Schroeter

888335

SURF INLET GOLD PROJECT

PRINCESS ROYAL ISLAND, B.C.

EXTRACTION OF GOLD FROM MILL TAILINGS AND MINE WASTE: PRELIMINARY TESTING

METALLURGICAL ASSESSMENT

PREPARED FOR FLEET DEVELOPMENTS LTD.

BY

GARY HAWTHORN, P. ENG.

Good

CONTENTS

1. SUMMARY

The mine waste dumps and the mill tailing at Surf Inlet probably contain in excess of $10 million in recoverable gold and silver.

The testing indicates that flotation will produce a concentrate containing 4-6 oz/t Au. This material may be either sold directly or leached on-site.

Additional testing will be required to determine the optimum metallurgical operating conditions, or the relative economics of flotation and cyanidation.

Future testing will investigate whether alternative hydrometallurgical techniques will enhance the overall recovery relative to cyanidation.

2. INTRODUCTION

The Surf Inlet property was previously mined in the periods of 1917 to 1926 and 1940 to 1943, leaving a substantial tonnage of flotation tailing (order of magnitude estimate 0.5 - 1.0 x 10^6 tons) grading .03-.05 oz/ton Au and mine waste (order of magnitude estimate 0.5 - 1.0 x 10^6 tons) grading approximately 0.1 oz/ton.*

Processing during these periods consisted of crushing/grinding/gravity/flotation to produce an auriferous pyrite concentrate for sale to smelters.

Available literature suggests that:

- feed grade was 0.3 - 0.6 oz/ton Au;
- recovery was approximately 92%;
- tailing losses were 0.03 - 0.05 oz/ton Au;
- the concentrate contained approximately 2.5% Cu and 6 oz/ton Au;
- the concentrate represented approximately 9 - 11% of the original feed weight;
- the mineralization was refractory to the cyanide process.

* See Shearer, J.T.; Jan. 15/86: "Report on Preliminary Sampling of Tailings and Stockpiles at the Surf Inlet Mine".

3. DESCRIPTION OF THE SAMPLES

Nominal Description	Number of Samples	Sample Identification
Mill Tailing	20	See attached Assay Cert.
Mine Waste Rock	3	East Surf 1 - A to C
Mine Waste Rock	3	West Surf 1 - A to C

Average Sample Weight 8 Kg

Sample Preparation

Tailing

Equal volumes were removed from each of the twenty sample bags and composited to provide a laboratory feed sample of approximately 15 Kg.

Mine Waste Rock

All six samples were jaw crushed to -6 mm (1/4") and two composites were prepared (East Surf/West Surf), utilizing the entire samples.

4. DISCUSSION OF TEST RESULTS

Sample	Compo. Grade (oz/t) Au	Ag
A - PLANT TAILING	* .060	.063
B - E SURF COMPO 1-A/C	.067	.29
C - W SURF COMPO 1-A/C	.151	.20

* During the periods 1917-1926 and 1940-1943, the ore was ground to 90% -220 mesh and 45-55% -200 mesh, respectively. The plant tailing was reported to be .03-.05 oz/t Au.

Field sampling of the plant tailing in Nov. 1985 (20 samples .046-.084 oz/t, average .060 oz/t Au) indicate that natural classification of the tailing in the disposal system has left an enriched coarse portion adjacent to the outfall.

The portion of the tailing which flowed into the lake will likely be both finer and lower grade than the sample material.

SUMMARY OF TEST RESULTS

Sample	Test	Tailing oz/t		Recovery (1)		Rougher Conc Grade		TLG. Sizing % -200 M
		Au	Ag	Au	Ag	Au	Ag	
A	F	0.47	.03	23.5	27.3	1.09	0.85	10.0
A	C	0.42	.084	30.0	nil	-	-	10.0
B	F	0.18	.080	78.8	57.9	1.03	1.69	66.5
B	C	0.47	.33	29.9	nil	-	-	56.7
C	F	0.31	.02	83.2	88.5	3.33	3.34	44.1

F - FLOTATION C - CYANIDATION

* Note: (1) recoveries in this summary have been computed using assays of the composites and the test tailings.

COMMENTS

1. The rougher concentrate grades ranged 1.0 to 3.3 ounces of gold per ton. It is expected that the final concentrate would duplicate 4 to 6 ounces of gold per ton achieved by the previous operation.

2. There is a reasonably consistent gold to suphide ratio which resulted in good quality flotation concentrate grades.

3. Due to a very fine gold distribution in a sulphide matrix and/or discreet gold minerals, the flotation concentration method is more effective than cyanidation.

4. It may be possible to process the flotation concentrate by an alternative hydrometallurgical technique. This may enhance the economics of the operation by producing a bullion on-site rather than having to incur the high cost of transporting and marketing a flotation concentrate.

   Techniques which may be worthy of consideration include: thiourea leaching, bio-oxidation/cyanidation. These are still in the experimental stage and plant scale technical and financial feasibility have not been demonstrated.

5. Flotation concentration is sensitive to the degree of grinding, as evidenced by the following comparison:

GRIND % -200 M	FLOT. TAILS Au- oz/t
10	.047 LAB
44	.031 "
66	.018 "
46	.029 PLANT 1940

6. Recovery by cyanidation was technically not as attractive as was flotation concentration. However, the sales revenue from marketing bullion is appreciably higher than that obtained from flotation concentrate: typically 99% vs 85%.

LABORATORY CONCENTRATE ANALYSIS

NOTE: Rougher Concentrate Only

	WEST SURF COMP.	EAST SURF COMP.
S	22.4%	8.0%
Cu	1.39%	Not Assayed
Fe	25.5%	13.7%
INSOL	37.4%	64.4%
Au	3.33 oz/t	1.03 oz/t
Ag	3.34 oz/t	1.69 oz/t

5. PROCESSING ASSESSMENT

A preliminary financial evaluation has been prepared based on the following assumptions:

1) Flotation concentrate only
2) Feed Grade .1 oz/T
3) NSR = 85% contained gold value
4) Capital Cost in the $2,000,000 range
5) Mining Rate 200 tons/day
6) Gold Price $450 CAN

Operating Cost Estimate:

	FUNCTION	$/TON	$/MONTH
	Stockpile Recovery and Haulage	2.00	12,000
	Supervision	4.00	24,000
	Mill Operators	1.00	6,000
	Miscellaneous Labour	0.50	3,000
*	Power (40 kwh/t @ $.25/kwh)	10.00	60,000
	Grinding Media	1.25	7,500
	Miscellaneous Supplies	1.50	9,000
	Tailing Disposal	1.00	6,000
		21.25	127,500

Projected Cash Flow:

Assumed Mine Waste (tons)	200,000	400,000	600,000
Life (years)	2.7	5.4	8.2
NSR ($/ton)	28.7	28.7	28.7
Operating Cost ($)	21.3	21.3	21.3
Capital Cost Allowance ($)	10.0	5.0	3.3
GROSS REVENUE; (Before Taxes/Interest) ($/ton)	-2.30	2.40	4.10
TOTAL ($)	-500,000	1,000,000	2,500,000

* NOTE: Power costs were based upon typical data from diesel-electric operation in remote locations. This high cost may provide some incentive to rehabilitate the hydro-electric facilities.

There is no suggestion that 200 t/d is an optimum rate.

6. CONCLUSIONS AND RECOMMENDATIONS

The testwork shows that flotation concentration is technically feasible for the extraction of gold from mill tailing and the mine waste dumps.

The percentage recovery obtained by straight cyanidation was not as high as that obtained by flotation. (Flotation 23.5% to 83.2%/Cyanidation 30%). Some combination of flotation followed by cyanidation after regrinding may enhance the economics of the operation. This will be the subject of future testing.

Additional laboratory testing must be undertaken to determine:

- Whether flotation followed by regrinding and cyanidation is economically superior to producing a flotation concentrate for sale.

- The relationship between the grind and recovery in flotation.

- The optimum conditions for cyanidation.

If the revenue from flotation and cyanidation is low relative to the contained Au content, it may be appropriate to perform additional leaching tests using thiourea and bio-oxidation.

7. METALLURGICAL INVESTIGATION

7.1 Summary of Test Results

Sample	Composite Grade Au	Ag
A) Plant Tailing	.060	.063
B) E. Surf Composition 1-A/C	.067	.29
C) W. Surf Composition 1-A/C	.151	.20

Sample	Test	Tailing oz/ton Au	Ag	Recovery % Au	% Ag	Concentrate Grade Au	Ag	Tailing Sizing (%-200M)
A	F	.047	.03	23.5	27.3	1.09	0.85	10.0
A	C	.042	.084	30.0	nil	-	-	10.0
B	F	.018	.080	78.8	57.9	1.03	1.69	66.5
B	C	.047	.33	29.9	nil	-	-	56.7
C	F	.031	.02	83.2	88.5	3.33	3.34	44.1

F - Flotation - rougher flotation
C - Cyanidation

7.2 Metallurgical Investigation - Details

Plant Tailing - Cyanidation

GRIND: Nil

LEACH: 500 g.24 hr/33% Solids

TIME	ADDITION (gm)		NaCN CONC.	PH	
	NaCN	$Ca(OH)_2$	g/1	Initial	Final
0	1.0	0.2	1.0	9.4	
2	-	-	0.9	11.8	
24	-	-	0.8	11.7	

REAGENT CONSUMPTION

	Kg/t
NaCN	0.4
$Ca(OH)_2$	0.4

NOTE: - High natural pH of 9.4
- In future testing add only 0.1 g $Ca(OH)_2$ per 500 g sample.

METALLURGY

	Au	Ag
TAILING	.042 oz/t	.084 oz/t
FEED	.060 oz/t	.063 oz/t
EXTRACTION	30%	nil

FRACTIONAL SCREEN ANALYSIS (Test Tailing)

MESH	% Wt.	Oz/Ton	
		Au	Ag
35	19.5	.029	.17
65	34.9	.034	.05
100	15.9	.032	.12
150	19.7	.029	.02
200	10.0	.032	.10
	100.0	(.042)	(.084)

7.3 Plant Tailing - Flotation

GRIND: Nil

CONDITION: 2 Minutes

FLOAT: To completion 8 Minutes

REAGENT: Potassium Anyl Xanthate
AF 65
Natural pH

METALLURGY

	% Wt.	Oz/Ton		Dist. - 1%	
		Au	Ag	Au	Ag
CONC.	1.3	1.092	.85	23.5	27.3
TAILING	98.7	.047	.03	76.5	72.7
FEED	100.0	(.061) .060	(.041) .063	100.0	100.0

REAGENTS	ADDITION POINT	ADDITION g/1
PAX	COND	130
	FLOAT	390
AF 65	COND	250

7.4 East Surf 1A to C Composite

CYANIDATION

GRIND: 500 g/4 minutes 50% Solids

LEACH: 24 Hr/33% Solids

TIME	ADDITION (gm)		NaCN CONC.	pH	
	NaCN	$Ca(OH)_2$	g/l	Initial	Final
0	1.0	0.1	1.0	9.6	
24	-	-	0.8	10.2	

REAGENT CONSUMPTION	Kg/t
NaCN	.4
$Ca(OH)_2$	.2

METALLURGY		Oz/t		Dist.	
	g	Au	Ag	Au	Ag
PREG SOL'N	1100	.028	.035	55.4	21.5
TAILING	463.5	.047	.33	44.6	78.5
FEED	463.5	(.121) .067	(.42) .29	100.0	100.0

( ) DENOTES CALCULATED VALUE

FRACTIONAL SCREEN ANALYSIS - TAILING

MESH	%Wt.	Oz/ton	
		Au	Ag
65	4.4	.031	.16
100	13.5	.034	.17
150	25.4	.046	.06
200	56.7	.052	.51
	100.0	(.047)	(.33)

7.5 East Surf Composite - Flotation

GRIND: 1000 g/12 minutes/50% Solids

CONDITION: 2 minutes

FLOAT: To Completion/6 minutes

REAGENTS: - Potassium Amyl Xanthate

- Cyanimid A.F. 65

- Natural pH 9.4

METALLURGY

	% Wt.	Oz/ton		Dist.	
		Au	Ag	Au	Ag
CONC.	6.1	1.032	1.69	78.8	57.9
TAILING	93.9	.018	.080	21.2	42.1
FEED	100.0	(.080) .067	(.18) .29	100.0	100.0

REAGENTS

REAGENT	ADDITION POINT	QUANTITY g/t
PAX	CONC.	130
	FLOAT.	390
AF 65	COND.	200

FRACTIONAL SCREEN ANALYSIS - TAILING

MESH	% Wt.	Oz/ton	
		Au	Ag
65	2.3	.036	.28
100	6.9	.006	.02
150	24.3	.006	.02
200	35.7	.015	.06
325	30.8	.032	.15
	100.0	(.018)	(.080)

7.6 West Surf Composite - Flotation

GRIND: 1000 G/6 minutes/50% Solids

CONDITION: 3 minutes

FLOTATION: To Completion: 8 Minutes

REAGENTS: PAX
AF 65
Natural pH

METALLURGY

	% Wt.	Oz/ton		Dist. - 1%	
		Au	Ag	Au	Ag
CONC.	4.41	3.33	3.34	83.2	88.5
TAILING	95.59	.031	.02	16.8	11.5
FEED	100.0	(.177) .151	(.166) .20	100.0	100.0

SCREENING: 44.1% -200 Mesh

Note that the E. Surf Compo was ground for 12 minutes to 66.5% -200 Mesh

REAGENTS: As in 5.4

8. REFERENCES

(1) Maconachie, R.J. 1940 - Research on Surf Inlet Tailing

(2) Report of the Minister of Mines, 1918 - F.40

ASSAY REPORT

SAMPLE DESC.	AU OZ/TON	AG OZ/TON
H1A	0.049	0.09
H1B	0.055	0.06
H1C	0.055	0.03
H1D	0.053	0.09
H1E	0.055	0.06
H1F	0.055	0.06
H1G	0.052	0.03
H1H	0.052	0.06
H1I	0.055	0.06
H2A	0.058	0.09
H2B	0.065	0.06
H2C	0.064	0.06
H2D	0.064	0.09
H2E	0.064	0.09
H3A	0.067	0.09
H3B	0.084	0.06
H3C	0.064	0.06
H3D	0.075	0.03
H3E	0.075	0.06
H4	0.046	0.03
	0.060	0.063

CERTIFICATION

I, Gary William Hawthorn, of the District of North Vancouver, Province of British Columbia, hereby certify as follows:

1. I am a Registered Professional Engineer residing at 3650 Emerald Drive, North Vancouver, B.C.

2. I graduated with a Bachelor of Science in Mining Engineering from Queen's University in Kingston, Ontario in 1964.

3. I have practiced my profession continually since graduation.

4. I have no interest, direct of indirect, in the claims of Fleet Developments Ltd. or in the Company nor do I expect to receive any such interest in the future.

5. The attached report is based on a study of materials supplied by the company in December, 1985.

6. I consent to the use of this report in or in conjunction with a prospectus or in a statement of material facts relating to the raising of funds for this project.

DATED at Vancouver, British Columbia this 4th day of February, 1986.

Gary W. Hawthorn, B.Sc.

73FLEETM

CERTIFICATION

I, Gary William Hawthorn, of the District of North Vancouver, Province of British Columbia, hereby certify as follows:

1. I am a Registered Professional Engineer residing at 3650 Emerald Drive, North Vancouver, B.C.

2. I graduated with a Bachelor of Science in Mining Engineering from Queen's University in Kingston, Ontario in 1964.

3. I have practiced my profession continually since graduation.

4. I have no interest, direct of indirect, in the claims of Fleet Developments Ltd. or in the Company nor do I expect to receive any such interest in the future.

5. The attached report is based on a study of materials supplied by the company in December, 1985.

6. I consent to the use of this report in or in conjunction with a prospectus or in a statement of material facts relating to the raising of funds for this project.

DATED at Vancouver, British Columbia this 4th day of February, 1986.

Gary W. Hawthorn, B.Sc.

73FLEETM

CERTIFICATION

I, Gary William Hawthorn, of the District of North Vancouver, Province of British Columbia, hereby certify as follows:

1. I am a Registered Professional Engineer residing at 3650 Emerald Drive, North Vancouver, B.C.

2. I graduated with a Bachelor of Science in Mining Engineering from Queen's University in Kingston, Ontario in 1964.

3. I have practiced my profession continually since graduation.

4. I have no interest, direct of indirect, in the claims of Fleet Developments Ltd. or in the Company nor do I expect to receive any such interest in the future.

5. The attached report is based on a study of materials supplied by the company in December, 1985.

6. I consent to the use of this report in or in conjunction with a prospectus or in a statement of material facts relating to the raising of funds for this project.

DATED at Vancouver, British Columbia this 4th day of February, 1986.

Gary W. Hawthorn, B.Sc.

73FLEETM