'TULAMEEN'
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T U L A M E E N

COALFIELD, PROPERTY AND PROJECT

INFORMATION SUMMARIES

AND REVIEW

Prepared

by

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for

IMPERIAL METALS CORPORATION

November, 1983

767

T U L A M E E N

INFORMATION SUMMARIES AND REVIEW

TABLE OF CONTENTS

LIST OF ENCLOSURES

x to accompany Executive Summary

\+ by Cyprus Anvil Mining Corporation - April, 1973

T U L A M E E N

EXECUTIVE SUMMARY

November, 1983

T U L A M E E N

EXECUTIVE SUMMARY

PROPERTY	high volatile bituminous thermal coal property: fourteen B.C. coal licences covering 2,400 hectares, held by Imperial Metals Corporation (100%), subject to a royalty agreement with Mullins Strip Mines
LOCATION	Southeastern British Columbia: NTS 92-I/7 and 10 Latitude 49°30'N, Longitude 120°45'W;
TOWNS	Coalmont (11 km), Tulameen (19 km), Princeton (32 km), Merritt (70 km)
HIGHWAY	at Coalmont (11 km) to Princeton and further on No. 3 to Vancouver (300 km)
RAILWAY	at Coalmont (11 km) to Vancouver, and southward to the United States (50 km)
COAL PORTS	Vancouver area, 420 kilometres by rail via Merritt (60 km)
PROJECT STATUS	the B.C. Government approval process under the Coal Guidelines: Prospectus: submitted (April, 1979) Stage I: waived Stage II: Feasibility Study completed, submission could be made no objection encountered.
TECHNICAL INFORMATION	o n P a g e T w o

GEOLOGY

Coal occurs in the middle member of the Tertiary (Eocene) Allenby Formation in a 5.5 kilometres long 4 kilometres wide conic basin. There are two, a lower and the main coal zones 3-8 and 10-40 metres thick respectively. The main zone is 15-40 (15-21 in the project area) metres thick and clean enough for mining along the southwestern edge of the basin where dips are also gentler (20°-45°) and the cover increases at a lesser grade.

PREVIOUS PRODUCTION

1916-1940: two million tonnes in five underground mines;
1954-1956: 0.2 million tonne in an open pit mine;

EXPLORATION

at feasibility study level

Cyprus Anvil Mining Corporation operated the property from 1977 to 1983 under an option agreement with Imperial Metals. In this period 20 holes were drilled, 11 major and numerous minor bulldozer trenches were dug, four bulk samples were taken and tested and a mining feasiblity study was completed at a total cost of approximately $700,000.

COAL RESERVES

12 million tonnes raw recoverable, proven, surface mineable;
Overburden ration = 2.90:1 m^3 waste per tonne of coal.

potential for additional surface mineable reserves:
surface pillars of old underground workings (very low overburden ratios) and at higher overburden ratios.

additional coal resources amenable to underground mining:
over 100 million tonnes geological in-place.

MINING FEASIBILITY

selective open pit mining using rippers and scrapers; mining rate: one million tonne annually (12 years); production rate: 550,000 tonnes clean coal; beneficiation: Batec jig and auxiliary equipment; plant recovery: 55% to produce 16.6% Ash clean coal;

Capital cost requirement: $36 million
Replacement and improvement capital cost $11.5 million in 12 years
Operating cost: $20.59 average, $18.00 in the first three years per tonne clean coal including contract trucking to railway
Figures in 1981 Canadian dollars.

POTENTIAL PRODUCT

high volatile C (-B) bituminous (ASTM) coal

Coal quality:		Run-of-mine	Clean
Moisture	%	6.0	13.2
Ash	%*	33.4	16.6
Volatile Matter	%*	27.1	27.0
Fixed Carbon	%	33.0	43.2
Heat Value	Kcal/kg	4,300	5,278
	Btu/lb	7,730	9,500
Sulphur	%	0.5	0.6

The deeper part of the reserves is probably high volatile B bituminous.

MARKETS

thermal coal for electric power generation and cement manufacturing

T U L A M E E N

RECOMMENDATIONS

1. B.C. Coal Licences 159 and 3663, covering 185 hectares, to be surrendered. Coal bearing strata do not underlay any part of these two licences.

2. The property should be actively marketed for participation. The product quality and project economics are competitive compared to other properties being proposed for development.

3. A quick optimization study to be carried out as soon as possible. It should not necessarily delay marketing the property, but having it done would improve Imperial Metals' position in the process. The return on its cost can be substantial.

   The objectives of this study would be to decrease the run of mine ash, increase the feasibly mineable tonnage and the annual clean coal output. There are indications, that these parameters could be feasibly improved. The shape and size of the pit would be optimized and feasibly separable partings would be identified by detailed but unexpensive analysis of the geological data. This study would also bring Imperial Metals' in-depth familiarity with the project to a desirable level. Imperial Metals was only indirectly involved with the technical aspects of the project in the past, but now, at least for the time being, has to speak for it.

4. Stage II submission to the B.C. Government should be made shortly after a partner for development is found. Reasons for this recommendation will be presented verbally.

5. A drilling program to be carried out by the developer on the down-dip part of the reserves in the proposed pit for a final mine design, production and investment commitments. Only two drill holes intersected the deeper part of the reserves scheduled for mining.

T U L A M E E N

TECHNICAL SUMMARY

November, 1983

T U L A M E E N

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T U L A M E E N

2. LAND TENURE SUMMARY

LAND DISTRICT	YALE DIVISION AND DISTRICT, B.C.
YEAR LICENCES ISSUED	1974: B.C.C.L. 125,145,154 1975: B.C.C.L. 69,70,71,126,146,147,158,159 1977: B.C.C.L. 3663,3664,3665
ANNIVERSARY DATE	May 11, uniform for all licences
RENTAL	$ 5.00/hectare per term (licence year)
WORK REQUIREMENTS	$50.00/hectare per term fulfilled until the end of the 1989-1990 term on all licences no excess work credit beyond the term above on any licence

	B.C.C.L.	LEGAL DESCRIPTION	AREA(ha)
PROJECT AREA	69	Lot 297	259
	70	Lot 298	259
	71	E1/2 of Lot 295	130
	126	W1/2 of Lot 295	130
	147	S1/2 of Lot 293	130
	PROJECT AREA TOTAL		908
EXTENSION AREA	125	Lot 379	259
	145	S1/2 of Lot 294	130
	146	N1/2 of Lot 293	130
	154	Lot 377	259
	158	S1/2 of Lot 788	130
	159	extension of B.C.C.L. 158 for 1/2 mile E (unsurveyed)	65
	3663	E1/2 of Lot 285	130
	3664	Lot 296	259
	3665	N1/2 of Lot 294	130
	EXTENSION AREA TOTAL		1,492
TULAMEEN PROPERTY	14 B.C. COAL LICENCES TOTAL		2,400

TITLE TO COAL

Crown,
disposed to Imperial Metals Corporation;

on licences 69, 70, 71, 125, 126:
subject to a royalty agreement with Mullins Strip Mines;

T U L A M E E N

3. SUMMARY OF WORK DONE EXPLORATION AND MINING

The objective of this summary is to assist further evaluation in finding original records and reports of exploration, mining and evaluation. It was not intended to be a comprehensive historic review or bibliography. The history of early activities is best reviewed in Rice (1947). Imperial Metals has a good collection of reports concerning the Tulameen Coalfield. Its index is a fairly complete bibliography.

Coal was first found around the turn of the century by placer gold miners and prospectors along the northeastern margin of the Tulameen Coalfield which is closer to the Tulameen River. This area was later (1910-1914) explored by the Columbia Coal and Coke Company. Several prospect tunnels were dug and several holes were drilled in this area from west to east at Collin's Gulch, Bears' Den, Fraser Gulch and on the Hayes-Vittoni prospects. The coal was found to be impure, crushed and steeply dipping against the hill. No commercial mining has taken place in this area.

Cleaner and less disturbed seams (parts of the main seam) have been found along the southwestern margin particularly in its southern part. Columbia Coal and Coke Company did the preliminary prospecting (1910-1914), which company was succeeded in 1914 by Coalmont Collieries. The latter operated five underground mines in the

Blakeburn Creek area and produced 2,364,561 short tones between 1919 and 1940. Plans of these mines can be obtained from the Mining Branch of the B.C. Ministry of Energy, Mines and Petroleum Resources in Victoria.

In 1950 Mullins Strip Mines Company acquired three (69,70,71) and subsequently two more (125,126) B.C. coal licences in the area of old workings. Between 1954 and 1956, 238,000 short tons of coal was extracted from the surface pillar of the old No. 3 Mine. The main seam is still well-exposed in this pit in a more than two kilometre strike length.

Imperial Metals acquired the five Mullins licences in the sixties under an option agreement which was exercised in the early seventies and became a royalty agreement still in effect. In this period and in 1977 Imperial Metals acquired nine additional licences. By 1976 five core holes were drilled. Four of them explored the subcrop area. The location and results of this work can only be learned indirectly from a report by Associated Engineering Services dated September 5, 1974. The original records could not be found. The fifth hole was drilled at the centre of the basin to approximately 450 metres and did not reach the coal zones. Extensive bulldozer and backhoe trenching was also carried out in the sixties and early seventies by Mullins Strip Mines and Imperial Metals, tracing the main seam for approximately 3

kilometres northward from the underground mines and at several other places along the margin of the basin. The main coal seam was sampled, analysed, tested and the property was evaluated several times.

Cyprus Anvil Mining Corporation operated the property from 1977 to 1983 under an option agreement with Imperial Metals. Most of the fieldwork was done in 1977 and 1978 on which reports are available. Several bulldozer trenches were dug, four bulk samples were taken and tested, twelve core holes were drilled in 1977 and seven rotary holes in 1978. Fourteen of these holes were logged geophysically. In addition, ground controlled photogrammetric mapping, surface geophysical and environmental surveys were also carried out. Work concentrated in the shallow cover area north of the old underground mines where reserves for potentially economic surface mining have been delineated. Mostly studies were done in 1979 and 1980, reports on which are also available.

A feasiblity study was completed in 1981 by Wright Engineers of Vancouver which include designs for a million tonne a year open pit mine, preparation plant, other facilities and for all aspects of the potential development. It also includes detailed cost estimates.

4. COAL RESERVES SUMMARY

PROPOSED PIT

YEAR	BENCH m ASL	THOUSAND TONNES RAW RECOVERABLE SECTIONS #1	#2	#3	#4	#5	SUBTOTAL	*WASTE	TOTAL
	1370	-	-	-	66.58	-	65.58	1.61	63.97
1	1360	-	-	5.51	95.12	18.04	118.67	2.86	115.81
	1350	-	-	135.65	102.25	90.92	328.82	7.93	320.89
	1340	-	-	142.35	102.25	106.33	350.93	8.47	342.46
	1330	-	112.36	142.35	102.25	106.33	463.29	11.18	452.11
2	1320	-	167.77	142.35	102.25	106.33	518.70	12.49	506.21
	1310	-	167.77	142.35	102.25	106.33	518.70	12.51	506.19
3	1300	-	167.77	142.35	102.25	106.33	518.70	12.50	506.20
	1290	29.07	167.77	142.35	102.25	106.33	547.79	13.20	534.59
4	1280	111.73	167.77	142.35	102.25	106.33	630.43	15.19	615.24
	1270	111.73	167.77	142.35	102.25	106.33	630.43	15.19	615.24
5	1260	111.73	167.77	142.35	102.25	106.33	630.43	15.19	615.24
6	1250	111.73	167.77	142.35	109.39	106.33	637.57	15.36	622.21
	1240	111.73	196.05	142.35	123.65	106.33	680.11	16.44	663.67
7	1230	111.73	213.53	142.35	137.92	106.33	711.86	17.21	694.65
8	1220	111.73	213.53	142.35	144.80	106.33	718.74	17.37	701.37
	1210	111.73	213.53	142.35	144.80	106.33	718.74	17.34	701.40
9	1200	111.73	213.53	142.35	144.80	106.33	718.74	17.38	701.36
10	1190	111.73	213.53	142.35	144.80	106.33	718.74	17.38	701.36
	1180	111.73	213.53	142.35	144.80	106.33	718.74	17.38	701.36
11	1170	70.58	213.53	142.35	104.64	70.23	603.33	14.59	688.74
	1160	-	213.53	142.35	-	-	355.88	8.62	347.26
12	1150	-	156.59	142.35	-	-	298.94	7.23	291.71
	1140	-	-	91.84	-	-	91.84	2.12	89.72
	TOTAL	1,328.70	3,515.40	3,080.00	2,383.80	1,988.80	12,296.70	296.70	12,000.00

* WASTE: partings schedule to be removed from the coal seam by selective mining.

Total waste: 34,695,510 m^3, including partings as above but in m^3
Overburden ratio: 2.89:1 m^3 waste per tonne of coal raw recoverable
Source: Feasibility Study, 1981 by Wright Engineers of Vancouver for Cyprus Anvil Mining Corporation

ADDITIONAL SURFACE MINEABLE RESERVES

- surface pillars of old underground mines, approximately 3 million tonnes
- down-dip extension of the pit

ADDITIONAL RESOURCES AMENABLE TO UNDERGROUND MINING

- down-dip from the pit and the old underground mines:
  at least 100 million tonnes geological in-place.

T U L A M E E N

5. COAL QUALITY SUMMARY

RANK (ASTM) high volatile C (-B) bituminous

POTENTIAL PRODUCT		CLEAN		RUN-OF-MINE	
		as received	dry	as received	dry
Proximate Analysis					
Moisture	%	13.2	0.0	6.0	0.0
Ash	%	16.6	19.1	33.4	35.4
Volatile Matter	%	27.0	31.1	27.1	28.9
Fixed Carbon	%	43.2	49.8	33.0	35.1
Ultimate Analysis					
Moisture	%	13.2	0.0		
Carbon	%	54.4	62.6		
Hydrogen	%	3.7	4.3		
Nitrogen	%	1.0	1.2		
Chlorine	%	0.0	0.0		
Sulphur	%	0.5	0.6		
Ash	%	16.6	19.1		
Oxigen	%	10.6	12.1		
Analysis of Ash					
P_2O_5	%		0.2		
SiO_2	%		70.5		
Fe_2O_3	%		5.1		
Al_2O_3	%		16.2		
TiO_2	%		0.7		
CaO	%		0.7		
MgO	%		0.5		
SO_3	%		0.4		
K_2O	%		1.4		
Na_2O	%		0.6		
Undetermined	%		3.7		
Capacity Moisture	%	9.8			
Heat Value	Kcal/kg	9,500	10,945	7,730	8,220
	Btu/lb	5,278	6,081	4,300	5,278
Hardgrove Grindibility Index				53	50

Maceral composition at 7% Mineral Matter: Vitrinite 89%, Resinite 3%, Exinite (Cutinite) 1%

Main Reflectance (Ro) of Vitrinite from 0.804 to 0.944
from 0 to 20 metres below the top of coal measures

The deeper part of the coal reserves is probably high volatile B bituminous.

6. REVIEW

NATURE AND OBJECTIVES OF THIS STUDY

Cyprus Anvil Mining Corporation operated the property from 1977 to early 1983. Substantial exploration has been carried out in this period, which delineated a feasibly surface mineable part of the deposit. Cyprus Anvil was expected to develop the property in the near future. For Imperial Metals, Tulameen was a royalty property with little need for technical involvement. This circumstance has changed completely with the withdrawal of Cyprus Anvil, as Imperial Metals became the operator of the property.

The nature of this study is a very general review with the following objectives:

- to organize the available information and to present summaries pertinent to further management and development of the property, and

- to indicate possiblities for further optimization of the development parameters, which Cyprus Anvil and Wright Engineers, who did the feasibility study, might have missed. Analysis of the geological data and actually doing such optimization was not required in this stage, however.

As various summaries, including an overall executive summary, are presented, this review concentrates on the reasons and recites data only to the extent which is necessary for meaningful discussion.

THE TULAMEEN COALFIELD

The Tulameen Coalfield is a late, continental stage local intermontane eugeosynclinal sedimentary basin in the Western Cordillera. Coal occurs in the middle member of the Tertiary (Eocene) Allenby Formation which is underlain and, unless eroded, overlainly by igneous rocks. The time of coal deposition coincided with (the Laramide) very intensive orogenetic activity causing unstable depositional environment and high rate of clastic sedimentation. As a result, the coal seams include lots of inorganic material. On the other hand, volcanic activity increased the geothermal gradient and the coal rank beyond which is expected from the age of the coal and the stratigraphic overburden.

There are two coal seams in the Tulameen Coalfield. The lower seam has an average thicknes of 7 to 7.6 metres but include 50% to 75% inorganic material and cannot be considered for mining. It occurs at the base of the coal measures underlain by a thick sandstone unit and further by the basal volcanics. It is thin, disturbed and steeply dipping along the northeastern margin of the basin. It is 15 to 40 metres thick along the southwestern margin of the basin. Its thickness and "coaliness" varies from east to west as follows:

Outcrop area	seam thickness metres	coal %
No. 3 Mine, Mullins pit and further to the east	27-35	80-85
No. 5 Mine, east end of the proposed pit	15-21	88
west end of the proposed pit	15-21	82
north of the patch of overlying volcanics	20	71
northwestern corner of the basin	40	41

Strata are folded into a northwesterly trending syncline dipping steeply along the northeastern and moderately along the southwestern margin, at 28 to 45 degrees along the subcrop in the area of the proposed pit. Strata do not flatten down-dip within the proposed pit according to the project documentation. It could have been easily missed, however, as all holes were drilled near the outcrop and the footwall contours were derived from cross-sections only. Minor rolls could have been missed for the same reasons.

A major fault zone separates No. 3 and No. 4 mines. Inseam trusting is observable in the Mullins pit. Beside these, at least major faulting is not apparent along the southwestern margin of the basin.

THE PROPERTY

Imperial Metals Corporation holds title to fourteen B.C. coal licences covering 2,400 hectares including the entire coalfield except the unprospective northeastern margin. The title to licences 69, 70, 71, 125 and 126 is subject to an agreement between Imperial Metals and Mullins Strip Mines. All surface mineable coal, except the northern end of the proposed pit (licence 147), is located on the licences acquired from Mullins. Cyprus Anvil Mining Corporation does not have any interest in the property since early 1983. Their removal from the title, although was applied for, has not been carried out by the time of writing this report.

Licences mentioned above covering 908 hectares are shown on the Land Tenure Summary as project area. They are very valuable. The rest of the property covering 1492 hectares is termed as extension area. Coal bearing strata do not underlie any part of licences 159 and 3663 covering 185 hectares and these are recommended to be dropped. Potential for coal mining on the balance of the extension area, covering 1297 hectares, is remote but cannot be ruled out completely, especially without exploration. (The main seam in this area is either highly impure or it is under deep cover, even in terms of underground mining, or both). Keeping this area, for the time being, is recommended if affordable ($6485 rental per year) as the work requirements are fulfilled to the end of the 1989-1990 term.

LOCATION AND INFRASTRUCTUE

The location of the Tulameen property is one of its main advantages. It is located along existing railway 420 kilometres from the Vancouver area coal ports. All Western Canadian coal, presently exported, comes from mines more than 1,000 kilometres away from ports. Most other elements of infrastructure also exist. The area has a pleasant climate for operation and manpower and a long tradition in mining.

THE TULAMEEN PROJECT

The main seam is 15-21 metres thick and clean enough along the southwestern margin of the basin. There is sufficient tonnage in this area under low enough cover for feasible surface mining. The proposed pit extends from the old No. 5 Mine to a pack of overlying volcanics, in a 1315 metre strike length along the outcrop and 130 to 230 metres down-dip. It includes 12 million tonnes raw recoverable coal at an average overburden ratio of 2.9 m^3 waste per tonne of coal. One million tonne of coal would be mined annually and cleaned by screening and jig-washing to produce 550,000 tonnes of 16.6% ash clean coal annually.

Several bulldozer and backhoe trenches explored the outcrop, from where four bulk samples were also taken and tested. Ten diamond and eight rotary drill holes explored some 100-120 metres down-dip extention. All these holes were logged geophysically except the four old Imperial Metals' holes. Only two diamond drill holes (T-77-11 and 12, neither of them logged geophysically) intersected the main seam further down-dip.

Additional surface mineable coal tonnages are available in the surface pillars of the old underground mines (approximately 3 million tonnes recoverable) and by mining further down-dip. The latter would significantly increase the waste to coal ratio on raw basis but possibly to a lesser degree on clean basis, if most of the additional coal comes from the southern part of the project area, where the coal seam is cleaner.

COAL QUALITY

The Tulameen coal is stated to be of high volatile C bituminous rank according to ASTM standards. It is defintely in the top range of this rank. Part of the coal, planned to be mined, may be actually high volatile B bituminous. Coal of both ranks, although the latter more, preferred as thermal coal in electrical power generation and cement manufacturing.

High volatile B bituminous coal is reported from the project area by Hughes (1954), Church and Brasnett (1982) of the B.C. Ministry of Energy, Mines and Petroleum Resources and by Donaldson (1972) of the Geological Survey of Canada. Donaldson also demonstrated, that rank increases with the cover. Coal, produced in the underground mines, is reported to contain 11,780 Btu/lb at 7.6% ash and 5.3% moisture. It is 12,749 Btu/lb at naturally moist mineral matter free basis (ASTM standard for the ranks in question), 251 Btu/lb short to be high volatile B bituminous. Converting the proposed project specification to this standard basis, the Btu/lb figure is 12,595 which is 405 Btu/lb short to be high volatile B bituminous. Considering, that the product specification has been derived from probably oxidized (thus reduced Btu/lb) surface bulk samples, and that rank increases with the cover, higher Btu/lb figures, possibly high volatile B bituminous rank can be expected down-dip.

High inorganic content of the coal is the main problem in the Tulameen field. Only the main seam along the southwestern margin (old underground mines and the area of the proposed pit) and down-dip to an unknown distance is clean enough for economic mining.

In the area of the proposed pit, the proportion of distinct partings increases from 12% to 18% from south to north. There also are thin partings and disseminated inorganic material in the coal. The ash content of the raw coal mined in the proposed pit would be 33.4% after some of the separable partings (2.5% of the total coal volume - seems

low) are removed by selective mining. An additional 45% loss would be incurred in the process of cleaning the coal to a marketable 16.6% ash level. All four bulk samples were taken from the northern part of the proposed pit, where the ash content is higher. A detailed analysis of the exploration data, including the core data and geophysical logs, would probably indicate somewhat better coal quality than presently known. Better definition of the removable partings for their increased removal by selective mining, further optimization of the shape and size of the pit may be possible on the basis of existing data. Eventually, however, more drilling and bulk samples will be needed.

MARKETS AND ECONOMY

The Tulameen coal is desirable for industrial thermal use in electrical power generation and cement manufacturing, if sufficiently cleaned. The proposed 16.6% product ash level seems to be adequate. It will be successfully marketable in the Pacific Rim countries: in northwestern United States and overseas. There will be difficulties, however, explaining that the project is feasible in spite of the 45% loss in coal preparation.

Tulameen clean coal would sell for approximately (CDN) $50 per tonne f.o.b. Vancouver even udner the presently depressed marketing conditions. It would cost $41 ($7.20 initial and replacement capital,

$20.59 operating, $13.29 transportation and port costs) per tonne in terms of 1981 Canadian dollars according to Wright Engineers' Feasibility Study. Thus, the project is competitive for short term development. Desirable coal quality and the low capital cost requirement make the project particularly attractive.

Feasibility would further improve if

- the run-of-mine ash could be decreased, and
- the annual clean coal output could be increased

without significant negative impact on other parameters. Suggestions to achieve these are presented in the subsequent section.

The following considerations and measures may ease a potential concern regarding a relatively short (12 years) initial mine life:

- additional surface mineable reserves are available:
  Designing the pit size requires very careful consideration of the various alternatives, as once the high-wall is established, it is very expensive to "push it back". Location of the high-wall is dictated by economics primarily.
- very large additional coal resources (at least 100 million tonnes) are amenable to underground mining;
- There is a possibility to develop Imperial Metals' Merritt property (similar coal 60 kilometres closer to Vancouver along the same railway) subsequent to and using surface mining equipment from Tulameen.

PIT OPTIMIZATION POSSIBILITIES

a. Based on existing geological data with no or little fieldwork

A quick optimization study is recommended. The objectives of this study would be to decrease the run-of-mine ash and to increase the feasibly mineable tonnage and the annual clean coal output. There are indications that these parameters could be feasibly improved. This study would also bring Imperial Metals' indepth familiarity with the project to a now required higher level. The project's economic parameters will likely improve, so will Imperial Metals' position in marketing the property for participation and the returns.

The shape and size of the pit would be optimized and feasibly separable partings would be identified by detailed but unexpensive analysis of the geological data. Among others, the following preliminary observations would be followed up by detailed analysis:

- Coal preparation starts in the pit. Distinct partings comprise half of the total inorganic content. Mining equipment (scrapers) was chosen for selective mining, yet the volume of partings scheduled for selective removal amounts to only 2.5% of the total coal volume.

- Distinct partings increase northward in the pit from 12% to 18% and the inorganic content generally increases in the same direction. It has also been demonstrated, that coal rank increases down-dip. All four bulk samples were taken from outcrops in the northern part of the pit. Most of the coal quality conclusions have been based on these bulk samples. Analytical results of coal samples from drill hole cores would be studied to determine coal quality in the proposed pit and to recognized trends useful in planning its possible extension down-dip.
- Some three million tonnes of very low overburden ratio coal (cleaner than coal in the pit and under very low cover) could be mined from the surface pillars of the old underground mines.
- The possibility and feasibility of moving the high-wall further down-dip would be examined. Consideration would be given to hinge its southern part somewhat to the northeast to include more coal in the southern part of the project area, where it is the cleanest. Cleaner coal could compensate for, at least to some extent, the higher overburden ratio.
- The pit area is the southwestern limb of a syncline. Down-dips may become shallower. There also seem to be minor rolls. A detailed structural analysis would reveal these features. A three-dimensional three-parameter (gross and net coal, overburden ratio) model would be the best basis for pit optimization. It includes section analysis used in the past, but also includes other interpretation techniques such as structure contours, isopachs, etc.

b. Further drilling and bulk sampling

The deeper part of the reserves in the propsoed pit is intersected only by two drill holes (T-77-11 and 12), neither of them were logged geophysically. Such projection is not acceptable, particularly in the eugeosynclinal intermontane basins of the Western Cordillera, where seam and coal thicknesses can change drastically over short distances and structural disturbances are common. Designing the pit size and the high-wall will require very careful consideration of the various alternatives, as the project is short in reserves and once the high-wall is established, it is very expensive "to push it back".

Not only the deeper part of the reserves have to be drilled, but a few holes have to explore the area beyond the proposed high-wall. Diamond, rahter than rotary drilling is recommended as the higher cost is more than repaid by superior sample quality and structural information. The core should also be logged for geotechnical purposes. The presently proposed pit is purely geometrical with no consideration to the orientations of weakensses. All holes should be logged geophysically adding a sonic tool to the suite used in the past. It helps to see fracture frequency and in choosing mining equipment.

A study, based on existing geological information, recommended in the previous section would also provide a good basis for designing efficient further exploration.

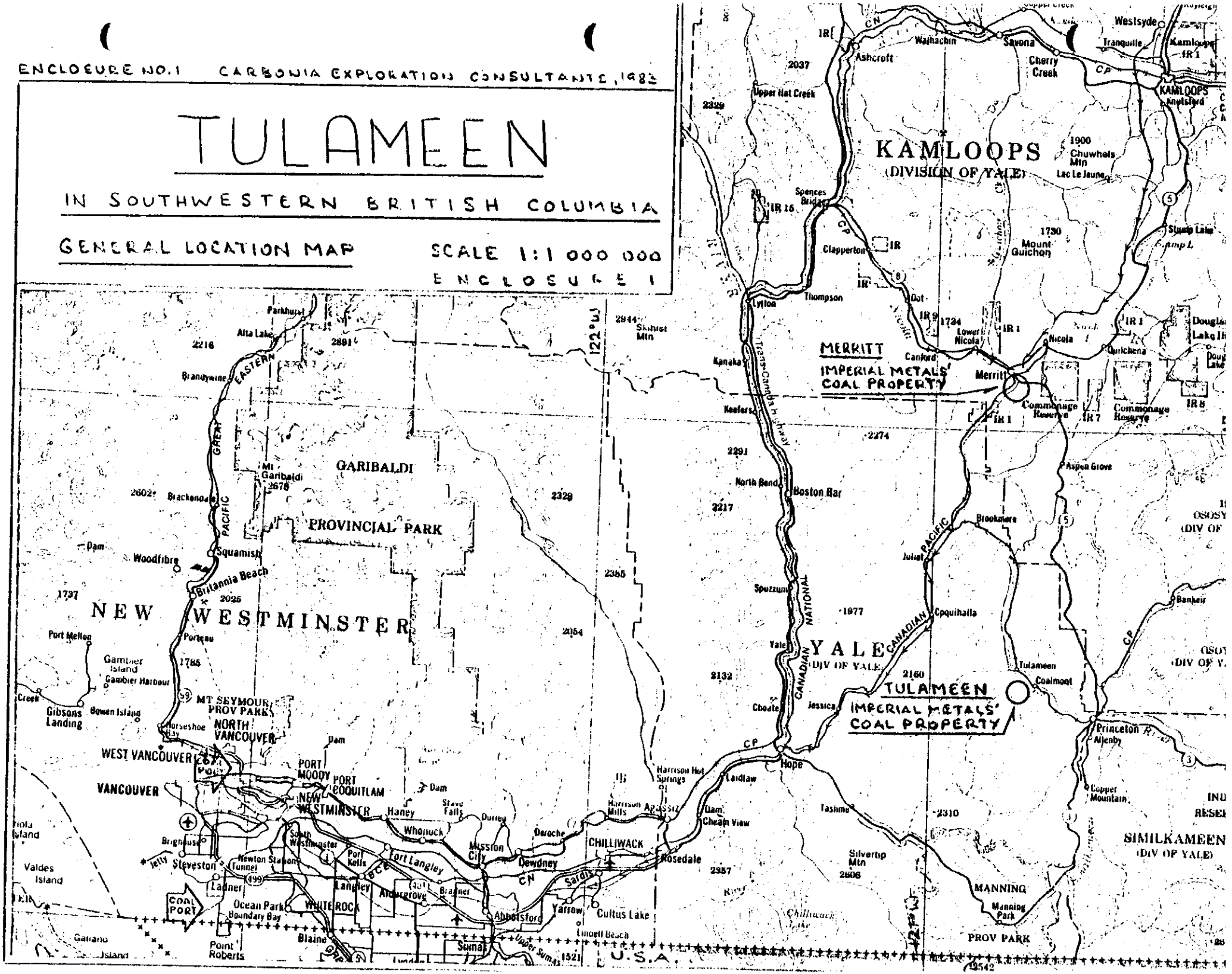
ENCLOSURE NO.1 CARBONIA EXPLORATION CONSULTANTS, 1982

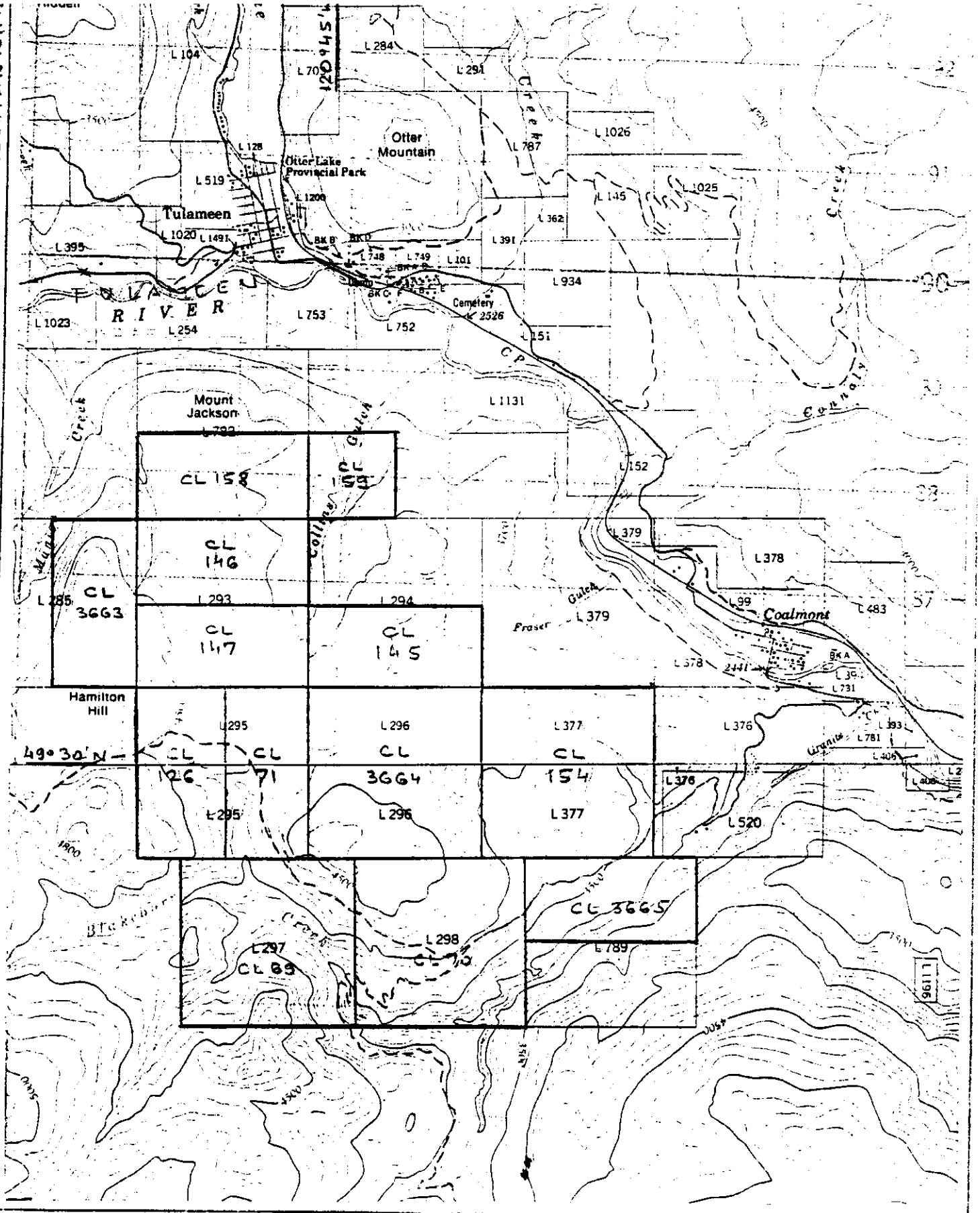
TULAMEEN

IN SOUTHWESTERN BRITISH COLUMBIA

GENERAL LOCATION MAP SCALE 1:1 000 000

ENCLOSURE 1





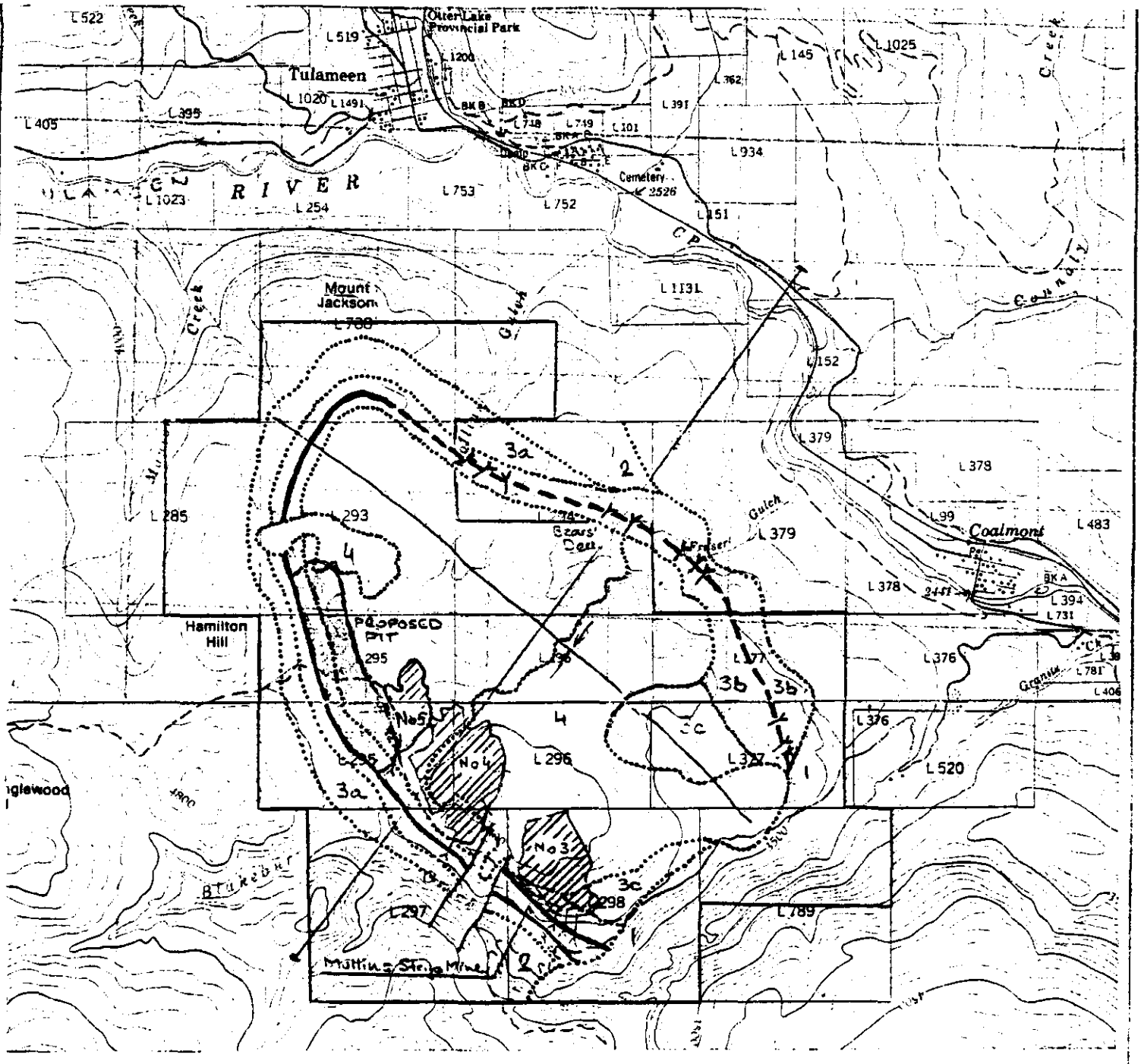
TULAMEEN

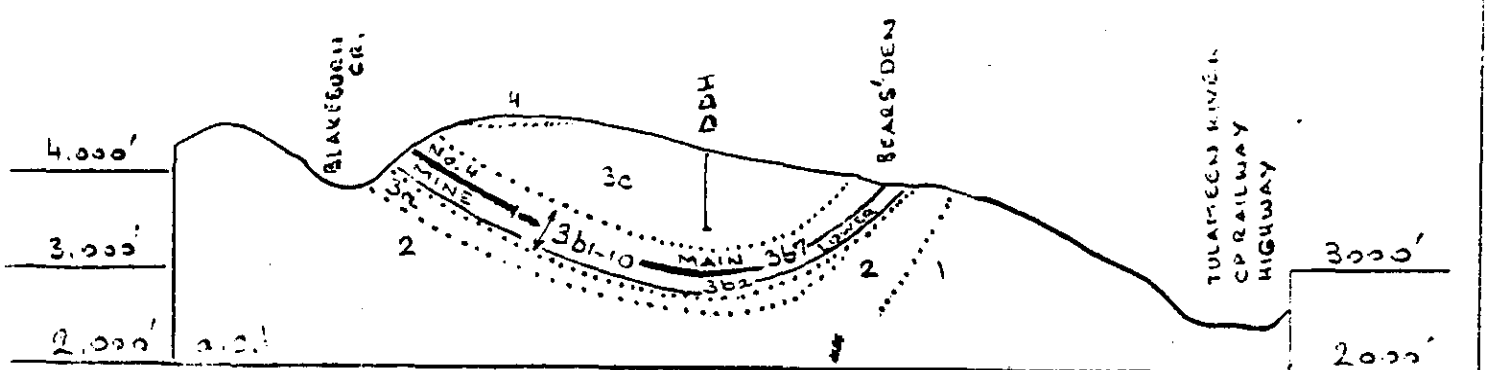
LOCATION AND LAND- MAP

SCALE 1 : 50 000

ENCLOSURE No. 2

CARBONIA EXPLORATION CONSULTANTS, 1983





4: PLATEAU BASALT
2: LOWER VOLCANICS
1: NICOLA VOLCANICS

3: ALLENBY FORMATION (EOCENE)

3c: UPPER SANDSTONE MEMBER
3b COAL BEARING MEMBER (1-10)
3a: LOWER SANDSTONE MEMBER

■ 3b7 MAIN COAL ZONE
– 3b2 LOWER COAL ZONE

SCALE 1 : 50 000

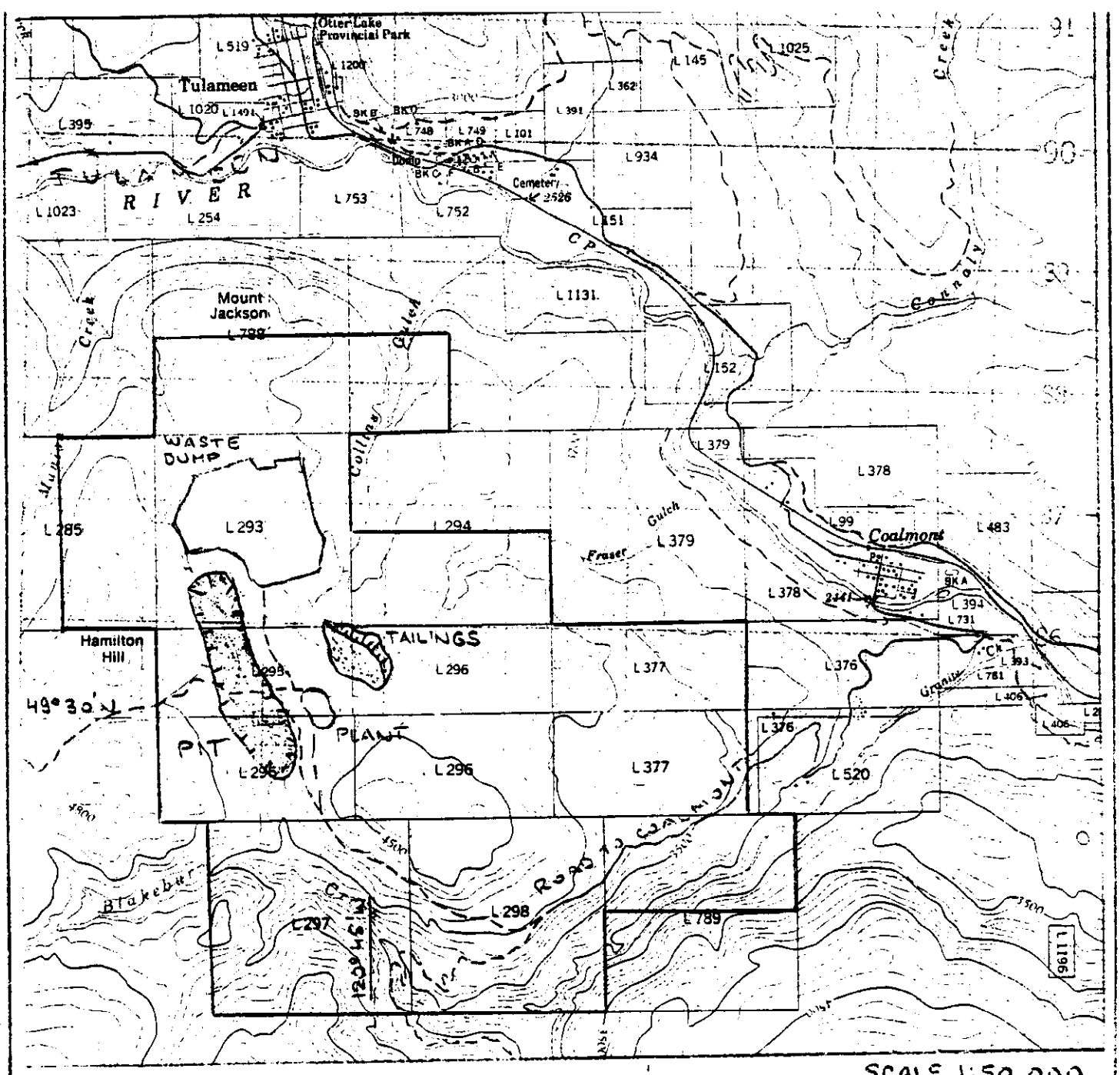
ENCLOSURE 0.3

TULAMEEN COALFIELD

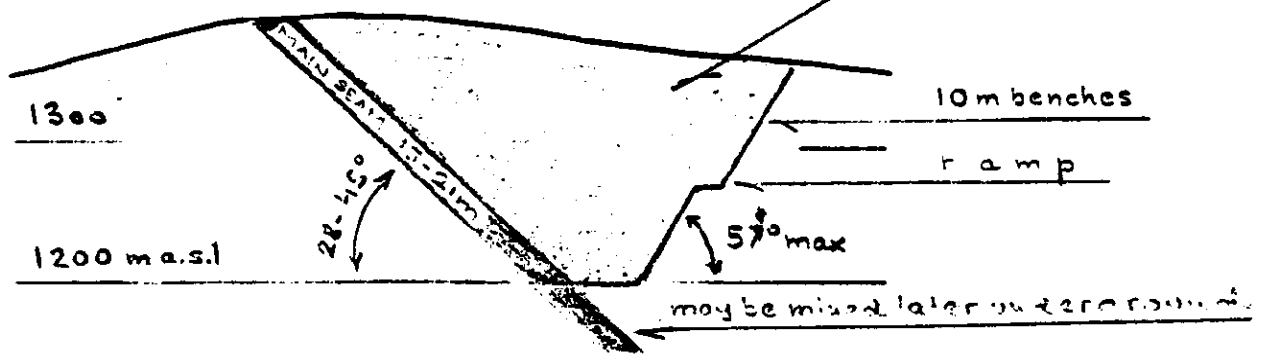
GEOLOGY MAP & DIAGRAMMATIC CROSS-SECTION

CARBOJUA EXPLORATIONS CONSULTANTS 1982

ENCLOSURE NO. 4



SCHEMATIC SECTION THROUGH THE PROPOSED PIT



TULAMEEN COAL PROJECT

PRELIMINARY MINE-SITE LAYOUT