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CONFIDENTIAL

GROUNDHOG COAL PROPERTY

GEOLOGICAL REPORT

DECEMBER, 1984

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'W and 128°10'W

Prepared by

J.M. DUFORD CONSULTING SERVICES LTD.

For

GROUNDHOG COAL LTD.

PREFACE

The Groundhog Coal Basin of northwest British Columbia has been the focus of numerous coal exploration projects in the last 75 years while the specific licence area of Groundhog Coal Ltd. has been part of several of these previous programs.

In July, 1984, Mr. A.F. Reeve of Groundhog Coal Ltd. contracted J.M. Duford Consulting Services Ltd. to supervise the coal exploration work on the Groundhog licences and complete the subsequent geological report. In addition to the current year's data, this report and the geological interpretation incorporate all data collected from previous exploration programs on the licences and adjacent areas to provide a current assessment of the geology, coal quality and resource potential.

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1.0 SUMMARY

The Groundhog Coal Ltd. licences are located on the west side of the Skeena River Valley of northwestern British Columbia, 180 kilometres north of Hazelton, B.C. and 150 kilometres northeast of Stewart, B.C. Access is currently limited to helicopter and fixed-wing aircraft utilizing a local airstrip. Vehicular access from the north is possible to within 15 kilometres of the property along a B.C.R. right-of-way.

The 1984 Groundhog Coal Exploration Program geologically mapped the licence area, documented seam thicknesses and characteristics, collected representative samples for rank, quality and washability analyses and compiled all data collected to date into one interpretation.

The coal is contained in the Upper Jurassic Currier unit. The composite stratigraphic section contains 15 coal seams averaging 1.08 metres in thickness with maximum measured seam thicknesses approaching two metres. Structure on most of the property consists of a broad plunging synclinal structure with excellent mining potential.

The total in-situ resource on the property is calculated to be 221.4 million tonnes and is composed of an indicated resource of 11.5 million tonnes and an inferred resource of 209.9 million tonnes.

Coal quality and washability analyses indicate that the Groundhog Coal licences are capable of producing a multi-product anthracite coal with product coal ash values as low as 5 percent. Clean coal calorific

values for the medium and low ash products would be 31.4 and 33.4 (MJ/kg) respectively. The hard, coarse nature of the extracted coal suggests an excellent anthracite product.

Based on the 1984 Exploration Program an additional drilling program is recommended to increase the geologic level of confidence. The acquisition of the two licences south of the property is also recommended to cover the extension of the two main seams.

Licence #	Trenches
7540	TRC 8409
	TRC 8407
	TRC 8410
	TRC 8411
4400	TRC 8406
	TRC 8402
4395	TRC 8404
	TRC 8405
	TRC 8403
	TRC 8412
7542	TRC 8401
4406	TRC 8408 (Labelled as 8108 on Geology map)

2.0 RECOMMENDATIONS

Based on the 1984 Groundhog Coal Exploration Program it is recommended that:

1. Exploration continue on the licence area. Additional drilling, sampling and mapping are required to increase the geologic level of confidence.

   An HQ Diamond Drilling Program should have the following objectives:

   a) establish the continuity of coal seam thickness and quality; and

   b) confirm the mining potential of the shallow synclinal structure which transects the property.

2. Future exploration include detailed core logging, of both old and new drill holes, geophysical logging, additional reflectance analyses and quality analyses to further establish the stratigraphy of the coal-bearing Currier unit in the basin.

3. Groundhog Coal Ltd. acquire the two coal licences to the south of the property to cover the extension of the Lower and Upper Discovery Creek seams.

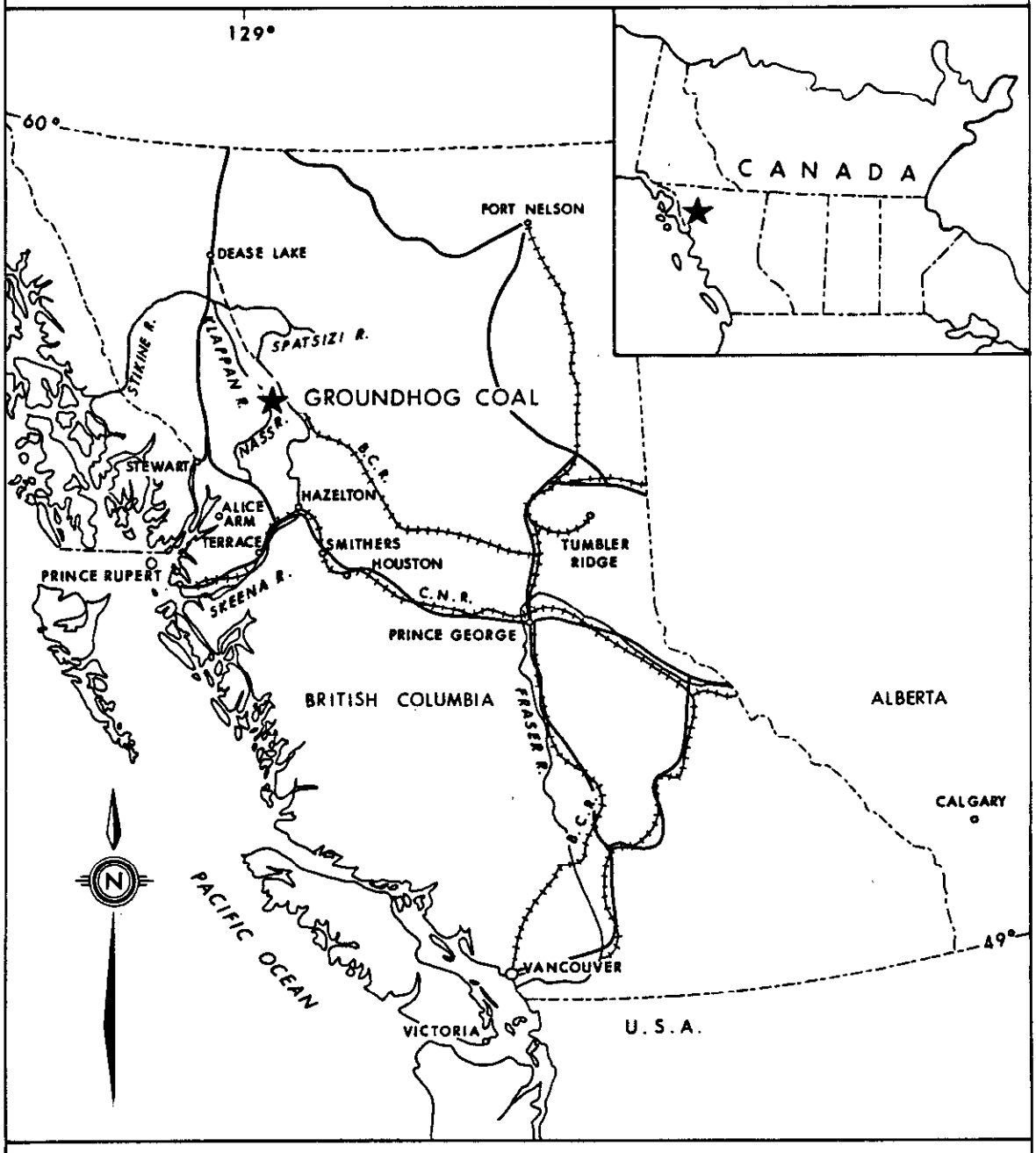
3.0 INTRODUCTION

3.1 LOCATION

The Groundhog Coal Ltd. licences are located on the west side of the Skeena River Valley of northwestern British Columbia, immediately northeast of the Groundhog Range of the Skeena Mountains (Figure 3.1). The area is between 56°50' and 56°55' north latitude and 128°20' and 128°10' west longitude, 180 kilometres north of Hazelton, B.C. and 150 kilometres northeast of Stewart, B.C.

GROUNDHOG COAL PROPERTY

LOCATION MAP



SCALE: 0 200 400 km

FIGURE 3.1

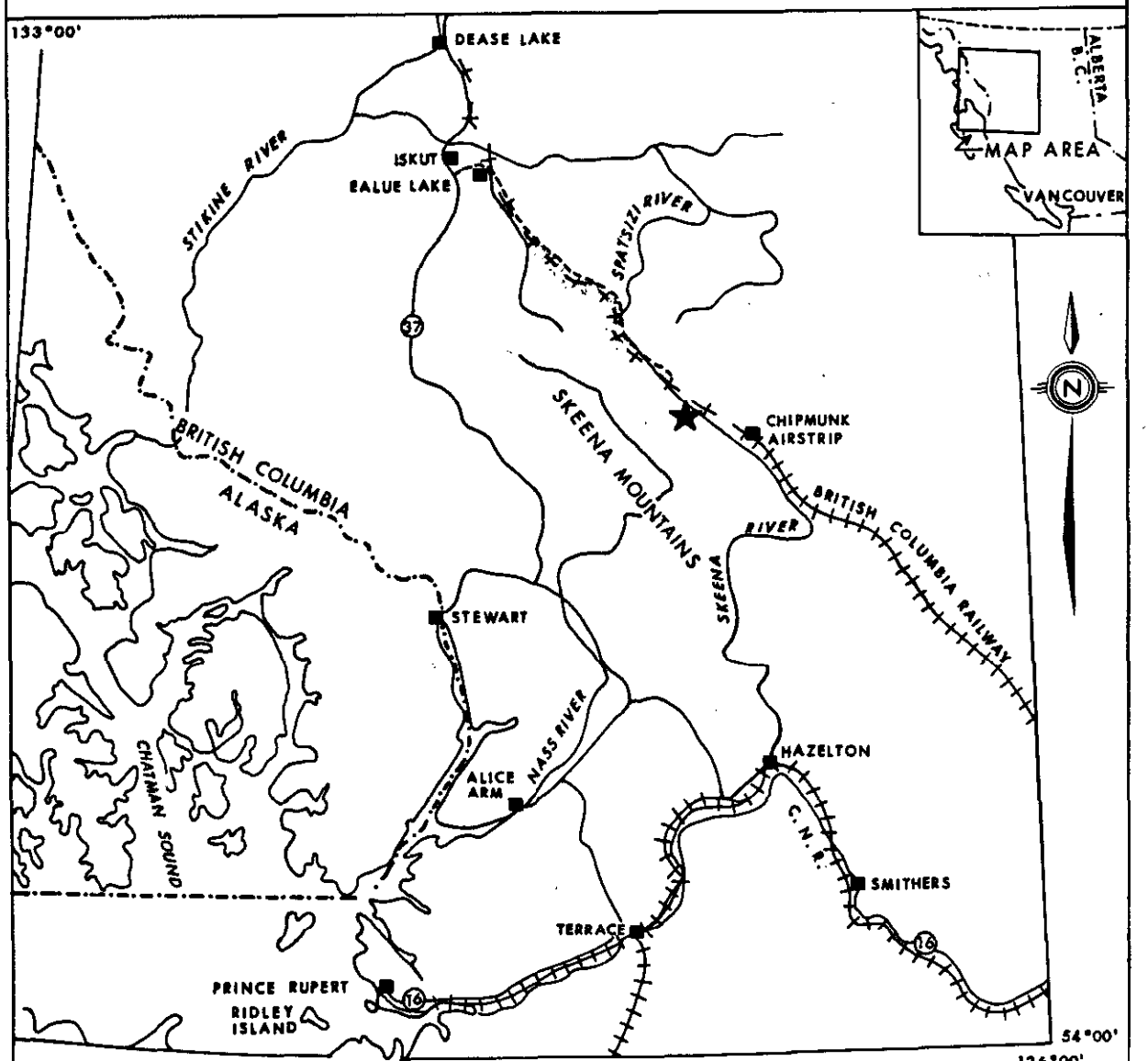
3.2 ACCESS

Access to the property is presently limited to aircraft. An airstrip for fixed-wing aircraft is located approximately 10 kilometres southeast of the licence area at the junction of the Kluatantan and Skeena rivers. A B.C.R. right-of-way and construction road has been cleared along the eastern bank of the Skeena River, crossing the northeast corner of the property (Figure 3.2). The rail ends approximately 35 kilometres southeast of the property at the Chipmunk airstrip. From here, the grade has been prepared to within 10 kilometres of the property.

While property access is presently limited to aircraft, the B.C.R. rail grade provides vehicular access from the north to within 15 or 20 kilometres of the property. Minor culvert repair is needed at several drainages to upgrade the rail bed and construction road the remaining distance to the property.

GROUNDHOG COAL PROPERTY

PROPERTY ACCESS



ROAD ACCESS

SEASONAL ROAD ACCESS

EXISTING RAILWAY

PREPARED RAILBED

GROUNDHOG COAL LICENCE AREA

SCALE

0 20 40 60 80 km

FIGURE 3.2

3.3 PROPERTY DESCRIPTION

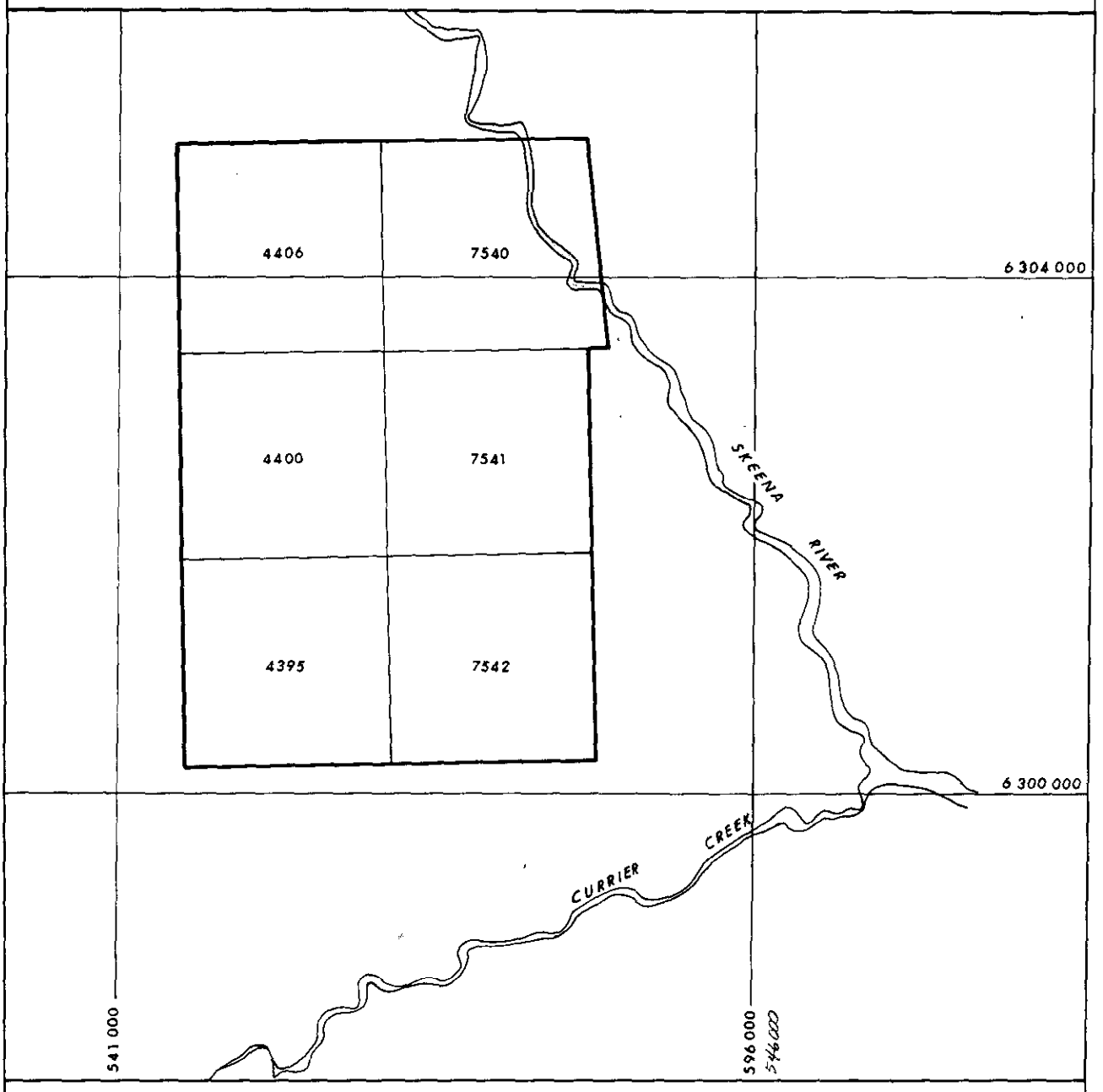
The Groundhog Coal licence area consists of six coal licences along the western portion of the Skeena River valley between Beirnes Creek and Currier Creek (Figure 3.3). The coal licences comprise 1554 hectares and were granted as follows:

Licence	Issue Date	Hectares	Series	Block
4395	Nov. 30, 1978	259	104 A/16	F
4400	Nov. 30, 1978	259	104 A/16	F
4406	Nov. 30, 1978	259	104 A/16	F
7540	Nov. 25, 1982	259	104 A/16	F
7541	Nov. 25, 1982	259	104 A/16	F
7542	Nov. 25, 1982	259	104 A/16	F

The six coal licences are continguous and are wholly owned by Groundhog Coal Ltd.

GROUNDHOG COAL PROPERTY

LICENCE MAP



CASSIAR LAND DISTRICT

NTS 104 A/16

SCALE 1: 50 000

FIGURE 3.3

3.4 BIOPHYSICAL ENVIRONMENT

The Groundhog Coal Field is within the Skeena Mountains Physiographic Region and lies near the headwaters of three major drainage systems. The Stikine River drains the northern portion; the Skeena River drains the southeastern portion; while the Nass River drains the southwestern portion.

The six coal licences are located on the western slopes of the Skeena River valley just north of Currier Creek and the Groundhog Range. Relief is low to moderate within the property and increases near the western licence margin. Elevations range from 910 metres along the Skeena River to 1460 metres at the western edge. Mountain peaks to the west of the licences rise to over 1990 metres.

The drainages of Discovery, Davis and Evans creeks transect the property and locally form steep escarpments.

The climate of the area is that of the northern and central plateau and mountain zone. Precipitation for nearby Dease Lake averages 40.6 cm per year with the mean daily temperature between that of Terrace and Dease Lake, B.C. A B.C. Hydro weather station is located approximately 55 kilometres northwest of the Groundhog property and has been monitored monthly since its installation four years ago.

The licence area is generally forested with stands of spruce, balsam, and occasional poplar trees. Underbrush is light in the lower areas, however, at higher elevations thick dense low-lying alpine spruce occur. There are numerous swamps within the licence area, particularly in the south, with swamp grass and tag alder the dominant vegetation. Tree line is approximately 1450 metres.

3.5 EXPLORATION HISTORY

The first discoveries of coal in the Groundhog area were made by prospectors travelling from Fraser Lake to the Cassiar area during the Gold Rush 1872-1878 (Buckham and Latour, 1950). The presence of coal was first recorded by DuPont (1901) at the confluence of the Spatsizi River and Didene Creek 50 kilometres north of the Groundhog licences. Subsequent reports established coal over a large area which included the Spatsizi, Skeena, Nass and Klappan watersheds (Dawson, 1901; Malloch, 1912, 1914; Leach, 1910; Evans, 1913; Dowling, 1915). The first 'authentic' discovery of coal in the Groundhog Coal Field was along Discovery Creek within the present Groundhog coal licence area where James McEvoy staked a number of claims in 1903 (Malloch, 1912).

Malloch (1912, 1914) was the first to apply a stratigraphy to the coal field. The strata were subdivided into the Lower Hazelton group and the Upper Skeena series. Buckham and Latour (1950) retained the subdivisions but renamed them the Upper and Lower Hazelton group. The Geologic Survey of Canada again visited the Bowser Basin in 1957 with Operation Stikine, which produced a preliminary map but did not determine the stratigraphy or structure of the coal field. Work by Eisbacher (1974b) along the eastern margin of the Bowser Basin subdivided the strata into three facies: the Duti River-Slamgeesh facies; the Groundhog-Gunanoot facies; and the Jenkins Creek facies. In addition, Eisbacher related the depositional history of the Bowser Basin to its tectonic history. Richards and Gilchrist (1979) referred to

the strata within the coal field as the Gunanoot assemblage containing four mappable lithofacies: channel; channel-overbank; overbank-channel; and overbank.

The unpublished coal exploration reports on open file with the British Columbia Ministry of Energy Mines and Petroleum Resources have dealt with the southern Groundhog coal basin in more detail. In 1968, Coastal Coal Ltd. (Black, 1968) mapped approximately 1500 square miles and subdivided the coal field into four units: upper and lower shales and upper and lower conglomerates. In 1969 and 1970 a joint venture of Placer Development Ltd., Quintana Minerals Corp. and National Coal Corp. (Tompson et al., 1970) completed an extensive mapping and drilling program in the southern coal field. Over 200 square miles were mapped and six diamond drill holes completed totalling 1029 metres. Three of these drill holes are on the present Groundhog Coal Ltd. licence area. This program produced the most comprehensive stratigraphy of the coal field to that time and outlined the areas underlain by the major coal-bearing strata. A brief mapping and sampling program was undertaken in 1980 which concentrated on the Discovery Creek area. Coal quality results indicated that reasonably clean coal might be obtained from mineable seams. An additional six diamond drill holes totalling 1036 metres were completed by Imperial Power and Metals in 1981. Most of these holes were geophysically logged. One of these drill holes is located on the Groundhog Coal Ltd. licence area.

Gulf Canada Resources Inc. has been very active since 1980 with three properties in the area: Panorama 12 kilometres to the southwest; Evans Creek directly north and east; and Mt. Klappan 32 kilometres northwest. Diamond drilling began on the Mt. Klappan property in 1982 and has continued each year. Suncor Inc. has a block of licences, the Mt. Jackson property, directly to the southeast of the Groundhog licences, where mapping and sampling was undertaken in 1983.

4.0 1984 EXPLORATION PROGRAM

4.1 INTRODUCTION

The Groundhog Coal Project was designed to accurately geologically map and sample coal seams on the six licences in the Groundhog Coal Field. The program commenced in mid-July and continued through to mid-December with the completion of the report. During the field program the entire licence area was geologically mapped and 12 coal exposures trenched with a total of 23 representative samples taken. The two best seams were sampled several times to provide 30-35 kilogram samples for possible future testing. The field portion of the project operated out of the Gulf Canada Resources Inc. Mt. Klappan camp. The 1984 exploration program provides a solid data base for future exploration work.

4.2 OBJECTIVES

The objectives of the 1984 Groundhog Coal Exploration Program were five-fold:

1. to geologically map the licence area and the areas immediately adjacent to the licences to determine structural style in the area;

2. to locate and trench surface coal exposures to document seam thicknesses and seam characteristics for accurate resource appraisal and possible correlation;

3. to collect representative coal samples for coal rank, quality and washability analyses;

4. to compile the data collected to date for the licence area into one interpretation; and

5. to delineate areas of potentially surface mineable resources.

4.3 CARTOGRAPHY

Government maps are available for the Groundhog area at a scale of 1:50000 and 1:250000. For the purpose of detailed mapping, this coverage was augmented by maps on a 10:000 scale with 10 metre contour intervals. The maps were prepared from existing survey control and aerial photography by Aero-Hardy Mapping Ltd.

4.4 FIELD CAMP

The 1984 Groundhog Coal Ltd. field program began August 22, 1984 and ended September 3, 1984. The Gulf Canada Resources Inc. Mt. Klappan camp facilities were utilized by Groundhog Coal personnel during this time. Road access exists to the camp via the B.C.R. rail grade, and Highway 37 utilizing three recently constructed bridges. Groundhog personnel accessed the camp via the Central Mountain Air flight to the nearby Summit Airstrip. Crews accessed the Groundhog licence area in a Hughes 500D helicopter supplied by Northern Mountain Helicopters of Prince George, B.C. Flight time from camp to the licence area was between 15 and 20 minutes.

4.5 GEOLOGIC MAPPING

The 1984 field mapping program was undertaken by staff consisting of two geologists. Mapping was completed at a scale of 1:10,000 using accurate altimeter readings and topography for control which was augmented by chaining from known points. Air photos were used extensively in the mapping program.

Bed orientation data and cleavage data were collected at the exposed folds. This data was plotted on stereographic equal area nets for fold axes orientations.

All geological information was transferred from 21 cm x 26 cm field map cards to a 1:10000 scale map in the office. The results of the geologic mapping program are summarized on the geologic map (Appendix G) and the cross sections (Appendix H). A map outlining each of the traverse locations is presented in Appendix I. In total, over 2000 hectares were mapped in the 1984 program.

A naming convention for data sources was adopted which incorporated previous exploration data sources and would provide consistency from year to year. Data source nomenclature consisted of TRC for trenches and DDH for diamond drill holes followed by the year the work was completed and the number of the data source for that year. For example, the third diamond drill hole completed in 1970 was labeled DDH7003.

4.6 TRENCHING

A hand-trenching program was an integral part of the field mapping program. A two-man crew worked under the direction of the geologists. The objective of the trenching was to fully expose those coal seams which were thought to exceed a minimum thickness of 0.5 metres, but were covered by overburden. The seam could then be accurately measured for resource appraisal, and sampled for coal rank and quality analyses.

A total of 12 trenches were completed for a cumulative length of 53 metres. Trench width averaged 1.7 metres while 1.0 metres was the average depth. Several other trenches were started, however, exposed coal thicknesses did not warrant further work.

The trench logs, illustrating the coal seam characteristics, are found in Appendix B while the trench locations are found on the 1:10000 geology map in Appendix G.

4.7 RECLAMATION

The area of environmental disturbance associated with the 1984 Groundhog Coal Exploration Program was minimal since all transportation was via helicopter or fixed-wing aircraft. Only minor disturbances were associated with trenching which was all well below treeline. In accordance with the Coal Mines Regulation Act, wherever possible trenches were hand-dug at right angles to the slope while overburden and topsoil were stockpiled separately for backfilling. Several hand trenches were left open for later viewing.

4.8 PROJECT MANAGEMENT AND CONTRACTORS

The 1984 Coal Exploration Program was managed by A.F. Reeve, President, Groundhog Coal Ltd. Field operations supervision and report writing was completed by J.M. Duford of J.M. Duford Consulting Services Ltd., while geological expertise was also contributed by W.D. Tompson, Consulting Geologist. The trenching crew consisted of Jack Hemmelshek and Dan Skinner.

The following is a list of the service companies and suppliers used during the project:

Northern Mountain Helicopters Inc.	Prince George, B.C.
Central Mountain Air	Smithers, B.C.
Rileys Reprographics	Calgary, Alberta
Cyclone Engineering Sales Ltd.	Edmonton, Alberta
David E. Pearson & Associates Ltd.	Victoria, B.C.
Neville Crosby	Vancouver, B.C.
Economy Bookbindery	Calgary, Alberta
Canadian Freightways	Smithers, B.C.
Ryder Word Processing	Calgary, Alberta
Crosbie Drafting Services	Calgary, Alberta
Copy Time	Calgary, Alberta
Carter Mapping (1979) Ltd.	Calgary, Alberta

5.0 GEOLOGY

5.1 REGIONAL GEOLOGY

5.1.1 Geologic Setting

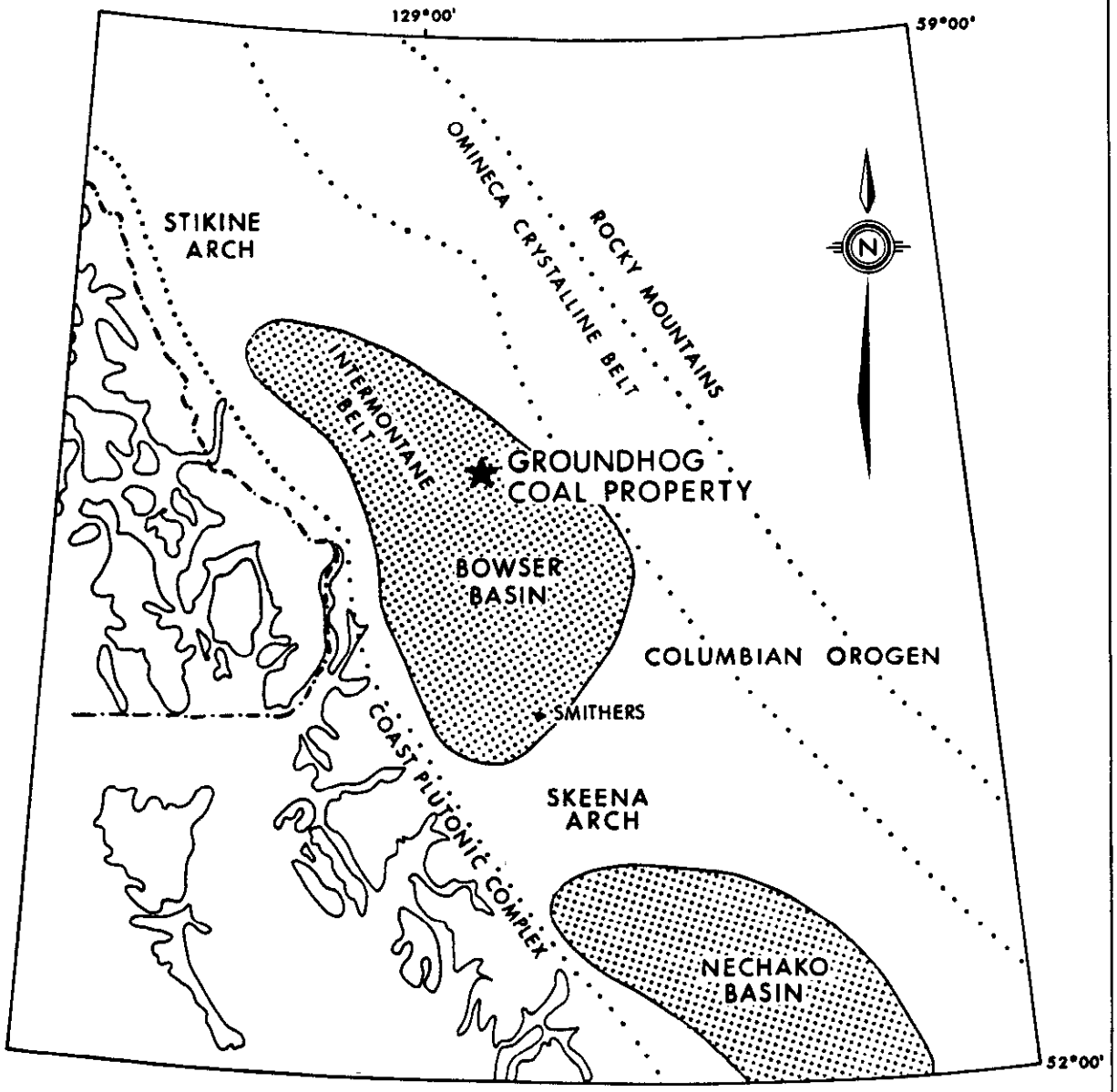
The coal measures of the Groundhog property are part of a series of sediments deposited in the central part of the Bowser Basin during Middle Jurassic to Early Cretaceous time.

This Jurassic-Cretaceous successor basin is underlain by regionally distinct assemblages of volcanic, plutonic and sedimentary rocks collectively termed the Cordilleran eugeosyncline. Several terrains or crustal blocks can be distinguished within this eugeosyncline. Three of these terrains, Stikine Terrain, Atlin Terrain and Omineca Crystalline Belt, join in the vicinity of the Bowser Basin. The interaction of these terrains controlled the development and sedimentation in the Bowser Basin (Eisbacher, 1981).

The uplift of the easterly trending Skeena Arch and the subsidence of the Stikine terrain during the Middle Jurassic divided the Early and Middle Jurassic Hazelton trough into the Bowser Basin in the north and the Nechako Basin in the south (Figure 5.1) (Tipper and Richards, 1976). The subsidence of the Stikine terrain and the uplift of the Atlin terrain during Mid-Jurassic to Early

GROUNDHOG COAL PROPERTY

JURASSIC - CRETACEOUS BOWSER BASIN



SCALE

0 100 200 km

(AFTER TIPPER AND RICHARDS, 1976)

FIGURE 5.1

Cretaceous time resulted in the deposition of a thick succession of marine and non-marine clastics and volcanics. The thickness of this succession is estimated to be between 6000 and 10000 metres (Geologic Survey of Canada, 1957; Koch, 1973).

In the southern portion of the Bowser Basin these sediments form the Bowser Lake Group and the Skeena Group and are separated by a hiatus (Tipper and Richards, 1976). Most of the strata in the Groundhog Coal Field are thought to be equivalent to the Bowser Lake Group.

The west margins of the basin appear to have been open to the sea while paleocurrent measurements in the north Bowser Basin indicate a sediment source from the northeast and southeast (Bustin and Moffat, 1983). The stratigraphy within the Groundhog Coal Field represents a regressive sequence with depositional environments which include distal deltaic facies and turbidites, prodelta sub-sea fans, distal to proximal distributary channels, paralic coal swamps and alluvial fans (Eisbacher, 1974b).

5.1.2 Regional Stratigraphy

In the southern Bowser Basin three groups have been recognized: the Early to Middle Jurassic Hazelton Group; the Upper Jurassic Bowser Lake Group; and the Early Cretaceous Skeena Group (Tipper and Richards, 1976). The Skeena Group contains significant coal while coal occurrences in the

Bowser Lake Group are relatively rare. This stratigraphy has not been applied successfully to the northern Bowser Basin. Initially the sedimentary package of the Groundhog Coal Field was referred to as the Skeena Series (Malloch, 1914). Later, Buckham and Latour (1950) referred to it as the Upper Hazelton Group, while Eisbacher (1974b) applied the term Groundhog-Gunanoot Facies. The sedimentary package was originally dated as Late Cretaceous (Malloch, 1914; Buckham and Latour, 1950), which was revised by Eisbacher (1974b) to Upper Jurassic to Late Cretaceous. The most recent data suggest that the coal-bearing rocks of the Groundhog Coal Field are uppermost Middle Jurassic to Early Late Jurassic (Bustin and Moffat, 1983). The regional stratigraphy is summarized in Figure 5.2.

Within the coal field itself, exploration groups generally have recognized a four unit stratigraphic sequence. This stratigraphy has been published by Bustin and Moffat (1983) who informally refer to the units as the "Jackson", "Currier", "McEvoy" and "Devil's Claw" (Table 5.1). Each of the units contain coal, however, the Currier unit generally contains the more economic seams.

5.1.2.1 Jackson Unit

The oldest unit exposed in the coal field, the Jackson unit, consists of a succession of shales, siltstones, sandstones and, locally, conglomerates. The unit coarsens upward and is gradational

		Malloch 1914	Buckham & Latour 1950	Souther & Armstrong 1966	Eisbacher 1974b	Tipper & Richards 1976	Richards & Gilchrist 1979	Bustin & Moffat 1983
		SOUTHERN GROUNDHOG COALFIELD	GROUNDHOG COALFIELD	NORTHERN BRITISH COLUMBIA	NORTHERN BOWSER BASIN	SOUTHERN BOWSER BASIN	NORTHERN GROUNDHOG COALFIELD	GROUNDHOG COALFIELD
Cretaceous	Upper			Sustut-Sifton Assemblage	Sustut-Sifton Assemblage	Sustut Group		
	Lower	Skeena Series	HAZELTON GROUP: Upper Part	Bowser Assemblage	BOWSER ASS. Jenkins Ck. Facies	Skeena Group	Gunanoot Assemblage	Devil's Claw Unit
Jurassic	Upper	Hazelton Group	Lower Part		Gunanoot-Groundhog Facies			McEvoy Unit
					Duti River Slamgeesh Facies	Bowser Lake Group		Currier Unit
	Middle			Takla-Hazelton Assemblage	Takla-Hazelton Assemblage	Hazelton Group		Jackson Unit
	Lower							
Triassic	Upper					Takla Group		
	Middle							

FIGURE 5.2 REGIONAL STRATIGRAPHY, BOWSER BASIN AND GROUNDHOG COALFIELD

(from Bustin and Moffat, 1983)

TABLE OF FORMATIONS

Age	Stratigraphic Unit	Thickness (m)	Lithology
Cretaceous	Devil's Claw unit	300-500	Homogeneous or large scale cross bedded, pebble to cobble conglomerate with rare lenticular sandstones. Conglomerates are light grey to vari-coloured, well rounded, well sorted and clast supported. The lower portion includes siltstones, claystones, sandstones and coal interbedded with conglomerate.
	McEvoy unit	400-800	Interbedded, indurated dark grey siltstone, claystone, locally carbonaceous with thin to thick bedded fine to medium grained sandstones, occasional conglomerate. Minor coal and thin limestone.
Jurassic	Currier unit	400-600	Recessive sequence of thin to thick bedded, tan to dark grey weathering sandstones. Dark brown to brown mudstones. Medium to dark grey siltstones containing local bivalve beds and coal.
	Jackson unit	1800	Tan to dark grey weathering siltstone and claystone, locally carbonaceous, and tan weathering, fine to medium grained, locally calcareous sandstones. Sandstones near the top contain marine bivalves.

TABLE 5.1 (from Bustin and Moffat, 1983).

with the overlying Currier unit. At Mt. Jackson the unit is composed of tan to dark-grey weathering siltstone and shale and tan weathering fine to medium grained sandstones up to 0.5 m thick. The sandstones are locally calcareous and show ripple or planar bedding and rip-up clasts. Thickness is estimated to be at least 1800 metres although the basal contact has not been observed within the coal field (Bustin and Moffat, 1983).

Marine fossils throughout the Jackson unit indicate that it is predominantly marine while the upper more coarse portion is considered transitional marine. The cyclicity of the coarsening upward sequences and moderate sorting of the sandstones suggests deltaic deposition for the upper Jackson unit in the Mt. Jackson area (Bustin and Moffat, 1983).

5.1.2.2 *Currier Unit*

The Currier unit is the main coal-bearing unit in the Groundhog Coal Field. This unit comprises a sequence of thin to thick-bedded sandstones with minor shale, siltstone and coal that outcrops between the Kluatantan and Nass rivers. The sequence is generally recessive which limits the exposures to the major drainages. The top of the Currier is the first appearance of limestone beds

or massive and thick siltstone beds which occurs with a marked decrease in coal occurrences.

The unit is estimated to be between 400 and 600 metres thick, however, poor exposures and complex structure hinder reliable thickness determination.

The environments of deposition for the Currier unit are thought to include marginal marine, deltaic and fluvial sediments (Bustin and Moffat, 1983).

5.1.2.3 McEvoy Unit

The McEvoy unit consists of a thick interbedded sequence of siltstones, shale, minor limestone, coal and conglomerates. The frequency of conglomerates increases towards the top of the unit which is determined by the first conglomerate greater than 5 metres in thickness. Generally the unit is composed of monotonously interbedded dark grey siltstones, and claystones with thin to thick bedded sandstones. The siltstones and claystones are well indurated, locally carbonaceous and present in intervals up to 40 m thick. The sandstones are commonly fine to medium grained, thin and thick bedded, massive or planar and trough

cross bedded. The minor limestones occur throughout as tan weathering beds up to 0.5 m thick or as concretionary horizons. The conglomerates are up to 5 metres thick commonly with an erosional base, but rarely cross bedded. Some occur as discrete channels, grade into coarse grained sandstones and pinch out laterally (Bustin and Moffat, 1983).

The McEvoy unit is composed of some marine sediments near the base but is mainly a non-marine deposit. The environment for the non-marine strata is thought to be lacustrine based on the predominance of fine grained sediments and lack of marine fossils (Bustin and Moffat, 1983).

5.1.2.4 Devil's Claw Unit

The Devil's Claw unit is a thick succession of conglomerates with minor interbeds of sandstone, siltstone and shale. Thickness ranges from 300 to 500 m. The conglomerates are homogeneous or large scale cross bedded, with pebble or cobble clasts and rare lenticular sandstones. Colour is light grey or varicoloured, clast-supported and composed of well-rounded and well-sorted chert, volcanic quartz and rare granodiorite clasts. The matrix is moderately sorted coarse-grained sandstone. The percentage of conglomerate increases towards the top of the unit.

The Devil's Claw unit coarsens upward from a gradational contact with the lower McEvoy where fine grained overbank deposits and coal are common, to abundant and thick conglomerate beds. The transition suggests higher energy conditions as distal fluvial and alluvial plain deposits are followed by proximal braided stream deposits (Bustin and Moffat, 1983).

5.1.3 Regional Structure

Structural deformation of the Bowser Basin sediments was mainly passive, resulting from intermittent tectonic stresses along the western cratonic margin from Cretaceous to Recent time. These stresses resulted in an extensive, shallow decollement, recumbent folds and local thrust faults extending less than a few kilometres along strike (Eisbacher, 1974a; Souther and Armstrong, 1966). The regional structural trend is generally northwest-southeast and related to the main uplift of the Coast Crystalline Belt. The general trend is recognized in fold axial planes, cleavages and thrust surfaces which regionally dip to the southwest (Souther and Armstrong, 1966).

Superimposed on the regional sructural trend are broad, open, northeast to southwest trending folds which may be due to compression caused by later right lateral transcurrent displacements. These broad folds affect the plunge of the main deformational event structures.

The latest deformational event produced strike-slip and some dip-slip faulting as well as quartz filled northeast-southwest extension fractures.

The style of deformation in the basin is related to the lithology. Higher in the section the competent, massive beds of the Devil's Claw and upper McEvoy units are characterized by broad, open, low-amplitude folds. The relatively thin-bedded and fine-grained lower McEvoy and Currier units are characterized by high amplitude, shorter wavelength folds that tend to be disharmonic with the overlying units (Bustin and Moffat, 1983). Associated with the folds in the lower units are fore-limb and back-limb thrust faults having limited displacement.

5.2 GROUNDHOG PROPERTY GEOLOGY

5.2.1 Groundhog Property Stratigraphy

The Groundhog property is completely underlain by the main coal-bearing unit, the Currier unit. As previously mentioned, the Currier unit is recessive and is comprised of thin to thick bedded sandstones with minor claystones, siltstones and coal. The top of the unit is the first occurrence of limestone beds and/or massive and thick siltstone beds. Coal and sandstone also show a marked increase below the contact. The base of the Currier is placed beneath the first thick sandstone bed in the transition from the fine-grained beds of the Jackson to the coarser sediments of the Currier (Bustin and Moffat, 1983).

The lower portion of the Currier unit contains a series of coarsening-upward cycles between 5 and 25 metres thick. The lower strata in these cycles are thinly interbedded medium to dark grey claystones grading upward to tan weathering, fine to medium to locally coarse grained sandstone. The sandstone consists of abundant volcanic rock fragments, chert and feldspar. Bedding is thin to thick with ripple cross-laminations and some trough cross bedding. Coal seams commonly cap the coarsening upward cycles (Bustin and Moffat, 1983).

The middle portion of the Currier unit is generally fine to medium-grained, tan to dark-grey weathering sandstone, dark brown to brown mudstone, siltstone and coal. These strata occasionally occur in distinct fining upward sequences up to 4 metres thick. The sandstones contain abundant rock fragments, feldspar, chert and are carbonaceous in places (Bustin and Moffat, 1983). Thick siltstone beds locally contain abundant bivalve beds exposed in several places along the Skeena River.

The upper part of the Currier unit consists of medium to dark grey siltstone and claystone, buff to medium grey, thin to thick-bedded sandstone, carbonaceous zones and coal. The sandstones are similar to those in the lower part of the Currier unit except that some sandstone channels pinch out laterally (Bustin and Moffat, 1983).

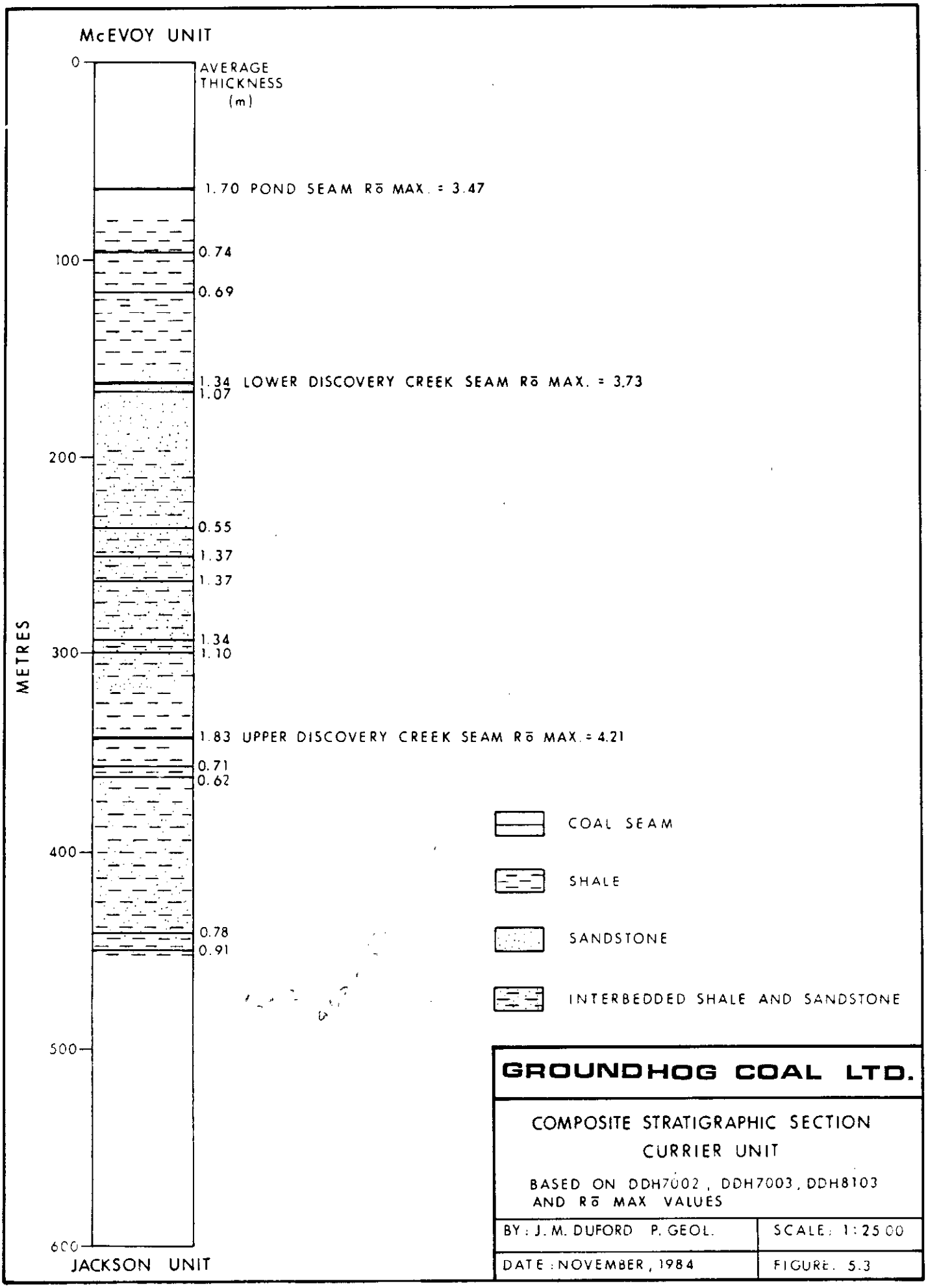
The basal portion of the Currier unit is considered to contain prodelta, delta front and delta plain sediments while the remaining unit is thought to be mainly fluvial in origin. The fluvial sections contain channel, overbank and back water swamp deposits (Bustin and Moffat, 1983). The presence of bivalves suggests local marine and transitional marine influence.

The recessive nature of the Currier unit limits the frequency of outcrop on the licences and thickness of outcrop exposures which hinders the construction of a

typical sequence. Drill logs from previous years' drilling do not include all of the necessary geophysical logs or enough detail to assist significantly in a determination of depositional environments for the Currier unit on the licences.

Based on the outcrop descriptions, position relative to the McEvoy unit and, most importantly, reflectance data, the strata of the Groundhog licence area are thought to be part of the middle or upper middle Currier unit. Evidence from the coal field suggests that the mean maximum vitrinite reflectance ($R\bar{o}max$) increases with depth of burial (Bustin, 1984). Gradients range from 1.8 to 3.5 per kilometre. A gradient of 2.67 per kilometre was applied to the licence area based on the total stratigraphic thickness (600 metres) and the $R\bar{o}max$ values for the top (3.3) and bottom (4.9) of the section.

Reflectance data (Appendix C) for the three major coal occurrences exposed during the 1984 exploration program suggest that these exposures represent three different coal seams and provide an indication of their relative position in the composite stratigraphic section (Figure 5.3). Since the down dip projections of the Discovery Creek coal seams were intersected in the 1970 diamond drill holes, the additional seams which were intersected have been included in the composite section. In a similar manner DDH8103 data contributed to the composite stratigraphic section. The



GROUNDHOG COAL LTD.

COMPOSITE STRATIGRAPHIC SECTION
CURRIER UNIT

BASED ON DDH7002, DDH7003, DDH8103 AND Rō MAX VALUES

BY: J. M. DUFORD P. GEOL.	SCALE: 1:25 00
DATE: NOVEMBER, 1984	FIGURE. 5.3

data from DDH7004 was not included in the compiled section due to the lack of data for correlation.

5.2.2 Coal Development

The data available to date suggests that the Groundhog coal property contains at least 15 coal seams greater than 0.5 metres in thickness with dry basis ash contents less than 50% as summarized by Figure 5.3. The three most developed coal seams have been named (from oldest to youngest): the Upper Discovery Creek Seam; the Lower Discovery Creek Seam; and the Pond Seam, after local geographic features. These seams are the thickest and highest quality seams noted to date.

Correlation and subsequent naming of additional seams on the property is difficult since geophysical logs are not available for any drill holes on the property, however, coal seams do appear to be laterally continous and correlatable for at least 500 metres. An excellent correlation exists between the two seams exposed in trenches TRC8403 and TRC8404 and drillhole DDH7002. Seams in DDH8103 and DDH7003 have been correlated based on stratigraphic position. Coal seams, intersected in DDH7004 have not been correlated with those of DDH7003 and as mentioned above, applied to the composite stratigraphic section due to the lack of geophysical data. Future drilling and associated geophysical logging is required to further ascertain the

coal seam continuity and depositional environments within the property.

The composite section (Figure 5.3) illustrates the 15 coal seams within 384 metres of the approximately 600 metre thick coal-bearing Currier unit. Total accumulated seam thickness for this section is 16.12 metres. No data is available for the top and bottom of the Currier unit, however, additional seams can be expected. The average seam thickness for this section is 1.08 metres while individual seams range in thickness from 0.5 metres to 1.91 metres. Interseam thicknesses based on drill hole intersections (Appendix D) range from approximately 2 metres to 78 metres and average 24.5 metres. All thickness values are true thickness values corrected for bedding to core angles where this information is available.

Coal occurrences are not limited to drill hole intersections and trenches. Numerous thin seams and local spoil sites are located throughout the licence area (Appendix J). These sites could not be hand trenched due to forest and overburden cover.

5.2.3 Property Structure

Structures on the Groundhog coal property generally trend southeast to northwest and consist of gentle to overturned folds and minor faulting. Deformation is more intense to

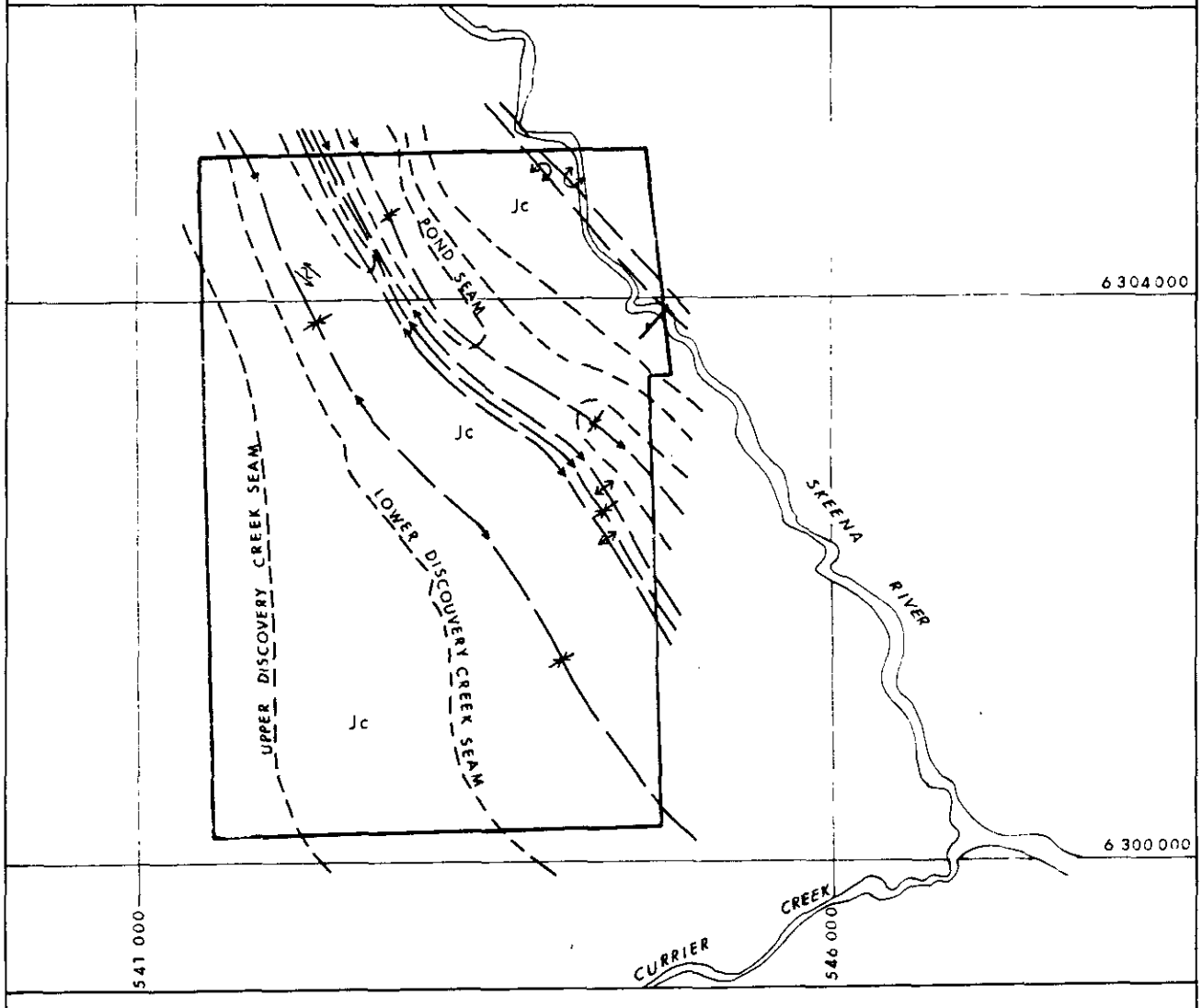
the north of the property and towards the Skeena River east of the licences.

In a broad sense the folding consists of an anticline-syncline pair with minor folds superimposed on the larger structures (Figure 5.4). The axis of the syncline runs through the west portion of the property and the limbs steepen towards the north. The anticline structure extends from the northeast licence corner to the southeast off the licences and has several superimposed overturned folds. The fold axes of the major stuctures are also gently folded perpendicular to strike producing several plunge changes on the property. These plunge changes suggest a second compressional phase. The limbs of the southwestern syncline are shallow enough that the observed dips are indicative of the structure's plunge direction.

Interpretation of the major property structures was aided by the use of reflectance data which indicated that the coal exposed along the Skeena River was lower in the stratigraphic section than the coal exposures in the centre of the property.

The fold structures which are superimposed on the major folds vary in wavelength from 100 to 700 metres and vary in amplitude from 100 to over 200 metres. The style of folding changes from southwest to northeast. Folds on most of the property tend to be broad and open with inclined

GROUNDHOG COAL PROPERTY
GEOLOGY MAP



LEGEND

- LICENCE BOUNDARY
- GEOLOGICAL CONTACT (INFERRED)
- COAL SEAM (INFERRED)
- ANTICLINE (APPROXIMATE)
- SYNCLINE (APPROXIMATE)
- OVERTURNED ANTICLINE
- OVERTURNED SYNCLINE

- JKd DEVILS CLAW UNIT
- JKm McEVOY UNIT
- Jc CURRIER UNIT
- Jj JACKSON UNIT

CASSIAR LAND DISTRICT
NTS 104 A/16

BY: J.M. DUFORD
DATE: NOV., 1984

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FIGURE: 5.4

axial planes but little evidence for shearing in the coal seams. This fold style produces shallow structures with coal seams relatively close to the topography particularly in the west. These shall structures have excellent mining potential. Folds in the northeast portion of the property and along the Skeena River are overturned with extensive cleavage and shearing developed.

Two minor faults are interpreted to exist on the property, a strike slip fault along upper Evans Creek and a thrust fault at the junction of Davis Creek and the Skeena River (Figure 5.4). The strike slip fault is located above a large slump feature and may be related to the slumping as opposed to tectonic deformation. There is no evidence to indicate that the fault continues, and if so, to what extent.

The minor thrust fault is associated with the more intense deformation along the Skeena River. The fault is interpreted to trend slightly east of north based on the axial trend of the overturned syncline just beneath the fault. Displacement along this fault is thought to be limited.

The broad western syncline interpreted to extend across the licences is the most favourable structure for open pit mining.

6.0 RESOURCES

6.1 PROCEDURES AND PARAMETERS

6.1.1 Introduction

Exploration on the Groundhog coal property has identified substantial indicated and inferred coal resources within the Upper Jurassic Currier unit. The resources have been classified according to the scheme adopted by Energy, Mines and Resources Canada. The resources are further divided into those from the three main seams with seam traces depicted on the map and the additional seams intersected in the drill holes and trenches.

All data for the resource calculations were entered into a computer which utilized a spreadsheet program for the calculations.

6.1.2 Indicated Resources

Indicated resources are those computed partly from specific measurements and partly from reasonable geologic projections. For the mountainous regions the maximum distance between points of observation should be 600 metres or less (Bielenstein et al., 1979). Tonnages are determined from the general formula:

$$\text{Area } (m^2)/\cos[\text{dip angle}] \times \text{Seam Thickness (m)} \times \text{Specific Gravity (tonnes/m}^3) = \text{Tonnes Raw Coal}$$

The areas are based on the planimetered area 300 metres around each drill hole or trench and include only the subsurface seam above 500 metres depth. The area is divided by the cosine of the dip to arrive at the true seam area.

The seam thicknesses used are the actual true seam thicknesses of each data point. Only seams greater than 0.5 metres with ash values less than 50% are included.

The specific gravity used in the calculations is 1.70 tonnes/m^3 and represents the weighted average, air dried specific gravity of all 1984 raw coal trench samples. This average specific gravity was used since specific gravity data is not available for the drill hole data.

Details of the indicated resource calculation are found in Appendix E.

6.1.3 Inferred Resources

Inferred resources are quantity estimates based largely on broad knowledge of the geologic character of the region for which few measurements of seam thickness are available. Estimates are based mainly on an assumed continuity of coal seams in areas remote from points of observation used to calculate indicated resources (Bielenstein et al., 1979).

The inferred resource is based on the composite stratigraphic section (Figure 5.3) described in Section 5.0. The 15 seams of this section have been extrapolated across the *entire licence area.*

Tonnages are determined from the general formula: Area (m^2)/cos [dip angle] x seam thickness (m) x specific gravity (tonnes/m^3) = Tonnes Raw Coal.

For the three main seams the area is the planimetered area which is underlain by each of these seams where they occur above 500 metres depth. The area is divided by the cosine of 13 degrees which is thought to represent the average dip for these areas.

The area applied for the additional seams intersected in the drill holes is conservatively based on the area of the main seam which overlays it.

The thickness used is the average true thickness where seam data exist from more than one data point. Only seams with thicknesses greater than 0.5 metres and ash contents less than 50% were used.

As in the indicated resource calculation, the weighted average specific gravity of the 1984 as received specific gravity values was applied.

In order to simplify the resource calculation procedure the inferred resource was based on the difference between the total resource (inferred and indicated) and the indicated resource.

Details of the inferred resource calculation are found in Appendix E.

6.2 INDICATED RESOURCES

Based on the parameters discussed in Section 6.1 an in-situ indicated resource of 11.5 million tonnes has been calculated on the Groundhog licence area. The three main seams (Pond seam, Upper and Lower Discovery Creek seams) contributed 3.3 million tonnes to this total, while the additional seams within the stratigraphic section contributed 8.2 million tonnes.

6.3 INFERRED RESOURCES

The in-situ inferred resources of the Groundhog coal property are 209.9 million tonnes as determined by the procedures outlined in Section 6.1. This figure represents the difference between the total resource of 221.4 million tonnes and the indicated resource of 11.5. The three main seams contribute 58.4 million tonnes or 28% to the total inferred resource.

7.0 QUALITY

7.1 PROCEDURES AND PARAMETERS

Rigid coal sampling procedures were followed in order to obtain as representative a surface sample as possible. Where conditions allowed, trenches were dug deep enough into the seams to reach solid, relatively unweathered coal. The exposed seams were logged in detail (Appendix B) and seam sub-samples determined where required. Sub-samples conformed to stratigraphic controls and were taken where total seam thickness exceeded one metre and where the seam roof and/or floor contact was gradational. Prior to sampling, the seam face was spray painted with two parallel lines outlining the sample channel for a representative sample.

The analytical flow sheet (Figure 7.1) can be subdivided into five general procedures: component analyses; compositing; size analyses; detailed washability; and product analyses.

The component analyses were completed on each individual sample to provide data for later compositing and data on the general quality of the thinner seams. Based on the component analyses three seams were selected for more complete analysis. The compositing of the three seams involved the weight averaging of the component results by length and specific gravity. If a gradational contact sample contributed too much rock to the total seam ash it was excluded from the composite sample. Following the compositing the samples were screened at +28 and 100 mesh to produce three size fractions:

COAL ANALYSIS FLOW SHEET

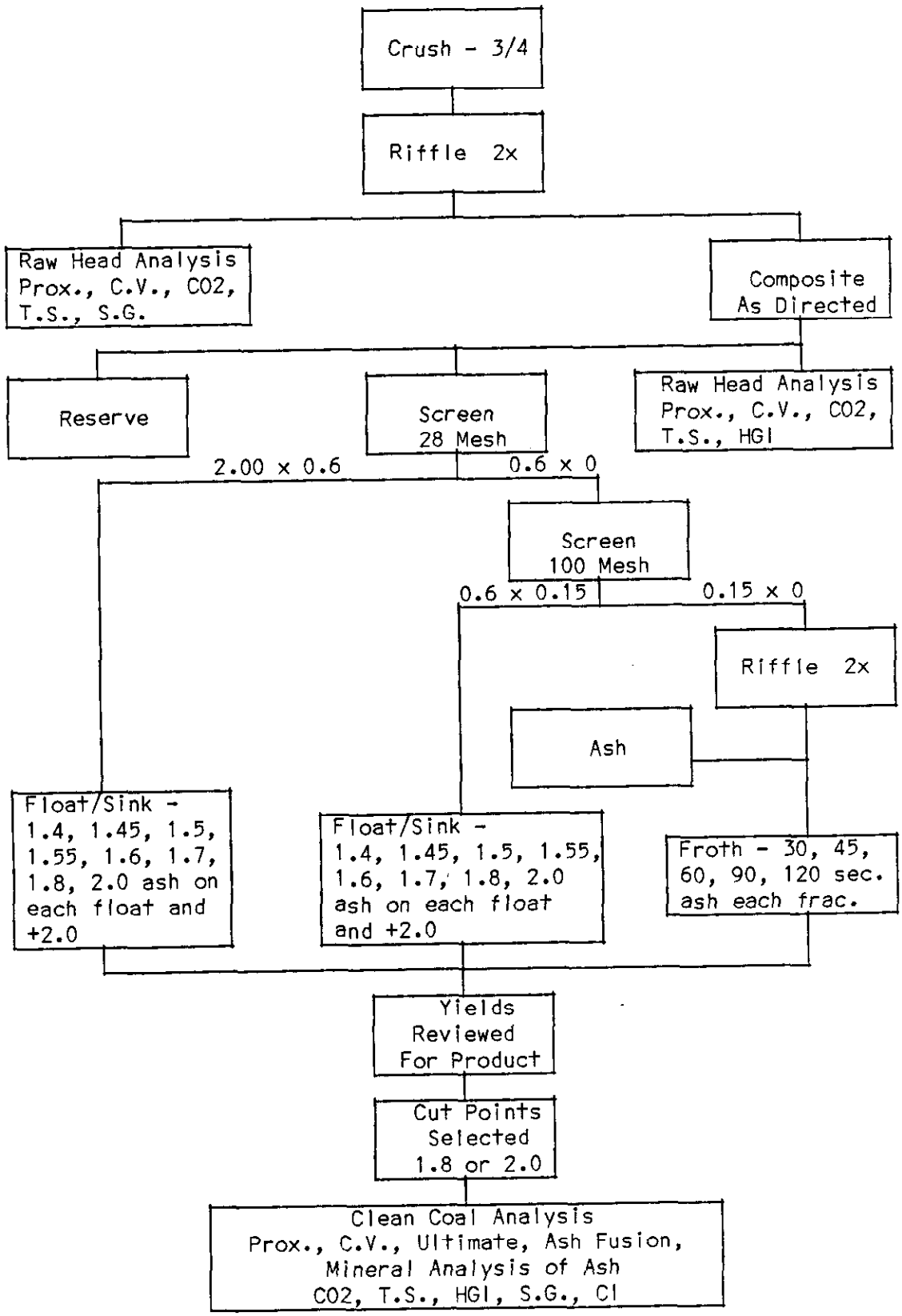

FIGURE 7.1

2.0x0.6 mm; 0.6x0.15 mm; and 0.15x0 mm. The two coarser fractions underwent detailed washability at 8 specific gravity intervals. Based on the results of the washability analyses specific gravity cut points were selected to produce a product coal with an ash of approximately 10% while maximizing the yield. The product sample was then formed from the float portions of the two coarser size fractions and subjected to a complete range of analyses. Preliminary froth flotation of the fine size fraction indicated that a minimal increase in yield was possible when a cleaned portion of this fraction was included in the product. This was due to the relatively high ash content of the fine fraction and the oxidized nature of the surface sample which inhibited the flotation of the fine particles. On the basis of this preliminary froth flotation, further flotation tests were eliminated from the analyses and the fine size fraction was eliminated from the product analyses.

7.2 RESULTS

Results of all analyses are found in Appendix F organized according to sample number. A trench sample summary is also located in Appendix F.

7.2.1 Coal Rank

The coal of the Groundhog licence area is an anthracite. The mean maximum reflectance ($R\bar{o}max$) ranges from 3.47 to 4.21 (Appendix C); the DMMF (dry, mineral matter free) volatiles (drill core samples) range from 3.5% to 8.0% (Appendix D); and the fuel ratio (fixed carbon/ volatile matter) ranges from 9 to over 19 where the ash is less than 30%. According to various classification schemes, coals are ranked as anthracites where $R\bar{o}max$ exceeds 2.5, the DMMF volatiles are between 2 and 8 percent or the fuel ratio is greater than 9.

Previous workers have identified the Groundhog coal as a bituminous coal usually based on surface samples. Most likely this rank was due to the relatively high volatile values of proximate analyses. The inherent ash and rock partings can contain some carbonates which release carbon dioxide. The gas is reported as part of the total volatiles. The carbon dioxide can significantly affect the total volatiles of anthracite coal when carbon dioxide exceeds one percent. Since the carbonates are part of the ash material the effect is greatest in higher ash coal.

Oxidation or weathering of surface coal also affects the volatile content as well as the moisture content. A comparison of trench data (Appendix F) and drill hole data (Appendix D) illustrates the increase in volatiles and moisture for surface samples.

7.2.2 1984 Raw Coal Quality

The trench samples collected during the 1984 exploration program indicate a range of coal quality. Table 7.1 summarizes the average coal quality for the trench seam composite data. Raw coal ash ranges from 18.6% to 47.9% with an average of 35.5% (dry basis). The average volatile content of 11.0% (dry basis) is not indicative of the true coal quality due to the moisture in the weathered sample. Air dried moisture values averaged 4.6% whereas moisture values from 1970 drill core were well below 1%.

Sulphur values are remarkably low, averaging 0.42% and ranging from 0.28 to 0.70%.

Size analyses demonstrate the hard nature of Groundhog coal. The average size consist (Table 7.2) shows almost 85% of the coal greater than 28 mesh with only 5% reporting to the fine fraction.

TRENCH SAMPLE COAL QUALITY SUMMARY

Dry Basis

Trench	Sample Numbers	Ash (%)	Volatile Matter (%)	Fixed Carbon (%)	Calorific Value (MJ/kg)	S (%)	CO_2 (%)	S.G. (g/cc)
TRC8401	9551-9553	38.82	11.15	50.03	19.35	0.28	0.19	1.76
TRC8402	9556	47.87	11.65	40.48	15.37	0.27	0.09	1.87
TRC8403	9557-9560	31.05	11.21	57.74	21.76	0.40	0.16	1.77
TRC8404	9564+9565	28.23	19.81	51.96	20.38	0.31	0.15	1.77
TRC8405	not analyzed							
TRC8406*	9568	62.71	12.49	24.80	9.83	0.22	0.22	2.11
TRC8407	9569	44.02	7.86	48.12	17.53	0.54	1.65	1.87
TRC8408	9570	18.57	10.08	71.35	27.63	0.50	0.26	1.57
TRC8409	9571	41.43	8.10	50.47	18.411	0.34	0.49	1.71
TRC8410	9572	34.08	8.47	57.45	21.95	0.70	0.75	1.68
Average		35.51	11.04	53.45	20.30	0.42	0.47	1.75

* Ash value exceeds 50% therefore excluded from all seam calculations.

TABLE 7.1

AVERAGE SIZE CONSIST

Size	Weight %	Ash %
3/4 " x 28 m	84.50	
28 m x 100 m	10.46	
100 mesh x 0	5.04	35.37

TABLE 7.2

A relationship between raw coal ash and specific gravity was determined based on a linear regression (Figure 7.2). The derived formula was:

$$\text{Specific Gravity (g/cc)} = 1.38 + (\text{Ash} \times 0.01)$$

The correlation coefficient for the equation is .95, however, a limited number of data points were available and more are needed to further refine this relationship.

7.2.3 Washability

The washability data (Appendix F) indicates that the Groundhog coal property would be capable of producing a multi-product coal. Although a 10% ash product was generated for product coal analyses the data indicates that a 5% ash product is feasible. Producing a 5% ash product would result in a yield exceeding 40% on the one product. Reject material from a low ash product would contribute to a medium or high ash product.

Cut points ranging from 1.8 g/cc to 2.0 g/cc were used for the product coal, producing an average product ash of 9.72% (dry basis) with an average total yield of 68.3%. Yields were as high as 76.6% despite the exclusion of the fine size fraction. Contribution of clean coal from the fine size fraction will increase the yield.

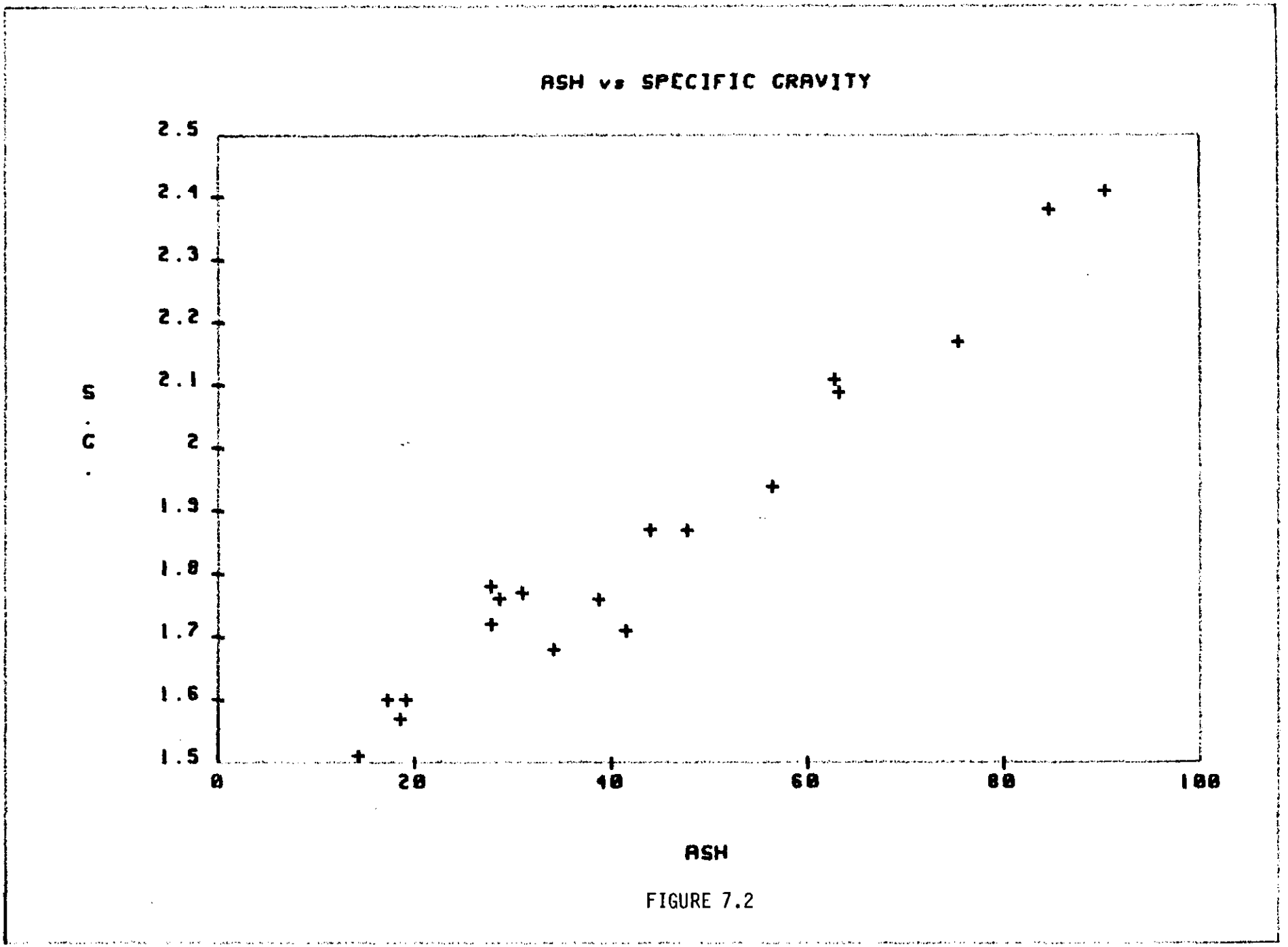
ASH vs SPECIFIC GRAVITY
S
.
G
.
2.5
2.4
2.3
2.2
2.1
2
1.9
1.8
1.7
1.6
1.5
0
20
40
60
80
100
ASH

FIGURE 7.2

The washability data indicates that most of the ash is contained in rock partings rather than disseminated throughout the entire seam. This coal characteristic limits the near gravity material and improves the washability particularly at the cut points used.

As previously discussed, extensive froth flotation tests of the fine size fraction were eliminated from the analysis due to the oxidized nature of the coal and the relatively small quantities involved.

7.2.4 Product Coal

A medium ash level was selected for the product coal since washability data suggested that a 10% ash product would represent most of the coal in the three main seams. Specific gravity cut points ranging from 1.8 to 2.0 g/cc were used providing a yield of over 68% with an average ash of 9.5% (air dried basis). A low ash product (5%) is also possible at cut points between 1.45 and 1.5 g/cc. As previously stated theoretical yields should exceed 40%. Undoubtably the property is capable of producing a high ash product, however, data from additional seams is required for an indication of the product quality.

The average medium ash product coal quality from the three composited samples, representing coal from the Pond seam, Lower Discovery Creek seam and Upper Discovery Creek seam, is presented in Table 7.3. The weathered nature of the

AVERAGE PRODUCT COAL QUALITY

		Air-Dry Basis	Dry Basis
Yield		68.32 %	-
Proximate	- Ash	9.50 %	9.72 %
	- Moisture	2.22 %	-
	- Volatile Matter	9.73 %	9.95 %
	- Fixed Carbon	78.55 %	80.33 %
Ultimate	- Carbon	79.57 %	81.37 %
	- Hydrogen	2.71 %	2.52 %
	- Nitrogen	0.97 %	0.99 %
	- Sulphur	0.44 %	0.45 %
	- Oxygen	6.80 %	5.87 %
Calorific Value (MJ/kg)		29.97	30.65
Specific Gravity (g/cc)		1.43	1.44
Hardgrove Grindability Index		35.7	-
Chlorine		0.03 %	

TABLE 7.3

AVERAGE PRODUCT COAL QUALITY
(cont'd.)

Ash Fusibility	Reducing Atmosphere (°C)	Oxidizing Atmosphere (°C)
Initial Deformation Temperature	1180	1243
Softening Temperature	1217	1262
Hemispherical Temperature	1233	1273
Fluid Temperature	1265	1293

Mineral Analysis of Ash	Weight (%)
SiO_2	41.26
Al_2O_3	24.13
Fe_2O_3	9.31
CaO	8.85
MgO	2.24
Na_2O	1.04
K_2O	1.13
P_2O_5	6.26
TiO_2	0.71
SO_3	3.73

TABLE 7.3 (cont'd.)

samples has contributed to the high moisture and volatile values. Drill core data (Appendix D) demonstrates that moisture levels for unweathered samples average just over 0.5% while volatile matter would range from 4 to 6% (dry basis).

The average calorific value (30.65 MJ/kg, dry basis) for the 10% ash product is approximately 13200 BTU and reflects the weathered nature of the coal. Utilizing the calorific values generated from a linear regression of ash and calorific values of all available Groundhog licence area data (Figure 7.3), a more representative calorific value can be obtained. The derived formula is:

Dry Basis Calorific Value (MJ/kg)
= 35.36 - (Ash x 0.40)

Utilizing the regression equation a calorific value of 31.36 MJ/kg (13482 BTU) can be obtained from a 10% ash (dry basis) product while a calorific value of 33.36 MJ/kg (14342 BTU) is possible from a 5% ash (dry basis) product.

The average hardgrove grindability index of 35.7 demonstrates the hardness of the coal which correlates well with the high percentage of coarse material. Hard, coarse coal is a desired anthracite characteristic.

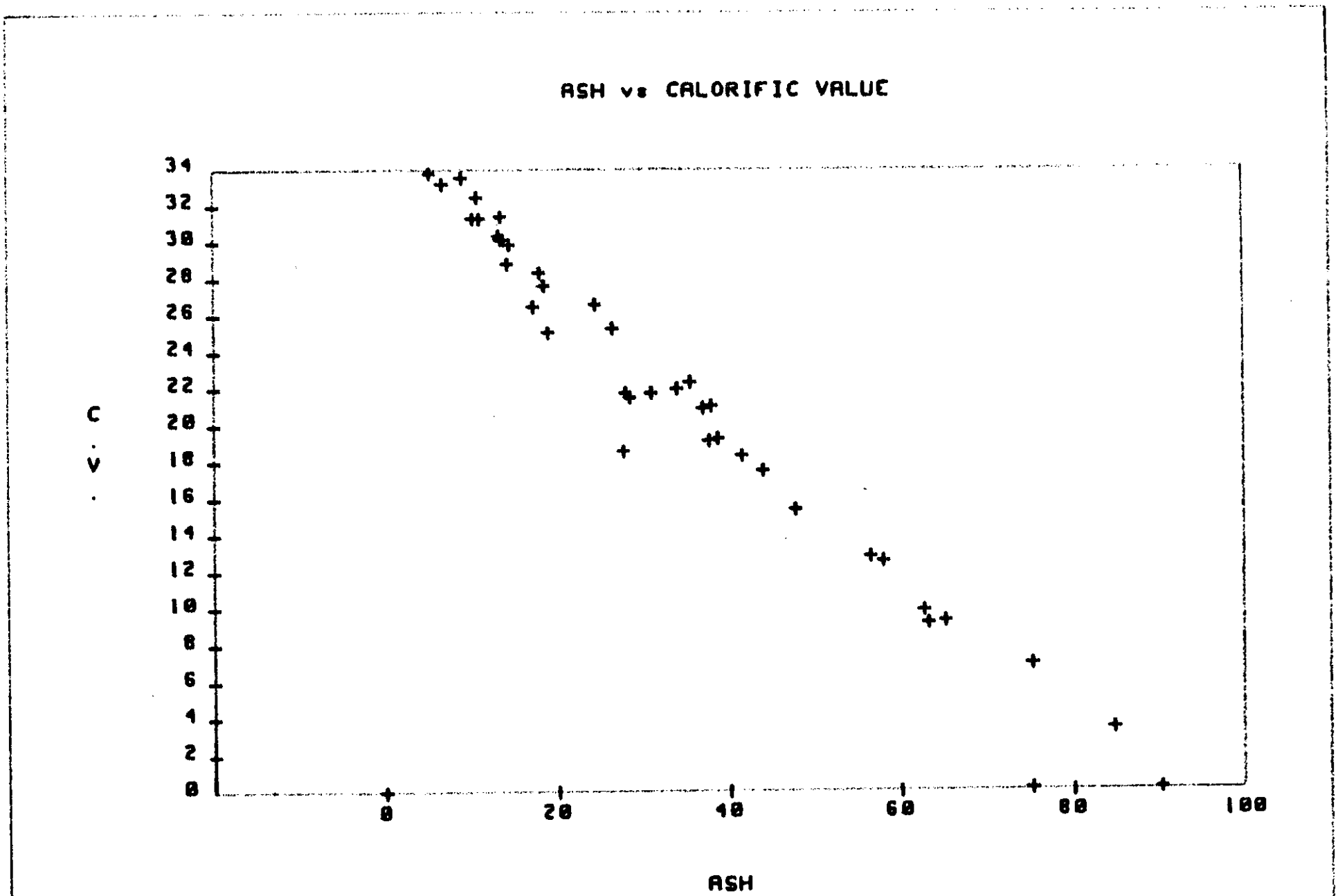
ASH vs CALORIFIC VALUE
C.V.
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
20
40
60
80
100
ASH

FIGURE 7.3

The average ash fusion, ultimate and ash analyses are illustrated in Table 7.3. Ash fusion temperatures indicate a medium slagging tendency while the base/acid ratio shows low-medium fouling tendency. The average chlorine content also shows a medium fouling tendency (Vaninetti and Busch, 1981).

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APPENDIX A

STATEMENT OF QUALIFICATIONS

STATEMENT OF QUALIFICATIONS

J. MATTHEW DUFORD

This is to certify that I obtained my Bachlor's Degree in Geology at Williams College, Massachusetts in 1972 and a Master's Degree in Geology at the University of Calgary in 1976.

My geological experience has been gained during exploration and mapping programs in Colorado, Wyoming, Alberta, British Columbia and the Yukon. Since receiving a M.Sc. degree I have spent nine years in coal exploration in Western Canada. During the first four of those years I was with Denison Mines Ltd., during which time I was responsible for the planning and supervision of coal exploration programs involving mapping and drilling. Since 1980, I have worked as an independent consultant on exploration programs and geologic applications of computers.

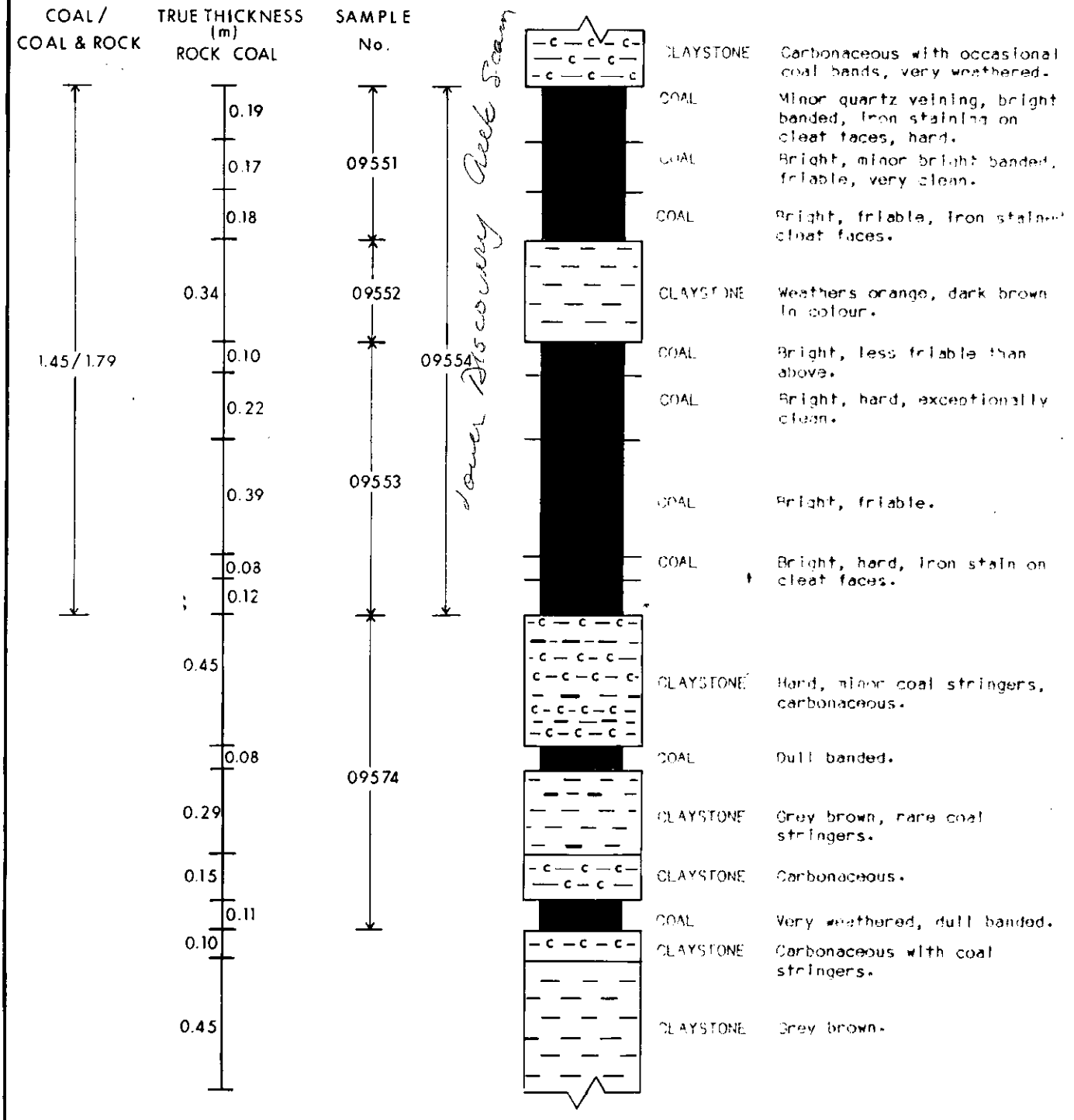
APPENDIX B

1984 TRENCH LOGS

SAMPLE AND TRENCH DATA SUMMARY

Sample Number	Trench Number	Coal (m)	Rock (m)	Coal & Rock (m)	Trench Seam Th. (m)
09551	8401	0.54		0.54	
09552	8401		0.34	0.34	1.79
09553	8401	0.91		0.91	
09574	8401	0.19	.89	1.08	
09554	8401	1.45	.34	1.79	comp
09556	8402	0.69	0.05	0.74	0.74
09557	8403	0.27	0.14	0.35	
09558	8403	0.88		0.88	
09559	8403		0.08	0.08	1.86
09560	8403	0.55		0.55	
09561	8403	1.64	0.22	1.86	
09562	8403	1.64	0.22	1.86	
09563	8404	0.18	0.49	.67	—
09564	8404	0.52		0.52	0.86
09565	8404	0.29	0.05	0.34	
09566	8405	0.84		0.84	0.84
09567	8403	1.64	0.22	1.86	
09568	8406	0.50	.31	.81	0.81*
09569	8407	0.95	0.15	1.10	1.10
09570	8408	1.51	0.13	1.70	1.70
09571	8409	0.47	0.07	0.54	0.54
09572	8410	0.56	0.06	0.62	0.62
09573	8403	1.64	0.22	1.86	
09574	8401	.19	.89	1.08	
N/A	84012	0.31	.13	0.44	
					1.12 AVE

* Excluded due to high ash.



ATTITUDE ROOF : STRIKE 180; DIP, 4° E

ATTITUDE FLOOR : STRIKE 059; DIP, 7° E

UTM COORD : N 6 301 ~~850~~ 820 E 543 150

ELEVATION: ~~1350~~ m 1170 m

TRENCH DEPTH : 1.0 m TRENCH WIDTH 1.5 m

TRENCH LENGTH : 8 m

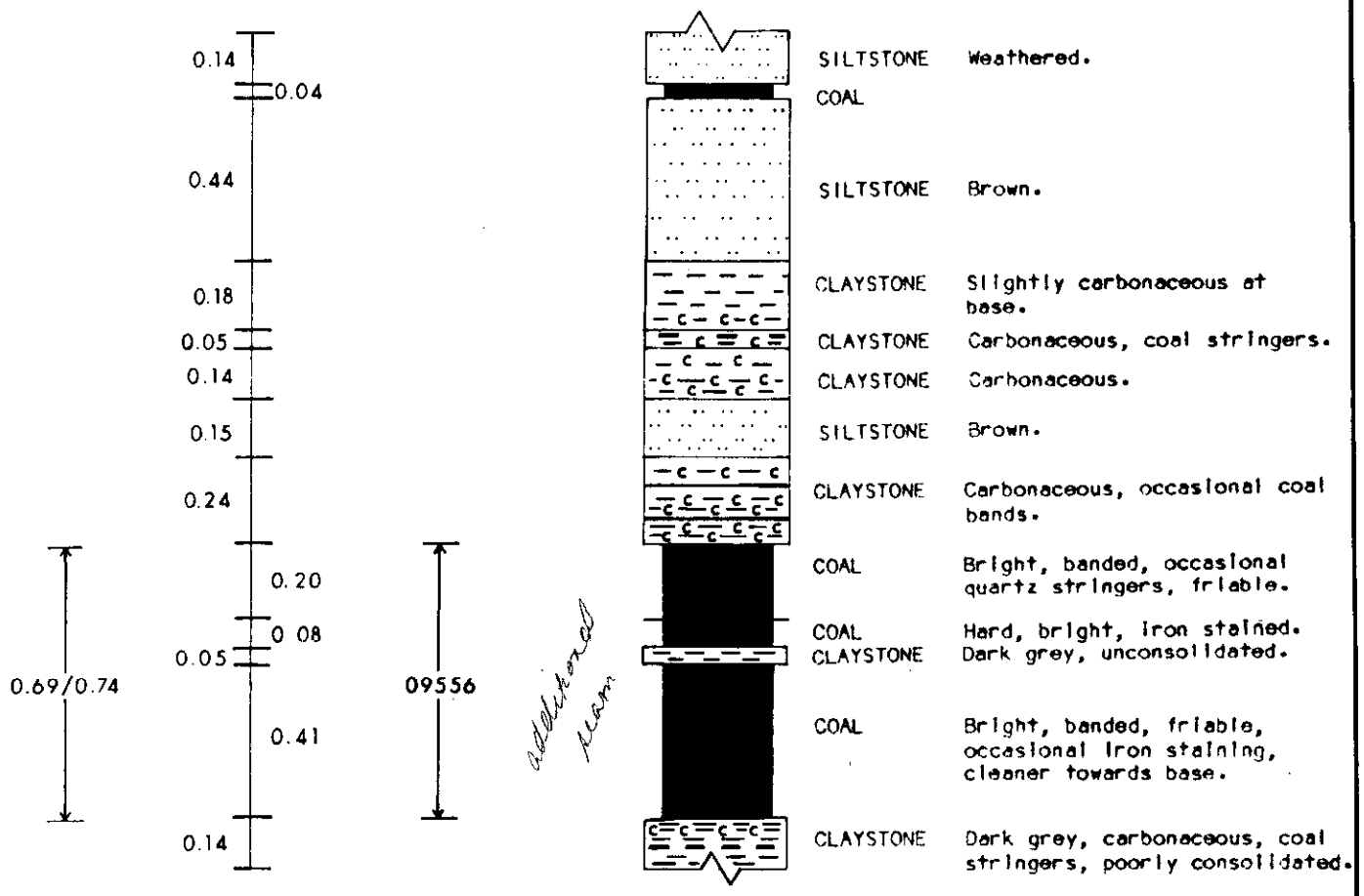
TRENCH BEARING : 169 °

TRENCH SLOPE 54°

GROUNDHOG COAL LTD.

TRENCH LOG
TRC - 84 - 01

BY : J. M. DUFORD P.GEOL.	SCALE : 1:20
DATE : NOVEMBER, 1984	FIGURE : APP. B



ATTITUDE ROOF : STRIKE 100°; DIP, 46° S

ATTITUDE FLOOR : STRIKE ; DIP,

UTM COORD : N 6301 ~~915~~ 880, E ~~543755~~ 542760

ELEVATION: ~~1230~~ 1235 m

TRENCH DEPTH : .5m TRENCH WIDTH : 1.0m

TRENCH LENGTH : 2.5 m

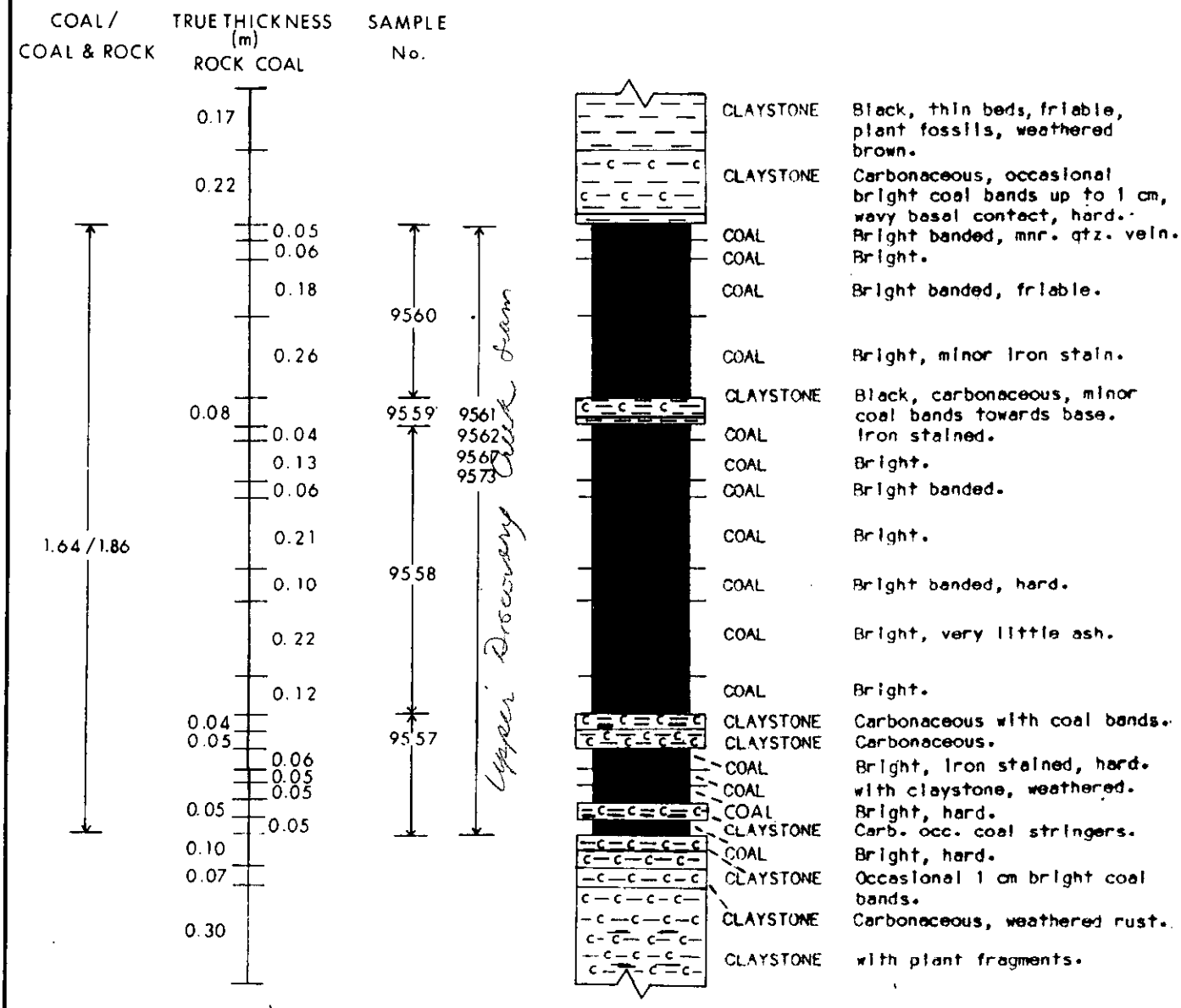
TRENCH BEARING : 173°

TRENCH SLOPE : 55°

GROUNDHOG COAL LTD.

TRENCH LOG
TRC - 84 - 02

BY : J. M. DUFORD P. GEOL.	SCALE; 1 : 20
DATE : NOVEMBER, 1984	FIGURE : APP. B



ATTITUDE ROOF : STRIKE 160°; DIP, 23° E

ATTITUDE FLOOR : STRIKE 180° ; DIP, 24° E

UTM COORD : N 6 301 ~~605~~ 575 , E 541 ~~800~~ 810

ELEVATION: ~~1385~~ 1355 m

TRENCH DEPTH: 1.0 m TRENCH WIDTH: 2.0 m

TRENCH LENGTH: 3.5 m

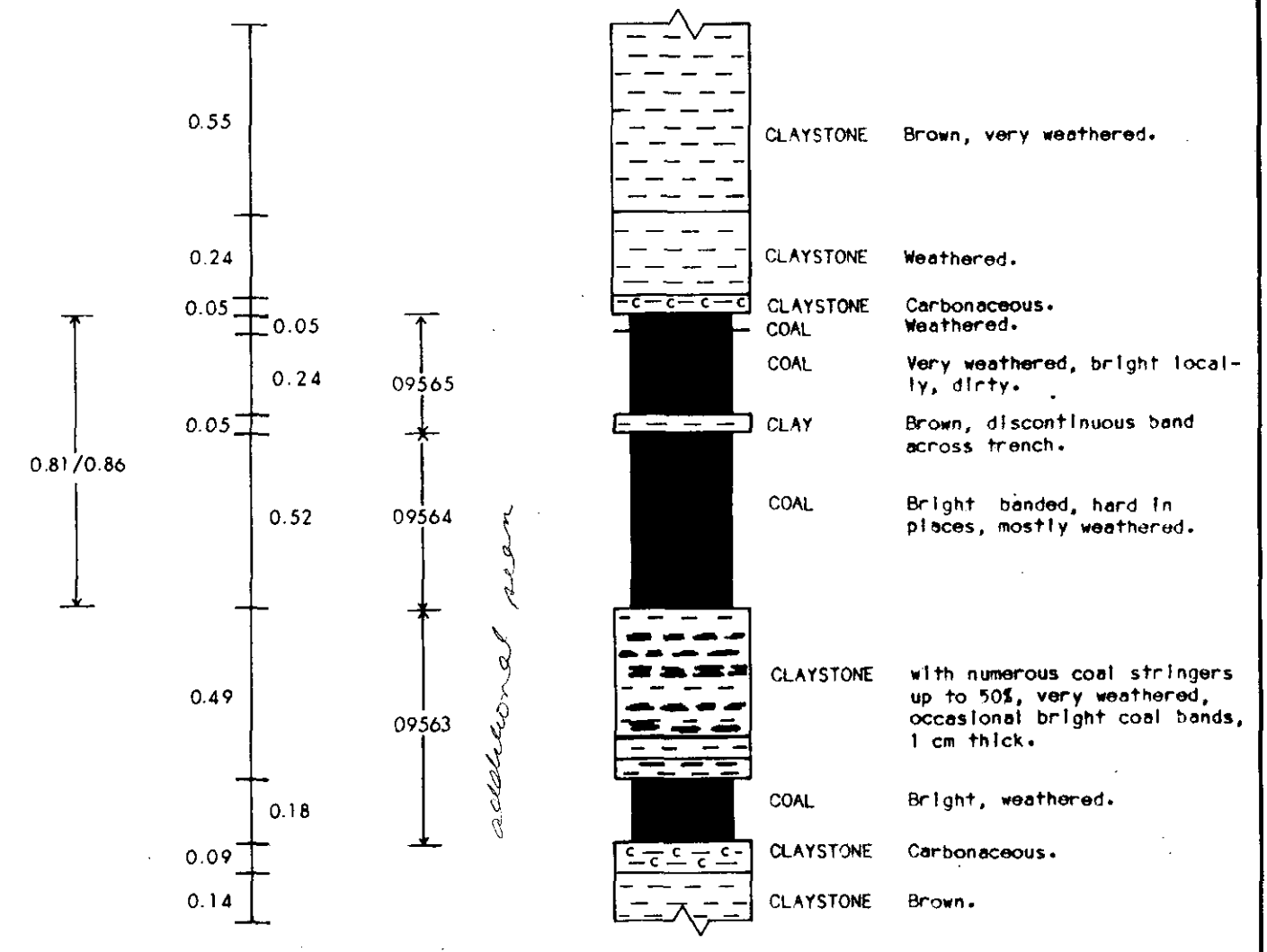
TRENCH BEARING: 111°

TRENCH SLOPE: 60°

GROUNDHOG COAL LTD.

TRENCH LOG
TRC - 84 - 03

BY: J. M. DUFORD P. GEOL.	SCALE: 1:20
DATE: NOVEMBER, 1984	FIGURE: APP. B



ATTITUDE ROOF : STRIKE ; DIP,

ATTITUDE FLOOR : STRIKE 010°; DIP, 22°E

UTM COORD : N 6 301 ~~565~~ 555 E 541 745

ELEVATION: ~~1365~~ 1360 m

TRENCH DEPTH : 1.0 m TRENCH WIDTH : 2.0 m

TRENCH LENGTH : 4.0 m

TRENCH BEARING : 154°

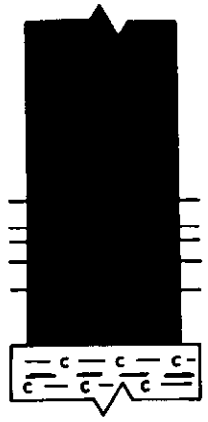
TRENCH SLOPE : 58°

GROUNDHOG COAL LTD.

TRENCH LOG
TRC - 84 - 04

BY : J. M. DUFORD P. GEOL.	SCALE : 1 : 20
DATE : NOVEMBER, 1984	FIGURE : APP. B

COAL / COAL & ROCK	TRUE THICKNESS (m) ROCK	TRUE THICKNESS (m) COAL	SAMPLE No.
	0.84/0.84	0.47	09566
		0.06	
		0.03	
		0.06	
		0.07	
		0.15	
	0.15		



COAL	Bright, hard.
COAL	Bright, soft, weathered.
COAL	Dull ¦ banded.
COAL	Bright banded.
COAL	Bright.
COAL	Bright, hard.
CLAYSTONE	Carbonaceous, very frequent coal stringers.

ATTITUDE ROOF : STRIKE ; DIP,

ATTITUDE FLOOR : STRIKE 015°; DIP, 15 E

UTM COORD : N 6 301 ~~565~~ 555 E 541 ~~280~~ 745

ELEVATION: ~~1370~~ 1360 m

TRENCH DEPTH: 0 TRENCH WIDTH: 1.0 m

TRENCH LENGTH: 2 m

TRENCH BEARING: 120 °

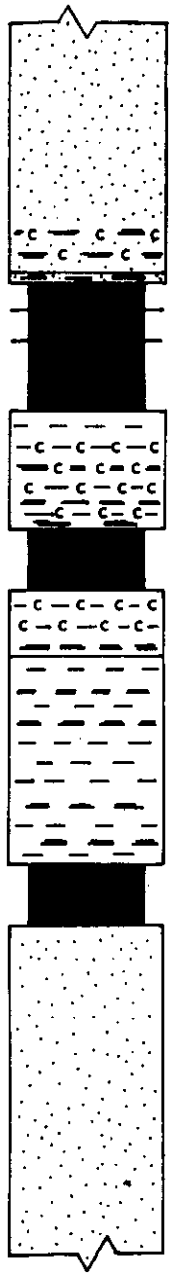
TRENCH SLOPE: 80 °

GROUNDHOG COAL LTD.

TRENCH LOG
TRC - 84 - 05

BY : J. M. DUFORD P. GEOL.	SCALE; 1 : 20
DATE : NOVEMBER , 1984	FIGURE: APP. B

COAL / COAL & ROCK	TRUE THICKNESS (m) ROCK	TRUE THICKNESS (m) COAL	SAMPLE No.
	0.66		
	0.03	0.07	
		0.09	
	0.18		
0.50/0.81	0.31		09568
	0.16		
	0.18		
	0.57		
	0.15		
	0.86		



SANDSTONE	Medium grained, very weathered, orange brown, carbonaceous stringers increase towards base.
SANDSTONE	with coal stringers.
COAL	Iron stained, bright, hard.
COAL	Bright banded, weathered, contains some claystone.
COAL	Bright, fairly hard.
CLAYSTONE	Very carbonaceous, occasional coal stringers, up to 1 cm, weathered.
COAL	Iron stained. Bright, banded.
CLAYSTONE	Carbonaceous, occasional coal stringers.
CLAYSTONE	Occasional coal stringers 1 cm thick at top, dark grey.
COAL	Dull banded, very hard.
SANDSTONE	Fine grained, weathered red-orange.

ATTITUDE ROOF: STRIKE 033°; DIP, 21 E

ATTITUDE FLOOR: STRIKE 034°; DIP, 27 E

UTM COORD: N 6 302 ~~615~~ 660 E 542 240

ELEVATION: ~~1237~~ 1260 m

TRENCH DEPTH: 1.0 m TRENCH WIDTH: 2.0 m

TRENCH LENGTH: 5.0 m

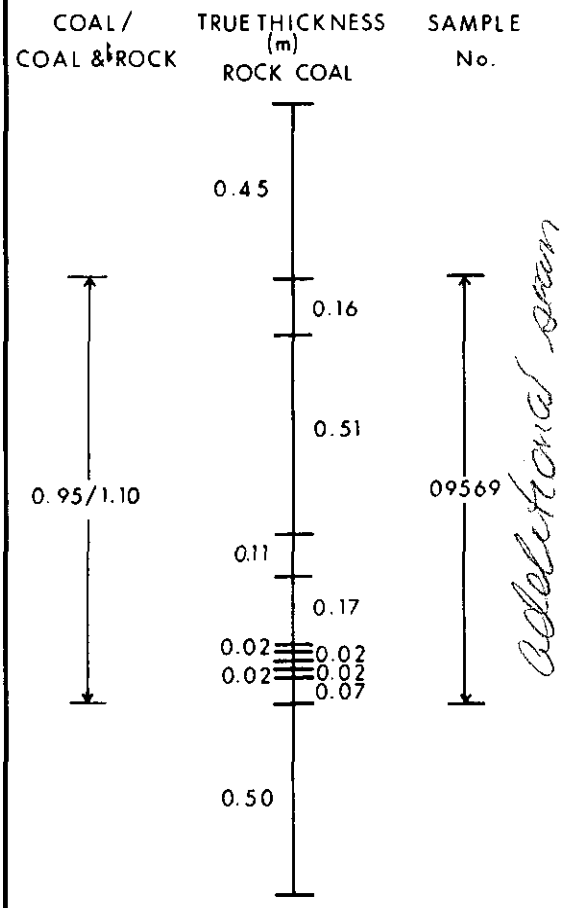
TRENCH BEARING: 158°

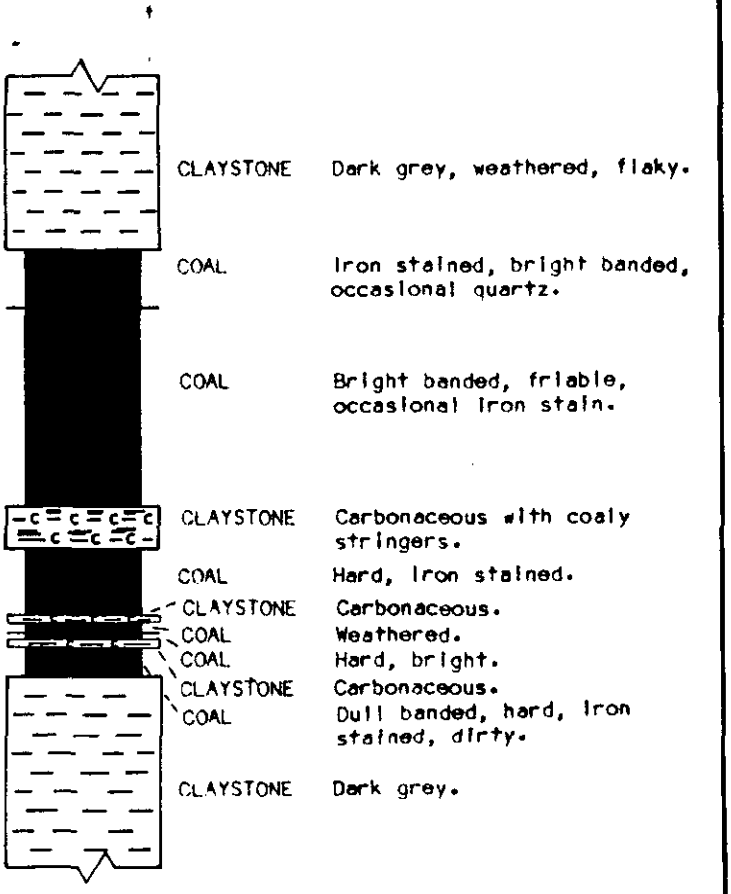
TRENCH SLOPE: 54°

GROUNDHOG COAL LTD.

TRENCH LOG
TRC-84-06

BY: J. M. DUFORD P. GEOL.	SCALE: 1:20
DATE: NOVEMBER, 1984	FIGURE: APP. B





ATTITUDE ROOF : STRIKE 072°; DIP, 24° S

ATTITUDE FLOOR : STRIKE 120°; DIP, 19° S

UTM COORD : N 6 303 ~~690~~ 705 E 544 685

ELEVATION: ~~920~~ 925 m

TRENCH DEPTH : 1.0 m TRENCH WIDTH : 3.0 m

TRENCH LENGTH : 3.0 m

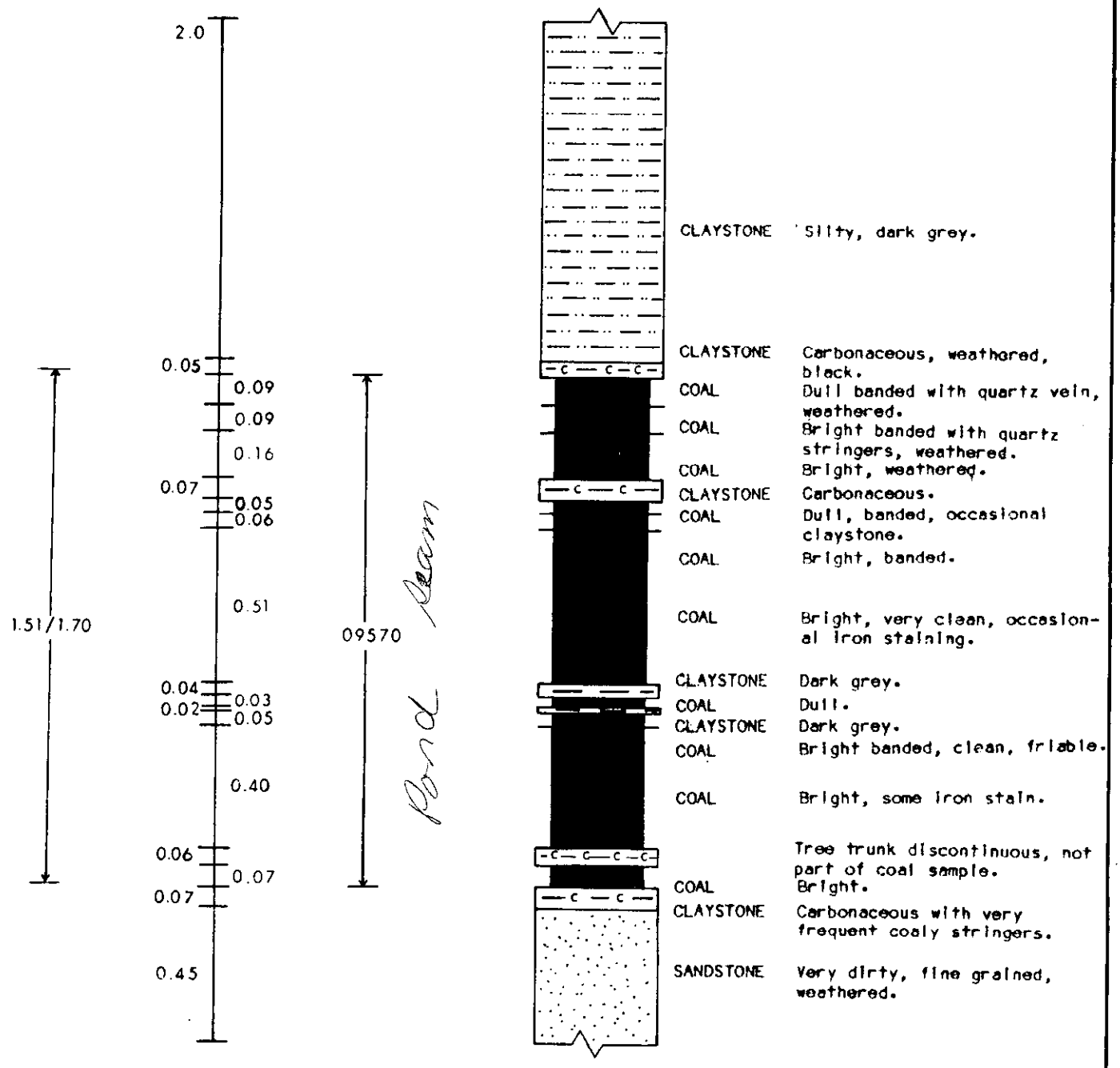
TRENCH BEARING : 140°

TRENCH SLOPE : 70°

GROUNDHOG COAL LTD.

TRENCH LOG
TRC-84-07

BY : J. M. DUFORD P. GEOL.	SCALE; 1:20
DATE : NOVEMBER, 1984	FIGURE: APP. B



ATTITUDE ROOF : STRIKE 040°; DIP, 14° N

ATTITUDE FLOOR : STRIKE 059°; DIP, 24° N

UTM COORD : N 6 304 ~~735~~ 740 E 542 ~~840~~ 833

ELEVATION: ~~1060~~ 1080 m

TRENCH DEPTH : 1.0 m TRENCH WIDTH : 2.0 m

TRENCH LENGTH : 5.0 m

TRENCH BEARING : 100°

TRENCH SLOPE : 60°

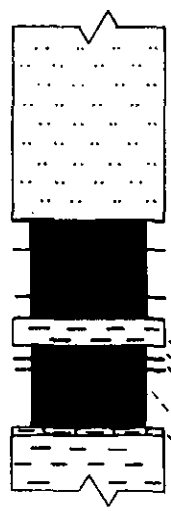
GROUNDHOG COAL LTD.

TRENCH LOG
TRC - 84 - 08

BY : J. M. DUFORD P. GEOL.	SCALE : 1 : 20
DATE : NOVEMBER, 1984	FIGURE. APP. B

COAL / COAL & ROCK	TRUE THICKNESS (m) ROCK	TRUE THICKNESS (m) COAL	SAMPLE No.
		0.50	
		0.08	
		0.13	
		0.05	
0.47/0.54		0.07	09571
		0.03	
		0.03	
		0.15	
		0.03	
		0.15	

Lower Discovery Creek Seam



SILTSTONE	Dark grey, weathered, may be slumped on top of seam.
COAL	Dull banded, very weathered.
COAL	Hard, iron stained, bright, minor dull bands.
COAL	Very weathered.
CLAYSTONE	Weathered.
COAL	Bright, quartz vein.
COAL	Dull banded.
COAL	Bright banded.
CLAYSTONE	Carbonaceous, coaly string.
CLAYSTONE	with plant fossils.

ATTITUDE ROOF: STRIKE ; DIP,

ATTITUDE FLOOR: STRIKE 119° ; DIP, 19° S

UTM COORD: N 6 304 ~~590~~ 610 E 543 ~~105~~ 115

ELEVATION: ~~1040~~ 1045 m

TRENCH DEPTH: 1.0 m TRENCH WIDTH: 2.0 m

TRENCH LENGTH: 3.0 m

TRENCH BEARING: 056°

TRENCH SLOPE: 059°

GROUNDHOG COAL LTD.

TRENCH LOG
TRC - 84 - 09

BY: J. M. DUFORD P. GEOL.	SCALE: 1:20
DATE: NOVEMBER, 1984	FIGURE: APP. B

COAL / COAL & ROCK	TRUE THICKNESS (m) ROCK	TRUE THICKNESS (m) COAL	SAMPLE No.
0.56/0.62	0.10	0.04	
	0.03		
		0.25	
	0.03		
		0.23	
		0.04	
	0.10		
	0.15		
09572			

CLAYSTONE	Very weathered, grey.
COAL	Very weathered.
CLAYSTONE	
COAL	Weathered, bright in places.
CLAYSTONE	Weathered.
COAL	Sheared, weathered.
COAL	Dull banded quartz stringers.
CLAYSTONE	Very carbonaceous with coal specks throughout, hard.
CLAYSTONE	Weathered.

ATTITUDE ROOF : STRIKE 025°; DIP, 13° W ?

ATTITUDE FLOOR : STRIKE ; DIP,

UTM COORD : N 6 303 ~~530~~ 535 E 543 ~~150~~ 155

ELEVATION: ~~1092~~ 1112 m

TRENCH DEPTH : 1.5 m TRENCH WIDTH :

TRENCH LENGTH : 3.0 m

TRENCH BEARING : 019°

TRENCH SLOPE : 80°

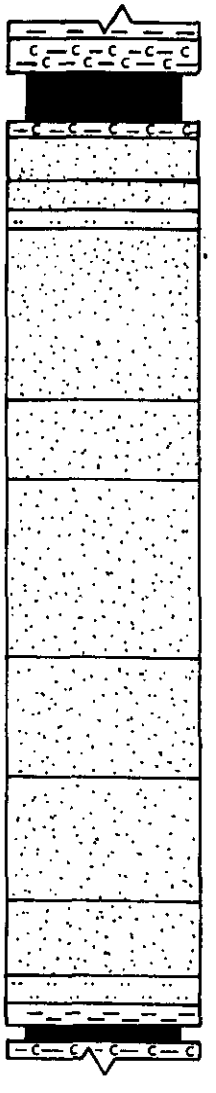
GROUNDHOG COAL LTD.

TRENCH LOG

TRC - 84 - 10

BY : J. M. DUFORD P. GEOL.	SCALE : 1 : 20
DATE : NOVEMBER, 1984	FIGURE. APP. B

TRUE THICKNESS (m) ROCK	TRUE THICKNESS (m) COAL	SAMPLE No.		
0.10			CLAYSTONE	Grey.
0.22			CLAYSTONE	Carbonaceous.
	0.33		COAL	Weathered, bright.
0.09			CLAYSTONE	Carbonaceous.
0.30			SANDSTONE	Silty, fine grained.
0.18			SANDSTONE	Weathered brown, siltst. intbds.
0.11			SILTSTONE	Hard.
1.12			SANDSTONE	Siltstone interbeds, fine to medium grained.
0.54			SANDSTONE	Brown, thick bedded.
1.13			SANDSTONE	with interbedded siltstone, fine to medium grained.
0.79			SANDSTONE	Intbdd. siltst., f-m., gr. sandstone is lt. gy. and weathered, v. thn. bdd.
0.80			SANDSTONE	Intbdd. siltst., f-m., gr. sandstone is lt. gy. and weathered, v. thn. bdd.
0.47			SANDSTONE	Medium grained.
0.18			SILTSTONE	Intbdd. f. gr. sandstone.
0.12			CLAYSTONE	Dark grey.
	0.09		COAL	Weathered.
0.10			CLAYSTONE	Carbonaceous.



ATTITUDE ROOF : STRIKE ; DIP,

ATTITUDE FLOOR : STRIKE 055°; DIP, 41° S

UTM COORD : N 6 303 ~~555~~ 540 E 543 210

ELEVATION : ~~1090~~ 1095 m

TRENCH DEPTH : 1.0 m TRENCH WIDTH : 9.0 m

TRENCH LENGTH : 1.0 m

TRENCH BEARING : 011

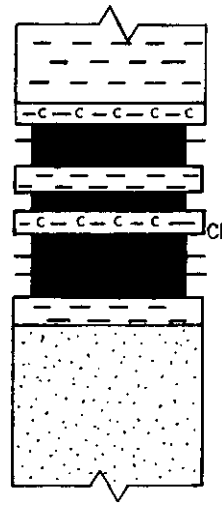
TRENCH SLOPE : 59°

GROUNDHOG COAL LTD.

TRENCH LOG
TRC - 84 - 11

BY : J. M. DUFORD P. GEOL.	SCALE : 1 : 50
DATE : NOVEMBER, 1984	FIGURE : APP. B

COAL / COAL & ROCK	TRUE THICKNESS (m) ROCK	TRUE THICKNESS (m) COAL	SAMPLE No.
0.31 / 0.44	0.20		
	0.06		
		0.04	
		0.07	
	0.06		
		0.05	
	0.07		
		0.05	
		0.04	
		0.06	
	0.07		
	0.43		



CLAYSTONE	Dark grey, silty.
CLAYSTONE	Carbonaceous, coal stringers.
COAL	Dull, weathered.
COAL	Dull banded.
CLAY	Grey.
COAL	Weathered.
CLAYSTONE	Carbonaceous, coal bands.
COAL	Weathered.
COAL	Dull banded.
COAL	Bright, hard.
CLAYSTONE	Grey, silty.
SANDSTONE	Very fine grained, grey, becomes medium grained towards base.

ATTITUDE ROOF: STRIKE 30°; DIP, 24°

ATTITUDE FLOOR: STRIKE 12°; DIP, 24°

UTM COORD: N 6 301 ~~660~~ 650 E ~~542 950~~ 541 955

ELEVATION: 1315 m

TRENCH DEPTH: .50 m TRENCH WIDTH: 2.0 m

TRENCH LENGTH: 5.0 m

TRENCH BEARING: 170°

TRENCH SLOPE: 50°

GROUNDHOG COAL LTD.

TRENCH LOG
TRC - 84 - 12

BY: J. M. DUFORD P. GEOL.	SCALE: 1:20
DATE: NOVEMBER, 1984	FIGURE: APP. B

APPENDIX C

PETROGRAPHIC DATA

Petrography

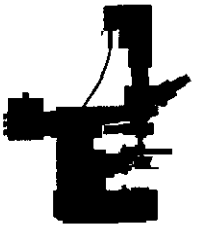
Of

Three Anthracite Samples.

November, 1984.

Prepared for

Barrier Reef Management Ltd.



David E. Pearson & Associates Ltd.

Consulting Coal Geologists & Petrographers,

804 Leota Place,

Victoria,

British Columbia.

V8Y 1H2

David E. Pearson & Associates Ltd.
Consulting Coal Geologists & Petrographers

804 Leota Place, Victoria, B.C. V8Y 1H2 (604) 658-5963

November 13, 1984.

Mr. Matt Duford,
P.O. Box 333,
Postal Station "G",
Calgary,
Alberta,
T3A 2G3.

Subject: Petrography Of Three Anthracite Samples.

Dear Matt:

We are pleased to provide you with the results of petrographic analyses on the above-described coals, following completion of our studies. We trust that you will find this information to be most useful.

We thank you for the opportunity to be of assistance to you.

Yours truly,
DAVID E. PEARSON & ASSOCIATES LTD.,

David E. Pearson, Ph.D., P.Eng.

INTRODUCTION

Three crushed coal samples were received at the Coal Laboratory on November 1, 1984. The samples were identified as follows:-

#9551 - #9553
#9557 - #9560
#9570

The reason for examining these coals microscopically was to determine whether or not they could represent the same seam, or whether they are unrelated.

SAMPLE PREPARATION

The coal samples were coned and quartered and reduced to provide sufficient material for one pellet. This coal was then placed in 25mm plastic moulds. Cold-set epoxy resin, to which had been added a portion of hardener, was then mixed with the coal and allowed to set. The pellets were then ground and polished with Beuhler equipment.

PETROGRAPHIC EXAMINATION

The polished samples were examined using a Leitz Orthoplan Compact-model microscope-photometer, the control panel of which is interfaced to a Hewlett-Packard 85 microcomputer, an Epson MX-80 printer and a Hewlett-Packard 7225A plotter, for electronic computation, tabulation and draughting of results.

Reflectance Analysis.

One hundred individual vitrinite 'A' grains were measured for reflectance in the rank analysis. Standardization of photometer-readout was performed before and after the analysis. Maximum reflectance values were retained by the computer.

Maceral Analysis.

One thousand macerals were counted in the maceral analysis. The macerals were divided into the simple maceral classes of vitrinite, semifusinite, fusinite, macrinite and inertodetrinite. All macerals in anthracites are inert,

that is, they do not soften as do the reactive macerals among bituminous coals.

RESULTS

The results of the analyses are contained in Table 1. Results of individual readings made in the reflectance analyses, the basic statistics and computer-generated histograms of the reflectance data are contained in the Appendix, together with maceral data.

DISCUSSION

The maceral compositions of the three coals are very similar, and the samples could therefore be of the same seam. However, evidence to the contrary is provided by the reflectance values.

There is a wide variation in the reflectance of the three samples. This may be strong evidence that the three coals are of different seams that have similar maceral compositions.

TABLE 1

RESULTS OF PETROGRAPHIC ANALYSES

SAMPLE #	ROMAX %	VITRINITE %
9551-9553	3.73	80.0
9557-9560	4.21	82.0
9570	3.47	81.3

SUMMARY OF PETROGRAPHIC ANALYSIS

SAMPLE IDENTIFICATION

Laboratory Number.....	M2068
Description.....	Sample #9551 - #9553

DISTRIBUTION OF VITRINITE TYPES

V-32.....%	2
V-33.....%	2
V-34.....%	7
V-35.....%	5
V-36.....%	22
V-37.....%	21
V-38.....%	25
V-39.....%	11
V-40.....%	4
V-41.....%	1

MACERAL COMPOSITION

Vitrinite.....%	80.0
Total Reactives.....%	80.0
* Inert Semifusinite.....%	16.9
Macrinite.....%	0.5
Fusinite.....%	2.5
Inertodetrinite.....%	0.1
Total Inerts.....%	20.0

PETROGRAPHIC INDICES

Mean Reflectance.....%	3.73

SUMMARY OF PETROGRAPHIC ANALYSIS

SAMPLE IDENTIFICATION

Laboratory Number.....	M2069
Description.....	Sample #9557 - #9560

DISTRIBUTION OF VITRINITE TYPES

V-36.....%	1
V-37.....%	
V-38.....%	1
V-39.....%	17
V-40.....%	14
V-41.....%	18
V-42.....%	16
V-43.....%	14
V-44.....%	8
V-45.....%	7
V-46.....%	3
V-47.....%	1

MACERAL COMPOSITION

Vitrinite.....%	82.0
Total Reactives.....%	82.0
* Inert Semifusinite.....%	15.8
Macrinite.....%	0.4
Fusinite.....%	1.6
Inertodetrinite.....%	0.2
Total Inerts.....%	18.0

PETROGRAPHIC INDICES

Mean Reflectance.....%	4.21

SUMMARY OF PETROGRAPHIC ANALYSIS

SAMPLE IDENTIFICATION

Laboratory Number.....	M2070
Description.....	Sample #9570

DISTRIBUTION OF VITRINITE TYPES

V-30.....%	1
V-31.....%	1
V-32.....%	14
V-33.....%	23
V-34.....%	31
V-35.....%	9
V-36.....%	7
V-37.....%	7
V-38.....%	3
V-39.....%	4

MACERAL COMPOSITION

Vitrinite.....%	81.3
Total Reactives.....%	81.3
* Inert Semifusinite.....%	16.6
Macrinite.....%	0.4
Fusinite.....%	1.7
Total Inerts.....%	18.7

PETROGRAPHIC INDICES

Mean Reflectance.....%	3.47

Vitrinite Reflectance Data For Barrier Reef Management
Sample #9551 — #9553
Pellet #2068/1

OBSERVATION NUMBER	ROMAX VALUE
1	3.85
2	3.87
3	3.55
4	3.70
5	3.96
6	3.70
7	3.71
8	3.84
9	3.87
10	3.95
11	3.79
12	3.76
13	3.79
14	3.94
15	3.65
16	4.08
17	3.88
18	3.68
19	3.84
20	3.93
21	3.43
22	3.29
23	3.75
24	3.70
25	3.63
26	3.87
27	3.41
28	3.64
29	3.21
30	3.88
31	3.52
32	3.89
33	3.71
34	3.42
35	3.80
36	3.77
37	3.69
38	3.91
39	3.99
40	3.71
41	3.73
42	3.75
43	3.87
44	3.75
45	3.76
46	3.73
47	3.69
48	4.07
49	3.88
50	3.84
51	3.45
52	3.45
53	3.39
54	3.90
55	3.68
56	3.90
57	3.78
58	3.82
59	3.82
60	3.43
61	4.00
62	3.48
63	3.58
64	3.60
65	3.50
66	3.91
67	3.67
68	3.84
69	3.62
70	3.63
71	3.33
72	3.85
73	3.67
74	4.10
75	3.60
76	3.92
77	3.62
78	3.61
79	3.80
80	3.69
81	3.84
82	3.83
83	3.67
84	3.68
85	3.84
86	3.73
87	3.63
88	3.63
89	3.74
90	3.54
91	3.64
92	3.83
93	3.73
94	3.72
95	3.84
96	3.97
97	3.82
98	3.65
99	3.87
100	4.01

Barrier Reef Management
Sample #9551 - #9553
Pellet #2068/1

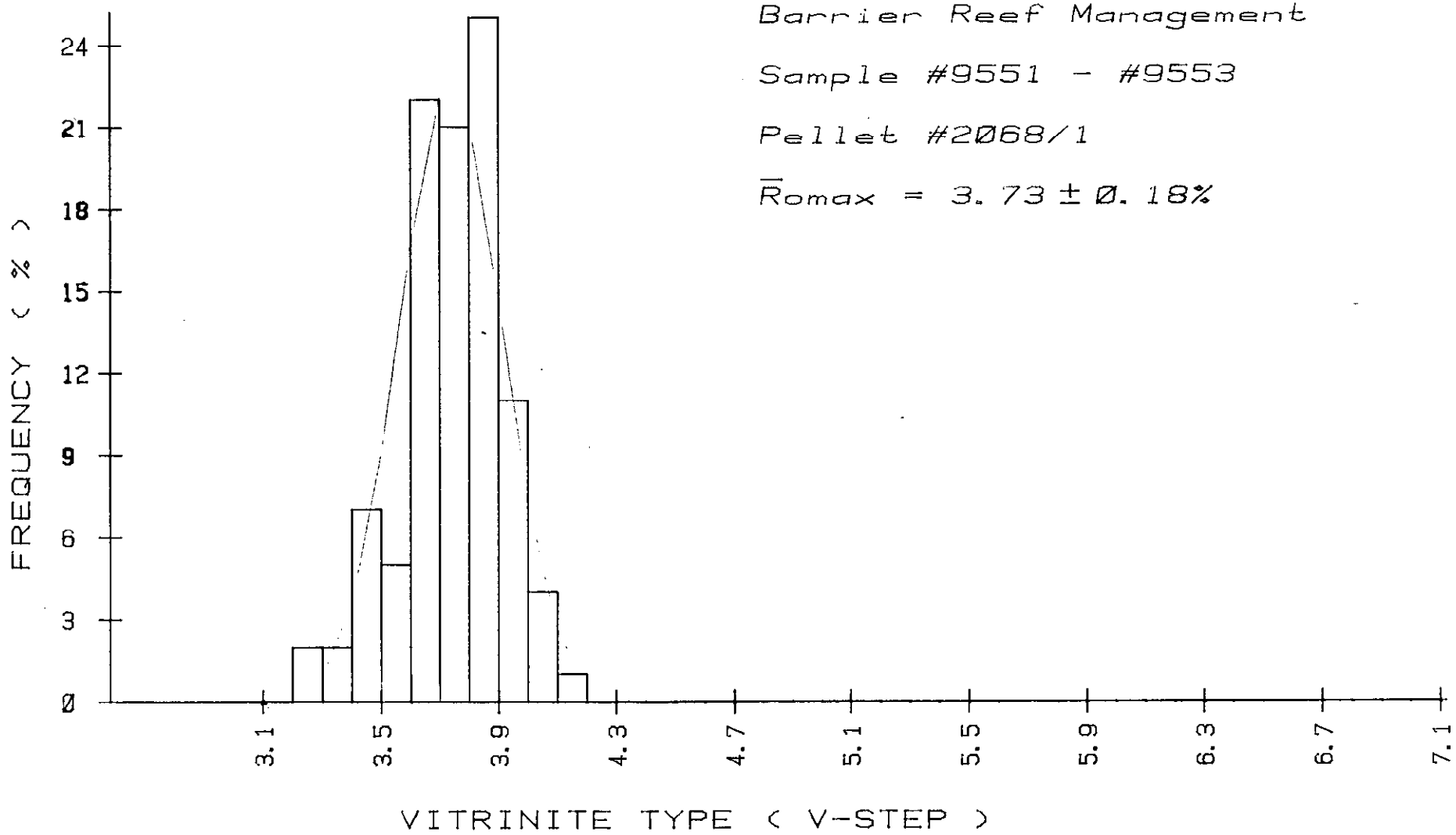
BASIC STATISTICS

NUMBER OF OBSERVATIONS	100
MEAN MAXIMUM REFLECTANCE OF VITRINITE (Romax).....%	3.73
STANDARD ERROR OF THE MEAN	0.02
COEFFICIENT OF VARIATION .....%	4.71
VARIANCE	0.0309
STANDARD DEVIATION	0.1758
SKEWNESS	-0.5282
KURTOSIS	3.2276

CELL STATISTICS

CELL NUMBER	LOWER LIMIT	NUMBER OF OBSERVATIONS	FREQUENCY (%)
2	3.20	2	2.00
3	3.30	2	2.00
4	3.40	7	7.00
5	3.50	5	5.00
6	3.60	22	22.00
7	3.70	21	21.00
8	3.80	25	25.00
9	3.90	11	11.00
10	4.00	4	4.00
11	4.10	1	1.00

VITRINITE FREQUENCY DISTRIBUTION



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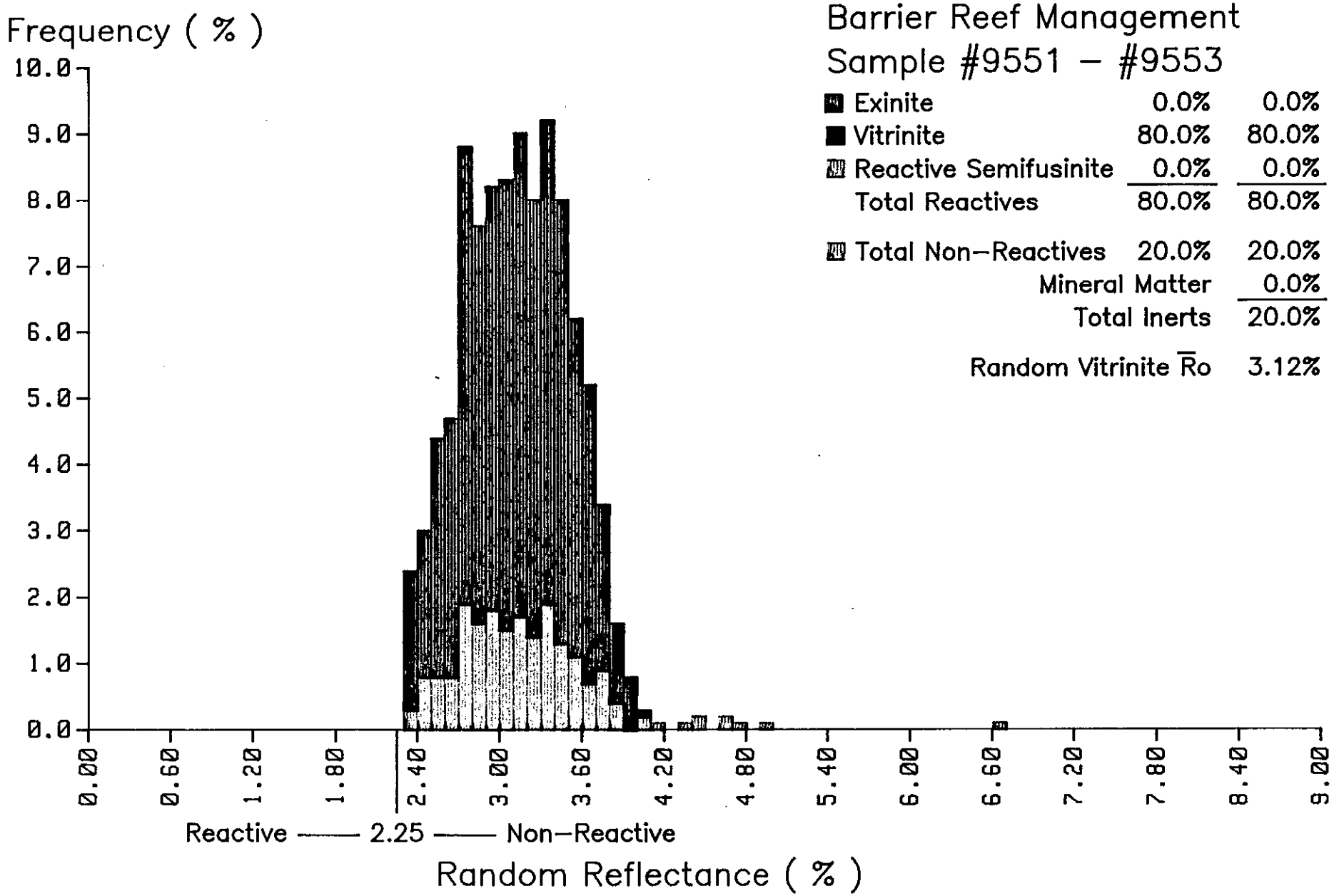
REFLECTOGRAM



Barrier Reef Management

Sample #9551 – #9553

Exinite	0.0%	0.0%
Vitrinite	80.0%	80.0%
Reactive Semifusinite	0.0%	0.0%
Total Reactives	80.0%	80.0%
Total Non–Reactives	20.0%	20.0%
Mineral Matter		0.0%
Total Inerts		20.0%
Random Vitrinite $\overline{R}o$		3.12%

David E. Pearson & Associates Ltd.

RESULTS OF MACERAL ANALYSIS

Semifusinite - Pearson Method

Barrier Reef Management
Sample #9551 — #9553

Count #	1	2	3	4	5	6	7	8	9	10
Vitrinite	84	78	63	79	87	86	87	78	83	75
Total Reactives	84	78	63	79	87	86	87	78	83	75
Macrinite	1	0	0	3	1	0	0	0	0	0
Inert Semifusinite	12	21	31	15	11	12	12	20	12	23
Fusinite	3	1	6	3	1	2	1	2	4	2
Inertodetrinite	0	0	0	0	0	0	0	0	1	0
Total Non-Reactives	16	22	37	21	13	14	13	22	17	25

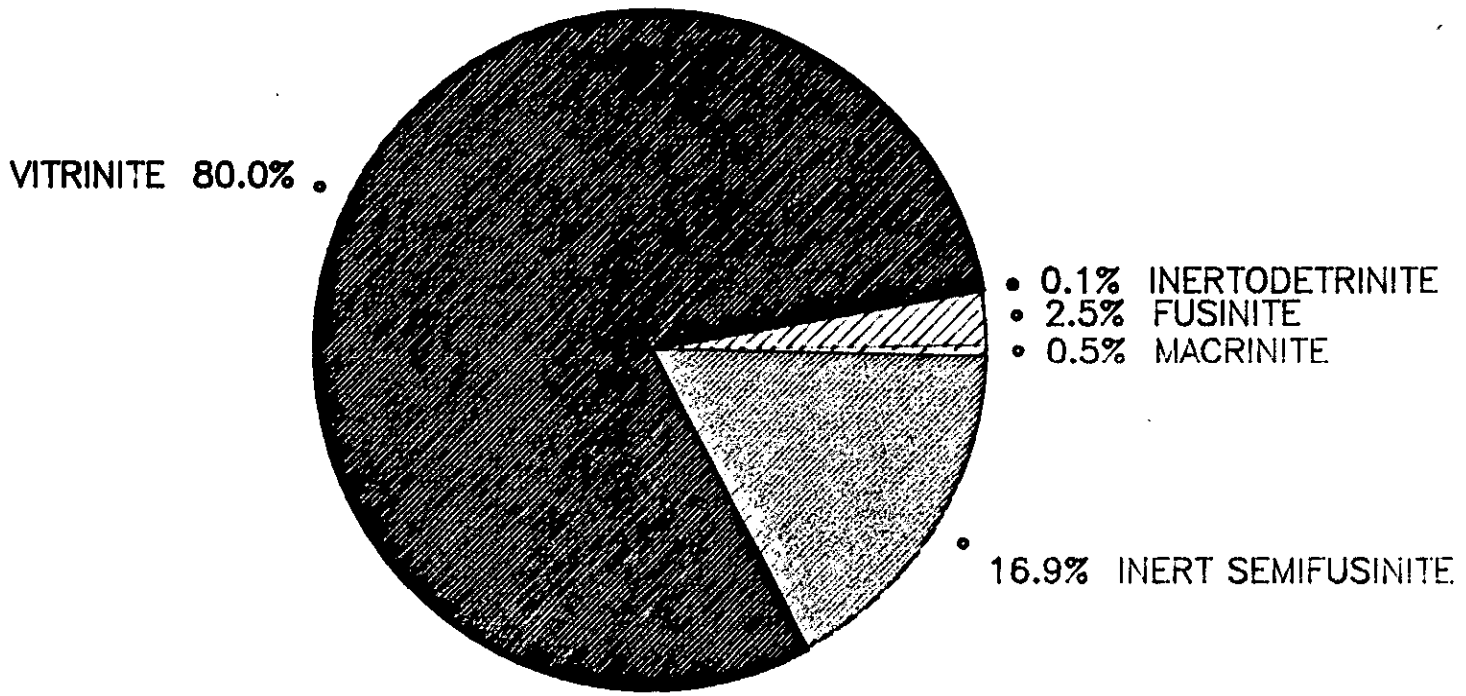
Basic Statistics	Mean	St.Deviation	Variance
Vitrinite	80.0	7.3	53.6
Total Reactives	80.0	7.3	53.6
Macrinite	.5	.9	.9
Inert Semifusinite	16.9	6.6	44.1
Fusinite	2.5	1.6	2.5
Inertodetrinite	.1	.3	.1
Total Non-Reactives	20.0	7.3	53.6

Maceral Data Corrected For Mineral Matter Content

Vitrinite	80.0
Total Reactives	80.0
Macrinite	.5
Inert Semifusinite	16.9
Fusinite	2.5
Inertodetrinite	.1
Total Non-Reactives	20.0
Total Inerts	20.0

MACERAL DISTRIBUTION

Semifusinite – Pearson Method



Barrier Reef Management
Sample #9551 – #9553

David E. Pearson & Associates Ltd.

Vitrinite Reflectance Data For Barrier Reef Management
Sample #9557 - #9560
Pellet #2069/1

OBSERVATION NUMBER	ROMAX VALUE
1	4.10
2	4.64
3	4.17
4	4.28
5	4.44
6	4.12
7	4.06
8	4.01
9	4.18
10	4.37
11	4.13
12	4.24
13	4.46
14	3.86
15	4.25
16	3.97
17	4.14
18	4.30
19	4.59
20	4.06
21	4.04
22	4.54
23	4.24
24	4.39
25	4.17
26	3.93
27	4.44
28	4.32
29	4.10
30	4.30
31	4.23
32	4.25
33	4.09
34	4.18
35	3.95
36	4.35
37	4.30
38	4.03
39	4.56
40	4.64
41	4.28
42	4.24
43	4.03
44	3.93
45	4.50
46	3.93
47	4.28
48	4.32
49	4.24
50	4.46
51	4.76
52	4.12
53	4.34
54	4.05
55	4.48
56	4.05
57	3.98
58	3.97
59	4.25
60	4.33
61	3.99
62	4.66
63	4.25
64	4.52
65	4.16
66	4.17
67	4.11
68	4.00
69	4.46
70	3.68
71	4.35
72	4.39
73	4.28
74	4.48
75	4.29
76	3.98
77	4.30
78	3.95
79	4.07
80	3.96
81	4.15
82	4.04
83	3.97
84	4.52
85	4.37
86	4.01
87	3.93
88	4.29
89	4.20
90	4.18
91	4.51
92	4.18
93	4.43
94	3.91
95	3.95
96	4.19
97	3.97
98	4.05
99	4.18
100	3.97

Barrier Reef Management
Sample #9557 — #9560
Pellet #2069/1

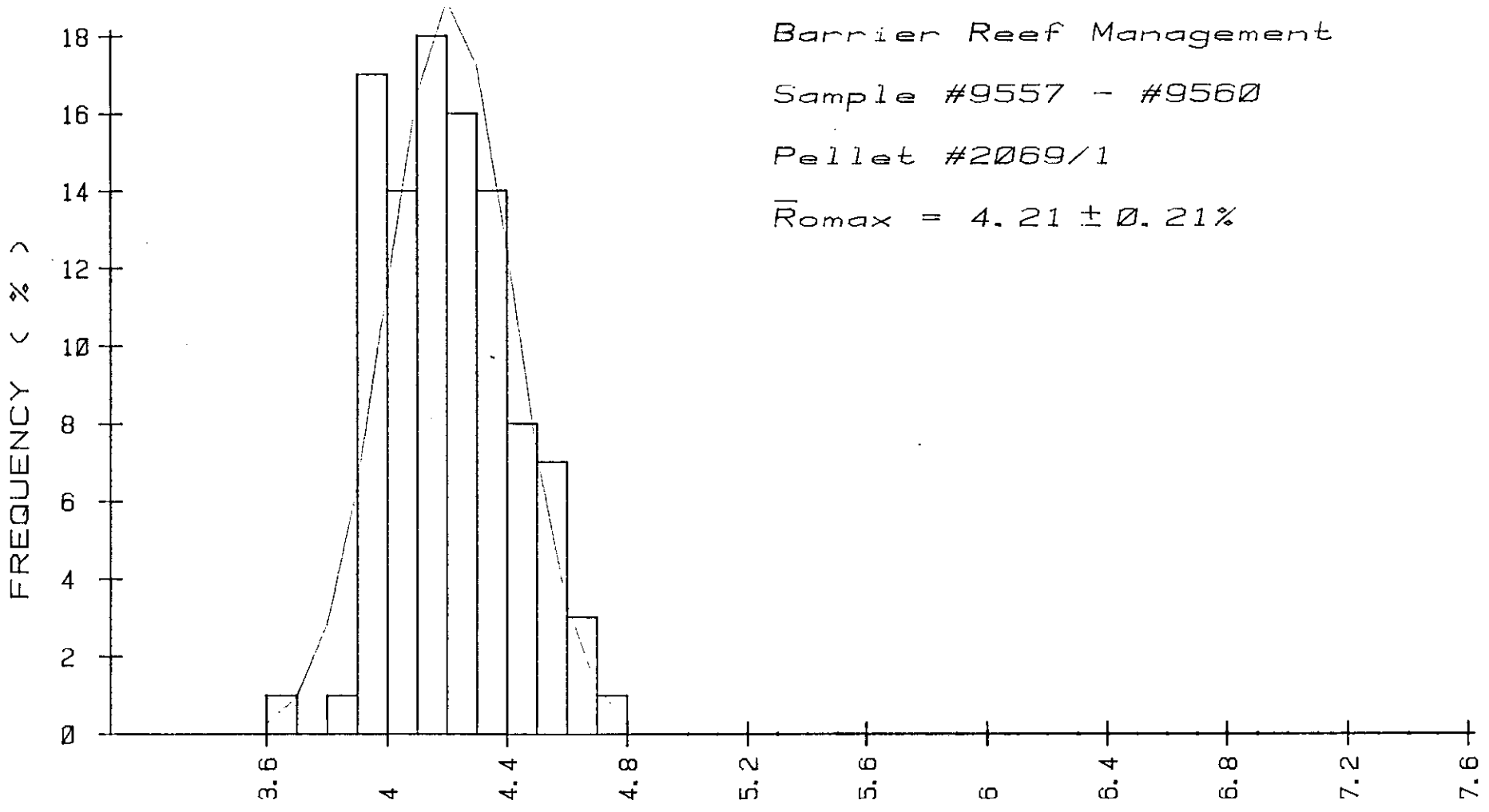
BASIC STATISTICS

NUMBER OF OBSERVATIONS	100
MEAN MAXIMUM REFLECTANCE OF VITRINITE (Romax).....%	4.21
STANDARD ERROR OF THE MEAN	0.02
COEFFICIENT OF VARIATION .....%	5.00
VARIANCE	0.0443
STANDARD DEVIATION	0.2105
SKEWNESS	0.2862
KURTOSIS	2.5989

CELL STATISTICS

CELL NUMBER	LOWER LIMIT	NUMBER OF OBSERVATIONS	FREQUENCY (%)
1	3.60	1	1.00
3	3.80	1	1.00
4	3.90	17	17.00
5	4.00	14	14.00
6	4.10	18	18.00
7	4.20	16	16.00
8	4.30	14	14.00
9	4.40	8	8.00
10	4.50	7	7.00
11	4.60	3	3.00
12	4.70	1	1.00

VITRINITE FREQUENCY DISTRIBUTION



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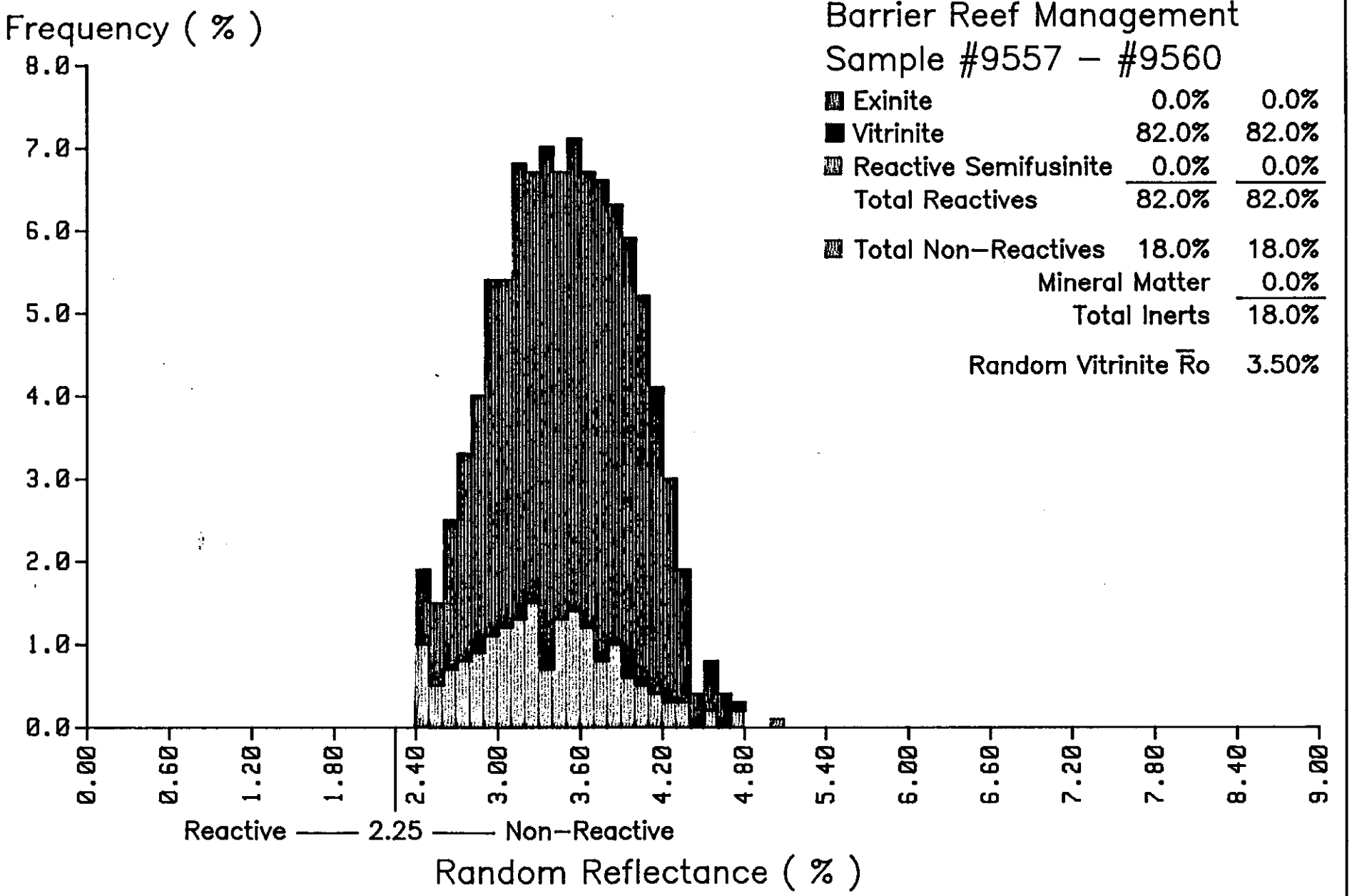
REFLECTOGRAM



Barrier Reef Management

Sample #9557 – #9560

Exinite	0.0%	0.0%
Vitrinite	82.0%	82.0%
Reactive Semifusinite	0.0%	0.0%
Total Reactives	82.0%	82.0%
Total Non–Reactives	18.0%	18.0%
Mineral Matter		0.0%
Total Inerts		18.0%
Random Vitrinite $\bar{R}o$		3.50%

David E. Pearson & Associates Ltd.

RESULTS OF MACERAL ANALYSIS

Semifusinite - Pearson Method

Barrier Reef Management
Sample #9557 — #9560

Count #	1	2	3	4	5	6	7	8	9	10
Vitrinite	88	82	80	86	76	79	81	85	84	79
Total Reactives	88	82	80	86	76	79	81	85	84	79
Macrinite	0	0	0	2	0	1	1	0	0	0
Inert Semifusinite	12	16	19	10	22	20	18	14	11	16
Fusinite	0	2	1	2	2	0	0	1	4	4
Inertodetrinite	0	0	0	0	0	0	0	0	1	1
Total Non-Reactives	12	18	20	14	24	21	19	15	16	21

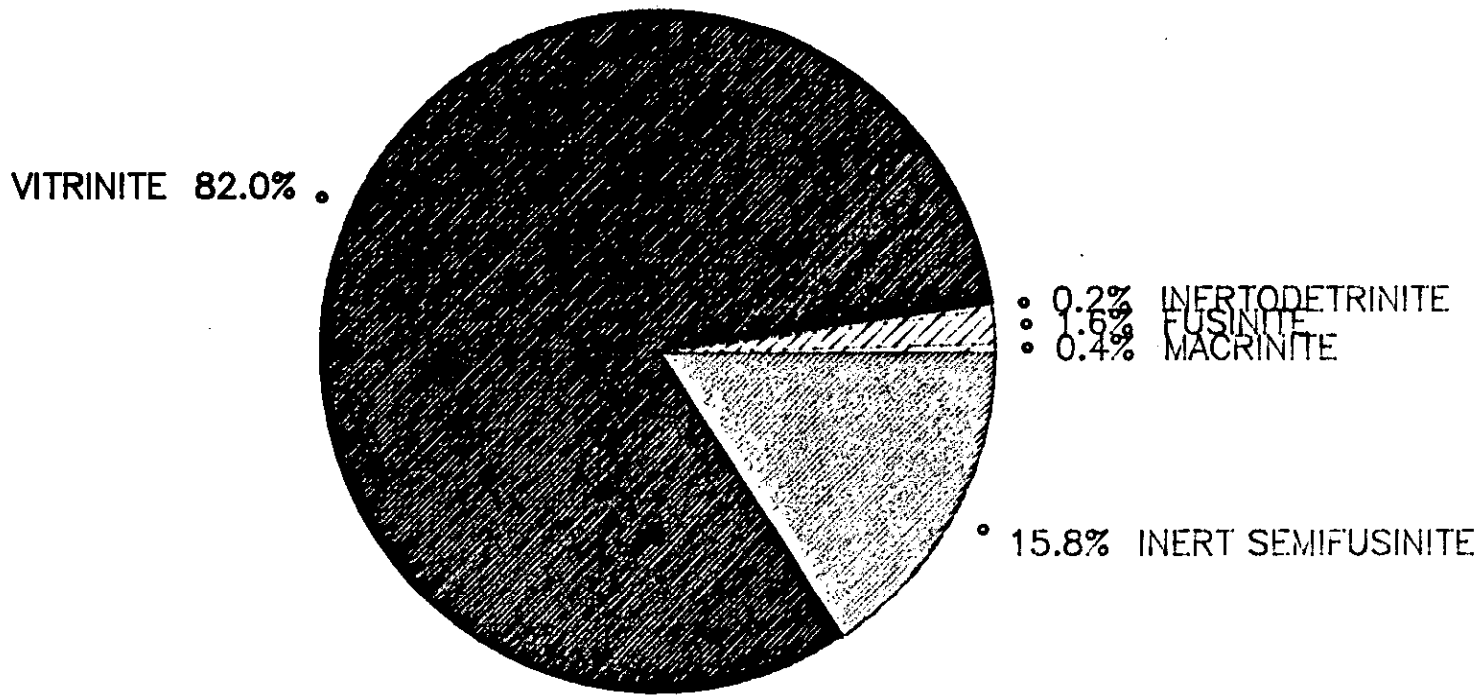
Basic Statistics	Mean	St.Deviation	Variance
Vitrinite	82.0	3.7	13.8
Total Reactives	82.0	3.7	13.8
Macrinite	.4	.7	.5
Inert Semifusinite	15.8	4.0	16.2
Fusinite	1.6	1.5	2.3
Inertodetrinite	.2	.4	.2
Total Non-Reactives	18.0	3.7	13.8

Maceral Data Corrected For Mineral Matter Content

Vitrinite	82.0
Total Reactives	82.0
Macrinite	.4
Inert Semifusinite	15.8
Fusinite	1.6
Inertodetrinite	.2
Total Non-Reactives	18.0
Total Inerts	18.0

MACERAL DISTRIBUTION

Semifusinite – Pearson Method



Barrier Reef Management
Sample #9557 – #9560

David E. Pearson & Associates Ltd.

Vitrinite Reflectance Data For Barrier Reef Management
Sample #9570
Pellet #2070/1

OBSERVATION NUMBER	ROMAX VALUE	OBSERVATION NUMBER	ROMAX VALUE
1	3.53	51	3.35
2	3.42	52	3.58
3	3.45	53	3.30
4	3.38	54	3.41
5	3.79	55	3.92
6	3.99	56	3.38
7	3.24	57	3.47
8	3.38	58	3.55
9	3.36	59	3.67
10	3.59	60	3.64
11	3.32	61	3.47
12	3.36	62	3.72
13	3.71	63	3.36
14	3.52	64	3.38
15	3.42	65	3.40
16	3.96	66	3.09
17	3.39	67	3.51
18	3.38	68	3.40
19	3.96	69	3.43
20	3.42	70	3.27
21	3.89	71	3.22
22	3.34	72	3.77
23	3.21	73	3.32
24	3.43	74	3.18
25	3.27	75	3.43
26	3.27	76	3.27
27	3.40	77	3.61
28	3.38	78	3.44
29	3.49	79	3.29
30	3.32	80	3.55
31	3.26	81	3.47
32	3.47	82	3.79
33	3.43	83	3.86
34	3.41	84	3.29
35	3.32	85	3.65
36	3.74	86	3.49
37	3.86	87	3.26
38	3.44	88	3.60
39	3.49	89	3.69
40	3.35	90	3.44
41	3.44	91	3.38
42	3.48	92	3.31
43	3.44	93	3.25
44	3.50	94	3.38
45	3.42	95	3.76
46	3.52	96	3.30
47	3.26	97	3.63
48	3.28	98	3.41
49	3.42	99	3.46
50	3.45	100	3.33

Barrier Reef Management
Sample #9570
Pellet #2070/1

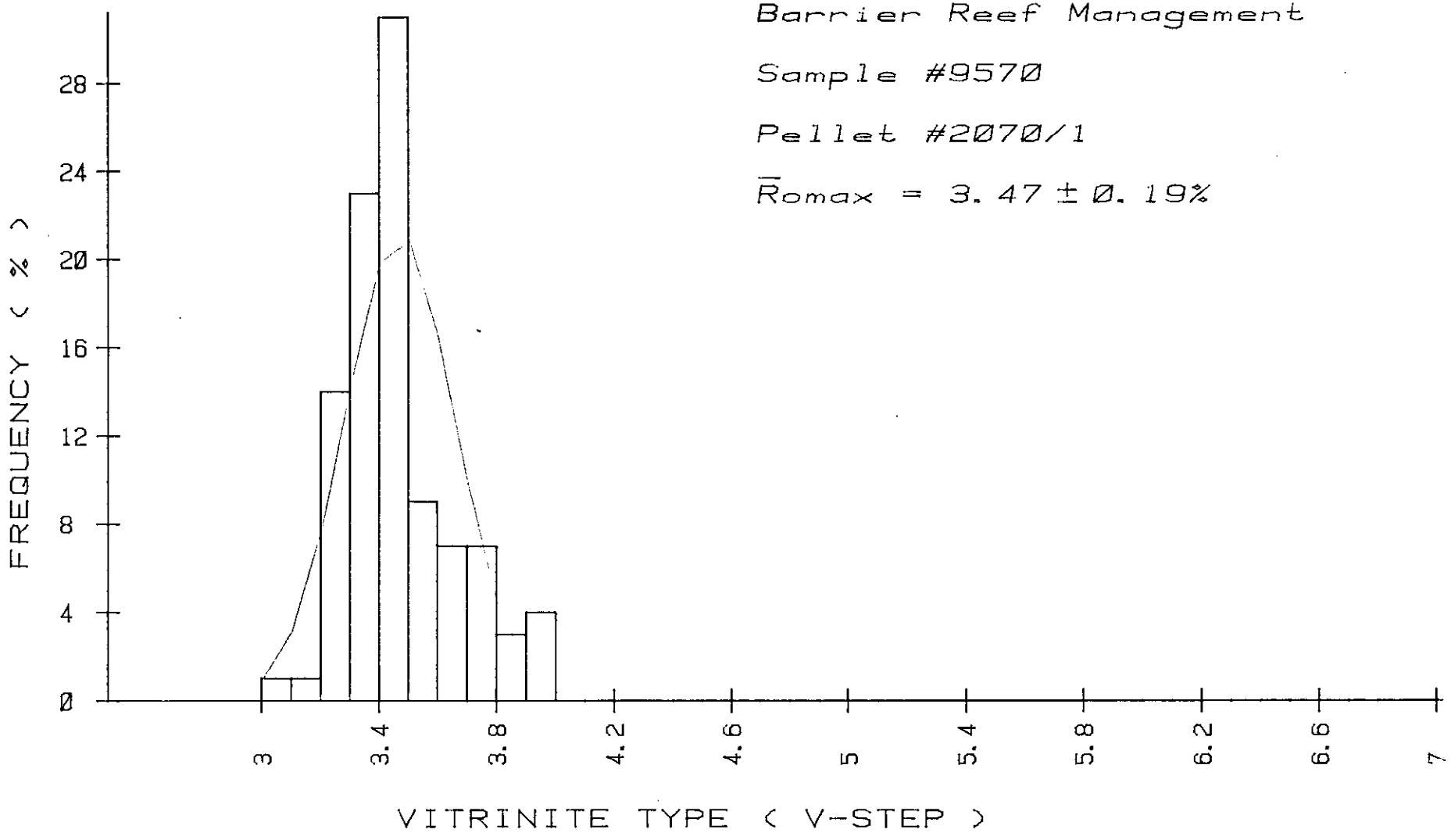
BASIC STATISTICS

NUMBER OF OBSERVATIONS	100
MEAN MAXIMUM REFLECTANCE OF VITRINITE (Romax).....%	3.47
STANDARD ERROR OF THE MEAN	0.02
COEFFICIENT OF VARIATION .....%	5.44
VARIANCE	0.0355
STANDARD DEVIATION	0.1885
SKEWNESS	0.9706
KURTOSIS	3.5153

CELL STATISTICS

CELL NUMBER	LOWER LIMIT	NUMBER OF OBSERVATIONS	FREQUENCY (%)
1	3.00	1	1.00
2	3.10	1	1.00
3	3.20	14	14.00
4	3.30	23	23.00
5	3.40	31	31.00
6	3.50	9	9.00
7	3.60	7	7.00
8	3.70	7	7.00
9	3.80	3	3.00
10	3.90	4	4.00

VITRINITE FREQUENCY DISTRIBUTION



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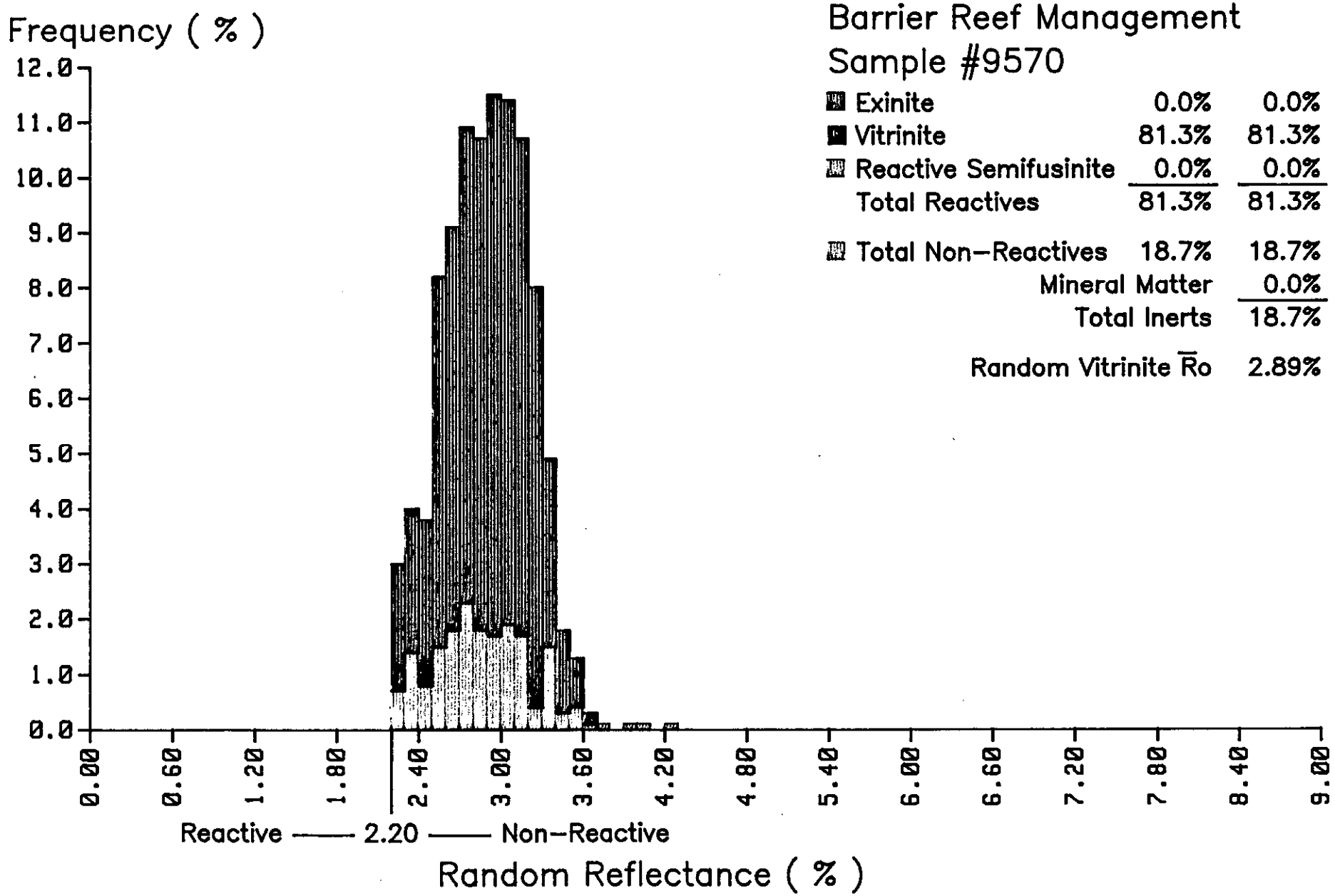
REFLECTOGRAM



Barrier Reef Management
Sample #9570

Exinite	0.0%	0.0%
Vitrinite	81.3%	81.3%
Reactive Semifusinite	0.0%	0.0%
Total Reactives	81.3%	81.3%
Total Non-Reactives	18.7%	18.7%
Mineral Matter		0.0%
Total Inerts		18.7%
Random Vitrinite $\overline{R}o$		2.89%

David E. Pearson & Associates Ltd.

RESULTS OF MACERAL ANALYSIS

Semifusinite - Pearson Method

Barrier Reef Management
Sample #9570

Count #	1	2	3	4	5	6	7	8	9	10
Vitrinite	91	89	90	80	69	82	83	77	77	75
Total Reactives	91	89	90	80	69	82	83	77	77	75
Macrinite	0	0	2	0	1	0	0	1	0	0
Inert Semifusinite	9	10	7	20	28	15	13	21	21	22
Fusinite	0	1	1	0	2	3	4	1	2	3
Total Non-Reactives	9	11	10	20	31	18	17	23	23	25

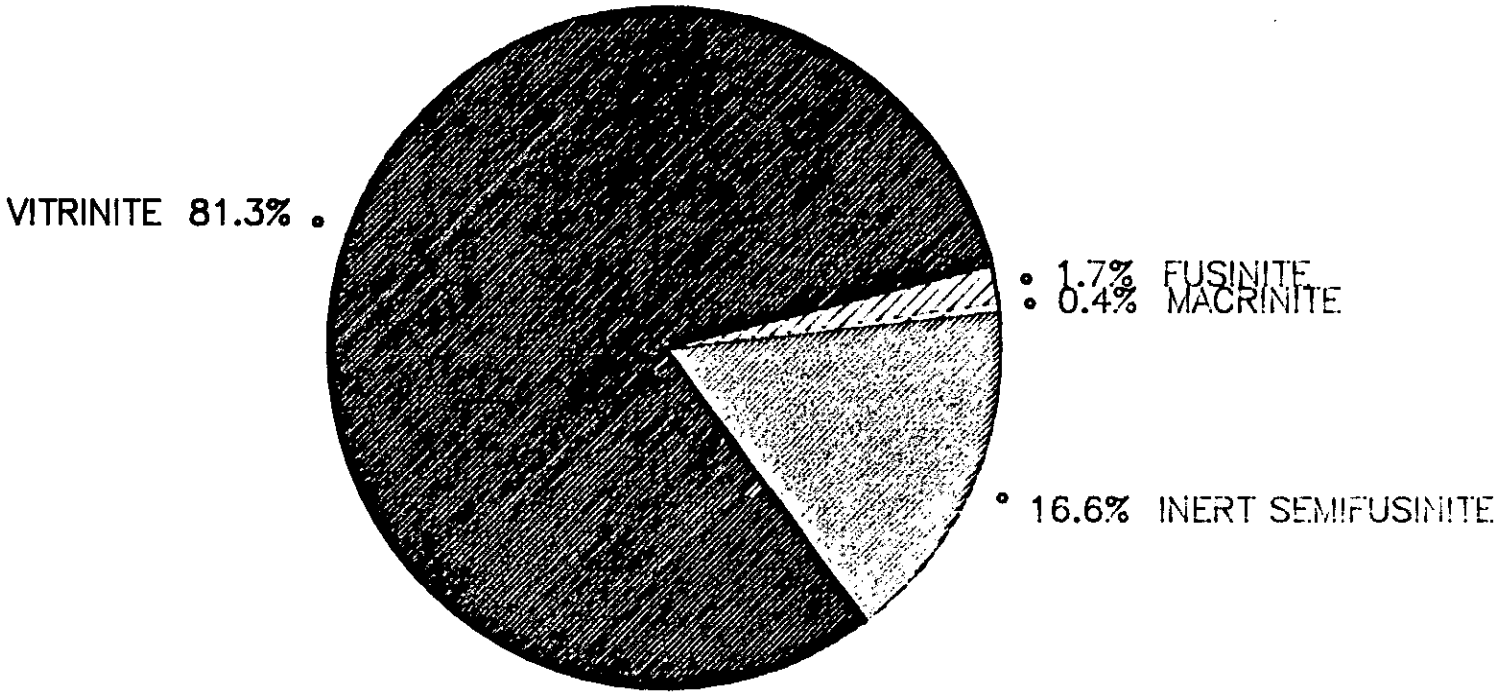
Basic Statistics	Mean	St.Deviation	Variance
Vitrinite	81.3	7.2	51.3
Total Reactives	81.3	7.2	51.3
Macrinite	.4	.7	.5
Inert Semifusinite	16.6	6.8	46.5
Fusinite	1.7	1.3	1.8
Total Non-Reactives	18.7	7.2	51.3

Maceral Data Corrected For Mineral Matter Content

Vitrinite	81.3
Total Reactives	81.3
Macrinite	.4
Inert Semifusinite	16.6
Fusinite	1.7
Total Non-Reactives	18.7
Total Inerts	18.7

MACERAL DISTRIBUTION

Semifusinite – Pearson Method



Barrier Reef Management
Sample #9570

David E. Pearson & Associates Ltd.

APPENDIX D

PRE-1984 DRILL HOLE SUMMARIES/COAL QUALITY DATA

DRILL HOLE SUMMARY DDH7002

BCA (°)	Drilled Sample (m)	Apparent Thickness (m)	True Thick-ness (m)	True Inter-seam TH. (m)	Sample ID	Dry Basis: Raw Coal Ash (%)	Volatile Matter (%)	Fixed Carbon (%)	Calorific Value (MJ/kg)	Sulphur (%)	Air-Dried Moisture (%)
18	59.31 - 61.2	1.89	1.80	12.37	29683	37.06	4.23	58.71	20.96	.43	0.49
15	74.07 - 74.65	0.58	.56		29684	35.47	6.35	58.18	22.34	2.36	0.39
	74.86 - 75.74*	0.88	.85	5.66	29685	65.23	4.05	30.72	9.25	0.24	0.73
15	80.31 - 80.95	0.64	.62	21.19	29687	26.53	5.62	67.95	25.35	1.07	0.23
5	102.47-103.85*	1.37	1.37	15.51	29688	75.31	4.77	19.92	.06	.34	0.63
	119.42-120.49*	1.07	1.07	39.10	29689	57.96	4.92	40.11	12.63	2.46	0.55
10	159.93-160.72	0.79	.78	7.17	29690	24.59	3.70	71.71	26.61	2.25	0.29
5	167.95 - 168.86	0.91	.91		29691	37.92	6.26	55.82	21.02	2.17	0.22

* Excluded from all calculation due to high ash.

DRILL HOLE SUMMARY DDH7003

BCA (°)	Drilled Sample (m)	Apparent Thickness (m)	True Thick-ness (m)	True Inter-seam TH. (m)	Sample ID	% Float 1.65 S.G. (%)	Dry Basis- Float Ash (%)	Volatile Matter (%)	Fixed Carbon (%)	Calorific Value (MJ/kg)	Sulphur (%)	Air-Dried Moisture (%)
	16.31 - 18.29	1.98	1.91		29692	17.6	13.28	5.46	81.26	30.41	1.05	0.61
				3.29								
	21.70 - 23.17	1.46	1.41		29693	41.9	13.39	4.92	81.69	31.40	.84	0.61
15												
5												
				66.65								
15												
5												
0												
0												
0	90.07 - 90.62	0.55	.55		29695	17.4	18.10	6.52	75.30	28.36	0.63	0.81
				15.15								
0	105.77-107.14	1.37	1.37		29697	34.2	14.49	5.09	80.42	29.85	1.24	0.48
				9.72								
	116.83-118.20	1.37	1.37		29699	25.7	10.95	4.37	84.68	31.31	0.79	0.41
5												
				27.39								
5	145.69-146.49*	0.79	.79		29700	68.1	10.86	5.10	84.04	32.51	1.82	0.77
				1.09								
0	147.58-148.13*	0.55	.55		29701	38.6	13.52	4.92	81.56	30.12	2.33	0.50
				2.84								
5	150.97-152.07	1.10	1.10		29702	52.1	13.65	4.99	81.36	30.08	.93	0.57

* Considered one seam.
Seam splits totalled for resource calculations.

DRILL HOLE SUMMARY DDH7004

BCA (°)	Drilled Sample (m)	Apparent Thickness (m)	True Thick-ness (m)	True Inter-seam TH. (m)	Sample ID	% Float 1.65 S.G. (%)	Float Ash (%)	Volatile Matter (%)	Fixed Carbon (%)	Calorific Value (MJ/kg)	Sulphur (%)	Air-Dried Moisture (%)
							Dry Basis					
10 9												
	29.93 - 30.54	0.61	.60		29704	60.6	10.32	5.88	83.80	31.33	0.39	0.71
				41.28								
	72.33 - 72.94	0.61	.60		29706	80.6	5.34	5.53	89.13	33.71	0.79	0.63
				6.22								
	79.16 - 80.41	1.25	1.21		29708	69.4	6.67	5.66	87.67	33.12	1.32	0.50
				52.81								
20												
	136.61-137.16	0.55	.52		29710	47.7	9.00	5.63	85.37	33.58	0.35	0.81

DRILL HOLE SUMMARY DDH8103

BCA (°)	Drilled Sample (m)	Apparent Thickness (m)	True Thick-ness (m)	True Inter-seam TH. (m)	Sample ID	Dry Basis: Raw Coal Ash (%)	Volatile Matter (%)	Fixed Carbon (%)	Calorific Value (MJ/kg)	Sulphur (%)
17	20.35 - 21.12	0.77	.74							
				18.56						
25	41.00 - 41.76	0.76	.69							
30				39.19						
17	85.58 - 86.76	1.18	1.13		H3-1	37.77			19.16	0.42
18				9.59						
18	94.85 - 95.66	0.77	.73							

CABLE ADDRESS COMTECO

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-0424

January 11, 1971

P. O. Box 8596
Vancouver, B. C.

QUINTANA MINERALS CORPORATION
2 Bentall Centre
Vancouver, B. C.

Report No. 67-0479

Sample identification:
Sample No. 29683
Composite 1.75 Float = 58.3% of
sample crushed to 3/8" x 0

PROXIMATE ANALYSIS

	DRY BASIS
% Ash	9.43
% Volatile	5.70
% Fixed Carbon	84.87
	100.00
Btu	13552
% Sulfur	0.43
FREE SWELLING INDEX	0

DDH No. 2. 194.6-200.8 feet, 6.2 feet thick. Upper Discovery Creek seam intersected in drill hole 1300 feet down dip from outcrop.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

R. A. Houser,
District Manager

RAH/rh

Sample No. 29683, Core
sample crushed to 3/8" Rd. x 0

QUINTANA MINERALS CORPORATION
Vancouver, B. C.

Lab. Nos. 67-0286 - 67-0295 FLOAT & SINK ANALYSIS November 30, 1970

SPECIFIC GRAVITY Sink	Float	% Wt.	% Ash	% Sul.	CUMULATIVE RECOVERY % Wt.	% Ash	% Sul.	CUMULATIVE REJECT % Wt.	% Ash	% Sul.
	1.40	1.3	1.51	0.48	1.3	1.51	0.48	100.0	35.51	0.33
1.40	1.50	25.6	3.41	0.46	26.9	3.32	0.46	98.7	35.96	0.33
1.50	1.60	21.1	9.15	0.45	48.0	5.88	0.46	73.1	47.35	0.28
1.60	1.65	5.5	22.21	0.39	53.5	7.56	0.45	52.0	62.86	0.21
1.65	1.70	2.3	29.84	0.35	55.8	8.48	0.45	46.5	67.66	0.19
1.70	1.75	2.5	32.61	0.35	58.3	9.51	0.44	44.2	69.63	0.18
1.75	1.80	1.9	33.91	0.37	60.2	10.28	0.44	41.7	71.85	0.17
1.80	1.90	3.2	38.26	0.41	63.4	11.70	0.44	39.8	73.66	0.17
1.90	2.00	4.1	47.18	0.41	67.5	13.85	0.44	36.6	76.76	0.14
2.00		32.5	80.49	0.11	100.0	35.51	0.33	32.5	80.49	0.11

DDH No.2, 194.6 - 200.8, 6.2 ft. Upper Discovery Creek seam.- intersected in drill hole 1300 feet down dip from outcrop.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

R. A. Houser,
District Manager

RAH/rh

Job Quintana Minerals Corp.
Lab. No. 67-0286 - 67-0295
Mine Sample No. 29683
Size Cr. to 3/8" Rd.
Raw Coal Ash 35.51%
Raw Coal Sul. 0.33%

Commercial Testing & Engineering Co.

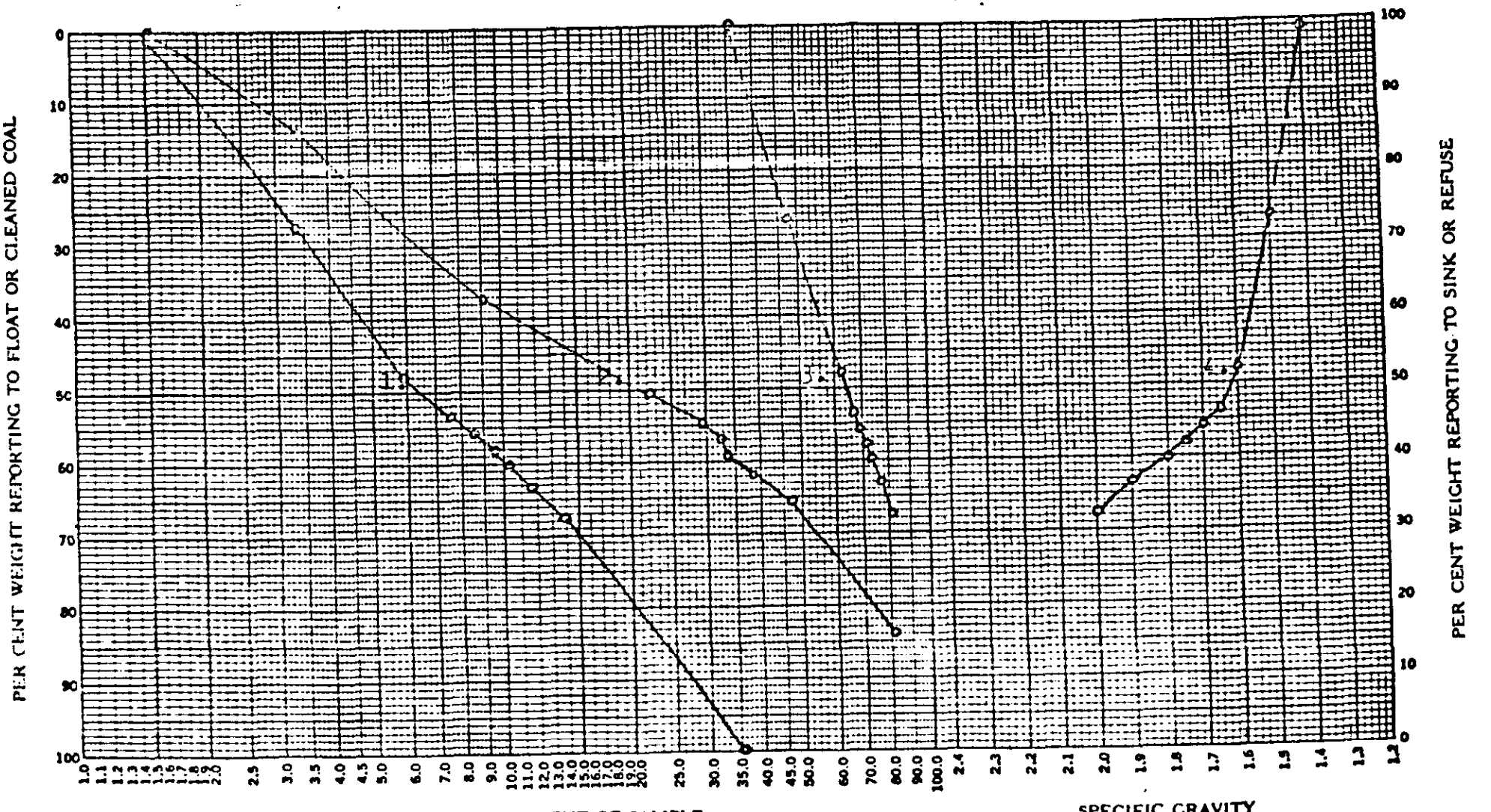
CONSULTING FUEL ENGINEERS
AND CHEMISTS
CHICAGO, ILL.

Charleston, W. Va. Terre Haute, Ind.

CURVE LEGEND

1 Cumulative Coal-Ash
2 Coal Characteristic
3 Cumulative Refuse-Ash
4 Yield-Specific Gravity
5 Separation Effected

WASHABILITY CURVES



Form WCR 3M 9-49

CABLE ADDRESS COMTESCO

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-8454

January 11, 1971

P. O. Box 8596
Vancouver 5, B. C.

QUINTANA MINERALS CORPORATION
2 Bentall Centre
Vancouver, B. C.

Report No. 67-0476

Sample identification:
Sample No. 29692
Composite 1.75 Float = 23.7% of
sample crushed to 3/8" Rd. x 0

PROXIMATE ANALYSIS

	DRY BASIS
% Ash	17.09
% Volatile	7.58
% Fixed Carbon	75.33
	100.00
Btu	11966
% Sulfur	0.97
FREE SWELLING INDEX	0

DDH No. 3. 53.5-60.0, 6.5 feet thick.
Lower Discovery Creek seam.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

R. A. Houser,
District Manager

RAH/rh

Sample No. 29692, Core
sample crushed to 3/8" Rd. x 0

QUINTANA MINERALS CORPORATION
Vancouver, B. C.

Lab. Nos.67-0414 - 67-0423

FLOAT & SINK ANALYSIS

December 31, 1970

SPECIFIC GRAVITY Sink	Float	% Wt.	% Ash	% Sul.	CUMULATIVE RECOVERY % Wt.	% Ash	% Sul.	CUMULATIVE REJECT % Wt.	% Ash	% Sul.
	1.40	0.3	4.54	0.58	0.3	4.54	0.58	100.0	54.55	1.26
1.40	1.50	7.2	4.62	0.87	7.5	4.62	0.86	99.7	54.70	1.27
1.50	1.60	7.1	12.97	1.26	14.6	8.68	1.05	92.5	58.60	1.30
1.60	1.65	4.0	24.84	0.92	18.6	12.15	1.02	85.4	62.40	1.30
1.65	1.70	2.8	33.52	0.85	21.4	14.95	1.00	81.4	64.24	1.32
1.70	1.75	2.3	37.50	0.76	23.7	17.14	0.98	78.6	65.34	1.34
1.75	1.80	3.7	39.44	0.56	27.4	20.15	0.92	76.3	66.18	1.35
1.80	1.90	6.0	41.07	0.52	33.4	23.91	0.85	72.6	67.54	1.39
1.90	2.00	8.9	48.61	0.52	42.3	29.11	0.78	66.6	69.92	1.47
2.00		57.7	73.21	1.62	100.0	54.55	1.26	57.7	73.21	1.62

DDH No.3, 53.5 - 60.0, 6.5 ft. Lower Discovery Creek seam.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

R. A. Houser,
District Manager

RAH/rh

Job Quintana Minerals Corp.
Lab. No. 67-0414 - 67-0423
Mine Sample No. 29692
Size Cr. to 3/8" Rd.
Raw Coal Ash 54.55%
Raw Coal Sul. 1.26%

Commercial Testing & Engineering Co.

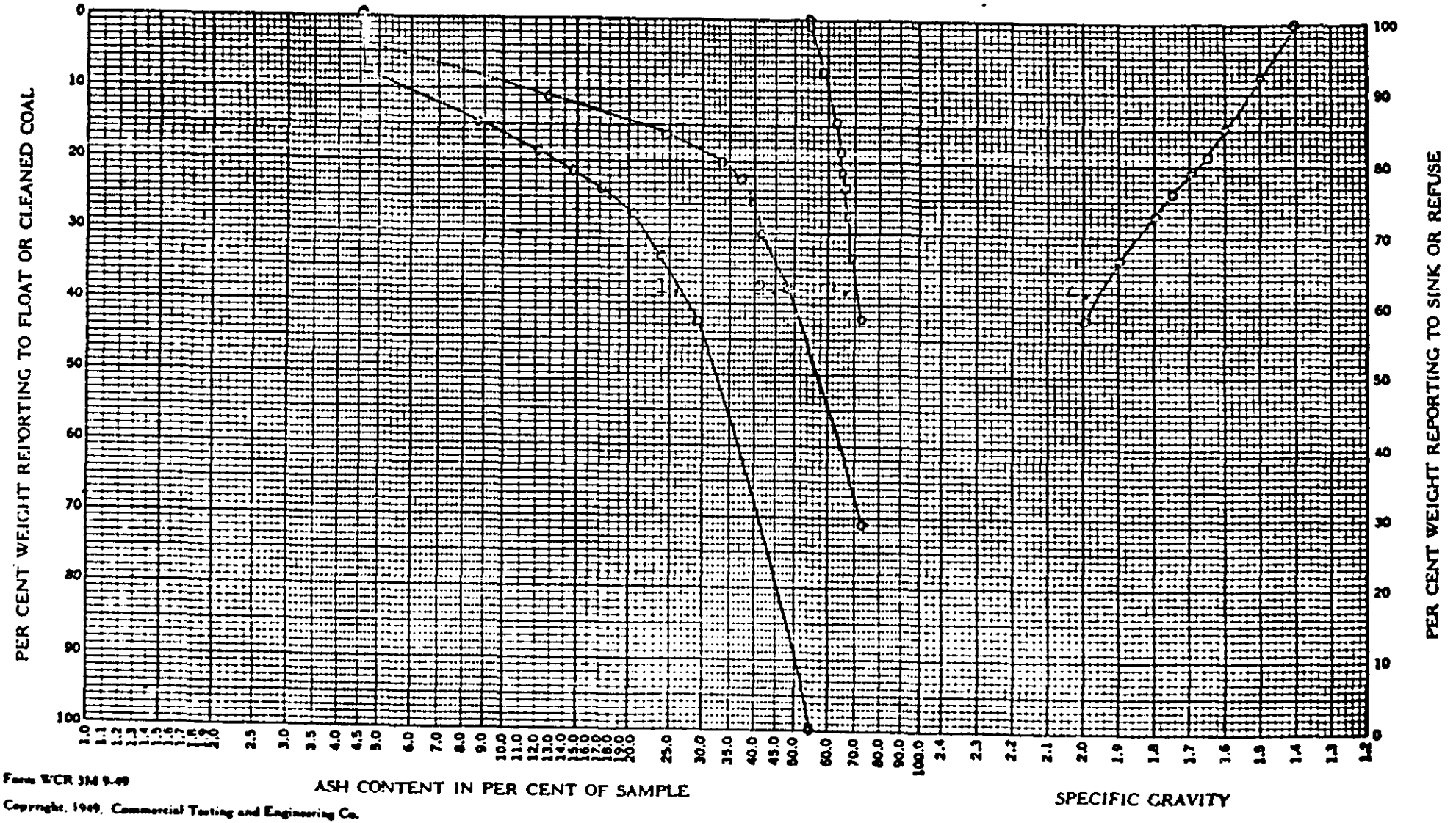
CONSULTING FUEL ENGINEERS
AND CHEMISTS
CHICAGO, ILL.

Charleston, W. Va. Terre Haute, Ind.

CURVE LEGEND

1 Cumulative Coal-Ash
2 Coal Characteristic
3 Cumulative Refuse-Ash
4 Yield-Specific Gravity
5 Separation Effected

WASHABILITY CURVES



Form W'CR 3M 9-49

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8424

January 11, 1971

P. O. Box 8596
Vancouver 5, B. C.

QUINTANA MINERALS CORPORATION
2 Bentall Centre
Vancouver, B. C.

Report No. 67-0484

Sample identification:
Sample No. 29693
Composite 1.75 Float = 38.9% of
sample crushed to 3/8" Rd. x 0

PROXIMATE ANALYSIS

	DRY BASIS
% Ash	13.08
% Volatile	6.21
% Fixed Carbon	80.71
	100.00
Btu	12645
% Sulfur	0.77
FREE SWELLING INDEX	0

DDH No. 3. 71.2-76.0 feet, 4.8 feet thick.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

R. A. Houser,
District Manager

RAH/rh

Sample No. 29693, Core
sample crushed to 3/8" Rd. x 0

Lab. Nos. 67-0404 - 67-0413

QUINTANA MINERALS CORPORATION
Vancouver, B. C.
FLOAT & SINK ANALYSIS

December 31, 1970

SPECIFIC GRAVITY					CUMULATIVE RECOVERY			CUMULATIVE REJECT		
Sink	Float	% Wt.	% Ash	% Sul.	% Wt.	% Ash	% Sul.	% Wt.	% Ash	% Sul.
	1.40	0.5	4.32	0.46	0.5	4.32	0.46	100.0	52.02	2.72
1.40	1.50	17.5	4.38	0.60	18.0	4.38	0.60	99.5	52.26	2.73
1.50	1.60	10.4	13.73	0.74	28.4	7.80	0.65	82.0	62.48	3.18
1.60	1.65	4.3	23.33	0.80	32.7	9.84	0.67	71.6	69.56	3.54
1.65	1.70	4.5	28.75	1.25	37.2	12.13	0.74	67.3	72.51	3.71
1.70	1.75	1.7	34.00	1.45	38.9	13.09	0.77	62.8	75.65	3.89
1.75	1.80	2.2	35.94	1.53	41.1	14.31	0.81	61.1	76.81	3.96
1.80	1.90	2.8	38.71	1.98	43.9	15.87	0.89	58.9	78.34	4.05
1.90	2.00	3.8	46.91	2.11	47.7	18.34	0.98	56.1	80.31	4.15
2.00		52.3	82.74	4.30	100.0	52.02	2.72	52.3	82.74	4.30

DDH No.3, 71.2 - 76.0, 4.8 ft.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

R. A. Houser,
District Manager

RAH/rh

Job Quintana Minerals Corp.
Lab. No. 67-0404 - 67-0413
Mine Sample No. 29693
Size Cr. to 3/8" Rd.
Raw Coal Ash 52.02%
Raw Coal Sul. 2.72%

Commercial Testing & Engineering Co.

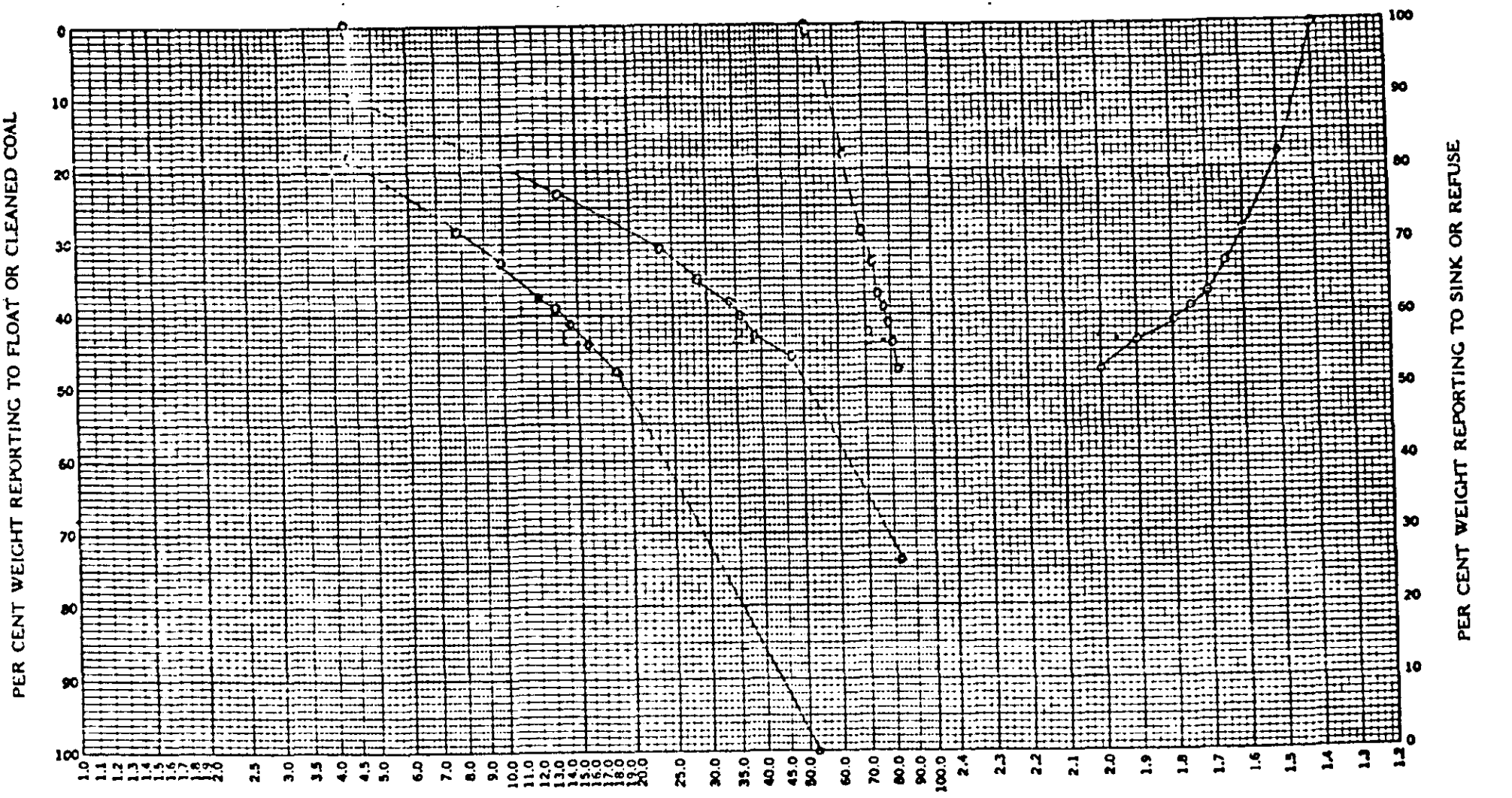
CONSULTING FUEL ENGINEERS
AND CHEMISTS
CHICAGO, ILL.

Charleston, W. Va. Terre Haute, Ind.

CURVE LEGEND

1 Cumulative Coal-Ash
2 Coal Characteristic
3 Cumulative Refuse-Ash
4 Yield-Specific Gravity
5 Separation Effected

WASHABILITY CURVES



Form WCR 3M 9-49

APPENDIX E

RESOURCE CALCULATION DATA

INDICATED RESOURCES

SEAM NAME	DATA SOURCE	AREA (sq km)	DIP	THK (m)	S.G. (T/m3)	MILLION TONNES
UPPER DISCOVERY CK.	TRC8403	0.100	22	1.86	1.70	0.3410
UPPER DISCOVERY CK.	DDH7002	0.272	18	1.80	1.70	0.8752
LOWER DISCOVERY CK.	TRC8401	0.084	7	1.79	1.70	0.2575
LOWER DISCOVERY CK.	TRC8409	0.141	20	0.54	1.70	0.1377
LOWER DISCOVERY CK.	DDH8103	0.235	18	1.13	1.70	0.4747
LOWER DISCOVERY CK.	DDH7003	0.211	15	1.91	1.70	0.7093
POND	TRC8408	0.153	25	1.70	1.70	0.4879
				SUB	TOTAL:	3.2833 mT
ADDITIONAL SEAM	TRC8404	0.100	22	0.86	1.70	0.1577
ADDITIONAL SEAM	TRC8410	0.141	23	0.62	1.70	0.1614
ADDITIONAL SEAM	TRC8402	0.141	7	0.74	1.70	0.1787
ADDITIONAL SEAM	TRC8407	0.141	21	1.10	1.70	0.2824
ADDITIONAL SEAM	DDH7002	0.283	15	0.56	1.70	0.2789
ADDITIONAL SEAM	DDH7002	0.283	15	0.62	1.70	0.3088
ADDITIONAL SEAM	DDH7002	0.283	10	0.78	1.70	0.3810
ADDITIONAL SEAM	DDH7002	0.283	5	0.91	1.70	0.4395
ADDITIONAL SEAM	DDH7003	0.283	15	1.41	1.70	0.7023
ADDITIONAL SEAM	DDH7003	0.283	0	0.55	1.70	0.2646
ADDITIONAL SEAM	DDH7003	0.283	0	1.37	1.70	0.6591
ADDITIONAL SEAM	DDH7003	0.283	5	1.37	1.70	0.6616
ADDITIONAL SEAM	DDH7003	0.283	0	1.34	1.70	0.6447
ADDITIONAL SEAM	DDH7003	0.283	5	1.10	1.70	0.5312
ADDITIONAL SEAM	DDH8103	0.283	17	0.74	1.70	0.3723
ADDITIONAL SEAM	DDH8103	0.283	18	0.69	1.70	0.3490
ADDITIONAL SEAM	DDH8103	0.283	18	0.73	1.70	0.3693
ADDITIONAL SEAM	DDH7004	0.283	9	0.60	1.70	0.2923
ADDITIONAL SEAM	DDH7004	0.283	9	0.60	1.70	0.2923
ADDITIONAL SEAM	DDH7004	0.283	20	1.21	1.70	0.6195
ADDITIONAL SEAM	DDH7004	0.283	20	0.52	1.70	0.2662
				SUB	TOTAL:	8.2128755 mT
					TOTAL:	11.496173 mT

INFERRED RESOURCES+

INDICATED RESOURCES

SEAM NAME	DATA SOURCE	AREA (sq km)	DIP	AVE. THK(m)	S.G. (T/m3)	MILLION TONNES
POND	TRC8408	0.7491	13	1.70	1.70	2.22184
ADDITIONAL SEAM	DDH8103	0.7491	13	0.74	1.70	0.96716
ADDITIONAL SEAM	DDH8103	0.7491	13	0.69	1.70	0.90181
LOWER DISCOVERY CK.	TRC8401	7.7521	13		1.70	
	TRC8409	7.7521	13		1.70	
	DDH8103	7.7521	13		1.70	
	DDH7003	7.7521	13		1.70	
		7.7521	13	1.34	1.70	18.12380
ADDITIONAL SEAM	DDH8103	7.7521	13		1.70	
	DDH7003	7.7521	13		1.70	
		7.7521	13	1.07	1.70	14.47199
ADDITIONAL SEAM	DDH7003	7.7521	13	0.55	1.70	7.43887
ADDITIONAL SEAM	DDH7003	7.7521	13	1.37	1.70	18.52955
ADDITIONAL SEAM	DDH7003	7.7521	13	1.37	1.70	18.52955
ADDITIONAL SEAM	DDH7003	7.7521	13	1.34	1.70	18.12380
ADDITIONAL SEAM	DDH7003	7.7521	13	1.10	1.70	14.87774
UPPER DISCOVERY CK.	DDH7002	12.9359	13		1.70	
	TRC8403	12.9359	13		1.70	
		12.9359	13	1.83	1.70	41.30216
ADDITIONAL SEAM	DDH7002	12.9359	13		1.70	
	TRC8404	12.9359	13		1.70	
		12.9359	13	0.71	1.70	16.02433
ADDITIONAL SEAM	DDH7002	12.9359	13	0.62	1.70	13.99308
ADDITIONAL SEAM	DDH7002	12.9359	13	0.78	1.70	17.60420
ADDITIONAL SEAM	DDH7002	12.9359	13	0.91	1.70	20.53823

TOTAL: 221.42626 mT

APPENDIX F

1984 COAL QUALITY DATA

SAMPLE AND TRENCH DATA SUMMARY

Sample Number	Trench Number	Coal (m)	Rock (m)	Coal & Rock (m)	Trench Seam Th. (m)
09551	8401	0.54		0.54	
09552	8401		0.34	0.34	1.79
09553	8401	0.91		0.91	
09574	8401	0.19	.89	1.08	
09554	8401	1.45	.34	1.79	
09556	8402	0.69	0.05	0.74	0.74
09557	8403	0.27	0.14	0.35	
09558	8403	0.88		0.88	
09559	8403		0.08	0.08	1.86
09560	8403	0.55		0.55	
09561	8403	1.64	0.22	1.86	
09562	8403	1.64	0.22	1.86	
09563	8404	0.18	0.49	.67	
09564	8404	0.52		0.52	0.86
09565	8404	0.29	0.05	0.34	
09566	8405	0.84		0.84	0.84
09567	8403	1.64	0.22	1.86	
09568	8406	0.50	.31	.81	0.81*
09569	8407	0.95	0.15	1.10	1.10
09570	8408	1.51	0.13	1.70	1.70
09571	8409	0.47	0.07	0.54	0.54
09572	8410	0.56	0.06	0.62	0.62
09573	8403	1.64	0.22	1.86	
09574	8401	.19	.89	1.08	
N/A	84012	0.31	.13	0.44	
					1.12 AVE

* Excluded due to high ash.

GROUNDHOG COAL COMPANY

SAMPLE: 09551

	As-Rec'd Basis	Air-Dry Basis	Dry Basis
PROXIMATE ANALYSIS:			
Ash %	15.73	17.85	19.12
Moisture %	17.69	6.62	-
Volatile Matter %	14.79	16.78	17.97
Fixed Carbon %	51.79	58.75	62.91
CALORIFIC VALUE:			
B.T.U./lb.	8,863	10,055	10,768
M.J./K.G.	20.62	23.39	25.05
SULPHUR %	0.28	0.32	0.34
CARBON DIOXIDE %	0.13	0.15	0.16
SPECIFIC GRAVITY	1.49	1.56	1.60

CYCLONE ENGINEERING SALES LTD.

File: S1-373

Sample: 1

Date: October 17, 1984
November 5, 1984

GROUNDHOG COAL COMPANY

SAMPLE: 09552

	As-Rec'd Basis	Air-Dry Basis	Dry Basis
PROXIMATE ANALYSIS:			
Ash %	83.32	88.32	90.32
Moisture %	7.75	2.21	-
Volatile Matter %	5.86	6.21	6.35
Fixed Carbon %	3.07	3.26	3.33
CALORIFIC VALUE:			
B.T.U./lb.	42	45	46
M.J./K.G.	0.09	0.10	0.10
SULPHUR %	0.04	0.04	0.04
CARBON DIOXIDE %	0.11	0.12	0.12
SPECIFIC GRAVITY	2.30	2.38	2.41

CYCLONE ENGINEERING SALES LTD.

File: S1-373

Sample: 2

Date: October 17, 1984

November 5, 1984

GROUNDHOG COAL COMPANY

SAMPLE: 09553

	As-Rec'd Basis	Air-Dry Basis	Dry Basis
PROXIMATE ANALYSIS:			
Ash %	12.61	13.55	14.23
Moisture %	11.41	4.79	-
Volatile Matter %	8.72	9.37	9.84
Fixed Carbon %	67.26	72.29	75.93
CALORIFIC VALUE:			
B.T.U./lb.	11,000	11,822	12,417
M.J./K.G.	25.59	27.50	28.88
SULPHUR %	0.41	0.44	0.46
CARBON DIOXIDE %	0.20	0.21	0.22
SPECIFIC GRAVITY	1.46	1.49	1.51

CYCLONE ENGINEERING SALES LTD.

File: S1-373

Sample: 3

Date: October 17, 1984

November 6, 1984

GROUNDHOG COAL COMPANY

SAMPLE: 09551 - 09553

	As-Rec'd Basis	Air-Dry Basis	Dry Basis
PROXIMATE ANALYSIS:			
Ash %	34.30	37.22	38.82
Moisture %	11.65	4.13	-
Volatile Matter %	9.85	10.69	11.15
Fixed Carbon %	44.20	47.96	50.03
CALORIFIC VALUE:			
B.T.U./lb.	7,349	7,975	8,319
M.J./K.G.	17.09	18.55	19.35
SULPHUR %	0.25	0.27	0.28
CARBON DIOXIDE %	0.17	0.18	0.19
SPECIFIC GRAVITY	1.67	1.73	1.76
HARDGROVE GRINDABILITY INDEX	-	42	-
CHLORINE %	0.02	0.02	0.02

CYCLONE ENGINEERING SALES LTD.

File: S1-373

Sample: 18

Date: November 6, 1984

GROUNDHOG COAL COMPANY

SAMPLE: 09551 - 09553

SIEVE ANALYSIS

SIZE	WEIGHT %	ASH %
3/4" x 28 m.	86.60	-
28 m. x 100 m.	9.16	-
100 mesh x 0	4.24	36.85
	100.00	

CYCLONE ENGINEERING SALES LTD.

FILE: S1-373

SAMPLE: 18

DATE: November 6, 1984

GROUNDHOG COAL COMPANY

SAMPLE: 09551 - 09553

WASHABILITY OF 3/4" x 28 m Size Fraction

SPECIFIC GRAVITY	FRACTIONAL		CUMULATIVE FLOAT		CUMULATIVE SINK	
	Wt.%	Ash %	Wt.%	Ash %	Wt.%	Ash %
- 1.40	-	-	-	-	-	-
+ 1.40 - 1.45	15.76	3.31	15.76	3.31	100.00	37.48
+ 1.45 - 1.50	25.02	5.63	40.78	4.73	84.24	43.87
+ 1.50 - 1.55	9.57	10.18	50.35	5.77	59.22	60.02
+ 1.55 - 1.60	3.03	17.70	53.38	6.45	49.65	69.63
+ 1.60 - 1.70	8.17	20.34	61.55	8.29	46.62	73.00
+ 1.70 - 1.80	3.20	24.36	64.75	9.08	38.45	84.20
+ 1.80 - 2.00	0.91	35.31	65.66	9.45	35.25	89.63
+ 2.00	34.34	91.07	100.00	37.48	34.34	91.07

CYCLONE ENGINEERING SALES LTD.

FILE: S1-373

SAMPLE: 18

DATE: November 6, 1984

GROUNDHOG COAL COMPANY

SAMPLE: 09551 - 09553

WASHABILITY OF 28 m x 100 m Size Fraction

SPECIFIC GRAVITY	FRACTIONAL		CUMULATIVE FLOAT		CUMULATIVE SINK	
	Wt.%	Ash %	Wt.%	Ash %	Wt.%	Ash %
- 1.40	0.66	1.71	0.66	1.71	100.00	32.64
+ 1.40 - 1.45	4.87	2.73	5.53	2.61	99.34	32.84
+ 1.45 - 1.50	9.48	4.13	15.01	3.57	94.47	34.40
+ 1.50 - 1.55	9.09	5.70	24.10	4.37	84.99	37.77
+ 1.55 - 1.60	6.96	6.99	31.06	4.96	75.90	41.61
+ 1.60 - 1.70	28.34	10.93	59.40	7.81	68.94	45.11
+ 1.70 - 1.80	7.76	18.47	67.16	9.04	40.60	68.97
+ 1.80 - 2.00	4.43	31.12	71.59	10.41	32.84	80.90
+ 2.00	28.41	88.66	100.00	32.64	28.41	88.66

CYCLONE ENGINEERING SALES LTD.

FILE: S1-373

SAMPLE: 18

DATE: November 6, 1984

GROUNDHOG COAL LTD.

SAMPLE: 09551 - 09553

COMPOSITION OF CLEAN COAL PRODUCT

SIZE	CUT POINT	YIELD % OF FRACTION	YIELD % OF RAW
+ 28 mesh	2.0	65.66	56.86
28 x 100 mesh	2.0	71.59	6.56
100 mesh x 0	-	-	-
Total			63.42

CYCLONE ENGINEERING SALES LTD.

File: S1-373

Sample: 18

Date: November 23, 1984

GROUNDHOG COAL LTD.

SAMPLE: 09551 - 09553

ANALYSIS OF CLEAN COAL PRODUCT

	AIR-DRY BASIS	DRY BASIS
PROXIMATE ANALYSIS:		
Ash %	9.16	9.35
Moisture %	2.03	-
Volatile Matter %	10.16	10.37
Fixed Carbon %	78.65	80.28
ULTIMATE ANALYSIS:		
Carbon %	79.97	81.63
Hydrogen %	2.73	2.55
Nitrogen %	1.05	1.07
Sulphur %	0.42	0.43
Oxygen %	6.67	4.97
CALOFIFIC VALUE:		
B.T.U./lb.	12,816	13,082
MJ/kg	29.81	30.43
SPECIFIC GRAVITY	1.43	1.44
HARDGROVE GRINDABILITY INDEX	31	-

CYCLONE ENGINEERING SALES LTD.

File: S1-373

Sample: 18

Date: November 23, 1984

GROUNDHOG COAL LTD.

SAMPLE: 09551 - 09553

ANALYSIS OF CLEAN COAL PRODUCT (Cont'd)

ASH FUSIBILITY:	REDUCING ATMOSPHERE, °C	OXIDIZING ATMOSPHERE, °C
Initial Deformation Temp.	1185	1240
Softening Temp.	1230	1265
Hemispherical Temp.	1240	1275
Fluid Temp.	1270	1300

MINERAL ANALYSIS OF ASH:	WEIGHT %
SiO_2	38.83
Al_2O_3	27.34
Fe_2O_3	9.28
CaO	7.63
MgO	2.09
Na_2O	1.06
K_2O	1.27
P_2O_5	6.39
TiO_2	0.76
SO_3	2.99

CYCLONE ENGINEERING SALES LTD.

File: S1-373

Sample: 18

Date: November 23, 1984

GROUNDHOG COAL COMPANY

SAMPLE: 09556

	As-Rec'd Basis	Air-Dry Basis	Dry Basis
PROXIMATE ANALYSIS:			
Ash %	40.55	45.49	47.87
Moisture %	15.29	4.98	-
Volatile Matter %	9.87	11.07	11.65
Fixed Carbon %	34.29	38.46	40.48
CALORIFIC VALUE:			
B.T.U./lb.	5,598	6,279	6,608
M.J./K.G.	13.02	14.60	15.37
SULPHUR %	0.23	0.26	0.27
CARBON DIOXIDE %	0.08	0.09	0.09
SPECIFIC GRAVITY	1.74	1.83	1.87

CYCLONE ENGINEERING SALES LTD.

File: S1-373

Sample: 4

Date: October 17, 1984
November 5, 1984

GROUNDHOG COAL COMPANY

SAMPLE: 09557

	As-Rec'd Basis	Air-Dry Basis	Dry Basis
PROXIMATE ANALYSIS:			
Ash %	49.91	54.71	56.41
Moisture %	11.53	3.02	-
Volatile Matter %	6.08	6.67	6.88
Fixed Carbon %	32.48	35.60	36.71
CALORIFIC VALUE:			
B.T.U./lb.	4,867	5,335	5,501
M.J./K.G.	11.32	12.41	12.80
SULPHUR %	0.24	0.26	0.27
CARBON DIOXIDE %	0.16	0.17	0.18
SPECIFIC GRAVITY	1.83	1.91	1.94

CYCLONE ENGINEERING SALES LTD.

File: S1-373

Sample: 5

Date: October 17, 1984
November 5, 1984

GROUNDHOG COAL COMPANY

SAMPLE: 09558

	As-Rec'd Basis	Air-Dry Basis	Dry Basis
PROXIMATE ANALYSIS:			
Ash %	14.97	16.30	17.29
Moisture %	13.39	5.71	-
Volatile Matter %	10.66	11.60	12.30
Fixed Carbon %	60.98	66.39	70.41
CALORIFIC VALUE:			
B.T.U./lb.	9,843	10,716	11,365
M.J./K.G.	22.90	24.92	26.44
SULPHUR %	0.32	0.35	0.37
CARBON DIOXIDE %	0.16	0.17	0.18
SPECIFIC GRAVITY	1.52 *	1.57 *	1.60 *

CYCLONE ENGINEERING SALES LTD.

File: S1-373

Sample: 6

Date: October 17, 1984

*Revised: November 5, 1984

GROUNDHOG COAL COMPANY

SAMPLE: 09559

	As-Rec'd Basis	Air-Dry Basis	Dry Basis
PROXIMATE ANALYSIS:			
Ash %	81.16	82.40	84.63
Moisture %	4.10	2.64	-
Volatile Matter %	7.17	7.28	7.48
Fixed Carbon %	7.57	7.68	7.89
CALORIFIC VALUE:			
B.T.U./lb.	1,385	1,406	1,444
M.J./K.G.	3.22	3.27	3.36
SULPHUR %	0.03	0.03	0.03
CARBON DIOXIDE %	0.15	0.15	0.15
SPECIFIC GRAVITY	2.32*	2.34*	2.38*

CYCLONE ENGINEERING SALES LTD.

File: S1-373

Sample: 7

Date: October 17, 1984

*Revised: November 5, 1984

GROUNDHOG COAL COMPANY

SAMPLE: 09560

	As-Rec'd Basis	Air-Dry Basis	Dry Basis
PROXIMATE ANALYSIS:			
Ash %	21.99	26.09	27.88
Moisture %	21.14	6.43	-
Volatile Matter %	13.21	15.67	16.75
Fixed Carbon %	43.66	51.81	55.37
CALORIFIC VALUE:			
B.T.U./lb.	7,366	8,740	9,341
M.J./K.G.	17.13	20.33	21.73
SULPHUR %	0.25	0.30	0.32
CARBON DIOXIDE %	0.18	0.21	0.22
SPECIFIC GRAVITY	1.56*	1.67*	1.72*

CYCLONE ENGINEERING SALES LTD.

File: S1-373

Sample: 8

Date: Oct. 17, 1984

* Revised: Nov. 5, 1984

GROUNDHOG COAL COMPANY

SAMPLE: 09557 - 09560

	As-Rec'd Basis	Air-Dry Basis	Dry Basis
PROXIMATE ANALYSIS:			
Ash %	26.98	29.69	31.05
Moisture %	13.09	4.37	-
Volatile Matter %	9.74	10.72	11.21
Fixed Carbon %	50.19	55.22	57.74
CALORIFIC VALUE:			
B.T.U./lb.	8,131	8,947	9,356
M.J./K.G.	18.91	20.81	21.76
SULPHUR %	0.35	0.38	0.40
CARBON DIOXIDE %	0.14	0.15	0.16
SPECIFIC GRAVITY	1.67	1.74	1.77
HARDGROVE GRINDABILITY INDEX	-	38	-
CHLORINE %	0.05	0.05	0.05

CYCLONE ENGINEERING SALES LTD.

File: S1-373

Sample: 19

Date: November 6, 1984

GROUNDHOG COAL COMPANY

SAMPLE: 09557 - 09560

SIEVE ANALYSIS

SIZE	WEIGHT %	ASH %
3/4" x 28 m.	86.72	-
28 m. x 100 m.	8.95	-
100 mesh x 0	4.33	41.28
	100.00	

CYCLONE ENGINEERING SALES LTD.

FILE: S1-373

SAMPLE: 19

DATE: November 6, 1984

GROUNDHOG COAL COMPANY

SAMPLE: 09557 - 09560

WASHABILITY OF 3/4" x 28 m Size Fraction

SPECIFIC GRAVITY	FRACTIONAL		CUMULATIVE FLOAT		CUMULATIVE SINK	
	Wt.%	Ash %	Wt.%	Ash %	Wt.%	Ash %
- 1.40	-	-	-	-	-	-
+ 1.40 - 1.45	2.22	2.20	2.22	2.20	100.00	29.80
+ 1.45 - 1.50	30.92	4.59	33.14	4.43	97.78	30.42
+ 1.50 - 1.55	13.03	6.58	46.17	5.04	66.86	42.37
+ 1.55 - 1.60	5.28	10.99	51.45	5.65	53.83	51.03
+ 1.60 - 1.70	12.02	16.90	63.47	7.78	48.55	55.39
+ 1.70 - 1.80	5.43	29.32	68.90	9.48	36.53	68.05
+ 1.80 - 2.00	4.93	42.12	73.83	11.66	31.10	74.81
+ 2.00	26.17	80.97	100.00	29.80	26.17	80.97

CYCLONE ENGINEERING SALES LTD.

FILE: S1-373

SAMPLE: 19

DATE: November 6, 1984

GROUNDHOG COAL COMPANY

SAMPLE: 09557 - 09560

WASHABILITY OF 28 m x 100 m Size Fraction

SPECIFIC GRAVITY	FRACTIONAL		CUMULATIVE FLOAT		CUMULATIVE SINK	
	Wt.%	Ash %	Wt.%	Ash %	Wt.%	Ash %
- 1.40	-	-	-	-	-	-
+ 1.40 - 1.45	0.79	2.11	0.79	2.11	100.00	31.85
+ 1.45 - 1.50	4.34	3.62	5.13	3.39	99.21	32.08
+ 1.50 - 1.55	10.43	5.26	15.56	4.64	94.87	33.39
+ 1.55 - 1.60	7.32	7.20	22.88	5.46	84.44	36.86
+ 1.60 - 1.70	22.37	11.46	45.25	8.43	77.12	39.67
+ 1.70 - 1.80	13.18	16.99	58.43	10.36	54.75	51.20
+ 1.80 - 2.00	10.57	33.19	69.00	13.86	41.57	62.05
+ 2.00	31.00	71.89	100.00	31.85	31.00	71.89

CYCLONE ENGINEERING SALES LTD.

FILE: S1-373

SAMPLE: 19

DATE: November 6, 1984

GROUNDHOG COAL LTD.

SAMPLE: 09557 - 09560

COMPOSITION OF CLEAN COAL PRODUCT

SIZE	CUT POINT	YIELD % OF FRACTION	YIELD % OF RAW
+ 28 mesh	1.8	68.90	59.75
28 x 100 mesh	1.8	58.43	5.23
100 mesh x 0	-	-	-
Total			64.98

CYCLONE ENGINEERING SALES LTD.

File: S1-373

Sample: 19

Date: November 23, 1984

GROUNDHOG COAL LTD.

SAMPLE: 09557 - 09560

FROTH FLOTATION OF 100 MESH X 0 SIZE FRACTION

	YIELD	ASH %
FROTH	17.56	21.77
TAILINGS	82.44	-
	100.00	

CYCLONE ENGINEERING SALES LTD.

File: S1-373

Sample: 19

Date: November 23, 1984

GROUNDHOG COAL LTD.

SAMPLE: 09557 - 09560

ANALYSIS OF CLEAN COAL PRODUCT

	AIR-DRY BASIS	DRY BASIS
PROXIMATE ANALYSIS:		
Ash %	9.25	9.44
Moisture %	2.06	-
Volatile Matter %	9.95	10.16
Fixed Carbon %	78.74	80.40
ULTIMATE ANALYSIS:		
Carbon %	80.07	81.75
Hydrogen %	2.60	2.42
Nitrogen %	0.96	0.98
Sulphur %	0.40	0.41
Oxygen %	6.72	5.00
CALOFIFIC VALUE:		
B.T.U./lb.	12,963	13.235
MJ/kg	30.15	30.78
SPECIFIC GRAVITY	1.43	1.44
HARDGROVE GRINDABILITY INDEX	36	-

CYCLONE ENGINEERING SALES LTD.

File: S1-373

Sample: 19

Date: November 23, 1984

GROUNDHOG COAL LTD.

SAMPLE: 09557 - 09560

ANALYSIS OF CLEAN COAL PRODUCT (Cont'd)

ASH FUSIBILITY:	REDUCING ATMOSPHERE, °C	OXIDIZING ATMOSPHERE, °C
Initial Deformation Temp.	1160	1260
Softening Temp.	1195	1270
Hemispherical Temp.	1220	1280
Fluid Temp.	1265	1310

MINERAL ANALYSIS OF ASH:	WEIGHT %
SiO_2	43.11
Al_2O_3	22.62
Fe_2O_3	11.71
CaO	8.09
MgO	2.20
Na_2O	0.87
K_2O	1.03
P_2O_5	4.51
TiO_2	0.76
SO_3	3.61

CYCLONE ENGINEERING SALES LTD.

File: S1-373

Sample: 19

Date: November 23, 1984

GROUNDHOG COAL COMPANY

SAMPLE: 09563

	As-Rec'd Basis	Air-Dry Basis	Dry Basis
PROXIMATE ANALYSIS:			
Ash %	56.87	60.65	63.24
Moisture %	10.07	4.09	-
Volatile Matter %	8.70	9.28	9.68
Fixed Carbon %	24.36	25.98	27.08
CALORIFIC VALUE:			
B.T.U./lb.	3,539	3,774	3,935
M.J./K.G.	8.23	8.78	9.15
SULPHUR %	0.13	0.14	0.15
CARBON DIOXIDE %	0.04	0.04	0.04
SPECIFIC GRAVITY	1.98	2.05	2.09

CYCLONE ENGINEERING SALES LTD.

File: S1-373

Sample: 9

Date: October 17, 1984
November 5, 1984

GROUNDHOG COAL COMPANY

SAMPLE: 09564

	As-Rec'd Basis	Air-Dry Basis	Dry Basis
PROXIMATE ANALYSIS:			
Ash %	22.96	26.69	28.55
Moisture %	19.58	6.53	-
Volatile Matter %	12.32	14.32	15.32
Fixed Carbon %	45.14	52.46	56.13
CALORIFIC VALUE:			
B.T.U./lb.	7,458	8,668	9,274
M.J./K.G.	17.35	20.16	21.57
SULPHUR %	0.27	0.31	0.33
CARBON DIOXIDE %	0.11	0.13	0.14
SPECIFIC GRAVITY	1.61	1.71	1.76

CYCLONE ENGINEERING SALES LTD.

File: S1-373

Sample: 10

Date: October 17, 1984
November 5, 1984

GROUNDHOG COAL COMPANY

SAMPLE: 09565

	As-Rec'd Basis	Air-Dry Basis	Dry Basis
PROXIMATE ANALYSIS:			
Ash %	18.56	25.15	27.75
Moisture %	33.10	9.37	-
Volatile Matter %	17.84	24.17	26.67
Fixed Carbon %	30.50	41.31	45.58
CALORIFIC VALUE:			
B.T.U./lb.	5,341	7,236	7,984
M.J./K.G.	12.42	16.83	18.57
SULPHUR %	0.18	0.25	0.28
CARBON DIOXIDE %	0.11	0.15	0.17
SPECIFIC GRAVITY	1.52*	1.71*	1.78*

CYCLONE ENGINEERING SALES LTD.

File: S1-373

Sample: 11

Date: October 17, 1984

* Revised: November 5, 1984

GROUNDHOG COAL COMPANY

SAMPLE: 09568

	As-Rec'd Basis	Air-Dry Basis	Dry Basis
PROXIMATE ANALYSIS:			
Ash %	51.77	59.54	62.71
Moisture %	17.44	5.05	-
Volatile Matter %	10.31	11.86	12.49
Fixed Carbon %	20.48	23.55	24.80
CALORIFIC VALUE:			
B.T.U./lb.	3,490	4,014	4,227
M.J./K.G.	8.12	9.34	9.83
SULPHUR %	0.18	0.21	0.22
CARBON DIOXIDE %	0.18	0.21	0.22
SPECIFIC GRAVITY	1.91	2.05	2.11

CYCLONE ENGINEERING SALES LTD.

File: S1-373

Sample: 12

Date: October 17, 1984
November 5, 1984

GROUNDHOG COAL COMPANY

SAMPLE: 09569

	As-Rec'd Basis	Air-Dry Basis	Dry Basis
PROXIMATE ANALYSIS:			
Ash %	39.09	42.56	44.02
Moisture %	11.19	3.31	-
Volatile Matter %	6.98	7.60	7.86
Fixed Carbon %	42.74	46.53	48.12
CALORIFIC VALUE:			
B.T.U./lb.	6,693	7,287	7,536
M.J./K.G.	15.57	16.95	17.53
SULPHUR %	0.48	0.52	0.54
CARBON DIOXIDE %	1.47	1.60	1.65
SPECIFIC GRAVITY	1.77	1.84	1.87

CYCLONE ENGINEERING SALES LTD.

File: S1-373

Sample: 13

Date: October 17, 1984
November 5, 1984

GROUNDHOG COAL COMPANY

SAMPLE: 09570

	As-Rec'd Basis	Air-Dry Basis	Dry Basis
PROXIMATE ANALYSIS:			
Ash %	16.00	17.47	18.57
Moisture %	13.87	5.93	-
Volatile Matter %	8.68	9.48	10.08
Fixed Carbon %	61.45	67.12	71.35
CALORIFIC VALUE:			
B.T.U./lb.	10,231	11,174	11,878
M.J./K.G.	23.80	25.99	27.63
SULPHUR %	0.43	0.47	0.50
CARBON DIOXIDE %	0.22	0.24	0.26
SPECIFIC GRAVITY	1.49	1.54	1.57
HARDGROVE GRINDABILITY INDEX	-	38	-
CHLORINE %	0.03	0.03	0.03

CYCLONE ENGINEERING SALES LTD.

File: S1-373

Sample: 17

Date: November 5, 1984

GROUNDHOG COAL COMPANY

SAMPLE: 09570

SIEVE ANALYSIS

SIZE	WEIGHT %	ASH %
3/4" x 28 m.	80.17	-
28 m. x 100 m.	13.27	-
100 mesh x 0	6.56	27.98
	100.00	-

CYCLONE ENGINEERING SALES LTD.

FILE: S1-373

SAMPLE: 17

DATE: November 5, 1984

GROUNDHOG COAL COMPANY

SAMPLE: 09570

WASHABILITY OF 3/4" x 28 m Size Fraction

SPECIFIC GRAVITY	FRACTIONAL		CUMULATIVE FLOAT		CUMULATIVE SINK	
	Wt.%	Ash %	Wt.%	Ash %	Wt.%	Ash %
- 1.40	1.06	2.51	1.06	2.51	100.00	17.38
+ 1.40 - 1.45	28.86	4.47	29.92	4.40	98.94	17.54
+ 1.45 - 1.50	24.52	7.61	54.44	5.85	70.08	22.92
+ 1.50 - 1.55	15.36	12.03	69.80	7.21	45.56	31.16
+ 1.55 - 1.60	2.70	16.08	72.50	7.54	30.20	40.90
+ 1.60 - 1.70	6.59	19.08	79.09	8.50	27.50	43.33
+ 1.70 - 1.80	3.48	29.66	82.57	9.39	20.91	50.98
+ 1.80 - 2.00	6.81	39.11	89.38	11.66	17.43	55.23
+ 2.00	10.62	65.57	100.00	17.38	10.62	65.57

CYCLONE ENGINEERING SALES LTD.

FILE: S1-373

SAMPLE: 17

DATE: November 5, 1984

GROUNDHOG COAL COMPANY

SAMPLE: 09570

WASHABILITY OF 28 m x 100 m Size Fraction

SPECIFIC GRAVITY	FRACTIONAL		CUMULATIVE FLOAT		CUMULATIVE SINK	
	Wt.%	Ash %	Wt.%	Ash %	Wt.%	Ash %
- 1.40	-	-	-	-	-	-
+ 1.40 - 1.45	15.40	2.93	15.40	2.93	100.00	22.57
+ 1.45 - 1.50	20.70	6.80	36.10	5.15	84.60	26.15
+ 1.50 - 1.55	14.54	10.16	50.64	6.59	63.90	32.41
+ 1.55 - 1.60	5.45	13.72	56.09	7.28	49.36	38.97
+ 1.60 - 1.70	15.31	18.17	71.40	9.62	43.91	42.10
+ 1.70 - 1.80	6.77	26.74	78.17	11.10	28.60	54.91
+ 1.80 - 2.00	7.75	38.84	85.92	13.60	21.83	63.65
+ 2.00	14.08	77.31	100.00	22.57	14.08	77.31

CYCLONE ENGINEERING SALES LTD.

FILE: S1-373

SAMPLE: 17

DATE: November 5, 1984

GROUNDHOG COAL LTD.

SAMPLE: 09570

COMPOSITION OF CLEAN COAL PRODUCT

SIZE	CUT POINT	YIELD % OF FRACTION	YIELD % OF RAW
+ 28 mesh	1.8	82.57	66.20
28 x 100 mesh	1.8	78.17	10.37
100 mesh x 0	-	-	-
Total			76.57

CYCLONE ENGINEERING SALES LTD.

File: S1-373

Sample: 17

Date: November 23, 1984

GROUNDHOG COAL LTD.

SAMPLE: 09570

ANALYSIS OF CLEAN COAL PRODUCT

	AIR-DRY BASIS	DRY BASIS
PROXIMATE ANALYSIS:		
Ash %	10.10	10.37
Moisture %	2.57	-
Volatile Matter %	9.09	9.33
Fixed Carbon %	78.24	80.30
ULTIMATE ANALYSIS:		
Carbon %	78.66	80.73
Hydrogen %	2.81	2.59
Nitrogen %	0.91	0.93
Sulphur %	0.50	0.51
Oxygen %	7.02	4.87
CALOFIFIC VALUE:		
B.T.U./lb.	12,875	13,215
MJ/kg	29.95	30.74
SPECIFIC GRAVITY	1.43	1.44
HARDGROVE GRINDABILITY INDEX	40	-

CYCLONE ENGINEERING SALES LTD.

File: S1-373

Sample: 17

Date: November 23, 1984

GROUNDHOG COAL LTD.

SAMPLE: 09570

ANALYSIS OF CLEAN COAL PRODUCT (Cont'd)

ASH FUSIBILITY:	REDUCING ATMOSPHERE, °C	OXIDIZING ATMOSPHERE, °C
Initial Deformation Temp.	1195	1230
Softening Temp.	1225	1250
Hemispherical Temp.	1240	1265
Fluid Temp.	1260	1270

MINERAL ANALYSIS OF ASH:	WEIGHT %
SiO_2	41.85
Al_2O_3	22.44
Fe_2O_3	6.95
CaO	10.84
MgO	2.42
Na_2O	1.19
K_2O	1.08
P_2O_5	7.89
TiO_2	0.62
SO_3	4.58

CYCLONE ENGINEERING SALES LTD.

File: SI-373

Sample: 17

Date: November 23, 1984

GROUNDHOG COAL COMPANY

SAMPLE: 09571

	As-Rec'd Basis	Air-Dry Basis	Dry Basis
PROXIMATE ANALYSIS:			
Ash %	36.53	39.98	41.43
Moisture %	11.83	3.49	-
Volatile Matter %	7.14	7.82	8.10
Fixed Carbon %	44.50	48.71	50.47
CALORIFIC VALUE:			
B.T.U./lb.	6,980	7,640	7,916
M.J./K.G.	16.23	17.77	18.41
SULPHUR %	0.30	0.33	0.34
CARBON DIOXIDE %	0.43	0.47	0.49
SPECIFIC GRAVITY	1.63*	1.69*	1.71*

CYCLONE ENGINEERING SALES LTD.

File: S1-373

Sample: 14

Date: October 17, 1984

* Revised: November 5, 1984

GROUNDHOG COAL COMPANY

SAMPLE: 09572

	As-Rec'd Basis	Air-Dry Basis	Dry Basis
PROXIMATE ANALYSIS:			
Ash %	28.38	32.96	34.08
Moisture %	16.71	3.28	-
Volatile Matter %	7.05	8.19	8.47
Fixed Carbon %	47.86	55.57	57.45
CALORIFIC VALUE:			
B.T.U./lb.	7,861	9,128	9,438
M.J./K.G.	18.28	21.23	21.95
SULPHUR %	0.59	0.68	0.70
CARBON DIOXIDE %	0.63	0.73	0.75
SPECIFIC GRAVITY	1.57	1.66	1.68

CYCLONE ENGINEERING SALES LTD.

File: S1-373

Sample: 15

Date: October 17, 1984
November 5, 1984

Ash %	66.85	73.03	75.33
Moisture %	11.25	3.05	-
Volatile Matter %	6.43	7.02	7.24
Fixed Carbon %	15.47	16.90	17.43
CALORIFIC VALUE:			
B.T.U./lb.	2,633	2,876	2,966
M.J./K.G.	6.12	6.69	6.90
SULPHUR %	0.19	0.21	0.22
CARBON DIOXIDE %	0.68	0.74	0.76
SPECIFIC GRAVITY	2.03	2.13	2.17

CYCLONE ENGINEERING SALES LTD.

File: S1-373

Sample: 16

Date: October 17, 1984
November 4, 1984

GROUNDHOG COAL COMPANY

SAMPLE: 09574

	As-Rec'd Basis	Air-Dry Basis	Dry Basis
PROXIMATE ANALYSIS:			
Ash %	66.85	73.03	75.33
Moisture %	11.25	3.05	-
Volatile Matter %	6.43	7.02	7.24
Fixed Carbon %	15.47	16.90	17.43
CALORIFIC VALUE:			
B.T.U./lb.	2,633	2,876	2,966
M.J./K.G.	6.12	6.69	6.90
SULPHUR %	0.19	0.21	0.22
CARBON DIOXIDE %	0.68	0.74	0.76
SPECIFIC GRAVITY	2.03	2.13	2.17

CYCLONE ENGINEERING SALES LTD.

File: S1-373

Sample: 16

Date: October 17, 1984
November 4, 1984

APPENDIX G

GEOLOGY MAP (1:10000)

M01

LEGEND

- LICENCE BOUNDARY
- GEOLOGICAL CONTACT (APPROXIMATE, INFERRED)
- COAL SEAM (OUTCROP, INFERRED)
- ANTICLINE (DEFINED, APPROXIMATE) ARROW INDICATES PLUNGE DIRECTION
- SYNCLINE (DEFINED, APPROXIMATE) ARROW INDICATES PLUNGE DIRECTION
- OVERTURNED ANTICLINE (DEFINED, APPROXIMATE)
- OVERTURNED SYNCLINE (DEFINED, APPROXIMATE)
- BEDDING (HORIZONTAL, INCLINED, OVERTURNED, VERTICAL)
- THRUST FAULT (DEFINED, APPROXIMATE) TEETH INDICATE UPTHRUST SIDE
- FAULT (DEFINED, APPROXIMATE)
- ADIT — DIAMOND DRILL HOLE (DDH 8102) — TRENCH (TRC 8401) — COAL SPOIL (C)
- CROSS SECTION LINE (A — A')

JKd DEVIL'S CLAW UNIT

Conglomerate with minor interbeds of sandstone, siltstone and claystone.

JKm McEVOY UNIT

Thick sequences of interbedded dark to medium grey siltstone and claystone with minor sandstone, limestone, coal and conglomerate.

Jc CURRIER UNIT

Fine to medium grained tan to dark grey weathering sandstone, dark brown to brown mudstone, siltstone locally containing bivalves and COAL.

Ji JACKSON UNIT

Tan or dark grey weathering siltstone and claystone, locally carbonaceous, and tan weathering, fine to medium grained sandstone.

SCALE 1:10,000

MILES 0 1 2 3 4 5 MILES

METRES 0 200 400 600 800 METRES

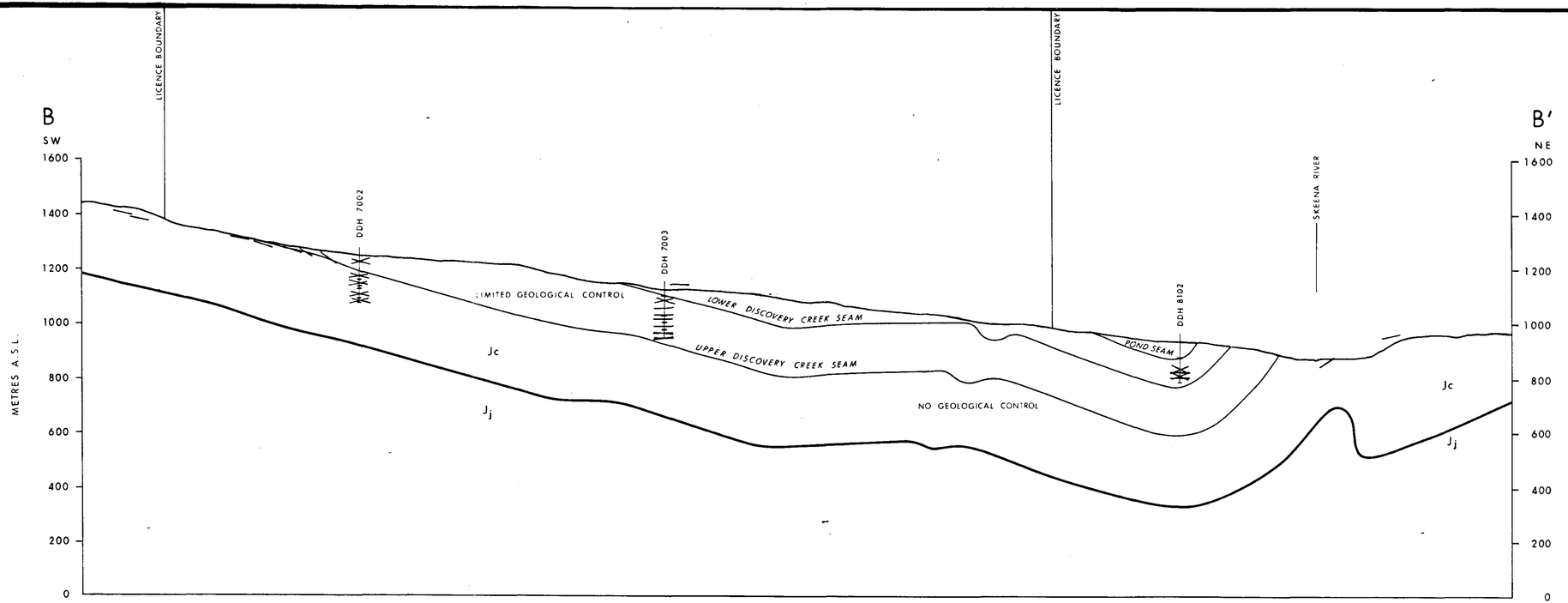
GROUNDHOG COAL LTD.

GEOLOGY MAP 105

BY: J. M. DUFORD P. GEOL.	CONTOUR INTERVAL: 10 m
DATE: NOVEMBER, 1984	FIGURE: APPENDIX G

APPENDIX H

GEOLOGICAL CROSS SECTIONS (1:10000)



LEGEND

JURASSIC — CRETACEOUS

JKd DEVIL'S CLAW UNIT

Conglomerate with minor interbeds of sandstone, siltstone and claystone.

JKm McEVOY UNIT

Thick sequences of interbedded dark to medium grey siltstone and claystone with minor sandstone, limestone, coal and conglomerate.

Jc CURRIER UNIT

Fine to medium grained tan to dark grey weathering sandstone, dark brown to brown mudstone, siltstone locally containing bivalves and COAL.

Jj JACKSON UNIT

Tan or dark grey weathering siltstone and claystone, locally carbonaceous, and tan weathering, fine to medium grained sandstone.

SCALE 1 10 000

MILES 0 1 2 3 4 5 MILES

METRES 0 200 400 600 800 METRES

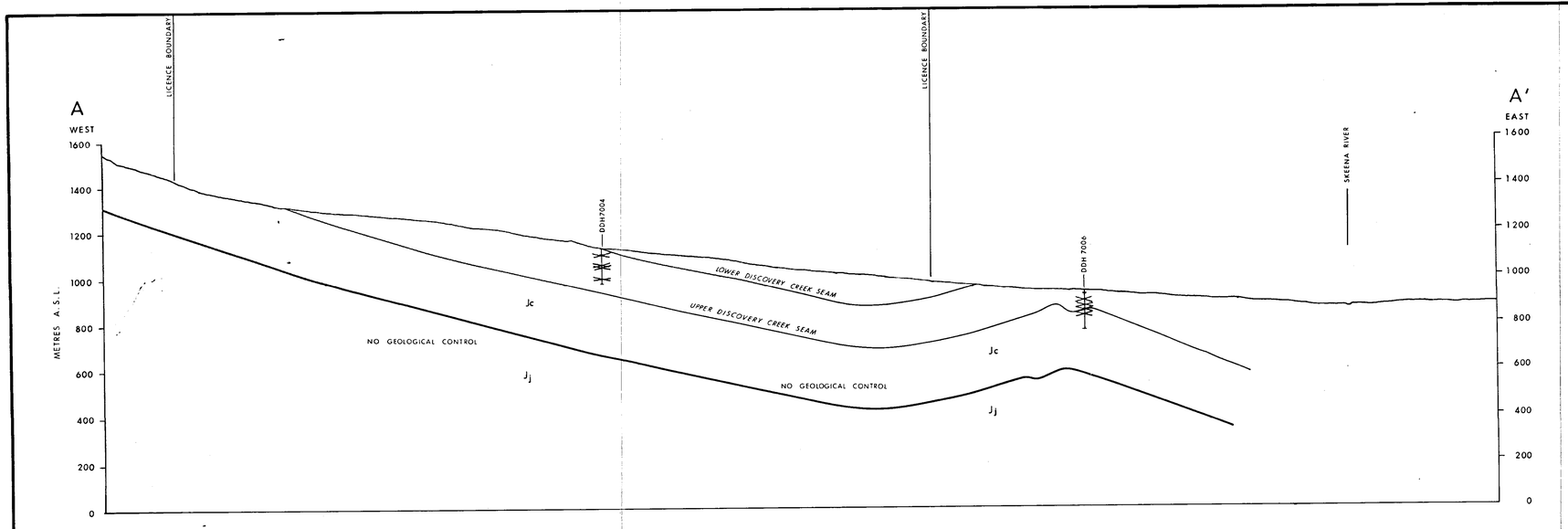
GROUNDHOG COAL LTD.

CROSS SECTION B - B'

105

M02

BY: J. M. DUFORD P. GEOL.	SCALE: 1: 10 000
DATE: NOVEMBER, 1984	FIGURE: APPENDIX H



LEGEND

CRETACEOUS — JURASSIC

JKd DEVIL'S CLAW UNIT

Conglomerate with minor interbeds of sandstone, siltstone and claystone.

JKm McEVOY UNIT

Thick sequences of interbedded dark to medium grey siltstone and claystone with minor sandstone, limestone, coal and conglomerate.

Jc CURRIER UNIT

Fine to medium grained fan to dark grey weathering sandstone, dark brown to brown mudstone, siltstone locally containing bivalves and COAL.

Jj JACKSON UNIT

Tan or dark grey weathering siltstone and claystone, locally carbonaceous, and tan weathering, fine to medium grained sandstone.

SCALE 1:10 000

MILES 0 1 2 3 4 5 MILES

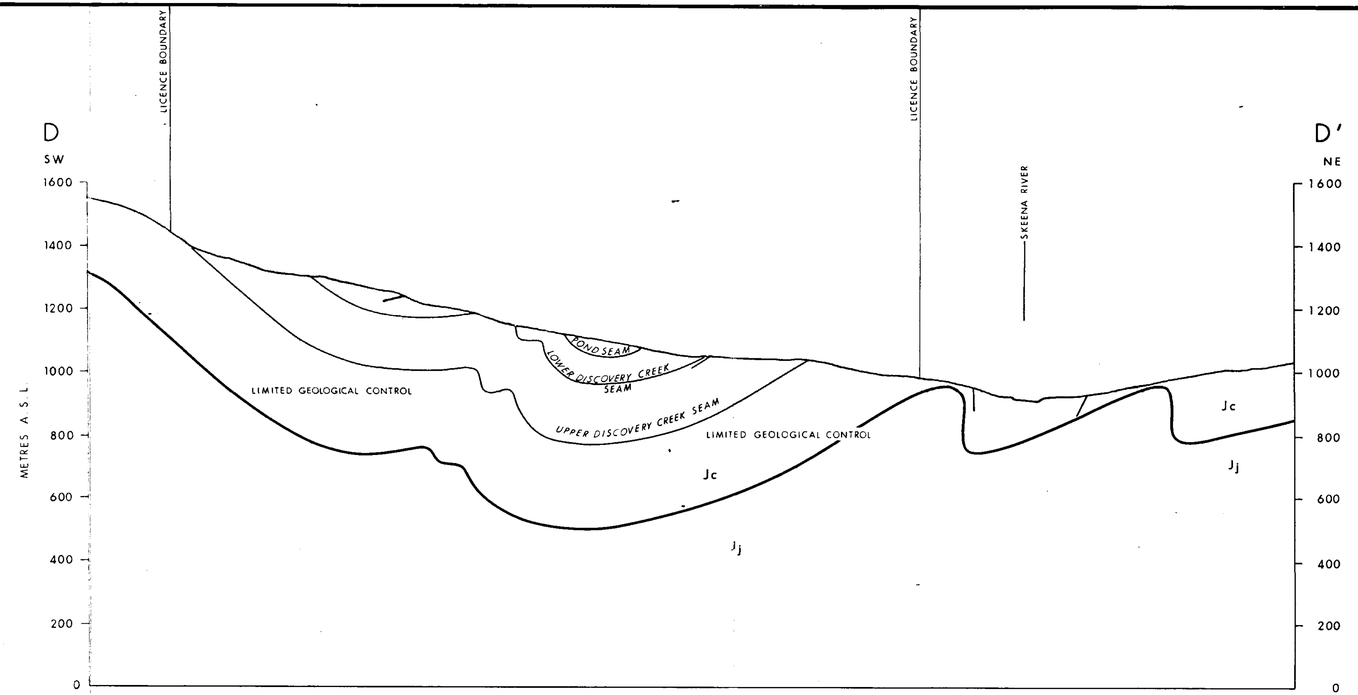
METRES 0 200 400 600 800 METRES

GROUNDHOG COAL LTD.

CROSS SECTION A-A'

BY: J.M. DUFORD P.GEOL.	SCALE: 1:10 000
DATE: NOVEMBER, 1984	FIGURE: APPENDIX H

105
H03



LEGEND

CRETACEOUS

JURASSIC

JKd DEVIL'S CLAW UNIT

Conglomerate with minor interbeds of sandstone, siltstone and claystone.

JKm McEVOY UNIT

Thick sequences of interbedded dark to medium grey siltstone and claystone with minor sandstone, limestone, coal and conglomerate.

Jc CURRIER UNIT

Fine to medium grained tan to dark grey weathering sandstone, dark brown to brown mudstone, siltstone locally containing bivalves and COAL.

Jj JACKSON UNIT

Tan or dark grey weathering siltstone and claystone, locally carbonaceous, and tan weathering, fine to medium grained sandstone.

SCALE 1:10 000

MILES 0 1 2 3 4 5 MILES

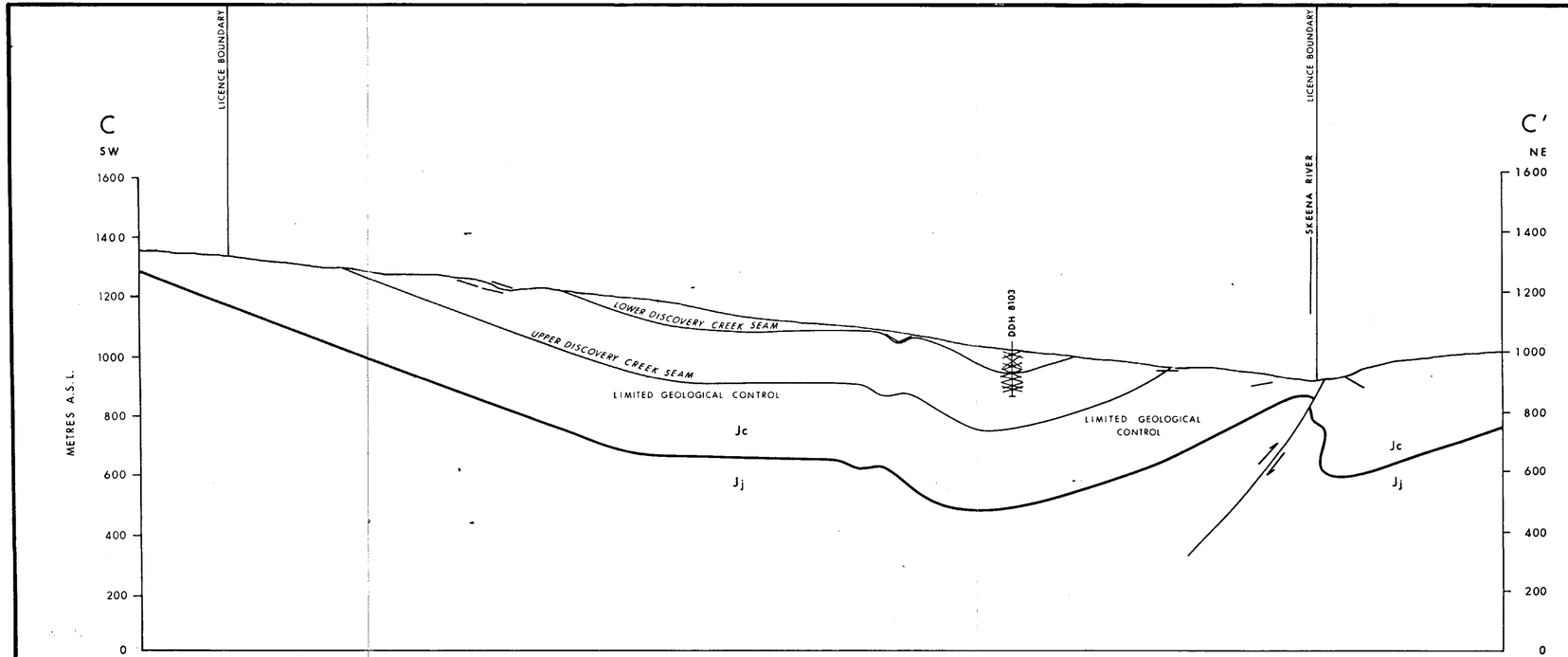
METRES 0 200 400 600 800 METRES

GROUNDHOG COAL LTD.

CROSS SECTION D - D'

BY: J. M. DUFORD P. GEOL.	SCALE: 1:10 000
DATE: NOVEMBER, 1984	FIGURE: APPENDIX H

105
H04



LEGEND

CRETACEOUS — JURASSIC

JKd DEVIL'S CLAW UNIT

Conglomerate with minor interbeds of sandstone, siltstone and claystone.

JKm McEVOY UNIT

Thick sequences of interbedded dark to medium grey siltstone and claystone with minor sandstone, limestone, coal and conglomerate.

Jc CURRIER UNIT

Fine to medium grained tan to dark grey weathering sandstone, dark brown to brown mudstone, siltstone locally containing bivalves and COAL.

Jj JACKSON UNIT

Tan or dark grey weathering siltstone and claystone, locally carbonaceous, and tan weathering, fine to medium grained sandstone.

SCALE 1:10 000

MILES 0 1 2 3 4 5 MILES

METRES 0 200 400 600 800 METRES

GROUNDHOG COAL LTD.

CROSS SECTION C - C'

BY: J. M. DUFORD P. GEOL.	SCALE: 1:10 000
DATE: NOVEMBER, 1984	FIGURE: APPENDIX H

105
MOS

APPENDIX I

1984 TRAVERSE LOCATION MAP (1:10000)

LICENCE BOUNDARY APPROXIMATE

SCALE 1:10,000

MILES 0 1 2 3 4 5 MILES

METRES 0 200 400 600 800 METRES

GROUNDHOG COAL LTD.

TRAVERSE LOCATION MAP

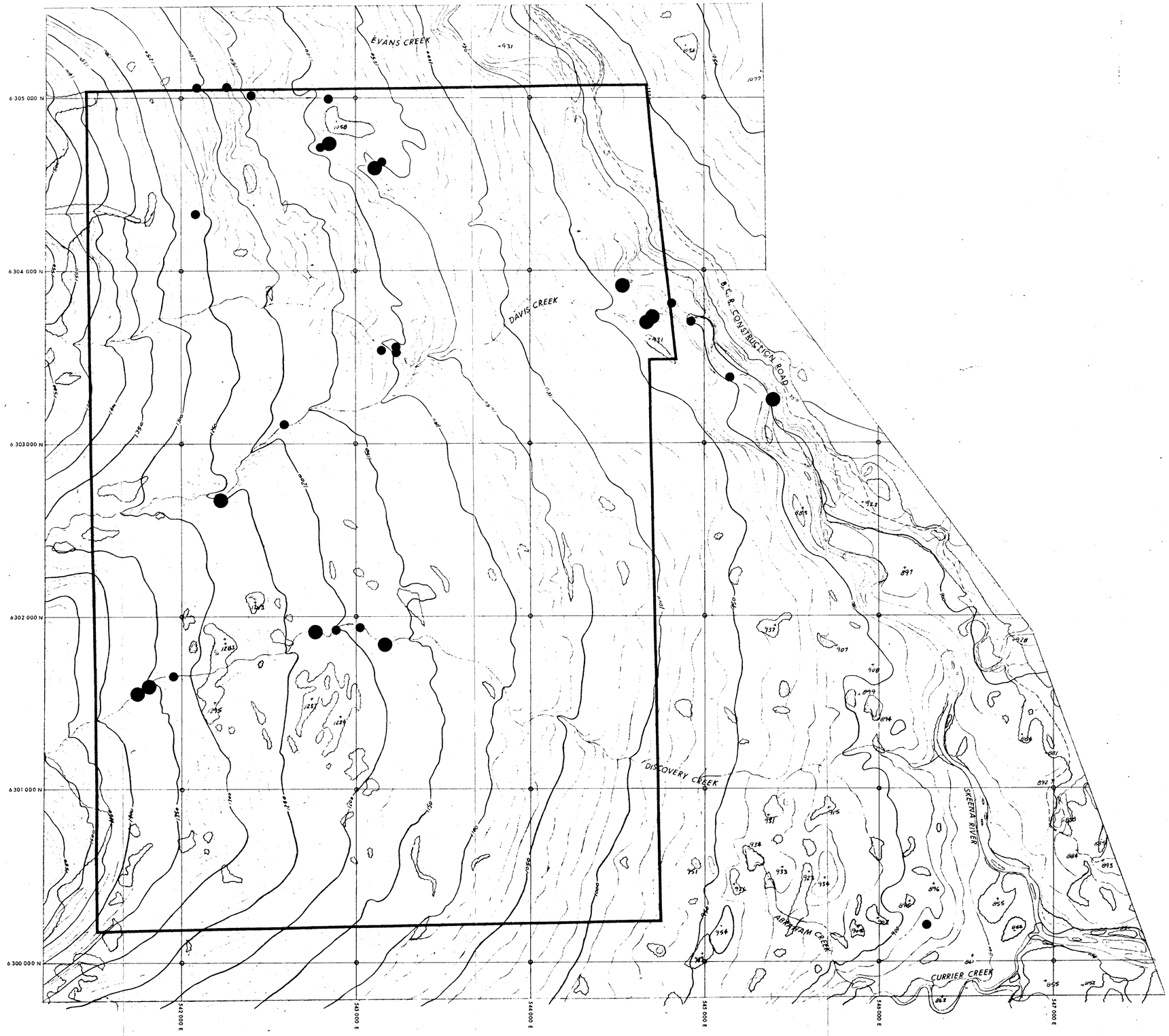
105

BY: J.M. DUFORD P. GEOL.	CONTOUR INTERVAL: 10 m
APPROVED:	FIGURE: APPENDIX I

M06

APPENDIX J

COAL OCCURRENCE MAP (1:10000)



LEGEND

- LICENCE BOUNDARY APPROXIMATE
- COAL EXPOSURE GREATER THAN 0.5
- COAL EXPOSURE LESS THAN 0.5 OR SPOIL

SCALE 1:10,000

MILES 0 1 2 3 4 5 MILES

METRES 0 200 400 600 800 METRES

GROUNDHOG COAL LTD.

COAL OCCURRENCE MAP

105

(107)

BY: J. M. DUFORD P. GEOL.	CONTOUR INTERVAL: 10 m
APPROVED:	FIGURE: APPENDIX J