825698

DOLLY VARDEN MINES LTD

SKEENA MINING DIVISION, BRITISH COLUMBIA

FEASIBILITY STUDY

June 23rd, 1969

CONTENTS

apparently been intersected (1300 and 1500, No. 2 vein, and 1450, No. 1 vein). Dr. Skerl suggests movement is probably rotational, thus explaining differing attitudes of the segments.

The main vein-shear zone indicates several and probably many periods of replacement and deposition. Banding and colloform structures are common. Secondary mineralization assemblages do not necessarily resemble those a few feet away. Sulphide content varies and apparently any silicified zone may run silver values but appearance is not always a good guide. Generally speaking there is a central shear zone, usually quite apparent, that carries quartz-carbonate, pyrite, marcasite, barite, argentiferous galena, sphalerite, pyrargyrite, and native silver in order of decreasing abundance. Smaller shears and tension gashes carrying mineralization decrease in number with distance from the main zone and the assay-wall so-formed is really a matter of statistical probability of hitting these random "pockets". What frequently appears to be good slickensides, shear cutoff, on the northwest walls can frequently detract attention from values beyond.

Latter stage low-angle faults aggravate the projected mining system slightly (eg. somewhere between the 1300 and 1500 No. 2 Adits, and at the 1500 No. 2 Adit) and minor offsets of as much as 15 feet may be more prevalent than imagined.

VI

ORE RESERVES

The reserve total has been derived by differing methods for different zones, and blocks. The data comes from many sources, from differing types of development, and the data processing therefore takes several forms. The Wolf reserves have had the most effort spent on them, both in the field and in the office; and the North Star reserves are also the result of personal work. Those listed reserves of the Torbrit and Dolly Varden have been taken from other sources.

WOLF RESERVES

Refer to Drawing No's 1380, 1389, 1391, 1049, 1395, 1396, 1383 and 1384

The Wolf veins No. 1 and 2 have been the subject of a recent development program. Three underground openings totalling approximately 900 feet on the vein structure, plus approximately 12,500 feet of percussion drilling, plus 21 old diamond drill hole intersections were used to delineate the present reserves. Percussion hole and channel sample data will be found in the folder.

Check assaying and check sampling have been carefully analyzed and appear in an appendix following this section, "WOLF ADDENDUM".

Wolf No. 2 reserves have been calculated by designing stope wall positions contingent upon geology, assay walls, and mining plan limitations (Drawings 1395 and 1396), then extrapolating average grades from ring-drilling sections (Drawing 1391). Some blocks are designed in more conventional fashion where continuity was not as clearly defined.

"Planned dilution" is automatically included in stope designs, but ore blocks defined by diamond drill holes have had a factor of 2.5 ft (true thickness) at 1.61 oz Ag/T added to their totals. "Overbreak" dilution has been estimated at 5% at 1.38 oz Ag/T and is applied to all Wolf reserves.

Ring drilling zones have been designated PROVEN, some conventional blocks on diamond drill intersections as PROBABLE, and extensions to 50 feet (or beyond if continuity is reasonably certain) as POSSIBLE. Vein zones, outside of these bounds are given GEOLOGICALLY INFERRED.

A large zone around the 800 foot elevation of the No. 2 vein (around DDH WS #83) was given a GEOLOGICALLY INFERRED tonnage potential of 275,000 tons.

Lead and zinc concentrations as used in cash flows have been derived from the pilot plant concentrate sample. What assays exist on the Wolf veins indicate grades around .5% Pb and .2% Zn.

NORTH STAR RESERVES

Refer to Drawing No's. 1050, 1052, 1054, 1058, 1056, 1057, 1053, 1055.

The data source was chiefly Newmont Mining Corporation of Canada Ltd.'s various plans and sections, plus some drill hole logs where available.

The average interval between drill hole intersections is approximately 50 feet, allowing relatively good definition of reserves. Using the Wolf reserves as precedent, the three North Star segments are not as well drilled as the Wolf 1200 level block, they are somewhat better defined than the large "Probable" mass, and are part of a vein system that appears less continuous. Therefore the PROBABLE category is applied. Reserves are totalled (see exhibits) by a more conventional method of zone of influence and expansion to adjacent section, and a 25-foot peripheral expansion. A grade cutoff of 2.82 ounces of silver per ton was used.

GEOLOGICALLY INFERRED reserves are variable according to position but generally apply to a further 50-foot extension on the periphery.

Lead and zinc concentrations taken from Newmont assaying give an overall average of 0.74 and 2.7 percent respectively. Concentrations derived prior to reserve calculations and used for metallurgical review were 0.70 and 2.6 percent respectively.

TORBRIT RESERVES

The data source was in old Torbrit Silver Mines Ltd. plans and sections, and a composite and reserve sheet by A. C. Skerl, Ph. D.

Dr. Skerl, in his April 12, 1968, Dolly Varden Mines Ltd. Summary Report, outlined four blocks as being reasonably assured and accessible. His tonnage and grade are based upon smooth outlining of an apparently undisturbed zone and combining drill hole averages. The data and drawings of necessary areas are possibly less current than in previously discussed zones. The structural character is more complex than other visited zones. Thus, Dr. Skerl's totals were checked and are presented as POSSIBLE reserves.

Lead and zinc concentrations are extrapolated from an old mill head production figure to be 0.17 and 0.22 percent respectively.

DOLLY VARDEN RESERVES

Reserves given by Dr. Skerl are based upon some historical estimates by the former Dolly Varden Mines Ltd. and subsequently by Hill, Starck and Associates, using additional evidence from three surface diamond drill holes.

The figures given could not be checked and the workings appeared inaccessible at time of visit, thus the reserves are put in a POSSIBLE category.

Lead and zinc values were not assumed.*

* Lead and zinc composite assays for the North Star vein samples were lower than expected, and mill head grades for combined material from the North Star, Torbrit and Dolly Varden of 0.4% Pb and 1.0% Zn were selected from predetermined ranges of 0.3 to 0.7 percent Pb and 1.0 to 2.0 percent Zn.

RESERVES (Tonnages not rounded-off)

	Proven		Probable		Possible		Geologically Inferred
	Tons	oz Ag/T	Tons	oz Ag/T	Tons	oz Ag/T	Tons
WOLF (Dilution 5% with 1.38 oz Ag/T)							
#1 Vein	66,680	13.67	27,130	8.24	16,365	16.26	22,000
#2 Vein	207,580	8.14	74,035	13.36	80,300	13.03	275,000
#3 Vein			72,975	6.45			115,000
NORTH STAR (Dilution 10% with 1.5 oz Ag/T)							
Segment 1			228,700	8.0			36,000
Segment 2			18,100	5.4			18,000
Segment 3			5,500	6.0			10,000
TORBRIT (Dilution unknown)					367,000	7.6	
DOLLY VARDEN (Dilution unknown)					50,000	20.0	

VII

MINING PLAN

OVERALL DEVELOPMENT & MINING SCHEDULE

1. Preproduction development prepares Wolf Veins 1 & 2 for mining.

2. Reserves above 1200 level to be mined first and development of remaining Wolf reserves, geologically inferred potential, and other little known vein segments to proceed concurrently.

3. While the remaining Wolf reserves are being mined, the vertical extensions of the North Star vein, plus the Dolly Varden vein should be explored and developed. (The Dolly Varden appears to have good potential on little evidence, particularly between the 800 and 1000 level, and the west extensions).

4. Modify the mill and phase in the Composite Ores as the Wolf is exhausted.

5. Investigate the Torbrit potential and Moose claims. (There are some scattered values along trends that suggest a fold structure on the Moose).

Exploration and development assaying should take into account the probable saleability of lead, zinc, cadmium and possible disposal of barite.

WOLF MINING PLAN

Refer to drawings 1388 and 1390.

The system proposed by G. Aaltonen and accepted in principle is to mine the continuous portions of the veins with long-hole open stoping. This method is relatively low cost, and can produce at a high rate. Shrinkage stoping may be necessary, in local areas. It is assumed that no stope filling or pillar loss will be required, and that all development except main haulage drifts will be in ore.

A nominal mill feed rate @ 700 tons per day, 350 days per year = 245,000 tons/year was selected. A mining rate of 1000 tons/day, 5 days/week, with 2% loss time is equivalent.

Working sub-levels will either be accessible from surface or in two cases, by raises. Although the proposed development sections indicate vertical retreating panels throughout, there will be some small fault block displacements that may require shrinkage stoping. Surface breakthrough should be withheld until such time as the dilution and water surge can be controlled. A high degree of grade control will be necessary. Slashing development drifts to full ore width will minimize this problem, but 2 holes in each panel that are driven to positively locate the assay wall will be required. It should not be necessary to selectively blast any drill hole toes or collars.

Broken muck will be picked up at draw points with LHD equipment, and taken to the underground coarse ore bin which is designed to hold at least ½ shift of ore. Winter conditions, road icing, and ore hangup, should be no problem to this point with all operations underground.

NORTH STAR, DOLLY VARDEN, TORBRIT MINING

No rigid mining plan has been projected for these deposits.

Variations of open stoping: sublevel stoping or blast-hole stoping might be utilized on portions of the North Star and Dolly Varden veins.

Shrinkage stoping could be used for most of these deposits and assuming this plus some open stoping an additional $1.00/ton was added to the overall mining cost.

Careful integration of activities will be necessary to maintain a 1000 ton/day operating rate at the projected costs.

SUMMARY OF ESTIMATED MINING COSTS

WOLF	Cost/ton
Stoping	$0.78
Tramming	0.46
General Labour	0.21
Development & Exploration	.89
Diamond Drilling	0.14
Mine Supervision	0.24
Total	$2.72

COMPOSITE	
Stoping	1.78
Tramming	.46
General Labour	.21
Development	.89
Diamond Drilling	.14
Mine Supervision	.24
Total	$3.72

VIII

METALLURGY

SUMMARY

Metallurgical characteristics of the several ore types in the Dolly Varden Mine area vary to some extent for any particular deposit.

In simplest terms there are 2 types of ores to be treated:

WOLF DEPOSIT

Silver minerals pyrargyrite, tetrahedrite, and native silver associated with pyrite and minor amounts of lead and zinc, in a gangue of quartz-barite-jasper-pyrite-carbonate.

COMPOSITE ORES

Dolly Varden, North Star, and Torbrit deposits.

In the Torbrit ores silver minerals are associated with pyrite and significant, though low, amounts of lead and zinc in a gangue of quartz, barite and carbonates.

Silver bearing minerals in order of abundance are native silver, pyrargyrite and related sulphantimonites, and argentiferous galena.

Sulphides, again in order of abundance, are pyrite, sphalerite and galena, chalcopyrite and marcasite.

In the operation of the Torbrit deposit by Torbrit Silver Mines Ltd. during the period 1949-59 concentration practice ultimately incorporated flotation of a high grade concentrate containing the silver minerals resistant to cyanidation, plus galena; followed by cyanidation of de-slimed flotation tailings to recover a silver-zinc precipitate which was refined to produce base bullion. Total silver recovery was on the order of 87%, being distributed approximately 71% from flotation and 16% from cyanidation.

In preliminary bench scale metallurgical testing conducted in 1968 by Britton Research Limited of Vancouver a method of treating Wolf ores was developed in which a total silver recovery of 86% was predicted. This method assumed flotation of separate silver-lead and pyrite-silver concentrates; followed by cyanidation of cleaned silver-lead concentrate and pyrite concentrate, smelting and refining of precipated silver to base bullion, and shipment of silver-lead residue to a smelter. This method admittedly would have entailed significant additions to capital costs for the cyanidation and refinery sections.

Early in 1969 Dolly Varden management retained a metallurgist, R.C. Smith, to implement further test work; and also requested Britton Research to continue with certain investigations.

Smith conducted a series of bench scale tests on grinding, flotation, and filtration - settling characteristics of a composite sample taken from 3 cross-cuts on the Wolf 1200 level. These tests were run in February and March at Texada Mines Laboratory.

Following completion of the bench tests, arrangements were made for pilot plant scale testing at the Mineral Processing Division, Department of Energy, Mines and Resources in Ottawa. All work was done by Department staff, with Mr. Smith in attendance as Dolly Varden representative.

While these tests were designed initially to confirm the bench results on a continuous basis, significantly they have demonstrated that on the Wolf ore sample, which is believed to be representative, an acceptable recovery of silver can be obtained by flotation alone without additional processing by cyanidation. This break-through is a very important one in that it should greatly simplify the operation, at least on the Wolf ores, by eliminating the cyanide section; and, if only a silver-lead flotation concentrate is marketed, it will also eliminate need for a refinery.

The proposed operating plan assumes that during the initial 2 to 3 years the source of milling ore will be almost entirely from the Wolf mine. Converstion to treatment of mixed ores from the Dolly Varden, North Star and Torbrit deposits will be co-ordinated with exhaustion of the Wolf deposit and availability of reserves developed on the other properties.

The present concept of mill design, which is being implemented by Interior Engineering Services Ltd., is based on crushing, grinding and flotation of a silver-lead concentrate, with no provision for a zinc circuit or other ancillary facilities which may be required for treatment of mixed ores.

Flow sheet for Wolf ore milling appears in Section IX, Milling Plant.

There has been no further study done on the composite ores since our May, 1968 report. For that report, we had asked Mr. John Britton, Britton Research Laboratories, to predict the most probable recoveries and concentrate compositions for the two ores. Mr. Britton had once tested a sample of the North Star ore, and this coupled with a historical study led to the figures which we will also use in this report for the Composite ores. Separate lead and zinc concentrates are projected.

METALLURGICAL TEST RESULTS

A. PILOT PLANT TESTS

The following review is taken from text of report submitted by R. C. Smith, Mill Superintendent, Dolly Varden Mines Ltd:

Summary

The pilot plant runs which have been completed show that ore represented by the bulk sample can be concentrated by a crushing, grinding, and flotation process.

The test results indicate that the above process would produce a 400 oz./ton silver-lead concentrate at an 85 per cent recovery. Test work is continuing to confirm the forecast recovery and establish whether an additional regrind circuit to recover silver values from a pyrite concentrate is economically feasible.

Introduction

The purpose of the test work, done by the staff of the Mineral Processing Division, Department of Energy, Mines and Resources, was to investigate on a pilot plant scale the concentration of ore from the Dolly Varden Mines Ltd. Wolf deposit; to establish that the batch test results reported by Mr. John Britton of Britton Research could be duplicated on a continuous basis; and in addition, to produce sufficient concentrate for smelter samples.

The Department of Mines, Mineral Processing Division, through its technical staff, has kept detailed notes of this investigation and it intends to produce a full report of the pilot plant tests.

Origin of Ore

Representative ore samples were obtained from the Wolf deposit in accordance with instructions from G. Aaltonen. The complete bulk sample, amounting to some 19.7 tons was crushed to minus $\frac{1}{2}$ inch and sampled. After crushing, the bulk sample was thoroughly mixed using a front-end loader and stored for the pilot plant runs. Before crushing, several specimens were taken for mineralogical work but with the exception of these nothing was taken from or added to the sample shipment.

Test Procedure

For each pilot plant run sufficient ore was taken from the minus $\frac{1}{2}$ inch material and further reduced to minus $\frac{1}{4}$ inch. During the test runs a sample of this minus $\frac{1}{4}$ inch material was cut from the mill feed belt and assayed as a daily head sample. The assays of three of these head samples and that of the original bulk sample are as follows:

Test 3	12.84 oz/ton
Test 4	12.10 oz/ton
Test 5	12.82 oz/ton
Bulk Sample	11.78 oz/ton

There was some considerable variation between the belt sample assay and the calculated head assay on each of the pilot plant runs. These discrepancies were discussed with several members of the Department's staff and the final consensus was that for this type of ore the calculated assay should be used for calculating the metallurgical balance in each pilot plant run.

The results of the first five pilot plant runs are shown on the following pages. All silver values reported there are determined by fire assay.

The initial flowsheet used in these tests was based on that described by Mr. Britton in a report dated March 18, 1969. And, with minor changes, this flowsheet is used in each of the tests described on these pages. Test One used the reagent combination recommended by Mr. Britton, lime in the Ag - Pb circuit and sulphuric acid to lower the pH in the pyrite circuit. It was found that large amounts of acid were required to adjust the pH to the desired level - for this reason soda ash was used in place of lime in subsequent tests.

In the pilot plant work a unit cell was used for silver-lead flotation of the Ball Mill discharge. This machine, depending on its adjustment, can recover a high grade - up to 590 ounces silver or a high proportion of the silver-lead concentrate at a lower grade. After the first two runs the unit cell concentrate was sent to the cleaner circuit and combined with the final concentrate.

RECEIVED APR 30 1969

April 30, 1969.

NOTES ON A MEETING WITH M.A. THOMAS

The meeting was attended by Mr. Thomas and Mr. Brodie of M.A. Thomas and Dr. A. Skerl and G. Aaltonen.

The Report was discussed in some detail and the following clarifying comments were made by Mr. Thomas and Mr. Brodie.

1. The water table supplying Kitsault Lake is sufficient to provide a continuous water supply for the existing plant but will not allow additions to it.

2. They have taken the least optimistic view in all cases and have allowed a good safety factor in their estimates.

3. Their view of a set 5 year life for the mine was not correct and should not be a factor in the report.

4. The old generating equipment should not be used as it is impossible to get parts for the engine.

5. In some cases there can be a savings in Penstock support costs by using rock bolts to hang it from, instead of doing extensive trestling. The estimate is based on bringing in treated timber to do the work.

6. There may be tax advantages in organizing a new company to operate the power plant.

7. The vibration in the plant was caused by a poorly designed low load water cut-off. Improvement in this design will not only cut out the major part of the vibration but should allow us to operate the plant without a regular operator.

8. They felt that the potential transformers on the metering system were of the wrong type and that because of this the meters would not be accurate.

9. The transmission line as recommended is cheaper than buying a cable that can be put on the ground. They feel it is the best system for our application and snow loading and other operating hazards have been calculated into it. If it is knocked down temporarily, it will still continue to operate.

   We can replace the existing line, as is, for about $30 to $40,000 less. This factor will have to be evaluated in the light of projected losses from shut downs and the availability of the supplementary power supply.

10. They will give us copies of their work sheets to show the projected costs of the various items and the distribution of labour.

11. It was pointed out to them that it would be impossible to do this work this summer because the road work would allow only limited access to this project. They agreed with this as their estimate is based on having truck transportation to the power house.

12. Their figure of added requirements of 1000 K.W. are probably in error. This should be 500 K.W. This would result in halving the owning cost as shown and the projected generating cost would be something over half of that shown because of the loss of the heating capacity of the second generating unit.

13. They felt that where the old electrical equipment could be worked into the design, that there was a real definite advantage in reconditioning and reusing it.

GA/lk

G. Aaltonen

GENERATING FACILITIES AND REUSEABLE EQUIPMENT

FOR

DOLLY VARDEN MINES LTD.

SCOPE

This report will describe the observed condition of certain electrical generating equipment in the Kitsault Valley, any remedial works required to restore the equipment to service and the estimated cost of this work.

The report will describe the means and estimate the cost of increasing the generating capacity to suit the outlined programme for mine, mill and camp.

The report will describe briefly certain other items of equipment that could be useable in the proposed mill development.

SUMMARY

The hydro electric installation is reuseable, but it will require a certain amount of work on the penstock and replacement of the transmission line.

The high speed diesel units are presently serviceable, but there is some doubt concerning the low speed unit.

There is no known hydro potential that can be economically developed to supplement the existing site based on a life of five years or less. The expansion will, for the purposes of this report, be based on the installation of further high speed diesel units.

There is a considerable amount of equipment available from the former mill that can be reused after cleaning, drying and small part replacement, much as would be done for a normal industrial overhaul.

INDEX

GENERAL

An examination of available documents, drawings and photographs was made April 1st, 1969. The information obtained provided the basis for the planning of a field trip.

A party of three went to the site April 7th and returned April 9th, 1969. While on site, an inspection was made and where appropriate, limited testing was carried out on the components of the hydro electric facility, other generating facilities and major items of mill equipment.

A large part of the mill site equipment was inspected and tested April 7th. The transmission line and the balance of the hydro electric generating facility were inspected and tested April 8th. The weather was good with bright sunshine and no wind and the helicopter did a most effective job of moving the members of the party from site to site as the work progressed. However, the depth of snow present made detailed examination of all sections of the penstock and the powerline quite impractical. The southern part was checked in some detail by following the mine road from camp up to the former mine compressor house. The extent of the study of the various areas is described in the appropriate section following and illustrated by the accompanying photographs.

Some further field work will be required to establish exactly the extent of the remedial works, but this cannot practically be done while the snow remains.

EXISTING GENERATING FACILITIES

The existing generating facilities include:

1.) 1250 KVA hydro electric
2.) 125 KVA high speed diesel electric
3.) 100 KVA low speed diesel electric
4.) small high speed diesel electric
5.) 94 KVA low speed generator only

A1. The 1250 KVA hydro electric installation utilizes water from Kitsault Lake with a head of 740 feet. The installation includes a storage dam at the natural outlet of the lake, an intake and spillway structure 7500 feet down the natural drainage channel, a wood and steel penstock following the channel for 5300 feet, a powerhouse containing two 625 KVA water wheel driven generators with auxiliaries and a 5.1 mile transmission line.

A2. The storage dam was not inspected thoroughly because of the depth of snow, but where visible, the remedial works appeared to have been done well. There is still appreciable leakage evident, particularly north of the flume (see ice-free aread, photograph no. 1) which seemed to be percolating under the dam. It also looks as though the control gate will be hard to reposition with full reservoir head applied because its travel is perpendicular to the axis of the logs forming its supporting face. Measurements were made to establish the level of the various spill sections relative to the bottom of the flume section and the corresponding lengths. The lower crest is 204" above the flume bottom and 23' - 5" long. The upper crest is 221 ½" above and 53' - 9" long.

A3. The intake and spillway structure was not inspected or measured because of the depth of snow and because it was assumed to have already been inspected and found satisfactory since no remedial work had been undertaken.

A4. The penstock and the supporting structures were examined at all exposed points throughout the total length. The penstock was not measured, but is reported to consist of 1543' of 26" and 1500' of 24" wood stave pipe plus 970' of 24", 530' of 22" and 800' of 20" steel pipe. The wood stave section is reported to be made up of 1½" x 3½" fir staves, treated with creosote to 8 lb. per cu. ft. retention. It is constrained by ½" steel banding spaced to suit the working head. The condition of the woodstave pipe was observed and

EXISTING GENERATING FACILITIES (Cont'd)

A4. (Cont'd)

tested by hammer and by boring through the staves at selected points. The wood fibre in the borings appears solid and there is still considerable creosote residue evident. There is at least one section of about 400 feet where the staves have fallen in, but the staves are generally sound. See photograph nos. 2, 3, 4, 5, 6 and 7. The banding seems to conform generally to the head profile, but is not uniformly tight and there are a considerable number of bands broken. These did not appear to be abnormally corroded but rather overstressed as from uneven tightening. There was some evidence of wood decay at the point of attachment of the guys supporting the stand pipe near the intake structure. This may be due to a purely local cause such as the guy attachment and/or saturation of the thermal insulation inside.

The steel pipe section is reported to be in lengths of 16' and 20' joined by Dresser couplings. The snow prevented inspection of much of this section, but where it was exposed there was no evidence of undue or damaging corrosion.

The supporting structures were apparently all made from locally cut and untreated timber. These have decayed badly as shown in photograph nos. 3 and 4. It was not possible to check at many points, but on the basis of those observed, all of the supporting structures must be considered unsafe and not repairable. They will require complete replacement to restore the correct alignment and support of the penstock.

A5. The powerhouse is a locally cut log structure which has been somewhat distorted - presumably by unbalanced snow loading. The logs forming the walls and the roof framing all appear reasonably sound and it should be possible to straighten the walls and provide some additional bracing to hold them in place. The snow loading is indicated in photograph no. 8 and the twisting in photograph no. 9.

The foundations were inspected on top and appeared to be stable and intact. There was no indication of cracking or altered alignment. The tail pits were not inspected, but should be as sound as the visible parts of the foundation.

EXISTING GENERATING FACILITIES (Cont'd)

A5. (Cont'd)

Mechanical examination was limited to that which could be done without dismantling, but the whole installation gave the impression of having been shut down with care. The runners can be checked through the inspection ports in the machine casings or possibly from the tail pits if they are accessible. The penstock may need to be opened at the bottom to remove any long pieces of wood or rock that might have fallen in through the collapsed sections to prevent blocking any of the valves. The water wheels appear to need only the reassembly of the cooling water lines and some jacking and oiling of the bearings to be ready to run.

The generators are mechanically in good condtion although the windings are very dirty. A megger test gave the following results:

	Leads	Stator	Rotor
No. 1 Generator	Leads & Stator	400 K ohms	0 ohms
No. 2 Generator	10 K ohms	0 ohms	30 K ohms

Typical values for machines in good condition would be 600 K and 100 K for stator and rotor respectively. This shows that dust and moisture have penetrated the windings in varying amounts and that the machines will require cleaning and drying.

The switchboard is generally in good condition and will require only some cleaning, checking of the circuit breaker mechanisms and operational testing to ensure that no relay or other contacts are corroded or stuck.

The station battery is completely discharged, but the cells are relatively free of deposit; hydrometer readings are similar from cell to cell and while the ampere-hour capacity will be reduced, it should be serviceable.

The station service has been taken directly from the switchboard bus without protection. This is contrary to good practice and to the Electrical Code and should be corrected before the plant goes into service.

EXISTING GENERATING FACILITIES (Cont'd)

A5. (Cont'd)

The line transformers were examined on top and given a megger test. The nameplates have been removed, but the serial numbers on the tanks are 133436, 133438 and 133440. Each primary showed in excess of 50 M ohms and the secondaries showed 400 K ohms together. These are good values and indicate that the units can be returned to service, but oil samples should be taken and tested to confirm that no water is present, that the acid level is low and that the breakdown voltage is high. There is an earlier report indicating leakage of water into the middle unit. There is also a piece of secondary bus to be replaced on the branch to the north unit where a light jumper has been installed past a burnt section.

A6. The transmission line was examined in part on site and in part from the air. The general alignment of the right-of-way appeared to have been well chosen and should generally be maintained. The wood structures, including the line poles and transformer station structures, appear to be local cut and untreated. A large percentage of these have fallen and the remainder must be considered unsafe. The state of decay is highlighted in photograph no. 11 which shows a pole that has been reinforced by a stub, but has still broken away. The conductor and many of the arms and insulators are salvageable, but the poles are not suitable for reuse - even with additional stubbing. This applies also to the timbering, decking and fencing of the transformer stations.

A7. The receiving transformers were examined on top and given a megger test. The nameplates have been removed, but the serial numbers on the tanks are 133435, 133437 and 133439. All the windings showed in excess of 50 M ohms except the secondary of 133435 which showed 2 M ohms. These are good values and indicate that the units can be returned to service, but oil samples should be taken and tested as outlined for the line transformers above. One loose HV bushing was also noted on 133435.

A8. The 125 KVA high speed (1800 RPM) diesel electric unit is in continuous service, providing power for the present camp facilities. It is assumed that the capabilities, age and conditon of this set are already known, so it was neither inspected nor tested. It was noted that the exhaust piping is probably restricting the maximum output of the engine because it is very long to be unmuffled and of minimum diameter for the engine.

EXISTING GENERATING FACILITIES (Cont'd)

A9. The 100 KVA low speed (257 RPM) diesel electric unit was built in 1927 and is of a very durable type. See photograph no. 14. No records were found of the time of erection on this site, the running hours or maintenance history, but the general appearance and the care taken in draining the unit suggests that it was operational when the camp was last closed. It was remarked that one of the last operating staff is resident at Alice Arm and this would be worth following up to see if he can shed any light on the mechanical state of the installation.

It is most likely that if this unit will operate it will have an output comparable to the 125 KVA high speed unit with about 80% of the fuel consumption. The generator, exciter and control were not tested, but with cleaning and drying are probably serviceable.

A10. The small high speed diesel unit is in service as the stand-by for the 125 KVA unit described in B1 above. Again, it is assumed that the capabilities, age and condition of this unit are known so it was neither inspected nor tested.

A11. The 94 KVA low speed generator only was built in 1928 and is again of a very durable type. This unit was arranged for flat-belt drive and installed with an engine which has since been removed. The generator, exciter and control were not tested, but with cleaning and drying are probably serviceable.

The installation can be completed by the addition of any engine having a governor and an output in excess of 125 HP at any speed up to about 1200 RPM. The engine would be direct connected to a jack shaft that will carry the driving pulley and take the belt loading. If a relatively high speed is selected, the drive will probably be V belts run on the existing flat driven pulley.

Relative fuel consumption of the installation will vary directly with the operating speed of the selected engine.

RECOMMENDED REMEDIAL WORK FOR GENERATING FACILITIES

The following outline is arranged in the same order as the preceeding review of facilities:

B1. Restoration of the hydro electric installation requires work in several areas, including replacement of penstock supports, repair of penstock, reconditioning of powerhouse, replacement of line and relocation and replacement of mill transformer station. Each of these will be dealt with in detail below.

B2. The storage dam remedial works cannot be properly judged until the reservoir has been filled. It is recommended that the gate be left closed until the reservoir overflows. At that time, the effectiveness of the works can be assessed and the gate mechanism tried. If either is considered unsatisfactory, steps should be taken to lower the level and make further alterations as required.

B3. The intake and spillway structure should be examined to ensure that the gate mechanisms are operational, that the trash rack is satisfactory and that the spilling while out of service has not undercut the support of the toe.

B4. The penstock and the supporting structures require a considerable amount of work. Once the snow is gone, the penstock will have to be surveyed carefully to establish the amount that has collapsed, the amount of new staves required, the amount of new banding required and the amount of treated lumber required to replace the supporting structures. It would be desirable to have the party to be responsible for the penstock repair and the party to be responsible for the supporting structure repair make the survey together in company with your representative. All the supporting structures should be replaced before the penstock repair is started so that all the required realignment will be completed before the penstock banding is tightened. The penstock will probably require some new staves in the collpased area and some 1500 new bands on the 26" section. The thrust blocking will have to be checked - particularly where wire rope and anchors have been used. Finally, the whole pipe will require flushing and pressure testing.

B5. The powerhouse structure should be jacked straight and anchored. There is a wire rope anchor holding the east end against the snow load on the north side that can be retained after the building is straight. There do not appear to be any drift pins in the walls adjacent to the door and window openings. These areas will require support and through-bolting to maintain alignment. This part of the work can be done by the same crew that is to do the penstock supporting structure

RECOMMENDED REMEDIAL WORK FOR GENERATING FACILITIES (Cont'd)

B5. (Cont'd)

repair. The chinking should be restored and the building generally cleaned up so that no more dirt will be introduced to the machines.

The machines should be thoroughly cleaned and dried with proper equipment used by competent workmen. The generator windings should then be retested and it is expected that they will be in satisfactory condition. If the insulation level cannot be brought up by cleaning, drying and painting, it could prove necessary to rewind, but this is most unlikely with 480 volt machines.

The cooling water piping should all be cleaned, checked for condition and reassembled. The pressure reducing valve should be removed and tested for setting. The associated alarm equipment, including all the bearing temperature relays and the annunciator, should be tested to ensure that it still meets the original intent.

The switchboard should be thoroughly cleaned, all connections checked for tightness, the circuit breaker contacts checked and dressed or replaced, the linkage adjusted, the relays tested and the protective circuitry proved. It will be necessary to have a small portable generator on site to carry out this work since the various units must be made to operate.

There are old reports indicating that the whole powerhouse has suffered from vibration and and high tail water during periods of operation with little or no load and the resulting deflector insertion. This should be corrected by the use of "economizer" switching of the spear drive from governor position. The design of this feature would include application of mechanica llimit switches to the governor, development of suitable travel rates for opening and closing and the inter-connecting wiring.

The station service overcurrent protection should be correctly installed adjacent to the tap from the bus. This applies also to the potential connection for the totalizing watthour demand meter. At the same time, consideration should be given to replacing the potential transformers with units intended for metering and to having the meter calibration checked. A meter of this type would normally require certification every four years if used for billing.

RECOMMENDED REMEDIAL WORK FOR GENERATING FACILITIES (Cont'd)

B5. (Cont'd)

The line transformers should have oil samples taken and tested. Depending on the result of the test, the oil may require filtering or replacement. The units should be touched up with a rust inhibiting primer and repainted. New nameplates should be obtained to provide details of rating, taps, connections, etc.

B6. The transmission line should be entirely replaced by a steel messenger supported fully insulated bundle of conductors suspended from new poles generally along the present right-of-way.

The new poles should be treated and fitted with breakaway type fastenings for the cable.

The cable should consist of three separate #1 aluminum conductors insulated for 15 KV ungrounded service with cross linked polyethylene, shielded, jacketted in polyethylene, bundled and taped to a ½" 30% EHS copper clad steel messenger by a rectangular copper strip.

This messenger has a breaking strength in excess of 20,000 lbs. and will preserve the continuity of the conductors by breaking either fastenings or poles and letting the cable down. The cable can continue to operate in this condition unless it is crushed on the ground. Except in this case, repair will consist of simply replacing a fastening and rehanging the cable.

B7. The receiving transformers should be checked, tested, etc., as outlined above for the line transformers. It is likely, considering the proposed site plan, that this transformer bank should be relocated to be nearer the new mill building.

B8. The 125 KVA 1800 RPM diesel electric unit should remain serviceable as long as the engine maintenance is kept up.

B9. The 100 KVA 257 RPM diesel electric unit will be worth rehabilitating only if the main parts are in good condition. As mentioned in A9, it was reported that one of the last operators is resident in Alice Arm and if this is true, he may be able to describe the operation of the unit and the nature of any problems. Without some guidance such as this, the unit should be left alone or treated as a spare time project under the direction of your Master Mechanic.

RECOMMENDED REMEDIAL WORK FOR GENERATING FACILITIES (Cont'd)

B10. The small unit should be treated as in B8 above.

B11. The 94 KVA 257 RPM generator should not be seriously considered at this time.

ESTIMATED COST OF REMEDIAL WORKS

The following outline is arranged in the same order as the preceeding sections.

C1. The total cost of restoration of the hydro electric installation as outlined in section B is estimated to be $215,451.00. The estimated cost of each of the components is developed below. It should be pointed out that the majority of this work can only be readily undertaken when there is no snow on the ground and the weather is reasonable. There is also some advantage in doing the work this summer because the hydro can then supply all the camp needs for power next winter. It could supply all the heat if electric elements were added to the various oil fired furnaces or the old heating system were restored. This would also provide a trial period to test the equipment under actual working conditions. As a result, the estimate is largely based on the work being done this summer.

C2. No allowance is included for any further work on the storage dam.

C3. No allowance is included for any work on the intake and spillway structure.

C4. The cost of restoring the penstock and supporting structures including a detailed survey of the damage, replacing all the supporting sleepers and vents, reassembly of the penstock, cleaning and pressure testing is estimated to be $90,651.00. The manpower included in this estimate is ten men for ten weeks.

C5. The cost of restoring the powerhouse, including the building, water wheels, generators, switchboard, controls and line transformers is estimated to be $14,150.00. The manpower included in this estimate is four men for four weeks.

C6. The cost of replacing the transmission line completely, including all poles and conductors as recommended, is estimated at $110,650.00. The manpower included in this estimate is eight men for six weeks.

C7. The cost of relocation and general rehabilitation of the three 400 KVA transformers at the mill is estimated at $3,200.00. The manpower included in this estimate is five men for one week.

ESTIMATED COST OF REMEDIAL WORKS

C8.
C9.
C10.
C11.

(C8.–C11.) No allowance is included for any work in connection with these units.

SOURCES OF ADDITIONAL POWER

The proper assessment of sources for additional power presumes knowledge of the peak demand to be satisfied, the probable load factor and the projected life of the operation.

A request was made to augment the existing plant by 1000 KW to supply a 700 tons per day mining and milling operation for five years. The total demand thus indicated appears high for an operation of this size and the expected duration of operation low for a feasible hydro-electric plant expansion. The combined demand for a camp, mill and mine capable of 700 tons per day should be less than 1500 KW and the requirements for stand-by facilities depend on the reliability of the prime source or sources.

There are three potential sources to be considered to supplement the existing hydraulic installation within the conditions stated above. These are reviewed below.

D1. The first to be considered is an installation consisting of two 500 KW high speed diesel electric units that would be operated with full ebullient cooling and exhaust heat recovery to provide electric power plus a proportionate amount of heat in the form of 12 pound steam.

The cost of the installation, including machines, controls, heat recovery units, auxiliaries and building would be approximately $185,000.00. Based on money borrowed at 8% compounded annually, disposal value in five years of $70,000.00, and the balance covered by a sinking fund earning 5%, the annual cost would be $35,600.00. The plant would probably produce 2,000,000 KWHR per year at an average incremental cost of $0.012/KWHR after making allowance for the use of the recovered heat. The total cost would then be $35,600.00 plus $24,000.00 which is $59,600.00 per year.

This plant would be capable of maintaining basic operation of camp and mill in the event of difficulty with the hydraulic installation.

D2. The second possibility to be considered is an installation of one or more additional hydro electric units.

The data available on the Kitsault Lake water shed shows that there is no way in which the existing hydro electric installation can be economically expanded to twice its current capacity.

SOURCES OF ADDITIONAL POWER (Cont'd)

D2. (Cont'd)

There are several other potential development sites, including the Kitsault River, in the canyon north of the camp and Kinskuch Lake which drains to the east. Either of these could be relied on to produce firm power, but it is expected that the required investment will be far too high to make a five year write-off reasonable. If estimates are desired, it will be necessary to check relative elevation and distances to make a preliminary selection and then to follow this up with some detailed field work on the most feasible site. Nothing further is available at this time.

D3. The third possibility involves a combination hydro and diesel installation based on using the undeveloped head between the existing Kitsault River dams for the hydro part and a high speed diesel at the camp.

The head available on the Kitsault River could be developed and would produce about 400 KW at the same water flow rate as the existing hydro development. This would provide sufficient capacity to carry the projected load under most conditions.

The back-up for the combined hydro installation would be a single 500 KW high speed diesel unit located at the camp.

The capital cost is estimated to be $300,000.00 for the hydraulic plant, plus $90,000.00 for the diesel plant or a total of $390,000.00. The annual cost of owning on the same basis as above would be $95,600.00. The incremental production cost is negligible, but the full production capability can be used in conjunction with the electric boiler to the extent of 1,300,000 KWHR which at $0.006/KWHR gives a credit of $7,800.00, leaving a net annual cost of $87,800.00.

D4. As was noted above, the annual cost figures for a diesel installation vary with average load and period in service, while the cost of a hydro installation varies only with the period in service. When production planning has established the various loads that are to be served, these figures can be reviewed and adjusted for any significant changes in demand or expected production period. If there are no major changes, the selection of the diesel electric installation outlined in D1 above is recommended.

INVENTORY OF PRINCIPAL ITEMS OF ELECTRICAL EQUIPMENT

Most of the major pieces of electrical equipment associated with the operation of the old mill were inspected and tested by megger. The notes pertaining to specific pieces of equipment are listed below, but generally, except for damage resulting from bad handling, the equipment is in reasonable condition. Every item will require cleaning and drying with motors needing more than transformers and control needing more than motors.

The following outline is intended only to provide general guidance to rehabilitating proceedures to provide a basis for assessment of cost and time involved.

Oil filled transformers will require the least rehabilitation of all the equipment on site, except where a tank seal has been broken. In every case the outside should be inspected for oil leaks then carefully cleaned. After cleaning the cover should be removed, the oil checked for level, water and sludge and the tap switch (if any) position recorded. All openings through the tank should be checked to see that bushings have not been broken and that the gaskets are secure. Any repairs that are needed should be done. If the oil shows water or sludge, it should be drained off, the core, coils and tank cleaned and the oil filtered or replaced by new oil. The unit can then be reassembled, taking care that the gaskets are straight and the outside repainted.

Dry type transformers will require cleaning and drying. The ventilated units will require cleaning of the core and coil assembly with special note taken of the ventilating passages to ensure they are not plugged.

Motors should be cleaned inside and out. The large open motors may be done assembled, but the small ones should be dismantled. The windings should be cleaned with a combination of solvents, vacuum and low pressure air. They should be thoroughly dried and varnished to produce an insulation level of 0.4 megohms or better. The rotor should be cleaned and the bearings of all small motors replaced. The condition of slip rings and brushes should be checked and repaired or replaced as necessary. The motors should be assembled and checked for free rotation and painted.

Control items should be dismantled to the point where they can be thoroughly cleaned, the contacts replaced, the coils dried, tested and varnished or replaced, the whole assembled and tested for mechanical operation. Any broken parts such as bases arc chutes or overload relays must be replaced.

INVENTORY OF PRINCIPAL ITEMS OF ELECTRICAL EQUIPMENT (Cont'd)

This work of reconditioning can be done progressively - provided that a reasonably clean, warm area can be set aside in which the work can be carried out and a second clean, dry area used to store the finished items until they are to be put into service. An allowance for the cost of rehabilitation can be made for all items that have not been damaged based on replacement cost at the rate of 15% for transformers, 20% for motors and 25% for control. This also gives an indication of the present value to the Mine of the equipment on site relative to having to purchase the functional equivalent and transport it to the site.

XIV

MARKETING

Composition and type of concentrate extractable were not determined until recently.

Under the projected mining schedule ores from the Wolf provide the initial 2.22 years of cash flow. A silver-lead concentrate will be produced, with minor quantities of zinc and cadmium contained. The nature of this concentrate (see Terms of Reference and Controls) makes it readily saleable on almost all markets.

Modification of the mill to treat ores of the North Star, Dolly Varden, and Torbrit deposits (Composite Ore) will result in production of two concentrates: a silver-lead and a silver-zinc. The projected silver-lead concentrate from this source will probably contain a lower proportion of silver than that of the Wolf (see Terms of Reference and Controls) but should still be readily saleable. The silver-zinc concentrate is not in such high demand.

Cominco, Trail, has been approached and has indicated a willingness to purchase the silver-lead concentrates; and "interest" in the zinc concentrate. Cominco letter is appended at the end of this section.

The silver market is difficult to predict. The price during the projected mine life should essentially depend on what ranges in prices the silver pools will sell for. This statement may not sound significant, but if one considers that there is enough "free" silver to fill the industrial-production gap for 5 to 7 years, then the human temptation (or necessity) factor becomes important. Recent rulings by the U.S. Treasury effectively reduced some of their control over the free market for silver. The long range positive or negative effect of this is uncertain, but prices should probably be somewhat more stable as a result.

The present E&MJ, Handy & Harmon silver price is $1.67/oz. U.S., or approximately $1.81/oz. Canadian. The tabulation below is our attempt at a forecast:

	$ Canadian per oz.
1970	$1.90
1971	$2.13
1972-1975	$2.25

Cash flow projections at these forecast prices were designated Case 1; Cases 2 and 3 cash flow projections were taken at constant prices $2.00/oz. and $2.50/oz. Canadian. The reason for the latter two was principally to permit construction of a graph.

Lead markets are currently strong and several price increases have occurred over the past 1½ years. Some softening of lead markets is anticipated, however, as construction activity and auto industry production levels may be adversely affected by rising interest rates and shortage of capital funds available for borrowing.

DERIVATION OF RETURNS - DETAIL

A Cominco open schedule was applied to both silver-lead and silver-zinc concentrates. Mr. de Basio, Cominco ore-buyer, intimated these should closely apply.

Base charge:

Lead concentrate:	base	$15.00
	lead deficiency	+1.80
	SiO_2 and lime	-2.90
	As and Pb	+ .27
	Truck unload	+ .75
		$14.92 - say $15.00
Zinc concentrate:	Same.	

NET SILVER RETURNS/YEAR

Silver Content:

	Tons	% Recovery	Ounces Recovered	Ounces Paid For	Source
1970	40,833	.85	356,456	340,414	Wolf Ag Conc.
1971	245,000	.85	2,138,728	2,042,485	" " "
1972	245,000	.85	2,138,728	2,042,485	" " "
1973	14,232	.85	124,238	118,648	Wolf Ag Conc.
	230,768	.65	1,288,493	1,224,068	Pb Conc.
		.15	297,345	237,876	Zn Conc.
1974	245,000	.65	1,367,957	1,299,560	Pb Conc.
		.15	315,682	252,546	Zn Conc.
1975	193,550	.65	1,080,686	1,026,652	Pb Conc.
		.15	249,389	199,511	Zn Conc.

CASE I

1970	$1.90 - .02	=	639,979	-	13,367	=	$ 626,611
1971	2.13 - .02	=	4,309,642	-	80,202	=	4,229,441
1972	2.25 - .02	=	4,554,741	-	80,202	=	4,474,539
1973	2.25 - .02	=	264,584	-	4,659	=	259,925
			+3,260,135	-	137,076	=	+3,123,059
1974	2.25 - .02	=	3,461,196	-	145,530	=	3,315,666
1975	2.25 - .02	=	2,734,344	-	114,969	=	2,619,376

CASE 2

1970	$2.00 - .02	=	674,020 -	13,367	=	$ 660,653
1971	2.00 - .02	=	4,044,120 -	80,202	=	3,963,918
1972	2.00 - .02	=	4,044,120 -	80,202	=	3,963,918
1973	2.00 - .02	=	234,922 -	4,659	=	230,263
			+ 2,894,649 -	137,076	=	2,757,573
1974	2.00 - .02	=	3,073,169 -	145,530	=	2,927,639
1975	2.00 - .02	=	2,427,804 -	114,969	=	2,312,835

CASE 3

1970	$2.50 - .02	=	844,227 -	13,367	=	$ 830,860
1971	2.50 - .02	=	5,065,362 -	80,202	=	4,985,159
1972	2.50 - .02	=	5,065,362 -	80,202	=	4,985,159
1973	2.50 - .02	=	294,246 -	4,659	=	289,587
			3,625,621 -	137,076		+3,488,545
1974	2.50 - .02	=	3,849,222 -	145,530	=	3,703,692
1975	2.50 - .02	=	3,040,885 -	114,969	=	2,925,917

WOLF CONCENTRATE MINOR METAL CONTENT

Basis: Will assume that 400 oz./t concentrate represents 85% recovery of 10.27 oz. grade.

∴ concentration ratio = 400/(.85)(10.27) = 45.82/1
say 46/1

(Inverse = 2.18 wt %)

∴ tons/shipment = 222.5 dry short tons.

LEAD: Concentrate contains 11.8%

∴ (245,000)(.0218)(.118)(2000) = 1.26 million lb./yr.

With a head assay of 0.32% Pb this is equivalent to an 80% recovery.

ZINC: Concentrate contains 4.47%

$\therefore$ (245,000)(.0218)(.0447)(2000) = 480,000 lb./yr.

CADMIUM: Unknown.

GOLD: (245,000)(.0218)(.025) = 134 oz./yr.

WOLF CONCENTRATE, BONUS SETTLEMENTS

LEAD: $\frac{1.26 \times 10^6}{24}$ = 52,500 lb./shipment

- 4,451 lb. deduction @ 20 lb./t

48,049 lb. paid for/shipment

Net return/yr. = (48,049)(24)(.12096* - .006)

= $132,570.

ZINC: $\frac{480,000}{24}$ = 20,000 lb./shipment

11,127 lb. min. deduction @ 50 lb./t

8,873 lb. paid for/shipment

Net return/yr. = (8873)(24)(.12238* - .055)

= $14,349.

GOLD: Net return/yr. = (134 oz./yr.)(.95)(37.70 - 1.25/oz.)

= $4,640.

TOTAL: Net return/yr. = $151,559.

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* "Net Tadanac Realized Prices" - April 30, 1969

COMPOSITE CONCENTRATE, MINOR METAL CONTENT

Basis: 245,000 tons/yr., bi-monthly shipment of the following concentrates:

	Wt. %	Assays Pb	Assays Zn	Assays Cd	Distribution % Pb	Distribution % Zn	Distribution % Cd
Pb Conc.	2.76	10.9	7.2	0.14	75	20	20
Zn Conc.	1.20	1.7	50.0	1.00	5	60	60

LEAD:
Pb Conc.: (245,000)(.004)(.75)(2000) = 1.47 mil. lb./yr.
Zn Conc.: (245,000)(.004)(.05)(2000) = 98,000 lb./yr.

ZINC:
Pb Conc.: (245,000)(.010)(.20)(2000) = 980,000 lb./yr.
Zn Conc.: (245,000)(.010)(.60)(2000) = 2.94 mil. lb./yr.

CADMIUM:
Pb Conc.: (245,000)(.0002)(.20)(2000) = 19,600 lb./yr.
Zn Conc.: (245,000)(.0002)(.60)(2000) = 58,800 lb./yr.

COMPOSITE CONCENTRATES, BONUS SETTLEMENTS

LEAD:

$\frac{1.47 \times 10^6}{24}$

61,250 lb./shipment
5,635 lb. min. deduction @ 20 lb./t
55,615 lb. paid for/shipment

Net return, Pb ore = (55,615)(24)(.12096 - .006) = $153,444

$\frac{98,000}{24}$

4,083 lb./shipment
2,450 lb. min. deduction @ 20 lb./t
1,633 lb. paid for/shipment

Net return, Zn ore = (1633)(24)(.12096 - .0335) = $3,428.

ZINC: Similarly

Net return, Pb ore = (26746)(24)(.12238 - .055) = $ 43,251

Net return, Zn ore = (99225)(24)(.12238 - .026) = $229,519.

CADMIUM: Similarly

Net return, Pb ore = no payment

Net return, Zn ore = (58800)(.70)(2.40 - .40) = $82,320.

TOTAL: Net return = $511,962.

Mr. Ferely
Chapman, Wood & Griswold Ltd.
133 East 14th
North Vancouver, B.C.

June 12, 1969

Dear Mr. Ferely:

This memo will serve to record our phone calls of June 11 in regard to Dolly Varden Concentrates.

The assay that you quoted was:

Pb	11.78%	SiO_2	19.37%	
Zn	4.47%	Cu	.88%	
Fe	24.17%	Hg	.02%	
S	28.79%	CaO	1.37%	
Sb	.64%	Au	.025	troy oz/sdt
As	.08%	Ag	397.8	troy oz/sdt
			but use 400 for calculation	

Tonnage 5346.8 tons/year delivered at two week intervals.

Based on the Open Schedule for Ores (copy attached) and recent prices, material of the above assay would be valued about $725/ sdt f.o.b. Tadanac. Any unusual receiving, sampling or assaying charges would be to the shipper's account. Other General Clauses would apply.

We are also enclosing an Open Schedule for the purchase of zinc concentrates.

Your tentative assay was:

50%	Zn
1.7%	Pb
1%	Cd
106	troy oz/sdt Ag

Tonnage - 240 tons/month

continued. . . . . .

We may be interested in the zinc concentrates when they become available. Please keep us informed on this matter.

When we receive our assay on the Dolly Varden sample of Pb-Ag concentrate, we will forward another memo on the value of this material.

If we can be of further assistance, please do not hesitate to contact us.

Yours truly,

for: W.G. Siddall
Administrative Assistant

Encl:

XV

COSTS

CAPITAL COST SUMMARY

PREPRODUCTION

Wolf Mine Exploration	$ 21,600
Wolf Mine Development	209,552
Site Preparation	104,638
Tailings Pond	4,032
Roads	174,184
Engineering & Planning	123,300
Total	$ 637,306

CAPITAL COSTS ONWARD

Mine Equipment (see "Mining Plan" for detail)	$ 313,198
Mill Equipment ("Milling Plant" for detail)	2,161,000
Service Building	149,766
Bunkhouse complex	292,000
Power (see "Power" for detail)	307,950
Housing, Alice Arm	352,700
Barge Grid and Warehouse	20,000
Service Vehicles and Equipment	88,500
Communications	21,200
Plant Services	7,600
Mine Services	11,500
Freight	91,000
Total	$3,816,414

OPERATING CAPITAL (1 month)	185,000
Less: that amount already spent on above projects	$ 211,250
TOTAL ONWARD CAPITAL REQUIREMENT	$4,427,470

OPERATING COST SUMMARY

All operating costs have been calculated on the basis of the present (ie assume June, 1969). Accordingly, a combined labour and supply escalation rate of 6%/year was applied to the ming, surface plant, engineering and geology, exploration, and concentrate haul sub totals. Millingplant and administration should not experience these increases and were left constant.

OPERATING COST ON WOLF ORE	Cost/Ton
Mining (see "Mining Plan" for details)	$2.72
Surface Plant	2.36
Milling	1.66
Engineering & Geology	.25
Administration	1.11
Exploration	.31
Concentrate Haul (see "Transportation" for details)	
Total	$9.04

Escalation rate: 6.27 @ 6%
2.77 @ 0%
net rate 4.20%

OPERATING COST ON COMPOSITE ORES

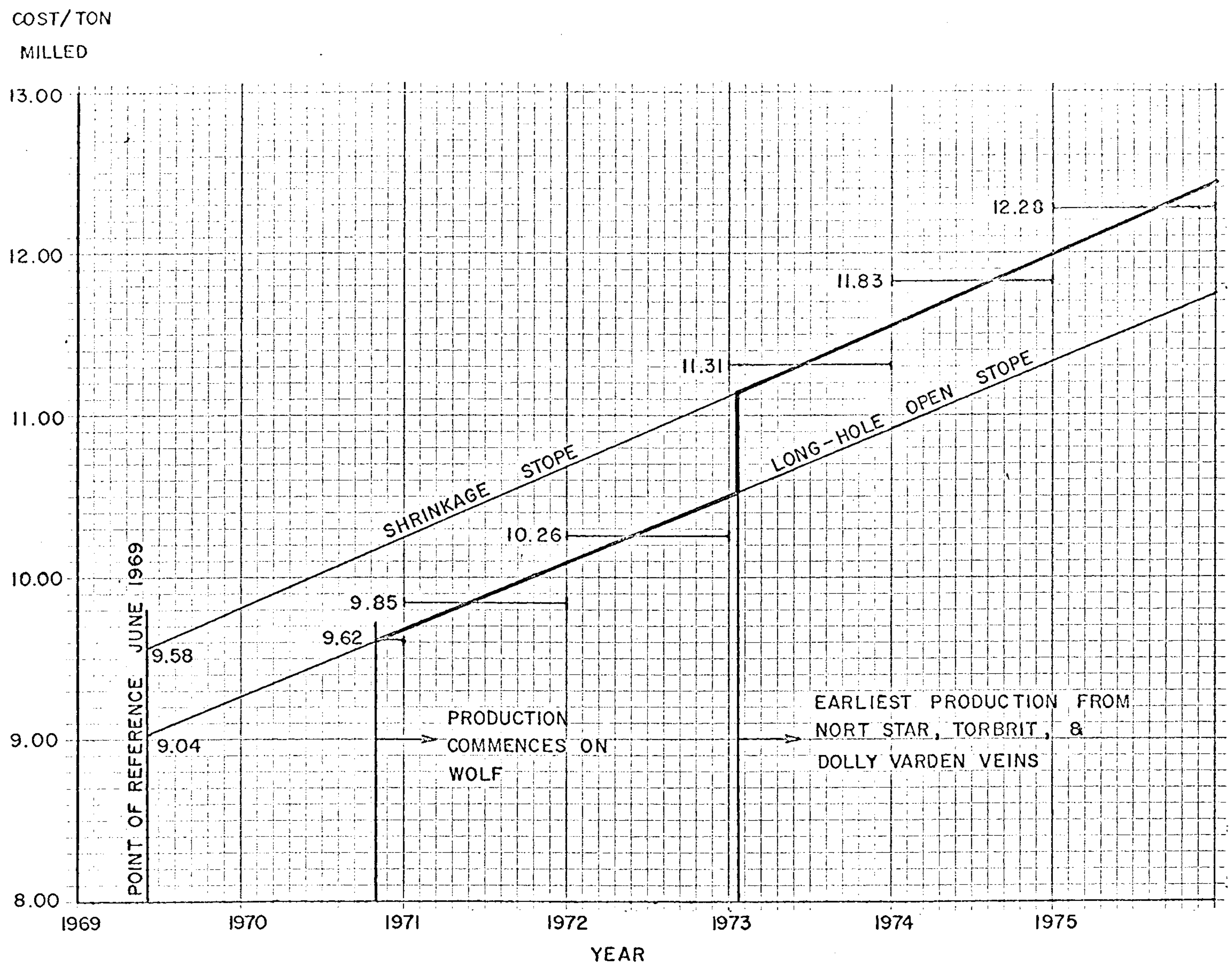
1) Add 10% to milling: reagent cost
2) Add $1.00/T to mining for shrinkage stoping allowance
3) Subtract $0.50/ton from ore-haul

Total $9.58

Escalation rate $6.77 @ 6%
$2.81 @ 0%
net rate 4.24%

YEARLY OPERATING COSTS

Average yearly costs according to the projected production schedules have been calculated and are presented graphically, with the escalation lines also shown.



ESCALATION OF OPERATING COSTS

C H A P M A N , W O O D , A N D G R I S W O L D L T D .

DOLLY VARDEN MINES LTD. (NPL) JUNE 11,1969 CASE 1

1000 CANADIAN $	1970	1971	1972	1973	1974	1975	TOTALS
METAL SALES	652.	4381.	4627.	3875.	3828.	3024.	20385.
OPERATING COST	393.	2414.	2514.	2771.	2899.	2377.	13366.
INTEREST INCOME	0.	0.	0.	0.	0.	0.	0.
TOTAL INCOME	260.	1968.	2113.	1104.	930.	648.	
INTEREST EXPENSE	0.	0.	0.	0.	0.	0.	0.
PROV. DEPR. 1.00	0.	0.	0.	0.	0.	0.	0.
PROV. DEPR. .50	0.	0.	0.	0.	0.	0.	0.
PROV. DEPR. .30	260.	1007.	765.	536.	375.	648.	3588.
PROV. DEPR. .25	0.	0.	0.	0.	0.	0.	0.
PROV. DEPR. .20	0.	0.	0.	0.	0.	0.	0.
PROV. DEPR. .15	0.	0.	0.	0.	0.	0.	0.
PROV. DEPR. .10	0.	0.	0.	0.	0.	0.	0.
PROV. PREPRODUCTION	0.	771.	0.	0.	0.	0.	771.
PROV. PFT. BFR. TX.	0.	191.	1348.	568.	555.	0.	2661.
FED. DEPR. 1.00	0.	0.	0.	0.	0.	0.	0.
FED. DEPR. .50	0.	0.	0.	0.	0.	0.	0.
FED. DEPR. .30	0.	0.	0.	170.	847.	648.	1663.
FED. DEPR. .25	0.	0.	0.	0.	0.	0.	0.
FED. DEPR. .20	0.	0.	0.	0.	0.	0.	0.
FED. DEPR. .15	0.	0.	0.	0.	0.	0.	0.
FED. DEPR. .10	0.	0.	0.	0.	0.	0.	0.
FED. PREPRODUCTION	0.	0.	0.	0.	0.	0.	0.
FED. PFT. BFR. TX.	0.	0.	0.	0.	0.	0.	0.
PROVINCIAL TAX	0.	29.	203.	86.	84.	0.	400.
FEDERAL DEPLETION	0.	0.	0.	0.	0.	0.	0.
FEDERAL TAX	0.	0.	0.	0.	0.	0.	0.
GROSS CASH FLOW	260.	1940.	1911.	1018.	847.	648.	6620.
LOAN REPAYMENT	0.	0.	0.	0.	0.	0.	0.
NEW CAPITAL ASSETS	0.	0.	200.	0.	0.	0.	200.
WORKING CAP.RDMTN.	0.	0.	0.	0.	0.	0.	0.
NET CASH FLOW	260.	1940.	1711.	1018.	847.	648.	6420.
CUM. CASH FLOW	260.	2199.	3909.	4927.	5773.	6420.	

CHAPMAN, WOOD, AND GRISWOLD LTD.

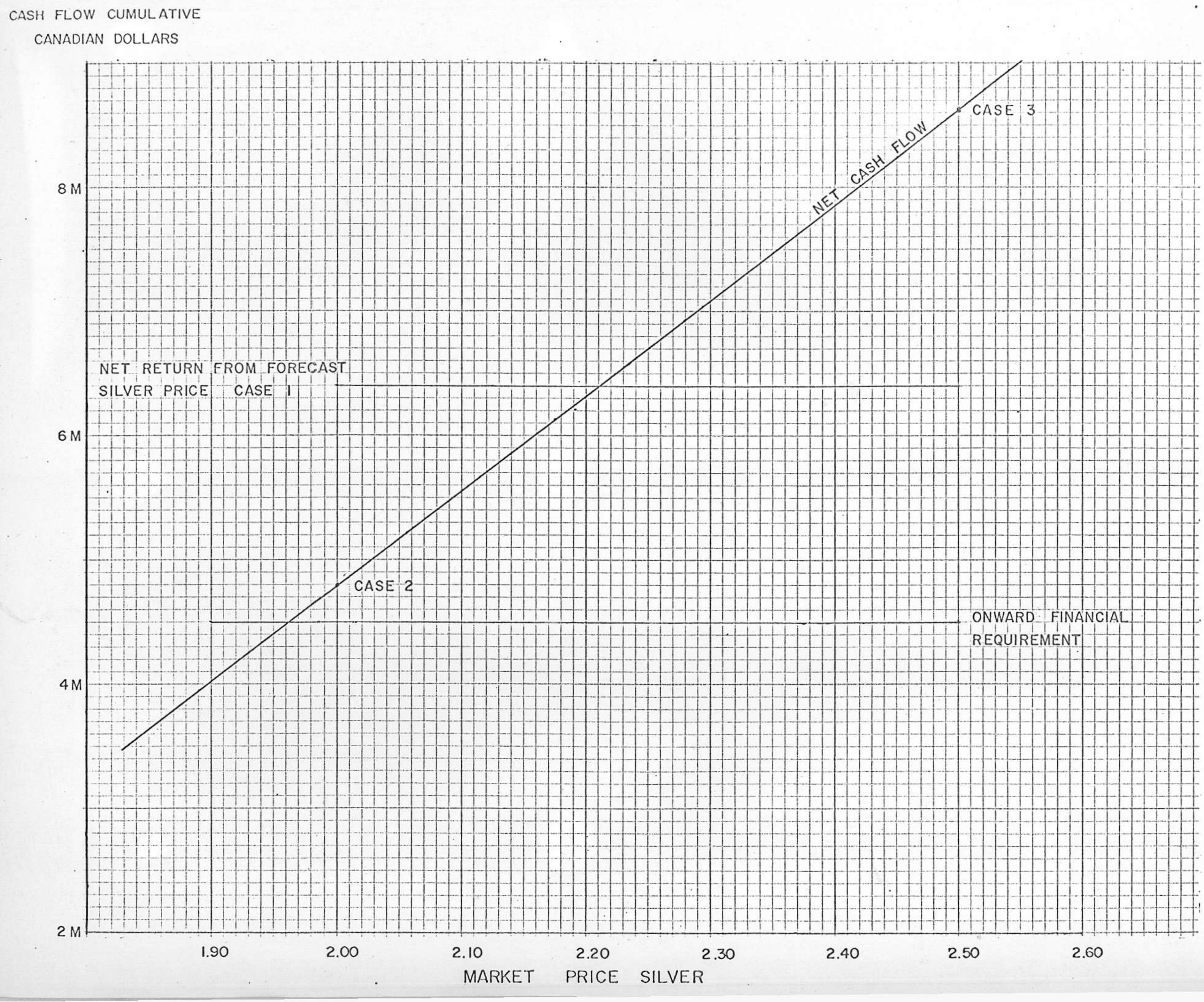
DOLLY VARDEN MINES LTD. (NPL) JUNE 11,1969 CASE 2

1000 CANADIAN $	1970	1971	1972	1973	1974	1975	TOTALS
METAL SALES	686.	4116.	4116.	3479.	3440.	2718.	18553.
OPERATING COST	393.	2414.	2514.	2771.	2899.	2377.	13366.
INTEREST INCOME	0.	0.	0.	0.	0.	0.	0.
TOTAL INCOME	294.	1703.	1602.	708.	542.	341.	
INTEREST EXPENSE	0.	0.	0.	0.	0.	0.	0.
PROV. DEPR. 1.00	0.	0.	0.	0.	0.	0.	0.
PROV. DEPR. .50	0.	0.	0.	0.	0.	0.	0.
PROV. DEPR. .30	294.	997.	758.	531.	372.	341.	3290.
PROV. DEPR. .25	0.	0.	0.	0.	0.	0.	0.
PROV. DEPR. .20	0.	0.	0.	0.	0.	0.	0.
PROV. DEPR. .15	0.	0.	0.	0.	0.	0.	0.
PROV. DEPR. .10	0.	0.	0.	0.	0.	0.	0.
PROV. PREPRODUCTION	0.	706.	66.	0.	0.	0.	771.
PROV. PFT. BFR. TX.	0.	0.	780.	178.	171.	0.	1127.
FED. DEPR. 1.00	0.	0.	0.	0.	0.	0.	0.
FED. DEPR. .50	0.	0.	0.	0.	0.	0.	0.
FED. DEPR. .30	0.	0.	0.	114.	516.	341.	970.
FED. DEPR. .25	0.	0.	0.	0.	0.	0.	0.
FED. DEPR. .20	0.	0.	0.	0.	0.	0.	0.
FED. DEPR. .15	0.	0.	0.	0.	0.	0.	0.
FED. DEPR. .10	0.	0.	0.	0.	0.	0.	0.
FED. PREPRODUCTION	0.	0.	0.	0.	0.	0.	0.
FED. PFT. BFR. TX.	0.	0.	0.	0.	0.	0.	0.
PROVINCIAL TAX	0.	0.	117.	27.	26.	0.	170.
FEDERAL DEPLETION	0.	0.	0.	0.	0.	0.	0.
FEDERAL TAX	0.	0.	0.	0.	0.	0.	0.
GROSS CASH FLOW	294.	1703.	1485.	682.	516.	341.	5018.
LOAN REPAYMENT	0.	0.	0.	0.	0.	0.	0.
NEW CAPITAL ASSETS	0.	0.	200.	0.	0.	0.	200.
WORKING CAP.RDMTN.	0.	0.	0.	0.	0.	0.	0.
NET CASH FLOW	294.	1703.	1285.	682.	516.	341.	4818.
CUM. CASH FLOW	294.	1996.	3281.	3962.	4478.	4818.	

C H A P M A N , W O O D , A N D G R I S W O L D L T D .

DOLLY VARDEN MINES LTD. (NPL) JUNE 11,1969 CASE 3

1000 CANADIAN $	1970	1971	1972	1973	1974	1975	TOTALS
METAL SALES	857.	5137.	5137.	4270.	4216.	3331.	22945.
OPERATING COST	393.	2414.	2514.	2771.	2899.	2377.	13366.
INTEREST INCOME	0.	0.	0.	0.	0.	0.	0.
TOTAL INCOME	464.	2724.	2624.	1499.	1318.	954.	
INTEREST EXPENSE	0.	0.	0.	0.	0.	0.	0.
PROV. DEPR. 1.00	0.	0.	0.	0.	0.	0.	0.
PROV. DEPR. .50	0.	0.	0.	0.	0.	0.	0.
PROV. DEPR. .30	464.	946.	722.	506.	354.	826.	3815.
PROV. DEPR. .25	0.	0.	0.	0.	0.	0.	0.
PROV. DEPR. .20	0.	0.	0.	0.	0.	0.	0.
PROV. DEPR. .15	0.	0.	0.	0.	0.	0.	0.
PROV. DEPR. .10	0.	0.	0.	0.	0.	0.	0.
PROV. PREPRODUCTION	0.	771.	0.	0.	0.	0.	771.
PROV. PFT. BFR. TX.	0.	1008.	1902.	993.	964.	129.	4994.
FED. DEPR. 1.00	0.	0.	0.	0.	0.	0.	0.
FED. DEPR. .50	0.	0.	0.	0.	0.	0.	0.
FED. DEPR. .30	0.	0.	0.	225.	1077.	935.	2237.
FED. DEPR. .25	0.	0.	0.	0.	0.	0.	0.
FED. DEPR. .20	0.	0.	0.	0.	0.	0.	0.
FED. DEPR. .15	0.	0.	0.	0.	0.	0.	0.
FED. DEPR. .10	0.	0.	0.	0.	0.	0.	0.
FED. PREPRODUCTION	0.	0.	0.	0.	96.	0.	96.
FED. PFT. BFR. TX.	0.	0.	0.	0.	0.	0.	0.
PROVINCIAL TAX	0.	152.	286.	149.	145.	20.	749.
FEDERAL DEPLETION	0.	0.	0.	0.	0.	0.	0.
FEDERAL TAX	0.	0.	0.	0.	0.	0.	0.
GROSS CASH FLOW	464.	2573.	2338.	1350.	1173.	935.	8830.
LOAN REPAYMENT	0.	0.	0.	0.	0.	0.	0.
NEW CAPITAL ASSETS	0.	0.	200.	0.	0.	0.	200.
WORKING CAP.RDMTN.	0.	0.	0.	0.	0.	0.	0.
NET CASH FLOW	464.	2573.	2138.	1350.	1173.	935.	8630.
CUM. CASH FLOW	464.	3036.	5174.	6523.	7696.	8630.	


CASH FLOW CUMULATIVE
CANADIAN DOLLARS
8 M
6 M
4 M
2 M
NET CASH FLOW
CASE 3
NET RETURN FROM FORECAST
SILVER PRICE CASE I
CASE 2
ONWARD FINANCIAL
REQUIREMENT
1.90
2.00
2.10
2.20
2.30
2.40
2.50
2.60
MARKET PRICE SILVER