CYPRUS ANVIL MINING CORPORATION

TULAMEEN COAL PROJECT

FEASIBILITY STUDY

PROJECT 1117 - 200

NOVEMBER 1981

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

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TRANSMITTAL LETTER

WRIGHT ENGINEERS LIMITED

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November 27, 1981

Project No. 1117-200

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
Feasibility Study

and trust it fulfills your immediate requirements.

We appreciate the opportunity of working with you 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

S.L. Szabolcsy

WFG/tm

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INTRODUCTION

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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 Feasibility Report based on reports, maps and other documents, including the Preliminary Feasibility Study made by WEL and in accordance with the following scope of work:

- preparation of detailed 4 year mining plans
- review and/or modification of general layouts of the wash plant and of the pertaining support facilities
- modification of equipment requirements
- review and/or modification of the clean coal transportation system
- modification of manpower requirements
- updating of the order-of-magnitude capital and operating cost estimates.

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

NOMENCLATURE

LCM	Loose Cubic Meter
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

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SUMMARY

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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 1,020,410 tonnes of raw coal per year, the life of the mine would be 12 years. That mining rate, allowing for 2% rejects at the planned Breaker Station, would correspond to 1,000,000 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 551,000 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 $36.14 million, that is $65.59 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 $18/tonne in years 1 to 3 to $23/tonne in years 7 to 9 and to $22/tonne in the 12th year. The cumulative average direct operating cost is estimated at $20.59/tonne, including truck to rail transport.

The improvement and replacement capital for the 12 year production period was estimated at $17.5 million, that is an average of $1.42/tonne.

The project would employ about 90 hourly paid workers. Their number would change slightly year by year depending on stripping requirements. The number of the supervisory and other monthly paid employees would be 19, 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 the estimated January, 1982 Canadian dollars.

SECTION 3

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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.

SECTION 4

GEOLOGY

SECTION 4

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 sedimentarty 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 1,020,410 tonnes of raw coal per year, assuring 1,000,000 tonnes per year wash plant feed upon a 2% loss at the rotary breaker, the life of the initial open pit would be 12 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.

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 D9L tractor is the most suitable on the basis of the manufacturers' specifications with a single shank ripper.

Among the wheel tractor-scrapers, Model 657AS is selected for coal haulage and 657B for stripping, in view of the following:

- The 657AS is self loading with the help of augers;

- The 657B units are versatile to carry coal, waste or refuse, either from the pit or from stockpile assisting each other in push loading;

- Both are powered by 950 hp combined capacity engines and are large enough to handle the volume in a moderate size fleet.

Other major equipment include 16G and 14G graders as well as a water/sander truck 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		D9L		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	12,296,700 tonnes	
Annual mining rate	1,020,410 tonnes	
Annual plant feed rate	1,000,000 tonnes	
Initial open pit life	12 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 657B scraper is:

33.6 x .9 x .74 = 22.38 BCM

Assume 22.5 BCM or 36.9 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 .625 to be used in the load calculation. With 85% of heaped capacity, each load of waste is then:

33.6 x .85 x .625 = 17.85 BCM

Assume 18.0 BCM per load.

Refuse

Both breaker reject and coarse refuse should load well. Using 95% of heaped capacity and a load factor of 0.80 corresponding to 25% swell, the volume per load is:

33.6 x .95 x .8 = 25.54 LCM

Assume 25.5 LCM or 45 RMT 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	350,930	8,470	342,460	844,130
	1330	180,640	4,360	176,280	1,020,410
2	1330	282,650	6,820	275,830	275,830
	1320	518,700	12,490	506,210	782,040
	1310	244,260	5,890	238,370	1,020,410
3	1310	274,440	6,620	267,820	267,820
	1300	518,700	12,500	506,200	774,020
	1290	252,480	6,090	246,390	1,020,410
4	1290	295,310	7,110	288,200	288,200
	1280	630,430	15,190	615,240	903,440
	1270	119,860	2,890	116,970	1,020,410
5	1270	510,570	12,300	498,270	498,270
	1260	535,040	12,900	522,140	1,020,410
6	1260	95,390	2,290	93,100	93,100
	1250	637,570	15,360	622,210	715,310
	1240	312,640	7,540	305,100	1,020,410
7	1240	367,470	8,900	358,570	358,570
	1230	678,190	16,350	661,840	1,020,410
8	1230	33,670	860	32,810	32,810
	1220	718,740	17,370	701,370	734,180
	1210	293,300	7,070	286,230	1,020,410
9	1210	435,440	10,270	425,170	425,170
	1200	609,940	14,700	595,240	1,020,410
10	1200	108,800	2,640	106,160	106,160
	1190	718,740	17,380	701,360	807,520
	1180	218,150	5,260	212,890	1,020,410
11	1180	500,590	12,120	488,470	488,470
	1170	518,800	13,140	531,940	1,020,410
12	1170	84,530	1,450	83,080	83,080
	1160	355,880	8,620	347,260	430,340
	1150	298,940	7,230	291,710	722,050
	1140	91,840	2,120	89,720	811,770

COAL HAULAGE CYCLES - 657AS

Bench	Tonnes	Distance	Slope	Time (minutes) Man.	Loaded	Empty	Total
1370	64,970	170	0	1.43	.42	.38	2.23
		600	-10		.88	1.68	2.56
		280	0		.62	.50	1.12
		580	0			.85	.85
							6.76
1360	115,810	250	0	1.43	.66	.48	2.57
		500	-10		.73	1.38	2.11
		280	0		.62	.50	1.12
		580	0			.85	.85
							6.65
1350	320,890	290	0	1.43	.70	.50	2.63
		400	-10		.58	1.18	1.76
		280	0		.62	.50	1.12
		580	0			.85	.85
							6.36
1340	342,460	290	0	1.43	.70	.50	2.63
		300	-10		.44	.92	1.36
		280	0		.62	.50	1.12
		580	0			.85	.85
							5.96
1330	452,110	360	0	1.43	.82	.60	2.85
		200	-10		.29	.65	.94
		280	0		.62	.50	1.12
		580	0			.85	.85
							5.76
1320	506,210	410	0	1.43	.88	.63	2.94
		100	-10		.15	.30	.45
		280	0		.62	.50	1.12
		580	0			.85	.85
							5.36
1310	506,190	460	0	1.43	1.00	.72	3.15
		280	0		.62	.50	1.12
		580	0			.85	.85
							5.12

COAL HAULAGE CYCLES - 657AS - Cont'd.

				Time (minutes)			
Bench	Tonnes	Distance	Slope	Man.	Loaded	Empty	Total
1300	506,200	550	0	1.43	1.20	.82	3.45
		100	+10		.50	.23	.73
		280	0		.62	.50	1.12
		580	0			.85	.85
							6.15
1290	534,590	400	0	1.43	.88	.63	2.94
		200	+10		1.08	.45	1.53
		280	0		.62	.50	1.12
		580	0			.85	.85
							6.44
1280	615,240	350	0	1.43	.82	.60	2.85
		300	+10		1.60	.72	2.32
		280	0		.62	.50	1.12
		580	0			.85	.85
							7.14
1270	615,240	400	0	1.43	.88	.63	2.94
		400	+10		2.20	.96	3.16
		800	0		1.30	1.05	2.35
		280	0			.50	.50
							8.95
1260	615,240	400	0	1.43	.88	.63	2.94
		500	+10		2.70	1.20	3.90
		800	0		1.30	1.05	2.35
		280	0			.50	.50
							9.69
1250	622,210	400	0	1.43	.88	.63	2.94
		600	+10		3.20	1.44	4.64
		800	0		1.30	1.05	2.35
		280	0			.50	.50
							10.43
1240	663,670	350	0	1.43	.82	.60	2.85
		700	+10		3.80	1.68	5.48
		800	0		1.30	1.05	2.35
		280	0			.50	.50
							11.18

COAL HAULAGE CYCLES - 657AS - Cont'd.

Bench	Tonnes	Distance	Slope	Time (minutes) Man.	Loaded	Empty	Total
1230	694,650	350	0	1.43	.82	.60	2.85
		800	+10		4.25	1.92	6.17
		800	0		1.30	1.05	2.35
		280	0			.50	.50
							11.87
1220	701,370	350	0	1.43	.82	.60	2.85
		900	+10		4.70	2.16	6.86
		800	0		1.30	1.05	2.35
		280	0			.50	.50
							12.56
1210	711,400	400	0	1.43	.88	.63	2.94
		1,000	+10		5.15	2.40	7.55
		800	0		1.30	1.05	2.35
		280	0			.50	.50
							13.34
1200	701,400	500	0	1.43	1.15	.75	3.33
		1,100	+10		5.60	2.63	8.23
		800	0		1.30	1.05	2.35
		280	0			.50	.50
							14.41
1190	701,360	550	0	1.43	1.20	.80	3.43
		1,200	+10		6.05	2.87	8.92
		800	0		1.30	1.05	2.35
		280	0			.50	.50
							15.20
1180	701,360	600	0	1.43	1.30	.85	3.58
		1,300	+10		6.50	3.11	9.61
		800	0		1.30	1.05	2.35
		280	0			.50	.50
							15.84
1170	615,020	300	0	1.43	.70	.50	2.63
		200	+5		.70	.48	1.18
		1,300	+10		6.50	3.11	9.61
		800	0		1.30	1.05	2.35
		280	0			.50	.50
							16.27

COAL HAULAGE CYCLES - 657AS - Cont'd.

Bench	Tonnes	Distance	Slope	Time (minutes) Man.	Loaded	Empty	Total
1160	347,260	200	0	1.43	.50	.40	2.33
		400	+5		1.25	.96	2.21
		1,300	+10		6.50	3.11	9.61
		800	0		1.30	1.05	2.35
		280	0			.50	.50
							17.00
1150	291,710	100	0	1.43	.30	.30	2.03
		600	+5		2.10	1.44	3.54
		1,300	+10		6.50	3.11	9.61
		800	0		1.30	1.05	2.35
		280	0			.50	.50
							18.03
1140	89,720	100	0	1.43	.30	.30	2.03
		600	+5		2.10	1.44	3.54
		1,300	+10		6.50	3.11	9.61
		800	0		1.30	1.05	2.35
		280	0			.50	.50
							18.03

COAL SCRAPER REQUIREMENTS - 657AS

Year 1

Bench	1370	64,970 RMT	0.064 year	6.76 min.
	1360	115,810 RMT	0.113 year	6.65 min.
	1350	320,890 RMT	0.314 year	6.36 min.
	1340	342,460 RMT	0.336 year	5.96 min.
	1330	176,280 RMT	0.173 year	5.76 min.

Average cycle: 6.18 min.

Scraper capacity:
50/6.18 + 50/6.18 + 45/6.18 = 145/6.18
(145/6.18) x 6.5 x 36.9 x 231 x .82 = 1,065,970 RMT

Number of scrapers required:
1,020,410/1,065,970 = 0.96

Year 2

Bench	1330	275,830 RMT	0.270 year	5.76 min.
	1320	506,210 RMT	0.496 year	5.36 min.
	1310	238,370 RMT	0.234 year	5.12 min.

Average cycle: 5.41 min.

Scraper capacity:
(145/5.41) x 6.5 x 36.9 x 231 x .81 = 1,202,840 RMT

Number of scrapers required:
1,020,410/1,202,840 = 0.85

Year 3

Bench	1310	267,820 RMT	0.262 year	5.12 min.
	1300	506,200 RMT	0.496 year	6.15 min.
	1290	246,390 RMT	0.241 year	6.44 min.

Average cycle: 5.94 min.

Scraper capacity:
(145/5.94) x 6.5 x 36.9 x 231 x .80 = 1,081,990 RMT

Number of scrapers required:
1,020,410/1,081,990 = 0.94

Year 4

Bench	1290	288,200 RMT	0.282 year	6.44 min.
	1280	615,240 RMT	0.603 year	7.14 min.
	1270	116,970 RMT	0.115 year	8.95 min.

Average cycle: 7.15 min.

Scraper capacity:
(145/7.15) x 6.5 x 36.9 x 231 x .77 = 865,180 RMT

Number of scrapers required:
1,020,410/865,180 = 1.18

Year 5

Bench	1270	498,270 RMT	0.488 year	8.95 min.
	1260	522,140 RMT	0.512 year	9.69 min.

Average cycle: 9.33 min.

Scraper capacity:
(145/9.33) x 6.5 x 36.9 x 231 x .76 = 654,410 RMT

Number of scrapers required:
1,020,410/654,410 = 1.56

Year 6

Bench	1260	93,100 RMT	0.091 year	9.69 min.
	1250	622,210 RMT	0.610 year	10.43 min.
	1240	305,100 RMT	0.299 year	11.18 min.

Average cycle: 10.59 min.

Scraper capacity:
(145/10.59) x 6.5 x 36.9 x 231 x .75 = 568,960 RMT

Number of scrapers required:
1,020,410/568,960 = 1.79

Year 7

Bench	1240	358,570 RMT	0.351 year	11.18 min.
	1230	661,840 RMT	0.649 year	11.87 min.

Average cycle: 11.63 min.

Scraper capacity:
(145/11.63) x 6.5 x 36.9 x 231 x .82 = 566,440 RMT

Number of scrapers required:
1,020,410/566,440 = 1.80

Year 8

Bench	1230	32,810 RMT	0.032 year	11.87 min.
	1220	701,370 RMT	0.687 year	12.56 min.
	1210	286,230 RMT	0.281 year	13.34 min.

Average cycle: 12.76 min.

Scraper capacity:
(145/12.76) x 6.5 x 36.9 x 231 x .81 = 509,980 RMT

Number of scrapers required:
1,020,410/509,980 = 2.00

Year 9

Bench	1210	425,170 RMT	0.417 year	13.34 min.
	1200	595,240 RMT	0.583 year	14.41 min.

Average cycle: 13.96 min.

Scraper capacity:
(145/13.96) x 6.5 x 36.9 x 231 x .80 = 460,390 RMT

Number of scrapers required:
1,020,410/460,390 = 2.22

Year 10

Bench	1200	106,160 RMT	0.104 year	14.41 min.
	1190	701,360 RMT	0.687 year	15.20 min.
	1180	212,890 RMT	0.209 year	15.84 min.

Average cycle: 15.25 min.

Scraper capacity:
(145/15.25) x 6.5 x 36.9 x 231 x .77 = 405,640 RMT

Number of scrapers required:
1,020,410/405,640 = 2.52

Year 11

Bench	1180	488,470 RMT	0.479 year	15.84 min.
	1170	531,940 RMT	0.521 year	16.27 min.

Average cycle: 16.06 min.

Scraper capacity:
(145/16.06) x 6.5 x 36.9 x 231 x .76 = 380,180 RMT

Number of scrapers required:
1,020,410/380,180 = 2.68

Year 12

Bench	1170	83,080 RMT	0.102 year	16.27 min.
	1160	347,260 RMT	0.428 year	17.00 min.
	1150	291,710 RMT	0.359 year	18.03 min.
	1140	89,720 RMT	0.111 year	18.03 min.

Average cycle: 17.41 min.

Scraper capacity:
(145/17.41) x 6.5 x 36.9 x 183.77 x .75 = 346,080 RMT

Number of scrapers required:
811,770/346,080 = 2.35

COAL SCRAPER REQUIREMENTS - 657B

Year 4

Average cycle:	8.15 min.
Scraper capacity: (145/8.15) x 6.5 x 36.9 x 231 x .77 =	759,020 RMT
Number of scrapers required: (1,020,410 - 865,180) / 759,020 =	0.20

Year 5

Average cycle:	10.33 min.
Scraper capacity: (145/10.33) x 6.5 x 36.9 x 231 x .76 =	591,060 RMT
Number of scrapers required: (1,020,410 - 654,410) / 591,060 =	0.62

Year 6

Average cycle:	11.59 min.
Scraper capacity: (145/11.59) x 6.5 x 36.9 x 231 x .75 =	519,870 RMT
Number of scrapers required: (1,020,410 - 568,960) / 519,870 =	0.87

Year 9

Average cycle:	14.96 min.
Scraper capacity: (145/14.96) x 6.5 x 36.9 x 231 x .82 =	429,610 RMT
Number of scrapers required: (1,020,410 - 920,780) / 429,610 =	0.23

Year 10

Average cycle:	16.25 min.
Scraper capacity: (145/16.25) x 6.5 x 36.9 x 231 x .77 =	380,680 RMT
Number of scrapers required: (1,020,410 - 811,280) / 380,680 =	0.55

Year 11

Average cycle:	17.06 min.
Scraper capacity: (145/17.06) x 6.5 x 36.9 x 231 x .76 =	357,890 RMT
Number of scrapers required: (1,020,410 - 760,360) / 357,890 =	0.73

Year 12

Average cycle:	18.41 min.
Scraper capacity: (145/18.41) x 6.5 x 36.9 x 231 x .75 =	260,370 RMT
Number of scrapers required: (811,770 - 692,160) / 260,370 =	0.46

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	1330	1,402,120	2,639,930
		1320	1,029,310	3,669,240
2	1330	1320	1,330,890	1,330,890
	1320	1310	2,317,750	3,648,640
	1310			
3	1310	1310	850,250	850,250
	1300	1300	2,203,800	3,054,050
	1290			
4	1290	1300	850,140	850,140
	1280	1290	1,278,590	2,128,730
	1270			
5	1270	1290	1,757,880	1,757,880
	1260	1280	46,110	1,803,990
6	1260	1280	2,030,360	2,030,360
	1250			
	1240			
7	1240	1280	964,190	964,190
	1230	1270	2,719,750	3,683,940
8	1230	1270	256,740	256,740
	1220	1260	2,679,710	2,936,450
	1210	1250	1,043,070	3,979,520
9	1210	1250	1,368,000	1,368,600
	1200	1240	2,071,860	3,440,460

STRIPPING SCHEDULE - Cont'd.

Year	Operating Bench Mine	Strip	Waste Volume (BCM)	Cumulative Volume (BCM)
10	1200	1240	104,580	104,580
	1190	1230	1,795,090	1,899,670
	1180	1220	935,630	2,835,300
11	1180	1220	625,930	625,930
	1170	1210	1,322,020	1,947,950
		1200	510,620	2,458,570
12	1170	1200	441,250	441,250
	1160	1190	710,500	1,151,750
	1150	1180	472,240	1,623,990
	1140	1170	213,700	1,837,690
		1160	105,060	1,942,750
		1150	35,610	1,978,360
		1140	1,300	1,979,660

WASTE HAULAGE CYCLES

				Time (minutes)			
Bench	BCM	Distance	Slope	Man.	Loaded	Empty	Total
1370	17,780	170	0	2.43	.42	.38	3.23
		300	-10		.44	.92	1.36
							4.59
1360	128,040	740	0	2.43	1.65	1.03	5.11
1350	340,230	420	0	2.43	1.05	.70	4.18
		100	+10		.65	.24	.89
		220	0		.60	.42	1.02
							6.09
1340	751,760	450	0	2.43	1.10	.65	4.18
		200	+5		.70	.48	1.18
		100	+10		.65	.24	.89
		220	0		.60	.42	1.02
							7.27
1330	702,120	350	0	2.43	.85	.60	3.88
		300	+10		1.75	.72	2.47
		480	0		1.13	.73	1.86
							8.21
	700,000	100	-10	2.43	.15	.30	2.88
		160	0		.35	.35	.70
		200	+10		1.30	.48	1.78
		450	0		1.10	.65	1.75
							7.11
1320	1,260,200	420	0	2.43	1.05	.60	4.08
		100	-10		.14	.30	.44
		400	0		.95	.68	1.63
							6.15
	1,100,000	420	0	2.43	1.05	.60	4.08
		200	+10		1.30	.48	1.78
		230	0		.65	.45	1.10
							6.96
1310	1,218,000	1,050	0	2.43	2.25	1.35	6.03
	1,950,000	400	0	2.43	.95	.68	4.06
		300	+10		1.75	.72	2.47
		400	0		.95	.68	1.63
							8.16

WASTE HAULAGE CYCLES - Cont'd.

Bench	BCM	Distance	Slope	Time (minutes) Man.	Loaded	Empty	Total
1300	1,253,940	400	0	2.43	.95	.68	4.06
		100	+10		.65	.24	.89
		900	0		1.90	1.17	3.07
							8.02
	1,100,000	400	0	2.43	.95	.68	4.06
		100	+10		.65	.24	.89
		150	0		.35	.30	.65
		500	+10		3.00	1.14	4.14
		150	0		.35	.30	.65
							10.39
	700,000	150	0	2.43	.35	.30	3.08
		100	+10		.65	.24	.89
		80	0		.20	.15	.35
		300	+10		1.75	.72	2.47
		150	0		.35	.30	.65
							7.44
1290	1,000,000	650	0	2.43	1.45	.90	4.78
		200	+10		1.30	.48	1.78
		150	0		.35	.30	.65
		500	+10		3.00	1.14	4.14
		300	0		.72	.55	1.27
							12.62
	2,036,470	650	0	2.43	1.45	.90	4.78
		200	+10		1.30	.48	1.78
		150	0		.35	.30	.65
		400	+10		2.30	.96	3.26
		150	0		.35	.30	.65
							11.12
1280	3,040,660	500	0	2.43	1.12	.75	4.30
		300	+10		1.70	.72	2.42
		50	0		.20	.20	.40
		600	-10		.88	1.44	2.32
		150	0		.35	.30	.65
							10.09
1270	2,976,490	400	0	2.43	.95	.68	4.06
		400	+10		2.30	.96	3.26
		50	0		.20	.20	.40
		600	-10		.88	1.44	2.32
		450	0		1.10	.65	1.75
							11.79

WASTE HAULAGE CYCLES - Cont'd.

				Time (minutes)			
Bench	BCM	Distance	Slope	Man.	Loaded	Empty	Total
1260	2,679,710	400	0	2.43	.95	.68	4.06
		500	+10		3.00	1.14	4.14
		400	0		.95	.68	1.63
							9.83
1250	2,411,670	400	0	2.43	.95	.68	4.06
		600	+10		3.70	1.44	5.14
		450	0		1.10	.65	1.75
							10.95
1240	2,176,440	350	0	2.43	.85	.60	3.88
		700	+10		4.20	1.68	5.88
		550	0		1.25	.85	2.10
							11.86
1230	1,795,090	350	0	2.43	.85	.60	3.88
		800	+10		4.70	1.92	6.62
		650	0		1.40	.95	2.35
							12.85
1220	1,561,560	350	0	2.43	.85	.60	3.88
		900	+10		5.10	2.16	7.26
		700	0		1.55	.98	2.53
							13.67
1210	1,322,020	400	0	2.43	.95	.68	4.06
		1,000	+10		5.50	2.40	7.90
		800	0		1.70	1.05	2.75
							14.71
1200	951,870	500	0	2.43	1.15	.75	4.33
		1,100	+10		5.90	2.63	8.53
		850	0		1.80	1.12	2.92
							15.78
1190	710,500	550	0	2.43	1.22	.80	4.45
		1,200	+10		6.30	2.87	9.17
		100	0		.30	.25	.55
		300	+10		1.75	.72	2.47
		150	0		.35	.30	.65
							17.29

WASTE HAULAGE CYCLES - Cont'd.

Bench	BCM	Distance	Slope	Time (minutes) Man.	Loaded	Empty	Total
1180	472,240	600	0	2.43	1.35	.85	4.63
		1,300	+10		6.70	3.11	9.81
		100	0		.30	.25	.55
		300	+10		1.75	.72	2.47
		150	0		.35	.30	.65
							18.11
1170	213,700	300	0	2.43	.72	.55	3.70
		200	+5		.70	.48	1.18
		1,300	+10		6.70	3.11	9.81
		100	0		.30	.25	.55
		300	+10		1.75	.72	2.47
		150	0		.35	.30	.65
							18.36
1160	105,060	200	0	2.43	.50	.35	3.28
		400	+5		1.60	.50	2.10
		1,300	+10		6.70	3.11	9.81
		100	0		.30	.25	.55
		300	+10		1.75	.72	2.47
		150	0		.35	.30	.65
							18.86
1150	35,610	100	0	2.43	.30	.25	2.98
		600	+5		2.30	.85	3.15
		1,300	+10		6.70	3.11	9.81
		100	0		.30	.25	.55
		300	+10		1.75	.72	2.47
		150	0		.35	.30	.65
							19.61
1140	1,300	100	0	2.43	.30	.25	2.98
		600	+5		2.30	.85	3.15
		1,300	+10		6.70	3.11	9.81
		100	0		.30	.25	.55
		300	+10		1.75	.72	2.47
		150	0		.35	.30	.65
							19.61

STRIPPING SCRAPER REQUIREMENTS - 657B

Year 1

				Cumulative	Average
Bench	1370	17,780 BCM	4.59 min.	17,780 BCM	4.59 min.
	1360	128,040 BCM	5.11 min.	145,820 BCM	5.05 min.
	1350	340,230 BCM	6.09 min.	486,050 BCM	5.78 min.
	1340	751,760 BCM	7.27 min.	1,237,810 BCM	6.68 min.
	1330	702,120 BCM	8.21 min.	1,939,930 BCM	7.23 min.
		700,000 BCM	7.11 min.	2,639,930 BCM	7.20 min.
	1320	1,029,310 BCM	6.15 min.	3,669,240 BCM	6.91 min.

Scraper capacity:
(145/6.91) x 6.5 x 18 x 231 x .82 = 465,050 BCM

Number of scrapers required:
3,669,240/465,050 = 7.89

Year 2

				Cumulative	Average
Bench	1320	230,890 BCM	6.15 min.	230,890 BCM	6.15 min.
		1,100,000 BCM	6.96 min.	1,330,890 BCM	6.82 min.
	1310	1,218,000 BCM	6.03 min.	2,548,890 BCM	6.44 min.
		1,099,750 BCM	8.16 min.	3,648,640 BCM	6.96 min.

Scraper capacity:
(145/6.96) x 6.5 x 18 x 231 x .81 = 456,080 BCM

Number of scrapers required:
3,648,640/456,080 = 8.00

Year 3

				Cumulative	Average
Bench	1310	850,250 BCM	8.16 min.	850,250 BCM	8.16 min.
	1300	1,253,940 BCM	8.02 min.	2,104,190 BCM	8.08 min.
		700,000 BCM	7.44 min.	2,804,190 BCM	7.92 min.
		249,860 BCM	10.39 min.	3,054,050 BCM	8.12 min.

Scraper capacity:
(145/8.12) x 6.5 x 18 x 231 x .80 = 386,100 BCM

Number of scrapers required:
3,054,050/386,100 = 7.91

Year 4

				Cumulative	Average
Bench	1300	850,140 BCM	10.39 min.	850,140 BCM	10.39 min.
	1290	1,278,590 BCM	11.12 min.	2,128,730 BCM	10.83 min.

Scraper capacity:
(145/10.83) x 6.5 x 18 x 231 x .77 = 278,630 BCM

Number of scrapers required:
2,128,730/278,630 = 7.64

Year 5

Bench	1290	757,880 BCM	11.12 min.	757,880 BCM	11.12 min.
		1,000,000 BCM	12.62 min.	1,757,880 BCM	11.97 min.
	1280	46,110 BCM	10.09 min.	1,803,990 BCM	11.92 min.

Scraper capacity:
(145/11.92) x 6.5 x 18 x 231 x .76 = 249,860 BCM

Number of scrapers required:
1,803,990/249,860 = 7.22

Year 6

Bench	1280	2,030,360 BCM	10.09 min.	2,030,360 BCM	10.09 min.

Scraper capacity:
(145/10.09) x 6.5 x 18 x 231 x .75 = 291,300 BCM

Number of scrapers required:
2,030,360/291,300 = 6.97

Year 7

Bench	1280	964,190 BCM	10.09 min.	964,190 BCM	10.09 min.
	1270	2,719,750 BCM	11.79 min.	3,683,940 BCM	11.34 min.

Scraper capacity:
(145/11.34) x 6.5 x 18 x 231 x .82 = 283,380 BCM

Number of scrapers required:
3,683,940/283,380 = 13.00

Year 8

				Cumulative	Average
Bench	1270	256,740 BCM	11.79 min.	256,740 BCM	11.79 min.
	1260	2,679,710 BCM	9.83 min.	2,936,450 BCM	10.00 min.
	1250	1,043,070 BCM	10.95 min.	3,979,520 BCM	10.25 min.

Scraper capacity:
(145/10.25) x 6.5 x 18 x 231 x .81 = 309,690 BCM

Number of scrapers required:
3,979,520/309,690 = 12.85

Year 9

Bench	1250	1,368,600 BCM	10.95 min.	1,368,600 BCM	10.95 min.
	1240	2,071,860 BCM	11.68 min.	3,440,460 BCM	11.50 min.

Scraper capacity:
(145/11.50) x 6.5 x 18 x 231 x .80 = 272,620 BCM

Number of scrapers required:
3,440,460/272,620 = 12.62

Year 10

Bench	1240	104,580 BCM	11.86 min.	104,580 BCM	11.86 min.
	1230	1,795,090 BCM	12.85 min.	1,899,670 BCM	12.79 min.
	1220	935,630 BCM	13.67 min.	2,835,300 BCM	13.08 min.

Scraper capacity:
(145/13.08) x 6.5 x 18 x 231 x .77 = 230,700 BCM

Number of scrapers required:
2,835,300/230,700 = 12.29

Year 11

Bench	1220	625,930 BCM	13.67 min.	625,930 BCM	13.67 min.
	1210	1,322,020 BCM	14.71 min.	1,947,950 BCM	14.38 min.
	1200	510,620 BCM	15.78 min.	2,458,570 BCM	14.67 min.

Scraper capacity:
(145/14.67) x 6.5 x 18 x 231 x .76 = 203,020 BCM

Number of scrapers required:
2,458,570/203,020 = 12.11

Year 12

				Cumulative	Average
Bench	1200	441,250 BCM	15.78 min.	441,250 BCM	15.78 min.
	1190	710,500 BCM	17.29 min.	1,151,750 BCM	16.71 min.
	1180	472,240 BCM	18.11 min.	1,623,990 BCM	17.12 min.
	1170	218,700 BCM	18.36 min.	1,837,690 BCM	17.26 min.
	1160	105,060 BCM	18.86 min.	1,942,750 BCM	17.35 min.
	1150	35,610 BCM	19.61 min.	1,978,360 BCM	17.39 min.
	1140	1,300 BCM	19.61 min.	1,979,660 BCM	17.39 min.

Scraper capacity:
(145/17.39) x 6.5 x 18 x 231 x .75 = 169,020 BCM

Number of scrapers required:
1,979,660/169,020 = 11.71

COARSE REFUSE HAULAGE

The annual tonnage of coarse refuse will consist of about 2% of the raw coal mined, that is 20,410 tonnes per year rejected at the braker station and of 32.3% of the wash plant feed, that is 323,000 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:	20,410 tonnes
Plant reject:	323,000 tonnes
Total	343,410 tonnes

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

			657B
Loading and unloading:			1.43 min.
Return empty,	1,080 m level	1.55 min.	
Haul loaded		1.70 min	
Difference:			.15 min.
Extra haul,	600 m level		1.10 min.
Return empty,	550 m level		.80 min.
Total			3.48 min.

Refuse haulage capacities:

Year	Capacity (RMT)	No. Required
1	(145/3.48) x 6.5 x 45 x 231 x .82 = 2,308,556	0.15
2	(145/3.48) x 6.5 x 45 x 231 x .81 = 2,280,403	0.15
3	(145/3.48) x 6.5 x 45 x 231 x .80 = 2,252,250	0.15
4	(145/3.48) x 6.5 x 45 x 231 x .77 = 2,167,790	0.16
5	(145/3.48) x 6.5 x 45 x 231 x .76 = 2,139,637	0.16
6	(145/3.48) x 6.5 x 45 x 231 x .75 = 2,111,484	0.16
7	(145/3.48) x 6.5 x 45 x 231 x .82 = 2,308,556	0.15
8	(145/3.48) x 6.5 x 45 x 231 x .81 = 2,280,403	0.15
9	(145/3.48) x 6.5 x 45 x 231 x .80 = 2,252,250	0.15
10	(145/3.48) x 6.5 x 45 x 231 x .77 = 2,167,790	0.16
11	(145/3.48) x 6.5 x 45 x 231 x .76 = 2,139,637	0.16
12	(145/3.48) x 6.5 x 45 x 231 x .75 = 2,111,484	0.16

TOTAL SCRAPER REQUIREMENTS

Year	Coal		Refuse		Waste	Total	
	657AS	657B	657AS	657B	657B	657AS	657B
1	0.96	-	0.04	0.11	7.89	1	8
2	0.85	-	0.15	-	8.00	1	8
3	0.94	-	0.06	0.09	7.91	1	8
4	1.00	0.20	-	0.16	7.64	1	8
5	1.00	0.62	-	0.16	7.22	1	8
6	1.00	0.87	-	0.16	6.97	1	8
7	1.80	-	0.20	-	13.00	2	13
8	2.00	-	-	0.15	12.85	2	13
9	2.00	0.23	-	0.15	12.62	2	13
10	2.00	0.55	-	0.16	12.29	2	13
11	2.00	0.73	-	0.16	12.11	2	13
12	2.00	0.46	-	0.16	11.71	2	13

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-9L 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:

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

	Years 1 - 6	Years 7 - 12
Peak annual waste haulage:	3,669,240 BCM	3,979,520 BCM
Average annual coal haulage:	622,200 BCM	622,200 BCM
Annual volume to be ripped:	4,291,440 BCM	4,601,720 BCM
Daily volume to be ripped:	18,578 BCM	19,920 BCM
Number of rippers required:	$\frac{18{,}578}{11{,}781} = 1.58$	$\frac{19{,}920}{11{,}781} = 1.69$

At 81% availability:

1.58/.81	= 1.95	1.69/.81	= 2.08

Required number in fleet: 2 rippers

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 14G grader is required. Another grader, a 16G will be required for the roads around the pit, plant site and waste dump.

The rest of the equipment should include a water/sanding truck, a service truck to serve the D9 equipment, ten pick-ups for supervisory personnel, an ambulance, a small standby loader, light towers, pumps and radios. 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 184 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 175 to 350 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 100 to 300 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 150-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 200 litre per second (3,180 US gpm).

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 supply will be approximately 205 litres per second (3,250 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 78-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 46 car train in about 9 hours, assuming that the loader also moves the rail cars past the loading point as required if, as anticipated, 2 train sets are utilized, there will be about a 50 hour cycle time available to complete train loading.

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 to work in two shifts per day is determined as follows:

Daily Production	551,000/231	=	2,385 tonnes
Truck cycle time	@ 40 kmph	=	48 minutes
Truck capacity/day	$\frac{2 \times 50}{48} \times 6.5 \times 36.3$	=	491.6 tonnes
Number of trucks required: 2,385/491.6		=	4.85 trucks
At 80% availability: 4.85/.80		=	6.1 trucks
In fleet:			6 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 $30,000 per annum for environment protection from years 1 to 10 and $60,000 for reclamation during years 11 and 12.

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 75 in the initial years to 91 in the 7th year. After the 10th year this number will decline to 88 during the last 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 $14.25 per hour to which 30% is added to cover payroll overhead ($18.525/hr total).

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
MINE												
Scraper operators	22	22	22	21	21	21	37	37	36	36	34	34
Ripper operators	6	6	6	6	6	6	6	6	6	6	6	6
Grader operators	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
Service truck op.	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
PLANT												
Braker attendants	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
Plant attendants	4	4	4	4	4	4	4	4	4	4	4	4
Mechanics	5	5	5	5	5	5	5	5	5	5	5	5
Electricians	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
OFFICE												
Rodman	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
Security Guards	3	3	3	3	3	3	3	3	3	3	3	3
	68	68	68	67	67	67	83	83	82	82	80	80
Absenteeism and vacation allowance	7	7	7	7	7	7	8	8	8	8	8	8
Total	75	75	75	74	74	74	91	91	90	90	88	88

MONTHLY PAID PERSONNEL

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

Position	No.	Salary	Payroll Cost
Operations Manager	1	$52,000	$ 65,000
Mine Superintendent	1	48,000	60,000
Plant Superintendent	1	48,000	60,000
Maintenance Superintendent	1	48,000	60,000
Mine Foremen	3	34,000	127,500
Plant Foremen	2	34,000	85,000
Surveyor	1	27,000	33,750
Chief Clerk	1	30,000	37,500
Payroll Clerk	1	25,000	31,250
Personnel and Safety Supervisor	1	30,000	37,500
Warehouse Clerk	1	27,000	33,750
Lab Technician	1	29,000	36,250
ClerkTypists	4	16,000	80,000
Total	19		$747,500

Cost per clean tonne mined:

747,500/551,000 = $1.357/tonne

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	125,000	
Mobile Equipment	10,152,000	
Miscellaneous Equipment	120,000	$10,677,000
COAL PREPARATION		
Site Preparation	$ 552,850	
Breaker Station	1,902,470	
Plant Feed System	302,030	
Wash Plant	3,901,530	
Clean Coal Loadout	324,540	
Tailings Disposal	299,480	
Lighting & Instrumentation	110,900	7,393,800
SUPPORT FACILITIES		
Ancillary Services Building	$ 3,320,550	
Power Supply & Distribution	2,430,800	
Tailings Pond	1,870,600	
Water Supply System	899,300	
Potable Water Supply	50,700	
Sewage Disposal	80,800	
Pit Dewatering System	659,300	9,312,050
TRANSPORTATION		
Access Road Construction	$ 592,600	
Bridge	334,000	
Railhead Storage & Ramp	849,100	1,775,700
Sub-total		$29,158,550
Engineering & Construction Management		2,267,000
Sub-total		$31,425,550
Contingencies - 15%		4,714,450
TOTAL		**$36,140,000**

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			125,000

Mobile Equipment

8	Scrapers - 657B	$6,216,000	
1	Scraper - 657AS	938,000	
2	Dozers - D9L	1,014,000	
1	Grader - 16G	365,000	
1	Grader - 14G	283,000	
1	Loader - 988B	411,000	
1	Loader - Standby	200,000	
10	Half-ton Pick-ups	110,000	
1	Water/Sand Truck - 769WS	437,000	
1	Lube Truck	100,000	
1	Mobile Crane	43,000	
1	Ambulance Car	35,000	$10,152,000

Miscellaneous Equipment

3	Light Towers	$ 64,000	
4	Pumps	45,000	
	Radios	11,000	$ 120,000
Total			**$10,677,000**

CAPITAL COST SUMMARY

COAL PREPARATION

Site Preparation	$ 552,850
Breaker Station	1,902,470
Plant Feed System	302,030
Wash Plant	3,901,530
Clean Coal Loadout	324,540
Tailing Disposal System	299,480
Lighting and Instrumentation	110,900
Total	**$7,393,800**

CAPITAL COST BREAKDOWN

COAL PREPARATION

BREAKER STATION	
Dump Hopper, Tunnel and Breaker Foundation	$ 634,130
Breaker Building	172,230
Rotary Breaker, Grizzly and Chutes	280,330
Feeder	56,310
Dust Control	53,850
Material Hoist	18,330
Conveyors	391,230
ROM Storage Lowering Tube and Tunnel	296,060
Sub-total	$1,902,470
PLANT FEED SYSTEM	
Feeders	$ 73,670
Conveyor	228,360
Sub-total	$ 302,030
WASH PLANT	
Building	$1,020,260
Scales, Samplers, Tramp Magnet	218,540
Batac Jig	1,462,880
Screens	233,470
Crushers	149,280
Slurry Pumps and Sumps	258,990
Clean-up Pumps	40,980
Hydrocyclones	115,930
Classifying Cyclones (8)	68,820
Classifying Cyclones (2)	30,920
Centrifuges	168,680
Sieve Bends	30,580
Overhead Crane (10-ton capacity)	80,640
Air Compressor	21,560
Sub-total	$3,901,530
CLEAN COAL LOADOUT	
Conveyor	$ 222,060
Storage Bin	102,480
Sub-total	$ 324,540
TAILINGS DISPOSAL SYSTEM	
Conveyors	$ 178,930
Storage Bin	103,120
Slurry Pipeline (200 mm)	17,430
Sub-total	$ 299,480

CAPITAL COST BREAKDOWN

SUPPORT FACILITIES

ANCILLARY SERVICES BUILDING

SHOPS

Structure		$ 1,285,890
Concrete Aprons:		65,340
Excavation	$ 1,940	
Gravel Fill	3,560	5,500
Crane	$ 70,580	
Hoist	29,420	
Bus Bar	3,740	
Switch	1,080	
Starter	2,690	
Wiring	4,300	111,810
Internal Offices	$ 75,640	
Office Furnishing	23,700	99,340
Maintenance Equipment		215,500
Sub-total		$ 1,787,380

OFFICES

Structure	$ 310,320
Office Furnishing	61,420
Sub-total	$ 371,740

DRY

Structure	$ 605,120
Lockers	25,860
Sub-total	$ 630,980

WAREHOUSE

Structure	$ 372,380
Office Furnishing	4,310
Storage Shelves, Bins and Racks	153,760
Sub-total	$ 530,450
TOTAL	**$ 3,320,550**

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CAPITAL COST BREAKDOWN

SUPPORT FACILITIES - Cont'd.

POWER SUPPLY AND DISTRIBUTION

POWER SUPPLY

Switchgear and Transformer		$ 323,250
60 kV Transmission Line		1,616,250
Mine Substation:		
60 kV Isolator Switch	$10,770	
Lightning Arresters	7,540	
Circuit Breaker	90,510	
Structure, Fence, Grounding	43,100	
1500 KVA, 60-0.6 kV Transformer	53,880	
600 volt Circuit Breaker	8,600	214,400
Sub-total		$2,153,900

POWER DISTRIBUTION

600 volt Switchgear		$ 37,700
Miscellaneous Equipment		46,300
Feeders to:		
Breaker Station	$12,900	
Wash Plant	52,800	
Ancillary Buildings	19,400	
Water Supply System	35,600	
Pit Dewatering Pumps	66,800	
Gatehouse	3,200	
Sewage Plant	2,200	192,900
Sub-total		$ 276,900
TOTAL		**$2,430,800**

CAPITAL COST BREAKDOWN

SUPPORT FACILITIES - Cont'd.

TAILING POND

Clearing & Excavations	$ 292,200
Dyke Construction	1,553,800
Spillway	24,600
Sub-total	$ 1,870,600

PROCESS WATER SUPPLY

Barge & Pump Inlet	$ 412,100
Pumps	56,400
Pipe Line	130,400
Water Storage Tank	77,800
Distribution System	215,500
Fire Hydrants	7,100
Sub-total	$ 899,300

POTABLE WATER SUPPLY

Water Storage Tank	$ 12,100
Distribution System	34,800
Hypochlorite Feeder	3,800
Sub-total	$ 50,700

SEWAGE DISPOSAL

Sewage System	$ 33,400
Sewage Treatment Plant	36,200
Drainage Field	11,200
Sub-total	$ 80,800

PIT DEWATERING SYSTEM

Borehole Wells	$ 344,800
Well Pumps	43,100
Testing & Development	21,500
Power Supply	18,700
Discharge Piping	231,200
Sub-total	$ 659,300

CAPITAL COST BREAKDOWN

TRANSPORTATION

ACCESS ROAD

General Upgrading	$ 215,500
Improvements & Diversions	231,700
Drainage Works	43,100
New Culverts	26,900
Town Bypass	75,400
Sub-total	$ 592,600

BRIDGE

Factored allowance	$ 334,000

RAILHEAD STORAGE AND RAMP

Track Works	$ 439,600
Turnouts	215,500
Signalling	53,900
Site Preparation	73,300
Concrete Curbing	66,800
Sub-total	$ 849,100
TOTAL	**$ 1,775,700**

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CAPITAL EXPENDITURES

($ Thousands)

Year	Pit Equ.	Plant	Facilities	Expl & D	Proj. Mg.	Cont. Capital	Total
PREPRODUCTION PERIOD:							
-1	-	477	1,473	502	517	-	2,969
0	11,814	8,026	10,212	1,020	2,089	--	33,171
Subtotal	11,814	8,503	11,685	1,532	2,607	--	36,140
PRODUCTION PERIOD:							
1	-	-	-	-	-	380	380
2	-	-	-	-	-	390	390
3	-	-	-	-	-	400	400
4	-	-	-	-	-	410	410
5	298	-	100	-	-	420	818
6	11	-	-	-	-	430	441
7	11,847	-	-	-	-	440	12,287
8	1,287	600	-	-	-	450	2,337
9	-	-	100	-	-	460	560
10	298	-	-	-	-	470	768
11	-	-	-	-	-	480	480
12	(2,230)	-	-	-	-	490	(1,740)
Subtotal:	11,511	600	200	-	-	5,220	17,531
Total	23,325	9,103	11,885	1,531	2,607	5,220	53,671

PREPRODUCTION COST BREAKDOWN

Year - 1

PLANT	
Site Preparation 75%	$ 414,600
Contingency	62,200
TOTAL	$ 476,800
FACILITIES	
Power Supply & Distr. 50%	$ 1,215,000
Potable Water Supply 50%	25,300
Sewage Disposal 50%	40,400
Subtotal	$ 1,280,700
Contingency	192,100
TOTAL	$ 1,472,800
EXPLORATION & DEVELOPMENT	
Exploration 50%	$ 50,000
Access Road Construction 50%	296,300
Clearing & Grubbing 50%	90,000
Subtotal	$ 436,300
Contingency	65,400
TOTAL	$ 501,700
PROJECT MANAGEMENT	
Engineering 20%	$ 150,000
Construction Management 20%	300,000
Subtotal	$ 450,000
Contingency	67,500
TOTAL	$ 517,500
TOTAL YEAR - 1	**$ 2,968,800**

PREPRODUCTION COST BREAKDOWN

Year 0

PIT EQUIPMENT	
Equipment	$ 10,272,000
Contingency	$ 1,541,600
TOTAL	$ 11,813,600
PLANT	
Site Preparation 25%	$ 138,250
Breaker Station	1,902,470
Plant Feed System	302,030
Wash Plant	3,901,530
Clean Coal Loadout	324,540
Tailings Disposal	299,480
Lighting & Instrumentation	110,900
Subtotal	$ 6,979,200
Contingency	1,046,900
TOTAL	$ 8,026,100
FACILITIES	
Ancillary Services Building	$ 3,320,550
Power Supply & Distribution 50%	1,215,800
Tailings Pond	1,870,600
Water Supply	899,300
Potable Water Supply 50%	25,400
Sewage Disposal 50%	40,400
Railhead Storage	849,100
Pit Dewatering System	659,300
Subtotal	$ 8,880,450
Contingency	1,332,050
TOTAL	$ 10,212,500
EXPLORATION & DEVELOPMENT	
Exploration 50%	$ 50,000
Access Road Construction 50%	296,300
Clearing & Grubbing 50%	90,000
Haulage Road Construction	125,000
Bridge Construction	334,000
Subtotal	$ 895,300
Contingency	134,300
TOTAL	$ 1,029,600
PROJECT MANAGEMENT	
Engineering 80%	$ 594,000
Construction Management 80%	1,223,000
Subtotal	$ 1,817,000
Contingency	272,400
TOTAL	$ 2,089,400
TOTAL YEAR 0	**$ 33,171,200**

1117-200

MINE EQUIPMENT REPLACEMENTS

Year	Equipment	Price	Salvage	Balance
5	Pick-ups	$ 110,000	$ 11,000	$ 99,000
	Light Towers	64,000	-	64,000
	Pumps	45,000	-	45,000
	Lube Truck	100,000	10,000	90,000
				$ 298,000
6	Radios	$ 11,000	-	$ 11,000
7	Scrapers - 657AS	$ 1,876,000	$ 131,320	$ 1,744,680
	- 657B	10,101,000	870,240	9,230,760
	D9's	1,014,000	141,960	872,040
				$ 11,847,480
8	Loader	$ 411,000	$ 57,500	$ 353,500
	Water/Sand Truck	437,000	61,200	375,800
	Grader - 16G	365,000	51,100	313,900
	- 14G	283,000	39,600	243,400
				$ 1,286,600
10	Pick-ups	$ 110,000	$ 11,000	$ 99,000
	Light Towers	64,000	-	64,000
	Pumps	45,000	-	45,000
	Lube Truck	100,000	10,000	90,000
				$ 298,000
12	Pickups		$ 27,500	
	Lube Truck		25,000	
	Scrapers - 657 AS		262,600	
	- 657 B		1,414,140	
	D9's		141,960	
	Loader		98,640	
	Water/Sand Truck		104,880	
	Grader - 16G		87,600	
	- 14G		67,920	
			$ 2,230,240	

SECTION 12

SECTION 12

OPERATING COST ESTIMATES

SECTION 12

OPERATING COST ESTIMATES

For all equipment, fuel cost is based on fuel at $0.30 per litre and caterpillar quoted consumption rates.

Lubricant cost is estimated at 10% of fuel cost.

Maintenance cost is based on hourly cost of maintenance contract quoted for a term of 18,000 hours in 6 years, and on the cost of incidental maintenance due to accident or abuse. The cost of these repairs is estimated at 10% of the maintenance contract rate per hour.

The estimated hourly equipment operating costs are presented on the following page.

1117-200

HOURLY EQUIPMENT OPERATING COSTS

Cost Component	657AS	657B	D9L	988B	16G	14G	769WS
Fuel	37.25	37.25	17.77	14.83	8.42	6.27	7.31
Lube	5.77	3.72	1.77	1.50	.84	.62	.73
Maint. Contract	57.81	58.13	53.66	41.17	32.85	31.03	22.59
G.E.T.	5.12	10.06	20.50	1.38	3.25	2.71	-
Tires	18.45	18.45	-	12.30	3.48	2.49	5.33
Repairs	5.78	5.81	5.37	4.12	3.29	3.11	2.25
Total	130.18	133.42	99.07	75.30	52.13	46.23	38.21

ANNUAL MINE OPERATING COSTS

Year	Scrapers ($)	Rippers ($)	Others ($)	Operating Labour ($)	Total ($)	Cost/Tonne ($/CMT)
1	3,563,247	589,560	448,740	1,437,836	6,039,383	10.961
2	3,519,792	582,370	448,740	1,437,836	5,988,738	10.868
3	3,476,338	575,180	448,740	1,437,836	5,938,094	10.777
4	3,345,975	553,611	448,740	1,403,602	5,751,928	10.439
5	3,302,521	546,421	448,740	1,403,602	5,701,284	10.347
6	3,259,067	539,232	448,740	1,403,602	5,650,641	10.255
7	5,935,532	589,560	448,740	1,951,349	8,925,181	16.198
8	5,863,146	582,370	448,740	1,951,349	8,845,605	16.054
9	5,790,761	575,180	448,740	1,917,115	8,731,796	15.847
10	5,573,607	553,611	448,740	1,917,115	8,493,073	15.414
11	5,501,223	546,421	448,740	1,848,647	8,345,031	15.145
12	4,324,270	428,977	357,438	1,472,515	6,583,200	14.718

ANNUAL COAL PREPARATION COST

Labour	
Midnight crew	$ 210,210
Day and afternoon crew	480,480
Sub-total	$ 690,690
Replacement Parts and Materials	
3.5% of Capital:	$ 258,780
Power Consumption	
Breaker Station	$ 10,618
Wash Plant	115,027
Water Recycling	30,821
Sub-total	$ 156,466
Supplies	
Flocculants $1.98/kg, 0.02 kg/tonne	$ 58,780
Lubricants at $0.02/CMT	11,020
Sub-total	$ 69,800
TOTAL	**$1,175,736**

Coal preparation cost per clean tonne: $ 2.134/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	780	5,544	4,324,320	527,567	115,027
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	1,226		6,694,584	$ 816,041	$ 178,076

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	Misc. Labor	Power	Envirmt	Transp	Admin. Labor	Total	Average
1	10.961	2.134	0.746	0.039	0.060	2.820	1.357	18.117	18.117
2	10.869	2.134	0.746	0.039	0.060	2.820	1.357	18.025	18.071
3	10.777	2.134	0.746	0.039	0.060	2.820	1.357	17.933	18.025
4	10.439	2.134	0.746	0.039	0.060	2.820	1.357	17.595	17.917
5	10.347	2.134	0.746	0.039	0.060	2.820	1.357	17.503	17.835
6	10.255	2.134	0.746	0.039	0.060	2.820	1.357	17.411	17.764
7	16.198	2.134	0.808	0.039	0.060	2.820	1.357	23.354	18.563
8	16.054	2.134	0.808	0.039	0.060	2.820	1.357	23.210	19.143
9	15.847	2.134	0.808	0.039	0.060	2.820	1.357	23.003	19.572
10	15.414	2.134	0.808	0.039	0.060	2.820	1.357	22.570	19.872
11	15.145	2.134	0.808	0.039	0.190	2.820	1.357	22.301	20.093
12	14.718	2.134	0.808	0.039	0.190	2.820	1.357	21.874	20.592

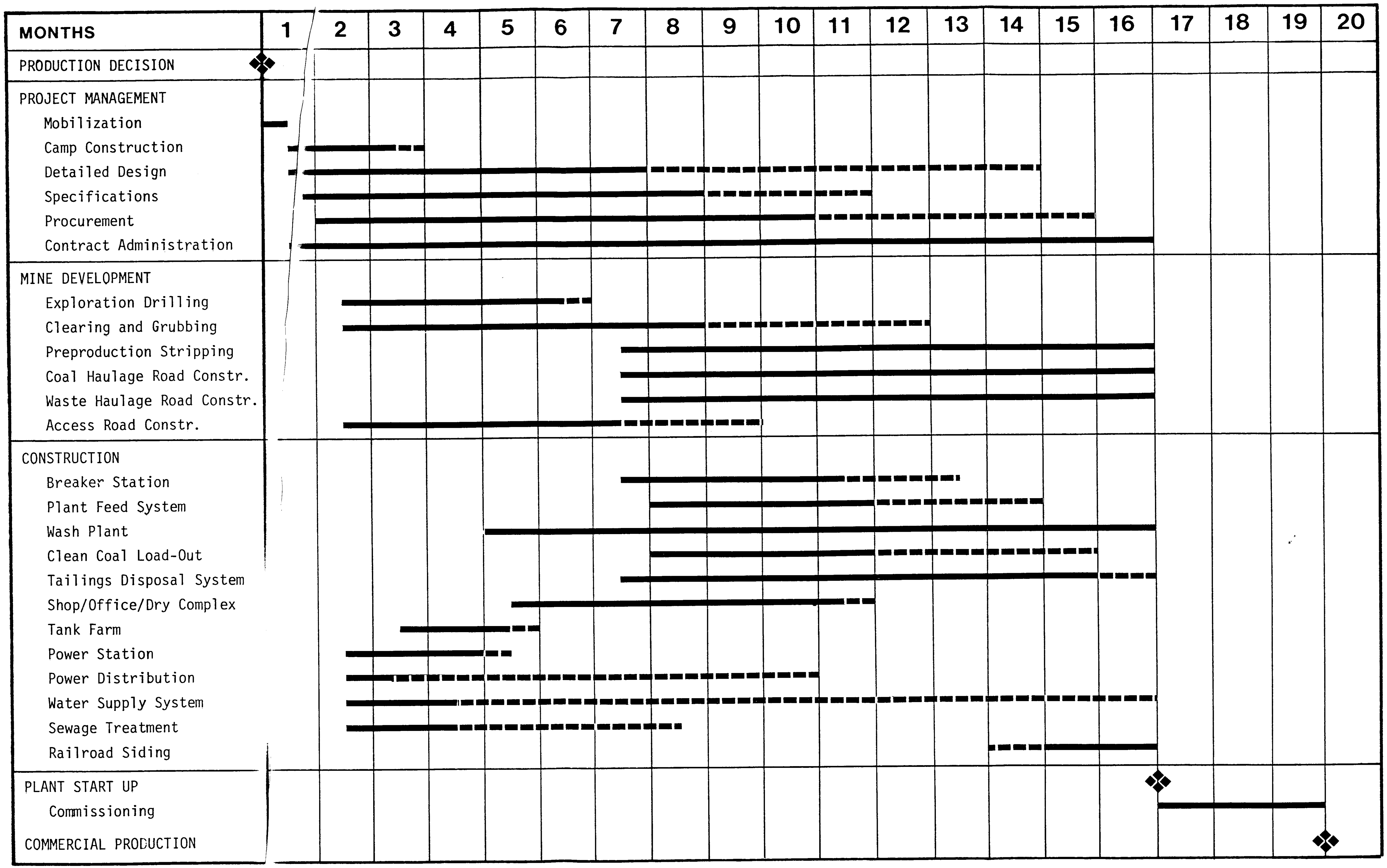
SECTION 13

SECTION 13

DEVELOPMENT SCHEDULE

TULAMEEN COAL PROJECT

DEVELOPMENT SCHEDULE



SUBMITTED BY

WRIGHT ENGINEERS LIMITED

W.F. GILMORE, P. ENG.

K.V. REMFERT

S.L. SZABOLCSY

VANCOUVER, B.C.
NOVEMBER, 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

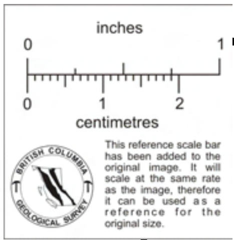
Rail Yard and Rail Loadout

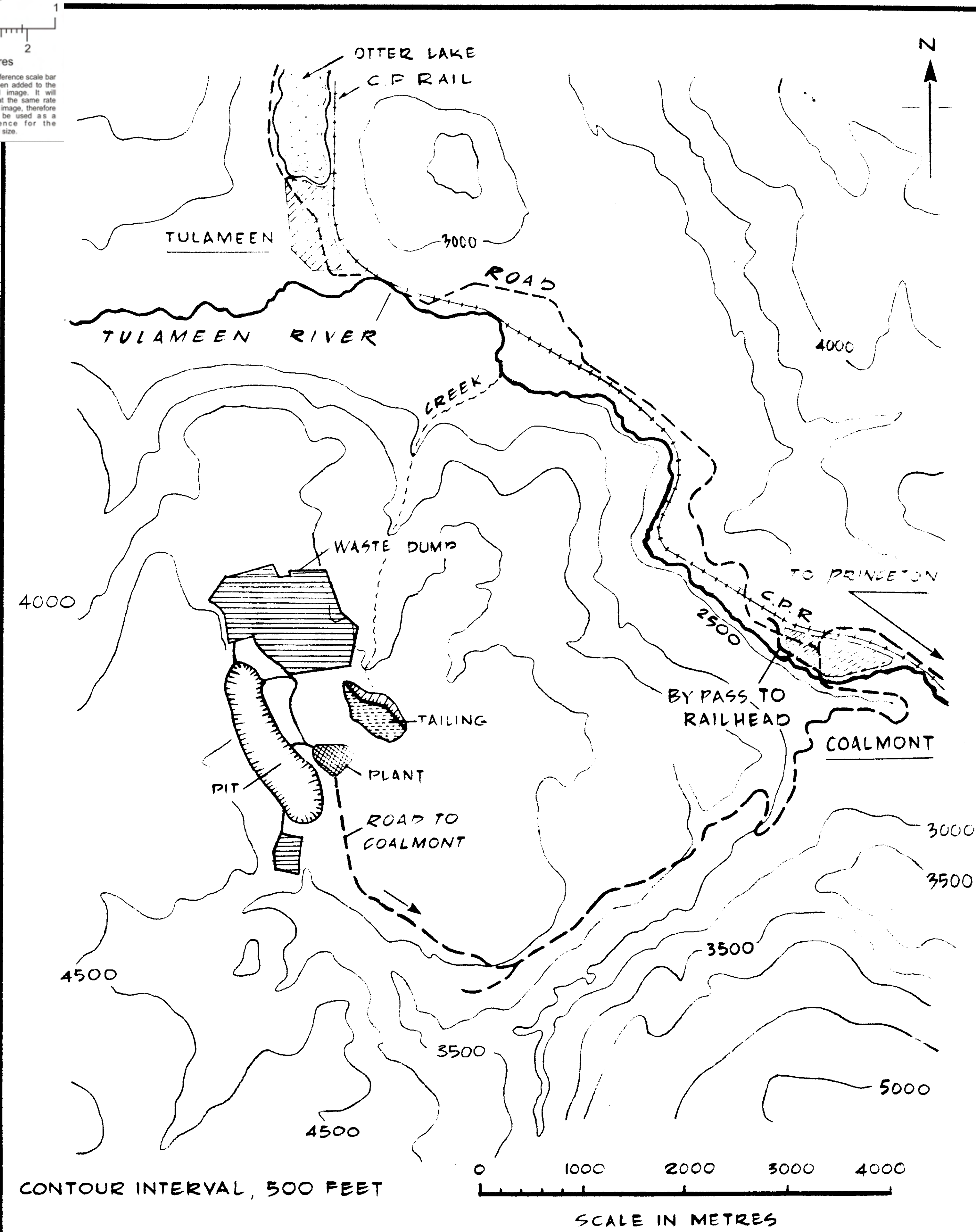
- Techman Ltd., 1978
- "Tulameen Project - Rail Transport Costs", Swan Wooster Engineering, December, 1978

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.



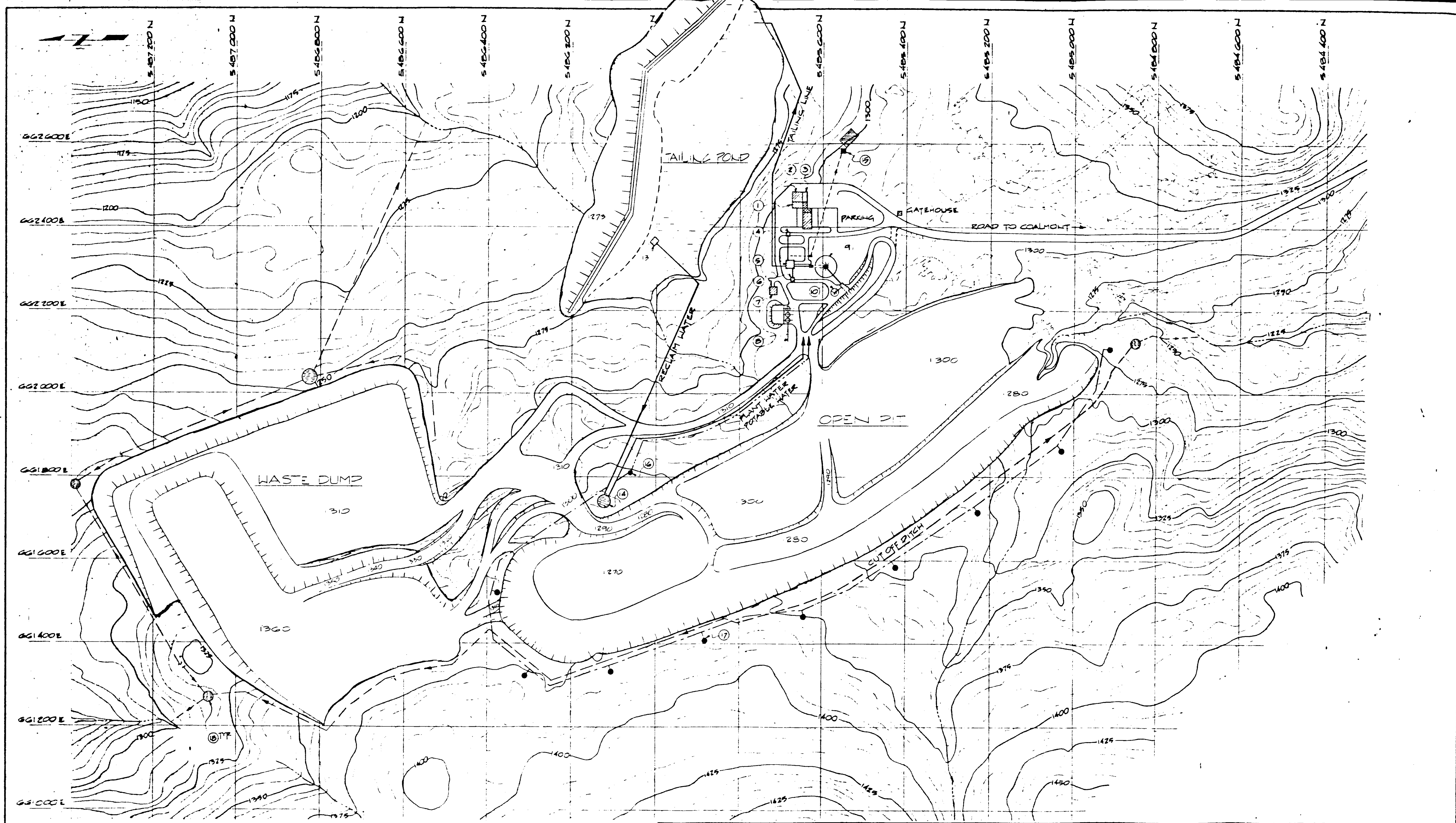


CYPRUS ANVIL MINING CORPORATION
TULAMEEN PROJECT

LOCATION PLAN

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

Drawn	J.E	Appr.		DRAWING NO.	REV
Check		Appr. Date		A 1117. 200 1201	



LEGEND –

1. WAREHOUSE
2. MINE (DRY)
3. OFFICE & ADMINISTRATION
4. COAL LOADOUT
5. COAL PREPARATION
6. REJECTS LOADOUT
7. SUBSTATION
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. U.S.)
15. SEWAGE PLANT & DRAINAGE FIELD
16. POTABLE WATER STORAGE
17. PIT DEWATERING WELLS (200 mm)
18. CUT-OFF DITCH SETTLING POND

CYPRUS ANVIL MINING CORPORATION
TULAMEEN PROJECT

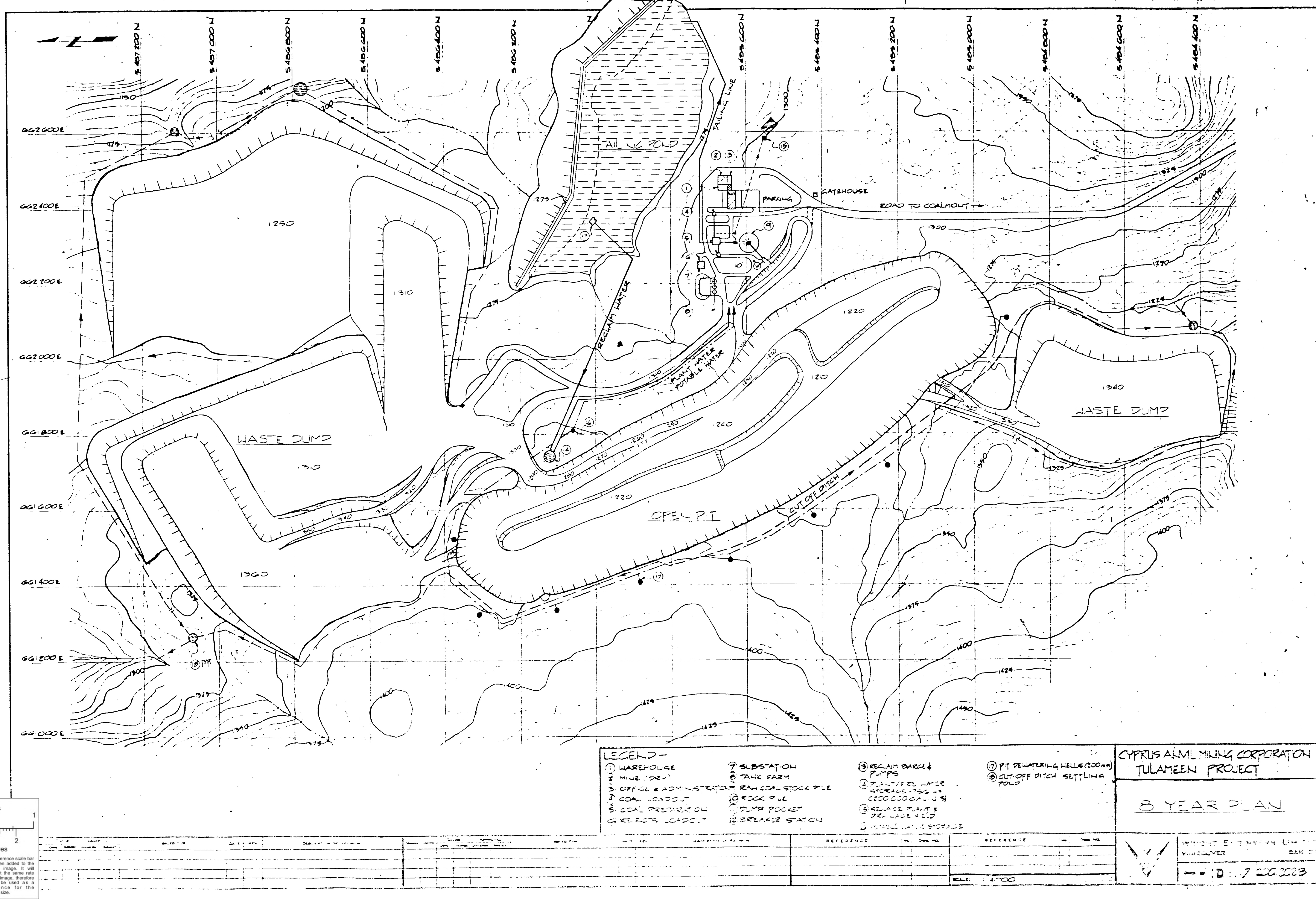
4 YEAR PLAN

REFERENCE	DWG. NO.	REFERENCE	DWG. NO.

SCALE: 1:4000

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

DWG. NO. D 11.7 200202A



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centimetres
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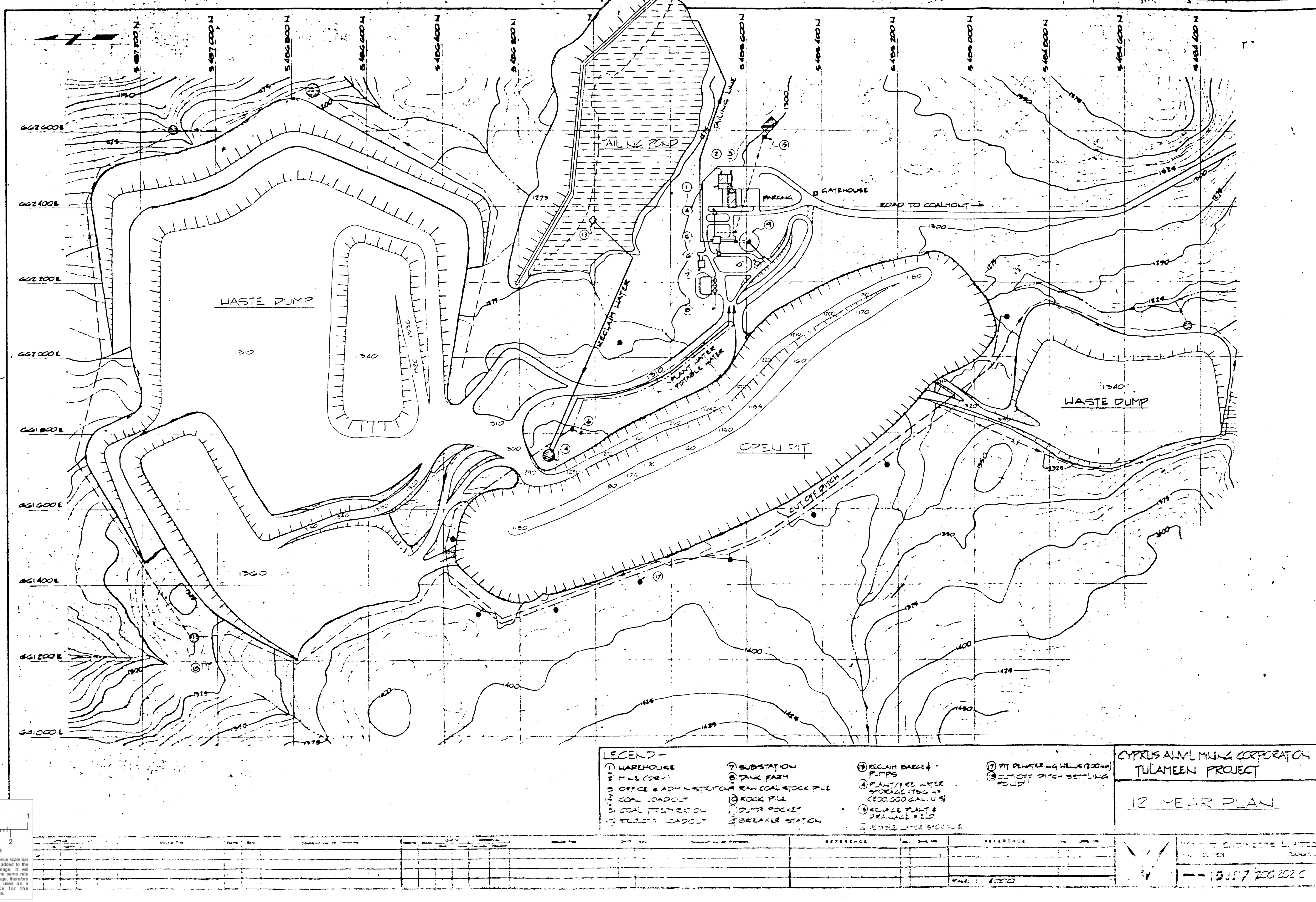

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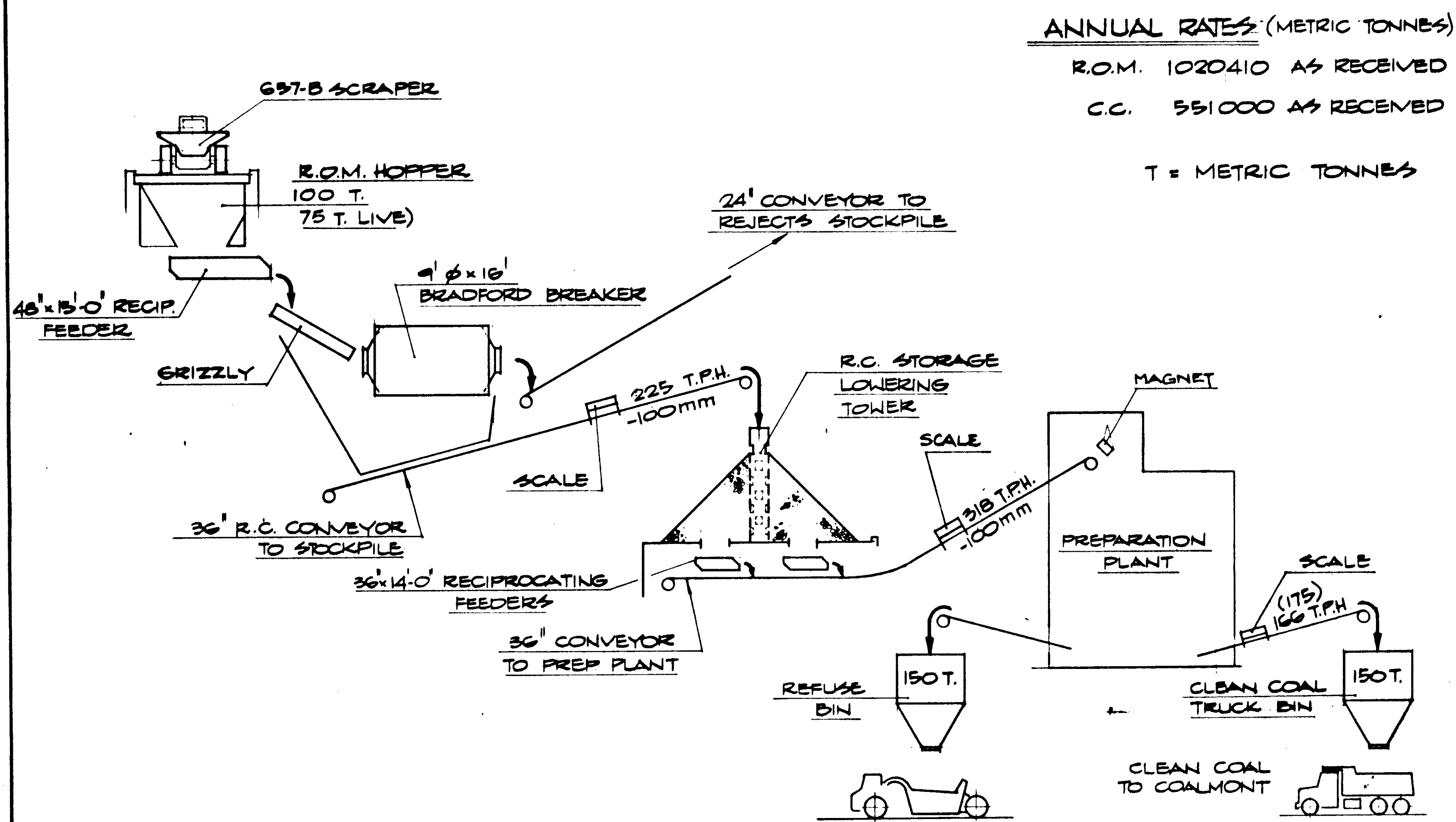

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CYRUS ANVIL MINING CORPORATION
TULAMEEN PROJECT

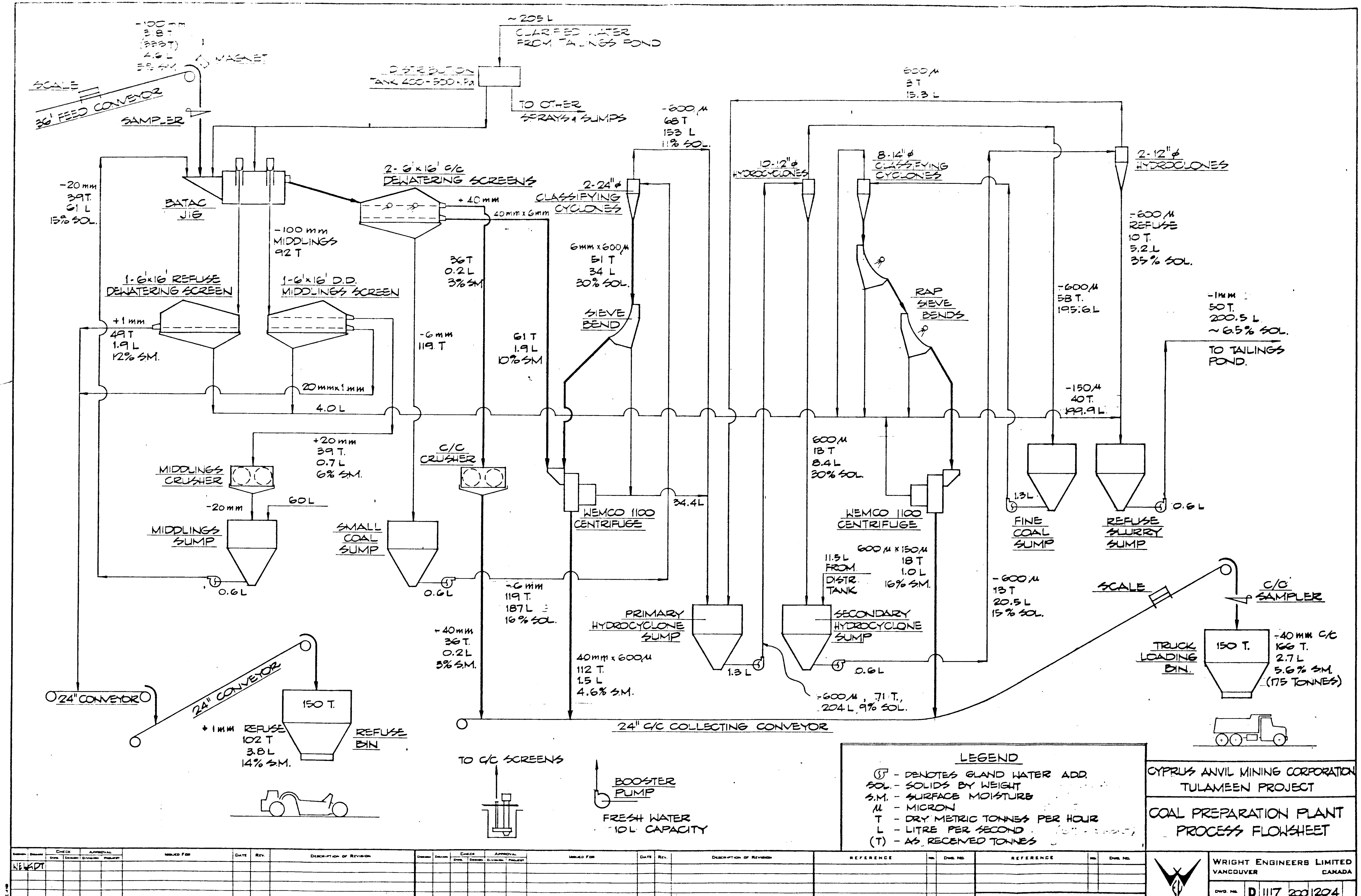
WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

COAL PREPARATION PLANT
GENERAL FLOWSHEET

SCALE: ———

DRAWING No. B 1117 200 1203

REV.


~205 L
CLARIFIED WATER FROM TAILINGS POND
DISTRIBUTION TANK 400-500 kPa
TO OTHER SPRAYS & SUMPS
-100 mm
2.8 T
4.6 L
MAGNET
SCALE
36" FEED CONVEYOR
SAMPLER
BATAC JIG
-20 mm
39 T.
61 L
15% SOL.
2-6'x16' C/C DEWATERING SCREENS
+40 mm
40 mm x 6 mm
-100 mm
MIDDLINGS
92 T
36 T
0.2 L
3% SM
1-6'x16' REFUSE DEWATERING SCREEN
1-6'x16' D.D. MIDDLINGS SCREEN
+1 mm
49 T
1.9 L
12% S.M.
20 mm x 1 mm
4.0 L
-6 mm
119 T
61 T
1.9 L
10% SM
+20 mm
39 T.
0.7 L
6% S.M.
MIDDLINGS CRUSHER
C/C CRUSHER
-20 mm
60 L
MIDDLINGS SUMP
SMALL COAL SUMP
0.6 L
0.6 L
-6 mm
119 T.
187 L
16% SOL.
+40 mm
36 T.
0.2 L
3% S.M.
2-24"ϕ CLASSIFYING CYCLONES
-600 μ
68 T
153 L
11% SOL.
6 mm x 600 μ
51 T
34 L
30% SOL.
SIEVE BEND
WEMCO 1100 CENTRIFUGE
34.4 L
40 mm x 600 μ
112 T.
1.5 L
4.6% S.M.
600 μ
3 T
15.3 L
10-12"ϕ HYDROCYCLONES
8-14"ϕ CLASSIFYING CYCLONES
2-12"ϕ HYDROCLONES
RAP SIEVE BENDS
600 μ
13 T
8.4 L
30% SOL.
WEMCO 1100 CENTRIFUGE
600 μ x 150 μ
18 T
1.0 L
16% S.M.
11.5 L FROM DISTR. TANK
PRIMARY HYDROCYCLONE SUMP
SECONDARY HYDROCYCLONE SUMP
1.3 L
0.6 L
-600 μ, 71 T., 204 L, 9% SOL.
-600 μ
13 T
20.5 L
15% SOL.
-600 μ
REFUSE
10 T.
5.2 L
35% SOL.
-600 μ
58 T.
195.6 L
-150 μ
40 T.
199.9 L
-1 mm
50 T.
200.5 L
~6.5% SOL.
TO TAILINGS POND.
1.3 L
FINE COAL SUMP
REFUSE SLURRY SUMP
0.6 L
SCALE
C/C SAMPLER
TRUCK LOADING BIN.
150 T.
-40 mm C/C
166 T.
2.7 L
5.6% SM.
(175 TONNES)
24" CONVEYOR
24" CONVEYOR
150 T.
+1 mm REFUSE
102 T
3.8 L
14% S.M.
REFUSE BIN
24" C/C COLLECTING CONVEYOR
TO C/C SCREENS
BOOSTER PUMP
FRESH WATER
10 L CAPACITY
LEGEND
- DENOTES GLAND WATER ADD.
SOL. - SOLIDS BY WEIGHT
S.M. - SURFACE MOISTURE
μ - MICRON
T - DRY METRIC TONNES PER HOUR
L - LITRE PER SECOND
(T) - AS RECEIVED TONNES
CYPRUS ANVIL MINING CORPORATION
TULAMEEN PROJECT
COAL PREPARATION PLANT
PROCESS FLOWSHEET
WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA
DWG. NO. D 1117 2001204
ISSUED FOR
DATE
REV.
DESCRIPTION OF REVISION
REFERENCE
DWG. NO.
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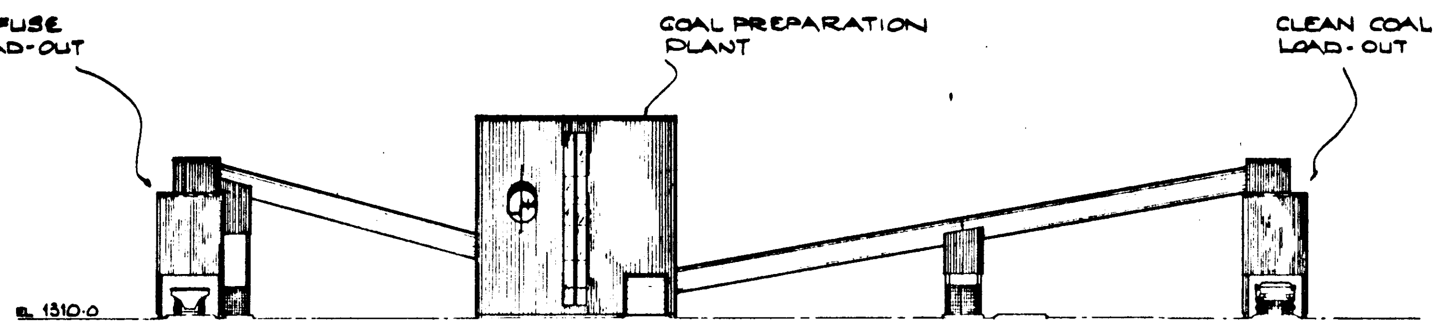
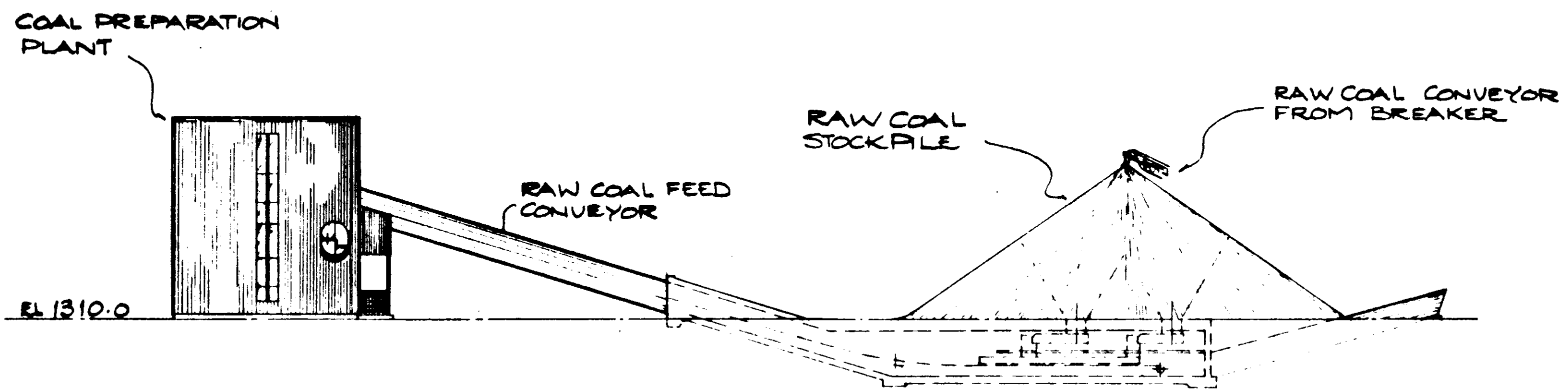


— ELEVATION — LOOKING NORTH



— ELEVATION — LOOKING EAST

DSGN.	DRAWN	CHECK	APPR.	ISSUED FOR	DATE	REV.	DESCRIPTION OF REVISION
WEL	KC						

CYPRUS ANVIL MINING CORPORATION
TULAMEEN PROJECT

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

COAL PREPARATION PLANT
NORTH & EAST VIEWS

SCALE: 1:500

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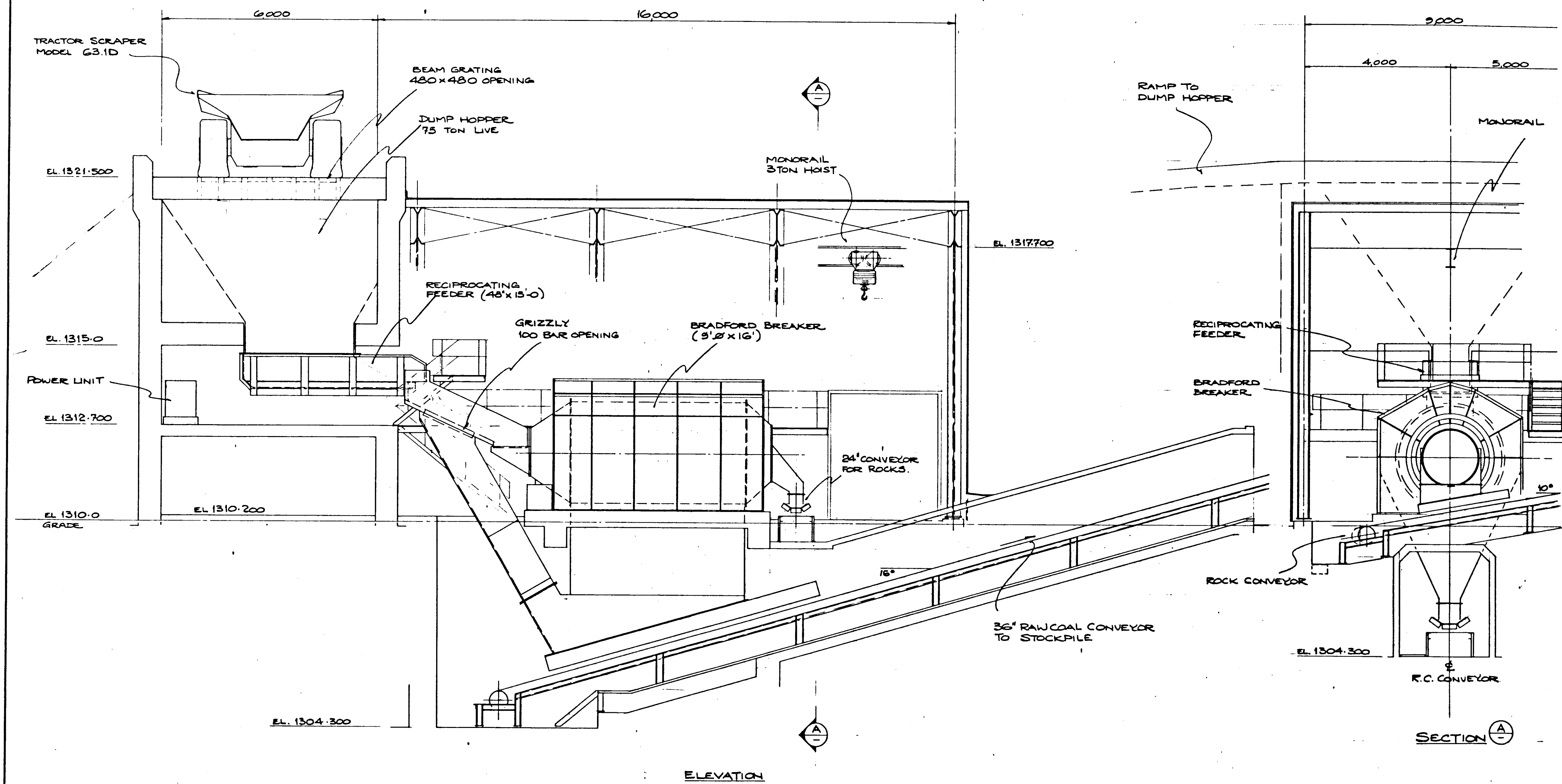

CYPRUS ANVIL MINING CORPORATION
TULAMEEN PROJECT

RAW COAL BREAKER STATION
GENERAL ARRANGEMENT
ELEVATION

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

DWG. NO. D 1117 200 1206

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

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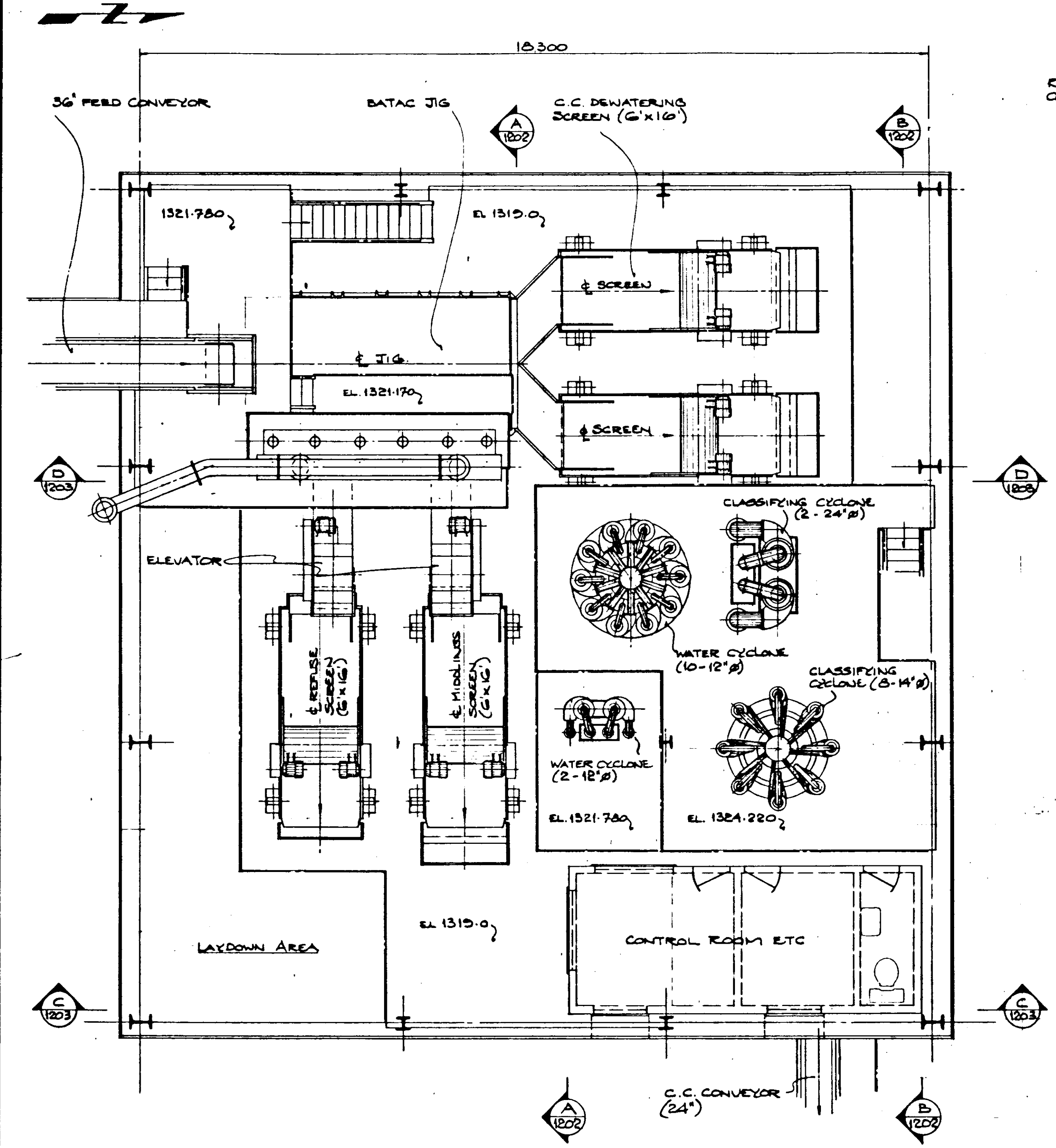
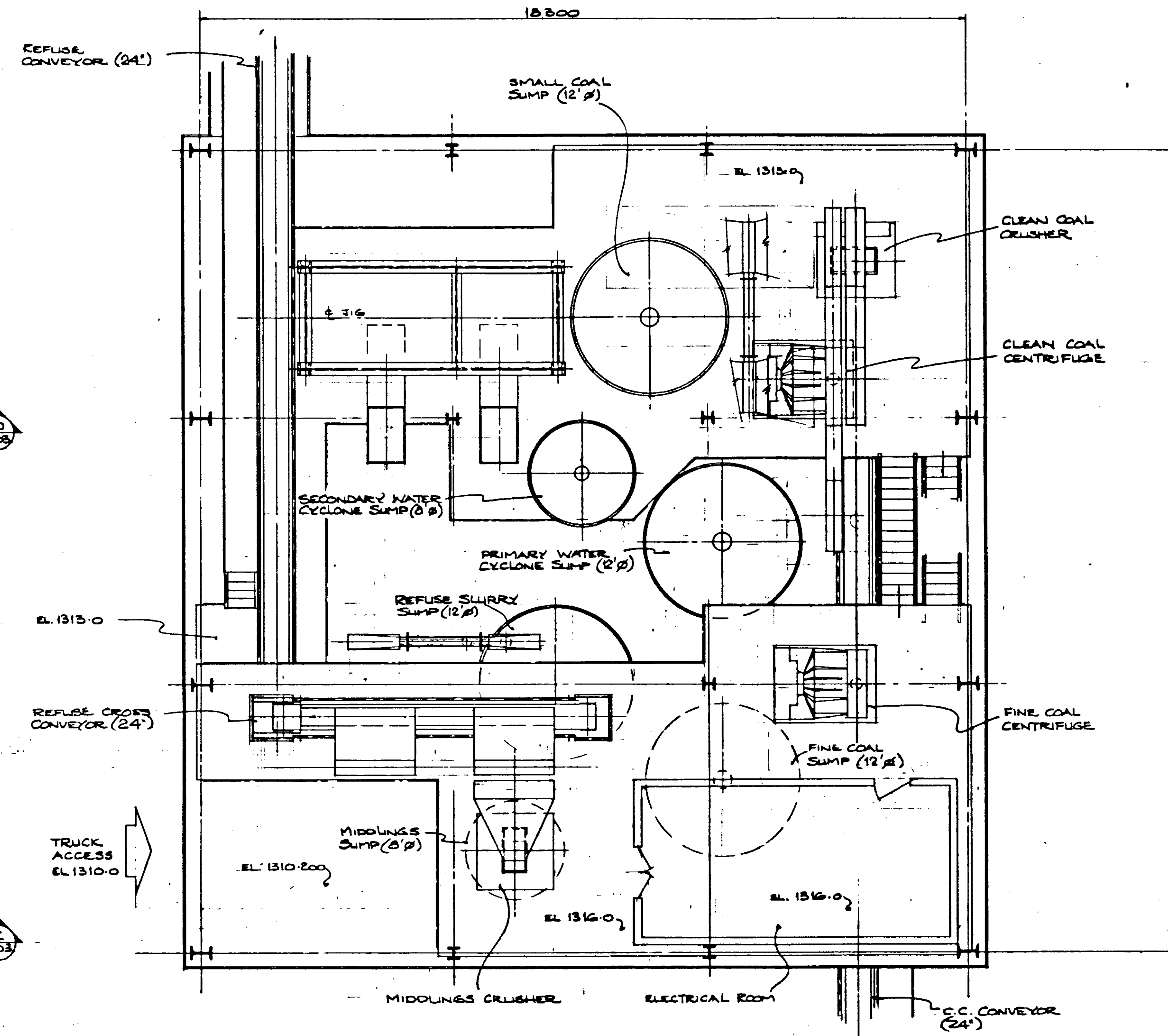


- PLAN - ABOVE EL 1324.220 LEVEL



- PLAN - ABOVE EL 1316.0 LEVEL

CYPRUS ANVIL MINING CORPORATION
TULAMEEN PROJECT

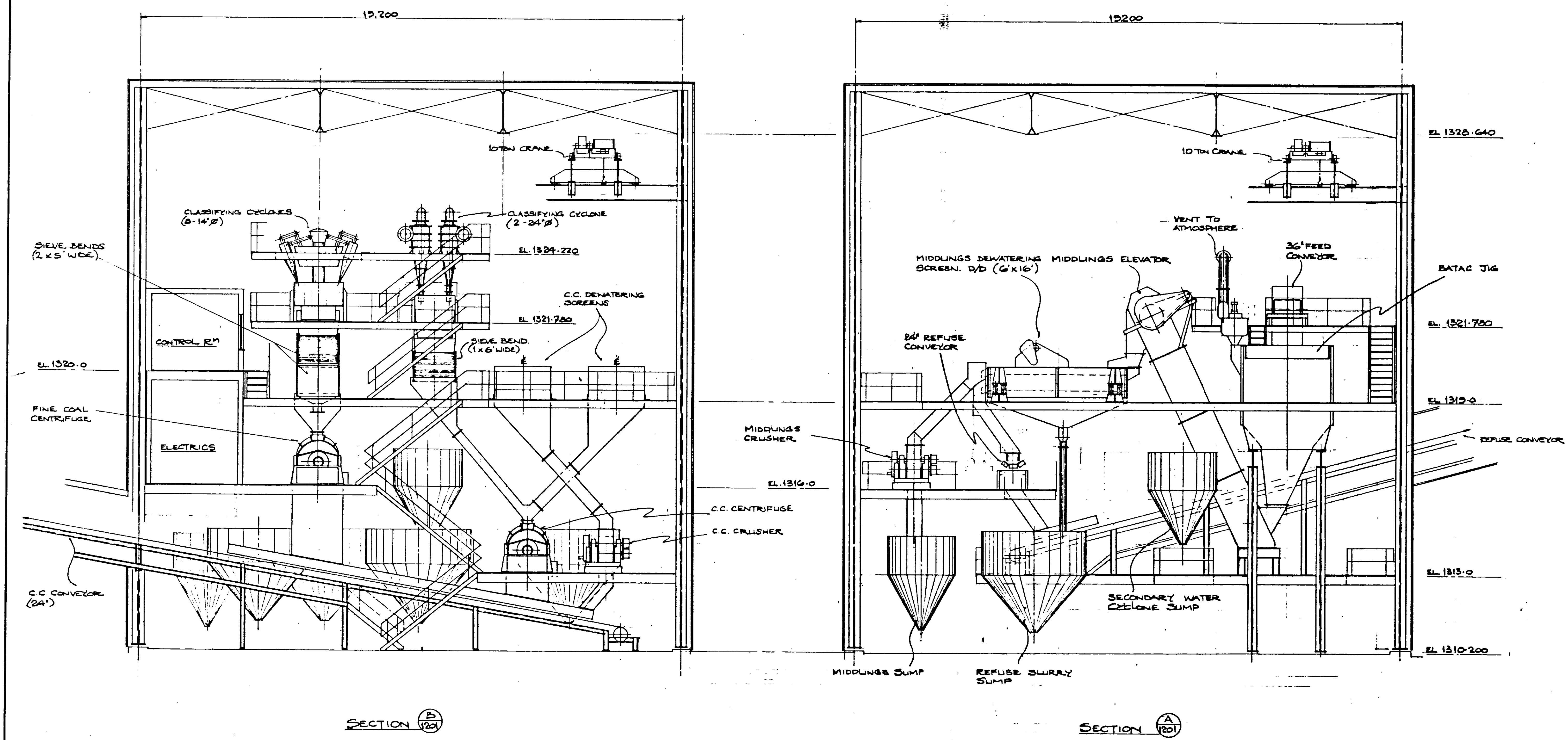
COAL PREPARATION PLANT
GENERAL ARRANGEMENT
PLANS

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

DWG. NO. D 1117 200 1207

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

SCALE:



CYPRUS ANVIL MINING CORPORATION
TULAMEEN PROJECT

COAL PREPARATION PLANT
GENERAL ARRANGEMENT
SECTIONS (SHEET 1 of 2)

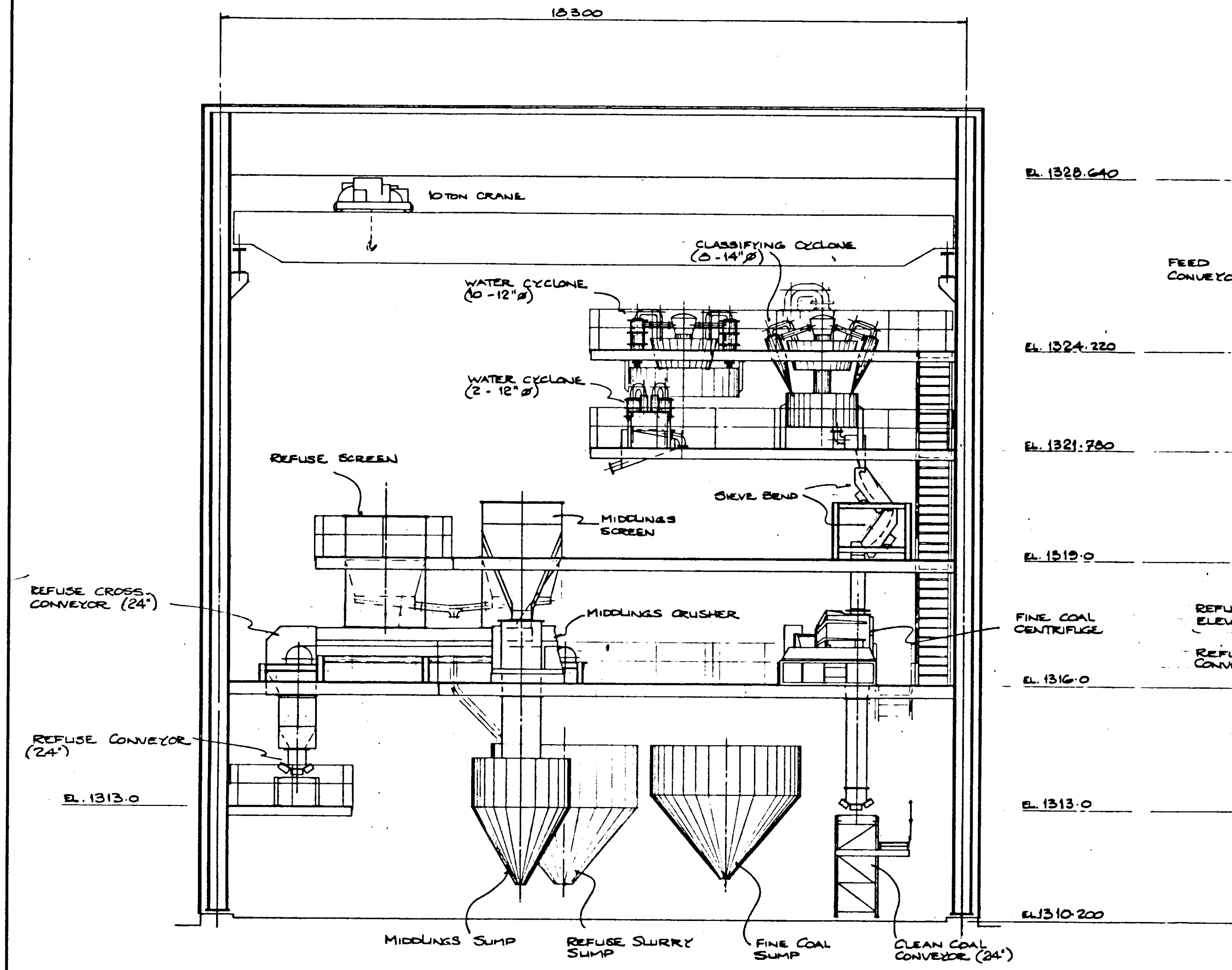
WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

DWG. NO. D 1117 200 1203

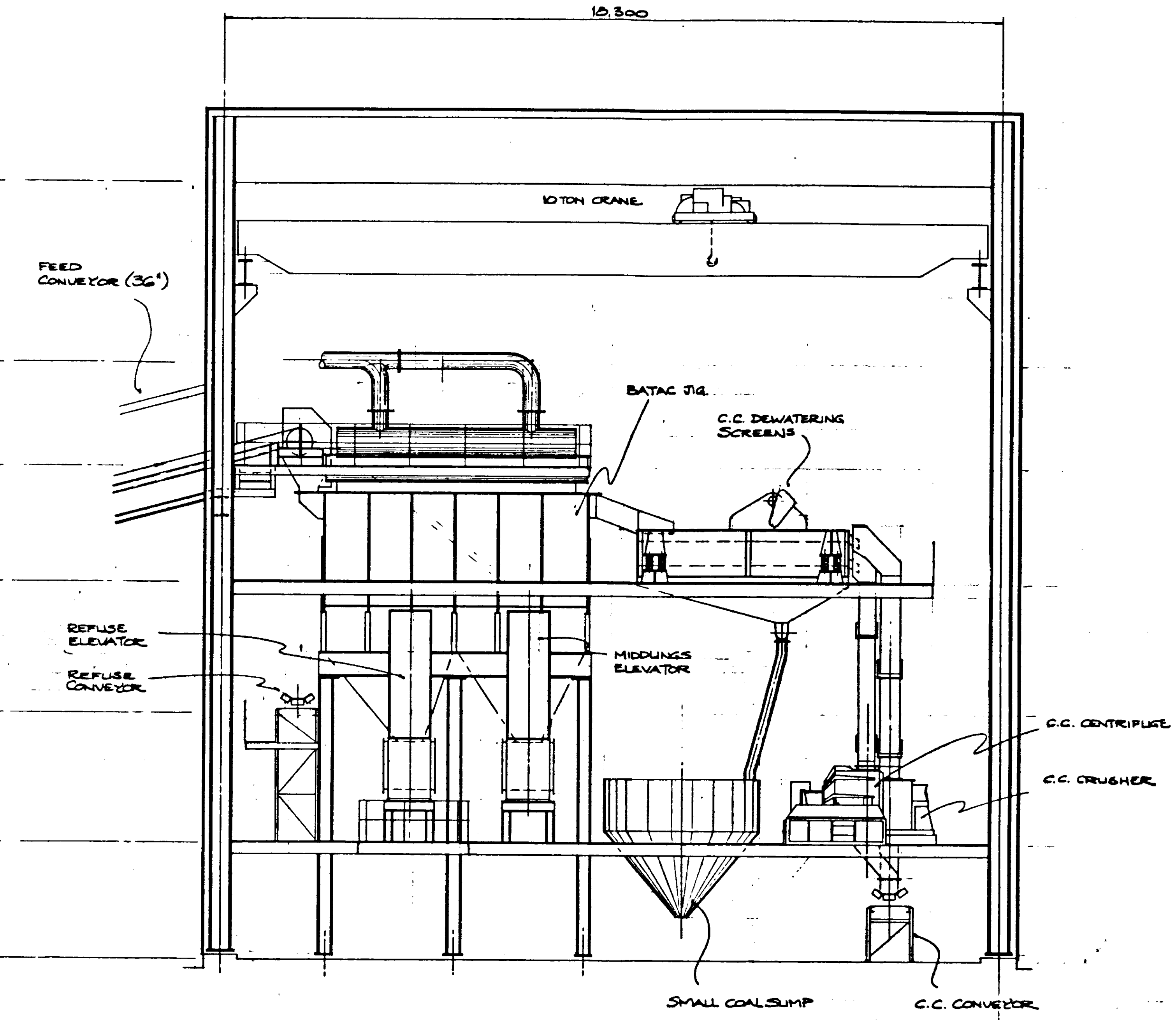
Design	Drawn	Check Dwg.	Check Design	Approval Division	Approval Project	Issued For	Date	Rev.	Description of Revision
WEL	K.C.								

REFERENCE

SCALE:



SECTION C/1201
(EXCLUDING ELECTRICAL & CONTROL ROOM)



SECTION D/1201

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

REFERENCE	NO.	DWG. NO.

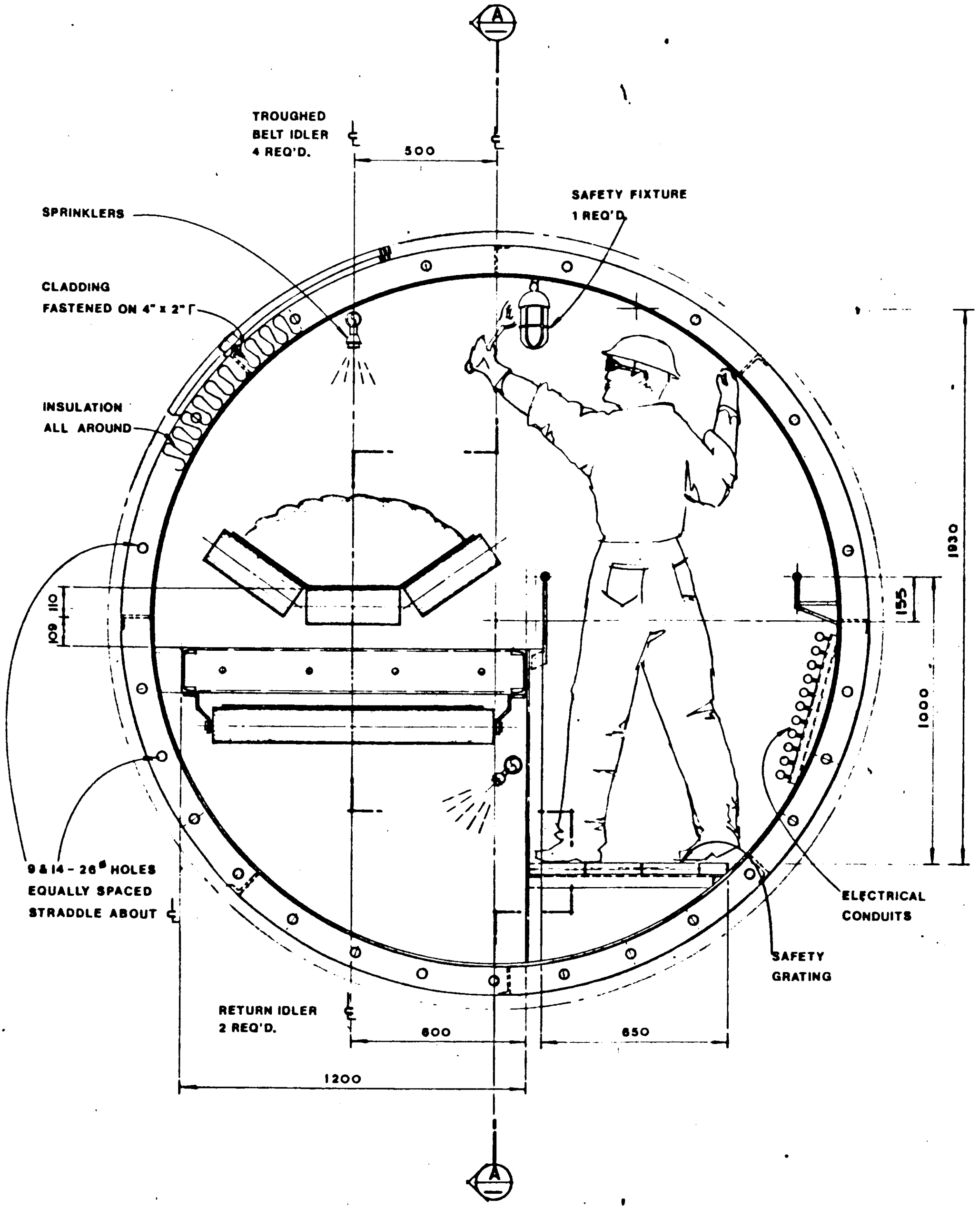
CYPRUS ANVIL MINING CORPORATION
TULAMEEN PROJECT

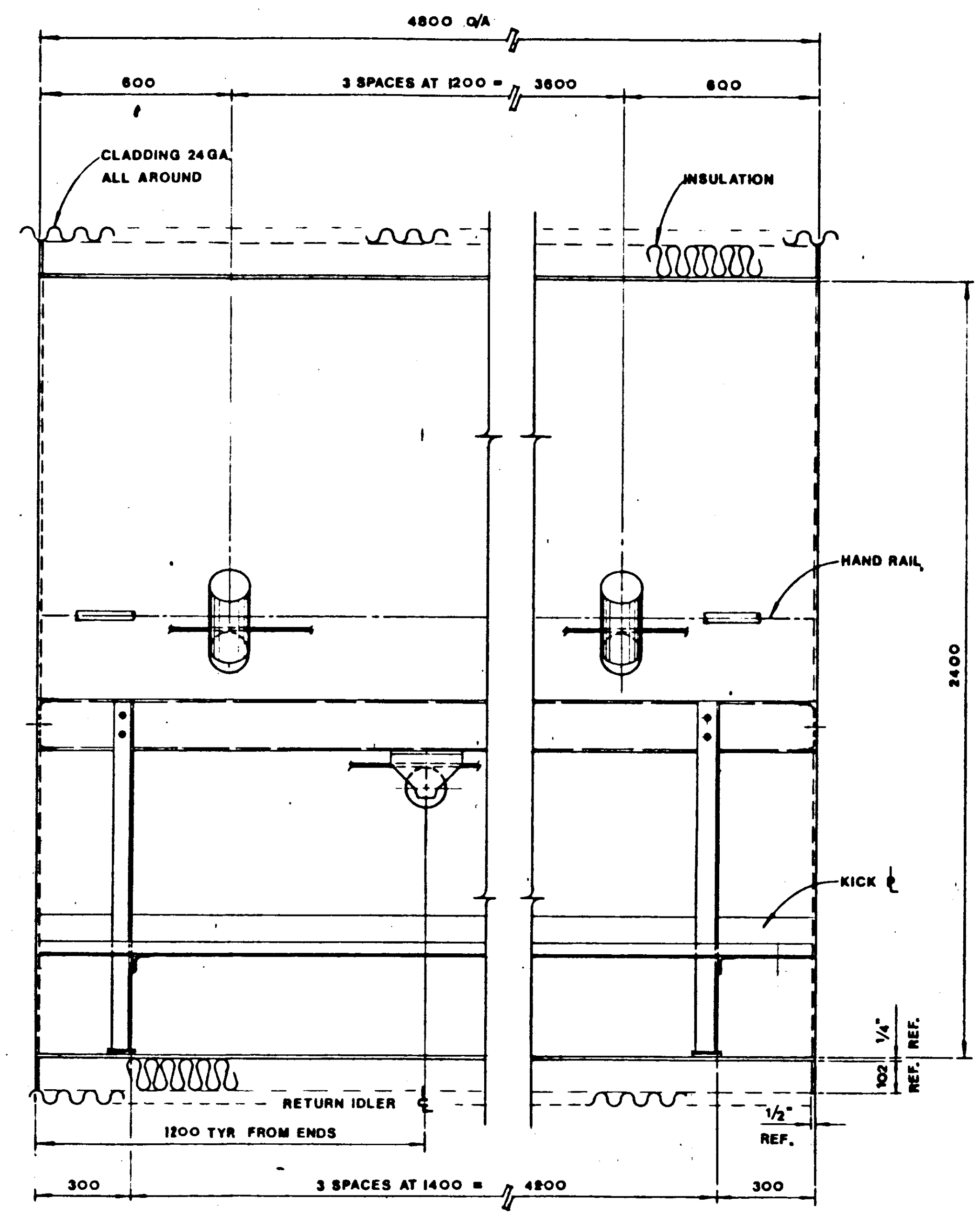
COAL PREPARATION PLANT
GENERAL ARRANGEMENT
SECTIONS (SHEET 2 OF 2)

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

SCALE:

DWG. NO. D 1117 200 1209





SECTION (A)

CYPRUS ANVIL MINING CORPORATION
TULAMEEN PROJECT

CONVEYOR GALLERY
TYPICAL ARRANGEMENT
SECTIONS

Design	Drawn	Check Dwg.	Check Design	Approval Division	Approval	Issued For	Date	Rev.	Description of Revision
	K.R.L.M.				T.O.		MARCH 1981		

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

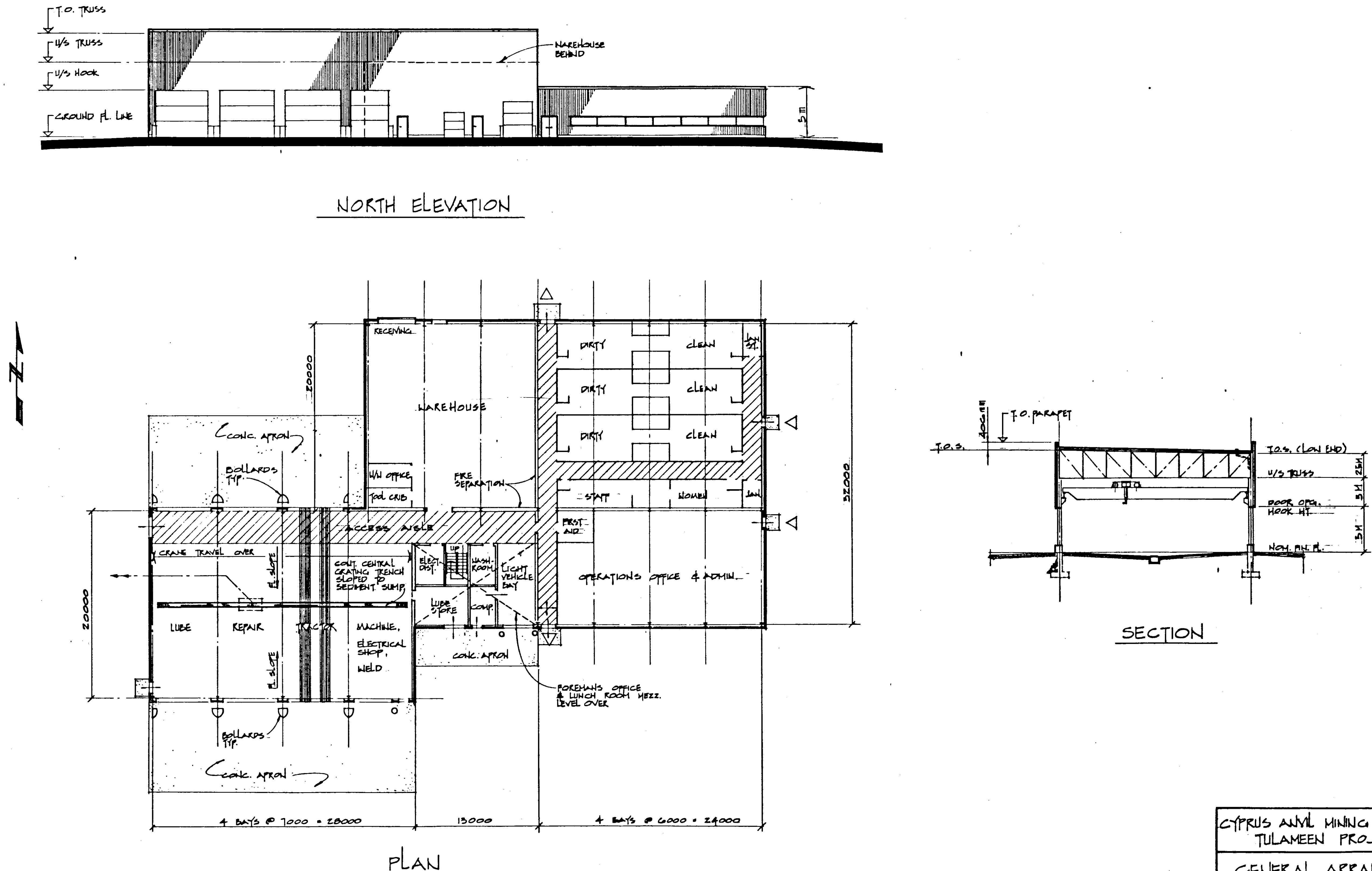
Reference	No.	Dwg. No.

Reference	No.	Dwg. No.

SCALE:

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

DWG. No. D 1117 200 1210



CYPRUS ANVIL MINING CORPORATION
TULAMEEN PROJECT

GENERAL ARRANGEMENTS
SHOP • WAREHOUSE
DRY • OFFICE

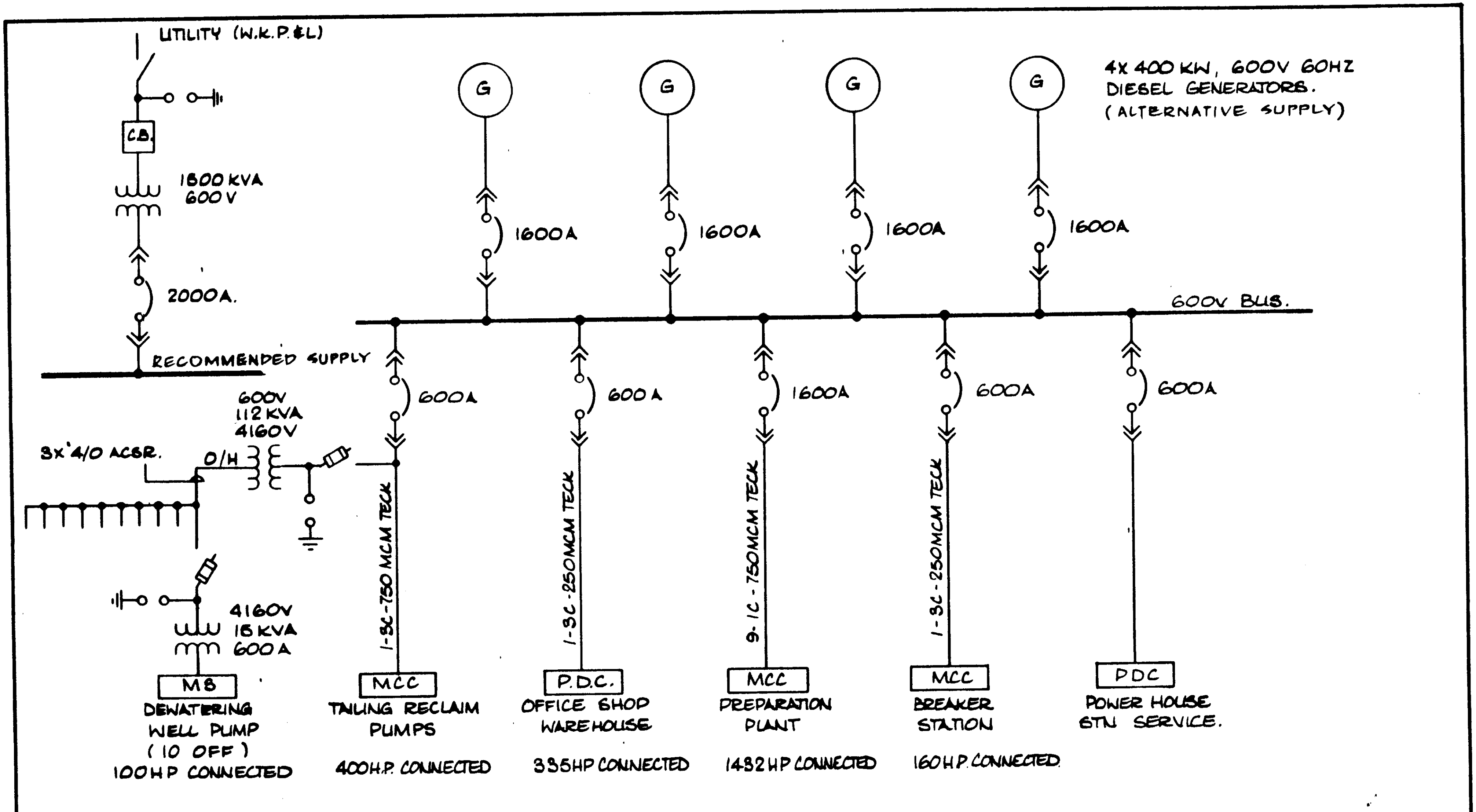
WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

DWG. NO. D 1117 200 1211

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

REFERENCE	NO.	DWG. NO.	REFERENCE	NO.	DWG. NO.

SCALE:



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

CYPRUS ANVIL MINING CORP
TULAMEEN PROJECT.

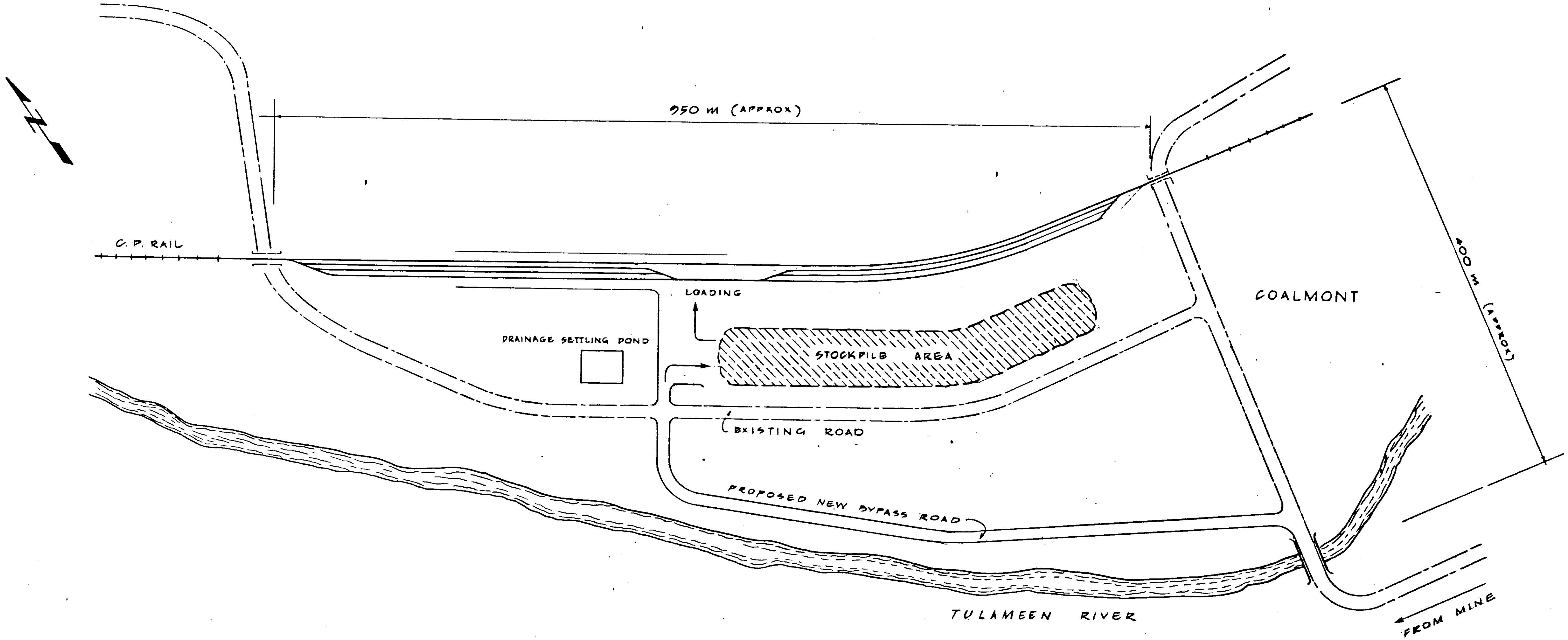
ELECTRICAL SINGLE LINE DIAGRAM.

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

SCALE:

DRAWING No. B 1117 200 1212.

REV.



PLAN- COALMONT AREA

(DO NOT SCALE)

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

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: —

CYPRUS ANVIL MINING CORPORATION
TULAMEEN PROJECT

COAL LOADING FACILITIES
COALMONT RAILHEAD

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

DWG. NO. D 1711 200 1213