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DOLMAGE CAMPBELL & ASSOCIATES (1975) LTD.
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PORTION OF March 1982 FEASIBILITY REPORT MT. NANSEN MINE

1. SUMMARY

The Mt. Nansen gold-silver deposits occur in an extensive system of relatively high-grade veins on which presently profitable ore reserves have been proven with a minimal amount of development per ton.

Existing data indicates that the ultimate tonnage potential of the veins on the property is excellent. This undeveloped potential is a primary attraction of the Mt. Nansen property.

PROPERTY

The property comprises 164 mineral claims and numerous fractions located 147 miles northnorthwest of Whitehorse in the Yukon Territories. It is connected to the town of Carmacks, on the Dawson-Whitehorse Highway, by 39 miles of all-weather gravel road that presently requires repair for summer use.

The Mt. Nansen mine comprises over three miles of underground level workings in three areas, the Webber, the Huestis and the Brown-McDade, each approximately one mile apart.

Steeply dipping, branching, gold-silver-bearing veins, averaging 3-4 feet in width are developed in an upper adit (Elev. 4260') at the Webber and in an upper (4300') and a lower (4100') adit at the Huestis. Similar veins up to 10 feet in width occur within a major fault zone on one developed level (4000') at Brown-McDade.

The mine produced 18,000 tons of ore in 1968-69 and 6,000 tons in 1976, all from the Webber and Huestis. This ore was treated in the 300 tpd mill that remains in reasonably good repair on the property. Although two year's supply of ore was developed, the mine was closed in 1969, primarily because of the lack of operating capital, aggravated by the low return for the bulk concentrate produced at that time.

ORE RESERVES

The ore reserves calculated from mine records are:

TOTAL PROVEN-PROBABLE 248,708 tons @ 0.452 oz/t Au, 9.98 oz/t Ag

define?
(O.K., see p. 18, 19)

The reserves in each deposit are:

	Proven-Probable	Au(oz/t)	Ag(oz/t)
Webber	79,440 tons	0.25	14.74
Huestis	98,398	0.41	8.98
Brown-McDade	66,645	0.66	4.80
Cabin Creek	4,225	0.23	25.60

The total POSSIBLE tons in the developed headings is estimated to be 175,000 tons. ← def. ?

The ore POTENTIAL of the property, indicated by the high ratio of ore to developed vein, as well as by the large number of unexplored, extensive and well established silver-arsenic soil anomalies on the property, suggests a probable life in excess of 50 years at 300 tons per day.

= ~4.5 m t. Depth constraints ?

METALLURGY

In 1968-69 the Mt. Nansen mill produced a bulk gold-silver concentrate that was shipped to Boliden, Sweden.

The metallurgical consultant who designed the original flow-sheet and mill, has submitted in this report modifications to improve mill efficiency and metal recoveries in separate silver and gold concentrates that are currently acceptable to smelters in Belgium and Boliden respectively.

Some metallurgical testing of typical ores is necessary for the verification of the recommended modifications and for the production of sample concentrates for smelters.

REHABILITATION AND CAPITAL COSTS

Apart from the mill, the camp and surface installations have largely been stripped of electrical, plumbing, culinary and other fixtures. The rehabilitation of the road, the camp, and the water supply system, all of which are necessary to reopen the mine, is estimated to cost approximately $540,000.

The remaining capital costs required to rehabilitate the mill, the powerplant, the tailings pond and the mine, and to approximately double the reserves by new development, as well as reach a positive cash flow, are estimated to total $14 million, including working capital.

The capital costs necessary to simply salvage the existing reserves are estimated to be $9-$11 million.

inclusive of → ?

YES ✓

PROJECTED CASH FLOW

The net smelter returns of the Mt. Nansen ore, (reserve grade), have been estimated from the schedules of the two smelters who have indicated acceptance of the concentrates.

The total operating costs for a 300 tpd mine and mill at Mt. Nansen are estimated to be $118 (Can.) per ton.

At an annual production of 100,000 tons of ore of the grade of existing ore reserves would produce the following approximate net profits, after one year of negative cash flow from mill start-up, depending on metal prices:

1979 -	(Gold $425/oz U.S.,	silver $17/oz U.S.)	=	$13.7 million
1981 -	(" 475 " ,	" 13 ")	=	8 11.1 million
(Feb.) 1982 -	(" 360 " ,	" 8 ")	=	3 million

2. INTRODUCTION

2.1 TERMS OF REFERENCE

This report reviews the economic viability of the Mt. Nansen Mine in terms of current costs and metal prices. Compilation of the report has been facilitated by the advanced state of mine development and by the previous operating data that are available for the Mt. Nansen mine and property.

The report is based on voluminous technical data from the years of mine development and operation and on the writers' examinations of the properties, surface installations and accessible underground workings in 1979 and 1981. Since the original exploration and development of the property was directed by personnel of Dolmage Campbell and Associates Ltd. in 1964-68, the knowledge gained at that time has contributed greatly to the compilation of this report.

Although the portals to the principal underground workings at Mt. Nansen are presently blocked by ice, preventing examination of the workings, access was available in 1979 when a cursory examination of the Huestis levels was made by two engineers of Dolmage Campbell. Apart from the portal sections of the adits, where ice and caved timber must be removed to rehabilitate the openings, the underground workings are in permanently frozen rock and are in stable condition, with air and water lines still intact; thus, underground rehabilitation will be a minimal task once the portals are repaired.

A thorough and comprehensive feasibility study of the Mt. Nansen Mine is possible without the necessity of an underground examination or a check sampling program because of the following conditions:

(1) The workings were in stable condition in 1976, when the mine was last worked, and in 1979, when last examined. They can be assumed to be still in good order because of the stabilizing effect of permafrost on the rock.

(2) When the mine operated in 1968 and 1969 the mine staff, comprising experienced geologists, engineers and technicians, surveyed, mapped and sampled all workings with a high degree of professionalism, producing geological maps, plans and sample records of excellent quality; all of which are available as a data base for feasibility studies.

The only data that are not available are the values of the ore remaining in the backs (upper faces) of three stopes in the Huestis workings that were mined to a limited degree in 1976, when 6,000 tons were produced. These stopes are: 41-585, 41-594 and 43-594, the last one of which is not critical because there is only about 40 feet of ore remaining between the present back and the surface. The sampling of the backs of the first two stopes would confirm a minor portion of the ore reserves. These portions now have to be estimated by extrapolation of sample results from former (lower) faces. The changes imposed on the calculated ore reserves by these missing stope assays are inconsequential because the assays influence only a minor increment of the reserve ore.

(3) The authors of this feasibility report made a thorough inventory and assessment of all of the surface plant and mill in 1981. This inspection, along with the examination of the underground in 1979 and a visit during stoping in 1969, forms the basis for the cost estimates presented in this report.

All costs used in this study are in 1981 Canadian dollars.

(4) In 1979, 1980 and 1981 the authors canvassed a considerable number of world smelters to determine which would purchase the type of concentrates produced by the Mt. Nansen mill. Boliden Metall, Sweden, agreed to accept the gold concentrate and Societe Generale des Minerais, Belgium, agreed to the silver concentrate. The estimated cash flows in the present report are based on the revenue derived from concentrates sent to the above smelters, on the basis of smelter schedules submitted in June, 1979 and May, 1980.

The authors and their consulting metallurgist, Mr. D. Gunn, are convinced that the 1969 mill circuit can be improved to produce lower volume concentrates and higher recoveries, and it is our recommendation that suitable testing be undertaken to achieve this. However, the present report is designed to demonstrate the economic feasibility of a mining operation at Mt. Nansen based solely on the conditions pertaining in the 1969 operation, which are known to be attainable.

The primary reason that the Mt. Nansen operation is presently profitable, rather than marginally so in 1969, is the increase in the prices of gold and silver since 1969, with a lesser proportionate increase in costs.

2.2 LOCATION (62°N, 137°W)

The Mt. Nansen Mine is located 235 km (147 miles) north-northwest of Whitehorse in the Yukon Territory, (Fig. 1). An access road some 63 km (39 miles) in length connects the property with the Klondike Highway at Carmacks, 174 km (108 miles) north of Whitehorse. The Klondike Highway is paved for a total of 77 km (48 miles) north from Whitehorse, with the remainder being good all-weather gravel road. The mine access road is presently in some disrepair but can be made into an all-weather gravel road without difficulty.

From Whitehorse, travel to southern Canada is by regular airline service to Vancouver, B.C. and Edmonton, Alberta; by railway to Skagway on the Alaskan coast and thence by ship to Vancouver; and by motor-vehicle via the Alaska Highway and connecting highways to Vancouver and Edmonton.

Whitehorse, the capital of Yukon Territory, has a population of approximately 16,000; it is the service and supply centre for most of the Yukon.

2.2.1 Topography and Climate

The topography in the region of the Mt. Nansen property is dominated by rounded hills and subdued relief. The hill slopes are generally covered by grass and buckbrush and tend to be somewhat soggy except in the driest of seasons. Ridge crests and some south slopes are commonly rocky and have firm, dry surfaces. Patches of small trees grow on south-facing slopes and in sheltered areas. Creeks are abundant.

The area has not been glaciated; therefore, unweathered bedrock lies beneath a generally frozen cover of soil, rock-soil and broken rock that ranges in thickness from a few feet on ridges, to over 50 feet in valley bottoms. Outcrops are not common.

Climate in the Mt. Nansen area is classified as sub-arctic. Summers are warm to occasionally quite hot and winters are lengthy and cold. The average annual number of frost-free days is 50. Temperature extremes are summer highs of 30°C and winter lows of -45°C. Precipitation is light, averaging 12 inches per year; about 50 percent of which occurs as snowfall. Maximum snow depth is in the order of 20 inches.

2.3 HISTORY

Following the Klondike Gold Rush in 1898, placer mining spread throughout the Yukon, and in 1910 most of the creeks in the area of Mt. Nansen were staked for placer gold. A number of placer claims were worked intermittently on the creeks north of Webber Creek and although some coarse gold was produced, none of the operations proved consistently economic.

In 1930, gold was found in bedrock on Mt. Freegold, 14 miles north of the present Mt. Nansen Mine, resulting in a small staking rush in the district. The Timmins Corporation began underground exploration on Mt. Freegold in 1934 and in 1965 Discovery Mines Ltd. brought the property, the La Forma Mine, into production for a few years at a rate of 125 tons per day.

The first Mt. Nansen lode deposit was found by prospectors Brown and McDade in 1943. Sampling of surface trenches and subsequent drilling returned sufficiently high values in gold and silver to induce

Leitch Gold Mines Ltd. to form Brown-McDade Mines Ltd. In 1946, the mineralized zone was exposed underground by drifting and drilling from a crosscut adit. At the same time Conwest Explorations Ltd. explored the Webber Creek area, two miles to the west, and the Huestis Syndicate trenched the Huestis Vein zone about one mile west of Brown-McDade. Underground results at Brown-McDade did not meet expectations and the project was abandoned in 1947. All other activity ceased in the area about the same time.

In 1958 prospecting activity revived in the area once again and in 1962-63 the Mt. Nansen Mines Syndicate (Newmont, Noranda, Rio Tinto, Kerr Addison, Conwest, and Faraday) was formed and extensively stripped the Webber and Huestis vein zones and drilled four holes into the Webber zones.

In 1964 Mt. Nansen Mines Ltd. came under the control of Peso Silver Mines Ltd. and a program of further stripping, sampling and extensive overburden drilling was done on the Webber and Huestis vein zones. The results of this work prompted underground exploration, and adits were collared in December, 1964, and March, 1965, on the Webber and the Huestis respectively. The exploration was conducted largely in 1965 and 1967 with sporadic work in 1966.

During 1967 and 1968, the property was brought to production by underground development and the construction of a concentrator and ancillary surface plant. It operated for eight months (18,000 tons production), being shut-down in April, 1969 because of adverse economics. The property lay dormant until 1976 when the mine and plant were operated intermittently from June to October (6000 tons production). No further work has been done to the present time.

No significant underground development or exploration was done in the mines after production started in 1968.

The approximate amount of underground development on the property is as follows:

	DRIFTS		RAISES	
	Metres	(Feet)	Metres	(Feet)
Huestis 4300	1290	(4,230)	70	(230)
Huestis 4100	1050	(3,450)	120	(400)
Huestis	2340	(7,680)	190	(630)
Webber 4300	1150	(3,775)	100	(330)
Webber 4100	260	(855)	-	-
Webber	1410	(4,630)	100	(330)
Total	3750	(12,310)	290	(960)

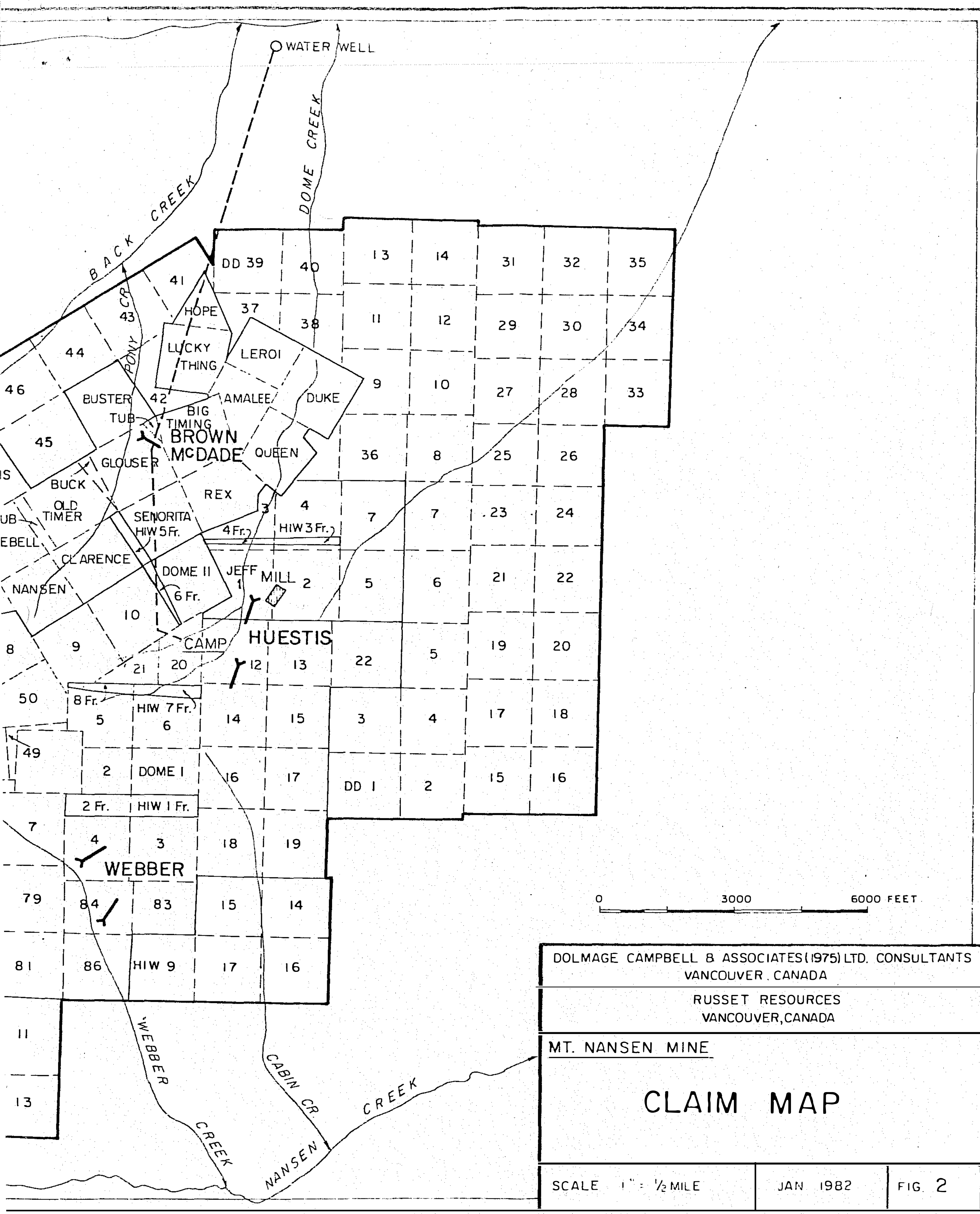
The relative locations of the underground workings are shown on Figure 3.

2.4 PROPERTY

Mt. Nansen property consists of three contiguous groups of claims, the Mt. Nansen Group, the DD Group, and the Brown-McDade Group, with a total of 170 claims. Details of the groups are listed in Table 1 and shown on Figure 2.

TABLE 1 - MT. NANSEN CLAIMS

Claim Name	Record Number	Expiry Date
Mt. Nansen Group		
Dome 1-7	73537-73543	Jul. 13, 1982
Dome 8-11	73694-73697	Jul. 15, 1982
Dome 12	73698	Jul. 15, 1981
Dome 13-18	73699-73704	Jul. 15, 1982
Dome 19	73705	May 1, 1982
Dome 20-21	73706-73707	Jul. 15, 1982
Dome 22	73708	Jul. 15, 1981
Dome 25-28	77746-77749	May 8, 1982
Dome 33-43	77754-77764	May 8, 1982
Dome 47-48	77768-77769	May 8, 1982
Dome 49-52	77770-77773	May 8, 1982
Dome 53-62	77774-77783	May 8, 1982
Dome 63-66	77784-77787	May 1, 1982
Dome 78-84	81842-81848	Sep. 18, 1982
Dome 86	81850	Sep. 18, 1982
HIW Fr. 1-8	YA24813-YA24820	Jul. 8, 1981
HIW 9	YA23835	Oct. 27, 1981
HIW Fr. 10-11	YA23836-YA23837	Oct. 27, 1981
HIW 12-17	YA23838-YA23843	Oct. 27, 1981
Jeff 1-4	77798-77801	May 8, 1982
Jeff 5	77802	May 8, 1982
Jeff 7	77804	May 8, 1982
Joanne 1-6	74238-74288	Jul. 28, 1982
Laura 9	93454	May 1, 1982
	Number of claims - 95	
DD Group		
DD 1-48	YA59536-YA59643	Jan. 27, 1982
	Number of claims - 48	
Brown-McDade Group		
As named on Figure 2.	Number of claims and fractions - 27	



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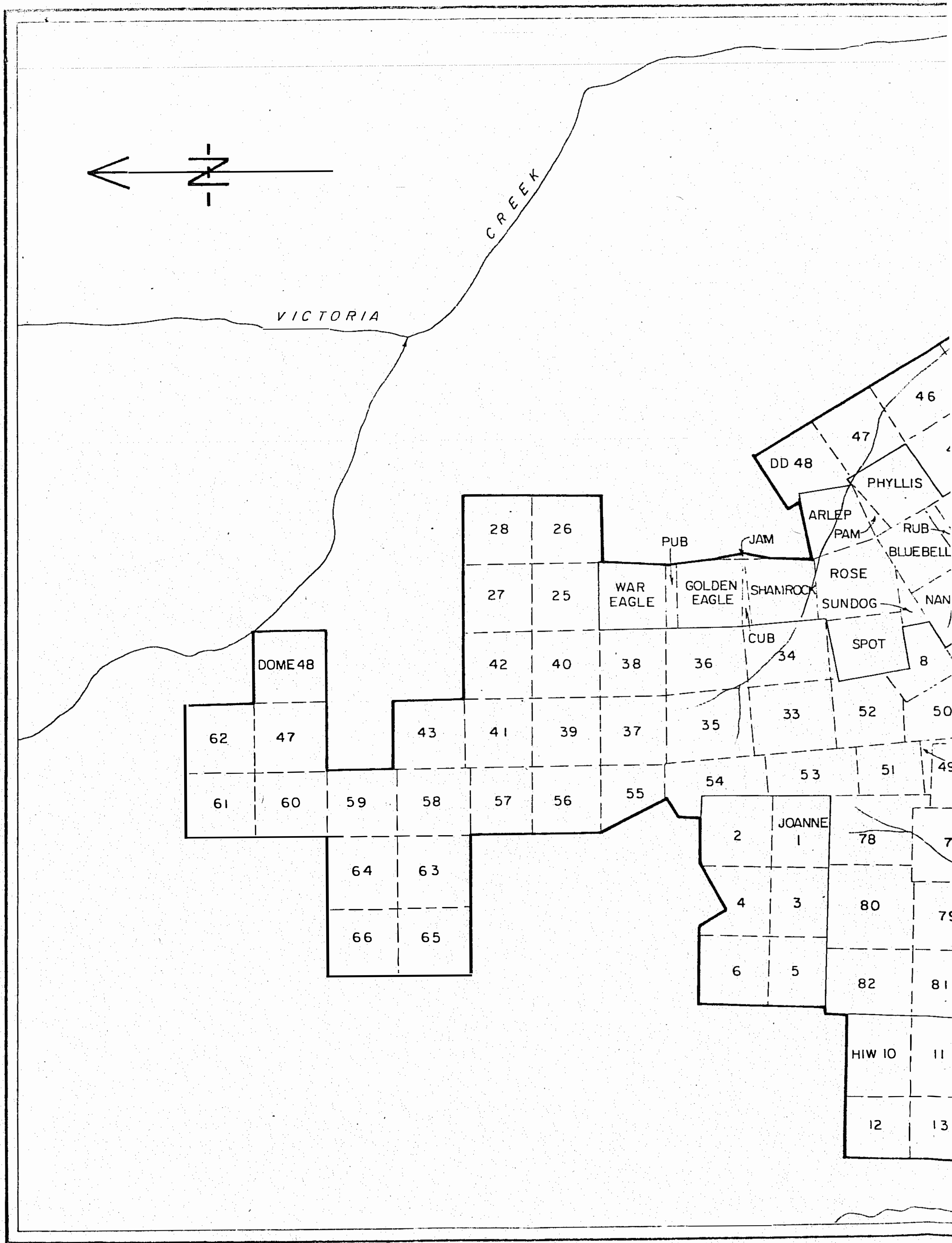
MT. NANSEN MINE

CLAIM MAP

SCALE 1" = ½ MILE	JAN 1982	FIG. 2


N
VICTORIA
CREEK
46
47
DD 48
PHYLLIS
ARLEP
PAM
RUB
BLUEBELL
28
26
PUB
JAM
ROSE
27
25
WAR EAGLE
GOLDEN EAGLE
SHAMROCK
SUNDOG
NAN
CUB
SPOT
DOME 48
42
40
38
36
34
8
33
52
50
62
47
43
41
39
37
35
54
53
51
61
60
59
58
57
56
55
2
JOANNE 1
78
64
63
4
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80
66
65
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82
81
HIW 10
11
12
13

3. GEOLOGY

3.1 REGIONAL

The Mt. Nansen area is situated within the eastern half of the Coast Crystalline Belt that trends northwesterly across southwest Yukon. The belt comprises extensive acidic to intermediate intrusive bodies of post-Triassic age that are interspersed with abundant septa and large bodies of variously metamorphosed pre-intrusive sedimentary and volcanic rocks.

In the mine area the oldest rocks are gneisses and schists of the Yukon Group, which is assumed to be Cambrian-Precambrian in age. These old formations are overlain by intermediate to basic volcanic units of the Mt. Nansen Group of Jurassic age. Small stocks and larger batholithic bodies of quartz porphyry, granite, granodiorite and diorite intrude the metamorphic and volcanic units.

No regional or major faults have been identified in the Mt. Nansen area; however, the ubiquitous cover of regolith overburden precludes definitive assumptions regarding the presence or absence of such faults. The Webber, Huestis and Brown-McDade vein zones are mineralized faults, of which the Brown-McDade appears to be regional in character. These faults strike northwestward and dip vertically to steeply east and west.

3.2 PROPERTY

Less than ten percent of the Mt. Nansen property area is bedrock outcrop. The remaining 90 percent comprises a regolith overburden of frozen soil and rock fragments representing the weathering products of the underlying bedrock. The depth of this regolith ranges from less than a foot or two, along ridge crests, to tens of feet on the lower hill slopes and valley bottoms. Considerable downslope displacement of the regolith occurs on the steeper hillsides.

Because of the lack of bedrock outcrops, the geology of the property must be largely extrapolated from the few outcrops, the mine exposures and from the rock debris in the regolith; thus, the property geology as shown in Figure 3 is the result of the best efforts of the geologists who have worked on the property to date. Although the map is generally correct in its locations of the major rock types, it cannot be considered to be accurately definitive at this stage. The major bedrock units on the Mt. Nansen property, depicted in Figure 3, are:

3.2.1 Yukon Group

The oldest rocks in the area comprise gneisses, schists and quartzites of the Yukon Group, believed to be possibly Precambrian in age. These rocks underlie the southern third of the Mt. Nansen claim area and occur on the property as alternating bands of schist, quartzite and amphibolite rock, all striking generally northwestward and dipping steeply west.

Most of the developed portion of the Huestis veins and about half of the developed Webber and Brown-McDade veins lie within Yukon Group rocks.

3.2.2 Mt. Nansen Group out of date

Unconformably overlying the Yukon Group rocks in this area is a thick sequence of Jurassic volcanic rocks termed the Mt. Nansen Group. Regionally this group comprises andesite flows and clastics, basalt flows and related dioritic hypabyssal (near-surface) intrusives.

The precise distribution of Mt. Nansen Group rocks on the Mt. Nansen property is as yet not clearly defined but it is evident that most of the central and western portion of the property is largely underlain by andesitic volcanic rocks and dioritic porphyritic intrusives that probably belong to the Group, (Fig. 3). Webber Ridge is largely underlain by diorite which appears to be contemporaneous with and/or intrusive into related basalts but which is intruded by granitic rocks. The Mt. Nansen Group volcanic rocks generally trend east-west across the Webber Ridge.

3.2.3. Granitic Intrusives

Intrusive into all of the preceding rocks are two types of granitic rocks, granodiorite and porphyritic granite, both believed to be of Jura-Cretaceous age. The two rocks occur side-by-side in the Brown-McDade adit but are separated by a fault three feet in width.

Approximately half of the developed Webber veins lie within granitic porphyry intrusive rocks.

3.2.4. Rhyolite Intrusives

Extensive rhyolite intrusive stocks and dikes crop out for the full length of Webber Ridge north to Victoria Mountain. These rocks intrude all of the above-described formations; they are pre-ore, sometimes occurring as dikes of intensely crushed and altered rhyolite in many of the mineralized veins. Plugs or pipes of rhyolite are erosion resistant and commonly form prominent domes along the ridges on the property.

3.2.5. Structures

Two sets of faults have been encountered in the underground work. One set strikes northnorthwest, parallel to the mineralized veins, with some of them being locally mineralized. These faults dip 50°-70° southwestward and comprise gouge-filled shear zones ranging in width from 1 to 45 feet; they include the mineralized Brown-McDade zone.

The second fault set strikes northeast and has steep to vertical dips. These faults offset the mineralized veins and all rock units with left-hand displacements of 2 to 100 feet. Major members of the set appear to be spaced at about 500 foot intervals in the mine area. Minor members are usually grouped in clusters in which individual members may be 3 to 6 feet apart. These faults commonly die out, or merge with the vein faults, along strike.

3.3 ECONOMIC GEOLOGY

3.3.1 Ore Structures

The mineralized structures in the Mt. Nansen area comprise complex fault-shear-alteration zones that cut all of the above described rocks and are persistent for nearly two thousand feet of explored length and up to five hundred feet of explored depth. All of these zones strike north to northnorthwest and dip steeply to the east and west. Some zones are characterized in places by a gouge plane, generally on the footwall, adjacent to which is intensely sheared and altered rock which is locally host to replacement lenses and veins of quartz, carbonate and ore minerals.

The mineralized sections of the vein zones range in width from a few inches to 10 feet, with the average width being about 3 feet.

Vein structures widen and pinch considerably when passing from one type of wallrock to another; in particular, the veins are widest within Yukon Group metamorphic rocks, and markedly narrower within the rhyolite intrusives. The Brown-McDade zone, over 100 feet in width in the mine, pinches to the north to less than 3 feet in width where it passes from granodiorite at the mine to Mt. Nansen Group basalt and diorite north of the mine. Where it passes back into granitic rocks in the north half of the property the vein zone widens again to nearly 100 feet.

The vein zones branch and anastomose extensively, with some branches being mineralized to ore grade, particularly near the parent vein structure.

The relative locations of the developed portions of the Webber and Huestis vein zones are shown in Figure 4. These vein zones are shown in more detail in Figures 6, 7 and 8.

3.3.2 Ore Mineralogy

The vein material in all of the vein zones consists of watery, cherty quartz and white crystalline quartz, the former generally as replacement along the vein-shear zones. In the wider sections of the veins the quartz and any included fragments of wallrock are generally rusty and sheared. Within the ore shoots the quartz is host to extremely finely divided pyrite and arsenopyrite which appear as watery black streaks or solid masses. No visible gold or identifiable silver minerals have been seen megascopically in the ore, even in places of extremely high assays.

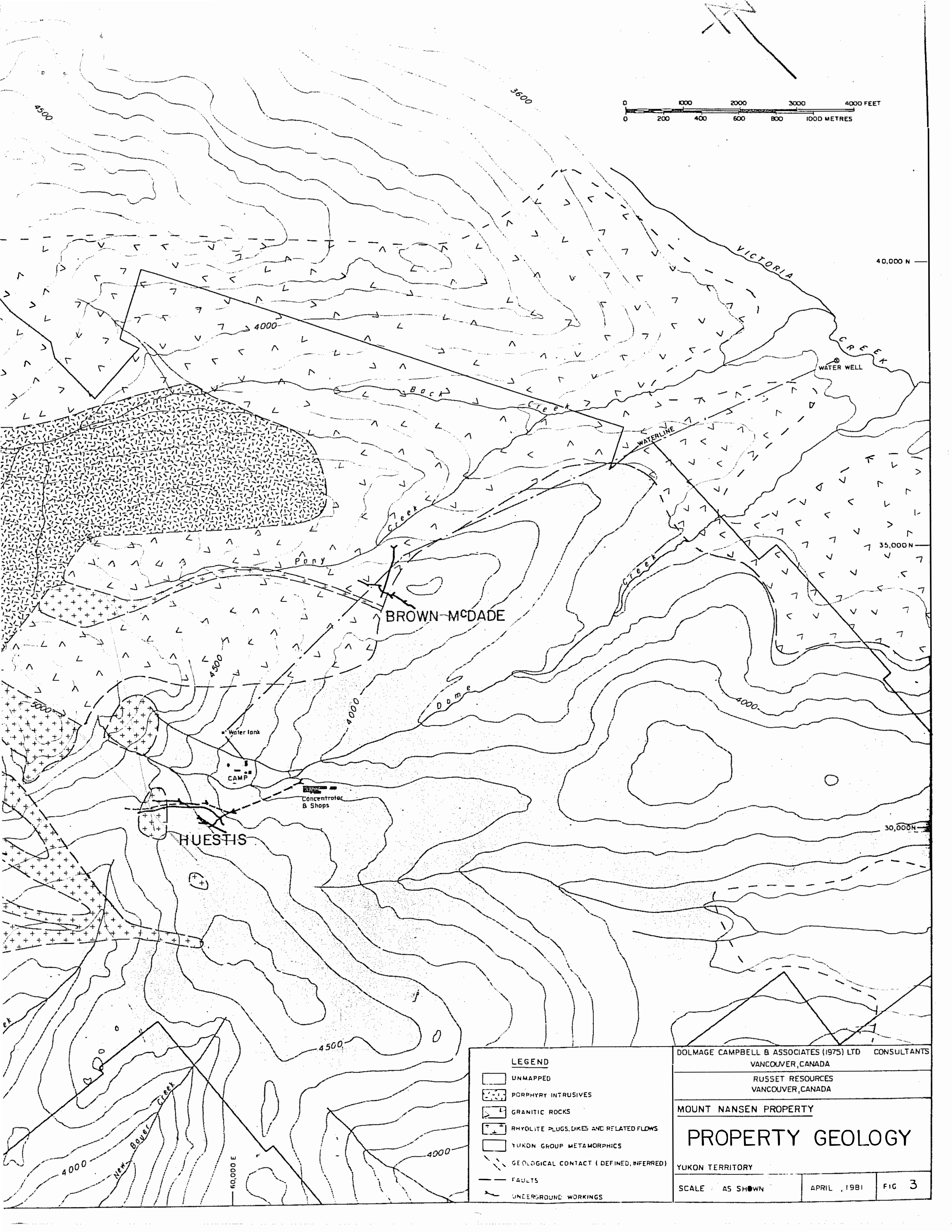
The silver content is generally less and the gold content greater in the Huestis veins than in the Webber. The gold and silver values occur in characteristically diffuse, fine grained black dispersions in very hard flinty, cherty quartz in all of the Huestis and Webber veins.

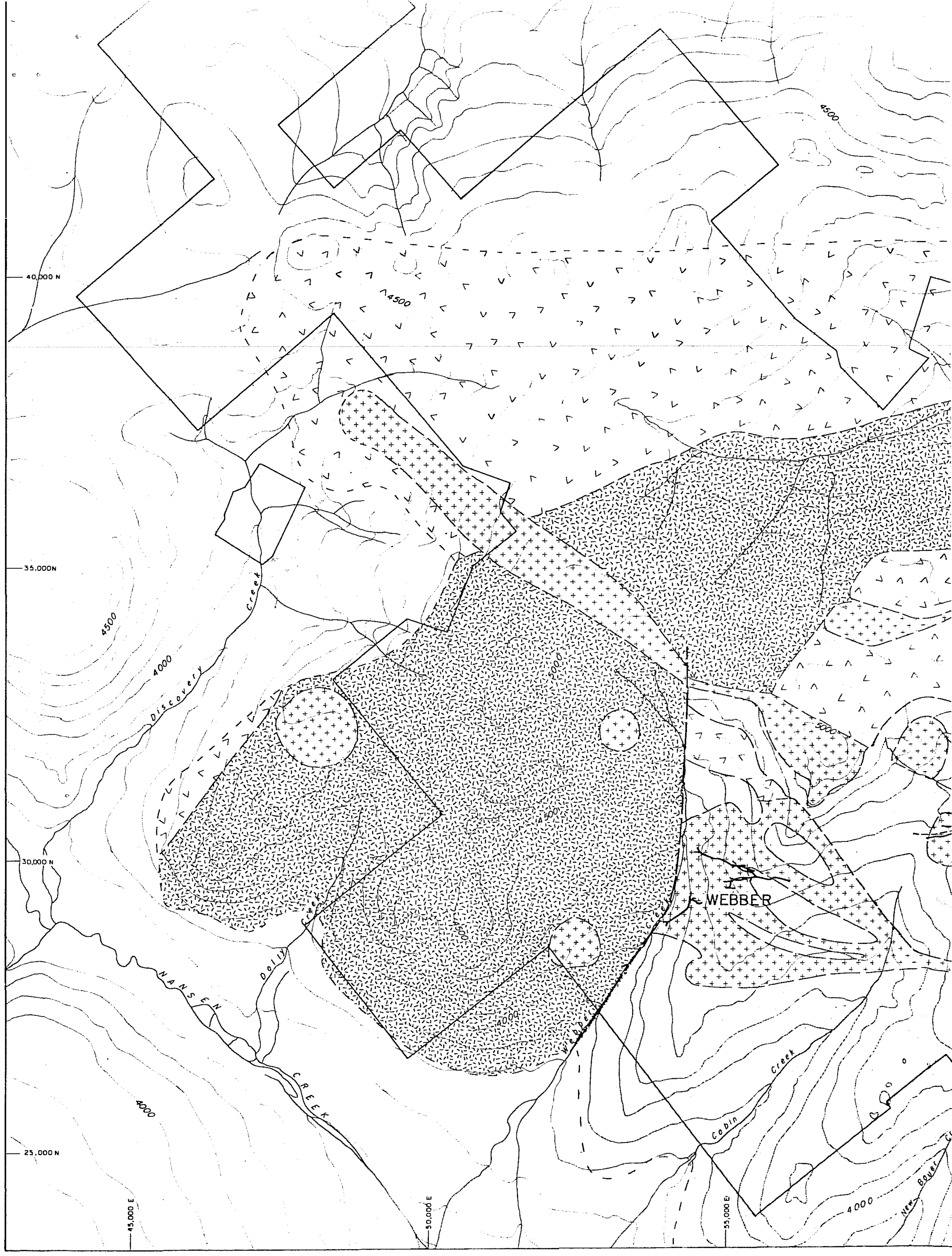
In the Brown-McDade zone the ore material is cherty replacement quartz within clay-altered and sheared wallrocks. Gold and silver values occur with very fine grained sulphides, both as replacement and open-space filling.

Pyrite is the most widely distributed mineral within and beside the ore zones but it is not related to the ore values. Arsenopyrite is the principal sulphide within the ore zones where, because it is finely divided, it imparts a characteristic bluish tinge to the ore material. Sphalerite, chalcopyrite and stibnite are locally plentiful but not to ore proportions, although lead and antimony report in the smelter returns.

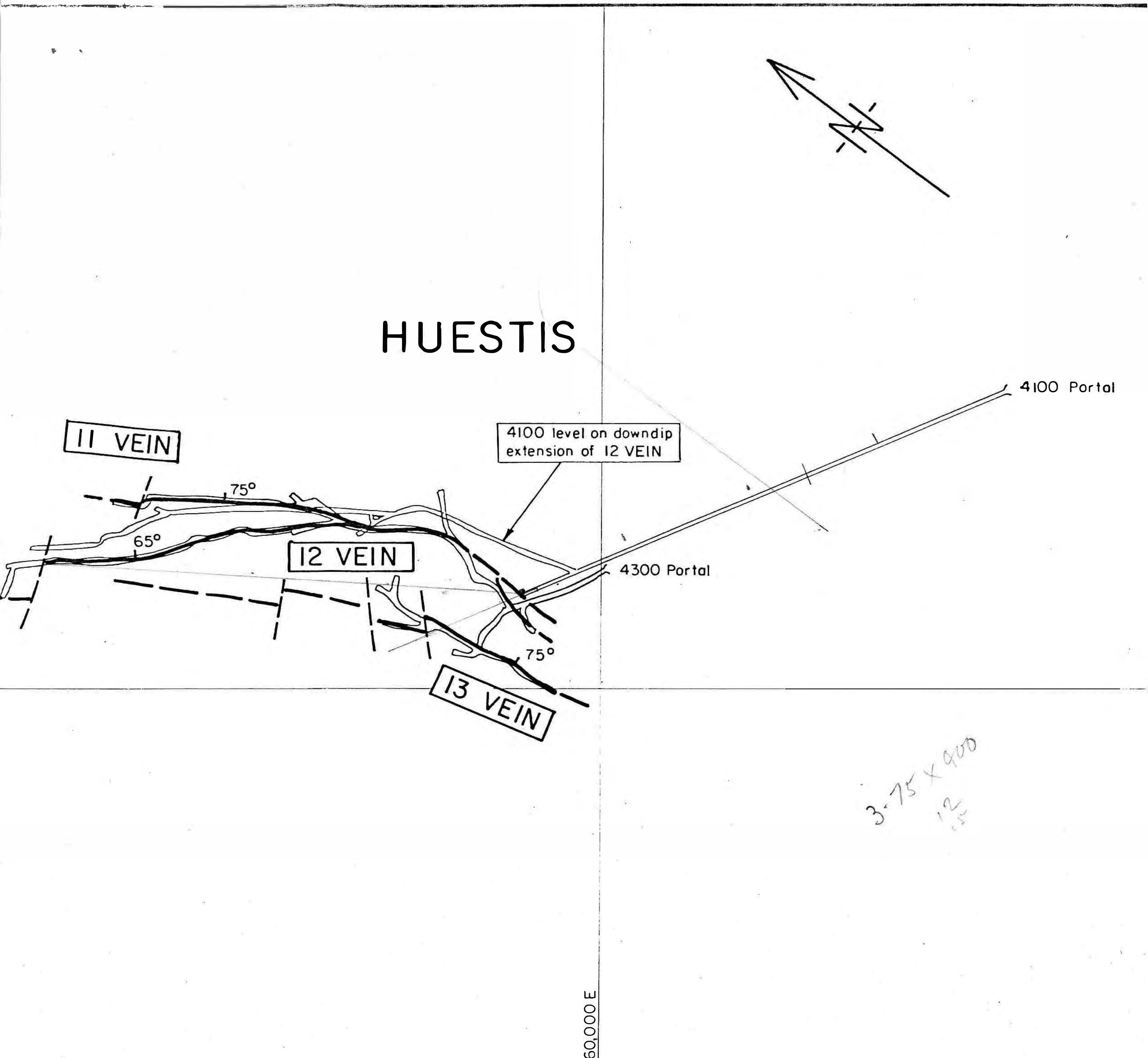
3.3.3 Wallrock Alteration

Hydrothermal alteration of the wallrocks of the Mt. Nansen vein zones is locally intense, generally pervasive and universally distributed. Two major types of alteration are encountered in various parts of all veins; silicification and argillic (clay) alteration, and both are generally accompanied by bleaching. The argillic alteration is the most widespread along the veins and faults and extends for tens of feet into the wallrocks along bedding or fracture planes. It does not provide a reliable guide to ore on the veins. The silicification occurs more sporadically along the veins but does not occur adjacent to faults, and generally has not penetrated more than a few feet from the source vein structure. In many places it has proven to be a definite indicator of ore on the veins.


0 1000 2000 3000 4000 FEET
0 200 400 600 800 1000 METRES
3600
4500
4000
VICTORIA CREEK
WATER WELL
Back Creek
WATERLINE
Pony Creek
Creek
BROWN-McDADE
4500
Dome
4000
5000
Water tank
CAMP
Concentrator & Shops
HUESTIS
40,000 N
35,000 N
30,000 N
4500
4000
4000
New Bauer Creek
60,000 E
LEGEND
UNMAPPED
PORPHYRY INTRUSIVES
GRANITIC ROCKS
RHYOLITE PLUGS, DIKES AND RELATED FLOWS
YUKON GROUP METAMORPHICS
GEOLOGICAL CONTACT (DEFINED, INFERRED)
FAULTS
UNDERGROUND WORKINGS
DOLMAGE CAMPBELL & ASSOCIATES (1975) LTD CONSULTANTS
VANCOUVER, CANADA
RUSSET RESOURCES
VANCOUVER, CANADA
MOUNT NANSEN PROPERTY
PROPERTY GEOLOGY
YUKON TERRITORY
SCALE AS SHOWN
APRIL, 1981
FIG 3



40,000 N
35,000N
30,000 N
25,000 N
45,000 E
50,000 E
55,000 E
4500
4000
5000
Discovery Creek
Dolly Creek
NANSEN CREEK
Webber Creek
Cabin Creek
New Bauer Cr
WEBBER



LEGEND

- EXPOSED VEIN
- PROJECTED VEIN
- FAULT

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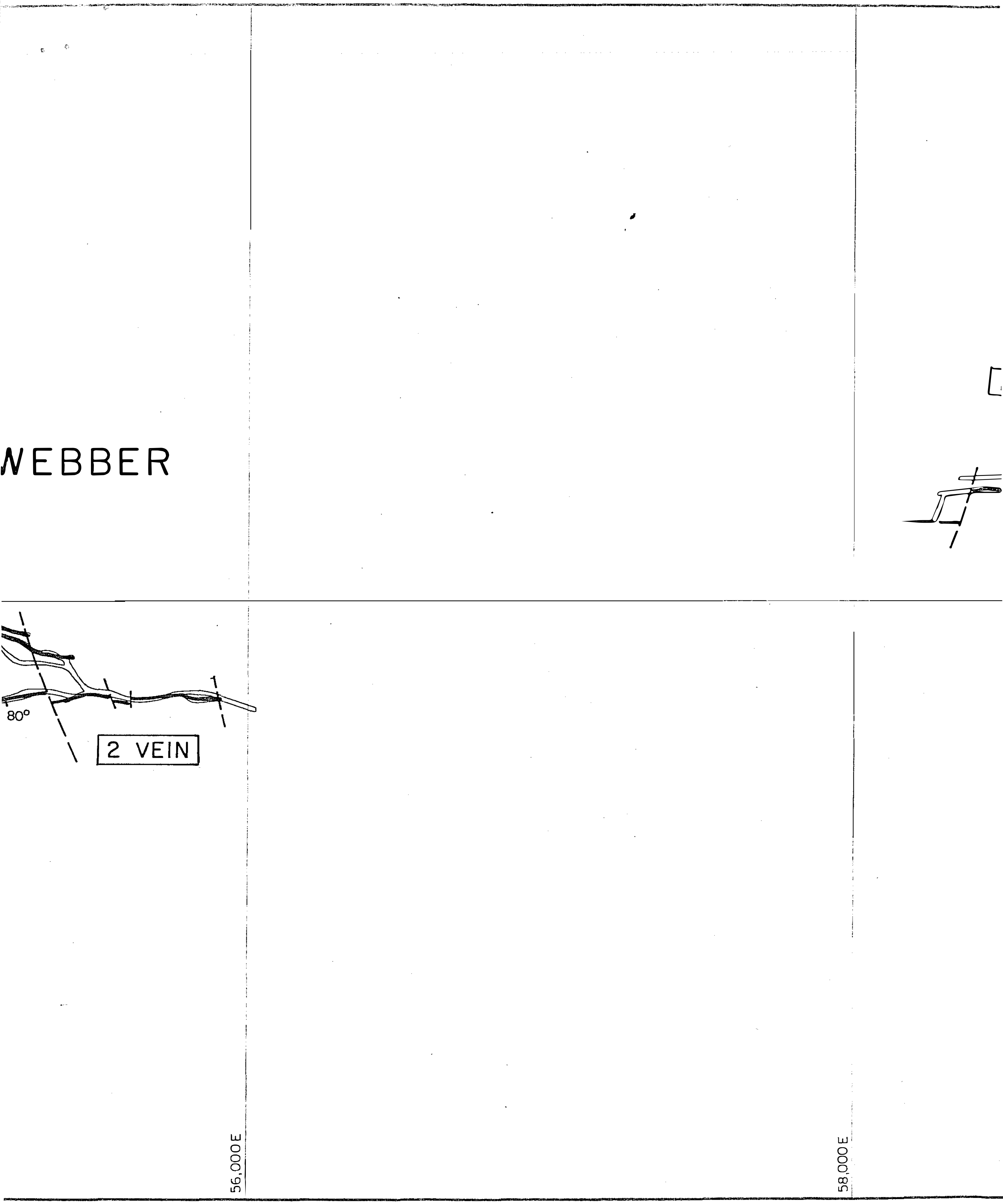
RUSSET RESOURCES
VANCOUVER, CANADA

MT. NANSEN MINE

WEBBER & HUESTIS VEIN ZONES

SCALE : 1" = 400'	APRIL 1981	FIG. 4


WEBBER
80°
2 VEIN
56,000 E
58,000 E

4. ORE RESERVES AND POTENTIAL

4.1 OREBODIES

All of the known ore reserves on the Mt. Nansen Property occur on the four explored vein systems; the Webber, the Huestis, the Brown-McDade and the Cabin Creek. The Huestis vein systems have been explored and developed on two adit levels, the Webber and the Brown-McDade on one and the Cabin Creek by surface trenching and drilling. Soil geochemical surveys have investigated the lateral extensions of all of these veins, and diamond drilling below the bottom Huestis level has confirmed depth continuity. (to ~500' below surface)

The ore reserves presented in this report are those exposed by the existing development. Most of the ore that was milled in 1968-69 and in 1976 was derived from development and stopes in the Huestis adits, with minor contribution from stoping and stock-piled development ore from the Webber and none from the Brown-McDade or Cabin Creek zones.

4.1.1 Webber Ore Shoots

The Webber vein zones are members of a tension fracture system, which strikes west of north and dips 70°W, that is related to, but not everywhere coincident with, strong northwest-trending fault structures that are characterized by a prominent hanging wall gouge plane with or without subsidiary shears. The principal wallrocks comprise extensively silicified foliated quartzites, quartzitic schists and finely banded gneisses, all belonging to the Yukon Group, which are intruded by an extensive body of granitic porphyry.

Generally, the presence of ore mineralization is indicated by the appearance of arsenopyrite and/or yellow stain; however, the grade cannot be estimated reliably using these indicators. The values in the Webber ore shoots can range up to several oz/ton in gold and about 50 oz/ton in silver. The ends of ore shoots are generally marked by a sharp transition between ore and waste. These lateral boundaries of the ore shoots show great regularity in vertical projection from the surface down to the bottom level.

Metallurgical testing indicates that the near-surface Mt. Nansen ores are variably oxidized. This condition seemed most common in the Webber ores that were milled in 1968 and was assumed to be the cause for the low recoveries in the milling of these ores. For this reason, only a minor amount of stoping was subsequently done on the Webber veins, principally to provide time for the mill circuits to be modified to handle the oxidized material. The actual extent of this possible oxidation of the veins in the Webber has not been determined because there is no megascopic difference between the suspected oxidized ore and the non-oxidized material. Also, the Huestis ore was mined to within 40 feet of the surface, where it too should be "oxidized", without detrimental effects in the mill, which by that time had been operating for nearly a year. It is therefore the opinion of the writers that the existence of oxidized ore, which is very obvious on surface exposures, may not be as extensive underground, and/or may not be so difficult to treat, as earlier suspected.

4.1.2 Huestis Ore Shoots

Three anastomosing vein zones have been exposed in the Huestis adits. They strike north-to-northwest and dip steeply eastward and are up to 200 feet apart. Widths range from one to eight feet, with an average of between three and four feet. The wallrocks are principally Yukon Group fine crystalline feldspar-hornblende gneisses intercalated with platey quartzites and thin to wide greenstone (metavolcanic) bands.

The character and mineralogy of the Huestis veins are essentially identical to those of the Webber veins, except that stibnite appears to be more widespread in the Huestis. The gold-silver values occur with diffuse, fine-grained black sulphide dispersions in cherty quartz. The development to date indicates that the Huestis gold values are higher, and the silver values lower, than those in the Webber ore shoots.

4.1.3 Brown-McDade Shoots

The Brown-McDade workings comprise the 1947 underground workings and ten bulldozer trenches which cross the vein zone at about 150-200 feet spacing for a vein length of 1600 feet, 650 feet of which lie beyond the south end of the underground workings. The underground workings comprise a crosscut adit 850 feet in length, a south drift 650 feet in length, and a north drift 500 feet in length. The Brown-McDade zone strikes N25°W and dips 50° to the west.

Because of intense clay alteration of the rock within and near the Brown-McDade vein zone, diamond drill core recovery within the zone has seldom been more than 50 percent and often less than 20; however, the zone has not been drilled using modern equipment which would likely produce much better recoveries.

Granodiorite forms the country rock for all but the extreme north end of the explored zone. The ore structures comprise two major fault or shear zones which trend northnorthwest and dip 50°-70° west. The west fault is the main vein zone and is a wide shear structure. The granodiorite between these two faults is appreciably more fractured and silicified than is normal for this area.

The Brown-McDade zone, (west fault), is a complex zone of gouge planes and altered and sheared rock which ranges in width from 25 to 75 feet. The hanging wall rock is highly fractured, hematized and argillized for widths up to 100 feet. South of the mine the zone enters the Yukon Group schists and pinches down abruptly, and the adjacent wallrock alterations become less pronounced. To the north the zone has been traced by a strong geochemical soil and E-M anomaly for a distance of 12,000 feet.

Adjacent to the main footwall fault of the Brown-McDade zone is a width of 15 feet of fault gouge and highly sericitized and mylonitic rock slices. In sharp contact with this shear zone is the ore zone which is from 5 to 30 feet width of silica-sericite-barite replacement and vein rock. Nests, veinlets, pods and disseminations of finely crystalline sulphide minerals occur dispersed rather erratically through this siliceous rock and consist principally of pyrite and arsenopyrite with minor chalcopyrite, galena and tetrahedrite. The precious metals are spatially related to the arsenopyrite and occur as native gold, andorite, freibergite and ruby silver. The hanging wall of the ore zone is an alteration zone about 75 feet in horizontal width, consisting principally of argillized feldspar, hematite and quartz within which relicts of granodiorite are recognizable.

A series of sinuous en echelon vein-like quartz replacement bodies occur in two general sites, one along the main footwall fault plane, and the other along the zone 20 to 40 feet in the hanging wall. These bodies average 200-400 feet in length and 5 to 15 feet in width and dip parallel to the footwall fault. At their ends along strike individual bodies tend to pinch out rather abruptly or turn sharply into a nearby body.

Underground drifts and drilling have indicated a total strike length of 2000 feet of these vein zones of which about 600 feet have been wholly or partially exposed by drifts and crosscuts. Of the 600 feet of zones that have been exposed by drifts 440 feet are of ore grade, occurring in four shoots three of which range in length from 120 to 155 feet and all of which range in width from 5 to 8 feet.

Two orebodies, 1N and 2N, are exposed underground north of the crosscut, but surface stripping does not extend north of the crosscut so there is no correlation for the upward extensions of these bodies. Similarly, an extremely high grade section is exposed in Trench No. 8, 400 feet south of the south drift face, with no depth correlation to underground.

The orebodies that are well exposed and sampled in the drift and have been intersected within 40 feet above and below the drift by limited drilling are designated as "proven". Where ore is partially exposed and drilled underground it is considered "probable".

4.2 RESERVE ESTIMATE DATA BASE

All estimates of the Mt. Nansen ore reserves that have been made to date by all parties variously involved in the operation have been based on the same data, namely the drift and drill hole sampling by the mine staff from 1967 to 1969. The writers who were directly involved with this work in 1967-68 are confident that the sampling and assaying were conscientiously done in a manner accepted as standard practice in underground mines on vein deposits. The integrity of the sample results at Mt. Nansen has been verified by the correspondence of the drift assay results with the muck assay results and with subsequent stoping results.

4.2.1 Sampling

The full drift width was channel sampled at 5-foot intervals along every exposed vein. For easier sampling with minimal interruption of mining, each face was sampled rather than the back. To ensure a check, two samples were cut at each face, one at 2.5 feet above the track and the other at 5 feet above track. In some headings subsequent back check samples were also taken until it was established that there was no significant difference between the results of the two sampling methods, at which time back sampling was discontinued. In the stopes the back was channel sampled at 5-foot intervals at each lift, until the final month or so of mining when no staff was available. Also, the operators that stoped 6000 tons from two stopes in 1976 did no sampling.

In cases where the vein is a few feet inside the wall of the drift it was sampled by collecting cuttings from test holes drilled at 3-foot intervals along the vein-length. Subsequent drifting of such a section in the Webber indicated excellent correspondence between the test hole assays and the later channel sample assays.

All of the Mt. Nansen sample records are clearly and accurately plotted on 20-scale plans, a reduced typical example of which has been included here as Figure 5 to illustrate the quality of the available data.

A comparison of the samples taken along the Huestis 43-590 ore shoot at 2.5 feet above the track with those taken 5 feet above the track reveals, as suspected, that the variance of the averages can be as high as 35 percent for vein lengths below 45 feet or so. This is evidently due to lenses of high grade that have erratic vertical distribution. For greater lengths this variance drops to acceptable proportions. This same type of variance is encountered in the channel sampling of the stope backs at lifts of five feet. In the case of the reserve calculations done for the present report, only one set of face channels has been used, generally the same one for each level.

4.2.2 Sample Verification

Verification of the channel sample results of the drifts at Mt. Nansen has been attained, with one exception, from two sources, the corresponding muck samples and the subsequent stoping results. The one exception has been the case of the 588 Ore Shoot on No. 12 Vein above the Huestis 4100 level, where the values in the vein apparently decreased sharply in the stope within 20 feet above the drift. (This situation is anomalous and should be investigated underground to determine if it is truly a drop in grade or if it is due to overbreak in the stope.)

Examples, from the Huestis 4100 drift on 12 Vein, of the type of correspondence between the channel face samples and the drift muck samples from the same ore shoots are:

(All channel samples averaged to 4-foot widths)

	Au (oz/t)	Ag (oz/t)	
Shoot 594 (300')	0.30	4.8	Channels
	0.21	6.4	Mucks
588 (240')	0.63	10.8	Channels
	0.32	7.8	Mucks
585 S (80')	0.67	11.8	Channels
	0.32	7.8	Mucks
585 N (96')	1.52	14.1	Channels
	0.70	8.3	Mucks

Considering that the average width of the drifts is 6-8 feet and that the muck grades should therefore be approximately half to two-thirds of those of the 4-foot channels, the above examples demonstrate excellent corroboration of the face channel samples by the (bulk) muck samples.

4.2.3 Earlier Reserve Estimates

Ore reserves for the Huestis and Webber veins have been estimated by various staff engineers and consultants in the past, particularly during the 1968-69 pre- and post-production period. These calculations were all made from the same sample results, with the later estimates having the benefit of some check sampling as well as stoping. Differences in these reserve estimates, which in some cases are considerable, have been due for the most part to the application of different cut-off grades, depending on metal prices, as well as the application of different minimum mining widths, some being less than 4 feet, which were subsequently demonstrated in production stoping as being impractical. Another factor contributing to differences in reserve estimates is the choice of properties included. In the present calculations the Brown-McDade ore is included with the Webber and Huestis because all of these properties are now under common ownership.

If the same minimum width and the same cut-off grades are used, the existing data should produce essentially the same results for all analyses, because there are no subjective geological or mining judgments that need be applied to these orebodies.

4.3 PROVEN-PROBABLE ORE RESERVES

4.3.1 Criteria

The ore reserve estimates made for this report comprise recalculations by the writers using the available mine assay records. The ore shoot grades were calculated to a common four-foot width for lengths dictated by the persistence of ore grades in the face channels. These results are shown on the accompanying level plans, (Figures 6, 7 and 8), for each level of the Huestis and the Webber. These shoots were then projected on the veins above and below the drifts for 40 feet each way as "proven ore". Projections on the veins, at the same average grades, for 40 feet beyond is designated as "probable ore". The same type of projections of shoot grades has also been applied to sampled raises, stope faces and surface trench sampling. These ore shoot projections are plotted to scale on longitudinal vein sections drawn in the plane of the vein, giving true depths. The Webber and Huestis sections are shown in Figures 9 and 10 of this report.

High-grade assays of gold and silver are not cut in the present calculations because very high erratic assays are uncommon and where they do occur they appear in both of the face samples and generally in two faces. Also, the correspondence between the average (uncut) channel sampling and the muck sampling indicates that cutting is unnecessary.

"Possible" ore has been estimated by extrapolations on the vertical sections as described in the following section, (4.3.2).

4.3.2 Results

Summaries of the proven and probable ore reserves of all of the known ore shoots at Mt. Nansen are given in Table 2 (Webber), Table 3 (Huestis), and Table 3A (Brown-McDade and Cabin Creek).

TOTAL RESERVES

Deposit	Tons Proven	Tons Probable	Grade (oz/t.) Au	Grade (oz/t.) Ag	Au:Ag
WEBBER	42,912		0.243	14.5	1:60
		36,528	0.258	15.03	1:60
HUESTIS	43,872		0.45	9.18	1:20
		54,526	0.38	8.81	1:23
BROWN-McDADE	14,795		0.61	5.1	1:8
		51,850	0.81	4.7	1:6
CABIN CREEK		4,225	0.23	26.6	1:115
Totals	101,579		0.386	10.83	
		147,129	0.497	9.39	

PROVEN-PROBABLE = 248,708 tons @ 0.452 oz/t. Au, 9.98 oz/t. Ag

POSSIBLE TONS

WEBBER
- Known shoots projected to 40 ft. below 4100 level = 48,500

HUESTIS
- Known shoots projected to 40 ft. below 4000 level = 79,500

BROWN-McDADE
- Known shoots to surface and 40 ft. below 4000 level = 47,000

TOTAL POSSIBLE = 175,000 tons

The wide differences in the ratios of gold/silver in each deposit is probably a function of two conditions, near-surface oxidation and differences in primary mineralization. In general the values of the two metals are inversely proportional, ie, the higher the gold the lower the silver and vice versa. It is conceivable that grades of mill feed may be adjusted to metal prices by balancing the feed from each deposit.

4.3.3 Comparison With Previous Estimates

The differences between the above figures for the proven-probable ore reserve at Mt. Nansen and those of earlier estimates are discussed below:

(1) 1968 Feasibility - Dolmage Campbell and Associates Ltd.

Webber	71,880 tons	0.40 Au	23.0 Ag
Huestis	58,345	0.55	12.7
Total	130,225	0.467	18.38

The major difference between the 1968 and 1982 estimates for the Webber is that wider mining widths and greater projections of lower grade material have increased the tonnage and lowered the grade. In the Huestis, the tonnage has increased appreciably because of the stoping and drifting completed since 1968 and the inclusion of appreciable low-grade material in the 1982 calculations, which was not considered to be ore at the low metal prices of 1968.

(2) 1969 Mine Staff - (Bianconi et al)

Webber	86,100 tons	0.38 Au	23.2 Ag
Huestis	91,075 tons	0.50	10.8
Total	177,175	0.44	16.81

There is no back-up data available for the above estimates by the Swiss geologists, but probably large amounts of high-value near-surface material was included in the Webber ore. The Huestis reserves are in reasonable correspondence with the 1982 estimates.

(3) 1979 Averaging of Available Estimates - Dolmage Campbell and Associates (1975) Ltd.

Webber	65,000 tons	0.35 Au	20.0 Ag
Huestis	45,000 tons	0.45	10.0
Total	110,000	0.40	15.0

The 1977 (Snell) estimates that were used in the above averaging strongly influenced the figures and considering that only the highest grade ore was used in those estimates, the above figures correspond well with the present estimates, which were made with all of the pertinent data available.

TABLE 2

WEBBER ORE RESERVES

(All widths = 4 ft.: cu.ft./t. = 12.5) Refer to Fig. 9

VEIN	ORE SHOOT	LEVEL	LENGTH	TONS PROVEN	TONS PROBABLE	GRADE (oz.t) AU	GRADE (oz.t) AG	Au : Ag
1	101	4260	45	576	576	0.17	4.4	1:25
		Surface	60 (Av.)	768		0.17	4.4	1:25
	105	Surface	40	512		0.42	54.0	1:128
		4260	45	1,440	576	0.27	13.3	1:50
	107	Surface	200	2,560		0.71	48.12	1:68
		4260	70	1,792	896	0.23	12.0	1:52
		550 Rse	70	1,344	320	0.23	12.0	1:52
	121	4260	50	1,280	768	0.21	29.3	1:140
	119	Surface	70	896	1,120	0.38	8.3	1:22
		4260	95	2,432	2,432	0.16	9.0	1:56
	120	4260	65	1,664	1,472	0.06	4.7	1:78
	122	4260	80	2,048	2,048	0.13	6.3	1:48
	ICS	Surface	70	896	896	0.40	11.8	1:30
	IAS	Surface	150	1,920	1,920	0.37	15.4	1:42
2	157	4260	160	4,096	4,096	0.31	13.8	1:44
	146	4260	35	896	896	0.23	5.2	1:23
	154	Surface	70	896	1,792	0.32	13.4	1:42
		4260	80	2,048	2,048	0.17	12.1	1:71
	153	4260	75	1,920	960	0.08	5.4	1:67
	139	4260	20	512	512	0.18	12.3	1:68
	129	Surface	180	2,304	2,304	0.43	35.1	1:82
		4260	60		1,152	0.10	10.2	1:101
	130	4260	80	2,048	2,048	0.06	15.0	1:250
	131	4260	45	1,152	1,152	0.13	7.5	1:58
	134	4260	50	1,280	1,280	0.14	8.9	1:63
	136	Surface	100	1,280	1,120	0.31	4.3	1:14
		4260	130	3,328	3,120	0.54	41.5	1:77
	South end	Surface	80	1,024	1,024	0.32	11.3	1:35

	PROVEN	PROBABLE		AU	AG
TOTAL PROVEN TONS	42,912		@	0.243	14.5
TOTAL PROBABLE TONS		36,528	@	0.258	15.03
TOTAL PROVEN-PROBABLE		79,440		0.25	14.74

Average Au:Ag @ surface = 1:50
" " " 4260 = 1:74
∴ Some relative enrichment of Au @ surface

TABLE 3

HUESTIS ORE RESERVES
(All widths = 4 ft.: cu.ft./t. = 12.5)

Refer to Figs. 7,8 and 10

VEIN	ORE SHOOT	LEVEL	LENGTH	TONS PROVEN	TONS PROBABLE	GRADE (oz.t) AU	GRADE (oz.t) AG	REMARKS
12	583	4100	40	1,024	1,024	0.48	14.00	
	585	4300	50		960	0.33	10.40	N.end of 585 St.
		43-585 ST	200+	4,000	2,690	0.50	8.27	
		41-585 ST	240	6,144		0.67	12.10	Ave.4100 + 4300
		4100	240	3,072	3,072	0.94	14.50	Below 4100
	588	4300	145	3,712	1,856	0.23	3.90	
		41-588 ST	125	1,600	3,840	0.43	9.65	
		4100	240	3,072	3,072	0.63	10.80	Below 4100
	590	43-590 ST	130	1,664	2,176	0.20	7.97	
		4300	175+	2,688	1,920	0.39	4.60	Some above 4200
		4100	80	2,048	2,300	0.21	1.40	
	591	4300	120	3,072	3,072	0.33	7.40	
		4100	55	1,408	1,408	0.26	3.60	
	594	43-594 ST	180		2,880	0.47	12.27	
		4300	190	2,432		0.58	19.20	Below 4300
		41-594 ST	180		5,184	0.31	8.30	
		4100	230	2,944	2,944	0.31	8.30	
	595	4300	60	1,536	1,152	0.23	14.00	
	610	4300	55		1,408	0.30	7.00	
	609	4300	95		2,432	0.41	6.00	
11	628	4300	75	1,920	1,920	0.28	1.30	
13	595	4300	60	1,536	1,536	0.32	14.30	
		4300	300		7,680	0.30	10.80	Drill holes

TOTAL PROVEN TONS	43,872		@	0.45	9.18
TOTAL PROBABLE TONS		54,526	@	0.38	8.81
TOTAL PROVEN-PROBABLE		98,398	@	0.41	8.98

TABLE 3A

BROWN-McDADE ORE RESERVES

ORE SHOOT	LEVEL	WIDTH	TONS PROVEN	TONS PROBABLE		GRADE (oz.t) AU	GRADE (oz.t) AG
1N	Surface	8		2,435		0.36	4.3
	4000 to Surf.	8		6,050		0.51	4.7
	4000	8	9,930			0.67	5.1
2N	Surface	8		10,430		0.68	3.7
				6,100		0.46	9.5
3N	4000	5		1,210		1.10	4.2
1S	Surface	5		3,810		1.04	3.2
	4000	5	4,865	4,865		0.50	5.0
	+4000	5		7,820		0.77	4.1
2S	Surface	5		4,570		0.75	4.5
7S	Surface	15		4,560		2.40	3.0
TOTAL PROVEN TONS			14,795		@	0.61	5.1
TOTAL PROBABLE TONS				51,850	@	0.81	4.7
TOTAL PROVEN-PROBABLE				66,645		0.66	4.8
POSSIBLE TONS				47,000			

CABIN CREEK ORE RESERVES

Surface
110 ft x 6.1 ft = 4,225 tons PROBABLE @ 0.23 oz/t. Au, 25.6 oz/t. Ag

4.4 ORE POTENTIAL

In all of the underground development at the Huestis, Webber and Brown-McDade mines, new ore has been proven or indicated with no limits established either laterally or at depth. The prospects for continued ore development at these mines must be considered to be very good.

The proven-probable reserves at Mt. Nansen are sufficient to sustain a 300 t/day mill for 2-1/2 years. The possible ore within the lateral limits of the proven-probable ore, when confirmed, would add nearly another two years.

The potential life of the mine is in all probability many times greater than this, as inferred by three features:

(1) the high ratio of ore to explored vein in the two mines,

(2) the excellent depth continuity to the ore shoots at least to 300-500 feet,

(3) and the encouraging results of the soil geochemical survey done in 1967.

The application of the above three characteristics of the Mt. Nansen vein deposits, discussed in detail in the following sub-paragraphs, suggests that the inferred ore potential of the Mt. Nansen property could sustain a 300 tpd mill for well over 50 years.

The inferred potential life is derived as follows:

(1) From approximately 5,500 feet of vein length presently developed on the property roughly 425,000 tons of proven-probable-possible ore have been indicated.

(2) The percent of ore length on the 5,500 feet of exposed veins is 55-75%, but this would appear to be high because of a fortuitous geological location of the workings. A percentage of 25% for projection beyond present workings would appear to be a more reasonable figure.

(3) From (1) and (2) above it is inferred that 5,500 feet of vein length on the Mt. Nansen property could contain about half of what has been exposed by the development to date; namely, approximately 200,000 tons.

(4) Well defined geochemical silver-arsenic soil anomalies, confirmed in many places by underground exposures, indicate a total potential ore-bearing vein length on the property of 117,500 feet. Thus 117,500 ft/5,500 ft × 200,000 tons = 4.273 mill. tons. ???

(5) The known ore reserves occur in a vertical range of about 250 feet. Topography of vein exposures, together with limited drilling and geological inference, indicate that the likelihood of ore extending over a 500-foot vertical interval is not unreasonable. This would double the above potential tonnage to 8.5 mill. tons.

(6) 8.5 mill. tons/100,000 tpa = 85 years.

4.4.1 Ore-Vein Ratio

In precious metal vein deposits the ratio of ore lengths to barren developed vein lengths ranges generally from 1:10 to perhaps 3:10. The ratios at Mt. Nansen are much higher, suggesting either a much greater than normal amount of ore along the veins or the fortuitous location of the present workings in a concentration of ore shoots. In either case, the discovery of new ore on the known veins by flat (drift) development from the existing workings is very promising within relatively short distances.

The percentages of ore along the developed lengths of the veins in the present workings are:

Webber	1 Vein (North strike)	55%
	2 Vein (NNW strike)	75%
Huestis	11 Vein (North strike)	11% (Branch)
	13 Vein (North strike)	11% (Branch)
	12 Vein (NNW strike)	65% (4300)
	12 Vein (NNW strike)	72% (4100)

The above data suggests that the more northerly striking branch veins appear to be less productive than the veins striking northwesterly; however, the present data base is too small for this trend to be established as a definitive guide beyond the present workings. The ratio of ore to vein in both the Webber and Huestis is unusually high, and of considerable promise, considering that the two mine areas are nearly a mile apart on strike.

4.4.2 Depth Continuity of Ore Shoots

Although the Mt. Nansen veins have not been explored to great depths, the generally even continuity in size and grade of the developed ore shoots, particularly on the Huestis veins, to depths approaching 500 feet below surface is a most promising feature for the development of new ore at depth.

4.4.3 Soil Geochemical Survey

Essentially all of the Mt. Nansen property is blanketed by a regolith ranging in depth from a few feet to tens of feet comprising oxidized rock-soil and relict rock fragments, all solidly frozen by permafrost. Because of the permafrost the excavation of surface trenches is tediously slow and costly, with the result that only the immediate environs of the existing underground workings have been explored by trenching, all prior to 1967. In fact, the results of the limited trenching dictated the locations of the workings. Because of environmental restrictions introduced since 1970, it is doubtful that such surface trenching would be permitted now.

In an attempt to find a meaningful and relatively inexpensive means of exploring for the continuity of the known veins in 1967, numerous experiments and field trials were made to determine if chemical analyses of samples taken from various depths of the regolith would provide a reproducible indication of the underlying known veins. Trials were made on samples to depths of about 2 feet, (top of permafrost in summer), for copper, lead, zinc, gold, silver, arsenic and antimony. The results of this work indicated that the known oreshoots were consistently reflected in the silver and, less so, arsenic contents of samples taken from the soil immediately beneath the grass roots. The anomalous values for silver range from about 1 to 10 ppm, versus a background of less than 0.5 ppm. The anomalous values for arsenic range from 3 to 175 ppm, against a general background of nil to 2 ppm. By combining the values of the two metals it is possible to follow the surface traces of the known veins with considerable precision.

Following these encouraging test results, the entire property was sampled on a grid of 400 x 100 feet in 1967, resulting in the pattern of generally sharp anomalies reproduced in Figure 11 of this report. These anomalies indicate strike extensions of the developed sections of the Webber, Huestis and Brown-McDade veins of thousands of feet and, perhaps more importantly, the probable occurrence of at least six other major vein zones with similar, and in some places considerably higher, silver-arsenic soil reflections, all suggesting a high potential for the existence of unexplored ore veins on the property.

The nine principal linear anomalies indicated by the soil geochemical survey are numbered on Figure 11 as follows:

	Name	Range (ppm) Ag	As	Length (feet)	Confirmation
1.	Back Creek	1-3	3-21	9,000	Unexplored
2.	Brown-McDade East	1-5	5-125	8,000	Unexplored
3.	Brown-McDade	1-8	5-175	26,000	1000' trenched and drifted
4.	Mill	1-5	10-75	21,000	400' trenched and drifted
5.	Huestis*	1-8.5	5-10	16,000	2000' trenched and drifted
6.	Webber **	1-8	2-68	9,000	2000' trenched and drifted
7.	Cabin Creek	.6-1.5	2-30	2,500	400' trenched and drilled
8.	Webber North	1-6.5	5-45	15,000	Unexplored
9.	Huestis South	.3-1	5-140	11,000	Unexplored
			Total	117,500 feet	

* Includes the anastomosing system northwest of the Huestis workings
** Includes anastomozing system to southeast

Note: The very wide Webber anomaly shown on Figure 11 is actually displaced downhill from the vein outcrop and is the result of Webber vein material having been washed downhill from the bulldozer heaps left from the stripping of the vein, which was done several years prior to the soils survey.

Figure 11 indicates a concentration of anomalies within an area of rhyolite intrusive dikes and plugs. This suggests a possible reason for the particular concentration of anomalies, namely a plumbing control related to, but later than, the rhyolite dike system. It is also possible that this concentration of anomalies may reflect an area where a potential for surface mining may exist.

The scope for exploration for new ore at Mt. Nansen based on the soil anomalies is great enough to occupy many seasons of surface drilling, and because of its critical importance in determining the ultimate life of the operation, it should be pursued as soon as possible, taking fullest advantage of each short season.

6.1.6 Production Run-up Period

The production run-up phase is from commencement of milling until the time when all aspects of the project (mine, mill, ancillary plant, concentrate transportation) are operating reasonably smoothly and are approaching design criteria. In the case of Mt. Nansen a four month period is envisioned.

During the production run-up period, problems normally associated with getting a complex, integrated operation underway commonly result in sub-par operating performances in the mine and mill and higher than estimated operating costs. The grade of mine ore may be lower than it should be, because of dilution, and ore supply to the mill may be somewhat erratic. Mill recoveries and concentrate grades are often lower than estimated and impurities in the concentrate too high.

Operating capital is required for the run-up period for two main reasons: 1) operating profit, as reflected by the amount and quality of the concentrate produced, is generally less than optimum, and 2) initial payments for concentrate shipments from Mt. Nansen may not be received for up to six months.

6.2 CAPITAL COSTS

Costs have been estimated for a 300 tons-per-day operation that replaces its depleted ore reserve by annual development of new ore, the annual tonnages at this rate being 90,000 to 100,000 tons. The concentrator, with the addition of a regrind mill, the ancillary plant and the mine are capable of handling these production rates. It is assumed that the mine will operate on a five days per week schedule or some combination thereof, and that the mill will operate continuously.

Inflation, at an average of 10% per year, has been included in both the capital and the operating cost estimates.

All of the capital costs, many of which are included under general headings, are listed in Table 6.

The total capital costs are presently estimated to be approximately $14 million. Of this total approximately $4 million will be required within the first four months, namely for rehabilitation. Additional costs within this period will be for surface exploration, underground diamond drilling, drifting, raising and stope preparation. The complete 10-year concept for the tailings dam can be constructed in stages, as illustrated in the Capital Cost Expenditure Schedule, Figure 13.

The capital cost expenditures fall into five 3-month stages, from start of rehabilitation, as follows: (See Figure 13)

(1) Stage 1 - $3,945,000 - Ordering equipment, camp service set-up, tailings disposal and environmental studies.

(2) Stage 2 - $3,038,000 - Camp services completion, mining commenced and construction of tailings disposal.

(3) Stage 3 - $1,795,000 - Preproduction, mine development.

(4) Stage 4 - $1,818,000 - Preproduction, mine development.

(5) Stage 5 - $770,000 - Mill and crusher overhaul completion and second stage tailings disposal.

(6) Future - Addition to tailings containment for extended life to 10 years, $700,000.

A list of the capital cost items is given in Table 6. The total cost of approximately $14 million is almost double the $7.6 million estimated in 1979 because of:

(1) The very appreciable extra costs (nearly $4 million) for the camp, surface installations and the tailings disposal, resulting from the new Yukon environmental regulations.

(2) The inclusion of the $2 million for working capital while the initial concentrates are in transit. This item was shown separately in the 1979 report.

(3) Inflation.

If a salvage operation were to be undertaken to recover the known readily minable reserves only, and not develop new ore, the total capital costs would be in the range of $9-$11 million. However, with the present indications of such high potential for a long life to the Mt. Nansen mine, it appears short-sighted and undesirable to invest this much money simply to take out the known readily minable ore reserves.

TABLE 6

ESTIMATED CAPITAL COSTS 300 t/d
(Not Salvage Operation)

Canadian Dollars x 1000, 1981

ENGINEERING		
Sitework, testwork	$ 60	
Office studies	60	
Contingency	20	
		$ 140
REHABILITATION		
Camp and services (power and water)	1,678	
Roads	110	
Mobile Equipment	535	
Mill	550	
Tailings disposal	1,700	
Mine	25	
Head office, supervision, etc.	475	
Contingency (10%)	507	
		5,580
PREPRODUCTION		
Surface exploration	170	
Mine equipment	720	
Drifting $113/ft	1,170	
Raising $150/ft	790	
Stope preparation	300	
Tramming and track	98	
U.G. exploration D.D.	240	
Mine general	200	
Power, air, water	725	
General overhead	560	
Permanent cookhouse, office, warehouse	530	
Head office costs	150	
On-site, salaried	410	
Contingency (5%)	303	
		6,366
INITIAL WORKING CAPITAL	2,000	2,000
	TOTAL	$14,086,000

6.3 OPERATING COSTS

The operating costs for Mt. Nansen are presented in Table 7. They represent the optimum costs for an operation that has been established long enough to have overcome teething problems associated with new operations. Thus, these are costs, exclusive of continuing inflation (beyond start-up), which will be applicable to Mt. Nansen after 3-4 months of operation. The operating costs can be expected to be appreciably higher at start-up but they should quickly drop to the estimated figures. Barring unusual problems, optimum operating costs should be achieved by the end of the first operating year; however, they should be within a few percent of optimum within four to six months of start-up.

The writers have been deliberately conservative in these cost estimates, taking into consideration the problems of keeping good labour in the Yukon and allowing for inflation on all items. The operating costs, not including transportation of concentrates, are summarized as follows:

Mining and exploration	$ 65/ton
Milling	20
Plant	30
Head Office	3.00
Total	$118.00

The cost of concentrate shipment to Boliden and Belgium will be in the range of $450/ton of concentrate, which is equivalent to approximately $70 per ton of mined ore. This cost has been accounted for in the cash flow calculations, Section 7.

6.4 WORKING CAPITAL

During the initial six months of the Mt. Nansen mining operation, there will be no income from concentrate sales because of the time required for producing and shipping the concentrate, and for smelter settlements to be received. Consequently, money must be available during this period to pay for operating costs. In addition, the initial operating period of most underground mines is plagued with abnormally high operating costs, lower than optimum productivity, and production of a sub-par product. At Mt. Nansen, the bulk of these teething problems should be overcome within the first four months of operation.

optimistic ?

The following approximation of the working capital required has been determined by making reasonable estimates for the above noted variables:

300 tons per day - $2,000,000 (Can.)

TABLE 7

ESTIMATED OPERATING COSTS

100,000 T/YEAR (300 t/day)

(Not including concentrate shipping costs)

Canadian Dollars/Ton

SURFACE EXPLORATION		$ 2.00
MINING		
Underground Core Drilling	$ 2.40	
Development	23.10	
Stoping, Tramming	22.00	
Mine General - Power-Air-Water	10.10	
Contingencies	5.40	
		63.00
MILLING		
Labour	9.00	
Supplies and Services	9.70	
Contingencies	1.30	
		20.00
PLANT		
Cookhouse	9.00	
Roads and Site Maintenance	3.50	
General Overhead	16.00	
Contingencies	1.50	
		30.00
HEAD OFFICE		
Salaries and Expenses	3.00	3.00
	TOTAL	$118.00/ton

6.5 200 T/D OPTION

All of the foregoing costs for the Mt. Nansen operation have been predicated on a 300 t/day mine production. Actually the initial production target should be about 200 tons/day, until mine exploration and development has proceeded far enough to identify and make accessible enough new ore to prepare the total of some 20 stopes estimated to be required to sustain a 300 t/day operation. A valuable headstart on this preparatory development will be gained if the winter of the initial year can be devoted to it.

In all likelihood, the start-up tonnage will be around 200 tons/day, with a proportionate reduction in planned revenue, and will work up gradually to 300 t/day, as the underground development permits. This has been taken into account in the cash flow calculations in the following section of this report.

If the large "potential" reserves can be confirmed to any degree, a higher daily production could be optimum. It would be necessary to balance increased capital cost (mill expansion) against lower operating costs. Interest costs on capital may now be lower than when this report was put together.

7. CASH FLOW

7.1 CRITERIA FOR ESTIMATES

7.1.1 Metal Prices

Two variables that have a major influence on cash flow estimates for a mining operation at Mt. Nansen are the prices of gold and silver and the value of the Canadian dollar relative to the U.S. dollar. The effect of the volatility of metal prices on the estimates for a 300 t/d operation at Mt. Nansen is illustrated by the comparison of the gold-silver prices for the last three years, (the profit figures are approximate for a 300 t/d at Mt. Nansen):

	1979	1981	1982 (Feb.)
Annual Profit	$13.7 million	$11.1 million	$3 million
Gold	$425/oz (U.S.)	$475/oz (U.S.)	$360/oz (U.S.)
Silver	$ 17/oz (U.S.)	$ 13/oz (U.S.)	$ 8/oz (U.S.)
Ratio	25:1	36:1	45:1

7.1.2 Concentrates

Concentrate shipping costs have been calculated on the basis of shipping to European smelters, trans-shipping to ocean transport at Vancouver.

Concentrate grades are those listed in Table 5, the best estimates available at this time. The original estimated concentrate assays were based on a grade of 0.5 oz/t. Au and 15 oz/t. Ag. Since the newly calculated ore reserve grade is 0.45 oz/t. Au and 10.0 oz/t. Ag, an adjustment has been made, for the present cash flow calculations, to the concentration ratios shown on Table 5 as follows:

	Concentration Ratio	
	Ag con	Au con
Table 5 (1979)	20	7.7
Present Report	24.4	11

There is no change in the concentrate grades because there is no change in mineralogy with the inclusion of lower grade ore, simply the addition of waste rock or low grade ore.

Net Smelter Returns are based on the smelter schedules obtained from the two smelters who have indicated agreement to purchase the Mt. Nansen gold and silver concentrates shown in Table 5.

The conversion factor for Canadian vs. U.S. dollars has a significant effect on operating profit; a change of 1% results in an approximate change of 2.5% in profit. For this study U.S. $1.00 = Cdn. $1.15 has been used.

7.2 NET PROFIT BEFORE TAXES

The progressive flow of revenue for the first 13 months of the Mt. Nansen operation, from mill start-up, is summarized in Table 8 for the 1981 metal prices given above. The salient items in the table are:

(1) The Operating Costs are higher during the first four months than the $118/ton estimated for the project because of anticipated low mine and mill production.

The monthly operating cost of $985,000, at optimum operation, is derived from 100,000 tons/year @ $118/ton.

(2) The Concentrate Shipping Costs are high because of the low concentration ratios; hopefully, metallurgical tests and mill efficiency will improve this item which is estimated here as equivalent to approximately $70/ton of mined ore.

(3) The Concentrate Values are derived from the earlier described smelter schedules.

(4) The Concentrate Bank Loan represents the operating capital required while the first concentrate shipments are in transit. This money can be borrowed using the in-transit concentrate as collateral.

The cumulated interest and principal thus must be repaid from the smelter returns which are estimated to begin on the fifth month after the first shipment.

It is apparent from Table 8 that approximately seven months are required for the system of mining, concentrating, shipping, initial concentrate settlements to reach equilibrium. At equilibrium the value of concentrate being produced is approximately equal to the concentrate payments being received.

In the case illustrated in Table 8, the operations are profitable in their first month on the basis of the value of concentrates produced. The cash flow from concentrate payments received begins to exceed operating costs in the sixth month and by the thirteenth month the cumulative cash flow is positive (all working capital is repaid).

The approximate annual net operating income before taxes after payback of the operating cost loan is estimated to be $11.1 million.

TABLE 8

CASH FLOW - 300 TONS PER DAY
(x 1000)

MONTH

	1	2	3	4	5	6	7	8	9	10	11	12	13
Operating Costs	985	1180	1020	1035	985	985	985	985	985	985	985	985	985
Conc. Shipping Costs	0	295	475	560	590	590	590	590	590	590	590	590	590
Total Costs	985	1475	1495	1595	1575	1575	1575	1575	1575	1575	1575	1575	1575
Silver Conc. Value	675	1140	1425	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
Gold Conc. Value	450	760	950	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Total Value	1125	1900	2375	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500
Conc. Bank Loan	0	900	1495	1595	450	(325)	(800)	(925)	(925)	(925)	(790)	0	0
Conc. Bank Loan Int.	0	0	10	25	40	45	45	35	25	15	10	0	0
Cum. Bank Loan	0	900	2405	4025	4515	4235	3480	2590	1690	780	0	0	0
Smelter Payment					1125	1900	2375	2500	2500	2500	2500	2500	2500
Cash Flow - Monthly	(985)	(1475)	(1495)	(1595)	(450)	325	800	925	925	925	925	925	925
- Cum.	(985)	(2460)	(3955)	(5550)	(6000)	(5675)	(4875)	(3950)	(3025)	(2100)	(1175)	(250)	675

Notes:

(1) Month 1-Production @ 50% capacity; Operating Costs @ 200% optimum; Conc. Quality @ 90% optimum
(2) Month 2-Production @ 80% capacity; Operating Costs @ 150% optimum; Conc. Quality @ 95% optimum
(3) Month 3-Production @ 95% capacity; Operating Costs @ 110% optimum; Conc. Quality @ 100% optimum
(4) Month 4-Production @ 100% capacity; Operating Costs @ 105% optimum; Conc. Quality @ 100% optimum
(5) $1.00 U.S. = $1.15 Cdn.
(6) All figures except metal prices are in Canadian dollars x 1000.
(7) 1Bf = .0335 Cdn.
(8) Interest on bank loan @ approximately 1% per month.

Metal Prices

Gold = 450
Silver = 15
Lead = .30
Antimony = 1.50

8. RECOMMENDATIONS

8.1 SURFACE PLANT

The normal first step in the rehabilitation of an old mine is to make the underground workings safe and then to resample specific workings in order to confirm potential or reported ore reserves. This procedure appeared to be the logical one in the case of Mt. Nansen; however, after reviewing the available data, examining the mine site and upon considering the shortness of the summer season in the Yukon, it has become evident to the writers that such a course is not the optimum one for this operation.

As explained earlier in this report, the comprehensive coverage and the reliability of the survey and sample data for the Mt. Nansen workings are such that the necessity of a check sampling program is minimal. It is highly doubtful whether the results of such resampling would have any effect at all on the ore reserves calculated for this report from the existing mine data. Also, the cost of installing a camp and renewing access to the adits for a sampling crew is more than half the total costs estimated for the first stage of establishing a permanent camp and proceeding with mine and surface plant rehabilitation. And finally, if full advantage is to be taken of the winter months to develop sufficient ore reserves and stopes to guarantee the mill at least three year's reserves when it begins operation, then a permanent camp and surface support plant must be established by September of the first year, for which only four summer months are available from the end of April. If the preliminary camp and sampling procedure is adopted, at least one or two months of that working season will be sacrificed, and the remainder will be insufficient to permit full underground rehabilitation by winter.

For the above reasons, it is strongly recommended that finances be made available to permit the establishment of a permanent camp and the rehabilitation of the mine to begin as soon as possible in any given year. At the same time check sampling can be done, of the two unsampled stope faces, along with the collecting of ore samples for metallurgical testing prior to finalization of the mill flow sheet, in order to bring the two incomplete items in the feasibility data to the desired level.

8.2 SURFACE EXPLORATION

Due to the shortage of pre-production capital, no definitive exploration was done at Mt. Nansen in 1968-69 to check the silver-arsenic soil anomalies that present great promise for the long term ore potential of the property. It would be invaluable for the development of an optimum program of advance of the Webber and Huestis drifts if information from surface drilling of the near-mine silver-arsenic soil anomalies was available as a guide.

It is therefore recommended, dependi[illegible] availability of drills, camp space and funds, that a program of s[illegible]diamond drilling of the silver-arsenic soil anomalies in the vicinity [illegible]present mine workings be undertaken the first summer and continu[illegible]ng as weather reasonably permits.

The excavation of surface trenches, eit[illegible] hand or by bulldozer, is not recommended for this exploration fo[illegible]easons, (1) because of the frozen ground this procedure is very slo[illegible]costly, and (2) because of present environmental regulations it is [illegible] if the type of unreclaimed trenching done in the 1960's would b[illegible]itted today.

8.3 MILL

Metallurgical samples should be collec[illegible]m selected drifts and stopes as soon as the rehabilitation of the[illegible]rground workings permits. These samples should be submitted [illegible]gnated metallurgical laboratories for tests, as directed by D. Gun[illegible] tests would determine the optimum flow sheet and concentrate for [illegible] Nansen ore.

Concentrate samples would then be pr[illegible]to smelters to establish the optimum market for the product.

All of the above metallurgical testing a[illegible]ket investigation can be done through the winter months, as the [illegible]being rehabilitated, so that the installations and circuit modificati[illegible] be completed for mill trials and run-up in the spring after the fir[illegible]er.

8.4 UNDERGROUND EXPLORATION

8.4.1 4100 Development

As soon as the mine is rehabilitated [illegible]he surface support facilities are in place, a program of drifting[illegible]raising should be commenced to confirm inferred ore reserves and[illegible]ish new ones. Drifting on ore veins can be started in both the [illegible] and the Huestis immediately; however, particular priority shou[illegible] given to two specific areas, (1) the extension of the Webber 4100[illegible]cut to intersect the No. 1 and No. 2 veins which are developed on [illegible]0 level above, and (2) the extension of the Huestis 4100 level to [illegible]h the Webber workings in order to facilitate the operation of the i[illegible]ed workings as well as to explore for new ore. The recommended [illegible] the 4100 level of both mines has more likelihood of developing unex[illegible]new ore than would development on the upper levels.

8.4.2. Other Drifting

Priority should be given, second to the 4100 level work described above, to drifting on the following known or indicated ore veins:

(1) Huestis 4300 level - North on 13 Vein through the existing drill intersections.

- Northwest on 12 Vein from the present face.

(2) Webber 4260 level - Northwest on 2 Vein from ore face to surface.

- Southeast on 2 Vein when faulted section is located by diamond drilling.

8.4.3. Raising

Raises should be driven on vein through the probable and possible portions of the richest ore shoots shown on Figures 9 and 10. The obvious priorities for this work are:

Huestis	Webber
4300-585(N)	4260-121
4300-588	" -157
4100-588	" -154
4100-590	" -129
4300-591	" -136(2)
4100-594	
4100-609	

8.4.4 Diamond Drilling

A program of underground exploratory diamond drilling should be an integral part of normal underground work; however, such a program could be delayed at Mt. Nansen until the winter months, after the recommended surface drilling has been completed.

The writers are prepared to finalize a comprehensive and specific exploration and development program for the first year and five year periods of operation at Mt. Nansen.