SCHAFT CREEK

A SUMMARY REPORT
ON
THE SCHAFT CREEK COPPER DEPOSIT
AND
THE IMPLICATIONS OF
MINING DEVELOPMENT
IN
NORTHWESTERN BRITISH COLUMBIA

PREPARED FOR:
SILVER STANDARD MINES LIMITED

PROJECT 1017 **AUGUST 1979**

WRIGHT ENGINEERS LIMITED
Vancouver Canada

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PROPERTY FILE

WRIGHT ENGINEERS LIMITED

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September 4, 1979

Silver Standard Mines Limited
1199 W. Hastings St.
Vancouver, B.C.

Attention: A.C. Ritchie, P.Eng.
President

Dear Sir:

Attached herewith, as requested, are 10 copies of my report entitled Schaft Creek Copper, A Summary Report on the Potential of the Schaft Creek Copper Deposit and the Implications of Mining Development in northwest British Columbia.

This summary report on Schaft Creek copper deposit and the implications of mining developments in the northwest sector of British Columbia is intended to present a picture of the possibilities that exist in that area; possibilities which can only be realized if one of two things occur. One is for the price of copper and molybdenum to increase to the point where the costs of development and operation are offset sufficiently to make the mining operation economically feasible; the second is a cooperative effort to share the cost of infrastructure; thus lowering operating costs and capital costs.

The report is brief and necessarily limited in detail. The scope of the subject is very wide and time does not permit investigating and reporting on many of the total implications.

It is hoped that the brief contents may stimulate discussion and perhaps initiate some action.

I trust you will find the report satisfactory and I look forward to comments on its reception.

Yours sincerely,

WRIGHT ENGINEERS LIMITED

T.S. Hughes, P.Eng.
Executive Assistant

TSH/jcb
Attach.

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INTRODUCTION

The development of northwest British Columbia is lying dormant awaiting the removal of the major constraint, which is the provision of infrastructure services; power, transportation, and townsite amenities such as schools, hospitals, utilities, drainage, water supply, sewerage.

The proven mineral resources are sufficient to support two large mining townsites, one of 10,000 and one of 5,000 people. The probable and possible mineral resources of the region are equal to or greater than those that have been proven to date. (See Table 1 and Figure 1) Schaft Creek Copper is one of the potential producers. The orebody would support an open pit operation of 50,000 tons per day, with drill indicated reserves of approximately 500,000,000 tons of copper-molybdenum ore with some gold, silver and rhenium values.

The northwest region is defined, for our purposes, as that region lying between the Yukon on the north and a line through Granduc to the south, the Alaska boundary to the west, and long. 128°W to the east. It comprises one-quarter of the land area of British Columbia and is undeveloped and totally unproductive, except for one mine at Cassiar and some very small logging operations.

This region and the mineral prospects adjacent to Schaft Creek are shown on Figure 1. The list of mineral prospects is indicative of the region's potential.

Schaft Creek illustrates the constraints to development of the mineral resources of the region. A look at Schaft Creek will focus on the problems associated with resource development in the total region and will also serve to demonstrate how the feasibility of prospects would be improved if power and transportation facilities were available at reasonable costs and if townsites were established on a coordinated and cooperative basis.

Probably, the northwest region is the last important mineral area of British Columbia that awaits development. It has mineral resources that are at least equal to those of the Highland Valley. The potential of the area may be easier to envision by comparison with the Highland Valley producers as shown in Table 2.

Name	Reserves		Exploration Activity		
	Million Tons Ore	Ore Type or Grade	Discovery Date	Approximate Diamond Drilling Feet	Period
A. PROSPECTS					
I. Prospects with Proven Ore Reserves - Some Potential for Production					
SCHAFT CREEK	395	0.33% Cu, 0.029 MoS_2	1957	115,000	1957 - 74
STIKINE COPPER	130	1% Cu, Some Au	1955	260,000	1960 - 73
KUTCHO CREEK	20	Cu, Zn, Grade Unknown	1973	30,000	1973 to date
II. Prospects with Apparently Some Potential but Requiring More Extensive Exploration					
DELLA MINES	0.4	0.17 MoS_2, Some Cu,Zn,Ag	Unknown	6,000	1968 - 73
MAGNO	0.4	Pb,Zn, Plus 3 ozs Ag	"	Unknown	1968 - 76
McDAME BELL	0.15	Ag,Pb,Zn values	1900	10,000	1963 - 74
AMY	0.1	Unknown	1948	10,000	1965 - 74
LETAIN LAKE	10	Asbestos	1955	20,000	1956 - 70
RED-CHRIS GROUP	38	0.59% Cu	1956	40,000	1973 - 76
NICKEL MOUNTAIN	3	0.62% Cu, 0.8% Ni	Unknown	9,000	1966 - 1971
B. EXISTING PRODUCERS					
CASSIAR	22	Asbestos	1956	Unknown	
C. EXPLORATION PROJECTS POTENTIAL UNKNOWN					
COPPER CANYON	Unknown	Cu Grade unknown	1956	3,300	1965
STIKINE NORTH AND EAST	"	" " "	1964	1,500	1974
MAY	"	Cu, MoS_2 Grade unknown		1,500	1972
BAM	"	Cu, MoS_2 " "		Unknown	1972
BRON	"		1908	"	1974
ATAN LAKE	20	Barite " "		1,400	1976
EAGLE	Unknown	Cu, MoS_2 " "		Unknown	1976
GNAT PASS	35	0.44% Cu	1965	"	

MINERAL PROSPECTS NORTHWEST REGION OF B.C.

TABLE 1

TABLE 2

PROPERTY	RESERVES TONS	Cu EQUIVALENT CuE%	TOTAL CuE lbs
Highland Valley			
Bethlehem	480,000,000	0.5	4,800,000,000
Lornex	500,000,000	0.5	5,000,000,000
Highmont	129,000,000	0.7	1,806,000,000
Valley	550,000,000	0.46	5,060,000,000
N.W.Region			
Red-Chris	43,700,000	0.60	500,000,000
Schaft Creek	500,000,000	0.8	8,800,000,000
Stikine	130,000,000	1.0	2,600,000,000

Total lbs. Cu E. Highland Valley 11,600,000,000 lbs.
Total lbs. Cu E. N.W. Area 11,900,000,000 lbs.

(Copper Equivalent (Cu E) is the combined percentage of all mineral values in the ore expressed in terms of copper only. The number is derived by relating the value of the other minerals to their equivalent copper value).

This rough comparison gives some indication of the enormous potential of the area. It is well known that other potential producers have been discovered and undoubtedly others await discovery. See Table 1, Mineral Prospects, Northwest region of British Columbia.

A summary description of Schaft Creek illustrates the magnitude of the comtemplated project and the high capital and operating costs encountered by mining developments in the northwest region of British Columbia. This summary does not deal with the factors of liveable townsites and their amenities, nor the necessity to reduce the effects of isolated locations by providing access to other centers, recreational facilities and social programmes.

SCHAFT CREEK DEPOSIT

The Schaft Creek deposit is located in the northwest sector of British Columbia, (See Figs. 1 and 2) 107 air miles northwest of Stewart and 660 air miles northwest of Vancouver. Access now is by light plane to an airstrip adjacent to the exploration camp on Schaft Creek.

The deposit lies on the west flank of a saddle between Mess Creek and Schaft Creek, with Mt. Edziza Park immediately to the east. The orebody is amenable to an open pit operation, with a low waste-to-ore ratio (0.7 to 1), easily planned access roads and minimum drainage problems. (See photographs showing general pit area).

Exploration and testwork expenditures to date approximate $4,000,000. The work includes 115,516 feet of diamond drilling in 115 holes, core analysis and metallurgical testwork. Prior to a production decision, additional diamond drilling should be carried out to more closely define some areas of the orebody. Also, an underground entry, or alternatively large diameter core holes, will be necessary to confirm rock characteristics and provide material for further metallurgical testing.

The metallurgical work carried out to date indicates recovery rates of 85% for copper and 90% for molybdenite. Separation of the two minerals appears feasible. Some payable gold, silver, and rhenium values occur, but would not be separated at this stage of concentration.

The mineral inventory at Schaft Creek is in excess of half a billion tons grading 0.308% copper and 0.030% molybdenite. Mineable reserves, calculated in 1978, were 393,000,000 tons averaging 0.33% copper and 0.029% molybdenite. Current high metal prices have the effect of revising these reserves upwards, because of a resulting decrease in cut-off grade. The present effective grade, or copper equivalent grade, is 0.8% copper. The mineral zone at Schaft Creek is open to the north and ultimate reserves may be much greater.

The drilling results indicate a possibility of mining somewhat higher grade ore in the early years. This "high grading" would improve early cash flow and accelerate debt repayment.

The climate at Mess Creek valley, the site of the proposed townsite, is moderate; temperatures range from 62°F to -6°F; snowfall averages 148 inches per annum and rainfall averages 9 inches per annum. The valley is east of the coastal region of heavy snowfall and could be a pleasant, liveable place. It is open, with broad, flat or gently sloping areas suitable for a townsite and plant buildings; the braided sections of Mess Creek can be readily channelled into one stream; there is an ample and readily available water supply from glacier-fed streams and gravels.

Tailing and waste dump areas are available in Schaft Creek valley and Mess Creek valley, These areas, as currently chosen, would not affect the valley environment adversely to a measurable extent.

SCHAFT CREEK COSTS

The following summarizes the costs of constructing and operating a 50,000 tons per day mining development at Schaft Creek. For a lesser production rate there would be corresponding reductions in some of the capital costs. The figures are the best currently available in 1978 dollars. They indicate the magnitude of the costs that are involved in a project of such a size in a remote location.

1. CAPITAL COSTS

Pre-production	75,602,300
Mine Development and Mine Plant	40,044,000
Process Plant and Ancillaries	229,952,800
Townsite	20,800,000
Power Supply and Distribution	109,043,700
Access road to Stewart-Cassiar Highway	16,500,000
Marine Facility	7,500,000
Total Project	$499,442,800

It is noteworthy that the above list includes a number of very high costs related to the isolated and undeveloped area in which this orebody lies; for example, the burden of road, power supply and townsite facilities other than housing totals $139,000,000.

2. OPERATING COSTS

Direct operating costs have been estimated at $3.35 to $3.50 per ton. The inclusion of indirect cost will increase this figure substantially.

A point worth noting in operating costs is that truck transportation now approximates $0.12 per ton-mile, and rail transportation would be $0.06 per ton-mile or less.

The property can sustain the operating and capital costs normal to a mining operation of this kind, but unless some assistance is forthcoming, the combined extraordinary costs of supplying power, transportation and adequate townsite facilities may make development impractical.

DISCUSSION OF CONSTRAINTS

Schaft Creek development is constrained by high capital and operating costs. As a single producer in the area, it is unlikely to proceed to production under present conditions. However, if some of the burden of capital and operating costs for infrastructure were removed by cooperative action by other producers, the Provincial Government, B.C. Hydro Authority and either C.N.Rail or B.C. Railway, then Schaft Creek would be feasible and the potential of the area would be realized.

It is noteworthy that if Schaft Creek and Stikine were to use a common townsite, the population would approximate 10,000.

Stikine Copper has the same constraints as Schaft Creek, although they are more severe because of Stikine's location. There is no townsite area or readily available road access (See Fig. 2).

It may be opportune here to note that studies on Stikine Copper have produced several alternatives for access and townsites. One alternative is to drive a tunnel from Galore Creek to Mess Creek valley, so that the townsite, and perhaps the concentrator, would be in a more pleasant environment than the Stikine River valley, and access to the provincial highway system would be more feasible. (See Figure 2)

Access from Stikine Copper to Mess Creek would mean a common townsite for Stikine and Schaft Creek Copper, with a host of benefits arising from such common use of townsite facilities; combined transportation facilities; and a single power supply.

Kutcho Creek, Letain Lake and Red-Chris are three other prospects which exploration indicates have a good possibility for production. Power, transportation and personnel accommodation are major factors affecting their feasibility in varying degrees.

Some idea of the immensity of the projected mining operations in the region may be gained from the following Table (3).

TABLE 3

Property		Concentrate Tons per year	Employees	Power Megawatts	Freight Tons per day Out	In
Schaft Cr.	Cu-Mo	237,000	515	80	650	350
Stikine	Cu	450,000	900	53	1100	600
Kutcho Cr	Cu-Zn	72,000	220	7	250	150
Letain	Asbestos	72,000	360	10	250	150
Red-Chris	Cu	65,000	250	10	200	100

The following is an outline of some of the implications that emerge as we consider the removal of constraints to development at Schaft Creek.

1. TOWNSITE Townsites in remote locations are viable in proportion to the quality of lifestyle they can provide. In the past, mining communities had great difficulty in retaining top quality staff until the standard of the townsite and/or its communication with "outside" was raised to an acceptable level. Examples of this kind of situation abound, notably at Stewart and B.C. Moly. At B.C. Moly the new owners are making a large investment to improve the townsite and access to other communities.

Schaft Creek operations alone would support a townsite of some 3,000 to 4,000 population. This is a reasonably viable town, but with a single employer. The capital cost of townsite infrastructure, that is, everything except houses, would be about $10,000,000. This cost would be about $15,000,000 if Stikine and Schaft Creek shared a townsite of 10,000 population. Such a townsite would make a long term viable community, which could be a centre for other mining developments in the vicinity.

Townsite services, water supply, sewage systems, power distribution, drainage, roads and streets, schools, hospital, public service buildings, are facilities whose costs could be assumed by government or shared.

2. TRANSPORTATION A road from Schaft Creek to Stewart-Cassiar Highway (70 km) would cost $17,000,000 to $20,000,000 for a gravel surface. The Stewart-Cassiar Highway has a gravel surface, and is slowly being upgraded.

The traffic from Schaft Creek, in concentrates and supplies, would mean one 30-ton truck passing a given point every 30 minutes. If we add Stikine to this traffic, it would mean a truck, going to Stewart or returning, every 11 minutes. This kind of traffic would require a paved highway. If the projected traffic from Stikine and other possible developments is added to the Schaft Creek traffic, and due weight given to the rising costs of fuel, then it appears that a railway must be considered.

Some considerations for a railway follow:

a) Freight movement, in and out, for Schaft Creek only, 1500 to 2000 tons per day. Schaft Creek and Stikine - 3,500 to 4,000 tons per day.

b) Rail to Stewart may be possible but dock sites are limited and railway grades difficult to achieve. Therefore, a route to New Hazelton or Terrace should be considered.

c) Rail access to the Terrace - Kitimat area opens up the possibility of a smelter-refinery complex in that area. 600,000 tons of copper concentrates per year would support a major smelter and refinery complex.

d) A rail corridor extended north to Watson Lake would make it possible to bring lead-zinc concentrates from the Yukon to the Terrace - Kitimat area and would open up consideration of a major metallurgical complex derived from the production of Anvil and the development of Summit Lake. However, mineral development in the Yukon is also constrained by lack of power.

These brief remarks are only indicative of the vast scope of the developments that await the provision of cheap transportation. Private enterprise may be able to undertake the construction of a railroad but only as a cooperative effort of all major parties; no single mining company could do it.

POWER

Table 3 indicates the estimated power requirements for the probable early developments.

If Stikine, Schaft Creek, Kutcho Cr. and Letain Lake come into production, the power requirement approximates 160 megawatts, plus power for townsites. Such a quantity of power must come from a presently undeveloped source. There are three choices:

a) thermal power from coal
b) diesel generated power
c) hydroelectric power

a) Thermal power from Groundhog coal is a possibility, or thermal coal from any of the northeast coal prospects. For Groundhog coal, a central thermal power plant at the coal mine might be feasible. If coal is brought in from the metallurgical coal areas, then plants at several locations may be more practical than one central plant. The coal at Groundhog is still in the prospect stage.

b) Diesel generated power will be expensive and the cost will continue to rise rapidly with the increasing cost of petroleum products.

c) An overhead line from Terrace is a possibility, but the capital cost ($109,000,000) makes it prohibitive. The scheme adds nothing to the provincial grid.

Hydroelectric power is the cheapest form of power but takes a relatively long time to install. There are suitable sites on the Iskut River system but investigations and construction times may approximate 10 years, unless the process is accelerated by an executive decision.

The power supply problem, then, appears to have two solutions; one, the short term, which would be to construct coal-fired or diesel plants at those mines which would go into production ealiest and two, the long term, to construct hydroelectric plants on the Iskut River system, on either or both of More Creek and Forrest Kerr Creek or the Iskut itself. Studies of power generation have been carried out on Forrest Kerr and More Creeks, so that the potential is known. Such a power source could supply power to all the known and projected mining developments, and in due course, when the inevitable mine exhaustion occurs, the power would be available to the provincial grid, or for other resource development in northwest British Columbia.

Time is a factor in considering hydro power generation and it may be most feasible to proceed first with thermal power plants, and assume that hydroelectric power will not be available for 10 years unless some events intervene to bring it on-stream earlier.

SUMMARY

To summarize, Schaft Creek development is typical of several mining properties in the northwest section of British Columbia. The constraints to development are obvious; the provision of power, transportation and townsite amenities at a cost which will remove some of the risk inherent in all mining ventures.

A recent financial analysis shows that Schaft Creek cannot come into production until copper reaches $1.25 per pound, with molybdenum at $8.00 per pound. It would also be necessary to remove some of the burden of infrastructure costs.

Removal of these constraints on development would open up the possibility of a major copper smelter - refinery complex, either at Schaft Creek or in the Terrace - Kitimat area.

Extension of the proposed railway to the Yukon opens up the possibility of a major metallurgical complex based on Yukon lead-zinc ores.

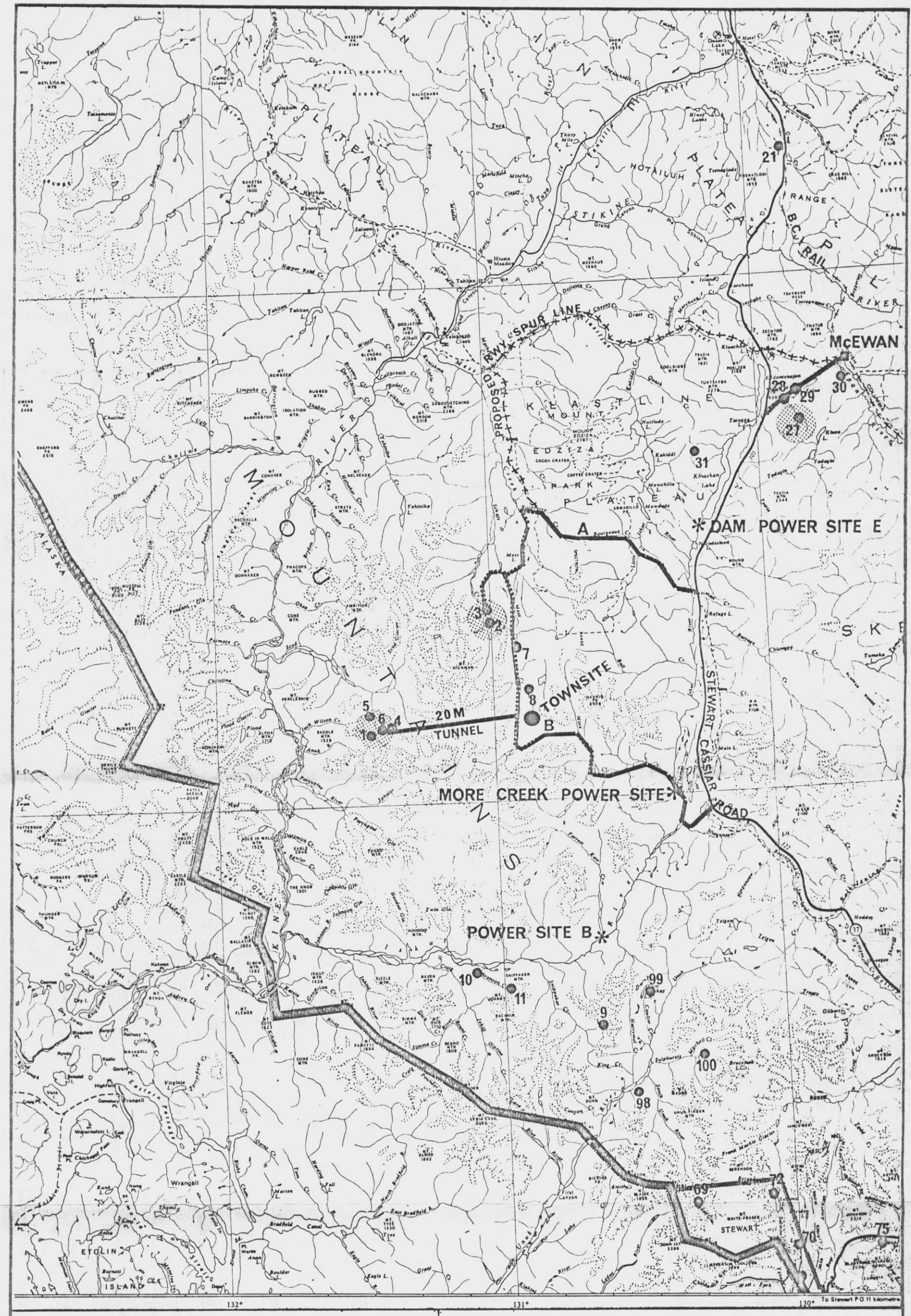
The elements of a massive development are all there; the constraints are known and can be removed by coordinated action. The concerned parties include major mining companies, B.C. Hydro, B.C. Rail, C.N. Rail, the Yukon Government and the Government of British Columbia. The logical leader to catalyse this development is the B.C. government and their consideration and early action is recommended.

In this case, government assistance to mining development cannot be considered in the usual context of subsidies. The development of hydroelectric power is a necessary element in the overall economic development of the province; a railroad to the Yukon is a multi-faceted

aid to development in general, not only to British Columbia but also the Yukon and eventually Alaska. The possibility of electrifying such a railway should not be ignored, particularly with the rising cost of petroleum products. The development of northwest British Columbia and the railway would undoubtedly spark the development of hydroelectric power sources in the Yukon. The scope is boundless once the initial steps are taken.

SCHAFT CREEK PROPERTY FROM AIRSTRIP IN SCHAFT CREEK VALLEY

VIEW OF SCHAFT CREEK DEPOSIT, MESS CREEK VALLEY IN BACKGROUND



Prospects			
1	STIKINE COPPER	27	RED CHRIS
2,3	SCHAFT CREEK	28	COYOTE CREEK
4	COPPER CANYON	29	ROSE
5	STIKINE NORTH	30	KLAPPAN
6	STIKINE EAST	31	GROAT
7	MAY	69	GRANDUC
8	BAM	70	BIG MISSOURI-UNICORN
9	NICKEL MOUNTAIN	71	SILBAK-PREMIER
10	BRON	75	BEAR PASS
11	INEL	98	MAX
21	GNAT PASS	99	TOM MACKAY LAKE
		100	SULPHURETS CREEK

SCALE 1:600 000
(1cm = 6km)

10 0 10 20 30 40 50 60 70 kilometres

inches
0 1
0 1 2
centimetres

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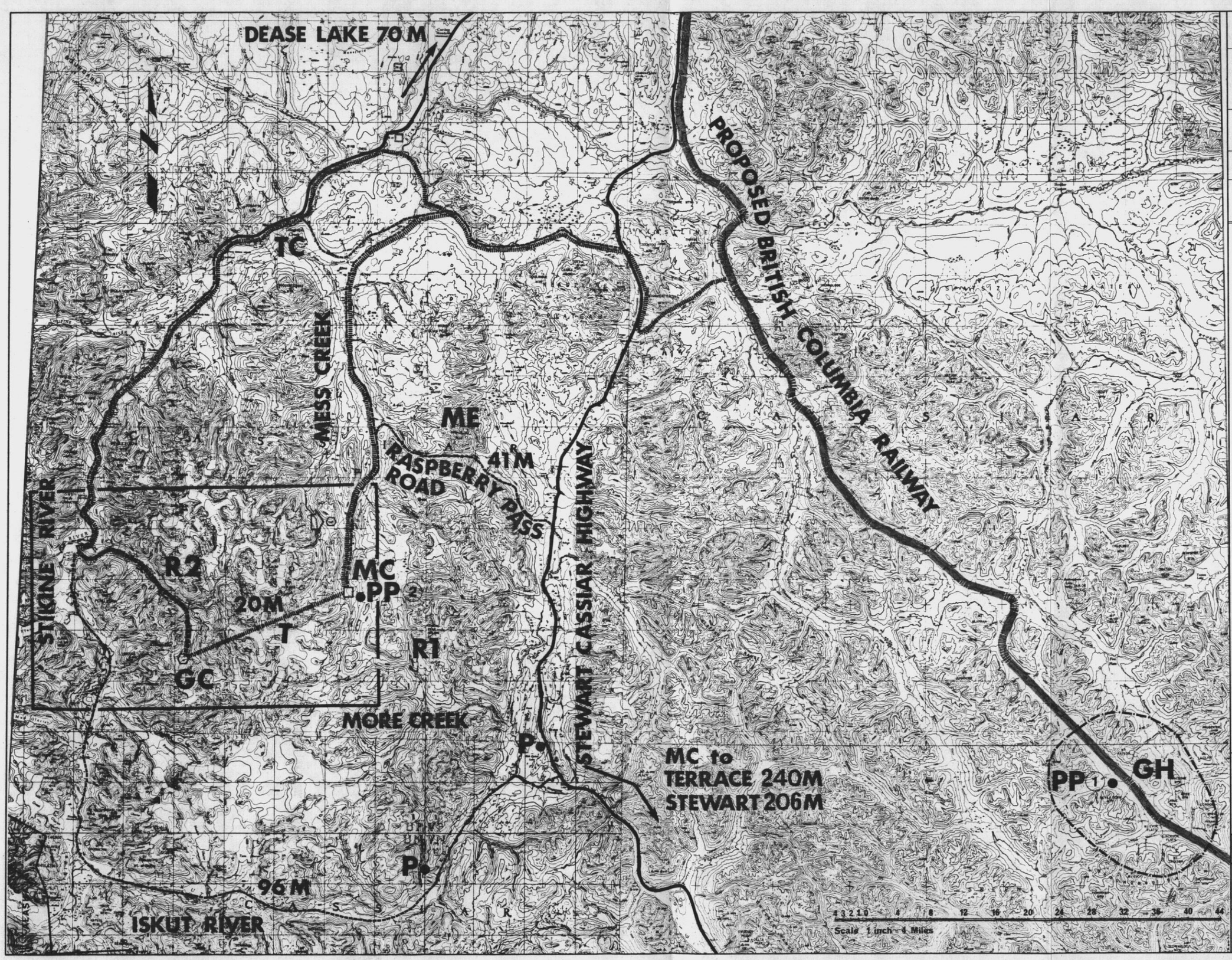
FIGURE 1

River Region: Mineral Prospects and Access Routes for SCHAFT CREEK



LEGEND

- Approximate Location Of British Columbia Railway Future Extension North
- Approximate Location Of Possible Railway Branch Lines
- Existing Public Highways
- Possible Future Highway Network

Schaft Creek

- **GC** GALORE CREEK PIT & PLANT
- **MC** MESS CREEK TERMINAL - TOWNSITE
- **T** RAILROAD TUNNEL
- **R1** MORE CREEK HIGHWAY
- **R2** SCUD PORTAGE ACCESS ROAD
- **TC** TELEGRAPH CREEK
- **ME** MOUNT EDZIZA PROVINCIAL PARK
- **GH** GROUNDHOG COAL DEPOSIT
- **PP** CENTRAL POWER PLANTS
- **P** POWER SITES

inches 0 1
centimetres 0 1 2

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

FIGURE 2

LOCATION AND ACCESS
SCHAFT CREEK & STIKINE

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