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WOLLONDILLY SHIRE COUNCIL

Administration Centre, 62-64 Menangle Street, Picton, N.S.W. 2571

16 December 1985

The Manager,
Clutha Development Pty Limited,
19-29 Queen Street,
NARELLAN N.S.W. 2567

Dear Sir,

Wollondilly Shire Council - N.S.W. Environmental Planning & Assessment Act, 1979. Interim Development Order No. 17 - Wollondilly Development Application No. 190/85

Applicant:	Clutha Developments Pty Limited
Address:	19-29 Queen Street, Narellan
Date of Application:	1 November 1985
Premises:	Portion 16 Parish of Bargo County of Camden Remembrance Driveway, Bargo (Tahmoor Colliery)
Brief Description of Proposal:	Surface civil and mechanical work for gas extraction from Tahmoor Mine

In pursuance of its power under the abovementioned order, the Council, as the Responsible Authority, resolved at its meeting held on 10 December 1985, to grant approval of the abovementioned application, subject to the following conditions which are hereby imposed to protect the amenity of the neighbourhood and so that the use will not be contrary to the public interest, viz

1. The development being carried out substantially in accordance with plans received by Council on 1 November 1985 except where amended by the conditions of consent.
2. The applicant is to satisfy the requirements of the State Pollution Control Commission with regard to approval under Section 27 of the Noise Control Act, evidence of such approval is to be submitted to Council prior to commencement of the operation.

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3. The erection of any structure shall be the subject of a building application accompanied by the proper plans and specifications prescribed by Ordinance 70 and the payment of the relevant building fees.

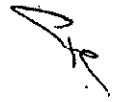
4. Submission of licences and approvals from the State Pollution Control Commission under the provisions of the Clean Air Act, if required to be obtained.


5. The applicant being informed that this approval shall be regarded as being otherwise in accordance with the information and particulars set out and described in the development application registered in Council's records as Development Application No. 190/85 on 1 November 1985 and that any alteration, variation or extension to the use for which approval has been given would require further development approval.

Should you feel aggrieved by Council's decision in this matter, or object to the conditions imposed, you are entitled to lodge an appeal with the Land and Environment Court of N.S.W. within twelve (12) months of the date appearing above. Forms for such are obtainable from the Court of Petty Sessions at your request.

You are further advised that this approval will expire if the development is not commenced within two (2) years of the date appearing above unless an application for extension is approved by Council.

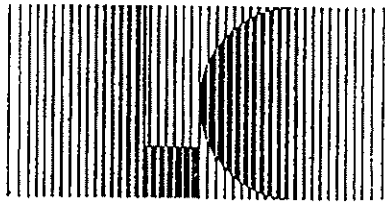
Yours faithfully,


G.T. CLARKE
SHIRE CLERK


fj 18/12

STATEMENT OF ENVIRONMENTAL FACTORS

1. Description of site in current condition: THE SITE IS AT PRESENT COVERED BY A WASHERY REJECT MOUND.
2. Description of region surrounding site: THE SITE IS WITHIN THE TAHMOOR MINE SITE, LOCATED IN SCRUB/REGROWTH AREA.
3. Will project involve demolition or alterations to any building? Give details (including age of building): NO
4. Will the project result in permanent destruction of vegetation or will it significantly effect any natural features of the site?: NO, THE MINE AREA HAVING BEEN CLEARED AT TIME OF ESTABLISHMENT OF MINE.
5. Give details of effluent produced, whether solids, liquids, gases, particulars. Give details of disposal: GAS; MIXTURE OF AIR, CH₄, CO₂ + SOME WATER VAPOUR: VENTED TO ATMOSPHERE.
6. Will the project produce any odour beyond the boundaries of the site? Give details: NO ODOUR.
7. Will the project produce any noise beyond the boundaries of the site? Give details: REFER 'ACOUSTICAL ASSESSMENT OF PROPOSED GAS EXTRACTION PLANT' BY LOUIS A. CHALLIS & ASSOCIATES PTY. LIMITED.
8. Give details and estimates of the traffic volume produced by the development: NO ADDITIONAL LONG-TERM TRAFFIC; SOME CONSTRUCTION TRAFFIC (SAY 15 MEN ON SITE FOR 14 WEEKS)
9. Will the project require amplification of utility services? NO.
10. Will the project produce any impact on the environment not described above, or may contribute to pollution of environment or the defacement or deterioration of the environment? NO.



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D F Craig BE

REPORT NO. 5075-1-85

ACOUSTICAL ASSESSMENT OF PROPOSED

GAS EXTRACTION PLANT

AT TAHMOOR COLLIERY

Prepared for and on behalf of :

B.P. Coal Australia
110 Alfred Street
MILSONS POINT 2061

21st October 1985

Measurement, Research and
Development in Acoustics,
Noise Control, Vibration Control,
Air Diffusion, Electro-Acoustics
and Environmental Impact Studies

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1. INTRODUCTION

This report presents the results of a detailed acoustical assessment of a proposed gas extraction plant to be located at the existing B.P. Coal Australia Tahmoor Colliery.

The assessment is based on a series of ambient sound level measurements conducted outside the nearest residents to the Colliery on the evening of 30th September, 1985. Noise level predictions were carried out to determine the likely noise levels at this location as a result of the operation of the proposed plant.

A series of recommendations are contained in this report to ensure that the noise emission levels are maintained within acceptable limits.

2. DESCRIPTION OF THE SITE AND THE PROPOSAL

The existing Tahmoor Colliery is situated on the old Hume Highway to the south of Tahmoor on a site which is buffered by land owned by the Colliery. The nearest residence is situated on a side road running off the Hume Highway approximately 400 metres north of the northern boundary of the Colliery site, and approximately 100 metres from the Highway. This is an isolated residence and there do not appear to be any other residences in the immediate area.

The proposed gas extraction plant would be situated on the Colliery site just inside the northern boundary and approximately 500 metres from the Hume Highway boundary. The proposed plant would therefore be at a distance of approximately 500 metres from the nearest residence. The plant area would be screened by an existing earth berm which would be excavated to create space for the plant. This berm presently runs from the plant site towards the Hume Highway boundary. A new earth berm would run along the northern boundary, as shown in plan view in Figure 1, and in cross-section in Figure 2. The plant itself would consist of the following primary noise producing items:

(i) Two (2) vacuum pumps rated as follows:

• 75 kW, 2350/m³ per hour, 40 kPa

• 110 kW, 5500/m³ per hour, 40 kPa

These would extract gas from underground areas and discharge through 15 metre high stacks of diameter 450 mm, incorporating flame arrestors consisting of perforated metal

- (ii) Cooling tower with forced draft fan rated at 7.5 kW, standing about 3 m high.
- (iii) Small air compressor rated at 7.5 kW, 850 l/min, 680 kPa.

The plant is proposed to operate on a 24 hour basis.

3. MEASUREMENT PROCEDURE

A detailed series of measurements of existing ambient sound levels was carried out on the side road adjacent to the nearest residence on the evening of 30th September 1985, between the hours 9:25pm and midnight. The measurements were carried out in the form of 10-minute statistical samples in which sound levels were recorded as percentile noise levels in decibels A-scale re 20 micropascals. The statistical indices recorded were as follows:

- $L_{0.1}$ - Sound level exceeded for 0.1% of the sample period, representing the typical maximum sound levels.
- L_{90} - Sound level exceeded for 90% of the same period, representing the mean minimum sound level commonly referred to as the "background sound level".
- L_{eq} - Equivalent continuous (constant) sound level

Simultaneous graphic level recordings were made to illustrate the sound levels of individual events in each noise sample.

Weather conditions were fine during the measurement period with almost no wind.

The results of the ambient noise level measurements are presented in Appendix No. 1 as Chart Recordings and Appendix No. 2 as a Histogram of statistical levels.

Details of the measurement equipment are presented in Appendix No. 3.

4. ACOUSTICAL ASSESSMENT

4.1 Existing Ambient Sound Levels

The existing ambient sound levels shown in Appendix No. 1.1 and 1.2 were dominated by the traffic on the old Hume Highway and the presence of frogs which created intermittent noise during the evening. The existing Colliery operations were audible at levels 35-40 dB(A) during the evening. Consistent rail traffic was also evident on the main southern line to the east. The $L_{0.1}$ levels shown in Appendix No. 2 varied between 63-74 dB(A) and were related to the peaks of noise from passing traffic. The L_{eq} levels ranged between 48-56 dB(A) and were largely determined by the noise of the traffic, trains and frogs. The L_{90} noise levels, ranging between 35-41 dB(A) were primarily determined by the noise of the Colliery.

4.2 Noise Criteria

Since the type of noise produced by the proposed gas extraction plant would be essentially constant in nature, the normal criterion which we would adopt for 24 hour operation is that the constant noise of the proposed plant, without pronounced tonal components, should not exceed the existing L_{90} noise level by more than 5 dB(A). However, in cases such as the present one where the L_{90} noise levels are already dominated by the noise of the existing Colliery operations, we believe it is appropriate to design the plant such that the noise level of the proposed section of plant would be 5 dB(A) below the existing background noise level, in order to minimise the "creeping noise" phenomenon.

The lowest L_{90} noise level recorded during the measurement period was 35 dB(A) at about 9:30 pm. Consequently a design criterion of 30 dB(A) for the gas extraction plant noise has been selected as the criterion for this study.

Apart from the constant noise of the cooling tower, compressor and pumps, there is a possibility of occasional gas venting through high pressure valves.

We would recommend that a criterion level of 50 dB(A) maximum should be adopted for the noise of gas venting at the nearest residence. This level is less than the existing $L_{0.1}$ levels measured at the nearest residence, and is consistent with the minimisation of sleep disturbance.

4.3 Noise Level Predictions

Noise level predictions were carried out for the nearest residences for 2 groups of sound sources in the proposed gas extraction plant as follows :

Group 1 Cooling tower compressor and pump casing noise.

Group 2 Vacuum pump stack discharge noise.

Source Group 1 is assumed to be at 2 metres above ground level whilst Source Group 2 is assumed to be at the top of the stacks 15 metres above ground level. The sound power levels for Source Group 1 were based on Mineco Specification No. M-TC-10 Section 3.21, which specifies that the "maximum acceptable noise level from any piece of equipment shall be 85dB(A) at 1 metre from the external surface of the equipment". Source Group 1 would be effectively screened by the proposed earth berm shown in Figure 2.

In the case of Source Group 2, there is limited data available for the prediction of the discharge sound power level of high pressure vacuum pumps. The basis of our predictions has been the Flakt type HDBB blower data, which would indicate an overall A-weighted sound power level of approximately of 116dB(A) for the larger of the 2 vacuum pumps and 115dB(A) for the smaller unit. The effect of the flame arrestors in the discharge line from each of the vacuum pumps is estimated to result in a reduction of approximately 6 dB(A) in the discharge noise. The elevation of the discharge stacks is such that the noise from this source will not be attenuated by the earth berms around the gas extraction plant.

Octave band sound power levels were determined for each of the sound Source Groups and the octave band sound pressure levels computed for a distance of 500 metres taken into account the following effects:

- Attenuation with distance.
- Air absorption.
- Barrier attenuation provided by earth mounds, (applying to Source Group 1 only).
- Directivity effects at discharge stacks.

Details of the computations are presented in Appendix No. 4 to this report.

The results of the computations show that the sound level component from Source Group 1 would be acceptable at the nearest residence in terms of the 30 dB(A) design criterion outlined in Section 4.2 above. This is contingent upon the achievement of the Minenco Specification calling for a sound level of 85 dB(A) at 1 metre from the individual plant items. The proposed earth berm along the northern boundary would result in a significant attenuation of approximately 10 dB(A) in the level of sound from this Source Group (see Appendix 4).

The computations for the discharge noise from the vacuum pumps (Source Group 2) indicates that silencing of the discharge would be required in order that the design criteria be met, and a design goal for this noise component is specified in Section 5 below.

No noise predictions were carried out for the case of gas venting, as this tends to be difficult to predict. However, the provision of vent silencers is a relatively simple matter, which is dealt with in Section 5 below.

5. RECOMMENDATIONS

5.1 Vacuum Pump Discharge

The discharge of each of the vacuum pumps shall be provided with the appropriate silencing such that the in-duct discharge sound power level shall not exceed the following levels:

Octave Band Centre Frequency (Hz)	63	125	250	500	1k	2k	4k	8k
In-Duct Discharge Sound Power Level, dB re 10-12W.	113	105	98	96	93	88	85	75

5.2 Gas Venting

The gas venting valves shall be provided with silencers such that the sound pressure level at a distance of 1 metre from the valve shall not exceed 100 dB(A) maximum during venting.

6. CONCLUSION

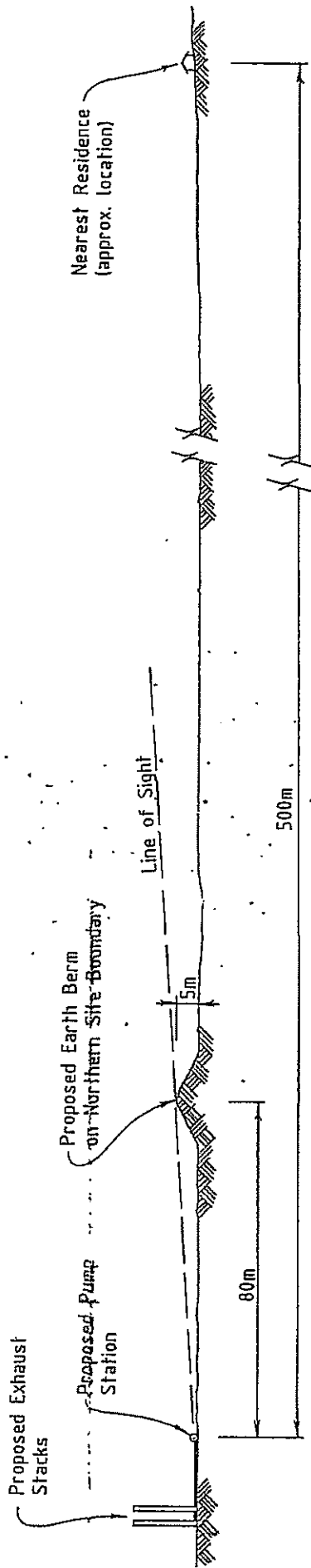
Our analysis of the proposed gas extraction plant to be constructed at the B.P. Coal Australia Tahmoor Colliery shows that provided the Minenco Specification for noise levels of individual items of equipment is complied with, and provided that the recommendations presented in Section 5 of this report are satisfactorily implemented, then the noise levels at the nearest residence would be maintained within acceptable limits.

John D. Macpherson

John Macpherson
5489A/300A/5075

Encl. Appendices 1-4

CROSS SECTION THROUGH PROPOSED GAS EXTRACTION SITE
SHOWING BARRIER CREATED BY PROPOSED EARTH BERM

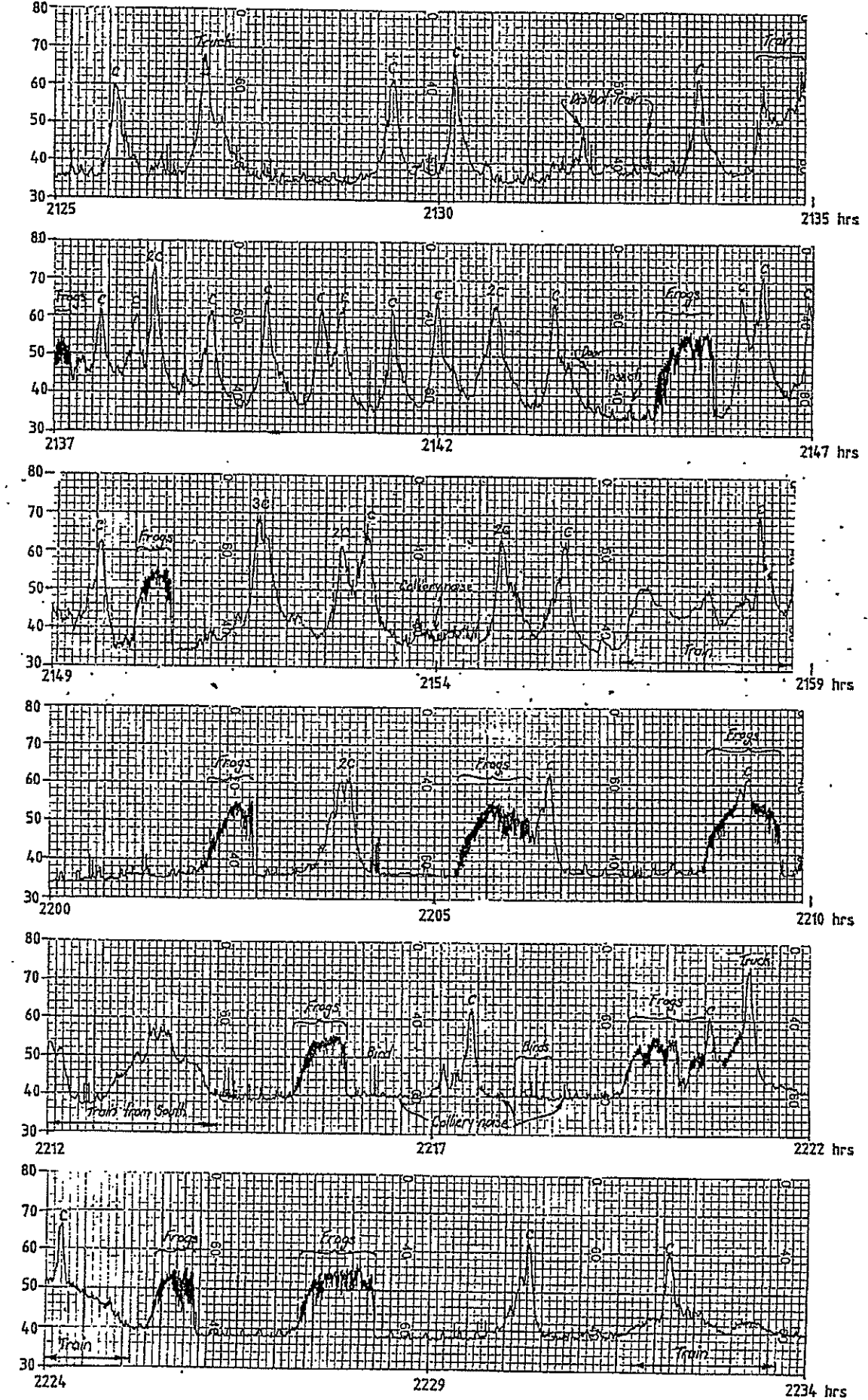


SECTION A-A
(FIGURE No:1)

EXISTING AMBIENT SOUND LEVELS
 OUTSIDE NEAREST RESIDENCE TO TAHMOOR COLLIERY
 EVENING OF 30th SEPTEMBER, 1985

Report No: 5075-1-85
 Appendix No: 1.1

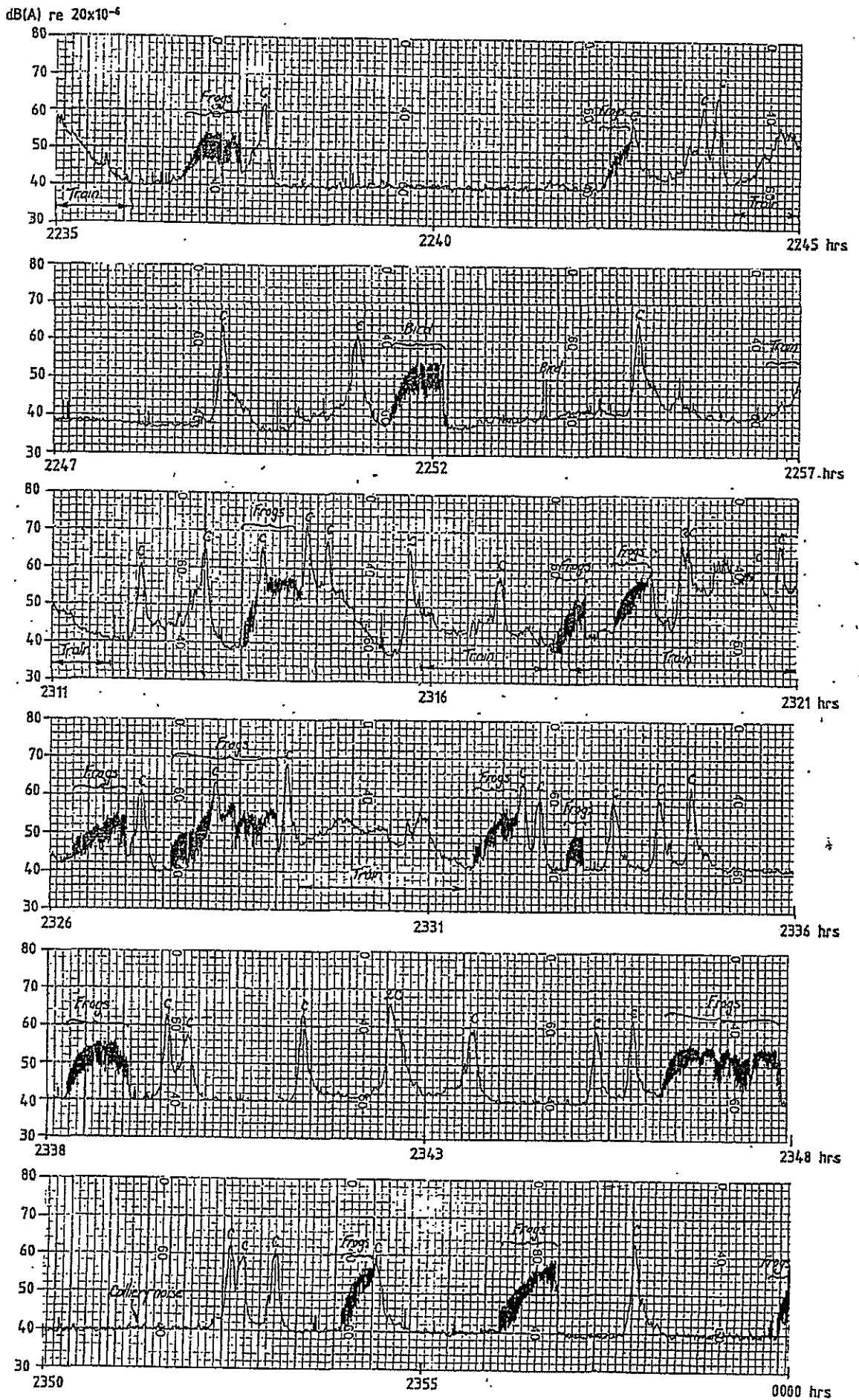
dB(A) re 20×10^{-5} Pa



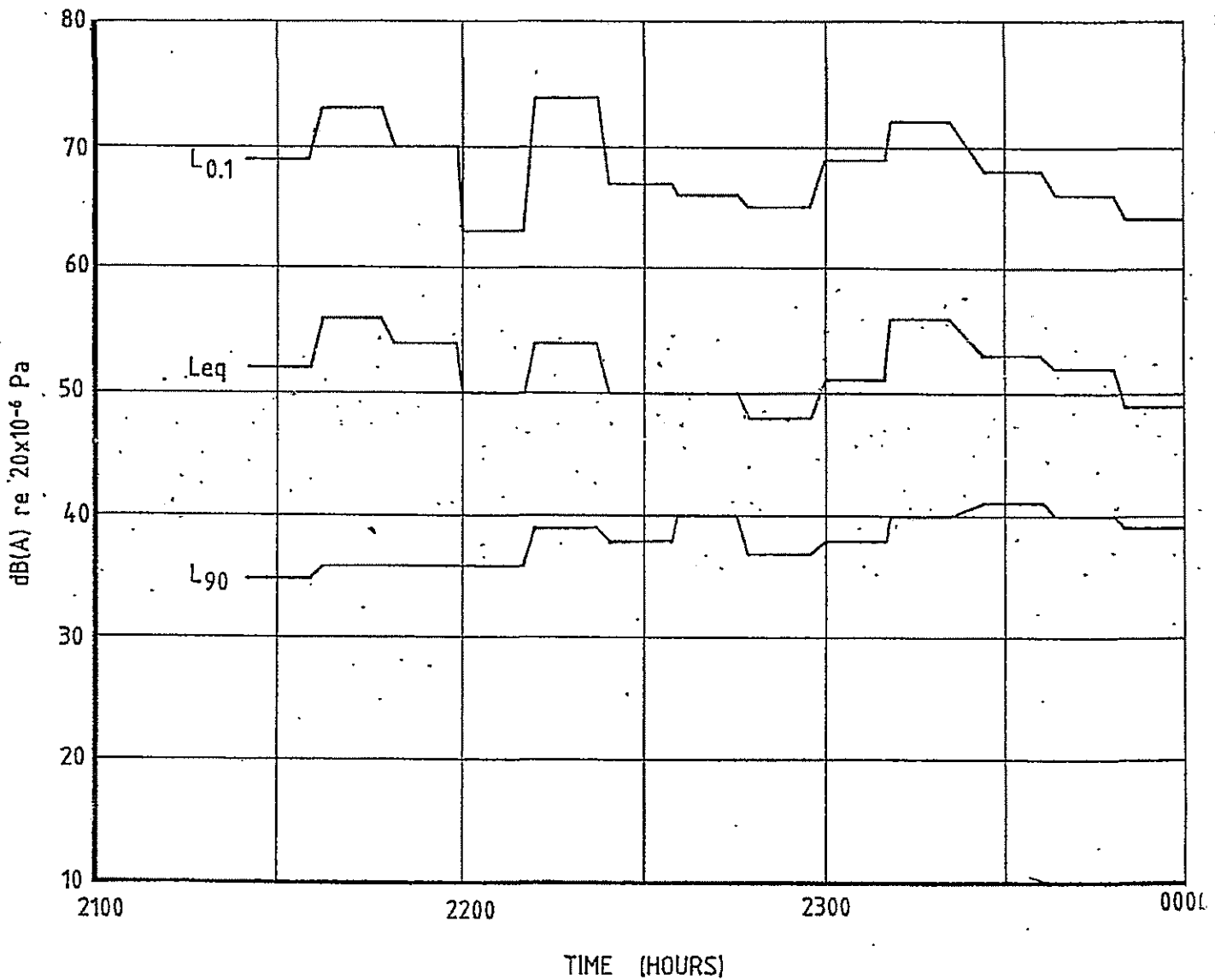


EXISTING AMBIENT SOUND LEVELS
OUTSIDE NEAREST RESIDENCE TO TAHMOOR COLLIERY
EVENING OF 30th SEPTEMBER, 1985

Report No: 5075-1-85
Appendix No: 12



STATISTICAL ANALYSIS OF EXISTING AMBIENT SOUND LEVEL OUTSIDE NEAREST RESIDENCE TO TAHMOOR COLLIERY EVENING OF 30th SEPTEMBER, 1985



L_{0.1} - Equals sound level exceeded for 0.1% of sample period.

L₉₀ - Equals sound level exceeded for 90% of sample period.

Leq - Equivalent continuous (constant) sound level.

Report No. 5075-1-85
Appendix No. 3

DETAILS OF MEASUREMENT EQUIPMENT

Community Noise Analyser	Genrad Type 1945
Microphone	Genrad Type 1971-9605
Windscreen	Brüel & Kjaer type UA0207
Chart Recorder	Linear type 142
Acoustic Calibrator	Brüel & Kjaer type 4230

This equipment has been calibrated in our laboratory for frequency response, linearity of digital read-out and accuracy of statistical computation. The reference level was checked before and after measurements using the acoustic calibrator and remained within the range 94 ± 1 dB(A).

Report No. 5075-1-85

Appendix No. 4

DETAILS OF NOISE LEVEL PREDICTIONS

Octave Band Centre Frequency (Hz)	63	125	250	500	1k	2k	4k	8k	dB(A)
<u>Source Group 1</u>									
Cooling Tower L _w , dB	99	99	96	93	89	86	83	75	95
Vacuum Pumps L _w , dB	-	88	94	91	92	91	88	79	96
Compressor L _w , dB	97	97	94	91	87	84	81	73	93
TOTAL L _w , dB	101	101	99	97	95	93	90	81	100
Distance and air Attenuation, dB	62	62	62	62	64	67	72	82	-
Barrier Attenuation, dB	7	8	9	10	12	14	16	18	-
Sound Level at nearest residence, dB	32	31	28	25	19	11	2	-	26
<u>Source Group 2</u>									
Vacuum pump discharge (specified) L _w , dB	116	108	101	99	96	91	88	78	103
Attenuation of flame arrestors, dB (estimate)	0	3	5	7	6	5	4	2	-
Distance and air Attenuation, dB	62	62	62	62	64	67	72	82	-
End Reflection, dB	13	7	3	0	0	0	0	0	-
Stack directivity, dB	0	0	1	3	5	7	9	11	-
Sound level at nearest residence, dB	41	36	30	27	21	12	3	-	28

D80004/018

ENGINEERING SERVICES
CLUTHA DEVELOPMENT PTY. LTD.

PLANS AND SPECIFICATION
FOR
SURFACE CIVIL AND MECHANICAL WORK
FOR GAS DRAINAGE
AT
TAHMOOR MINE

CLUTHA DEVELOPMENT PTY. LIMITED
19-29 QUEEN STREET,
NARELLAN, NSW, 2567

SEPTEMBER, 1985

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1.1 MINE OPERATIONS BACKGROUND

Tahmoor Mine is located inland, between Woollongong and Sydney.

Underground coal mining is carried out.

The coal seams contain quantities of gas.

This gas poses a threat due both to its asphyxiant properties, and to its explosion potential when mixed with air.

A network of gas drainage holes will therefore be drilled from the underground workings into the coal and surrounding strata, and connected to a suction pipe network served by an above-ground vacuum pump station.

A second similar drainage system will remove gas from a different underground area not requiring suction. It will emerge via a separate borehole and separate discharge piping system also located on the vacuum pump station site.

The whole system is referred to as a "Mine Gas Drainage System".

The gas will either be vented to atmosphere via separate stacks or, subject to combustibles content, may in the future be recovered and usefully burnt.

The present specification concerns an above-ground Analyser Station monitoring the gas streams in the two separate discharge systems.

1.2 SCOPE OF WORK

1.2.1 General

In recognition of the need to consider Analysers, sampling, conditioning, calibration and housing/environmental aspects as interdependent, it is proposed to place all aspects of the Analyser System design through commissioning with a single Analyser supply company. This company may be invited to also offer on-going system service.

Each tenderer shall offer a conforming system, with such variations as he considers necessary as a pre-requisite for accepting responsibility for satisfactory functioning of the system overall.

Evaluation of tenders will be assisted by supporting comments relating to proposed variations.

Tenders should include cost of transport to site and cost of installing the building on a base provided by others.

Tenders should identify any components that are consumable or generally expected to have a service life of less than one year, and should recommend suitable site holdings of consumables and key spares, or confirm their ready availability from local stock.

Location and nature of service/backup facilities should be mentioned, and anticipated frequency and scope of normal service requirements should be discussed.

1.2.2 System Overview

The gas streams are to be sampled continuously from the above-ground discharge mains, where pressure will be at, or slightly above atmospheric. The analysers are to cycle between the two separate gas discharge systems, alternately selecting a sample from the two separate primary sample loops. Nominally 2 minutes on each stream is envisaged subject to response time constraints. A master changeover signal will be provided by the existing PLC system.

Separate analyses are required for METHANE, CARBON MONOXIDE, CARBON DIOXIDE, and OXYGEN.

The analysers shall be mounted inside an analyser hut, nominally of 3m x 4m size, or suitable supplier standard.

This hut shall be of transportable construction, and delivered to site with all analysers, sample transfer and conditioning, calibration, venting and condensate drainage and signal transmission provisions fully assembled and pre-tested.

The hut will be located nominally 10m from the 350mm dia. process suction mains, just outside the Zone II area, i.e. in the "non-hazardous area".

The analyses will be transmitted as 4-20mA signals to separately housed multichannel recorders and a PLC, provided by others, which will continuously calculate the upper explosive limit of the air-free mixture, and the degree to which the air content causes it to approach this condition.

Various status signals will also be transferred to the remote PLC.

1.2.3 Purpose of Analyses

The primary purpose of the analyses is to detect any tendency toward formation of explosive mixtures in the drainage system, and in that event the separately supplied PLC will automatically shut down and isolate the vacuum pumps, and bypass the gas direct to the vent stack. A search for the source of leakage will then be initiated, aided by analysis results available from other analyser stations at separate locations in the underground suction pipework system. (N.B. - these underground stations are mentioned for reference only, and are NOT related to the present specification for an above-ground analyser system).

The CO analysis is used as a warning of abnormal occurrence of combustion in the coal seams.

The above-ground analysis is also required for evaluation of fuel value potential, and general system operational surveillance.

1.3 WORK INCLUDED

The Contractor shall have demonstrated experience in, and shall be responsible for, all aspects of the design, supply, installation and commissioning of the Analyser System, including:-

- 1.3.1 Field sampling systems including all supports.
- 1.3.2 Sample pumping.
- 1.3.3 Sample conditioning.
- 1.3.4 Transportable analyser hut with air conditioner.
- 1.3.5 Four analysers.
- 1.3.6 Calibration gas system.
- 1.3.7 Bottled utilities gas systems if applicable.
- 1.3.8 Provision of comprehensive operating and maintenance documentation.
- 1.3.9 Transport to site and cost of installing the building on a base provided by others.
- 1.3.10 System commissioning.

REVISION 0

- 4 -

1.4 WORK EXCLUDED

1.4.1 Others will supply and install cables to the Analyser Hut, as follows, and terminate these to a power distribution board or signal terminal box provided with the Hut by the Analyser Supplier.

- (a) 240 VAC general supply for air-conditioner, Lighting, G.P.O.'s and possible future hot water unit for sample line tracing.
- (b) 240 VAC from U.P.S. in Instrument/Switch Room for analysers and sampling system.
- (c) Multipair for 4-20mA analyser outputs.
- (d) Multipair for analyser and sampling system fault statuses, room temp. alarm, sample selection changeover signal, calibration initiate and calibration completed confirmation signal.
- (e) 3-core for L.E.L. methane detector head in Analyser Hut. (N.B. in this case only, the cable goes direct to the Methane detector head, not through the terminal box shared by the other signals).

The flameproof methane detector head will be "free issue" to the Analyser Supplier by the Principal.

- (f) Telephone.

1.4.2 Miscellaneous

- (a) Site compressed air may be available within 10-15m dependent on installation timetable, but is not suitable for instrument purging and will not be provided as a permanent service to the Analyser Hut.
- (b) Building footings/slab to be constructed by others, but specified by Analyser Contractor.

1.5 STANDARDS, CODES AND APPROVALS

- 1.5.1 Electrical work shall be carried out in accordance with the requirements of AS 3000.
- 1.5.2. The detailed design of the Analyser Facility will be subject to the approval of the Chief Inspector of Coal Mines, Dept. of Industrial Relations.

Approaches to the Department of Industrial Relations shall only be made through, or with the approval of the responsible Tahmoor Mine or BP Coal officer.

SECTION 2 - SERVICE CONDITIONS AND CRITERIA

2.1 PROJECTED GAS COMPOSITION AND OTHER PROCESS CONDITIONS

2.1.1 Composition

The major constituents of the gas, as present in the rocks, are CO₂ and METHANE, in variable proportions.

CO may be present at low ppm, but rises to some hundreds of ppm if combustion occurs in the coal seam. (This is an abnormal condition, but the primary purpose of the CO analysis will be to monitor such occurrences).

The gas will suffer dilution with air due to diffusion through the rocks and to a lesser extent through leaks into the suction pipework.

The proportion of air drawn in will vary with drainage system vacuum, typically being expected to be around 40% of the gas passing the Analyser Station.

When vacuum pumps are stopped, analysis requirements continue. Gas diffuses out of the rock more slowly, under its own pressure, and the proportion of air is expected to reduce to a low percentage.

Under abnormal conditions of excessive air in-leakage, air may constitute 60% (or more) of the mixture, and the resulting mixture may cross the UPPER EXPLOSIVE LIMIT boundary into the area of combustible mixtures.

Gas analysis will be required under all normal and abnormal conditions.

A typical analysis will be

42%	CO ₂	<u>Note:</u> For the Post-Drainage Borehole (unassisted by any suction), little, if any, air should be present and CO ₂ /Methane will be correspondingly higher.
18%	METHANE	
40%	AIR	
Low PPM CO		

2.1.2 Process Temperature

Typically 15 - 30°C

2.1.3 Process Humidity

Taken as saturated, but the moisture content predictions have been subject of considerably varied projections and will not be known with any degree of confidence until the system commences operation.

2.1.4 Contaminants

Quantitative data not available, but qualitatively the gas is expected to contain moderate amounts of dust.

2.1.5 Pressure

Normally in the range 0kPa to +4kPa, but may on occasion, go to +15kPa.

SECTION 3 - DESIGN AND CONSTRUCTION

3.1 ANALYSER FEATURES REQUIRED

3.1.1 Analyser Ranges (Nominal)

CO ₂	0 - 100%
CH ₄	0 - 100%
O ₂	0 - 25%
CO	0 - 1000 ppm

The availability of switch-selectable alternative ranges (e.g. nominally 0 - 50% for CO₂ and CH₄, 0 - 500 ppm for CO) would be well regarded, but is not mandatory).

3.1.2 Accuracy $\pm 1\%$ of span or better.

3.1.3 Front panel measurement display.

3.1.4 Linear 4-20mA output.

3.1.5 Suitable for sample compositions both outside and within the explosive limits.

3.1.6 Air purged case using fans or compressor provided with Analyser Hut. (Site compressed air is not suitable). Purge flow failure sensing, contributing to analyser fault status output, below.

3.1.7 Electrical wiring to comply with AS 3000.

3.1.8 Dry contact output for analyser fault status (opens on fault or loss of power).

3.1.9 Minimum cross-sensitivity to other stated components in the sample.

3.1.10 Sample flowrate indicator (e.g. rotameter) to each analyser and (if relevant), sample supply pressure gauge.

3.2 PERFORMANCE DATA REQUIRED WITH TENDER

Manufacturers standard data on:

- (a) Measuring principle.
- (b) Zero and span drift.
- (c) Repeatability.
- (d) Ambient and sample temperature sensitivity.

- (e) Exhaust and sample pressure sensitivity.
- (f) Sample flow and flow sensitivity.
- (g) Response speed.
- (h) Cross-sensitivity data.
- (i) Recommended calibration frequency and time/skill/facilities requirements.
- (j) Auto calibration capability, if applicable
- (k) Warm-up time.
- (l) Effect of sample moisture. Whether drying is mandatory/desirable.
- (m) Data concerning effect on analyser output of variation in case purge air.

3.3 CALIBRATION PROVISIONS

3.3.1 General

The Contractor shall offer a conforming calibration scheme or recommend suitable alternative calibration facilities, and incorporate these in his Analyser System design.

Factors which shall be taken into account in the system design are:-

- (a) Inherent analyser stability/calibration frequency needs.
- (b) Suspension of analyser-based plant control/alarm functions during calibration.
- (c) Analyser auto calibration capability.
- (d) Continuous remote surveillance of plant, but infrequent physical presence of personnel.
- (e) Existence of separate plant control PLC that will at least need to know when calibrations are in progress, but that could be further used to schedule and issue a master "calibration start" signal or possibly to exercise more detailed control of calibration stages, if necessary.

- (f) The separate analysers will probably each require their own separate calibration gas supply systems.
- (g) Cross-checking of analyses by the remote PLC is envisaged.

3.3.2 Conforming Analyser Calibration Scheme

The calibration scheme shall comply with the following:

1. The existing plant control PLC would issue a master "calibration initiate" signal.
 - (a) Based on a regular time schedule, and
 - (b) Based on the occurrence of apparent analysis discrepancies, or
 - (c) Based on a PLC control console manual request.

Since the PLC controls plant operation, it can select a calibration time that has the least adverse effect on plant process control/alarm functions.

Part of the PLC's normal function will be to continuously verify that CO₂, CH₄, (CO), and air (deduced from % O₂), together add up to 100% within a specified tolerance. If they do not, this can be used as a basis for initiating a calibration gas check, as listed above.

This cross-check too, of course, will be suspended during calibration.

The logging printer linked to the operator terminal of the plant control PLC will automatically log the occurrence of a calibration whether based on (a), (b) or (c).

2. On receipt of the master "calibration initiate" signal, control provisions within the analysers or separately supplied as part of the analyser system overall, will apply first zero gas and then span gas as suited to each separate analyser for an appropriate time interval.
3. The PLC will receive the 4-20mA analysis results. It will compare the initial low analysis and the subsequent high analysis

for each analyser with the calibrating gas composition values stored in the PLC, and it will issue this comparison to the logging printer of the operator terminal.

4. In those cases where there is too large a discrepancy between these values, an alarm is raised and the printout is more prominent.

It is now necessary to schedule a visit from a technician to carry out a manual calibration check and adjustment.

IT IS ASSUMED THAT THE ANALYSERS DO NOT HAVE SELF-ADJUSTING CAPABILITY.

If they do, then the above is varied to suit.

5. The analyser system issues a "calibration completed" signal to the PLC.

Note: Cabling to the Analyser Hut, and PLC interfacing, are based on this scheme.

The Analyser Tenderer must highlight any desired deviation from this scheme so that corresponding cabling/interfacing adjustments can be evaluated and later implemented.

3.4 CALIBRATING GAS STORAGE AND DISTRIBUTION

The Analyser Hut Design shall include an exterior bottle rack, making provision for one of each required calibrating gas on-line, and space for a spare unconnected bottle of each gas immediately next to each on-line bottle.

The attached Table 1 is a suggested selection of calibrating/testing gases, permitting span, zero and "typical" gases to be presented to each of the four analysers, yet using only four separate gas types in all. This selection is again subject to the Analyser Contractor's own experience and to discussion with a gas supplier such as C.I.G. Specialty Gases section, in regard to feasible gas compositions and trace components.

The following shall be complied with:

- 3.4.1 Bottles shall be secured in place, under a rain shelter roof.

- 3.4.2 Bottle locations shall be clearly labelled.
- 3.4.3 Bottles on-line shall be connected via a flexible connecting tube and rack-mounted isolating valve to a low capacity two-stage regulator with inlet and outlet gauges, set to deliver a low pressure comparable with normal sample delivery pressure at the analyser. An in-line relief valve shall be provided in a branch tee downstream of the regulator, to relieve excessive fault pressures to an elevated vent point clear of building openings. Relief valves shall carry an affixed engraved tag showing pressure setting.
- 3.4.4 Because calibration gas consumption is expected to be relatively low, no provision for low-pressure switches on gas bottles is specified. However, a flow-failure device at the inlet to each analyser should be provided, at a point common to flow of sample and calibrating gas.

This could take the form of a proximity pick-up on a rotameter float tube. This individual analyser sample failure signal would be commoned with other analyser fault statuses to provide a "per analyser" fault signal.

(Note that momentary sample flow "failure", e.g. on stream switching, can be accommodated by suitable remote PLC programming).

- 3.4.5 Each calibrating gas supply line shall be fitted with a manual three-way valve as close as practical to each analyser inlet connection.

The branch shall be vented to the building exterior.

The purpose of this valve is to permit rapid flushing of the sample supply line during commissioning and following connection of a new calibrating gas bottle. It will also be useful in diagnosing possible leakage of sample/calibration gas changeover solenoid valves.

Refer to Sketch E-TC-06-03 attached.

3.5 PRIMARY SAMPLING LOOPS

3.5.1 General

The two primary sampling loops continuously extract samples from their respective process mains, and transfer them as rapidly as possible to

the Analyser Hut, where the stream selection/secondary sampling will take off a smaller proportion of each in turn for analysis. The unused balance in the primary systems is returned to the process mains downstream of the original sampling points.

Refer to the enclosed sketches.

- Primary Gas Sampling System Arrangement
E-TC-06-01
- Above-Ground Sampling Details
E-TC-06-02

The Analyser Tenderer shall submit a tender for a conforming system with such variations as he considers necessary as a pre-requisite for accepting responsibility for satisfactory functioning of the system overall.

Evaluation of tenders will be assisted by supporting comments related to proposed variations.

3.5.2 Process Sampling Point

This shall be part of the contractors responsibility to detail, supply and install.

It shall include a sample probe projecting to nominally 1/3 D, inserted vertically down through a packed gland and isolation valve, that permit total probe withdrawal without gas escape, with the process "live". Probe typically 1/2" SS pipe.

The process will be at, or slightly above atmospheric pressure.

The end of the probe outside the main shall be fitted with a shutoff valve, immediately followed by a filter/flame trap and an in-line relief valve set to nominally 10kPa.

The sintered metal element of the filter/flame-trap shall provide a relatively large flow area to cater for possible dust/moisture. It shall be arranged to drain back into the probe.

Trace heating suited for the hazardous location should be considered for the filter/flame trap and sample line, possibly utilizing a source of hot water in the Analyser Building. For economy and simplicity, installation of tracing shall be deferred pending results of initial operation. Its purpose would be to suppress condensation in the filter/flame trap and sampling lines.

The filter/flame-trap shall be fitted in a way permitting convenient element cleaning or replacement.

The purpose of the in-line relief valve is to oppose mains pressure and gas escape from the main, except when suction from the sample pump is applied.

3.5.3 Excess Sample Return

The in-line relief valve here should be set to the lightest practical setting, probably a few kPa, yet still providing effective closure against back-flow, should the process main be at or near atmospheric.

No probe is required here. The excess sample may simply enter the main through an isolation ball valve and socket.

3.5.4 Primary Systems to be Outside Hut

Primary Sampling System components and secondary sample flow adjustment/indication/flow switch shall be outside the hut, such that accidental leakage inside the hut will be limited to the maximum flow of the secondary system rather than the higher flows of the two primary systems.

3.6 PRIMARY SAMPLING SYSTEMS TUBING SUPPORTS

- 3.6.1 The two primary sampling systems shall share a common tubing support way between process mains and Analyser Building.
- 3.6.2 The route shall nominally be from the Analyser Building, crossing above the No. 1 discharge main, then recrossing it to reach the No. 2 discharge main, then parallel with the No. 2 main for a short distance. (Refer Sketch E-TC-06-03). The object shall be to access each main for sample withdrawal, and to access each main again nominally 5 diameters minimum downstream for return of surplus sample.
- 3.6.3 The support way shall consist of a single run of carefully levelled horizontal Unistrut P1000 channel supported by Unistrut P1000 uprights at nominally 2m intervals. (Levelling provides for condensate drainage in the direction of gas flow).
- 3.6.4 The uprights shall be set in concrete footings and shall be capped at the top.
- 3.6.5 The horizontal channel shall be secured to the upright in a way that facilitates vertical adjustment of horizontal channels without encroachment of fasteners into the interior of the horizontal channels and without obstructing the up-facing opening of the horizontal channels. Horizontal channels shall have de-burred 10mm drainage holes midway between supports.
- 3.6.6 Prior to placement of tubing in horizontal channels, a strip of woven fibreglass tape of nominally 100mm width and suitable commercially available bulk shall be pressed into the base and sides of the channel, to serve as thermal insulation. After installing tubes, the horizontal channel shall be sealed with standard snap-on capping strips.
- 3.6.7 Tubing shall be one 10mm o.d. supply and one return nylon tube for each of the two primary sampling systems, and (in the future), possibly one supply and one return tube for hot water tracing, supplied from the Analyser Building, i.e. a maximum of 6 x 10mm tubes. Sample tube shall be in continuous lengths to minimise potential leakage at joins.

(Note: Nylon rather than polythene is specified for sample tubing to retain a better pressure rating under possible heat-tracing conditions).

(Flavell brand Nylon tubing is recommended based on previously established superior resistance to embrittlement in sunlight).

- 3.6.8 Tube entries to the Unistrut channel shall be horizontal or down-sloping in the direction of required gas flow/condensate drainage, and shall be arranged for minimum practical entry of rainwater into the channels.

3.7 SECONDARY SAMPLING SYSTEM

Refer to enclosed sketch "Typical Secondary Sampling System and Calibration Provisions", E-TC-06-03.

The Analyser Tenderer shall submit a tender for a conforming system with such variations as he considers necessary as a pre-requisite for accepting responsibility for satisfactory functioning of the system overall.

Evaluation of tenders will be assisted by supporting comments relating to proposed variations.

- Notes:
1. Solenoid valves should be 24VDC flameproof.
 2. The moisture detector signal shall be commoned with the secondary flow failure device. Its purpose is to react to actual liquid water being carried forward.

3.8 ENCLOSURE/VENTILATION OF SECONDARY SAMPLING SYSTEM AND CALIBRATING GAS SELECTION SYSTEMS

The tubing and accessories passing the secondary sample or calibrating gases shall be in an enclosure inside the Analyser Hut, immediately adjacent to (and probably below) the analysers.

(The primary sampling system components and secondary flow valve and rotameter shall be outside the Analyser Hut, with no enclosure, but with rain/sun shelter overhead).

The sampling system enclosure inside the hut shall be so designed as to provide the main exhaust path for the air-flow from the once-through room air-conditioner.

This air shall enter a grill at one end of the cabinet, sweep the length of the cabinet, and exhaust to outside the room through a counterweighted louvre panel, fitted with a position/flow switch.

The room methane detector head (free issue) shall be located at this exhaust louvre, thus monitoring accidental escape of methane anywhere in the room or sampling enclosure.

The position switch on the exhaust louvre panel shall be commoned with the room temperature switch, to provide air conditioner failure signal to the remote PLC, resulting (after a suitable delay) in remote isolation of all power to the building.

Note that opening of the enclosure for servicing or adjustment is permissible, as air-flow should still exit through the louvres. Temporarily, the enclosure flushing will not be as thorough.

3.9 ANALYSER HUT

The following shall be provided:

3.9.1 Transportable, fully pre-assembled, with all analyser equipment fitted and pre-tested prior to site delivery.

3.9.2 Once-through general purpose rating air-conditioner whose primary task will be room ventilation at a throughput providing sufficient dilution to prevent ignitable mixtures in the event of a sample or calibrating line break in the building.

The secondary task of the air-conditioner will be heat removal from the building to limit temperature build-up to nominally 27°C.

Frequent air-conditioner cooling cycle on/off automatic operation is to be avoided if possible to avoid anticipated effect on analyser output.

3.9.3 No electrical equipment or power outlets shall be installed within 300mm of the floor. Elsewhere General Purpose electrical equipment may be used.

3.9.4 General room lighting to provide even illumination of 400 lux nominal.

3.9.5 At least 4 uncommitted general purpose 240V power outlets, suitably spaced.

3.9.6 Analyser and sampling system 240V power distribution to be separate from lighting, G.P.O.'s and air-conditioner power distribution.

Analysers and sampling will be supplied from a remote U.P.S. giving half hour nominal sustained operation in event of general power failure.

U.P.S. and General Power loadings shall be estimated in the tender.

3.9.7 The tenderer may comment on the need for fire fighting provisions and may quote these as optional extras.

3.9.8 Air-conditioner exhaust flow from the room to be through weighted louvres, via sample enclosure as elsewhere discussed.

3.9.9 The Analyser Tenderer shall be responsible for specifying minimum suitable building footings/slabs, which will be installed as part of general site civil work.

3.10 ALARM/STATUS/SWITCHING SIGNALS FROM/TO ANALYSER HUT

The following shall sbe provided as clean contacts wired to a terminal strip:

3.10.1 Analyser #1 fault status

(Includes flow failure of secondary sample, or of calibration gas flow, or of case ventilation air flow, to this analyser. Also includes any equipment fault status that may be provided as a standard feature for this analyser.

3.10.2 Analyser #2 fault status (similar).

3.10.3 Analyser #3 fault status (similar).

3.10.4 Analyser #4 fault status (similar).

3.10.5 Sample System Fault:

This comes from the flow failure device on the total secondary flow rotameter.

3.10.6 Air-Conditioner Fault.

(Combines a position switch on the counterweighted room exhaust louvres i.e. trips on air-flow failure; and a room high-temperature switch).

3.10.7 "Calibration completed" signal (subject to calibration scheme proposed).

3.10.8 "Calibration Initiate" signal (from remote PLC by others).

3.10.9 "Primary Sample Stream Selection" signal (from remote PLC by others, to operate stream selection solenoid, by Analyser supplier).

3.1.10 Methane detector head, "free issue", for location at room exhaust louvre. (Not via terminal strip).

SECTION 4 - COMMISSIONING AND ACCEPTANCE TESTS/DEMONSTRATIONS

4.1 GENERAL

The Analyser Supplier shall fully test the preassembled analyser system at the factory before delivery to site.

After installation, the Analyser Supplier shall complete all necessary site testing, adjustment and where necessary, revisions to establish a fully functional running system operating within specifications.

Only then shall he conduct an acceptance demonstration to be witnessed by the Client's designated Instrument Commissioning Engineer.

The demonstration shall include a comprehensive set of tests as separately specified. A minimum of one full day or such longer time as is considered necessary is to be set aside for this acceptance demonstration.

The Analyser Supplier shall be responsible for providing all necessary test instruments as well as ample calibration and test gases to complete the initial system testing and setup, and commissioning and acceptance demonstrations.

4.2 LIST OF ACCEPTANCE TESTS

The following or equivalent witnessed tests shall be carried out.

4.2.1 Analyser Room Air-Conditioner Performance

Present chart recordings of earlier testing of air-conditioning over several days, showing ambient diurnal temperature variation and room temperature variation due to air-conditioner cycling.

Testing shall have been with all room heat loads on.

4.2.2 Relative Immunity of Analyser Outputs to Room Temperature Variations

Review chart recordings of analyser outputs on ambient air against simultaneous chart recordings of room temperature variations associated with air-conditioner cycling.

4.2.3 Sampling System Flow Capability

Adequate primary, secondary, and individual analyser sample flows shall be demonstrated under live or simulated process conditions, with the whole sampling system in use.

4.2.4 Calibration Correctness and Stability

Results of prior testing shall be presented, to demonstrate stability of calibrations between recommended calibration intervals.

A witnessed calibration check on span, zero and typical gases shall be performed for all analysers, after a time of nominally 2 days has elapsed since the previous calibration or adjustment.

This check shall exercise the full calibration provisions to be remotely initiated by the PLC.

4.2.5 Analyser Malfunction Alarms

As far as practicable, the correct initiation of analyser fault alarms in response to specific simulated fault conditions shall be demonstrated.

4.2.6 Sampling System Malfunction Alarm

Similar to previous item. Relates to secondary sampling system total flow.

4.2.7 Room High Temperature Alarm

In-situ demonstration of correct initiation shall be carried out, utilising a temporary warmed enclosure around the temperature alarm unit.

4.2.8 Analysis System Response Speed and Accuracy

A live or prepared gas of typical composition shall be drawn through the whole sampling system under live or simulated process conditions, and then a sustained step-change in gas composition introduced at the sampling point.

Fast chart recordings of dynamic response of analysers from initiation of composition change shall be provided to demonstrate the normal response speed of each analyser as part of the total system.

The stable analyses reached shall be within specified system accuracy of certified test gas composition.

4.2.9 Analyser Sensitivity To Sample Flow Variation

While running "typical composition" prepared calibrating gas deliberate sample flow changes shall be made, to demonstrate relative immunity of analyses to likely sample flow changes.

4.2.10 Analyser Sample Vent Discharge

Demonstrate relative immunity of analyser performance to wind impingement on discharge vent outlet (if applicable).

4.2.11 Air-Conditioner Flow Failure

Demonstrate correct operation of the air-conditioner flow failure device located on the room exhaust louvres.

4.2.12. Analysis Stabilisation Following Stream Selection Switching

Demonstrate analyser response recordings for several cycles of stream switching, with typical gas in one system and air in the other, confirming stabilisation of signals for the selected stream switching frequency.

APPENDIX 1

EVALUATION AND DISCUSSION OF GAS IGNITION RISKS
AND DESIGN PRECAUTIONS ADOPTED

NOTE: THIS APPENDIX IS INTENDED BOTH FOR THE ANALYSER TENDERER AND FOR THE AUTHORITY RESPONSIBLE FOR APPROVAL OF THE PROPOSED SYSTEM.

A.1.1 GENERAL

The original proposed plant hazardous area boundaries were laid out on the basis of major process pipes and equipment. Subsequently, the Analyser Hut and small diameter sampling system were added, deliberately locating the Hut outside the plant hazardous area boundaries.

It is anticipated that the presence and nature of the Analyser Hut and sampling system small diameter piping will not require a revision to plant hazardous area boundaries.

The requirements for uncontaminated samples for accurate gas analysis impose a high standard of care in achieving a secure, leak-proof installation, also leading to a high level of security against gas leaks into the atmosphere.

The installation is seen as generally comparable in character to a laboratory utility fuel gas distribution system, though necessarily installed to more exacting standards, and (unlike gas burners), designed to at all times contain the gas.

It is therefore intended to seek to have the building classified as a "laboratory", carrying a general non-hazardous classification except for a region up to 300mm above floor level, within which region, no general purpose electrical equipment would be permitted. (Refer AS 2430, Part 1, Sect. A9.2.2).

Despite the belief in the inherent security of the system, and the appropriateness of a "laboratory" classification, a detailed discussion of possible areas of risk and precautions taken in regard to these follows.

It is important not to lose sight of a key reason for placing the Analysers into a building in a "safe area" in the first place, namely to make it possible to carry out servicing and adjustment of the analyser system live, under clean, sheltered conditions that best guarantee accurate, trouble-free performance. This could be largely thwarted if needlessly restrictive conditions of access such as relate to more stringent hazard classifications, were imposed.

A.1.2 AREAS OF RISK ADDRESSED

1. Propagation of accidental ignition from the sampling system back into the process mains.
2. Escape of sample gas outdoors from a leaking or totally fractured primary sampling system line.
3. Escape of calibrating gas outdoors from a leaking or fractured line.
4. Escape of sample gas inside the building, from a leaking or totally fractured secondary sampling system line, or a calibrating gas line.
5. Potential ignition of a correctly contained sample actually having a composition within the upper and lower ignition limits, due to use of inappropriate measuring devices.
6. Escape of sample or calibrating gas within the body of the analysers due to a fault, and potential ignition from the general purpose electronics within the analyser housings.
7. Occurrence, from whatever source of methane in the Analyser Building, and possibility of ignition.

These areas of risk are variously met by use of secure, well-installed systems; flame traps; limits on pressures and flows, with higher flow/pressure systems kept outside the building; containment and forced ventilation of potential leakage areas with appropriate volumes of dilution air; flow failure sensing for ventilation air; methane detection at the ventilation exit to atmosphere; selection of appropriate measuring devices safely able to monitor even explosive mixtures; remote PLC surveillance of all safety statuses; and provision for remote PLC shutdown of power to the Analyser Building if a hazardous situation nevertheless arises.

A.1.3 DETAILED DISCUSSION OF IGNITABLE ATMOSPHERES

A.1.3.1 GENERAL

All installed sampling system and calibration gas joints will have been pressurised with air or nitrogen and leak-tested with Swagelock "Snoop" or equivalent solution, following installation. No detectable leaks will initially be present.

A.1.3.2 EXTERIOR

1. Sampling tubes will be as far as practical in continuous runs of Nylon tubing, minimising joints.
2. Sampling tubes will be protected from damage by installation in heavy-duty galvanised Unistrut channel with capping strip closure.
3. Flame traps will be fitted where primary sample is drawn from the process mains and where primary sample excess is returned to the mains.

(The very unlikely event of ignition in the sampling system would thus be confined to that system and could not enter the process mains).

4. The suction side of the primary sample pumps, in operation, is at slightly negative pressure. Any leak here would cause air to enter the sample rather than causing escape of gas.

With the pumps off, pressures of a few kPa positive would prevail. Any small leak path would lose only minute amounts of gas, diluted by ambient air to harmless levels.

A total line break with sample pump running would cause an immediate analyser alarm, due to the sample composition dropping below the Upper Explosive Limit monitored by the remote PLC.

Gas would cease to flow out of the process main in the event of a line break or other fault that prevented effective sample pump suction, since the in-line relief valve in the sample line at the probe will not open at normal process pressure unless assisted by pump suction.

5. The pressure side of the primary sampling pump is limited to delivering the maximum flow permitted by the primary sample needle valve.

Minor leaks would be effectively diluted, and in any case unlikely.

A total line fracture would cause:

- (a) Flow failure on the secondary sampling system with resultant PLC alarm. It is believed that maximum primary sample system flow escape should be tolerated rather than automatically initiating an Analyser System shutdown because this amount of gas in the open will still be effectively diluted, while a shutdown will make it much more difficult to subsequently pinpoint the problem. An acceptable approach could be to use nominally a 30 minute period of grace while such an occurrence persists, and then to shut the Analyser System down if no follow-up has occurred. Note that restarting the Analyser system is a manual procedure and unnecessary Analyser shutdowns would be unwelcome.
- (b) Back-flow of gas from the process via the excess sample return point cannot occur because the in-line relief/check valve there prevents it. It requires positive assistance from the sample pump for this valve to open, to admit return flow to the process main.

A.1.3.3 ANALYSER BUILDING INTERIOR

1. The higher-flow primary sampling systems, sample selection, and secondary flow restrictor and flowmeter are all outside the building, where generally and leakage is diluted as already discussed.

Leaks in the building are limited, in the (unlikely) worst case, to the maximum flow of the secondary sampling system, whose maximum pressure is limited by a safely vented relief valve.

2. High-pressure calibrating gas bottles are kept in a rack outside the building and there pressure is broken down to a low level, with added security of a low-pressure relief to a safe vent. Only low volume, low pressure calibrating gas could enter the air in the building in the event of an accidental leak.
3. Secondary sample system components and calibration gas components inside the analyser building will be in an enclosure so designed as to serve as the exhaust path for the once-through room air-conditioning, thus providing efficient containment and ventilation of the main potential leakage area.
4. The once-through Air-conditioner will be selected for a flow capable of effectively diluting the worst gas escape for a (rather unlikely) total fracture of the secondary sampling system or for a calibrating gas system break.
5. The exhaust from the room and sampling enclosure to the exterior will be fitted with weighted exhaust louvres fitted with a position sensor serving as a flow failure detector. This will cause a remote PLC alarm for sustained air flow failure, and after a period of grace, will cut power to the Analyser Building.
6. A flameproof Methane detector head (free-issue to the Analyser Contractor) will be fitted at the air-conditioner exhaust louvres, and this will provide an initial warning and, at slightly higher concentration, power cutoff to the Analyser Building (via the remote PLC) on occurrence of methane levels approaching the lower explosive limit.
7. Individual analyser cases shall be force ventilated to the exterior and equipped with ventilation flow-failure sensing.

The ventilation fan(s) to be provided with the analysers shall be sized to effectively dilute the total sample flow passed by the needle valve/rotameter, preceeding each analyser.

The failure signal shall be commoned to the "Analyser Fault" signal for each analyser.

8. The analysers are specified as needing to be suitable for all sample concentrations including sample compositions between the Upper and Lower Explosive Limits.

[3921/H]

DRAWINGS AND DATA REQUIREMENTS

1. GENERAL

The Seller shall submit drawings and data to the extent and within the period of time specified in Sheet 3 of this Appendix.

2. SUBMISSION PROCEDURE

All drawings and data shall be submitted for approval to Clutha's Engineer, BP Coal Australia, addressed thus:

Engineering Branch
BP Coal Australia
110 Alfred Street
Milsons Point NSW 2061

All drawings and data shall be submitted with a covering numbered Transmittal Note which shall show Clutha's Order Number and list all documents included in the submission, the revision numbers of the issue where appropriate, and the number of copies submitted.

In the event that submitted drawings and/or data are not approved by the Engineer, then the Seller shall resubmit documentation without delay, but in any event not later than two weeks after the rejected documentation is returned to the Seller.

The Transmittal Note for such resubmission of drawings or data shall also state that the documentation is a resubmission.

3. DRAWING REQUIREMENTS

All drawings submitted shall be transparencies. These shall be clear reproducible copies on plastic film.

General arrangement drawings shall be in sufficient detail to show layout of equipment, access for maintenance and operation and for any necessary design by others of foundations, supports and any other interfaces.

Generally, drawings will be reviewed and approved by the Engineer only as regard to arrangement and conformance to the Specifications and related drawings. The Engineer's approval of the Seller's drawings shall not relieve the Seller for full responsibility for mistakes or omissions therein or therefrom (including any resultant mistake or error in the goods) or for any discrepancy or deviation from the Specification and other drawings.

DRAWINGS AND DATA REQUIREMENTS

The Seller shall be responsible for and shall pay for all alterations of the goods due to any discrepancies, mistakes or omissions in or from the drawing or other information by or through him, whether such drawings or information have been approved by the Engineer or not.

4. AS-BUILT SUBMISSION

As a condition precedent to final payment, the Seller shall submit to the Engineer one set of fully amended 'as-built' drawings in the form of a first generation full sized transparency together with copies of calculation sheets revised as necessary to match 'as-built' drawings.

DRAWINGS AND DATA REQUIREMENTS

Item	Document Description	Required (Sets)		When Required - Weeks After Date of Award	Approval Needed Before Supply/ Manufacture (Yes/No)
		Prints	"i" parentheses		
1.	Drawing list (setting out all drawings to be utilised by Contractor) showing drawing number, title, brief description of what is shown, date to be submitted to Engineer.	-	-	-	-
2.	General arrangement drawings including outline dimensions, connection points (size, type, dimensioned location), mass and certified foundation and support details	-	1	4	YES
3.	Cross section drawings	-	-	-	-
4.	Shop details and assembly drawings	-	1	6	YES
5.	Complete parts and equipment lists	2	-	6	YES
6.	Flow diagrams	-	-	-	-
7.	Piping diagrams and fittings schedules	-	1	6	NO
8.	Welding procedures	-	-	-	-
9.	Plate sheets	-	-	-	-
10.	Process and instrumentation diagrams	-	-	-	-
11.	Logic diagrams and instrument loop diagrams	-	-	-	-
12.	Electrical single line diagrams	-	-	-	-
13.	Electrical schematics with 3 line diagrams	-	1	6	YES
14.	Electrical layout detail drawings	-	-	-	-
15.	Cabling, wiring and termination diagrams	-	1	8	YES
16.	Installation instruction manuals	6	-	16	NO
17.	Test results and certificates	2	-	16	NO
18.	Operation instruction manuals	6	-	16	NO
19.	Maintenance instruction manuals	6	-	16	NO
20.	Lubrication schedule	-	-	-	-
21.	List of priced spares recommended for one year's operation	2	-	8	NO
22.	List of special tools	-	-	-	-
23.	Calculations	2	-	8	NO

SECTION 1 - GENERAL

1.1 SCOPE OF WORK

The Contractor shall supply all labour, materials and equipment for the detailed design, manufacture, painting, assembly, testing, packing, including securing against damage the Principal supplied equipment installed in the building by the Contractor, and delivery FOT the Surface Gas Extraction Plant Site, Tahmoor Mine, Tahmoor, New South Wales of a prefabricated Electrical Switch/Instrument Room.

1.2 WORK INCLUDED

The scope of work shall include but not be limited to the following.

1.2.1 Design.

1.2.2 Preparation and supply of documentation including drawings.

1.2.3 Manufacture and supply of prefabricated building.

1.2.4 Manufacture or purchase and supply of medium voltage switchgear assembly.

1.2.5 Purchase and supply of power transformer.

1.2.6 Installation of Principal supplied enclosures and equipment within the prefabricated building.

1.2.7 The supply, installation and connection of all necessary cabling between the various items of equipment within the prefabricated building.

1.2.8 The testing of all equipment supplied by the Contractor including point to point checking of all interconnections between Principal supplied equipment.

1.2.9 Supply of commissioning spares.

1.2.10 Transport and insurance to Site.

1.3 WORK EXCLUDED

The following are excluded from this Contract:

- 1.3.1 Unloading of equipment at Site.
- 1.3.2 Site erection.
- 1.3.3 All power, control and instrumentation cabling external to the prefabricated Electrical Switch/Instrument Room.
- 1.3.4 The electrical energisation and testing of Principal supplied cubicles and equipment.

1.4 SERVICE CONDITIONS

- 1.4.1 The equipment shall be erected at Tahmoor Mine, Tahmoor, New South Wales.
- 1.4.2 The equipment shall be designed to operate continuously 24 hours per day 365 days per year.
- 1.4.3 The Contractor shall ensure that all equipment supplied by him and located within the prefabricated building shall be able to operate indefinitely in a 44°C ambient.
- 1.4.4 All component parts of equipment supplied by the Contractor shall be rated and assembled in accordance with the component parts' manufacturer's recommendations.
- 1.4.5 The electrical supply system is an isolated neutral system with the 11 kV single fault, earth fault current limited to 25 amps and three phase fault level at transformer 11 kV terminal of 60 MVA.
- 1.4.6 The ambient conditions at the Site are:

Summer maximum temperature	40°C
Average summer temperature	32°C dry bulb 23°C wet bulb
Altitude	280 metres
Wind blown industrial dust.	

SECTION 2 - STANDARDS, CODES AND SPECIFICATIONS

2.1 GENERAL

All work shall comply with the latest issues, addenda, amendments and supplements of all relevant Regulations, Codes and Statutory requirements and the relevant clauses of the following standard specifications:

EP 2/1 Form 3 415 V Motor Control Centres
E-1 Supply of Power Transformers.

2.2 MANUFACTURE

The Contractor shall employ his standard methods of manufacture for the equipment. However, where relevant, the provisions of Appendix G - Nominated Equipment - shall apply.

2.2.1 Dimensions

The equipment shall be fully assembled in the workshop before shipment.

All critical dimensions shall be verified before shipping to Site. This particularly relates to location fixings and interface points when equipment is split for transport.

SECTION 3 - DESIGN AND CONSTRUCTION

3.1 GENERAL

The Contractor shall design to sufficient detail to meet the following requirements to the satisfaction of the Superintendent.

3.2 ELECTRICAL SWITCH/INSTRUMENT ROOM ARRANGEMENT

The Electrical Switch/Instrument Room shall comply with floor plan shown on Drawing TC-SKM-002. Cable access to each unit shall be from underneath. A 200 mm high cableway will be provided in the base of the Principal supplied equipment to facilitate field cable clamping and interconnection cabling.

3.3 ELECTRICAL SWITCH/INSTRUMENT ROOM ENCLOSURE

The enclosure shall be designed by the Contractor to comply with all applicable Statutory Regulations and Requirements of Local Authorities.

Full details of the design shall be submitted to the Superintendent for approval before manufacture commences. Particular stress is laid upon adequate space being available for cable access and sufficient support pads being provided.

It is envisaged that the enclosure will be mounted upon a full concrete base, cast in-situ, complete with cable access penetrations or the enclosure will be mounted upon a number of concrete pads with cable trenches between some of the pads.

The doors, and other penetrations through the enclosure shall be fitted with adequate seals to prevent the ingress of industrial wind-borne dust.

The transformer section shall be fenced or otherwise enclosed around the perimeter to prevent accidental contact with the transformer and earthing resistor tanks.

3.4 POWER TRANSFORMER

3.4.1 The Contractor shall supply and install a 1 MVA, 11000/433 Volt, 3 phase, 50 Hz, Dyn 11 transformer complete with a continuously rated neutral earthing resistor of 50 ohms.

3.4.2 The transformer shall comply with Standard Specification E-1 except where modified below:

[+3873H]

- (a) The secondary windings shall be terminated in a separate air insulated busbar chamber along with the insulated neutral point. The secondary winding busbar chamber shall be located on the transformer such that a direct insulated busbar connection may be made to the top of the 415 Volt motor control centre.
- (b) Cast steel wheels will not be required.
- (c) The transformer shall be painted in accordance with the manufacturer's standard practice.
- (d) The word "Superintendent" shall be read in place of the word "Engineer" throughout the Specification.

3.5 MEDIUM VOLTAGE SWITCHGEAR ASSEMBLY

- 3.5.1 The Contractor shall supply and install a medium voltage switchgear assembly generally in accordance with Standard Specification EP 2/1, Form 3 - 415 Volt Motor Control Centres - except where modified below.
- 3.5.2 The main items of equipment in the switchgear assembly are defined on drawings TC-560-600, TC-560-601 and TC-560-602.
- 3.5.3 The motor control centre control supply shall comprise one 415/110 Volt transformer, not two transformers, as defined in Clause 3.3.6 of Specification EP 2/1.
- 3.5.4 Power factor correction equipment as defined in Clause 3.3.7 of Specification EP 2/1 is not required and shall not be provided.
- 3.5.5 Centralised cable marshalling as defined in Clause 3.3.8 of Specification EP/2 shall not be provided. Cables shall be terminated in each motor drive unit or feeder circuit as shown on drawings TC-560-600, TC-560-601 and TC-560-602.

3.6 ELECTRIC SWITCH/INSTRUMENT ROOM DOMESTIC INSTALLATION

The Contractor shall design, supply and install the domestic electric installation for the switch/instrument room to provide the illumination level required and number of GPOs as shown on TC-SKM-002. In addition, the Contractor shall install a weatherproof fluorescent light outside and above each of the doors, and an air

conditioning system which may be either mounted through the side wall or on the roof to provide human comfort conditions with the building exposed to the design temperature conditions quoted in Clause 1.4.6.

3.7 PRINCIPAL SUPPLIED INSTRUMENT EQUIPMENT

3.7.1 The Contractor shall install the Principal supplied instrument equipment, listed below, in locations shown on Drawing TC-SKM-002:

- . . PC Cabinet A
- . PC Cabinet B
- . PC Cabinet C
- . I/S Barrier Cabinet D
- . I/S Barrier Cabinet E
- . Instrument Cabinet F
- . Printer
- . VDU
- . Keyboard
- . Desk
- . UPS
- . 24 Volt Distribution Board
- . 24 Volt Battery

3.7.2 The Contractor shall supply and install the interconnecting wiring between all of the various items of instrument equipment and between the items of instrument equipment and the distribution boards supplied as part of the motor control centre. A supplementary package of documents will be produced defining the required connections and wire types required between various items of equipment before work commences.

See Attachment entitled, "Basis for Estimating Price of Connecting Principal Supplied Equipment".

BASIS FOR ESTIMATING PRICE TO CONNECT
PRINCIPAL SUPPLIED INSTRUMENT EQUIPMENT

The Contractor shall assume:

- (a) 12 24 Vdc power supplies required
 - 6 240 Vac secure (ex UPS) power supplies required
 - 3 240 Vac raw (ex Distribution Board) power supplies required
 - 200 terminations to be made to each enclosure A to F excluding C & E which are installed ready for future use
 - 10 terminations to UPS and battery distribution system.
- (b) All power supply cables shall run in a cable way provided between the MCC, UPS, battery and instrument panels beneath the floor of the Switch/Instrument Room.
- (c) Variations to these amounts shall be charged as per the schedule of rates given in the tender documents.

CLUTHA DEVELOPMENT PTY LIMITED

SPECIFICATION NO.
M-TC-14

SURFACE CIVIL AND MECHANICAL WORK FOR GAS DRAINAGE
AT TAHMOOR MINE

Revision	Date
0	8. 8. 85

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SECTION 1 - GENERAL

1.1 INTERPRETATIONS

In this Specification and in the other Specifications the following words and expressions shall have the meanings hereby assigned to them:-

- "Company" shall be deemed to be interpreted as 'Principal' as defined in Clause 1 of the General Conditions Of Contract.
- "Engineer" shall be deemed to be interpreted as 'Superintendent' as defined in Clause 1 of the General Conditions Of Contract.
- "Seller", "Supplier" and "Vendor" shall be interpreted as 'Contractor' as defined in Clause 1 of the General Conditions Of Contract.

1.2 SCOPE OF WORK

The Specification applies to the supply of all necessary labour, materials, plant, equipment, transport and supervision for all civil (including structural) and mechanical work and some electrical (including instrumentation) work required for the surface civil and mechanical work for gas drainage at Tahmoor mine, N.S.W.

The Works shall be in accordance with the Drawings listed in Section 4 of this Specification.

The Works are contained within the battery limit (fence) shown on Drawing No. TC-560-001.

1.3 WORK INCLUDED

The work to be performed shall include, but is not necessarily limited to, the following:

- (a) the co-ordination of work on Site including liaison with other contractors working on the Site, i.e., borehole contractor and/or electrical contractor;
- (b) the preparation of detailed designs, layout and shop drawings for civil, mechanical and electrical work;
- (c) the construction of drains and sumps;
- (d) the supply and erection of permanent and temporary chainwire fences on the battery limit, including all gates and like fixtures;
- (e) the construction of earthworks for footings and slabs including backfilling operations.
- (f) the construction of concrete footings and slabs;

- (g) the supply and installation (unless noted otherwise) of the following major items of mechanical equipment:-
- flame arrestors (9 off)
 - air compressor (1 off)
 - process liquid cooler (1 off)
 - water pumps (2 off)
 - carbon steel vessel:- PV 7 (1 off)
- (h) the installation of equipment supplied by the Principal;
- (i) the supply and erection of exhaust stacks including the attachment of lightning conductors;
- (j) the supply, installation and connection of compressed air, flammable gas, plant water, recirculated water, waste water and fire water piping;
- (k) the supply and erection of a pump house including steelwork and cladding;
- (l) the detailed design (where necessary) of anchor bolts of sufficient diameter, length and fixing mechanisms for machinery and equipment installed under this Contract, and the fabrication and/or supply, installation and painting (if necessary) of these anchor bolts;
- (m) the detailed design of all necessary safety guards for machinery and equipment installed under this Contract, and the fabrication and/or supply, installation and painting of these safety guards;
- (n) the painting of items erected or installed under this Contract where required to do so by the Specification or the Drawings;
- (o) the detailing and/or fabrication and/or supply, installation and painting necessary of minor parts, components, supports and other items not shown on the Drawings or explicitly mentioned in the Specification where such parts, components, supports and other items are required and necessary to complete the depicted and specified work in a workmanlike manner;
- (p) the detailed design of minor concrete items and civil works required for the completion of work otherwise shown or specified, and the construction of these;
- (q) the participation in testing and final commissioning of the surface gas extraction plant;
- (r) the making good (if necessary) of the Site ground surface to the "as received" condition;

The Contractor shall also do everything else necessary to meet the obligations arising out of and to satisfy the requirements of all the terms and conditions of this Contract.

1.4 WORK NOT INCLUDED

The following work is not included in the Contract:-

- (a) work in the underground mine
- (b) the construction of the access road
- (c) the supply and erection of the analyser house
- (d) the supply and erection of the switch/instrument room

1.5 STANDARDS, STANDARD SPECIFICATIONS AND DRAWINGS

In construction of the Works the Contractor shall comply with the latest edition of the applicable Standards including any amendments thereto.

The Contractor shall comply with all Specifications and Drawings included in the Contract.

CLUTHA DEVELOPMENT PTY LIMITED

SPECIFICATION NO.
S-TC-01

MISCELLANEOUS INFORMATION FOR

- DRAINS AND SUMPS
- PERMANENT AND TEMPORARY CHAINWIRE FENCES
- PIPING

Revision	Date
0	9.8.85

CLUTHA DEVELOPMENT PTY LIMITED

SPECIFICATION NO.
C-TC-01

EARTHWORKS FOR FOOTINGS AND SLABS

Revision	Date
0	2.4.85
1	9.8.85

This specification is of a general nature and only those sections where applicable shall apply to the Works.

SPECIFICATION NO. C-TC-01
REVISION 1

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SECTION 1 - SCOPE

This Specification applies to the construction of earthworks for pile caps and grade beams, footings, slabs, sumps and pits. It includes the requirements for excavation, filling, backfilling and compaction and inspection of the finished earthworks.

SECTION 2 - DEFINITIONS

In this Specification:

- "backfill" means fill placed between the sides of a structure and the sides of the excavation in which the structure is built.
- "bedding" means sand or fine crushed rock placed on completed subgrade or fill to provide a working surface for the construction of a concrete slab.
- "common fill" means fill composed of approved material obtained from the excavations or from stockpiles or borrow pits within the Principal's property.
- "common material" means, for the purpose of classification of excavation, all material required to be excavated, which is not classified as rock.
- "excavation - close shoring" means excavation in ground which requires shoring, bracing and sheet piling or close planking to be installed to support the sides of the excavation.
- "fill" means any earth, sand, gravel or crushed rock placed as part of the Works.
- "footing" means that part of any structure, other than a slab, which is supported directly on the foundation.
- "foundation" means the ground, whether undisturbed or filled, which supports footings (including blinding concrete) and slabs.

- "general conditions" means General Conditions of Contract.
- "selected fill" means fill composed of material obtained from outside the Principal's property.
- "manual excavation" means excavation in ground where mechanical equipment, power tools or explosives cannot be used and includes removal of material from the excavation by manual labour, i.e. pick and shovel work.
- "normal excavation" means excavation in locations where the ground can be excavated by mechanical equipment.
- "power tool excavation" means excavation in rock which, in the opinion of the Superintendent, requires the use of hand operated power tools to break the rock in locations where explosives cannot be used and includes the removal of material from the excavation by manual labour or mechanical equipment.
- "rock" means, for the purpose of classification of excavation:
- (a) ground which cannot be broken using a crawler dozer (Cat D7G or equivalent) fitted with single tyne ripper (Cat No. 7 or equivalent) or a hydraulic crawler excavator (Cat 215 or equivalent) equipped with a suitably sized heavy duty rock bucket with ripper teeth, when the equipment is in good working order and operated and maintained by qualified and experienced personnel in accordance with the equipment manufacturer's specification and recommendations; or
 - (b) In locations where the Superintendent considers that it is impracticable to classify by use of the ripper or excavator described in (a) above, ground which is of such hardness and texture that it cannot be loosened or broken down by a pick weighing not less than 2.7 kg, having a handle not less than 850 mm long.

"subgrade" means that part of any earthworks carried out by others, and the base of any excavation carried out by the Contractor, upon which fill, bedding or concrete is to be placed.

SECTION 3 - APPLICABLE DOCUMENTS

The Works shall be carried out in accordance with the requirements contained in this Specification, the Drawings, the New South Wales Construction Safety Regulations, and Coal Mines Regulation Act, and the latest edition of the relevant Australian Standards listed in Attachment A.

SECTION 4 - SETTING OUT

4.1 ACCEPTANCE OF SITE

The Contractor shall check the details of the Site, including levels of the existing surface, prior to commencement of the Works and shall notify the Superintendent in writing of his acceptance of the Site and of any discrepancies from the specified levels, before commencing any excavations.

Levels of existing subgrades which do not differ from the specified levels by more than ± 50 mm shall be accepted by the Contractor. If the specified levels vary by more than ± 50 mm, the Superintendent may direct the Contractor to do additional work as a variation to the Contract.

4.2 SETTING OUT AND APPROVAL

The Contractor shall be provided with a base line and bench marks sufficient to set out the Works on Site.

The Contractor shall, on completion of setting out each portion of the Works, notify the Superintendent and obtain approval to proceed. Such approval shall not, however, relieve the Contractor of his responsibility to set out the Works correctly.

SECTION 5 - EXISTING SUBGRADE

Unless specified otherwise, existing subgrades have been compacted to a depth of 300 mm by others, to not less than 98% of standard maximum density in accordance with Test Method E 1.1 of AS 1289.

Prior to the placement of any fill, bedding or concrete, the Contractor shall check the density of existing subgrades and, if necessary, carry out additional compaction in accordance with Section 7 of this Specification to increase the subgrade density, for a depth of 300 mm below the surface, to the percentage specified above. The Contractor shall notify the Superintendent before proceeding with such additional compaction, which shall be a variation to the Contract.

SECTION 6 - EXCAVATION

6.1 GENERAL

Excavation shall be carried out as specified below, in the locations shown on the Drawings. The Contractor shall perform all excavation, regardless of the character of material encountered, as required for completion of the work. Classification of materials and methods of excavation are defined in this Specification.

6.2 PERMISSION TO EXCAVATE

Not less than 7 days prior to commencing any excavation in any area the Contractor shall obtain a permit from the Superintendent.

6.3 EXTENT OF EXCAVATION

6.3.1 Excavation in existing uncompacted mine refuse shall be taken down to natural ground having a safe bearing capacity of not less than 200 kPa.

The base of each excavation shall, on all sides, extend beyond the plan positions of the sides of the footing or slab by an amount not less than the depth of the excavation below the respective edge of the footing or slab.

6.3.2 Excavation in compacted granular fill, which has been approved by the Superintendent for use as a foundation, shall be to the dimensions and depths shown on the Drawings or as necessary to permit placing and removal of formwork, falsework, draining and dewatering facilities, cleaning, inspection and testing.

6.4 TOLERANCES

Allowable tolerances from the design levels and lines shall be as follows:

- 6.4.1 Finished level of subgrade on which bedding or concrete is to be placed, +10 mm, -20 mm.
- 6.4.2 Finished level of subgrade on which fill is to be placed, +30 mm.
- 6.4.3 Finished line and level of batters which will remain uncovered, +100.mm, unless otherwise specified, with a neat and uniform appearance.

6.5 OVER-EXCAVATION

The Contractor shall not excavate beyond the levels and lines shown on the Drawings, or specified in Clause 6.3 above, without prior written approval of the Superintendent.

Any over-excavation of subgrade shall be reported to the Superintendent who will direct restoration of the subgrade in compliance with Section 7 herein or by such other methods that the Superintendent deems necessary to ensure that the required bearing capacity is achieved.

Where over-excavation occurs due to carelessness by the Contractor, or is required to remove soft or wet ground caused by errors in excavated levels or by lack of proper drainage, the cost of such over-excavation and all remedial works shall be borne by the Contractor.

If the Superintendent directs that over-excavation and remedial action is required because of poor in-situ conditions the additional work shall be a variation to the Contract.

6.6 MAINTAINING EXCAVATIONS

The method of securing excavations shall be approved by the Superintendent and shall, where applicable, be designed to effectively support adjacent buildings, structures, pavings, other excavations and any other item which may be affected by the Works.

Care shall be exercised by the Contractor in securing excavations to ensure that no material is removed beyond the dimensions determined by the Superintendent.

The Contractor shall also at his own cost execute and maintain all timbering, boxing, sheeting or planking that may be necessary until its removal is necessitated by backfilling operations. Timbering and like fixtures shall not remain permanently in position except with the written permission of the Superintendent.

Excavations shall be kept free of all loose material until all work within the excavation has been completed.

6.7 INGRESS OF WATER

The Contractor shall take all measures necessary to prevent the ingress of water into the excavation. Where ingress of water into the excavation has softened the subgrade the Contractor shall reinstate the subgrade in accordance with Section 7 herein at his own expense.

Irrespective of the source of the water, the Contractor shall be responsible for keeping all excavations dry by approved methods during the entire excavation process and subsequent phases of the work, as required by the Superintendent.

Dry conditions shall be maintained at all times until the work components placed in the excavation are able to withstand the effects of water, or until backfilling and compaction have been completed.

NOTE: For the purpose of this clause the term "dry" shall not mean to preclude the presence of dampness contained in the earth as distinct from free water being present provided that any damp earth or "muck" cannot enter or contaminate the various components of the Works.

Protection against ingress of water shall not be stopped without prior approval of the Superintendent.

Water shall not be discharged or conveyed onto the ground or into any stormwater drain without the Superintendent's permission. Disposal arrangements shall not cause any damage to or have any detrimental effect on adjacent structures, services or adjoining land. All damage caused by the disposal of water shall be made good at the Contractor's expense.

6.8 COMPACTION OF SUBGRADE

Immediately after acceptance by the Superintendent of any completed excavation and prior to the placement of any fill, bedding or concrete, the Contractor shall compact the subgrade in accordance with Section 7 herein. Inspections are required in accordance with Section 10, herein and soil testing will be performed in accordance with Section 7 herein.

SECTION 7 - FILLING AND BACKFILLING

7.1 FILL AND BACKFILL MATERIALS

Fill and backfill shall be either common fill or selected fill as defined in Section 2 herein.

Fill and backfill material shall be obtained from a source approved by the Superintendent and shall be well graded granular material with maximum particle size of 100 mm, liquid limit not exceeding 35, and plasticity index not exceeding 15.

7.2 FILL AND BACKFILL PLACEMENT

7.2.1 No fill or backfill shall be placed on any subgrade without the Superintendent's prior written approval.

Any material which has been placed without the approval of the Superintendent shall be removed and disposed of by the Contractor at his own expense.

7.2.2 Fill and backfill shall be placed in uniform horizontal layers of not more than 200 mm loose thickness.

7.2.3 Placement and compaction of fill and backfill shall be modified as necessary to prevent structural components being adversely affected.

No surcharge shall be imposed on retaining walls.

The Contractor shall obtain details of the maximum allowable loads which can be superimposed on the various sections of the Works and ensure that these loads are not exceeded.

Fill and backfill placed around footings and walls shall be placed and compacted uniformly so that the difference in level between the lowest and highest parts of the fill surface is at no time more than 300mm.

All formwork shall be removed prior to backfilling taking place.

Backfill shall not be placed against concrete components until the concrete has cured for seven (7) days, or such longer time as the Superintendent may direct.

7.3 COMPACTION

- 7.3.1 It shall be the Contractor's responsibility at all times to assess the degree of compactive effort required to meet the Specification and to select suitable methods and provide appropriate equipment capable of achieving the required compaction density.

The degree of compaction specified hereunder and elsewhere in this Specification, is expressed as a percentage of the material's standard maximum dry density at the optimum moisture content determined in accordance with AS 1289, Test E 1.1.

- 7.3.2 Random soil testing will be performed by the Superintendent at no cost to the Contractor.

The testing program will include field tests and laboratory tests to determine the degree of compaction obtained.

The Contractor shall not rely on the Superintendent's testing program and shall take whatever measures are necessary to ensure that the specified degree of compaction is being obtained.

- 7.3.3 Prior to the placement of any fill, bedding or concrete on any subgrade, the Contractor shall check the density of the subgrade and, if necessary, the subgrade shall be rolled to raise the standard compaction density, for a depth of 300 mm, to the percentage shown on the Drawings, or, if not shown on the Drawings, in accordance with Section 5 herein.

If the Contractor is unable to obtain the required subgrade density at the founding levels shown on the Drawings, the Contractor shall immediately notify the Superintendent.

The Superintendent will instruct the Contractor in the remedial action to be taken by the Contractor to obtain the required bearing capacity, such as excavation of additional material and refilling with compacted fill or Grade 15 concrete.

7.3.4 Prior to the placement of any bedding, concrete or additional fill on fill previously compacted by the Contractor, the procedure specified in Clause 7.3.3 for subgrades shall be followed.

7.3.5 All fill and backfill shall be compacted to the percentage of standard compaction density shown on the Drawings, or if not shown on the Drawings, to 98%.

7.4 FILL MOISTURE CONTENT

During compaction of fill or backfill material, sufficient water shall be added to the material to attain optimum moisture content as agreed with the Superintendent, with an allowable tolerance of plus 1%, minus 2%.

If the material is too wet to allow proper compaction, the work shall be stopped and the affected material harrowed and allowed to dry out to the correct moisture content before compaction proceeds.

7.5 TOLERANCES

Allowable tolerances from the design levels and lines shall be as follows:

7.5.1 Finished surface levels of formation on which bedding or concrete is to be placed, +10 mm, -20 mm.

7.5.2 Finished surface levels of bedding to ground slabs, +0 mm, -15 mm.

7.5.3 Finished surface level of formation other than as described in 7.5.1 above, ± 30 mm.

7.5.4 Finished line and level of batters which will remain uncovered, ± 100 mm, unless otherwise specified, with a neat and uniform appearance.

7.6 BEDDING TO GROUND SLABS

Unless noted otherwise on the Drawings, all ground slabs shall be bedded on a minimum compacted depth of 50 mm of bedding, which shall consist of approved fine crushed rock of 20 mm nominal size, or approved sand.

The bedding shall be compacted by watering and rolling with a minimum of 4 passes of a 1/2 tonne minimum weight roller, or equivalent.

7.7 DISPOSAL OF SURPLUS MATERIAL

All unused and unsuitable excavated and fill material shall be removed from the Site by the Contractor to a disposal area located within the Principal's property as nominated by the Superintendent.

SECTION 8 - MEASUREMENT OF EARTHWORKS

8.1 APPLICATION AND NOTICE

When the Contract provides for the payment for excavation or filling at a rate per cubic metre, the Contractor shall measure the relevant volumes of each type of excavation and fill in accordance with Clause 8.2 herein and shall obtain the Superintendent's agreement to his measurements as the work proceeds.

The Contractor shall be responsible for notifying the Superintendent when he considers that a change in classification of excavation or filling occurs and when measurements are to be taken. Payment will not be made at rates higher than for normal excavation unless such notification is received by the Superintendent and his agreement to the classification and measurements obtained, before the Contractor proceeds with further excavation.

8.2 MEASUREMENT

Quantities shall be the solid volume of excavation or fill between the lines and levels shown on the Drawings or otherwise directed and agreed by the Superintendent. No payment will be made for over-excavation and filling of over-excavated areas unless the Superintendent has directed such over-excavation and filling in accordance with Section 6 herein.

SECTION 9 - COMPLETION OF EARTHWORKS AND TRIMMING

On the completion of concrete work, all necessary backfilling to concrete structures shall be completed and all excess material shall be removed from the Site.

The area around the perimeter of concrete structures and slabs shall be graded and trimmed to blend with the surrounding levels.

SECTION 10 - INSPECTION

10.1 GENERAL

The Superintendent shall have unrestricted access to the Works to undertake any inspections he desires, including the following:

- 10.1.1 On completion of excavation work before compacting subgrade.
- 10.1.2 On compaction of subgrade before placing any fill material.
- 10.1.3 The completed excavation or compacted fill before placing blinding concrete.
- 10.1.4 Completion of backfill and trimming after concrete work is completed.

10.2 NOTIFICATION

The Contractor shall give the Superintendent two (2) days prior notice that any of the foregoing stages of the Works will be ready for inspection.

ATTACHMENT A
LIST OF STANDARDS

The following Standards form part of this Specification:

- | | |
|---------|---|
| AS 1141 | Methods for Sampling and Testing Aggregates. |
| AS 1152 | Test Sieves |
| AS 1470 | Code of General Principles for Safe Working in Industry |
| AS 1289 | Methods of Testing Soils for Engineering Purposes |
| AS 1348 | Glossary of Terms Used in Road Engineering. |
| AS 2057 | Code of Practice for Soil Treatment for Protection of Buildings against Subterranean Termites |
| AS 2187 | SAA Explosives Code |
| AS 2188 | Magazines for Storage of Explosives |

CLUTHA DEVELOPMENT PTY LIMITED

SPECIFICATION NO.
C-TC-02

CONSTRUCTION OF IN-SITU CONCRETE

Revision	Date
0	29.3.85
1	9.8.85

This specification is of a general nature and only those sections where applicable shall apply to the Works.

STANDARD SPECIFICATION NO. C-TC-02
REVISION 1

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SECTION 1 - SCOPE

This Specification applies to the construction of all in-situ concrete works in mass or reinforced concrete and includes the requirements of formwork, concrete materials, reinforcement, workmanship and repairs to concrete structures.

SECTION 2 - STANDARDS

The work to which this Specification refers shall be constructed in accordance with the requirements of AS 1480 and other relevant standards listed in Attachment A of this Specification. The latest edition of these standards shall apply.

SECTION 3 - INSPECTION

The Contractor shall not place concrete until all formwork, installation of reinforcement and embedded parts and preparation of surfaces involved in the placing have been approved by the Superintendent. The Contractor shall give the Superintendent twenty-four hours notice of his intention to proceed with each phase of the work.

SECTION 4 - MATERIALS

Cement used shall comply with the requirements of AS 1315 Type A, normal Portland cement. When cement is stored on the Site it shall be supplied and delivered to the Site in the manufacturer's branded and sealed bags and the Contractor shall arrange adequate protective cover and storage clear of the ground to prevent deterioration and the intrusion of foreign material. The Contractor shall take particular care to protect the cement from damage caused by high temperatures and shall keep the cement as cool as practicable. It shall be stacked so that each delivery batch may be identified enabling the cement to be used in its order of delivery.

All damp, lumpy or otherwise defective cement shall be removed from the Site immediately by the Contractor.

Where bulk cement is used, it shall be stored in weatherproof silos. If in the opinion of the Superintendent any dead storage exists, the silos shall be completely emptied at least every four months by the Contractor.

Any cement intended for work under the Contract and deemed to be inferior by the Superintendent shall not be used in the Works and shall be removed from the site within four hours of any notice given by the Superintendent.

All aggregates shall be obtained from an approved source and shall be dense natural aggregate complying with AS 1465 unless the prior approval of the Superintendent has been given to vary the provision of the relevant standards.

All water used in the mixing of concrete, grout or mortar, in cleaning out or wetting forms, in washing materials and equipment, and in curing concrete, shall be clean and potable.

Admixtures or fly ash shall not be used without the written approval of the Superintendent.

Reinforcement shall comply with the relevant Standards listed in Attachment A.

Reinforcement shall be stored clear of the ground.

SECTION 5 - QUALITY OF CONCRETE

5.1 SPECIFICATION OF CONCRETE

Concrete other than for minor concrete work and lean concrete shall have the required properties as shown on the Drawings.

Concrete for minor concrete work shall be a 1:2:3 mix to Table 4.1.4 of AS 1480 proportioned by weight.

Lean Concrete shall be of an approved mix proportioned by weight.

5.2 SAMPLING AND TESTING

The Contractor shall carry out the required sampling and testing programme using an independent laboratory approved by the Superintendent.

5.3 FURTHER TESTING

Should further testing of the finished concrete, due to the rejection of test specimens be required by the Superintendent, it shall be carried out in accordance with the procedures laid down in AS 1480.

5.4 REJECTION OF CONCRETE

The Superintendent may, at his discretion, reject any concrete if the test specimens are not acceptable. If, after further testing in accordance with Clause 5.3 above, the results fail to meet the requirements of this Specification the Superintendent will reject the concrete. Concrete may also be rejected in accordance with AS 1480, Rule 8.1.

The Contractor shall make good any concrete rejected by the Superintendent.

SECTION 6 - CONSTRUCTION, CONCRETE MIXING, TRANSPORTATION
AND PLACING

6.1 CONSTRUCTION - GENERAL

Prior to commencing work, the Contractor shall submit to the Superintendent for approval, a schedule showing the number, size and sequence of the concrete placements he proposes. The schedule shall recognise any construction joints shown on the Drawings. No concrete shall be placed prior to the approval of this schedule.

All foundations shall be taken down at least to the depths shown on the Drawings and on to ground having a safe bearing capacity at least that nominated in the Soils Report and to the approval of the Superintendent.

Over-excavated areas shall be reinstated in accordance with Specification C-TC-01 "Earthworks for Footings and Slabs."

Where specified on the Drawings, a layer of blinding concrete shall be placed to the levels indicated and allowed to harden before commencement of placing the structural concrete. Blinding concrete shall be as specified on the Drawings.

Where specified on the Drawings, a 0.2 mm polyethylene membrane shall be placed between the ground and all concrete to be placed.

All joints in the polyethylene sheeting shall be lapped 150 mm and taped to provide a complete seal. Where no side forms are used, and where shown on the Drawings the sheeting shall be continued up the sides of the excavation a minimum distance of 100 mm above finished grade.

6.2 CONCRETE PREPARATION, MEASURING, MIXING AND TRANSPORTING

The requirements of AS 1480 shall apply.

6.3 PLACING AND LIGHTING

All concrete shall be placed in daylight or under such lighting conditions that may be approved by the Superintendent.

During concreting, a competent steel fixer and a competent carpenter shall be in continuous attendance to adjust and correct the positions of any reinforcement or formwork which may become displaced. Immediately before placing concrete, all surfaces of foundations, upon or against which the concrete is to be placed, shall be free from standing water, mud, debris, oil, objectionable coatings and loose, semi-detached or unsound fragments. Where directed by the Superintendent surfaces of foundations shall be cleaned with air-water jets. The surfaces of absorptive foundations shall be moistened thoroughly.

6.4 COMPACTION

Compaction of concrete in forms shall be by approved immersion type vibrators .

The minimum rate of vibration when immersed in the concrete shall be as follows :

Vibrators less than 100 mm diameter 7000 rpm

Vibrators equal to or greater than
100 mm diameter 6000 rpm

In compacting each layer of concrete, the vibrator shall be operated in a near vertical position and the vibrating head shall be allowed to penetrate and revibrate the concrete in the upper position of the underlying layer. Contact of the vibrating head with the surface of the forms and reinforcement shall be avoided.

Vibration shall be limited to the time necessary to produce thorough compaction of the concrete without segregation. Under no circumstances shall vibrators be used to move concrete laterally.

During placing, and until curing as specified is completed, the concrete shall be protected as directed by the Superintendent against the harmful effects of exposure to sunlight, wind and rain.

SECTION 7 - REINFORCEMENT

Reinforcement shall not be reworked after initial forming.

Welding of reinforcement shall not be carried out unless shown on the Drawings, specified, or otherwise approved by the Superintendent.

SECTION 8 - FORMWORK

The Contractor shall design and be responsible for all formwork and falsework erected. If so requested by the Superintendent, the Contractor shall supply design calculations and drawings for the formwork and falsework, for approval. Forms shall have sufficient strength to withstand the pressure resulting from placement and vibration of the concrete and shall be maintained rigidly in position. Deflection of forms between joists and/or studs shall not exceed one five-hundredth (1/500) of the joist or stud spacing.

Forms shall comply with AS 1509 and be of wood, metal, structural hardboard or other suitable material which will produce clean concrete surfaces consistent with the specified finishes and within the specified tolerances.

Temporary openings shall be provided at the bases of all column and wall forms and at other points where necessary to facilitate cleaning and inspection immediately before the placing of the concrete.

The recommended minimum stripping times, as laid down in AS 1509, Table 4.2, shall be observed unless otherwise approved by the Superintendent.

The Contractor shall obtain the approval of the Superintendent prior to the removal of forms.

All formwork shall be removed prior to backfilling, unless otherwise approved by the Superintendent.

SECTION 9 - SURFACE FINISHES

Allowable deviations from plumb or level and from the alignment, profile grades and dimensions shown on the Drawings, are defined as "tolerances" and are distinguished from irregularities in finish as described in this clause. Surface irregularities are classified as "abrupt" or "gradual". Offsets caused by displaced or misplaced form sheeting, form lining, form sections, loose knots or otherwise defective form timber will be considered as abrupt irregularities and will be tested by direct measurements. All other irregularities will be considered as gradual and will be tested by either a straight edge or its equivalent for curved surfaces. The length of the straight edge will be 1500 mm for formed surfaces and 3000 mm for unformed surfaces.

Visible formed surfaces shall use Class 3 formwork in accordance with AS 1510 Part 1 lined with plastic faced plywood or other approved equivalent with a minimum area of 1.25 sq. metres per sheet with taped joints. Exposed internal and external corners of concrete shall be chamfered 25 mm. Non-visible formed surfaces shall use Class 4 formwork in accordance with of AS 1510 Part 1.

The classes of finishes for unformed finished surfaces are designated U1, U2 and U3.

Finish U1 (screeded finish) applies to unformed surfaces that will be covered by fill material or concrete. The surfaces shall be level and screeded sufficiently to provide even, uniform surfaces with surface irregularities not exceeding 10 mm.

Finish U2 (floated finish) applies to unformed surfaces not permanently sealed by fill material or concrete, and not required for finish U3. Floating shall be delayed until the screeded surfaces have stiffened to prevent the formation of laitance and shall be the minimum necessary to provide a surface free from screed marks and uniform in texture. Surface irregularities shall not exceed 6 mm.

Finish U3 (trowelled finish) applies where a dense uniform surface is required. When the floated surface has hardened sufficiently to prevent excessive fine material being drawn to the surface, steel trowelling shall be continued so as to flatten the sandy texture of the floated finish and produce a dense, uniform surface, free from blemishes and trowel marks. Surface irregularities shall not exceed 6 mm.

SECTION 10 - DEFECTS

Surface defects permitted without repair shall be limited to those specified in AS 1510 for the Class of formwork used.

For Class 3 formwork, blowholes with a largest visible dimension exceeding 12 mm but less than 23 mm shall be limited to 10 per square metre.

Concrete with defects in excess of the above shall be liable for rejection. If the Superintendent permits repairs, the defects shall be repaired by one or more of the following methods, as approved :

- (a) bagging, within 24 hours of exposing the surface, with a mortar consisting of one part cement to three parts of sand followed by subsequent stoning by skilled workmen to blend the repair surface to the adjoining formed surface.
- (b) repair with an epoxy/cement mortar to the manufacturer's directions, not sooner than 28 days after exposing the surface.
- (c) breaking out the defective concrete, reforming and replacing new concrete using an approved bonding agent between the new and old concrete.
- (d) injection under controlled pressure of a suitable epoxy resin, in accordance with the manufacturer's recommendations.

All repair work shall be at the Contractor's expense.

SECTION 11 - CONSTRUCTION TOLERANCES

The Contractor shall carefully and accurately set out the work true to the positions, levels, slopes and dimensions shown on the Drawings.

Construction tolerances shall comply with AS 1480. If these tolerances are exceeded the Contractor may be required, at the discretion of the Superintendent, to remove and replace or to modify the placed concrete before acceptance.

SECTION 12 - CURING

Curing shall comply with AS 1480, Rule 7.5

SECTION 13 - EMBEDDED METALWORK

All exposed embedded steelwork such as holding down bolts, edge protection angles and like fixtures shall be galvanized.

Where holding down bolts project from a formed surface, the formwork shall be drilled after erection, and the bolts rigidly fixed through such holes. Care shall be taken to ensure that mortar cannot leak from the form, and that bolts cannot move if struck by an internal vibrator during concrete compaction.

Holding down bolts in other positions shall be placed as follows :

- 13.1 A solid timber or steel template shall be used to maintain the exact position of the bolts during casting operations, and such templates shall be rigidly fixed to the formwork.
- 13.2 Where bolts are detailed on the Drawings with base plate and sleeves, full length sleeves of approved material shall be fitted concentrically around each holding down bolt and shall be kept in firm contact with the base plate.
- 13.3 On completion of casting operations the templates shall be removed taking care not to disturb the position of the bolts. Any concrete surfaces obscured by the templates shall then be finished as required.

Holding down bolt groups shall be fabricated into diagonally braced cages with 10 mm diameter bar tack welded so as to be rigidly held in all directions.

SECTION 14 - OTHER FIXTURES

Where shown on the Drawings other fixtures shall be set in the concrete to the details given and to the approval of the Superintendent.

SECTION 15 - WATERSTOPS

Waterstops, where shown on the Drawings, shall be manufactured from high grade PVC to "Expandite (Rawlplug) Aust. Pty Ltd" specifications, or approved equivalents, and shall be adequately secured when casting concrete to ensure a final position as shown on the Drawings.

All joints shall be fabricated using approved welding jigs as supplied by the manufacturer and be carried out strictly in accordance with the manufacturer's recommended procedure. Waterstops shall be prefabricated by the manufacturer into maximum lengths to minimise on site jointing. Tee intersections, where applicable, shall be incorporated into these prefabricated lengths.

ATTACHMENT A

LIST OF STANDARDS

The following Standards form part of this Specification:

AS1012	Methods of Testing Concrete
AS1129)	(Fly Ash for Use in Concrete
AS1130)	(
AS1141	Methods for Sampling and Testing Aggregates
AS1163	Structural Steel Hollow Sections
AS1170	SAA Loading Code
	Part 1 - Dead and Live Loads
	Part 2 - Wind Forces
AS1302	Steel Reinforcing Bars for Concrete
AS1303	Hard Drawn Steel Reinforcing Wire for Concrete
AS1304	Hard-drawn Steel Wire Reinforcing Fabric for Concrete
AS1315	Portland Cement
AS1317	Blended Cements
AS1379	Ready-mixed Concrete
AS1465	Dense Natural Aggregates for Concrete
AS1467	Lightweight Aggregates for Structural Concrete
AS1478	Chemical Admixtures for Use in Concrete
AS1479	Code of Practice for the Use of Chemical Admixtures in Concrete
AS1481	SAA Prestressed Concrete Code
AS1509	SAA Formwork Code
AS1510	Code of Practice for Control of Concrete Surfaces
	Part 1 - Formwork
AS1530	Methods of Fire Tests on Building Materials and Structures
AS1554	SAA Code for Welding in Building
	Part 3 - Welding of Reinforcing Steel
AS1475	SAA Code for Concrete Block Masonry
AS CCl	Part 1 - SAA Wiring Rules
ACI318-77	Building Code Requirements for Reinforced Concrete

CLUTHA DEVELOPMENT PTY LIMITED

SPECIFICATION NO.
C-TC-03

SUPPLY, FABRICATION AND ERECTION OF
STRUCTURAL STEELWORK

Revision	Date
0	1.4.85
1	9.8.85

This specification is of a general nature and only those sections where applicable shall apply to the Works.

SPECIFICATION C-TC-03
REVISION 1

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SECTION 1 - SCOPE

This Specification applies to the supply of material, fabrication, delivery to Site and erection on site of structural steelwork, steel platework and related operations.

SECTION 2 - STANDARDS

The Works to which this Specification refers shall be constructed in accordance with the latest edition of AS 1250, "SAA Steel Structures Code".

The latest edition of the Standards listed in Attachment A shall also apply, where relevant.

SECTION 3 - FABRICATION

3.1 TYPE AND GRADE OF STEEL

Hot rolled structural steel sections and hot rolled plate shall be Grade 250 complying with AS 1204.

Structural steel hollow sections shall be Grade 250 complying with AS 1163.

No grade of steel other than those stated above shall be used without the written approval of the Superintendent, except for purlins which shall be manufactured from Grade 450 steel complying with AS 1397.

3.2 SHOP DRAWINGS AND APPROVALS

The Superintendent's 'Issued for Construction' Drawings will show all member sizes, typical details and typical connections.

The Contractor shall carry out all necessary calculations to detail for fabrication all structural and other steelwork, and shall prepare shop drawings showing full shop details of all numbers. The overall layout of the finished steelwork shall conform to that shown on the Drawings.

The Contractor shall prepare erection drawings for all steelwork to be erected. The erection drawings shall show the location in the finished structure of every individual shipping piece as identified by a unique marking letter and/or number. The erection drawings shall also include bolt lists stating the required number of each type and size field bolt, with diameter, length, and washer type shown. The joint and members to be connected shall be stated by cross reference to the erection markings.

The Contractor shall supply the Superintendent with three copies of all shop drawings and erection drawings not less than eight working days before commencement of fabrication or erection. Within five working days, one copy of each drawing supplied shall be returned to the Contractor with the Superintendent's endorsement, and the Contractor shall proceed with the work in accordance with such endorsement unless a resubmission of the drawing is required. Should this be the case, the Contractor shall, within three working days, resupply three copies of the drawing amended to comply with the Superintendent's requirements.

The endorsement of a drawing as acceptable shall not relieve the Contractor of the responsibility for the accuracy of dimensions, correctness of member and bolt sizes, and general compliance of the finished steelwork

with Drawings and Specification requirements. Any on site corrections required because of inconsistencies, oversights and lack of compliance of detail on shop drawings with contract requirements shall be carried out by the Contractor at his own expense and to the satisfaction of the Superintendent.

In addition, the Contractor shall supply two final prints and one final mounted microfilm of each drawing before site erection commences.

3.3 CONNECTION DETAILING

In detailing gussets, plates and sections for connections, the details shall be consistent with the methods of cutting to be used so that compliance with Table 9.6.2 of AS 1250 is ensured. The shop drawings shall show the method of cutting to be used, which shall be consistent with edge distances shown on the shop drawings.

3.4 BENDING OF STEEL PLATEWORK COMPONENTS.

All plates and sections required to be bent to shape shall be shaped by cold forming in angle-ring bending roll machines, plate rolls or brake-presses as appropriate.

Sections rolled to shape shall be free of distortion before welding, so that they lie in a flat plane. Any distortion shall be corrected by pressing or heating. Hammering shall not be used.

3.5 WELDING

3.5.1 Weld Category

All welding shall be S.P. (Special Purpose) as defined in AS 1554, Part 1.

All electrodes for manual arc welding shall be Grade E48, shall be compatible with the parent metal and shall comply with AS 1553. Electrodes for other welding processes shall comply with the relevant Australian Standards.

3.5.2 Distortion and Shrinkage

In assembling and joining parts of a structure of built-up members and in welding reinforcing parts to members, the procedure and sequence shall be such as will minimise distortion and shrinkage.

As far as practicable, all welds shall be deposited in a sequence that will balance the applied heat of welding while the welding progresses.

The Contractor shall prepare a welding sequence for a member or structure which, in conjunction with the joint welding procedures and overall fabrication methods, will produce members or structures meeting the quality requirements specified. The welding sequence and distortion control program shall be submitted to the Superintendent, for approval, before the start of welding on a member or structure in which shrinkage or distortion is likely to affect the adequacy of the member or structure.

The direction of the general progression in welding on a member shall be from points where the parts are relatively fixed in position with respect to each other towards points where they have a greater relative freedom of movement.

Joints expected to have significant shrinkage shall be welded before joints expected to have lesser shrinkage. They shall also be welded with as little restraint as possible.

All shop splices in each component part of a cover-plated beam or built-up member shall be made before the component part is welded to other component parts of the member. Long girders or girder sections may be made by shop-splicing subsections, subject to Clause 2.3 above, each made in accordance with this paragraph.

In making welds under conditions of severe external shrinkage restraint, the welding shall be carried continuously to completion or to a point that will ensure freedom from cracking before the joint is allowed to cool below the minimum specified preheat and interpass temperature.

3.5.3 Certification of Welders

Each welder shall be qualified for each welding process he uses. The welder may, at the Superintendent's discretion, be qualified by evidence of a certificate issued within the previous twelve months by a State or Commonwealth Instrumentality or similar body, stating that the welder has passed tests for the particular welding process, weld type and positions to be used.

Alternatively the welders shall be tested in the presence of the Superintendent, for the welds they are to lay down using an approved welding procedure. The welds shall be assessed by visual examination and by macro testing to AS 2205.5.1 of test pieces by a NATA registered laboratory.

The permissible level of imperfections determined by visual examination shall not exceed those given in Table 6-2 of AS 1554, otherwise such imperfections shall be cause for rejection without further testing.

3.6 SUPPLY AND SUBSTITUTION

Substitution of structural sections shall not be made without approval of the Superintendent. Members shall not be made of short lengths without the approval of the Superintendent. Details of any proposed member splices other than those shown on the working drawings shall be submitted to the Superintendent for approval. Any member spliced without the Superintendent's approval shall be rejected and replaced by the Contractor at his cost.

3.7 TOLERANCES

The structural components shall comply with the tolerance limits of Clause 11.2 of AS 1250, together with the following requirements:

Crane Girders

Negative camber shall not exceed $\frac{L}{1000}$

Where L is the length of the member.

Squareness of End Plate and Welded Cleat Connections

The maximum deviation from squareness of the end shall be:

- | | |
|---|---|
| Plates and cleats with minimum dimension less than or equal to 800 mm | 1 mm per 400 mm of depth to a max. of 2 mm |
| Plates and cleats with minimum dimension over 800 mm | 1 mm per 400 mm of depth to a maximum of 3 mm |

The maximum deviation from flatness across the plate or cleat in any direction shall be:

- . Up to 800 mm 1 mm per 400 mm
of depth to a
maximum of 2 mm
- . Over 800 mm 1 mm per 400 mm
to a maximum of
3 mm

Edges of Plates to be Welded to Other Members

- . The flatness of plates at edges shall not deviate from straight or their specified configuration by more than 3 mm in any 3 metres.

Twist in a Member

The horizontal distance measured at the top flange from the vertical centreline of the out of plumb web shall not exceed:

- . For torsionally stiff members $\frac{L}{1500}$
- . For flexible members $\frac{L}{1000}$

Where L is the length of the member.

Camber and Sweep

Camber and Sweep shall be in accordance with Appendix B of AS 1227.

Combined Tilt and Warpage of Flange Plates

The combined warpage and tilt of flanges, shall be determined by measuring the offsets of the edges of the flanges from their position shown on the Drawings, which shall not exceed

$\frac{\text{Flange Width mm}}{200}$

or 3 mm, whichever is the lesser.

All measurements shall be made with an approved steel tape or rule. Dimensions of all steelwork shown on the Drawings or specified in Standards shall be assumed to apply at 22°C.

3.8 INSPECTION

Further to AS 1250, Clause 11.1.1, no structural steelwork shall leave the Contractor's workshop until such steelwork has been inspected and approved by the Superintendent.

3.9 TESTING

The Contractor shall ensure that manufacturers' certificates are available for inspection in compliance with AS 1227.

All non-destructive testing shall be performed by a testing laboratory registered by the National Association of Testing Authorities of Australia, or other approved authority, but the decision of the Superintendent on whether or not the defects shown by such testing are acceptable shall be final.

3.10 SURFACE TREATMENT

Surface treatment shall be carried out in accordance with Standard Specification No. M-TC-11.

3.11 HANDRAILING

All handrailing shall be "Monowill Tubular" handrail system or approved equal and shall be hot dipped galvanised, unless otherwise specified.

SECTION 4 - MARKING DELIVERY AND STORAGE

4.1 MARKING

Every separate member shall be plainly and permanently marked with paint to show position and direction as necessary for easy identification and correct placing. Loose pieces for connections shall be attached to their respective members. Bolts, where not in holes, shall be metal tagged, each type and size in a separate container.

Connections which are to be made by High Strength Bolts shall be given a 75 mm wide distinctive flash of colour clear of holes for easy identification.

The extent and size of all fillet welds which are to be made in the field shall be clearly marked. Where welds are to be made between dissimilar steels they shall be given a distinctive flash of colour.

Exposed, unpainted steel shall be marked with tags.

4.2 DELIVERY AND STORAGE

Each metal surface having a factory applied special finish shall be protected from physical or chemical damage in a manner approved by the Superintendent.

All structural steelwork shall be handled at all times so that it is not damaged, bent or twisted, and is stored clear of the ground in a way that the collection of water in low points is reduced to a minimum.

Damage to steelwork shall be repaired on site only with the consent of the Superintendent who, at his absolute discretion, will decide whether the repairs are to be carried out on site, whether the damaged items are to be returned to the fabrication shop for repairs, or whether the damaged items are to be replaced. Repairs to or replacement of damaged steelwork shall be carried out by the Contractor at his expense.

SECTION 5 - ERECTION

5.1 ERECTION METHODS

Not later than one month prior to commencing erection, the Contractor shall submit to the Superintendent details of the equipment and method he proposes to use in the erection of the steelwork. The methods and equipment shall be subject to the approval of the Superintendent, but the Contractor shall remain wholly responsible for the adequacy and safety of the work.

The Contractor shall have on site appropriate and adequate plant and equipment and sufficient skilled personnel for the safe and proper erection of structural steelwork, and shall comply with the erection requirements of AS 1250 (Steel Structures Code).

The Contractor shall set out such marks, lines and levels as may be necessary for the erection of all structural steelwork, and shall erect such steelwork to the dimensions, positions and alignments shown on the Drawings.

Before the erection of any member on concrete foundations, the Contractor shall thoroughly clean the concrete surfaces and clean out holding-down bolt pockets, removing all dirt, debris and all traces of forming material, and shall ensure that all holding down bolts will freely pass through the bolt holes in the base plates.

During erection, the structural steelwork shall be made safe against the wind and all erection stresses and loading conditions, including those due to erection equipment, by adequate bolting, guying or temporary bracing to make the structure secure. Permanent bolting or welding shall not be carried out until correct alignment has been obtained in each member of the structure within the tolerances specified by AS 1250.

Additional members used to facilitate erection shall be connected in a manner that does not weaken the steelwork.

Erection methods shall comply with the requirements of the relevant statutory authorities.

5.2 BOLTING

5.2.1 General

The bolts used shall be consistent with the bolting procedures shown on the Drawings for the connections. These procedures shall be one of the following :

Procedure Designation	Description	Relevant Application Code
4.6 S	M.S. bolts, threads included in shear plane, tightened to "Snug Tight" condition only defined in Clause 4.2.2 AS 1551	AS 1111, AS 1511
8.8 TF	H.S. bolts, fully tensioned, friction grip joints, (faying surfaces to be left unpainted or primed only, using inorganic zinc silicate)	AS 1511, AS 1252
8.8 TB	H.S. bolts, fully tensioned, acting in bearing, threads included in shear plane	AS 1511 AS 1252
8.8 S	H.S. bolts, tightened to "Snug tight" condition only.	AS 1511, AS 1252

At least one washer shall be placed under the bolt head or nut, whichever is to be rotated. Taper washers shall be used where the part under the bolt head or nut is not perpendicular to the centreline of the bolt.

Nuts of bolts where noted on the Drawings, and vertical bolts in tension shall be locked in position by an approved method.

All bolts, washers and nuts shall be hot dip galvanised to AS 1214.

All major bolted connections shall use only high strength steel complying with AS 1252. High strength bolts shall be 20 mm diameter unless otherwise shown and shall be torqued in accordance with AS 1511, using the "Part Turn of Nut Method".

Load indicating washers or bolts designed for special tightening procedures shall not be used unless approved by the Superintendent.

Burred, damaged, corroded or otherwise unserviceable bolts shall not be used.

5.2.2 Mild Steel Bolts

Minor connections for purlins and girts, door and window frames, handrails, ladders and minor platforms may be connected using commercial class mild steel bolts complying with AS 1111. Commercial class bolts shall be 16 mm diameter unless otherwise shown on the Drawings.

5.2.3 High Strength Bolts

High strength bolting shall be in accordance with AS 1511.

For high strength bolts and nuts, attention is drawn to the requirements of AS 1252 for the treatment of coated nuts and assembly testing.

The Contractor shall provide details of his proposed inspection and testing procedures for high strength bolt assembly components which shall be approved prior to placing a firm order for their supply and shall comply with the requirements of AS 1252.

5.3 BEDDING AND GROUTING

Where steelwork is supported by concrete, masonry or like material, it shall be set up on packing or wedges to facilitate alignment and permit subsequent grouting. Such packs, if permanent, shall be either of solid steel or grout of similar strength to the permanent grout. All other packs shall be removed before completion of grouting.

All grouting shall conform to AS 1250 with respect to materials and methods. Before grouting, the surfaces shall be cleaned of extraneous matter and, if dry, lightly wetted. The grout shall be a non-shrink type to the Superintendent's approval; it shall be a flowing type at placement placed under pressure. Dry-pack mortar shall not be used.

Polystyrene and other hole formers must be properly removed before grouting to ensure a good bond.

5.4 SITE CUTTING, DRILLING AND WELDING

During erection, steel members shall not be cut, burnt, welded or drilled without approval. Drifting may only be used for bringing parts into position, not to match unfair holes, enlarge holes, or distort metal.

Galvanised members shall not be reworked after galvanising, unless the Superintendent's written approval is first obtained.

SECTION 6 - CLADDING

6.1 GENERAL

The work specified in this Section includes the supply and fixing of all "Colourbond" profiled galvanized steel sheeting, flashings, and the like.

6.2 CLADDING MATERIALS

All roof sheeting and accessories shall be Lysaght's beige colour Colourbond sheeting of the Regular Spandek thickness and profile.

Accessories shall be formed from 0.67 mm thick sheet.

6.3 HANDLING AND STORAGE OF MATERIALS

All sheeting shall be supplied wrapped in secure watertight covers and shall be crated so that bundles can be lifted without damaging sheet edges.

No materials shall be placed directly on the ground. All materials shall be kept dry and undercover. Any sheeting or material which is water stained, mud stained or mottled shall be rejected and replaced at the Contractor's expense. Materials which are deformed or have damaged coating shall similarly be rejected.

6.4 FIXING

Cladding shall not be fixed to any steelwork until any site spray painting is completed within a minimum 15 m radius of the cladding to be fixed unless adequate precautions as approved by the Superintendent are taken to protect cladding from overspray.

The responsibility for protection of cladding from paint overspray and for cleaning or replacement of cladding which becomes marked, either by painting or by other causes, shall rest with the Contractor at all times.

Roof sheets shall be fixed through the ridges. Fasteners shall be self-tapping screws fitted with neoprene washers conforming to the recommendations of Lysaght Brownbuilt Industries (Selefast No. 920 Hexhead Type AB; or Buildex Type 23 thread cutting screw). Sheets shall be fixed with 5 fasteners per sheet at each end and 3 fasteners per sheet to each intermediate support.

All side laps of roof sheets shall be stitched by one screw between each pair of supports. Stitch fasteners shall conform to LBI recommendations (Selefast No. 9204 Slotted Panhead Type AB or Buildex Type S, both with neoprene washers).

All holes for the fixing of cladding shall be drilled. Punching of holes will not be permitted.

Care shall be taken to ensure that corrugations line up well over the full length of the roofs or walls and that side lap and end lap are properly meshed and fully bedded to ensure a tight seal at all joints in the roofs or walls. All sheets shall be overlapped in accordance with the manufacturer's recommendations.

Lifting sheets into position shall be carried out without the use of holes in sheets. It shall be done by wedging or some other approved method which does not damage the sheet.

ATTACHMENT A

LIST OF STANDARDS

The following Standards form part of this Specification:

Structural Steel

AS 1204	Structural Steels - Ordinary Weldable Grades.
AS 1205	Structural Steels - Weather-Resistant Weldable Grades.
AS 1131	Dimensions of Hot-Rolled Structural Steel Sections.
AS 1227	General Requirements for the Supply of Hot-Rolled Steel Plates, Sections, Piling and Bars for Structural Purposes.
AS 1397	Hot-dipped Zinc-coated Steel Coil and Cut Lengths
AS 1538	SAA Cold-formed Steel Structures Code.
AS 1595	Cold Rolled Unalloyed Low Carbon Steel Sheet and Strip.
AS 1365	Tolerances for Hot Rolled and Cold Rolled Unalloyed Low Carbon Steels (Coils and Cut Lengths).
AS 1163	Welded and Seamless Steel Hollow Sections for General Structural Purposes (Metric Units).
AS 1391	Methods for Tensile Testing of Metals.
AS 1657	Platforms and Ladders.

Bolting

AS 1111	ISO Metric Hexagon Commercial Bolts and Screws.
AS 1112	ISO Metric Hexagon Nuts, Including Thin Nuts, Slotted Nuts and Castle Nuts.
AS 1237	Flat Metal Washers for General Engineering Purposes.
AS 1275	Metric Screw Threads for Fasteners (Based on ISO Recommendations).
AS 1511	SAA High-Strength Structural Bolting Code.
AS 1252	General Grade High-Strength Steel Bolts with Associated Nuts and Washers for Structural Engineering (ISO Metric Series).

Welding

AS 1554	SAA Structural Welding Code.
AS 1796	Rules for the Certification of Welders.

ATTACHMENT A
LIST OF STANDARDS

AS 2214 SAA Structural Welding Supervisors' Certification Code.
AS 2207 Methods for the Ultrasonic Testing of Fusion Welded Joints.
AS 2177 Radiography of Welded Butt Joints in Metal Products.
AS 1552 Classification of Covered Electrodes.
AS 2203 Carbon Steel Electrodes Cored (for Arc Welding).
AS1858 Electrodes Welding Fluxes for Submerged Arc Welding of Carbon and Low Alloy Steels.
AS 1586 Low Alloy Steel Covered Electrodes for Manual Metal Arc Welding.
AS 1553 Low Carbon Steel Covered Electrodes for Manual Metal Arc Welding.
S2205.5.1 Part 5 - Metallographic tests - Macro Test - Cross Section Examination.

Related Codes

AS 1170 SAA Loading Code.
Part 1 - Dead and Live Loads.
Part 2 - Wind Forces.
AS 1480 SAA Concrete Structures Code.
AS 2121 SAA Earthquake Code.

Reference Manuals

SAA MA1 Manual on Steel Structures.
SAA MA1.8 Fabrication.
SAA MA1.9 Erection.

CLUTHA DEVELOPMENT PTY LIMITED

SPECIFICATION NO.
M-TC-02

WATER PUMPS

Revision	Date
0	28.3.85
I	9.8.85

CLUTHA DEVELOPMENT PTY LIMITED

SPECIFICATION NO.
M-TC-04

PROCESS LIQUID COOLER

Revision	Date
0	28.3.85
1	9.8.85

CLUTHA DEVELOPMENT PTY LIMITED

SPECIFICATION NO.
M-TC-05

FLAME ARRESTORS

Revision	Date
0	23.3.85
1	9.8.85

CLUTHA DEVELOPMENT PTY LIMITED

SPECIFICATION NO.
M-TC-06

CARBON STEEL VESSEL: PV-7

Revision	Date
0	3.4.85
1	9.8.85

CLUTHA DEVELOPMENT PTY LIMITED

SPECIFICATION NO.
M-TC-07

PIPING MATERIALS

Revision	Date
0	12.3.85
1	11.4.85
2	9.8.85

CLUTHA DEVELOPMENT PTY LIMITED

SPECIFICATION NO.
M-TC-08

SUPPLY OF MATERIALS AND LABOUR
AND
MECHANICAL INSTALLATION OF EQUIPMENT AND SERVICES

Revision	Date
0	28.3.85
1	9.8.85

CLUTHA DEVELOPMENT PTY LIMITED

SPECIFICATION NO.
M-TC-09

AIR COMPRESSORS

Revision	Date
0	28.3.85
1	9.8.85

CLUTHA DEVELOPMENT PTY LIMITED

SPECIFICATION NO.
M-TC-10

MECHANICAL EQUIPMENT

Revision	Date
0	1.4.85
1	9.8.85

This specification is of a general nature and only those sections where applicable shall apply to the Works.

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SECTION 1 - SCOPE

This Specification is supplementary to all equipment and construction specifications and covers the requirements for the selection, design, manufacture, supply, inspection and installation of mechanical equipment.

SECTION 2 - GENERAL REQUIREMENTS

2.1 UNITS

S.I. metric units shall be used for all drawings and calculations.

2.2 STANDARDS

All mechanical work shall comply with the latest issues, addenda, amendments and supplements of all relevant Australian Standards, Regulations, Codes and Statutory Requirements.

Notwithstanding the above, unless otherwise approved by the Superintendent, the equipment supplied shall also conform to the requirements of the relevant Standard Specification and /or Equipment Data Sheets

2.3. DATA SHEETS

Data Sheets containing all relevant information required to specify particular items of equipment shall accompany and/or be provided with the equipment.

Data Sheets may be:

- (a) fully detailed by the Superintendent
- (b) only partially detailed by the Superintendent
- (c) blank or not provided by the Superintendent

For cases (b) and (c) above the Contractor/Supplier shall complete or provide a completed Data Sheet to the Superintendent for approval prior to supply of the relevant item of equipment.

SECTION 3 - TECHNICAL REQUIREMENTS

3.1 LIMITS AND FITS

Limits and fits shall be selected in accordance with the system and recommendations covered by AS 1654, Limits and Fits for Engineering.

3.2 TOLERANCES

Equipment shall be manufactured to the tolerances shown on the Drawings.

In cases where dimensions are not toleranced on the Drawings, the following tolerances shall apply.

Machined components	± 0.25 mm
Small welded or cast components	± 1.5 mm
Large welded or cast components	± 3.0 mm

3.3 SURFACE FINISH

All machine surface finish designations shall be clearly noted on workshop drawings and shall be in accordance with AS 1100 Part 201, "Technical Drawing - Mechanical Drawing".

Where surface finish is not defined, it shall be medium machined to an Ra roughness grade of 3.2 um as defined in Table 4.5 of the above code.

3.4 DRIVES AND TRANSMISSIONS

3.4.1 General

Foot mounted drives are preferred. Drives shall be direct coupled where possible and the use of vee-belts and chains avoided except where speed changes may be necessary. Drives shall be fitted with guards which shall be easily removed for maintenance.

The service rating of each item of equipment shall be appropriate to the duty and shall be as specified on the respective approved Equipment Data Sheets.

The layout of drives and adjacent structures shall permit the removal of complete drive assemblies.

3.4.2 Gears and Gearboxes

Gearboxes shall preferably be helical type speed reducers selected from the manufacturer's standard range.

Gearboxes shall be capable of withstanding the fully stalled motor torque or any other overload torque produced by the motor or the braking torque of the equipment.

Gearboxes shall be designed for easy removal as a unit for maintenance purposes. Suitable lifting points shall be provided on all gearboxes.

The input shaft shall be capable of either clockwise or anti-clockwise rotation and all components shall be capable of operating in either direction. The replacement of individual gears or bearings shall be possible with a minimum of interference to other components.

Water cooling of lubricating oil and external air cooling shall be avoided if possible.

Gear casings shall be to the manufacturer's standard design, and shall be oil tight, water-tight, dustproof and of robust design. Fabricated gears and gear cases shall be stress relieved before machining.

Gearboxes shall be fitted with vents and breathers which are designed to prevent the loss of lubricant and the entry of water and dust.

The maximum oil temperature shall not exceed that recommended by the supplier of the oil.

To allow draining to be carried out quickly and cleanly, space shall be provided under gearboxes to admit a container equivalent to the gearbox capacity or extension pipes are to be fitted.

Gearboxes shall be provided with adequate facilities for inspection and/or minor maintenance operations.

3.4.3 Drive Bases

All items in the drive train shall be mounted together on a common, fabricated base, designed to withstand all loading combinations.

The baseplate shall be provided with pads machined in one setting. Not less than 1.5 mm of removable shims shall be provided between the baseplate pads and the feet of the drive components.

Jacking screws shall be provided to facilitate the alignment of drive components.

Bases shall be stress relieved after welding and prior to machining. All equipment shall be fully dowelled after final alignment using dowels, at least half the diameter of the anchor bolts and in no case less than 8 mm diameter.

3.4.4 Vee-Belt Drives

Vee-belt drives shall be avoided where possible, but when necessary, for general use, anti-static high tension wedge belt drives of SPZ, SPA, SPB, and SPC sections shall be used. Service factors and minimum pulley diameters shall be appropriate to the duty and as specified on the particular Equipment Data Sheets. For general applications the maximum ratio shall be 3:1, and the maximum number of belts per drive shall be five. Pulleys shall be attached to their shafts with taper lock bushes and parallel keys.

For multi-drives, banded belts shall be used in preference to matched sets of individual belts.

The use of non-standard pulleys shall be avoided.

For belt speeds below 25 m/s the pulleys and hubs shall be statically balanced. For belt speeds above 25 m/s the pulleys and hubs shall be dynamically balanced.

3.4.5 Mechanical Couplings

All couplings shall be radially and angularly flexible, except for rigid spacer couplings necessary to facilitate maintenance.

3.4.6 Fluid Couplings

Fluid coupling installations shall incorporate a suitable rigid spacer shaft between the motor and the coupling enabling easy motor or coupling removal.

When the equipment is operated at full speed and load conditions, the coupling slip shall not exceed 3.5%. The input side of the fluid couplings shall incorporate a flexible coupling, where possible.

The coupling shall be fully specified on Data Sheets.

3.5 BEARINGS

3.5.1 Ball and Roller Bearings

Where possible, all bearings shall be of standard types and sizes readily available in Australia and the number of different sizes used shall be minimised. Ball and roller bearing details shall be specified on the Data Sheets.

Preferred manufacturers are SKF or CBC. Bearings shall have a B10 life of not less than 60 000 hours.

Provision shall be made on bearings larger than 100 mm for high pressure oil injection or equivalent to facilitate removal.

3.5.2 Housings

Bearing housings shall be fitted with grease purged, "Taconite" labyrinth seals.

Unless otherwise specified by the Superintendent, housed bearings shall be grease lubricated and provided with grease nipples to the labyrinth cavities only. Bearing cavities shall be drilled, tapped and plugged.

Jacking screws shall be used for lateral adjustment of all bearing housings. The base end faces of plunger blocks shall be machined and bolt holes shall be spot faced.

Housings shall be aligned such that labyrinth radial clearances shall not differ on either side by more than 0.5 mm.

3.5.3 Mounting

The mounting of bearings shall be such as to facilitate ready removal without removal of shaft or items from the shaft (where practicable).

3.6 SCREW THREADS

Where machinery and equipment are manufactured specifically for the project the design shall be in accordance with AS 1275, Metric Screw Threads for Fasteners.

The minimum size bolt to be used shall be 16 mm diameter.

Unless otherwise specified, all bolts and nuts shall conform to one of the following Australian Standards:

- AS 1110 - ISO Metric Hexagon Precision Bolts and Screws
- AS 1111 - ISO Metric Hexagon Commercial Bolts and Screws
- AS 1112 - ISO Metric Hexagon Nuts.

Where proprietary items of equipment are used, the manufacturer's standard of threads will be accepted.

For normal static applications bolts shall be provided with nuts and lock washers, however, where bolted connections are subject to extreme vibration self-locking all metal nuts shall be used and all bolts, screws etc. which are assembled into blind holes shall be treated with a thread locking compound prior to assembly. Alternatively, Nyloc nuts may be selected for extreme vibration conditions.

Clearances for fitted bolts are to be in accordance with the drawings or as otherwise stated. Wherever practicable, all holes for fitted bolts shall be reamed on assembly and the mating components including the bolts shall be match marked by metal stamping.

3.7 KEYS AND KEYWAYS

Unless otherwise specified, all keys and keyways shall be in accordance with British Standard BS 4235, Keys and Keyways. The grade of key material shall be clearly shown on all drawings.

3.8 HEAT TREATMENT AND STRESS RELIEVING

Where heat treatment or stress relieving is specified, the procedure shall be fully described on the drawings or specifications.

A certificate from an approved N.A.T.A. testing laboratory shall be provided for all components that have been heat treated or stress relieved.

3.9 CASTINGS

Castings shall be produced in accordance with AS 1830, Grey Iron Castings, AS 2074, Steel Castings for General Engineering Purposes, or equal approved standards.

All castings shall be clearly identified with the manufacturer's part number.

The castings shall be free from harmful defects. In the event of defects which do not impair the usefulness of the casting, repairs may be carried out only after the approval of the Superintendent has been given. All rectification work shall be carried out at the expense of the supplier.

All testing of castings shall be performed on separately cast testbars and shall be the responsibility of the supplier.

3.10 PACKS AND SHIMS

All packs used in the levelling of equipment or its component parts shall be made up to the required thickness, with a flat surface free from indents or burrs. Uncoated new material only shall be used for packs.

All shims shall be cut from first class shimming material, free from indents and burrs. Shims are required to cover the mating surfaces and shall contain the minimum number of pieces. Edges shall not protrude proud of mating surfaces. Single shims shall be used wherever possible.

3.11 SEALS

All shaft seals shall be suitable for operation in an abrasive dust laden atmosphere and shall be high pressure water hose proof. 'Taconite' type seals with wiper seals are preferred.

3.12 WELDING

Unless otherwise specified, all arc welding shall be in accordance with AS 1554, Welding of Steel Structures.

Where welding procedures and consumables are not pre-qualified in accordance with Section 4 of the above code the proposed qualification tests and the results of the qualification tests shall be submitted to the Superintendent for approval.

All welding personnel shall be qualified for the work in accordance with Clause 4.11 of AS 1554 Part 1.

At the discretion of the Superintendent, welds shall be tested for the relevant types of imperfections by a test method nominated by the Superintendent, in accordance with the appropriate sections of AS 1554. Test reports shall be submitted to the Superintendent and shall conform to Clause 6.4.2 of AS 1554 Part 1.

Any proposed rectification of defective welds shall be appraised by the Superintendent.

Lifting lugs, alignment pads and all similar temporary attachments shall be of the same material as the parent metal, and the same welding materials and procedures shall be used.

Where specified, welded components shall be stress relieved. No further welding will be permitted after stress relieving.

For all highly stressed welds, a test sample shall be made and tested by an approved laboratory. The approved procedure shall be strictly adhered to during welding.

3.13 LUBRICATION

3.13.1 General

All lubrication points, grease points, and labyrinth seal cavities shall be piped to an accessible position. All grease lines shall be permanently marked for identification. Multiple points shall be piped to a common grease station.

Where applicable, automatic or manually operated centralised lubrication systems shall be provided.

Pumps and reservoirs shall be located at easy access positions with due consideration being given to the replenishment of grease reservoirs.

Type, grade and quantity of lubricants used in equipment shall be specified on a lubrication schedule to be provided with the equipment.

3.13.2 Grease Lubrication

Lubrication of bearings shall be strictly in accordance with manufacturer's recommendations.

Frequency of greasing of the bearing cavity shall be based on life of grease. Frequency of greasing of labyrinth cavities shall be based on labyrinth contamination.

Grease nipples shall be large button-head type 8 mm nominal bore BSP nipples and standardised throughout the plant.

3.13.3 Oil Lubrication

Bearings designed with circulatory oil systems shall be designed to incorporate filters which can be cleaned in service without isolation and without the use of tools.

Oil flow sight glasses or indicators of an approved type shall be installed in the return line from each bearing.

A protective device shall be fitted to stop the equipment in case of lubrication failure.

3.14 PNEUMATIC SYSTEMS

Filters, lubricators, and pressure regulators complete with auto-drain units shall be provided where necessary to ensure that equipment manufacturer's requirements are met.

Instrument air provisions shall be made where required with suitable oil and particulate filters.

Drain units shall be provided at low points in lines.

Pneumatic systems shall be made failsafe.

Air receivers shall meet the requirements of AS 1210 - Unfired Pressure Vessels.

The air receiver shall be fitted with the following equipment:

- . Pressure gauge with isolation cock
- . Inspection hole
- . Drain
- . Safety relief valve
- . Plugged socket
- . Flanged Inlet and Outlet.

The receiver shall be approved and stamped by an Australian Department of Labour.

3.15 GUARDS

Guards shall be provided at every dangerous point of all moving machinery. The guards shall be designed to satisfy the requirements of the applicable Statutory Authorities.

The guards shall be an integral part of the design of the machine and shall not in themselves provide a hazard.

Guards shall not require removal during normal draining, lubrication or belt and chain tension adjustments.

3.16 INSPECTION

The Principal reserves the right to inspect all equipment during and after manufacture.

The Contractor's/Supplier's specifications and drawings shall clearly describe all materials, manufacturing procedures, treatment and testing and all components.

The Contractor shall maintain records of all inspections for review by the Superintendent at his request.

3.17 TESTING

3.17.1 General

The Contract includes provision for all reasonable tests requested by the Superintendent and mandatory tests.

Adequate notice of all proposed tests shall be given to the Superintendent who at his discretion shall arrange for the tests to be witnessed.

The results of all tests shall be submitted on appropriate Test Certificates to the Superintendent for approval.

3.17.2 Materials

Unless manufacturer's certified test certificates are supplied, selected materials shall be tested as follows.

(a) Destructive Tests

Where nominated by the appropriate code, specified, or required by the Superintendent, destructive testing of samples shall be carried out by a N.A.T.A. approved laboratory.

(b) Non-Destructive Tests

Non-destructive testing shall be carried out where specified or when in the opinion of the Superintendent, it is warranted.

Non-destructive testing shall be carried out by approved authorities.

Where visual inspection or the use of magnetic particles or dye penetrants reveals surface defects, the Superintendent may at his discretion nominate that ultrasonic or X-ray examination shall be used to establish the extent of the defects.

3.17.3 Shop Assembly and Testing

Where possible, equipment shall be fully shop-assembled and tested. The equipment shall be designed and fabricated to eliminate any welding in the field. Sub-assemblies shall be as large as transportation permits, and all parts shall be clearly marked for field erection.

Shop tests shall be simulated as near as possible to the expected site operating conditions, and shall include overload provision where applicable.

3.17.4 Site Performance and Acceptance Tests

After installation and before acceptance, all equipment shall be tested to prove its capability of meeting its performance specification.

3.18 PAINTING

Unless otherwise specified, all mechanical components shall be painted in accordance with the manufacturers standard.

3.19 PACKAGING AND PROTECTION

Before delivery and after final inspection, all machined surfaces shall be given a coat of an approved rust-preventative and the completed equipment suitably packed or crated so as to guard against any loss or damage in any way during transit.

All crates shall be clearly identified.

All screw threads shall be protected by grease or other approved protective coating and where mechanical damage may be sustained during transit shall be suitably wrapped or otherwise protected.

The mating surfaces of all components permanently assembled prior to painting shall be uniformly coated with an approved rust-preventative prior to assembly. Surfaces which will be packed or shimmed shall be coated with an approved rust preventative.

To prevent brinnelling of bearings, shafts shall be blocked to relieve the bearings of load during transportation.

3.20 DRAWINGS

Reproducible drawings shall be supplied with all equipment.

As a minimum, drawings shall show all dimensions necessary to locate the equipment, with respect to associated equipment, and secure it to its mountings.

SI units shall be used for all drawings and calculations.

3.21 NOISE

The maximum acceptable noise level from any piece of equipment shall be 85 dB(A) at 1 metre from the external surface of the equipment.

Where noise levels are likely to exceed these limits, sound attenuating enclosures, approved by the Superintendent shall be provided around the equipment so as to reduce the noise level to a maximum of 85 dB(A) at a distance of 1 metre from the outside surface of the attenuator.

CLUTHA DEVELOPMENT PTY LIMITED

SPECIFICATION NO.
M-TC-11

PAINTING SPECIFICATION

Revision	Date
0	1.4.85
1	9.8.85

This specification is of a general nature and only those sections where applicable shall apply to the Works.

CLUTHA DEVELOPMENT PTY LIMITED

SPECIFICATION NO.
E-TC-100

415 VOLT SQUIRREL CAGE INDUCTION MOTORS (FLAMEPROOF)

Revision	Date
0	27.8.85

This specification is of a general nature and only those sections where applicable shall apply to the Works.

CLUTHA DEVELOPMENT PTY LIMITED

SURFACE CIVIL AND MECHANICAL WORK FOR GAS DRAINAGE
AT TAHMOOR MINE

SPECIFICATION AND DRAWINGS

Specification

The Specification comprises the following:-

- Specification No. M-TC-14, Rev 0
- Specification No. S-TC-01, Rev 0
- Specification No. C-TC-01, Rev 1
including: Attachment A
- Specification No. C-TC-02, Rev 1
including: Attachment A
- Specification No. C-TC-03, Rev 1
including: Attachment A
- Specification No. M-TC-02, Rev 1
including: Data Sheet No DS-TC-PU-4
Attachment A
- Specification No. M-TC-04, Rev 1
including: Data Sheet No DS-TC-HE-1
Attachment A
- Specification No. M-TC-05, Rev 1
including: Data Sheet No DS-TC-AR-1
Attachment A
- Specification No. M-TC-06, Rev 1
including: Attachment A
- Specification No. M-TC-07, Rev 2
- Specification No. M-TC-08, Rev 1
- Specification No. M-TC-09, Rev 1
including: Data Sheet No DS-TC-CM-1
Data Sheet No 1243-JDS-006
Data Sheet No 1243-JDS-002
Attachment A
- Specification No. M-TC-10, Rev 1
- Specification No. M-TC-11, Rev 1
- Specification No. E-TC-100, Rev 0
- Appendix A

The Contractor shall be wholly responsible for performing the Works in accordance with the Specification

Drawings

The Drawings listed hereunder form part of the Contract documents and shall be read in conjunction with the Specification.

- (A) The following Drawings (full B1 size) define the scope of the work to be carried out under the Contract and show the overall layout and details of the surface civil and mechanical work for gas drainage at Tahmoor mine:-

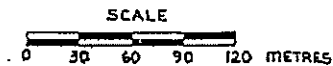
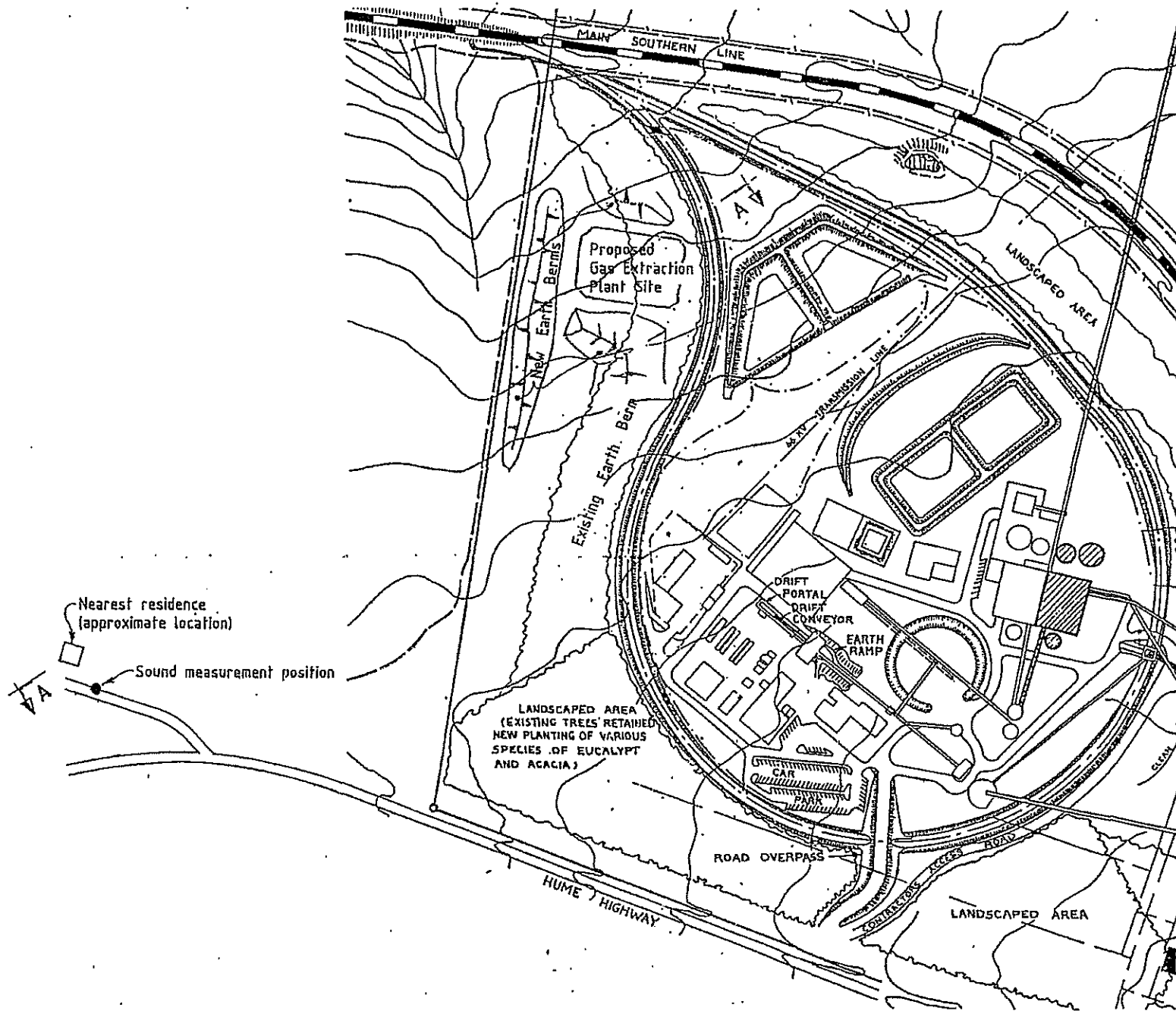
<u>Drawing No.</u>	<u>Revision</u>	<u>Title</u>
T/L/1001	D	Tahmoor Mine Surface Gas Extraction Plant Site Plan
T/F/1005	B	Tahmoor Mine Gas Extraction Surface Plant Pump Station Concrete Layout and Details
T/F/1006	B	Tahmoor Mine Gas Extraction - Surface Miscellaneous Concrete Footing Details
T/F/1007	B	Tahmoor Mine Gas Extraction - Surface Plant Standard Drawings Concrete Details
T/S/1010	B	Tahmoor Mine Gas Extraction - Surface Plant Pump Station Steelwork Arrangement
T/S/1011	B	Tahmoor Mine Gas Extraction - Surface Plant Pump Station Steelwork Details
T/S/1012	B	Tahmoor Mine Gas Extraction - Surface Plant Standard Drawings Steelwork Details
T/P/1015	B	Tahmoor Mine Surface Gas Extraction Plant Pumping Station Arrangement
T/P/1016	B	Tahmoor Mine Surface Gas Extraction Plant Piping Layout

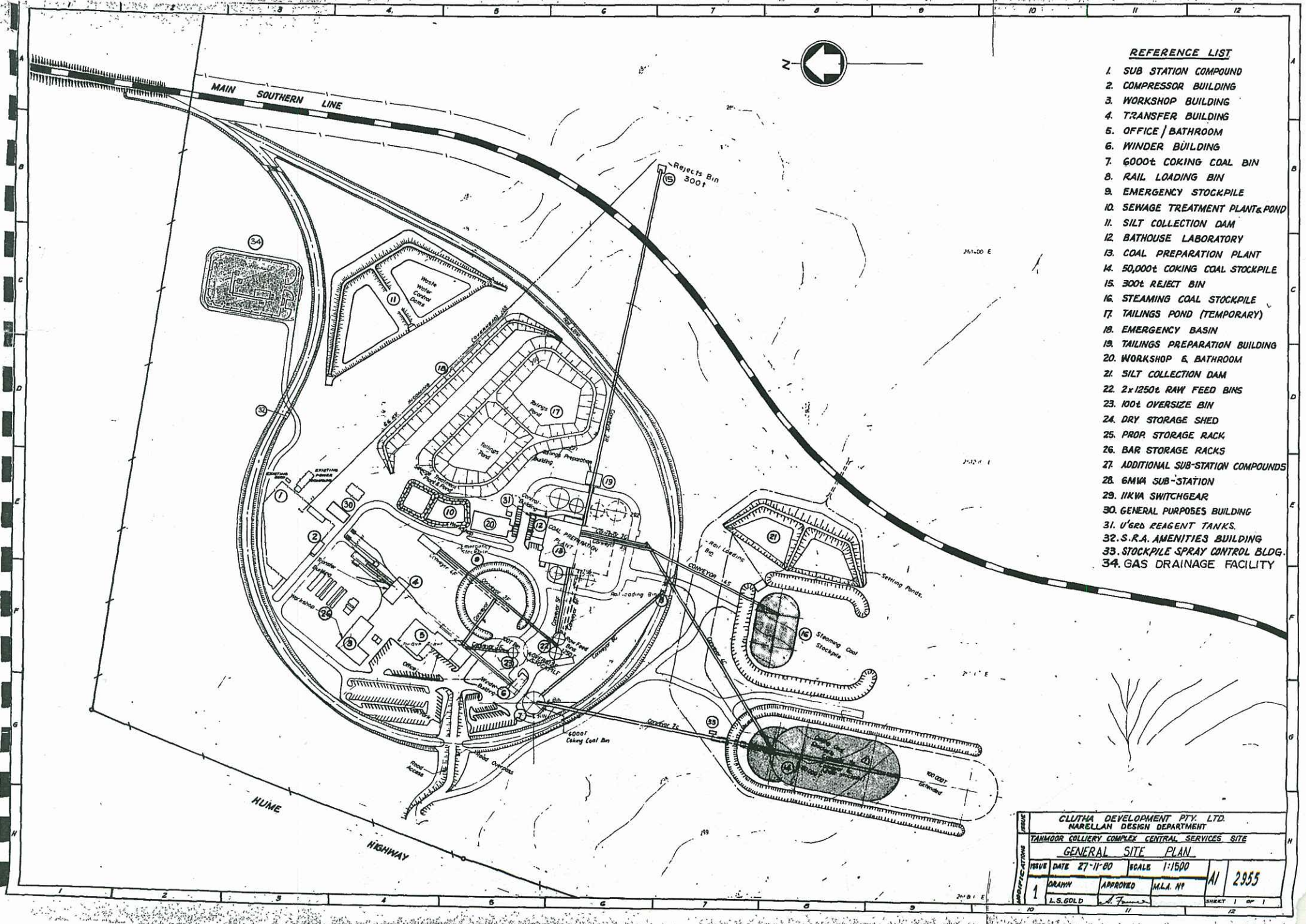
<u>Drawing No.</u>	<u>Revision</u>	<u>Title</u>
T/P/1017	A	Tahmoor Mine Surface Gas Extraction Plant Piping Details
T/I/1020	B	Tahmoor Mine Surface Gas Extraction Plant Suction Assisted Drainage Piping & Instrumentation Diagram
T/I/1021	A	Tahmoor Mine Surface Gas Extraction Plant Services Piping & Instrumentation Diagram
T/I/1022	C	Tahmoor Mine Surface Gas Extraction Plant Piping & Instrument Diagram Post Drainage Borehole
T/G/1050	B	Tahmoor Mine Gas Extraction - Surface Plant Standard Drawings Security Fencing Details

- B) The following Drawings (full B1 size) are provided for information and show details of the main electrical cable routes:-

<u>Drawing No.</u>	<u>Revision</u>	<u>Title</u>
T/E/1043	C	Tahmoor Mine Surface Gas Extraction Plant Equipment Layout & Main Cable Route Diagram Sheet 1 of 2
T/E/1044	B	Tahmoor Mine Surface Gas Extraction Plant Equipment Layout & Main Cable Route Diagram Sheet 2 of 2

SITE PLAN SHOWING
MEASUREMENT POSITION

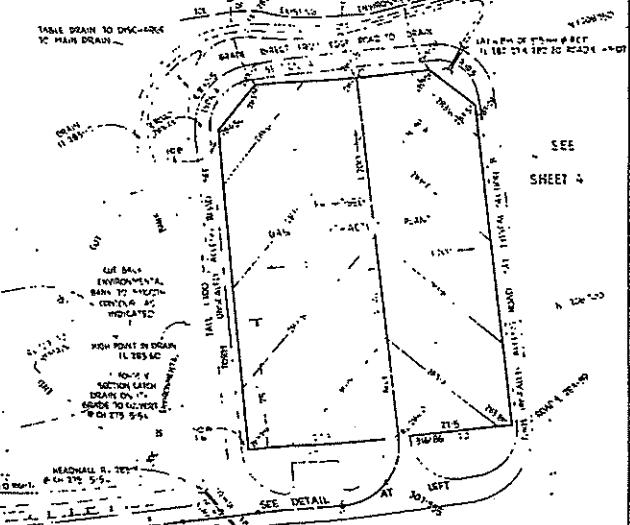
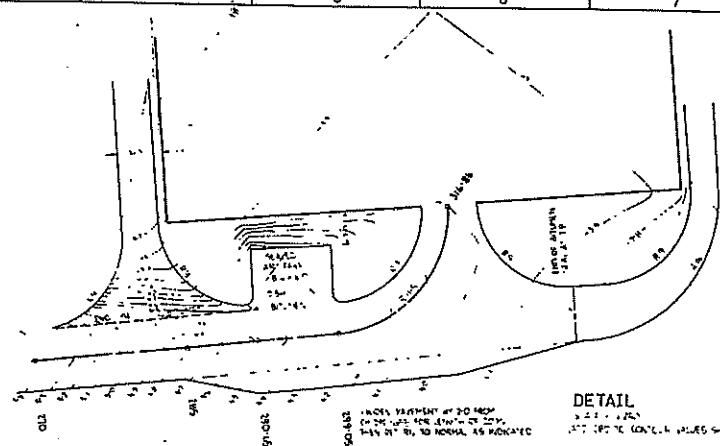
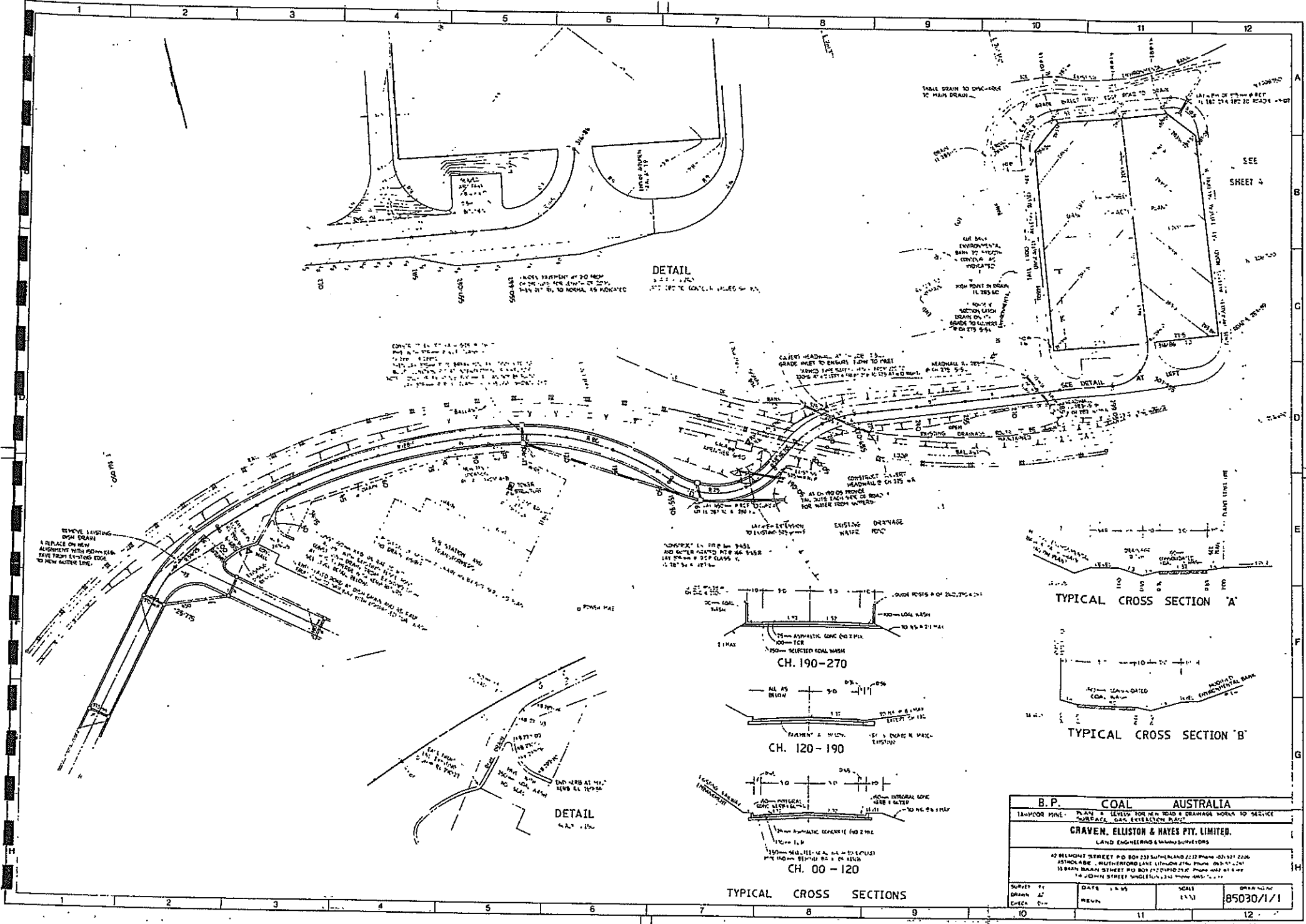




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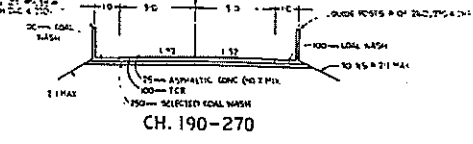
1. SUB STATION COMPOUND
2. COMPRESSOR BUILDING
3. WORKSHOP BUILDING
4. TRANSFER BUILDING
5. OFFICE / BATHROOM
6. WINDER BUILDING
7. 6000t COKING COAL BIN
8. RAIL LOADING BIN
9. EMERGENCY STOCKPILE
10. SEWAGE TREATMENT PLANT & POND
11. SILT COLLECTION DAM
12. BATHOUSE LABORATORY
13. COAL PREPARATION PLANT
14. 50,000t COKING COAL STOCKPILE
15. 300t REJECT BIN
16. STEAMING COAL STOCKPILE
17. TAILINGS POND (TEMPORARY)
18. EMERGENCY BASIN
19. TAILINGS PREPARATION BUILDING
20. WORKSHOP & BATHROOM
21. SILT COLLECTION DAM
22. 2x1250t RAW FEED BINS
23. 100t OVERSIZE BIN
24. DRY STORAGE SHED
25. PROR STORAGE RACK
26. BAR STORAGE RACKS
27. ADDITIONAL SUB-STATION COMPOUNDS
28. 6MVA SUB-STATION
29. 11KVA SWITCHGEAR
30. GENERAL PURPOSES BUILDING
31. U'6rd REAGENT TANKS.
32. S.R.A. AMENITIES BUILDING
33. STOCKPILE SPRAY CONTROL BLDG.
34. GAS DRAINAGE FACILITY

CLUTHA DEVELOPMENT PTY. LTD.			
MARELLAN DESIGN DEPARTMENT			
TANMOOR COLLIERY COMPLEX CENTRAL SERVICES SITE			
GENERAL SITE PLAN			
ISSUE DATE	27-11-80	SCALE	1:1500
DRAWN	APPROVED	M.L.A. NY	A1 2955
L.S.G.D.L.D.	A. F.		SHEET 1 OF 1

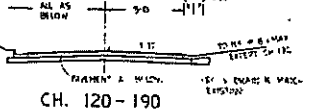


REMOVE EXISTING DRAIN
 & REPLACE ON NEW ALIGNMENT WITH 150mm DIA. PIPE FROM EXISTING EDGE TO NEW OUTLET LINE.

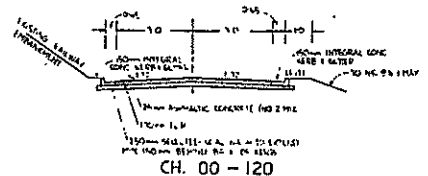
CONSTRUCT DRAIN HEADWALL @ CH 175
 AT D POINTS PROVIDE 150mm DIA. PIPE AT EACH SIDE OF ROAD FOR WATER FROM INTERSECTIONS.



TYPICAL CROSS SECTION 'A'

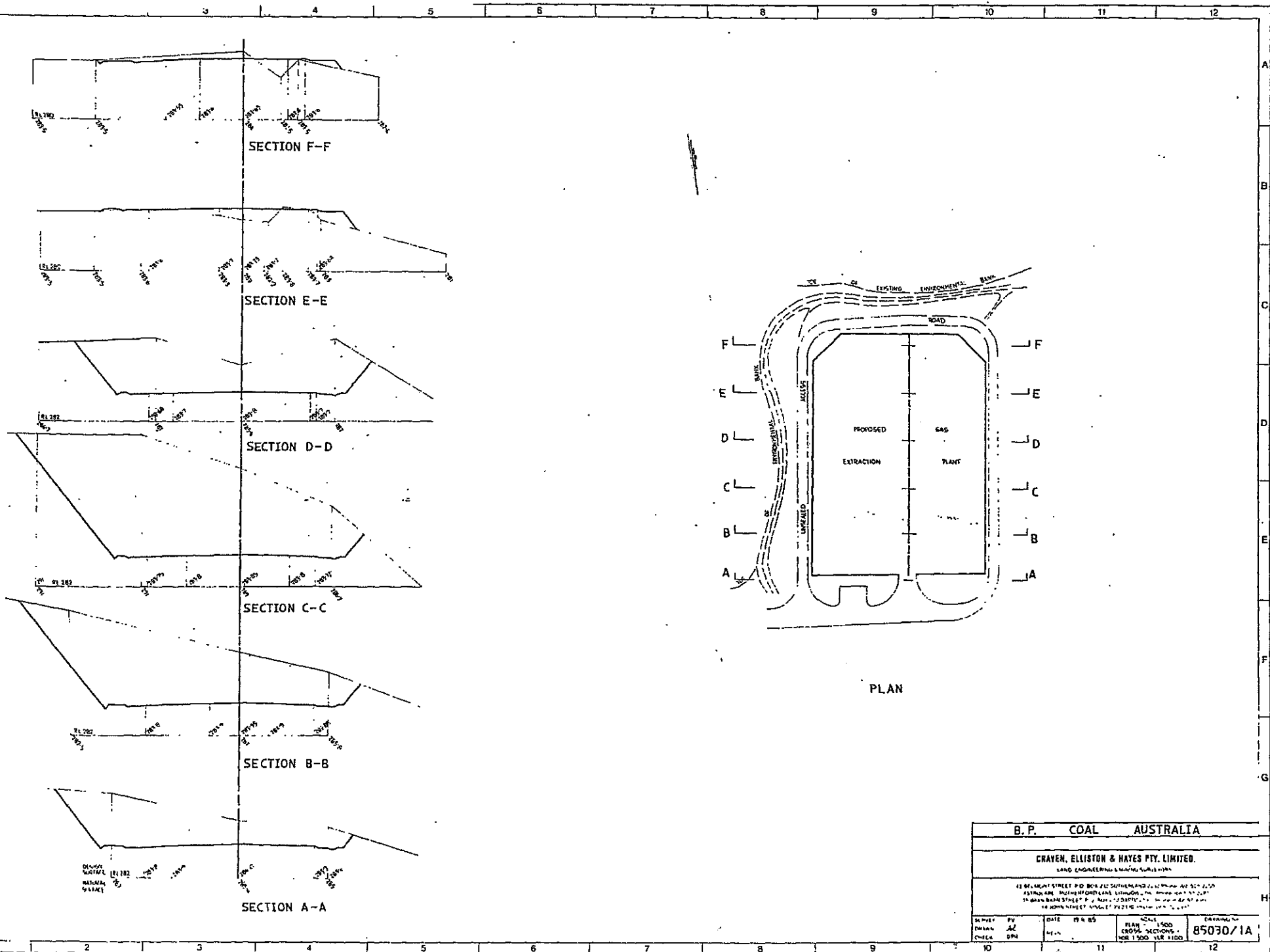


TYPICAL CROSS SECTION 'B'



TYPICAL CROSS SECTIONS

B.P. COAL AUSTRALIA			
LANSHOOR MINE	PLAN & LEVELS FOR NEW ROAD & DRAINAGE WORKS TO SERVICE UNDERFACE, GASK EXTERIOR WALL		
GRAVEN, ELLISTON & HAYES PTY. LIMITED.			
LAND ENGINEERING & MINING SURVEYORS			
42 BELMONT STREET P.O. BOX 232 SUTHERLAND 2212 PH (08) 927 2206			
ASPHOLABE - MULLENBOROUGH LITHIUM PTY. LTD. PH (08) 927 2207			
15 BARRY STREET SHEPPARTON P.O. BOX 72 DUNDAS PH (08) 927 2208			
14 JOHNSON STREET MORGANTOWN PH (08) 927 2209			
SURVEYED BY DRAWN BY CHECKED BY	DATE REVISED	SCALE 1:100	DRAWING NO. 85030/1/1



SECTION F-F

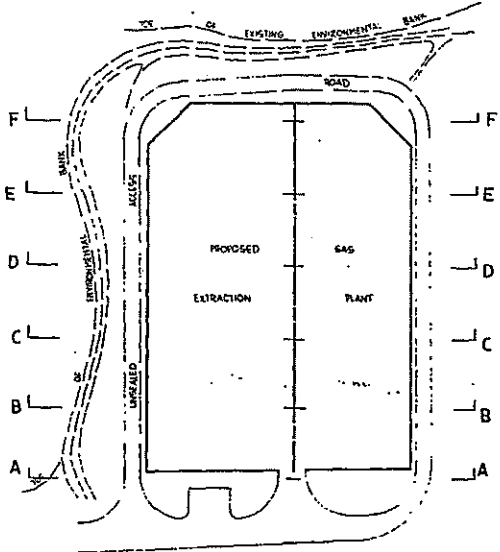
SECTION E-E

SECTION D-D

SECTION C-C

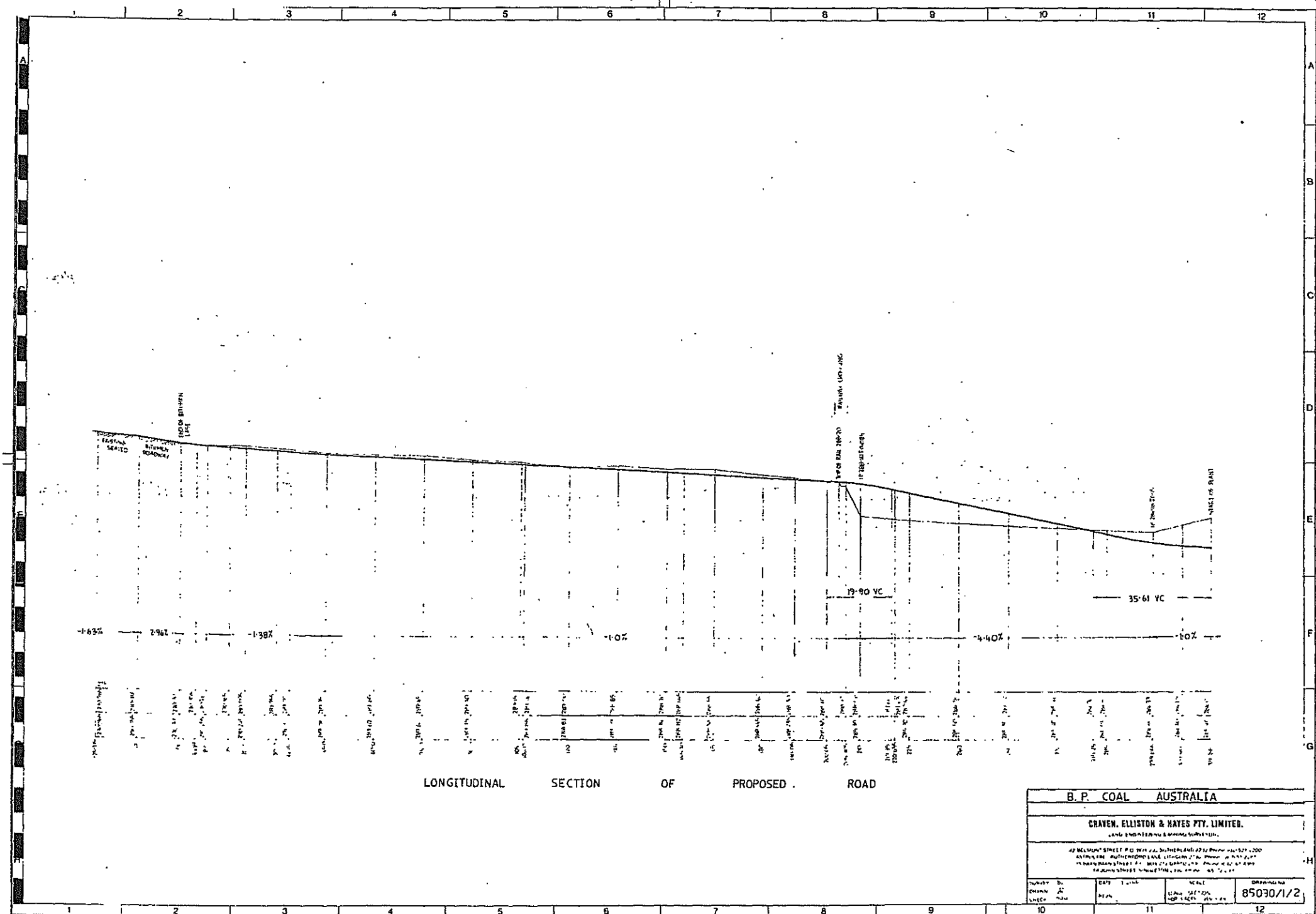
SECTION B-B

SECTION A-A

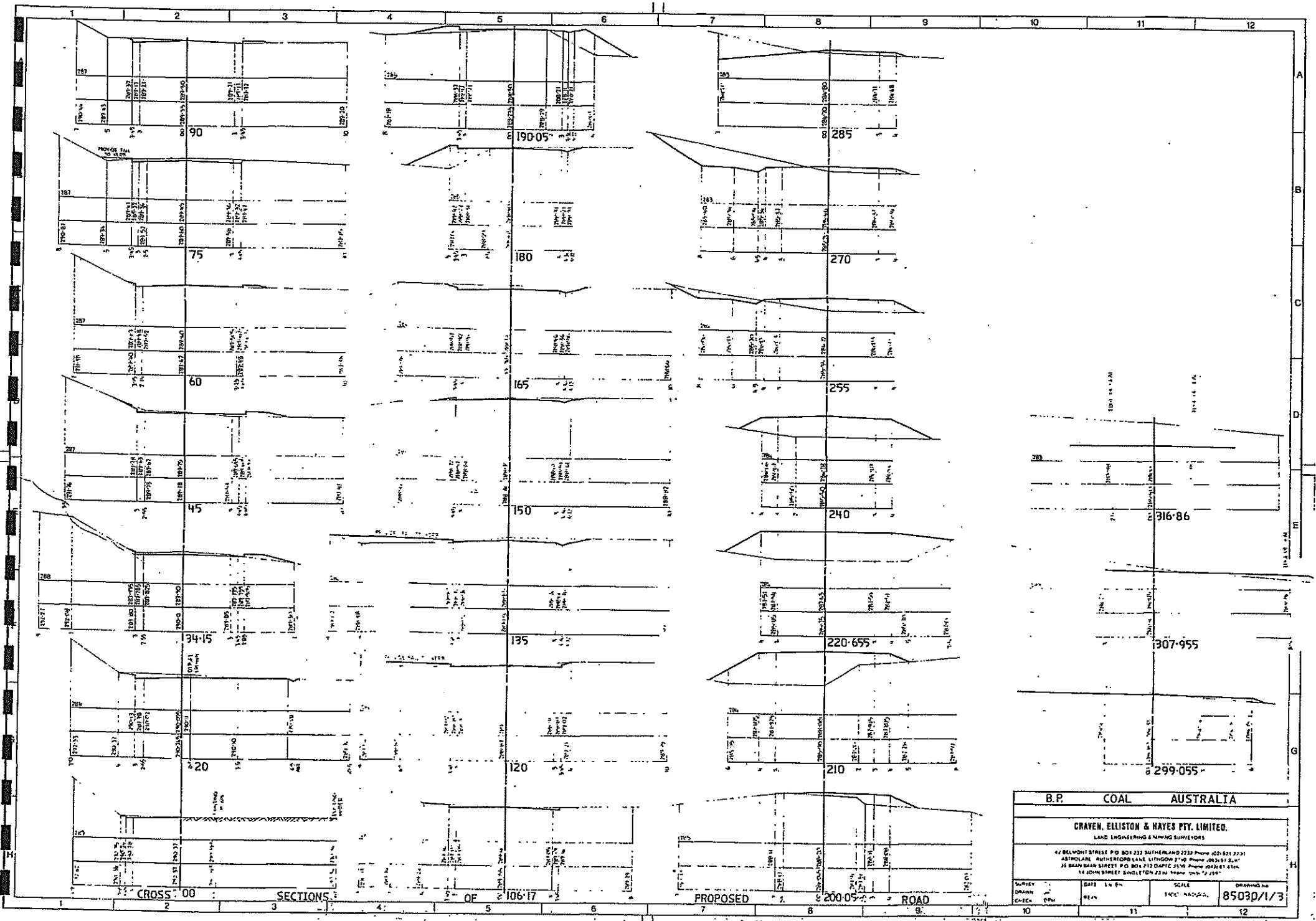


PLAN

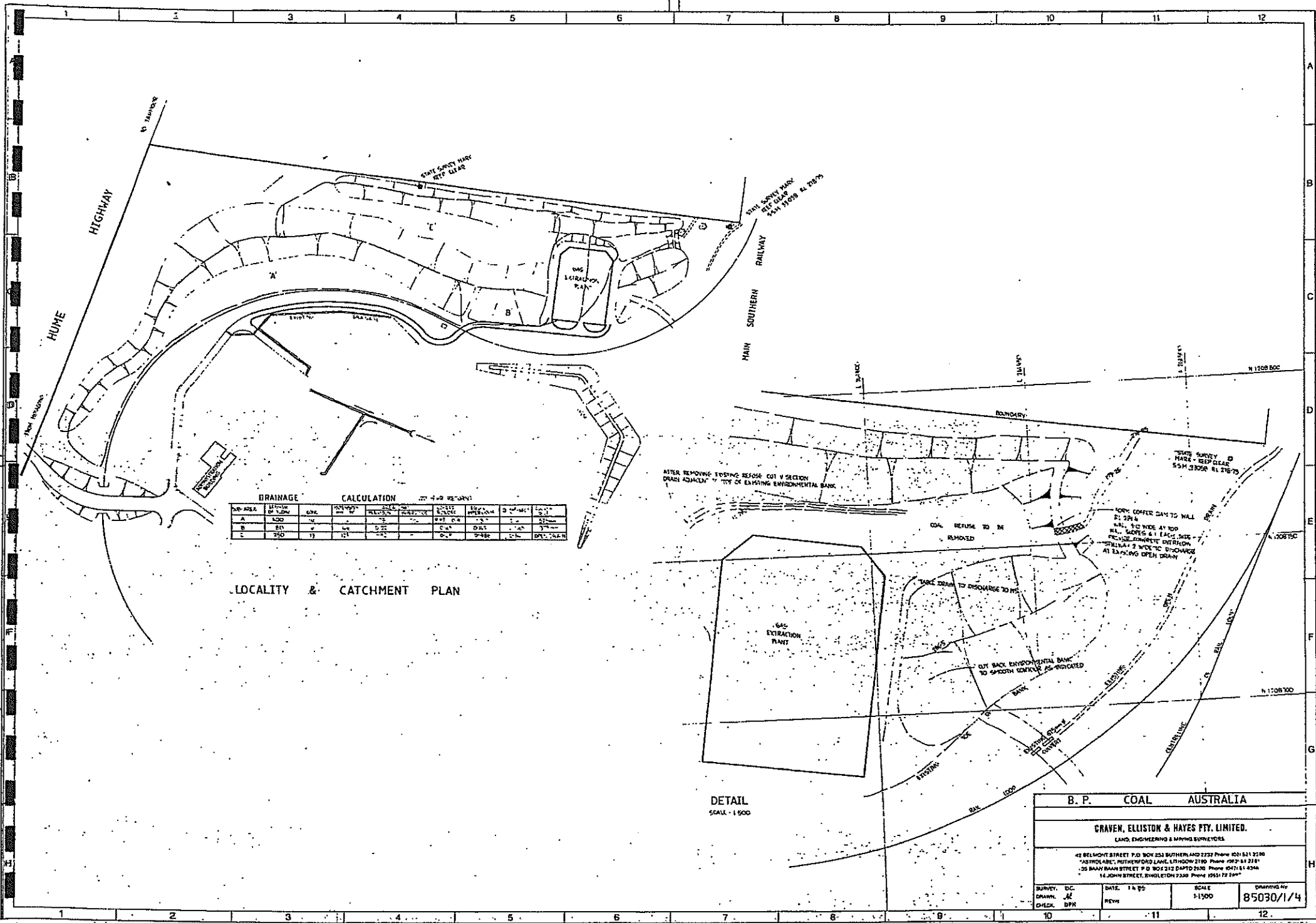
B. P. COAL AUSTRALIA					
CRAYEN, ELLISTON & HAYES PTY. LIMITED. LAND ENGINEERING CONSULTANTS					
13 BELMONT STREET P.O. BOX 210 SUTHERLAND N.S.W. 2557 ESTABLISHED IN 1954 10 JOHN STREET P.O. BOX 2300 SYDNEY N.S.W. 2001 10 JOHN STREET SYDNEY N.S.W. 2001					
DESIGNED BY CHECKED BY	DATE 1/2	DATE 1/2	DATE 1/2	SCALE PLAN 1:500 CROSS SECTIONS 1:500 V.R. 1:100	DRAWING NO. 85030/1A



B. P. COAL AUSTRALIA			
CRAWEN, ELLISTON & NAYES PTY. LIMITED.			
47 BELLSHOP STREET, P.O. BOX 222, BELLSHOP, AUSTRALIA 3200			
15 BERRY STREET, P.O. BOX 274, BERRY, AUSTRALIA 2716			
DATE	SCALE	DRAWING NO.	
1/11/72	1:100	85030/1/2	



B.P. COAL AUSTRALIA			
CRAVEN, ELLISTON & HAYES PTY. LIMITED.			
LAND ENGINEERS & MINING SURVEYORS			
42 BELVOUE STREET P.O. BOX 232 SUTHERLAND 2232 Phone (02) 521 2201			
ASTORIA, PERTH/STURDY LANE LITHGOW 2700 Phone (08) 511 2111			
25 BLENHEIM STREET P.O. BOX 213 GARDIC 2550 Phone (08) 221 4144			
14 JOHN STREET ANGLETON 2230 Phone (08) 72 2287			
SURVEY	DATE	SCALE	DRAWING NO.
CHECK	11/87	1"=100'	85030/1/3
	11		12

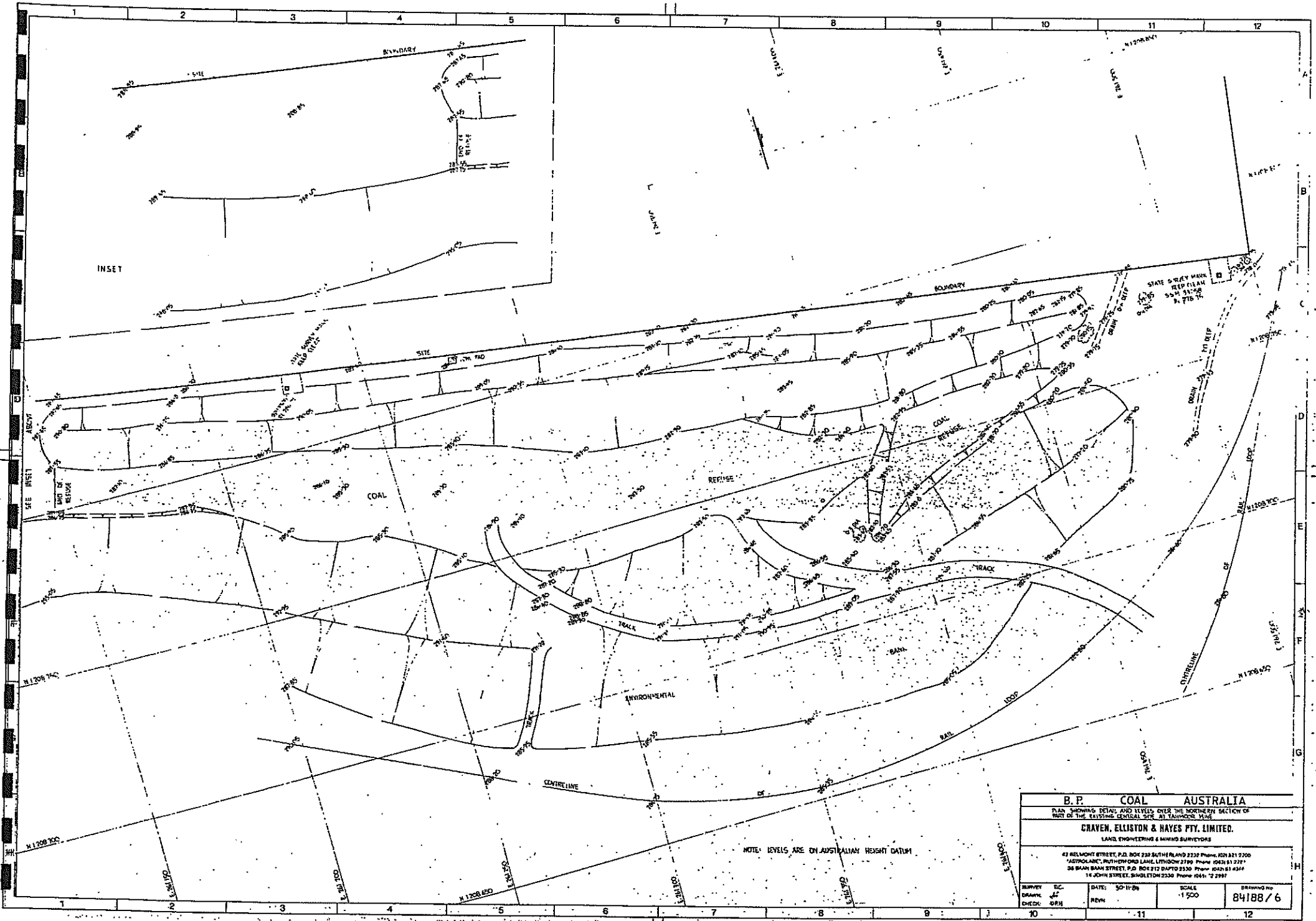


DRAINAGE		CALCULATION		CROSS SECTION		CROSS SECTION		CROSS SECTION	
NO.	AREA	PERCENT	PERCENT	PERCENT	PERCENT	PERCENT	PERCENT	PERCENT	PERCENT
A	100	10	10	10	10	10	10	10	10
B	80	8	8	8	8	8	8	8	8
C	250	13	13	13	13	13	13	13	13

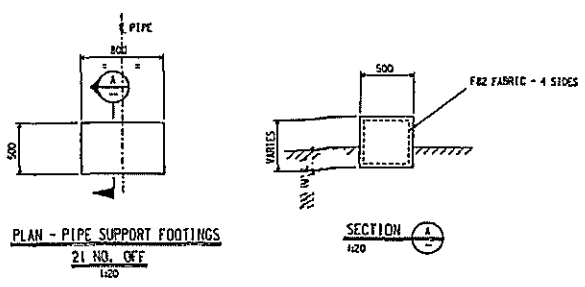
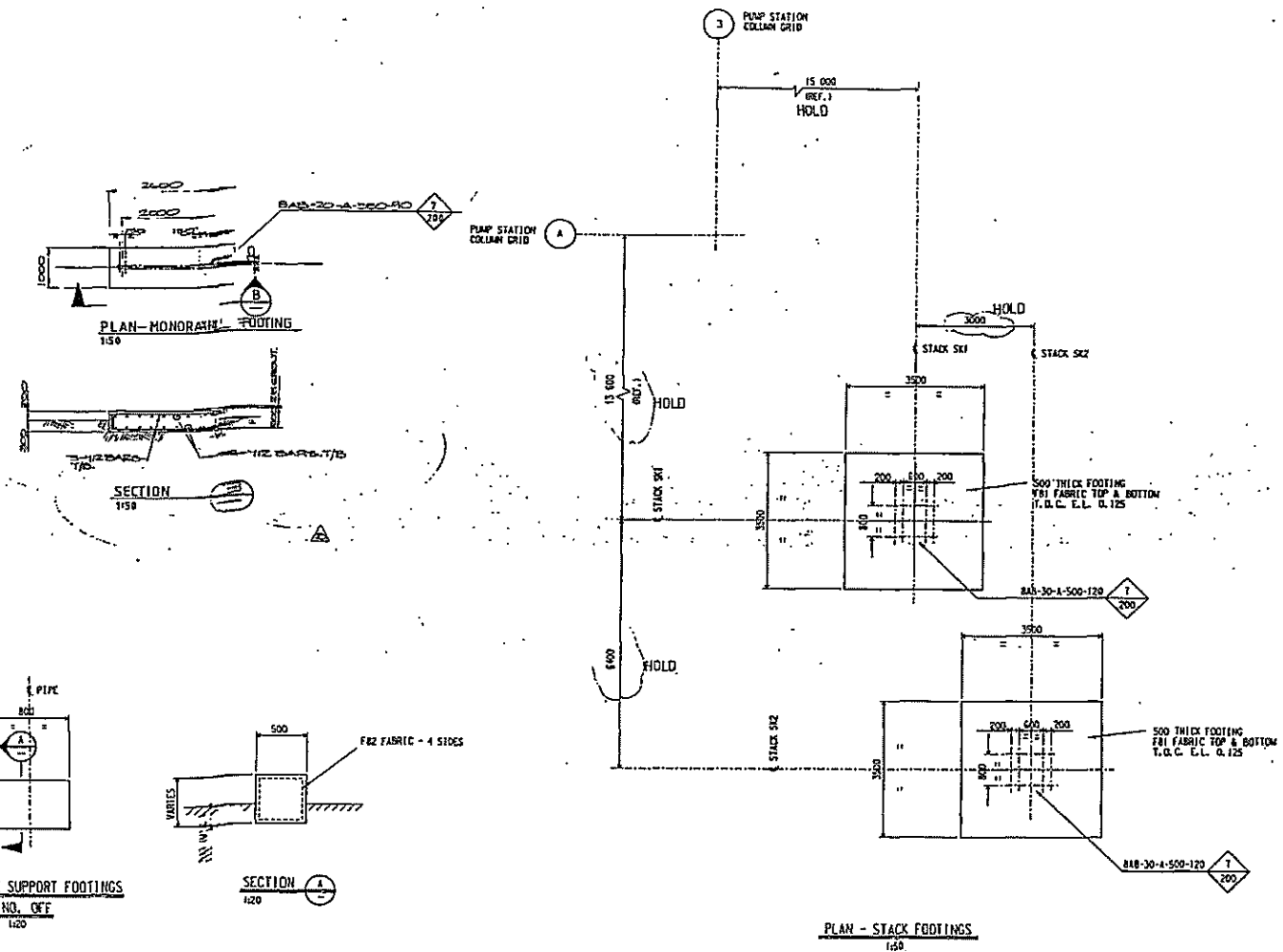
LOCALITY & CATCHMENT PLAN

DETAIL
SCALE - 1:500

B. P. COAL AUSTRALIA			
GRAVEN, ELLISTON & HAYES PTY. LIMITED.			
LAND ENGINEERING & MINING SURVEYORS			
41 BELMONT STREET, P.O. BOX 253 BUTHERLAND 2222 Phone (02) 621 2280			
"ASTROLABE", PUTHURFIELD LAKE, LITHGOW 2180 Phone (082) 81 2181			
"55 BAYVIEW STREET", P.O. BOX 312 EMPTON 2305 Phone (082) 81 4344			
"14 JOHN STREET, KINGOLETT 2308 Phone (082) 72 244"			
SURVEY: D.C.	DATE: 14/85	SCALE: 1:500	DRAWING No: 85030/1/4
DRAWN: J.E.	REVISED:		
CHECK: D.P.H.			



B. P. COAL AUSTRALIA			
PLAN SHOWING DETAILS AND LEVELS OVER THE NORTHERN SECTION OF PART OF THE ELLISTON COALFIELD SITE, 37 KILOMETERS N.W.M.			
GRAVEN, ELLISTON & HAYES PTY. LIMITED.			
LAND ENGINEERING & MINING SURVEYORS			
43 BELMONT STREET, P.O. BOX 232 SOUTH ARLAND 2330 Phone: (02) 821 2300 "ASTROLABE", RUTHVEN ROAD LAKE LITHGOW 2780 Phone: (042) 81 2781 36 BAHN BAHN STREET, P.O. BOX 212 DAPTO 2530 Phone: (024) 81 4341 14 JOHN STREET, SINGLETON 2330 Phone: (051) 2 2381			
DRAWN BY JCH	EC JCH	DATE 50-11-88	SCALE 1:500
CHECKED BY JCH	REV -11		DRAWING NO 84188/6



NOTE:
1. FOR GENERAL CONCRETE NOTES
REFER DRG. TC-240-200

REV	DATE	SIGNATURE	REV	DATE	SIGNATURE	DESCRIPTION	DATE	APP	APP	DATE	DESCRIPTION	DATE	APP	APP	DATE	DESCRIPTION	DATE	APP	APP	DATE	DESCRIPTION

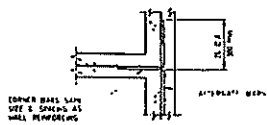
**CLUTHA DEVELOPMENT
PTY. LIMITED**

SCALE: 1/50

MURPHY ENGINEERING CONSULTANTS, MELBOURNE, AUSTRALIA

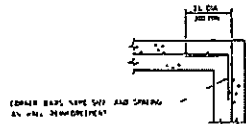
**TANMOOR MINE
GAS EXTRACTION - SURFACE PLANT
MISCELLANEOUS CONCRETE
FOOTING DETAILS, SHY. 1**

PROJECT NO.	1243-001
DATE	17 FEB 1985
PROJECT APPROVED	17 FEB 1985



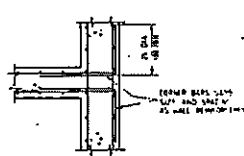
TYPICAL DETAIL AT JUNCTION

FOR CONCRETE THICKNESS LESS THAN 75 MM

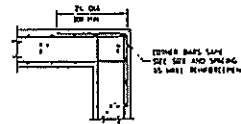


TYPICAL DETAIL AT CORNER

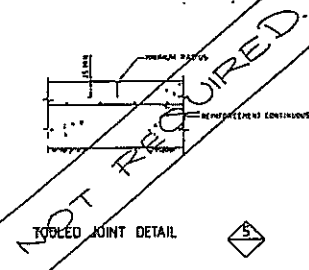
FOR CONCRETE THICKNESS LESS THAN 75 MM



TYPICAL DETAIL AT JUNCTION

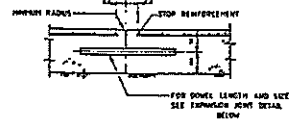


TYPICAL DETAIL AT CORNER

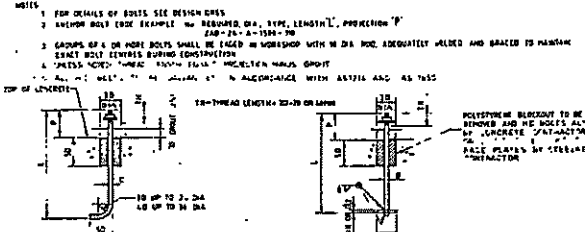


TOOLED JOINT DETAIL

- REVISIONS, COMMENTS, NOTES**
- ALL CONCRETE WORK SHALL BE IN ACCORDANCE WITH THE SPECIFICATION.
 - FOR DETAILS OF TYPES OF CONCRETE, ADHESIVES AND CONCRETE FINISHES, SEE SPECIFICATION.
 - WHERE PLACING CONCRETE, THE CONTRACTOR SHALL WEED REINFORCEMENT FOR ALL WEEDS AND OTHER MATERIALS REMAINING IN THE DETAIL AND LOCATION OF ALL PROPOSED BARS, BOLTS, WELLS, ETC.
 - THE CHARACTERISTIC COMPRESSIVE STRENGTH OF CONCRETE, F_{CD} IS TO BE NOT LESS THAN 35 MPa FOR UNREINFORCED CONCRETE - 35 MPa (N) REINFORCED CONCRETE - 35 MPa
 - MAXIMUM SIZE OF AGGREGATE SHALL BE 20 MM.
 - MAXIMUM ALUMINA SHALL BE - SLABS - 75 MM
 - MAXIMUM SULPHUR SHALL BE - 0.4%
 - THE TYPE OF CONTROL TESTING SHALL BE PROJECT.
 - REINFORCEMENT SHALL BE DESIGNATED AS FOLLOWS:
 - TYPE AND SIZE OF BARS
 - TYPE AND SIZE OF BARS
 - TYPE AND SIZE OF BARS
 - TYPE AND SIZE OF BARS
 - REINFORCEMENT LAP LENGTHS FOR REINFORCEMENT SHALL BE AS PER THE DESIGN DRAWING. WHERE NOT SPECIFIED THE FOLLOWING LENGTHS SHALL APPLY. LAPS SHALL BE STAGGERED.
 - SLAB REINFORCEMENT - 40D
 - SLAB REINFORCEMENT - 40D
 - SLAB REINFORCEMENT - 40D
 - SLAB REINFORCEMENT - 40D
 - REINFORCEMENT LAP LENGTHS FOR REINFORCEMENT SHALL BE AS PER THE DESIGN DRAWING. WHERE NOT SPECIFIED THE FOLLOWING LENGTHS SHALL APPLY. LAPS SHALL BE STAGGERED.
 - TYPE AND SIZE OF BARS
 - TYPE AND SIZE OF BARS
 - TYPE AND SIZE OF BARS
 - TYPE AND SIZE OF BARS
 - ALL REINFORCEMENT SHALL BE PLACED IN THE MIDDLE OF THE SLAB UNLESS OTHERWISE SPECIFIED. THE CLEARANCE FROM THE BOTTOM REINFORCEMENT TO THE TOP OF THE SLAB SHALL BE 25 MM.
 - ALL REINFORCEMENT SHALL BE PLACED IN THE MIDDLE OF THE SLAB UNLESS OTHERWISE SPECIFIED. THE CLEARANCE FROM THE BOTTOM REINFORCEMENT TO THE TOP OF THE SLAB SHALL BE 25 MM.



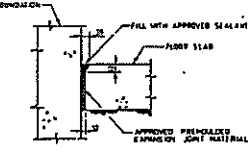
CONSTRUCTION JOINT DETAIL



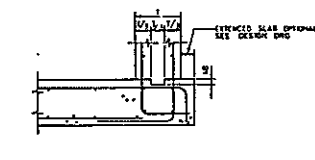
TYPE A

TYPE B

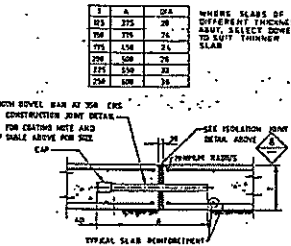
ANCHOR BOLT DETAILS



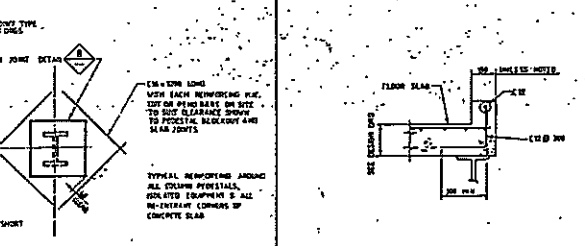
ISOLATION JOINT DETAIL



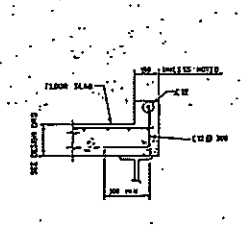
CONSTRUCTION JOINT DETAIL



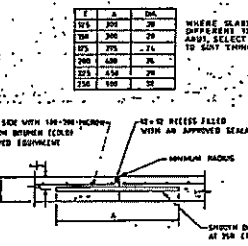
EXPANSION JOINT DETAIL



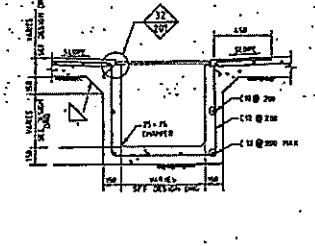
SLAB REINFORCEMENT DETAIL



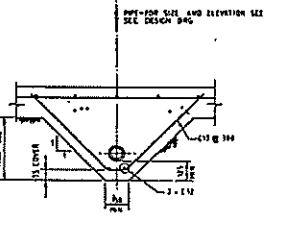
TYPICAL KERB



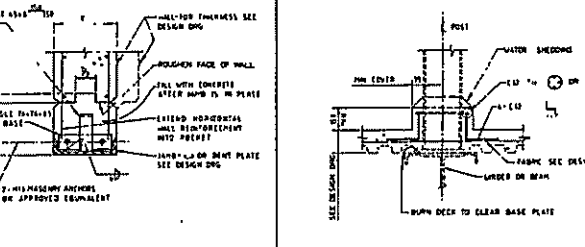
SEALED CONSTRUCTION JOINT DETAIL



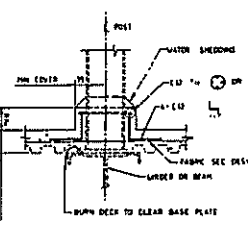
TRENCH OR PIT



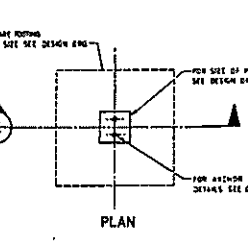
EMBEDDED PIPE



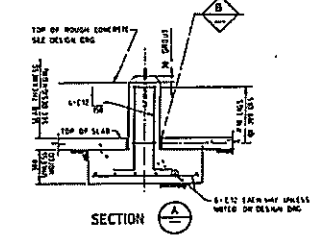
DOOR JAMB AT CONCRETE WALL OR KERB



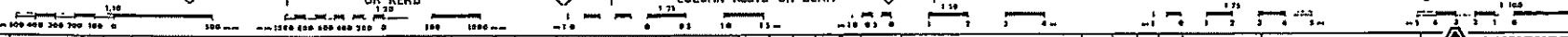
TYPICAL COLUMN KERB WHERE COLUMN RESTS ON BEAM



INDIVIDUAL FOOTING FOR POST PEDESTAL



SECTION



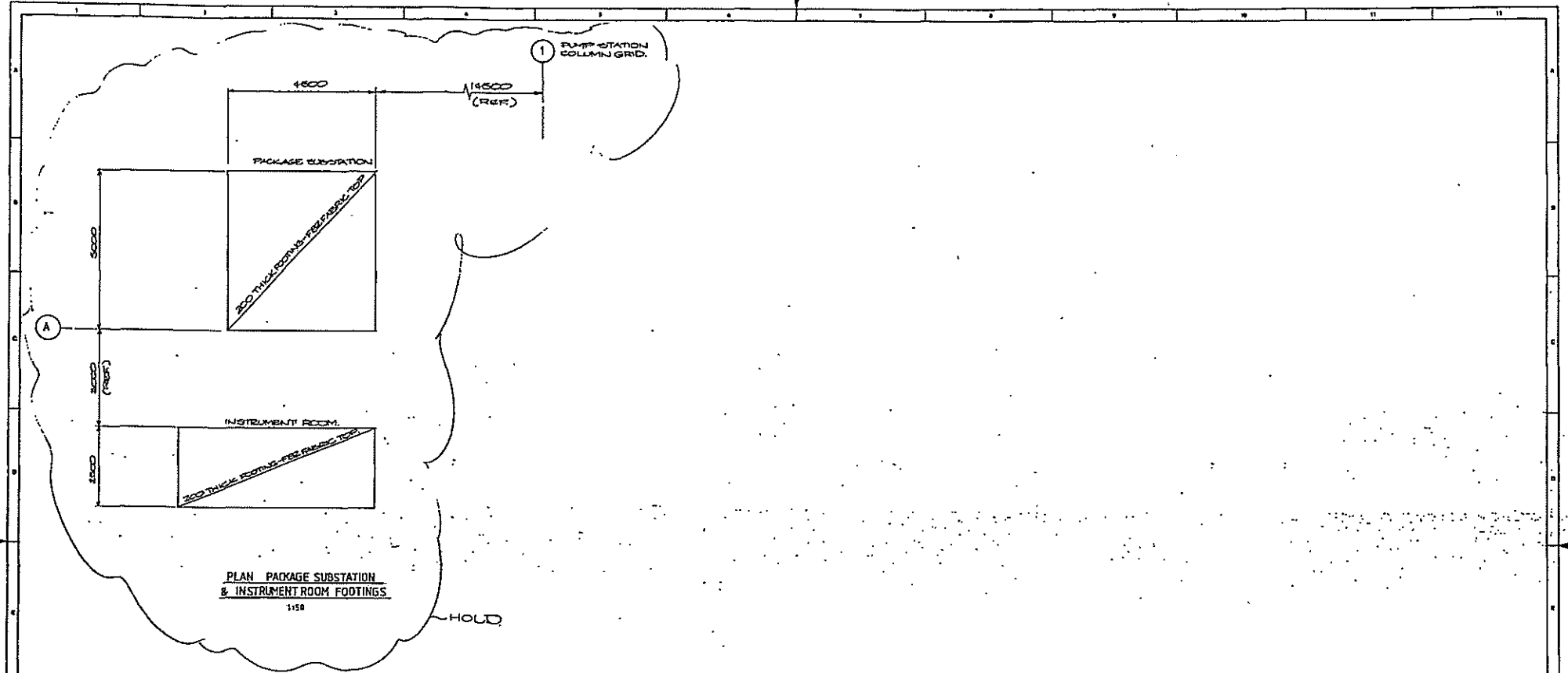
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CLUTHA DEVELOPMENT
PTY LIMITED.

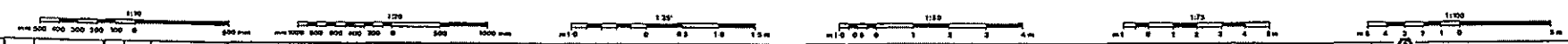
SCALE: MTS

TAHMOOR MINE
GAS EXTRACTION - SURFACE PLANT
STANDARD DRAWINGS
CONCRETE DETAILS.

123-001
TC-040-200
TIF/1007



**PLAN PACKAGE SUBSTATION
& INSTRUMENT ROOM FOOTINGS**
1:50



REV.	DATE	SIGNATURE	REV.	DATE	SIGNATURE	DRAWING NO.	DESCRIPTION	REV.	DATE	SYMBOL	DRAWN	CHK.	APP.	DATE	PROJECT	DRAWN	CHK.	APP.	WORKS	PROJECT APPROVER

MINENCE
PERTH, AUSTRALIA

TANMOOR MINE
GAS EXTRACTION SURFACE PLANT
MISCELLANEOUS CONCRETE
FOOTING DETAILS SHT. 2

CLIENT
**CLUTHA DEVELOPMENT
PTY LIMITED**

PROJECT NO.
1243-001

DRAWING NO.
TC-560-202

ISSUE NO.
T/E/1008

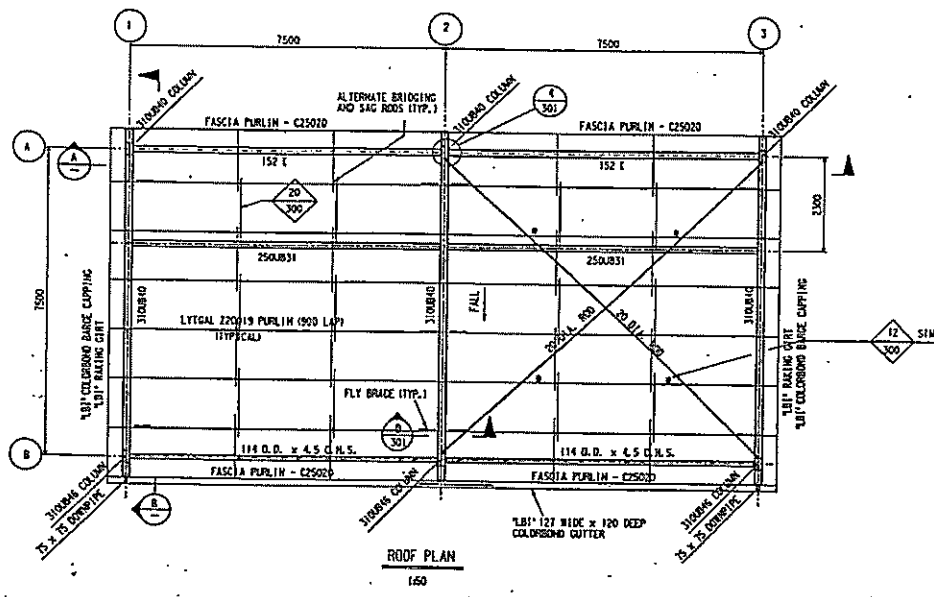
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DATE
12/15/08

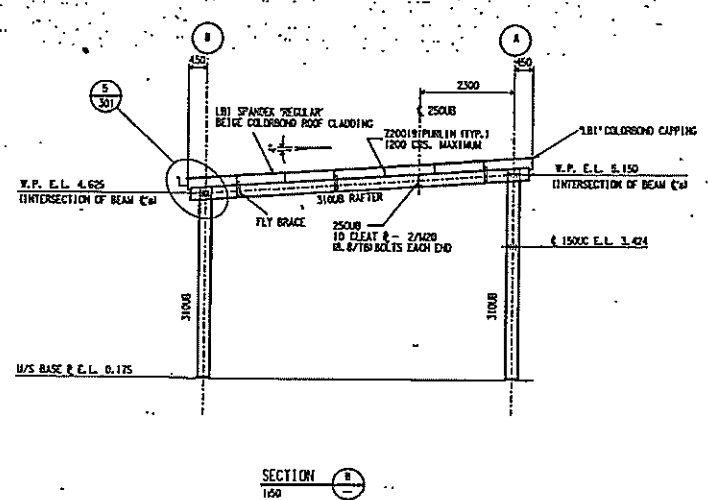
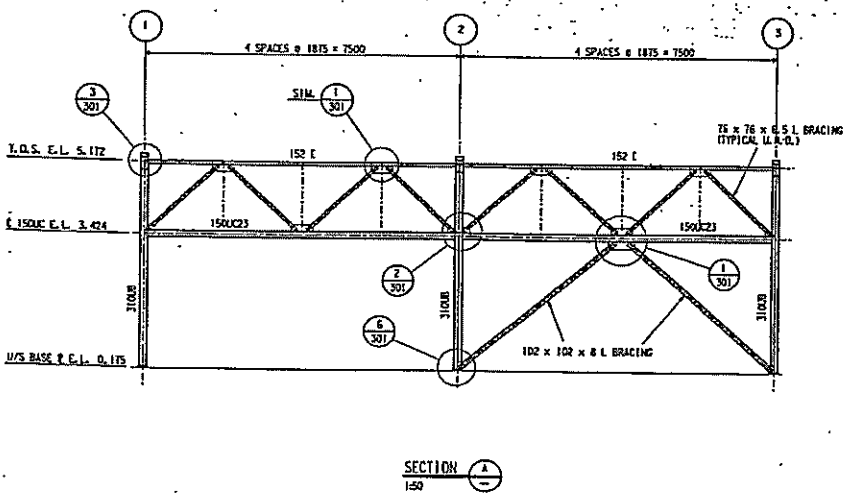
BY
J.V.Z.

FOR
T/E/AC

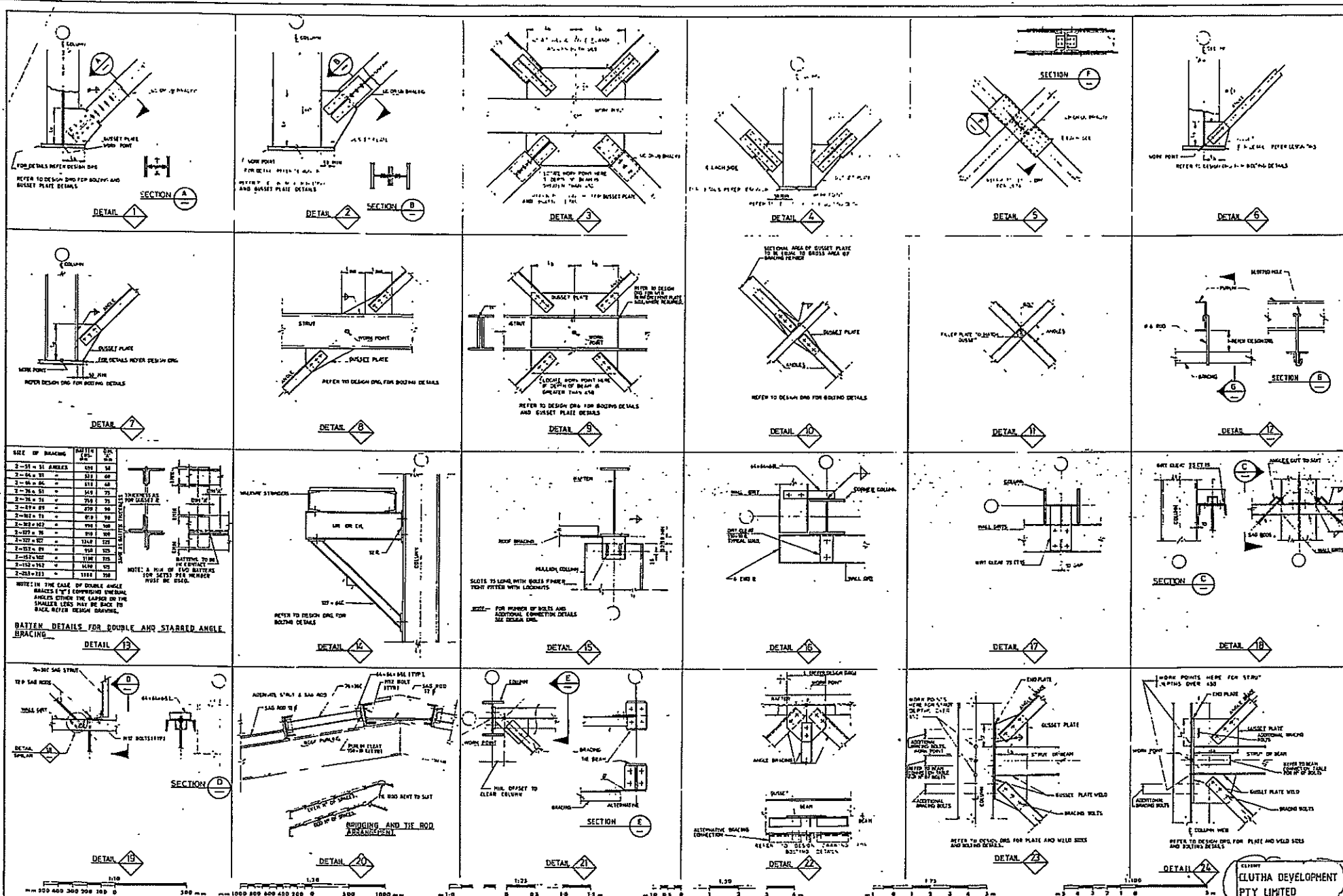
PROJECT APPROVER
T/E/AC



- GENERAL STEELWORK NOTES:-**
- STRUCTURAL STEEL SHALL BE GRADE 250 TO AS SUPPLIED FABRICATED, PAINTED AND ERECTED PER SPECIFICATION.
 - CONNECTIONS FOR MAIN STRUCTURAL MEMBERS SHALL BE DESIGNED USING HIGH STRENGTH STRUCTURAL GRADE BUB BOLTS WITH BEARING TYPE JOINTS, ASSURING THREADS IN SHEAR PLANE UNLESS NOTED OTHERWISE. A MINIMUM OF 2 NO. BOLTS PER CONNECTION SHALL BE USED UNLESS THE BOLTS SHALL BE FULLY TENSIONED BY PART TURN OF THE NUT METHOD TO THE REQUIREMENTS OF AS 1511. BOLTED CONNECTIONS FOR PURLIN AND MINOR FRAMING SUCH AS LADDERS, HANDRAIL, POSTS, MAIN DOOR AND WINDOW FRAMES SHALL BE MADE USING HIGH COMMERCIAL GRADE 4.8 BOLTS WITH A MINIMUM OF 2 NO. BOLTS PER CONNECTION UNLESS OTHERWISE NOTED. ALL HIGH STRENGTH AND COMMERCIAL BOLTS, NUTS AND WASHERS SHALL BE GALVANNEAL.
 - ALL WELDS SHALL BE CATEGORY SP IN ACCORDANCE WITH AS 1554. ALL ELECTRODES SHALL BE CLASS 48R. MINOR WELD SIZE SHALL BE 6mm CONTINUOUS FILLET WELD TO COMPLETELY SEAL THE CONNECTED PARTS UNLESS OTHERWISE NOTED.
 - ALL BUTT WELDS SHALL BE FULL STRENGTH COMPLETE PENETRATION WELDS.
 - ALL GUSSET PLATES SHALL BE 10mm THICK. MINOR UNLESS OTHERWISE NOTED. PURLIN AND GIRT CLEATS ONLY MAY BE 6mm THICKNESS.



												CLUTHA DEVELOPMENT PTY. LIMITED.					
												MINERCO MINING AND ENGINEERING CONSULTANTS, MELBOURNE, AUSTRALIA					
												TAHMOOR MINE GAS EXTRACTION - SURFACE PLANT PUMP STATION STEELWORK ARRANGEMENT					
												PROJECT NO. 1243-001					
												MINERCO REF. TC-560-300					
												DRAWING NO. T/S/1010..					
												REV. B					
REV	DATE	SIGNATURE	REV	DATE	SIGNATURE	REV	DATE	SIGNATURE	REV	DATE	SIGNATURE	REV	DATE	SIGNATURE	REV	DATE	SIGNATURE
				TC-560-301 STEELWORK DETAILS								SCALE 1:50					
				REFERENCE DRAWINGS								DRAWN: M. J. MURPHY					
												CHECKED: M. J. MURPHY					
												DESIGNED: M. J. MURPHY					
												DESIGN CHECKED: M. J. MURPHY					
												DESIGN APPROVED: M. J. MURPHY					
												PROJECT APPROVED: M. J. MURPHY					
												SCALE 1:50					
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												CHECKED: M. J. MURPHY					
												DESIGNED: M. J. MURPHY					
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												PROJECT APPROVED: M. J. MURPHY					

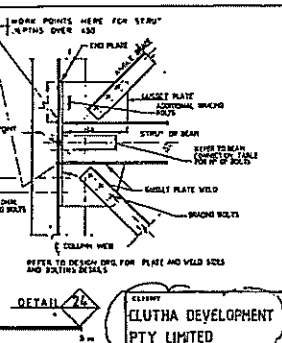
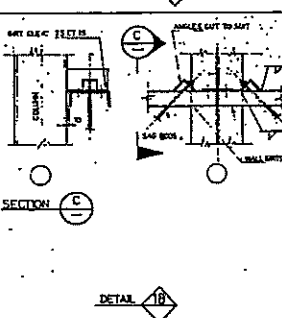
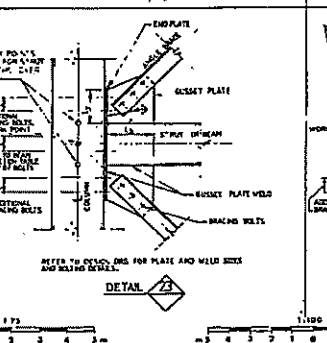
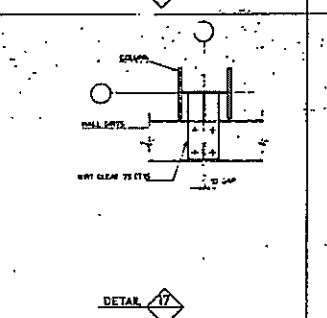
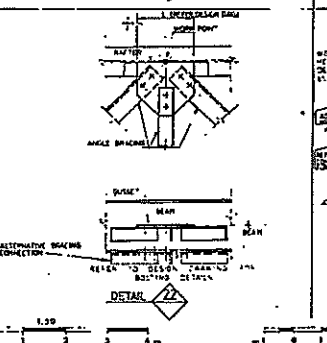
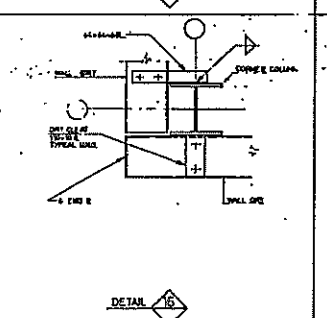
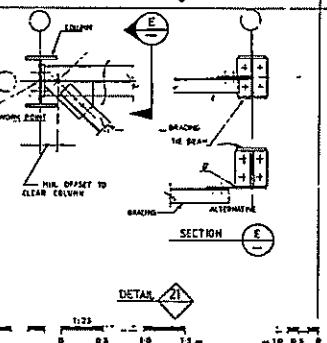
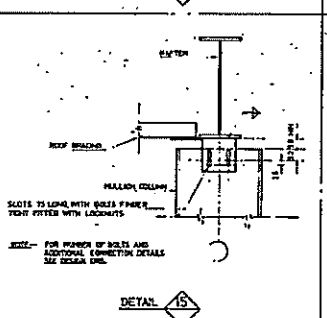
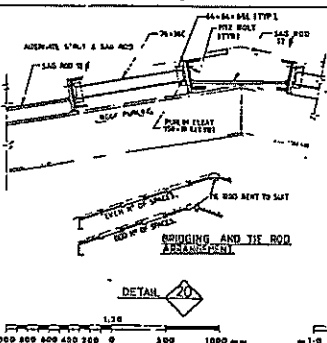
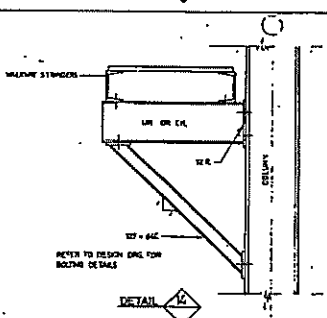
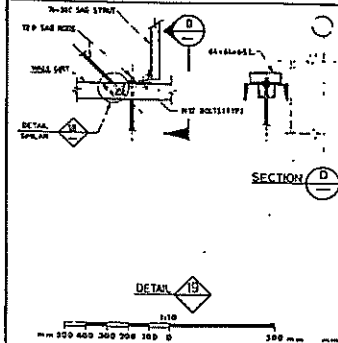


SIZE OF BRACING	NO. OF BOLTS	MIN. DIST. BETWEEN BOLTS
2-51 x 51 ANGLE	4	51
2-64 x 64 "	4	64
2-76 x 76 "	4	76
2-89 x 89 "	4	89
2-102 x 102 "	4	102
2-114 x 114 "	4	114
2-127 x 127 "	4	127
2-140 x 140 "	4	140
2-152 x 152 "	4	152
2-165 x 165 "	4	165
2-178 x 178 "	4	178
2-190 x 190 "	4	190

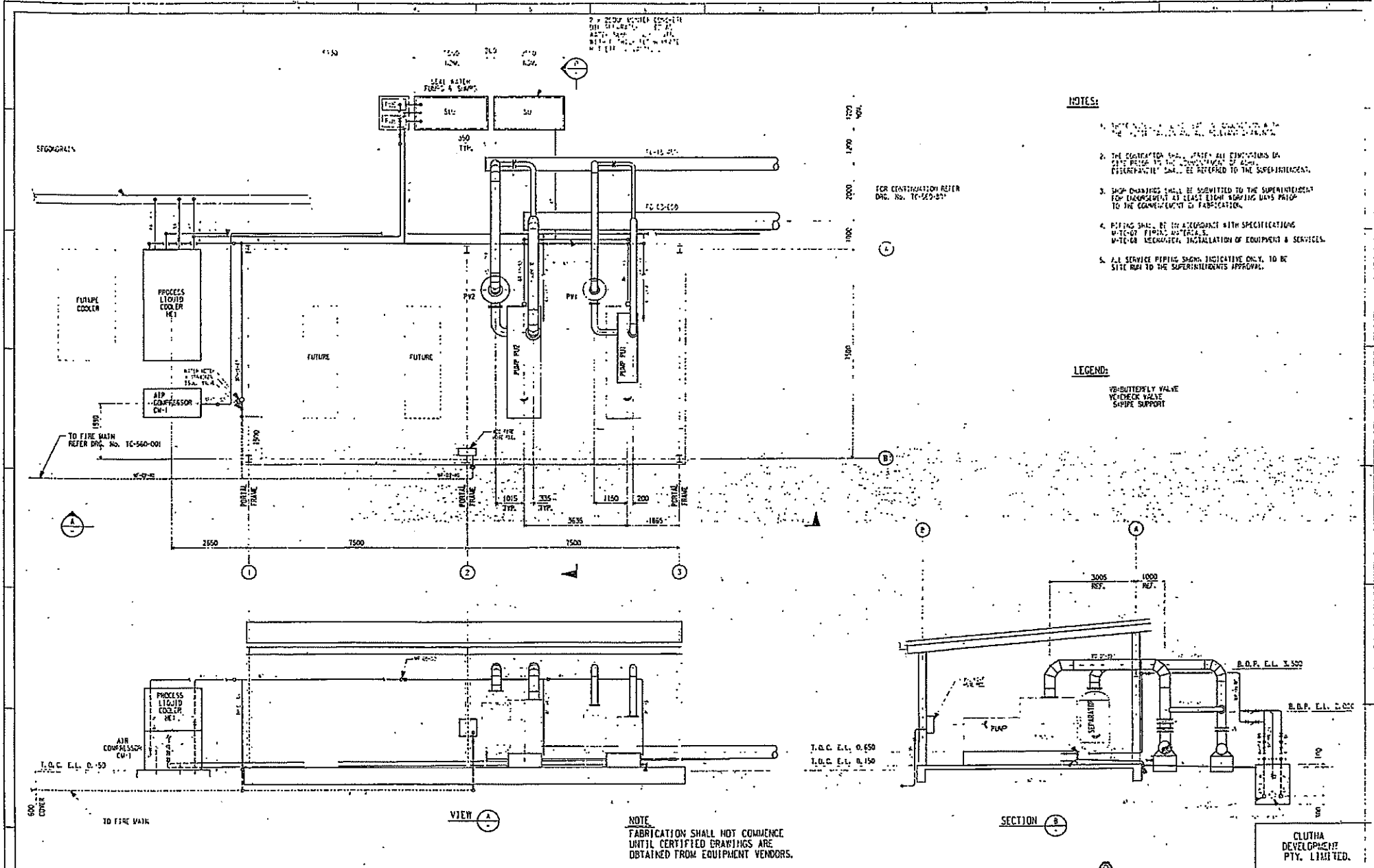
NOTE: IN THE CASE OF DOUBLE ANGLE BRACING 1/2" COMPRESSIVE STRONG ANGLE OTHER THE LARGER OF THE SMALLER LEGS MAY BE BACK TO BACK WITH REDUCED BRACING.

BATTEN DETAILS FOR DOUBLE AND STARRED ANGLE BRACING

DETAIL 13



<table border="1"> <thead> <tr> <th>DATE</th> <th>SIGNATURE</th> <th>REV.</th> <th>DATE</th> <th>SIGNATURE</th> <th>REVISION</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>				DATE	SIGNATURE	REV.	DATE	SIGNATURE	REVISION							<table border="1"> <thead> <tr> <th>DATE</th> <th>SIGNATURE</th> <th>REV.</th> <th>DATE</th> <th>SIGNATURE</th> <th>REVISION</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>				DATE	SIGNATURE	REV.	DATE	SIGNATURE	REVISION							<table border="1"> <thead> <tr> <th>DATE</th> <th>SIGNATURE</th> <th>REV.</th> <th>DATE</th> <th>SIGNATURE</th> <th>REVISION</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>				DATE	SIGNATURE	REV.	DATE	SIGNATURE	REVISION							<table border="1"> <thead> <tr> <th>DATE</th> <th>SIGNATURE</th> <th>REV.</th> <th>DATE</th> <th>SIGNATURE</th> <th>REVISION</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>				DATE	SIGNATURE	REV.	DATE	SIGNATURE	REVISION							<table border="1"> <thead> <tr> <th>DATE</th> <th>SIGNATURE</th> <th>REV.</th> <th>DATE</th> <th>SIGNATURE</th> <th>REVISION</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>				DATE	SIGNATURE	REV.	DATE	SIGNATURE	REVISION						
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<p>SCALE: 1:50</p> <p>TAHMOOR MINE GAS EXTRACTION-SURFACE PLANT STANDARD DRAWINGS STEELWORK DETAILS</p> <p>PROJECT NO: 1243-001 DRAWING NO: TC-040-300 DATE: 7/5/10 12</p>																																																																															



- NOTES:**
1. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS ON SITE PRIOR TO THE COMMENCEMENT OF ANY FABRICATIONS. ALL DIMENSIONS SHALL BE REFERRED TO THE SUPERINTENDENT.
 2. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS ON SITE PRIOR TO THE COMMENCEMENT OF ANY FABRICATIONS. ALL DIMENSIONS SHALL BE REFERRED TO THE SUPERINTENDENT.
 3. SHOP DRAWINGS SHALL BE SUBMITTED TO THE SUPERINTENDENT FOR ENDORSEMENT AT LEAST EIGHT WORKING DAYS PRIOR TO THE COMMENCEMENT OF FABRICATION.
 4. PIPING SHALL BE IN ACCORDANCE WITH SPECIFICATIONS W-1000 PIPING SYSTEMS, W-1000 MECHANICAL INSTALLATION OF EQUIPMENT & SERVICES.
 5. ALL SERVICE PIPING SHOWN INDICATIVE ONLY, TO BE SITE RUN TO THE SUPERINTENDENT'S APPROVAL.

- LEGEND:**
- VB-BUTTERFLY VALVE
 - VE-CHECK VALVE
 - SS-PIPE SUPPORT

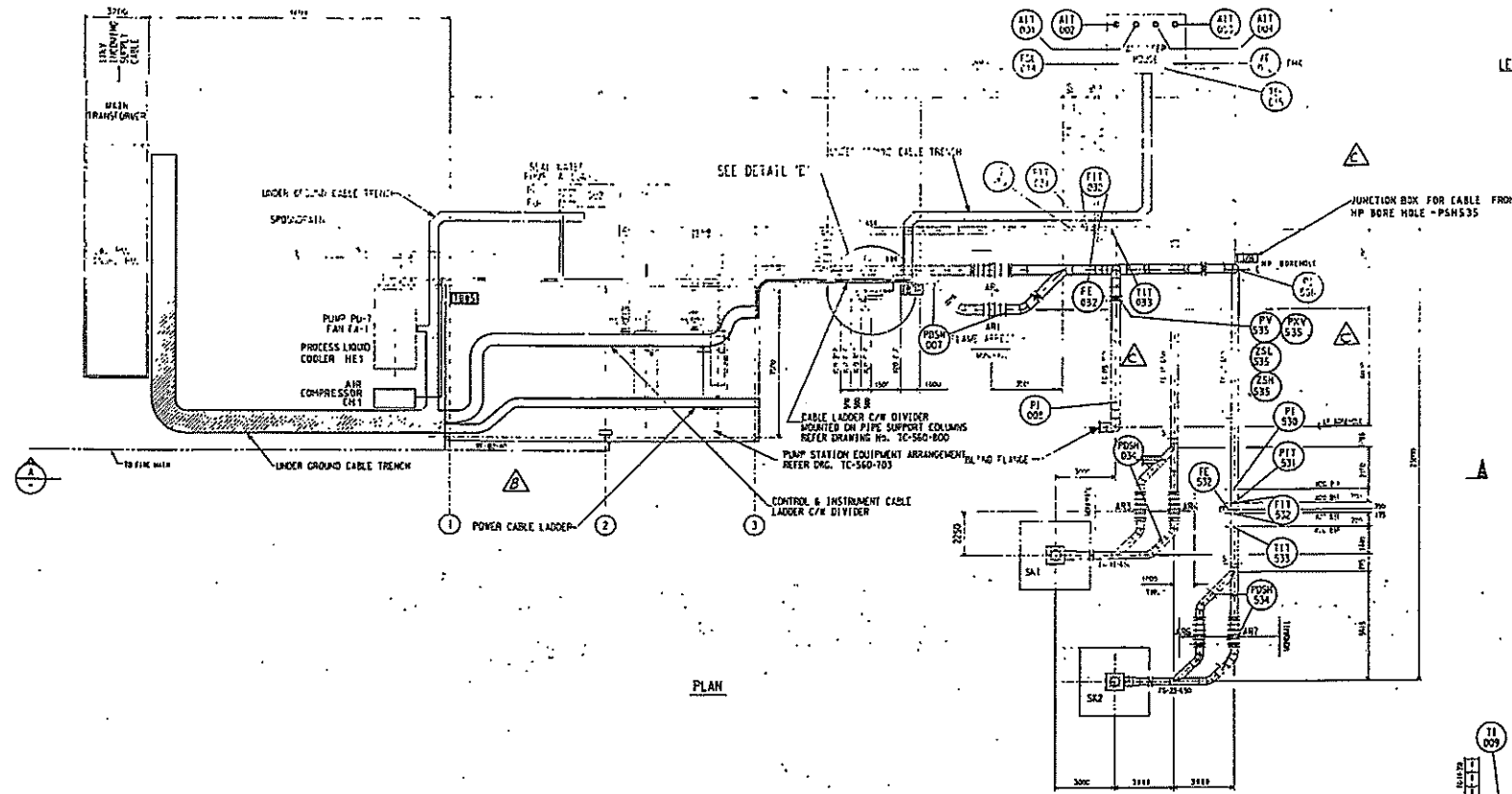
NOTE:
FABRICATION SHALL NOT COMMENCE UNTIL CERTIFIED DRAWINGS ARE OBTAINED FROM EQUIPMENT VENDORS.

REV.	DATE	BY	CHKD.	DESCRIPTION	DATE	REVISIONS	DATE	BY	CHKD.	DESCRIPTION	DATE	BY	CHKD.	DESCRIPTION	DATE
1				SITE PLAN											
2				REVISIONS											
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11				REVISIONS											
12				REVISIONS											

CLUTHA DEVELOPMENT PTY. LIMITED.

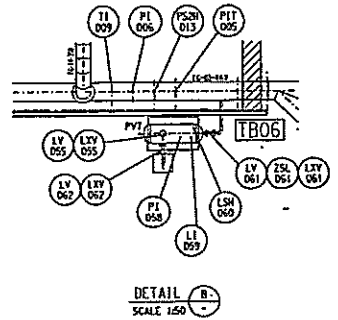
TAHMOOR MINE SURFACE GAS EXTRACTION PLANT PUMPING STATION ARRANGEMENT

PROJECT NO. 1243-001
 DRAWING NO. TC-560-501
 DATE 1/7/1015

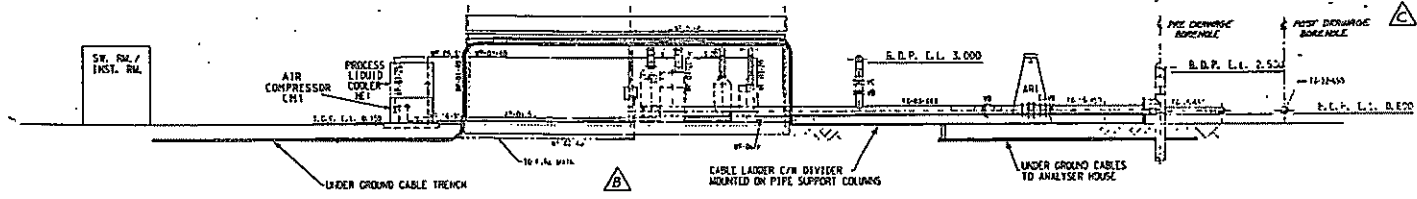


LEGEND
 [Symbol] LOCAL CONTROL STATION
 [Symbol] INSTRUMENT POINT
 [Symbol] TERMINAL BOX
 [Symbol] INSTRUMENT TAG RANGE

PLAN



DETAIL B
SCALE 1:50



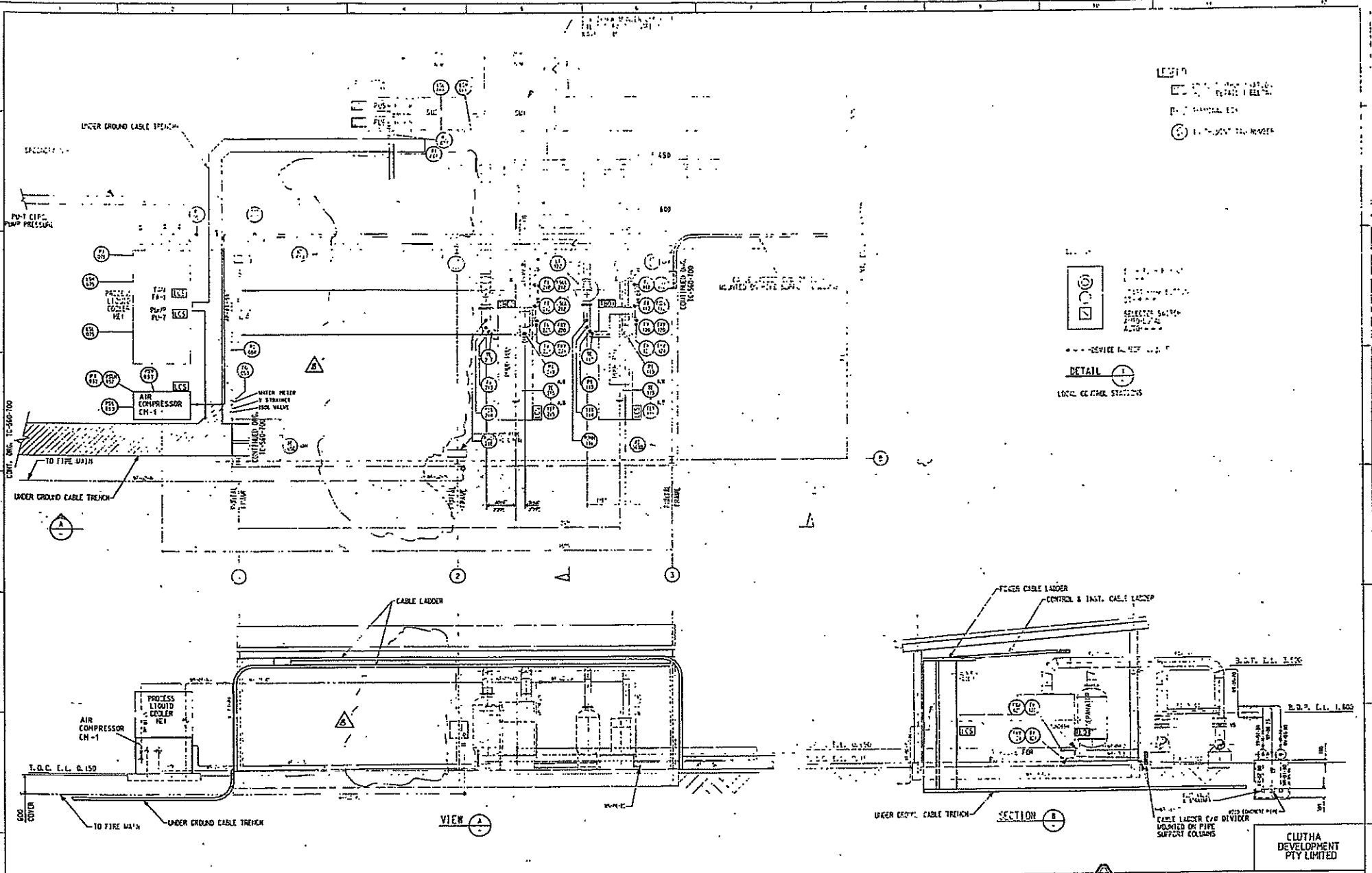
VIEW A
NOT TO SCALE FOR CLARITY

REV	DATE	SIGNATURE	DESCRIPTION	REV	DATE	SIGNATURE	DESCRIPTION
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2	10-24-81		INSTRUMENT CABLE SCHEMATIC REVISION				
3	10-24-81		INSTRUMENT CABLE SCHEMATIC REVISION				
4	10-24-81		INSTRUMENT CABLE SCHEMATIC REVISION				
5	10-24-81		SUNCTION ASSISTED BOREHOLE PIPING & INSTR. DIAG.				
6	10-24-81		SUNCTION ASSISTED BOREHOLE PIPING & INSTR. DIAG.				

SCALE	1:100	PROJECT NO.	1243-001
DATE	10/24/81	PROJECT NAME	TANDOR MINE SURFACE GAS EXTRACTION PLANT
CHECKED	[Signature]	CLIENT	CLUTHA DEVELOPMENT PTY LIMITED
DESIGNED	[Signature]	DATE	10/24/81
DESIGN CHECKED	[Signature]	SCALE	1:100
DESIGN APPROVED	[Signature]	SHEET	1 OF 2

LESTO
 □ SERVICE IN USE
 □ SERVICE IN HOLD
 ○ SERVICE TO BE MOVED

DETAIL
 LOCAL GEOM. STATIONS



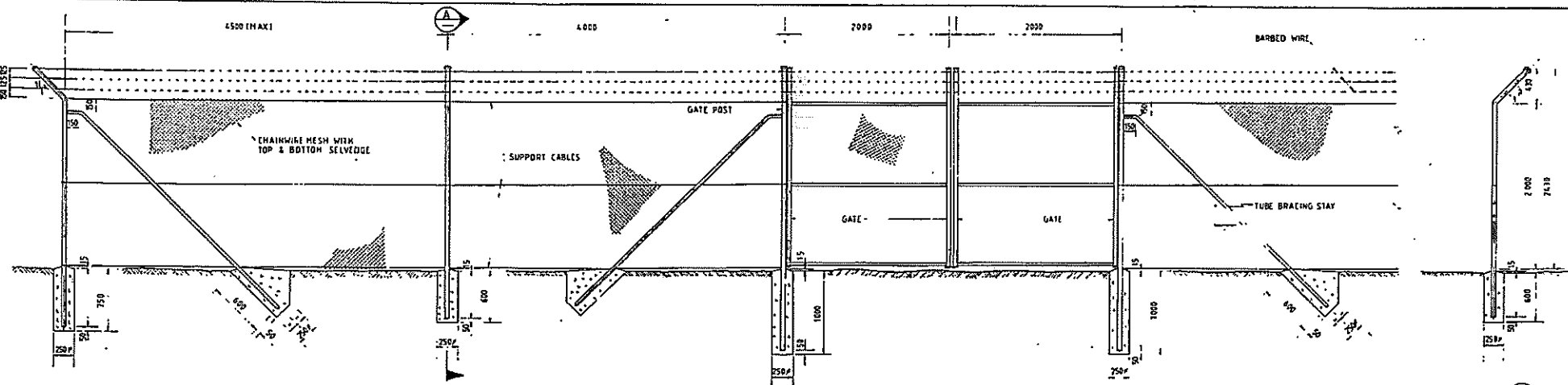
VIEW A

SECTION B

REV		DATE	SIGNATURE	REV	DATE	SIGNATURE	DESCRIPTION	DATE	REVISIONS	DRAWN	CAD	APP	APP	REV	DATE	FUNCTIONS	SCALE	1:50	PROJECT NO.	1243-001
1				CLIENT APPROVAL																
2				REFERENCE CHANGES																
3				REVISIONS																
4				REVISIONS																
5				REVISIONS																
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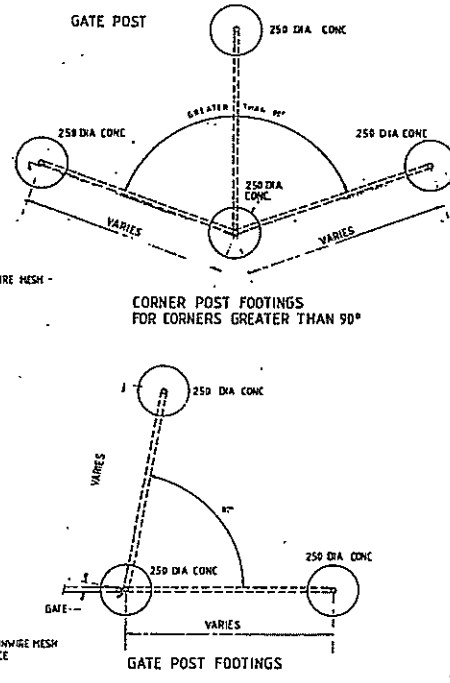
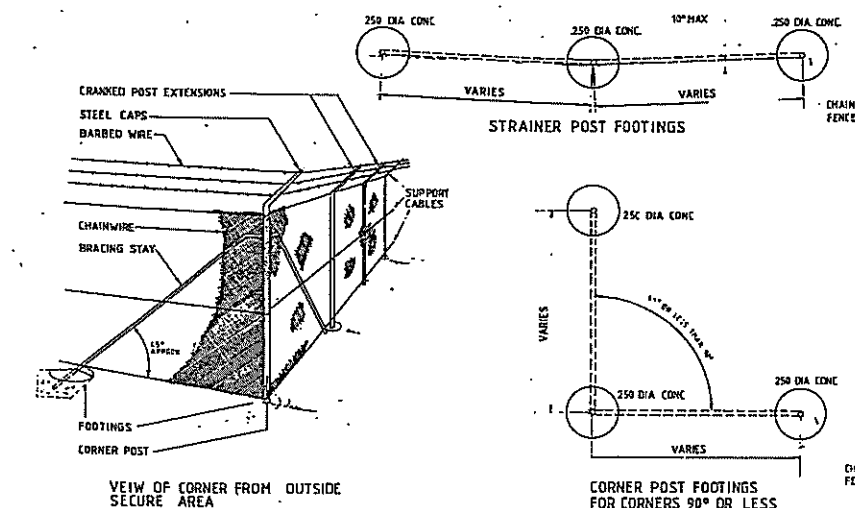


CLUTHA DEVELOPMENT PTY LIMITED
 PROJECT NO. 1243-001
 TARMOOR MINE SURFACE GAS EXTRACTION PLANT EQUIPMENT LAYOUT & MAIN CABLE ROUTE DIAGRAM
 SHEET 2 OF 2
 DRAWING NO. T/E/1064



CORNER POST
INTERMEDIATE POST
GATE POST
GATE POST

FENCE & GATE COMPONENTS (TYPICAL)
(FROM INSIDE SECURE AREA)



SECTION THROUGH INTERMEDIATE POST

NOTES

1. GATES, FRAMES, POSTS AND FOOTINGS:

POST HEIGHT (mm)	FIXED COLLAR	END POST CHAIN & LOCK	POST BRACING	GATE POST	POST SPACING (mm)
1000	32	32	25	—	50
1500	32	32	25	—	50
2000	32	32	25	—	50
2500	40	40	32	32	80
3000	40	40	32	32	80
3500	40	40	32	32	100
4000	40	40	32	32	100

- THE HEIGHT OF THE GATE SHALL MATCH THE HEIGHT OF THE FENCE.
 - THE GATES SHALL BE COVERED WITH CHAINWIRE TO MATCH THE FENCE. THE COVERING SHALL BE DRAWN TAUT AND LACED TO THE OUTER FRAME & TIED TO EACH INTERNAL MEMBER.
 - BARBED WIRE SHALL BE TIED TO THE GATE EXTENSIONS TO MATCH THE LINES OF THE BARBED WIRE ON THE FENCE.
 - BARBED WIRE SHALL BE DOUBLE STRAND 2.5mm 10WA PATTERN WITH 2mm FOUR POINT BARBS AT 90 CENTRES.
 - TWO COATS OF APPROVED ZINC RICH PAINT SHALL BE APPLIED IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS TO ANY GALVANISED SURFACE DAMAGED BY WELDING.
 - ALIGNMENT - THE FENCE SHALL BE CONSTRUCTED ON THE ALIGNMENT SHOWN ON THE PROJECT DRAWING.
 - ALL OVERHANGING BARBED WIRE SECTIONS INTO STREETS OR PRIVATE PROPERTIES ARE TO BE SUBJECT TO AN AGREEMENT BETWEEN THE COUNCIL, YOUR BUILDING BOARD OR ADJOINING PROPERTY OWNER.
 - CONSTRUCTION - SURPLUS MATERIAL FROM EARTHWORKS SHALL BE DAMPED & SPREAD WHERE DIRECTED.
 - ALL BRACING SHALL BE WITHIN THE SECURE AREA.
 - CONCRETE BLOCK 300x300x300 WITH 32 NB SOCKETS SHALL BE PLACED TO HOLD THE GATES IN AN OPEN POSITION.
 - A CHAIN OF APPROVED SIZE & LENGTH SHALL BE WELDED TO ONE LEAF OF GATE AS DIRECTED & A HEAVY DUTY PIN LOCK WITH 2 LABELED KEYS SHALL BE SUPPLIED BY THE CONTRACTOR.
 - CHAINWIRE - HEAVILY GALVANISED TO AS 1650-1775 TYPE A HEIGHTS SHALL BE 1800, 2180, 2475 OR AS SHOWN ON PROJECT DRAWINGS.
 - END & CORNER POSTS SHALL BE 50mm ID PIPE. INTERMEDIATE POSTS SHALL BE 50mm ID PIPE AT MAXIMUM 5 METRE CENTRES.
 - THE TOPS OF ALL POSTS SHALL BE PROVIDED WITH TIGHTLY FITTED GALVANISED CAPS.
 - BRACING SHALL BE REINFORCED AT END, CORNER & GATE POSTS ON CONTINUAL LENGTHS WITHOUT CHANGE IN DIRECTION AT MAXIMUM 90 DEGREE INTERVALS.
 - DIAGONAL STAY BRACE 42.4mm OD TUBE SHALL BE FIXED TO BRACE POST WITH COMPRESSION FITTINGS APPROX 500mm BELOW THE TOP SELVEDGE OF CHAINWIRE & AT AN ANGLE OF APPROX 45° SET INTO CONCRETE AT THE BASE.
 - DIAGONAL BRACE POST FOR STRAIGHT LENGTHS SHALL BE AT MAXIMUM OF 90 METRE CENTRES.
 - BRACKETS OF 42.4mm OD TUBE SHALL BE REQUIRED ON CORNERS OF GREATER THAN 90° DEVIATION & LESS THAN 90° TO BE SET ON THE INSIDE OF THE FENCE LINE & ATTACHED TO THE POSTS WITH COMPRESSION FITTINGS AT APPROX 275 FROM GROUND LEVEL & AT AN ANGLE OF APPROX 60° SET INTO CONCRETE AT BASE.
 - LEAD WIRES SHALL BE DOUBLE TWISTED 3.15mm HEAVY GALVANISED.
 - ATTACHMENT OF MESH-LACING WIRE SHALL BE HEAVY GALVANISED 2mm DIA WIRE FULLY LACED THROUGH EACH DRUMMED AT THE END GATE & CORNER POSTS WHERE THE MESH DOES NOT HAVE THE INTERNAL SUPPORT OF THE POST WHEN TENSIONED. THE WIRE SHALL BE HEAVY GALVANISED 2mm DIA WIRE WITH 3 FULL POINTS CUT OFF NEATLY TO BE USED ON ALL POSTS AT APPROX 200mm INTERVALS. IT ALSO BE USED ON ALL LABEL WIRES AT APPROX 350mm INTERVALS. 2 ON BARBED WIRES WHERE THEY INTERSECT WITH POSTS.
 - CONCRETE FOOTINGS - CONCRETE SHOULD BE ALLOWED TO SET FOR A MINIMUM 24 HOURS BEFORE FINISHING & TENSIONING. IF THE FINISH IS NOT BE GOOD THIS PERIOD SHOULD BE SUIT TO SUIT THE TOP OF THE CONCRETE FOOTING TO PROVIDE A NEAT FINISH WITH A FALL OF 10mm AWAY FROM POST.
- UNLESS OTHERWISE INDICATED ALL FOOTINGS 250 DIA 250 250 250 250

Scale bars: 1:50, 1:20, 1:10, 1:5, 1:2.5, 1:1.25, 1:0.625, 1:0.3125, 1:0.15625, 1:0.078125.

REV	DATE	SIGNATURE	REV	DATE	SIGNATURE	DESCRIPTION

REV	DATE	SIGNATURE	REV	DATE	SIGNATURE	DESCRIPTION

REV	DATE	SIGNATURE	REV	DATE	SIGNATURE	DESCRIPTION

CLUTHA DEVELOPMENT PTY LIMITED

MINENCO
TAMMOOR MINE
GAS EXTRACTION - SURFACE PLANT
STANDARD DRAWINGS
SECURITY FENCING DETAILS.

PROJECT NO: 1243-001
DRAWING NO: TC-040-100
DATE: 7/7/10