Quintette Coal Limited

QUINTETTE PROJECT

PRELIMINARY

FEASIBILITY

REPORT

1975

Volume III

Section 1

Kilborn

PRELIMINARY OPEN PIT MINE DESIGN
FOR THE QUINTETTE PROPERTY
DENISON MINES (B.C.) LIMITED
FOR
KILBORN ENGINEERING LIMITED

Dames & Moore Job. No.6594-001-31

October, 1975

DAMES & MOORE
CONSULTING ENGINEERS

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October 8, 1975

Kilborn Engineering Limited
36 Park Lawn Road
Toronto. Ontario

Attention: Mr. R. Roach, P.Eng.
Vice President
Mining and Metallurgy

Dear Mr. Roach:

It is with pleasure that we enclose four copies of our report "Preliminary Open Pit Mine Design for the Quintette Property of Denison Mines (B.C.) Limited." The report was prepared in general accordance with our proposal of April 30, 1975, although some items have been completed beyond the original scope of work at the request of both the client and the owner. Kilborn requested that an appreciation of the potential alternative open pit reserves other than those of the Windy and Roman areas be developed, and Denison required some basic rock mechanics input. Further, in the course of preparing data related to a design approach based upon cut-off criteria, the owner requested that such concepts be abandoned in favour of an initial approach using selected overall stripping ratios. Again, the strategy for mining the total open pit tonnage, equally divided between Windy and Roman areas was input by the owner, part way through the work. This policy may be usefully examined further.

At the time of the preparation of this report, the results of point load tests on selected core specimens representative of the stratigraphic column of the Windy area is unavailable and will be reported shortly.

It has been a pleasure to deal with Kilborn staff on this interesting project; do not hesitate to contact us, should any questions arise from this work.

Yours very truly
DAMES & MOORE

REGISTERED PROFESSIONAL ENGINEER W. D. BULLOCK PROVINCE OF ONTARIO

W. Derek Bullock, P.Eng.
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REGISTERED PROFESSIONAL ENGINEER J. E. TOSNEY PROVINCE OF ONTARIO

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PRELIMINARY OPEN PIT MINE DESIGN

FOR

THE QUINTETTE PROPERTY

DENISON MINES (B.C.) LIMITED

FOR

KILBORN ENGINEERING LIMITED

<u>CONTENTS</u>

(Note that the numbering of the various chapters has been selected to conform to Volume II detailed report, Kilborn Engineering).

2.1 INTRODUCTION

The proposed mining complex at the Quintette property includes coal extraction by both surface and underground techniques. Open-pit mine design work is required for selected areas in order to investigate, in a preliminary but comprehensive manner, such items as recoverable coal reserves, stripping requirements, capital and operating costs and geotechnical and environmental factors.

Dames & Moore's involvement in such design work was outlined in a proposal to Kilborn Engineering Limited of April 30, 1975. The work was to consist of the actual design of up to four open pits, suitable for delivery of sufficient raw coal to allow production of 1.5 million tonnes of clean coal annually from the coal preparation plant. As the studies progressed, the scope of work was refined to include design work of pits in the Windy area, and the Roman Mountain area, at overall stripping ratios of both 7 cubic yards of waste to 1 short ton of raw coal, and 10 cubic yards of waste to 1 short ton of raw coal. These ratios were to be expressed in metric units.

Denison Mines (B.C.) Limited, on behalf of the property owners have stressed throughout the preliminary nature of these studies, based upon the lack of a complete geological data base for the specific areas in question, and also for the region as a whole. A number of potentially attractive areas are available.

Office studies on this project have been supported with site visits by

Dr. B. Stimpson and J. E. Tosney, P.Eng., of Dames & Moore, and by J. Hopkinson, P.Eng. of Kilborn Engineering Limited. Liaison meetings to discuss and approve costs, operating and geological assumptions, have been held in Toronto, Calgary and Vancouver, between Dames & Moore, the client and the owner.

The design work has been completed under the metric system; geological data at a scale of 1:5000 was made available in mid-September that included much of the latest results from Denison's field program of summer 1975.

2.2 SURFACE MINING, ULTIMATE PIT DESIGNS

2.2.1 Methodology

Two approaches to the preparation of ultimate pit designs have been considered in this study. The traditional approach involved the derivation of the cut-off stripping ratio, selection of an acceptable ultimate slope angle, together with minimum operating requirements for the prime equipment. These items, in conjunction with the coal reserve disposition and topography, define the basic pit geometry. The alternative approach was based upon accepting two overall stripping ratios, for test purposes, and adjusting the pit parameters to conform, while keeping the same operating constraints as in the initial approach.

There are advantages to adopting the cut-off concept:

a) The ratio allows examination of the effect of change in unit product price and operating costs.

b) The ratio is relatively insensitive to capital costs, but reflects changes due to fluctuations in annual output.

c) The concept is well-known, and has a history of successful application.

The disadvantages, associated with an initial study, are related to the difficulty of obtaining accurate unit estimates to input to the equation. In particular, the unit cost of stripping influences the cut-off stripping ratio (C.O.S.R.) directly, and the ratio does not incorporate concepts of the time value of money.

Use of an overall stripping ratio (O.S.R.) for examination of ultimate pit geometry is based upon selection of a ratio of similar value to those in use at comparable mining operations elsewhere. For an initial study this has undoubted intuitive appeal, but a number of problems may be identified with the approach.

a) Few mining properties are in fact reasonably comparable.

b) Confusion exists between the concepts of the overall stripping and the instantaneous stripping ratio (I.S.R.), with the O.S.R. normally being of a higher value than the I.S.R. during the early years of an operation.

c) The use of an overall stripping ratio concept does not allow examination of the effect of changes of unit prices, costs or productivities.

d) Acceptance of ratios from comparable operations implies an acceptance of that owner's corporate objectives.

On account of the preliminary nature of the information available on the reserves in question, the owner has requested that the approach to be accepted for these studies is to assume that reserves available between overall ratios of 7-10 cubic yards/short ton raw coal will be developed in the ultimate plan. These figures are somewhat higher than in use at some western Canadian operations, since most operations consider long tons, but are of similar value to those derived from basic cut-off criteria.

2.2.2 Mining Method

A conventional equipment configuration is recommended for mining operations, which envisages that the waste rock will be drilled and blasted prior to removal by large shovel and truck units, and that the coal, which will not require blasting, will be loaded by both shovel and front-end loaders. Dragline and bucketwheel operations were examined, but rejected here for the reasons noted below.

a) Recent delivery dates have been quoted between 3½-5 years for these units.

b) This equipment is too inflexible for the applications considered, with respect to:

   (i) Raw coal blending requirements

   (ii) Local faulting in the Windy area

   (iii) Distribution of reserves.

c) Greater pre-production site preparation is necessary than with shovel applications.

d) These units mine with less selectivity between coal and waste rock.

e) In the size range to be effective, too much production would be linked to one piece of high-cost capital equipment.

f) Recent western Canadian experience shows that bucketwheels have not been utilized to date, and experience with large draglines has not been encouraging.

In addition, bucketwheel excavation must be operated under rigidly engineered conditions of both maintenance and layout, and will not handle blocky material.

The mining methods conceptualized in these studies are based upon output requirements of 1,500,000 tonnes of clean coal per annum and up to 15,000,000 cubic metres of waste per annum, combined production from both Windy pit and Roman Mountain pit. It may be assumed that, in the Windy pit, coal can be selectively mined to a minimum thickness of one metre, while the corresponding figure for the Roman Mountain area is one and a half metres. Coal losses at the top and bottom of each seam are assumed to be 0.15 metres.

Windy Pit coal will be loaded by front-end loaders into trucks in the 170 tonne size range, following drill, load, blast and strip activities with shovels sized to $13m^3$ bucket capacity. Hard coal may be ripped and pushed, using dozers of approximately 700 H.P. This method of mining is well established in western Canada, and may be regarded as entirely conventional. (Figure 1A).

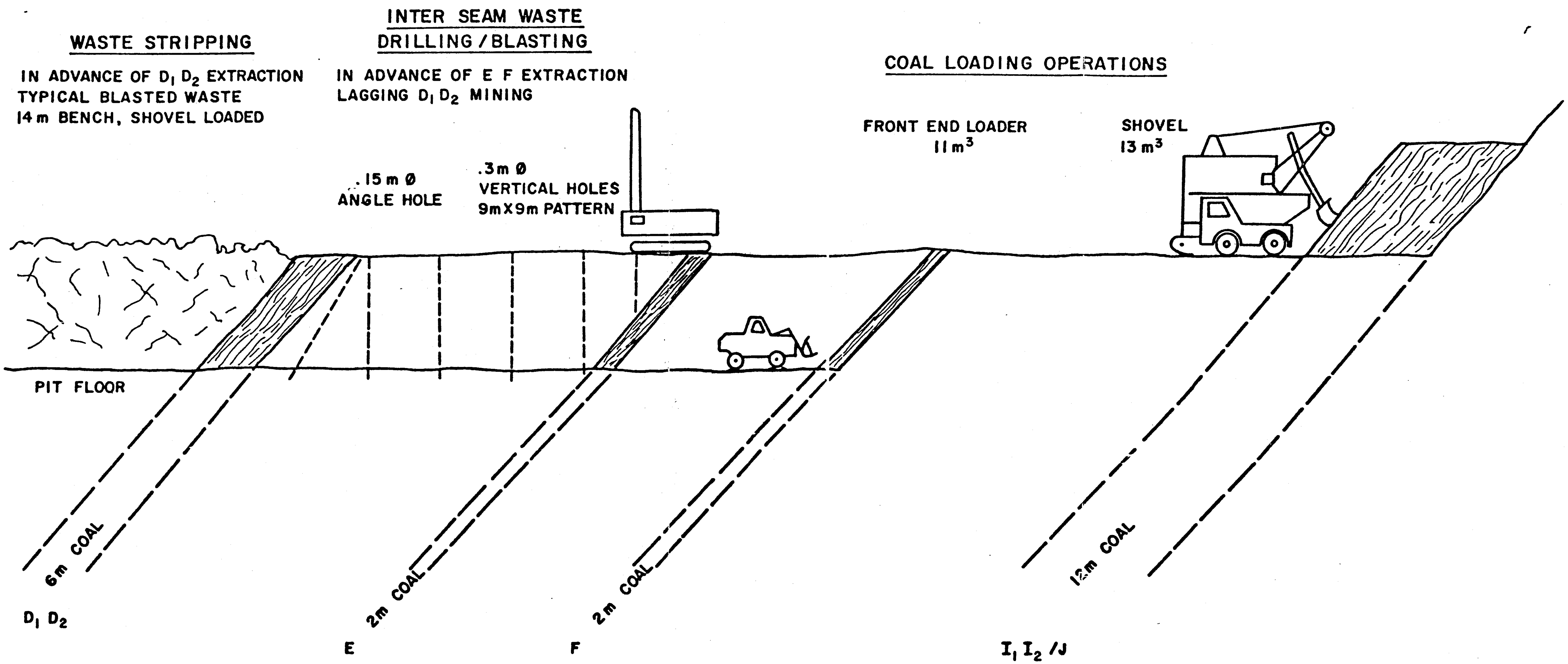
Roman Mountain reserves have typical dips in the range 45^o-50^o, distributed in four seams within some 110 metres of the Commotion formation. At present, no coal is being mined in western Canada, by open-pit techniques, with comparable thickness and attitudes, and a new combination of existing equipment is proposed (Figure 1B).

Waste volume requirements indicate that benches some 14 metres high should be mined in order to utilize the productive capacity of the drills and shovels available. Coal loading may thus be accomplished by a number of methods. For the thicker seams, i.e. D_1D_2, I_1I_2/J, it is likely that a shovel with a bucket capacity of the order of $13m^3$ will be most effective, and recent advances in shovel technology will allow selection of a front-end configuration whose digging arc is compatible with the dip of the coal beds. (Alternatively, thick coal may be pushed by dozers towards front-end loader units or more conventional shovel types. Pushing of coal from the thin E and F seams is not likely to be effective.) The shovel can also handle loading from the E and F coal beds, but this represents an inefficient utilization of a unit sized essentially for large-scale stripping work and a better approach would be to use $11m^3$ front end loaders on the coal face directly. The proviso attached to this concept concerns the ease with which the coal would be dislodged from the upper 5 metres of the exposed seam (a function of its cleat, joint and shear properties), and approval of the inspectorate for the method.

Lower bench heights between coal seams could readily be selected, but it is felt that this would unnecessarily restrict productivity.

Underlying seams D_1D_2, E and F, a wedge of waste rock will require blasting prior to stripping. While this wedge could be drilled off a broken waste rock pad, dumped back over the slope, the use of smaller diameter angled drill holes is proposed. The drill selected for this specialist purpose might also find application in perimeter blasting at the ultimate slopes.

The strike length available in the Roman Mountain pit is such that sufficient individual coal faces may be exposed a satisfactory distance apart, so as not to constrain operations, while ensuring that blending capabilities are available. In the case of the Windy reserves, the width of the pit is such as to afford these advantages.



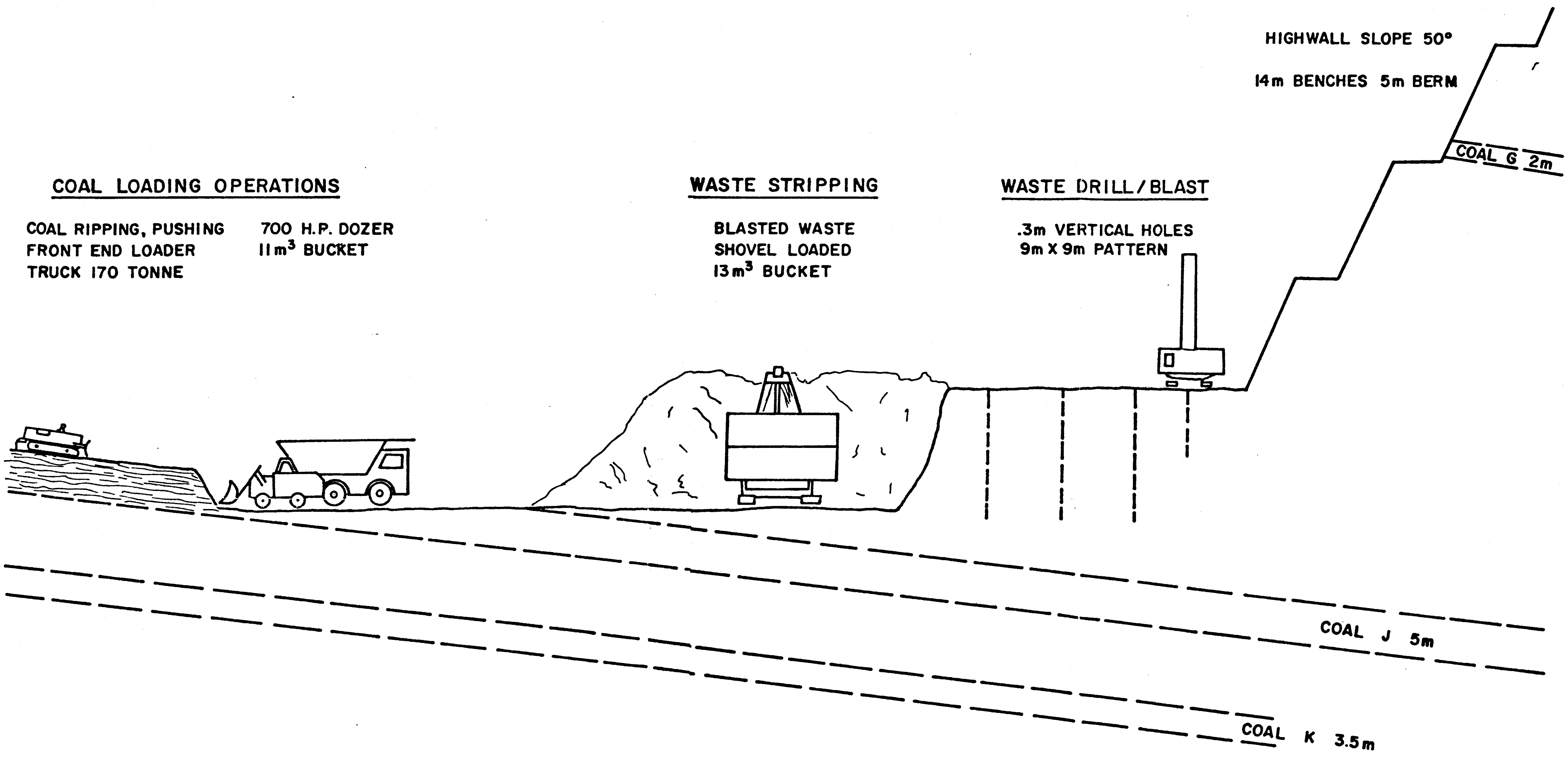
COMPOSITE SECTION

DAMES & MOORE

SCHEMATIC MINING METHOD
ROMAN MOUNTAIN PIT

DESIGNED: J.E.T.
CHECKED: W.D.B.
DRAFTED: L.S.

SCALE: 1:50
DATE: OCT. 3, 1975
JOB NO: 6594-001-31



COMPOSITE SECTION

DAMES & MOORE

SCHEMATIC MINING METHOD
WINDY PIT

DESIGNED: J.E.T.
CHECKED: W.D.B.
DRAFTED: L.S.

SCALE: 1:50
DATE: OCT. 3, 1975
JOB NO: 6594-001-31

PLATE 1A

2.2.3 Geotechnical Aspects

Some important assumptions are used in this study, based upon very preliminary geotechnical data. Prime amongst these assumptions is the slope angle selected for the ultimate pit walls of both the Windy and Roman pits. While the 50° slope angle selected represents a reasonable starting point, more detailed evaluation of the rock fabric and in-situ bulk properties will be required before final selection of the definitive angle. The high wall in the Windy pit will be comprised of bedded strata dipping gently into Babcock Mountain, while the major slopes of the Roman Pit will be composed of sedimentary beds, lying parallel to the slope. This latter configuration is inherently less stable than the former, assuming even a moderately jointed rock mass.

The bulk moduli of the waste rock, together with its joint patterns, will directly influence the optimum blast hole pattern, and the corresponding properties in the coal beds will affect its rippability and dilution properties.

Dump site selection will be influenced by the depth of overburden cover and the subsurface bedrock topography. The surface water regime will also affect dump site selection, as well as haulage road location. Qualitative data of a soils and hydrologic nature is sparse. Further, cleft water has an influence on slope stability, through a number of mechanisms such as its effect on the shear strength of the rock mass through the static head it may create.

Local pit operations will require control of both surficial water and ground water, through graded floors and a sump system, for example, but also of importance will be the ultimate means of disposal of this water which may be both turbid and acidic.

Geotechnical aspects are further discussed in the sections on ultimate pit design and dump design.

2.2.4 Environmental Aspects

Mine operators have a number of rights, privileges and obligations under the statutes and regulations of British Columbia. The major acts affecting open-pit mining in British Columbia are; The Coal Mines Regulations Act, Environmental and Land Use Act, Mines Regulations Act, Pollution Control Act, Health Act, Minerals Act, Water Act, Forest Act, Fisheries Act, Wildlife Act, Park Act, Noxious Weeds Act, and the Ecological Reserves Act. The first four acts noted above are the most important with respect to development although specialized problems may be covered under other acts.

While the Mines Regulations Act and the Coal Mines Regulations Act cover the safe and efficient operations of mines in British Columbia, they also deal with environmental protection and conservation. The criteria for environmental protection are published as guidelines rather than regulations, which allow for a greater amount of flexibility between regulatory agencies and mine operators.

The major environmental problem associated with this operation appears at this time to concern the placement of waste material dumps. Of particular interest are the items of erosion control, interference with water courses, and seepage into ground and surface waters. The Pollution Control Act prohibits the discharge either directly or indirectly into air, water or land of any contaminant that may impair environmental quality; settling ponds may be required to prevent high levels of suspended solids entering the water regimes.

The guidelines to preparation of reclamation programs and reports under the Mines Regulations Act describe the details required for such operations. These guidelines recommend early liaison with various provincial agencies, and state that the objective of the reclamation program is to permit maximum recovery of mineral resources with minimum disturbance of the environment, and then to reclaim the disturbed environment to best and fullest use.

While the full scope of environmental considerations are dealt with elsewhere, it may be noted here that a complete baseline survey will be required. Of importance will be the vegetational distribution, microclimatic regime and mammal, bird and fish inventories. Productivity estimates are necessary to ensure the reclamation program returns the land to full potential; microclimate analysis will provide input to both revegetation studies and building design.

The task of reclamation can be facilitated by stockpiling topsoil from disturbed areas, and care should be taken to ensure that topsoil is not placed as waste, or covered by dumps.

2.2.5 Ultimate Pit

The leading criteria associated with the ultimate pit designs are consolidated below for ease of reference.

a) The designs are based upon overall stripping ratios of $6.2m^3$/tonne raw coal and $8.12m^3$/tonne raw coal in the Windy area, and $4.0m^3$/tonne raw coal for the Roman Pit.
(Note 7 cubic yards/short ton raw coal is approximately $6m^3$/tonne raw coal and 10 cubic yards/short ton is equivalent to $8m^3$/tonne raw coal).

b) Ultimate slope angle selected is 50° for both mines, the minimum operating width required is 50m. Haul roads are graded 5% for coal haulage downgrade, and not greater than 8% elsewhere. Operating bench height is selected at 14m.

c) No ultimate internal pit road has been provided since both deposits may be approached from a number of open horizons, off existing topography.

d) Provision for full perimeter access and a pit power loop has been assumed to be 70m in width, adjacent to the ultimate crest.

e) The preliminary nature of the current geological data base has been stressed by the owner, and although sections at a scale of 1:5000 have been provided at intervals of 200m, a number of these sections do not contain specific geological evidence.

Windy Area - Plates 2A and 2B show the ultimate pit plan and selected sections respectively, of the Windy pit at a scale of 1:5000, for an overall stripping ratio of $6.2m^3$/tonne. Plate 2C shows the ultimate pit at an overall ratio of 8.12m^3/tonne; Plate 2B also shows sections applicable to this ratio. The dump locations and haul road are shown on Plate 4, together with a proposal for the access road to the Mesa reserves, and the general breaker station location.

For the open pit designs presented for the Windy area there are apparent cut-off ratios that correspond to the overall ratios selected, and the approximate values are noted below:

Overall stripping ratio	Apparent Cut-off Stripping Ratio
6.2m^3/tonne	6.9m^3/tonne
8.12m^3/tonne	11.7m^3/tonne

Roman Mountain - Plates 3A and 3B show the ultimate pit plan and selected sections respectively of the Roman Mountain pit at a scale of 1:5000. The overall stripping ratio for these reserves is 4.0m^3/tonne raw coal. This is below the overall limits suggested by the owner, and as a result no alternate designs are presented. Cut-off stripping concepts do not have any application in this case.

2.2.6 Coal Reserves and Stripping

The calculation of coal reserves for the open-pits of a mineable nature has been based on the following:

a) Sections provided by Denison Mines (B.C.) Limited at 200 metres intervals across the Windy area and Roman Mountain.

b) Minimum mining thicknesses of (i) Windy area - 1 metre

(ii) Roman Mountain - 1.5 metres

i.e. such thicknesses of coal or waste are regarded as mineable separately. (Single exception, hole QBD-7511-K seam).

c) Specific gravities of (i) Coal - 1.38 ($1m^3$ = 1.38 tonne)

(ii) Internal Waste - 2.29 ($1m^3$ = 2.29 tonne)

d) Waste volumes include overburden, inter-seam waste of over mineable thickness, oxidized coal and losses of 0.15m from the top and bottom of each seam. Waste is expressed in cubic metres.

e) Raw coal tonnages include both coal and internal waste, since these will together form the feed to the washing plant. The losses associated with mining a particular coal horizon have been assumed to be all coal. This is a conservative approach and by inspection of the seam sections provided, is correct in the majority of cases.

f) All coal down to a depth of 25 metres below the natural surface is assumed to have been oxidized, and has been treated as waste material, to be stockpiled separately.

g) At the ends of the open-pits the area of influence has been adjusted to compensate for the end effects of the open-pits.

The resultant coal reserves, that is raw coal available for delivery to the washing plant, are summarized below in Table 1:

TABLE 1 Quintette Open Pit Coal Reserves

Area	Total Raw Coal tonnes x 10^6	Waste Stripping m^3 x 10^6	Stripping Ratio m^3/tonne
Windy (7 cu.yds./sh.ton)	17.3	107.5	6.2:1
Windy (10 cu.yds/sh.ton)	36.0	292.5	8.1:1
Roman Mountain	32.8	129.8	4.0:1

The waste is expressed in bank cubic metres. When blasted and loaded, a swell factor of 1.3 has been applied in determining the size of required dump areas and fleet requirements.

Complete coal reserves by seam for each area are included in Tables 2, 3 and 4. The breakdown includes coal and internal waste tonnages for each seam. This analysis suggests that internal waste constitutes approximately

a) 30.1% of the raw coal for Windy area at 7:1 and 10:1

b) 31.3% of the raw coal for Roman Mountain

Using the criteria established for delineating ordinary raw coal reserves as described in section 2.2.6 (Coal Reserves), estimates of the recoverable raw tonnes of oxidized coal have been made. These estimates were ostensibly for the calculation of dump space requirements in the event that a secondary market develops for the sale of oxidized coal. The results are summarized below.

	Raw Oxidized Coal
Windy Area	approximately 3,400,000 cubic metres
Roman Mountain	approximately 2,500,000 cubic metres
TOTAL	approximately 6,000,000 cubic metres

This is equivalent to some 9.6 million tons at a specific gravity of 1.6.

2.2.7 Dump Design

The basic concept associated with dump design is to provide for the minimum amount of waste haulage, and this principle is constrained by the items noted below. No data is available at this time on a number of the

WINDY AREA PIT COAL RESERVES AND WASTE STRIPPING

6.2m³/tonne

All Units x 10^3

SEAM	D		E		F		G		I/J		K		Total Raw Coal			Stripping	
SECTION	Coal Only tonnes	Waste Only (Internal) tonnes	Coal Only tonnes	Waste Only (Internal) tonnes	Coal Only tonnes	Waste Only (Internal) tonnes	Coal Only tonnes	Waste Only (Internal) tonnes	Coal Only tonnes	Waste Only (Internal) tonnes	Coal Only tonnes	Waste Only (Internal) tonnes	Coal Only tonnes	Waste Only (Internal) tonnes	Total tonnes	Waste Volume m^3	Ratio raw coal : waste tonne : m^3
2-2	-	-	-	-	-	-	-	-	50.3 339.9	96.1	143.1	84.3	533.3	180.4	713.7	5222.3	1 : 7.3
3-3	20.6	14.4	49.9	49.1	56.6	20.8	58.2	33.6	594.2	300.7	339.2	82.8	1118.6	501.4	1620.0	10970.5	1 : 6.8
4-4	15.0	2.8	20.6	22.1	39.5	32.4	55.2	5.9	582.3	226.0	341.9	228.1	1054.5	517.3	1571.8	9760.0	1 : 6.2
5-5	34.4	8.7	32.9	35.4	61.7	50.6	64.4	6.9	549.7	170.7	400.5	261.1	1143.6	533.4	1677.0	9138.4	1 : 5.5
6-6	79.1	19.9	57.7	61.9	81.4	66.8	80.5	8.6	286.8	89.0	222.2	144.8	807.7	391.0	1198.7	5944.0	1 : 5.0
7-7	30.6	5.3	59.2	41.7	80.4	9.8	101.8	4.8	254.4	145.9	161.6	105.3	688.0	312.8	1000.8	5464.9	1 : 5.5
8-8	9.4	1.6	20.5	14.5	36.3	4.4	65.9	3.1	221.9	127.3	154.8	100.0	508.8	251.8	760.6	4871.3	1 : 6.4
9-9	16.5	2.8	29.6	20.9	46.7	5.7	62.9	2.9	178.6	102.5	114.4	74.6	448.7	209.4	658.1	3983.4	1 : 6.0
10-10	14.4	1.5	42.3	13.4	49.2	-	29.2	9.3	174.3	66.4	65.4	90.1	374.8	180.7	555.5	3149.5	1 : 5.7
11-11	48.1	4.9	91.7	29.1	89.2	-	49.6	15.7	429.4	163.7	160.3	220.5	868.3	433.9	1302.2	9181.3	1 : 7.0
12-12	235.6	24.0	518.5	164.3	544.1	198.0	147.7	29.9	742.8	184.8	377.6	317.9	2566.3	918.9	3485.2	19439.1	1 : 5.6
13-13	40.9	4.2	105.8	33.5	243.9	88.8	129.6	26.2	723.5	180.0	370.3	311.8	1614.0	644.5	2258.5	14799.0	1 : 6.6
14-14	37.9	3.9	73.7	23.3	54.9	-	27.7	8.8	121.4	46.3	44.0	60.5	359.6	142.8	502.4	5614.5	1 : 11.2
TOTALS	582.5	94.0	1102.4	509.2	1383.8	477.3	872.7	155.7	5249.5	1399.4	2895.3	2082.7	12086.2	5218.3	17304.5	107538.2	1 : 6.2

Figures have been rounded to produce balanced table.

TABLE 2

DAMES & MOORE

WINDY AREA PIT COAL RESERVES AND WASTE STRIPPING

$8.1 m^3$/tonne

All Units x 10^3

SEAM	D		E		F		G		I/J		K		Total Raw Coal			Stripping	
SECTION	Coal Only tonnes	Waste only (Internal) tonnes	Coal Only tonnes	Waste only (Internal) tonnes	Coal Only tonnes	Waste only (Internal) tonnes	Coal Only tonnes	Waste only (Internal) tonnes	Coal Only tonnes	Waste only (Internal) tonnes	Coal Only tonnes	Waste only (Internal) tonnes	Coal Only tonnes	Waste only (Internal) tonnes	Total tonnes	Waste Volume m^3	Ratio raw coal : waste tonne : m^3
2-2	-	-	8.3	7.4	41.9	18.1	-	-	111.9 756.8	214.1	294.8	173.7	1213.7	413.3	1627.0	12196.0	1 : 7.5
3-3	220.8	154.2	244.5	240.9	226.0	83.3	206.6	119.2	1004.0	508.1	568.3	138.7	2470.2	1244.4	3714.6	27416.6	1 : 7.4
4-4	254.3	48.1	185.3	199.1	236.9	194.3	239.1	25.5	964.2	374.2	560.7	374.2	2440.5	1215.4	3655.9	33625.8	1 : 9.2
5-5	268.2	67.5	173.0	185.8	229.5	188.3	220.7	23.5	874.8	271.6	629.4	410.2	2395.6	1146.9	3542.5	28263.2	1 : 8.0
6-6	275.1	69.3	175.0	188.0	222.1	182.2	211.5	22.6	559.3	173.6	414.0	269.8	1857.0	905.5	2762.5	20858.9	1 : 7.6
7-7	193.2	33.3	216.5	152.5	259.3	31.6	308.3	14.3	627.8	360.2	393.8	256.7	1998.9	848.6	2847.5	26056.0	1 : 9.2
8-8	167.3	28.8	173.2	122.0	210.0	25.6	266.4	12.5	584.5	335.4	380.3	247.9	1781.7	772.2	2553.9	24796.8	1 : 9.7
9-9	167.3	28.8	175.4	123.6	212.6	25.9	254.4	11.9	525.0	3[illegible]1.2	329.9	215.0	1664.6	706.4	2371.0	22535.3	1 : 9.5
10-10	117.8	12.0	194.0	61.5	181.6	-	91.8	29.1	441.9	168.4	162.5	223.6	1189.6	494.6	1684.2	14822.0	1 : 8.8
11-11	151.5	15.4	250.4	79.4	224.7	-	112.2	35.6	871.3	332.1	257.4	354.0	1867.5	816.5	2684.0	21190.2	1 : 7.9
12-12	379.8	38.7	751.3	238.0	666.1	242.4	193.8	39.2	897.1	223.2	452.6	381.1	3340.7	1162.6	4503.3	29571.5	1 : 6.6
13-13	110.6	11.3	204.6	64.8	337.7	122.9	168.6	34.1	853.7	212.4	435.7	366.9	2110.9	812.4	2923.3	20515.6	1 : 7.0
14-14	105.5	10.8	174.6	55.3	135.7	-	84.5	26.8	242.7	92.5	88.1	121.1	831.1	306.5	1137.6	10616.4	1 : 9.3
TOTALS	2411.4	518.2	2926.1	1718.3	3184.1	1114.6	2357.9	394.3	9315.0	3567.0	4967.5	3532.9	25162.0	10845.3	36007.3	292464.3	1 : 8.12

Figures have been rounded to produce balanced table.

TABLE 3

DAMES & MOORE

ROMAN MOUNTAIN PIT COAL RESERVES AND WASTE STRIPPING

$4.0 m^3/tonne$

All Units x 10^3

SEAM	D		E		F		I/J		Total Raw Coal			Stripping	
SECTION	Coal Only tonnes	Waste only (Internal) tonnes	Coal Only tonnes	Waste only (Internal) tonnes	Coal Only tonnes	Waste only (Internal) tonnes	Coal Only tonnes	Waste only (Internal) tonnes	Coal Only tonnes	Waste only (Internal) tonnes	Total Raw Coal tonnes	Waste m^3	Ratio Raw Coal tonne : Waste Strip m^3
A-A	-	-	-	-	-	-	216.6	114.3	216.6	114.3	330.9	743.1	1 : 2.3
B-B	-	-	-	-	-	-	305.5	161.1	305.5	161.1	466.6	1058.3	1 : 2.3
C-C	-	-	-	-	11.8	2.3	652.7	344.2	664.5	346.5	1011.0	3167.1	1 : 3.1
D-D	36.6	37.8	29.2	13.5	61.7	12.1	944.3	498.0	1071.8	561.4	1633.2	5828.2	1 : 3.6
E-E	-	-	41.2	19.1	75.9	15.0	1055.4	556.6	1172.5	590.7	1763.2	5992.4	1 : 3.4
F-F	32.0	33.0	36.0	16.7	75.9	15.0	999.9	527.3	1143.8	592.0	1735.8	6112.6	1 : 3.5
G-G	59.5	61.4	48.1	22.3	90.1	17.7	1097.1	578.6	1294.8	680.0	1974.8	6814.8	1 : 3.5
H-H	-	-	37.8	17.5	99.6	19.6	1277.6	673.8	1415.0	710.9	2125.9	8064.2	1 : 3.8
I-I	160.2	165.2	77.3	35.9	147.0	28.9	1430.4	754.3	1814.9	984.3	2799.2	10605.0	1 : 3.8
J-J	233.5	240.7	108.2	50.2	184.9	36.5	1624.8	856.8	2151.4	1184.2	3335.6	13423.9	1 : 4.0
K-K	339.3	240.4	140.6	90.0	145.3	55.8	2152.1	701.8	2777.3	1088.0	3865.3	18562.4	1 : 4.8
L-L	408.2	289.2	161.2	103.2	164.4	63.2	2324.9	758.2	3058.7	1213.8	4272.5	20703.5	1 : 4.9
M-M	360.5	255.4	148.1	94.8	143.7	55.2	2089.2	681.3	2741.5	1086.7	3828.2	16538.8	1 : 4.3
N-N	84.8	60.1	71.2	45.6	89.4	34.4	1602.3	522.5	1847.7	662.6	2510.3	9371.7	1 : 3.7
O-O	-	-	-	-	-	-	848.5	276.6	848.3	276.6	1124.9	2714.5	1 : 2.4
TOTALS	1714.6	1383.2	898.9	508.8	1289.7	355.7	18621.1	8005.4	22524.3	10253.1	32777.4	129700.5	1 : 4.0

Figures have been rounded to produce balanced table.

TABLE 4

DAMES & MOORE

geotechnical items discussed in 2.2.3.

a) The dump limits will be 75 metres from the ultimate pit crest to allow for the pit power loop and access thereto, and to avoid surcharge problems.

b) The dump toes will be some 150 metres from significant streams, as noted on the available plans.

c) The dumps will be located on ground currently held by the owners.

d) The dumps will not be placed so as to sterilize potential future coal reserves amenable to either underground or open-pit methods (Note underground reserves may require as yet undetermined access and ventilation openings).

e) A swell factor of 1.3 will be assumed for run-of-mine waste.

f) The slope angle will be 30° for initial design purposes which is a compromise between the natural angle of repose (36°-38°) and the "biological angle of repose" (24°-28°), that is the angle above which special revegetation techniques would be required. The 30° slope can be obtained by dumping in, say, 15 metre lifts and by subsequent profile work.

g) The dumps will be accessed by haul roads of not steeper than 8%, and will be located compatibly with the coal haul road.

h) A minimum working width of 170 metres has been provided at the dump top, and the maximum elevation of the dump is not higher than 70 metres above the local pit crest.

Separate dump bases will be provided for oxidized coal, to reflect the potential future market for this product. These stockpiles are located in close proximity to the ultimate pits and adjacent to the haul roads, on levelled terrain to facilitate secondary recovery.

There is no information available at this time to comment upon the potential for spontaneous combustion of oxidized coal. Should the oxidized coal be prone to spontaneous ignition, then problems could arise if local amounts of such material were to form pockets in the general waste dump area. Once on fire, such material may be very difficult to extinguish. The proposed coal stockpile areas may require monitoring if there is evidence of spontaneous combustion potential.

Windy Pit - The dump volume required is some 290,000,000m^3, at an overall stripping ratio of 8.1m^3/tonne (the largest requirement considered here). Two main dump areas have been selected, dump 1 to the south west of the pit, and dump 2 to the north of the east section of the pit. At this time, no dumping over the Gething formation has been proposed, based upon uncertainty regarding potential future reserves in this member.

The capacity of number 1 dump is approximately 120,000,000m^3, and number 2 dump will contain about 70,000,000m^3. The remaining requirements can be placed between dumps 1 and 2, with some capacity available for material to be dumped back in the pit as mining close to the outcrops is pushed back to limit.

Roman Mountain Pit - The dump volume required is approximately 170,000,000m^3, at an overall stripping ratio of 4.0m^3/tonne. Two dump areas were selected, to the south and west of the ultimate pit, based on the criteria noted earlier, and the following points:

a) Better revegetation potential on southern facing slopes, and improved aesthetics with respect to dump visibility from the plant area.

b) Coal haul road from higher coal reserves to be constructed on the northern slope of Roman Mountain, on account of reduced problems anticipated with freeze/thaw cycle and associated road maintenance problems.

Number 1 dump has a capacity of approximately $80,000,000m^3$ and number 2 dump will contain aobut $90,000,000m^3$. Alternative dump capacity could be selected to the immediate south east of the mine.

2.2.8 General Recommendations

It is recognized that the mining design concepts explored in this section on open-pit work are based upon preliminary geological data, and initial corporate objectives for the property. Within this framework, a number of areas for future work can be identified that would have direct bearing upon definitive feasibility study. Roman Mountain reserves have been indicated by surface mapping and trenching, supported by two diamond drill holes, and clearly greater drill coverage is required to prove up this deposit. Much data of a geotechnical and hydrological nature would be available from such a drill program, and it is recommended that this input be obtained at that time. Similar remarks apply to coal reserves adjacent to the prospective highwall position of the Windy area, where drill coverage is somewhat sparse.

Potential rock slope failure in both pit areas, and along rock-cuts excavated for haulage road construction are likely to be structurally controlled. Structural geological data (faults, shears, joints, etc.) will provide useful input to future design work. Similarly, regional and local soils properties will influence approaches to plant site selection, road and rail routes and design factors.

The study presented herein is based upon bringing both the Windy area pit and the Roman Mountain pit on stream simultaneously. This strategy should be subject to scrutiny, since there is evidence such an approach would be sub-optimal. For example, early capital requirements will be increased, with respect to a case which proposed the early development of reserves in close proximity to the plant site. Preparatory access, power and stripping requirements will be duplicated, and key supervisory resources will be dispersed geographically.

Roman Mountain reserves may be completely extracted within the limits imposed by the lower tentative overall stripping criteria, and this should be verified, as new drilling is completed. The effect of various cut-off criteria on the Windy reserves should be examined to develop a conventional ultimate pit, and at the same time, an evaluation may be made of the optimum economic criteria for transition to underground methods.

Geological mapping and limited drilling should be completed to ensure that selected dump areas do not contain reserves of coal and minerals that would be sterilized by dump placement.

APPENDIX 1

CUT-OFF STRIPPING RATIO CALCULATIONS

Selling Price of Coal F.O.B. Port	49.22/tonne
Plant Recovery, assume 70%	
Net Selling Price, in-situ Equivalent, Raw	34.45/tonne
Coal Mining Cost Average	1.48/tonne
Depreciation, assume	0.49/tonne
Total Cost Mining Raw Coal, Raw Equivalent	1.97/tonne
Rail Cost, Raw Equivalent	8.27/tonne
Wharf Cost	2.07/tonne
Royalty	1.03/tonne
Land Tax	0.25/tonne
Stripping Cost/m^3 average	1.57
Depreciation, assume/m^3	0.12
Total Cost Mining Waste at 2.37 S.G.	1.69
Wash Plant Operating Costs, assume	1.03/tonne
Depreciation, assume	0.98/tonne
Total Wash Plant Costs, Raw Coal	2.28/tonne
Minimum Profit, or Contingency Factor	5.89

(Based upon 40% of total costs at an operating ratio of 7.5m^3/tonne)

The Cut-off Stripping Ratio:

$$= \frac{\text{Recoverable value/tonne - (Mining and Processing costs/tonne, including contingency, but exclusive of stripping)}}{\text{Stripping Cost/m}^3}$$

$$= \frac{(34.45) - (1.97 + 8.27 + 2.07 + 1.03 + 0.25 + 2.28 + 5.89)}{1.69}$$

$= 7.5m^3$/tonne.

Note: These estimates may be influenced by rates of production and scale of operations.

APPENDIX 2

CAPITAL COST ESTIMATION

The preliminary capital cost estimations presented below, are based on the following assumptions:

1) Annual clean coal requirement 1,500,000 tonnes
2) Plant recovery 0.70
3) Annual raw coal requirement 2,143,000 tonnes, equally distributed from Windy Pit and Roman Pit
4) Waste stripping to be mined at the overall stripping ratio for each pit Windy a) 6.2m^3/tonne, b) 8.1m^3/tonne; Roman 4.0m^3/tonne.
5) For daily production estimates the following capital equipment is regarded as captive in each pit; Shovels, Drills, Dozers.
6) Mobile equipment includes Trucks, Front-End Loaders, Service Vehicles.
7) Operating days per annum, assume 350 days, 3 shifts per day. (Unit requirements are directly related to the individual operating shift schedule).

DRILLS

a) Waste

One 15m drill hole on a 9m x 9m pattern gives 1134m^3 waste. (1m subgrade).

Daily waste required 1) Windy at O.S.R. (i) 6.2m^3/tonne
(ii) 8.1m^3/tonne

2) Roman at O.S.R. 4.0m^3/tonne

Drilling rate 0.3m/minute for 400 minutes/shift; 8 holes capacity.

Drill availability 0.8

Number of holes required per day:

1) Windy at O.S.R. (i) $\frac{1,071,500 \times 6.2}{350 \times 1134} = 16.7$

(ii) $\frac{1,071500 \times 8.12}{350 \times 1134} = 21.9$

2) Roman at O.S.R. $\frac{1,071,500 \times 4.0}{350 \times 1134} = 10.8$

Number of drills required:

1) Windy at O.S.R. (i) $\frac{16.7}{19} = 0.9$ or say 1 unit

(ii) $\frac{21.9}{19} = 1.15$ or say 1 unit

2) Roman at O.S.R. $\frac{10.8}{19} = 0.57$ or say 1 unit

b) Perimeter Drilling and Angle Drilling

Allow one unit; angle drilling only required at Roman, and perimeter blasting not required in early production.

SHOVELS

a) Waste

One 13m^3 shovel will dig at 870m^3/hour

Daily stripping required 1) Windy (i) 18980m^3

(ii) 24860m^3

2) Roman 12245m^3

Allow 7 hours operating/shift and 0.9 availability

Number of shovels required 1) Windy (i) 1.15 say 1 unit

(ii) 1.5 way 2 units

2) Roman 0.74 say 1 unit

b) Coal

Assume that in the case of Roman pit, 50% of the coal will be mined by shovel, and 50% by front end loader;

All Windy coal will be extracted using front end loaders.

One $13m^3$ shovel will dig approximately 1000 tonnes/hour

Daily shovel coal loading required 1530 tonnes

Shovel capacity required 0.08 units

Thus overall shovel requirements are (1) Windy at $6.2m^3$/tonne 2 units total

(ii) Windy at $8.12m^3$/tonne 3 units total

DOZERS

a) Windy Pit

Annual requirement 1,071,500 tonnes of raw coal

Assume all output will be ripped and dozed.

Over an operating distance of 0' - 75m, one dozer will rip and push in a shift of 400 minutes approximately 2000 tonnes.

Availability 0.75

Dozer required in coal $= \frac{1,071,500}{350 \times 3 \times 2000 \times 0.75} = 0.68$, say 1 unit

b) Roman Pit

Annual requirement 1,071,500 tonnes of raw coal

Assume 50% of the output will be ripped and pushed

Dozers required in coal $= \frac{535,750}{350 \times 3 \times 2000 \times 0.75} = 0.34$, say ½ unit

In addition, 1½ units will be required for dump work, and 2 units for miscellaneous duties, total Dozers - 5.

FRONT END LOADERS

a) Windy Pit

All coal requirement loaded with front end loader equipment

Assume output of 400 tonnes per hour, for 6½ operating hours per shift, and 0.7 availability.

$$\text{Loaders required} = \frac{1,071,500}{350 \times 3 \times 6.5 \times 400 \times 0.7} = 0.56, \text{ say } \underline{1 \text{ unit}}$$

b) Roman Pit

Assume 50% of requirement handled with front end loaders.

$$\text{Loaders required} = \frac{535.750}{350 \times 3 \times 6.5 \times 400 \times 0.7} = 0.28, \text{ say } \underline{1 \text{ unit}}$$

TRUCKS

Fleet requirements based upon the use of 170 tonne trucks with a rated capacity of $85m^3$ payload.

a) Coal

(i) Windy Pit

Required production per operating shift = 1020 tonnes

Typical trips per unit per shift, haul distance 7.5 km is 8.

Availability 0.80

$$\text{*Coal Fleet required } \frac{1020}{8 \times 140 \times 0.8} = 1.14$$

(ii) Roman Pit

Typical trips per unit per shift, haul distance 7.5 km is 8.

$$\text{Coal fleet required } \frac{1020}{8 \times 140 \times 0.8} = 1.14 \text{ (see 1 above)}$$

b) Waste

Combined waste requirement per shift

(i) Windy at $6.2m^3$/tonne O.S.R.

Typical output 20 trips per truck shift of 7 operating hours.

$$\text{Fleet required Windy} = \frac{1,071,500 \times 6.2}{350 \times 3 \times 20 \times 85 \times 0.8} = 4.65 \text{ units}$$

$$\text{Fleet required Roman} = \frac{1,071,500 \times 4.0}{350 \times 3 \times 20 \times 85 \times 0.8} = 3.00 \text{ units}$$

(ii) Windy at $8.12m^3$/tonne O.S.R.

$$\text{Fleet required Windy} = \frac{1,071,500 \times 8.12}{350 \times 3 \times 20 \times 85 \times 0.8} = 6.09 \text{ units}$$

* Assume S.G. of raw coal as mined is 1.60, and effective coal payload in 170 tonne standard truck is 140 tonnes.

Fleet required Roman = 3 units

Total Fleet requirements, coal and waste are:

a) Windy at 6.2m^3/tonne O.S.R. 10 units

b) Windy at 8.12m^3/tonne O.S.R. 12 units

ROADWAYS

a) Plant to Windy area distance 6.85 kilometres

Road construction cost at $60/m $411,000

b) Plant to Roman area distance 3.05 kilometres

Road construction cost at $60/m $183,000

POWERLINES

a) (i) Main line to Windy area distance 6.85 kilometres

Pole line cost at $20/m $137,000

(ii) Pit loop line distance 6.4 kilometres

Pole line cost at $15/m $ 96,000

b) (i) Main line to Roman area distance 2.74 kilometres

Pole line cost at $20/m $ 55,000

(ii) Pit loop line distance 6.1 kilometres

Pole line cost at $15/m $ 91,000

CAPITAL COST SUMMARY - Major Mine Equipment, both pits.

	Windy at 6.2m^3/tonne	Windy at 8.12m^3/tonne
Drills	1,007,000	1,007,000
Shovels	3,618,000	5,427,000
Loaders	772,000	772,000
Dozers	1,185,000	1,185,000
Trucks	5,510,000	6,612,000
Miscellaneous field	999,000	999,000
Roadways	594,000	594,000
Powerlines	379,000	379,000
TOTALS	$ 14,064,000	$ 16,975,000

OPEN PIT MINE EQUIPMENT SUMMARY

ITEM	CAPITAL COST*	OPERATING LIFE (Yrs)	AVAIL-ABILITY	TOTAL REQUIREMENT Windy at 6.2	Windy at 8.12	NOTES
MAJOR EQUIPMENT						
Drill (Production)	416,000	20	0.8	2	2	
(Special)	175,000	20	0.8	1	1	
Shovel	1,809,000	20	0.9	2	3	
Dozer	237,000	10	0.75	5	5	
Front End Loader	386,000	8	0.70	2	2	
Truck	551,000	10	0.80	10	12	
GENERAL EQUIPMENT						
Grader	154,000	10	0.80	4	4	
Air Track	58,000	10	0.85	2	2	
Supply Truck	48,000	10	0.85	3	3	
Water Truck	48,000	10	0.85	1	1	
Bulk Explosives	-	-	-	-	-	...der Supplier
Flatbed	75,000	10	0.85	1	1	

*All Capital Costs include a 5% spares inventory.

APPENDIX 3

OPERATING COST ESTIMATE

Windy Area	$
Direct cost of mining raw coal	1.33/tonne
Direct cost of stripping - both pits	1.57/m^3
Direct operating cost mining and stripping at O.S.R. 6.2m^3/tonne	11.06/tonne raw coal
Direct operating cost mining and stripping at O.S.R. 8.1m^3/tonne	14.05/tonne raw coal

Roman Area	
Direct cost of mining raw coal	1.63/tonne
Direct cost of mining and stripping at O.S.R. 4.0m^3/tonne	7.91/tonne raw coal

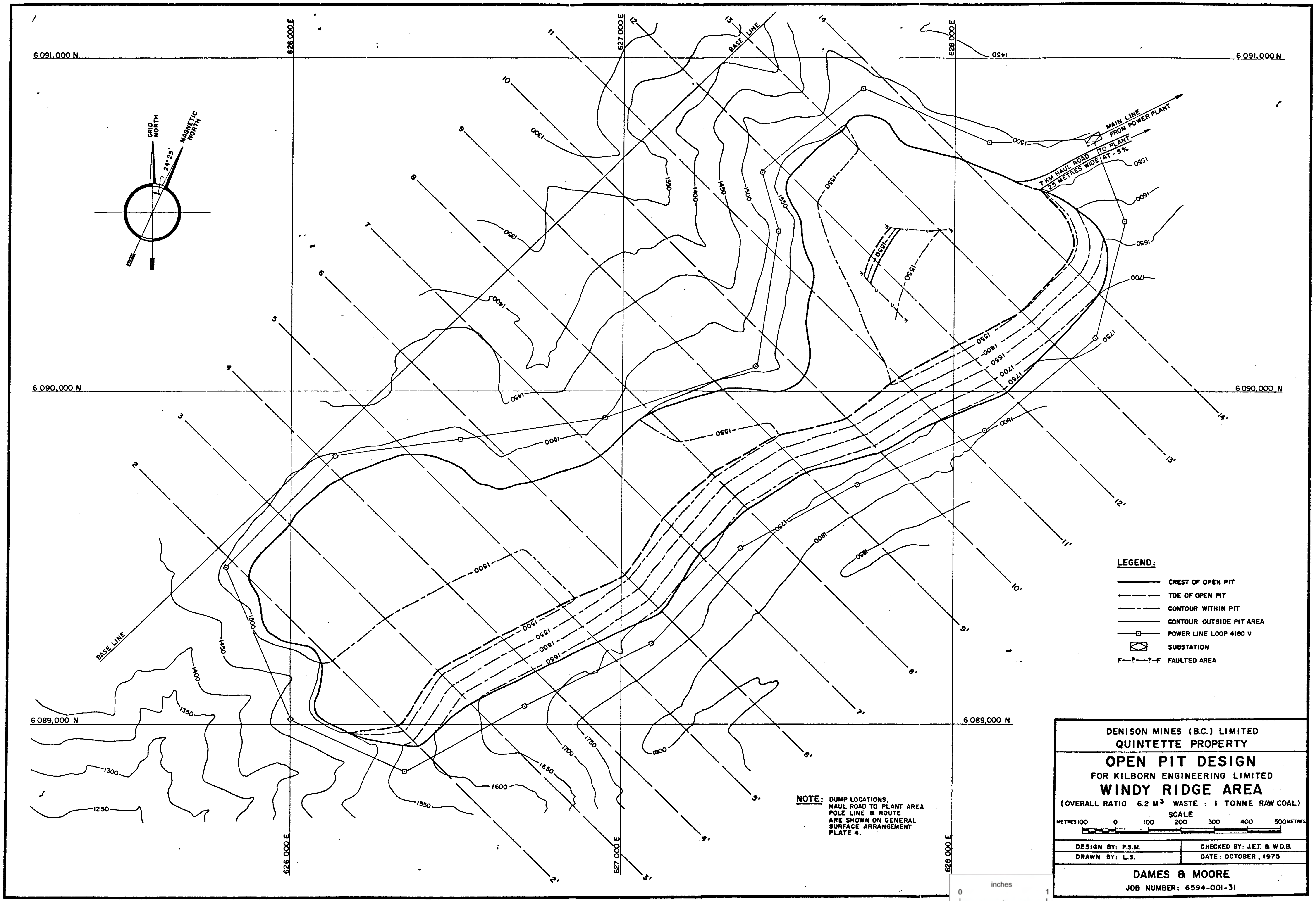
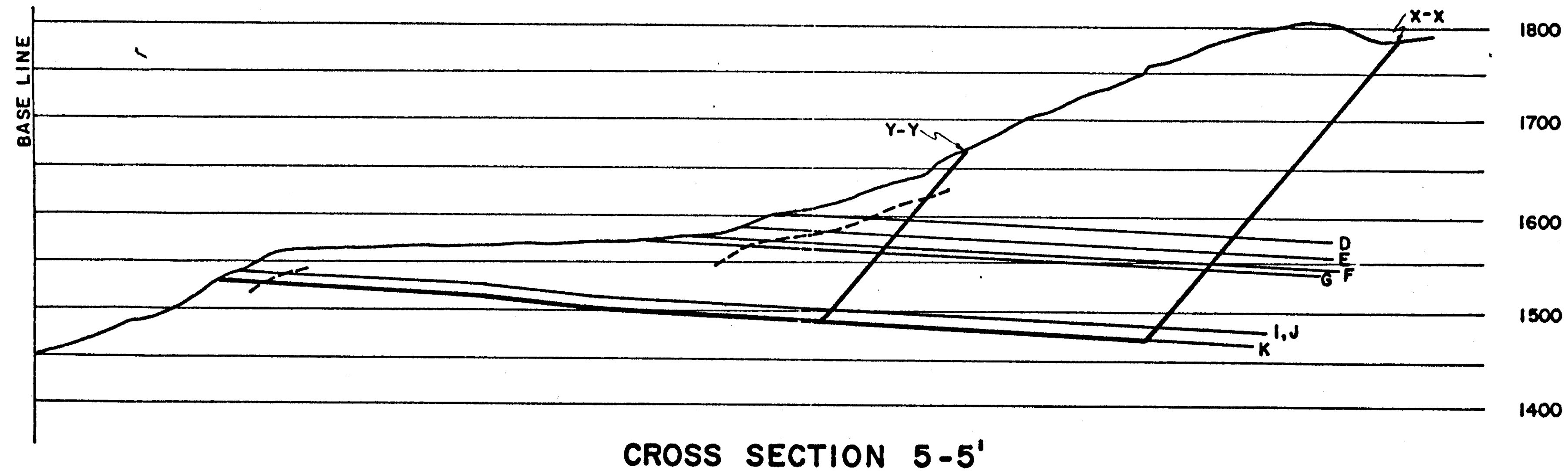
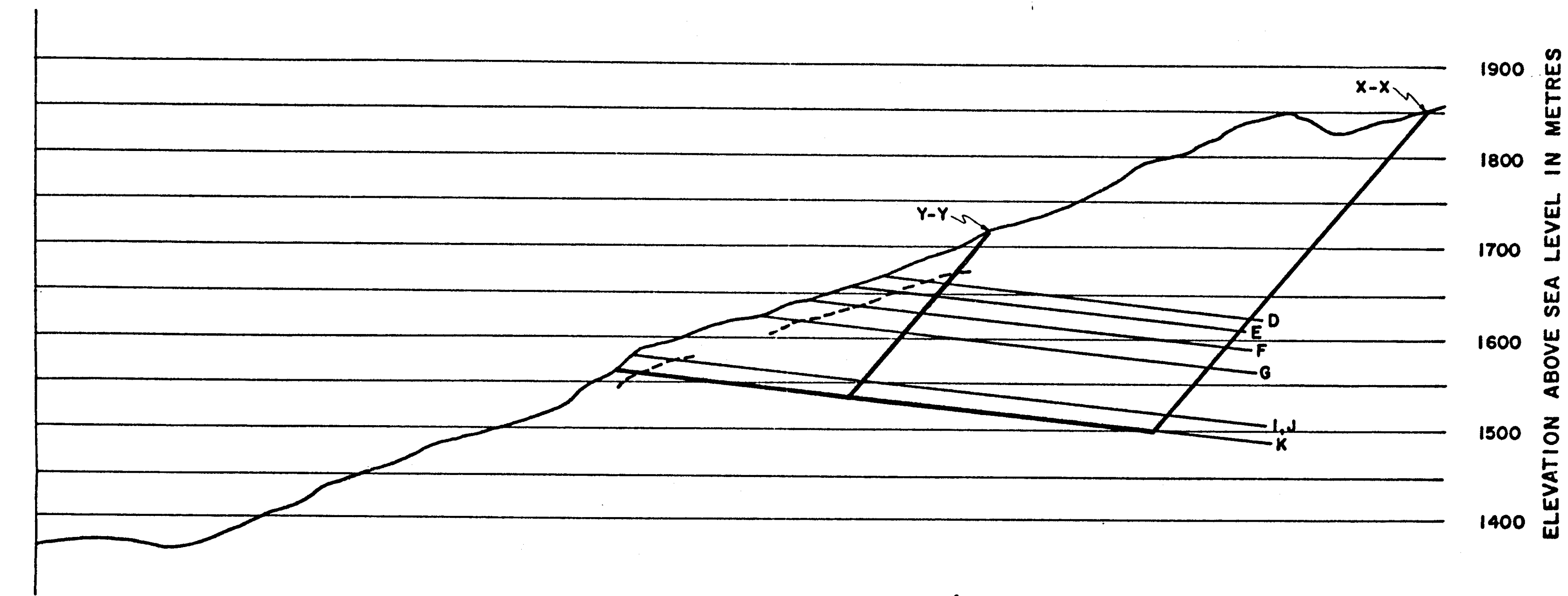

DENISON MINES (B.C.) LIMITED
QUINTETTE PROPERTY
OPEN PIT DESIGN
FOR KILBORN ENGINEERING LIMITED
WINDY RIDGE AREA
(OVERALL RATIO 6.2 M3 WASTE : 1 TONNE RAW COAL)
SCALE
METRES 100 0 100 200 300 400 500 METRES
DESIGN BY: P.S.M.
DRAWN BY: L.S.
CHECKED BY: J.E.T. & W.D.B.
DATE: OCTOBER, 1975
DAMES & MOORE
JOB NUMBER: 6594-001-31
LEGEND:
CREST OF OPEN PIT
TOE OF OPEN PIT
CONTOUR WITHIN PIT
CONTOUR OUTSIDE PIT AREA
POWER LINE LOOP 4160 V
SUBSTATION
FAULTED AREA
NOTE: DUMP LOCATIONS, HAUL ROAD TO PLANT AREA POLE LINE & ROUTE ARE SHOWN ON GENERAL SURFACE ARRANGEMENT PLATE 4.
GRID NORTH
MAGNETIC NORTH
24°25'
MAIN LINE FROM POWER PLANT
7 KM HAUL ROAD TO PLANT
25 METRES WIDE AT -5%
BASE LINE
6 091,000 N
6 090,000 N
6 089,000 N
626 000 E
627 000 E
628 000 E

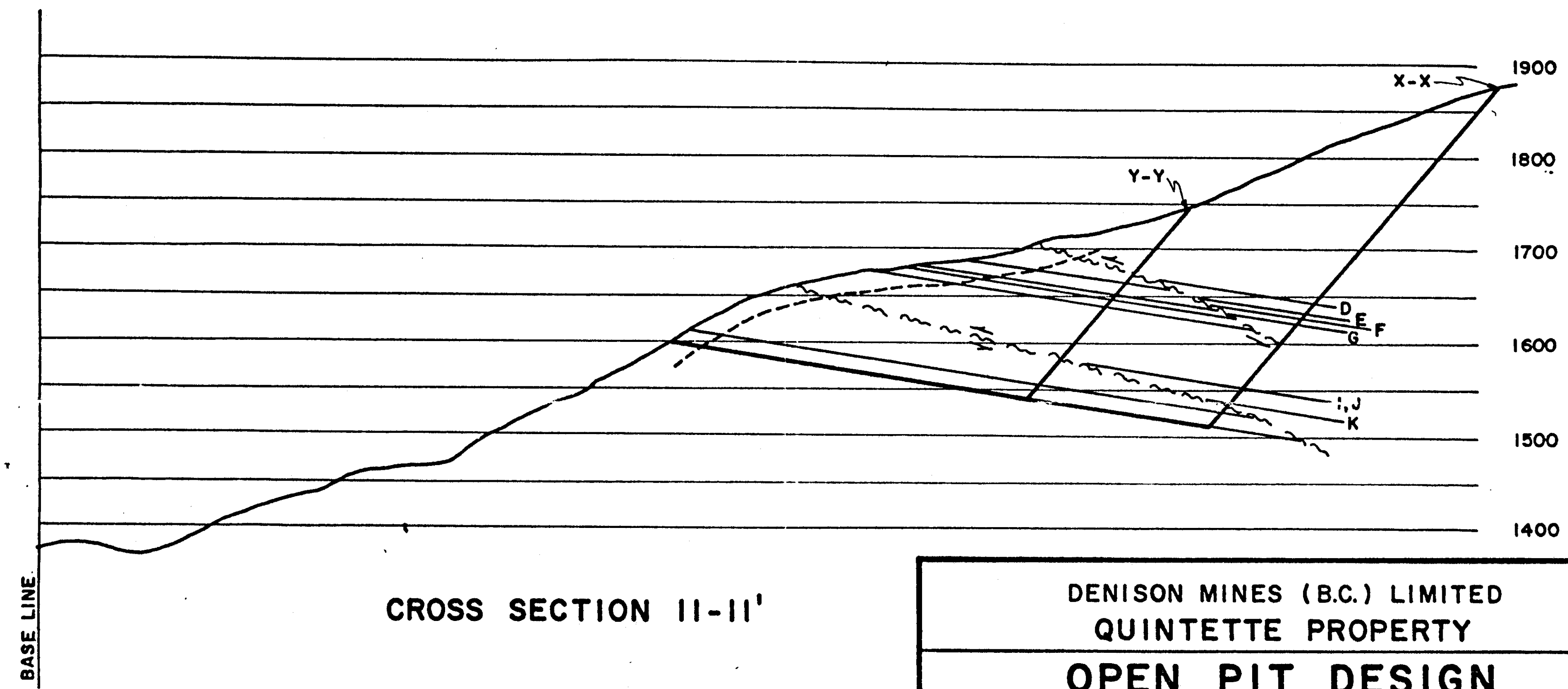
PLATE 2A



CROSS SECTION 5-5'



CROSS SECTION 8-8'



CROSS SECTION 11-11'

LEGEND:

- - - - - -	LIMIT OF OXIDATION
———— D	COAL SEAM
━━━━	OUTLINE OF OPEN PIT
~ ~ ~ ~	FAULT
X-X	HIGH WALL AT 8.1 M^3/ TONNE
Y-Y	HIGH WALL AT 6.2 M^3/ TONNE

DENISON MINES (B.C.) LIMITED
QUINTETTE PROPERTY

OPEN PIT DESIGN

FOR KILBORN ENGINEERING LIMITED

WINDY AREA CROSS SECTIONS

(3 TYPICAL EXAMPLES)

SCALE

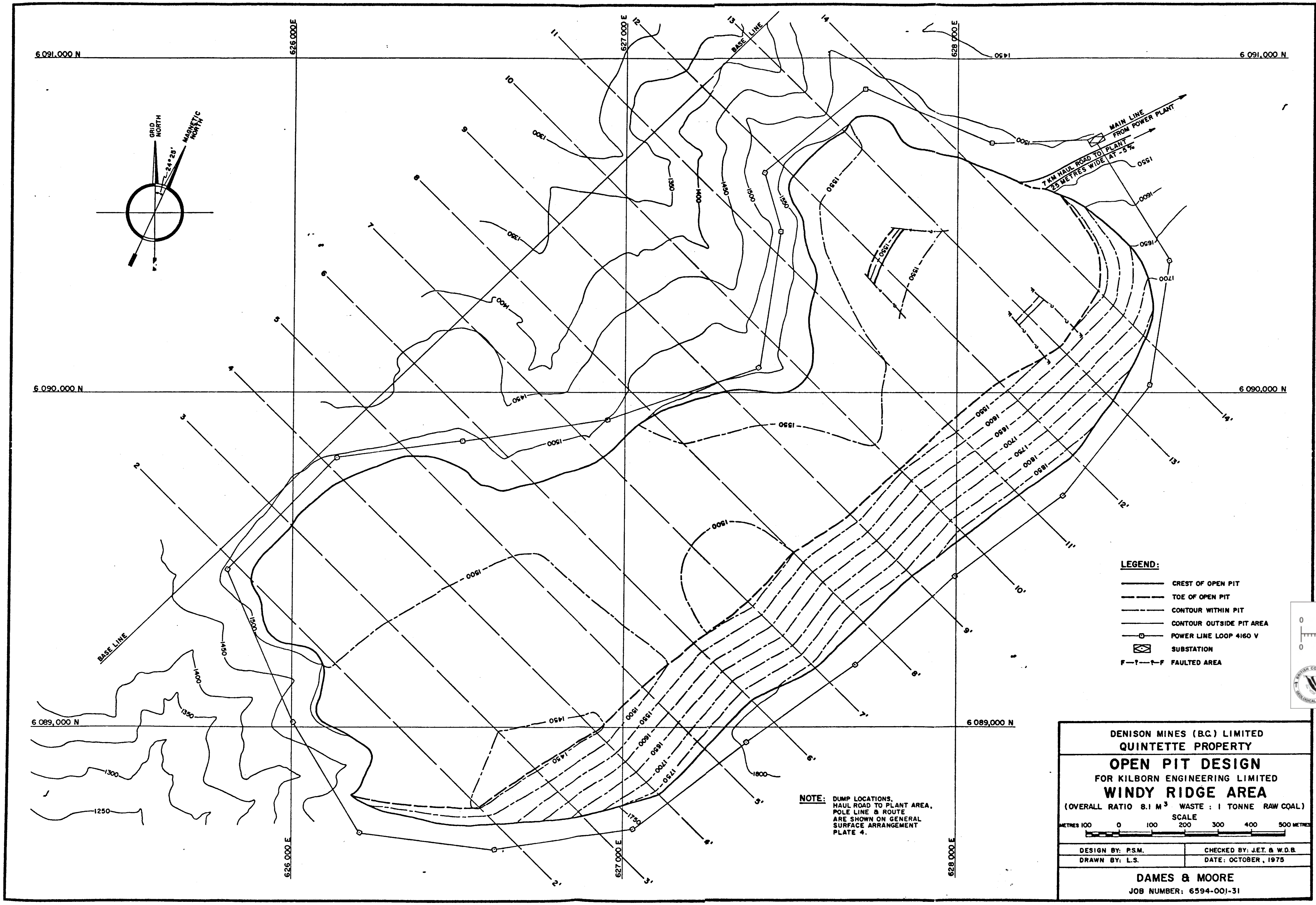
METRES 100 0 100 200 300 400 500 METRES

DESIGN BY: P.S.M.	CHECKED BY: J.E.T. & W.D.B
DRAWN BY: L.S.	DATE: OCTOBER, 1975

DAMES & MOORE

JOB NUMBER: 6594-001-31

PLATE 2B



6 091,000 N
6 090,000 N
6 089,000 N
626 000 E
627 000 E
628 000 E
GRID NORTH
MAGNETIC NORTH
24°28'
BASE LINE
7 KM HAUL ROAD TO PLANT
25 METRES WIDE AT -5%
MAIN LINE
FROM POWER PLANT
LEGEND:
CREST OF OPEN PIT
TOE OF OPEN PIT
CONTOUR WITHIN PIT
CONTOUR OUTSIDE PIT AREA
POWER LINE LOOP 4160 V
SUBSTATION
F—?—?—F FAULTED AREA
NOTE: DUMP LOCATIONS, HAUL ROAD TO PLANT AREA, POLE LINE & ROUTE ARE SHOWN ON GENERAL SURFACE ARRANGEMENT PLATE 4.
DENISON MINES (B.C.) LIMITED
QUINTETTE PROPERTY
OPEN PIT DESIGN
FOR KILBORN ENGINEERING LIMITED
WINDY RIDGE AREA
(OVERALL RATIO 8.1 M³ WASTE : 1 TONNE RAW COAL)
SCALE
METRES 100 0 100 200 300 400 500 METRES
DESIGN BY: P.S.M.
DRAWN BY: L.S.
CHECKED BY: J.E.T. & W.D.B.
DATE: OCTOBER, 1975
DAMES & MOORE
JOB NUMBER: 6594-001-31

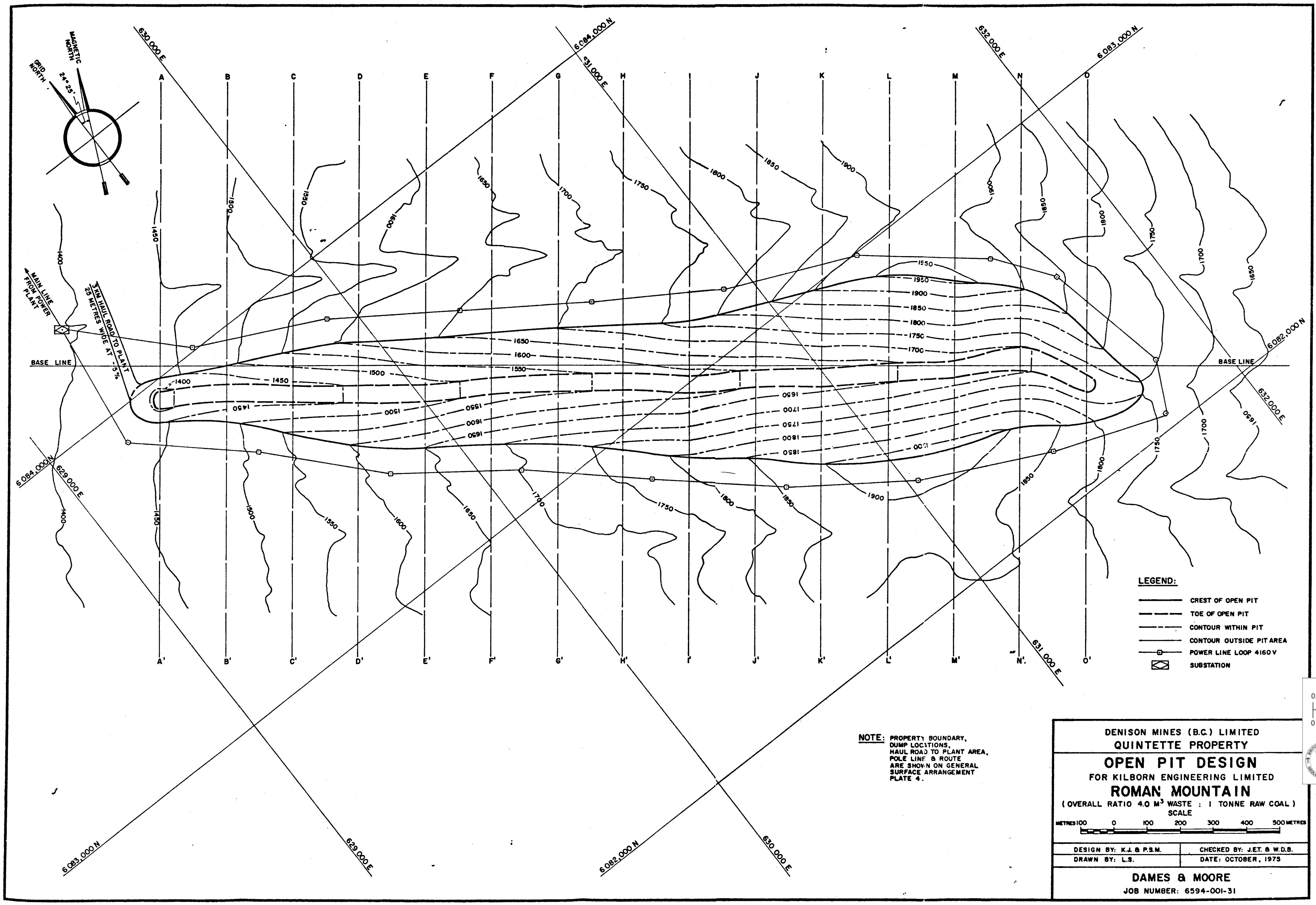
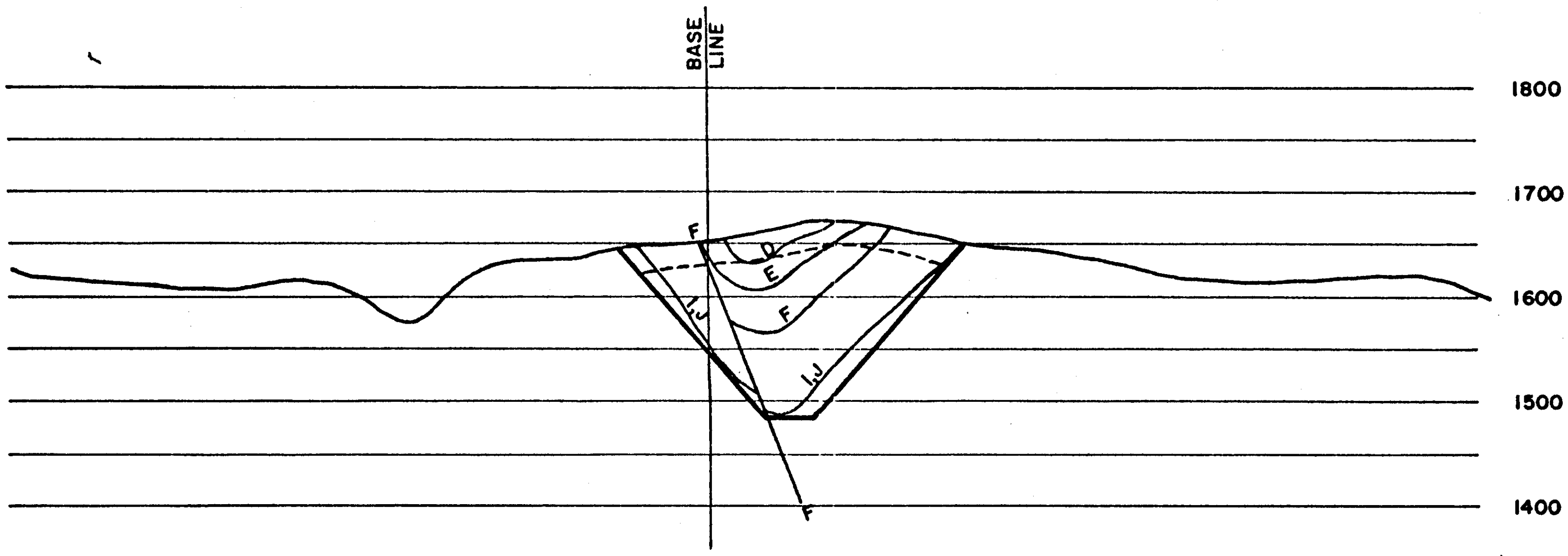
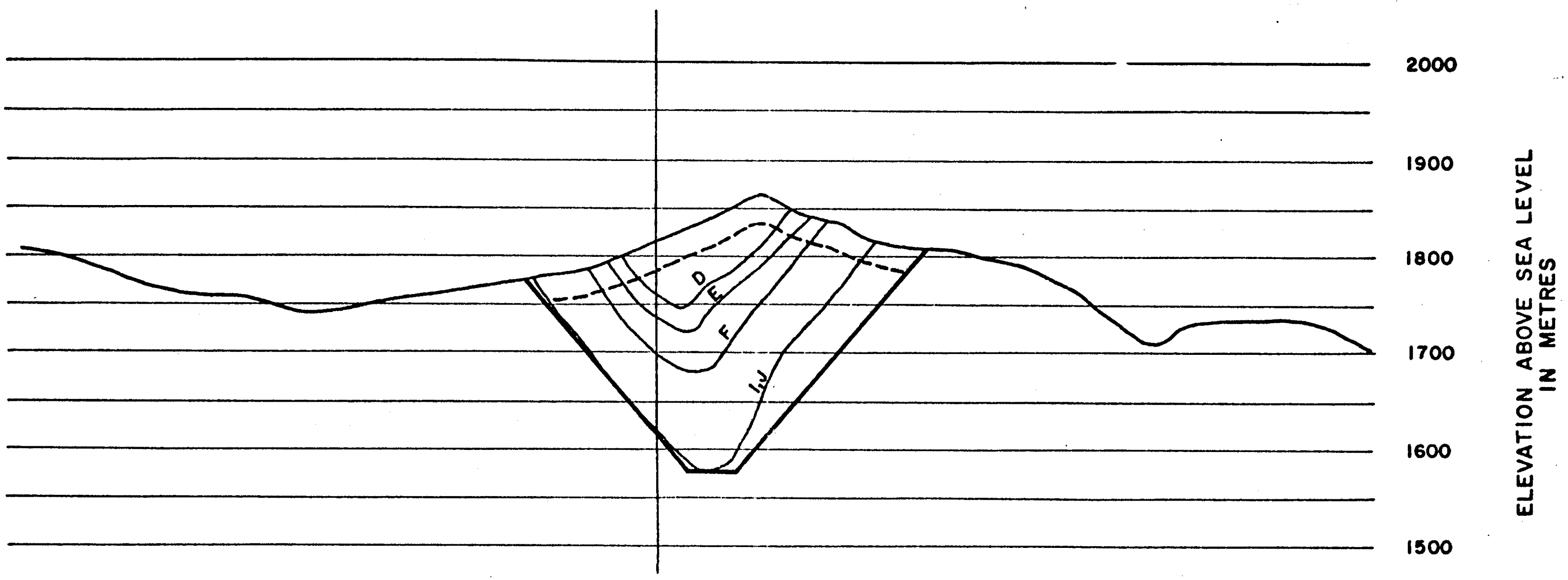

MAGNETIC NORTH
GRID NORTH
24° 25'
MAIN LINE FROM POWER PLANT
3 KM HAUL ROAD TO PLANT 25 METRES WIDE AT -5%
BASE LINE
630,000 E
6,084,000 N
631,000 E
632,000 E
6,083,000 N
6,082,000 N
629,000 E
LEGEND:
CREST OF OPEN PIT
TOE OF OPEN PIT
CONTOUR WITHIN PIT
CONTOUR OUTSIDE PIT AREA
POWER LINE LOOP 4160 V
SUBSTATION
NOTE: PROPERTY BOUNDARY, DUMP LOCATIONS, HAUL ROAD TO PLANT AREA, POLE LINE & ROUTE ARE SHOWN ON GENERAL SURFACE ARRANGEMENT PLATE 4.
DENISON MINES (B.C.) LIMITED
QUINTETTE PROPERTY
OPEN PIT DESIGN
FOR KILBORN ENGINEERING LIMITED
ROMAN MOUNTAIN
(OVERALL RATIO 4.0 M³ WASTE : 1 TONNE RAW COAL)
SCALE
METRES 100 0 100 200 300 400 500 METRES
DESIGN BY: K.J. & P.S.M.
CHECKED BY: J.E.T. & W.D.B.
DRAWN BY: L.S.
DATE: OCTOBER, 1975
DAMES & MOORE
JOB NUMBER: 6594-001-31

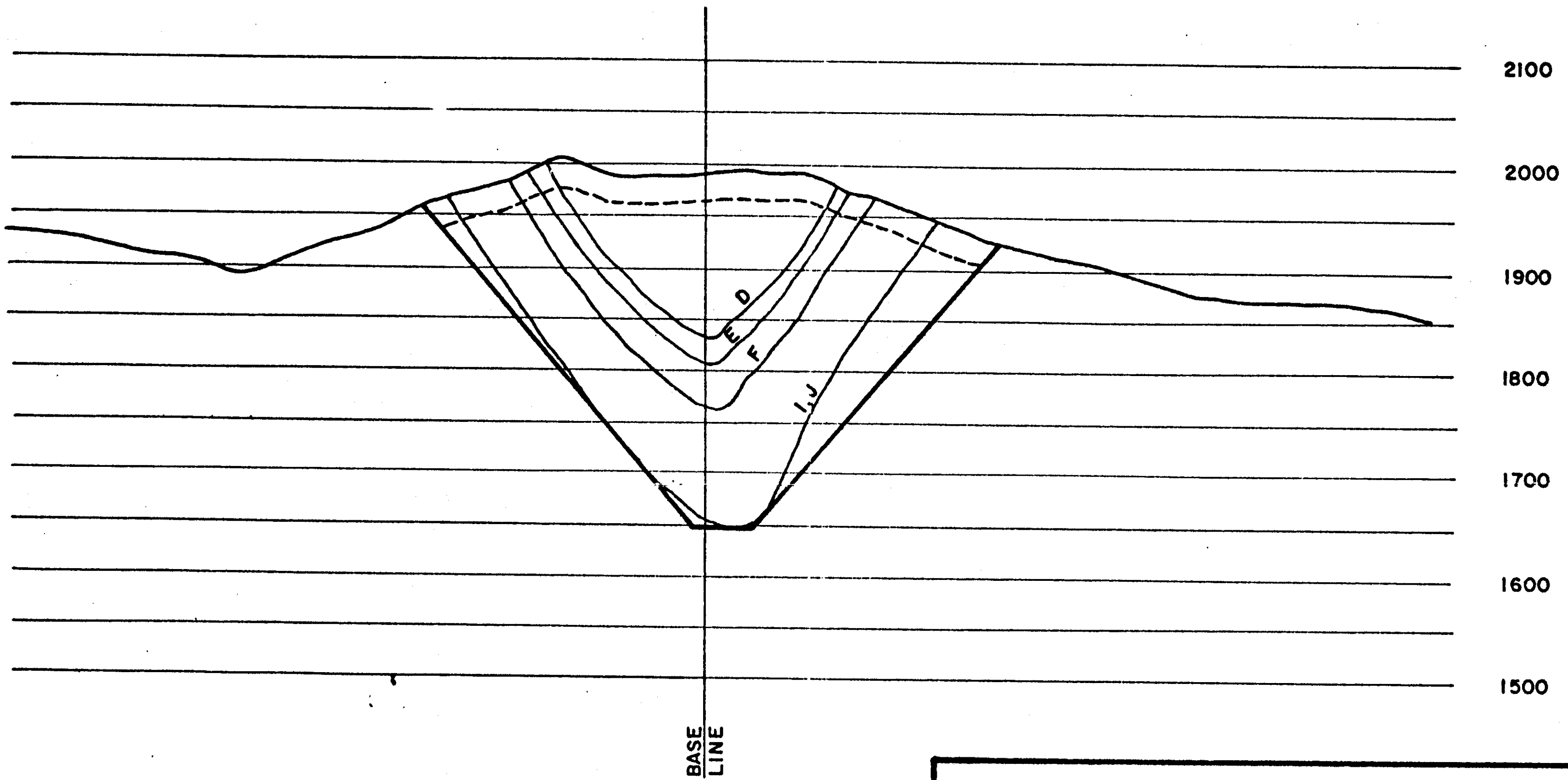
PLATE 3A



CROSS SECTION E-E'



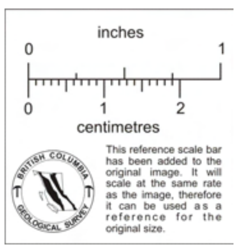
CROSS SECTION I-I'



CROSS SECTION L-L'

LEGEND:

- ------ LIMIT OF OXIDATION
- ——D COAL SEAM
- —— OUTLINE OF OPEN PIT
- F——F FAULT



DENISON MINES (B.C.) LIMITED

QUINTETTE PROPERTY

OPEN PIT DESIGN

FOR KILBORN ENGINEERING LIMITED

ROMAN MOUNTAIN CROSS SECTIONS

(3 TYPICAL EXAMPLES)

SCALE

METRES 100 0 100 200 300 400 500 METRES

DESIGN BY: K.J.	CHECKED BY: J.E.T. & W.D.B.
DRAWN BY: L.S.	DATE: OCTOBER, 1975

DAMES & MOORE

JOB NUMBER: 6594-001-31

PLATE 3B

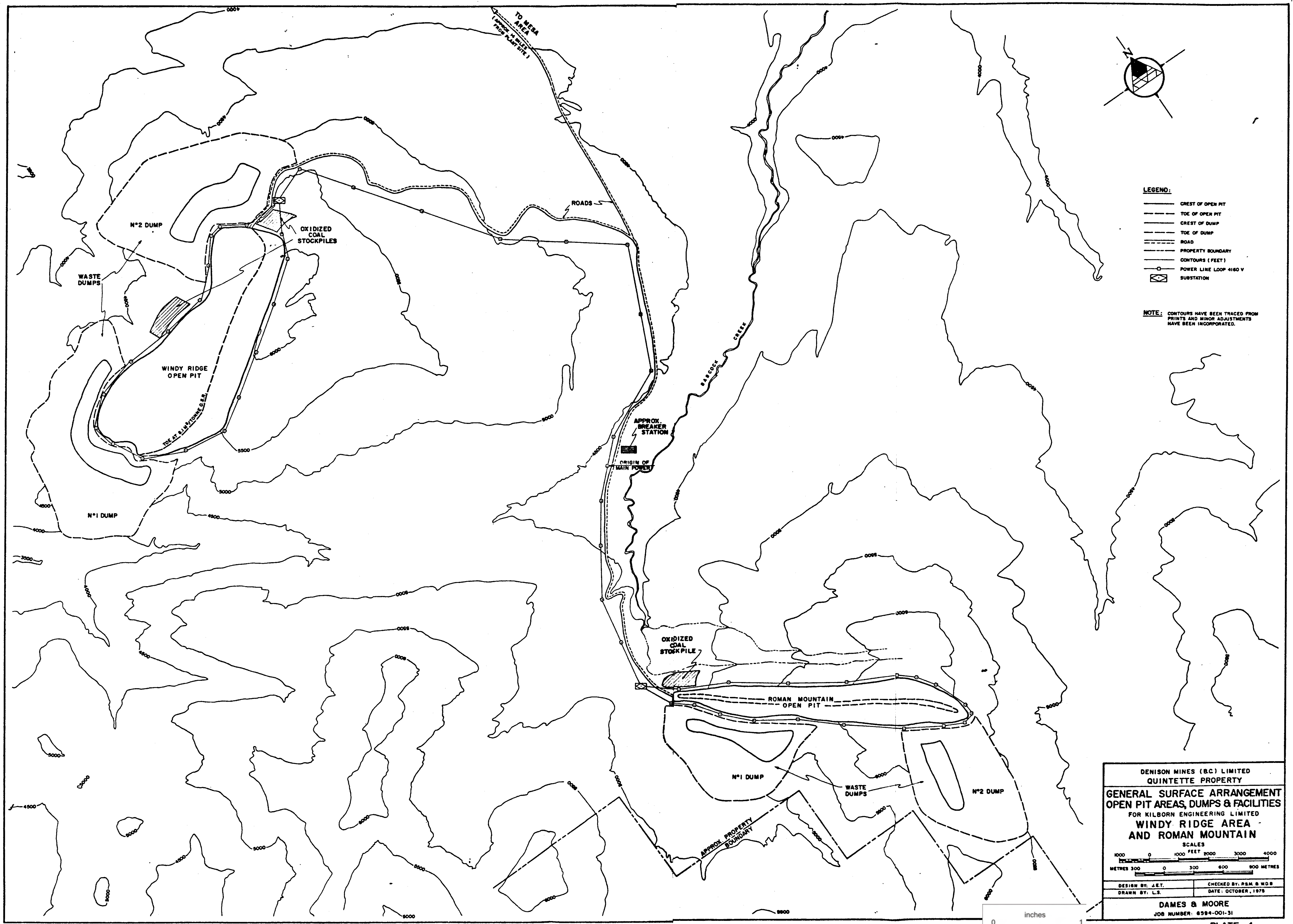

TO MESA AREA
(APPROX. 14 MILES FROM PLANT SITE)
ROADS
N°2 DUMP
OXIDIZED COAL STOCKPILES
WASTE DUMPS
WINDY RIDGE OPEN PIT
N°1 DUMP
BABCOCK CREEK
APPROX. BREAKER STATION
ORIGIN OF MAIN POWER
OXIDIZED COAL STOCKPILE
ROMAN MOUNTAIN OPEN PIT
N°1 DUMP
WASTE DUMPS
N°2 DUMP
APPROX. PROPERTY BOUNDARY
4000
4500
5000
5500
6000
6500
N
LEGEND:
CREST OF OPEN PIT
TOE OF OPEN PIT
CREST OF DUMP
TOE OF DUMP
ROAD
PROPERTY BOUNDARY
CONTOURS (FEET)
POWER LINE LOOP 4160 V
SUBSTATION
NOTE: CONTOURS HAVE BEEN TRACED FROM PRINTS AND MINOR ADJUSTMENTS HAVE BEEN INCORPORATED.
DENISON MINES (B.C.) LIMITED
QUINTETTE PROPERTY
GENERAL SURFACE ARRANGEMENT
OPEN PIT AREAS, DUMPS & FACILITIES
FOR KILBORN ENGINEERING LIMITED
WINDY RIDGE AREA
AND ROMAN MOUNTAIN
SCALES
FEET
1000 0 1000 2000 3000 4000
METRES 300 0 300 600 900 METRES
DESIGN BY: J.E.T.
CHECKED BY: R.S.M. & W.D.B.
DRAWN BY: L.S.
DATE: OCTOBER, 1975
DAMES & MOORE
JOB NUMBER: 6594-001-31

PLATE 4