PRELIMINARY FEASIBILITY REPORT

FOR

500 AND 750 TPD

MINING & CONCENTRATING PLANTS

WITH

RELATED SERVICES AND FACILITIES

ALWIN MINING COMPANY LTD.

HIGHLAND VALLEY

BRITISH COLUMBIA

BY

BACON & CROWHURST LTD.

CONSULTING ENGINEERS

VANCOUVER, B.C.

OCTOBER, 1969

TELEPHONE:
688-5485

102 - 1111 WEST GEORGIA STREET
VANCOUVER 5, B.C.

BACON & CROWHURST LTD.
CONSULTING ENGINEERS

27 October 1969

Alwin Mining Company Ltd.,
807 - 409 Granville St.,
Vancouver 2, B.C.

Attention: Mr. H.E. Jacques,
President

Dear Sir:

Pursuant to your recent request, we are pleased to submit herewith a report concerning a preliminary feasibility study of your Highland Valley, B.C., Alwin Mining Company Ltd. property.

This report envisages the construction of a concentrator designed to treat 500 tons of ore per day, or 175,000 tons of ore per year.

As a result of this study it would appear reasonable that the mine could support a concentrator capable of treating 750 tons per day. Therefore, preliminary estimates have also been compiled for an operation of this size.

Respectfully submitted,
BACON & CROWHURST LTD.

J.J. Crowhurst

J.J. Crowhurst, P. Eng.

JJC/ok

TERMS OF REFERENCE

At a meeting in the Alwin Mining Company, Vancouver Office on September 3rd, 1969, Bacon & Crowhurst Ltd. were instructed to proceed with the preparation of this preliminary feasibility report.

Authorization was issued to J.J. Crowhurst relative to engaging the services, when deemed necessary, of other engineers and technical personnel.

SCOPE OF THE REPORT

This report contemplates the following:

(1) Rate of Production

The concentrator will process 500 tons of ore per day for 350 operating days per year, or 175,000 tons of ore per year. Using this analysis as a basis, this report also includes estimates related to the treatment of 750 tons of ore per day, or 262,500 tons of ore per year. This ore will be extracted from the mineralized zones situated on the O.K. and I.O.U. Crown grant mineral claims in the Highland Valley area, B.C.

(2) General Mining Plan

This mine will be developed by means of a vertical three compartment shaft, 850 feet in depth, with five levels established at 150 foot intervals. Approximately one half of the ore zones will be mined by cut and fill methods and the other half by shrinkage stoping.

It should be noted that the alternative of driving a decline, with accompanying trackless and/or conveyor belt haulage, should be investigated in detail before a final decision is made.

(3) Concentrator & Plant Services Location

The concentrator will be situated close to the headframe at the top of the shaft, as will the plant services, such as offices, warehouses and mechanical and electrical repair buildings. Freedom to expand has been studied and incorporated in the design.

(4) Metallurgical Performance

The test work results submitted by the Department of Energy, Mine and Resources, Ottawa, in April 1969 concerning fairly comprehensive but preliminary samples have been assumed to be representative of the general nature of the ore.

(5) Water Supply

It is proposed and assumed that arrangements can be made with the Director of Indian Affairs and the Cook's Ferry (Pemeynoos) Indian Reserve members concerning the use of water from Calling Lake, O.K. Lake, Island Lake and the associated drainage area, currently under their control.

Recent discussions have been held with representatives from these groups; no serious obstacles appear to exist. This report outlines a plan to divert water for Alwin's use, and at the same time satisfy the Indian interests, but final details and arrangements concerning negotiations will have to be established. Since these procedures will undoubtedly be time-consuming, it is assumed for the purposes of this report that the above-mentioned water supply will be available for use by Alwin. Subject to the outcome of a detailed hydrological study, it is presently considered that this water supply is adequate.

(6) Power

It is assumed that the Alwin Mining Company will build a transmission line and purchase power from the British Columbia Hydro & Power Authority.

Preliminary investigations with the Authority indicates that this will be possible. Delivery can be effected by about the end of July 1970; rental portable diesel-electric units are suggested in the interim period.

(7) Price of Copper

The economic analyses in this report are calculated using metal prices per lb. of 50¢, 55¢ and 60¢ U.S. for copper, and $1.73 U.S. per troy ounce for silver.

(8) Marketing

Since it is not known at the present time where Alwin will sell the copper concentrates, it is assumed for the purpose of this report that the terms of a recently negotiated typical copper smelter contract (name with-held for confidential reasons) will apply, and that the concentrates will be sold F.O.B. ship at Vancouver, B.C.

(9) Capital Expenditures

No allowance has been made for yearly capital expenditures required for routine replacement of various (usually small) pieces of machinery, or expenditures incurred regarding purchases of new machinery to replace or supplement the regular equipment in the interests of increased efficiency and/or decreased costs.

(10) Economics

An economic analysis has been compiled including preproduction costs, capital expenditures, warehouse inventory, working capital, operating costs and operating profit,before taxes and allowances for depreciation, depletion and financing charges.

It is to be noted that the following items are not included:

(a) Title of the mineral claims.

(b) Financing arrangements and related costs.

(c) Dominion Income and Provincial Mining Taxes.

(11) Purchase of Equipment

The cost of new equipment has been used throughout the report.

If deemed desirable, a substantial reduction in the estimated capital cost can be effected by the use of good used machinery, which would be carefully examined, and perhaps tested before purchase.

Such a reduction is estimated to be of the order of $145,000 for an operation of 500 T.P.D. and $185,000 for 750 T.P.D.

ACKNOWLEDGMENTS

Acknowledgments are made to the following, all of whom contributed valuable assistance in part or in whole toward the sections noted:

(1) J.A.C. Ross & Associates Ltd.

J.A.C. Ross - P. Eng.	General appraisal of whole report.

(2) Alwin Staff

A.E. Wells - Property Superintendent	Ore Reserves, Mining, Plant Services.
W. Cumming - Chief Geologist	Ore Reserves

(3) SANDWELL AND COMPANY LIMITED

Senior Staff Engineers	Crushing plant and concentrator layout, mine level plans, Fresh water supply, power and plant services.

(4) The Granby Mining Company Limited

D.A. Livingstone - P. Eng.	Metallurgy & Concentrator Design

TABLE OF CONTENTS

TABLE OF ILLUSTRATIONS

CHAPTER I
SUMMARY & FINANCIAL

SUMMARY

Ore reserves as at 1st of October 1969 are estimated at 1,127,700 tons assaying 2.49% copper and 0.375 ounces of silver per ton of material in place, and 1,369,600 assaying 2.04% copper and 0.300 ounces of silver per ton after allowance for mining dilution.

It is conservatively estimated that a minimum of 200,000 tons of similar material will be found by future exploration.

(A) TREATMENT RATE - 500 TONS OF ORE PER DAY

Capital Costs

It is estimated that a total investment of $5,161,900 will be required to prepare the underground workings for production, and to construct a concentrator with related facilities, including townsite requirements, capable of processing 500 tons of ore per day (175,000 tons per year).

The present ore reserves will suffice for 7.83 years operation at this rate, with a further 1.17 years anticipated, for a total of 9 .00 years.

The sum of $70,000 representing inventory of supplies, and the sum of $474,700 representing three months' operating costs for working capital is included in the $5,161,900 total.

Operating Costs and Operating Profit

Operating costs are estimated at $10.851 per ton milled for the first three years, and $11.623 per ton milled thereafter.

Operating profit before allowances for depletion, depreciation, financing charges, royalties, or taxation, is estimated as follows in 000's $ Canadian funds.

	Price of Copper		
	50¢ U.S.	55¢ U.S.	60¢ U.S.
Year 1	$1,914	$2,362	$2,811
2	1,914	2,362	2,811
3	1,031	1,375	1,720
4	1,031	1,375	1,720
5	822	1,158	1,493
6	797	1,130	1,463
7	798	1,131	1,464
8	797	1,130	1,463
9	798	1,131	1,464
Totals	$9,902	$13,154	$16,409

(B) TREATMENT RATE - 750 TONS OF ORE PER DAY

Capital Costs

It is estimated that a total investment of $6,410,700 will be required to prepare the underground workings for production, and to construct a concentrator with related facilities, including townsite requirements, capable of processing 750 tons of ore per day (262,500 tons per year).

The present ore reserves will suffice for 5.22 years operation at this rate, with a further 0.78 years anticipated, for a total of 6.00 years.

The sum of $90,000 representing inventory of supplies, and the sum of $637,800 representing three months' operating costs for working capital is included in the $6,410,700 total.

Operating Costs & Operating Profit

Operating costs are estimated at $9.719 per ton milled for the first three years, and $10.317 per ton milled thereafter.

Operating profit before allowances for depletion, depreciation, financing charges, royalties, or taxation, is estimated as follows in 000's $ Canadian funds.

	Price of Copper		
	50¢ U.S.	55¢ U.S.	60¢ U.S.
Year 1	3,168	3,841	4,513
2	2,370	2,949	3,527
3	1.706	2,206	2,707
4	1,549	2,049	2,550
5	1,549	2,049	2,550
6	1,549	2,049	2,550
Totals	11,891	15,143	18,397

SUMMARY - ESTIMATED CAPITAL COSTS 500 T.P.D.

(1)	Mine		
	(a) Equipment	577,400	
	(b) Preproduction development & stoping	990,300	
	Total Mine		$1,567,700
(2)	Crushing Plant		356,400
(3)	Concentrator		633,100
(4)	Mine Backfill & tailings disposal		37,500
(5)	Plant Services		483,700
(6)	Water Supply		130,000
(7)	Power		252,000
(8)	Camp buildings & housing		223,000
* (9)	Mine administration - 12 months @ $27,100/month		325,200
* (10)	Vancouver Head Office - 12 months @ $4,500/month		54,000
	Sub-total		$4,062,600
	Contingencies @ 10%		406,300
			$4,468,900
	Engineering @ 5% on Items 1(b), Items 2 to 7 inclusive, part of Item 8 ($82,000) - i.e. 5% x $2,965,000		148,300
			$4,617,200
	Inventory of supplies		70,000
			$4,687,200
	Working Capital - 3 months operating costs or 3 x 14,583 tons/month x $10.851 per ton		474,700
	Total		$5,161,900

Note: * If all negotiations and arrangements can be concluded at an early date, the design, mine development and plant construction can be completed in about 10 months.

ESTIMATED TONS OF CONCENTRATES PRODUCED - 500 T.P.D.

	MILL FEED				CONCENTRATES	
Year	Tons	Assay % Cu.	Tons of Copper	000's lbs Copper	000's lbs. Cu Recovered @94%	Dry Tons @ 32% Cu
1	175,000	2.530	4,427.5	8,855	8,324	13,006
2	175,000	2.530	4,427.5	8,855	8,324	13,006
3	175,000	1.944	3,402.0	6,804	6,396	9,994
4	175,000	1.944	3,402.0	6,804	6,396	9,994
5	175,000	1.895	3,316.2	6,632	6,234	9,741
6	175,000	1.879	3,288.2	6,576	6,181	9,658
7	175,000	1.879	3,288.3	6,577	6,182	9,659
8	175,000	1.879	3,288.2	6,576	6,181	9,658
9	175,000	1.879	3,288.3	6,577	6,182	9,659
TOTAL	1,575,000	2.040	32,128.2	64,256	60,400	94,375

ESTIMATED NET SMELTER RETURNS

Assumptions

Grade of copper concentrate - 32.0% Cu + 0.035 ozs. Au/ton + 5.40 ozs. Ag/ton
Moisture content - 8%
Price of copper - 50.0¢ U.S. - 55.0¢ U.S. - 60.0¢ U.S. per lb.
Price of silver - $1.73 U.S. / per oz.

(a) Price of Copper - 55.0¢ U.S. per lb.

Gross Value	Per Short Ton of Concentrate
Copper contained - 640#	
Copper paid for - 640 - 24# = 616#	
Value of copper - 616 x (55¢ - 1¢) =	$ 332.64 U.S.
Value of silver - 5.40 ozs. x 1.73 x 90% =	8.40 U.S.
Value of gold, since content is less than requirements	-
	$ 341.04 U.S.

Deductions

(1) Treatment Charge - $25.00 / dry metric ton
i.e. Less $\frac{25.00 \times 2000}{2204.6}$ per dry short ton = 22.68 U.S.

Net $ 318.36 U.S.
Plus U.S. - Can. exchange at 7-3/4% 24.67
Net $ 343.03 CAN.

(2) Concentrate handling and Freight

	Per wet ton of concentrate
Loading	0.75
Trucking (4¢ per ton mile x 250 miles to Vancouver	10.00
Sampling, warehousing, shiploading	3.50
	14.25

or - per short dry ton of concentrate 14.25 x 1.08 = 15.39 CAN.

Net value per short dry ton of concentrate 327.64 CAN.
Net value per lb of copper contained = $\frac{327.64}{640}$ = 51.19¢ CAN.

ESTIMATED NET SMELTER RETURNS (Cont'd)

(b) Price of Copper - 50.0¢ U.S. and 60.0¢ U.S. per lb.

Since it will be noted that at 55.0¢ U.S. or 59.26¢ Can/lb, net value per lb amounts to 51.19¢ Can/lb, for expediency it has been assumed the same deduction will apply to the other two prices, i.e.:

Price Copper - ¢ per lb.		Net Value per lb. of	Difference	Net Value per Short Dry Ton
U.S.	Can. @ 1.0775xU.S.	Copper Contained	¢ Can/lb	Of Concentrate $ Can.
50	53.88	45.81	8.07	293.18
55	59.26	51.19	8.07	327.64
60	64.65	56.58	8.07	362.11

ESTIMATED OPERATING COST - 500 TPD or 175,000 TPY

	First 4 Years		Next 5 Years	
	Amt./yr. 000's $	Per Ton Milled	Amt./yr. 000's $	Per Ton Milled
Mining	1,190,700	6.804	1,325,800	7.576
Milling	329,000	1.880	329,000	1.880
Mine administration, Plant Services & townsite	325,100	1.858	325,100	1.858
Vancouver Head Office	54,000	0.309	54,000	0.309
	$1,898,800	10.851	$2,033,900	11.623

These costs have been calculated on the basis of labour and supplies as estimated to cost during 1970-71. No allowances have been included for escalation in the costs as it has been assumed these will be offset by improvement in mining technology and general increases in the price of metals.

500 T.P.D.

ESTIMATED OPERATING PROFIT - CAN. FUNDS

PRICE OF COPPER - 50¢ U.S.

Year	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	Total & Avge
Tons milled - 000's	175	175	175	175	175	175	175	175	175	1,575
Tons concentrates	13,006	13,006	9,994	9,994	9,741	9,658	9,659	9,658	9,659	94,375
Net smelter returns 000's $ Can. @ $293.18 / ton of concentrates	3,813	3,813	2,930	2,930	2.856	2,831	2,832	2,831	2,832	27,668
N.S.R. per ton of ore milled	21.789	21.789	16.743	16.743	16.320	16.177	16.182	16.177	16.182	17.567
Operating Cost per ton of ore milled	10.851	10.851	10.851	10.851	11.623	11.623	11.623	11.623	11.623	11.280
Operating Profit per ton of ore milled	10.939	10.939	5.893	5.893	4.697	4.554	4.559	4.554	4.559	6.287
Operating Profit - 000's $ Can.	1,914	1,914	1,031	1,031	822	797	798	797	798	9,902

500 T.P.D.

ESTIMATED OPERATING PROFIT - CAN. FUNDS

PRICE OF COPPER - 55¢ U.S.

Year	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	Total
Tons milled - 000's	175	175	175	175	175	175	175	175	175	1,575
Tons concentrates	13,006	13,006	9,994	9,994	9,741	9,658	9,659	9,658	9,659	94,375
Net smelter returns 000's $ Can. @ $327.64 / ton of concentrates	4,261	4,261	3,274	3,274	3,192	3,164,	3,165	3,164	3,165	30,920
N.S.R. per ton of ore milled	24.349	24.349	18.709	18.709	18.240	18.080	18.086	18.080	18.086	19.632
Operating cost per ton of ore milled	10.851	10.851	10.851	10.851	11.623	11.623	11.623	11.623	11.623	11.280
Operating profit per ton of ore milled	13.499	13.499	7.858	7.858	6.617	6.457	6.463	6.457	6.463	8.352
Operating profit - 000's $ Can.	2,362	2,362	1,375	1,375	1,158	1,130	1,131	1,130	1,131	13,154

500 T.P.D. ESTIMATED OPERATING PROFIT - CAN. FUNDS

PRICE OF COPPER 60¢ U.S.

Year	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	Total
Tons milled - 000's	175	175	175	175	175	175	175	175	175	1,575
Tons concentrates	13,006	13,006	9,994	9,994	9,741	9,658	9,659	9,658	9,659	94,375
Net smelter returns 000's $ Can. @ $362.11 per ton of concentrate	4,710	4,710	3,619	3,619	3,527	3,497	3,498	3,497	3,498	34,175
N.S.R. per ton of ore milled	26.914	26.914	20.680	20.680	20.154	19.983	19.989	19.983	19.989	21.698
Operating cost per ton of ore milled	10.851	10.851	10.851	10.851	11.623	11.623	11.623	11.623	11.623	11.280
Operating profit per ton of ore milled	16.063	16.063	9.829	9.829	8.531	8.360	8.366	8.360	8.366	10.418
Operating profit - 000's $ Can.	2,811	2,811	1,720	1,720	1,493	1,463	1,464	1,463	1,464	16,409

CHAPTER II

PROPERTY, HISTORY, GEOLOGY & ORE RESERVES

PROPERTY AND LOCATION

The Alwin Mining Company Ltd. hold a group consisting of three Crown-granted mineral claims and twenty-six recorded claims in the Highland Valley Area. This group is situated about $4\frac{1}{2}$ to 5 miles west of the Bethlehem Copper Corporation Ltd. concentrator, and is connected to the Ashcroft-Bethlehem hard surfaced highway by 5 miles of good gravel road.

HISTORY

The property was located originally in the early 1900's. 11,000 tons of ore with an average grade of 3.25% copper, 0.30 ounces of silver and a trace of gold per ton were mined by the Ashcroft Copper Company Ltd. in the period 1916, 1917 and 1918.

It appears that the mine was shut down in 1918 because the price of copper declined, since reported estimates of material remaining amounted to 10,000 tons averaging 4.85% copper and 0.28 ounces of silver per ton.

The Alwin Mining Company Ltd. acquired title shortly after incorporation in 1964. Induced polarization, magnetic and geochemical surveys led to extensive surface diamond drilling with successful results.

During 1968 and 1969, further surface diamond drilling was completed. An adit at the 4680 elevation has been driven easterly on line for 2700' and a 700' northerly crosscut through at least seven mineralized zones completed from a point about 1700' from the portal.

Drifting and raising has partially explored four of the zones at and above this 4680 elevation and numerous underground diamond drill holes have probed the various zones at 100' intervals, from the surface, (approximate elevation 4,980) down to about the 4100 elevation.

BUILDINGS AND PLANT

Present buildings are temporary in nature, consisting of a number of trailers and plywood buildings suitable to accommodate an exploration crew of about thirty men.

Similarly, a plywood building houses a compressed air and generating plant consisting of three 600 cfm diesel operated portable compressors. Electricity is supplied by means of two diesel generators, one 25 kW and one 75 kW in size.

GEOLOGY AND MINERALIZATION

The adit area is in the eastern part of the Alwin property, in Bethsaida granodiorite. This rock is fractured along steeply dipping, N60°E and N70°W, planes.

At least seven (and possibly more) mineralized zones of economic significance have been discovered, which occupy such fractures and vary from one foot to over thirty feet in width.

Chalcopyrite and lesser amounts of bornite are present with generally abundant sericite in the fracture fillings. Pyrite occurrence is quite minor.

A north-south dyke of feldspar porphyry, twenty feet wide, traverses the various mineralized zones. It dips 45° easterly and has the effect of segmenting the ore. Another lesser dyke of similar rock is known in the underground workings.

ORE RESERVES - SUMMARY

As of 1 October 1969, the ore reserves are estimated to be 1,127,700 tons in place, containing 2.49% copper and 0.375 ounces of silver per ton. After an allowance of an average of about 20% at 0.10% copper for mining dilution, these reserves are estimated at 1,369,600 tons assaying 2.04% copper. This represents approximately 1850 tons per vertical foot of depth. All of the ore will have to be mined by underground methods.

Drifting and raising conducted along and upwards from the 4680 level has confirmed much of the results indicated by previous diamond drilling, and has demonstrated that the mineralization possesses good continuity.

The zones vary from about one foot to thirty-two feet and average about 10.5 feet in true width. They are spread along a total strike length of about 1,700 feet, and although some appear to have weakened or have been delimited by the exploration work completed to date, several are still open in strike and in depth.

From the present underground openings it has been possible to probe the structure by long diamond drill holes to about 800 feet below the surface. No change in the favourable geological environment has been observed at this depth and some zones are still open.

The lower limit of this deep diamond drilling represents an approximate economic limit for further exploration by this means.

Along the strike of the favourable structure possibilities still exist relative to the discovery of additional zones of the extension of the present ones.

Four surface diamond drill holes situated about 400' easterly from the underground work cut interesting copper values worthy of further investigation.

Similarly, several diamond drill holes directed across the structure about 500' westerly from the main mineralized zones cut narrow widths of good grade mineralization with extensions as yet not fully determined.

Summarizing, additional ore will undoubtedly be found therefore both easterly and westerly of the presently explored zone with depth extensions possible.

Extensive work was carried on in 1969 in an effort to prove or disprove the presence of disseminated or "porphyry" type copper deposits on other parts of Alwin's claim group.

Tractor trenching at regular intervals followed by surface diamond drilling, designed to explore several areas showing copper geochemical anomalous values, failed, however, to disclose anything of any economic significance.

CHAPTER III
MINING

GENERAL

It is proposed to excavate and timber a three compartment vertical shaft 850' in length at the approximate coordinates 96,470 North - 97,430 East. Levels will be cut at 150' intervals, or at the 4830 elevation (No. 1), the 4530 elevation (No. 3), the 4380 elevation (No. 4) and 4230 elevation (No. 5). A crosscut about 150' in length from the present 4680 level (No. 2) will be driven to connect with the shaft.

The section of the shaft from No. 2 level to the surface will probably be constructed by boring a pilot hole about 10" in diameter first, followed by reaming to 48" in diameter. This will subsequently be enlarged to the full shaft size after installation of the production hoist and a head frame, by normal progress downwards using the 48" diameter hole as a "cut", and removing the broken rock out on the No. 2 level. This method should be investigated in greater detail in comparison with standard raising and/or sinking methods, in terms of time and cost.

The section of the shaft below No. 2 level will then be sunk, and the No. 3, 4 and 5 stations established prior to production, in order to avoid interference with mining later on.

SELECTION OF STOPING BLOCKS

The widest (11' - 30' - average 20') stoping blocks have been selected for the initial production period. These are situated between Section 48 and Section 53 (see attached plans) and will be complemented by the extraction of certain of the "narrow" blocks above the No. 2 level as soon as possible.

The following calculation shows that the average grade for the first 2.96 years, if all this ore could be extracted initially, could therefore be 2.530% copper, as hoisted and fed to the concentrator.

	After Mining Dilution Allowance		
	Percentage of Total	Tons	Grade % Cu
"Wide" blocks above and below 2 level	77.8	402,652	2.366
Selected narrow blocks above 2 level	22.2	114,660	3.105
Total	100.0	517,312	2.530

or $\frac{517,312}{175,000} = 2.96$ years

In the interest of good practice, however, other blocks will be developed as well, and form part of the feed to the concentractor after the first two years, with orderly level development proceeding downwards through the mine in advance of requirements.

For the purposes of this report the average grade for the first 2.00 years therefore has been assumed to be 2.530% copper, and the grade for the next 2.25 years has been obtained by combining all the ore situated close to the shaft remaining after the first 2.00 years, as follows:

"First" Blocks - close to the shaft - after dilution allowance.

	Tons	Grade % Cu
Wide blocks above and below 2 level	402,652	2.366
Narrow blocks above 3 level	341,773	2.048
Total $\left(\frac{744,425}{175,000} = 4.254 \text{ yrs.}\right)$	744,425	2.220
Less mined as assumed during first 2.00 yrs.	350,000	2.530
$\left(\frac{394,425}{175,000} = 2.254 \text{ yrs.}\right)$	394,425	1.944

Similarly the grade of ore for the balance of the ore reserves will be as follows:

	Tons	Grade % Cu
Present ore reserves - including anticipated	1,575,000	2.040
Less mined during first 4.254 years	744,425	2.220
Balance of 9.00 years = 4.746 yrs.	830,575	1.879

It will be noted that it is assumed, for the purposes of this report, that the grade of 2.040% copper will apply to the further ore anticipated, and that there will be 9.00 years operation in all.

RECAPITULATION - TONS & GRADE OF COPPER MINED BY YEARS
(after mining dilution)

YEARS	Tons Mined	Grade - % Cu
1 and 2	350,000	2.530
3 and 4	350,000	1.944
First part 5th year	44,425	1.944
Last part 5th year	130,575	1.879
Total - 5th year	175,000	1.895
6th - 9th Year Incl.	700,000	1.879
TOTALS	1,575,000	2.040

ESTIMATE FIRST STOPING BLOCKS - "WIDE"

ABOVE #2 LEVEL

Sect-Block-Zone	Width Ft.	Tons	Grade % Copper	Dilution Factor	Ore Reserves After Dilution Tons	Ore Reserves After Dilution Grade % Copper
48-19-5	19.1	21,830	1.65	0.100	24,010	1.51
49-28-5	18.7	21,370	2.85	0.100	23,510	2.60
50-32-2	17.2	13,110	2.24	0.120	14,680	2.01
* 50-33-2	27.5	11,790	4.25	0.070	12,620	3.97
50-35-5	20.0	25,710	2.62	0.100	28,280	2.39
50-36-3	16.0	25,140	4.09	0.126	28,310	3.64
* 50-G18-3	4.1	3,900	0.67	0.350	5,260	0.52
50-37-3	14.4	14,400	2.04	0.133	16,310	1.81
* 50-G19-3	5.7	4,890	0.73	0.250	6,110	0.60
51-48-3	23.7	25,960	1.17	0.080	28,040	1.09
* 51-49-3	7.6	5,430	5.15	0.227	6,660	4.22
52-58-3	20.6	22,560	4.28	0.100	24,820	3.90
Totals & Average					218,610	2.466

* Mined due to location.

BELOW #2 LEVEL

48-24-6	12.7	12,710	2.35	0.166	14,820	2.03
49-29-6	28.0	24,530	2.63	0.070	26,250	2.46
50-34-2	20.0	5,710	1.82	0.100	6,280	1.66
50-41-6	13.6	32,380	1.06	0.146	37,110	0.94
51-55-6	17.7	25,240	2.21	0.113	28,092	2.00
52-59-3	30.0	14,290	4.28	0.060	15,150	4.04
52-61-3	20.0	17,140	3.29	0.100	18,850	3.00
53-84-3	28.3	35,038	2.83	0.070	37,490	2.64
Totals & Average					184,042	2.245
Total Above & Below #2 Level					402,652	2.366

ESTIMATE FIRST STOPING BLOCKS - "NARROW"

ABOVE #2 LEVEL

Sect-Block-Zone			Width Ft.	Tons	Grade % Copper	Dilution Factor	Ore Reserves After Dilution Tons	Grade % Copper
46	1	2	6.0	6,000	4.48	0.250	* 7,500	3.60
46	2	2	4.0	3,310	1.61	0.350	4,895	1.12
46	4	5	5.8	7,790	5.10	0.250	* 9,740	4.10
47	7	2	7.7.	7,630	2.58	0.220	* 9,310	2.13
47	8	5	4.0	4,380	2.51	0.350	5,910	1.89
47	10	3	7.0	3,330	1.36	0.235	4,110	1.12
47	12	3	6.0	2,860	0.93	0.250	3,570	0.76
48	15	2	7.0	4,800	3.00	0.235	5,930	2.44
48	17	5	4.9	2,800	1.09	0.350	3,780	0.83
48	21	3	4.0	1,900	2.55	0.350	2,570	1.91
49	25	1	9.2	9,640	1.84	0.210	11,660	1.54
50	30	1	5.0	4,760	4.38	0.300	* 6,190	3.39
50	31	2	4.4	6,290	2.85	0.325	* 8,330	2.18
50	38	3	10.7	3,570	2.15	0.173	4,190	1.85
50	40	4	4.0	3,430	0.95	0.350	4,630	0.73
50	43A	4	3.9	3,710	2.07	0.350	5,008	1.56
51	44	2	10.2	5,340	2.89	0.200)	* 12,090	2.34
			5.1	4,370	2.89	0.300)		
51	46	5	4.7	5,820	3.43	0.300	* 7,570	2.66
51	52	4	5.0	2,860	2.14	0.300	3,720	1.67
51	54	4	4.6	5,910	1.24	0.335	7,890	0.95
52	56	3	4.5	4,080	3.14	0.335	* 5,450	2.38
52	57	3	6.3	7,200	2.30	0.250	* 9,000	1.86
52	65	4	7.5	7,140	4.96	0.227	* 8,760	4.06
52	66	4	5.6	5,070	1.92	0.250	6,340	1.56
52	67	4	7.4	6,340	2.71	0.227	7,780	2.23
53	75	2	4.0	1,900	1.30	0.350	2,560	0.99
53	76	2	4.0	1,900	1.90	0.350	2,560	1.44
53	77	4	8.4	13,040	4.89	0.215	*15,840	4.04
53	78	4	8.9	9,070	0.90	0.210	10,970	0.76
54	86	4	4.0	6,480	4.47	0.350	* 8,750	3.34
55	92	4	4.4	7,420	1.78	0.320	9,790	1.37
55	93	4	4.0	2,930	1.51	0.350	3,960	1.14
55	96	4	4.3	5,570	4.03	0.320	* 7,350	3.08
Totals & Average							227,703	2.250
Totals Selected Blocks Marked *							114,660	3.105

ESTIMATE FIRST STOPING BLOCKS - "NARROW"

BETWEEN #3 & 2 LEVEL

Sect-Block-Zone	Width Ft.	Tons	Grade % Copper	Dilution Factor	Ore Reserves After Dilution Tons	Grade % Copper
48-16-2	5.0	4,760	1.22	0.300	6,190	0.96
48-18-5	4.9	2,570	1.09	0.300	3,340	0.86
48-20-5	4.0	4,080	0.77	0.350	5,510	0.60
48-22-3	4.0	1,900	2.55	0.350	2,570	1.91
49-26-2	4.5	1,080	7.18	0.325	1,430	5.45
50-34-2	20.0	5,710	1.82	0.100	6,280	1.66
50-39-3	7.0	5,670	2.15	0.235	7,000	1.76
50-42-3	7.5	7,500	1.08	0.227	9,200	0.90
51-50-3	7.6	4,340	2.42	0.227	5,320	1.99
51-51-3	7.7	8,800	2.94	0.227	10,800	2.41
51-53-4	5.0	2,620	2.14	0.300	3,410	1.67
52-62-3	5.2	2,480	1.29	0.300	3,220	1.02
52-64-2	4.4	3,350	5.88	0.325	4,440	4.46
52-68-4	8.9	8,060	1.36	0.210	9,750	1.14
52-70-4	8.3	7,110	1.67	0.220	8,670	1.39
53-82-2	4.0	1,450	1.30	0.350	1,960	0.99
53-83-2	4.0	2,740	1.19	0.350	3,700	0.96
54-87-3	5.1	5,440	3.52	0.300	7,070	2.73
54-88-3 ($\frac{1}{2}$)	7.4	4,300	2.16	0.230	5,290	1.77
54-91-3	5.1	3,300	1.04	0.300	4,290	0.82
55-94-4	4.0	3,430	1.51	0.350	4,630	1.14
Totals & Average					114,070	1.643
Add: - Blocks above #2 Level - "Narrow"					227,703	2.250
Total Above "3 Level - "Narrow"					341,773	2.048

MINE NORTH

200 S

400 S

600 S

800 S

PROPOSED SHAFT

R 96 7350 / 3.08

R 65 8760 / 4.06

R 80

R 86 8750 / 3.33

R 66 6340 / 1.56

R 40 4630 / 0.73

R 54 7890 / 0.95

R 78 10,970 / 0.76

R 4 9740 / 4.05

R 56 5450 / 2.37

R 36 28,310 / 3.64

R 57 9000 / 1.86

G 18 5260 / 0.52

R 35 28,780 / 2.40

R 15 5930 / 2.44

R 31 8330 / 2.17

R 25 11,660 / 1.53

R 30 6100 / 3.39

4400 E

4600 E

4800 E

5000 E

5200 E

5400 E

5600 E

5800 E

LEGEND

18,203 / 2.21 — TONS / GRADE - % Cu

TO ACCOMPANY REPORT DATED OCT 22, 1969

DWG. No.	REFERENCE	REF No.	DWG. No.	REFERENCE	REF No.

REV.	BY	DATE	REVISION	APP'D.

BY	DATE	PRELIMINARY ISSUE

APPROVED

DATE

D 2463-4

SCALE 1" = 50'-0" | DR'N B.N. | CH'K'D | APP'D | APP'D

ALWIN MINING CO. LTD.
HIGHLAND VALLEY
ORE OUTLINES ON No. 1 LEVEL
ELEV. 4830'

SANDWELL

BACON & CROWHURST LTD.
VANCOUVER B.C.

DWG. D 2463-4 REV

MINE NORTH

PROPOSED SHAFT

R 21 2570 / G 11 1.91

R 12 9310 / G 8 2.13

R 10 4110 / G 7 1.12

R 19 24,010 / 1.51

R 8 9310 / 2.13

R 17 3780 / 0.83

R 1 7500 / 3.60

R 2 4895 / 1.12

R 7 9310 / 2.13

R 16 6190 / G 9 G 10 0.96

R 26 1430 / 5.45

R 33 12,620 / 4.20

R 32 14,680 / 2.01

R 44 12,090 / 2.34

R 43A 5008 / 1.55

G 10 6,110 / 0.60

R 38 4190 / 1.84

R 37 1630 / 1.81

R 28 23,510 / 2.60

R 35 28,280 / 2.40

R 46 7570 / 2.60

R 54 7890 / 0.8

R 52 3,770 / 1.61

R 48 28,040 / 1.10

R 49 6660 / 4.21

R 67 7780 / 2.22

R 78 10,970 / 0.76

R 58 24,820 / 3.80

R 93 3960 / 1.14

R 76 2560 / G 27 1.44

R 75 2560 / G 26 0.99

BOUNDARY DYKE

200 S

400 S

600 S

800 S

4400 E

4600 E

4800 E

5000 E

5200 E

5400 E

5600 E

5800 E

LEGEND

18,293 / 2.21 - TONS / GRADE - %CU

TO ACCOMPANY REPORT DATED OCT 22 1969

DWG. No.	REFERENCE	REF No.	DWG. No.	REFERENCE	REF No.

REV.	BY	DATE	REVISION	APP'D

BY	DATE	PRELIMINARY ISSUE

APPROVED

DATE

D 2463-5

SCALE 1" = 100'

DR'N BM

CH'K'D

APP'D

APP'D

ALWIN MINING CO LTD

HIGHLAND VALLEY

ORE OUTLINES ON No 2 LEVEL

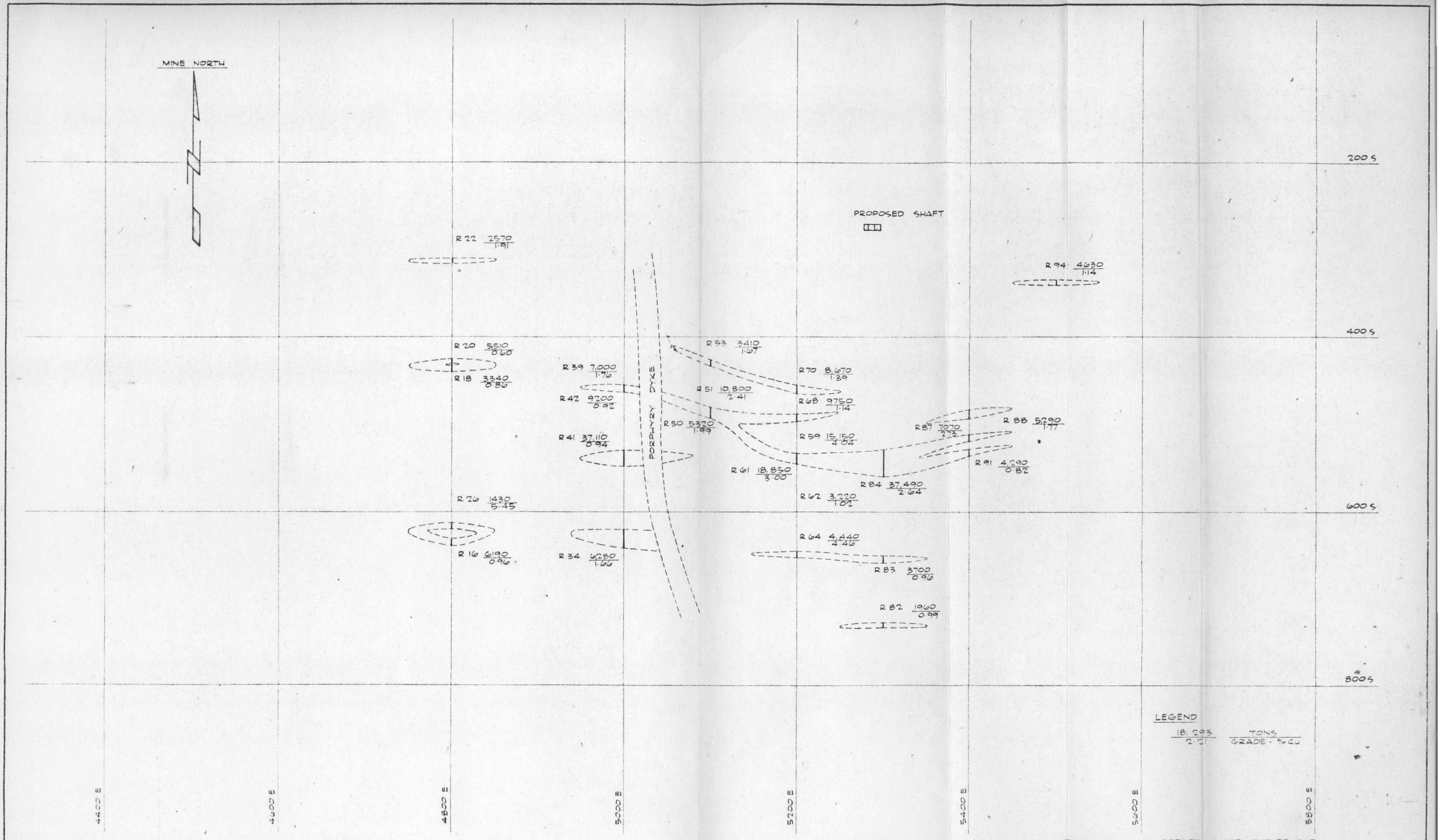
ELEV 4680

BACON & CROWHURST LTD

VANCOUVER B.C.

SANDWELL

DWG. D 2463-5 REV



TO ACCOMPANY REPORT DATED OCT 22 1969

APPROVED	SCALE 1" = 50·0'		ALWIN MINING CO. LTD
DATE	DR'N B.M. 21·10·69		HIGHLAND VALLEY
	CH'K'D		ORE OUTLINES ON Nº 3 LEVEL
D 2463-6	APP'D		ELEV 4550'
	APP'D		

THIS DRAWING IS THE PROPERTY OF SANDWELL AND MUST BE RETURNED TO SANDWELL ON REQUEST. ITS CONTENTS ARE SECRET AND CONFIDENTIAL. ANY INFORMATION OBTAINED BY INSPECTION OF THIS DRAWING SHALL NOT BE USED FOR ANY OTHER THAN THE SPECIFIC PURPOSE FOR WHICH ITS INSPECTION IS AUTHORIZED BY SANDWELL

SANDWELL

BACON & CROWHURST LTD
VANCOUVER BC

DWG. D 2463-6 REV

DWG. No.	REFERENCE	REF No.	DWG. No.	REFERENCE	REF No.	REV.	BY	DATE	REVISION	APP'D.	REV.	BY	DATE	REVISION	APP'D.

BY	DATE	PRELIMINARY ISSUE

MINE NORTH

PROPOSED SHAFT

PORPHYRY DYKE

R42 $\frac{9200}{0.92}$

R55 $\frac{28,092}{2.00}$

R41 $\frac{37,110}{0.94}$

R24 $\frac{14,820}{2.03}$

R29 $\frac{26,250}{2.46}$

R88 $\frac{5290}{1.77}$

200S

400S

600S

800S

4600E

4800E

5000E

5200E

5400

5600E

5800E

LEGEND

$\frac{18,293}{2.21}$ - $\frac{\text{TONS}}{\text{GRADE - \% CU}}$

TO ACCOMPANY REPORT DATED OCT 22, 1969

DWG. No.	REFERENCE	REF No.	DWG. No.	REFERENCE	REF No.

BY	DATE	REVISION	APP'D

BY	DATE	PRELIMINARY ISSUE

APPROVED

DATE

D 2463-7

SCALE 1"=50.0'

DR'N B.M.

CH'K'D.

APP'D.

APP'D.

ALWIN MINING CO LTD
HIGHLAND VALLEY
ORE OUTLINES ON No 4 LEVEL
ELEV 4400'

BACON & CROWHURST LTD
VANCOUVER B.C.

SANDWELL

DWG. D 2463-7 REV

MINE NORTH

PROPOSED SHAFT

R55 $\frac{28,092}{2.00}$

R24 $\frac{14,820}{2.03}$

R41 $\frac{37,110}{0.84}$

R29 $\frac{26,750}{2.46}$

200 S

400 S

600 S

800 S

LEGEND

$\frac{18,293}{2.21}$ TONS / GRADE - % Cu

4400 E

4600 E

4800 E

5000 E

5200 E

5400 E

5600 E

5800 E

TO ACCOMPANY REPORT DATED OCT 20 1969

BY	DATE	PRELIMINARY ISSUE

APPROVED	
DATE	
D 2463-8	
SCALE	1"=50'-0"
DR'N	B.M.
CH'K'D	
APP'D	
APP'D	

ALWIN MINING CO. LTD.
HIGHLAND VALLEY
ORE OUTLINES ON No. 5 LEVEL
ELEV. 4250'

BACON & CROWHURST LTD
VANCOUVER B.C.

SANDWELL

DWG. D. 2463-8' REV

DWG No.	REFERENCE	REF No.	DWG No.	REFERENCE	REF No.

REV	BY	DATE	REVISION	APP'D
1				

REV	BY	DATE	REVISION	APP'D

ESTIMATED STOPE PRODUCTION

It is contemplated that the stope and development mine crews will work 5 days per week, on a 2 shift/day basis.

In order to supply the concentrator with the required $\frac{175,000}{12}$ or 14,583 tons of ore per month, the mine must produce an average of 701 tons of ore per day on a 20.8 day per month basis (250 days per year). Ore produced from stope development and exploration will probably supply about 1500 tons per month on the average, leaving 13,083 tons per month to result from stoping, or a net of 629 tons per day.

It is estimated 8 stopes of the "wider" category, fully developed and available, will be required initially. 6 of these will produce 6 x 80 tons/stope/day or 480 tons/day toward the required feed to the concentrator. The other 2 are to allow a 25% margin for breakdowns, unforeseen ground conditions, possible lack of ore continuity, interference with the "cut & fill" cycle, and other unforeseen difficulties.

In addition, it is estimated that 7 stopes of the "narrower" category must be well advanced to produce the other 149 tons required daily on the average (629 minus 480), taking into account the fact that until the stope is carried up to the level above, only 1/3 of the broken rock can be drawn. If 5 of these, at any time during this initial period, are in various stages, i.e. starting, partly finished, and finished, it is estimated the required average of 30 tons per stope can be drawn daily.

Since the average shrinkage stope at Alwin contains approximately 2,000 to 3000 tons or ore, about 3 to 4 months are required to advance a stope upwards from one level to the level above and start drawing the other two thirds of the broken ore supply.

An increasing broken ore supply will probably be established in the shrinkage stopes if the rate of breaking ore contemplated is carried out continuously. The wider cut and fill stopes will also be largely finished, however, by this time; this combination of events will tend to level out costs over the life of the mine.

In summary, the feed to the concentrator is therefore estimated as follows:

Estimate - Tons Produced (first 3 - 4 years)

	Cut & fill	Shrinkage	Development & Exploration	Total
Monthly	9,984	3,099	1,500	14,583
Daily	480	149	72	701
Stopes - total	8	7		
in use	6	5		
Production/day/stope	80	30		
Production/shift/stope	40	15		

ESTIMATED CAPITAL COSTS - EQUIPMENT

A.	COMPRESSORS - with allied equipment i.e. electrics, receivers, piping valves, etc.		
	4 machines - each 1200 cfm Free air-installed		$144,000
B.	UNDERGROUND		
	1. Raise, climber and/or long hole boring machine-rental -		
	2. Mucking machines		
	Exploration and development	1	
	Stopes	2	
	Total	3 @ $6000 each	18,000
	3. Rock Drills		
	Cut and fill stopes	7	
	Shrinkage stopes	12	
	Development and exploration	6	
	Spares	5	
	Total	30 @ average of $1600 each	48,000
	4. Compressed Air Autoloaders		
	3 @ average of $12,000 each		36,000
	5. Storage Battery Locomotives		
	One 4 to 5 ton and two 1-1/2 ton size with charging equipment to spare batteries		30,000
	6. Mine cars - 20 @ $800 each		16,000
	7. Ventilation Fans - Surface 1 @$5000 = $5,000; U/G 2 @$3000 = $6,000		11,000
	8. Tugger hoists - 17 @$2000 each		34,000
	9. Air slushers - 8 @$3500 each		28,000
	10. Scrapers - 8 @$800 each		6,400
	11. Shaft pumps		5,000
	12. Small tools and miscellaneous		10,000
		Total	$386,400

C. SHAFT

Double drum electrical hoist - size 4-1/2' to 6' drum diameter - complete with electrics -			
(Second hand (?))	$75,000		
Installation	15,000	$90,000	
Sheaves, and ropes		8,000	
Skips (2) and cage		11,000	
Head Frame-with dumping mechanism and gear and rock bin - installed - 100' high - (second hand)? steel if available		45,000	
			154,000

D. ELECTRIC POWER DISTRIBUTION

Transmission line down shaft, transformers, distribution on levels, control switches, shaft signals, lighting and miscellaneous	37,000
Total	577,400

ESTIMATED PREPRODUCTION MINE DEVELOPMENT

Plans are attached to this report showing the proposed initial approximate ore block outlines on each of the five levels between Sections 46 East and 58 East.

The level development necessary to gain access to the eighteen "wider" ore zones and to fifty-four "narrower" zones on No. 1, 2 and 3 levels has been planned diagrammatically.

This level development is as follows:

Level No.	Drifting & X-Cutting
1	1,700
2	500
3	2,100
Total	4,300

It is therefore assumed that 3000 feet of this total will be completed prior to production.

Delimiting and exploratory diamond drilling (or percussion drilling) will outline the various ore blocks at 50' intervals, and at 25' intervals where deemed necessary.

ESTIMATED COST - PREPRODUCTION MINE DEVELOPMENT AND STOPING

1. Shaft

a. Section - Surface to No. 2 Level

i. Boring 10" diameter pilot hole and reaming to 48" diameter 300' at $95/Foot plus overhead of $1,500 — $30,000

ii. Erecting headframe, equipping with sheaves, rock bin, and installing hoist - (included under Capital Costs) — -

iii. Enlarging 48" diameter hole to 3 compartment, timbering, rock removal and equipping generally.

Equivalent of 300' at $230/Foot — 69,000

iv. Cut No. 1 Level Station.

Equivalent of 25' at $230/Foot — 5,700

v. Access to shaft on 2 Level and 2 Level Station

Equivalent of 150' at $70/Foot — 10,500

115,200

b. Section - 2 Level to 5 Level and Sump

2 Level to 4 Level - 3 x 150'	450'		
Sump	100'		
Cut 2 stations at equivalent of 25' each of shaft	75'		
	625' at $365/Foot		228,100

c. Loading Pocket Below 2 Level and rock storage bin — 30,000

Total - Shaft — $373,300

2. Drifting and Cross-cutting

Level 1	1700 ft		
Level 2	500 ft		
Level 3	800 ft		
Total	3000 ft at $60/Foot		180,000

3. Raising

Ore and waste pass system - 2 Level to 1 Level with control chutes 2 x 150' at $60/Foot	$ 18,000	
Ventilation raise - 2 Level to Surface 2 x 300' at $50/Foot	30,000	
Stope raises - one for each stope - 15 x 170' of raise or 2,550' at $60/Foot	153,000	
Total raising		$201,000

4. Stope Preparation

a. Sub-levels

8 Cut and fill stopes	- 800'		
7 Shrinkage	- 700'		
	1500' at $40/Foot	60,000	

b. Drawpoints

8 Cut and fill stopes two per stope = 16 x 25'	400'		
7 Shrinkage stope - one every 20' or $\frac{700}{20}$ x 25' =	875'		
	1275' at $40/Foot =	51,000	
Total Stope Preparation			$111,000

5. Delimiting Drilling - at 25' and 50' intervals

15,000' at $3.00/Foot	45,000

6. Stoping (prior to production and including hoisting and stockpiling)

10,000 tons at $8.00/ton	80,000
Total	$990,300

MINE BACKFILL & TAILING DISPOSAL

Concentrator tailings will be cycloned, and the sand used for backfill in the stopes in the mine. No test work has been conducted, but it is expected that about 200 tons of sand per day satisfactory for backfill purposes will be produced.

The cyclone overflow, containing the fine particles and most of the water will be conveyed by pipe line down hill to Little O.K. Lake, which will be used for tailings disposal and water reclamation.

The capital cost is estimated as follows:

	Equipment & Materials	Construction & Installation	Total
Pumps, tanks & cyclones	10,000	2,500	12,500
Tailings line	12,000	3,000	15,000
Fill lines, valves etc.	5,000	2,000	7,000
Tailings overflow facilities	2,000	1,000	3,000
Totals	29,000	8,500	37,500

ESTIMATED MANPOWER & LABOUR COST

(A) First Four Years

	No.	Average Cost Per month including 20% fringe benefits	Total Cost per month	
(1) Underground Crew				
Machine men				
Cut & fill stopes	12			
Shrinkage	14			
Development & exploration	6			
	32	780	$24,960	
Slushermen	12	745	8,940	
Timber & fill	6	780	4,680	
Tramming & drawpoint loading	8	715	5,720	
Pipefitting & track	3	715	2,145	
General underground	6	680	4,080	
Hoistmen & skiptenders	6	745	4,470	
Samplers	2	715	1,430	
Dry & Lamps	2	680	1,360	
	77			$57,785

	No.	Average Cost Per month including 20% fringe benefits	Total Cost per month	
(2) Surface Crew				
Blacksmith-welder	1	780	780	
Rock drill & repair & bits	1	745	745	
Mechanic - compressors - hoist, etc. (combined with mill mechanical - electrical crew)	1	780	780	
Helper	1	715	715	
	4			$ 3,020
(3) Underground Staff				
Superintendent	1		1,500	
Shift Bosses	2		2,000	
Geology	1		1,000	
Surveyor & helper	2		1,500	
Safety & ventilation	1		700	
First Aid man	1		700	
	8			$ 7,400
Totals	89			68,205
Total Supplies & other costs				31,020
Total Estimated Mining operating cost - per month				99,225

or $\frac{99,225}{14,583}$ = $6.804/ton milled

(B) After First Four Years

No detailed calculations have been made, but it is considered that the mining crew will require later an additional 10 men to compensate for increased tramming distances from the shaft, and steadily decreasing average widths for the ore stoping blocks.

It is estimated therefore that the average mining cost will increase to $7.576 per ton milled.

CHAPTER IV

METALLURGY, CRUSHING PLANT & CONCENTRATOR

REPORT - D.A. LIVINGSTONE, P. ENG.

Mr. D.A. Livingstone, P. Eng., Chief Metallurgist, The Granby Mining Company Limited, Vancouver, B.C. has prepared a report and a preliminary plant layout on Metallurgy, Crushing and Ore Concentration relative to the treatment of ore from the Alwin Mining Company property at the rate of 500 tons per day.

Mr. Livingstone's report is based upon flotation test work and the mineralogical examination of ore samples carried out by the Mines Branch, Department of Energy, Mines and Resources, Ottawa.

The text of his report is as follows:

METALLURGICAL TEST WORK

The results of eight flotation tests, including one locked-cycle test, are summarized in Mines Branch Investigation Report IR 69-28, April 1969, and the mineralogical examination is covered by Report IR 69-5, January 1969.

It is management's plan to follow up this work by a more extensive investigation on a new ore sample to check and enlarge upon these preliminary tests, for the purpose of obtaining a few details necessary for the finalizing of flowsheet and sizing of equipment. Meanwhile, indications are that this ore can be concentrated very well by conventional flotation methods when ground to a medium fineness of 50 - 60% minus 200 mesh. Ore the same as that used in the test work may be expected to yield 94% recovery in concentrates grading at least 32% copper on heads containing 2.0% copper.

Chalcopyrite, as coarse to medium grains disseminated in gangue, is the main copper occurrence, but about 10% of the total occurs in the form of bornite and chalcocite. Gold and silver are reported as 0.0024 oz/ton and 0.41 oz/ton, respectively, and therefore inconsequential insofar as mill planning is concerned. The flotation performance and analytical data available to date have indicated no deleterious metallic or nonmetallic constituents which would affect adversely either flotation of the ore or marketability of the concentrates.

CRUSHING AND GRINDING

Crushability tests were not performed, so it is assumed that it is similar to other copper ores in the area. A Bond Work Index as a measure of grindability is reported as 17.4, which is medium-hard, and probably similar in this respect to Bethlehem ore.

In ores of this type, copper recovery is almost invariably proportional to the fineness of grind. Since the tests have not proceeded to the point where optimum fineness has been established, a fineness of 60% - 200 mesh is assumed. If coarser grinding proves to be acceptable, operating costs and mill capacity will benefit accordingly.

From the accompanying drawings, Nos. D 2463-1, 2 and 3 it will be noted that uncrushed run-of-mine ore, having passed a 12" grizzly underground, will be reduced in one stage of open circuit jaw crushing, and a second stage of closed circuit crushing to minus $\frac{1}{2}$", at a rate of 80 TPH, Minimal coarse ore live storage of about 500 tons is provided, whereas the fine ore storage is planned for 1500 live tons to permit a 2-shift, 5-day work week in the crushing end.

Using the reported Work Index figure of 17.4, a ball mill feed size of $\frac{1}{2}$" (13,000 microns) and a flotation feed size of about 60% minus 200 mesh (140 microns), it is calculated that grinding will consume 384 hp, thereby necessitating a ball mill 9' x 10', or equivalent, with 400 installed hp, in closed circuit with a 15" cyclone classifier.

FLOTATION AND DEWATERING OF CONCENTRATES

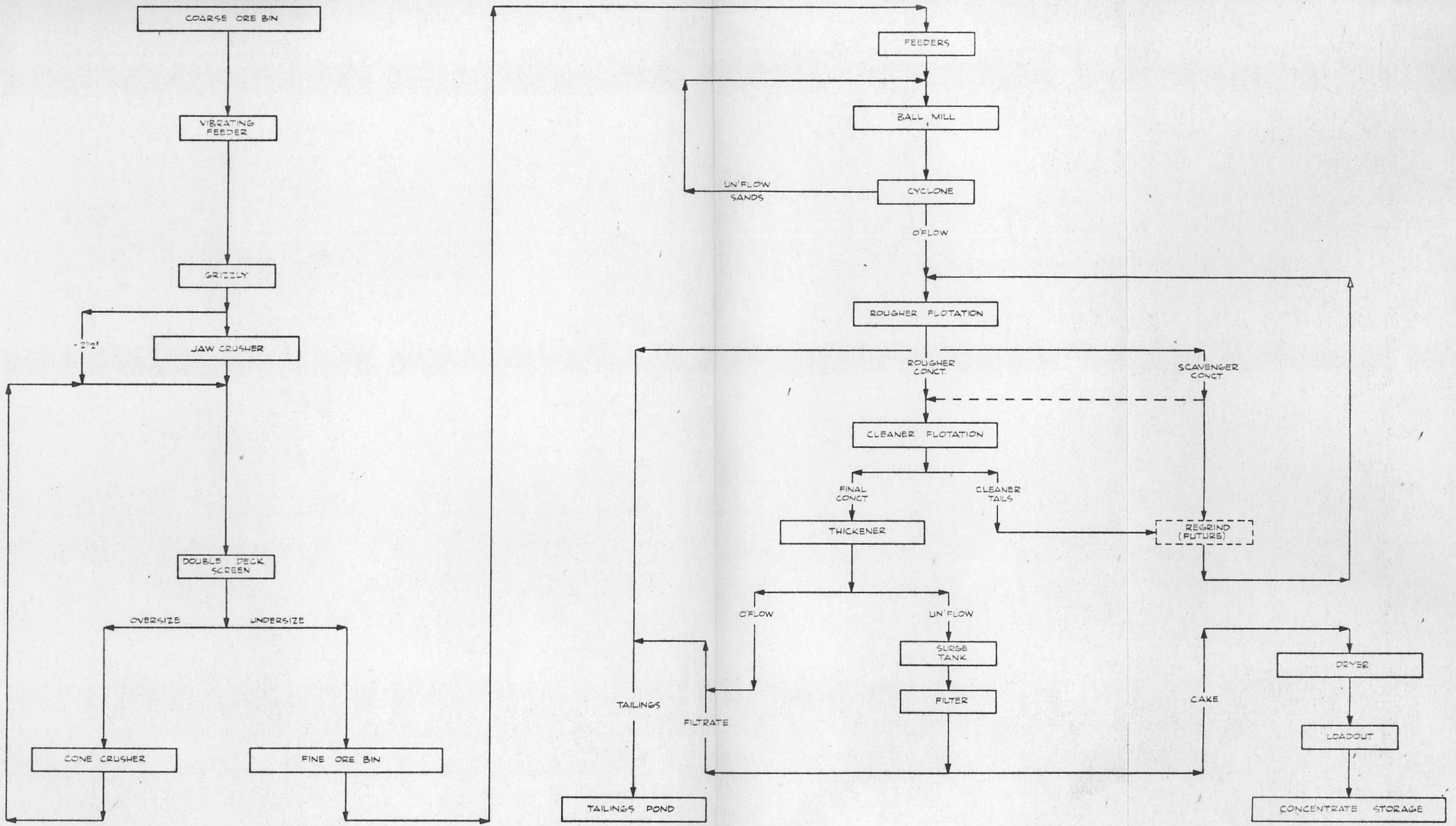
Flotation requirements for roughing are estimated at approximately 500 cubic feet, for example 10 cells of 50 cubic feet each, and for cleaning about 200 - 240 cubic feet. In each case space should be provided for 20% additional cells.

Final concentrates will be partially dewatered in a thickener, the exact size of which is awaiting further tests, followed by a disc filter and dryer. A surge tank ahead of the filter will permit intermittent operation of the dryer to accommodate fluctuating output.

PLANT LAYOUT

The general arrangement drawings show a simplified compact layout, which should lend itself well to maximum efficiency in supervision, maintenance and power distribution. However, it should be borne in mind that the ultimate selection of flowsheet and equipment and the physical layout will be dependent upon several factors not yet finalized, including the completion of the metallurgical test programme, the availability of satisfactory used equipment, and the ground and rock contours of the site.

It is expected that process water will be reclaimed from the tailings pond for the purposes of water conservation and avoiding pollution.



FLOWSHEET

TO ACCOMPANY REPORT DATED OCT 22, 1969

DWG. No	REFERENCE	REF No.	DWG. No	REFERENCE	REF No.

REV	BY	DATE	REVISION	APP'D

BY	DATE	PRELIMINARY ISSUE

APPROVED
DATE
D 2463-1

SCALE	NONE
DR'N.	B.M.
CH'K'D.	
APP'D	
APP'D	

ALWIN MINING CO. LTD
HIGHLAND VALLEY
500 TON P/D CONCENTRATOR
PRELIMINARY FEASIBILITY STUDY

BACON & CROWHURST LTD
VANCOUVER B.C.

SANDWELL

DWG. D 2463-1 REV.

PERSONNEL

The following personnel would be required for operating the crushing plant and concentrator, excluding electricians and men for yard handling of supplies or concentrates, and tailings disposal:

Mill superintendent, one repair lead head, two repairmen, one laboratory worker (technician-clerk), one crusherman and a helper on each of two shifts, one flotation operator and one ball mill operator on each of three shifts, one day labourer, for a total of 18. For the tune-up period, allowance should be made for at least 2 extra workmen.

Additionally, a maximum of 3 men, including the chief assayer, will operate the assay office.

OPERATING DATA & CONSIDERATIONS

1. METAL BALANCE

Assuming 515 TPD for an average throughput per calendar day of 500.

Product	Tons	% Copper	% Distribution
Mill Heads	515	2.00	100.0
Concentrates	30	32.00	94.0
Tailings	485	0.12	6.0

Owing to the low contents of gold and silver, the test results showed erratic recoveries. Consequently these are not included in the metal balance, but the concentrates may be expected to run about 0.035 oz./ton in gold, and 5.4 oz./ton in silver.

2. CRUSHING PLANT

The tentative selection of a 24" x 36" jaw crusher and 4' shorthead cone crusher represents the minimum requirements for the reduction of run-of-mine ore to minus $\frac{1}{2}$" in 2 stages. The possible advantages of selecting machines one size larger, for example, 30" x 42" jaw and $5\frac{1}{2}$' cone, would permit the handling of larger pieces from underground and an increase in crushing rate by approximately 50%. Another alternative for the secondary crusher is a $4\frac{1}{4}$' standard cone.

3. ORE BINS: Broken ore, 18 cu ft/ton. Specific Gravity 2.86.
Coarse ore bin, 60% draw-off through 1 drawpoint.
Fine ore bin, 70% draw-off through 6 drawpoints.
Run-of-mine ore, through 12" parallel grizzly.

4. COARSE ORE FEEDER: Vibrating feeder sized to accommodate "run-of-mine" ore rather than for the required feed rate.

5. CONVEYOR SLOPES: 14° for coarse "run-of-mine" ore
16° for intermediate sizes up to 4"
18° for minus $\frac{1}{2}$" ore
20° for concentrates

6. MAGNETITE: The amount present in the ore is assumed to be insufficient to interfere with a suspended magnet.

7. CONCENTRATE OUTPUT: While the average output from 2.0% copper heads will be 30 TPD, the likelihood of occasional higher heads would raise this figure by as much as 150%. Accordingly, the concentrate dewatering section should be designed for a peak output of 75 TPD.

8. POWER REQUIREMENTS (Installed HP)

Crushing Plant	HP	
Jaw crusher	75	
Cone crusher	150	
Vibrating screen	5	
Conveyors	60	
Dust collection	20	
Vibrating feeder, Magnet, Crane, Lighting, miscellaneous	30	
Total for crushing plant		340
Concentrator		
Grinding & Classification	425	
Feeders & Conveyors	20	
Flotation & Blower	85	
Pumps - Slurry, Sump, Filtrate, Vacuum	65	
Concentrate Dewatering - Thickener, Filter, Dryer & Scrubber	25	
Crane, lighting, assay office	50	
Total for concentrator		670

NOTES RE - POWER:

i. Load factor assumed 80% in crushing plant when operating, and 90% in the concentrator. On this basis the power consumed will approximate 23 KWH/ton.

ii. No hp is shown for tailings because the disposition of the tailings and the static head against which reclaimed water will be pumped are not presently known. (N.B. - covered elsewhere in this report.)

iii. No hp is shown for compressed air in the mill, it being assumed that this will be provided by the mine compressors.

iv. The hp shown for conveyors and pumps is subject to finalizing of flowsheet, plant layout and elevations.

9. WATER REQUIREMENTS, CRUSHING PLANT AND CONCENTRATOR ONLY

For an average milling rate of 500 tons/calendar day, 97% running time, the required throughput will be 515 TPD, and the estimated tailings flow will average 485 tons of solids per day at a dilution of 25% solids, for a volume of 270 USGPM, of which 242 USGPM will be water. Therefore the process water requirements will be 242 USGPM, to which must be added increments for sealing water in crusher and vacuum pump, cooling water, domestic and miscellaneous not included in the tailings flow, say 30 USGPM, for a total of 272 USGPM, or 286 USGPM including a 5% contingency, but excluding fire protection.

Subject to the results of further settling tests, it is estimated that 65% of the water content of the tailings flow can be reclaimed, thereby necessitating a fresh water make-up of 129 USGPM.

10. OPERATING COST - CRUSHING & CONCENTRATING

	$/Ton
Crushing and conveying	.32
Grinding and classifying	.66
Flotation	.36
Concentrate dewatering	.14
Assaying and laboratory	.21
Supervision	.10
Contingency 5%	.09
Total	$1.88

OPERATING COSTS - CRUSHING & CONCENTRATING (Cont'd)

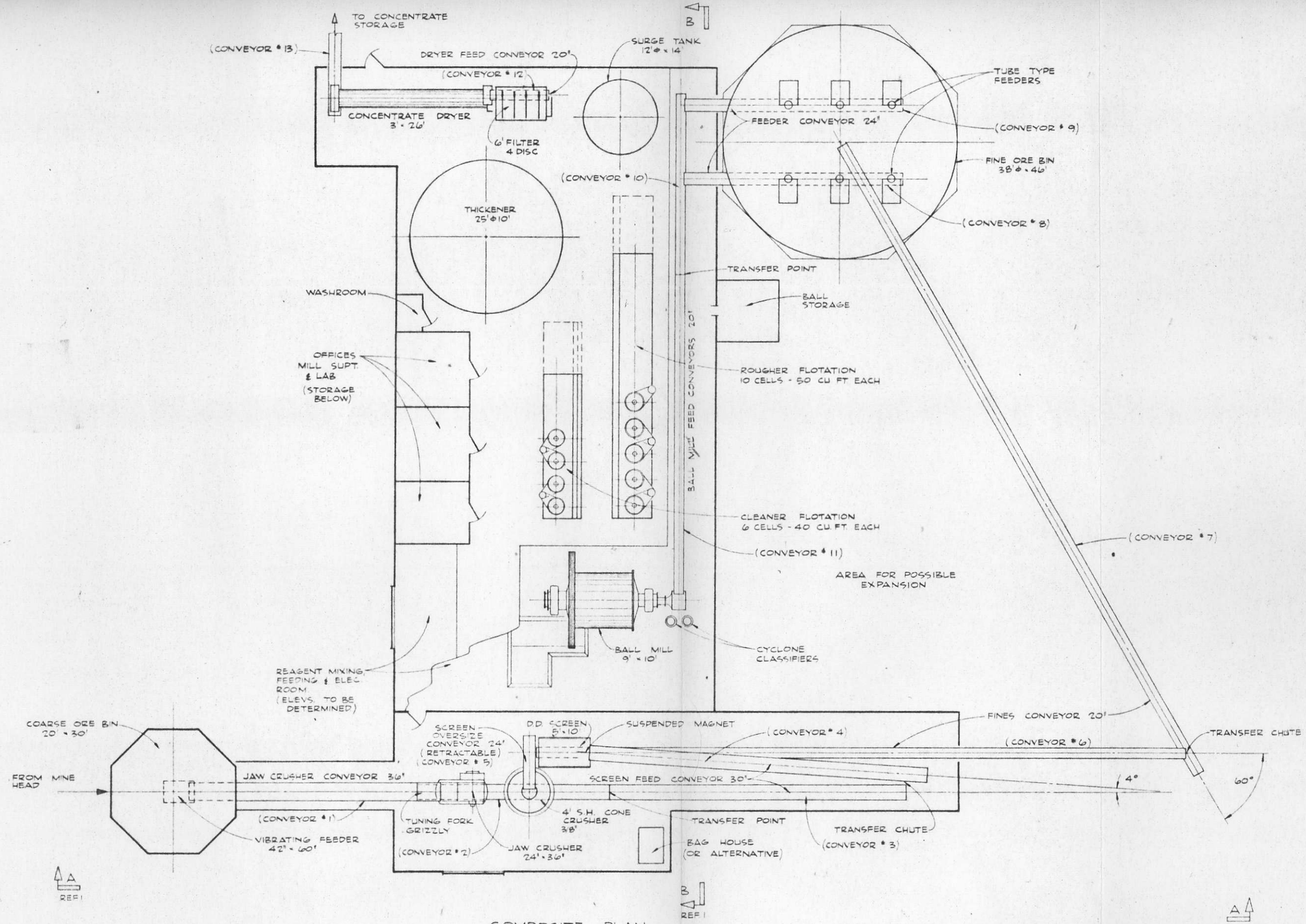
This will be distributed roughly as follows:

Labour & Supervision	$1.10
Power	.23
Supplies & Sundries	.55
Total	$1.88

Fringe benefits amounting to roughly 20% are added to the labour cost.

D.A. LIVINGSTONE, P. Eng.

DAL/



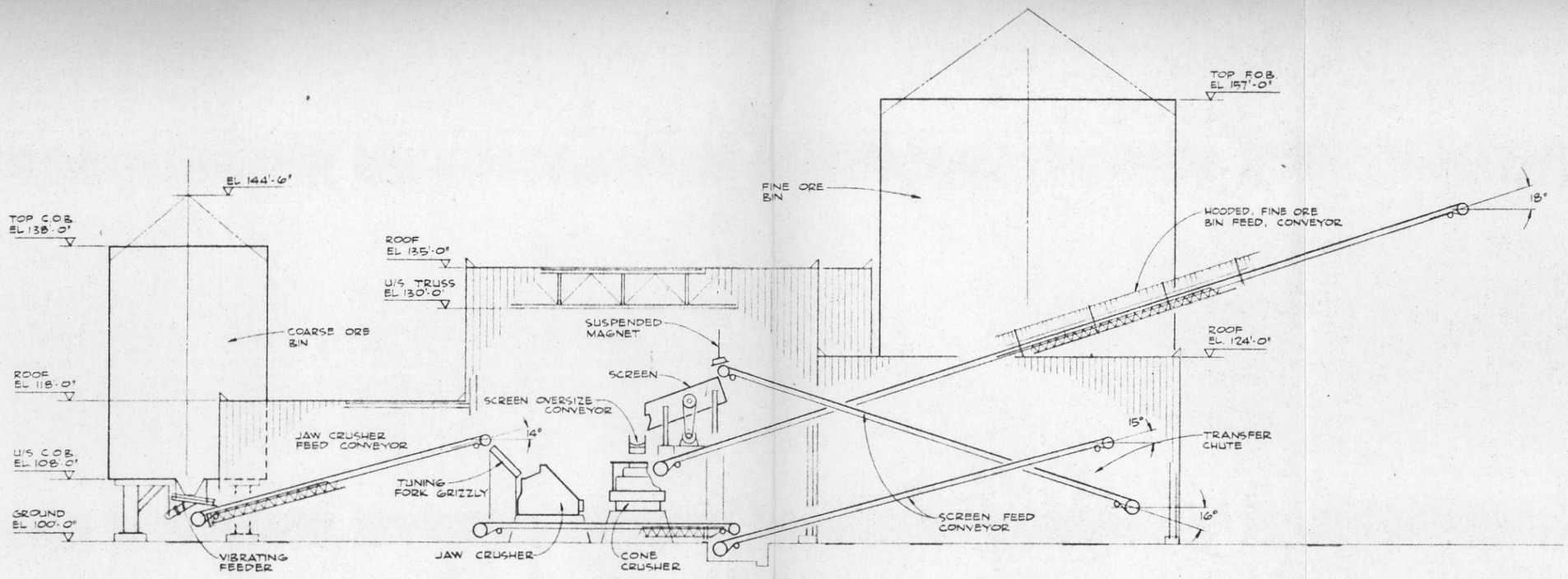
COMPOSITE PLAN

TO ACCOMPANY REPORT DATED OCT 22 1969

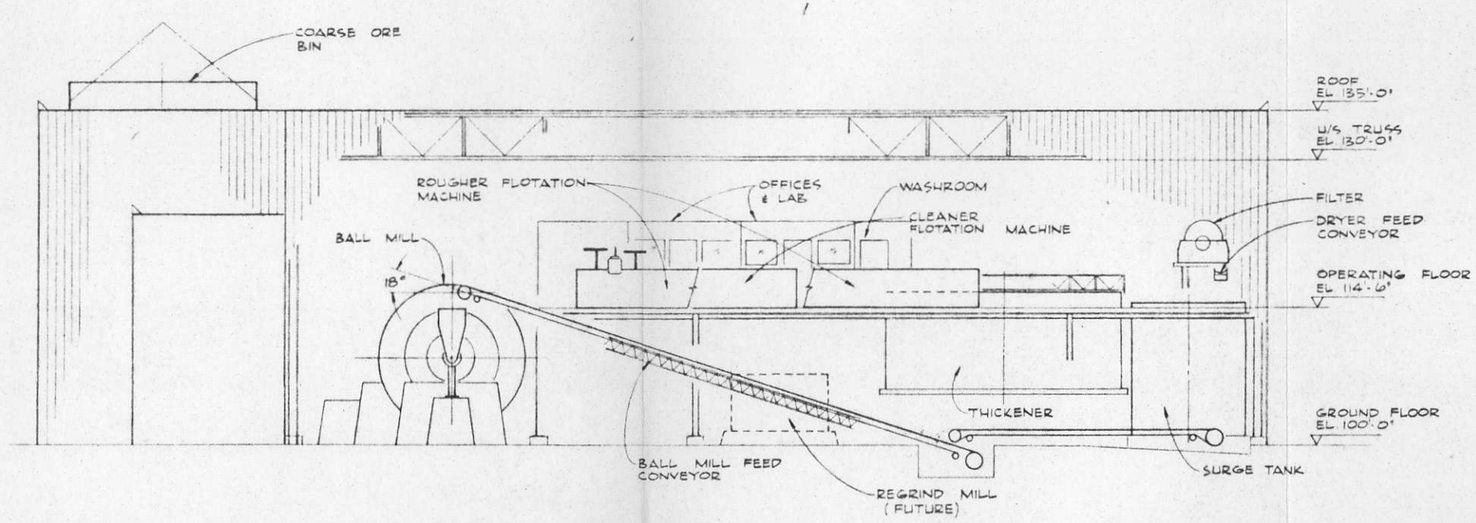
APPROVED	SCALE	1"=1'-0"		ALWIN MINING CO LTD	
DATE	DR'N.	B.M.		HIGHLAND VALLEY	
	CH'K'D			500 TON P/D CONCENTRATOR	
D 2463-2	APP'D			PRELIMINARY FEASIBILITY STUDY	
	APP'D			BACON & CROWHURST LTD. VANCOUVER B.C.	
SANDWELL				DWG. D 2463 - 2	REV

DRAWING SECTIONS A-A & B-B

PRELIMINARY ISSUE



'A-A'
REF 1



'B-B'
REF 1

TO ACCOMPANY REPORT DATED OCT 22 1969

SECTOR 3 COMPOSITE PLAN

DWG. No.	REFERENCE	REF No.	DWG. No.	REFERENCE	REF No.

REV.	BY	DATE	REVISION	APP'D.
			PRELIMINARY ISSUE	

APPROVED
DATE
D 2463-3

SCALE	1" = 1'-0"
DR'N.	B. M.
CH'K'D.	
APP'D.	
APP'D.	

ALWIN MINING CO LTD.
HIGHLAND VALLEY
500 TON P/D CONCENTRATOR
PRELIMINARY FEASIBILITY STUDY

SANDWELL

BACON & CROWHURST LTD.
VANCOUVER, B.C.

DWG. D 2463-3 REV

CRUSHING PLANT - 500 T.P.D:

CAPITAL COST ESTIMATE

	Cost		
	Equipment and Material	Construction & Installation	Total
Provision for conveyor & trestle from head frame bin to coarse ore bin - length 150' - @ $110/ft - plus trestle.	$ 19,500	$ 3,900	$ 23,400
Coarse Ore Bin	8,000	4,000	12,000
Vibrating Feeder	6,000	1,200	7,200
Conveyor #1-length 40' @ $100/ft plus supports	4,300	900	5,200
Tuning fork grizzly	5,000	1,000	6,000
Jaw crusher feed & grizzly chutes	2,000	1,000	3,000
Jaw crusher with motor & drive and foundations	42,000	13,000	55,000
Jaw crusher discharge chute	100	100	200
Conveyor #2 & #3 - total length -85' @ $80/ft plus supports	7,800	1,600	9,400
Transfer chute	500	500	1,000
Conveyor #4 - length 56' @ $80/ft plus supports	5,500	1,100	6,600
Magnet	3,000	-	3,000
Screen - 5' x 10' - double deck	13,000	3,200	16,200
Screen discharge chutes	2,000	1,000	3,000
Conveyor #5 - retractable - 10' long	1,500	300	1,800
Cone crusher with motor & drive	45,000	4,000	49,000
Cone crusher - foundations	1,000	3,000	4,000
Conveyor #6 & #7 - total length approx. 235' @ $70/ft	16,500	3,300	19,800

CRUSHING PLANT - 500 T.P.D.
CAPITAL COST ESTIMATES (Cont'd)

	Cost		
	Equipment and Material	Construction & Installation	Total
Conveyor #6 & #7 trestle & housing	$ 3,000	$ 2,000	$ 5,000
Fine Ore Bin	23,000	7,000	30,000
Baghouse & dust collection	5,000	3,000	8,000
5 Ton Crane	3,000	1,000	4,000
Electrical Control & Distribution	16,000	4,000	20,000
Building, incl. floor slab, platforms & stairs, heating & ventilation, fire protection & lighting	41,400	10,300	51,700
Freight on equipment	4,000	-	4,000
Sub total	278,100	70,400	348,500
Allowance for sales taxes - various items	7,900	-	7,900
Total	$ 286,000	$ 70,400	$ 356,400

CONCENTRATOR - 500 T.P.D.

CAPITAL COST ESTIMATE

	Equipment and Materials	Construction & Installation	Total
(6) 8" Tube Feeders	$ 3,000	$ 600	$ 3,600
Conveyors #8 & #9 - total length = 2 x 36' = 72' @ $70/ft plus supports & skirting	5,500	1,600	7,100
Conveyor #10 & #11 length 81' @ $70/ft plus supports & discharge chute	6,000	1,800	7,800
Ball mill - plus liners & ball charge	127,000	5,000	132,000
Ball mill foundations	2,000	10,000	12,000
Cyclone	1,500	200	1,700
Flotation blower	1,500	300	1,800
Flotation machines - (10 x 50 cu ft)	19,000	4,000	23,000
Flotation machines - (6 x 40 cu ft)	17,000	3,400	20,400
Flotation launders	5,000	4,000	9,000
Thickener - with electrics	14,000	4,000	18,000
Thickener foundations	4,000	2,000	6,000
Surge tank	1,500	200	1,700
Filter & accessory equipment	30,000	6,000	36,000
Dryer feed conveyor #12 - length = 10'	1,000	1,000	2,000
Concentrate dryer plus foundations & dust collection	35,000	5,000	40,000
5 ton crane	5,000	1,000	6,000
2 ton portable crane	1,500	-	1,500
Weightometers, reagent feeders & lines automatic sampler & other process control equipment	15,000	2,000	17,000

	Equipment and Materials	Construction & Installation	Total
Provision for lime storage tank & distribution	$ 2,000	$ 500	$ 2,500
Pumps & pump boxes - various- say 14 @ 1,000 each	14,000	2,800	16,800
Process piping, hoses & launders	20,000	10,000	30,000
Conveyor #13 to concentrate storage approx. length = 80' @ $70/ft plus trestle & housing	7,000	1,500	8,500
Concentrate storage bin & house	2,000	2,000	4,000
Electrical Control & distribution	37,600	9,400	47,000
Building, including floor slab, platforms, stairs, offices, heating & ventilation, plumbing, fire protection & lighting	124,200	31,200	155,400
Freight on equipment	7,000	-	7,000
Sub total	508,300	109,500	617,800
Allowance for sales taxes - various items	15,300	-	15,300
Total	$ 523,600	$ 109,500	$ 633,100

CHAPTER V
FRESH WATER SUPPLY

ESTIMATED REQUIREMENTS

	U.S. G.P.M. 500 TPD	750 TPD
Concentrator	129*	193
Mine	50	65
Camp, plant facilities and miscellaneous	21	22
Total	200	280

* As per D.A. Livingstone's calculations

RAINFALL AND RUNOFF DATA

Climatic studies for the area indicate an average annual precipitation of approximately 15 inches at the 5,200 to 5,500 ft. levels. Past stream flow measurements carried out indicate a runoff equivalent $\left(\frac{\text{Total runoff}}{\text{runoff Area}}\right)$ of 2 inches. Use of this equivalent to estimate runoff should provide fairly conservative results.

ALTERNATE SCHEMES

1. Use of Island Lake

This scheme assumes 200 U.S. GPM of water pumped from Island Lake into the Alwin water system with the balance provided from water reclaimed from the tailings disposal at Little O.K. Lake. Island Lake would be dammed at both ends under this scheme. The Island Lake drainage area would provide a minimum of 55 million gallons per year. The yearly demand based on 200 U.S. GPM is 105 million gallons which would apparently deplete Island Lake by 55 million U.S. gallons per year. The lake under the above circumstances would be dry in approximately 5 years.

This scheme provides the lowest estimated capital cost of the possibilities studied but there is a chance of depleting the reservoir while the mine is still in operation.

To accommodate the Indian Water Rights, utilization of this scheme will necessitate some compensation to owners of hayfields at the Thompson River. Preliminary discussions with the Indian Band indicate that adequate compensation in this regard would include the provision of an irrigation system for low level hayfields and irrigation piping for upper hayfields.

2. Use of Island Lake Plus Calling Lake

In this scheme, any deficiency relative to the Island Lake

supply would be provided by gravity flow through a 4 inch diameter pipeline from Calling Lake. The line would not be buried as the line flow capacity of 200 U.S. GPM would be used only during the frost free period.

Island Lake could be used to supply the required flow during the winter months and would be replenished during the spring runoff while Calling Lake would supply the demand during the frost free months.

The 4 inch line would have a screen and control valve at Calling Lake.

As in Scheme 1, compensation to owners of the hayfields would be made.

3. Pumping from Highland Valley

This scheme entails the drilling of two wells in the Divide Lake Valley area and providing two high head multiple stage pumps to pump the required fresh water demand of 200 U.S. GPM through a 6 inch diameter line to the mill site, a distance of approximately 3 miles against a head of approximately 1600 ft.

The flow would be continual and provision for burying pipe for prevention of freezing would be required.

Note - Preliminary discussions with various governmental officials indicate that Little O.K. Lake could be used in all the above schemes as a tailings disposal pond and source for recirculated water.

RECOMMENDATIONS

In view of the uncertainties concerning the accuracy of rainfall and other related estimates, in the immediate area, it is recommended that the use of Scheme #1 (i.e. Island Lake plus Little O.K. Lake and substitution of supply for the Indian requirements) offers an excellent chance of success.

1. If after the first year of operation, it is apparent that Island Lake is being depleted, it is recommended that Scheme 2 be executed by installing a line from Calling Lake. Alternatively, at this time it may be possible to obtain water from a large diameter pipeline presently being planned to supply water to other mining operations in the Highland Valley area.

2. Further hydrological studies be initiated.

3. The feasibility of well installations in the Highland Valley be investigated.

4. Further discussions should be initiated as soon as possible with the appropriate government agencies concerning the use of Little O.K. Lake as a tailings disposal pond.

STATISTICAL DATA FOR DRAINAGE AREAS

HYDROLOGICAL DATA

ITEM	UNIT	AMOUNT ISLAND LAKE	AMOUNT CALLING LAKE
Drainage area	Acre	1000	2100
Average estimated rain	In./Annum	15	15
Total estimated rain on drainage area	MUSG/Annum	410	790
*Estimated runoff equivalent	In.	2	2
Surface area of lake	Acre	80	90
Mill Requirement (fresh water)	200 U.S. GPM		
Mill Requirement	105 MUSG/Annum		

*Estimated Runoff Equivalent - $\frac{\text{Lake Discharge (cu ft)}}{\text{Drainage Area (sq ft)}} \times 12$
= 2 in.

CLIMATIC DATA

WEATHER STATION	20 YEAR AVERAGE	TOTAL PRECIPITATION (INCHES) 1966	1967
Ashcroft	7.55	9.77	6.50
Ashcroft Radio	9.44	9.32	6.37
Merritt	9.20 (6 yr. av.)	10.37	
Craigmont		9.41	
Highland Valley elev. 4800			14.53
Mine "X" elev. 5200			23.01

COSTS FOR ALTERNATE WATER SUPPLY SCHEMES

LOCATION	PUMP	PUMP INSTALL.	STRUC.	PIPE LINES	ELEC.	DAM	TOTAL
Little O.K.	$ 4,600	$500	$ 1,500	$ 1,700	$ 8,200	Tail-ings	$ 16,500
Island	6,000	500	1,500	39,000	24,000	$2,500	73,500
Calling			1,000	20,000	*3,000	1,000	25,000
Highland V (2 wells)	9,200	500	10,000	112,000 + 8,300			140,000
Hayfields							
Lower	9,000	500	15,000	6,000	*4,500		35,000
Upper	17,500	500	3,000	32,000	*2,000		55,000
Upper-irrigation pipe at site				5,000			

*MISC.

SCHEMES	CAPITAL COSTS	
1. Little O.K.	$ 16,500	
Island	73,500	
Lower Hayfield	35,000	
Upper Hayfield - irrigation pipe only	5,000	
TOTAL		$130,000
2. Scheme 1 as above	$130,000	
Calling Lake	25,000	
		$155,000
3. Highland Valley	$140,000	
Little O.K.	16,500	
		$156,500

CHAPTER VI

POWER

REQUIREMENTS AND AVAILABILITY

The mine development and exploration such as shaft sinking and whatever work can be completed from the present No. 2 Level should be started immediately after financing arrangements are completed. Most of the power related to the mine therefore will be required early. For this reason and for construction purposes, rental diesel electric sets will be required until delivery of power from the Hydro Authority can be effected; costs have been included in the estimates.

Power for the concentrator and the trailer camp will probably not be required until immediately prior to production.

A preliminary meeting with a representative from the B.C. Hydro Authority disclosed that an existing 60 KV line comes within 3-3½ miles of the proposed shaft location. It is anticipated that this voltage will be increased to 138 KV. Power therefore will be delivered to Alwin at 60 KV initially and 138 KV later.

Estimated Cost

Transformers, line and related installations	$217,000
Tap on B.C. Hydro line	35,000
Total	$252,000

The estimated installed h.p. is as shown in the table on the next page.

INSTALLED HP

(1) Crushing Plant & Concentrator

As per D.A. Livingstone, P. Eng., report

Crushing Plant	340	
Concentrator	670	
Total		1010

(2) Mine

Compressors - 4 units	1000	
Hoist	250	
Ventilation fan	100	
Battery chargers	50	
Pumps	60	
Shaft signals, lighting & shop	40	
Backfill plant & misc.	50	
		1550

(3) Surface Plant

Mechanical & electrical shops, office, warehouse, assay office, conveyor to coarse ore bin	50

(4) Camp & Change House		200
(5) Water Supply & Tailings		100
Total		3910

GENERAL

Because the mine is only four to five hours away from mechanical and electrical repair maintenance services in Vancouver, B.C., only minimum facilities are required at the mine.

Similarly, since the concentrator can be situated close to the head frame-shaft location, all the buildings and services can be concentrated in one area.

ESTIMATED CAPITAL COSTS

	Total
Hoist room & compressor house	$ 12,800
Machine & electrical & welding shop	75,800
Change house, general & engineering Offices & assay office	90,000
Warehouse - heated & cold	17,000
Access & plant roads and mobile equipment	95,000
Sewage disposal - plant & camp	22,000
Fire protection	60,000
Fuel oil storage	10,000
Central heating plant & steam distribution	56,100
Site clearing & excavation	45,000
	$483,7000

ESTIMATED OPERATING COST - PER MONTH

	Labour	Supplies	Other	Total
Supervision	3,000	200	100	3,300
Office	3,000	300	100	3,400
Cookhouse & single men's quarters	-	-	9,000 (loss)	9,000
Trailer camp	700	150	100	950
Medical & safety	-	100	100	200
Camp operation	2,250	2,250	-	4,500
Access & plant roads	800	600	-	1,400
Mechanical - electrical safety & fire protection	-	100	100	200
Insurance	-	-	800	800
Travelling	-	-	500	500
Telephone & telegraph			300	300
Taxes - school & property			1,200	1,200
Miscellaneous	700	150	500	1,350
TOTALS	10,450	3,850	12,800	$27,100

Cost per ton milled = $\frac{27,100}{14,583}$ = $1.858

CAMP BUILDINGS & HOUSING

In view of the current activity in the mining industry in the Highland Valley area in British Columbia, it would appear that there is a strong possibility that a small to medium size new town (or an addition to one of the surrounding ones) will be undertaken during the next few years in the immediate vicinity.

Alwin's needs, however, will very likely have to be satisfied before such a development takes place, and since present nearby facilities are inadequate, it is suggested that temporary housing must be provided in the interim, in order to secure the necessary personnel for a successful operation.

Construction would be of such a nature that the units could be moved or re-sold in the event that participation in a larger centre of population appears desirable.

The estimated cost of the temporary camp and housing is as follows:

		Employee Accommodation	Cost
a.	Senior staff residences (Ashcroft ?)	6	$ 96,000
b.	Single man quarter - at mine	74	82,000
c.	Trailer camp	30	
	Clearing 5,000		
	Roads 10,000		
	Services - power & sewage 15,000		30,000
d.	Present Camp Addition and alterations to cookhouse Use present trailers for visitors & construction in crew in addition to (b) above	-	15,000
	Total	110	$ 223,000

Note: - It is assumed that other 10 employees required make their own housing arrangements.

CHAPTER VIII

ESTIMATES re 750 TON PER DAY OPERATION

(A) MINING

GENERAL

The shaft, stations and levels will be as in the 500 TPD analysis, except that a greater amount of development on the lower levels will be required prior to production.

SELECTION OF STOPING BLOCKS

	Percentage of Total	After Mining Dilution Allowance Tons	Grade % Cu	Tons x Grade
Wide blocks above & below 2 level	63.88	402,652	2.366	952,483
Narrow blocks above 2 level	36.12	227,703	2,250	512,363
	100.00	630,355	2,324	1,464,846
Narrow blocks - between #3 & # 2 level		114,070	1,643	187,467
		744,425	2,220	1,652,313

TONS & GRADE OF COPPER MINED BY YEARS (after mining dilution)

Years	Tons Mined	Grade - % Cu	Tons x Grade
1	262,500	2.530	664,125
2	262,500	2.177	571.462
3	262,500	1.883	494,288
4	262,500	1.883	494,288
5	262,500	1.883	494,288
6	262,500	1.883	494,288
Total	1,575,000	2.040	3,212,739

ESTIMATED STOPE PRODUCTION

Tons of ore = $\frac{2,625,000}{12}$ = 21,875 per month

Tons of ore from stope development & exploration = 2,000 per month

Stope production = 21,875-2,000 = 19,875 per month

or $\frac{19,875}{20.8}$ = 956

Tons of ore total produced per working day = $\frac{21,875}{20.8}$ = 1052

Concentrator Feed

	Cut & Fill Stopes	Shrinkage Stopes	Development & Exploration	Total
Monthly	12,700	7,175	2,000	21,875
Daily	717	239	96	1,052
Stopes - total	11	11		
in use	9	8		
Production/day/stope	80	30		
Production/shift/stope	40	15		

ESTIMATED CAPITAL COSTS

A. Compressors

5 machines each 1200 cfm free air-installed $180,000

B. Underground

1. Raise climber, etc., - rented -

2. Mucking machines
   Exploration & Development 1
   Stopes 3
   4 @ $6,000 ea. 24,000

3.	Rock drills			
	Cut & fill stopes	10		
	Shrinkage stopes	18		
	Development & exploration	9		
	Spares	7		
		44	@ $1,600 average ea.	70,400
4.	Compressed air autoloaders	4	@ $12,000 average ea.	48,000
5.	Locomotives			45,000
6.	Mine cars - 30 @ $800 ea.			24,000
7.	Ventilation fans			
	Surface - 1 @ $5,000	$5,000		
	U/G 3 @ $3,000	9,000		14,000
8.	Tugger hoists - 22 @ $2,000 ea.			44,000
9.	Air slushers - 12 @ $3,500 ea.			42,000
10.	Scrapers - 12 @ $800 ea.			9,600
11.	Shaft pumps			5,000
12.	Small tools & miscellaneous			12,000
				518,000

C. SHAFT

As before 154,000

D. ELECTRIC POWER DISTRIBUTION

As before	$37,000	
Plus extras	3,000	40,000
		$712,000

SUMMARY - MANPOWER

Mine

Underground	77
Surface	4
Staff - incl. engineering	8
Sub Total	89

Crushing Plant & Concentrator

Crusher	2
Mill operators - (2 swing men)	8
Repair crew	2
Assay office	2
Labourer	1
Superintendent	1
	16

Surface

Foreman	1
Mechanical - electrical	2
Carpenter	1
Concentrate loading & general	2
Mobile equipment	2
Labourers	2
	10

Staff

Manager	1
Accounting & bookkeeping	4
Total	120

MINE BACKFILL & TAILINGS DISPOSAL

Capital cost as before $ 37,500

ESTIMATED MANPOWER & LABOUR COST

A. First Three Years

	No.	Average Cost Per Month, Including 20% Fringe Benefits		Total Cost Per Month
1. Underground Crew				
Machine Men				
Cut & fill stopes	18			
Shrinkage	24			
Development & exploration	8			
Total	50	780	$39,000	
Slushermen	18	745	13,410	
Timber & fill	9	780	7,020	
Tramming & drawpoint loading	10	715	7,150	
Pipe fitting & track	4	715	2,860	
General underground	8	680	5,440	
Hoistmen & skiptenders	6	745	4,470	
Samplers	3	715	2,150	
Dry & lamps	2	680	1,360	
	110			82,860
2. Surface Crew				
Blacksmith welder	1	780	780	
Rock drill & repair & bits	1	745	745	
Mechanic etc.	2	780	1,560	
Helper	2	715	1,430	
	6			4,515
3. Underground Staff				
As before	8			$ 7,400
Totals	124			94,775
Total Supplies & other costs				44,305
Total estimated mining operating cost - per month				139,080

or 139,080 = $6.358
21,875

B. Second Three Years

Additional 12 men required
Mining cost increases to $6.956/ton milled

METALLURGY CRUSHING PLANT & CONCENTRATOR

A. Estimated Operating Cost	Cost Per Ton Milled
Labour & supervision	$0.770
Power	0.230
Supplies & sundries	0.550
Total	$1.550

ESTIMATED CAPITAL COST - CRUSHING PLANT

Add the following increases in cost to the 500 T.P.D. estimate for the items noted:

	Estimated Increase in Cost
Vibrating feeder	$ 1,500
Conveyor #1	1,000
Tuning fork grizzly	1,000
Jaw crusher	10,000
Conveyors #2 and 3	2,000
Conveyor #4	1,300
Screen	5,000
Cone crusher	16,000
Conveyor #6 and #7	5,600
Fine ore bin	10,000
Electrical control and distribution	7,000
Building	18,000
Freight	1,000
Miscellaneous	10,000
Sub-total	89,400
Allowances for sales taxes	3,000
Total	92,400
Cost as per 500 T.P.D. estimate	356,400
Total estimated cost	$ 448,800

ESTIMATED CAPITAL COST - CONCENTRATOR

	Estimated Increase in Cost
Tube Feeders	$ 1,400
Conveyors # 8 and 9	1,800
Conveyors # 10 and 11	2,000
Ball mill	33,000
Ball mill foundations	3,000
Cyclone and blower	500
Flotation machines - (50 cu ft)	11,500
Flotation machines - (40 cu ft)	10,200
Thickener	6,000
Foundations	2,000
Filter and accessories	15,000
Conveyor #12	500
Concentrate dryer	15,000
Weightometers and process control	4,000
Pump boxes	5,000
Process piping	9,000
Conveyor #13	2,000
Concentrate storage bin	1,500
Electrical control and distribution	23,500
Building	31,000
Freight	3,000
Sub-total	180,900
Allowance for sales tax	7,600
Total	$188,500
Cost as per 500 T.P.D. estimate	633,100
Total estimated cost	$821,600

FRESH WATER SUPPLY

Scheme (2)		Estimated Cost
Little O.K		$ 16,500
Island Lake		73,500
Lower hayfield		35,000
Upper hayfield - pipe		5,000
Calling Lake		25,000
	Total	$155,000

PLANT SERVICES, ADMINISTRATION AND MANPOWER

(A) Estimated Capital Costs

		Estimated Increase in Cost
Compressor house		$ 2,000
Change house		20,000
Warehouse		5,000
Fire protection		10,000
Fuel oil storage		3,000
Central heating plant etc.		15,000
Site clearing and excavation		15,000
	Total	$ 70,000
Cost as per 500 TPD estimate		483,700
	Total	$ 553,700

(B) Estimated Operating Cost - Per Month

Supervision	3,300
Office	4,200
Cookhouse etc.	12,000
Trailer camp	1,300
Medical and safety	300
Camp operation	6,000
Access and plant roads	2,000
Mechanical - electrical	300
Insurance	1,100
Travelling	500
Telephone and telegraph	300
Taxes - school and property	1,800
Miscellaneous	2,000
	$ 35,100

$$\text{Cost per ton milled} = \frac{35,100}{21,875} = \$1.605$$

ESTIMATED COST - TEMPORARY CAMP AND HOUSING

		Employee Accommodation	Cost
(a)	Senior staff -	7	$ 112,000
(b)	Single men's quarters at mine	103	114,000
(c)	Trailer camp	40	40,000
(d)	Present camp	-	15,000
	Totals	150	$ 281,000

SUMMARY - MANPOWER

Mine

Underground -		110
Surface		6
Staff		8
	Sub-total	124

Crushing Plant and Concentrator

As before		16

Surface

Foreman		1
Mechanical electrical		3
Carpenter		1
Concentrate loading		3
Mobile equipment		3
Labourers		3
	Sub-total	14

Staff

Manager		1
Accounting and bookkeeping		5
	Sub-total	6
	TOTAL	160

ESTIMATED OPERATING COST PER TON OF ORE MILLED

(262,500 Tons/Year)

	FIRST 3 YEARS		SECOND THREE YEARS	
	Amt/year	Cost/ton milled	Amt/year	Cost/ton milled
Mining	$1,668,975	6.358	1,825,950	6.956
Milling	406,875	1.550	406,875	1.550
Plant Services & Mine Administration	421,312	1.605	421,312	1.605
Vancouver Head Office	54,000	0.206	54,000	0.206
	$2,551,162	9.719	$2,708,137	10.317

ESTIMATED TONS OF CONCENTRATES PRODUCED

Year	Tons	Assay % Cu	Tons of Copper	000's lbs Copper	000's lbs Cu recovered @ 94%	Dry Tons @ 32% Cu.
1	262,500	2.53	6,641.2	13,282	12,485	19,508
2	262,500	2.177	5,714.6	11,429	10,743	16,786
3	262,500	1.883	4,942.9	9,886	9,293	14,520
4	262,500	1.883	4,942.9	9,886	9,293	14,520
5	262,500	1.883	4,942.9	9,886	9,293	14,520
6	262,500	1.883	4,942.9	9,886	9,293	14,520
Totals	1,575,000	2.040	32,127.4	64,255	60,400	94,374

SUMMARY - ESTIMATED CAPITAL COST 750 TONS PER DAY

(1)	Mine		
	(a) Equipment	$ 712,000	
	(b) Preproduction development & stoping	1,263,700	
	Total - Mine		$1,975,700
(2)	Crushing Plant		448,800
(3)	Concentrator		821,600
(4)	Mine backfill & tailings disposal		37,500
(5)	Plant Services		553,700
(6)	Water Supply		155,000
(7)	Power		252,000
(8)	Camp buildings & housing		281,000
* (9)	Mine administration - 12 months @ $35,100		421,200
(1)	Vancouver Head Office - 12 months @ $4,500/month		54,000
	Sub-total		5,000,500
	Contingencies @ 10%		500,100
			5,500,600
	Engineering @ 5% on Items 1(b), Items 2-7 inclusive, part of Item 8 (114,000) - i.e. 5% x 3,646,300		182,300
			5,682,900
	Inventory of supplies		90,000
			5,772,900
	Working capital - 3 months operating costs or 3 x 21,875 x 9.719 per ton		637,800
	Total		$6,410,700

* If all negotiations and arrangements can be concluded at an early date, the design, mine development and plant construction can be completed in about 10 months.

750 T.P.D. ESTIMATED OPERATING PROFIT - CAN. FUNDS

PRICE OF COPPER - 50¢ U.S.

Year	(1)	(2)	(3)	(4)	(5)	(6)	Total
Tons milled - 000's	262.5	262.5	262.5	262.5	262.5	262.5	1,575
Tons concentrates	19,508	16,786	14,520	14,520	14,520	14,520	94,374
Net smelter returns 000's $ Can. @ $293.18/ton of concentrates	5,719	4,921	4,257	4,257	4,257	4,257	27,668
N.S.R. per ton of ore milled	21.787	18.747	16.217	16.217	16.217	16.217	17.567
Operating Cost per ton of ore milled	9.719	9.719	9.719	10.317	10.317	10.317	10.017
Operating Profit per ton of ore milled	12.068	9.028	6.498	5.900	5.900	5.900	7.550
Operating Profit - 000's $ Can.	3,168	2,370	1,706	1,549	1,549	1,549	11,891

ESTIMATED OPERATING PROFIT - CAN. FUNDS

PRICE OF COPPER - 55¢ U.S.

Year	(1)	(2)	(3)	(4)	(5)	(6)	Total
Tons milled - 000's	262.5	262.5	262.5	262.5	262.5	262.5	1,575
Tons concentrates	19,508	16,786	14,520	14,520	14,520	14,520	94,374
Net smelter returns 000's $ Can. @ $327.64/ton of concentrates	6,392	5,500	4,757	4,757	4,757	4,757	30,920
N.S.R. per ton of ore milled	24.350	20.952	18.122	18.122	18.122	18.122	19.632
Operating cost per ton of ore milled	9.719	9.719	9.719	10.317	10.317	10.317	10.017
Operating profit per ton of ore milled	14.631	11.233	8.403	7.805	7.805	7.805	9.615
Operating profit - 000's $ Can.	3,841	2,949	2,206	2,049	2,049	2,049	15,143

ESTIMATED OPERATING PROFIT - CAN. FUNDS

PRICE OF COPPER - 60¢ U.S.

Year	(1)	(2)	(3)	(4)	(5)	(6)	Total
Tons milled - 000's	262.5	262.5	262.5	262.5	262.5	262.5	1,575
Tons concentrates	19,508	16,786	14,520	14,520	14,520	14,520	94,374
Net smelter returns 000's $ Can. @ 362.11/ton of concentrates	7,064	6,078	5,258	5,258	5,258	5,258	34,174
N.S.R. per ton of ore milled	26.910	23.154	20.030	20.030	20.030	20.030	21.698
Operating Cost per ton of ore milled	9.719	9.719	9.179	10.317	10.317	10.317	10.017
Operating Profit per ton of ore milled	17.191	13.435	10.311	9.713	9.713	9.713	11.681
Operating Profit - 000's $ Can.	4,513	3,527	2,707	2,550	2,550	2,550	18.397