EIS 1346 Vol 2

AB020018

Proposed Continuation of Quarrying Landfilling and Site Rehabilitation at Metford, Maitland Environmental Impact Statement.

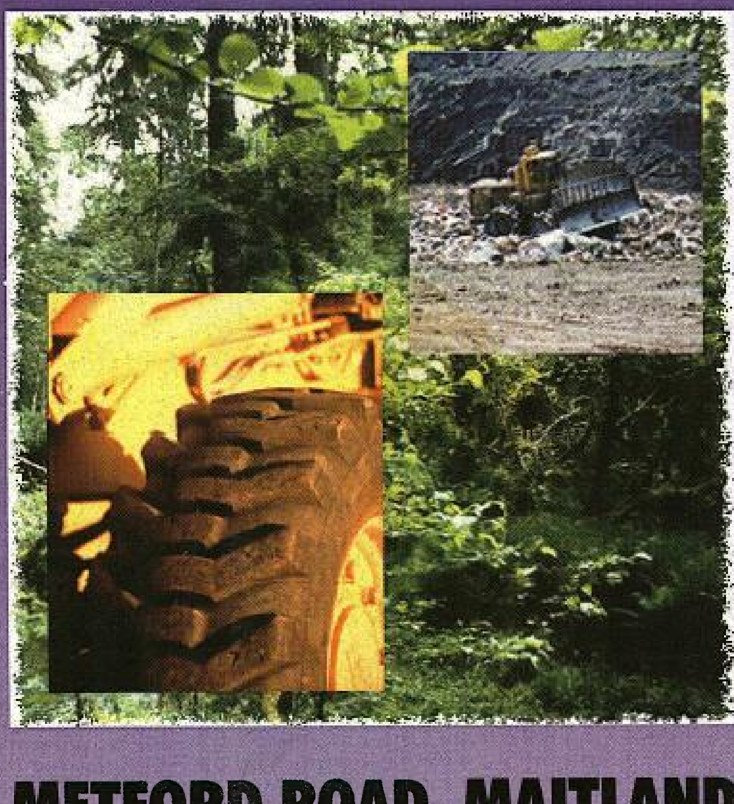
ENVIRONMENTAL IMPACT STATEMENT

CSR
PGH

Enviroguard
COMMUNITY WASTE MANAGEMENT

PROPOSED CONTINUATION OF QUARRYING, LANDFILLING AND SITE REMEDIATION

AT THE PGH BRICKWORKS SITE



METFORD ROAD, MAITLAND

VOLUME 2 - APPENDICES

Prepared by
CMPS&F ENVIRONMENTAL

PROPOSED CONTINUATION OF
QUARRYING LANDFILLING
AND SITE REHABILITATION
AT
METFORD, MAITLAND

ENVIRONMENTAL IMPACT STATEMENT
VOLUME TWO
APPENDICES

SEPTEMBER, 1997

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NOTICE TO ALL READERS

This Environmental Impact Statement (EIS) consists of 2 volumes. Volume 2 contains all of the appendices. The EIS is prepared and placed on public exhibition for the purpose of allowing all persons who have an interest in the project the opportunity to obtain whatever information they require on the project, its benefits and its effects.

Persons wishing to make comment, criticise, query or support the proposal should write a submission and post it to Maitland City Council by the date nominated in the advertisement in local papers.

Further information on any aspect of the project can be obtained by contacting CMPS&F Environmental, Environmental Assessment Division, on (02) 9412-9888 or CSR on (02) 9372-5896.

VOLUME TWO APPENDICES

APPENDIX A
REQUIREMENTS OF THE DEPARTMENT OF URBAN AFFAIRS AND PLANNING

New South Wales Government
Department of Urban Affairs and Planning

Mr Stephen Hills
Environmental Planning Manager
CMPS&F Pty Limited - Environmental
P.O. Box 201
CHATSWOOD NSW 2057

Contact: Cled Brown

Our Reference: N 96/390

Your Reference: VH0018 SH.TF

Dear Mr Hills,

18 DEC 1996

Re: Proposed Quarrying, Landfilling, and Site Rehabilitation at the PGH Brickworks Site Metford, Maitland

Thank you for your letter of 7 November 1996 seeking consultation with the Director-General for the preparation of an environmental impact statement (EIS) for the above development.

If development consent is required for the proposal and it is designated development within the meaning of Schedule 3 of the Environmental Planning and Assessment Regulation (the Regulation) 1994, an EIS must accompany the development application. The EIS shall be prepared in accordance with Clause 51 of the Regulation and shall bear a certificate required by Clause 50 of the Regulation.

Attachment No. 1 - EIS Guideline - Quarries and **Attachment No. 2 - EIS Guideline - Landfilling** [both printed October 1996] each contain a guide on the type of information most likely to be relevant to the proposed development. Not all the matters contained in each guide may be appropriate for consideration in the EIS for your proposal; equally, both guides are not exhaustive.

The issues emerging from consultation with relevant local, State and Commonwealth government authorities, service providers and community groups are to be addressed in the EIS. The applicant should also identify and consult with any other parties who may have an interest in the proposal.

Should you require any further information regarding the Director-General's requirements for the EIS, please contact Cled Brown on (02) 9391 2155.

INCOMING CORRESPONDENCE	
DATE IN	20th Dec 96.
PROJECT MGR.	SHills | INTL SH
PROJECT No.	VH0018/004
FILE No.	004
TO	SH
A/I/C	kw
INTL	SH

Governor Macquarie Tower
1 Farrer Place, Sydney 2000
Box 3927 GPO, Sydney 2001

Telephone: (02) 9391 2000
Facsimile: (02) 9391 2111

Yours sincerely

for David Mutton
Acting Manager
Major Assessments and Hazards Branch
As Delegate for the Director-General

APPENDIX B
RESOURCE AND QUALITY INVESTIGATION

CSR Limited

Monier PGH Holdings Limited

PGH Metford Quarry

Maitland

Resource and Quality Investigation

Compiled by :

Ron Bush B.Sc. (Geol.)
Development Manager
CSR Construction Materials

June 1997

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LIST OF DRAWINGS

1.0 Introduction

Monier PGH Holdings Limited (PGH) is a wholly owned business unit of CSR Limited and forms part of the CSR Building Materials division. The Monier PGH business is a leading Australian supplier of clay brick and pavers , roof tiles and earthware products. Well known brand names marketed by this business include PGH , Zacuba , Monier and Wunderlich.

PGH operate a clay and shale quarry at Metford. This quarry supplies part of the raw materials used within PGH brick plant located on site. Other raw material supplies are also imported to the site from other PGH quarries at Thornton and elsewhere.

The quarry is located at Metford , east of Maitland within the lower Hunter. Access to the quarry is via Metford Road.

The quarry operation on the site was originally established during 1882 by Turton and the operation has since been consolidated into the PGH business. The site has been continuously worked since this time.

A Environmental Impact Statement is currently being prepared for the future extraction and restoration of the site. The purpose of this report is to detail the geology of the site , resource investigations undertaken , extractable reserves , reserve quality and to outline the proposed staged development of the site.

2.0 Property Details / Land Tenure

The PGH Metford quarry is located on Lots 378 , 401 , 266 , Portion 2 and unallocated Crown Land , within the Parish of Maitland , County of Northumberland. All of the land is Crown land and Lots 378 and 401 are held by PGH by a Crown Special Lease No. 61/7.

PGH holds Mining Leases ML 875 , ML 2843 , ML 4589 , ML 5848 , ML 5090 , ML 4865 , ML 2841 and MLA 87 at the site.

The Mining Leases cover approximately 50 hectares and are located wholly within the Maitland City Local Government Area.

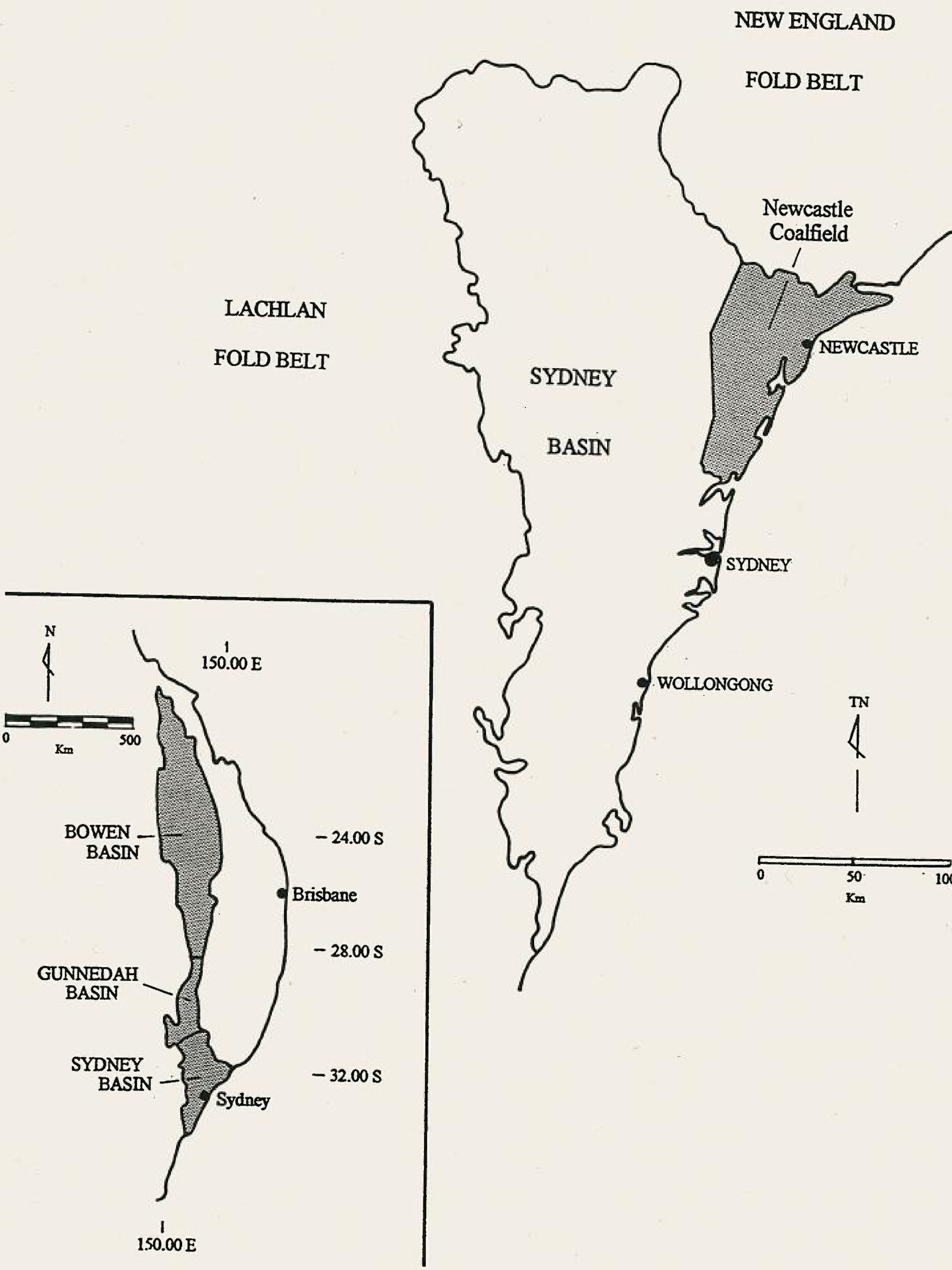


Figure 1 : Location of the Newcastle Coalfield within the Sydney Basin

Period		Stratigraphy		Lithology
Triassic	Middle	Hawkesbury Sandstone		Quartz sandstone and minor siltstone
	Early	Narrabeen Group	Terrigal Formation	Sandstone, siltstone
			Clifton Subgroup	Conglomerate, sandstone, siltstone, claystone, tuff, minor coal
Permian	Late	Newcastle Coal Measures	Moon Island Beach Subgroup	Conglomerate, sandstone, siltstone, coal, tuff
			Boolaroo Subgroup	Sandstone, conglomerate, siltstone, coal, tuff
			Adamstown Subgroup	Conglomerate, sandstone, siltstone coal, tuff
			Lambton Subgroup	Sandstone, siltstone, claystone, coal, tuff
			Waratah Sandstone	Sandstone
		Tomago Coal Measures	Dempsey Formation	Siltstone, sandstone, coal, tuff, minor carbonaceous claystone
			Four Mile Creek Formation	Sandstone, siltstone, claystone, coal, tuff
			Wallis Creek Formation	Laminated sandstone, claystone siltstone, coal, tuff
		Maitland Group	Mulbring Siltstone	Siltstone, sandstone
			Muree Sandstone	Sandstone, conglomerate, minor claystone
			Branxton Formation	Conglomerate, sandstone, siltstone
		Greta Coal Measures		Sandstone, conglomerate, siltstone, coal
	Early	Dalwood Group	Farley Formation	Silty sandstone
			Rutherford Formation	Siltstone, marl, minor sandstone
			Allandale Formation	Conglomerate, lithic sandstone
			Lochinvar Formation	Basalt, siltstone, sandstone

Figure 2 : Stratigraphy of the Newcastle Coalfield

3.0 Geology

3.1 Regional Setting

Sydney Basin

The Lower Hunter Region is located within the north eastern portion of a major structural sedimentary basin , known as the Sydney - Bowen Basin. The basin extends from Batemans Bay in the south to Collinsville , Queensland in the north and consists of several structural units.

The Sydney Basin is one of several smaller sedimentary basins which make up the larger structure. The Sydney Basin is triangular in shape and extends from Bellata in the north and intersects the east coast at Newcastle and Batemans Bay.

The Sydney Basin consists of mainly sedimentary rocks which range from Permian to Triassic age. The Sydney Basin overlies the Palaeozoic rocks of the Lachlan Fold Belt.

Newcastle Coalfield

The Newcastle Coalfield consists of three coal measure sequences - the Early to Late Permian Greta Coal Measure , the Late Permian Tomago Coal Measure and the Late Permian Newcastle Coal Measures.

The three coal measure sequences are separated by marine intervals , such as the marine Dalwood Group , underlying the Greta Coal Measures ; the marine Maitland Group separating the Greta and Tomago Coal Measures and the marine Dempsey Formation - Waratah Sandstone which separates the Tomago and Newcastle Coal Measures. The Early Triassic Narrabeen Group overlies the Newcastle Coal Measures.

Figure 1 outlines the location of the Newcastle Coalfield in relation to the Sydney Basin and Figure 2 outlines the stratigraphy of the Newcastle Coalfield.

3.2 Tomago Coal Measures

Figure 3 outlines the stratigraphy of the Tomago Coal Measures.

The Tomago Coal Measures are divided into three formations , the Wallis Creek Formation or Subgroup , the Four Mile Creek Formation or Subgroup and the Dempsey Formation or Hexham Subgroup.

Wallis Creek Formation

The Wallis Creek Formation is the basal formation of the Tomago coal Measures and consists of sandstone , siltstone , claystone and thin coal seams. The formation is approximately 185 metres thick at Maitland and has a maximum thickness of 300 metres. Within the sediments bioturbation is common. The coal seams are the Morpeth, lower Rathluba , upper Rathluba , Scotch Derry and Tomago Thin Seams.

Four Mile Creek Formation

Overlying the Wallis Creek Formation the Four Mile Creek Formation is the principal coal bearing interval within the Tomago Coal Measures. It consists of siltstone , claystone , sandstone and coal. Several thick coal bearing seams occur , including the Big Ben seam and Lower Donaldson seam.

Dempsey Formation

The uppermost formation is the Dempsey Formation and consists of siltstone , claystone , sandstone and thin coal seams. The Demspey Formation is approximately 590 metres thick at its maximum development.

3.3 Site Geology

Several resource drilling investigations have been completed to evaluate the geology of the site in detail , with the most recent investigation being undertaken during February 1997. Drilling programs are also conducted on a localised basis prior to extraction campaigns to assist in short term quarry development. Drill hole

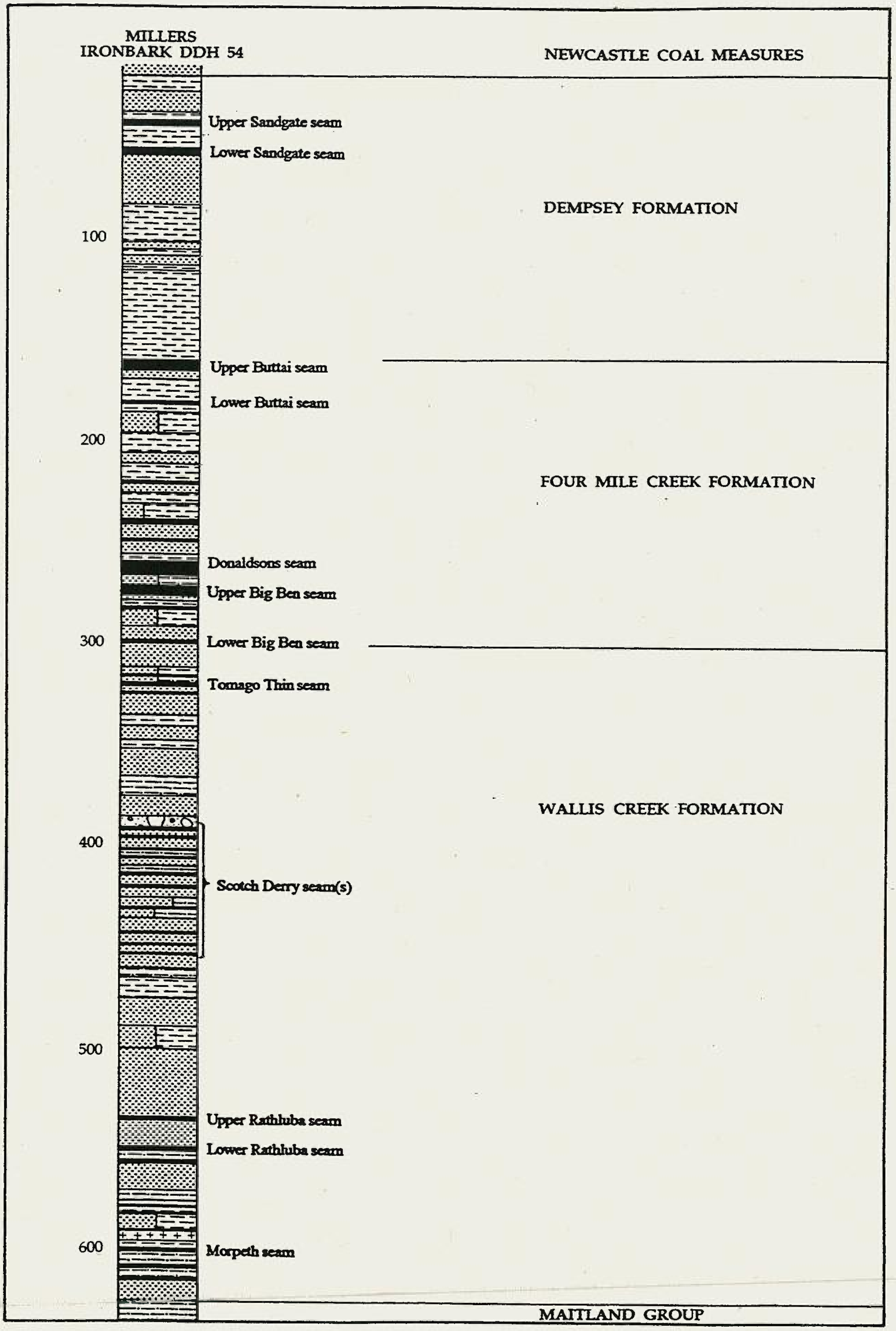


Figure 3 : Stratigraphy of the Tomago Coal Measures

locations are identified on Drawing No. 2. Drill hole logs are contained within Appendix No. 1.

A total of 15 percussion holes (up to 11 metres deep) and 11 diamond drill holes (up to 30 metres deep) have been drilled covering a total of 413.5 linear metres over the property. An additional 6 water monitoring holes have also been drilled on the property.

The drill information available over the site is used in conjunction with the exposures contained within the current quarry to schedule mining operations of the different raw material types on site.

The majority of the material mined on site are clayey sandstone , shale and siltstone. The on site materials fire a range of colours , from off white / cream , pink , beige and grey. The raw materials mined on site are stockpiled , and with other raw materials transported to the site , are blended to produce a batch which will be used to manufacture a certain brick colour type.

4.0 Reserves

Reserves of clay and shale for brickmaking purposes have been calculated for the stages of development at the site.

Drawing No. 1 outlines the existing surface contours at the site.

Drawings No. 3 to Drawing No. 5 outline the proposed development stages.

Reserves are detailed within Table 1 and were calculated using SURPAC mine design software by Australian Mine Design and Development Pty Ltd (AMDAD) using digital ASCII data supplied by Geospectrum Pty Ltd.

Air space available on the site to be landfilled as restoration of the voids was also calculated by AMDAD and is outlined within Table 1.

The following assumptions were provided to AMDAD to be used in designing the clay extraction pits:

Surface haul roads -	25 metres wide
Pit Ramps -	10 metres wide , 1 in 8-10 gradient
Batter slopes -	55° from the horizontal
Density conversion factor -	2.0 t / m^3
Landfill compaction density -	1 tonne per 1 m^3 airspace

The reserve figures outlined on Table 1 are insitu reserves for the site and will have to be discounted for overburden , interburden and contaminated lenses to be converted to winnable reserves. This is done during each mining campaign where the volume extracted is checked against product and waste stockpile surveys.

The amount of waste material from the previous several years mining campaigns has ranged at about 20% of the insitu reserves , which is mainly from removal of sandstone lenses which are unsuitable for brickmaking purposes mainly due to the fired colour or hardness. This waste material is currently used for bund construction and site works. Once landfilling operations commence on the site the overburden will also be used as daily cover.

Table 1 : *PGH Metford Quarry*
Quarry Reserves and Air Space Potential

Quarry		
Stage	*m³*	*tonnes*
A	0	0
B	300,000	600,000
C	107,702	215,404
D	0	0
E	421,939	843,878
F	5,000	10,000
Total	**834,641**	**1,669,282**

Landfill	
Stage	*m³*
A	492,899
B	489,505
C	129,242
D	928,937
E	506,327
F	0
	2,546,910

The expected yield of each raw material type is approximately :

80%	Sandstone / shale - cream , pink , beige fired colours
20%	waste as overburden
100%	

5.0 Quality

The on site sediments have been a main source of structural ceramic material used within the Maitland region for over a century.

Bores drilled or bulk samples taken in advance of mining operations are quality tested to assist in the selective mining process employed at the site. Mined stockpiled material is also tested to ensure consistent quality during the brick making process. Quality control is conducted on a regular basis by technical personnel employed by the company.

Table 2 outlines results of Metford material tested during 1995-6.

The quality results outlined within Tables 2 confirms that the clayey sandstone and shale reserves mined at the quarry are of sufficient quality to be used for the manufacture of bricks.

Table 2 *PGH Metford Quarry*
1995-6 Quality Results - Stockpile Sampling

Sample		**Metford No. 3 Pit**	**Fieldsend**	**Metford No. 4 Pit**	**Metford No. 4 Pit**
Date		15/8/95	23/8/96	14/10/96	28/95
Sample No.		N8-95	8/96	6/96	TB8/95
@ 1050°C	**Colour**	Biscuit	Magnolia	Biscuit	Shell Pink
	MC %	23.7	25.3	20.5	17.9
	Dried Shrinkage %	3.8	7.6	3.4	2.9
	Fired Shrinkage %	3.2	4.6	3.4	3.7
@ 1070°C	**Colour**	Beige			Beige
	MC %				
	Dried Shrinkage %				
	Fired shrinkage %	4.8			5
LOI	%		6.5	3.1	
Clay Content	%	51	87.1	39.4	49

93/01293

Parpitt

6.0 Quarry Development

Discussed below are the site works which will be conducted in conjunction with the extraction of each stage of development and the subsequent landfilling of each stage.

Stage A and B Development (Drawing No.3)

- Relocate internal haul road around southern Fieldsend pit extension.
- Construct bund wall along western and southern boundaries on Fieldsend pit and along the southern boundary on main pit.
- Upgrade water management system on the site and pump out Fieldsend pit
- Extract remaining shale reserves from the southern Fieldsend pit while landfilling the northern Fieldsend pit.

Stage C , D and E Quarry Development (Drawing No.4)

- Extract clay and shale reserves from the extraction areas on the plant side.
- Restoration of C extraction void by commencing landfill.
- Use waste rock and overburden as cover material.

Stage C , D and E Landfill Development (Drawing No.5)

- Landfill extraction stages C , D and e using landfill.
- Use waste rock and overburden as cover material.

7.0 Conclusion

The PGH Metford Quarry extracts sandstone and shale from the Tomago Coal Measures of the Newcastle Coalfield sediments. The sandstone and shale reserves extracted at the quarry are of suitable quality to be used as a raw material source for the manufacture of bricks. The on site raw materials have been successfully used for brick manufacture for over a century.

Approximately 1.67 million tonnes of clay and shale reserves are contained within the site.

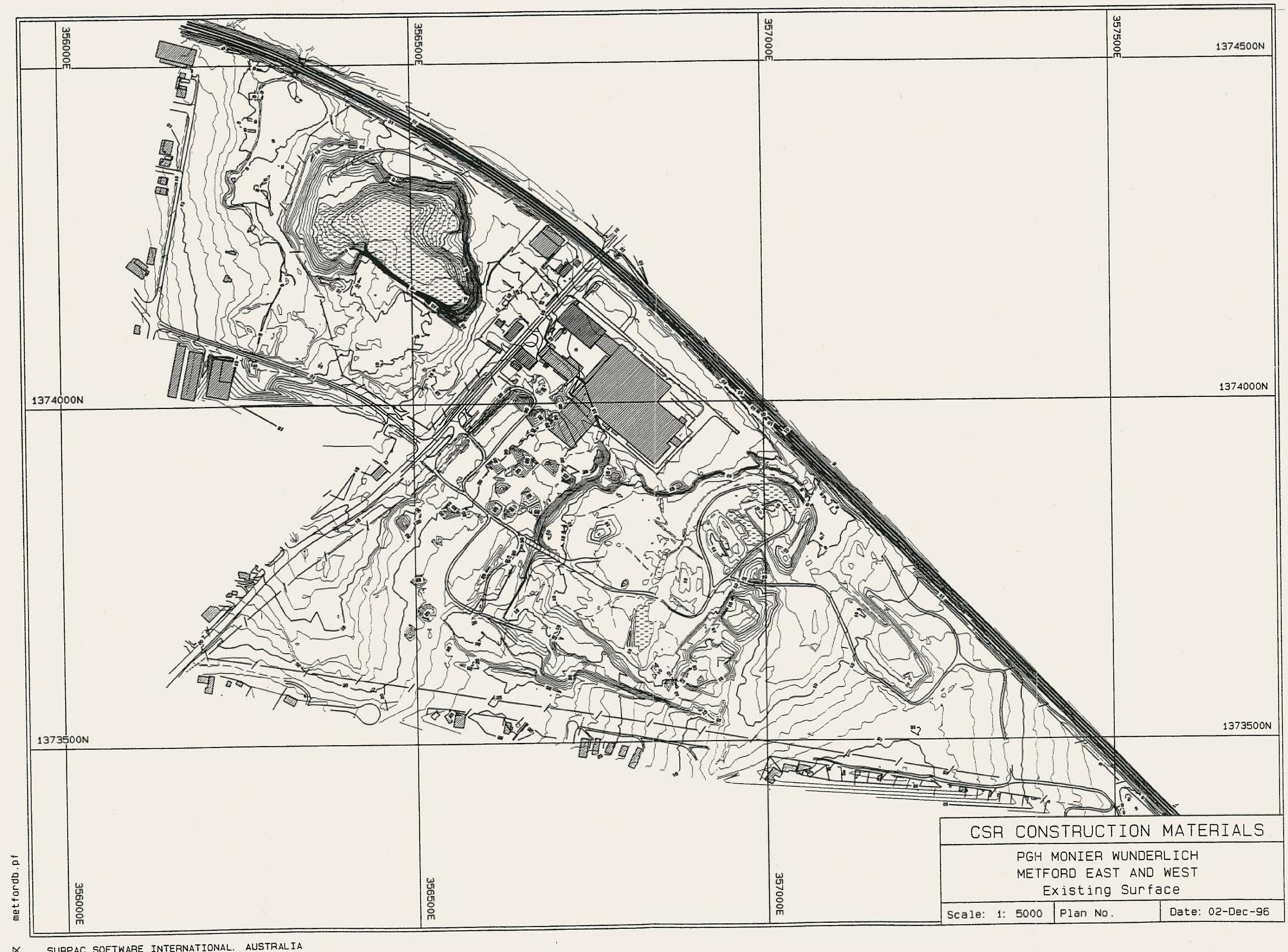
Development at the site is proposed within six development areas and the resultant voids are proposed to be restored by landfill to produce a final stable landform. Approximately 2.5 million m^3 of air space is available for landfill within the six development areas.

References :

S.P Hawley & J.S Brunton

The Newcastle Coalfield
Notes to Accompany the Newcastle Coalfield Regional Geology Map.

Geological Survey of NSW Report No. GS 1995/256
Department of Mineral Resources , September 1995


356000E
356500E
357000E
357500E
1374500N
1374000N
1374000N
1373500N
1373500N
356000E
356500E
357000E
CSR CONSTRUCTION MATERIALS
PGH MONIER WUNDERLICH
METFORD EAST AND WEST
Existing Surface
Scale: 1: 5000
Plan No.
Date: 02-Dec-96
metfordb.pf
SURPAC SOFTWARE INTERNATIONAL, AUSTRALIA

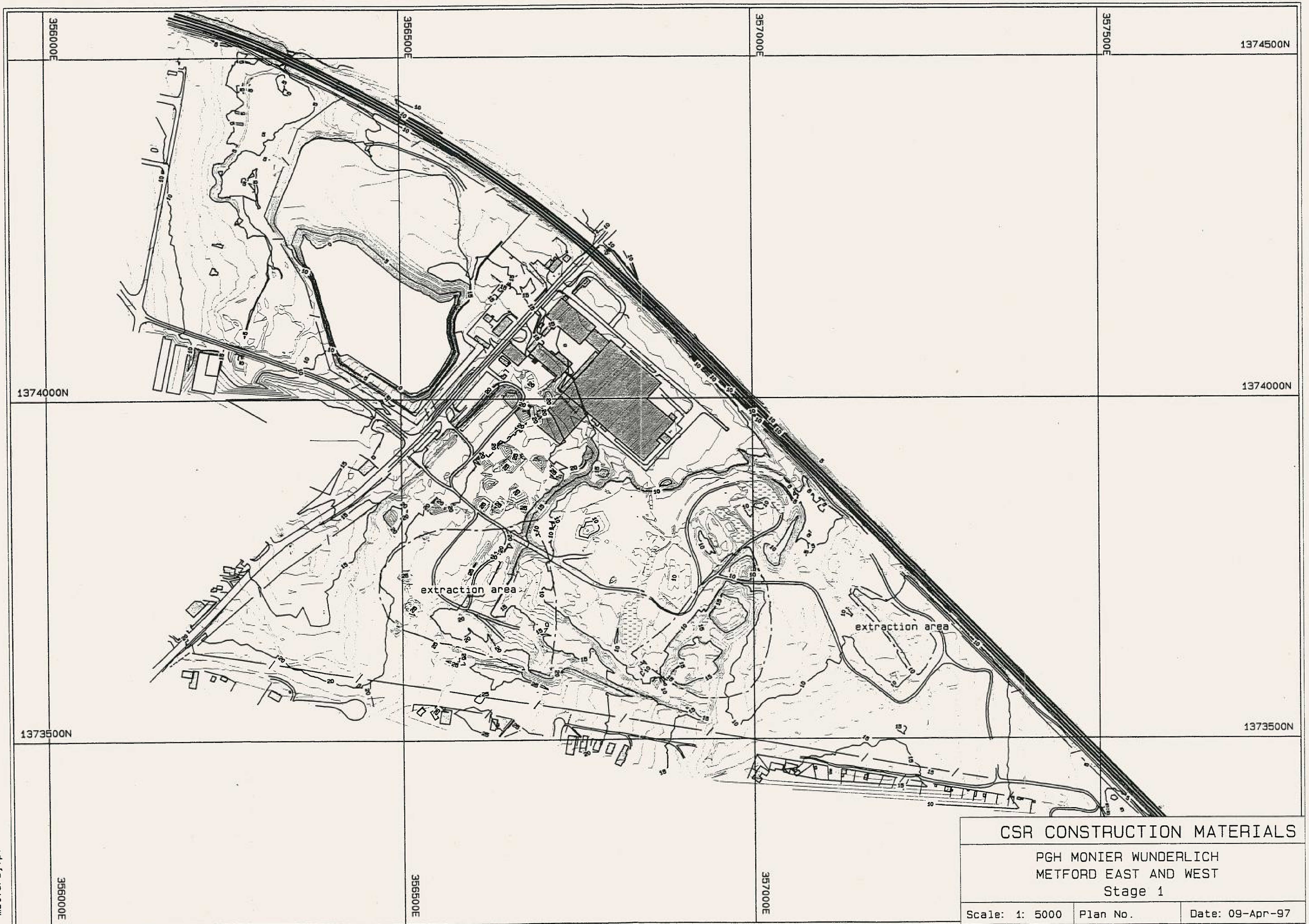
CSR CONSTRUCTION MATERIALS

PGH MONIER WUNDERLICH
METFORD EAST AND WEST
Drill Hole Location Plan

Scale: 1: 5000	Plan No.	Date: 21-May-97

metholed.pf

SURPAC SOFTWARE INTERNATIONAL. AUSTRALIA



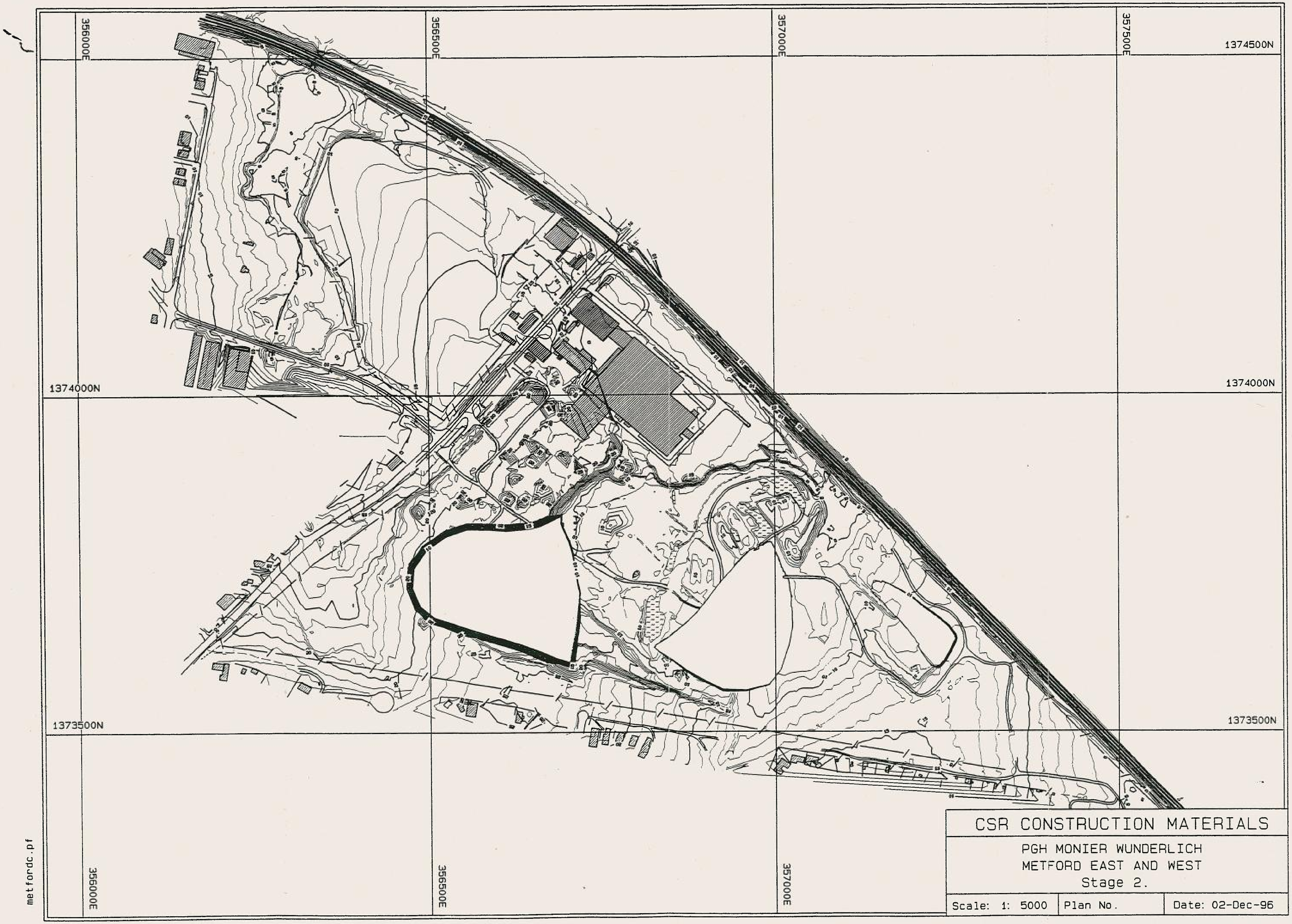
CSR CONSTRUCTION MATERIALS

PGH MONIER WUNDERLICH
METFORD EAST AND WEST
Stage 1

Scale: 1: 5000	Plan No.	Date: 09-Apr-97

metfordj.pf

SURPAC SOFTWARE INTERNATIONAL, AUSTRALIA

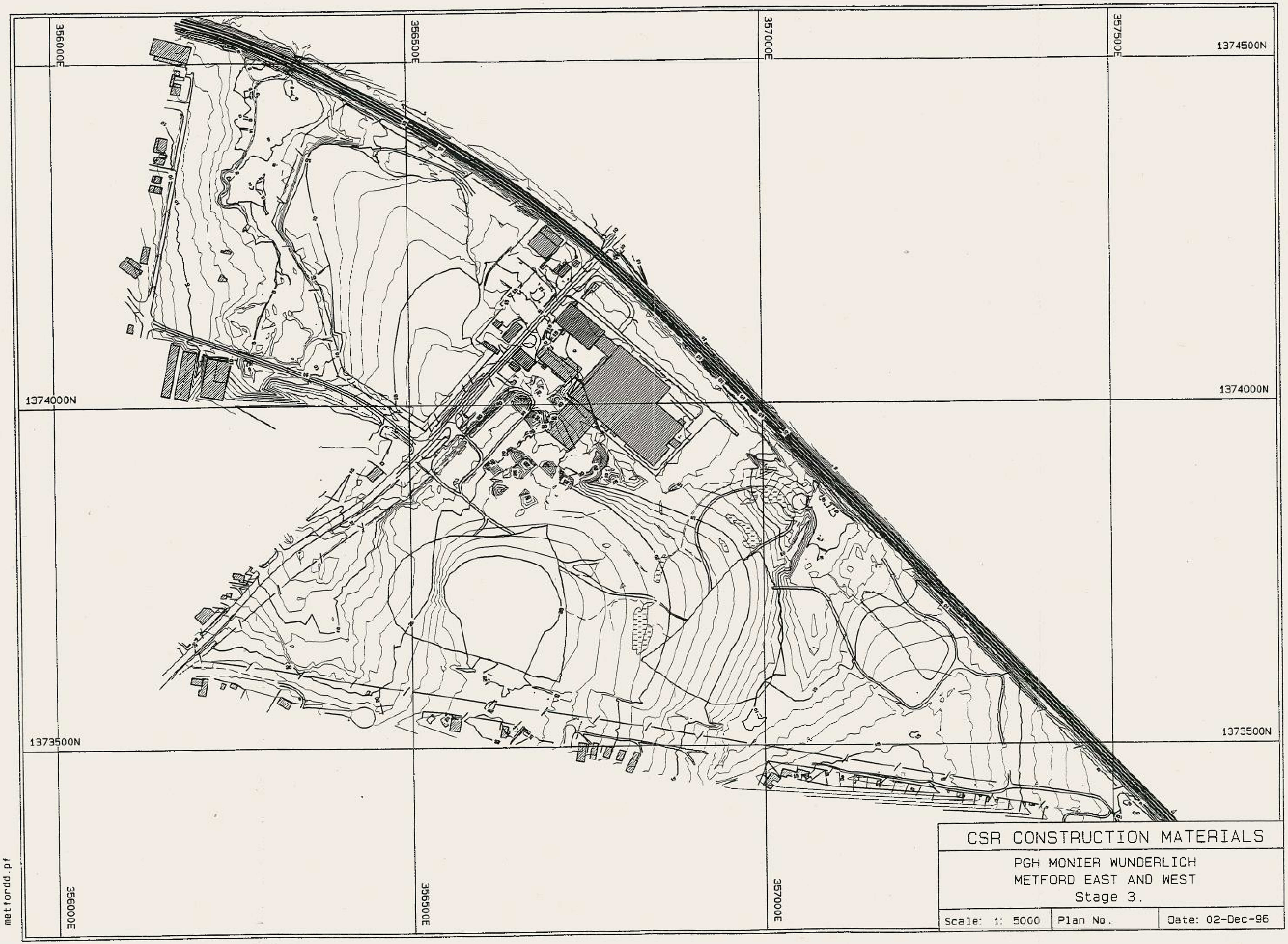


CSR CONSTRUCTION MATERIALS

PGH MONIER WUNDERLICH
METFORD EAST AND WEST
Stage 2.

Scale: 1: 5000	Plan No.	Date: 02-Dec-96

SURPAC SOFTWARE INTERNATIONAL. AUSTRALIA



SURPAC SOFTWARE INTERNATIONAL. AUSTRALIA

APPENDIX NO. 1

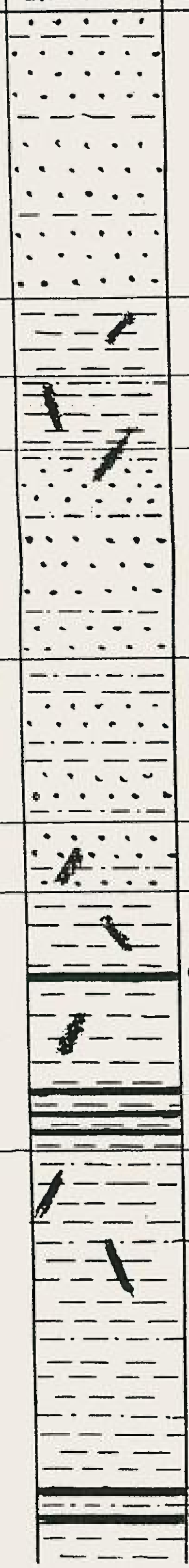
PGH N.S.W LOG SHEET

BORE HOLE: MDDH 1	**DATUM LEVEL:**
SITE: Maitland Brickworks Quarry	**LOGGED BY:**
DATE START:	**DATE END:**

DEPTH	REL. LEVEL	GRAPHIC	DESCRIPTION
0.0			Soil/clay
			Clayey Siltstone
5.0			
			Sandstone
			Clayey Sandstone
10.0			Sandstone
			laminite
15.0			Clay (carbonaceous and coaly)
			Silty Claystone (carbonaceous)
			Claystone (carbonaceous)
20.0			Silty claystone
			Silty Sandstone
		Coal	Claystone
25.0			
			Silty Claystone
			Silty Sandstone
			Sandstone (coaly and carbonaceous)
30.0			

PGH N.S.W LOG SHEET

BORE HOLE: MDDH2	DATIUM LEVEL: 15 m
SITE: Maitland Brickworks Quarry.	LOGGED BY:
DATE START:	DATE END:

DEPTH	REL. LEVEL	GRAPHIC	DESCRIPTION
0.0			Clayey Sandstone
5.0			
			Claystone (carbonaceous)
			Silty Sandstone
			Claystone (carbonaceous)
10.0			Silty Sandstone
			Siltstone/Claystone/Sandstone
15.0			
			Silty Sandstone
		Coal	Claystone
20.0			
			Silty Claystone
25.0			
		Coal	
30.0			

PGH N.S.W LOG SHEET

BORE HOLE: MDDH3	DATIUM LEVEL: 14m
SITE: Maitland Brickyard Quarry	LOGGED BY:
DATE START:	DATE END:

DEPTH	REL. LEVEL	GRAPHIC	DESCRIPTION
0.0			Sandstone (Caystone and laminite)
			Clayey Sandstone
5.0			
			Claystone (carbonaceous)
			Laminite
			Sandstone
10.0			
			Silty Sandstone
			Coal
15.0			Clayey Sandstone
			Laminite
			Clayey Sandstone
20.0			
			Siltstone / Claystone
			Calcite Veining
25.0			Sand stone
			Siltstone/Claystone
			Claystone E.O.H 29·65
30.0			

PGH N.S.W LOG SHEET

BORE HOLE: MDD174	**DATIUM LEVEL:** RL≃12 m
SITE: Maitland Brickyard Quarry	**LOGGED BY:**
DATE START:	**DATE END:**

DEPTH	REL. LEVEL	GRAPHIC	DESCRIPTION
0			Sandstone
			Claystone (carbonaceous)
			Clayey Sandstone
		Coal	Claystone
5.0			Clayey Sandstone
			Silty Laminite
			Tuff
10.0			Sandstone/Claystone/Siltstone
			Sandstone
15.0			Sandstone/Claystone/Siltstone
20.0			Claystone
			Coal
			Claystone
			Coal
			Claystone
			Silty Sandstone
25.0			Claystone
			Silty Cayey Sandstone
		Coal	Siltstone/Claystone
30.0			

PGH N.S.W LOG SHEET

BORE HOLE: MDDH5	**DATIUM LEVEL:** ≃ RL 12 8m
SITE: Maitland Brickyard Quarry	**LOGGED BY:**
DATE START:	**DATE END:**

DEPTH	REL.LEVEL	GRAPHIC	DESCRIPTION
0.0			Clayey Silty Sandstone
			Silty Claystone
5.0			Silty Sandstone
			Sandstone/Claystone/Siltstone
			Siltstone/Claystone
10.0			Coal
			Claystone
			Sandstone/Claystone/Siltstone
15.0			Claystone (Coaly)
			Clayey Siltstone
			Silty sandstone
20.0			Silty Claystone
			Claystone
25.0			Silty Clayey Sandstone
			Sand Stone
30.0			

PGH N.S.W LOG SHEET

BORE HOLE: MDDH6	**DATUM LEVEL:** RL 13m
SITE: Maitland Brickyard Quarry	**LOGGED BY:**
DATE START:	**DATE END:**

DEPTH	REL. LEVEL	GRAPHIC	DESCRIPTION
0.0			Claystone
			Silty Claystone
5.0			Sandstone
			Laminite
10.0			Claystone
			Core Loss
			Sandstone/Claystone/Siltstone
			Coal
15.0			Laminite
			Sandstone/Claystone/Siltstone (carbonaceous)
20.0			Silty Claystone
			Coal
			Claystone
			Clayey Siltstone
25.0			Sandstone
			Cavity
			Sandstone
			E.O.H 28.95 Clayey Siltstone

PGH N.S.W LOG SHEET

BORE HOLE: MDDH7	**DATIUM LEVEL:** RL 15m
SITE: Maitland Brickyard Quarry	**LOGGED BY:**
DATE START:	**DATE END:**

DEPTH	REL. LEVEL	GRAPHIC	DESCRIPTION
0.0			Fill core loss
			Clay
			Clayey Siltstone
			Sandstone
			Silty Claystone
5.0			Silty Clayey Sandstone
			Coaly
			Silty Claystone (Carbonaceous)
			Sandstone
			Clayey Shaley Siltstone
			Coal
10.0			Silty Sandstone
			Laminite
			Clayey Siltstone
			Sandstone
15.0			Laminite
20.0			Sandstone
			Coal
			Clay
25.0			Coal
			Coal/Clay
			Coal
			Carbonacous/Coaly Shale
			Laminite
30.0			

PGH N.S.W LOG SHEET

BORE HOLE: MDDH8	**DATIUM LEVEL:** RL 13m
SITE: Maitland Brickyard Quarry	**LOGGED BY:**
DATE START:	**DATE END:**

DEPTH	REL.LEVEL	GRAPHIC	DESCRIPTION
0			Sandstone
			Siltstone
5.0			Sandstone
			Coal
			Claystone
			Sandstone
10.0			ClayeySittey Sandstone
			Clayey Siltstone
			Laminite
15.0 20.0			Sandstone
			Claystone pyrite
25.0			E.O.H 25.25 - due to washing out of Core
30.0			

19/7/93

MW1 - DRILLING

HOLE MW1

0 - 1.0 m OVERBURDEN

1.0 - 4.0 m (1). YELLOW - WHITE SANDSTONE

4.0 - 5.0m (2) LIGHT BROWN SANDSTONE WITH CLAY BANDS.

5.0 - 6.0m (3) ORANGE - WHITE SANDSTONE.

6.0 - 7.0m S/STONE & COAL.

7.0 - 9.0m (4) GREY SILTSTONE.

9.0 - 10.0m (5) LIGHT GREY SILTSTONE - CLAYSTONE.

10.0 - 14.0m (6) GREY SILTSTONE.

14.0 - 17.0m (7) GREY SILTY SHALE WITH COAL SEAM & THIN BAND OF CLAY.

17.0 - 18.0 (8). GREY SHALE

18.0 - 21.0 (9) GREY COARSE SANDSTONE

21.0 - 24.0 (10). GREY CLAY & WATER MIX (VERY SLOPPY).

24.0 - 25.0 (11). LIGHT GREY SANDSTONE (WET)

END OF HOLE

20/7/93

DRILLING

HOLE MW2

0 – 1.0 m		SILTY OVERBURDEN
1.0 – 4.0	1	YELLOW - GREY - BROWN CLAY.
4.0 – 5.0	2.	BROWN SILTSTONE
5.0 – 6.0	3	GREY SILTY SHALE & COAL
6.0 – 7.0	4	GREY-BROWN SILTSTONE
7.0 – 10.0	5	SOFT GREY SANDSTONE
10.0 – 13.0	6	FINE LIGHT GREY SILTY CLAY. -SILTSTONE
13.0 – 15.0	7	OFF-WHITE SOFT SILTSTONE.
15.0 – 16.0	8.	WHITE SILTSTONE RUNNING INTO COAL.
16.0 – 19.0	9	GREY CLAYSTONE.
19.0 – 20.0	10	GREY SANDSTONE (WET)
20.0 – 23.0	11	LIGHT GREY SANDSTONE (WET)

END OF HOLE

22/7/93

DRILLING – MN 3

HOLE MN 3

0 – 1.0 m		OVERBURDEN RUNNING INTO BROWN CLAY
1.0 – 2.0	1	BROWN CLAY
2.0 – 3.0		BROWN CLAY RUNNING INTO CREAM SANDSTONE
3.0 – 4.0	2	CREAM SANDSTONE.
4.0 – 5.0	3	CREAM S/STONE RUNNING INTO D/BROWN CLAY & COAL
5.0 – 7.0	4.	GREY SILTSTONE RUNNING INTO COAL.
7.0 – 8.0	5	OFF-WHITE SANDSTONE
8.0 – 9.0	6	GREY SILTSTONE
9.0 – 10.0	7	OFF-WHITE SANDSTONE
10.0 – 11.0	8	GREY SILTSTONE
11.0 – 12.0	9	OFF-WHITE SANDSTONE
12.0 – 15.0	10	GREY SILTSTONE
15.0 – 220	11	OFF-WHITE SANDSTONE
22.0 – 24.0	12	DARK GREY SHALE - SILTSTONE. & THIN CLAY SEAM
[illegible]0 – 260	13	COAL & THIN LIGHT GREY CLAY SEAM.
26.0 – 27.0	14	WET GREY SILTY SHALE
27.0 – 30.0	15	WET GREY SILTSTONE.
30.0 – 32.0	16	GREY SANDSTONE & CLAY MIX
32.0 – 33.0		GREY S/STONE RUNNING INTO COAL

27/10/87

M1

		Fired colour
0		
	CLAY / SHALE	RED
1m	CLAY	BROWN / RED
	CLAY	PINK
	CLAY	PINK
2m	CLAY / SHALE	PINK
	CLAY / SHALE	PINK
3m	SAND / SHALE	PINK / CREAM
	SAND / BROWN SHALE	RED
	SAND / SHALE	PINK
4m	SAND	PINK
	SAND	CREAM / PINK
5m	SAND	CREAMY / PINK
	SAND	CREAMY / PINK
6m	SAND	LIGHT CREAMY / PINK
	SAND / CLAY	RED / PINK
	SAND	RED PINK
7m	SAND	CREAM / PINK
8m	SAND	CREAM / PINK
	SAND	CREAM / PINK
9m	SAND	CREAM PINK

28/10/87

M2

		Fired colour
0		
	CLAY	CREAM / LIGHT BROWN
1m	COAL	CREAM
2m	GREY SHALE	PINK / CREAM
	SHALE	PINK / GREY
3m	SHALE	PINK / GREY
	SHALE / COAL	GREY
4m	SAND	LIGHT GREY
	SAND	LIGHT GREY
5m	SAND	LIGHT GREY
	SAND	LIGHT GREY
6m	SAND	LIGHT GREY
	SAND	LIGHT GREY
7m	SAND	PINKY GREY
	SAND	GREY
8m	SAND	GREY
	SAND	GREY PINK
9m	SAND CLAY	GREY PINK
	CLAY	GREY PINK
10m	CLAY	GREY PINK
	CLAY	GREY PINK

28/10/87

M4

0		
	CLAY	CREAM LIGHT BROWN
1m	CLAY/SAND	CREAM LIGHT BROWN
	SAND/CLAY	PINK YELLOW
2m	BROWN SHALE	PINK CREAM
	BROWN SHALE	PINK CREAM
3m	BROWN SHALE	RED PINK
	BROWN SHALE SAND	PINK BROWN
4m	SAND	RED PINK
	SAND/SHALE	PINK RED
5m	BROWN SAND	BROWN-PINK
	BROWN SHALE	CREAMY PINK
	SHALE	PINKY CREAM
6m	CLAY	PINKY CREAM

9/11/87

M5

0		
	CLAY	YELLOW CREAM
1m	RED BEAM	RED PINK
	CLAY	PINK BROWN
	SHALE CLAY	YELLOW CREAM
2m	CLAY	YELLOW CREAM
	BROWN SHALE	YELLOW CREAM
3m	BROWN SHALE	
	BROWN SHALE	CREAMY YELLOW
	BROWN PEAT	CREAM YELLOW
4m	PEAT COAL	CREAMY YELLOW
	PEAT - COAL	CREAMY YELLOW
5m	PEAT - COAL	CREAM YELLOW
	PEAT - COAL	CREAM YELLOW
6m	BROWN SHALE & COAL	CREAM YELLOW
	BROWN SHALE & COAL	CREAMY PINK
7m	BROWN SHALE	CREAM
	GREY SHALE	CREAM
8m	GREY SHALE	YELLOW CREAM
9m	PEAT & WHITE CLAY	YELLOW CREAM

M6

		Field colours
1m	RED CLAY	BROWN PINK
2m	GREY CLAY	YELLOW CREAM
	GREY CLAY	YELLOW CREAM
3m	GREY CLAY	YELLOW CREAM
	BROWN CLAY	YELLOW CREAM
	GREY SHALE	CREAM
4m	GREY SHALE	CREAM
	GREY SHALE	WHITE CREAM
5m	GREY SHALE	WHITE CREAM
	GREY SHALE	WHITE CREAM
6m	GREY SHALE SAND	BROWN
	CLAY & STONE	BROWN
7m	SAND STONE	PINK-BROWN
	BROWN SHALE	LIGHT BROWN
8m	BROWN SHALE	BROWN
	BROWN SHALE	BROWN

M7

		Field colours
	RED CLAY	RED
	RED/WHITE CLAY	PINK RED
1m	RED/WHITE CLAY	ORANGE PINK
	CLAY/SAND	PINK
	CLAY/SAND	PINK
2m	CLAY/SAND	PINK
	CLAY/SAND	DARK BROWN
3m	CLAY/BROWN SHALE	PINK
	SAND/WHITE CLAY	CREAM PINK
	SAND/CLAY	CREAM PINK
4m	SAND/CLAY	CREAM LIGHT BROWN
	SAND/CLAY	PINK
	SAND	PINK
5m	SAND	PINK
	SAND	PINK
6m	SAND	PINK
7m	SAND	PINK
	SAND	PINK
8m	GREY SHALE	CREAM PINK
	GREY SHALE	CREAM PINK
9m	GREY SHALE CLAY	CREAM PINK
	BROWN SHALE	CREAM PINK
10m	BROWN SHALE	CREAM PINK
	CLAY/SHALE	GREY BROWN
11m	BROWN SHALE & COAL	LIGHT GREY BROWN

11/11/87

M8

	CLAY	RED COLOUR / YELLOW CREAM
1M	SAND / CLAY	PINK CREAM
	SAND	PINK CREAM
	SAND	CREAM WHITE
	SAND / CLAY	PINK CREAM
2M	SAND	RED ORANGE
	SAND	ORANGE
	SAND	GREY CREAM
3M	SAND	GREY CREAM
	SAND	GREY CREAM
	SAND	RED ORANGE
4M	SAND	GREY PINK
	SAND	GREY PINK
5M	SAND	GREY CREAM
	SAND	GREY CREAM
6M	SAND	CREAM CRE
	SAND	GREY CREAM

11/11/87

M9

	CLAY	ORANGE
	STONE	RED ORANGE
1m	CLAY	ORANGE
	CLAY	ORANGE
2m	STONE / CLAY	ORANGE
	SANDSTONE	ORANGE
	SANDSTONE	ORANGE
3m	SAND / CLAY	CREAMY ORANGE
	CLAY	CREAMY ORANGE
4m	CLAY	CREAMY ORANGE
	CLAY	CREAMY ORANGE
5m		

24/11/87

M10

Depth		FRED COLOUR
	SAND / CLAY	CREAMY ORANGE
1M	SAND | CLAY	CREAMY ORANGE
	SAND | CLAY	ORANGE
2M	SAND | CLAY	ORANGE
	CLAY	CREAM
3M	CLAY | PEAT	CREAM
	SHALE	CREAM
4M	SHALE	CREAM
	SHALE	CREAM
5M	GREY SHALE	WHITE CREAM
	GREY SHALE	WHITE CREAM
6M	SHALE	PINKY CREAM
	SHALE	PINKY CREAM
7M	SHALE	PINKY CREAM
	~~GREY CREAM~~ SHALE & COAL	GREY CREAM
8M	SHALE	GREY.

25/11/87

M 11

Depth		
	CLAY	ORANGE
1M	CLAY -	ORANGE.
	SAND | CLAY	CREAMY ORANGE.
	SAND	ORANGE
2M	SAND | CLAY	WHITE.
	SAND CLAY	CREAMY PINK
3M	SAND CLAY	ORANGE
	SAND CLAY	ORANGE.
4M	SAND CLAY	CREAM WHITE
	SAND CLAY	CREAMY WHITE
5M	SAND	CREAMY PINK
	SAND	CREAM PINK
6M	COAL | SHALE	CREAM GREY
	SAND	ORANGE
	CLAY | SAND	CREAM PINK
7M	SAND/CLAY	CREAMY BROWN
	CLAY | SHALE	BONE CREAM
8M	SHALE	YELLOW | CREAM.

APPENDIX C
RESPONSES FROM PUBLIC AUTHORITIES

AGL

AGL Gas Companies

INCOMING CORRESP	
DATE IN	22nd Nov. 96
PROJECT MGR.	SH INTL
PROJECT No.	VH0018
FILE No.	027
TO	SH
A/I/C	
INTL	SH

ENG:DC

20 November 1996

CMPS & F PTY Limited
PO Box 201
CHATSWOOD NSW 2057

Attention: Mr S. Hills

Dear Sir,

RE: PREPARATION OF AN EIS FOR QUARRYING, LANDFILLING, AND SITE REHABILITATION AT PGH BRICKWORKS SITES. WARNERVALE AND METFORD.

With reference to your letters concerning the EIS process associated with above PGH sites.

To confirm, AGL mains are unaffected by the proposal at either location and I attach, for your information copies of the Company's gas main plans which indicate the location of gas mains with regard to the subject sites.

Should you require further information concerning the location of gas mains or the supply of natural gas please do not hesitate in contacting myself on telephone No. (02) 9736-5782.

Yours faithfully
AGL Gas Companies (NSW) Limited

D.J. Churchill

D. J. Churchill
Mains Liaison Officer

AGL Gas Company (NSW) Limited ACN 003 004 322 • Tennyson Road Mortlake NSW 2137
P.O. Box 35 Concord NSW 2137 Phone: (02) 922 0101 Fax: (02) 736 5755

A:\MAINS28\M28DIR\DC.127

MORPETH 7B

SCALE 1:2000

50 0 50 100 150 200

THIS MAP UPDATED ON 23/06/95
THIS PLAN IS DIAGRAMATIC ONLY. DISTANCES SCALED FROM THIS PLAN MAY NOT BE ACCURATE.
DATE ALTERED:............ BY:..........

ME4C	ME4D	ME5C
ME7A	ME7B	ME8A
ME7C	ME7D	ME8D

ADJOINING MAPS

217 215 216

NETWORK AREA

MAITLAND

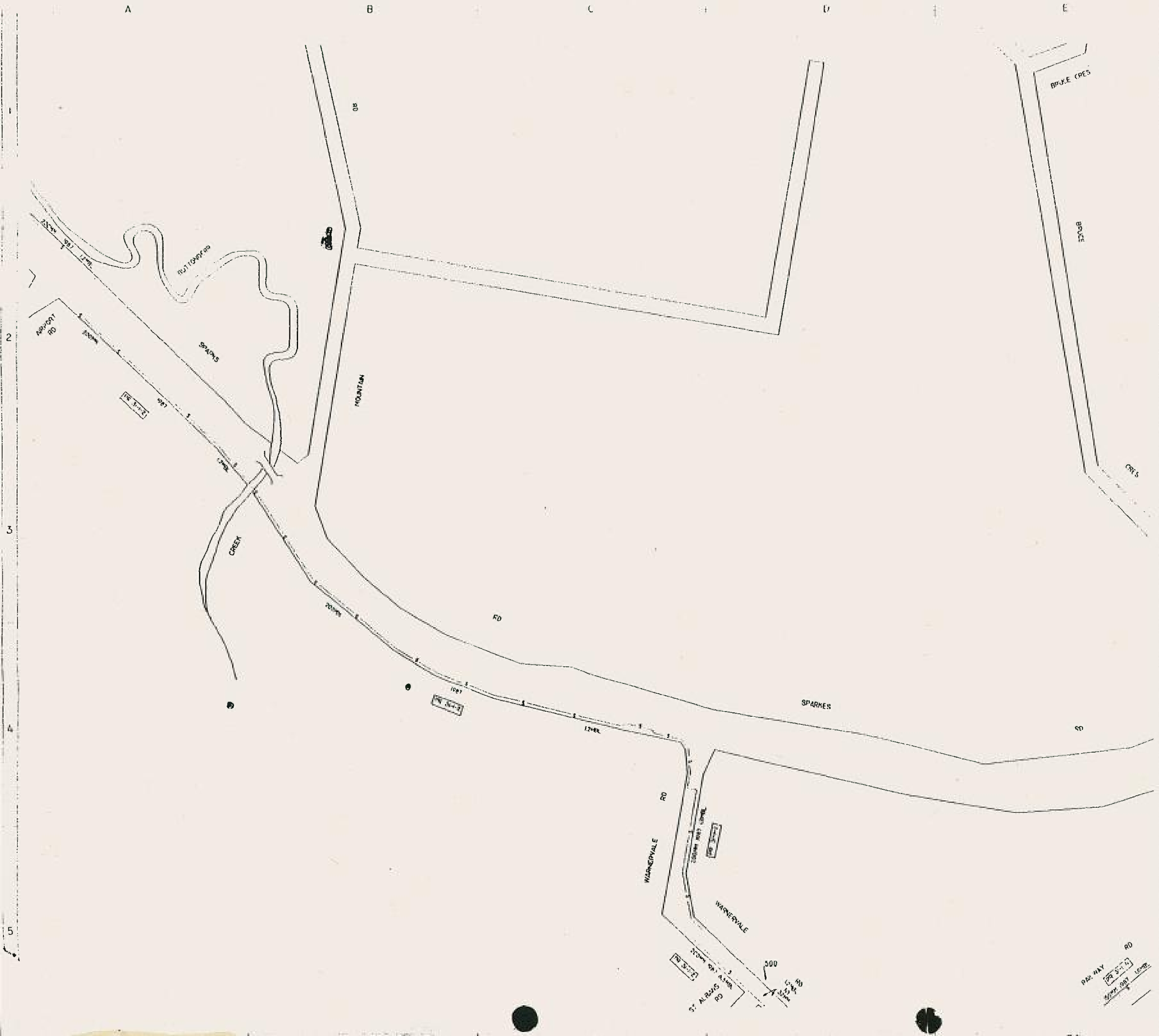
MUNICIPALITY AREA

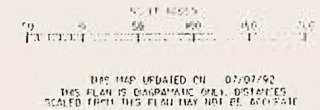
KEY - NEWCASTLE

MAX ALLOWABLE OPERATING PRESSURE

T	TRUNK MAIN	7000 kPa
P	PRIMARY MAIN	3500 kPa
S	SECONDARY MAIN	1050 kPa
		300 kPa
		210 kPa
		30 kPa
		2 kPa
400		400 kPa
100		100 kPa
	PROPOSED MAINS	
FR 8-2 3	STEEL MAIN PROJECT NUMBER	
	VALVE	
	SYSTEM PRESSURE REGULATOR	
S	SIPHON	
123	NETWORK NODES	
1238	ITEM DETAIL SKETCH AVAILABLE	
	VALVE NUMBER (OLD NUMBERING)	
6NB	6 INCH CAST IRON MAIN	
150MM	150MM STEEL MAIN	
110MM PE/NY	110MM POLYETHYLENE/NYLON MAIN	
6NB 50MM NY	50MM NYLON INSERTED INTO 6NB MAIN CAST IRON MAIN	
1.2MBL	DISTANCE IN METRES OF MAIN FROM BUILDING LINE (TOLERANCE OF 0.4M)	
1957	YEAR LAID	
	MUNICIPALITY BOUNDARY	
	NETWORK BOUNDARY	
63	HOUSE NUMBER	

MORPETH 7B





DD8A	DD8B	DD9A
DD8C	DD8D	DD9C
WY2A	WY2B	WY3A

ADJOINING MAPS

	WYONG
NETWORK AREA	MUNICIPALITY AREA

KEY

MAX ALLOWABLE OPERATING PRESSURE

T	TRUNK MAIN	7000 kPa
P	PRIMARY MAIN	3500 kPa
S	SECONDARY MAIN	1050 kPa
		300 kPa
		210 kPa
		7 kPa
400		400 kPa
100		100 kPa
		2 kPa
	PROPOSED MAINS	
PP 0-2 3	STEEL MAIN PROJECT NUMBER	
	VALVE	
	SYSTEM PRESSURE REGULATOR	
S	SIPHON	
123	NETWORK NODES	
123S	ITEM DETAIL SKETCH AVAILABLE	
	VALVE NUMBER (OLD NUMBERING)	
6NB	6 INCH CAST IRON MAIN	
150MM	150MM STEEL MAIN	
110MM PE/NY	110MM POLYETHYLENE/NYLON MAIN	
(6)NB 50MM NY	50MM NYLON INSERTED INTO 6NB MAIN CAST IRON MAIN	
1.2MBL	DISTANCE IN METRES OF MAIN FROM BUILDING LINE (TOLERANCE OF 0.6M)	
1957	YEAR LAID	
	MUNICIPALITY BOUNDARY	
	NETWORK BOUNDARY	
	HOUSE NUMBER	

DURREN DURREN 8D

DURREN DURREN 8A

SCALE 1:2000

50 0 50 100 150 200

02/05/87

THIS MAP UPDATED ON
THIS PLAN IS DIAGRAMATIC ONLY. DISTANCES SCALED FROM THIS PLAN MAY NOT BE ACCURATE.

DD4D	DD5C	DD5D
DD7B	DD8A	DD8B
DD7D	DD8C	DD8D

ADJOINING MAPS

	WYONG
NETWORK AREA	MUNICIPALITY AREA

NG

KEY

MAX ALLOWABLE OPERATING PRESSURE

T	TRUNK MAIN	7000 kPa
P	PRIMARY MAIN	3500 kPa
S	SECONDARY MAIN	1050 kPa
		300 kPa
		210 kPa
		7 kPa
400		400 kPa
100		100 kPa
		2 kPa
	PROPOSED MAINS	
FR 8-2 3	STEEL MAIN PROJECT NUMBER	
	VALVE	
	SYSTEM PRESSURE REGULATOR	
S	SIPHON	
123	NETWORK NODES	
1238	ITEM DETAIL SKETCH AVAILABLE	
	VALVE NUMBER (OLD NUMBERING)	
6NB	6 INCH CAST IRON MAIN	
150MM	150MM STEEL MAIN	
110MM PE/NY	110MM POLYETHYLENE/NYLON MAIN	
6NB 50MM NY	50MM NYLON INSERTED INTO 6NB MAIN CAST IRON MAIN	
1.2MBL	DISTANCE IN METRES OF MAIN FROM BUILDING LINE (TOLERANCE OF 0.4M)	
1957	YEAR LAID	
-+-+-+-	MUNICIPALITY BOUNDARY	
	NETWORK BOUNDARY	
63	HOUSE NUMBER	

DURREN DURREN 8A

699 P01 DEC 20 '96 10:46

AUSTRALIAN HERITAGE COMMISSION

GENERAL FILE

INCO[illegible]					
DATE	21/12/96				
PROJECT [illegible]GR	SHills			L	SH
PROJEC[illegible]	VH0018				
FILE	027				
TO	SH				
A/I/C	A				
INTL	SH				

FACSIMILE MESSAGE

TO: Stephen Hills

FAX: (02) 9412 9876

FROM: Amanda Sanderson

DATE: 20 December 1996 PAGES FOLLOWING: 0

SUBJECT: Register of the National Estate.

MESSAGE

In response to your letter of 25 November, I have checked our database of registered properties in the national estate for the following sites:

PGH Brickworks Site, Warnervale, Wyong
" " Metford, Maitland
" " Horsley Park, Fairfield
" " Schofields, Blacktown

We have no listing of any of these sites, nor any sites nearby.

If you have any further questions, please don't hesitate to contact us.

[...]TA HOUSE 39 BRISBANE AVENUE BARTON ACT 2600 PHONE (06) 217 2111 MTA FAX (06) 217 2095 IBM FAX (06) 217 2000
GPO BOX 1567 CANBERRA ACT 2601 AUSTRALIA

LAND & WATER
CONSERVATION

The Director,
CMPS&F,
PO Box 201,
Chatswood,
NSW 2057.

FAXED 17.6.97

17 June 1997.

ATTENTION: Ms. Felicity Stening.

Dear Madam,

EIS FOR BRICKWORKS,MAITLAND.

Further to the planning focus meeting held on 9 December last.

Issues of concern to this Department have been adequately canvassed before in previous correspondence dated as below from the former agencies now incorporated into DLWC and as well were covered again at the focus meeting and in your meeting minutes dated 20/12/96.

The letters of relevance are:- Dated	24/5/95,	signed by	P. Dwyer, (CALM)
--	30/5/95	--	C. Page, (DLWC)
--	20/6/95	--	T. StGeorge, (CALM)
--	25/5/95	--	E. Harris. (Water Resources)

I believe you have copies of these letters, but if not I could supply copies.

We would appreciate if you could supply copies of the existing mining leases to Mr. Ian Tapper at our Maitland office P.O. Box 6, East Maitland, NSW 2323.

Should there be any further enquiry in this matter, please contact Mr. Jeff Hunt, Catchment Planning Manager, at our Newcastle Office on 049 294346.

Yours faithfully,

J Hunt

Jeff Hunt, CATCHMENT PLANNING MANAGER.

19th June 97
V400018 TL SH
SH
FS
I
PB

464 King Street Newcastle West NSW 2302 PO Box 2213 Dangar NSW 2309 DX 4335 Newcastle West
Telephone (049) 294 346 Facsimile (049) 296 364

our ref: MD80 H2606
Thursday, 04 September, 1997

LAND & WATER CONSERVATION

Development Manager
CSR Construction Materials
Level 8, 9 Help Street
CHATSWOOD 2057

PGH METFORD QUARRY - PROPOSED DEVELOPMENT WORKS

Dear Sir

Reference is made to your Development Application for continuation of extraction and site restoration via non putrescible landfill at the PGH Metford Quarry.

Following the supply of additional information as requested on 11 August, 1997, the Department is now generally satisfied with the content of the Environmental Impact Study and approval is now given to lodge the Development Application with Maitland City Council.

Yours faithfully

Tony Burgin

Tony Burgin
Regional Director, Hunter

INCOMING CORRESPONDENCE					
DATE IN	10/9/97				
PROJECT MGR.	SH	INTL	CH		
PROJECT No.	VH0018				
FILE No.	0027				
TO					
A/I/C					
INTL.					

MINERAL RESOURCES

NSW DEPARTMENT OF MINERAL RESOURCES
Minerals and Energy House, 29-57 Christie Street
(P.O. Box 536), St Leonards, NSW 2065, Australia
Phone (02) 9901 8888 · Fax (02) 9901 8777
DX 3324 St Leonards

Ms F Stening
CMP & F Pty Ltd
PO Box 201
CHATSWOOD NSW 2057

INCOMING CORRESPONDENCE					
DATE IN	14th Feb 97				
PROJECT MGR.	SH	INTL	SH		
PROJECT No.	VH0018				
FILE No.	027				
TO	SH				
A/C	A				
INTL	SH				

Our Ref : L96/0630
Your Ref : VH0018

Dear Madam

PREPARATION OF EIS FOR PGH BRICKWORKS SITE, METFORD

In response to the recent planning focus meeting at Maitland concerning the proposed development application for quarrying, land filling and site rehabilitation at the PGH Metford brickworks site, the Department has prepared the following comments on items which should be addressed in the EIS.

1. Characteristics of the clay/shale resources

   Appropriate details should be provided on the geology, size, quality and intended use of the resources and the methods used to assess the resources (eg drilling, trenching, etc). Plans and cross sections summarising this data and showing the location of any drillholes should be included. Relevant supporting documentation such as drill logs should be appended or referenced.

2. Rate of Extraction

   The proposed rate of extraction and expected duration of extraction operations should be specified.

3. Resource Sterilization

   Details should be provided of any clay/shale resources which will sterilized by landfilling and any such sterilization should be justified.

4. Composition of landfill and capping material

The composition and inherent characteristics of landfill and capping material to be used for the rehabilitation of void areas should be clearly identified in the EIS. The combustibility and consolidative nature of fill material, thickness and porosity of the capping layer, and source of any topsoil to be used are aspects of the proposal which will need to be further assessed.

5. Configuration and treatment of the final voids prior to landfill emplacement

The final configuration (size, dimensions) of the mine voids are to be documented in the EIS. The treatment of the highwall and remaining floor and sidewalls to prevent groundwater movement and ensure stability should also be addressed.

6. Dewatering of the mine voids

Dewatering of the mine voids as they are being filled is an issue which will need to be addressed in the EIS. Control provisions should be adopted to ensure that water which enters the voids during this time is separated and properly treated before any discharge of effluent can be considered.

Routine monitoring of general mine-site run-off as well as water within the pit should be carried out to determine the impact landfill is having on water quality and the best means for treatment and final use.

7. Management of rehabilitated areas

7.1 Drainage control

Drainage control of the final rehabilitated site will require consideration of :

a) the effects of gradual and incidental subsidence) eg surface ponding),

b) disturbance and movement (slip) of consolidated material above the capping layer which, after construction, would serve as a drain floor,

c) flooding events, and

d) the separation of contaminated run-off from the mine-site and diversion to a central holding area (dam or wetland) with the capacity to contain and passively treat waters.

Any drainage mechanism or system should also require minimum to zero maintenance over the long-term.

There should also be no undue impact or deleterious effect on the ecology and flow to the existing wetland, west of the site. Any diversionary works at the mine-site should seek not to impede the usual and dependant water flow that would otherwise feed the wetland.

7.2 Selection of species for revegetation

Deep-rooting trees should be avoided in areas above the final capping layer of rehabilitated voids. This is to ensure there is no penetration of the capping layer by the root system of trees which may expose landfill within the void to the cumulative and deleterious effects of air and water. This would create a management problem extending many years after full decommissioning of the site.

7.3 Subsidence monitoring and response

The system of survey and monitoring to determine subsidence over the total rehabilitated area needs to be described in the EIS. The measures proposed to ameliorate impact from subsidence events should also be detailed.

8. Alternatives to the proposal

A serious assessment of the feasibility of an alternative final land-use for the site needs to be made in the EIS. The possibility of converting the voided areas into wetlands and linking them with the neighbouring wetland system to the east of the site needs to be considered.

9. Impact of trucks carting landfill to the site on local traffic

An assessment of the likely impact from an increased number of turning, heavy-load vehicles using public roads for access to the Metford site needs to be documented in the EIS.

10. Flood Management

A Flood Management Study of the mine-site and surrounding area is needed to ascertain the probable chance and severity of a flood event. The likelihood of such an event and its impact on the proposed future mining and rehabilitation at Metford should be determined and incorporated into the design and planning of the water management system for the site.

11. Use of recyclable materials in landfill

There should be minimal placement of recyclable landfill material in the final voids. Only material which has limited or no potential for re-cycling should be used as landfill. Recyclable materials should only be used where they serve as an important consolidated aggregate within the total landfill material.

If you have any queries concerning the environmental issues outlined above, please contact Mr C Bagnall at the Department's Singleton office, on (065) 721 899. Any queries relating to mineral resources should be directed to Mr I Paterson at the Department's head office, on (02) 9901 8368.

Yours faithfully

S R Lishmund
for Director-General

11/2/97

Reference NA/GEN/97-975
Contact: Noel Armstrong
Phone: (049) 51 519456

energyAustralia

145 Newcastle Road
Wallsend NSW Australia
Telephone (049) 51 9555
+61 49 51 9555
Facsimile (049) 51 9320

Address all mail to
PO Box 487
Newcastle NSW
2300 Australia
DX 7853 Newcastle

19 June 1997

CMPS&F
Po Box 201
CHATSWOOD 2057

Dear Sir

MAITLAND QUARRY E.I.S.

I refer to your facsimile dated 12 June1997 regarding the above E .I. S.

EnergyAustralia has no objection or requirements to the proposal as detailed.

Should there be further power requirements or our assets require relocating because of the expansion programme these costs will be met by the applicant under our policy for that work at the appropriate time.

If you require any further information on this matter don't hesitate to call me on the above phone number.

Yours sincerely

N Armstrong
Customer Supply
North

INCOMING CORRESPONDENCE				
DATE IN	24/6/97			
PROJECT MGR	SH	INTL		
PROJECT No.	VH0018			
FILE No.	004			
TO	SH			
A/I/C				
INTL				

INCOMING CORRESPONDENCE				
DATE IN	12th Dec. 96.			
PROJECT		INTL		
PROJECT No	VH0018			
FILE No.	027			
TO				
A/I/C				
INTL				

EPA

Environment Protection Authority
New South Wales

NSW Government Offices
117 Bull Street Newcastle West NSW 2302
PO Box 488G Newcastle NSW 2300
Tel .049. 26 9971 Fax .049. 29 6712

Ms Felicity Stening
CMPS&F Pty Ltd
PO Box 201
CHATSWOOD NSW 2057

Our Reference: 270032A3 AL:MB

Your Reference: VH0018

10 DEC 1996

Contact: Mr Andrew Ling

Dear Ms Stening

RE: PREPARATION OF EIS, PGH BRICKWORKS SITE, METFORD - PLANNING FOCUS MEETING

I refer to your facsimile of 22 November 1996 seeking confirmation of the Environment Protection Authority's (EPA) representation at a planning focus meeting for the above activity. I also note your invitation to the EPA to attend a meeting in Wyong for a similar development at Warnervale.

CMPS&F have already requested the EPA's comments and requirements to be addressed in separate EIS's currently being prepared for the proposed developments. I have enclosed a detailed response for the Metford site.

Essentially, the issues of primary interest to the EPA are similar in both circumstances. While I thank you for the invitation to attend the meeting at Maitland, on the basis of all the above, I see no benefit in an additional officer duplicating the views of the EPA in this process.

However, we would be happy to review and comment on minutes from the meeting or any further queries that may arise.

Should you require further information regarding this matter, please contact Mr Andrew Ling at this office on (049) 269 969.

Yours faithfully

Halverson

COLIN HALVERSON
Head Operations Unit, Hunter
for Director-General

INCOMING CORRESPONDENCE				
DATE	12th Dec. 96			
PROJECT MGR.	SH	INITL		
PROJECT No.	VH0018			
FILE No.	027			
TO	SH			
A/INC	A			
INTL	SH			

EPA

Environment Protection Authority
New South Wales

NSW Government Offices
117 Bull Street Newcastle West NSW 2302
PO Box 488G Newcastle NSW 2300
Tel .049. 26 9971 Fax .049. 29 6712

CMPS&F Pty Ltd
PO Box 201
CHATSWOOD NSW 2057
Attention: Mr Stephen Hills

Our Reference: 270032A3 AL:MB

Your Reference: CR-I:\VH\0018\LETT\L004.DOC

Contact: Mr Andrew Ling

10 DEC 1996

Dear Mr Hills

RE: PREPARATION OF AN EIS - QUARRYING, LANDFILLING AND SITE REHABILITATION AT PGH BRICKWORKS SITE, METFORD

I refer to your letter of 14 November 1996 seeking the Environment Protection Authority's (EPA) requirements for inclusion in an Environmental Impact Statement (EIS) for the above activity.

The EIS should provide the following information to enable the EPA to accurately assess the environmental implications of the activity. For convenience, our response is arranged in three sections i.e. extractive and landfilling activities and site rehabilitation.

EXTRACTIVE ACTIVITIES

PLAN OF OPERATION

1. Description of the operation including:

   - map of the general locality;
   - detailed site layout;
   - extent of existing and proposed extraction areas;
   - existing and final landform; and
   - proposed access routes.

2. Details of adjoining/nearest residences and any land use or environmentally sensitive area likely to be affected by the extraction operation and haulage routes.

NOISE CONTROL

Extractive industries having a site area of 20,000 square metres or more are scheduled under the Noise Control Act (NCA) and must comply the requirement of the Act. The EIS should include an acoustic report. Data presented in the report should demonstrate that planning objectives as outlined in the EPA's "Environmental Noise Control Manual, (Chapters 19-21)" will be achieved. Where these objectives cannot be achieved this should be clearly stated and any impacts on sensitive receptors quantified.

WATER POLLUTION

The EIS should identify the sources or processes likely to cause water pollution and detail the measures to be implemented to prevent adverse impacts on the water quality of local watercourses and groundwater.

The proponent should be aware that EPA approval is required for the construction and/or modification of any polluted water treatment, collection or disposal measures. The EPA is unlikely to grant a licence to discharge contaminated stormwater from the site. The EIS should include a water management plan that is based on a site water balance (incorporating local rainfall/evapcration data) and the following principles:

1. Diversion of uncontaminated surface water and stormwater around the extraction operation;

2. Segregation of contaminated water from non-contaminated water;

3. Maximum on-site reuse of contaminated stormwater (eg. dust suppression and rehabilitation) together with the use of control and storage works to avoid, to the maximum practicable extent, any discharge;

4. Allocation of priorities in water use so that the poorest quality stored water is reused first; and

5. Strict controls to limit clearing of vegetated areas for soil extraction, stockpiling, access or other operational purposes.

The water management plan should be capable of implementation by the site operators to ensure the above principles are applied.

Potential hazards from the storage and/or handling of fuels/ chemicals should be identified and assessed. Appropriate control measures to prevent contamination of surface water, groundwater and the soil should be presented in the EIS.

In regard to water currently contained in the pit, the EPA remains cautious of any proposals to discharge this water to the environment. Our concerns relate primarily to the potential rate of pit recharge by further inflows of groundwater.

In order to satisfy our concerns, investigations should be undertaken in order to establish the hydrogeological setting of the site including the groundwater flow direction, depths below ground level, flow rates and water quality.

AIR POLLUTION

Your client must meet our objectives which are to control, to the maximum extent practicable, the generation of dust on-site, to restrict any dust generated to the soil extraction area, to minimise adverse effects of the operation on the amenity of local residents and sensitive land uses, and to limit the individual and cumulative effects of dust on regional air quality.

The EIS should also include:

1. Identification of individual dust sources.

2. Projected dust emission and deposition rates from the project.

3. An assessment of meteorological conditions under which nearby residences and sensitive land uses may be affected.

4. Details of dust control measures to be applied to extraction, processing, handling and transport operations.

5. Details of any proposed dust monitoring program.

ENVIRONMENTAL MANAGEMENT

The proponent will rely on effective management and a high level of day-to-day supervision to ensure compliance with their legal responsibilities. A site environmental management plan must be developed to address all environmental impacts associated with the activity.

In summary the EPA requires that the EIS addresses all matters relating to potential air, water or noise pollution including but not limited to the handling of contaminated stormwater, dust control, waste disposal and site rehabilitation. The document must identify potential pollution problems and propose control measures using best available technology economically achievable (BATEA) principles. All impacts likely to affect residential properties should be identified and quantified.

LANDFILL ACTIVITIES

SITE LOCATION

Site selection is a critical issue for landfill proposal. Sites with minimal environmental constraints are likely to reduce the need for impact mitigation and ongoing management measures. Levels of community concern and potential delays in approval processes can also be minimised through appropriate site selection.

Site selection criterion are listed in the publications "EIS Practice Guideline: Landfilling" (NSW DUAP, July 1996), and "Environmental Guidelines - Solid Waste Landfills" (EPA, Jan 1996). Preliminary investigations should be undertaken to identify whether there are any fundamental deficiencies of the intended site which may render it unsuitable for landfilling.

The EPA has no "in-principle" objection to the restoration/ rehabilitation of the clay pit by incorporating some form of commercial landfilling, providing our concerns with the site can be adequately addressed. These concerns include:

- the close proximity of the site and proposed landfilling activity to existing residential areas;
- the close proximity of the proposed landfilling activity to existing watercourses and wetlands; and
- the natural hydrogeological setting of the site including the potential for groundwater to recharge the pit and the potential for ground waters to be contaminated by leachate generated in the landfill.

WASTE MINIMISATION & MANAGEMENT ACT 1995

Under the Waste Minimisation & Management Act 1995 (WMMA), solid waste landfills that receive more than 5,000 tonnes of waste per annum irrespective of their location, receive hazardous waste or are located in an environmentally sensitive area will be licensed by the EPA.

In the case of new landfills proposed to be located in environmentally sensitive locations i.e. listed in Table 1 of the "Environmental Guidelines - Solid Waste Landfills" (EPA, Jan 1996), the EPA will require licences for such landfills.

However, the EPA will generally not be prepared to issue a licence for new landfills in such locations.

LANDFILL ENVIRONMENTAL MANAGEMENT PLANS

The EPA has developed "Environmental Guidelines - Solid Waste Landfills" (EPA, Jan 1996), to provide a consistent and environmentally responsible approach to managing landfills across the state.

The guidelines focus on the environmental management of landfills and provide operators and the community with:

- a clear outline of the environmental issues that need to be managed;
- a system for regulating landfills; and
- an outline of the techniques currently available to manage the environmental issues.

Operators of landfill facilities that are required to be licensed will be required to produce a Landfill Environmental Management Plan (LEMP). In the case of new landfills, the matters required to be addressed in the LEMP must be documented in the EIS.

The EIS should be developed in accordance with the document titled "EIS Practice Guideline: Landfilling" (NSW DUAP, July 1996), and be consistent with all relevant matters in the document titled "Environmental Guidelines - Solid Waste Landfills" (EPA, Jan 1996). The EPA guidelines also provide the relevant matters to be addressed in an LEMP.

The EIS would benefit greatly if all aspects of the proposed waste disposal operation were identified and assessed against the environmental guidelines. In addition, the EIS must:

- identify and ensure the site attributes, all operational aspects and all environmental protection techniques will enable the operator to meet the Environmental Goal(s) and provide environmental performance at least equal to or better than the Benchmark techniques listed in Appendix A of the guidelines;
- identify and justify any departures from the Benchmark Techniques (listed in the EPA's Guidelines) and related Environmental Goals; and
- provide a risk assessment supporting any substantial departures from the Benchmark Techniques.

<u>POLLUTION CONTROL APPROVAL</u>

The proponent will be required to obtain Pollution Control Approval under the Clean Waters Act, 1971, for the installation/construction of any leachate management system.

Approval would be dependent upon the above matters being addressed to the satisfaction of the EPA.

SITE REHABILITATION

The EIS must contain proposals for rehabilitation. Precise requirements in this regard are primarily the responsibility of the Department of Water and Land Conservation. It is imperative that, to prevent wind and water erosion of unvegetated areas, rehabilitation is carried out regularly and at the earliest opportunity. The preparation of a rehabilitation plan is strongly recommended.

I hope this information assists in your inquiry. Should you require further information regarding this matter, please contact Mr Andrew Ling at this office on (049) 269 969.

Yours faithfully

CHalverson

COLIN HALVERSON
Head Operations Unit, Hunter
for Director-General

VH0018/027.

COPY to VH0018/004

EPA

Environment Protection Authority
New South Wales

NSW Government Offices
117 Bull Street Newcastle West NSW 2302
PO Box 488G Newcastle NSW 2300
Tel .049. 26 9971 Fax .049. 29 6712

Mr Ron Bush
Project Manager
CSR Construction Materials
Level 8, 9 Help Street
CHATSWOOD NSW 2067

Our Reference: 270032A3 AL:LV

Your Reference:

23 OCT 1996

Contact: Mr Andrew Ling

Dear Sir

DISCHARGE OF WATER FROM DISUSED CLAY PIT PGH METFORD

I refer to a preliminary report by Mr Bryan Liddle of AGC Woodward-Clyde Pty Ltd, on behalf of CSR Construction Materials, outlining a proposal to de-water the existing clay pit to assist with site investigations to redevelop the site.

The Environment Protection Authority (EPA) has reviewed the preliminary report and we provide the following comments.

The EPA has no "in-principle" objection to the restoration/rehabilitation of the clay pit by incorporating some form of commercial landfilling; and we have no "in-principle" objection, based on the water quality data provided, for the controlled discharge of 120 Ml of highly saline water directly to the Hunter River (ie Option 2 in your report) provided the discharge has no impact on water quality that would naturally occur in the river.

However, we remain cautious of your proposal to de-water the pit in the absence of preliminary information identifying the potential rate of pit recharge by further inflows of groundwater. Consequently, the EPA does not support this proposal based on the lack of data relating to management of groundwater that may recharge the pit and be discharged to natural waters.

In order to satisfy our concerns, further preliminary investigations should be undertaken in order to establish the hydrogeological setting of the site including the groundwater flow direction, depths below ground level, flow rates and water quality.

In regard to your proposal to establish a commercial landfilling operation at the site, I would like to take the opportunity to draw your attention to the *Waste Minimisation & Management Act (WMMA) 1995,* which establishes a framework for the implementation of key reform initiatives, including the regulation of waste disposal facilities and activities.

The *Waste Minimisation & Management Regulation* (WMMR), which is expected to be gazetted later this year, will require waste facilities of any one or more of the prescribed class to be licensed under the Act. Licensed landfills will be subject to specific requirements relating to their establishment, operation, closure, monitoring and reporting. I suggest you seek a copy of the document *"Environmental Guidelines - Solid Waste Landfills"* (EPA, Jan 1996) at an early stage in your planning of this project.

Should you wish to discuss any of the matters raised please contact the EPA's Environmental Protection Officer, Mr Andrew Ling on (049) 269 969.

Yours faithfully

CHalverson

COLIN HALVERSON
Head Regional Operations Unit, Hunter
for Director-General

13 February 1997

Mr Ron Bush
Development Manager, Waste Management
CSR Construction Materials
9 Help Street
CHATSWOOD NSW 20676

Subject: East Maitland Quarry, Inflow Estimates

Dear Ron,

Further to your request, we have carried out groundwater inflows and rates of water level recovery in the East Maitland quarry in the event that the latter is completely pumped out.

The calculations are based on the current understanding of the groundwater regime of the rockmass surrounding the site, which is summarised as follows:

- the water in the quarry pond is of groundwater origin, as shown by the similar salinities,
- the pond is a window into the surrounding water table; in other words, the current pond level is in equilibrium with the groundwater,
- due to the evaporation from the waterbody and to other factors within the rockmass, the pond acts as a sink on the surrounding groundwater causing a gentle local gradient towards the pond,
- at some small distance away from the pond, estimated at approximately 700 m, the regional groundwater gradient is to the northeast,
- the permeability of the surrounding rockmass is low and the preferential groundwater flow paths are represented by the coal seams, albeit thin and potentially discontinuous,
- the aquifer is semi-confined to confined, and
- the total volume of water stored in the pond is estimated as 120ML (Singleton Surveys)

In calculating the expected groundwater inflows, we have adopted the following assumptions:

- based on hydraulic tests carried out on the 9 existing groundwater monitoring bores, the hydraulic conductivity (permeability) of the rockmass surrounding the pond is 2.0×10^{-6}m/sec or 0.173m/day (geometric mean),
- the saturated thickness of the formation above the bottom of the pond is 9m,
- the perimeter of the pond at the water level is approximately 700m, and
- the hydraulic gradient around the pond is between 0.013 and 0.06,
- the piezometric head around the empty pond is approximately 9m.

The inflows into the pit have been calculated by two different methods.

Darcy Equation

This method measures the steady state flow through a cross-sectional area of aquifer:

$$Q = KiA$$

where: Q = flow, m^3/day

K = hydraulic conductivity, m/day

i = hydraulic gradient

The inflow calculated using the two gradients indicated above ranges between 12.6 and 58 m^3/day.

Thiem Equation

The Thiem equation has been modified to allow for the diameter of the pond and is expressed as follows:

$$Q = \frac{2.73 \times K \times b \times h}{\log\left(r_0 / r_{pond} \right)}$$

where: Q = flow, m^3/day | K = hydraulic conductivity, m/day

b = aquifer thickness, m | h = piezometric head, m

r_o = radius of drawdown, m | r_{pond} = radius of pond, m

Using the same values as for the Darcy equation, radii of drawdown of 700 and 1000m and a pond radius of 111m, inflow values of 42.5 and 35.5m^3/day have been obtained. These values fall within the range calculated with the Darcy equation.

Adopting the minimum and maximum inflow rates obtained using both methods, it is calculated that, if the pond was empty, it would fill up again in 9523 days (26 years) and 2069 days (5.7 years) respectively. We would suggest that the least conservative value of 2069 days be used for general planning.

We trust the above meets with your approval. Should you have queries, please, do not hesitate to contact the undersigned.

Yours sincerely,
AGC WOODWARD-CLYDE PTY LIMITED

Fabio Carosone
Senior Hydrogeologist

B. Liddle
Bryan Liddle
Principal Engineer

FC:fc

Heritage Council

New South Wales Government

HERITAGE OFFICE

Level 21, Governor Macquarie Tower, 1 Farrer Place, Sydney
Postal Address: Governor Macquarie Tower, 1 Farrer Place, Sydney, NSW, 2000
Telephone (02) 9391-2255 Fax (02) 9391-2336

Stephen Hills
Environmental Planning Manager
CMPS&F PTY LTD
PO Box 201
CHATSWOOD NSW 2057

Contact:	Kylie Seretis
Telephone:	(02) 9391-2079
File:	S90/01507
Your Ref:	

Dear Mr Hills,

Re consultation in connection with the preparation of an EIS to accompany a development application for quarrying, landfilling, and site rehabilitation at the PGH Brickworks site, Metford, Maitland.

I refer to your letter requesting the comments of the Heritage Council of NSW about the above project. The following comments are provided on behalf of the Heritage Council.

The Heritage Council maintains a public register of items protected under the Heritage Act, 1977. You are welcome to inspect the register to determine if any of the properties listed will be impacted upon by this project.

You should also contact the local Aboriginal Land Council, the National Trust of NSW, the Australian Heritage Commission and local historical societies or similar organisations. These organisations can comment on any other items of heritage significance in the area affected by the proposal.

In addition to consulting the above organisations and registers, you should assess the heritage significance of the land that will be affected by the proposed activity, and the impact of the proposals on that significance. This assessment should include natural areas and places of Aboriginal, historical or archaeological significance, as well as buildings, works or other archaeological deposits. A statement of heritage impact should be prepared for heritage items which may be affected by the proposal (including trhe stables).

You should be aware that under Section 140 of the Heritage Act, if any disturbance to archaeological relics, or a site known or suspected to contain relics is proposed, an excavation permit must be obtained from the Heritage Council.

Any further information on this matter may be directed to Kylie Seretis on 02 391 2079.

Yours sincerely

K Seretis

Rosalind Strong
Acting Director
22/11/96

INCOMING	
DATE IN	27th Nov. 96.
PROJECT MGR	SH / TL / SH
PROJECT No.	VH0008
FILE No.	027
TO	SH
A/I/C	A
INTL	SH

Hunter Catchment Management Trust

Care for the land

PO Box 204
Maitland NSW 2320
Email: hunter.trust@hunterlink.net.au

Telephone: (049) 335 455
Facsimile: (049) 335 164

Our ref:
Your ref: 1325

Mr Stephen Hills
Environmental Planning Manager
CMPS & F Pty Limited
PO Box 201
CHATSWOOD 2057

Dear Mr Hills

EIS for Quarrying, Landfilling and Site Rehabilitation at the PGH Brickworks Site at Metford

Thank you for your letter dated the 7 January 1997 regarding the proposals for the Metford PGH Brickworks Site.

Water quality is of high concern to the Hunter community, and the Hunter Trust has worked to achieve agency and community agreement on water issues. Creating a climate for attitude change in the community to achieve positive environmental improvements, sustained utilisation and improved water quality in the Hunter River system is of high importance to the Hunter Trust. This includes assuring the community that appropriate mitigation methods are implemented for new and existing developments which have the potential, if correct procedures are not utilised, to have a significant impact on the Hunter's natural and social environment.

At this stage, the Hunter Trust has no objection in principle to the abovementioned project provided that adequate measures are incorporated to ensure that no material is lost or leached from the landfill sites to local drainage lines or larger waterways.

Please contact the Hunter Trust if you require any further assistance with respect to total catchment management issues in the preparation of the environmental impact statement for this development.

Yours sincerely

CHeinrich

Cherie Heinrich
for Glenn Evans
Chief Executive Officer

21 January 1997

INCOMING CORRESPONDENCE				
DATE IN	23rd Jan 97			
PROJECT MGR.	SHills	INTL	SH	
PROJECT No.	VH0018			
FILE No.	027			
TO	SH			
A/IC	A			
INTL	SH			

Hunter Waste Planning and Management Board

INCOMING CORRESPONDENCE
DATE 21ST July 97
PROJ UH00 18
RW
I

18 July 1997

CMPS&F Pty Limited
PO Box 201
CHATSWOOD NSW 2057

Attention: Ronnen Wise

Dear Mr Wise

RE: PREPARATION OF AN EIS FOR A DEVELOPMENT APPLICATION FOR QUARRYING, LANDFILLING, AND SITE REHABILITATION AT THE PGH BRICKWORKS SITE, METFORD, MAITLAND

I refer to your correspondence of 18 July 1997, where it was highlighted that your company has been commissioned by CSR Ltd to prepare an Environmental Impact Statement (EIS) for a quarrying, landfilling and site rehabilitation at their Metford site in Maitland (PGH Brickworks site).

Section 17, Part 3, Division 4 of the Waste Minimisation and Management Act 1995, No. 102 lists the objectives of the Waste Boards as:

1. To co-ordinate the Waste Services provided for the Waste Board's waste management region.

2. To ensure that the constituent Councils adopt efficient waste management practices and policies and

3. To operate in accordance with the principles of ecologically sustainable development contained in Section 6 (2) of the Protection of the Environment Administration Act 1991.

Accordingly, I can advise that the Board is currently preparing a detailed Regional Waste Plan (RWP) consistent with the satisfaction of the above objectives.

It would be appreciated if a copy of the completed environmental impact statement (EIS) applying to the proposed development, could be forwarded to the Board for assessment. It should also be noted that the Draft Regional Waste Plan will be available in July 1997, that may place additional requirements on new developments in the areas of waste management and minimisation.

Should you have any further enquiries please telephone my office on (049) 400 400 during office hours.

Yours faithfully,

Tony Cade

Tony Cade
Acting General Manager

Hunter Water

HUNTER WATER CORPORATION LIMITED

ACN 053 102 837

URBAN DEVELOPMENT BUSINESS UNIT

Ground Floor, 426-432 King Street Newcastle West
PO Box 5171B, Newcastle West, NSW, 2302 DX 7858, Newcastle
Telephone (049) 26 7267 Fax (049) 26 7293

LLOYD'S REGISTER QUALITY ASSURANCE ISO9002

Reference: C5/23184
Enquiries: Jeff Hamilton
Extension: 410

466/lp/jeff/letter/eastmait/23184.doc

12 February 1997

INCOMING CORRESPONDENCE					
DATE IN	13/2/97				
PROJECT MGR.	SHills	INTL	SH		
PROJECT No.	VH0018				
FILE No.	027				
TO	SH				
A/I/C	A				
INTL	SH				

The Manager
CMPS & F Pty Limited
P O Box 201
CHATSWOOD NSW 2057

ATTENTION: MR STEPHEN HILLS

Dear Sir

RE: PROPOSED EIS - PGH BRICKWORKS SITE METFORD ROAD, EAST MAITLAND

Your letter dated 15 January 1997 and delivered to our Maitland Business Office has been passed on to the Urban Development Unit and in response the following comments are offered:-

- Part Portion 2 is traversed by Hunter Water's One Mile Creek sewer carriermain. This critical sewer extends between Fieldsend Street & the Great Northern Railway line east of Turton Street. The main ranges in size from 530 to 600mm diameter. The pipeline is protected by easement in favour of Hunter Water Corporation and acquired on 19 April 1974. Hunter Water has statutory powers under Section 25 of the Hunter Water Board (Corporatisation) Act 1991 which prohibit interference, damage etc to this main. Any quarrying, landfilling and site rehabilitation of the site would need to take account of this main. Some opportunity could be available to temporarily (or otherwise) re-route the main should mining operations threaten its security. Costs would need to be borne by your client.

- Portion 266 is traversed by a 300 diameter sewer carriermain laid from Metford Road south easterly towards Tennyson Street, Metford. A 150 sideline is located within this land to the east and parallel with Metford Road. The mains are not within easements but are afforded protection under Section 25 of the Act.

- Hunter Water maintains a 100 diameter CICL watermain in Metford Road which extends from the Great Northern Railway line southerly to the existing brickworks building. Your letter confirms that this area of the site is not to be disturbed by the proposed operations.

- Attached are copies of Hunter Water plans showing the location of the above sewers and watermains.

Please contact the writer if further information would be of assistance.

Yours faithfully

Urban Development
Engineering Manager

MAITLAND CITY COUNCIL

TELEPHONE: (049) 34 9700
FACSIMILE: (049) 33 3209
DX 21613 MAITLAND

All correspondence should be addressed to General Manager
P.O. BOX No. 220, MAITLAND, N.S.W. 2320
Administration Building, MAITLAND, N.S.W.

Our Ref. GC:NR DA 95177
Your Ref.

Telephone Enquiries: Greg Clayden 349 827

3 July, 1997

INCOMING CORRESPONDENCE			
DATE IN	8/7/97		
PROJECT No.	SH	INTL	SH
PROJECT	VA0018		
FILE No.			
TO	RW		
A/C	I		
INTL			

Mr Ronnen Wise
CMPS & F Pty Ltd
PO Box 201
CHATSWOOD NSW 2057

Dear Sir,

RE: EIS - PGH QUARRIES, METFORD ROAD, METFORD.

I refer to your facsimile to Mark Ihlein dated 12 June, 1997 in relation to the above and provide the following comments for consideration in preparing the EIS, with particular reference to proposed landfill operations:

1. The application is to be prepared taking into account the "EIS Guidelines" prepared by the Department of Urban Affairs and Planning (October, 1996).

2. The application should detail the rehabilitation proposed making reference to the end use of the various sites. Open space/recreational use aspects should be considered with input from Council's Community Outcomes Section - Richard Upston (Manager).

3. Landfill proposal(s) should detail the type of waste to be received, expected annual volumes, the expected catchment, the nature and type of transport arriving at the site and day to day management procedures.

4. With the focus by State Government and Council of achieving a 60% reduction of the volume of waste to landfill by the year 2000, the application should describe what processes or opportunities will be provided to re-use or recycle material.

5. The Waste Minimisation and Management Act has seen the establishment of the Hunter Waste Board and in turn the preparation of the Regional Waste Plan. Discussions should be held with the Waste Board and the application should address the role (if any) the site may play within the regional plan.

6. The application should detail the proposed construction of the landfill areas and cells with reference to EPA landfill requirements. A copy of the Landfill Environmental Management Plan (LEMP) should accompany the application. The expected life of extractive operations and a time frame for completion of all landfill/rehabilitation works is to be specified.

7. The application needs to address landscaping issues, particularly in regard to perimeter berms. The removal of existing weeds (whether noxious or not) should be carried out and a management plan for weed control prepared.

8. Site dust control and wet weather migration of mud etc. off site should be detailed.

9. Proposed or likely travel/transport routes and expected vehicle movements and types associated with both extractive and landfill operations should be detailed.

10. Details should be provided as to how the heritage listed stables will relate to the site and what measures or site management procedures will be used to preserve them.

11. The application should detail how the de-watering of the existing excavations is proposed, where the material will be pumped to and that appropriate approvals (such as EPA licences) have been or can be received.

12. The application should address the hours of operation, equipment and/or machinery to be used on site, the nearest residents most likely to be affected by noise, dust or vibration. Staged extraction from and rehabilitation of the site is to be detailed and considered with the above.

I trust the above information is satisfactory to you. If you require clarification on any issue please contact me on (049) 349 827.

Yours faithfully,

Greg Clayden

GREG CLAYDEN
DEVELOPMENT ASSESSMENT PLANNER

INCOMING					
DATE IN	23.3.97				
PROJECT MGR	S. Hills		L	SH	
PROJECT No.	VH0018				
FILE No.	027				
TO	SH				
A/I/C	A ✓				
INTL	SH ✓				

NSW NATIONAL PARKS AND WILDLIFE SERVICE

Mr Stephen Hills
Environmental Planning Manager
CMPS&F Pty Ltd
PO Box 201
CHATSWOOD NSW 2057

Dear Mr Hills

RE: PREPARATION OF AN EIS TO ACCOMPANY A DA FOR QUARRYING LANDFILLING AND SITE REHABILITATION AT THE PGH BRICKWORKS SITE, METFORD, MAITLAND

Thank you for your letter dated 14 November 1996 in which you consulted with the National Parks and Wildlife Service on the above proposal. The Service apologises for the delay in our written response, however, as you are aware has participated in a Planning Focus meeting.

The Service has a statutory responsibility for the protection and care of native flora, native fauna and Aboriginal sites, and for the management of Service estate. Accordingly the Service has an interest in ensuring that potential impacts to these attributes are appropriately assessed.

To assist you in this regard, it is recommended that the matters referred to in the attached guidelines be addressed in your assessment where appropriate. The attached guidelines also provide information on any approvals that may be relevant under the National Parks and Wildlife Act and a summary of the Service's databases which may be of assistance to you in your assessment.

For your future information, the Service has established Zone offices in order to deal more effectively and consistently with environmental assessment matters. The Zone boundaries are based on Local Government Area boundaries and the Maitland municipality falls within the Sydney Zone. To assist the Service in providing timely advice, all future correspondence should be forwarded to the address below and not to the Environmental Protection Unit Head Office:

Environmental Planning Unit
Sydney Zone
National Parks and Wildlife Service
P.O. Box 1967
Hurstville NSW 2220

Sydney Zone
6th Floor
43 Bridge Street
Hurstville NSW
Australia
PO Box 1967
Hurstville 2220
Fax: (02) 9585 6442
Tel: (02) 9585 6678

If you have any questions concerning this matter, please contact Jacqualine Breakspear, Environmental Planning Officer, on (02) 9585-6920.

Yours sincerely,

Jacqualine Breakspear

Jacqualine Breakspear
Environmental Planning Unit

GENERAL GUIDELINES FOR IMPACT ASSESSMENT

The National Parks and Wildlife Service (NPWS) has an interest in the potential impacts of the proposal on the following:

- areas of native vegetation,
- areas of potential value as habitat for native fauna,
- sites and places of Aboriginal heritage, and
- land dedicated under the National Parks and Wildlife Act (NPW Act).

If these attributes are anticipated to be present in your study area and / or likely to be impacted, it is recommended that assessments by a suitably qualified person be undertaken to determine the extent of impact. Details of the qualifications and experience of the person undertaking the work should be provided. In addition, a detailed description of survey methodology including survey design, sampling methods, weather conditions, time and duration of surveys and location of survey sites and transect lines should also be provided.

The matters recommended to be addressed in the assessment are as follows:

- description of the proposal and the way in which the environment will be modified;
- map(s) placing the proposal in a regional and local setting;
- applicability of Local Environmental Plans, Regional Environmental Plans and State Planning Policies (including SEPP 44 and SEPP 46)to the proposal should be discussed;
- information on the current and past land uses of the site and that of the surrounding area;
- detailed description and mapping of all vegetation communities in the study area;
- identification of any vegetation communities or plant species which are of local, regional or state conservation significance (including threatened communities, plant species or populations listed under the Threatened Species Conservation Act, 1995). The criteria for establishing significance should be documented;
- description of known or expected fauna assemblages within the study area;
- identification of fauna habitat likely to be of local, regional or state significance (including habitat of threatened fauna species or

populations listed under the Threatened Species Conservation Act, 1995);
- identification of whether there are any sites or places of cultural significance to the Aboriginal community;
- mapping of the location of all Aboriginal sites (including archaeological sites and potential sites) within the study area and an assessment of the significance of these sites;
- identification of habitat corridors and linkages between areas of remnant native vegetation which may assist faunal movement through the area;
- prediction of the likely impact of the proposal on the above attributes (quantification of the extent of impact where practical);
- assessment of measures available to minimise the impact of the proposal on these attributes and monitoring program if appropriate, and
- prediction of the likely impact of the proposal on land dedicated under the NP&W Act.

Threatened Species legislation

You are also advised that the Threatened Species Conservation Act, 1995 (TSC Act) came into effect on the 1 January 1996. The TSC Act effectively replaces the legislative scheme introduced by the Endangered Fauna (Interim Protection) Act, 1991 and amends the way threatened species are considered under the Environmental Planning and Assessment Act, 1979 and the National Parks and Wildlife Act, 1974.

It is recommended that consideration be given to the provisions of the TSC Act when undertaking the assessment of a proposal. Information on the provisions of the TSC Act may be obtained from the Department of Urban Affairs and Planning Circular No. A13 (12 December 1995). The Service has also produced an Information Pack on the TSC Act.

Aboriginal heritage and community consultation

With regard to Aboriginal heritage, it is recommended that an assessment of whether there are any places of cultural significance to the Aboriginal community be conducted. This should involve consultation with community representatives and if necessary documentary research to establish whether there are any places of traditional or historic significance to the Aboriginal community.

It is further recommended that assessment be conducted of the archaeological potential of the study area if the proposal involves disturbance to substantially unmodified ground surfaces. One means to assess archaeological potential is to obtain a site search from the Service.

In providing this information, the Service will provide advice as to the archaeological potential of the site and whether further surveying is recommended.

If the site does have archaeological potential then it is recommended that a survey be undertaken in consultation with the Local Aboriginal Land Council.

Should Aboriginal archaeological sites be present in the study area, you should consider the requirements of the NP&W Act with regard to Aboriginal relics. Under s90 of the Act it is an offence to knowingly damage or destroy relics without the prior permission of the Director-General of the NPWS.

Databases
The NPWS has two GIS databases which may provide information of use to you if you proceed to undertake further assessment. These are:

- Atlas listing of fauna and flora records in NSW;
- Aboriginal Sites register.

The material from these databases is available upon written application and the receipt of the appropriate fee. If you are interested in obtaining access to the Atlas database, please contact the Data Licensing Officer, GIS Division, on 585-6684. Records from the Aboriginal Sites register may be obtained upon written application to the Registrar, Cultural Heritage Conservation Division, on 585-6471.

The National Trust
of Australia (New South Wales)

NATIONAL TRUST

Observatory Hill
Sydney NSW 2000

GPO Box 518
Sydney NSW 2001

Telephone (02) **258 0123**
Fax (02) **251 1110**

kb.iac.wyong.brickworks

14 January 1997

Mr Stephen Hills
Environmental Planning Manager
CMPS&F Pty Limited
PO Box 201
CHATSWOOD NSW 2057

Dear Mr Hills

CONSULTATION IN CONNECTION WITH THE PREPARATION OF AN EIS TO ACCOMPANY A DEVELOPMENT APPLICATION FOR QUARRYING, LANDFILLING AND SITE REHABILITATION AT THE PGH BRICKWORKS SITE, METFORD, MAITLAND

I refer to your letter in regard to the above dated 17 December 1996. This site is listed on the Trust's Industrial Sites Master List although it is not classifed by the Trust.

This matter has been considered by the Chair of the Trust's Industrial Archaeology Committee and the Trust has no objection to the proposed works as long as no brickworks buildings, chimneys, kilns or associated structures are moved or otherwise affected by the proposed works.

Should you wish to discuss this matter further please contact Katherine Brooks, Conservation Officer, at the address provided.

Yours sincerely

Stephen Davies
Deputy Executive Director & Head, Conservation

DATE IN	17th Jan 97
PROJECT MGR.	S Hills
PROJECT No.	VH0018
	027
IC	SH
	A
	SH

NSW Agriculture

Regional Director - Hunter Region
PO Box 123, Maitland, NSW 2320
Phone (049) 302 417, Fax (049) 302410

Our Ref: Glenda Briggs
Agricultural Environmental Officer

Mr S Hills
Environmental Planning Manager
CMPS & F Pty Limited
PO Box 201
Chatswood 2067

Dear Sir,

Re Proposed EIS for Development at PGH Brickworks, Metford, Maitland

I refer to your letter of 7th January 1996 which sought the views of NSW Agriculture on the proposal for quarrying, landfill and site rehabilitation at the PGH Brickworks at Metford.

Departmental Officers are familiar with the site and concur with information contained in your well presented summary, that it adjoins expanding urban and industrial areas. The proposed development is unlikely to have any impacts on agriculture in the region and NSW Agriculture has no comment to make on the proposal.

Yours faithfully,

G Briggs

Glenda Briggs
for John Wilson,
Regional Director of Agriculture

13 January, 1997

INCO[illegible]	CORRESPONDEN[illegible]			
DATE	16/1/96			
PRO[illegible]	SHills		[illegible]	
PRO[illegible]	VH0018			
FILE	027			
TO	SH			
A/I/C	A			
INTL	SH			

NSW FISHERIES

Our Ref: CM(C) JH:JP 5617
Your Ref:

INCOMING CORRESPONDENCE					
DATE IN	14th Feb 97				
PROJECT MGR.	SHills		INTL	SH	
PROJECT No.	VH0018				
FILE No.	027				
TO	SH				
A/I/C	A				
INTL	SH				

Mr Stephen Hills
Environmental Planning Manager
CMPS&F Pty Limited
P O Box 201
CHATSWOOD
N S W 2057

11 February 1997

Dear Mr Hills

Re: **PGH Brickworks Site, Metford, Maitland**
EIS to accompany a development application for Quarrying, Landfilling, and Site Rehabilitation

In reference to the above, the site has been inspected and predicted environmental impacts assessed by officers of NSW Fisheries. NSW Fisheries has no objection to this proposal.

For further information, please contact me on (049) 82 1232.

Yours faithfully

JHolliday

Dr John Holliday
CONSERVATION MANAGER (CENTRAL)

CENTRAL REGION
Port Stephens Research Centre - Taylors Beach Road - Taylors Beach NSW 2316 - Australia
Telephone: (049) 82 1232 • **Facsimile:** (049) 82 1107

HUNTER PUBLIC HEALTH UNIT
Harker Building, Wallsend Health Services, Longworth Avenue, Wallsend
PO Box 466 Wallsend NSW 2287 Australia
Telephone (049) 24 6477 Fax (049) 24 6490

12 December 1996

CMPS & F PTY LIMITED
PO Box 201
CHATSWOOD 2057

INCOMING CORRESPONDENCE				
DATE IN	19th Dec. 96			
PROJECT MGR.	S Hill	INTL	SH	
PROJECT No.	0018			
FILE No.	027			
TO	SH			
A/I/C	A			
INTL	SH			

Attention: Stephen Hill
Environmental Planning Manager

Dear Sir

Subject: ***EIS and D/A for PGH Brickworks, Metford, Maitland***

Reference is made to your letter of 14 November 1996 and the subsequent Planning Focus meeting on 9 December 1996 in relation to the above proposal.

At the Planning Focus meeting, the Hunter Public Health Unit representative raised the following issues that are likely to impact on public health.

1. Noise generated from the operation.
2. Dust generation.
3. Impact of increased heavy vehicle movements on the amenity of the existing residential development.

These issues need to be addressed in the Environmental Impact Statement accompanying the above D/A.

Should you require any further information regarding these issues, please contact Chris Williams on (049)246482 weekdays.

Yours sincerely

John James
Manager Environmental Health
for A/Director
cw:br ENH/TDPL/0005

HUNTER HEALTH
Improving Health in the Hunter

Your reference
Our reference DO560: AF

13 January 1997

CMPS & F Pty Limited
Environmental Assessment and Planning
PO BOX 201
Chatswood 2057

STATE FORESTS

RE: Development application at the PGH Brickworks site, Metford, Maitland

State Forests of New South Wales

Morisset District
PO Box 171
Morisset NSW 2264
Phone (049) 73 3733
Fax (049) 70 5079

I have reviewed your development application and find that the region in question has no significant commercial timber present. Jurisdiction over these matters lies with State Forests when the timber being removed is commercial, State Forests therefore, has no objections to the proposed development.

Yours faithfully

Alex Flint

Alex Flint
for Steve Shaw
DISTRICT FORESTER

INCOMING CORRESPONDENCE					
DATE IN	15th Jan 97				
PROJECT MGR.	Hills	INTL	SH		
PROJECT No.	VH0018				
FILE No.	027				
TO	SH				
A/I/C	A				
INTL	SH				

GW2111LH\PGHMETF
307.5395/96;1
Mr G Warnick
Ph (049) 240 267
Fax (049) 240 347

Roads and Traffic Authority
New South Wales

RTA

Better Roads. Safer Roads. Saving Lives.

Road Safety & Traffic
Newcastle Zone
59 Darby Street
(Locked Bag 30)
Newcastle NSW 2300
DX 7813
Newcastle

Environmental Planning Manager
CMPS & F Pty Limited
Environmental
PO Box 201
CHATSWOOD NSW 2057

CONSULTATION IN CONNECTION WITH THE PREPARATION OF AN EIS TO ACCOMPANY A DEVELOPMENT APPLICATION FOR QUARRYING, LANDFILLING, AND SITE REHABILITATION AT THE PGH BRICKWORKS SITE, METFORD, MAITLAND.

Dear Mr Hills

I refer to your letter dated 14 November 1996 concerning the above subject.

A reply will be forwarded as soon as practicable.

Yours sincerely

T Keating

T Keating
Road Safety and Traffic Manager
Newcastle Zone Office
21 November, 1996

INCOMING CORRESPONDENCE				
DATE IN	26th Nov. 96			
PROJECT MGR	SHills	INTL	SH	
PROJECT No.	VH0018			
FILE No.	C27			
TO	SH			
A/I/C	A			
INTL	SH			

Roads and Traffic Authority
New South Wales

RTA

Better Roads. Safer Roads. Saving Lives.

Zone Planning Section
59 Darby Street
Locked Bag 30
Newcastle NSW 2300
Telephone (049) 24 0331
Facsimile (049) 24 0342
DX 7813 Newcastle

307.5390;1
Mr C Johnstone
(049) 240 332

INCOMING CORRESPONDENCE				
DATE IN	17/12/96			
PROJECT MGR.	SHills	INTL	SH	
PROJECT No.	0018			
FILE No.	027			
TO	SH			
A/I/C	A			
INTL	SH			

The Manager
CMPS&F Pty Limited
PO Box 201
CHATSWOOD NSW 2057

Attention Mr Stephen Hills

CITY OF MAITLAND. STATEMENT OF ENVIRONMENTAL EFFECTS FOR QUARRYING, LANDFILLING AND REHABILITATION AT PGH BRICKWORKS, METFORD ROAD, METFORD.

Dear Sir

It is considered that the Environmental Impact Statement for the area outlined in your letter of 14 November 1996 (your reference CR-I\VH\0018\LETT\L004.DOC) will need to address the impact of any proposals for the area on the efficiency and safety of the existing road system. With the exception of the New England Highway these roads are generally under the care and control of Maitland City Council.

Appropriate traffic studies to determine possible traffic volumes, peak flows, travel desire corridors, accident rates and possible intersection arrangements should be undertaken to ensure minimal impact on the major roads in the study area.

Yours faithfully

Mr C Nunn
Zone Planner

20/12/96

c:\winword\eis\pghcmpsf.doc

956 Hunter Street Newcastle West NSW 2302 Phone (049) 21 2900 Fax (049) 21 2929 DX 7980 Newcastle
ALL CORRESPONDENCE TO PO BOX 2186 DANGAR NSW 2309

Reference :

WorkCover
New South Wales

November 20, 1996

Mr Stephen Hills
Environmental Planning Manager
CMPS & F Pty Ltd
P.O.Box 201
Chatswood NSW 2067

Dear Mr Hills,

I refer to two recent letters regarding the preparation of a E.I.S. for PGH Brickworks,Metford and PGH Brickworks, Wyong.

Quarrying and Mines are the responsibility of the state Department of Mineral Resources and WorkCover would not normally be involved in such operations.

If the site has is not registered as a mining lease during the construction stage the Occupational Health & Safety and Construction Safety Acts may apply and if there are dangerous goods to be kept on the sites, the Dangerous Goods Act could apply.

If you need clarification on this matter please contact me on 049 212910.

Yours sincerely,

Allan Kemp
Regional Manager

INCOMING CORRESPONDENCE					
DATE IN	22nd Nov. 96				
PROJECT MGR.	SH	INTL.	SH		
PROJECT	VH00018				
FILE No.	027				
TO	SH				
A/I/C	A				
INTL	SH ✓				

APPENDIX D
COMMUNITY CONSULTATION

(i) Newsletters Distributed to Residents
(ii) Minutes of Planning Focus Meeting
(iii) Minutes of Community Meeting No. 1
(iv) Minutes of Community Meeting No. 2

INFORMATION STATEMENT

PGH BRICKWORKS METFORD, MAITLAND

ENVIRONMENTAL IMPACT STATEMENT TO ACCOMPANY A DEVELOPMENT APPLICATION TO MAITLAND COUNCIL

BACKGROUND

The PGH Brickworks at Maitland stand on the site of the old 'East Maitland Pottery' works, which began operation around 1840. Clay and shale has been quarried from the site since 1882. The site, bounded by the Great Northern Railway line on its northern edge, covers 50 hectares and includes land on both sides of Metford Road.

The site has been operated for many years by PGH which is a wholly owned unit of CSR Limited. CSR/PGH has appointed CMPS&F Environmental to prepare an Environmental Impact Statement to accompany a development application which will be lodged with Maitland Council in early 1997, for the continued quarrying, landfilling and rehabilitation of their Metford site.

The clay and shale of the Metford area are identified in the Hunter Regional Environmental Plan 1989 as key resources in the local brick making industry.

DETAILS OF THE PROPOSAL

The proposal involves the continuation of existing quarrying in a staged process over most of the site. It is proposed that each stage of extraction will be followed by site rehabilitation via landfilling.

Landfill material will be within the category of Solid Waste Class 2 (non putrescible), ie. clean material such as demolition and building waste.

Three stages of extraction will be followed by 3 stages of landfilling. The first stage will be the landfilling and continuation of extraction at the Fieldsend Pit.

The current and expected annual extraction rate from the site is approximately 60,000 tonnes per year with estimated reserves of approximately 20-30 years. Landfilling will follow each stage of extraction over a similar time period.

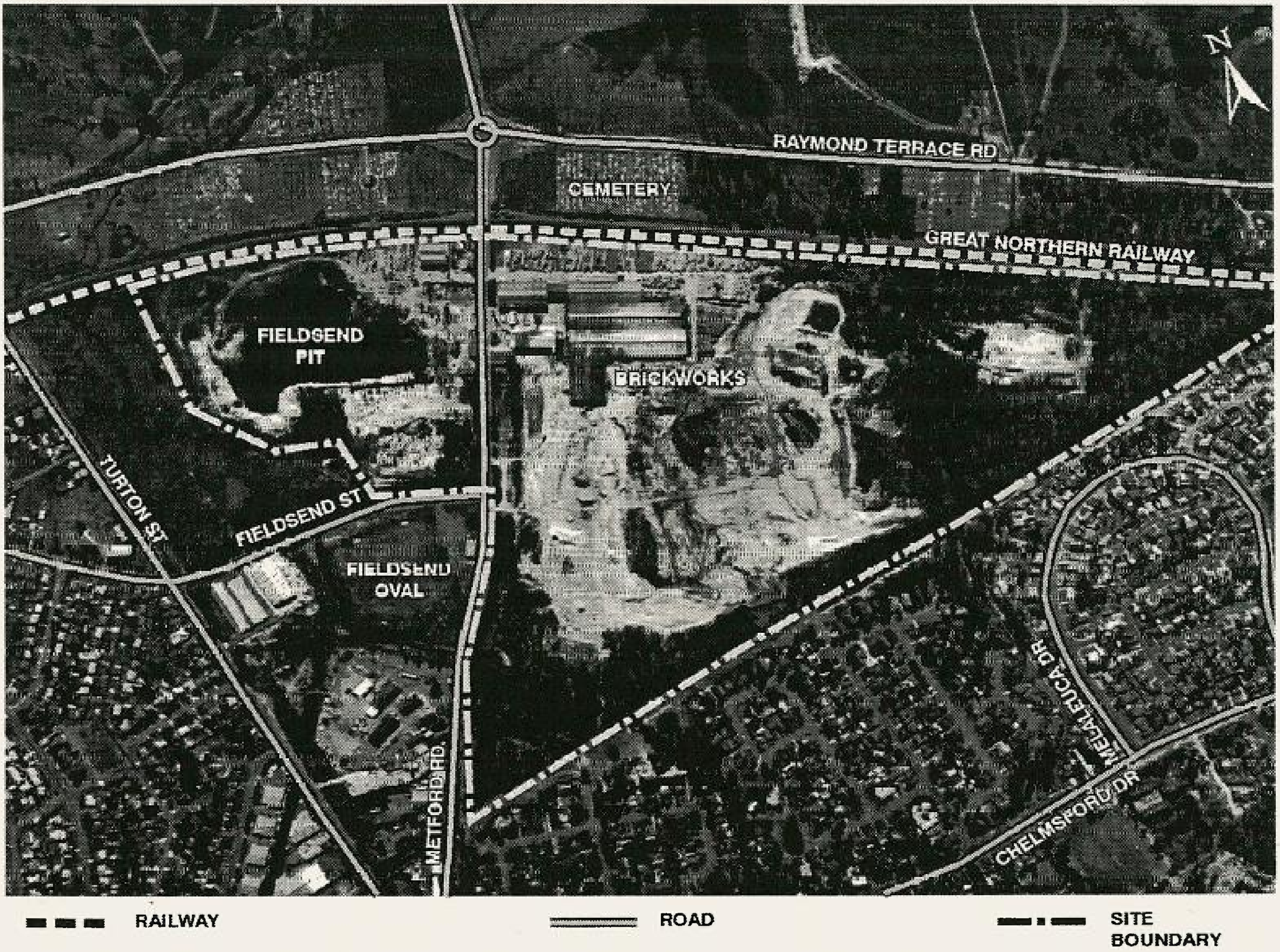
ENVIRONMENTAL EFFECTS

It is the requirement of the Environmental Planning and Assessment Act 1979 that the EIS should address all environmental effects which result from the proposed development. The key issues to be assessed are noise, traffic, air, and water quality issues.

As part of the proposed development a landscaped earth mound will be constructed around most of the perimeter of the site to minimise any adverse acoustic or visual impacts.

An important part of the EIS will be to consider the most appropriate end-use of the site following its remediation. In this regard the preferred open space/recreational use of the land will be sought from the local community.

SITE DETAILS - Maitland EIS



COMMENTS / FURTHER INFORMATION

If you require any further information with regard to this development proposal and the EIS, and/or you wish to comment on the proposal or any impacts of the proposal which you feel should be addressed in the EIS, please contact either:

Jenny Ehmsen
CMPS&F Newcastle
Tel. (049) 293 2555
Fax (049) 265 319

Felicity Stening
CMPS&F Sydney
Tel. (02) 9412 9572
Fax (02) 9412 9876

MINUTES OF PLANNING FOCUS MEETING

***"EIS to accompany a DA for the continued extraction, landfilling and site rehabilitation of the PGH site at Metford, Maitland"* by CSR/PGH**

Location: Maitland Town Hall, Maitland

Date: 9 December 1996

Time: 2 PM

1.	Introduction	Mark Ihlein, Maitland Council
2.	Outline of proposal	Ron Bush, CSR
3.	Presentation of Environmental Impact Statement	Stephen Hills, CMPS&F
4.	Focus Group Discussion	

Present:

Mark Ihlein	Maitland Council
Greg Clayden	Maitland Council
Michael Alexander	Maitland Council
Henry Wilson	Maitland Council
Richard Upston	Maitland Council
David Bortfeld	Maitland Council
Ron Bush	CSR
Matthew Olney	PGH
Stephen Hills	CMPS&F
Felicity Stening	CMPS&F
Bryan Liddle	Woodward-Clyde
Chris Williams	NSW Health
Gary Dunnett	NPWS
Ian Tapper	Dept Land & Water Conservation
Lance Watt	Dept Land & Water Conservation
Carl Bagnall	Dept Mineral Resources
Ian Patterson	Dept Mineral Resources

Apologies:

Andrew Ling	EPA
Col Johnston	RTA

ISSUES DISCUSSED AND COMMENTS MADE

1. DUST

Dust monitoring occurring on monthly basis. Every year major monitoring for OH&S purposes to test for free silica, etc.

If mud becomes a problem a cattle grid will be installed to shake off the mud, or a wheel wash or wheel brush. Additionally, roads will be sprayed to minimise dust and sprinklers may be installed if dust generation is significant. Water use from these activities will be drained back to a sediment pit for further reuse.

2. TRAFFIC

Traffic studies to be carried out by sub-consultant. Council presently undertaking a traffic study (Norm Yeend council contact). Existing state-wide policy to replace level crossings.

Trucks would essentially follow the roads through the industrial section on Metford Road, not through residential areas.

50,000T of waste per year entering landfill, around 30 trucks per day. Expected truck movements mainly from New England Highway, coming from Maitland and Newcastle industrial areas, Port Stephens and Raymond Terrace.

3. NOISE

Noise studies to be carried out by sub-consultant.

May need to extend height of bund in areas where the anticipated noise at receptor points (residential dwellings) has the potential to exceed noise design goals.

4. WATER MANAGEMENT

Fieldsend Pit - 5 groundwater monitoring wells. Water is saline and discussions are currently taking place with EPA to determine best method and route for discharge into Hunter River at Hexham.

Coal seam at bottom of Fieldsend Pit will be looked at by Dept Mineral Resources.

Water will be pumped out of quarry. The water will be pumped to Hunter River either along the railway line across one landholding, or pumped via Four Mile Creek across 15 landholdings.

While the site is being landfilled existing and extra sediment dams will control water. Dirty and clean water will be separated. Some of this collected water will be reinjected in the landfill or sprayed onto roads to stop dust

5. FLORA/FAUNA/HERITAGE

NPWS comment that SoEE section on flora/fauna is fairly adequate, although it is important to analyse whether the Green & Gold frog species is present. This species has a particular attachment to old quarry sites.

Aboriginal/heritage assessments through National Parks & Wildlife Service, National Trust and Australian Heritage Commission will be carried out.

6. CROWN LAND

The PGH Brickworks and quarries are situation on Crown Land. Dept Land & Water Conservation will have to consent to development as land owner.

Future zoning of the site was discussed. Possible landuses could include open space, recreational, residential, industrial with possible light industrial around brickworks.

7. LANDFILL

Solid Waste Landfill Class 2 accepting non-putrescible wastes (ie no food, liquid, chemical or hazardous wastes).

Follow landfill standards that have been set at Erskine Park
Cleanaway tied into the venture with Brambles, Cleanaway would provide around 40-50% of the waste material. Almost guaranteed that the nature of the waste Cleanaway is bringing in is all non-putrescible.

Council comment re separation and sorting of materials entering the site. The focus should not be on filling the holes as quickly as possible with waste, but to ensure that the materials going into the quarry holes are non-putrescible and have little value as a reusable resource.

CSR comment that materials such as concrete may be separated for later use and large quantities of metals or organic waste could be diverted to Sims Metal and the Mt Wilson Waste Treatment Facility

Landfill would be overfilled by 2-5m so that in 5 years it would settle down. (Erskine Park landfill 100m deep). The final landform, grassed and domed, would be capped with .6m - 1m clay with topsoil on top, although in areas where trees are proposed to be planted a deeper layer of topsoil will be placed.

8. END-USE OF SITE

Council planners prefer recreational use of area A, until area B completed - would prefer low key, unstructured passive recreation, ie urban bushland or grassed open space.

CSR comment on fund dedicated to Crown Land and council so that if development falters or goes awry there is money available for further rehabilitation of the site.

Heritage walk/info signs around brick kilns and chimney, focus on this site

CALM suggested BMX track in the corner of the quarry that will be rehabilitated/revegetated first.

Possibility of underpass under the railway to link Morpeth with East Maitland.

MINUTES OF MAITLAND COMMUNITY MEETING

***"EIS to accompany a DA for the continued extraction, landfilling and site rehabilitation of the PGH site at Metford, Maitland"* by CSR/PGH**

Location: Metford Community Hall, Metford

Date: 9 December 1996

Time: 6.30 PM

1.	Introduction	Cr Tony Keating, Maitland Council
2.	Outline of proposal	Ron Bush, CSR
3.	Presentation of Environmental Impact Statement	Stephen Hills, CMPS&F
4.	Focus Group Discussion	

Present:

Cr Tony Keating	Maitland Council
Cr Jennifer Rolls	Maitland Council
Ron Bush	CSR
Anthony Steer	PGH
Matthew Olney	PGH
Noel Peacock	PGH
Stephen Hills	CMPS&F
Felicity Stening	CMPS&F
Bryan Liddle	Woodward-Clyde
13 community members	

Apologies:

Cr John Martin	Mayor, Maitland Council

ISSUES DISCUSSED AND COMMENTS MADE

1. TRAFFIC

Traffic studies to be carried out by sub-consultant. Council presently undertaking a traffic study in Metford which will be looked at in this study.

Trucks would essentially follow the roads through the industrial section on Metford Road, not through residential areas.

50,000T of waste per year entering landfill, around 30 trucks per day. Main truck movements expected from the New England Highway with trucks from Maitland and Newcastle industrial areas, Port Stephens and Raymond Terrace. Comment on increase in noise level and dust generation. Trucks would not be B-doubles, but would include garbage trucks (from 5T) and trucks carrying skip bins.

Hours of operation at PGH Brickworks are 7am - 3pm, Mon - Fri and half day on Saturday. Residents asked to contact PGH if contractors are working out of designated hours.

2. DUST

If mud becomes a problem a cattle grid will be installed to shake off the mud, or a wheel wash or wheel brush. Additionally, roads will be sprayed to minimise dust and sprinklers may be installed if dust generation is significant. Water use from these activities will be drained back to a sediment pit for further reuse.

3. NOISE

Noise studies to be carried out by sub-consultant.

May need to extend height of bund in areas where the anticipated noise at receptor points (residential dwellings) has the potential to exceed noise design goals.

4. WATER MANAGEMENT

Fieldsend Pit - 5 groundwater wells, water is saline, have EPA approval to pump it out.

Water will be pumped out of quarry, discussions with EPA have begun. The water will be pumped to Hunter River either via Hexham along the railway line across one landholding, or pumped via Four Mile Creek across several land owners.

While the site is being landfilled existing and extra sediment dams will control water. Dirty and clean water will be separated into sediment ponds and some of this water will be reinjected in the landfill or sprayed onto roads to stop dust.

5. FLORA/FAUNA/HERITAGE

Aboriginal/heritage assessments through National Parks & Wildlife Service, National Trust and Australian Heritage Commission will be carried out.

CSR/PGH confirmed that trees located in fringe areas will remain and will not be part of excavation. Similarly where existing bushland occurs in areas C & D, minimal tree removal will occur.

6. CROWN LAND

The PGH Brickworks and quarries are situated on Crown Land. Dept Land & Water Conservation will have to consent to development as land owner.

Future zoning of the site was discussed. Possible landuses could include open space, recreational, residential, industrial with possible light industrial around brickworks.

7. EXTRACTION/LANDFILL

Solid Waste Landfill Class 2 accepting non-putrescible wastes (ie no food, liquid, chemical or hazardous wastes). Mainly building and demolition wastes and industrial wastes. May have an arrangement with Mt Vincent Waste Management Facility, may involve storing quantities of organic waste on site at PGH, then transferring it to Mt Vincent.

Area B will be excavated 15-17m in depth.

Level of extraction is currently around 38,000T/yr, but could be as much as 60,000T/yr.

The proposed operation will follow landfill standards that have been set at Erskine Park, Penrith. Cleanaway tied into the venture with Brambles, Cleanaway would provide around 40-50% of the waste material. Almost guaranteed that the nature of the waste Cleanaway is bringing in is all non-putrescible. Proposed site visit for interested residents.

Landfill would be overfilled by 2-5m so that in 5 years it would settle down. (Erskine Park landfill 100m deep). The final landform, grassed and domed, would be capped with .6m - 1m clay with topsoil on top, although in areas where trees will be planted a deeper layer of topsoil will be planted.

8. END-USE OF SITE

Recreational use, low key, unstructured passive recreation, ie urban bushland or grassed open space.

Heritage walk/info signs around brick kilns and chimney, focus on this site

Possibility of underpass under the railway to link Morpeth with East Maitland.

Areas A and B will be rehabilitated within 15 years for use by the community.

Resident comment about future use of site as ovals.

COMMENTS

Any comments on the proposal can be made at anytime to the consultants (see below) or during the next meeting. When the Development Application (DA) and Environmental Impact Statement (EIS) are lodged with Maitland Council in early 1997 they will be on exhibition. The EIS will also be available to buy at $20.00.

There will be another Community Meeting on Monday 10 February 1997 at Metford School Hall.

Please forward written comments to: Felicity Stening, CMPS&F Environmental, PO Box 201, CHATSWOOD NSW 2057.

MINUTES OF MAITLAND COMMUNITY MEETING NO. 2

"EIS to accompany a DA for the continued extraction, landfilling and site rehabilitation of the PGH site at Metford, Maitland" by CSR/PGH

Location: Metford Public School, Metford

Date: 10 February 1997

Time: 6.30 PM - 9.00 PM

1. AGENDA

1.	Introduction	Cr Tony Keating, Maitland Council
2.	PGH/CSR Presentation and Outline of Proposal	Ron Bush, CSR
3.	CMPS&F Presentation EIS Progress of EIS	Stephen Hills, CMPS&F
4.	Water Quality and Water Management	Bryan Liddle, Woodward Clyde
5.	End use of Site Concept Plans	Ken Wallace, Woods Bagot
6.	Discussion (especially future open space/recreational use of the land)	
7.	Conclusion	

2. PERSONS ATTENDING

Present:

Cr Tony Keating	Maitland Council
Cr Jennifer Rolls	Maitland Council
Ron Bush	CSR
Matthew Olney	PGH
Noel Peacock	PGH
Owen Ward	PGH
Stephen Hills	CMPS&F
Felicity Stening	CMPS&F
Bryan Liddle	Woodward-Clyde
Ken Wallace	Woods Bagot
10 community members	

3. ISSUES DISCUSSED AND COMMENTS MADE

3.1 ENVIRONMENTAL IMPACT STATEMENT (EIS)

The Environmental Impact Statement (EIS) will accompany a Development Application (DA) to Maitland Council in late March/early April.

The three main components of the EIS will be continued extraction of the site, landfilling of the voids and rehabilitation of the site.

PGH will continue to extract clay/shale for brickmaking on the site.

Enviroguard Pty Ltd, a joint venture between Cleanaway and Brambles, will manage the site. Enviroguard has managed the Erskine Park Landfill in Sydney since 1993.

The Fieldsend Pit will be dewatered, ie drained via a pipeline to the Hunter River at Hexham. The Environmental Protection Authority (EPA) has given 'in-principle' approval to this proposal.

The Metford site is documented as "clay conservation area" in the Maitland Local Environment Plan (LEP). The area is also disturbed land.

The average extraction rate will be 60,000 tonnes/year (creating a void of approximately 30,000m^3 per year). This is about the same level of extraction that has previously occurred. The proposed landfilling rate is 45,000 tonnes per year (equivalent to approximately 45,000m^3 space within the landfill).

3.2 LANDFILL

As minimal further extraction is proposed in the south-east corner of the site this area will be rehabilitated first. This land could possibly be available in the future to the community as an urban bushland/passive recreation area.

Landfill activity is planned first in the area north of Metford Road, in the Fieldsend Pit.

The site will be landfilled with 'Solid Waste Class 2' material. This is commercial and demolition waste, building rubble, plastics and metals. No putrescible waste, ie waste collected by domestic garbage service, waste containing food, liquid or hazardous waste will enter the landfill.

The majority of waste entering the landfill, is expected to be sourced from the Newcastle and the Lower Hunter Valley region.

At the landfill there will be three points of assessing the waste - at the weighbridge upon entry to the site, at the tipface and through the docket/reporting system. These checks will be monitored by CSR staff, with a yearly audit by the EPA.

3.3 NOISE

The existing landscaped bund, along the southern boundary of the site, will be filled and revegetated especially where gaps presently exist. A new landscaped bund will be constructed along the Turton Street and Fieldsend Street frontages of the site.

The height of the bund will be determined both by visual and acoustic studies which are currently being undertaken.

Residents were advised by PGH that no activities occur on the site outside normal hours, however they were asked to contact Maitland Council or PGH (049) 337 211, if they detect that extraction machinery is being operated outside of normal working hours, 7am - 5pm.

3.4 TRAFFIC

Essentially traffic movements will not occur through the residential areas of Metford, trucks will enter Chelsmford Drive from the New England Highway, and follow Metford Road to the site.

Entry may occur from Raymond Terrace Road. At the intersection Raymond Terrace Road and Metford Road there is a 2 lane roundabout that will be able to handle truck movements. The roundabout was built 2 years ago as a recognition of the importance of Metford Road.

RTA are presently looking at 2 sets of fully signalised movements, (ie. traffic lights) on the New England Highway/cnr Chelmsford Drive and the New England Highway/cnr Chisholm Road (old name Metford Road).

The aim of the traffic study, currently being undertaken as part of the EIS, is to determine capacity of the road network, and the impacts of the frequency and loading of traffic generated by the proposed development.

Daily waste loads based on landfilling 45,000 tonnes per annum, have been estimated. The landfilling will generate approximately 60 additional daily vehicular trips which presents an increase of less than 1% of current volumes along Metford Road. 1997 volumes are estimated at:

7,400 vehicles/day - Metford Road
9,200 vehicles/day - Chelmsford Road

3.5 DUST

An air quality study is currently being undertaken. Dust suppression will take place by management techniques especially water spraying.

A water truck will be in use on-site and potentially manned full-time.

3.6 WATER QUALITY

Surface water and groundwater is currently being assessed by Woodward Clyde.

The study has determined so far that:

4 Mile Creek catchment has high quality water.

The groundwater samples are consistent with water quality in the Hunter River, with few heavy metals detected, but a high level of salinity.

The landfill will be clay lined and capped.

Monitoring will occur to determine leachate leakage.

Sedimentation basins will collect sediment, solids will settle out and the water will be reused on the site for dust suppression.

Runoff will be collected in a leachate collection pit/dirty water pit in a low point, and pumped to the surface, again reused for dust suppression.

Local flooding issues are being addressed.

The clay pit lining may be extended up the sides of the pit.

3.7 REHABILITATION

Landscaping by the planting of trees/shrubs will primarily take place around the edges of the landfill cells.

Heavy tree planting will not occur directly on the landfill site as roots may penetrate the landfill surface and crack clay capping. Grassed areas are the most appropriate landform over the landfill. Native vegetation will be used in all replanting.

Two options have been developed:

Concept 1

Fieldsend Pit as a soccer pitch with terraced stands along the bund.

On the southern side of Metford Road, a large open space would dominate the area, as well as urban bushland (remnant bushland, described as medium conservation value) in the southeastern corner.

Concept 2

Fieldsend Pit as a "Brickworks Park" area where the chimneys and stables are located, as recognition of their historical significance, and as an entry into a formal park layout (circular).

Possible angle parking along Fieldsend Street.

The southern side could incorporate a large oval, with vehicle access from the extension of Stradbroke Street, and further south, walking trails through the bushland.

3.8 RESPONSIBILITY

The land is owned by the Crown. CSR is bound to a post closure care period.

4. COMMENTS

Any comments on the proposal can be made at anytime to the consultants (see below).

The EIS will on exhibition at council and be available for purchase in late March/early April. People attending meetings will be sent a copy.

Please forward written comments to:

Attention: Felicity Stening
CMPS&F Environmental
PO Box 21
CHATSWOOD NSW 2057

APPENDIX E
DUST IMPACT ASSESSMENT

PROPOSED CONTINUATION OF QUARRYING LANDFILLING AND SITE REHABILITATION AT METFORD, MAITLAND

DUST IMPACT ASSESSMENT

JULY 1997

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67 Albert Avenue
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1. INTRODUCTION

This report has been prepared to assess the impacts on air quality associated with the proposed continuation of quarrying, landfilling and site rehabilitation at the PGH Metford site, Maitland. The subject site has an area of approximately 50 hectares and is bounded by the Great Northern Railway line along its eastern edge (refer to *Figure 1.1* in the main EIS document).

The proposed development includes:

- continuation of existing clay/shale quarrying over most of that part of the site which has been previously disturbed by quarrying activities;
- controlled filling of the current and resulting quarry voids with solid waste in conformity with the EPA definition of a Solid Waste Class 2 landfill;
- revegetating the final land surface for open space/recreational uses in association with adjoining residential and industrial development;
- controlled placement of sufficient overburden around certain sections of the perimeter of the site to form a landscaped earthen mound as boundary screening and to assist in reducing noise impacts on adjoining residents in advance of extraction and landfill activities; and
- integrating proposed quarry/landfill operations with existing approved operations which include:
  - brick manufacture, stockpiling and delivery from the site;
  - stockpiling clay/shale materials on the site;
  - importing clay/shale materials to the site.

Much of the dust generated from the proposed extension of the existing quarry and landfill operations has the potential to pass to the surrounding environs. To estimate the expected impacts at surrounding properties, a computer based Gaussian plume dispersion model, ISCST3 was used along with estimated dust emissions and local meteorological data. The model was used to predict the annually averaged monthly dust deposition rate and annual average concentration isopleths around the site. The predicted levels were then compared to NSW EPA guidelines.

This report identifies the operations that would generate dust emissions and describes the air quality safeguards and controls which are proposed for the site. A review of meteorological data of the area and relevant air quality criteria has also been considered. The methodology of dispersion modelling, including an inventory of dust emissions and the results of the dispersion modelling (including both the dust deposition and the concentration of total suspended particulates) are also outlined in this report.

2. DESCRIPTION OF THE PROPOSED DEVELOPMENT

2.1 SITE DESCRIPTION

The PGH Brickworks and extraction site at Metford covers a total area of approximately 50 hectares and is bounded by the Great Northern Railway line along its northern edge (refer to *Figure 1.1* in the main EIS document). The site is separated into two parts by the Metford Road which has a "level crossing" with the railway immediately to the north of the site's northern boundary (refer to *Figure 1.2* in the main EIS document). To the south of the Metford Road, the site is triangular in shape and is bounded by the Metford Road, the railway line and the interface with the existing residential area of Metford. To the north of the Metford Road, the site is rectangular in shape and is bounded by Metford Road, Fieldsend Street, Turton Street and the railway line.

The site is currently in a disturbed state as extraction operations have been carried out at the site generally since 4 August, 1882. A bund wall and vegetation buffer zone exist between the southern areas and adjacent residences in Metford to the south.

The property is within land which is zoned 1(b) Secondary Rural within the provisions of Maitland LEP 1993. This zone contains all rural land which is either not of prime agricultural value or has not been set aside for rural residential development. The land adjoining the site is primarily medium density residential to the south, light industrial to the north and west and rural residential to the east.

2.2 STAGED OPERATIONS

The proposed development will occur in a staged manner as indicated in *Figures 2.1 and 2.3* in the main EIS document. As the environmental impacts will vary over the life of the project, four different scenarios were modelled. Stages 1, 3, 4 and 5 were chosen as being representative of conditions over the life of the quarry and landfill. Stage 5 represents both quarrying and landfilling activities occurring at a location closest to nearby residents and is therefore potentially the stage most likely to impact on these residents.

2.3 OPERATIONS

2.3.1 Quarrying

The proposal is to undertake extraction up to 60,000 tonnes/yr between years 0 to 27.8 (Stages 1 to 6) of the project. Of this material it is estimated that about 20% will be classified as overburden. Overburden will be used in site works or as landfill cover. Overburden will be stockpiled adjacent to the landfill areas or in the central stockpile area.

Quarrying operations will be undertaken on a campaign basis for three months of the year. Hence extraction rates will be at 20,000 tonnes per month.

The clay/shale material which is excavated from the quarry areas will be used in the brickworks on-site. In considering this, it is assumed that as the clay/shale material is excavated from the quarrying areas, it is transferred to the central stockpile area to the south of the brickworks.

2.3.2 Landfill

A landfill is to operate in excavated areas and can accept up to 150 tonnes of waste per day. In addition to this waste, around 8 m^3/day of overburden will be used as cover. Refer to *Section 2* of the main EIS document for further information on the proposed programme of quarrying and landfilling.

Activities undertaken in the brickworks building located on the site are covered by existing approvals and are not considered in this report.

2.3.3 Quarry Traffic

For the purposes of this assessment, the following scenario is assumed for extraction operations on the northern side of Metford Road (ie area B):

- A loader or excavator will be used to excavate approximately 670 tonnes/day of clay/shale material and 170 tonnes/day of overburden material from the quarry pit (based on a 72 day year).
- Clay/shale material will be transported by 16-17 tonne off-road dump trucks to the central stockpile on the southern side of the Metford Road. It is therefore estimated that 40 trips to the main stockpile per day are required.
- Overburden material will be transported by 16-17 tonne off-road dump trucks to a small stockpile adjacent to landfill area A. It is therefore estimated that 10 trips to this stockpile per day are required.

The following scenario is assumed for extraction operations on the southern side of Metford Road (ie areas C and E):

- A bulldozer and a 30 tonne scraper will be used to excavate approximately 667 tonnes/day of clay/shale material and 167 tonnes/day of overburden material from the quarry pit (based on a 72 day year).
- Clay shale and overburden materials will be transported by scrapers to the central stockpile. It is therefore estimated that 22 trips per day for the clay/shale material and 6 trips per day for the overburden material to the main stockpile are required.

It has been assumed that the above quarry equipment is in use for 10 hours per day, and is fully employed in the operations of removing and scraping clay/shale and overburden materials, hauling the materials from the quarry pits to the stockpiles, dumping the materials on the stockpiles and reshaping the stockpiles.

2.3.4 Landfill Traffic

It is proposed that trucks delivering waste will enter from Metford Road. They will then proceed along a sealed internal road to the weighbridge (a temporary weighbridge will be located on the northern side of Metford roads for Stages 1 to 4 of the proposed operations). From the weighbridge trucks will proceed on internal roads to the landfill floor and tipping face. Empty trucks will return via a wheel-wash to the weighbridge before exiting the site. The office and weighbridge will be located approximately 100m from the site entrance.

Approximately 150 tonnes per day of waste will be received by the landfill operations. It is estimated approximately 20 waste trucks will enter and leave the landfill site each day (refer to *Section 5.2* of the main EIS document).

Approximately 8 m^3/day of overburden material from the quarry operations will be required for landfill cover material. Haulage of this material from the overburden stockpiles to the landfill areas will result in an average of 1 truck trip per day.

TABLE 1 SUMMARY OF VEHICLE NUMBERS

Operation	Vehicle	No. of vehicles or trips/day
Quarrying	Loader/Excavator	1
	16-17 tonne dump trucks	2
	Dump truck to the clay/shale stockpile	40 trips/day
	Dump truck to the overburden stockpile	10 trips/day
	Scraper	1
	Dozer	1
	Scraper to the clay/shale stockpile	22 trips/day
	Scraper to the overburden stockpile	6 trips/day
Landfill	Bulldozer/loader	1
	Compactor	1
	Off road dump truck	1
	Haulage of cover material	1 trip/day
	Import waste trucks	20 trips/day

2.4 HOURS OF OPERATION

Quarry operations will be undertaken on a campaign basis for about three months of the year between the hours of 7.00 am to 5.00 pm, Monday to Friday. There will be no quarrying on weekends or public holidays.

Landfill operations will continue throughout the year between the hours of 6.00 am and 6.00 pm Monday to Friday, and 6.00 am to 4.00 pm on Saturdays. The depot will not operate on Sundays or public holidays. It will cease to receive waste an hour before closing time to allow for compaction and the application of cover material.

Note that while quarry operations are only proposed to be undertaken for 16 weeks in a year (generally in four week periods), restrictions in the modelling package used do not allow for this. It has therefore been assumed that quarrying operations will occur for the whole year, based on the hours of the week as given above. This in turn will provide a conservative estimate for the dust concentration and deposition rates calculated.

2.5 PROPOSED MITIGATION, MANAGEMENT AND MONITORING

In order to generally reduce dust concentration and dust deposition rates in the area, a series of measures are proposed, including:

- installation of a metrological station on the property;
- installation of a wheel-wash facility to be used by all departing landfill vehicles;
- use of polymer-based binders to spray over product stockpiles and other bare surface material when ever it is not being worked;
- establishment of grass cover over any extensive bare areas until the area is required for quarrying;
- minimising (where possible) dumping heights;
- watering unsealed roads during dry conditions;
- watering of working areas; and
- ceasing all significant dust generating activities including quarrying, stockpile addition or subtraction and landfilling should the average wind speed over 30 minutes exceed 10 metres per second.

It should be noted that stopping significant dust generating activities such as quarrying, stockpiling or landfill operations when consistently higher wind speeds are experienced (over 10m/s in any 30 minute period) has not been taken into account for these calculations. This too will result in a more conservative result for dust deposition and dust concentration results.

In addition, no account has been taken of the effects of the bund and surrounding vegetation in the model. These are also likely to reduce off-site impacts, particularly in the direction of nearby residents.

3. DISPERSION MODELLING OF OFF-SITE IMPACTS OF DUST EMISSIONS

3.1 CHOICE OF MODEL

An air dispersion model (ISCST3) was used to predict dust deposition rates and dust concentrations in the vicinity of the quarry/landfill. ISCST3 has been widely used by the United States Environment Protection Agency (USEPA) and is fully endorsed by the New South Wales Environment Protection Authority (EPA). A full technical description is presented in the USEPA ISCST3 Technical Manual. ISCST3 uses a Gaussian model and the dry deposition model is able to model the deposition of both fine and medium fractions of dust.

The dispersion model requires several classes of input data, namely meteorological, emission rate and source configuration.

3.2 METEOROLOGICAL DATA

A twelve month meteorological data file in ISCST3 format was compiled for 1980 and is considered to be representative of the quarry site. Meteorological data was sourced from Lochinvar, located approximately 15 km from the site.

To the south and to the west of the proposed development area lies medium density residential areas which may be affected by the quarrying and landfill operations. These residences are located along the boundaries of the Maitland site. Based on the meteorological data, which shows winds predominantly in an east-south easterly direction and a north-northwest direction, it can be expected that off-site areas in these directions are most likely to experience an impact from dust. Depending on the location of quarrying and filling activities, these wind directions and subsequent dust impacts may potentially be in the direction of the nearby residences.

3.3 EMISSION RATE DATA

Dust emission rates for the variety of operations/activities vary significantly during the life of the quarry/landfill. Rates have been obtained from both USEPA and NSW EPA inventories. **Section 5** deals with the emission rates in detail.

4. AIR QUALITY CRITERIA

The effects of dust on health and amenity is twofold; it can have an impact on the amenity of a region through dust deposition, and it can impact on health through inhalation of particle concentrations in the air.

The aesthetic impacts due to particulates include:
- a reduction in visibility during high wind episodes; and
- the cumulative deposition onto cars, washing etc.

Particulates include any solid material suspended in the atmosphere which might enter the breathing zone. Suspended particulates range in size from large particles up to 50 microns in size, such as grit and sand, down to miniature droplets only fractions of microns in size, such as found in mist and smokes.

The human respiratory tract is able to exclude large particles in the upper airways, so that the only particles likely to enter the lower respiratory tract (the so called respirable fraction) are those sized 10 microns or smaller (PM_{10}). With respect to effects on health, the smaller PM_{10} particles are the major concern. Current research is focusing on the potential effects of these very small particles. Generally it has been found that these small particles may cause bronchitis and asthma. For clay/shale quarries such as Metford the percentage of PM_{10} particles in the dust emissions is below 50 percent of all particles transported from the site, SPCC (1986).

The effects of both total suspended particulates (TSP) and PM_{10} particles can be assessed by comparing dust deposition rates and dust concentrations with recognised air quality criteria established in New South Wales and overseas.

4.1 EXISTING AIR QUALITY

Dust deposition and concentration levels at receiver locations depend strongly on the distance from the dust source and the prevailing meteorological conditions.

No long term dust monitoring has been conducted on the PGH Metford site. Results for dust monitoring undertaken at a nearby clay/shale quarry site have been obtained and are provided in **Table 2**. The Thornton quarry is located 4 km east of the Metford site and the results are considered indicative of the conditions of the Metford site. Dust deposition rates were measured at three locations around the Thornton site with deposition rates typically between 0.6 and 7.0 grams per square metre per month (g/m^2/month). The averaged value of 2.3 g/m^2/month is considered representative of the ambient conditions at the Thornton and Metford sites.

Note however that this value will incorporate some contribution from the Thornton quarry operations, and is therefore an overestimate of background.

TABLE 2 MONTHLY DUST GAUGE RESULTS - THORNTON QUARRY

Month/Year	D1	D2	D3
January 1994	0.9	2.4	1.6
February 1994	1.3	2.1	1.4
March 1994	1.7	4.3	1.1
April 1994	3.1	2.5	1.6
May 1994	0.7	1.8	1.7
June 1994	0.7	(1)	1.8
July 1994	0.6	6.8	2.0
August 1994	1.0	7.0	1.5
September 1994	1.3	5.9	2.4
October 1994	1.7	6.0	3.1
November 1994	1.5	3.2	2.0
December 1994	1.4	1.4	2.2
January 1995	1.2	1.3	2.6
February 1995	2.4	2.1	1.2
March 1995	2.0	4.7	2.8
April 1995	0.9	4.2	1.5
Gauge Average	**1.4**	**3.7**	**1.9**
Average	**2.3**		

Source: Metford Laboratories
Note 1: Invalid results due to contamination by hay.

An ambient level of 2.3 g/m^2/month (annual average) for dust deposition has been adopted. There is no data available on ambient air dust concentrations, however using the approximation that an annual average deposition rate of 4 g/m^2/month is equivalent to an annual average ambient concentration of 90 micrograms/cubic metre ($\mu g/m^3$), local ambient dust concentrations are likely to be of the order of 55 $\mu g/m^3$.

4.2 DUST CONCENTRATION CRITERIA

The National Health and Medical Research Council of Australia (NHMRC) recommends a maximum annual average atmospheric particulate concentration level of 90 micrograms per cubic metre ($\mu g/m^3$) to protect public health in residential environments. This level is generally endorsed by the NSW EPA with the additional criteria of 50$\mu g/m^3$ (annual average) and 150 $\mu g/m^3$ (24 hour average) for particles smaller than 10 microns (PM_{10}).

4.3 DUST DEPOSITION CRITERIA

The EPA has established air quality goals for dust deposition. These are based on an incremental approach in which acceptable increases in dust deposition depend on the background level up to a specified maximum. **Table 3** summarises the criteria.

TABLE 3 NSW EPA DUST DEPOSITION GOALS

Existing Dust Level (g/m^2/month)	Maximum Acceptable Increase Over Existing Dust Level	
	Residential Suburban (g/m^2/month)	Other Areas (g/m^2/month)
2	2	2
3	1	2
4	0	1
above 4	0	0

For example, in residential areas with annual average deposition levels of two g/m^2/month, an increase of two g/m^2/month would be the maximum acceptable increase above background levels.

5. DUST EMISSIONS

Activities on the site were broadly classified into the operations/activities as listed in **Table 4**. The emission factors given for these are used to approximate emission rates for the 22 emission sources on site.

Emission factors were derived from a number of sources including data developed by the NSW EPA and the United States EPA. A list of individual activities, emission factors adopted and the sources is presented in **Table 6**.

TABLE 4 DUST EMISSION FACTORS USED IN MODELLING OF PROPOSED OPERATIONS

Operation/Activity	Emission Factor	Reference
Wind Erosion	0.4 kg/ha/hr	SPCC(1983)
Dumping	0.06 kg/T material	SPCC (1983)
Haulage (unsealed roads)	4.0 kg/km	SPCC (1983)
Reshaping stockpiles/dozing	1.8 kg/hr	USEPA
Loading Operations	0.018 kg/t material	USEPA
Scraper	4.11 kg/km	USEPA

By implementing a number of dust suppression measures the following emission factors were calculated as shown in **Table 5**:

TABLE 5 MODIFIED DUST EMISSION FACTORS

Operation/Activity	Emission Factor	Reference
Wind Erosion	0.2 kg/ha/hr	Up to 70% reduction in erosion with adequate watering. Have used 50% (SPCC, 1983).
Haulage (unsealed roads)	2.0 kg/km	50% control on haul roads with adequate watering (SPCC, 1983).
Dumping	0.018 kg/T material	Up to 70% control (SPCC, 1983) (Note: this is still double the value reported in the NERDDC, 1988 report).

5.1 DUST EMISSION INVENTORY FOR METFORD QUARRY

Due to the changes in operation over the life of the quarry, the likely air quality impacts of the quarry will change over its life. Therefore four scenarios were modelled, identified as Stages 1, 3, 4 and 5. Stage 5 operations involve the operation of the landfill and the quarry at areas in the closest vicinity to nearby residences. In addition, Stage 5 has the highest potential for creating dust since it has the highest dust production rates.

The estimated dust emissions depend on the quarry extraction and landfill programme described in **Section 2** with the following assumptions;

- completed areas will be rehabilitated and stabilised by planting grass;
- watering of all haulage areas to suppress the emission of dust from haul trucks;
- all areas are regularly sprayed with water to reduce dust emissions;

- trucks entering the landfill having their loads covered; and
- dumping distances are kept to a minimum.

Table 6 summarises the estimated emissions for each activity on site for each stage. Emissions were calculated on the basis of known tonnages, operation times, distances travelled by vehicles, and documented vehicle cycle times (Nunnally, 1993).

TABLE 6 DUST EMISSION INVENTORY (KG/YEAR)

		Dust Emissions (kg/yr)			
Area	**Operation / Activity**	**Stage 1**	**Stage 3**	**Stage 4**	**Stage 5**
Extraction Area		B	C	E	E
Landfill Area		A	B	B	C
Wind erosion	Central stockpile	5,346	5,346	5,346	5,346
	Overburden Stockpile	1,074	-	-	-
	Quarry	6,048	3,632	5,636	5,636
	Landfill	6,576	6,048	6,048	3,632
Quarry	Scrapers operating	-	617	617	617
	Scrapers hauling clay/shale	-	6,172	1,966	1,966
	Scrapers hauling overburden	-	1,542	491	491
	Scrapers dumping clay/shale	-	864	864	864
	Scrapers dumping overburden	-	216	216	216
	Dozer Ripping	1,296	1,296	1,296	1,296
	Loading overburden into trucks	216	-	-	-
	Trucks hauling overburden	1,247	-	-	-
	Trucks dumping overburden	216	-	-	-
	Loading clay/shale into trucks	864	-	-	-
	Trucks hauling clay/shale	6,899	-	-	-
	Trucks dumping clay/shale	864	-	-	-
Landfill	Haulage (Imports)	9,774	8,304	8,304	22,800
	Dumping (import) trucks	810	810	810	810
	Reshaping landfill, overburden	6,480	6,480	6,480	6,480
Cover	Loading trucks	43	43	43	43
	Trucks Hauling cover	276	408	408	912
	Trucks dumping cover	43	43	43	43
TOTAL		**48,073**	**41,822**	**38,568**	**51,153**

In addition to the dust emission rates for each activity the proportion of dust within different particle size categories was estimated. The three categories used were fine, medium and coarse. **Table 7** summarises the data used in the dispersion model.

TABLE 7 SIZE FRACTIONATION OF DUST EMISSIONS ASSUMED FOR PROPOSED DEVELOPMENT

Operation /Activity	% Fine particles (0 to 2.5 μm)	% Medium particles (2.5 to 15 μm)	% Coarse particles (> 15 μm)	Reference
Wind erosion	0	67	33	SPCC (1986)
Dumping	4	49	47	SPCC (1986)
Haulage	6	53	41	SPCC (1986)
Dozing	10	15	75	US EPA (1991)
Loading	6	57	37	SPCC (1986)
Scraper	3	42	55	US EPA (1991)

5.2 SOURCE SPECIFICATION

Many dust sources at the Metford site are likely to occur within an open pit (quarrying and landfill operations) thus trapping much of the dust within the pit itself. ISCST3 options enable a pit source to be specified which generates an effective area for the pit.

For most of the time operations will be below the natural surface. It was assumed that simultaneous quarry and landfill operations will not occur at the surface. Over the course of each stage, pit depths vary with time as they are landfilled or excavated. As the pit takes into account the height at which emissions are released, emissions have been calculated for worst case scenarios ie. the year when the pits are at their shallowest.

Other dust emission sources (ie sources other than those arising within the landfill or quarry) have been designated as area sources.

6. DISPERSION MODEL RESULTS

The estimated rates of dust emission were applied together with the meteorological data to calculate dust dispersion and to predict concentration and deposition rates at off-site receptors. A sample input file for the model is included in **Appendix A**. A computer plotting routine (Surfer) was used to draw isopleths of the predicted dust deposition rates and concentrations of particulates in the air. These isopleths are included in **Appendix B**.

As described previously, given that operations and hence environmental impacts will change over the life of the quarry, four different stages of the quarry life were modelled for stages 1, 3, 4 and 5 to take this into consideration. Descriptions of the impacts for these stages of the quarry/landfill are presented below.

6.1 DUST DEPOSITION

Figures 1 to **4** (**Appendix B**) show the predicted dust deposition due to Stages 1, 3, 4 and 5 of the quarry/landfill operations respectively. The figures show the area of land expected to experience an increase in dust fallout.

The existing ambient dust deposition rate has been estimated to be 2.3 g/m^2/month (refer to **Section 4.1**). The impact of the proposed development on air quality may be assessed in terms of the EPA objective which for the existing ambient dust deposition level considers an increase of 1.7 g/m^2/month as the maximum acceptable. Dust deposition rate increases of 1.7 g/m^2/month (annual average) are typically contained within the Metford site boundaries.

Two small areas surrounding the Maitland site are predicted to experience an exceedance of the criteria. The two areas predicted to experience dust deposition rates from the quarry/landfill activities at levels just above 1.7g/m^2/month (annual average) are located to the west of the site, where the Fieldsend Oval recreational area is located (during Stages 1 and 3) and to the south of the site, where some residences are located (during Stage 5 only). The exceedance in the residential area is minor and is limited to a very small area. In considering this exceedence, the following important points should be noted:

- based on the adoption of a conservative background concentration the allowable predicted increase (1.7g/m^2/month) is likely to be higher.
- the presence of a bund wall (which has not been accounted for in this model due to model restrictions) can be expected to reduce the dust deposition.
- modelling restrictions meant that it was assumed quarrying operations were occurring throughout the year. These operations only occur for approximately three months and hence the monthly deposition rates (based on annual average data) can be expected to be much lower.

In considering these points, it is expected that no residents will experience any loss of amenity during quarry/landfill activities of Stage 1, 3, 4 and 5.

6.2 DUST CONCENTRATION

Figures 5 to **8** (**Appendix B**) show the predicted increases in annual average dust concentrations during Stages 1, 3, 4 and 5 of the quarry/landfill operations respectively.

Existing annual average total suspended particulate (TSP) concentrations are estimated at approximately 55 $\mu g/m^3$ and hence an increase of 35 $\mu g/m^3$ would be required before the NHMRC annual average concentration goal of 90 $\mu g/m^3$ would be reached. The area expected to experience an increase in annual average dust concentrations of 35 $\mu g/m^3$ (annual average) falls within the area of the site.

Inherent in the results presented is the assumption that the majority of the dust emissions are able to follow a path free of obstruction (excluding pit sources) to the receptor locations. Physical obstacles such as rises in terrain and vegetation such as trees will interfere with the dispersion of the particulates and a certain portion would be expected to be removed from the air. The formulation describing this removal mechanism are unreliable and are therefore not generally included in dispersion models. Predicted dust levels, are therefore likely to over-estimate the actual levels. The site will have a 3 to 5 metre high bund constructed on its western and southern boundaries. The bund would be vegetated with trees.

6.3 SHORT TERM DUST EPISODES

Short term dust episodes relate to temporary increases in the amount of dust raised from disturbed surfaces and other dust containing areas, by strong winds in dry weather conditions. Short term dust episodes are not common as they require the combination of dry and high wind conditions. The nature, strength and duration of a dust episode is determined by a variety of factors which are difficult to quantify. Typically short term dust episodes occur with wind speeds greater than 10 metres per second.

To reduce the likelihood of a short term dust episode, measures are being incorporated into the development to minimise the potential for significant episodic dust events. These include permanent rehabilitation works, temporary revegetation of exposed surfaces, watering of all working and haulage areas, minimising dumping distances and washing landfill trucks before they leave the site. Sensible management will further minimise the potential of dust generation from the site. For example, cessation of work during periods of high winds will minimise the potential for dust generation.

7. SUMMARY AND CONCLUSIONS

The generation and dispersion of dust from the proposed operations at the PGH Metford Quarry/Landfill site has been assessed. Baseline conditions for this assessment were derived from the Thornton clay/shale quarry located 4 km to the east of the Metford site.

The quarry/landfill will include the following dust controls:

- watering of all working and haulage areas;
- establishment of grass cover on exposed areas;
- minimisation of cleared land awaiting quarrying or rehabilitation; and
- landfill trucks leaving the site driving through a wheel wash.

Stages 1, 3, 4 and 5 were selected to develop dust emission inventories as they represent the typical operations within the quarry and landfill.

The impact of the quarrying/landfill operations on the air quality was assessed using air dispersion modelling techniques and meteorological data collected in Lochinvar.

The combination of dust controls, the meteorological conditions, and the separation distance available between work areas and residences was shown to limit the annual dust concentration and generally the dust deposition to below the EPA guidelines. The results of the modelling indicate that the EPA guidelines for long term dust deposition and concentration at nearby residences may possibly be exceeded for Stage 5 only of the proposed quarrying/landfill activities. However, given restrictions in the model, known operations and the adopted background concentration it is considered unlikely that long term amenity at nearby residences will be adversely affected by the proposed operations of the quarry/landfill.

To provide verification of compliance with EPA guidelines, a meteorological station and dust monitoring gauges should be established around the perimeter of the site. Data should be analysed monthly for compliance and corrective action should be taken to reduce any exceedances of the NSW EPA guidelines if they occur.

Due to restrictions in the model, a number of important factors that are likely to influence both dust deposition and concentrations off-site have been excluded from the model. These include:

- it is proposed that quarry operations will only occur for about three months of the year, however model restrictions meant that dust emissions (excluding erosion) from quarry operations are occurring for 10 hours a day, 5 days a week and every week of the year.
- the construction of a bunded area along the western and southern boundaries which also serves as a buffer zone, will impact on off-site dust. This area is

currently heavily vegetated and it is proposed that the bund will also be well vegetated.

Due to the exclusion of these factors from the model, the predicted dust levels are likely to over-estimate the actual levels.

In conclusion it has been found that dust generation from the proposed activities at the Metford site can be satisfactorily controlled so that dust deposition and concentrations will be acceptable at nearby residences.

8. REFERENCES

NERDDC (1988)

Air Pollution from Surface Coal Mining: Volume 1 and 2, National Energy Research and Development Council.

US EPA (1985)

Compliance of air pollutants emission factors, United States Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina.

US EPA (1988)

Compilation of Air Pollutant Emission Factors, United States Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina.

SPCC (1983)

Air Pollution from Coal Mining and Related Developments.

SPCC (1986)

Particle size distributions from open cut coal mines in the Hunter Valley.

NSW EPA (1993)

EPA, State of the Environment, NSW Air Quality Standards, Part 1: Current State of the Environment, Chapter 3: Air Quality

US EPA (1995)

Office of Air Quality Planning and Standards: Emissions, Monitoring and Analysis Division, Volumes 1 and 2: Users guide for the Industrial Source Complex (ISCST3) Dispersion Models

Nunnally S. W.

Construction Methods and Management, Third Edition, Regents/Prentice Hall, 1993

APPENDIX A
STAGE 1 SAMPLE INPUT FILE

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APPENDIX B
DUST DEPOSITION AND CONCENTRATION ISOPLETHS

PREDICTED INCREASE IN DUST DEPOSITION - STAGE 1
(G/M^2/MONTH) ANNUAL AVERAGE

DUST ASSESSMENT - METFORD, MAITLAND

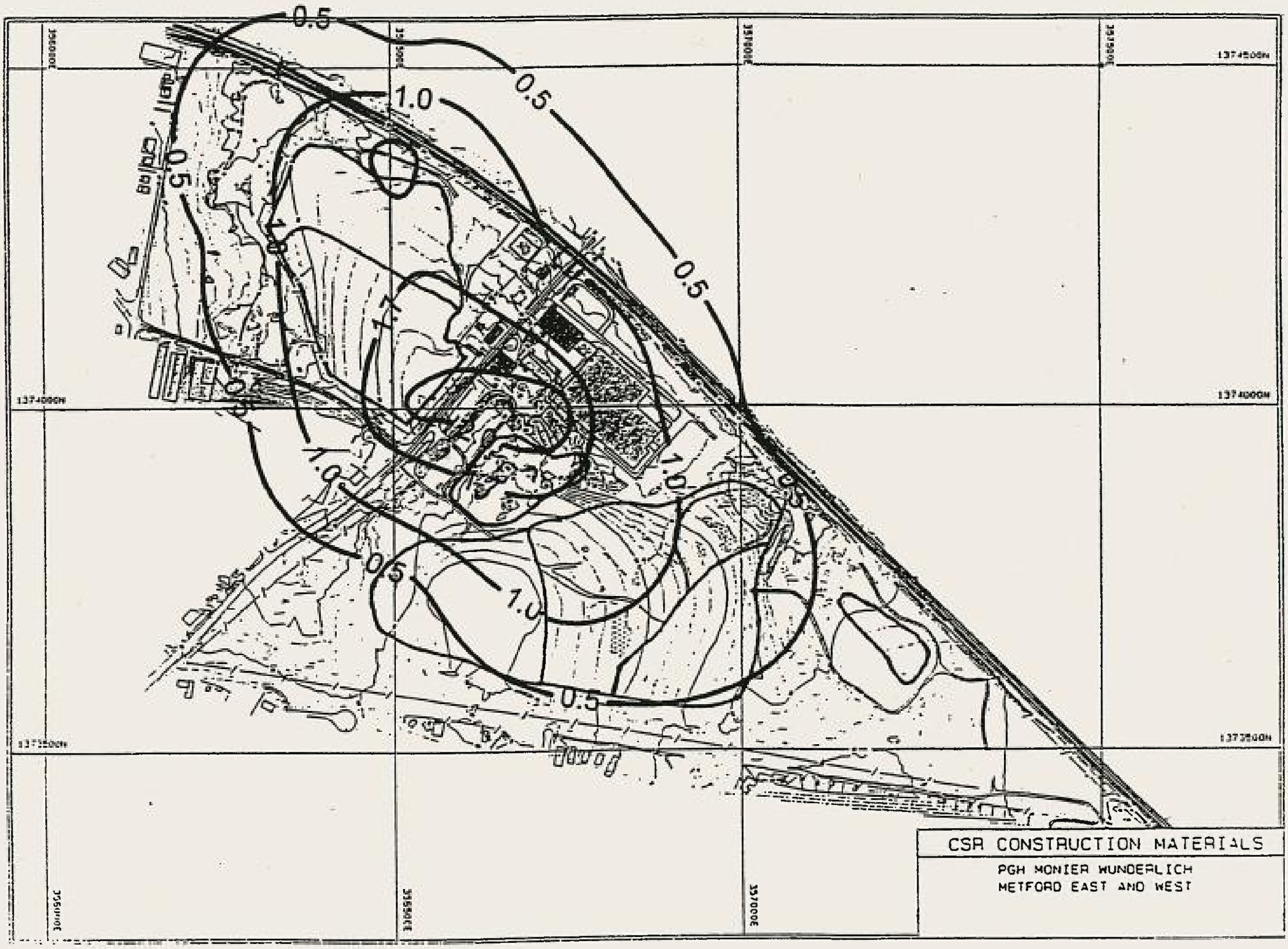

Figure 1

CMPS&F

PREDICTED INCREASE IN DUST DEPOSITION - STAGE 3

(G/M²/MONTH) ANNUAL AVERAGE

DUST ASSESSMENT - METFORD, MAITLAND

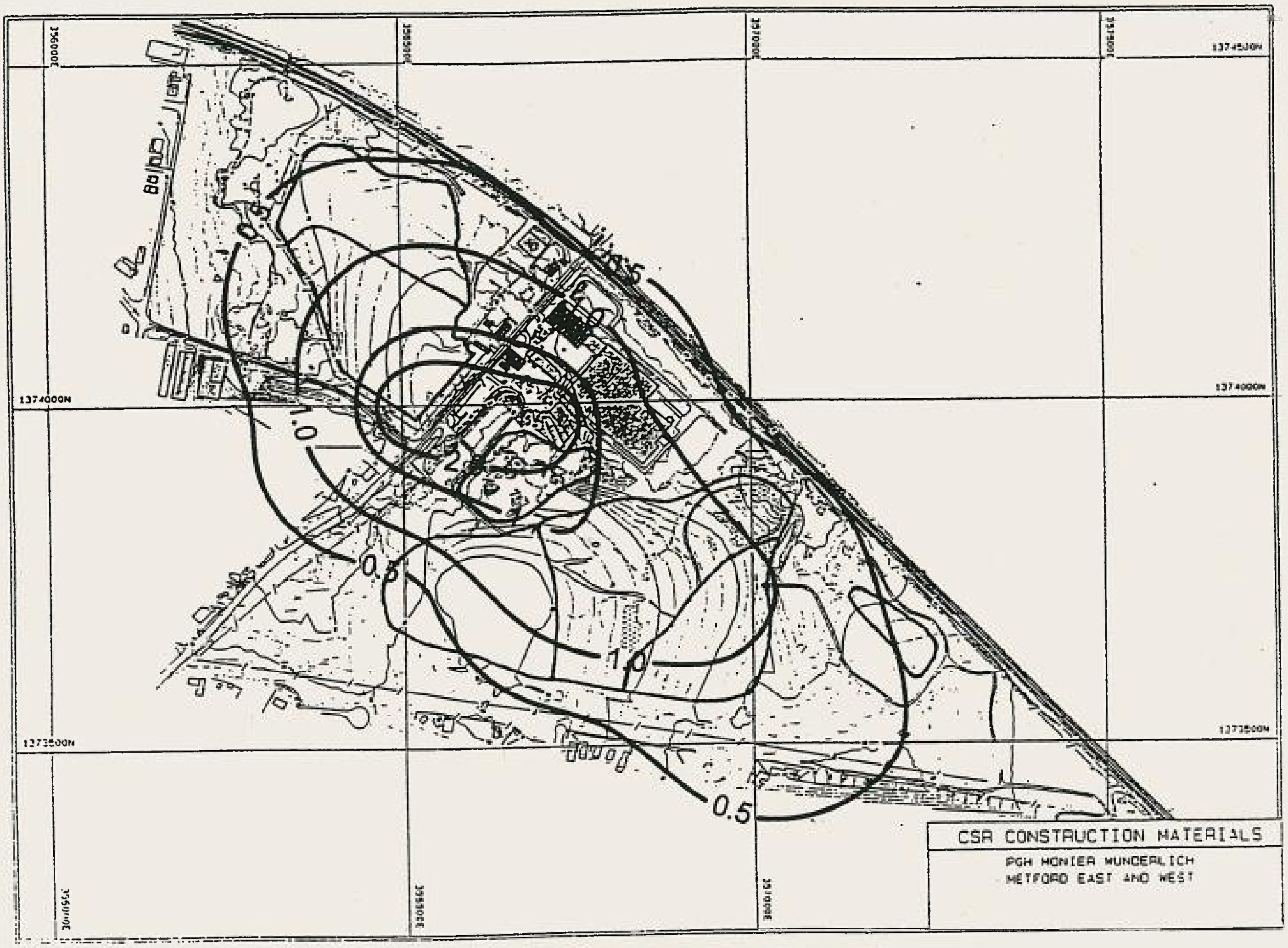

Figure 2

CMPS&F

PREDICTED INCREASE IN DUST DEPOSITION - STAGE 4
(G/M²/MONTH) ANNUAL AVERAGE

DUST ASSESSMENT - METFORD, MAITLAND

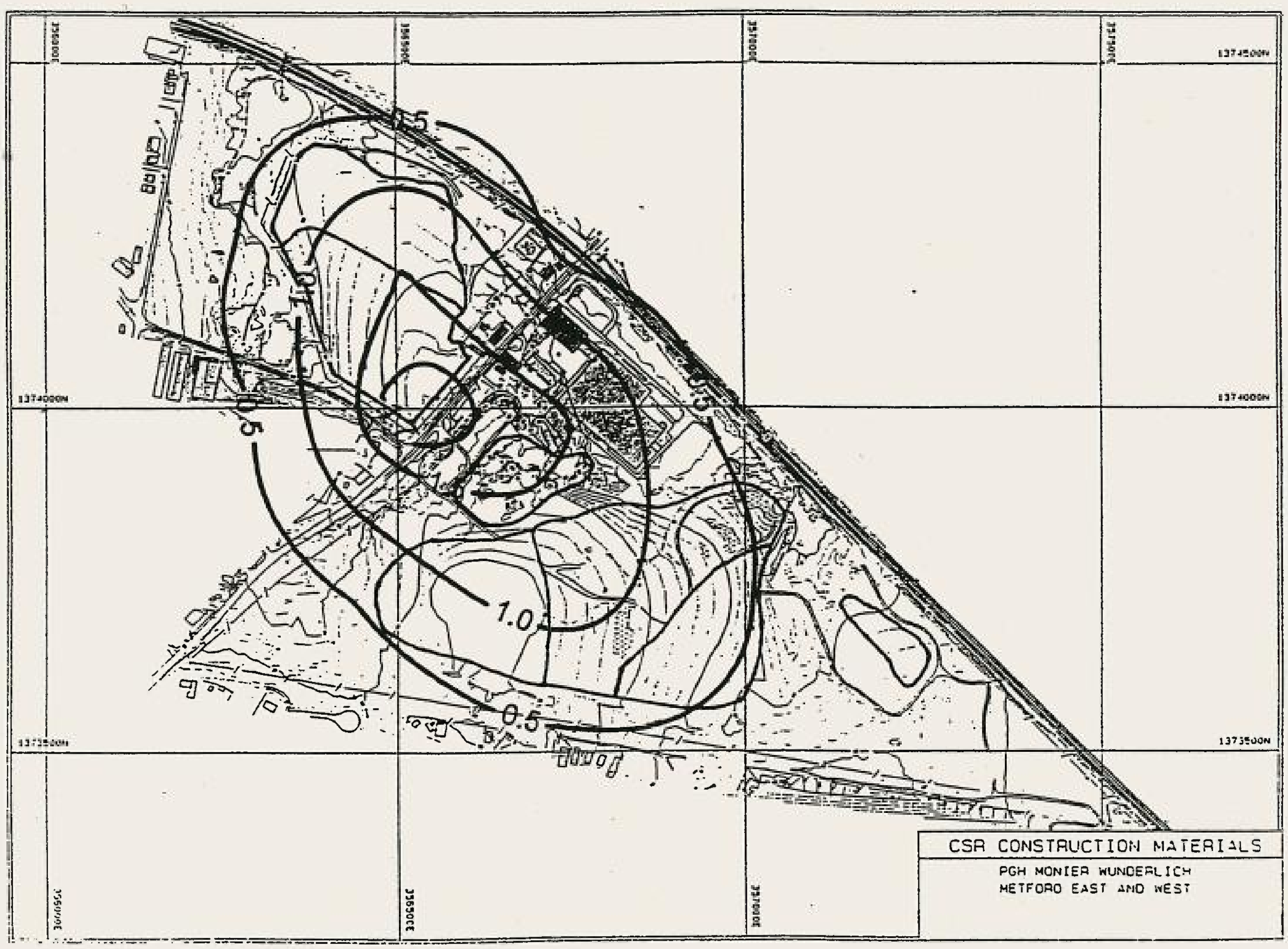

Figure 3

CMPS&F

PREDICTED INCREASE IN DUST DEPOSITION - STAGE 5
(G/M²/MONTH) ANNUAL AVERAGE

DUST ASSESSMENT - METFORD, MAITLAND

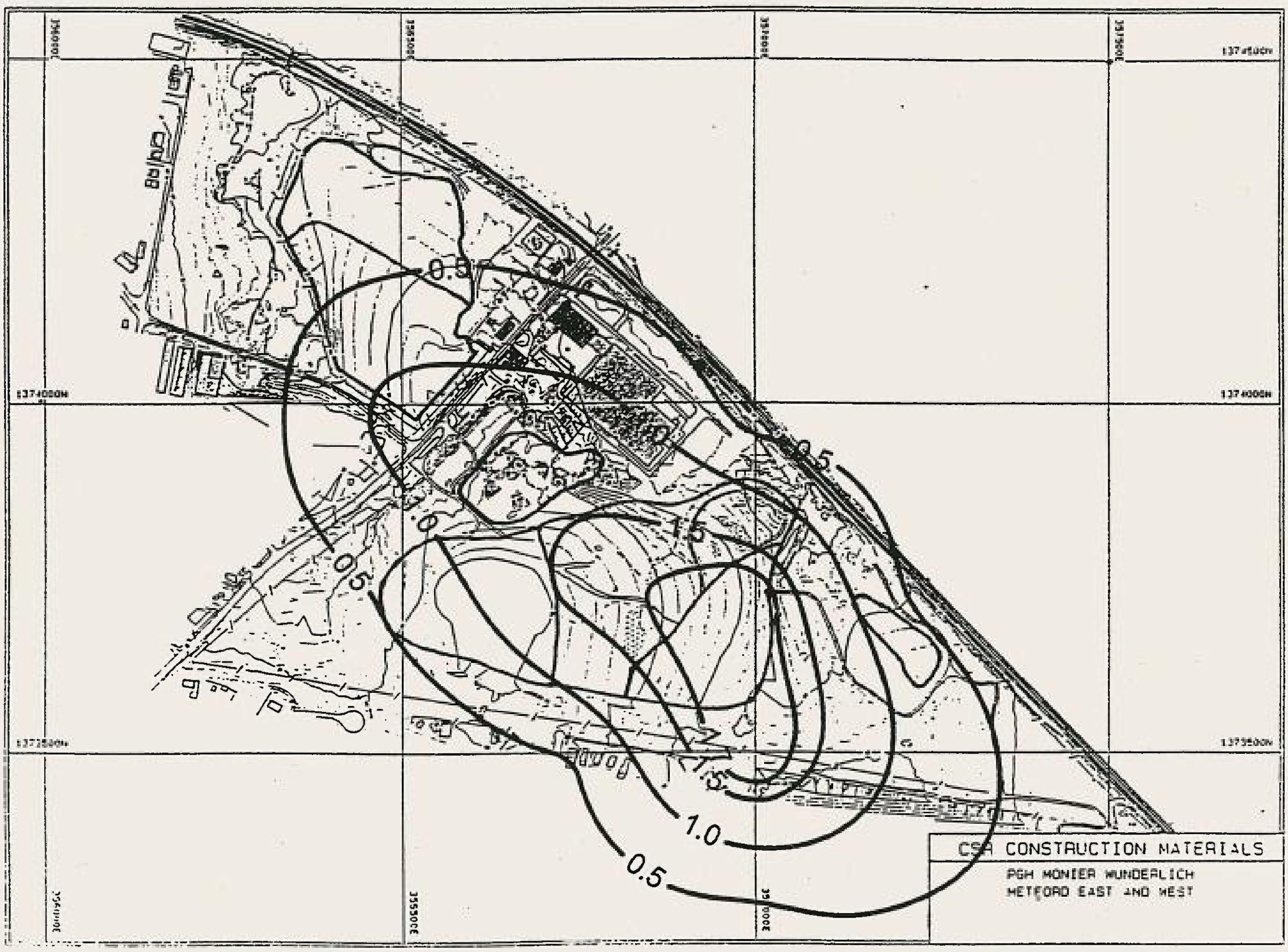

Figure 4

CMPS&F

PREDICTED INCREASE IN DUST CONCENTRATION - STAGE 1
($\mu g/m^3$) ANNUAL AVERAGE

DUST ASSESSMENT - METFORD, MAITLAND

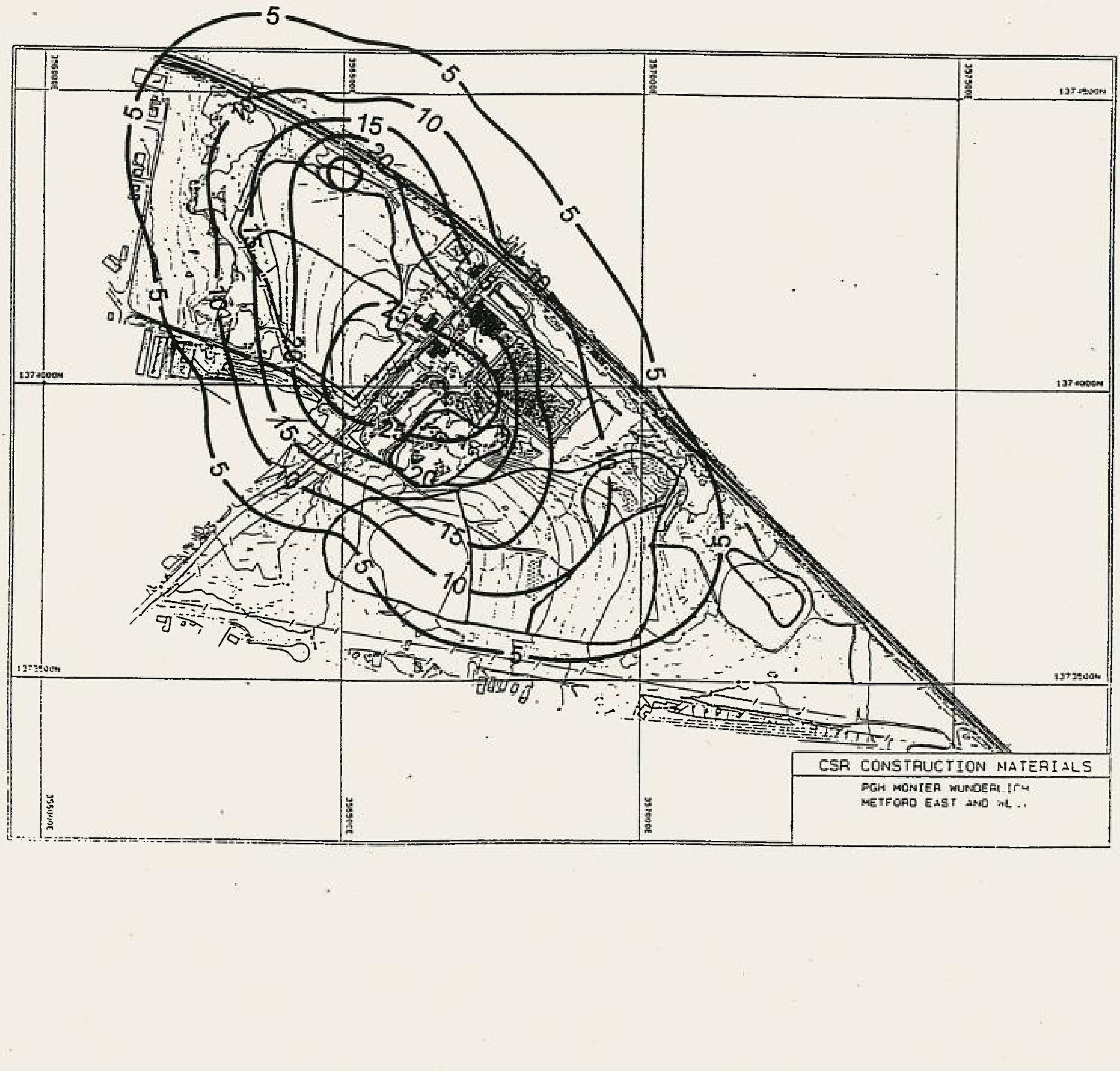

Figure 5

CMPS&F

PREDICTED INCREASE IN DUST CONCENTRATION - STAGE 3
($\mu g/m^3$) ANNUAL AVERAGE

DUST ASSESSMENT - METFORD, MAITLAND

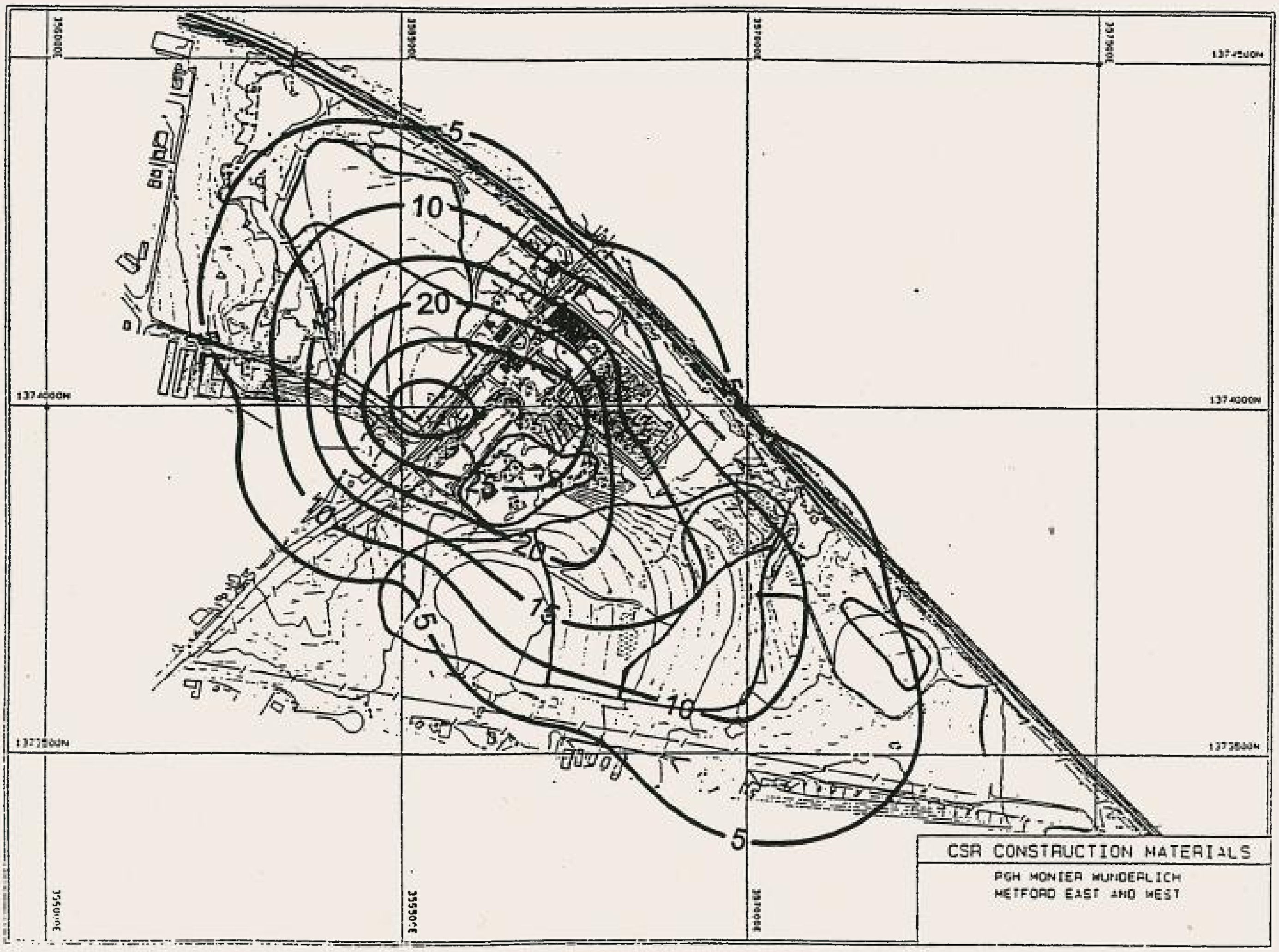

Figure 6

CMPS&F

PREDICTED INCREASE IN DUST CONCENTRATION - STAGE 4
($\mu g/m^3$) ANNUAL AVERAGE

DUST ASSESSMENT - METFORD, MAITLAND

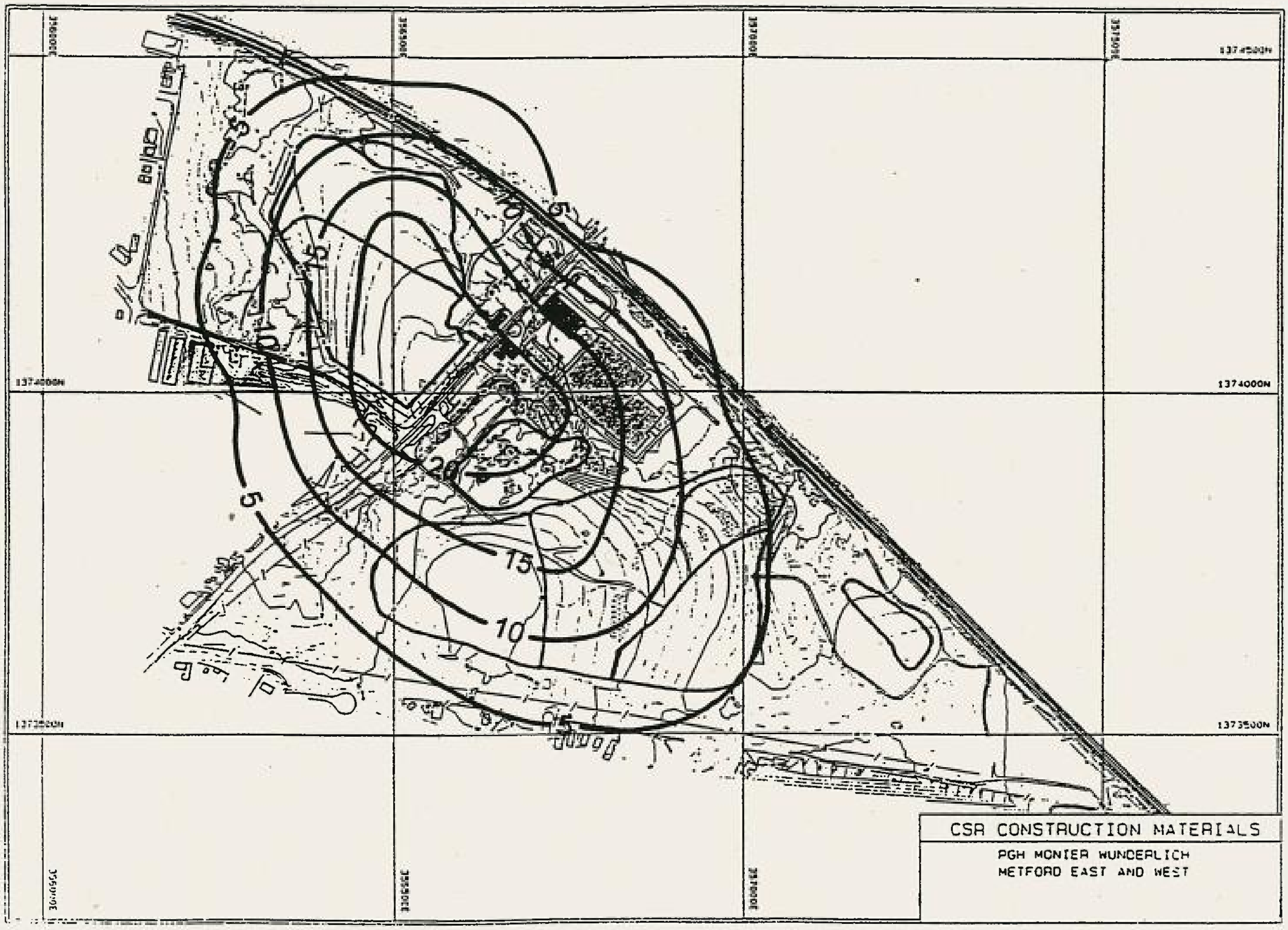

Figure 7

PREDICTED INCREASE IN DUST CONCENTRATION - STAGE 5

($\mu g/m^3$) ANNUAL AVERAGE

DUST ASSESSMENT - METFORD, MAITLAND

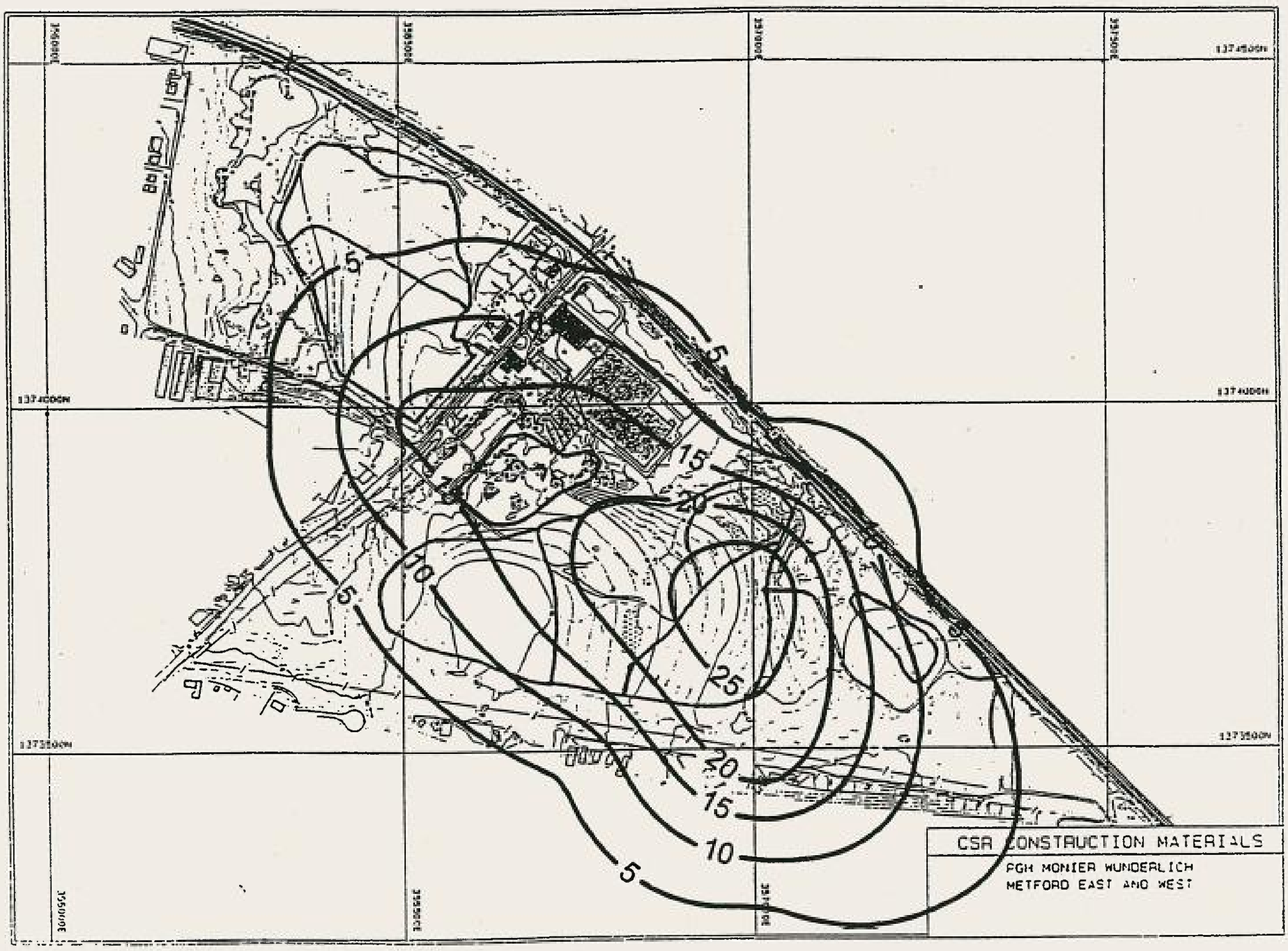

Figure 8

CMPS&F

APPENDIX F
NOISE IMPACT ASSESSMENT

Quality System

Quality Endorsed Company

ISO 9001 Lic 3236 Standards Australia

REPORT 6319-R1
(Revision 1)

NOISE IMPACT ASSESSMENT
PROPOSED CONTINUATION OF QUARRYING AND LANDFILLING
PGH'S CLAY BRICK PLANT, MAITLAND

Prepared for

CMPS&F Pty Limited
67 Albert Avenue
CHATSWOOD NSW 2067

30 June 1997

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REPORT 6319-R1

(Revision 1)

NOISE IMPACT ASSESSMENT
PROPOSED CONTINUATION OF QUARRYING AND LANDFILLING
PGH'S CLAY BRICK PLANT, MAITLAND

Quality System

Richard Heggie Associates Pty Ltd operates under a Quality System which has been certified by Quality Assurance Services Pty Limited to comply with all the requirements of AS/NZS ISO 9001:1994 "Quality Systems - Model for Quality Assurance in Design, Development, Production, Installation and Servicing" (Licence No 3236).

This document has been prepared in accordance with the requirements of that System.

Association of Australian Acoustical Consultants - AAAC

Richard Heggie Associates is a Member Firm of the Association of Australian Acoustical Consultants.

Reference	Status	Date	Prepared	Checked	Authorised
R85\6319R1	Revision 0	18.6.97	CS	DG	DG
N126\6319R1R1	Revision 1	30.6.97	C Schulte	DG	

NOISE IMPACT ASSESSMENT
PROPOSED CONTINUATION OF QUARRYING AND LANDFILLING
PGH'S CLAY BRICK PLANT, MAITLAND

EXECUTIVE SUMMARY

Introduction

This report presents the results and findings of a detailed noise impact assessment for the proposed continuation of quarrying and landfilling for the PGH clay brick plant, located in Maitland, NSW.

PGH proposes to progressively extend quarrying operations over most of the site and to rehabilitate resulting quarry voids with solid waste Class 2 (building and demolition waste and commercial and industrial waste). The proposal to extend the workings will not greatly change the intensity or method of current operations. Quarrying will continue at a rate of up to 60,000 tonnes per year, of which at least 48,000 tonnes will be useable clay/shale, with the remainder not suited for manufacturing. This will be returned to the quarry either as landfill cover or base material for the landscaped mounds.

The major sources of noise emissions may be grouped into two distinct areas for the purpose of impact assessment and are as follows:

a. Noise emission from quarrying and landfilling operations ie mobile equipment and product trucks.

b. Noise emission from traffic on public roads ie product trucks.

Existing Acoustical Environment and Recommended Planning Levels

Two Key Monitoring Locations (N1 and R3) were selected to be representative of existing premises potentially most affected by the proposed quarrying and landfilling operations. These premises are shown on the Site Layout attached as **Appendix A**. Unattended continuous noise logging was conducted at each location for a period of one week commencing Friday 14 February 1997.

The "minimum repeated" ambient $L_{A90(15minute)}$ noise levels at each of the monitoring locations for the periods 7.00 am to 5.00 pm Monday to Friday (quarrying) and 6.00 am to 6.00 pm Monday to Friday and 6.00 am to 4.00 pm Saturday (landfilling) are presented in the table below. On the basis of the minimum repeated $L_{A90(15minute)}$ ambient noise levels and the EPA's Environmental Noise Control Manual, the acceptable $L_{A10(15minute)}$ contributed noise level design goals for the proposed hours of operation are summarised and also presented in the table below.

Location Number	Residence	Minimum Repeated $L_{A90(15minute)}$ Ambient Noise Level		$L_{A10(15minute)}$ Noise Level Design Goal	
		Quarrying	Landfilling	Quarrying	Landfilling
N1	15 Turton Street	43 dBA	41 dBA	48 dBA	46 dBA
R3	28 Foveaux Street	40 dBA	39 dBA	45 dBA	44 dBA

EXECUTIVE SUMMARY

Analysis of Potential Impacts

In order to determine the acoustical impact of the proposed quarrying operations, a computer model was developed incorporating the significant noise sources, the surrounding terrain and nearby potentially affected residential properties.

For the purpose of predicting the noise emission levels during the quarry's life, the following operating scenarios were assessed:

- Stage 1 Extracting and landfilling of Northern Site (Areas B and A respectively).
- Stage 2 Extracting and landfilling of Southern Site (Areas D and C respectively).

The contributed $L_{A10(15minute)}$ noise emissions for the proposed operating scenarios to the nearest potentially affected residential receivers have been calculated for "neutral" atmospheric conditions in accordance with the EPA's requirements (ie 20°C air temperature, 70% relative humidity, 0°C/100 m temperature gradient and zero wind speed).

The predicted overall contributed $L_{A10(15minute)}$ noise emission levels for the two operating scenarios to the two nearest potentially affected residential receivers are presented in the table below together with the respective acceptable $L_{A10(15minute)}$ noise level design goals.

Location Number	Residence	Stage 1		Stage 2		L_{A10} Noise Level Design Goal	
		Quarrying and Landfilling	Landfilling	Quarrying and Landfilling	Landfilling	Quarrying and Landfilling	Landfilling
N1	15 Turton Street	51 dBA	49 dBA	32 dBA	32 dBA	48 dBA	46 dBA
R3	28 Foveaux Street	41 dBA	37 dBA	46 dBA	45 dBA	45 dBA	44 dBA

Enhancement of noise levels may occur under adverse atmospheric conditions. Using our computer model, the predicted increase in noise level at residence N1 is 3 dBA and at residence R3 is 4 dBA under adverse atmospheric conditions discussed in **Section 10**.

Noise Mitigation and Management

In order to comply with EPA criteria at the representative receiver locations, N1 and R3, two barriers will be required:

- "Western" barrier, to the west of the northern operations, will be a bund wall with a batter of 1:3 and height ranging from 6 m to 7 m above ground, following the natural topography of the land.

EXECUTIVE SUMMARY

- "Southern" barrier, to the south of the southern operations, will be a bund wall with a batter of 1:3 and height ranging from 2 m to 5 m above ground, running parallel to the southern property boundary.

The predicted overall contributed $L_{A10(15minute)}$ noise emission levels for the two operating scenarios, with noise controls, to the two nearest potentially affected residential receivers are presented in the table below together with the respective acceptable $L_{A10(15minute)}$ noise level design goals.

Location Number	Residence	Stage 1		Stage 2		L_{A10} Noise Level Design Goal	
		Quarrying and Landfilling	Landfilling	Quarrying and Landfilling	Landfilling	Quarrying and Landfilling	Landfilling
N1	15 Turton Street	48 dBA	46 dBA	32 dBA	32 dBA	48 dBA	46 dBA
R3	28 Foveaux Street	41 dBA	37 dBA	45 dBA	44 dBA	45 dBA	44 dBA

On the basis of this assessment, it is concluded that with the incorporation of the nominated noise controls the proposed quarrying and landfilling operations will have a subjectively negligible impact on the existing acoustical amenity of nearby residential receivers.

NOISE IMPACT ASSESSMENT
PROPOSED CONTINUATION OF QUARRYING AND LANDFILLING
PGH'S CLAY BRICK PLANT, MAITLAND

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REPORT 6319-R1
(Revision 1)

NOISE IMPACT ASSESSMENT
PROPOSED CONTINUATION OF QUARRYING AND LANDFILLING
PGH'S CLAY BRICK PLANT, MAITLAND

CMPS&F PTY LIMITED

1 INTRODUCTION

PGH currently operates a clay brick manufacturing plant at Metford Road, Maitland. Raw material is obtained by quarrying clay/shale from the site which is the subject of this current application as well as from other sites within the local area.

The PGH property at Metford has an area of approximately 50 hectares and is bounded by the Great Northern Railway line along its eastern edge. The total site is separated into two parts by the Metford Road, which connects Chelmsford Road to the south-west to Raymond Terrace Road to the north-east. The two parts of the site are referred to in this report as the "northern" and "southern" sites. All manufacturing and current quarry related development occurs on the southern site, while the northern site contains the void of the former "Fieldsend Pit".

PGH proposes to progressively extend quarrying operations over most of the site and to rehabilitate resulting quarry voids with solid waste Class 2 (non putrescible waste). The proposal to extend the workings will not greatly change the intensity or method of current operations. Quarrying will continue at a rate of up to 60,000 tonnes per year, of which at least 48,000 tonnes will be useable clay/shale, with the remainder not suited for manufacturing. This will be returned to the quarry either as landfill cover or base material for the landscaped mounds.

In relation to the potential noise levels associated with PGH's Metford site, Richard Heggie Associates (RHA) are commissioned to assess the likely impacts on the surrounding residential receivers from the proposed extension.

2 SITE DETAILS/EXISTING OPERATIONS

2.1 Site Layout

As shown on the Site Layout attached as **Appendix A** the site consists of five potential areas of extraction, three of which are on the southern side of Metford Road (Areas C, D and E) and the other two on the northern side of Metford Road (Areas A and B). The brickworks plant and operations area is located on the southern part of the site, but are not part of the current development application.

Operations involve the extraction and stockpiling of clay/shale and sandstone which is to be manufactured into bricks. It is expected that approximately 60,000 tonnes of clay/shale per annum will be extracted.

It is proposed to retain the current extraction methods in existing pits, that is excavation by dozer and scraper, loading by excavator and frontend loader into rigid highway haul trucks for the Fieldsend Pit (Areas A and B) and off-road haul trucks for Areas C and D.

2.2 The Existing Brick Plant

The plant consists of several buildings including a tunnel kiln, brick storage area, milling shed, dry store, house, production office, sales office, chimneys and storage sheds. This report only addresses the extraction, landfilling, and site rehabilitation proposed at the site. No alterations or modifications will be made to the existing brickworks plant.

2.3 Internal Traffic

Trucks transporting clay/shale to the stockpile area will either enter the southern part of the site from Metford Road or access the area internally from that part of the site. Departing trucks will leave the same way. Scrapers will transport clay/shale material from the quarry floor of areas C and D to the stockpile area via the internal road.

Trucks delivering waste during the landfilling of Areas A and B will enter the site via the new access created immediately to the north of the Fieldsend Street/Metford Road junction. Empty trucks will return to the weighbridge before exiting the site. The access road will be sealed from the site entrance to the wheel wash area. A similar arrangement will take place on the southern part of the site once landfilling is complete within the northern part of the site after 18 years.

Simultaneous quarry and landfill operations will commence after initial establishment works are completed.

3 QUARRYING AND LANDFILL OPERATION

3.1 Introduction

Following the implementation of this proposed development, there will be four main operations that will take place within the site:

- Extraction of the clay/shale resource. This will be stockpiled for use in brickmaking on site. Overburden and quarry waste produced as a result of the clay/shale extraction would also be stockpiled for later use as cover material.
- Filling the airspace created with solid waste imported to the site in combination with overburden and waste from the extraction process.
- Rehabilitating the site after each stage of landfilling is complete and the land has been recontoured to its final profile.
- Production of bricks using the clay/shale extracted from the site and imported from other locations and the storage and subsequent export of the finished product.

3.2 Staging

It is estimated that there are approximately 1.61 million tonnes of material able to be extracted at Metford. **Table 3.2.1** gives the volume of material resource which is available for extraction from each of the five areas.

Table 3.2.1 Clay/Shale Resources

Areas	Tonnes
A (existing Fieldsend Pit)	0
B (areas adjoining existing Fieldsend Pit)	545,000
C	216,000
D and E	844,000

Source: Monier PGH Holdings Ltd

Clay/shale extraction will generally be completed in each area and activity moved to the next area before landfilling commences, allowing a continuous staged operation at the site. Each area will be rehabilitated following the completion of landfilling.

Completion of extraction from Area B will produce a void space of approximately 1 million cubic metres (the current unused volume of Area A is approximately 0.5 million cubic metres). Extraction is expected to continue for another 27 years producing a total space for landfilling of about 2.5 million cubic metres.

An earth mound will be constructed on the north-western boundary of the site and the existing earth mound on the southern boundary will be upgraded.

The estimated time frame for the completion of significant portions of the development are:

- Area E rehabilitated - by Year 4
- Earth mounds constructed and/or upgraded and vegetated - by Year 4
- Extraction completed in northern area - Year 14
- Northern area rehabilitated - Year 22
- Extraction completed in total site - Year 27
- Eastern part of southern site rehabilitated - Year 32
- Entire site rehabilitated - Year 51

3.3 Quarry Operations

The total resource is estimated at approximately 1.61 million tonnes, which at an extraction rate of approximately 60,000 tonnes per year equates to 27 years of supply of material. The current depths of the various areas of the site are:

Area A (Fieldsend Pit) - 9 m AHD
Area B (extension of Fieldsend Pit) - 2 m AHD
Area C 6 m AHD
Area D 10 m AHD and
Area E 8 m AHD

Rubber tyred scrapers will excavate overburden and the underlying shale. A bulldozer will rip the shale and push the scrapers when required. Blasting will not be required to loosen the material. Equipment will enter and leave each extractive area from a road which will be progressively developed along the rim of the quarry. Quarrying will be undertaken on a bench approximately 50 m wide. The maximum slope of the quarry wall will be about three vertical to one horizontal.

Overburden not required for earth mound construction will be used within the landfill as cover and to achieve the final landform profile.

Clay/shale will be transported by scrapers or trucks to the stockpile area within the southern part of the site. Frontend loaders will maintain stockpiles, transport material to the clay crushing and milling building.

3.4 Mobile Equipment

3.4.1 Quarrying

The mobile equipment proposed for use in the extraction process is listed in **Table 3.4.1.1**.

Extraction will only occur in one pit at a time as operations are limited by the amount of equipment available to PGH. Two scenarios are possible for extraction operations, namely:

- The use of a bulldozer, front-end loader and off-road dump trucks together; or
- Using the scraper and bulldozer only.

These scenarios will not occur simultaneously.

Table 3.4.1.1 Mobile Equipment - Quarrying

Stage	Item of Equipment	Quantity	Overall Sound Power Level - Per Item
1	Caterpillar D9L Bulldozer	1	113 dBA
1	Kawasaki KSS70 Front end Loader	1	113 dBA
1	30 Tonne Off-road Dump Truck	1	111 dBA
1	25 Tonne Highway Tipper Truck	1	111 dBA
1 & 2	12 Tonne Water Truck	1	105 dBA
2	Caterpillar D7 Bulldozer	1	110 dBA
2	Caterpillar 633 Elevating Scraper	1	111 dBA

3.4.2 Landfill and Establishment

Plant and equipment used on the site will be determined by the contractors. It is anticipated those items shown in **Table 3.4.2.1** or their equivalent will be used.

Table 3.4.2.1 Mobile Equipment - Landfilling

Stage	Item of Equipment	Quantity	Overall Sound Power Level - Per Item
1 & 2	Caterpillar 826 Compacter	1	110
1 & 2	Caterpillar 973 Tracked Loader	1	110
1 & 2	10 Tonne Highway Tipper Truck	2	108
1 & 2	12 Tonne Water Truck	1	105

During earth mound construction, two tipping trucks will be used to cart overburden with a bulldozer to form and compact the material.

4 HOURS OF OPERATION

4.1 Quarrying

Hours of extraction operation are proposed to be 7.00 am to 5.00 pm Monday to Friday. Extraction will operate on a campaign basis for approximate total of 12 weeks per year and will generally be undertaken in four week intervals. No work will be conducted on weekends or public holidays.

4.2 Landfill Operation and Establishment

Landfill and establishment operations will continue throughout the year between the hours of 6.00 am and 6.00 pm Monday to Friday, and 6.00 am to 4.00 pm on Saturdays. The depot will not operate on Sundays or public holidays.

5 TRAFFIC MOVEMENT

Traffic volumes on the local road network are shown **Table 5.1**.

Table 5.1 Existing Two Way Daily Traffic Volumes on Selected Links in the Road Network

Location of Count	Local Daily Flow	Date of Count
1 Raymond Terrace Road (West) (West of Hunter Street)	5410	1996
2 Raymond Terrace Road (East) (West of Taylor Avenue) MR 104	7429	1994
3 Raymond Terrace Road (East) (East of Forest Drive) MR 104	3868	1994
4 Metford Road (North of Chelmsford Drive)	6875	1995
5 Chelmsford Drive (North of New England Highway)	8910	1996
6 New England Highway (West of Chelmsford Drive) SH9	22640	1993
7 Chisholm Road (South of New England Highway)	5243	1994
8 Chisholm Road South (North of South Seas Drive)	991	1994

Source: RTA and Council Statistics

At present, clay/shale material is delivered to the site from other PGH sites in 26 tonne trucks. This volume of material delivered to the site and the number of truck movements which it generates is not expected to change as a result of the proposal. The only potential impact on the external road system as a result of the continued extraction programme is the crossing of Metford Road by trucks carrying extracted clay/shale during Stage 1 of the operations.

Traffic Crossing Metford Road

Movement across Metford Road would be undertaken during the transport of material from stockpiles for mound construction around the perimeter of the northern section of the site and the movement of excavated material from that part of the site to the stockpiles to the south of Metford Road. This would involve the movement of approximately 50,000 tonnes of material in a 3 month period per year and would be undertaken over a period of about 14 years. Assuming a 9 hour day, 60 days operation and 22 tonne truck loads, this equates to 4 truck loads per hour per day, ie 8 truck movements crossing Metford Road to/from the Fieldsend Pit to the storage area during the period of excavation.

Import of Solid Waste to the Site for Landfilling

Waste would be transported to the site in a range of vehicles with differing capacities. The proportion of each in the total vehicle mix will determine the average load carried which in turn will determine the total number of trips based on an annual landfilling rate of 45,000 tonnes. The proportions of waste vehicles of various types has been estimated from experience gained in similar landfills amended to reflect the anticipated market at Metford, Maitland.

It is estimated that 19 truck loads per day of solid waste will arrive to the site. This equates to 38 truck movements per day.

External Truck Traffic Generation

The total number of trips expected to be generated due to activity at the site is summarised in **Table 5.2**

Table 5.2 Truck Traffic Generated Per Day

Activity	Number of Movements
Receipt of Waste	38
TOTAL	**38**

6 EXISTING ACOUSTICAL ENVIRONMENT

In order to quantify the existing acoustical environment in the area surrounding the existing and proposed operations, ambient noise surveys were conducted over the period Friday 14 February to Friday 21 February 1997.

Two of the existing premises representative of those potentially most affected by the proposed quarrying and landfilling operations were selected as ambient noise monitoring locations. These premises are indicated on the Site Plan attached as **Appendix A** and presented in **Table 6.1** as residences N1, representing those residences to the west of the site and R3, representing those to the south.

Table 6.1 Ambient Noise Monitoring Locations

Location	Residence	Monitoring Duration
N1	15 Turton Street	14.2.97 to 21.2.97
R3	28 Foveaux Street	14.2.97 to 21.2.97

The ambient noise monitoring procedures were conducted in accordance with Australian Standard 1055-1989 "Acoustics - Description and Measurement of Environmental Noise" and the Environment Protection Authority's (EPA's) Environmental Noise Control Manual.

An ARL Environmental Noise Logger (Model EL-215) was deployed at each of the nominated receiver locations to obtain continuous statistical noise exceedance levels over 15 minute intervals. The noise loggers were calibrated before and after the measurement surveys and the variation in calibrated levels did not exceed ±0.5 dBA.

The results from Monitoring Locations N1 and R3 are presented in **Appendix B** and **Appendix C** respectively.

6.1 Statistical Analysis

Environmental noise levels vary with time and consequently it is necessary to describe the noise in terms of statistical descriptors. The statistical noise exceedance levels (L_{AN}) are the levels exceeded for N% of the interval period. The L_{A90} represents the level exceeded for 90% of the interval period and is referred to as the "average minimum" noise level. Similarly, the L_{A10} and L_{A1} are the levels exceeded for 10% and 1% of the time and are usually referred to as the "average maximum" and "maximum" noise level respectively. The L_{Aeq} is the equivalent continuous sound pressure level and represents the steady sound level which is equal in energy to the fluctuating level of the interval period.

6.2 Ambient Noise Survey Results

A summary of the "minimum repeated" ambient L_{A90} noise levels at each of the monitoring locations for the periods 7.00 am to 5.00 pm Monday to Friday (quarrying) and 6.00 am to 6.00 pm Monday to Friday and 6.00 am to 4.00 pm Saturday (landfill) is presented in **Table 6.2.1.**

Table 6.2.1 Summary of Existing Ambient L_{A90} Noise Levels

Location	Residence	Minimum Repeated Ambient Noise Level	
		Quarrying and Landfilling	Landfilling
N1	15 Turton Street	43 dBA	41 dBA
R3	28 Foveaux Street	40 dBA	39 dBA

7 IMPACT ASSESSMENT PROCEDURES

7.1 Airborne Noise Emission General Objectives

Responsibility for the control of noise emissions in New South Wales is vested in Local Government and the Environment Protection Authority (EPA) which administers the Noise Control Act, 1975. In implementing its environmental noise control policy, the EPA has two broad objectives:

a. That the noise from any single source does not intrude greatly above the prevailing background noise level.

b. That background noise level does not exceed the level appropriate for the particular locality and land use.

7.2 Quarry Operation Noise Emission Design Goal

To assist in balancing possibly adverse effects on individuals and potential benefits to the broader community arising from infrastructure development and resource use (especially in the light of its social worth or as a result of government decisions), the Environment Protection Authority (EPA) has drafted a schedule of recommended L_{A90} background noise levels for various land-use categories. An extract from the schedule relating to the three most stringent classifications appears in **Table 7.2.1**.

Table 7.2.1 EPA Recommended Outdoor Background Noise Levels

Zoning Description	Time Period	Recommended Limit - LA90	
		Acceptable	**Maximum**
Residences in Rural Areas (approximately R1 in AS 1055)	Day Night	45 dBA 35 dBA	50 dBA 40 dBA
Residences in Residential Areas (approximately R1 - R2 in AS 1055)	Day Night	45 dBA 35 dBA	50 dBA 40 dBA
Residential area on a busy road or near an industrial area (approximately R2 - R3 in AS 1055)	Day Night	50 dBA 40 dBA	55 dBA 45 dBA

Notes: 1 For Monday to Saturday, "day" is defined at 7.00 am to 10.00 pm
2 On Sundays and Public Holidays, "day" is defined as 8.00 am to 10.00 pm

In order to satisfy Item a. of **Section 7.1**, the EPA recommends that the LA10 noise level contribution from the source or sources under consideration should not exceed the LA90 background level by more than 5 dBA.

In localities where there is likely to be ongoing industrial or commercial development, consideration needs to be given to the cumulative effects of noise from successive development in order to avoid what is known as a "creeping background noise" effect.

For such situations, the EPA recommends certain LA90 planning noise levels for residential receivers. These recommended planning levels are given in **Table 7.2.2**.

Table 7.2.2 EPA's Recommended LA90 Planning Levels

Existing background noise level at the most sensitive point in an affected residential area	Recommended maximum LA90 noise level, for planning approval purposes, at that point as a result of a proposed new noise source
Background is above relevant acceptable level (from **Table 7.2.1**)	Preferably, set maximum planning level 10 dBA or more below acceptable level at least, set maximum planning level 10 dBA below existing background level
Background is at acceptable level	Set maximum planning level 10 dBA below acceptable level
Background is below acceptable level by 1 dBA 2 dBA 3 dBA 4 dBA 5 dBA 6 dBA or more	Set maximum planning level at 9 dBA below acceptable level 5 dBA below acceptable level 3 dBA below acceptable level 2 dBA below acceptable level 2 dBA below acceptable level 5 dBA above background level

The results of the L_{A90} ambient noise measurements at the nominated locations adjacent to the project site are presented in **Table 6.2.1**. On the basis of the minimum repeated L_{A90} ambient noise levels and in accordance with the EPA's Environmental Noise Control Manual (Chapter 20), the acceptable L_{A10} contributed noise level design goals for the proposed hours of operation are presented in **Table 7.2.3**. For the size and nature of the subject operations the L_{A10} is considered to be the controlling design goal.

Table 7.2.3 EPA Acceptable L_{A10} Contributed Noise Level Design Goals

Residential Location	Minimum Repeated L_{A90} Level		L_{A10} Noise Level Design Goal	
	Quarrying and Landfilling	Landfilling	Quarrying and Landfilling	Landfilling
N1	43 dBA	41 dBA	48 dBA	46 dBA
R3	40 dBA	39 dBA	45 dBA	44 dBA

7.3 Road Traffic Noise Design Goals

Whilst operating on privately owned property in the vicinity of quarrying operations, the noise assessment procedure for product trucks is as outlined in **Section 7.2**, that is, the predicted L_{A10} noise contributions are added to the predicted L_{A10} noise level of the items of mobile equipment and processing plant and compared to the design goal.

Away from the quarrying operations, when vehicles travel on public roads (or when the trucks are on a private access road where the noise emission characteristics would be perceived in a similar fashion to normal traffic), different criteria apply for vehicle noise impact assessment.

The EPA's criteria for truck operations on roads having traffic flows of less than about 1,000 vehicles per day are described under the section "Intermittent or Low Traffic Flow" in Chapter 157 of its Environmental Noise Control Manual. The noise level descriptor employed is $L_{Aeq,T}$ and the time interval generally used is 60 minutes.

The EPA's preferred hours for truck movements are presented in **Table 7.3.1**.

Table 7.3.1 EPA's Preferred Hours for Truck Movements

Frequency of Vehicle Movement	Preferred Hours of operation	
	Monday to Saturday	Sunday and Public Holidays
Normal frequency	0700 hr to 1800 hr	Minimal movement, subject to individual assessment
At substantially reduced frequency	0600 hr to 0700 hr 1800 hr to 2200 hr	0800 hr to 1800 hr
Minimal or isolated occurrence	2200 hr to 0600 hr	1800 hr to 0800 hr

For rural situations, the EPA recommends that residences should not be exposed to an $L_{Aeq,T}$ of more than 50 dBA for new developments and 55 dBA for existing operations during daytime hours. During night-time hours (10.00 pm to 7.00 am) the received $L_{Aeq,T}$ criterion for truck movements is generally taken as being 5 dBA less than the criterion applying to daytime operations.

On roads with existing traffic flows greater than about 1,000 vehicles per day, the EPA advocates the use of the Calculation of Road Traffic Noise (CORTN) method to evaluate the $L_{A10(18hour)}$ noise levels for existing traffic flows and proposed increased traffic volumes.

The criteria generally recommended are that the increases in the $L_{A10(18hour)}$, due to traffic generated by a proposed development, does not exceed 2 dBA. Also, that the overall maximum $L_{A10(18hour)}$ traffic noise level does not exceed 63 dBA. This latter environmental goal is almost numerically equivalent to the RTA's 60 dBA $L_{Aeq(24hour)}$ design goal for new roads.

8 MAJOR SOURCES OF NOISE EMISSION

The major sources of noise emissions may be grouped into two distinct areas for the purpose of impact assessment and are as follows:

a. Noise emission from quarrying and landfilling operations, ie mobile equipment and product trucks.

b. Noise emission from traffic on public roads ie product trucks.

9 ASSESSMENT OF IMPACTS

9.1 Evaluation of Noise Emission Levels - General Discussion

In order to determine the acoustical impact of the quarrying, landfilling and product transportation operations, a computer model was developed incorporating the significant noise sources, the surrounding terrain and nearby potentially affected receivers and, where required, noise mitigation.

The PGH Metford computer model was prepared using the SoundPLAN Noise Model Version 4.1, a commercial software system developed by Braunstein and Berndt GmbH in Germany. The acoustical algorithms utilised by this software result in this noise model being one of the most appropriate predictive methodologies currently available. For this project the CONCAWE method, developed in the Netherlands for the assessment of large industrial plants, has been selected.

The model calculated the maximum contributed noise emission levels (approximately equivalent to L_{A1}) in octave bands from each source to the receiver locations considered potentially most affected by the quarrying project.

Based on field measurements of noise emissions from large resource excavation/processing projects, the difference between the maximum overall level and the average maximum (L_{A10}) noise levels can be up to about 10 dBA, depending on the number of items of mobile equipment, their relative contributions and the variation in the intensity of the work. The difference between the maximum overall and L_{A10} noise levels for small quarries/landfilling operations is greater than the difference arising from large operations as the former is more sporadic and variable in nature.

For plant and equipment items of the number and operational nature as those at the subject site, a conservative reduction of 5 dBA has been applied to convert the maximum overall noise emission to an L_{A10} level.

CONCAWE defines six meteorological categories, based on a combination of Pasquil Stability Categories (representing the Environmental Lapse Rate) and vector wind speeds (m/s), and are shown in **Table 9.1.1** with the effect on noise propagation attenuation.

Table 9.1.1 CONCAWE Meteorological Categories

Meteorological Category (Decreasing Attenuation)	Pasquil Stability Category		
	A, B	C, D, E	F, G
1	v<-3.0	-	-
2	-3.0 <v<-0.5	v<-3.0	-
3	-0.5<v<+0.5	-3.0<v<-0.5	v<-3.0
4	+0.5<v<+3.0	-0.5<v<+0.5	-3.0<v<-0.5
5	v>+3.0	+0.5<v<+3.0	-0.5<v<+0.5
6	-	v>+3.0	+0.5<v<+3.0

Note: "V" is wind speed in m/s, with positive direction from source to receiver

All initial calculations were based on "neutral" atmospheric conditions in accordance with the EPA's requirements (ie CONCAWE Meteorological Category 4).

9.2 Quarry Operations

Noise levels of available items of mobile equipment operating on the site were measured and recorded in February 1997 for input to the SoundPLAN noise model. Attached as **Appendix D** is the noise model data which provides the mobile equipment description, the overall A-weighted sound power level and the linear octave band sound power level for each item.

The mobile equipment for quarrying and landfilling were located in the model for the early stages of operations when the equipment is at the existing surface height. It is therefore considered that predicted noise levels will be the "worst-case" scenarios for operations.

Subsequently, as the depths of extraction increase, the received noise levels will be decreased and the need for acoustic shielding will gradually be eliminated.

The location of the mobile equipment for each modelling scenario are given in **Table 9.2.1**, together with ground and source RL heights.

Table 9.2.1 Location of Mobile Equipment for Noise Modelling Stages 1 and 2

Stage	Equipment Item	Ground RL(m)	Source RL(m)	Location
1 Quarrying	D9L Dozer	0	2.9	Extraction of Northern Site - Area B
	KSS70 FEL	0	4.0	
	30 Tonne Dump Truck	6	9.0	
	25 Tonne Tipper Truck	18	20.5	
	Water Truck	10	12.3	
1 Landfilling	826 Compactor	11	13.5	Landfill of Northern Site Area A
	973 Tracked Loader	11	13.5	
	10 Tonne Tipper Truck	11	13.5	
	10 Tonne Tipper Truck	12	14.5	
	Water Truck	13	15.3	
2 Quarrying	D7 Dozer	22	24.5	Extraction of Southern Site - Area D
	633 Scraper	20	22.0	
	Water Truck	19	21.3	
2 Landfilling	826 Compactor	8	10.5	Landfill of Southern Site - Area C
	973 Tracked Loader	8	10.5	
	10 Tonne Tipper Truck	8	10.5	
	10 Tonne Tipper Truck	8	10.5	
	Water Tank	8	10.5	

The resultant overall A-weighted sound pressure levels have been determined at the two potentially most affected residential receivers.

Based on the maximum overall sound power levels given in **Appendix D**, the contributed L_{A10} noise emission levels are presented in **Table 9.2.2** together with the respective noise design goals for the project.

Table 9.2.2 Predicted L_{A10} Noise Emission Contributions - Quarrying and Landfilling

Receiver Number	Predicted L_{A10} Noise Contribution				L_{A10} Noise Level Design Goal	
	Stage 1		Stage 2		Quarrying and Landfilling	Landfilling
	Quarrying and Landfilling	Landfilling	Quarrying and Landfilling	Landfilling		
N1	51 dBA	49 dBA	32 dBA	32 dBA	48 dBA	46 dBA
R3	41 dBA	37 dBA	46 dBA	45 dBA	45 dBA	44 dBA

Impact Assessment

The following information is derived from the contributed $L_{A10(15minute)}$ noise emission levels presented in **Table 9.2.2** and the EPA criteria discussed in **Section 7.2**:

- Predicted $L_{A10(15minute)}$ noise emission contribution for Stage 1 concurrent quarrying and landfilling operations moderately exceed the corresponding (7.00 am to 5.00 pm Monday to Friday) design goal by 3 dBA at residential receiver N1 but clearly comply with the corresponding design goal at residential receiver R3.
- Predicted $L_{A10(15minute)}$ noise emission contributions for Stage 1 landfilling operations moderately exceed the corresponding (6.00 am to 6.00 pm Monday to Friday and 6.00 am to 4.00 pm Saturday) design goal by 3 dBA at residential receiver N1 but clearly comply with the corresponding design goal at residential receiver R3.
- Predicted $L_{A10(15minute)}$ noise emission contribution for Stage 2 concurrent quarrying and landfilling operations marginally exceed the corresponding (7.00 am to 5.00 pm Monday to Friday) design goal by 1 dBA at residential receiver R3 but clearly comply with the corresponding design goal at residential receiver N1.
- Predicted $L_{A10(15minute)}$ noise emission contributions for Stage 2 landfilling operations marginally exceed the corresponding (6.00 am to 6.00 pm Monday to Friday and 6.00 am to 4.00 pm Saturday) design goal by 1 dBA at residential receiver R3 but clearly comply with the corresponding EPA criteria at residential receiver N1.

9.3 Quarrying and Landfilling Operations Noise Contour Diagrams

The contributed $L_{A10(15minute)}$ noise emission contour diagrams are presented in **Appendices F** to **I** for the proposed quarrying and landfilling operations under neutral atmospheric conditions, as shown in **Table 9.3.1**.

Table 9.3.1 Contributed $L_{A10(15minute)}$ Noise Emission Contour Diagrams

Appendix	Operating Scenario
F Page 1	Stage 1 - Without barriers
G Page 1	Stage 1 - With barriers
H Page 1	Stage 2 - Without barriers
I Page 1	Stage 2 - With barriers

It is noteworthy that the calculation of noise contours involves numerical interpolation of a noise level array. The noise contours are therefore presented with a graphical accuracy of approximately ±2 dBA.

9.4 Traffic Noise

Based on **Table 5.1**, the two-way traffic flow details on Metford Road (1995 figures) are shown in **Table 9.4.1**. In the absence of any precise details on heavy vehicle usage, it is assumed that approximately 5% of vehicle movements along Metford Road would be attributable to heavy vehicles.

Also presented in the **Table 9.4.1** are the average daily heavy vehicle movements associated with the subject operations.

Table 9.4.1 1995 Daily Traffic Flow - Metford Road

Location	Traffic Flow	Estimated Heavy Vehicle Use*	Average Daily Company Heavy Vehicle Movements
Metford Road	6,875	344	38

*Assumed 5%

Since the 1995 traffic flow figures for Metford Road are 6,875, the CORTN method was adopted to predict the change in the $L_{A10(18hour)}$ noise level due to the contribution to the traffic volume from external truck movements associated with the operations.

The closest residence to the site potentially most affected by traffic noise from Metford Road is that situated immediately south of the site, approximately 20 m from the eastern side of Metford Road.

Table 9.4.2 summarises the predicted noise levels with and without the proposed operations. A road grade of 0% was used for the noise predictions together with a mean speed of 60 km/h, and the predicted levels included a building facade reflection correction of 2.5 dBA.

Table 9.4.2 Predicted $L_{A10(18hour)}$ Traffic Noise Levels at 20 m

Location	Daily Traffic Flows		Percentage Heavy Vehicles		Calculated $L_{A10(18hour)}$	
	With Operations	Without Operations	With Operations	Without Operations	With Operations	Without Operations
Metford Road	6,913	6,875	5.5%	5%	62.9 dBA	62.7 dBA

From **Table 9.4.2**, the calculated increases in the $L_{A10(18hour)}$ noise levels on Metford Road with the proposed increase in truck traffic generated by the subject operations is 0.2 dBA. This increase is well within the recommended 2 dBA tolerance limit and, the overall noise level does not exceed 63 dBA.

It is possible that Enviroguard, the operators of CSR's Maitland Brick Plant, may increase, over time, the annual landfilling rate of 45,000 tonnes to 70,000 tonnes. This would result in an increase of 11 truck loads per day, or 22 truck movements. The resulting increase in the $L_{A10(18hour)}$ noise level with and without the operations is 0.3 dBA.

In terms of the noise impact of trucks crossing Metford Road, the appropriate noise level criterion is an $L_{Aeq(1hour)}$ of 55 dBA.

Based on the proposed average 8 truck movements per hour travelling at an average speed of 40 km/hr, the predicted $L_{Aeq(1hour)}$ is 37 dBA at 400 m, the approximate distance to the closest residential receivers. This clearly complies with the 55 dBA $L_{Aeq(1hour)}$ criterion.

10 EFFECTS OF METEOROLOGY ON NOISE LEVELS

Steady light to moderate winds produce higher noise levels downwind, and lower noise levels upwind from a given source than in still air. Strong winds tend to increase local ambient noise, due to turbulence or movement of trees and shrubs, which can mask noise from more distant sources.

Under temperature inversion conditions, air temperature increases with altitude, and sound rays are diffracted downwards. This causes focussing of sound intensity at some radius from the source, and an increase in received sound levels.

Further to the noise level predictions given in **Table 9.2.2** for neutral atmospheric conditions, predictions were conducted for adverse atmospheric condition (ie CONCAWE Meteorological Category 5).

The predicted noise levels at the two representative residences for the various operation scenario under adverse atmospheric conditions are given in **Table 10.1** together with the associated design goals.

Table 10.1 Predicted L_{A10} Noise Contributions under Adverse Atmospheric Conditions

Receiver Number	Predicted L_{A10} Noise Contribution				L_{A10} Noise Level Design Goal	
	Stage 1		Stage 2			
	Quarrying and Landfilling	Landfilling	Quarrying and Landfilling	Landfilling	Quarrying and Landfilling	Landfilling
N1	54	51	37	37	48	46
R3	45	41	50	49	45	44

The following information is derived from **Table 10.1** and the EPA criteria discussed in **Section 7.2**:

- Predicted $L_{A10(15minute)}$ noise emission contributions for Stage 1 concurrent quarrying and landfilling operations under adverse weather conditions appreciably exceed the corresponding (7.00 am to 5.00 pm Monday to Friday) design goal by 6 dBA at residential receiver N1 but comply with corresponding design goal at residential receiver R3.
- Predicted $L_{A10(15minute)}$ noise emission contributions for Stage 2 concurrent quarrying and landfilling operations under adverse weather conditions clearly comply with the corresponding (7.00 am to 5.00 pm Monday to Friday) design goal at residential receiver N1 but appreciably exceed the corresponding design goal (by 5 dBA) at residential receiver R3.
- Predicted $L_{A10(15minute)}$ noise emission contribution for Stage 1 landfilling operations under adverse weather conditions moderately exceed the corresponding (6.00 am to 6.00 pm Monday to Friday, 6.00 am to 4.00 pm Saturday) design goal (by 3 dBA) at residential receiver N1 but clearly complies with the corresponding design goal at residential receiver R3.
- Predicted $L_{A10(15minute)}$ noise emission contributions for Stage 2 landfilling operations under adverse weather conditions clearly complies with the corresponding (6.00 am to 6.00 pm Monday to Friday, 6.00 am to 4.00 pm Saturday) design goal at residential receiver N1 but appreciably exceeds the corresponding design goal at residential receiver R3.

11 RECOMMENDED NOISE MITIGATION MEASURES AND MANAGEMENT

In order to comply with EPA criteria at the representative receiver locations, N1 and R3, barriers will be required at the Maitland PGH quarry.

With the assistance of the quarry operator, two suitable barrier locations were defined; one to the west of the northern operations and the other to the south of the southern operations. SoundPLAN calculations were subsequently conducted to determine the required heights of the barriers.

The resulting barrier designs are presented in **Appendix E**, showing barrier locations and heights. The "western" barrier will be a bund wall with a batter of 1:3 and height ranging from 6 m to 7 m above ground, following the natural topography of the land. The "southern" barrier will be a bund wall with a batter of 1:3 and height ranging from 2 m to 5 m above ground, running parallel to the southern property boundary.

A reduction of 3 dBA for the "western" barrier is expected at the representative Receiver Location N1 and at least 3 dBA at all other affected residential receivers. A reduction of 1 dBA is expected for the "southern" barrier at the representative Receiver Location R3 and at least 1 dBA at all other affected residential receivers.

Close consultation with the quarry operator has ensured that the proposed barriers are practical in terms of the heights and locations.

Management

The Maitland PGH quarrying and landfilling operations must be carried out using the best available technology and best practices to meet the EPA criteria including fitting of "residential" class muffler, noise reduction kits and acoustic enclosures to plant and equipment.

All items of plant or equipment must be maintained in proper efficient working order, and used and operated in a proper and efficient manner.

12 CONCLUSION

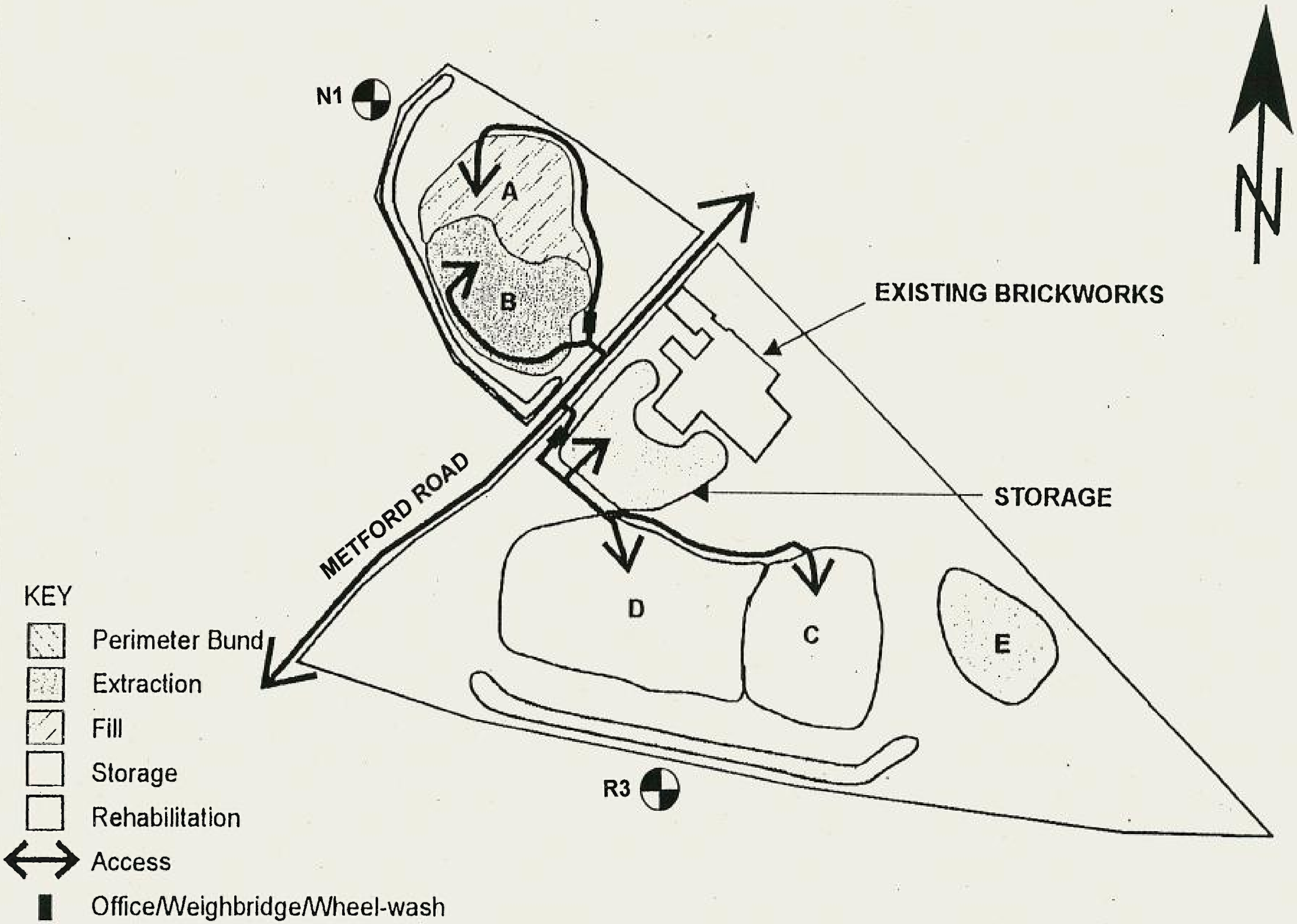
An assessment of the acoustical impact on the surrounding residential receivers resulting from proposed quarrying, landfilling and rehabilitation of the existing PGH quarry at Metford Road, Maitland NSW has been undertaken.

Calculation of noise level emissions from quarrying and landfilling operations under neutral and adverse weather conditions were carried out using a computer model incorporating the significant noise sources, the surrounding terrain and nearby potentially affected receivers and, where required, noise mitigation.

Calculation of the road traffic noise levels resulting from the movement of product trucks on the adjacent roadway was conducted using the UK Department of Transport's CORTN method to predict $L_{A10(18hour)}$ noise levels at the nearest affected residence.

The results of the calculations were compared to the design goals to assess the noise impact of the proposed operations. Under neutral weather conditions, with the recommended bund walls in place, noise emission levels comply with the EPA criteria at all locations.

On the basis of this assessment, it is concluded that with the incorporation of the nominated noise controls, the proposed operations will have a subjectively negligible impact on the existing acoustical amenity of nearby residential receivers.



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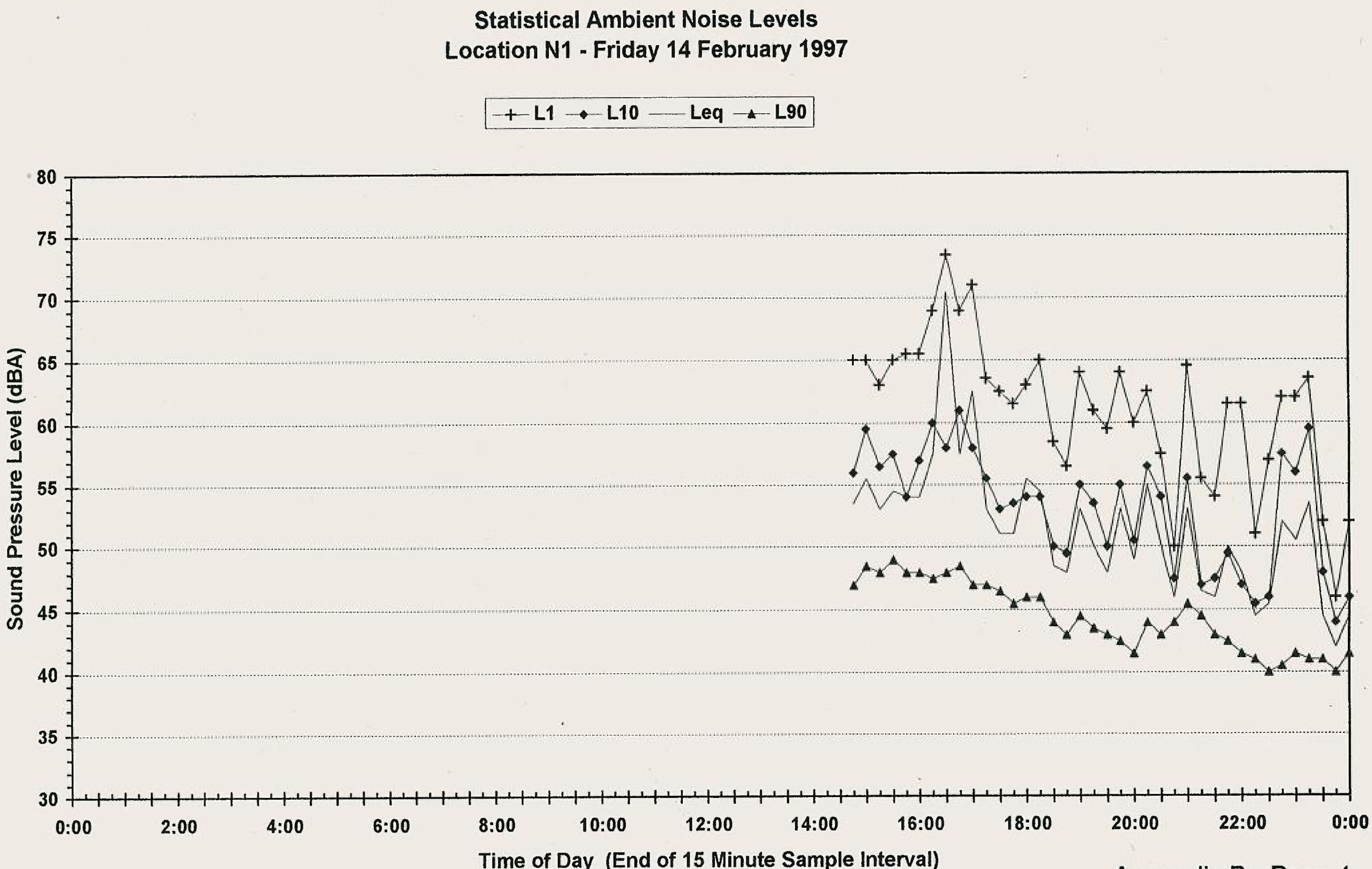
SITE LAYOUT



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Statistical Noise Levels

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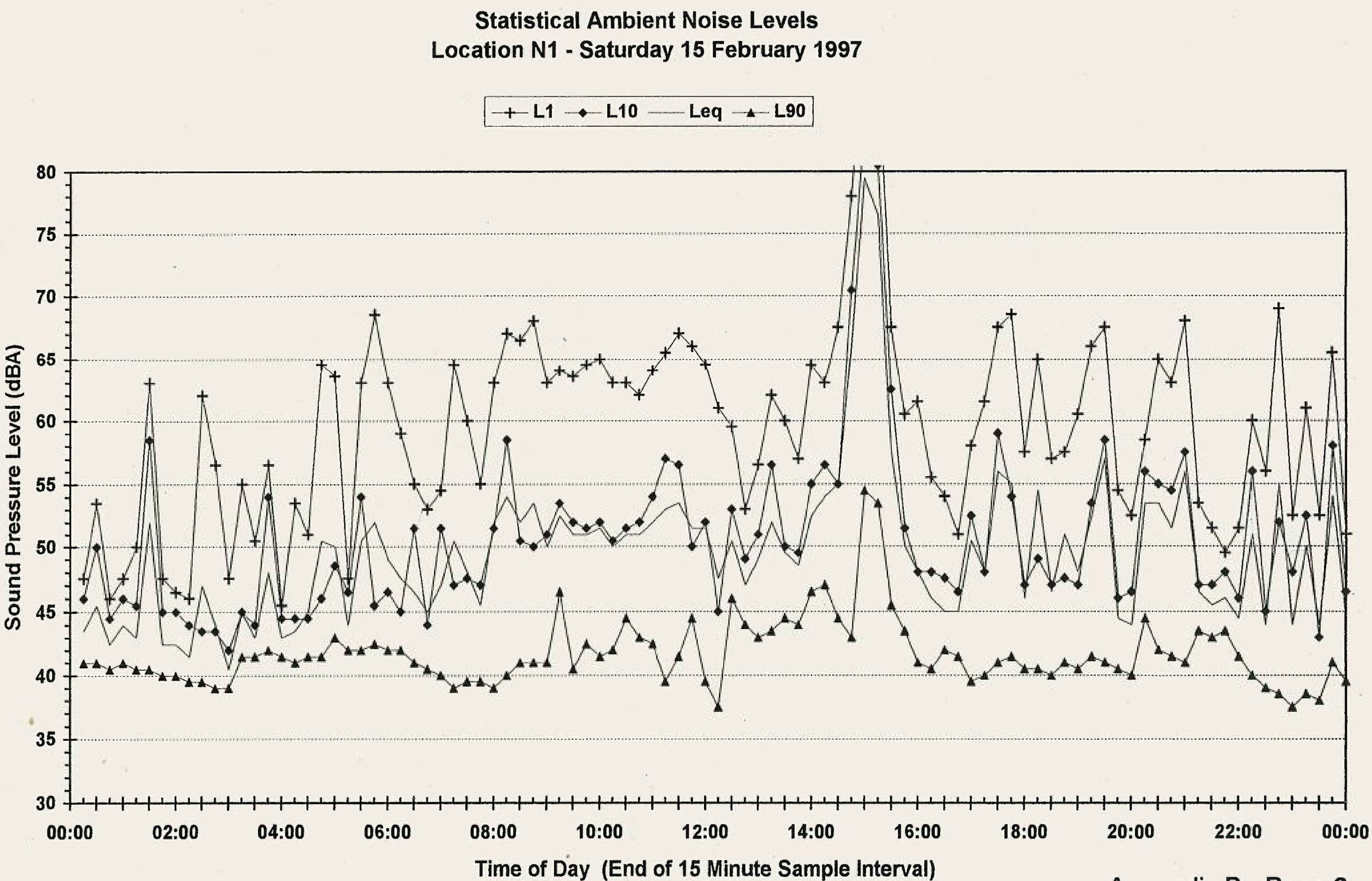

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Statistical Noise Levels

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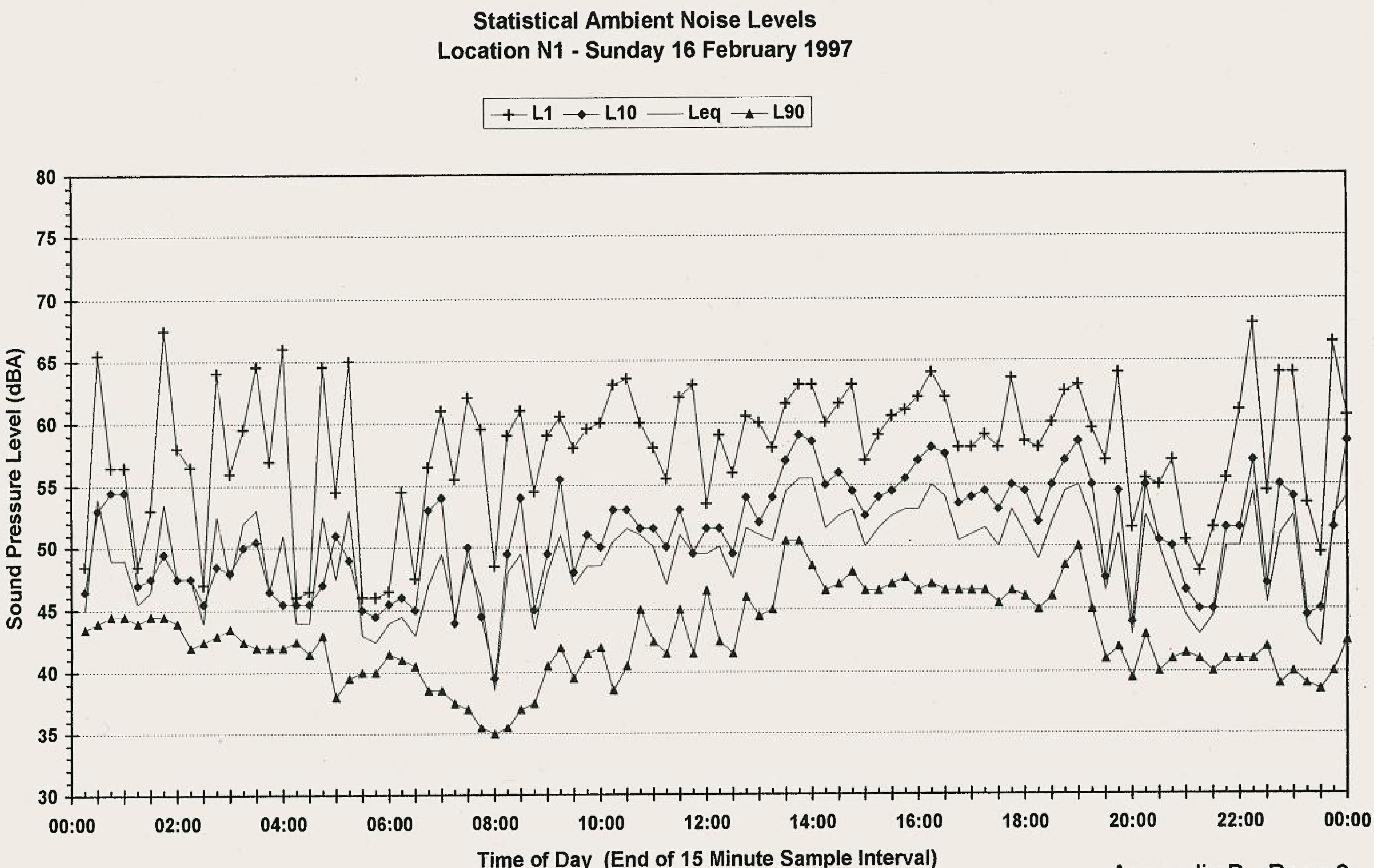

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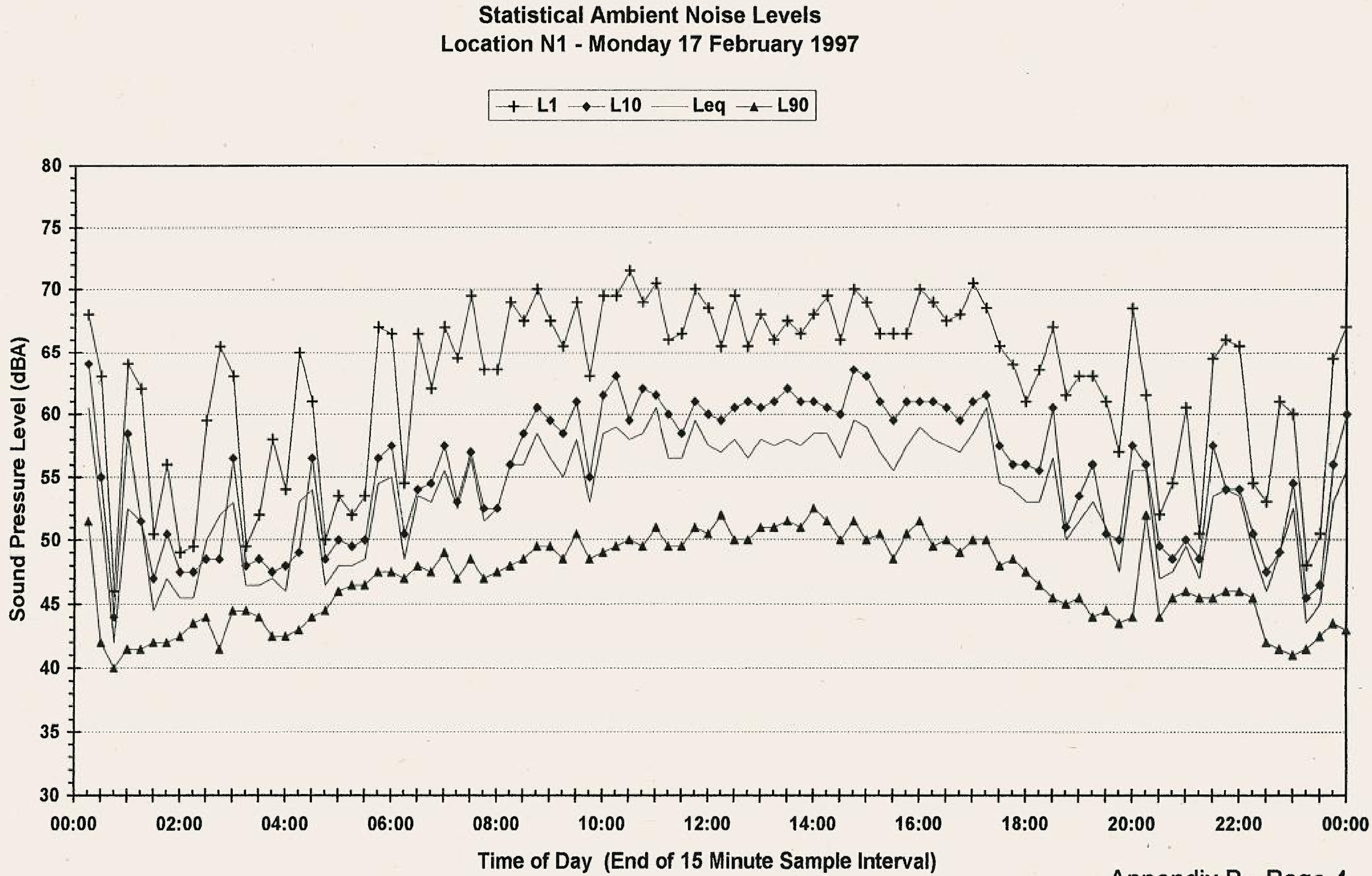

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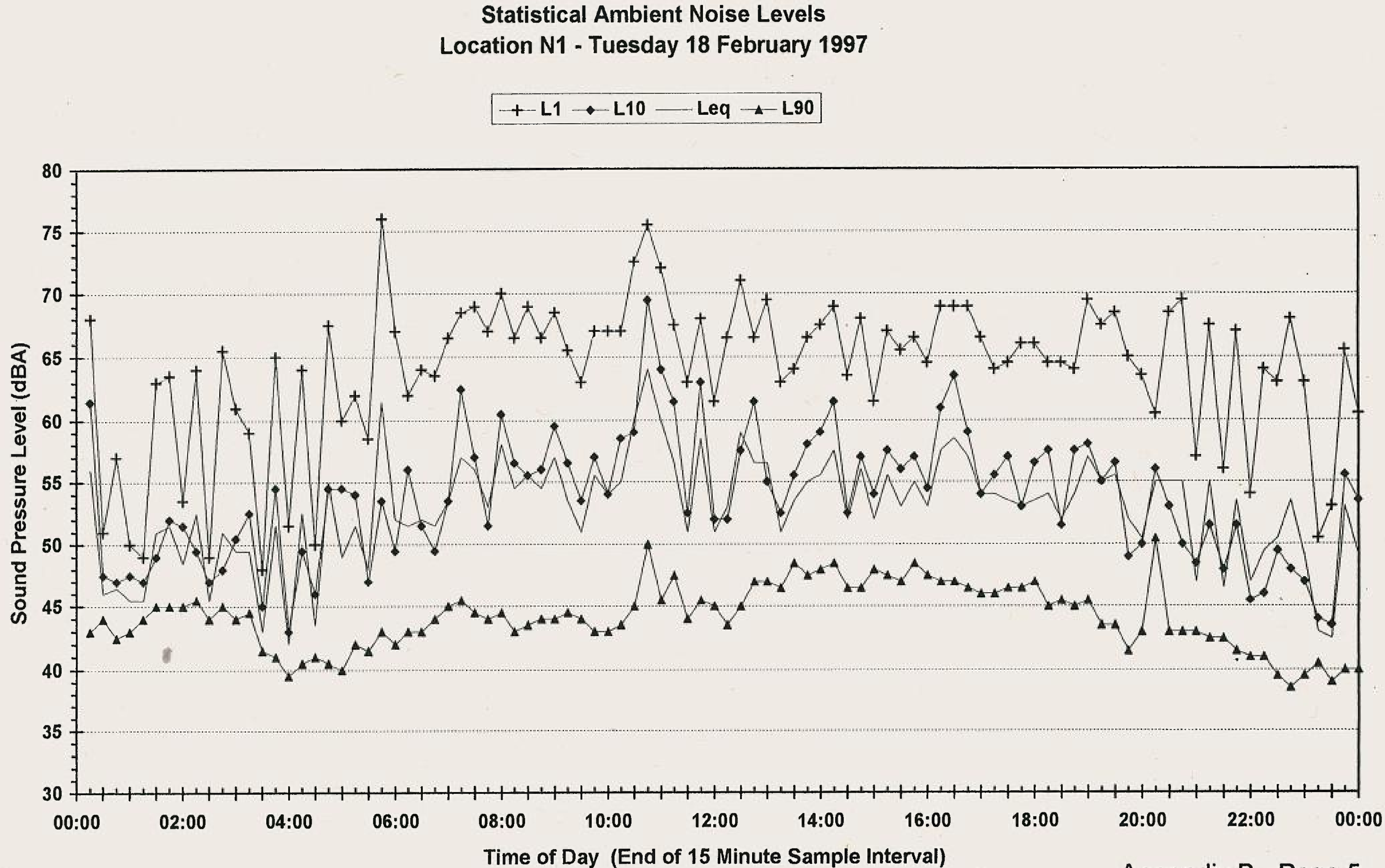
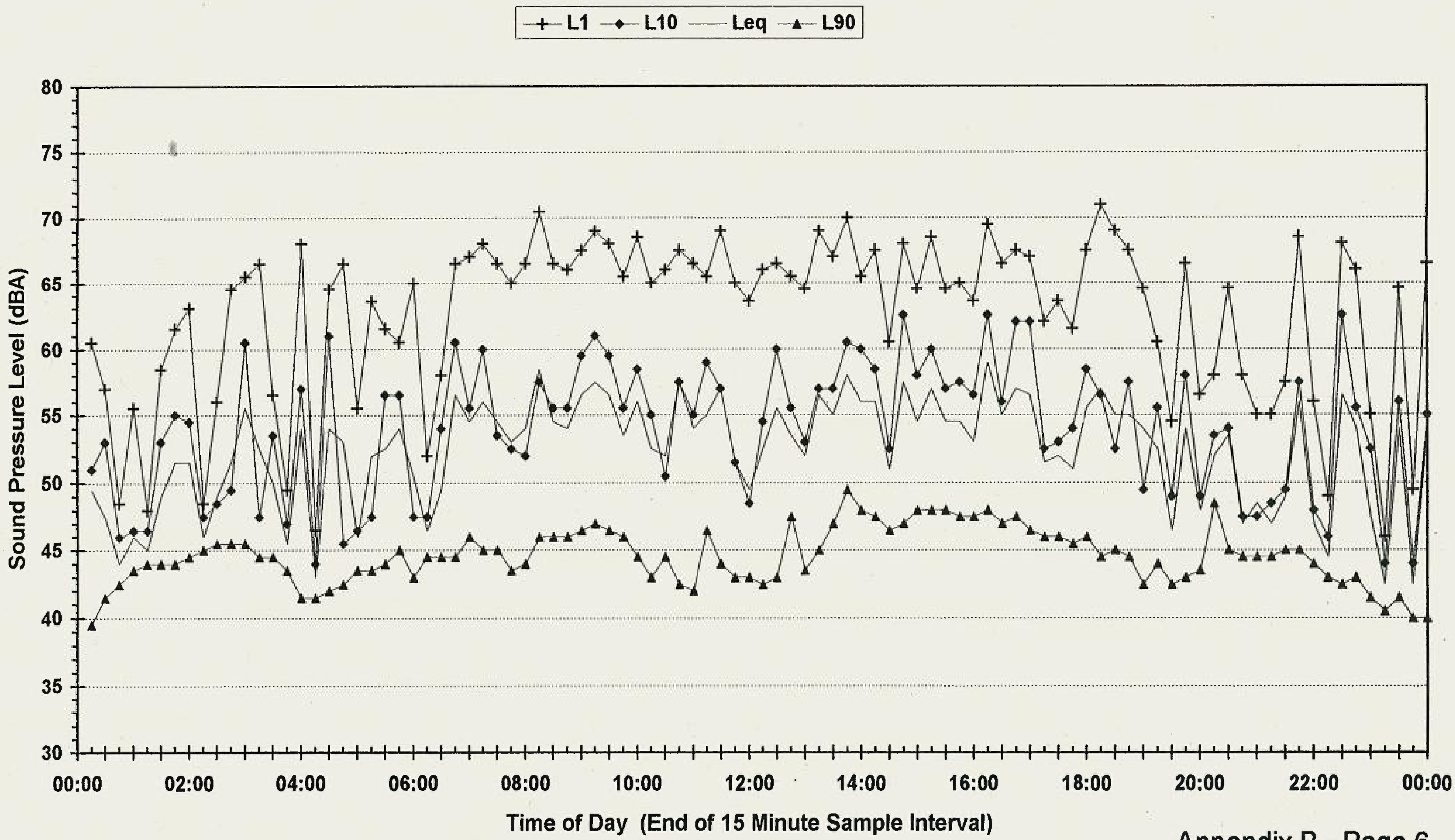


6319n1.xls N- Tue 18.2.97

Statistical Ambient Noise Levels
Location N1 - Wednesday 19 February 1997



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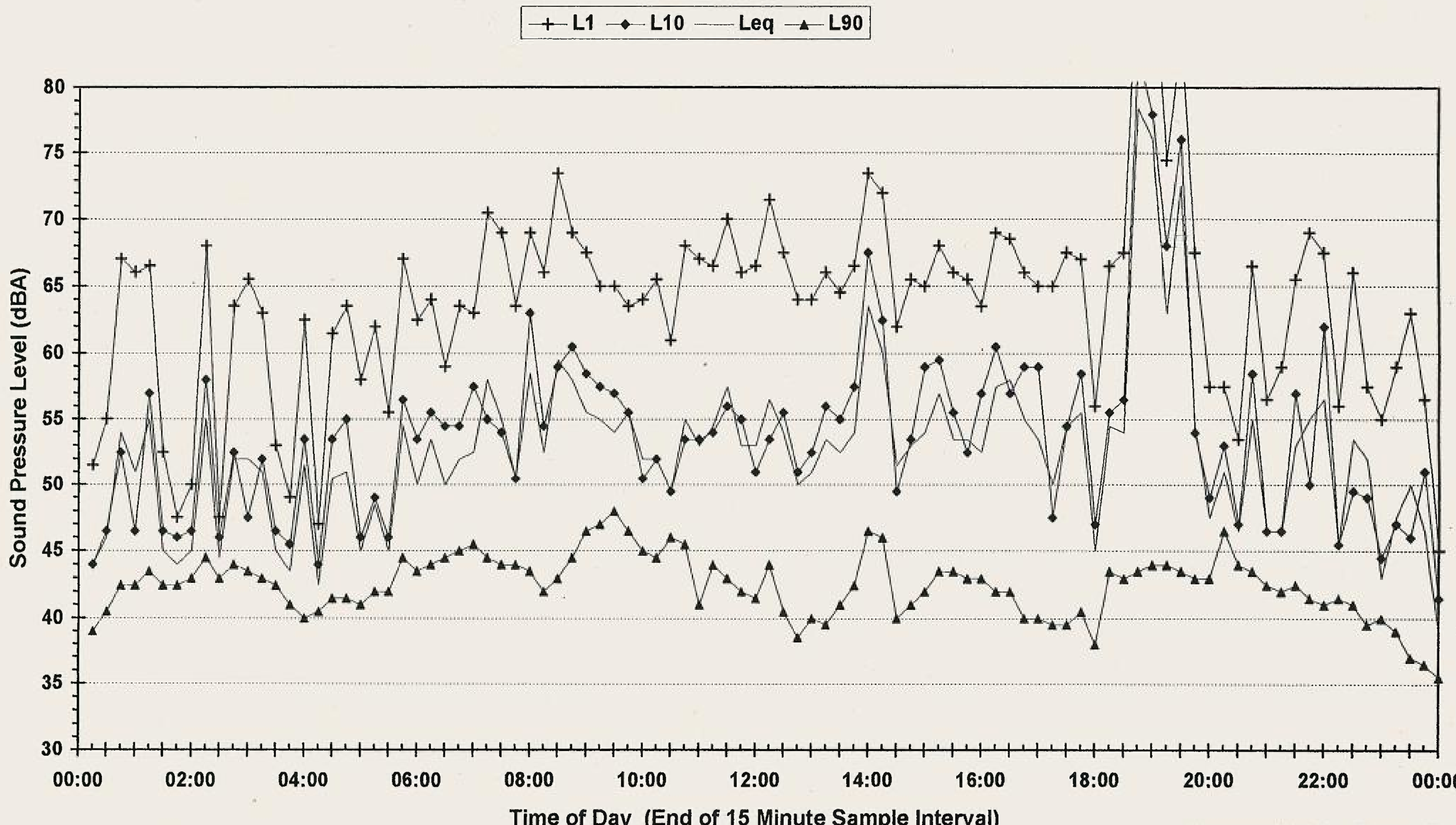
Statistical Noise Levels
Report 6319

6319n1.xls N- Wed 19.2.97

Statistical Ambient Noise Levels
Location N1 - Thursday 20 February 1997



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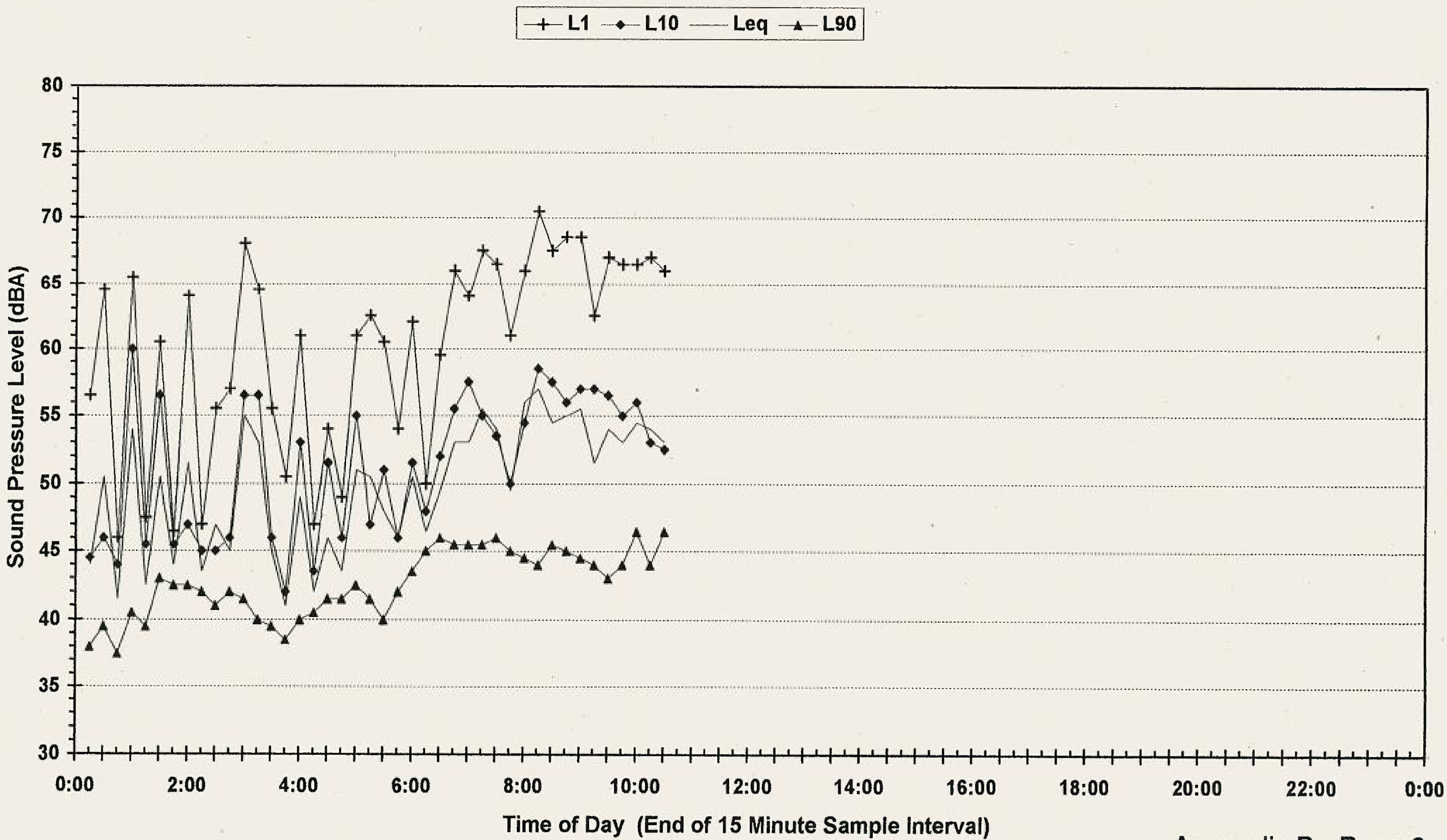
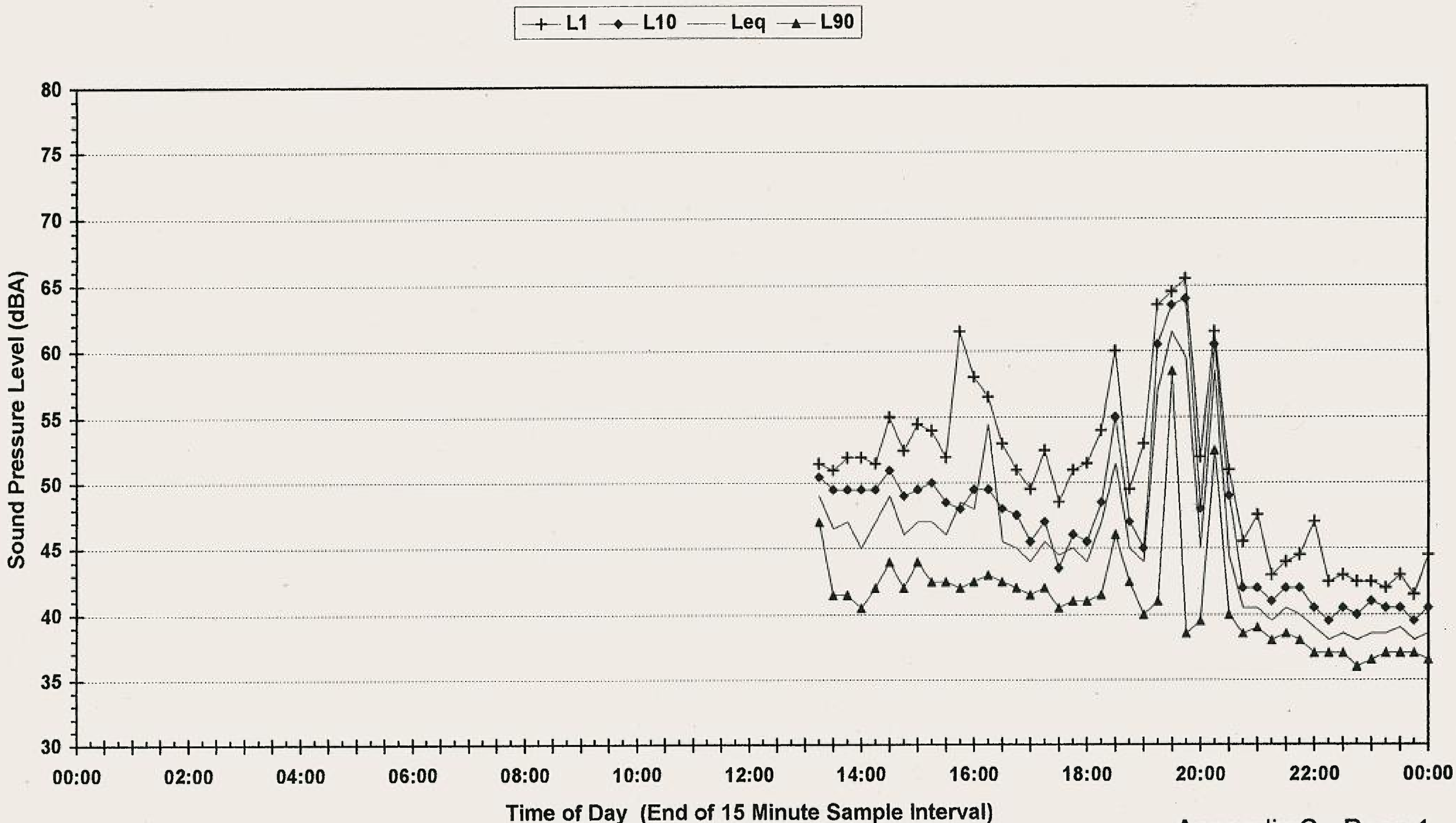
Statistical Noise Levels
Report 6319

Statistical Ambient Noise Levels
Location N1 - Friday 21 February 1997

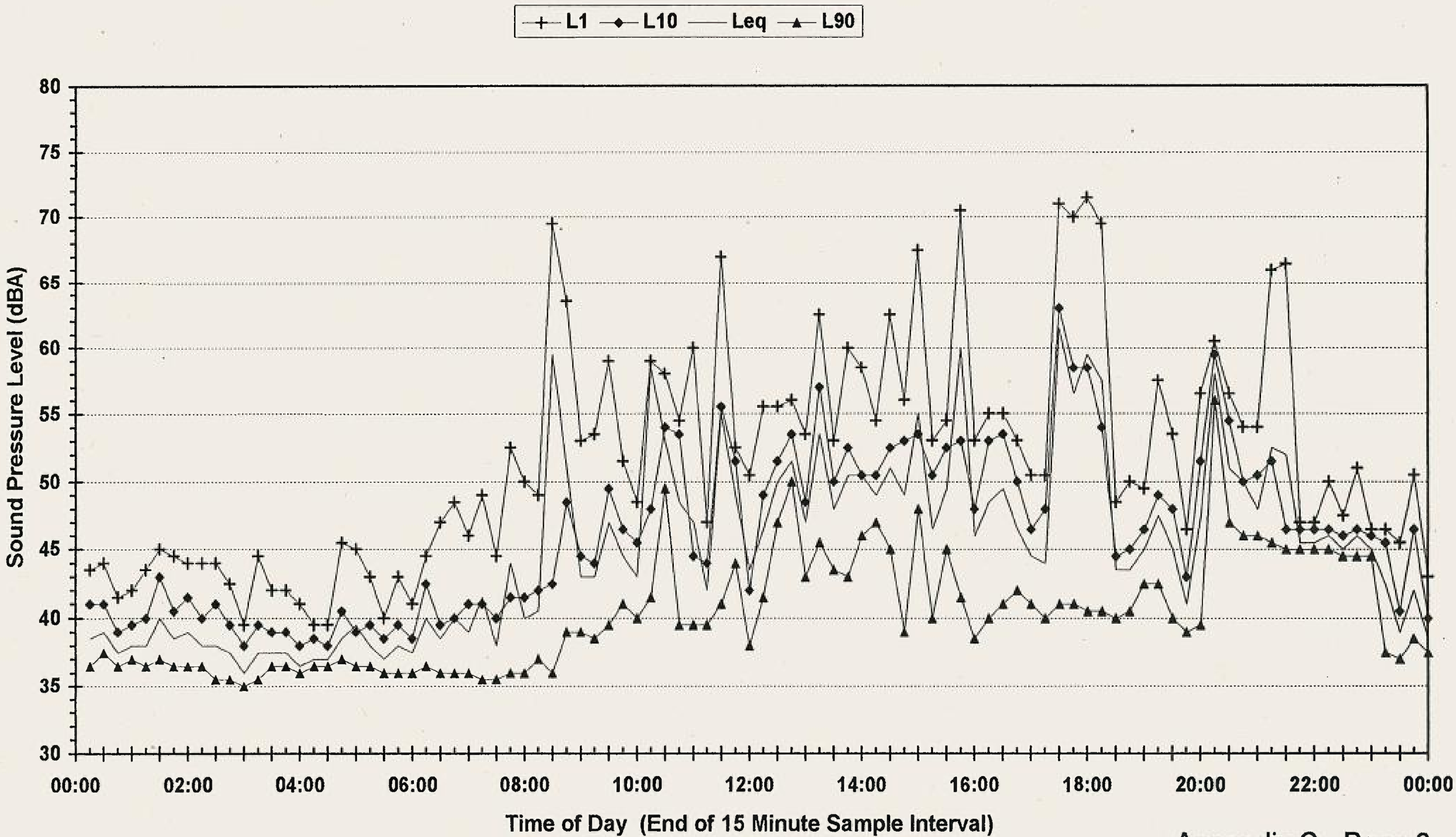


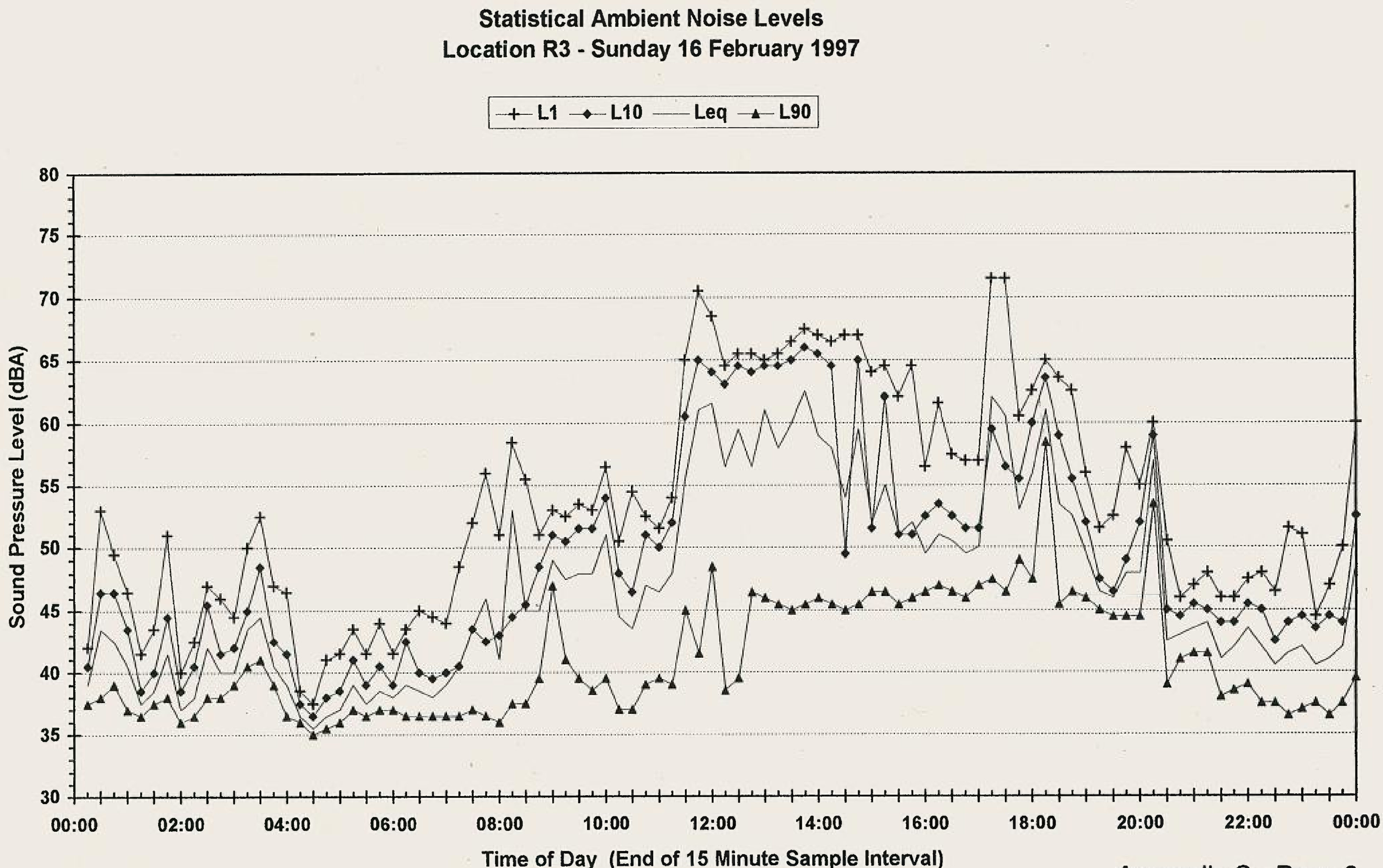
Statistical Ambient Noise Levels
Location R3 - Friday 14 February 1997



6319r3.xls N- Fri 14.2.97

Statistical Ambient Noise Levels
Location R3 - Saturday 15 February 1997





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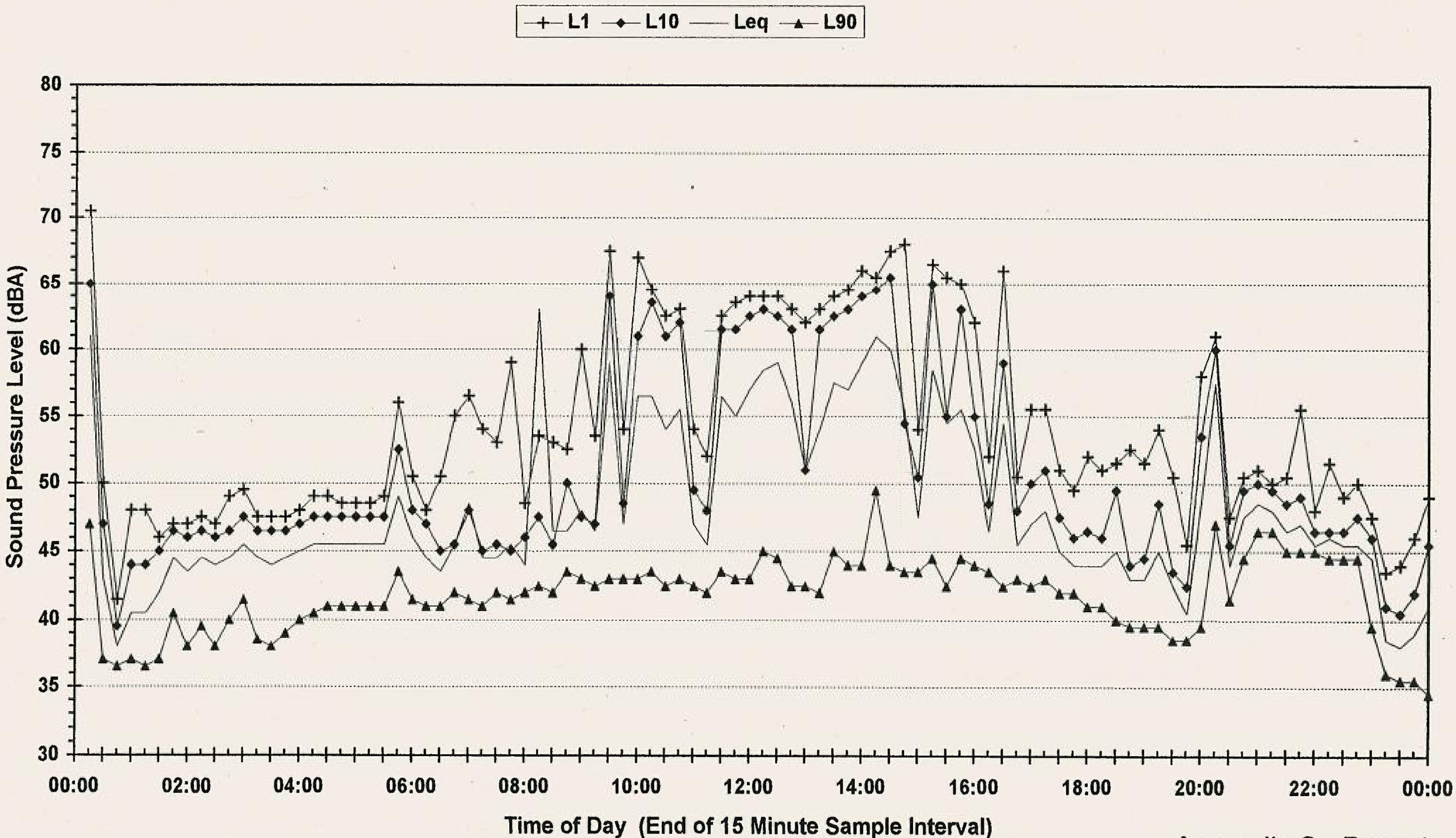
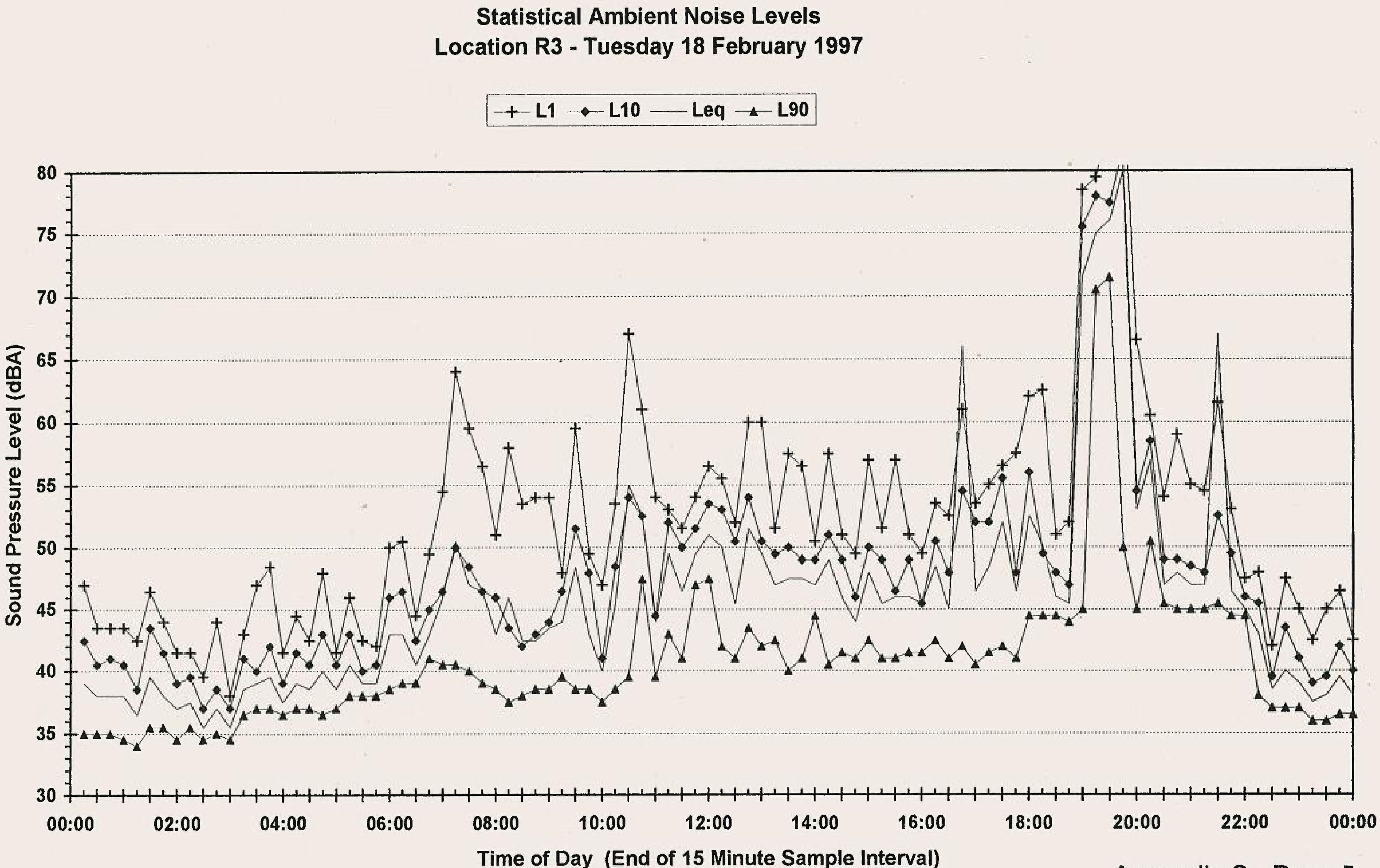
Statistical Noise Levels

Report 6319

6319r3.xls N- Sun 16.2.97

Statistical Ambient Noise Levels
Location R3 - Monday 17 February 1997





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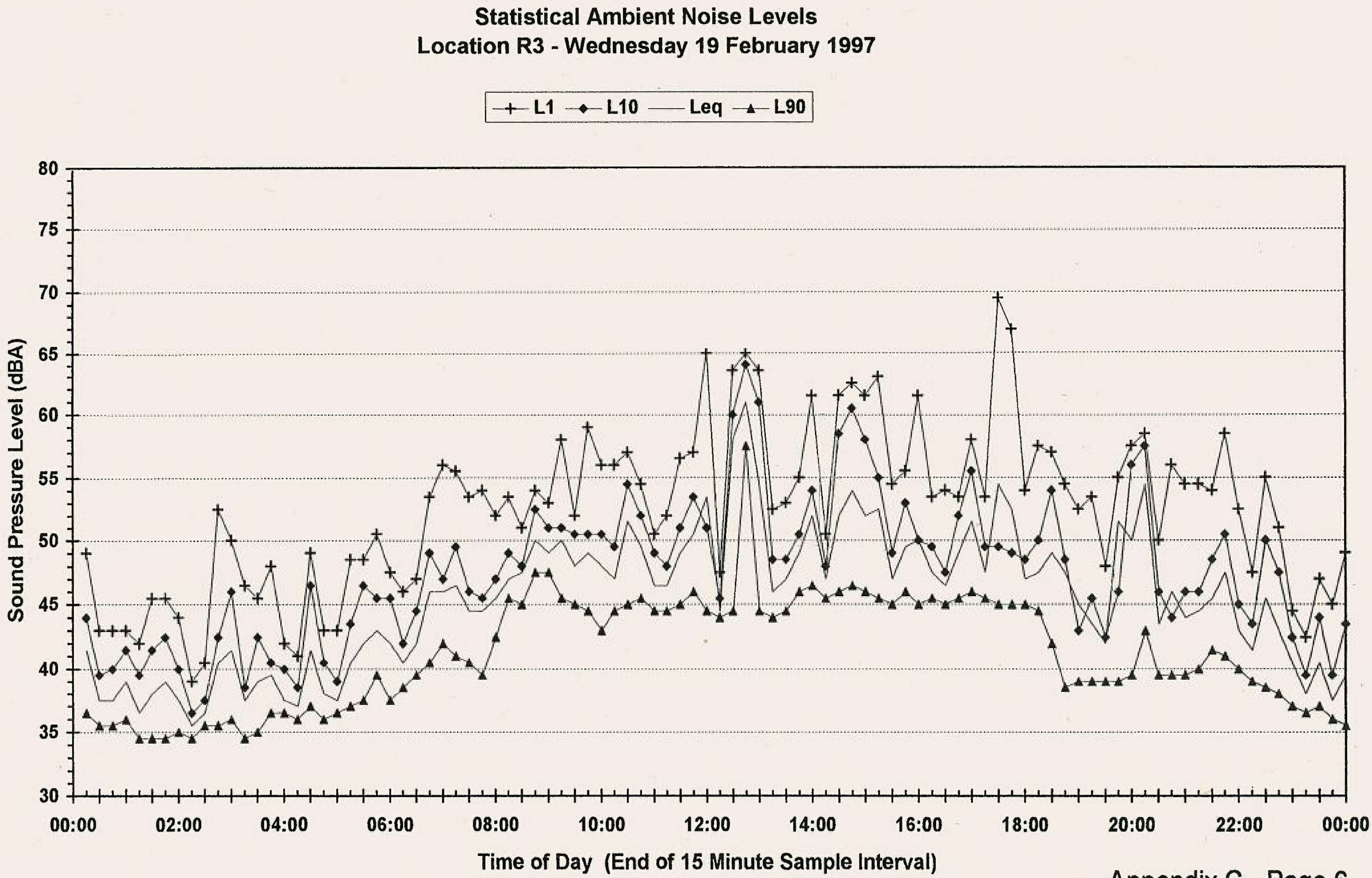

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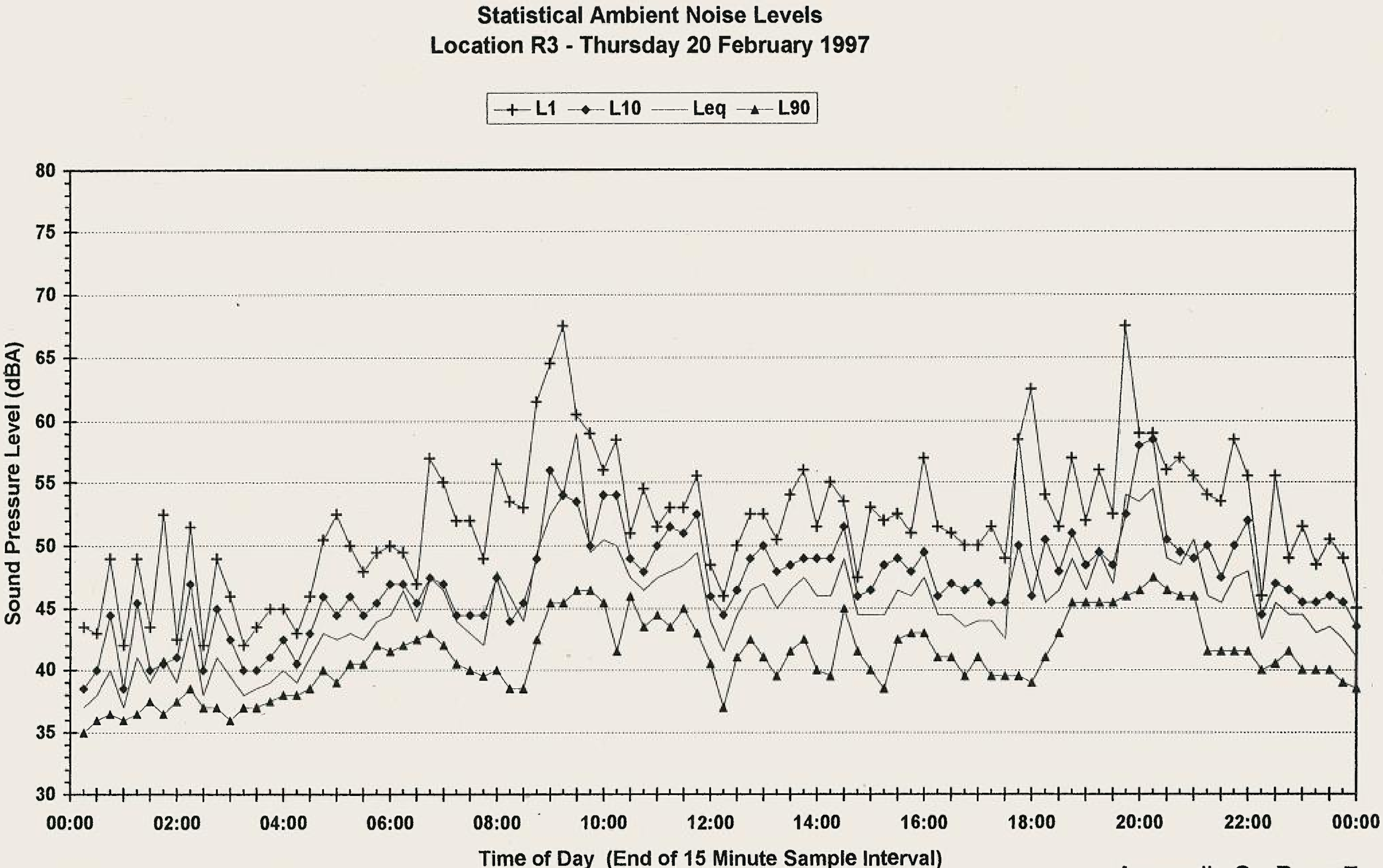
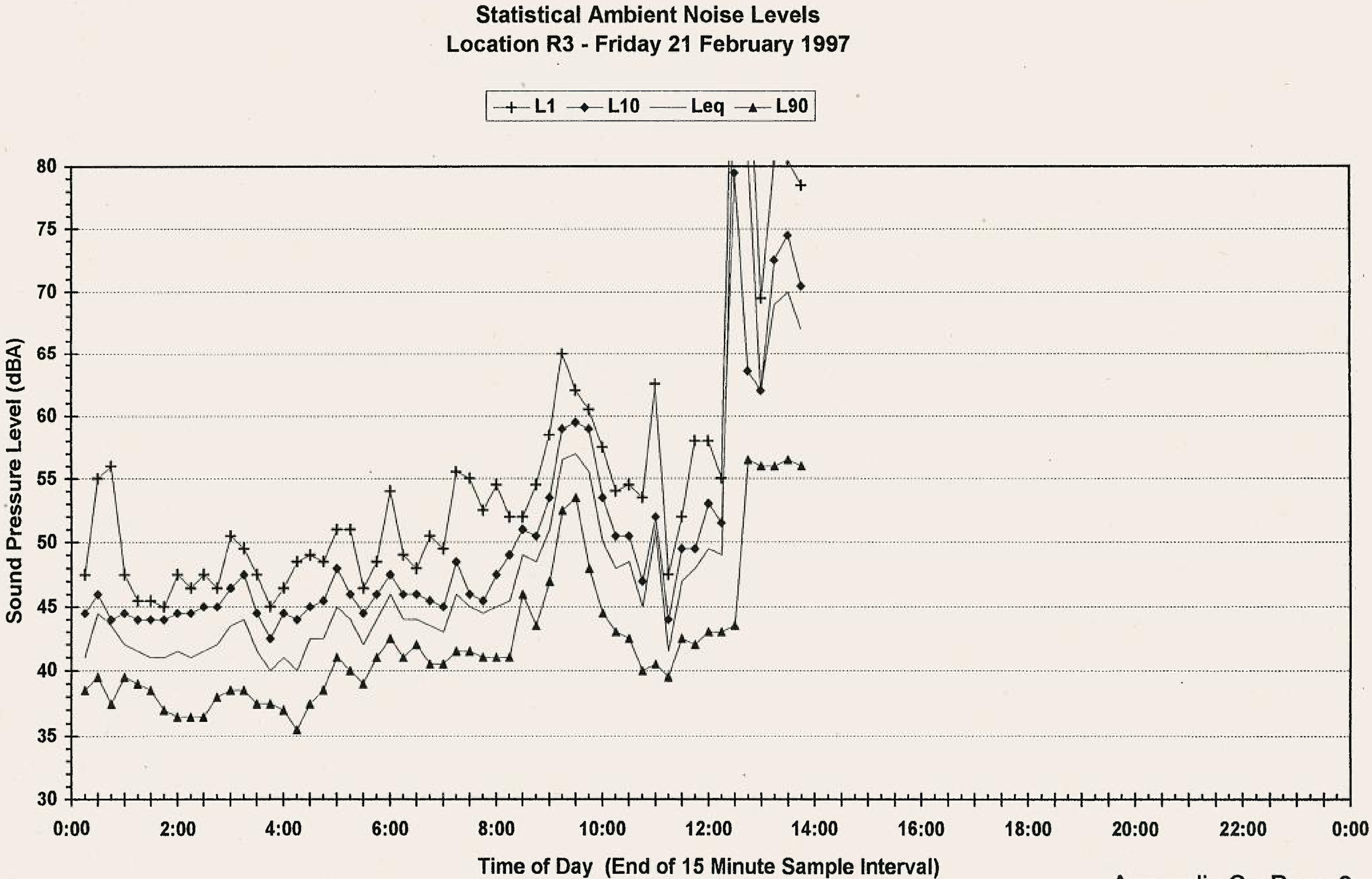

Statistical Ambient Noise Levels
Location R3 - Thursday 20 February 1997
L1
L10
Leq
L90
Sound Pressure Level (dBA)
80
75
70
65
60
55
50
45
40
35
30
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00
Time of Day (End of 15 Minute Sample Interval)



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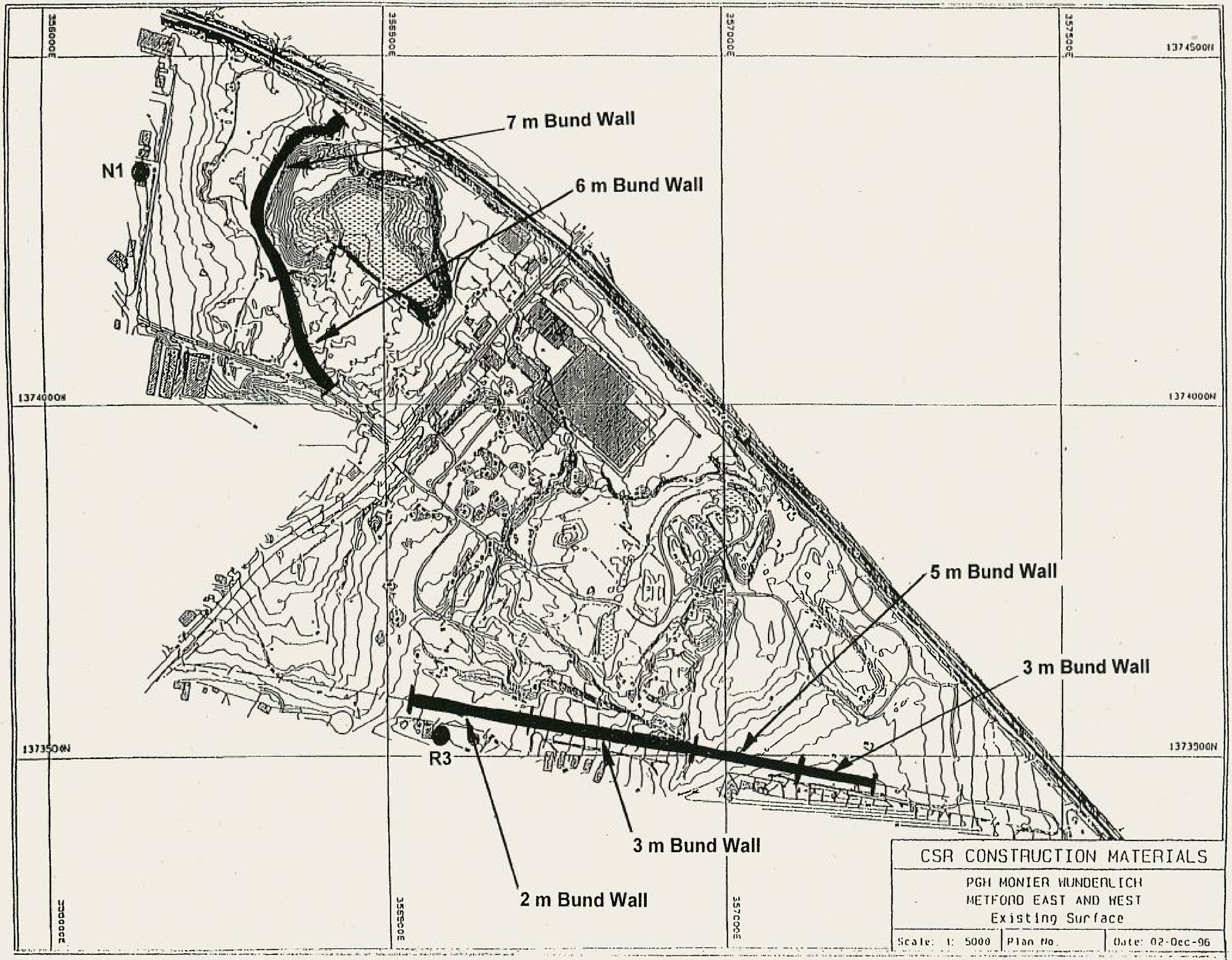
Statistical Noise Levels

Report 6319

6319 - Maitland PGH Noise Impact Assessment

Mobile Plant Sound Power Levels - 7/3/97

Equipment Description	Octave Band Linear Sound Power Level - dB re 1pW 63	125	250	500	1k	2k	4k	8k	dBA Overall	Ground RL (m)	Source RL (m)
Metford Stage 1 Extraction											
CAT D9L Bulldozer	112	122	109	108	106	107	103	94	113	0	2.9
Kawasaki KSS70 Front-end Loader	105	116	108	111	107	105	100	93	113	0	4.0
30 Tonne Off-road Dump Truck	120	112	112	108	105	103	98	91	111	6	3.0
25 Tonne Highway Tipper Truck	114	109	111	106	106	103	99	90	111	18	2.5
12 Tonne Water Truck	103	105	106	102	100	95	90	77	105	10	2.3
Metford Stage 1 Landfilling											
CAT 826 Compactor	104	109	112	107	105	102	96	90	110	11	2.5
CAT 973 Tracked Loader	112	111	108	110	103	101	99	93	110	11	2.5
10 Tonne Highway Tipper Truck	115	102	109	104	102	99	100	92	108	11	2.5
10 Tonne Highway Tipper Truck	115	102	109	104	102	99	100	92	108	12	2.5
12 Tonne Water Truck	103	105	106	102	100	95	90	77	105	13	2.3
Metford Stage 2 Extraction											
CAT D7 Bulldozer	112	111	108	110	103	101	99	93	110	22	2.5
CAT 633 Elevating Scraper	116	115	109	107	106	104	97	92	111	20	2.0
12 Tonne Water Truck	103	105	106	102	100	95	90	77	105	19	2.3
Metford Stage 2 Landfilling											
CAT 826 Compactor	104	109	112	107	105	102	96	90	110	8	2.5
CAT 973 Tracked Loader	112	111	108	110	103	101	99	93	110	8	2.5
10 Tonne Highway Tipper Truck	115	102	109	104	102	99	100	92	108	8	2.5
10 Tonne Highway Tipper Truck	115	102	109	104	102	99	100	92	108	8	2.5
12 Tonne Water Truck	103	105	106	102	100	95	90	77	105	8	2.3



Appendix E
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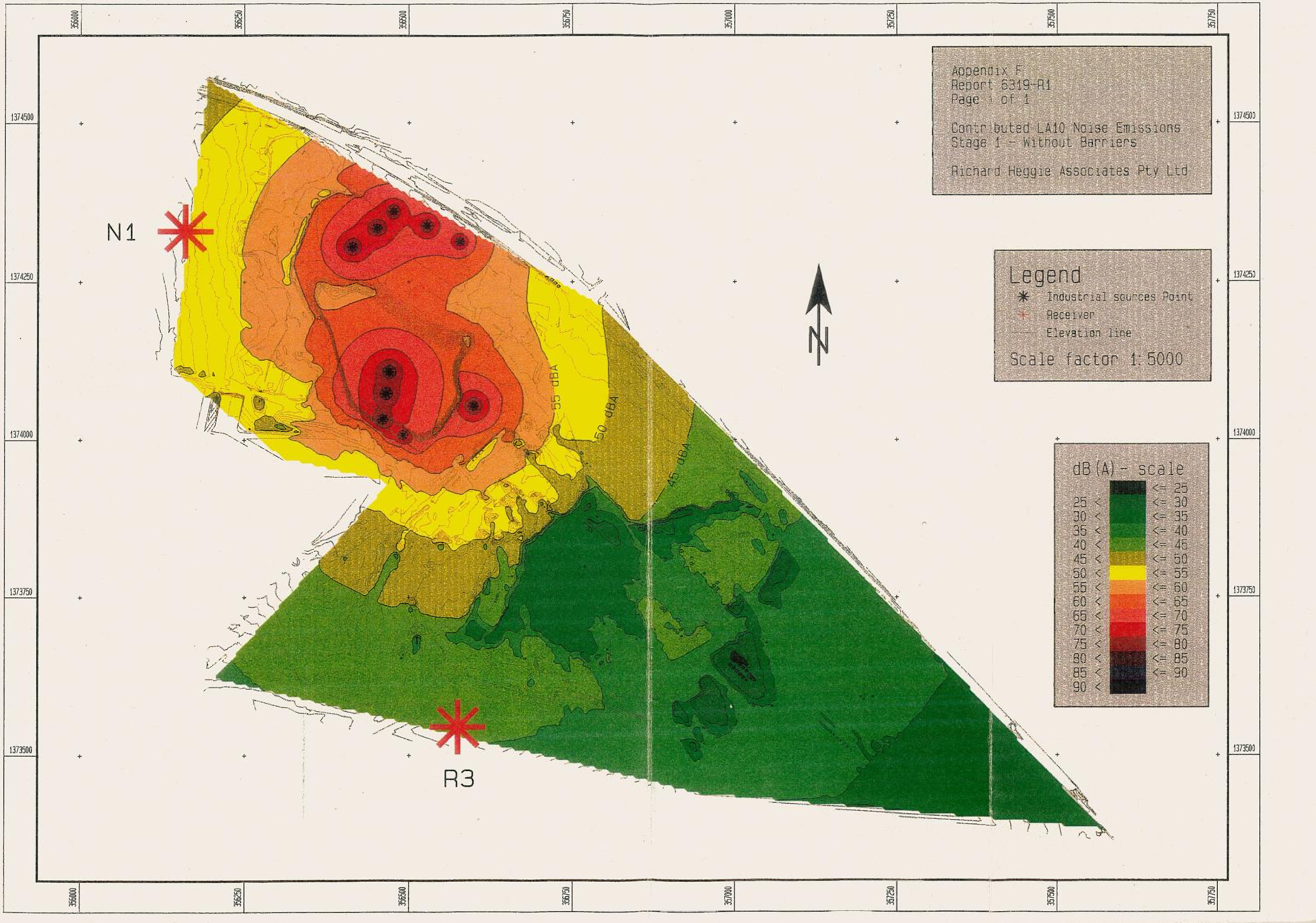
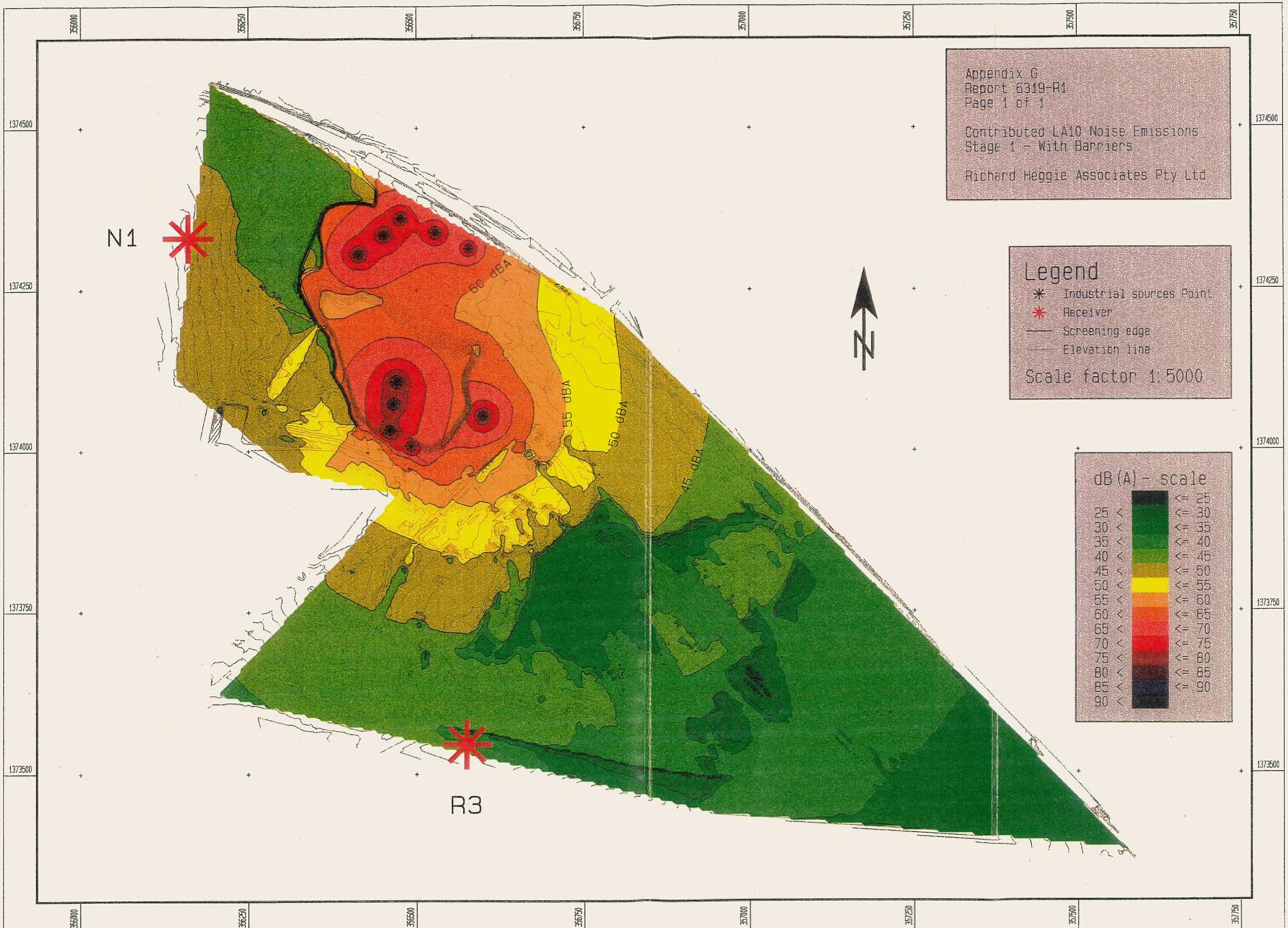
Page 1 of 1
BUND WALL LOCATIONS


Appendix F
Report 6319-R1
Page 1 of 1
Contributed LA10 Noise Emissions
Stage 1 - Without Barriers
Richard Heggie Associates Pty Ltd
Legend
Industrial sources Point
Receiver
Elevation line
Scale factor 1:5000
dB(A) - scale
<= 25
25 < <= 30
30 < <= 35
35 < <= 40
40 < <= 45
45 < <= 50
50 < <= 55
55 < <= 60
60 < <= 65
65 < <= 70
70 < <= 75
75 < <= 80
80 < <= 85
85 < <= 90
90 <
N
N1
R3
55 dBA
50 dBA
45 dBA
356000
356250
356500
356750
357000
357250
357500
357750
1374500
1374250
1374000
1373750
1373500


Appendix G
Report 6319-R1
Page 1 of 1
Contributed LA10 Noise Emissions
Stage 1 - With Barriers
Richard Heggie Associates Pty Ltd
Legend
Industrial sources Point
Receiver
Screening edge
Elevation line
Scale factor 1:5000
dB(A) - scale
<= 25
25 < <= 30
30 < <= 35
35 < <= 40
40 < <= 45
45 < <= 50
50 < <= 55
55 < <= 60
60 < <= 65
65 < <= 70
70 < <= 75
75 < <= 80
80 < <= 85
85 < <= 90
90 <
N
N1
R3
60 dBA
55 dBA
50 dBA
45 dBA
356000
356250
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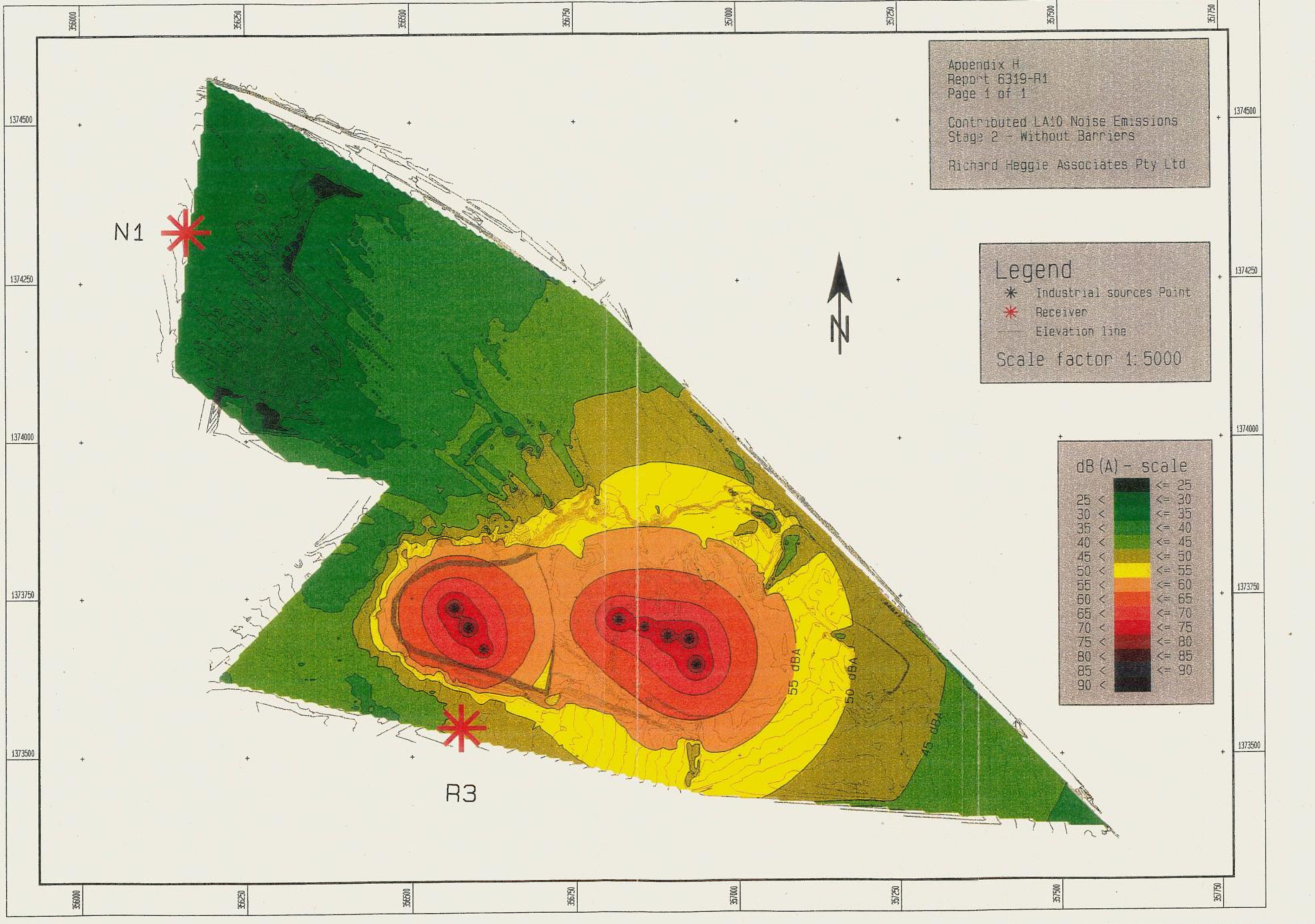
356750
357000
357250
357500
357750
1374500
1374250
1374000
1373750
1373500



Appendix H
Report 6319-R1
Page 1 of 1
Contributed LA10 Noise Emissions
Stage 2 - Without Barriers
Richard Heggie Associates Pty Ltd
Legend
Industrial sources Point
Receiver
Elevation line
Scale factor 1:5000
dB (A) - scale
<= 25
25 < <= 30
30 < <= 35
35 < <= 40
40 < <= 45
45 < <= 50
50 < <= 55
55 < <= 60
60 < <= 65
65 < <= 70
70 < <= 75
75 < <= 80
80 < <= 85
85 < <= 90
90 <
N1
R3
N
55 dBA
50 dBA
45 dBA
356000
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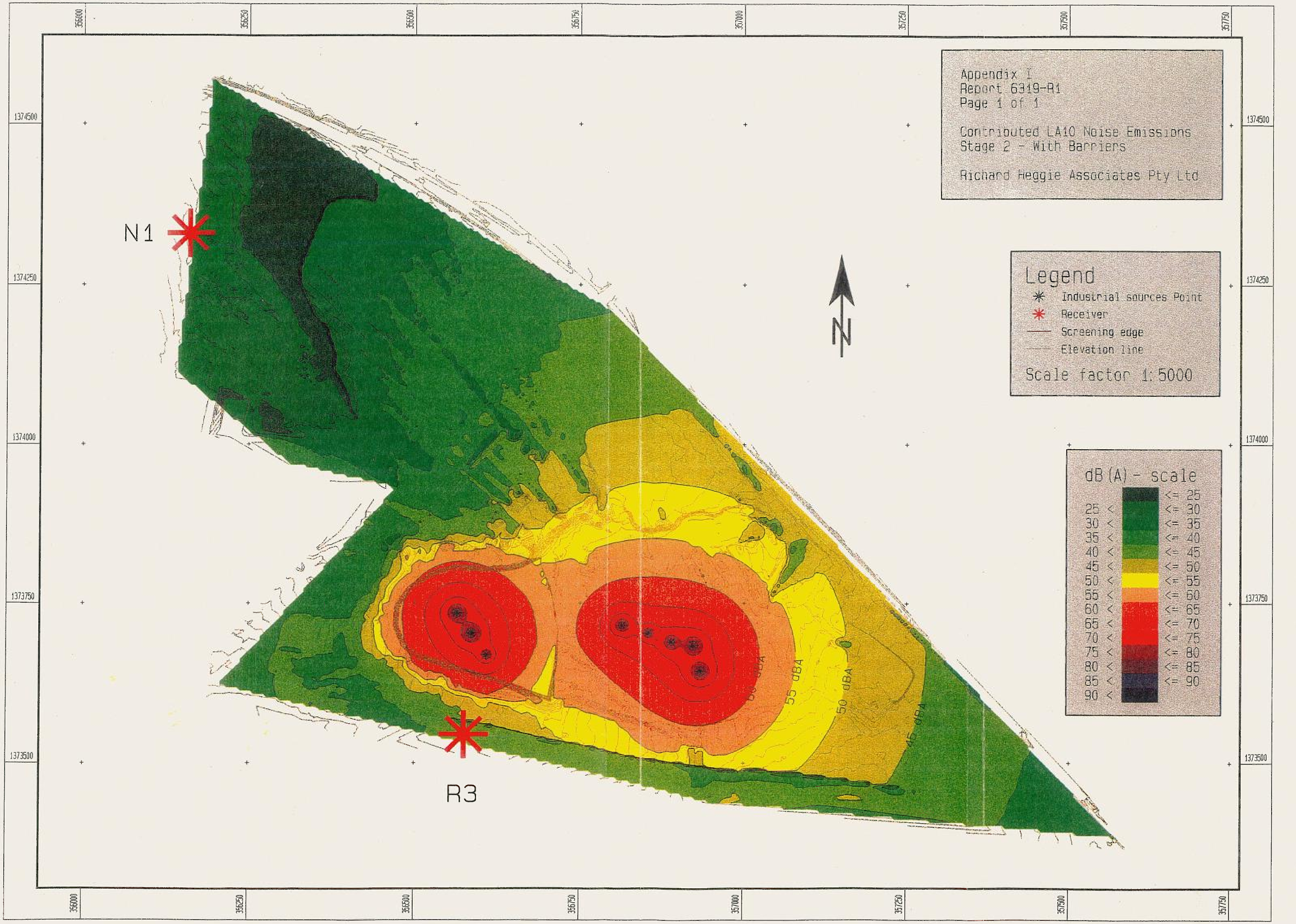
356750
357000
357250
357500
357750
1374500
1374250
1374000
1373750
1373500



Appendix I
Report 6319-R1
Page 1 of 1
Contributed LA10 Noise Emissions
Stage 2 - With Barriers
Richard Heggie Associates Pty Ltd
Legend
Industrial sources Point
Receiver
Screening edge
Elevation line
Scale factor 1:5000
dB (A) - scale
<= 25
25 < <= 30
30 < <= 35
35 < <= 40
40 < <= 45
45 < <= 50
50 < <= 55
55 < <= 60
60 < <= 65
65 < <= 70
70 < <= 75
75 < <= 80
80 < <= 85
85 < <= 90
90 <
N
N1
R3
55 dBA
50 dBA
45 dBA
356000
356250
356500
356750
357000
357250
357500
357750
1374500
1374250
1374000
1373750
1373500

APPENDIX G
DLEMP AND TECHNICAL REPORTS

(I) DLEMP (CMPS&F Environmental)
(ii) Water Management and Landfill Technical Report (Woodward-Clyde)
(iii) Installation of Monitoring Wells and Groundwater Sampling (Woodward-Clyde)
(iv) Stage 2 Groundwater Investigations (Woodward-Clyde)
(v) Groundwater Investigations (Woodward-Clyde)

ENVIROGUARD

METFORD LANDFILL

DRAFT

LANDFILL ENVIRONMENTAL MANAGEMENT PLAN

JULY 1997

Document No VN 5489\RP02

Prepared by

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Fax: (02) 9412 9876
ACN 000 912 630

REVIEW AND APPROVAL RECORD					
REV	DATE	DESCRIPTION OF RELEASE	PREP'D	REV'D	APPR'D
A	4-3-97	Preliminary Draft Report	BMM	RJM	SAD
B	1-7-97	Draft Report	BMM	SAD	SAD
0	23-7-97	Final	RS	[illegible]	[illegible]

TABLE OF CONTENTS

Glossary

Building & Demolition Waste	Waste derived from building and demolition activities
CBD	Central Business District
Clean-up Waste	Household rubbish that is too large to fit in garbage bins. Typically collection of items from a clean-up.
Compost Bins	Large containers, usually made from plastic, for home composting of organic material
Commercial / Industrial Waste	Waste derived from commercial and industrial activities
CSR	CSR is one of the world's largest building and construction material companies, and also has substantial timber, sugar and aluminium operations. Most of CSR's products are well known products such as PGH, Readymix, Monier, Gyprock, or Masonite.
Enviroguard	Enviroguard, a joint venture between CSR and Brambles Industries Ltd , was established in 1993 principally to restore old quarry sites using solid waste as landfill. Enviroguard will be the operators of the Metford landfill, and currently operates the Erskine Park landfill.
EPA	Environment Protection Authority of NSW
Garden Waste	Organic waste from gardens (such as clippings, grass, etc)
Green Waste	Organic wastes including garden waste, food and wood wastes
HDPE	High density polyethylene (plastic)
Landfill	Facility where wastes are buried for disposal.
Landfill gas	Gaseous emissions resulting from the decomposition of organic matter within the landfill. The gas typically comprises 60% methane and 40% carbon dioxide
Leachate	Water that has percolated / migrated through landfilled waste and generally contains contaminants absorbed from the waste material
LEMP	Landfill Environmental Management Plan
LGA	Local Government Area
LRRA now BIEC	Litter & Recycling Research Association (Beverage Industry Association)

MGB	Mobile Garbage Bin, usually a plastic garbage bin with wheels, and generally suitable for mechanical collection.
PET	Polyethylene terephthalate (plastic), such as used for beverage bottles
PGH	PGH was established in 1989 and is wholly owned by CSR Limited of Australia. The organisation manufactures roof tiles, clay bricks, pipes and paver products.
Scavenging	Recovery of waste materials from the active tipping face of the waste landfill
White goods	Household white goods including refrigerators, washing machines, hot water systems and other materials with a high metal content that makes the items attractive to scrap metal merchants.

ACKNOWLEDGMENT

Technical aspects of the proposed landfill development and selected sections of this document have been based on two reports prepared by AGC Woodward-Clyde and provided by CSR Construction Materials:

- Water Management Plan and Landfill Technical Report PGH East Maitland, AGC Woodward Clyde, March 1997 (See Appendix G of CMPS&F's East Maitland Landfill EIS)
- PGH Quarry East Maitland, Installation of Monitoring Wells and Groundwater Sampling, AGC Woodward Clyde, December 1996 (See Appendix G of CMPS&F's East Maitland Landfill EIS)

Please note that the technical aspects of the proposed landfill development reflect and remain Woodward Clyde's recommendations, and not necessarily that of CMPS&F.

1. INTRODUCTION

1.1 GENERAL

Monier PGH Holdings Limited, a wholly owned subsidiary of CSR Limited, proposes to rehabilitate its East Maitland clay quarry site by landfilling with inert solid waste and non-putrescible solid waste. The proposed landfilling operation would be undertaken by Enviroguard under contract to CSR Limited.

This Draft Landfill Environmental Management Plan (LEMP) has been prepared for Enviroguard to accompany a Development Application to Maitland City Council seeking approval for establishment of a Class 2 Solid Waste Landfill. The document has been prepared in accordance with NSW Environment Protection Authority (EPA) guidelines and describes the proposed landfilling operation in some detail. Aspects addressed include:

- a description of the existing site;
- the design and operation of the proposed landfill;
- environmental management measures that would be implemented at the site;
- environmental monitoring that would be undertaken;
- site rehabilitation and post closure management; and
- reporting.

Generally, the Draft LEMP describes the proposed landfilling operation and the level of performance that will be achieved by Enviroguard in developing, operating and rehabilitating the site. The document has been developed to facilitate the safe and efficient operation of the Landfill, to maximise the life of the site and ensure that the environment and nearby communities are safeguarded from pollution and off-site effects.

Enviroguard will ensure all staff employed at the proposed Landfill are familiar with the requirements and operational procedures described in this document.

Further, Enviroguard will ensure that the Landfill is operated in strict accordance with all regulatory requirements as specified in Section 2.

1.2 COMPANY PROFILE

Enviroguard Pty Ltd was created in a joint venture between CSR Limited and Brambles Industries Ltd. The company was established in 1993 principally to restore old quarry sites using solid waste as landfill.

Enviroguard currently operates the Erskine Park Landfill within the Penrith local government area. The operation of this landfill provides a good example of the high standard of facility management and procedures that would be replicated at East Maitland.

The Erskine Park quarry located within a total site area of 168 hectares and with a capacity of some 6 million cubic metres opened for public use in August 1994, and is expected to be completed in 10-13 years. It was one of the first solid waste landfills to be operated within a strict management regime agreed with the NSW EPA and Penrith City Council. The site accepts non-putrescible solid waste deemed unsuitable for recycling or reprocessing, Category 3 asbestos waste, and low level contaminated soils as licensed by the EPA. A recycling centre is located at the site and green waste is shredded and screened for sale via a company subsidiary, Envirogreen Pty Ltd.

Monitoring is an integral part of the Erskine Park site management programme. Parameters included in the programme are noise, dust generation, water quality, litter, rehabilitation and leachate and gas generation. The results of the monitoring programmes are reported on a regular basis to the EPA and Penrith City Council.

One of the major objectives of the Erskine Park project was to rehabilitate the quarry to a form which is compatible with surrounding employment and residential uses. It was therefore essential that the site operations and the final land use remain acceptable to the community. This has been achieved by a programme of continuing interaction between the community and the proponent. On completion the site will be landscaped to form a public park, including bicycle and walking tracks, with a profile shaped into a low hill intended to provide focus for the area.

The proposed development at the East Maitland site will reflect the procedures and experience gained at the Erskine Park site.

2. STATUTORY REQUIREMENTS

2.1 NSW ENVIRONMENT PROTECTION AUTHORITY

2.1.1 Licensing

The Waste Minimisation and Management Act was legislated in December, 1995. The Act and it regulations provides the legislative framework for regulation of solid waste landfilling within NSW. The Act requires various classes of landfills to be licensed. Under the Act the proposed Class 2 solid waste landfill will be required to be licensed by the EPA as the facility will receive greater than 5,000 tonnes of solid waste per annum. An application for such a licence will be made after development approval is granted for the proposal.

In addition to licensing under the Waste Minimisation and Management Act, the proposed landfill will also be required to be licensed under the Pollution Control Act, 1979, in regard to leachate and stormwater control measures. An application for such will also be made once development approval has been granted for the proposal.

2.1.2 Landfill Environmental Management Plan

To provide a consistent and environmentally responsible approach to managing landfills within NSW, the NSW EPA issued some guidelines for solid waste landfilling titled *Environmental Management Guidelines : Solid Waste Landfills*. A performance based approach to landfill management has been adopted by the EPA to allow the most appropriate mechanisms to be implemented to achieve specific environmental goals. The goals and the approach to landfill regulation and management are described in the guidelines. The environmental goals are geared toward:

- preventing water pollution;
- preventing air pollution;
- promoting responsible land management and conservation; and
- preventing hazards and loss of amenity.

The mechanism for EPA regulation of landfilling operations is based around licensing those facilities which have the greatest potential to cause environmental impact. All licensed facilities are required to have a detailed LEMP, which describes the strategy and measures for managing the landfilling operation and achieving the environmental goals as defined in the EPA's Solid Waste Landfill Guidelines. This Draft LEMP has been prepared for the proposed Metford Landfill in preparation for applying for a licence. The document has been prepared in accordance with EPA requirements, as defined in the EPA's Solid Waste Landfill Guidelines and the EPA's *Draft LEMP Preparation Manual*.

2.1.3 Landfill Environmental Goals

A summary of the Solid Waste Landfill Guidelines environmental goals as defined in the EPA's Solid Waste Landfill Guidelines and where to find the proposed measures to achieve the goals in this LEMP is provided in Table 2.1.

2.2 OTHER

Enviroguard shall comply with all relevant requirements of:

i. Acts of the Commonwealth.

ii. Acts and ordinances of the State of New South Wales.

iii. Ordinances, regulations, by-laws, orders and proclamations.

iv. Persons exercising statutory powers enabling them to give directions affecting the operation of the landfill.

TABLE 2.1 ENVIRONMENTAL GOALS AND PROPOSED CONTROL MEASURES

Environmental Goal	Relevant Section of Draft LEMP
1. Water Pollution	
1.1. Preventing pollution of water by leachate	4.6, 4.10, 5.1
1.2. Detecting water pollution	6.1, 6.2, 6.3, 6.4
1.3. Remediating water pollution	6.2, 6.3, 6.4
2. Air Pollution	
2.1. Preventing landfill gas emissions	4.10, 5.2
2.2. Detecting landfill gas emissions	6.5
2.3. Remediating landfill gas emissions	5.2
3. Land Management and Conservation	
3.1. Assuring quality of design, construction and operation	4.21
3.2. Assuring quality of incoming waste	4.7
3.3. Recording of wastes received	4.7, 4.20,
3.4. Minimising landfill space used	4.9
3.5. Maximisation of recycling	4.8
3.6. Remediating landfill after closure	7.1, 7.2, 7.3,
4. Hazards and Loss of Amenity	
4.1. Preventing unauthorised entry	4.15
4.2. Preventing degradation of local amenity	5.3, 5.4, 5.5, 5.6
4.3. Preventing noise pollution	5.7
4.4. Adequate fire fighting capacity	4.19
4.5. Adequate staffing and training	2.1, 4.11, 4.12, 4.16, 6.1

To ensure that the environmental goals are being achieved the EPA requires a significant level of reporting of the landfills operation. This will be undertaken in accordance with EPA requirements and is described in Section 8 of this document.

3. EXISTING SITE

3.1 LOCATION

The PGH Quarry at Metford is located west of Newcastle in NSW. It is approximately two kilometres east of Metford Railway Station, bounded by the Great Northern Railway line along its northern edge. The site, which is divided into two sections by Metford Road, covers a total area of approximately 50 ha. The entrances to both the western and eastern sections of the site are on Metford Road. Figure 1.1 in the main EIS document shows the location of the landfill. The surrounding land use to the west and south is primarily residential.

3.2 LAND USE AND PLANNING

The landfill site is located within the Maitland Local Government Area. Development on the property is subject to state, regional and local planning instruments, including SEPP 37 - Continued Mines and Extractive Industries; SEPP 44 - Koala Habitat Protection; Hunter REP 1989; Hunter Coastal Urban Settlement Strategy 1994; Maitland LEP 1993; and Maitland Development Control Plan No. 4 - Conservation of Clay Resources 1985.

The subject site is zoned 1(b) Secondary Rural Zone under the provisions of the Maitland Local Environmental Plan 1993. This zone contains all rural land which is either not of prime agricultural value or has not been set aside for rural residential development.

The site is currently in a disturbed state as extraction operations have been carried out at the site since 1882. Clay and shale extraction from the site is currently taking place under the following Mining Licences - ML4865 (transferred to PGH on 31 July 1975), ML5090, ML5848, ML2843, ML875 and ML5090.

3.3 LAND OWNERSHIP

The site is crown land and referred to as Portion 2 and Portions 266, 378 and 401, Parish of Maitland, County of Northumberland. Extractive operations have been taking place on the site since 1882.

3.4 TOPOGRAPHY

The Metford site slopes gently to the north-east towards the Hunter River at an approximate grade of 2%. The land to the north-east (north of the railway line) is part of the flood plain of the Hunter River and contains extensive areas of low-lying wetlands. (refer to Figure 2 Woodward Clyde's report, Water Management Plan and Landfill Technical Report, PGH East Maitland.).

3.5 GEOLOGY

The Metford landfill is underlain by sedimentary sequences belonging to the Sydney Basin Tomago Coal Measures of Upper Permian age. The Tomago Coal Measures consist mainly of shales, mudstone and sandstone with a number of coal seams and claystone horizons, some of which are of tuffaceous origin. The sedimentary sequences are characterised by rapid vertical and lateral facies changes to the extent that the more reliable elements for correlation are represented by the coal seams.

Regionally, the Tomago Coal Measures outcrop on the eastern flank of the Lochinvar Anticline and dip gently in a general south-easterly direction towards the coast. However, in the quarry area the formation dips to the west at 7°, due to local structural variation. On site, the surficial coal is vitreous, highly cleated with some trace amounts of pyrite. The majority of the rock type exposed in the quarry area is sandstone, which is soft in parts due to weathering processes.

Recent drilling results confirmed the regional geology with the intersection of surficial silty clay before encountering siltstone, shale or sandstone. Approximately 5m of coal were encountered at a depth of 19m in borehole MOW-07.

3.6 GROUNDWATER HYDROLOGY

The rocks belonging to the Tomago Coal Measures are known to be generally poor aquifers because of their fine grained, cemented nature. Water in these formations are generally stored in fractures and joints and, to the extent that these fractures and joints are interconnected, these formations will behave as aquifers. However, the coal seams represent the more permeable elements of the coal measures formations, and are therefore the more significant permeability paths.

Drilling at boreholes MONW-07 and MONW-08, where coal strata were intersected, confirmed the relatively permeable nature of the coal as an increase in the airlifted water volumes was observed at these levels.

There are nine groundwater wells located on the site as shown in Figure 5.5b in the main EIS document. A summary of groundwater levels measured in these wells is presented in Table 3.1.

TABLE 3.1 SUMMARY OF DEPTH TO GROUNDWATER

Groundwater Bore	Date	Elevation - Top of Bore Casing (mAHD)	Groundwater Depth (m Below Casing)	Groundwater Elevation (mAHD)
MONW-01	11-12-96	12.91	13.14	-0.23
MONW-02	11-12-96	9.84	8.98	0.86
MONW-03	11-12-96	17.89	16.9	0.99
MONW-04	11-12-96	9.91	9.97	-0.06
MONW-05	11-12-96	7.86	*	-
MONW-06	11-12-96	13.42	dry hole	-
MONW-07	11-12-96	19.53	19.04	0.49
MONW-08	11-12-96	25.01	17.14	7.87
MONW-09	11-12-96	9.35	4.87	4.48

* Bore damaged and blocked at 7.85 m

The water levels indicate an uneven head distribution around the site, due to the quarrying activities. The water table in the vicinity of the main pit north-west of Metford Road is significantly influenced by the pit which is acting as a "sink" (MONW-1,2 &4,5). Water levels taken in MONW-08 and MONW-09 on the south-eastern site provide a better indication of the groundwater gradient as it is not affected by the main pit. The groundwater is interpreted to flow towards the east to north-east.

The water levels in MONW-06 (dry), MONW-07 and MONW-08 are below the anticipated final depth of the quarry and of the base of the proposed landfill cells, given as 6m R.L.

The main pit on the north-western side, is below the water table, and therefore above the final depth of the quarry and landfill. Care with the base liner will have to be taken to minimise infiltration and prevent excessive quantities of leachate generated.

The quality of the groundwater in the area was measured by Woodward Clyde (1997). The recorded pH values were slightly alkaline and were consistent over the south-eastern area. However, bores on the north-western area, were slightly acidic. The total dissolved solids (TDS) values measured ranged from 1840 mg/L to 11 100 mg/L. According to Woodward Clyde, these values were atypical, as the recorded values for all monitoring wells have generally been between 3 000 and 5 000mg/L. The groundwater is a predominantly sodium-chloride type.

The groundwater, because of its' salinity and relatively low permeability of the rock mass, has no exploitable common application.

3.7 SOILS

The Metford area is dominated by the Beresfield, Cockle Creek; and Hunter landscapes. These soils are generally characterised with the possibility of high erodability and moderate acidity. Most of the quarry itself is classified as disturbed due to past activities (Matthei 1995a&b).

Potential acid sulphate soils (ASS), have been located in the area north of Raymond Terrace Road, however ASS risk maps shows no occurrence of these soils in the site itself (Murphy, 1995). These soils contain iron sulphides or their oxidation products, which, when the soil is disturbed and exposed to oxygen, sulphuric acid is produced. This acid can acidify the soil water, groundwater and surface waters, hence impacting on surrounding and receiving ecosystems. If the unlikely event that these soils are identified on site, care should be taken to avoid unnecessary disturbance.

3.8 CLIMATE

The Metford-Thornton area experiences a warm temperate climate. Temperature, rainfall, humidity and wind data has been obtained from the Bureau of Meteorology's Williamtown weather station, the nearest official station to the site providing long-term, continuous meteorological records. Mean temperature ranges from a minimum of 6.2 degrees Celsius in July to a maximum of 27.7 degrees Celsius in January. Mean monthly relative humidity ranges from 57.5 percent to 70 percent. Average annual rainfall is 1124 millimetres, with 137 mean number of rain days per year. The period of highest rainfall is from January to June.

3.9 SURFACE WATER HYDROLOGY

The site is within the catchment of Four Mile Creek which has its headwaters near John Renshaw Drive and flows in a northerly direction past the site finally joining the Hunter River east of Morpeth sloping with a pronounced ridge line running generally from south-west to north-west.

The majority of the north-western site area drains to the disused pit, with the remaining running through a natural watercourse on the western side of the area. The estimated volume of water contained in the pit is 120ML. This water will need to be removed from the pit prior to landfilling commencing.

The south-eastern site area has two natural watercourses flowing through; one through the disturbed area and one through the less disturbed south-eastern corner. Both watercourses flow towards the north where they meet and flow under the railway line via a concrete culvert.

Due to its elevation (approximately 10 to 25 m AHD) and natural drainage the site is unlikely to be flood prone.

Woodward Clyde (1997) carried out a limited sampling program of the surface waters of Four Mile Creek. The results taken indicated that pH, suspended solids and chloride were all within the normal range. Low levels of total dissolved solids were recorded (310 mg/L to 920 mg/L). In general, Woodward Clyde (1997) reported that the quality of the surface waters in the area is good and acceptable for livestock purposes except for short periods following heavy rainfall, when high concentrations of bacteria from the adjacent pastures would tend to wash into the creeks and dams.

3.10 FLORA AND FAUNA

A survey of flora, fauna and fauna habitats on the property was undertaken, which identified two vegetation communities on the site - open forest and sedgeland. Open forest covers approximately 17 hectares, or most of the area that is not used for quarrying operations. Most of this community occurs in the eastern block, but a small patch of about 0.6 hectares is present adjacent to the Fieldsend pit to the north-west of Metford Road. The Sedgeland community occurs in several small areas within the open forest community.

A number of fauna species were recorded within the site, although there is a history of disturbance within the site from quarrying activities, clearing and invasion by weed species. A range of birds were sighted, along with a few mammals, reptiles and amphibians. Flora and fauna is detailed in Section 5.11 of the EIS.

4. LANDFILL DESIGN, CONSTRUCTION AND OPERATION

4.1 GENERAL

The proposed landfill will be designed, constructed and operated in accordance with the commitments made in this LEMP to achieve the EPA's environmental goals, and will generally comply with the requirements of the NSW EPA and all other relevant statutory requirements.

It is proposed that the Metford landfill will accept only inert solid waste and non-putrescible solid waste. Potentially recyclable material will be diverted to the Mount Vincent Waste Disposal Depot for recycling. Due to the stable nature of inert and non-putrescible solid wastes, the potential for environmental impact from the proposed landfill, eg from leachate, landfill gas and odour, will be low. Regardless, Enviroguard propose to implement comprehensive measures to minimise any potential for environmental impact, as described in this LEMP. This will include:

- a rigorous waste screening and inspection program;
- a leachate containment and on-site management system;
- stormwater management which aims to minimise the generation of contaminated waters and ensure no detrimental impact on surrounding waterways;
- appropriate site management and staffing to ensure an effective and efficient landfilling operation;
- landfill techniques which minimise leachate generation and nuisance eg litter, odour, dust, noise or vermin;
- a landfill gas management system; and
- a comprehensive environmental monitoring and reporting programme

The following sections describe the design, construction and operation of the proposed landfill.

4.2 SOURCES AND CHARACTERISTICS OF SOLID WASTE

The proposed landfill operation at Metford will seek a licence as a solid waste landfill class 2, as defined in the NSW EPA's Environmental Guidelines: Solid Waste Landfills. Previously this class of landfill was referred to as non-putrescible solid waste landfill.

Typical wastes expected to be received at the proposed landfill includes:

- demolition and building wastes such as masonry, glass, timber and metals;
- excavated material;
- inert manufacturing by-products such as fly-ash and clinker;
- inert consumer items such as furniture and other household waste; and

- commercial waste such as paper, cardboard and packaging from offices.

Waste to be received at the landfill will not include putrescible waste ie. waste liable to putrefaction (rapid degradation by micro organisms such as food, offal or dead animals), or chemical, liquid, hazardous or toxic wastes.

Some of the waste received will be capable of being broken down slowly by micro-organisms. These include garden waste, paper, timber and some plastics. Other waste may decompose by chemical changes such as corrosion or oxidation. In the proposed landfill these will be mixed with inert materials such as masonry, glass and excavated material and will decompose very slowly.

Figure 1.3 of the main EIS document indicates the likely catchment area from which non-putrescible solid waste will be sourced for the proposed landfilling operation. The likely catchment would primarily include Maitland, Newcastle and Port Stephens, with some contributions from Dungog, Cessnock, and possibly Lake Macquarie and Singleton.

The current total quantities of solid waste generated in this likely catchment area would be in the order of 250,000 tonnes per year - see Table 4.1. This estimation was based on 1995 Australian Bureau of Statistics Population data, and waste generation data per person from Maitland City Council and HROC (Hunter Region Organisation of Councils).

On the basis that 80% of the Commercial and Industrial stream and 100% of Building and Demolition stream is non-putrescible, the proposed landfill at East Maitland would have access to a potential solid waste market of approximately 110,000 tonnes per year. Municipal waste would not be accepted at the facility.

TABLE 4.1 TOTAL SOLID WASTE QUANTITY GENERATED IN POTENTIAL CATCHMENT AREA (TONNES/YEAR)

LGA	Population[1]	Municipal Waste[2]	Commercial & Industrial Waste[3]	Building & Demolition Waste[4]	Total Waste Generation
Maitland	51,910	25,436	19,207	7,267	51,910
Newcastle	138,350	67,792	51,190	19,369	138,350
Cessnock	11,630	5,699	4,303	1,628	11,630
Dungog	4,110	2,014	1,521	575	4,110
Port Stephens	25,810	12,647	9,550	3,613	25,810
Singleton	5,092.5	2,495	1,884	713	5,093
Lake Macquarie	1,0185	4,991	3,768	1,426	10,185
Total	**247,087.5**	**121,073**	**91,422**	**34,592**	**247,088**

Notes
1 1995 ABS Figures
2 Based on 490 kg/person/year
3 Based on 370 kg/person/year
4 Based on 140 kg/person/year

4.3 QUANTITIES OF SOLID WASTE

The actual quantity of waste that would be received at the proposed Metford landfill facility would be dependent on many factors including:

- competition from other disposal sites (particularly their pricing policy);
- the opening/closure of other landfill depots in the region;
- restrictions or limitations imposed by or on the landfill operator;
- future waste generation rates (dependent largely on population increases and waste minimisation activities);
- the impact the Waste Minimisation and Management Act 1995 (and associated guidelines) has on the amount of waste diverted from the waste stream (via recycling or other processes); and
- the effect of development in and surrounding areas. It should be noted that the neighbouring LGA of Port Stephens has a relatively high population growth rate, which may correspond to increased construction and generation of wastes.

The potential non-putrescible waste market is in excess of 100 000 tonnes per annum, while the proposed Enviroguard landfill will be restricted to a landfilling rate of 45 000 tonnes per year to minimise the impact of the facility.

4.4 SITE LAYOUT

The proposed site layout is shown in Figure 2 of Woodward Clyde's report, Water Management Plan and Landfill Technical Report, PGH East Maitland. Access to the site is off Metford Road.

The site consists of six pits, four of which are on the eastern side of Metford Road (Pit C, D, E and F) and the other, pits A and B on the western side of Metford Road (Fieldsend Pit). The sales office and manufacturing plant, which are still in use, are located on the opposite side of the road.

The fact that this quarry/landfill is a staged development will influence the site layout in the future. Initially, the existing layout will not be greatly altered by the proposal.

4.5 PLAN OF FILLING

4.5.1 Staging

Following the approval of the proposed development, there will be three main operations that will take place within the site:

1. Extraction of the clay/shale material. This will be used for brick making, however, an amount will be stockpiled for later use as cover material. Removal of this material creates void space for landfilling.

2. Filling of the airspace created with solid waste imported to the site in combination with the stockpiled extracted material which would be returned to the quarry as cover material.

3. Rehabilitation of the site after significant stages of landfilling are complete and the land has been contoured to its final profile.

These activities will be undertaken in a progressive manner over a period of approximately 35 years. The proposed sequence of extraction and landfilling is shown in Figures 2.1a - 2.1e of the main EIS document, and is summarised in Table 4.2 & 4.3.

TABLE 4.2 SUMMARY OF EXTRACTION, LANDFILL AND REHABILITATION STAGING

Stage	Period	Extract	Landfill	Rehabilitate
1	0.0 - 10.2	Area B (C+E+F)	Area A	Area E
2	10.2 - 10.4	Area C(+E)	Area A	
3	10.4 - 13.8	Area C(+E)	Area B	Area A
4	13.8 - 20.7	Area E	Area B	
5	20.7 - 23.5	Area E	Area C	Area B
6	23.5 - 27.8	Area E	Area D	Area C
7	27.8 - 43.1		Area D	
8	43.1 - 53.8		Area E	Area D
9	53.8 - 55			Area E

TABLE 4.3 SUMMARY OF EXTRACTION AND LANDFILLING VOLUMES

Area	Clay/Shale Extraction Volume (m^3)	Landfill Volume (m^3)
A	0	492 899
B	300 000	489 505
C	107 702	129 242
D	0	928 937
E	421 939	506 327
F	5 000	0
TOTAL	**834 641**	**2 546 910**

The total space required for landfill over time will be approximately 2,500,000 cubic metres. Some approximately 167,000 cubic metres of quarry overburden will be returned to the void, mostly as cover material. The remaining 2.3 million cubic metres will be filled using solid waste imported to the site (including 0.13 million cubic metres of solid waste which is suitable for cover purposes).

It is anticipated that landfilling rate will be approximately 47,000 cubic metres per year. This consists of 40,000 cubic metres of waste for landfill and 7,000 cubic metres of cover (both overburden and suitable waste) per year.

Enviroguard will update the filling plan when each cell is started or completed, or when directed by the EPA.

A survey of the landfill shall be undertaken at least every twelve months by a registered surveyor to identify the extent of landfilling and estimate the quantity of landfill space consumed.

4.5.2 Final Landform and Life of the Site

The final landform has been designed as a low slope surface, suitable for future recreational uses as shown on Figure 2.1e, of the main EIS document. Allowance for settlement, estimated to be about 15% of the depth of waste, will be made while still providing for surface water to be shed without ponding. Generally, surface gradients will be about one vertical to 20 horizontal (5%) to promote free surface drainage and minimise the potential for erosion. These areas will be stabilised and landscaped as discussed in Section 7.

It is estimated that the proposed operations will be completed and the site fully rehabilitated some 55 years after commencement

4.6 WASTE DISPOSAL AREA (PIT) PREPARATION AND FILLING

4.6.1 General

It is proposed that landfilling of the voids created by the clay extraction will occur after each clay pit has been exhausted. Preparation of the pit for landfilling will encompass undertaking stormwater diversion drainage works, construction of a base liner and installation of leachate collection drainage. After preparation works are complete the pit will be progressively landfilled. These activities are described in some detail in the following sections.

4.6.2 Stormwater Diversion Drainage

Stormwater diversion drainage will be constructed around the rim of each excavated clay pit to prevent stormwater runoff flowing into the pits. The diversion drainage will typically comprise open channel V drains as shown in Figure 5 of Woodward Clyde's report, Water Management Plan and Landfill Technical Report, PGH East Maitland.

4.6.3 Base Liner

A landfill base liner acts as a barrier for any leachate generated within the cell over a period of time thus minimising the potential for environmental impacts. As specified in the EPA's Environmental Guidelines for Solid Waste landfills (1996), *a leachate barrier system for new landfills and lateral expansions of operating landfills is a liner system that forms a barrier between groundwater, soil and substrata, and the waste. Characteristics of a suitable liner include:*

- *A recompacted clay or modified soil liner at least 90 cm thick with an in-situ coefficient of permeability of less than 10^{-9}m/s.*

- *The surface of the liner should be so formed that once settling has finished, the upper surface of the liner or barrier must exhibit a transverse gradient of greater than 3% and a longitudinal gradient of greater than 1%.*

Results from the clay samples taken from the site are still to be finalised by Woodward Clyde. Therefore it is unknown whether the clay from on-site will be suitable to use for the baseliner of the landfill. If it is not suitable, then measures will need to be taken to import a suitable material to line the base of the landfill.

Groundwater recovery tests were carried out in each of the new bores and the results compared with those obtained from previous investigations. The geometric mean of the permeability values measured for both sides of Metford Road during past and more recent investigations is 2.9×10^{-6}m/s. This value exceeds (ie. is more permeable than) the NSW EPA criteria of 10^{-8}m/s for landfill sites. As a result, wherever a rock base occurs within a potential landfill area, site specific measures, such as utilising a clay or synthetic liner to seal the base and, possibly, the sides of the excavation, would be required to mitigate and overcome the higher permeabilities of the rock mass. The actual extent of the base and side lining would be evaluated once excavation of the clay extraction pits has been completed.

4.6.4 Leachate Drainage

Provision will be made in each landfill area to allow subsurface leachate to be monitored and collected. This will encompass:

- drainage layer constructed over the base liner. The layer will be a minimum 30 cm thick and comprise drainage aggregate having a minimum permeability of 1×10^{-3} m/s;

- grading of the base liner and drainage trenches to a sump, located at the lowest point in the clay pit. The liner and drainage trenches will be have a minimum longitudinal grade of 1%;

- the leachate sump will be constructed above the base liner and comprise coarse drainage aggregate; and

- a 1500 mm concrete riser pipe located within the leachate sump, and founded on a concrete base. The riser pipe will be progressively raised as the pit is landfilled and will have drainage slots cut into the pipe to allow leachate entry.

Typical arrangement and details of the drainage system are shown on Figure 4 in Woodward Clyde's report, Water Management Plan and Landfill Technical Report, PGH Metford.

4.6.5 Landfilling of Each Clay Pit

Each clay pit will be progressively filled in lifts of no greater than 2 metres in height. Figure 4 in Woodward Clyde's report, Water Management Plan and Landfill Technical Report, PGH Metford, shows the typical filling process that would be employed. Details of the actual waste deposition process are described in Section 4.9 and 4.10.

4.7 WASTE RECEIVAL

4.7.1 General

All vehicles entering the site will pass through the gatehouse and weighbridge. Details of each load will be recorded, including vehicle type and registration number together with the nature and volume/weight of the waste.

The gatehouse attendant will undertake random inspections of waste entering the landfill to ensure that only acceptable wastes are landfilled (see Sections 4.7.2 & 4.7.3). Any vehicles observed to be containing waste of a type which is not accepted at the site will be turned away at the weighbridge.

Vehicles will be directed to the active landfilling face/quarry floor, where a tipping supervisor will direct vehicle movements and waste tipping. Once discharged, the tipping supervisor will generally inspect the load prior to compaction and covering. Any potentially unacceptable waste will be isolated for further checking and/or removal from the site. Details of rejected waste and the method of disposal will be recorded.

4.7.2 Wastes to be Accepted at the Landfill

Only wastes classified as Inert Solid Waste and Class 2 Solid Waste, as defined in the NSW EPA Environmental Guidelines: Solid Waste Landfills, will be accepted for disposal at the landfill. This will generally encompass all non-hazardous, non-putrescible, degradable solid waste, including non putrescible commercial and industrial solid waste, and construction and demolition waste.

Putrescible solid waste will not be accepted at the landfill.

Inert solid waste is defined as waste which does not undergo environmentally significant physical, chemical or biological transformations and has no potentially hazardous content once landfilled. This includes building and demolition waste such as bricks, concrete, glass, plastics, metal and timber.

With the exception of those wastes satisfying the EPA's classification and licensing requirements, the following wastes will not be accepted for disposal at the landfill:

- liquid wastes of any description;
- radioactive material;
- any inflammable liquid or material derived from grease, oil, tar, petroleum, shale or coal;
- any sludge or material (unless it can be shown to be innocuous and harmless) being the waste from any industrial process carried on in:

- tanning or leather processing plant;
- petroleum or petrochemical plant;
- chemical plant;
- paint manufacturing plant;
- metal treatment plant;
- vegetable oil or mineral oil plant;
- pharmaceutical or drum manufacturing plant.

- any material containing:

  - asbestos;
  - arsenic;
  - cyanide;
  - sulphide.

- any toxic salt of the following:

Barium	Copper	Selenium
Boron	Lead	Silver
Cadmium	Manganese	Zinc
Chromium	Mercury.	

- any pesticide or weedicide and in particular:

  - chlorinated hydrocarbons;
  - fluorinated hydrocarbons;
  - organophosphates;
  - phenols.

- any soluble acid or alkali or acidic or basic compounds.

4.7.3 Waste Control and Inspection

Enviroguard will conduct a Waste Control Program to ensure that only Inert Solid Waste and Class 2 Solid Waste is accepted for disposal at the landfill.

The Waste Control Program will comprise:

- prominent signage at the entrance to the landfill defining acceptable solid wastes;

- random daily inspection of vehicles entering the landfill. All vehicles suspected of containing unacceptable waste will be refused permission to deposit waste until the waste is verified as being acceptable. Enviroguard will require and collect appropriate evidence from the driver of the vehicle, eg. test certificate, as appropriate, to substantiate that the waste is acceptable;

- random monitoring and inspection of wastes as they are discharged from vehicles at the waste disposal area. All waste suspected of being unacceptable will be segregated and checked as to its acceptability, eg. by detailed inspection and/or testing, as deemed appropriate by Enviroguard;

- monitoring of the deposited waste during spreading, compaction and covering. All waste suspected of being unacceptable will be segregated and checked to determine its acceptability eg. by detailed inspection and/or testing, as deemed appropriate by the Enviroguard;

- documentation of all wastes that are controlled under a tracking system will be checked before acceptance at the site;

- recording of all incidences of identification of unacceptable wastes in the daily operators log. The record will include:

  - details of the waste, eg. type; and
  - source of the waste eg. identification, driver identification and, generator of the waste.

In the event that unacceptable is identified in an incoming vehicle, the vehicle will be refused entry and details of the incident recorded as described above. Enviroguard will advise the driver of the vehicle to contact the EPA for advice on correct disposal of the Excluded Waste.

In the event that unacceptable waste is identified during deposition by a vehicle, Enviroguard will immediately segregate and contain the waste away from the active tipping face. The details of the waste, such as type, the source, and the vehicle and driver identification, will be recorded by the Enviroguard. Enviroguard will advise the driver of the vehicle that the waste is not acceptable and will load the waste back onto the vehicle where practical and safe to do so. The vehicle will then be escorted from the landfill by Enviroguard. Enviroguard will advise the driver of the vehicle to contact the EPA for advice on the correct disposal of the Excluded Waste.

In the event that unacceptable waste is identified during the spreading and compaction of deposited waste Enviroguard will segregate and contain the waste away from the active waste disposal area. Enviroguard will make all practical efforts to identify the source of the waste, including:

- inspecting the waste for possible identification labels on containers; and

- identifying the type of waste and consequently the possible sources.

Enviroguard will contact the EPA to determine the proper acceptable disposal options and will dispose of the unacceptable waste in accordance with the EPA's requirements.

4.8 WASTE MINIMISATION

Waste minimisation is a priority activity for Enviroguard in its business to provide integrated waste management services to the community. The proposed Metford Landfill will comprise one component of Enviroguard's waste management operations and it is proposed that the facility will be a dedicated waste disposal site for commercial and industrial customers only. The general public will not be permitted access to the site for safety, health, and security reasons.

Where possible, recyclable material will be diverted to the Mount Vincent Waste Disposal Depot, Mount Vincent Road, Maitland. Currently the Mount Vincent Waste Disposal Depot provides recycling facilities for the recycling of glass bottles, aluminium cans and engine oil. Greenwaste is accepted at the same charge as mixed waste and is chipped and shredded on site.

The following measures would be considered for the proposed Metford Landfill:

- co-ordination with clients to direct recyclable materials to the Mount Vincent Waste Disposal Depot;
- education of users of the facility to utilise the Mount Vincent Waste Disposal Depot and other nearby facilities for recyclable materials; and
- separation, stockpiling and transport of wood waste and garden waste to Mount Vincent Waste Disposal Depot for processing.

4.9 WASTE DEPOSITION

Waste will be deposited in a manner which minimises any nuisance or environmental impact and achieves maximum practical in situ density thus obtaining maximum practical life from the site.

The total length of the active landfilling face will not exceed 40m. All wastes will be deposited, spread and compacted in layers. Each layer will generally have a maximum compacted depth of 600 mm. Enviroguard will place and compact the deposited waste to achieve a minimum effective density of 850 kg of waste per cubic metre of landfill air space (or 1.18 m^3 of landfill space per tonne of waste). The compactor will generally make 3 to 5 passes over the waste and will not operate on slopes exceeding 25% due to reduced compaction and operational safety considerations.

At the end of each working day the deposited waste will be covered with a minimum of 150 mm of approved cover material. The maximum lift height (of waste), after which a daily cover layer would be applied, is 1.85 metres.

It is proposed that no waste will be deposited into water. Each active waste disposal cell will be maintained in a dry condition during the life of the cell, as far as is practical. All water removed from the active waste disposal cell will be disposed of to the leachate management system (Section 5.1).

Every layer of waste deposited in the landfill will be evenly and properly compacted by a steel wheel landfill compactor to achieve the specified effective waste density. Large bulky wastes such as refrigerators, washing machines, furniture and tree trunks will be broken up before covering. Such wastes will not be deposited in the final lift of a waste disposal cell since settlement of the fill may result in these large items piercing the landfill cap.

All weather access will be provided and maintained within the waste disposal cell for all user vehicles from the sealed access road to the active tipping face.

4.10 COVERING LAYERS

4.10.1 Daily Cover

At the end of each working day, all exposed waste surfaces, will be covered with a layer of compacted soil or other suitable material not less than 150 mm in depth. The daily cover layer will be graded at a minimum 1% slope to prevent ponding of water.

Waste may be covered throughout the working day, as well as at the end of the day if necessary to prevent environmental impact, such as litter or odour.

The material used for the covering of waste will be sourced from stored overburden and waste rock on site, or incoming waste material. Other inert, non-combustible, material may be used.

Enviroguard will ensure there is, at all times, sufficient cover material on site for daily covering of the deposited waste.

In addition, cover material used for daily covering will be stockpiled at a point convenient to the active waste disposal area. The stockpile will be maintained to provide at least 2 weeks supply of cover material. Silt fences and other approved sediment erosion control measures will be provided around the stockpiles as required.

4.10.2 Intermediate Cover

Where a filled area has not reached the final landform level, but due to the staging of filling will remain inactive for a period greater than 3 months an intermediate covering layer shall be applied. The intermediate covering layer will comprise a 300 mm layer of compacted daily cover material over the original daily cover layer. The area will be graded at a minimum 1% slope to promote runoff and will be seeded with a suitable grassing/fertiliser mixture as soon as practical after application of the intermediate cover layer.

4.10.3 Final Cover

The final covering layer will be progressively constructed as soon as practical after reaching the final landform levels. Notwithstanding this, the construction of the final covering layer will commence within one (1) month of completion of waste disposal operation within a cell, weather permitting. It will be completed within three months of the date of commencement. Drawing 2 shows the proposed final cover layer.

4.11 SITE SUPERVISION AND CONTROL

The landfill shall be supervised at all times during hours of operation for the receival of wastes. The landfill shall be operated to ensure the following tasks are undertaken:

- overall supervision of the operation by a person experienced in the operation of a solid waste landfill;
- supervision of the active tipping face of the waste disposal areas;

- daily spreading, compaction and covering of the deposited waste using a specialised landfill compactor; and
- recording of incoming vehicles including estimating waste quantity, type, and source. This will be achieved by the installation of a weighbridge at the entrance of the landfill.

Enviroguard will ensure the effective control of traffic within the landfill and in particular at the active tipping face of the waste disposal area.

Enviroguard will ensure that the equipment engaged in the movement, spreading, compaction and covering of deposited waste in the vicinity of the active tipping face are not operated in such a way as to constitute a risk to persons disposing of waste or the delivering of the waste.

Enviroguard will be responsible for the supply and placing of barricades and/or signs, in order that the above requirements are maintained at all times.

Enviroguard will keep an operators daily log book for recording activities and incidences that occur during the operation of the landfill. Information to be recorded is described in Section 4.19 of this document.

4.12 STAFFING

Enviroguard will ensure that the landfill is appropriately staffed by qualified and experienced personnel. A minimum of two personnel shall be in attendance at the landfill at all operational times. When the landfill is open the gatehouse will be manned and the active landfill face and the transfer station supervised.

At a minimum, staff training will be undertaken to ensure that:

- all operators of compaction or earthworks equipment are skilled at undertaking all tasks required of them;
- all those that operate gas testing, water sampling or water testing apparatus are familiar with required testing and sample retention protocols to a standard approved by the EPA; and
- all those inspecting incoming wastes are skilled at identifying wastes that are unacceptable and accurate data recording.

4.13 HOURS OF OPERATION

Landfill operations will continue throughout the year between the hours of 6.00 am to 6.00 pm Monday to Friday, and 6.00 am to 4.00 pm on Saturdays. The depot will not operate on Sundays or public holidays. It will cease to receive waste an hour before closing time to allow for compaction and the application of cover material.

Typically, heavy earthmoving and landfilling equipment will only operate between 7.00am and 6.00pm Monday to Friday and 8.00am to 4.00pm Saturday. In the event of an urgent need to facilitate burial of wastes or rectify a problem, heavy earthmoving and landfilling equipment may operate outside the above hours.

4.14 EQUIPMENT

Enviroguard will maintain and/or engage sufficient and appropriate machinery, plant and equipment to meet the requirements of the DLEMP. This will include, but is not limited to, equipment for:

- winning and/or retrieving of cover material;
- spreading, compaction and covering of deposited waste;
- compacting, trimming, shaping, grading and levelling of cover layers;
- dust suppression;
- fire control and fire fighting, and
- any other operation required for the proper and efficient operation of the landfill.

Enviroguard will provide additional plant and equipment, as required to allow construction of new waste disposal cells/areas.

Notwithstanding the above, the minimum plant requirements at the landfill, at all times, will be:

- a landfill compactor for spreading, compaction and covering of deposited waste;
- a dozer/loader to assist in the waste disposal operations, and
- a water cart for dust suppression and fire fighting.

All plant and equipment will conform to the relevant Australian Standards.

All machinery, equipment, and plant will be maintained in proper working order in accordance with the manufacturers requirements. In the event of equipment or plant failure Enviroguard will organise replacement plant or equipment as soon as practical to ensure the requirements of DLEMP are fully complied with at all times.

4.15 SECURITY

Public access to the landfill will only be permitted during opening hours. The site is fenced and outside opening hours all access gates will be locked and Enviroguard will maintain the security of the site.

4.16 HEALTH AND SAFETY PROCEDURES

Enviroguard will take all necessary precautions to ensure the safety of all personnel engaged at the landfill and all public visiting the site.

Enviroguard will be responsible for ensuring that all employees are instructed concerning potential hazards at the landfill and that safe working practices are observed.

Enviroguard will provide, equip and maintain a first aid treatment station at the landfill and will have a person, trained in first aid, on site, during all operating times.

It is Enviroguard's responsibility to be familiar with the provisions of the Occupational Health and Safety Act, 1985. The duties and all other obligations that the Act places on an employer will be property discharged by Enviroguard.

Enviroguard will ensure that all necessary protective clothing and safety equipment is available and/or issued to all employees, is maintained in good condition and used where necessary.

4.17 WET WEATHER OPERATION

Enviroguard will ensure that the landfill is able to accept solid waste under all reasonable weather conditions without compromising the environmental management of the landfill. In the event that wet weather prevents access to and/or operation of the waste disposal area, Enviroguard may provide an alterative temporary waste disposal mechanism.

4.18 ACCESS ROAD MAINTENANCE

Temporary internal access roads within the waste disposal areas will be constructed so as to minimise damage to vehicles using the roads and will provide effective access across the waste disposal area. Materials suitable for the construction of such roads, eg building and demolition rubble, will be stockpiled for use when required. Access roads, will be wide enough to permit safe two-way movement by all vehicles using the landfill alternatively they must be arranged to permit one-way flow of traffic.

The use of steel wheel compacters and other heavy earth moving machinery on site access roads will be minimised.

4.19 FIRE CONTROL

The EPA's Solid Waste Landfill Guidelines recommend the development of a fire management plan to minimise the incidence and impact of fire and this will be prepared for the site as part of the licensing process. The fire management plan will detail:

- the procedure to follow, persons responsible and equipment to be used in the event of a fire;
- maintenance schedule for all fire fighting equipment and facilities. This will, at a minimum include, weekly checks of equipment and facilities for damage, and test operation every three months;
- fire fighting equipment at site buildings;
- clear signposting and access of all fire fighting equipment;

- construction and maintenance of appropriate firebreaks; and
- staff training in fire fighting techniques.

A water tanker capable of being used for fire fighting as well as dust suppression will be kept on site at all times and maintained in working condition. This will be provided with adequate water supply.

Enviroguard will comply with all requirements of the Clean Air Act., and therefore prevent fires to minimise emissions to the atmosphere. No waste will be burnt at the site and no fires will be deliberately lit on the site, without the permission of the EPA.

Incoming wastes which are found during inspection to be hot or on fire prior to deposition will be directed away from the active landfilling areas to a location where the material can be extinguished without risk of causing a fire on site.

In the event of a fire occurring at the site, Enviroguard will take prompt action to extinguish the fire. The Local Fire Brigade will be immediately notified of all fires irrespective of the extent of the fire and whether or not it has been controlled. Enviroguard will co-operate fully with the Fire Brigade in fighting fires on the site.

All fire events will be recorded in detail including the date, time, location, expected cause of the fire, time it was extinguished, notification of authorities and whether any future preventative measures are appropriate or were taken.

In the event of a surface fire occurring at the site, water and earth will be used as appropriate to extinguish the fire.

A firebreak, not less than 20 metres wide and cleared of all flammable material will be provided and maintained around the boundaries of the waste disposal area. All sections of the firebreak will be maintained to allow access for firefighting vehicles in accordance with the requirements of the Fire Brigade. Enviroguard will liaise with the Fire Brigade to establish and maintain these requirements.

All employees will receive fire protection, fire fighting and emergency procedures training. Training assistance will be sought from the Fire Protection section of the NSW Fire Brigade.

Enviroguard will hold yearly safety awareness meetings to ensure each employee is conscious of the fire safety standard required and the continued need to operate safely.

Other measures that will be taken to prevent fire include:

- a ban on smoking around the active landfilling area, with clear posted signs indicating such;
- clear posted signs on display to the public advising that flammable liquids are not permitted on the site;
- cell construction, compaction and use of cover material should be undertaken in a manner that prevents fire;

- all sealed or contaminated drums should not be accepted unless they are delivered as a special waste whose contents are clearly identified and suitable for acceptance; and

- all fuels or flammable solvents for operational use should be stored in an appropriately ventilated and secure store.

4.20 RECORD KEEPING

All vehicles entering the landfill will be recorded, along with the tonnage of waste weighed over the weighbridge. Each month details of the amount, type and source of waste will be reported to the EPA by Enviroguard. The format of the data will be in accordance with EPA requirements.

An annual survey of the site, carried out by a registered surveyor, will be used to calculate the amount of landfill space that has been used in the preceding twelve months. The survey results and records of tonnages deposited will be used to determine the compaction density that is being achieved. These results will be included in the annual report to the EPA.

Enviroguard will establish controls to prevent unrecorded vehicular access to the landfill.

4.21 QUALITY ASSURANCE

Once development approval of the proposal has been granted, the following measures will be undertaken to assure the quality of the design, construction and operation of the proposed landfill:

- design and document the landfill development under a quality system accredited to AS/NZS/ISO 9001:1994;

- construct the landfill under a quality system accredited to AS/NZS/ISO 9002:1994;

Enviroguard will also consider that an Environmental Management System for the facility be developed and operated in accordance with the requirements of AS/NZS/ISO 14000.

5. ENVIRONMENTAL MANAGEMENT

5.1 WATER

5.1.1 General

Four Mile Creek and the Hunter River are not classified waterways under the Clean Waters Act and, therefore, no specific water quality criteria is applicable for industrial discharges. Nevertheless, any discharge to the watercourses in the area, other than uncontaminated stormwater, will be subject to a licence issued by the EPA under the Pollution Control Act.

Site operations will generate different quality surface waters, which include:

- runoff from undisturbed areas (clean water runoff);
- runoff from disturbed areas (turbid water runoff);
- runoff from within the landfill (leachate);
- possibly occasional leachate from within the landfill; and
- dirty water from operational activities on the site eg. truck wheel wash facility.

Management of water on site is aimed at:

- preventing deterioration of surface and groundwater quality in the vicinity of the site;
- ensuring water is available to meet operational requirements; and
- using the poorest quality of water acceptable for each particular task.

Wherever practical clean stormwater runoff will be diverted around disturbed areas of the site to minimise the generation of dirty water.

As part of the licensing process, plans and specifications for all water management activities will be submitted to the NSW EPA and DLWC for approval prior to construction.

In the following sections the sites' water requirements, and the proposed management of clean water, dirty water, and leachate are outlined.

5.1.2 Water Demands

Water is required for staff amenities, dust suppression and irrigation of areas undergoing rehabilitation. Dust suppression will be required during dry weather on unsealed active haul roads and cover material excavation areas. Watering of revegetated areas will be achieved by spraying runoff collected from disturbed areas. Leachate from the landfill will be sprayed back onto the landfill or, if of sufficient quality, used to irrigate revegetated areas.

Based on a water application rate of 1.5 times the average evaporation rate (1.2 m per year), the maximum water demand for dust suppression is estimated to be approximately 2 megalitres annually. The majority of this can be met by storing stormwater runoff. Landscaping and quarry rehabilitation areas will require water at a rate of 300mm per year over an area of about one hectare. This is equivalent to a demand of about five megalitres per year.

The total annual requirement for non-potable water will, therefore be approximately seven megalitres. Based on a water balance assessment, Woodward-Clyde (1997) report that the majority of this demand can be met by storing stormwater runoff (dirty/turbid water) and when shortfalls occur, water could be sourced from the reticulated supply from Hunter Water. Leachate from the landfill could also be used to irrigate revegetated areas, if found to be of suitable quality.

Existing sedimentation ponds provide treatment of the water prior to discharge from the site.

In order to meet EPA water discharge conditions that are likely to be imposed, two new sedimentation dams, one on each side of Metford Road, are to be constructed to provide adequate protection of the watercourses through the period of extraction/landfilling.

5.1.3 Stormwater

Wherever practicable, clean water runoff will be diverted around disturbed areas to minimise the volume of sediment laden water, which will be collected, treated and used on site.

Clean stormwater runoff from undisturbed areas of the site will be diverted away from disturbed areas, wherever practical, and allowed to discharge off site.

Storm water runoff from areas of the site which have been stripped of vegetation cover, either for cover material or unsealed haul road construction, will be considered potentially turbid and directed by open earth catch drains (and pipe drains if necessary) to strategically located settlement ponds. These dams, referred to as Dams 1 and 2, will be located in the lowest corner of the respective catchment areas.

A conceptual plan for management of stormwater on the site following the above philosophy has been developed by Woodward-Clyde and is shown on Figures 3 and 4; and typical details of the sedimentation ponds are provided in Figures 5 of Woodward Clyde's report, Water Management Plan and Landfill Technical Report, PGH Metford.

The proposal will require a small workshop to be located near the office/weighbridge for minor equipment maintenance. All runoff arising from within the workshop will drain to a trade waste sump which will be regularly emptied by a licensed waste contractor.

Enviroguard will design, construct and maintain all temporary stormwater drains that may be required to prevent stormwater runoff from entering the active waste disposal area.

All temporary drains will be earthen drains constructed at grades no steeper than 1%, to minimise scouring. Where these grades cannot be achieved, steeper graded drains will be lined with appropriate scour protection, eg. jutemesh, concrete etc. All earthen drains will be grassed to minimise erosion.

All drainage structures will be designed in accordance with the relevant design criteria, including the EPA's "Environmental Guidelines: Solid Waste Landfills", Department of Land and Water Conservation "Urban Erosion and Sediment Control" 1992, and "Australian Rainfall and Runoff". Plans and specifications for all clean water diversion works will need to be submitted to the Environment Protection Authority, the Department of Land and Water Conservation and Wyong Shire council for approval prior to construction.

Generally a minimum grade of 1% will be adopted for sizing drains. For a 1% slope, typical earth catch drains will be 200mm deep with side batters of 1 vertical to 3 horizontal, to carry the flow in each of the catchment areas (Woodward Clyde 1997). The size of the drains will vary over the length of the drain as the catchment area and hence the volume of water increases. A more detailed analysis will be included in the final engineering design of the drains.

5.1.4 Leachate

Leachate is deemed to include all water that has come into contact with waste.

The proposed landfilling operation will only accept inert waste and Class 2, solid waste. This is non-putrescible waste and as a result leachate that may be generated by the landfill will not contain the high level of contaminants that is commonly found in leachate from a putrescible waste landfill. In spite of this, Enviroguard will ensure the collection of all surface and subsurface leachate so that no leachate nor leachate contaminated water will be discharged to local surface waters or groundwaters.

All practicable measures will be taken to minimise the volume of leachate generated, including :

- grading of the land surface around the rim of each quarry pit or construction of bunding or diversion drainage to prevent surface water from flowing into the landfill area;
- minimising infiltration of surface water through the landfilled waste by providing the specified cover layers and grading the cover layers to promote runoff; and
- minimising the contamination of surface water runoff by undertaking proper covering of the deposited waste, by grading filled areas to direct surface water runoff away from the active waste disposal area and by minimising exposed areas at the landfill.

Stormwater and surface run-off generated within the landfill area, will be designated 'dirty' water. It will be directed via drainage channels into a dedicated pond located on the active fill, this pond will be continually relocated, being constructed using clay sourced on site, as the clay pits are filled. The dirty water will be pumped out of the landfill area to a more permanent 'dirty' water/leachate collection pond on the surface.

Enviroguard will ensure that all surface generated leachate is collected and discharged into the leachate management system. Temporary earth catch drains will be constructed, as required, to collect surface leachate. The temporary earth drains will be constructed in accordance with the requirements of DLWC and the EPA.

To contain any leachate that may be generated within the landfilled waste, a base liner will be installed within each clay pit. Details have been described previously in Section 4.6. A leachate collection system formed by, grading the base liner and constructing drainage layers that will direct leachate to a collection sump which will be fitted with a concrete riser pipe, this will allow early identification and monitoring of leachate. Details have been described in Section 4.6. This system will also allow leachate to be extracted, treated and disposed of if necessary.

Two dirty water / leachate collection ponds would be constructed to cater for the proposed landfill areas. The ponds would nominally be sized to hold $40m^3$. A typical arrangement is shown on Figure 5 in Woodward Clyde's report, Water Management Plan and Landfill Technical Report, PGH Metford.

All collected leachate will be stored on-site in the leachate ponds. The ponds will be maintained to ensure that no leachate leaks through the bed or banks of the pond. Water in the dams will be used, during dry weather, to ensure that an adequate volume is available for run-off storage during wet weather.

Collected leachate will be disposed of by irrigating over inactive landfilled areas (not accessed by the public) as well as used for dust suppression (in suitably secure locations on site). Irrigation will only take place on revegetated areas in order to avoid erosion. Prior to irrigating revegetated areas, the quality of the leachate will be monitored to ensure no damage to vegetation.

5.1.5 Other Water

The proposal will necessitate provision of toilet and wash facilities for landfill employees. All wastewater generated by these facilities will be collected in a storage tank and regularly collected by a licensed sullage contractor, or an Envirocycle system will be installed.

Employees working in the quarry currently use amenities located near the brick manufacturing plant. This system is on the sewer, and will not require modification as a result of the proposal.

Wash down water from the truck wheel washing facility would be directed into the leachate collection pond as managed as if leachate.

5.1.6 Maintenance

All stormwater drainage works will be maintained in proper functioning order so as to prevent flooding of the landfill and contamination of local waterways. Maintenance will include:

- regular cleaning of drains/pipes/pits and removal of accumulated sediments;
- regular trimming of overgrown vegetation, and
- stabilisation of eroded drains.

The leachate drainage system will be maintained in an operable and effective condition at all times. Care will be taken to ensure the leachate drainage pipes are not damaged by waste disposal or other operational activities. Enviroguard will undertake periodic inspection and maintenance of leachate drainage pipes and catch drains, where possible, to ensure the on-going effectiveness of the leachate collection system.

All leachate sumps and pipelines will be considered hazardous areas and will not be entered until all requirements of the Occupational Health and Safety Act - Confined Spaces Regulations have been satisfied. Manproof covers will always be in place and signs on the cover will indicate the hazard present. All appropriate regulations relating to confined spaces will be observed.

All employees, subcontractors or agents of Enviroguard operating at the landfill will be instructed of the hazards present in these sumps and drainage pipes.

Enviroguard will maintain the leachate storage ponds in proper and effective working order. Such maintenance will include:

- maintaining the active volume of the ponds by periodic cleaning and removal of sediment and excess vegetation;
- freeing outlets of debris, sediment and excess vegetation growth; and
- maintaining the integrity of the pond embankments.

5.2 LANDFILL GAS

The expected rate of gas generation for the Metford landfill is low because it is a non-putrescible landfill. Therefore, it is likely to be managed through passive venting of the gas through the landfill cover layers. Monitoring of gas generation will be carried out as landfilling proceeds (Woodward Clyde, 1997).

An appropriate gas extraction/control system would be implemented should gas monitoring show that the atmospheric methane concentrations regularly exceed 25% of the lower explosive limit (LEL). This will be identified via the Landfill gas monitoring system. If the concentration of gas or odour becomes a problem, a series of temporary gas extraction wells may be installed to permit flaring of the gases. Flaring of the gases extracted from the landfill will destroy the odorous traces associated with the landfill gases.

Prior to final capping of the landfill cell a gas drainage layer will be constructed. This will consist of a number of trenches 30 cm deep constructed across the surface of the waste material and terminating at appropriate locations around the perimeter of the filled landfill. The trenches will be filled with suitable media to allow movement of landfill gas to venting points for passive venting or flaring, depending on the recorded volumes of gases.

5.3 ODOUR

As putrescible wastes will not be landfilled at the site odour is not expected to be a significant issue, however, the landfill will be operated in a way that minimises the generation of odours, thus minimising possible effects in the surrounding area.

Odours can be significantly reduced by operating the site in accordance with sanitary landfilling methods and good site management. Such as:

- filling from the high end of the waste disposal cells towards the lower end, thus ensuring minimal surface water entrappment in the waste;
- not depositing waste in standing water;
- depositing wastes in thin layers to optimise compaction;
- covering all exposed waste at the end of each working day with at least 150 mm of daily cover material;
- the use of deodorising sprays when required; and
- minimising disturbance of previously filled areas.

A record of complaints regarding odours shall be kept in the daily log book.

5.4 LITTER

All practicable measures shall be taken to confine litter arising from the operation of the landfill, within the boundaries of the site.

Movable litter screens shall be used as necessary at the active waste disposal area to control windblown waste.

Regular litter patrols will be undertaken along the boundary of the landfill and along roads leading to the landfill. In the event of windblown litter being discharged from the site Enviroguard will collect and dispose of the escaped litter as soon as possible, but no longer than 24 hours after the event.

Each week litter screens, litter fencing and other site fencing will be cleared of litter.

All loads entering the landfill must be covered. Enviroguard will enforce load covering to prevent litter.

5.5 VERMIN

As the landfill is non-putrescible, vermin are not anticipated to be a critical issue. However, should they become a problem, Enviroguard may implement a vermin control program for the landfill. Vermin could be insects, rodents, foxes, birds, feral cats or other pests.

The vermin control program may include:

- the use of insecticides and pesticides;
- baiting; and
- the use of scarecrows and or other bird scares.

The need for such a control program will be minimised by utilising effective sanitary landfilling methods including good compaction and covering of deposited waste, and of the covering layers.

Care shall be taken to ensure that pesticides do not enter stormwater or leachate or pose an airborne pollution hazard or nuisance.

Enviroguard will ensure that the leachate and sedimentation ponds are kept free from mosquito breeding larvae and that no other water ponds develop where mosquito breeding could take place.

5.6 DUST

All practicable measures shall be taken by Enviroguard to minimise dust emissions arising from the operations of the landfill. These include:

- minimising vehicle access to landfill face by directing all small vehicles to the transfer station;
- immediate burial and covering of dusty loads; and
- use of a water cart, dust suppressant chemicals, or surfactant wetting agents as required.

5.7 NOISE

All practicable measures will be taken by Enviroguard to minimise operational noise emissions. Noise levels, at any residence outside the boundary of Enviroguard's land, may not exceed levels specified in the Noise Control Act and associated regulations.

Noise reduction measures could be:

- maintaining all landfill plant and machinery in proper working order;
- locating all internal access roads and fixed plant as far as is possible from residential areas;

- ensuring that all vehicles accessing the site use the designated access roadways; and
- construction of temporary earth bunding or growing screening vegetation to attenuate noise emissions.

Enviroguard shall implement such measures as are necessary to satisfy all EPA requirements relating to noise pollution.

5.8 OTHER

5.8.1 Vehicle Wheel Washing

A facility for cleaning the wheels of the vehicles leaving the site shall be provided. This is to minimise the potential impact on local amenity and stormwater runoff that could occur by vehicles carrying mud and litter off site. Signs shall be displayed advising users of the landfill that it is their responsibility to ensure that remnants of their loads or material stuck to the underside of their vehicle does not litter public roads. Water from wheel washing will be diverted to the settlement ponds, where it will be treated along with the disturbed surface water runoff.

5.8.2 Bund Walls

Bund walls will be constructed, if necessary, to minimise noise, odour or dust emissions and to improve the aesthetic appearance of the site.

5.8.3 Noxious Weeds

Noxious weeds that occur on the site will be controlled to prevent spreading into surrounding areas. The program will be monitored by the site manager.

6. ENVIRONMENTAL MONITORING

6.1 GENERAL

Enviroguard will undertake regular monitoring in accordance with any licence conditions set by the NSW EPA. Monitoring will typically include ground water, surface water, leachate, landfill gas and dust to ensure that the landfill does not have a detrimental environmental impact.

Every 12 months the operation will be reviewed to assess the compliance with regulatory requirements and the Environmental Management Plan.

Sampling will be carried out in accordance with EPA acceptable procedures as described in the EPA's Environmental Management Guidelines fro Solid waste Landfills (1996).

All analyses of samples will be performed by a laboratory accredited by the National Association of Testing Authorities (NATA) to undertake the analyses specified. Minimum field quality control will comprise:

- testing of field blanks, these must represent 5% or at least one blank where less than 20 samples are analysed in a batch. A documented investigation report is required if the blanks exceed the required detection limits;
- testing of field spikes, these must represent 5% or at least one spike where less than 20 samples are analysed in a batch. A documented investigation report is required if spike recovery is outside the 80 to 120 per cent range; and
- testing of duplicated field samples, these must represent 5% or at least one duplicate where less than 20 samples are analysed in a batch. A documented investigation report is required if the variation between duplicates exceeds 20% difference.

Statistical analysis will be used to analyse the results and determine if there is significant change in the indicator parameters.

After two years of monitoring it is proposed that the monitoring program be reviewed, particularly in regard to the water quality parameters which may be reduced to a set of trigger parameters.

The following sections outline in more detail the proposed environmental monitoring program.

6.2 GROUND WATER

A groundwater monitoring program will be implemented to provide a means of checking for leachate migration from the landfilled areas and to identify and characterise the impact of any leachate on the ground water system.

The number and location of groundwater monitoring bores are shown in Figure 2 Woodward Clyde's Report on Installation of Monitoring Wells and Groundwater Sampling (1996).

Enviroguard will monitor the quality of ground water from all monitoring bores. The monitoring interval will be three months, or more regularly at Enviroguard's discretion. Monitoring will comprise:

- measurement of depth to groundwater; and
- analysis of groundwater samples for the parameters shown in Table 6.1.

TABLE 6.1 WATER QUALITY MONITORING PARAMETERS

LABORATORY ANALYSIS	
• Total Dissolved Solids [1]	(mg/L)
• Suspended Solids	(mg/L)
• Bicarbonate [1]	(mg/L)
• Carbonate [1]	(mg/L)
• Biological Oxygen Demand [1]	(mg/L)
• Chemical Oxygen Demand [1]	(mg/L)
• Total Organic Carbon	(mg/L)
• Nitrite as N [1]	(mg/L)
• Nitrate as N [1]	(mg/L)
• Ammonia - Nitrogen	(mg/L)
• Total Kjeldahl Nitrogen [1]	(mg/L)
• Total Phosphorus [1]	(mg/L)
• Arsenic [1]	(mg/L)
• Aluminium [1]	(mg/L)
• Iron	(mg/L)
• Zinc [1]	(mg/L)
• Copper [1]	(mg/L)
• Cadmium [1]	(mg/L)
• Chromium	(mg/L)
• Absorbable Organic Halogens	(mg/L)
• Total Alkalinity	(mg/L)
• Calcium	(mg/L)
• Chloride	(mg/L)
• Fluoride	(mg/L)
• Magnesium	(mg/L)
• Manganese	(mg/L)
• Mercury [1]	(mg/L)
• Total Phenolics	(mg/L)
• Potassium	(mg/L)
• Sodium	(mg/L)
• Sulfate	(mg/L)

TABLE 6.1 WATER QUALITY MONITORING PARAMETERS CONT'D

FIELD MEASUREMENT	
• Electrical Conductivity	(µS/cm)
• Dissolved Oxygen	(mg/L)
• pH	
• Temperature	(°C)
• Redox Potential	(mV)

Note: [1]. These parameters are specified in the NSW EPA's Solid Waste Landfill Guidelines.

If monitoring indicates that groundwater or sub soil has been contaminated, the affected monitoring bores will be resampled as soon as possible after this indication. If resampling confirms contamination, the EPA will be notified, in writing, within 14 days. Within 28 days of the written notification a groundwater assessment program will be prepared, the aim will be to identify the specific contaminants and delineate the extent of pollution. This plan would be submitted to the EPA for approval prior to implementation. Information collected during the groundwater assessment program will be used to prepare a groundwater remediation plan, if required.

6.3 STORMWATER

A stormwater monitoring program will be implemented to identify and characterise the quality of the surface water generated on-site and to assess any impacts of any discharge on local surface water.

Enviroguard will monitor the quality of surface water discharged from the site (near Four Mile Creek) every three (3) months, or more regularly at Enviroguard's discretion. Sampling will take place during or immediately after wet weather, where possible. If no discharge occurs from the site at the time of monitoring, or it was not possible to sample a discharge event in any given three month period, then samples will be taken from the stormwater ponds as required by the EPA. Analysis of the surface water samples will be for the same parameters listed in Table 6.1.

Surface water samples will also be collected from the nearby water course (Four Mile Creek) every six months, or more regularly if required by the EPA, and the samples would be analysed for the parameters listed in Table 6.1.

If monitoring indicates that contamination of any local surface water course has occurred, the affected sampling locations will be resampled as soon as possible thereafter. If contamination is confirmed, the EPA will be notified, in writing, within 14 days. Within 28 days of the written notification a surface water assessment program will be prepared, which aims to identify the source of contamination, and extent of surface water pollution. This plan would be submitted to the EPA for approval prior to implementation. Information collected during the surface water assessment program will be used to plan remedial drainage measures and to prepare a surface water remediation plan, if required.

6.4 LEACHATE

Enviroguard will implement a leachate monitoring program to allow characterisation of leachate generated by the landfilled waste., This will assist with interpreting groundwater and surface water monitoring results and will trace the development of degradation processes occurring within the landfill, showing when the waste has stabilised. The monitoring will also allow assessment of the leachate's suitability for irrigation onto completed areas of the landfill.

It is proposed that leachate samples from the riser or from the leachate dams will be taken every 6 months, or more frequently if required by the EPA. The samples will be analysed for the parameters listed in Table 6.1.

To initially characterise the leachate, the first four samples collected from the leachate dams will be analysed for aromatics, volatiles, halocarbons and base, neutral and acid extractable organic contaminants. This will include screening for monocyclic aromatics, halogenated hydrocarbons, phenols, organochlorinated pesticides (OCP's), organophosphate pesticides (OPP's), Polychlorinated Biphenols (PCB's) and Polycyclic Aromatic Hydrocarbons (PAH's).

In addition, the water level and frequency of pumping out of each riser will be recorded as well as an estimate of the quantity of leachate removed.

6.5 LANDFILL GAS

Landfill gas generation is not expected to be high, as the wastes will be non-putrescible. In spite of this, regular monitoring of landfill gas will be undertaken, as landfilling proceeds, to ensure that the levels of methane at the landfill do not present a hazard.

The proposed monitoring program will encompass:

- quarterly atmospheric monitoring;
- quarterly gas accumulation monitoring within any buildings within 250m of the landfilled waste;
- quarterly monitoring of emissions from within the concrete riser pipes.

Sampling and analysis will be in accordance with EPA requirements as specified in their Solid Waste Landfill Guidelines.

Should monitoring indicate levels of methane in excess of 1.25% (v/v) the EPA would be notified within 24 hours and further monitoring would be undertaken within 14 days to assess the hazards presented by the emissions. If the assessment shows the need, an appropriate gas extraction/control system may be implemented. This may encompass the installation of a series of temporary gas extraction wells to permit flaring of the gases. Flaring of the gases extracted from the landfill will also destroy traces of odorous gases that may be associated with the other landfill gases.

6.6 DUST

Dust from the landfills will be monitored by installing dust deposition gauges in accordance with AS 2471.1-1984 (Ambient Air Particulate Matter, Part 1 - Determination of Deposited Matter Expressed as Insoluble Solids. Ash, Combustible Matter, Soluble Solids and Total Solids.) These dust deposition gauges will be equally spaced around the boundary of the landfill and will remain for a period of 2 years.

The results from dust monitoring will be compared against relevant EPA criteria. The need for dust mitigation measures and additional monitoring of dust deposition will be re-evaluated after two years when a reasonable estimate of annual average dust deposition will be available.

Sampling and testing will be done by a suitably qualified person and a National Association of Testing Authorities registered laboratory.

6.7 NOISE

It is not proposed to undertake any noise monitoring, due the proposed control measures, however, if noise complaints are received at the proposed landfill, then Enviroguard will investigate the need for a noise monitoring programme.

6.8 COMPLAINTS

Enviroguard will clearly display at the entrance of the site, and on the site, the contact details for any person wishing to make a complaint.

Enviroguard will maintain a complaints register and all complaints will be registered. Details of the complaint and the person reporting the complaint will be recorded.

All complaints will be dealt with promptly. Any action resulting from a complaint will be recorded and reported to person making the complaint.

The complaints recorded will be made available to the EPA for review upon request and all complaints will be reported in the annual review report.

7. SITE REHABILITATION AND POST CLOSURE MANAGEMENT

7.1 INTRODUCTION

It is proposed that the voids created by the clay extraction activities will be rehabilitated by progressive filling with solid waste and quarry overburden. As sections of the quarry are filled, the final landform will be capped and landscaped.

Landfilling operations for the proposed development will commence some two years after development consent is issued when the quarry has advanced sufficiently to allow simultaneous quarrying and landfilling. The gross quarry void will be approximately 2.5 million cubic metres. Approximately 167,000 cubic metres of quarry overburden will be returned to the void, mostly as cover material. The remaining 2.3 million cubic metres will be filled using solid waste imported to the site (including 0.13 million cubic metres of solid waste which is suitable for cover purposes).

The rate of filling with waste and cover will be greater than the rate of void creation: approximately 47,000 cubic metres per year. This consists of 40,000 cubic metres of waste for landfill and 7,000 cubic metres of cover (both overburden and suitable waste) per year (or 135 cubic metres and 24 cubic metres per day respectively).

The following sections provide a description of the proposed rehabilitation and post closure management activities.

7.2 SITE REHABILITATION

7.2.1 Future Land Use

The rehabilitated site would provide the opportunity to return the area to its earlier use as an open space, passive recreation for urban bushland areas. Final usage would be determined closer to the completion date of the landfill activities when local requirements were much clearer. However, whatever uses are eventually determined, the rehabilitation and future management of the site will recognise and reinforce its contribution to local habitat values. Figure 2.1f in the main EIS document illustrates the future uses and rehabilitated site.

7.2.2 Final Landform

The final landform of the site (see Figure 2.1e in the main EIS document) will result in a marginally different profile from that existing prior to any activity taking place. The ground profile will be raised in a dome shape in order to accommodate long term settlement (up to 15%) and maintain drainage run-off to the periphery. The perimeter bunds will be reshaped on their inner faces to remove any unnatural appearance and to blend into the re-contoured profile resulting from the overtopping. This new profile will be designed to achieve the following:

- encourage maximum runoff from the site thereby reducing the potential for infiltration and the production of leachate; and
- provide an interesting final landform of a natural appearance suitable for an appropriate end-use.

The landform will be finished with a gas drainage layer followed by an impervious cap. The former will consist of a number of trenches, 300 millimetre thick, constructed across the surface of the waste and terminating at appropriate locations around the perimeter of the landfill. These trenches will be filled with a suitable drainage media which will allow any collected landfill gas to be directed to the selected venting points for passive dispersion or flaring, depending on the volume of gas.

The construction of the impervious cap will be designed to achieve the following:

- minimise the infiltration of rainwater;
- contain the waste to prevent the effects of windblown litter, dust and odour;
- assist in the management of surface water; and
- provide a growing medium for the rehabilitation of the site.

Details of the proposed final capping (cover) layer are described in Section 4.10.

7.2.3 Landscaping

Earth mounds around the southern and western boundaries of the site will be quickly stabilised and landscaped following construction. Landfill areas will be progressively rehabilitated as final contours are reached. Parts of the site is currently screened by established planting, mainly along the southern perimeter. This will be reinforced with by planting fast growing indigenous trees to provide an appropriate screen and blend with the natural landscape. The use of indigenous species would also restore natural wildlife habitat., particularly in the eastern areas of the site.

All grassing will be carried out using a machine drill working up and down the slopes. Hydromulching is recommended to speed the growing of vegetation on final slopes and provide some soil stability until the vegetation cover develops.

Seeding would be accompanied by optimal application of superphosphate and trace element fertiliser. The rate of application will be determined by testing the soils on the reconstructed landfill.

Grass planting will be established as an initial cover crop to minimise erosion potential, using the following seed mix:

- Kangaroo Valley Rye grass 9 kg/ha
- Red Clover 5 kg/ha
- White Clover 3 kg/ha
- Rhodes Grass 5 kg/ha.

Final rehabilitation may also include tree planting, to complete the landscape works for the site, with special provision to ensure that tree roots do not penetrate the clay capping layer. On-going management will involve supplementary sowing/planting works, fertilisation and cropping or controlled grazing. In order to make a positive and significant contribution to the ecological resources of the area it is proposed, as far as possible, to raise seedlings from seed collected on site.

Once the initial grass cover has been established to reduce the risk of erosion, the long term objective is to re-establish native grasses (including Kangaroo Grass and Wallaby

Grass). These grasses would have originally occurred on the site and their use would supplement the ecological value of the area and will reducing on-going maintenance requirements.

7.3 POST CLOSURE MANAGEMENT

7.3.1 Environmental Management

Ongoing management of the site would be undertaken following closure of the site for landfilling. This would consist primarily of continuing monitoring of the site and any maintenance action should it be required. (See Section 7.3.3).

Enviroguard will ensure that all leachate collection, gas collection, stormwater controls and reporting practices are maintained at the same level employed during the operational life of the landfill. The environmental management measures will continue until Enviroguard can demonstrate that the landfill does not pose a threat to the environment.

Enviroguard will ensure that waste materials are not received for disposal at the site after the landfilling operations cease. Any waste materials that are intended for use in the rehabilitation will be documented and reported in the same method used during the operation of the landfill.

7.3.2 Environmental Monitoring

Enviroguard will maintain the same monitoring program as used throughout the operation of the site and described in Section 6, except for dust and noise monitoring which will be discontinued. Monitoring will continue until Enviroguard can demonstrate that the landfill no longer has the direct potential to impact on the environment. Enviroguard will ensure that all neighbouring residents know who to contact to report and discuss problems with (eg. odour emissions). Any complaints that are received will be recorded in the operators log book.

7.3.3 Maintenance

Regular maintenance of the final landform and landscape will be undertaken. This will comprise:

- monitoring of surface water and leachate dams and drains, and undertaking repairs where necessary;
- filling of any cracks that may occur in the final cover layer;
- filling of depressions created by settlement of the landfilled waste (to ensure shedding of surface water runoff);
- replacement of vegetation affected by landfill gas, if necessary, to maintain the vegetation density; and
- repairing erosion scours.

The above activities would continue until the landfill has been stabilised.

8. REPORTING

8.1 INCIDENT REPORTING

Any incident that represents a threat to the environment and which may lead to a breach of licence conditions will be communicated to the EPA within six hours of first seeing the incident. Initial contact will be via the 24 hour Pollution Line. Written notice will follow within 21 days. Examples of incidences which will be reported include but are not limited to:

- identification of non-domestic quantities (200 g/tonne) of hazardous waste mixed with solid waste;
- fires at the landfill (other than those approved for fire hazard reduction by the EPA);
- mixing of leachate and stormwater or waste and stormwater;
- identification of any failure of an environmental protection system;
- identification of a significant difference in groundwater indicator parameters;
- detection of subsurface gas migration in a perimeter gas well at greater than 5% (v/v) methane;
- any other incident or observation that could potentially pose an immediate environmental hazard outside normal operating conditions; and
- any proposed change in the landfill ownership or operator.

The occurrence of any such incident will also be recorded in the operators daily log book.

8.2 MONTHLY REPORTING

Enviroguard will send the total tonnage of waste received and tonnages of specific source separated wastes to the EPA each month.

8.3 ANNUAL REPORTING

Each year the following information will be provided to the EPA in support of the annual licence renewal application. All information in the report must be up to date to within 30 days prior to the licence renewal date.

The report shall include the following:

- a summary report of the total wastes received (including cover), its composition and its eventual fate eg. landfill, recycling market etc;

- a registered surveyor's report of the volume of landfill space consumed in the period for which the report is prepared and an estimate of the compaction density achieved over the period;

- an estimate of remaining landfill capacity;

- an assessment of the changes detected in the groundwater monitoring results over the period of operation, updated for the preceding 12 months. Any changes in hydraulic gradient or statistically significant variations in contaminant concentrations shall be highlighted and explained;

- a report on leachate collection that identifies the quantity and composition of any leachate generated over the preceding 12 months. Observable trends will be highlighted and compared with environmental variables such as monthly rainfall or biological activity as shown by known trends within landfills.

- a report on landfill gas emissions to demonstrate achievement of the appropriate environmental objectives. If landfill gas extraction is carried out the composition of the raw gas and the stack gases shall be identified and any changes over time explained;

- a record of odour, litter and other complaints that have been received by the landfill in the preceding 12 months and their correlation with prevailing weather conditions or waste reception circumstances;

- a summary report of surface water monitoring results gathered over the past twelve months including all previous data;

- a summary of all dust monitoring results gathered over the preceding 12 months; and

- a summary of any incident reports for the 12 month period.

9. REFERENCES

AGC Woodward Clyde Pty Ltd., 1997 *PGH Quarry Metford, Installation of Monitoring Wells and Groundwater Sampling*. Prepared for CSR Construction Materials.

AGC Woodward Clyde Pty Ltd., 1997 *Water Management Plan and landfill Technical Report PGH Metford*. Prepared for CSR Construction Materials.

Australian Water Quality Guidelines for Fresh and Marine Waters. Australian and New Zealand Environment and Conservation Council (ANZECC). November 1992

Bureau of Meteorology, 1988. *Climatic Averages Australia*. Department of Environment, Sport and Territories, Commonwealth of Australia.

Environmental Protection Authority, 1996. *Environmental Guidelines:Solid Waste landfills*.

Environmental Protection Authority, 1996. LEMP Preparation Manual.

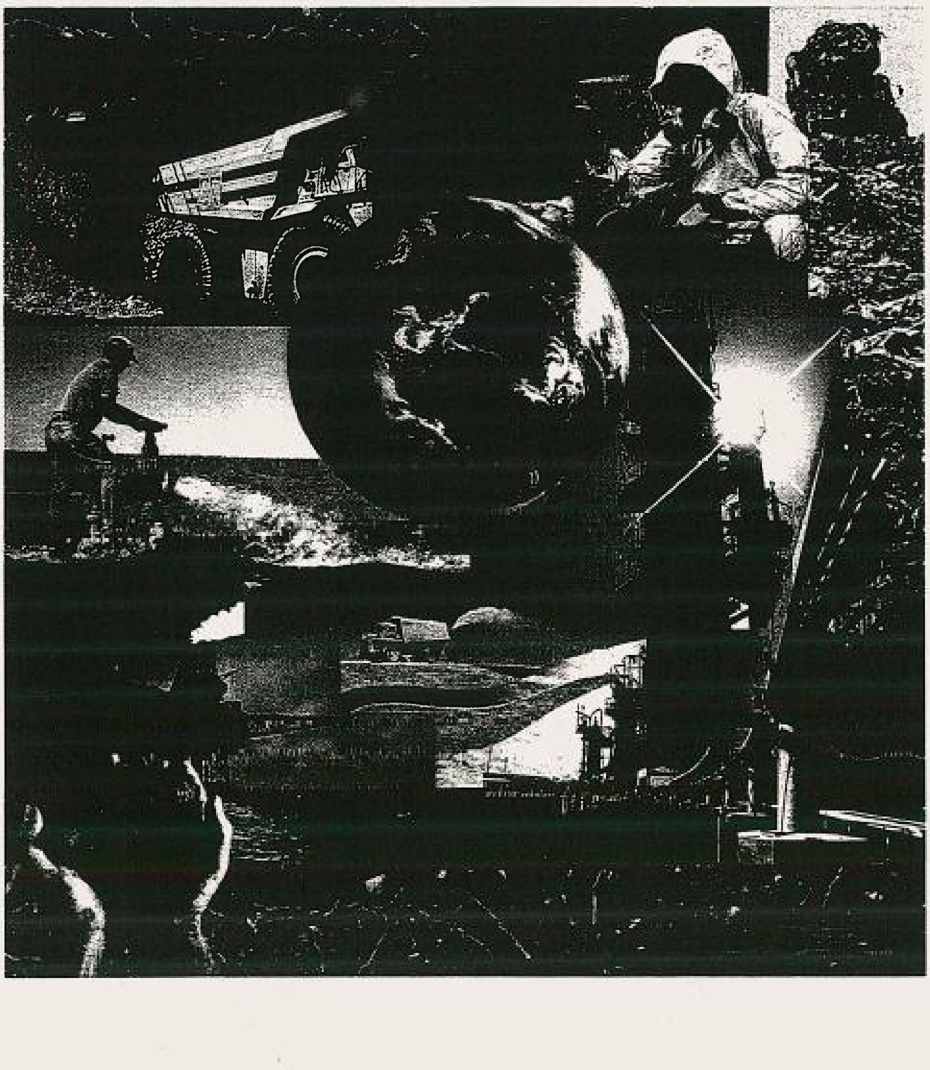
Geological Survey of NSW, 1966. *Newcastle Sheet SI 56-2, 1:250,000 Geological Series*. Department of Mines.

Matthei L.E., 1995a. *Newcastle 1:100,000 Soil Landscapes Map Sheet*. DLWC.

Matthei L.E., 1995b. *Soil Landscapes of the Newcastle 1:100,000 Map Sheet*. DLWC.

Waste Minimisation and Management Act 1995 and Regulations 1996.

WATER MANAGEMENT PLAN AND LANDFILL TECHNICAL REPORT PGH EAST MAITLAND



PREPARED FOR
CSR CONSTRUCTION MATERIALS

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1.0 INTRODUCTION

At the request of Mr Ron Bush, CSR Construction Materials, AGC Woodward-Clyde (Woodward-Clyde) has conducted a water management and technical review of the various issues applicable to the proposed landfilling of the PGH Quarry at East Maitland, west of Newcastle in NSW.

As part of its East Maitland operations, CSR Building Materials through its wholly owned subsidiary Monier PGH Holdings Limited (PGH) has been extracting clay for brick making purposes from its quarries on both sides of Metford Road, East Maitland. The main pit is located on the north-western side of Metford Road, while the sales office and manufacturing plant, which are still in use, are located on the opposite side of the road. Figure 1 shows the location of the property.

The main pit has ponded water since operations ceased at the site, with the current level measured at an elevation of approximately -0.9 m AHD.

It is understood that PGH plans to extract more material from the south-western area of the main pit prior to final cessation of quarrying.

The various quarry areas on the East Maitland site (both sides of Metford Road), as part of the final restoration/rehabilitation process, are being considered as a potential landfills for solid wastes Class 2.

It is proposed to continue quarrying the clay on both sides of Metford Road during the landfilling by carefully managing the site's activities such that once clay extraction for the brickmaking ceases in a particular area the resultant pit can be transformed easily into a solid waste landfill. Clay extraction will then recommence in another designated area.

Current policy dictates that a landfill shall not degrade any beneficial use of the surface water or groundwater environment. The surrounding land use is not to be affected by the operation of the landfill and regulations, including the Clean Air Act, the Clean Waters

Act and the Noise Control Act, must be considered when developing a management plan. In order to ensure that all EPA and Council concerns regarding environmental regulations associated with landfill practices are met, Woodward-Clyde has carried out a preliminary review of all technical issues that were considered relevant to the proposed development of a solid waste landfill at the PGH brickmaking facility at East Maitland.

The PGH Quarry at East Maitland is located in Metford Road approximately two kilometres east of Maitland Railway Station. See Figure 1. The surrounding land use to the west and south is primarily residential.

2.0
SITE CHARACTERISTICS

2.1 GEOLOGY

The PGH Quarry site is underlain by sedimentary sequences belonging to the Sydney Basin Tomago Coal Measures of Upper Permian age. The Tomago Coal Measures consist mainly of shales, mudstone and sandstone with a number of coal seams and claystone horizons, some of which are of tuffaceous origin. The sedimentary sequences are characterised by rapid vertical and lateral facies changes to the extent that the more reliable elements for correlation are represented by the coal seams.

Regionally, the Tomago Coal Measures outcrop on the eastern flank of the Lochinvar Anticline and dip gently in a general south-easterly direction towards the coast. However, in the quarry area the formation dips to the west at 7°, due to local structural variations. On site, the surficial coal is vitreous, highly cleated with some trace amounts of pyrite. The majority of the rock type exposed in the quarry area is sandstone, which is soft in parts due to weathering processes.

Recent drilling results confirmed the regional geology with the intersection of surficial silty clay before encountering siltstone, shale or sandstone. Approximately 5m of coal were encountered at a depth of 19 m in borehole MOW-07.

2.2 HYDROLOGY AND HYDROGEOLOGY

2.2.1 Surface Drainage

The topography of the East Maitland site slopes gently to the north-east towards the Hunter River at an approximate grade of 2%. The land to the north-east (north of the railway line) is part of the flood plain of the river and contains extensive areas of low-lying wetlands.

The site is within the catchment of Four Mile Creek which has its headwaters near John Renshaw Drive and flows in a northerly direction past the site finally joining the Hunter

River east of Morpeth sloping with a pronounced ridge line running generally from south-west to north-east. All surface water from the site flows into this drainage system.

Due to its elevation (approximately 10 m AHD) and natural drainage the site is unlikely to be flood prone.

2.2.2 Surface Water Quality

Woodward-Clyde carried out a limited sampling program of the surface waters of Four Mile Creek on 16 May 1996 both upstream and downstream of the site. Only pH, electrical conductivity (EC), total dissolved solids (TDS), suspended solids (SS) and chloride were analysed.

The results of the water taken from the natural watercourses indicated that pH, suspended solids and chloride were all within the normal range. Low levels of TDS ranging from 310 mg/L to 920 mg/L in the creek system and 400 mg/L to 440 mg/L in the Hunter River were also recorded.

In general, it would appear that the quality of the surface waters in the area is good and would be acceptable for livestock purposes except for short periods following heavy rainfall, when high concentrations of bacteria from the adjacent pastures would tend to wash into the creeks and dams.

2.2.3 Groundwater Investigation

An additional groundwater investigation of the site was conducted in November 1996 by Woodward-Clyde to assess the nature and quality of the groundwater. Four monitoring bores were installed on the south-eastern side of Metford Road to supplement five monitoring wells installed during previous investigations (July 1993 and September 1996) on the north-western site area.

The potential for contamination of the groundwater from the proposed landfilling operations was reviewed.

The new boreholes were installed as permanent groundwater monitoring bores. For a more detailed review of the groundwater investigation, refer to Woodward-Clyde report "PGH Quarry East Maitland Installation of Monitoring Wells and Groundwater Monitoring - February 1997".

The following information, relative to this report, has been extracted from the previously mentioned report.

2.2.4 Hydrogeology of the Area

The rocks belonging to the Tomago Coal Measures are known to be generally poor aquifers because of their fine grained, cemented nature. Generally, water in these formations is stored in fractures and joints and, to the extent that these fractures and joints are interconnected, these formations will behave as aquifers. Commonly, however, the coal seams represent the more permeable elements of the coal measures formations and are generally regarded as the more significant permeability paths.

Recent drilling of the boreholes, where coal strata were intersected, confirmed the relatively permeable nature of the coal as an increase in the airlifted water volumes was observed at these levels

2.2.5 Groundwater Levels and Flow

The bores wellheads have been surveyed and levelled in order to obtain an accurate definition of the water table around the site.

The December 1996 water levels indicated an uneven head distribution, due to the quarry activities around the site. Specifically, the water table in the vicinity of the main pit north-west of Metford Road is significantly influenced by the pit which is acting as a "sink". Water levels taken on the south-eastern site area did not appear to be affected by the main pit and, therefore, provide a better indication of the groundwater gradient. The groundwater is interpreted to flow towards the east to north-east.

The recorded water levels on the south-eastern site area were below the anticipated final depth of the quarry and of the base of the proposed landfill cells, given as 6m AHD. This condition differs from that on the north-western side of Metford Road, where the excavation of the main pit is below the water table.

2.2.6 Field Permeability Tests

The permeability of the rockmass present under the site is such that only hydraulic tests of the "slug" type are practical in the circumstances. These tests consist of injecting, or removing, a known volume of water in, or from, the bore and in measuring the rate of water level recovery to the original level.

Results of these tests indicated that the geometric mean of the permeability values measured on the recently installed bores is 2.0×10^{-6} metres per second with the values being grouped within a narrow range. After combining all the bores present on both sides of Metford Road, the geometric mean is 2.9×10^{-6} metres per second. This value exceeds (ie. is more permeable) the NSW EPA criteria of 10^{-8} metres per second for landfill sites. As a result, site specific measures, such as utilising a clay or synthetic liner to seal the base and, possibly, the sides of the excavation, would be required to mitigate and overcome the higher permeabilities of the rock mass should a landfill operation be considered.

2.3 SOIL GEOTECHNICAL ANALYSIS

Two clay samples, one from either side of Metford Road, were submitted for permeability testing to Australian Soil Testing to evaluate the suitability of this material as a clay liner for landfill cells.

The results indicated an average value over three tests of 1.6×10^{-10} metres per second for the sample taken from the eastern side of Metford Road and 2.0×10^{-10} metres per second for the sample taken from the western side. These clay permeability values are similar to those of material of similar origin at other sites in the same area. After re-working and compaction, this material is expected to be eminently suited as a landfill cell clay liner.

2.3.1 Groundwater Quality

The recorded pH values were slightly alkaline and are consistent over the south-eastern area. These values are, however, not in agreement with the values recorded in the bores on the north-western area, which were slightly acidic. No immediate explanation is available for such inconsistency. Future monitoring will assist in this regard.

The total dissolved solids (TDS) values measured ranged from 1 840 mg/L to 11 100 mg/L. The high value recorded was considered atypical, as the recorded values for all monitoring wells have generally been between 3 000 and 5 000 mg/L.

The groundwater is of a predominantly sodium-chloride type. Its chemical composition and general ionic proportions reflect the character of typical mineral dissolution with low recharge.

The groundwater, because of its salinity and relatively low permeability of the rock mass, has no exploitable common application.

3.0
SURFACE WATER MANAGEMENT PLAN

3.1 INTRODUCTION

Management of the water on site is aimed at:-

- ensuring water is available to meet operational requirements;
- using the poorest quality water acceptable for each particular task; and
- preventing deterioration of water quality standards in surface waterways and groundwater in the vicinity of the site.

A surface water management strategy has been developed to ensure that site runoff will be isolated from any potential leachate generated at the site. Clean water, including water and seepage, will be diverted around the proposed landfill areas.

3.2 WATER DEMANDS

Water is required for staff amenities, dust suppression and irrigation of areas undergoing rehabilitation.

Dust suppression will be required during dry weather on unsealed active haul roads and cover material excavation areas.

Watering of revegetating areas will be achieved by spraying runoff collected from disturbed areas. Leachate from the landfill will be sprayed back onto the landfill or, if of sufficient quality, used to irrigate revegetated areas.

The principal source of water will be a reticulated supply from Hunter Water. This will meet potable requirements at the site and, if necessary, provide a backup supply for dust suppression.

Dust suppression will be required during dry weather on the unsealed access roads and active quarry and landfill work areas. Dust suppression may marginally increase as a result of simultaneous quarrying and landfill operations, however, it should be possible to provide sufficient water for dust suppression by storing and using water from stormwater run-off. When necessary, this can be supplemented by the reticulated water supply. Based on a water application rate of 1.5 times the average evaporation rate (1.2 metres per year), the maximum water demand (based on the maximum combined length of access roads) is estimated to be approximately two megalitres.

Landscaping and quarry rehabilitation areas will require some watering, however, it is proposed to use endemic plant species which are adapted to local climatic conditions. Watering will, therefore, be restricted to the first few months of plant or grass growth. It is anticipated that watering will be required at a rate of 300 mm per year over an area of about one hectare. This is equivalent to a demand of about three megalitres per year.

The total annual requirement for non-potable water will, therefore, be approximately five megalitres.

3.3 WATER SUPPLY

3.3.1 Site Drainage

Under existing conditions, the majority of the north-western site area drains to the disused pit with the remaining surface water entering a natural watercourse on the western side of the area. The estimated volume of water contained in the pit is 120 ML. This water will need to be removed from the pit prior to landfilling commencing.

Two natural watercourses flow through the south-eastern site area; one through the disturbed area and one through the less disturbed south-eastern corner. Both watercourses flow towards the north where they meet and flow under the railway line via a concrete culvert. Existing sedimentation ponds provide treatment of the water prior to discharge from the site.

Apart from the water contained in the disused pit on the north-western site area, there is currently very little water storage on site. The water that is available, however, is of a suitable quality to meet non-potable water demands. Should a deficit occur, water could be sourced from the reticulated supply.

In order to meet EPA water discharge conditions that are likely to be imposed, two new sedimentation dams, one on each side of Metford Road, are to be constructed to provide adequate protection of the watercourses throughout the period of extraction/landfilling. See Figure 3 for locations.

3.4 WATER QUALITY OBJECTIVES

Four Mile Creek and the Hunter River are not a classified waterways under the Clean Waters Act and, therefore, no specific water quality criteria is applicable for industrial discharges.

Any discharge, other than uncontaminated stormwater, to the watercourses in the area will, however, be subject to a licence issued by the EPA under the Pollution Control Act.

In determining water quality standards for any discharges from the site, the EPA will likely consider the average surface water quality of the receiving waters as well as existing agricultural water uses and aquatic systems in the lower Hunter River. It is likely that water quality guidelines published by the Australian and New Zealand Environment and Conservation Council (ANZECC) in 1992 will form the basis for the applicable water quality standards.

3.5 POLLUTION CONTROL

Site operations will generate different quality waters, which include:-

- stormwater runoff within the landfill;
- clean water runoff from undisturbed areas;
- turbid water runoff from disturbed areas;
- possibly occasional leachate from within the landfill; and
- dirty water from site activities.

Wherever practicable, clean water runoff will be diverted around disturbed areas to minimise the volume of sediment laden water which will be collected and treated. The area around the rim of the quarry excavation and the landfill area will be graded away from the excavation or bunded to prevent surface water from flowing into the area. Provided that this water does not come into contact with any of the waste materials and remains uncontaminated it will be acceptable for discharge to the local watercourse.

Plans and specifications for all clean water diversion works will need to be submitted to the Environment Protection Authority for approval prior to construction.

3.5.1 Design Criteria

All drainage structures will be designed in accordance with the relevant design criteria.

The Department of Land and Water Conservation (formerly the Department of Conservation and Land Management (CALM)) in its publication "Urban Erosion and Sediment Control" - 1992 recommends that a storm with a one in ten year "average recurrence interval" (ARI), six hour duration ($I_{10/6}$), be adopted for the design of sediment ponds.

The design of all other surface drainage structures will also based on a design storm of one in ten year "average recurrence interval" (ARI), however, the design discharges for these structures will be based on a storm duration equivalent to the time of concentration as recommended in “Australian Rainfall and Runoff”.

A minimum grade of 1% will be adopted for sizing drains. For a 1% slope, typical earth vee drains will need to be in the order of 200mm deep with side batters of 1 vertical to 3 horizontal to carry the flow in each of the catchment areas. The actual size of the drains will likely vary over the length of the drain to reflect the actual catchment area flowing to that section of drain. A more detailed analysis will be included in the final engineering designs of the drains.

3.5.2 Catchment Areas and Discharges

When calculating the required capacity of the sedimentation ponds, the formula for calculating the discharge (Q_{10}) of the various catchment areas is:

$Q_{10} = 0.00278 \text{ x } C \text{ x } I \text{ x } A$

where: $C_{10} = 0.4$ (co-efficient of run-off for a 1 in 10 year storm)
$I_{10/6} = 14.77$ mm/hr (rainfall intensity for a 1 in 10 year storm. 6 hour duration)
A = catchment area (hectares)

The calculated discharges for the design storm for the various catchments (see Figure 3) are:

Table 3.3 CATCHMENT DISCHARGES (m^3/sec)

	CATCHMENT AREA 1 (North-west)	CATCHMENT AREA 2 (South-east)
Catchment Area (Ha)	8.5	22.8
Max. Design Discharge (m^3/sec)	0.14	0.37

3.5.3 Design of Sedimentation Dams

The settlement dams for the East Maitland site have been designed in accordance with the Department of Land and Water Conservation (formerly the Department of Conservation and Land Management (CALM)) guidelines "Urban Erosion and Sediment Control - 1992". These guidelines are considered the most appropriate as the current draft "Treatment Techniques" issued by the Environment Protection Authority in September 1996 are not relevant. It is stated in the Introduction to the publication that:

> *"These practices are intended for application in existing and new urban residential areas. The techniques are not intended to apply to major road or freeway projects or industrial sites."*

In calculating the design parameters for the sedimentation dams the following assumptions have been made:

- catchments are as shown on the relevant plan;
- areas are exclusive of buildings and known excavations on the sites and are approximate only; and
- locations of the dams and dimensions are indicative only with the final locations dependent on the actual determination of future clay extraction areas.

The following is a summary of the sedimentation dams for the East Maitland site.

Table 3.4 DETAILS - SEDIMENTATION DAMS

	DAM 1	DAM 2
Catchment Area (Ha)	8.5	22.8
Storage Volume (m^3)	1 382	3 675
Surface Area (m^2)	588	1 518
Total Depth (m)	2.35	2.42
Surface Dimensions (m)	14 x 42	22.5 x 67.5
Detention Time (hrs)	2.74	2.76

Discharge from the settlement dams will be by means of an outlet pipe to a drainage channel which will direct the treated water to the natural watercourse.

A typical settlement dam arrangement is shown in Figure 5.

3.5.4 Runoff From Disturbed Areas

Runoff from areas of the site which have been stripped of vegetation cover, either for cover material or unsealed haul road construction, will be directed by open earth vee drains (and pipe drains if necessary) to strategically located settlement ponds. These dams, referred to as Dams 1 and 2, will be located in the lowest corner of the respective catchment areas (see Figure 3 for indicative locations).

Runoff associated with any capped nonactive cells within the landfill will be collected in temporary sumps from where it will be pumped to the surface to a stormwater settlement pond by means of pipes and/or open channels.

3.5.5 Dirty Water/Leachate Management

The majority of waste will be delivered, compacted and covered during dry weather. Waste has the capacity to absorb water and will continue to do so until it has reached its field capacity. Moisture will seep from the landfill at varying rates depending on a number of factors such as rainfall, evaporation, infiltration, groundwater inflow, surface run-off, soil characteristics and depth, temperature and make-up of fill.

Stormwater infiltration is one of the major contributors to the generation and migration of leachate in landfills. The management strategy of the landfill will ensure that minimal stormwater infiltration occurs on the clean fill cover material.

Stormwater surface run-off from within the landfill area will be considered as 'dirty' water and will be directed into a dedicated sump from where it will be stored and subsequently pumped to the surface to a 'dirty' water/leachate collection pond (see Figure 4 for typical details). The dedicated sump will initially be located in the base of the landfill, however, as filling progresses it will be relocated to a higher level so as to avoid isolating a large area of the landfill around the sump (increasing batters lead to increased area affected).

In addition to the collection sump within the landfill, a 1500 mm diameter concrete pipe riser will be constructed in the centre of each of the landfill cells (either side of Metford Road). A sump will be excavated in the floor of the landfill and filled with coarse filter material. A vertical concrete pipe with drainage slots cut into the lower section will then be set into a concrete base. This pipe will be progressively extended as the landfilling progresses. The main purpose of the riser is to allow for the collection and monitoring of the groundwater and/or leachate that may be generated from the landfilling activities. Any leachate detected in the riser will be pumped to the surface and combined with the dirty water in the designated collection facility. It should be noted that, as the landfill will not be accepting putrescible waste material, the generation of leachate is not expected to be an issue during the landfilling of the individual cells. Once landfilling has ceased a lid will be placed over the pipe for protection. Figure 4 shows typical riser details.

Dirty water pumped from the landfill will be combined with other surface generated dirty water in the dirty water/leachate pond for disposal by evaporation, irrigation, dust suppression or recycling over the active landfill as appropriate.

3.5.6 Truck Wheel Washing Facilities

Wash down water from the wheel washing facilities will also be directed into the dirty water/leachate collection pond. Upon completion of tipping, each truck which is leaving the site completely, will travel along the access road to the truck washdown area. The washdown area will consist of a bitumen area sloped towards a collection pit at one end of the area. The wheels and chassis will be washed down using a high pressure low volume water hose. The runoff water will flow into the collection pit from where it will be directed, by pipe, into the leachate collection pond.

A coarse mesh basket in the collection pit will collect any large refuse; this material will then be disposed of in a waste receptacle placed adjacent to the washdown area.

3.5.7 Dirty Water/Leachate Collection Pond

This pond has been nominally sized at 40 m^3 to allow sufficient storage capacity for irrigation purposes. It will be located in a convenient position adjacent to the operating landfill and will have sufficient capacity to prevent overflow.

Leachate stored in the collection pond may be used for on-site irrigation and dust control (where necessary). Spray application over the active cell areas may also be used as a method of disposal. Most leachate from such sites has proven suitable for irrigation and may provide a source of nutrient rich irrigation water for site revegetation. Its contaminant load would, therefore, remain within the confines of the site.

If necessary, a leachate pond may be retained on the site, post closure, for collection and disposal of any unacceptable leachate releases from the site.

Locations for the dirty water/leachate collection ponds for both catchment areas are shown on Figure 3.

3.5.8 Water Management Plan

The Water Management Plan, to be incorporated in the development proposal for the East Maitland site, generally reflects the current site activities and water management strategy together with recommended amendments to accommodate the proposed development.

Stormwater from the quarry and landfill workings will drain to separate collection sumps. In the case of the quarry water will be directed to the sediment dams on the margins of the site whereas water pumped from the landfill areas will be stored in the dirty water/leachate collection pond.

All extraction/landfilling areas will be fully protected from the ingress of stormwater with strategically located diversion drains and bunds directing water around the areas and into the sediment dams. All stormwater will be fully controlled within the site with no uncontrolled discharges onto adjoining properties.

Details of the design criteria adopted for the sediment dams was provided in Section 3.5.3.

Figure 3 shows the suggested locations of leachate storage facilities for each stage of development.

Completed landfill areas and earth mounds undergoing revegetation will drain to temporary sediment ponds and silt fences will remain in position until these areas are sufficiently stabilised. Storage capacity of ponds will also be based on the Department of Land and Water Conservation guidelines (200 m^3 per hectare of disturbed catchment).

4.0
LANDFILL CONCEPT DESIGN

4.1 LINING OF LANDFILL CELLS

4.1.1 Existing and Proposed Clay Extraction Pits

Clay, for the manufacture of bricks, is still being quarried from the south-western site area whenever required. The current clay extraction area is to be extended on both ends as part of the on-going manufacturing activities. The level of the base of the quarry (RL 6m AHD), however, will not be increased.

On the north-western site area it is proposed to develop a new clay extraction area on the southern side of the disused pit. The depth of the new extraction area will be similar to the existing pit ie. -9m AHD. See Figure 3 for the location.

4.1.2 Base Liner

A landfill base liner acts as a leachate barrier and contains the leachate within the cell over a period of time thus minimising the potential for environmental impacts.

As specified in the EPA's Environmental Guidelines for Solid Waste Landfills, *a leachate barrier system for new landfills and lateral expansions of operating landfills is a liner system that forms a barrier between groundwater, soil and substrata, and the waste. Characteristics of a suitable liner include:*

- *A recompacted clay or modified soil liner at least 90 cm thick with an in-situ coefficient of permeability of less than 10^{-9} metres per second.*
- *The surface of the liner should be so formed that once settling has finished, the upper surface of the liner or barrier must exhibit a transverse gradient of greater than 3% and a longitudinal gradient of greater than 1%.*

As the base of the quarry at East Maitland is clay it may be possible to tyne and recompact the clay to the depth of 90 cm specified by the EPA. Alternatively, it may be necessary to strip the clay to the required depth and replacing and compacting it in layers to achieve the required compaction. Typical base details are shown in Figure 4.

The method chosen will be determined in detail on the north-western side once the water has been pumped out and on the south-western side once the quarrying has been completed.

Whether there is a need to compact the clay in the walls of the quarry and, if so, how far will depend on the extent and quality of the clay. The actual extent of the clay liner up the walls of the landfill will vary depending on the location within the cell and will be confirmed once the characteristics of the natural materials in the walls of the quarry are known (after removal of the ponded water).

As part of a recent program in which a number of additional groundwater monitoring wells were installed at the East Maitland site, two clay samples (one from each side of Metford Road) were submitted for permeability testing to Australian Soil Testing to evaluate the suitability of this material as a clay liner for landfill cells.

The results indicated an average value over three tests of 1.6×10^{-10} metres per second for the western site area and 2.0×10^{-10} metres per second for the eastern site area. After re-working and compaction, this material is expected to be eminently suited as a landfill cell clay base liner as it meets the EPA criterion of 1×10^{-9} metres per second.

Groundwater recovery tests were also carried out in each of the new bores and the results compared with those obtained from previous investigations. The geometric mean of the permeability values measured for both sides of Metford Road during past and more recent investigations is 2.9×10^{-6} metres per second. This value exceeds (ie. is more permeable) the NSW EPA criteria of 10^{-8} metres per second for landfill sites. As a result, wherever a rock base occurs within a potential landfill area, site specific measures, such as utilising a clay or synthetic liner to seal the base and, possibly, the sides of the excavation, would be required to mitigate and overcome the higher permeabilities of the rock mass. The actual extent of the base and side lining would be evaluated once excavation of the clay extraction pits has been completed.

4.2 COVER AND TOPSOIL

4.2.1 General

In order to review the final cover and intermediate cover requirements for the proposed landfill at East Maitland, we have evaluated the material requirements necessary to meet the Guideline benchmarks and standard landfill engineering estimates. This assessment is generally applicable to all solid waste landfills in NSW.

4.2.2 Cover Material Requirements

The EPA has established specific cover material requirements in its *Environmental Guidelines: Solid Waste Landfills*[1] (Guidelines). Environmental Goal 33 outlines the purposes of cover material as:

"Use of cover material helps to protect the full range of environmental management objectives by limiting run-on and infiltration of water, controlling and minimising risk of fire, minimising emission of landfill gas, suppressing site odour, reducing fly propagation and rodent attraction, and decreasing litter generation."

The Guidelines establish a benchmark of daily soil cover at a minimum depth of 15 centimetres over waste noting that all waste should be covered prior to ceasing operations at the end of each day. The intermediate cover benchmark established in the guidelines also provides that suitable selected intermediate cover should be applied to a depth of 30 centimetres over surfaces which will be exposed for more than 90 days.

In summary, typical cover requirements have been derived on the basis of the following assumptions.

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[1] Environment Protection Authority. 1996. *Environmental Guidelines: Solid Waste Landfills.*

- Each 10 m cell of the landfill will comprise four 2 m lifts.
- Each lift will be covered with 15 cm of cover material.
- The initial thickness of each cell will be approximately 10 m.

Figure 4 shows typical landfill cover arrangements.

4.2.3 Availability of Materials

Sufficient cover material is available within the property boundaries for intermediate and final capping requirements. As previously discussed, recent permeability testing of on-site clay material indicated average values of 'K' over three tests of 1.6×10^{-10} and 2.0×10^{-10} metres per second for the western and eastern site areas respectively. After re-working and compaction, this material is expected to be eminently suited as a landfill cell clay cover material as it meets the EPA criterion of 1×10^{-8} metres per second.

Rehabilitation of the cover material extraction areas will require the appropriate contouring of disturbed areas and the immediate sowing of grass species. A sterile annual species may be the most appropriate for immediate cover, followed by the establishment of other selected species.

4.2.4 Design of Final Cover

The final capping requirements from the Guidelines are reasonably stringent. They include:

- A seal bearing surface should consist of a properly designed and engineered layer of material.
- A gas drainage layer should have a minimum thickness of 30 centimetres.
- A sealing layer should consist of a clay layer at least 50 cm thick and having a permeability less than $K = 10^{-8}$ metres per second.

- A drainage layer of permeability not less than $K = 10^{-5}$ metres per second should be placed over the sealing layer. The drainage layer will be not less than 30 cm deep.

- A revegetation layer of depth of not less than 100 cm should be placed over the drainage layer.

For the East Maitland landfill it is proposed that a final sealing layer at least 90 cm thick, of compacted impervious material be used to minimise rainfall infiltration into the individual landfill masses. The final surface of the sealing layers will also topographically slope at an approximate grade of 5% to promote surface runoff away from the landfill masses.

As required by the EPA, the final sealing layers for the landfills will comprise compacted clay with a permeability (K) of, at least, 1×10^{-8} metres per second. This material is available on the site as previously discussed in Section 4.2.3.

Final covering of the sealing layer will comprise a 30 cm drainage layer together with a revegetation layer of 100 cm. The final landscaping profile is necessary to promote revegetation and moisture storage over the landfill surface and with the final capping sequence, will minimise rainfall infiltration to the landfill masses. The final revegetation layers will include mulch and compost to promote the vegetation and to minimise odours from any fugitive gas emissions. It is particularly important that a thickness of 100 cm of soil is used to generate the necessary texture and depth to resist erosion of surface soils immediately after planting.

The final revegetation cover will also provide a biologically and mineralogically active filter for suppression of odours. Allowance for vehicular access, even during periods of extreme wet weather, will be provided.

4.2.5 Cover and Topsoil Extraction and Treatment

Cover material will generally be extracted progressively from the quarry areas on the site. The scheduling of extraction for cover material should be designed to assist in the management of surface run-off from the site, limit the area of land disturbed at any one time and allow completed areas to be rehabilitated in a contiguous manner.

The sequence of operation of each cover material extraction area will be:

- construction of diversion drains and vehicle access;
- clearing, stripping of topsoil, transport of topsoil to a completed portion;
- excavation of cover material;
- spreading of topsoil from another portion; and
- revegetation.

The operation may involve the clearing and stripping of topsoil from an area and the transporting of the underlying clay cover material to the landfill. Spreading, compaction, topsoiling and revegetation will take place progressively.

Clay cover material will either be loosened by ripping with a bulldozer and loaded by front end loader into haul trucks for transport to the landfill, or transported to the landfill by scrapers.

For topsoil reclamation, the topsoil will be stripped while in a damp state. Where the soil is dry, it will be dampened by water sprays before stripping. The soil will be stripped by track driven bulldozers to depths to be determined during detailed design of the project and then stored in mounds of up to two metres height when it is proposed that the topsoil will be reused within two weeks of stripping. Should it be necessary to stockpile the topsoil for longer periods, the mounds shall not exceed 60 cm in height.

Batters on the higher stockpiles will not exceed 3:1 (horizontal:vertical). Stockpile surfaces will be left in as rough a condition as possible to minimise erosion and be immediately revegetated and watered. Sterile crops (e.g. Japanese Millet) may be used for this purpose, although annual resewing is then necessary. Hay bales or sediment filter fences will be placed around the perimeter of the stockpiles to act as erosion and sediment controls. Stockpiles of topsoil will not be located within 10 metres of a drainage line.

At the completion of land disturbance, topsoil will be respread to a minimum depth of 100 mm on areas to be rehabilitated.

Respreading of topsoil will occur around the contour and care will be take to leave no vehicle tracks which may intercept and concentrate runoff. Rehabilitation areas will be seeded immediately with any failed areas resown. Maintenance will occur until the areas are well established and stable.

4.3 SETTLEMENT OF LANDFILL

4.3.1 General

Settlement or subsidence of the finished landform due to surcharge loading within the fill itself may result in the final landform becoming irregular in appearance. The settled topography will tend to reflect the degree of compaction achieved and the topography of the landfill base i e. a greater thickness of waste material results in greater compaction. This settlement is the result of primary consolidation due to compaction and surcharges as well as secondary consolidation (creep) and the decomposition of any biodegradable waste material.

Generally, landfills with depths of 30 to 40 metres have an overall degree of compaction of at least 850 kg/m^3, however, it is expected that at East Maitland an average compaction density of at least 1 000 kg/m^3 will be achieved. It should be noted that the compaction encountered at the base of the landfill will likely be much higher. Based on our previous experience gained on many landfill sites, overfilling by approximately 15% will be required to compensate for consolidation and to achieve the designed finished surface levels. Typically, the majority of the settlement will occur in the first three to four years following closure of the landfill cell.

4.3.2 Settlement Monitoring

Routine settlement monitoring should be undertaken during the filling period to allow a better understanding of the volume of overfilling required for the site. An on-going monitoring program incorporating a marker layer at a specific elevation at the cell boundary is one technique suitable for determining the consolidation settlement relative to an off-site benchmark.

5.0
LANDFILL CONTROL STRATEGIES

5.1 LEACHATE MANAGEMENT

5.1.1 General

Leachate is derived from rainfall infiltration, stormwater inflow, groundwater inflow, irrigation, water infiltrations and decomposition waters. The nature of leachate is chemically related to the waste products of decomposition and by other matter within and adjacent to the landfill mass which is rendered soluble by the leachate chemistry.

Management of leachate at a site is dependent upon the extent to which the beneficial use of the water resources and contiguous environment need to be protected at the site. Existing groundwater conditions at the East Maitland site indicated that, due to the saline nature of the water, there is no beneficial use of the groundwater below the site.

A brief outline of the practices to be adopted regarding stormwater runoff and potential leachate generation is as follows: stormwater runoff from any non-active cells is, subject to testing, treated as clean water and is diverted to the stormwater retention pond. Any stormwater accumulation at the surface within the active cell is treated as leachate and is diverted to the surface leachate collection pond.

In a landfill, there are three principal mechanisms by which the refuse mass is transferred to water percolating through it, ie.: the entrainment of refuse particulate and the soluble material in the water, the dissolution of soluble salts in the refuse and the stabilisation of the refuse through degradation of organic material to gaseous and soluble form.

In a solid waste Class 2 landfill consisting primarily of non-putrescible wastes the amount of organic material normally comprises only wood and paper wastes and the potential for degradation is considerably lower than in a landfill receiving putrescible wastes. Regardless of this, leachate will still be generated in the proposed landfill cells at East Maitland and an assessment of possible impacts will need to be carried out as part of the final design by modelling (using LANDFILL program, or similar) each of the landfill cells. For the modelling to be meaningful, a more specific analysis of the waste stream and predicted volumes over the life of each of the landfill cells will need to be assessed.

The LANDFILL model is able to predict:

- the potential leachate generation rate within the landfill and determine whether leachate will flow from it;
- the likely impact of landfill leachate generation on adjacent groundwater; and
- the design parameters for a leachate collection system.

5.1.2 Leachate Volumes

Without detailed modelling of the predicted leachate generation within each of the landfill cells it is not possible to predict the likely volumes of leachate generated in each cell. From previous experience we would expect that the maximum leachate generation rate would occur in about the twentieth year and would continue for possibly twenty five years after landfilling has ceased.

We would also expect that leachate generated within each cell under average climatic conditions will not exceed the field capacity potential of the waste at any time. This means that the leachate will be stored in the matrix of the waste material as the system ultimately achieves its field capacity and, since the cells are capped with low permeability clay, the field capacity factor is not expected to be exceeded. Flow of leachate from the base of the active cells and seepage to the water table are, therefore, not likely to occur under average climatic conditions.

5.1.3 Landfill Leachate Quality

The leachate which is generated from water percolating through solid waste material derives its chemical character from the solution, solubilisation and exchange of chemicals and compounds which occur within the waste mass. The influent water takes up some of the chemical components in the process of run off and these will be added to by the soluble salts found in the waste mass (plaster, etc.) and by chemical compounds released in biodegradation of vegetative matter.

The actual quality of the leachate that may be generated at East Maitland cannot be predicted with any degree of certainty because of the anticipated variability of the non-putrescible waste stream.

5.1.4 Leachate Control

Leachate control facilities will be included in the final designs of the landfill cells.

Over the liner at the base of the landfill cell will be placed a number of drainage trenches with a minimum thickness of 30 cm. The drainage filter media will comprise material having a minimum coefficient of permeability (K) of 1×10^{-3} metres per second. The base liner and drainage trenches will be graded to a sump located in the lowest point within the cell. As filling of the landfill proceeds, the drainage system will direct any run-off water or leachate into the sump.

The sump will initially be constructed in the clay liner on the floor of the landfill but, after every ten metre lift of the landfill has been completed, it will be relocated to that level for easier management of the filling and leachate control. The decommissioned collection pond will be sealed with compacted clay prior to overtopping with waste material. Figure 4 shows a typical leachate collection system in a landfill.

A permanent riser will be provided from the initial sump in the base of the landfill to the surface leachate collection pond. The length of the riser will be adjusted each time that the leachate sump is relocated.

As the level of the collected leachate reaches a predetermined level in the sump, it will be pumped to the surface collection facilities from where it will be used for dust suppression within the landfill area or for landscaping (if the quality is acceptable). There will be no release of the leachate to the surrounding natural watercourses.

A typical surface leachate collection pond is shown in Figure 6.

To assist in the early identification and management of leachate, as previously mentioned in Section 3.5.5, a concrete pipe riser will be constructed in the centre of each landfill cell and will extend from an excavated sump in the base of the landfill to the finished surface. See Figure 7 for details. This will allow regular monitoring of the groundwater immediately below each cell and, hence, the early detection of leachate.

5.1.5 Impact of Leachate on Groundwater

The interaction between the landfill cells and the groundwater flow system at East Maitland is considered to be minimal. With the provision of a 900 mm thick low permeability, compacted clay base liner and drainage system as described in Section 4.1.2, and the low volume of leachate predicted, the vertical migration of leachate into the groundwater will be effectively controlled.

Once the landfill begins to fill the water table is expected to gradually recover to the regional groundwater level which is within the lower areas of the cells. As this will take many years to occur and as the regional groundwater gradient is quite flat, there should be no movement off-site of any leachate contained within the cells.

On completion, each landfill cell will be capped and graded to ensure the promotion of surface run-off away from cells and so minimise potential infiltration of water through the capping. This will assist in controlling the on-going generation of leachate.

5.2 LANDFILL GAS MANAGEMENT

5.2.1 General

The proposed landfill at East Maitland will comprise, at completion, a number of thick layers of saturated and partially saturated non-putrescible wastes capped with a low permeability clay. Although the non-putrescible material will comprise predominantly inert wastes such as plastics, soil and concrete, there are expected to be significant quantities of paper and wood that will degrade over time and produce landfill gas.

The following issues must be taken into account when assessing the rate of gas generation:

1. Biodegradable wastes are divided into two groups - rapidly degradable wastes and moderately degradable wastes.

2. Rapidly degradable wastes have a half life of 1 year. This means that half of the waste decomposes in a year. Moderately degradable wastes degrade at a much slower rate and have a half life of 15 years.

3. The mass of degradable wastes is the volume of the landfill mass corrected for the volume of inert material (clean fill and cover) divided by the compaction density of the waste.

5.2.2 Landfill Gas Control

The expected rate of gas generation for the East Maitland landfills is low and will likely be managed through passive venting of the gas through the landfill cover layers. Monitoring of gas generation will be carried out as landfilling proceeds.

Prior to final capping of the landfill cell a gas drainage layer will be constructed. This will consist of a number of trenches 30 cm thick constructed across the surface of the waste material and terminating at appropriate locations around the perimeter of the filled landfill. The trenches will be filled with a suitable drainage media which allow any collected landfill gas to be directed to the selected venting points for passive venting or flaring depending on the recorded volumes of gases.

An appropriate gas extraction/control system will be implemented should gas monitoring confirm that the methane concentrations are regularly exceeding 25% of the lower explosive limit (LEL). If the concentration of gas or odour becomes a problem, a series of temporary gas extraction wells may be installed to permit flaring of the gases. Flaring of the gases extracted from the landfill will destroy the odorous traces associated with the landfill gases.

5.3 NOISE MANAGEMENT

Noise associated with landfill development generally comes from two sources, namely equipment operating on the site and from waste vehicles entering and leaving the site.

Detailed discussion on noise issues is contained in a separate noise report.

6.0 MONITORING PROGRAMMES

6.1 SURFACE WATER AND GROUNDWATER

The hydrogeological analyses carried out indicate that the landfill can be operated without significant adverse effects on the groundwater and surface water system. It is, however, important that monitoring of the site be carried out on a regular basis to ensure that impacts of the landfill remain acceptable. If unforseen contamination does occur, the monitoring would detect this and allow for modifications in the operation or design to be made to protect groundwater users in the area.

Groundwater depths will be recorded for each of the monitoring wells, prior to disturbance due to sampling. Levels will be measured with respect to a datum (the top of the PVC casing) which has been surveyed to Australian Height Datum (AHD). This will permit an on-going comparison of water levels across the site.

It is proposed that quarterly monitoring be carried out on the monitoring wells that have been drilled at the site. The monitoring programme will incorporate water level measurement to determine fluctuations in the water table, and laboratory testing of the groundwater quality. Sampling will be carried out in accordance with EPA guidelines and the samples will be analysed by a laboratory accredited by the National Association of Testing Authorities (NATA).

Sampling will only be carried out after each well has been purged of at least three bore volumes of water, i.e. the volume of water contained within the PVC casing and gravel packing in the annulus of the bore. This purging procedure removes stagnant water and helps to obtain a representative sample of the groundwater. The parameters measured in the field, detailed below, are monitored to ensure stable hydrochemical conditions prior to sampling. Sampling will then be carried out directly after purging using either the pump or a teflon bailer.

The samples will be collected in containers, preserved where appropriate and kept in a chilled ice-box. The samples will then be transferred to the testing laboratory under chain of custody procedures.

The analyses will initially cover the full suite of analytical parameters shown below:

- pH, electrical conductivity, redox potential, dissolved oxygen, temperature (all measured in the field)
- cations/anions: sodium, calcium, magnesium, potassium, chloride, sulphate, bicarbonate, carbonate, total alkalinity
- nitrate as N, nitrite as N, ammonium as N
- kjeldahl nitrogen as N
- total phosphorous
- fluoride
- manganese
- iron
- total phenolics
- adsorbable organic halogens (AOX)
- chemical oxygen demand (COD)
- total organic carbon (TOC)
- biochemical oxygen demand (BOD_5)
- suspended solids
- metals: cadmium, chromium, copper, lead, zinc, iron, arsenic, mercury, aluminium

Bi-annually, two surface water samples will be collected from the watercourse downstream of the site at the time of monitoring. They will be analysed for the same range of parameters. The surface water results will be compared with the groundwater results to detect any inconsistencies.

The analysis results, with a record of date and time of sampling, showing the NATA stamp of endorsement from the testing laboratory, will be suitably recorded in a register specifically allocated for that purpose.

After two (2) years of landfilling operations at the site, the surface water and groundwater monitoring program will be reviewed and annual monitoring for a reduced set of trigger parameters may be implemented and continued until groundwater levels and leachate levels equilibrate.

In order to assist in interpreting the surface water and groundwater analytical results, it is recommended that a pre-landfilling surface water and groundwater monitoring programme be instigated as soon as possible so that information on the current quality of the surface waters and groundwaters can be accumulated. This information will then be available for comparison purposes once landfilling has commenced.

6.2 LEACHATE MONITORING

No leachate will be released to the groundwater until saturation levels in the landfill equilibrate with the external groundwater levels.

The leachate management program to be implemented at the site will incorporate monitoring of leachate only in the post closure period or in the event that it becomes necessary to discharge leachate from the site. Monitoring of the landfill leachate (i.e. analytical testing) would then be undertaken at 6 monthly intervals (i.e. at the same time as groundwater monitoring) to enable characterisation of the leachate for as long as the occurrence of the leachate is assessed by the EPA as representing an environmental risk or by the operator as an operational problem.

6.3 AIR QUALITY MONITORING

Dust from the landfills will be monitored by installing dust deposition gauges in accordance with AS 2471.1-1984 (Ambient Air Particulate Matter, Part 1 - Determination of Deposited Matter Expressed as Insoluble Solids. Ash, Combustible Matter, Soluble Solids and Total Solids). These dust deposition gauges will be equally spaced around the boundary of the landfill.

The results from dust monitoring will be compared against relevant New South Wales Environment Protection Authority's criteria. The need for dust mitigation measures and additional monitoring of dust deposition will be evaluated after 2 years when a reasonable estimate of annual average dust deposition will be available.

6.4 NOISE MONITORING

A separate review of noise issues, including noise monitoring requirements, is outlined within a separate noise report. This report will include a noise monitoring program which will be evaluated according to guidelines in the NSW EPA's Environmental Noise Control Manual.

7.0
COST ESTIMATES

The following unit rates are indicative only and are provided for budget purposes only.

	ITEM	UNIT RATE
1	***Base Liner***	
	Excavate from borrow area on site and load, haul, place and compact 900 thick clay base.	$12-00/m^2$
2	***Leachate Control Facilities***	
	a) Construct drainage trenches 300 thick over base liner.	$4-00/Lineal metre
	b) Excavate leachate collection pond	$2 000 L.S.
	c) Install pump and riser.	$3 000 L.S.
	d) Construct surface leachate collection pond (40 KL).	$2 500 L.S.
3	***Capping*** Layer	
	a) Construct gas drainage trenches 300 thick beneath final sealing layer.	$4-00/Lineal metre
	b) Excavate from borrow area on site and load, haul, place and compact 900 thick clay sealing layer.	$12-00/m^2$
	c) Construct drainage layer 300 thick over sealing layer.	$4-00/Lineal metre
	d) Construct revegetation layer 1 000 thick over drainage layer.	$10-00/m^2$

L.S. = Lump Sum

8.0 CONCLUSION

Following our technical investigations into the proposed landfilling of the PGH Quarry at East Maitland, we consider that controlled landfilling with solid wastes Class 2 appears to be a potentially viable option from a physical and environmental viewpoint.

Our technical investigations, which have resulted in the above assessment, have shown that:

- based on the information provided by CSR Construction Materials the base of the initial landfill cell (main pit) will be at RL -9 mAHD.

- a limited investigation (two samples) into the properties of the in-situ clay material has revealed that it is suitable for use as an intermediate and final cover material for the proposed landfilling. The co-efficient of permeability (K) for the two samples tested from the western and eastern sides of Metford Road were measured as 1.6×10^{-10} metres per second and 2.0×10^{-10} metres per second respectively. This was within the minimum guideline value of $K=1 \times 10^{-8}$ metres per second defined in the Environment Protection Authority's Environmental Guidelines for Solid Waste Landfills, January 1996.

- A preliminary review of the groundwater quality has revealed that the water underlying the site is saline and does not have any potential uses. There was no obvious contamination of the groundwater due to organic or inorganic compounds.

- The permeability of the rock mass beneath the site suggests that an impermeable clay liner will be required wherever it is encountered in the base of the landfill in order to inhibit the potential vertical migration of leachate from the landfill.

- A preliminary review of the water management and leachate management issues for the proposed filling method has shown that, provided drainage run-off and run-on is controlled and that sediment collection facilities are provided, there should be no impact on the surrounding environment.

- It is suggested that a pre-landfilling monitoring programme for surface water and groundwater be implemented as soon as possible so that sufficient background information can be accumulated prior to landfilling commencing. This information will be used for comparison purposes during landfilling. Regular monitoring of these natural water sources will need to be undertaken once landfilling has commenced.

- An air and noise monitoring programme, developed in accordance with EPA requirements, will also need to be implemented once landfilling has commenced.

9.0
LIMITATIONS

This report has been prepared based on information provided by CSR Construction Materials and from the results of a recent geotechnical investigation and groundwater sampling program of the site performed by Woodward-Clyde.

Laboratory analyses of the groundwater may not be representative of overall conditions. Inferences about the nature and continuity of conditions arising from the sampling points, where made, cannot be guaranteed.

Opinions and judgements expressed herein, which are based on our understanding and interpretation of current regulatory standards, should not be construed as legal opinions. This document and the information contained herein have been prepared solely for the use of CSR Construction Materials. Any reliance on this report by any other third parties shall be at such party's sole risk.

This report has been prepared for the particular investigation described and no responsibility is accepted for the use of any part of the report in any other context or for any other purpose.

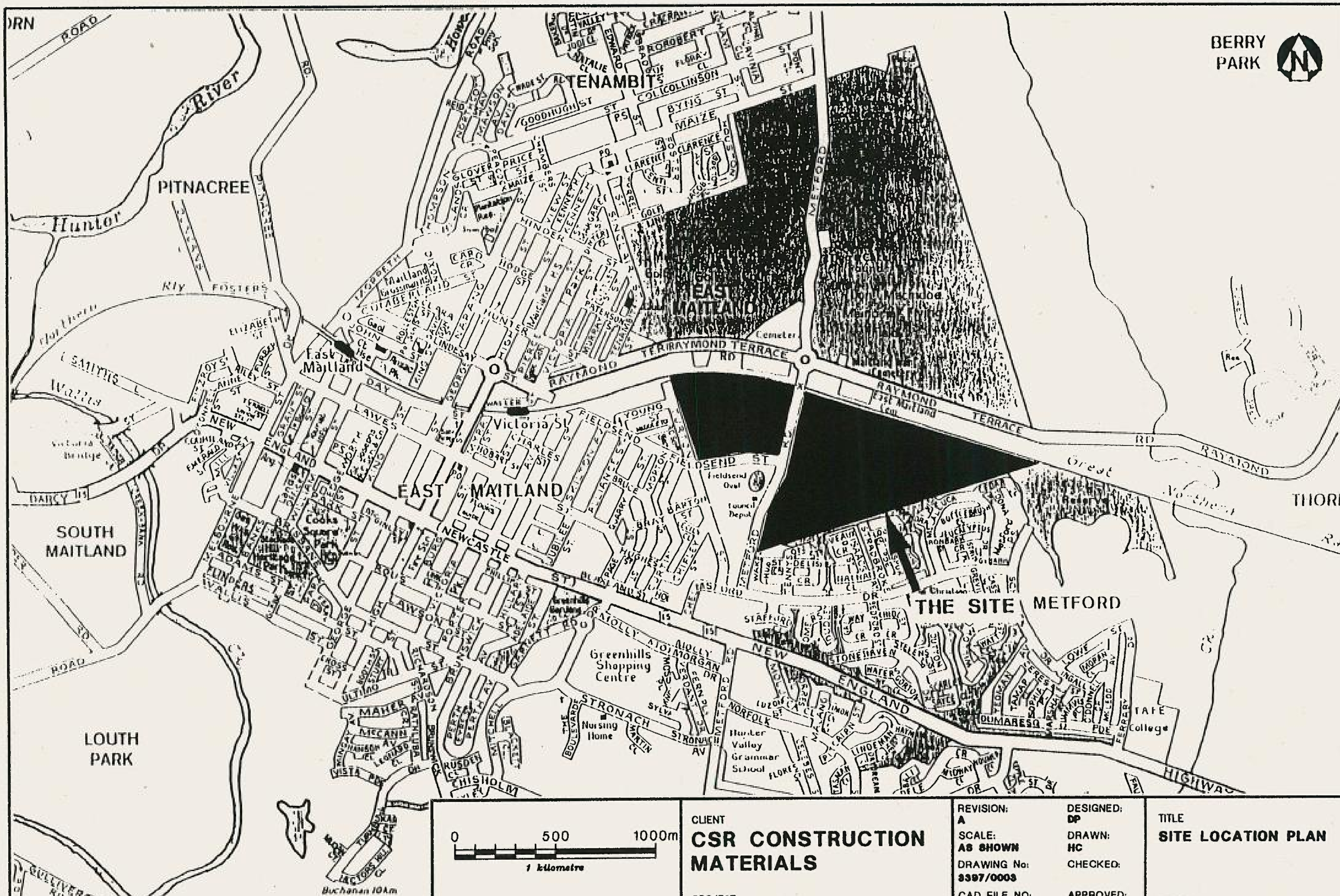
10.0 REFERENCES

AGC Woodward-Clyde, *"PGH Quarry East Maitland Installation of Monitoring Wells and Groundwater Sampling"* December 1996.

Environment Protection Authority of NSW, *"Environmental Guidelines for Solid Waste Landfills"* 1996.

The Institution of Engineers Australia, *"Australian Rainfall and Runoff"* 1991.

FIGURES



CLIENT
CSR CONSTRUCTION MATERIALS

PROJECT
EAST MAITLAND PGH MONIER QUARRY

REVISION: A	DESIGNED: DP
SCALE: AS SHOWN	DRAWN: HC
DRAWING No: 3397/0003	CHECKED:
CAD FILE NO: Q.011	APPROVED: BL
DATE: 21/3/97	STATUS: FINAL

TITLE
SITE LOCATION PLAN

FIGURE
1

A4

Woodward-Clyde

SYD/LJE/9-95

REVISION:	A	DESIGNED:	DP
SCALE:	1:5000	DRAWN:	HC
DRAWING No:	3397/0003	CHECKED:	
CAD FILE NO:	Q.012	APPROVED:	BL
DATE:	21/3/97	STATUS:	FINAL

LEGEND

MONITORING WELL LOCATIONS

SEDIMENTATION PONDS

0 50 100 150 200 250

metres

CLIENT

CSR CONSTRUCTION MATERIALS

PROJECT

EAST MAITLAND PGH QUARRY

TITLE

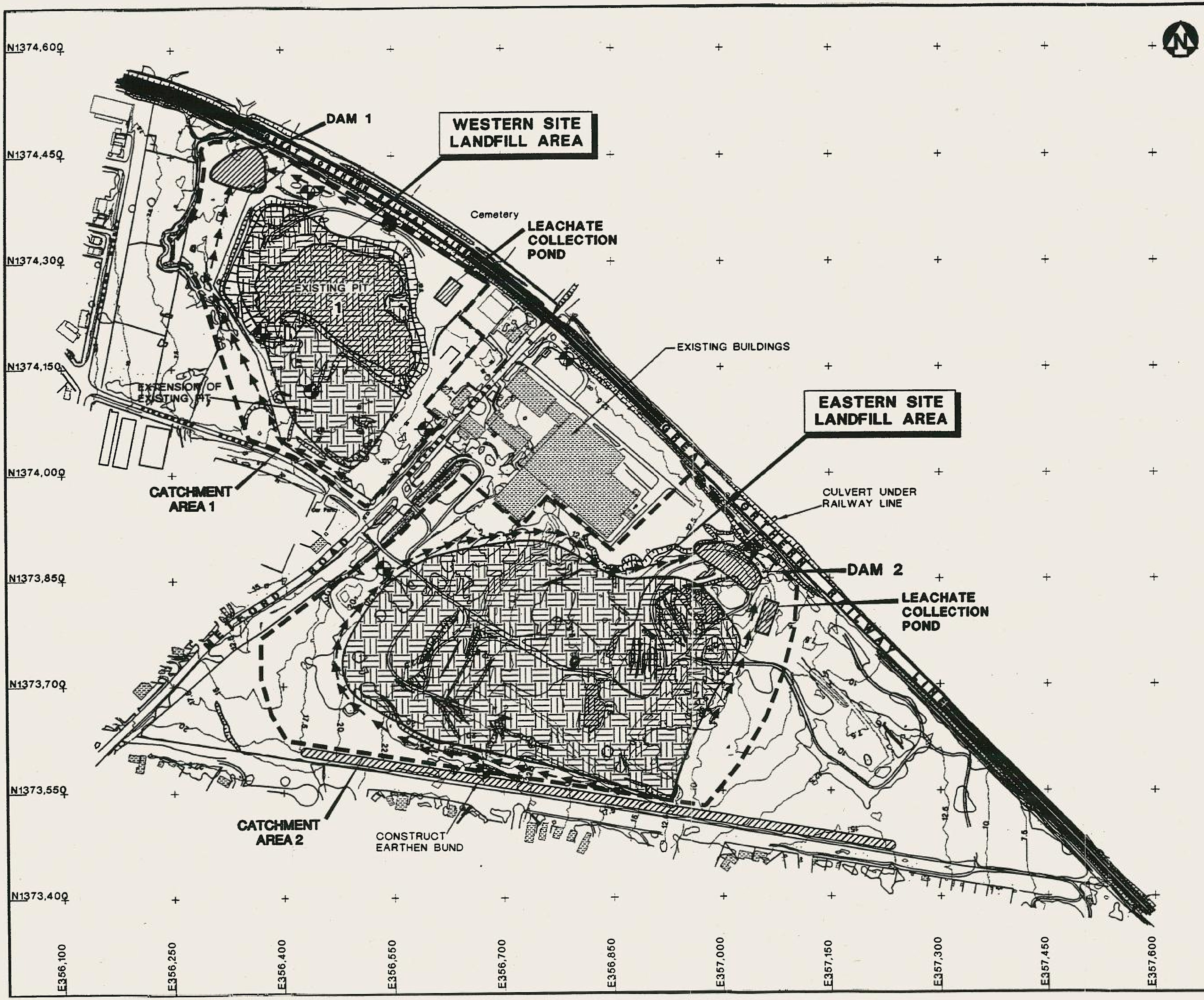
EXISTING SITE LAYOUT

FIGURE

2

A3

Woodward-Clyde



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CAD FILE NO:	G.018	APPROVED:	BL
DATE:	21/3/97	STATUS:	FINAL

LEGEND

- MONITORING WELL LOCATIONS
- QUARRY AREAS
- SEDIMENTATION PONDS
- CATCHMENT BOUNDARIES
- DIVERSION DRAIN

0 50 100 150 200 250
metres

CLIENT
CSR CONSTRUCTION MATERIALS

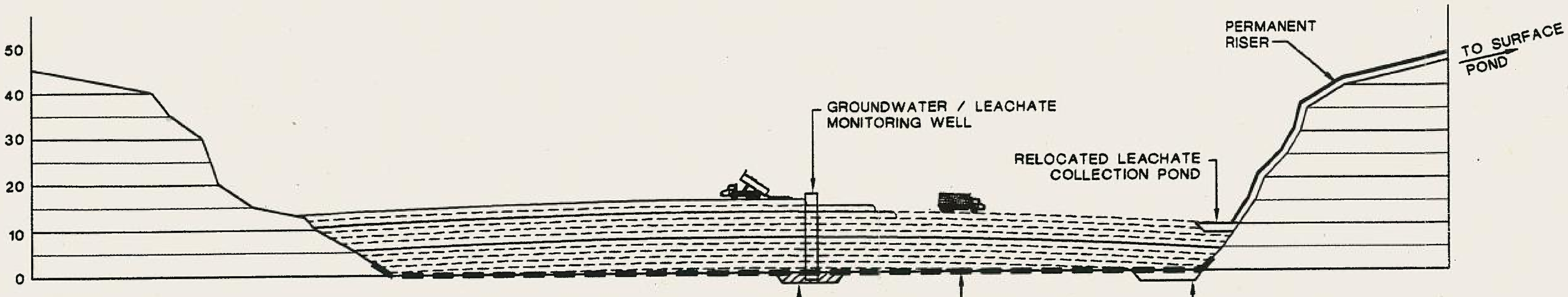
PROJECT
EAST MAITLAND PGH QUARRY

TITLE
PROPOSED SITE LAYOUT AND CATCHMENT PLAN

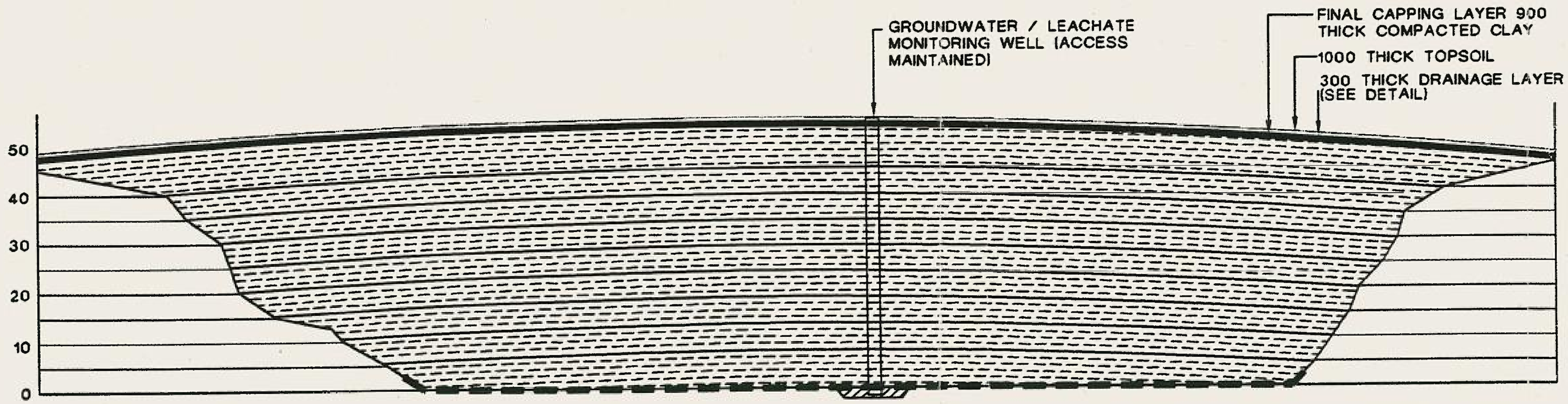
FIGURE
3

A3

Woodward-Clyde

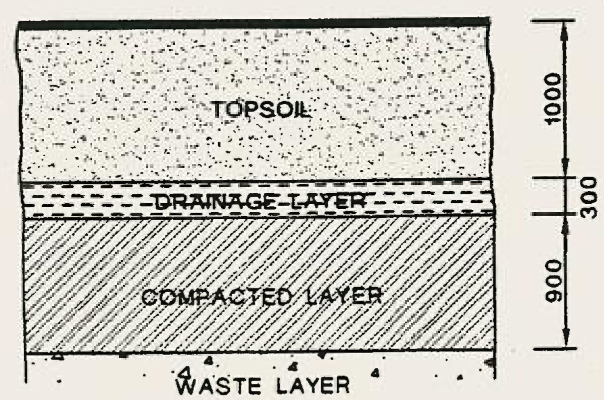


DURING FILLING



FILLING COMPLETED

BASE LINER DETAIL



LANDFILL CAPPING DETAILS

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SCALE:	N.T.S.	DRAWN:	HC
DRAWING No:	3397/0003	CHECKED:	
CAD FILE NO:	G.014	APPROVED:	BL
DATE:	21/3/97	STATUS:	FINAL

CLIENT
CSR CONSTRUCTION MATERIAL

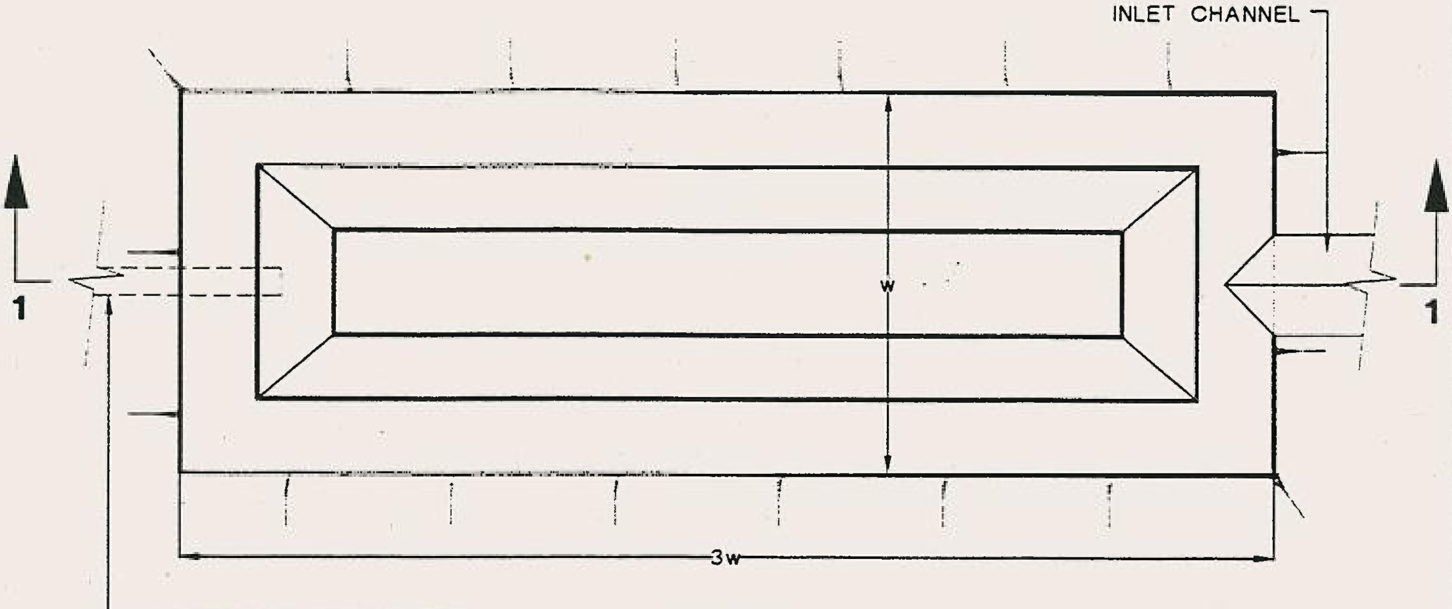
PROJECT
EAST MAITLAND PGH QUARRY

TITLE
TYPICAL LANDFILL CROSS-SECTION SHOWING LEACHATE COLLECTION

FIGURE
4

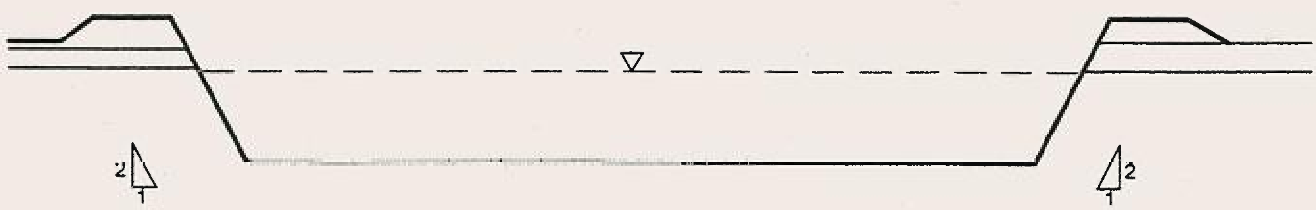
A3

Woodward-Clyde



PLAN

N.T.S.

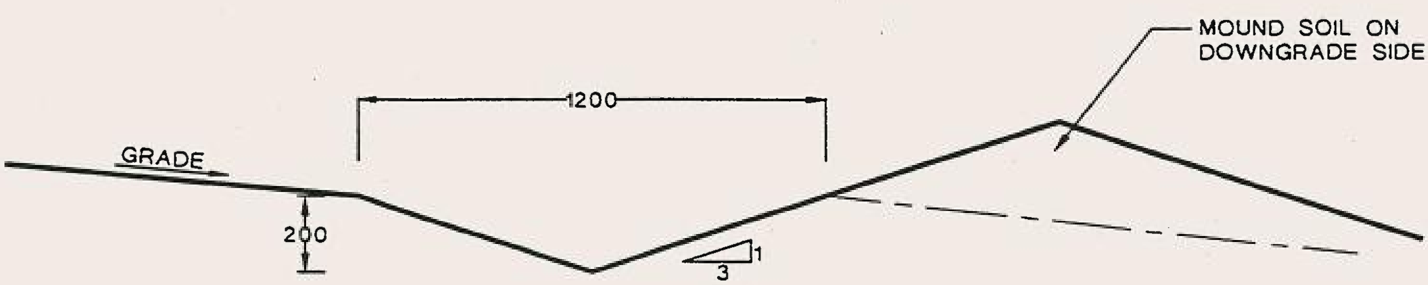


SECTION 1 - 1

TYPICAL SETTLEMENT POND ARRANGEMENT

(INLET AND OUTLET ARRANGEMENT MAY BE VARIED TO SUIT)

N.T.S.



DETAIL

OPEN 'V' DRAINS

SCALE 1:20

0 200 400 600 800
(SCALE 1:20)

Woodward-Clyde

CLIENT
CSR CONSTRUCTION MATERIALS

PROJECT
EAST MAITLAND PGH QUARRY

REVISION: A
SCALE: AS SHOWN
DRAWING No: 3397/0003
CAD FILE NO: Q.015
DATE: 21/3/97

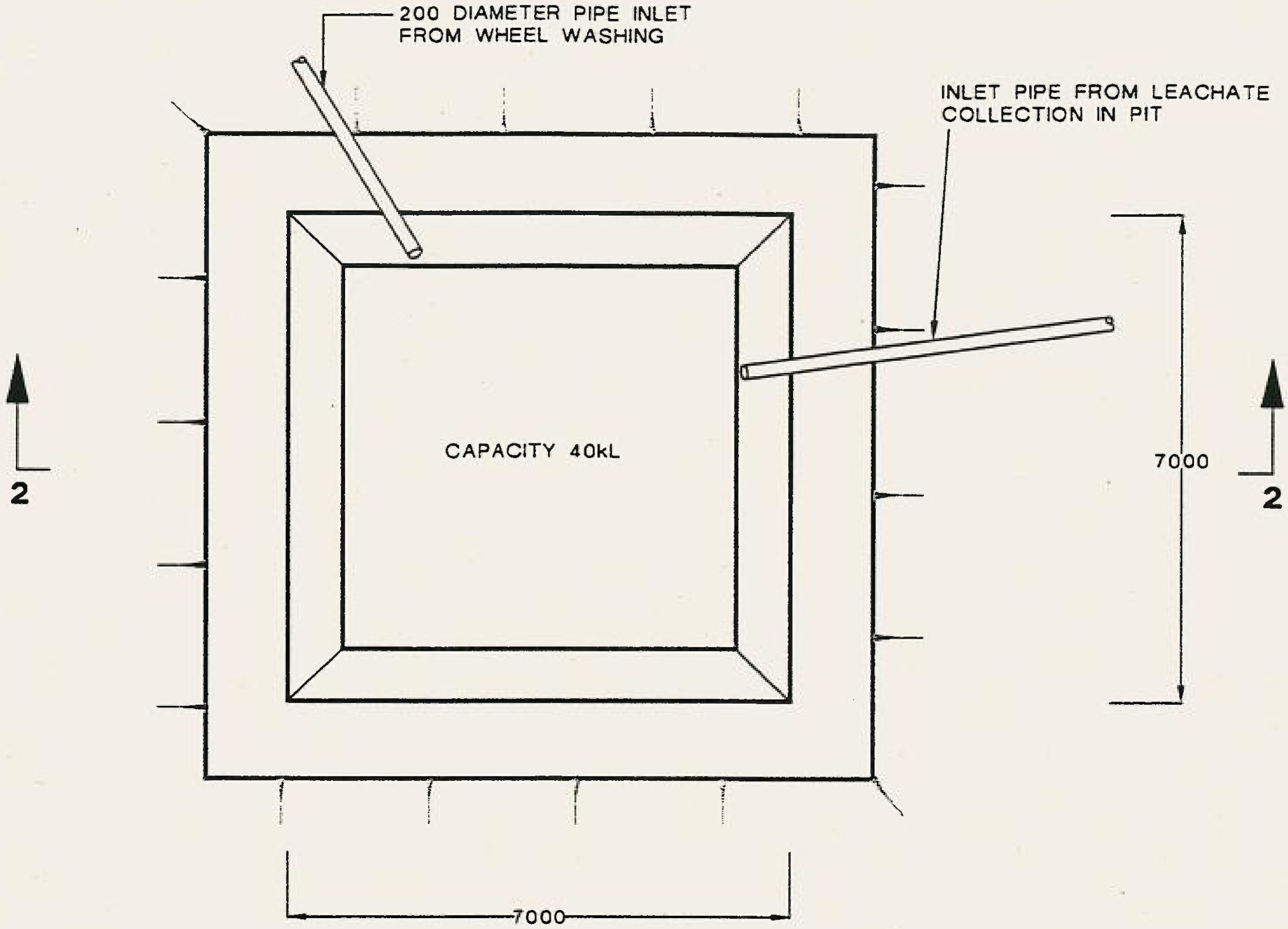
DESIGNED: BQL
DRAWN: HC
CHECKED:
APPROVED: BL
STATUS: FINAL

TITLE
TYPICAL SETTLEMENT POND DETAILS

FIGURE
5

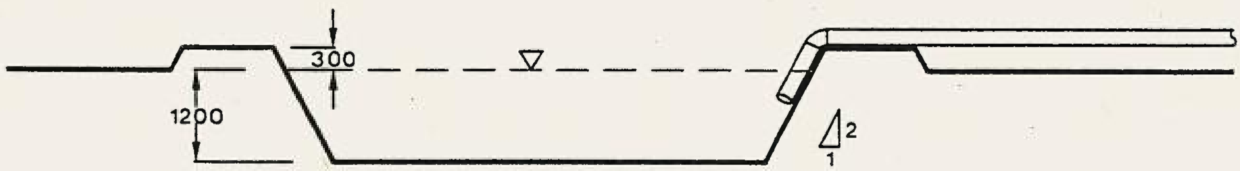
A4

SYD/LJE/9-95



PLAN

SCALE 1:100



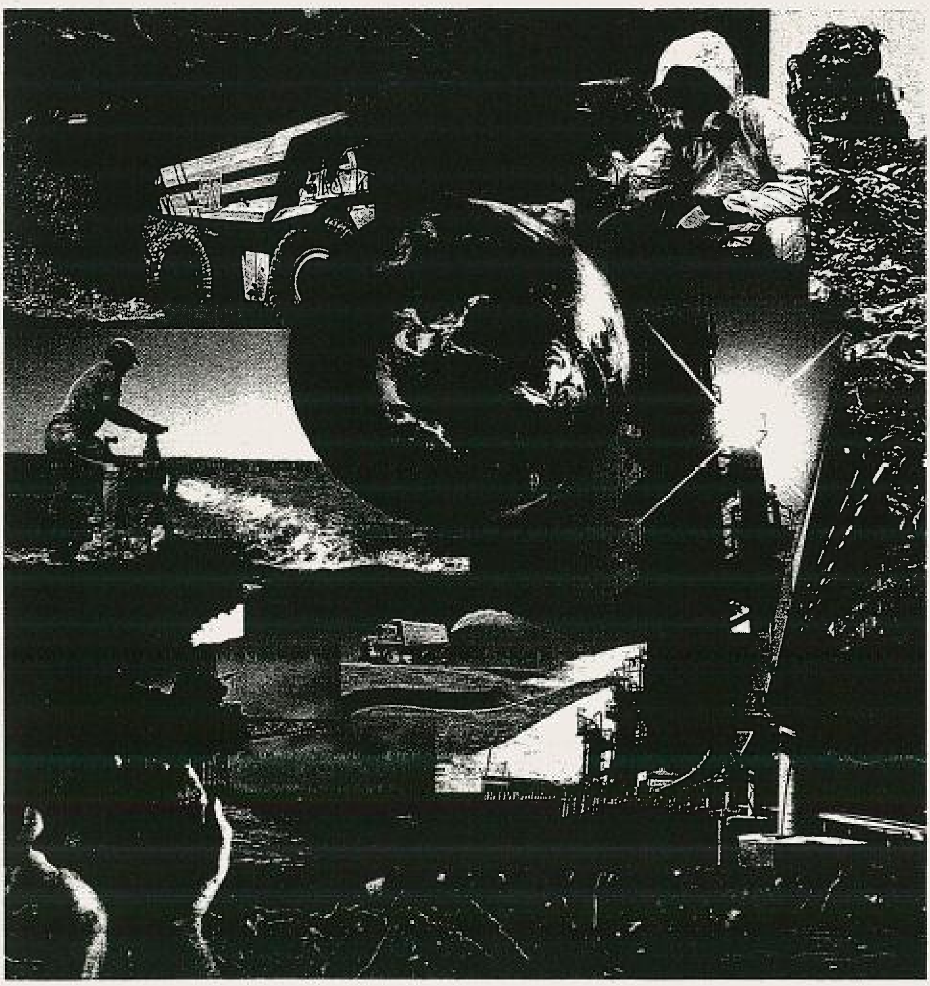
SECTION 2 - 2

DIRTY WATER/LEACHATE SURFACE COLLECTION POND

SCALE 1:100

0 200 400 600 800 (SCALE 1:20)	CLIENT **CSR CONSTRUCTION MATERIALS**	REVISION: A SCALE: AS SHOWN DRAWING No: 3397/0003 CAD FILE NO: G.016 DATE: 21/3/97	DESIGNED: SGL DRAWN: HC CHECKED: APPROVED: BL STATUS: FINAL	TITLE **SURFACE LEACHATE COLLECTION POND DETAILS**
Woodward-Clyde	PROJECT **EAST MAITLAND PGH QUARRY**			FIGURE **6** A4

SYD/LJE/9-95



MONIER-PGH QUARRY

EAST MAITLAND

INSTALLATION OF MONITORING WELLS AND GROUNDWATER SAMPLING

PREPARED FOR:
CSR CONSTRUCTION MATERIALS

FEBRUARY 1997
Project No. 3397.3
Document REP030-A.DOC

Woodward-Clyde

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ACN 000-691-690

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1.0 INTRODUCTION

1.1 GENERAL

As part of its East Maitland operations, CSR Building Materials through its wholly owned subsidiary PGH Ltd has been extracting clay for brick making purposes from its quarries on both sides of Metford Road, East Maitland. The main pit is located on the north-western side of Metford Road, while the sales office and manufacturing plant, which are still in use, are located on the opposite side of the road. Figure 1 shows the location of the property.

The main pit has ponded water since operations ceased at the site, with the current level measured at an elevation of approximately -0.9 m AHD.

It is understood that the Company plans to extract more material from the south-western area of the main pit prior to final cessation of quarrying.

The various quarry areas on the East Maitland site (both sides of Metford Road), as part of the final restoration/rehabilitation process, are being considered as a potential landfills for solid wastes Class 2.

As the initial groundwater investigation programmes carried out in July 1993 and September 1996, by Woodward-Clyde Pty Limited (Woodward-Clyde) only related to the north-western site area it was necessary to implement a supplemental investigation covering the south-eastern site area.

The recent investigations carried out in December 1996 involved the installation and testing of four monitoring wells on the south-eastern site area. This report describes the field work carried out and the results of the investigations.

1.2 SCOPE OF WORKS

The scope of works of this task of the project included:

- the installation of four groundwater monitoring bores to a depth greater than the final depth of the planned landfill cells;
- the collection of groundwater samples to be analysed for a selected list of analytes; and
- carry out permeability tests to determine the hydrogeological parameters.

2.0 INVESTIGATION RESULTS

2.1 GENERAL

The four monitoring bores were installed on the south-eastern side of Metford Road as shown in Figure 2, which also includes the other portion of the quarry area and the five monitoring wells installed on previous investigations (July 1993 and September 1996). The drilling contractor was Intertech Drilling Services under the supervision of Woodward-Clyde. The work was conducted and completed on the 14 and 15 November, 1996.

Drilling was carried by air rotary methods, using blade bits in the upper section of the profile and conventional down-the-hole hammer into the fresher rock. The target depth of the bores was set at approximately 4 m below the expected final depth of the quarry pits in order to evaluate the groundwater conditions across this profile. Groundwater samples were collected from this depth in order to establish background conditions as reference prior to commencement of landfilling.

Details of the bores construction and geological logs are given in Appendix A and a summary of statistics of the existing bores within the Monier-PGH Quarry site is given in Table 1. Data from the previous investigations (Woodward-Clyde Monier-PGH Quarry East Maitland Stage 2 Groundwater Investigations - September 1996) has been included for reference.

The four recently installed bores at the Maitland site have been licensed with the NSW Department of Land and Water Conservation at Muswellbrook under approval number 20 BL 166567 as required by law.

2.2 GEOLOGY

The Monier-PGH Quarry site is underlain by sedimentary sequences belonging to the Sydney Basin Tomago Coal Measures of Upper Permian age. The Tomago Coal Measures consist mainly of shales, mudstone and sandstone with a number of coal seams and claystone horizons, some of which are of tuffaceous origin. The sedimentary sequences are characterised by rapid vertical and lateral facies changes to the extent that the more reliable elements for correlation are represented by the coal seams.

Regionally, the Tomago Coal Measures outcrop on the eastern flank of the Lochinvar Anticline and dip gently in a general south-easterly direction towards the coast. However, in the quarry area the formation dips to the west at 7°, due to local structural variations. On site, the surficial coal is vitreous, highly cleated with some trace amounts of pyrite. The majority of the rock type exposed in the quarry area is sandstone, which is soft in parts due to weathering processes.

Drilling results confirmed the regional geology with the intersection of surficial silty clay before encountering siltstone, shale or sandstone. Approximately 5m of coal were encountered at a depth of 19 m in borehole MONW-07, which confirms the westerly dip of the strata.

2.3 HYDROGEOLOGY

The rocks belonging to the Tomago Coal Measures are known to be generally poor aquifers because of their fine grained, cemented nature. Generally, water in these formations is stored in fractures and joints and, to the extent that these fractures and joints are interconnected, these formations will behave as aquifers. Commonly, however, the coal seams represent the more permeable elements of the coal measures formations and are generally regarded as the more significant permeability paths.

Drilling at boreholes MONW-07 and MONW-08, where coal strata were intersected, confirmed the relatively permeable nature of the coal as an increase in the airlifted water volumes was observed at these levels.

2.3.1 Groundwater levels

The bores wellheads have been surveyed and levelled in order to obtain an accurate definition of the water table around the site. A summary of past and recent measured water levels is presented in Table 1.

Bore MONW-06 is a virtually dry bore with only a small accumulation of water (0.7 m) within the sump at the base of the casing. This water level was not considered reliable and representative and has not been included in Table 1. For the same reason, groundwater samples could not be collected from this bore.

Bore MONW-05, inspected on 11 December 1996, has had its wellhead vandalised and it appears to have a blockage inside the PVC pipe at 7.85 m below the surface. No static water level could be measured.

The December 1996 water levels indicated an uneven head distribution, due to the quarry activities around the site. Specifically, the water table in the vicinity of the main pit north-west of Metford Road is significantly influenced by the pit which is acting as a "sink". Water levels taken in MONW-08 and MONW-09 on the south-eastern site area are not affected by the main pit and, therefore, provide a better indication of the groundwater gradient. The groundwater is interpreted to flow towards the east to north-east.

As shown in Table 1, the water levels in MONW-06 (dry), MONW-07 and MONW-08 are below the anticipated final depth of the quarry and of the base of the proposed landfill cells, given at 6m R.L. This condition differs from that on the north-western side of Metford Road, where the excavation of the main pit is below the water table.

The recently measured water levels in wells MONW-01, MONW-02, MONW-03, and MONW-04 on the north-western site area are within approximately 0.10 m of levels measured on 11 July 1996. This small change is due to natural fluctuations

2.3.2 Field Permeability Tests

The permeability of the rockmass present under the site is such that only hydraulic tests of the "slug" type are practical in the circumstances. These tests consist of injecting, or removing, a known volume of water in, or from, the bore and in measuring the rate of water level recovery to the original level.

Recovery (rising head) tests were carried out on the three bores with additional falling head tests performed on bores MONW-07 and MONW-08. Results of these tests, analysed using standard techniques, are summarised in Table 2, with plots presented in Appendix B.

Bore MONW-06 could not be successfully tested, because it was dry. The bore base is at an elevation of 1.2 m AHD, approximately 4.8 m below the final depth of the proposed quarry pit.

The geometric mean of the permeability values measured on the recently installed bores is 2.0×10^{-6} m/sec (MONW-7, MONW-08, MONW-09) with the values being grouped within a narrow range. After combining all the bores present on both sides of Metford Road, the geometric mean is 2.9×10^{-6} m/sec. This value exceeds (ie. is more permeable) the NSW EPA criteria of 10^{-8} m/sec for landfill sites. As a result, site specific measures, such as utilising a clay or synthetic liner to seal the base and, possibly, the sides of the excavation, would be required to mitigate and overcome the higher permeabilities of the rock mass should a landfill operation be considered.

3.0 GROUNDWATER SAMPLING

3.1 SAMPLING PROGRAMME

Upon completion of drilling and development, groundwater samples were collected from the bores for the performance of a suite of analyses. Samples were submitted to Australian Laboratory Services (ALS) for a range of inorganic and organic analyses, to EML Consulting Services Pty Ltd (EML) for total coliforms and to Levay and Co Environmental Services (South Australia) for a halogens AOX scan. A number of field parameters were measured at the well head and these are summarised and presented in Table 3.

3.2 ANALYTICAL RESULTS

The analytical results are tabulated in Table 4 and the laboratory certificates are presented in Appendix C. For comparison purposes, included in Table 4 are the analytical results from the previous groundwater sampling carried out in August 1996.

3.2.1 General Parameters

The recorded pH values are slightly alkaline and are consistent over the south-eastern area. These values are, however, not in agreement with the values recorded in the bores on the north-western area, which were slightly acidic. No immediate explanation is available for such inconsistency. Future monitoring will assist in this regard.

The total dissolved solids (TDS) values measured on the three samples range from 1 840 mg/L at MONW-07 to 11 100 mg/L at MONW-09. The high value, recorded at bore MONW-09 is considered atypical, as the recorded values for all monitoring wells have generally been between 3 000 and 5 000 mg/L.

The groundwater is of a predominantly sodium-chloride type. Its chemical composition and general ionic proportions reflect the character of typical mineral dissolution with low recharge. The analytical results have been plotted on the Piper trilinear diagram of Figure 3. The diagram represents the proportions of the anions and cations in the lower triangles and a unique position in the central diamond characterises the water. All groundwater samples in the three bores plot in a position grouped around that of seawater, reflecting the nature of the sediments and the incomplete flushing of connate salts.

The groundwater, because of its salinity and relatively low permeability of the rock mass, has no exploitable common application.

3.2.2 Metals

Metals are present in generally low level concentrations and are considered to be of natural origin.

3.2.3 Amenable Cyanide

The cyanide amenable to chlorination has been detected in one (MONW-08, 0.02 mg/L) out of the three samples collected. The reason for the detectable concentration of cyanide is not clear and future sampling and monitoring will show whether this measurement was an isolated occurrence or otherwise.

This parameter offers an indication of the presence of readily dissociated cyanides that could be treated by alkaline chlorination, should such need arise.

3.2.4 Phenols

Phenolic compounds have not been detected in any of the samples analysed.

3.2.5 TPH - BTEX

No petroleum hydrocarbon or volatile aromatic hydrocarbons were detected in any of the samples analysed.

3.2.6 Halogens AOX

Adsorbable organic halogens (AOX) is used as an indicator analyte for organic compounds containing halogens. These groups of compounds include volatile aliphatic halogenated compounds (solvents) and organochlorine pesticides. The NSW EPA (1996) *Environmental Guidelines for Solid Waste Landfills* requires that AOX be used to indicate the presence of these groups of organic compounds when conducting groundwater monitoring at solid waste landfills. For these reason AOX testing has been included as part of this groundwater investigation.

The AOX analyses were carried out be Levay & Co. - Environmental Services, which is associated with the Ian Wark Research Institute, University of South Australia. Although Levay is not NATA registered for the AOX analyses, it is the only laboratory in Australia capable of performing the AOX analysis as requested by the NSWEPA.

Detected AOX levels were generally low, ranging from 104 µg/L to 124 µg/L which is considered the background level at the site.

3.2.7 Sulphide

No concentrations of sulphides were detected in any of the samples analysed.

3.2.8 Nitrogen

Ammonia and nitrate concentrations were consistent amongst the three samples reflecting the local background levels. Ammonia and nitrate concentrations ranged from 0.2 to 0.22 mg/L, and 0.04 to 0.05 mg/L, respectively.

3.2.9 BOD_5

Two out of the three samples reported concentrations below the LOR. One sample (MONW-07) reported 8 mg/L. The reason for the detection is not clear and future sampling and monitoring will show whether this measurement was an isolated occurrence or otherwise.

3.2.10 Total Coliforms

Total colony forming coliforms have been reported as "less than" the level of detection in all samples.

3.3 SOIL GEOTECHNICAL ANALYSIS

A clay sample was submitted for permeability testing to Australian Soil Testing to evaluate the suitability of this material as a clay liner for landfill cells. Results of the laboratory tests are presented in Appendix C.

The results indicate an average value over three tests of (? to be confirmed) m/sec. These clay permeability values are similar to those of material of similar origin at other sites in the same area. After re-working and compaction, this material is expected to be eminently suited as a landfill cell clay liner.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

4.1 GENERAL

The following Quality Assurance measures were utilised during the site works and a summary of the quality control water analyses is presented in Table 5.

- All samples were collected by a Woodward-Clyde environmental scientist specifically trained in field investigation techniques, and health and safety procedures. All techniques used are specified in AGC Woodward-Clyde's technical guidelines, which are based on methods specified by the United States Environmental Protection Agency (USEPA).

- All field sampling equipment (teflon bailer, etc.) were decontaminated prior to use and between samples to minimise the potential for cross contamination. Water samples were transferred immediately to laboratory prepared sample containers containing preservative agents.

- All samples were identified with a unique sample number. Relevant sampling details were included on the sample label and were reproduced in field logging sheets and chain of custody records.

- The sample containers were packed in ice at the time of collection and transported under chain of custody procedure from the site directly to Australian Laboratory Services (ALS).

- The samples arrived intact and still chilled at the analytical laboratory and were analysed within the relevant holding times for the target analytes.

- One field duplicate sample (DUP01) was prepared in the field during sampling of MONW-09. This duplicate was submitted to the laboratory as an independent sample. Field duplicates are used to measure the precision of the whole sampling and analysis process (sampling, sample preparation and analysis). Duplicate sample results showed low variability between the sample result and the duplicate result and were within acceptable limits.

- A rinsate blank sample was collected by running purified water over the sampling equipment after decontamination. The collection of field blanks enables the measurement of accidental or incidental contamination during the sampling, transport, sample preparation and analysis process. These samples are prepared and analysed in the same manner as the regular samples.

- In addition to the field duplicate, the laboratory also carried out organics batch quality control analyses in the form of matrix spike samples. The samples are spiked with a pre-determined concentration of analytes and then analysed in the same manner as the original sample. The results are compared to determine the effects of sample matrix on the accuracy and precision of the analysis. Accuracy is assessed by calculation of the relative percent difference (RPD).

- Organic surrogates, which are included in the TPH analyses, are compounds similar to the analytes of interest and are spiked in all samples in precise amounts prior to the analysis. Percent recoveries are calculated for each surrogate, providing an indication of analytical accuracy.

The Quality Control analytical results indicate that all analyses were performed within the limits set by the quality criteria for the various methods used. A full presentation of the laboratory Quality Control procedures is included in the original laboratory certificates in Appendix C.

5.0
CONCLUSIONS

5.1 GENERAL

The field investigations carried out at the Monier-PGH Quarry have revealed that:

- the groundwater underlying the site is moderately saline and does not have any potential use;

- the permeability of the formation is 2.0×10^{-6} m/sec (bores MONW-07, MONW-08, MONW-09) which exceeds the NSW EPA criteria for landfill site of 10^{-8} m/sec;

- the permeability tests carried out on the natural clay material indicated that, with proper compaction, the clay is suitable for use as a landfill base liner and capping material;

- the recorded water table has an uneven head distribution, due to the quarry activities around the site. Specifically, the water table in the vicinity of the main pit north-west of Metford Road is significantly influenced by the pit which is acting as a "sink". Water levels taken in MONW-08 and MONW-09 on the south-eastern site area are not affected by the main pit and, therefore, provide a better indication of the groundwater gradient. The groundwater is interpreted to flow towards the east to north-east; and

- no obvious contamination due to organic or inorganic compounds has been detected in the current set of analyses.

6.0 RECOMMENDATIONS

6.1 GENERAL

It is recommended that:

- a monthly groundwater level monitoring programme be set up in order to assess the seasonal and longer term variations of the water table,
- a quarterly groundwater sampling programme be implemented to identify variations in the quality of the groundwater and to collected data to establish current and background conditions prior to the establishment of landfilling operations, and
- replacement of the damaged bore MONW-05 be carried out in order to continue monitoring groundwater quality and water levels at this location in the future.

7.0 REFERENCES

AGC Woodward-Clyde Pty Limited *"Monier-PGH Quarry, Maitland, Groundwater Investigations"* Prepared for CSR-Readymix and Cleanaway, September 1993

AGC Woodward-Clyde Pty Limited *"Monier-PGH Quarry, East Maitland, Stage 2 Groundwater Investigations"* Prepared for CSR Construction Materials, August 1996

NSWEPA *"Environmental Guidelines for Solid Waste Landfills"* 1996

TABLES

TABLE - 4 LABORATORY ANALYTICAL RESULTS

Parameter	Units	LOR	MONW-07	MONW-08	MONW-09	MONW-01	MONW-02	MONW-03	MONW-04	MONW-05
Date			11.12.96	11.12.96	11.12.96	31.07.96	31.07.96	31.07.96	31.07.96	31.07.96
pH		0.01	7.49	7.69	7.92	6.7	6.6	6.6	6.5	7
Total Dissolved Solids (TDS)	mg/L	1	1840	2340	11100	3790	5470	3110	3470	5370
Calcium	mg/L	1	27	34	156	76	135	115	118	105
Magnesium	mg/L	1	33	58	446	115	228	96	195	195
Sodium	mg/L	1	625	820	3060	1100	1460	876	1010	1530
Potassium	mg/L	1	15	18	41	24	25	25	31	29
Bicarbonate as $CaCO_3$	mg/L	1	247	220	394	484	568	490	505	462
Sulphate	mg/L	1	207	162	558	359	506	312	313	688
Chloride	mg/L	1	776	1210	5710	1570	2390	1270	1510	2310
Iron	mg/L	0.1	1.4	1.2	2.4	1.6	3	0.9	2	0.6
Arsenic	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	mg/L	0.001	<0.001	<0.001	<0.001	-	-	-	-	-
Copper	mg/L	0.001	0.004	0.004	0.007	<0.01	<0.01	<0.01	<0.01	<0.01
Manganese	mg/L	0.001	0.129	0.581	4.39	0.56	0.33	0.09	0.1	0.21
Lead	mg/L	0.001	0.001	<0.001	0.049	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	mg/L	0.001	0.01	0.019	0.018	0.04	0.07	0.08	<0.01	0.12
Cyanide (amenable to chlorination)	mg/L	0.005	<0.005	0.02	<0.005	-	-	-	-	-
Ammonia as N	mg/L	0.01	0.22	0.22	0.2	-	-	-	-	-
Nitrate as N	mg/L	0.01	0.04	0.04	0.05	0.05	0.06	0.07	0.05	0.07
Sulphide	mg/L	0.1	<0.1	<0.1	<0.1	-	-	-	-	-
Biochemical Oxygen Demand (BOD_5)	mg/L	2	8	<2	<2	-	-	-	-	-
Phenols	mg/L	0.2	<0.2	<0.2	<0.2	-	-	-	-	-
Total Coliforms	cfu/100 mL	2	<2	<2	<2	-	-	-	-	-
Total Petroleum Hydrocarbons										
C6 - C9 fraction	µg/L	20	<20	<20	<20	<20	<20	<20	<20	<20
C10 - C14 fraction	µg/L	50	<50	<50	<50	<50	<50	<50	<50	<50
C15 - C28 fraction	µg/L	100	<100	<100	<100	518	192	129	117	<100
C29 - C36 fraction	µg/L	50	<50	928	204	113	<50	<50	<50	<50
BTEX										
Benzene	µg/L	1	<1	<1	<1	-	-	-	-	-
Toluene	µg/L	2	<2	<2	<2	-	-	-	-	-
Chlorobenzene	µg/L	2	<2	<2	<2	-	-	-	-	-
Ethylbenzene	µg/L	2	<2	<2	<2	-	-	-	-	-
meta- & para-Xylene	µg/L	2	<2	<2	<2	-	-	-	-	-
ortho-Xylene	µg/L	2	<2	<2	<2	-	-	-	-	-
Halogens AOX	ppb		104	123	124	-	-	-	-	-
Volatile TPH/BTEX Compound Surrogate						-	-	-	-	-
1,2-Dichloroethane-D4		%	101	85	121	-	-	-	-	-
Toluene-D8		%	102	86	114	-	-	-	-	-
4-Bromofluorobenzene		%	99	84	114	-	-	-	-	-

Note: DUP-01 is a duplicate of MONW-09
Polar compounds contribute to the C29-C36 band in samples MONW-08, MONW-09 & DUP-01.

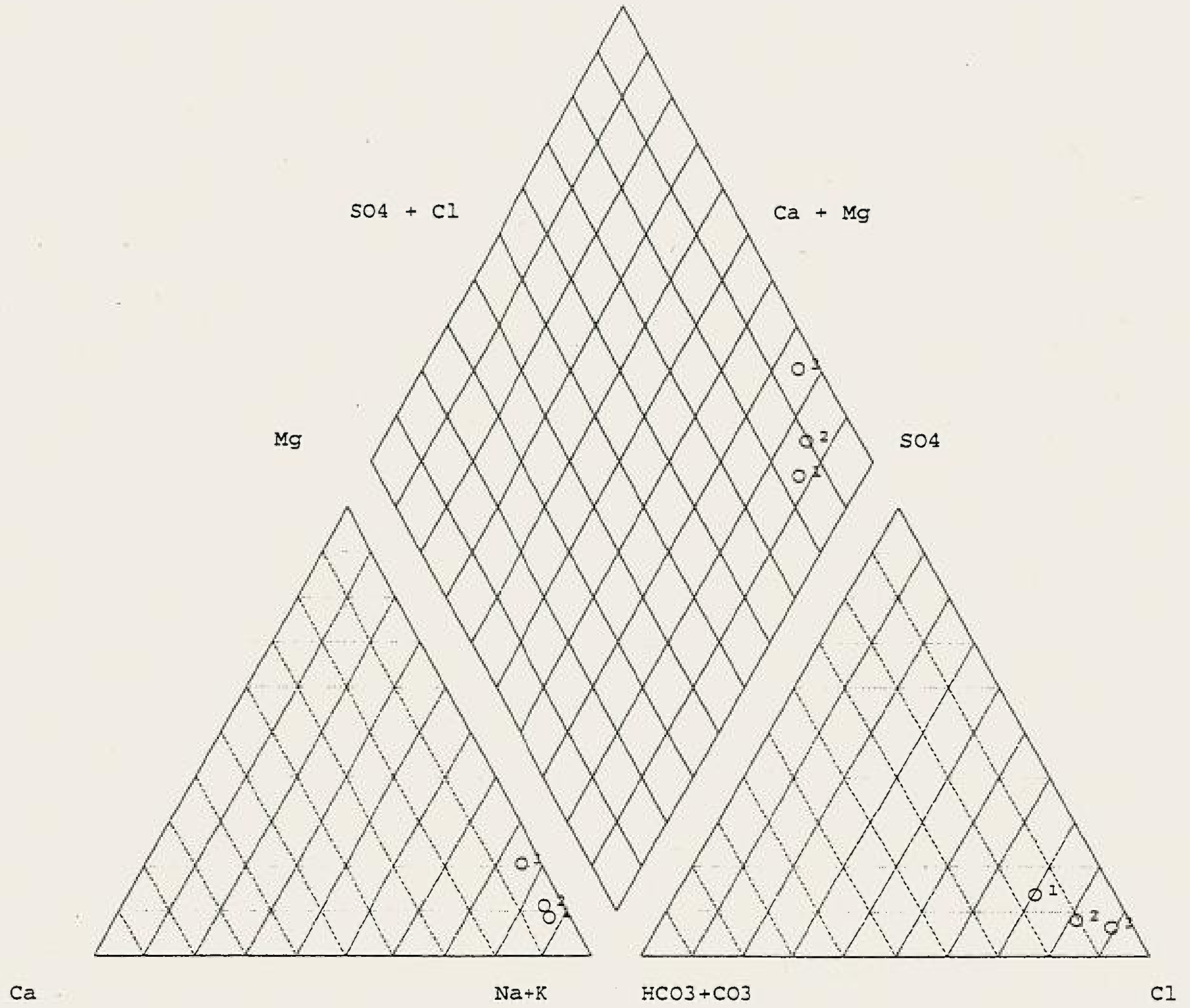
Prepared by: DFP
Checked by:..PC

TABLE - 5 QUALITY CONTROL ANALYSES

Parameter	Units	LOR	DUP-01	BLANK
Date			11.12.96	11.12.96
pH		0.01	7.89	5.74
Total Dissolved Solids (TDS)	mg/L	1	9320	2
Calcium	mg/L	1	159	<1
Magnesium	mg/L	1	450	<1
Sodium	mg/L	1	3010	1
Potassium	mg/L	1	44	<1
Bicarbonate as $CaCO_3$	mg/L	1	407	3
Sulphate	mg/L	1	561	<1
Chloride	mg/L	1	5600	1
Iron	mg/L	1	2.4	<0.1
Arsenic	mg/L	0.01	<0.01	<0.01
Cadmium	mg/L	0.001	<0.001	<0.001
Copper	mg/L	0.001	0.007	<0.001
Manganese	mg/L	0.001	4.33	0.009
Lead	mg/L	0.001	0.061	<0.001
Zinc	mg/L	0.001	0.026	<0.001
Cyanide (amenable to chlorination)	mg/L	0.005	<0.005	<0.005
Ammonia as N	mg/L	0.01	0.22	<0.01
Nitrate as N	mg/L	0.01	0.07	0.08
Sulphide	mg/L	0.1	<0.1	<0.1
Biochemical Oxygen Demand (BOD_5)	mg/L	2	<2	<2
Phenols	mg/L	0.2	<0.2	<0.2
Total coliforms	cfu/100mL	2	<2	0
VOLATILE TPH/BTEX COMPOUND SURROGATE				
1,2-Dichloroethane-D4	%	1	113	91
Toluene-D8	%	1	110	92
4-Bromofluorobenzene	%	1	111	91

Note: DUP01 is a duplicate sample of MONW-09

Prepared by: DFP
Checked by:..T.C..



Plot No	Sample No	Na+ (meq/L)	K+ (meq/L)	Ca++ (meq/L)	Mg++ (meq/L)	Cl- (meq/L)	HCO3- (meq/L)	CO3-- (meq/L)	SO4-- (meq/L)	Balance (% Diff)
1	MONW07	27.19	.38	1.35	2.71	21.89	4.94	.	4.31	.79
2	MONW08	35.67	.46	1.7	4.77	34.13	4.4	.	3.37	.82
3	MONW09	133.1	1.05	7.78	36.69	161.06	7.88	.	11.62	-.54

Woodward-Clyde	CLIENT CSR CONSTRUCTION MATERIALS PROJECT EAST MAITLAND PGH QUARRY	REVISION: A SCALE: AS SHOWN DRAWING No: 3397/0003 CAD FILE NO: G.009 DATE:	DESIGNED: FC DRAWN: HC CHECKED: FC APPROVED: STATUS: FINAL	TITLE PIPER DIAGRAM FIGURE 3 A4

TABLE - 1 BORE STATISTICS SUMMARY

Bore	Easting	Northing	Quarry Max. Depth m AHD	Surface m AHD	Total Depth m b.s.	Bore Base m AHD	Screened Interval m b.s.	Screened Interval m AHD	Datum m a.s.	Datum m AHD	SWL 14.8.93 m b.d.	SWL 18.7.96 m b.d.	SWL 11.12.96 m b.d.	SWL 11.12.96 m AHD
MONW-01	356547.73	1374353.82	-	12.46	26.7	-14.24	17.2-26.1	-4.7 to -13.6	0.45	12.91	13.83	13.07	13.14	-0.23
MONW-02	356437.78	1374398.83	-	9.39	23.7	-14.31	17.8-23.7	-8.4 to -14.3	0.45	9.84	9.69	9.03	8.98	0.86
MONW-03	356596.08	1374064.08	-	17.46	32.8	-15.34	20.2-32.0	-2.7 to -14.5	0.43	17.89	17.02	16.75	16.9	0.99
MONW-04	356441.771	1374118.139	-	9.34	29.6	-20.26	9.9-29.6	-0.6 to -20.3	0.57	9.91	-	9.85	9.97	-0.06
MONW-05	356372.399	1374199.763	-	7.33	24	-16.67	7.8-24.0	-0.47 to -16.7	0.53	7.86	-	7.83	*	-
MONW-06	356790.249	1374161.834	6	12.429	11.2	1.2	6.0-10.5	6.4 to 1.9	0.99	13.42	-	-	dry hole	-
MONW-07	356537.544	1373866.958	6	18.556	24.0	-5.4	17.0-23.0	1.6 to -4.4	0.97	19.53	-	-	19.04	0.49
MONW-08	356671.304	1373578.629	6	23.823	23.0	0.8	15.0-21.0	8.8 to 2.8	1.18	25.01	-	-	17.14	7.87
MONW-09	357041.763	1373889.112	6	8.472	12.0	-3.5	6.5-11.0	2.0 to -2.5	0.88	9.35	-	-	4.87	4.48

* = Bore damaged and blocked at 7.85 m
m b.s. = Metres below surface
m a.s. = Metres above surface
m b.d. = Metres below datum
m AHD = m Australian Height Datum

Prepared by: DFP
Checked by: FC

TABLE - 2 PERMEABILITY TESTS SUMMARY

Bore	Interval Tested m b.s	K m/sec	Type of test
MONW-01	17.2 - 26.1	1×10^{-5}	Falling head
MONW-02	17.8 - 23.7	6×10^{-6}	Falling head
MONW-03	20.2 - 32.0	1×10^{-6}	Falling head
MONW-04	9.8 - 29.6	6×10^{-6}	Falling head
MONW-05	7.8 - 24.0	3×10^{-6}	Falling head
MONW-06	-	-	-
MONW-07	17.0-23.0	4.2×10^{-6}	Recovery
		1.6×10^{-6}	Falling Head
MONW-08	15.0-21.0	4.7×10^{-6}	Recovery
		2.2×10^{-6}	Falling Head
MONW-09	6.5-11.0	2.2×10^{-7}	Recovery

Note:
MONW-06 is a dry well

Prepared by: DFP
Checked by:..FC

TABLE - 3 FIELD PARAMETERS SUMMARY

Bore Number	Date Sampled	Turbidity NTU	EC (µS/cm)	pH	DO (%)	DO (mg/L)	Redox (mV)	Temp ^{0}C	Volume Purged (L)	Comments
MONW-06	12/11/96	-	-	-	-	-	-	-	-	Dry hole, not sampled
MONW-07	12/11/96	60	3710	6.29	17	1.37	316	23	120	Low to moderate turbidity, brown
MONW-08	12/11/96	593	4940	6.58	48	3.97	313	23	153	Low to moderate turbidity, brown
MONW-09	12/11/96	12	19190	6.32	48	4.27	357	19.6	135	Almost clear, hint of brown

Note:

\- = Not measured

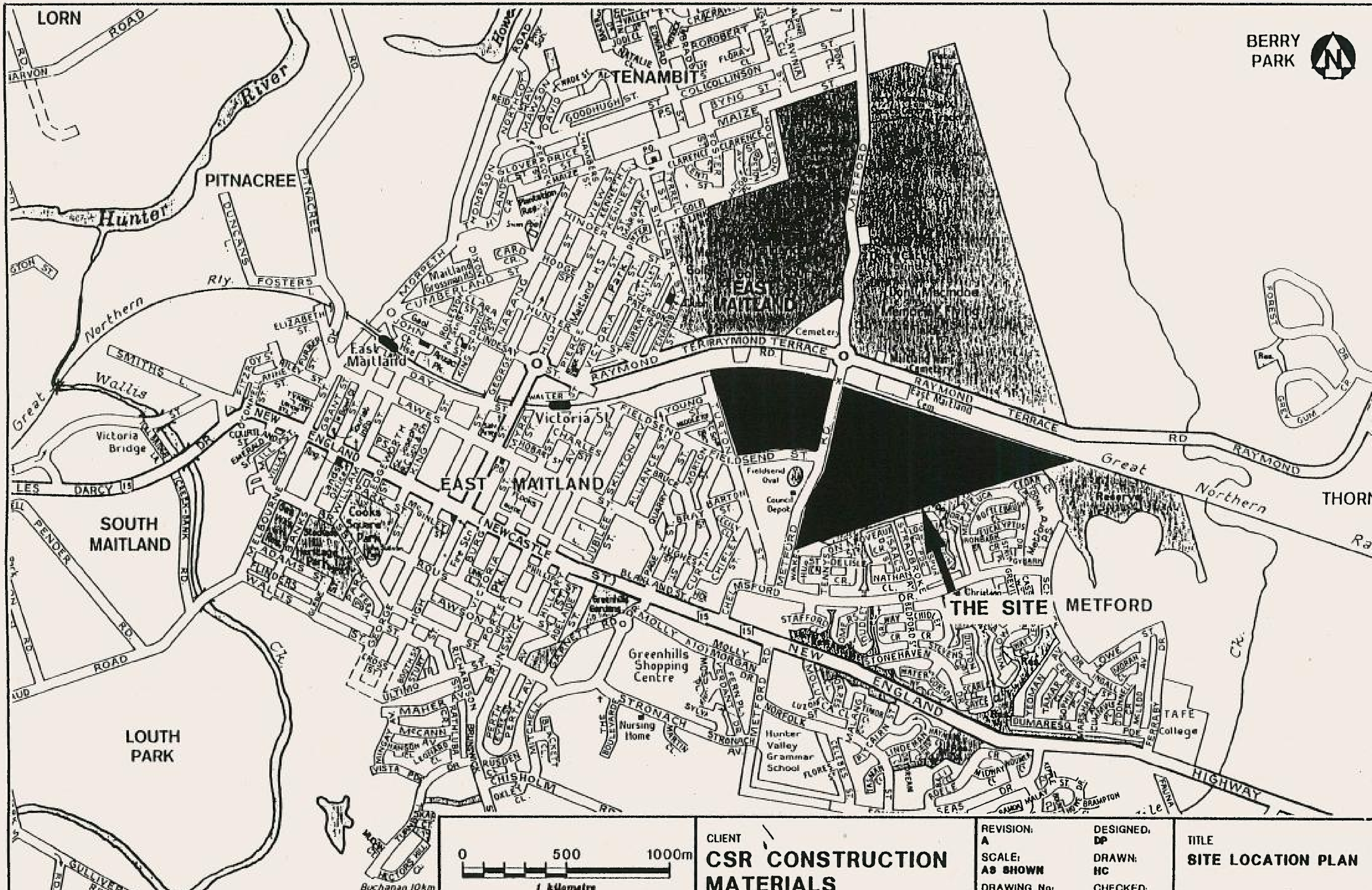
Eh= Redox potential (corrected values)

EC= Electrical conductivity

DO= Dissolved oxygen

Prepared by: DFP
Checked by:..FC

FIGURES

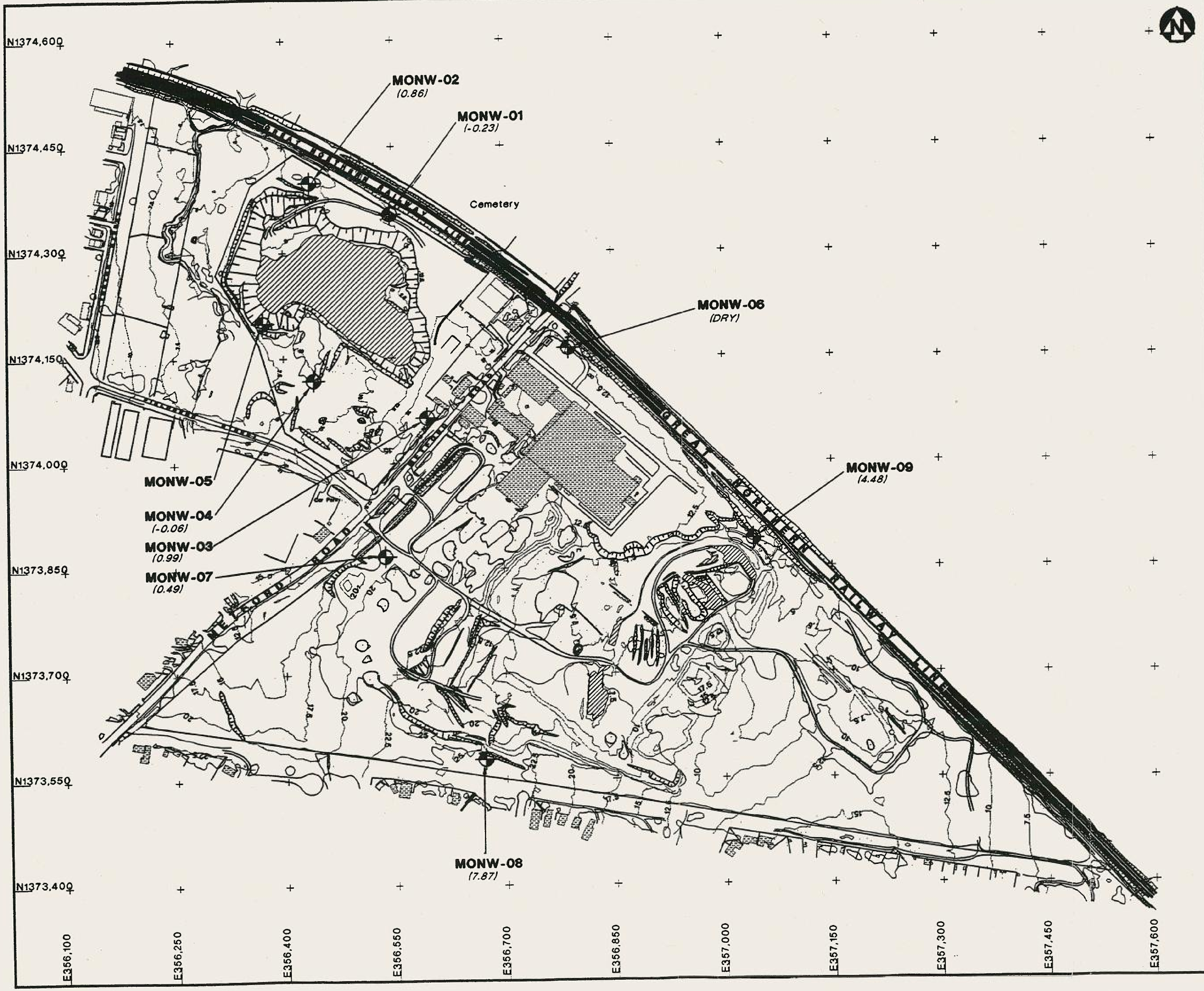


CLIENT **CSR CONSTRUCTION MATERIALS**	REVISION: A	DESIGNED: DP	TITLE **SITE LOCATION PLAN**
	SCALE: AS SHOWN	DRAWN: HC	
	DRAWING No: 3397/0003	CHECKED: FC	
PROJECT **EAST MAITLAND PGH MONIER QUARRY**	CAD FILE NO: Q.011	APPROVED:	FIGURE 1
	DATE:	STATUS: FINAL	A4

0 500 1000m
1 kilometre

Woodward-Clyde

SYD/LIF/9-95



REVISION: A
SCALE: 1:5000
DRAWING No: 3397/0003
CAD FILE NO: G.009
DATE:
DESIGNED: DP
DRAWN: HC
CHECKED: FC
APPROVED: BL
STATUS: FINAL

CLIENT
CSR CONSTRUCTION MATERIALS

PROJECT
EAST MAITLAND PGH QUARRY

TITLE
SITE PLAN AND MONITORING WELL LOCATION

FIGURE
2

A3

Woodward-Clyde

APPENDIX A

BORE CONSTRUCTION LOGS

WOODWARD - CLYDE

PROJECT :	CSR - Construction Materials	JOB NO:	3397/003
LOCATION:	East Maitland	DATE STARTED:	14.11.96
SUPERVISOR:	Dino Parisotto	DATE COMPLETED:	14.11.96

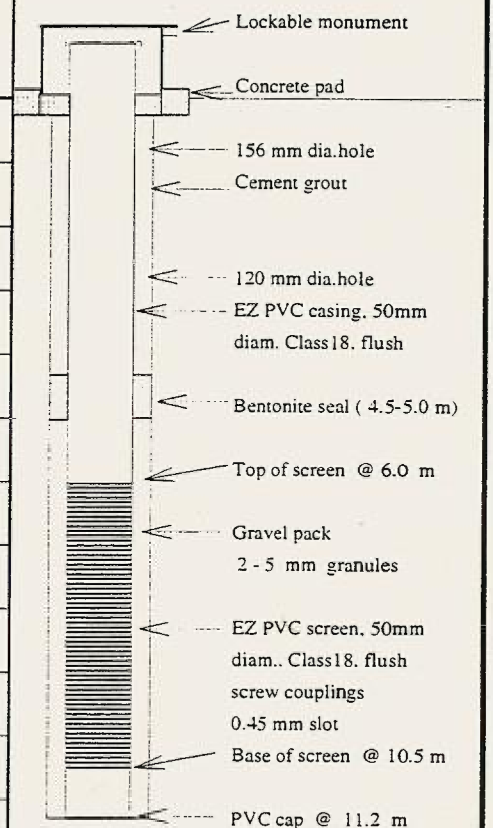
INSTALLED BY:	Intertech Drilling	METHOD:	RAB	DIAMETER:	156 mm, 120 mm
RIG:	Intertech 650	TOTAL DEPTH :	11.2 m	R.L. GROUND:	12.429 m AHD
DATUM:	m AHD	SWL:	dry (btoc 11/12/96)	R.L. SWL :	-

BORE NUMBER: MONW-06

Lithological Log		Remarks
0 -4 m	FILL: brown silty to clayey loam, some: bricks, carbonaceous shale, coal, organic matter, moist.	Blade bit 156 mm
2-5 m	SILTY CLAY: brown-grey, plastic, firm, minor fine grained sand, moist.	Blade bit 120 mm injecting water
4-7.5 m	SILTY CLAY: grey-brown, plastic, firm, trace of fine sand, moist.	
	@ 6-7 m grey silty clay	cut water 0.1 L/sec
7.5-10 m	SILTSTONE: brown, highly weathered, soft, partly clayey (grey) with trace of coal (grey/black).	
10-11.2 m	SILTY CLAY: dark grey, organic rich with humic odour, plastic, soft.	~ 0.1 L/sec upon airlift
11.2 m	**Bottom of the hole**	

Depth (m): 2, 4, 6, 8, 10, 12, 14, 16, 18

Bore Construction



S:\3397.003\MONW06.XLS\12/16/96\DP

Prepared by: DP
Checked by: FC

WOODWARD - CLYDE

PROJECT :	CSR - Construction Materials	JOB NO:	3397/003
LOCATION:	East Maitland	DATE STARTED:	15.11.96
SUPERVISOR:	Dino Parisotto	DATE COMPLETED:	15.11.96

INSTALLED BY:	Intertech Drilling	METHOD:	RAB/Conventional Hammer	DIAMETER:	156 mm, 120 mm
RIG:	Intertech 650	TOTAL DEPTH :	24.0 m	R.L. GROUND:	18.556 m AHD
DATUM:	m AHD	SWL:	18.99 m (btoc 10/12/96)	R.L. SWL :	0.49 m AHD

BORE NUMBER: MONW-07

Lithological Log		Remarks	Depth (m)
0 -1 m	FILL: brown loam and brown-grey sandy clay, some sandstone fragments.	Blade bit 156 mm	
1-3 m	SILTY CLAY: grey, plastic, firm, minor sandy clay-brown-grey, slight moisture.	Hammer 120 mm injecting water	2.5
3-5 m	SILTY SAND: brown-grey, quartz rich, fine to medium grained, slight moisture. @ 4-5 dark brown-grey, some weathered shale/coal		5
5-6 m	SANDSTONE: brown-grey and red-brown (Fe stained) highly weathered, some silty clay.		
6-10 m	SILTSTONE: grey, highly weathered, partly carbonaceous, massive, soft.		7.5
	@ 8-9 m fossiliferous siltstone, grey, slight weathering		
	@ 9-10 m some fine grained sandstone, grey.		10
10-15 m	SANDSTONE: light grey, highly weathered, mainly sand, fine to medium grained, friable.		12.5
	@ 14-15 m trace of grey clay		15
15-19 m	SILTSTONE: grey, highly weathered, fossiliferous, some brown-grey claystone, soft.		17.5
19-24 m	COAL/CARBONACEOUS SHALE: dark grey to black, brittle, large chips (heavily cleated), trace of pyrite, some interlaminated carbonaceous shale and stoney coal.	cut water ~ 0.1 L/sec	20
	@ 22-23 m some grey-brown claystone		22.5
		~ 0.2 L/sec upon airlift	
24.0 m	**Bottom of the hole**		25

Bore Construction

S:3397.003/MONW07.XLS/NOV96/DP

Prepared by: DP
Checked by: FC

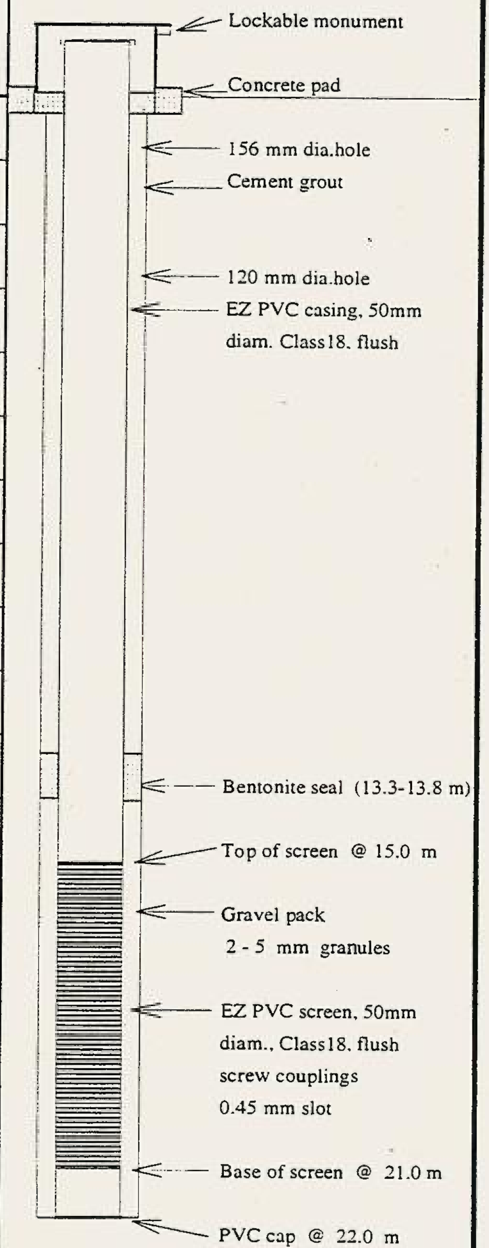
WOODWARD - CLYDE

PROJECT : CSR - Construction Materials		JOB NO:	3397/003
LOCATION: East Maitland		DATE STARTED:	14.11.96
SUPERVISOR: Dino Parisotto		DATE COMPLETED:	14.11.96
INSTALLED BY: Intertech Drilling	METHOD: RAB/ Conventional Hammer	DIAMETER:	156 mm, 120 mm
RIG: Intertech 650	TOTAL DEPTH : 22.0 m	R.L. GROUND:	23.823 m AHD
DATUM: m AHD	SWL: 17.11 m (btoc 10/12/96)	R.L. SWL :	7.87m AHD

BORE NUMBER: MONW-08

Lithological Log	Remarks	Depth (m)
0 -3 m FILL: brown clayey loam, minor rock fragments. @ 2-3 m silty clay, grey with fragements of shale/ siltstone.	Blade bit 156 mm	
	Blade bit 120 mm injecting water	2.5
3-22 m SILTSTONE/SHALE: grey-brown, highly weathered, partly carbonaceous, soft-friable, slight moisture. @ 4-5 m some brown-grey claystone - soft. @ 5-6 m "smutty shale" carbonaceous shale and claystone with red-brown Fe staining. @ 6-9 m some brown-grey claystone with moderate to slight weathering.		5 7.5
@ 8-9 m minor fine grained sandstone -light grey slight weathering @ 8-12 m dominantly siltstone -fossiliferous 10 m base of weathering @ 10-11 m minor fine grained sandstone -light grey @ 11-12 m finely laminated, partly carbonaceous		10
@ 13-14 m minor carbonaceous shale/ coal and brown-grey claystone.	Hammer 120 mm	12.5
@ 15-16 m dominantly sandstone, fine grained, light grey.		15
@ 18-19 m dominantly black shiny coal		17.5
@ 19-20 m dominantly carbonaceous shale and brown-grey claystone. @ 20-22 m dominantly grey siltstone, partly carbonaceous, trace of sandstone.		20
	< 0.1 L/sec upon airlift	22.5
22.0 m **Bottom of the hole**		

Bore Construction



S:3397.003/MONW08.XLS/DEC96/DP

Prepared by: DP
Checked by: FC

WOODWARD - CLYDE

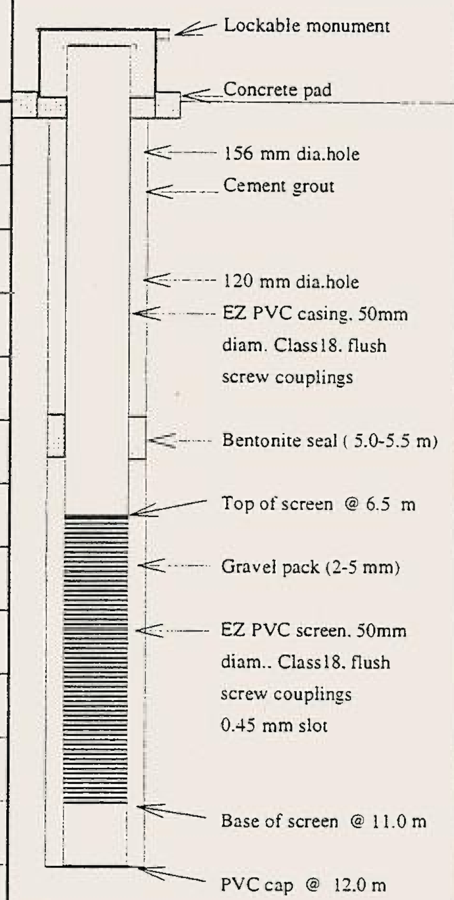
PROJECT :	CSR - Construction Materials	JOB NO:	3397/003
LOCATION:	East Maitland	DATE STARTED:	14.11.96
SUPERVISOR:	Dino Parisotto	DATE COMPLETED:	14.11.96

INSTALLED BY:	Intertech Drilling	METHOD:	RAB	DIAMETER:	156 mm, 120 mm
RIG:	Intertech 650	TOTAL DEPTH :	12.0 m	R.L. GROUND:	8.472 m AHD
DATUM:	m AHD	SWL:	4.82 m (btoc 10/12/96)	R.L. SWL :	4.48 m AHD

BORE NUMBER: MONW-09

Lithological Log		Remarks	Depth (m)
0 -3.5 m	FILL: brown silty clay, minor sand with some bricks tiles and sandstone, dry.	Blade bit 156 mm Blade bit 120 mm	2
3.5-6 m	SILTSTONE: brown-grey, highly weathered, friable, slight moisture.		4 6
6-7 m	SANDSTONE: brown, highly weathered, friable, mostly silty sand.	injecting water	
7-12 m	SILTSTONE: brown-grey, highly weathered, friable, some brown-grey claystone, carbonaceous and clayey in parts. @ 8-9 m dominantly grey silty clay, minor fine sand @ 8-9 m dominantly grey plastic silty clay and clay @ 10-12 m grey siltstone, friable-soft, finely laminated, fossiliferous, some silty clay.	~ 0.1 L/sec upon airlift	8 10 12
12.0 m	**Bottom of the hole**		14 16 18

Bore Construction



S:3397.003/MONW09.XLS/NOV96/DP

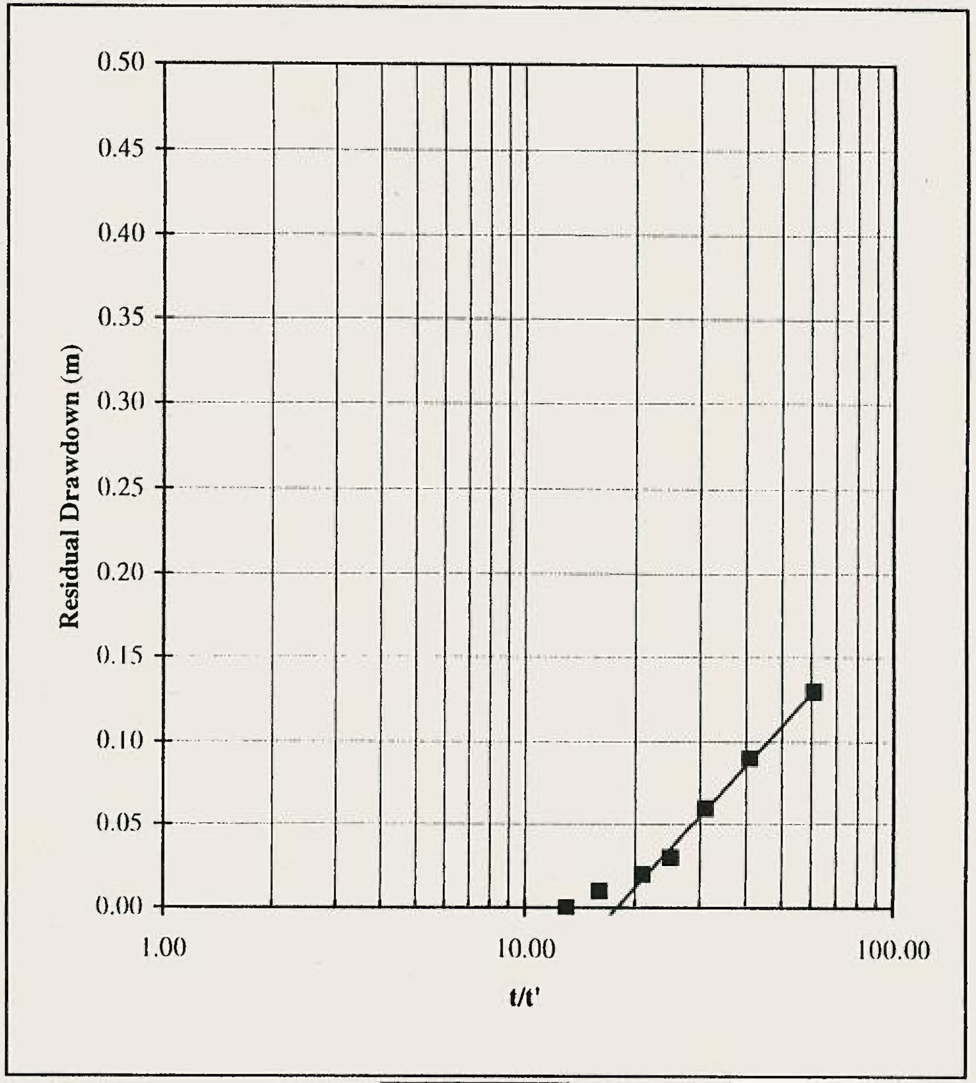
Prepared by: DP
Checked by: FC

APPENDIX B

PERMEABILITY TESTS

Test Date	10.12.96
Pumping Duration (min)	60.00
Standing Water Level (m)	18.99
Time Pumping Started	5:05 PM
Volume Removed (L)	120.00
Discharge Rate (m3/d)	2.88

Time Since Pumping Started, t (min)	Time Since Pumping Stopped, t' (min)	t/t'	Water Level (m)	Residual Drawdown s' (m)
61.00	1	61.00	19.12	0.13
61.50	1.5	41.00	19.08	0.09
62.00	2	31.00	19.05	0.06
62.50	2.5	25.00	19.02	0.03
63.00	3	21.00	19.01	0.02
64.00	4	16.00	19	0.01
65.00	5	13.00	18.99	0.00



	Transmissivity (m2/d)	2.15	^S	0.25
Aquifer section Tested (m) 5.9	Hydraulic conductivity (m/day)	3.64E-01	Y Intercept	-0.31

Woodward-Clyde

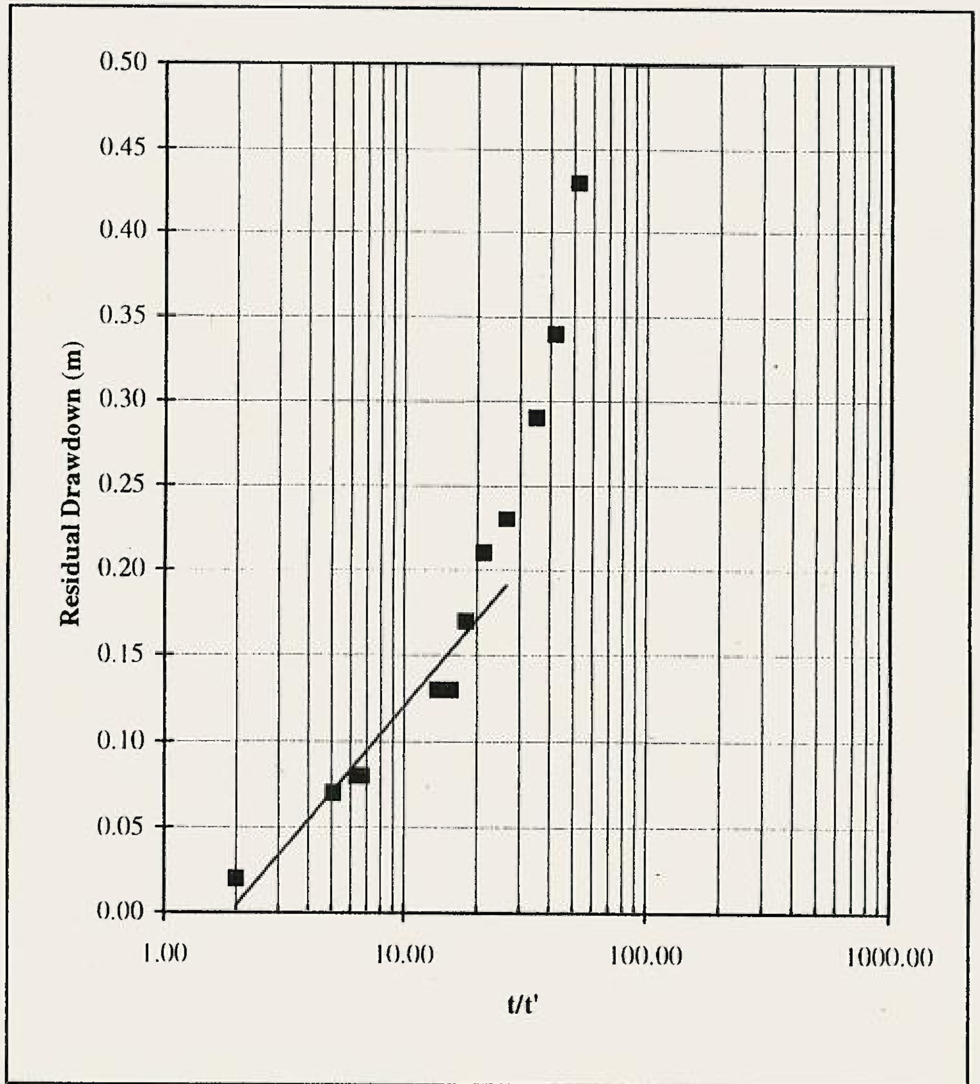
CSR : Maitland
RECOVERY TEST
BORE: MONW-07

S:\OSYDJOBS\3397.003\RECOVY07
.XLS\DEC96\DP

PREPARED BY: DP
CHECKED BY: FC
APPROVED BY:

Test Date	10.12.96
Pumping Duration (min)	102.00
Standing Water Level (m)	17.11
Time Pumping Started	2:10 PM
Volume Removed (L)	153.00
Discharge Rate (m3/d)	2.16

Time Since Pumping Started, t (min)	**Time Since Pumping Stopped, t' (min)**	**t/t'**	**Water Level (m)**	**Residual Drawdown s' (m)**
102.50	0.5	205.00	17.95	0.84
103.00	1	103.00	17.75	0.64
103.50	1.5	69.00	17.68	0.57
104.00	2	52.00	17.54	0.43
104.50	2.5	41.80	17.45	0.34
105.00	3	35.00	17.4	0.29
106.00	4	26.50	17.34	0.23
107.00	5	21.40	17.32	0.21
108.00	6	18.00	17.28	0.17
109.00	7	15.57	17.24	0.13
110.00	8	13.75	17.24	0.13
120.00	18	6.67	17.19	0.08
121.00	19	6.37	17.19	0.08
127.00	25	5.08	17.18	0.07
204.00	102	2.00	17.13	0.02



Transmissivity (m2/d) 2.38 **^S** 0.17

Aquifer section Tested (m) 5.8 **Hydraulic conductivity (m/day)** 4.10E-01 **Y Intercept** -0.05

Woodward-Clyde

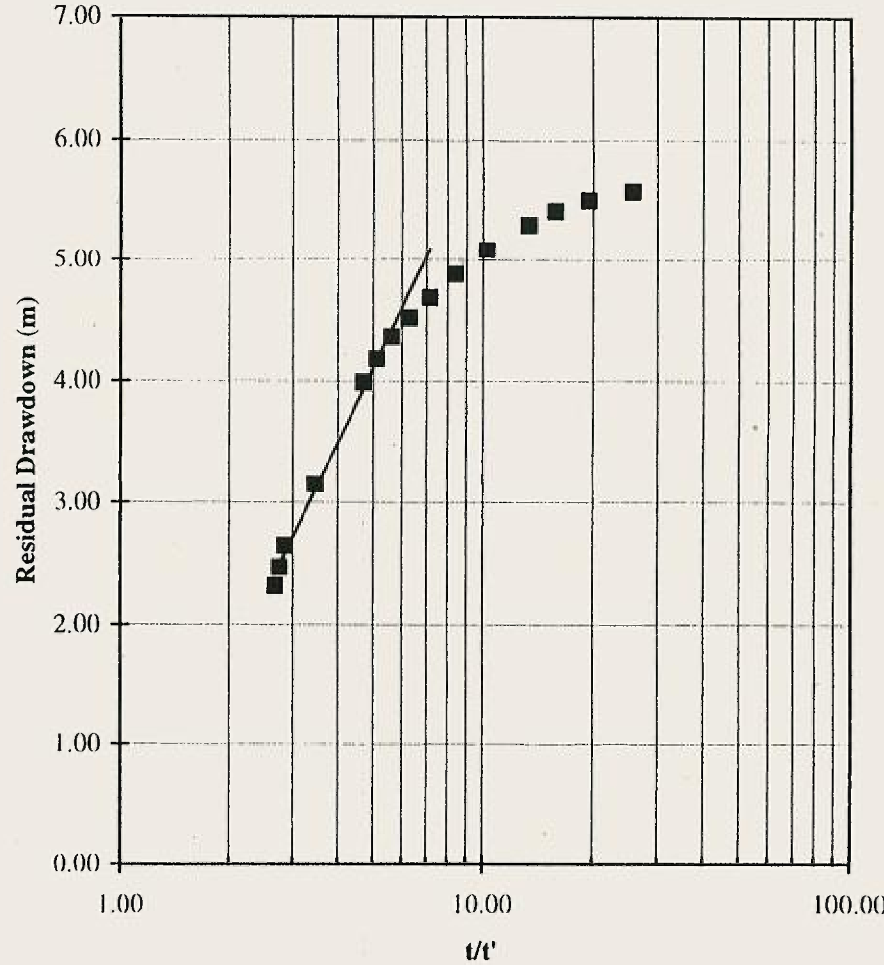
CSR : Maitland
RECOVERY TEST
BORE: MONW-08

S:\OSYDJOBS\3397.003\RECOVY08
.XLS\DEC96\DP

PREPARED BY: DP
CHECKED BY: FC
APPROVED BY:

Test Date	10.12.96
Pumping Duration (min)	37.00
Standing Water Level (m)	4.82
Time Pumping Started	6:53 PM
Volume Removed (L)	135.00
Discharge Rate (m3/d)	5.25

Time Since Pumping Started, t (min)	Time Since Pumping Stopped, t' (min)	t/t'	Water Level (m)	Residual Drawdown s' (m)
38.50	1.5	25.67	10.4	5.58
39.00	2	19.50	10.33	5.51
39.50	2.5	15.80	10.24	5.42
40.00	3	13.33	10.12	5.30
41.00	4	10.25	9.91	5.09
42.00	5	8.40	9.7	4.88
43.00	6	7.17	9.51	4.69
44.00	7	6.29	9.34	4.52
45.00	8	5.63	9.18	4.36
46.00	9	5.11	9	4.18
47.00	10	4.70	8.81	3.99
52.00	15	3.47	7.97	3.15
57.00	20	2.85	7.46	2.64
58.00	21	2.76	7.28	2.46
59.00	22	2.68	7.13	2.31



Aquifer section Tested (m) 8

Transmissivity (m2/d) 0.15

Hydraulic conductivity (m/day) 1.90E-02

^S 6.31

Y Intercept -0.30

Woodward-Clyde

CSR : Maitland
RECOVERY TEST
BORE: MONW-09

S:\OSYDJOBS\3397.003\RECOVY09.XLS\DEC96\DP

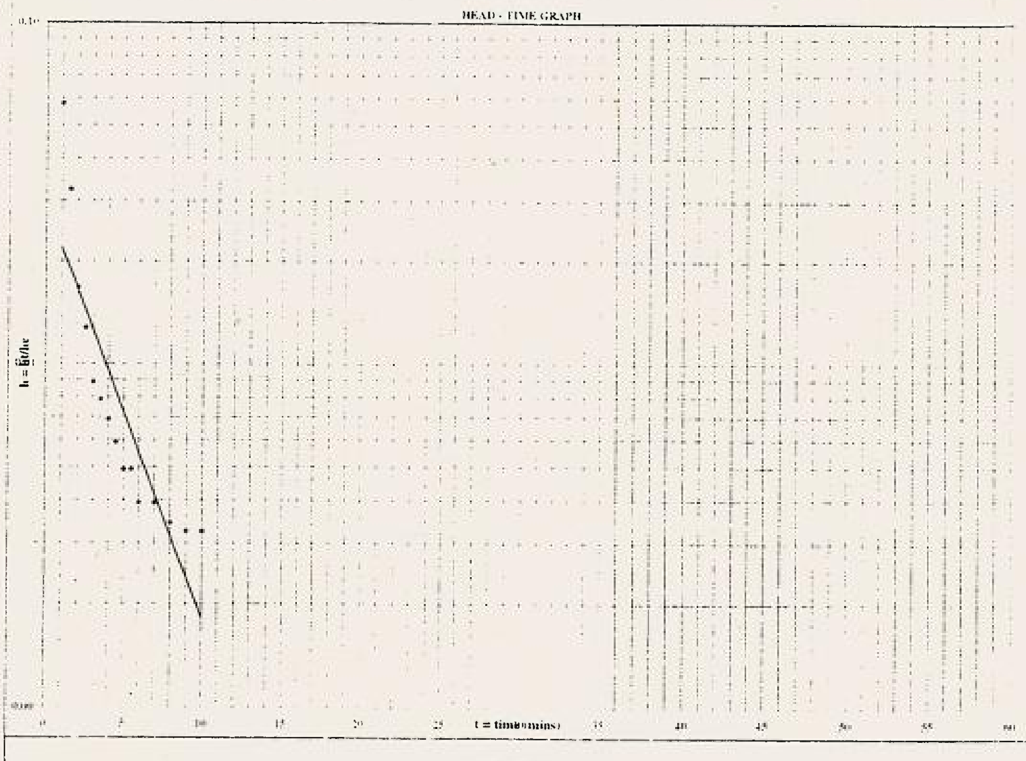
PREPARED BY: DP
CHECKED BY: FC
APPROVED BY:

FALLING HEAD TEST

Date:	11.12.96	**BORE/WELL No**	MONW7		
Project No.:	3397.3	**Location:**	MAITLAND	**Recorder's Name:**	DP
				Time:	
Cased Depth (m bRP):	24.85	**Depth to Screened Section (m):**	18.99		
SWL (m bRP) - *Hw:*	18.99	**Volume of water injected (m^3):**	0.02		
Intial Head (m) - *he:*	10.19	(head in excess of SWL at beginning of test)			
Length screened section (m): - *L*	5.9				
Radius of bore hole (m) - *r:*	0.06				
Radius of casing (m) - *rc:*	0.025			**Document #:**	REP099

Time, t (min)	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5
Depth to water (m) *hw*	18.4	18.66	18.82	18.86	18.9	18.91	18.92	18.93	18.94	18.94
Excess head (m) *ht = Hw - hw*	0.59	0.33	0.17	0.13	0.09	0.08	0.07	0.06	0.05	0.05
ht/he	0.06	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.005	0.005

Time, t (min)	6	7	8	9	10
Depth to water (m) *hw*	18.95	18.95	18.955	18.957	18.957
Excess head (m) *ht = Hw - hw*	0.04	0.04	0.04	0.03	0.03
ht/he	0.004	0.004	0.003	0.003	0.003



CALCULATIONS

METHOD 1

K = 0.133 x S x (rc²)/L m/sec — K = 1.6E-6 m/sec; 1.4E-1 m/day

METHOD 2

K = 0.019 x S x (rc²)/L x (lnL/r) m/sec for L/r>8 — K = 1.1E-6 m/sec 9.3E-2 m/day

K = 0.019 x S x (rc²)/L x [ln(L/2r) + sqrt(1+(L/2r)²)] m/sec for L/r<8 — K = m/sec; m/day

where

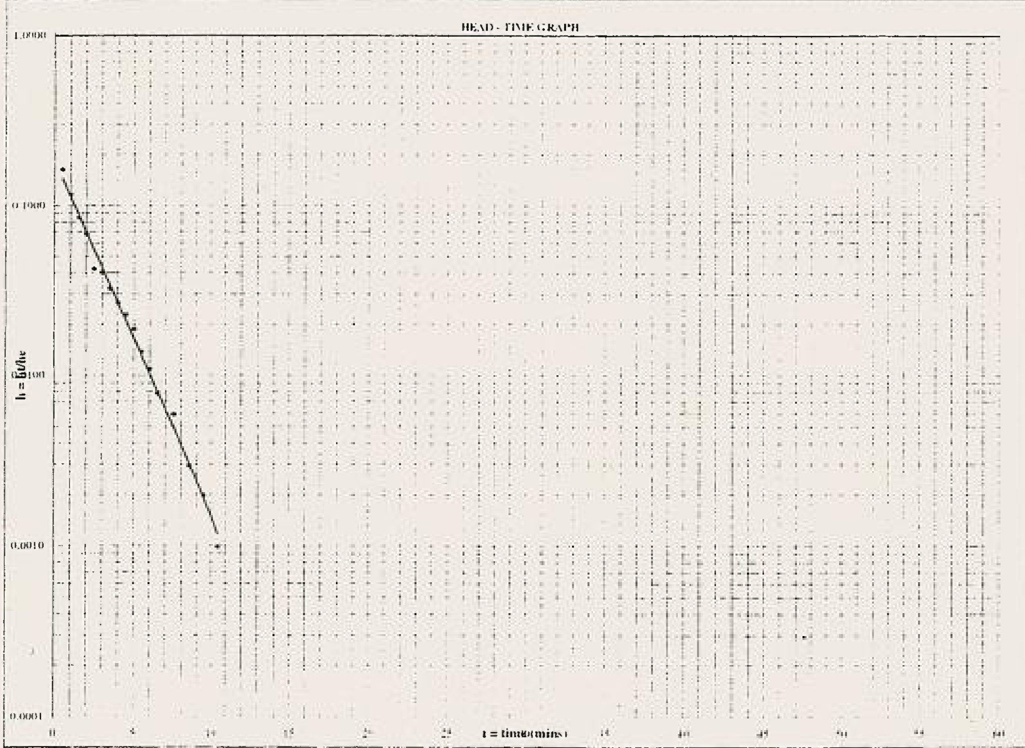
S = (log (h1/h2))/(t2-t1) i.e. slope of plot

FALLING HEAD TEST

Date:	11.12.96	**BORE/WELL No**	MONW8		
Project No.:	3397.3	**Location:**	MAITLAND	**Recorder's Name:**	DP
				Time:	
Cased Depth (m bRP):	22.92	**Depth to Screened Section (m):**	14.95		
SWL (m bRP) - *Hw:*	17.1	**Volume of water injected (m^3):**	0.02		
Intial Head (m) - *he:*	10.19	head in excess of SWL at beginning of test)			
Length screened section (m): - *L*	8				
Radius of bore hole (m) - *r:*	0.06				
Radius of casing (m) - *rc:*	0.025			**Document #:**	REP099

Time, t (min)	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
Depth to water (m)										
hw	15.44	15.92	16.24	16.41	16.67	16.69	16.77	16.83	16.87	16.91
Excess head (m)										
ht = Hw - hw	1.66	1.18	0.86	0.69	0.43	0.41	0.33	0.27	0.23	0.19
ht/he	0.16	0.12	0.08	0.07	0.04	0.04	0.03	0.03	0.023	0.019

Time, t (min)	5.5	6	6.5	7.5	8.5	9.5	10.5
Depth to water (m)	16.96	16.99	17.02	17.04	17.07	17.08	17.09
hw							
Excess head (m)							
ht = Hw - hw	0.14	0.11	0.08	0.06	0.03	0.02	0.01
ht/he	0.014	0.011	0.008	0.006	0.003	0.002	0.001



CALCULATIONS

METHOD 1

K = 0.133 x S x (rc²)/L m/sec — K = 2.2E-6 m/sec
1.9E-1 m/day

METHOD 2

K = 0.019 x S x (rc²)/L x (ln(L/r)) m/sec for L/r>8 — K = 1.5E-6 m/sec 1.3E-1 m/day

K = 0.019 x S x (rc²)/L x [ln(L/2r) + sqrt(1+(L/2r)²)] m/sec for L/r<=8 — K = m/sec
m/day

where

S = (log (h1/h2))/(t2-t1) i.e. slope of plot

Woodward- Clyde

S:\3397.3\MONW8.XLS\12/13/96\DP.tc

Prepared by DP
Checked by FC

APPENDIX C

LABORATORY CERTIFICATES

AUSTRALIAN LABORATORY
SERVICES P/L
A.C.N. 009 936 029

[redacted]

ANALYTICAL REPORT

AMENDED

LABORATORY:	AM4064
BATCH NUMBER:	0
SUB BATCH:	5
No. OF SAMPLES:	03/02/97
DATE RECEIVED:	03/02/97
DATE COMPLETED:	

CONTACT: MR F CAROSONE
CLIENT: AGC WOODWARD-CLYDE (NSW)
ADDRESS: LEVEL 6, 486-494 PACIFIC H'WAY
ST LEONARDS NSW 2065

ORDER No.: 3397/3 SAMPLE TYPE: WATER PROJECT:

Method	Analysis description	Units	LOR	MONW-07 11/12/96	MONW-08 11/12/96	MONW-09 11/12/96	DUP-01 11/12/96
EA-005	pH Value		0.01	7.49	7.69	7.92	7.89
EA-015	Total Dissolved Solids (TDS)	mg/L	1	1840	2340	11100	9320
ED-005F	Calcium - Filtered	mg/L	1	27	34	156	159
ED-010F	Magnesium - Filtered	mg/L	1	33	58	446	450
ED-015F	Sodium - Filtered	mg/L	1	625	820	3060	3010
ED-020F	Potassium - Filtered	mg/L	1	15	18	41	44
ED-035	Bicarbonate as CaCO3	mg/L	1	247	220	394	407
ED-040F	Sulphate - Filtered	mg/L	1	207	162	558	561
ED-045	Chloride	mg/L	1	776	1210	5710	5600
EG-005F	Iron - Filtered	mg/L	0.1	1.4	1.2	2.4	2.4
EG-020F	Arsenic - Filtered	mg/L	0.01	<0.01	<0.01	<0.01	<0.01
	Cadmium - Filtered	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
	Copper - Filtered	mg/L	0.001	0.004	0.004	0.007	0.007
	Manganese - Filtered	mg/L	0.001	0.129	0.581	4.39	4.33
	Lead - Filtered	mg/L	0.001	0.001	<0.001	0.049	0.061
	Zinc - Filtered	mg/L	0.001	0.010	0.019	0.018	0.026
EK-030	Cyanide amenable to chlorination	mg/L	0.005	<0.005	0.020	<0.005	<0.005
EK-055A	Ammonia as N	mg/L	0.01	0.22	0.22	0.20	0.22
EK-058A	Nitrate as N	mg/L	0.01	0.04	0.04	0.05	0.07
EK-085	Sulphide	mg/L	0.1	<0.1	<0.1	<0.1	<0.1
EP-030	Biochemical Oxygen Demand	mg/L	2	8	<2	<2	<2
EP-035	Phenols	mg/L	0.2	<0.2	<0.2	<0.2	<0.2
EZ-005	Total Cations	me/L	0.01	31.63	42.60	179	177
EZ-010	Total Anions	me/L	0.01	31.14	41.91	181	178
EZ-015	Actual (Anion / Cation) Difference	me/L	0.01	0.49	0.69	1.94	0.78
EZ-020	Allowed (Anion / Cation) Difference	me/L	0.01	0.59	0.76	2.91	2.86

DATE RECEIVED: 5-2-97. 6
PROJECT No. 3397.3
DOCUMENT No.
DISTRIBUTION FC

COMMENTS:

LOR denotes level of reporting
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• Results apply to sample(s) as submitted by client.

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ANALYTICAL REPORT

CONTACT:	MR F CAROSONE	LABORATORY:	AMENDED
CLIENT:	AGC WOODWARD-CLYDE (NSW)	BATCH NUMBER:	AM4064
ADDRESS:	LEVEL 6, 486-494 PACIFIC H'WAY ST LEONARDS NSW 2065	SUB BATCH:	0
		No. OF SAMPLES:	5
		DATE RECEIVED:	03/02/97
		DATE COMPLETED:	03/02/97

ORDER No.: 3397/3 SAMPLE TYPE: WATER PROJECT:

Method	Analysis description	Units	LOR	BLANK 11/12/96
EA-005	pH Value		0.01	5.74
EA-015	Total Dissolved Solids (TDS)	mg/L	1	2
ED-005F	Calcium - Filtered	mg/L	1	<1
ED-010F	Magnesium - Filtered	mg/L	1	<1
ED-015F	Sodium - Filtered	mg/L	1	1
ED-020F	Potassium - Filtered	mg/L	1	<1
ED-035	Bicarbonate as CaCO3	mg/L	1	3
ED-040F	Sulphate - Filtered	mg/L	1	<1
ED-045	Chloride	mg/L	1	1
EG-005F	Iron - Filtered	mg/L	0.1	<0.1
EG-020F	Arsenic - Filtered	mg/L	0.01	<0.01
	Cadmium - Filtered	mg/L	0.001	<0.001
	Copper - Filtered	mg/L	0.001	<0.001
	Manganese - Filtered	mg/L	0.001	0.009
	Lead - Filtered	mg/L	0.001	<0.001
	Zinc - Filtered	mg/L	0.001	<0.001
EK-030	Cyanide amenable to chlorination	mg/L	0.005	<0.005
EK-055A	Ammonia as N	mg/L	0.01	<0.01
EK-058A	Nitrate as N	mg/L	0.01	0.08
EK-085	Sulphide	mg/L	0.1	<0.1
EP-030	Biochemical Oxygen Demand	mg/L	2	<2
EP-035	Phenols	mg/L	0.2	<0.2
EZ-005	Total Cations	me/L	0.01	0.04
EZ-010	Total Anions	me/L	0.01	0.09
EZ-015	Actual (Anion / Cation) Difference	me/L	0.01	0.05
Z-020	Allowed (Anion / Cation) Difference	me/L	0.01	0.11

MMENTS:

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is is the Final Report which supersedes any preliminary reports with this batch number.

• Results apply to sample(s) as submitted by client.

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ANALYTICAL REPORT

LABORATORY:	AMENDED
BATCH NUMBER:	AM4064
SUB BATCH:	0
No. OF SAMPLES:	5
DATE RECEIVED:	03/02/97
DATE COMPLETED:	03/02/97

CONTACT: MR F CAROSONE
CLIENT: AGC WOODWARD-CLYDE (NSW)
ADDRESS: LEVEL 6, 486-494 PACIFIC H'WAY
ST LEONARDS NSW 2065

ORDER No.: 3397/3 SAMPLE TYPE: QUALITY CONTROL PROJECT:

Method	Analysis description	Units	LOR	MONW-07 %SPK REC 11/12/96	BLANK CHK 11/12/96	METHOD BLANK 12/12/96
EA-005	pH Value		0.01	----	5.75	----
EA-015	Total Dissolved Solids (TDS)	mg/L	1	----	<1	<1
ED-005F	Calcium - Filtered	mg/L	1	----	<1	<1
ED-010F	Magnesium - Filtered	mg/L	1	----	<1	<1
ED-015F	Sodium - Filtered	mg/L	1	----	<1	<1
ED-020F	Potassium - Filtered	mg/L	1	----	<1	<1
ED-035	Bicarbonate as CaCO3	mg/L	1	----	----	----
ED-040F	Sulphate - Filtered	mg/L	1	----	<1	<1
ED-045	Chloride	mg/L	1	121 %	<1	<1
EG-005F	Iron - Filtered	mg/L	0.1	111 %	<0.1	<0.1
EG-020F	Arsenic - Filtered	mg/L	0.01	94.0 %	<0.01	<0.01
	Cadmium - Filtered	mg/L	0.001	99.0 %	<0.001	<0.001
	Copper - Filtered	mg/L	0.001	105 %	<0.001	<0.001
	Manganese - Filtered	mg/L	0.001	102 %	<0.001	<0.001
	Lead - Filtered	mg/L	0.001	101 %	<0.001	<0.001
	Zinc - Filtered	mg/L	0.001	90.0 %	<0.001	<0.001
K-030	Cyanide amenable to chlorination	mg/L	0.005	----	<0.005	<0.005
K-055A	Ammonia as N	mg/L	0.01	87.0 %	<0.01	<0.01
K-058A	Nitrate as N	mg/L	0.01	93.0 %	<0.01	<0.01
K-085	Sulphide	mg/L	0.1	----	<0.1	<0.1
P-030	Biochemical Oxygen Demand	mg/L	2	----	----	----
P-035	Phenols	mg/L	0.2	92.0 %	<0.2	<0.2
Z-005	Total Cations	me/L	0.01	----	<0.01	----
Z-010	Total Anions	me/L	0.01	----	<0.01	----
Z-015	Actual (Anion / Cation) Difference	me/L	0.01	----	<0.01	----
Z-020	Allowed (Anion / Cation) Difference	me/L	0.01	----	0.11	----

MMENTS:

Results which appear on this report are for laboratory QUALITY CONTROL purposes.

R denotes level of reporting
is is the Final Report which supersedes any preliminary reports with this batch number.

• Results apply to sample(s) as submitted by client.

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ANALYTICAL REPORT

CONTACT:	MR F CAROSONE
CLIENT:	AGC WOODWARD-CLYDE (NSW)
ADDRESS:	LEVEL 6, 486-494 PACIFIC H'WAY ST LEONARDS NSW 2065
LABORATORY:	AMENDED
BATCH NUMBER:	AM4064
SUB BATCH:	1
No. OF SAMPLES:	5
DATE RECEIVED:	03/02/97
DATE COMPLETED:	03/02/97

ORDER No.: 3397/3 SAMPLE TYPE: WATER PROJECT:

Method	Analysis description	Units	LOR	MONW-07 11/12/96	MONW-08 11/12/96	MONW-09 11/12/96	DUP-01 11/12/96
EP-071-WS	TOTAL PETROLEUM HYDROCARBONS						
	C6 - C9 Fraction	ug/L	20	<20	<20	<20	<20
	C10 - C14 Fraction	ug/L	50	<50	<50	<50	<50
	C15 - C28 Fraction	ug/L	100	<100	<100	<100	<100
	C29 - C36 Fraction	ug/L	50	<50	<50	<50	<50
EP-080-WS	BTEX						
	Benzene	ug/L	1	<1	<1	<1	<1
	Toluene	ug/L	2	<2	<2	<2	<2
	Chlorobenzene	ug/L	2	<2	<2	<2	<2
	Ethylbenzene	ug/L	2	<2	<2	<2	<2
	meta- & para-Xylene	ug/L	2	<2	<2	<2	<2
	ortho-Xylene	ug/L	2	<2	<2	<2	<2
EP-080S-WS	VOLATILE TPH/BTEX COMPOUND SURROGATES						
	1,2-Dichloroethane-D4	%	1	101	85	121	113
	Toluene-D8	%	1	102	86	114	110
	4-Bromofluorobenzene	%	1	99	84	114	111

OMMENTS:

This batch supersedes ES4064.

OR denotes level of reporting

his is the Final Report which supersedes any preliminary reports with this batch number.

• Results apply to sample(s) as submitted by client.

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AUSTRALIAN LABORATORY SERVICES P/L

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ANALYTICAL REPORT

CONTACT:	MR F CAROSONE	LABORATORY:	AMENDED
CLIENT:	AGC WOODWARD-CLYDE (NSW)	BATCH NUMBER:	AM4064
ADDRESS:	LEVEL 6, 486-494 PACIFIC H'WAY ST LEONARDS NSW 2065	SUB BATCH:	1
		No. OF SAMPLES:	5
		DATE RECEIVED:	03/02/97
		DATE COMPLETED:	03/02/97

ORDER No.: 3397/3 SAMPLE TYPE: WATER PROJECT:

Method	Analysis description	Units	LOR	BLANK 11/12/96
EP-071-WS	TOTAL PETROLEUM HYDROCARBONS			
	C6 - C9 Fraction	ug/L	20	<20
	C10 - C14 Fraction	ug/L	50	<50
	C15 - C28 Fraction	ug/L	100	<100
	C29 - C36 Fraction	ug/L	50	<50
EP-080-WS	BTEX			
	Benzene	ug/L	1	<1
	Toluene	ug/L	2	<2
	Chlorobenzene	ug/L	2	<2
	Ethylbenzene	ug/L	2	<2
	meta- & para-Xylene	ug/L	2	<2
	ortho-Xylene	ug/L	2	<2
EP-080S-WS	VOLATILE TPH/BTEX COMPOUND SURROGATES			
	1,2-Dichloroethane-D4	%	1	91
	Toluene-D8	%	1	92
	4-Bromofluorobenzene	%	1	91

MMENTS:

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• Results apply to sample(s) as submitted by client.

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ORGANICS QUALITY CONTROL REPORT

BATCH NO : ES4064

DATE BATCH RECEIVED : 12/12/96

CLIENT : AGC WOODWARD-CLYDE

DATE BATCH COMPLETED : 02/01/97

Method Code	Test	Matrix	Method Reference		QC Lot Number	Date Samples Extracted	Date Samples Analysed
			Extraction	Analysis			
EP-071	TPH-Volatile	Water	USEPA 5030 A	USEPA 8260A	NVOCW 103	N/A	20/12/96
	-Semivolatile	Water	USEPA 3510B	USEPA 8015A	NTPHW 95	11/12/96	19/12/96
EP-080	BTEX	Water	USEPA 5030 A	USEPA 8260A	NVOCW 103	N/A	20/12/96

DATE RECEIVED 6/1 FAX/MAIL/COURIER
PROJECT No. FILE No.
DOCUMENT No.
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BATCH QUALITY CONTROL

ALS EP-071 : Total Petroleum Hydrocarbons by Fractions

QC Lot No. : NVOCW103
MATRIX: Water

ANALYST: S. Asre

Volatile Components

COMPOUND	Level Of Reporting (LOR)	Blank Conc	Spike Conc	SPIKE RESULTS				CONTROL LIMITS		
				SCS conc	DCS conc	Av. Rec.	RPD	Recovery (%)		RPD
	ug/L	ug/L	ug/L	ug/L	ug/L	%	%	Low	High	%
C6-C9	20	<LOR	200	196	195	97.8	0	83	113	20
C10	20	<LOR	50	50	47	96.7	5	74	121	20

COMMENTS :
1) The control limits are based on ALS laboratory statistical data. (Method QWI-ORG/06)
2) * : Recovery or RPD falls outside of the recommended control limits.

BATCH QUALITY CONTROL

ALS EP-071 : Total Petroleum Hydrocarbons by Fractions

MATRIX: Water

ANALYST: H.FLAMPOULIDIS

QC LOT No.: NTPHW95

Semivolatile Components

COMPOUND	BATCH ADJ. (MDL)	Blank Conc.	Spike Conc.	Spike Results				Control Limits		
				SCS Conc.	DCS Conc.	Av. Rec.	RPD	Recovery %		RPD
	ug/L	ug/L	ug/L	ug/L	ug/L	%	%	Low	High	%
C11-C14	25	<LOR	208	154	220	90	35	56	117	20
C15-C28	25	<LOR	530	438	584	96	29	76	128	20
C29-C36	25	<LOR	304	292	375	110	25	76	129	20

COMMENTS:

1) The control limits are based on ALS laboratory statistical data (Method QWI-ORG/07).

2) * : Recovery or RPD falls outside the recommended control limit.

3) MDL = Method Detection Limit

4) LOR = Level Of Reporting

BATCH QUALITY CONTROL

ALS EP-080 : BTEX ANALYSIS

QC Lot No. : NVOCW103
MATRIX: Water

ANALYST: S. ASRE

COMPOUND	Blank Results	Spike Conc	QC SPIKE RESULTS				Control Limits		
			SCS Conc	DCS Conc	Av. Rec.	RPD	Recovery		RPD
	ug/L	ug/L	ug/L	ug/L	%	%	Low	High	%
Benzene	<LOR	10	9.50	8.97	92	6	72	128	20
Toluene	<LOR	10	9.95	9.87	99	1	76	125	20
Chlorobenzene	<LOR	10	9.98	10.01	100	0	86	115	20
Ethylbenzene	<LOR	10	9.66	9.70	97	0	86	114	20
m- & p-Xylene	<LOR	10	9.69	9.61	97	1	86	115	20
o-Xylene	<LOR	10	9.90	9.91	99	0	88	114	20

COMMENTS :

1) The control limits are based on ALS laboratory statistical data (Method QWI-ORG/07).
2) * : Recovery or RPD falls outside of the recommended control limits.

LEVAY & CO. - ENVIRONMENTAL SERVICES

Job No. L&C-96-143

24th December, 1996

Australian Laboratory Services Pty. Ltd.,
<u>Attn. Mr. BRIAN WILLIAMS.</u>
P.O. Box 63,
Rydalmere. NSW 2116.

Dear Brian,

<u>REPORT</u>

RE: MEASUREMENT OF HALOGENATED ORGANICS

Purchase Order No. 58347
Ref. No. ES4064

I refer to your request regarding AOX analysis of aqueous samples received on 13th December, 1996.

The results are now attached.

Yours sincerely,

George Levay
Managing Director

Enc.

Ian Wark Research Institute
Uni of South Australia, The Levels SA 5095 Tel. 08-8302 3130 Fax. 08-8302 3549 Email george.levay@unisa.edu.au

Water Quality, Water Treatment and Environmental Pollution Research Laboratories

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Water Quality, Water Treatment and Environmental Pollution Research Laboratories

Job No.			
L&C-96-143			
	AUSTRALIAN LABORATORY SERVICES PTY. LTD. New South Wales		
Sample No.	Sample Description	Date	AOX (ppb)
	AOX Analyses		
	Purchase Order. No. 58347 Ref. No. ES4064		
1	MONW-7	11/12/96	104
2	MONW-8	"	123
3	MONW-9	"	124
4	DUP-01	"	162
5	Blank	"	4

Ian Wark Research Institute, University of South Australia, The Levels SA 5095
Tel: (08) 8302-3130, Fax: (08) 8302-3549, Email: george.levay@unisa.edu.au

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EML Reference: 96/09326 Order No:

Report Date: 16 Dec 96

AGC Woodward Clyde Pty Ltd
Level 6, 486-494 Pacific Hwy
ST LEONARDS NSW 2065

Attention: Dino Parisotto

QUALITY SYSTEM NATA CERTIFIED ISO 9002

Certificate of Analysis

Samples Received: 12 Dec 96 at 08:30 am
Samples Tested: 12 Dec 96 at 11:37 am

Overall Sample Marking:

EML	Sample Markings	Coliforms
1	MONW-07	<2
2	MONW-08	<2
3	MONW-09	<2
4	BLANK	0
5	DUP-01	<2

Test Code	Test Description	Units	EML Method
Coliforms	Coliforms	/ 100ml	3.3.2.3

cfu: Colony Forming Units
est: Estimated
<: Less than
app: Approximate
ND: Not Detected

Yours faithfully,
EML Consulting Services Pty. Ltd.

Cheryl Newton BSc (Hons) MASM AAIFST
Microbiologist

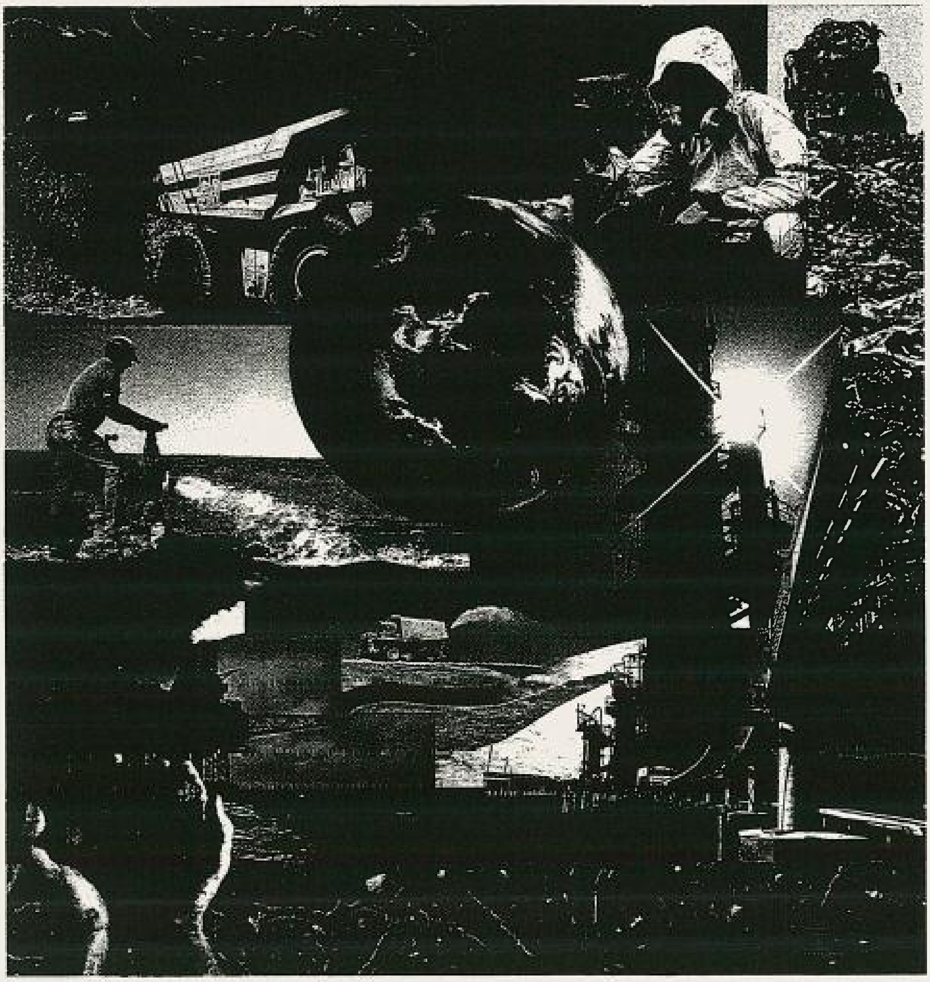
EML GROUP OF LABORATORIES
Consulting Chemists & Microbiologists Sydney • Melbourne

MONIER-PGH QUARRY

EAST MAITLAND

STAGE 2, GROUNDWATER

INVESTIGATIONS



PREPARED FOR
CSR CONSTRUCTION MATERIALS

AUGUST 1996
Project No. 3397/2
Document R002-A.DOC

Woodward-Clyde

AGC Woodward-Clyde Pty Limited
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1.0 INTRODUCTION

AGC Woodward-Clyde Pty Limited (Woodward-Clyde) was engaged by CSR Construction Materials (CSR) to undertake groundwater investigations at the Monier PGH quarry site at East Maitland.

This work is supplementary to an initial groundwater investigation programme carried out in July 1993, when a general hydrogeological understanding of the environment surrounding the quarry was obtained.

The September 1993 report contained various recommendations for further investigations, which included two additional monitoring wells, chemical sampling and permeability testing on the newly completed and future wells.

At the time of the initial investigations, the southern and western areas of the quarry were not accessible to a drilling rig.

The recent investigations were undertaken in July 1996 and this report describes the results obtained from that work.

2.0 DRILLING PROGRAMME

Two additional drilling locations (MONW4 and MONW5) were chosen around the south western corner of the quarry to enhance the data previously collected during the initial site investigation. These two locations are illustrated on Figure 1.

Minor earthworks were undertaken prior to the drilling works commencing to provide access to the location for MONW4. This work included scraping and compacting a section of low lying land in a swampy area of the property.

The drilling programme was carried out on 17 and 18 July 1996 by Engineering Exploration Pty Limited under the direct supervision of Woodward-Clyde personnel.

Both monitoring wells were installed according to a design similar to that of the three previously installed wells (MONW1 - MONW3) to provide consistency. Well construction details and lithological logs for MONW4 and MONW5 are provided in Appendix A, which also includes the logs for the three wells installed during the previous site investigation for reference.

Drilling was carried out by IVRC (Induced Vacuum Reverse Circulation), a technique previously employed on the site which worked appropriately for accurate logging of site formations.

Following drilling, the monitoring wells were constructed, air lift developed and completed with a fixed lockable monument for protection.

2.1 GEOLOGY

Lithologies intercepted during the drilling of MONW4 and MONW5 are similar to those encountered in previous wells and can be correlated with those of MONW3. Coal horizons were predominantly in thin bands with clay interbeds and attained a maximum thickness of six metres near the base in MONW4. The coal appeared bright and generally clean except at the base of MONW4, where it was thinly interbedded with blue grey clay. Minor pyrite inclusions were observed in the lower coal seam in MONW5.

2.2 HYDROGEOLOGY

Groundwater was encountered in both MONW4 and MONW5 and was directly associated with the intersection of coal seams within the bore.

Water levels recorded in all monitoring wells were recorded during the investigation and are presented in Table 1.

Groundwater levels in all wells across the site were above that of the pond. This reflects the same conditions observed in 1993 and confirms the initial hydrogeological model in which the pond represents a sink in the local water table, maintaining an inward hydraulic gradient. Such condition prevents any potential migration away from the pond water.

An evaluation of the data presented in Table 1 shows that the water levels in both the wells and in the pond have risen since the 1993 investigations.

The water levels in wells MONW1, MONW2 and MONW3 have risen by between 0.76 m and 0.3 m. The pond level, levelled at the beginning of September 1996, was found to be at -0.371 mAHD, a rise of 0.54 m.

This change appears to be due to natural fluctuations, following wet and dry cycles in the rainfall pattern. The 1993 measurements were taken at the end of a prolonged drought, when evaporation and lack of incident rainfall would have caused the level in the pond to fall, followed by a sympathetic, but subdued, fall in the surrounding water table.

Table 1 - Groundwater Statistics

Bore	Ground Elevation (concrete)	SWL 1996	Datum Top of mon.	SWL 1996	SWL 1996	Pond Water Level 1996	Water Table 1996	Pond Water Level (1993)	Water Table (1993)	W.Table Diff. 1993-1996
	m AHD	m b.d.	m a.g.	m b.g.	m AHD	m AHD	m a.pond	m AHD	m a. pond	m
MONW1	12.46	13.07	0.45	12.62	-0.16	-0.371	+0.21	-0.91	-0.01	+0.20
MONW2	9.39	9.03	0.45	8.58	0.59	-0.371	+1.18	-0.91	+1.06	+0.12
MONW3	17.46	16.75	0.43	16.32	1.14	-0.371	+1.51	-0.91	+1.77	-0.26
MONW4	9.34	9.85	0.57	9.28	0.06	-0.371	+0.43	-0.91	-	-
MONW5	7.33	7.83	0.53	7.30	0.03	-0.371	+0.40	-0.91	-	-

2.2.1 Permeability tests

Permeability tests were performed on all monitoring wells (MONW1 - MONW5) using the falling head method.

The test method involves the instantaneous injection of a known volume of water into the well and the measurement of the rate of decline of the water level as it returns to the original level. The tests were carried out after purging and sampling of each well had been completed to avoid potential interference with the groundwater sample.

Plots of the falling head test are presented in Appendix C and are tabulated in Table 2.

Table 2 - Permeability Tests Results

	MONW01	MONW2	MONW3	MONW4	MONW5
k m/sec	$1x10^{-5}$	$6x10^{-6}$	$1x10^{-6}$	$6x10^{-6}$	$3x10^{-6}$
k m/day	1.1	0.51	0.10	0.53	0.24

The results show consistent permeability values across the site perimeter, with the exception of MONW1 which is nearly one order of magnitude higher.

The rockmass in which the quarry is situated consists of shale, claystone and sandstone strata with coal layers interspersed with clay interbeds. Because of the nature of the different lithologies, the rockmass permeability is derived from interconnected fractures and bedding planes and, principally, from coal horizons.

Coal horizons can be correlated with some confidence around the site, although they appear to be discontinuous and, possibly, lensiform, their thicknesses varying substantially from place to place. However, at the scale of the area of the quarry, the rock mass permeability does not appear to be influenced by the coal horizons variability, as the tests results show.

3.0 GROUNDWATER SAMPLING

3.1 SAMPLING PROGRAMME

Groundwater sampling of all five monitoring wells (MONW1 to MONW5) was undertaken on 31 July 1996. Water samples were collected using a teflon bailer following purging of a minimum of three bore volumes from each well and stabilisation of field parameters. Field parameters monitored during the well purging included electrical conductivity (EC), pH and temperature. Water samples were placed into laboratory certified clean bottles with appropriate preservatives; samples for metals analysis were filtered through a 0.45 µm filter.

Analyses were undertaken on samples for the following analytes:

- metals (Cu, Pb, Zn, Fe, As, Mn and Hg);
- pH, electrical conductivity, sulfate, Total Dissolved Solids (TDS), cations and anions
- total petroleum hydrocarbons (TPH);

All samples were dispatched under standard Woodward-Clyde chain of custody procedures to Australian Laboratory Services for analyses. The laboratory is NATA registered for the nominated analytes.

4.0 ANALYTICAL RESULTS

4.1 RESULTS

The analytical results are presented in Tables 3 to 5 and the laboratory reports are provided in Appendix B. A brief outline of the results is presented below.

The analytical results are compared for the purpose of an environmental assessment with the Australian and New Zealand Environment and Conservation Council (ANZECC), 1992, summary guidelines for the protection of aquatic ecosystems (fresh and marine waters).

Applied to groundwater, these guidelines refer to the receiving water bodies conditions. In brief, this means that the concentration of a particular substance in the groundwater should not cause an increase above the guideline concentration of that substance in the receiving body of fresh or marine water. Low levels of metals or other substances detected in the monitoring wells analyses are unlikely to be a cause of concern with respect to those guidelines, because of the dilution effects likely to be experienced upon the groundwater entering a fresh water body.

Under the hydraulic gradients conditions described earlier, the receiving body of water at the Maitland quarry is the pond, which is brackish to saline.

4.1.1 General Parameters

TDS values ranged from 3110 to 5470 mg/L with the highest value occurring in MONW2 and are generally in the same range as those measured in 1993. However, a 16% decrease from 6350 mg/L to 5470 mg/L is evident in MONW2, whereas an increase of 24% from 2500 mg/L to 3110 mg/L occurred in MONW3. Although these changes result in a closer grouping of values around the pond, it is not clear at this stage what mechanism may have caused them.

Sulfate concentrations ranged from 312 to 688 mg/L with the highest concentration being reported at MONW4 and MONW5. These values are not surprising given the presence of pyrite and coal and the consequent oxidation of sulphides.

The groundwater chemical analyses have been plotted on the Piper diagram of Fig.2. The diagram is a chemical characterisation tool that allows the comparison of several analyses at the same time. A single point in the upper diamond places the water in the groundwater evolution path. All groundwater samples in the monitoring wells plot in a position grouped around that of seawater (point 7), reflecting the nature of the sediments and the incomplete flushing of connate salts.

The water in the pond is similar in character to the groundwater, has a comparable salinity, but a considerably higher level of sulphate, most probably derived from the oxidation of sulphides in the coal bands.

4.1.2 Metals

Analytical results for metals were generally below the respective levels of reporting except for zinc and mercury. Low levels of zinc, marginally above the ANZECC guidelines were reported in MONW2, MONW3 and MONW5. One low level occurrence of mercury above the guidelines was reported in MONW2.

4.1.3 TPH

Petroleum hydrocarbons in the C_{15}-C_{28} fraction, which correspond generally to light lubricating oils, have been detected at low concentrations in four of the five monitoring wells. One detection of heavier hydrocarbons in the C_{29}-C_{36} fraction has been recorded in MONW1.

The source of these low level concentrations of hydrocarbons is most likely to be found in the coal seams and shales intersected and screened in the monitoring wells and, therefore, is a natural occurrence.

5.0
QUALITY ASSURANCE

The following Quality Assurance measures were utilised during the site works.

- All samples were collected by a Woodward-Clyde environmental scientist specifically trained in field investigation techniques, and health and safety procedures. All techniques used are specified in AGC Woodward-Clyde's technical guidelines, which are based on methods specified by the United States Environmental Protection Agency (USEPA).

- All field sampling equipment (teflon bailer, etc.) were decontaminated prior to use and between samples to minimise the potential for cross contamination. Water samples were transferred immediately to laboratory prepared sample containers containing preservative agents.

- All samples were identified with a unique sample number. Relevant sampling details were included on the sample label and were reproduced in field logging sheets and chain of custody records.

- The sample containers were packed in ice at the time of collection and transported under chain of custody procedure from the site directly to Australian Laboratory Services (ALS).

- The samples arrived intact and still chilled at the analytical laboratory and were analysed within the relevant holding times for the target analytes.

- One field duplicate sample (DUP01) was prepared in the field during sampling of MONW2. This duplicate was submitted to the laboratory as an independent sample. Field duplicates are used to measure the precision of the whole sampling and analysis process (sampling, sample preparation and analysis). Duplicate sample results showed low variability between the sample result and the duplicate result and were within acceptable limits.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

The results of the recent groundwater investigations allow the following conclusions to be made:

- the groundwater surrounding the pond is located at a higher elevation than the pond water;
- water levels in the pond and in the wells fluctuate according to rainfall cycles; however, a positive head has been maintained in the groundwater against the pond;
- some salinity changes have been observed from the sampling carried out in 1993, but these may be the results of natural adjustments;
- the chemical character of the water in the pond is similar to that of the groundwater, but with a higher level of sulphate;
- minor occurrence of zinc and mercury were recorded in the groundwater. However, these metals are significantly diluted after entering the pond, and
- in its current state, as well as in a dewatered state, the quarry should maintain, and should continue to maintain, an inward hydraulic gradient, which will prevent outward migration of potential contaminants, until full recovery of the groundwater to the regional level.

6.2 RECOMMENDATIONS

In consideration of the water levels fluctuations observed in the monitoring wells and in the pond since 1993, it is recommended that:

- a groundwater monitoring programme be set up based on the monthly measurements and recording of water levels in the five monitoring wells,
- a measuring staff be installed at a suitable location in the pond and water level measurements be taken and recorded at monthly intervals,
- the collected data be reviewed at six monthly intervals for the first year, and yearly thereafter,
- the monitoring schedule be altered to weekly intervals in the event of the quarry dewatering plan being approved, to observe the impact of the pump out on groundwater.

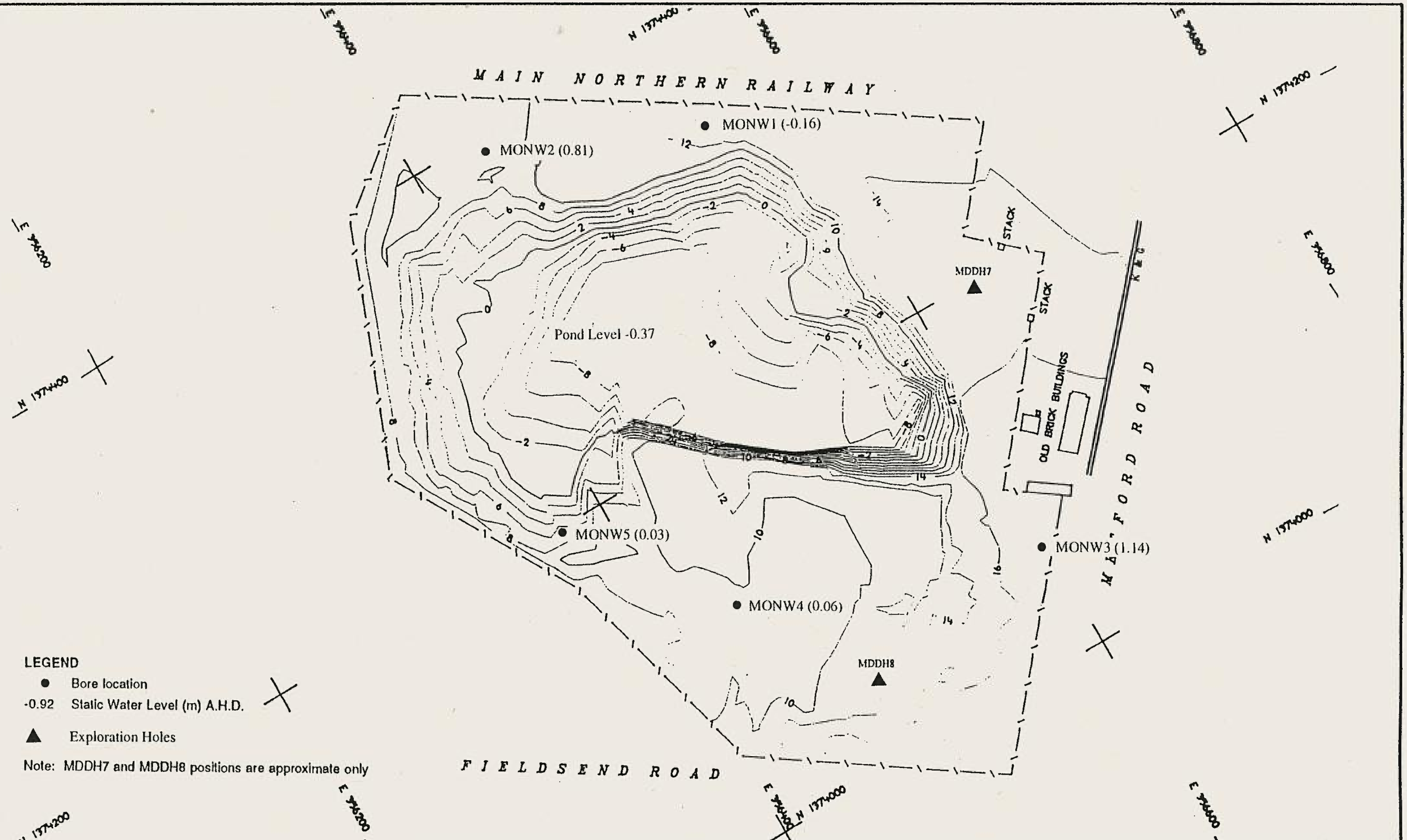
7.0 REFERENCES

Australian and New Zealand Environment and Conservation Council, *"Australian Water Quality Guidelines for Fresh and Marine Waters"* November 1992

AGC Woodward-Clyde Pty Limited, *"Monier-PGH Quarry, Maitland. Groundwater Investigations"* Prepared for CSR-Readymix and Cleanaway, September 1993

AGC Woodward-Clyde Pty Limited *"PGH Quarry, East Maitland. Review of Options for Removing Ponded Water"* Prepared for CSR Construction Materials, August 1996.

FIGURES



LEGEND

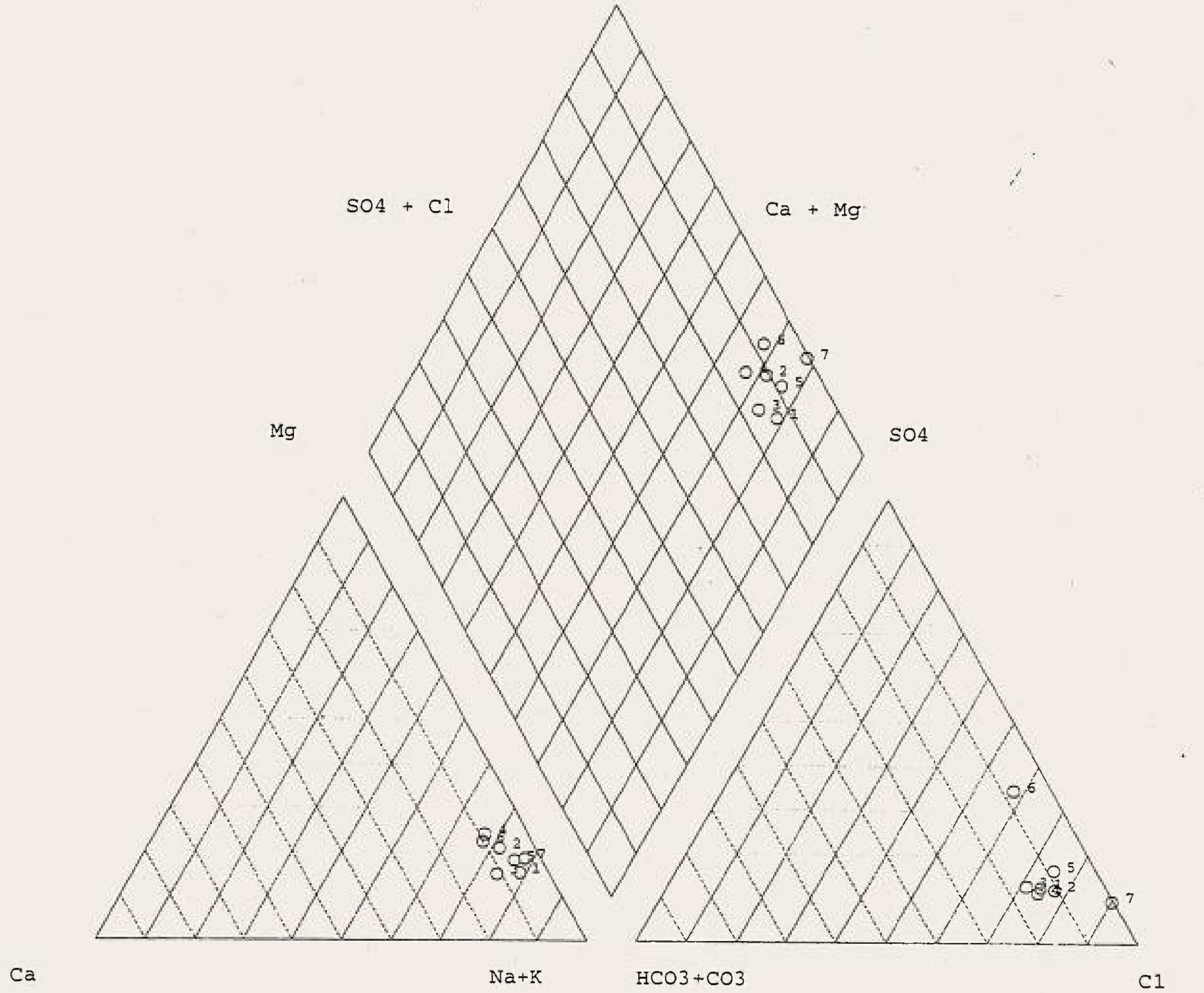
- ● Bore location
- -0.92 Static Water Level (m) A.H.D.
- ▲ Exploration Holes

Note: MDDH7 and MDDH8 positions are approximate only

metres 0 20 40 60 80 APPROX. SCALE Woodward-Clyde	CLIENT **CSR CONSTRUCTION MATERIALS** PROJECT **MONIER PGH QUARRY**	REVISION: A SCALE: AS SHOWN DRAWING No: 3397\0002 CAD FILE NO: Q.001 DATE:	DESIGNED: PDS DRAWN: LJE CHECKED: FC APPROVED: STATUS: FINAL
		TITLE **BORE LOCATIONS**	FIGURE **1**

A4

SYD/LJE/9-95



Plot No	Sample No	Na+ (mg/L)	K+ (mg/L)	Ca++ (mg/L)	Mg++ (mg/L)	Cl- (mg/L)	HCO3- (mg/L)	CO3-- (mg/L)	SO4-- (mg/L)	TDS (mg/L)
1	MONW1	1100	24	76	115	1570	484		359	3790
2	MONW2	1460	25	135	228	2390	568		506	5470
3	MONW3	876	25	115	96	1270	490		312	3110
4	MONW4	1010	31	118	195	1510	505		313	3470
5	MONW5	1530	29	105	195	2310	462		688	5370
6	POND	1000	29	133	178	1300	299		1050	3320
7	Sea	10500	390	410	1350	19000	142		2700	35000

Woodward-Clyde

CLIENT
CSR CONSTRUCTION MATERIALS

PROJECT
MONIER PGH QUARRY

REVISION: A
SCALE: AS SHOWN
DRAWING No: 3397/0002
CAD FILE NO: Q.002
DATE:

DESIGNED: FC
DRAWN: LJE
CHECKED: FC
APPROVED:
STATUS: FINAL

TITLE
PIPER DIAGRAM

FIGURE
2

A4

TABLES

TABLE 3 -GROUNDWATER ANALYTICAL RESULTS

SAMPLE LOCATION	Units	MONW1	MONW2	MONW3	MONW4	MONW5	DUP01	Acceptance Criteria
pH		6.7	6.6	6.6	6.5	7.0	6.6	6.5 - 9.0
Temperature	^{0}C	19.5	20.0	20.0	19.0	21.0	20.0	NR
Electrical Conductivity (EC)	µS/cm	6010	8250	5000	5550	7500	8250	NR
Total Dissolved Solids (TDS)	mg/L	3790	5470	3110	3470	5370	5590	NR
Calcium	mg/L	76	135	115	118	105	121	NR
Magnesium	mg/L	115	228	96	195	195	227	NR
Sodium	mg/L	1100	1460	876	1010	1530	1560	NR
Potassium	mg/L	24	25	25	31	29	25	NR
Bicarbonate (CaCO3)	mg/L	484	568	490	505	462	538	NR
Sulphate	mg/L	359	506	312	313	688	503	NR
Chloride	mg/L	1570	2390	1270	1510	2310	2540	NR
Nitrate as N	mg/L	0.05	0.06	0.07	0.05	0.07	0.06	NR
Total Kjeldahl Nitrogen	mg/L	0.2	0.6	<0.1	0.80	0.3	0.6	NR
Phosphorus as P	mg/L	0.25	0.23	19.7	0.53	0.11	0.29	NR
Total Cations	mg/L	61.72	89.65	52.38	59.59	88.58	93.22	NR
Total Anions	mg/L	61.45	89.32	52.13	59.22	88.73	92.89	NR

Note:
DUP01 = duplicate of MONW2
Acceptance Criteria based upon the ANZECC Summary Guidelines for the protection of aquatic ecosystems (fresh and marine waters)
NR = No recommendation made

Prepared by: PDS
Checked by: .FC

TABLE 4 -GROUNDWATER ANALYTICAL RESULTS - METALS

SAMPLE LOCATION	MONW1	MONW2	MONW3	MONW4	MONW5	DUP01	Summary Guidelines
Arsenic	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.05
Manganese	0.56	0.33	0.09	0.1	0.21	0.34	NR
Iron	1.6	3.0	0.9	2.0	0.6	2.9	NR
Copper	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.002-0.005
Lead	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001-0.005
Zinc	0.04	0.07	0.08	<0.01	0.12	0.05	0.005-0.05
Mercury	<0.0001	0.0003	<0.0001	<0.0001	<0.0001	0.0001	0.0001

[box] = Exceeds ANZECC Summary guidelines for protection of aquatic ecosystems (fresh and marine waters)

Notes :

Units = mg/L

NR = No recommendation made

DUP01 = Duplicate of MONW2

Prepared by: PDS
Checked by: FC

TABLE 5 - GROUNDWATER ANALYTICAL RESULTS - TPH

SAMPLE LOCATION	MONW1	MONW2	MONW3	MONW4	MONW5	DUP01	Summary Guidelines
Total Petroleum Hydrocarbons							
C6-C9	<20	<20	<20	<20	<20	<20	NR
C10-C14	<50	<50	<50	<50	<50	<50	NR
C15-C28	518	192	129	117	<100	150	NR
C29-C36	113	<50	<50	<50	<50	<50	NR

Notes :

Units = µg/L

DUP01 = Duplicate of MONW2 sample

NR = No recommendation made. There should be no visible sheen.

Prepared by: PDS
Checked by: FK

APPENDIX A

BORE LOGS

PROJECT : Monier PGH Quarry
LOCATION: Metford Road, East Maitland
SUPERVISOR: F. Carosone

JOB NO: 3397
DATE STARTED: 19/07/93
DATE COMPLETED: 20/07/93

INSTALLED BY: Eng. Exploration
RIG: Edson 3000
DATUM: 0.45 m a.g.

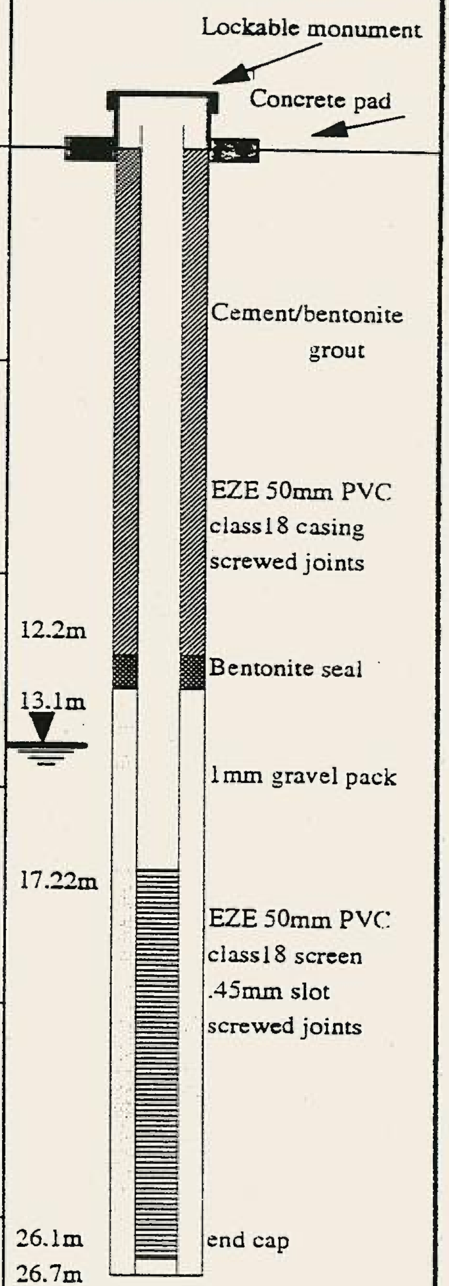
METHOD: IVRC
TOTAL DEPTH (m): 26.7
SWL: 13.83 m b.d.

DIAMETER (mm): 104
R.L. GROUND (m): 12.46
R.L. SWL (m): -0.92

BORE NUMBER: MONW1

Lithological Log	Remarks	(m)
		0
0-0.5 CLAY: (topsoil) red and grey, damp		
0.5-3.5 SANDSTONE: yellow, orange, light brown, fine to medium, rounded, well sorted qtz grains, with Fe stained bands and cement		
3.5-5 SHALE/SILSTONE: dark grey, fine, with laminitic bands		
		5
5-6.5 SANDSTONE: Yellow-orange, medium hard, Fe cement, fine to medium, sorted rounded qtz grains, ferruginous layers		
6.5-6.8 COAL: black, bright , brittle		
6.8-9 SHALE/CLAYSTONE: dark grey, medium hard, very finely layered, silty		
9-10 SILTSTONE: light grey, firm		10
10-20 SHALE: grey to dark grey, fine, silty		
	rattle	
		15
15.5 a thin band of coal		
17 becoming coarser, some clay, grey/white		
17.5 a thin coal band	water	
		20
20- 26.7 SANDSTONE: grey, medium to hard, sub-rounded sorted qtz grains, with black fragments, slightly carbonaceous, some clay	water	
		25
harder (change to rock roller bit)		
26.7 Bottom of the hole		
		30

Geological Description or Bore Construction



PROJECT : Monier PGH Quarry
LOCATION: Metford Road, East Maitland
SUPERVISOR: F. Carosone

JOB NO: 3397
DATE STARTED: 20/07/93
DATE COMPLETED: 21/07/93

Eng. Exploration
RIG: Edson 3000
DATUM: 0.45 m.a.g.

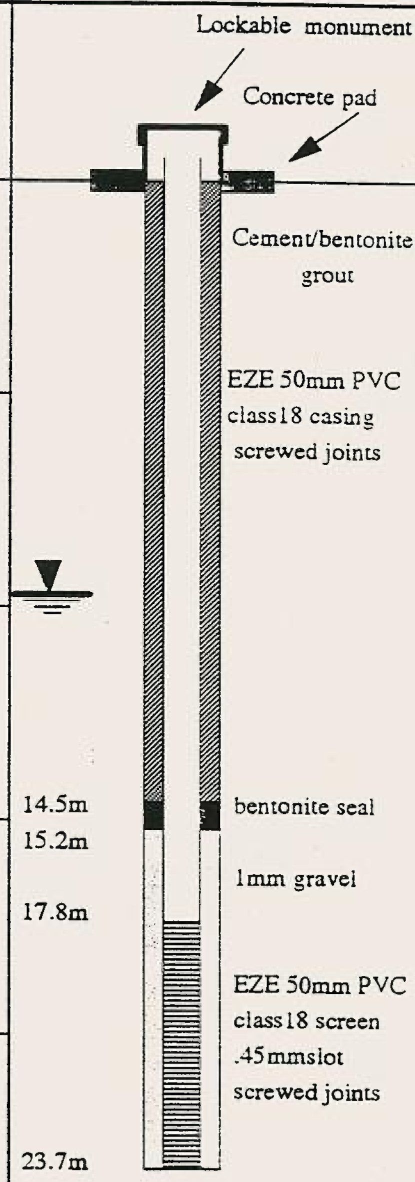
METHOD: IVRC
TOTAL DEPTH (m): 23.7
SWL: 9.69 m b.d.

DIAMETER (mm): 104
R.L. GROUND (m): 9.39
R.L. SWL (m): 0.15

BORE NUMBER: MONW2

Lithological Log	Remarks	Depth (m)
0-1 FILL: railway ballast, clay		0
1-4 CLAY/SHALE: cream, plastic, silty, orange bands 2-3 more frequent orange bands 3-4 some grey clay		
4-8 SHALE: grey to dark grey, minor silt, carbonaceous 5-5.7 a thin band of coal 6-7 grey, dark grey, dark brown 7-8 some light grey bands		5
8-10 SANDSTONE: light grey, grey, medium to fine well sorted qtz grains some clay , becoming finer at bottom	water	10
10-15-5 SILTSTONE: grey, fine, well sorted, subrounded qtz grains 11-12 some clay, hard 12-14.5 somewhat darker, hard 14.5-15.5 softer becoming coarser, maybe fine sandstone	change to rock roller bit	15
15.5-16 COAL: black, some moisture		
16-20 SHALE: brown, light brown, medium hard 16.5 becoming harder 17.3-17.5 dark brown, carbonaceous 19-20 some grey clay, plastic 19.8 wet, muddy returns, some coal	rattle	20
20-22 SANDSTONE: grey, medium well sorted qtz grains, some clay 21-22 some white clay?		
22-22.5 COAL: black, hard, bright	water returns	
22.5-23.3 SANDSTONE: as @ 20-22, finely layered (laminitic?)	increasing	
23.3-23.7 SILTSTONE: grey, fine softer		25
23.7 Bottom of the hole		30

Geological Description or Bore Construction



PROJECT : Monier PGH Quarry
LOCATION: Metford Road, East Maitland
SUPERVISOR: F. Carosone

JOB NO: 3397
DATE STARTED: 22/07/93
DATE COMPLETED: 22/07/93

INSTALLED BY: Eng. Exploration
RIG: Edson 3000
DATUM: 0.43 m.a.g.

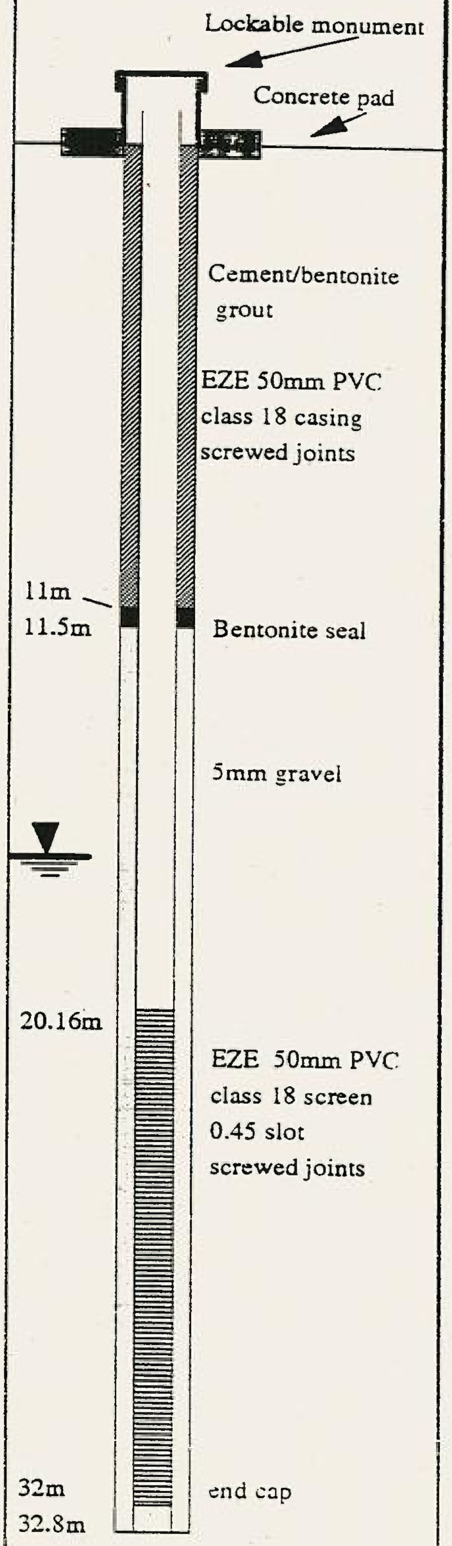
METHOD: IVRC
TOTAL DEPTH (m): 32.8
SWL: 17.02 m b.d.

DIAMETER (mm): 104
R.L. GROUND (m): 17.46
R.L. SWL (m): 0.86

BORE NUMBER: MONW3

Lithological Log	Remarks	Depth (m)
0-2.5 CLAY: grey-brown, mottled, Fe stained, fill?		0
2.5-4.7 SILTSTONE: cream, soft, weathered, some coarser material some ferruginous bands, some shale thin layers		
4.7-5.2 COAL: black,hard		5
5.2-5.5 SILTSTONE/CLAYSTONE: cream-white		
5.5-6.5 SHALE: dark grey, carbonaceous, finely layered		
6.5-8 SANDSTONE: light grey, grey, medium to fine qtz grains		
8-9 SHALE: grey, dark grey,		
9-10.5 SILTSTONE: grey, fine soft		10
10.5-11.5 SHALE: grey, silty		
11.5-17 SILTSTONE: grey, finely layered 12.2 darker, some shale, grey silty 13.7 soft 14.5 a 20cm hard band, alternating sequence of thin bands of siltstone sandstone, claystone, sometimes carbonaceous		15
17-22 SANDSTONE: brown, grey, medium to fine ,sorted, subrounded qtz grains 18 soft, light grey	damp rattle	20
22-28.5 COAL: black, with some thin bands of silty grey clay (2-3cm) 23 some carbonaceous shale 27 some grey clay	water, steady returns	25
28.5-29 SANDSTONE: grey, finely layered		
29-30.5 COAL: black, hard	water increas	30
30.5-32 SILTSTONE: grey, soft, clayey, dry?		
32-32.8 COAL: black, hard, some grey clay	water increase	
32.8 Bottom of the hole		

Geological Description or Bore Construction



GROUNDWATER MONITORING WELL

Woodward-Clyde

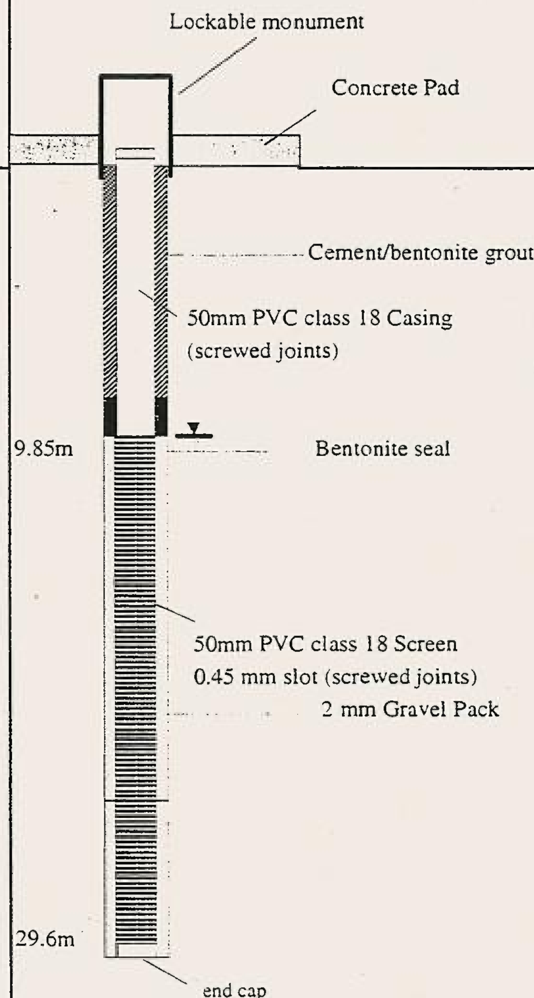
PROJECT :	Monier PGH Quarry	**JOB NO:**	3397/2
LOCATION:	Metford Road East Maitland	**DATE STARTED:**	18/7/96
SUPERVISOR:	P. Scherbak	**DATE COMPLETED:**	18/7/96

CONTRACTOR:	Eng. Exploration	METHOD:	IVRC	DIAMETER (mm):	100
RIG:	Edson 3000	DEPTH:	29.6 m	R.L. GROUND (m):	9.34 m AHD
DATUM:	0.57	SWL(m):	85 m b.d.	R.L. SWL (m):	0.06 m AHD

BORE NUMBER: MONW4

Lithological Log	Sample Data	Depth (m)
0-1.2m SILTY CLAY and minor well rounded gravel up to 20mm in size. dark brown.		0.0
1.2-2.5 m CLAY. cohesive. soft moist. lt brown. plastic. minor organic ashy layer observed at 2.0m.		
2.5-3.0m CLAY. ochre. dry with minor plastic cohesive clasts with minor sand.		5.0
3.0-4.0 m CLAY. light grey. dry. loose with extremely weathered clasts of sandy siltstone.		
4.0-9.8m SILTSTONE. light grey. sandy. weathered.		10.0
9.8-10.3 COAL. black. bright. minor pyritic component		
10.3-14.5 m CLAYSTONE. dark grey soft. dry. black organic laminations. sand component increasing with depth.		
14.5-14.6m COAL. black. bright. thin layer approx. 100mm thick.		15.0
14.6-15.0m CLAY. slightly moist. dark brown/grey. plastic.		
15.0- 17.5m SILTSTONE. very moist. light grey. with ferruginous (orange) bands occurring throughout.		
17.5-23.5 m SILTSTONE. unweathered. brittle. dark grey. dense.		20.0
23.5-29.5m COAL. black. bright. soft with thin bands of silty clay material.		25.0
29.5-29.6 m CLAY. blue/grey. plastic. Occurs interbedded throughout coal profile to a depth of 29.6m		
		30.0
End of Hole at 29.6 m		
		35.0

Bore Construction Details



Prepared by: PDS
Checked by: Fc

GROUNDWATER MONITORING WELL

Woodward-Clyde

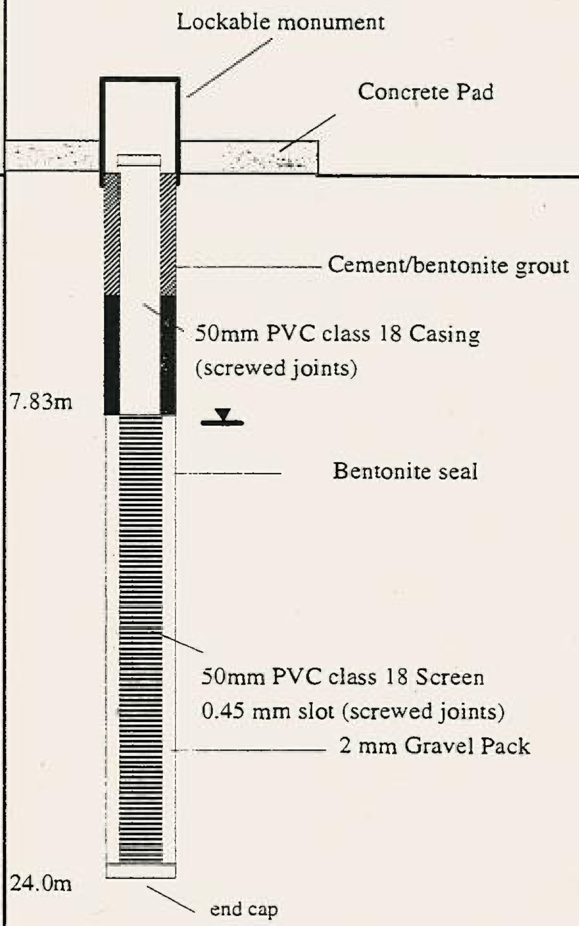
PROJECT :	Monier PGH Quarry	**JOB NO:**	3397/2
LOCATION:	Metford Road East Maitland	**DATE STARTED:**	18/7/96
SUPERVISOR:	P. Scherbak	**DATE COMPLETED:**	18/7/96

CONTRACTOR:	Eng. Exploration	METHOD:	IVRC	DIAMETER (mm):	100
RIG:	Edson 3000	DEPTH:	24.0 m	R.L. GROUND (m):	7.33 m AHD
DATUM:	0.53	SWL(m):	83 m b.d.	R.L. SWL (m):	0.03 m AHD

BORE NUMBER: **MONW5**

Lithological Log	Sample Data	Depth (m)
0.0-0.1 m FILL, minor rail ballast and loose gravel		0.0
0.1-3.0m CLAY, dry, loose, fine and silty, light grey to yellow with small chips of iron stained sandstone.		5.0
3.0-8.5m CLAYSTONE, sandy, dark grey,		
8.5-9.0 m COAL, bright, brittle, approximately 0.5 m thick.		10.0
9.0-14.5 m SILTSTONE, lt grey, dry, with very fine grained sand, hard with pieces of core being recovered.		15.0
14.5-17.8 m SANDSTONE, coarse grained, light grey, dense and hard, bit refusal at 17.8m and had to install new TC bit.		20.0
17.8-22.5m MUDSTONE, light grey with thin black laminations, increase in sand with depth.		
22.5-24.0 m COAL, black, bright and soft, with minor pyrite inclusions.		25.0
24.0 MUDSTONE, soft, light grey, worm burrows and coalified roots observed in this layer.		
End of Hole at 24.0 m		30.0
		35.0

Bore Construction Details



Prepared by: PDS
Checked by: FV

APPENDIX B

LABORATORY REPORTS

AUSTRALIAN LABORATORY SERVICES P/L

A.C.N. 009 936 029

[redacted]

ANALYTICAL REPORT

LABORATORY: ENV SYDNEY
BATCH NUMBER: ES2696
SUB BATCH: 0
No. OF SAMPLES: 6
DATE RECEIVED: 02/08/96
DATE COMPLETED: 15/08/96

CONTACT: MR B LIDDLE
CLIENT: AGC WOODWARD-CLYDE (NSW)
ADDRESS: LEVEL 6, 486-494 PACIFIC H'WAY
ST LEONARDS NSW 2065

ORDER No.: 3397/2 SAMPLE TYPE: WATER PROJECT:

Method	Analysis description	Units	LOR	MONW1 31/07/96	MONW2 31/07/96	MONW3 31/07/96	MONW4 31/07/96
EA-015	Total Dissolved Solids (TDS)	mg/L	1	3790	5470	3110	3470
ED-005F	Calcium - Filtered	mg/L	1	76	135	115	118
ED-010F	Magnesium - Filtered	mg/L	1	115	228	96	109
ED-015F	Sodium - Filtered	mg/L	1	1100	1460	876	1010
ED-020F	Potassium - Filtered	mg/L	1	24	25	25	31
ED-035	Bicarbonate as CaCO3	mg/L	1	484	568	490	505
ED-040F	Sulphate - Filtered	mg/L	1	359	506	312	313
ED-045	Chloride	mg/L	1	1570	2390	1270	1510
EG-005F	Copper - Filtered	mg/L	0.01	<0.01	<0.01	<0.01	<0.01
	Iron - Filtered	mg/L	0.1	1.6	3.0	0.9	2.0
	Manganese - Filtered	mg/L	0.01	0.56	0.33	0.09	0.10
	Zinc - Filtered	mg/L	0.01	0.04	0.07	0.08	<0.01
EG-020F	Arsenic - Filtered	mg/L	0.01	<0.01	<0.01	<0.01	<0.01
	Lead - Filtered	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
EG-035F	Mercury - Filtered	mg/L	0.0001	<0.0001	0.0003	<0.0001	<0.0001
EK-058A	Nitrate as N	mg/L	0.01	0.05	0.06	0.07	0.05
EK-061A	Total Kjeldahl Nitrogen as N	mg/L	0.1	0.2	0.6	<0.1	0.8
EK-067A	Phosphorus as P - Total	mg/L	0.01	0.25	0.23	19.7	0.53
EZ-005	Total Cations	me/L	0.01	61.72	89.65	52.38	59.59
EZ-010	Total Anions	me/L	0.01	61.45	89.32	52.13	59.22
EZ-015	Actual (Anion / Cation) Difference	me/L	0.01	0.27	0.33	0.26	0.37
EZ-020	Allowed (Anion / Cation) Difference	me/L	0.01	1.06	1.49	0.91	1.02

DATE RECEIVED 22/8 FAX/MAIL/COURIER
PROJECT No 3397/2 FILE No.
DOCUMENT No. LAB 043
DISTRIBUTION BL

OMMENTS:

This report supersedes any previous preliminary reports of the same batch number.

LOR denotes level of reporting
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• Results apply to sample(s) as submitted by client.

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[redacted]

ANALYTICAL REPORT

LABORATORY: ENV SYDNEY
BATCH NUMBER: ES2696
SUB BATCH: 0
No. OF SAMPLES: 6
DATE RECEIVED: 02/08/96
DATE COMPLETED: 15/08/96

CONTACT: MR B LIDDLE
CLIENT: AGC WOODWARD-CLYDE (NSW)
ADDRESS:
LEVEL 6, 486-494 PACIFIC H'WAY
ST LEONARDS NSW 2065

RDER No.: 3397/2 SAMPLE TYPE: WATER PROJECT:

hod	Analysis description	Units	LOR	MONW5 31/07/96	DUP01 31/07/96
)15	Total Dissolved Solids (TDS)	mg/L	1	5370	5590
)05F	Calcium - Filtered	mg/L	1	105	121
)10F	Magnesium - Filtered	mg/L	1	195	227
)15F	Sodium - Filtered	mg/L	1	1530	1560
)20F	Potassium - Filtered	mg/L	1	29	25
)35	Bicarbonate as CaCO3	mg/L	1	462	538
)40F	Sulphate - Filtered	mg/L	1	688	503
)45	Chloride	mg/L	1	2310	2540
)05F	Copper - Filtered	mg/L	0.01	<0.01	<0.01
	Iron - Filtered	mg/L	0.1	0.6	2.9
	Manganese - Filtered	mg/L	0.01	0.21	0.34
	Zinc - Filtered	mg/L	0.01	0.12	0.05
20F	Arsenic - Filtered	mg/L	0.01	<0.01	<0.01
	Lead - Filtered	mg/L	0.001	<0.001	<0.001
35F	Mercury - Filtered	mg/L	0.0001	<0.0001	0.0001
58A	Nitrate as N	mg/L	0.01	0.07	0.06
61A	Total Kjeldahl Nitrogen as N	mg/L	0.1	0.3	0.6
/67A	Phosphorus as P - Total	mg/L	0.01	0.11	0.29
)05	Total Cations	me/L	0.01	88.58	93.22
)10	Total Anions	me/L	0.01	88.73	92.89
)15	Actual (Anion / Cation) Difference	me/L	0.01	0.15	0.33
)20	Allowed (Anion / Cation) Difference	me/L	0.01	1.48	1.55

MENTS:

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[redacted]

ANALYTICAL REPORT

LABORATORY:	ENV SYDNEY
BATCH NUMBER:	ES2696
SUB BATCH:	0
No. OF SAMPLES:	6
DATE RECEIVED:	02/08/96
DATE COMPLETED:	15/08/96

CONTACT: MR B LIDDLE
CLIENT: AGC WOODWARD-CLYDE (NSW)
ADDRESS: LEVEL 6, 486-494 PACIFIC H'WAY
ST LEONARDS NSW 2065

ORDER No.: 3397/2 SAMPLE TYPE: QUALITY CONTROL PROJECT:

ethod	Analysis description	Units	LOR	MONW1 %SPK REC 31/07/96	DUP01 CHK 31/07/96	BLANK
A-015	Total Dissolved Solids (TDS)	mg/L	1	----	5680	<1
D-005F	Calcium - Filtered	mg/L	1	----	122	<1
D-010F	Magnesium - Filtered	mg/L	1	----	229	<1
D-015F	Sodium - Filtered	mg/L	1	----	1560	<1
D-020F	Potassium - Filtered	mg/L	1	----	26	<1
D-035	Bicarbonate as CaCO3	mg/L	1	----	535	<1
D-040F	Sulphate - Filtered	mg/L	1	----	508	<1
D-045	Chloride	mg/L	1	100 %	2540	<1
G-005F	Copper - Filtered	mg/L	0.01	92.0 %	<0.01	<0.01
	Iron - Filtered	mg/L	0.1	88.0 %	3.0	<0.1
	Manganese - Filtered	mg/L	0.01	108 %	0.34	<0.01
	Zinc - Filtered	mg/L	0.01	96.0 %	0.05	<0.01
G-020F	Arsenic - Filtered	mg/L	0.01	110 %	<0.01	<0.01
	Lead - Filtered	mg/L	0.001	84.0 %	<0.001	<0.001
G-035F	Mercury - Filtered	mg/L	0.0001	98.0 %	0.0002	<0.0001
K-058A	Nitrate as N	mg/L	0.01	107 %	0.06	<0.01
K-061A	Total Kjeldahl Nitrogen as N	mg/L	0.1	96.0 %	0.6	<0.1
K-067A	Phosphorus as P - Total	mg/L	0.01	92.0 %	0.29	<0.01
Z-005	Total Cations	me/L	0.01	----	93.46	----
Z-010	Total Anions	me/L	0.01	----	92.93	----
Z-015	Actual (Anion / Cation) Difference	me/L	0.01	----	0.52	----
Z-020	Allowed (Anion / Cation) Difference	me/L	0.01	----	1.55	----

MMENTS:

Results which appear on this report are routine laboratory duplicates for QUALITY CONTROL purposes.

OR denotes level of reporting
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[redacted]

ANALYTICAL REPORT

LABORATORY: ENV SYDNEY
BATCH NUMBER: ES2696
SUB BATCH: 1
No. OF SAMPLES: 6
DATE RECEIVED: 02/08/96
DATE COMPLETED: 15/08/96

CONTACT: MR B LIDDLE
CLIENT: AGC WOODWARD-CLYDE (NSW)
ADDRESS:
LEVEL 6, 486-494 PACIFIC H'WAY
ST LEONARDS NSW 2065

RDER No.: 3397/2 SAMPLE TYPE: WATER PROJECT:

thod	Analysis description	Units	LOR	MONW1 31/07/96	MONW2 31/07/96	MONW3 31/07/96	MONW4 31/07/96
-071-WS	TOTAL PETROLEUM HYDROCARBONS						
	C6 - C9 Fraction	ug/L	20	<20	<20	<20	<20
	C10 - C14 Fraction	ug/L	50	<50	<50	<50	<50
	C15 - C28 Fraction	ug/L	100	518	192	129	117
	C29 - C36 Fraction	ug/L	50	113	<50	<50	<50

MMENTS:

Samples: MONW1, MONW2, MONW3, MONW4 AND DUP01 : Phthalate compounds are contributing to the C15-C28 band.

R denotes level of reporting
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ANALYTICAL REPORT

LABORATORY: ENV SYDNEY
BATCH NUMBER: ES2696
SUB BATCH: 1
No. OF SAMPLES: 6
DATE RECEIVED: 02/08/96
DATE COMPLETED: 15/08/96

CONTACT: MR B LIDDLE
CLIENT: AGC WOODWARD-CLYDE (NSW)
ADDRESS: LEVEL 6, 486-494 PACIFIC H'WAY
ST LEONARDS NSW 2065

ORDER No.: 3397/2 SAMPLE TYPE: WATER PROJECT:

lethod	Analysis description	Units	LOR	MONW5 31/07/96	DUP01 31/07/96
P-071-WS	TOTAL PETROLEUM HYDROCARBONS				
	C6 - C9 Fraction	ug/L	20	<20	<20
	C10 - C14 Fraction	ug/L	50	<50	<50
	C15 - C28 Fraction	ug/L	100	<100	150
	C29 - C36 Fraction	ug/L	50	<50	<50

OMMENTS:

OR denotes level of reporting
This is the Final Report which supersedes any preliminary reports with this batch number.

• Results apply to sample(s) as submitted by client.

AUSTRALIAN
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ORGANICS QUALITY CONTROL REPORT

BATCH No: ES2696

DATE BATCH RECEIVED: 02/08/96

CLIENT: AGC Woodward-Clyde (NSW)

DATE BATCH COMPLETED: 19/08/96

Method Code	Test	Matrix	Method Reference		QC Lot Number	Date Samples Extracted	Date Samples Analysed
			Extraction	Analysis			
EP-071	TPH-Volatile	Water	USEPA 5030A	USEPA 8260A	NVOCW70	05/08/96	07/08/96
	-Semivolatile	Water	USEPA 3510B	USEPA 8015A	NTPHW65	05/08/96	07/08/96

SYFORM(10/2)

DATE RECEIVED 20/8 FAX/MAIL/COURIER
PROJECT No .... FILE No. ....
DOCUMENT No. ....
DISTRIBUTION BL

ORGANICS QUALITY CONTROL - Sample Identification

Batch No: ES2696

Client: AGC Woodward-Clyde (NSW)

ALS Sample ID	Client Sample ID	Date
1	MONW1 - Water	31/07/96
2	NONW2 - Water	31/07/96
3	MONW3 - Water	31/07/96
4	MONW4 - Water	31/07/96
5	MONW5 - Water	31/07/96
6	DUP01 - Water	31/07/96

ORGFM(73/0)

BATCH QUALITY CONTROL

ALS EP-071 : Total Petroleum Hydrocarbons by Fractions

QC Lot No. : NVOCW70
MATRIX: Water

ANALYST: S. ASRE

Volatile Components

COMPOUND	Level Of Reporting (LOR)	Blank Conc	Spike Conc	SPIKE RESULTS				CONTROL LIMITS		
				SCS conc	DCS conc	Av. Rec.	RPD	Recovery (%)		RPD
	ug/L	ug/L	ug/L	ug/L	ug/L	%	%	Low	High	%
C6-C9	20	<LOR	250	261	269	106	3	83	113	20
C10	20	<LOR	48	46	46	96.1	0	74	121	20

COMMENTS :
1) The control limits are based on ALS laboratory statistical data. (Method QWI-ORG/06)
2) * : Recovery or RPD falls outside of the recommended control limits.

BATCH QUALITY CONTROL

ALS EP-071 : Total Petroleum Hydrocarbons by Fractions

MATRIX: Water

ANALYST: H.FLAMPOULIDIS

QC LOT No.: NTPHW65

Semivolatile Components

COMPOUND	BATCH ADJ. (MDL)	Blank Conc.	Spike Conc.	Spike Results				Control Limits		
				SCS Conc.	DCS Conc.	Av. Rec.	RPD	Recovery %		RPD
	ug/L	ug/L	ug/L	ug/L	ug/L	%	%	Low	High	%
C11-C14	25	<LOR	191	198	196	103	1	57	127	20
C15-C28	25	<LOR	463	480	477	103	1	70	138	20
C29-C36	25	<LOR	379	376	387	101	3	69	133	20

COMMENTS:

1) The control limits are based on ALS laboratory statistical data (Method QWI-ORG/07).

2) * : Recovery or RPD falls outside the recommended control limit.

3) MDL = Method Detection Limit

4) LOR = Level Of Reporting

SURROGATE RECOVERIES

ALS EP-080/071(V) : BTEX/TPH(V) ANALYSIS

BATCH No. : ES2696
QC LOT No. :NVOCW70
MATRIX : Water

ANALYST : M. Heery
UNITS : % Recovery

SPIKE CONCENTRATION : 50 ug/L

Sample ID	SURROGATE COMPOUND		
	1,2-Dichloro-ethane-d4	Toluene-d8	4-Bromofluoro-benzene
-1	121	109	113
-2	123	111	114
-3	122	109	114
-4	120	107	111
-5	125	110	115
-6	123	108	113

MS : Matrix Spike
MSD : Matrix Spike Duplicate
D : Duplicate
: Samples required dilution prior to analysis. Standard surrogate additions were therefore out of analytical range.

APPENDIX C

PERMEABILITY TEST RESULTS

FALLING HEAD TEST

Date: 1.8.96 | **BORE/WELL No:** MONW1

Project No.: 3397/2 | Location: PGH - Monier | Recorder's Name: PDS

Time:

Cased Depth (m bRP):

Depth to Screened Section (m):

SWL (m bRP) - Hw: 13.095

Volume of water injected (m^3): 0.015

Intial Head (m) - he: 7.64 (head in excess of SWL at beginning of test)

Length screened section (m): - L 9.48

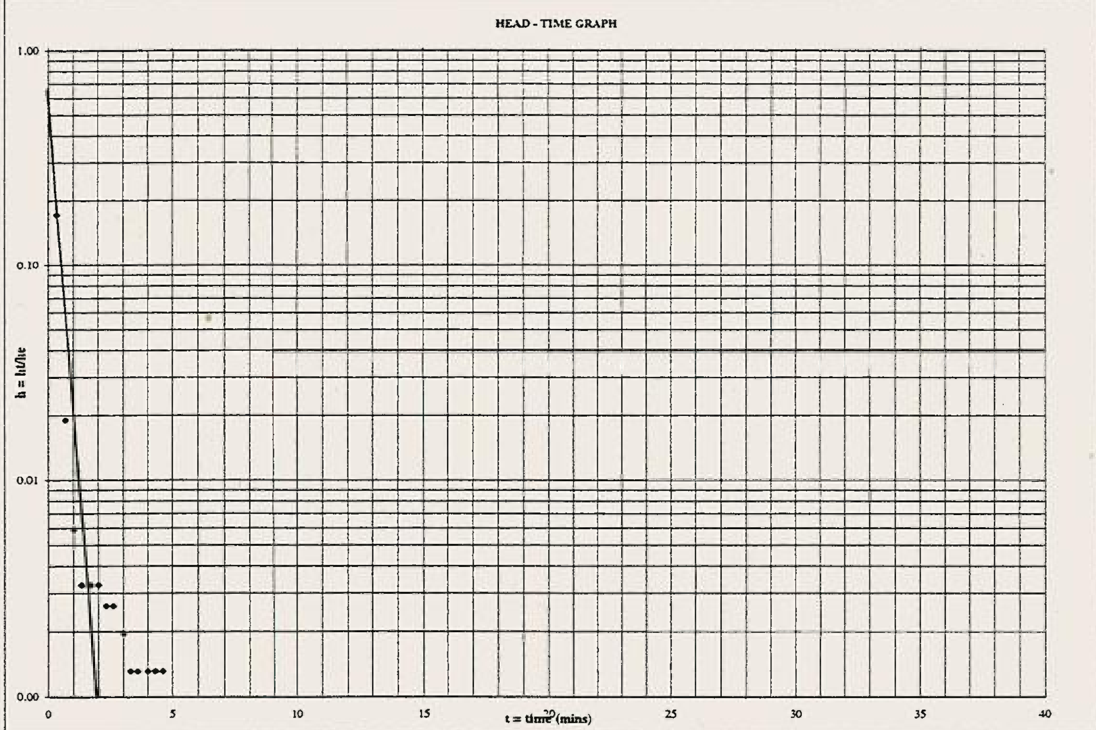
Radius of bore hole (m) - r: 0.052

Radius of casing (m) - rc: 0.025

Document #: FH001

Time, t (min)	0.33	0.67	1	1.3	1.67	2	2.3	2.6	3	3.3
Depth to water (m) hw	11.79	12.95	13.05	13.07	13.07	13.07	13.075	13.075	13.08	13.085
Excess head (m) $ht = Hw - hw$	1.31	0.15	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.01
ht/he	0.17	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Time, t (min)	3.6	4	4.3	4.6						
Depth to water (m) hw	13.085	13.085	13.085	13.085						
Excess head (m) $ht = Hw - hw$	0.01	0.01	0.01	0.01						
ht/he	0.00	0.00	0.00	0.00						



CALCULATIONS

METHOD 1

K = 0.133 x S x (rc²)/L m/sec

K = 1E-05 m/sec 1.1534 m/day

METHOD 2

K = 0.019 x S x (rc²)/L x (lnL/r) m/sec for L/r>8

K = 0.019 x S x (rc²)/L x [ln(L/2r) + sqr rt(1+(L/2r)²)] m/sec for L/r <=8

where

S = (log (h1/h2))/(t2-t1) i.e. slope of plot

s:\3397\2\PERMB.XLS\MONW1\30/08/96\PDS:pds

Woodward- Clyde

Prepared by: PDS
Checked by: FL

FALLING HEAD TEST

Date: 1.8.96 **BORE/WELL No** MONW2

Project No.: 3397/2 **Location:** PGH - Monier **Recorder's Name:** PDS

Time:

Cased Depth (m bRP): **Depth to Screened Section (m):**

SWL (m bRP) - *Hw:* 8.88 **Volume of water injected (m^3):** 0.015

Intial Head (m) - *he:* 7.64 (head in excess of SWL at beginning of test)

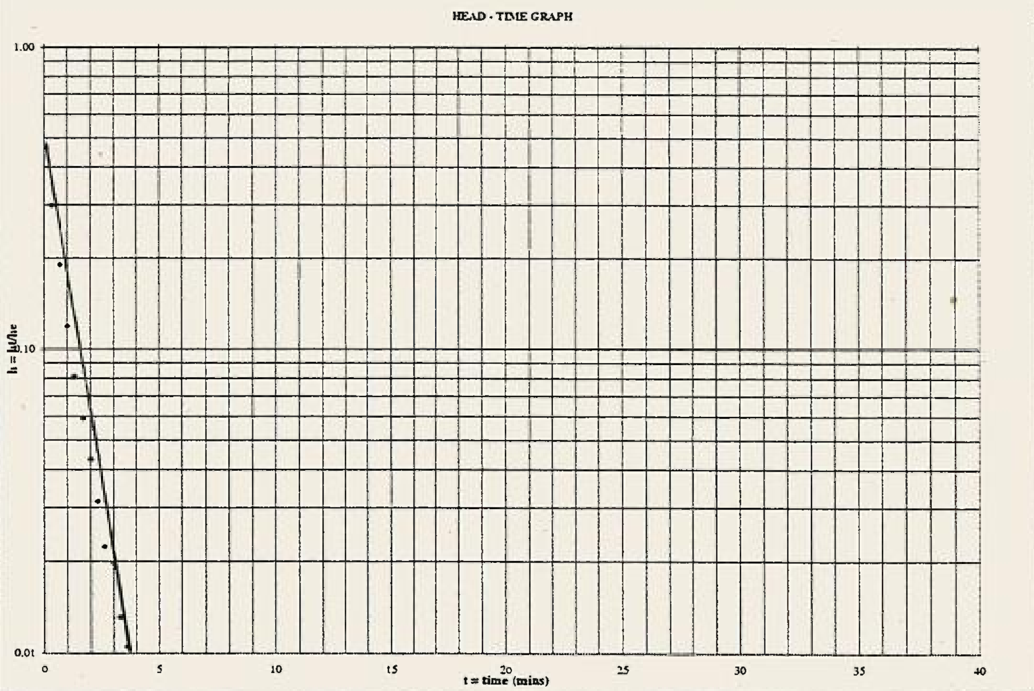
Length screened section (m): - *L* 5.9

Radius of bore hole (m) - *r:* 0.052

Radius of casing (m) - *rc:* 0.025 **Document #:** FH002

Time, t (min)	0.33	0.67	1	1.3	1.67	2	2.3	2.6	3	3.3
Depth to water (m)										
hw	6.6	7.43	7.97	8.26	8.43	8.55	8.64	8.71	8.73	8.78
Excess head (m)										
ht = Hw - hw	2.28	1.45	0.91	0.62	0.45	0.33	0.24	0.17	0.15	0.1
ht/he	0.30	0.19	0.12	0.08	0.06	0.04	0.03	0.02	0.02	0.01

Time, t (min)	3.6
Depth to water (m)	
hw	8.8
Excess head (m)	
ht = Hw - hw	0.08
ht/he	0.01



CALCULATIONS

METHOD 1

K = 0.133 x S x (rc²)/L m/sec K = 6E-06 m/sec 0.508 m/day

METHOD 2

K = 0.019 x S x (rc²)/L x (lnL/r) m/sec for L/r>8

K = 0.019 x S x (rc²)/L x [ln(L/2r) + sqr rt(1+(L/2r)²)] m/sec for L/r <=8

where

S = (log (h1/h2))/(t2-t1) i.e. slope of plot

Woodward- Clyde

x:\3397\PERMB.XLS\MONW2\30/08/96\PDS:pds

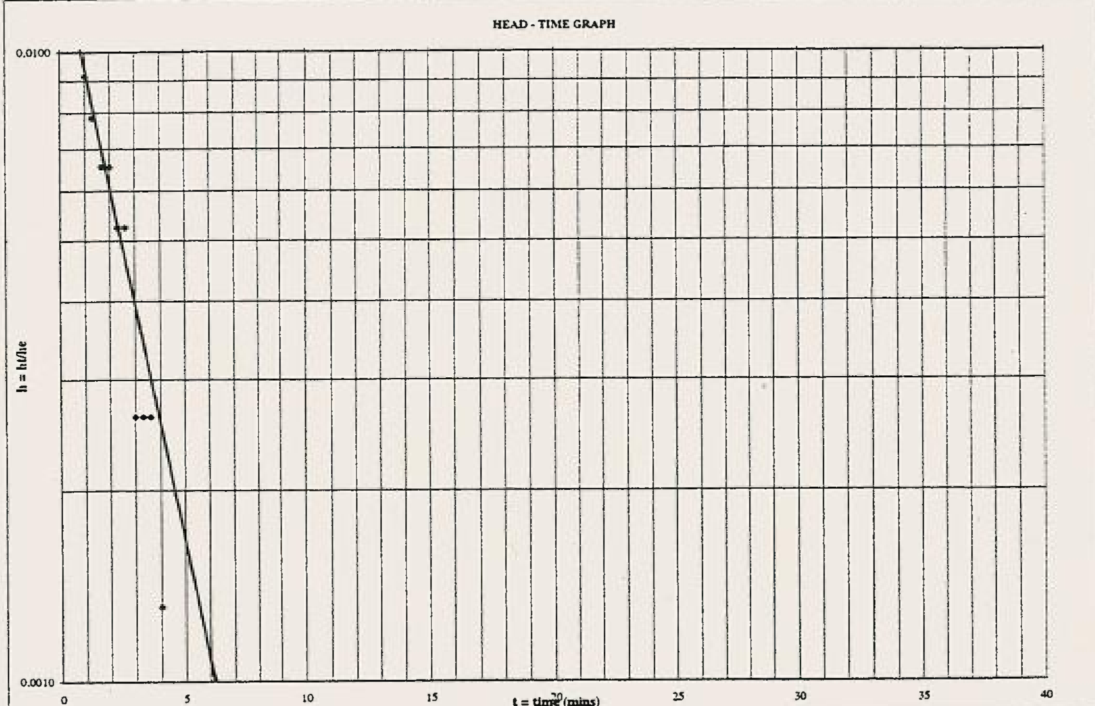
Prepared by: PDS
Checked by: FC

FALLING HEAD TEST

Date:	1.8.96	BORE/WELL No:	MONW3		
Project No.:	3397/2	Location:	PGH - Monier	Recorder's Name:	PDS
				Time:	
Cased Depth (m bRP):		Depth to Screened Section (m):			
SWL (m bRP) - *Hw*:	16.78	Volume of water injected (m^3):	0.015		
Intial Head (m) - *he*:	7.64	(head in excess of SWL at beginning of test)			
Length screened section (m): - *L*	12.64				
Radius of bore hole (m) - *r*:	0.052				
Radius of casing (m) - *rc*:	0.025			Document #:	FH003

Time, t (min)	0.33	0.67	1	1.3	1.67	2	2.3	2.6	3	3.3
Depth to water (m) *hw*	16.61	16.68	16.71	16.72	16.73	16.73	16.74	16.74	16.74	16.76
Excess head (m) *ht = Hw - hw*	0.17	0.1	0.07	0.06	0.05	0.05	0.04	0.04	0.04	0.02
ht/he	0.0223	0.0131	0.0092	0.0079	0.0065	0.0065	0.0052	0.0052	0.0052	0.0026

Time, t (min)	3.6	4	4.3	4.6						
Depth to water (m) *hw*	16.76	16.76	16.76	16.77						
Excess head (m) *ht = Hw - hw*	0.02	0.02	0.02	0.01						
ht/he	0.0026	0.0026	0.0026	0.0013						



CALCULATIONS

METHOD 1

K = 0.133 x S x (rc^2)/L m/sec

K = 1E-06 m/sec 0.1038 m/day

METHOD 2

K = 0.019 x S x (rc^2)/L x (lnL/r) m/sec for L/r>8

K = 0.019 x S x (rc^2)/L x [ln(L/2r) + sqr rt(1+($(L/2r)^2$)] m/sec for L/r <=8

where

S = (log (h1/h2))/(t2-t1) i.e. slope of plot

FALLING HEAD TEST

Date:	1.8.96	BORE/WELL No:	MONW4
Project No.:	3397/2	Location:	PGH - Monier
Recorder's Name:	PDS	Time:	

Cased Depth (m bRP):

Depth to Screened Section (m):

SWL (m bRP) - *Hw:* 9.84

Volume of water injected (m^3): 0.015

Intial Head (m) - *he:* 7.64 (head in excess of SWL at beginning of test)

Length screened section (m): - *L* 19.6

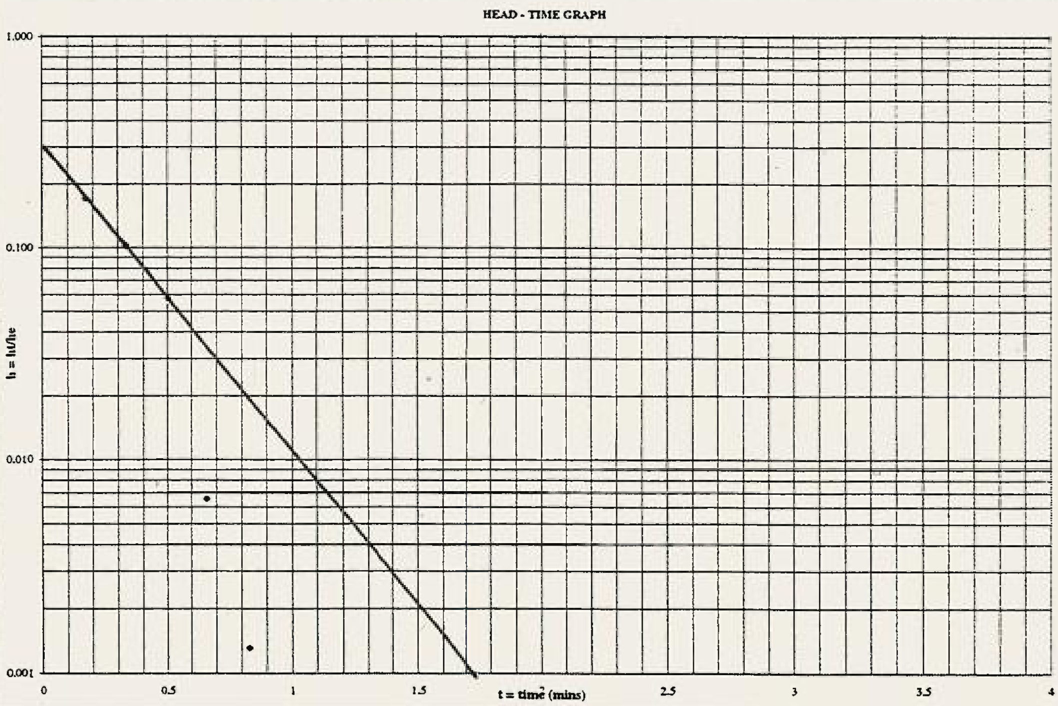
Radius of bore hole (m) - *r:* 0.052

Radius of casing (m) - *rc:* 0.025

Document #: FH004

Time, t (min)	0.17	0.33	0.5	0.66	0.83	1.0			
Depth to water (m) *hw*	8.54	9.06	9.4	9.79	9.83	9.84			
Excess head (m) *ht = Hw - hw*	1.3	0.78	0.44	0.05	0.01	0			
ht/he	0.17	0.10	0.06	0.01	0.001	0.00			

Time, t (min)									
Depth to water (m) *hw*									
Excess head (m) *ht = Hw - hw*									
ht/he									



CALCULATIONS

METHOD 1

K = 0.133 x S x (rc^2)/L m/sec

K = 6E-06 m/sec 0.5339 m/day

METHOD 2

K = 0.019 x S x (rc^2)/L x (lnL/r) m/sec for L/r>8

K = 0.019 x S x (rc^2)/L x [ln(L/2r) + sqr rt(1+(L/2r)²)] m/sec for L/r <=8

where

S = (log (h1/h2))/(t2-t1) i.e. slope of plot

FALLING HEAD TEST

Date: 1.8.96 **BORE/WELL No:** MONW5

Project No.: 3397/2 Location: PGH - Monier Recorder's Name: PDS

Time:

Cased Depth (m bRP): Depth to Screened Section (m):

SWL (m bRP) - *Hw*: 7.87 Volume of water injected (m^3): 0.015

Intial Head (m) - *he*: 7.64 (head in excess of SWL at beginning of test)

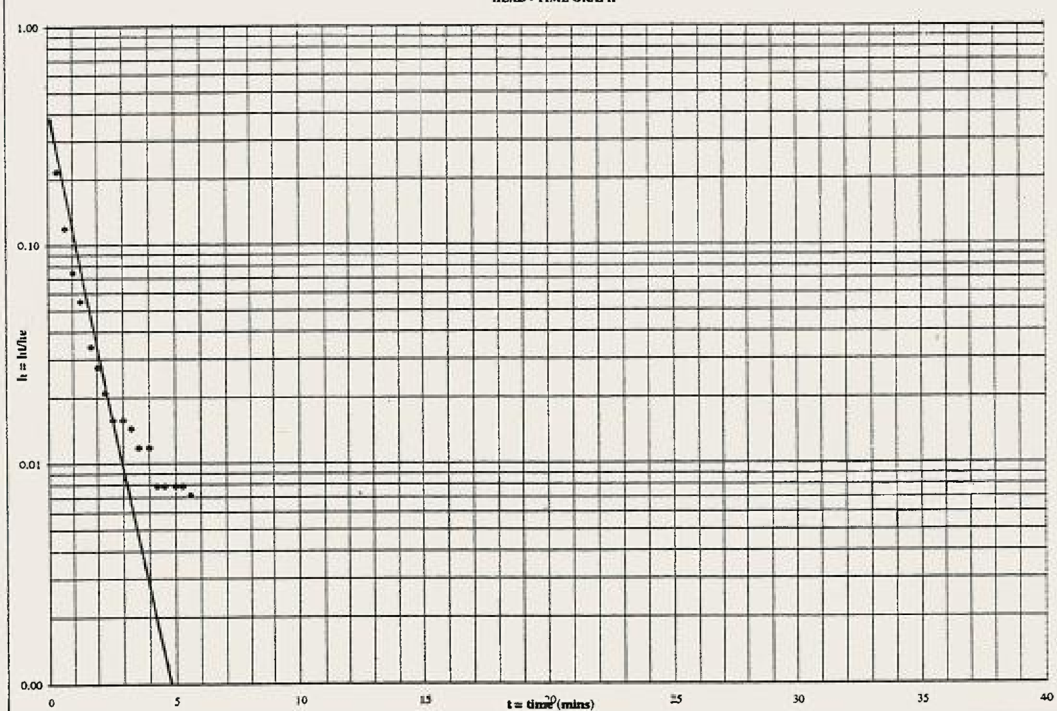
Length screened section (m): - *L* 16

Radius of bore hole (m) - *r*: 0.052

Radius of casing (m) - *rc*: 0.025 Document #: FH005

Time, t (min)	0.33	0.67	1	1.3	1.73	2	2.3	2.6	3	3.3
Depth to water (m) *hw*	6.22	6.96	7.3	7.45	7.61	7.66	7.71	7.75	7.75	7.76
Excess head (m) *ht = Hw - hw*	1.65	0.91	0.57	0.42	0.26	0.21	0.16	0.12	0.12	0.11
ht/he	0.22	0.12	0.07	0.05	0.03	0.03	0.02	0.02	0.02	0.01

Time, t (min)	3.6	4	4.3	4.6	5	5.3	5.6
Depth to water (m) *hw*	7.78	7.78	7.81	7.81	7.81	7.81	7.815
Excess head (m) *ht = Hw - hw*	0.09	0.09	0.06	0.06	0.06	0.06	0.055
ht/he	0.01	0.01	0.01	0.01	0.01	0.01	0.01



CALCULATIONS

METHOD 1

K = 0.133 x S x (rc²)/L m/sec

K = 3E-06 m/sec 0.2413 m/day

METHOD 2

K = 0.019 x S x (rc²)/L x (lnL/r) m/sec for L/r>8

K = 0.019 x S x (rc²)/L x [ln(L/2r) + sqr rt(1+(L/2r)²)] m/sec for L/r <=8

where

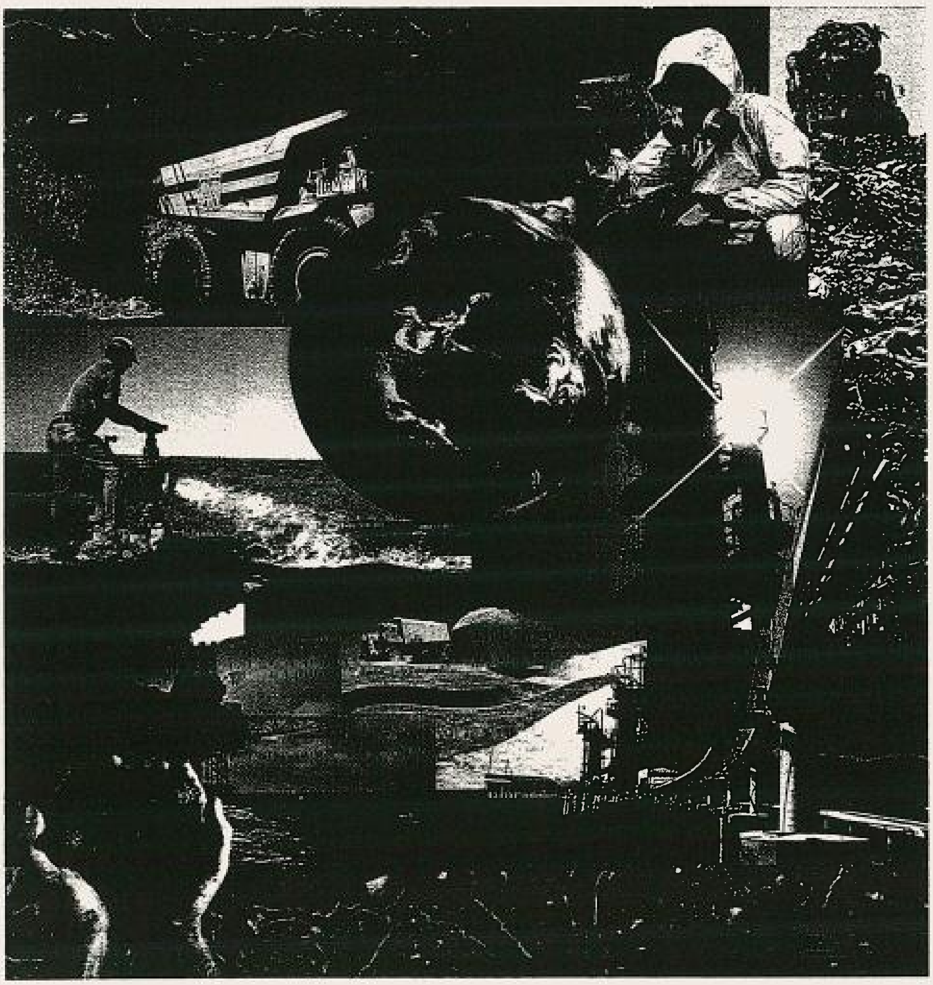
S = (log (h1/h2))/(t2-t1) i.e. slope of plot

MONIER-PGH QUARRY

MAITLAND

GROUNDWATER

INVESTIGATIONS



PREPARED FOR
CSR-READYMIX & CLEANAWAY

SEPTEMBER 1993
PROJECT NO. 3397

Woodward-Clyde

TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

1.0 INTRODUCTION

CSR-Readymix/Cleanaway is investigating the suitability of an abandoned quarry, at the Monier-PGH brickworks site in Maitland, for use as a landfill. In the evaluation of the site for such a purpose, the issue of potential groundwater contamination from the landfill operation needs to be addressed. CSR-Readymix has retained Woodward-Clyde to carry out preliminary groundwater investigations to collect data in order to obtain an initial understanding of the various aspects of the hydrogeology of the site. In addition, the issue of whether a lining system would be required in the landfill design was also to be addressed.

This report describes the field work carried out and the results it provided.

2.0 GENERAL SITE DESCRIPTION

The quarry under investigations is situated on the northwestern side of Metford Road, East Maitland and south of the Main Northern Railway. The brickworks started operations at this site around the turn of the century and is still active. The quarry has an elongated shape, approximately 320 m long by 170 m wide and an approximate depth of 23 m (possibly more), with the floor ranging in elevation from just over 17 m to -6 m AHD. Old photographs of the site indicate the presence of a deep sump at the eastern end of the quarry, likely to have been several metres below the quarry floor.

The quarry has filled up with water since operations ceased at this site, with the current level measured at an elevation of -0.91 m AHD.

More recently, surficial material was won at the southern portion of the property, resulting in a broad, shallow excavation. It is understood that the Company plans to extract further material from this area, prior to final abandonment of quarrying operations at this site.

3.0
GEOLOGY AND HYDROGEOLOGY

The formations under the site belong to the Sydney Basin Tomago Coal Measures of Upper Permian age. This formation overlies the marine Maitland Group and is overlain, in turn, by the Newcastle Coal Measures. The Tomago Coal Measures consist mainly of shales, mudstone and sandstone with a number of coal seams and claystone horizons, some of which are of tuffaceous origin. The sediments are characterised by rapid vertical and lateral facies changes to the extent that the more reliable elements for correlation are represented by the coal seams.

The coal present in the quarry rocks has been identified in previous studies as belonging to the Rathluba Seam, part of the Wallis Creek Formation, one of the three main formations making up the Tomago Coal Measures. The Wallis Creek Formation increases in thickness towards the coast and attains its known maximum thickness of 300 m in the vicinity of Newcastle.

Regionally, the Tomago Coal Measures outcrop on the eastern flank of the Lochinvar Anticline and dip gently in a general southeasterly direction towards the coast. However, in the quarry area, according to information provided by PGH, the formation dips to the west at 7°, due to local structural variations.

The rocks belonging to the Sydney Basin coal measures are known to be generally poor aquifers because of their fine grained and cemented nature. Generally, water in these formations is stored in fractures and joints and, to the extent that these fractures and joints are interconnected, these formations will behave as aquifers, i.e. will be able to store and transmit water. Commonly, however, the coal seams represent the more permeable elements of the coal measures formations and are generally regarded as the more significant aquifers.

Future hydrogeological studies will need to concentrate on the coal seams identified under the site, as these are likely to represent the major pathways for groundwater movement and possible contaminant migration.

4.0 INVESTIGATION PROGRAMME

The investigation programme was based on the establishment of three groundwater monitoring bores and on the collection of water samples from these bores and from the pond for chemical analyses.

4.1 DRILLING PROGRAMME

Three sites were chosen around the perimeter of the quarry in order to given adequate spacial distribution around the pit. Some of the areas originally intended as possible sites were not accessible without major earthwork preparation. Such preparation will be necessary for future sites, as required.

The drilling programme was carried out between 19 July and 23 July 1993 by Engineering Exploration Pty Limited under the direct supervision of Woodward-Clyde personnel.

The bores were designed to penetrate the formation to a depth equal or deeper than the bottom of the quarry. Statistical data regarding these bores are presented in Table 1 and their position is marked in Figure 1. Appendix A presents the lithological and construction logs.

Drilling was carried out by IVRC (Induced Vacuum Reverse Circulation), a technique particularly suited to the site formations in that it provides accurate depth sampling and water intersection logging.

4.2 SAMPLING PROGRAMME

On completion of development, samples were collected from the bores and the western end of the pond for chemical analyses. The samples were collected and handled in accordance with Woodward-Clyde quality control procedures and were delivered under chain of custody to Sydney Analytical Laboratories for analysis. The laboratory's report are attached as Appendix B, which also includes a summary sheet with conversions and cation-anion percentage error calculations. The latter indicate that the analyses have been performed correctly and within the acceptable error margins.

5.0
RESULTS

5.1 GEOLOGY

A probable, general geological correlation can be drawn between the coal sequence in bore MONW3 and that in borehole PGH MDDH7 (Appendix A), which is located approximately 160 m north of MONW3 and along strike. Correlations between the three new bores are not possible due to the 7° dip to the west , that results in the coal seam being below the bottom of bore MONW2.

5.2 HYDROGEOLOGY

Groundwater was intersected in all three bores and the estimated yields during airlift development ranged between 0.2 and 0.7 L/sec. Water intersections were mostly associated with coal seams, particularly in bore MONW3, which had the highest yield and the greatest thickness of coal (between 22 and 33 m).

Water levels recorded in the three monitoring bores and in the pond during this investigation are presented in Table 1.

With the exception of MONW1, which is marginally (1 cm) below the pond level, bores MONW2 and MONW3 have a water level more than one metre (see Table 1) above that of the pond, indicating that groundwater can flow into the quarry from at least these two sites. Groundwater contribution to the salinity of the pond's water is evident in the results of the water analyses (see later). Although the presence of the quarry hole is expected to have locally influenced the groundwater underflow pattern, current data indicate that the regional groundwater flow is in a generally northeasterly direction, towards the low lying area north of the railway line.

Measurements of the pond water level have been taken in January 1993 (-1.35 m RL) and in August 1993 (-0.91 m RL) and show a difference of 0.44 m between this year's summer and winter values, with the latter values being higher. This difference cannot be explained totally by climatic variations over eight months and, furthermore, does not follow the wet summer/dry winter pattern. Groundwater inflows are likely to be responsible for most of this variation.

5.3 CHEMICAL ANALYSES

Groundwater chemical data reveal variations in Total Dissolved Salts (TDS) between the three bores ranging from 6 350 mg/L at bore MONW2 to 2 500 mg/L at bore MONW3, with bore MONW1 in between these two values. No clear pattern is evident from these data and it is considered that salinity may be influenced by local factors, such as fractures, recharge and preferential flow paths, that tend to flush out salts originally deposited within the formations sediments.

The pond water and the groundwater are not suitable for drinking nor, generally, for irrigation purposes and it appears that groundwater in the area is not a widely exploited resource. A search of water bores records held by the Department of Water Resources has shown an absence of bores in the general area around the quarry.

The water in the pond is brackish and presents some affinity with the character of the groundwater. The sample analysed is a surficial sample only and would almost certainly be less saline than the deeper water, due to salinity stratification resulting from rainfall dilution, temperature and density differences. Salinity stratification will need to be determined in order to establish the quality of the water for disposal to local streams, should the project proceed to the next feasibility stage.

More data points will, eventually, be required around and, also, outside the quarry to confirm the hydrogeological regime as currently understood. However, the establishment of a landfill operation within the quarry will necessitate the pumping out of the water and the maintenance of dry conditions within the excavation. As a consequence, an inward groundwater gradient will be maintained during the life of the landfill and for a long period after the closure of operations, so that areas located downgradient from the quarry will not be subjected to possible leachate contamination of the groundwater.

TABLE 1 - BORE STATISTICS

Bore	Easting	Northing	Ground elevation mAHD	Total Depth m	SWL mbd	Datum mag	SWL mbg	SWL mAHD	Pond* water RL mAHD	Water table a.pond m
MONW1	356547.73	1374353.82	12.46	26.7	13.83	0.45	13.38	-0.92	-0.91	-0.01
MONW2	356437.78	1374398.83	9.39	23.7	9.69	0.45	9.24	0.15	-0.91	+1.06
MONW3	356596.08	1374064.08	17.46	32.8	17.02	0.43	16.60	0.86	-0.91	+1.77

* measured at 14 August 1993

6.0
LINER REQUIREMENTS

The current New South Wales Government regulations do not make the lining of a solid waste landfill site compulsory at present, provided that adequate technical information and guarantees, such as to satisfy the EPA requirements, are given by the landfill operators with regards to the containment of leachate within the landfill site.

However, present trends at local and state government levels are such that a landfill design that does not incorporate a lining system will have difficulties gaining approval. The move is towards the adoption of standards similar to those contained in Subtitle D of The Resource Conservation and Recovery Act, adopted by the US EPA. The US EPA standards require that most new landfills sites (and unless there are exceptionally favourable circumstances, this really means all new sites) need to be constructed with a composite liner and leachate collection system.

The Maitland site has some favourable conditions in terms of low host rock permeability (yet to be measured) and groundwater salinity. However, the presence of higher permeability paths represented by the coal seams mitigates against these conditions unless these paths can be clearly identified and dealt with, but it unlikely that the coal seams can be rendered impermeable on an individual basis to the satisfaction of the EPA and the local council.

It may be that the installation of a liner will be a condition of the Development Consent for a landfill.

Developments such as the landfill proposed at Maitland will likely require the lodgement of performance bonds with the EPA, to cover possible site rehabilitation costs and with the local council to cover possible rehabilitation costs and maintenance. The performance bonds cover the operational and the post-closure periods.

These can be considerable sums and suggest that serious consideration be given to the installation of a liner in order to minimise the financial risk and liability for corrective measures should leachate be detected in the groundwater in the operational and post-closure periods.

7.0
CONCLUSIONS

The groundwater investigations programme carried out at the Monier-PGH quarry has provided initial data that allows preliminary conclusions to be drawn on the overall hydrogeological regime of the property.

The main conclusions are:-

- the main aquifer in the area is represented by the coal seams;
- this aquifer appears to dip 7^0 to the west and may pass below the quarry;
- regional groundwater gradients are to the northeast;
- a local inward gradient exists within the quarry perimeter;
- the maintenance of an inward gradient will contain potential contaminants within the quarry perimeter;
- groundwater is brackish to saline and has a higher salinity on the northeastern side of the quarry;
- water in the quarry pond is brackish and may be salinity stratified at depth; and
- disposal of brackish water from the quarry to local streams will require negotiations with the EPA and the Department of Water Resources.

8.0 RECOMMENDATIONS

The investigation programme has identified areas that will need further assessment before commitments are made with respect to future stages of the project. The main recommendations arising from this study are that:-

- a sampling programme be carried out to establish the vertical salinity profile of the water stored in the pond as input to the feasibility of pumping out to local streams;

- data be collected on the salinity and discharge volumes of local streams;

- discussions be held with relevant regulatory authorities (EPA and Department of Water Resources) as to the feasibility of discharging pond water to the local streams for disposal;

- the groundwater monitoring network be enlarged around the perimeter of the quarry, especially in the currently inaccessible areas in the southwestern quadrant of the property. If possible, two additional bores should be constructed;

- a regular programme of monitoring water levels in the newly established bores and in the pond be implemented;

- evaluations of existing and new bores be made to assess:-

    a) the nature and distribution of permeability;
    b) the regional permeability values applying; and
    c) the persistence of preferred flow path.

- evaluation of the sensitivity of the local groundwater discharge areas to solid industrial waste landfills.

In addition, it is recommended that dewatering of the ponded water be undertaken, subject to the approval of the relevant authorities. The advantages of pumping out the water are many, not the least of these would be:-

a) the basis for an excellent hydrogeological evaluation;
b) the opportunity to map the hydrogeological influences in the quarry wall;
c) the opportunity for water sampling to determine sensitivity; and
d) the opportunity to define any zones around which lining may be required.

9.0 SUMMARY OF COSTS

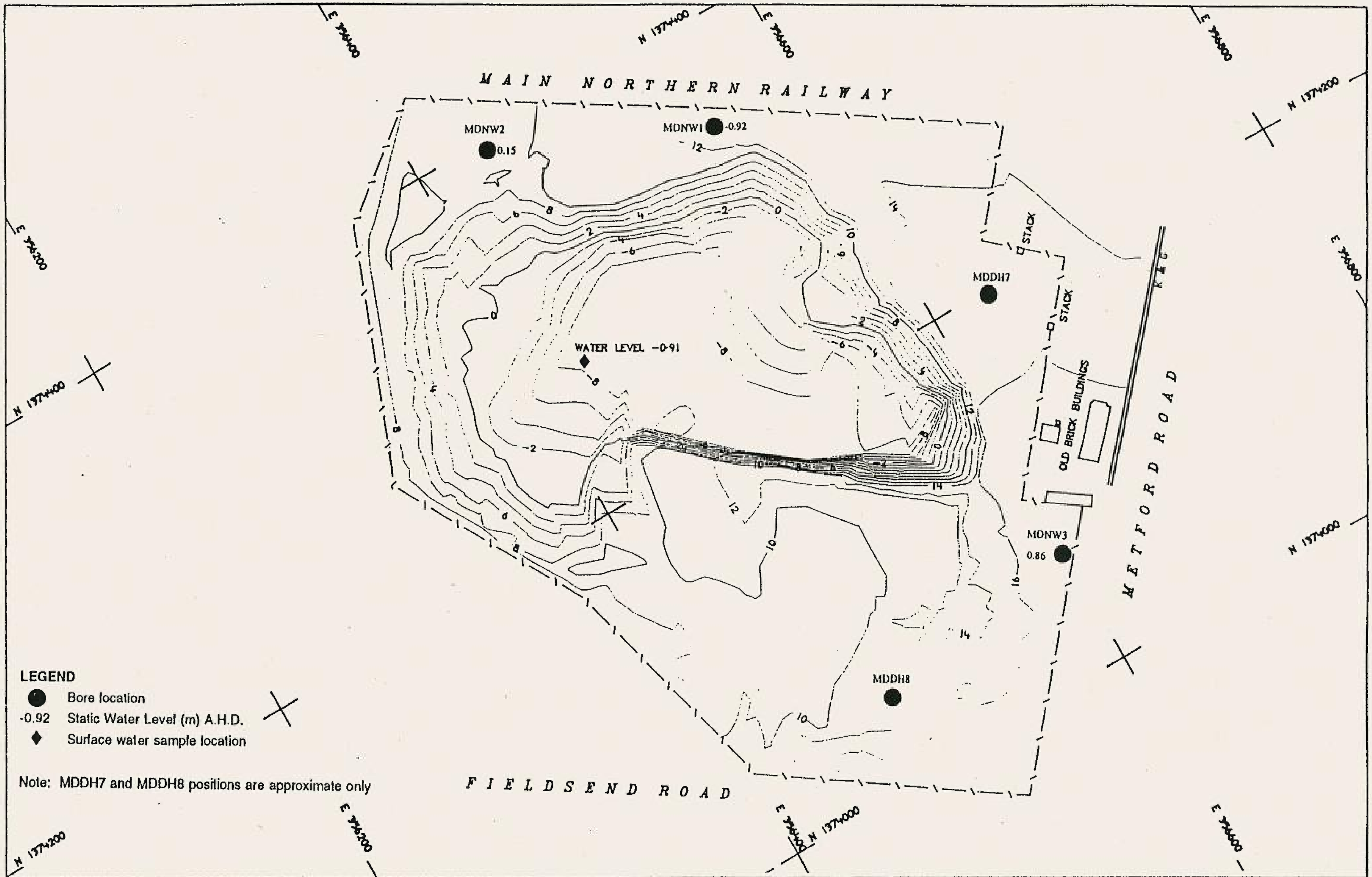
The following summary of costs provides an indication of the costs associated with the individual items as discussed in Section 8 above.

It has been assumed that your company will arrange for the dewatering of the ponded water.

We are prepared to carry out the work on a cost and expenses basis with the individual totals for each item regarded as an upper limiting fee.

Item	Fees ($)	Expenses ($)	Sub Contractors	TOTAL
1. Pond Sampling	1 000	750	700	**$2 450**
2. Hydrologic Data Collection	800	100	-	**$900**
3. Discussions with EPA/DWR	900	100	-	**$1 000**
4. Additional Mon. Bores (2) incl. Reporting	4700	2950	9250	**$16 900**
5. Permeability Tests	1950	700	-	**$2 650**
TOTAL	**9 350**	**4 600**	**9 950**	**$23 900**

FIGURES



PGH LIMITED	DRAWN: K. HADDOW	DESIGNED: FC	**CSR-READYMIX**
		DRAWN: LJE	MONIER-PGH QUARRY- BORE LOCATIONS
DETAIL SURVEY OF METFORD ROAD	DATE: 17th AUG. 1993	CHECKED:	**AGC WOODWARD-CLYDE PTY LIMITED**
		APPROVED:	LEVEL 6, 4860494 PACIFIC HIGHWAY ST LEONARDS, NSW, AUSTRALIA 2065 PHONE:(02) 436 4666
OLD PIT	SCALE: 1:2000	DATE: 17 AUG 1993	DATE: SEPTEMBER 1993 DWG NO: 3397-001 FIGURE: 1

APPENDIX A

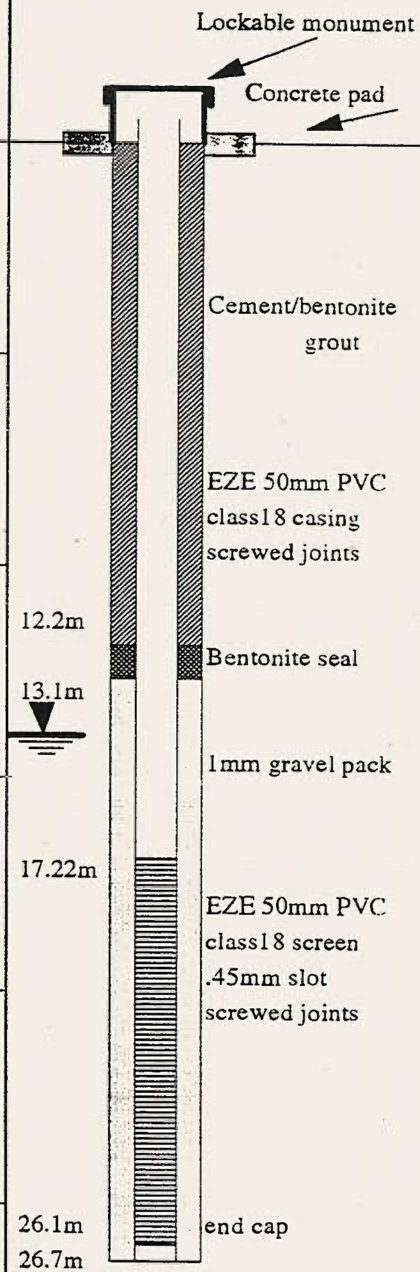
PROJECT : Monier PGH Quarry		JOB NO:	3397
LOCATION: Metford Road, East Maitland		DATE STARTED:	19/07/93
SUPERVISOR: F. Carosone		DATE COMPLETED:	20/07/93

INSTALLED BY: Eng. Exploration	METHOD:	IVRC		DIAMETER (mm):	104
RIG: Edson 3000	TOTAL DEPTH (m):	26.7		R.L. GROUND (m):	12.46
DATUM: 0.45 m a.g.	SWL: 13.83	m b.d.		R.L. SWL (m):	-0.92

BORE NUMBER: MONW1

Lithological Log	Remarks	(m)
		0
0-0.5 CLAY: (topsoil) red and grey, damp		
0.5-3.5 SANDSTONE: yellow, orange, light brown, fine to medium, rounded, well sorted qtz grains, with Fe stained bands and cement		
3.5-5 SHALE/SILSTONE: dark grey, fine, with laminitic bands		5
5-6.5 SANDSTONE: Yellow-orange, medium hard, Fe cement, fine to medium, sorted rounded qtz grains, ferruginous layers		
6.5-6.8 COAL: black, bright , brittle		
6.8-9 SHALE/CLAYSTONE: dark grey, medium hard, very finely layered, silty		
9-10 SILTSTONE: light grey, firm		10
10-20 SHALE: grey to dark grey, fine, silty	rattle	15
15.5 a thin band of coal		
17 becoming coarser, some clay, grey/white		
17.5 a thin coal band	water	20
20- 26.7 SANDSTONE: grey, medium to hard, sub-rounded sorted qtz grains, with black fragments, slightly carbonaceous, some clay	water	25
harder (change to rock roller bit)		
26.7 Bottom of the hole		30

Geological Description or Bore Construction

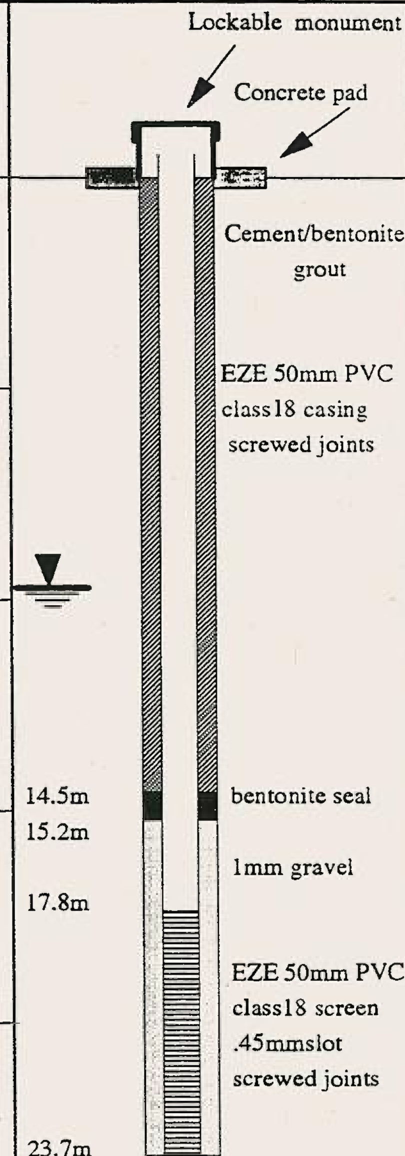


PROJECT : Monier PGH Quarry		JOB NO:	3397
LOCATION: Metford Road, East Maitland		DATE STARTED:	20/07/93
SUPERVISOR: F. Carosone		DATE COMPLETED:	21/07/93
Eng. Exploration	METHOD: IVRC	DIAMETER (mm):	104
RIG: Edson 3000	TOTAL DEPTH (m): 23.7	R.L. GROUND (m):	9.39
DATUM: 0.45 m.a.g.	SWL: 9.69 m b.d.	R.L. SWL (m):	0.15

BORE NUMBER: MONW2

Lithological Log	Remarks	Depth (m)
		0
0-1 FILL; railway ballast, clay		
1-4 CLAY/SHALE: cream, plastic, silty, orange bands 2-3 more frequent orange bands 3-4 some grey clay		
4-8 SHALE: grey to dark grey, minor silt, carbonaceous 5-5.7 a thin band of coal 6-7 grey, dark grey, dark brown 7-8 some light grey bands		5
8-10 SANDSTONE: light grey, grey, medium to fine well sorted qtz grains some clay , becoming finer at bottom	water	10
10-15-5 SILTSTONE: grey, fine, well sorted, subrounded qtz grains 11-12 some clay, hard 12-14.5 somewhat darker, hard 14.5-15.5 softer becoming coarser, maybe fine sandstone	change to rock roller bit	15
15.5-16 COAL: black, some moisture		
16-20 SHALE: brown, light brown, medium hard 16.5 becoming harder 17.3-17.5 dark brown, carbonaceous 19-20 some grey clay, plastic 19.8 wet, muddy returns, some coal	rattle	20
20-22 SANDSTONE: grey, medium well sorted qtz grains, some clay 21-22 some white clay?		
22-22.5 COAL: black, hard, bright	water returns	
22.5-23.3 SANDSTONE: as @ 20-22, finely layered (laminitic?)	increasing	
23.3-23.7 SILTSTONE: grey, fine softer		
		25
23.7 Bottom of the hole		
		30

Geological Description or Bore Construction



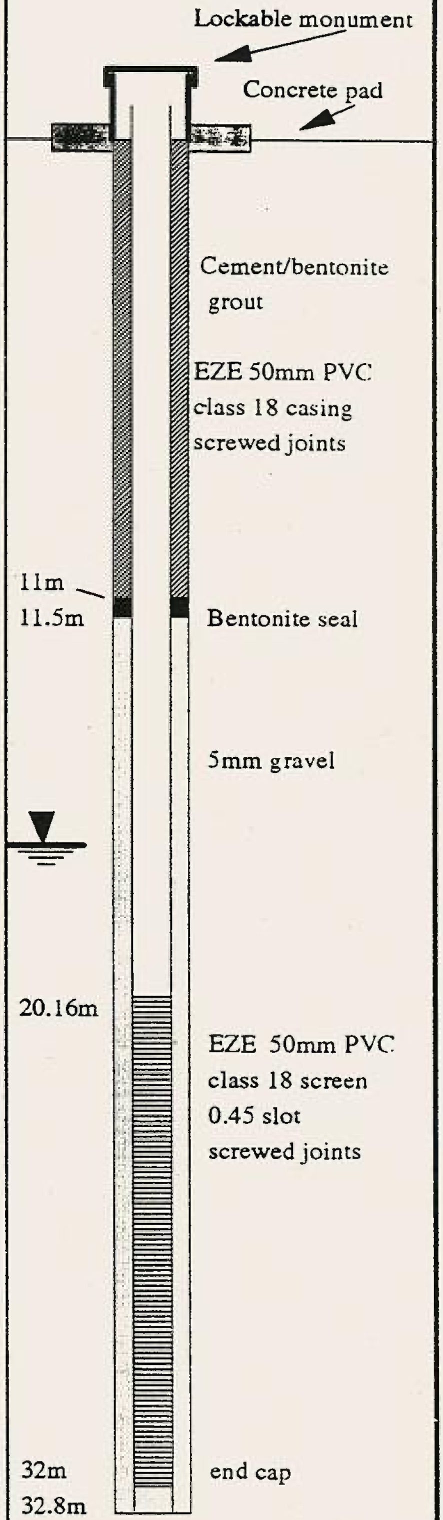
PROJECT : Monier PGH Quarry	JOB NO: 3397
LOCATION: Metford Road, East Maitland	DATE STARTED: 22/07/93
SUPERVISOR: F. Carosone	DATE COMPLETED: 22/07/93

INSTALLED BY: Eng. Exploration	METHOD: IVRC	DIAMETER (mm): 104
RIG: Edson 3000	TOTAL DEPTH (m): 32.8	R.L. GROUND (m): 17.46
DATUM: 0.43 m.a.g.	SWL: 17.02 m b.d.	R.L. SWL (m): 0.86

BORE NUMBER: MONW3

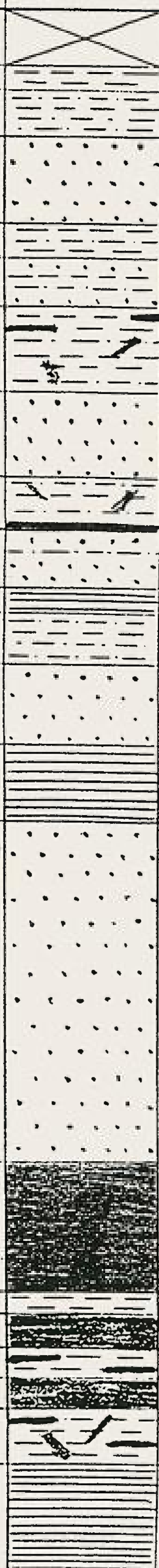
Lithological Log	Remarks	Depth (m)
0-2.5 CLAY: grey-brown, mottled, Fe stained, fill?		0
2.5-4.7 SILTSTONE: cream, soft, weathered, some coarser material some ferruginous bands, some shale thin layers		
4.7-5.2 COAL: black,hard		5
5.2-5.5 SILTSTONE/CLAYSTONE: cream-white		
5.5-6.5 SHALE: dark grey, carbonaceous, finely layered		
6.5-8 SANDSTONE: light grey, grey, medium to fine qtz grains		
8-9 SHALE: grey, dark grey,		
9-10.5 SILTSTONE: grey, fine soft 10.5-11.5 SHALE: grey, silty		10
11.5-17 SILTSTONE: grey, finely layered 12.2 darker, some shale, grey silty 13.7 soft 14.5 a 20cm hard band, alternating sequence of thin bands of siltstone sandstone, claystone, sometimes carbonaceous		15
17-22 SANDSTONE: brown, grey, medium to fine ,sorted, subrounded qtz grains 18 soft, light grey	damp rattle	20
22-28.5 COAL: black, with some thin bands of silty grey clay (2-3cm) 23 some carbonaceous shale 27 some grey clay	water, steady returns	25
28.5-29 SANDSTONE: grey, finely layered		
29-30.5 COAL: black, hard	water increase	30
30.5-32 SILTSTONE: grey, soft, clayey, dry?		
32-32.8 COAL: black, hard, some grey clay	water increase	
32.8 Bottom of the hole		

Geological Description or Bore Construction



PGH N.S.W LOG SHEET

BORE HOLE: MDDH7	DATIUM LEVEL: ≈ 14.4m
SITE: Maitland Brickyard Quarry	LOGGED BY:
DATE START:	DATE END:



DEPTH	REL. LEVEL	GRAPHIC	DESCRIPTION
0.0			Fill core loss
			Clay
			Clayey Siltstone
			Sandstone
			Silty Claystone
5.0			Silty Clayey Sandstone
			Coaly
			Silty Claystone (Carbonaceous)
			Sandstone
			Clayey Shaley Siltstone
10.0			Coal
			Silty Sandstone
			Laminite
			Clayey Siltstone
			Sandstone
15.0			Laminite
20.0			Sandstone
			Coal
25.0			Clay
			Coal
			Coal / Clay
			Coal
			Carbonacous/Coaly Shale
			Laminite
30.0			

E.O.H 30.65

APPENDIX B

SYDNEY
ANALYTICAL
LABORATORIES

PO BOX 48, ERMINGTON, N.S.W., 2115
TELEPHONE: 02-838 8903
FAX: 02-838 8919
A.C.N. 003 614 695
NATA Reg. 1884

ANALYTICAL REPORT for:

AGC WOODWARD-CLYDE

6/486-494 PACIFIC HIGHWAY
ST LEONARDS 2065

ATTN: ANDREW HELMS

JOB NO:	SAL1817
CLIENT ORDER:	3397
DATE RECEIVED:	26/07/93
DATE COMPLETED:	30/07/93
TYPE OF SAMPLES:	WATERS
NO OF SAMPLES:	5

Issued on 02/08/93
Lance Smith
(Chief Chemist)

SYDNEY ANALYTICAL LABORATORIES

ANALYTICAL REPORT

JOB NO: SAL1817
CLIENT ORDER: 3397

DATE OF COLLECTION		23/07/93	23/07/93	23/07/93	23/07/93	23/07/93
SAMPLES		MON W1	MON W2	MON W3	MON W4	POND
pH		6.8	6.7	6.9	6.8	8.3
Conductivity	uS/cm	5700	9290	3720	5560	4870
Total Dissolved Solids	mg/L	3580	6350	2500	3690	2760
Colour	HAZEN	12	13	12	11	12
Turbidity	NTU	700	45	40	490	2.1
Chloride Cl-	mg/L	1570	3130	1000	1590	1040
Bicarbonate HCO3-	mg/L	600	590	590	640	260
Nitrate NO3-	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Phosphate PO4---	mg/L	<0.1	<0.1	0.25	<0.1	<0.1
Sulphate SO4--	mg/L	420	640	260	420	620
Sodium Na+	mg/L	1100	1900	800	1180	660
Potassium K+	mg/L	21	24	20	21	22
Calcium Ca++	mg/L	62	120	78	71	160
Magnesium Mg++	mg/L	102	240	46	94	120
Copper	mg/L	0.01	0.01	<0.01	0.01	<0.01
Lead	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	mg/L	0.02	0.03	<0.01	0.03	<0.01
Iron	mg/L	0.06	2.6	0.46	0.24	0.16
Manganese	mg/L	0.66	0.60	0.09	0.61	0.02
Arsenic	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Mercury	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

SYDNEY
ANALYTICAL
LABORATORIES

ANALYTICAL REPORT

JOB NO: SAL1817
CLIENT ORDER: 3397

METHOD OF PREPARATIONS AND ANALYSIS USED

The tests contained in this report have been carried out on the samples as received by the laboratory, in accordance with the APHA standard methods 17th Edition, or other approved methods listed below:

4500HB	pH
2510	Conductivity
2540C	Total Dissolved Solids
2120B	Colour
2130	Turbidity
4500D	Chloride Cl-
2320B	Bicarbonate HCO3-
4500C	Nitrate NO3-
4500E	Phosphate PO4---
4500B	Sulphate SO4--
3111B	Sodium Na+
3111B	Potassium K+
3111B	Calcium Ca++
3111B	Magnesium Mg++
3111B	Copper
3111B	Lead
3111B	Zinc
3111B	Iron
3111B	Manganese
3114B	Arsenic
3112B	Mercury

JOB NUMBER	3397					
DESCRIPTION		Groundwater and pond water samples, 23/07/93				
SAMPLE	MonW1	MonW2	MonW3	MonW4*	Pond	SEA WATER
EC µS/cm	5700	9290	3720	5560	4870	
pH	6.8	6.7	6.9	6.8	8.3	
TDS calc mg/l	3580	6350	2500	3690	2760	
mg/L						
Na	1100	1900	800	1180	660	10500
Ca	62	120	78	71	160	410
Mg	102	240	46	94	120	1350
K	21	24	20	21	22	390
NH4						
Cl	1570	3130	1000	1590	1040	19000
SO4	420	640	260	420	620	2700
HCO3	600	590	590	640	260	142
CO3						
NO3						
TDS summation	3875	6644	2794	4016	2882	34492
meq/L						
Na	47.83	82.61	34.78	51.31	28.70	456.54
Ca	3.09	5.99	3.89	3.54	7.99	20.46
Mg	8.39	19.74	3.78	7.73	9.87	111.02
K	0.54	0.61	0.51	0.54	0.56	9.98
NH4	0.00	0.00	0.00	0.00	0.00	0.00
Sum cation	59.85	108.95	42.97	63.12	47.11	598.00
Cl	44.27	88.27	28.20	44.84	29.33	535.80
SO4	8.74	13.32	5.41	8.74	12.91	56.21
HCO3	9.83	9.67	9.67	10.49	4.26	2.33
CO3	0.00	0.00	0.00	0.00	0.00	0.00
NO3	0.00	0.00	0.00	0.00	0.00	0.00
Sum anions	62.85	111.26	43.28	64.07	46.50	594.34
Sum cat an	122.70	220.21	86.25	127.19	93.61	1192.34
Cations-anions	-3.00	-2.31	-0.31	-0.95	0.62	3.66
% diff	-2.45	-1.05	-0.36	-0.75	0.66	0.31
Percent Distribution						
Na	79.92	75.82	80.95	81.29	60.91	76.34
Ca	5.17	5.50	9.06	5.61	16.95	3.42
Mg	14.02	18.12	8.80	12.25	20.95	18.57
K	0.90	0.56	1.19	0.85	1.19	1.67
NH4	0.00	0.00	0.00	0.00	0.00	0.00
Cl	70.44	79.33	65.15	69.98	63.07	90.15
SO4	13.91	11.98	12.51	13.65	27.76	9.46
HCO3	15.65	8.69	22.34	16.37	9.16	0.39
CO3	0.00	0.00	0.00	0.00	0.00	0.00
NO3	0.00	0.00	0.00	0.00	0.00	0.00
* Duplicate sample of MonW1						

APPENDIX H
HERITAGE

(i) NPWS - Search of Aboriginal Sites Register
(ii) Maitland LEP - Heritage Listing

NATIONAL PARKS AND WILDLIFE SERVICE - SEARCH OF ABORIGINAL SITES REGISTER

Minark Report Page 1 Printed 11Dec96 11:26

Site Number	Location and Sitename	Amg E	Amg N	Date Recorded	Recorder	Assoc Report	Sitetype
38-4-0362	Tenambit	369290	6375200	20JAN1995	Ruig, J. L.	?	Isolated find
38-4-0363	Tenambit_2	369780	6375250	20JAN1995	Ruig, J. L.	?	Isolated find
38-4-0364	Tenambit 3	369880	6375220	20JAN1995	Ruig, J.L.		Isolated find

Number of sites in printout: 3
£ of sites excluded by security rating: 0

Output completed: 11Dec96 11:26

Metford
****

MINARK D.B.M.S. V4.12

Database name: Z56
This retrieval performed: 11Dec96 11:25
Data last updated: 15Oct96 13:40
Total sites in database with data: 18128
£ of sites excluded by security rating: 0

Subset name: TEMP £ of sites in subset: 3

Selection criteria:
All sites selected

[✓] New recording [ ] Additional In

National Parks and Wildlife Service

Box 1967, Hurstville NSW 2220. Tel: (02) 585 6444

Standard Site Recording Form ~~Revised 1/88~~ Revised 12/92

1:250,000 map sheet: NEWCASTLE — NPWS Code: 38

	250K		250K	
AMG Grid reference (Full reference - please include leading digits)	369290	mE	6375200	mN
	25K		5/6 25K	

Scale of map used for grid reference (Please use largest scale available): [✓] 25K, 50K (preferred) [ ] 100K [ ] 250K

1:25K, 50K, 100K map name: BERESFIELD 9232-3-N (2nd ed)

HEAD OFFICE USE ONLY:

NPWS Site no: 38-4-362

Site types: Isolated FIND.

Accessioned by: ______ Date: ______

Data entered by: BK Date: 28 JAN 9

~~Owner~~/Manager: DEPT. C.A.L.M.

Address: P.O. Box 42k East Maitland 2323

Site name: TENAMBIT 1

Locality/property name: TENAMBIT RECREATIONAL RESERVE

NPWS District: HUNTER. Region: CENTRAL.

Reason for investigation: Archaeological study needed for inclusion in a Development Application to be lodged with Maitland City Council.

~~Portion no~~: CROWN RESERVE: R89147

Parish: MAITLAND.

COUNTY: NORTHUMBERLAN

Photos taken? YES

How many attached? REFER REPORT

How to get to the site (refer to permanent features, give best approach to site eg. from above, below, along cliff. (Draw diagram on separate sheet.)

From Metford proceed along Metford-Morpeth Road northwards – over rail line, through roundabout – cross small creek – approx 30m north – through fence on east – approx 25m east.

Other sites in locality? YES

Are sites in NPWS Register? YES. (61 in 400 sq kms)

Site Types include: OPEN CAMPSITES, ISOLATED FI, SCARRED TREES, MISSIONS, BURIA

Have artefacts been removed from site? No. When? N/A.

By whom? N/A Deposited where? N/A.

Is site important to local Aborigines? Low Significance.

Give contact(s) name(s) + address(es): MINDARIBBA LOCAL ABORIGINAL LAN COUNCIL. P.O. BOX 453. MAITLAND, 2320.

Contacted for this recording? YES.

(Attach additional information separately) If not, why not?

Verbal/written reference sources (including full title of accompanying report). RESULTS OF AN ARCHAEOLOGICAL SURVEY FOR THE IDENTIFICATION OF ABORIGINAL OCCUPATIONAL SITES WITHIN THE TENAMBIT WETLANDS PROJECT AREA, TENAMBIT, VIA MAITLAND NSW.

NPWS Report Catalogue #:

Checklist: surface visibility, damage/disturbance/ threat to site

Condition of site: DISTURBED – RISING MAIN ROUTE.

SURFACE VIS: LOW: 5-10% EXPOSED AR 6x3 m².

Recommendations for management & protection (attach separate sheet if necessary):

That test excavations be undertaken due to low surface vis, high arch. sensitivity environmental zon

Site recorded by: Jill L. Ruig. Date: 20.01.1995.

Address/institution: 30 Simpson Terrace. [illegible] 2320 NSW.

J. L. Ruig.

SITE POSITION & ENVIRONMENT | OFFICE USE ONLY: NPWS site no:

1. Land form a. beach/hill slope/ridge top, etc: Gentle slope to Swamp. b. site aspect: Nthly. c. slope: < 5°

d. mark on diagram provided *or* on your own sketch the position of the site:

e. Describe briefly: Site < 10m ASL Swampland heavily degraded.

f. Local rock type: Permian Tomago Coal Measures (Tuff, shale, coal, mudstone). g. Land use/effect: Dog Pound & Grazing.

2. Distance from drinking water: Adjacent. Source: Swamplands & Creekline.

3. Resource Zone associated with site (estuarine, riverine, forest etc): Swampland.

4. Vegetation: Eucalypts spp., Melaleuca spp. (Common reeds) Juncus spp. Grasses.

5. Edible plants noted: Typha sp. Eucalypts (lerp)

6. Faunal resources (include shellfish): Possibly shellfish - freshwater mussels. (NONE NOTED) Avian fauna.

7. Other exploitable resources (river pebbles, ochre, etc):

Site type: Isolated Find.

CHECKLIST TO HELP: length, width, depth, height of site, shelter, deposit, structure, element eg. tree scar, grooves in rock.

DEPOSIT: colour, texture, estimated depth, stratigraphy, contents-shell, bone, stone, charcoal, density & distribution of these, stone types, artefact types.

ART: area of surface decorated, motifs, colours, wet, dry pigment, technique of engraving, no. of figures, sizes, patination.

BURIALS: number & condition of bone, position, age, sex, associated artefacts.

TREES: number, alive, dead, likely age, scar shape, position, size, patterns, axe marks, regrowth.

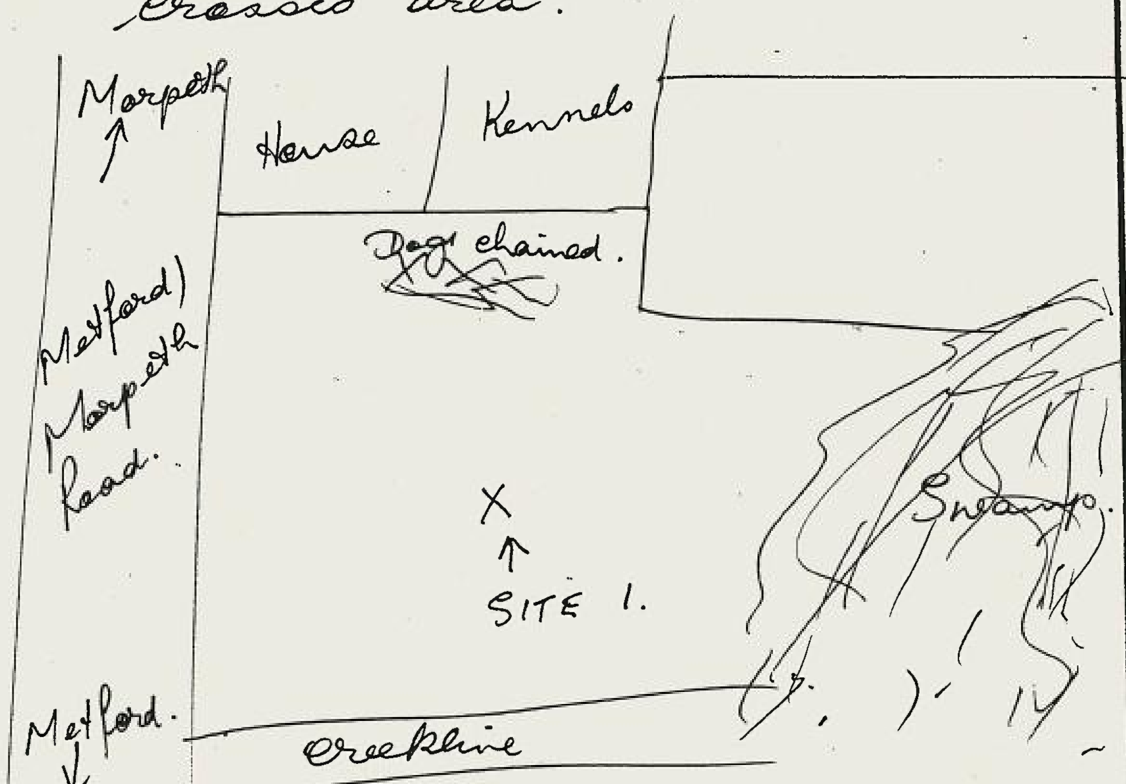
QUARRIES: rock type, debris, recognisable artefacts, percentage quarried.

OTHER SITES EG. structures (fish traps, stone arrangements, bora rings, mia mias), mythological sites, rock holes, engraved groove channels, contact sites (missions massacres cemeteries) as appropriate

DESCRIPTION OF SITE & CONTENTS.
Note state of preservation of site & contents. Do NOT dig, disturb, damage site or contents.

1. Flake - broken - 20 × 7 × 4 mm
No retouch, Broad Platform, No cortex, Transverse snap.

Site disturbed - rising main crosses area.



Attach sketches etc. eg. plan & section of shelter., show relation between site contents, indicate north, show scale.
Attach annotated photos (stereo where useful) showing scale, particularly for art sites.

[✓] New recording [ ] Additional Inf

National Parks and Wildlife Service
Box 1967, Hurstville NSW 2220. Tel: (02) 585 6444
Standard Site Recording Form ~~xxxxxxxxxx~~ Revised 12/92

1:250,000 map sheet: NEWCASTLE NPWS Code 38

AMG Grid reference (Full reference - please include leading digits): 369780 mE 6375250 mN

Scale of map used for grid reference (Please use largest scale available): [✓] 25K, 50K (preferred) [ ] 100K [ ] 250K

1:25K 50K, 100K map name: BERESFIELD 9232-3-N (2nd ed)

HEAD OFFICE USE ONLY:
NPWS Site no: 38-4-363
Site types: Isolated FIND.
Accessioned by: [illegible] Date: 28/2/[illegible]
Data entered by: Date:

~~Owner~~/Manager: DEPT. C.A.L.M.
Address: P.O. BOX 424 EAST MAITLAN 2320

Site name: TENAMBIT 2.
Locality/property name: TENAMBIT RECREATIONAL RESERVE.
NPWS District: HUNTER
Region: CENTRAL.

Reason for investigation: Archaeological study needed for inclusion in a Development Application to be lodged with Maitland City Council.

~~Portion no~~: CROWN RESERVE: R89147
Parish: MAITLAND
County: NORTHUMBERLAN

Photos taken? Yes.
How many attached? Refer Report.

How to get to the site (refer to permanent features, give best approach to site eg. from above, below, along cliff. (Draw diagram on separate sheet.)
Proceed from Metford northwards along Metford, Morpeth Road, cross rail line, through roundabout - stop at 1st house on eastern side - approx 25m from last bldg structure on east.

Other sites in locality? YES
Are sites in NPWS Register? YES (61 in 400 sq km)
Site Types include: Open campsites, Mission Isol. Finds, Burials Scarred Trees.

Have artefacts been removed from site? NO
When? N/A
By whom? N/A
Deposited where? N/A.

Is site important to local Aborigines? Some Significance.
Give contact(s) name(s) + address(es). MINDARIBBA L.A.L.C. P.O. BOX 453, MAITLAND, 2320.
Contacted for this recording? YES.
(Attach additional information separately) If not, why not?

Verbal/written reference sources (including full title of accompanying report). Results of an Archaeological Survey for the Identification of Aboriginal Occupational Sites within the Tenambit Wetland's Project Area, Tenambit, Via Maitland, N.S.W.

NPWS Report Catalogue #

Checklist: surface visibility, damage/disturbance/ threat to site

Condition of site: DISTURBED - SURFACE VIS: LOW: 10% EXPOSED AREA 20 x 1m = 20 sq.m

Recommendations for management & protection (attach separate sheet if necessary):
That test excavations be undertaken due to low vis, high arch. sensitivity of landform.

Site recorded by:
Address/institution:
JILL L. RUIG
30 Simpson Terrace
Singleton. 2330
Ph. (065) 72 4343

Date: 20.01.1995.

J. L. Ruig

SITE POSITION & ENVIRONMENT | OFFICE USE ONLY: NPWS site no:

1. Land form a. beach/hill slope/ridge top, etc: slope b. site aspect: Nthly. c. slope: <5°

d. mark on diagram provided *or* on your own sketch the position of the site:

e. Describe briefly: Site < 10m ASL. Swampland heavily degraded.

f. Local rock type: Permian Tomago Coal Measures/Tuff, shale, Mudstone (+ coal). g. Land use/effect: Dog Pound + Grazing.

2. Distance from drinking water: 50m. Source: Swamp.

3. Resource Zone associated with site (estuarine, riverine, forest etc): Swampland.

4. Vegetation: Typha spp. , Eucalyptus spp (lerp). Grasses, Juncus spp. Melaleuca spp.

5. Edible plants noted: Typha spp Eucalyptus spp (lerp).

6. Faunal resources (include shellfish): Possibly freshwater mussels (NONE NOTED) Avian Fauna

7. Other exploitable resources (river pebbles, ochre, etc):

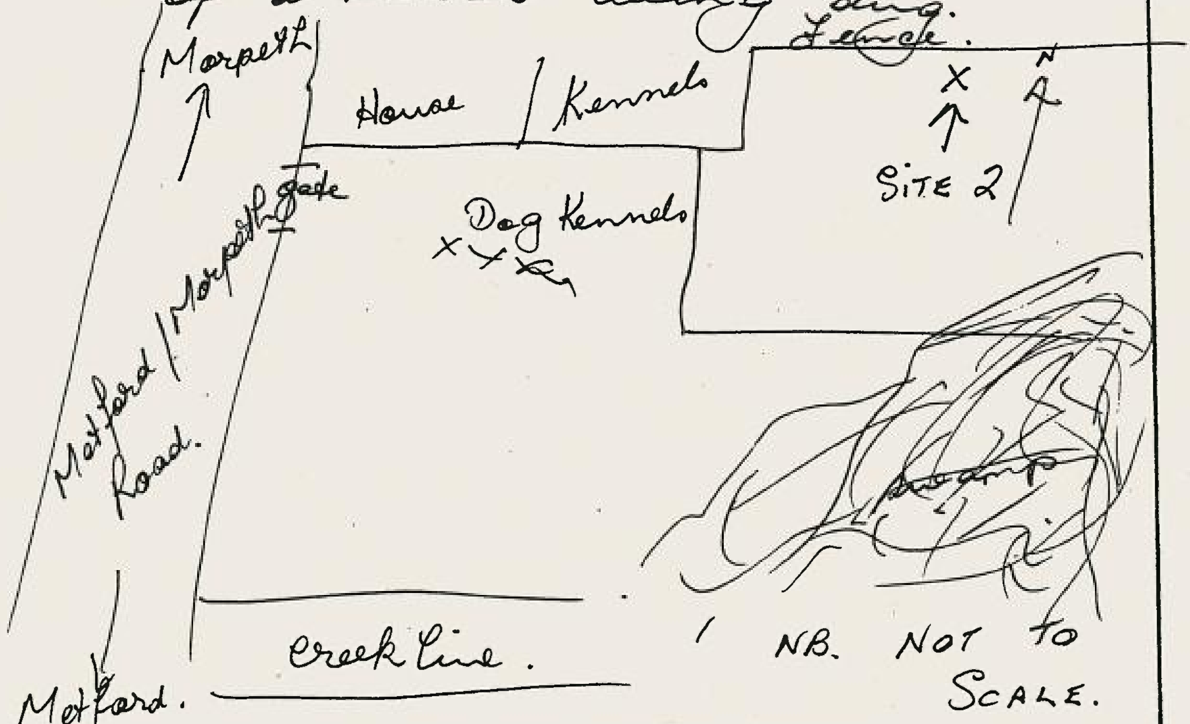
Site type: Isolated Find.

CHECKLIST TO HELP: length, width, depth, height of site, shelter, deposit, structure, element eg. tree scar, grooves in rock.
DEPOSIT: colour, texture, estimated depth, stratigraphy, contents-shell, bone, stone, charcoal, density & distribution of these, stone types, artefact types.
ART: area of surface decorated, motifs, colours, wet, dry pigment, technique of engraving, no. of figures, sizes, patination.
BURIALS: number & condition of bone, position, age, sex, associated artefacts.
TREES: number, alive, dead, likely age, scar shape, position, size, patterns, axe marks, regrowth.
QUARRIES: rock type, debris, recognisable artefacts, percentage quarried.
OTHER SITES EG. structures (fish traps, stone arrangements, bora rings, mia mias), mythological sites, rock holes, engraved groove channels, contact sites (missions massacres cemeteries) as appropriate

DESCRIPTION OF SITE & CONTENTS.
Note state of preservation of site & contents. Do NOT dig, disturb, damage site or contents.

1. Flake, broken, 21 x 20 x 8 mm. No retouch, Broad Platform. No cortex, Transverse snap.

Site disturbed - ridge of soil - mounded (slight) - possibly result of a trench being dug.



Attach sketches etc. eg. plan & section of shelter, show relation between site contents, indicate north, show scale.
Attach annotated photos (stereo where useful) showing scale, particularly for art sites.

[✓] New recording [ ] Additional Info

National Parks and Wildlife Service

Box 1967, Hurstville NSW 2220. Tel: (02) 585 6444

Standard Site Recording Form ~~xxxxxxxxx~~ Revised 12/92

1:250,000 map sheet: NEWCASTLE NPWS Code 38

AMG Grid reference (Full reference - please include leading digits): 369880 mE 6375220 mN

Scale of map used for grid reference (Please use largest scale available): [✓] 25K, 50K (preferred) [ ] 100K [ ] 250K

1:25K, 50K, 100K map name: BERESFIELD 9232-3-N

HEAD OFFICE USE ONLY:
NPWS Site no: 38-4-364
Site types: ISOLATED FIND.
Accessioned by: 89 Date: 28 FEB 95
Data entered by: Date:

~~Owner~~/Manager: Dept. C.A.L.M.
Address: P.O. Box 424, MAITLAND 2323.

Site name: TENAMBIT 3. Locality/property name: TENAMBIT REGREATIONAL RESERVE.

NPWS District: HUNTER. Region: CENTRAL.

Reason for investigation: Archaeological study required for inclusion within a Development Application to be lodged with Maitland City Council

~~Portion no~~: CROWN RESERVE: R89147.
Parish: MAITLAND.
County: NORTHUMBERLAND
Photos taken? YES.
How many attached? REFER REPORT.

How to get to the site (refer to permanent features, give best approach to site eg. from above, below, along cliff. (Draw diagram on separate sheet.)
Proceed from Metford along (northwards) Metford/Morpeth Road - over rail line - through roundabout - just before 1st house there's a gate (east side) - site near ~~a large tree where fenceline~~ corner approx 30 m sth east of gate.

Other sites in locality? YES (61 in 400 sq kms)
Are sites in NPWS Register? YES
Site Types include: open campsites, burials, missions, isol. finds, scarred trees.

Have artefacts been removed from site? NO. When? N/A.
By whom? N/A. Deposited where? N/A.

Is site important to local Aborigines? Low Significance.
Give contact(s) name(s) + address(es): MINDARIBBA L.A.L.C. P.O. Box 453, MAITLAND 2320.
Contacted for this recording? YES.
(Attach additional information separately) If not, why not?

Verbal/written reference sources (including full title of accompanying report): Results of an Archaeological Survey for the Identification of Aboriginal Occupational Sites Within the Tenambit Wetlands Project Area, Tenambit, Via Maitland, N.S.W.
NPWS Report Catalogue #

Checklist: surface visibility, damage/disturbance/ threat to site
Condition of site: DISTURBED.
SURFACE VIS: HIGH: 80%
EXPOSED AREA. 3x1 m = 3 sq.m.

Recommendations for management & protection (attach separate sheet if necessary):
That test excavations be undertaken - vis < 80% on exposure. high arch sensitivity this landform

Site recorded by:
Address/institution:
JILL L. RUIG
30 Simpson Terrace
Singleton. 2330
Ph. (065) 72 4343

Date: 20.01.1995.

Jill L. Ruig.

SITE POSITION & ENVIRONMENT

OFFICE USE ONLY: NPWS site no:

1. Land form a. beach/hill slope/ridge top, etc: slope. b. site aspect: nthly. c. slope: < 5°

d. mark on diagram provided *or* on your own sketch the position of the site:

e. Describe briefly: Site < 10 m ASL Swampland heavily degraded.

f. Local rock type: Permian Tomago Coal Measures (Tuff, shale, Mudstone + Coal). g. Land use/effect: Dog Pound + Grazing.

2. Distance from drinking water: 50 m. Source: Creekline (1st order).

3. Resource Zone associated with site (estuarine, riverine, forest etc): Swampland.

4. Vegetation: Typha spp. Eucalyptus spp. Grasses, Juncus spp. Melaleuca spp.

5. Edible plants noted: Typha spp. Eucalyptus spp. (lerp)

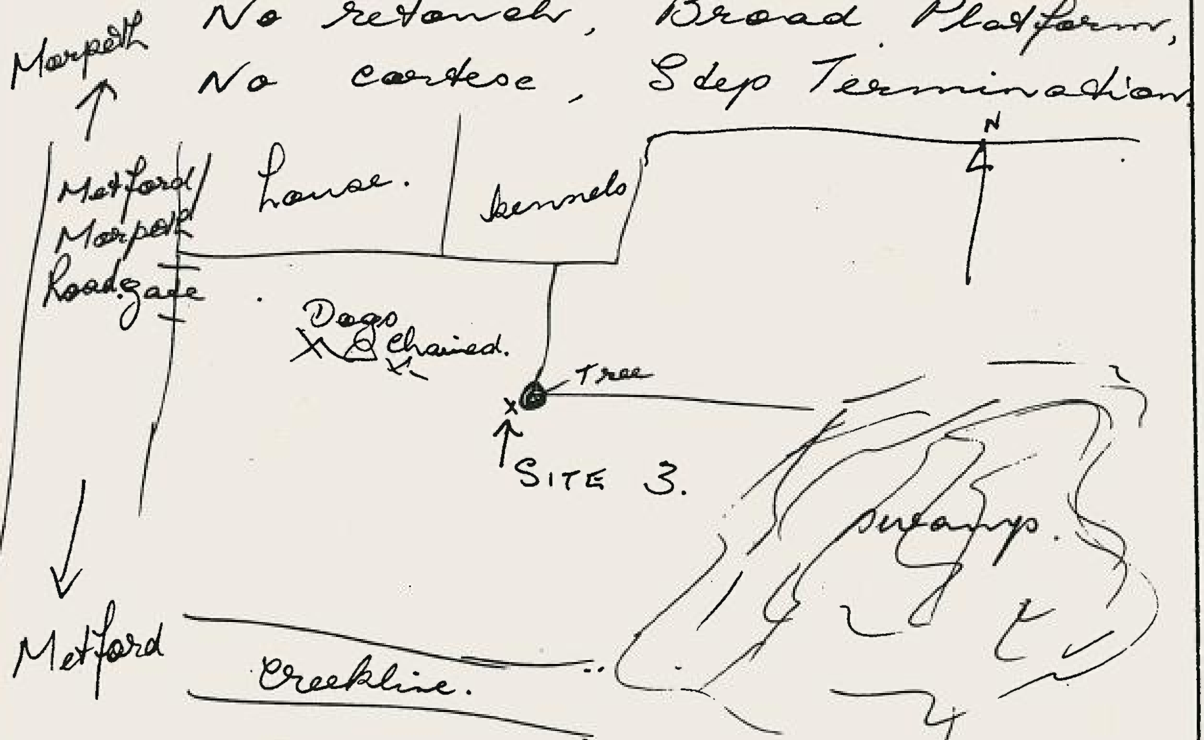
6. Faunal resources (include shellfish): Possibly freshwater mussels (none noted)

7. Other exploitable resources (river pebbles, ochre, etc): Avian Fauna.

Site type: Isolated Find.

DESCRIPTION OF SITE & CONTENTS.
Note state of preservation of site & contents. Do **NOT** dig, disturb, damage site or contents.

1. Flake, mudstone, 33 x 29 x 7 mm No retouch, Broad Platform, No cortex, Step Termination



NB. NOT TO SCALE

CHECKLIST TO HELP: length, width, depth, height of site, shelter, deposit, structure, element eg. tree scar, grooves in rock.
DEPOSIT: colour, texture, estimated depth, stratigraphy, contents-shell, bone, stone, charcoal, density & distribution of these, stone types, artefact types.
; area of surface decorated, motifs, colours, wet, dry pigment, technique of engraving, no. of figures, sizes, patination.
BURIALS: number & condition of bone, position, age, sex, associated artefacts.
TREES: number, alive, dead, likely age, scar shape, position, size, patterns, axe marks, regrowth.
QUARRIES: rock type, debris, recognisable artefacts, percentage quarried.
OTHER SITES EG. structures (fish traps, stone arrangements, bora rings, mia mias), mythological sites, rock holes, engraved groove channels, contact sites (missions massacres cemeteries) as appropriate

Attach sketches etc, eg. plan & section of shelter, show relation between site contents, indicate north, show scale.
Attach annotated photos (stereo where useful) showing scale, particularly for art sites.

SCHEDULE 1

HERITAGE CONSERVATION AREAS **Clause 31**

Column 1 **Description of heritage conservation area**	Column 2 **Manner shown on heritage map**
Central Maitland Heritage Conservation Area	Shown by black edging and lettered *Central Maitland Heritage Conservation Area*
Lorn Heritage Conservation Area	Shown by black edging and lettered *Lorn Heritage Conservation Area*
East Maitland Heritage Conservation Area	Shown by black edging and lettered *East Maitland Heritage Conservation Area*
Morpeth Heritage Conservation Area	Shown by black edging and lettered *Morpeth Heritage Conservation Area*
Bolwarra Heritage Conservation Area	Shown by black edging and lettered *Bolwarra Heritage Conservation Area*
Regent Street Heritage Conservation Area	Shown by black edging and lettered *Regent Street Heritage Conservation Area*

SCHEDULE 2

HERITAGE ITEMS **Clause 31**

Column 1 **Description of Heritage Item**		Column 2 **Significance**	Column 3 **Manner lettered on Heritage map**	
ABERGLASSLYN				
Aberglasslyn Lane	Aberglasslyn House(1860)	State	No 1	Sheet 3
Aberglasslyn Road	Aberglasslyn Cottage	Local	No 2	Sheet 3
BISHOPS BRIDGE				
Ravensfield Road	Stone Quarry(Brown's)	Regional	No 3	Sheet 1
BOLWARRA				
Addison & Westbourne Rds	War Memorial	Local	No 4	Sheet 8
Bayswater Road	*Bolwarra House*	Local	No 5	Sheet 8
Kensington Road 59	*Gowan Brae*	Regional	No 6	Sheet 8
Kensington Road 34	Bolwarra Stone Barn	Regional	No 7	Sheet 8
Paterson Road 4	Residence	Local	No 8	Sheet 8
Paterson Road 6	Residence	Local	No 9	Sheet 8
Paterson Road 8	Residence	Local	No 10	Sheet 8
Westbourne Avenue 2	*Dareel*	Local	No 11	Sheet 8
Westbourne Avenue 11	*Virginia House*	Local	No 12	Sheet 8
Westbourne Avenue 20	*Shenstone*	Local	No 13	Sheet 8
DUCKENFIELD				
Duckenfield Road	Berry Park	Regional	No 14	Sheet 18
Duckenfield Road	Berry House	Regional	No 15	Sheet 18
Off Duckenfield Road	Duckenfield House Remains	Local	No 16	Sheet 18
Edithville Rd/Martins Wharf Rd	Hedge Rows	Local	No 17	Sheet 18
EAST MAITLAND				
Banks Street 14	Former Cottage of Content Inn	Regional	No 18	Sheet 13
Banks Street 18	Literary Institute	Regional	No 19	Sheet 13
Banks Street 36	Mathew Talbot Hostel	Regional	No 20	Sheet 13
Banks Street 40	Red Lion Inn	Regional	No 21	Sheet 13
Banks Street 49/51	Residential Row	Local	No 22	Sheet 12
Banks Street	St. Peter's Rectory	Regional	No 23	Sheets 12,14
Banks Street 67	Georgian House	Local	No 24	Sheet 12
Banks & William Streets	St. Peter's Church Group	State	No 25	Sheets 12,14
Burg Street 57a	House	Local	No 26	Sheets 14,15

Brunswick Street 55	House	Local	No 27	Sheet 15
Cumberland/John Lindsay Streets	Courthouse	State	No 28	Sheet 13
Cumberland/John Lindsay Streets	Former Police Cottage and Lockup	State	No 29	Sheet 13
Cumberland/John Lindsay Streets	Police Barracks	State	No 30	Sheet 13
Cumberland/John Lindsay Streets	Former Police Station	State	No 31	Sheet 13
Cumberland/John Lindsay Streets	Gaol	State	No 32	Sheet 13
Cumberland/John Lindsay Streets	Sergeants Residence	State	No 33	Sheet 13
Cumberland/John Lindsay Streets	Outbuildings & Stables	State	No 34	Sheet 13
Cumberland/John Lindsay Streets	Parklands	State	No 35	Sheet 13
Day Street 20	Former Post Office	State	No 36	Sheet 13
Day Street 9	*Roseneath*	Regional	No 37	Sheet 13
Elizabeth Street 1	House	Local	No 38	Sheet 13
Fitzroy Street 23	Former Manse	Local	No 39	Sheet 12
George Street 40	House	Local	No 234	Sheet 13
George Street 121	House	Local	No 40	Sheet 15
Off George Street	Burial Ground *Gleve Gully*	State	No 41	Sheet 14
High Street 35/45	Houses	Local	No 233	Sheet 13
High Street 58	House	Local	No 42	Sheets 13,15
High Street 60	House	Local	No 43	Sheets 13,15
High Street 62	House	Local	No 44	Sheets 13,15
High Street 64	House	Local	No 45	Sheets 13,15
High Street 66	House	Local	No 46	Sheets 13,15
High Street 74	House	Local	No 47	Sheet 15
High Street 80	House	Local	No 48	Sheet 15
High Street 82	House	Local	No 49	Sheet 15
High Street 84	House	Local	No 50	Sheet 15
High/Hunter Streets	Former High School Group	Regional	No 51	Sheet 13
Hiland Cresent	Cemetery	Regional	No 52	Sheet 13
John Street 26/28	House	Local	No 53	Sheet 13
King Street 34/40	Terraces	State	No 54	Sheets 13,15
King Street 42/44	*Goonnoobah & Woodlands*	State	No 55	Sheets 13,15
King Street 43	House	Local	No 56	Sheets 13,15
King Street 45	House	Local	No 57	Sheets 13,15
King Street 46/48	House	Local	No 58	Sheet 15
King Street 49	House	Local	No 59	Sheets 13,15
King Street 50	*Villa Maria*	Local	No 60	Sheet 15
King Street 51	House	Local	No 61	Sheets 13,15
King Street 53	House	Local	No 62	Sheets 13,15
King/Newcastle Road	St. Josephs Church	Local	No 63	Sheet 14
Lawes & William Streets	*Joss House*	Local	No 64	Sheet 13
Lawes & Melbourne Streets	Former Hotel & Stables	Regional	No 65	Sheet 13
Lindsay Street 18/20	*Nenagh*	Local	No 66	Sheet 13
Lindsay Street 42	House	Local	No 67	Sheet 13
Melbourne Street	Former A J S Bank	Regional	No 68	Sheet 12
Melbourne Street	George & Dragon Hotel	Local	No 69	Sheet 13
Melbourne Street 82	Shop	Local	No 70	Sheets 12,13
Melbourne Street 84	Shop	Local	No 71	Sheets 12,13
Mill Street 3	Fm Charoline Chisholm Barracks	State	No 72	Sheet 12
Morpeth Road 18	*Hillside*	Local	No 73	Sheet 13
Nerang Street 67	House	Local	No 74	Sheet 13
Newcastle Road	Former Smith's Flour Mill	State	No 75	Sheet 12
Newcastle Road	Lands Office	Regional	No 76	Sheet 12
Newcastle Road	Public School	Regional	No 77	Sheet 13
Newcastle Road	*Englefield*	Local	No 78	Sheet 12
Newcastle Road 46	Former Rose Inn	Local	No 79	Sheet 12
Newcastle Road 64	Hanks House	Local	No 80	Sheet 12
Pitnacree Road 3	*Ekelene*	Local	No 81	Sheet 13
Pitnacree Road 7	Timber House	Local	No 82	Sheet 13
Pitnacree Road 38	House	Local	No 83	Sheet 13
Pitnacree Road	Pender & Forster Sawmill	Local	No 84	Sheet 13

Raymond Terrace Road 55	House	Local	No 85 Sheet 15
Rous Street 40/42	House	Local	No 86 Sheet 14
Victoria Street 86	Two Storey Residence	Local	No.235 Sheet 15
Victoria Street 88	Two Storey Residence	Local	No.236 Sheet 15
Wallis Street 12	*Oldholme*	State	No 87 Sheet 14
FARLEY			
Owlpen Lane 60	*Owlpen*	Local	No 88 Sheet 1
GOSFORTH			
Anambah Road	*Anambah House*	State	No 89 Sheet 1,3
LARGS			
John Street 7/9	Fm.Catholic Sch &Presbytery	Local	No 90 Sheet 7
Morpeth Road	Largs Public School	Regional	No 91 Sheet 7
LOCHINVAR			
Cantwell Road	*Victoria House*	Local	No 92 Sheet 2
New England Highway	*Kaludah*	Regional	No 93 Sheet 1
New England Highway	*St Helena* Cottage	Regional	No 94 Sheets 1,2
New England Highway	Holy Trinity Church	Regional	No 95 Sheet 2
New England Highway	Catholic Cemetery	Regional	No 96 Sheet 2
New England Highway	*Windermere*	Regional	No 97 Sheet 2
Railway Lane	Police Station	Local	No 98 Sheet 2
Station Lane	*Clifton*	Local	No 99 Sheet 1
LORN			
Belmore Road 38	Two Storey Brick House	Local	No 100 Sheet 9
Belmore Road 42	*Rosecliffe*	Local	No 101 Sheet 9
Belmore Road 54	Brick House	Local	No 102 Sheet 9
Belmore Road 68	*Nameerah*	Local	No 103 Sheet 9
Belmore Road 72	*Niara*	Local	No 104 Sheet 9
Belmore Road 92	*Warrane* and Grounds	Local	No 105 Sheet 9
Brisbane Street 6	House	Local	No 106 Sheet 9
Nillo Street 14	*Nillo House*	Local	No 107 Sheet 9
Roxburgh Street 33	*Ingleburn*	Local	No 108 Sheet 9
Roy Street 5/5A	*Lorn House*	Regional	No 109 Sheet 9
LOUTH PARK			
Louth Park Road	Jewish Cemetery	Regional	No 110 Sheet 11
LUSKINTYRE			
Hunter River	Luskintyre Bridge	Regional	No 111 Sheet 1
MAITLAND			
Various locations	Government Railway	Regional	No 112 Sheets 1,3,5, 6,10/13,15,18
Ballard Street 16	*The Hermitage*	Local	No 113 Sheet 10
Bloomfield Street	Brick Cottage (with timber Annex)	Local	No 114 Sheet 11
Bourke Street 28	House	Regional	No 115 Sheet 10
Bourke Street 30/32	House	Regional	No 116 Sheet 10
Bourke Street 40	House	Regional	No 117 Sheet 10
Bourke Street 41	House	Regional	No 118 Sheet 10
Bourke Street 51	House	Regional	No 119 Sheet 10
Bourke Street 60	House	Regional	No 120 Sheet 10
Bourke Street 81	House	Regional	No 121 Sheet 10
Bourke Street	Grand Central Hotel	Regional	No 122 Sheet 10
Bulwer Street 41	Brick Cottage	Local	No 123 Sheet 10
Bulwer Street 50	Brick Cottage	Local	No 124 Sheet 10
Carrington Street 43-49	Terrace	Local	No 125 Sheet 10
Carrington Street 78/80	Villa *Lemarne* (c.1856)	Local	No 126 Sheet 10
Carrington Street 85	Georgian House	Local	No 127 Sheet 10
Carrington Street 111	Two Storey House	Local	No 128 Sheet 10

Cathedral Street	Former St. Johns Cathedral	State	No 129 Sheet 10
Cathedral Street	Bishops Residence	Regional	No 130 Sheet 10
Church/Banfield Streets	Former Jewish Synagogue	State	No 131 Sheet 10
Church Street	St. Mary's Church & Rectory	State	No 132 Sheet 10
Church Street	Grand Junction Hotel	Regional	No 133 Sheet 10
Church Street	*Brough House*	Regional	No 134 Sheet 10
Church Street	*Grossman House*	Regional	No 135 Sheet 10
Church Street	Maitland Public School	Local	No 136 Sheet 10
Cross & Devonshire Street	St. Paul's Church Group	Regional	No 137 Sheet 11
Cross Street 15	*Rose Mary*	Local	No 138 Sheet 11
Devonshire Street 26-30	Brick Terrace	Local	No 139 Sheet 10
Elgin Street 18/22	Offices	Local	No 140 Sheet 10
Elgin Street 43	Former Hotel	Local	No 141 Sheet 10
Elgin Street 45A & 45B	Shops	Local	No 142 Sheet 10
Elgin Street 71	*Somerset*	Local	No 143 Sheet 10
Elgin Street 87	*St. Elmo*	Local	No 144 Sheet 10
Free Church Street	Presbyterian Church Group	Regional	No 145 Sheet 10
Hannan Street 13	Georgian House	Local	No 146 Sheet 9
Hannan Street 14	*Hannan House*	Local	No 147 Sheet 9
High Street 1 & 3	Wallis House Group	State	No 148 Sheet 12
High Street	Maitland Town Hall	State	No 149 Sheet 10
High Street	Technical College	State	No 150 Sheet 10
High Street 48	Georgian Cottage	Local	No 151 Sheet 12
High Street 226	Former Cohens Warehouse Facade	Regional	No 152 Sheet 10
High Street	St John's Pro Cathedral	Local	No 153 Sheet 10
High Street 303	McLaughlins Bakery	Local	No 154 Sheet 10
High Street 315	NAB Bank	State	No 155 Sheet 10
High Street	Former A J S Bank	Regional	No 156 Sheet 10
High Street	Maitland Mercury	Regional	No 157 Sheet 10
High Street 349/351	Methodist Church	Regional	No 158 Sheet 10
High Street	Post Office	Regional	No 159 Sheet 10
High Street	Former Congregational Church	Regional	No 160 Sheet 10
High Street 437	A N Z Bank	Regional	No 161 Sheet 10
High Street 473	*Barden & Ribee* Shop	State	No 162 Sheets 9,10
High Street	Court House	State	No 163 Sheet 9
High Street 224	Former C B C Bank	Local	No 164 Sheet 10
High Street 255	Two Storey Shop	Local	No 232 Sheet 10
High Street 534/540	Hampton Court	Local	No 165 Sheets 5,9
High Street 541	Dr Sollings House	Local	No 166 Sheet 9
New England Highway & Ledsam Street	*Roads End*	Local	No 167 Sheet 5
New England Highway	The Family Hotel	Regional	No 227 Sheet 5
Little Bourke Street	Timber Settlers Cottage	Local	No 168 Sheet 10
Parrallel Street	Maitland Park War Memorial	Regional	No 169 Sheet 11
Radford Street 7	Two Storey House	Local	No 170 Sheet 10
Regent Street 16	House	Regional	No 171 Sheet 5
Regent Street 30	*Benhome*	Regional	No 172 Sheet 5
Regent Street 34	*Cintra* & Stables	State	No 173 Sheet 5
Regent Street 76	*Helyhurst*	Local	No 174 Sheet 5
Regent Street	Victorian Villa	Regional	No 175 Sheet 5
Robin Street 9	Brick Cottage	Local	No 176 Sheet 10
Russell Street 19-21	Slab Cottage	Local	No 177 Sheet 10
Rose Street 69	Timber Cottage	Local	No 178 Sheet 11
Sempill Street 65	*Riverview*	Local	No 179 Sheet 9
Sempill Street	Police Station and Residence	Regional	No 180 Sheet 9
Station Street	Railway Station	Regional	No 181 Sheet 10
St. Andrews Street 34	*Springfield*	Local	No 237 Sheet 10
Victoria Street 5	Masonic Hall	Regional	No 182 Sheet 10

Victoria Street 7	Terrace	Local	No 183 Sheet 10
Victoria Street 9	Training College	Regional	No 184 Sheet 10
Victoria Street	Convent	Regional	No 185 Sheet 10
New England Highway	Maitland Hospital Group	Regional	No 186 Sheet 5
MAITLAND VALE			
Rosebrook Road	*Eelah*	Regional	No 187 Sheet 3
Campbells Road	*Maitland Vale*	Local	No 188 Sheet 3
MELVILLE ROAD			
Melville Ford Road	*Melville House*	Regional	No 189 Sheets 1,3
MINDARIBBA			
Tocal Road	*Mindaribba*	Regional	No 190 Sheet 3
Tocal Road	*Bellevue*	Local	No 191 Sheet 3
MORPETH			
Close Street	Former Bakery	Local	No 192 Sheet 17
Edward Street	Grandstand	Local	No 193 Sheet 17
George and James Street	Roman Catholic Church	Regional	No 194 Sheet 17
Green Street	Slab Cottage	Local	No 238 Sheet 17
High and Edward Street	*Kiora*	Local	No 195 Sheet 17
High and George Streets	Police Station	Regional	No 196 Sheet 17
High and Tank Street	St. James Parish Hall	Regional	No 197 Sheet 17
High Street 50	State School	Local	No 198 Sheet 17
High Street 85	Former Cinema	Local	No 199 Sheet 17
High Street 110	School of Arts	Regional	No 200 Sheet 17
James Street	Former Roman Catholic School and Convent Group	Regional	No 201 Sheet 17
John Street 5	Georgian Cottage	Local	No 202 Sheet 17
McFarlanes Road	Former *Morpeth House*	Local	No 203 Sheet 18
Morpeth Road	*Closebourne*	State	No 204 Sheet 17
Morpeth Road	*Morpeth House*	Regional	No 205 Sheet 17
Northumberland Street	Morpeth Bridge	Regional	No 206 Sheet 17
Robert Street 7	*White's* Factory	Local	No 207 Sheet 17
Off Swan Street	Former. Queens Wharf & Railway Station	Local	No 208 Sheet 17
Swan Street	Former Bond Store Group	Regional	No 209 Sheet 17
Swan Street	Former Courthouse	Regional	No 210 Sheet 17
Swan Street	Post Office and Residence	Regional	No 211 Sheet 17
Swan Street	Former Campbells' Store	Regional	No 212 Sheet 17
Swan Street	Former CBC Bank	Regional	No 213 Sheet 17
Swan Street	Marlborough House	Regional	No 214 Sheet 17
Swan Street 67/69	Villa	Local	No 215 Sheet 17
Swan Street 127	Commercial Hotel	Local	No 216 Sheet 17
Tank Street	St. James Group	Regional	No 217 Sheet 17
Tank Street	General Cemetery	Regional	No 218 Sheet 17
OAKHAMPTON			
Oakhampton Road	Former School	Local	No 219 Sheet 6
Oakhampton Road	*Lyndon Oakes*	Local	No 220 Sheet 6,8
Oakhampton Road	Oakhampton Methodist Cemetery	Regional	No 221 Sheet
6Oakhampton Road	Timber Cottage (Lot 4 DP 939730)	Local	No 222 Sheet 6,8
Scobies Lane	Walka Water Works	State	No 223 Sheet 6,8
OSWALD			
Oswald Road	General Cemetery	Regional	No 224 Sheet 1
PHOENIX PARK			
Largs Road	Old Campbells House	Local	No 225 Sheet 16

RUTHERFORD			
New England Highway	Cemetery	Regional	No 226 Sheet 4
TELARAH			
Junction Street	South Maitland Railway Yards	Regional	No 228 Sheet 5
South Street	Campell's Hill Cemetery	Regional	No 229 Sheet 5
Thomas Street	*Byrn Glas* (1904)	Local	No 230 Sheet 5
WOODVILLE			
Paterson Road	Dunmore House	Regional	No 231 Sheet 3

SCHEDULE 3

ADDITIONAL USES OF LAND **Clause 48**

Lot 11, DP561385, Louth Park Road, Louth Park: Subdivision creating 3 lots and the erection of a dwelling house on each lot so created. R6/87.

Lot 250, DP620745, Louth Park Road, Louth Park: Subdivision creating 6 lots and the erection of a dwelling house on each lot so created. R10/87.

Lot 2, DP533727, Sharkeys Lane, Lorn: Subdivision creating 2 lots (one with an area of at least 900m2 and the erection of a dwelling house on the smaller of the two lots. R19/89.

Part Lot 2 and part Lot 3, DP2577, New England Highway, Rutherford: Retail and wholesale butcher shop. R9/90.

Lot 6, DP702764, Louth Park Road, Louth Park: Subdivision creating 5 lots and the erection of a dwelling house on each lot so created. R4/91.

Lot 1, DP721804, Scotch Creek Road, Millers Forest: Processing of sand and gravel for use by the water filtration industry. R3/91.

Lot 1 DP790534, Wollombi Road, Farley: Erection of a dwelling house. R103/62.

Lot 67, DP703751, Wollombi Road: Subdivision creating 5 lots each with a minimum area of 2.5 hectares and the erection of a dwelling-house on each lot so created. R103/62.

Lot C DP155362, Johnson Street, Maitland: A warehouse. R11/89.

Portions 15 and 16, Tocal Road, Mindaribba: Resubdivision into 2 allotments and the erection of a dwelling on each allotment. R7/91.

Lot 2, DP605272, Raymond Terrace Road, Millers Forest: Subdivision into 2 allotments and the erection of a dwelling on each allotment created. R11/91.

Lot 1, DP797522, and Lot 65, DP810466, Oakhampton Road, Oakhampton; The erection of a dwelling on the allotment created by the amalgamation of those lots. R12/91.

Lot A, D 164365, and Part DP976482, Sharkeys Lane, Lorn: A road transport terminal. R1/92.

Lot 667, DP568399, Cantwell Road, Lochinvar: Subdivision creating 2 allotments and the erection of a dwelling on each lot. R4/92.

DP156976; Lots 46 and 47 Section D, DP192940: Lots 1 to 5 and Part 6, Section C, DP192940; and Lot 1, DP584084; Subdivision creating 5 allotments and the erection of a dwelling on the 4 smaller sized lots with the largest sized lot being utilised as a wetland and recreation area. R2/93.

Lots 101 to 104 and Lot 143, DP813190: Subdivision creating 7 allotments and the erection of a dwelling on each allotment. R103/62.

Part Lots 26-29, Lots 30-33 and Part Lots 35-39 and 60, DP976249, Lot 200, DP615601, Lots 101 and 102, DP635079, Lot 1, DP577409, Lot 112, DP804336 and Part Lot 258, DP813454, Louth Park Road, Louth Park, (Amendment No. 1): Rezone to 1(c) Rural Small Holdings and Community titles subdivision creating no more than 165 lots in accordance with the Community Land Development Act 1989. R8/91.

Land within DP447038, Swan Street, Morpeth: Erection of a dwelling house. (Amendment No.4). R8/92.

Lot 1, DP150582, William Street, East Maitland: A warehouse. (Amendment No.9). R3/93.

Lot 2, DP205370, Aberglasslyn Road, Aberglasslyn: Subdivision of 2 lots and the erection of a dwelling house on the vacant allotment so created. (Amendment No.6). R5/93.

Lot 1, DP634523, Station Lane, Lochinvar: Subdivision of 2 lots and the erection of a dwelling-house on the vacant lot created. (Amendment No.3). R7/92.

SCHEDULE 3

ADDITIONAL USES OF LAND
Continued.......

Clause 48

Part Portion 66, New England Highway, Harpers Hill: Subdivision of 2 lots and erection of a dwelling-house on the vacant lot created. (Amendment No.7). RZ93007.

Lot 1, DP783137 and Lot 12, DP591006, Morpeth Road, East Maitland: Subdivision creating 2 allotments and the erection of a dwelling-house above the 1 in 100 year flood line on the vacant allotment so created. (Amendment No.12). RZ93009.

Part Lot 43 and Lot 44, Hunter Street, Largs: Subdivision creating 2 vacant allotments and the erection of a dwelling -house on each allotment so created. (Amendment No.15). RZ93011.

Lot 2, DP239754, Winders Lane, Lochinvar: Subdivision creating 2 lots and the erection of a dwelling-house on the vacant lot so created. (Amendment No.16). RZ93008.

Lot 4, DP818231, Duckenfield Road, Duckenfield: Subdivision creating 3 lots, the erection of a dwelling-house on each of 2 of the vacant lots so created and the use of the third lot for a flood-free stock refuge. (Amendment No.17). RZ94002.

Lot 324, DP831201, Station Lane, Lochinvar. Subdivision creating 2 lots and the erection of a dwelling-house on the vacant allotment created. (Amendment No. 18). RZ94010.

Part Lot 14, DP571495, Oswald Lane, Oswald. Subdivision creating 2 lots and the erection of a dwelling-house on the vacant allotment created. (Amendment No. 19). RZ94012.

Lot 1, DP239754, Winders Lane, Lochinvar. Subdivision creating 2 lots and the erection of a dwelling-house in the vacant lot so created. (Amendment No. 20). RZ94010.

Part Por 42 & 44 Parish of Alnwick, McFarlanes Road, Berry Park. Subdivision creating 2 lots and the erection of a dweeling-house in the vacant lot so created. (Amendment No.21). RZ94011.

Lot 6, DP210081, Melville Ford Road, Melville. Subdivision creating two (2) lots and the erection of a dwelling-house on the lot so created. (Amendment No. 27). RZ94007.

Lot 21, DP734775, Lots A & B, DP151567, DP711706 & Lots 4, 6 & 16, DP572214, Ken Tubman Drive & St. Andrews Street, Maitland. Business Premises; Office Premises. (Amendment No.31). RZ95001.

Part Por. 63, Parish of Maitland, Cnr. Green & Elizbeth Streets, Morpeth. Rezone land to allow Retail/Tourist Activities. (Amendment No.33). RZ95004.

Lot 3, DP509046, Aberglasslyn Road, Rutherford, Erection of a dwelling-house. (Amendment No.29). RZ95006.

Lot 1, DP740055, New England Highway, Lochinvar. Subdivision creating 3 lots and the erection of one dwelling/ house on each of the 2 vacant lots created. (Amendment No. 32). RZ95005.

SCHEDULE 4

CLASSIFICATION AND RECLASSIFICATION OF PUBLIC LAND AS OPERATIONAL

Clause 51

Part Lot 841, DP774734, Melbee and Arthur Streets, Rutherford. Reclassification of land to operational land. (Amendment No. 8). RZ93010.

Lot 119 and Part Lot 118, DP76097, Elgin Street, Maitland. Reclassification of land to operational land. (Amendment No. 23). RZ94013.

Portion 185, Bent Street, Maitland. Reclassification of land to operational land. (Amendment No.24). RZ94014.

Lot 7, DP831701, Dunmore Road, Largs. Reclassification of land to operational land. (Amendment No.26). RZ94015.

Lot 1, DP831701, Dunmore Road, Largs. Reclassification of land to operational land. (Amendment No.28). RZ94018.

APPENDIX I
FLORA AND FAUNA REPORTS

(i) Frog Investigation Report (Australian Museum)
(ii) Flora and Fauna Report (ERM Mitchell McCotter)

A M
Understanding our natural environment and cultural heritage

~~Mr Stephen Hills~~
Environmental Planning and Assessment
CMPS&F Pty Ltd
PO Box 201
Chatswood, NSW 2057

24 February 1997

Dear Mr Hills:

This is a report of my recent visit to the CSR (PGH) quarry in Metford, Maitland with regard to the possible occurrence of the Green and Golden Bell Frog, Litoria aurea.

I visited the site on 23 February 1997. I spent one and a half hours (1345-1500 h) surveying the quarry. The day was clear and hot with a moderate wind. I concentrated on the reed beds and fringing grassy areas that were accessible, the largest of these being on the west side. I looked for frogs sitting in the emergent vegetation, especially the bulrushes (Typha), a favoured day-time resting site; metamorphs in the emergent vegetation and in the grass, and tadpoles in the water. I also dip-netted the submerged fringing vegetation for tadpoles.

I saw no Green and Golden Bell Frogs, nor any other frogs for that matter. The structure of the emergent vegetation, the clarity of the water, and the absence of small predatory fish all provide seemingly excellent physical conditions for Green and Golden Bell Frogs. However, the absence of any sign of the frog leads me to conclude that this species almost certainly does not occur in the quarry. The absence of tadpoles is especially telling as the Green and Golden Bell Forgs have bred elsewhere this season on the central coast, and tadpoles, when they occur, are usually conspicuous due to their large numbers and size. The apparent absence of frogs in general (no tadpoles) leads me to wonder if there may not be some aspect of water chemistry, e.g., salinity, that discourages their occurrence.

Thank you for inviting me to examine this quarry for Green and Golden Bell Frogs. If you need any additional information or wish to discuss my findings further, please do not hesitate to contact me.

Sincerely yours,

Allen E. Greer

Allen E. Greer
Principal Research Scientist

A U S T R A L I A N M U S E U M
6 College Street, Sydney. NSW 2000. Phone: (02) 9320 6000

3.5 FLORA AND FAUNA

A survey of the study area was made on 5 June, 1995. Flora and fauna surveys were limited to vegetated areas outside of existing pits and associated stockpiles and infrastructure. A description of the methodology of the flora and fauna survey is provided in the following sections.

3.5.1 Flora

i. Methodology

The primary objectives of the flora survey were:

- to describe the vegetation communities in accordance with the classification system of Specht (1981);
- to compile a list of the flora occurring in the study area, identifying any rare, threatened, regionally or locally significant plants; and
- to assess the likely impacts of continued operations on flora, and to propose recommendations for minimising any impacts.

Vegetation analysis involved a general description of the plant communities using qualitative field observations. Random traverses across the study area were undertaken, identifying all vascular plant species observed. A list of representative flora species occurring in the study area is provided in *Appendix B*. Detection and identification of some flora species is limited by seasonality and a lack of suitable flowering and/or fruiting material, thus some flora species may not have been recorded.

ii. Vegetation Communities

Two vegetation communities were identified in the study area, namely open forest and sedgeland. A discussion of each of these is provided below, and the location of vegetated areas is presented in *Figure* 2.2. A total of 47 vascular plant species were identified in the study area, and a full list is provided in *Appendix B*.

- Open Forest

Open forest covers approximately 17 hectares, or most of the study area that is not used for quarrying operations. Most of this community occurs in the eastern block, but a small patch of about 0.6 hectares is present adjacent to the Fieldsend pit to the north-west of Metford Road. The dominant tree species in this community is Spotted Gum (*Eucalyptus maculata*), with other less common tree species being Narrow-leaved Ironbark (*E. crebra*), White Mahogany (*E. acmenoides*), Broad-leaved Apple (*Angophora subvelutina*) and Grey Gum (*E. punctata*). Trees are generally 10 to 12 metres high, with some mature trees reaching 20 to 25 metres in height. Projective foliage cover is approximately 40 to 60 per cent.

A mid-understorey layer is generally absent throughout this community, however where it does occur it is primarily composed of Camphor Laurel (*Cinnamomum camphora*). A dense lower shrub layer is present throughout much of this community, but is absent in other parts. Dominant shrub species include Gorse Bitter Pea (*Daviesia ulicifolia*), Blackthorn (*Bursaria spinosa*), *Acacia falcata* and Silver-stemmed Wattle (*Acacia parvipinnula*). Numerous invasive exotic plant species are present in the shrub layer, including Lantana (*Lantana camara*), Blackberry (*Rubus* sp.) and Small-leaved Privet (*Ligustrum sinense*).

The ground layer is made up of species such as Blady Grass (*Imperata cylindrica*), *Entolasia stricta* and Flatweed (*Hypochoeris radicata*).

Numerous exotic plant species have invaded the open forest, particularly close to drainage lines. This has probably occurred as a result of the relatively large edge to area ratio of the community, and the abundance of weed species in the quarry and nearby residential gardens.

- Sedgeland

Several small areas of sedgeland community occurs within the open forest community close to the Two Mile Creek drainage line. This community is dominated by Broadleaf Cumbungi (*Typha orientalis*) and *Philydrum lanuginosum*. Bracken (*Pteridium esculentum*) and several species of grass, such as Couch Grass (*Cynodon dactylon*) also occur here. Water is generally available, and these areas may be inundated in times of heavy rainfall.

iii. Conservation Assessment of Flora

A total of 47 plant species were identified in the study area. No Rare or Threatened Australian Plants (ROTAP), as listed by Briggs and Leigh (1988), were identified in the study area.

The open forest occurring in the study area can be regarded as part of the *Eucalyptus maculata* association, as identified by Benson and Hager (1994). Benson and Hager (1994) list the *E. maculata* association as not or poorly conserved in north-east New South Wales from the Hunter River to the Queensland border. The community is also assessed as not or poorly conserved to inadequately conserved in the southern zone of that region, from the Hunter River to Kempsey (Benson and Hager, 1994).

The *E. maculata* and *E. paniculata* association identified by Benson (1989) would also include the open forest in the study area. Benson (1989) notes that throughout New South Wales much of this association is of a young age due to the effects of logging, grazing and significant changes in fire regime since European settlement. This association is given a conservation value of N2 by Benson (1989), with N meaning that it is not threatened in the foreseeable future, but could become threatened if land uses change, and 2 meaning that it is inadequately conserved with relatively small areas in reserves or major parts of its geographical range remain unprotected.

The open forest vegetation in the study area also fits in to the *E. crebra – E. maculata* suballiance identified by Winning (1994), who states that this association is widespread throughout the lower Hunter region.

3.5.2 *Fauna*

i. Methodology

A survey of the fauna habitats in the study area was undertaken in conjunction with the flora survey on 5 June, 1995. Assessment of the fauna habitat value of the study area was based on the following features:

- broad vegetation types described in accordance with the classification system of Specht (1981);
- diversity of flora species in each strata;
- availability of mature trees providing hollows;

- density of ground cover such as shrubs, fallen trees, leaf litter and herbs;
- level of disturbance of habitats, such as vehicular tracks and weed infestations;
- connectivity of habitats with similar habitats outside of the development area;
- fire regime; and
- presence or absence of standing or flowing water.

As specified in the Endangered Fauna (Interim Protection) Act, 1991, the fauna survey sought to determine whether the proposed development will significantly impact upon the habitat of endangered fauna, as listed in Schedule 12 of the National Parks and Wildlife Act, 1974.

Identification of fauna species was primarily made by opportunistic sightings while undertaking other activities in the study area. However, specific searches for reptiles were made in preferred microhabitats, such as under leaf litter, logs and decorticated bark, and amphibians were searched for in wetter areas, such as ponds and gullies.

During the flora and fauna survey there was no rain, a slight breeze and approximately one quarter cloud cover. The minimum and maximum temperatures, recorded at the nearest weather station at Williamtown, were 8.1 and 17 degrees Celsius, respectively. Up to 9 am on the morning of the survey, 6.2 millimetres of rain was recorded at Williamtown.

ii. Fauna Habitats

The study area contains two distinct fauna habitats, open forest and sedgeland. The location of existing native vegetation is presented in *Figure 2.2*, and the flora species present have been discussed in *Section 3.5.2*. Both habitats have a history of disturbance from quarrying activities, clearing and invasion by weed species.

- Open Forest

Open forest is made up of an upper storey dominated by *Eucalyptus* species. This storey has an average height of 10 to 12 metres, with a projective foliage cover of approximately 40 to 60 per cent. A mid–understorey vegetation layer is present in some areas, while a lower shrub layer is generally present throughout the habitat.

Very few hollows were observed in trees throughout this community. A moderate amount of litter is present, with fallen branches and logs providing potential habitat for reptiles. A number of tracks cut through the open forest, and dumped rubbish occurs in some areas.

Fire does not appear to have occurred in this habitat in recent times, however it may have occurred infrequently previously. Water is probably intermittently available in drainage lines throughout the habitat.

□ Sedgeland

Sedgeland occurs in several small areas within the open forest community. Large amounts of vegetation litter are present, and water pools on the surface after periods of rainfall.

iii. Fauna Species Recorded in the Study Area

A number of fauna species were recorded in the study area. *Table 3.4* lists those species recorded, as well as the means by which they were identified.

Table 3.4 FAUNA SPECIES OBSERVED IN THE STUDY AREA

Scientific Name	Common Name	Method of Identification
i. Birds		
Streptopelia chinensis	Spotted Turtle-dove	o
Cacatua roseicapilla	Galah	o, ac
Coracina novaehollandiae	Black-faced Cuckoo-shrike	o, ac
Pachycephala pectoralis	Golden Whistler	o, ac
Rhipidura fuliginosa	Grey Fantail	o
Phipidura leucophrys	Willy Wagtail	o
Daphoenositta chrysoptera	Varied Sittella	o
Anthochaera chrysoptera	Little Wattlebird	o
Melithreptus lunatus	White-naped Honeyeater	o
Lichenostomus melanops	Yellow-tufted Honeyeater	o
Lichenostomus chrysops	Yellow-faced Honeyeater	o, ac
Acanthorhynchus tenuirostris	Eastern Spinebill	o, ac
Pardalotus punctatus	Spotted Pardalote	o, ac
Aegintha temporalis	Red-browed Finch	o
Oriolus sagittatus	Olive-backed Oriole	o
Gymnorhina tibicen	Australian Magpie	ac
Corvus coronoides	Australian Raven	o, ac

Table 3.4 continued

ii. Mammals		
Canis familiaris	Dog	i
iii. Reptiles		
Ctenotus robustus		o
Sphenomorphus delicata	Garden Skink	o
iv. Amphibians		
Crinia signifera	Common Eastern Froglet	o

Note: Method of Identification: o = observed; ac = audible call; i = indirect evidence (scats, tracks).

All species were recorded in open forest habitat, apart from the Common Eastern Froglet (*Crinia signifera*), which was observed in sedgeland near Metford Road.

A number of other fauna species, not detected by this survey, are expected to occur in the study area. Possums and gliders, such as the Common Brushtail Possum (*Trichosurus vulpecula*) and Squirrel Glider (*Petaurus norfolcensis*) are likely to inhabit the trees, and there is a low likelihood that some macropod species would be present, such as the Swamp Wallaby (*Wallabia bicolor*).

Bat species were not surveyed, but a number of endangered and protected bats are considered likely to occur. A number of bat species were recorded by call identification near Thornton, approximately three kilometres east of the study area. Several endangered bat species, including the Eastern Little Mastiff-bat (*Mormopterus norfolkensis*), Great Falsistrelle (*Falsistrellus tasmaniensis*), Common Bent-wing Bat (*Miniopterus schreibersii*) and Gerater Broad-nosed Bat (*Scoteanax rueppellii*) were tentatively, but not positively identified at that site (Parnaby, 1995).

Domestic and feral species are also likely to exist in the study area, including the Fox (*Vulpes vulpes*), Cat (*Felis catis*) and Rabbit (*Oryctolagus cuniculus*).

iv. Wildlife Corridors

Open forest and sedgeland in the study area is effectively isolated from other areas of similar vegetation in the local area. To the north and north-east the study area is bounded by the Main Northern Railway Line. A small area of Spotted Gum open forest is present to the north of the railway line, but this is not contiguous with other open forest in the local area. A light industrial area adjoins the study area to the west, and residential areas are present to the south.

No wildlife corridors connect the study area to areas of similar vegetation in the local area. Thus, the quality of the habitat for most fauna species, except birds and bats, is somewhat limited, due to restricted movement into and out of the study area.

v. Endangered Fauna

No endangered fauna as listed on Schedule 12 of the National Parks and Wildlife Act, 1974, were identified in the study area. However, a number of endangered fauna species may be expected to occur in the study area. *Table 3.5* lists those species of endangered fauna recorded in the local region, that is in the Maitland, Raymond Terrace and Seaham localities, or those which are likely to occur in the study area.

Table 3.5 ENDANGERED FAUNA RECORDED FROM THE LOCAL REGION OR EXPECTED TO OCCUR IN OPEN FOREST IN THE STUDY AREA

Scientific Name	Common Name	Status	Records	Reference	Likelihood of Occurrence
Burhinus grallarius	Bush Stone-curlew	T	West of Paterson, Karuah.	NPWS database.	Low, due to high density of shrubs.
Ptilinopus magnificus	Wompoo Fruit-dove	VR	Black Hill.	Morris (1975).	Unlikely – no suitable habitat.
Calyptorhynchus lathami	Glossy Black Cockatoo	VR	West of Cessnock, Woodberry.	HBOC, (1993).	Low – limited amount of foraging and nesting habitat.
Neophema pulchella	Turquoise Parrot	VR	Old record at Maitland.	Morris (1975).	Low – no suitable habitat.
Ninox strenua	Powerful Owl	VR	New Lambton Heights.	HBOC (1993).	Low – may forage in study area.
Tyto novaehollandiae	Masked Owl	VR	No records.		Low – may forage in area.
Grantiella picta	Painted Honeyeater	VR	East Maitland; recently at Thornton.	HBOC (1993).	Low – bird of passage.
Xanthomyza phrygia	Regent Honeyeater	T	Kurri Kurri.	HBOC records.	Low – bird of passage.
Petaurus norfolcensis	Squirrel Glider	VR	Thornton.	ERM Resource Planning (1995).	High – suitable habitat exists.
Dasyurus maculatus	Spotted-tailed Quoll	VR	Paterson, Seaham, Raymond Terrace.	NPWS database.	Low, due to poor habitat connectivity.
Phascogale tapoatafa	Brush-tailed Phascogale	VR	Generally north of Hunter River.	NPWS database.	Low, due to poor habitat connectivity.
Phascolarctos cinereus	Koala	VR	Most records from Port Stephens, one old record from Hinton.	NPWS database.	Low – no connectivity with surrounding habitat.

Table 3.5 (Cont'd)

Scientific Name	Common Name	Status	Records	Reference	Likelihood of Occurrence
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	VR	No local records.		Moderate – habitat may be utilised for foraging.
Mormopterus norfolkensis	Eastern Little Mastiff-bat	VR	Possible at Thornton.	Parnaby (1995).	Moderate – suitable habitat present, but at southern limit of range.
Falsistrellus tasmaniensis	Great Falsistrelle	VR	Possible at Thornton.	Parnaby (1995).	Moderate – not known in low altitude forests in Hunter Valley.
Miniopterus australis	Little Bent-wing Bat	VR	Grahamstown Dam.	Ecotone (1995).	Moderate – suitable foraging habitat; near southern limit of distribution.
Miniopterus schreibersii	Common Bent-wing Bat	VR	Grahamstown Dam; possible at Thornton.	Ecotone (1995), Parnaby (1995)	High – suitable foraging habitat is present.
Scoteanax rueppellii	Greater Broad-nosed Bat	VR	Thornton.	Parnaby (1995).	High – suitable habitat is present.
Litoria aurea	Green and Golden Bell Frog	T	Maitland.	Resource Planning (1994).	Moderate – small areas of suitable habitat.

Status from Schedule 12 NPW Act, 1974. VR = Vulnerable and Rare; T = Threatened.

Table 3.5 above indicates that certain endangered fauna species are more likely to occur than other species. Those identified at Thornton (Parnaby, 1995) are probably most likely to be present in the study area due to the similarity in habitats.

Many bats, hollow-dependent birds and arboreal mammals require hollows as a critical component of their habitat. Very few hollows are present in the study area, thus limiting its potential use for species requiring hollows as den, hibernation, nesting or maternity sites.

The primary potential use of the study area for endangered fauna species is likely to be as foraging habitat. However, many non-flying species may be excluded because of the study area's isolation from and low connectivity with similar habitat in the local area.

None of the habitat identified as occurring in the study area will be removed for continued quarrying operations. The only impacts that continued operations will have on fauna species are those potential impacts which currently exist, such as dust and noise.

3.5.3 *State Environmental Planning Policy 44 – Koala Habitat Protection*

i. Statutory Requirements

State Environmental Planning Policy No. 44 – Koala Habitat Protection (SEPP 44) aims to:

> ' .. encourage the proper conservation and management of areas of natural vegetation that provide habitat for Koalas, to ensure permanent free-living populations over their present range and to reverse the current trend of population decline. '

The Director of the Department of Planning has issued guidelines regarding the operation of SEPP 44. The practical effect of SEPP 44 and the guidelines is that councils must, when determining a development application (DA), ensure that consent is not issued without investigation of 'potential' and 'core' Koala habitat. If 'core' Koala habitat is identified a plan of management must accompany the DA before the council can consider granting development consent.

The policy applies to land in relation to which a DA has been made (which has an area of more than one hectare) and to all local government areas within the known statewide distribution of the Koala as identified in Schedule 1 of SEPP 44, including Maitland local government area.

'Potential' Koala habitat is defined as vegetation which incorporates a minimum of 15 percent of the total number of trees in the 'upper or lower strata of the tree component' being those species listed in Schedule 2 of SEPP 44. Information pertaining to 'potential' Koala habitat can only be provided by a person who is qualified in tree identification (clause 7 (2)).

If the subject land is not deemed to have 'potential' Koala habitat under clause 7 of the policy, then council is not prevented by this policy from granting consent to the development application. Upon identification of 'potential' Koala habitat, further investigation is necessary to determine whether this is in fact 'core' habitat. 'Core' Koala habitat is defined as

> ' an area of land with a resident population of Koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a Koala population.'

If council is satisfied that the area is not 'core' Koala habitat, then under clause 8 of the policy, council is not prevented from granting consent to the development application. Council can only be satisfied after investigation by a person with appropriate qualifications and experience in biological science and fauna survey and management. If, however, the land is deemed 'core' Koala habitat, then an approved plan of management must be prepared and accompany the development application.

ii. Identification of 'potential' Koala Habitat

As outlined above, the identification of 'potential' Koala habitat is based on an assessment of the percentage cover of Koala feed trees as listed in Schedule 2 of SEPP 44. *Table 3.6* lists Schedule 2 feed trees.

Table 3.6 KOALA FEED TREES LISTED IN SCHEDULE 2 OF SEPP 44

SCIENTIFIC NAME	COMMON NAME
Eucalyptus albens	White Box
Eucalyptus camaldulensis	River Red Gum
Eucalyptus haemastoma	Scribbly Gum
Eucalyptus microcorys	Tallowwood
Eucalyptus populnea	Bimble Box
Eucalyptus punctata	Grey Gum
Eucalyptus robusta	Swamp Mahogany
Eucalyptus signata	Scribbly Gum
Eucalyptus tereticornis	Forest Red Gum
Eucalyptus viminalis	Ribbon Gum

The SEPP 44 survey was undertaken on 5 June, 1995 to provide a quantitative assessment of the percentage of feed trees in the open forest in the study area.

Three 20 metre by 20 metre plots sampled the open forest habitat. A plot size of 20 metres by 20 metres was selected as the standard sized plot used by the National Herbarium and the New South Wales National Parks and Wildlife Service.

Within each plot the number and type of tree species were recorded in the upper and lower strata. The upper strata is the forest canopy lower and emergents. The lower strata is the mid-understorey or sub-canopy of the community being trees ranging in height from approximately five to ten metres. From this the percentage of each species for the plot were determined. *Table 3.7* indicates the results of this survey.

Table 3.7 SEPP 44 POTENTIAL KOALA HABITAT SURVEY IN OPEN FOREST

Plot Number	Number of Trees		Schedule 2 Species		Potential Habitat (yes/no)
	Upper Strata	Lower Strata	Number	%	
1	9	11	0	0	No
2	11	20	14	45	Yes
3	14	19	1	3	No
Average	11.3	16.6	5	17.9	Yes

The only Schedule 2 tree species present in the study area is Grey Gum (*E. punctata*). When averaged, the results indicate that the open forest in the study area provides 'potential' Koala habitat.

iii. Identification of 'core' Koala Habitat

In accordance with SEPP 44, assessment of 'core' Koala habitat should address the following:

- extent of tree use based on observation of Koalas and assessment of indirect evidence of the presence of Koalas, that is scats or scratch marks;
- estimated size of Koala population;
- evidence of breeding females; and
- the presence of juveniles and sub-adults.

This information is derived from field observations and a review of available information on Koala records in the study area and region.

In conjunction with the plot based survey for 'potential' Koala habitat, a plot based survey to assess the extent of tree use by Koalas was undertaken. Extent of tree use is based on searches for evidence of the presence of Koalas such as searches of the ground at the bases of trees and between feed trees for scats. Smooth barked trees were inspected for evidence of scratch marks. Within the plots and areas between the plots were visually inspected for the presence of individual Koalas.

The following assessment of 'core' Koala habitat addresses the four points provided for identification of 'core' Koala habitat listed above.

a) *extent of tree use based on observation of Koalas and assessment of evidence of the presence of Koalas, that is scats or scratch marks;*

Searches for direct and indirect evidence to determine the presence of Koalas were undertaken within the study area. No evidence of scats were noted within the study area, and no individuals were observed in the study area. However, scratch marks were observed on a Grey Gum in plot 2, but it could not be determined what species produced the marks.

b) *estimated size of Koala population;*

No estimate of the size of the Koala population in the study area is available as there were no direct sightings of Koalas. However, the study area is not expected to support a population of Koalas. The closest known Koala sighting was at Hinton in 1958, and the majority of Koala records in the Hunter Valley occur in the Port Stephens area, east of the Williams River.

c) *evidence of breeding females; and*

There was no evidence of breeding female Koalas in the study area during the surveys.

d) *the presence of juveniles and sub-adults.*

There was no evidence of juvenile and sub-adult Koalas in the study area during the surveys. Regional information or records of juveniles and sub-adults are not available. Breeding populations of Koalas are primarily located to the east of the Williams River.

It can therefore be concluded that the study area does provide 'potential' Koala habitat, but does not provide 'core' Koala habitat.

3.5.4 *Impacts of Continued Quarrying on Flora and Fauna*

Quarrying operations will be limited to the areas presently encompassed by the pits, ensuring no future disturbance or clearance of existing vegetation in the study area. Thus, the future impacts on flora and fauna are expected to be minimal, and limited to indirect disturbances such as dust and noise.

The continued use of the quarry may affect flora and fauna by producing dust and noise pollution. However, the scale of these impacts is expected to be minimal, and similar to those impacts previously produced by the operation of the quarry. No work is proposed to be undertaken at night, thus the effects of continued operation on nocturnal fauna are unlikely to be significant.

Although the open forest community has been identified as 'potential' Koala habitat (*Section 3.5.4*), it is not expected that a population of Koalas would be present in the study area. In addition, no future removal of this vegetation community is planned. Therefore, it can be considered that the effects of continued operation of the quarry on Koalas in the local area would be insignificant.

No endangered fauna species were identified in the study area, however a number of species are likely to be present. The following discussion assesses the likely impact of the continued operation of the quarry on those endangered species considered likely to occur in the study area. This assessment is based on the seven point test of significance established in section 4A of the Environmental Planning and Assessment Act, 1979.

i. The extent of modification or removal of habitat, in relation to the same habitat type in the locality.

The continued operation of the quarry will be restricted to the existing and previously cleared areas and will not require the clearance of any area of undisturbed fauna habitat. The fauna habitats identified in the study area are relatively common and widespread in the lower Hunter Valley.

ii. The sensitivity of the species of endangered fauna to removal or modification of its habitat.

All endangered species identified as having some likelihood of occurrence in the study area are sensitive to habitat modification or removal. However, since no undisturbed fauna habitat will be removed, local fauna populations will not be significantly affected by the continued operation of the quarry.

iii. *Regeneration of habitat.*

Regeneration of the quarry areas will occur when operations have ceased, using exotic and locally endemic plant species. This will provide habitat in the both the short term and long term and in the very long term there will be the development of tree hollows for arboreal fauna. Details of the rehabilitation strategy are provided in *Section* 2.5.

iv. *Recovery of fauna populations.*

No fauna populations are expected to be affected by the continued use of the quarry. In addition, fauna species are expected to return to the rehabilitated quarrying areas when habitat attributes are sufficient for their use.

v. *Any proposal to ameliorate the impact.*

No significant impact is expected to result from continued quarrying operations, therefore no amelioration measures are proposed, apart from staged rehabilitation.

vi. *Wilderness assessment.*

The study area is not under consideration for wilderness assessment by the Director-General of the NSW National Parks and Wildlife Service.

vii. *Any adverse effect on the survival of the species or populations of the species.*

No undisturbed native vegetation will be cleared for future quarrying operations. It is expected that the only potential impacts of continued operation of the quarry on endangered fauna will be indirect impacts, such as noise and dust. Therefore, it is unlikely that any significant adverse effect on the survival of species or populations of species will result from the operations.

Appendix B

PLANT SPECIES OBSERVED IN THE AREA

The following list includes all vascular plant species observed in the study area at Metford. It should be noted that as the survey design comprises sampling of vegetation across the site along transects, it is possible that some species have been inadvertently omitted.

Scientific/Common Names

Scientific names do not include authorities and follow Harden (1990, 1991, 1992 & 1993). Common names follow Harden.

Introduced species are indicated by an asterisk (*).

Species not accurately identified are indicated by a question mark (?). These species have been identified as accurately as possible. With some specimens identification has been constrained by a lack of suitable flowering or fruiting material.

FAMILY/Scientific Name	Common Name
FILICOPSIDA	FERNS
DENNSTAEDTIACEAE	
Pteridium esculentum	Bracken
MAGNOLIOPSIDA	FLOWERING PLANTS
Magnoliidae	Dicotyledons
APOCYNACEAE	
Parsonsia straminea ?	Common Silkpod
ASCLEPIADACEAE	
Leichhardtia leptophylla	Bullock
ASTERACEAE	
* *Bidens pilosa*	Cobbler's Peg
* *Chrysanthemoides monilifera*	Bitou Bush
* *Hypochoeris radicata*	Flatweed
BIGNONIACEAE	
* *Jacaranda mimosifolia*	Jacaranda
CASUARINACEAE	
Casuarina glauca	Swamp Oak

FAMILY/Scientific Name	Common Name
CRASSULACEAE	
* *Bryophyllum delagoense*	Mother-of-millions
EPACRIDACEAE	
Epacris pulchella	
EUPHORBIACEAE	
Daviesia ulicifolia	Gorse Bitter Pea
Dillwynia retorta	
Pultenaea cunninghamii	
Pultenaea villosa	
MIMOSOIDEAE	
Acacia elongata	
Acacia falcata	
Acacia parvipinnula	Silver-stemmed Wattle
LAURACEAE	
* *Cinnamomum camphora*	Camphor Laurel
MYRTACEAE	
Angophora subvelutina	Broad-leaved Apple
Callistemon linearis	Narrow-leaved Bottlebrush
Eucalyptus acmenioides	White Mahogany
Eucalyptus crebra	Narrow-leaved Ironbark
Eucalyptus maculata	Spotted Gum
Eucalyptus punctata	Grey Gum
Leptospermum polygalifolium	
OLEACEAE	
* *Ligustrum sinense*	Small-leaved Privet
PHYTOLACCACEAE	
* *Phytolacca octandra*	Ink weed
PITTOSPORACEAE	
Bursaria spinosa	Blackthorn
PLANTAGINACEAE	
Plantago lanceolata ?	
PROTEACEAE	
Hakea sericea	
ROSACEAE	
Rubus sp.	Blackberry
SANTALACEAE	
Exocarpos cupressiformis	Native Cherry
Leptomeria acida	Native Currant
VERBENACEAE	
* *Lantana camara*	Lantana
* *Verbena bonariensis*	Purple-top Vervain
Liliidae	**Monocotyledons**
ASPARAGACEAE	
Asparagus sprengeri	
LOMANDRACEAE	
Lomandra longifolia	Mat-rush
PHILYDRACEAE	

FAMILY/Scientific Name	Common Name
Philydrum lanuginosum	Woolly Frogmouth
PHORMIACEAE	
Dianella sp.	
POACEAE	
Cortadeira selloana	Pampas Grass
Cynodon dactylon	Couch Grass
Entolasia stricta	
Eragrostis sp.	Lovegrass
Imperata cylindrica	Blady Grass
* *Paspalum dilatatum*	Paspalum
TYPHACEAE	
Typha orientalis	Broadleaf Cumbungi
XANTHORRHOEACEAE	
Xanthorrhoea sp.	

APPENDIX : Definition Of ROTAP Conservation Codes

Example: *Rarus planticus* 3ECi+

3 **Distribution Category for the species or taxon** (can be 1,2 or 3).

1 = Known from one collection only.

2 = Geographic range <100 kilometres.

3. = Geographic range >100 kilometres.

E **The Conservation Code (can be X, E, V, R, or K).**

X = **Presumed Extinct.** The taxon has not been collected or otherwise verified over the past 50 years despite thorough searching, or all known wild populations have been destroyed more recently.

E = **Endangered.** The taxon is in serious risk of disappearing from the wild within 10-20 years if present landuse and other threats continue.

V = **Vulnerable.** The taxon is not presently endangered but is at risk of disappearing from the wild over a longer period (20-50 years) through continued depletion, or occurs on land whose future use is likely to change and threaten its survival.

R = **Rare.** A taxon which, while rare in Australia and hence usually the world is not currently threatened by any identifiable factor.

K = **Poorly Known.** The taxon is suspected but not definitely known to belong to one of the above categories.

C = **Reserved.** The taxon has at least one population within a national park or other proclaimed conservation reserve.

i+ **Size Of Reserved Population (can be a, i, + or -)**

a = indicates that 1,000 plants or more are known to occur within a conservation reserve(s).

i = indicates that less than 1,000 plants are known to occur within a conservation reserve(s).

+ = indicates that although recorded from within a reserve the population size is unknown.

- = indicates that the taxon also has a natural distribution outside Australia.

APPENDIX J
CLAUSE 50 CERTIFICATION

SUBMISSION OF ENVIRONMENTAL IMPACT STATEMENT (EIS)

PREPARED UNDER THE ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979 - SECTION 77

EIS PREPARED BY

Name:	Stephen Hills
Qualifications:	B.A. (Hons), Dip T.P., MRTPI, MRAPI
Address:	CMPS&F Environmental 67 Albert Avenue CHATSWOOD NSW 2067

DEVELOPMENT APPLICATION

Applicant Name:	Monier PGH Holdings Limited
Applicant Address:	Level 5, 9 Help St, Chatswood
Land to be developed: Address	Metford Road, East Maitland
Lot No. DP/MPS, Vol/Fol etc:	Part Portion 2 and Portions 266, 378, 401, Parish of Maitland, County of Northumberland.
Proposed Development:	Proposed continuation of clay/shale quarrying, landfilling and site rehabilitation

ENVIRONMENTAL IMPACT STATEMENT

☑ an environmental impact statement (EIS) is attached

CERTIFICATE

I certify that I have prepared the contents of this Statement and to the best of my knowledge

- it is in accordance with clauses 51 and 52 of the Environmental Planning and Assessment Regulation 1994, and
- it is true in all material particulars and does not, by its presentation or omission of information, materially mislead.

Signature: Stephen Hills

Name: Stephen Hills

Date: 1/9/97

APPENDIX K
STUDY TEAM

This environmental impact statement was prepared by staff of CMPS&F Environmental and is based on initial work undertaken by ERM Mitchell McCotter. The work was undertaken by the following team:

CMPS&F PTY LTD

John Yeates	*Project Director*
Stephen Hills	*Project Manager*
Michelle Kelsey	*Environmental Scientist*
Felicity Stening	*Environmental Scientist*
Edwina Laginestra	*Environmental Scientist*
Ronnen Wise	*Environmental Planner*
Kate Wingrove	*Environmental Engineer*
Andrew Rose	*Environmental Engineer*
Shane Rigney	*Graphic Designer*
Yvette Worboys	*Graphic Designer*
Trish Foster	*Word Processor*

SPECIALIST STUDIES

Tim Pollock	*Senior Environmental Engineer (Air Quality)*
Emma Every	*Chemical Engineer (Air Quality)*
Stuart Dever	*Senior Engineer (Waste Management)*
Duncan Appleby	*Civil Engineer (Traffic)*
Dick Godson/Chris Schulten	*Richard Heggie Associates (Acoustical Consultants)*
Ken Wallace	*Woods Bagot (Landscape Architect)*
Bryan Liddle	*Woodward Clyde (Geotechnical/Landfill Technical)*
Allen Greer	*Australian Museum (Fauna)*