SH-TULAMEEN 25(1)A

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PRELIMINARY REPORT

ON

TULAMEEN, BRITISH COLUMBIA
COAL DEPOSIT
FOR
DOMINION FOUNDARIES AND STEEL LTD.

SUBMITTED BY:

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00 199(3)

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CONCLUSIONS AND RECOMMENDATIONS

The Tulameen coal deposit has probable recoverable reserves of 7.2 million short tons of unwashed coal at a 4:1 ratio. This reserve could sustain a 500,000 ton per year operation for about 14 years. Preliminary analyses on coal samples from the Tulameen deposit indicate that on an unwashed basis, the expected coal quality will be in the 7,300 to 8,900 B.t.u. range having 10 percent moisture and ash ranging from 24 to 30 percent. If the coal is benificiated, the expected product will have an ash content of 17 to 20 percent, 10 percent moisture and B.t.u. values ranging from 8,700 to 9,400.

The surface trenching completed to date in the reserve area indicates that a subsequent drilling program is necessary to confirm seam thickness, structure, coal quality and reserves. The estimated coast of this program will be about $157,000.

A feasibility study should follow the drilling program. If the deposit should prove economic to mine, a market survey should be initiated.

SUMMARY

A total of two days, November 9 and 10, 1975 were spent on the site. Because of snow cover no field mapping was carried out. During this period, eight sample sites were cleared of snow and debris for mapping and sampling. Two of the sampling sites were in the former strip pits. The sampling program showed that the samples from the trenches tended to be lower in B.t.u. values than those from the strip pits.

The mapping of the coal seam shows that the seam varies

from about 93 feet to 68 feet in thickness with dips ranging from about 30 degrees to about 45 degrees. The coal seam contains zones of hard bright coal interlayered with bands of shale, clays, siltstones and sandstones. Because of the steep dips, it is unlikely that the seam can be selectively mined by surface methods.

Further work on the property should consist of trenching and drilling to confirm coal seam thickness and coal quality.

LOCATION AND ACCESS

The Tulameen coal field is located about 100 miles east of Vancouver and about 30 miles north of the United States border (Fig. 1). The road distance from Vancouver to Princeton is about 150 miles. A gravel road connects Princeton with Coalmont, a distance of about 12 miles. The property is accessible by a five-mile narrow road. This road is extremely slippery during the winter months and it is unlikely that this five-mile section could handle coal-truck traffic. If the deposit should be developed, an alternate transportation route to C.P.R. rail at Coalmont should be developed. The rail distance from Coalmont to Vancouver is near 260 miles.

PROPERTY OWNERSHIP

The ownership of the various coal licenses is shown in Fig. 2. Coal License No.'s 145, 146, 147, 158 and 159 are held by Dominion Foundaries and Steel, Limited for Imperial Metals and Power. Coal License No.'s 69, 70, 71, 125 and 126 are held by Dominion Foundaries and Steel, Limited for Mullin's Strip Mines Ltd. The Free Miner Certificate Numbers for Dominion Foundaries and Steel, Limited is 143312; Imperial Metals and Power Ltd. No. 143312; and for Mullins Strip Mines Ltd. No. 125988.

HISTORY

Published reports indicate that the total coal production from the Tulameen coalfield between 1919 and 1940 was about 2.4 million tons. This production was obtained from underground mines. Two small strip pits were started in 1954. Between 1954 and 1956, Mullins Strip Mines Ltd. produced 238,000 tons of coal from these pits.

MARKETS

It is anticipated that any coal produced from the Tulameen coal field will be mined by surface methods. The coal will probably be beneficiated by mechanical means or washed. At this time it is expected that the maximum recoverable reserve will be about 7.2 million tons of unwashed coal. It is probable that the property could sustain a mine having an annual production of 500,000 tons for about 14 years.

It is expected that markets for the Tulameen coal will eventually develop within the interior of British Columbia or along the Pacific Coast between Vancouver, B.C. and Portland, Oregon.

GEOLOGY

The Princeton-Tulameen coal areas contain sedimentary rocks of Tertiary age. These sediments consist of shale, sandstones, conglomerates and coal. The sedimentary rocks rest conformably on metamorphosed rocks of the Nicola Group. The sedimentary rocks are overlain by Miocene flows of amygdaloidal basalt; however, within the proposed strip area (Fig. 3) the sedimentary rocks are not believed to be overlain by volcanics.

STRUCTURE

The Tulameen coal basin is an oblong structure about 6.5 miles long and 4.5 miles wide (Fig. 2). The only known major faulting is in the southwest corner where at least four faults occur. Along the eastern side of the basin, the dips are very steep and a number of drag folds have been observed.

These steep dips and minor folds have hindered early mining attempts. Dips ranging from about 20 to 50 degrees have been observed in the southwest and western parts of the basin.

The change in dip and coal seam thickness can be observed in Fig. No.'s 4 to 10 inclusive. The strikes and dips were based upon field observations during mapping and sampling of the trenches.

COAL QUALITY

A total of 33 samples were taken from eight trenches Fig. 2. These samples were then combined to form eight composites (one for each trench). Chemical analyses were first performed on the samples by Loring Laboratories Ltd. and then by Birtley Engineering Ltd. A comparison of the two sets of analytical data showed some variation between the two laboratories. The samples were subsequently analyzed by Dominion Foundaries and Steel, Limited (Dofasco). The Dofasco chemical data was then confirmed by petrographic analyses. A comparison of the moisture free chemical analyses amoung Loring, Birtley and Dofasco appears in Table 1 of Appendix A and a report on the Tulameen coal quality by Birtley Engineering is in Appendix B. It is now believed that the Dofasco and the Birtley data is representative of coal quality for the surface samples.

The Tulameen coal ranges in rank from sub-bituminous to high volatile B (See Fig.1, Appendix A). This variation in rank has been attributed one or a combination of the following factors.

1. The Tulameen coal deposit appears to have been formed in a deltaic environment. This shown by the variable

thicknesses and interlayering of shale, sandstone, clay and coal. From surface mapping it is difficult to correlate the coal seam from trench to trench (Fig. 3 and Fig's 11 to 17).

2. In the reserve area studied, the coal seam varies dip from 30 to 45 degrees. The coal rank is likely to have increased locally because of tectonic movement which may explain in part, variations in rank from trench to trench.

3. Another factor which may have caused local varitations in rank could have been geothermal gradients from intrusives.

A summary of the moisture free data based on the Dofasco anaylsis is given in Table 1:

Table 1: Summary of Moisture Free Analyses for trenches 1 to 8 inclusive

Trench No.	B.t.u. (Birtley)	% Ash	% Volatile Matter	% Fixed Carbon	% Sulphur
1	8190	26.5	36.1	37.4	0.33
2	9165	27.5	32.2	40.3	0.39
3	6100	33.4	41.1	25.5	0.23
4	7315	31.1	34.4	34.5	0.24
5	9300	27.9	31.4	40.7	0.49
6	7820	32.04	32.4	35.6	0.45
7	10095	24.30	32.1	43.6	0.52
8	10379	19.5	32.1	48.4	0.47
Average	8571	27.7	34.0	38.3	0.39

Table 1 shows that the best quality coal comes from trenches 7 and 8 (Fig 2). These samples were taken from strip pits formerly operated by Mullins Strip Mines Ltd. The coal appears to deteriorate in quality going north in trenches 1 to 6 inclusive with the lowest B.t.u. values occuring at trenches at 3 and 4. At first it was thought, that the lower coal quality for trenches 1 to 6 inclusive could be attributed soley to the shallow depth of the trenches and that the samples were oxidized. However the Dofasco petrographic data indicates that only about 25% of the coal is oxidized and that there are variations in coal rank. On this basis it is not expected that the coal quality will improve greatly with depth with the exception of a decrease in inherent moisture. A preliminary drilling and coring program as shown in Fig 3 is required to assess the variations in coal rank and quality and the improvement in coal quality with depth of cover.

On the strength of surface sampling, it appears that on a raw basis the coal will have an ash content between 24 and 30 percent, moisture of 10 percent and a B.t.u. value in the range of 7300 to 8900. (Refer to the Birtley Engineering Report, Appendix B). If the coal is benificiated by an inexpensive preparation plant, the expected product will have an ash content of 17 to 20 percent, moisture 10 percent and B.t.u. values ranging from 8,700 to 9,400.

It is unlikely that further sampling of the trenches on the Tulameen coal deposit would produce any significantly different analytical data. The next logical step would be a combined surface mapping and quality drilling program.

RESERVES

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In determining the coal reserves, the seam thicknesses used were based on field observations. The maximum thickness is found in Trench 1. The seam thickness decreases from about 93 feet at Trench No.1 to about 68 feet at Trench No.6 (See Fig. No.3). The coal seam contains bands of hard bright coal, shale, sandstone, bentonite and clay. The coal is extremely hard, having a grindability of 47.4 (See Appendix C). It is unlikely that the coal seam can be selectively mined using open pit mining methods.

In calculating the coal reserves, cross-sections were constructed every 400 feet (Fig. No.'s 4 to 10 inclusive). These sections show the coal seam thickness and the apparent dip. The coal reserves and overburden were calculated for each cross-section going down in increments of 100 feet. This data was then plotted on the graphs appearing below each cross-section. From the graphs, it is possible to obtain the tons of coal and overburden per foot of section at specific ratios. The coal reserves are shown as recoverable raw short tons in place. The following are the parameters used in making the reserve calculations.

1. Overburden = Cubic yards + 10%.
2. Coal Density = 1,600 tons per acre foot
   or 0.0367 tons per cubic ft.
3. Raw Coal = Raw coal in place less 10%
   for pit loss.

A summary of coal reserves by cross-section appears in Table 2.

TABLE 2: Reserve Summary for Unwashed Coal In Place.

LINE	2:1 RATIO		3:1 RATIO		4:1 RATIO	
	YDS^3 (000)	COAL (000)	YDS^3 (000)	COAL (000)	YDS^3 (000)	COAL (000)
18	1,000	508	2,020	642	3,060	760
20	880	434	1,820	574	2,900	742
22	420	210	1,000	336	1,710	420
24	540	270	1,140	420	2,060	508
26	600	300	1.280	434	2,140	538
28	440	224	960	330	1,800	448
30	560	280	1.200	400	2.360	584
32	420	224	1,000	336	1.740	430
34	620	300	1,340	464	2,200	560
36	640	328	1,360	460	2,340	592
38	520	288	1,300	446	2,400	588
40	500	244	1,100	362	1,920	476
42	660	334	1,500	488	2,520	632
TOTALS	7,800	3,944	17,020	5,692	29,150	7,278

The approxiamte stripping limits at specified ratios for raw coal in place are shown on Fig. No. 3.

It is recommended that preliminary feasibility studies should be carried out for the raw coal in place at the 2:1, 3:1, and 4:1 ratios. These studies should take the following into consideration:

Case 1. Use all contract equipment for over-burden removal, coal hauling, road maintenance, and reclamation for a 500,000 ton per year, 14 year operation.

Case 2. This study should allow for the purchase of equipment to perform the operations described in Case 1.

Case 3. The present road system is inadequate and a new haul road to Coalmont will have to be constructed. The preliminary feasibility studies should allow for the construction of about five miles of haul road. This will be one of the major capital items in order to get the property into operation.

No reserve estimates were made for possible strip coal in the vicinity of the underground workings. This area will require mapping and drilling to assess the strippable reserves. This work should not be done until a drilling program has been completed between lines 18 and 42 (Fig. 3). Further trenching and drilling to the North and East of Trench 6 could possibly double the Tulameen reserves.

EXPLORATION

The area lying between lines 18 and 42 should be drilled

utilizing a rotary drill. The drilling program is necessary to confirm the structural geology, coal seam thickness, coal quality and quantity. The existing trenches (No.'s 1 to 6 inclusive) indicate that the coal seam reaches a maximum thickness of 93 feet at Trench 1. The coal seam appears to decrease in thickness going north and at Trench No.5, the seam is 68 feet thick.

The proposed drill-sites are shown on Fig. 3. It is recommended that a total of 21 holes be drilled to ascertain coal seam thickness and structure. This program should be carried out in stages. A rotary drilling rig should be used. Rotary drilling, plus gramma, resistivity and density logs will provide the necessary information to determine coal seam thickness and seam characteristics. The drilling should be done in stages as follows:

1. Two holes should be drilled on lines spaced at 800 foot intervals (total of 14 holes). The first hole will be about 250 feet deep and second hole about 550 feet deep.
2. A second series of seven holes should be drilled parallel to the first set of 250 foot holes. Six of these holes should be drilled to the top of the coal seam. The coal seam should then be continuously cored using a plastic-sleeved Christenson or equivalent core barrel. One of the holes should be continuously cored from surface to the bottom of the coal seam. The core for the overlying rock should be examined by a rock mechanics laboratory to determine drillability and blasting characteristics. In addition, a study of

the rock core will give some indication of high-wall stability.

3. Core-Handling Procedures:

(a) Rock-Core: The rock-core should be logged immediately and photographed. A plastic resin should then be poured over the core to prevent moisture loss. The loss of moisture from the rock-core can give erroneous data in regard to the drilling and blasting characteristics.

(b) The coal core should be retained within a plastic sleeve to prevent moisture loss. This sleeve should not be removed until the core is ready for logging. The core should be photographed, logged, and split for as received analysis and for washability studies. Although it is not expected that the coal will be washed, the washability data may be of importance at a later date.

To carry out this drilling program the expenses are estimated as follows:

TABLE 3: Estimated Exploration Expenses

Drilling (One Rig):

7 holes @ 550 ft. each = 3,850 ft.

14 holes @ 250 ft. each = 3,500 ft.

Total 7,350 ft.

Cost = $\frac{7,350 \text{ ft.}}{20 \text{ ft/hr.}}$ x $80.00/hr. = $29,400

Reclamation		$ 15,000
Contingencies		10,000
	TOTAL	$157,000

The $80.00 per hour drilling rate allows for a Sanderson Cyclone top drive drill complete with

1. Two men
2. Water truck
3. 4 x 4 service vehicle
4. Fuel
5. Subsistence
6. Travelling time to and from the job site.

Further trenching is required to trace the coal outcrop. It is recommended that a D-8 Cat be used. This Cat will also be for trenching, preparation of access trails, drill sites, and assist in moving the drilling equipment from drill site to drill site.

Mobilization and Demobilization 1400 miles @ $3.00/mile	$ 4,200
Bits: 40 Bits @ $70.00 each =	2,800
Mud Additives: 21 holes @ $100 per hole =	2,100
Casing: 100 feet @ $8.00 per foot =	800
Caterpillar Tractor (D-8)	
35 days @ 12 hrs/day x $60.00/hr =	25,200
Core Barrel:	
Rental - 1.5 months @ $400/mo. =	600
Bits - 3 @ $2,500 each =	7,500
Supervision	1,200
Electric Logging Equipment:	
1.5 months @ $13,000/mo. =	19,500
Analytical:	
7 holes @ $1,000/hole =	7,000
Rock Mechanic Studies (estimated)	3,000
Drill Foreman:	
1.5 months @ $3,000/mo. =	4,500
Vehicle, 1.5 months @ $1,200/mo. =	1,800
Subsistance, 1.5 months @ $1,000/mo. =	1,500
Consulting Geologist:	
Supervision, Report Preparation and expenses	10,000
Mapping:	
600 acres @ $10/acre (1" = 400' and 1" = 100' for mine planning)	6,000
Surveying:	
10 days @ $500/day =	5,000

M.S. CHOLACH - STATEMENT OF QUALIFICATIONS

This is to certify that:

1. I am a graduate of the University of Alberta, B.Sc., 1967 and M.Sc. in Geology 1969.
2. Since my graduation I have continuously practised my profession in mining and exploration geology.
3. I am a member of the Association of Professional Engineers, Geologists and Geophysicists of Alberta as a Professional Geologist.
4. I am a member of the Association of Professional Engineers for the Yukon Territory as a Professional Engineer.
5. I was a member in 1974 and 1975 of the Coal Exploration Committee in the Canadian Institute of Mining and Metallurgy.
6. That I was employed by Connaught Mines Ltd. from May, 1969 to June, 1970 as Resident Geologist in mineral exploration.
7. That I was employed by the Consolidation Coal Company as a Project Geologist from July, 1970 to July, 1971 and as Manager of Canadian Exploration from August, 1971 to December 1974.
8. That I have been a Consulting Geologist since January, 1975.
9. I have visited the Tulameen coal deposit in British Columbia.
10. That I do not have any shares or interests in Dominion Foundaries and Steel Ltd.

Respectfully submitted,

M. S. Cholach, P. Geol., P. Eng.

April 6, 1976.

Springfield Consulting Ltd.,
45 Springfield Ave.,
Red Deer, Alberta
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APPENDICES

SM-TULAMEEN 75(4)A

APPENDIX "A"

COAL ANALYSES by

Dominion Foundaries and Steel, Limited

00199 (1)

DOMINION FOUNDRIES AND STEEL, LIMITED
P.O. BOX 460
HAMILTON, ONTARIO
L8N 3J5

40

April 19, 1976

Mr. M. Cholach
Springfield Consulting Ltd.
45 Springfield Avenue
Red Deer, Alberta

Dear Mike:

We feel confident now that we have ironed out the differences in analyses, but, unfortunately, we confirm the variations in rank in coal from trench to trench as outlined in the attached report.

We had some trouble at first on petrographic estimation of rank because we had two conflicting charts. However, you will see from Fig. 2 that the chart we ended up using, our petrographic results were used in every case, but the volatile matter results as analyzed by Loring, Birtley and Dofasco were plotted against these petrographic results.

I look forward to receiving your report on the likely explanation of the Tulameen coal field and the necessary expansion program to prove out the different reserves.

Yours truly,

Noel

Noel G. Thomas
Director of Research

NGT:dl

Attach.

cc: H. G. Stephenson
D. F. Symonds

April 14, 1976

Mr. N. G. Thomas

RANK OF TULAMEEN SAMPLES

PURPOSE

To establish the rank and chemical analysis of coal samples from the Tulameen property.

BACKGROUND

Recently an evaluation of coal from eight trenches on the Tulameen property was undertaken. The analyses were performed by Birtley Engineering and the Loring Laboratory. There was such a wide variation in results that Mr. N. G. Thomas asked for samples to be sent to Dofasco for analysis. The chemical analysis done by Dofasco did not agree with either of the other labs (see my report of March 3, 1976). Also, the rank as established by reflectance analysis did not coincide with the rank as established by ASTM Btu value in all cases. Accordingly, N. G. Thomas requested that Birtley send us the samples that they had analyzed so that cross-checks could be carried out.

CONCLUSIONS

1. Based on the series of chemical analyses performed at Dofasco, it is felt that the Dofasco results are correct. (Table I).

2. On the basis of petrography and moist, mineral matter free Btu:

   a. Trenches 1, 3 and 4 are sub-bituminous.
   b. Trenches 2 and 6 are high volatile C
   c. Trench 8 is borderline high volatile C-B
   d. Trenches 5 and 7 are questionable. Figure 1

3. On the basis of dry, ash-free volatile matter and mean maximum reflectance:

   a. Trenches 1, 3 and 4 are sub-bituminous.
   b. Trenches 2, 5, 6 and 7 are high volatile C.
   c. Trench 8 is borderline high volatile B.

4. Dofasco's results show good agreement with the established relationship between volatile matter and mean maximum reflectance whereas those from Birtley and Loring have poorer agreement. (Figure 2).

RECOMMENDATIONS

1. That Dofasco's results be taken as correct and be used as the basis of any further evaluation of this property.

DISCUSSION

From past experience, it has been shown that reflectance measurements are precise and accurate. It has also been shown that the chances of making an error in reflectance reading significant enough to change the ranking of a coal is extremely remote. Since the reproducibility of Dofasco's readings was very good, it is felt that these reflectance readings are indicative of the rank of the samples. In addition to this, the dry, ash-free volatile matter from Dofasco's results shows good agreement with the established classification chart shown in Fig. 1. In light of these two separate findings, it is felt that Dofasco's results represent an accurate picture of both the rank and chemical properties of these coals.

AJH/hl

A. J. Hampson

Attach.

IRR76/15

FIGURE 1

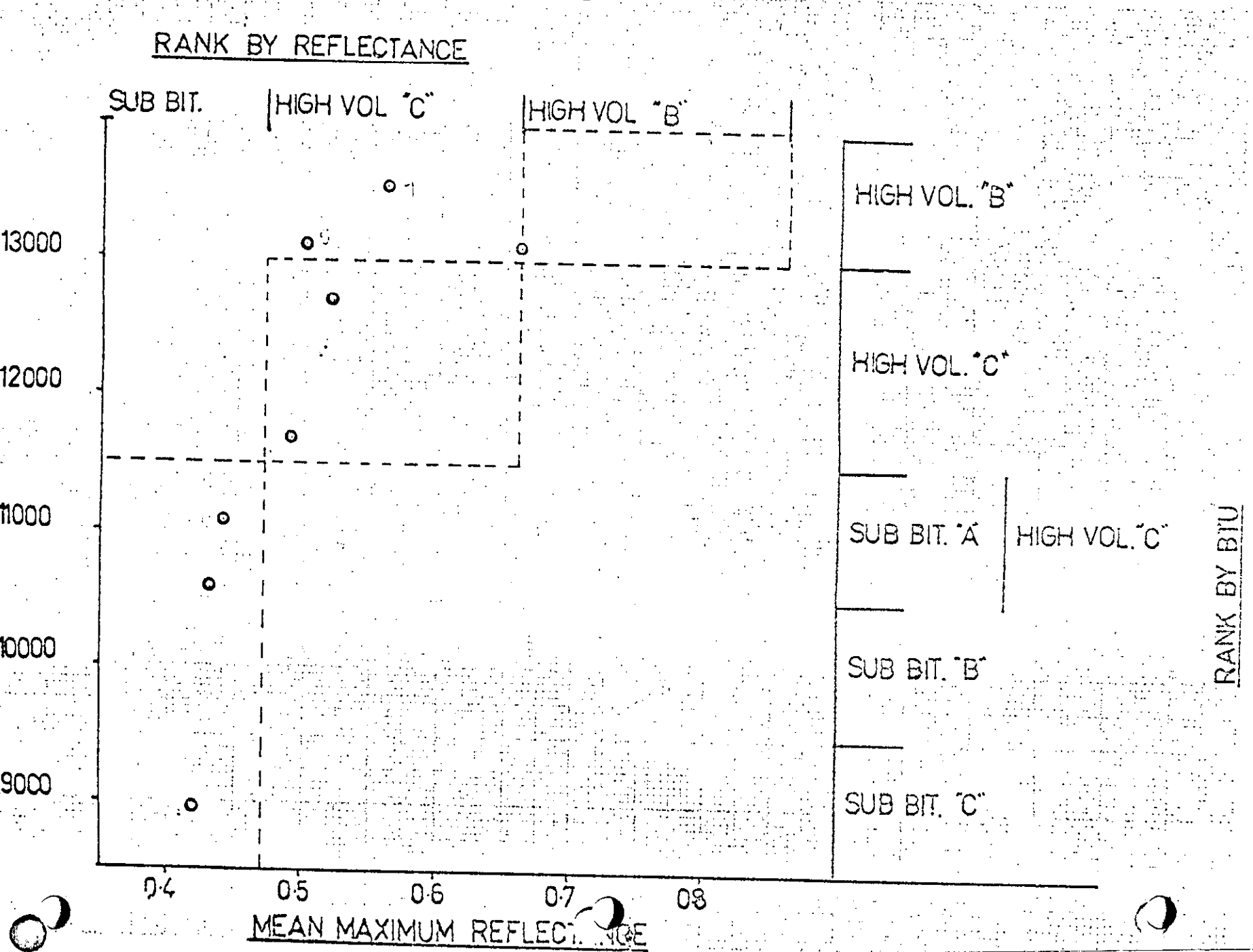

RANK BY REFLECTANCE
SUB BIT.
HIGH VOL "C"
HIGH VOL "B"
13000
12000
11000
10000
9000
MOIST, MINERAL MATTER FREE BTU
0·4
0·5
0·6
0·7
0·8
MEAN MAXIMUM REFLECTANCE
HIGH VOL. "B"
HIGH VOL. "C"
SUB BIT. "A"
HIGH VOL. "C"
SUB BIT. "B"
SUB BIT. "C"
RANK BY BTU

FIGURE 2

Sub-Bituminous
High Volatile C
High Volatile B
High Volatile A
Medium Volatile
Low Volatile
DOSASCO
DIRLEY
KISSING
Volatile Matter (Dry Basis) Limits, Mineral Matter Free
Volatile Matter, Percent Dry, Ash-Free Basis
High
Medium
Low
50
40
30
20
10
0
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
Mean Maximum Reflectance in Oil, Percent

TABLE I

Trench No.	% Ash			% Volatile Matter			% Fixed Carbon			% Sulphur			Mean Maximum Reflectance
	Dofasco	Birtley	Loring	Dofasco	Birtley	Loring	Dofasco	Birtley	Loring	Dofasco	Birtley	Loring	
1	26.5	28.0	29.0	36.1	31.1	23.5	37.4	40.9	47.5	0.33	0.41	0.37	0.44
2	27.5	28.0	28.7	32.2	28.4	21.8	40.3	43.6	49.5	0.39	0.42	0.50	0.52
3	33.4	35.8	34.7	41.1	32.6	29.0	25.5	31.6	36.3	0.23	0.32	0.33	0.42
4	31.1	32.5	32.2	34.4	30.3	30.6	34.5	37.2	37.2	0.24	0.30	0.33	0.43
5	27.9	29.0	30.3	31.4	28.9	23.2	40.7	42.1	46.5	0.49	0.49	0.60	0.50
6	32.04	33.9	33.2	32.4	28.5	30.1	35.6	37.6	36.7	0.45	0.55	0.51	0.49
7	24.30	25.0	25.1	32.1	28.4	25.1	43.6	46.6	49.8	0.52	0.59	0.57	0.56
8	19.5	19.8	19.7	32.1	29.4	22.3	48.4	50.8	58.0	0.47	0.53	0.55	0.66

APPENDIX "B"

COAL ANALYSES AND REPORT

By

Birtley Engineering (Canada) Ltd.

BIRTLEY ENGINEERING (CANADA) LTD.

Subsidiary of Great West Steel Industries Ltd.

5112-3rd ST. S.E., CALGARY, ALBERTA T2H 1J6 PHONE 403-253-3719

REPORT NO. B-0085

A REPORT TO

SPRINGFIELD CONSULTING LTD.

ON THE

QUALITY OF THE COAL FROM TRENCHES 1-8

TULAMEEN PROJECT

FALL, 1975

Submitted By:

Dr. D. F. Symonds, P. Eng.
General Manager

BIRTLEY ENGINEERING (CANADA) LTD.

February, 1976

BIRTLEY ENGINEERING (CANADA) LTD.

Subsidiary of Great West Steel Industries Ltd.

5112-3rd ST. S.E., CALGARY, ALBERTA T2H 1J6 PHONE 403-253-3719

A REPORT TO SPRINGFIELD CONSULTING LTD. ON THE QUALITY OF THE COAL FROM TRENCHES 1-8, TULAMEEN PROJECT, FALL, 1975

1. INTRODUCTION

This assessment is based upon the analytical results of samples from Trenches 1 - 8 of the Tulameen Property extracted under the supervision of Mr. M. Cholach of Springfield Consulting Ltd. The laboratory work was performed by Loring Laboratories Ltd. and by the Coal Science and Minerals Testing Division of Birtley Engineering (Canada) Ltd.

It had been previously pointed out by Mr. Cholach that some of the samples came from shallow trenches and exhibited definite visible symptoms of oxidation, i.e. wet, friable, grey colorations, etc. (see geological report by M. Cholach).

N.B. Any assessment of the coal quality from such a limited exploration programme can only be of a very general nature.

SPRINGFIELD CONSULTANTS LTD.

February 18, 1976.

TULAMEEN PROJECT

HEAD RAW ANALYSIS

IDENTIFICATION		ASH %	S. %	REMARKS
TR #1	0- 23'	36.37	0.41	All results on a dry basis.
	36- 50'	22.03	0.29	
	50- 70'	40.32	0.23	
	70- 90'	35.49	0.35	
	90-110'	31.88	0.37	
	110-130'	30.15	0.46	
	130-150'	26.49	0.60	
	150-172'	32.95	0.30	
TR #2	0- 20'	35.21	0.38	
	20- 40'	30.83	0.38	
	40- 60'	35.08	0.55	
	60- 80'	21.48	0.55	
	80-93'	27.62	0.35	
TR #5	0- 20'	29.38	0.31	
	20- 40'	41.69	0.51	
	40- 60'	43.59	0.64	
	60- 80'	26.04	0.41	
	80- 98'	35.30	0.73	
TR #6	0- 20'	29.86	0.54	
	20- 43'	46.72	0.43	

TABLE I

SPRINGFIELD CONSULTANTS LTD.

February 18, 1976.

TULAMEEN PROJECT

HEAD RAW ANALYSIS

IDENTIFICATION		ASH %	S. %	REMARKS
TR #4	0-20'	33.42	0.29	All results on a dry basis.
	20- 40'	33.26	0.39	
	40- 60'	33.28	0.31	
	60- 76'	54.88	0.18	
TR #3	0- 20'	45.26	0.23	
	20- 40'	42.15	0.27	
	40- 62'	27.10	0.31	
TR #7	0-100'	23.78	0.43	
	100-200'	26.58	0.49	
	200-300'	36.51	0.65	
TR #8	0-100'	24.63	0.44	
	100-200'	24.72	0.62	
	200-300'	22.23	0.54	

TABLE 2

SPRINGFIELD CONSULTANTS LTD.

February 18, 1976.

TULAMEEN PROJECT

HEAD RAW ANALYSIS

LAB. NO.	% RESIDUAL* MOISTURE	ASH %	VOL %	F.C. %	S. %	BTU/lb	CALC. FACTORS
7128 Trench #1	4.0	31.5 32.8	27.9 29.1	36.6 38.1	0.39 0.41	7391 7700	adb db
7129 Tench #2	2.7	29.1 29.9	27.8 28.6	40.4 41.5	0.41 0.42	8670 8910	adb db
7133 Trench #3	5.1	35.9 37.8	30.1 31.7	28.9 30.5	0.48 0.49	5613 5915	adb db
7132 Trench #4	4.7	35.8 37.6	26.9 28.2	32.6 34.2	0.46 0.48	6510 6831	adb db
7130 Trench #5	2.7	34.6 35.6	26.2 26.9	36.5 37.5	0.29 0.30	8221 8450	adb db
7131 Trench #6	3.3	37.0 38.3	26.3 27.2	33.4 34.5	0.23 0.24	7155 7400	adb db
7134 Trench #7	1.9	28.5 29.1	27.0 27.5	42.6 43.4	0.53 0.54	9420 9605	adb db
7135 Trench #8	2.5	23.3 23.9	27.6 28.3	46.6 47.8	0.52 0.53	9801 10055	adb db

*NOTE: The samples may have been over dried prior to arriving at our laboratory.

MEAN	3.4	32.0	27.5	37.2	0.41	7848	adb
MEAN		33.1	28.4	38.4	0.43	8108	db

TABLE 3

SPRINGFIELD CONSULTANTS LTD.

February 18, 1976

TULAMEEN PROJECT

Screen Analyses - Raw Coal

SAMPLE NUMBER	IDENTIFICATION	1" x 1/4" WT %	1/4" x 0 WT %
Composite #1	TR #1	18.8	81.2
Composite #2	TR #2	47.1	52.9
Composite #3	TR #3	14.1	85.9
Composite #4	TR #4	20.0	80.0
Composite #5	TR #5	46.8	53.2
Composite #6	TR #6	44.9	55.1
Composite #7	TR #7	47.6	52.4
Composite #8	TR #8	41.3	58.7

N.B. All of the coal was crushed to pass 1" and then screened at 1/4".

TABLE 4

40

SPRINGFIELD CONSULTANTS LTD. February 18, 1976.

TULAMEEN PROJECT

1/4" X 0 fraction of 1" X 0 Raw Coal

LAB. NO.	A.D.M. %	R.M. % / % TOT. MOIST.	ASH %	VOL. %	F.C. %	S. %	PER/LB B.T.U.	CALC. FACTORS
7136 Trench #1	3.0	4.3 7.2	26.8	29.8	39.1	0.43	7838	adb
			28.0	31.1	40.9	0.45	8190	arb db
7137 Trench #2	-	2.3 -	27.4	27.7	42.6	0.52	8954	adb
			28.0	28.4	43.6	0.53	9165	arb db
7138 Trench #3	4.7	6.1 10.5	33.6	30.6	29.7	0.30	5726	adb
			35.8	32.6	31.6	0.32	6100	arb db
7139 Trench #4	5.3	4.3 9.4	31.1	29.0	35.6	0.32	7000	adb
			32.5	30.3	37.2	0.33	7315	arb db
7140 Trench #5	0.1	2.3 2.6	28.3	28.2	41.2	0.58	9086	adb
			29.0	28.9	42.1	0.59	9300	arb db
7141 Trench #6	0.8	3.4 4.2	32.7	27.5	36.4	0.53	7555	adb
			33.9	28.5	37.6	0.55	7820	arb db
7142 Trench #7	-	1.5 -	24.6	28.0	45.9	0.58	9943	adb
			25.0	28.4	46.6	0.59	10095	arb db
7143 Trench #8	0.2	1.9 3.8	19.4	28.8	49.9	0.53	10378	adb
			19.8	29.4	50.9	0.54	10579	arb db

TABLE 5

SPRINGFIELD CONSULTANTS LTD.

February 18, 1976.

TULAMEEN PROJECT

HEAD RAW ANALYSIS

SAMPLE NO.	IDENTIFICATION	SAMPLE TYPE	RECOVERY %		ASH %	S. %
			SINK	FLOAT		
Comp. #1	TR #1 1 X 1/4"	-1.60	-	45.08	20.37	0.52
		+1.60	54.92	-	68.72	0.20
Comp. #2	TR #2 1 X 1/4"	-1.60	-	60.08	18.84	0.56
		+1.60	39.92	-	59.58	0.25
Comp. #3	TR #3 1 X 1/4"	-1.60	-	19.91	20.00	0.38
		+1.60	80.09	-	61.00	0.21
Comp. #4	TR #4 1 X 1/4"	-1.60	-	40.28	13.49	0.43
		+1.60	59.72	-	63.73	0.16
Comp. #5	TR #5 1 X 1/4"	-1.60	-	51.50	14.67	0.60
		+1.60	48.50	-	65.50	0.42
Comp. #6	TR #6 1 X 1/4"	-1.60	-	53.18	20.16	0.77
		+1.60	46.82	-	72.24	0.29
Comp. #7	TR #7 1 X 1/4"	-1.60	-	62.96	18.57	0.54
		+1.60	37.04	-	64.88	0.43
Comp. #8	TR #8 1 X 1/4"	-1.60	-	68.89	16.97	0.71
		+1.60	31.11	-	66.96	0.35

REMARKS: All results on a dry basis.

TABLE 6

SPRINGFIELD CONSULTANTS LTD.

TULAMEEN PROJECT

Hardgrove Grindability Indices

February 18, 1976

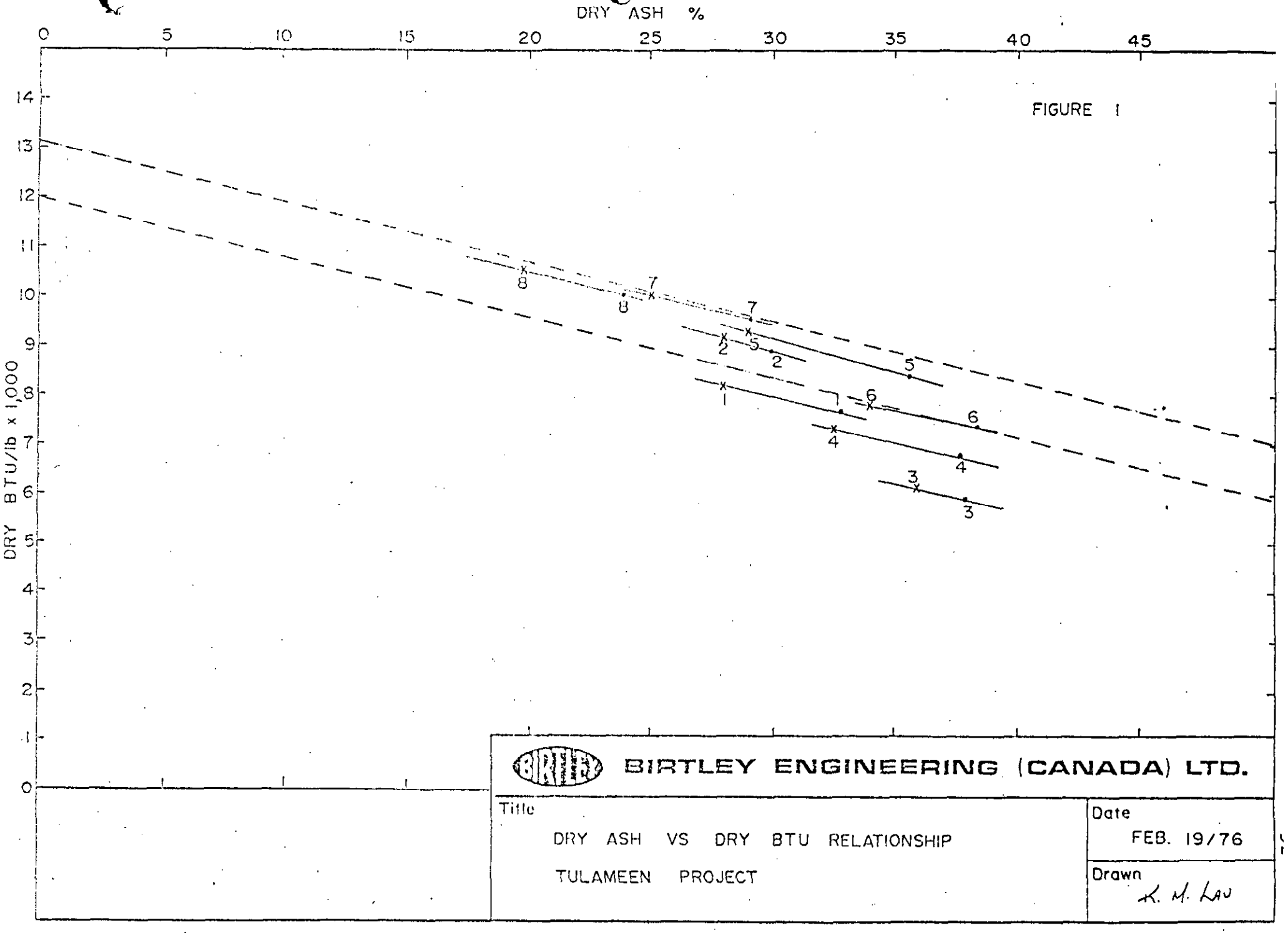
These tests were performed on the 1.60 S. G. float material from the 1" x 1/4" Fraction.

SAMPLE NUMBER	HARDGROVE GRINDABILITY INDICES
Composite #1	52.5
Composite #2	49.0
Composite #3	*
Composite #4	*
Composite #5	42.8
Composite #6	43.5
Composite #7	47.6
Composite #8	49.0

* Insufficient Sample

TABLE 7

FIGURE 1



BIRTLEY ENGINEERING (CANADA) LTD.

Title

DRY ASH VS DRY BTU RELATIONSHIP

TULAMEEN PROJECT

Date

FEB. 19/76

Drawn

K. M. Lau

2. ANALYTICAL RESULTS

The analytical results upon which this assessment is made are shown in Tables 1 to 7.

The trench samples were analysed on approximately 20' intervals (see Tables 1 and 2) after which they were composited into a total raw fraction for each trench (see Table 3). These composites were then crushed to pass 1" and screened at 1/4". The 1" x 1/4" fractions were subjected to a sink-float separation at 1.60 S.G. and the 1/4" x 0 were analysed raw.

3. COMMENTS

3.1 Rank

The results from the eight trenches were surprisingly inconsistent particularly in terms of rank and ash-BTU relationship. Figure 1 indicates that there is a possible spread of almost 2000 BTUs for a given ash level between trenches 3 and 7. Some errors were made by the initial laboratory when determining inherent moisture and this will obviously have an effect on the dry BTU levels. However, there is also a noticeable variation in the moist mineral matter free calorific values as shown in Table 8 on the following page.

TABLE 8

40

MOIST MINERAL MATTER FREE BTU LEVELS

Trench No.	MMMF BTU/lb Using As Rec'd Moisture Levels from Table 5	MMMF BTU/lb Using 10% Total Moisture and Figures from Table 5	ASTM Rank Classification
1	10570	10130	Sub B
2	12760	11340	Sub A or hvcb
3	8338	8420	Sub C
4	9711	9630	Sub B
5	13038	11660	hvcb
6	11550	10500	Sub A or hvcb
7	13560	12010	hvcb
8	12810	11790	hvcb
Mean Values	11542	10685	

It is felt by Mr. Cholach that some of the samples, particularly tenches 3 and 4, were oxidized. Oxidation can have a deleterious effect upon the calorific value of a coal sample but we doubt that it could result in the tremendous difference between the Trench 3 and Trench 7 samples, for example Donaldson* noted a rank variation in the Tulameen coals and attributed it to variations in depth of burial in an area of abnormally high geothermal gradient. We suggest that petrography work be undertaken on the samples in an

* Donaldson, J.R. "The Petrography of the coal from the Blakeburn Strip Mine in the Tulameen Coal Area, B.C." Paper 72-39, Geological Survey of Canada, 1973

attempt to find out the degree of oxidation of the samples.

Due to the initial errors made on inherent moistures contents, we had to assume certain levels for rank determinations. A total moisture content of 10% was assumed, at an inherent moisture content of 5%; this was thought to be fair for a coal in the high volatile C/sub bituminous A category.

3.2 Ash Contents

The ash contents of the raw coal samples were generally high (23%-35%) and we anticipate that some degree of cleaning would be necessary before it became an attractive source of fuel to a remote consumer. It is noticeable that the ash content of the raw minus 1/4" coal is approximately 4% lower than the plus 1/4".

3.3 Size Analysis

The amount of minus 1/4" coal is surprisingly high in the cases of the samples from trenches 1, 3 and 4, (greater than 80% minus 1/4"). We feel, however, that this phenonemon is due to the oxidized characteristics of the coal and is not an inherent property of the unweathered reserves. For later calculations we assumed that 30% of the 4" x 0 feed would be minus 1/4". This assumption is thought to be reasonable based on the hardgrove grindability indices of 45-50 as shown in Table 7.

4.2 Partially Washed Product

In this case we have assumed that the 1/4" x 0 represents 30% of the total raw feed. The 1/4" x 0 raw coal is mixed with the 1.60 S.G. floats from the coarse fraction.

MEAN VALUES					
Fraction	Yield (100%) (a.d.) %	Yield (R.C.) (a.d.) %	Total Moisture %	Ash % (dry)	BTU/lb. (dry)
Flts. @ 1.60 S.G.	50	35.0	12	17.9	10,700
Raw minus 1/4"	100	30.0	10	29.0	8,570
Total		65.0	11	23.0	9,720
			11*	20.5*	8,650*

* As Received Values

OPTIMISTIC VALUES					
Fraction	Yield (100%) (a.d.) %	Yield (R.C.) (a.d.) %	Total Moisture %	Ash % (dry)	BTU/lb. (dry)
Flts. @ 1.60 S.G.	66	46.2	12	17.8	10,700
Raw minus 1/4"	100	30.0	10	22.4	10,340
Total		76.2	12	19.6	10,560
			12*	17.3	9,290

* As Received Values

The above tables indicate that a cleaned coal product could be

in the range 17-20% ash and 8500-9500 BTU/lb. on an as received basis.

There is obviously quite a substantial difference in the yield and quality of the clean coal product depending on whether we choose to accept the mean values or the results from Trenches 7 and 8. If the optimistic results are considered marketable then it is essential that the true quality of the mineable coal is determined as early as possible.

5. CONCLUSIONS

The exploration and analytical work undertaken in the fall of 1975 has left many questions unanswered with regard to the quality of the coal from the Tulameen area.

The rank of the coal appears to vary between sub bituminous C and high volatile bituminous C. We doubt that such a change in rank can be attributable to recent oxidation of the samples. However, further petrographic work currently being undertaken by Dofasco should throw more light on the degree and effects of oxidation.

The raw coal probably has an ash content in the range 24-30% (as received) and a calorific value in the range 7300-8900 BTU/lb. (with 10% total moisture included). The coal could be beneficiated in a relatively cheap preparation plant to give a product with an as received ash content of 17-20% and a calorific value of 8700 to 9400 BTU/lb. (with 10% moisture included). Further beneficiation and drying could improve the quality more

4. POSSIBLE SALEABLE PRODUCTS

We have had great difficulty in assessing the quality of a saleable product from this property due to the variation of coal characteristics between trenches. We do not feel justified in discounting the results for Trenches 3 and 4 since they do not stand out as being completely different from the others, but rather at the lower end of a trench (see Figure 1). Messrs. Stephenson and Cholach, however, feel that these samples were oxidized and not representative of the potential coal to be mines. In fact, they suggest that the two deeper trenches namely 7 and 8 are more representative. We, therefore, have decided to make two separate estimates of the coal quality one using the mean values of all the results and the other, designated "optimistic value" using the results from only Trenches 7 and 8.

4.1 Raw Product

Mean Value					Optimistic Value				
Air Dried Yield %	Total Moisture %	Ash %	BTU/#	S%	Air Dried Yield %	Total Moisture %	Ash %	BTU/#	S%
100	10	29.8	7300	0.4	100	10	23.9	8850	0.5

The above results are on an "as received" basis including 10% total moisture.

but it is thought that this would not be economic unless large reserves are found. The sulphur levels are good at less than 0.5%.

40

6. RECOMMENDATIONS

We recommend that the economics of this property be undertaken using the quality data for the most optimistic case (i.e. the results from Trenches 7 and 8). If the project proves to be economical or marginally economical under these conditions then we suggest that the drilling programme be undertaken to provide more conclusive information with regard to ultimate coal quality.

ASTM air drying procedures should be carefully followed to ensure that correct determinations of inherent moisture can be made.

40

APPENDIX "C"

HARDGROVE GRINDABILITY INDEX.

To: DOMINION FOUNDRIES AND STEEL
LTD.,
Box 460,
Hamilton, Ontario.
ATTN: M. Cholach

File No. 10741
Date November 28, 1975
Samples Coal

Certificate of ASSAY

LORING LABORATORIES LTD.

SAMPLE No.	HARDGROVE GRINDABILITY INDEX
-1.60 Floats	
Composite # 1	52.5
Composite # 2	49.0
Composite # 3	*
Composite # 4	*
Composite # 5	42.8
Composite # 6	43.5
Composite # 7	47.6
Composite # 8	49.0

I Hereby Certify THAT THE ABOVE RESULTS ARE THOSE ASSAYS MADE BY ME UPON THE HEREIN DESCRIBED SAMPLES . . . .

* Insufficient Sample

Rejects Retained one month.

Pulps Retained one month unless specific arrangements made in advance.

Licensed Assayer of British Columbia

SM-TULAMEEN 75(2)A

TULAMEEN COALFIELD
(MAPS)

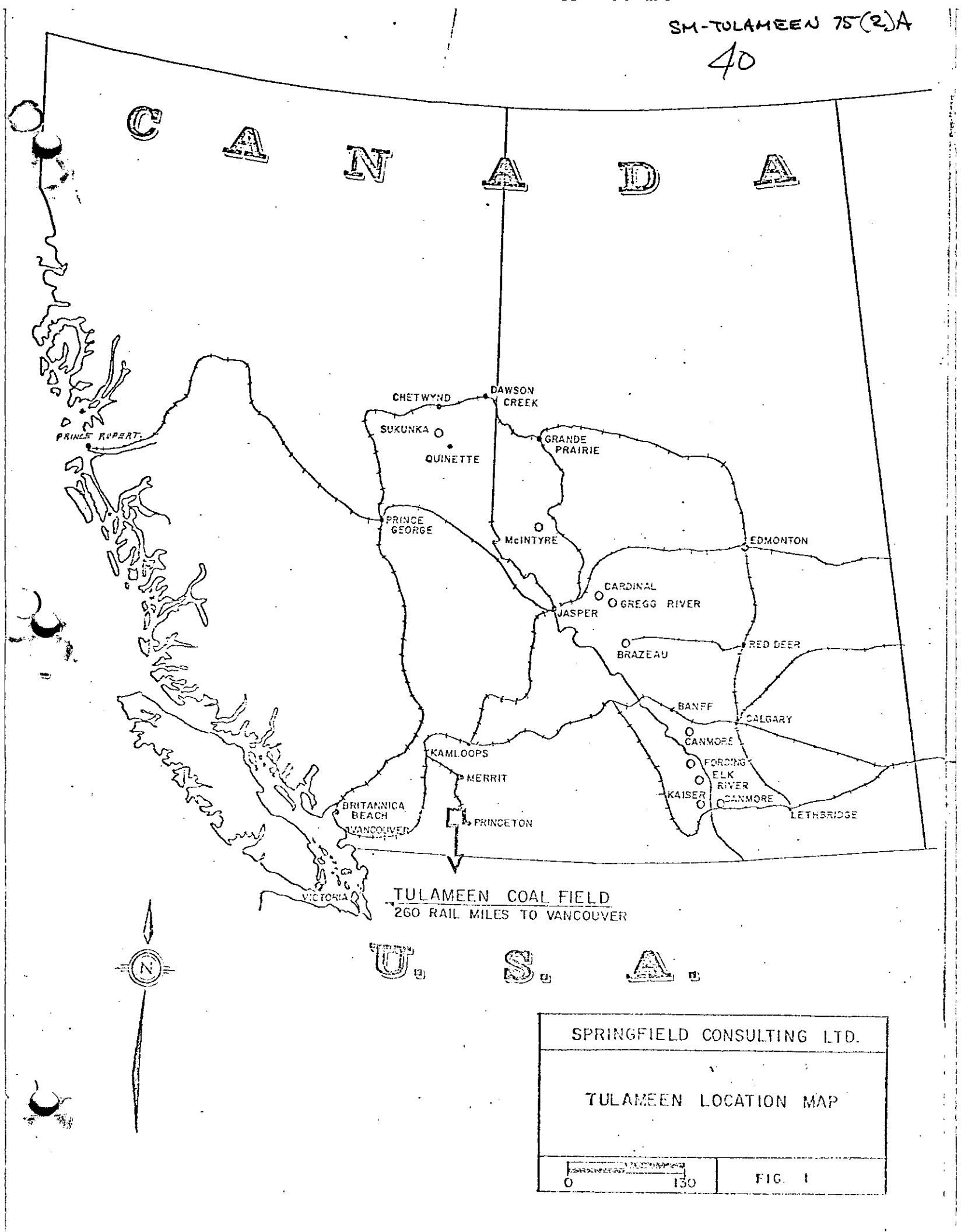
M.S. CHOLACH

APRIL 1976

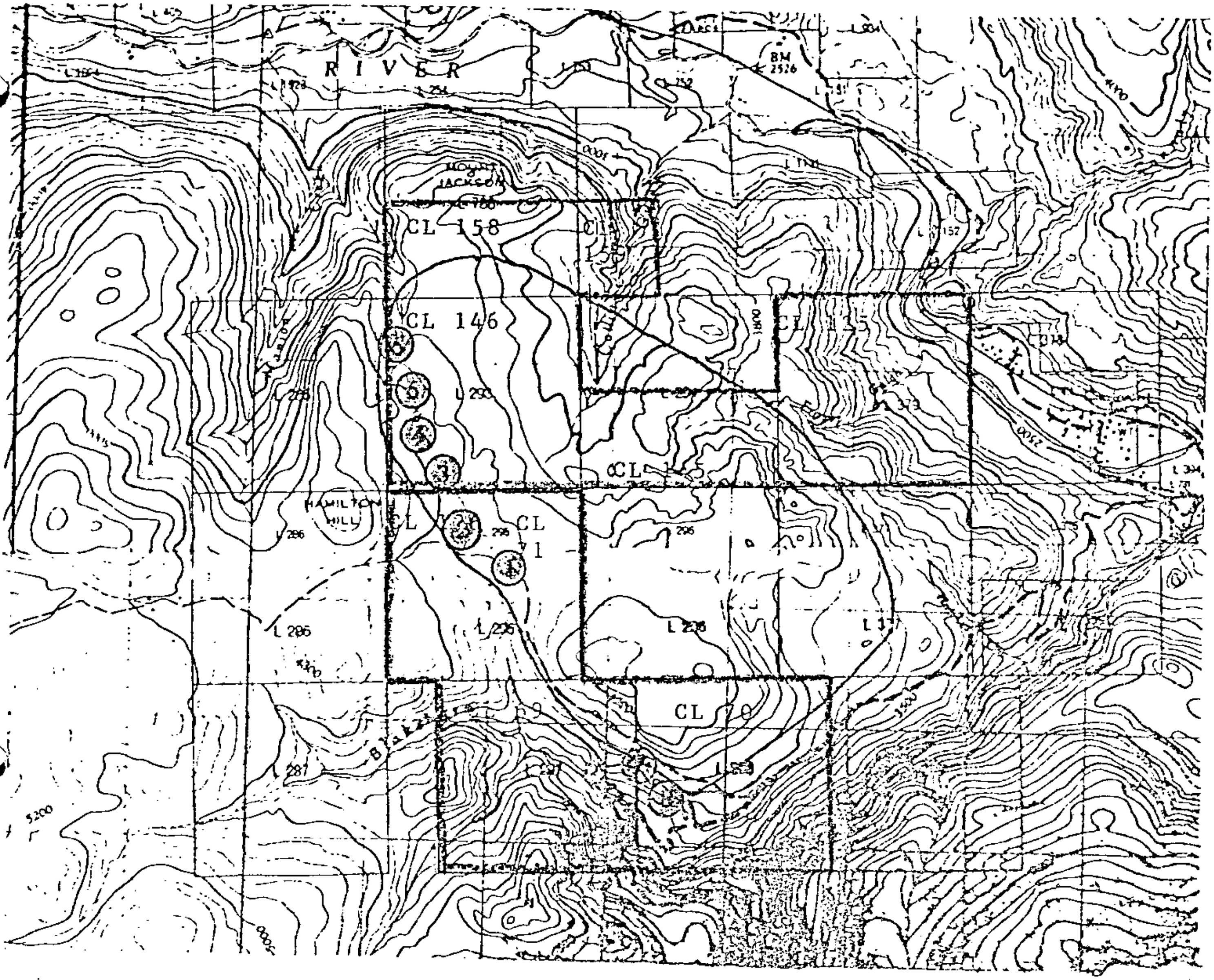
00199 (2)

SM-TULAMEEN 75(2)A

40



SPRINGFIELD CONSULTING LTD.	
TULAMEEN LOCATION MAP	
0 130	FIG. 1



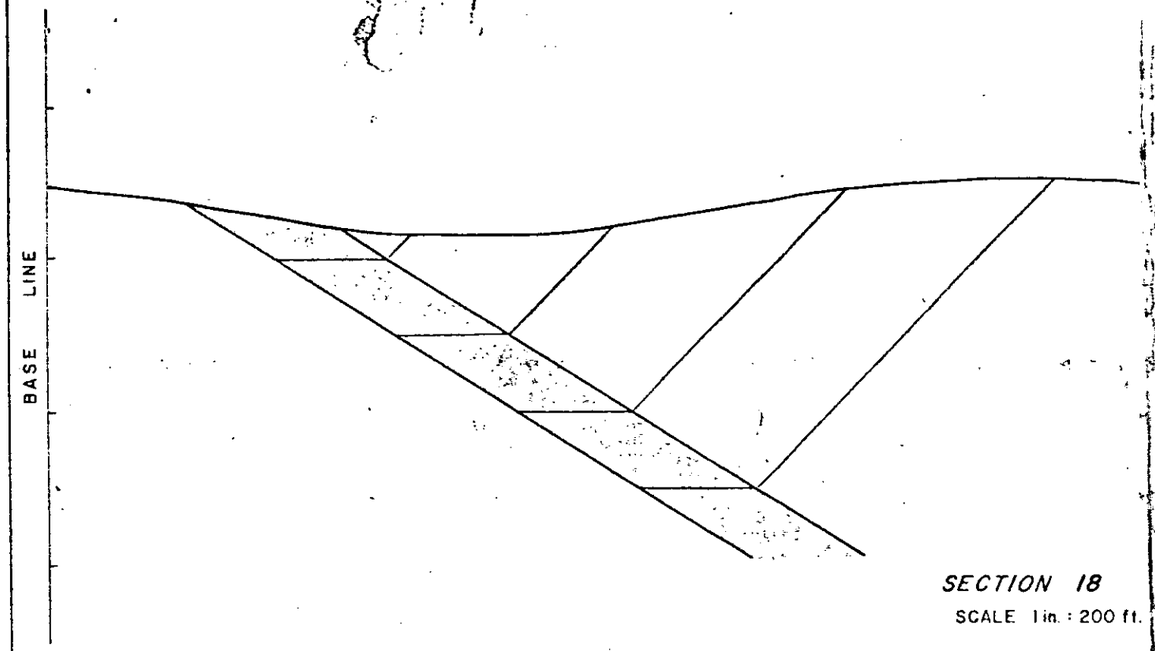
MULLINS STRIP MINES LTD.

IMPERIAL METALS & POWER LTD.

SAMPLE SIZE

SM-TULAMEEN 75(2)A.

SPRINGFIELD CONSULTING LTD.	
TULAMEEN COAL FIELD COAL LICENCES	
0 MILES 0.83	FIG. 2



SECTION 18
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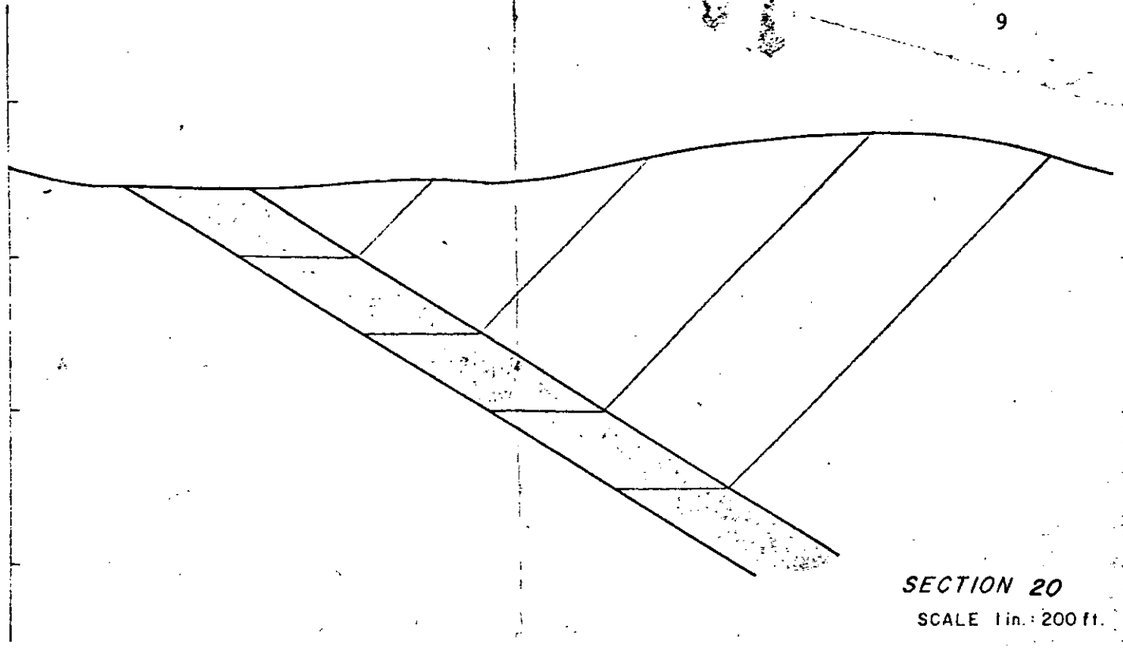

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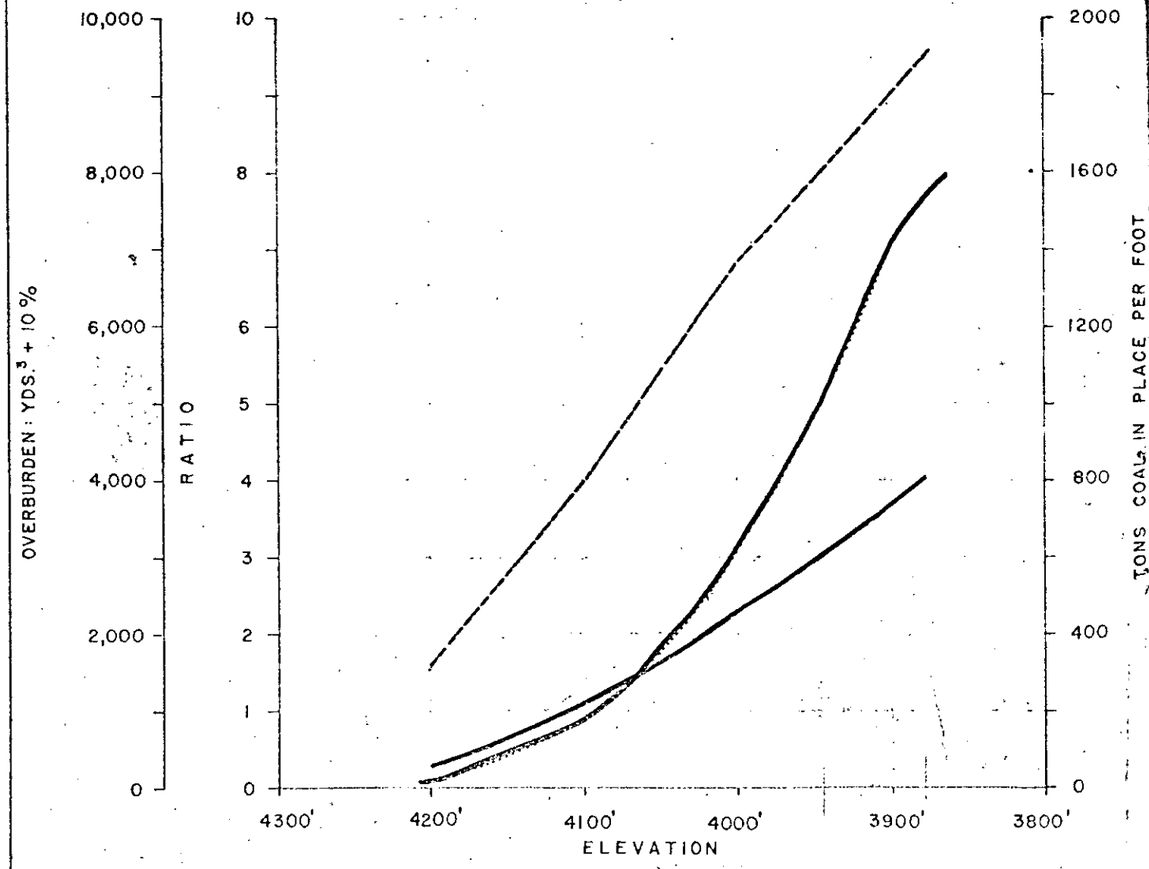
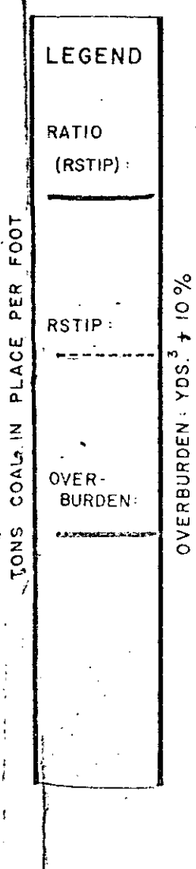
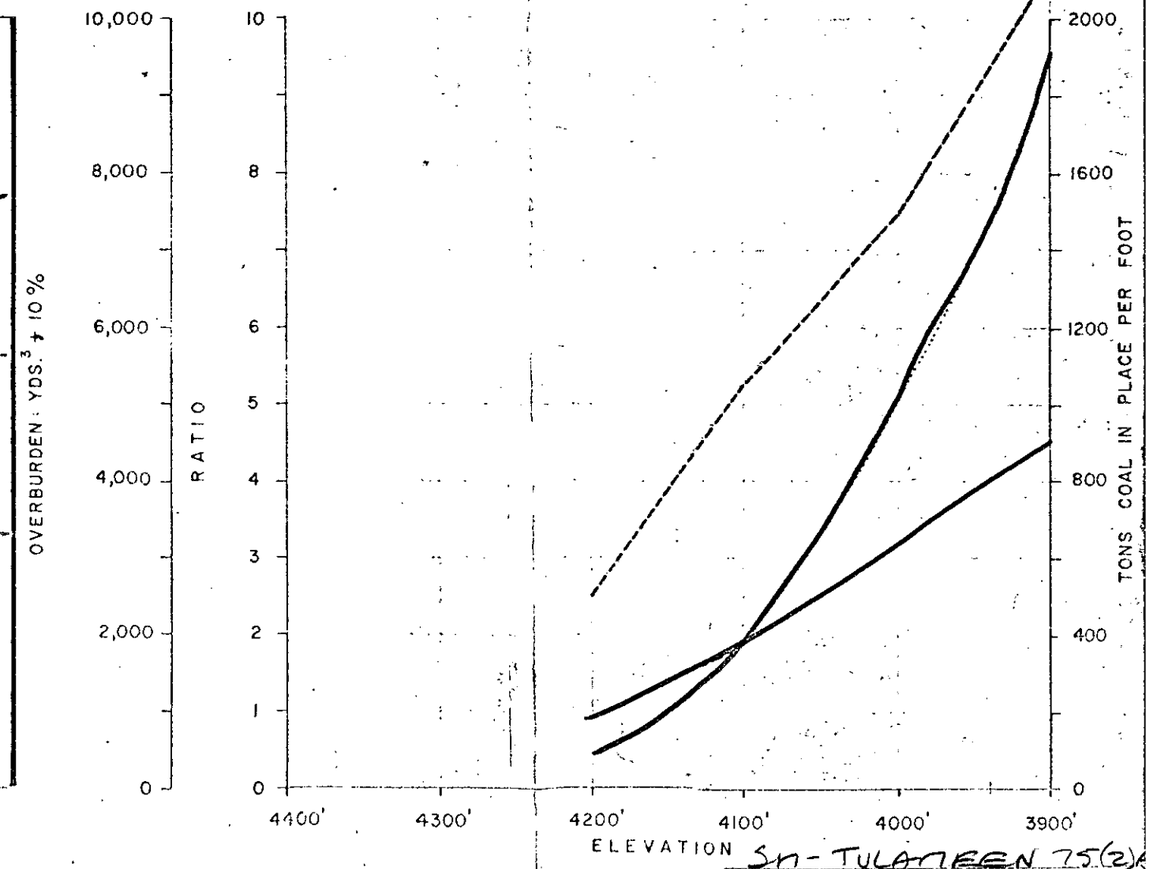




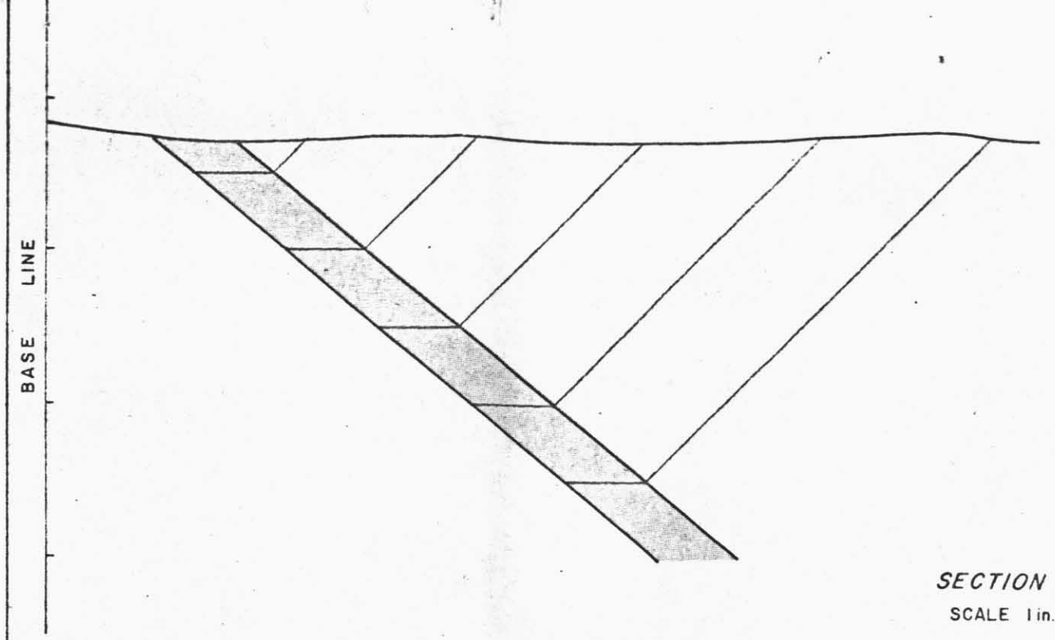


CROSS-SECTIONS 18 AND 20 WITH ACCOMPANYING RESERVE AND RATIO GRAPHS

SM-TULAMEEN 75(2)

SPRINGFIELD CONSULTING LTD.

Fig. 4



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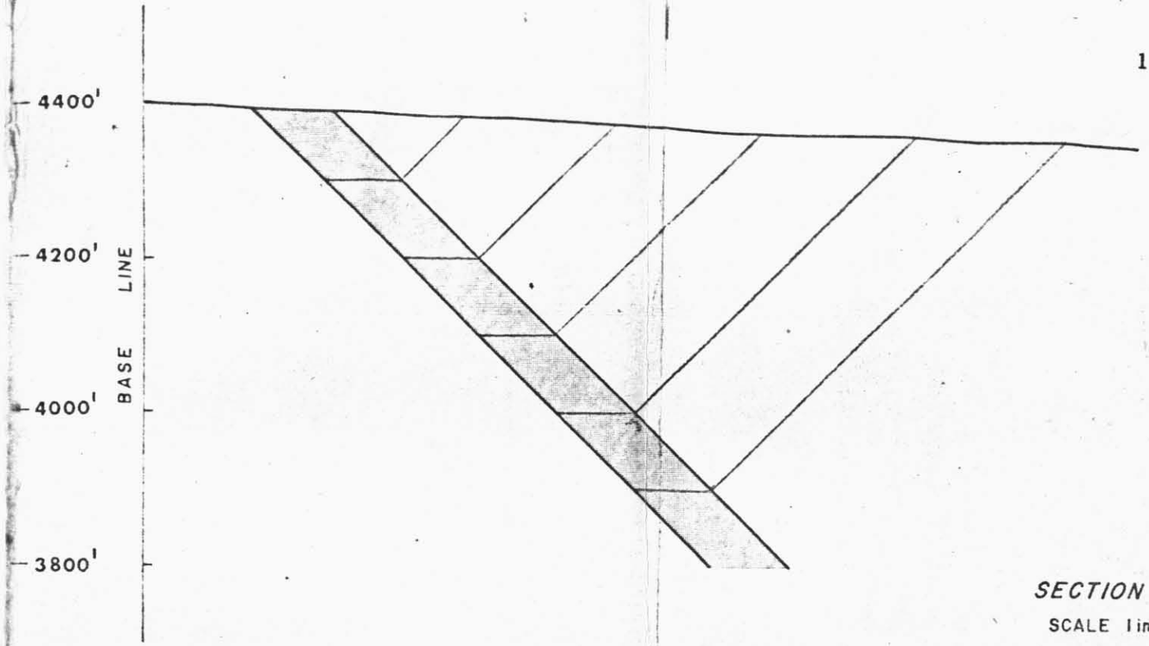

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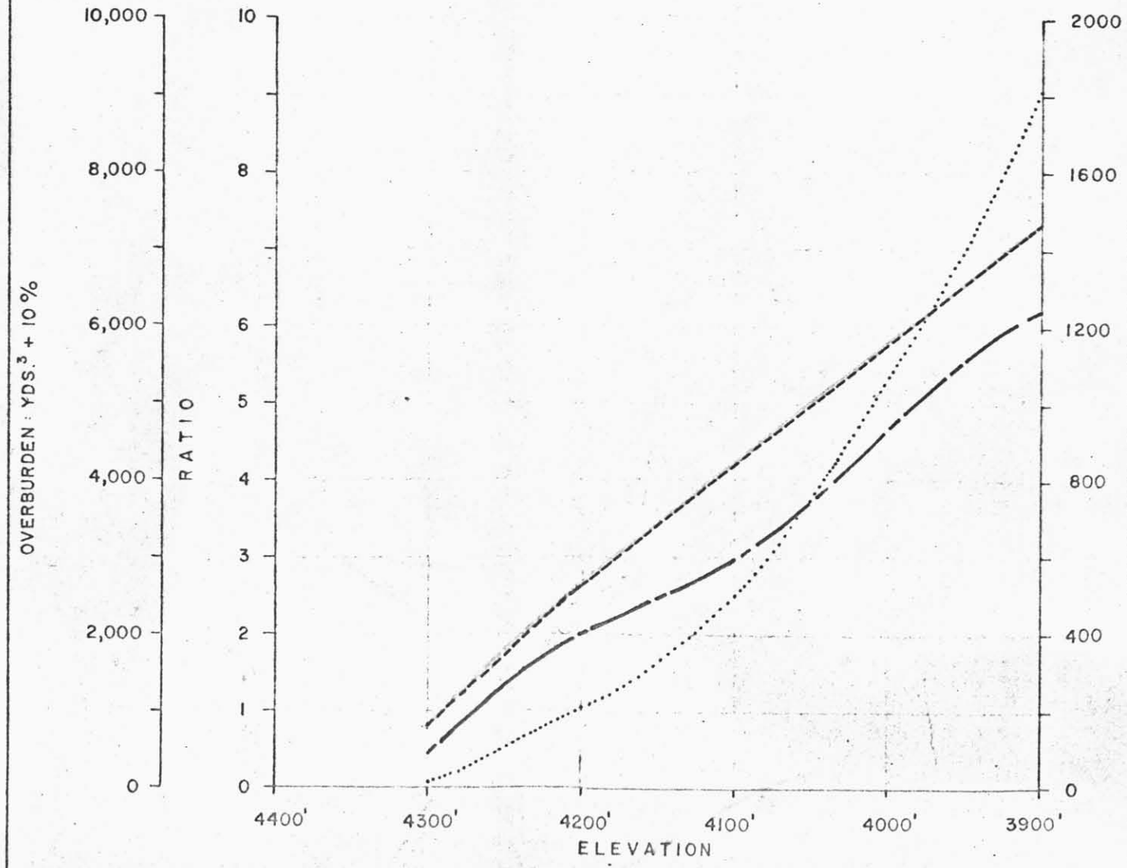
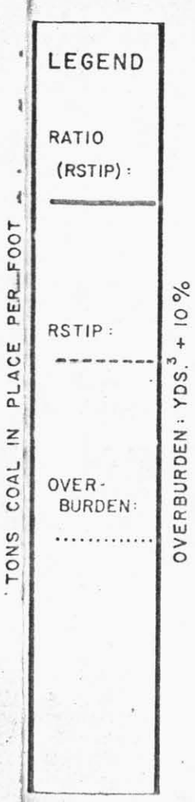
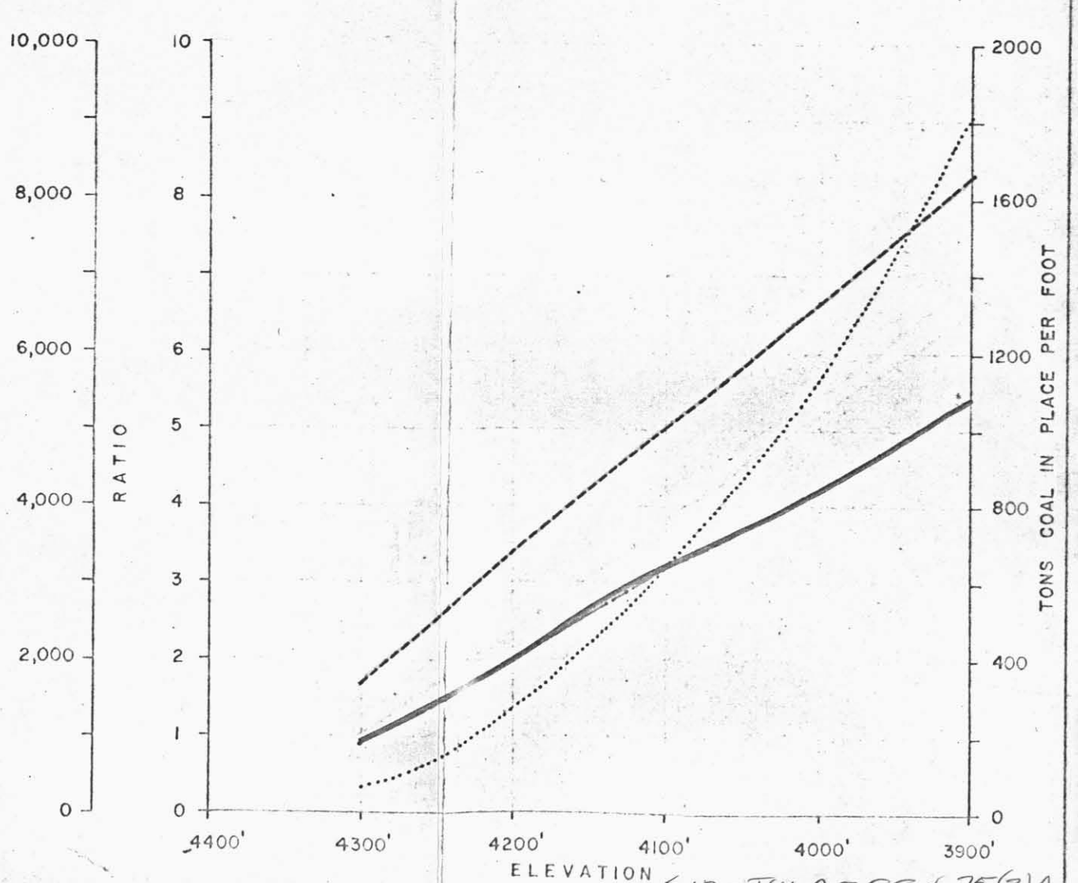
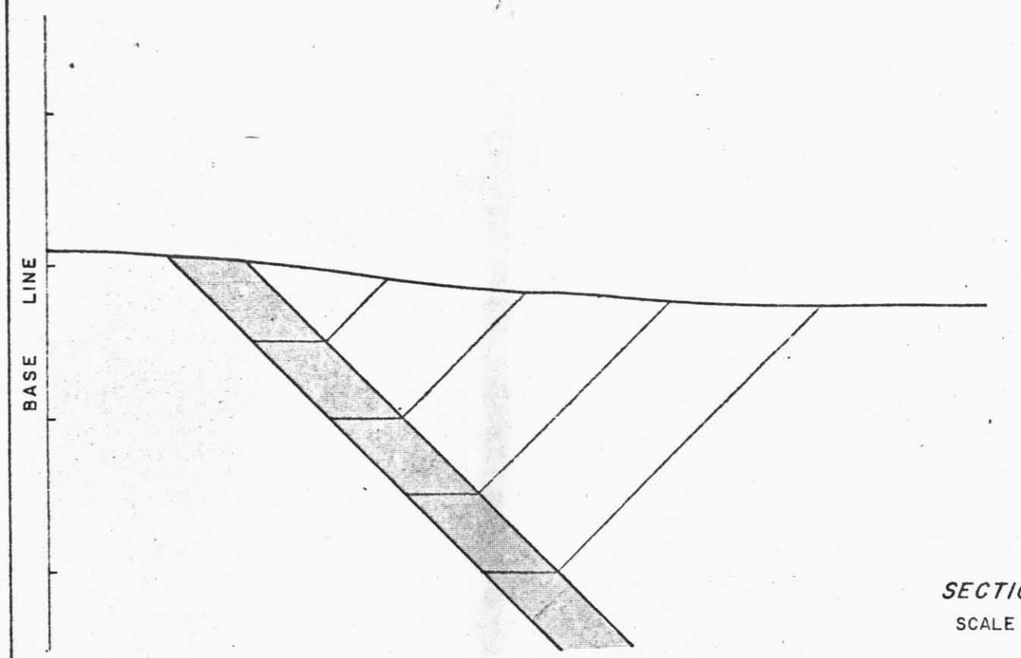






CROSS-SECTIONS 22 AND 24 WITH ACCOMPANYING RESERVE AND RATIO GRAPHS

SM-TULAMEEN 75(2)A
SPRINGFIELD CONSULTING LTD.
Fig. 5



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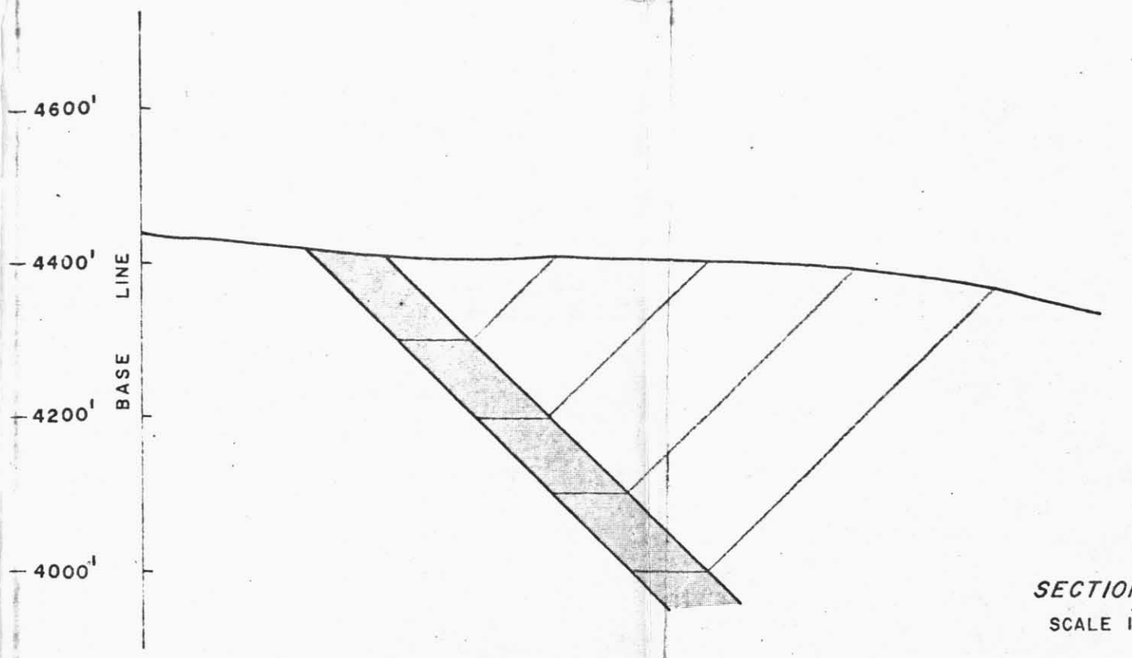

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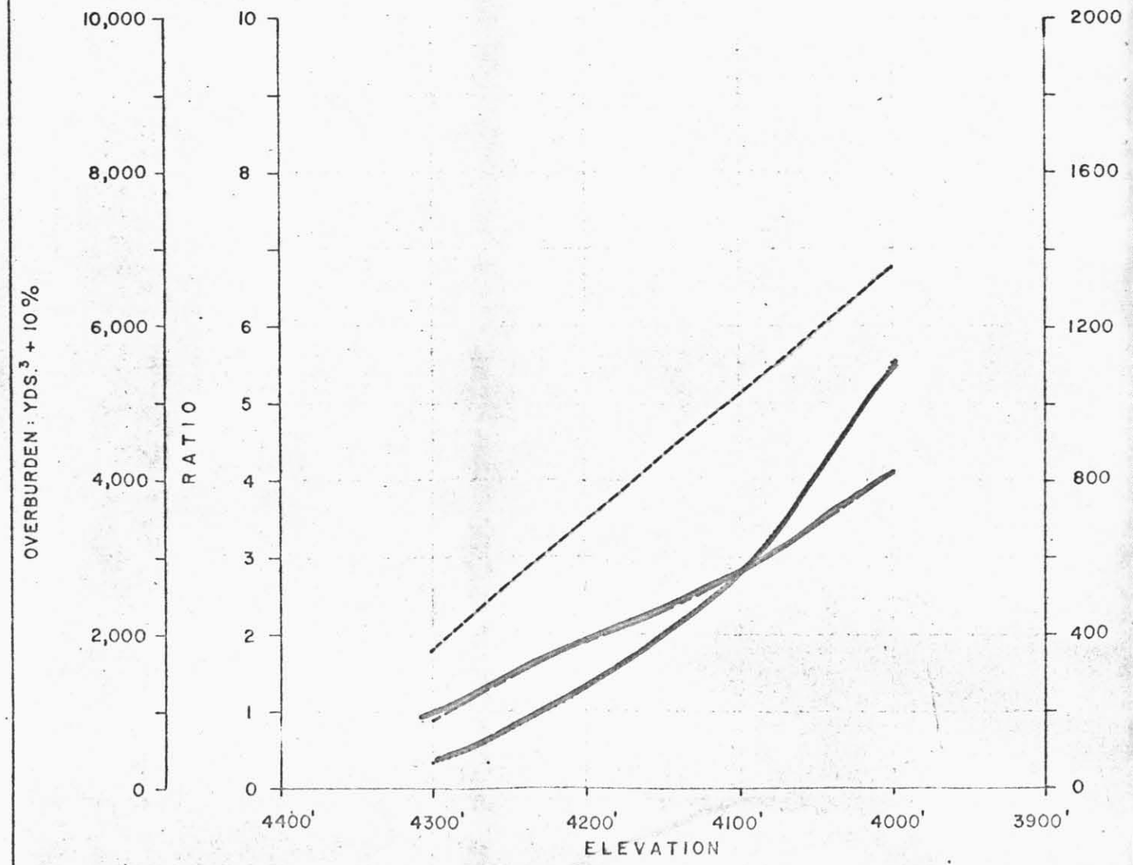

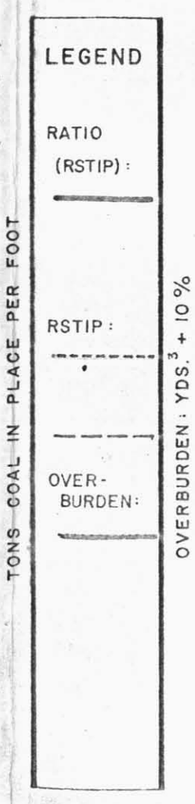

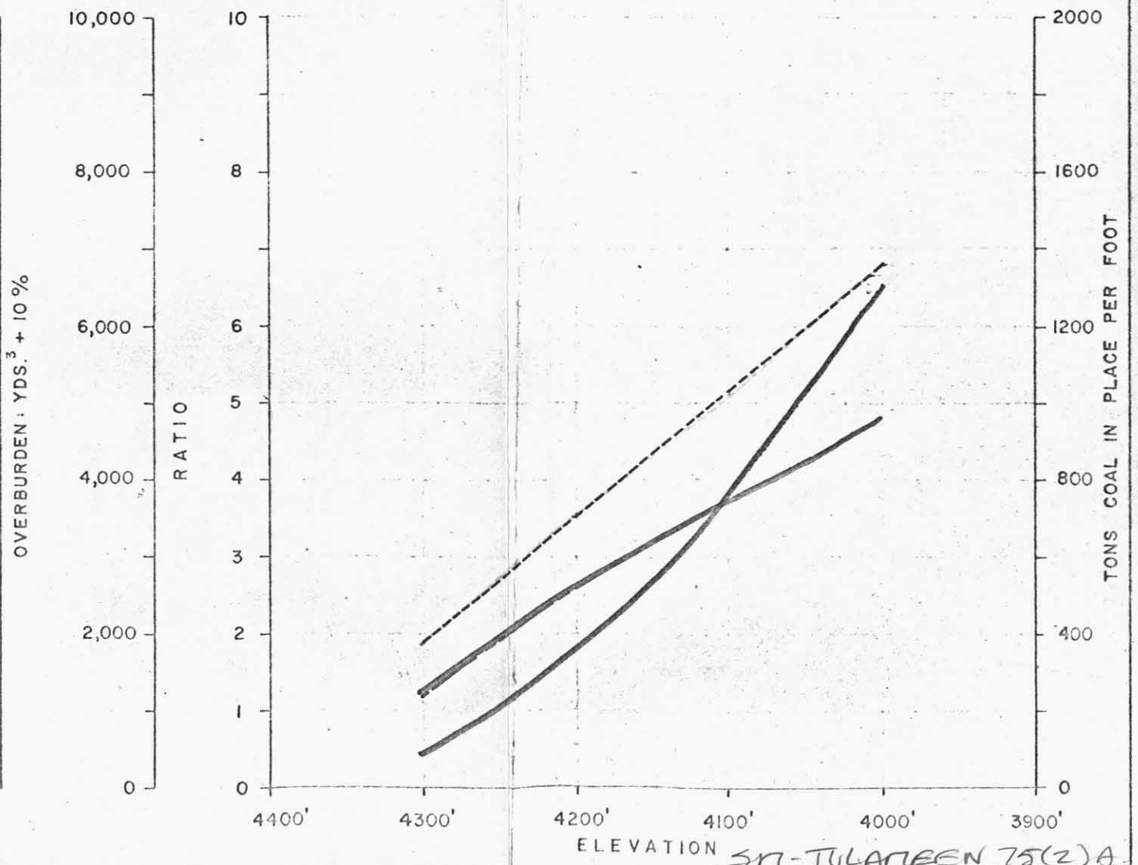

CROSS-SECTIONS 26 AND 28 WITH ACCOMPANYING RESERVE AND RATIO GRAPHS

SM-TULAMEEN 75(2)A
SPRINGFIELD CONSULTING LTD.
Fig.6

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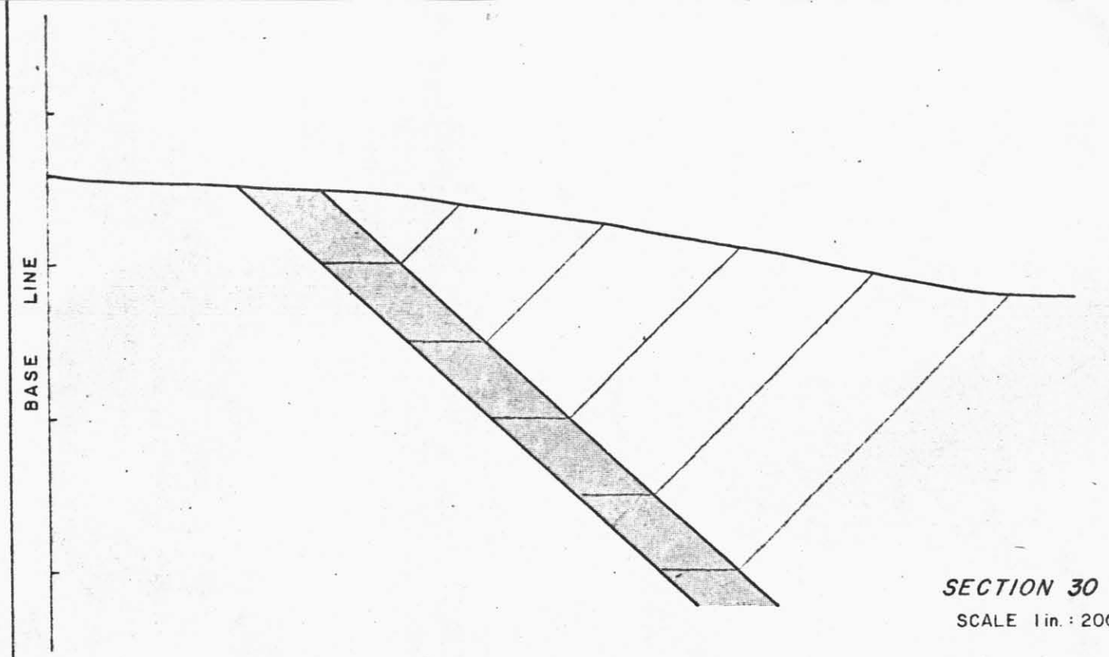

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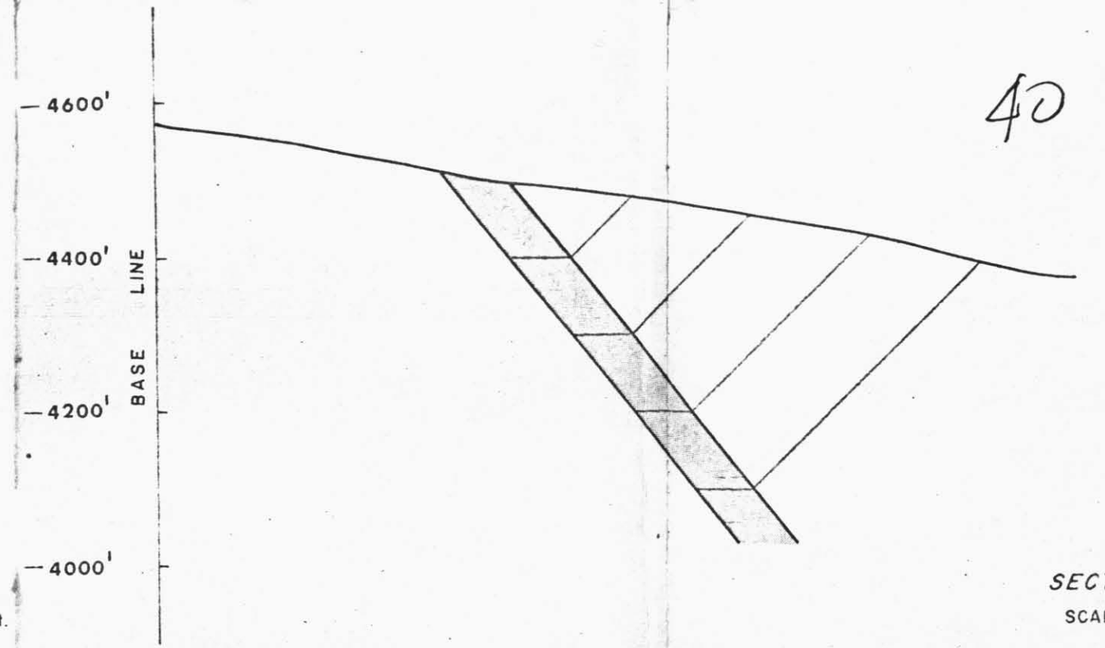

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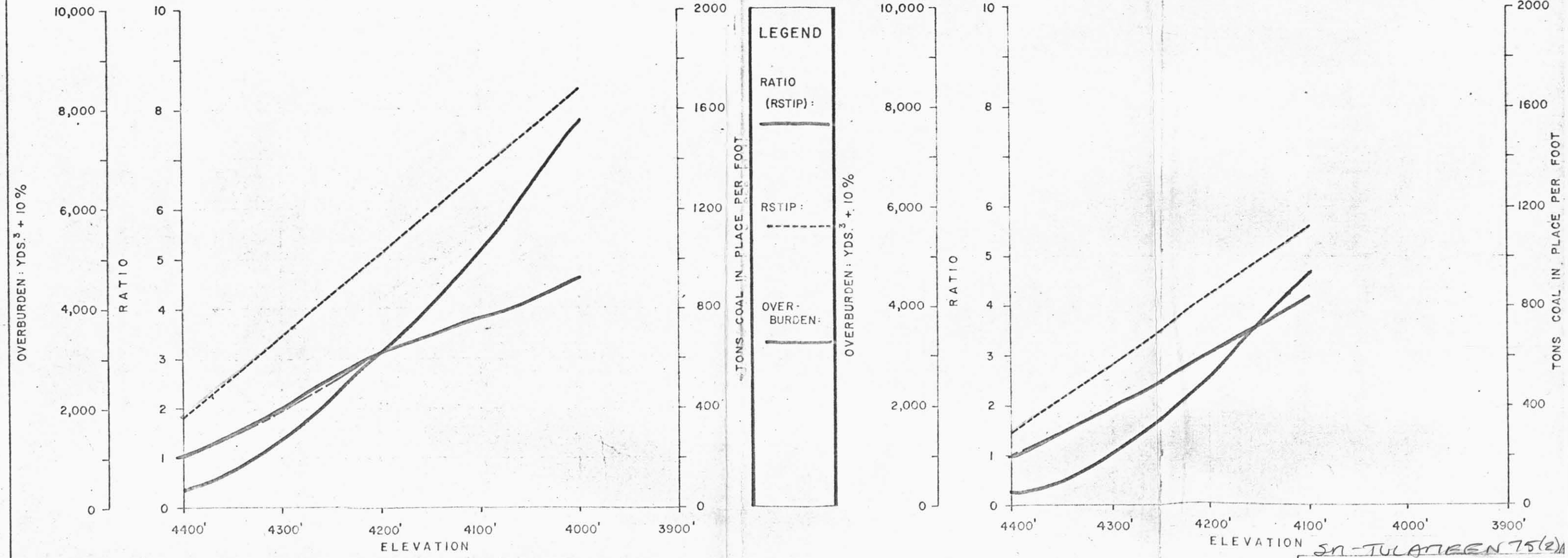
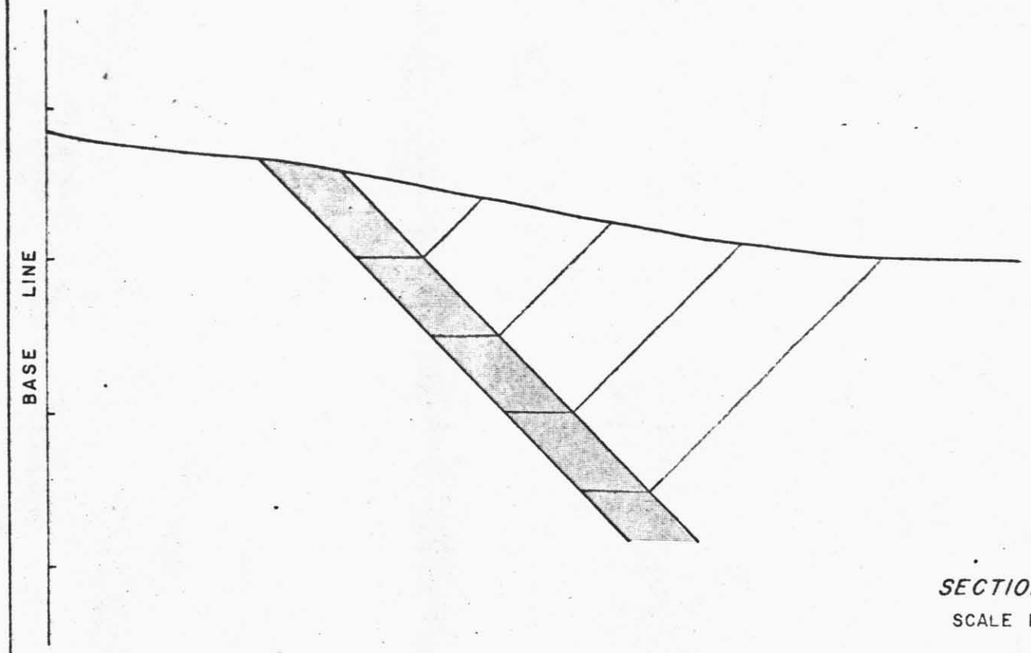


CROSS-SECTIONS 30 AND 32 WITH ACCOMPANYING RESERVE AND RATIO GRAPHS

SN-TULAMEEN 75(2)A
SPRINGFIELD CONSULTING LTD.
Fig 7



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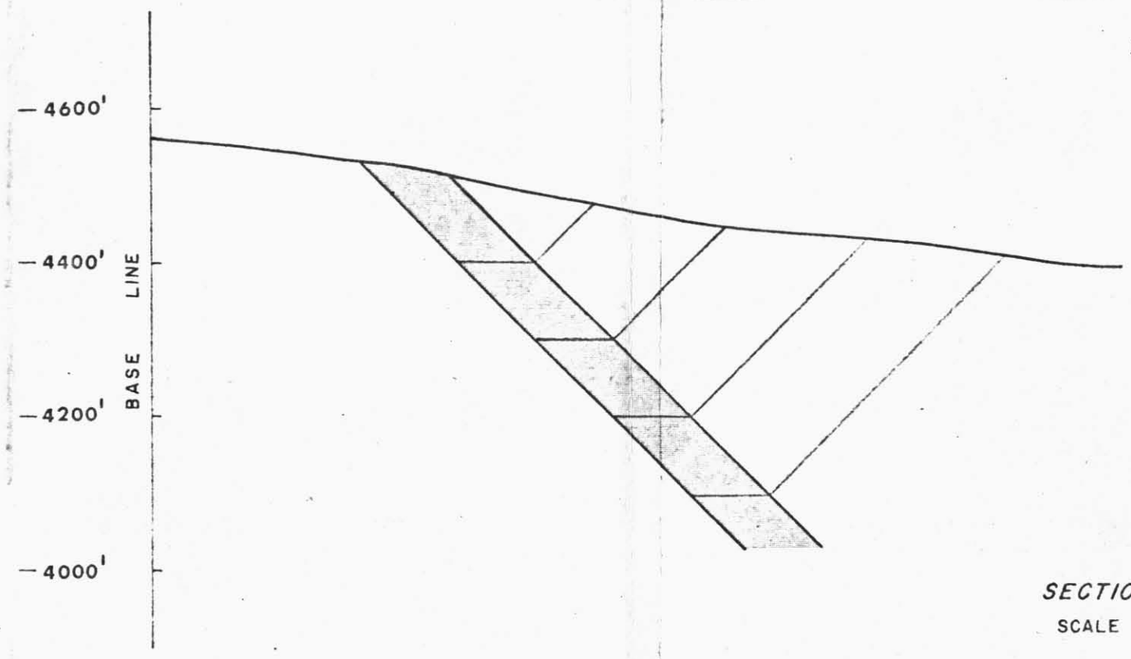
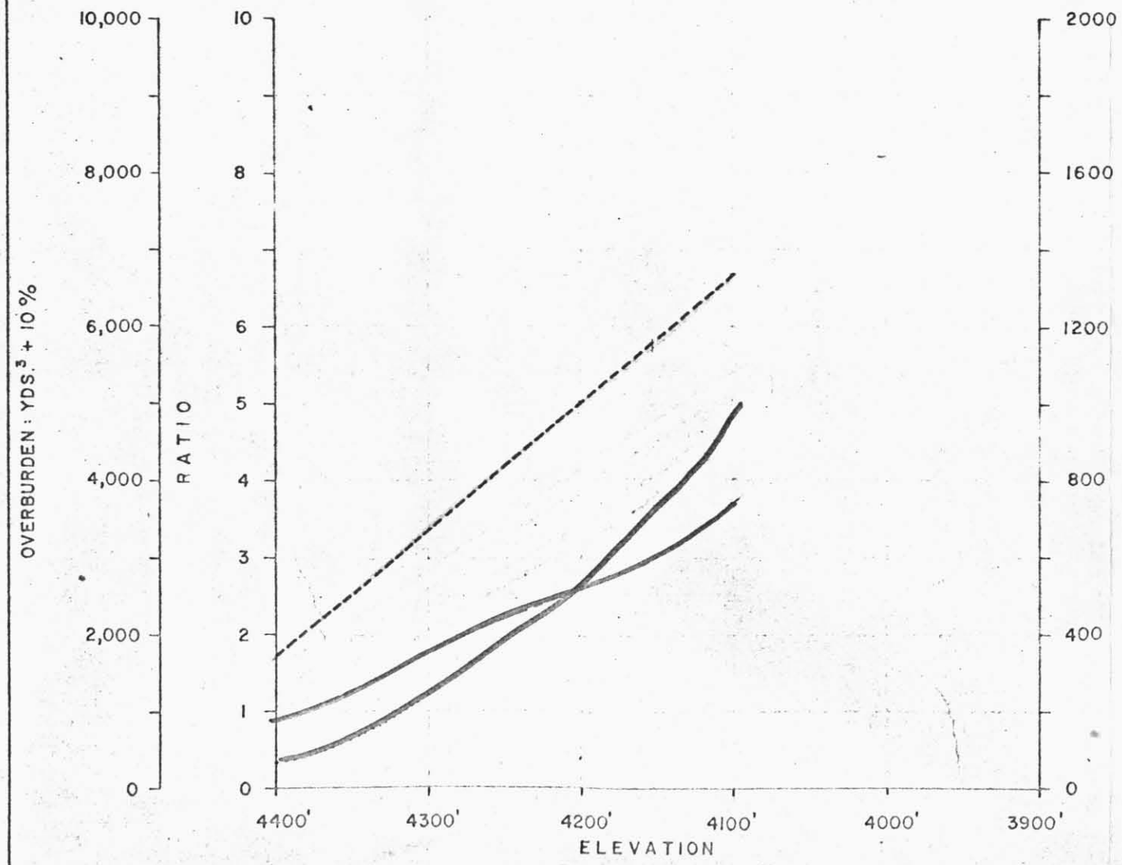
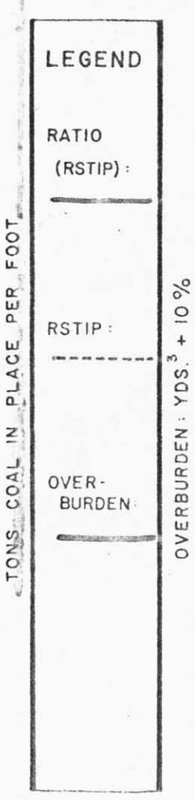
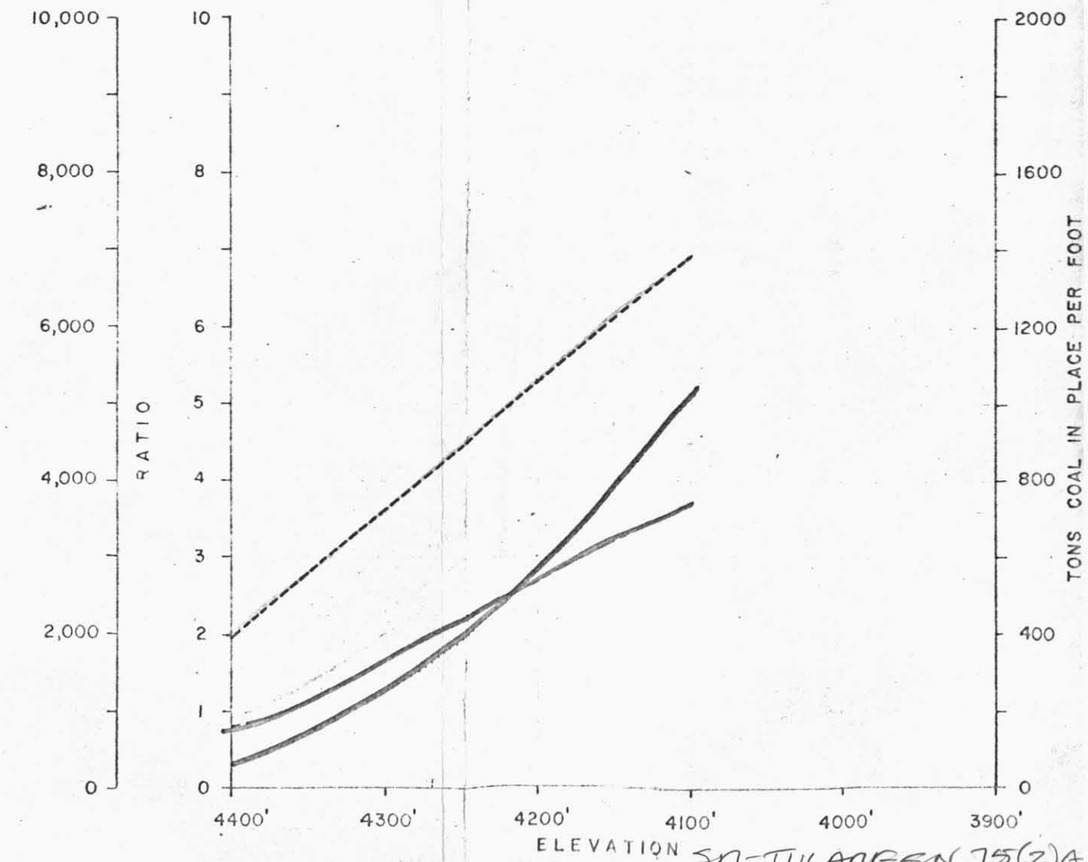


SECTION 36
SCALE 1 in. : 200 ft.

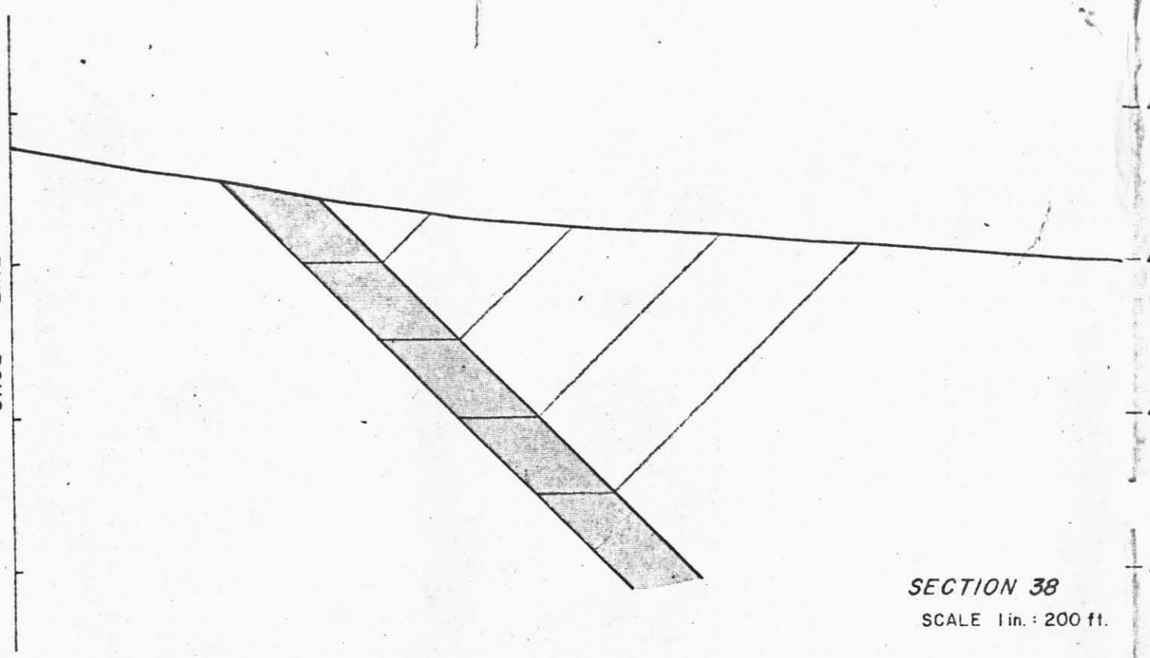




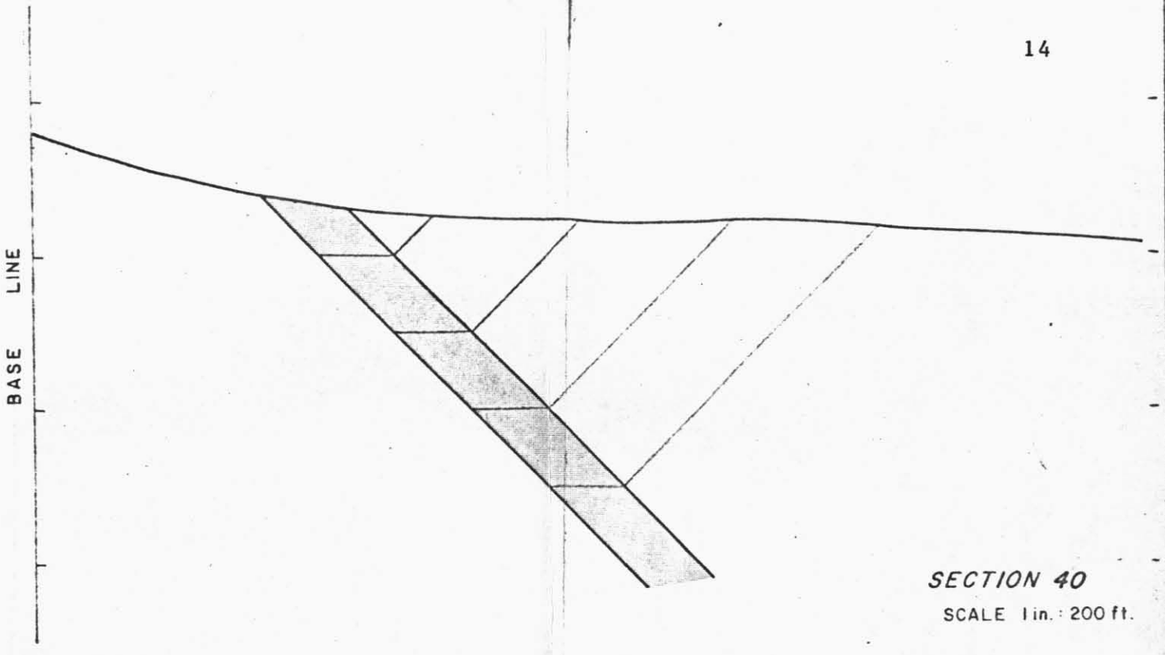


CROSS-SECTIONS 34 AND 36 WITH ACCOMPANYING RESERVE AND RATIO GRAPHS

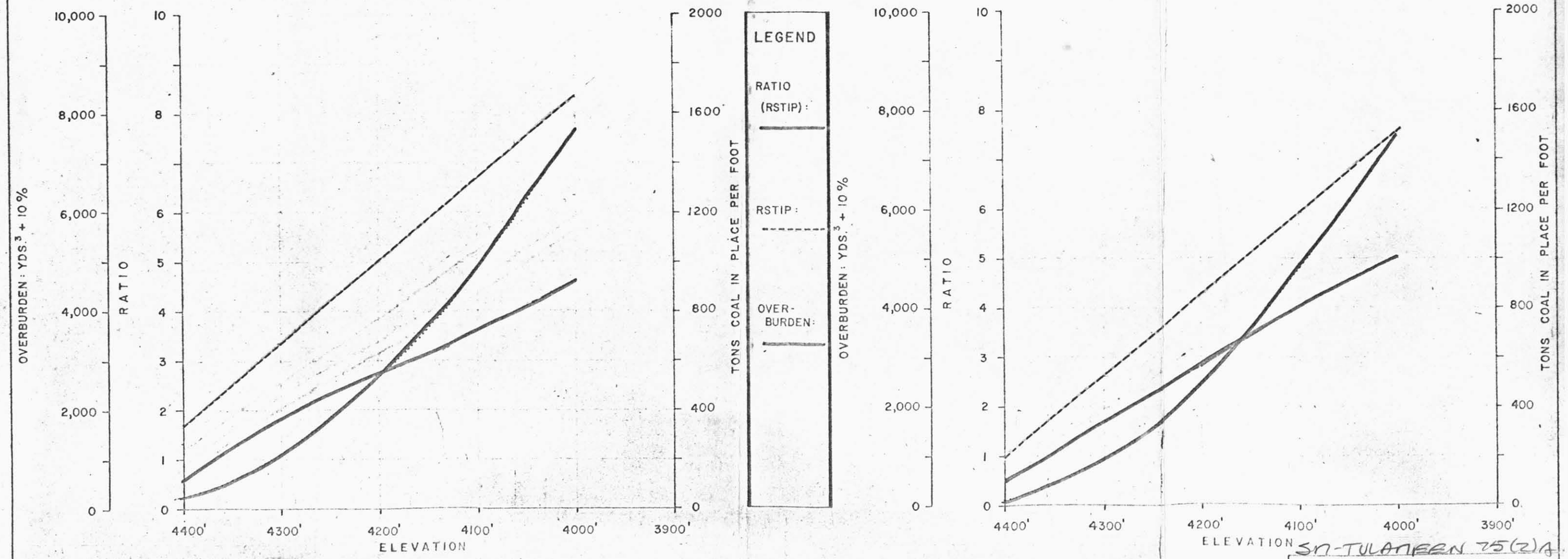
SPRINGFIELD CONSULTING LTD.
Fig. 8



SECTION 38
SCALE 1 in. : 200 ft.



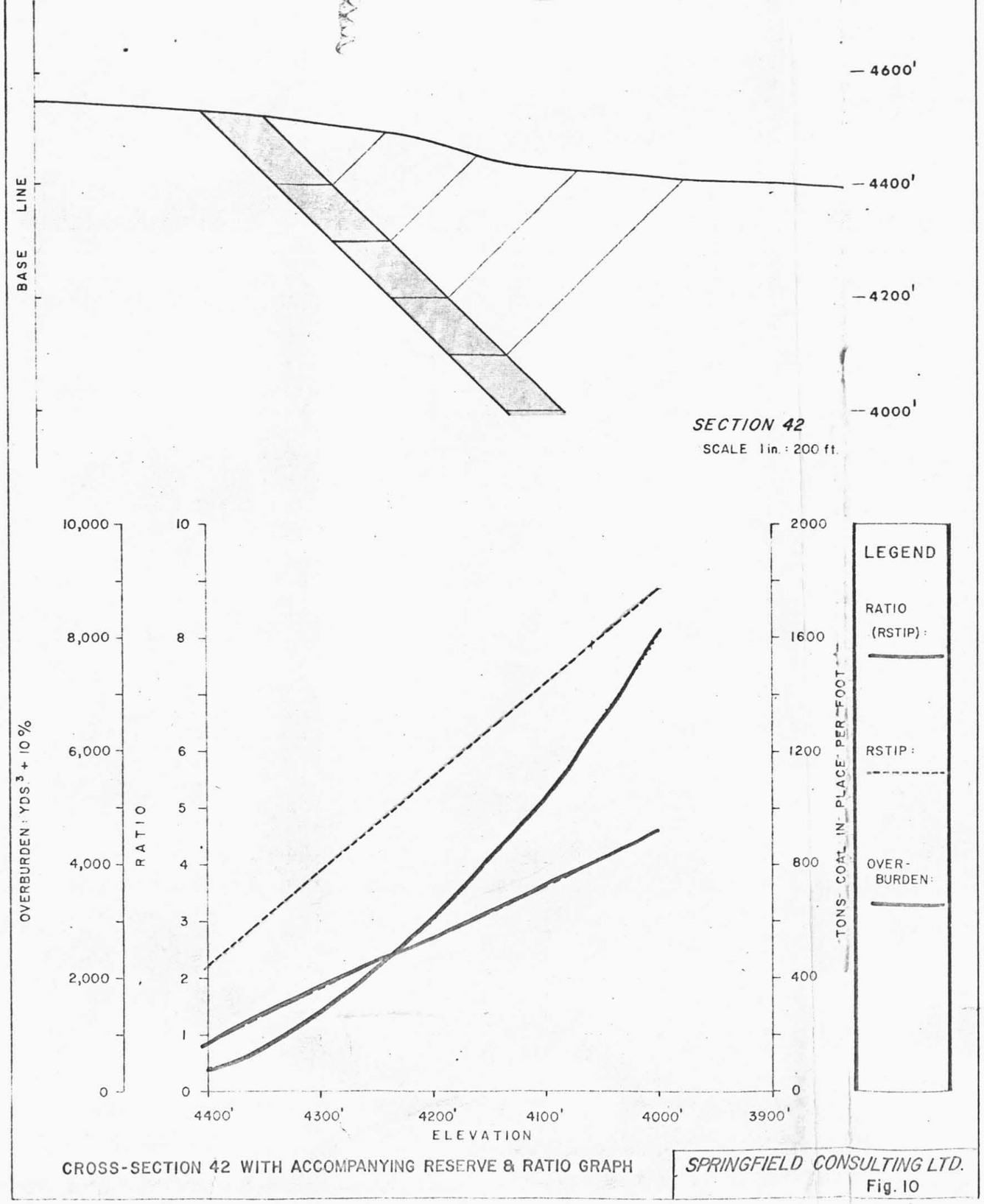
SECTION 40
SCALE 1 in. : 200 ft.



CROSS-SECTIONS 38 AND 40 WITH ACCOMPANYING RESERVE AND RATIO GRAPHS

SM-TULAMEEN 75(2)A
SPRINGFIELD CONSULTING LTD.
Fig. 9

40



CROSS-SECTION 42 WITH ACCOMPANYING RESERVE & RATIO GRAPH

SPRINGFIELD CONSULTING LTD.
Fig. 10

SM- TULAMEEN 75(2)A

TRENCH No. 7

Floor :
Strike - 155° Az
Dip - 37° N.E.

Roof :
Strike - 165° Az.
Dip - 37° N.E.

TRENCH No. 8

0 50 100 150 200 250 300

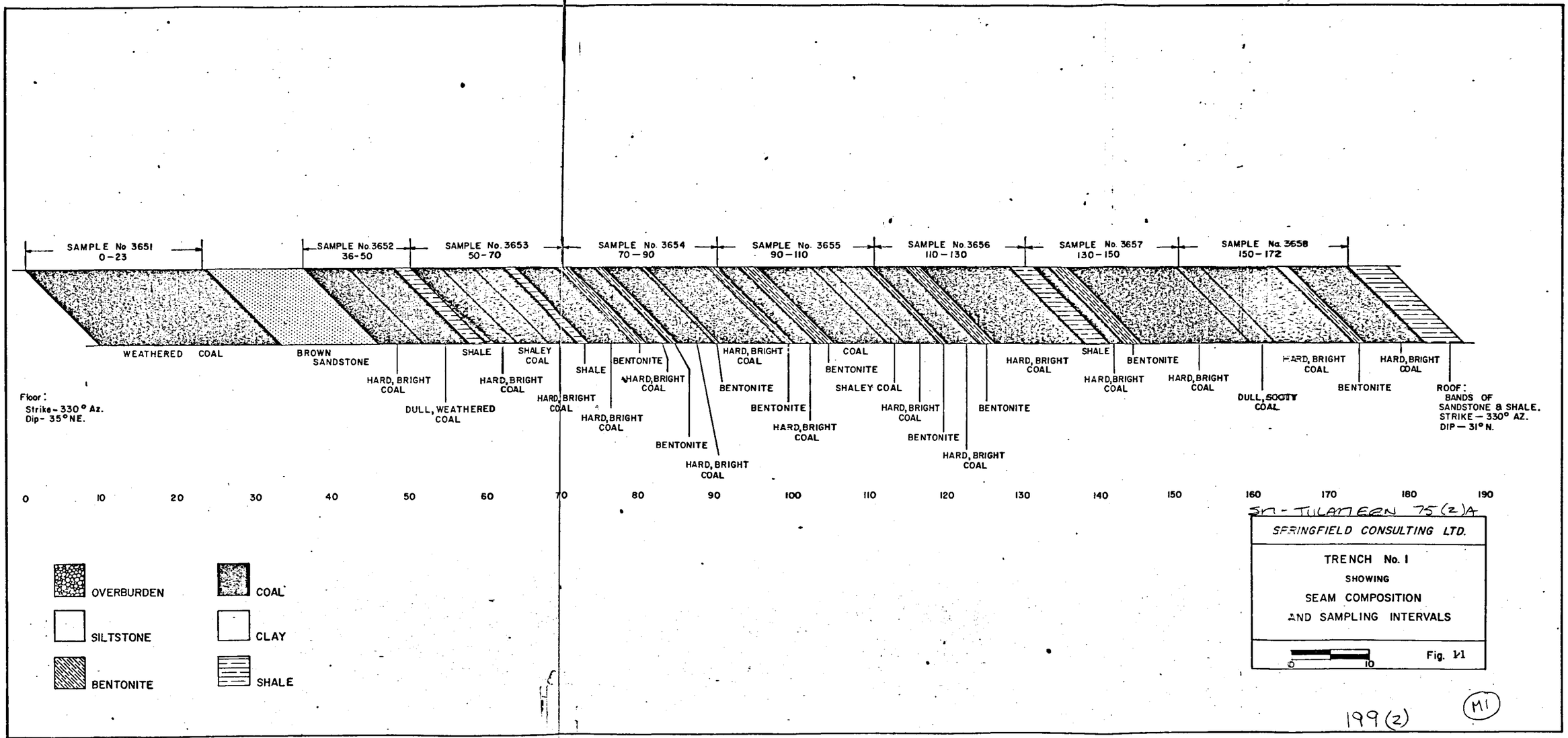
SPRINGFIELD CONSULTING LTD.

TRENCHES No. 7 & No. 8
SHOWING
SAMPLE INTERVALS

0 100

Fig. 17

SM-JULAMEEN 75(2)A



SM - TULAMEEN 75(2)A

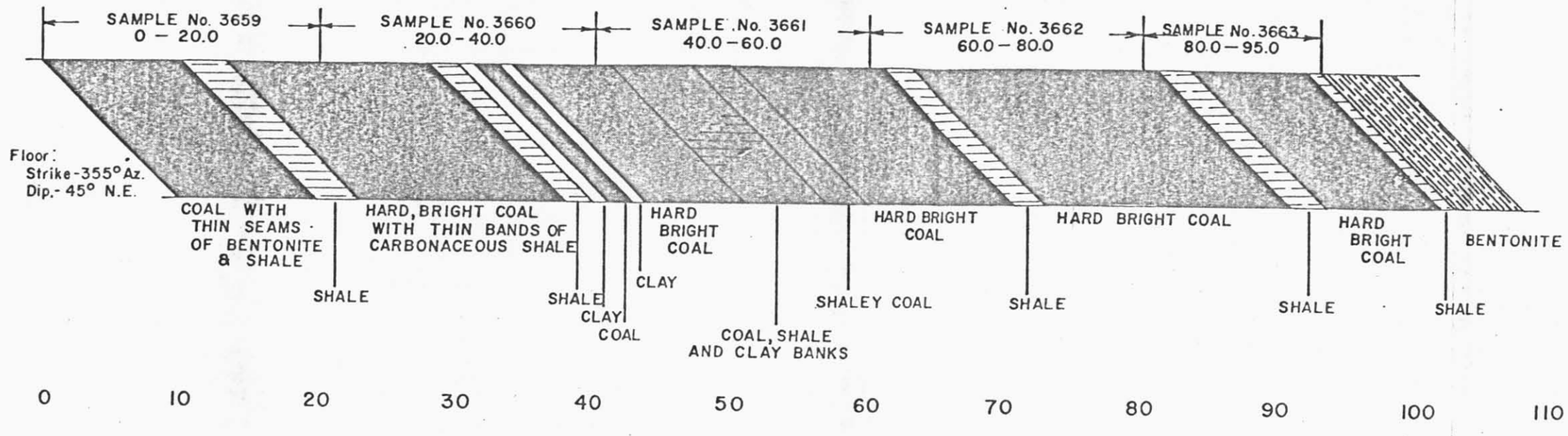
SPRINGFIELD CONSULTING LTD.

TRENCH No. 1
SHOWING
SEAM COMPOSITION
AND SAMPLING INTERVALS

0 10 Fig. 11

199(2)

(M1)



OVERBURDEN

SILTSTONE

CLAY

COAL

BENTONITE

SHALE

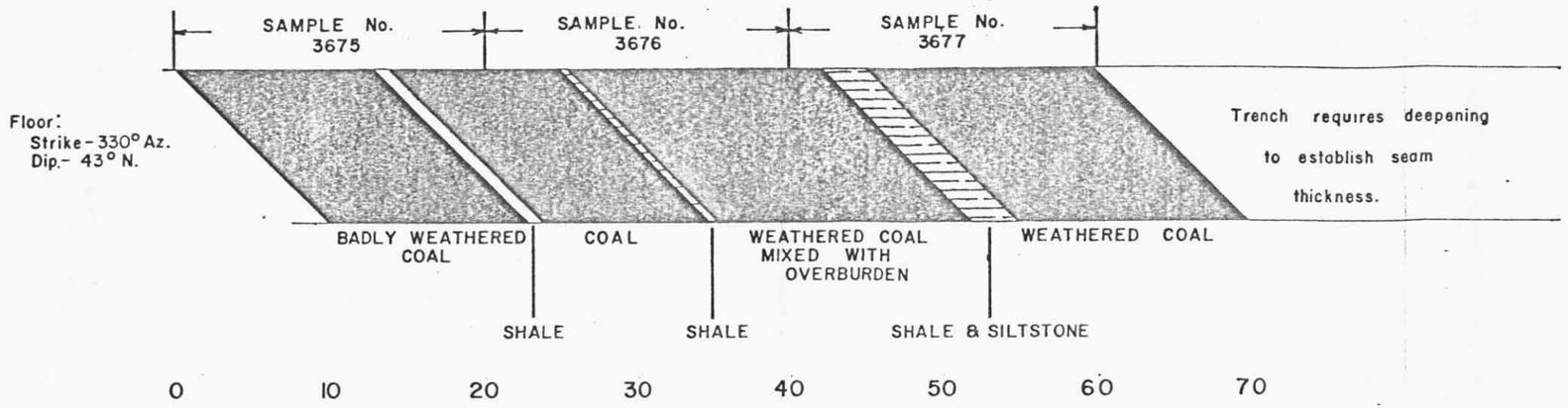
SPRINGFIELD CONSULTING LTD.

TRENCH No. 2
SHOWING
SEAM COMPOSITION
AND SAMPLING INTERVALS

0 10

Fig. 12

SM-TULAMEEN 75(2)A



OVERBURDEN

SILTSTONE

CLAY

COAL

BENTONITE

SHALE

SPRINGFIELD CONSULTING LTD.

TRENCH No. 3

SHOWING

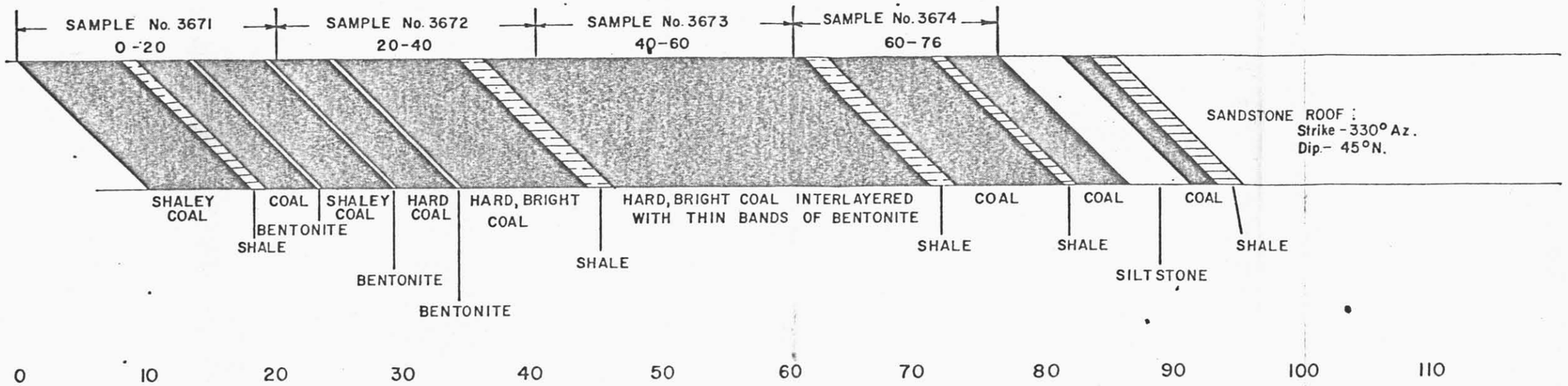
SEAM COMPOSITION

AND SAMPLING INTERVALS

0 10

Fig 13

SM-TULAMEEN 75(2)A



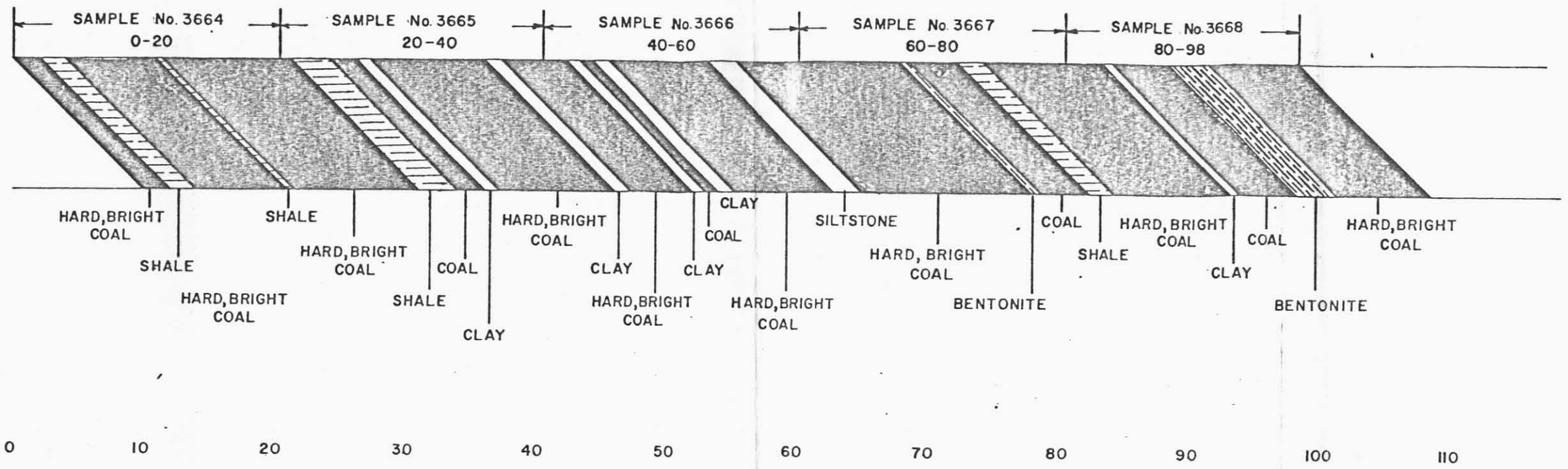
SPRINGFIELD CONSULTING LTD.

TRENCH No. 4
SHOWING
SEAM COMPOSITION
AND SAMPLING INTERVALS

0 10

Fig. 14

SM-JULAMEEN 75(2)A



OVERBURDEN

SILTSTONE

CLAY

COAL

BENTONITE

SHALE

SPRINGFIELD CONSULTING LTD.

TRENCH No. 5

- SHOWING

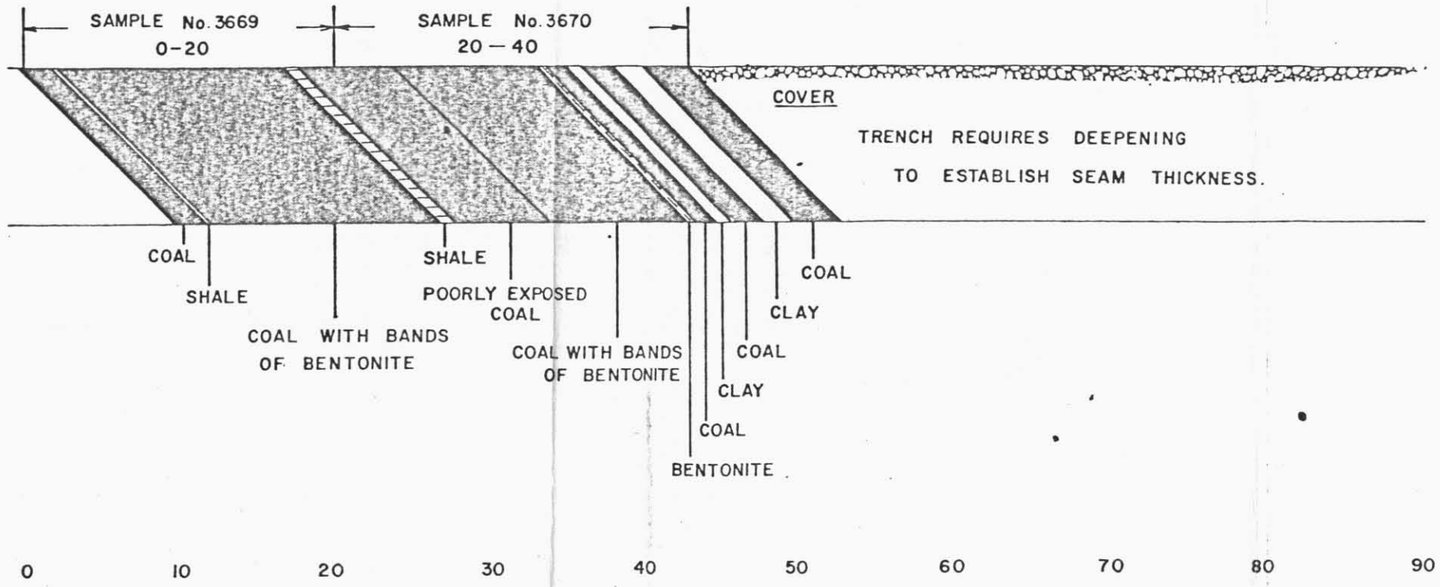
SEAM COMPOSITION

AND SAMPLING INTERVALS

0 10

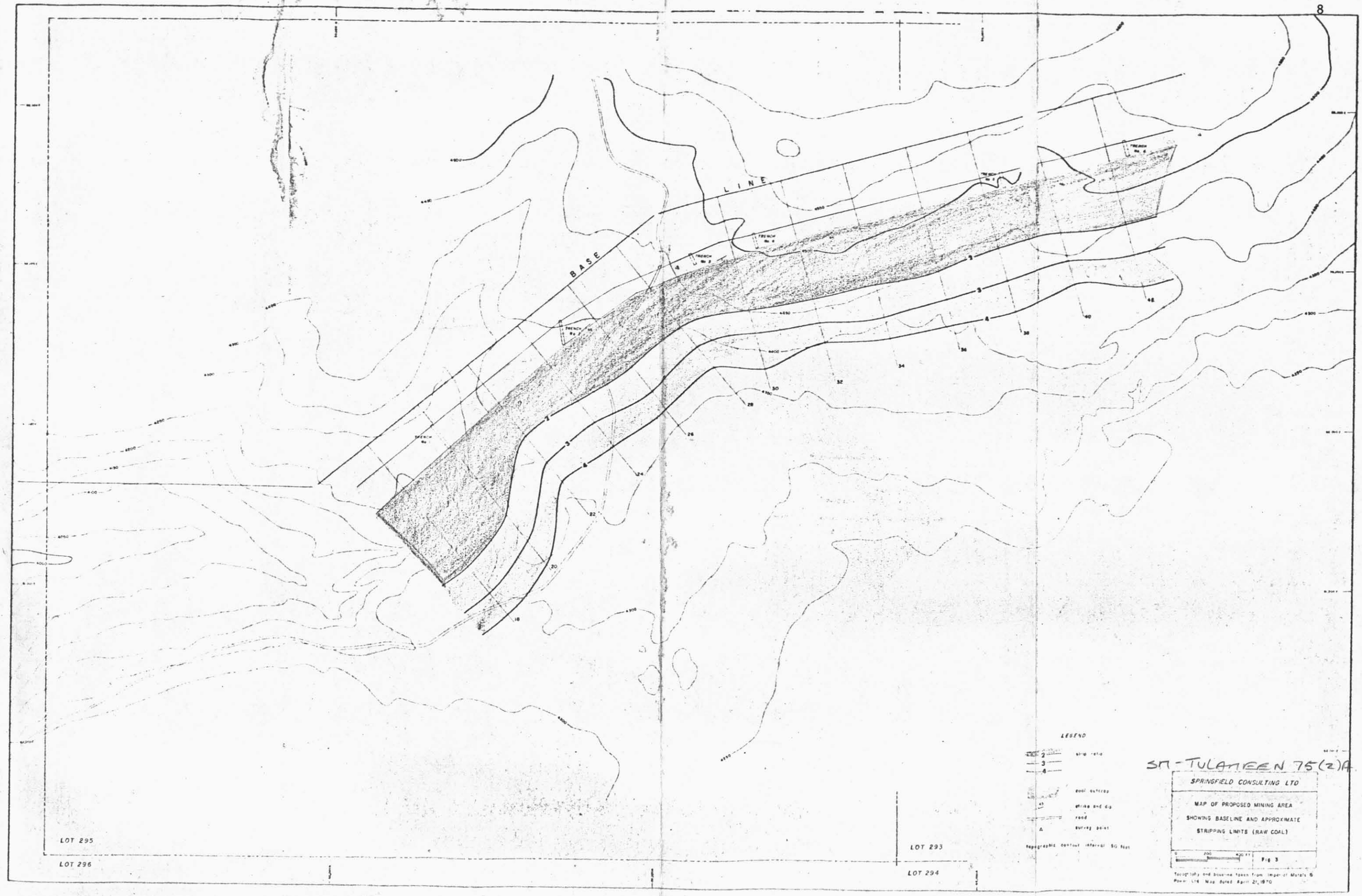
Fig. 15

SM JULAMEEN 75(2)A



SPRINGFIELD CONSULTING LTD.	
TRENCH No. 6 SHOWING SEAM COMPOSITION AND SAMPLING INTERVALS 0 — 10	Fig. 16

SA-TULAMEEN 75(2)A


BASE LINE
LOT 295
LOT 296
LOT 293
LOT 294
LEGEND
seam ratio
coal outcrop
strike and dip
road
survey point
topographic contour interval 50 feet
SM-TULAMEEN 75(2)A
SPRINGFIELD CONSULTING LTD
MAP OF PROPOSED MINING AREA
SHOWING BASELINE AND APPROXIMATE
STRIPPING LIMITS (RAW COAL)
Fig 3
Topography and baseline taken from Imperial Metals & Power Ltd Map dated April 21, 1970