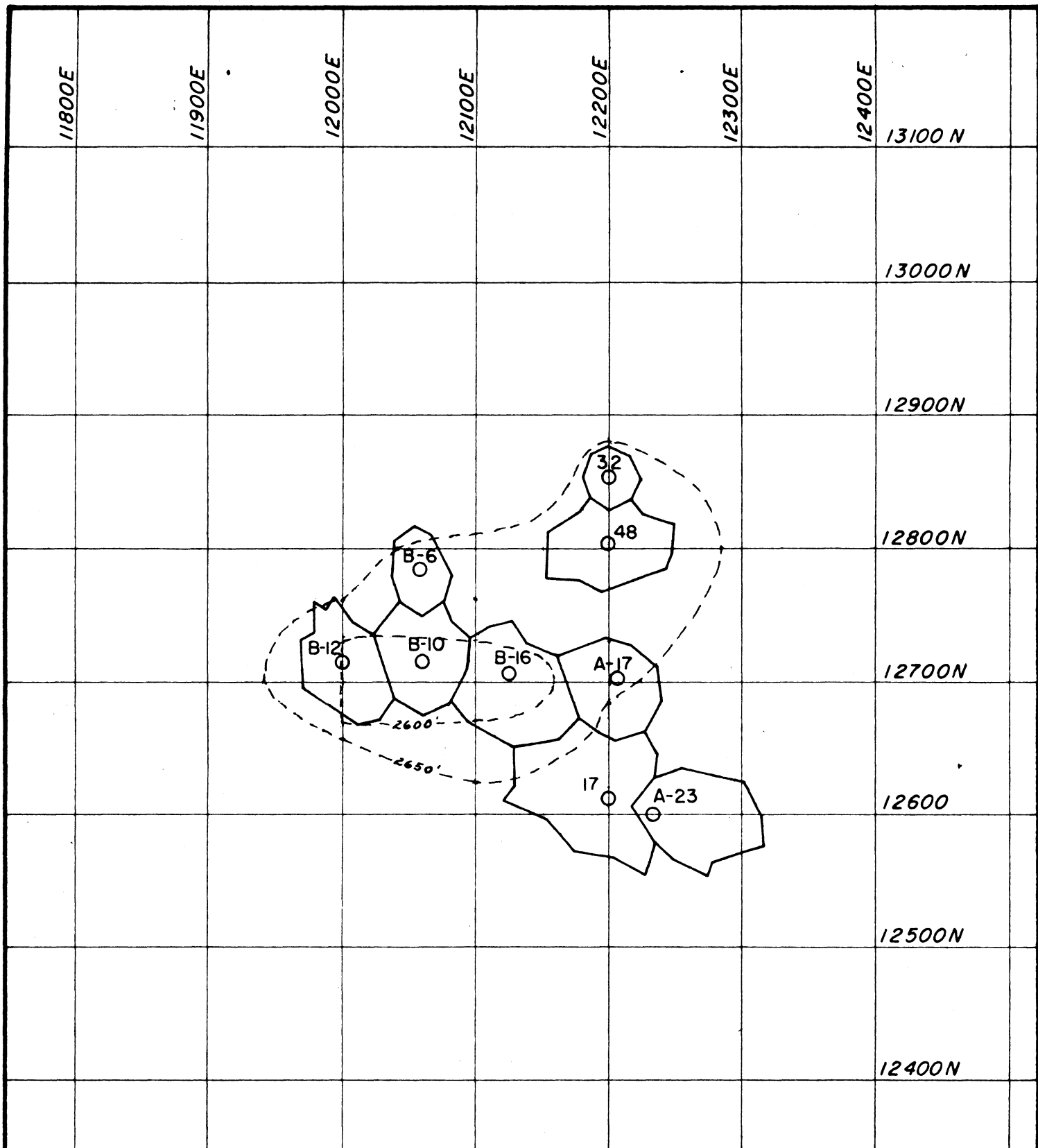
**ALLEN GEOLOGICAL
 ENGINEERING LTD.**
Alfred R. Allen



DRILL INDICATED ORE
 122.292 TONS
 GRADE: 0.77 % Cu.

Probable Final Pit Contour ---
 O D.D.H.

CUMBERLAND MINING CO. LTD.		
HORIZONTAL SECTION		
EL. 2650' - 2700'		
GREYHOUND MINE		
VANCOUVER, B.C.		
DRAWN BY:	DATE	ALLEN GEOLOGICAL ENGINEERING LTD. <i>Alfred R. Allen</i>
R. R.	25/9/67	
SCALE	DWG. NO.	
1 inch = 100 ft.	G 4	



DRILL INDICATED ORE
 98,420 TONS
 GRADE: 0.90% Cu.

Probable Final Pit Contour ---
 O.D.D.H.:

CUMBERLAND MINING CO. LTD.

HORIZONTAL SECTION

EL. 2600'-2650'

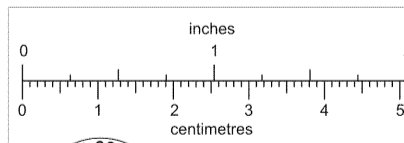
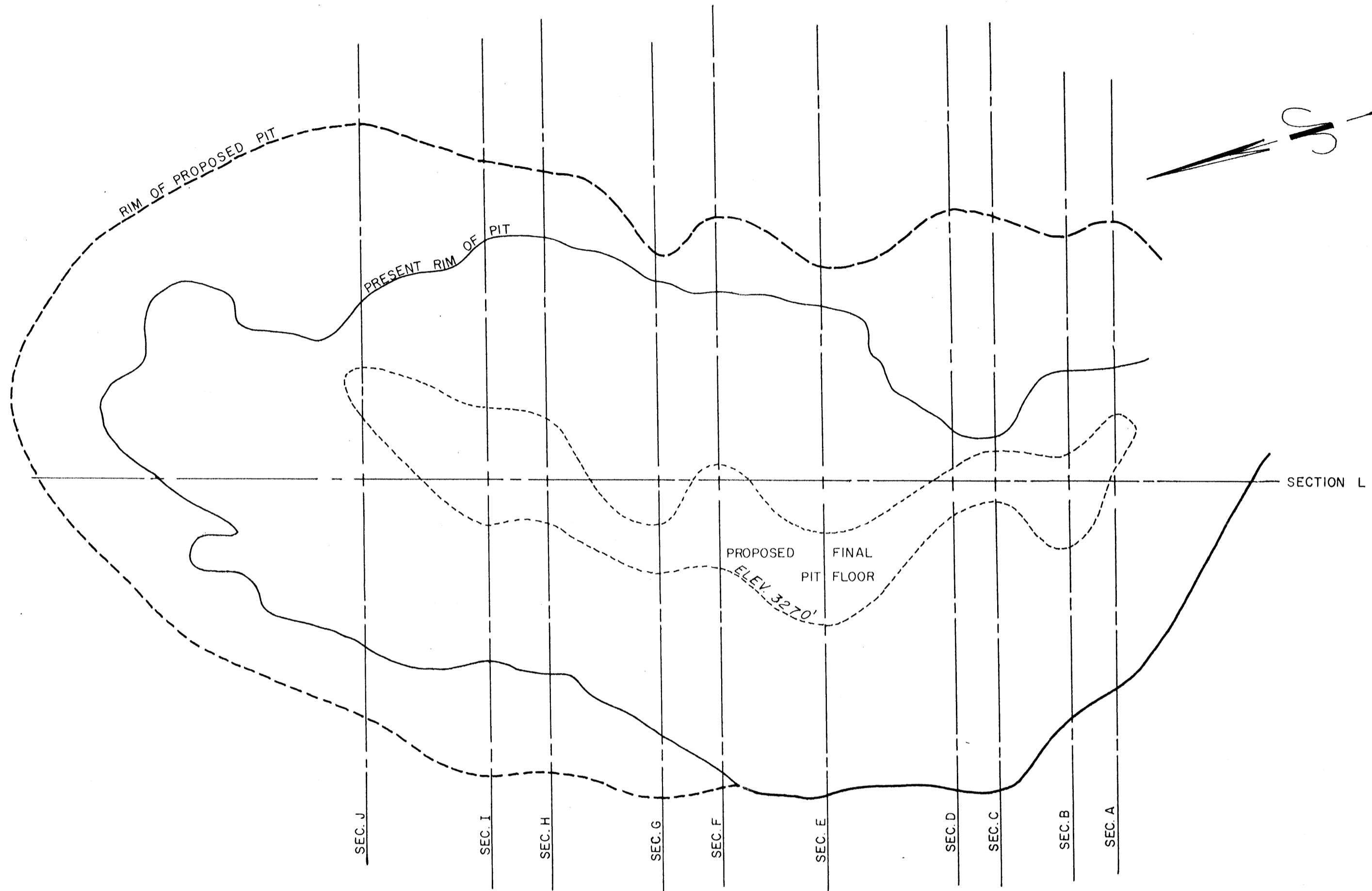
GREYHOUND MINE

VANCOUVER, B.C.

DRAWN BY: R.R. DATE: 25/9/67

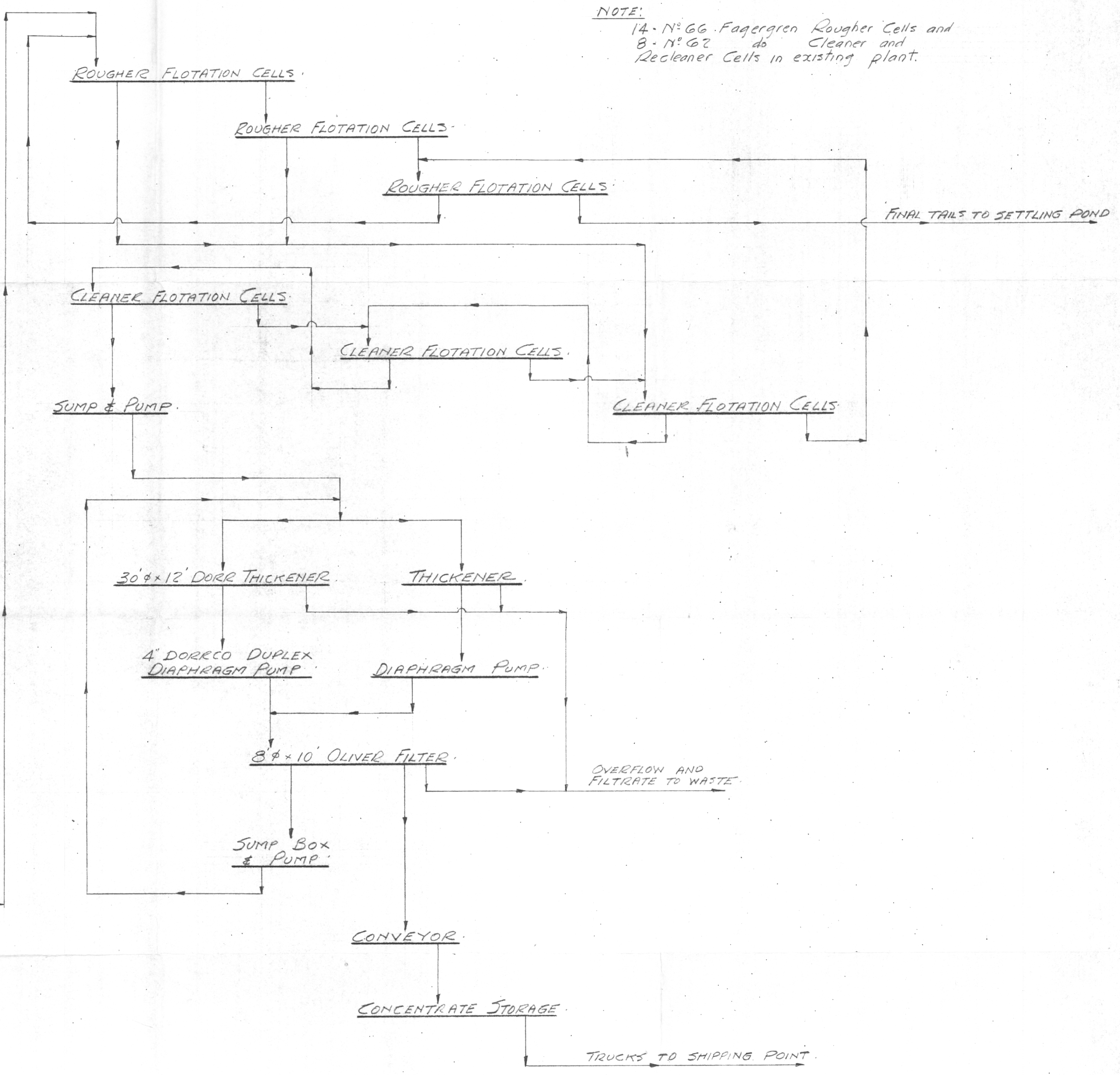
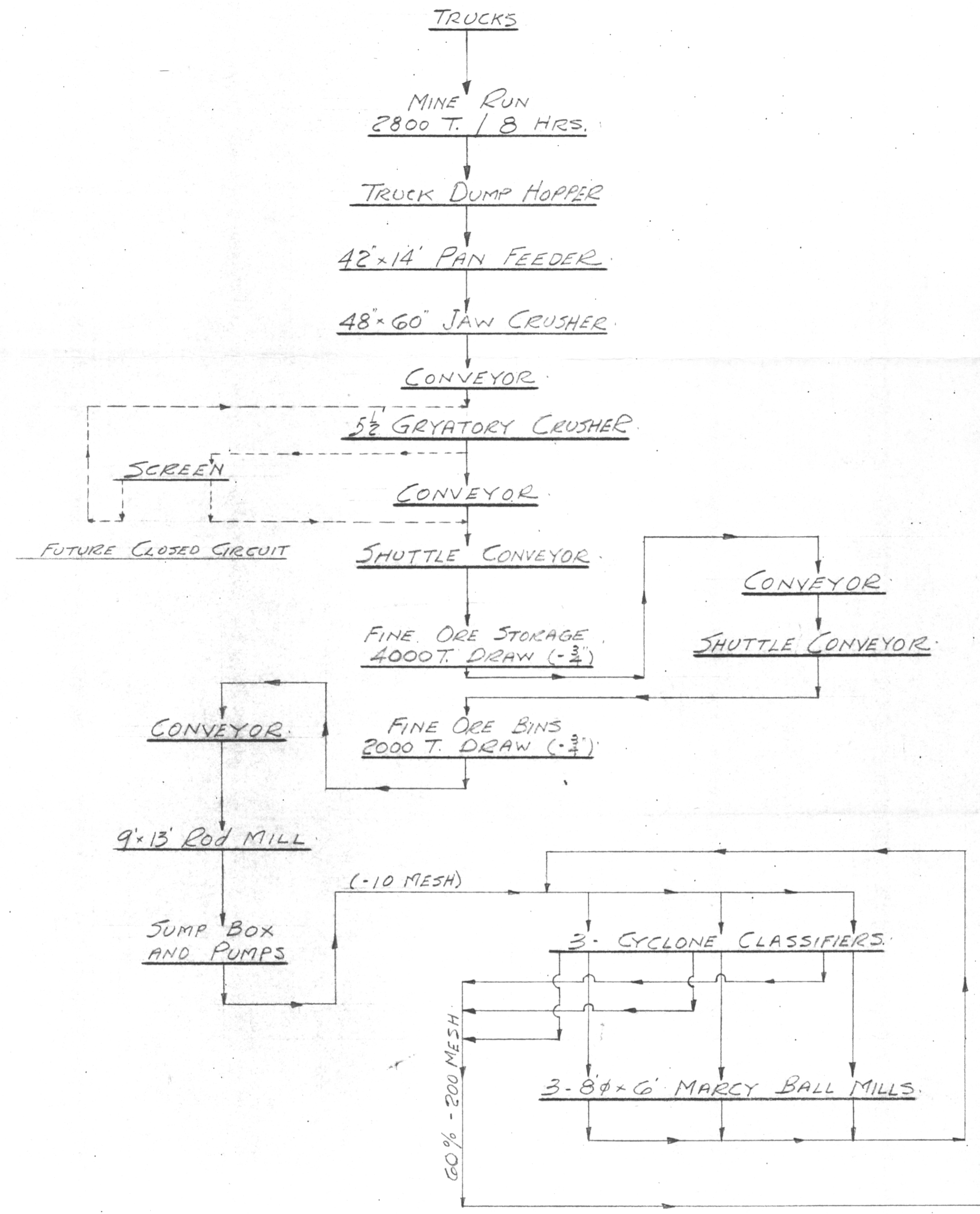
SCALE: 1 inch = 100 ft. DWG. NO.: G 5

ALLEN GEOLOGICAL
 ENGINEERING LTD.
Allen & Allen



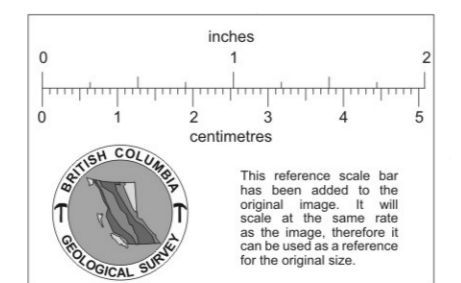
This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.

CUMBERLAND MINING CO. LTD		
PLAN OF PRESENT & PROPOSED PIT OUTLINES MOTHER LODE MINE VANCOUVER, B.C.		
DRAWN BY R.R.	DATE 25/9/67	ALLEN GEOLOGICAL ENGINEERING LTD. <i>Allen B. Allen</i>
SCALE 1 inch = 100 feet	DWG. No. M. 1	



NOTE:
 14 - N° 66 Fagergren Rougher Cells and
 8 - N° 62 do Cleaner and
 Recleaner Cells in existing plant.

PRELIMINARY



SCALE

MARK	REVISIONS	DATE

Prepared by
F. E. WORTHINGTON & ASSOCIATES LTD.
 Structural & Mechanical Designers

CUMBERLAND MINING CO. LTD.
 569 HOWE ST.
 VANCOUVER 1, B.C.
 MINE AT GREENWOOD, B.C.

2800 TON CRUSHING PLANT
 2000 TON FLOTATION PLANT
 FLOW SHEET

Designed
 Drawn F.E.W.
 Checked
 Approved

JOB No. _____
 DWG. No. _____

