Groundhog Coal Project

Geological Report

1983

680833
104A/16

GROUNDHOG COAL GEOLOGICAL REPORT

AUGUST-SEPTEMBER, 1983

COAL LICENCE NUMBERS

4395, 4400, 4406, 7540-42

CASSIAR LAND DISTRICT

NTS MAP NUMBER 104A/16

Latitude Between 56° 50' N and 56° 55' N

Longitude Between 128° 20' N and 128° 10' N

prepared by

J.M. Duford Consulting Services Ltd.

for

Gulf Canada Resources Inc.

December, 1983

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1.0 SUMMARY

The Groundhog Coal Geological Report contains a synthesis of geologic data from the Groundhog Basin. The data available from any location in the basin is limited; therefore any viable interpretation or exploration work must extend beyond the area of immediate investigation to include surrounding areas.

Gulf Canada Resources Inc. conducted a small exploration program in the Groundhog Coal Basin during the summer months of August and early September, 1983. A verbal agreement was made between Gulf and Groundhog Coal Ltd. which allowed access to the Groundhog Coal licence area. Exploration work, specific to the Groundhog property, was restricted to a mapping and coal sampling traverse along the Skeena River.

The geology is complex with occassional thrust faults and tight folds. The Groundhog sequence represents the main coal bearing unit in the area. The coal is anthracite in rank and varies in thickness from under 0.5 metres to 2.8 metres.

Based on recently collected data a reliable estimate of the coal resources within the licence area is not possible.

Coal quality data indicates a high ash content with relatively low washability yields, however this is based on limited data.

2.0 INTRODUCTION

2.1 General Statement

This report represents work completed by J.M. Duford Consulting Services Ltd. for Gulf Canada Resources Inc. on the Groundhog Coal Limited licences. Due to the lack of outcrop, any geological evaluation must incorporate a large study area to more fully evaluate the tectonic style and stratigraphy. Therefore, the geology of the Groundhog Coal licences represents data collected from surrounding areas as well as within the licence boundaries themselves.

2.2 Location and Access

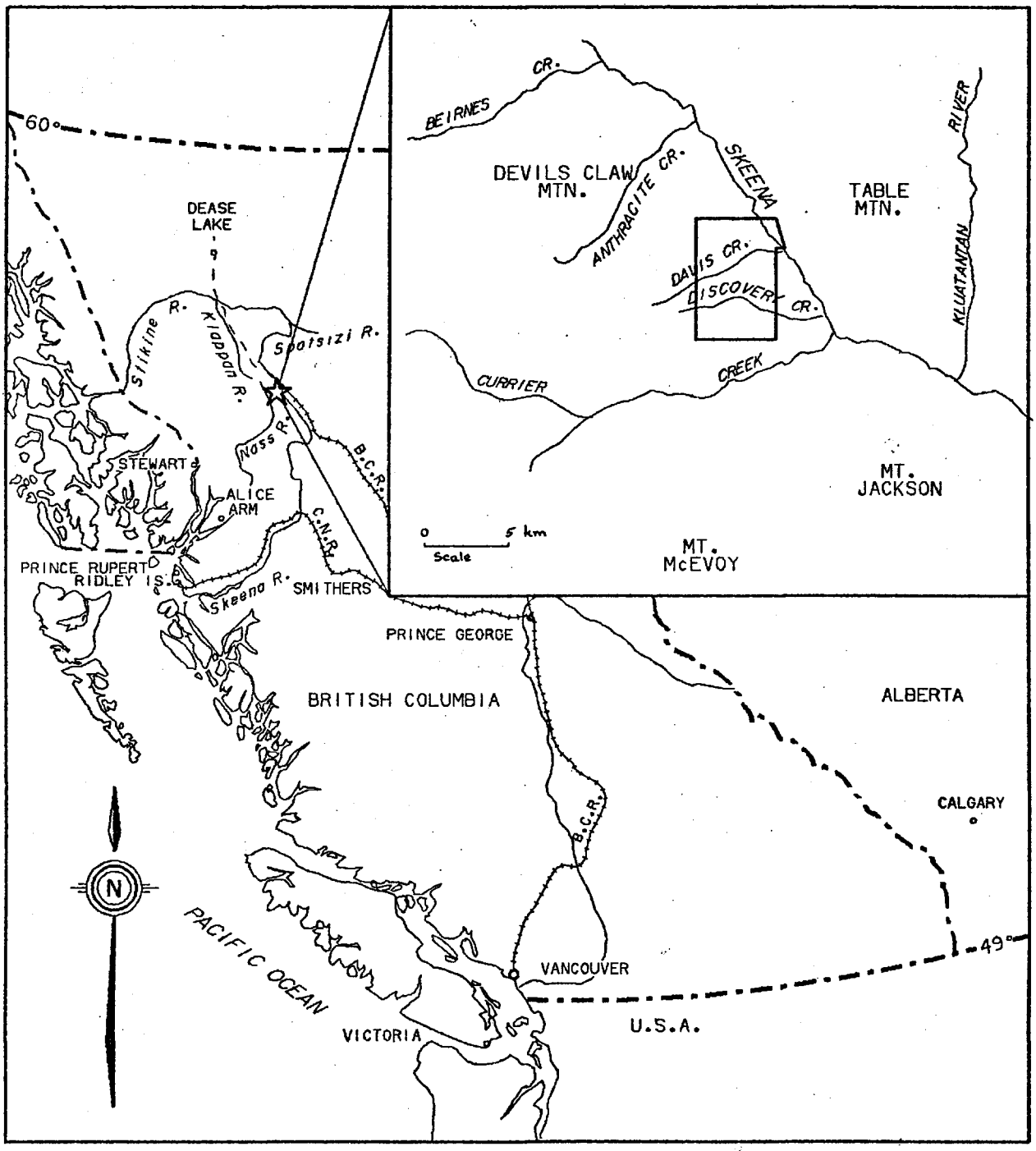
The Groundhog Coal Limited licence area is located in northwestern British Columbia, 180 kilometres north of Hazelton, B.C., and 150 kilometres northeast of Stewart, B.C. (Figure 2.1).

Access to the property is limited to aircraft. An airstrip for fixed wing aircraft is located approximately 10 kilometres southeast of the licence area near the Kluatantan River. A B.C.R. right-of-way and construction road has been cleared along the eastern bank of the Skeena River. The rail ends about 35 kilometres southeast at the Chipmunk airstrip.

FIGURE 2.1

GROUNDHOG COAL LIMITED PROPERTY

LOCATION MAP



GROUNDHOG COAL LIMITED LICENCE AREA

GULF CANADA RESOURCES INC.
09/01/84

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2.3 Property Description

The Groundhog Coal licence area consists of 6 coal licences (Appendix D) along the western bank of the Skeena River between Beirnes Creek and Currier Creek. The coal licences comprise 1554 hectares and were granted as follows:

Licences	Acquistion Date	Hectares
4395	June 28/78	259
4400	June 28/78	259
4406	June 28/78	259
7540	June 22/82	259
7541	June 22/82	259
7542	June 22/82	259

The six coal licences are wholly owned by Groundhog Coal Limited.

2.4 Biophysical Environment

The Groundhog licence area lies near the headwaters of the Skeena River, and is drained by three minor creeks; Evans Creek, Davis Creek and Discovery Creek. Topography is fairly subdued in the Skeena River valley, but rises sharply near the western edge of the licences. Elevations range from about 910 metres along the Skeena to over 1370 metres at the western licence margin. Peaks to the west of the licences rise to over 1980 metres.

The licence area is generally forest covered with stands of spruce and balsam. Tree line is approximately 1500 metres.

2.5 History

The history of the Groundhog Coal field is well documented in the numerous open file reports available for this area. Coal was initially discovered along Discovery Creek in 1903; followed by some development work from 1904 to 1913. The Geological Survey of Canada was active in the basin in 1948. Coastal Coal completed a summers' mapping program in 1966; while a joint venture with Placer Development Ltd, Quintana Minerals Corp. and National Coal Corp. mapped the area in 1969 and 1970 and drilled in 1970.

3.0 FIELD PROGRAM

A two man crew headed by J.M. Duford, P. Geol., began work in the Groundhog Coal licence area in late August and finished in early September, 1983. One to two days were spent on parts of the Groundhog coal licences with the bulk of the exploration concentrating on the surrounding area. The crew was mobilized from Smithers and supported from Gulf Canada's Mt. Klappan camp, approximately 60 kilometres north of the study area. A Glacier helicopter, on contract at the Mt. Klappan camp, was utilized for the Groundhog field work.

The work consisted of applying the stratigraphy established in 1980 for the Panorama area to the Groundhog Coal licence area. Concepts of the structural style were then developed for the licence area. Since the outcrop is limited, data was acquired along the Skeena River and from adjacent areas of high relief and applied to the geology of the licence area.

Coal seams were exposed where feasible, logged and sampled for proximate and 1.70 float/sink analyses. Analyses were completed by Commercial Testing and Engineering Co. in Golden, Colorado (Appendix C).

4.0 GEOLOGY

The Groundhog Coal Property is part of the Groundhog Coal field in the east central portion of the Bowser Basin. The basin consists of a 6000-10000 metre thick succession of marine and continental clastics and minor volcanics (Bowser Lake Group) of Jurassic to early Cretaceous age. The stratigraphic package within the coal field itself can be sub-divided into 4 major units; the Rhondda, Malloch, Groundhog and Panorama sequences which are described in detail in this report.

Deformation of the Bowser Lake Group probably began in early Cretaceous time. The resulting structural style is characterized by broad to tight northwest to southeast trending folds which are generally overturned to the northeast. Evidence for thrust faulting does exist; however, thrusts are thought to be minor.

4.1 STRATIGRAPHY

The stratigraphy of the Groundhog Coal Property appears to conform to that developed by Gulf for their 1980 and 1981 Panorama Reports and the open file report of Bustin and Petro Canada (1981). These reports define essentially 4 stratigraphic divisions. The four stratigraphic sequence names used in the Gulf 1980 Panorama Report (Panorama, Groundhog, Malloch and Rhondda) will be used here, as outlined in Figure 4.1. The oldest of these three units does not outcrop on the Groundhog Coal Property however it appears to outcrop further south along the Skeena River. A majority of the property consists of the coal bearing Groundhog sequence with only minor occurrences of Malloch lithologies along the property margin. The conglomeratic Rhondda sequence is limited to the highest peaks and ridges west of the Groundhog licences.

4.1.1 Panorama Sequence

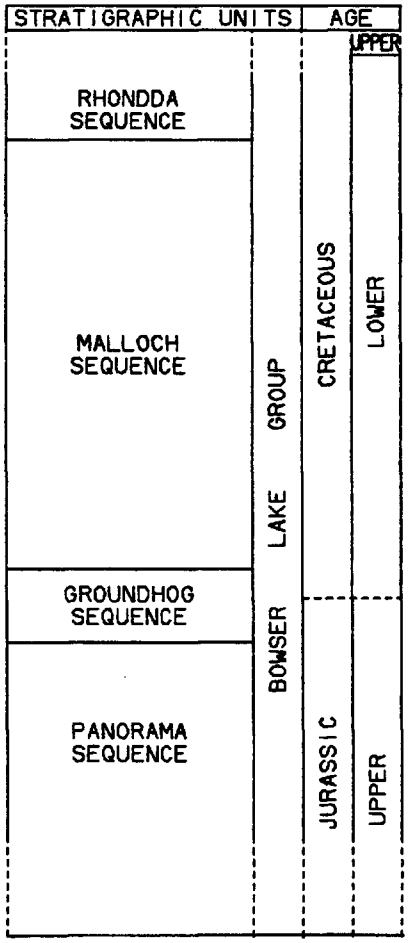
The Panorama Sequence is the stratigraphically lowest mapped unit in the Groundhog Basin. The base of the sequence is not exposed, but the unit is at least 500 metres thick.

Lithologically, the unit consists of fine to medium-grained, medium to thick-bedded, grey sandstone gradationally associated with subordinate interbeds of recessive claystone to siltstone. Coal is rarely developed in these finer grained carbonaceous sediments. Primary sedimentary structures in the form of ripple marks and cross-bedding are not uncommon.

FIGURE 4.1

GROUNDHOG COAL PROPERTY

GENERALIZED STRATIGRAPHIC COLUMN



GULF CANADA RESOURCES INC.
09/01/84

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Fossil bivalves are preserved at a number of localities, and plant fossils are locally abundant.

The top of the Panorama sequence is marked, and generally recognized, by a succession of thick-bedded cliff-forming sandstones.

4.1.2 Groundhog Sequence

The Groundhog sequence, which is the principal coal-bearing member, conformably overlies the Panorama sequence. The base of the Groundhog is most confidently recognized through the location of the oyster-bearing horizon at the top of the Panorama sequence. Twelve separate oyster bands have been observed at a complete exposure of this marine interval. Fewer oyster bands are found in poorer exposures at other localities.

Primary distinction of the Groundhog sequence from the Panorama is made on a lithologic basis. The Groundhog sequence is predominantly finer grained than the Panorama sequence, with abundant, thinly-bedded dark argillites and siltstones. Sandstones are less massive and some are recessive. There is considerable vertical and, particularly, lateral gradation between lithologies.

The scarcity of ripple marks and small scale cross-bedding, relative to the Panorama sequence, suggest a lower-energy depositional environment for the Groundhog sequence. The absence of primary sedimentary structures to indicate tops, sometimes makes structural interpretation difficult.

Fossils, however, are relatively abundant within the Groundhog sequence. Plant fragments appear in all lithologies and bivalves are locally abundant at a number of horizons. The latter were not found to be useful in correlation, suggesting localized lacustrine and fluvial rather than marine environments of deposition.

Although the Groundhog sequence outcrops along most of the Skeena River Valley, low relief and overburden severely limit the amount of outcrop. Due to the lack of outcrop in the recessive Groundhog sequence a complete stratigraphic section does not exist. Sections up to 490 metres have been measured (Malloch's Mt. Jackson section) adjacent to the Groundhog licences. Bustin, in the Petro Canada report, suggested a total thickness of 600-800 metres for the equivalent unit, however his schematic diagrams illustrate a thickness in order of 400-500 metres.

The thickness for the Groundhog sequence used in this report is 600 metres.

4.1.3 Malloch Sequence

The Malloch conformably overlies the Groundhog sequence.

Lithologically, the Malloch sequence is composed of interbedded sandstones, siltstones, and claystones with a predominance of the finer grained lithologies. From a distance, the Malloch sequence is a distinct, monotoneus, dark-green unit, In hand sample, olive-green sandstones and dark brown siltstones are common. The unit is characterized by step-like topography caused by the resistant, often thickly-bedded, coarse sandstone and granular to pebbly conglomerates interbedded with recessive siltstone/claystone sequences.

Primary sedimentary structures are common in the Malloch; including large-scale cross-bedding, ripple marks and small-scale Bouma sequences.

The thickness of the unit is in the order of 1000 metres.

4.1.4 Rhondda Sequence

The thick, prominent conglomerates which overlie the Malloch sequence do not occur within the Groundhog Coal

area. The contact between these conglomerates, here included in a sequence named the Rhondda, and the Malloch sequence, can be found immediately to the northwest of the licence area on Devil's Claw Mountain. It is surprising that such a prominently weathering and resistant sequence as the Rhondda does not have a more extensive distribution. However, the factors controlling its erosion or non-deposition in the licence area are not known.

4.2 COAL

Coal is present in each of the four sequences, however seam thickness and frequency of occurrence is greatest in the Groundhog sequence. Data on coal is limited to exposures along the Skeena River and its tributaries as well as the drill hole intersections from the 1970 and 1981 drilling programs (Appendix E). Coal seams are generally thin with frequent claystone interbeds. Early workers in the area reported structural pinching and fault terminations of some seams within drifts. Seams measured on the licences range from less than 0.5 metres to just over 2 metres in thickness.

Continuity of the coal seams could not be well documented from the currently available data; however early workers felt that seams in Discovery Creek and Abraham Creek could be correlated. Coal intersections of DDH-1, along Beirnes Creek, can be directly correlated with seams which outcrop in the stream bank. Seam thicknesses appear to be maintained along the approximately 200 metre distance between outcrop and drill hole intersection suggesting, at least, some continuity. Correlation between drill holes is difficult due to the complete lack of bedding to core angles or geophysical logs for many drill holes. In the field, limited outcrop and structural complexities prevent seam tracing for any distance.

Two coal seams were exposed and sampled on or near the Groundhog licence area; SKE-TRC 83035 and 83045. The seams exposed by these trenches were both 1.1 metres in true thickness (Appendix B).

4.3 STRUCTURE

The general structure of the area consists of a large, broad anticline with smaller folds and faults superimposed on it. This general anticline, the Skeena anticline, is the northeastern limb of the broad Mt. Beirnes syncline which plunges southeastward from the Mt. Klappan property. In the vicinity of Beirnes Creek the plunge appears to gradually change bringing the coal bearing Groundhog sequence topographically higher. This plunge may be responsible for placing the coal bearing unit as high as Mt. Jackson.

Folding is the dominant structural element in the area and is associated with minor local thrust faulting. All observed fold noses were overturned while some were recumbent. This tight folding is typical of interbedded sequences of sandstone, siltstone and shale.

The fold style appears to be one of relatively long shallow southwest dipping anticline limbs with steep to overturned northeast limbs (Appendix D). The lack of surface control prevents a reliable estimate of fold wavelength or amplitude.

The 1981 Drill hole data indicates that fracturing of the rock is common, with over 25% of the lithology units described as either breccia or containing quartz or calcite filled fractures. In addition over 75% of the individually described coal intervals were soft, very broken, sheared or brecciated. A majority of the fractures and shearing are probably related to intense folding and bedding plane movement, rather than faulting. Some of the fracturing may have been related to the drilling process.

At least one fault was observed near the mouth of Langlois Creek, probably a forelimb thrust, and is interpreted to extend a short distance along strike. Displacement along this fault is minor and estimated to be less than 100 metres. Other faults may be present; however these are likely minor as well.

Minor plunge changes along strike are frequent, as seen in exposures near the Skeena River. The plunges are in the order of 10 degrees and do not affect the overall structural interpretation.

5.0 RESOURCES

Due to the reconnaissance nature of the mapping and the very limited data on coal occurrences, reliable estimates of in-situ resources are not possible at this time.

6.0 COAL QUALITY

Based on the coal quality results from the surface trenches (Appendix C), the coal on the Groundhog licence area is an anthracite with a relatively high ash content. Float/sink data from SKE-TRC 83045 indicate that the expected yield from the seam would be quite low while that from SKE-TRC 83035 might be acceptable. Quality data available from previous reports indicates several acceptable seams.

7.0 REFERENCES

AMERICAN SOCIETY for TESTING and MATERIALS, 1980, Part 26 Gaseous Fuels; Coal and Coke: Atmospheric Analysis

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APPENDIX A

APPENDIX A

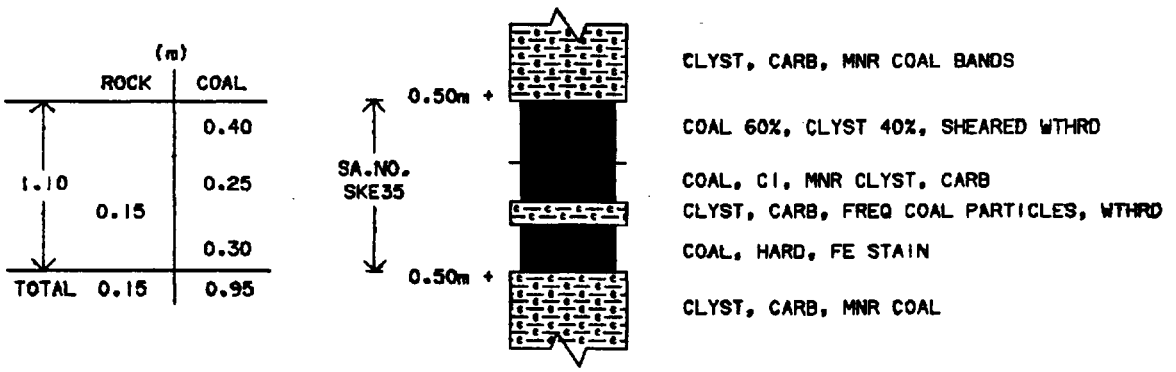
Statement of Costs for Exploration
During the 1983 Season on Licences
4395, 4400, 4406, 7540-42

Salaries & Wages	$ 1,400.00
Food & Accommodation	120.00
Support Aircraft (helicopter & fixed wing)	2,550.00
Field Supplies (radios, safety equipment)	100.00
Laboratory Analyses (Commercial Testing & Engineering Co. Ltd.)	350.00
Report Compilation	500.00
	$ 5,020.00

Signed_____

J.M. Duford, Consulting Services. Ltd.

APPENDIX B



ATTITUDE OF ROOF : N.A.
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UTM COORDINATES : 6194350N, 544691E
ELEVATION : 945m
MAP CARD NUMBER : N.A.
TRENCH DEPTH : 0.20m
TRENCH WIDTH : 0.30m
TRENCH LENGTH : 1.50m
TRENCH BEARING : 007°
TRENCH SLOPE : 44° N

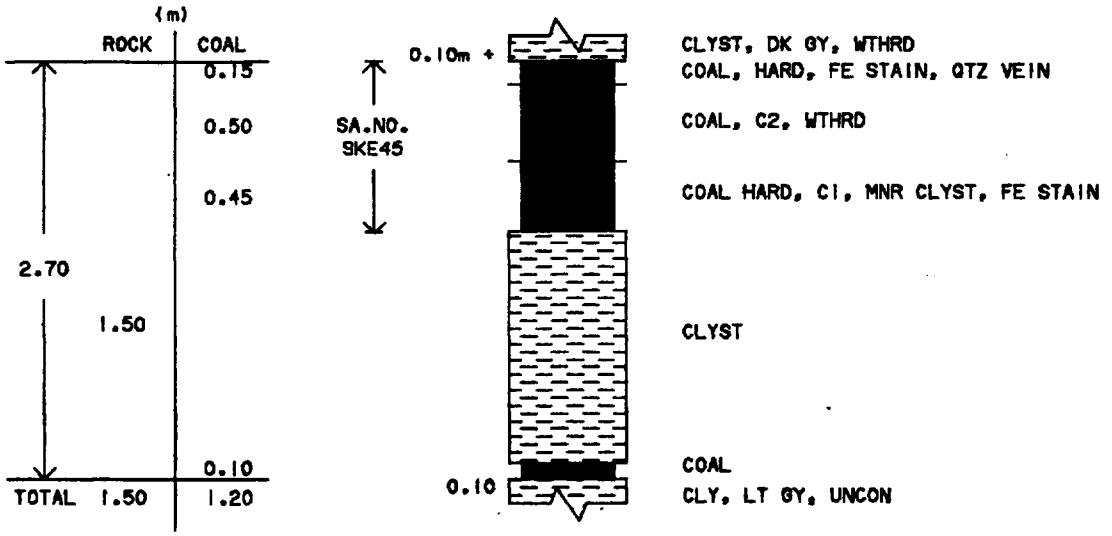
GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

GROUNDHOG COAL PROJECT

TRENCH LOG
SKE-TRC-83035

DRAWN BY: C. NOGAS	SCALE: 1:50
LOGGED BY: C. NOGAS	DATE: SEPT. 83
APPROVED BY:	

QSO:[205,56184025B001.LOG: 15/03/84



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MAP CARD NUMBER : N.A.
TRENCH DEPTH : 0.30m
TRENCH WIDTH : 0.48m
TRENCH LENGTH : 2.00m
TRENCH BEARING : 010°
TRENCH SLOPE : 65°S

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

GROUNDHOG COAL PROJECT

TRENCH LOG
SKE-TRC-83045

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LOGGED BY: C. NOGAS	DATE: SEPT. 83
APPROVED BY:	

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APPENDIX C

APPENDIX C

Coal Quality

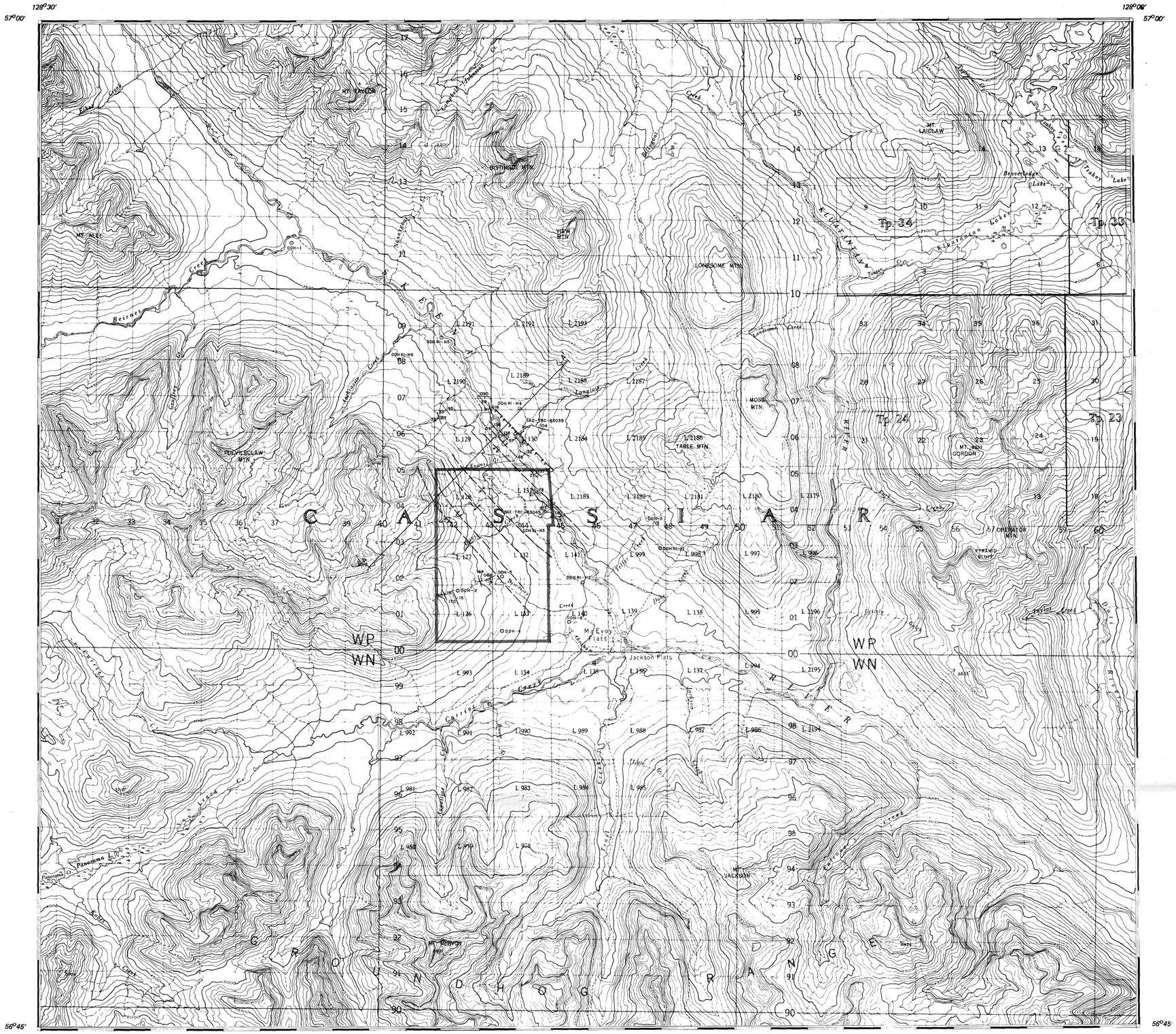
RAW COAL

Sample I.D.	Thickness (m)	Moist (A.R.)	Ash (D.B.)	V.M. (D.B.)	F.C. (D.B.)	C.V. (c/g)	S	Ro
SKE-35	1.10	10.49	35.27	5.61	59.12	4868	0.36	4.91
SKE-45	1.10	8.69	52.09	10.76	37.15	3062	1.16	4.87

1.70 Float/Sink Data

Sample I.D.	1.70 Float	Moist (A.R.)	Ash (D.B.)	V.M. (D.B.)	F.C. (D.B.)	C.V. (c/g)	S
SKE-35	45.7	4.26	20.56	5.74	73.70	6176	0.45
SKE-45	13.3	2.75	16.94	5.11	77.95	6559	0.98

APPENDIX D



Published 1950.
Compiled by the Topographical Survey in 1949 from photographs taken in 1948 by the Royal Canadian Air Force.

Contours, interval 100 feet

LEGEND

- LICENCE BOUNDARY (GROUNDHOG COAL LTD.)
- CROSS-SECTION LINE
- FAULT
- SYNCLINE, ANTICLINE
- OVERTURNED ANTICLINE, SYNCLINE
- BEDDING ATTITUDE
- TRENCH
- DRILL HOLE

LEGEND

ROADS AND RELATED FEATURES

- HARD SURFACE, ALL WEATHER
- LOOSE SURFACE
- CART TRACK, WINTER ROAD, UNDER CONSTRUCTION
- TRAIL, CUTLINE, PORTAGE
- BUILT UP AREA
- RAILWAY, SIDING, STATION, STOP
- BRIDGE
- SEAPLANE BASE, ANCHORAGE

LANDMARK FEATURES

- HOUSE, BARN
- CHURCH, SCHOOL
- POST OFFICE
- HISTORICAL SITE
- TOWERS, FIRE, RADIO
- WELL, OIL, GAS
- TANK, OIL, GASOLINE, WATER
- TELEPHONE LINE
- POWER TRANSMISSION LINE
- MINE
- CUTTING, EMBANKMENT
- GRAVEL PIT

BOUNDARIES AND CONTROL

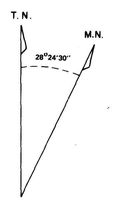
- INTERNATIONAL, PROVINCIAL, BOUNDARY MONUMENT
- COUNTY, DISTRICT
- TOWNSHIP, PARISH — SURVEYED — UNSURVEYED
- TOWNSHIP, DLS — SURVEYED — UNSURVEYED — SECTION CORNERS
- MUNICIPALITY
- INDIAN RESERVE, PARK, ETC
- HORIZONTAL CONTROL POINT
- BENCH MARK
- SPOT ELEVATION, ELEVATION APPROXIMATE

DRAINAGE AND RELATED FEATURES

- STREAM, SHORELINE, INDEFINITE
- DIRECTION OF FLOW
- LAKE, INTERMITTENT
- INUNDATED, FLOODED LAND
- MARSH OR SWAMP (WOODED)
- DRY RIVER BED WITH CHANNELS
- SAND, ABOVE, IN WATER
- STRING BOG
- TUNDRA PONDS, POLYGONS
- RAPIDS
- FORESHORE FLATS
- ROCK
- DAM
- WHARF
- DITCH

RELIEF FEATURES

- CONTOURS
- APPROXIMATE CONTOUR
- DEPRESSION
- ESKER
- PINGO
- SAND, SAND DUNES
- PALSA BOG
- WOODED AREA



CORRECTED TO 1980

ANNUAL CHANGE DECREASING 3.5'

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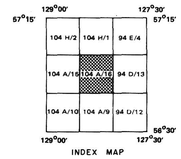

INDEX MAP

inches 0 1 2
centimetres 0 1 2 3 4 5

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GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

104 A/16

GEOLOGY

GROUNDHOG COAL LICENCES

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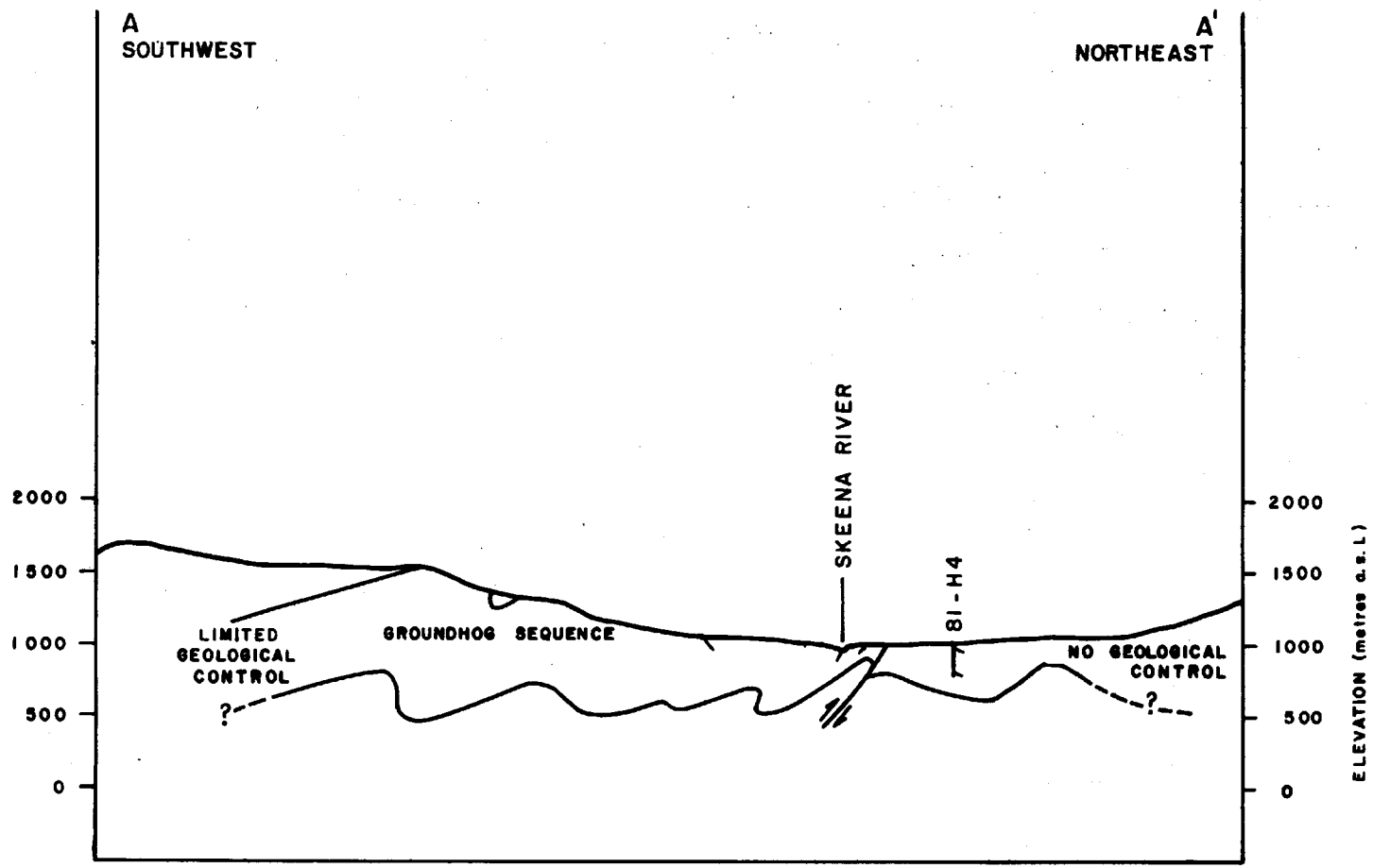
APPROVED BY:	DATE: DEC. 83	



GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

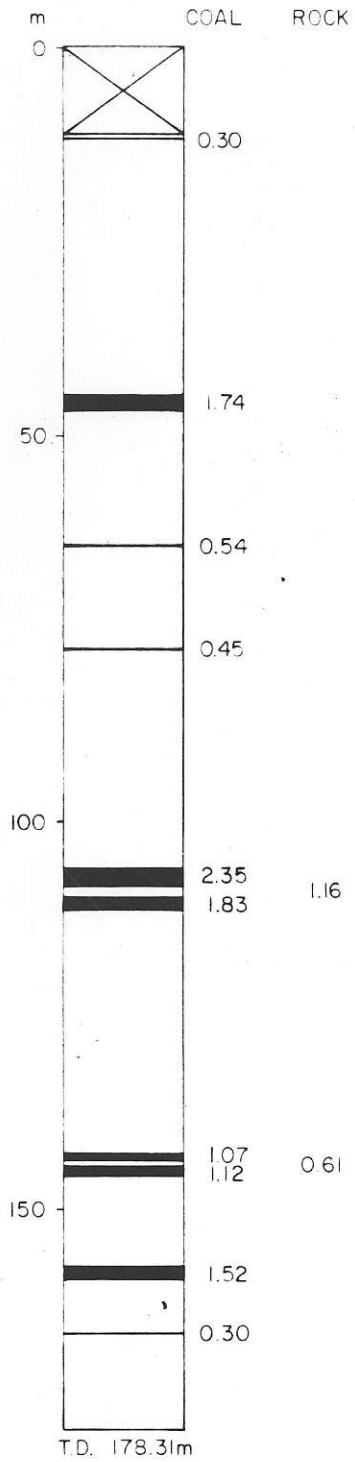
Gulf

GROUNDHOG COAL PROPERTY

CONCEPTUAL CROSS-SECTION A-A'

PREPARED BY: J.M. DUFORD	SCALE 1 : 50 000
APPROVED BY: J.M. DUFORD DATE: MAR. '86	DRAWING No.

APPENDIX E



GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

QUINTANA DRILL HOLE

DDH – 1
1970

PREPARED BY E. SWANBERGSON		SCALE 1:1000
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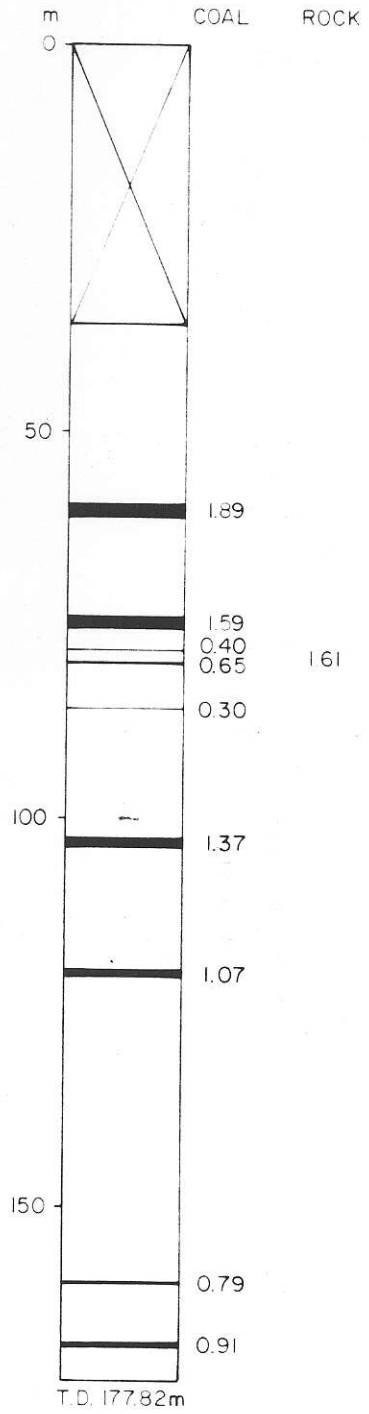

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

Gulf

QUINTANA DRILL HOLE

DDH - 2

1970

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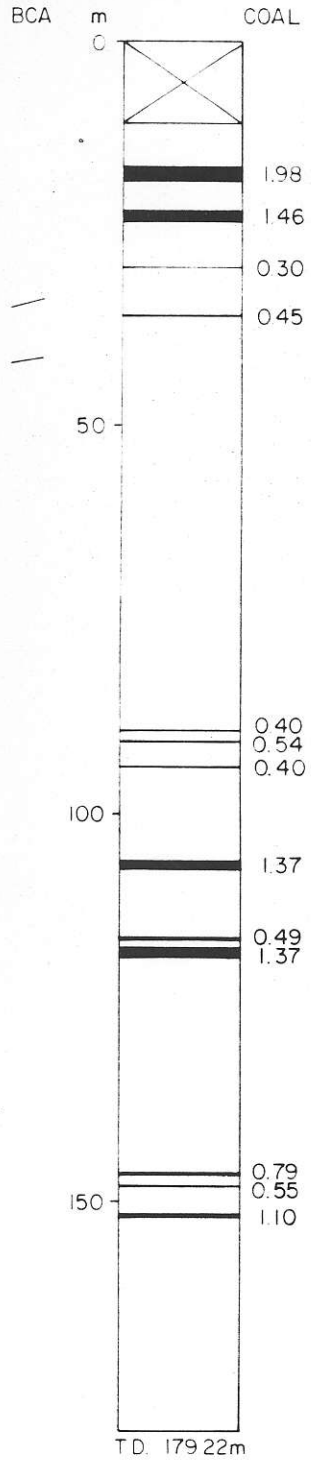


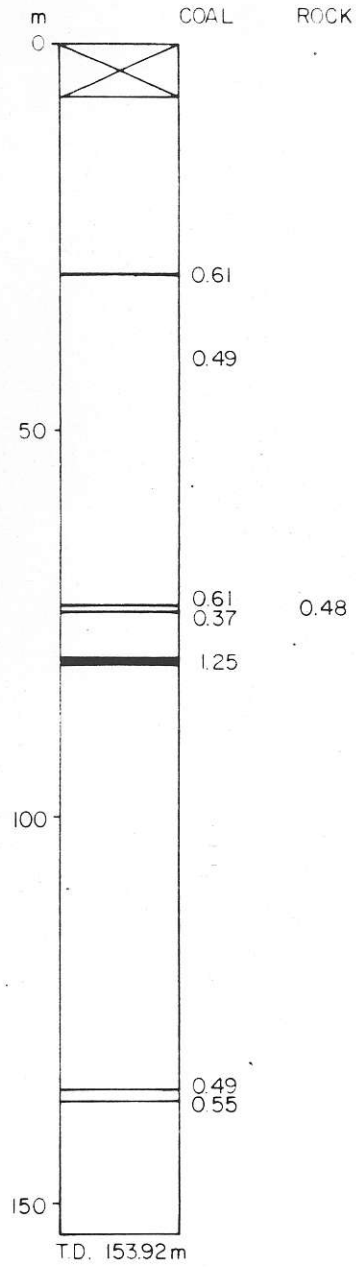
GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

QUINTANA DRILL HOLE

DDH-3

1970

PREPARED BY	E. SWANBERGSON	SCALE 1:1000	
APPROVED BY	DATE APR./84	DRAWING No	



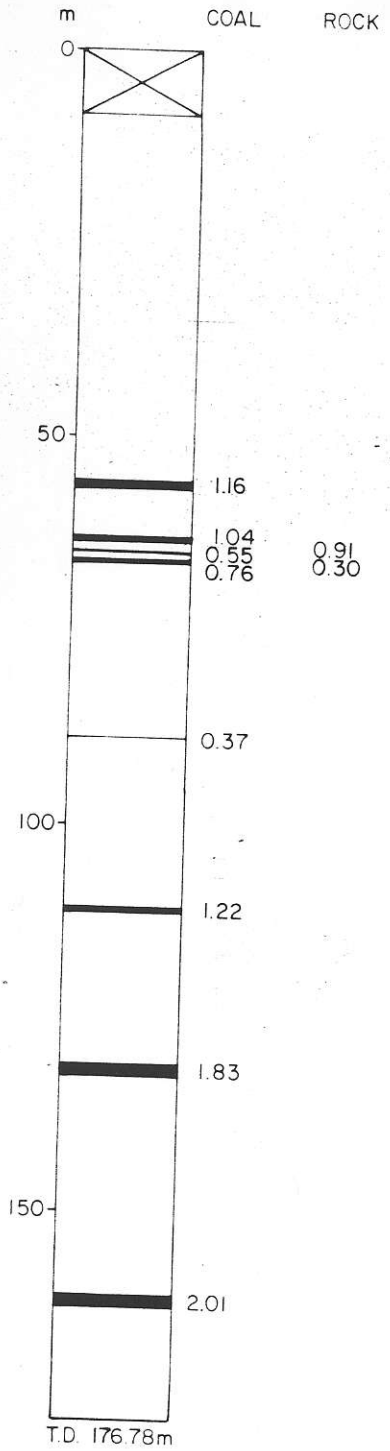
GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

QUINTANA DRILL HOLE

DDH - 4

1970

PREPARED BY E SWANBERGSON	SCALE 1 : 1000
APPROVED BY DATE APR. / 84	DRAWING No



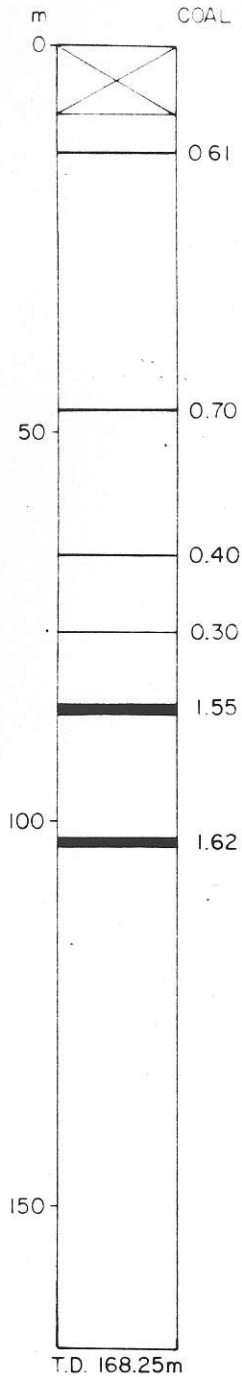
GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

QUINTANA DRILL HOLE

DDH - 5

1970

PREPARED BY E. SWANBERGSON	SCALE 1 : 1000
APPROVED BY DATE APR. / 84	DRAWING No



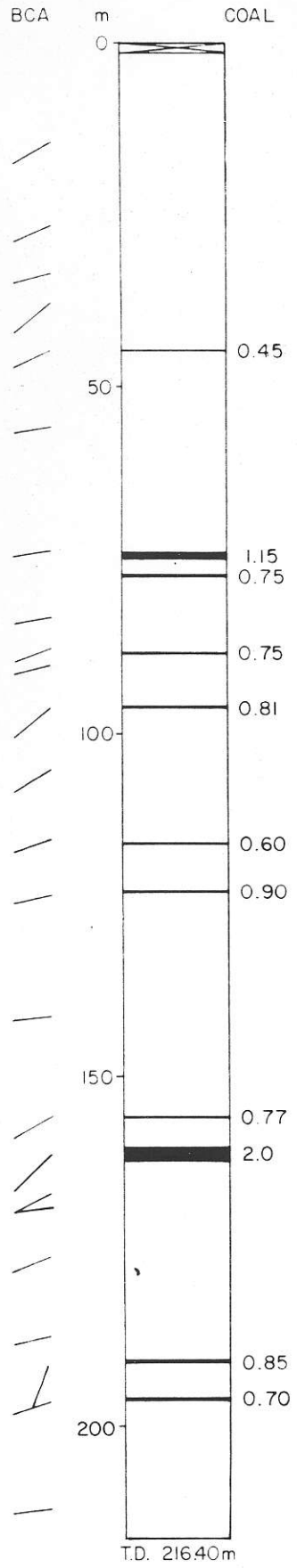
GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

QUINTANA DRILL HOLE

DDH-6

1970

PREPARED BY E. SWANBERGSON	SCALE 1:1000
APPROVED BY DATE APR. / 84	DRAWING No



GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

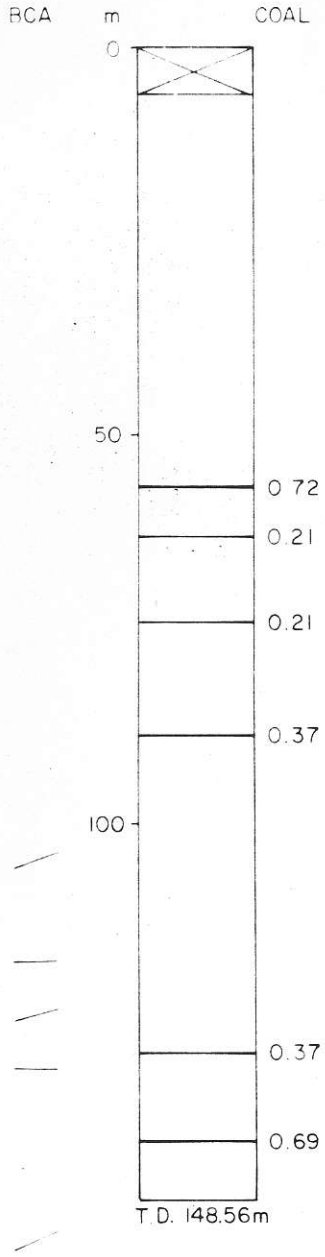
Gulf

IMPERIAL METALS DRILL HOLE

DDH 81-H1

1981

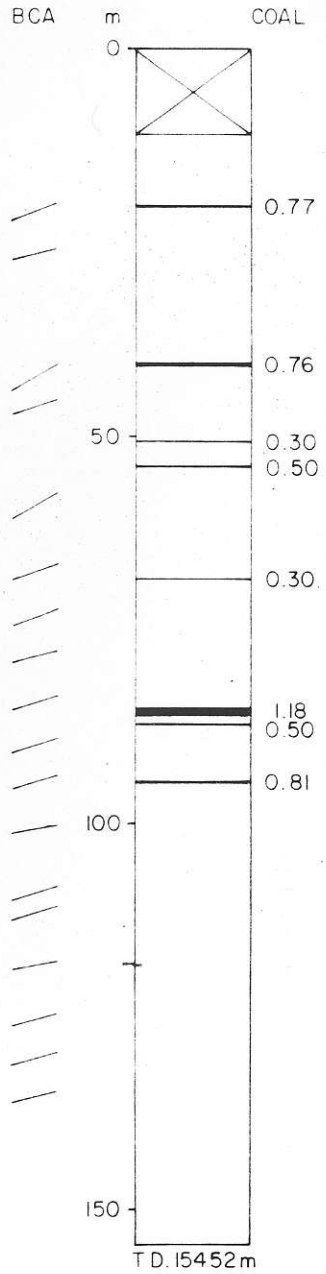
PREPARED BY E. SWANBERGSON		SCALE 1:1000
APPROVED BY	DATE APR./84	DRAWING No



GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

IMPERIAL METALS DRILL HOLE
DDH 81-H2
1981

PREPARED BY E. SWANBERGSON		SCALE 1:1000
APPROVED BY	DATE APR / 84	DRAWING No



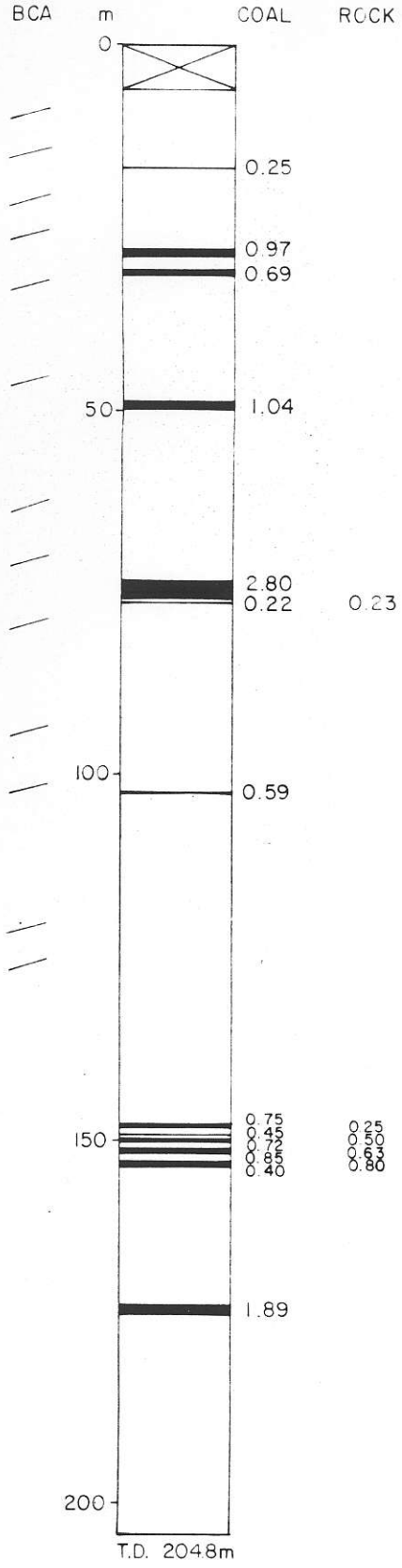
GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

IMPERIAL METALS DRILL HOLE

DDH 81-H3

1981

PREPARED BY E SWANBERGSON		SCALE 1:1000
APPROVED BY	DATE APR /84	DRAWING No



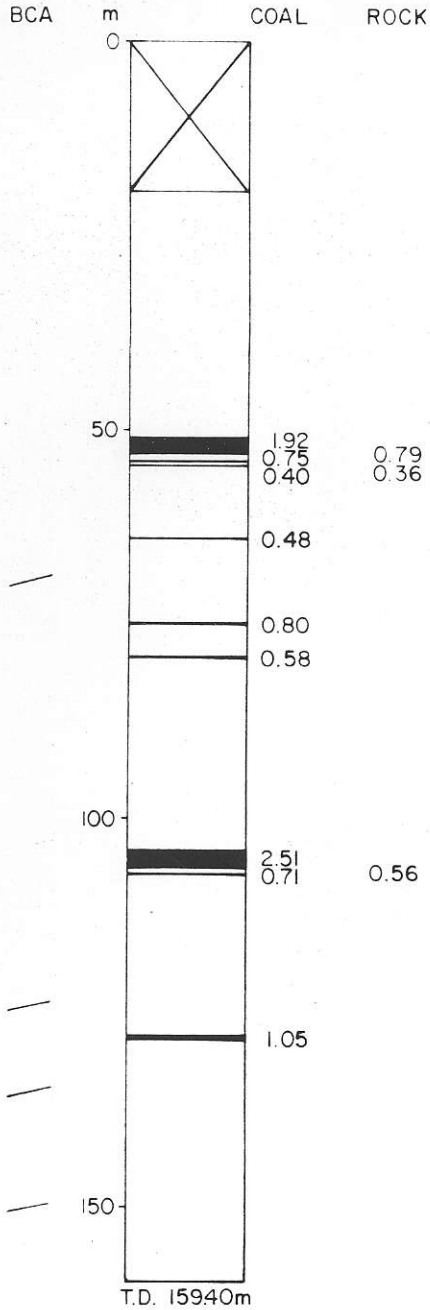
GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

IMPERIAL METALS DRILL HOLE

DDH 81-H4

1981

PREPARED BY	E. SWANBERGSON		SCALE 1:1000
APPROVED BY		DATE APR / 84	DRAWING No



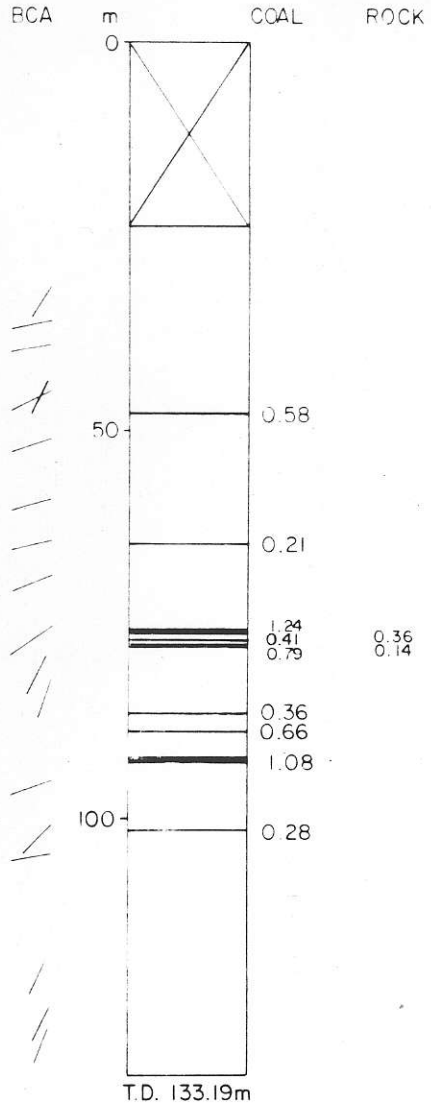
GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

IMPERIAL METALS DRILL HOLE

DDH 81-H5

1981

PREPARED BY E. SWANBERGSON	SCALE 1:1000
APPROVED BY DATE APR./84	DRAWING No



GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

Gulf

IMPERIAL METALS DRILL HOLE

DDH 81-H6

1981

PREPARED BY E. SWANBERGSON		SCALE 1:1000
APPROVED BY	DATE APR./84	DRAWING No