CYPRUS ANVIL MINING CORPORATION

VANCOUVER BRITISH COLUMBIA

TULAMEEN COAL PROJECT

PRELIMINARY FEASIBILITY STUDY

PROJECT 1117-100 APRIL 1981

WRIGHT ENGINEERS LIMITED

VANCOUVER CANADA

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TRANSMITTAL LETTER

SUMMARY AND CONCLUSIONS

Please refer to Graphs I through IV. The following table summarizes the price of clean coal in Beg. 1982 $CDN per MT to yield a return on investment of 15% for the two cases considered. For each of the cases the effect of three levels of rail and port charges - Low: $C 14.00/CMT; Medium: $C 16.00/CMT; High: $C 18.00/CMT - were analyzed.

Price of Coal
(1982 $C/CMT)

Rail & Port Charges	High	Medium	Low
Case B	63.50	61.80	60.00
Case D	59.50	57.70	55.50

Should a higher than 15% ROI be required, the necessary price of coal can easily be determined for the appropriate case from Graphs I and II. Graphs III and IV illustrate the sensitivity of the coal price required to yield a ROI of 15% with fluctuations in rail and port charges.

RESULTS

The percentage return on investment for the various price assumptions in the cases considered can be summarized as follows:

Case B

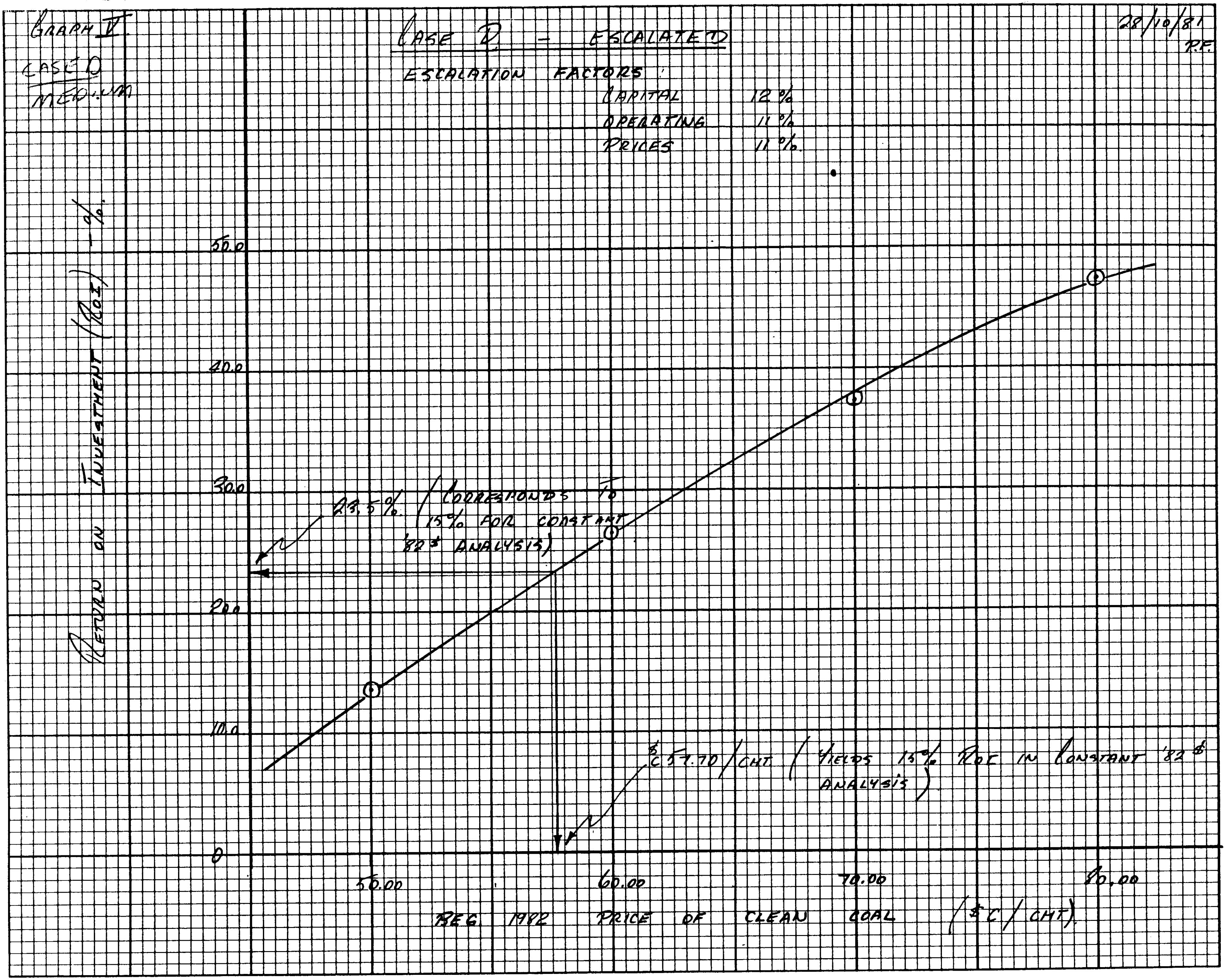
Return on Investment (%)

	Coal Price ($CDN/CMT)		
	50.00	65.00	80.00
Rail & Port Charges			
High - $C18.00/CMT	1.00	16.20	28.20
Medium - $C16.00/CMT	3.50	18.00	29.80
Low - $C14.00/CMT	5.80	19.70	31.45

Case D

Return on Investment (%)

	Coal Price ($CDN/CMT)		
	50.00	60.00	70.00
Rail & Port Charges			
High - $C18.00/CMT	3.55	15.30	24.80
Medium - $C16.00/CMT	6.10	17.30	26.70
Low - $C14.00/CMT	8.70	19.40	28.60


GRAPH V
CASE D
MEDIUM
28/10/81
R.F.
CASE D - ESCALATED
ESCALATION FACTORS:
CAPITAL 12 %
OPERATING 11 %
PRICES 11 %
RETURN ON INVESTMENT (ROI) - %
50.0
40.0
30.0
20.0
10.0
0
23.5% (CORRESPONDS TO 15% FOR CONSTANT '82$ ANALYSIS)
$C 57.70 / CMT (YIELDS 15% ROI IN CONSTANT '82$ ANALYSIS)
50.00
60.00
70.00
80.00
BEG. 1982 PRICE OF CLEAN COAL ($C / CMT)

WRIGHT ENGINEERS LIMITED

Phone: 684-9371 • Cable "WRIGHTENG" • Telex: 04-54367

1444 Alberni Street, Vancouver, British Columbia, Canada, V6G 2Z4

May 20, 1981

Project 1117-100

Cyprus Anvil Mining Corporation
330 - 355 Burrard Street
Vancouver, B.C.
V6C 2G8

Attention: Mr. T.J. Adamson
Senior Geologist, Coal Projects

Dear Sirs:

We are pleased to submit herewith 12 copies of our report entitled:

Tulameen Coal Project
Preliminary Feasibility Study

and trust it fulfills your immediate requirements.

We appreciate the opportunity of working with you again on this project and thank you for entrusting this important study to Wright Engineers Limited. Should any questions arise regarding the contents we would be pleased to discuss them with you at your convenience.

Yours very truly,

WRIGHT ENGINEERS LIMITED

W.F. Gilmore, P.Eng.

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SECTION 1

SECTION 1

INTRODUCTION

SECTION 1

INTRODUCTION

CYPRUS ANVIL MINING CORPORATION has entered into an option agreement with Imperial Metals and Power Ltd. and Mullins Strip Mine Ltd., holders of coal licences covering the Tulameen Coal Field, with regards to the potential development of a coal mining project.

WRIGHT ENGINEERS LIMITED (WEL) has been retained by Cyprus Anvil to prepare a Preliminary Feasibility Report, based on the reports, maps and other information provided to WEL, in accordance with the following scope of work:

- review and/or modification of the mine design and the respective recoverable coal reserves
- preparation of general layouts of the wash plant and of the pertaining support facilities
- review of equipment requirements
- review of the clean coal transportation system
- review of manpower requirements
- preparation of order-of-magnitude capital and operating cost estimates.

The information made available to WEL is itemized in Appendix I.

NOMENCLATURE

BCM	Bank Cubic Meter
RMT	Raw Metric Tonne
CMT	Clean Metric Tonne
E.G.	Effective Grade
kmph	Kilometer per hour
DDH	Diamond Drill Hole
HGI	Hardgrove Grindability Index
R.M.	Residual Moisture
V.M.	Volatile Matters
F.C.	Fixed Carbon

SECTION 2

SECTION 2

SUMMARY

SECTION 2

SUMMARY

In accordance with the scope of work indicated in the introduction, WEL has investigated the technically viable and economically optimal methods of mining, preparation and transportation of the Tulameen coal.

It has been established that 12.3 million tonnes of raw coal could be recovered from an open pit at an overall stripping ratio of 2.80:1 (m^3/tonne), using rippers and scrapers for both selective mining and for stripping. Additional drilling may prove greater recoverable reserves at the same or at a lower stripping ratio. At the proposed mining rate of 816,330 tonnes of raw coal per year, the life of the mine would be over 14 years. That mining rate, allowing for 2% rejects at the planned Breaker Station, would correspond to 800,000 tonnes per year raw coal feed to the Wash Plant.

On the basis of combustion tests, the Tulameen coal is expected to provide a good boiler fuel. It contains, however, a high percentage of ash and it must be washed.

The main feature of the Wash Plant is a Batac jig, supplied with recycled water from the tailings pond, separating the clean coal, the refuse and the middlings. Other equipment include vibrating double deck screens, double roll crushers, sieve bends, centrifuges and classifying cyclones to produce -40 mm clean coal at 55.1% recovery, that is 440,800 tonnes per year.

The mine, plant and all necessary ancillary services have been designed for this production rate, operating 5 days a week for a total of 231 days per year.

The ancillary facilities include shops for the repair and servicing of mobile equipment, a warehouse, dry and offices in one building complex, power supply from a public utility line and power distribution, tailings and decanting ponds, process water and potable water supplies, sewage system and a pit dewatering system.

The transport of the clean coal to the railhead is to be contracted out to keep the initial capital requirements low. The completion and upgrading of the access road, the replacement of a bridge and the construction of the train loading ramp and storage, however, will be part of the project development work.

The capital cost of the project, including fees for engineering and construction management, as well as provisions for contingencies, totals \$32.67 million, that is \$74.71 per annual tonne capacity.

The direct operating cost varies from year to year due mainly to the varying costs of stripping from an initial cost of \$19/tonne in years 1 to 5 to \$21/tonne in years 6 to 12 and to \$14/tonne in the 15th year. The cumulative average direct operating cost is estimated at \$20.17/tonne, including truck to rail transport.

The improvement and replacement capital for the 14.7 years production period was estimated at \$25.2 million, that is an average of \$3.89/tonne.

The project would employ about 109 hourly paid workers. Their number would decrease due to lower stripping requirements during the last three years of operations. The number of the supervisory and other monthly paid employees would be 23, without any change from the first to the last year of operations.

The development of the project, including detailed design, procurement, construction and start-up, would take approximately 20 months from the date of decision to proceed.

All costs are expressed in 1981 2nd quarter Canadian dollars.

SECTION 3

SECTION 3

SITE DESCRIPTION

SECTION 3

SITE DESCRIPTION

LOCATION AND ACCESS

The Tulameen Coal Basin is located at latitude 49° 30' North and longitude 120° 45' West in the south western region of British Columbia, on the east flank of the Cascade Mountains. It is found south of the Tulameen River, between the settlements of Tulameen and Coalmont, about 170 kilometres east of Vancouver and 48 kilometres north of the U.S. border.

The prospective mine site is accessible from Coalmont by a good 11 kilometre gravel road, passing through a bridge on the Tulameen River. Coalmont is connected by a paved road to Princeton to the south and to Merritt on the north, both being larger population centres.

The elevation of the prospective mine area is around 1,300 metres, while the elevation of the town of Coalmont is at 750 metres above sea level.

A branch line of the Canadian Pacific Railway runs from Princeton through Coalmont and Tulameen to the main line at Spences Bridge. The total rail distance from Coalmont to Vancouver is 420 kilometres.

PROPERTY STATUS

Cyprus Anvil Mining Corporation holds title to coal licences covering most of the coal basin, subject to an agreement between Imperial Metals and Power Ltd., Mullins Strip Mines Ltd. and Cyprus Anvil Mining Corporation.

Upon making a production commitment, Cyprus Anvil shall hold absolute title to the following licences, free of all claims, excepting some royalties become payable on production to Imperial Metals and Power Ltd., and to Mullins Strip Mines Ltd.:

Licence No.		Hectares	
69	Mullins	259	
70	Mullins	259	
71	Mullins	129.5	
125	Mullins	259	
126	Mullins	129.5	
145	Imperial	129.5	
146	Imperial	129.5	
147	Imperial	129.5	
154	Imperial	259	
258	Imperial	129.5	
159	Imperial	64.75	
3663	Imperial	129.5	
3664	Imperial	259	
3665	Imperial	129.5	
		2,395.75	(5,920 acres)

Field work to date has been carried out on the properties under Surface Work Permit #C-115 issued in 1977, pursuant to Section 9 of the Coal Mines Regulation Act.

PHYSIOGRAPHY

According to the physiographic classification outlined by Holland (1964), the Tulameen Coal Basin is in the Southern Plateau subdivision of the Interior System, in an area known as the Thompson Plateau. This plateau is a gentle, rolling upland of low relief, generally between 1,200 metres and 1,500 metres above sea level, which has been deeply incised. Regionally, the highest and lowest features surrounding the prospective site are Lodestone Mountain (Elevation 1,895 metres) and Tulameen River (Elevation 731 metres).

The prospective mine site is situated within the Columbia River drainage system and is drained by the Similkameen River via the Tulameen River flowing from Tulameen to Princeton. The site area is incised by the tributaries of Tulameen River, namely Granite, Marion and Blakeburn Creeks and by Collins and Fraser Gulches.

The area is heavily timbered, primarily with mixed conifers ranging up to .5 metres in diameter. The soils are quite thin, ranging from 30 centimetres to 2 metre thickness over bedrocks and over morainal or glacial till materials which are the most extensive surficial material types in the area.

CLIMATE

The climate in the Tulameen Coal Basin area is continental type, that is relatively moderate. Temperatures average to daily highs of 30 degrees C and lows of 7 degrees C in mid summer, and to daily highs of -4 degrees C and lows of -12 degrees C in mid winter respectively. Temperatures of 40 degrees C and -40 degrees C are considered extreme.

The average annual precipitation is 500 mm of which 90% is in the form of snow. Rainfalls can be expected on about 60 days, and snowfalls on about 50 days.

Snowfalls can be expected from October through April. On the average, however, the snow pack is deepest in the months of March and April. The average snow depth for the month of April between 1960 and 1975 was 125 cm, the minimum being 74 cm and the maximum 193 cm. The snow usually stays on the ground through late May, the mid May snow depth averaging 41 cm. The worst case to date was observed in 1971, when 74 cm snow was measured on the ground on June 17th.

The growing season probably ranges from 125 to 150 days without any water deficit.

HISTORY

Coal occurrences in the Tulameen Coal Basin have been known before the turn of the century, however, these were not actively explored until 1910.

In 1911, underground development work on the northeast side of the basin revealed, more specifically in the Collins Gulch area, that several steeply dipping coal seams were present, but these were too badly crushed to be of commercial value.

Other underground development was started on the southwest side of the basin, on the north fork of Granite Creek. The coal in the moderately dipping seams in this area was found to be more satisfactory and the first coal production was started in 1916. The community of Blakeburn, now deserted, was established then, as production by Coalmont Collieries Ltd. from their Mines #3, #4 and #5 continued until 1940. A total of 2.15 million tons of coal has been produced from these underground mines. Only one seam was mined, that is, the upper basin seam. Extracting only a portion of the total seam thickness lead to numerous problems of roof and floor convergence, spalling and ventilation.

There was no mining operation until 1953, when Mullins Strip Mines started producing coal for local use. This operation consisted of ripping, dozing and truck loading. The operation halted in 1957 after the extraction of a total of 225,000 tons from two small open pits established in the surface pillars of the above underground mines.

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GEOLOGY

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GEOLOGY

REGIONAL GEOLOGY

The regional geology of the Tulameen area (Princeton Map, Sheet NTS 92H East) has been first compiled and described by Rice (1947).

According to the regional setting, the Tulameen Coal Basin is a Tertiary sedimentary basin consisting of sediments and lavas of the Princeton Group which unconformably overlie the sediments and lavas of the Triassic Nicola Group. The strata of the Nicola Group and of the underlying older formations have been folded into tight anticlines and synclines. One of these north trending synclines is occupied by the Tulameen Coal Basin.

The Nicola Group, the most widespread unit in the area, consists of both volcanic and interbedded sedimentary rocks. Although not well metamorphosed, these rocks are highly sheared and fractured along the margins of intrusive units.

A series of Jurassic intrusive rocks are the next oldest rocks in the area. Ultramafic intrusives occur between Lodestone Mountain and Olivine Mountain, consisting of peridotites, pyroxenites and gabbros.

Coast intrusions occur in several belts, composed mainly of granodiorite, quartz diorite and gabbro. The Copper Mountain intrusions surround Copper Mountain, cut into the Nicola Group and are overlain by the Princeton Group. They consist of mafic intrusives.

There are pyroclastic rocks with interbedded sediments to the southwest belonging to the Lower Cretaceous to Jurassic Dewdney Creek Group and to the Pasayten Group of uncertain age.

There are some manifestations of the Lower Cretaceous Spence Bridge Group in the area which consist of extrusive volcanics.

The Kingsvale Group is a thick sequence of volcanics with sediments near the base to the north and west.

The youngest intrustives in the area are the Upper Cretaceous to Tertiary Otter Creek and Lightning Creek intrusions. They consist of granites, granodiorites and quartz diorites.

The Tertiary Princeton Group forms the Princeton and Tulameen Coal Basins, consisting of shale, mudstone, conglomerate and coal.

On the plateaus, the surficial material present is glacial till, generally less than 5 metres thick and covered by thin soil. In the valleys, the surficial materials are composed of alluvium, glacial till or outwash and of lacustrine deposits. In the Tulameen River valley, the surficial sediments may reach 100 metres thickness consisting of clays, sand and gravels, silts and glacial till.

COAL FORMATION

The Tulameen Coal Basin and the Princeton Coal Basin form part of the Similkameen Coal Field, whose origin is relatively very young. The seams of the Tulameen Coal Basin are classified as high volatile bituminous C coals of Tertiary age.

Considering that the sedimentation took place in a temperate climate and not more than 50 million years ago, these seams should still be lignites. The heat from the volcanic activities in the area, however, has accelerated the coalification process, driving off some of the moisture and some of the volatile matters.

On the basis of present findings, the formation of the Tulameen Coal Basin took place probably as follows:

In the Upper Triassic period, about 185 to 195 million years ago, the volcanic eruptions ceased and sediments started to build up on the uneven surface. During the next 50 million years, in the Jurassic age, sedimentation continued but was interrupted from time to time by intrusions of plutonic rocks. Sedimentation continued well into the Cretaceous age, when the area was uplifted by orogenic movements and the process reversed to erosion for a period of 25 to 30 milion years. Deposition of organic matters started when the area became relatively flat, followed by the formation of peat with the help of aerobatic and anaerobatic bacteria. The peat deposits were shortly covered first by mud and clay, then by sand layers, providing the physical conditions for lignite formation. The sand cover at one time has reached a thickness of at least 1,500 metres which led to the following results: First, the temperature in the lignite bed increased to about 75 degrees C, due to the increase of the geothermal gradient providing the heat for sub-bituminous coal formation; secondly, the sand cover has consolidated into sandstone. The next geological events were again orogenic movements including the formation of synclines and anticlines leading to the uneven development of cleating in the seams. This was followed by the erosion of the unconsolidated sand cover, interrupted from time to time by frequent volcanic activities.

Volcanic eruptions led to the formation of a basaltic mantle over a large portion of the coal seams which, thanks to the excellent heat conduction property of the sandstone cover, could now evolve from the sub-bituminous to the bituminous phase, under and around the mantle. Increased pressure by the mantle led to some tectonic movements, exposing the limbs of the coal basin on the surface, which then have been subsequently eroded partly by the advancing ice shield during the ice age, and partly by floods and weathering afterwards.

STRATIGRAPHY

The Tulameen Coal Basin is an oval, 6 kilometre long and 4 kilometre wide northwesterly trending basin of sedimentary and volcanic rocks. The beds within the basin are asymmetrically folded with the southwest limb dipping 25 degrees to 45 degrees toward northeast and the northeast limb dipping 40 degrees to 85 degrees toward southwest. A structural map prepared by W.S. Shaw (1952) indicates a number of fault zones and flexures on the southwest limb.

The Upper Triassic Nicola Group uncomformably underlies and completely surrounds the Tulameen Coal Basin.

The volcanic rocks at the base of the Princeton Group, known as Lower Volcanics, consist of andesitic and felsitic lavas, reaching about 500 metre thickness on the northeastern side of the basin. Towards east, this formation thins out.

The Princeton Group sediments are divided into three units: the Lower Sandstone, the Coal Member and the Upper Sandstone. The Lower Sandstone is about 120 metres thick and composed of fractured sandstones interbedded with minor mudstone and shale. The Coal Member is about 130 metres thick and contains two significant coal seams. Both seams include thinly bedded shale, mudstone and bentonite. The upper sandstone is about 580 metres thick and composed of sandstone and granular conglomerate with minor mudstone and shale.

The Tertiary plateau basalts, known as Upper Volcanics, unconformably overlie the Princeton Group as sheets of flat lying flows.

The two significant seams in the Coal Member are known as the Main Coal Seam and the Lower Coal Seam. The Main Coal Seam varies in thickness from 15 metres to 21 metres, and in dip from 28 degrees in the south to 45 degrees in the north along the west margin of the basin. The percentage of waste partings in relation to coal also increases progressively from south to north, the increments being due mainly to interbeds of volcanic origin. The Lower Coal Seam is 7 metres to 7.6 metres thick, dipping parallel with the Main Seam. Its ash content, however, is too high to be of economic interest.

The individual coal seams consist of well distinguishable bands. Generally, vitrain and clarain predominate (approximately 90% of the total), with minor durain and fusain. Nodules of bright, clear amber are scattered throughout the coal.

A major northeast trending fault is known to exist between the abandoned No.3 and No.4 underground mines which can be seen on the surface. A similar fault zone has been described as forming the southeast limit of the former No. 3 mine. Further to the north, numerous small scale faults and drag folds can be found, but without any major displacement.

TERTIARY

4 UPPER VOLCANICS (PLATEAU BASALT)

Brown to black, fine grained basalt unconformity

3 COAL BEARING SEDIMENTS (Princeton Group)

3C Upper Sandstones (600 m)

3C2 Granite conglomerate, sandstone, minor shale, mudstone

3C1 Transitional unit; sandstone, mudstone, minor thin coal

3B Coal Member (130 m)

3B10 Blocky mudstone and shales
3B9 Finely laminated, fissile shales
3B8 Thin coal, incl. bentonite, shales, mudstones
3B7 Main coal seam, incl. volcanic and sediment partings
3B6 Light gray sandstone; white muddy matrix
3B5 Dark gray blocky mudstone
3B4 Light to dark gray shales, mudstones and muddy sandstone
3B3 Brownish to dark gray, massive to laminated mudstone
3B2 Lower coal seam (7 to 7.6 m); raw coal ash 52% (a.d.b.)
3B1 Bentonitic tuff, thin coal, coaly mudstone

3A Lower Sandstone (150 m)

2 LOWER VOLCANICS (Princeton Group)

Massive to porphyritic andesite and felsite (500 m) unconformity..

UPPER TRAISSIC

1 NICOLA GROUP

Highly metamorphosed volcanics and sediments

EXPLORATION PROGRAMS

Geological exploration programs have been conducted on the field since the summer of 1977, mainly to define the quantity and quality of coal which could be recovered by potential open cast mining methods. These programs included:

- New aerial photography;
- Preparation of base maps and other photos;
- Geological surface mapping (1:5,000 and 1:2,000 scales);
- Bulldozer and backhoe trenching;
- Bulk sampling;
- Diamond drilling (12 holes, 1,479 metres total);
- Electrologging (gamma, density and neutron);
- Geophysical ground survey (resistivity, seismic);

All drilling and trenching, and most of the surface mapping have been carried out along the western margin of the Tulameen Coal Basin. In this area, dips are moderate toward east, and for a considerable distance the topography also slopes to the east, resulting in a favourable situation for open pit mining.

Diamond drilling extended from the old Mine No. 5 northwards to the extreme northern limit of the basin. The Main Coal Seam was intercepted by all twelve diamond drill holes, having an average raw ash content of 38% (a.d.b.) from drill nole T77-1 to T77-5. From hole T77-6 and continuing through T77-10, there is a rapid increase in ash content from 50% to 70%. The Lower Coal Seam has been intercepted by holes T77-3 through T77-6 with an average ash content of 50%. On the basis of these findings, the limits of the potential open pit are quite well defined.

COAL RESERVES

The indicated geological in situ reserves of the Tulameen Coal Basin are estimated to be in excess of 100 million tons. The speculative reserves are even greater, however, the indicated and speculative reserves are either too deep below surface or too imbedded with impurities to be considered economically recoverable at this time.

The economically mineable measured reserves are located on the western side of the basin, extending toward north from the abandoned underground Mine No.5 for a distance of about 1.3 km, where there is a sudden increase in ash content. In an initial open pit mine planned for the extraction of these reserves, the following coal and waste volumes have been calculated:

Section	Pit Floor Elevation	Strike (m)	Coal (t)	Waste (m^3)
1	1,180	215	1,328,700	3,895,800
2	1,160	310	3,515,400	10,152,500
3	1,150	280	3,080,000	8,573,600
4	1,176	290	2,383,800	7,397,900
5	1,180	220	1,988,800	4,494,800
TOTAL		1,315	12,296,700	34,514,600

These volumes correspond to an overall stripping ratio of 2.80:1 (m^3/metric tonne of raw coal mined).

In order to reduce the high ash content of the coal, some impurities may be removed by selective mining. It is estimated that about 2.5% of the reserves can be so removed. The mineable coal reserves are reduced then to 12,000,000 tonnes, while the waste volume is increased to 34,695,510 m^3. Accordingly, the overall stripping ratio also changes to 2.89:1 (m^3/metric tonne).

The mining of the 12 million tonnes of coal with the relatively low stripping ratio is possible due mainly to two factors:

a) Only one ramp is developed to the pit bottom;

b) Upon completion of the mine, coal from the pit floor is also mined down to as narrow width as possible.

By setting the production facilities to mine 816,330 tonnes of raw coal per year, assuring 800,000 tonnes per year wash plant feed upon a 2% loss at the rotary breaker, the life of the initial open pit would be 14.7 years.

Additional surface mineable coal reserves (in the range of 2 to 3 million tonnes) are also available along the surface pillars of the abandoned Mines Nos. 3, 4 and 5, as well as within those mines, since only a 3 to 4 metre leaf has been extracted from the 20 metre thick Main Seam mined.

Still more reserves may be developed at increased stripping ratios, depending on future economic conditions.

Additional drilling within the planned open pit may also prove greater reserves. In the case of two sections where two holes were drilled, it was found that the seam became thicker and its angle of dip became flatter with depth. In the case of the other sections, only single holes were drilled near the outcrop line. Thus, thinner seam intersections were projected at steeper angles, corresponding to rapidly increasing stripping ratios. Accordingly, the 12 million tonnes of reserves can be considered as a conversative estimate.

The 34.5 million bank cubic metre of waste when dumped will require a space of approximately 56 million cubic metres, together with the coarse refuse from the wash plant. This space is available northeast from the open pit, at a short distance.

COAL QUALITY

Proximate analysis, calorific values and Hardgrove Grindability Indices of drill core samples (on air-dry basis) pertaining to the coal within the planned open pit limits are as follows:

DDH	R.M.	V.M	F.C.	Ash	S	BTU/lb	HGI
1	5.4	25.0	31.5	37.7	0.4	7,220	46
2	5.4	27.5	30.1	36.6	0.4	7,460	50
3	5.8	26.8	30.8	36.1	0.4	7,540	47
4	6.0	25.4	27.4	40.7	0.4	6,880	59
5	6.4	24.8	27.6	40.8	0.4	6,640	62
Average	5.8	26.0	29.5	38.3	0.4	7,273	53

The average density of the coal with 38.7% ash content (including sulphur) is 1.64 which figure is used in the coal reserve calculations.

A bulk sample taken from a trench in the same area for testing has been analyzed as follows:

	R.M.	V.M.	F.C.	Ash	S	BTU/lb	HGI
Air-Dry	6.0	27.1	33.0	33.4	0.5	7,730	50
Dry	-	28.9	35.1	35.4	0.6	8,220	

Analyses of the clean coal expected to be produced, on the basis of washability tests, are as follows:

PROXIMATE ANALYSIS

	As Received	Dry
% R.M.	13.2	-
% V.M.	27.0	31.1
% F.C.	43.2	49.8
% Ash	16.6	19.1
% S	0.56	0.65
Btu/lb	9,500	10,945
Kcal/kg	5,278	6,080

ULTIMATE ANALYSIS

	As Received	Dry
% R.M.	13.2	-
% Carbon	54.4	62.6
% Hydrogen	3.7	4.3
% Nitrogen	1.0	1.2
% Chlorine	-	-
% Sulfur	0.5	0.6
% Ash	16.6	19.1
% Oxygen	10.6	12.1

FUSION TEMPERATURES OF ASH (°C)

	Reducing Atmosphere	Oxidizing Atmosphere
Initial deformation	1,288	1,354
Softening (spherical)	1,399	1,438
Softening (hemispherical)	1,435	1,460
Fluid temperature	1,482	1,482

ANALYSIS OF ASH

	Ign. Basis
Phos Pentoxide P_2O_5	0.2
Silica SiO_2	70.5
Ferric Oxide Fe_2O_3	5.1
Alumina Al_2O_3	16.2
Titanium TiO_2	0.7
Lime CaO	0.7
Magnesia MgO	0.5
Sulfur Trioxide SO_3	0.4
Potassium Oxide K_2O	1.4
Sodium Oxide Na_2O	0.6
Undetermined	3.7

SULFUR FORMS

	As Received	Dry
Pyritic	0.09	0.10
Sulfate	0.01	0.01
Organic	0.46	0.54
Total	0.56	0.65

Equilibrium Moisture:	9.8%
Hardgrove Grindability Index:	59
Base/Acid Ratio:	0.095; Rs = 0.06; Rf = 0.06
Classification:	High Volatile Bituminous "C"
Fuel Ratio FC/VOL:	1.6

A five tonne sample of clean coal was subjected to a combustion testing program conducted by the Canadian Combustion Research Laboratory at Bell's Corner, Ontario. The pilot scale experiments indicated satisfactory performance of the Tulameen Coal. More specifically:

- It handles and flows readily at 12% moisture content;
- It produces easily ignited stable flames;
- With a specification of 80% through 200 mesh (75), the carbon content of the fly ash is less than 3%;
- Gaseous SO_2 emissions show little evidence of neutralization;
- Nitric oxide emissions are moderate and amenable to control by staged combustion or by flue gas recirculation;
- It is suitable for dry bottom operation without fouling or slagging problems.

On the basis of the combustion tests, the Tulameen coal is expected to provide a good boiler fuel when used in pulverized form.

SECTION 5

SECTION 5

MINING

SECTION 5

MINING

MINING METHOD AND EQUIPMENT

The selected method for both stripping and coal extraction in the initial open pit mine is the use of conventional scrapers, assisted by tractors for ripping and for push loading.

In order to establish the ripping equipment requirements, a seismic survey was conducted by Peter E. Walcott and Associates in the area of the planned initial open pit, from Section 2 through Section 5.

Three ranges of seismic wave velocities (ft./sec.) have been observed corresponding to various depths, as follows:

Section	V_1	V_2	V_3
2	900 - 1,300	2,900 - 5,000	6,000 - 8,200
3	1,029 - 1,465	2,350 - 3,800	6,150 - 7,900
4	725 - 1,500	2,050 - 3,635	5,100 - 7,500
5	1,100 - 1,500	2,550 - 3,400	5,600 - 6,950

The lower velocities (V_1 and V_2) indicate relatively shallow depths of top soil and weathered rocks of small volume. The higher velocities (V_3) represent the better consolidated sedimentary strata of the coal bearing formation of large volume for which the equipment has to be selected.

Among the various sizes of rippers, the D9H tractor is the most suitable on the basis of the manufacturers' specifications with a 9D single shank ripper.

Among the wheel tractor-scrapers, Model 631D is the most suitable in view of the following:

- It is compatible with the D9H tractor for push loading;
- It is versatile to carry coal, waste or refuse, either from the pit or from stockpiles;
- It is large enough to handle the volume in a moderate size fleet, but it is small enough to move around in the pit.

Initially, the coal and the waste will be hauled downhill. As the pit will deepen, the 631 D scrapers will be replaced by 637 D models with identical load capacities, but with two engines to shorten round trip cycles.

Other major equipment include 12G graders as well as sander and water trucks for road maintenance.

Due to the relatively steep dip of the coal seam and to the configuration of the waste bands, it is expected that some sorting and removal of impurities could be done efficiently by the above rippers and scrapers.

On the basis of suitability to the given geological conditions and of economic performance, the ripping-scraping method compares favourably with dragline, bucket wheel, conveyor belt and other open pit mining methods.

SEISMIC WAVE VELOCITY LIMITS (FT/SEC) OF RIPPER PERFORMANCES

Tractor Performance	D8K		D9H		D10	
	Rippable	Marginal	Rippable	Marginal	Rippable	Marginal
Coal	6,500	8,000	8,000	10,200	8,400	11,000
Shale	6,000	8,000	8,300	10,100	10,000	12,000
Sandstone	6,500	8,400	8,000	10,500	9,500	11,500
Siltstone	6,600	8,500	8,600	10,500	9,600	11,500
Claystone	7,000	8,600	8,700	10,400	9,500	11,500
Conglomerate	6,400	8,000	8,200	10,200	9,000	11,000
Breccia	6,000	7,500	8,000	10,100	8,700	11,000
Schist	6,500	8,200	7,500	9,300	8,000	10,000
Slate	6,500	8,000	7,600	9,400	8,300	10,500

ASSUMPTIONS AND DESIGN CRITERIA

Access ramp grade	10% maximum	
Footwall slope	28 degress to 45 degrees	
Hanging wall slope	57 degrees maximum	
Raw coal reserves	12,000,000 tonnes	
Annual mining rate	816,330 tonnes	
Annual plant feed rate	800,000 tonnes	
Initial open pit life	14.7 years	
Working days per year:		
One year		365 days
Less 5-day week	104	
Less statutory holidays	12	
Less vacation	15	
Unscheduled allowance	3	
Total non-working days		134
Total working days		231 days
Shift utilization	81% - 6.5 operating hours	
Shift efficiency	83% - 50 effective min/op.hour-daytime	
	75% - 45 effective min/op.hour-nightime	
Pit Volumes:		
Total pit volume	42,012,600 m^3	
Coal volume	7,317,100 m^3	
Waste volume	34,695,500 m^3	

COAL RESERVES

(Tonnes)

Bench	Section #1	Section #2	Section #3	Section #4	Section #5	Total
1370	-	-	-	66,580	-	66,580
1360	-	-	5,510	95,120	18,040	118,670
1350	-	-	135,650	102,250	90,920	328,820
1340	-	-	142,350	102,250	106,330	350,930
1330	-	112,360	142,350	102,250	106,330	463,290
1320	-	167,770	142,350	102,250	106,330	518,700
1310	-	167,770	142,350	102,250	106,330	518,700
1300	-	167,770	142,350	102,250	106,330	518,700
1290	29,090	167,770	142,350	102,250	106,330	547,790
1280	111,730	167,770	142,350	102,250	106,330	630,430
1270	111,730	167,770	142,350	102,250	106,330	630,430
1260	111,730	167,770	142,350	102,250	106,330	630,430
1250	111,730	167,770	142,350	109,390	106,330	637,570
1240	111,730	196,050	142,350	123,650	106,330	680,110
1230	111,730	213,530	142,350	137,920	106,330	711,860
1220	111,730	213,530	142,350	144,800	106,330	718,740
1210	111,730	213,530	142,350	144,800	106,330	728,740
1200	111,730	213,530	142,350	144,800	106,330	718,740
1190	111,730	213,530	142,350	144,800	106,330	718,740
1180	111,730	213,530	142,350	144,800	106,330	718,740
1170	70,580	213,530	142,350	104,640	72,230	603,330
1160	-	213,530	142,350	-	-	355,880
1150	-	156,590	142,350	-	-	298,940
1140	-	-	91,840	-	-	91,840
TOTAL	1,328,700	3,515,400	3,080,000	2,383,800	1,988,800	12,296,700

LOAD FACTORS

Coal

The coal is expected to rip fairly fine and the scrapers should load easily. Using 90% of heaped capacity with a load factor of 0.74, each load of the 631D scaper is:

$$23.7 \times .9 \times .74 = 15.78 \text{ BCM}$$

Assume 15.5 BCM or 25.5 RMT per load

Waste

The shale is foliated which may produce large pieces and the scraper may not be filled well. The swell factor of most rocks is about 60% resulting in a load factor of 62.5%. Each load of waste is then:

$$23.7 \times .85 \times .625 = 12.59 \text{ BCM}$$

Assume 13.0 BCM per load.

COAL MINING SCHEDULE

(Tonnes)

Year	Bench	Tonnage	Waste	Clean	Cumulative
1	1370	66,580	1,610	64,970	64,970
	1360	118,670	2,860	115,810	180,780
	1350	328,820	7,930	320,890	501,670
	1340	322,440	7,780	314,660	816,330
2	1340	28,490	690	27,800	27,800
	1330	463,290	11,180	452,110	479,910
	1320	344,740	8,320	336,420	816,330
3	1320	173,960	4,170	169,790	169,790
	1310	518,700	12,510	506,190	675,980
	1300	143,820	3,470	140,350	816,330
4	1300	374,880	9,030	365,850	365,850
	1290	461,600	11,120	450,480	816,330
5	1290	86,190	2,080	84,110	84,110
	1280	630,430	15,190	615,240	699,350
	1270	119,870	2,890	116,980	816,330
6	1270	510,560	12,300	498,260	498,260
	1260	325,920	7,850	318,070	816,330
7	1260	304,510	7,340	297,170	297,170
	1250	531,980	12,820	519,160	816,330
8	1250	105,590	2,540	103,050	103,050
	1240	680,110	16,440	663,670	766,720
	1230	50,840	1,230	49,610	816,330
9	1230	661,020	15,980	645,040	645,040
	1220	175,530	4,240	171,290	816,330
10	1220	543,210	13,130	530,080	530,080
	1210	293,340	7,090	286,250	816,330
11	1210	425,400	10,250	415,150	415,150
	1200	411,080	9,900	401,180	816,330
12	1200	307,660	7,440	300,220	300,220
	1190	528,900	12,790	516,110	816,330
13	1190	189,840	4,590	185,250	185,250
	1180	646,720	15,640	631,080	816,330
14	1180	72,020	1,740	70,280	70,280
	1170	603,330	14,590	588,740	659,020
	1160	161,220	3,910	157,310	816,330
15	1160	194,660	4,710	189,950	189,950
	1150	298,940	7,230	292,710	481,660
	1140	91,840	2,120	89,720	571,380

COAL HAULAGE TIMES - 631 D

		Level			Slope			Level			
Bench	Load Unload	Dist	LD	E	Dist	LD	E	Dist	LD	E	Total Time
1370	1.4	250	0.6	0.5	-600	1.0	2.2	200	0.5	0.5	6.7
1360	1.4	300	0.7	0.6	-500	0.8	1.7	200	0.5	0.5	6.2
1350	1.4	350	0.8	0.6	-400	0.6	1.3	200	0.5	0.5	5.7
1340	1.4	450	1.0	0.8	-300	0.5	1.0	200	0.5	0.5	5.7
1330	1.4	550	1.2	0.9	-200	0.3	0.7	200	0.5	0.5	5.5
1320	1.4	600	1.2	1.0	-100	0.2	0.4	200	0.5	0.5	5.2
1310	1.4	800	1.5	1.2	-	-	-	-	-	-	4.1
1300	1.4	300	0.7	0.6	+100	0.7	0.1	450	1.0	0.8	5.3
1290	1.4	400	0.9	0.7	+200	1.3	0.2	600	1.2	1.0	6.7
1280	1.4	600	1.2	1.0	+300	1.9	0.4	900	1.7	1.3	8.9
1270	1.4	550	1.2	0.9	+400	2.5	0.5	900	1.7	1.3	9.5
1260	1.4	500	1.1	0.8	+500	3.1	0.6	900	1.7	1.3	10.0
1250	1.4	450	1.0	0.8	+600	3.8	0.7	900	1.7	1.3	10.7
1240	1.4	400	0.9	0.7	+700	4.4	0.8	900	1.7	1.3	11.2
1230	1.4	350	0.8	0.6	+800	5.1	1.0	900	1.7	1.3	11.9
1220	1.4	400	0.9	0.7	+900	5.7	1.1	900	1.7	1.3	12.8
1210	1.4	450	1.0	0.8	+1,000	6.3	1.2	900	1.7	1.3	13.7
1200	1.4	500	1.1	0.8	+1,100	6.9	1.3	900	1.7	1.3	14.5
1190	1.4	600	1.2	1.0	+1,200	7.6	1.4	900	1.7	1.3	15.6
1180	1.4	700	1.4	1.1	+1,300	8.2	1.6	900	1.7	1.3	16.7
1170	1.4	600	1.2	1.0	+1,400	8.8	1.7	900	1.7	1.3	17.1
1160	1.4	500	1.1	0.8	+1,500	9.5	1.8	900	1.7	1.3	17.6
1150	1.4	400	0.9	0.7	+1,600	10.2	1.9	900	1.7	1.3	18.1
1140	1.4	300	0.7	0.6	+1,700	10.8	2.0	900	1.7	1.3	18.5

LD - Loaded
E - Empty

COAL HAULAGE TIMES - 637 D

Bench	Load Unload	Level			Slope			Level			Total Time
		Dist	LD	E	Dist	LD	E	Dist	LD	E	
1270	1.6	550	1.0	0.8	+400	1.6	0.5	900	1.4	1.2	8.1
1260	1.6	500	0.9	0.7	+500	2.1	0.6	900	1.4	1.2	8.5
1250	1.6	450	0.9	0.7	+600	2.5	0.7	900	1.4	1.2	9.0
1240	1.6	400	0.8	0.6	+700	2.9	0.8	900	1.4	1.2	9.3
1230	1.6	350	0.7	0.6	+800	3.3	1.0	900	1.4	1.2	9.8
1220	1.6	400	0.8	0.6	+900	3.7	1.1	900	1.4	1.2	10.4
1210	1.6	450	0.9	0.7	+1,000	4.2	1.2	900	1.4	1.2	11.2
1200	1.6	500	0.9	0.7	+1,100	4.6	1.3	900	1.4	1.2	11.7
1190	1.6	600	1.1	0.8	+1,200	4.9	1.4	900	1.4	1.2	12.4
1180	1.6	700	1.2	1.0	+1,300	5.3	1.6	900	1.4	1.2	13.3
1170	1.6	600	1.1	0.8	+1,400	5.8	1.7	900	1.4	1.2	13.6
1160	1.6	500	0.9	0.7	+1,500	6.2	1.8	900	1.4	1.2	13.8
1150	1.6	400	0.8	0.6	+1,600	6.6	1.9	900	1.4	1.2	14.1
1140	1.6	300	0.6	0.5	+1,700	7.0	2.0	900	1.4	1.2	14.3

COAL SCRAPER REQUIREMENTS

631 D SCRAPERS

YEAR 1

Bench	1370	64,970	RMT	0.080	year	6.7	min
	1360	115,810	RMT	0.142	year	6.2	min
	1350	320,890	RMT	0.393	year	5.7	min
	1340	314,660	RMT	0.385	year	5.7	min

Average Cycle 5.85 min

Scraper Capacity:
50/5.85 + 50/5.85 + 45/5.85 = 145/5.85
(145/5.85) x 6.5 x 25.5 x 231 = 949,025 RMT

Number of scrapers required:
816,330/949,025 = 0.86

YEAR 2

Bench	1340	27,800	RMT	0.034	year	5.7	min
	1330	452,110	RMT	0.554	year	5.5	min
	1320	336,420	RMT	0.412	year	5.2	min

Average Cycle 5.38 min

Scraper Capacity:
(145/5.38) x 6.5 x 25.5 x 231 = 1,031,932 RMT

Number of scrapers required:
816,330/1,031,932 = 0.79

YEAR 3

Bench	1320	169,790	RMT	0.208	year	5.2	min
	1310	506,190	RMT	0.620	year	4.1	min
	1300	140,350	RMT	0.172	year	5.3	min

Average Cycle 4.53 min

Scraper Capacity:
(145/4.53) x 6.5 x 25.5 x 231 = 1,225,562 RMT

Number of scrapers required:
816,330/1,225,562 = 0.67

YEAR 4

Bench	1300	365,850	RMT	0.448	year	5.3	min
	1290	450,480	RMT	0.552	year	6.7	min

Average Cycle 6.07 min

Scraper Capacity:
(145/6.07) x 6.5 x 25.5 x 231) = 914,629 RMT

Number of scrapers required:
816,330/914,629 = 0.89

YEAR 5

Bench	1290	84,110	RMT	0.103	year	6.7	min
	1280	615,240	RMT	0.754	year	8.9	min
	1270	116,980	RMT	0.143	year	9.5	min

Average Cycle 8.76 min

Scraper Capacity:
(145/8.76) x 6.5 x 25.5 x 231 = 633,767 RMT

Number of scrapers required:
816,330/633,767 = 1.29

637 D SCRAPERS

YEAR 6

Bench	1270	498,260	RMT	0.610	year	8.1	min
	1260	318,070	RMT	0.390	year	8.5	min

Average Cycle 8.26 min

Scraper Capacity:
(145/8.26) x 6.5 x 25.5 x 231 = 672,130 RMT

Number of scrapers required:
816,330/672,130 = 1.21

YEAR 7

Bench	1260	297,170	RMT	0.364	year	8.5	min
	1250	519,160	RMT	0.636	year	9.0	min

Average Cycle 8.82 min

Scraper Capacity:
(145/8.82) x 6.5 x 25.5 x 231 = 629,455 RMT

Number of scrapers required:
816,330/629,455 = 1.30

YEAR 8

Bench	1250	103.050	RMT	0.126	year	9.0	min
	1240	663,670	RMT	0.813	year	9.3	min
	1230	49,610	RMT	0.061	year	9.8	min

Average Cycle 9.29 min

Scraper Capacity:
(145/9.29) x 6.5 x 25.5 x 231 = 597,610 RMT

Number of scrapers required:
816,330/597,610 = 1.37

YEAR 9

Bench	1230	645,040	RMT	0.790	year	9.8	min
	1220	171,290	RMT	0.210	year	10.4	min

Average Cycle 9.93 min

Scraper Capacity:
(145/9.93) x 6.5 x 25.5 x 231 = 559,093 RMT

Number of scrapers required:
816,330/559,093 = 1.46

YEAR 10

Bench	1220	530,080	RMT	0.649	year	10.4	min
	1210	286,250	RMT	0.351	year	11.2	min

Average Cycle 10.68 min

Scraper Capacity:
(145/10.68) x 6.5 x 25.5 x 231 = 519,831 RMT

Number of scrapers required:
816,330/519,831 = 1.57

YEAR 11

Bench	1210	415,150	RMT	0.509	year	11.2	min
	1200	401,180	RMT	0.491	year	11.7	min

Average Cycle 11.45 min

Scraper Capacity:
(145/11.45) x 6.5 x 25.5 x 231 = 484,873 RMT

Number of scrapers required:
816,330/484,873 = 1.68

YEAR 12

Bench	1200	300,220	RMT	0.368	year	11.7	min
	1190	516,110	RMT	0.632	year	12.4	min

Average Cycle 12.14 min

Scraper Capacity:
(145/12.14) x 6.5 x 25.5 x 231 = 457,314 RMT

Number of scrapers required:
816,330/457,314 = 1.78

YEAR 13

Bench	1190	185,250	RMT	0.227	year	12.4	min
	1180	631,080	RMT	0.773	year	13.3	min

Average Cycle 13.10 min

Scraper Capacity:
(145/13.1) x 6.5 x 25.5 x 231 = 423,801 RMT

Number of scrapers required:
816,330/423,801 = 1.93

YEAR 14

Bench	1180	70,280	RMT	0.086	year	13.3	min
	1170	588,740	RMT	0.721	year	13.6	min
	1160	157,310	RMT	0.193	year	13.8	min

Average Cycle 13.61 min

Scraper Capacity:
(145/13.61) x 6.5 x 25.5 x 231 = 407,920 RMT

Number of scrapers required:
816,330/407,920 = 2.00

YEAR 15

Bench	1160	189,950	RMT	0.332	year	13.8	min
	1150	292,710	RMT	0.512	year	14.1	min
	1140	89,720	RMT	0.156	year	14.3	min

Average Cycle 14.03 min

Scraper Capacity:
(145/14.03) x 6.5 x 25.5 x 231 = 395,709 RMT

Number of scrapers required:
816,330/395,709 = 2.06

WASTE VOLUMES

(BCM)

Bench	Section #1	Section #2	Section #3	Section #4	Section #5	Total
1370	-	-	-	16,800	-	16,800
1360	-	-	-	126,300	-	126,300
1350	-	-	68,000	232,900	34,500	335,400
1340	-	-	212,400	336,700	197,500	746,600
1330	-	172,700	379,500	435,000	408,100	1,395,300
1320	-	670,500	546,700	623,000	494,600	2,334,800
1310	-	1,064,700	835,600	793,600	467,300	3,161,200
1300	93,820	1,012,900	804,400	698,600	436,600	3,046,320
1290	303,620	946,800	745,000	642,500	390,500	3,028,420
1280	466,600	894,000	702,400	603,200	364,200	3,031,400
1270	558,130	846,000	665,600	564,000	333,500	2,967,230
1260	497,850	774,100	600,500	510,600	287,400	2,670,450
1250	446,500	728,000	563,700	409,600	254,500	2,402,300
1240	392,920	664,700	518,100	364,700	226,000	2,166,420
1230	323,700	575,500	402,200	300,200	183,000	1,784,600
1220	272,370	512,200	362,500	252,500	151,400	1,550,970
1210	223,250	443,200	317,200	204,800	123,000	1,311,450
1200	158,500	310,700	255,000	140,300	76,800	941,300
1190	105,000	238,800	212,400	94,400	48,300	699,900
1180	53,540	172,700	172,800	45,000	17,600	461,640
1170	-	95,000	107,600	2,200	-	204,800
1160	-	29,000	70,800	-	-	99,800
1150	-	-	31,200	-	-	31,200
Total	3,895,800	10,152,500	8,573,600	7,397,900	4,494,800	34,514,600

TOTAL WASTE VOLUMES

Bench	Impurity		Waste	Total
	(Tonnes)	(BCM)	(BCM)	(BCM)
1370	1,610	980	16,800	17,780
1360	2,860	1,740	126,300	128,040
1350	7,930	4,830	335,400	340,230
1340	8,470	5,160	746,600	751,760
1330	11,180	6,820	1,395,300	1,402,120
1320	12,490	7,620	2,334,800	2,342,420
1310	12,510	7,630	3,161,200	3,168,830
1300	12,500	7,620	3,046,320	3,053,940
1290	13,200	8,050	3,028,420	3,036,470
1280	15,190	9,260	3,031,400	3,040,660
1270	15,190	9,260	2,967,230	2,976,490
1260	15,190	9,260	2,670,450	2,679,710
1250	15,360	9,370	2,402,300	2,411,670
1240	16,440	10,020	2,166,420	2,176,440
1230	17,210	10,490	1,784,600	1,795,090
1220	17,370	10,590	1,550,970	1,561,560
1210	17,340	10,570	1,311,450	1,322,020
1200	17,340	10,570	941,300	951,870
1190	17,380	10,600	699,900	710,500
1180	17,380	10,600	461,640	472,240
1170	14,590	8,900	204,800	213,700
1160	8,620	5,260	99,800	105,060
1150	7,230	4,410	31,200	35,610
1140	2,120	1,300	-	1,300
Total	296,700	180,910	34,514,600	34,695,510

STRIPPING SCHEDULE

Year	Operating Bench Mine	Operating Bench Strip	Waste Volume (BCM)	Cumulative Volume (BCM)
1	1370	1370	17,780	17,780
	1360	1360	128,040	145,820
	1350	1350	340,230	486,050
	1340	1340	751,760	1,237,810
		1330	1,402,120	2,639,930
		1320	260,610	2,900,540
2	1330	1320	2,081,810	2,081,810
	1320	1310	358,400	2,440,210
3	1310	1310	2,569,550	2,569,550
	1300			
4	1300	1310	240,880	240,880
	1290	1300	2,073,100	2,313,980
5	1280	1300	980,840	980,840
	1270	1290	1,148,460	2,129,300
6	1270	1290	1,888,010	1,888,010
	1260	1280	1,161,580	3,049,590
7	1260	1280	1,879,080	1,879,080
	1250	1270	1,250,730	3,129,810
8	1250	1270	1,725,760	1,725,760
	1240	1260	1,526,340	3,252,100
9	1230	1260	1,153,370	1,153,370
	1220	1250	2,225,080	3,378,450
10	1220	1250	186,590	186,590
	1210	1240	2,176,440	2,363,030
		1230	771,860	3,134,890
11	1210	1230	1,023,230	1,023,230
	1200	1220	1,561,560	2,584,790
		1210	252,570	2,837,360

12	1190	1210	1,069,450	1,069,450
		1200	951,870	2,021,320
		1190	453,830	2,475,150
13	1180	1190	256,670	256,670
	1170	1180	472,240	728,910
14	1160	1170	213,700	213,700
		1160	105,060	318,760
15	1140	1150	35,610	35,610
		1140	1,300	36,910

WASTE HAULAGE TIMES - 631 D

		Level			Slope			Slope			Level			Total
Bench	LD	Dist	LD	E	Dist	LD	E	Dist	LD	E	Dist	LD	E	Time
1370	1.4	350	0.8	0.6	-200	0.3	0.7	-500	0.8	1.7	100	0.3	0.3	6.9
1360	1.4	450	1.0	0.8				-500	0.8	1.7	100	0.3	0.3	6.3
1350	1.4	550	1.2	0.9				-400	0.6	1.3	100	0.3	0.3	6.0
1340	1.4	300	0.7	0.6				-900	1.5	3.0	100	0.3	0.3	7.8
1330	1.4	400	0.9	0.7				-800	1.3	2.7	200	0.5	0.4	7.9
1320	1.4	1,000	1.8	1.4	-100	0.2	0.4	-600	1.0	2.2	200	0.5	0.4	9.3
1310	1.4	1,000	1.8	1.4				-600	1.0	2.2	250	0.6	0.5	8.9
1300	1.4	1,000	1.8	1.4	+100	0.7	0.1	-600	1.0	2.2	250	0.6	0.5	9.7
1290	1.4	550	1.2	0.9	+200	1.3	0.2	-600	1.0	2.2	500	1.1	0.8	10.1
1280	1.4	600	1.2	1.0	+300	1.9	0.4	-600	1.0	2.2	500	1.1	0.8	11.0
1270	1.4	550	1.2	0.9	+400	2.5	0.5	-600	1.0	2.2	500	1.1	0.8	11.6
1260	1.4	500	1.1	0.8	+500	3.1	0.6				800	1.5	1.2	9.7
1250	1.4	450	1.0	0.8	+600	3.8	0.7				800	1.5	1.2	10.4
1240	1.4	400	0.9	0.7	+700	4.4	0.8				800	1.5	1.2	10.9
1230	1.4	350	0.8	0.6	+800	5.1	1.0				800	1.5	1.2	11.6
1220	1.4	400	0.9	0.7	+900	5.7	1.1				800	1.5	1.2	12.5
1210	1.4	450	1.0	0.8	+1,000	6.3	1.2				800	1.5	1.2	13.4
1200	1.4	500	1.1	0.8	+1,100	6.9	1.3				800	1.5	1.2	14.2
1190	1.4	600	1.2	1.0	+1,200	7.6	1.4				800	1.5	1.2	15.3
1180	1.4	700	1.4	1.1	+1,300	8.2	1.6				800	1.5	1.2	16.4
1170	1.4	600	1.2	1.0	+1,400	8.8	1.7				800	1.5	1.2	16.8
1160	1.4	500	1.1	0.8	+1,500	9.5	1.8				800	1.5	1.2	17.3
1150	1.4	400	0.9	0.7	+1,600	10.2	1.9				800	1.5	1.2	17.8
1140	1.4	300	0.7	0.6	+1,700	10.8	2.0				800	1.5	1.2	18.2

WASTE HAULAGE TIMES - 637 D

		Level			Slope			Slope			Level			Total
Bench	LD	Dist	LD	E	Dist	LD	E	Dist	LD	E	Dist	LD	E	Time
1290	1.6	550	1.0	0.8	+200	0.7	0.2	-600	1.0	1.6	500	0.9	0.7	8.5
1280	1.6	600	1.1	0.8	+300	1.2	0.4	-600	1.0	1.6	500	0.9	0.7	9.3
1270	1.6	550	1.0	0.8	+400	1.6	0.5	-600	1.0	1.6	500	0.9	0.7	9.7
1260	1.6	500	0.9	0.7	+500	2.1	0.6				800	1.3	1.1	8.3
1250	1.6	450	0.9	0.7	+600	2.5	0.7				800	1.3	1.1	8.8
1240	1.6	400	0.8	0.6	+700	2.9	0.8				800	1.3	1.1	9.1
1230	1.6	350	0.7	0.6	+800	3.3	1.0				800	1.3	1.1	9.6
1220	1.6	400	0.8	0.6	+900	3.7	1.1				800	1.3	1.1	10.2
1210	1.6	450	0.9	0.7	+1,000	4.2	1.2				800	1.3	1.1	11.0
1200	1.6	500	0.9	0.7	+1,100	4.6	1.3				800	1.3	1.1	11.5
1190	1.6	600	1.1	0.8	+1,200	4.9	1.4				800	1.3	1.1	12.2
1180	1.6	700	1.2	1.0	+1,300	5.3	1.6				800	1.3	1.1	13.1
1170	1.6	600	1.1	0.8	+1,400	5.8	1.7				800	1.3	1.1	13.4
1160	1.6	500	0.9	0.7	+1,500	6.2	1.8				800	1.3	1.1	13.6
1150	1.6	400	0.8	0.6	+1,600	6.6	1.9				800	1.3	1.1	13.9
1140	1.6	300	0.6	0.5	+1,700	7.0	2.0				800	1.3	1.1	14.1

STRIPPING SCRAPER REQUIREMENTS

631 D SCRAPERS

YEAR 1

					Cumulative		Average
Bench	1370	17,780	BCM	6.9 min	17,780	BCM	6.9 min
	1360	128,040	BCM	6.3 min	145,820	BCM	6.4 min
	1350	340,230	BCM	6.0 min	486,050	BCM	6.1 min
	1340	751,760	BCM	7.8 min	1,237,810	BCM	7.1 min
	1330	1,402,120	BCM	7.9 min	2,639,930	BCM	7.5 min
	1320	260,610	BCM	9.3 min	2,900,540	BCM	7.7 min

Scraper Capacity:
(145/7.7) x 6.5 x 13 x 231 = 367,575 BCM

Number of scrapers required:
2,900,540/367,575 = 7.89

YEAR 2

Bench	1320	2,081,810	BCM	9.3 min	2,081,810	BCM	9.3 min
	1310	358,400	BCM	8.9 min	2,440,210	BCM	9.2 min

Scraper Capacity:
(145/9.24) x 6.5 x 13 x 231 = 306,312 BCM

Number of scrapers required:
2,440,210/306,312 = 7.96

YEAR 3

Bench 1310 2,569,550 BCM 8.9 min

Scraper Capacity:
(145/8.9) x 6.5 x 13 x 231 = 318,014 BCM

Number of scrapers required:
2,569,550/318,014 = 8.08

YEAR 4

						Cumulative		Average
Bench	1310	240,880	BCM	8.9	min	240,880	BCM	8.9 min
	1300	2,073,100	BCM	9.7	min	2,313,980	BCM	9.6 min

Scraper Capacity:
(145/9.62) x 6.5 x 13 x 231 = 294,213 BCM

Number of scrapers required:
2,313,980/294,213 = 7.86

YEAR 5

						Cumulative		Average
Bench	1300	980,840	BCM	9.7	min	980,840	BCM	9.7 min
	1290	1,148,460	BCM	10.1	min	2,129,300	BCM	9.9 min

Scraper Capacity:
(145/9.92) x 6.5 x 13 x 231 = 285,430 BCM

Number of scrapers required:
2,129,300/285,430 = 7.46

637 D SCRAPERS

YEAR 6

						Cumulative		Average
Bench	1290	1,888,010	BCM	10.1	min	1,888,010	BCM	10.1 min
	1280	1,161,580	BCM	9.3	min	3,049,590	BCM	9.8 min

Scraper Capacity:
(145/9.795) x 6.5 x 13 x 231 = 288,956 BCM

Number of scrapers required:
3,049,590/288,956 = 10.55

YEAR 7

						Cumulative		Average
Bench	1280	1,879,080	BCM	9.3	min	1,879,080	BCM	9.3 min
	1270	1,250,730	BCM	9.7	min	3,129,810	BCM	9.5 min

Scraper Capacity:
(145/9.46) x 6.5 x 13 x 231 = 299,189 BCM

Number of scrapers required:
3,129,810/299,189 = 10.46

YEAR 8

					Cumulative		Average
Bench	1270	1,725,760	BCM	9.7 min	1,725,600	BCM	9.7 min
	1260	1,526,340	BCM	8.3 min	3,252,100	BCM	9.0 min

Scraper Capacity:
(145/9.04) x 6.5 x 13 x 231 = 313,089 BCM

Number of scrapers required:
3,252,100/313,089 = 10.39

YEAR 9

Bench	1260	1,153,370	BCM	8.3 min	1,153,370	BCM	8.3 min
	1250	2,225,080	BCM	8.8 min	3,378,450	BCM	8.6 min

Scraper Capacity:
(145/8.63) x 6.5 x 13 x 231 = 327,964 BCM

Number of scrapers required:
3,378,450/327,964 = 10.30

YEAR 10

Bench	1250	186,590	BCM	8.8 min	186,590	BCM	8.8 min
	1240	2,176,440	BCM	9.1 min	2,363,030	BCM	9.1 min
	1230	771,860	BCM	9.6 min	3,134,890	BCM	9.2 min

Scraper Capacity:
(145/9.2) x 6.5 x 13 x 231 = 307,644 BCM

Number of scrapers required:
3,134,890/307,644 = 10.19

YEAR 11

Bench	1230	1,023,230	BCM	9.6 min	1,023,230	BCM	9.6 min
	1220	1,561,560	BCM	10.2 min	2,584,790	BCM	10.0 min
	1210	252,570	BCM	11.0 min	2,837,360	BCM	10.0 min

Scraper Capacity:
(145/10.05) x 6.5 x 13 x 231 = 281,485 BCM

Number of scrapers required:
2,837,360/281,485 = 10.08

YEAR 12

					Cumulative		Average
Bench	1210	1,069,450	BCM	11.0 min	1,069,450	BCM	11.0 min
	1200	951,870	BCM	11.5 min	2,021,320	BCM	11.2 min
	1190	453,830	BCM	12.1 min	2,475,150	BCM	11.4 min

Scraper Capacity:
(145/11.41) x 6.5 x 13 x 231 = 248,013 BCM

Number of scrapers required:
2,475,150/248,013 = 9.98

YEAR 13

Bench	1190	256,670	BCM	12.2 min	256,670	BCM	12.2 min
	1180	472,240	BCM	13.1 min	728,910	BCM	12.8 min

Scraper Capacity:
(145/12.78) x 6.5 x 13 x 231 = 221,413 BCM

Number of scrapers required:
728,910/221,413 = 3.29

YEAR 14

Bench	1170	213,700	BCM	13.4 min	213,700	BCM	13.4 min
	1160	105,060	BCM	13.6 min	318,760	BCM	13.5 min

Scraper Capacity:
(145/13.47) x 6.5 x 13 x 231 = 210,121 BCM

Number of scrapers required:
318,760/210,121 = 1.52

YEAR 15

Bench	1150	35,610	BCM	13.9 min	35,610	BCM	13.9 min
	1140	1,300	BCM	14.1 min	36,910	BCM	13.9 min

Scraper Capacity:
(145/13.91) x 6.5 x 13 x 231 = 203,474 BCM

Number of scrapers required:
36,910/203,474 = 0.18

COARSE REFUSE HAULAGE

The annual tonnage of coarse refuse will consist of about 2% of the raw coal mined, that is 16,330 tonnes per year rejected at the braker station and of 32.3% of the wash plant feed, that is 258,400 tonnes rejected at the plant. The total annual coarse refuse to be hauled from the plant site by scrapers to the waste dump is:

Breaker reject:	16,330 tonnes
Plant reject:	258,400 tonnes
Total	274,730 tonnes

The time by which the coal haulage cycle has to be extended for the coarse refuse haulage is as follows:

			631 D	637 D
Loading and unloading			1.4 minutes	1.6 minutes
Loaded:	1,500 m level at	3.3% E.G.	2.7 minutes	2.1 minutes
Return:	1,500 m level at	3.3% E.G.	1.9 minutes	1.9 minutes
			6.0 minutes	5.6 minutes

631 D refuse haulage capacity per scraper per year:

$$\left(\frac{2 \times 50}{6} + \frac{45}{6}\right) \times 6.5 \times 30 \times 231 = 1{,}088{,}590 \text{ BCM}$$

Number of scrapers required:

$$\frac{274{,}730}{1{,}088{,}590} = 0.25$$

637 D capacity:

$$\left(\frac{145}{5.6}\right) \times 6.5 \times 30\ 231 = 1{,}166{,}340 \text{ BCM}$$

Number required:

$$\frac{274{,}730}{1{,}166{,}340} = 0.24$$

TOTAL SCRAPER REQUIREMENT

Year	Stripping	Coal	Refuse	Total	Fleet	Model
1	7.89	0.86	0.25	9.00	12	631 D
2	7.96	0.79	0.25	9.00	12	631 D
3	8.08	0.67	0.25	9.00	12	631 D
4	7.86	0.89	0.25	9.00	12	631 D
5	7.46	1.29	0.25	9.00	12	631 D
6	10.55	1.21	0.24	12.00	16	637 D
7	10.46	1.30	0.24	12.00	16	637 D
8	10.39	1.37	0.24	12.00	16	637 D
9	10.30	1.46	0.24	12.00	16	637 D
10	10.19	1.57	0.24	12.00	16	637 D
11	10.08	1.68	0.24	12.00	16	637 D
12	9.98	1.78	0.24	12.00	16	637 D
13	3.29	1.93	0.24	5.46	7	637 D
14	1.52	2.00	0.24	3.76	5	637 D
15	0.17	2.06	0.24	2.47	3	637 D

RIPPER REQUIREMENTS

During the operation of the former Mullins pit in the area, the waste rock was ripped with a D-8 tractor. This suggests that the range of seismic wave velocities is between 5,000 and 6,000 feet per second and well within the ripping capacity of a D-9 tractor.

To establish the ripping requirements, the following assumptions are made:

Rip spacing:	1.00 m	
Tip penetration:	0.50 m	
Ripping distance:	100.00 m	
Speed:	1.67 km/hr=	26.7 m/minute
Cycle:	100/26.7 =	3.75 minutes
	Turning	0.25 minute
	Total	4.00 minutes
Cycle/hour:	60/4.0 =	15
Production/cycle:	100.0 x 1.0 x 0.5 =	50 BCM

Average daily production per ripper:

$$\left(\frac{2 \times 50}{4.0} + \frac{45}{4.0}\right) \times 6.5 \times 50 = 11{,}781 \text{ BCM}$$

Average annual waste haulage:	2,360,000 BCM
Average annual coal haulage:	497,760 BCM
Annual volume to be ripped:	2,857,760 BCM
Daily volume to be ripped:	12,370 BCM

Number of rippers required at 100% availability:

$$\frac{12{,}370}{11{,}781} = 1.05$$

Number of rippers required at 75% availability:

1.05/0.75 = 1.4

Required number in fleet: 2 rippers

PUSHER REQUIREMENTS

The capacity of the self-loading 631D scrapers can be increased by as much as 10% with the use of pushers, that is D9 dozers equipped with cushion blades. Usually a pusher can handle several scrapers and when not pushing, it can be used for cut maintenance as well as for other jobs.

A pusher's cycle time is assumed to be as follows:

Boost time	0.10 minute
Return time	0.98 minute
Maneuvre time	0.15 minute
Total	1.23 minute

Pushers required for coal scrapers in years 1 to 5:

Longest cycle time	8.76 minutes
Number of scrapers handled by one pusher	8.76/1.23 = 7.12
Actual number of scrapers to be pushed	two
Number of pushers required	one

Pushers required for stripping scrapers in years 1 to 5:

Longest cycle time	9.92 minutes
Number of scrapers handled by one pusher	9.92/1.23 = 8.06
Actual number of scrapers to be pushed	nine
Number of pushers required	two

In year 6 the 631 D scrapers will be replaced by 637 D scrapers which will push each other during loading, thus eliminating the need for extra pushers.

ADDITIONAL EQUIPMENT REQUIREMENTS

In view of the project economics, the haulage of clean coal from the plant site to the railroad in Coalmont should be contracted out, at least initially. For the maintenance of the haulage road, however, a grader is required. Another grader will be required for the roads around the pit, plant site and waste dump. It is expected that Caterpillar Model 12G will be sufficient in both areas.

The rest of the equipment should include water and sanding trucks, a service truck to serve the D9 equipment in the pit and at the dump, a small mobile crane to facilitiate on site maintenance work and repair, a van to carry D9 operators to their place of work, ten pick-ups for supervisory personnel and an ambulance. Finally, a model 988B wheel loader is selected for train loading and to provide miscellaneous services in the plant area in between train shipments.

SECTION 6

SECTION 6

COAL PREPARATION

SECTION 6

COAL PREPARATION

The general arrangement plans are based on the flowsheet designed by Coal Systems Inc. of Salt Lake City, Utah, and on previous studies carried out by Techman Ltd. of Calgary, Alberta, and by Paul Weir Co. of Chicago, Illinois.

BREAKER STATION

Raw coal from the mine is to be delivered by scrapers to the Breaker Station at an average of 147 tonnes per hour. The scrapers will haul the coal up on a 5 degree ramp to a dump hopper of 68 tonnes (28 minutes retention) capacity, covered by a steel grid with 480 mm x 480 mm openings. Oversize coal pieces will be broken by the scrapers crossing the grid, while the oversize rocks will be reloaded and hauled to the waste dump.

The raw coal from the hopper will be moved by a hydrostroke reciprocating feeder with variable speed drive at a rate of 136 to 272 tonnes per hour. The feeder will be activated and deactivated by high and low level probes. The discharge will be passed over a stationary grizzly with 100 mm bar spacing. The oversize material will be fed into a 2.74 m (9 ft) diameter and 6.5 m (16 ft) long rotary breaker. The broken coal passing 100 mm will be collected along with the grizzly undersize on a 914 mm (36 in) belt conveyor and deposited in a stockpile of 7,260 tonnes capacity, of which approximately 20% or 1,450 tonnes will be live storage. This should provide sufficient surge to the Wash Plant without the need for heavy reclaiming equipment.

A monorail hoist will be provided for general maintenance and service in the Breaker Station and a tunnel sump pump for dewatering below the breaker.

Breaker rejects, estimated at 2% of the raw coal feed, will be collected by a 610 mm (24 in) conveyor and deposited in a small stockpile for subsequent disposal at the waste dump by scrapers returning to the pit.

PLANT FEED SYSTEM

Raw coal from the stockpile will be reclaimed by two hydrostroke reciprocating feeders with variable speed drives. Each feeder shall be able to provide 90 to 270 tonnes per hour, according to plant requirements. The plant feed rate and the total tonnage will be monitored by a conveyor scale. A manually operated sampler will be installed to collect plant feed data for process control and for short range mine planning. A magnet will also be installed at the head chute of the feed conveyor to remove tramp iron.

WASH PLANT

The raw coal will be fed into a Batac jig, along with clarified water originating from the tailings pond, where the plant feed will be separated into three products: refuse, middlings and clean coal.

The refuse will be dewatered on a single deck vibrating screen using profile wires with 1 mm spacing.

The original flowsheet calls for a 600 micron (28 mesh) separation of dewatering. It is WEL's opinion, however, that the volume of kaolinite and montmorillonite in the clay partings indicated will cause build up and blinding on the refuse and middling screens. Operating experience with such clay partings has shown that the build up on stainless steel profile will cause flooding of the screen deck. Accordingly, a larger spacing is recommended. The corresponding increase of fine refuse reporting to the refuse slurry sump is considered insignificant.

The dewatered refuse will be conveyed to a loadout bin of 150 tonnes capacity for subsequent haulage by scrapers to the waste dump area, while the fine refuse slurry will be pumped to the tailings pond.

Jig middlings will discharge onto a vibrating double-deck screen to be sized into three fractions: +20 mm (+3/4 in), 20 mm x 1 mm (3/4 in x 16 mesh) and -1 mm (-16 mesh).

The coarse middling fraction will be crushed to -20 mm (-3/4 in) by a small double roll crusher, slurried with water in a sump and pumped back to the jig for reprocessing. The 20 mm x 1 mm (3/4 in x 16 mesh) will be piped by gravity to the refuse slurry sump.

The clean coal product from the jig will be discharged onto another vibrating double-deck screen to be sized into three fractions. The top deck oversize of +40 mm (+1-1/2 in) will be crushed by a double roll crusher to -40 mm (-1-5/8 in) as required by typical thermal coal specifications, and will be discharged onto the clean coal collecting conveyor. The second deck oversize coal of 40 mm x 6 mm (1-1/2 in x 1/4 in) will be rinsed free of fines and fed into a Wemco Model 1100 centrifuge to be dewatered and discharged onto the clean coal collecting conveyor. The -6 mm (-1/4 in) coal will be collected in slurry form in a small coal sump then pumped to two classifying cyclones. The +600 micron coal will be passed over a sieve bend, then fed into the Wemco centrifuge. The -600 micron fraction, along with the slurry from the sieve bend and from the centrifuge, containing both coal and fine clay, will be collected in a sump and pumped to a bank of ten 305 mm (12 in) primary hydrocyclones utilizing a 10 unit circular cyclopac.

The cyclopac underflow will be reslurried in another sump and pumped to a bank of two secondary hydrocyclones, whose underflow will be piped to the refuse slurry sump and whose overflow will be fed back to the primary hydrocyclone sump.

The cyclopac overflow will be piped to a fine coal sump, from where it will be pumped to another cyclopac containing eight 356 mm (14 in) classifying cyclones. The underflow from here will be deslimed and dewatered over two sieve bends in series, using a rapping device as well as water sprays. The sieve bend cake will be fed into a Wemco centrifuge with a fine mesh basket for final dewatering, then discharged onto the clean coal collecting conveyor. The overflow from the cyclones, as well as the effluents from the sieve bends and from the centrifuge will be piped into the refuse slurry sump. The initial flowsheet had indicated three centrifuges, each a different model. Subsequent investigations, however, led to the findings that two Wemco Model 1100 centrifuges are sufficient to achieve the required dewatering.

CONVEYOR GALLERIES

Tubular conveyor galleries are proposed for the Wash Plant feed, refuse and clean coal collecting conveyors. These galleries are to be heated during cold weather to avoid freezing problems associated with refuse and clean coal products containing 12% to 18% moisture.

CLEAN COAL LOADOUT

The clean coal will be fed into a 100-ton capacity truck loading bin by the collecting conveyor. A belt scale and sampler will be provided for monitoring and controlling product quality and quantity.

TAILINGS DISPOSAL SYSTEM

A dyke will be built with waste materials from the pit, to create a tailing pond on the hillside near the Wash Plant. Slurry from the refuse slurry sump will be pumped there at the rate of 178 litre per second (2,820 US gpm) in a 200 mm (8 in) pipeline.

SECTION 7

SECTION 7

SUPPORT FACILITIES

SECTION 7

SUPPORT FACILITIES

ANCILLARY SERVICES BUILDING

The Ancillary Services Building will be located adjacent to the Wash Plant and will comprise a maintenance and repair shop, a warehouse, a dry and various administrative offices.

The shops will consist of:

- a drive through lubrication bay to handle the regular shift servicing and the scheduled service inspections of the scrapers and of other mobile equipment;

- one drive through repair bay for scrapers, with tire change and other miscellaneous repair equipment;

- a drive through tractor repair bay with rails cast in the floor, providing repair facilities for bulldozers, graders, wheel loaders and other ancillary equipment;

- a bay for welding and repair of both mining and plant equipment;

- a small machine shop and electrical shop;

- one smaller bay for servicing and repair of service trucks and pick-ups;

- separate areas allocated for lube storage, compressors, tool crib, electric distribution room, wash rooms and others.

The main bays will be serviced by an overhead crane.

An equipment wash pad will be located near the shops.

A component replacement maintenance system is recommended and the shops, as well as the warehouses should be furnished accordingly. Component overhaul work should be sent out to larger population centres equipped to handle that highly skilled type of work.

The dry facilities are designed to have separate clean and dirty clothes sections, complete with showers and washrooms. Within those sections, separate areas are provided for staff and for women.

The operations and administration offices are arranged to provide assembly areas for work assignments, as crews pass through from the dry to the shops, the plant and to the mine areas.

ELECTRIC POWER SUPPLY AND DISTRIBUTION

Power Supply

Two alternatives can be considered for the supply of electric power: on-site diesel generation and public utility.

The on-site diesel generation system would consist of four 400 kW, 600 volt, 3 phase, 60 Hz generators connected to a common bus and equipped for manual synchronizing. Each generator would be rated at 400 kW continous and 550 kW standby power. Normally, three sets would be in operation, carrying an estimated load of 1,200 kW, while the fourth set would be available for maintenance and overhaul. In the event that one set would go down while another is being overhauled, the remaining two sets would operate at their standby rating of 1,100 kW total. Thus, security of power supply would be maintained.

As an alternative, West Kootenay Power and Light have the capacity at Princeton to supply the required load, although their present distribution line to Coalmont is inadequate, being 7,200 volt, single phase. In order to provide the required power, that line would have to be rebuilt to three phases at a higher voltage level. In addition, a suitable switchgear and transformation will have to be installed at Princeton. To date, the new transmission voltage has not yet been determined. For cost comparison purposes, it is assumed that 60 kV would be selected. Accordingly, the substation at the mine site would consist of 60 kV incoming switchgear and a 1,500 KVA, 60-0.6 KV transformer.

Examining the costs of the two alternatives, it is found that the lower capital cost of a diesel installation is offset by its relatively high operating cost:

		Diesel	Utility
Depreciation	/RMT	\$0.05	\$0.18
Operating Cost	/RMT	\$0.97	\$0.21
Overall Cost	/RMT	\$1.02	\$0.39

The above diesel operating cost is based on the current diesel fuel cost at \$0.38 per litre (\$1.75 per Imperial gallon) which will escalate in line with the planned increases in the cost of crude oil.

It is recommended, therefore, that the public utility power supply should be developed.

POWER DISTRIBUTION

The power distribution is designed to be the same, regardless which power supply will be developed. 600 volt power from either the diesel plant or from the substation will be fed to a 600 volt switchboard. Individual circuit breakers will feed the Breaker Station, Wash Plant, Water Supply System, Ancillary Services Building and the Mine Dewatering System.

All feed circuits will be buried cables, with the exception of the Water Supply System's circuit which will be a 4,160 volt overhead line, complete with a step-up transformer, as well as individual step-down transformers at the pumps.

PROCESS WATER SUPPLY

The process water from the tailings pond will be pumped through a 400 mm diameter pipe line to a 760 m^3 (200,000 U.S. gallons) storage tank. This tank capacity will be sufficient to provide an hour's supply of process water or fire fighting water.

Process water usage will be approximately 180 litre per second (2,850 U.S. gpm) at 400 to 500 kPa (60 to 80 psi) pressure.

Water lost in the process as moisture and by seepage or evaporation will be made up by water obtained from pit dewatering.

POTABLE WATER SUPPLY

The pit dewatering system will feed a 34 m^3 (9,000 U.S. gallons) potable water storage tank. This tank capacity will correspond to two days normal supply to the plant site.

The potable water will be disinfected with liquid hypochlorite and distributed through a 75 mm diameter mild steel pipe line.

SEWAGE DISPOSAL

Sewage from the plant and offices will be collected in a system of 100 mm diameter concrete lined ductile iron sewers and treated in a prefabricated package sewage treatment plant discharging to a small drainage field.

PIT DEWATERING

The pit will be dewatered by a system of ten 200 mm diameter boreholes. Each borehole will be furnished with a 14 kW submersible pump discharging into a 100 mm steel pipe line feeding the process water tank. At spring time, overpumping will be required to provide for the excessive evaporation losses of the summer months.

Should water from pit dewatering prove insufficient at any time, it may be necessary to drill additional wells in an adjacent aquifer.

ACCESS ROAD

Access to the site from Coalmont at present is via an existing road on the west side of Granite Creek. It can be improved to a 6.1m (20 ft) wide gravel road with 1.5m (5 ft) wide shoulders and having a maximum gradient of 10%.

Consideration was given to an alternate access road route via Fraser Gulch. Although the route is slightly shorter and transportation costs would be less than on the Granite Creek road, it would require a substantially greater initial capital expenditure for its construction.

Immediately west of Coalmont the Tulameen River is crossed by a public bridge which was constructed in 1922 consisting of untreated timber on concrete abutments. It is currently subject to a road restriction of 11,000 kgm (90,000 lbs) which effectively bars trucks with 18 tonne (20 ton) payloads. It is proposed to install a new heavy-duty bridge across the Tulameen River and an allowance has been made for it in the capital costs. It is possible, however, that it would be paid for by the B.C. Department of Highways.

SECTION 8

SECTION 8

TRANSPORTATION

SECTION 8

TRANSPORTATION

The clean coal will be transported in 36.3 tonnes payload capacity trucks from the plant site to the rail siding at Coalmont upon improvement of the access road and installation of a stronger bridge.

A contract to haul the clean coal would be awarded to an independent contractor to reduce initial capital investments by what would be otherwise required for a fleet of haulage trucks and for the corresponding maintenance facilities.

The coal will be delivered to a stockpile area, having a capacity of approximately 15,000 tonnes, situated adjacent to the rail spur.

From the stockpile, the clean coal will be reclaimed and loaded directly into the 71-ton capacity railroad cars by a Caterpillar Model 988B wheel loader having 6 m^3 bucket capacity and a lifting height at discharge of 3.53 m (11 ft x 7 in). This loader should be able to load 7.5 cars per hour, or to load a full 48 car train in about 9 hours, assuming that the loader also moves the rail cars past the loading point as required.

The scheduled turn around time of the train will be 65 hours which will provide ample time for the loader to work around the mine site in between train loading activities.

The size of the haulage fleet is determined as follows:

Daily Production	440,800/231	=	1,908 tonnes
Truck cycle time	@ 40 kmph	=	48 minutes
Truck capacity/day	$\left(\frac{2 \times 50}{48} + \frac{45}{48}\right) \times 6.5 \times 36.3$	=	712.8 tonnes
Number of trucks required: 1,908/712.8		=	2.68 trucks
At 75% availability: 2.68/.75		=	3.57 trucks
In fleet:			4 trucks

SECTION 9

SECTION 9

ENVIRONMENTAL PROTECTION

SECTION 9

ENVIRONMENTAL PROTECTION

In keeping with general practices, an amount should be budgeted annually, in proportion with the clean coal produced, for the protection of the environment, as well as for reclamation upon termination of the mining activities.

The proposed amounts are $25,000 per annum for environment protection from years 1 to 15 and $60,000 for reclamation during years 14 and 15.

From what is known on the basis of surveys done to date, the prospective mine development is expected to have only a minor impact on the area. Examining the various constituents of the local environment, the following may be stated:

VEGETATION

- All plant communities and individual species identified in the area are common and widespread in southwestern B.C.

- Most of the area has already been moderately-to-severely affected by previous human activities over the past 100 years.

- No climax plant communities are to be effected.

WILDLIFE

- the B.C. Wildlife Inventory ungulate map indicates moderate-to-severe limitations for the production of ungulates in the area, due to snow depth and rock outcrops.

- The B.C. Wildlife Inventory waterfowl map indicates severe limitations, due to adverse topography, that is the absence of ponds or lakes.

- No rare or endangered species of wildlife have been observed in the area, nor are any likely to occur.

AGRICULTURE

- The Canada Land Inventory classifies the area east of Hamilton Hill without capacity for agriculture or permanent pasture.

- The Blakeburn Creek valley area is classified as 70% containing some natural pasture, only a small part of which, however, could be improved by range management practices.

- The area is characterized by rugged topography, outcropping of bedrock, stony soil and lack of soil moisture.

- The area in Coalmont to be used for rail loading appears to lie within an agricultural land reserve. This land, however, was used previously as the terminus of an abandoned aerial tramway, covered at the present by building foundations, roadways and other non-agricultural features.

FORESTRY

- The Canada Land Inventory indicates 70% of the area having moderate, and 30% having moderately severe limitations of commercial forest growth.

- The forest in the area consists of immature trees, the oldest ones ranging in age from 80 to 100 years.

- Timber cleared from exploration sites and access roads, representing a reasonable cross section of the tree occurrences in the area, could not be marketed by the B.C. Forest Service due to poor quality and had to be burned.

HERITAGE

- There are two "ghost towns" in the area: Granite Creek which was abandoned in 1912 and is maintained by the B.C. Forest Service, and Blakeburn which was abandoned in 1940 and mostly dismantled. Neither sites would be affected by the proposed mine development.

- The former Hudson Bay trail leading to the B.C. interior has been flagged by the B.C. Historical Society and is used by hikers in the summer months. The trail crosses through the middle of the future open pit. Consequently, a portion of the trail will have to be rerouted.

In accordance with the above findings, the mining operations can be reclaimed to a satisfactory level of usefulness, and no permanent or long term damage will be inflicted on the local ecology.

SECTION 10

SECTION 10

MANPOWER ESTIMATE

SECTION 10

MANPOWER ESTIMATE

The total number of hourly paid personnel is expected to increase from 107 in the initial years to 109 in the 3rd year. After the 12th year this number will decline to 75 during the last three years of operations.

The total number includes the estimated number required, plus an allowance of 10% to cover absenteeism, overtime and vacations.

For the required positions and for the geographical area, compared with existing mining operations nearby, the average wage is estimated at $12.00 per hour to which 30% is added to cover payroll overhead.

Due to the relatively small size of operations, the number of supervisory and other, monthly paid personnel should be kept low. This may be achieved by employing well or highly qualified personnel in the required positions.

HOURLY PAID PERSONNEL

Jobs	Years 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
MINE															
Scraper operators	27	27	27	27	27	36	36	36	36	36	36	36	18	12	9
Ripper operators	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Pusher operators	9	9	9	9	9	0	0	0	0	0	0	0	0	0	0
Grader operators	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Water/sand truck op.	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Service truck op.	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
PLANT															
Braker attendants	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Plant operators	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Plant attendants	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Mechanics	5	5	7	7	7	7	7	7	7	7	7	7	7	7	7
Electricians	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Laborers	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
SHOP															
Mechanics	4	4	4	4	4	4	4	4	4	4	4	4	3	3	3
Laborers	8	8	8	8	8	8	8	8	8	8	8	8	6	6	6
Tool-crib/storage alt.	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Loader operators	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
OFFICE															
Rodman	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Clerk	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Security Guards	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	97	97	99	99	99	99	99	99	99	99	99	99	78	72	69
Absenteeism and vacation allowance	10	10	10	10	10	10	10	10	10	10	10	10	8	7	7
Total	107	107	109	109	109	109	109	109	109	109	109	109	86	79	75

MONTHLY PAID PERSONNEL

The number of the supervisory personnel is not expected to change through the years; 25% payroll overhead is applied.

Jan 1/82 no load

Position	No.	Mid P.	Salary	Payroll Cost
Operations Manager	1	52,000	$40,000	$ 50,000
Mine Superintendent	1	48,000	35,000	43,750
Plant Superintendent	1	48,000	35,000	43,750
Maintenance Superintendent	1	48,000	35,000	43,750
Mine Foremen	3	34,000	30,000	112,500
Plant Foremen	3	"	30,000	112,500
Maintenance Foremen	3	"	30,000	112,500
Surveyor	1	27,000	25,000	31,250
Chief Clerk	1	30,000	30,000	37,500
Payroll Clerk	1	25,000	25,000	31,250
Personnel and Safety Supervisor	1	30,000	30,000	37,500
Warehouse Clerk	1	27,000	20,000	25,000
Lab Technician	1	29,000	25,000	31,250
ClerkTypists	4	16,000	18,000	22,500
Total	23			$735,000

Cost per clean tonne mined:

735,000/440,800 = $1.67/tonne

Labour Avg Rate – 14.25

Jan 82 / no load
(Mtce contract for Heavy Equip)

SECTION 11

SECTION 11

CAPITAL COST ESTIMATES

SECTION 11

CAPITAL COST ESTIMATES

CAPITAL COST SUMMARY

MINING			
Clearing and Grubbing	$ 180,000		
Exploration	100,000		
Haulage Road Construction	120,000		
Mobile Equipment	8,768,060	$ 9,168,060	(13,360,110)
COAL PREPARATION			
Site Preparation	$ 510,000		
Breaker Station	1,773,800		
Plant Feed System	280,310		
Wash Plant	3,608,220		
Clean Coal Loadout	287,820		
Tailings Disposal	279,180		
Lighting & Instrumentation	102,900	6,842,230	
SUPPORT FACILITIES			
Ancillary Services Building	$ 3,082,310 (4,134,270)		
Power Supply & Distribution	2,256,000 (2,756,000)		
Tailings Pond	1,736,000		
Water Supply System	834,650		
Potable Water Supply	47,000		
Sewage Disposal	75,000		
Pit Dewatering System	612,000	8,642,960	(10,1[illegible])
TRANSPORTATION			
Access Road Construction	$ 550,000		
Bridge	310,000		
Railhead Storage & Ramp	788,000	1,648,000	
Sub-total		$26,301,250	
Engineering & Construction Management		2,104,000	
Sub-total		$28,405,250	
Contingencies - 15%		4,260,750	
TOTAL		$32,666,000	(3[illegible] 770,000)

CAPITAL COST BREAKDOWN- MINING

Clearing and grubbing	180 acres at $1,000/acre		$ 180,000
Exploration drilling	4 holes totalling 60 m		100,000
Construction of coal and waste haulage roads			120,000

Mobile Equipment

12	Scrapers - 631D	$5,421,890	
5	Dozers - D9L	2,331,440	
2	Graders - 12G	369,940	
1	Loader 988B	414,340	
10	Half-ton Pick-ups	131,700	
1	Mobile Crane	42,850	
1	Sanding Truck	19,320	
1	Lube Truck	11,580	
1	Personnel Transport Van	10,000	
1	Ambulance Car	15,000	
			$ 8,768,060
Total			**$ 9,168,060**
			+ 500,000

SCRAPER ACQUISITION SCHEDULE

				Operating Hours		
Year	Buy New	Replace	Retire	Current	Cumulative	Average
1	12-631	-	-	30,405	30,405	2,534
2	-	-	-	30,405	60,810	5,067
3	-	-	-	30,405	91,215	7,601
4	-	-	-	30,405	121,620	10,135
5	-	-	-	30,405	152,025	12,669
6	16-637	-	12-631	40,540	40,540	2,534
7	-	-	-	40,540	81,080	5,067
8	-	-	-	40,540	121,620	7,601
9	-	-	-	40,540	162,160	10,135
10	-	-	-	40,540	202,700	12,669
11	-	16-637	-	40,540	40,540	2,534
12	-	-	9-637	40,540	81,080	5,067
13	-	-	2-637	18,446	99,526	7,702
14	-	-	2-637	12,703	112,229	10,243
15	-	-	3-637	5,840	118,069	12,190

Replacement is based on 13,500 operating hours:

$3 \times 6.5 \times 0.75 \times 231 \times 4 = 13{,}513.5$

DOZER ACQUISITION SCHEDULE

				Operating Hours		
Year	Buy New	Replace	Retire	Current	Cumulative	Average
1	5	-	-	12,670	12,670	2,534
2	-	-	-	12,670	25,340	5,067
3	-	-	-	12,670	38,010	7,601
4	-	-	-	12,670	50,680	10,135
5	-	-	-	12,670	63,350	12,670
6	-	2	3	5,068	5,068	2,534
7	-	-	-	5,068	10,136	5,067
8	-	-	-	5,068	15,204	7,601
9	-	-	-	5,068	20,272	10,135
10	-	-	-	5,068	25,340	12,670
11	-	2	-	5,068	5,068	2,534
12	-	-	-	5,068	10,136	5,067
13	-	-	-	5,068	15,204	7,601
14	-	-	-	5,068	20,272	10,135
15	-	-	2	3,548	23,820	12,200

Replacement is based on 13,500 operating hours:

$3 \times 6.5 \times 0.75 \times 231 \times 4 = 13{,}513.5$

CAPITAL COST SUMMARY

COAL PREPARATION

Site Preparation	$ 510,000
Breaker Station	$1.773.800
Plant Feed System	280,310
Wash Plant	3,608,220
Clean Coal Loadout	287,820
Tailing Disposal System	279,180
Lighting and Instrumentation	102,900
Total	**$6,842,230**

CAPITAL COST BREAKDOWN

COAL PREPARATION

BREAKER STATION	
Dump Hopper, Tunnel and Breaker Foundation	$ 588,510
Breaker Building	159,840
Rotary Breaker, Grizzly and Chutes	260,170
Feeder	52,260
Dust Control	50,000
Material Hoist	17,020
Conveyors	359,000
ROM Storage Lowering Tube and Tunnel	287,000
Sub-total	$1,773,800
PLANT FEED SYSTEM	
Feeders	$ 68,370
Conveyor	211,940
Sub-total	$ 280,310
WASH PLANT	
Building	$ 946,880
Scales, Samplers, Tramp Magnet	202,810
Batac Jig	1,357,660
Screens	216,680
Crushers	138,540
Slurry Pumps and Sumps	229,040
Clean-up Pumps	38,040
Hydrocyclones	107,590
Classifying Cyclones (8)	63,870
Classifying Cyclones (2)	28,700
Centrifuges	156,580
Sieve Bends	26,990
Overhead Crane (10-ton capacity)	74,840
Air Compressor	20,000
Sub-total	$3,608,220
CLEAN COAL LOADOUT	
Conveyor	$ 206,130
Storage Bin	81,690
Sub-total	$ 287,820
TAILINGS DISPOSAL SYSTEM	
Conveyors	$ 167,310
Storage Bin	95,700
Slurry Pipeline (200 mm)	16,170
Sub-total	$ 279,180

CAPITAL COST BREAKDOWN

SUPPORT FACILITIES

ANCILLARY SERVICES BUILDING

SHOPS

Structure		$ 1,193,400
Concrete Aprons:		64,350
Excavation	$ 1,800	
Gravel Fill	3,300	5,100
Crane	$ 65,500	
Hoist	27,300	
Bus Bar	3,470	
Switch	1,000	
Starter	2,500	
Wiring	3,990	103,760
Internal Offices	$ 70,200	
Office Furnishing	22,000	92,200
Maintenance Equipment		200,000
Sub-total		$ 1,658,810

OFFICES

Structure	$ 288,000
Office Furnishing	57,000
Sub-total	$ 345,600

DRY

Structure	$ 561,600
Lockers	24,000
Sub-total	$ 585,600

WAREHOUSE

Structure	$ 345,600
Office Furnishing	4,000
Storage Shelves, Bins and Racks	142,700
Sub-total	$ 492,300
TOTAL	**$ 3,082,310**

CAPITAL COST BREAKDOWN

SUPPORT FACILITIES - Cont'd.

POWER SUPPLY AND DISTRIBUTION

POWER SUPPLY

Switchgear and Transformer		$ 300,000
60 kV Transmission Line		1,500,000
Mine Substation:		
60 kV Isolator Switch	$10,000	
Lightning Arresters	7,000	
Circuit Breaker	84,000	
Structure, Fence, Grounding	40,000	
1500 KVA, 60-0.6 kV Transformer	50,000	
600 volt Circuit Breaker	8,000	199,000
Sub-total		$1,999,000

POWER DISTRIBUTION

600 volt Switchgear		$ 35,000
Miscellaneous Equipment		43,000
Feeders to:		
Breaker Station	$12,000	
Wash Plant	49,000	
Ancillary Buildings	18,000	
Water Supply System	33,000	
Pit Dewatering Pumps	62,000	
Gatehouse	3,000	
Sewage Plant	2,000	179,000
Sub-total		$ 257,000
TOTAL		**$2,256,000**

CAPITAL COST BREAKDOWN

SUPPORT FACILITIES - Cont'd.

TAILINGS POND

Clearing & Excavations	$ 271,200
Dyke Construction	1,442,000
Spillway	22,800
Sub-total	$ 1,736,000

PROCESS WATER SUPPLY

Barge & Pump Inlet	$ 382,500
Pumps	52,300
Pipe Line	121,000
Water Storage Tank	72,250
Distribution System	200,000
Fire Hydrants	6,600
Sub-total	$ 834,650

POTABLE WATER SUPPLY

Water Storage Tank	$ 11,200
Distribution System	32,300
Hypochlorite Feeder	3,500
Sub-total	$ 47,000

SEWAGE DISPOSAL

Sewage System	$ 31,000
Sewage Treatment Plant	33,600
Drainage Field	10,400
Sub-total	$ 75,000

PIT DEWATERING SYSTEM

Borehole Wells	$ 320,000
Well Pumps	40,000
Testing & Development	20,000
Power Supply	17,400
Discharge Piping	214,600
Sub-total	$ 612,000

CAPITAL COST BREAKDOWN

TRANSPORTATION

ACCESS ROAD

General Upgrading	$ 200,000
Improvements & Diversions	215,000
Drainage Works	40,000
New Culverts	25,000
Town Bypass	70,000
Sub-total	$ 550,000

BRIDGE

Factored allowance	$ 310,000

RAILHEAD STORAGE AND RAMP

Track Works	$ 408,000
Turnouts	200,000
Signalling	50,000
Site Preparation	68,000
Concrete Curbing	62,000
Sub-total	$ 788,000
TOTAL	**$ 1,648,000**

CAPITAL EXPENDITURES

($ Thousands)

Year	Pit Equ.	Plant	Facilities	Expl & D	Proj. Mg.	Cont. Capital	Total
PREPRODUCTION PERIOD:							
-1	-	440	1,367	477	518	-	2,802
0	10,083	7,429	9,478	972	1,902	-	29,864
Subtotal	10,083	7,869	10,845	1,449	2,420	-	32,666
PRODUCTION PERIOD:							
1	-	-	-	-	-	380	380
2	-	-	-	-	-	390	390
3	152	-	-	-	-	400	552
4	-	-	-	-	-	410	410
5	-	-	100	-	-	420	520
6	11,434	-	-	-	-	430	11,864
7	-	-	-	-	-	440	440
8	-	-	-	-	-	450	450
9	152	-	100	-	-	460	712
10	-	650	-	-	-	470	1,120
11	11,282	-	-	-	-	480	11,762
12	(4,214)	-	-	-	-	490	(3,724)
13	(647)	-	100	-	-	500	(47)
14	(325)	-	-	-	-	510	185
15	(194)	-	-	-	-	360	166
Subtotal:	17,640	650	300	-	-	6,590	25,180
Total	**27,723**	**8,519**	**11,145**	**1,449**	**2,420**	**6,590**	**57,846**

PREPRODUCTION COST BREAKDOWN

Year - 1

PLANT		
	Site Preparation 75%	$ 382,500
	Contingency	57,400
	TOTAL	$ 439,900
FACILITIES		
	Power Supply & Distr. 50%	$ 1,128,000
	Potable Water Supply 50%	23,500
	Sewage Disposal 50%	37,500
	Subtotal	$ 1,189,000
	Contingency	178,350
	TOTAL	$ 1,367,350
EXPLORATION & DEVELOPMENT		
	Exploration 50%	$ 50,000
	Access Road Construction 50%	275,000
	Clearing & Grubbing 50%	90,000
	Subtotal	$ 415,000
	Contingency	62,250
	TOTAL	$ 477,250
PROJECT MANAGEMENT		
	Engineering 20%	$ 150,000
	Construction Management 20%	300,000
	Subtotal	$ 450,000
	Contingency	67,500
	TOTAL	$ 517,500
TOTAL YEAR - 1		**$ 2,802,000**

PREPRODUCTION COST BREAKDOWN

Year 0

PIT EQUIPMENT	
Equipment	$ 8,768,060
Contingency	$ 1,315,210
TOTAL	$ 10,083,270
PLANT	
Site Preparation 25%	$ 127,500
Breaker Station	1,773,800
Plant Feed System	280,310
Wash Plant	3,608,220
Clean Coal Loadout	287,820
Tailings Disposal	279,180
Lighting & Instrumentation	102,900
Subtotal	$ 6,459,730
Contingency	968,960
TOTAL	$ 7,428,690
FACILITIES	
Ancillary Services Building	$ 3,082,310
Power Supply & Distribution 50%	1,128,000
Tailings Pond	1,736,000
Water Supply	834,650
Potable Water Supply 50%	23,500
Sewage Disposal 50%	37,500
Railhead Storage	788,000
Pit Dewatering System	612,000
Subtotal	$ 8,241,960
Contingency	1,236,290
TOTAL	$ 9,478,250
EXPLORATION & DEVELOPMENT	
Exploration 50%	$ 50,000
Access Road Construction 50%	275,000
Clearing & Grubbing 50%	90,000
Haulage Road Construction	120,000
Bridge Construction	310,000
Subtotal	$ 845,000
Contingency	126,750
TOTAL	$ 971,750
PROJECT MANAGEMENT	
Engineering 80%	$ 540,000
Construction Management 80%	1,114,000
Subtotal	$ 1,654,000
Contingency	248,040
TOTAL	$ 1,902,040
TOTAL YEAR 0	$ 29,864,000

SECTION 12

SECTION 12

OPERATING COST ESTIMATES

SECTION 12

OPERATING COST ESTIMATES

HOURLY EQUIPMENT OPERATING COST

Equipment	Scraper 637 D	Scraper 631 D	D9L Dozer	12G Grader	988B Loader
Delivered Price	$ 646,900	$ 508,300	$ 466,300	$ 184,970	$414,340
Depreciation/hr.	$ 47.92	$ 37.65	$ 34.54	$ 13.70	$ 30.69
Fuel Costs	21.70	13.80	12.60	4.40	11.20
Lube	0.80	0.60	0.90	0.50	.60
Tires	16.60	16.60	-13.50	2.10	12.00
Repairs	43.10 (39.10)	33.90 (31.00)	31.10	8.20	27.60
Ripper	-	-	3.30	-	-
TOTAL	**$ 82.20**	**$ 64.90**	**$ 47.90** (90.58)	**$ 15.20** (14G 40.07)	**$ 51.40** (66.13)

40,540 hrs
1,747,274
171,400
1,921,674

30,405 hrs
#1,030,700

12,670 hrs
394,000

1,424,700

342,555

171,054

1,117,000

5,068

171,400

OPERATING MINING AND LABOUR COSTS

Year	Scraper ($)	Dozer ($)	Other ($)	Labour ($)	Total ($)
1	1,973,285	606,893	468,274	1,527,926	4,567,378
2	1,973,285	606,893	468,274	1,527,926	4,576,378
3	1,973,285	606,895	468,274	1,527,926	4,576,378
4	1,973,285	606,893	468,274	1,527,926	4,576,378
5	1,973,285	606,893	468,274	1,527,926	4,576,378
6	3,332,388	242,757	468,274	1,527,926	5,571,345
7	3,332,388	242,757	468,274	1,527,926	5,571,345
8	3,332,388	242,757	468,274	1,527,926	5,571,345
9	3,332,388	242,757	468,274	1,527,926	5,571,345
10	3,332,388	242,757	468,274	1,527,926	5,571,345
11	3,332,388	242,757	468,274	1,527,926	5,571,345
12	3,332,388	242,757	468,274	1,527,926	5,571,345
13	1,516,261	242,757	468,274	1,009,008	3,236,300
14	1,044,187	242,757	468,274	836,035	2,591,253
15	480,048	169,930	327,790	524,684	1,502,452

"Other" equipment operating cost includes operation of loader, graders and other mobile equipment at the following total hourly rate:

Graders	2 x 15.20 =	$ 30.40/hr
Loader		51.40
Water/Sand Trucks		17.25
Lube and Crane Trucks	2 x 15.00 =	30.00
		$129.05/hr

Annual effective operating hours:
$\frac{(2 \times 50 + 45)}{60} \times 6.5 \times 231 =$ 3,628.62 hrs

Annual Operating Cost: 3,628.62 x $129.05 = $468,274

The labour cost is calculated as $12.00 basic hourly wage, plus 30% benefits: $15.60/hr

MINE OPERATING COSTS PER TONNE

Year	Total Cost	Cost/Tonne $/RMT	Cost/Tonne $/CMT
1	$ 4,576,378	$ 5.61	$10.38
2	4,576,378	5.61	10.38
3	4,576,378	5.61	10.38
4	4,576,378	5.61	10.38
5	4,576,378	5.61	10.38
6	5,571,345	6.82	12.64
7	5,571,345	6.82	12.64
8	5,571,345	6.82	12.64
9	5,571,345	6.82	12.64
10	5,571,345	6.82	12.64
11	5,571,345	6.82	12.64
12	5,571,345	6.82	12.64
13	3,236,300	3.96	7.34
14	2,591,253	3.17	5.88
15	1,502,452	2.63	4.77

ANNUAL COAL PREPARATION COST

	Years 1-2	Years 3-15
Labour		
Midnight crew	$ 144,144	$ 201,802
Day and afternoon crew	461,261	461,261
Sub-total	$ 605,405	$ 663,063
Replacement Parts and Materials		
3.5% of Capital:	$ 239,478	$ 239,478
Power Consumption		
Breaker Station	10,618	$ 10,618
Wash Plant	110,308	110,308
Water Recycling	30,821	30,821
Sub-total	$ 151,747	$ 151,747
Supplies		
Flocculants $1.02/kg, 0.09 kg/tonne	$ 54,144	$ 54,144
Lubricants at $0.02/CMT	8,320	8,320
Sub-total	$ 62,464	$ 62,464
TOTAL	$1,059,094	1,116,752
Coal preparation cost per clean tonne:	$ 2.40/CMT	$ 2.53/CMT

ANNUAL POWER CONSUMPTION COSTS

Area	Demand KW	Annual Op. Hrs.	Annual KWHrs.	Annual Cost Diesel	Annual Cost Utility
Breaker Station	72	5,544	399,168	$48,000	$ 10,618
Wash Plant	748	5,544	4,146,912	505,923	110,308
Water Recycling	209	5,544	1,158,696	141,361	30,821
Pit Dewatering	40	8,760	350,400	42,749	9,321
Ancillary Services Bldg.	125		462,000	56,364	12,289
TOTAL	**1,194**		**6,517,176**	**$795,095**	**$ 173,357**

The West Kootenay Power and Light rate schedule is not yet available. The above calculations are based on the B.C. Hydro rate which is 2.66 ¢ per kwhr. The diesel power cost is based on the diesel fuel cost, plus the cost of maintenance totalling 12.2 ¢ per kwhr.

DIRECT OPERATING COST
($/CMT)

Year	Mine	Plant	Power	Labour	Envirmt	Transp	Admin	Total	Average
1	10.38	2.40	0.05	2.16	0.06	2.82	1.67	19.54	19.54
2	10.38	2.40	0.05	2.16	0.06	2.82	1.67	19.54	19.54
3	10.38	2.53	0.05	2.16	0.06	2.82	1.67	19.67	19.58
4	10.38	2.53	0.05	2.16	0.06	2.82	1.67	19.67	19.60
5	10.38	2.53	0.05	2.16	0.06	2.82	1.67	19.67	19.62
6	12.64	2.53	0.05	2.16	0.06	2.82	1.67	21.93	20.00
7	12.64	2.53	0.05	2.16	0.06	2.82	1.67	21.93	20.28
8	12.64	2.53	0.05	2.16	0.06	2.82	1.67	21.93	20.48
9	12.64	2.53	0.05	2.16	0.06	2.82	1.67	21.93	20.64
10	12.64	2.53	0.05	2.16	0.06	2.82	1.67	21.93	20.77
11	12.64	2.53	0.05	2.16	0.06	2.82	1.67	21.93	20.88
12	12.64	2.53	0.05	2.16	0.06	2.82	1.67	21.93	20.97
13	7.34	2.53	0.05	1.83	0.06	2.82	1.67	16.30	20.61
14	5.88	2.53	0.05	1.77	0.19	2.82	1.67	14.91	20.20
15	4.77	2.53	0.05	1.70	0.19	2.82	1.67	13.73	20.17

The transportation cost is based on 26.25¢/tonne - km (42¢ per tonne - mile)

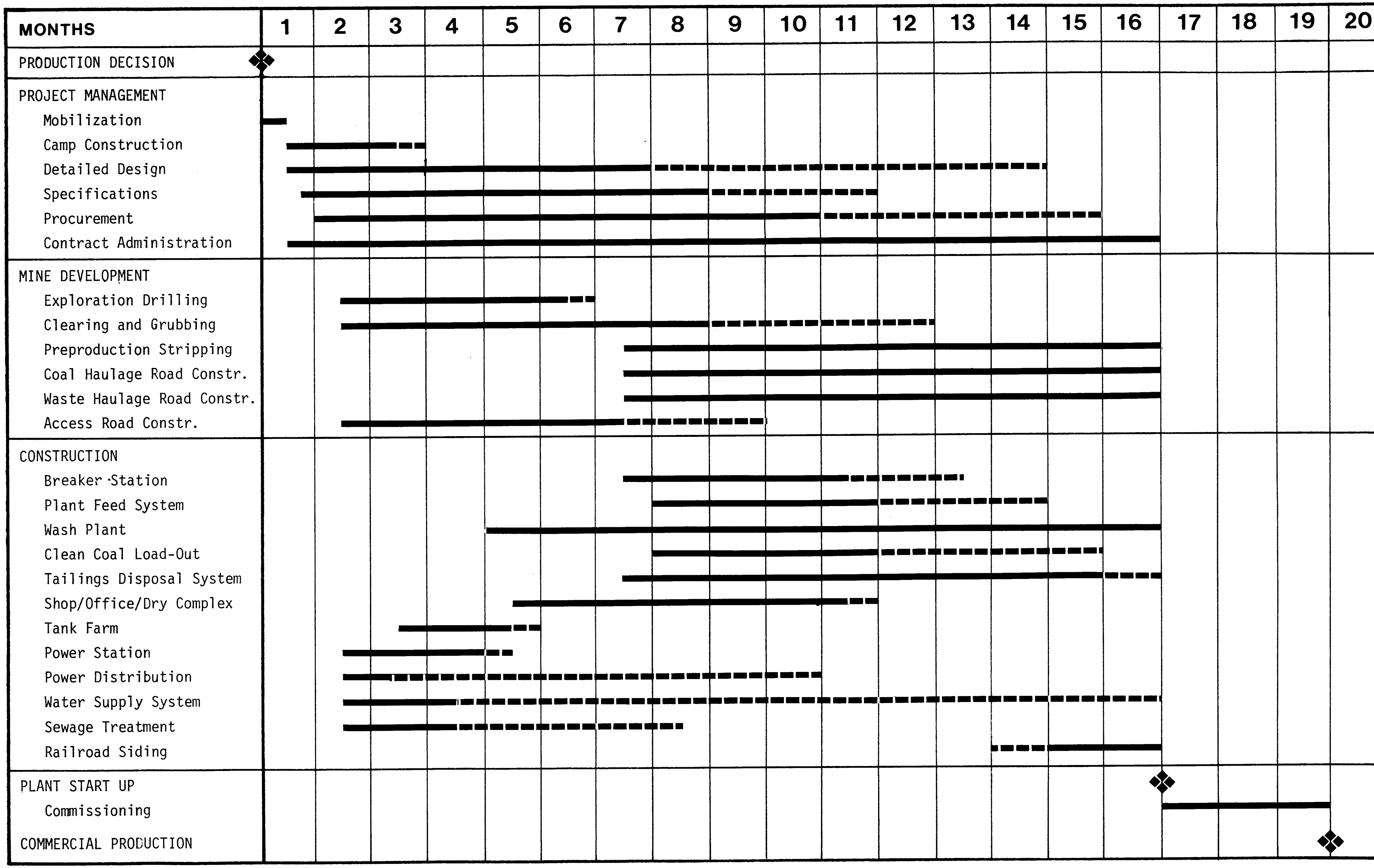
SECTION 13

SECTION 13

DEVELOPMENT SCHEDULE

TULAMEEN COAL PROJECT

DEVELOPMENT SCHEDULE



SUBMITTED BY

WRIGHT ENGINEERS LIMITED

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
J. A. BARRAT

J.A.BARRAT, P.ENG.

F.H.DOLLING,

W.F. GILMORE, P.ENG.

G.V. LYNCH

K.V. REMFERT

S.L. SZABOLCSY

VANCOUVER, B.C.
APRIL, 1981.

APPENDIX I

APPENDIX I

LIST OF INFORMATION MADE AVAILABLE TO WRIGHT ENGINEERS LIMITED

APPENDIX I

LIST OF INFORMATION MADE AVAILABLE TO WEL

GENERAL

"Report on 1977 Field Work", T.J. Adamson, Cyprus Anvil Mining Corporation, March, 1978.

"1978 Progress Report", T.J. Adamson, Cyprus Anvil Mining Corporation, February, 1980.

"Data for D.C.F. - R.O.R. Analysis", Cyprus Anvil Mining Corporation, January, 1979, revised July, 1980.

"Project Introduction and Coal Quality Report", Cyprus Anvil Mining Corporation, January, 1981.

MINING

"Prefeasibility Mining Plan", M.O. Hampton, Cyprus Anvil Mining Corporation, November, 1978.

"A Rippability Study Seismic Survey", P.E. Walcott, P.Eng., December, 1978.

"A Review of Prefeasibility Mining Plan", K.L. McRorie, Wright Engineers Limited, September, 1979.

Memo "Tulameen Mining Costs", M.O. Hampton, Cyprus Anvil Mining Corporation, July, 1980.

"Preliminary Groundwater Evaluation", Brown, Erdman & Assoc., January, 1980.

COAL QUALITY AND COAL PREPARATION

"Prefeasibility Study - Coal Quality and Coal Preparation", Techman Ltd., March, 1978.

"Coal Quality (Sec. 7.0) and Coal Preparation (Sec. 8.0)", Techman Ltd., March, 1979 (these sections incorporated into a 1979 Cyprus Anvil marketing report).

"Tulameen Thermal Coal Project - Coal Preparation", Coal Systems Inc., December, 1980 (this was incorporated in its entirety into "Project Introduction and Coal Quality Report", Cyprus Anvil Mining Corporation, January, 1981.

ANCILLARY FACILITIES

Recycle Water System	)
Freshwater System	)
Tailings Pond	) Techman Ltd., March, 1978
Sewage Treatment	)
Power	)

Access Road
- Hampton, 1978
- McRorie, 1979

Truck Haulage
- Techman, March, 1978
- Hampton, 1978
- McRorie, 1979

TRANSPORTATION SYSTEM

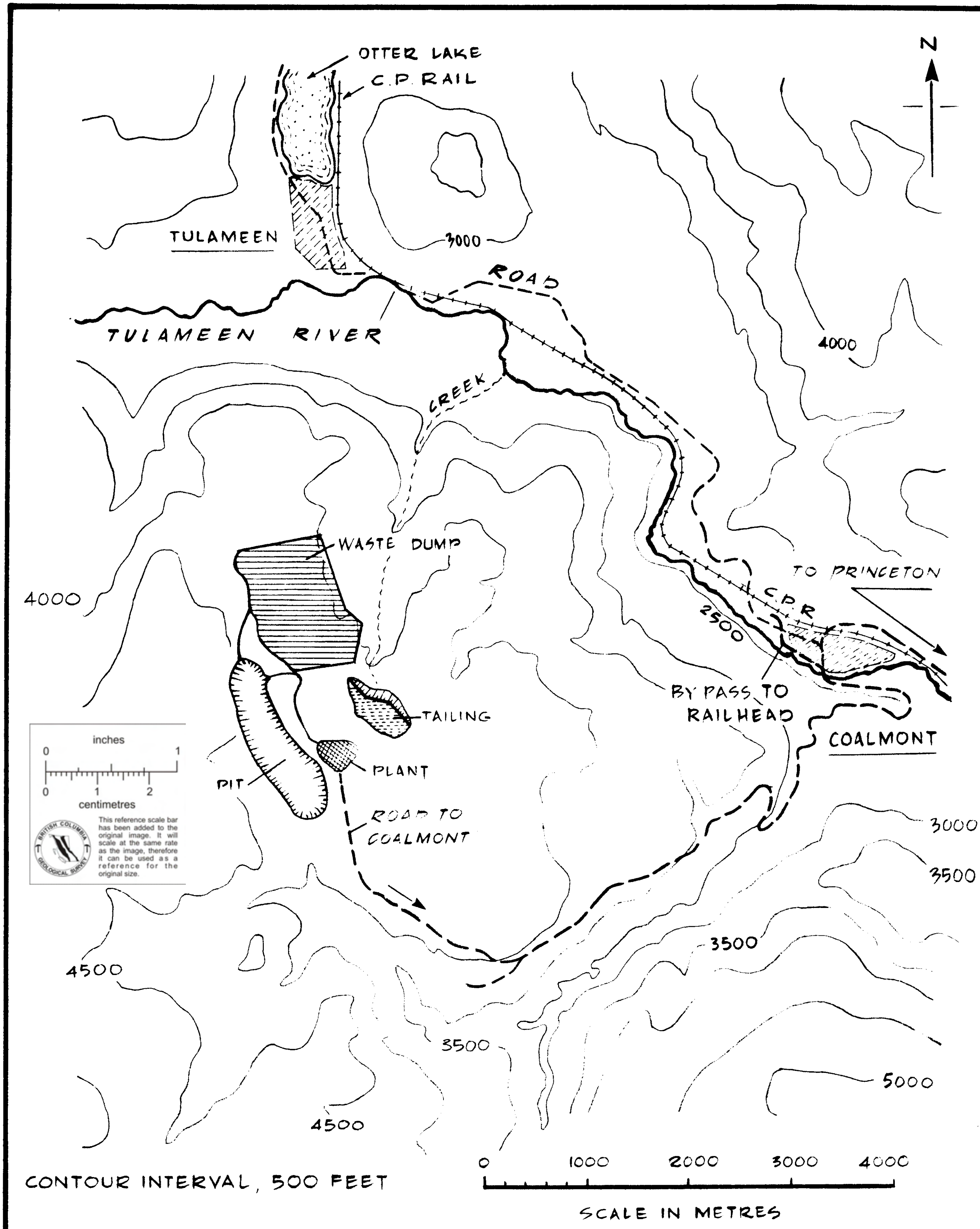
Rail Yard and Rail Loadout

- Techman Ltd., 1978
- "Tulameen Project - Rail Transport Costs", Swan Wooster Engineering, December, 1978

Rail Transport Model

- C.P. Rail letter, October 13, 1978
- Swan Wooster report, December, 1978
- C.P. Rail letter, January 29, 1980
- Swan Wooster letter, February 14, 1980

In addition, some geological interpretations and old mine maps of the former underground mines in the Tulameen Coal Field were also made available to WEL.



CYPRUS ANVIL MINING CORPORATION
TULAMEEN PROJECT

LOCATION PLAN

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

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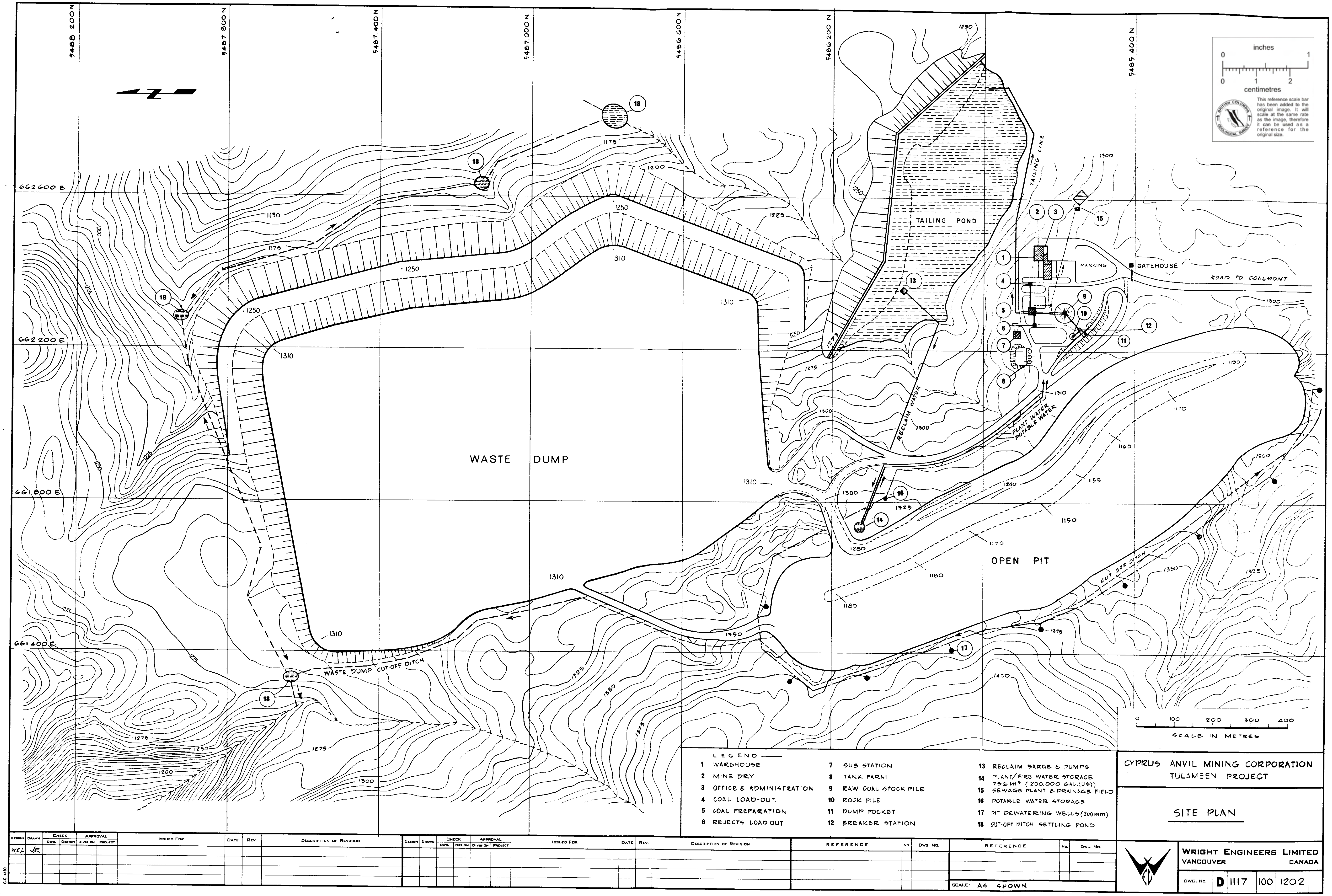
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5487 400 N
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BRITISH COLUMBIA GEOLOGICAL SURVEY
WASTE DUMP
TAILING POND
TAILING LINE
RECLAIM WATER
PLANT WATER
POTABLE WATER
OPEN PIT
PARKING
GATEHOUSE
ROAD TO COALMONT
WASTE DUMP CUT-OFF DITCH
CUT OFF DITCH
1150
1175
1200
1225
1250
1275
1300
1310
1325
1350
1375
1400
1155
1160
1170
1180
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1280
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200
300
400
SCALE IN METRES
LEGEND
1 WAREHOUSE
2 MINE DRY
3 OFFICE & ADMINISTRATION
4 COAL LOAD-OUT.
5 COAL PREPARATION
6 REJECTS LOAD OUT
7 SUB STATION
8 TANK FARM
9 RAW COAL STOCK PILE
10 ROCK PILE
11 DUMP POCKET
12 BREAKER STATION
13 RECLAIM BARGE & PUMPS
14 PLANT/FIRE WATER STORAGE 756 m³ (200,000 GAL.(US))
15 SEWAGE PLANT & DRAINAGE FIELD
16 POTABLE WATER STORAGE
17 PIT DEWATERING WELLS (200mm)
18 CUT-OFF DITCH SETTLING POND
CYPRUS ANVIL MINING CORPORATION
TULAMEEN PROJECT
SITE PLAN
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DWG.
DESIGN
APPROVAL
DIVISION
PROJECT
ISSUED FOR
DATE
REV.
DESCRIPTION OF REVISION
WEL
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REFERENCE
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DWG. NO.
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WRIGHT ENGINEERS LIMITED
VANCOUVER
CANADA
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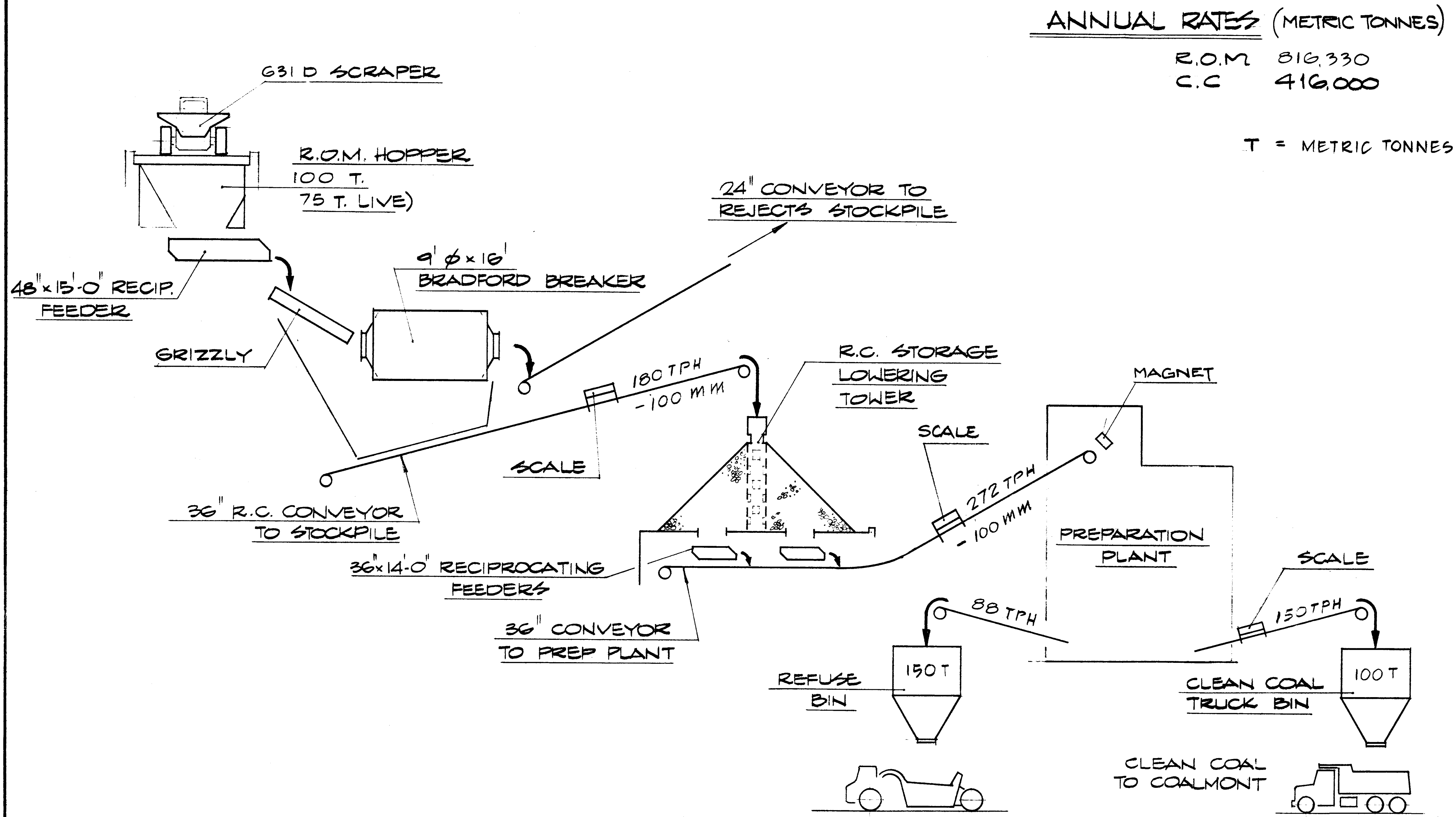
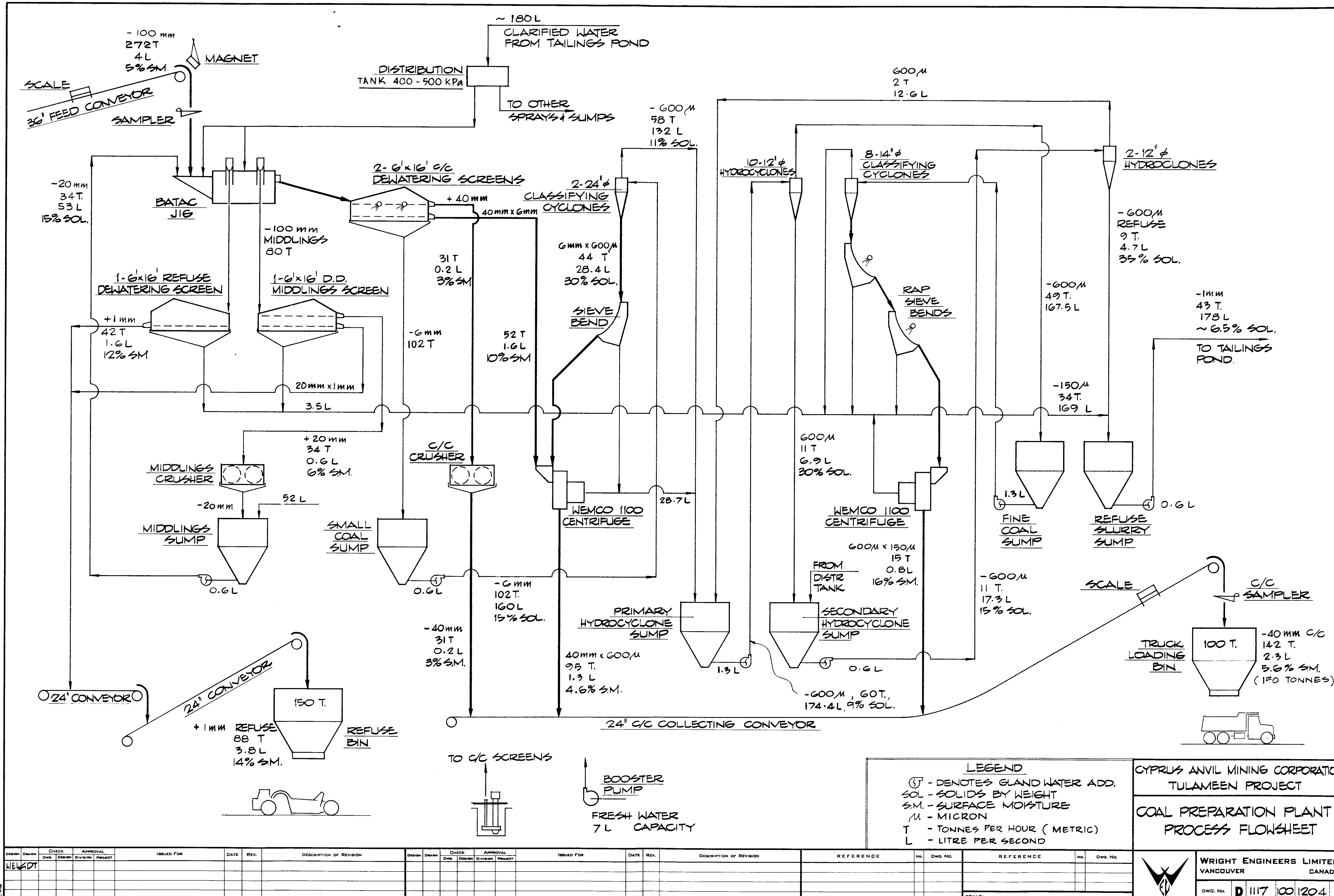


DSGN.	DRAWN	CHECK	APPR.	ISSUED FOR	DATE	REV.	DESCRIPTION OF REVISION	CYRUS ANVIL MINING CORPORATION TULAMEEN PROJECT	COAL PREPARATION PLANT GENERAL FLOWSHEET
								WRIGHT ENGINEERS LIMITED VANCOUVER CANADA	SCALE: ——— DRAWING No. B 1117 100 1203 REV.


~ 180 L
CLARIFIED WATER FROM TAILINGS POND
DISTRIBUTION TANK 400 - 500 KPa
TO OTHER SPRAYS & SUMPS
- 100 mm
272 T
4 L
5% S.M.
MAGNET
SCALE
36" FEED CONVEYOR
SAMPLER
-20 mm
34 T.
53 L
15% SOL.
BATAC JIG
2 - 6' x 16' C/C DEWATERING SCREENS
+ 40 mm
40 mm x 6 mm
-100 mm
MIDDLINGS
80 T
31 T
0.2 L
3% S.M.
1 - 6' x 16' REFUSE DEWATERING SCREEN
1 - 6' x 16' D.D. MIDDLINGS SCREEN
+1 mm
42 T
1.6 L
12% S.M.
20 mm x 1 mm
3.5 L
-6 mm
102 T
52 T
1.6 L
10% S.M.
- 600 μ
58 T
132 L
11% SOL.
2 - 24" ϕ CLASSIFYING CYCLONES
6 mm x 600 μ
44 T
28.4 L
30% SOL.
SIEVE BEND
600 μ
2 T
12.6 L
10 - 12" ϕ HYDROCYCLONES
8 - 14" ϕ CLASSIFYING CYCLONES
2 - 12" ϕ HYDROCLONES
RAP SIEVE BENDS
- 600 μ
REFUSE
9 T.
4.7 L
35% SOL.
- 600 μ
49 T.
167.5 L
-1 mm
43 T.
178 L
~ 6.5% SOL.
TO TAILINGS POND.
-150 μ
34 T.
169 L
+ 20 mm
34 T
0.6 L
6% S.M.
MIDDLINGS CRUSHER
C/C CRUSHER
-20 mm
52 L
MIDDLINGS SUMP
0.6 L
SMALL COAL SUMP
0.6 L
WEMCO 1100 CENTRIFUGE
28.7 L
600 μ
11 T
6.9 L
30% SOL.
WEMCO 1100 CENTRIFUGE
600 μ x 150 μ
15 T
0.8 L
16% S.M.
FROM DISTR. TANK
1.3 L
FINE COAL SUMP
0.6 L
REFUSE SLURRY SUMP
- 600 μ
11 T.
17.3 L
15% SOL.
-6 mm
102 T.
160 L
15% SOL.
PRIMARY HYDROCYCLONE SUMP
SECONDARY HYDROCYCLONE SUMP
1.3 L
0.6 L
-40 mm
31 T
0.2 L
3% S.M.
40 mm x 600 μ
95 T.
1.3 L
4.6% S.M.
- 600 μ, 60 T.,
174.4 L, 9% SOL.
SCALE
C/C SAMPLER
TRUCK LOADING BIN
100 T.
-40 mm C/C
142 T.
2.3 L
5.6% S.M.
(150 TONNES)
24" CONVEYOR
24" CONVEYOR
150 T.
+ 1 mm REFUSE
88 T
3.8 L
14% S.M.
REFUSE BIN
24" C/C COLLECTING CONVEYOR
TO C/C SCREENS
BOOSTER PUMP
FRESH WATER
7 L CAPACITY
LEGEND
Ⓖ - DENOTES GLAND WATER ADD.
SOL - SOLIDS BY WEIGHT
S.M. - SURFACE MOISTURE
μ - MICRON
T - TONNES PER HOUR (METRIC)
L - LITRE PER SECOND
CYPRUS ANVIL MINING CORPORATION
TULAMEEN PROJECT
COAL PREPARATION PLANT PROCESS FLOWSHEET
WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA
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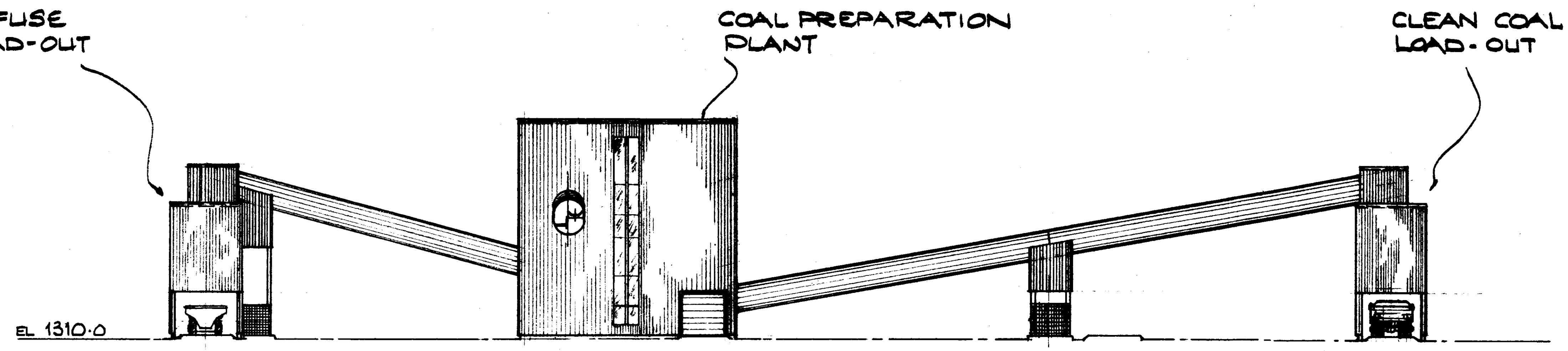

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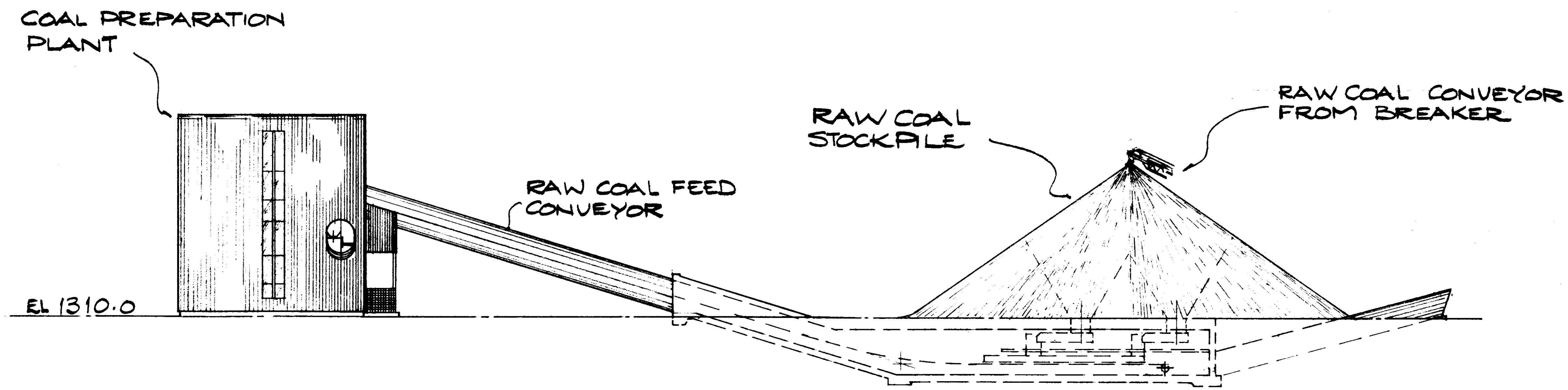
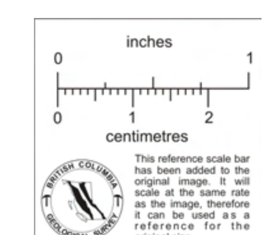


— ELEVATION — LOOKING EAST



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CYPRUS ANVIL MINING CORPORATION
TULAMEEN PROJECT

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

COAL PREPARATION PLANT
NORTH & EAST VIEWS

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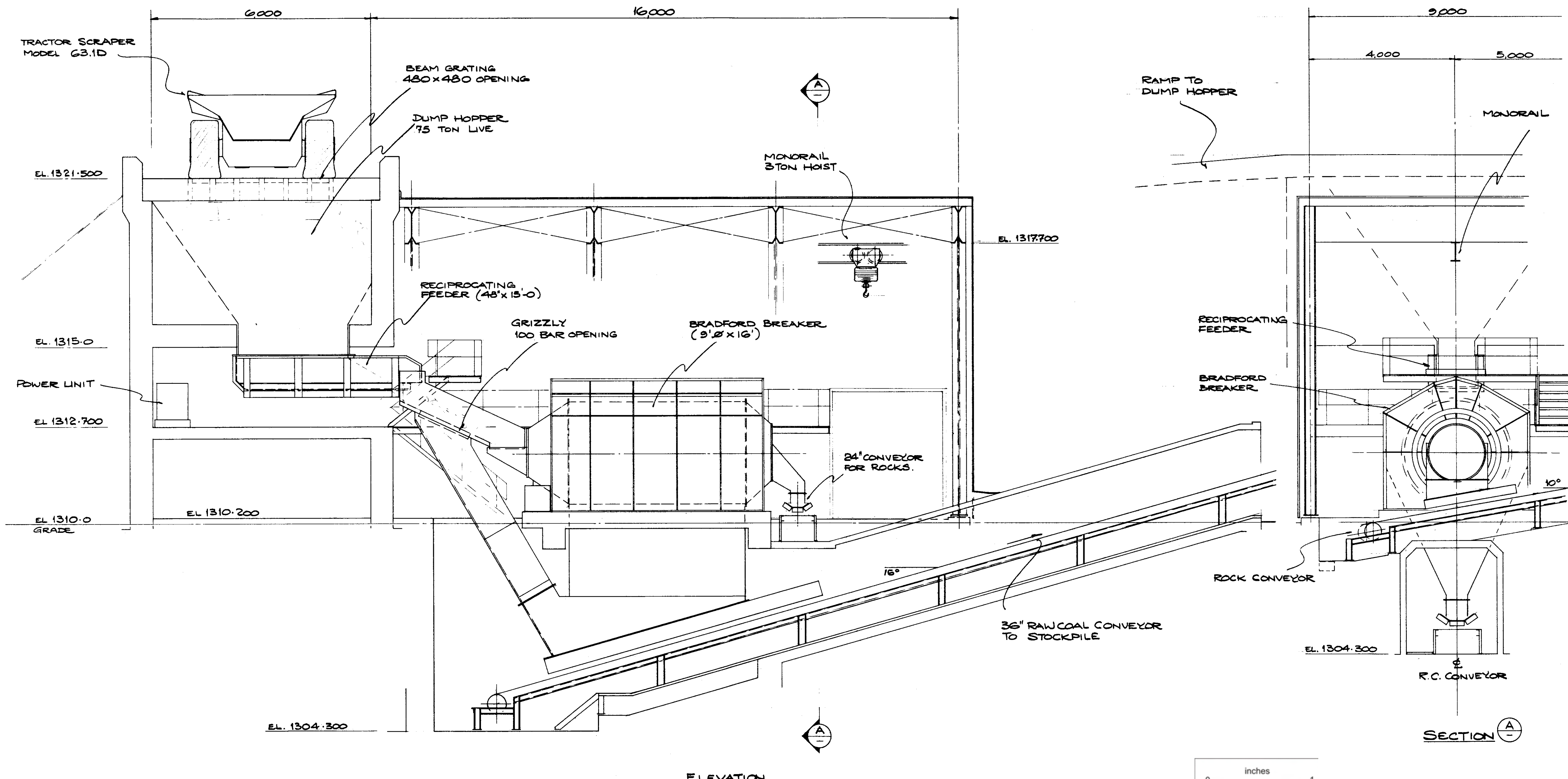

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CYPRUS ANVIL MINING CORPORATION
TULAMEEN PROJECT

RAW COAL BREAKER STATION
GENERAL ARRANGEMENT
ELEVATION

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

DWG. NO. D 1117 100 1206

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WEL	KC																								

SCALE:

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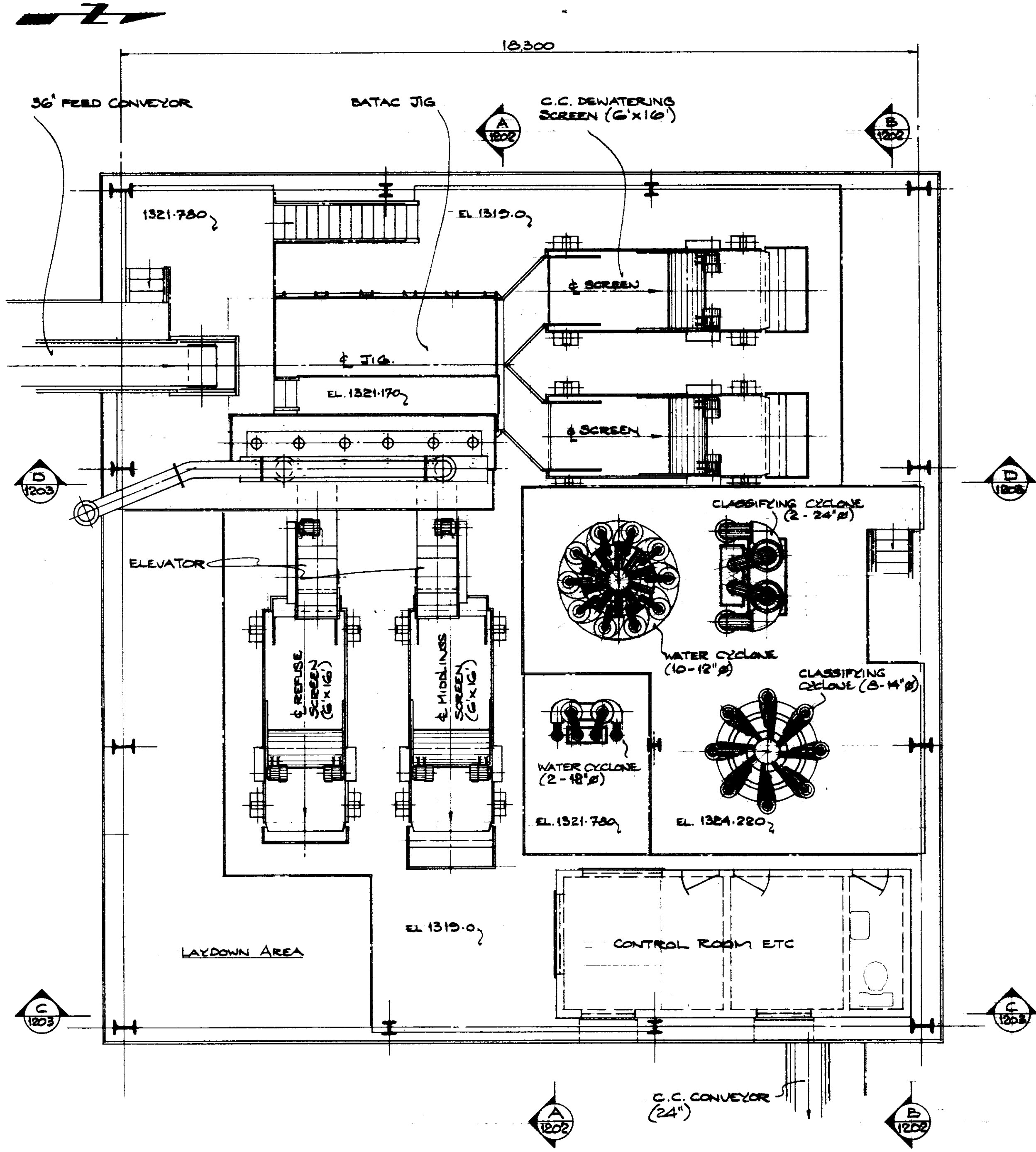

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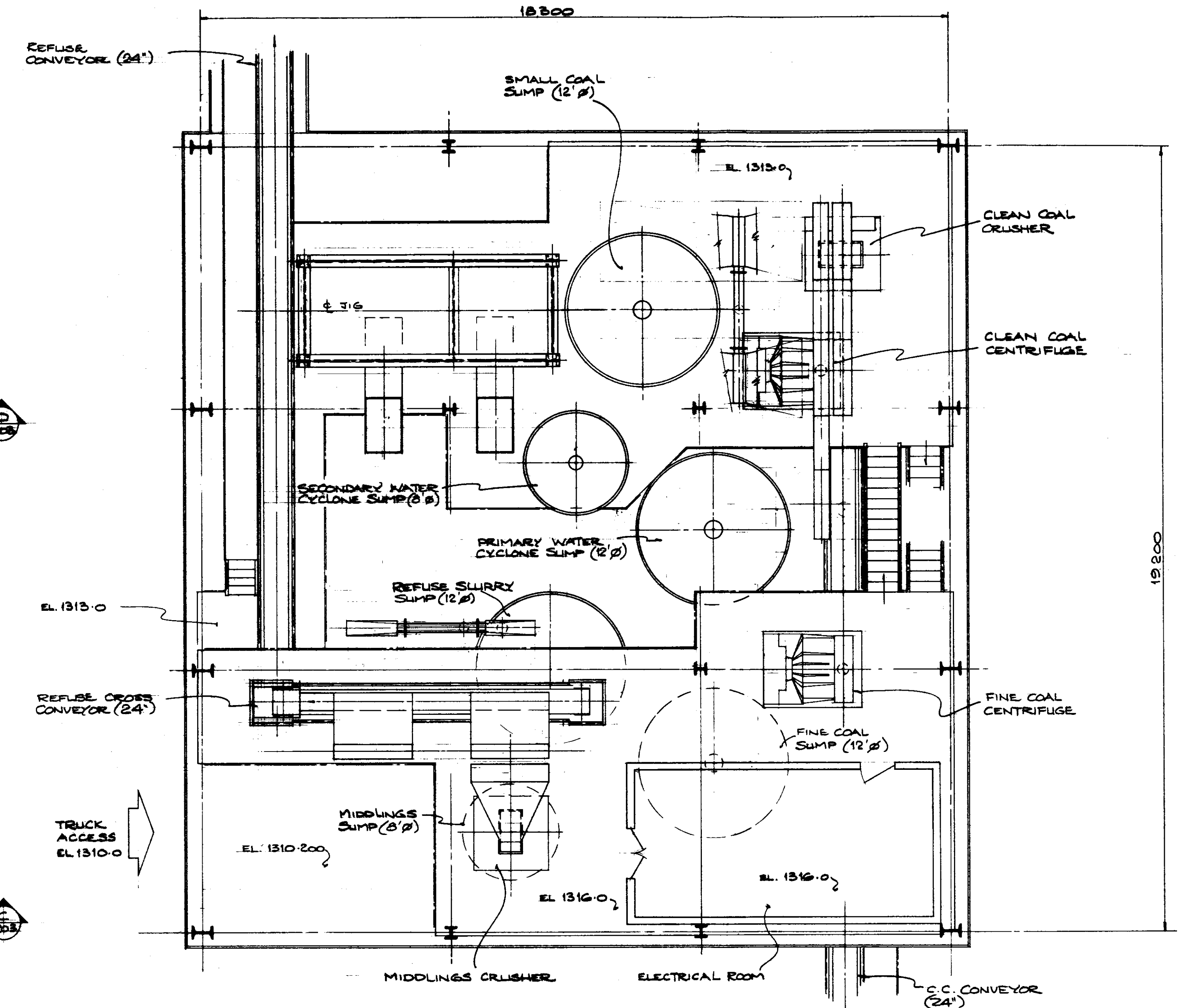

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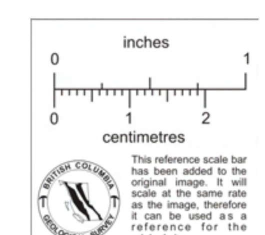


CYPRUS ANVIL MINING CORPORATION
TULAMEEN PROJECT

COAL PREPARATION PLANT
GENERAL ARRANGEMENT
PLANS

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

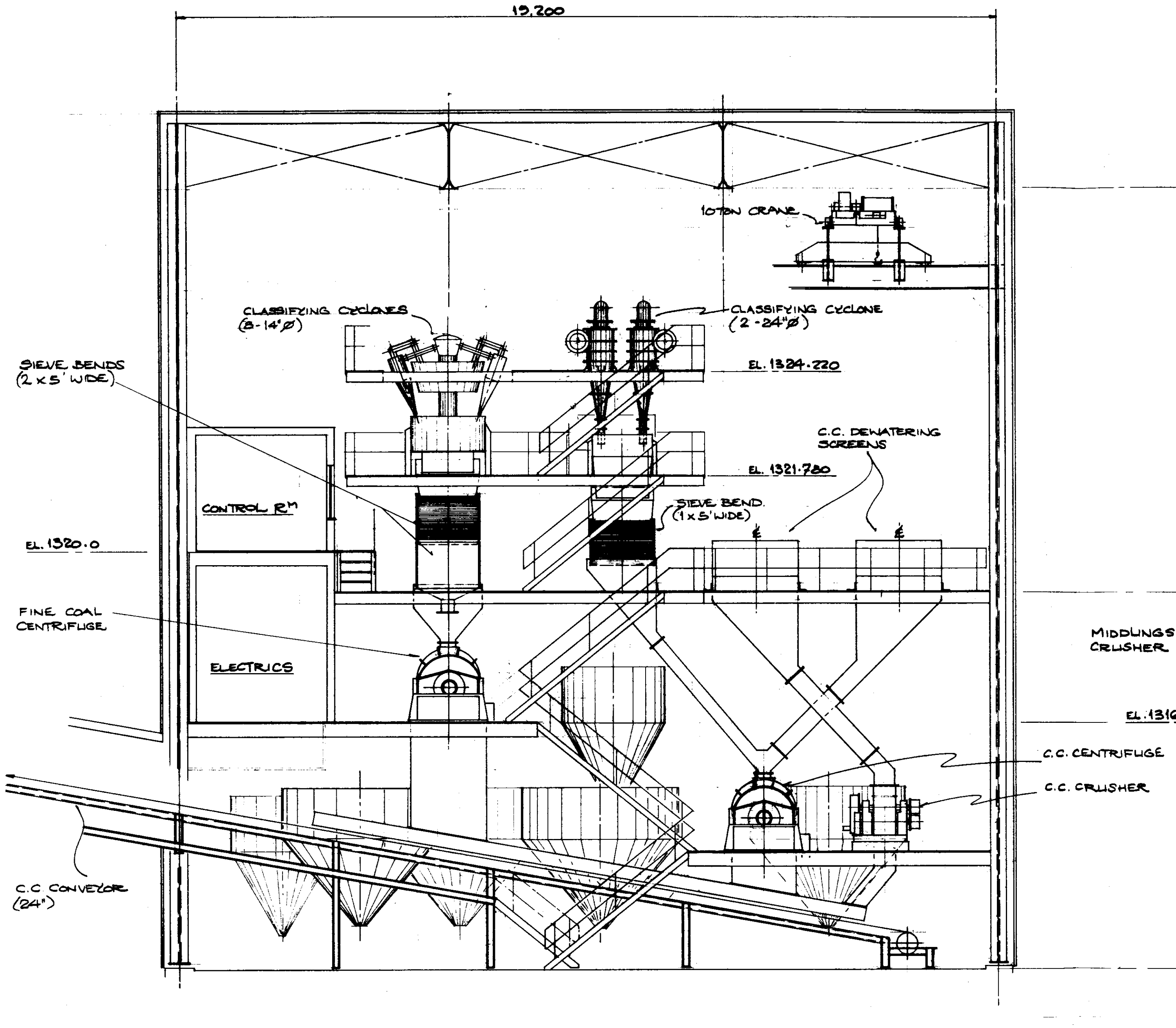
DWG. NO. D 1117 100 1207

DESIGN	DRAWN	CHECK DWG.	CHECK DESIGN	APPROVAL DIVISION	APPROVAL PROJECT	ISSUED FOR	DATE	REV.	DESCRIPTION OF REVISION
WEL	KC								

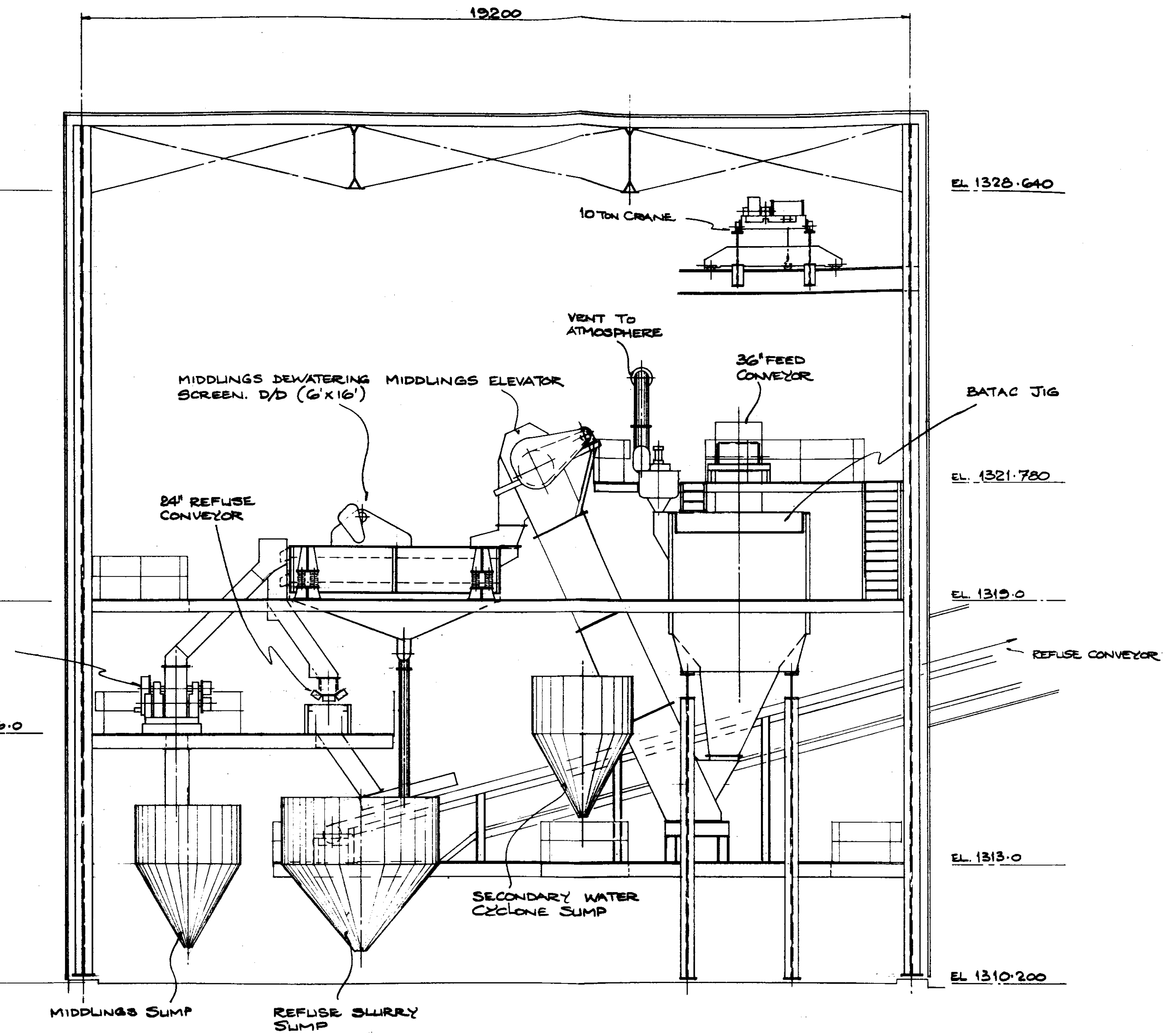
DESIGN	DRAWN	CHECK DWG.	CHECK DESIGN	APPROVAL DIVISION	APPROVAL PROJECT	ISSUED FOR	DATE	REV.	DESCRIPTION OF REVISION

REFERENCE	NO.	DWG. NO.	REFERENCE	NO.	DWG. NO.
SCALE:					

G.C. 4180



SECTION B/1201



SECTION A/1201

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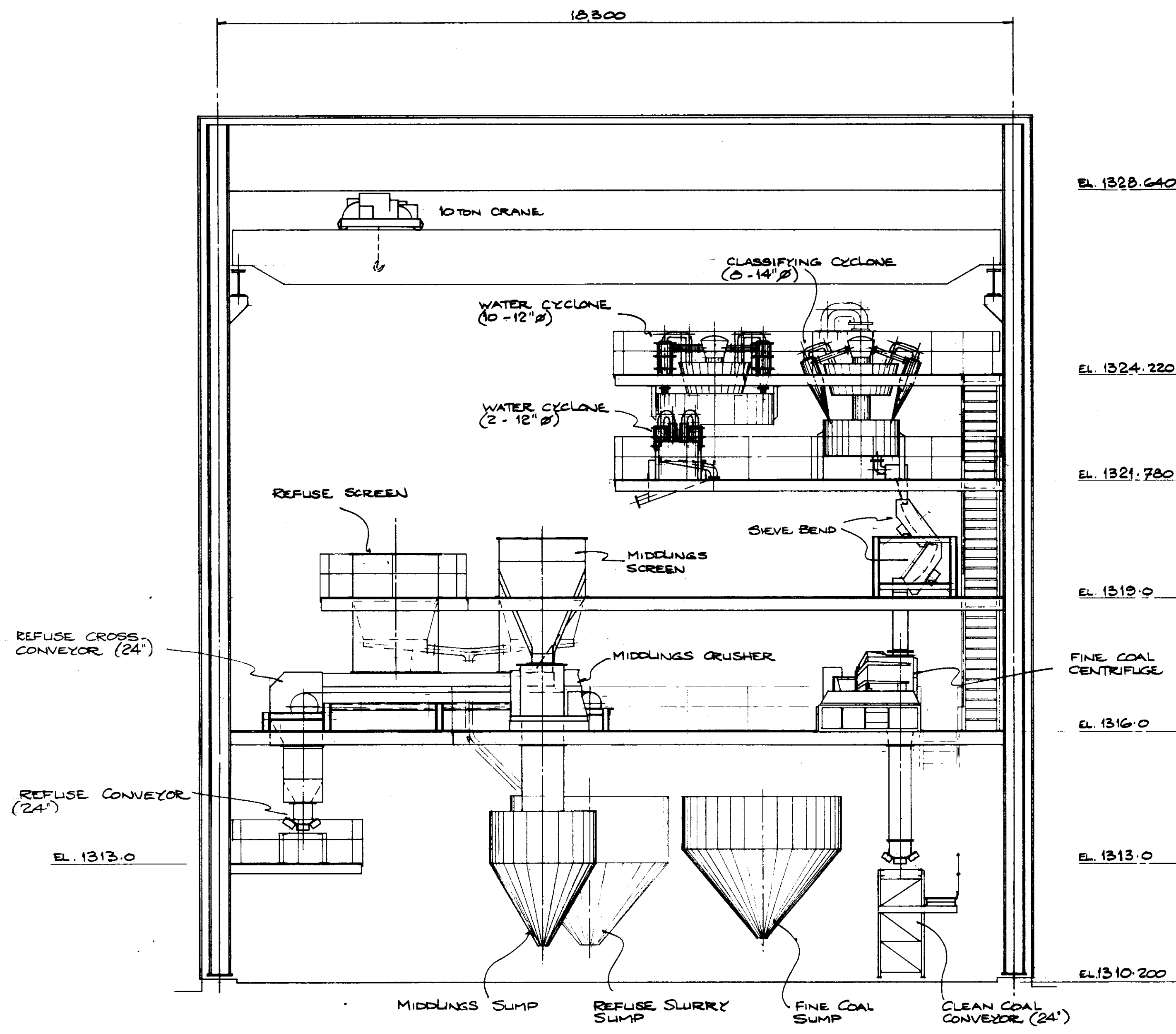
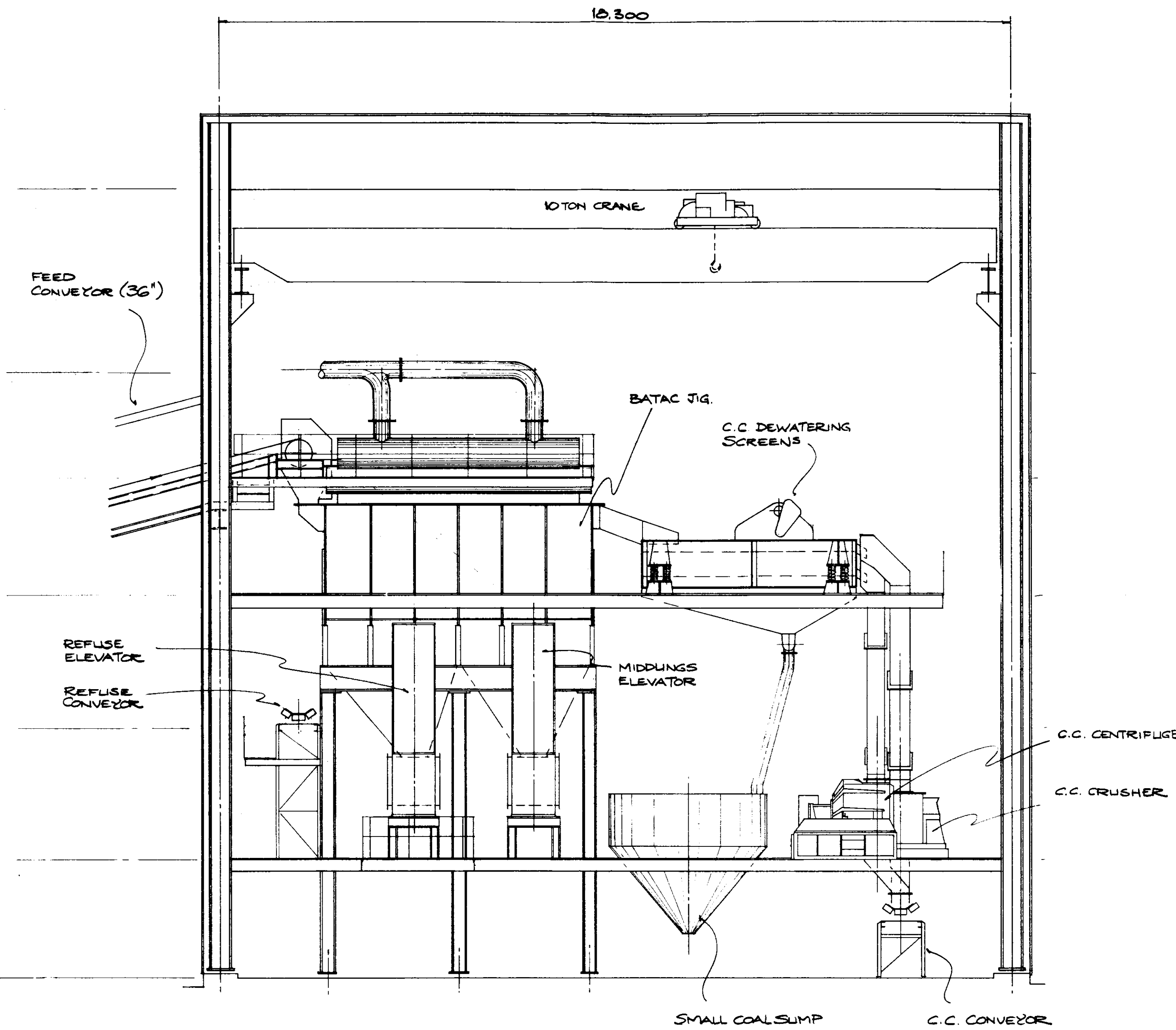
CYPRUS ANVIL MINING CORPORATION TULAMEEN PROJECT	
COAL PREPARATION PLANT GENERAL ARRANGEMENT SECTIONS (SHEET 1 OF 2)	
WRIGHT ENGINEERS LIMITED VANCOUVER CANADA	
DWG. NO.	D 1117 100 1208

Design	Drawn	Check Dwg.	Check Design	Approval Division	Approval Project	Issued For	Date	Rev.	Description of Revision	Reference	No.	Dwg. No.
WEL	K.C											

SCALE:



SECTION C/1201
(EXCLUDING ELECTRICAL & CONTROL ROOM)



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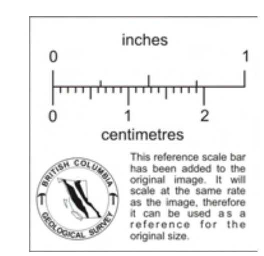


CYPRUS ANVIL MINING CORPORATION
TULAMEEN PROJECT

COAL PREPARATION PLANT
GENERAL ARRANGEMENT
SECTIONS (SHEET 2 OF 2)

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

DWG. No. D 1117 100 1209

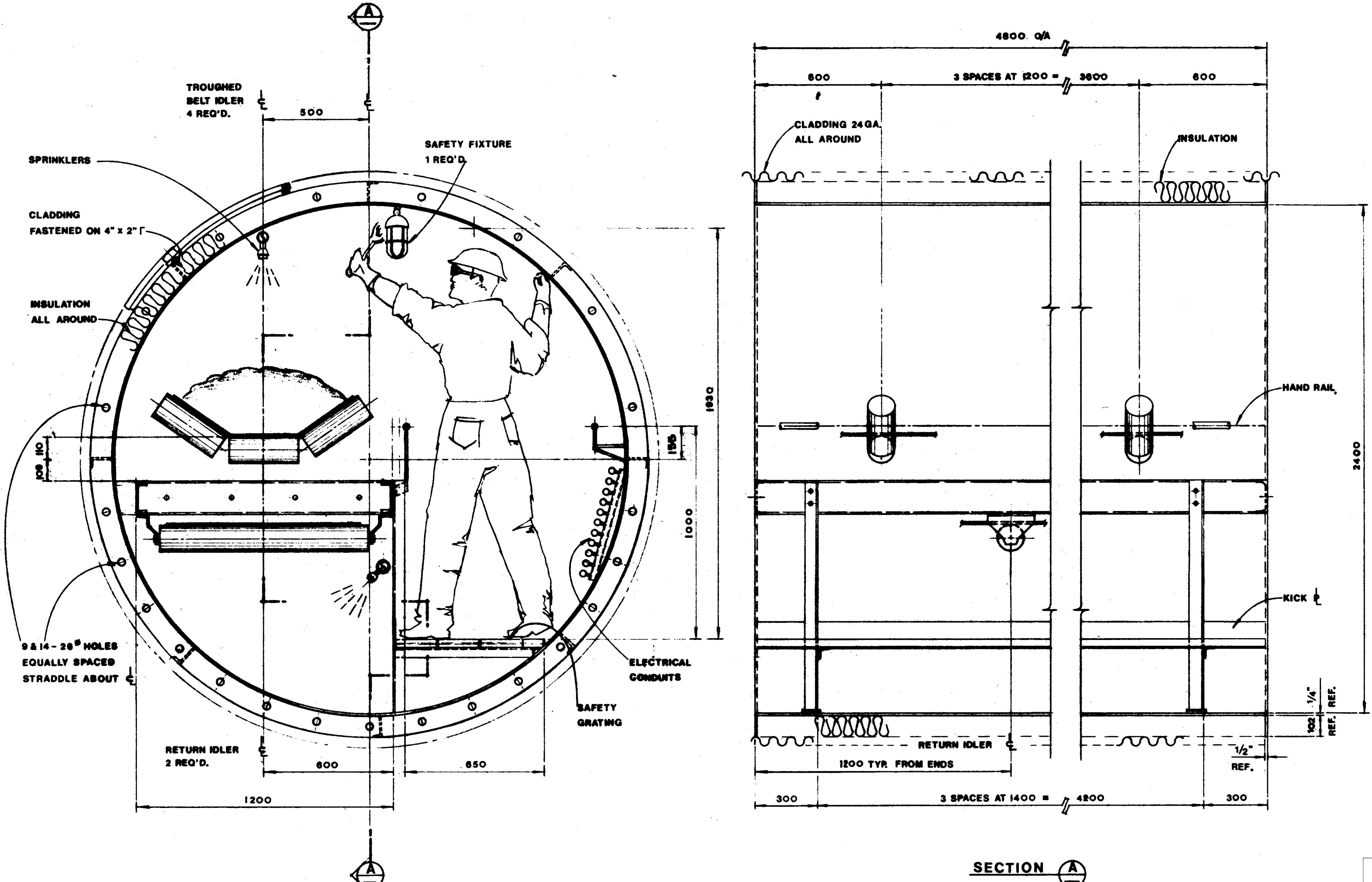
Design	Drawn	Check Dwg.	Check Design	Approval Division	Approval Project	Issued For	Date	Rev.	Description of Revision
WEL	K.C								

Design	Drawn	Check Dwg.	Check Design	Approval Division	Approval Project	Issued For	Date	Rev.	Description of Revision

Reference	No.	Dwg. No.	Reference	No.	Dwg. No.

SCALE:

G.C. 418B



CYPRUS ANVIL MINING CORPORATION TULAMEEN PROJECT	
CONVEYOR GALLERY TYPICAL ARRANGEMENT SECTIONS	
WRIGHT ENGINEERS LIMITED VANCOUVER CANADA	
DWG. NO.	D 1117 100 1210

Design	Drawn	Check Dwg.	Check Design	Approval Division	Approval Project	Issued For	Date	Rev.	Description of Revision
	K.D.L.M.						MARCH 1981		

REFERENCE | No. | DWG. No.

SCALE:

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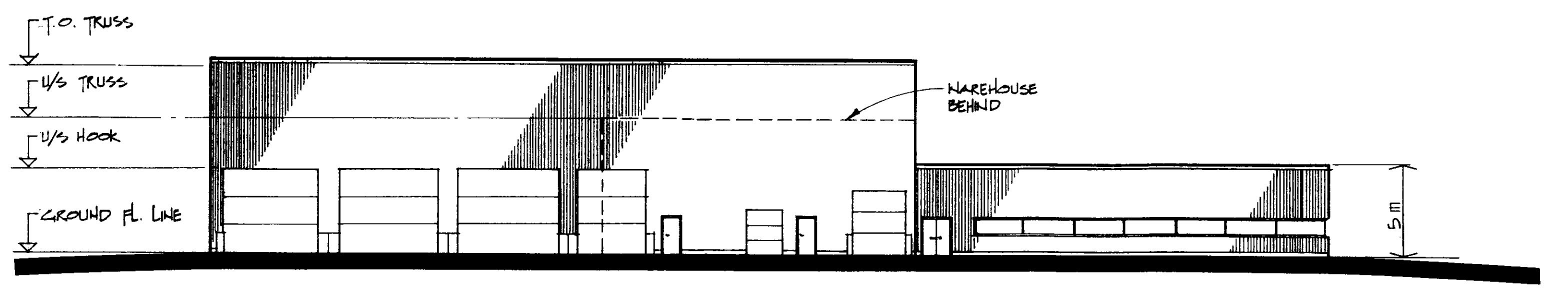
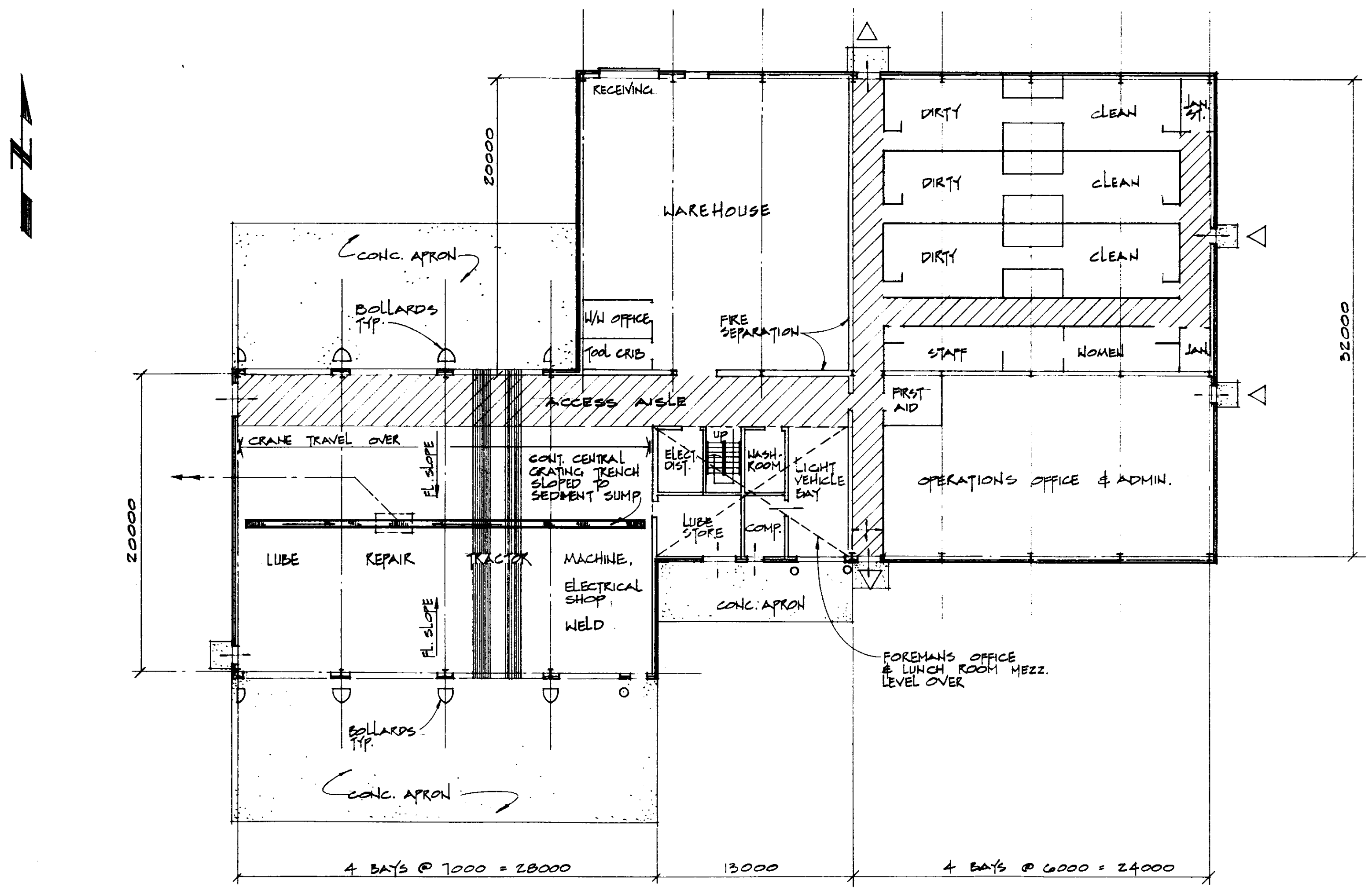
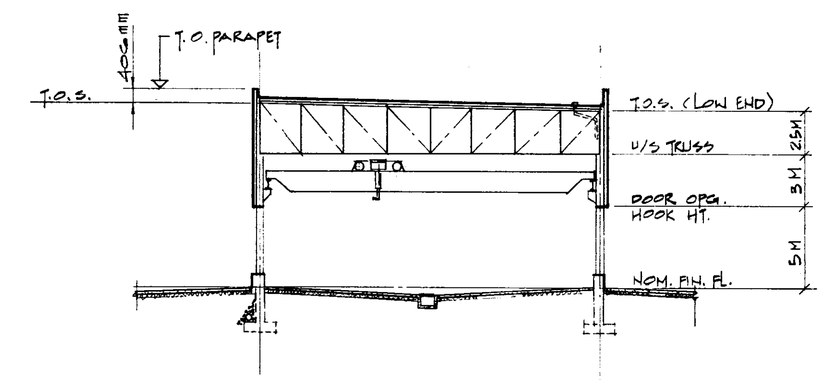


NORTH ELEVATION



PLAN



SECTION

inches
0 1
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centimetres

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CYPRUS ANVIL MINING CORPORATION
TULAMEEN PROJECT

GENERAL ARRANGEMENTS
SHOP • WAREHOUSE
DRY • OFFICE

Design	Drawn	Check Dwg.	Check Design	Approval Division	Approval Project	Issued For	Date	Rev.	Description of Revision
	BT								

Design	Drawn	Check Dwg.	Check Design	Approval Division	Approval Project	Issued For	Date	Rev.	Description of Revision

Reference	No.	Dwg. No.

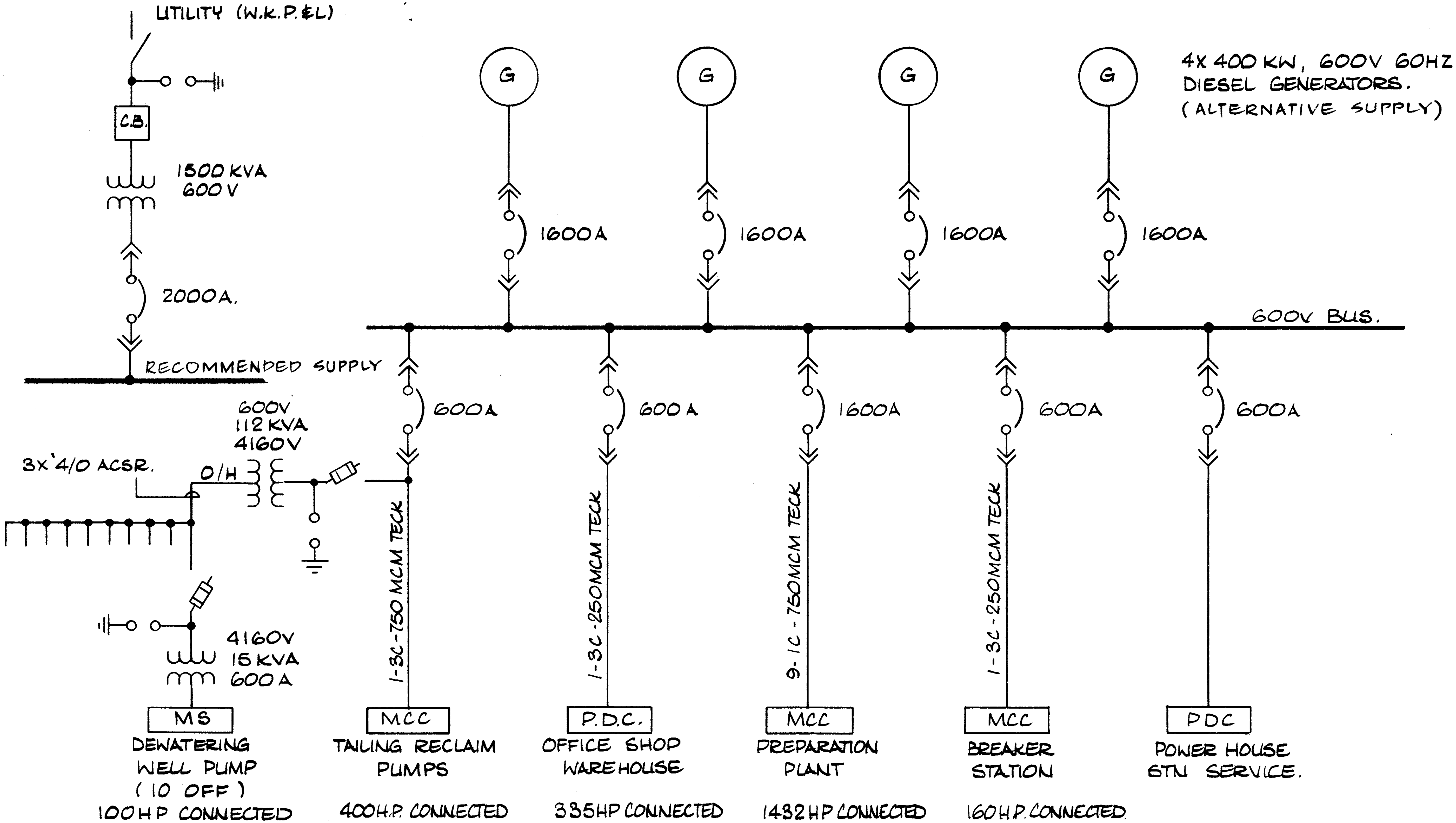
Reference	No.	Dwg. No.

SCALE:

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

DWG. NO. D 1117 100 1211

G.C. 4189



DSGN.	DRAWN	CHECK	APPR.	ISSUED FOR	DATE	REV.	DESCRIPTION OF REVISION
JAB	MTM	JaB			APR 15-81		

CYPRUS ANVIL MINING CORP
TULAMEEN PROJECT.

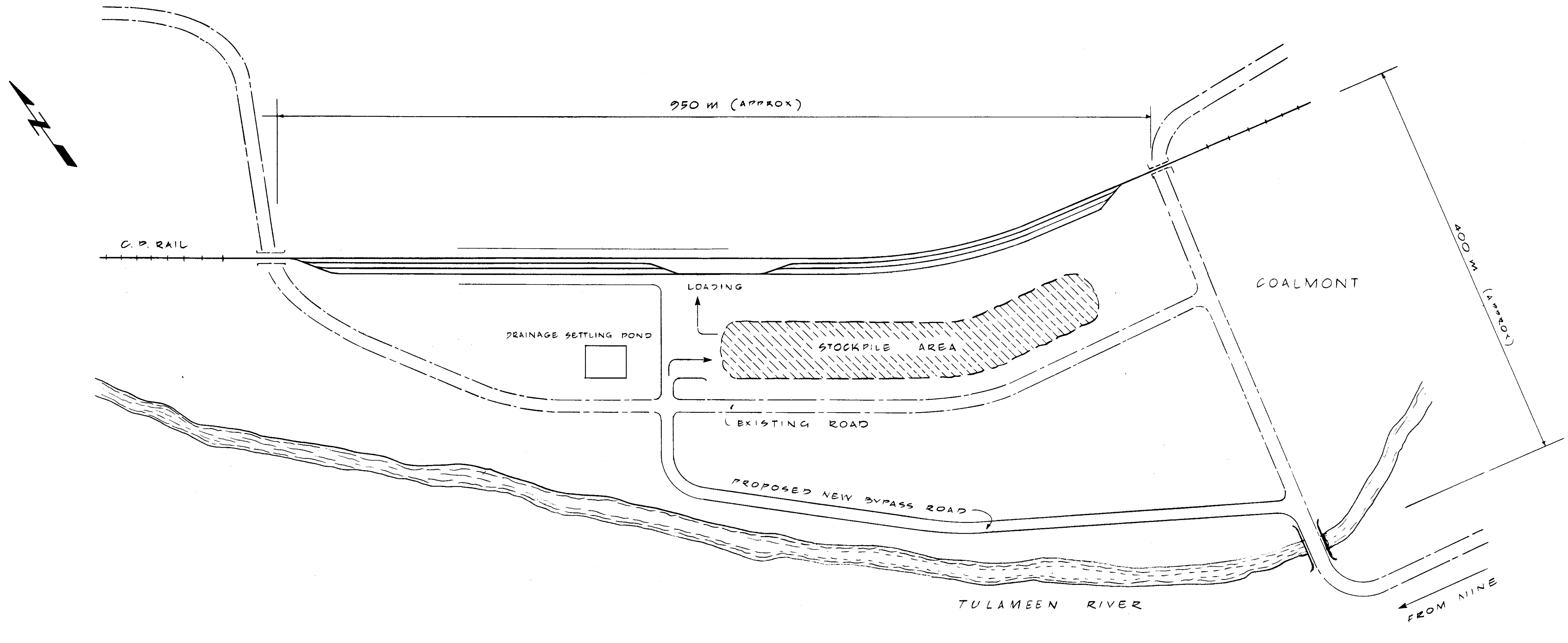
WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

ELECTRICAL SINGLE LINE DIAGRAM.

SCALE:

DRAWING No. B 1117 100 1212.

REV.



PLAN - COALMONT AREA

(DO NOT SCALE)

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CYPRUS ANVIL MINING CORPORATION
TULAMEEN PROJECT

COAL LOADING FACILITIES
COALMONT RAILHEAD

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

DWG. NO. D 1711 100 1213

Design	Drawn	Check Dwg.	Check Design	Approval Division	Approval Project	Issued For	Date	Rev.	Description of Revision
	J.E.								

Reference	No.	Dwg. No.	Reference	No.	Dwg. No.
			SCALE: —		

O.C. 4180