PR Goodrich E2(1)#1

PR COALFIELD

GOODRICH COAL PROPERTY

GEOLOGICAL REPORT

1982

VOLUME 1

LIST OF COAL LICENCES - See Attached.

Approximate Centre of Property
Lat 55° 30'
Long 122° 30'

See Page 36 for list of which licences had work done on them.

Allen E. Tienin

Gulf Canada Resources Inc.
Coal Division

December 1982

GOODRICH COAL PROPERTY

VOLUME 1

GEOLOGICAL REPORT 1982

TABLE OF CONTENTS

		Page No.
	PREFACE	
1.0	SUMMARY	1
2.0	RECOMMENDATIONS	5
3.0	INTRODUCTION	9
	3.1 Summary	9
	3.2 Property Location, Size and Access	11
	3.3 Physiography	14
	3.4 History of Land Tenure	15
	3.5 History of Exploration	18
4.0	1982 EXPLORATION PROGRAM	24
	4.1 Summary	24
	4.2 Objectives	25
	4.3 Field Camp and Logistics	27
	4.4 Geological Mapping	32
	4.5 Trenching	35
	4.6 Bulk Sampling	41
	4.7 Reclamation	49
	4.8 Other Studies	51

		Page No.
5.0	GEOLOGY	52
	5.1 Summary	52
	5.2 Regional Stratigraphy	55
	5.2.1 Fernie Formation	55
	5.2.2 Beaudette Group	58
	5.2.2.1 Monteith Formation	59
	5.2.2.2 Beattie Peaks Formation	59
	5.2.2.3 Monach Formation	60
	5.2.3 Crassier Group	60
	5.2.3.1 Brenot Formation	61
	5.2.3.2 Dresser Formation	63
	5.2.3.3 Gething Formation	67
	5.2.4 Fort St. John Group	68
	5.2.4.1 Bluesky Formation	70
	5.2.4.2 Moosebar Formation	71
	5.2.4.3 Commotion Formation	72
	5.2.4.4 Hasler Formation	74
	5.2.4.5 Goodrich Formation	74
	5.3 Regional Structure	76
	5.3.1 Faults	79
	5.3.2 Folds	80
	5.4 Lossan Mine Area	82
	5.4.1 Summary	82
	5.4.2 Detailed Geology	84
	5.4.2.1 Folds	84
	5.4.2.2 Faults	86

Page No.

5.4.3 Coal Occurrences 87
5.4.3.1 Gething No. 1 Seam 87
5.4.3.2 Gething No. 2 Coal Zone 89
5.4.3.3 Gething No. 3 and No. 4 Seams 89
5.4.3.4 Gething No. 5 Seam 90
5.4.3.5 Gething No. 6 Seam 90
5.5 Regional Prospects 91
5.5.1 Goodrich South Cirque Prospect 91
5.5.1.1 Folds 95
5.5.1.2 Faults 95
5.5.1.3 Coal Occurrences 96
5.5.2 Goodrich South Table Prospect 99
5.5.2.1 Folds 99
5.5.2.2 Faults 102
5.5.2.3 Coal Occurrences 103
5.5.3 Hasler Creek Prospect 105
5.5.3.1 Folds 107
5.5.3.2 Faults 107
5.5.3.3 Coal Occurrences 108
5.5.4 Beaudette Syncline Prospect 111
5.5.4.1 Folds 113
5.5.4.2 Faults 113
5.5.4.3 Coal Occurrences 114
5.5.5 Goodrich Central Prospects 118
5.5.5.1 Folds 121
5.5.5.2 Faults 125
5.5.5.3 Coal Occurrences 127

Page No.

5.5.6 Moberly Prospect 128
5.5.6.1 Folds 130
5.5.6.2 Faults 132
5.5.6.3 Coal Occurrences 133
5.6 Whiterabbit Block 136
5.6.1 Folds 137
5.6.2 Faults 138
5.6.3 Coal Occurrences 138

6.0 COAL RESOURCES 141
6.1 Regional Coal Resources 141
6.2 In-Situ Reserves of the Lossan Mine Area 144
6.3 Potential Coal Resources of Prospect Areas 149
6.3.1 Goodrich South Cirque 149
6.3.2 Goodrich South Table Area 151
6.3.3 Hasler Creek Area 152
6.3.4 Beaudette Syncline 153
6.3.5 Goodrich Central 153
6.3.6 Moberly Area 154

7.0 COAL QUALITY 156
7.1 Summary of 1981 Data 156
7.1.1 Coal Quality Specifications - Gething No. 1 Seam 156
7.1.2 Coal Quality Specifications - Gething No. 5 Seam 159
7.1.3 Procedure 161

Page No.

7.2 Summary of the 1982 Data 165

7.2.1 Metallurgical Coal Products 176

7.2.2 Thermal Coal Products 176

7.2.3 Attrition Tests 178

7.2.4 Other Tests 178

7.3 Coal Petrography 180

8.0 GLOSSARY 182

9.0 REFERENCES 183

Goodrich Coal Property

Volume 1

Geological Report 1982

List of Figures

Figure No.	Description	Page No.
2.0.1	Coal Licence Map	8
3.2.1	Location Map	10
3.2.2	Peace River Coalfield	12
3.4.1	History of Licence Acquisition	16
3.5.1	Geological Mapping Blocks	21
4.4.1	Topographic Map Coverage	33
4.6.1	Adit Location Map	42
4.6.2	Adit Site Diagram	44
4.6.3	Adit Plan	45
4.6.4	Location of Oxidized Bulk Sample	47
5.1.1	Regional Geology Map	54
5.2.3.2	Alluvial Fan Model	66
5.2.3.3	Stratigraphic Log Description	69
5.3.1	Regional Structural Trends	78
5.3.2	Schematic Diagram Illustrating Fold Styles	81
5.4.1	Lossan Mine Area - Location	83
5.4.2.1	Typical Cross Section - Lossan Mine Area	85
5.4.2.2	Lossan Mine Area - Typical Cross Sections (detailed)	88

List of Figures (cont'd)

Figure No.	Description	Page No.
5.5.0	Regional Prospects	92
5.5.1	Goodrich South Cirque - Location	94
5.5.1.3	Goodrich South Cirque - Typical Cross Section	97
5.5.2	Goodrich South Table Area - Location	100
5.5.2.3	Goodrich South Table Area - Typical Cross Section	104
5.5.3	Hasler Creek Prospect - Location	106
5.5.3.3	Hasler Creek Area - Typical Cross Section	109
5.5.4	Beaudette Syncline - Location	112
5.5.4.3	Beaudette Syncline - Typical Cross Section	115
5.5.5(a)	Goodrich Central South - Location	119
5.5.5(b)	Goodrich Central North - Location	120
5.5.5.1	Goodrich Central North - Typical Cross Section	123
5.5.5.1.2	Goodrich Central South - Typical Cross Section	124
5.5.6	Moberly Prospect - Location	129
5.5.6.1	Moberly Prospect - Typical Cross Section	131
6.1.1	Regional Coal Resources	142
6.2.1	Drill Hole Influence Map	148

Goodrich Coal Property

Volume 1

Geological Report 1982

List of Tables

Table No.	Description	Page No.
2.0.1	Summary of Coal Licences Surrendered, 1982	7
3.5.1	Summary of Exploration Activities, 1980-81	23
4.3.1	List of Personnel Employed	28
4.3.2	List of Contractors and Services	30
4.5.1	1982 Trench Summary	36
5.2.1	Table of Formations	56
5.2.2	Formation Thickness Variation	57
5.5.1.3	Goodrich South Cirque Trench Summary	98
5.5.3.3	Hasler Creek Prospect - Trench Summary	110
5.5.4.3	Beaudette Syncline - Drill Hole Summary	116
5.5.4.3.1	Beaudette Syncline - Trench Summary	117
5.5.5.3	Goodrich Central - Summary of Coal Seam Data	127
5.5.6.3	Moberly Prospect - Trench Summary	135
5.6.3	Whiterabbit Block - Summary of Coal Trench Data	139
6.1.1	Summary of In-Situ Regional Coal Resources	143
6.2.1	Lossan Mine Area - Summary of In-Situ Coal Reserves	145
6.3.1	Summary of In-Situ Coal Resources in Prospect Areas	150
7.1.1	Preliminary Specifications of Coal Quality - No. 1 Seam	157

List of Tables (cont'd)

Table No.	Description	Page No.
7.1.2	Preliminary Specifications of Coal Quality No. 5 Seam	160
7.1.3	List of Drill Holes and Composite Samples	164
7.2.1	Coal Quality Summary - Bulk Samples B2, B3A, B3B and B1	173
7.2.2	Average Ash Fusion Temperature of Thermal Coal Product from Total Seam	177
7.2.3	Summary of Dry Attrition Data from ADT 82-1	179
7.3.1	Summary of Petrographic Results from ADT 82-1 Channel Samples	181

Goodrich Coal Property

Volume 1

Geological Report 1982

Table of Volumes and Appendices

Volume 1 — Geological Report

Text

1:100 000 Coal Licence Map

1:50 000 Regional Geology Maps

Appendix A

Part 1 — Geology Maps and Regional Cross Sections

Moberly Geology Map GDR-82-010

1:25 000

Moberly Cross Sections

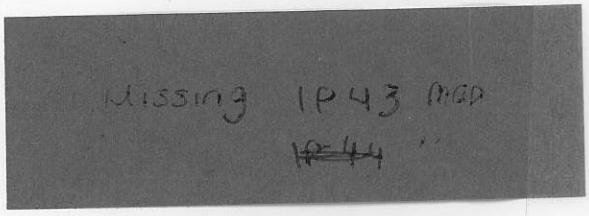
1:25 000

- 0 000 N
- 2 000 N
- 4 000 N
- 6 000 N
- 8 000 N
- 10 000 N
- 12 000 N
- 14 000 N
- 16 000 N
- 18 000 N
- 20 000 N
- 22 000 N

Goodrich East Geology Maps

1:5 000

- IP42
- IP43
- IQ42
- IQ43
- IQ44
- IQ45
- IR44
- IR45



Goodrich East Cross Sections

1:5 000

- AA-AA'
- BB-BB'
- CC-CC'
- DD-DD'
- EE-EE'
- FF-FF'
- GG-GG'

Goodrich East Cross Sections

(Beaudette Syncline)

1:5 000

- T1-T1'
- T2-T2'
- T3-T3'
- T4-T4'
- T5-T5'
- T6-T6'

Goodrich South Geology Maps

1:5 000

- IR40
- IP39
- IP40
- IP41
- IQ40
- IQ41

1:10 000

- 93P/5WF
- 93P/5WE
- 93P/5WD
- 930/8EA
- 930/8EH

1:50 000

- Table Area

Goodrich South Cross Sections

1:10 000

- N1 000
- N2 000
- N3 000
- N4 000
- N5 000
- N6 000
- N7 000
- N8 000

1:5 000

- N9 000
- N10 000
- N11 000

1:50 000

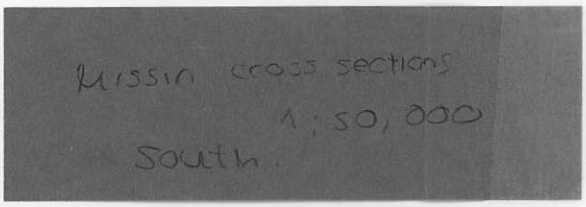
J1-J1'

J2-J2'

J3-J3'

J4-J4'

J5-J5'



Appendix A

Part 2 Geology Maps and Regional Cross Sections

Goodrich Central Geology Maps

1:5 000

IS45

IS46

IT45

IT46

IU44

IU45

IU46

IV44

IV45

IV46

IW46

1:10 000

930/9WC

930/9WD

930/9WE

930/9WL

930/10EH

Goodrich Central and Whiterabbit Geology Maps

1:10 000

930/10EI

930/10EJ

930/15WF

Whiterabbit Geology Maps

1:10 000

930/15EB

930/15WC

Goodrich Central Cross Sections

1:10 000

E-E' 1:5000

F-F'

G-G'

H-H'

I-I'

J-J'

K-K'

L-L'

Goodrich Central and Whiterabbit Cross Sections

1:10 000

M-M'

N-N'

Whiterabbit Cross Sections

1:10 000

O-O'

Q-Q'

T-T'

U-U'

V-V'

W-W'

X-X'

Y-Y'

Appendix A - Part 3

Appendix B Lossan Mine Area Maps & Cross Sections

Part 1 Bulk Sampling Program and Coal Quality

Lossan Mine Area Geological Cross Sections

1:5000

- N0000
- N0250
- N0500
- N0750
- N1000
- N1250
- N1500
- N1750
- N2000
- N2250
- N2500
- N2750
- N3000
- N3250
- N3500
- N3750
- N4000
- N4250
- N4500
- N4750
- N5000
- N5250
- N5500
- N5750
- N6000

N6250
N6500
N6750
N7000
N7250
N7500
N7750
N8000
N8250
N8500
N8750
N9000
N9250
N9500

Lossan Mine Area Geology Maps
1:5 000

- IR-42
- IR-43
- IS-42
- IS-43
- IS-44
- IT-43
- IT-44

Lossan Block Geology Map
1:5 000 - IR-41

Lossan Mine Area Composite Geology Map
1:5 000

Drill Hole Influence Map

Structure Contour Maps
1:5 000

- No. 1 Seam
- No. 5 Seam

Bulk Sampling Program and Coal Quality

1.0 Summary

2.0 Adit Driveage

3.0 Bulk Sampling

4.0 Coal Quality of Channel Samples

5.0 Coal Quality of Bulk Samples

6.0 Coal Petrography

Appendix B — Lossan Mine Area

Part 2 — Geophysical Log Correlations

— Drill Hole Correlation Charts

N0500

N1500

N1750

N2000

N2500

N2750

N3250-3500

N4250

N5500

N6500

N7500

N8000

— Axis Syncline West Limb

Sheet 1

Sheet 2

— Lossan Syncline East Limb

Sheet 1

Sheet 2

— Typical Geophysical Log Response of Formation Stratigraphy - Lossan Mine Area

Appendix C — Coal Trench Logs and Data Source Records

Coal Quality of Trench Samples

Trench Location Map 1:50 000

East Sheet

West Sheet

Appendix D — Coal Quality Drill Hole Data

Part 1 — Coal Quality

DDH-80-36 to DDH-80-44

DDH-81-01 to DDH-81-22

Part 2 — Petrography

Raw Coal Samples

Part 3 — Petrography

Clean Coal Samples

PREFACE

Gulf Canada Resources Inc. has recently completed its fourth field exploration program on the Goodrich coal property, located in northeastern British Columbia.

Since the acquisition of the property in 1979, GCRI has successfully carried out exploration programs which have resulted in the identification of several areas within the Goodrich Property which contain potentially economic coal deposits. One of these areas, known as the Lossan Mine Area, has been explored to a much higher level of geological confidence than the remaining prospects. Since the Lossan Mine Area was the first prospect discovered on the property, it has had a greater concentration of exploration activities to date, such that there is currently enough data to provide the basis for a preliminary feasibility study.

The 1982 field exploration program objectives were twofold. This program was designed to allow for concentrated mapping efforts to be conducted over the entire property in order to evaluate, on a preliminary basis, the coal potential of various formations and structures located outside of the Lossan Mine Area. In addition, a bulk sample of coal was obtained from within the mine area in order that the thermal and metallurgical properties of this coal could be studied in greater detail.

Gulf Canada Resources' coal staff geologists are currently involved in ongoing interpretation and evaluation of data. This report was compiled by the Coal Division staff in November, 1982, to summarize and present the most current results available at that time.

1.0 SUMMARY

Gulf Canada Resources Inc. holds 276 crown coal licences (80 681 hectares) known as the Goodrich Coal Property. The property is located in the Inner Foothills of Northeastern British Columbia, some sixty road kilometres west of Chetwynd, B.C.

The Goodrich Property covers sedimentary strata ranging from Upper Jurassic to Lower Cretaceous in age. Structurally it consists of folded and faulted strata trending in a northwesterly direction.

The total in-situ coal resources for the Goodrich Property have been estimated to be 2.35 billion tonnes. To date one potential mine area has been defined which contains 298 million tonnes of in-situ coal.

In addition to the mine area, seven potential open pit prospect areas have been identified on the Goodrich Property. These prospect areas contain approximately eighty percent of the total in-situ resources estimated for the entire property. The prospect areas and estimated coal resources are briefly summarized as follows:

Prospects Identified	In-Situ Coal Resources (million tonnes)	In-Situ Coal Resources with Overburden to Coal Ratios less than 10:1 (million tonnes)
Goodrich South Cirque Prospect	578	182
Goodrich South Table Prospect	198	50 - 60
Hasler Creek Prospect	271	76
Beaudette Syncline and Possible Extension	3	1 - 3
Goodrich Central Prospect North and South Area	256	33 - 40
Moberly Prospect Syncline and Monocline	619	270
Total	1925	612 - 631

As a result of the past three years of intensive exploration programs conducted by Gulf Canada Resources on the Goodrich Property it is apparent that the property may have the potential to contain one of the largest coal resources within the Peace River Coalfield.

During the 1982 field coal exploration program, GCRI obtained five bulk samples of the Gething No. 1 Seam within the Lossan Mine Area. This seam contains approximately 112 million tonnes of the 298 million tonnes of in-situ coal estimated for the mine area.

The bulk samples have been washed and analyzed in detail and the results have been compared with the predicted coal quality of the No. 1 Seam which are:

Thermal Coal Product
(air-dried basis)

Total Moisture	8.0 %
Residual Moisture	1.0 %
Ash	14.0 %
Volatiles	26.0 %
Fixed Carbon	59.0 %
Sulphur	0.3 %
F.S.I.	1 - 2-1/2
Fuel Ratio	2.3
Calorific Value (Cal/g)	7100
Ash Fusion Temperature S.T.	1350°F
F.T.	+1450°F
Nitrogen	1.28%
Na_2O in Ash	0.91%
Cl in Coal	0.03%
Base/Acid Ratio in Ash	0.27
Hardgrove Index	64
Volatiles (dmmf)	30.0 %

The bulk sample analysis has confirmed preliminary indications that the No. 1 Seam consists of two distinct types of coal, the upper portion containing a medium to high volatile bituminous coal with the following specifications:

Upper Portion of Seam
(including rejects from Lower Portion)
(air-dried basis)

Total Moisture	6.0 %
PROXIMATE ANALYSIS	
Residual Moisture	0.6 %
Ash	12.7 %
Volatiles	23.3 %
Fixed Carbon	63.4 %
Sulphur	0.30%
F.S.I.	1
Calorific Value (Cal/g)	7286
Cl in Coal	0.04%
Hardgrove Index	60
Fuel Ratio	2.72
Volatiles (dmmf)	25.92%

and the lower portion of the seam containing a high volatile bituminous coal with the following specifications:

Lower Portion of Seam
(air-dried basis)

PROXIMATE ANALYSIS	
Residual Moisture	0.9 %
Ash	6.3 %
Volatiles	29.1 %
Fixed Carbon	63.7 %
Sulphur	0.32%
F.S.I.	7
Calorific Value (Cal/g)	7954
Hardgrove Index	69
Volatiles (dmmf)	30.9 %

2.0 RECOMMENDATIONS

Based on the 1982 exploration program it is recommended that:

1) Gulf relinquish 33 crown coal licences, totalling 9684 hectares. These licences are listed in Table 2.0.1 and their location shown in Figure 2.0.1. The licences to be surrendered cover non-coal-bearing strata of the Monach, Beattie Peaks, and Monteith Formations.

   Currently the Whiterabbit Block is being assessed and a decision to retain or relinquish these licences will be made in the early part of 1983.

2) Exploration be continued within the Lossan Mine Area to enable development of these coal reserves at the earliest possible time. Additional mapping, drilling and bulk sampling is required to bring the geological level of confidence of the reserves to a proven category.

3) Concentration of future exploration activities be centred on the following Gething and Brenot prospects in order that these areas may be incorporated in the next stage of the preliminary feasibility study.

   a) Moberly Syncline
   b) Moberly Monocline
   c) Hasler Creek Prospect

d) Goodrich South Table Prospect

e) Goodrich Central Prospect

f) Beaudette Syncline and possible extension

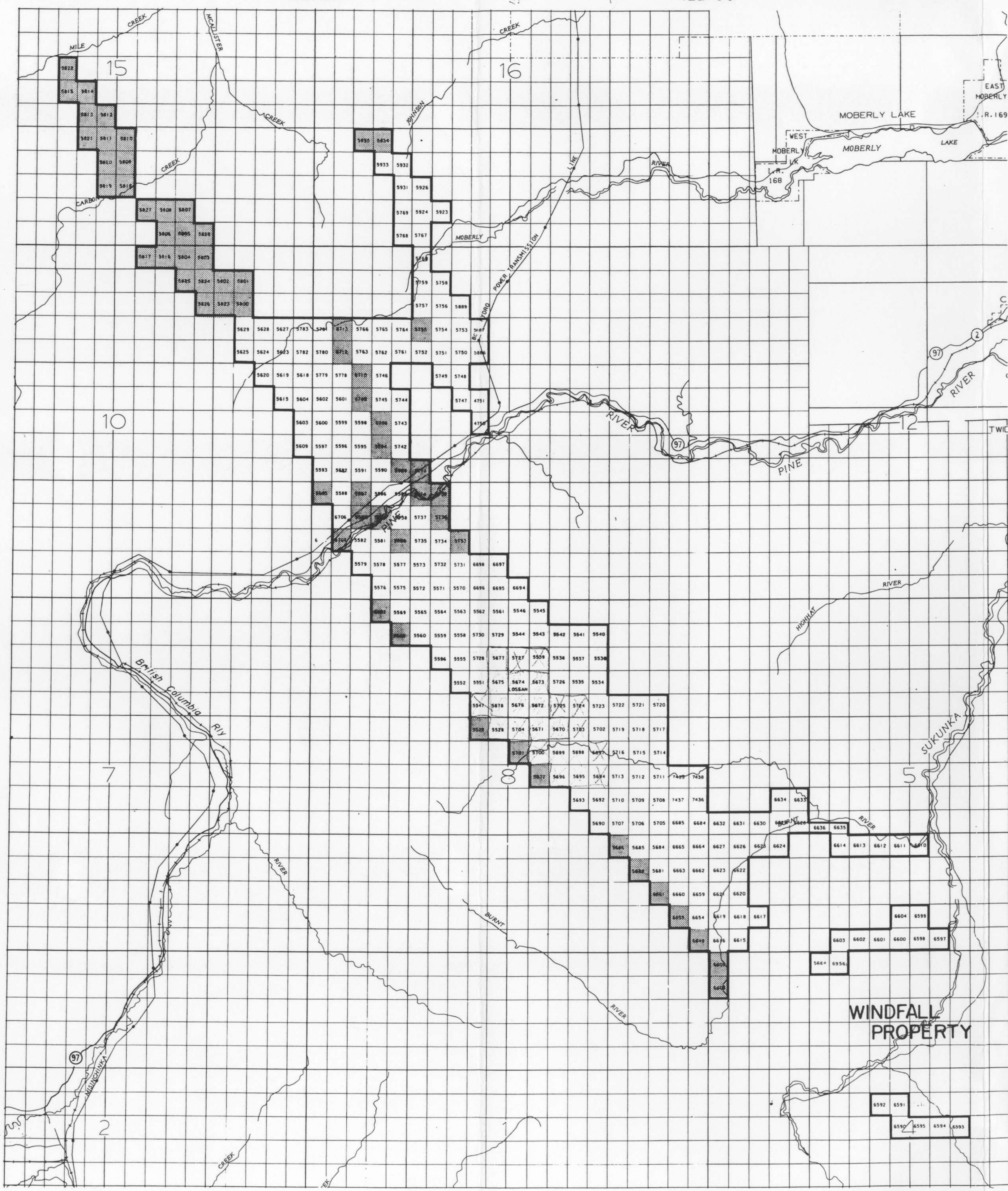
g) Goodrich South Cirque Prospect

4) Exploration be continued over the Goodrich Property, particularly within the largely unexplored areas of coal-bearing Brenot Formation strata, in order to evaluate its potential for mining prospects.

TABLE 2.0.1

Goodrich Coal Property
Summary of Coal Licences Surrendered - 1982

Licence No.	Hectares	Date of Acquisition
5594	293	Nov. 26, 1979
5589	293	Nov. 26, 1979
5587	293	Nov. 26, 1979
5584	293	Nov. 26, 1979
5583	293	Nov. 26, 1979
5580	293	Nov. 26, 1979
5574	293	Nov. 26, 1979
5568	294	Nov. 26, 1979
5532	295	Nov. 26, 1979
5529	294	Nov. 26, 1979
5605	293	Nov. 26, 1979
5682	295	Nov. 19, 1979
5686	295	Nov. 19, 1979
5755	292	Jan. 25, 1980
5739	293	Nov. 19, 1979
5736	293	Nov. 19, 1979
5733	293	Nov. 19, 1979
5701	294	Nov. 19, 1979
5935	291	Mar. 1, 1980
5934	291	Mar. 1, 1980
6692	294	Sept. 29, 1980
6661	295	Sept. 29, 1980
6655	295	Sept. 29, 1980
6649	295	Sept. 29, 1980
6609	296	Sept. 29, 1980
6608	296	Sept. 29, 1980
6713	292	Sept. 29, 1980
6712	292	Sept. 29, 1980
6711	293	Sept. 29, 1980
6710	293	Sept. 29, 1980
6709	293	Sept. 29, 1980
6708	293	Sept. 29, 1980
6704	293	Sept. 29, 1980
Total 33 Licences	9684 Hectares	



▨ – LICENCES TO BE RELINQUISHED 1982

GULF CANADA RESOURCES INC.
Coal Division
CALGARY — ALBERTA
Gulf

FIGURE 2.0.1
GOODRICH COAL PROPERTY
COAL LICENCE MAP

PREPARED BY: A. BIENIA		SCALE N.T.S.
APPROVED BY:	DATE: OCT./82	DRAWING No.

3.0 INTRODUCTION

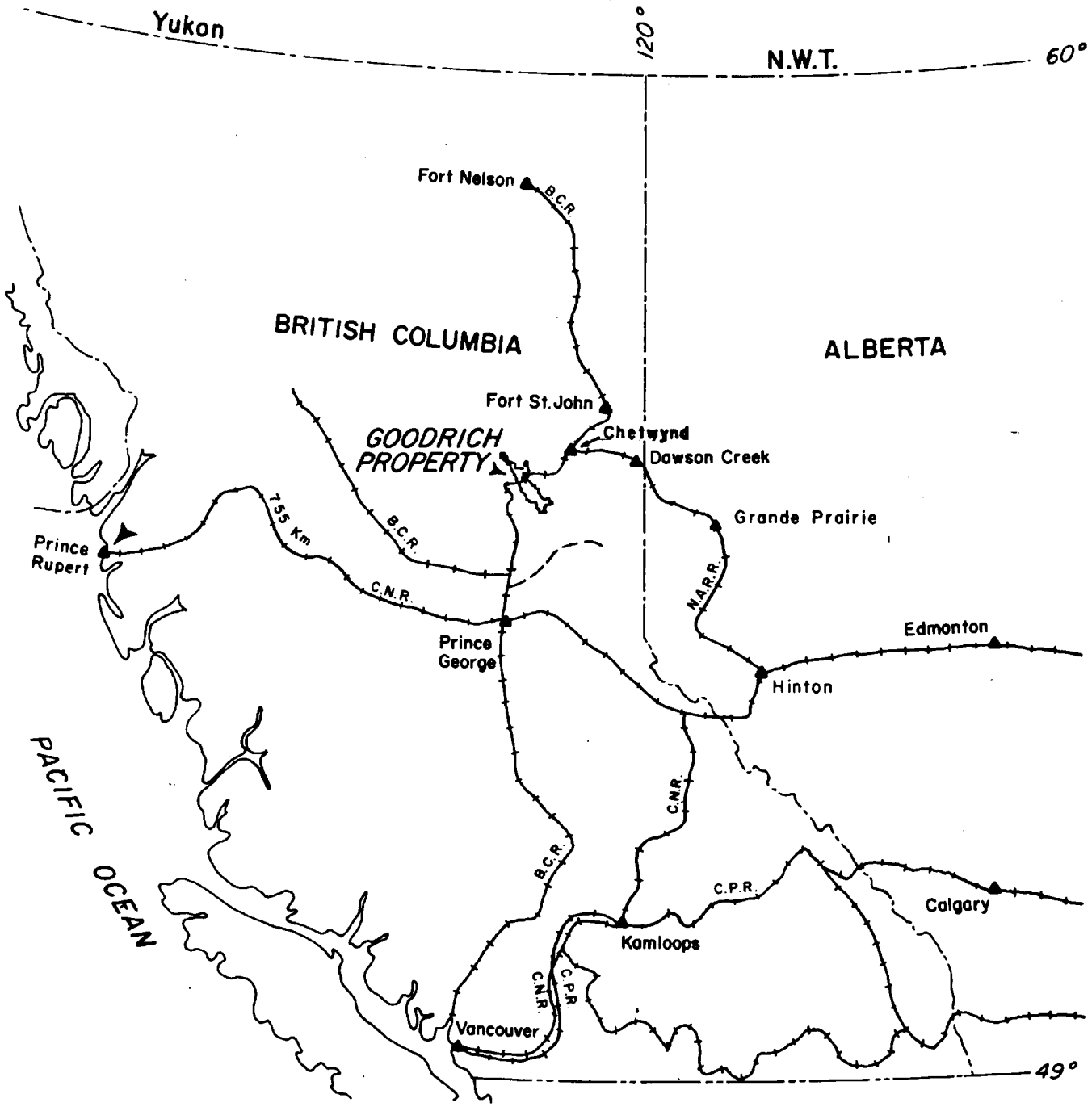
3.1 Summary

The Goodrich Property is located within the Peace River Coalfield in Northeastern British Columbia. The property prior to the most recent surrenders, covered an area of 80 681 hectares consisting of 276 crown coal licences. The property is underlain by coal-bearing strata of Lower Cretaceous age.

Access to the property is afforded by helicopter, forestry roads, seismic lines, and several good to excellent all-weather roads.

Topographically the area contains northwesterly trending ridges and valleys. Within the 800 square kilometres that comprise the Goodrich Property, elevations range from 2100 metres to 680 metres.

Gulf Canada Resources Inc. began exploration during 1979 in the previously unexplored area between the Sukunka River in the south and the Moberly River in the north, and subsequently acquired crown coal licences in this area, collectively known as the Goodrich Coal Property. To date GCRI has completed four field programs and three years of ongoing data compilation and interpretation. During 1980 and 1981, the property was mapped at various scales and several drill targets were identified. A total of 349 coal exposures were trenched and 86 drill holes completed for a total of 23 869 metres of drilling. Sixty-eight of these



LEGEND

Railroad

Anzac Railroad

0 40 80 120 160 200 KMS (APPROXIMATE)

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

FIGURE 3.2.1
GOODRICH COAL PROPERTY
LOCATION MAP

PREPARED BY: A. BIENIA		SCALE
APPROVED BY:	DATE: OCT./82	DRAWING No.

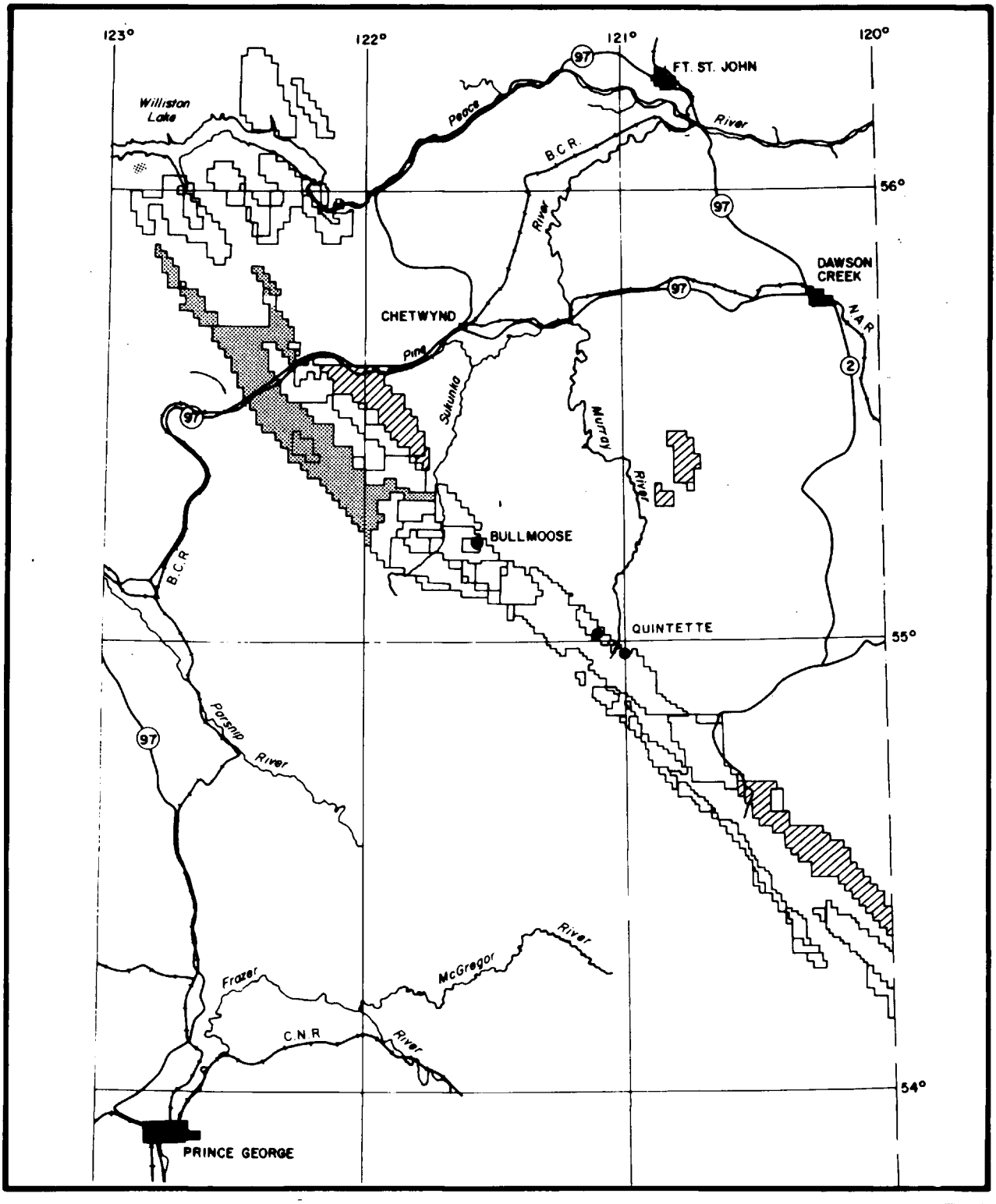
drill holes were located in the prospect area known as the Lossan Prospect. Sufficient data was collected during 1980 and 1981 from the Lossan Prospect area to allow geologists to redefine this prospect as a potential mine area. This area is currently being assessed in a preliminary feasibility study.

3.2 Property Location, Size and Access

Situated approximately 60 road kilometres west of Chetwynd, British Columbia, Gulf's Goodrich Coal Property consists of 276 crown coal licences covering an area of 80 681 hectares. The coal licences lie within the Inner Foothills of the Rocky Mountains in Northeastern B.C. Figure 3.2.1 illustrates the location of the Goodrich Property with respect to the town of Chetwynd. The licences cover northwest trending coal-bearing Lower Cretaceous strata for approximately 90 kilometres of strike length. The property which extends from the Burnt River in the south to Eleven Mile Creek in the north covers approximately 800 square kilometres and is one of the largest in the northeast coalfield. The position of licences held by Gulf with respect to other companies involved in the Peace River Coalfield is shown in Figure 3.2.2.

The John Hart Highway and the British Columbia Railway both of which lie within the Pine River Valley transportation corridor afford access to the Goodrich Property.

The Lossan Mine Area, south of the corridor, is accessed via the gravelled all-weather Hasler Creek Road which begins some 26 kilometres west of Chetwynd near the confluence of Hasler Creek -



GOODRICH

OTHER GULF INTERESTS

PEACE RIVER COALFIELD

● COAL MINES (UNDER CONSTRUCTION)

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

Gulf

FIGURE 3.2.2.
GOODRICH COAL PROPERTY
PEACE RIVER COALFIELD

PREPARED BY: A. BIENIA		SCALE
APPROVED BY:	DATE:	DRAWING No.

with the Pine River. As the road heads southward from the Pine River it parallels Hasler Creek for some 29 kilometres and then turns westwards and follows Brazion Creek onto the Goodrich Property.

Additional four-wheel drive access to small portions of the property is possible by several logging roads.

North of the John Hart Highway, road access is provided by B.C. Hydro transmission power lines and seismic lines.

3.3 Physiography

Physiographically, the Goodrich Property lies within the Rocky Mountain Inner Foothills Belt. Topographically, the area consists of heavily glaciated northwesterly trending ridges and valleys with elevations ranging from 2100 metres at Mt. Stephenson to 680 metres at the Pine River Valley. The average elevation within the Lossan Mine Area is 1100 metres.

The property is drained by portions of the Pine, Moberly, and Sukunka River watersheds.

Vegetation ranges from alpine tundra in the higher elevations to sub-alpine spruce and fir on the uplands adjacent to the river valleys. The river valleys are dominated by large stands of spruce, fir and some birch.

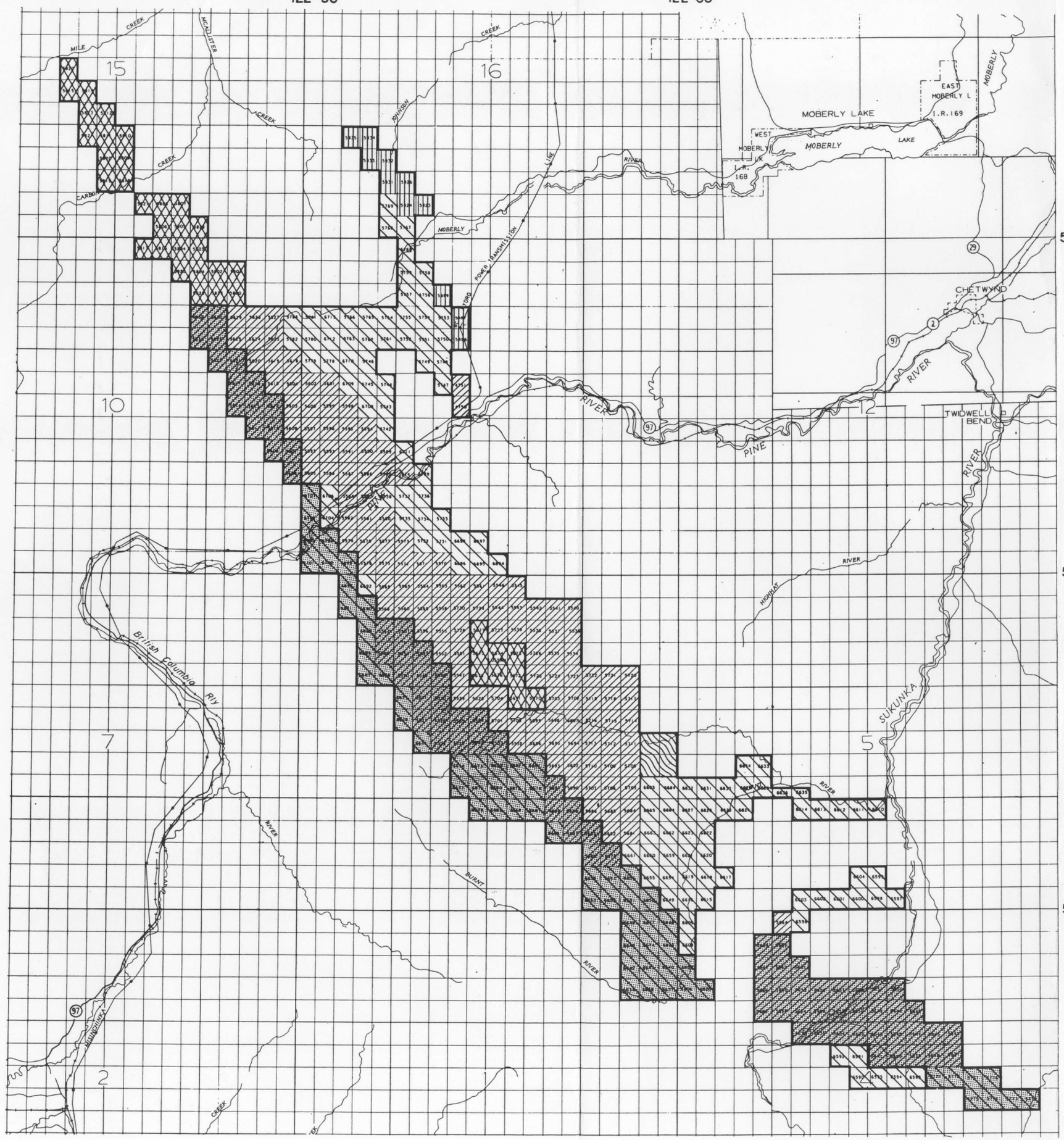
122°30'

122°00'

55°45'

55°30'

55°15'



LEGEND

- 1979 ACQUISITION
- 1980 ACQUISITION
- 1981 ACQUISITION
- 1981 SURRENDER
- OPTION FROM M. SUSKA
- LICENCE TRANSFER FROM TREFI PROPERTY

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

Gulf

FIGURE 3.4.1
GOODRICH COAL PROPERTY
HISTORY OF LICENCE ACQUISITION

PREPARED BY: V. ODEGAARD	SCALE
APPROVED BY: H. ZSCHACH DATE: OCT. 82	DRAWING No.

The exploration work completed during the 1982 field season has resulted in the relinquishing of 33 crown coal licences for a total of 9684 hectares. Licences relinquished contain essentially non-coal-bearing strata of Fernie to Monach Formations.

When surrender of these licences is completed the Goodrich Property will cover 243 coal licences for a total of 70 997 hectares. If a decision is made to relinquish the Whiterabbit Block, this will reduce the size of the property an additional 29 licences for 8458 hectares. This will be decided during the early part of 1983.

3.5 History of Exploration

Upon completion of the acquisition stage of the licences, Gulf Canada Resources Inc. began intensive exploration of the Goodrich Property. Since 1980 GCRI has completed four field programs and three years of ongoing data compilation and interpretation. The objectives of GCRI are briefly listed below:

1) To explore the property in order to distinguish the coal-bearing formations from the non-coal-bearing formations.

2) To consolidate the land position to cover only areas containing potentially economic coal deposits.

3) To continue to evaluate the already identified potentially mineable prospect areas as quickly as time will allow.

4) To bring one or more of these potentially mineable areas to the feasibility stage as quickly as possible in order to ensure Gulf's active involvement in the coal industry.

5) To identify specific areas other than those currently known, which contain potentially mineable coal within the property.

Work on the property is continuing each year to consolidate the land position and to identify specific areas of the property

that contain potential for open pit mining. In order to accomplish these objectives four field programs have been completed and these are described briefly below:

Two field programs were completed in 1980: a summer mapping and drilling exploration program which was followed by a fall and winter drilling program.

During the summer exploration program, Gulf completed a 1:50 000 scale reconnaissance mapping program of the entire property. Portions of the property were mapped on 1:10 000 scale maps and 1:50 000 scale airphotos. The property was flown during late summer and a new set of airphotos produced at a scale of 1:30 000 as government airphotos of the area were outdated.

As a result of the summer's exploration program and the exposure of 197 trenches which were logged in detail, several drill targets were located.

The fall and winter program was undertaken to test some of these targets, the primary one being the Lossan Prospect.

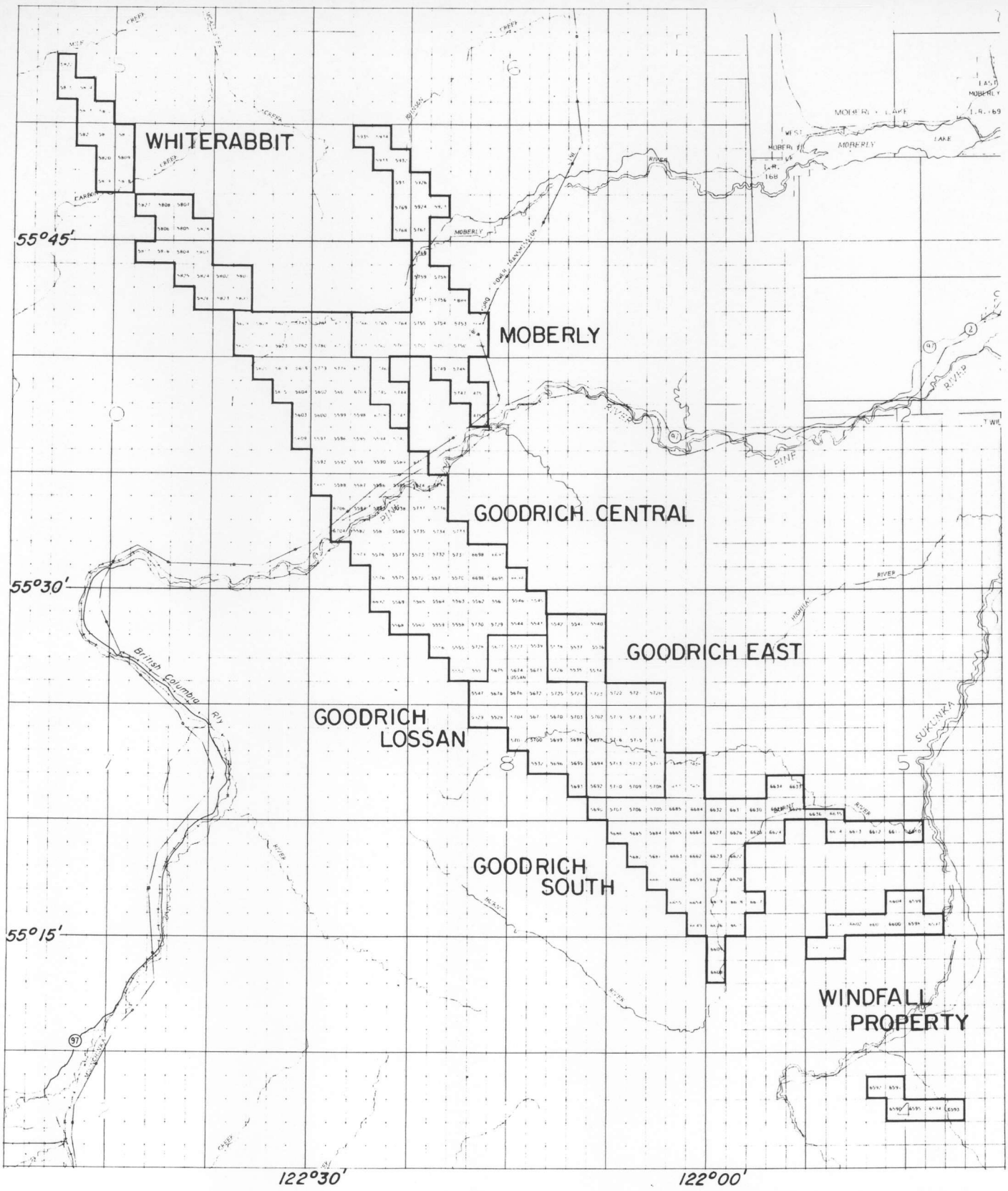
During the fall and winter of 1980, GCRI completed 6138 metres of drilling in 26 rotary holes, and 8098 metres in 28 diamond drill holes for a total of 14 236 metres of drilling. All drill holes were geophysically logged and their elevations and locations surveyed. Coal core samples were taken and coal quality analyses of raw and clean coal samples were completed. In

addition, 3.1 km of electrical (resistivity and gravity) surveys were run to determine the feasibility of alternate subsurface investigation techniques. These techniques were not found to be satisfactory for the structures within the Goodrich Property.

During the 1981 field season, work was concentrated on the Lossan Prospect as a result of the encouraging results of the previous years exploration program. In order to facilitate the drilling program, 4.1 km of new road were built. This road is now referred to as the Lossan Road. Thirty-two drill holes were completed for a total of 9633 metres. Sixty-eight holes were drilled in the Lossan area during the 1980 and 1981 field seasons. This density of drilling allowed the Lossan Prospect to reach a level of geological confidence such that a preliminary feasibility study was initiated in 1982 and is now in progress.

In addition to advancing the Lossan Mine Area to a preliminary feasibility stage, reconnaissance mapping was carried out over the Whiterabbit and Moberly Blocks (see Figure 3.5.1) at 1:25 000 scale and the Goodrich South Block at a scale of 1:50 000 and 1:10 000. The remaining blocks were mapped at a scale of 1:5000. A total of 152 hand trenches were dug, measured and logged.

As a result of these activities, two additional drilling targets were selected and subsequently tested. These were:



GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

Gulf

FIGURE 3.5.1
GOODRICH COAL PROPERTY
GEOLOGICAL MAPPING BLOCKS

PREPARED BY: A BIENIA		SCALE
APPROVED BY:	DATE: NOV. '82	DRAWING No.

1) The Beaudette Syncline.

2) A Gething target within the Goodrich Central Block.

In addition, one new reconnaissance high resolution seismic survey was run (Mini-Sosie). The results of this survey also proved to be inconclusive.

The exploration activities described here are briefly summarized in Table 3.5.1.

TABLE 3.5.1

Summary of Exploration Activities

1980 - 1981

Description of Work	1980	1981
Diamond Drill Holes	28 (8098 m)	22 (7054 m)
Rotary Drill Holes	26 (6138 m)	10 (2579 m)
Mapping	1:10 000, 1:50 000	1:5000, 1:10 000 1:25 000, 1:50 000
Trenching	197 Trenches	152 Trenches
Coal Analyses	420 individual samples 19 composite samples	195 individual samples 44 composite samples
Seismic Surveys	Gravity Survey (1560 m) Electromagnetic Survey (1600 m)	Mini-Sosie Survey (8500 m)
Road Construction	-	4.1 km
Geophysical Logs	Gamma Ray-Neutron, Density, Focus-Beam-Electric, Deviation, Caliper	

4.0 1982 EXPLORATION PROGRAM

4.1 Summary

The objectives of the 1982 exploration program were twofold. The first objective was to evaluate the coal occurrences and prospect potential of specific areas and mapping blocks. This was accomplished during the 1982 field program. In addition to this mapping, 152 additional coal exposures were located and trenched, bringing the total coal exposures trenched on the property to 501.

The second objective of the 1982 field program was to obtain a bulk sample of coal from the main seam (Gething No. 1) in the Lossan Mine Area to further test and evaluate the coal quality of the mine area.

One adit was driven into the No. 1 Seam in the mine area during the 1982 exploration program. Three separate unoxidized bulk samples were removed from the adit, and were washed and analyzed at Birtley Coal and Minerals Testing Laboratories in Calgary.

4.2 Objectives

As a result of the 1980 and 1981 exploration programs it became apparent that the Goodrich coal property may have the potential to contain the largest in-situ coal resource of any property within the Peace River Coalfield.

At the close of the 1981 field season, one potential mine area, named the Lossan Mine Area, was defined and two additional areas were identified on the property that warranted further investigation.

The objectives defined for the 1982 program are summarized briefly below:

1) To evaluate the Whiterabbit Block.

2) To evaluate the coal-bearing Brenot Formation south of the Pine River Valley.

3) To further investigate the coal occurrences and prospect potential of the Moberly and Goodrich Central Blocks.

4) To further investigate the coal quality of the Lossan Mine Area by obtaining a bulk sample of coal from the Gething No. 1 Seam (main seam).

5) Time permitting, to evaluate the coal-bearing potential of the northeast edge of the Moberly Block and the eastern coal licences in the Goodrich East and South Blocks.

6) To complete a preliminary feasibility study of the Lossan Mine Area.

4.3 Field Camp and Logistics

The 1982 geological field party consisted of four two-person mapping crews. Lodging and field offices were maintained in the Windrem Place Apartments in Chetwynd, B.C. Meals were obtained from several restaurants in Chetwynd.

Radio communications were maintained with all field crews by hand held portable radios and a battery operated repeater station located on Mt. LeHudette.

Transportation of field crews to the mapping areas was primarily by helicopter. Northern Mountain Helicopters of Prince George, B.C. supplied one Bell 206. Four-wheel drive vehicles were leased for the duration of the program from West Wheels Leasing of Calgary, Alberta.

The construction of the portal and adit driveage was completed by Target Tunnelling of Calgary.

Supplies and services were obtained locally in Chetwynd, whenever feasible.

A list of geological and support staff is presented in Table 4.3.1. Table 4.3.2 summarizes major contractors and services used during the 1982 program.

TABLE 4.3.1

List of Personnel Employed

Gulf Personnel

G.D. Childs - P.Geol.	Manager Coal Exploration
A.E. Bienia - P.Geol.	Project Supervisor
H.D. Zschach - P.Geol.	Project Geologist
C.S. Williams	Geologist
V.L. Duford	Geologist
M.G. Besso	Geologist
K.L. Acker	Geological Assistant
R.G. Inkster	Geological Assistant
M.J. Millard	Geological Assistant
D.J. Fyvie	Geological Assistant
J.H. Heidema	Geological Assistant
M.J. Milne	Geological Assistant
G.I. Thomson	Geological Assistant
S.M. Wiseman	Geological Assistant
M.A. Dagenais	Geological Assistant
C.R. Goodings	Geological Assistant
S. Gregg	Geological Assistant
S.M. Sparks	Technologist
L.M. Callow	Co-ordinator, Environmental Planning
G.S. Ingram	Systems Analyst
G.G. Erickson	Systems Analyst
C.B. Boyko	Secretary
A. Gill	Secretary
P. Tsavalos	Bookkeeping and Accounting

Consultants and Contract Geologists

W.F. Carpenter	Norwest Resource Consultants Ltd.
J. LaMarre	Norwest Resource Consultants Ltd.
Mr. K. Fujita	Norwest Resource Consultants Ltd.
G. Hellyer	Reclamation Consultant
K. Lee	Patchwork Enterprises

Report Preparation

GCRI	Drafting Department
	Reprographics Department

TABLE 4.3.2

List of Contractors and Services

Accommodations

Holiday Inn	Calgary, Alberta
Palliser Inn	Calgary, Alberta
Windrem Place Apartments	Chetwynd, B.C.
Stagecoach Inn	Chetwynd, B.C.

Aircraft

Northern Mountain Helicopters	Prince George, B.C.

Equipment and Fuel

P. Demuellemeester	Chetwynd, B.C.
Gulf	Chetwynd, B.C.
Texaco	Chetwynd, B.C.
Petro-Canada	Chetwynd, B.C.

Truck Rentals

West Wheels Leasing	Calgary, Alberta

Trucking

Tortor Trucking	Chetwynd, B.C.
J&M Contracting	Chetwynd, B.C.

Adit Driveage

Target Tunnelling Ltd.	Calgary, Alberta

Coal Quality

Loring Laboratories	Calgary, Alberta
Birtley Coal & Minerals Testing	Calgary, Alberta
D.E. Pearson & Associates	Vancouver, B.C.
CANMET	Ottawa, Ontario

Communications

West Can Electronics	Calgary, Alberta
B.C. Telephones	Chetwynd, B.C.

Surveying

McElhanney	Chetwynd, B.C.
R.M. Hardy & Associates	Calgary, Alberta

Miscellaneous

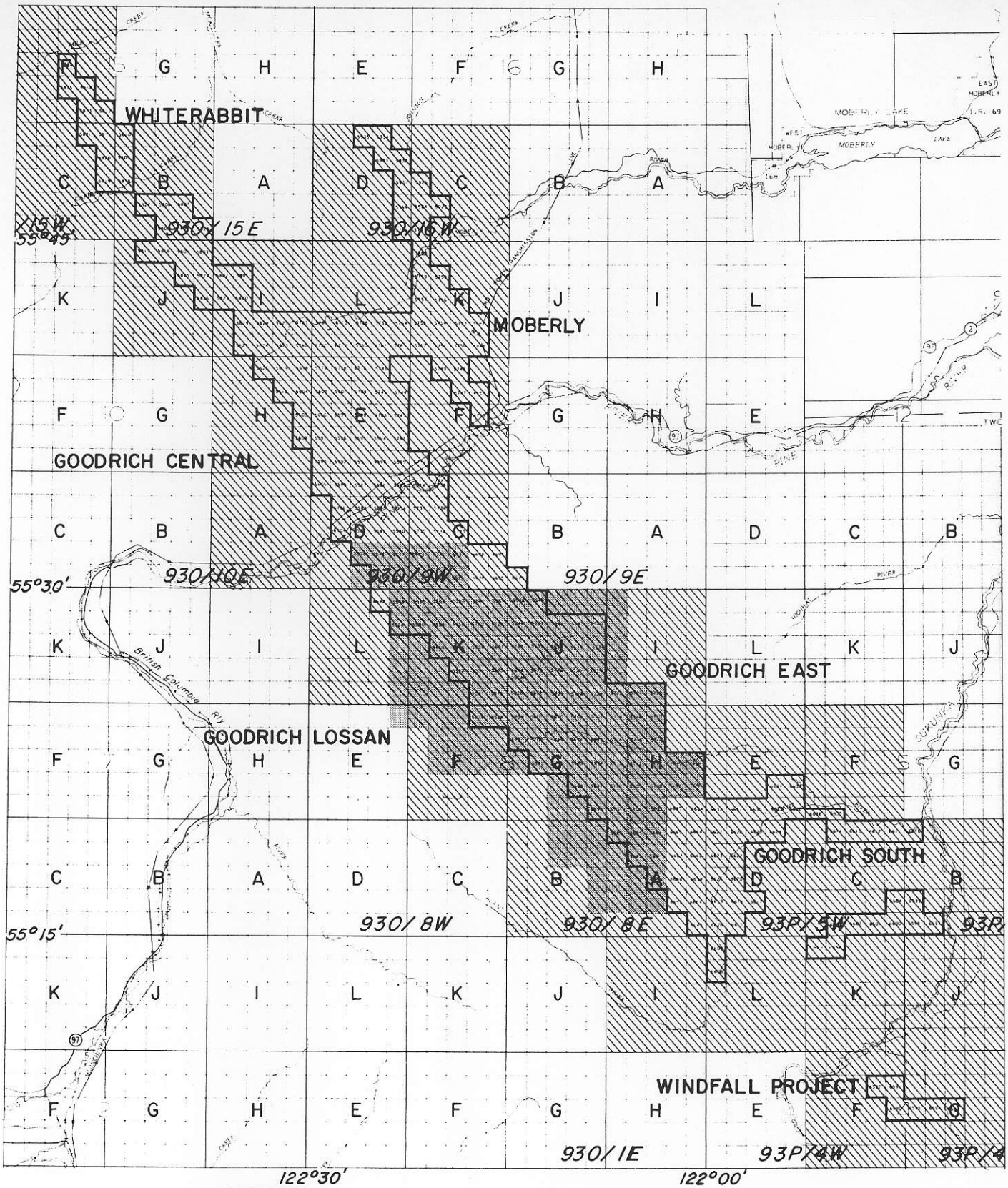
Northland Storage	Chetwynd, B.C.
Economy Bookbindery	Calgary, Alberta
Cad West Graphics	Calgary, Alberta

4.4 Geological Mapping

The 1982 field mapping program was undertaken by summer staff consisting of graduates and undergraduates, and supervised by Gulf's permanent coal geologists.

In order to facilitate mapping of the Goodrich Property, the area was divided into several mapping blocks. The mapping blocks and respective mapping scales are illustrated in Figure 4.4.1. Each field mapping team was assigned several "mapping blocks" at the beginning of the summer exploration program. The mapping blocks and their specific associated mapping targets together with their status at the end of the 1982 season are summarized below.

Block	Subdivision of Mapping Blocks	Status
Whiterabbit		Mapped
Moberly		Mapped
Goodrich Central	North of John Hart Highway	Mapped
	South of John Hart Highway	Incomplete
Goodrich East	Beaudette Syncline	Mapped
	Beaudette Syncline Extension	Incomplete
Goodrich South	Table Area	Mapped
	South Cirque	Mapped
	North Cirque	Mapped
Lossan		Mapped



LEGEND

Area covered by 1 : 5000 maps

Area covered by 1 : 10000 maps

All areas covered by 1 : 50000 maps

scale in miles

0 5 10

0 8 16

scale in kilometres

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

FIGURE 4.4.1
GOODRICH COAL PROPERTY
TOPOGRAPHIC MAP COVERAGE

PREPARED BY: A. BIENIA	SCALE
APPROVED BY:	DATE: OCT./82 DRAWING No.

Of the ten areas listed above, eight have been mapped in detail. The mapping of the Goodrich Central Block (south of the John Hart Highway) and Goodrich East (Beaudette Syncline extension) is incomplete and will require additional work during the 1983 field season.

As in previous years, field data was collected at various map scales depending on available map coverage. The Goodrich South Table area was mapped on a reconnaissance basis at a scale of 1:50 000. The Goodrich South Cirque, Whiterabbit and Goodrich Central (north of highway) Blocks were mapped at a scale of 1:10 000. The Moberly Block was mapped at 1:25 000. All remaining areas were mapped in detail at a scale of 1:5000.

The resulting geological interpretations of all mapping areas have been presented on cross sections at their respective scales. Subsequently the geology has been compiled on a 1:50 000 topographic base map.

4.5 Trenching

Hand trenching was undertaken by geological mapping teams during routine traverses as coal exposures were discovered. Overall, 152 trenches were dug and logged during the 1982 exploration program: 50 in the Goodrich South Block, 33 in Goodrich East, 33 in Whiterabbit, 18 in Moberly, 12 in Goodrich Central, and 6 in Lossan. These supplement the 349 trenches dug during the two previous exploration seasons and bring the total of trenches dug on the Goodrich Coal Property to 501.

The dimensions of the trenches dug during 1982 averaged 2.00 metres in length, 0.40 m in depth, and 0.50 m in width. All Goodrich trench locations have been plotted on a 1:50 000 Trench Location Map, which can be found in Appendix C. The 1982 trench data, including trench logs and data source records, can also be found in the same Appendix. Table 4.5.1 summarizes the 1982 trench coal/coal plus rock ratios and licences on which the trenches are located. Some coal exposures were not excavated but were simply the result of natural erosion. These natural coal exposures were logged as trenches but may not lie within Gulf's property boundary.

In accordance with the Coal Mines Regulations Act, all trenches were hand dug wherever possible at right angles to the slope; overburden and topsoil were stockpiled separately and later backfilled.

TABLE 4.5.1
1982 Trench Summary

Trench	Coal/Coal Plus Rock (True Thickness-metres)	Licence*
GC-TRC-82001	0.60/0.60	5592
GC-TRC-82002	1.50/1.83	5604
GC-TRC-82003	0.65/0.65	5602
GC-TRC-82004	1.09/1.19	5609
GC-TRC-82005	2.35/3.00	5609
GC-TRC-82006	0.25/0.25	5609
GC-TRC-82007	0.40/0.40	5609
GC-TRC-82008	0.80/0.80	5597
GC-TRC-82009	0.50/0.50	5597
GC-TRC-82010	0.38/0.38	5597
GC-TRC-82011	0.70/0.70	5597
GC-TRC-82012	2.65/2.65	5597
GE-TRC-82001	4.96/4.96	5702
GE-TRC-82002	2.07/2.07	5540
GE-TRC-82003	0.27/0.27	5702
GE-TRC-82004	3.07/3.07	5702
GE-TRC-82005	0.82/0.82	5702
GE-TRC-82006	0.71/0.71	5702
GE-TRC-82007	0.59/0.70	5721
GE-TRC-82008	0.64/0.97	5721
GE-TRC-82009	0.94/1.47	5721
GE-TRC-82010	0.67/0.74	5721
GE-TRC-82011	0.32/0.32	5702
GE-TRC-82012	0.23/0.23	5702
GE-TRC-82013	0.55/0.55	5702
GE-TRC-82014	0.44/0.44	5702
GE-TRC-82015	0.45/0.45	5724
GE-TRC-82016	0.12/0.12	5724
GE-TRC-82017	0.22/0.22	5724
GE-TRC-82018	0.30/0.30	5714
GE-TRC-82019	0.24/0.24	5721

1982 Trench Summary (con't)

Trench	Coal/Coal Plus Rock (True Thickness-metres)	Licence*
GE-TRC-82020	0.62/0.62	5721
GE-TRC-82021	0.32/0.32	5719
GE-TRC-82022	0.23/0.23	5715
GE-TRC-82023	0.98/1.07	5711
GE-TRC-82024	0.73/0.73	5721
GE-TRC-82025	1.51/2.61	5721
GE-TRC-82026	0.44/0.44	5724
GE-TRC-82027	0.60/0.60	5716
GE-TRC-82028	1.19/1.70	5721
GE-TRC-82029	3.75/5.49	--
GE-TRC-82030	1.59/2.48	5720
GE-TRC-82031	1.15/1.71	5720
GE-TRC-82032	0.42/0.42;0.32/0.32	--
GE-TRC-82033	0.22/0.22	5720
GS-TRC-82001	0.53/0.53	5681
GS-TRC-82002	1.04/1.14	5681
GS-TRC-82003	0.25/0.25	6655
GS-TRC-82004	0.39/0.66	6660
GS-TRC-82005	0.43/0.43	6659
GS-TRC-82006	0.62/0.62	6659
GS-TRC-82007	1.66/1.66	6659
GS-TRC-82008	0.34/0.34	5709
GS-TRC-82009	0.74/1.07	5709
GS-TRC-82010	0.97/1.05	6664
GS-TRC-82011	0.38/0.38	5684
GS-TRC-82012	0.31/0.35	5684
GS-TRC-82013	0.47/0.47	6663
GS-TRC-82014	0.20/0.20	6663
GS-TRC-82015	0.13/0.13	5681
GS-TRC-82016	0.45/0.45	6663
GS-TRC-82017	1.76/1.76	6663
GS-TRC-82018	1.25/1.25	6663
GS-TRC-82019	0.97/0.97	6663
GS-TRC-82020	0.17/0.17	6663

1982 Trench Summary (con't)

Trench	Coal/Coal Plus Rock (True Thickness-metres)	Licence*
GS-TRC-82021	0.98/1.34	6663
GS-TRC-82022	1.15/1.15	6663
GS-TRC-82023	1.78/2.16	6663
GS-TRC-82024	0.10/0.10	5684
GS-TRC-82025	0.51/0.67;...; 0.71/1.00;...	5684
GS-TRC-82026	0.17/0.17	5681
GS-TRC-82027	0.65/0.65	5685
GS-TRC-82028	0.45/0.45	5685
GS-TRC-82029	0.63/0.63	5685
GS-TRC-82030	0.48/0.48	5685
GS-TRC-82031	0.62/0.62	5685
GS-TRC-82032	1.33/1.33	5685
GS-TRC-82033	1.24/1.24	5685
GS-TRC-82034	1.34/1.48	5685
GS-TRC-82035	0.36/0.46	--
GS-TRC-82036	0.73/0.77	6663
GS-TRC-82037	0.54/0.92	--
GS-TRC-82038	0.36/0.39	--
GS-TRC-82039	0.91/0.91	--
GS-TRC-82040	0.90/0.90	--
GS-TRC-82041	7.37/10.74	--
GS-TRC-82042	1.14/1.14	--
GS-TRC-82043	0.28/0.28	7438
GS-TRC-82044	0.32/0.32;0.43/0.60	--
GS-TRC-82045	0.38/0.38	--
GS-TRC-82046	0.38/0.38	5707
GS-TRC-82047	0.37/0.46	6627
GS-TRC-82048	0.30/0.30;0.65/1.10	--
GS-TRC-82049	1.25/1.45	--
GS-TRC-82050	0.42/0.42	6611
LN-TRC-82001	0.55/0.94	5695
LN-TRC-82002	1.27/2.02	5670
LN-TRC-82003	0.96/0.96	5671
LN-TRC-82004	2.90/3.87	5678
LN-TRC-82005	0.50/0.50	5678
LN-TRC-82006	2.10/2.10	5678

1982 Trench Summary (con't)

Trench	Coal/Coal Plus Rock (True Thickness-metres)	Licence*
MB-TRC-82001	1.15/1.15	5758
MB-TRC-82002	0.76/0.76	--
MB-TRC-82003	0.65/0.73	5746
MB-TRC-82004	1.10/1.10	5746
MB-TRC-82005	0.21/0.21	--
MB-TRC-82006	1.08/1.28	--
MB-TRC-82007	0.79/0.81	5762
MB-TRC-82008	0.51/0.55	5762
MB-TRC-82009	0.26/0.26/0.18/0.18	5762
MB-TRC-82010	1.33/2.18	5762
MB-TRC-82011	1.27/1.27	5762
MB-TRC-82012	0.35/0.35	5764
MB-TRC-82013	0.24/0.24	5769
MB-TRC-82014	2.07/2.89	5768
MB-TRC-82015	5.81/6.26	--
MB-TRC-82016	2.38/2.91	5759
MB-TRC-82017	1.82/1.90	5759
MB-TRC-82018	2.45/2.45	5764
WR-TRC-82001	0.75/0.75	--
WR-TRC-82002	0.40/0.40	5804
WR-TRC-82003	1.00/1.00	5807
WR-TRC-82004	0.49/0.49	5808
WR-TRC-82005	0.69/0.69	5808
WR-TRC-82006	0.42/0.42	5811
WR-TRC-82007	1.68/2.29	5811
WR-TRC-82008	0.43/0.43	5811
WR-TRC-82009	1.31/1.53	5811
WR-TRC-82010	0.56/0.56	5811
WR-TRC-82011	0.42.0.42	5811
WR-TRC-82012	0.46/0.46	5811
WR-TRC-82013	0.46/0.66	5811
WR-TRC-82014	0.94/0.94	5811
WR-TRC-82015	0.64/0.64	5811
WR-TRC-82016	1.03/1.10	5811
WR-TRC-82017	0.50/0.50	5811

1982 Trench Summary (con't)

Trench	Coal/Coal Plus Rock (True Thickness-metres)	Licence*
WR-TRC-82018	0.67/0.67	5811 x
WR-TRC-82019	0.53/0.53	5811 x
WR-TRC-82020	0.54/0.54	5811 y
WR-TRC-82021	2.11/2.38	—
WR-TRC-82022	0.80/0.80	--
WR-TRC-82023	0.80/0.80	—
WR-TRC-82024	0.92/0.92	5818 x
WR-TRC-82025	0.49/0.49	—
WR-TRC-82026	0.77/0.77	--
WR-TRC-82027	0.57/0.57	5816 y
WR-TRC-82028	0.93/0.93	5806 x
WR-TRC-82029	1.05/1.05	5806 x
WR-TRC-82030	0.83/1.00	5806 y
WR-TRC-82031	0.75/0.75	5806 x
WR-TRC-82032	1.32/1.61	5817 x
WR-TRC-82033	0.76/0.76	5827 x

*where no licence is recorded, the trench describes a naturally occurring exposure located off the Goodrich coal licences.

4.6 Bulk Sampling Program

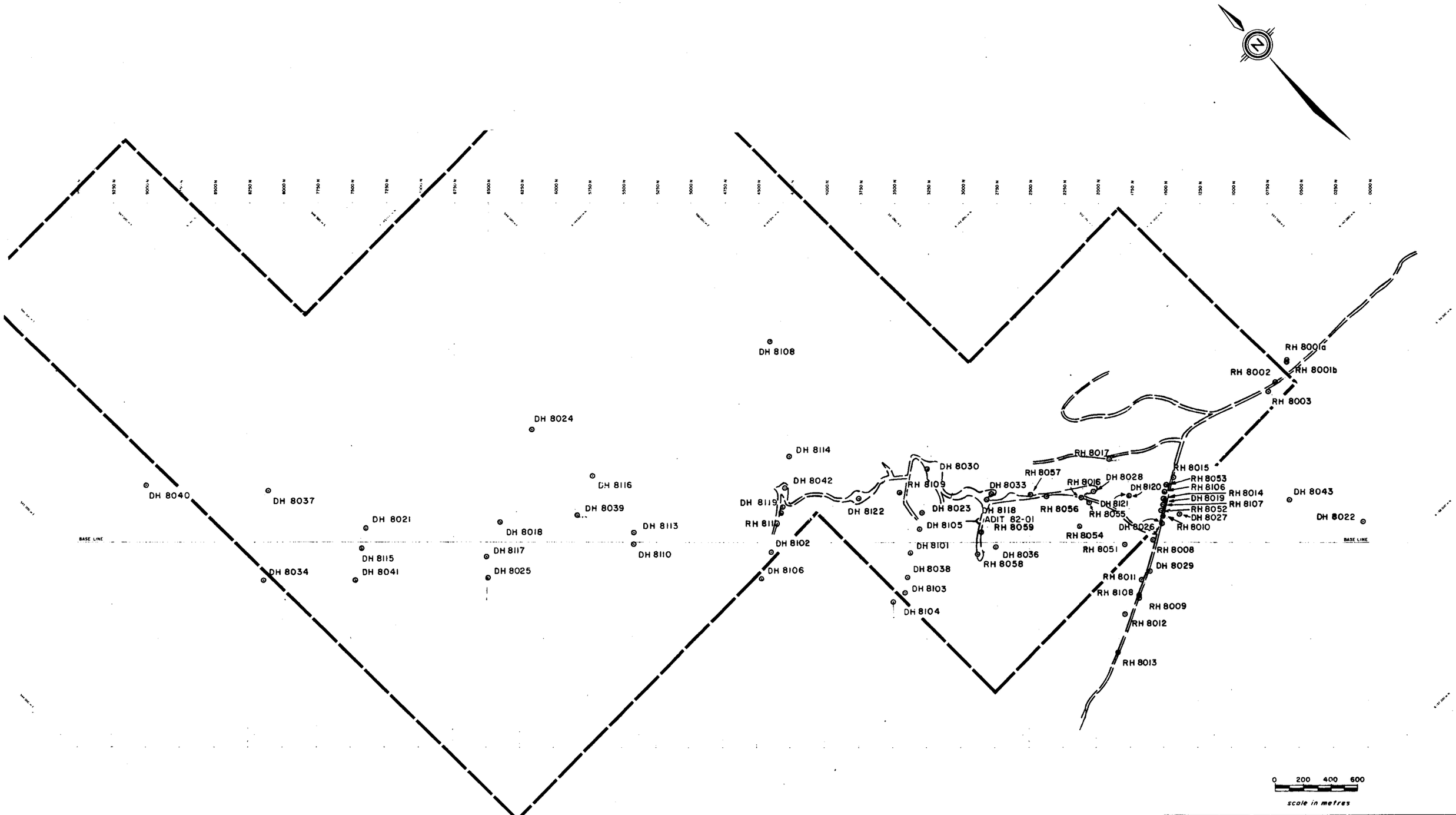
The adit driveage and bulk sampling program was undertaken during the months of July and August and was supervised by GCRI Coal Division personnel and W.F. Carpenter of Norwest Resource Consultants Ltd.

Target Tunnelling Ltd. of Calgary, Alberta was contracted to drive one adit, designated ADT-82-1, into the Gething No. 1 Seam in the west dipping limb of the Lossan Syncline in the Lossan Mine Area.

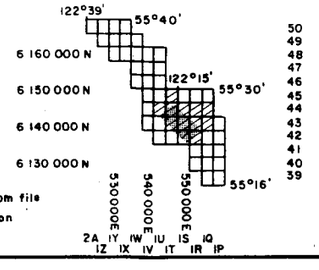
The adit site is located approximately 90 metres east of drill hole RDH-80-59 and adjacent to trench LB-81-13 (see Figure 4.6.1). The adit location is easily accessible via the Hasler Creek and Lossan roads. The survey coordinates and elevation for the portal are given below.

ADT-82-1	Location	Elevation
	Lat. 55° 24' 31"	
	Long. 122° 12' 43"	1124.54 m AMSL
	UTM 6, 140, 341.23 mN	
	549, 892.08 mE	

Site construction for the adit commenced on June 28, 1982 and was completed on July 19, 1982. Prior to pre-stripping and



INDEX MAP



LEGEND

- ADIT
- DDH - DIAMOND DRILL HOLE
- RDH - ROTARY DRILL HOLE
- ROAD
- LOSSAN BLOCK BOUNDARY

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FIGURE 4.6.1
GOODRICH COAL PROPERTY
ADIT LOCATION

PREPARED BY:	SCALE
APPROVED BY: DATE:	DRAWING No.

stockpiling of all organic material, surrounding trees were removed and all logs were stripped of branches and piled on the ground. The coal seam was excavated to a depth of 5.0 metres. A site diagram, Figure 4.6.2, illustrates the adit site layout. Drainage ditches to collect both surface water and ground water were constructed. Small settling ponds along the drainage route were constructed to collect any solid material to prevent contamination of the surrounding area and to facilitate reclamation.

During the period of July 19 to July 20, 1982, 67.7 metres of auger drilling was undertaken. This portion of the program consisted of augering two .305 metres diameter holes into the exposed seam. The auger holes were drilled to test seam continuity. Coal samples were obtained for every 1.5 metre increment to provide a preliminary indication of the depth of oxidization.

Construction of the portal began on July 22, 1982 with adit driveage commencing immediately upon completion of the portal. The bulk sampling program consisted of driving the adit for a total length of 54.3 metres into the Gething No. 1 Seam. The adit dimensions were approximately 2.0 metres x 1.5 metres. The adit was driven at an overall decline of 6 degrees. Several cross-cuts were made to expose the entire seam which had a thickness of 6.99 metres. Channel samples were obtained at 1.5 metre intervals along the adit length in order to determine the unoxidized bulk sampling point (see Figure 4.6.3). Details of the sampling

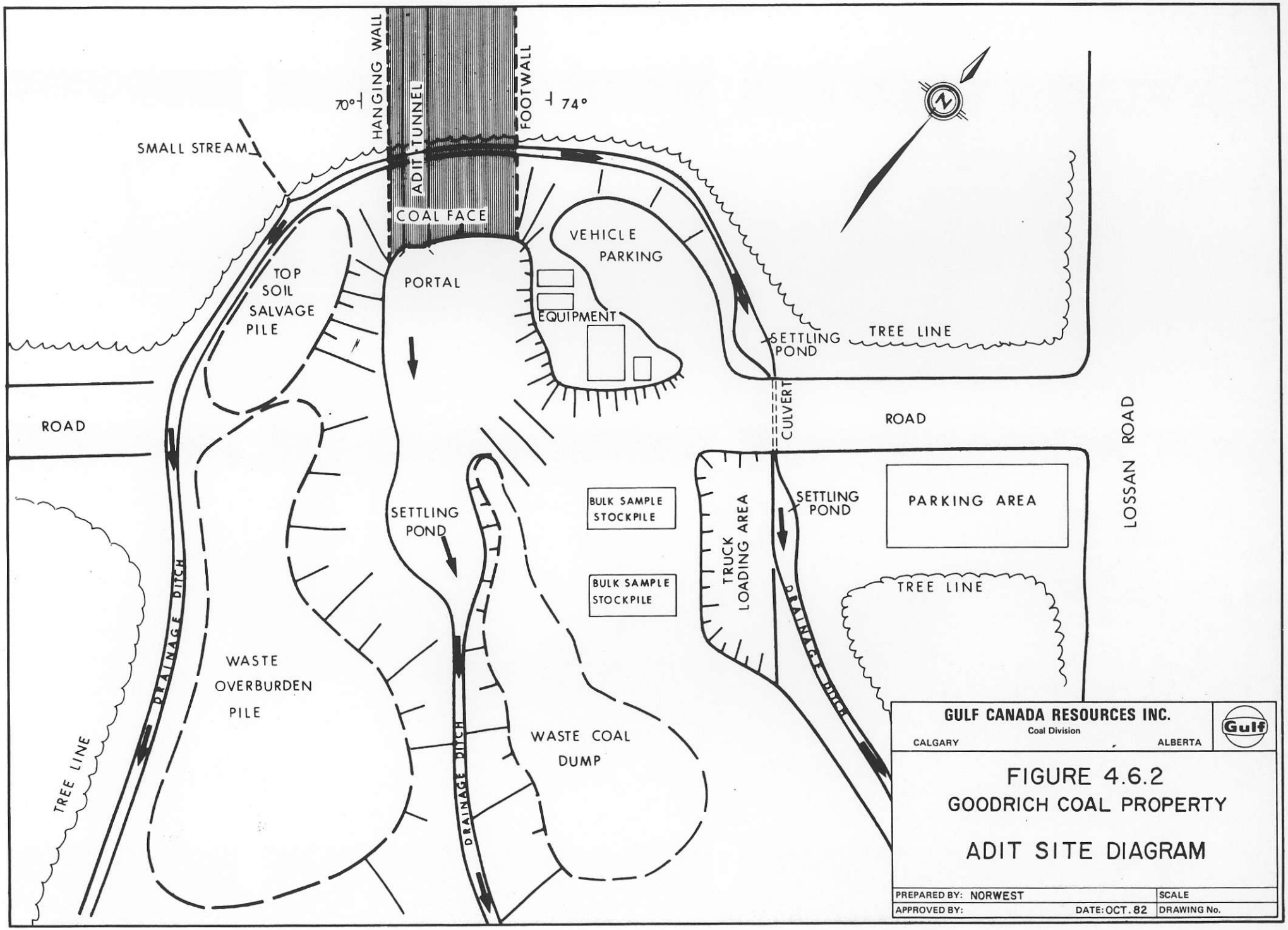
HANGING WALL
FOOTWALL
70°
74°
ADIT TUNNEL
COAL FACE
SMALL STREAM
TOP SOIL SALVAGE PILE
PORTAL
VEHICLE PARKING
EQUIPMENT
SETTLING POND
TREE LINE
ROAD
CULVERT
ROAD
LOSSAN ROAD
SETTLING POND
BULK SAMPLE STOCKPILE
BULK SAMPLE STOCKPILE
TRUCK LOADING AREA
PARKING AREA
TREE LINE
DRAINAGE DITCH
WASTE OVERBURDEN PILE
DRAINAGE DITCH
WASTE COAL DUMP
TREE LINE
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FIGURE 4.6.2
GOODRICH COAL PROPERTY
ADIT SITE DIAGRAM
PREPARED BY: NORWEST
SCALE
APPROVED BY:
DATE: OCT. 82
DRAWING No.

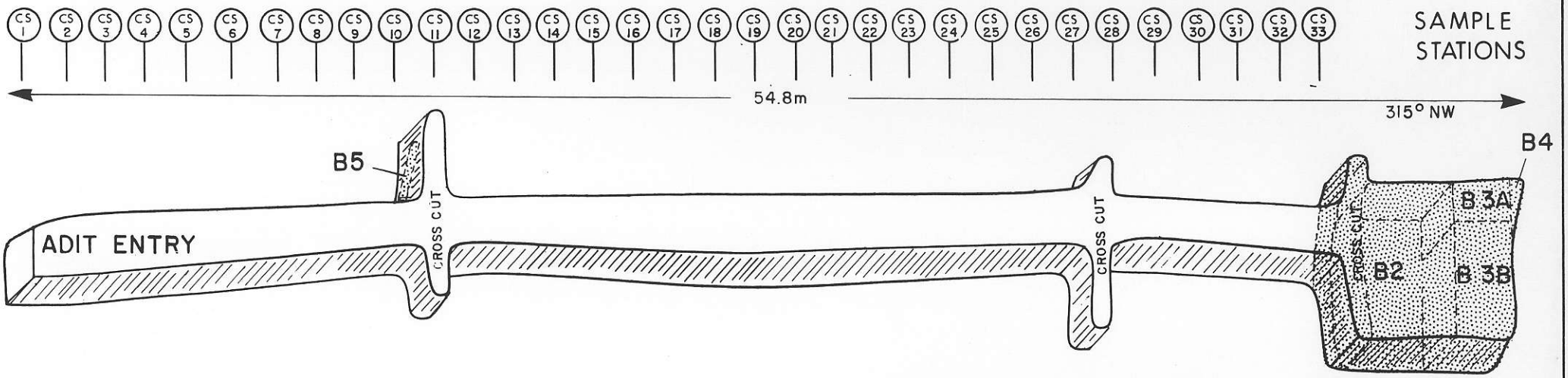

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FIGURE 4.6.3
GOODRICH COAL PROPERTY
ADIT PLAN

PREPARED BY: NORWEST	SCALE
APPROVED BY: DATE: OCT./82	DRAWING No. —

procedures and results of the field tests including schematics of the bulk sampling locations, auger samples, crosscuts and channel samples are documented in Appendix B, Part I of this report.

A total of 84.8 tonnes of unoxidized raw coal was removed from the adit at a point 54.3 metres from the portal. The depth of cover at the sampling point was 14.1 metres.

Several bulk samples were taken each representing a potential mine product. These samples consisted of:

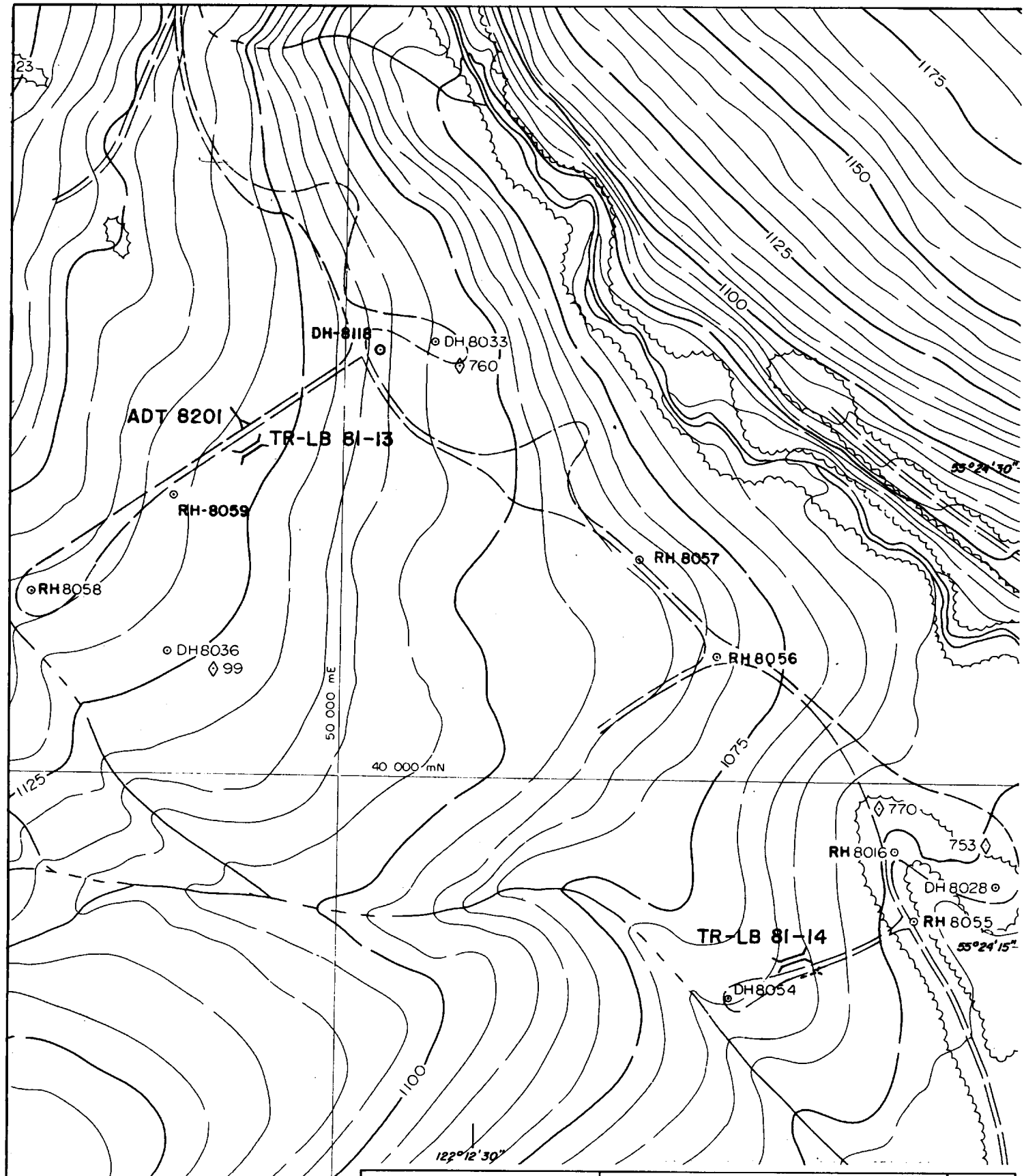
Sample B2 - a 53.5 tonne unoxidized sample representative of the entire seam.

Sample B3A - a 8.3 tonne unoxidized sample representative of the metallurgical (higher FSI) portion of the seam.

Sample B3B - a 23 tonne unoxidized sample of the thermal (lower FSI) portion of the seam.

In addition to these bulk samples obtained from the adit, a 3.0 tonne oxidized sample was taken from the Gething No. 1 Seam at trench location LB-81-14 (see Figure 4.6.4).

All bulk samples were trucked to Birtley Coal and Minerals Testing in Calgary. A representative sub-sample of each bulk sample was sent to Loring Laboratories in Calgary for confirmation of coal quality analysis.



LEGEND

- Adit
- Oxidized Bulk Sample
- Road

0 100 200

scale in metres

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FIGURE 4.6.4
GOODRICH COAL PROPERTY
LOCATION OF OXIDIZED BULK SAMPLE

PREPARED BY: A. BIENIA		SCALE	1:5000
APPROVED BY:	DATE: OCT. 82	DRAWING No.	

Representative bulk samples of clean coal have been sent to the CANMET facilities in Ottawa for coke oven and burn tests. The coal quality results obtained from the bulk and channel samples taken from Adit 82-1 are summarized in Section 7.2 of this report and presented in their entirety in Appendix B, Part I.

4.7 Reclamation

The reclamation program was carried out by G. Hellyer, Reclamation Consultant, and K. Lee of Patchwork Enterprises under the direction of Gulf's Environmental Planning Division. All surface disturbances were reclaimed in accordance with the British Columbia "Guidelines for Coal and Mineral Exploration".

Reclamation during the 1982 field season consisted primarily of coal trench closures and adit site restoration. Approximately 0.15 hectares of land was cleared for the bulk sampling program. No new road was constructed as the adit site was located on an existing access corridor. A detailed reclamation report has been submitted to the various branches of the Ministry of Energy, Mines and Petroleum Resources of British Columbia.

The site construction for the adit location was planned in consultation with the Goodrich Project Geologist, Gulf's Environmental Planning Division, Heavy Equipment Construction Supervisor and Mineral Resources Branch Regional Reclamation Inspector. Attention was paid to separate and individually stockpile the topsoil, underlying overburden and waste coal. A network of drainage channels was created to maintain a well-drained adit site.

Site reclamation was undertaken shortly after adit closure when dry weather permitted. Again, a reclamation plan was discussed, in the field, with all concerned parties.

Emplacement of culverts, separate burial of coal waste, covering of topsoil, recontouring and seeding of the adit site are detailed in a separate reclamation report.

4.8 Other Studies

In addition to the 1982 field program of mapping and bulk sampling, Gulf Canada Resources Inc. has undertaken several additional studies of the Goodrich property. The studies have resulted in the letting of a contract for a preliminary feasibility study, which is currently underway.

The preliminary feasibility study of the Lossan Mine Area is being prepared in order to evaluate:

a) Costs of providing infrastructure such as hydro-electric power, railway and road access to the mine area.

b) Potential annual production rates of product thermal coal and the possibility of production of a metallurgical coal.

c) Design and costs of preparation plants required.

d) Socioeconomic and environmental impact resulting from the construction and operation of the mine.

5.0 GEOLOGY

5.1 Summary

The Goodrich coal licences are situated west of Chetwynd, B.C. and lie within the Rocky Mountain Foothills. The property extends from the Burnt River in the south to Eleven Mile Creek in the north.

Geologically, the area consists of an elongated, northwest trending, tectonic slice of coal-bearing and non-coal-bearing Lower Cretaceous-Jurassic sediments. The property exposes strata of the Fernie Formation and the Beaudette, Crassier, and Fort St. John Groups.

Coal measures are found in the Brenot, Dresser, and Gething Formations of the Crassier Group, as well as in the Commotion Formation of the Fort St. John Group.

Several areas with open pit and underground mining potential have been identified in the Gething Formation. To date the thickest coal seams found have been located in the Upper Gething Formation. Drilling has confirmed the presence of at least six coal seams within the Gething with an aggregate true thickness of 20 metres over a 240 metre interval.

The Brenot Formation, also of the Crassier Group, contains potential for coal seam development, particularly in the southern portions of the property. Exploration efforts to date indicate -

that the Brenot Formation tends to thicken to the south and coal seams become more prolific.

The geology of the property is illustrated in Figure 5.1.1 as well as on a 1:50 000 Regional Geology Map included with this volume.

5.2 Regional Stratigraphy

Cretaceous rocks are exposed along the entire Foothills Belt of the Rocky Mountains within northeastern British Columbia. These rocks contain deposits of several major deltas and reveal a complex interrelationship of continental to marine sediments.

The Goodrich Property is underlain by Jurassic and Lower Cretaceous sediments, specifically, the Jurassic Fernie Formation, the Jurassic - Cretaceous Beaudette Group, and the Lower Cretaceous Crassier and Fort St. John Groups.

The main emphasis of exploration on the Goodrich Property has been within the Crassier Group which can be further subdivided into the Brenot Formation, Dresser Formation, and the Gething Formation. The Crassier Group represents a time of major coal deposition in the Cretaceous. The Goodrich Coal Property is mainly underlain by strata of the Crassier Group with localized outcrops of younger and older strata.

A table of formations is presented in Table 5.2.1 and the variation in thickness of key formations over the Goodrich Property is illustrated in Table 5.2.2.

5.2.1 Fernie Formation

The Fernie Formation of Jurassic age is the oldest unit exposed on the property and consists of dark grey to black shales, mudstones, siltstones and sandstones; although

TABLE 5.2.1
TABLE OF FORMATIONS

Series	Group 1	Group 2	Formation	Approx. Thickness (m)	Lithology
			Goodrich	150 - 250	Sandstone, siltst. & mudstone, minor conglomerate.
			Hasler	210 - 340	Clay St.siltst.thin sandst.marine.
			Commotion Walton MBR	320 - 520	Siltst.sandst.clayst. COAL.
			Boulder Cr. MBR		Fine-grained, well sorted sandst. massive conglomerates, non-marine sandst. and mudstones
Lower			Hulcross MBR		Dark grey marine shale with sidesitic concretions.
			Gates MBR		Fine-grained, marine and non-marine sandst.conglomerates,mudstns.,COAL.
Cretaceous	Fort St. John	Fort St. John	Moosebar	350 - 450	Mudstone, minor siltstone, marine.
			Bluesky	2 - 5	Fine to medium-grained sandstone, mudstone, thin conglomerate unit at top with or without glauconite.
			Gething	350 - 500	Cyclothems; dark grey mudstone, siltstone; very fine to medium-grained sandstone, carbonaceous silty, sandy mudstones; coalified plant debris, minor bentonite, black shale and occasional minor tuffs in upper unit. COAL.
	Crassier	Bullhead	Dresser	250 - 300	Incomplete cyclothems, discontinuous coal measures in varying thicknesses; medium to very coarse-grained sandst. grits and conglomerate.
			Brenot	150 - 500	Lithic "salt & pepper" sandstone, siltstone, mudstone, carbonaceous mudstone. COAL
Transitional			Monach	125 - 250	Marine lithic & quartzose sandstone, with thick beds of clean, coarse-grained white quartzite at top. Minor shales, siltstones and sandstones, with occasional thin conglomerate.
	Beaudette	Minnes	Beattie Peaks	225 - 350	Buff to brownish sandstones, fine to medium-grained, thinly bedded black & dark grey shales, silt-stones, thin sandstones with iron-stone banding.
			Monteith	350 - 450	Grey & brown sandstones, fine to medium-grained. Fine to very coarse-grained quartzite. Minor beds of shales, and shales with siltstone & sandstone partings, with occasional thin conglomerate.
Jurassic	Fernie	Fernie	Fernie	Incomplete Section	Dark grey to black shale, mudstone, siltstone, sandstone, marine.

1. Gulf Canada Resources Classification (J. E. Hughes).
2. Geological Survey of Canada Classification.

TABLE 5.2.2

Formation Thickness Variation

Over the Goodrich Property

		Formation (thickness in metres)				
	Area	Gething	Dresser	Brenot	Monach	Beattie Peaks
N	Whiterabbit		300	150	125	300
|	Moberly	350	300	200	150	350
|	GDR Central	450-500	300	450-200	225-150	250-350
|				S-N	S-N	S-N
|	GDR Lossan	450-500	300	400-450	250	250
|	GDR East	450	300	500	200	300
|	Table		300	500	200	300
S	GDR South		300	400	200	300

shales and mudstones are generally the predominant lithologies. The Fernie Formation was deposited under marine conditions and represents a transgressive phase (Stott, 1973). The Formation thickness was not recorded in the field, because there is no complete section exposed in the Goodrich area.

On the Goodrich Property the Fernie is found south of the Pine River. There, a southwesterly trending belt of Fernie is exposed and upthrusted by the sub-parallel trending Gilliland Thrust. The surface exposure of the formation is limited because of its recessive nature. The lack of exposure makes it difficult to determine the stratigraphic thickness of the Fernie. Much of the formation is tree covered and in most cases, forms valleys.

5.2.2 Beaudette Group

The Upper Jurassic-Lower Cretaceous Beaudette Group transitionally overlies the Fernie Formation and is comprised of the Monteith, Beattie Peaks, and Monach Formations. The group has a maximum thickness of approximately 1000 metres between the Burnt and Peace River areas, and is exposed throughout the Goodrich Property. The group forms positive areas such as Mount Bickford north of the Pine Valley, Mount Stephenson and Mount Gilliland south of Pine Valley, and Mount LeHudette in the Goodrich East area. The Beaudette Group is essentially non-coal-bearing.

5.2.2.1 Monteith Formation

The Monteith Formation is the oldest of the Beaudette Group and consists of predominantly fine to medium-grained sandstones of delta front origin (Stott, 1973). The formation is characterized by some thick intervals of fine to coarse-grained quartzites at the top. This resistant unit is interbedded with minor recessive beds of shale and thin beds of conglomerate. The Monteith Formation is generally finer-grained than the Monach (especially the quartzites) and the two can usually be distinguished on that basis (Karst, 1980). The formation varies in thickness from 350 to 450 metres, and is predominantly exposed along the west edge of the property and in other isolated locations.

5.2.2.2 Beattie Peaks Formation

The Beattie Peaks conformably overlies the Monteith. The formation consists of fine to medium-grained, brown to medium grey sandstones with minor iron stain. Tidal flat, prodeltaic, and mid-basin deposits are represented in the thinly bedded marine shales and siltstones facies (Stott, 1973). Thin, fine-grained sandstones with ironstone banding were also found during mapping.

The formation varies in thickness from 225 to 350 metres and is very well exposed throughout the property. Its contact with the underlying Monteith Formation forms the majority of the peaks and the ridges that lie within the property.

5.2.2.3 Monach Formation

The Monach Formation represents the top of the Beaudette Group and consists of marine lithic and quartzose sandstones. Thin resistant beds of clean, coarse-grained white quartzites are found at the top, along with minor shales, siltstones and sandstones with occasional thin conglomerates. The quartzose to argillaceous sandstone facies of the Monach Formation represents delta-front deposits (Stott, 1973).

This formation conformably overlies the Beattie Peaks Formation and varies in thickness from 125 to 250 metres. Exposures of the formation are widespread throughout the property because of its resistance to erosion.

5.2.3 Crassier Group

The Crassier Group, of Lower Cretaeous age, represents a period of coal measure deposition. It is subdivided into three formations: the Brenot, Dresser, and Gething Formations (Hughes, 1964). The Crassier Group is equivalent to the Bullhead Group, excluding the Brenot Formation.

The Crassier Group has a complex lithology shown by assemblages and cyclothems of shales, mudstones, coals, siltstones, sandstones, grits, and conglomerates. In the eastern foothills, and as far west as Mount Bickford in the Pine Valley, the formations of the Crassier Group are more clearly differentiated than further west (Hughes, 1964). The increasing complexity of structure coupled with the increase in similarity of lithologies makes it difficult to distinguish between the formations of the Crassier Group.

The group covers most of the Goodrich Property and forms many of the valleys which contain associated drainage systems.

The group varies in thickness from 750 to 1300 metres because of facies changes and other depositional factors associated particularly with the Dresser and Cadomin relationship as described in Section 5.2.3.2.

5.2.3.1 Brenot Formation

The continental rocks and the coal measures that underlie the Dresser Formation were first recognized by J.E. Hughes in 1964. He proposed that these rocks be called the Brenot Formation.

This formation was left unnamed by Stott, 1973, as he refers to it as a succession of continental strata that lies above the Monach Formation.

In the Goodrich area the Formation lies between the Beaudette Group and the Dresser Formation. The upper part of the Brenot Formation consists of salt and pepper, very fine to fine-grained sandstones, and coal. Carbonaceous mudstones, dark grey siltstones, thin coals, and occasional medium-grained sandstones comprise the lower part of the formation. According to Hughes, 1964, cyclic deposition was common in the following ascending order: fine-grained, argillaceous sandstones, thin beds of silty and sandy mudstones with coarse plant debris (floor); thin, fissile, carbonaceous shales (roof) passing upward to mudstones and shales; thinly interbedded shales and sandstones. The formation differs from the Gething Formation in its greater proportion of sand and silt, thinner bedding and lack of plant fossils.

On the Goodrich South Block, the Brenot Formation contains a continuous and mappable quartzose sandstone unit which is resistant to erosion. The unit lies approximately in the middle of the formation, and is about 40 metres thick with a 0.10 metre thick conglomeratic band at its base. This sandstone unit may prove to be valuable for correlation purposes.

The Brenot Formation varies in thickness from 150 to 500 metres, and is exposed over the entire property. Maximum exposure of the formation occurs in the area between the Pine and Burnt Rivers.

In the Brenot Formation, coal seams have been found in the Goodrich East, Goodrich Lossan, and Goodrich South Blocks. The seams occur in the upper and middle Brenot in the north and in the middle and lower Brenot in the south. The coal/coal plus rock ratio ranges up to 3.16 m/3.60 metres in Goodrich South. The Brenot coal seams appear to be fairly clean with only minor rock bands.

5.2.3.2 Dresser Formation

The Dresser Formation of the Lower Cretaceous Crassier Group conformably overlies the Brenot Formation, and its upper contact with the Gething Formation is gradational.

South of the property, this formation is known as the Cadomin Formation and is defined by Stott, 1965, as:

> "massive conglomerates containing well rounded pebbles, cobbles, and boulders of extremely resistant rocks. Some coarse-grained sandstone, minor coal, and shale are included within the formation at some localities."

Further north, according to Stott, 1965, the conglomerate is more lenticular and much less

prominent, and disappears south of the Pine River. Pebbly, coarse-grained sandstone in a similar stratigraphic position within the Peace River foothills is considered equivalent. J.E. Hughes, 1964, called these equivalent sediments north of Goodrich property and in the vicinity of the Peace River Canyon region, the Dresser Formation and described them as:

> "very coarse to medium-grained sandstones and grits... They form beds of 3 to 12 metres thick... The formation may contain one or a few beds of conglomerates more than 3 metres thick, but these are absent at some localities... The coarse sandstones, grits, and conglomerates, are lenticular bodies and not persistant... Altogether, the sandstone makes up more than two-thirds of the formation. The coarse sandstone and grits form more than one-third, or as much as one-half of the formation. The intervening coal measures consisting of shales, siltstones, medium and fine-grained sandstones, form units up to 20 metres thick."

The clastic sediments that were described by Stott in the Peace River region, are essentially the same sediments that were described by Hughes in that area. These sediments are deposited in a series

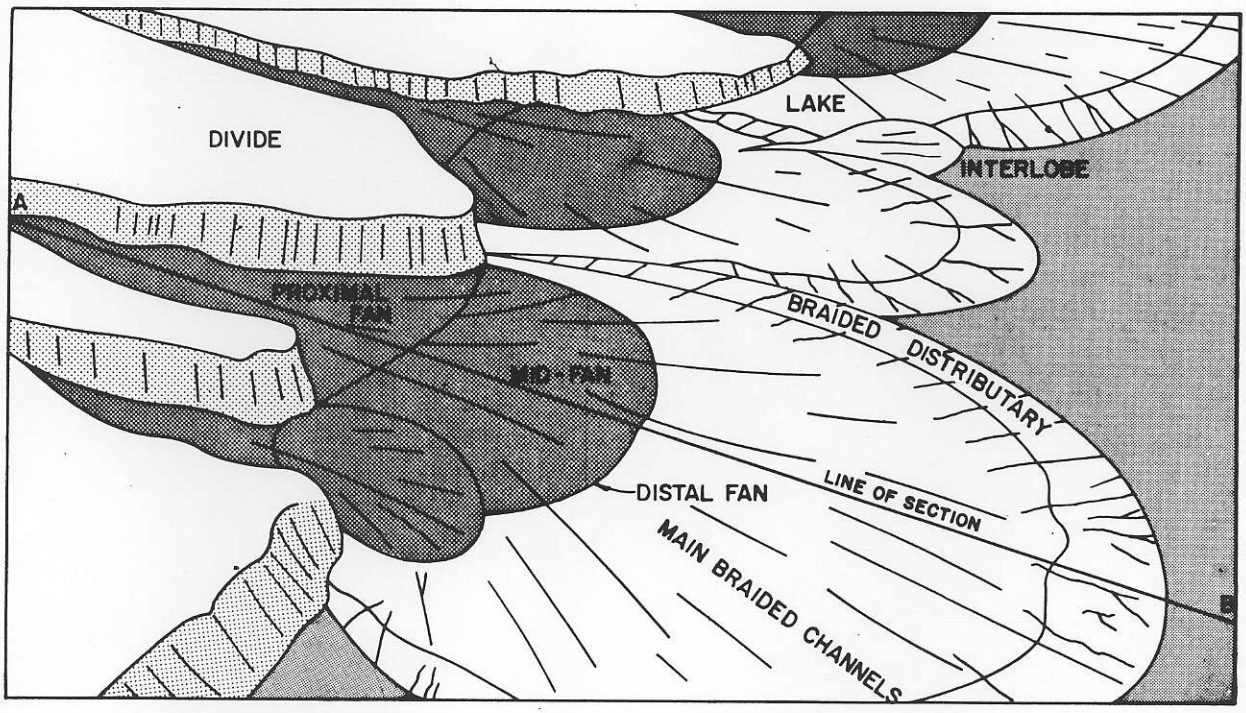
of alluvial fans (Bajada-like distribution) as shown in Figure 5.2.3.2.

According to the descriptions of these formations by both authors, the Cadomin Formation falls within the proximal to mid-fan part of the alluvial fan, whereas the Dresser Formation falls within the distal part of the fan.

On the Goodrich Property, the formation consists of medium to very coarse-grained sandstones, grits, conglomerates, and discontinuous coal measures of varying thicknesses. The definition of these clastic sediments on the Goodrich Property fits the distal facies part of the fan, in other words, the Dresser Formation. To the south of the property, and particularly on the Goodrich South Block (ie. Goodrich Peak Saddle) the Cadomin/Dresser-like clastic sediments co-exist.

The formation is very resistant to erosion, therefore the exposures are widely distributed throughout the property.

In the Dresser Formation, coal seams have been found and trenched in the Moberly, Whiterabbit, Goodrich Central, and Goodrich East Blocks. These occur in the upper part of the formation. The coal/coal plus rock ratio ranges up to 3.08 m/3.81



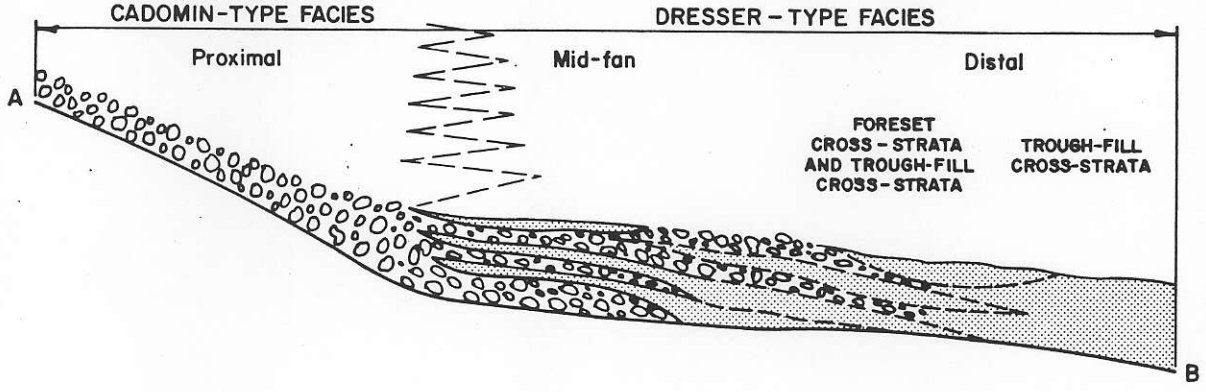


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FIGURE 5.2.3.2
GOODRICH COAL PROPERTY
ALLUVIAL FAN MODEL

PREPARED BY:	SCALE NTS
APPROVED BY: DATE: OCT./82	DRAWING No.

metres (BCWT-81-04) with seams thickening and becoming cleaner (fewer rock bands) toward the north.

5.2.3.3 Gething Formation

The non-marine Gething Formation also of the Crassier Group, conformably overlies the Dresser Formation, and underlies the Bluesky Formation of the Fort St. John Group. It consists of multiple fining upward cyclothems that strongly suggest a fluvial environment. The geophysical logs of diamond drill holes GDR-DDH-81-08 and GDR-DDH-80-39, accompanying the 1981 Geological Report, illustrate the depositional cycle of the Gething Formation.

The Gething Formation is distinguished from the Brenot Formation by its greater proportion of shales and numerous coal measures, and also by its greater proportion of plant fossils. It consists of dark grey mudstones; siltstones; lithic, very fine to coarse-grained sandstones; carbonaceous, silty and sandy mudstones; coalified plant debris; minor bentonite, black shale; occasional minor tuffs in the upper part; and coals. Drill holes in the Lossan Mine Area indicate that below the Bluesky Formation the Upper Gething is made up of distinctive, interbanded, dark grey mudstones and lighter grey siltstones approximately 30 to 40 metres thick. The sandstones in the upper portion of the formation

contain pebbles and coal stringers. They are cross-bedded, bioturbated, and show evidence of soft sediment deformation. Fossil bivalves and worm burrows are also found in some parts of the formation. The formation varies in thickness from 350 to 500 metres. In the Lossan Mine Area, drill holes intersected a Gething thickness of approximately 380 to 430 metres.

In the Gething Formation, coal seams have been found and trenched throughout the whole of the Goodrich property. The majority of the seams occur in the upper and middle Gething, although some seams have been located in the lower Gething Formation. Many of the seams trenched were over one metre thick. Coal/coal plus rock ratios range from 0.50 m / 0.50 m in thickness up to 7.37 m/10.74 metres true thickness (GDR-GS-TRC-82041). The main Gething seam tends to thin northwards to a thickness of 4.94 / 5.07 metres, true thickness. Figure 5.2.3.3 illustrates a typical section of Gething strata.

5.2.4 Fort St. John Group

The Lower Cretaceous Fort St. John Group of the Inner Foothills include the Bluesky, Moosebar, Commotion, Hasler, Goodrich, and Cruiser Formations. The marine shale to marine sandstone, and non-marine rocks caused by both vertical and lateral facies changes are a characteristic feature of the group (Stott, 1960).

TABLE OF FORMATIONS

	Q	QUATERNARY Glacial deposits and alluvium
Lower Cretaceous	Kcm	COMMOTION FORMATION Siltstones, sandstones interbedded, claystones of marine origin, COAL at the top member, and conglomerates.
	Kmb	MOOSEBAR FORMATION Mudstones, minor siltstones, marine
	Kbk	BLUESKY Fine to medium grained sandstones, mudstones, thin conglomerate unit at top with or without glauconite
	Kgt	GETHING FORMATION Conglomeratic dark grey mudstones, siltstones, carbonaceous, silty, sandy mudstones, coalified plant debris, minor bentonite, black shales, and occasional minor tuffs in upper unit, COAL
Jurassic-Lower Cretaceous — GRASSES GROUP	Kcc	CADOMIN FORMATION Pebble conglomerate, sandstones, COAL
	Krd	DRESSER FORMATION Predominate cyclothems: discontinuous coal measures in varying thicknesses, medium to very coarse grained sandstones, grits, and conglomerates; (Kcd mostly conglomeratic)
	JKb	BRENOT FORMATION Lithic "salt and pepper" sandstones, siltstones, mudstones, carbonaceous mudstones, COAL
Jurassic — Tithonian — BEAUDETTE GROUP	JKmo	MONACH FORMATION Marine lithic and quartzose sandstones with thick beds of clean, coarse grained white quartzites at top. Minor shales, siltstones and sandstones with occasional thin conglomerates
	JKtp	BEATTIE PEAKS FORMATION Grey and brown sandstones, fine to medium grained, thinly bedded black and dark grey shales, silty shales, siltstones, thin sandstones with ironstone banding
	JKm	MONTEITH FORMATION Grey and brown sandstones, fine to medium grained; fine to very coarse grained quartzite. Minor beds of shales, and shales with siltstone and sandstone partings; occasional thin conglomerates
	J1	FERNIE FORMATION Dark grey and black shales, mudstones, sandstones, siltstones, marine

LEGEND

GEOLOGICAL SYMBOLS

- Coal Seam Subcrop
- Geological Boundary (defined, approximate)
- Anticline (defined, approximate)
- Syncline (defined, approximate)
- Anticline and Syncline (overturned)
- Fault (defined, showing dip, approx. position of fault)
- Normal Fault
- Strike and Dip (bedding, overturned bedding)
- Cross Section Location
- Monocline
- Bedding (vertical, horizontal)
- Trench Location

LITHOLOGICAL SYMBOLS

- Conglomerate
- Sandstone
- Siltstone
- Quartzite
- Claystone/Mudstone
- Coal
- Silty Claystone
- Carbonaceous Claystone

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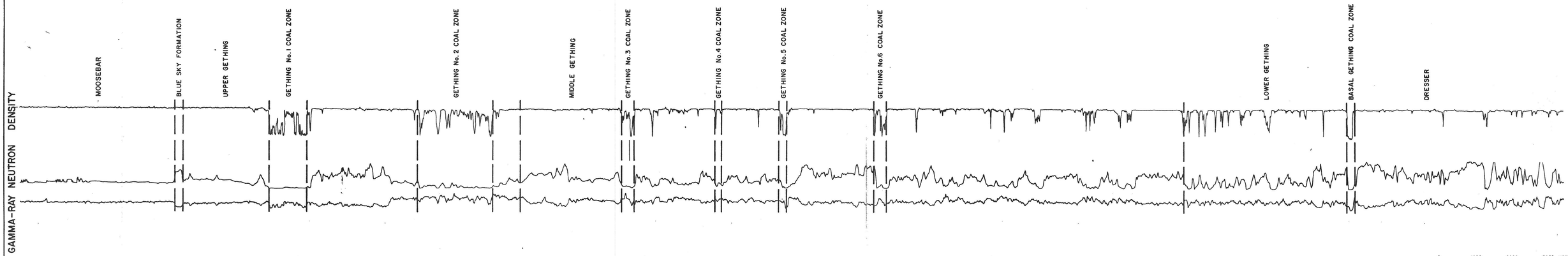
FIGURE 5.1.1

GOODRICH COAL PROPERTY

REGIONAL GEOLOGY MAP

PREPARED BY: GOODRICH GEOLOGICAL STAFF | SCALE
APPROVED BY: C. WILLIAMS | DATE: OCT '82 | DRAWING No.



0 1000 2000 3000 METRES

SCALE 1:12,500

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FIGURE 5.2.3.3

GOODRICH COAL PROPERTY

STRATIGRAPHIC LOG DESCRIPTION

533pg69

PREPARED BY: A. BIENIA	SCALE
APPROVED BY: DATE: OCT./82	DRAWING No.

The Bluesky and Moosebar are the only two formations of the Fort St. John group that outcrop in the central region of the Goodrich property. The Commotion, Hasler, and Goodrich Formations outcrop only along the northeastern boundary of the property on the Moberly block.

5.2.4.1 Bluesky Formation

The Bluesky Formation represents the basal unit of the Fort St. John Group in northeast British Columbia. The formation consists of fine to medium-grained sandstone, mudstone, and thin, very coarse conglomerates having well rounded quartzite phenoclasts of up to 15 cm across in a sandstone matrix. According to R.H. Karst et al, 1979, the Bluesky reprsents shoreline deposition of the rapidly transgressing Clearwater Sea from the north. The Bluesky is glauconitic and on the Goodrich Lossan block, drill hole intersections show the unit thickness to range from 2 to 5 metres.

This unit, which is a valuable marker on geophysical logs, is illustrated in Figure 5.2.3.3, the Stratigraphic Log Description.

The formation is exposed in several areas along the limbs of the Lossan and Axis Synclines in the Lossan mine area as well as along the east limb of the Fisher Syncline, and in creek cuts on the Moberly

block. It appears to thicken marginally to the northeast, approaching 5 to 7 metres in thickness on the Moberly block.

The Bluesky has previously been considered to be equivalent to the upper beds of the Gething Formation (Stott, 1965). On the Goodrich property, however, Gulf's geologists have given the Bluesky formational status because it maintains a consistent geophysical log response over the area.

5.2.4.2 Moosebar Formation

The Moosebar Formation is one of the youngest formations exposed on the property. The marine Moosebar Formation consists of dark to medium grey sandstones, grading upward to dark grey siltstones. Highly glauconitic beds occur near the base of the formation and its contact with the Bluesky.

The upper beds of the Moosebar are gradational and the upper boundary with the Commotion Formation is drawn at the base of the first thick succession of sandstone.

In the Lossan Mine Area, one drill hole (GDR-DDH-81-02) intersected approximately 270 metres of the Moosebar. As many as six tuff bands up to 10 cm in thickness have been identified in the core and

on the geophysical logs. Five of these bands are contained within 20 to 30 metres above the Moosebar-Bluesky contact. It is believed that these tuff bands could be valuable in correlation work.

Exposure of this formation is limited, due to its recessive nature. South of the Pine Valley, the main exposure occurs in Axis Creek, a tributary of Brazion Creek. North of the Pine Valley, the formation is exposed along the Fisher Creek in the west and Crassier Creek, east of the Moberly block.

5.2.4.3 Commotion Formation

The Commotion Formation was defined by Wickenden & Shaw (1943) as a succession of sandstones, shales, and conglomerates, followed by thin coal measures conformably overlying the Moosebar Formation. The Commotion Formation is composed of four distinct members: the Gates, Hulcross, Boulder Creek, and the Walton members.

The Gates member in the Goodrich area is comprised of black, fissile carbonaceous shales; dark, rubbly mudstones; sandstones and siltstones; and thin coal measures. The contact with the overlying Hulcross is abrupt and defined by the last occurrence of sand and carbonaceous sediments. There is often a thin, coarse conglomerate at the top of the formation,

followed by thin sandstones, carbonaceous shales, and thin coals. The coarse sandstone-conglomerate units often coarsen upward, suggesting a prograding delta (Karst, 1980). The member varies in thickness from 80 to 200 metres.

The Hulcross member is made up of recessive marine mudstones, which often display laminae of very fine-grained sand. Ripple marks in some sand laminae suggest that the water depth was not great (Karst, 1980). The member conformably overlies and is underlain and overlain by the Gates and the Boulder Creek members, respectively. The Hulcross member varies in thickness from 90 to 120 metres.

The Boulder Creek member consists of fine-grained, well sorted sandstones, massive conglomerates, and non-marine mudstones and sandstones. The upper part of the member is continental and contains coal seams, and the basal part of the member consists of a thick, sandstone conglomerate unit that coarsens upward (Karst, 1980). The member varies in thickness from 80 to 110 metres.

The Walton member, or previously known as Member IV (Hughes, 1967), is the uppermost member of the Commotion Formation. The member varies in thickness from 50 to 80 metres and consists of siltstones, thin sandstones, and coal.

The Commotion Formation was not mapped in great detail in the Goodrich area, as this formation exposure is limited and occurs outside of the licence's northeastern boundary. Gulf's Trefi property consists of licences containing coal of the Walton member of the Commotion Formation.

5.2.4.4 Hasler Formation

The marine Hasler Formation consists of thinly interbedded and interlaminated grey siltstones, claystones, and shales, with minor sandstones. The formation was defined by Wickenden & Shaw (1943) as those shales overlying the Commotion Formation. The formation varies in thickness from 210 to 340 metres and is exposed outside and along the northeastern part of the property, where detailed mapping was limited by heavy ground cover and poor exposure.

5.2.4.5 Goodrich Formation

The Goodrich Formation consists of sandstones, occasional conglomeratic sandstones, siltstones, claystones, and a few thin coals. The formation varies in thickness from approximately 150 to 250 metres. The lower portion of the formation is characterized by a number of cliff forming sandstones, which become increasingly thicker from the base upwards. The contact with the underlying Hasler

Formation is defined as the first sandstone above the Hasler sediments in excess of 0.5 metres.

The Goodrich Formation is the youngest formation exposed on the Goodrich property. It forms limited outcrops along the northeastern boundary of the licences on the Moberly block.

5.3 Regional Structure

The Goodrich coal licences are located to cover several distinct structural trends in the northeastern portion of the Peace River Coalfield. The structures trend in a northwesterly direction and each major structure contains strata which have been folded and faulted into a series of synclines and anticlines.

Fold styles on the Goodrich Property change from east to west. Gentle box folds are found along the eastern edge of the property, whereas the western portion of the property is characterized by more tightly folded strata approaching chevron style fold patterns. Major stresses and pressures originated from the west, resulting in the western half of the property having undergone greater deformation.

Several major faults have been located on the property which have displaced strata in the order of 300 metres. In addition, a number of relatively small scale faults (10 to 50 metres displacement) have been defined. Many of these small scale faults have resulted in the repetition of coal seams on the property. Most faults on the Goodrich Property are high angle west-dipping faults.

Drilling to date has indicated that generally thicker than normal intersections of coal are found in the axis of many of the

more tightly folded synclines found in the central and western portions of the property.

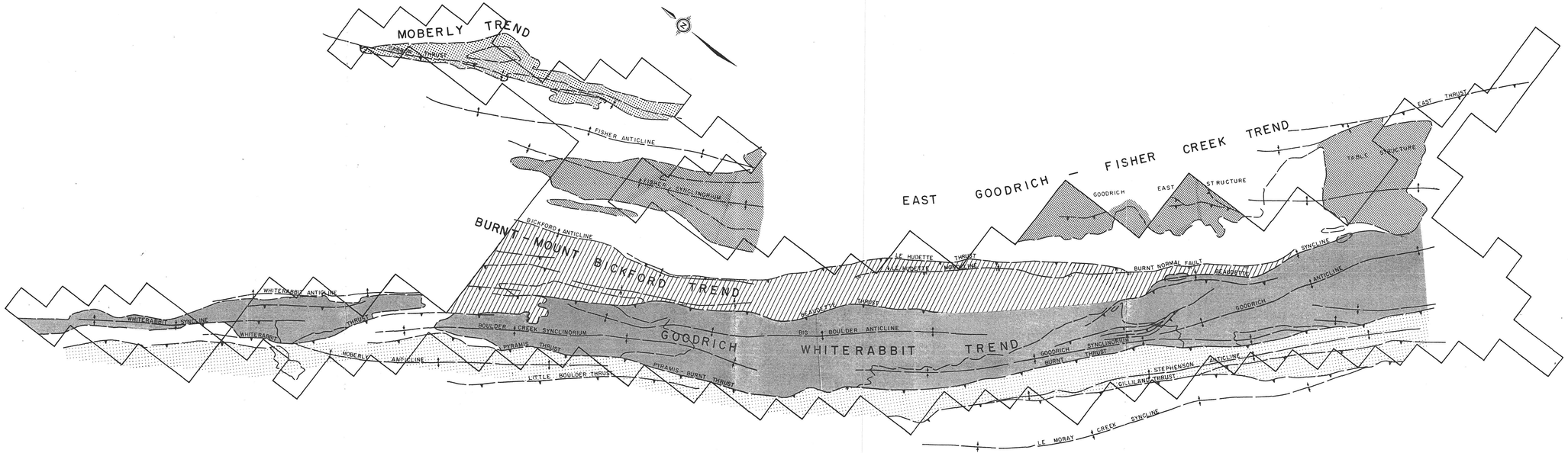
The dominant structures on the Goodrich Property are shown in Figure 5.3.1. These structures trend in a northwesterly direction. The main structural trends from the southwest to the northeast are:

1) The Gilliland Pyramis Trend, which delineates the younger strata of the Fernie to Brenot Formations.

2) The Goodrich - Whiterabbit Trend which preserves coal-bearing strata of the Gething and Brenot Formations. Three potential mining prospects have been identified within this structural trend and are discussed in more detail in Section 6.0 of this report.

3) The Burnt-Mount Bickford Trend, which contains Brenot and Gething strata at the northern end of the property and older non-coal-bearing strata of the Monteith, Monach and Beattie Peaks Formations in the south.

4) The East Goodrich - Fisher Creek Trend, which contains coal-bearing strata of the Brenot, Dresser and Gething Formations. Three prospect areas have also been delineated within the East Goodrich - Fisher Creek structural trend. The prospects are described in Section 6.0.



LEGEND

- MOBERLY TREND
- EAST GOODRICH – FISHER CREEK TREND
- GOODRICH WHITERABBIT TREND
- BURNT-MOUNT BICKFORD TREND
- PYRAMIS-GILLILAND TREND

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FIGURE 5.3.1

GOODRICH COAL PROPERTY
REGIONAL STRUCTURAL TRENDS

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APPROVED BY:		DATE: NOV. 82	DRAWING No.

5) The Fisher Creek Anticline preserves mainly coal-bearing Brenot strata at the crest of the structure.

6) The Moberly Trend, which contains mainly Gething Formation sediments and older sedimentary strata of the Fort St. John Group. Two potential mining prospects have been identified within the Moberly structural trend.

In general, the structural complexity of the trends described above tend to increase to the northwest and across the property to the west.

5.3.1 Faults

Major west-dipping thrust faults found in the Goodrich property follow the structural trends in a northwesterly direction. The major faults display displacement of strata upwards of 300 metres. Minor scale thrust faults are common on the Goodrich Property and are associated with the crest and troughs of folds. Many of these small scale thrust faults displace strata by 10 to 50 metres and have resulted in the repetition of coal seams.

The Burnt Normal Fault - located within the Burnt - Mount Bickford Trend was originally believed to be a slumped thrust fault. Current interpretations have resulted in this fault being reclassified as a late - normal fault.

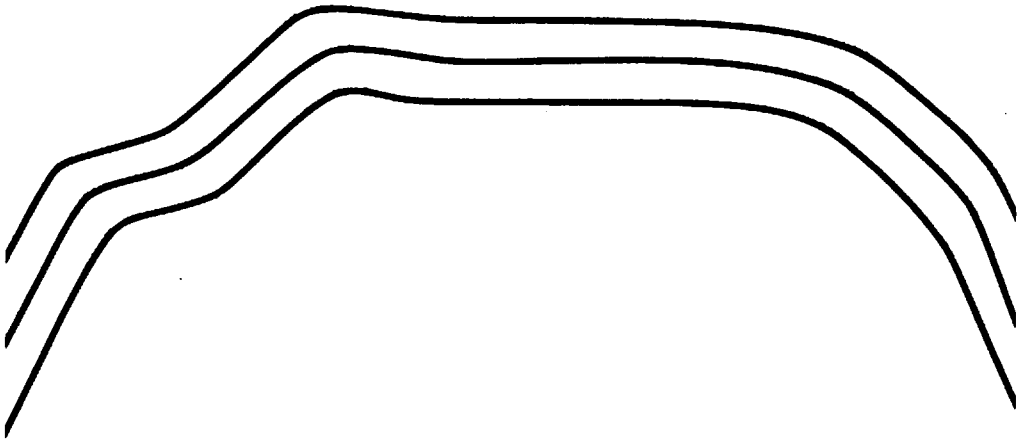
5.3.2 Folds

Fold structures on the Goodrich property trend from the southeast to the northwest. Several plunge reversals of the fold axes occur along the trends.

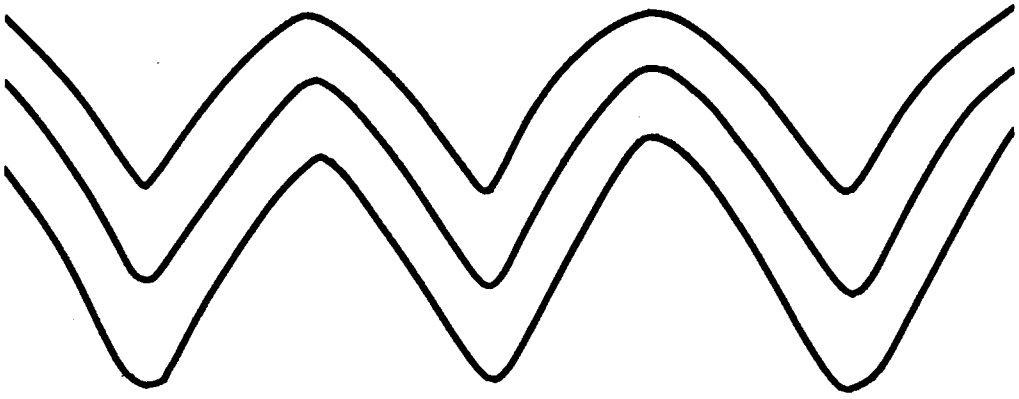
The fold style changes from gentle box folds in the outer foothills (Table area) to more tightly asymmetrical lambate-cuspate or chevron-type folding (see Figure 5.3.2) in the more disturbed area to the west (Lossan and Goodrich South Blocks). The thickness of interbedded incompetent and competent strata is the major factor in determining the stage of the lambate-cuspate or chevron folding.

Fold styles essentially remain unchanged along the structural trend of the folds. The only possible exception being the cuspate-lambate folds which become more cuspate to the northwest, for example within the Goodrich Central Block north of the John Hart Highway and within the Whiterabbit Block.

BOX



CUSPATE - LAMBATE



CHEVRON

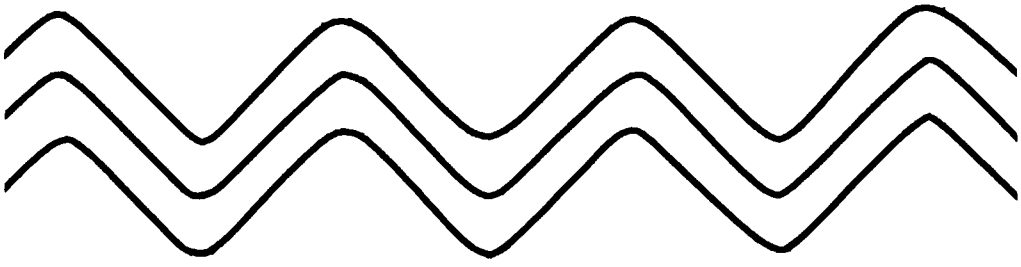


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FIGURE 5.3.2
GOODRICH COAL PROPERTY
SCHEMATIC DIAGRAM ILLUSTRATING FOLD STYLES

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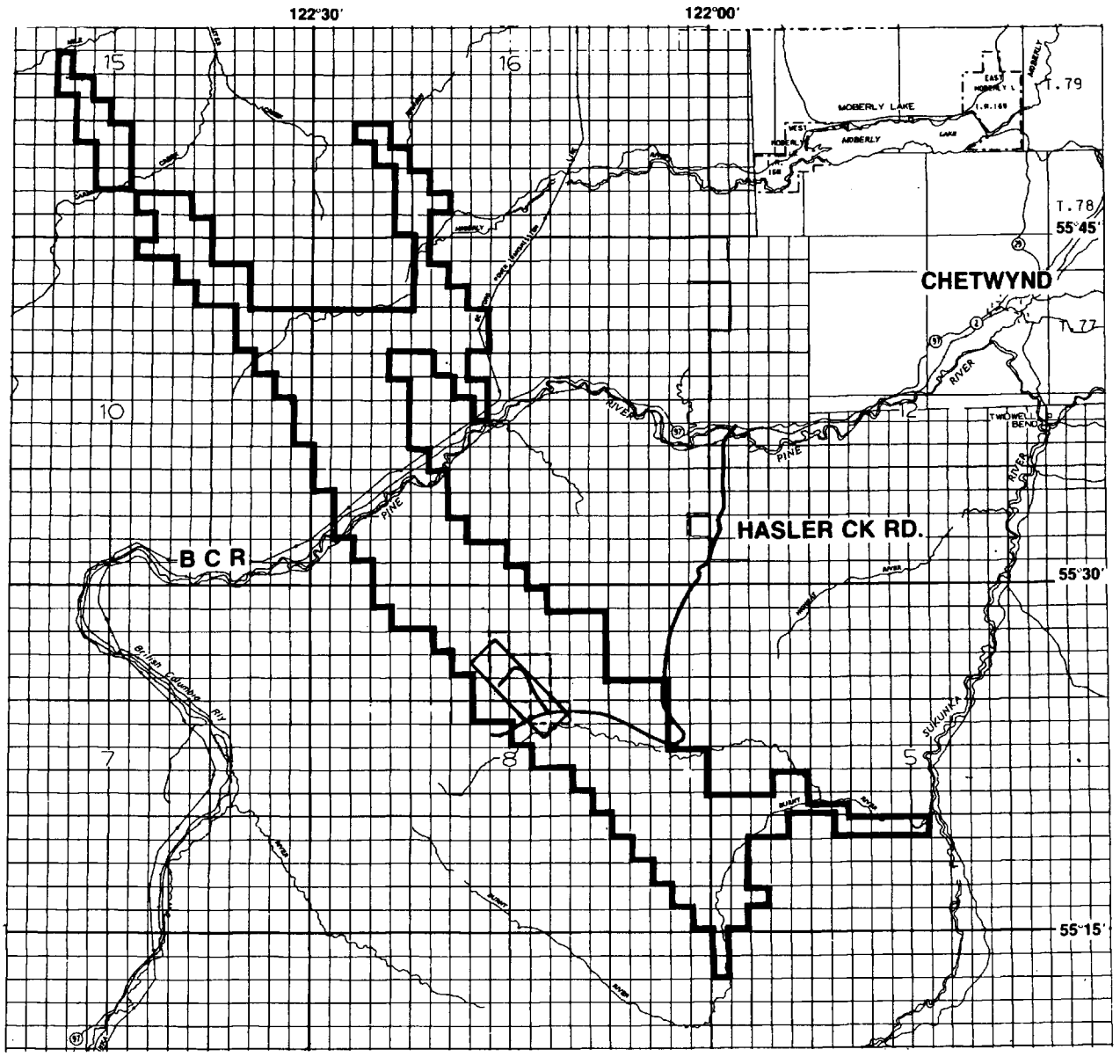
5.4 Lossan Mine Area

5.4.1 Summary

The proposed Lossan Mine Area is located approximately central to those Goodrich licences situated south of the Pine River as shown in Figure 5.4.1. Access to the mine area is afforded by the Hasler Creek Road.

The Lossan Mine Area was intially discovered as a result of field exploration work in 1980. Since its delineation as a prospect in that year, the area has undergone intense exploration to evaluate its open pit mining potential.

The mine area consists of Gething Formation strata which has been folded into a series of anticlines and synclines. The uppermost Gething seam known as the No. 1 Seam constitutes the bulk of the open pit reserves in the mine area. The seam thickness of the No. 1 Seam averages approximately 8.6 metres within the mine area. Small scale faulting combined with the relatively tight folds characteristic of the mine area, has in places resulted in a thickening of the coal upwards of three times its average thickness. Total in-situ geological reserves for the mine area have been calculated to be 298 million tonnes. The reserves are described in more detail in the Coal Resources section of this report (Section 6.2). Geology maps and cross-sections at a 1:5000 scale are provided in Appendix B, Part 1 of this report.



GOODRICH COAL LICENCE

MINE AREA

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FIGURE 5.4.1
GOODRICH COAL PROPERTY
LOSSAN MINE AREA LOCATION

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5.4.2 Detailed Geology

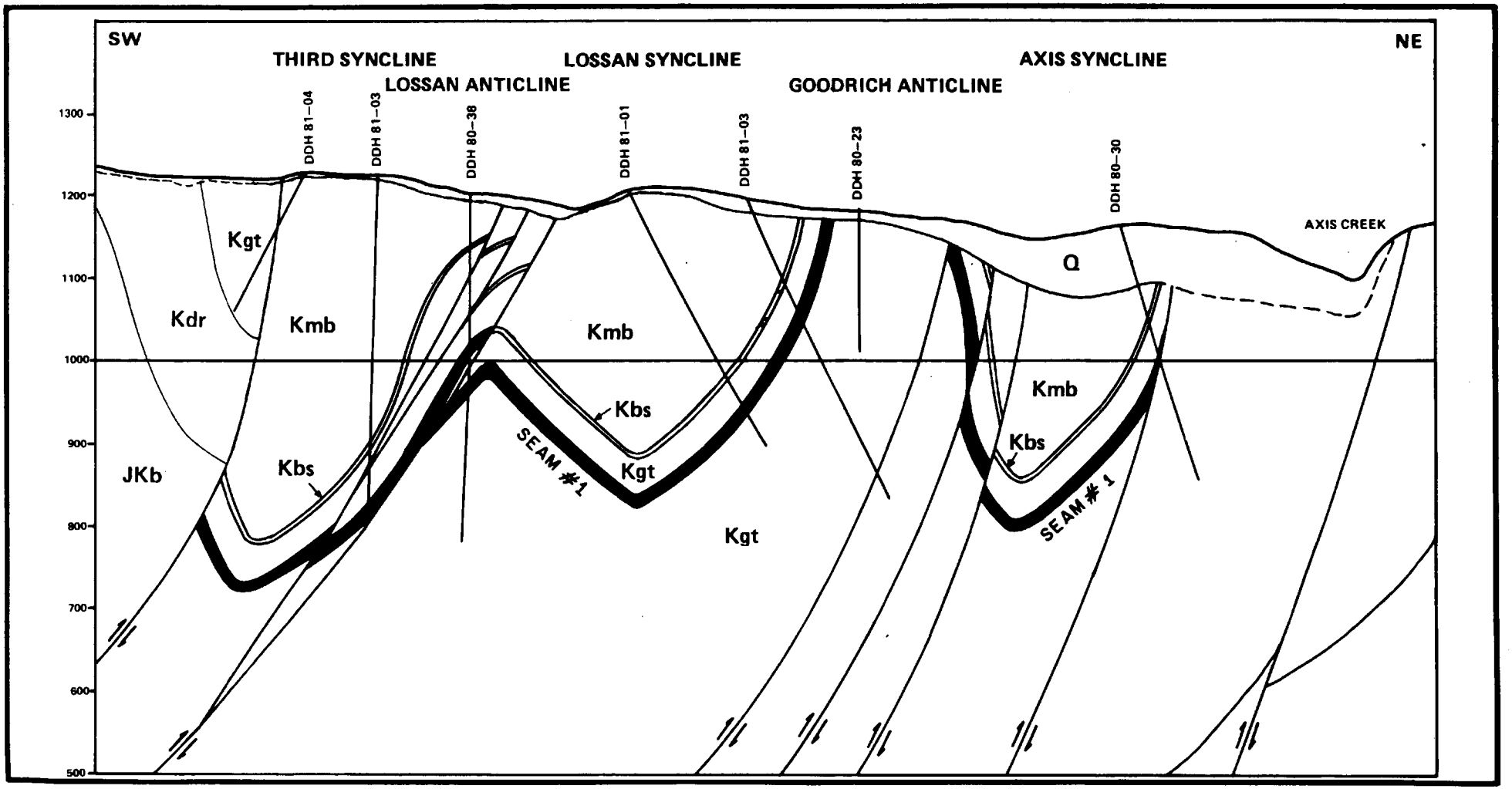
5.4.2.1 Folds

The Lossan Mine Area is underlain by four northwesterly trending fold structures within a major synclinorium (the Goodrich Central Synclinorium) located within the Burnt - Mount Bickford structural trend.

The fold structures underlying the mine area are from east to west, the Axis Syncline, the Goodrich Anticline, and the Lossan Syncline and Anticline. An additional syncline has been identified to the west of the Lossan Anticline as a result of the 1981 and 1982 exploration. This syncline is currently named the Third Syncline (see Figure 5.4.2.1).

The Axis Syncline is a tightly folded syncline, the western limb of which is near vertical to overturned.

The Lossan Syncline is a simple fold structure. Its east limb is slightly flexured dipping from near vertical to 30° at the surface. The syncline is tightly folded and is nearly symmetrical about the fold axis. The east limb of the Lossan syncline is coincident with the west limb of the Goodrich Anticline which separates the Axis and Lossan



Q	QUATERNARY
Kmb	MOOSEBAR FORMATION
Kbs	BLUESKY
Kgt	GETHING FORMATION
Kdr	DRESSER FORMATION
JKb	BRENOT FORMATION

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FIGURE 5.4.2.1
GOODRICH COAL PROPERTY
TYPICAL CROSS-SECTION
LOSSAN MINE AREA

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Synclines. The Third Syncline to the west of the Lossan Syncline is relatively deeper than the Lossan Syncline.

The marine Moosebar and the coal-bearing Gething Formations are contained within the Lossan, Axis, and Third Synclines (see Figure 5.4.2.1).

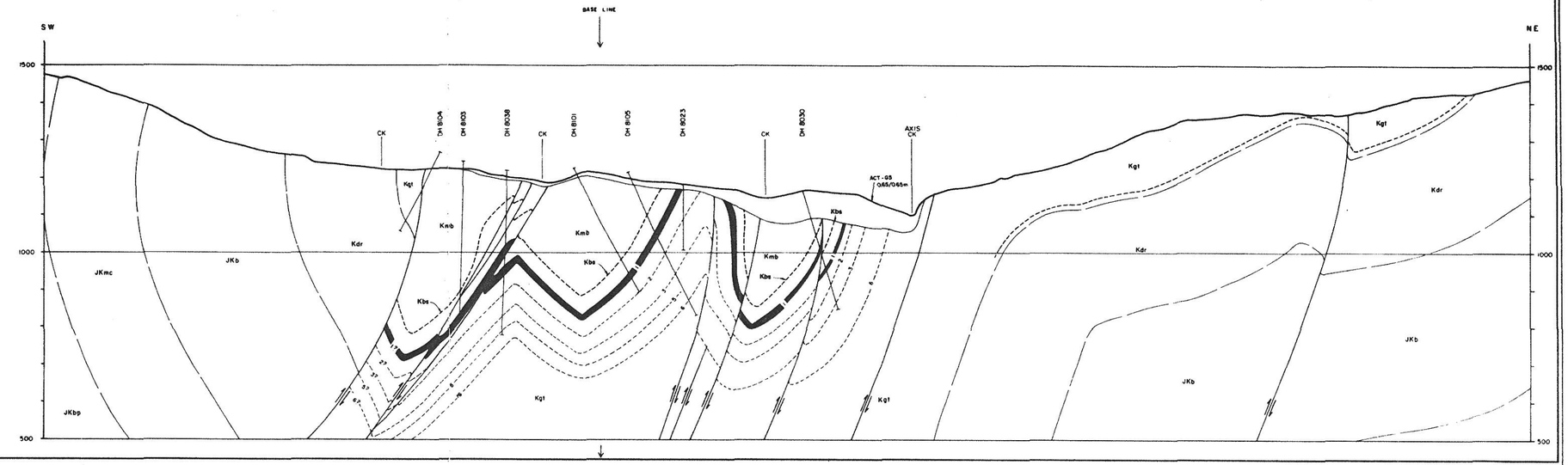
5.4.2.2 Faults

The Lossan Mine Area contains a number of small scale faults with two major thrust faults bounding the western and eastern boundaries of the mine area.

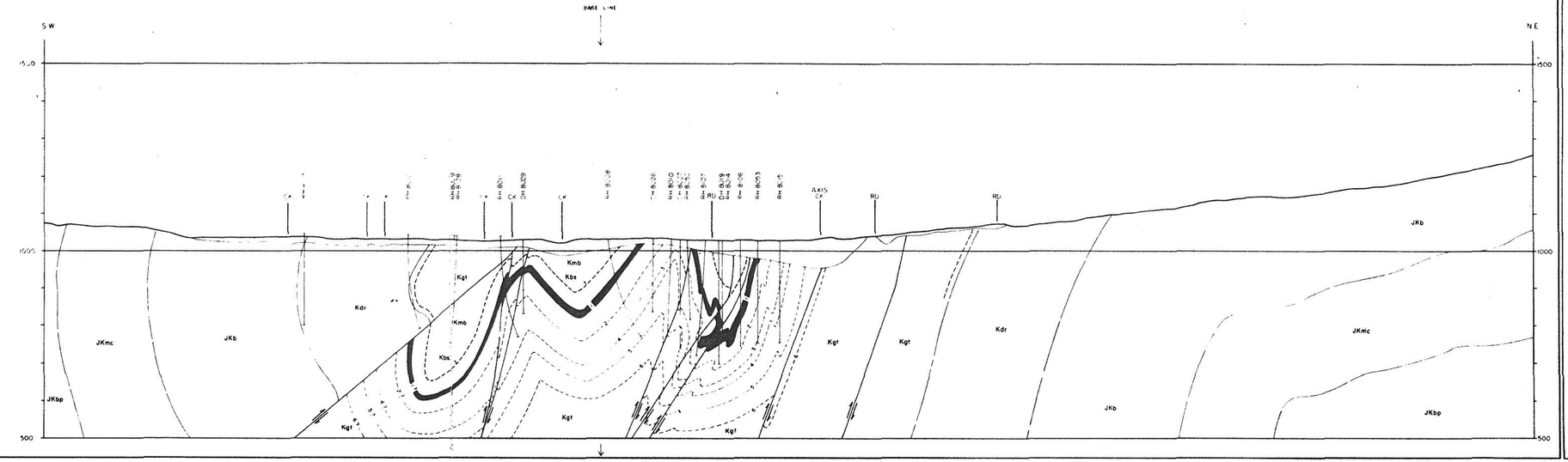
The major most westerly fault is a part of the Pyramis Thrust plate. An easterly located splay of the Pyramis Thrust, although limited in length, overrides the younger Moosebar Formation contained in the Goodrich Synclinorium. The splay is interpreted as a relatively high angle fault with a displacement of significant magnitude (30 to 40 metres).

At least four thrust splays are interpreted in the west limb of the Axis Syncline near the southern end of the structure (see Lossan Mine Geological Section N1500). A combination of fault repeats have resulted in tectonic thickening of coal within the Axis Syncline. The east limb of the Axis

1500N



3250N



LEGEND

	Q	*QUATERNARY* — *Glacial deposits & alluvium*
LOWER CRETACEOUS — TRANSITIONAL — JURASSIC	Kcm	*COMMOTION FORMATION* — *Siltstones, sandstones interbedded, claystones of marine origin, COAL at the top member & conglomerates*
	Kmb	*MOOSEBAR FORMATION* — *Mudstones, minor siltstones, marine*
	Kbs	*BLUESKY* — *Fine to medium grained sandstones, mudstones, thin conglomerate unit at top with or without glauconite*
CRASSIER GROUP	Kgt	*GETHING FORMATION* — *Cyclothems, dark grey mudstones, siltstones, carbonaceous, silty, sandy mudstones, coalified plant debris, minor bentonite, black shales, and occasional minor tuffs in upper unit; COAL*
	Kdr	*DRESSER FORMATION* — *Incomplete cyclothems, discontinuous coal measures in varying thicknesses, medium to very coarse grained sandstones, grits and conglomerates*
	JKb	*BRENOT FORMATION* — *Lithic "salt & pepper" sandstones, siltstones, mudstones, carbonaceous mudstones; COAL*
BEAUDETTE GROUP	JKmc	*MONACH FORMATION* — *Marine lithic & quartzose sandstone with thick beds of clean, coarse grained white quartzites at top. Minor shales, siltstones & sandstones with occasional thin conglomerates*
	JKbp	*BEATTIE PEAKS FORMATION* — *Buff to brownish sandstones, fine to medium grained; thinly bedded black & dark grey shales, silty shales, siltstones, thin sandstones with ironstone banding*
	JKmt	*MONTEITH FORMATION* — *Grey & brown sandstones, fine to medium grained; fine to very coarse grained quartzite. Minor beds of shales, and shales with siltstone & sandstone partings, occasional thin conglomerates*
	Jf	*FERNIE FORMATION* — *Dark grey & black shales, mudstones, sandstones, siltstones, marine*

↓ BASELINE LOCATION

--- --- COAL SEAM

NOTE : Section number indicates distances in metres along baseline from south to north to include all 1980 and 1981 drill holes.

SCALE 1:5000

METRES 0 200 400 METRES

HORIZ 1:5000
VERT 1:5000

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FIGURE 5.4.2.2
GOODRICH COAL PROPERTY
LOSSAN BLOCK MINE AREA
TYPICAL CROSS SECTIONS
1500N , 3250N

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APPROVED BY: DATE OCT. / 82	DRAWING No.

Syncline appears relatively free of thrust faulting.

5.4.3 Coal Occurrences

Six separate coal zones have been identified within the Gething Formation in the Lossan Mine Area. The majority of these coal seams lie within the upper half of the Gething Formation. Surface data and occasional drill hole intersections of the lower half of the Gething Formation indicate that several additional coal seams are present in the Gething; however, drilling will be required before a definitive correlation can be made. The six coal seams or zones are described briefly below (see Figure 5.4.2.2).

5.4.3.1 Gething No. 1 Seam

The Gething No. 1 Seam is the uppermost seam within the Gething Formation and is located 40 metres below the Gething - Bluesky contact. Generally the geological mining section averages 8.6 metres within the mine area but faulting associated with folding has thickened the No. 1 Seam to as much as 35 metres (true thickness).

The No. 1 Seam is easily identifiable on geophysical logs (see correlation charts - Appendix B, Part 2). Within the mine area, the No. 1 Seam is

overlain by a distinctive zone of regularly interbedded siltstone and mudstone and underlain by a relatively clean medium-grained sandstone. The seam itself contains at least one tuffaceous band which aids in correlation of drill core or trench data. Within the mine area the No. 1 Seam thins in a northerly direction.

5.4.3.2 Gething No. 2 Coal Zone

The second coal zone within the Gething Formation has been designated the No. 2 Coal Zone, which lies approximately 40 to 50 metres below the No. 1 Seam. This zone is generally one to two metres thick and consists of coal, carbonaceous mudstones, and shale. The individual coal plys within this zone are generally in the order of one metre in thickness.

5.4.3.3 Gething No. 3 and No. 4 Seams

The Gething No. 3 and No. 4 Seams lie 90 and 100 metres respectively below the No. 1 Seam. The average thickness of these seams is in the order of one metre. Further drilling will be required in order to confirm the continuity of these seams within the Lossan Mine Area.

5.4.3.4 Gething No. 5 Seam

The Gething No. 5 Seam (previously correlated as the No. 3 Seam) lies some 120 metres below the No. 1 Seam. The average thickness of the No. 5 Seam is approximately 3 to 5 metres as indicated by several trenches and drill hole intersections.

Current calculations indicate that there are approximately 61.5 million tonnes of in-situ coal based on the No. 5 Seam. The bulk of these reserves lie in the northern end of the mine area (Sections N6000 to N9500). These reserves have not been included in the preliminary feasibility study as they are inferred reserves. Preliminary drilling, however, indicates that this area could provide additional tonnages to the current estimates of possible production from the mine area.

5.4.3.5 Gething No. 6 Seam

The Gething No. 6 Seam lies some 180 metres below the No. 1 Seam. The average seam thickness of this seam is approximately 2.5 to 3 metres.

All current coal seam correlations from previous exploration programs are presented in Appendix B, Part 2 of this report.

5.5 Regional Prospects

To date, seven prospect areas have been defined on the Goodrich property in addition to the Lossan Mine Area. The prospects identified are:

South Cirque Prospect
Table Prospect
Hasler Creek Prospect
Beaudette Syncline Prospect
Goodrich Central Prospect
Moberly Monocline
Moberly Syncline

The prospect areas contain 1.925 billion tonnes of in-situ coal which represents approximately eighty percent of the total in-situ coal estimated for the Goodrich coal property.

Many of the prospects contain areas of relatively shallow dipping strata (from 10 to 45 degrees) which have coal to overburden ratios generally being less than 10:1. Drilling programs will be required in each of these areas to evaluate coal thicknesses and quality, and to evaluate on a preliminary basis, their economic potential. The location of these prospects are shown in Figure 5.5.0.

5.5.1 Goodrich South Cirque Prospect

The South Cirque Prospect area lies within the Goodrich South Block. Geographically it is a glacial cirque

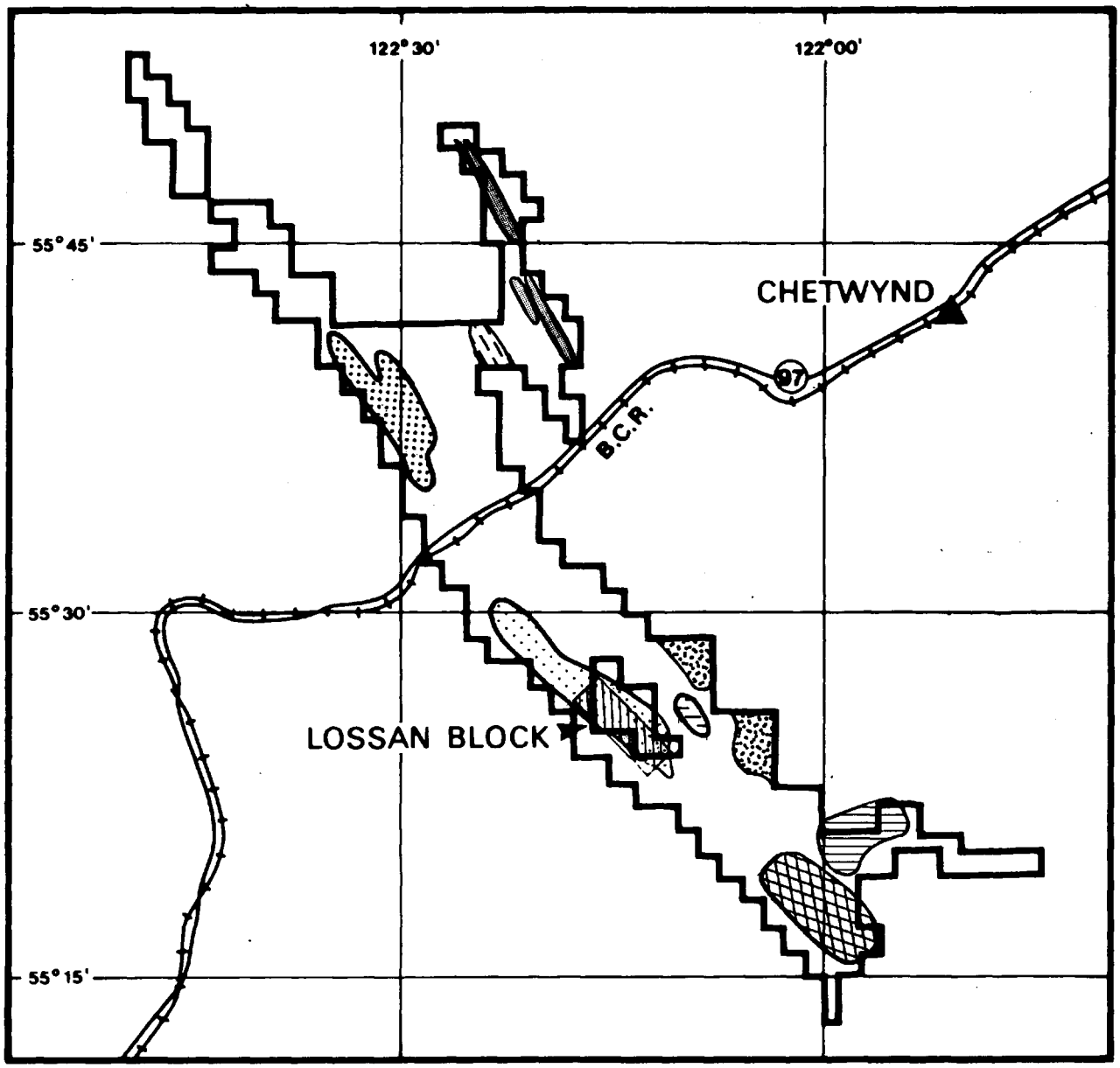

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FIGURE 5.5.0
GOODRICH COAL PROPERTY
REGIONAL PROSPECTS

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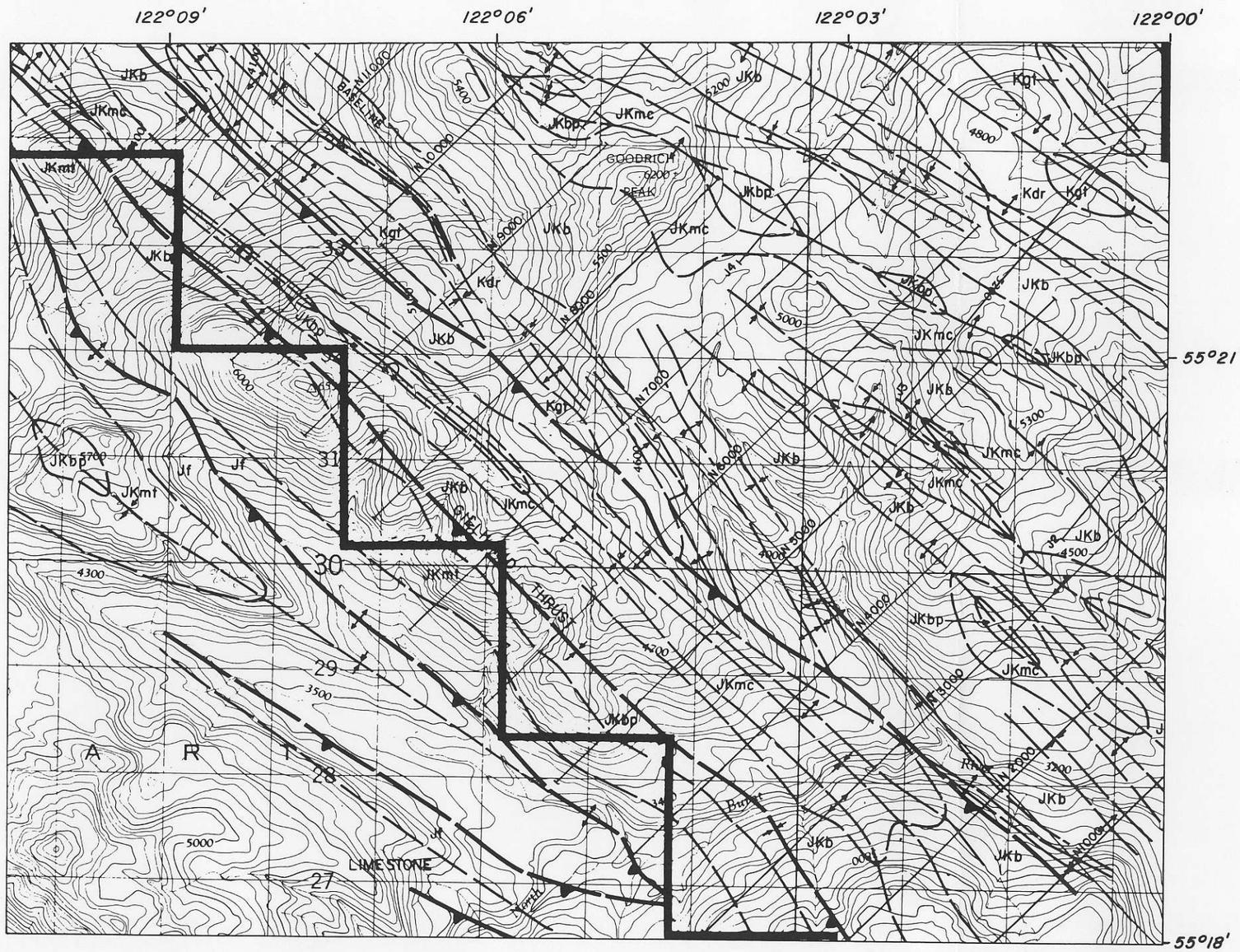
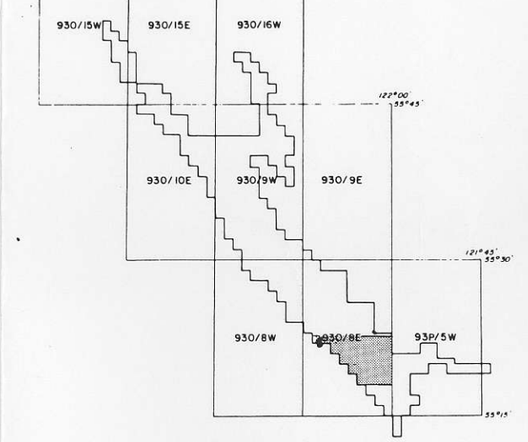


LEGEND

- Property Boundary
- Coal Seam Subcrop
- Geological Boundary, (defined, approximate)
- Anticline (defined, approximate)
- Syncline (defined, approximate)
- Anticline and Syncline (overturned)
- Fault (defined showing dip, approx. position of fault)
- Normal Fault
- Strike and Dip (bedding, overturned bedding)
- A — A' Cross Section Location
- Monocline
- Bedding (vertical, horizontal)
- Kgt — Gething
- JKb — Brenot



INDEX MAP

0 1000 2000 3000 4000

scale in metres

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FIGURE 5.5.1
GOODRICH COAL PROPERTY
GOODRICH SOUTH CIRQUE LOCATION

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APPROVED BY: DATE: OCT. 82	DRAWING No.

bounded to the north by the southwesterly trending Goodrich Peak Saddle and to the south by the North Burnt River. To the west the continuation of the Mt. Stephenson Ridge marks the geographical limit and the eastern edge is limited by the northwest-southeast trending Goodrich Peak Ridge. The resulting glacial basin has an aerial extent of some 24 square kilometres (see Figure 5.5.1).

Geologically, the prospect area is contained within the heavily glaciated Goodrich Synclinorium. Strata within the synclinorium consist largely of the coal-bearing Brenot Formation and a few exposures of the Dresser, Gething and Monach Formations. The western boundary is marked by the major Stephenson Anticlinorium which brings to surface the Monteith and Monach Formations. In an easterly direction the synclinorium is bounded by the Goodrich Anticline, a major geological feature exposing the Monach Formation.

The Goodrich South area contains surface mining potential for the coal-bearing Crassier Group. To date a total of 102 trenches have been dug and logged within the vicinity of the Goodrich South Cirque; of those 102 trenches 77 were within the Brenot Formation. Due to the prolific coal-bearing nature of the Brenot Formation within the area further exploration, particularly drilling and mapping, is definitely needed in order to properly ascertain the true potential of the Brenot Formation. In addition, it should be stated again that the Brenot Formation on the Goodrich Property appears to thicken and contain more coal southward.

5.5.1.1 Folds

As previously stated, the area consists of three major northwest-southeast trending folds. These are, from west to east, the Mt. Stephenson Anticlinorium, the Goodrich Synclinorium, and the Goodrich Peak Anticline.

The Goodrich Synclinorium extends from north of the Goodrich Peak Saddle to the North Burnt River at the southern end. It consists of several lesser parasitic folds of the chevron-cuspate fold style. These folds are more pronounced at the southern end of the cirque with most dying to the north near the Goodrich Peak Saddle, possibly because of a plunge reversal in this area. The plunge in the South Cirque is believed to increase from 0° to 5° on the Goodrich Peak Saddle to 10° to 15° near the North Burnt River. North of the saddle the plunge has not been determined due to lack of exposure.

The last major fold, the Goodrich Peak Anticline, extends from north of Goodrich Peak south to the Burnt River.

5.5.1.2 Faults

Two major northwesterly trending thrust faults have been identified within the Goodrich South

Block. They are, from west to east, the Gilliland Splay Thrust and the Burnt Thrust. However, only the Burnt Thrust affects the Goodrich South Cirque by bringing up lower to middle Brenot onto lower Gething and Dresser Formations. The thrust originates north of Mt. Stephenson and extends southeast to the North Burnt River.

No other evidence of faulting has been found in the area to date.

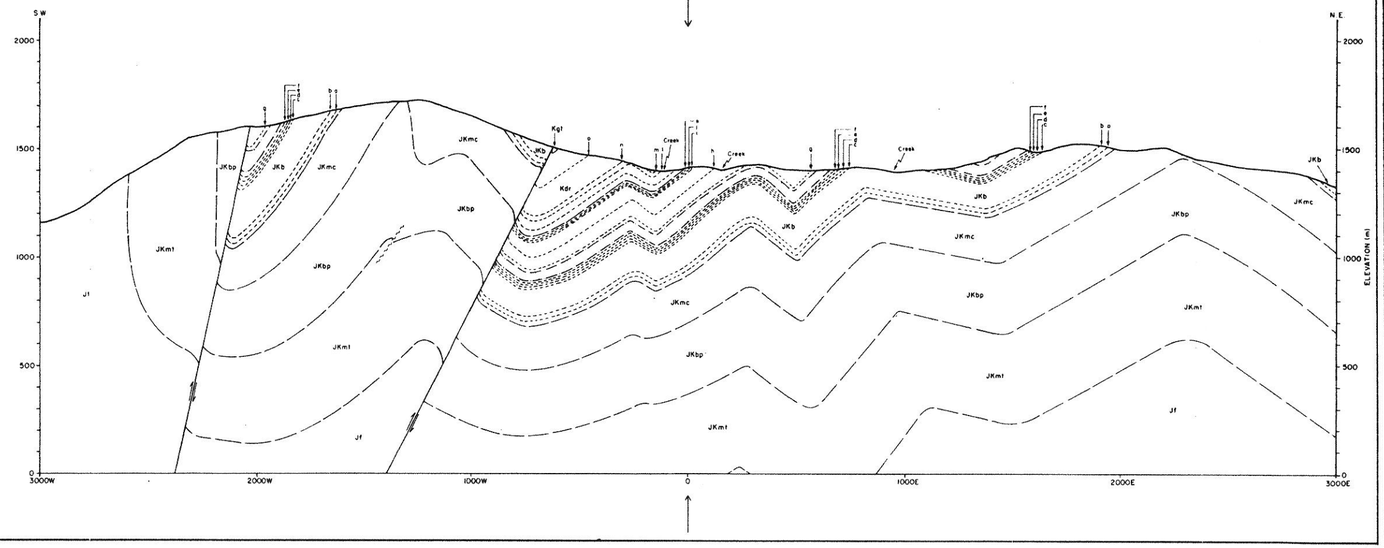
5.5.1.3 Coal Occurrences

During the 1982 mapping program a total of 29 coal exposures were trenched and logged within the Brenot Formation in the South Cirque, further confirming the prolific coal-bearing nature of the Brenot Formation in the area. In addition, four trenches were logged within the Gething Formation and one within the Dresser Formation. The prospect area contains 11 coal seams with an aggregate true thickness of approximately 18 metres (see Figure 5.5.1.3). Table 5.5.1.3 lists the major trenches by formation and the coal to coal plus rock ratios for all seams one metre or greater in true thickness. All trenches are shown and listed on a 1:50 000 Trench Location Map in Appendix C.

5000

LEGEND
COAL SEAM IDENTIFICATION

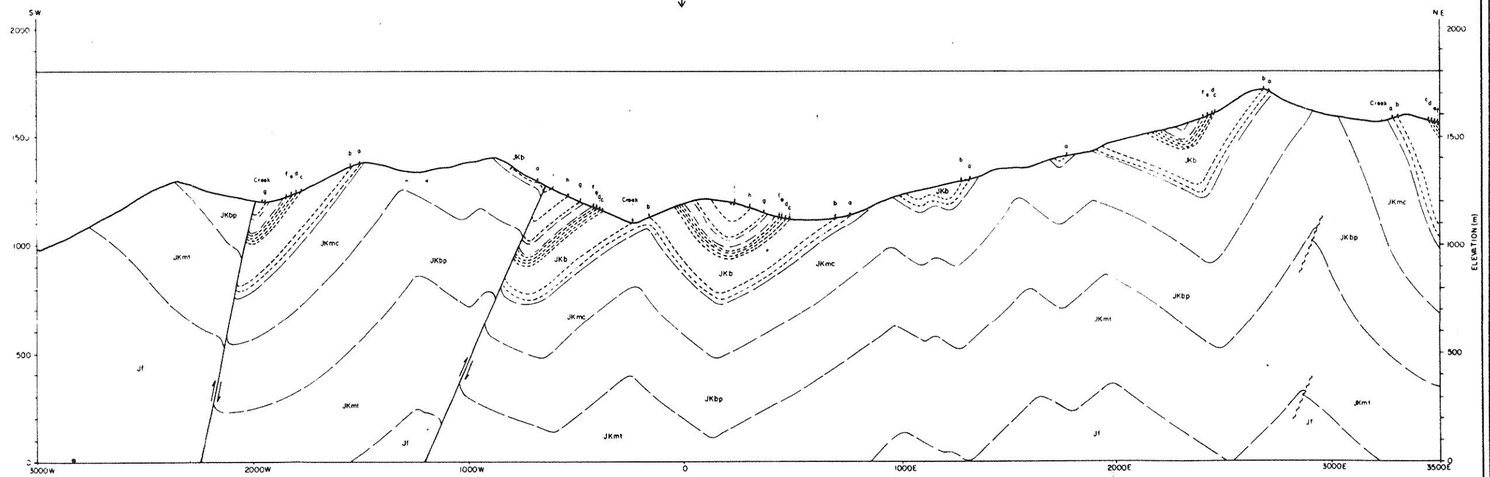
Fm	COAL SEAM	RATIO COAL/COAL + ROCK	TRENCH LOCATION No.
Kgt	q	133/133	(GDR-GS-TRC-82032)
	p	124/124	(GDR-GS-TRC-82033)
	o	083/110	(GRT-#G13)
Kdr	n	134/148	(GDR-GS-TRC-82034)
	m	141/194	(GRT-#G3)
	l	112/112	(GRT-#B35)
	k	125/125	(GDR-GS-TRC-82018)
	j	176/176	(GDR-GS-TRC-82017)
	i	111/123	(GRT-#B30)
	h	097/097	(GDR-GS-TRC-82019)
	g	098/134	(GDR-GS-TRC-82021)
JKb	f	134/134	(GRT-#B18)
	e	115/115	(GDR-GS-TRC-82022)
	d	316/360	(GRT-#B16)
	c	178/216	(GDR-GS-TRC-82023)
	b	158/160	(GRT-#B3)
	a	170/170	(GRT-#B5)



7000

LEGEND
COAL SEAM IDENTIFICATION

Fm	COAL SEAM	RATIO COAL/COAL + ROCK	TRENCH LOCATION No.
Kgt	q	133/133	(GDR-GS-TRC-82032)
	p	124/124	(GDR-GS-TRC-82033)
	o	083/110	(GRT-#G13)
Kdr	n	134/148	(GDR-GS-TRC-82034)
	m	141/194	(GRT-#G3)
	l	112/112	(GRT-#B35)
	k	125/125	(GDR-GS-TRC-82018)
	j	176/176	(GDR-GS-TRC-82017)
	i	111/123	(GRT-#B30)
	h	097/097	(GDR-GS-TRC-82019)
	g	098/134	(GDR-GS-TRC-82021)
JKb	f	134/134	(GRT-#B18)
	e	115/115	(GDR-GS-TRC-82022)
	d	316/360	(GRT-#B16)
	c	178/216	(GDR-GS-TRC-82023)
	b	158/160	(GRT-#B3)
	a	170/170	(GRT-#B5)



LEGEND

JURASSIC — TRANSITIONAL — LOWER CRETACEOUS

BEAUDETTE GROUP

CRASSIER GROUP

- **Q** — *QUATERNARY*
  Glacial deposits & alluvium
- **Kcm** — *COMMOTION FORMATION*
  Siltstones, sandstones interbedded, claystones of marine origin, COAL at the top member & conglomerates
- **Kmb** — *MOOSEBAR FORMATION*
  Mudstones, minor siltstones, marine
- **Kbs** — *BLUESKY*
  Fine to medium grained sandstones, mudstones, thin conglomerate unit at top with or without glauconite
- **Kgt** — *GETHING FORMATION*
  Cyclothems, dark grey mudstones, siltstones, carbonaceous, silty, sandy mudstones, coalified plant debris, minor bentonite, black shales, and occasional minor tuffs in upper unit; COAL
- **Kdr** — *DRESSER FORMATION*
  Incomplete cyclothems, discontinuous coal measures in varying thicknesses, medium to very coarse grained sandstones, grits and conglomerates
- **JKb** — *BRENOT FORMATION*
  Lithic "salt & pepper" sandstones, siltstones, mudstones, carbonaceous mudstones; COAL
- **JKmc** — *MONACH FORMATION*
  Marine lithic & quartzose sandstone with thick beds of clean, coarse grained white quartzites at top. Minor shales, siltstones & sandstones with occasional thin conglomerates
- **JKbp** — *BEATTIE PEAKS FORMATION*
  Buff to brownish sandstones, fine to medium grained; thinly bedded black & dark grey shales, silty shales, siltstones, thin sandstones with ironstone banding
- **JKmt** — *MONTEITH FORMATION*
  Grey & brown sandstones, fine to medium grained; fine to very coarse grained quartzite. Minor beds of shales, and shales with siltstone & sandstone partings, occasional thin conglomerates
- **Jf** — *FERNIE FORMATION*
  Dark grey & black shales, mudstones, sandstones, siltstones, marine

↓ BASELINE LOCATION

--- --- COAL SEAM

NOTE : Section number indicates distances in metres along baseline from south to north to include all 1980 and 1981 drill holes.

SCALE 1:10,000
0 500 1000
METRES

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

FIGURE 5.5.1.3
GOODRICH COAL PROPERTY
GOODRICH SOUTH CIRQUE
TYPICAL CROSS SECTIONS
5000 , 7000

PREPARED BY: A. BIENIA	SCALE
APPROVED BY: DATE: OCT. / 82	DRAWING No.

TABLE 5.5.1.3

Goodrich South Cirque Trench Summary

Trench Number	Year 1980	Year 1982	Coal/Coal & Rock Ratios (True Thickness) Brenot Fm	Dresser Fm	Gething Fm
B3	X		1.58/1.60		
B5	X		1.70/1.70		
B16	X		3.16/3.60		
B18	X		1.34/1.34		
B30	X		1.11/1.23		
B35	X			1.12/1.12	
G3	X			1.41/1.94	
G13	X		0.83/1.10		
GS-TRC-82002		X	1.04/1.14		
GS-TRC-82007		X	1.66/1.66		
GS-TRC-82010		X	0.97/1.05		
GS-TRC-82017		X	1.76/1.76		
GS-TRC-82018		X	1.25/1.25		
GS-TRC-81019		X	0.97/0.97		
GS-TRC-82021		X	0.98/1.34		
GS-TRC-82022		X	1.15/1.15		
GS-TRC-82023		X	1.78/2.16		
GS-TRC-82032		X			1.33/1.33
GS-TRC-82033		X			1.24/1.24
GS-TRC-82034		X		1.34/1.48	

5.5.2 Goodrich South Table Prospect

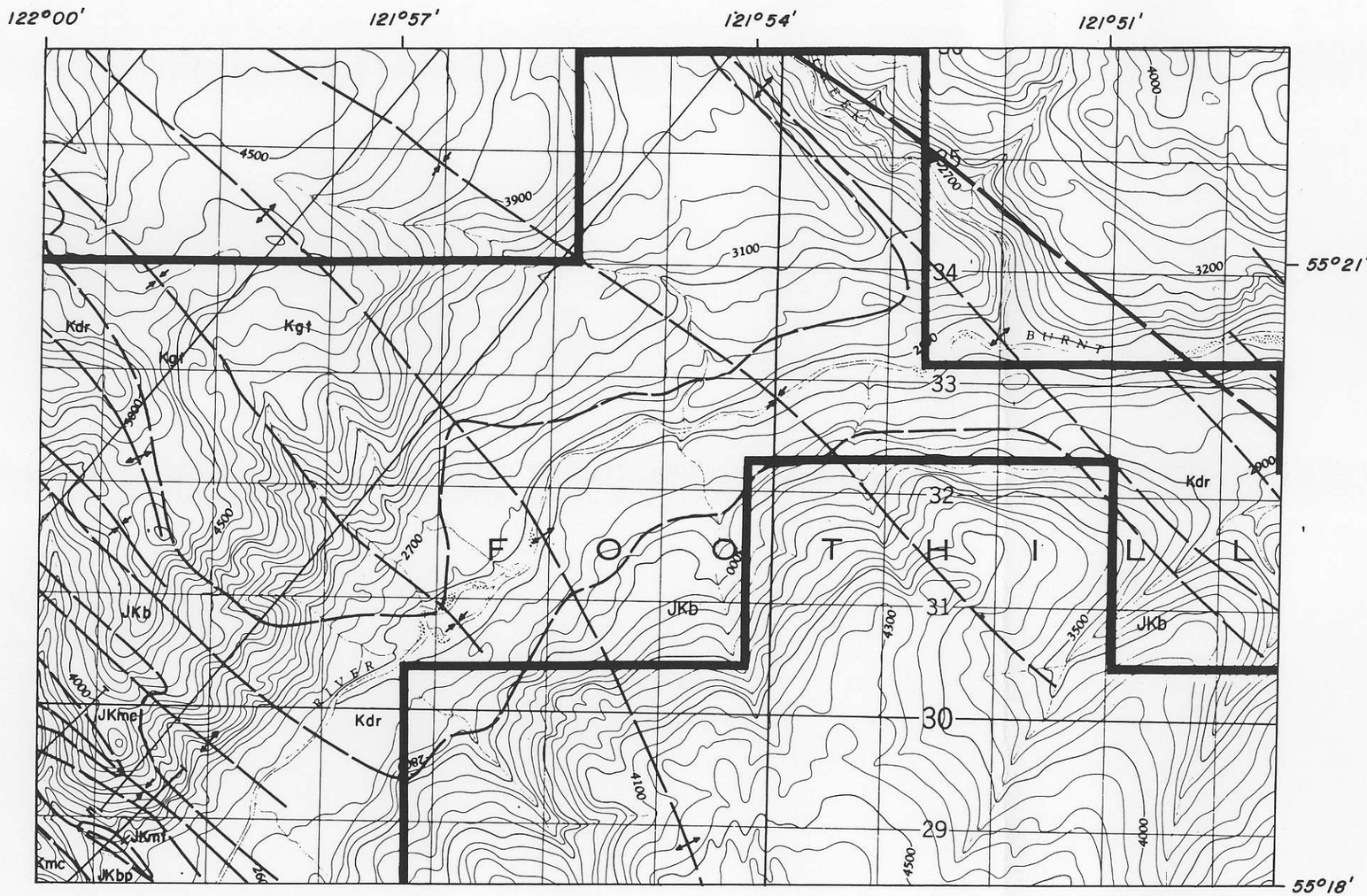
The Table Area covers approximately 14 900 hectares, or 29 coal licences and is located at the easternmost extension of the Goodrich Property (See Figure 5.5.2).

The major structure in the area is an undisturbed shallow-dipping box anticline that exposes a large area of coal-bearing Gething sediments. During the 1982 field season a significant 7.0 metre seam was trenched in the Upper Gething Formation. Four more seams of at least one metre each were identified, bringing the total to at least five seams in the Gething with an aggregate mineable thickness of approximately 14 metres. In-situ resources calculated on the basis of 1982 trench data are 198 million tonnes. No drill hole data is available to date in this region; however, extrapolation from better known areas indicates a high possibility of more than five seams being present, thereby significantly increasing this potential.

This area is close to road access and appears highly attractive for future development.

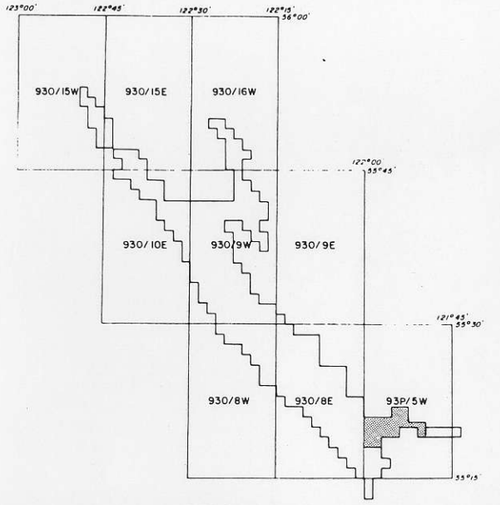
5.5.2.1 Folds

The folds in this area are northwesterly trending, and show a gentle southeast plunge. There



LEGEND

- Property Boundary
- Coal Seam Subcrop
- Geological Boundary, (defined, approximate)
- Anticline (defined, approximate)
- Syncline (defined, approximate)
- Anticline and Syncline (overturned)
- Fault (defined showing dip, approx. position of fault)
- Normal Fault
- Strike and Dip (bedding, overturned bedding)
- A — A' Cross Section Location
- Monocline
- Bedding (vertical, horizontal)
- Kgt — Gething
- JKb — Brenct



INDEX MAP

0 1000 2000 3000 4000

scale in metres

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

FIGURE 5.5.2
GOODRICH COAL PROPERTY
GOODRICH SOUTH
TABLE AREA LOCATION

PREPARED BY: A. BIENIA	SCALE 1: 50,000
APPROVED BY: DATE: OCT. 82	DRAWING No.

are two major fold structures occuring in the Table area, from west to east these are:

1) The Goodrich Anticline
2) The Table Syncline

The Goodrich Anticline defines the southwest boundary of this block and has little effect on the geology of the Table area. It is a tight, chevron fold, slightly overturned to the east in places, and it appears to open towards the south. This anticline exposes older strata of the Beaudette Group in its core and coal-bearing Crassier strata on its limbs.

Numerous low amplitude folds occur between the Goodrich Anticline and the Table Syncline. These folds die out rapidly to the southeast.

The Table Syncline originates north of the Brazion Creek and extends southeast past the Burnt River. This syncline is the dominant feature of the area; it is a broad open fold with shallow-dipping relatively undisturbed strata. This structure exposes a large area of coal-bearing Gething sediments.

5.5.2.2 Faults

There are two major faults that extend into the Table area. These are from west to east:

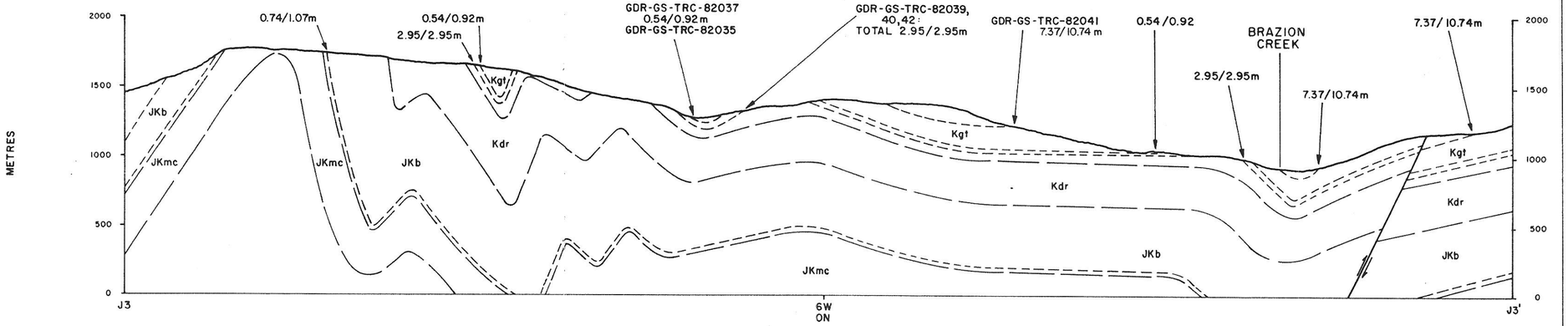
1) The Burnt Normal Fault
2) The East Thrust

The Beaudette Thrust dies out in the northwestern portion of the area and has very little effect on the geology.

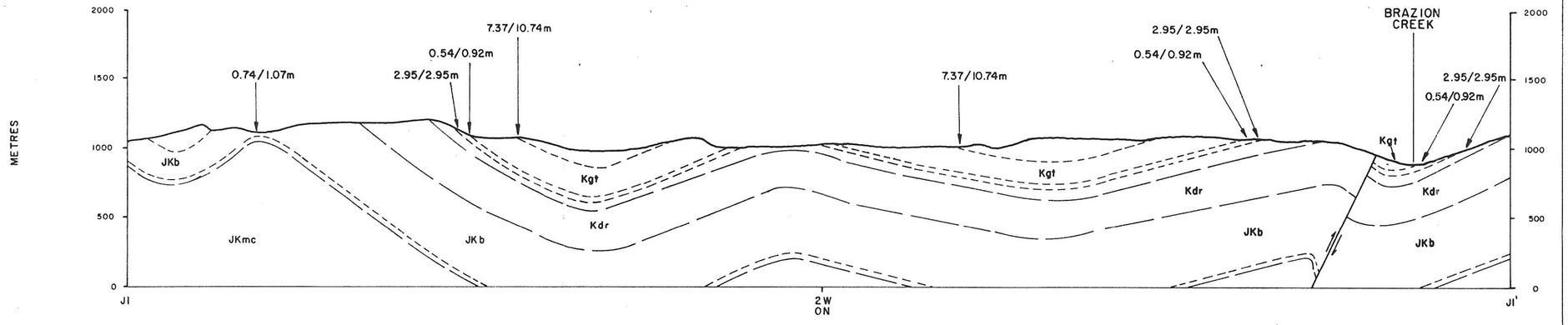
The Burnt Normal Fault is a listric normal fault that only slightly affects the northwestern corner of the Table area (see cross section (J_5-J^1_5). It shows approximately 150 metres displacement, with Dresser sediments lying over Brenot.

The East Thrust is located 8 kilometres east of the Goodrich Anticline. This thrust defines the eastern most boundary of the area. Displacement is minor, ranging from 100 to 150 metres thrusting coal-bearing Crassier onto itself.

J3 - J3'



J1 - J1'



LEGEND

- Q — QUATERNARY — Glacial deposits & alluvium
- Kcm — COMMOTION FORMATION — Siltstones, sandstones interbedded, claystones of marine origin, COAL at the top member & conglomerates
- Kmb — MOOSEBAR FORMATION — Mudstones, minor siltstones, marine
- Kbs — BLUESKY — Fine to medium grained sandstones, mudstones, thin conglomerate unit at top with or without glauconite
- Kgt — GETHING FORMATION — Cyclothems; dark grey mudstones, siltstones, carbonaceous, silty, sandy mudstones, coalified plant debris, minor bentonite, black shales, and occasional minor tufts in upper unit; COAL
- Kdr — DRESSER FORMATION — Incomplete cyclothems, discontinuous coal measures in varying thicknesses, medium to very coarse grained sandstones, grits and conglomerates
- JKb — BRENOT FORMATION — Lithic "salt & pepper" sandstones, siltstones, mudstones, carbonaceous mudstones; COAL
- JKmc — MONACH FORMATION — Marine lithic & quartzose sandstone with thick beds of clean, coarse grained white quartzites at top. Minor shales, siltstones & sandstones with occasional thin conglomerates
- JKbp — BEATTIE PEAKS FORMATION — Buff to brownish sandstones, fine to medium grained; thinly bedded black & dark grey shales, silty shales, siltstones, thin sandstones with ironstone banding
- JKmf — MONTEITH FORMATION — Grey & brown sandstones, fine to medium grained; fine to very coarse grained quartzite. Minor beds of shales, and shales with siltstone & sandstone partings, occasional thin conglomerates
- Jf — FERNIE FORMATION — Dark grey & black shales, mudstones, sandstones, siltstones, marine

JURASSIC — TRANSITIONAL — LOWER CRETACEOUS
BEAUDETTE GROUP — GRASSIER GROUP

↓ BASELINE LOCATION

--- --- COAL SEAM

NOTE Section number indicates distances in metres along baseline from south to north to include all 1980 and 1981 drill holes.

0 200 400 600 800 metres

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

FIGURE 5.5.2.3

GOODRICH COAL PROPERTY

GOODRICH SOUTH TABLE AREA TYPICAL CROSS SECTIONS

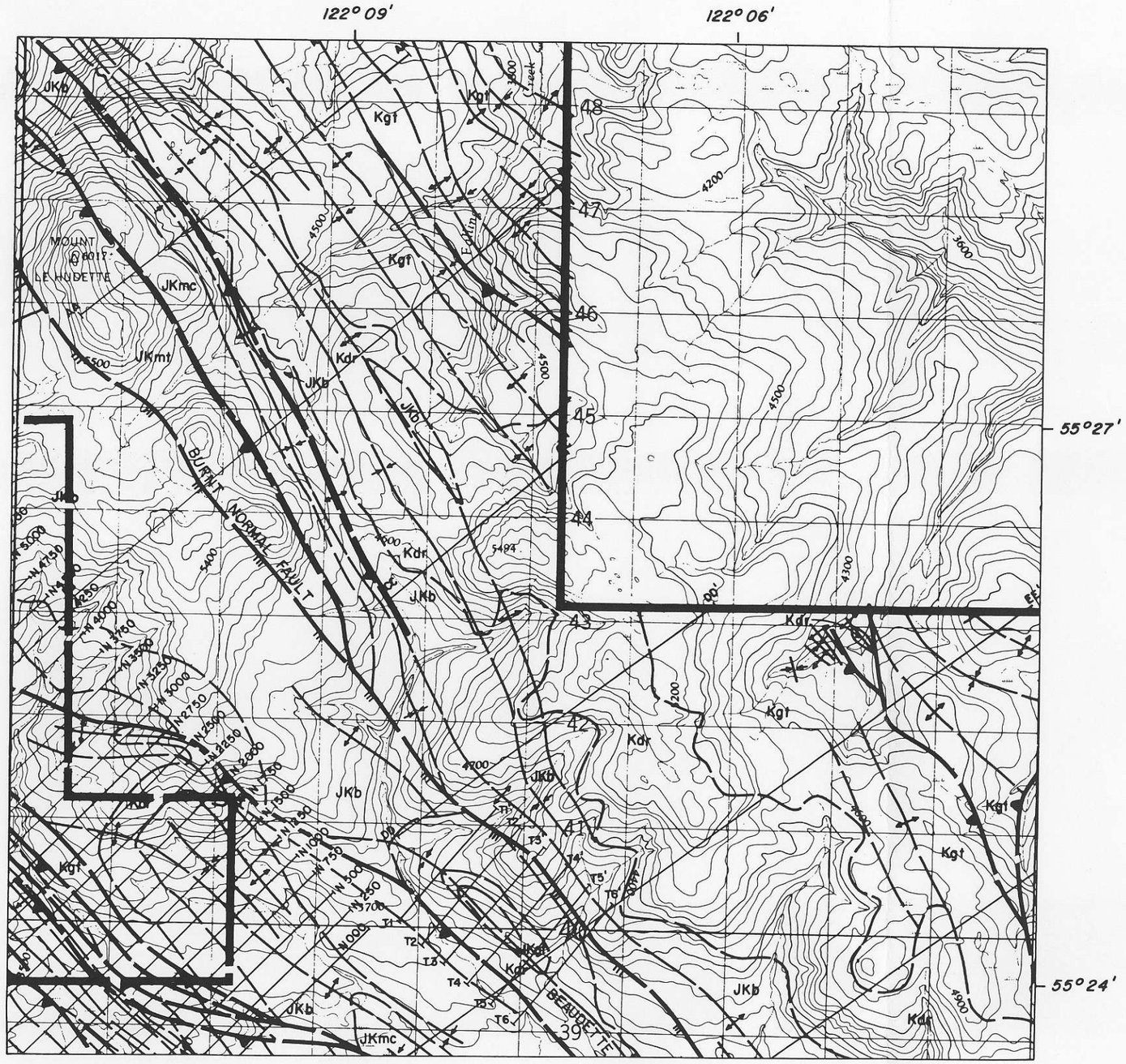
J1 - J1', J3 - J3'.

PREPARED BY: A. BIENIA	SCALE
APPROVED BY:	DATE: OCT. / 82 — DRAWING No.

5.5.2.3 Coal Occurrences

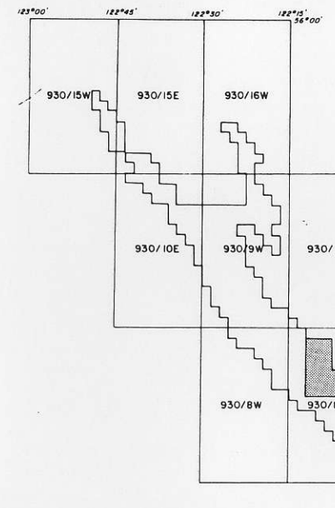
During the 1982 field season sixteen coal exposures were trenched in the Table Area, twelve in the Gething Formation, and four in the Brenot Formation. The most significant seam trenched was located in the upper Gething exposed near the top of the shallow dipping table ridge. This seam is represented in trench log GDR-GS-TRC-82041 (refer to Appendix C) and has a coal/coal plus rock ratio of 7.37/10.74 m. Full scale maps and cross-sections of the Table area are provided in Appendix A. At least four other seams approximately one metre each have also been identified in this area to date.

This major synclinal structure with shallow dips ranging from 10° to 15° is located approximately 1.5 kilometres from the Hasler Creek road, making it geologically and geographically highly favourable for future development (see Figure 5.5.2.3).



LEGEND

- Property Boundary
- Coal Seam Subcrop
- Geological Boundary, (defined, approximate)
- Anticline (defined, approximate)
- Syncline (defined, approximate)
- Anticline and Syncline (overturned)
- Fault (defined showing dip, approx. position of fault)
- Normal Fault
- Strike and Dip (bedding, overturned bedding)
- Cross Section Location (A — A')
- Monocline
- Bedding (vertical, horizontal)
- Kgt — Gething
- JKb — Brenot



INDEX MAP

0 1000 2000 3000 4000

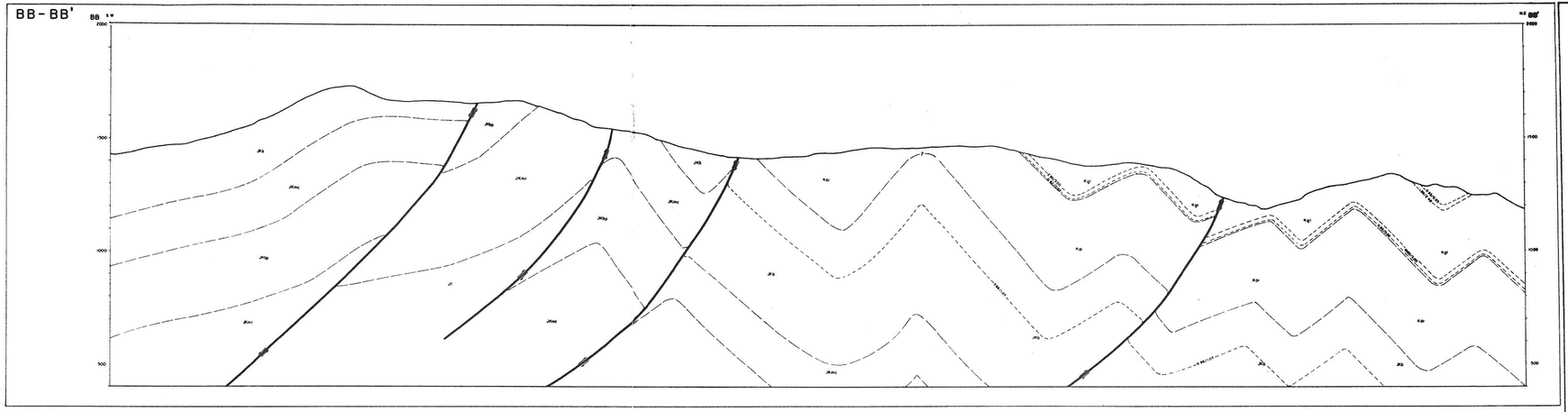
scale in metres

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

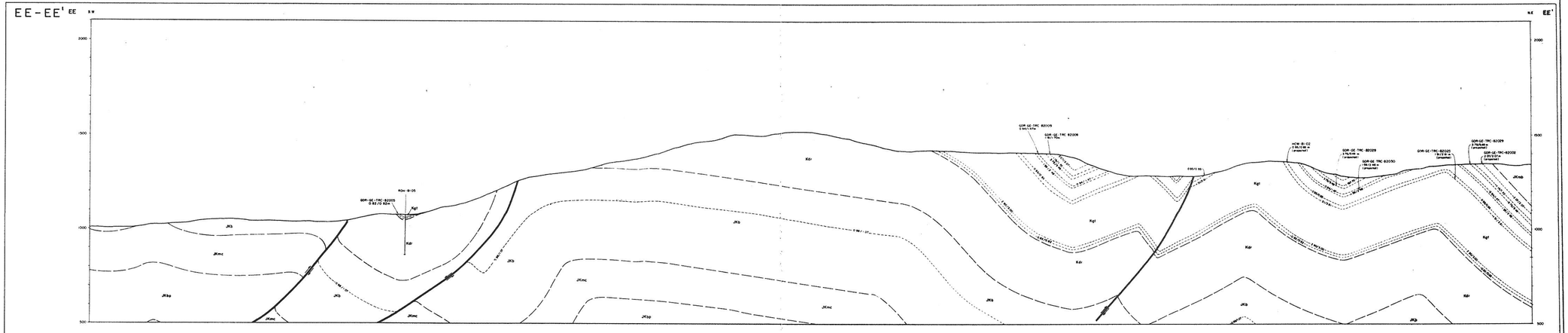
FIGURE 5.5.3
GOODRICH COAL PROPERTY
HASLER CREEK PROSPECT
LOCATION

PREPARED BY: A. BIENIA	SCALE 1:50,000
APPROVED BY:	DATE: OCT. 82 DRAWING No.

BB-BB'



EE-EE'



LEGEND

LOWER CRETACEOUS — TRANSITIONAL — JURASSIC

CRASSIER GROUP

- **Q** — *QUATERNARY*
  Glacial deposits & alluvium
- **Kcm** — *COMMOTION FORMATION*
  Siltstones, sandstones interbedded, claystones of marine origin, COAL at the top member & conglomerates
- **Kmb** — *MOOSEBAR FORMATION*
  Mudstones, minor siltstones, marine
- **Kbs** — *BLUESKY*
  Fine to medium grained sandstones, mudstones, thin conglomerate unit at top with or without glauconite
- **Kgt** — *GETHING FORMATION*
  Cyclothems, dark grey mudstones, siltstones, carbonaceous, silty, sandy mudstones, coalified plant debris, minor bentonite, black shales, and occasional minor tuffs in upper unit; COAL
- **Kdr** — *DRESSER FORMATION*
  Incomplete cyclothems, discontinuous coal measures in varying thicknesses, medium to very coarse grained sandstones, grits and conglomerates
- **JKb** — *BRENOT FORMATION*
  Lithic "salt & pepper" sandstones, siltstones, mudstones, carbonaceous mudstones; COAL

BEAUDETTE GROUP

- **JKmc** — *MONACH FORMATION*
  Marine lithic & quartzose sandstone with thick beds of clean, coarse grained white quartzites at top. Minor shales, siltstones & sandstones with occasional thin conglomerates
- **JKbp** — *BEATTIE PEAKS FORMATION*
  Buff to brownish sandstones, fine to medium grained; thinly bedded black & dark grey shales, silty shales, siltstones, thin sandstones with ironstone banding
- **JKmt** — *MONTEITH FORMATION*
  Grey & brown sandstones, fine to medium grained; fine to very coarse grained quartzite. Minor beds of shales, and shales with siltstone & sandstone partings, occasional thin conglomerates
- **Jf** — *FERNIE FORMATION*
  Dark grey & black shales, mudstones, sandstones, siltstones, marine

↓ BASELINE LOCATION

--- --- COAL SEAM

NOTE : Section number indicates distances in metres along baseline from south to north to include all 1980 and 1981 drill holes.

0 100 200 300 400 500
SCALE IN METRES

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

FIGURE 5.5.3.3
GOODRICH COAL PROPERTY
HASLER CREEK AREA
TYPICAL CROSS SECTIONS
BB-BB', EE-EE'

PREPARED BY: A. BIENIA	SCALE
APPROVED BY:	DATE: OCT. / 82
	DRAWING No.

5.5.3 Hasler Creek Prospect

The Hasler Creek Prospect lies on the eastern edge of the Goodrich East Block. Its approximate geographical boundaries are the Falling Creek Anticline to the west, Hasler Creek to the east, Brazion Creek to the south and Falling Timber Creek to the north. (See Figure 5.5.3 for the approximate area).

Structurally the area is controlled by the easterly-dipping limb of the Falling Creek Anticline. In addition, several lesser parasitic folds exist with a northwest - southeast trend. The structures appear to have a gentle plunge to the northwest.

Stratigraphically, the area consists mainly of the Gething and Dresser Formations with some Brenot outcropping in the Brazion Creek Valley. The Dresser Formation is largely confined to the western and southern edges of the prospect area. The Gething Formation forms the majority of the easterly-dipping limb. It should be noted that the very eastern edge of prospect area may contain a complete or nearly complete section of Gething.

This pseudo-dip slope situation contains potential for near surface coal. To date only hand trenches have been dug in the Hasler Creek Prospect and there has been no

drilling. Maps and cross-sections for the prospect are listed under Goodrich East and can be found in Appendix A, Part 1. This prospect has the potential to contain additional coal seams not located by surface trenching.

5.5.3.1 Folds

As previously stated the Hasler Creek prospect area is formed by the easterly dipping limb of the Falling Creek Anticline. This anticline begins northeast of Mt. LeHudette and follows the regional trend northwest to southeast. The anticline is contained largely within the Dresser and Brenot Formations.

Additional folds are numerous and largely parasitic in nature. These parasitic folds are contained mainly within the Gething Formation and are cuspate in fold style. Regionally, the plunge is low and to the northwest.

5.5.3.2 Faults

At this time only one thrust of any sizeable displacement is believed to exist within this prospect. The Boundary Thrust, which has a displacement of 30 to 50 metres, results in a partial repeat of the Gething section.

Smaller faults are present throughout the area, however, the exact number and their extent are not known at this time.

5.5.3.3 Coal Occurrences

Coal/coal plus rock ratios within the Hasler Creek Prospect area range from 0.24/0.24 metres to 3.75/5.49 metres in true thickness. Most of these coal occurrences have been found within the Gething Formation. A few have been trenched and logged within the Dresser and Brenot sequences. To date a total of 14 trenches have been dug in the Hasler Creek Prospect area (see Figure 5.5.3.3).

Based on the known coal seams listed in Table 5.5.3.3 the inferred resources for the Hasler Creek Prospect have been calculated at 271 million tonnes.

TABLE 5.5.3.3

Hasler Creek Prospect - Trench Summary

Data Source	Coal/Coal plus Rock Ratio (True Thickness)
GDR-GE-TRC-82002	2.02/2.07 m
GDR-GE-TRC-82025	1.51/2.61 m
GDR-GE-TRC-82028	1.19/1.70 m
GDR-GE-TRC-82029	3.75/5.49 m
GDR-GE-DDH-81004	2.90/3.00 m
GDR-GE-DDH-81044	0.82/0.82 m

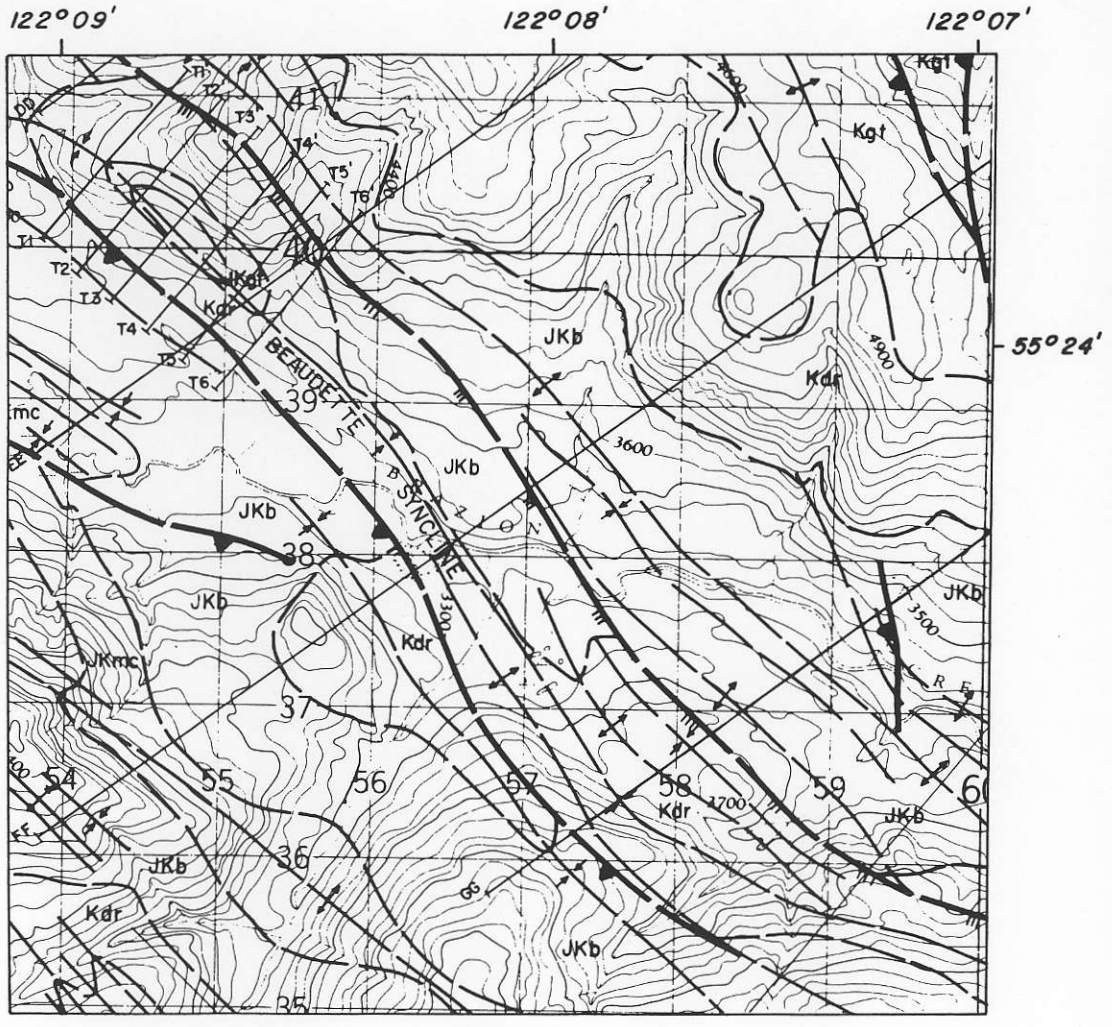
5.5.4 Beaudette Syncline Prospect

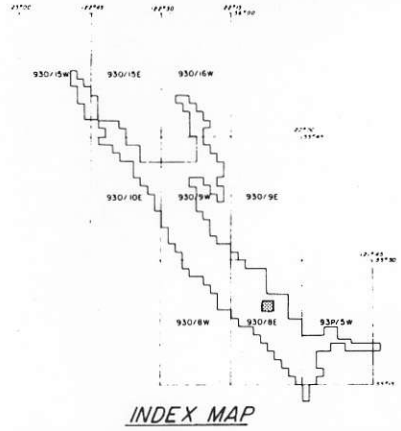
The western portion of the Goodrich East Block contains the Beaudette Syncline Prospect. The geographical and geological limits of the prospect are outlined by the Goodrich Anticline to the south, the west limb of the Falling Creek Anticline to the east, Brenot Creek to the west and Mt. LeHudette to the north (see Figure 5.5.4).

Geologically, the area consists of folded and faulted Monteith to Gething sediments. Structurally, the trend is northwest to southeast. The maps and cross sections for this prospect area are listed under Goodrich East and can be found in Appendix A, Part 1.

Potential for this prospect area lies within several small synclines. The first and best known area of coal potential is the trenched and drilled Beaudette Syncline which contains the basal Gething coal seam. In addition, the area immediately along strike and down plunge to the south, holds potential for further low strip ratio coal. This extension of the Beaudette Syncline runs from north of Brazion Creek Road southwards along strike across Brazion Creek, for a distance of approximately seven kilometres and has a width of 0.5 to 1.0 kilometres.

Because the area is heavily tree covered, exposure is limited. Therefore, the testing of the Beaudette Syncline and its extention will require further drilling and mapping.





INDEX MAP

0 1000 2000 3000 4000

scale in metres

LEGEND

- Property Boundary
- Coal Seam Subcrop
- Geological Boundary (defined approximate)
- Anticline (defined approximate)
- Syncline (defined approximate)
- Anticline and Syncline (overturned)
- Fault (defined showing dip, approx. position of fault)
- Normal Fault
- Strike and Dip (bedding, overturned bedding)
- A — A' Cross Section Location
- Monocline
- Bedding (vertical, horizontal)
- Kgt — Gething
- JKb — Brenot

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

Gulf

FIGURE 5.5.4
GOODRICH COAL PROPERTY
BEAUDETTE SYNCLINE LOCATION

PREPARED BY: A. BIENIA		SCALE 1:50,000
APPROVED BY:	DATE: OCT. 82	DRAWING No.

To date less than one million tonnes has been identified for the Beaudette Syncline alone but there is a potential for an additional 2 - 3 million tonnes in the Beaudette extension.

5.5.4.1 Folds

Folding within the Beaudette Prospect is primarily of the cuspate to chevron style. The dominant folds are the Burnt Anticline which exposes the older Monteith to Monach Formations; the Goodrich Anticline again exposing older Beattie Peaks and Monach Formations; the Falling Creek Anticline exposing Dresser and Gething sediments, and the Beaudette Syncline which contains the coal-bearing Dresser and Gething Formations (see Figure 5.5.4.3).

All folds follow the northwest to southeast regional trend but with varying plunges. The Burnt Anticline and Beaudette Syncline plunge to the southeast, while the Falling Creek Anticline and the Goodrich Anticline both have a northern plunge.

5.5.4.2 Faults

Three major thrust faults are believed to exist within the Beaudette Prospect area. They are

from west to east the Brazion Thrust, the Beaudette Thrust and the Falling Creek Thrust. All of the thrusts trend from northwest to southeast.

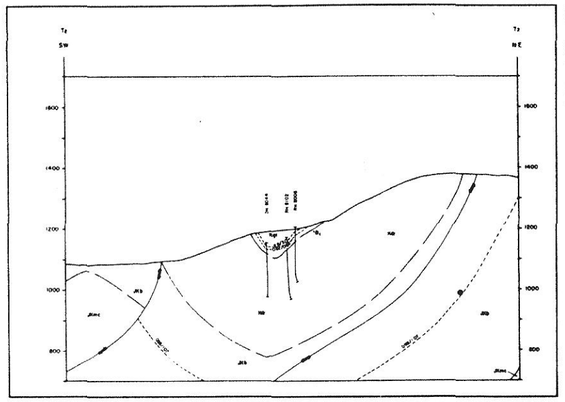
The Brazion Thrust appears to originate within the vicinity of Brazion Creek. The Beaudette Thrust originates northeast of Goodrich Peak whereas the Falling Creek Thrust originates southeast of Mt. LeHudette.

5.5.4.3 Coal Occurrences

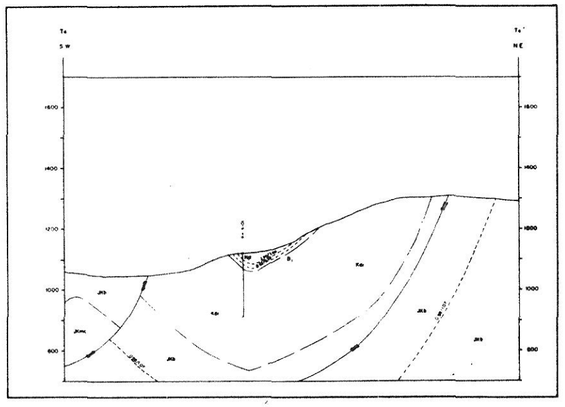
Known coal occurrences within the Beaudette prospect are currently confined to the immediate vicinity of the Beaudette Syncline. Many exposures are the result of the logging and road building activities of Canfor Ltd. in the area.

The Beaudette Syncline has to date had eight rotary and diamond holes drilled within the syncline for a total of 1642 metres of drilling. As a result of these holes and numerous trenches approximately one million tonnes of in-situ coal have been identified. However, as previously stated, additional potential does exist to the south and should be investigated. See Tables 5.5.4.3 and 5.5.4.3.1 for a list of data sources for the area.

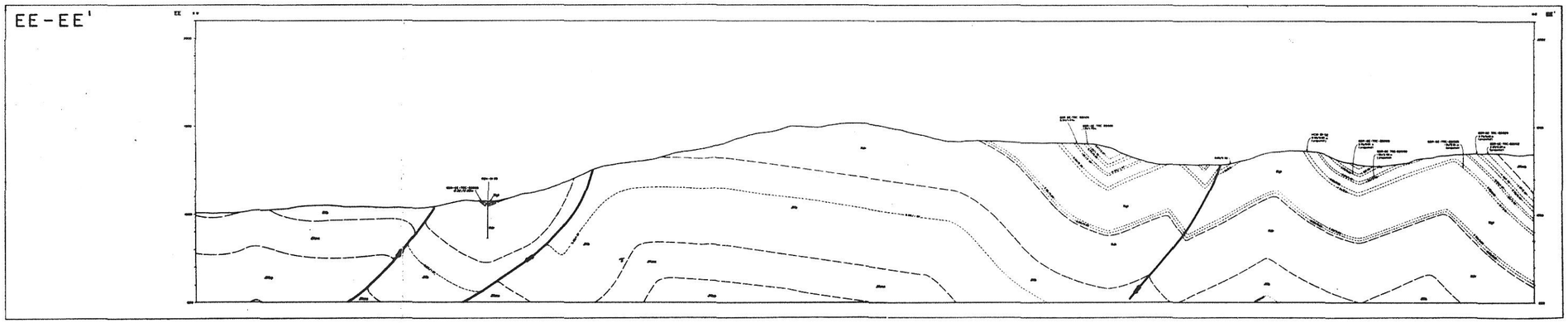
T2-T2'



T4-T4'



EE-EE'



LEGEND

JURASSIC — TRANSITIONAL — LOWER CRETACEOUS

	Q	QUATERNARY Glacial deposits & alluvium
	Kcm	COMMOTION FORMATION Siltstones, sandstones interbedded, claystones of marine origin, COAL at the top member & conglomerates
	Kmb	MOOSEBAR FORMATION Mudstones, minor siltstones, marine
	Kbs	BLUESKY Fine to medium grained sandstones, mudstones, thin conglomerate unit at top with or without glauconite
CRASSIER GROUP	Kgt	GETHING FORMATION Cyclothems; dark grey mudstones, siltstones, carbonaceous, silty, sandy mudstones; coalified plant debris, minor bentonite, black shales, and occasional minor tufts in upper unit; COAL
CRASSIER GROUP	Kdr	DRESSER FORMATION Incomplete cyclothems, discontinuous coal measures in varying thicknesses, medium to very coarse grained sandstones, grits and conglomerates
	JKb	BRENOT FORMATION Lithic "salt & pepper" sandstones, siltstones, mudstones, carbonaceous mudstones; COAL
BEAUDETTE GROUP	JKmc	MONACH FORMATION Marine lithic & quartzose sandstone with thick beds of clean, coarse grained white quartzites at top. Minor shales, siltstones & sandstones with occasional thin conglomerates
BEAUDETTE GROUP	JKbp	BEATTIE PEAKS FORMATION Buff to brownish sandstones, fine to medium grained; thinly bedded black & dark grey shales, silty shales, siltstones, thin sandstones with ironstone banding
BEAUDETTE GROUP	JKmt	MONTEITH FORMATION Grey & brown sandstones, fine to medium grained; fine to very coarse grained quartzite. Minor beds of shales, and shales with siltstone & sandstone partings, occasional thin conglomerates
	Jf	FERNIE FORMATION Dark grey & black shales, mudstones, sandstones, siltstones, marine

↓ BASELINE LOCATION

--- --- COAL SEAM

NOTE : Section number indicates distances in metres along baseline from south to north to include all 1980 and 1981 drill holes.

0 200 400 600 800 metres

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

FIGURE 5.5.4.3
GOODRICH COAL PROPERTY
BEAUDETTE SYNCLINE
TYPICAL CROSS SECTIONS
T_2-T_2', T_4-T_4', EE-EE'

PREPARED BY: A. BIENIA	SCALE
APPROVED BY: DATE: OCT. / 82	DRAWING No.

TABLE 5.5.4.3

Beaudette Syncline Prospect
Drill Hole Summary

Data Source	Coal Zone Major Intersections (metres)
GDR-XX-DDH-80-44	2.79
GDR-XX-RDH-80-05	2.74
GDR-XX-RDH-80-06	1.42
GDR-XX-RDH-80-01	2.16
GDR-XX-RDH-81-02	2.50
GDR-XX-RDH-81-03	2.34
GDR-XX-RDH-81-04	1.87

TABLE 5.5.4.3.1

Beaudette Syncline Trench Summary

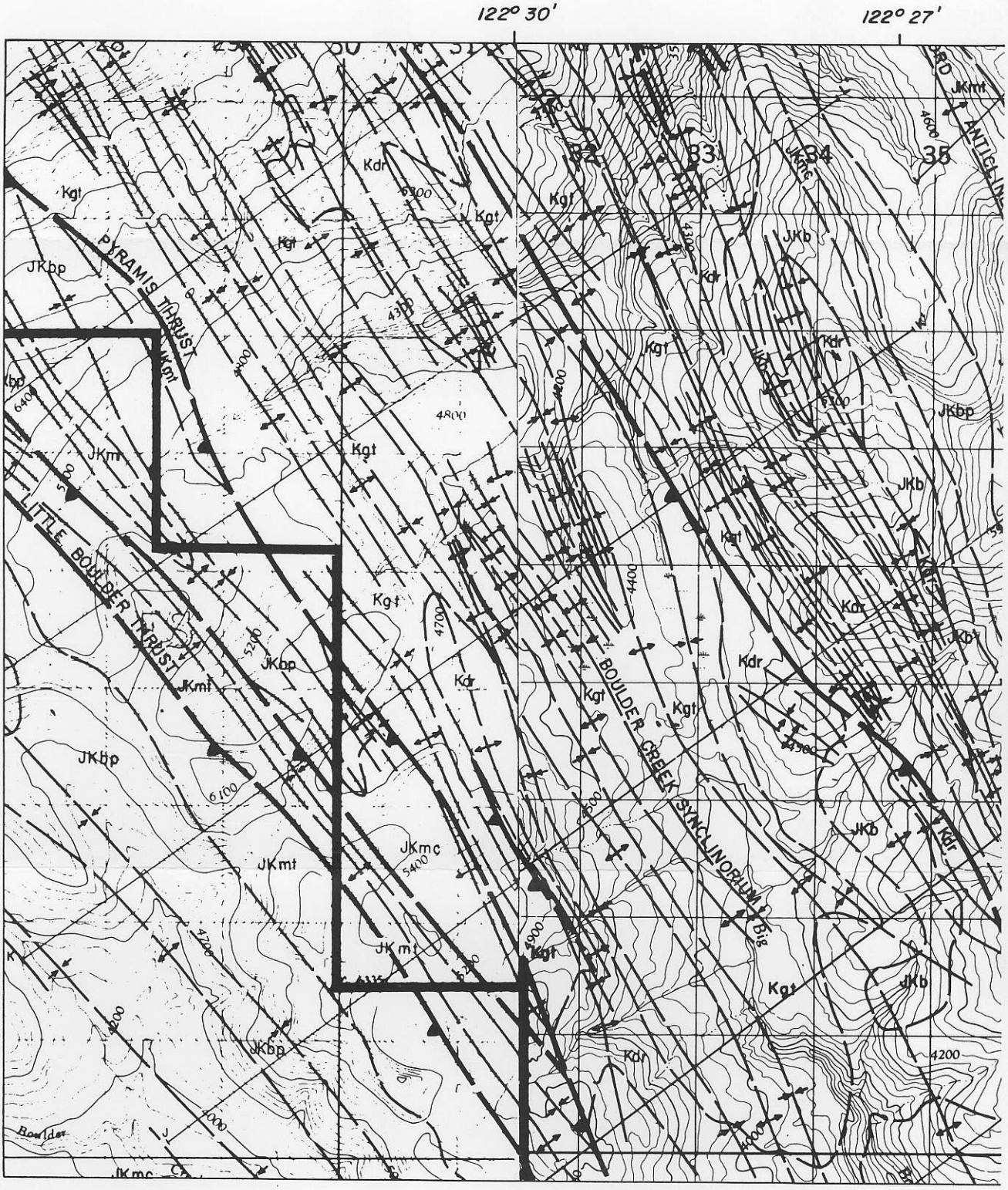
Data Source	Coal/Coal plus Rock Ratio
GDR-GE-TRC-82004	3.07/3.07 m

5.5.5 Goodrich Central Prospects

The Goodrich Central Block is the largest block on the Goodrich Property, covering approximately 29 000 hectares in a highly favourble coal-bearing region of Cretaceous sediments in the Rocky Mountain Foothills. The area straddles the John Hart Highway and extends from the Moberly River south to the Lossan Block and from Mt. Bickford west to Le Moray and Little Boulder Creeks (see Figure 5.5.5 a and b).

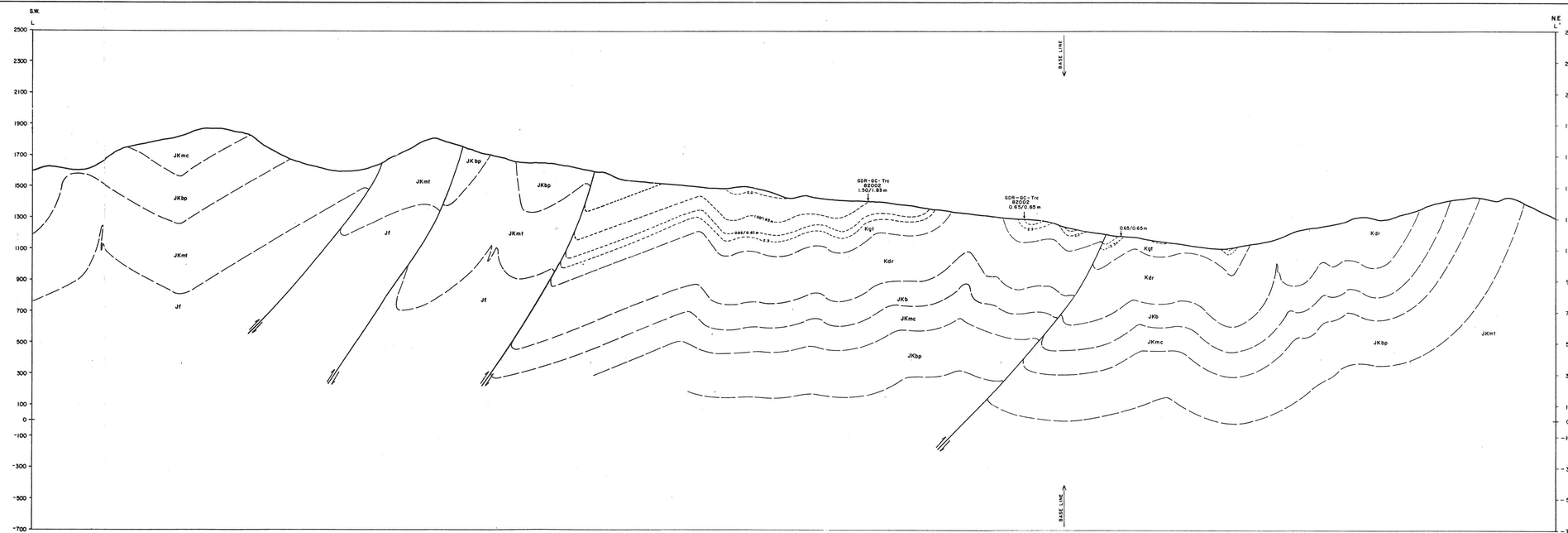
Structures in the Goodrich Central block are northwesterly trending, exposing strata from the Jurassic Fernie Formation to the Lower Cretaceous Gething Formation, as shown in cross section G-G^1 in Appendix A, Part 2. Geologically, the area is bisected by the Boulder Anticline arch which is a region of pronounced plunge reversal in the northwesterly trending Boulder Anticline. The arch occurs approximately at the Pine River Valley. Synclinoriums north and south of the valley hold significant coal potential in the Gething and Dresser Formations. The Lossan Mine Area is located along the same trend only a few kilometres to the south.

Outcrop exposure is poor in this area but information gathered from trenches and drill hole intersections has provided a calculation of inferred resources of 195 million tonnes in the Gething Formation and 61 million tonnes in the Dresser Formation.


122° 30'
122° 27'
PYRAMID THRUST
LITTLE BOULDER THRUST
BOULDER CREEK SYNCLINORIUM
ANTICLINE
Kgt
Kdr
JKbp
JKmt
JKmc
JKb
JKmt
Boulder


122° 24'
122° 21'
122° 18'
Kgt
JKmt
5200
Kdl
5000
Kdr
JKb
JKmc
3700
4000
4200
50
JKb
4700
49
Kdr
Kgt
Kdr
JKmt
JKb
5200
48
JKmc
JKb
Beaudette
Le Murray
3700
JKmt
5400
JKb
Kdr
JKbp
JKbp
47
Kgt
GOODRICH
CENTRAL
SYNCLINORIUM
4400
Kgt
Kdr
Falls
46
5100
JKmt
3800
JKmt
Kgt
Kdr
JKbp
JKb
45
5600

L - L '



LEGEND

- Q — QUATERNARY — Glacial deposits & alluvium
- Kcm — COMMOTION FORMATION — Siltstones, sandstones interbedded, claystones of marine origin, COAL at the top member & conglomerates
- Kmb — MOOSEBAR FORMATION — Mudstones, minor siltstones, marine
- Kbs — BLUESKY — Fine to medium grained sandstones, mudstones, thin conglomerate unit at top with or without glauconite
- Kgt — GETHING FORMATION — Cyclothems, dark grey mudstones, siltstones, carbonaceous, silty, sandy mudstones, coalified plant debris, minor bentonite, black shales, and occasional minor tuffs in upper unit; COAL
- Kdr — DRESSER FORMATION — Incomplete cyclothems, discontinuous coal measures in varying thicknesses, medium to very coarse grained sandstones, grits and conglomerates
- JKb — BRENOT FORMATION — Lithic "salt & pepper" sandstones, siltstones, mudstones, carbonaceous mudstones; COAL
- JKmc — MONACH FORMATION — Marine lithic & quartzose sandstone with thick beds of clean, coarse grained white quartzites at top. Minor shales, siltstones & sandstones with occasional thin conglomerates
- JKbp — BEATTIE PEAKS FORMATION — Buff to brownish sandstones, fine to medium grained, thinly bedded black & dark grey shales, silty shales, siltstones, thin sandstones with ironstone banding
- JKmt — MONTEITH FORMATION — Grey & brown sandstones, fine to medium grained, fine to very coarse grained quartzite. Minor beds of shales, and shales with siltstone & sandstone partings, occasional thin conglomerates
- Jf — FERNIE FORMATION — Dark grey & black shales, mudstones, sandstones, siltstones, marine

JURASSIC — TRANSITIONAL — LOWER CRETACEOUS — CRASSIER GROUP — BEAUDETTE GROUP

↓ BASELINE LOCATION

COAL SEAM

NOTE : Section number indicates distances in metres along baseline from south to north to include all 1980 and 1981 drill holes.

0 200 400 600 800 1000

scale in metres

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

FIGURE 5.5.5.1
GOODRICH COAL PROPERTY
GOODRICH CENTRAL NORTH
TYPICAL CROSS SECTION
L - L'

PREPARED BY: A. BIENIA	SCALE
APPROVED BY:	DATE: OCT. / 82 DRAWING No.

5.5.5.1 Folds

Major fold structures in the Goodrich Central block are generally northwest-trending and all undergo a prominant plunge reversal at the Pine River Valley. Those structures north of the Boulder Anticline arch plunge northwest while those to the south of the arch are generally southeast plunging. The folds are predominantly symmetrical and chevron, tighten to the west, and exhibit decollement features and associated drag folding as illustrated by Goodrich Central cross sections $E\text{-}E^1$ to $0\text{-}0^1$ found in Appendix A, Part 2.

For ease of discussion of folds, the area of Goodrich Central is divided into two areas: north and south of the Boulder Anticline arch, i.e. north and south of the John Hart Highway (see Figures 5.5.5 (a) and 5.5.5. (b). North of the highway, there are five major fold structures, from west to east these are: The Moberly Anticline, the Boulder Creek Synclinorium, the Big Boulder Anticline, the Coyote Syncline and the Bickford Anticline.

The Moberly Anticline which extends from the Whiterabbit Block south to the Pine Valley, exposes older Beaudette Group strata at its core.

The major structure of economic interest in the Goodrich Central Block north of the highway is the

Boulder Creek Synclinorium which plunges shallowly to the northwest from the arch at the Pine River Valley. The synclinorium is approximately 3 km wide and exposes coal-bearing strata of the Crassier Group.

The Big Boulder Anticline extends north and south of the Pine River Valley, exposing Beaudette and lower Crassier Group strata. This anticline decreases in amplitude northward and terminates at the Beaudette Thrust west of Mt. Bickford. The Coyote Syncline (Hughes, 1967) trends north, exposing Dresser and lower Gething Formation sediments. The Bickford Anticline which straddles the boundary of the Goodrich Central and Moberly Blocks passes through Mt. Bickford. The anticline exposes older Beaudette Group strata at its core (see Figure 5.5.5.1).

South of the highway, there are three major fold structures. These are from west to east: The Goodrich Central Synclinorium (previously referred to as the Lossan Anticline-Syncline pair in the 1981 Geological Report), the Big Boulder Anticline, and the LeHudette Monocline.

The major structure of economic interest on Goodrich Central south of the highway is the Goodrich Central Synclinorium which extends from the Pine Valley to the Lossan Block. The syncline is approximately two kilometres in width, and exposes

Gething Formation sediments approximately five kilometres south of the Pine River valley as it plunges shallowly to the southeast.

The Big Boulder Anticline exposes Beaudette and lower Crassier Group strata as it extends from Goodrich Central north of the highway south towards the Lossan Block.

The southwest dipping LeHudette Monocline extends along the eastern region of Goodrich Central Block south of the highway and exposes Beaudette Group sediments. This structure is thought to be the western limb of the failed Bickford Anticline which lies north of the Pine Valley (see Figure 5.5.5.1.2).

5.5.5.2 Faults

There are four major faults within the strata of the Goodrich Central Block. From west to east these are: The Little Boulder Thrust, the Pyramis Thrust, the Beaudette Thrust, and the LeHudette Thrust. The faults are generally northwest-southeast trending with steep southwest dips.

The Little Boulder Thrust extends along the western region of the Goodrich Central Block, north of the highway. This fault lies predominantly within the

Monteith Formation and is interpreted to have a displacement of approximately 300 metres as illustrated on Goodrich Central cross section K-K^1 in Appendix A, Part 2.

The Pyramis Thrust is a major fault that extends from the Whiterabbit Block in the north to near Mt. Stephenson in the south. North of the Pine Valley the Pyramis Thrust has an associated splay, which results in a total displacement of over 700 metres. Along its extent, the fault thrusts older Beaudette Group strata onto younger Crassier Group strata.

The Beaudette Thrust lies approximately three kilometres to the east of Pyramis Thrust. The fault originates south of the Moberly River and extends south to near the headwaters of Beaudette Creek where the displacement becomes negligible. The thrust lies predominantly in Crassier Group strata in the north and in Upper Beaudette - Lower Crassier Group strata in the south. The maximum displacement along this fault is 300 metres as illustrated on Goodrich Central cross section L-L^1, in Appendix A, Part 2.

The LeHudette Thrust extends along the eastern boundary of the Goodrich Central Block and has a minimal effect on the geology of the block. This fault is considered to be the southward extension of

the faulted Bickford Anticline axis, with the LeHudette Monocline being the failed arm of the same anticline. This fault thrusts Fernie and Monteith Formation strata onto Monach Formation strata with a maximum displacement of 550 metres as illustrated on Goodrich Central cross-section G-G[1] in Appendix A, Part 2.

5.5.5.3 Coal Occurrences

Trench data in conjunction with information obtained from drilling diamond holes GDR-DDH-80-31 and GDR-DDH-80-35 (accompanying the 1980 Geological Report), suggest the presence of at least four seams in the Gething Formation north of the highway. These have an aggregate mineable thickness of at least 8 metres. This is illustrated on Goodrich Central cross-section J-J[1] in Appendix A, Part 2. Table 5.5.5.3 summarizes this data.

TABLE 5.5.5.3
Goodrich Central North of
The John Hart Highway
Summary of Coal Seam Data

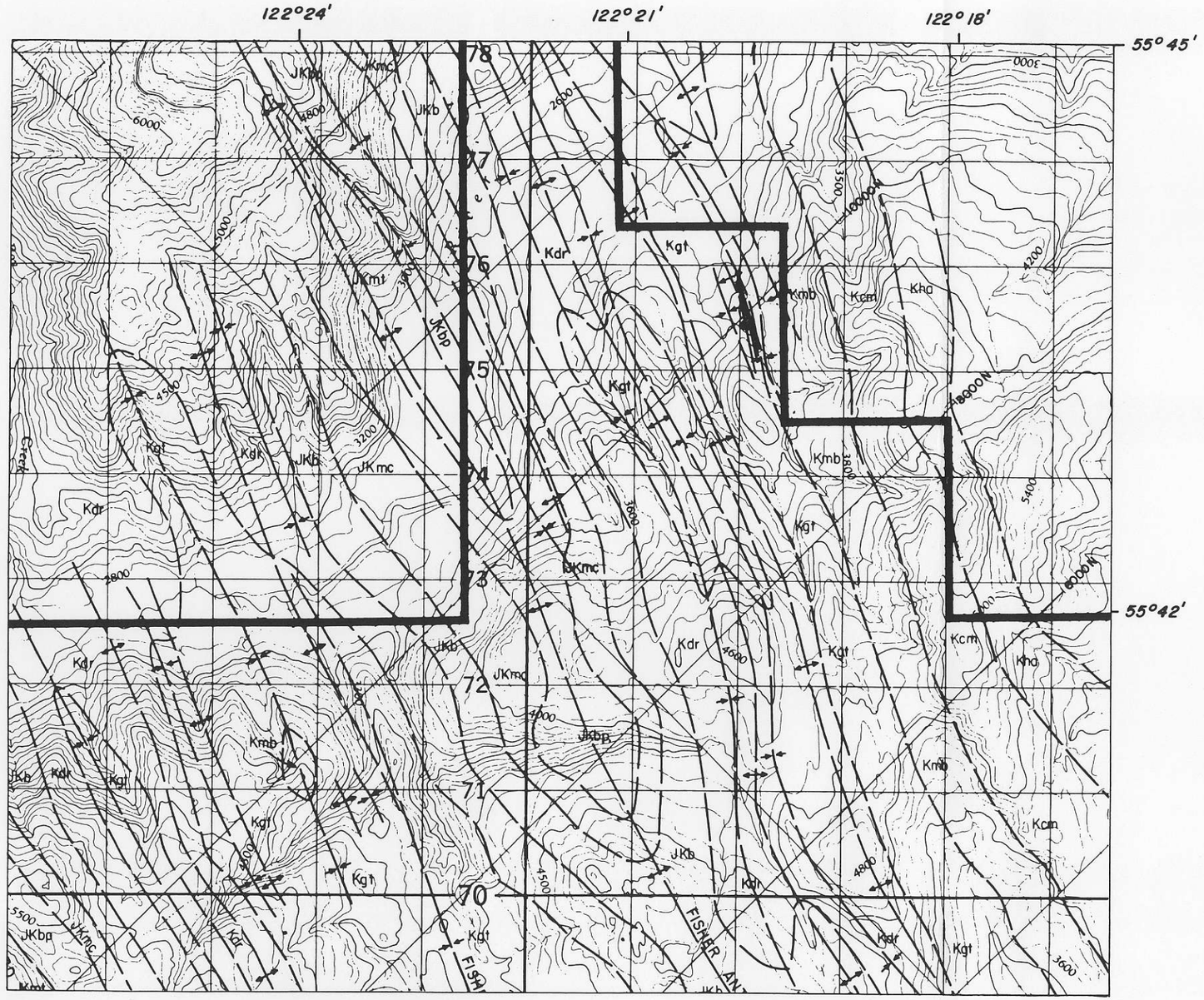
Data Source	Coal/Coal plus Rock (m)
GDR-GC-TRC-82012	2.65/2.65
GDR-GC-TRC-82011	0.60/0.60
GDR-DDH-80-31	0.73/1.27
GDR-DDH-80-31	2.29/3.50

South of the highway on the Goodrich Central Block, at least three coal seams exist in the Gething Formation, with an aggregate mineable thickness of about 7.5 metres. Once again, ground cover has limited outcrop exposure and the potential for increased coal resources almost certainly exists within the Goodrich Central and Boulder Creek Synclinoriums. Trenches south of the highway on Goodrich Central block have coal/coal plus rock ratios ranging up to 2.09/3.65 metres in the Gething Formation and up to 3.08/3.81 metres in the Dresser Formation, giving an aggregate mineable thickness from both formations in the range of 15 to 16 metres.

5.5.6 Moberly Prospect

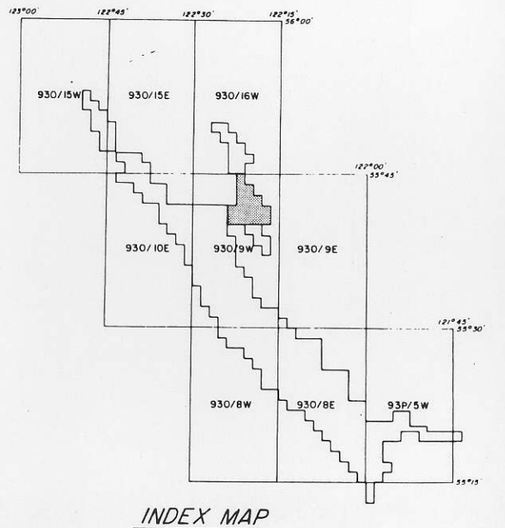
The Moberly Block licences cover an area situated in the Outer Foothills of the Rocky Mountains. This area extends northwest from the Pine River to just south of Mt. McAllister, west to Mt. Bickford, and east to Crassier and Fred Nelson Creeks (see Figure 5.5.6).

Northwesterly trending folds and minor southeast dipping thrust faults in the Moberly Block expose strata from the Jurassic-Cretaceous Monteith Formation to the Cretaceous Goodrich Formation, the youngest formation found on the Goodrich Property. The Moberly Geology Map (1:25 000 scale) can be found in Appendix A, Part 1.



LEGEND

- Property Boundary
- Coal Seam Subcrop
- Geological Boundary, (defined, approximate)
- Anticline (defined, approximate)
- Syncline (defined, approximate)
- Anticline and Syncline (overturned)
- Fault (defined showing dip, approx. position of fault)
- Normal Fault
- Strike and Dip (bedding, overturned bedding)
- A — A' Cross Section Location
- Monocline
- Bedding (vertical, horizontal)
- Kgt — Gething
- JKb — Brenot



INDEX MAP

0 1000 2000 3000 4000

scale in metres

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

FIGURE 5.5.6
GOODRICH COAL PROPERTY
MOBERLY PROSPECT
LOCATION

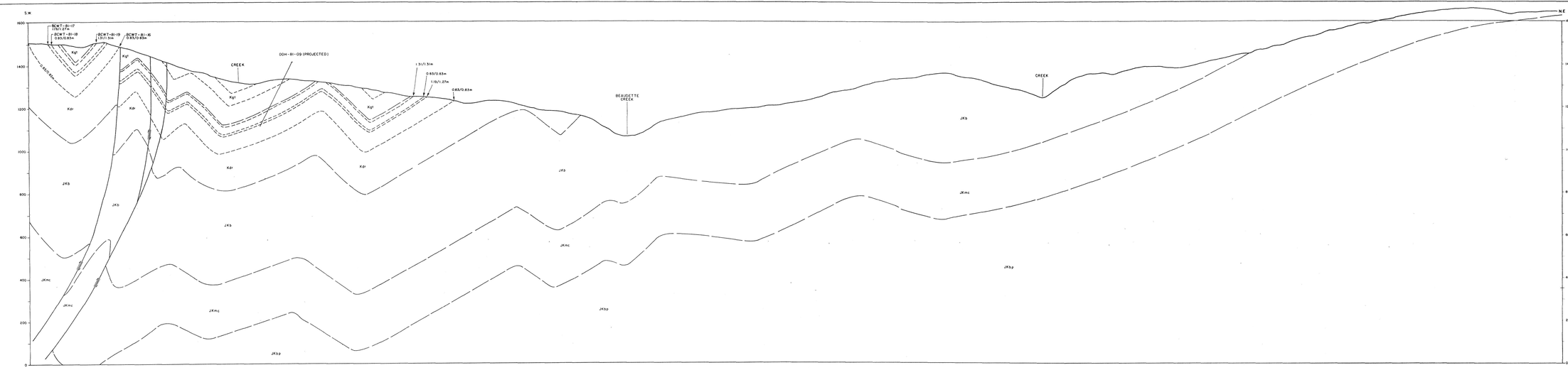
PREPARED BY: A. BIENIA	SCALE 1 : 50,000
APPROVED BY:	DATE: OCT. 82 DRAWING No.

This area holds potential for possible surface and underground mining of coal from at least seven coal seams within the Gething Formation which have an aggregate mineable thickness ranging from 18 to 21 metres. Figure 5.5.6.1 shows the positions of these seams. Potential resources from the Gething Formation in this area are calculated to be 619 million tonnes.

In the shallow-dipping western limb of the Hulcross Syncline, the axis of which is situated several kilometres to the east of the Moberly Block, these resources are potentially minable by surface and underground methods. This structure is referred to as the Moberly Monocline for the purposes of this report. An underground mining operation within this structure is presently being developed along strike, southeast of Gulf's Moberly Block.

5.5.6.1 Folds

There are three major folds in the strata of the Moberly Block: The Fisher and Crassier Anticlines, and the Fisher Syncline. The Bickford Anticline straddles the boundary of the Moberly and Goodrich Central Blocks. These folds trend northwest-southeast and plunge shallowly (approximately 2° to 5°) to the southeast. With the major folds, there are associated minor folds and a few small overturned folds accompanying thrust faulting.



LEGEND

- Q — QUATERNARY: Glacial deposits & alluvium
- Kcm — COMMOTION FORMATION: Siltstones, sandstones interbedded, claystones of marine origin, COAL at the top member & conglomerates
- Kmb — MOOSEBAR FORMATION: Mudstones, minor siltstones, marine
- Kbs — BLUESKY: Fine to medium grained sandstones, mudstones, thin conglomerate unit at top with or without glauconite
- Kgl — GETHING FORMATION: Cyclothems, dark grey mudstones, siltstones, carbonaceous, silty, sandy mudstones, coalified plant debris, minor bentonite, black shales, and occasional minor tuffs in upper unit, COAL
- Kdr — DRESSER FORMATION: Incomplete cyclothems; discontinuous coal measures in varying thicknesses, medium to very coarse grained sandstones, grits and conglomerates
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- JKbp — BEATTIE PEAKS FORMATION: Built to brownish sandstones, fine to medium grained, thinly bedded black & dark grey shales, silty shales, siltstones, thin sandstones with ironstone bonding
- JKmt — MONTEITH FORMATION: Grey & brown sandstones, fine to medium grained, fine to very coarse grained quartzite. Minor beds of shales, and shales with siltstone & sandstone partings, occasional thin conglomerates
- Jf — FERNIE FORMATION: Dark grey & black shales, mudstones, sandstones, siltstones, marine

JURASSIC — TRANSITIONAL — LOWER CRETACEOUS — CRASSIER GROUP — BEAUDETTE GROUP

BASELINE LOCATION

COAL SEAM

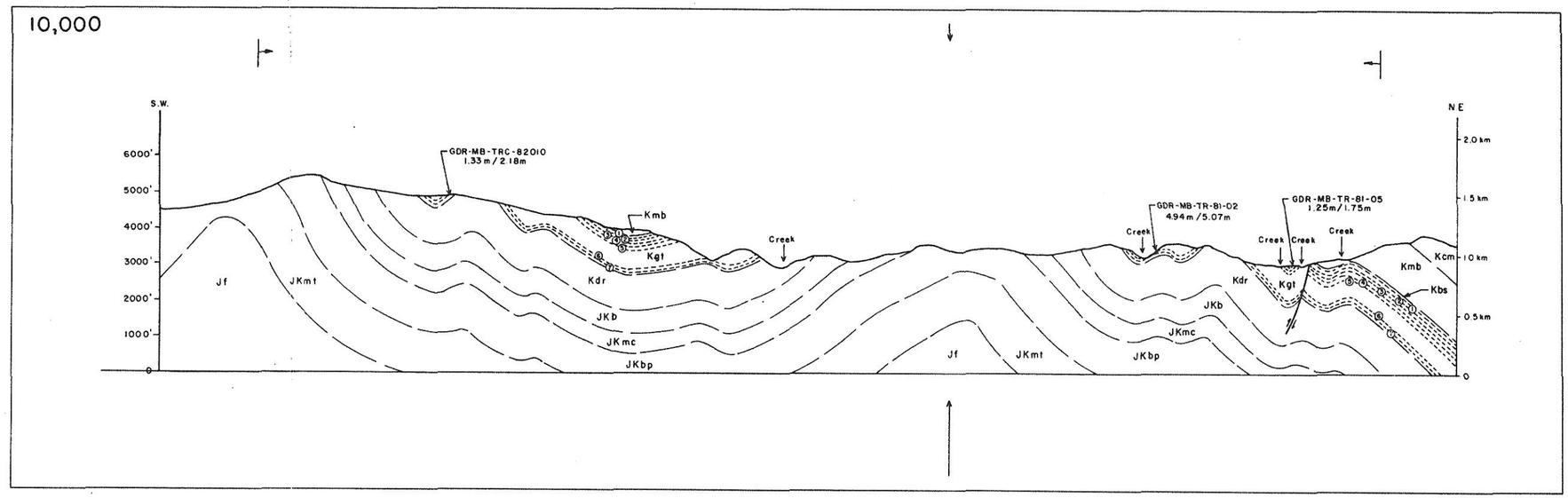
NOTE Section number indicates distances in metres along baseline from south to north to scale at 1980 and 1981 drill holes.

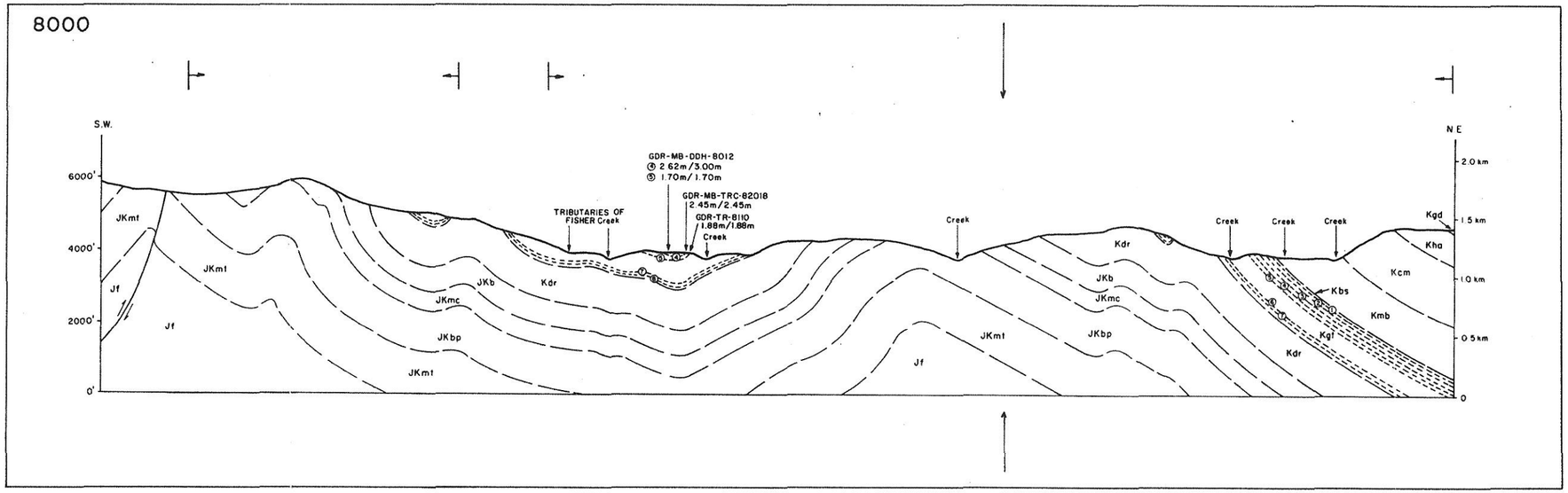
0 200 400 600 800 metres

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

FIGURE 5.5.5.1.2
GOODRICH COAL PROPERTY
GOODRICH CENTRAL
TYPICAL CROSS SECTION SOUTH
E – E'

PREPARED BY A. BIENIA	SCALE
APPROVED BY	DATE OCT. 1982 DRAWING No.





LEGEND

- **Q** — *QUATERNARY*
  Glacial deposits & alluvium
- **Kcm** — *COMMOTION FORMATION*
  Siltstones, sandstones interbedded, claystones of marine origin, COAL at the top member & conglomerates
- **Kmb** — *MOOSEBAR FORMATION*
  Mudstones, minor siltstones, marine
- **Kbs** — *BLUESKY*
  Fine to medium grained sandstones, mudstones, thin conglomerate unit at top with or without glauconite
- **Kgt** — *GETHING FORMATION*
  Cyclothems; dark grey mudstones, siltstones, carbonaceous, silty, sandy mudstones, coalified plant debris, minor bentonite, black shales, and occasional minor tufts in upper unit; COAL
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  Incomplete cyclothems, discontinuous coal measures in varying thicknesses, medium to very coarse grained sandstones, grits and conglomerates
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- **JKmc** — *MONACH FORMATION*
  Marine lithic & quartzose sandstone with thick beds of clean, coarse grained white quartzites at top. Minor shales, siltstones & sandstones with occasional thin conglomerates
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  Buff to brownish sandstones, fine to medium grained; thinly bedded black & dark grey shales, silty shales, siltstones, thin sandstones with ironstone banding
- **JKmt** — *MONTEITH FORMATION*
  Grey & brown sandstones, fine to medium grained; fine to very coarse grained quartzite. Minor beds of shales, and shales with siltstone & sandstone partings, occasional thin conglomerates
- **Jf** — *FERNIE FORMATION*
  Dark grey & black shales, mudstones, sandstones, siltstones, marine

JURASSIC — TRANSITIONAL — LOWER CRETACEOUS
BEAUDETTE GROUP — CRASSIER GROUP

LEGEND

- Baseline
- Gulf Licence Boundaries
- Coal Seam
- Coal / Coal + Rock

1 1.08m / 1.28m
2 5.81m / 6.26m
3 1.25m / 1.75m
4 2.62m / 3.00m
5 1.70m / 1.70m
6 4.94m / 5.07m
7 1.33m / 2.18m

SCALE 1:25,000
0 500 1000
METRES

HORIZ SCALE 1:25,000
VERT SCALE 2:4,000

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

FIGURE 5.5.6.1.
GOODRICH COAL PROPERTY
MOBERLY
TYPICAL CROSS SECTIONS
10,000 , 8000

PREPARED BY: A. BIENIA	SCALE
APPROVED BY: DATE: OCT. / 82	DRAWING No.

The Fisher Anticline extends from the northwest to the southeast through the approximate centre of the Moberly Block, east of the Fisher Syncline. This structure exposes the oldest strata of the area and generally plunges to the southeast with minor plunge reversals throughout its extent. The Crassier Anticline trends approximately parallel to the Fisher Anticline and also plunges to the southeast. This Anticline does, however, go through a plunge reversal at the Moberly River and also 5 km northwest of the Pine River where it regains its southeast plunge. The Crassier Anticline is interpreted to be the largest parasitic fold on the dominant Fisher Anticline.

The Fisher Syncline provides the major exposure of Gething sediments on the Moberly Block. It trends northwest-southeast between the Moberly and Pine Rivers approximately 4 km east of Bickford Lake. The syncline is interpreted to be a broad synclinorium containing many discontinuous parasitic folds with a plunge averaging 5° to the southeast. Diamond drill hole GDR-DDH-81-12 is located just west of the axis of the syncline as shown in Moberly geological cross section 8000N found in Appendix A, Part 1.

5.5.6.2 Faults

There are only two faults which are significant in the strata of the Moberly Block: the Carbon

Thrust in the northern half of the block, and the thrust associated with and lying to the east of the Bickford Anticline. Both of these faults lie almost entirely outside of the areas of potential mineable resources.

The Carbon Thrust extends southeast from Mt. McAllister and dies out north of the Moberly River. At the point at which it passes into the Moberly block from the north, it has an interpreted displacement of approximately 500 metres. The thrust fault to the east of Bickford Anticline lies predominantly within sediments of the Monteith Formation and is interpreted to have a displacement of approximately 100 metres. Other localized thrust faulting is present but is considered to be of minor importance.

5.5.6.3 Coal Occurrences

During the 1982 exploration program a total of 18 trenches were hand dug bringing the total to 30 recorded trenches on the Moberly Block. All significant coal exposures found and trenched were in the Gething Formation.

A study of the trench data in conjunction with information from diamond drill hole GDR-DDH-81-12 has suggested that there are at least seven coal seams, with an aggregate mineable thickness ranging

from 18 metres to 21 metres, within the Gething Formation. The first five seams lie in the upper half of the formation while the remaining two seams lie at the base of the formation, as shown in Figure 5.5.6.1. See Table 5.5.6.3 for identification of the sources of the seam thicknesses. The trench data, including trench logs, data source records, and a 1:50 000 scale Trench Location Map can be found in Appendix C.

The trench locations and their coal/coal plus rock ratios are also plotted on the 1:25 000 scale Moberly Geology Map, found in Appendix A, Part 1.

During 1982, three trenches were dug in the Dresser Formation (upper part); coal/coal plus rock was 0.79/0.81 metres in GDR-MB-TRC-82007. No significant coal was uncovered in the Brenot Formation but this could be due in part to generally poor exposure of this formation on the Moberly Block.

TABLE 5.5.6.3
Moberly Prospect Trench Summary

Seam No.	Data Source	Coal/Coal plus Rock (True Thickness)
1	GDR-MB-TRC-82006	1.08 m/1.28 m
2	GDR-MB-TRC-82015	5.81 m/6.26 m
2	'Hughes trench' 1980	2.96 m/2.96 m
3	TR-MB-81-05	1.25 m/1.75 m
4	GDR-DDH-81-12	2.62 m/3.00 m
5	GDR-DDH-81-12	1.70 m/1.70 m
6	TR-MB-81-02	4.94 m/5.07 m
7	GDR-MB-TRC-82010	1.33 m/2.18 m
7	GDR-MB-TRC-82014	2.07 m/2.89 m

5.6 Whiterabbit Block

The Whiterabbit Block covers an area of the Inner Foothills of the Rocky Mountains and consists of the northernmost licences of the Goodrich Property. The block extends from Eleven Mile Creek southeast to the Moberly River, as shown in Figure 3.5.1.

During the 1982 exploration program, reconnaissance mapping was undertaken at 1:10 000 scale, with maps and cross sections produced at the same scale. They can be found in Appendix A, Part 2.

Northwesterly trending folds and southwest-dipping thrust faults expose strata from the Jurassic-Cretaceous Monteith Formation to the Cretaceous Gething Formation. Sediments of the Beaudette and Crassier Groups appear to be significantly thinner in this region, relative to the rest of the Goodrich Property. Notable plant fossils are apparent in the Brenot Formation on the Whiterabbit Block whereas elsewhere on the Goodrich Property the formation is charateristically devoid of plant fossils. The differences in stratigraphic thickness and sediment characteristics may reflect a drastic change in depositional environment in this area. Also, coals appear thinner and less continuous in the Gething Formation in this area.

5.6.1 Folds

There are three major folds in the strata of the Whiterabbit block: The Whiterabbit Syncline and Anticline, and the Moberly Anticline. In addition, there are numerous parasitic folds which are characteristically discontinuous. Between the Whiterabbit Syncline and Anticline there is a region south of Carbon Creek which contains tightly folded Gething Strata, as shown on Whiterabbit geological cross-sections V-V' and W-W'.

The Whiterabbit Syncline provides the major exposure of Gething sediments. This Syncline runs subparallel to and east of the Whiterabbit Thrust. Growing from a point just north of the Moberly River, it plunges generally northwest with minor plunge reversals throughout its extent. During the 1980 exploration program, diamond drill hole GDR-DDH-80-32 was drilled approximately 100 metres to the east of the Synclinal axis as shown on Whiterabbit geological cross-section Y-Y'. Information pertaining to this drill hole can be found accompanying the 1980 Geological Report.

The Whiterabbit Anticline has folded strata along the eastern edge of the property, exposing predominantly Dresser Formation strata at its core. The Moberly Anticline has folded strata along the

southwestern region of the Whiterabbit Block and exposes predominantly Beaudette Group sediments at its core. It plunges to the north, terminating at the Whiterabbit Thrust, south of Carbon Creek.

5.6.2 Faults

The Whiterabbit Block has predominantly northwest trending thrust faults with steep southwest dips. Two major thrusts are notable; many other thrusts of limited extent are indicated on the Whiterabbit geology maps and cross-sections.

The Whiterabbit Thrust trends northwest through the western region of the Whiterabbit Block, north of Carbon Creek, and again southeast through the central region of the block, south of Carbon Creek, eventually terminating south of the Moberly River in the Goodrich Central Block. The fault has thrusted Beaudette Group sediments onto Crassier Group sediments. In the region just south of Carbon Creek there is evidence for associated overturned folds as shown on Whiterabbit geological cross-section W-W'. The fault displacement ranges from 100-400 metres on the Whiterabbit Block.

5.6.3 Coal Occurrences

During the 1982 exploration program a total of

33 trenches were hand dug bringing the total to 69 recorded trenches on the Whiterabbit Block. All significant coal exposures were found and trenched within the Gething Formation (see Table 5.6.3).

TABLE 5.6.3

Typical Gething Formation Coal Trench Data from the Whiterabbit Block

Data Source	Coal/Coal + Rock (True Thickness)
GDR-WR-TRC-82003	1.00m/1.00m
GDR-WR-TRC-82007	1.68m/2.29m
GDR-WR-TRC-82009	1.31m/1.53m
GDR-WR-TRC-82016	1.03m/1.10m
GDR-WR-TRC-82021	2.11m/2.38m
GDR-WR-TRC-82029	1.05m/1.05m
GDR-WR-TRC-82032	1.32m/1.61m

In addition, there were several trenches ranging from 0.50 m coal (true thickness) to less than 1.00 m coal (true thickness) in the Gething Formation.

During the 1980 exploration program, diamond drill hole GDR-DDH-80-32 intersected 1.90 metres of coal (true thickness) in the lower part of the Gething Formation, as shown on Whiterabbit geological cross-section Y-Y'. Information pertaining to this drill hole can be found in the 1980 Geological Report.

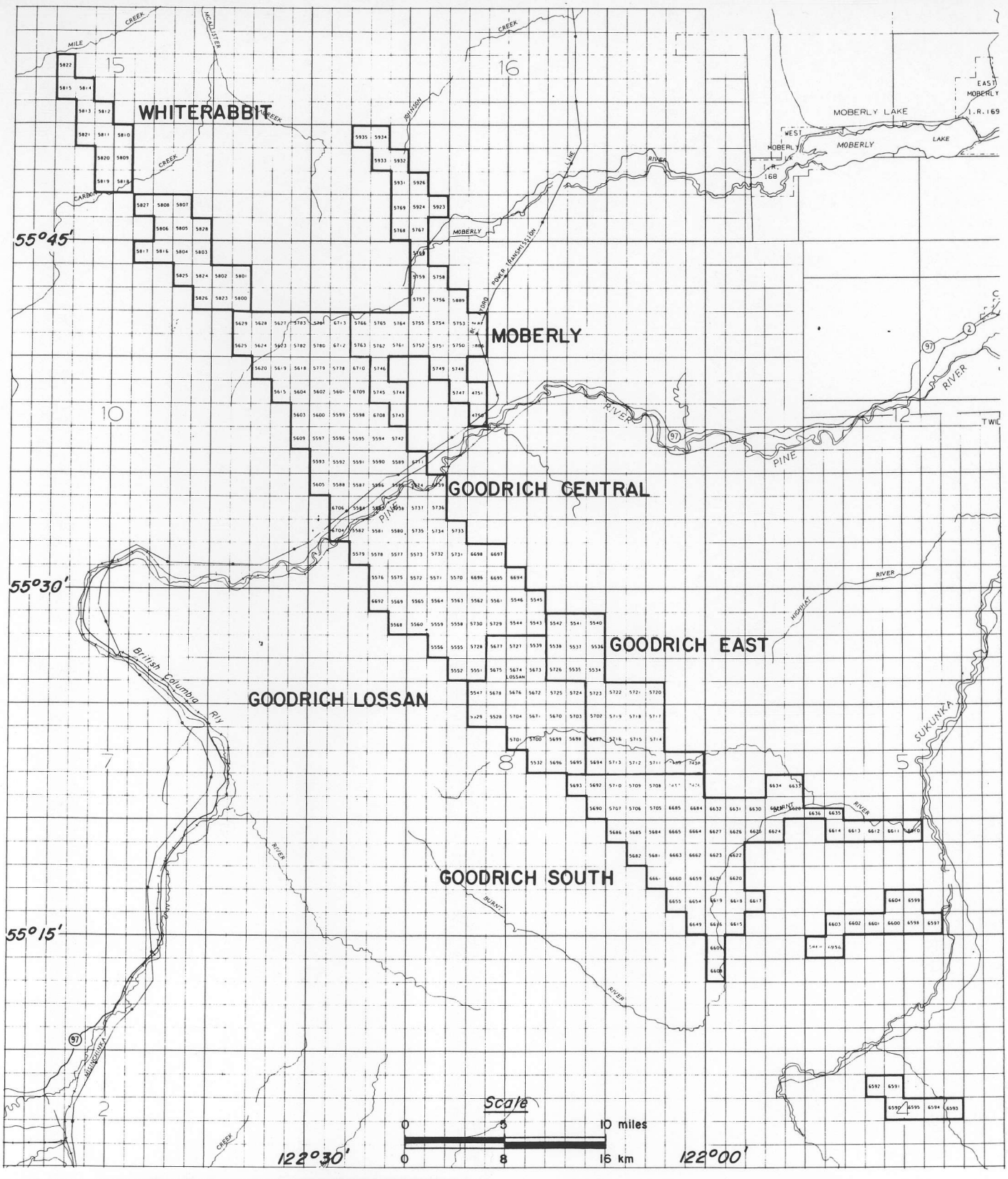
To date no significant coal seams have been trenched within the Brenot or Dresser Formations. The 1982 coal trench data, including trench logs, data source records and a 1:50 000 Trench Location Map can be found in Appendix C of this report. Trench locations and coal/coal plus rock ratios are also plotted on the 1:10 000 scale Whiterabbit geology maps found in Appendix A, Part 2.

6.0 COAL RESOURCES

6.1 Regional Coal Resources

Exploration on the Goodrich Property to date has identified in-situ coal resources conservatively estimated to be approximately 2.35 billion tonnes within the Brenot, Dresser, and Gething Formations.

The in-situ regional resources of the Goodrich Property have been calculated for each geological mapping area, as shown in Figure 6.1.1. Table 6.1.1 summarizes the results of resource calculations based on drill hole coal intersections and/or coal trench measurements. The table also shows the ranges of true coal seam thicknesses used. Resources were calculated by the geological cross-section method to a vertical depth of 500 metres and along strike lengths assigned to each cross section after taking all geological data into consideration. A specific gravity of 1.5 tonnes/m^3 was used for the tonnage calculations.



PROSPECTS	(million tonnes)		
	BRENOT	DRESSER	GETHING
GOODRICH SOUTH CIRQUE	522	49	7
TABLE AREA	29		169
HASLER CREEK	61		210
BEAUDETTE SYNCLINE	2		1
GOODRICH LOSSAN			298
GOODRICH CENTRAL		61	195
MOBERLY			619
WHITERABBIT			133

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

Gulf

FIGURE 6.1.1
GOODRICH COAL PROPERTY
REGIONAL COAL RESOURCES

PREPARED BY: A. BIENIA	SCALE NTS
APPROVED BY:	DATE: OCT./82 DRAWING No.

TABLE 6.1.1
Summary of In-Situ Regional Coal Resources
of the Brenot, Dresser, and Gething Formations
(million tonnes)

Block	BRENOT FORMATION True Seam Thickness (metres) 0.5 -1.0	1.0 -2.0	2.0 -3.0	>3.0	Sub-Total	DRESSER FORMATION True Seam Thickness (metres) 0.5 -1.0	1.0 -2.0	2.0 -3.0	>3.0	Sub-Total	GETHING FORMATION True Seam Thickness (metres) 0.5 -1.0	1.0 -2.0	2.0 -3.0	>3.0	Sub-Total	ALL 3 FORMATIONS Sub-Total
Moberly	—	—	—	—	—	—	—	—	—	—	—	98	218	303	619	619
Goodrich Central	—	—	—	—	—	15	31	—	17	61	31	80	33	51	195	256
Hasler Creek	—	61	—	—	61	—	—	—	—	—	33	14	132	31	210	271
Beaudette Syncline	—	2	—	—	2	—	—	—	—	—	—	—	1	—	1	3
Goodrich South Table	—	29	—	—	29	—	—	—	—	—	21	—	59	89	169	198
Goodrich South Cirques	14	322	72	114	522	—	49	—	—	49	—	7	—	—	7	578
Lossan	—	—	—	—	—	—	—	—	—	—	—	52	49	197	298	298
Whiterabbit	—	—	—	—	—	—	—	—	—	—	—	89	44	—	133	133
Total																2356

6.2 In-Situ Reserves of the Lossan Mine Area

In-situ coal resources of the Lossan Mine Area have been calculated based on the correlation of six seams totalling 20 metres within the Gething Formation. The in-situ resources are conservatively estimated to be approximately 298 million tonnes[1], located within synclinal structures. Table 6.2.1 summarizes the results of resource calculations of the Lossan Block.

Of the 298 million tonnes of in-situ coal resources, 174 million tonnes have been identified as in-situ reserves from the Gething No. 1 and Gething No. 5 Seams. Table 6.2.1 shows the distribution of in-situ reserves (No. 1 and No. 5 Seams) in the mine area.

The in-situ reserve calculations are based on calculated true thickness intervals of coal seam sections.

The minimum true thickness used was:

---

1. Presently this figure includes oxidized coal. Oxidized coal tonnage will be calculated when oxidization limits have been determined.

TABLE 6.2.1

Lossan Mine Area

Summary of In-Situ Coal Reserves

Seam No.	Formation	Reserves (million tonnes)
1	Gething	112
5	Gething	62
2, 3, 4, 6	Gething	124
	TOTAL	298

a) 0.5 metres, where the bedding to core angle (BCA) of the seam measures between 30° and 90° (90° represents flat-lying strata);

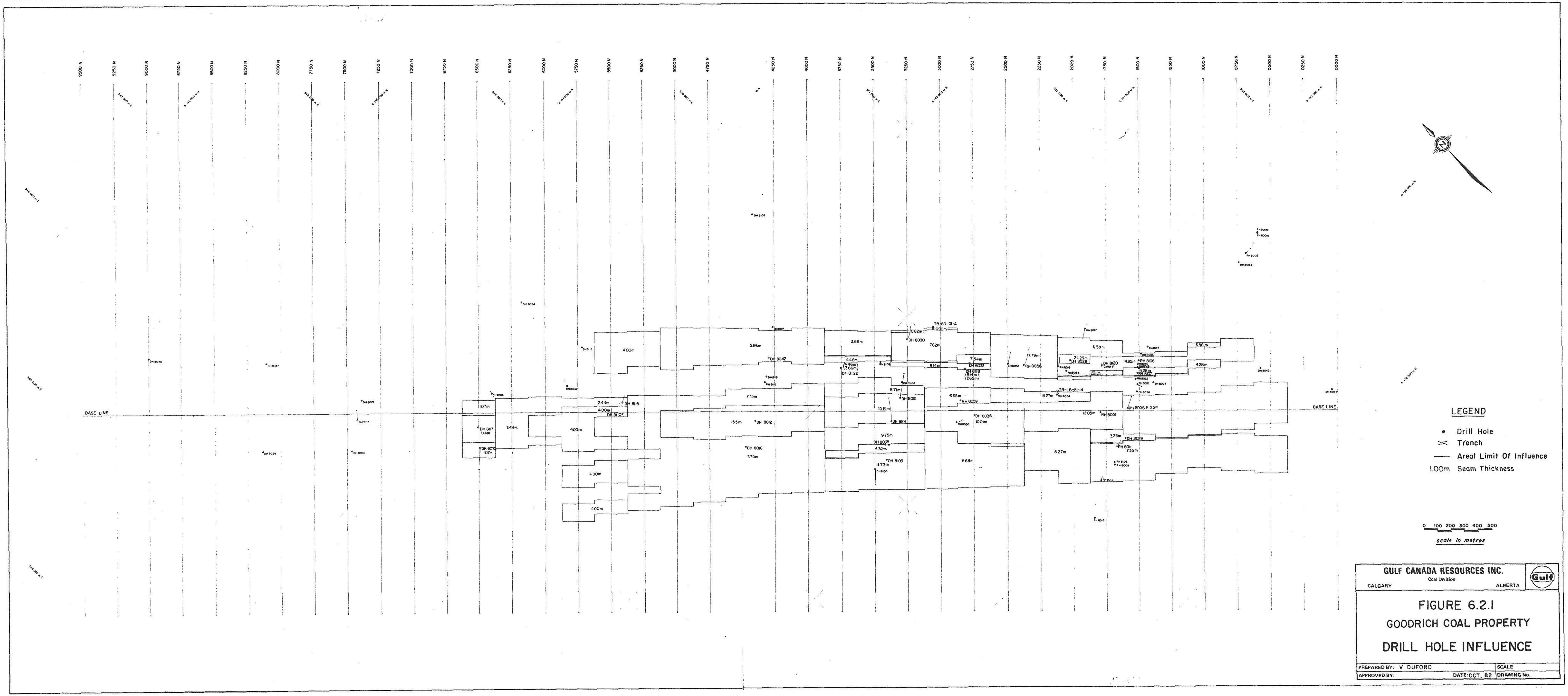
b) 1.0 metres, where the bedding to core angle (BCA) of the seam measures between 0° and 30° (0° represents vertically dipping strata);

Calculations of true interval thicknesses are based on the following set of parameters:

1. Where a coal seam was intersected by a diamond drill hole, the drill core bedding plane measurement (BCA) was used to calculate the true thickness interval.

2. Where a rotary drill hole intersected a coal seam, true thickness was estimated utilizing dips measured in either nearby diamond drill holes and/or surface geological data.

A drill hole influence map of the No. 1 Seam used for calculations is illustrated in Figure 6.2.1. This map was developed for the Gething No. 1 Seam. An average thickness for the Gething No. 5 Seam was assumed as there are significantly fewer drill hole intersections of this seam compared to the No. 1 Seam. The No. 5 Seam thicknesses varied from 3 - 5 metres. and calculations were made for the entire mine area (Sections 0000N to 9500N). The thicker No. 5 Seam intersections were, however, located in the northern portion of the mine area (Sections 6000 to 9500N).


BASE LINE
LEGEND
Drill Hole
Trench
Areal Limit Of Influence
1.00m Seam Thickness
0 100 200 300 400 500
scale in metres
GULF CANADA RESOURCES INC.
Coal Division
CALGARY
ALBERTA
Gulf
FIGURE 6.2.1
GOODRICH COAL PROPERTY
DRILL HOLE INFLUENCE
PREPARED BY: V DUFORD
APPROVED BY:
DATE: OCT. 82
SCALE
DRAWING No.

6.3 Potential Coal Resources of Prospect Areas

The prospect areas of the Goodrich Coal Property constitute a remarkable quantity of in-situ coal resources. Based on the information gathered from mapping, trenching, and limited drilling these areas hold potential for the economic development of coal resources and therefore have been delineated as future drilling targets. The locations of the prospect areas are shown in Figure 5.5.0. Table 6.3.1 summarizes the in-situ coal resources of the prospect areas.

6.3.1 Goodrich South Cirque

The Goodrich South Cirque area holds potential for surface mineable coal, primarily from the Brenot Formation, with in-situ resources estimated to be over 520 million tonnes. Resources from the Dresser and Gething Formations supplement the Goodrich South Cirque in-situ resource base by almost 60 million tonnes.

At least eleven seams totalling over 18 metres (within less than 400 metres of Brenot section) provide the conservative basis for our resource estimates. Additional seams may be discovered in future exploration programs since the Brenot Formation appears to be a highly favourable coal-bearing sequence in this area.

Coal/coal plus rock ratios ranging up to 3.16 metre/ 3.60 metres (true thickness) have been measured in trenches

TABLE 6.3.1

Summary of In-Situ Coal Resources
in the Prospect Areas
(million tonnes)

Prospect	FORMATION			
	Brenot	Dresser	Gething	Total
Goodrich South Cirques	522	49	7	578
Goodrich South Table Area	29	—	169	198
Hasler Creek	61	—	210	271
Beaudette Syncline	2	—	1	3
Moberly	—	—	619	619
Goodrich Central	—	61	195	256
Total				1925

on the Goodrich South Block. Current interpretations of the structure and strata of the area indicates that of the 578 million tonnes of in-situ coal located in the South Cirque area, 182 million tonnes lie at a overburden to coal ratio of less than 10:1. The recognition of this area as a prospect is recent, consequently no drilling has been undertaken on the block.

6.3.2 Goodrich South Table Area

The Table area, which constitutes a significant portion of the in-situ regional coal resources of the Goodrich coal property contains an estimated 198 million tonnes within the Gething Formation.

Resources from the Gething Formation are calculated based on five seams found during the 1982 exploration program. Over half of the 169 million tonnes are from the uppermost and thickest seam which has a coal/coal plus rock ratio of 7.37 metres/10.74 metres (GDR-GS-TRC-82041). The seam lies at an average depth of less than 75 metres below the surface in the Table area.

It is estimated that the overburden to coal ratio for approximately sixty million tonnes of the in-situ resources averages between 7 and 8 to 1.

Although, in the Table area, only one coal seam has been identified in the Brenot, the proximity of this prospect to the South Cirque prospect, which has an estimated 18

metres of coal within the Brenot Formation, suggests that there may be additional Brenot coal resource in the Table area.

6.3.3 Hasler Creek Area

The Hasler Creek area (Goodrich East) is estimated to contain a significant quantity of near surface coal. In-situ coal resources have been calculated to be 210 million tonnes in the Gething Formation and a conservative 61 million tonnes in the Brenot Formation.

The major portion of Gething coal resources occur along the eastern region of the Goodrich East Block, as illustrated on Goodrich East cross section EE-EE' in Appendix A, Part 1. Relatively open folds occurring along the eastern margin of the area within the Gething Formation exposed at surface creates an extremely favourable near surface deposit with coal/coal plus rock ratios ranging up to 3.75 metres / 5.49 metres (GDR-GE-TRC-82029).

The estimates of resources from the Brenot Formation are based solely on limited outcrop exposure of the formation. The potential to have greatly increased resources at reasonable coal to overburden ratios exists if the coal-bearing strata uncovered in the nearby Goodrich South Cirque area extend into the Goodrich East - Hasler Creek Prospect area.

6.3.4 Beaudette Syncline

The Beaudette Syncline, also in the Goodrich East Block, comprises a relatively small portion of the total in-situ coal resource base of the Goodrich Property. However, stripping ratios are estimated to be very low, making the 3.4 million tonnes attractive for the development of a small open pit. Based on drill hole intersections and trenching, in-situ resources are calculated to be 1.5 million tonnes from two seams in the Gething Formation and 2 million tonnes from one seam in the Brenot Formation. These seams and their respective coal/coal plus rock ratios are shown on the Beaudette Syncline cross-sections in Appendix A, Part 1.

6.3.5 Goodrich Central

The Goodrich Central Prospect consists of two areas, one north and one south of the John Hart Highway, each contained in a broad synclinorium. North of the highway, in-situ coal resources have been calculated to be 169 million tonnes from the Gething Formation, based on information from mapping, trenching, and limited drilling. South of the highway, on the same basis, in-situ coal resources have been calculated to be 26 million tonnes from the Gething Formation and 61 million tonnes from the Dresser Formation.

Potential exists for greatly increased resources in the Gething Formation south of the highway as the prospect is in the same synclinal trend, and only a few kilometres north

of the Lossan Mine Area. North of the highway, resource estimates are based on limited data. If the Gething in Goodrich Central contains as many coal seams as the nearby Moberly area, the resource figures would be greatly improved. Current calculations of resources in this area are very conservative however; preliminary estimates indicate that at least 33 to 40 million tonnes of in-situ coal are contained in areas where the overburden to coal ratio is 10 to 1 or less.

6.3.6 Moberly Area

The Moberly area contains the largest in-situ coal resources of any single prospect area on the Goodrich property, and holds the majority of Gething Formation in-situ coal resources outside the Lossan Mine Area. In-situ coal resources from the Gething Formation in the Moberly area have been calculated to be 619 million tonnes of near surface potentially mineable coal. The potential also exists for a portion of the coal resources along the eastern region of the Moberly area to be mined by underground and/or open pit methods.

Based on mapping and information from one diamond drill hole (GDR-DDH-81-12), a total of seven seams with coal/coal plus rock ratios ranging up to 5.81 metres / 6.26 metres were used in the calculation of the in-situ coal resources. From these seven seams, there is an aggregate mineable thickness of coal of over 21 metres with

approximately 15 metres in the upper 150 metres of the Gething Formation. Two hundred and seventy million tonnes of in-situ coal are contained in the upper 150 metres. The potential exists for future mapping, trenching, and drilling to uncover more seams within the proven highly favourable coal-bearing strata of the Gething Formation.

7.0 COAL QUALITY

7.1 Summary of 1981 Data

7.1.1 Coal Quality Specifications - Gething No. 1 Seam

The Gething No. 1 seam is a bituminous coal with unique coking and thermal coal properties that are attractive to potential export markets.

A good quality thermal and metallurgical coal product can be obtained from the No. 1 Seam. The washability data indicates that a low ash (6.5%), medium volatile (27-30% dmmf basis), and low sulphur (<0.3%) coking coal with a free swelling index of 4-6, maximum fluidity of 40-300 ddpm and dilatation of 30-100% can be produced.

Petrographic studies of fourteen Goodrich coal samples indicated that the No. 1 Seam could produce a strong metallurgical coke. The mean reflectance averages 1.15 and ranges from 1.07 to 1.28 which places the Goodrich coal in the medium to high volatile category. The total reactives average is 64.04%.

Thermal coal production from the same seam is of similar high quality readily meeting all the Japanese Coal Development Company specifications (see Table 7.1.1). The No. 1 Seam has a volatile content in the upper range for -

medium volatile coals with a low fuel ratio averaging 2.3. In producing a product with 14% ash the calorific value is approximately 7100 Cal/g. The ash fusion temperatures exceed the required initial deformation and fluid temperatures in an oxidizing atmosphere.

Detailed core sample analyses from several drill holes confirm a marked difference in the coking characteristics between the upper 2/3 and the lower 1/3 of the Gething No. 1 Seam. The upper portion of the coal seam generally exhibits poorer coking properties, with an average FSI of about 2.6 at a specific gravity of 1.65 and an FSI of 3.2 at a specific gravity of 1.4. In contrast, the lower portion shows an average FSI of 4 and 5.7 for the same respective specific gravities. In addition to an already high range of fluidity, three samples from within the lower seam portion have tested at high maximum fluidities of 2721, 1578, and 1365 ddpm. These results are considered very unique for a western Canadian coking coal.

The float and sink analysis of the Gething No. 1 Seam shows a high clean coal recovery of the near gravity material. Some 40 to 50% yield with less than 6.5% ash was attained at a specific gravity cut point of 1.5.

Review of all available coal quality data, and subsequent numerous computer case studies of the washability characteristics, confirm that a metallurgical and thermal

coal product could be obtained from the Gething No. 1 Seam, if selective mining of the two coals was economically feasible. Furthermore, the relatively inexpensive jig could be utilized in a basic washplant design to produce at a relatively high yield, either exclusively a thermal coal or a combined thermal and metallurgical coal product.

7.1.2 Coal Quality Specifications - Gething No. 5 Seam

The Gething No. 5 Seam is a low volatile bituminous coal. The volatiles range from 20 to 26% on a dry mineral matter free (dmmf) basis. The average FSI obtained is 4.75 at a 5% ash level. The coal quality presented in Table 7.1.2 is based on an average of four drill core samples only. Further studies may be required to test the possiblity of using this coal as a blend with other coals or as a source of formed coke material.

7.1.3 Procedure

The two product coal specifications are largely based on the results of the coal quality analysis of 151 individually sampled core intervals and 43 composite sample intervals taken from 19 of 22 *HQ diamond drill holes drilled during the summer of 1981. The previous years' core sampling and analysis program proved instrumental in establishing the 1981 coal quality analysis program.

The individual core sample intervals were selected after the drill core had been visually logged by a geologist and correlated to the geophysical gamma ray-neutron and density logs, and corrected for true interval thickness. (The geophysical logs and drill core descriptions are available in the 1981 Geological Report, Appendix B).

Coal seams with a true thickness of less than 0.5 metres (or less than 1.0 metre if the bedding core angle is between 0-30°) were not deemed mineable and therefore, were not sampled.

---

*DDH 81-04 intersected Lower Gething only no mineable coal seams were intersected.

All samples taken were placed in plastic bags and sealed to prevent sample deterioration and/or contamination during transport. The 1981 Goodrich coal quality analyses were conducted by Loring Laboratories in Calgary, Alberta.

The composite intervals were chosen and tested after the results of the individual ply samples were reviewed and closely correspond to the mining sections of the No. 1 Seam. Both the 1980 and 1981 sampled drill core intervals are identified according to drill hole intersection in Appendix D, Part 1, illustrating the individual ply samples that were recombined for the composite sample tests.

To evaluate the potential for a two product coal with only limited amounts of core sample, the drill holes sampled were split into two groups. Coal quality flow sheets 1 and 2 were designed to test the coking coal product potential at 9.5% and 6.5% respectively, and thereafter analyze the thermal product potential. Table 7.1.3 summarizes the locations of the drill holes that were sampled as shown in Figures 7.1.1 and 7.1.2.

Critical to the overall quality of the thermal product is the inclusion of the metallurgical coal reject material.

The maceral and reflectance study was undertaken by D.E. Pearson and Associates and this report can be found in Appendix D, Part 2. To study the effects of coal beneficiation, the petrography was done on raw head composites and clean head composite samples.

TABLE 7.1.3

List of Drill Holes and Composite Samples

List of Drill holes and Composite Samples tested for Metallurgical Coal Product with 9.5% ash:

DRILL HOLE NUMBER	COMPOSITE I.D.	TESTS
81-01	10, 02, 03, 04	C
81-02	05, 06, 07	C, T, P
81-05	10, 11, 12, 13	C, P
81-07	17	C
81-11	19, 20	C
81-12	21	C
81-14	22	C
81-15	23, 24	C (P for 23)
81-16	25	C
81-17	26, 27	C, T
81-18	28, 29, 30, 31, 32, 33	C, T, P
81-19	34	C, T
81-20	35, 36	C, T

List of Drill holes and Composite Samples tested for Metallurgical Coal Product at 6.5% ash and Thermal Coal Product at 14% Ash:

DRILL HOLE NUMBER	COMPOSITE I.D.	TESTS
81-03	08, 09	C, T
81-06	14, 15, 16	C, T
81-10	18	C
81-21	37, 38, 39	C, T
81-22	40, 41, 42, 43	C, T

TESTS:

C - Coke Product
T - Thermal Product
P - Petrography

7.2 Summary of the 1982 Data

Coal quality analyses and washability tests performed by Birtley Coal and Minerals Testing show that excellent metallurgical and thermal coal products were obtained from the adit (ADT-82-1) bulk sampling program of the Gething No. 1 Seam.

Three unoxidized bulk samples were taken at the adit and tested for various product specifications, as shown in flowsheets B2, B3A and B3B. At the Birtley pilot plant, clean coal fractions were obtained from the dense medium cyclone (19.1 x 0.6 mm), two stage water only cyclone (0.6 x 0.21 mm) and froth floatation circuits (0.21 x 0.0 mm) and were combined to form the clean coal product. For samples B2, B3A and B3B, a sub-sample was extracted and sent to Loring Laboratories in Calgary to run similar tests on these coals. The coal quality analyses were conducted according to flowsheets FC2, FC3A and FC3B.

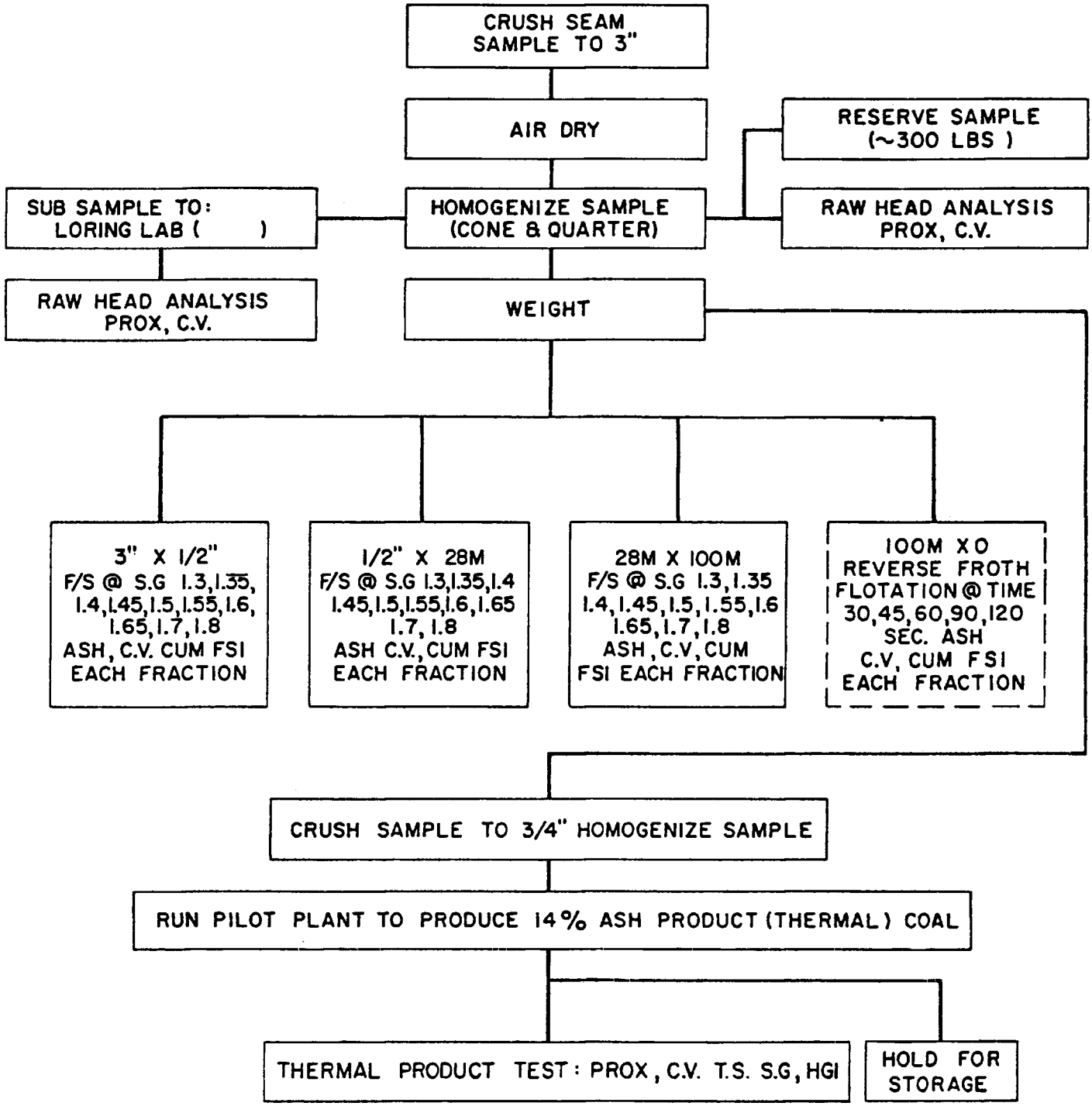
A fourth, oxidized bulk sample was removed from nearby trench LB 81-14 and coal quality tests were conducted according to flowsheet B1. A clean coal product was obtained using only the dense medium cyclone and two stage water only circuits.

Table 7.2.1 summarizes the coal quality of the selected product specifications that were obtained from the Gething No. 1 Seam. Details of the individual analyses are presented in Appendix B.

On-going studies on coal quality will be presented in future reports.

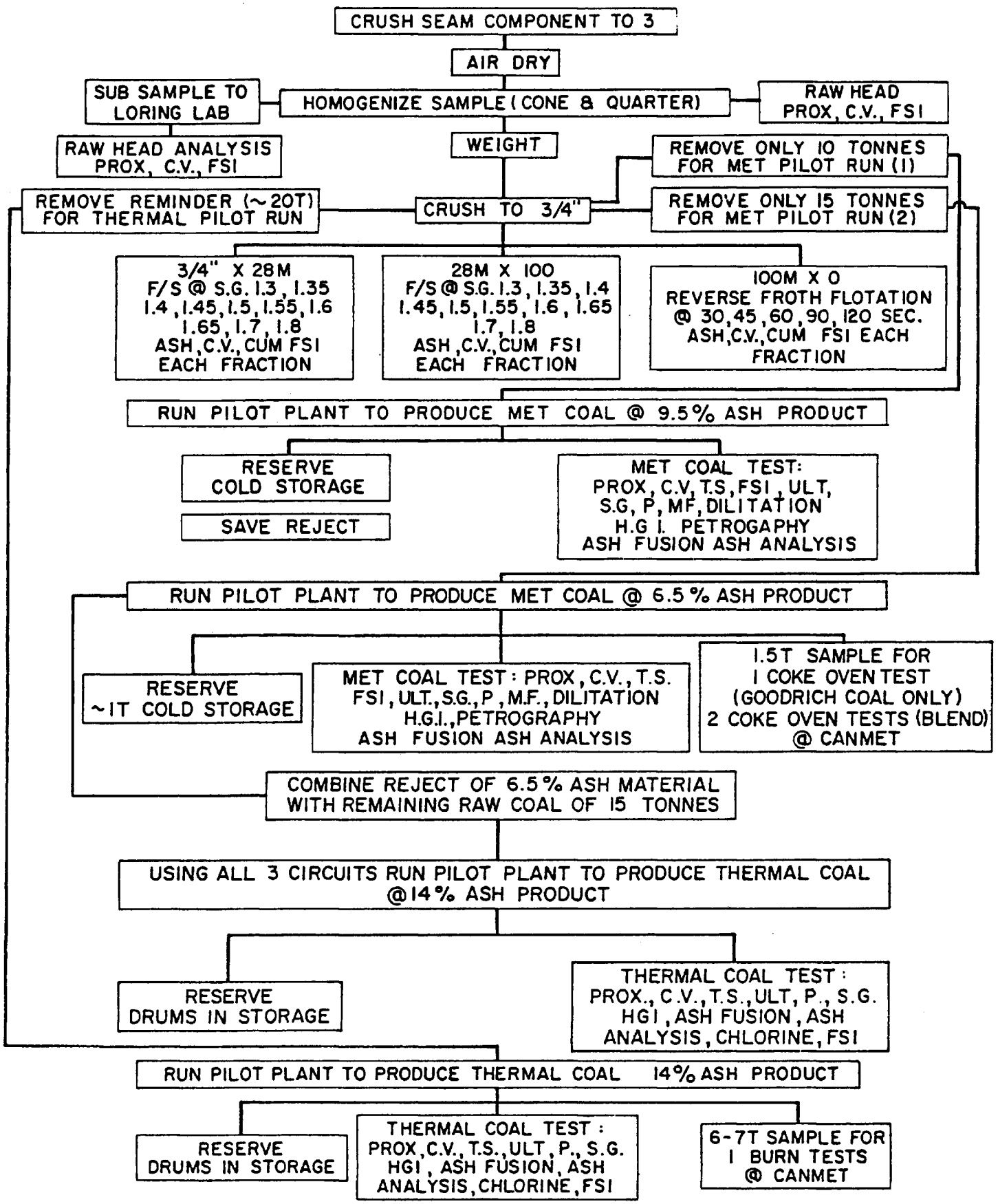
GOODRICH COAL PROPERTY 1982
COAL QUALITY ANALYSIS
FLOWSHEET B1

OXIDIZED COAL SAMPLE (TOTAL SEAM SAMPLE)



1) BULK SAMPLE TO BIRTLEY

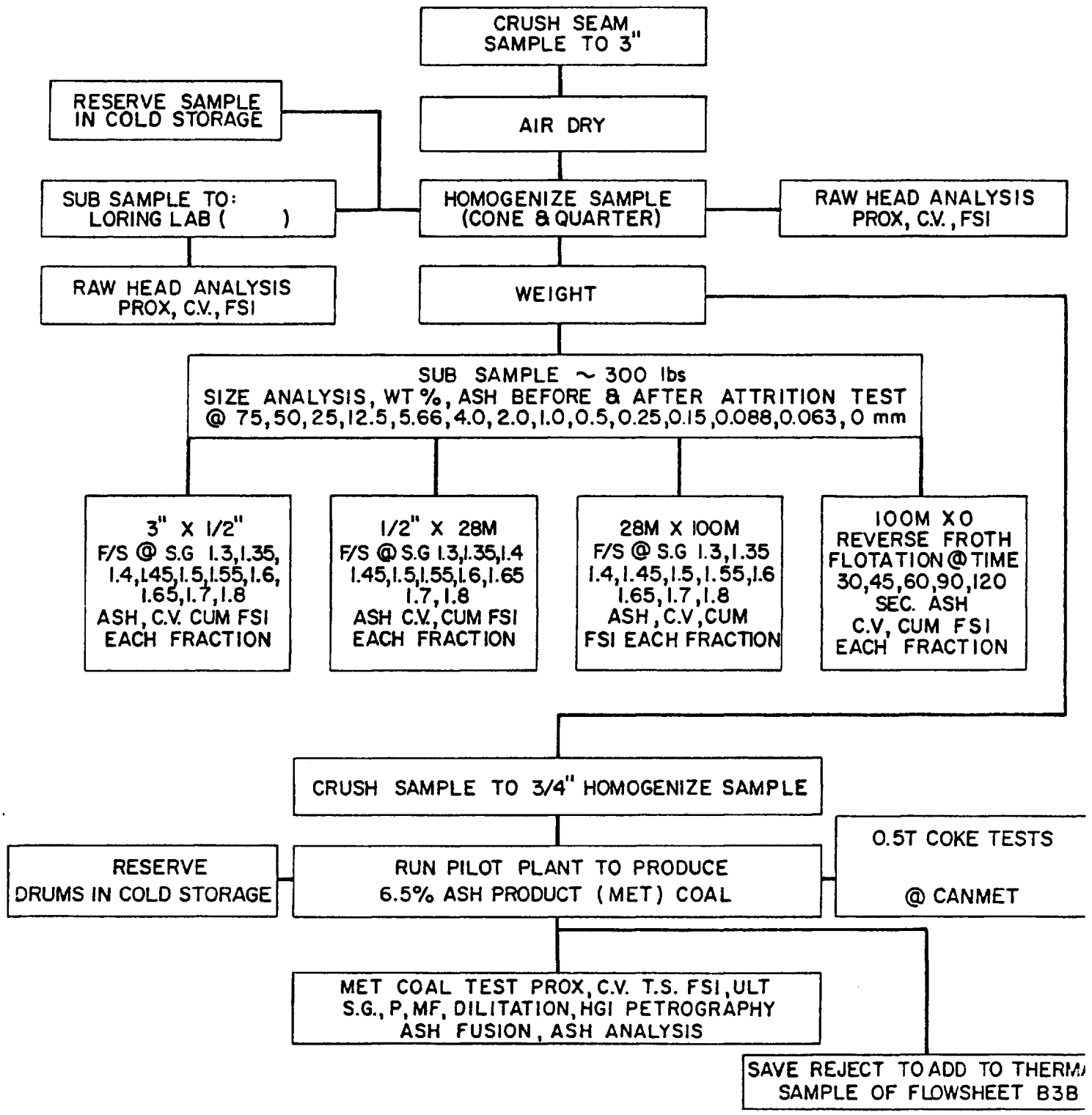
GOODRICH COAL PROPERTY 1982
COAL QUALITY ANALYSIS
FLOWSHEET B2
UNOXIDIZED COAL SAMPLE (TOTAL SEAM SAMPLE)



GOODRICH COAL PROPERTY 1982
COAL QUALITY ANALYSIS
FLOWSHEET B3A

UNOXIDIZED COAL SAMPLE

(SELECTIVELY MINED MET COAL PORTION OF SEAM)



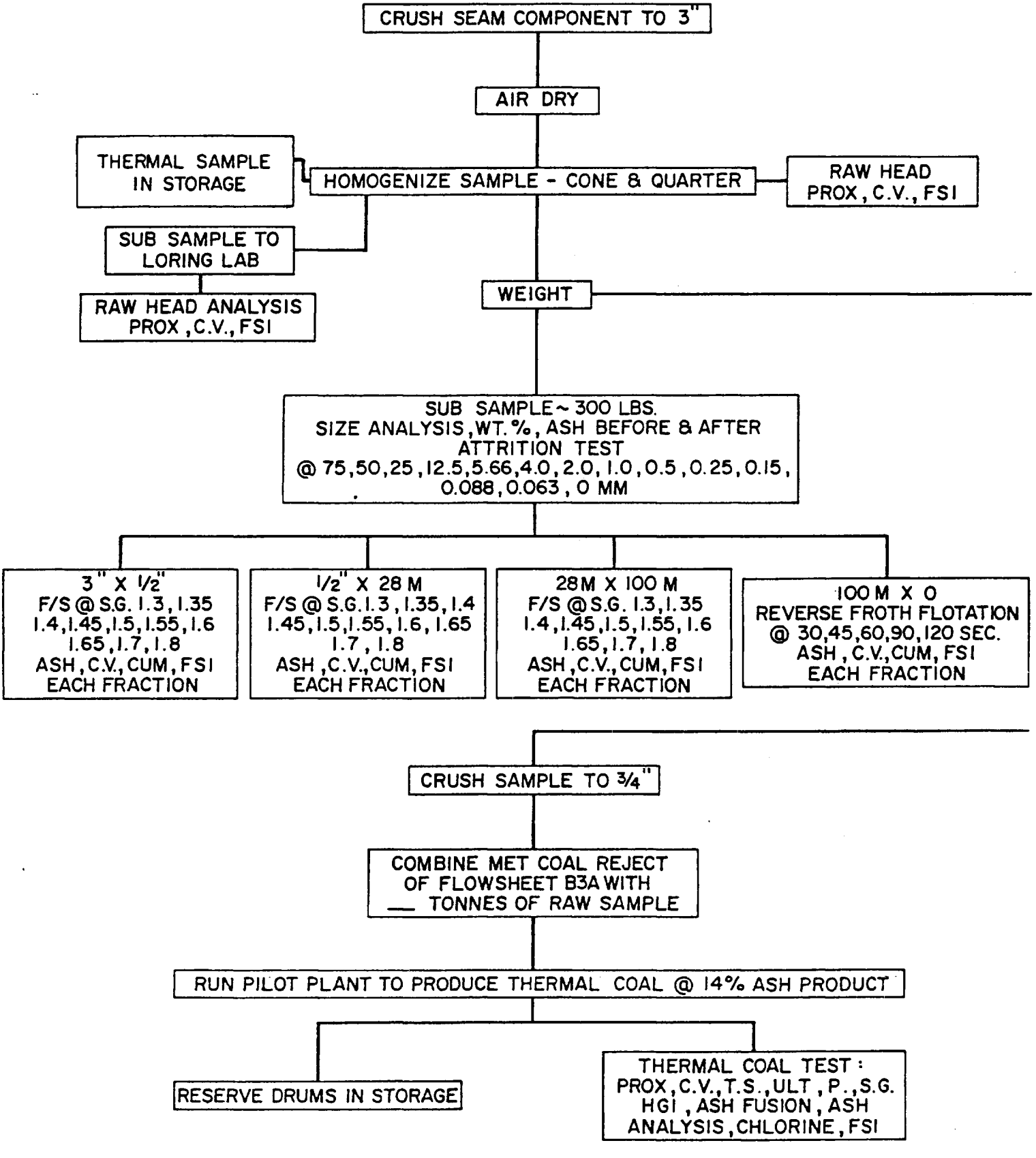
GOODRICH COAL PROPERTY 1982

COAL QUALITY ANALYSIS

FLOWSHEET B3B

UNOXIDIZED COAL SAMPLE

(SELECTIVELY MINED THERMAL COAL PORTION OF SEAM)

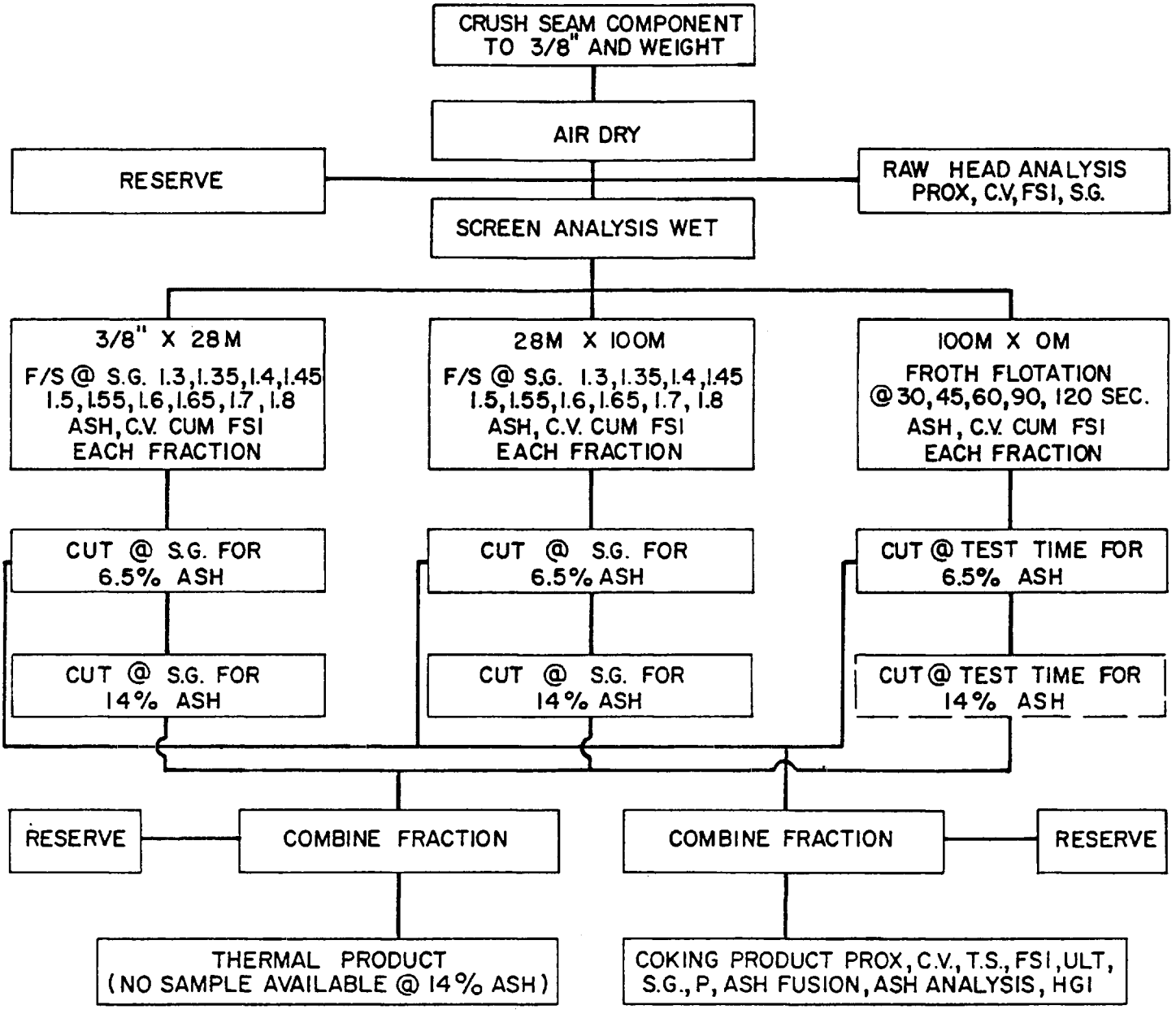


GOODRICH COAL PROJECT 1982

COAL QUALITY FLOW SHEET (FC2)

ADIT 1 – UNOXIDIZED SUB-SAMPLE OF ENTIRE SEAM

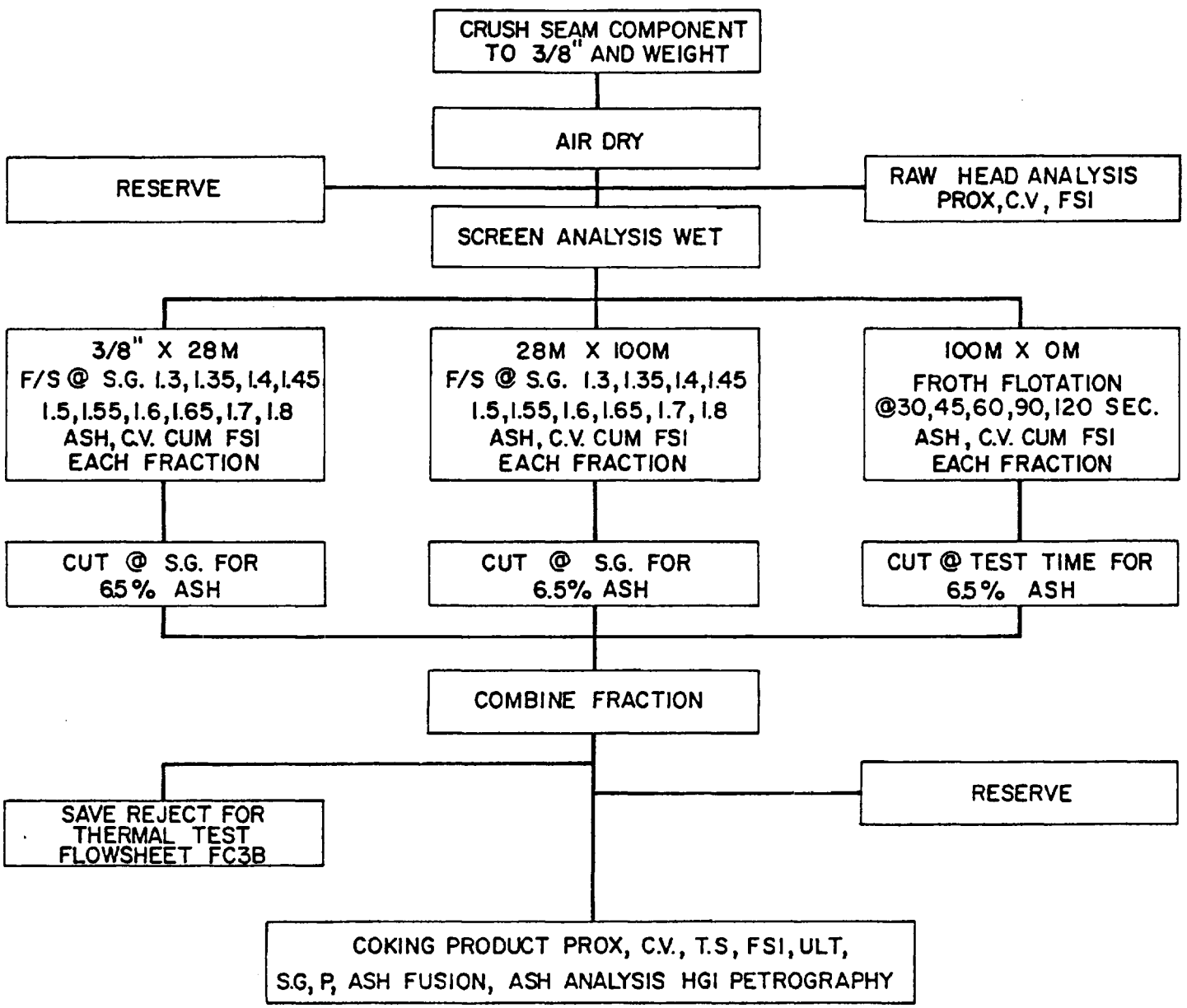
(LORING TESTS)



GOODRICH COAL PROJECT 1982

COAL QUALITY FLOW SHEET (FC3A)

ADIT 1 – UNOXIDIZED SUB-SAMPLE OF MET COMPONENT ONLY
(LORING TESTS)

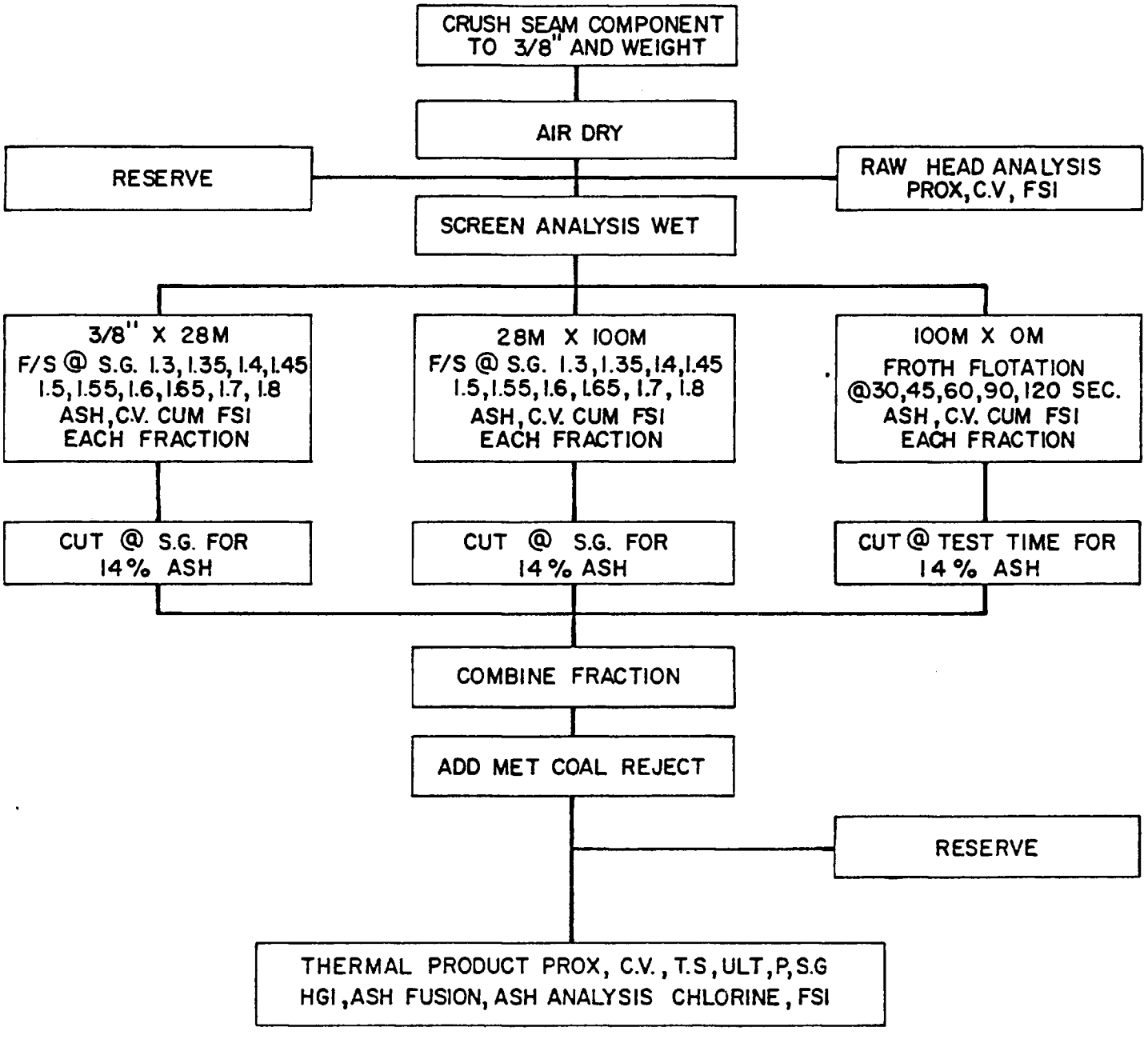


GOODRICH COAL PROJECT 1982

COAL QUALITY FLOW SHEET (FC3B)

ADIT 1 – UNOXIDIZED SUB-SAMPLE OF THERMAL COMPONENT ONLY

(LORING TESTS)



7.2.1 Metallurgical Coal Products

The metallurgical coal products from the entire seam sample (B2) were washed and tested separately at 9.5% and 6.5% ash levels. The volatile matter on a dry mineral matter free basis (dmmf) for both the 9.5% and 6.5% ash product is about 26%, the free swelling index is 2 to 2.5, and the clean coal recoveries are 78% and 66% respectively.

Although below average results were obtained from the clean metallurgical coal products from the entire seam, excellent coking characteristics were identified in the selectively mined metallurgical coal portion of the No. 1 Seam.

The separately mined 6.5% ash metallurgical coal product tested as a high volatile (30.9% dmmf) coking coal with an FSI of 7, dilatation of 32%, and maximum fluidity of 333 ddpm.

The coal products contain approximately .32% total sulphur and less than .03% phosphorus.

7.2.2 Thermal Coal Products

A high calorific thermal coal of greater than 7100 Cal/gm is attainable from the No. 1 Seam regardless of the mining method.

Phosphorus and chlorine content in the thermal products are less than .09% and .04%, respectively. Nitrogen content in the coal is less than 0.95%.

The Hardgrove Index ranges, for all products, between 60 to 69.

The average ash fusion temperatures are shown in Table 7.2.2.

TABLE 7.2.2
Average Ash Fusion Temperature (C°)
of Thermal Coal Product from Total Seam

Atmosphere	Initial Deform. Temp.	Softening Temp.	Hemispherical Temp.	Final Temp.
Oxidizing	1332.2	1423.9	1446.1	1460.0
Reducing	1237.8	1340.6	1390.6	1482.3

Mining the entire seam produced a run of mine coal with an ash level of 20.6%. At a clean coal ash level of 12.3% (well below the product specification) the total yield is 86.7%. In comparison, the selectively mined thermal portion of the No. 1 Seam has a run of mine ash level of 12.7%. The tonnage of product coal produced is dependent on the thickness of the thermal portion of the seam*.

Exclusion of the tuffaceous claystone zone that separates the thermal portion of the seam from the metallurgical portion is considered instrumental in the lower ash level of the separately mined seam product.

Furthermore, a higher than average fuel ratio of 2.7 (versus the predicted value of 2.3 indicated by the drill core) and lower volatile contents are attributed to the below average thickness of metallurgical coal encountered at the bulk sampling point.

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*The thermal to metallurgical coal thickness ratio at the adit sampling location is 4.45/1.15 metres. This ratio varies within the mine area.

7.2.3 Attrition Tests

Dry attrition tests were conducted with an ASTM standard test drum at 40 revolutions per minute for 20 minutes to establish the plant feed size distribution of the Gething No. 1 Seam. Table 7.2.3 summarizes the size analyses before and after attrition was performed on the bulk samples of the selectively mined coking coal and thermal coal portion of the seam.

7.2.4 Other Tests

One carbonization and several coke tests of the 9.5% and 6.5% ash metallurgical coal products are presently being undertaken at the CANMET Laboratories in Ottawa, as shown on the flowsheets. One Burn Test on the 14% Ash Thermal coal is also scheduled. Results of these tests will be reported under separate cover when they become available.

7.3 Coal Petrography

Petrographic results obtained from D. Pearson & Associates on six adit channel samples indicate that none of the coal was oxidized.

Three stations along the adit were sampled in the upper and lower portion of the Gething No. 1 Seam to test for the zone of oxidization.

Table 7.3.1 is a summary of the results of the maceral and reflectance study that is presented in Appendix B.

On an average the mean reflectance for the upper and lower portion of the seam is 1.12 and 1.00, respectively.

The average total reactives for the upper and lower portion of the No. 1 Seam is 45.8% and 73.3% respectively.

Independent petrographic results obtained from Cascade Coal Petrography Ltd. confirm Birtley washed coal quality to be within the .97 to 1.11 reflectance range, while the total reactives range from 66.3% to 74.9%. These results are also included in Appendix B.

This places the Goodrich Gething coal in the upper range of the medium volatile bituminous coal category according to the ASTM classification.

8.0 GLOSSARY

Block: a large area defined by coal licences boundaries and/or geography in order to facilitate geological Mapping.

Area: a smaller geographically and/or geologically defined area within a mapping Block.

Prospect: a geologically defined area of definite economical coal potential within a block an area.

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