EIS 1278 Vol 2

AB020071

Proposed continuation of quarrying, landfilling and site rehabilitation at Schofields, Blacktown : environmental impact statement

ENVIRONMENTAL IMPACT STATEMENT

NSW DEPT PRIMARY INDUSTRIES
AB020071

CSR PGH

Enviroguard
COMMUNITY WASTE MANAGEMENT

PROPOSED CONTINUATION OF QUARRYING, LANDFILLING AND SITE REMEDIATION

AT THE PGH BRICKWORKS SITE

SCHOFIELDS, BLACKTOWN

VOLUME 2 - APPENDICES

NSW DEPARTMENT OF
RAL RESOURCES
- 1 JUL 1997
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Prepared by
CMPS&F ENVIRONMENTAL

L94/0216

PROPOSED CONTINUATION OF QUARRYING, LANDFILLING AND SITE REHABILITATION AT SCHOFIELDS, BLACKTOWN

ENVIRONMENTAL IMPACT STATEMENT

VOLUME TWO

APPENDICES

MAY 1997

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APPENDIX A
REQUIREMENTS OF THE DEPARTMENT OF URBAN AFFAIRS AND PLANNING

The guidelines referred to in the Department of Urban Affairs and Planning's letter dated 7 June 1996 have since been updated. The September 1996 guidelines have been included as their replacement.

New South Wales Government
Department of Urban Affairs and Planning

RECEIVED
14 JUN 1996

Mr Terry Perram
Principal
Perram and Partners Pty Ltd
12 Clanwilliam Street
EASTWOOD NSW 2122

Contact: Gordon Kirkby

Our Reference: P90/00255/001

Your Reference: 94137L1

7 JUN 1996

Dear Mr Perram,

Extension of Quarry and Landfilling, Lot 3, DP 232474, Townson Rd, Schofields.

Thank you for your letter dated 29 May 1996 inquiring as to whether the Director-General has any additional requirements for the preparation of an EIS for the above development to those issued on 29 July 1994.

The Director-General has no specific requirements in addition to those previously issued. Attachments Nos 1 and 2 are recent Best Practice Guidelines which contain a advice on the type of information most likely to be relevant to the proposed development. These documents should be taken into consideration in finalising the EIS.

The EIS shall be prepared in accordance with clauses 50 and 51 of the Environmental Planning and Assessment Regulation 1994. Statutory requirements for the form and content of the EIS are outlined in Attachment No. 3.

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. You should also identify and consult with any other parties who may have an interest in the proposal.

Should you have any further enquiries please do not hesitate to contact Gordon Kirkby on 02 391 2071.

Yours sincerely,

for Stephen Brown
Manager
Major Assessments and Hazards Branch

M:\DR\LETTERS\P9000255.DOC

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

Telephone: (02) 391 2000
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New South Wales Government

Department of Planning

RECEIVED - 2 AUG 1994

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Contact : M. Beveridge

Our Reference : P90/00255

Your Reference :

Mitchell McCotter
PO Box 943
CROWS NEST NSW 2065

INCOMING CORRESPONDENCE					
DATE	2/8/94				
PROJECT MGR.	SHWO	INTL	SH		
PROJECT No.	VH0009				
FILE No.	027				
TO	SH				
A/I/C	A				
INTL	B				

Attention: Mr T Perram

Dear Mr Perram,

Extension of existing quarry at the PGH Plant:
Lot 2, DP 232574 and Lot 3, DP 232474, Schofields

Thank you for your letter of 10 June, 1994 indicating that you are consulting with the Director with regard to the preparation of an environmental impact statement (EIS) for the above development.

2. As development consent is required for the proposal and it is a designated development within the meaning of Schedule 3 of the Environmental Planning and Assessment Regulation, 1980, as amended, an EIS must accompany the development application to the Blacktown Council. The EIS shall be prepared in accordance with clause 34 of the Regulation and shall bear a certificate required by clause 26(1)(b) of the Regulation (see Attachment No. 1).

3. In addition, pursuant to clause 35 of the Regulation, the Director requires that the following matters be specifically addressed in the EIS:

Extraction and Stockpiling Activities:

* a review of the extraction activities which have previously occurred on site, particularly in relation to the environmental impact of these activities, and an assessment of the need for further environmental protection measures;

* description of proposed quarrying activities, including intended rates of extraction, the intended life of the operation, and the proposed method of extraction. Description also of proposals for stockpiling of excavated material on adjacent property;

Non-Putrescible Landfill Operations:

* identification of wastes to be accepted at the landfill, including descriptions of the wastes and their characteristics, their sources, and the likely quantities to be disposed of;

The EIS should include an undertaking that only non putrescible wastes will be accepted, and should describe a management system for ensuring that only these types of wastes are accepted;

* proposals for separating and recycling of suitable wastes;

* consideration of the environmental suitability of the site to act as a landfill. This should particularly include a hydrological study of the site to define existing groundwater conditions and assess the hydrologic suitability, and assess the need for pit liners. The geological suitability of the site should also be demonstrated.

* impacts relating to health and safety, including potential for spread of disease, procedures for handling any hazardous materials, or hazards relating to the generation of landfill gases. The EIS should also assess the need to include a preliminary hazard analysis, and if required, the PHA should be prepared in accordance with the Department of Planning publication entitled Hazardous Industry Planning Advisory Paper No.6 - Guidelines for Hazard Analysis.

Extraction/Stockpiling and Non-Putrescible Landfilling:

* consideration of relevant matters in the Sydney Regional Environmental Plan No. 19 - Rouse Hill Development Area, Sydney Regional Environmental Plan No. 20 - Hawkesbury-Nepean River, Sydney Regional Environmental Plan No.9 - Extractive Industry;

* assessment of impacts of proposal on existing and future land uses. This should be considered as follows:

  - consideration of proposed future development of the area (particularly, the Rouse Hill Development Area, future uses of the former HMAS Nirimba site). The EIS should identify any constraints resulting from the proposed operations which might impact upon these developments, and should pay particular attention to the staging of these developments in relation to the operational life of the quarry and landfill;

  - specific impacts upon the amenity of existing and future land uses, particularly in relation to noise, dust, odour, visual impact, traffic, and vermin. Where appropriate the cumulative impacts from both the landfill and quarrying operations should be considered. Measures to control such impacts should be identified;

  - assessment of operations on the heritage value of the Heritage Conservation Area comprising part of the site;

* consideration of flood related issues;

* impacts on flora and fauna and proposed mitigation measures;

* comprehensive identification of site rehabilitation proposals, including the staging of rehabilitation, proposals for planting and visual screening;

* measures for controlling sedimentation and soil erosion;

* assessment of impacts on groundwater and nearby surface waters. This should consider such issues as sedimentation,leaching, and contamination or pollution of groundwater and surface waters (particularly means to avoid pollution to waters of the Hawkesbury- Nepean Catchment Area). A water management and monitoring plan for the whole site operations should be outlined;

* assessment of transport and traffic impacts having regard to the capacity of the existing road network;

* proposals for the day to day management of the whole site operations;

* proposals for ongoing monitoring of the environmental impacts of both the landfilling and quarrying operations;

* results of consultation with:

  - Roads and Traffic Authority;
  - Environment Protection Authority;
  - National Parks and Wildlife Service;
  - Hawkesbury-Nepean Catchment Management Trust;
  - Department of Conservation and Land Management;
  - Department of Water Resources;
  - Department of Mineral Resources;
  - NSW Fisheries;
  - NSW Agriculture;
  - NSW Health Department.

4. Attachments 2a and 2b are guides to the type of information most likely to be relevant to the development you propose; not all of the matters raised therein may be appropriate for consideration in the EIS for your proposal; equally, the guides are not exhaustive.

5. In preparing your EIS you should approach the Blacktown Council and take into account any comments Council considers may apply to its determination of the proposal.

6. Should you require any further information regarding this matter please do not hesitate to contact us again.

Yours faithfully,

N Osborne 28/7/94
Acting Manager
Assessments and Major Hazards Branch
As Delegate for the Director

DEPARTMENT OF URBAN AFFAIRS AND PLANNING

Attachment No. 1

STATUTORY REQUIREMENTS FOR THE PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT UNDER PART 4 OF THE ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979

In accordance with the *Environmental Planning and Assessment Act 1979* (the Act), an environmental impact statement (EIS) must meet the following requirements.

Content of EIS

Pursuant to Schedule 2 and clause 51 of the *Environmental Planning and Assessment Regulation 1994* (the Regulation), an EIS must include:

1. A summary of the environmental impact statement.
2. A statement of the objectives of the development or activity.
3. An analysis of any feasible alternatives to the carrying out of the development or activity, having regard to its objectives, including:
   (a) the consequences of not carrying out the development or activity; and
   (b) the reasons justifying the carrying out of the development or activity.
4. An analysis of the development or activity, including:
   (a) a full description of the development or activity; and
   (b) a general description of the environment likely to be affected by the development or activity, together with a detailed description of those aspects of the environment that are likely to be significantly affected; and
   (c) the likely impact on the environment of the development or activity, having regard to:
      (i) the nature and extent of the development or activity; and
      (ii) the nature and extent of any building or work associated with the development or activity; and
      (iii) the way in which any such building or work is to be designed, constructed and operated; and
      (iv) any rehabilitation measures to be undertaken in connection with the development or activity; and
   (d) a full description of the measures proposed to mitigate any adverse effects of the development or activity on the environment.
5. The reasons justifying the carrying out of the development or activity in the manner proposed, having regard to biophysical, economic and social considerations and the principles of ecologically sustainable development.
6. A compilation, (in a single section of the environmental impact statement) of the measures referred to in item 4(d).
7. A list of any approvals that must be obtained under any other Act or law before the development or activity may lawfully be carried out.
8. For the purposes of Schedule 2, the principles of **ecologically sustainable development** are as follows:
   (a) The precautionary principle - namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
   (b) Inter-generational equity - namely, that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.
   (c) Conservation of biological diversity and ecological integrity.
   (d) Improved valuation and pricing of environmental resources.

Note

The matters to be included in item (4)(c) might include such of the following as are relevant to the development or activity:

(a) the likelihood of soil contamination arising from the development or activity;
(b) the impact of the development or activity on flora and fauna;

(c) the likelihood of air, noise or water pollution arising from the development or activity;
(d) the impact of the development or activity on the health of people in the neighbourhood of the development or activity;
(e) any hazards arising from the development or activity;
(f) the impact of the development or activity on traffic in the neighbourhood of the development or activity;
(g) the effect of the development or activity on local climate;
(h) the social and economic impact of the development or activity;
(i) the visual impact of the development or activity on the scenic quality of land in the neighbourhood of the development or activity;
(j) the effect of the development or activity on soil erosion and the silting up of rivers or lakes;
(k) the effect of the development or activity on the cultural and heritage significance of the land.

An environmental impact statement referred to in Section 77(3)(d) of the Act shall be prepared in written form and shall be accompanied by a copy of Form 2 of the Regulation signed by the person who has prepared it.

Procedures for public exhibition of the EIS are set down in clauses 55 to 57 of the Regulation.

Attention is also drawn to clause 115 of the Regulation regarding false or misleading statements in EISs.

Note

Should the development application to which the EIS relates not be made within 2 years from the date of issue of the Director-General's requirements, under clause 52(5) of the Regulation the proponent is required to reconsult with the Director-General.

Department of Urban Affairs and Planning

ATTACHMENT NO 2a

ADVICE ON THE PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT (EIS) FOR AN EXTRACTIVE INDUSTRY

Extractive industries have prompted considerable public controversy in the past since, among other things, they affect visual amenity, generate heavy vehicle movements, raise dust and cause disturbance through noise and blasting. This is the prime reason for designation of extractive industries under the Environmental Planning and Assessment Act, 1979.

The purpose of this paper is to outline various issues relevant to the preparation and consideration of an EIS for extractive industries. It is intended to assist the preparation of the EIS. However, it is the applicant's responsibility to identify and address as fully as possible the matters relevant to the specific development proposal in complying with the requirements for EIS preparation (see Attachment No 1).

The matters nominated in this paper are not intended as a comprehensive identification of all issues which may arise in respect of an extractive industry. Some of the issues nominated may not be relevant to a specific proposal. On the other hand, there may be other issues, not included, that are appropriate for consideration in the EIS.

Information provided should be clear, succinct and objective and where appropriate be supported by maps, plans, diagrams or other descriptive detail. The purpose of the EIS is to enable members of the public, the consent authority (usually the Council) and the Department of Urban Affairs and Planning to properly understand the environmental consequences of the proposed development.

1. Description of the proposal.

The description of the proposal should provide general background information on the location and extent of the works proposed, an indication of adjacent developments, and details of the site, land tenure, zonings and relevant forward planning proposals and any other land use constraints.

The EIS should address the compatibility of the proposal with any regional strategy for extractive industries in the area and with the provisions of the Local Environmental Plans for existing and proposed development.

This section should provide specific information on the nature, intent and form of the development. It should, as far as possible, include such details as the processes involved (highlighting any proposed crushing or blasting), disposal of wastes, landscaping and site rehabilitation. A description should also be provided of associated operations such as the transport of materials and use of the end product if likely to have environmental implications.

Particular details that may be relevant include:

- Characteristics and economic significance of the resource.
- Possible availability of alternative resources.

- Quantity of materials to be extracted.
- Details of any blasting and/or crushing.
- Effects of vibrations.
- Type of machinery and equipment to be used for dredging and stockpiling operations and for any processing plant.
- Expected life of the operation.
- Hours of operation.
- Details of necessary stockpiling.
- Access arrangements - truck routes, truck numbers etc.
- Site drainage and erosion controls.
- Proposals for rehabilitation.

2. Description of the Environment.

This should provide details of the environment in the vicinity of the development site and also of aspects of the environment likely to be affected by any facet of the proposal. In this regard, physical, natural, social, archaeological and economic aspects of the environment should be described to the extent necessary for assessment of the environmental impact of the proposed development.

3. Analysis of Environmental Impacts.

Environmental impacts usually associated with extractive industries are listed below. Where relevant to the specific proposal, these should be addressed in the EIS, taking into account the adequacy of safeguards proposed to minimise them.

- The flow of any affected rivers or watercourses.
- The effect of the extraction on the sediment transport rate of any affected rivers or watercourses.
- The bed and bank stability of any affected rivers during and after completion of the operations and any need for recurrent maintenance dredging.
- Any possible siltation, sedimentation or downstream effects of the operation.
- Any likely cumulative effects of the proposed operation when considered together with other operations in the vicinity.
- Details of floods and any likely effects of the operation on flood liability of surrounding lands.
- The possible effects of flooding on the operation.
- Effects on flora and fauna.
- The agricultural viability of the land holding.
- Likely noise/vibration disturbance caused by the operations, including transport operations, on nearby residences.

- Other impacts of trucking movements, including access over railways and onto highways.
- Dust nuisance likely to be caused.
- Effects on water quality of nearby watercourses.
- Disposal of waste material.
- Effects on the visual environment.
- Any likely affectation of sites of Aboriginal archaeological or European heritage value if located in the vicinity of operations.
- Impact of the operations on navigation aspects for all types of shipping (commercial, recreational, etc.).

In addition, any potential for hazard or risks to public safety and any proposals to monitor and reduce environmental impacts should be included.

4. Contact with relevant Government Authorities.

In preparing the EIS, it is suggested that authorities, such as those listed below, should be consulted and their comments taken into account in the EIS.

- The Environment Protection Authority in regard to air, water and noise impacts and relevant pollution control legislation requirements;
- The Department of Mineral Resources concerning its responsibilities under Sydney REP No 9 Extractive Industry;
- The Department of Water Resources concerning the implications of the proposal on their jurisdiction;
- The Department of Conservation and Land Management regarding appropriate erosion control and rehabilitation procedures;
- The Department of Agriculture if prime agricultural land may be affected by the proposal;
- New South Wales Fisheries if the proposal is for extraction of resources in or adjacent to a waterway;
- The Heritage Council of NSW if the proposal is likely to affect any place or building having heritage significance for the State; the National Parks and Wildlife Service if aboriginal places or relics are likely to be affected.
- The Maritime Services Board in relation to navigational aspects of shipping; and
- The Public Works Department in relation to hydrological impacts and relevant legislative requirements.

It is the responsibility of the person preparing the EIS to determine those Departments relevant to the proposed development.

Department of Urban Affairs and Planning

ATTACHMENT NO 2b

ADVICE ON THE PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT (EIS) FOR AN INDUSTRIAL WASTE DISPOSAL DEVELOPMENT

The purpose of this paper is to outline various issues relevant to the preparation and consideration of an EIS for an industrial waste disposal development. It is intended to assist the preparation of the EIS. It is the applicant's responsibility to identify and address as fully as possible the matters relevant to the specific development proposal in complying with the statutory requirements for the EIS preparation (see Attachment No 1).

The matters nominated in this paper are not intended as a comprehensive identification of all issues which may arise in respect of this type of development. Some of the issues nominated may not be relevant to a specific proposal. On the other hand, there may be other issues, not included, that are appropriate for consideration in the EIS.

Information provided should be clear, succinct and objective and where appropriate be supported by maps, plans, diagrams or other descriptive detail. The purpose of the EIS is to enable members of the public, the consent authority (usually the Council) and the Department of Urban Affairs and Planning to properly understand the environmental consequences of the proposed development.

1. Existing Environment

The EIS should pay particular attention to the following matters when describing the existing environment:

i) planning controls: - development control and land use (present and anticipated) should be determined through consultation with Council. If investigations lead to identification of sites at the boundary of the local government area you should also consult with neighbouring local councils.

   Adjacent land use, including the location and distance to residences and other occupied buildings should be mapped for subsequent assessment.

ii) geography: - assess the potential for wind as well as drainage (katabatic drift) of odours relative to adjacent land use. The potential for airborne matter should also be assessed.

iii) hydrology: - water is generally a valuable resource and in many cases the presence of water courses and drainage lines will limit the utility of sites. Design of the site must incorporate drainage work to prevent unnecessary contamination of rainfall runoff, and ensure that any runoff which is contaminated can be stored and treated. The liability of the site to flood inundation should also be assessed. Information in this regard should be sought from the Department of Water Resources and the Council.

iv) soils:- soils over certain areas may be highly permeable and the advice of the Soil Conservation Service should be sought at the outset, with regard to soil mapping.

v) hydrogeology:- consideration of groundwater resources may also be relevant. The advice of the Department of Land and Water Conservation should be sought to ascertain the location and depth of aquifers, ground water drainage directions, water quality, present usage and potential, groundwater recharge areas and any other information on the dynamics of this resource, having regard to the effect of other adjacent land uses such as irrigation, on rise in water tables.

vi) vegetative cover:- In many agricultural and urban areas the existence of natural vegetation may assume special significance. In this sense selection of a cleared site would be preferable to an uncleared site.

Wetlands are also important nature conservation areas and site selection near a wetland may result in degradation from site runoff.

vii) truck routes: - consideration should also be given to likely truck routes. Scenic and tourist drives should be avoided and the route should be flood free.

2. Description of proposal

This description should not only describe the proposal at the site but also describe all associated operations such as handling and transport of materials, disposal of wastes, and pollution control safeguards.

Particular matters to be covered include:

- Criteria used in selecting the proposed site and justification of that selection, (particularly in terms of safety and pollution issues), including consideration of feasible alternatives to the proposal and reasons for their rejection.
- Full description of any further extractive works which will occur, including volumes of materials to be extracted, proposed use of extractive material.
- A list of the major chemical materials, plus any hazardous materials, to be disposed of, and the amounts to be disposed of.
- A brief description of the type of machinery and equipment to be used.
- A description of the safety, pollution and environmental controls incorporated into the proposal.
- Details of quantities stored and storage arrangements of materials, with safeguards proposed to control their impact on the environment, in particular the storage and disposal of flammable, toxic or hazardous chemicals.
- Transportation arrangements including means of access to site, details of on-site parking and loading/unloading and mode of transport proposed for receiving raw materials, including details of proposed haul roads.
- Workforce requirements, including transport workforce.
- Hours of operation.

- Proposals for any intended future expansion, including a statement of any proposals for staging of the proposed development and the likely implementation timing.

3. Site management

Handling of wastes will to some extent be defined by the nature of wastes, the quantities involved and the site characteristics. The Department encourages recycling of packaging and other materials. The opportunity should be investigated for establishing a facility to handle glass, ferrous metal, aluminium, paper and certain plastics for recycling. While storage areas for recycling will take up some of the area of the depot, the life of the depot may be significantly increased and the amount of earthworks reduced by sorting. The potential for recycling/recovery of waste materials could be discussed with the Environment Protection Authority.

There are several advisory documents on this aspect of waste disposal and it is suggested that specific reference be made to the the Environment Protection Authority's Environmental Standards WDI - "General Condition of Approval for Land Fill Waste Disposal Depots" and WD2 - "Environmental Criteria for Landfill Waste Disposal in New South Wales".

A number of substances are also subject to the Environmentally Hazardous Chemicals Act 1985. Substances may for instance be listed as a chemical waste, or be subject to a chemical control order under this Act. The EIS should clearly specify any substances to be received at the facility which are so classified, and demonstrate that all EPA requirements will be complied with.

Medical Wastes

The EIS should clearly specify whether any medical wastes are to be received and outline proposals for safe handling of these substances.

The EIS should also demonstrate that there is no significant threat to human health from these substances.

Asbestos

The EIS should clearly specify whether any asbestos bearing material is to be received by the facility. Measures to prevent the dispersion of any asbestos fibres should be clearly specified in the EIS.

Toxic and Hazardous Materials

Any toxic and hazardous wastes to be received by the facility should be clearly described and identified. The likely environmental impact of these substances should be identified and measures to mitigate their impact should be proposed.

Any likely impacts of these substances on human health (in the case of people living near, and working at the site) should be specified, and measures taken to protect the health of workers and nearby residences from these effects should be specified.

In the event that toxic or hazardous substances are to be disposed of, the EIS should include a preliminary hazard analysis.

The preliminary hazard analysis should include:

- A comprehensive identification of possible sources and causes of potentially hazardous incidents;
- A detailed outline of all operational and organisational safety controls, and their basis;
- A generalised consequence/probability quantification of the most relevant hazardous incidents identified above;
- An assessment of cumulative risk levels expected from the proposed development and safety implications for surrounding land uses.

The adequacy of the proposed safeguards should be evaluated against the risk levels above.

In addition to the matters mentioned in 'B' above, the EIS should include:

- An outline of emergency/counter-disaster principles for the installation and commitments that existing procedures will be reviewed and updated before commissioning;
- Commitments for hazard and operability studies to be undertaken as an integral part of the design;
- A comprehensive description of fire prevention and protection measures with details of the basis upon which they have been formulated;
- Commitments for a detailed fire safety study as part of the design.

4. Analysis of environmental impact

Assessment of the environmental impact and measures to be adopted to ameliorate impacts especially with regard to:

- Water pollution controls, surface and groundwater, monitoring measures.
- Likely noise disturbance caused by the operations, including transport operations, on nearby residences.
- Other impacts of trucking movements.
- Gas movement, odour, monitoring measures.
- Treatment and disposal of solids and sludge.
- Landscaping measures and effects on the visual environment.
- Any likely affectation of sites of Aboriginal archaeological or heritage value if located in the vicinity of the operations.
- identification and assessment of impact associated with any further extraction works.

5. Alternatives

The EIS should assess strategies which may enable resource recovery, or recycling as an alternative to this proposal or to reduce the scale of this proposal.

It should be noted that in some cases the proposed recovery of waste products may involve manufacture of chemicals or separation of materials and storage of chemicals such that the processes and operations may in themselves be designated developments as defined by the Regulation.

6. Contact with other authorities

In preparing your EIS it will be necessary to consult with various authorities concerning licenses and approvals for the proposal or where the proposal may affect some aspect within their administration. The following authorities may have an interest in your proposal:

- State Pollution Control Commission
- Department of Water Resources
- Department of Agriculture and NSW Fisheries
- Soil Conservation Service Division of Department of Conservation and Land Management
- Department of Health
- Roads and Traffic Authority
- National Parks and Wildlife Service

It is however your responsibility to determine the authorities appropriate for consultation. Any response received should be incorporated in the EIS.

7. Monitoring

The EIS should discuss the need for an ongoing monitoring program.

APPENDIX B
RESOURCE AND QUALITY INVESTIGATION

CSR Limited

Monier PGH Holdings Limited

PGH Schofields Quarry

Resource and Quality Investigation

Compiled by :

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

January 1997

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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 Schofields. This quarry supplies part of the raw materials used within PGH brick and paver plants located at Schofields , Cecil Park , Horsley Park and Doonside.

The quarry is located at Schofields , approximately 17 kilometres north west of Parramatta. Access to the quarry is via Meadow Road / Townson Road , which is an easterly junction off Richmond Road.

The quarry operation on the site was originally established during 1963 by Autobric Industries Pty Ltd , since 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

The PGH quarry is located on Lot 3 DP 232474 within the Parish of Gidley and County of Cumberland. Lot 3 is owned by freehold title by a business unit of CSR , Monier PGH Holdings Limited.

The property covers 46 hectares and is separated into two land parcels by Townson / Meadows Roads. Lot 3 is located within the Blacktown Local Government Area.

Lot 3 is identified within Sydney REP No. 9 as an significant source of brick making clay and shale of significance.

3.0 Geology

3.1 Regional Setting

Sydney Basin

Sydney is located within 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 the 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.

Wianamatta Group

The Wianamatta Group is the top most unit of the Sydney Basin sediments and is of Mid Triassic age. The Wianamatta Group is distribution covers most of the central Sydney region and extends to the south west to the Southern Highlands , as highlighted on Figure 1.

The Wianamatta Group consists of four units , shown on Figure 2 , which conformably overlie the well known Hawkesbury Sandstone. The lowest unit , the Mittagong Formation , is a transitional unit of 0 - 15 metres thickness between the Hawkesbury Sandstone and the Ashfield Shale.

The Ashfield Shale consists of sideritic claystone and siltstone which grades to a laminite sequence. The Ashfield Shale ranges in thickness from 40 to 60 metres. The Ashfield Shale was deposited within a marine environment.

The Minchinbury Sandstone overlies the Ashfield Shale and is between 0 to 6 metres thick. This sand consists of fine grained sediments deposited within a beach environment.

The Bringelly Shale is the upper most unit and consists of a complex sequence of shaley sediments which vary from claystone , siltstone , laminate to sandstones. The Bringelly Shale is approximately 250 metres thick and was deposited within a coastal plain environment.

Figure 1 : *Distribution of Wianamatta Group*

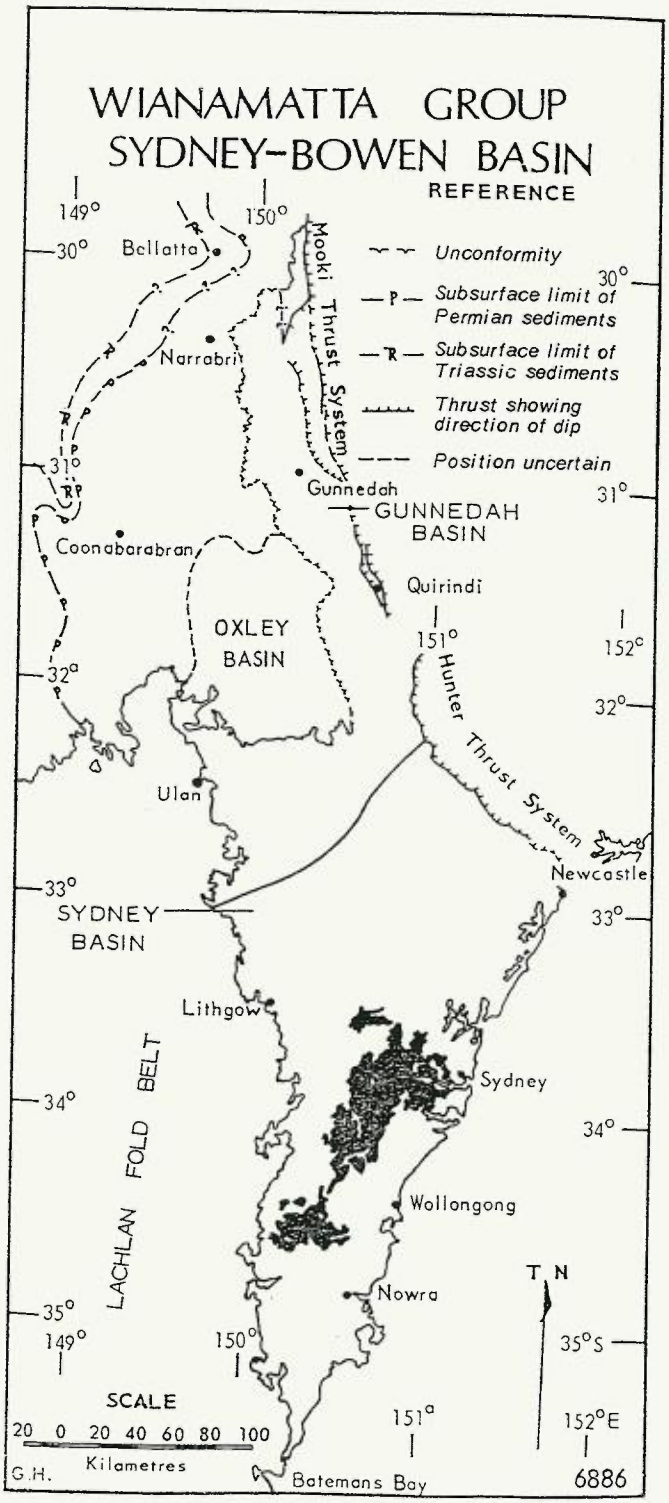
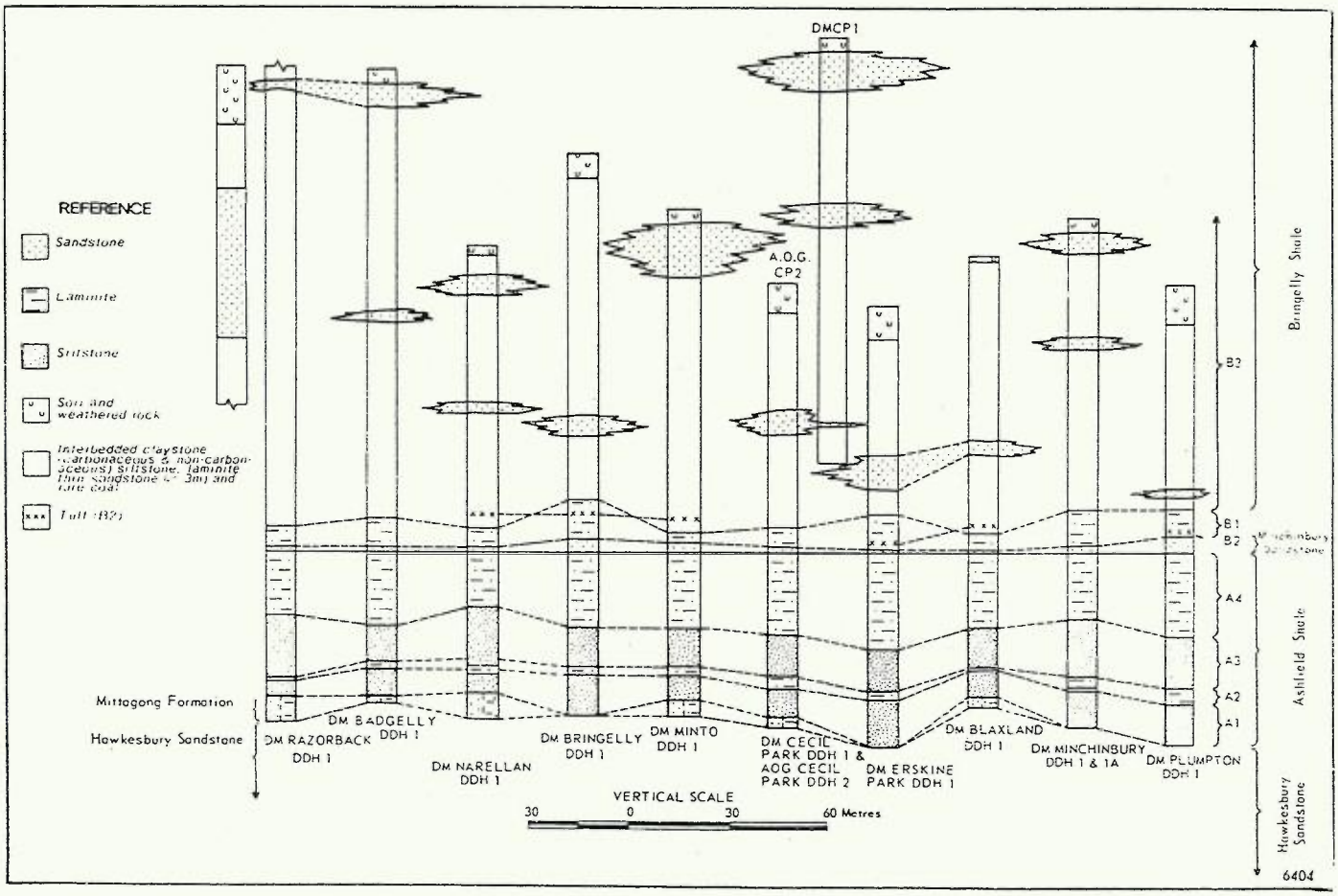


Figure 2 : *Lithologies of the Wianamatta Group*



3.2 Bringelly Shale

The dominate lithologies of the Bringelly Shale are claystones and siltstones although laminates occur throughout the sequence. Carbonaceous claystones occur mainly within the lower parts of the sequence and sandstone occurs commonly as localised lenses of varying thickness.

The Bringelly Shale was deposited by meandering streams with extensive floodplains. The finer sediments such as the claystones and siltstones were deposited during times of overbank sedimentation and the laminates and carbonaceous claystones were deposited within swampy billabongs or lagoons. The sandstone were deposited as alluvial streams which cut through the low lying swampy coastal plain sediments.

The most common lithologies of the Bringelly Shale consists of light to dark grey to black fine grained sediments with varying concentrations of carbonaceous material. Plant debris and fossil roots are common due to the preservation of fossil soils formed during sedimentation. Siderite nodules are disseminated throughout the sediments but commonly occur in discrete lenses.

The fine grained sediments of the Bringelly Shale consist of mainly fine grained quartz and clay minerals. The dominate clay minerals are kaolinite and a mixed layer illite - smectite clay assemblage. Siderite occurs throughout the sediments up to 25 % and minor amounts of feldspar , calcite and other trace minerals are present.

The Bringelly Shale commonly has a weathering profile which extends to depths of up to 15 metres from the surface. Commonly a distinctive weathering profile is developed.

Generally a light coloured heavily leached zone of plastic clay extends from the surface for several metres overlying a zone of brown weathered shale. This zone is generally brown due to oxidation of the leached iron from the upper zone.

3.3 Site Geology

Approximately 5 separate drilling investigations have been completed over recent years to evaluate the geology of the site in detail. Simplified drill logs are included within Appendix No. 1 and drill hole locations are identified on Drawing No. 2.

A total of 34 percussion holes and 9 diamond drill holes have been drilled covering a total of 1033.5 linear metres. Twenty one of the percussion holes were drilled on the southern property and the 9 diamond drill holes were all drilled within the northern property.

The drill information available over the site has been assessed in conjunction with the exposures contained within the current quarry to develop a detailed geological section of the site which is used to assist in mine scheduling and operations.

The geological section of the northern property is well defined due to the diamond drill holes which allow the different stratigraphic units to be correlated easily. In the future a diamond drilling programme is required on the southern property to finalise the geological section in advance of the final stages of extraction from this area.

Geological Section - Northern Property

0 - 1 metres	Topsoil	
0 - 2 metres	Pink Clay	burns light to salmon pink colour
2 - 3 metres	Brown Shale	burns terra cotta colour
3 - 15 metres	Grey Shale	*Cream lenses* - burns driftwood colour *Apricot lenses* - burns mushroom pink to apricot colour
15 - 20 metres	Sandstone	
20 + metres	Grey Shale	mainly burns apricot colour

The pink clay and brown shale at the site represent the typical Bringelly Shale weathering features discussed above.

The grey shale below the pink clay and brown shale consists of 1 to 2 metre lenses of laminates and claystones which either burn a cream colour or a apricot colour.

The laminate lenses generally burn a cream colour due to lower percentages of siderite while the siltstone and claystone lenses burn a apricot colour and contain a higher percentage of siderite mineralisation.

This grey shale section is selectively mined to provide stockpiles of cream burning and apricot burning clays to be blended during the brickmaking process.

A distinctive sandstone lense occurs at the base of the quarry and from the diamond drilling is intersected over the whole northern property at approximately RL 15. The sandstone lense ranges in thickness from two to six metres and dips gently towards the south east.

Grey shale below the sandstone mainly burns apricot and only minor lenses of cream burning shale being noted.

Southern Property - Geological Section

0 - 0.5 metres	Topsoil	
0.5 - 5 metres	Pink Clay	burns salmon pink colour
5 - 7 metres	Brown Shale	burns terra cotta colour
7 - 13 metres	Grey Shale	burns cream to apricot colours
13 - 25 metres	Grey Shale	burns apricot , pink/brown colours

The southern property has similar surface lithologies as that of the northern property which follow the typical Bringelly Shale weathering profile.

The upper unit of grey shale has mixed cream and apricot lenses which can be selective mined.

The southern property differs from the northern property by the absence of the thick sandstone lense. Several minor sandstone lenses were encountered in the drilling but only of thickness up to 0.5 metres suggesting that the sandstone found on the northern property lense out in this area.

The grey shale below the cream burning grey shale unit consists of a series of mixed layers which burn a range of colours depending upon the amount of siderite contained within the sediments.

A future diamond drilling programme is planned to finalise the geological section developed for the southern property.

4.0 Reserves

Reserves of clay and shale for brickmaking purposes have been calculated from 6 stages of development at the site.

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

Drawings No. 3 to Drawing No. 8 outline the proposed development stages.

Drawing No. 9 shows the final rehabilitated surface levels.

Drawings No. 10 to 12 outline cross sections over the site showing the proposed extraction pit base and the final landfill surface.

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 North West Surveys Pty Ltd and Geospectrum Pty Ltd.

Air space available on the site to be landfilled 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 -	18 metres wide , 1 in 10 gradient
Batter slopes -	55° from the horizontal
Distance between crests -	25 metres
Distance between haul road and crest -	5 metres
Distance between toe of bunds and crest -	20 metres
Density conversion factor -	2.0 t / m^3
Max. quarry production -	240,000 tonnes per year
Landfill rate -	120,000 tonnes per year
Landfill compaction density -	1 tonne per 1 m^3 airspace

The quarry pit bases on the northern property were taken to approximately RL 15 to near the top of the thick sandstone lense. The southern pits bases were set at RL 0 as the thick sandstone lenses does not occur in this location.

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 from 20 to 30% of the insitu reserves. This waste material is currently used for bund construction and site works. Once landfilling operations recommence on the site some waste will also be used as daily cover and final capping with the remainder export / sold from the site as fill material.

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

Quarry			
Stage	*m³*	*tonnes*	*expected life*
1	372918	745836	3.1
2	192550	385100	1.6
3	685985	1371970	5.8
4	252078	504156	2.1
5	621502	1243004	5.2
6	647607	1295214	5.4
Total	**2772640**	**5545280**	**23.3**

Landfill		
Stage	*m³*	*expected life*
A	880299	7.3
B	274261	2.3
C	724851	6.0
D	335407	2.8
E	688165	5.7
F	699202	5.8
	3602185	**30**

From each extraction Stage within the northern property the expected yield of each raw material type is approximately 20% pink clay , 10% brown shale , 22.5% apricot shale , 22.5% cream shale and 25% waste.

The expected yields from the southern property are expected to be similar to the northern property and will be confirmed in the future following the completion of a diamond drilling programme on the site.

5.0 Quality

The Wianamatta Group of sediments is the main source of structural ceramic material used within the Sydney region. Historically the low plasticity and dark burning Ashfield Shale was the main raw material source for brickmaking. As urbanisation covered the closer surface outcrops of this unit and brickmaking technology moved from dry press methods of making bricks to extruded methods during the 1960's , the Bringelly Shale unit has become the main source.

Herbert , 1979 outlines the ceramic potential of the Bringelly Shale in detail and the following is summarised from this report:

- average plasticity index of siltstones and claystones is 8.5 and 5.0 within the laminates.

- high green strength

- average % linear drying shrinkage of 5% in the siltstones and claystones and 3% in the laminate.

- average moisture loss of 23.5% in the claystones and siltstones and 18.3% in the laminates.

- colour varied from cream , buff , brown to apricot

Bores drilled in advance of mining operations are quality tested to assist in the selective mining process employed at the site, as are stockpiled mined material 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 Schofields material tested during 1992 and Table 3 outlines results of the most recent 1996 stockpile sampling. These reports are contained within Appendix 2.

The quality results outlined within Tables 2 and 3 confirm that the clay and shale mined at the quarry are of sufficient quality to be used for the manufacture of bricks and pavers.

Table 2 *PGH Schofields*
1992 Quality Results - Stockpile Sampling

Sample	Max. Expansion %@ x °C	Onset of Rapid Shrinkage	contraction at Quartz inversion 600-500°C	Total Shrinkage %	Fired Colour	Clay Dehydroxylation Peak Temp (°C)	Dehydroxylation weight loss %	Clay Mineral type	Quartz Content
White Clay	0.98 @ 680	900	0.16	2.44	Pale Pink	525	4.8	Kaolinite	Low
Cream Shale	0.98 @ 680	910	0.20	1.66	Pale Mauve	510	8.5	Kaolinite	Low
Brown Shale	1.10 @ 670	890	0.19	2.43	Pink	525	4.6	Kaolinite	Low
Grey Shale	0.91 @ 680	900	0.19	2.51	Buff	505	8.5	Kaolinite	Low
Red Clay	0.67 @ 630	850	0.36	1.80	Terra Cotta Orange	500	3.2	Kaolinite & Illite	High

Table 3 *PGH Schofields*
1996 Quality Results - Stockpile Sampling

Sample	Apricot Shale	Cream Shale
Max. expansion %@°C	0.79 @ 650	0.90 @ 660
Onset of rapid shrinkage °C	865	880
Return to original length °C	965	985
Contraction at quartz inversion	0.18	0.20
Total shrinkage @1050°C	2.28	1.75
weight loss 100 - 200°C	0.10	0.15
Dehydroxylation weight loss %	< 10.3	< 7.6
Dehydroxylation peak temp. °C	~495	515
quartz peak size	low	low
Loss on ignition %	10.9	8.6
Other	significant organics	some organics
Main clay mineral	Kaolinite	Kaolinite

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 1 Development (Drawing No.3)

- Relocate internal haul road around west pit extension.
- Upgrade bund wall along eastern and southern boundaries
- Upgrade water management system on the site
- Extract remaining shale reserves from the eastern section and western section of the pit.

Stage 2 Development (Drawing No.4)

- Progressively upgrade the bund along the eastern property boundary in the northern area.
- Relocate the north dam and water storage to its final position on the eastern property boundary in readiness for Stage 3 extraction.
- Extract clay and shale reserves from the Stage 2 extraction area.
- Restoration of the Stage 1 extraction void by commencing Stage A Landfill.

Stage 3 Development (Drawing No.5)

- Extract clay and shale reserves from the Stage 3 extraction area.
- Complete restoration of the Stage 1 extraction by Stage A Landfill. Commence restoration of Stage 2 extraction with Stage B landfill.

- Use waste rock and overburden to commence construction of southern bund walls.

Stage 4 Development (Drawing No.6)

- Extract clay and shale reserves from the Stage 4 extraction area.
- Complete restoration of the Stage 2 extraction by Stage B Landfill. Commence restoration of Stage 3 extraction with Stage C landfill.
- Use waste rock and overburden to commence construction of southern bund walls.

Stage 5 Development (Drawing No. 7)

- Extract clay and shale reserves from the Stage 5 extraction area.
- Complete restoration of the Stage 3 extraction by Stage C Landfill.

Stage 6 Development (Drawing No.8)

- Extract clay and shale reserves from the Stage 6 extraction area.
- Complete restoration of the Stage 4 extraction by Stage D Landfill.

Stage E and F Landfill (Drawing No.9)

- Complete restoration of the Stage 5 and 6 extraction by Stage E and F Landfill.

7.0 Conclusion

The PGH Schofields Quarry extracts clay and shale from the Bringelly Shale unit of the Wianamatta Group of sediments. The clay and shale extracted at the quarry are of suitable quality to be used as a raw material source for the manufacture of bricks and pavers.

Approximately 5.5 million tonnes of clay and shale reserves are contained within the site , including approximately 1.1 million tonnes of scarce cream burning shale.

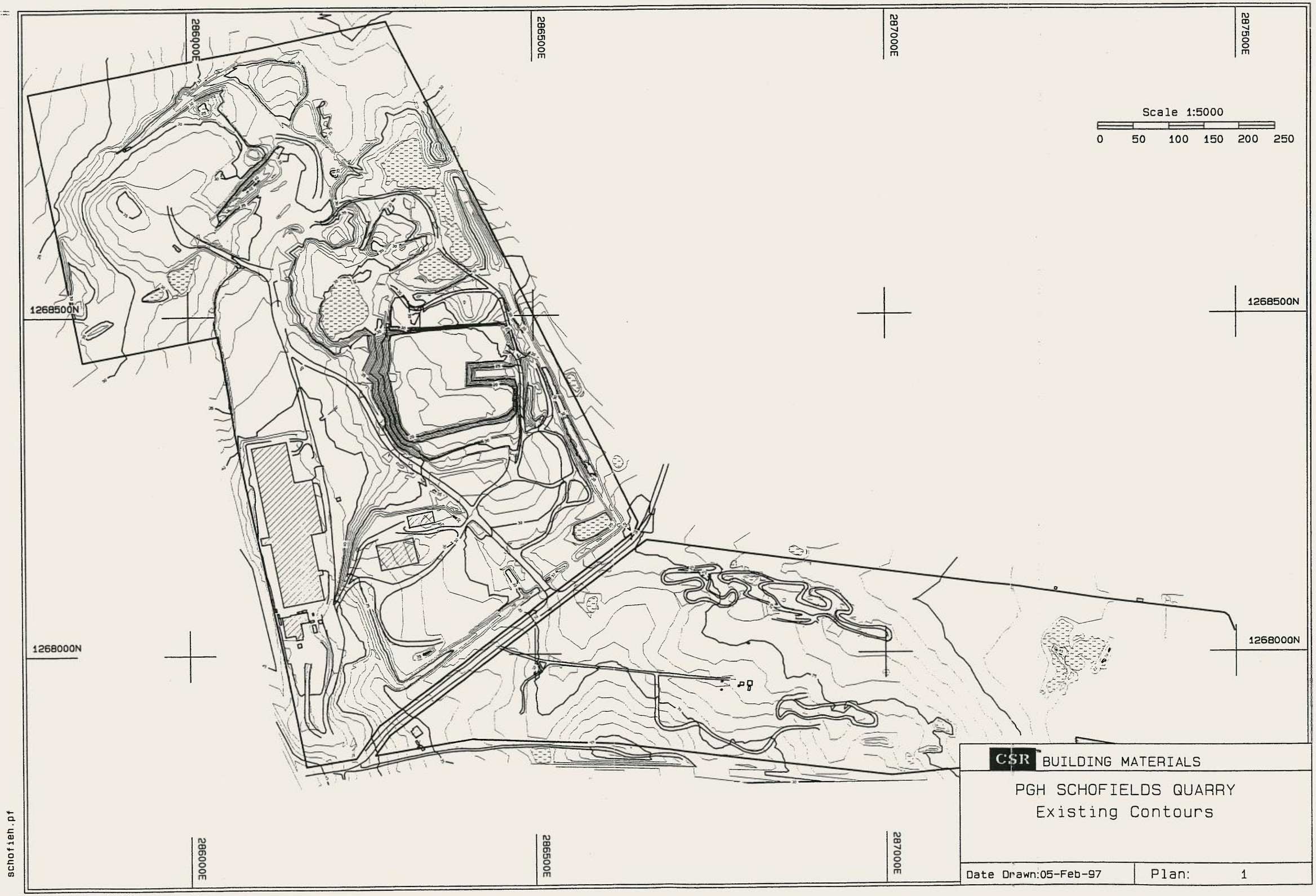
Development at the site is proposed over six progressive stages and the resultant voids are proposed to be restored by landfill to produce a final stable landform. Approximately 3.6 million m^3 of air space is available for landfill within the six development stages.

References :

C . Herbert The Geology and Resource Potential of the Wianamatta Group.

Geological Survey of NSW Bulletin 25
Department of Mineral Resources
1979

DRAWINGS.



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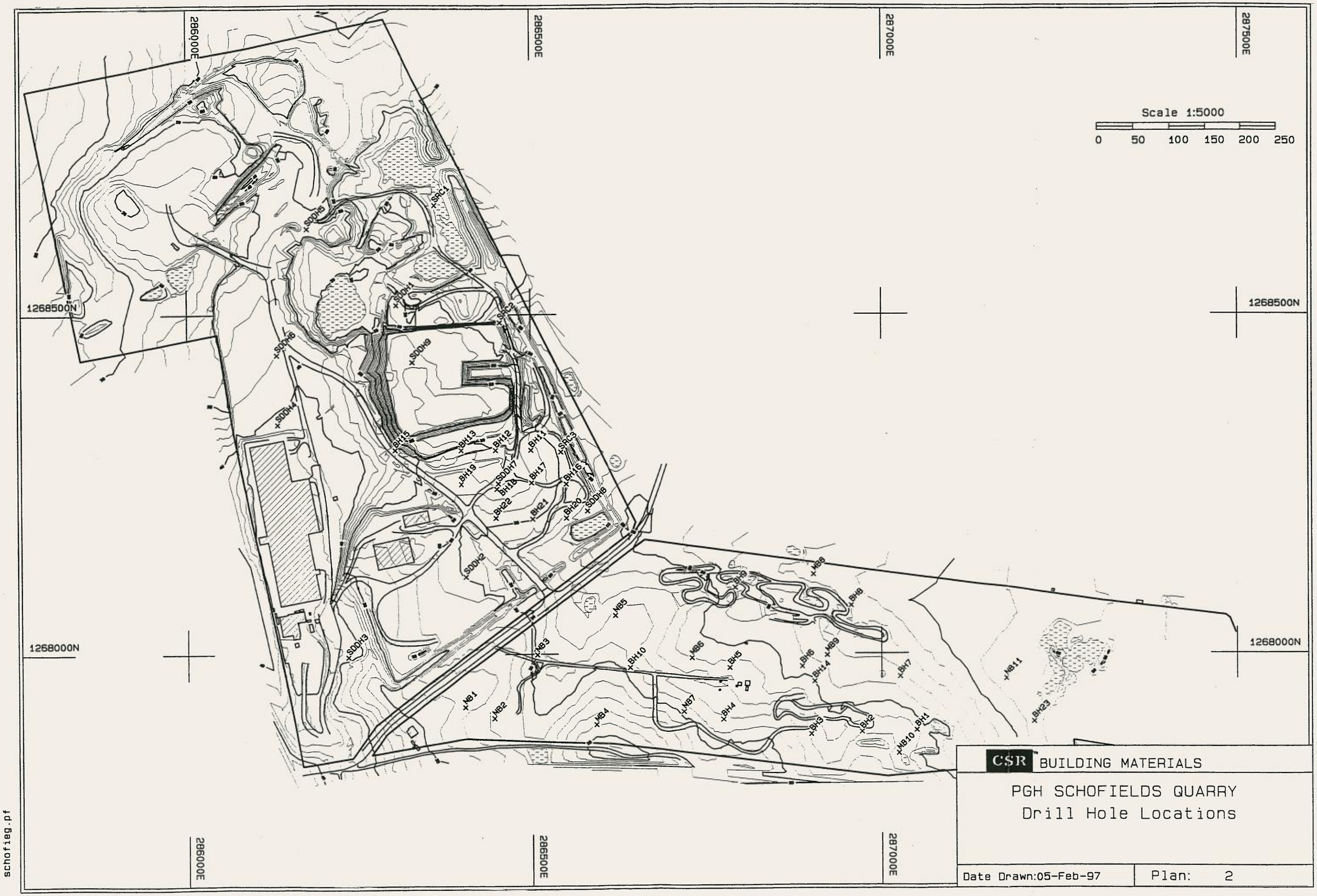
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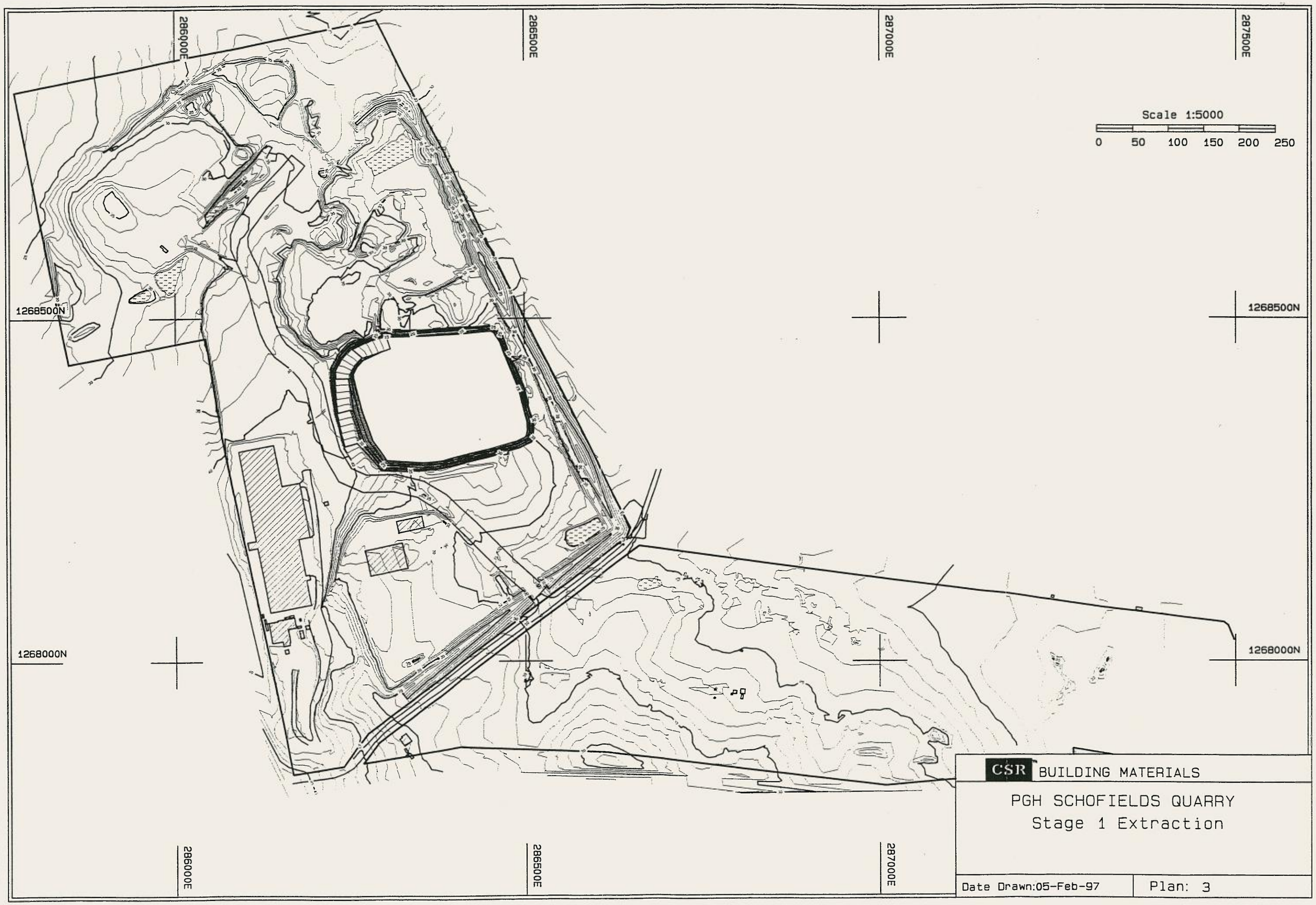

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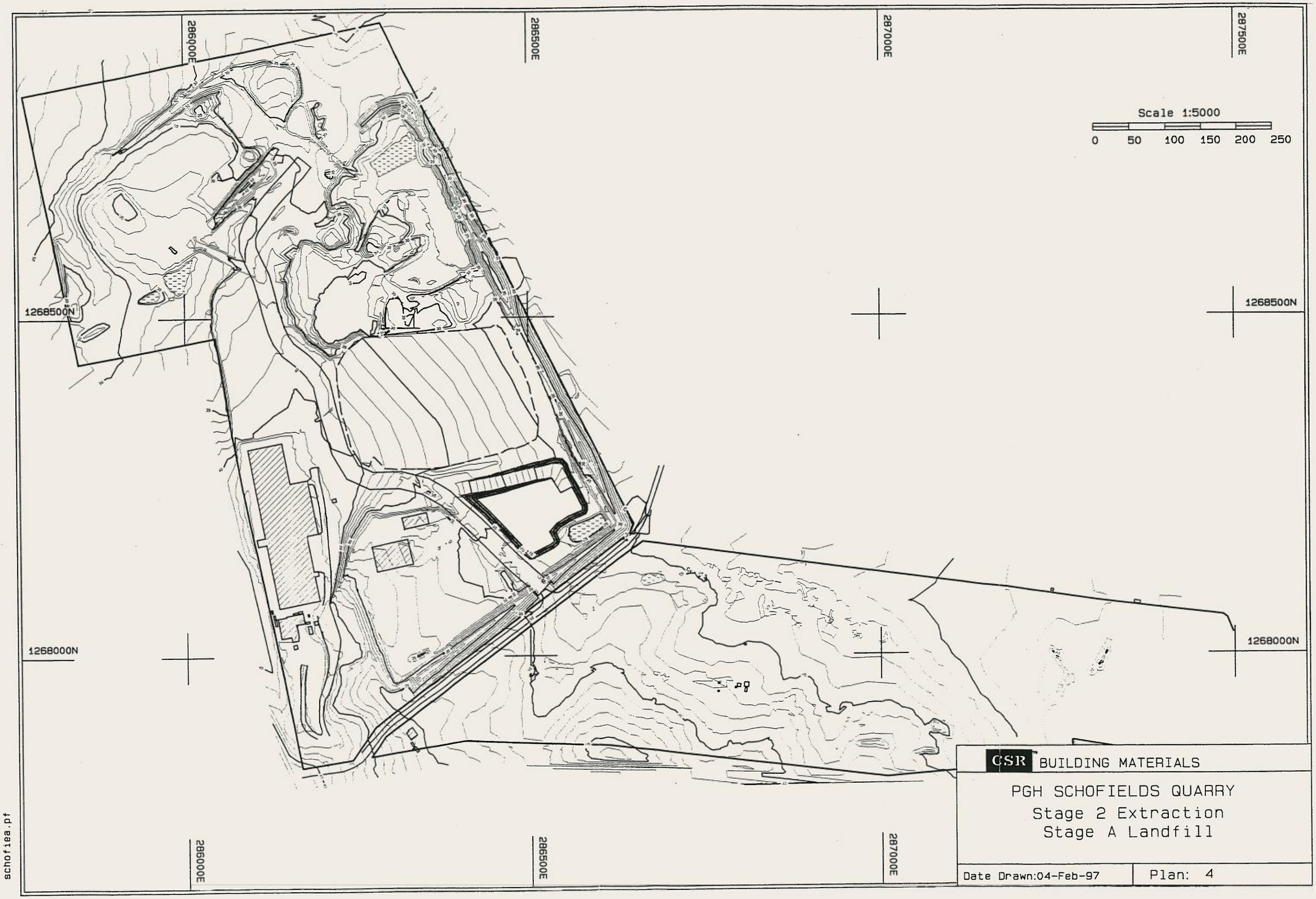
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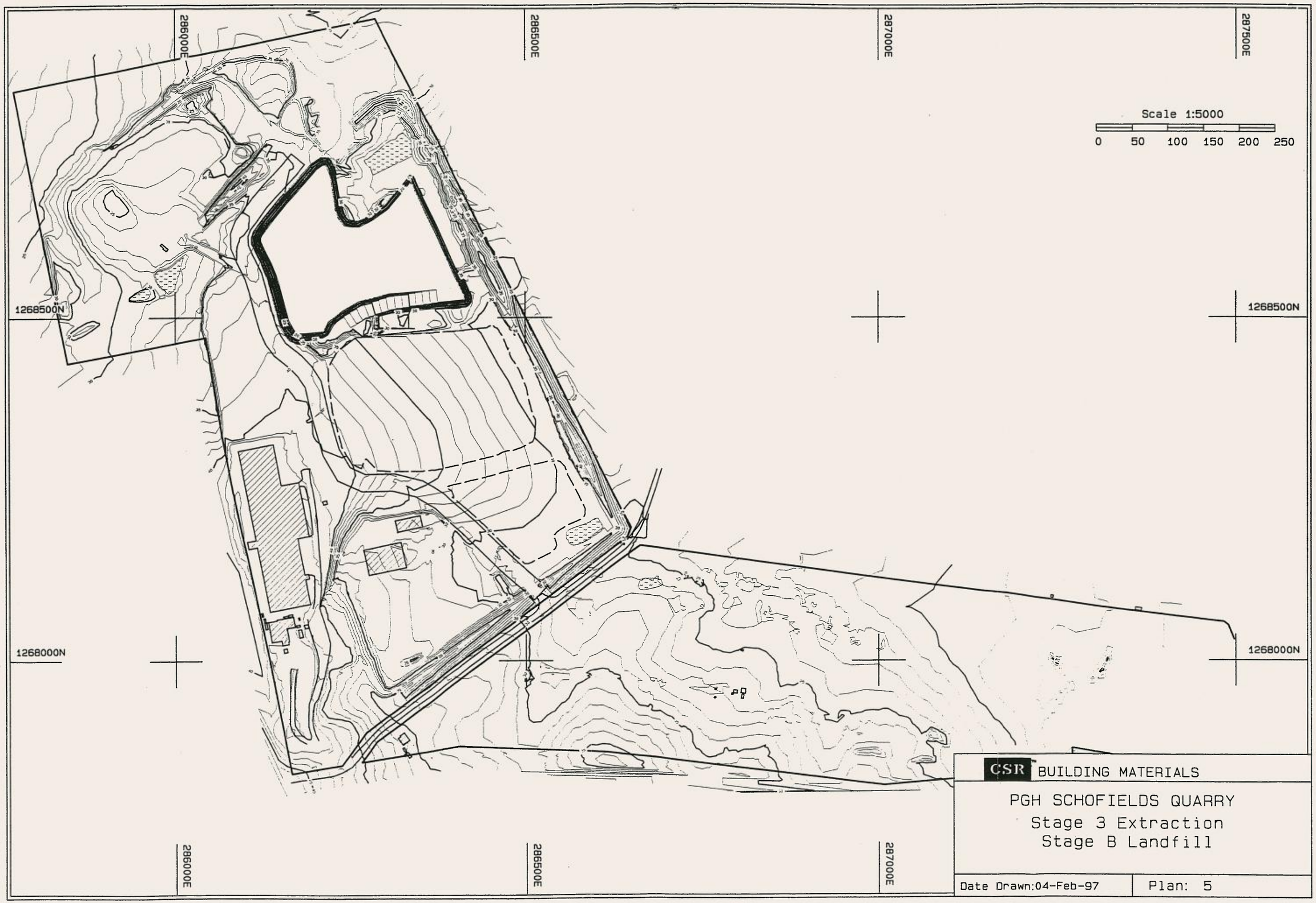

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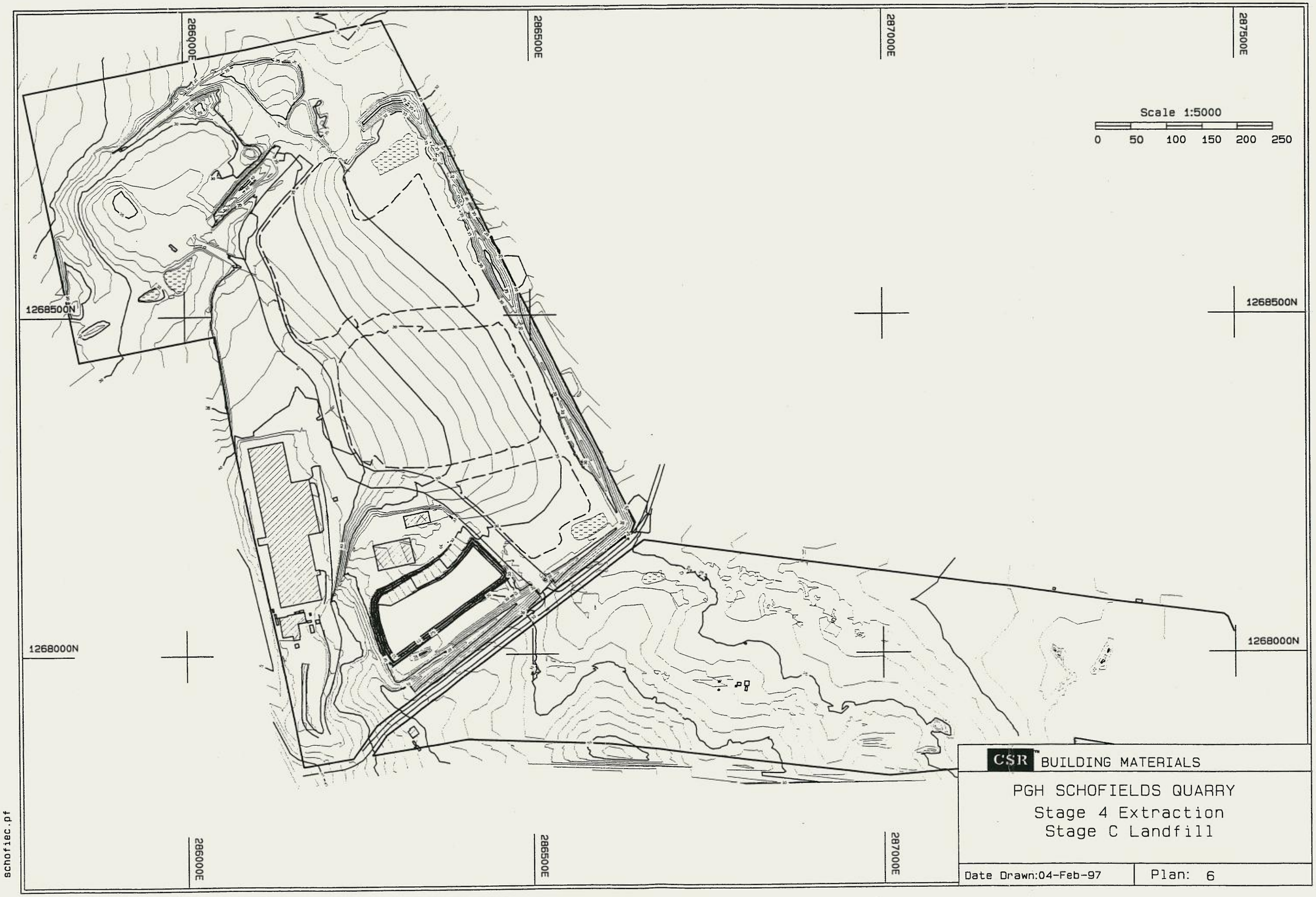

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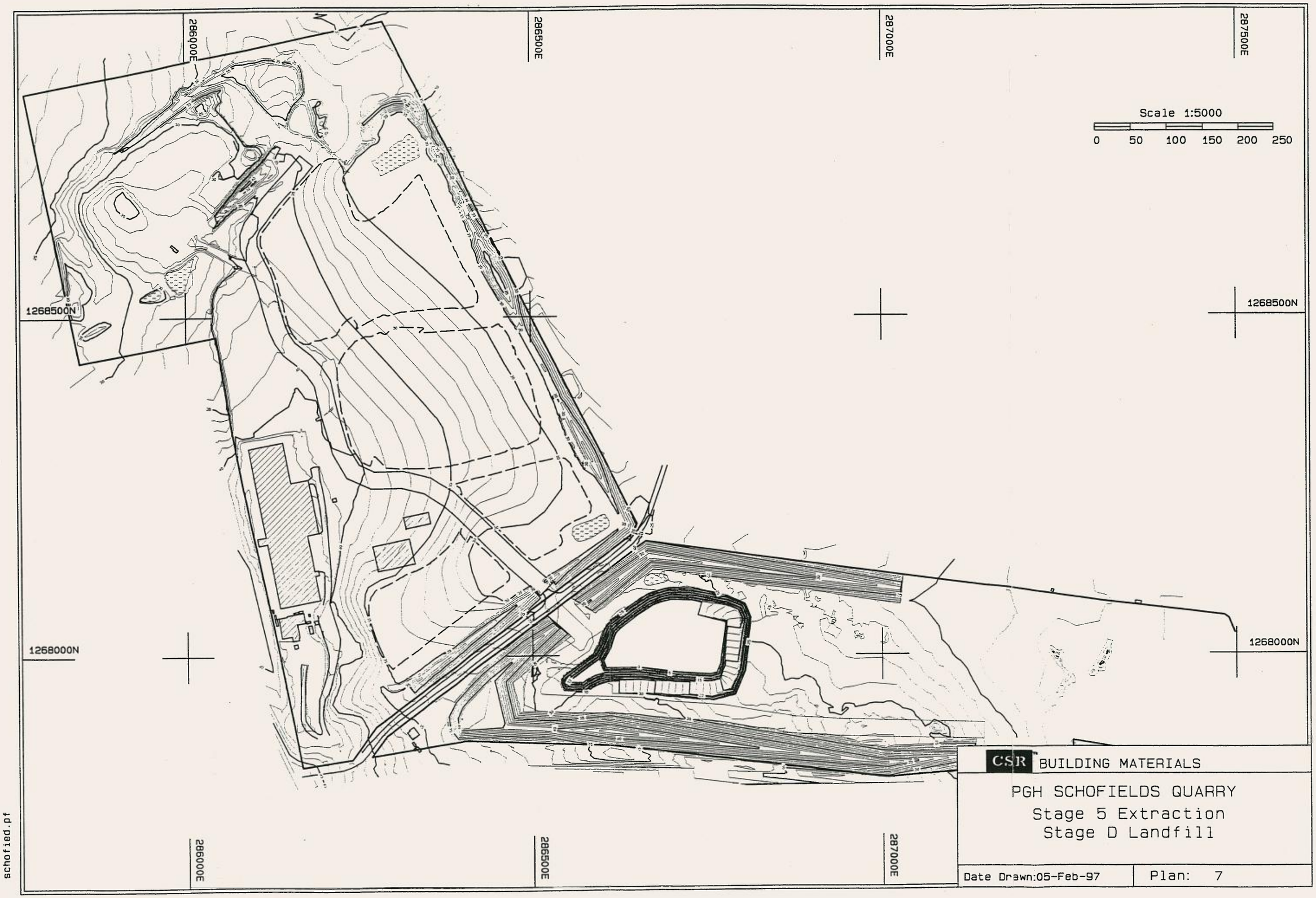

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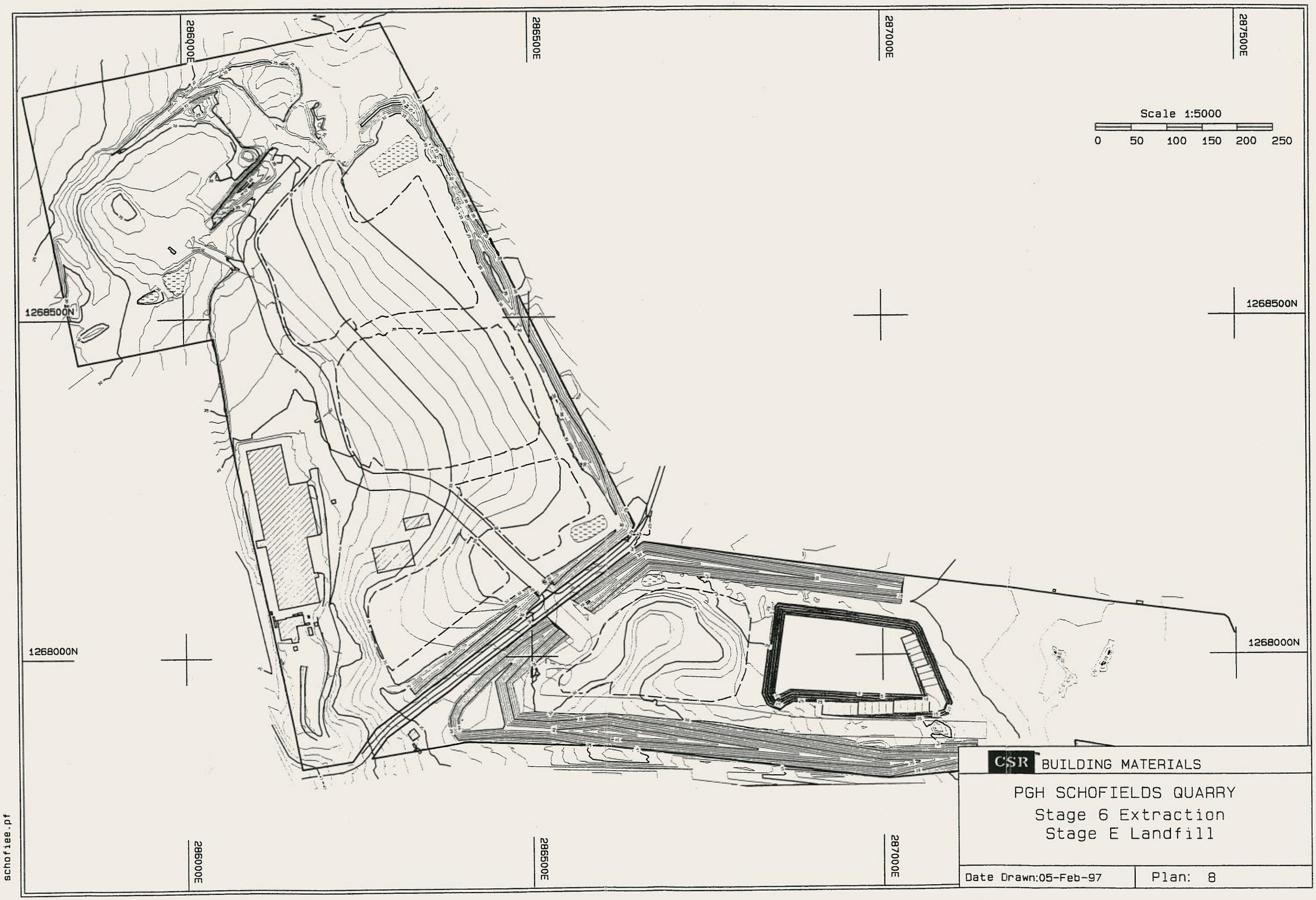

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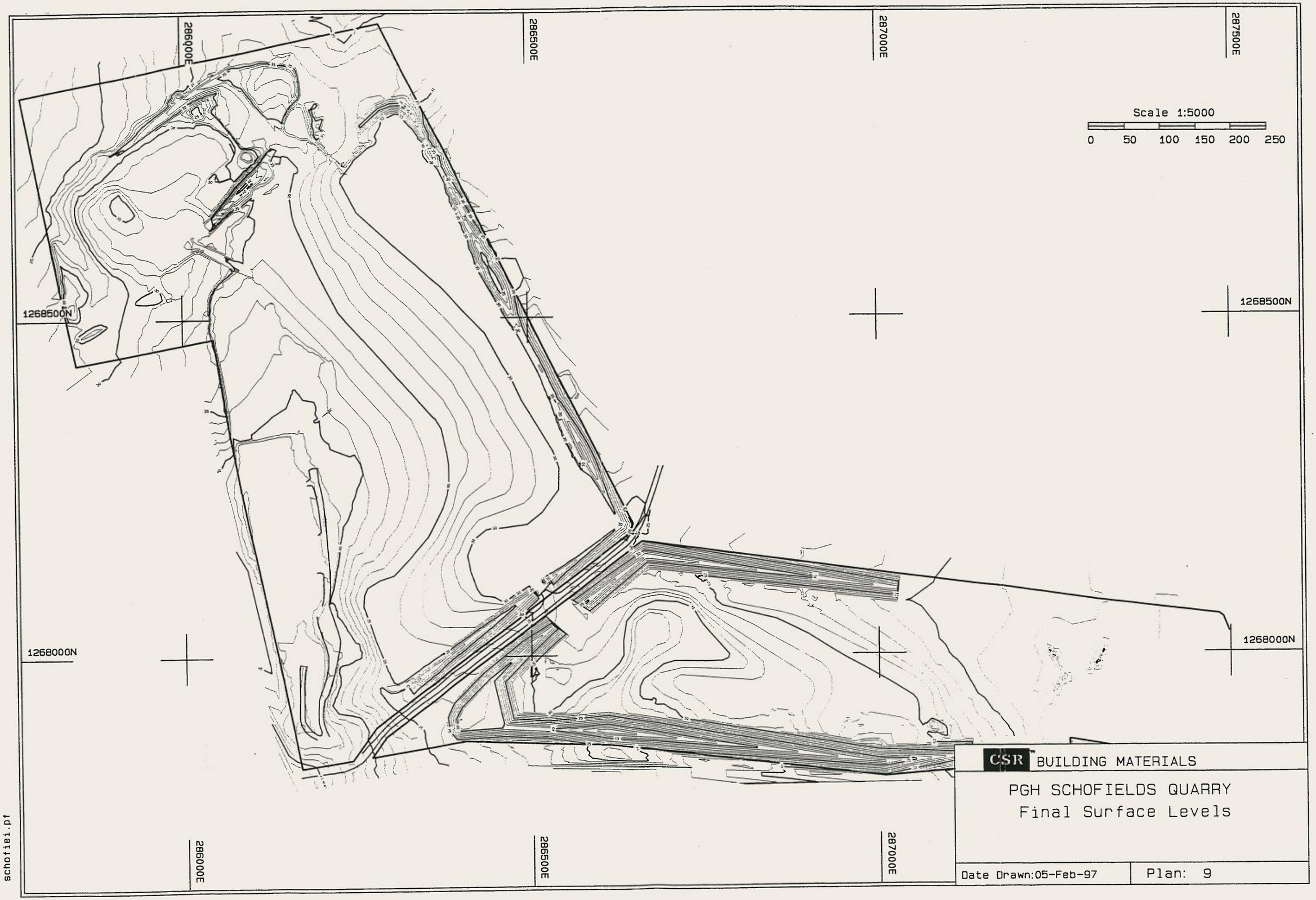
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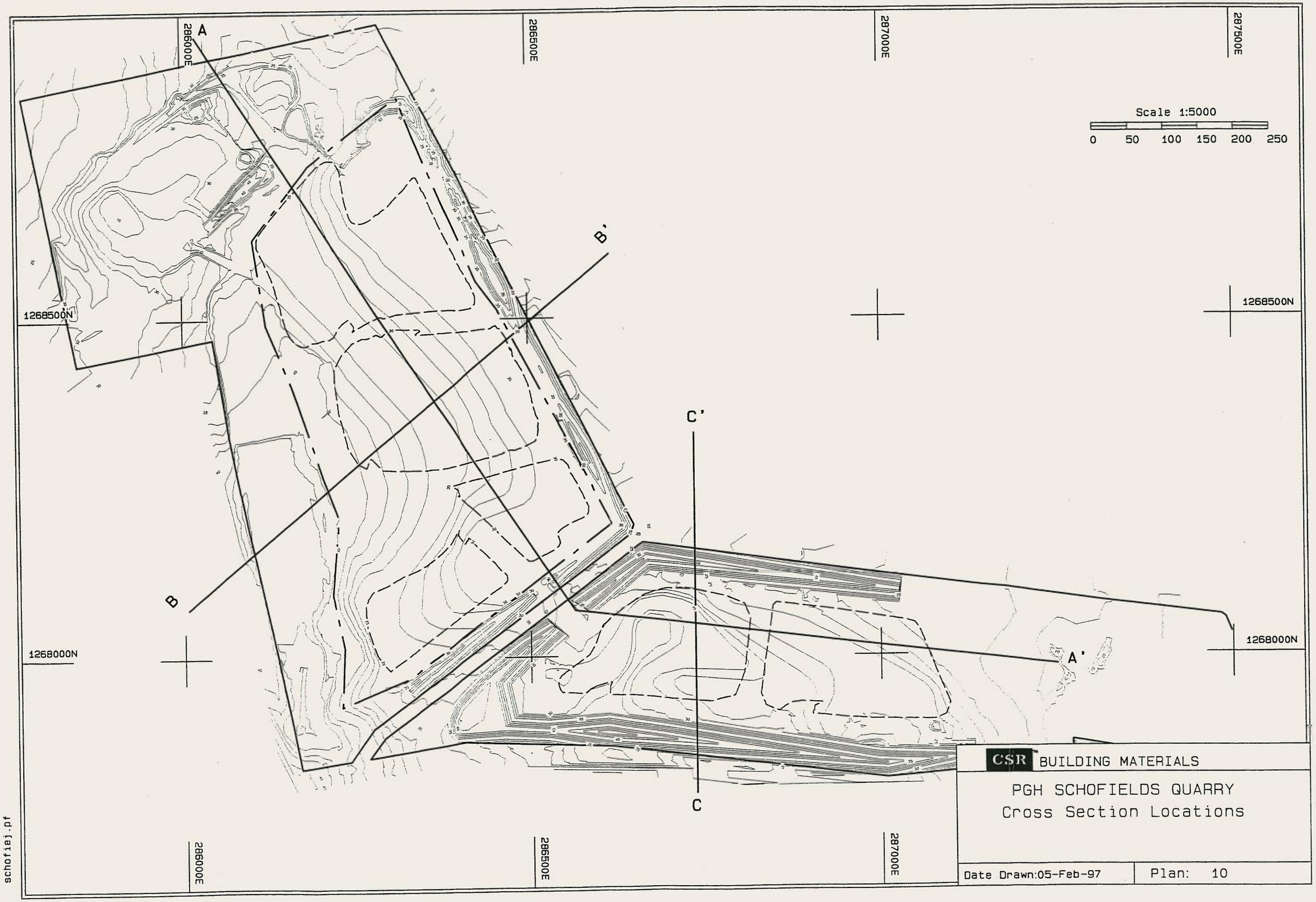

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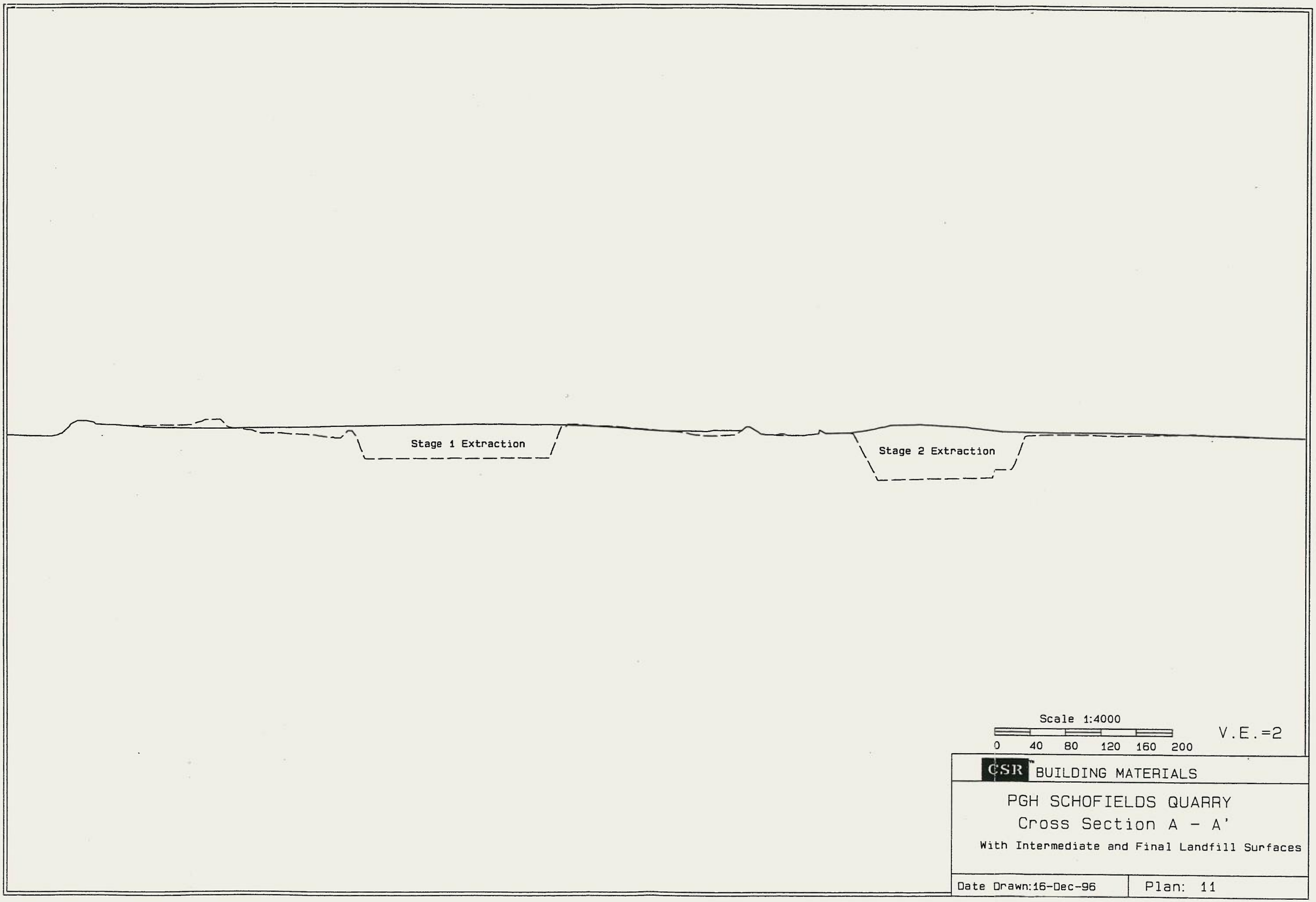

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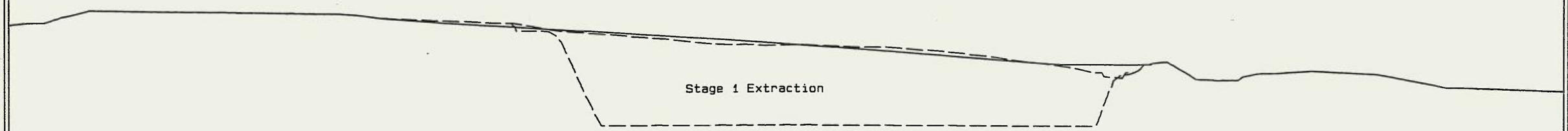

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CSR BUILDING MATERIALS

PGH SCHOFIELDS QUARRY

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With Intermediate and Final Landfill Surfaces

Date Drawn:16-Dec-96

Plan: 12

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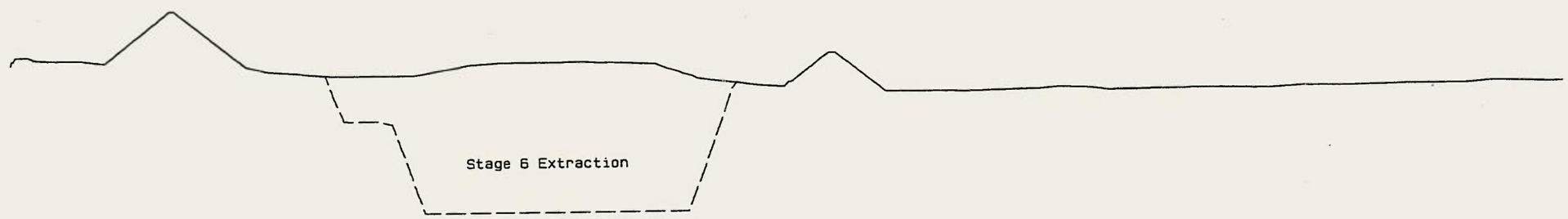

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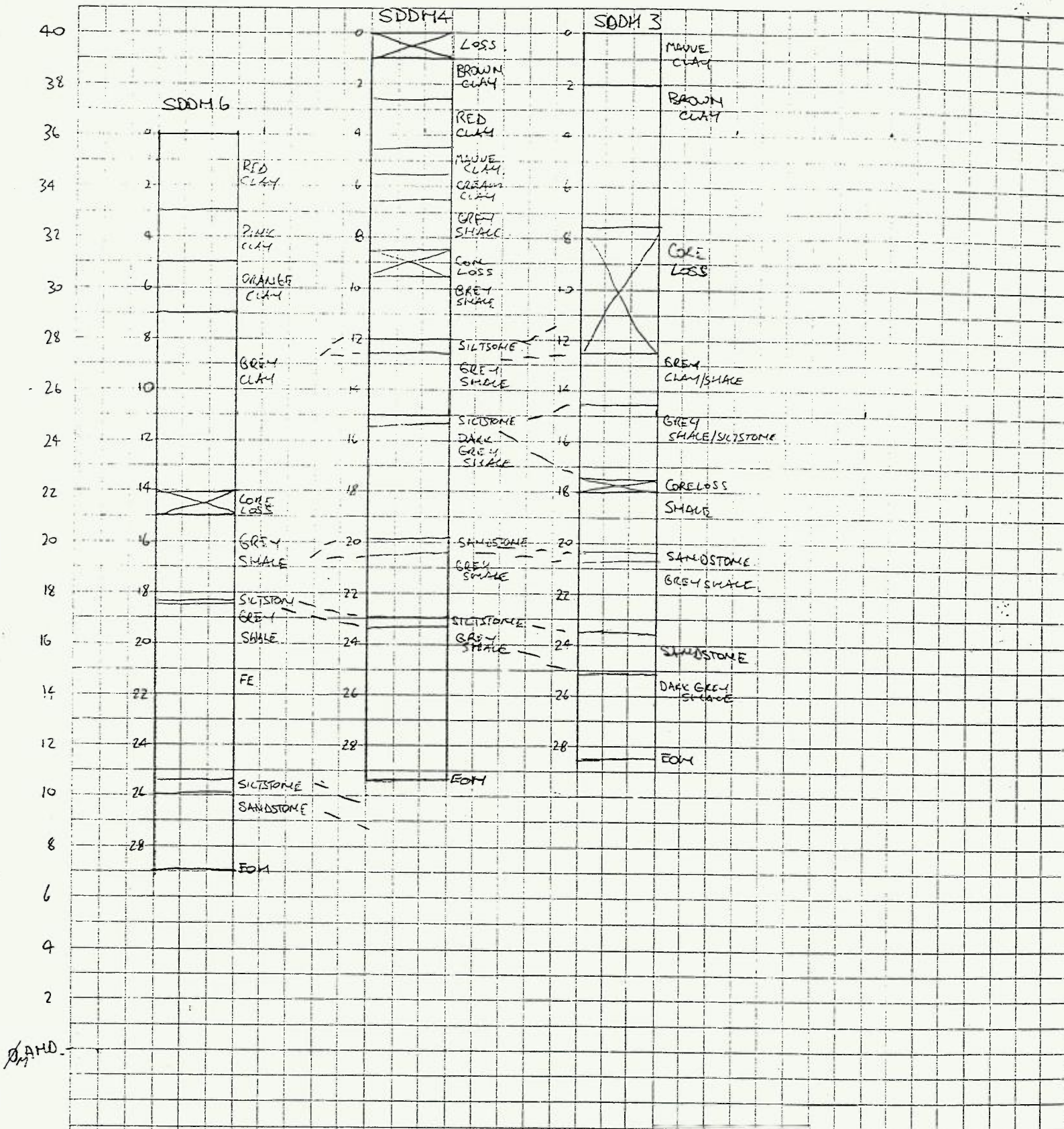
APPENDIX 1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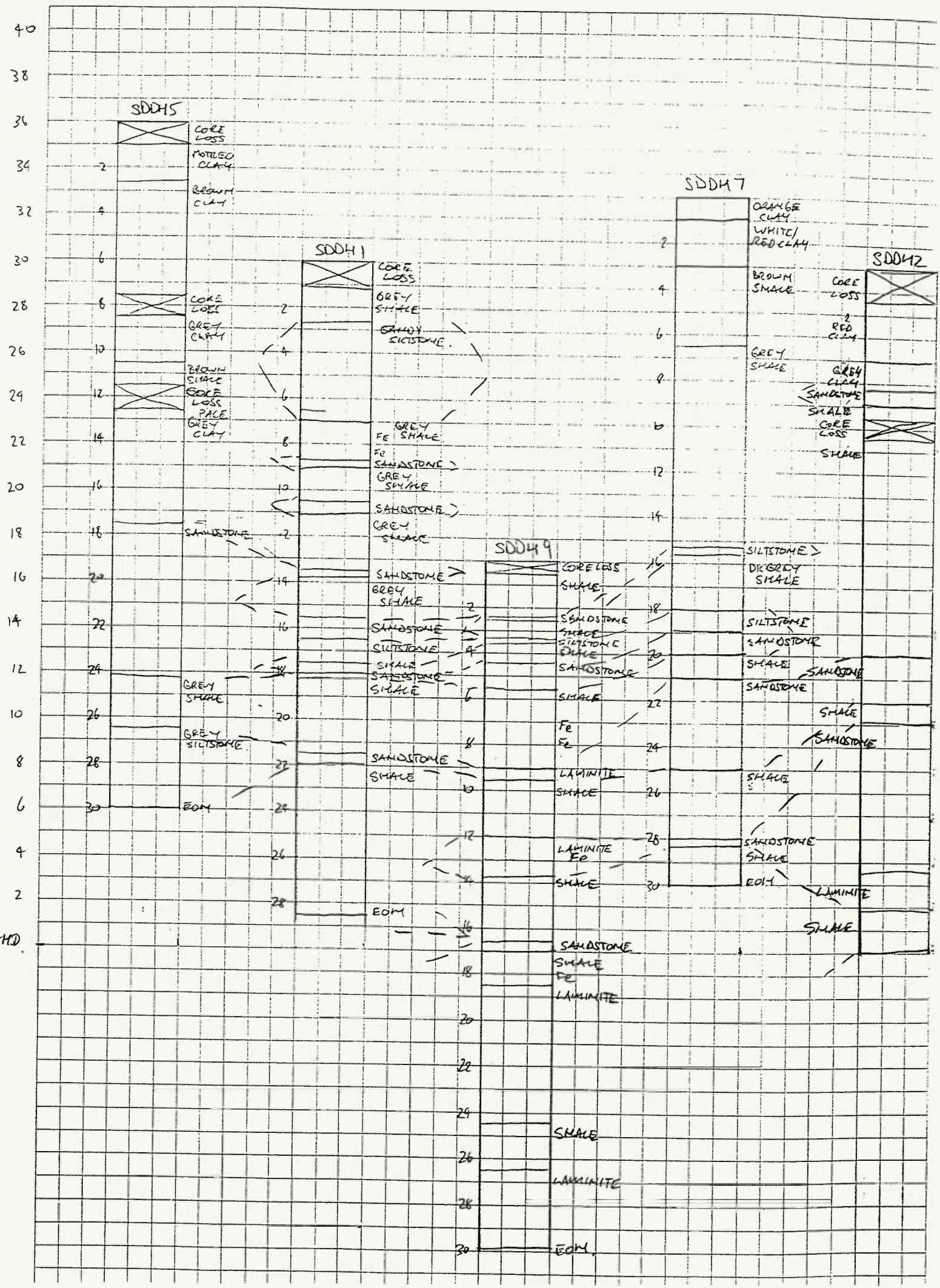
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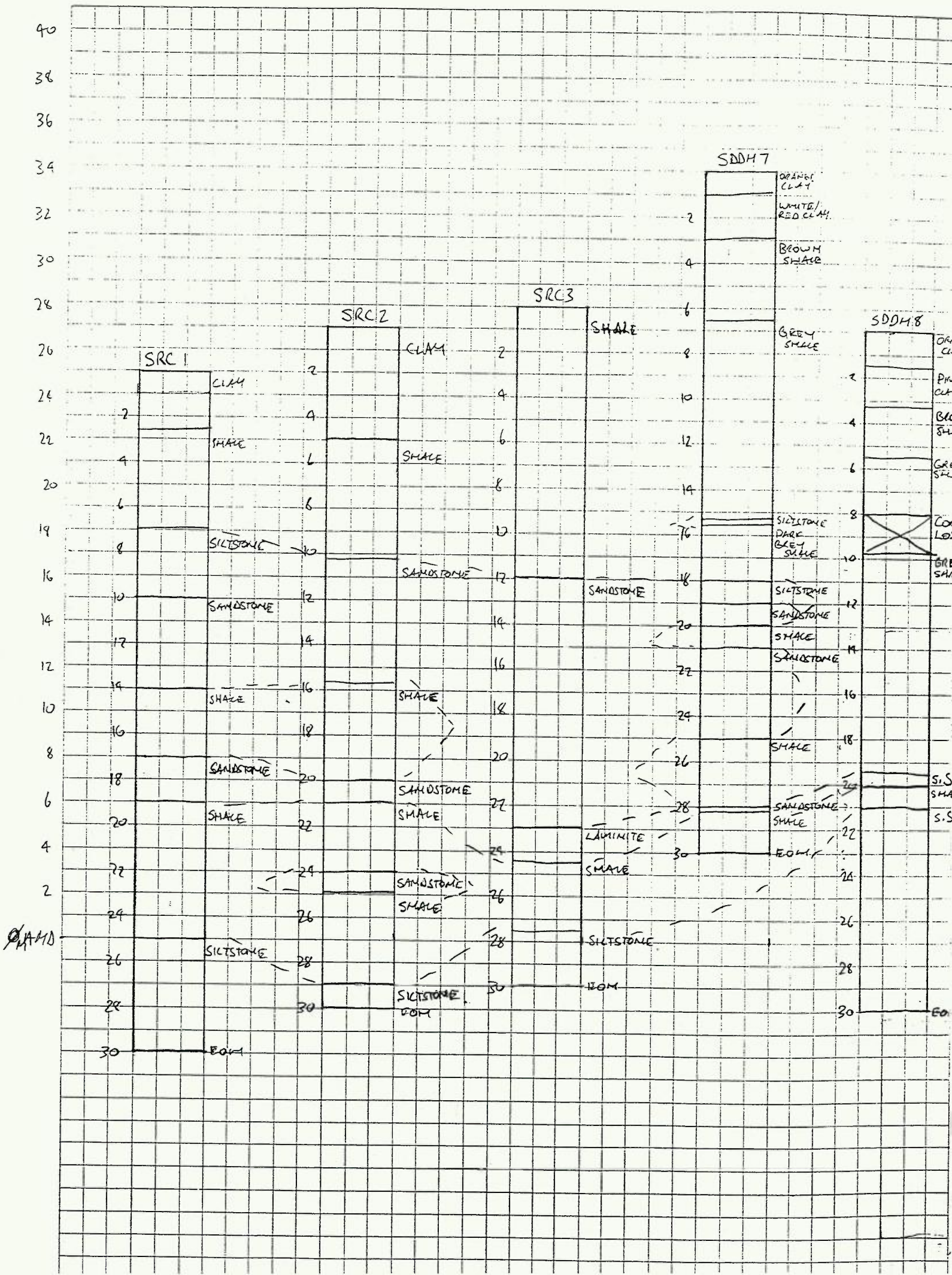
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SANDSTONE
SHALE
SILTSTONE
EOM
SRC3
SHALE
SANDSTONE
LAMINITE
SHALE
SILTSTONE
EOM
SDDH 7
ORANGE CLAY
WHITE/ RED CLAY
BROWN SHALE
GREY SHALE
SILTSTONE
DARK GREY SHALE
SILTSTONE
SANDSTONE
SHALE
SANDSTONE
SHALE
SANDSTONE
SHALE
EOM
SDDH 8
EO

MINI BIKE TRACK

FIRED COLOURS

	Hole 1 RL 29	Hole 2 RL 31	Hole 3 RL 29
	yellow-orange	yellow-orange	orange
1m	orange	pink-brown	yellow-orange
	orange	pink	pink-brown
2m	pink	pink	pink-cream
	pink	pink	pink-cream
3m	pink-brown	pink-brown	light-pink
	pink-brown	pink-brown	pink-cream
4m	brown	pink	orange-pink
	pink-cream	brown	brown
5m	brown	brown	brown
	brown	—	light-brown
6m	pink	brown	cream
	brown	orange-brown	pink-cream
7m	pink-brown	cream-pink	pink-brown
	pink-brown	pink	brown
8m	brown	grey-brown	brown-cream
	brown	grey-brown	brown-cream
9m	brown	grey-brown	brown-cream
		grey-brown	pink-brown

MINI BIKE TRACK

FIRED COLOURS.

Hole 4 RL 33

	orange
1m	orange
1m	orange
	orange
2m	orange
3m	pink-orange
	brown
4m	pink
	pink-white
5m	pink-white
	pink-white
6m	pink-white
	pink
7m	pink
	pink
8m	pink
	pink
9m	pink-brown
	pink-brown
10m	brown
	light-brown
11m	brown
	cream-brown

Hole 5 RL 26

	orange-yellow
1m	orange
	orange-brown
2m	red
	red
3m	brown
	pink-brown
4m	pink-brown
	pink-brown
5m	pink-brown
	pink-brown
6m	pink-brown
	pink-orange
7m	pink-brown
	pink-brown
8m	pink-brown
	pink-brown
9m	pink-brown
	pink-brown

Hole 6 RL 26

	orange-red
1m	red
	red
2m	red
	red
3m	red
	brown-red
4m	pink-cream
	orange-brown
5m	orange-brown
	orange-brown
6m	orange-brown
	orange-brown
7m	pink
	orange-pink
8m	pink-brown
	brown
9m	brown

MINI BIKE TRACK

FIRED COLOURS

	Hole 7 RL 29	Hole 8 RL 22	Hole 9 RL 25
	orange-yellow	orange	orange
1m	yellow-cream	pink-orange	orange
	pink-grey	pink	orange-yellow
2m	pink-grey	pink	pink-brown
	grey	pink	pink-brown
3m	grey-pink	pink	pink-brown
	grey-pink	pink	brown
4m	grey-pink	pink-brown	brown
	grey-pink	pink-brown	brown
5m	pink-cream	pink	pink-brown
	pink-cream	pink	pink-brown
6m	light-brown	pink-brown	pink-brown
	light-brown	pink-brown	
7m	light-brown	pink-brown	
	pink-brown	pink	
8m	pink-brown	pink	
	pink-brown	pink	
9m		brown	

FIRED Cobbles

RL 28

Hole 10

	—
1m	orange-red
	orange-red
2m	red
	red
3m	orange
	pink-orange
4m	pink-brown
	pink
5m	pink-cream
	pink-cream
6m	pink-brown
	pink-brown
7m	brown
	pink-brown
8m	brown
	pink-brown
9m	pink-brown
	pink-brown

RL 19

Hole 11

	orange
1m	yellow
	yellow
2m	pink
	pink
3m	pink
	pink
4m	pink
	pink
5m	pink
	pink
6m	orange-pink
	pink
7m	pink
	pink

RL26 FIRED COLOURS.

Hole 12

1m	orange-red
2m	orange-red
3m	orange-red
4m	pink-brown
5m	pink-brown
6m	red
7m	orange-red
8m	orange-red
9m	orange-red
10m	brown
11m	grey-brown

Hole 12 (cont.)

12m	brown
13m	dark-brown
14m	dark-brown
15m	dark-brown

DEPTH		CLAY/SHALE	FIRED COLOUR
BORE HOLE 4			
L74	Thickness		
4.4-6.0		GREY CLAY	CREAM - RED
6.0-7.0		BROWN CLAY	ORANGE
7.0-9.0		BROWN SHALE + IRON	RED
9.0-9.4		GREY SHALE	PINK
9.4-10.0		GREY SHALE	CREAM
10.0-12.9		GREY SHALE	CREAM
12.9-14.0	1.1	STONE	CREAM
14.0-14.4		GREY SHALE	BROWN
14.4-16.6		GREY SHALE	CREAM
16.6-17.0	0.4	STONE + SOME SHALE	PINK
17.0-20.0		GREY SHALE	CREAM
20.0-21.4		GREY SHALE	DIRTY PINK
21.4-22.0		GREY SHALE	CREQM
[illegible] 23.0	1	STONE + SOME GREY SHALE	PINK - BROWN
[illegible] 24.0		GREY SHALE + IRONSTONE	CREAM + IRON
24.0-26.5		GREY SHALE + IRONSTONE	BROWN
26.5-27.3	1	STONE	PINK - BROWN
27.3-30.0		GREY SHALE	PINK - BROWN
RL20 BORE HOLE 5			
3.8-5.3		GREY - RED CLAY	YELLOW - ORANGE
5.3-6.0		BROWN CLAY	YELLOW- ORANGE
6.0-7.0		BROWN CLAY	RED
7.0-7.7		BROWN SHALE	RED
7.7-9.0		GREY - BROWN SHALE	PINK
9.0-10.0		GREY SHALE	PINK
10.0-10.6		GREY SHALE + STONE	PINK
RL9.4 10.6-12.3	1.7	[illegible]ONE	PINK - RED
12.3-13.0		[illegible]EY SHALE	CREAM
13.0-13.6		[illegible]EY SHALE + STONE	PINK

DEPTH	CLAY/SHALE	FIRED COLOUR
BORE HOLE 5 CONTINUED		
15.0-17.0	GREY SHALE	PINK-GREY
17.0-18.4	GREY SHALE + IRONSTONE	CREAM
18.4-18.7	STONE	PINK
18.7-22.6	GREY SHALE	PINK
22.6-24.0	STONE	PINK
24.0-26.5	GREY SHALE	PINK-GREY
BORE HOLE 3		
3.8-4.2	CLAY	BROWN
4.2-4.6	BROWN SHALE	BROWN
4.6-5.5	GREY SHALE	CREAM-BROWN
5.5-5.9	GREY SHALE	GREY-PINK
5.9-8.3	GREY SHALE + SOME STONE	CREAM
8.3-9.4	GREY SHALE	PINK-BROWN
9.4-10.0	GREY SHALE	CREAM-PINK
10.0-10.5	GREY SHALE	GREY-BROWN
10.5-11.3	GREY SHALE	CREAM -PINK
11.3-12.0	GREY SHALE + SOME COAL	GREY -PINK-CREAM
12.0-12.6	GREY SHALE +STONE	BROWN
12.6-13.2	GREY SHALE	BROWN
13.2-13.8	GREY SHALE + COAL	YELLOW-BROWN
13.8-14.3	GREY SHALE	CREAM-YELLOW
14.3-15.5	GREY SHALE + IRONSTONE	PINK
15.5-17.0	GREY SHALE + STONE	BROWN
17.0-17.3	GREY SHALE + STONE	CREAM
17.3-17.6	GREY SHALE + IRONSTONE	YELLOW
17.6-18.0	SHALE + STONE	BROWN
18.0-20.0	GREY SHALE	CREAM + IRON
20.0-21.5		

BORE HOLE 3 CONTINUIED

DEPTH	CLAY/SHALE	FIRED COLOUR
20.0-21.5	STONE	CREAM
21.5-22.4	GREY SHALE	CREAM + IRON
22.4-24.0	STONE + SOME SHALE	BROWN
24.0-27.0	GREY SHALE + STONE	PINK
27.0-27.5	STONE	BROWN
27.5-29.0	SHALE + STONE	LIGHT BROWN
29.0-30.6	SHALE + STONE	CREAM - BROWN

BORE HOLE 6

3.8-4.2	BROWN CLAY	BROWN
4.2-4.7	CLAY WITH COAL	ORANGE
4.7-5.2	BROWN CLAY	ORANGE
5.2-5.6	GREY CLAY	YELLOW-ORANGE
5.6-6.8	GREY SHALE + IRONSTONE	CREAM
6.8-7.5	GREY SHALE	PINK
7.5-8.0	GREY SHALE + SOME STONE	GREY-PINK
8.0-9.0	GREY SHALE	CREAM
9.0-9.3	CLAY	YELLOW
9.3-10.0	GREY SHALE	CREAM
10.0-11.3	GREY SHALE	PINK
11.3-13.3	GREY SHALE	CREAM-PINK
13.3-14.2	GREY SHALE + STONE	PINK
14.2-15.0	GREY SHALE	CREAM
[illegible].0-15.6	GREY SHALE	PINK
15.6-16.0	STONE	PINK
16.0-17.0	GREY SHALE	PINK
17.0-17.9	GREY SHALE	PINK
17.9-19.3	STONE + SOME GREY SHALE	PINK
19.3-20.2	GREY SHALE	CREAM + IRON
20.2-21.2	STONE	PINK

BORE HOLE 9

DEPTH	CLAY/SHALE	FIRED COLOUR
3.8-4.2	CLAY	WHITE_CREAM
4.2-5.5	STONE+IRONSTONE	BROWN
5.5-7.6	STONE	OFF WHITE
7.6-8.7	SHALE + SOME STONE	PINK _ GREY
8.7-10.0	GREY SHALE + SOME STONE	CREAM+ A LOT OF IRON
10.0-10.9	SHALE	CREAM + IRONSTONE
10.9-14.3	SHALE + SOME STONE	CREAM - PINK
14.3-14.8	STONE	PINK
14.8-17.0	GREY SHALE	PINK
17.0-18.6	GREY SHALE + STONE	BROWN + IRONSTONE
18.6-20.0	GREY SHALE + STONE	CREAM - PINK
20.0-20.7	GREY SHALE	CREAM- PINK
20.7-23.6	GREY SHALE	CREAM - PINK

BORE HOLE 7

3.8-6.0	CLAY	YELLOW - CREAM
6.0-7.0	CLAY - SAND	GREY
7.0-8.0	GREY + IRON	CREAM - PINK
8.0-10.0	GREY SHALE + COAL	CREAM
10.0-10.3	STONE	PINK - CREAM
10.3-10.8	GREY SHALE	PINK
10.8-12.7	GREY SHALE	CREAM + IRON
12.7-15.0	GREY SHALE + STONE	CREAM - PINK
15.0-15.5	[illegible]	PINK
15.5-16.5	GREY SHALE	CREAM
16.5-17.0	GREY SHALE	PINK
17.0-17.7	GREY SHALE	CREAM
17.7-18.5	STONE	PINK
18.5-19.6	GREY SHALE	CREAM
19.6-21.0	STONE	CREAM - PINK

BORE HOLE 8

DEPTH		CLAY/SHALE	FIRED COLOUR
3.8-4.6		BROWN CLAY	BROWN
4.6-6.4	2m	GREY CLAY	CREAM-BROWN
6.4-7.2	0·8	SHALE	CREAM
7.2-7.4		STONE	PINK + IRON
7.4-7.8		GREY SHALE	GREY-CREAM
7.8-8.0		GREY SHALE	BROWN
8.0-8.6	0·6	GREY SHALE	CREAM
8.6-9.4	1·2	GREY SHALE	PINK
9.4-10.0		CORE LOSS	
10.0-10.3		CORE LOSS	
10.3-11.0		SHALE	BROWN
11.0-14.0		GREY SHALE + SOME STONE	PINK
13.0-13.4		STONE	PINK-BROWN
13.4-13.8		SHALE	BROWN
13.8-14.3		GREY SHALE	CREAM + IRON
14.3-15.2		GREY SHALE	PINK
15.2-16.0	0·8	GREY SHALE	CREAM
16.0-16.4		STONE	BROWN
16.4-17.0	0·6	GREY SHALE	CREAM
17.0-17.5		GREY SHALE	CREAM + IRON
17.5-18.3		STONE	BROWN
18.3-20.0		GREY SHALE + STONE	PINK-BROWN

BORE HOLE 2

5.4-6.2		BROWN SHALE	BROWN
6.2-6.5		GREY SHALE + IRON STONE	PINK
6.5-7.9		SHALE + IRON STONE	PINK
7.9-9.0	1·1	GREY SHALE	CREAM-YELLOW

BORE HOLE 2 CONTINUED

DEPTH	CLAY/SHALE	FIRED COLOUR
10.0-10.2	GREY SHALE	PINK
10.2-10.9 0·7	STONE	CREAM
10.9-11.2	GREY SHALE + SOME STONE	PINK-BROWN
11.2-12.0	GREY SHALE + IRON STONE	PINK-BROWN
12.0-13.8 1·8	GREY SHALE + IRON STONE	CREAM-YELLOW
13.8-14.2	STONE	LIGHT BROWN
14.2-14.7	GREY SHALE	BROWN
14.7-15.5 0·8	GREY SHALE	YELLOW-CREAM
15.5-15.8	GREY SHALE + IRON STONE	BROWN
15.8-16.7 1·1	GREY SHALE	CREAM
16.7-17.0	GREY SHALE	YELLOW
17.0-18.0	STONE + SHALE	LIGHT BROWN
18.0-18.5 0·5	GREY SHALE + IRON STONE	CREAM
18.5-19.0 0·5	GREY SHALE + STONE	CREAM + IRON
19.0-20.8 1·8	GREY SHALE	CREAM-PINK + IRON
20.8-21.4 0·6	GREY SHALE	CREAM
21.4-22.0 0·6	STONE	CREAM
22.0-22.4	STONE	BROWN
22.4-23.3 0·9	GREY SHALE	CREAM
23.3-26.0	STONE + SOME SHALE	PINK-BROWN
26.0-27.0	GREY SHALE	PINK-BROWN + IRON
27.0-27.7	GREY SHALE + STONE	PINK-BROWN
27.7-29.0	STONE + SHALE	CREAM-PINK

BORE HOLE 1

4.0-5.5	brown clay	yellow
5.5-6.0	CLAY + COAL	BROWN
6.0-6.5	BROWN SHALE	BROWN
6.5-7.5	STONE	GREY
7.5-8.2	GREY SHALE	PINK-BROWN

BORE HOLE 1 CONTINUED

DEPTH	CLAY/SHALE	FIRED COLOUR
8.2-10.0	GREY SHALE + COAL	CREAM -YELLOW
10.0-10.7	STONE	CREAM
10.7-11.0	GREY SHALE	CREAM -PINK
11.0-12.0	GREY SHALE	CREAM-YELLOW
12.0-12.3	GREY SHALE	BROWN
12.3-13.0	GREY SHALE	CREAM-BROWN
13.0-13.5	GREY SHALE	CREAM-YELLOW
13.5-14.5	GREY SHALE	BROWN
14.5-15.0	GREY SHALE	CREAM-YELLOW
15.0-15.4	GREY SHALE	CREAM-BROWN
15.4-15.9	STONE + SHALE	CREAM-BROWN
15.9-16.4	GREY SHALE	YELLOW-CREAM
16.4-17.0	GREY SHALE	BROWN + IRON STONE
17.0-18.0	GREY SHALE + COAL	BROWN
18.0-19.6	GREY SHALE	CREAM + IRON STONE
19.6-21.4	STONE + SHALE	GREY-PINK
21.4-25.0	GREY SHALE + STONE	PINK-BROWN
25.0-28.0	GREY SHALE + STONE + IRONSTONE	PINK-BROWN + [illegible]

APPENDIX 2

MONIER PGH TECHNICAL SUPPORT LABORATORY
10 Grand Ave, Rosehill NSW 2142
P.O. Box 147, Parramatta NSW 2124
Telephone : (02) 9638 0281
Facsimile : (02) 9638 7125

TEST REPORT

Test Required : Dilatometry & DTA/TG

Requested By : M. Olney, Rosehill

Sample Description : Schofields raw materials (from stockpiles):
Schofields Apricot Shale
Schofields Cream Shale

Date Tested :

Tested By : B. Small

Results : See Tables

Dilatometry

Measurement	Apricot Shale	Cream Shale
Maximum expansion (% @ °C)	0.79 @ 650	0.90 @ 660
Onset of rapid shrinkage (°C)	865	880
Return to original length (°C)	965	985
Contraction at quartz inversion, 600°-500°C (%)	0.18	0.20
Total shrinkage, 1050 °C (%)	2.28	1.75

Copies of the instrument charts are attached.

DTA/TG

	Apricot Shale	Cream Shale
Weight loss, 100° - 200°C, (%)	0.10	0.15
Dehydroxylation weight loss (%)	<10.3	<7.6
Dehydroxylation peak temp. (°C)	~495	515
Quartz peak size	low	low
Loss on ignition (%)	10.9	8.6
Other	Significant organics	Some organics
Main clay mineral type	kaolinite?	kaolinite?

Copies of the instrument charts are attached.

Comments:

Schofields Apricot Shale This sample shows moderate expansion on heating, with a curve suggesting a fairly high kaolin content. Shrinkage begins around 885°C, and is fairly rapid, indicating a firing temperature in the vicinity of 1050°C. At this temperature the total shrinkage is moderate, at ~2.3%.
When compared to a recent test on this material (9/96), the current sample shows: less expansion on heating; a slightly earlier shrinkage, leading to a higher total shrinkage; an d a marginally lower quartz contraction.

DTA/TG results show the presence of a significant organic content, which along with the relatively high kaolin content, results in a fairly high loss on ignition (LOI) value. The amount of free quartz is reasonably low.

Schofields Cream Shale This material has heating expansion behaviour more like a typical shale. It commences shrinkage at a similar temperature to the Apricot Shale, but has a slightly lower rate of shrinkage up to ~1000°C, leading to a reduced total shrinkage. Quartz contraction is marginally higher than for the Apricot Shale, no doubt contributing to the slightly more stable nature.

The DTA/TG indicates that the organic content is less than for the Apricot Shale; clay mineral content may also be slightly less.

B Small

B. Small
2nd December, 1996

MONIER [redacted]

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3.3.7 Schofields Red Clay

Report # : 92-545

Title : Dilatometry And Thermal Analysis (DTA/TG) Of Clay And Shale Samples From PGH

Author : B.G. Small

Work By : B.G. Small

Date : 24th August, 1992

Approved By : [redacted]

Distribution : N. Peall [redacted]
P. Carpenter

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MONIER

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CONTENTS (Cont'd)

1. INTRODUCTION

Dry samples of clay and shale materials were sum PAGE
Mr. J. Pickles of PGM on 27/2/92 and 02/03/92.

4. CONCLUSIONS & RECOMMENDATIONS 10

It was requested that combined Differential Thermal Analysis and Thermogravimetry (DTA/TG) and thermal dilatometry be carried out on each of the samples.

APPENDIX 1 : Dilatometry Charts Figures 1 - 10

APPENDIX 2 : DTA/TG Charts Figures 11 - 22

The samples were identified as follows :

1. Scaddens Patonga Red Mudstone
2. Scaddens Patonga Claystone (Grey)
3. Schofields White Clay
4. Schofields Cream Shale
5. Schofields Brown Shale
6. Schofields Grey Shale
7. Schofields Red Clay
8. Doyalson White Clay

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1. INTRODUCTION

Ten samples of clay and shale materials were submitted by Mr. J. Pickles of PGH on 27/2/92 and 03/03/92.

It was requested that combined Differential Thermal Analysis and Thermogravimetry (DTA/TG) and thermal dilatometry be carried out on each of the samples.

The samples were identified as follows :

1. Scaddens Patonga Red Mudstone
2. Scaddens Patonga Claystone (Grey)
3. Schofields White Clay
4. Schofields Cream Shale
5. Schofields Brown Shale
6. Schofields Grey Shale
7. Schofields Red Clay
8. Doyalson White Clay
9. Voutos White Clay
10. Voutos Shale

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2. WORK CONDUCTED

2.1 Sample Preparation

Test bars suitable for use in the dilatometer were prepared from the "as received" ground materials. The sample bars were dried at 80°C prior to being tested in the dilatometer.

Powdered samples of each material, suitable for testing by DTA/TG were prepared by grinding to approximately -100 mesh (-150μm) particle size.

2.2 Dilatometry

Samples of each material were heated in the Orton dilatometer to 1050°C. A graph of the percentage change in length with temperature was produced.

2.3 DTA/TG

A sample of each material was tested in the Rigaku DTA/TG unit. Plots of temperature differential (endotherms and exotherms) and weight change were produced.

Where testing in air resulted in significant organic peaks, a re-run in nitrogen was conducted to suppress the oxidation peaks. This was necessary for the Cream Shale and Grey Shale samples from Schofields.

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3. RESULTS (Cont'd)

3.1 Dilatometry

The dilatometry curves are seen in Figures 1-10. A number of characteristic parameters were determined from the curves and are summarised in Table 1. These parameters are maximum expansion, onset of rapid shrinkage, contraction at quartz inversion and total shrinkage. [illegible] haviour. Quartz content is moderate, as is [illegible] the overall firing shrinkage. The clay [illegible] On several of the charts, recorder pen repositioning was necessary on the cooling cycle to allow the curve to fit on the chart. In these cases, the expansion axis is renumbered on the right side of the chart.

3.2 DTA/TG

This material has very similar behavioral properties to the Scaddens Patonga Red [illegible]

Figures 11-22 show the thermal analysis curves produced for each of the materials. Figures 15 and 18 show the curves for analysis in a nitrogen atmosphere, for the Schofields Cream Shale and Grey Shale respectively. Table 2 lists parameters derived from the instrument curves.

This is a kaolinitic material relatively low [illegible] Dehydroxylation peak temperature is generally indicative of the type of clay mineral present (peak shape and peak size need also to be considered), while for a particular clay mineral, the amount of weight lost during dehydroxylation should be proportional to the quantity of the clay present. This relationship becomes more complex when more than one clay species is present.

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3. **RESULTS** (Cont'd)

3.3 **Comments** (Cont'd)

The results are interpreted as follows:

3.3.1 Scaddens Patonga Red Mudstone

The dilatometry shows typical shaly clay behaviour. Quartz content is moderate, as is the overall firing shrinkage. The clay mineral content (mainly kaolinite) is also moderate.

3.3.2 Scaddens Patonga Claystone (Grey)

This material has very similar behavioral properties to the Scaddens Patonga Red Mudstone. Quartz content and clay content are similar to that material, although the proportion of illite appears greater. Organic material and possibly pyrites may have

3.3.3 Schofields White Clay

This is a kaolinitic material relatively low in quartz. Firing shrinkage is higher than for the Patonga materials. Kaolinite content is estimated to be approximately 40%.

3.3.4 Schofields Cream Shale

This is also a mainly kaolinitic material, moderate to low in quartz content. The kaolinite content appears to be approximately 60-65% although some interference from organics and/or pyrites might be occurring.

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3. **RESULTS** (Cont'd)

3.3 **Comments** (Cont'd)

3.3.4 Schofields Cream Shale (Cont'd)

The firing shrinkage is slightly lower than the other Schofields shales.

3.3.5 Schofields Brown Shale

This material is kaolinitic, with a moderately low quartz content. Its firing behaviour was found to be very similar to that of the Schofields White Clay.

3.3.6 Schofields Grey Shale

Kaolinite was found to be the main clay mineral present, with an apparent content of 60-65%, although the presence of organic material and possibly pyrites may have introduced some uncertainty into the kaolinite determination.

3.3.8 Behaviour during heating is fairly similar to the other Schofields shales, with a moderate contraction on cooling due to quartz content and around 2.5% overall shrinkage.

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3. **RESULTS** (Cont'd)

3.3 **Comments** (Cont'd)

3.3.7 Schofields Red Clay

This Red Clay has, as its clay mineral component, a mix of kaolinite and illite, or possibly a fine grained kaolinite. Significant levels of hydrated iron-bearing material is present along with some organic matter. Quartz content is quite high. The dilatometry shows a region of shrinkage from 120°C - 160°C. This may be associated with the loss of water from the more plastic fine grained components.

3.3.10 Voutos Shale

Rapid shrinkage occurs relatively early, at around 850°C, but overall shrinkage is limited by the high quartz content, and the quartz content is moderately high. The clay mineral

3.3.8 Doyalson White Clay

This material is also relatively refractory. This material has quite a low clay mineral content (less than 20%) and a very high level of free quartz. This is reflected in the dilatometric results, where an overall expansion is produced after heating of the sample to 1050°C.

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3. **RESULTS** (Cont'd)

TABLE 3.3 **Comments** (Cont'd)

3.3.9 Voutos White Clay

This is a kaolinitic clay, with a low quartz content. Clay mineral content is estimated to be approximately 50%. The relatively low absorbed water content indicates a limited plasticity.

The dilatometry shows the material to be relatively refractory, with 0.84% shrinkage after heating to 1050°C.

3.3.10 Voutos Shale

This shale is also of a kaolinite type. Some organic material is present, and the quartz content is moderately high. The clay mineral content is similar to the Voutos White Clay. This material is also relatively refractory, with less than 0.5% shrinkage after heating to 1050°C.

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3. RESULTS (Cont'd)

TABLE 1 - DILATOMETRY RESULTS

SAMPLE	MAXIMUM EXPANSION (% @ °C)	ONSET OF RAPID SHRINKAGE (°C)	CONTRACTION AT QUARTZ INVERSION 600°C-500°C (%)	TOTAL SHRINKAGE (%)	FIRED COLOUR
Scaddens Patonga Red Mudstone	0.95 @ 710	900	0.21	2.05 Kaolinite	Terra Cotta Orange
Scaddens Patonga Claystone (Grey)	0.99 @ 680	880	0.21	1.94 Kaolinite	Pale Terra Cotta
Schofields White Clay	0.98 @ 680	900	0.16	2.44 Kaolinite	Pale Pink
Schofields Cream Shale	0.98 @ 680	910	0.20	1.66 Kaolinite	Pale Mauve
Schofields Brown Shale	1.10 @ 670	890	0.19	2.43 Kaolinite	Pink
Schofields Grey Shale	0.91 @ 680	900	0.19	2.51 Kaolinite	Buff
Schofields Red Clay	0.67 @ 630	850	0.36	1.80 Kaolinite + Illite	Terra Cotta Orange
Doyalson White Clay	1.60 @ 640	N/A	0.94	0.28 Expansion Kaolinite	Cream
Voutos White Clay	1.04 @ 700	910	0.15	0.84 Kaolinite	White
Voutos Shale	1.05 @ 700	940	0.26	0.44	White

6 10

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24/6/02

3. **RESULTS** (Cont'd)

TABLE 2 - DTA/TG RESULTS

SAMPLE	CLAY DEHYDROXYLATION PEAK TEMPERATURE (°C)	DEHYDROXYLATION WEIGHT LOSS (%)	CLAY MINERAL TYPE	QUARTZ CONTENT
Scaddens Patonga Red Mudstone	510	3.1	Kaolinite	Moderate
Scaddens Patonga Claystone (Grey)	505	3.0	Kaolinite + Illite	Moderate
Schofields White Clay	525	4.8	Kaolinite	Low
Schofields Cream Shale	510	8.5 *	Kaolinite	Low
Schofields Brown Shale	525	4.6	Kaolinite	Low
Schofields Grey Shale	505	8.5 *	Kaolinite	Low
Schofields Red Clay	500	3.2	Kaolinite + Illite	High
Doyalson White Clay	490	1.5	Illite Kaolinite	Very High
Voutos White Clay	525	5.8	Kaolinite	Low
Voutos Shale	525	5.8	Kaolinite	Moderate - High

* May be affected by oxidizable components.

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4. CONCLUSIONS AND RECOMMENDATIONS (cont'd)

4.1 The Patonga materials have comparable behaviour and composition. Quartz is present but not to an excessive degree. Firing temperatures of approximately 1050°C would be expected to produce suitable properties.

4.2 The Schofields Brown and Grey shales and the White clay have similar firing behaviour, although the White clay has the lowest quartz content. Firing temperatures of approximately 1050°C should be suitable for these materials.

The Schofields Cream shale has a lower rate of shrinkage above 900°C and may require a firing temperature above 1050°C.

The presence of organic matter and possibly pyrite in the Grey and Cream shales may necessitate precautions to avoid black coring.

4.3 The Schofields Red clay has firing characteristics somewhat different to the other Schofields materials. The early shrinkage (below 200°C) may mean that extra care is required in preheating ware containing this material, and the high quartz content would need to be considered in the cooling stages.

A firing temperature of slightly more than 1050°C is indicated.

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4. **CONCLUSIONS AND RECOMMENDATIONS** (Cont'd)

4.4 The Doyalson White "clay" is very high in fine quartz and so is quite refractory at 1050°C, actually resulting in a residual expansion after being heated to this temperature. Use of high proportions of this material may lead to problems with dunting.

4.5 The Voutos White clay appears to be a useful white-firing clay, with relatively low quartz content. Firing temperature should not be excessive, but would probably need to be close to 1100°C.

The Voutos shale is more refractory than the clay, which may be caused by the higher quartz content and would also require a firing temperature of approximately 1100°C.

Dilatometry Charts

Figures 1 - 10

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APPENDIX C
RESPONSES FROM PUBLIC AUTHORITIES

AUSTRALIAN HERITAGE COMMISSION

GENERAL FILE

INCG	
DATE	20/12/96
PROJECT	SHIRS
PROJECT	VH009
FILE No.	027
TO	81
A/C	A
INT	P

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.

MTA 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

[redacted]

Head Office
ORANGE

NSW Agriculture

161 Kite Street,
Locked Bag 21
ORANGE NSW 2800
AUSTRALIA

Telephone (063) 91 3100
Facsimile (063) 91 3336

30 April, 1997
VA 0009

INCOMING CORRESPONDENCE					
DATE IN	30/4/97				
PROJECT MGR.	[illegible]	INTL	SH		
PROJECT NO.	VH0009				
Management	027				
TO	SH				
A/I/C	A				
INTL	G				

Felicity Stening
Environmental Planning and Management
CMPS&F Pty Ltd
PO Box 201
CHATSWOOD NSW 2057

Dear Ms Stening

EIS PREPARATION - PGH/CSR SITE, SCHOFIELDS

I refer to your facsimile of 29 April 1997 which sought preliminary comments from NSW Agriculture on the preparation of an EIS for the continuation of quarrying and landfill activities at the PGH/CSR site at Schofields, Blacktown.

Due to the short notice of your request a site inspection of the site has not been possible. However, for the information you have supplied I wish to offer the following comments.

First, I believe the EIS will need to address issues of potential impacts on water quality. The EIS will need to specify potential impacts on both surface and ground waters. Potential impacts from both the extraction and landfill stages will also need to be assessed.

Second, the EIS should identify any agricultural activities in proximity to the site that may be adversely affected by dust or noise generated by the proposal. Should any agricultural activities be identified methods of avoiding these impacts should also be specified.

I trust these comments are of some assistance in the preparation of the EIS. I invite you to contact me directly should you have any further queries

Yours sincerely

Tom Grosskopf
Agricultural Environment Officer
Windsor

FROM :NSW AG - AG RESOURCE MGT TO : 0241298 75 1997.04-30 12:53 #654 P.02/02

VH0009/027
Phone call to:
Mr Adam Smith, Department of Fisheries
Phone: 95667837
Date: 30 April 1997

DEPARTMENT OF FISHERIES RESPONSE TO CONSULTATION REGARDING PROPOSED DEVELOPMENT AT PGH QUARRY SCHOFIELDS

Personal communication with Mr Adam Smith, Habitat Unit, Department of Fisheries.

A fax was sent to Mr Smith requesting comment on the proposed development, with an attached information statement and a map of the nearest receiving waterways to the site. Mr Smith stated that Department of Fisheries has no comment on the proposed development, due to the small nature of the site and its position (not close to any major rivers or tributaries).

INCOMING CORRESPONDENCE					
DATE IN	5th May 97				
PROJECT MGR.	Shiles	INTL	SH		
PROJECT No.	VH0004				
FILE No.	027				
TO	SH				
A/I/C	A				
INFO	D				

LAND & WATER CONSERVATION

Contact: Greg Daley
Phone: (02) 9895 7361
Fax: (02) 9895 7255
e-mail: gdaley@dlwc.nsw.gov.au

Our Ref: 0194816
[G:\GDALEY\EXTEIS02.DOC]
Your Ref: 0194816

Ms Felicity Stening
Environmental Planning and Assessment
CMPS&F Pty Ltd
PO Box 201
CHATSWOOD, NSW, 2057

Attention: Ms Felicity Stening

1 May, 1997

Dear Madam

Re: EIS Preparation for the Development Application for the Continuation of Quarrying, Landfilling and Site Rehabilitation at the PGH/CSR Brickworks Site at Schofields, Blacktown.

Thank you for your enquiry regarding the issues that the Department of Land & Water Conservation (DLWC) would like to be addressed in the Environmental Impact Statement (EIS) for the proposal for continuation of quarrying, landfilling and site rehabilitation at the PGH/CSR brickworks site, Schofields, Blacktown.

The 1:25,000 orthophotomap, Riverstone 9030-I, indicates that the nearest major stream is Eastern Creek, approximately one kilometre east of the subject site , and is located in the Hawkesbury/Nepean Catchment. This office is concerned with potential impacts to the area's water resources, ie. aquatic and riparian issues, from the proposal.

It should be noted that a small watercourse was identified flowing through the south-western boundary of the present extraction site, and then on to Eastern Creek. The proponent must ensure that this creek is not impacted by current or proposed operations.

Generally you will need to provide, within the EIS, information on the existing environment of the site, the likely impacts resulting from the proposal and mitigative measures that the proponent must undertake to ameliorate any environmental impacts.

In terms of the aquatic and riparian habitat, there are a number of factors that the EIS will need to consider, including:

<u>Aquatic and Riparian Habitat</u>

The Department encourages the maintenance and/or regeneration of a vegetative buffer of at least 20 metres from the bank of a waterway. Environmentally sensitive areas should have a greater buffer width. A vegetative buffer helps to maintain waterways in a sustainable manner by reducing levels of erosion and sedimentation, enhancing habitat values, improving water quality and generally mitigating stream degradation. The buffer should contain native flora that is endemic to the area and appropriate to the site.

Development of natural resources usually encourages the introduction and growth of weed species. Weeds are readily dispersed along drainage lines and flood prone land and once introduced they are very difficult to remove. The EIS needs to provide a Weed Eradication Plan outlining the proposed treatment of declared noxious weeds (as defined by the *Noxious Weeds Act 1993*). It is recommended that such a plan be implemented prior to extraction activities.

Aquatic environments provide valuable habitat for flora and fauna particularly breeding and nursery areas, which may be affected if the proposed development results in changes in the frequency, depth, extent or volume of flow in the waterway. The proponent must ensure that the instream environment will not be impacted by the discharge of harmful pollutants (eg. chemicals, nutrients, heavy metals and bacteria) into the waterway, seepage of pollutants to an adjacent aquifer, the introduction or proliferation of exotic plant and animal species and the physical disturbance to the waterway (including clearing of aquatic vegetation).

If the proposal is likely to cause any impact on water resources, compensatory works may be considered as a condition of development consent. This may include rehabilitation of natural habitats, re-establishment of vegetation buffer zones adjacent to streams and wetlands, restoration of wetland areas, maintenance of aquatic and wetland habitats by ensuring adequate streamflows, stabilisation of all disturbed areas, and provision of retention basins to minimise downstream impacts.

The proponent must consider the potential for the proposed development to adversely impact the riverine corridor, the adequacy of erosion controls and revegetation proposals (the use of indigenous species is encouraged), the possibility of changes to the stream geometry through excavation, obstruction or cuttings within and/or near the waterway, and the likelihood of increased runoff (through removal of vegetation, urbanisation, etc.).

The EIS must also assess the impact on existing vegetation and fauna, and the likelihood of rare and endangered species occurring on-site and/or being affected by the proposal.

Surface Water Quality and Supply

Potentially all development within a catchment will impact upon its waterways. Where developments are immediately adjacent to a watercourse safeguards must be incorporated to prevent contaminated runoff (including excessive sediment) from discharging directly into the watercourse, during and after construction. The proponent must prove that the proposal will not affect the availability of a reliable water supply, impact on other water users, cause the deterioration of water quality within the catchment (eg. change in temperature, turbidity, salinity or input of pollutants such as suspended solids, organic material, nutrients, pesticides and trace metals) or change the streamflow regime (eg. volume, reliability, variability, quantity, quality, timing, duration).

DLWC strongly recommends that constructed ponds should not be built on existing watercourses as this will greatly affect surface water quality and its supply to various sections of the environment.

Levels of pollutants entering surface and ground water as a result of the proposal, can only be determined by monitoring. DLWC encourages the implementation of a monitoring scheme, including; the monitoring of water quality both internal and external to the subject land, and analysis for pH, non-filterable residue, turbidity, total alkalinity and visible oil and grease.

Groundwater Quality and Supply

The development must not adversely affect either existing or potential groundwater users, groundwater levels, adjacent ecosystems dependant on groundwater (eg. wetlands), or the interaction between groundwater and surface water. Other impacts that the proponent must guard against includes the possible rise of groundwater levels due to vegetation clearance, the potential creation of waterlogging problems through rising water tables, the possibility of salinity problems (where the groundwater or soil profile is saline such as occurs in the vicinity of this proposal), or the potential for seepage of pollutants into the groundwater system (including chemicals, petroleum products, nutrients, heavy metals, bacteria).

To assess the impact of the proposal on groundwater resources the proponent may initiate a monitoring programme to identify unexpected impacts.

Environmental Legislation

The proponent should be aware that an authority is required from the Department, under the *Soil Conservation Act 1938* (s. 21C - Riverine Protected Land), to damage or destroy trees within 20 metres of a gazetted stream. Similarly if works occur within 40 metres of a stream then the proponent must obtain a permit from DLWC, under Part 3A of the *Rivers & Foreshores Improvement Act 1948*.

Furthermore, the proponent will need to comply with the principles of Total Catchment Management, the State Rivers and Estuaries Policy and the Wetlands Management Policy. By considering these policies, impacts on the aquatic and riparian zone, downslope of the development, will be minimised.

Runoff and Soil Controls

The proposed development raises a number of catchment management issues, including pollution and weed invasion along the drainage lines, a possible increase in discharge of stormwater from the proposal and resultant erosion, turbidity and sedimentation problems. To minimise environmental impact it is recommended that soil and drainage controls are provided on-site to prevent sediment loss. The use of mitigation measures such as sedimentation basins, filtering devices (eg. hay bales and silt curtains), diversion banks and vegetation buffers will assist in protecting aquatic/riparian habitat from uncontrolled runoff and pollution. To this end the proponent needs to provide an Erosion and Sediment Control Plan to the satisfaction of DLWC, possibly as a consent condition at the DA stage.

If the subject site is rehabilitated by planting a representative vegetation community, it is recommended that progressive rehabilitation be concentrated on the slope leading down to intermittent streams that may occur in the locality, as this is the area of greatest possible environmental impact via erosion and water concentration.

Furthermore, the proponent should be aware of the potential of an increase in erosion resulting from the removal of vegetation on lands with slopes greater than 20%. The Department recommends that the proponent does not clear native vegetation from steep slopes, so as to minimise erosion.

If you have any further queries with regard to the above, please contact Greg Daley on (02) 9895-7361.

Yours faithfully,

Greg Daley
Environmental/Ecological Impact - Sydney/South Coast Region

94137

DEPARTMENT OF MINERAL RESOURCES

NEW SOUTH WALES GOVERNMENT

RECEIVED 26 JUL 1994

MINERALS AND ENERGY HOUSE
29-57 CHRISTIE STREET
CORRESPONDENCE PO BOX 536
ST LEONARDS NSW 2065
DX 3324 ST LEONARDS
TELEPHONE (02) 901 8888
FACSIMILE (02) 901 8777

21 July 1994

Mr T W Perram
Principal
Mitchell McCotter & Associates P/L
PO Box 943
CROWS NEST
NSW 2065

Dear Sir

RE: EXTENSION OF CLAY/SHALE QUARRY, TOWNSON ROAD, SCHOFIELDS

I refer to your letter of 8 July 1994 concerning preparation of an Environmental Impact Statement (EIS), for PGH Clay Bricks and Pavers at Schofields.

Attached for your consideration is a copy of Guidelines for Preparation of Mining Rehabilitation and Environmental Management Plans (MREMPS). MREMPS are similar to mini-EIS's, and are generally prepared by Mineral Lease holders prior to the commencement of mining operations.

Although the property owned by PGH Clay Bricks and Pavers is not a Mining Lease, some of the points outlined in the Guidelines for Preparation of MREMPS, may be used in the EIS.

For further information, please contact me on Tel (02) 9018455.

Yours faithfully

P J Diamantes
Regional Inspector of Mines(Sydney)

GUIDELINES - PREPARATION OF MREMPS

These guide-lines specifically address the issues under the general headings of safety, water management,waste management,revegation, and erosion control.

Safety

* Mine site are to present no dangers to members of the public.

* The vibration and pressure effects of blasting must comply with appropriate Australian Standards.

* Open pit excavations must be rendered safe and geomorphically stable., Placement of waste in open pits voids is to; be encouraged wherever possible.

* At the completion of operations, shafts or other openings are to be securely capped and made safe.

Water Management

* The management plan should specify the location of monitoring points and the frequency of monitoring, species methodology, and what is being analysed for in a total site integrated monitoring program. Such monitoring must commence prior to any new mining or construction operations in order to establish background levels.

* Results and assessment of monitoring should be undertaken and based on pre mining surveys. This applies specifically to radiation, water, and noise. Also to be taken into consideration in monitoring water quality are the beneficial uses downstream of the mine. Receiving water standards are generally more important than discharge standards in evaluating impact on the environment.

* Water management must be designed to cope adequately with foreseeable extreme conditions such as flood,storms, and drought. In high rainfall areas, design should be such as to permit water to be shed off site safely while in dry and arid areas water retention is required to encourage water harvesting.

* Segregation of water of differing qualities is to be encouraged.

* Provision must be made to mitigate any effects of the unacceptable outflow of contaminated waters after the cessation of mining.

* Management regimes must be designed to minimise any risk of surface or ground water contamination. Provision must be made to contain and dispose of any leachate, both during and after mining. Where there is a

leachate problem, water management measures to prevent contamination of ground water will be required.

* Storm water drain and diversion dams must be adequate for any foreseeable eventuality.

* Reject dumps and dams, and water control dams must be designed to ensure long term stability on sound geomorphic principles. Any slopes in excess of 1 vertical to 3 horizontal will require normally require benching or regrading to minimise erosion and to facilitate revegetation.

* Where feasible, retreatment or rehabilitation of any derelict land prior to mining should be considered.

Waste Management

* The generation of waste, both mullock and other material such as petroleum wastes and human wastes, must be kept to a minimum. Use and disposal of fuel and lubricants, human waste, toxic waste, and noxious waste are issues needing to be addresses for most mine sites.

* Characterisation of removed materials, including topsoil to be determined to assess its suitability for utilisation. Such materials are to be utilised in the final deposition site as soon as possible. If it cannot be immediately used, stockpiles should be low mounds and stabilises to endure the longevity of the projects. Stockpiles must be managed to maximise viability and stabilised to prevent wind and water erosion.

* Monitoring of noise and dust emission is to be undertaken in accordance with the appropriate Australian Standards.

* Mine life estimates of the volumes of waste rock or overburden requiring disposal or emplacement will be required to adequate plan for disposal.

* Wastes which might be toxic, noxious or difficult to rehabilitate, susceptible to spontaneous combustion, or which might contaminate surface or groundwater should be identified as early as possible. Selective emplacement should be adopted wherever possible.

* Topography of the waste dump must be designed to blend with local topography and requirements.

* Options to increase the size of tailings dams must be canvassed. Every proposal for extensions to dams must be referred to the relevant authority for approval.

* As built drawings of tailing/reject dams and dumps should be provided with the management plan.

Revegetation

* The plan must contain schedules detailing proposed progressive rehabilitation. The reports made against the plan should include details of progress made against the plan.

* Rehabilitation trials must be started early in the mine life.

Erosion Control

All exposed surfaces are to be stabilised as soon as practicable to minimise dust generation and water erosion.

* Roads, tracks, earthworks and other temporary constructions must be implemented in accordance with the requirements of the relevant government authority.

* Protection or improvement of the visual amenity of the site is to be a consideration at all stages of mining and as a final rehabilitation objective.

* Prior to the demolition or removal of surface infrastructure or facilities, likely users should be considered, some facilities, such as those compatible with the post mining land use or with heritage values, may be retained after the cessation of mining.

94137 corresp.

New South Wales Government

Water Resources

Mitchell McCotter & Associates Pty Ltd
PO Box 943
CROWS NEST 2065

RECEIVED 18 JUL 1994

Attention: T W Perram, Principal

Telex: 121188
Facsimile: (02) 895 7281
Telephone: (02) 895 6211
Ext: 7441
Contact Name: John Ross
Our Reference: 0100081
Your Ref.: 94137L1
[AKW9046#]

14.7.94

Dear Sir,

Re: EIS Requirements - Clay/Shale Quarry Extension, Townson Rd, Schofields

Thank you for your letter of 8 July 1994 seeking this Department's comments and requirements for the above EIS.

Enclosed for your information and retention are the following Departmental documents:

a) "Amendments to the NSW Rivers and Foreshores Improvement Act";

b) "The 7-Step Method of controlling Bank Erosion and Sediment Build-up";

c) "The Importance of the Riparian Zone in Water Resource Management - A Literature Review";

d) "NSW State Rivers and Estuaries Policy";

e) 'Minimum Standards for Works in Rivers and Lakes"; and

f) "General Requirements for Environmental Impact Statements". (This is essentially a checklist of water resources matters to be addressed in the assessment of environmental impacts).

I trust the above and enclosed information will prove useful.

Yours sincerely,

John A. Ross
for J.F. Clarke, Regional Director
Sydney-South Coast

Encl.

RECEIVED 29 SEP 1994

94-137

EPA

Environment
Protection
Authority
New South Wales

PO Box 1135 Chatswood NSW 2057
Tel .02. 795 5000 Fax .02. 325 5678

Mr T Perram 23/9/94
Mitchell McCotter and Associates Pty Ltd
PO Box 943
CROWS NEST NSW 2065

Our Reference: CH96

Your Reference: 94137L1

Contact: Les Johnston (047) 213 700

16 SEP 1994

Dear Mr Perram,

Extension of Clay/Shale Quarry, Schofields

I refer to your letter dated 8 July 1994 and apologise for the delay in providing this reply.

The EPA considers that the proposal will need to address a number of environmental issues including air quality impact, water quality impact (both surface and groundwater), noise and ground contamination management. Existing environments need to be described and both qualitatively and quantitatively assessed. Any proposed environmental protection measures should be identified. The effectiveness of any proposed controls and monitoring requirements should be assessed and criteria provided for such purposes. Site rehabilitation strategies need to be clearly outlined in conjunction with the necessary management plans to address environmental concerns.

Please contact Les Johnston on (047) 213 700 should you wish to discuss the above.

Yours sincerely

WARREN HICKS
Regional Manager Outer Sydney
for Director-General

Hawkesbury Nepean
CATCHMENT MANAGEMENT TRUST

6th May 1997

CMPS&F PTY LTD
PO Box 201
CHATSWOOD 2057

Contact: Tony Towers
Our Ref: LM/BL/EIS
q-pgh-schof
Your Ref: VA0009

Attention: Felicity Stening

Dear Ms Stening,

Proposed quarry and landfill - PGH/CSR site, Schofields, Blacktown.

Thank you for your letter seeking our requirements for the EIS on the above proposal. The Trust commented on a previous proposal by Camide Pty Ltd for a landfill on part of the site, to bring "the abandoned quarry back to pre-quarrying levels".

The EIS should indicate the way in which the following criteria will be achieved:

1. Satisfying the Trust's policy on water quality and quantity:

   - *Any water flow or changes in flow from the area should not alter the downstream natural hydrology (frequency or peaks) for all events up to the one in two year storm event (30 minute event), and should not alter the downstream peak levels for events up to the 1 in 100 year event.*
   - *Surface runoff should not compromise the: ANZECC Guidelines standard for healthy rivers - aquatic ecosystems, water supply for livestock, fish etc for human consumption; and NHMRC Guidelines for recreational water quality - visual amenity and secondary contact recreation.*
   - *Groundwater should be protected from the impacts of any contaminated surface waters and/or leachate.*

   In this location the Trust is particularly concerned with possible impact on Eastern Creek, particularly as runoff from the site has created turbid conditions downstream and there a considerable amount of silt material has been extracted from the watercourse below the site.

2. Establish in terms of ESD principles: the need for, and appropriateness of, using such a site for landfill and consistency with an overall strategy for the use of former quarries in the area; ways in which the sources of fill can be guaranteed and the filling closely monitored to prohibit other than approved fill. Identification of proposed final uses.

3. Construction of a final landform that will be geomorphologically stable in the long term.

4. The Extractive Industries/Quarries Practice Guideline (July 1994) prepared by the DUAP identifies the need for an Environmental Management and Rehabilitation Plan. The Trust strongly supports the preparation of such a plan.. It needs to specifically identify who is responsible for implementation of each action and the timeframe; document reporting mechanisms including the management routine for after hours activation of alarms; an incident management system; management and monitoring. An outline of the plan should be indicated in the EIS, including:

   (a) Water quality management that will achieve the Trust's policy, including: the flow regime of receiving waters; likely impact of the proposal; the means of collection and disposal of surface water run-off; the management of waste waters, oils and grease; control of drainage, both quantity and quality; appropriate leachate control measures and any likely infiltration into the ground water and effects on water bores.

Hawkesbury-Nepean Catchment Management Trust, 68 Mileham St, (PO Box 556), Windsor NSW 2756
Tel: (045) 77 4243 Fax: (045) 77 4236

Healing the Hawkesbury - Nepean

(b) Vegetation management including, but not limited to: important vegetation communities; revegetation of disturbed areas.

(c) A site management plan aimed at ensuring that the site is managed effectively, that impacts upon the environment are minimised and that there are effective monitoring and reporting mechanisms in place. This plan should consider on-site materials management; day to day operating procedures; erosion and sediment controls; emergency/contingency plans.

(d) The environmental management plans should indicate a requirement for preparation of working documents for works supervisors on the ground, specifying required outcomes and best practice to achieve the outcomes in relation to:

- Water cycle, drainage, erosion and sediment control;
- air quality;
- waste;
- rehabilitation/regeneration.

The Trust considers that the applicant should suggest in the EIS that they will propose an EMS in accordance with ISO 14000 and that the Environmental Management and Rehabilitation Plan will be a component of the EMS.

5. Provision for an environmental impact prediction verification report. The Trust considers that this is particularly useful as it establishes a process for determining whether the predictions made for a proposal are valid; provides for reporting at several stages; gives the opportunity, depending upon the outcomes of the report, for the permitting and regulatory authorities to require amendments to the operations; and produces a document that can be made available to the public.

6. Fauna and flora will be adequately protected. Any significant effect on threatened species, populations or communities is to be assessed in terms of the Threatened Species Conservation Act.

7. Air quality will be maintained. The EIS will indicate measures for dust suppression from activities, haulage vehicles and waste disposal.

8. The consistency of the proposal with the:

- *Environmental Guidelines: Solid Waste Landfills*, NSW E.P.A. 1996; and
- *EIS Practice Guideline: Landfilling*, NSW DUAP 1996

The EIS also address the provisions of Sydney Regional Environmental Plan No 20 Hawkesbury-Nepean River and the draft amendments to the Plan, in particular the consistency of the proposal with the Plan's aims, objectives and criteria.

Should you wish to discuss any matter raised in this letter, please contact the Trust's staff.

Yours sincerely,

Malcolm Hughes

Director, Planning & Assessment

cc. Erich Weller Chairperson
Michael Druce Catchment Co-ordinator
South Creek Catchment Management Committee

Healing the Hawkesbury - Nepean

INCOMING CORRESPONDENCE			
DATE IN	29/4		
PROJECT MGR.	SHW	INTL	SH
PROJECT No.	VH0009		
FILE No.	027		
TO	SH		
A/I/C	A		
ACTIL	RS		

NSW NATIONAL PARKS AND WILDLIFE SERVICE

SYDNEY ZONE

TO: Felicity Stening

FROM: Derek Steller.

DATE: 29/4/96

NO. OF PAGES FOLLOWING: 3

SUBJECT: Proposed continuation of Quarrying, Landfilling & Sites Rehabilitation at PGH Brickworks site, Schofield.

Ph (02 9585 6678 Fax (02) 9585 6442

P.O. Box 1967
Hurstville NSW 2220

Please refer to attached guidelines for matters to be considered in the EIS.

Derek Steller
Env. Planning Officer
Sydney Zone.

NSW NATIONAL PARKS AND WILDLIFE SERVICE

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

29/04 '97 15:42 ☎61 2 58564442 NPWS SYDNEY ZONE 002/004

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.

29/04 '97 15:42 ☎61 2 5856442 NPWS SYDNEY ZONE 003/004

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.

29/04 '97 15:43 ☎61 2 5856442 NPWS SYDNEY ZONE 004/004

OP 22/7 94-137

Western Sector
Public Health Unit

A joint unit of
Western Sydney and
Wentworth Area
Health Services

13 New Street
North Parramatta
NSW 2151
Telephone (02) 840 3603
Facsimile (02) 840 3608

18 July, 1994

RECEIVED 22 JUL 1994

OUR REF : 3100
YOUR REF: 94137L1

Mr T W Perram
Mitchell McCotter & Associates Pty Ltd
PO Box 943
CROWS NEST NSW 2065

Dear Sir,

Extension of Clay/Shale Quarry, Townson Road Schofields

Thank you for your letter of 8 July 1994, seeking matters of concern to the NSW Health Department regarding the proposal by PGH Clay Bricks and Pavers to quarry and rehabilitate resulting voids with non-putrescible wastes.

Unfortunately the scope of the EIS framework does not really permit the full assessment of environmental health issues. Nevertheless the following factors may be addressed:

- Odour
- Noise
- Vermin
- Dust and windblown debris
- Fire fighting
- Leachate
- Stormwater control and watercourse protection
- Supervision of waste receipt
- Unauthorised access
- Scavenging prevention
- Wet weather contingencies
- Tipping control
- Waste disposal from staff amenities

Yours faithfully,

Neil Shaw

Neil Shaw
SENIOR ENVIRONMENTAL HEALTH OFFICER
for DIRECTOR

TERRY

94137.

RECEIVED - 1 AUG 1994

New South Wales Fire Brigades

Fire Prevention

Incorporating *Fire Safety*
Fire Investigation
Public Education

Telephone: (02) 742 7400

Facsimile:
Fire Prevention (02) 742-7486
Fire Safety (02) 742-7483
Fire Investigation (02) 742-7385
Public Education (02) 742-7486

All communications to be addressed to the Commissioner
NSW Fire Brigades
Locked Bag 12
P.O. GREENACRE NSW 2190

Amarina Avenue
CHULLORA NSW 2190

Your Ref: 94137L1
Our Ref: FSD/FAC/102918

Contact: L Beauchamp / jt

28 JUL 1994

Mitchell McCotter & Associates
PO Box 943
CROWS NEST NSW 2065

Dear Sir

Clay/Shale Quarry
Townson Road
SCHOFIELDS

I refer to your letter dated 8 July 1994, requesting the Brigades' comment on areas of concern that should be addressed in the Environmental Impact Statement.

The Brigades' requirements to be included within the scope of the Environmental Impact Statement are as follows:

1. Details of the site layout and process.

2. Identification of potentially hazardous processes.

3. An outline of all fire prevention, protection and fire fighting measures and equipment.

4. Details of either compliance of, or departure from the Building Code of Australia, Australian Standards or any other regulations applicable to the development.

Yours faithfully

For Commissioner

RECEIVED - 1 AUG 1994

PACIFIC POWER
SERVICES

Services/Property & Survey
Telephone 268 6432
Your Reference 94137L1
Our Reference PS/2760 P&S/LP/984

Mitchell McCotter
PO Box 943
CROWS NEST NSW 2065

28th July 1994

Dear Sir/Madam

EXTENSION OF CLAY/SHALE QUARRY, TOWNSON ROAD SCHOFIELDS

I refer to your correspondence dated 8th July, 1994, concerning the abovementioned matter.

As from 1st July, 1994, Pacific Power's electricity transmission network has been vested in PacificGrid Pty Limited. PacificGrid Pty Limited is a wholly-owned subsidiary of Pacific power. Responsibility for operating, maintaining and developing the network; for acquiring easements necessary for transmission lines; and for constructing new lines now rests with PacificGrid Pty Limited.

I am authorised to answer property enquiries on behalf on Pacific Power and on behalf on PacificGrid Pty Limited.

Following investigation, I wish to advise that the subject land is traversed by an easement for the Sydney West - Sydney North No 1 330 kV Transmission Line, as shown on attached copies of survey plans P3755 and P3756.

This easement was acquired by Pacific Power to provide adequate working space along the route of the line for construction and maintenance work. This also ensures that no activity is undertaken near the transmission line or the structures which could create an unsafe situation either for persons or for the security of the transmission line.

Having regard to the above, attention is drawn to restrictions applicable within the easement area:

1. Buildings or other substantial structures of parts thereof shall not be erected within the easement area.

2. Minor structures, plant, equipment or fencing shall not be erected or installed within the easement area without the prior written approval of PacificGrid.

3. Unobstructed vehicular access to the transmission line structures shall be available at all times for PacificGrid plant and personnel. In this regard a continuous and unobstructed access way 4.5 metres wide shall be retained along the easement. Notwithstanding where vehicle access is not available along the easement for geographic reasons (i.e. valleys, cliffs, escarpments, rivers, water courses etc.) suitable alternative vehicle access (4.5 metres wide) shall be provided. Access gates should be installed in agreed locations as required.

4. Obstructions of any type shall not be placed within 15 metres of any part of a transmission line structure.

5. Excavation work or other alterations to existing ground levels shall not be carried out within the easement area without the prior written approval of PacificGrid. Approval will not normally be granted for such work within 16 metres of any transmission line structure.

6. Vehicles, plant or equipment having a height exceeding 4.3 metres when fully extended shall not be brought onto or used within the easement area without the prior approval of PacificGrid.

7. The parking of vehicles within the easement area shall be limited to types whose height when fully extended does not exceed 4.3 metres. Where vehicular access or parking is within 16 metres of a transmission line structure, adequate precautions shall be taken to protect the structure from accidental damage.

8. Utility services, whether above or below ground, shall not be installed within the easement area without the prior written approval of PacificGrid. All underground services installed within 30 metres of a transmission line structure are required to be non-metallic.

9. Flammable materials, explosives, flammable liquid carriers, caravans and other camping vehicles or site offices shall not be placed within the easement area.

10. Garbage, refuse or fallen timber shall not be placed within the easement area.

11. Explosives shall not be used within the easement area without the prior written approval of PacificGrid.

12. Trees and shrubs may be planted within the easement area provided that they are species whose mature height is less than 4 metres and

Mitchell McCotter
PS/2760 P&S/LP/984

do not interfere with access to any transmission structure.

It should be noted that the above list is not exhaustive and, where there is any doubt concerning a particular activity within the easement area, advice should be sought from PacificGrid, Mains Enquiry Section, Wallgrove.

All proposed activities within the easement area require written approval from PacificGrid. For such approval, detailed plans drawn to scale and fully dimensioned, showing property boundaries and other relevant information should be forwarded to this office.

Further, there are long term plans for the upgrading of the Sydney West - Sydney North No 1 330 kV Transmission Line, which may involve some realignment of the existing easement. However there is no Board approval for this proposal as yet.

Please note that care should be taken to ensure safety to personnel working in the vicinity of the transmission line, in the case of an earth fault occurring on this circuit. For further queries concerning possible hazards related to earth faults and mitigation procedures, please contract Pacific Power's Earthing and Co-ordination Engineer, Mr Mel Quach on (02) 268 7823.

It is hoped that the above information will be of assistance to you. Should you require further information, please contact Mrs Linda Paillard on (02) 268 6432.

Yours faithfully

J TAGGART
FOR MANAGER/PROPERTY & SURVEY

~~Municipality of~~
Shire of Blacktown

(26)

THE ELECTRICITY COMMISSION OF N.S.W.

SYDNEY WEST - SYDNEY NORTH 330 kV. TRANSMISSION LINE

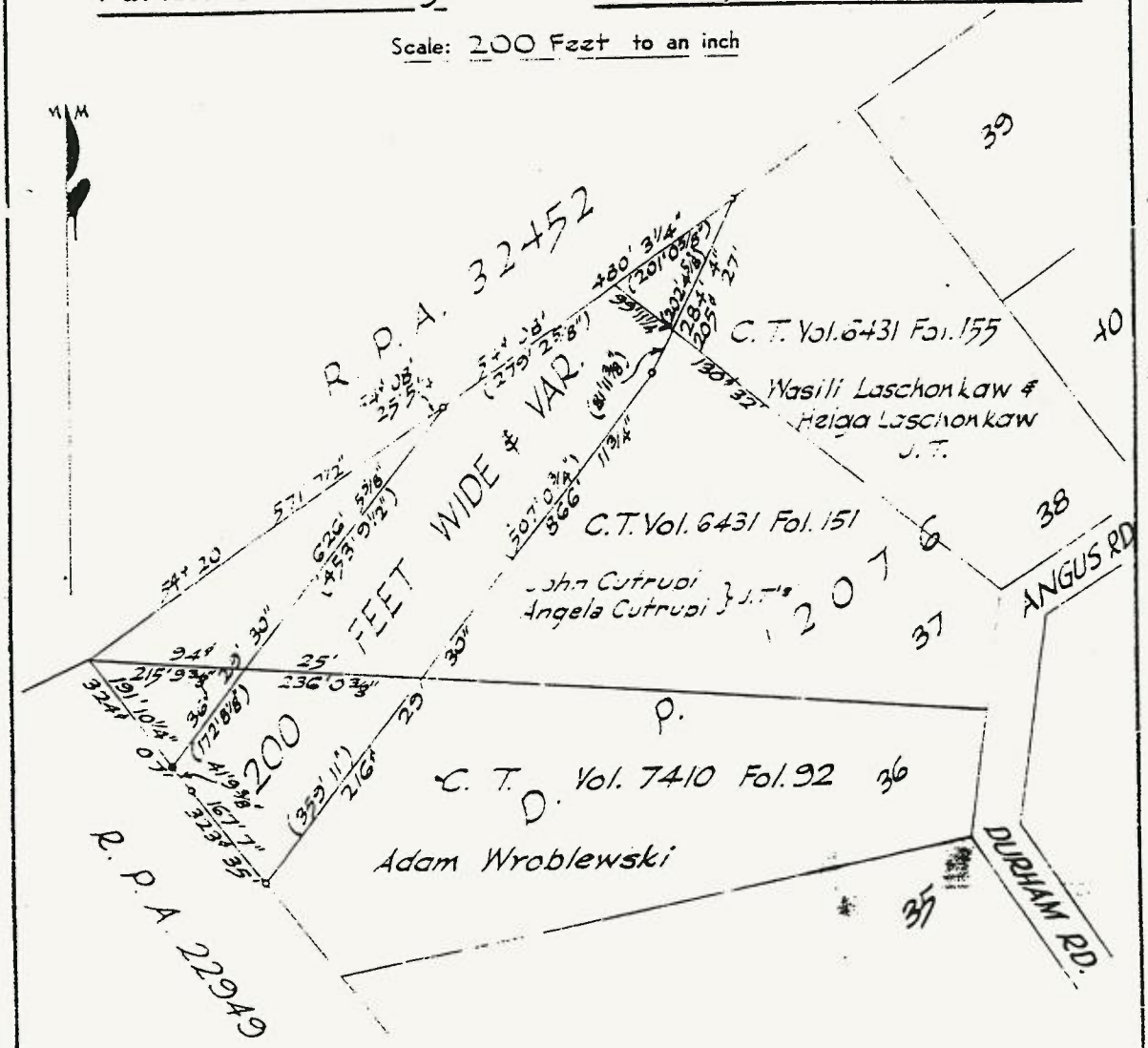
Trans. line

PLAN

SHOWING SITE OF EASEMENT PROPOSED TO BE RESUMED FOR TRANSMISSION LINE

Parish of Gidley County of Cumberland

Scale: 200 Feet to an inch



I certify that this plan has been compiled from information in D.P. 12076 and is correct.

H. Raymond
of J. T. S. Ryan & Co.
Surveyor Registered under The Surveyors Act, 1929.

Date 1.1.60

P.3756

Municipality of
Shire of Blacktown

EASEMENT FOR TRANSMISSION LINE
RESUMED BY NOTIFICATION IN GAZETTE
DE 14-4-61 No. 44 FOLIO 1081.

EASEMENT RESUMED 14-4-61

THE ELECTRICITY COMMISSION OF N.S.W.

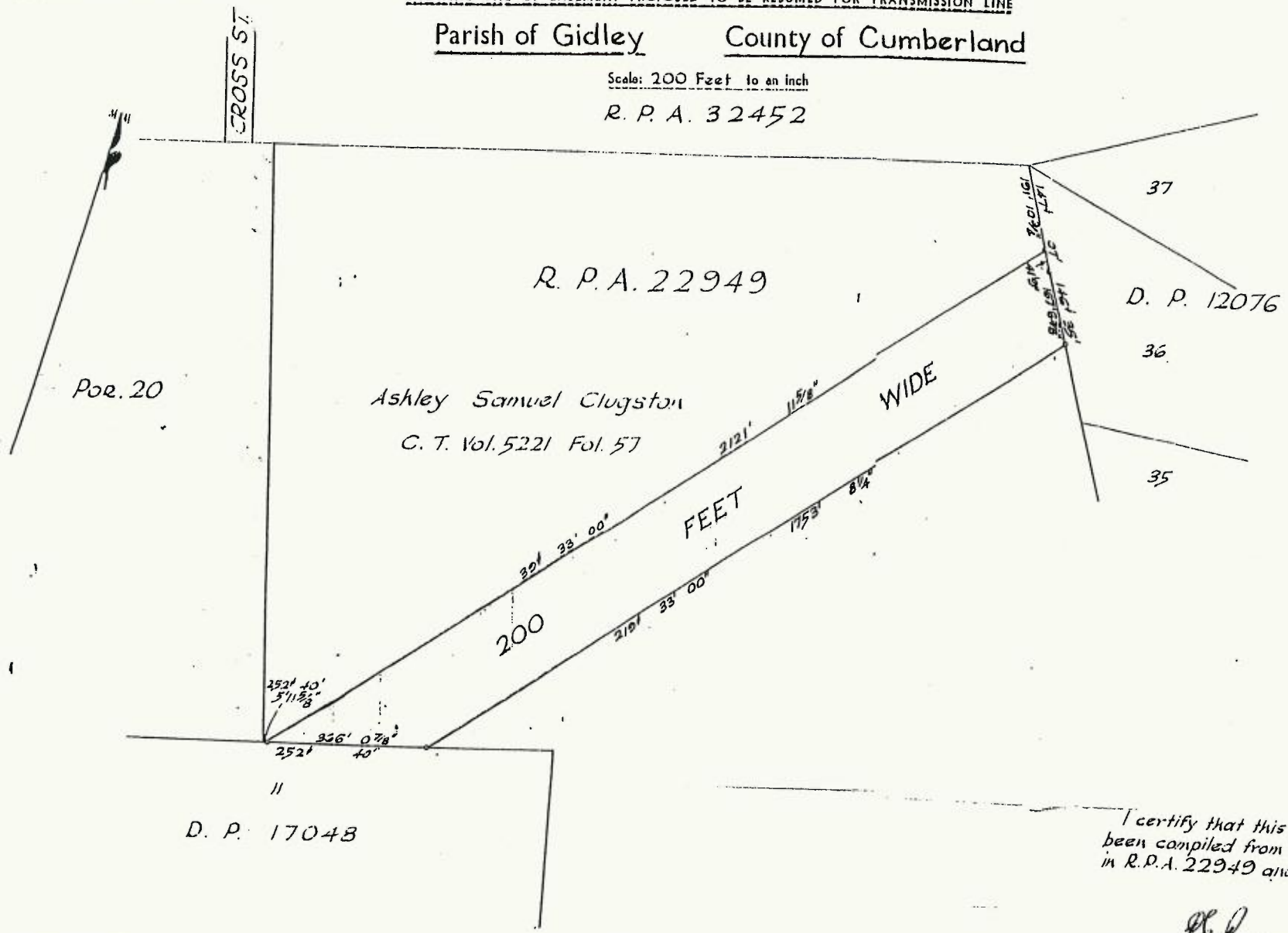
SYDNEY WEST – SYDNEY NORTH 330kV. TRANSMISSION LINE

PLAN

SHOWING SITE OF EASEMENT PROPOSED TO BE RESUMED FOR TRANSMISSION LINE

Parish of Gidley County of Cumberland

Scale: 200 Feet to an inch



Date 1.1.60

I certify that this plan has been compiled from information in R.P.A. 22949 and is correct.

R. Raymond
of J. T. S. Ryan & Co.
Surveyor Registered under The Surveyors Act, 1929.

P3755

ROADS AND TRAFFIC AUTHORITY
SYDNEY OPERATIONS DIRECTORATE
SYDNEY DEVELOPMENT SERVICES BRANCH

INCOMING CORRESPONDENCE	
DATE IN	29/4
PROJECT MGR.	SHW INTL SH
PROJECT No.	VH009
FILE No.	927
TO	SH
A/I/C	
INITIAL	

To: FELICITY STENING
CMPS & F

From: Mr Graham Richards
Land Use/Transport Planner
Sydney Operations Directorate
Roads & Traffic Authority
83 Flushcombe Road
BLACKTOWN NSW 2148

Phone: (02) 9831-0988 (Direct)
9831-0911 (Switchboard)

Facsimile: (02) 9831-0155

email: graham_richards@rta.nsw.gov.au

Postal Address
PO Box 558
BLACKTOWN NSW 2148
DX 8120, BLACKTOWN

GENERAL RTA REQUIREMENTS FOR AN EIS.

The RTA would like to see an E.I.S. give consideration to :-

(i) the preparation of a traffic impact report, outlining the likely traffic movements generated by the proposed development;

(ii) the need (if any) for improvements to existing road and intersection conditions (in terms of traffic and pedestrian safety and efficiency) in the immediate vicinity of the development, to accommodate the additional traffic generated by the development. Items including vehicle turning movements (and possible delay or queuing), improved pedestrian facilities, pavement condition, street lighting, street signs and parking restrictions could be addressed.

For the Wallgrove site, an analysis of the Wallgrove Road/Old Wallgrove Road intersection operation will be required (for existing traffic and the additional traffic generated by the proposed development).

For the Schofields site, an analysis of the Richmond Road/Townson Road intersection will be required.

(iii) development of a transport management plan identifying truck routes to be used (particularly as truck movements are expected between 10pm and 6am). Where the truck routes identified pass through residential areas an assessment of the traffic noise impact (during day and night) should be made ;

(iv) the proposed access driveway treatment (and any alternative locations considered) and onsite parking layout for staff, visitors and heavy vehicles;

(v) an assessment of the level of access to public transport for staff. Where access to public transport is poor, consideration could be given to establishing a car pool or ride sharing program,

CONFIDENTIALITY NOTICE FOR RECIPIENTS EXTERNAL TO THE RTA

The information contained in this facsimile is intended for the named recipient only. It may contain privileged and confidential information. If you are not the intended recipient, you must not copy, distribute, take any action in reliance on it, or disclose any details of the facsimile to any other person, firm or corporation. If you have received this facsimile in error, please notify us immediately by reverse charge call and return the original to us by mail. We will reimburse you any costs you may incur in notifying us and returning the original facsimile to us.

PLEASE CALL IF YOU NEED ADDITIONAL INFO.

TransGrid

Central Region - Metropolitan Area
Old Wallgrove Road Wallgrove
PO Box 87 Horsley Park
New South Wales 2164 Australia
Facsimile (02) 620 0728
Telephone (02) 620 1150

GRID/C/MET/GBH/DVV/13850

MONIER PGH
P.O. BOX 147
PARRAMATTA NSW 2124

ATTENTION: MATTHEW D WALTON BSC.

25 July 1995

Dear Sir

PROPOSED QUARRY ON LOT 3 IN DP 232574
AT MEADOWS ROAD SCHOFIELDS

I refer to your facsmile dated the 7th March 1995 and our subsquent letter dated 8th March 1995 and a site meeting that followed regarding the future planning of the proposed quarry on the above mentioned property which is affected by an easement for the Sydney West - Sydney North 330kv transmission line.

In a site meeting on the Thursday 5th May 1995 it was advised that transmission line easements are acquired by the Electricity Transmission Authority (now trading as TransGrid) to provide adequate working space along the route of the line for construction and maintenance work and also to ensure that no work or other activity is undertaken under or near the transmission line or the structures which could either by accident or otherwise create an unsafe situation either for persons or for the security of the transmission line.

Having regards to the above it agreed that you would at some time in the future submit plans showing the overall proposed plan for extraction. You suggested that the finished ground levels when rehabilitation of the site is complete would like to be approximately 1 metre above the natural ground level.

Kevin Maynard and Graham Hobbs request that you submit plans when they are available showing the levels at the base of the transmission line tower and the proposed level between the towers.

From further investigations it has been found that the statuatory clearances would not be maintained if the levels were increased by the 1 metre talked about in our meeting.

It was agreed:

see over page

Quality Endorsed Company

1. that the stuctures would have platform of a 30 metre raduis to the top of the batter of the quarry excavation.

2. an alternate vehicular access would be provided to the structures when the quarrying commenced.

Further to the discussions at the site meeting the following list is for your information.

1. Details of the proposed ground levels on the easement area are to be submitted for examination when available to ensure that adequate clearances are maintained. It should be noted that formal approval will not be given to the development if such clearances are not maintained.

2. Access to the transmission line structures shall be available at all time TransGrid's plant and personnel. In this regard a continuous and unobstructed access way 4.5 metres wide shall be retained along the easement. Notwithstanding where vehicle access is not available along the easement for geographic reasons (i.e. valleys, cliffs, escarpments, rivers, water courses etc.) suitable alternative vehicle access (4.5 metres wide) shall be provided. Access gates should be installed in an agreed location.

3. Excavation work or other alterations to existing ground levels shall not be carried out within the easement area without the prior written approval of the TransGrid. Approval will not normally be granted for such work within 16 metres of any supporting structure.

4. Utility services, whether above or below ground, shall not be installed within the easement area without the prior written approval of TransGrid. All underground services installed within 30 metres of a transmission line structure are required to be non-metallic.

5. Site sheds, containers, buildings or other substantial structures or parts thereof shall not be erected within the easement area.

6. Minor structures, plant or equipment, fences or barbeques shall not be erected or installed within the easement area without the prior written approval of TransGrid.

7. Obstructions of any type shall not be placed in the easement area within 15 metres of any part of a transmission line structure.

8. Vehicles, plant or equipment having a height exceeding 4.3 metres when fully extended shall not be brought onto or used within the easement area without prior TransGrid approval.

9. The parking of vehicles within the easement area shall be limited to types whose height when fully extended does not exceed 4.3 metres. Where vehicular access or parking is within 16 metres of a transmission line structure, adequate precautions shall be taken to protect the structure from accidental damage.

10. Trees and shrubs may be planted within the easement area provided that they are species whose mature height is less than 4 metres and do not interfere with access to any transmission line structure.

11. Garbage, refuse or fallen timber shall not be placed within the easement area.

12. Flammable material shall not be stored within the easement area.

13. Explosives shall not be used within the easement area without the prior written approval of TransGrid.

14. Flammable liquid carriers, fuel tank and caravans shall not be parked within the easement area.

Additionally we discussed the fill (unfired bricks) being located at a height (changing the natural ground levels by more than 3 metres) on the easement that would impede the statuatory clearance if the practise proceeded. You asured us that the matter would be corrected in due course.

For any further assistance please do not hesitate to contact the Engineering Officer Easements on Telephone Number (02) 620 1150.

Yours faithfully

G HOBBS FOR
MANAGER/CENTRAL REGION

APPENDIX D
COMMUNITY CONSULTATION

(i) Newsletters Distributed to Residents
(ii) Minutes of Planning Focus Meeting
(iii) Minutes of Community Meeting

Proposal to Continue Quarrying

Monier PGH, Schofields

Monier PGH has been producing clay products at its Schofields brick and paver manufacturing plant for 30 years. Clay/shale is extracted from a quarry on the site in Townson Road. An exhausted section of the quarry is currently being filled. Filling will be completed by May 1995, followed by revegetation. An Environmental Impact Statement for a proposal to continue quarrying and filling is currently being prepared and will be submitted to Blacktown City Council.

This newsletter is to advise you of the proposal and explain how it may affect the surrounding environment.

Proposal

The Monier PGH property includes an area of approximately 67 hectares on both sides of Meadow Road. The company proposes to extend quarrying operations over most of the site and progressively fill and revegetate quarried areas. The clay/shale resource at Schofields is valuable to the community and is much in demand. At present there is a shortage of supply in the Sydney region. It is estimated that there is sufficient resource on site for 25 years of quarrying activities.

Landfilling will resume approximately four years after development consent is granted and will continue until the quarry void is filled. Rehabilitation will involve filling, contouring, topsoiling and landscaping so that the completed site will blend into the rural environment. Clean materials including demolition and building rubble, excavated material, office discards, furniture and household clean-up material and garden clippings will be used for filling. Domestic garbage, liquid, chemical or hazardous wastes ***will not*** be accepted.

Quarrying will initially continue on the Monier PGH property north of Meadow Road. At the same time landscaping works will be undertaken around the boundary of the adjoining Monier PGH property south of Meadow Road in preparation for quarrying at a later date.

Environmental Effects

A number of safeguards will be included in the proposal to control the effects on the environment.

- Water Management

An effective water management plan is currently in place for existing operations and this will be modified as quarry and landfill operations proceed. Rainfall runoff will be collected and used for suppressing dust on the access road and operational areas. Sedimentation ponds and other controls will ensure that runoff draining from the site meets an acceptable standard. Leachate generated in the landfill will be collected and disposed of by irrigating onto landscaped areas.

- Noise

Noise from quarrying and landfill operations will be controlled by acoustic barriers at the site boundary. These barriers will consist of landscaped earth walls that will limit noise emanating from

the site. Noise on neighbouring properties will also be controlled by silencers on equipment and restricted operating hours.

- Air Quality

Initially, most of the bare ground will be regrassed to limit dust generation from the present site. In addition all active work areas and access roads will be regularly sprayed with water to limit dust generation. There will be no noticeable gas or odour generated by the operations.

- Traffic

Traffic will enter the site from Meadow Road. Traffic volumes will be similar to levels which have occurred during past quarrying and filling. A quantity of clay/shale will be exported from the site to the Monier PGH brick manufacturing plant at Horsley Park.

- Visual

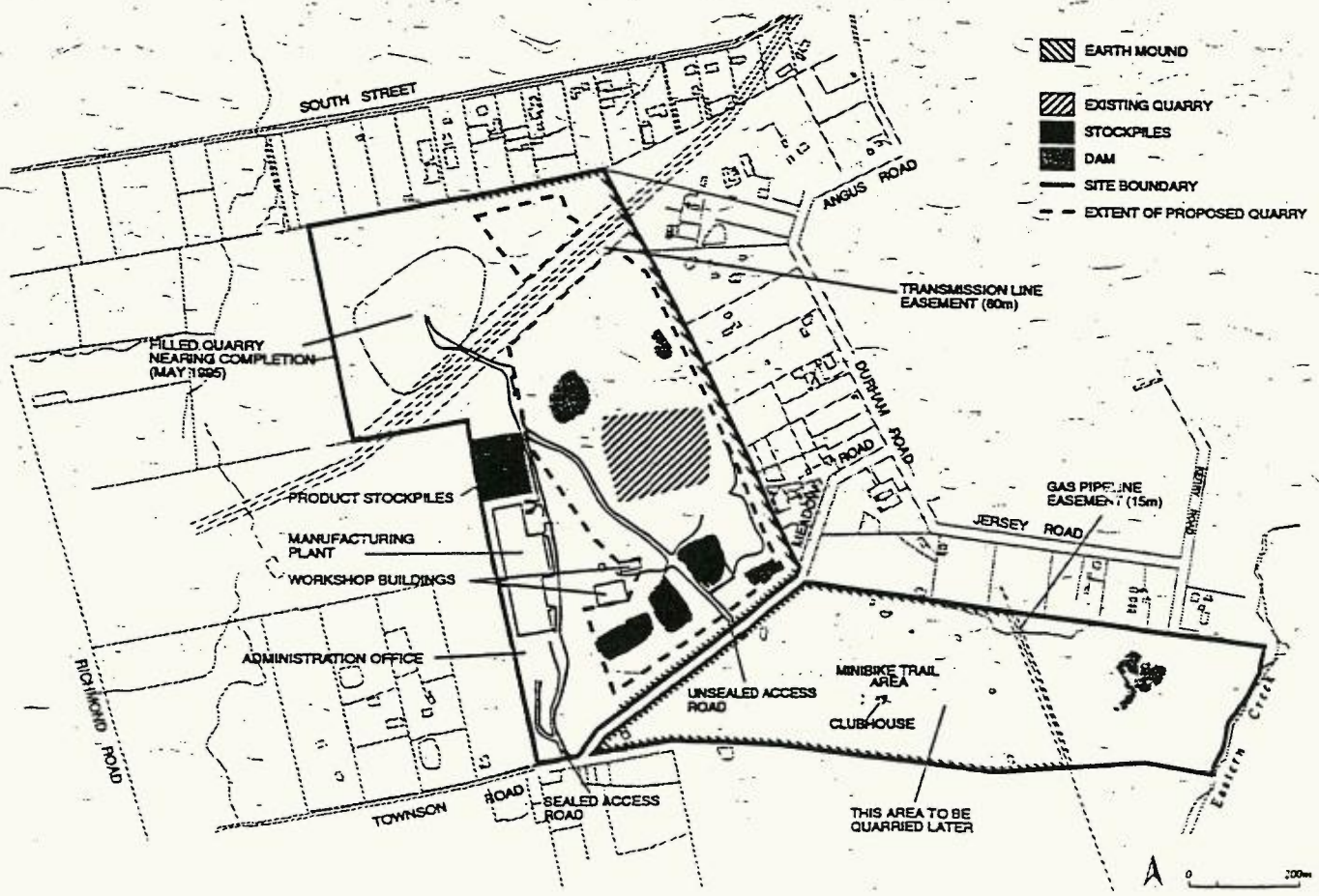
Landscaping around the property boundaries will effectively screen site operations from surrounding areas. Completed sections of quarry will be progressively planted with grass, trees and shrubs.

Comments/Further Information

If you would like further information or to comment on our proposal, you can contact:

Nick Valentine (906 1666)
ERM Mitchell McCotter

Matthew Walton (638 0281)
Monier PGH



INFORMATION STATEMENT

PGH BRICKWORKS SITE SCHOFIELDS, BLACKTOWN

ENVIRONMENTAL IMPACT STATEMENT TO ACCOMPANY A DEVELOPMENT APPLICATION TO BLACKTOWN COUNCIL

BACKGROUND

The PGH clay/shale quarry at Schofields, has been operating for over 25 years. PGH is a wholly owned unit of CSR Limited.

The quarry site covers an area of approximately 67 ha. on both the northern and southern sides of Meadow Road, Schofields. Access to the site is along Townson Road from Richmond Road.

The significance of the clay and shale resource within the site has been recognised in the Sydney Regional Environmental Plan No. 9.

PROPOSAL

CSR/PGH has appointed CMPS&F Environmental to prepare an Environmental Impact Statement (EIS) to accompany a development application which will be lodged with Blacktown Council in early 1997, for the continued quarrying, landfilling and rehabilitation of the site.

It is proposed that there will be 7 stages of extraction within the site and that each stage will be followed by site rehabilitation via landfilling. Landfill material will be within the category of solid waste class 2 (non putrescrible), ie. clean material such as demolition and building waste.

Each stage of extraction will take place within a 2-7 year time period, although the actual extraction process occurs during several `campaigns' each of a few months duration. The sequence of extraction and landfilling is indicated on the attached plan.

The expected annual extraction rate from the site will be in the order of 200,000 tonnes with estimate reserves of approximately 20 years. Landfilling will take place 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 upgraded or constructed progressively 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 rehabilitation. In this regard the preferred open space/recreational use of the land will be sought from the local community.

SITE DETAILS - Schofields EIS

SITE BOUNDARY ROAD DEVELOPMENT STAGES

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:

Michelle Kelsey
CMPS&F Sydney
Tel. (02) 9412 9797
Fax (02) 9412 9876.

MINUTES FROM COMMUNITY MEETING NO. 1

SCHOFIELDS PGH QUARRY EIS, BLACKTOWN

Location: Schofields Quarry

Date: Tuesday, 17 December 1996

Time: 6.30 pm

Attendees: Ron Bush CSR, Matthew Olney PGH, Lee Arnett PGH, Steve Hills CMPS&F, Michelle Kelsey CMPS&F, plus approximately 24 residents.

1. Introduction — Ron Bush, CSR

2. Summary of Key Issues — Steve Hills, CMPS&F
   - air quality - dust
   - noise
   - water
   - traffic
   - waste management strategy
   - final end use
   - visual

3. Community Discussion

Water

- drain under road needs cleaning out;
- dams need cleaning out;
- presently causeway in flood - cuts off Durham Road;
- presently water is being pumped down to Carnarvon Road to creek at bottom of road;
- will bund walls stop the overflow and cause some dams to go dry? CSR - can put a culvert through the bund wall and allow overflow to continue through;
- CSR will provide water management strategies at next community meeting and will bring person from Woodward-Clyde to answer any questions;
- what happened to original idea to have 3 dams - 1 flowing into the next so that water was clean by the time it reached the river (on the southern side of the site - Stages 6 and 7)?;
- currently bird life in dams - like to keep it there.

Noise

- reversing noises from machinery, trucks very loud;

need a bund wall at least 4m high to stop noise.

Traffic

- currently have 30 tonnes trucks using 5 tonne limited roads;
- water mains have been shaken out of the road by heavy trucks;
- Mulgoa quarry trucks have been using wrong roads, including Durham, Carnarvon Roads;
- minibikes very noisy;
- will trucks used to carry excavated material still continue? CSR - yes, current number of trucks will continue;
- intersection at entrance to quarry very difficult - tree opposite the entrance blocks the view when there are oncoming trucks.

Dust

- if EPA doesn't regularly visit the site, there will always be problems with dust;
- dust comes into houses;
- truck wash on site is not always used;
- watering down of roads causes problems with mud - very slippery.

General

- lighting - previous problems with bright lights on the quarry site - timer gets overridden by workers. Can deflectors be put on these lights?;
- odour;
- tankers coming in at night;
- PGH happy to handle problems that may arise, contact Lee if any problems;
- what sort of waste will be landfilled? Will it smell?;
- what will compaction rate be on landfill? CSR - need to get at least 1 tonne in 1 cubic metre of air space;
- CSR - asbestos and tyres will not be allowed;
- how can CSR get permission to destroy Aboriginal sites? CSR - haven't got permission yet, will apply to NPWS;
- property values will decrease if living next door to a tip. CSR - willing to discuss with the owners. CMPS&F - quarry was always planned to operate over the next 20-30 years, will now just be landfilling at the same time;
- suggestion to form a small committee of residents to discuss issues with quarry plant manager, Lee. Residents agreed, nominated 4 people , will meet at a time to be decided eg. fortnightly, monthly;
- when is next meeting? CSR - in February 1997, will notify residents in same way as previously notified.

APPENDIX E
DUST ASSESSMENT

PROPOSED CONTINUATION OF QUARRYING, LANDFILLING AND SITE REHABILITATION AT SCHOFIELDS, BLACKTOWN

DUST ASSESSMENT

Prepared for

CMPS&F ENVIRONMENTAL

Ref No: ANW126R1

ANW Consultants PTY LTD

CONSULTANTS IN ENVIRONMENTAL WIND AND AIR QUALITY

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Chapter 1

INTRODUCTION

This report has been prepared to assess the air quality impacts associated with the proposed continuation of quarrying, landfilling and site rehabilitation at the PGH Schofields site, Schofields. The subject site is located north and south of Meadow Road, Schofields and is described as Lot 3 in DP 232474.

The proposed development is described in detail in **Section 2** of the EIS.

A proportion of atmospheric particulates generated from the proposed extension of the existing quarry and landfill operations will pass to the surrounding environs. A computer based gaussian plume dispersion model with estimated dust emissions and local meteorological data was used to predict annual average dust deposition and concentrations isopleths around the site so as to assess any impacts.

The operations that would generate atmospheric dust, and air quality safeguards/controls which are proposed for the site, are outlined in Chapter 2. Chapter 3 reviews the meteorological data of the area while Chapter 4 presents relevant air quality criteria and Chapter 5 describes the existing air quality of the area. The methodology of dispersion modeling, including an inventory of dust emissions, is presented for all the operations of the quarry/landfill in Chapter 6. The results of the dispersion modelling are presented in Chapter 7, including both the dust deposition and the concentration of total suspended particulates. The results at this stage are related to the current air quality objectives and criteria. To complete the report Chapter 8 summarises the main conclusions derived in the main body of the report.

Chapter 2

DESCRIPTION OF THE PROPOSED DEVELOPMENT

2.1 OUTLINE OF THE PROPOSAL

The proposal is to continue excavation at a rate similar to the current production of up to approximately 240,000 tonnes per year. Some 30 per cent of this material is made up of overburden and waste clay/shale not suitable for the use in product production at the Schofields plant. This will be used as cover for the waste. Commencing when sufficient area is available, the void will be progressively filled with solid waste unit a ground profile surface is achieved, capable of effectively shedding rainwater. The final land form will be progressively topsoiled and landscaped. During the earlier years of quarrying, overburden will be progressively placed around the boundaries to form a landscaped mound of up to 5 metres in height. The amount of material to be quarried and landfilled is detailed in **Section 2.6** of the EIS and summarised in *Table 2.1* below:

Table 2.1 SUMMARY OF AVERAGE LANDFILL AND EXTRACTION RATES.

Material	Material quarried on site (tonnes)	Material exported from site (tonnes)	Material imported on site (tonnes)
Clay/Shale	170,000	120,000	150,000
Overburden	70,000	-	-
Landfill waste	-	-	96,000

Figures 2.1(a) to **2.1(e)** in the EIS show the overall development for the whole site.

A 50 metre buffer will be maintained between the quarry and the property boundaries. The existing buffer on the eastern side of the present quarry contains a bund wall at present which would be upgraded and extended as part of the proposal.

Operations on the southern property, south of Meadow Road, will initially be confined to a similar perimeter buffer area. Quarry in this area would commence once the northern property is exhausted. Landfilling will follow as each cell is completed. Excavated clay/shale will be stored in the existing stockpiles adjacent to the southern boundary.

2.2 TRAFFIC AND INTERNAL ROADS

Trucks transporting clay/shale will enter from Meadow Road through the western gate and proceed a short distance to the stockpile area in the south-western portion of the site. Departing trucks will leave the same way. Scrapers will transport clay/shale material from the quarry floor to the stockpile area via internal roads.

Trucks delivering waste will enter the site through the eastern gate. They will then proceed via an office and weigh bridge, and a ten metre wide road way to the landfill floor and tipping face. Empty trucks would return via a wheel wash to the weigh bridge before existing the site. The office and weigh bridge would be located approximately 100 metres from the site entrance. The access road will be sealed from the site entrance to the wheel wash area.

Clay/shale material is transferred to and from the site in 26 tonne trucks at present. The volume of material transferred and the number of truck movements will not change as a result of the proposal.

For the landfill it has been assumed that the average load entering the site is equivalent to 5 tonnes. This would result in a conservative estimate of trucks entering and leaving the landfill site.

Based on the above assumptions the number of vehicles generated by the proposal is estimated in *Table 2.2*.

Table 2.2 AVERAGE DAILY VEHICLE NUMBERS.

Operation	Origin	Average Daily Vehicle Numbers
Quarry	Importing	17
	Exporting	7
Landfill	Importing-	76

2.3 PLANT AND EQUIPMENT

It is anticipated that the items of plant and equipment shown in *Table 2.3* would be used on site

Table 2.3 PLANT AND EQUIPMENT.

Operation	Plant	Number of Items
Quarry	Caterpillar D9 bulldozer	1
	Caterpillar 631 Scraper	2
	12 tonne water truck	1
Landfill	Caterpillar 826 wheeled loader with steel wheels (compactor)	1
	Caterpillar D6 bulldozer or Cat 972 tracked loader	1
	12 tonne water truck	1

Rubber tyred scrapers would excavate overburden and the underlying shale. A bulldozer would scrape the shale and push the scrapers when required. Blasting would not be required to loosen material.

Clay/shale will be transported by scrapers to the stockpile areas near the site entrance. Front end loaders would maintain stockpiles, transport material to the brick manufacturing building and load trucks exporting material from the site.

2.4 HOURS OF OPERATION

Quarry operations will be undertaken for approximately three months per year between the hours of 6:00am to 6:00pm, Mondays to Friday, and 6:00am to 2:00pm Saturdays. There would be no quarrying on Sundays or public holidays.

Trucks moving clay/shale to and from the site would operate throughout the year between the hours of 7:00am and 6:00pm, Mondays to Friday.

Landfill operations would continue throughout the year between 6.00am to 6.00pm, Monday to Saturday, and 6:00am to 2:00pm Saturdays. The landfill site would be closed on Sundays and public holidays.

2.5 PROPOSED MITIGATION, MANAGEMENT AND MONITORING

In order to mitigate airborne dust the following series of measures are proposed, including:

- installation of a metrological station on the property;
- installation of a wheel wash to be used by all departing vehicles;
- sealing the access road between the wheel wash and Meadow Road;
- 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 the large bare areas north of the existing quarry until the area is required for quarrying;
- watering unsealed roads during dry conditions; 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.

Chapter 3

REVIEW OF WEATHER DATA

3.1 DATA REQUIREMENTS

An air dispersion model (ISC3) was used to predict dust deposition rates and dust concentrations in the vicinity of the quarry/landfill. ISC3 has been widely used by the United States Environment Protection Agency USEPA and is fully endorsed by the New South Wales Environmental Protection Authority. A full technical description is presented in the USEPA ISC3 Technical Manual. ISC3 uses a Gaussian sector-average plume model and the dry deposition model is based on a dry deposition algorithm by (Pleim et al., 1984) contained in the Acid Deposition and Oxidant Model (ADOM). This algorithm was selected by the USEPA as a result of an independent model evaluation study (EPA, 1994).

Climatic inputs to the model are wind speed, wind direction and atmospheric stability class.

This section provides a brief summary of the climatic data available.

3.2 WIND DATA

Wind data used for the study was collected near Penrith. Approximately two years of data was used for the study from January 1993 to December 1994. *Figures E3* through to *E7* show seasonal and annual wind roses for a two year period with all data being combined to form a single two year average.

The annual average wind speed was 2.0 metres per second, which is considered light to moderate, while 48.1 per cent of winds were less than 1.5 metres per second. A review of the wind roses indicate highly directional wind patterns. On an annual basis the most common winds are from the south and south-west. Winds from these directions are predominantly low speed. A similar pattern persists throughout the year, with southerly winds dominating, but north and north and north-easterly winds increase in summer/spring and westerly winds increase in winter.

3.3 STABILITY CLASS

Stability class is used in dispersion models to determine the rate at which a dust plume grows by the process of turbulent mixing. Each stability class is associated with a different dispersion curve. These are used by the model to calculate the plume dimension and dust concentration at points downwind of the source. In ISC3 the Paquill-Gifford curves were used to represent dispersion in the vertical and horizontal direction.

There are six stability classes referred to as A to F. Stability class data was estimated from sigma theta data supplied with the metrological data set. The frequency of occurrence of stability class are shown in *Table 3.1* below.

Table 3.1 FREQUENCY OF OCCURRENCE OF STABILITY CLASSES

Stability Class	Percentage of Occurrence
A	27
B	22
C	2.5
D	4
E	2.5
F	42
TOTAL	100

Stability Class A applies under sunny conditions with light winds when dispersion of the plume is most rapid. Stability Class D applies under windy and/or overcast conditions when dispersion is moderately rapid and stability Class F applies normally at night or early mornings when winds are light and the sky is clear. Dispersion under Class F conditions is poor. Class B, C and E describe intermediate conditions between those described above.

3.4 MIXING HEIGHTS

Information on mixing height is required as input to the dispersion model. Mixing height refers to the height that fine dust will ultimately be mixed in the atmosphere. For dust dispersion models, where most of the sources are non-buoyant ground level emissions, the predictions are not particularly sensitive to mixing height.

No long term direct measurements on mixing height are available for the site and theoretical derived values have been used. The theoretical values have been estimated by assuming that the mixing height reached during the day was 1500, 1200, 1000 and 1200 metres for summer, autumn, winter and spring, respectively.

Chapter 4

AIR QUALITY CRITERIA

4.1 INTRODUCTION

The effects of dust on health and amenity can be assessed by comparing dust deposition rates and dust concentrations with recognised air quality criteria established in New South Wales and overseas.

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

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 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 Schofields the percentage of PM_{10} particles in the fugitive emissions is below 50 percent of all particles transported from the site, SPCC (1986).

4.2 DUST CONCENTRATION CRITERIA

The National Health and Medical Research Council of Australia (NHMRC) recommends a maximum annual 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 Environment Protection Authority (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 4.1* summarises the criteria.

Table 4.1 NSW EPA DUST DEPOSITION GOALS

Existing Dust Level $g/m^2/month$	Maximum Acceptable Increase Over Existing Dust Level $g/m^2/month$	
	Residential Suburban	Other Areas
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 grams per square metre per month ($g/m^2/month$), an increase of two $g/m^2/month$ would be the maximum acceptable increase above background levels.

Chapter 5

EXISTING AIR QUALITY

5.1 INTRODUCTION

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

5.2 DUST DEPOSITION MONITORING

To determine levels of dust deposition in the area around the site a monitoring program was commenced in November 1994. This program measures dust deposition at five positions around the site. Gauge locations are shown in *Figure E1*. Results from the deposition gauges are presented in *Table 5.1*.

Table 5.1 DUST DEPOSITION RECORDS (INSOLUBLE SOLIDS) $g/m^2/month$

Year	Month	Gauge 1	Gauge 2	Gauge 3	Gauge 4	Gauge 5
94	November	3.3	3.0	2.5	2.5	3.7
	December	3.0	1.6	1.5	1.9	1.9
	Average	**3.15**	**2.3**	**2.0**	**2.2**	**2.8**
95	January	3.1	3.0	1.0	1.2	1.8
	February	1.5	1.6	0.9	0.9	0.5
	March	1.3	7.9	0.9	1.1	0.9
	April	2.4	1.1	0.7	0.8	1.3
	May	2.5	1.1	1.1	0.8	0.2
	June	1.9	20.9	7.7	1.7	1.0
	July	0.5	3.0	0.9	0.8	0.9
	August	-	-	-	--	-
	September	3.7	-	1.7	3.0	4.6
	October	2.1	3.5	1.5	1.6	5.5
	November	1.3	6.7	2.7	1.5	3.1
	December	1.4	1.9	1.5	0.7	3.3
	Average	**2.00**	**5.1**	**1.9**	**1.3**	**2.1**
96	January	0.6	9.9	**12.8**	2.9	7.7
	February	1.9	11.2	-	1.4	4.9
	March	0.9	15.1	7.7	0.2	4.0
	April	1.1	5.9	0.5	3.0	1.0
	May	0.9	16.3	0.6	0.5	0.8
	June	3.2	-	3.8	0.8	0.7
	July	2.1	-	2.7	1.2	1.0
	August	2.0	0.7	1.3	0.9	2.5
	Average	**1.6**	**9.9**	**4.2**	**1.4**	**2.8**

Note: - Sample not available due to lost equipment or fault.

5.3 REVIEW OF MEASURED DUST DEPOSITION LEVELS

Dust deposition gauges 1, 2 and 3 are situated on the eastern side of the existing quarry approximately 200 to 300 metres from the existing quarry. Deposition rates for these gauges for 1995 were between 1.9 and 5.1 g/m^2/month (annual average). The levels were typically within EPA guidelines except gauge three where the annual deposition rate was dominated by one high reading. Gauges 2 and 3 for 1996 recorded a deposition of dust equivalent to 9.9 and 4.2 g/m^2/month (annual average), respectively. The data from these gauges for 1996 were again dominated by a number of high readings. that could overestimate the true deposition level.

Gauges 4 and 5 are situated on the southern side of the existing quarry. Gauge 5, which is situated on the south western boundary, registered deposition levels of between 2.1 to 2.8 g/m^2/month (annual average). Gauge 4 is located directly south of the existing site. This gauge has registered deposition levels of between 1.3 to 2.2 g/m^2/month (annual average).

The location of the deposition gauges are relatively close to the existing quarry and therefore would be affected by operations within the quarry. Generally the deposition levels conform to relevant criteria which limits dust deposition rates to 4 g/m^2/month (annual average).

Since the deposition levels around the existing quarry would more likely than not be affected by the operations within the quarry, there is no available data on background levels of dust deposition and concentration in the area without the quarry. Therefore, estimates of local background air quality were derived from data for comparable areas.

Ambient levels of 1.5 grams per square metre per month (g/m^2/month) annual average for dust deposition and 40 micrograms per cubic metre ($\mu g/m^3$) annual average were adopted. These levels are typical of rural areas within New South Wales, NERDDC (1988).

LOCATION OF DUST DEPOSITION GAUGES

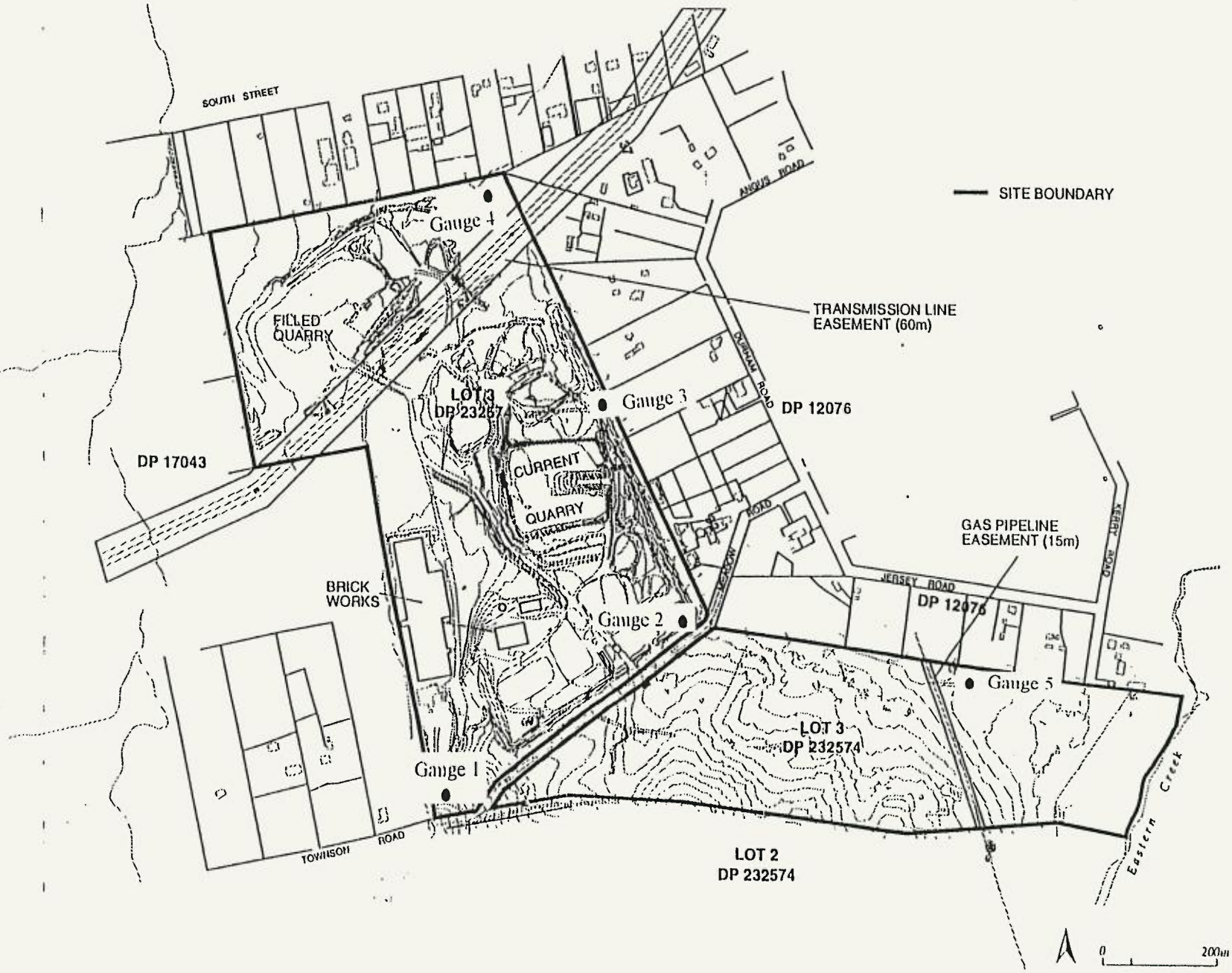

Figure E1

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Chapter 6

DUST EMISSIONS

6.1 INTRODUCTION

Detailed emission inventories of atmospheric dust were prepared from dust emission factors for each of the proposed activities. The emission factors were derived from data developed by the NSW Environment Protection Authority (EPA) and by the United States EPA. A list of individual activities, emission factors adopted and the sources is presented in *Table 6.1*.

Table 6.1 DUST EMISSION FACTORS

Operation/Activity	Emission factor (2)	Reference
Wind Erosion	0.40 kg/ha/hr	SPCC(1983)
Dumping	0.012 kg/t	SPCC(1983)
Haulage (1)	2.0 kg/km	SPCC(1983)
Reshaping Stockpiles/ Dozer	2.75 kg/hr	US EPA(1985)
Loading operations	0.025 kg/t	US EPA(1985)
Scraper	4.2 kg/km	US EPA(1985)
Stack Emission	0.25 kg/m^3	SPCC(1983)

(1) Dust suppression system working.

(2) kg - Kilograms, ha - hectares, hr - hour, km - kilometre, m - metre.

6.2 DUST EMISSION INVENTORY

The likely air quality impacts of the quarry will change over its life due to the relative movement of quarrying activities and the changes in production. Therefore four scenarios were modelled, previously identified as Stages 1, 2, 3 and 6. Stage 2 has the highest potential for creating dust since it has the highest production rates.

Table 6.2 summarises the estimated emissions for each activity on site for each stage.

The estimated dust emissions depend on the quarry extraction and landfill programme described in Chapter 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;
- the area north of the existing pit is stabilised at the outset with grass cover;
- trucks leaving the quarry having their loads covered;
- the maximum haulage distance on site is travelled (worst case); and
- trucks leaving the quarry driving through a wheel wash.

Table 6.2 DUST EMISSION INVENTORY.

Operation/Activity	Operation/Activity	Stage 1	Stage 2	Stage 3	Stage 6
Wind erosion	Stockpile	14,016	14,016	14,016	14,016
	Quarry	14,016	3,506	17,520	7,008
	Landfill	-	14,016	3,506	10,512
Clay/shale and overburden	Scrapers operating	8,006	8,006	8,006	8,006
Clay/shale and overburden	Dozer Ripping	1,815	1,815	1,815	1,815
Overburden Extraction	Scrapers dumping at o/b stockpile	840	840	840	840
	Dozer loading trucks - overburden	875	875	875	875
	Haulage of overburden to bund	2,154	2154	2154	2154
	Truck dumping overburden	840	840	840	840
	Reshaping overburden	1,815	1,815	1,815	1,815
Clay Extraction	Scraper haulage to stockpiles	5,440	2,720	9,520	9,520
	Scraper dumping to stockpile	2,040	2,040	2,040	2,040
	Reshaping stockpile	3,781	3,781	3,781	3,781
	Loading (export) trucks	3,000	3,000	3,000	3,000
	Dumping (import) trucks	1,800	1,800	1,800	1,800
	Haulage (Imports)	4,615	4,615	4,615	4,615
	Haulage (Exports)	3,692	3,692	3,692	3,692
Landfill	Haulage (Imports)	-	30,720	15,360	23,040
	Reshaping landfill and overburden	-	9,075	9,075	9,075
	Dumping (import) trucks	-	1,152	1,152	1,152
Factory	Stack	2,460	2,460	2,460	2,460
TOTAL		**71,205**	**112,938**	**107,882**	**112,056**

The total annual emissions of dust from the site for Stages 2 and 4 were estimated to be 224 and 314 tonnes of dust per year respectively.

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, inhaleable and coarse. *Table 6.3* summarises the data used in the dispersion model.

Table 6.3 DUST EMISSION INVENTORY FOR THE PROPOSED DEVELOPMENT

Operation /Activity	% Fine particle (0 to 2.5 microns)	% Inhaleable particles (2.5 to 15 microns)	% Coarse particles (> 15 microns)	Reference
Wind erosion	0	67	33	US EPA (1981)
Loading	6	57	37	SPCC (1986)
Placing	4	49	47	SPCC (1986)
Haulage	6	53	41	SPCC (1986)
FEL	6	48	4.6	US EPA (1991)

Chapter 7

PREDICTION OF AIR QUALITY IMPACTS

7.1 METHODOLOGY

Air quality impacts were assessed using the computer-based dispersion model known as ISC3. ISC3 has been widely used and validated.

The estimated rates of dust emission were applied together with the meteorological data to calculate dust dispersion. A computer plotting routine was used to draw isopleths of the predicted dust deposition rates and concentrations of particulates in the air.

As described previously, the likely environmental impacts will change over the life of the quarry, therefore four scenarios were modelled for stages 1, 2, 3 and 6 to take this into consideration. Descriptions of the impacts for these stages of the quarry/landfill are presented below.

There are a number of residences neighbouring the proposed development area which may be affected by the quarrying works, these are shown in *Figure E2*. The residences are generally located on the eastern side of the quarry/landfill.

7.2 RESULTS

7.2.1 Deposition

Figures E8, E9, E10 and *E11* show the predicted dust deposition due to Stages 1, 2, 3 and 6 of the quarry/landfill. The figures show the area of land expected to experience an increase in dust fallout. The shape of the dust deposition isopleths reflect the direction of the main winds from the south and south-west.

The existing **ambient** dust deposition rate has been estimated to be 1.5 g/m^2/month. 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 2.5 g/m^2/month as the maximum acceptable. Dust deposition increases of 2.5 g/m^2/month (annual average) on the critical eastern and southern boundaries where the residences are located are typically contained within the quarry/landfill boundaries. A small exceedance of the criteria does exist, however no privately owned residences were predicted to experience dust deposition from the quarry/landfill activities significantly above 2.5 g/m^2/month (annual average). Therefore the residences or any potential residential areas will not experience any loss of amenity during quarry/landfill activities of Stage 1, 2, 3 and 6.

7.2.2 Concentration

Figures E12, E13, E14 and *E15* show the predicted increases in annual average dust concentrations during Stages 1, 2, 3 and 4 of the quarry/landfill activities. Existing annual average total suspended particulate (TSP) concentrations are approximately 40 $\mu g/m^3$ and hence an increase of 50 $\mu g/m^3$ 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 50 $\mu g/m^3$ (annual average) falls within the area predicted to experience an increase of 2.5 g/m^2/month (annual average) dust deposition. The 50 $\mu g/m^3$ (annual average) contour is approximately contained within the site boundary and therefore meets the appropriate EPA criterion.

Inherent in the results presented is the assumption that the majority of the dust emissions are able to follow a path free of obstruction 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 included in regulatory dispersion models. Predicted dust levels, therefore generally over-estimate the actual levels. The site will have a five metre high bund constructed on its eastern and southern boundaries. The bund would be vegetated with trees. In addition for most of the time operations will be below the natural surface. At no time will simultaneous quarry and landfill operations occur at the surface. This has not been included in the dispersion modelling and will likely reduce the predicted levels.

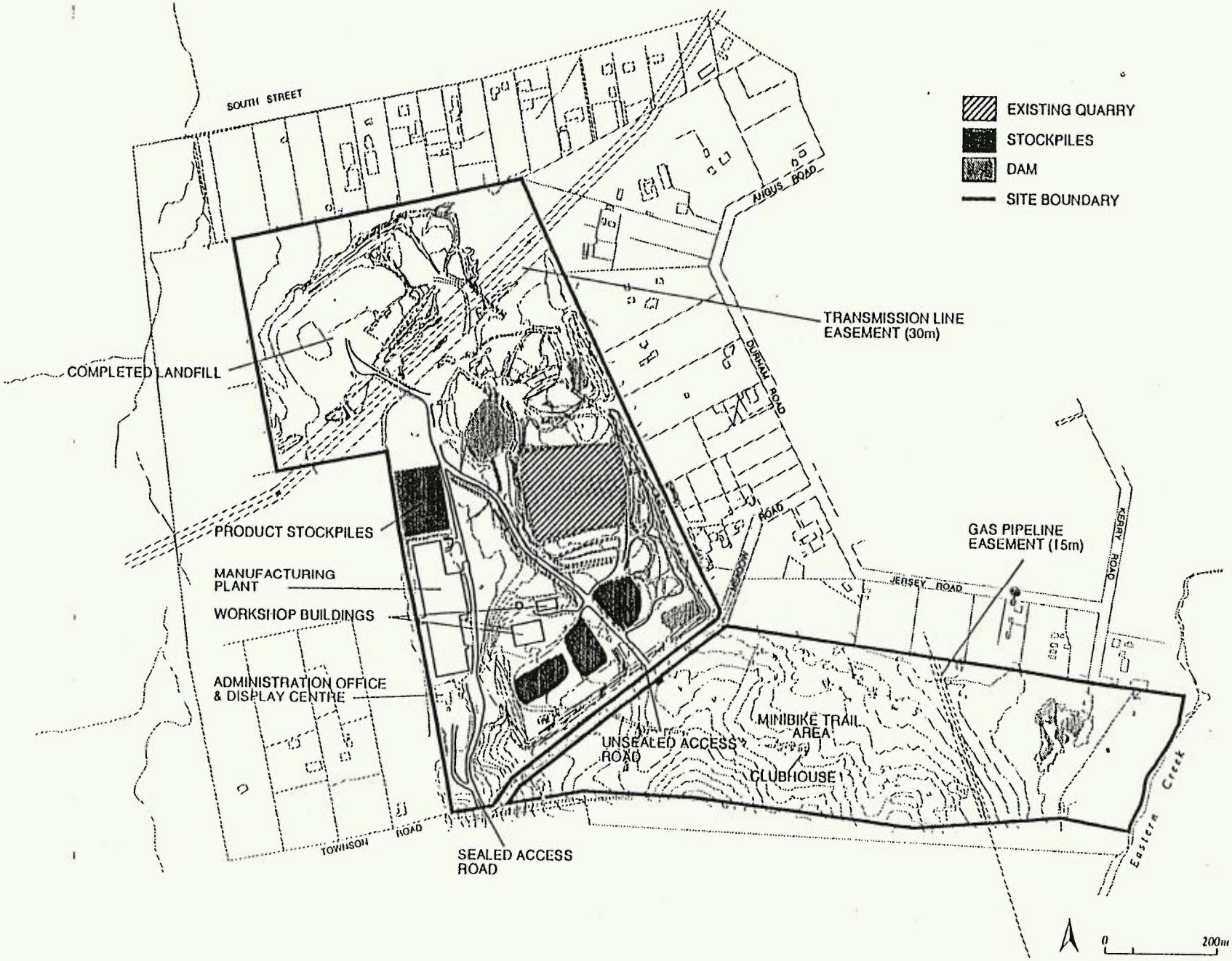
7.3 SHORT TERM DUST EPISODES

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 rare 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. A realistic prediction of dust concentrations in the air during an episodic event is more difficult to achieve with accuracy than the corresponding predictions of annual dust levels.

Typically short term dust episodes occur with wind speeds greater than 10 metres per second. The wind data for western Sydney used in our studies showed that wind speeds greater than or equal to 10 m/s occurred less than 2 per cent of the time.

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, sealing of the access road, and covering and washing 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.



CLOSEST RESIDENCES

Figure E2

ANW CONSULTANTS

Chapter 8

CONCLUSIONS

The generation and dispersion of dust from the proposed operations at the PHG Schofields Quarry/Landfill site has been assessed. Baseline conditions for this assessment were derived from the results of dust deposition monitoring data collected over approximately two years.

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;
- trucks leaving the quarry having their loads covered; and
- trucks leaving the quarry driving through a wheel wash.

Stages 1, 2, 3 and 6 were selected to develop dust emission inventories as they represent the typical operations within the quarry.

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

The results of the modelling indicated that the EPA guidelines for long term dust deposition and concentration at nearby residences will not be exceeded in any of the stages of the proposed quarrying/landfill activities. 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 deposition and concentration to below the EPA guidelines.

It is therefore concluded that long term amenity at nearby residences will not be adversely affected by the proposed operations of the quarry/landfill.

To provide an indication of compliance with EPA guidelines, dust deposition monitoring at the existing five monitoring locations will continue. These results will be analysed monthly for compliance and corrective action will be taken to reduce any exceedances of the NSW EPA guidelines if they occur.

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

Chapter 9

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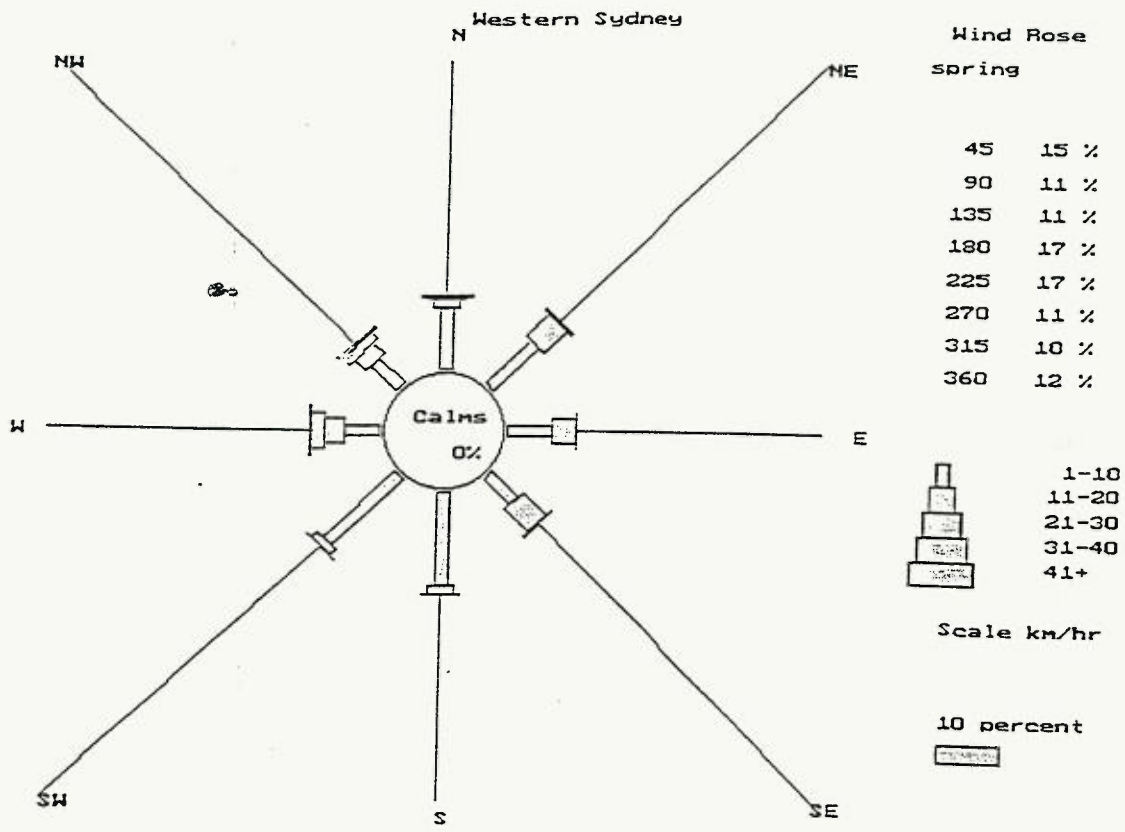

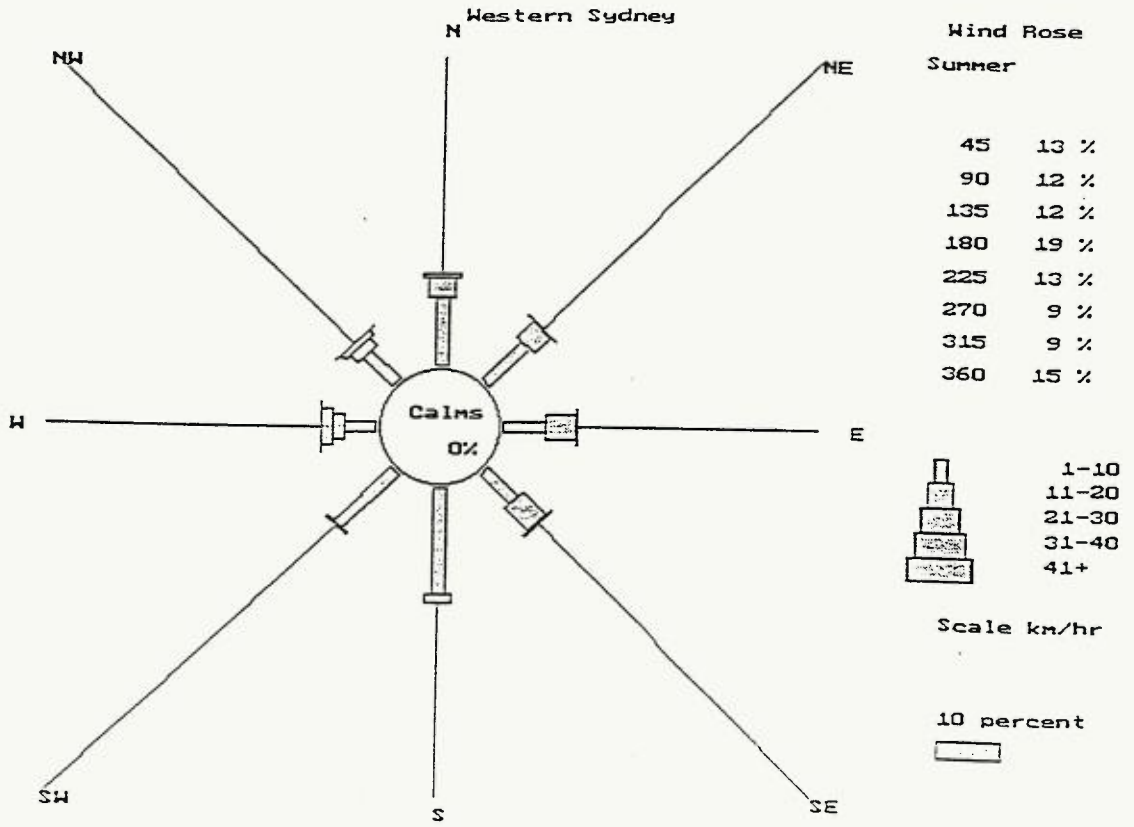

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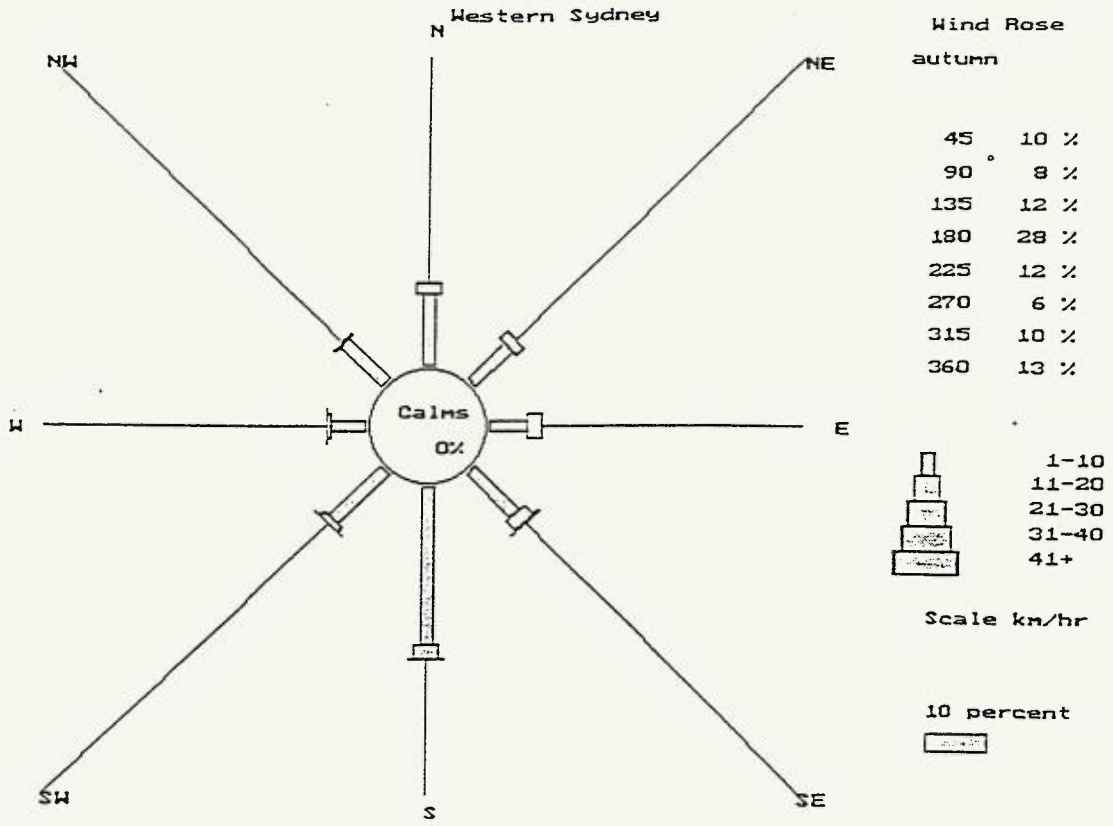

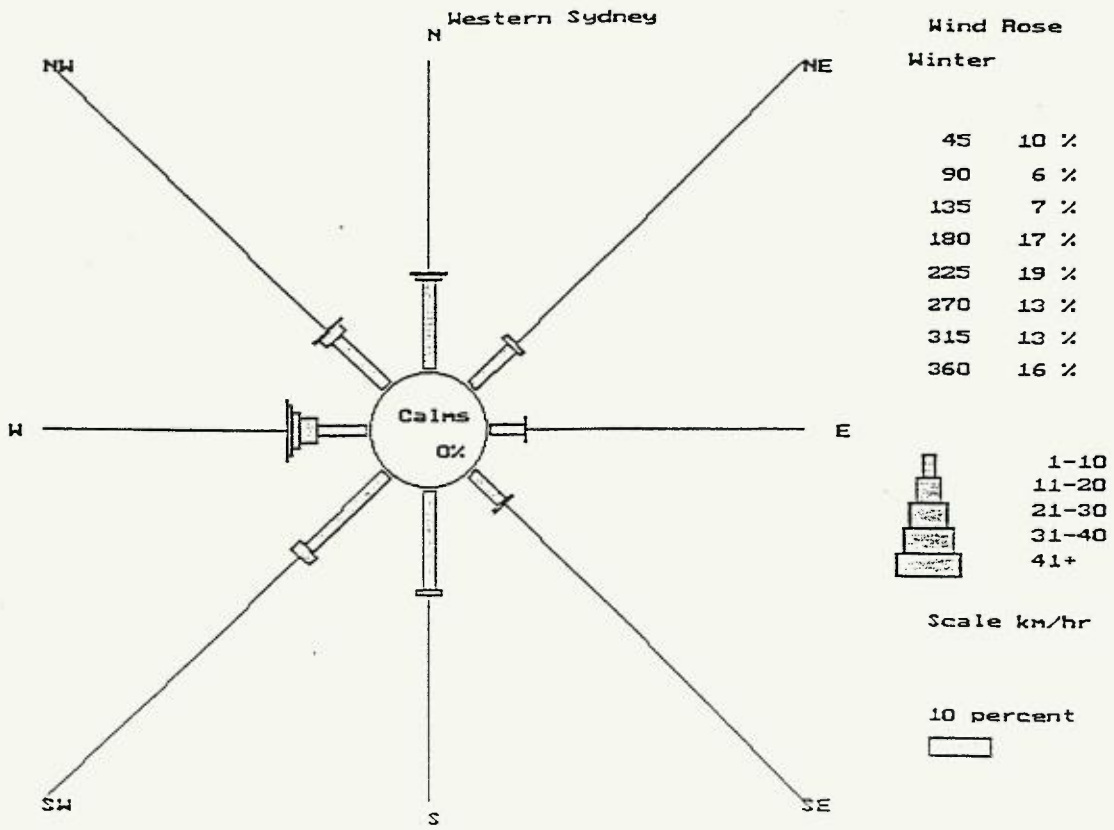

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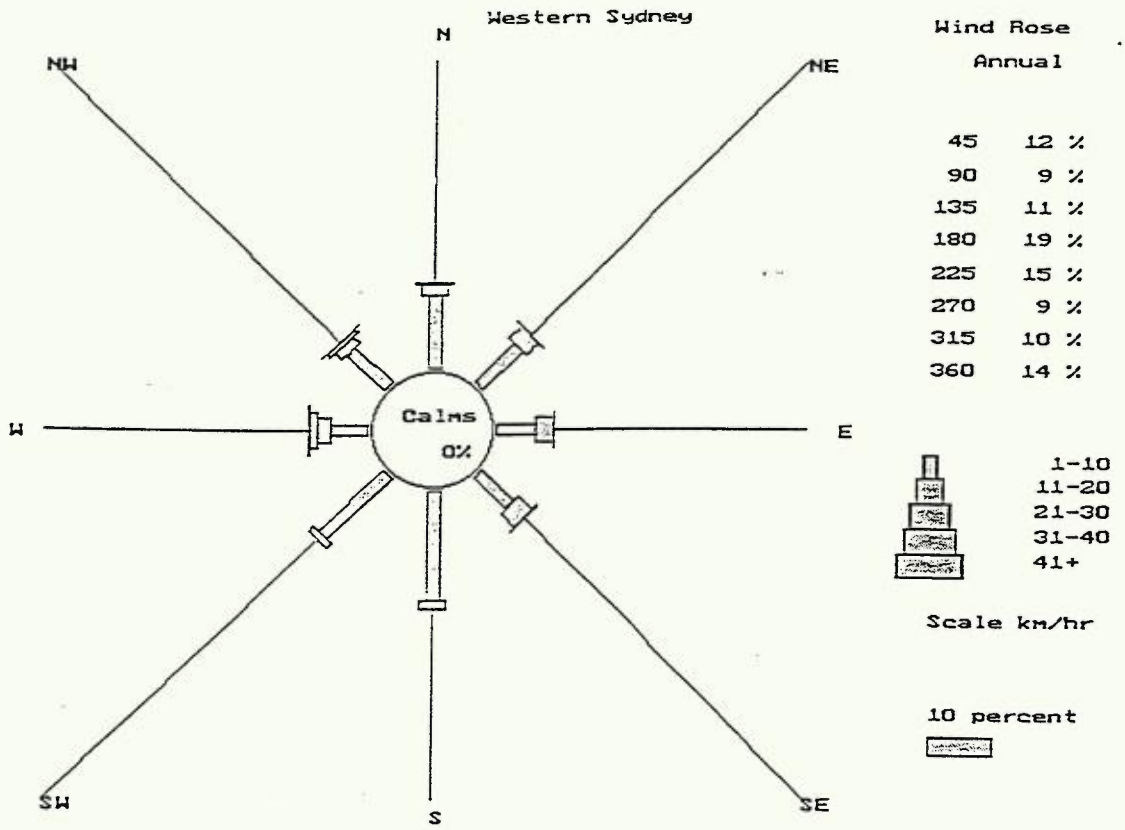
Western Sydney
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NE
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SW
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NW
Calms
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Wind Rose
Annual
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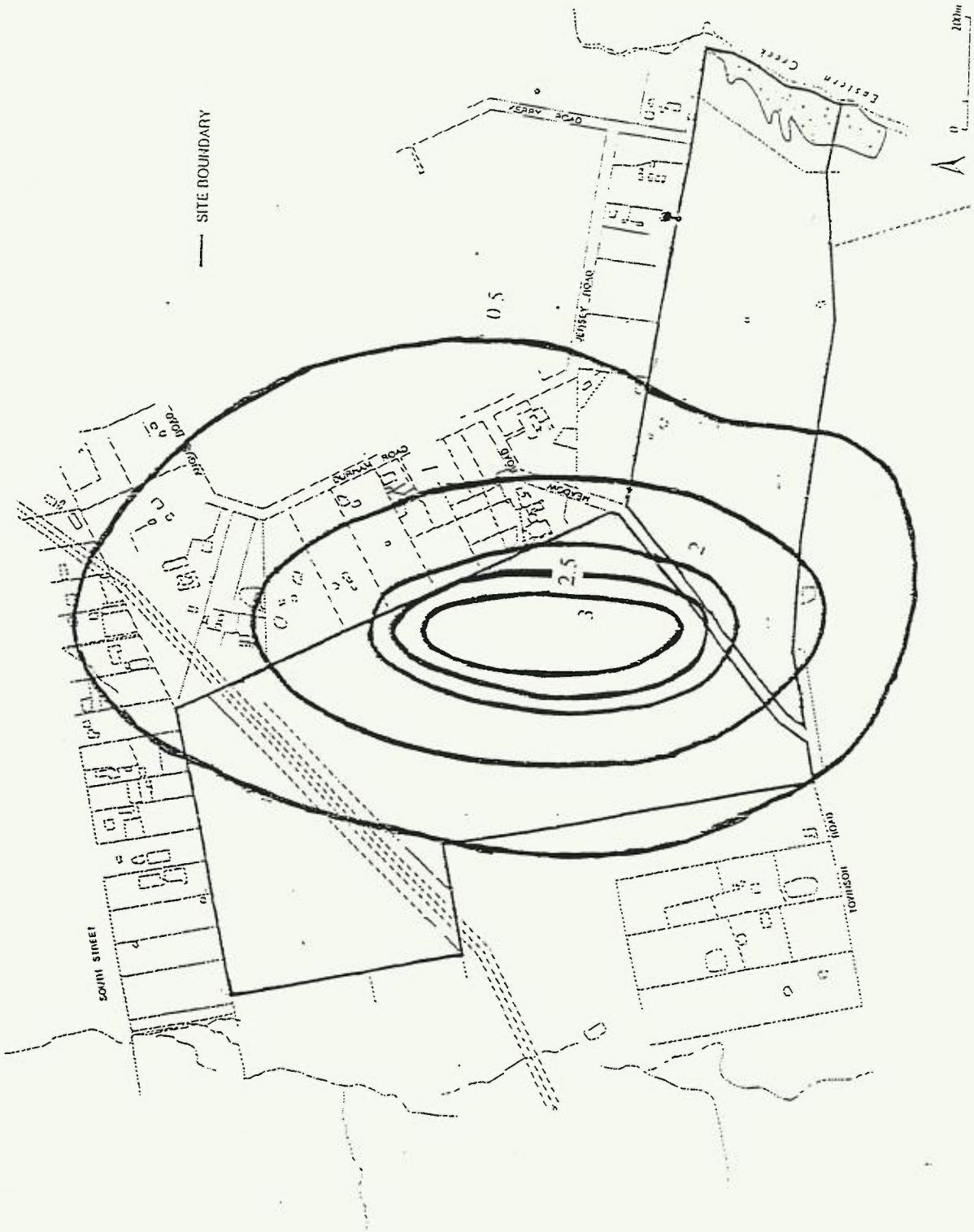
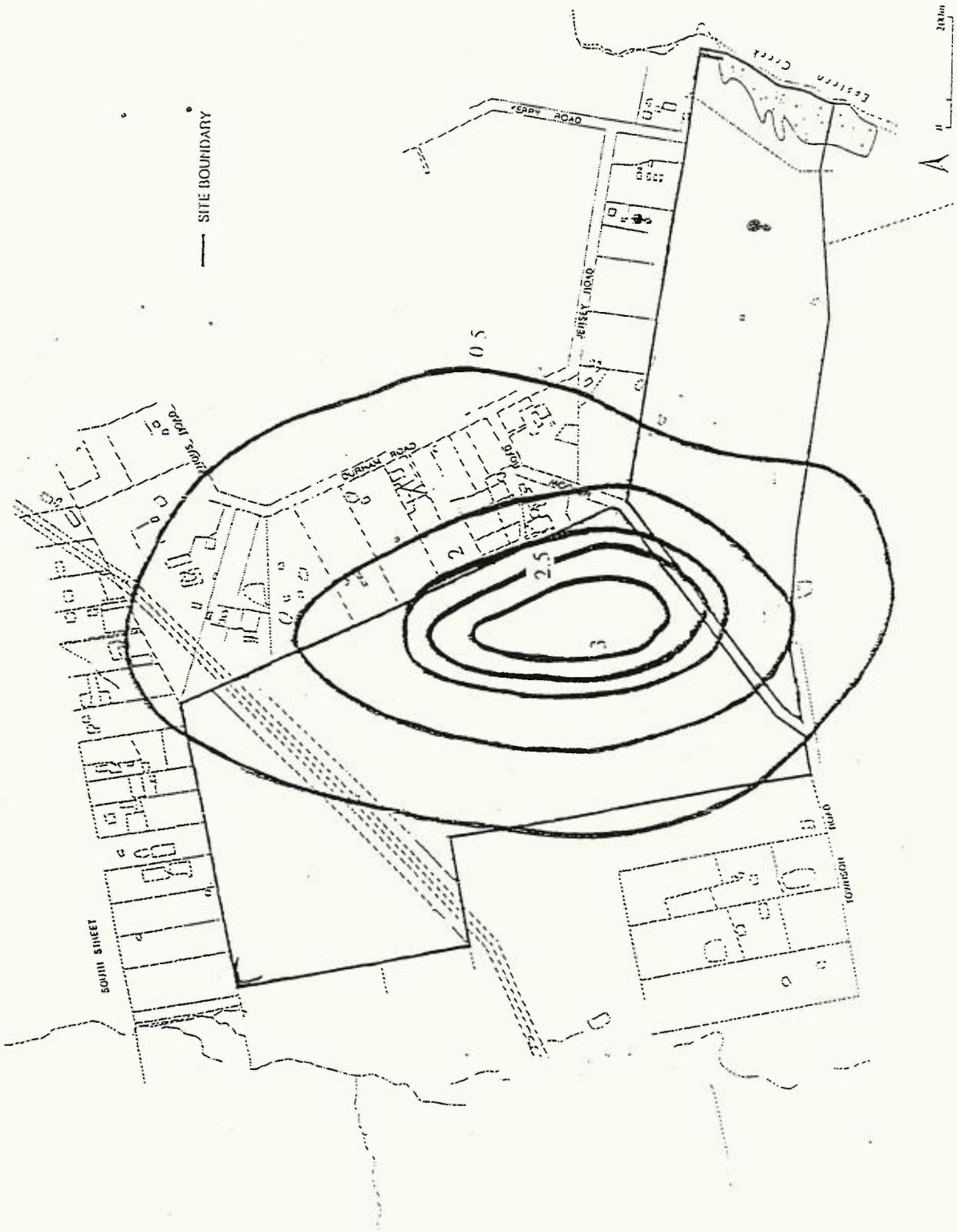
90 9 %
135 11 %
180 19 %
225 15 %
270 9 %
315 10 %
360 14 %
1-10
11-20
21-30
31-40
41+
Scale km/hr
10 percent

Figure E7



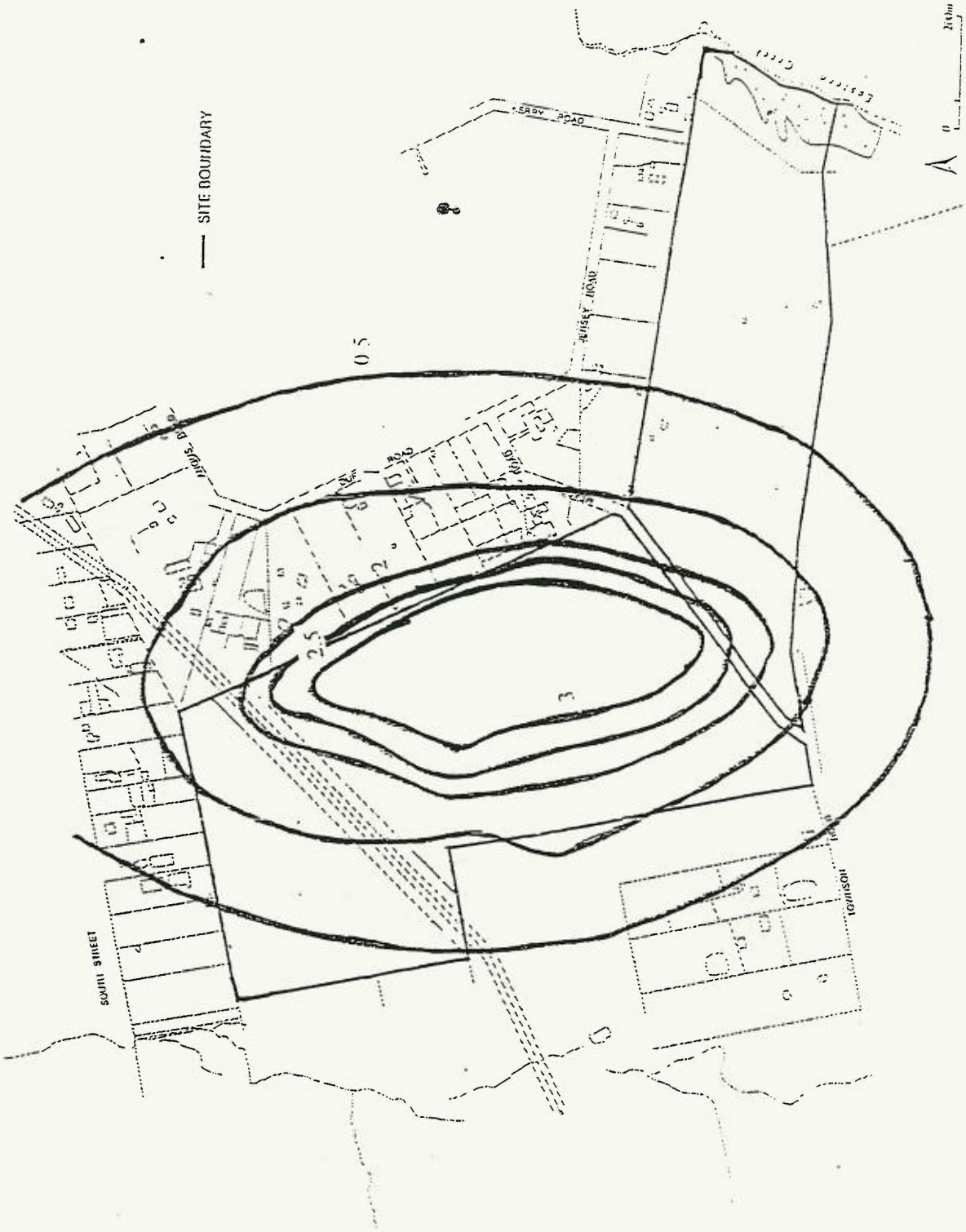
PREDICTED INCREASE IN DUST DEPOSITION
- STAGE 1 (g/m^2/month) Annual Average

Figure E8



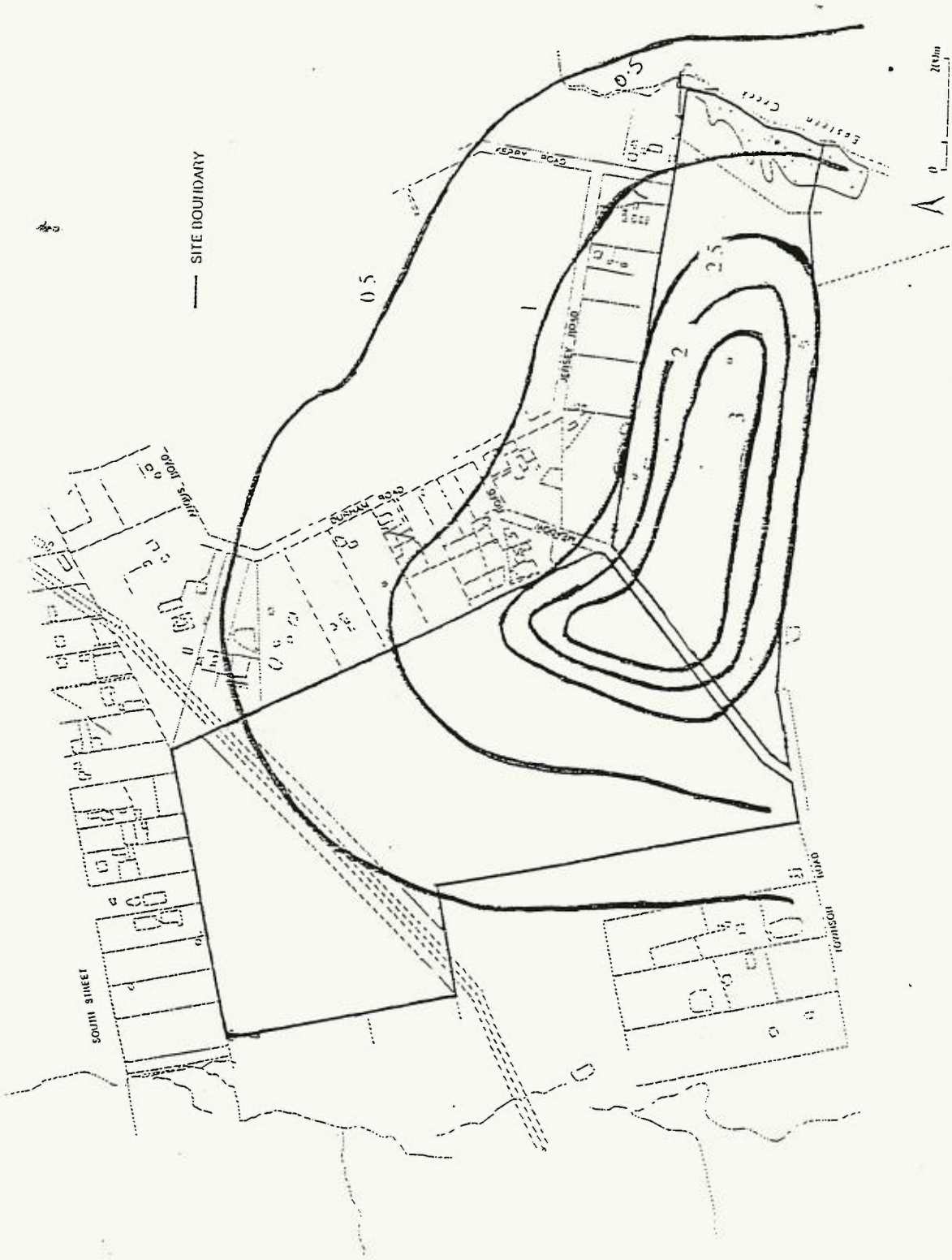
PREDICTED INCREASE IN DUST DEPOSITION
- STAGE 2 (g/m^2/month) Annual Average

Figure E9



PREDICTED INCREASE IN DUST DEPOSITION
- STAGE 3 (g/m^2/month) Annual Average

Figure E10

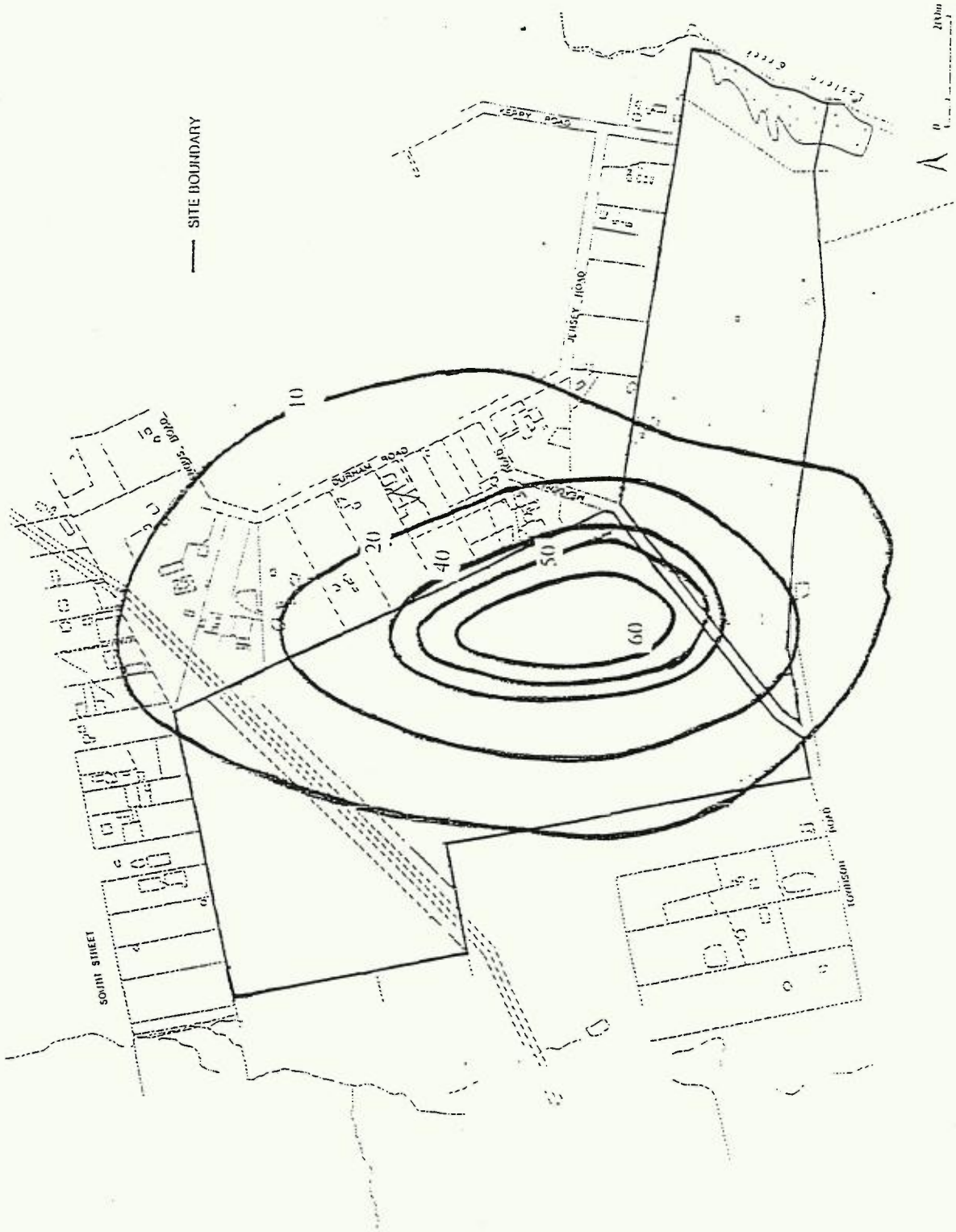


PREDICTED INCREASE IN DUST DEPOSITION
- STAGE 6 (g/m^2/month) Annual Average

Figure E11

PREDICTED INCREASE IN DUST CONCENTRATION
- STAGE 1 (μg/m^3) Annual Average

Figure E12

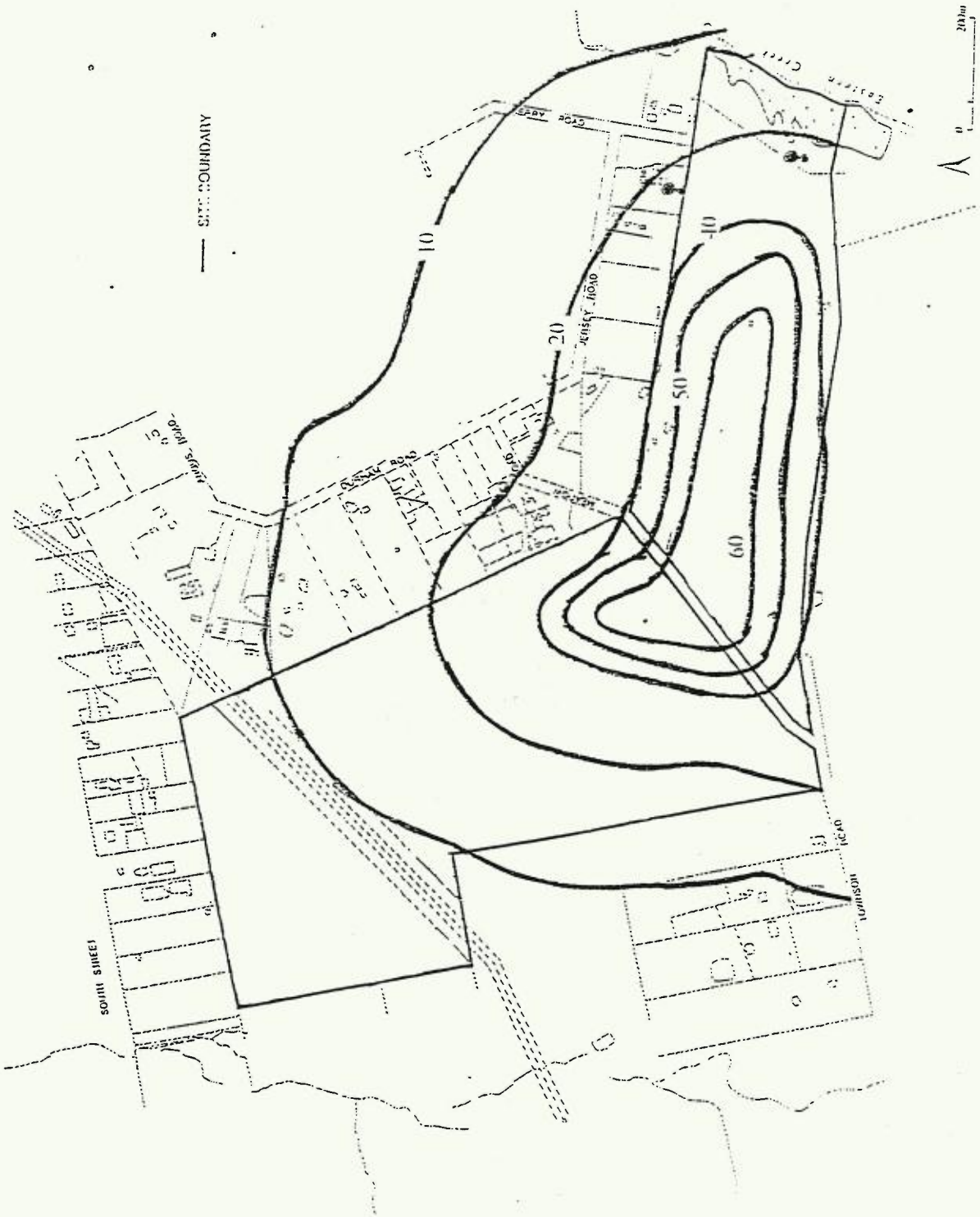


PREDICTED INCREASE IN DUST CONCENTRATION
- STAGE 2 (μ/m^3) Annual Average

Figure E13

PREDICTED INCREASE IN DUST CONCENTRATION - STAGE 3 (μ/m^3) Annual Average

Figure E14



PREDICTED INCREASE IN DUST CONCENTRATION
- STAGE 6 (μ/m^3) Annual Average

Figure E15

APPENDIX F
NOISE ASSESSMENT

(i) Noise Impact Assessment (Vipac Engineers and Scientists, March 1997)

(ii) Noise Assessment Peer Review (Richard Heggie Associates Pty Ltd, May 1997)

CSR CONSTRUCTION MATERIALS

PGH Schofields Quarry
Noise Impact Assessment

Report No. 24787

March 1997

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- NOISE IMPACT ASSESSMENT -

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REVISION HISTORY		
Rev.No.	Date Issued	Reasons / Comments
0	March 1997	Original Report
DISTRIBUTION		
Copy No.	Rev.No.	Destination
0	0	Project File - Sydney
1-2	0	CSR Construction Materials
3	0	Vipac Melbourne Library

ABSTRACT/KEY WORDS: PGH Schofields Quarry, SoundPLAN Noise Predictions, Field Monitoring, CSR Construction Materials

EXECUTIVE SUMMARY

Vipac Engineers and Scientists Ltd have been commissioned by CSR Construction Materials to perform a computer model noise impact assessment of their proposal to extend quarrying operations and subsequently landfill the created voids at the PGH Schofields Quarry site in Blacktown. We have examined three groups of operational scenarios:

i. current Brick Making Plant Equipment
ii. current and future Quarrying and Landfilling Equipment, and
iii. the above plus optimised Noise Barriers.

The Schofields Quarry site has been delineated into six (6) stages for future excavation and subsequent filling. The extraction stages are denoted by numerals (1-6) and the landfilling stages alphanumerically (A-F). It is possible that quarrying at one site, e.g. Stage 2, can be occurring at the same time that landfilling is taking place at the previous site, which would in this case be Stage A.

In order to describe the existing acoustic environment at the site and to delineate 'normal' brick making operations from future quarrying and landfilling, the following scenarios were modelled:

- Background Brick manufacturing and mobile equipment noise (brickmaking noise)
  - L10 Daytime scenario (0700-2200 hrs)
- Background Brick manufacturing without mobile equipment noise
  - L10 Night time scenario (2200-0700 hrs)

We note that these operations are covered by existing EPA-agreed criteria, namely L10 limits of 57 dBA (day-time) and 50 dBA (night-time) respectively (EPA Licence number 002014).

It is to be noted that the existing extraction operation on the site have not been included within the description of the existing acoustic environment. Existing extraction operations take place on a 'campaign' basis of about three month in every year.

Computer model noise predictions in the quarry precinct were performed using the SoundPLAN software package, utilising SURPAC data supplied by Australian Mine Design and Development and edited and compiled by Vipac Engineers and Scientists Ltd.

The actual noise predictions were carried out in accordance with the German Standards VDI 2714/ VDI 2720 Model for plant and mobile equipment noise and with the US Federal Highway Administration, USFHWA, prediction method for road traffic noise. These standards have been adopted as they are internationally recognised and have been used by Vipac on previous similar noise assessments.

For future Quarrying and Landfilling operations we examined worst case scenarios only, namely:

simultaneous	quarrying (Stage 2)	&	landfilling (Stage A)	
'	quarrying (Stage 3)	&	landfilling (Stage B)	
'	quarrying (Stage 4)	&	landfilling (Stage C)	etc.

For each quarrying/landfilling pairing, we modelled two options with the relevant operations at the top and near the bottom of each void. Superimposed upon the above operations was car and heavy vehicle traffic on Meadow Road which was assumed to be similar for all future scenarios, regardless of the particular quarrying/landfilling pairing.

All results from the computer modelling were expressed as LA10 levels for comparison to EPA noise level objectives.

During the month of November 1996, Vipac engineers also carried out environmental noise monitoring at locations within and around the perimeter of the Brick manufacturing site. This consisted of logging of A-weighted noise statistics, LMAX, L10, L90, LMIN, LEQ, at both near-field and far-field sites of interest. It is to be noted that no extraction activities took place within the site during this period.

The field noise measurements showed good agreement with the computer model noise predictions for existing operational noise levels.

On the basis of future noise predictions and agreed EPA noise levels targets, we then examined the need for noise attenuation at particular residences.

Noise ameliorative options which were studied, namely current and future planned noise barriers in the form of earth mounds, were found to be satisfactory in terms of limiting noise emissions to acceptable levels in the surrounding community. These included both the enhancement (to 5 metres) of the existing 3-5-metre berm running along the eastern perimeter of the site north of Meadow Road, and the 8-metre berm planned for the voids south of Meadow Road.

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1 INTRODUCTION

Vipac Engineers and Scientists Ltd have been commissioned by CSR Construction Materials to perform a computer model noise impact assessment of their proposal to extend quarrying operations and subsequently landfill the created voids at the PGH Schofields Quarry site in Blacktown

The Schofields Quarry site has been delineated into six (6) stages for future excavation and subsequent filling. The extraction stages are denoted by numerals (1-6) and the landfilling stages alphanumerically (A-F). It is possible that quarrying at one site, e.g. Stage 2, can be occurring at the same time that landfilling is taking place at the previous site, which would in this case be Stage A. We have examined:

- 'normal' Brick Making operations (daytime and night-time) which are covered by existing EPA-agreed noise criteria, namely:
  - daytime (0700:2200 hrs) LA10 Levels of 57 dBA
  - night time (2200:0700 hrs) LA10 Levels of 50 dBA
- future Quarrying and Landfilling Equipment covered by recently agreed-upon EPA criteria following negotations between the EPA and the Clay Brick and Pavers Association (CBPA) of NSW, namely:
  - daytime (0700:2200 hrs) LA10 Levels of 55 dBA
  - night time (2200:0700 hrs) LA10 Levels of 40 dBA

For future Quarrying/Landfilling operations we examined worst case scenarios only:

simultaneous	quarrying (Stage 2)	&	landfilling (Stage A)	
'	quarrying (Stage 3)	&	landfilling (Stage B)	
'	quarrying (Stage 4)	&	landfilling (Stage C)	etc.

For each quarrying/landfilling pairing, we modelled two options with the relevant operations at the top and near the bottom of each void. Superimposed upon the above operations was car and heavy vehicle traffic on Meadow Road which was assumed to be similar for all future scenarios, regardless of the particular quarrying/landfilling pairing.

During the month of November 1996, Vipac engineers also carried out limited environmental noise monitoring at locations within and around the perimeter of the Brick manufacturing site to compare to the computer model noise predictions for existing operational noise levels.

Finally, on the basis of future noise predictions and agreed EPA noise levels targets, we investigated the need for noise attenuation at particular residences, through the use of earth mounds. Existing and planned berms were shown to be satisfactory in terms of limiting noise emissions to acceptable levels in the surrounding community.

2 COMPUTER NOISE MODEL INPUT PARAMETERS

2.1 Brick Making Plant Noise

The current Schofields operation is located just to the east of Richmond Road and is bounded by Meadow Road to the south. The site previously occupied by the Blacktown and District Mini Byke and Mini Cycle Club, on the southern side of Meadow Road, will be used for the last of the proposed quarrying/landfill stages.

Current brick making plant operations and our initial background computer model noise predictions include the following noise sources:

1. Brick manufacturing equipment
2. Crushing equipment
3. Forklifts
4. Conveyors

In terms of daily operations:

- During the **'Daytime'** period (0700-2200 hrs), all of the above equipment are operational
- During the **'Night-time'** period (2200-0700 hrs), the forklifts and external conveyors cease working, although there is a 'Special Morning' period (0600-0700 hrs) when one or two forklifts and some of the conveyors may on occasion begin daily operations.

2.2 Traffic Volumes and Vehicle Make-up

CSR provided Vipac with existing daily two-way traffic volume information for Meadow Road. These were used to estimate conservative hourly traffic volumes for the computer model. The input data values were :

For **Meadow Road**:

Total Daily Count	= 470

From the above, we have derived the following **peak** hourly values:

Peak Hourly Light Vehicle Count	= 20
Peak Hourly Medium Vehicle Count	= 10
Peak Hourly Heavy Vehicle Count	= 20

The following average speeds for the modelled roads were used:

main road	V	= 50 kph
secondary roads within the site	V	= 15 kph

The USFHWA road traffic model assumes a uniform source height of 0.5 metres above road elevation for light vehicles, 0.7 metres for medium vehicles and of 2.4 metres for heavy vehicles. We chose to ustilise this model in view of its utility when a significant precentage of heavy vehicles are involved in the traffic flow. This is the RTA's preferred model in such situations.

2.3 Mobile Quarrying and Land filling Machinery

For the future quarrying/landfilling operations, our computer model noise predictions were made incorporating the following noise sources. The Sound Power Level (SPL) values coincide with those chosen in a previous noise assessment for the site (ERM report) and are representative of values measured by Vipac on numerous construction sites.

Quarrying	*SPL dB(A)*
1. bulldozer (1)	115
2. scraper (2)	114
3. watertruck (1)	108
4. trucks	108
Landfilling	*SPL dB(A)*
5. bulldozer (1)	115
6. front end loader (1)	110
7. compactor (1)	110

8. watertruck (1)	108
9. trucks	108

The computer model makes use of the following input parameters:

1. The 1/3 octave band spectrum of each individual noise source item and is overall sound power level (SPL)
2. The type of source and the directivity of the noise
3. The percentage of time the noise source is in use
4. The reflection due to surrounding reflecting surfaces such as adjacent walls and ground plane

2.4 Ground Terrain, Building and Receiver Input Data

Figure 1 on the following page shows a view of the area incorporated in the SoundPLAN ground terrain model and also includes an outline of the six quarrying/landfilling voids as well as the location of residences of interest within the modelled area and the location of the receivers placed at the nine (9) adjoining critical residences.

We note that there is an existing incomplete earth mound, approximately 3-5 metres in height, running along the eastern perimeter of the quarry site north of Meadow Road. In the future, this will be enhanced to be 5 metres everywhere.

Plant buildings inside the site varied between 7-10 metres in height to their eave elevation. Houses outside the site were modelled as being 3 metres in height.

For single point receiver calculations, a receiver is placed at a distance of 3 metres from the noisiest facade of the critical residences and at a height of approximately 1.5-2 metres above the ground level at that location 3.

3 SOUNDPLAN COMPUTER MODEL NOISE PREDICTION RESULTS - BASELINE OPERATIONS

3.1 Model Assumptions - Earth Berms

At the present time there is an incomplete 3-5 metre height earth mound running along the eastern perimeter of the site (parallel to Durham Road) north of Meadow Road.

For future operation predictions, the model results described below include an assumption that the existing eastern perimeter earth mounds will be enhanced so as to be 5-metres in height everywhere north of Meadow Road and that an 8 metre mound will be created around the southern voids (south of Meadow Road), **before** the process of quarrying and landfilling is commenced near these areas.

3.2 Existing Noise Contour Diagrams and Single Point Receiver Calculations

The computer model noise predictions for normal Brick Making and Current Operation scenarios are shown in contour form in Appendix A.

- For the **existing Daytime** Scenario, predicted LA10 values range from 51 dBA close to the most critical residences, e.g. Residence No.6, to below 45 dBA for residential areas in quieter areas but still within the influence of the general noise environment of the site, e.g. Residence No.8.

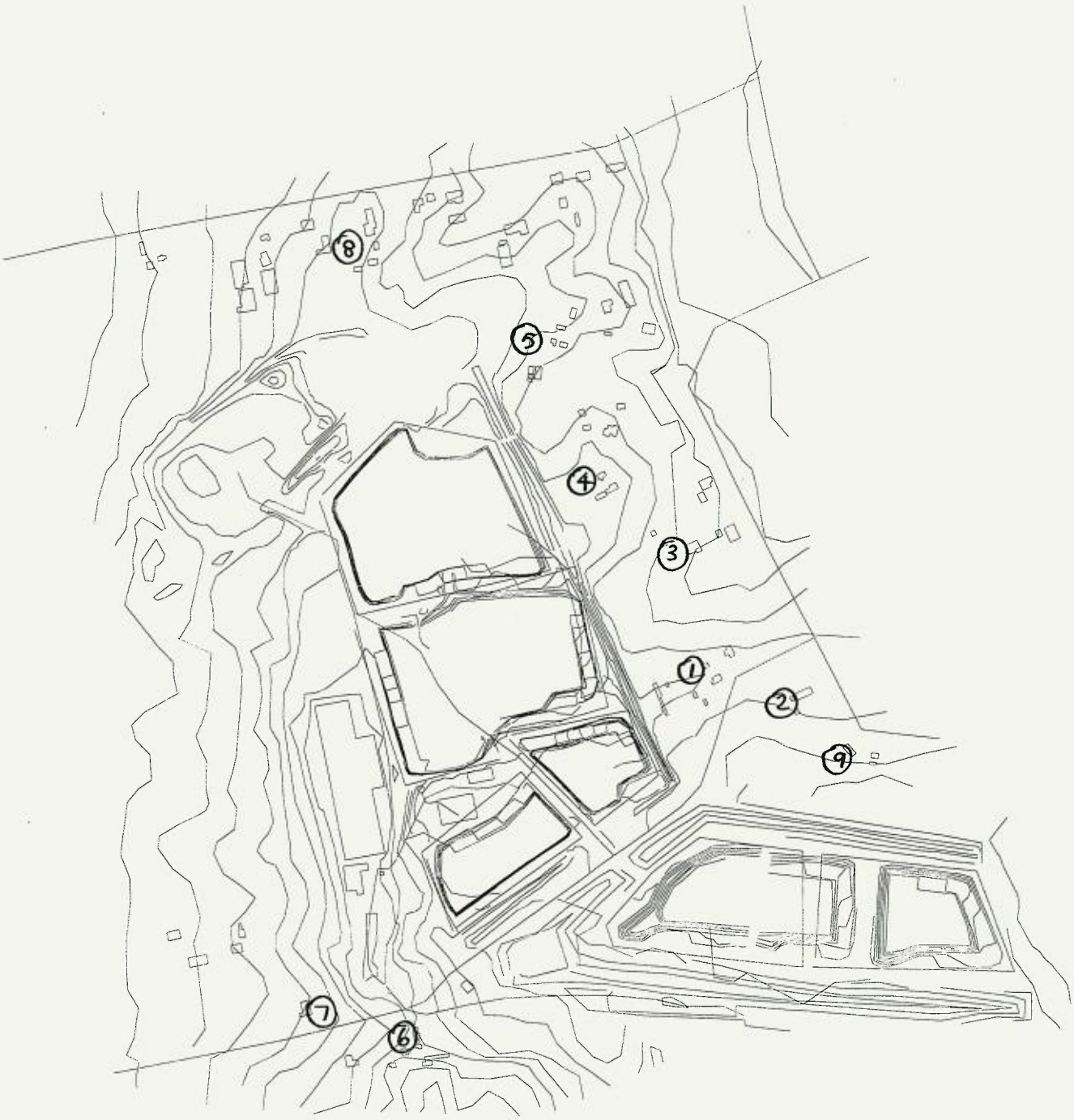


Figure 1 SoundPLAN Terrain Model plus Receiver Locations

- For the **Night-time** scenario, levels at nearby residences drop by between 5-10 dB and range between 35-45 dBA depending upon the location of the residence relative to the location of forklift and conveyor operations.

Using the same SoundPLAN model of current brick making operations, single point receiver calculations were performed at critical residences. The location of these residences is shown in Figure 1.

Resulting predicted LA10 levels for different periods of the day are shown below in Table 1. In these computations, a receiver is placed in front of the most exposed facade of the residence and hence the predicted LA10 values contain a facade effect similar to that which would exist if the actual noise level was being monitored by a sound level meter in the field.

TABLE 1 COMPUTER MODEL PREDICTION RESULTS - LA10 LEVELS, EXISTING SITUATION (VALUES ROUNDED TO THE NEAREST 0.5 DBA)

Residence	Daytime 7.00-22.00	Night time 22.00-7.00
1	52	44.5
2	49	43
3	50	42
4	50.5	42.5
5	49	40.5
6	51	46.5
7	44	38.5
8	45	35.5
9	47.5	40.5

Notes: 'Daytime' involves full brick making operatoinal noise and no quarrying or landfilling. 'Night-time' involves brick making operation minus forklifts and minus conveyors but with no quarrying or landfilling.

4 FIELD MONITORING RESULTS

The validity of the SoundPLAN model results was checked through comparison between computer-calculated single point receiver values for the current operational noise levels and on-site values measured at noise logging stations during the month of November 1996.

As previously discussed, during this period, Vipac engineers carried out environmental noise monitoring within the site, in the proximity of selected noise sources (e.g. adjacent to conveyors, forklift operations etc.) and in the quieter background (e.g. eastern perimeter of site). This consisted of the logging of A-weighted noise statistics (LMAX, L10, L90, LMIN, LEQ).

4.1 Instrumentation

The following instrumentation was used for the on-site measurements:

- Larson Davis Integrating Sound Level Meter, Model LD2900.

During the measurement period, weather conditions were fine and mild; temperatures ranged from 16-23 deg Celsius and wind speeds were below 5 kph.

4.2 Monitoring Results - Graphical Presentation

Graphs of 1-hour LAMIN, LAMAX, LA90, LAEQ and LA10 values at each of the background locations where data were obtained have been included in Appendix B.

In general, the comparison between computer predictions and the measured field data is good:

- The computer noise predictions for residences are within +1/-1.5 dBA of the measured field data.

On the basis of this comparison, we recommend that the model predictions should **not be modified.**

5 COMPLIANCE WITH NOISE LEVEL OBJECTIVES

5.1 Assessment Criteria

The criteria to be applied to this project come from two sources:

(i) previously agreed EPA criteria for brick making operations which were put into effect for the EPA license covering current operations
(ii) environmental goals derived from recent discussions held between EPA personnel and representatives of the NSW Clay Brick and Pavers Association.

These are summarised below in Table 2.

TABLE 2 EPA NOISE LEVEL OBJECTIVES (3M FROM THE RESIDENCE FACADE)

Metric	Existing Background Level Brickplant Operations (dBA)	Future Mobile Plant Level Quarrying/Landfilling (dBA)
EPA LA10 (Daytime) (7:00 am to 10.00 pm)	57	55
EPA LA10 (Night time) (10:00 pm to 7:00 am)	50	40

Notes: 1. Background Level refers to noise generated by normal brick making operations but not involving any quarrying and/or landfilling activities
2. Mobile Plant Level includes quarrying/landfill operations

5.2 Compliance with EPA LA10 Daytime/Night-time Criteria for Existing Operations

If the ambient noise levels shown in Table 1 are compared to the Background Noise level targets shown in Table 2, it is evident that:

- all residences close to the site boundary **comply** with the current EPA license Daytime criterion (L10 of 57 dBA).
- all residences close to the site boundary **comply** with the current EPA license Night-time criterion (L10 of 50 dBA).

5.3 Compliance with Future Quarrying/Landfilling Noise Operations

For future Quarrying and Landfilling operations we examined **worst-case** scenarios only, namely:

simultaneous	quarrying (Stage 2) & landfilling (Stage A)	Q.2/L.A
'	quarrying (Stage 3) & landfilling (Stage B)	Q.3/L.B
'	quarrying (Stage 4) & landfilling (Stage C)	Q.4/.LC.

For each quarrying/landfilling pairing, we modelled two options with the relevant operations at the top and near the bottom of each void. Superimposed upon the above operations was car and heavy

vehicle traffic on Meadow Road which was assumed to be similar for all future scenarios, regardless of the particular quarrying/landfilling pairing.

We have included in this Report the computer model noise predictions for two representative future Quarrying/Landfilling Operations scenarios, north and south of Meadow Road. These are shown in contour form in Appendix C:

Q.3 (surface) / L.2 (bottom)	file drawing rlk53.plf
Q.6 (surface) / L.5 (bottom)	file drawing rlk56.plf

In Table 3 shown on the following page, we show the model predicted **future** daytime operational LA10 noise levels for all quarrying/landfilling pairings.

TABLE 3 LA10 DAYTIME MODEL PREDICTIONS (INCLUDES THE INCOMPLETE 3-5 METRE HEIGHT BERM ON THE EASTERN PERIMETER)

Scenario	Residence No. (see Fig.1)								
	1	2	3	4	5	6	7	8	9
Q2/LA	55	50.5	49.5	49.5	45	47	40	34.5	48.5
Q3/LB	50.5	47	47.5	51	49.5	45.5	38.5	40.5	45.5
Q4/LC	51	47	47	48.5	46	50.5	40.5	37.5	46
Q5/LD	49	48.5	43.5	43	39	46.5	38.5	25.5	49.5
Q6/LE	48	46.5	41.5	41.5	38	45.5	37	25	48

NOTES:
1. ALL FUTURE QUARRYING/LANDFILLING PAIRINGS
2. ALL VALUES ROUNDED OFF TO THE NEAREST 0.5 DB
3. NOISE LEVELS ARE WITH EXISTING TOPOGRAPHY

In the above comparison, it is clear that, partly because of the benefit of the existing 3-5 metre height berm on the eastern perimeter (north of Meadow Road), all residences close to the site boundary **would comply** with the newly agreed Daytime EPA Mobile Plant objective of 55 dB.

5.4 Noise Barrier - Earth Mounds

Both as an ameliorative solution to the increased noise caused by future mobile quarrying and landilling equipment and to make use of expected excess overburden material, the future operations include a provision for:

(i) enhancement of the eastern perimeter earth mound so that it will be 5-metres in height north of Meadow Road, and

(ii) an 8-metre high earth mound totally enclosing the last of the future voids,i.e. Stage No.6, located on the south side of Meadow Road.

Earth mounds (not actual walls) are possible because of the space available.

In Table 4 shown on the following page, we show the model predicted **future** daytime operational LA10 noise levels for all quarrying/landfilling pairings with the above earth berms in place.

It can be seen that as a result of the already planned earth mounds around the site ranging from 5 metres (east) to 8 metres (south), noise levels at nearby residences, even when the particular quarrying/landfilling pairing operation is at its **closest point**, are within recently agreed EPA criteria for mobile plant daytime operations.

TABLE 4 LA10 DAYTIME MODEL PREDICTIONS (INCLUDES EASTERN PERIMETER 5-METRE AND SOUTH SIDE 8-METRE BERM)

Scenario	Residence No. (see Fig.1)								
	1	2	3	4	5	6	7	8	9
Q2/LA +B	53.5	49.5	48.5	49	44.5	47	40	34.5	48
Q3/LB +B	50.5	46.5	47.5	50	47.5	45.5	38.5	40.5	45
Q4/LC +B	50.5	47	46.5	48	44.5	50.5	40.5	37	46
Q5/LD +B	48.5	47	43	42.5	38.5	46	38	25	47
Q6/LE +B	47	45.5	41	40.5	37	44.5	36.5	24	46

NOTES:
1. ALL FUTURE QUARRYING/LANDFILLING PAIRINGS
2. ALL VALUES ROUNDED OFF TO THE NEAREST 0.5 DB
3. NOISE LEVELS ARE WITH PLANNED CONTINUOUS EARTH BERMS
4. QUARRYING (STAGE 2) & LANDFILLING (STAGE A) WITH BUND WALLS = Q2/LA +B
5. QUARRYING (STAGE 3) & LANDFILLING (STAGE B) WITH BUND WALLS = Q3/LB +B

6 SUMMARY AND RECOMMENDATIONS

Noise predictions and environmental noise monitoring have been carried out for the PGH Schofields Quarry precinct near the existing Brickwork manufacturing and proposed quarrying and landfilling sites.

- Noise predictions were carried out for both current and future operational scenarios using the SoundPLAN noise software package.
- Field monitoring at several locations of interest was also undertaken in this study. Noise logging took place within the quarry site during the month of November 1996.

A comparison of the computer model noise predictions with field noise logging results has shown **good agreement**. Noise predictions at the residences of interest indicate LA10 levels within +1/-1.5 dBA of the measured field data.

With respect to EPA LA10 targets

Our predictions and field monitoring show that all residences close to the site boundary **satisfy** the existing daytime and night-time LA10 targets of 57 dB and 50 dB respectively mandated by the existing EPA license for current brick making operations.

Future quarrying and landfilling scenarios show that noise level increases close to the site boundary will be modest.

From the above, we make the following recommendations...

(i) Given the close proximity of residences to the site perimeter, the use of earth mounds acting as noise barriers is advisable, where space permits.

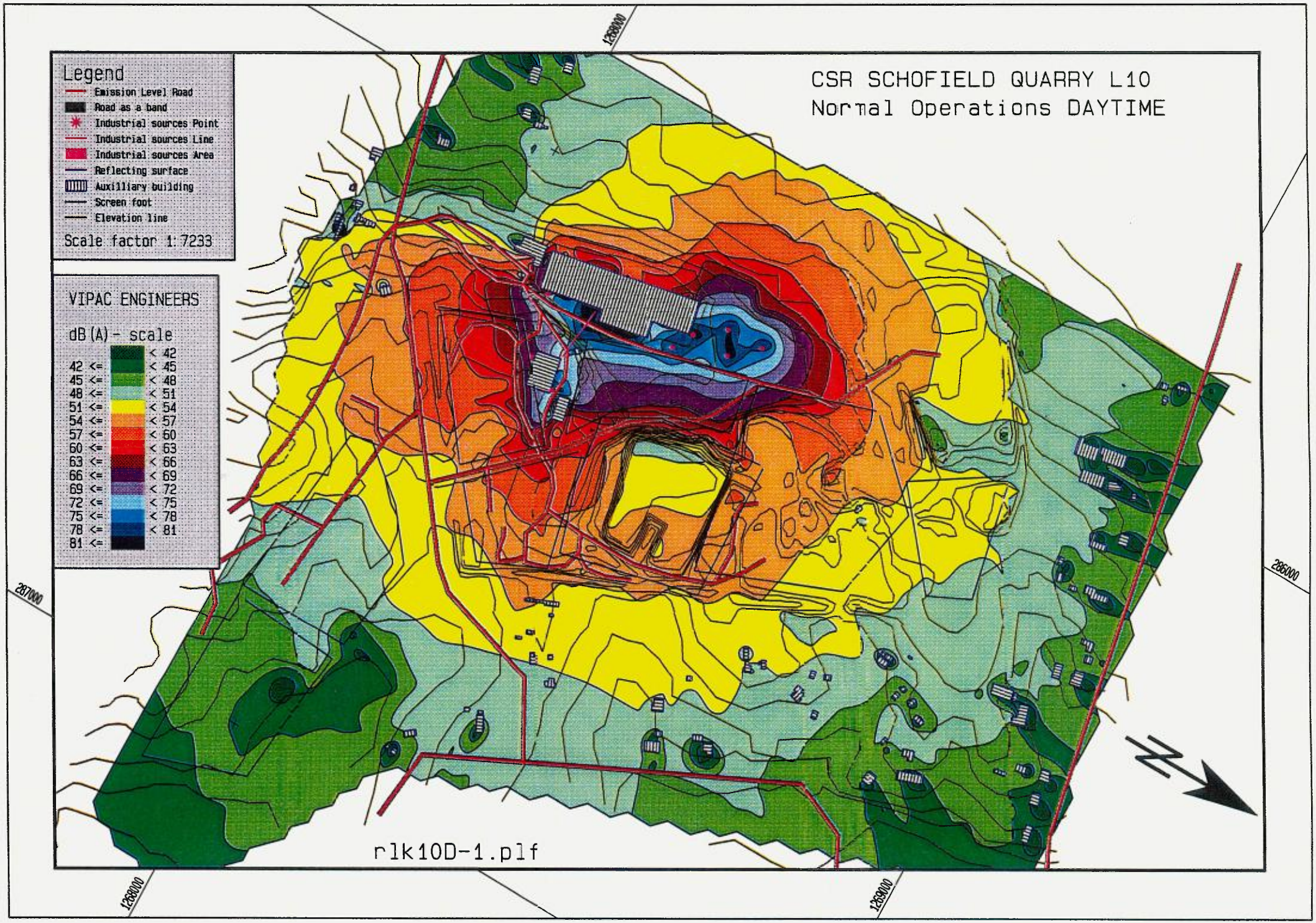
(ii) In particular the use of earth mounds alone (existing plus planned) is more than sufficient to satisfy recently-agreed EPA criteria for mobile plant equipment, 55 and 40 dBA for daytime and night-time periods respectively, for all of the future quarrying/landfilling scenarios.

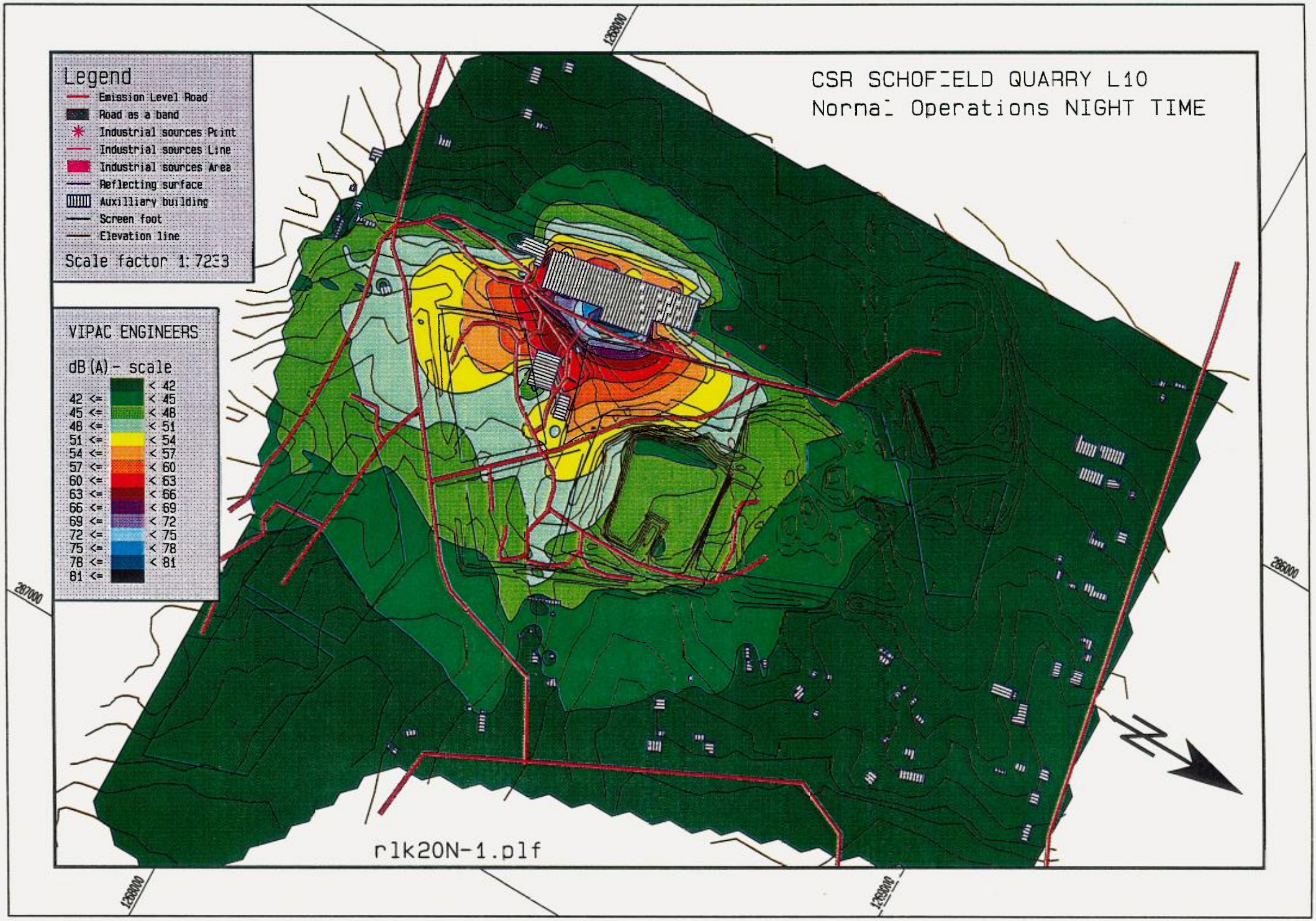
APPENDIX A

NOISE CONTOUR DIAGRAMS - CURRENT

LA10 VALUES

- DAYTIME EXISTING SCENARIO
- NIGHT TIME EXISTING SCENARIO
- SPECIAL CASE (DAYTIME MORNING) SCENARIO


CSR SCHOFIELD QUARRY L10
Normal Operations DAYTIME
Legend
Emission Level Road
Road as a band
Industrial sources Point
Industrial sources Line
Industrial sources Area
Reflecting surface
Auxiliary building
Screen foot
Elevation line
Scale factor 1:7233
VIPAC ENGINEERS
dB(A) - scale
42 <= < 42
45 <= < 45
48 <= < 48
51 <= < 51
54 <= < 54
57 <= < 57
60 <= < 60
63 <= < 63
66 <= < 66
69 <= < 69
72 <= < 72
75 <= < 75
78 <= < 78
81 <= < 81
1268000
287000
286000
1268000
1269000
rlk10D-1.plf


CSR SCHOFIELD QUARRY L10
Normal Operations NIGHT TIME
Legend
Emission Level Road
Road as a band
Industrial sources Point
Industrial sources Line
Industrial sources Area
Reflecting surface
Auxilliary building
Screen foot
Elevation line
Scale factor 1:7233
VIPAC ENGINEERS
dB(A) - scale
< 42
42 <= < 45
45 <= < 48
48 <= < 51
51 <= < 54
54 <= < 57
57 <= < 60
60 <= < 63
63 <= < 66
66 <= < 69
69 <= < 72
72 <= < 75
75 <= < 78
78 <= < 81
81 <=
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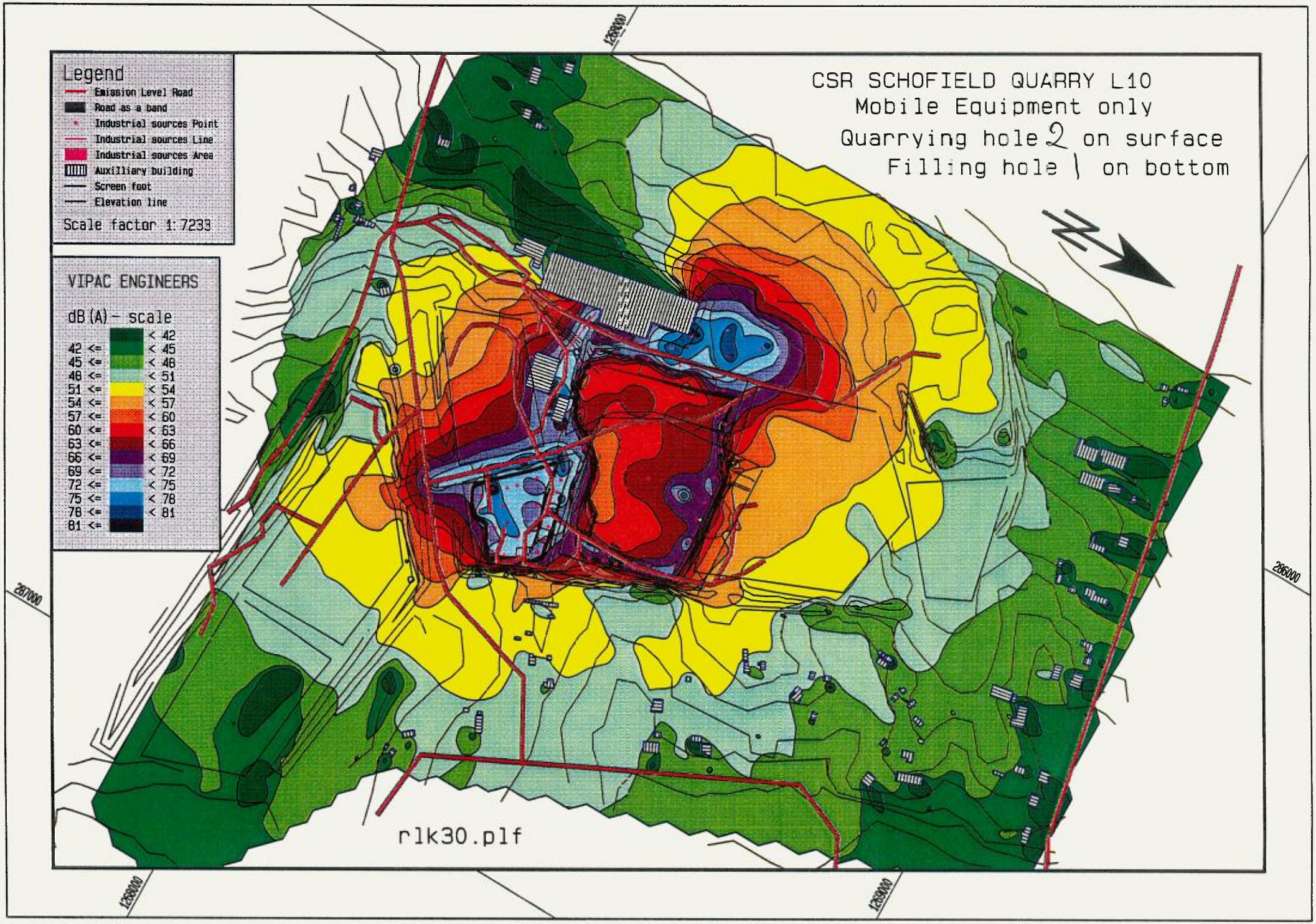
286000
1268000
1265000
rlk20N-1.plf


CSR SCHOFIELD QUARRY L10
Mobile Equipment only
Quarrying hole 2 on surface
Filling hole 1 on bottom
Legend
Emission Level Road
Road as a band
Industrial sources Point
Industrial sources Line
Industrial sources Area
Auxiliary building
Screen foot
Elevation line
Scale factor 1:7233
VIPAC ENGINEERS
dB(A) - scale
< 42
42 <= < 45
45 <= < 48
48 <= < 51
51 <= < 54
54 <= < 57
57 <= < 60
60 <= < 63
63 <= < 66
66 <= < 69
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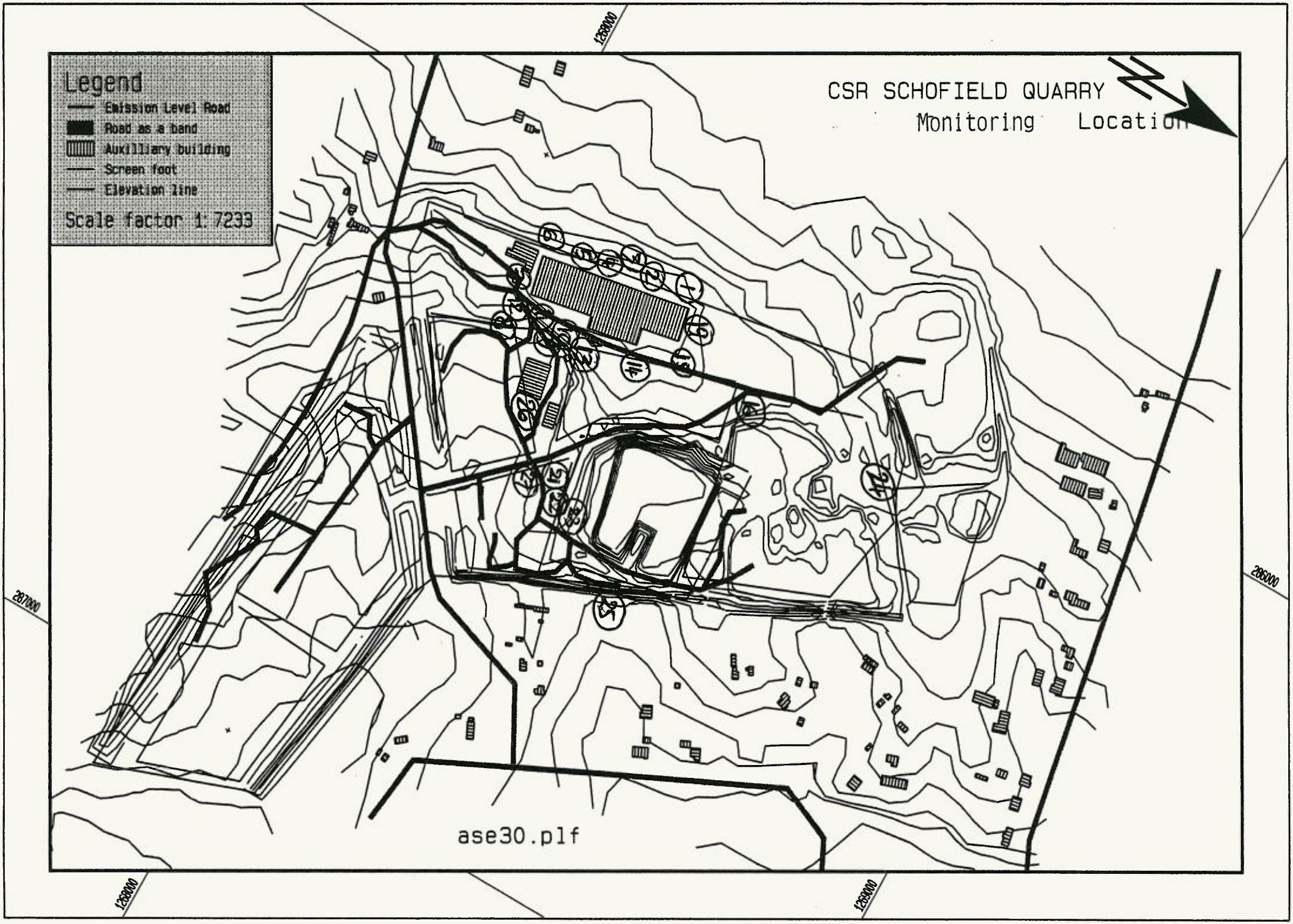
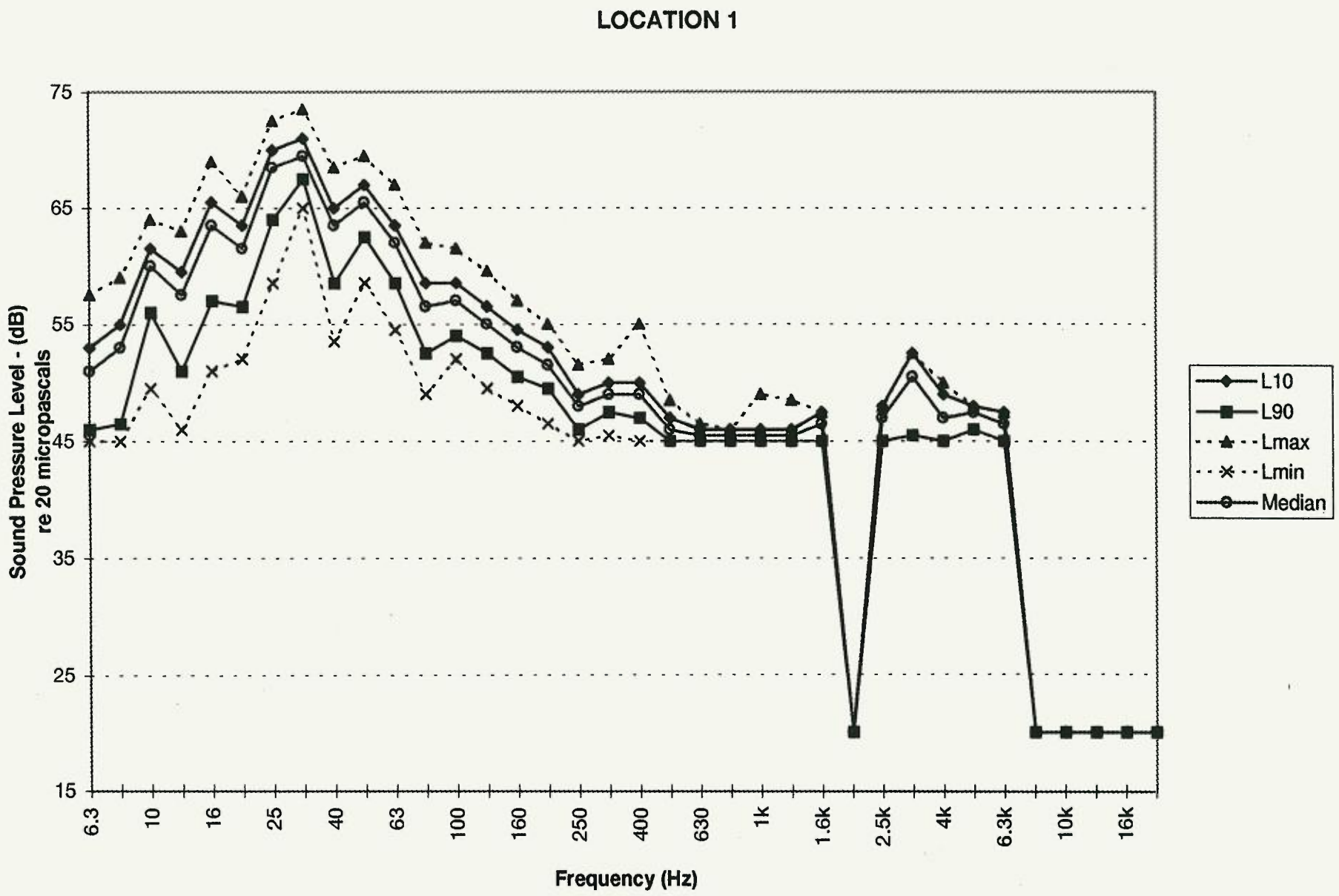
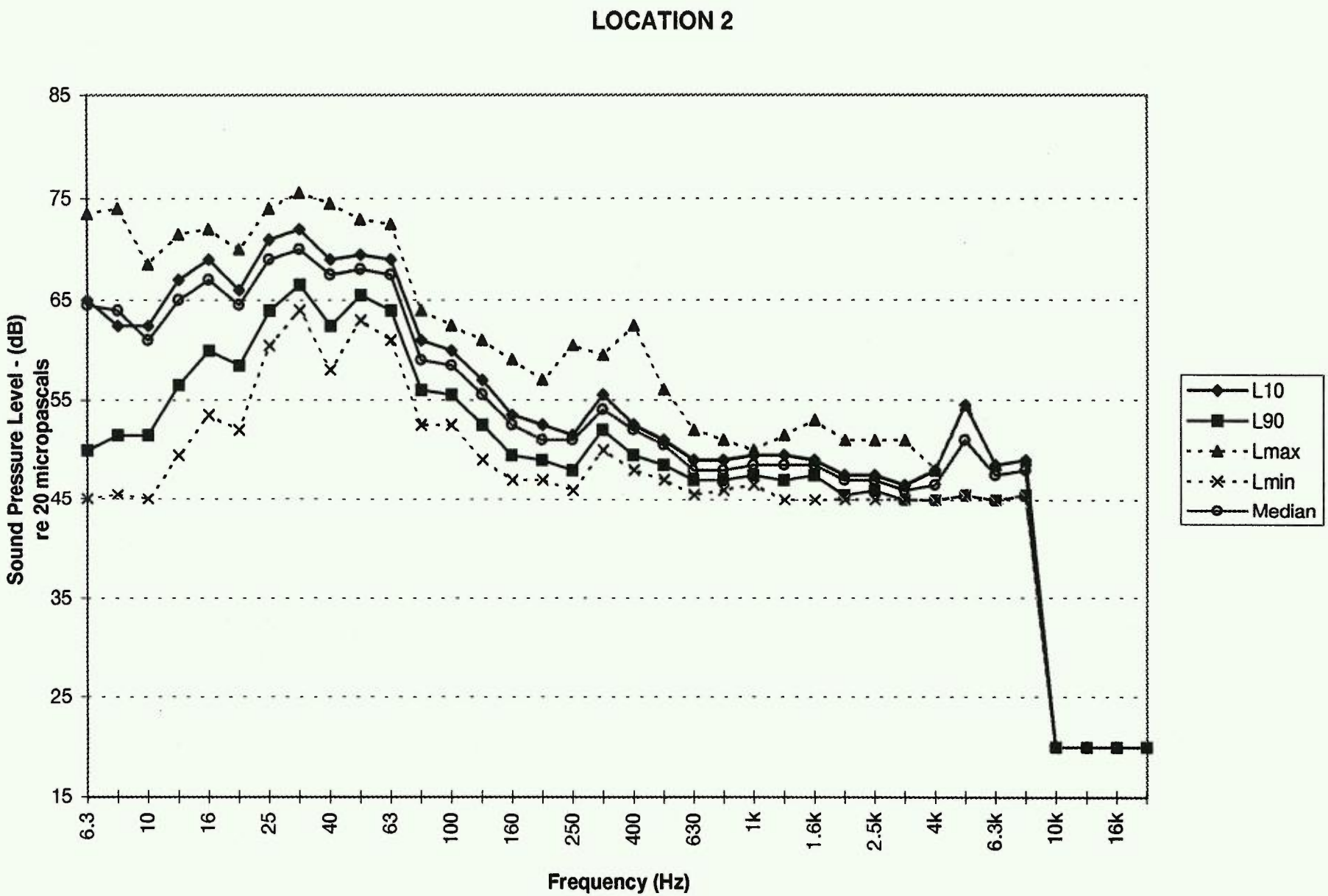
75 <= < 78
78 <= < 81
81 <=
287000
286000
rlk30.plf

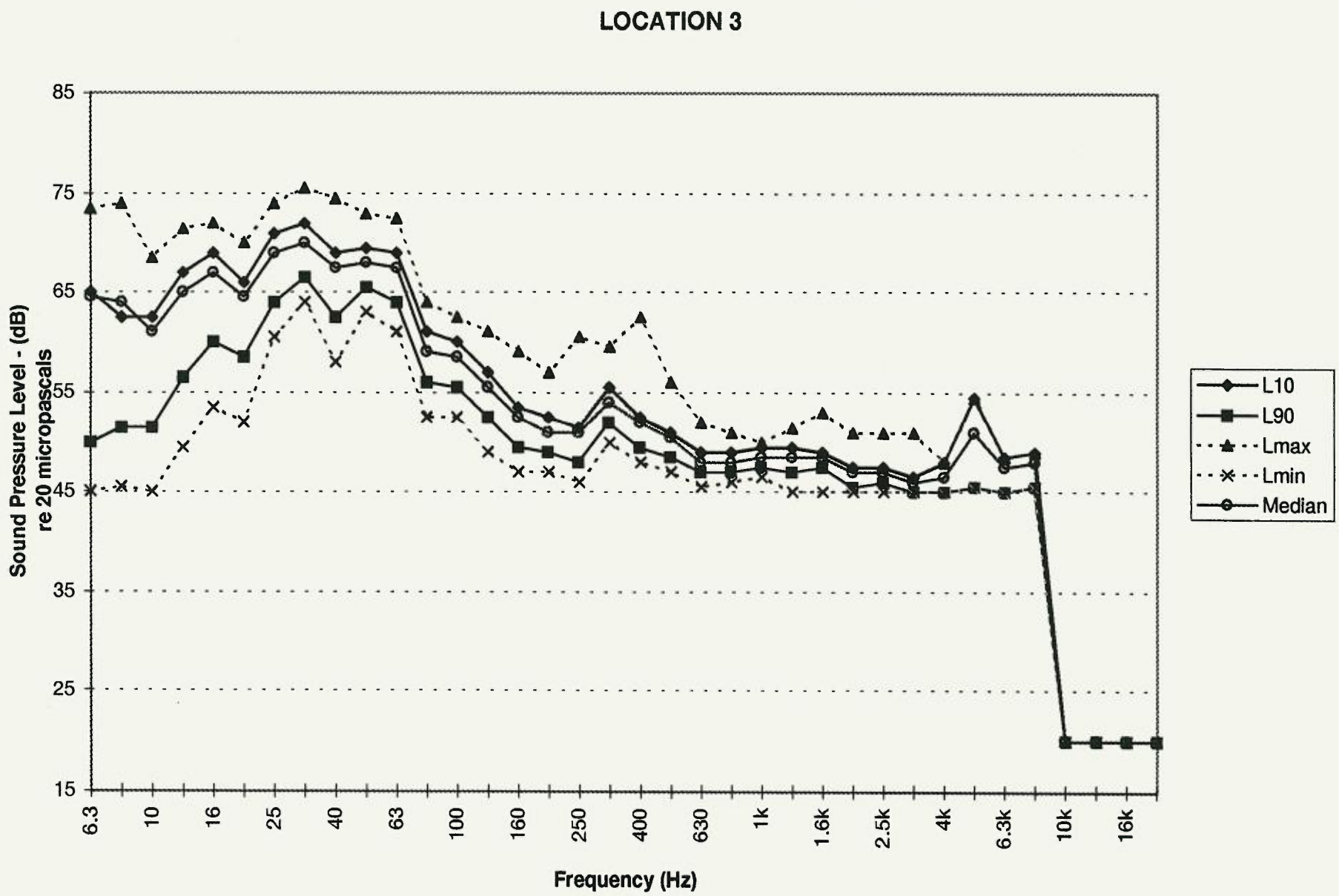
APPENDIX B

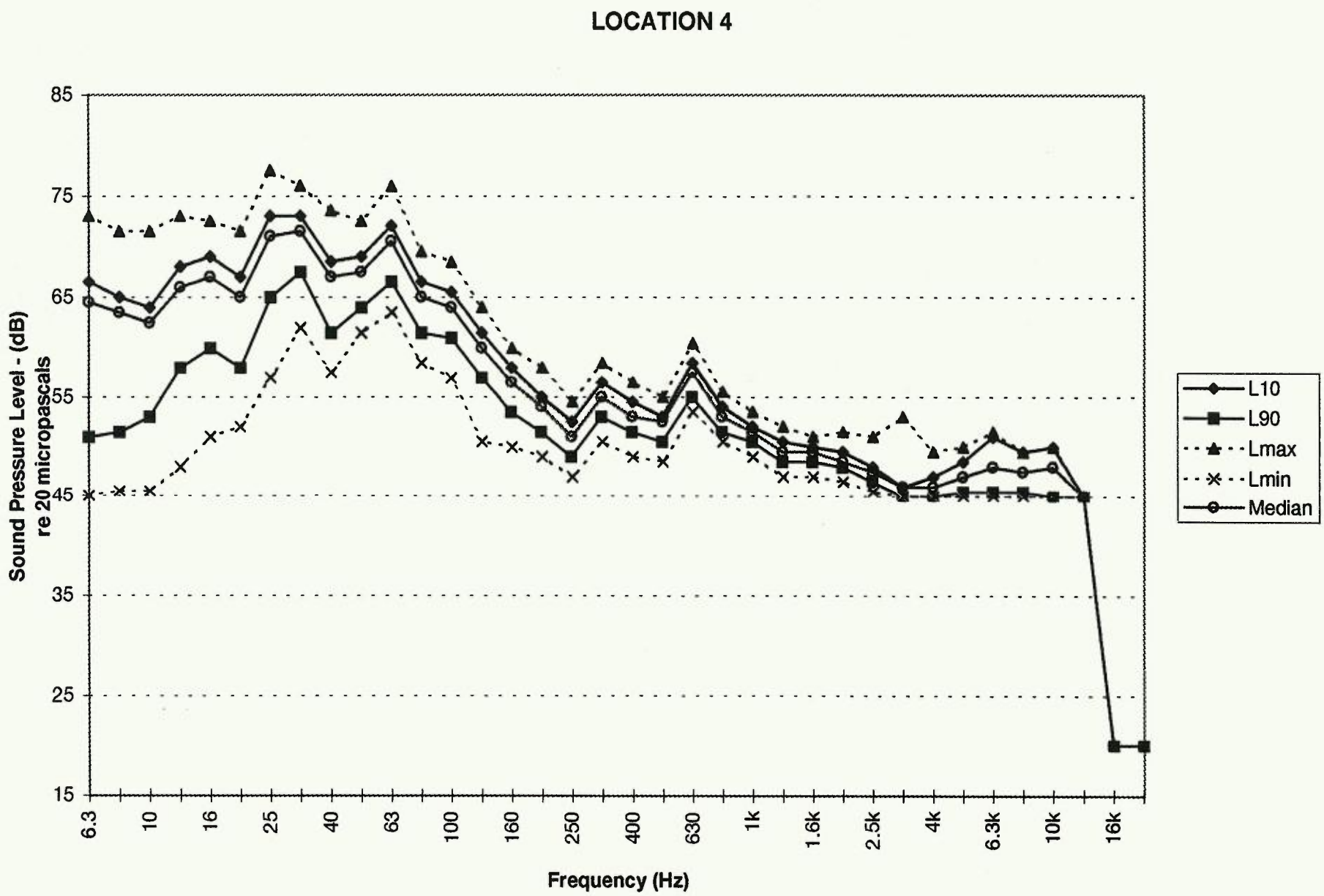
FIELD MONITORING RESULTS

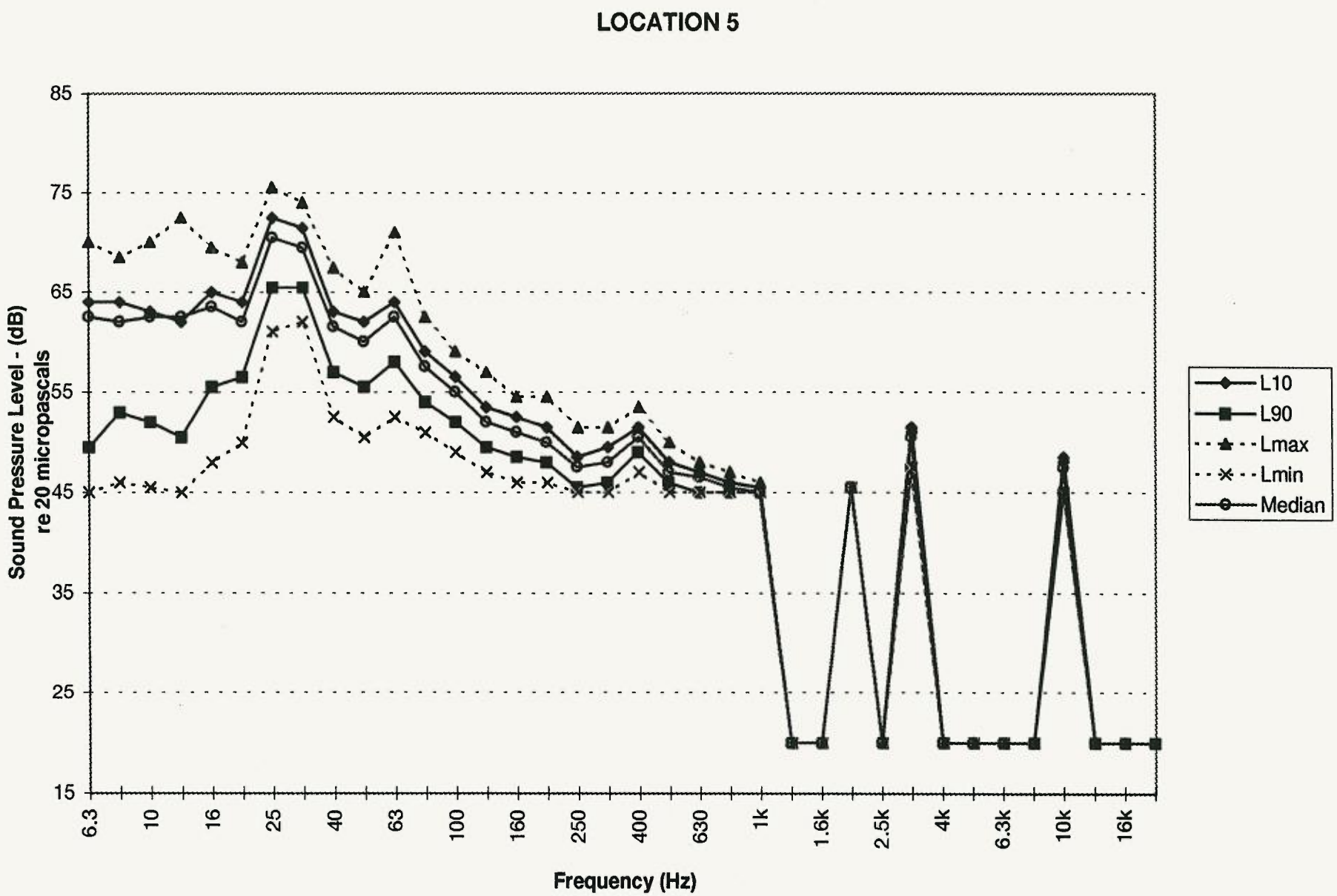

CSR SCHOFIELD QUARRY
Monitoring Location
Legend
Emission Level Road
Road as a band
Auxilliary building
Screen foot
Elevation line
Scale factor 1:7233
ase30.plf
1268000
1269000
287000
286000


LOCATION 1
Sound Pressure Level - (dB) re 20 micropascals
75
65
55
45
35
25
15
6.3
10
16
25
40
63
100
160
250
400
630
1k
1.6k
2.5k
4k
6.3k
10k
16k
Frequency (Hz)
L10
L90
Lmax
Lmin
Median

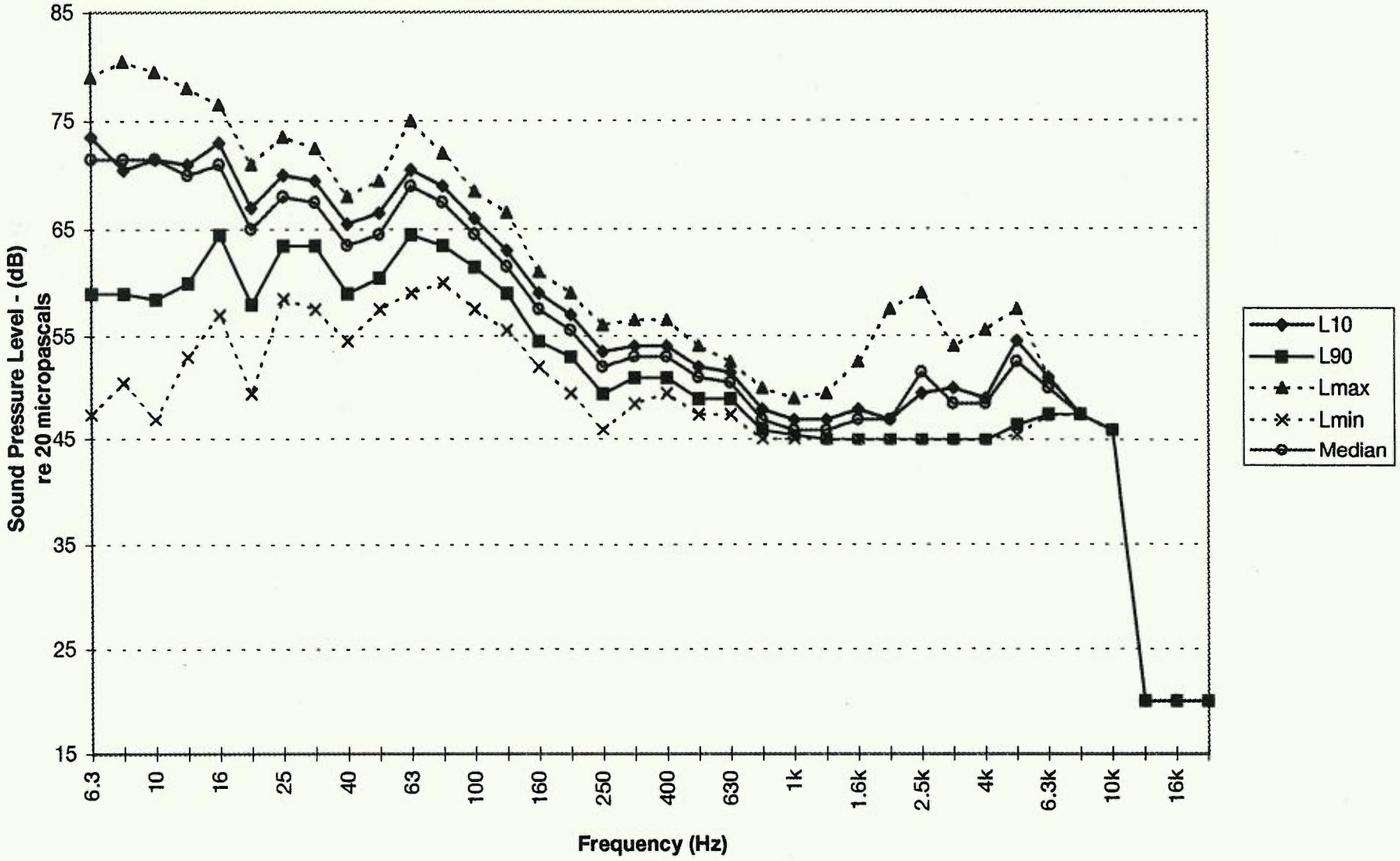

LOCATION 2
Sound Pressure Level - (dB) re 20 micropascals
85
75
65
55
45
35
25
15
6.3
10
16
25
40
63
100
160
250
400
630
1k
1.6k
2.5k
4k
6.3k
10k
16k
Frequency (Hz)
L10
L90
Lmax
Lmin
Median

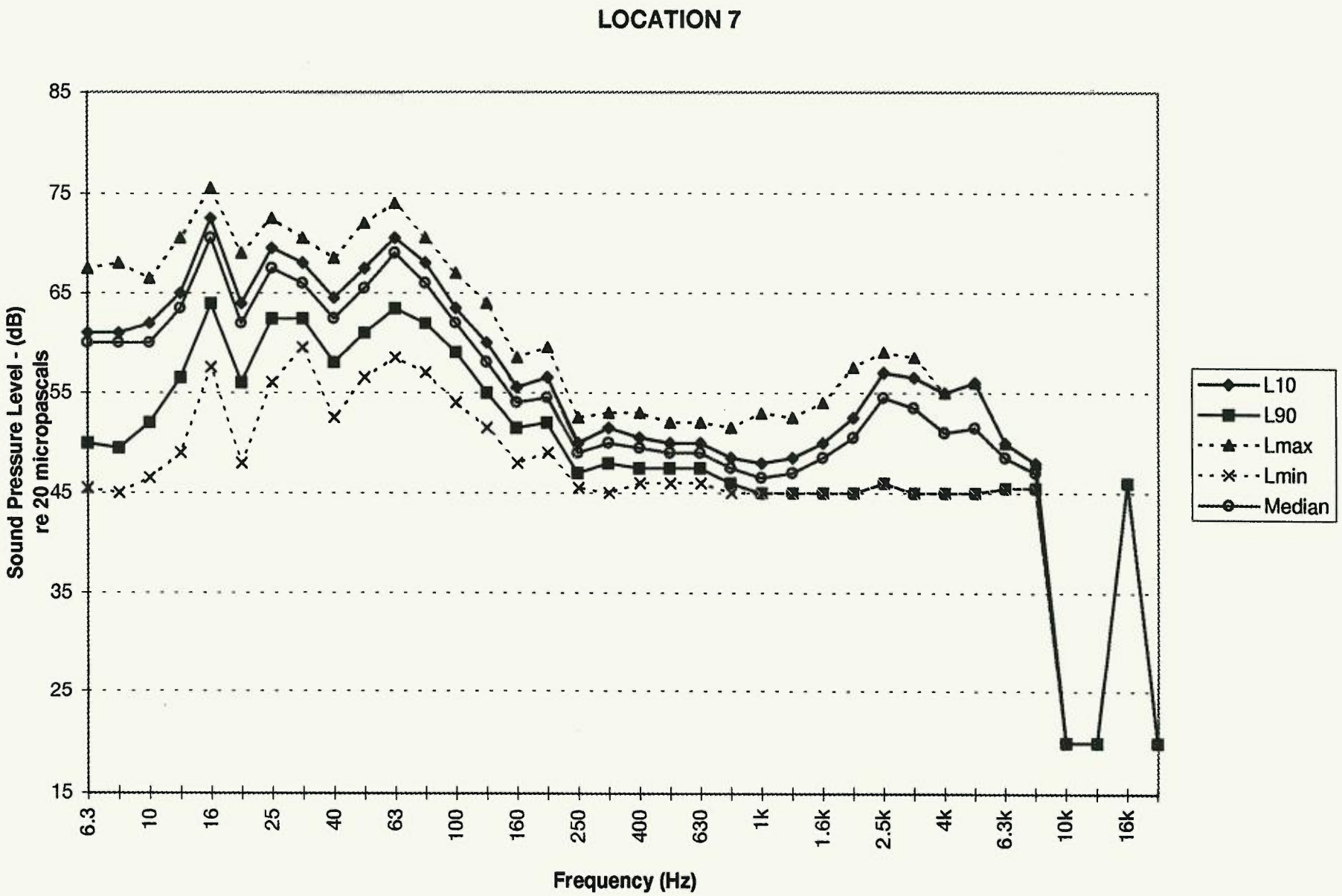

LOCATION 3
Sound Pressure Level - (dB) re 20 micropascals
85
75
65
55
45
35
25
15
6.3
10
16
25
40
63
100
160
250
400
630
1k
1.6k
2.5k
4k
6.3k
10k
16k
Frequency (Hz)
L10
L90
Lmax
Lmin
Median

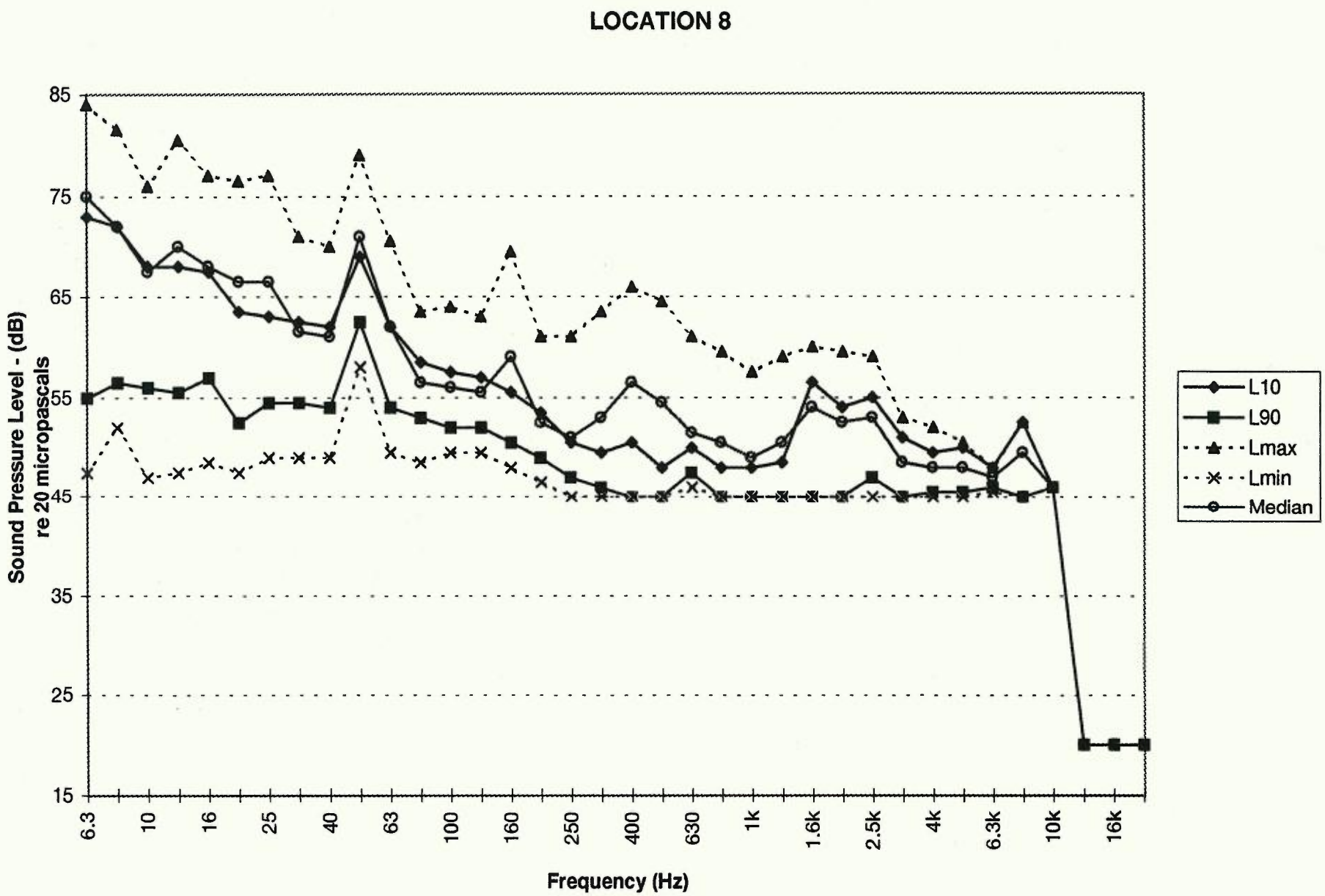

LOCATION 4
Sound Pressure Level - (dB) re 20 micropascals
85
75
65
55
45
35
25
15
6.3
10
16
25
40
63
100
160
250
400
630
1k
1.6k
2.5k
4k
6.3k
10k
16k
Frequency (Hz)
L10
L90
Lmax
Lmin
Median


LOCATION 5
Sound Pressure Level - (dB) re 20 micropascals
85
75
65
55
45
35
25
15
6.3
10
16
25
40
63
100
160
250
400
630
1k
1.6k
2.5k
4k
6.3k
10k
16k
Frequency (Hz)
L10
L90
Lmax
Lmin
Median

LOCATION 6


85
75
65
55
45
35
25
15
Sound Pressure Level - (dB)
re 20 micropascals
6.3
10
16
25
40
63
100
160
250
400
630
1k
1.6k
2.5k
4k
6.3k
10k
16k
Frequency (Hz)
L10
L90
Lmax
Lmin
Median


LOCATION 7
Sound Pressure Level - (dB) re 20 micropascals
85
75
65
55
45
35
25
15
6.3
10
16
25
40
63
100
160
250
400
630
1k
1.6k
2.5k
4k
6.3k
10k
16k
Frequency (Hz)
L10
L90
Lmax
Lmin
Median


LOCATION 8
Sound Pressure Level - (dB) re 20 micropascals
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75
65
55
45
35
25
15
6.3
10
16
25
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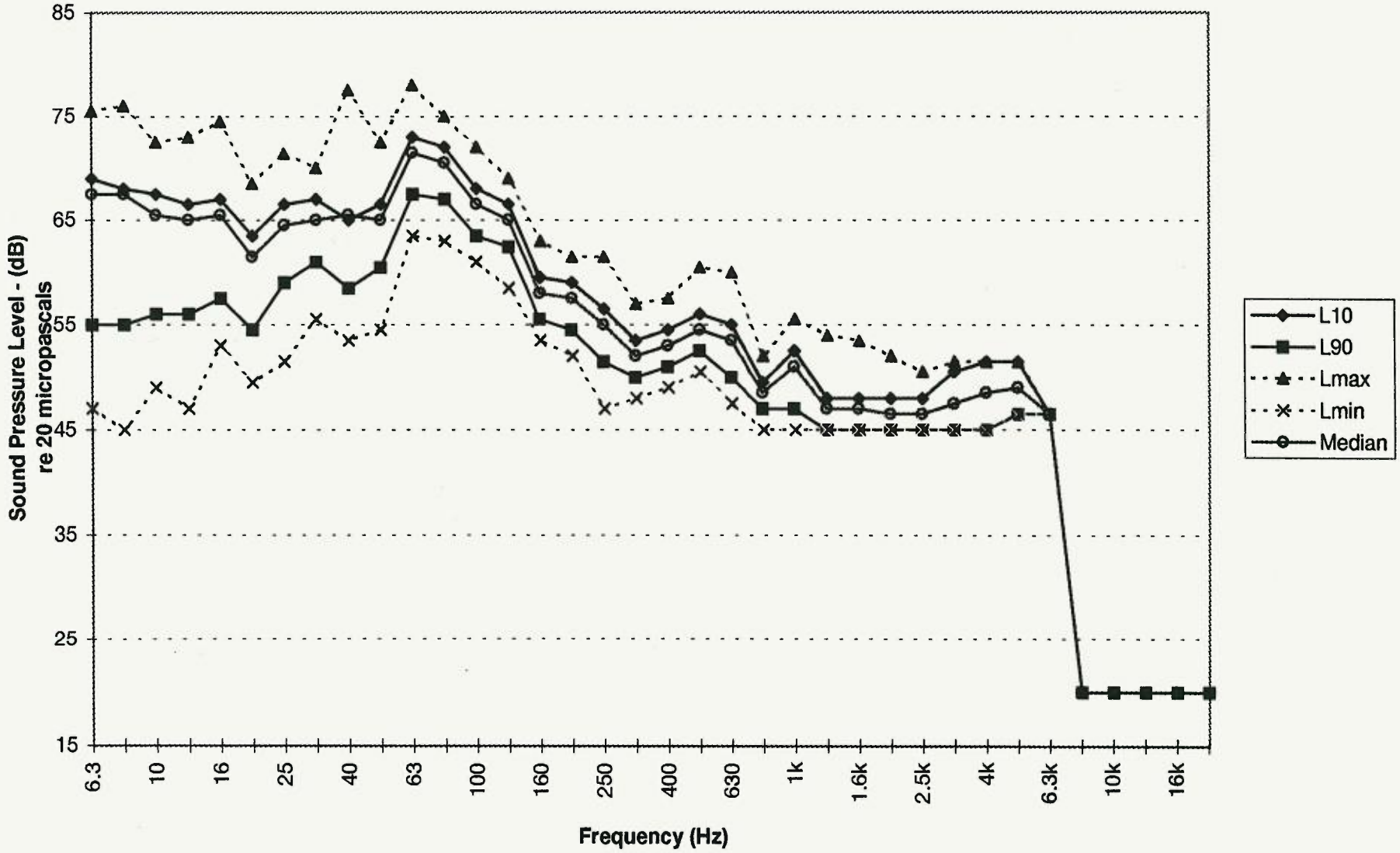
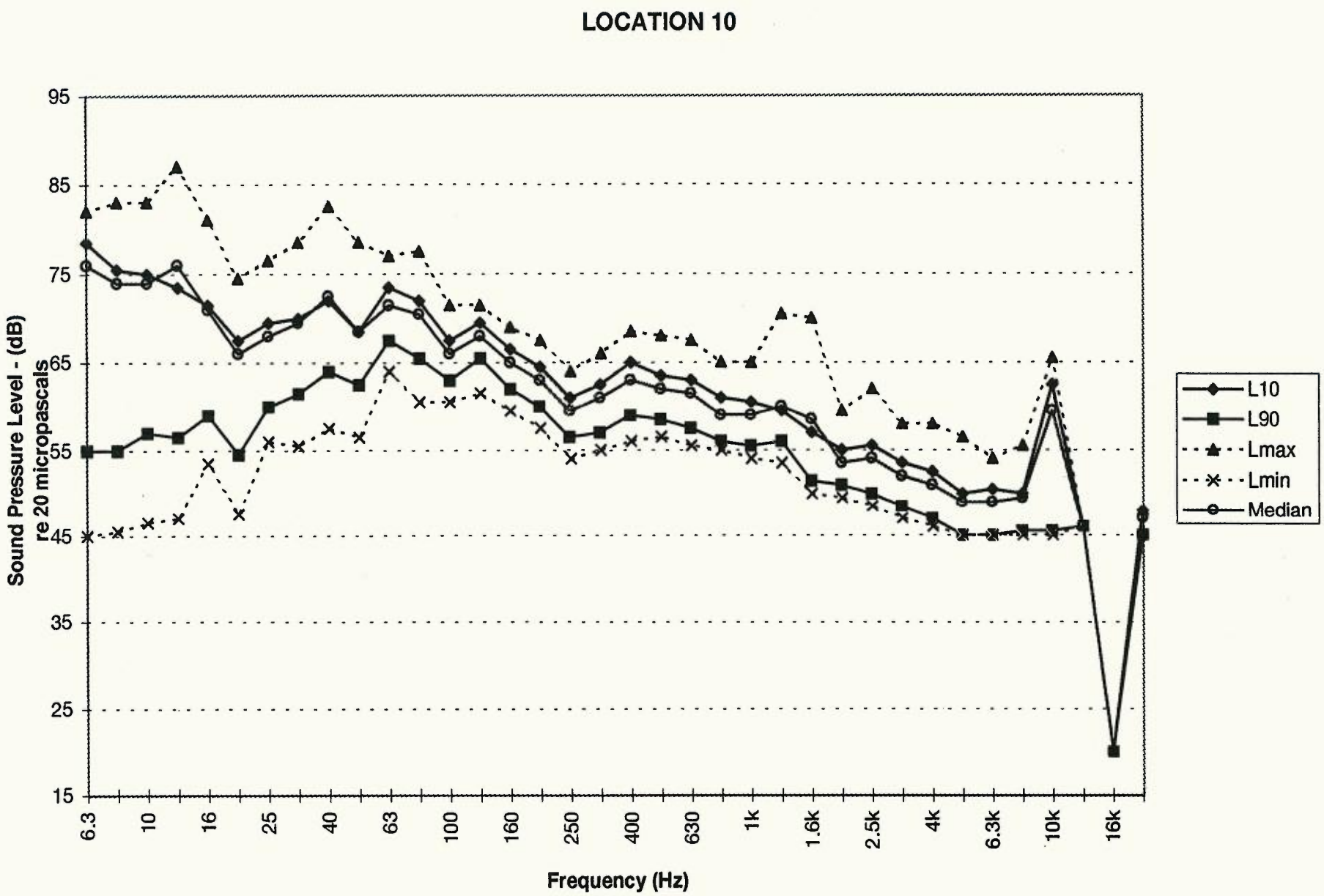
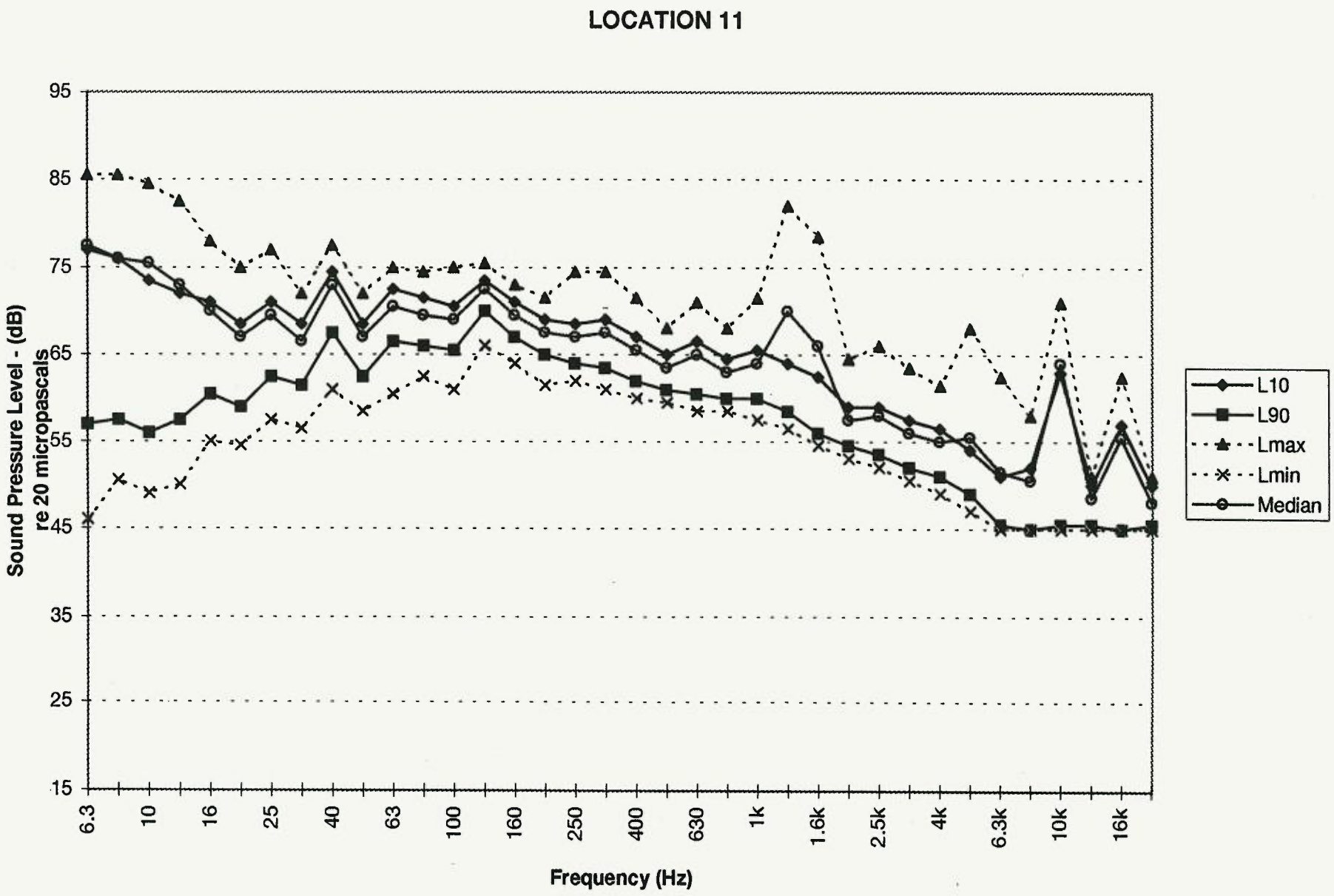
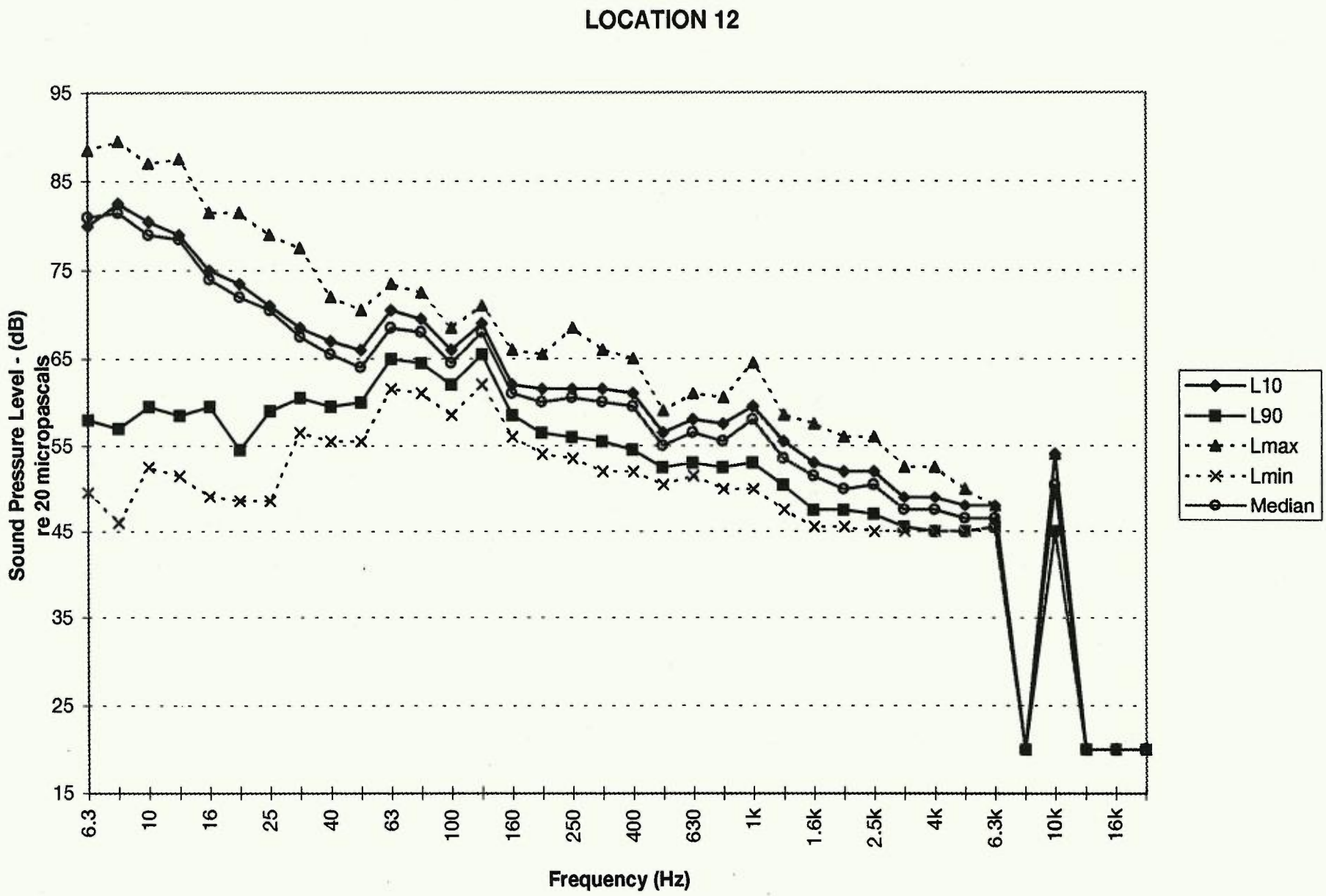
100
160
250
400
630
1k
1.6k
2.5k
4k
6.3k
10k
16k
Frequency (Hz)
L10
L90
Lmax
Lmin
Median

LOCATION 9


85
75
65
55
45
35
25
15
Sound Pressure Level - (dB) re 20 micropascals
6.3
10
16
25
40
63
100
160
250
400
630
1k
1.6k
2.5k
4k
6.3k
10k
16k
Frequency (Hz)
L10
L90
Lmax
Lmin
Median


LOCATION 10
Sound Pressure Level - (dB) re 20 micropascals
95
85
75
65
55
45
35
25
15
6.3
10
16
25
40
63
100
160
250
400
630
1k
1.6k
2.5k
4k
6.3k
10k
16k
Frequency (Hz)
L10
L90
Lmax
Lmin
Median


LOCATION 11
Sound Pressure Level - (dB) re 20 micropascals
95
85
75
65
55
45
35
25
15
6.3
10
16
25
40
63
100
160
250
400
630
1k
1.6k
2.5k
4k
6.3k
10k
16k
Frequency (Hz)
L10
L90
Lmax
Lmin
Median


LOCATION 12
Sound Pressure Level - (dB) re 20 micropascals
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75
65
55
45
35
25
15
6.3
10
16
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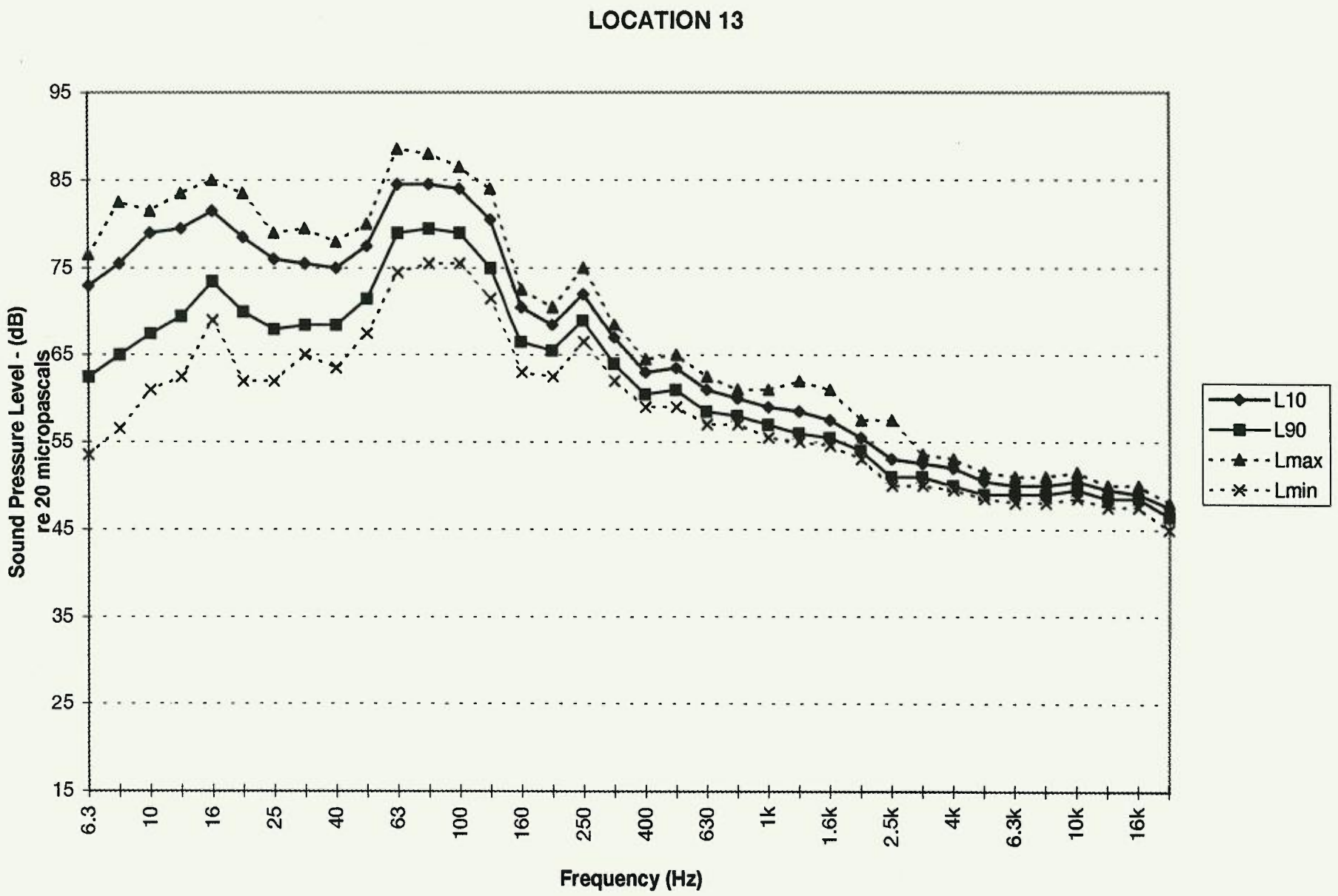
160
250
400
630
1k
1.6k
2.5k
4k
6.3k
10k
16k
Frequency (Hz)
L10
L90
Lmax
Lmin
Median


LOCATION 13
Sound Pressure Level - (dB) re 20 micropascals
95
85
75
65
55
45
35
25
15
6.3
10
16
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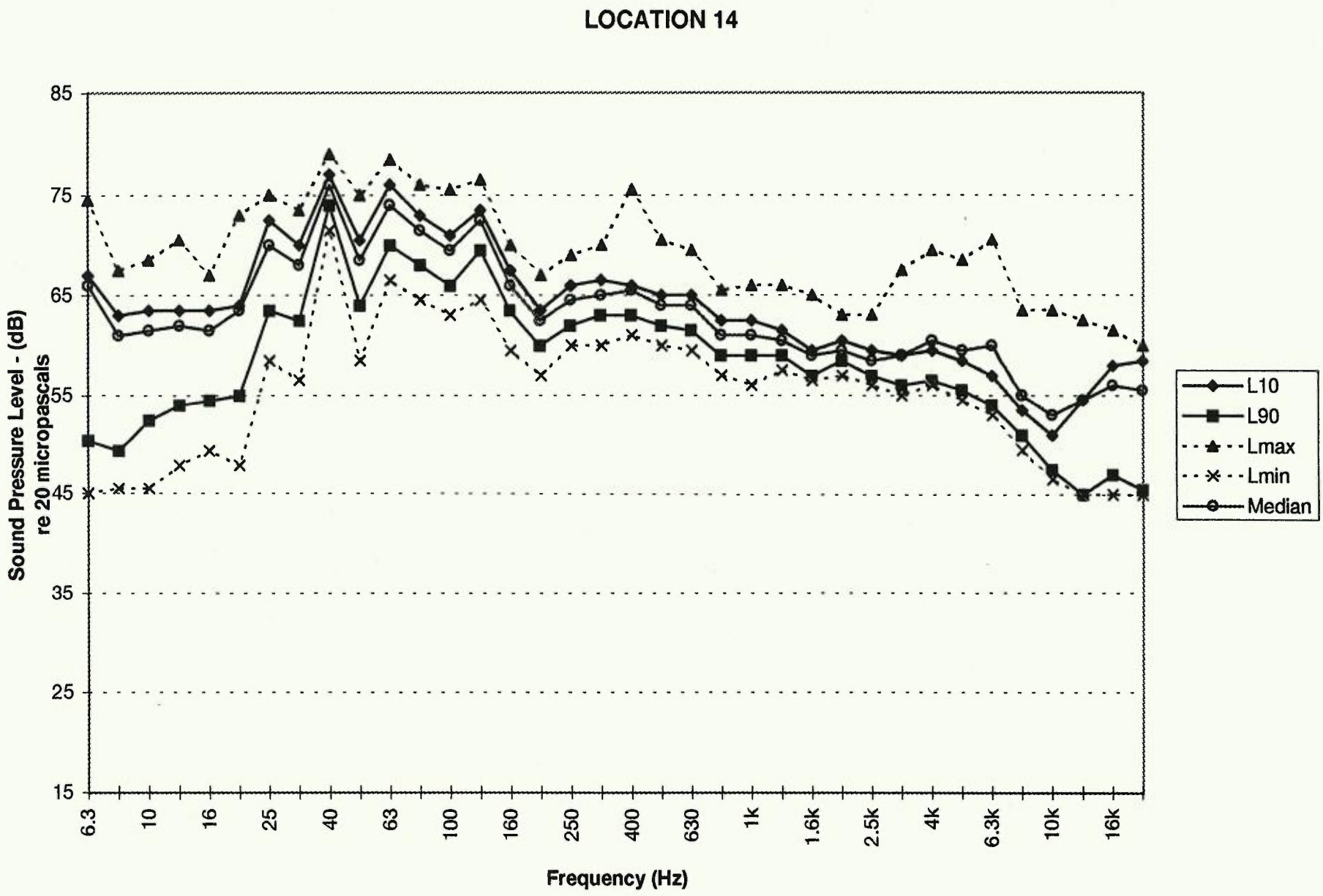
40
63
100
160
250
400
630
1k
1.6k
2.5k
4k
6.3k
10k
16k
Frequency (Hz)
L10
L90
Lmax
Lmin


LOCATION 14
Sound Pressure Level - (dB) re 20 micropascals
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75
65
55
45
35
25
15
6.3
10
16
25
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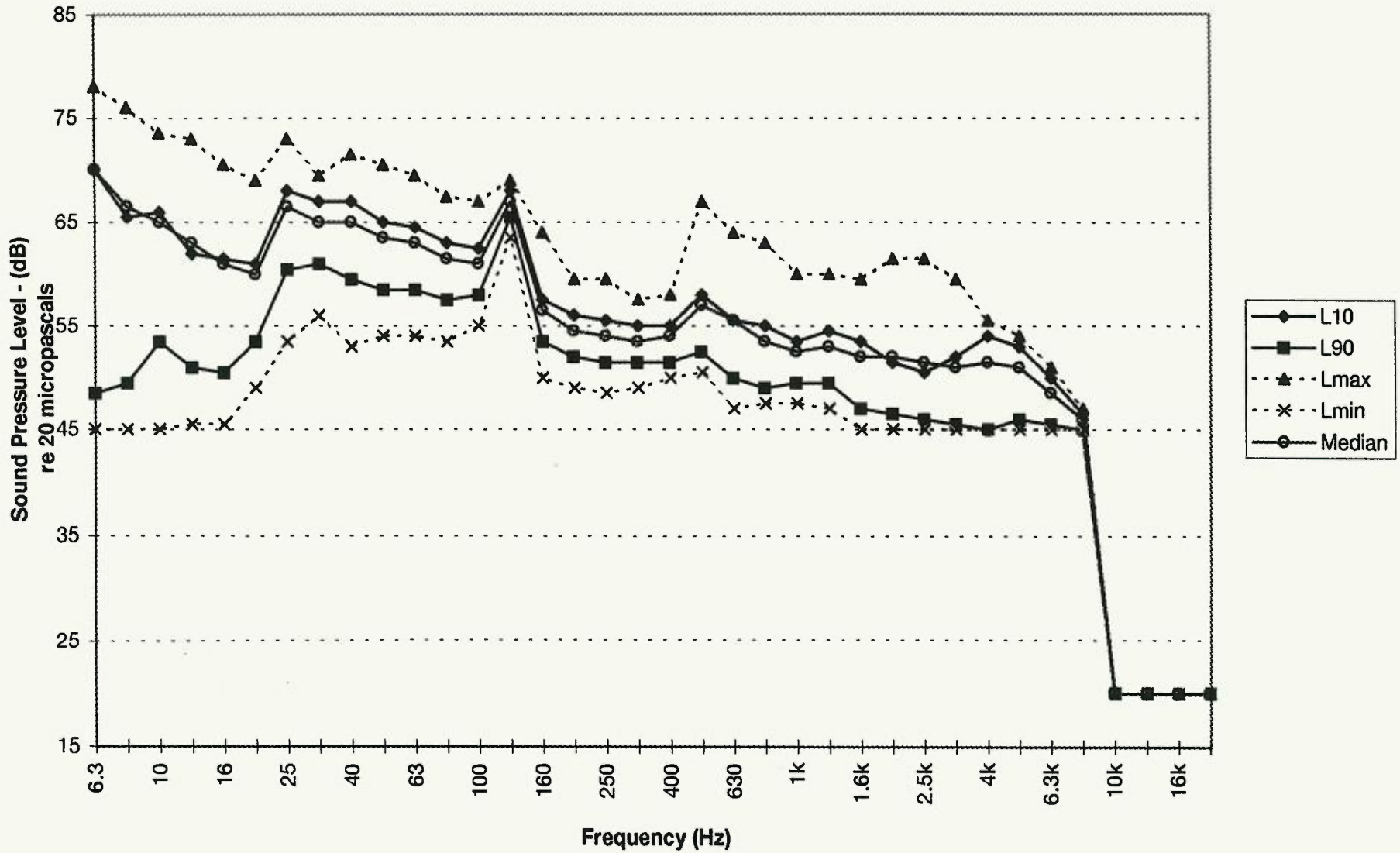
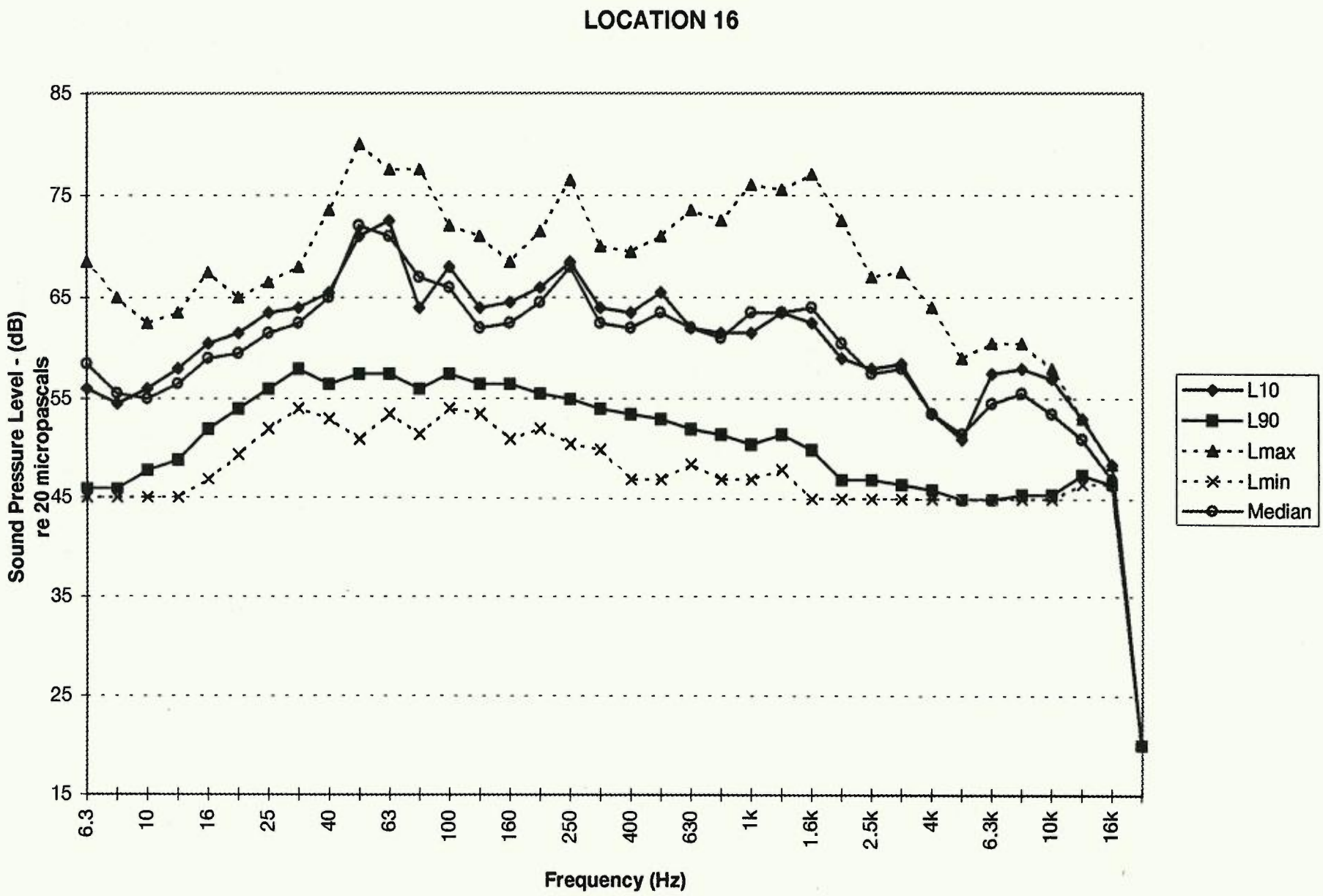
100
160
250
400
630
1k
1.6k
2.5k
4k
6.3k
10k
16k
Frequency (Hz)
L10
L90
Lmax
Lmin
Median

LOCATION 15


85
75
65
55
45
35
25
15
Sound Pressure Level - (dB) re 20 micropascals
6.3
10
16
25
40
63
100
160
250
400
630
1k
1.6k
2.5k
4k
6.3k
10k
16k
Frequency (Hz)
L10
L90
Lmax
Lmin
Median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Frequency (Hz)
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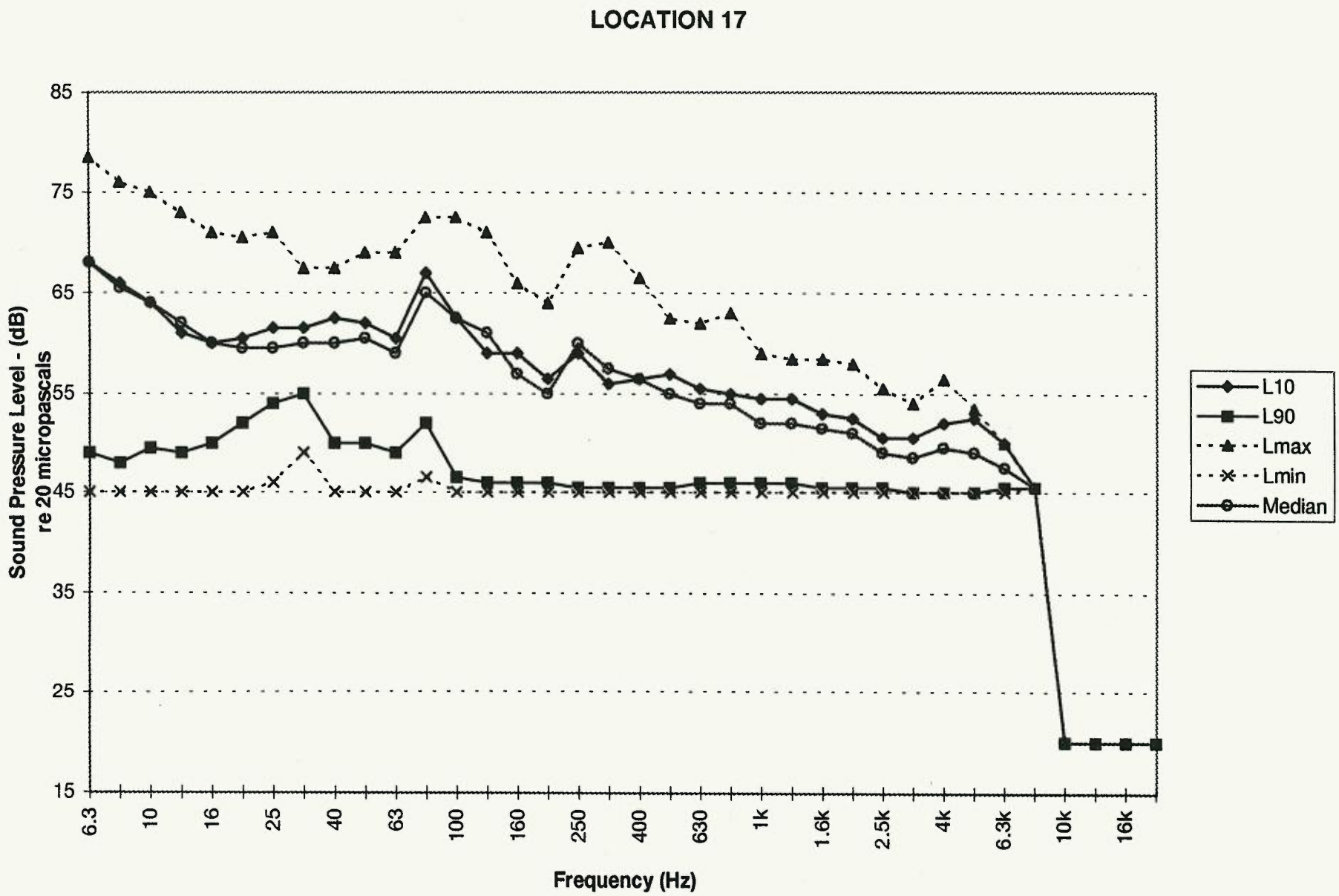
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250
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630
1k
1.6k
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4k
6.3k
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16k
Frequency (Hz)
L10
L90
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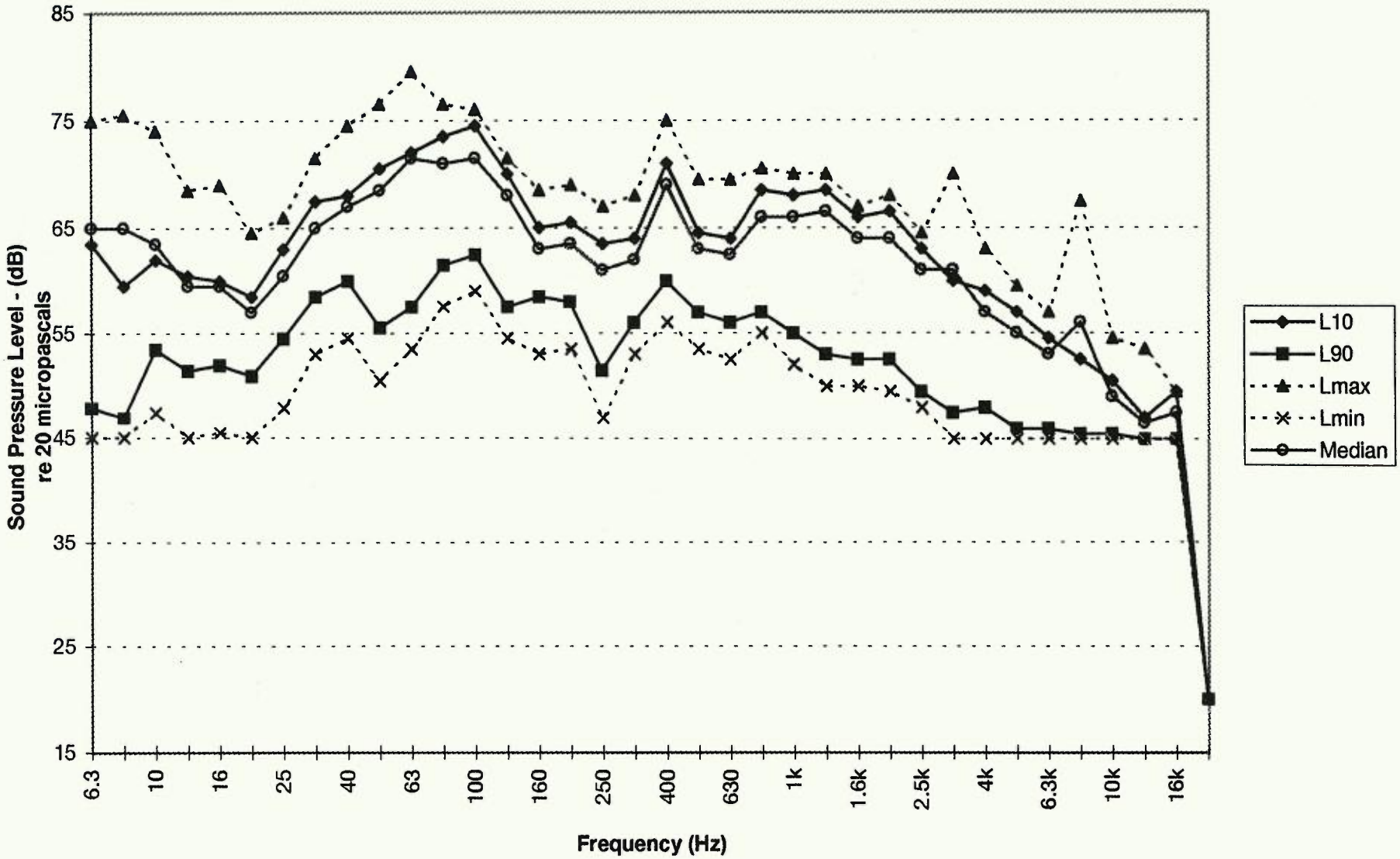
Median

LOCATION 18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Sound Pressure Level - (dB) re 20 micropascals
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1k
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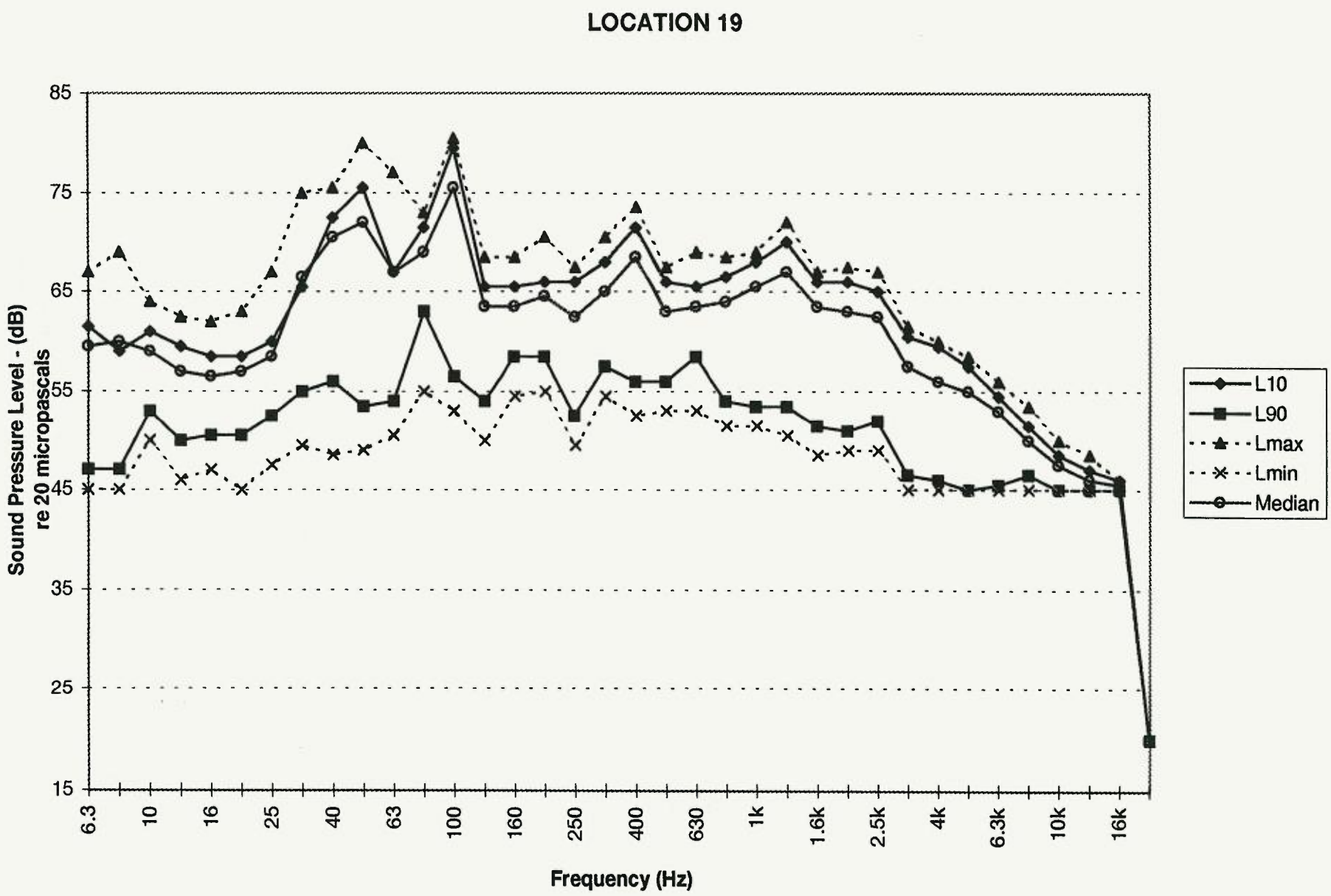
4k
6.3k
10k
16k
Frequency (Hz)
L10
L90
Lmax
Lmin
Median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1k
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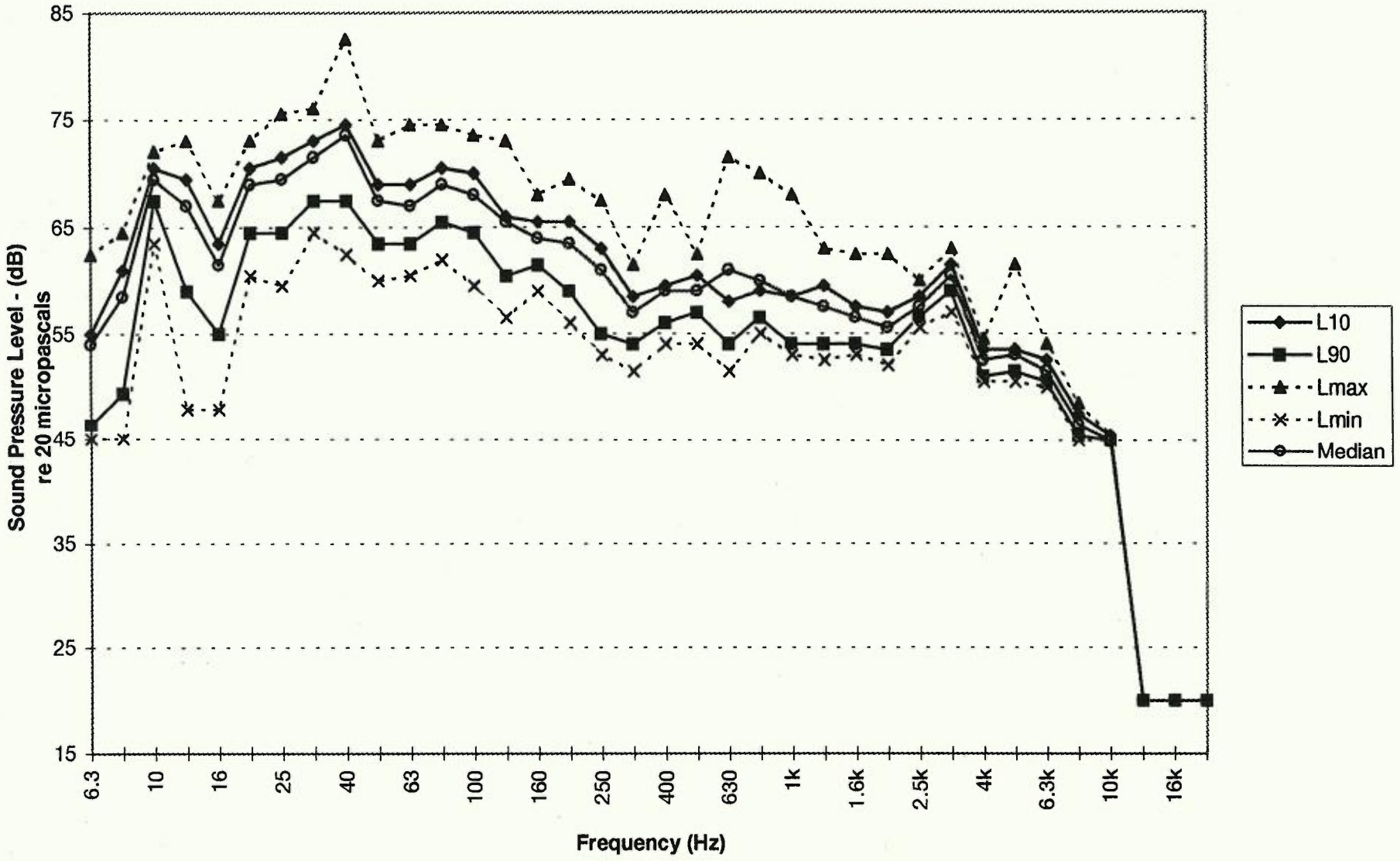
4k
6.3k
10k
16k
Frequency (Hz)
L10
L90
Lmax
Lmin
Median

LOCATION 20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Sound Pressure Level - (dB)
re 20 micropascals
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Frequency (Hz)
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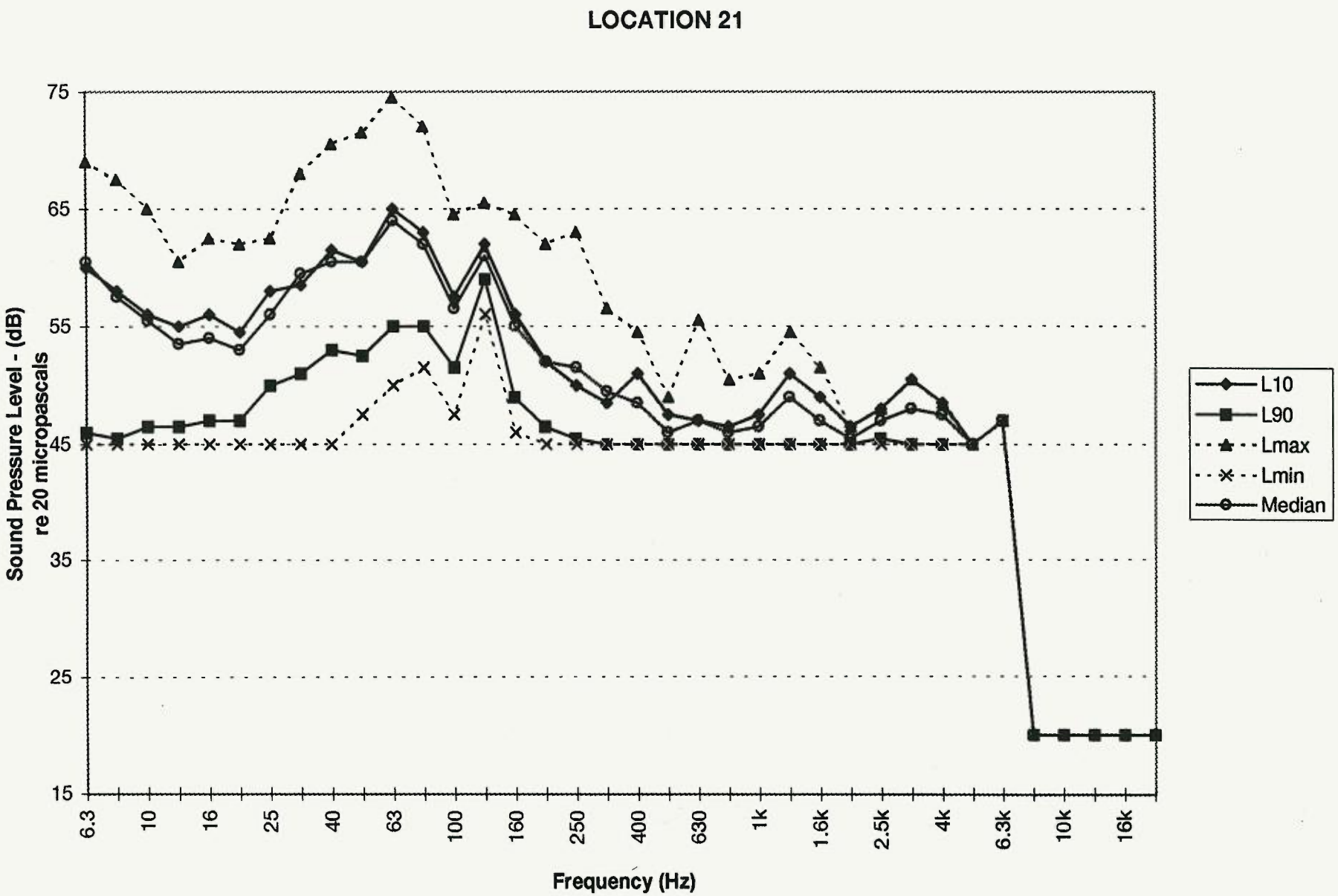
Lmin
Median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16k
Frequency (Hz)
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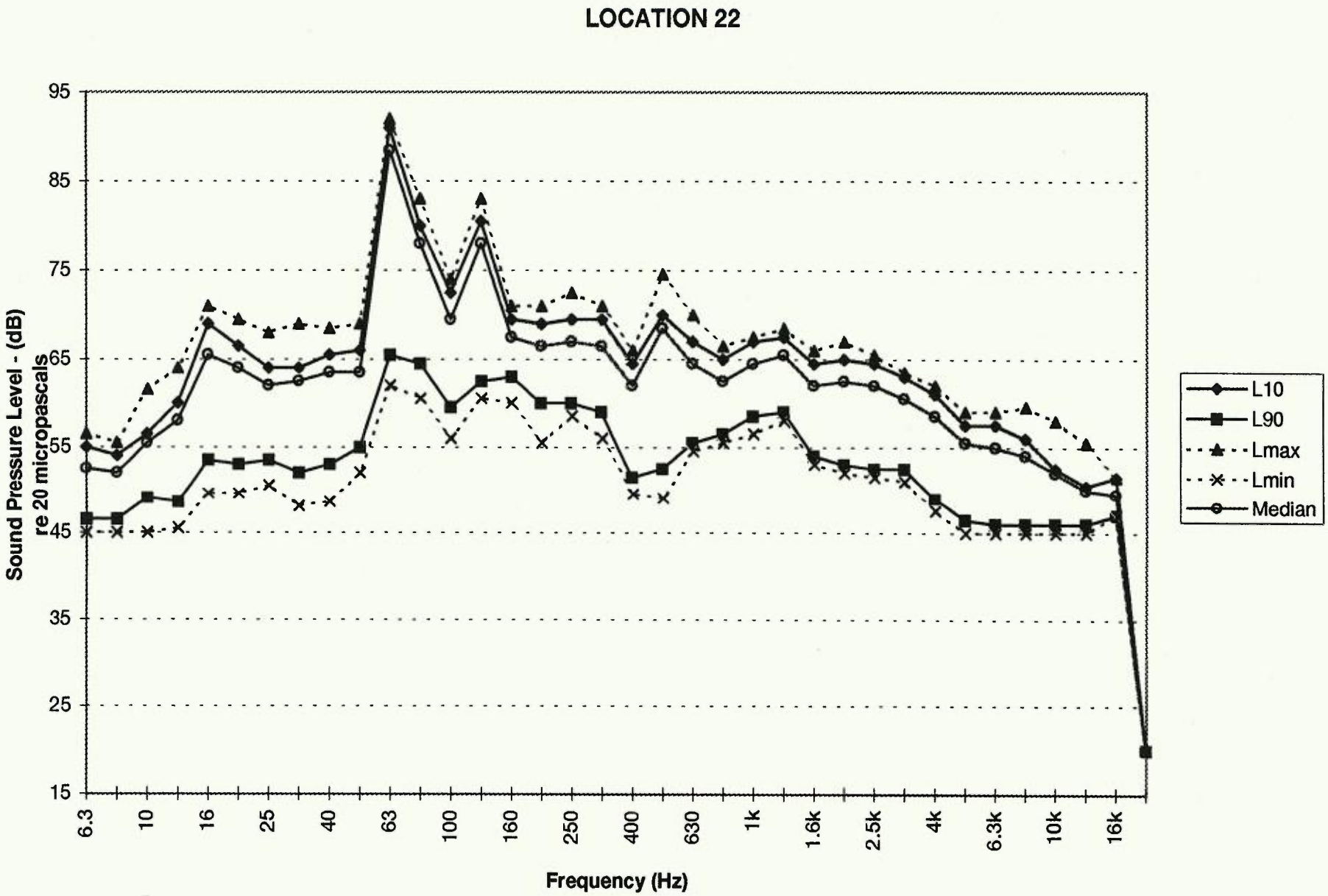
Lmin
Median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Sound Pressure Level - (dB) re 20 micropascals
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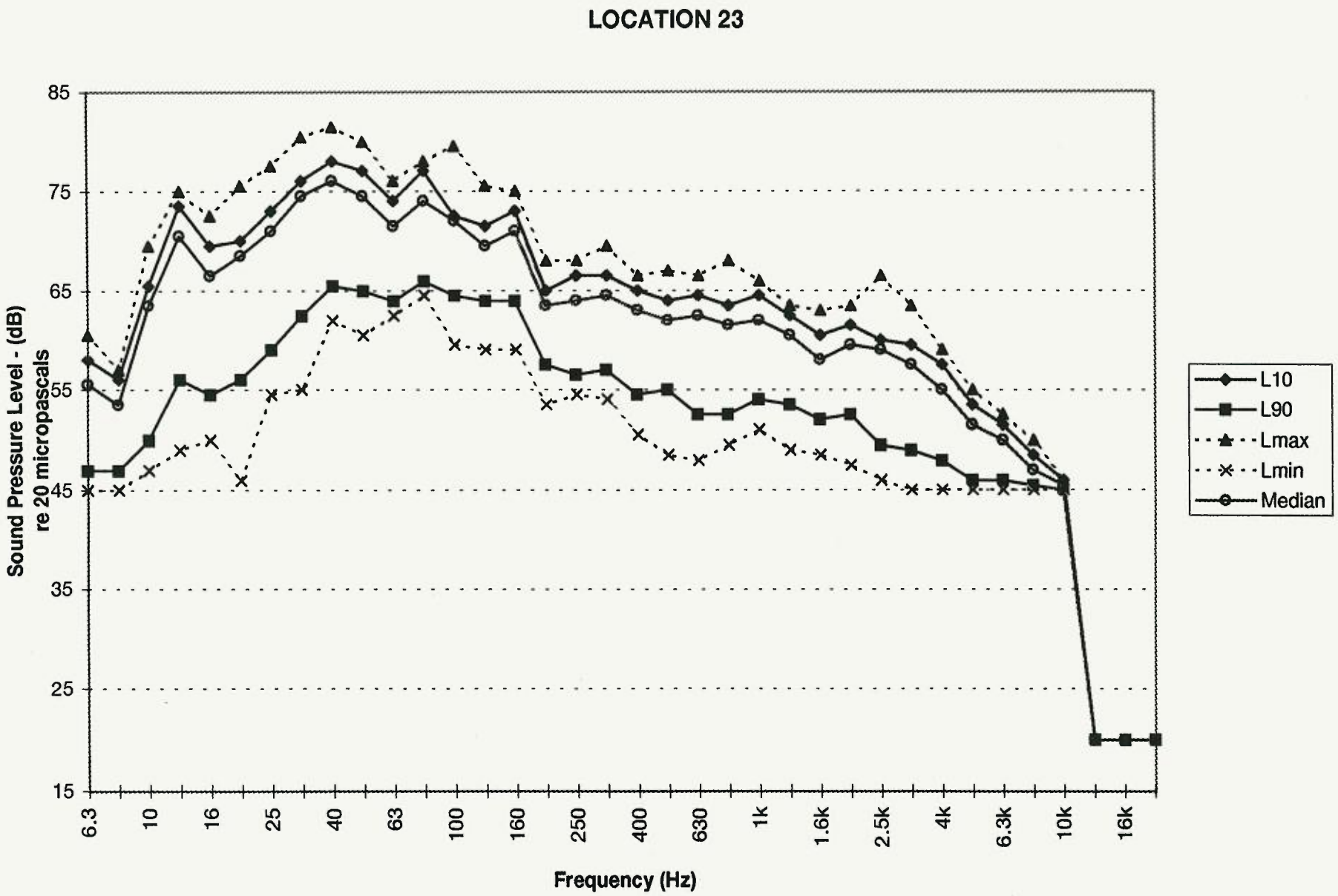
4k
6.3k
10k
16k
Frequency (Hz)
L10
L90
Lmax
Lmin
Median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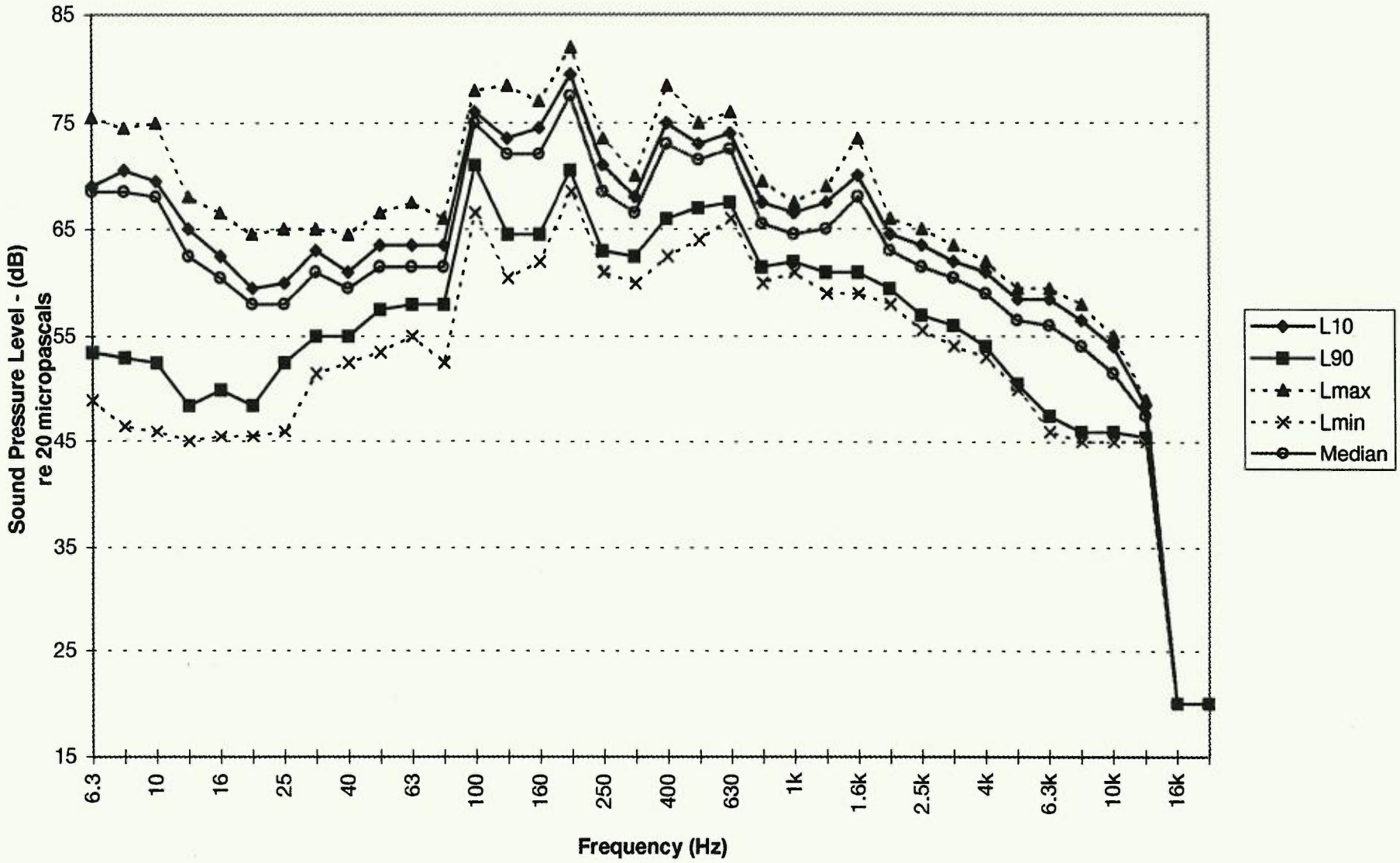
630
1k
1.6k
2.5k
4k
6.3k
10k
16k
Frequency (Hz)
L10
L90
Lmax
Lmin
Median

LOCATION 24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Sound Pressure Level - (dB) re 20 micropascals
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1k
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4k
6.3k
10k
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Frequency (Hz)
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Lmax
Lmin
Median

LOCATION 25
Sound Pressure Level - (dB) re 20 micropascals
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1k
1.6k
2.5k
4k
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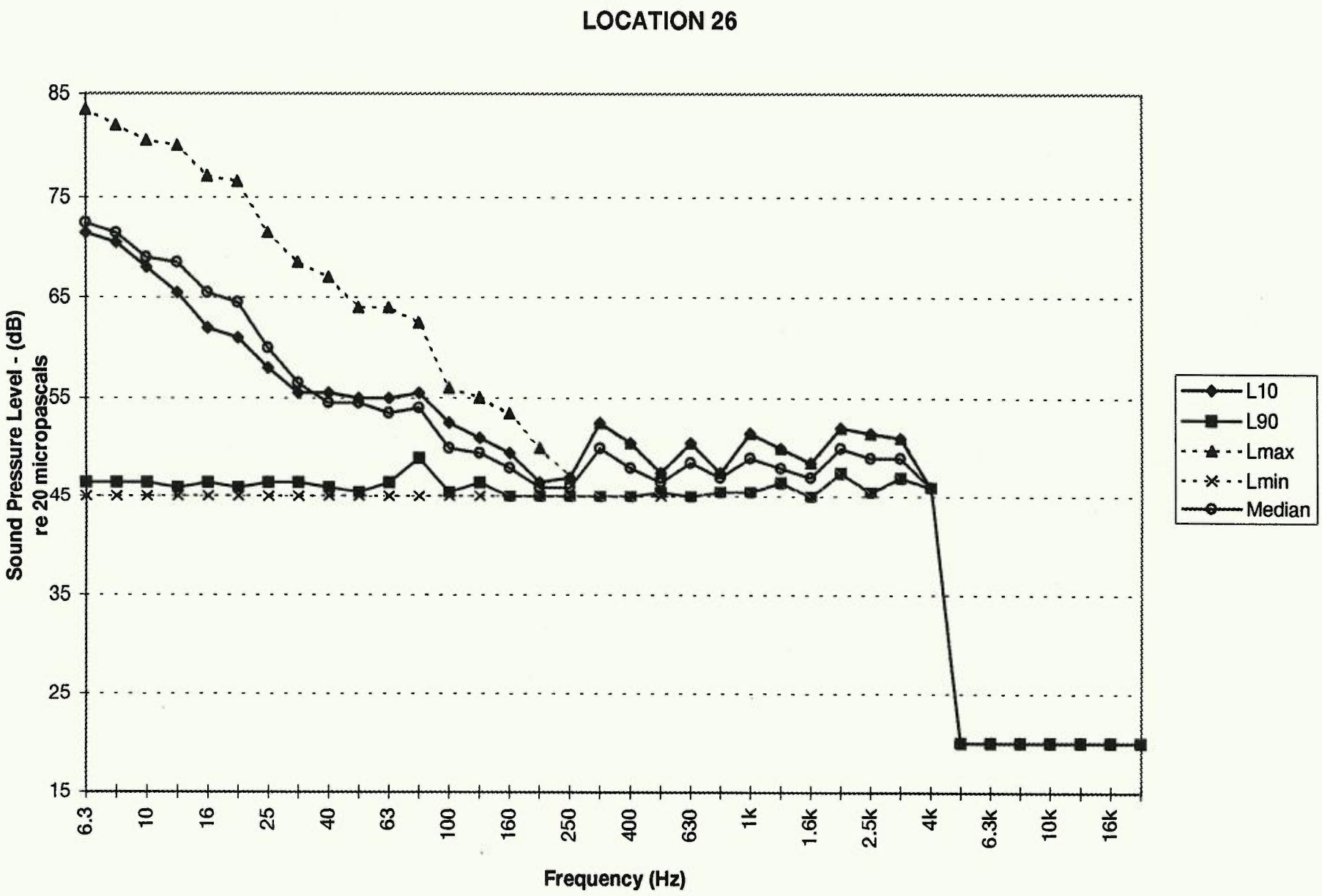
10k
16k
Frequency (Hz)
L10
L90
Lmax
Lmin
Median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1k
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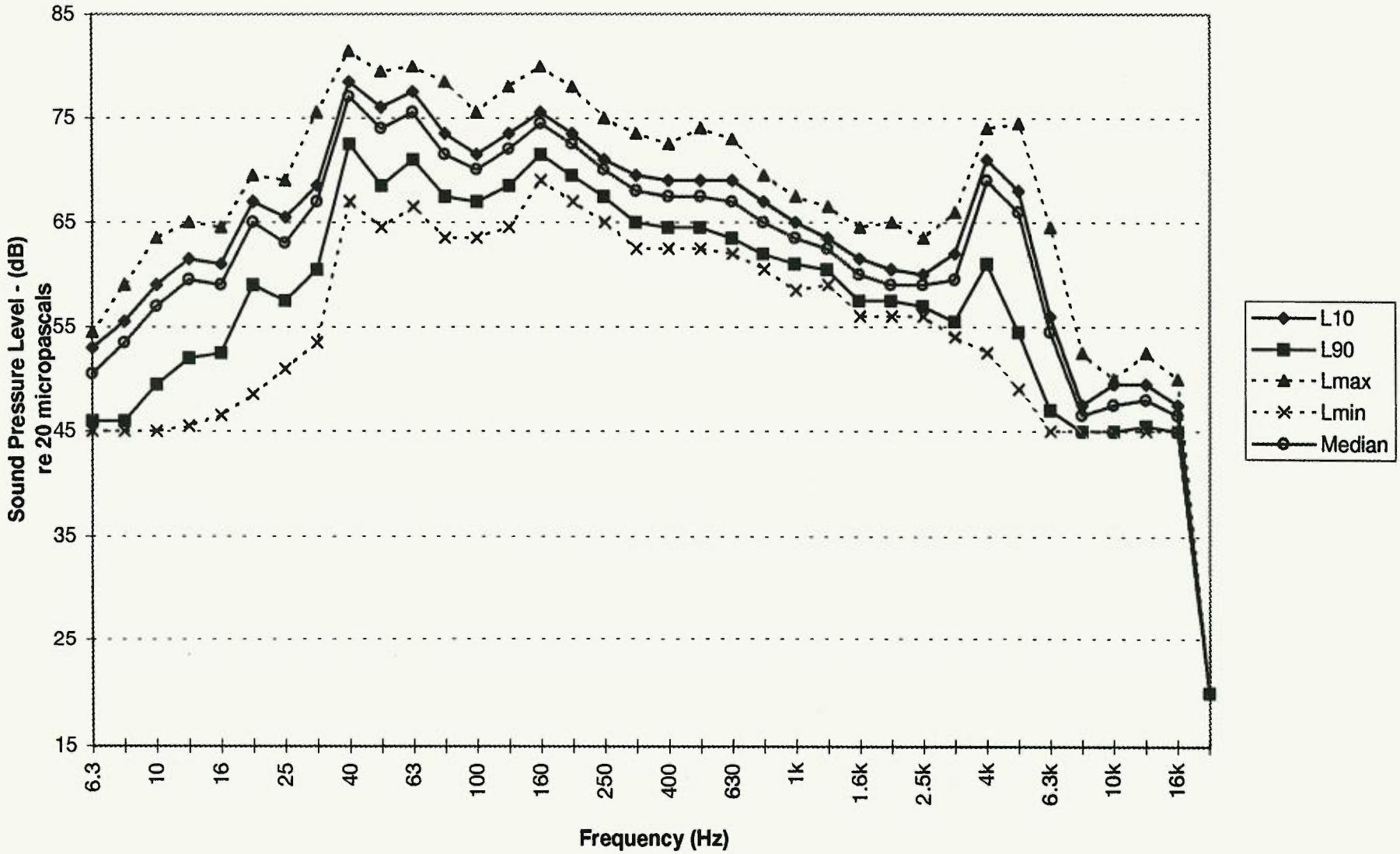
4k
6.3k
10k
16k
Frequency (Hz)
L10
L90
Lmax
Lmin
Median

LOCATION 27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Sound Pressure Level - (dB) re 20 micropascals
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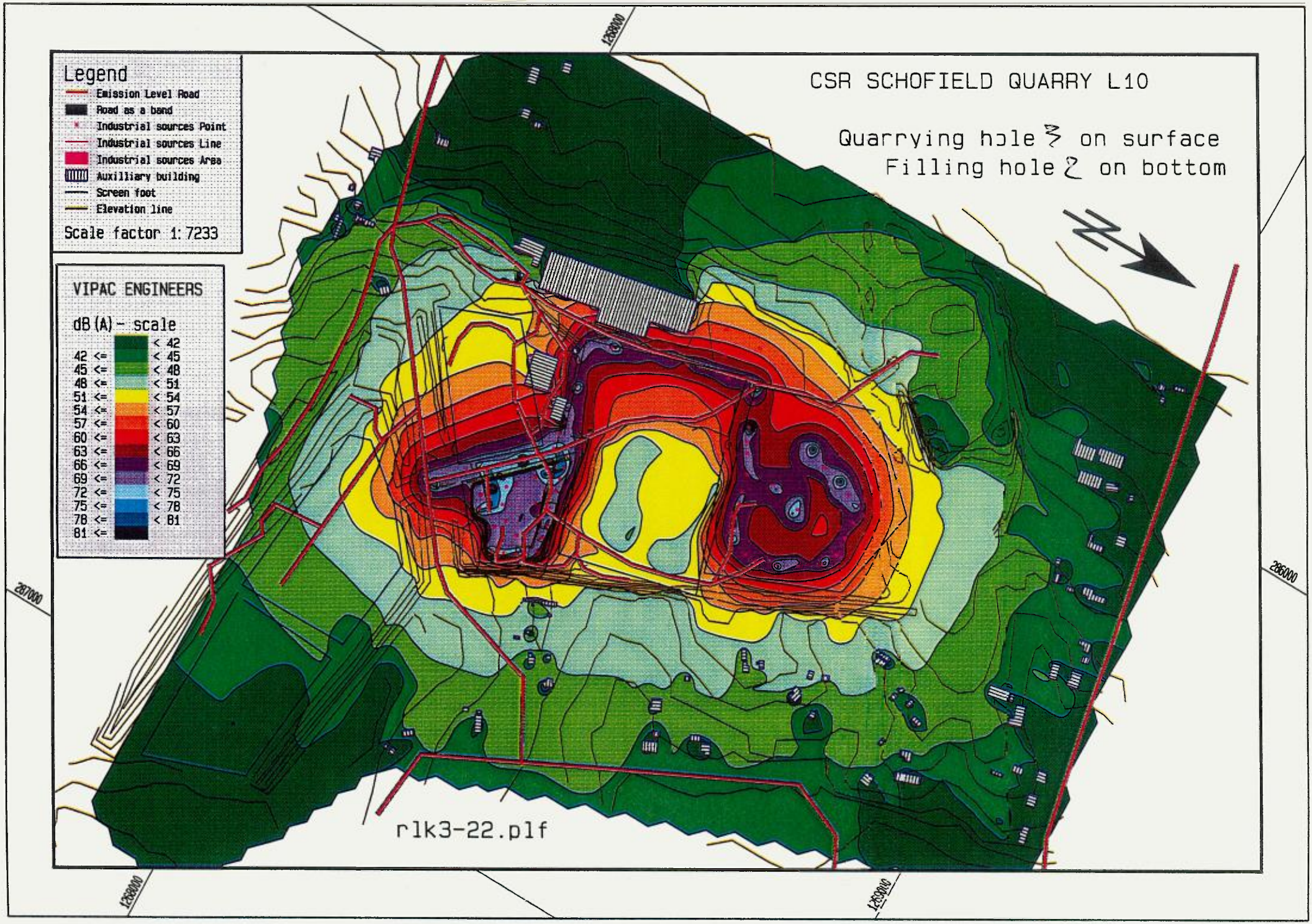
1k
1.6k
2.5k
4k
6.3k
10k
16k
Frequency (Hz)
L10
L90
Lmax
Lmin
Median

APPENDIX C

NOISE CONTOUR DIAGRAMS - FUTURE

LA10 CONTOUR DIAGRAMS
(no noise barriers)

- QUARRYING Stage 3 / LANDFILLING Stage B
- QUARRYING Stage 6 / LANDFILLING Stage E


CSR SCHOFIELD QUARRY L10
Quarrying hole 3 on surface
Filling hole 2 on bottom
Legend
Emission Level Road
Road as a band
Industrial sources Point
Industrial sources Line
Industrial sources Area
Auxilliary building
Screen foot
Elevation line
Scale factor 1:7233
VIPAC ENGINEERS
dB(A) - scale
< 42
42 <= < 45
45 <= < 48
48 <= < 51
51 <= < 54
54 <= < 57
57 <= < 60
60 <= < 63
63 <= < 66
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81 <=
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286000
1268000
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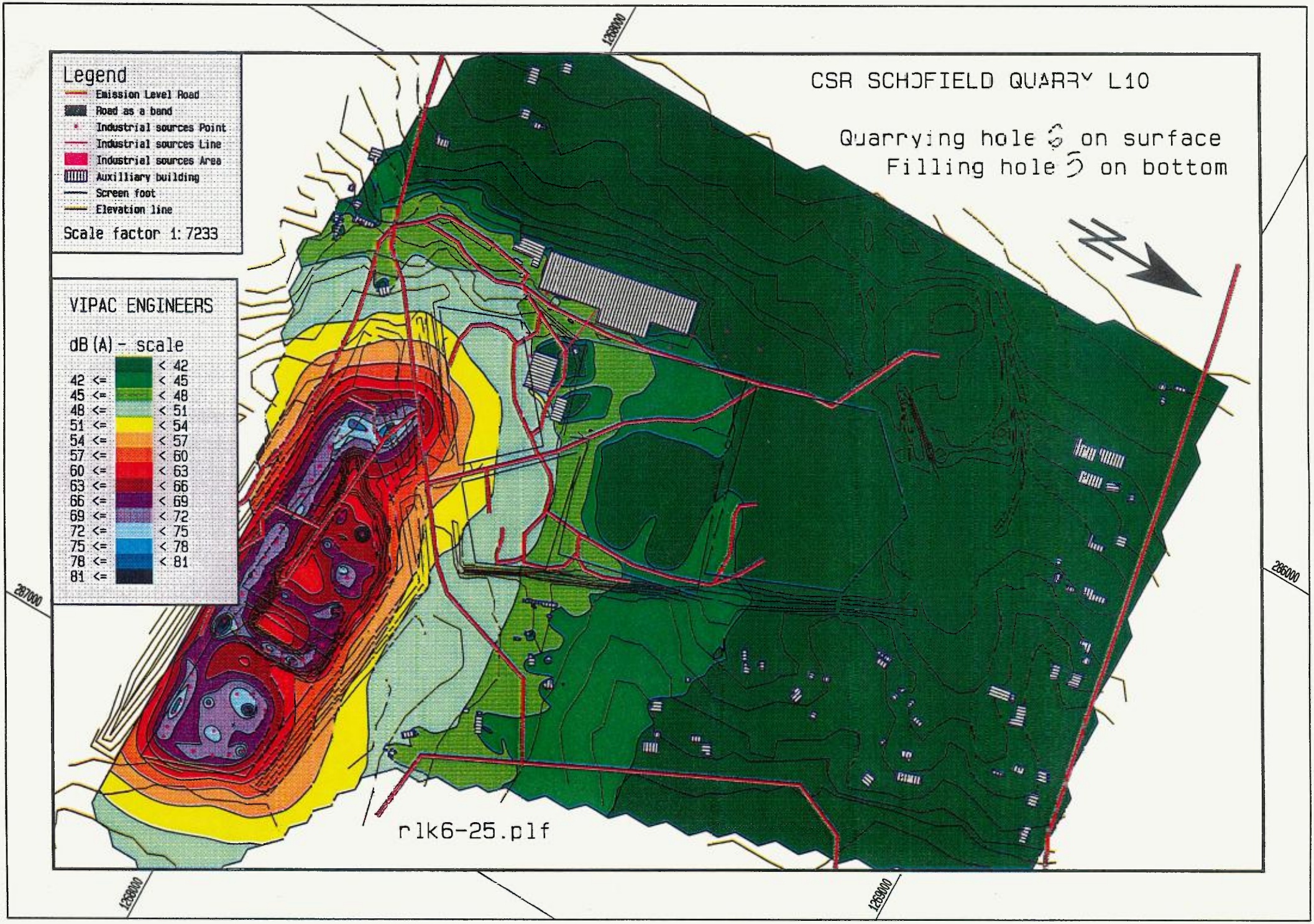
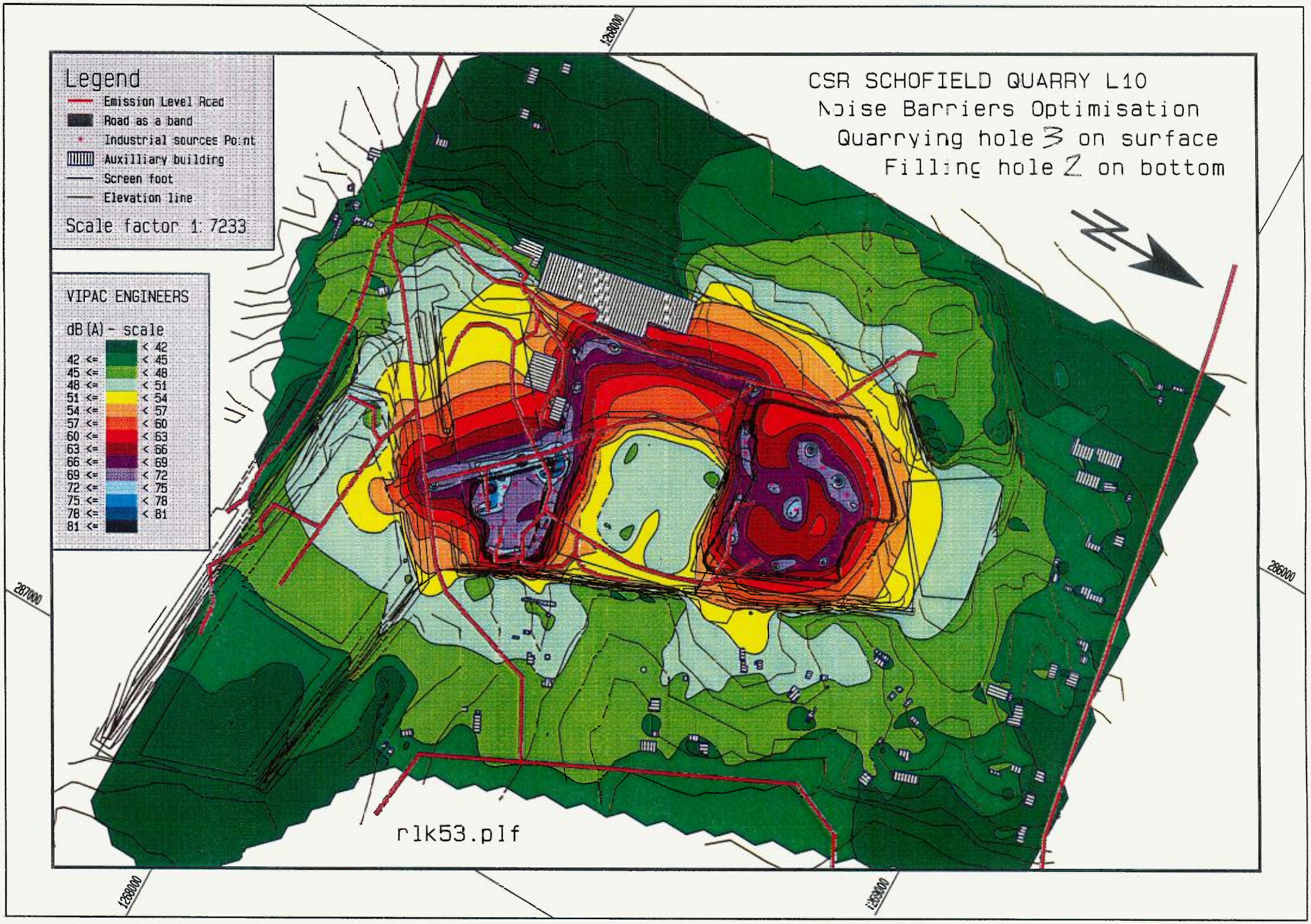

CSR SCHOFIELD QUARRY L10
Quarrying hole 5 on surface
Filling hole 5 on bottom
Legend
Emission Level Road
Road as a band
Industrial sources Point
Industrial sources Line
Industrial sources Area
Auxilliary building
Screen foot
Elevation line
Scale factor 1:7233
VIPAC ENGINEERS
dB(A) - scale
< 42
42 <= < 45
45 <= < 48
48 <= < 51
51 <= < 54
54 <= < 57
57 <= < 60
60 <= < 63
63 <= < 66
66 <= < 69
69 <= < 72
72 <= < 75
75 <= < 78
78 <= < 81
81 <=
287000
286000
1268000
1269000
rlk6-25.plf

APPENDIX D

NOISE CONTOUR DIAGRAMS - FUTURE

LA10 CONTOUR DIAGRAMS WITH
EARTH BERM NOISE WALLS

- QUARRYING Stage 3 / LANDFILLING Stage B
- QUARRYING Stage 6 / LANDFILLING Stage E


CSR SCHOFIELD QUARRY L10
Noise Barriers Optimisation
Quarrying hole 3 on surface
Filling hole 2 on bottom
Legend
Emission Level Road
Road as a band
Industrial sources Point
Auxilliary building
Screen foot
Elevation line
Scale factor 1: 7233
VIPAC ENGINEERS
dB(A) - scale
< 42
42 <= < 45
45 <= < 48
48 <= < 51
51 <= < 54
54 <= < 57
57 <= < 60
60 <= < 63
63 <= < 66
66 <= < 69
69 <= < 72
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81 <=
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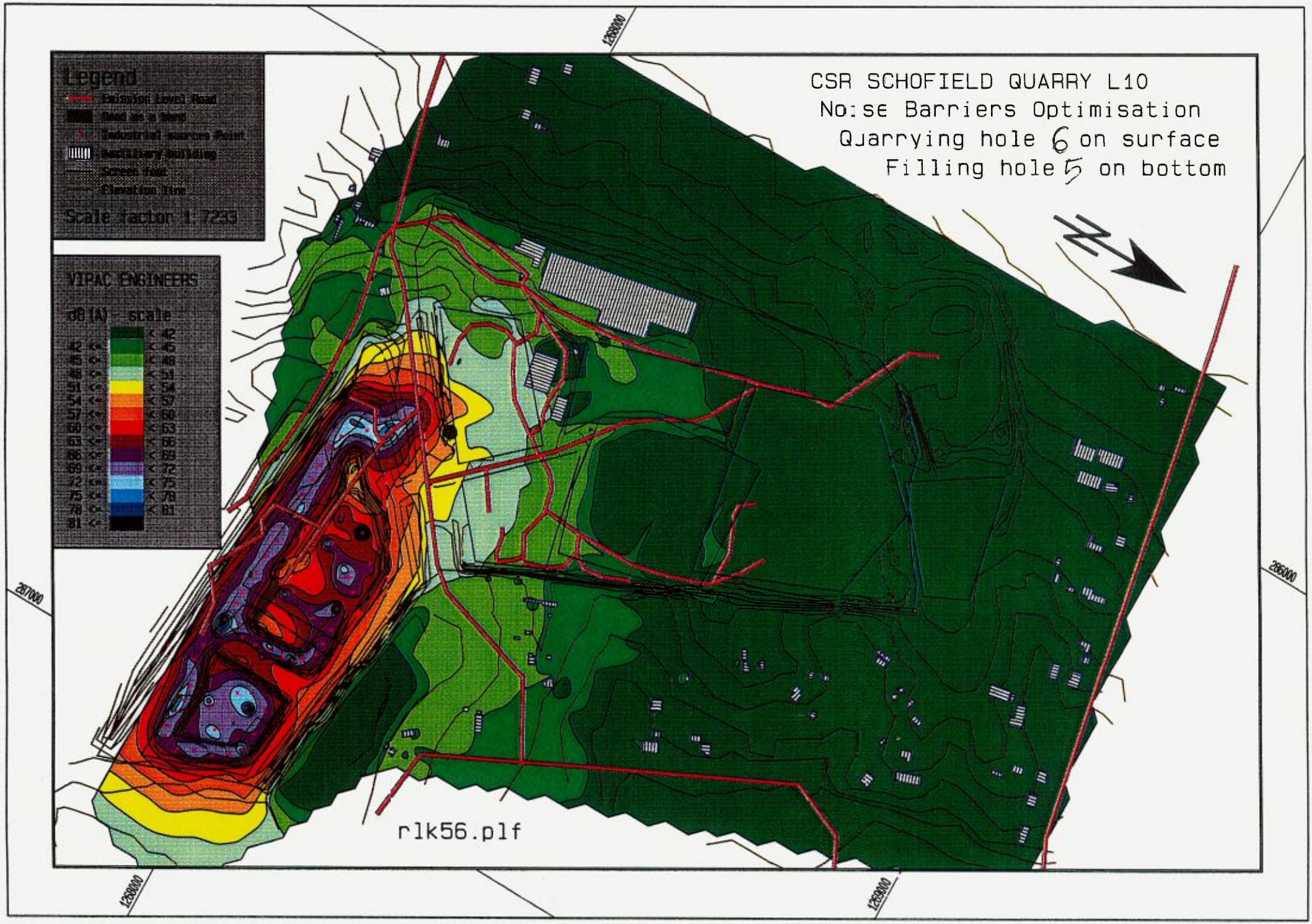
287000
286000
1268000
1268000
rlk53.plf


CSR SCHOFIELD QUARRY L10
No:se Barriers Optimisation
Quarrying hole 6 on surface
Filling hole 5 on bottom
Legend
Emission level Road
Road as a land
Industrial sources Point
Auxiliary building
Screen line
Elevation line
Scale factor 1:7239
VIPAC ENGINEERS
dB(A) scale
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66 <= < 69
69 <= < 72
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78 <= < 81
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1268000
1269000
287000
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rlk56.plf

RICHARD HEGGIE ASSOCIATES PTY LTD
ACN 001 584 612
CONSULTING ENGINEERS

Level 2, 2 Lincoln Street (PO Box 176)
Lane Cove NSW 2066
Australia

Fax (02) 9427 8200
Telephone (02) 9427 8100

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INCOMING CORRESPONDENCE
DATE IN 5/5/97
PROJECT MGR. SHWS
PROJECT No. VH0009
FILE No. 010
TO SH
A/C A
B

N119\7116R025

2 May 1997

CSR Construction Materials
Level 8
9 Help Street
CHATSWOOD NSW 2067

Attention: Mr Ron Bush, Development Manager

Dear Mr Bush

Noise Level Design Goals
Noise Report for PGH's Schofields EIS

1 Introduction

Further to your letter of 21 April 1997 regarding the subject draft Noise Report No 24787 of March 1997 prepared by Vipac, we have provided background information on the appropriateness of the noise level design goals used.

2 Noise Level Design Goals

2.1 History

The EPA has recently reviewed the noise licences for the existing Clay Brick and Paver operations in the Sydney Region. As part of this review, a number of discussions have been held between the EPA and the Clay Brick and Paver Association with regard to licence requirements.

The Association was very concerned about some of the proposed Licence Conditions with respect to noise and wished to ensure that the new licence conditions were realistic and achievable, and that they catered for the history of the operations. Some of the members of the Association have existing licence conditions for noise, others do not. All brickworks sites have been operating for many years and have seen incompatible land uses gradually encroaching towards their boundaries. The principle operations of concern were those of CSR PGH, Boral and Austral.

In preparation for the various meetings with the EPA regarding future Licence Conditions, the Association engaged Richard Heggie Associates (RHA) to visit each site and conduct (limited) additional noise emission investigations, where necessary, to complete and/or supplement the work completed already, to collate and bring focus to the acoustical studies and documentation accumulated to date, and to prepare a Noise Management Strategy document recommending noise emission limits for each extraction and processing plant site.

2.2 Industry Noise Emission Characteristics

The character of the noise emitted by mobile plant and equipment, as utilised in the quarrying, landfill, crusher loading and truck loading operations is that of high peak excursions from the general ambient level which are best described by the L_{A10} noise level parameter. However, the noise of the brickmaking plant (kilns and fans) is ostensibly continuous ie the L_{A10} and L_{A90} noise parameters are similar in level. Noise from the brickmaking plant is therefore potentially more annoying than the mobile equipment noise and should therefore attract a lower criterion.

2.3 CSR's Schofields Operations - Existing Licence Conditions

The EPA's Pollution Control Act Licence Condition N1 (year commencing 2 July 1996) for the Schofields operations states that:

> *"The level of noise emanating from the operation of the plant, including loading and unloading of materials in or on the above premises, must not exceed a sound pressure level ($L_{A10,T}$) of 57 dBA (daytime) or 50 dBA (night-time), when measured or computed at any point within 1 m of the plant boundary over any time period between 10 to 15 minutes using the "FAST" response on the sound level meter; 5 dBA must be added to the measured level if the noise is substantially tonal or impulsive in character, (daytime refers to 0700 hours to 2200 hours 7 days per week and night-time refers to all other times)."*

Note: These noise criteria are for the brickmaking plant (kilns) only.

2.4 Future Licence Conditions

Based on a review of all available relevant data, particularly the existing licence condition for the brickmaking operations, together with the history of the operations, and the surrounding environment, it was recommended that the following Condition be adopted by the EPA in their licence for the subject operations under the Pollution Control Act:

"The $L_{A10,T}$ level emitted from the sources of continuous noise associated with the brickmaking plant and/or process, including loading and unloading of materials in or on the above premises, must not exceed a sound pressure level of 57 dBA during the daytime and 50 dBA at other times.

The $L_{A10,T}$ noise level emitted from the mobile plant and equipment, including loading and unloading of materials, in or on the above premises, must not exceed a sound pressure level of 55 dBA during the daytime and 45 dBA at other times.

Daytime is defined as 7.00 am to 10.00 pm Monday to Saturday, and 8.00 am to 10.00 pm Sundays and Public Holidays

The $L_{A10,T}$ sound pressure level must be measured or computed at any point within 3 m of any residence or other noise sensitive area in the vicinity of the premises, under neutral weather conditions. Where measurable, the $L_{A10,T}$ is to be measured over a period of between 10 and 15 minutes using the "Fast" response on the sound level meter. 5 dBA must be added to the measured level if the noise is substantially tonal or impulsive in character."

Discussions with the EPA on the above recommended noise criteria indicated that they were generally in agreement with the recommended conditions but that they preferred a night-time criteria of 40 dBA for quarrying/landfilling. PGH has subsequently accepted the EPA's preferred night-time criterion.

Further, a letter has recently been sent to EPA by the Clay Brick and Paver Association confirming acceptance of the EPA's preferred noise level criteria and formalisation of the future Licence Conditions for the Clay Brick and Paver industry is expected from the EPA shortly.

The noise level design goals used in the subject noise impact assessment report for the existing and future operations at Schofields are therefore consistent with those to be formalised by the EPA for their future Licence Conditions.

I trust this review meets your present requirements, however should you wish to discuss any of the above in more detail or have any queries, please call me.

Regards

DICK GODSON

APPENDIX G
DLEMP AND TECHNICAL REPORTS

(i) DLEMP (CMPS&F Environmental)
(ii) Water Management Plan and Landfill Technical Report (Woodward-Clyde)
(iii) Installation of Monitoring Wells and Groundwater Sampling (Woodward-Clyde)

ENVIROGUARD

SCHOFIELDS LANDFILL

DRAFT LANDFILL ENVIRONMENTAL MANAGEMENT PLAN

May 1997

DOCUMENT NO. VN\5489\RP01

Prepared by

CMPS&F PTY LIMITED
Environmental Engineering Division
ACN 000 912 630

67 Albert Avenue
Chatswood NSW 2067
Telephone: 61 2 9412 9888
Fax: 61 2 9412 9686

REVIEW AND APPROVAL RECORD					
REV	DATE	DESCRIPTION OF RELEASE	PREP'D	REV'D	APPR'D
A	20-2-97	Preliminary Draft Report	RJM	SAD	SAD
0	28-4-97	Final Draft Report	BM	SAD	SAD
1	2-5-97	Final Report	BM	S. Dever	S. Dever

ENVIROGUARD

SCHOFIELDS LANDFILL
DRAFT LANDFILL ENVIRONMENTAL MANAGEMENT PLAN

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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 Schofields, AGC Woodward Clyde, March 1997 (See Appendix G of CMPS&F's Schofields Landfill EIS)
- PGH Quarry Schofields, Installation of Monitoring Wells and Groundwater Sampling, AGC Woodward Clyde, December 1996 (See Appendix G of CMPS&F's Schofields 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.

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.
DCP	Development Control Plan
DLWC	Department of Land and Water Conservation
DUAP	Department of Urban Affairs and Planning
EIS	Environmental Impact Statement
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 Horsley Park 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
LEL	Lower Explosive Limit
LEMP	Landfill Environmental Management Plan

Leachate	Water that has percolated / migrated through landfilled waste and generally contains contaminants absorbed from the waste material
LGA	Local government area
LRRA now BIEC	Litter & Recycling Research Association (Beverage Industry Environment Council)
MGB	Mobile Garbage Bin, usually a plastic garbage bin with wheels, and generally suitable for mechanical collection.
NATA	National Association of Testing Authorities
OCP	Organochlorinated Pesticides
OPP	Organophosphate Pesticides
PAH	Polyaromatic Hydrocarbons
PCB	Polychlorinatedbiphenyls
PET	Polyethylene terephthalate plastic, such as for drink 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.

1. INTRODUCTION

1.1 GENERAL

Monier PGH Holdings Limited, a wholly owned subsidiary of CSR Limited, proposes to rehabilitate their Schofields 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, as part of an Environmental Impact Statement (EIS), to Blacktown 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 material.

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 Schofields.

The Erskine Park quarry 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. 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. 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 comprehensive recycling centre is located at the site, accepting paper, cardboard, waste oil, plastics (PET, HDPE, PVC), aluminium cans, steel cans and glass. Green waste is diverted from the landfill as it 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, surface and ground water quality, 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 Schofields 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 enacted in December, 1995. The Act and associated regulations provides the legislative framework for regulation of solid waste landfilling within NSW. The Act specifies that each landfill be categorised according to the types of waste received at the site. Under this system, it is proposed that the Schofields landfill be classified as a Class 2 Solid Waste landfill, accepting 'all solid waste, with the exception of putrescible waste and other wastes approved by the EPA'.

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 guidelines for solid waste landfilling titled Environmental Management Guidelines : Solid Waste Landfills (1996). A performance based approach to landfill management has been adopted by the EPA which allows the most appropriate mechanisms to be implemented at each landfill site 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 Landfill Environmental Management Plan (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. Operation of the landfill must then comply with the LEMP and operators are required to report annually to the EPA, who check the performance of the

operation against the commitments made in the LEMP. This Draft LEMP has been prepared for the proposed Schofields Landfill in preparation for applying for a licence under the Waste minimisation and Management Act. The document has been prepared in accordance with EPA requirements, as defined in the EPA's Solid Waste Landfill Guidelines (1996) and the EPA's Draft LEMP Preparation Manual (1996).

2.1.3 Landfill Environmental Goals

A summary of the 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 will comply with all relevant requirements of:

i) Acts of the Commonwealth

ii) Acts and ordinances of the State of New South Wales;

iii) Workcover Authority of NSW;

iv) any ordinances, regulations, by-laws, orders and proclamations in force in NSW;

v) 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

3. EXISTING SITE

3.1 LOCATION

The proposed Schofields Landfill is located at Schofields in Western Sydney, off the intersection of Meadow and Townson Roads, approximately 17 km north-west of Parramatta. Figure 1.1 in the main EIS document shows the location of the proposed landfill.

3.2 LAND USE AND PLANNING

Monier PGH Holdings Limited (PGH) currently operate a clay brick and paver manufacturing plant on the site. Raw material is obtained by quarrying clay/shale from the site supplemented by material brought to the site from other quarries located at Horsley Park, Mulgoa and elsewhere. The PGH property includes an area of approximately 67 ha which is separated by Meadow Road into north and south portions.

The landfill site is located within the Blacktown local government area. Development on the property is subject to state, regional and local planning instruments.

The site is zoned General Rural 1(a) under Blacktown Local Environment Plan (LEP) 1988. Agriculture (other than intensive lot feeding of livestock or which requires the filling of flood liable land) is permissible without development consent in this zone. Prohibited uses include purposes such as bulk stores, hazardous industries, industries (other than rural industries or extractive industries) mineral sand mines and mines. Other purposes are permissible but only with development consent. Therefore the proposed development is permissible with development consent as it is not listed as a prohibited use. Surrounding land is zoned predominantly General Rural 1(a).

A total of 27 properties adjoin the site, mainly dwellings and agricultural activities.

3.3 LAND OWNERSHIP

The Landfill is located on Lot 3 in DP 232474. The land is wholly owned by Monier PGH Holdings Limited, which is a unit of CSR Limited.

3.4 TOPOGRAPHY

The regional topography of the site comprises a broad ridge orientated north-south which occupies the south-western portion of the site at an elevation of about 40 mAHD. The surrounding ground gently slopes down; to the east towards Eastern Creek and to the north-west towards Bells Creek. The approximate normal water levels in these two watercourses is at an elevation of about 15 mAHD and 20 mAHD respectively (Golders, 1994). The topography of the site has been, and will continue to be, altered by the quarrying and landfilling operation.

3.5 GEOLOGY

The Schofields Landfill is underlain by metasediments belonging to the Bringelly Shale, which is the uppermost formation of the Wianamatta Group of the mid Triassic age. This Group occupies a central position within the Sydney Basin and is overlain by localised thin deposits of Quaternary alluvium, mostly associated with water courses, flood plains and streams. The Bringelly Shale sediments were deposited on the Hawkesbury Sandstone alluvial plain during a single regressive episode, on a broad, low lying coastal plain, intersected by meandering estuarine and alluvial channels.

The thickness of the Bringelly Shale varies around the area according to the topography, this formation being the exposed upper unit of the Group and, therefore, subject to erosion. The Bringelly Shale is made of variable sub-horizontal sequences of carbonaceous claystones, siltstones, sandstones, mostly lensform, and thin lenses of bright coal. The exposed materials of the Bringelly Shale have been weathered to dense, mottled clays with siderite nodules. This is the material principally sought after by the brick-making industry and exposed in the pit in the quarry. The upper clay layer at the site is generally two to three metres thick and the depth of weathered material ranges up to 14 m.

The central part of the site is located at the northern end of a north-south extending ridge capped by a thin cover of Tertiary sediments known as the St Marys Formation. These sediments, of fluvial origin, consist of laterised sand and clay with ferricrete bands and sandstone and shale boulders.

The hydrogeological regime of the area is determined by the structural and textural characteristics of the Bringelly Shale and the Wianamatta Group in general. The claystones, siltstones and sandstones underlying the site are rocks of negligible primary porosity and permeability because of their fine grained nature and the degree of their intergranular cementation. Groundwater in these formations is stored and migrates principally in fractures and joints and, to the extent that such joints are open and interconnected, the rocks will exhibit secondary permeability.

Surface clays, derived from the weathering and alteration of the Bringelly Shale, form a capping layer over the underlying and less weathered rockmass and restrict rainfall infiltration and groundwater recharge. The limited groundwater recharge and low permeability results in poor flushing from the rockmass of the connate salts trapped in the sediments at the time of their deposition. Therefore, high salinity and low yields are a common trait of the groundwater from the Wianamatta Group formations.

The permeability of the fractured rock beneath the site is reported by Golder Associates (1994) to be between 1.4×10^{-6} m/s and 8.8×10^{-9} m/s. Results of additional testing by Woodward Clyde (1996) lie between 2.4×10^{-6} m/s and 5.4×10^{-8} m/s. The geometric mean reported by Woodward Clyde (1996) of 13 results recorded between May 1992 and November 1996 is 1.2×10^{-7} m/s.

3.6 SOILS

The overburden soils on the site are generally clayey and therefore have low infiltration characteristics (Golders, 1994). Published information from the Soil Conservation

Service (Bannerman and Hazelton, 1989) indicates that the surface soils comprise the Blacktown Series of textured podsolic soils derived by insitu weathering of the underlying shale bedrock.

Higher landscape positions (crests, upper slopes and mid-slopes) are characterised by red and brown podsolics with texture contrast profiles. The soils of this series have friable A horizons and hard-setting mottled B horizons. Lower slopes are characterised by yellow podsolic soils that exhibit similar features (Bannerman and Hazelton, 1989). Eastern Creek is part of the South Creek Soil Series. These soils evolved from Quaternary alluvium derived from the Wianamatta Group, and are dominated by brown loams and bright brown clays. Where the site has not been significantly disturbed, soils vary in depth from approximately 50 mm on elevated parts to 300 mm on lower sections.

3.7 GROUNDWATER HYDROLOGY

Several groundwater wells are located on the site as shown in Figure 1 of Woodward Clyde's Report on Installation of Monitoring Wells and Groundwater Sampling (1996).

A summary of groundwater levels measured in these wells is presented in Table 2.1.

TABLE 2.1 SUMMARY OF DEPTH TO GROUNDWATER

Groundwater Bore	Date	Datum (mAHD)	Groundwater Depth (m)	Groundwater Elevation (mAHD)
BH1	17-10-94	40.96	13.46	27.50
BH2	17-10-94	29.27	8.88	20.39
BH3	17-10-94	39.55	14.4	25.15
BH4	17-10-94	38.72	20.8	17.92
GA1	17-10-94	33.00	11.16	21.84
GA2	17-10-94	28.66	7.16	21.50
GA5	27-3-96	28.38	8.6	19.78
GA6	27-3-96	31.88	12.35	19.53
BHA1	17-10-96	31.27	10.29	20.98
SRC1	17-10-96	26.29	5.32	20.97
BH9	4-12-96	28.52	4.50	24.02
BH10	4-12-96	40.88	21.04	19.85
BH11	4-12-96	34.09	12.53	21.56
BH12	4-12-96	31.91	14.4	17.51

The water levels indicate an uneven static head distribution around the site, which may be a result of quarrying activities. The effect of the current pit on the water table in its immediate vicinity may be reflected in the lower than average groundwater elevation in

BH12. In general, it appears that a small depression in the water table is present at the site superimposed on an overall hydraulic gradient towards the east and north-east, in the direction of Eastern Creek.

Woodward Clyde (1996) report that, the extreme variability in salinity and groundwater chemistry, bore to bore, indicate that regional groundwater flow under natural gradients is likely to be insignificant and at depth below the local watercourses, and that for this reason, groundwater is not seen as a significant concern in regard to the release of contaminant loads generated by the landfill.

3.8 CLIMATE

Climatic information was obtained from the Bureau of Meteorology for the nearest comprehensive meteorological station, at Prospect Reservoir which is within approximately 15 km from the site.

Seasonal temperature variations are in the order of 10°C. The average daily maximum temperature ranges from 28°C in January to 17°C in July. Average daily minimum temperatures for these months are 16°C and 6°C respectively. Temperature inversions resulting in fogs occur on average for two days per year in summer and up to nine days per year in winter.

The mean annual rainfall over 104 years of record is 884 mm. Average seasonal rainfall varies considerably from 109 mm in March to 37 mm in July. The average number of rain days per month is fairly consistent throughout the year varying between 8 days per month during summer to 14 days per month during autumn.

Evaporation has marked seasonal variations ranging from 298 mm in December to only 54 mm in June. In winter, evaporation is lower than rainfall, leaving the possibility of soil saturation. However, in summer a relatively large soil moisture deficit is expected as evaporation is more than twice the average rainfall.

Winds are predominantly from the north-east to south in summer, from south to west in Autumn and Winter and are variable in spring. Strongest winds are from the west and south-west, particularly in autumn and winter.

3.9 SURFACE WATER HYDROLOGY

The fact that the overburden soils are clayey with a low permeability, results in a relatively small amount infiltrating to the groundwater system. A large proportion of the rainfall therefore becomes surface runoff.

There are four defined catchments on site with more than half of the site draining toward Meadow Road to the south. All buildings and the existing pit are located in this area. The major natural watercourse is Bells Creek located to the west of the site. Bells Creek flows in a northerly direction ultimately joining Eastern Creek about 3.5 km north of Townson Road. Eastern Creek then continues in a northerly direction joining South Creek which eventually enters the Hawkesbury River at Windsor.

Due to its elevation and natural drainage the site is unlikely to be flood prone, although substantial ponding of stormwater may occur in the vicinity of Meadow Road following heavy rainfall. (Woodward Clyde, 1997)

3.10 FLORA AND FAUNA

The area north of Meadow Road has been extensively disturbed, therefore vegetation is generally restricted to a small strip along property boundaries. South of the Meadow Road the site is only partly cleared, with some stands of natural vegetation having being retained. A survey of flora, fauna and fauna habitats on the property was undertaken (Mitchell McCotter, 1996) which identified four vegetation communities on the site. These were a *Grey Box* Woodland around the perimeter of the northern property and in patches on the southern property, a *Ironbark/Melaleuca* Woodland in the north-east corner of the northern property, a *Casurina* Open Forest part of a continuous band along the Eastern Creek boundary of the southern property and a *Reed* Swamp mainly in the southern site.

A range of birds were sighted during the fauna survey (Mitchell McCotter, 1996). Evidence was also found of introduced mammals, although the site is also expected to be used by native mammals including echidnas, possums and bats. No reptiles or amphibians were observed on the site, but again an extensive range of species are expected to be present.

4. LANDFILL DESIGN, CONSTRUCTION AND OPERATION

4.1 INTRODUCTION

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 Schofields landfill will accept only inert solid waste and non-putrescible solid waste. Potentially recyclable material will be diverted to the Erskine Park Landfill 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 contaminant 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 WASTE

The proposed landfill operation at Schofields will seek a licence as a Solid Waste Landfill Class 2, as defined in the NSW EPA's Environmental Guidelines: Solid Waste Landfills (1996). Previously this class of landfill was referred to as a non-putrescible 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 may be capable of being degraded slowly by micro-organisms. These may 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 are expected to 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 potential sources of wastes would primarily be the western suburbs of Sydney, including Penrith, Liverpool, Fairfield, Blacktown, Holroyd and other surrounding suburbs. This predicted catchment area is based knowledge gained from the operation of Enviroguard's Erskine Park Depot, and experience has shown that waste could be sourced from as far out as the northern beaches.

4.3 QUANTITIES OF WASTE

The actual quantity of waste that would be received at the proposed Schofields 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)
- the effect of the Olympics - the rate of construction in the Sydney region is increasing, and this is likely to increase the amount of building and demolition waste produced.

The many factors involved and the uncertainty of the market make the prediction of quantities of waste that could be received at the Schofields Landfill difficult. The potential waste market is estimated to be in excess of 850 000 tonnes per annum. However, regardless of the available market, to minimise the impact of the facility, the quantity of waste received at the depot would be restricted to 110 000 tonnes per year (or approximately 360 tonnes per day). This is due to the volume of space generated from the quarrying activities.

Previous landfilling activities at Schofields confirm that the such a rate for the proposed quarry is sustainable (the previous landfilling operation at the Schofields site received up to 500 tonnes per day).

At present, the demand for landfill space is very high in Sydney, so the landfilling rate will be dependent on the volume of space generated by the quarrying activities. However, this rate may change if the generation of waste in the Sydney area decreases in the future. Schofields landfill will be managed in conjunction with the other Enviroguard Landfills in the area (for example Erskine Park), so that the waste quantities can be regulated between these sites if necessary. Should one Enviroguard landfill have a surplus supply of waste, and one have a deficit, then waste can be redirected as necessary.

4.4 SITE LAYOUT

The proposed layout of the site is shown in Figure 2 of Woodward Clyde's report, Water Management Plan and Landfill Technical Report, PGH Schofields. Access to the site is off Meadow Road via Townson Road from the south-west side of the site. The brick plant and kiln, showrooms and offices and brick storage area are located on the western side of the site. Service building, staff amenities building and recycling station are on the south-western boundary of the site.

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. The extraction and landfilling operations will take place to the east of the access road and operations of the brick plant. The existing access road to the extraction area from Meadow Road, will be realigned around the western edge of the progressing pit. At the same time, landfill-associated facilities including an office, weighbridge and wheel wash facility will be located near the site entrance in an area which will not be excavated until the final stage of quarrying. As quarrying proceeds initially to the south and then in a northerly direction, an existing surface dam will be relocated closer to the western boundary of the site. In the final stages of quarry development the product stockpile area will be relocated onto a finished section of landfill.

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 total space available for landfill over time will be approximately 3.6 million cubic metres. Approximately 3.1 million cubic metres of void will be filled with solid waste imported to the site, and about 0.5 million cubic metres of overburden will be included as cover material for the waste (2/3 of this will be sourced from the overburden, and 1/3 will be sourced from offsite). This is equivalent to approximately 3.6 million tones of uncompacted waste. It is anticipated that waste will be landfilled at a rate of approximately 120, 000 cubic metres per year.

Filling of the Landfill will encompass six discrete areas of the site as generally shown on the filling plans in Figures 2.1a to 2.1d in the main EIS document, and is summarised in Table 4.1. Sufficient area will be available to commence landfilling by about 3 years. Simultaneous quarrying and landfilling will continue for about 20 years, when the quarry will be exhausted. Landfill operations will then continue for another 10 years, depending on the rate of waste receipts. It is intended that on average landfilling will proceed at a slightly higher volumetric rate than quarrying, although from year to year this will depend on the relationship between product demand and waste disposal requirements.

Enviroguard will update the filling plan when each cell is started or completed, or when directed by the EPA

TABLE 4.1 : PROPOSED PLAN OF FILLING

Stage	Proposed Time Period (year)	Proposed Fill Volume (m^3)
Initial	0 to 3	Final Quarrying of Stage A Volume
1	3-10	880300
2	10 to 13	274300
3	13 to 19	724800
4	19 to 22	335400
5	22 to 27	688200
6	27 to 33	699200
Final Landform	Total	3602200

A survey of the landfill will be undertaken at least every twelve (12) months by a registered surveyor to identify the extent of landfilling and estimate the quantity of landfill space consumed and life remaining.

4.5.2 Final Landform of the Site

The final landform on the north side of Meadow Road will be achieved at completion of Stage 4 and on the south side at the completion of Stage 6. The final landform will be sloped at a minimum 5% grade to minimise infiltration. Figure 2.1e in the main EIS document shows the final landform of the site. The rehabilitated site will be a gently sloping dome, as indicated in Figure 2.1f in the main EIS document.

The estimated capacity of the proposed landfill is 3.6 million m^3 of solid waste.

The life of the existing site will be dependent on the rate of waste receival and compacted waste densities, however, based on the expected tonnages (shown in Table 4.1), the life of the existing site would be of the order of 30-35 years

4.6 WASTE DISPOSAL AREA (PIT) PREPARATION AND LANDFILLING

4.6.1 General

The large extraction pit currently being worked has had the clay extracted to the underlying sandstone base at an approximate RL of 15 mAHD. The pit is therefore approximately 30 metres deep. It is proposed to extract all clay to the sandstone base material.

A sandstone lens approximately six metres thick overlays further clay horizons, however this underlying clay is not of a suitably high quality or of a unique colour for brick or paver use. Therefore PGH does not plan to excavate the sandstone lens and extract the underlaying material.

Upon completion of the clay and shale extraction, each pit will be prepared for landfilling. This will encompass construction of stormwater diversion drainage, a base liner and leachate drainage. The following sections describe these preparation works and generally how each pit will be filled.

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 8 of Woodward Clyde's report, Water Management Plan and Landfill Technical Report, PGH Schofields.

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%.*

Prior to landfilling, the base of each clay pit will be covered by a compacted clay liner 90cm thick, following the above EPA liner criteria. Figure 7 in Woodward Clyde's report, Water Management Plan and Landfill Technical Report, PGH Schofields shows the proposed base liner details. The clay liner will extend approximately two metres up the walls of the quarry so as to effectively seal the base of the landfill.

A clay sample from Schofields site tested by Australia Soil Testing for Woodward Clyde (1996) indicated that the average permeability of the clay over three tests was 6.1 x 10^{-10} m/s. These clay permeability values are similar to those of material of similar origin at other sites in the same area. Therefore, after re-working and compaction, this material is expected to be suitable as a landfill cell clay base liner as it meets the EPA criterion of 1 x 10^{-9}m/s.

In relation to groundwater inflow into the quarry/filling operations, Woodward Clyde estimated that the groundwater infiltration rate was 1.2 x 10^{-7} m/s. This measured permeability is in the low range and would suggest that groundwater recovery will be slow and should not interfere with the landfilling activities.

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 trenches constructed over the base liner. The trenches will be a minimum 30 cm thick and comprise drainage aggregate having a minimum permeability of 1 x 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;

- 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 7 in Woodward Clyde's report, Water Management Plan and Landfill Technical Report, PGH Schofields.

4.6.5 Landfilling of Each Pit

Each clay pit will be progressively filled in lifts of no greater than 2 metres in height. Figure 7 in Woodward Clyde's report, Water Management Plan and Landfill Technical Report, PGH Schofields, 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 non-putrescible solid waste, as defined in the NSW EPA Environmental Guidelines: Solid Waste Landfills (1996), will be accepted for disposal at the landfill. This will generally encompass all non-hazardous, non-putrescible solid waste, including commercial and industrial solid waste, and construction and demolition waste. A waste screening and inspection program as described in Section 4.7.3 will be implemented to ensure only the above wastes are accepted.

Putrescible solid waste will not be accepted at the landfill.

Solid waste will be as defined in the NSW EPA's Draft Environmental Guidelines: Solid Waste Assessment (1996).

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 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 waste 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 Schofields 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.

Enviroguard's Erskine Park Landfill, which is located nearby, will be the focal point of Enviroguard's waste minimisation activities in the region and recyclable materials will be directed to this facility. Currently the Erskine Park Landfill provides comprehensive recycling facilities encompassing the following:

- a recycling centre which accepts paper and cardboard, various plastics (PVC, PET, HDPE), glass, milk cartons, steel cans, aluminium cans and scrap steel;
- a tyre shredding operation;
- a wood waste shredding operation; and
- garden waste composting operation.

To complement the above activities at the Erskine Park landfill the following measures would be considered for the proposed Schofields Landfill:

- co-ordination with clients to direct recyclable materials to the Erskine Park Landfill;
- education of users of the facility to utilise the Erskine Park Landfill and other nearby facilities for recyclable materials;
- separation and recycling of steel;
- separation, stockpiling and transport of tyres, wood waste and garden waste to Erskine Park 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 40 m. 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.

Generally, covering of the deposited waste will be undertaken throughout the day, however, at a minimum, 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 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, not less than 150 mm in depth, or other suitable material. 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 shale/clay material extracted on site, incoming waste material, or imported material if necessary. 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 will 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 constructed upon completion of filling each clay pit. The final cover layer will comprise a gas drainage layer, a 900mm thick compacted clay sealing layer, a 300mm drainage layer and a 1000mm revegetation layer. A typical detail is shown on Figure 7 in Woodward Clyde's report, Water Management Plan and Landfill Technical Report, PGH Schofields.

Details of the gas drainage layer are described in Section 5.2.

The clay sealing layer will be constructed using clay sourced on site, which will be worked to achieve a minimum permeability $k < 10^{-8}$ m/s.

The drainage layer will comprise coarse drainage aggregate with a permeability $k > 10^{-5}$ m/s.

The revegetation layer will include mulch and compost to promote vegetation ant to minimise odours from any fugitive gas emissions. The surface of the final cover layer will be graded at approximately a 5% slope to promote surface runoff from the landfilled area.

Construction of the final covering layer will commence within one (1) month of completion of waste disposal operation within a pit, weather permitting. It will be completed within three months of the date of commencement. This area will then be rehabilitated once all landfilling is complete. All vehicles entering the Landfill must do so through the gatehouse. The attendant will undertake random inspections of waste entering the Landfill to ensure that only permitted wastes are accepted at the Landfill. Large vehicles will be directed to the active landfilling face.

4.11 SITE SUPERVISION AND CONTROL

The Landfill will be supervised at all times when open for the receival of wastes. The Landfill will 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.
- Recording of incoming vehicles including estimating waste quantity, type, and source, where able. This should 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 supply and place 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 elsewhere in this document.

4.12 STAFFING

Enviroguard will ensure that the Landfill is appropriately staffed by qualified and experienced personnel. A minimum of two personnel will be in attendance at the Landfill at all times. When the Landfill is open the gatehouse will always be manned and the active landfill face supervised.

At a minimum staff training will be undertaken to ensure that:

i) all operators of compaction or earthworks equipment are skilled at undertaking all tasks required of them;

ii) 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;

iii) all those that are to inspect 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.

In the event of unforeseen public emergencies which require the need for immediate disposal of wastes, the Landfill may be opened to allow for disposal of wastes. All access to the Waste Landfill outside the above specified operating hours is subject to the approval of the Enviroguard. Enviroguard will record all variations in hours of operation of the Waste Landfill in the operators daily log book.

Typically, heavy earthmoving and landfilling equipment will only operate between 7.00 am and 6.00 pm Monday to Friday and 8.00 am to 6.00 pm 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 this Management Plan. 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, when required, so as not to cause adverse impact on the waste disposal operation in regard to meeting the requirements of this Management Plan.

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 the Enviroguard will organise replacement plant or equipment as soon as practical to ensure the requirements of the Management Plan 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 on site a person trained in first aid the landfill at all time the landfill is open for the receival of wastes.

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 properly 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 the Waste Landfill is able to accept Permitted Waste under all 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 not to cause damage to vehicles using the roads and will provide effective access across the waste disposal areas. Materials suitable for the construction of such roads include building and demolition rubble, which will be stockpiled for use when required. Access roads will be sufficiently wide to safely permit two-way traffic by all vehicles using the Landfill or 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 all equipment and facilities being checked for damage on a weekly basis, and be test operated every three months;
- fire fighting equipment at site buildings;

- clear signposting and access of all fire fighting equipment;
- construction and maintenance of appropriate firebreaks are to be constructed; and
- staff training in fire fighting techniques.

A water tanker capable of being used for fire fighting as well as dust suppression will be provided and maintained 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.

All fire events will be recorded in detail including the date, time, location, expected cause of the fire, time it was extinguished, bodies notified and whether any future preventative measures are appropriate and 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 and fighting training and training in emergency procedures. Assistance in training 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 undertaken in a manner conducive to the prevention of a landfill fire;

- all sealed or contaminated drums should be banned from landfill unless they are delivered as a special waste whose contents are clearly identified and classified as acceptable; 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 and the tonnage of waste weighed on the weighbridge. All data collected on the amount, type and source of waste will be reported to the EPA by Enviroguard on a monthly basis. The format of the data will be in accordance with EPA requirements.

The results of the annual survey of the site (carried out by a registered surveyor) will be used to confirm the amount of landfill space consumed in the past twelve months. The survey will be included in an annual report to the EPA. The results of the survey will be reconciled with the monthly waste acceptance reports to determine the compaction density being achieved.

Enviroguard will establish controls to prevent vehicles entering the landfill without being recorded.

4.21 QUALITY ASSURANCE

Once development approval of the proposal has been granted, the following measures will be undertaken if necessary, to assure the quality of the design, construction and operation of the proposed landfill,

- conduct of the detailed design and documentation of the proposed landfill development under a quality system accredited to AS/NZS/ISO 9001:1994;

- construction of the landfill under a quality system accredited to AS/NZS/ISO 9002:1994;

Enviroguard would also consider the development and implementation of an Environmental Management System (EMS) for the facility, in accordance with the requirements of AS/NZS/ISO 14000 series of standards, if and when required by the EPA.

5. ENVIRONMENTAL MANAGEMENT

5.1 WATER

5.1.1 General

Many of the creeks and lakes in the western Sydney region are classified waterways under the Clean Waters Act, and therefore are subject to specific water quality criteria.

Bells Creek and Eastern Creek are not classified waterways under the Clean Water Act. Therefore, no specific water quality criteria is applicable for industrial discharges. The sensitivity of the Hawkesbury River catchment, into which the site drains, will likely be taken into consideration by the EPA when developing licence conditions under the Pollution Control Act for any discharge from the site. Woodward-Clyde (1997) report that it is likely that the 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.

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:

- ensuring water is available to meet operational requirements;
- minimising the generation of contaminated water;
- using the poorest quality of water acceptable for each particular task; and
- preventing deterioration of water quality standards in surface waterways and potentially groundwater in the vicinity of the site.

Wherever practical clean stormwater runoff will be diverted around disturbed areas of the site to minimise the volume of dirty water to manage.

As part of the licensing process, plans and specifications for all water management activities will be submitted to the NSW EPA and DLWC fro approval prior to construction.

The following sections outline water demands on site, and the management of clean storm water, dirty water, and leachate.

5.1.2 Water Demands

Water is required on site for staff amenities, dust suppression and irrigation of areas undergoing rehabilitation (although this will only begin once all landfilling has ceased).

Potable water for staff amenities will be obtained from Sydney Water's reticulated system. Dust suppression will be required during dry weather on unsealed active haul roads and cover material excavation areas. A water demand study by Woodward Clyde (1996) estimates that the total annual requirement for non-potable water will be approximately nine megalitres.

Based on this water balance assessment, Woodward-Clyde (1997) report that the majority of this demand can be met by storing stormwater runoff, including dirty / turbid water and when shortfalls occur water could be sourced from Sydney Water's reticulated system. Leachate from the landfill could also be used to irrigate revegetated areas, if found to be of suitable quality.

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 (1997) and is shown on Figures 3, 4, 5, 6, 10 and 11 in Woodward Clyde's report, Water Management Plan and Landfill Technical Report, PGH Schofields. Typical details of the sedimentation ponds are provided in Figures 8 in the same report.

The proposal will require a small workshop to be located near the office/weighbridge for minor equipment maintenance associated with landfill operations. 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 required to prevent stormwater runoff from entering the active waste disposal area.

All temporary drains will generally be earthen drains constructed at grades no steeper than 1%, to minimise scouring. Where steeper grades are required which result in flow velocities that may cause scour, the drains will be lined with appropriate scour protection, eg. jutemesh, concrete etc. Notwithstanding this, 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" (Woodward Clyde 1997). 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 Blacktown City 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 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 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 wast (non-putrescible waste) and as a result any leachate generated by the landfill will not contain the high level of contaminants in leachate from a putrescible waste landfill. Regardless, Enviroguard will ensure the collection of all surface and subsurface leachate such that no leachate or leachate contaminated water is discharged to local surface waters or ground waters.

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 into 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 surface run-off from within the landfill area will be considered as 'dirty' water and directed via surface drainage into a dedicated pond located on the active fill area, from where it will subsequently be pumped to the surface to a 'dirty' water/leachate collection pond. The dedicated pond located on the active landfill area will be continually relocated as the clay pits are filled. The pond will be constructed using clay sourced on site.

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 occurring 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. To allow early identification and monitoring of leachate provision will be made in each landfill area for drainage trenches, grading of the base liner, a leachate drainage sump and a concrete riser pipe. Again, 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 9 proposed landfill areas. The ponds would nominally be sized to hold $40m^3$. A typical arrangement is shown on Figure 9 in Woodward Clyde's Water Management Plan and Landfill Technical Report, PGH Schofields.

All collected leachate will be stored on-site in the leachate ponds. The leachate dams will be maintained to ensure no leakage of impounded leachate through the bed or banks of the ponds. The dams will be operated during dry weather to maintain an adequate freeboard depth to prevent overflow from the ponds 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.

Employees working in the quarry currently use amenities located near the brick manufacturing plant. Wastewater is treated in a licensed aerobic treatment system and effluent is spray irrigated over landscaped areas. This system 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 able, to ensure the collection system remains effective in collecting and draining leachate from the landfilled waste.

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 placed on the cover indicating 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 accumulated sediment and excess vegetation growth;
- maintaining the outlets free of debris, sediment and excess biological vegetation growth; and
- maintaining the integrity of the pond embankments.

5.2 LANDFILL GAS

The expected rate of gas generation for the Schofields landfills is low because it will accept only inert solid waste and non-putrescible solid waste. Therefore, it is proposed to be managed via passive venting of the gas through the landfill cover layers. Monitoring of gas generation will be carried out as landfilling proceeds (Woodward Clyde, 1997).

Prior to final capping of the landfilled waste, 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 may be implemented should gas monitoring confirm that the atmospheric methane concentrations are regularly exceeding 25% of the lower explosive limit (LEL). This will be identified via the Landfill gas monitoring programme. 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 ODOUR

The Landfill will be operated to minimise the generation and effect of odours arising from the waste disposal operation on properties in the area.

All practicable measures will be taken to contain any odours within the boundaries of the site.

Odours will be significantly reduced by operating the site in accordance with sanitary landfilling methods and good site management.

Odours will be minimised by:

a) generally filling from the high end of the waste disposal cells towards the lower end, ensuring minimal surface water runoff water becomes entrapped in the waste during filling operations

b) not depositing waste in standing water

c) depositing wastes in thin layers to optimise compaction

d) covering all exposed waste at the end of each working day with at least 150 mm of daily cover material

e) the use of deodorising sprays when required

f) minimising disturbance of previously filled areas.

A record of complaints regarding odours will be kept in the daily log book.

5.4 LITTER

All practicable measures will be taken to confine litter arising from the operation of the Landfill, within the boundaries of the site.

Movable litter screens will 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 as soon as practicable, but no later than 24 hours after the event, collect and dispose of the escaped litter.

All litter screens, litter fencing, and all other site fencing will be cleared of litter on a weekly basis.

All loads entering the Landfill will be required to be covered. Enviroguard will enforce load covering to prevent litter.

5.5 VERMIN

As only inert solid waste and non-putrescible solid waste will be landfilled, vermin are not anticipated to be a critical issue. However, should it become a problem, Enviroguard will implement an effective vermin control program for the Landfill. Vermin includes insects, rodents, foxes, birds, feral cats and other pests.

The vermin control program may include:

- the use of insecticides and pesticides
- baiting, and
- the use of scarecrows and 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, including compaction of the covering layers.

Care will 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 to be kept free of mosquito breeding larvae and that water does not pond in any other location which may propagate mosquito breeding.

5.6 DUST

All practicable measures will be taken by Enviroguard to minimise dust emissions arising from the operations of the Landfill. These may include:

- immediate burial and covering of dusty loads;
- 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 noise emissions arising from the operations of the Landfill. It is Enviroguard's responsibility to ensure that the operational noise levels at any residence outside the boundary of the Enviroguard's land do not exceed the permitted levels as specified in the Noise Control Act and associated Regulations.

The impact of noise arising from the landfill operations on all surrounding residential areas will be minimised by implementing the following measures:

a) Maintaining all landfill plant and machinery in proper working order.

b) Locating all internal access roads and fixed plant as far as is practicable from residential areas.

c) All vehicles accessing the site will use the designated access roadways.

d) Construction of temporary earth bunding/vegetation screening as required to attenuate noise emissions.

Enviroguard will 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 will 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 will 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.

5.8.2 Bund Walls

Bund walls will be constructed to minimise noise, aesthetic, odour and dust from impacting the surrounding area.

5.8.3 Noxious Weeds

Noxious weeds that occur on the site shall be controlled by a programme of spraying with herbicides, to prevent the spreading of weeds into other areas. This programme will be regularly monitored by the Site Manager.

6. ENVIRONMENTAL MONITORING

6.1 GENERAL

Enviroguard will undertake regular monitoring of ground water, surface water, leachate, landfill gas and dust to ensure the operation of the Landfill is not causing a detrimental environmental impact. In addition, every 12 months the operation of the Landfill will be reviewed to assess the compliance of the Landfill operation with regulatory requirements and the Plan of Management.

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.

- 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.

Sampling will be carried out in accordance with EPA acceptable procedures, as described in the EPA's Environmental Management Guidelines for Solid Waste Landfills (1996).

6.2 GROUNDWATER

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 1 in 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 on a quarterly basis, or more regularly at Enviroguard's discretion. Monitoring will comprise:

- measurement of depth to the ground water table; and

- analysis of groundwater samples for the parameters shown in Table 6.1.

TABLE 6.1 WATER QUALITY MONITORING PARAMETERS

FIELD MEASUREMENT	
• Electrical Conductivity	(uS/cm)
• Dissolved Oxygen	(mg/L)
• pH	
• Temperature	(°C)
• Redox Potential	(mV)
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)

Note: 1. These parameters are recommended by Woodward-Clyde (1997) and are additional to those specified in the NSW EPA's Solid Waste Landfill Guidelines

Should monitoring indicate that contamination of the groundwater or sub soil has occurred, the affected monitoring bores will be re-sampled as soon as possible after identification of the possible contamination. If the contamination is confirmed by the re-sampling the EPA will be notified in writing within 14 days. Within 28 days of the written notification a groundwater assessment program will be prepared, which aims to identify the specific contaminants and extent of pollution of the groundwater. 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 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 Analysis of the surface water samples will be for those parameters listed in Table 6.1.

Surface water samples will also be collected from the nearby water course (Eastern Creek) every six months or more regularly if required by the EPA. The samples would be analysed for the parameters listed in Table 6.1.

Should monitoring indicate that contamination of any local surface water ways has occurred, the affected sampling locations will be re-sampled as soon as possible after identification of the possible contamination. If the contamination is confirmed by the re-sampling 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 specific contaminants, causes and extent of pollution of the surface water. 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 determine necessary remedial drainage measures and to prepare a surface water remediation plan, if required.

6.4 LEACHATE

Enviroguard will implement a leachate monitoring program allow characterisation of leachate generated by the landfilled waste, which will assist with interpreting both groundwater and surface water monitoring results as well as provide a picture of the degradation process occurring within the landfill and determine 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 sampling of leachate from the riser or from the leachate dams will be undertaken every six months, or more regularly if required by the EPA, and the samples will be analysed for those parameters listed in Table 6.1 (Woodward Clyde 1997).

Further, to allow initial characterisation of the leachate the first four samples collected will also 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 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

Although landfill gas generation is not expected to be high, due to the non-putrescible nature of the wastes landfilled, monitoring of landfill gas will be undertaken regularly at the site 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 destroy the odorous traces associated with the landfill gases.

6.6 DUST

Currently, there are several dust deposition gauges installed at Schofields which are monitored monthly. These will continue to be used and will be incorporated in all future monitoring programs. The dust deposition gauges have been installed 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.)

The results from dust monitoring will be compared against relevant New South Wales Environment Protection Authority's criteria.

Sampling and testing will be done by a suitably qualified person and a NATA 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, 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 are 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 three 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 3.6 million cubic metres. It is anticipated that the landfilling will proceed continuously until the north of Meadow Road is completely quarried and the void filled. Operations will then move progressively to the site to the south.

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 a grazing property or alternatively it would provide a significant passive recreation resource if the adjacent population substantially increased due to urban development. 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

Figure 2.1f in the main EIS document shows the proposed landscape treatment for the final landform.

Generally, the finished landform will be planted with fast growing native tree species to provide an appropriate screen, filtering views to the landfill site and improving the overall landscape and visual amenity of the area. The use of native tree species would also increase the wildlife habitat values, particularly due to the close proximity of the site to the Eastern Creek corridor.

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 a heavy application of superphosphate fertiliser including trace elements. The rate of application will be determined following the testing of 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, maintenance fertiliser applications, slashing and/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. These grasses would have originally

occurred on the site and their use would supplement the ecological values of the area as well as 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 are advised of contact persons to discuss any problems (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 denseness of the vegetation cover; 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 require reporting include but are not limited to:

- identification of non-domestic quantities (200 g/tonne) of hazardous waste mixed amongst 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;
- 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 will 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 last 12 months. Any changes in hydraulic gradient or statistically significant variations in contaminant concentrations will be highlighted and explained.
- A report on leachate collection that identifies the quantity and composition of any leachate generated over the past 12 months. Any trends that can be demonstrated will be highlighted and explained, where possible, in terms of the biological activity within the landfill. The trends will generally be related to monthly rainfall and quarterly sampling results.
- 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 will be identified and any changes over time explained.
- The record of odour, litter and other complaints that have been received by the Landfill in the past 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 past 12 months.
- A summary of any incident reports for the 12 month period.

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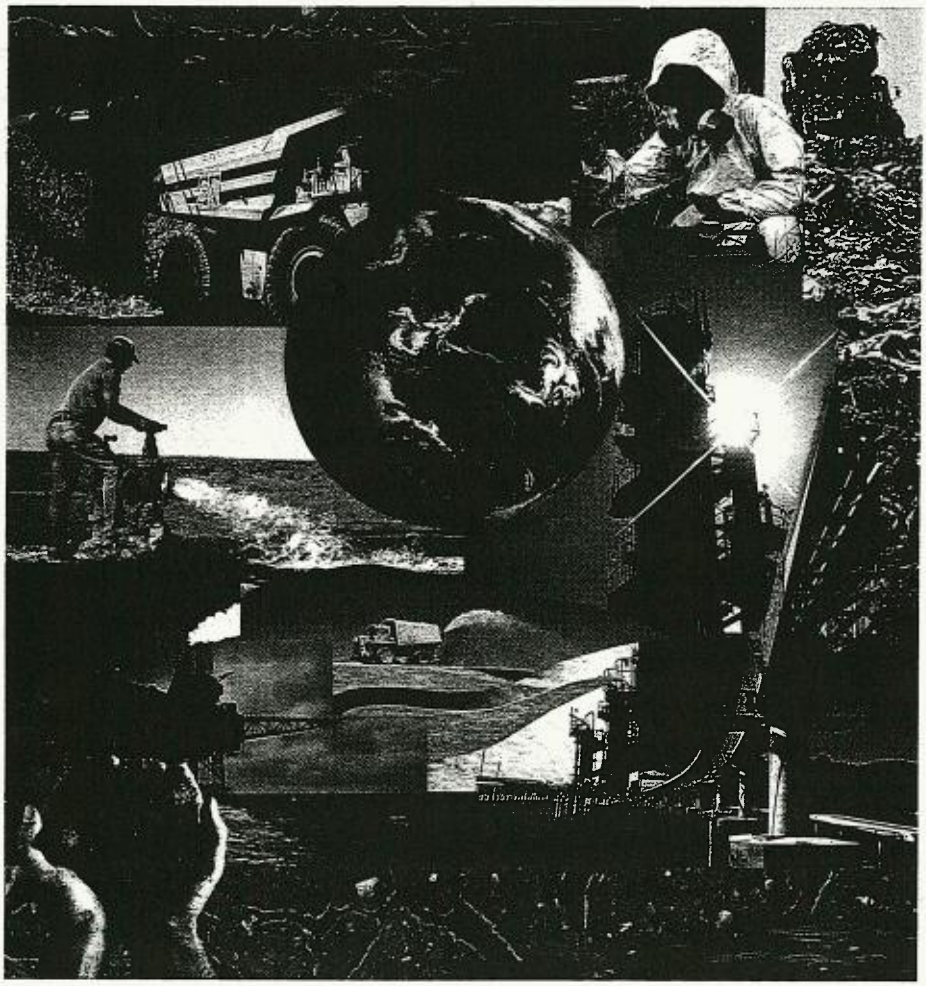

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1.0
INTRODUCTION

At the request of Mr Ron Bush, CSR Construction Materials, AGC Woodward-Clyde (Woodward-Clyde) has conducted a technical review of the various issues applicable to the proposed landfilling of the PGH Quarry at Schofields.

The quarry is to remain operational 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 Class 2 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 Schofields in western Sydney.

The PGH Quarry at Schofields is located in Townson Road, Schofields approximately 36 kilometres north-west of the Sydney CBD. See Figure 1. The surrounding land use is primarily low density residential.

2.0
SITE CHARACTERISTICS

2.1 GEOLOGY

The PGH Quarry site is underlain by metasediments belonging to the Bringelly Shale, which is the uppermost formation of the Wianamatta Group of mid Triassic age. This Group occupies a central position within the Sydney Basin and is overlain by localised thin deposits of Quaternary alluvium, mostly associated with water courses and flood plains of streams and rivers. The Bringelly Shale sediments were deposited on the Hawkesbury Sandstone alluvial plain during a single regressive episode, on a broad, low lying coastal plain, intersected by meandering estuarine and alluvial channels.

The thickness of the Bringelly Shale varies around the area according to the topography, this formation being the exposed upper unit of the Group and, therefore, subject to erosion.

The Bringelly Shale is made of variable sub-horizontal sequences of carbonaceous claystones, siltstones, sandstones, mostly lensiform, and thin lenses of bright coal.

The exposed materials of the Bringelly Shale have been weathered to dense, mottled clays with siderite nodules. This is the material principally sought after by the brick-making industry and exposed in the pit in the quarry. The upper clay layer at the site is generally two to three metres thick and the depth of weathered material ranges up to 14 m.

The central part of the site is located at the northern end of a north-south extending ridge capped by a thin cover of Tertiary sediments known as the St Marys Formation. These sediments, of fluvial origin, consist of laterised sand and clay with ferricrete bands and sandstone and shale boulders.

2.2 HYDROLOGY AND HYDROGEOLOGY

2.2.1 Surface Drainage

The topography of the site is relatively flat with no pronounced ridge lines. There are four defined catchments with more than half the site draining toward Meadow Road to the south. All buildings and the existing pit are located in this area. The major natural watercourses are Bells Creek located to the west of the site and Eastern Creek to the east. Bells Creek flows in a northerly direction ultimately joining Eastern Creek about 3.5 kilometres north of Townson Road. Eastern Creek then continues in a northerly direction joining South Creek which eventually enters the Hawkesbury River at Windsor.

Due to its elevation and natural drainage the site is unlikely to be flood prone, although substantial ponding of stormwater may occur in the vicinity of Meadow Road following heavy rainfall.

2.2.2 Surface Water Quality

There has been some limited water sampling of the large surface dam in the quarry in June 1996. Recorded analytes were pH, suspended solids, free chlorine, biochemical oxygen demand and faecal coliforms. Based on the results of the limited sampling program, the quality of the surface water in the dam was satisfactory.

It is expected that the water quality of the natural watercourses in the vicinity of the quarry would be quite 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

A groundwater investigation of the site was conducted in November 1996 by Woodward-Clyde to assess the nature and quality of the groundwater. The potential for contamination of the groundwater from the proposed landfilling operations was also reviewed. As part of the investigation, four boreholes were drilled in various locations around the site supplementing

the six earlier shallow boreholes constructed by Golder and Associates. The four 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 Schofields Monitoring Bores Installation - December 1996".

The following information, relative to this report, has been extracted from the previously mentioned report.

2.2.4 Hydrogeology of the Area

The structural and textural characteristics of the Bringelly Shale, and of the Wianamatta Group in general, determine the hydrogeological regime of the area. The claystones, siltstones and sandstones underlying the site are rocks of negligible primary porosity and permeability because of their fine grained nature and the degree of their intergranular cementation. Groundwater in these formations is stored and migrates principally in fractures and joints and, to the extent that such joints are open and interconnected, the rock will exhibit secondary permeability.

Surface clays derived from the weathering and alteration of the Bringelly Shale form a capping layer over the underlying and less weathered rockmass and restrict rainfall infiltration and groundwater recharge. The limited groundwater recharge and the low permeability results in a poor flushing from the rockmass of the connate salts trapped in the sediments at the time of their deposition. High salinity and low yields are a common trait of the groundwater from the Wianamatta Group formations.

2.2.5 Groundwater Levels

The bores well head were surveyed and levelled in order to obtain an accurate definition of the water table around the site.

The water levels indicated an uneven head distribution around the site, a fact interpreted as being the result of the quarrying activities. In general, it appears that a small depression in the water table is present at the site superimposed to an overall hydraulic gradient towards the east and north-east, in the direction of Eastern Creek.

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 these circumstances. These tests consist in 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.

Rising head (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 coefficient of permeability (K) is 1.2×10^{-7} metres per second, which is an order of magnitude lower than that calculated for Horsley Park and other sites around western Sydney. The measured permeability is, nonetheless, still in the low range. A compacted clay liner would be required on the base of the landfill to inhibit the potential vertical migration of leachate to the groundwater.

2.3 SOIL GEOTECHNICAL ANALYSIS

A clay sample was submitted for permeability testing to a NATA registered laboratory to evaluate the suitability of this material for use as a clay liner for the landfill cells.

The calculated coefficient of permeability (K) is 6.1×10^{-10} metres per second, a value 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 meeting the EPA requirements for a base liner and the final sealing layer.

2.3.1 Groundwater Quality

In general, the water in the Bringelly Shale is saline and its chemical composition and general ionic proportions reflect the character of sea water.

The groundwater under the Schofield's site was found to be neutral to slightly alkaline.

The total dissolved solids (TDS) ranged between 13 800 mg/L and 18 500 mg/L which is typical of the Bringelly Shale groundwater salinity. The range of values encountered may be the results of quarry operations that have opened a window into the water table into which rainfall occurs and, consequently, possible dilution.

Typically, the water has high levels of sodium, chloride and bicarbonate. Sulphate displays a wide range of values (114 mg/L to 1 040 mg/L) and this could possibly be explained with the nature of the sediments encountered in each bore, given their variable carbonaceous and pyritic content, in accord with their depositional history, as mentioned earlier.

The groundwater, because of its salinity and because of the low permeability of the rockmass, has no exploitable common application.

2.3.2 Groundwater Flow

The water levels in the recently constructed wells indicated that locally, the water levels are impacted by the void space created by the existing clay quarry. The hydraulic gradients are very high and the quarry records reveal that groundwater inflows are very small.

Overall, apparent regional groundwater gradients are to the north but the extreme variability in salinity, bore to bore, and the groundwater chemistry indicated that regional groundwater flow under natural gradients is likely to be insignificant and at depth below the local watercourses. For this reason, groundwater is not seen as a significant element in releasing contaminant loads generated by the proposed landfilling activities.

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 Sydney 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 six 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 nine megalitres.

3.3 WATER SUPPLY

3.3.1 Water Balance

Under existing conditions, the majority of the property drains to a thirty five megalitre dam in the north-eastern corner of the site. As described above this water, supplemented where necessary from the town water supply, is available for non-potable purposes.

A water balance was calculated to determine the availability of water to meet demands under average and dry climatic conditions, and using the highest operational demands. Rainfall data from the Prospect Dam Meteorological Station was used to determine average and dry years which are respectively defined as the average (884 mm) and driest ten percent (547 mm) of annual rainfalls.

Historical years reflecting these rainfalls were selected and water balances calculated to simulate the monthly variability of non-potable water demands and storage characteristics under dry, average and wet conditions. For calculation purposes the total dam storage was assumed to be half full at the beginning of the year. It was assumed that half the available runoff would be available to replenish dam storages. It was also assumed that collected runoff would be available for dust suppression and plant watering as a priority use. Any surplus could then be used to supplement brick manufacturing requirements. Modelling results are presented in Tables 3.1 and 3.2.

Table 3.1 WATER BALANCE RESULTS - AVERAGE YEAR (megalitres)

Month	Supply	Demand	Storage	Surplus	Deficit
			5.0		
January	1.8	1.2	10		
February	6.6	1.0	10	1.2	
March	7.0	0.9	10	6.1	
April	4.9	0.5	10	4.4	
May	0.5	0.5	3		
June	11.4	0.6	3	10.8	
July	8.5	0.6	2.6	7.9	
August	9.1	0.7	3	8.4	
September	2.3	0.7	3	1.6	
October	5.4	0.9	3	4.5	
November	0.5	1.0	3		
December	1.0	1.1	2		

Table 3.2 WATER BALANCE RESULTS - DRY YEAR (megalitres)

Month	Supply	Demand	Storage (max 35 ML)	Surplus	Deficit
			5.0		
January	4.6	1.0	8.6		
February	1.8	1.0	9.4		
March	10.7	0.8	10	9.3	
April	0.4	0.7	9,7		
May	0.2	0.7	9.2		
June	2.0	0.6	10	0.6	
July	1.4	0.6	9.5		
August	0.8	0.7	9.6		
September	9.1	0.7	10	8.0	
October	2.8	0.9	10	1.9	
November	0.7	1.1	9.6		
December	1.3	1.1	9.8		

During both an average and unusually dry year non-potable water demands could be adequately met from dam storage. Based on the above model a sufficient quantity of water could be sourced from dam storages to meet non-potable water demands during most climatic conditions. Should a deficit occur, water could be sourced from the reticulated supply.

3.4 WATER QUALITY OBJECTIVES

Bells Creek and Eastern Creek are not classified waterways under the Clean Waters Act and, therefore, no specific water quality criteria are 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 Hawkesbury 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. Figures 4, 5 and 6 show the locations of the proposed diversion channels for the various stages of the excavation/landfill activities.

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 Existing Drainage System

The existing stormwater drainage system will need to be revised prior to commencement of landfilling.

3.5.2.1 Problems With The Existing System

The existing drainage system consists of a number of open surface drains directing water into a large pond located in the south-eastern corner of the northern site area. Water is also contained in similar ponds in the north-eastern and northern areas of the site.

An earthen bund wall, which is discontinuous in one section, has been constructed along the eastern boundary and part of the southern boundary. The bund wall prevents uncontrolled discharges of stormwater from the property by redirecting the flow into the water storages on the site. The bund wall forms the embankment of the pond in the south-eastern corner.

See Figure 2 for details of the existing drainage system.

Water from the pond in the south-eastern corner is discharged via a concrete outlet pit and 600 mm diameter pipe which exits the site through the earthen bund wall. After passing through the wall the water flows uncontrolled across the footpath and into a single reinforced pipe culvert under Meadow Road. Because of extensive silting it was not possible to determine the exact diameter of the pipe culvert, however, it was estimated to be 900 mm. The pipe culvert discharges into a shallow open drain which flows through the private property opposite.

Because of the discontinuity of the earthen bund in the northern section of the eastern boundary, the property immediately downstream (to the north-east) is liable to flooding during periods of heavy rainfall. Similarly, the property opposite the pipe culvert is also subject to local flooding during adverse weather conditions, however, the problem in this case has been exacerbated by the lack of maintenance of the road drainage.

It should be noted that some properties to the north-east of the property rely on water from the PGH site to fill their dams.

With the impending landfilling activities it would seem appropriate to upgrade the drainage system to alleviate the problems being experienced by some of the local residents.

3.5.2.2 Recommended Improvements to the Drainage System

As part of the general site development works for the proposed landfilling activities the earthen bund along the eastern boundary will be made continuous and, if necessary for noise reduction purposes, may be increased in height. The existing dam in the south-eastern corner (designated Dam 1 on Figure 3) will be increased in capacity as discussed in Sections 3.6.2 and 3.6.3. The outlet pit and 600 mm diameter outlet pipe through the bund wall will remain.

At the exit point from the bund a concrete drainage pit will be constructed. The outlet pipe from the pit will be 900 mm diameter and it will carry the flow under the footpath and into a sealed pit from where it will enter the relocated new reinforced pipe culvert constructed under Meadow Road (see Figures 10 and 11 for details). No road drainage

will enter the system. The pipe culvert will be extended to the PGH property boundary on the south-eastern side of Meadow Road where a concrete headwall will direct flow into an open channel.

The open channel will be located between the northern property boundary of the eastern site area and an earthen bund. See Figure 3. The flow will pass through a sedimentation pond (Dam 4), to be constructed towards the eastern end of the property, before discharging to Eastern Creek.

The redirection of the discharged water from the northern site area, through a closed pipe system and into a newly constructed drainage system located wholly within the PGH property on the opposite side of Meadow Road should prevent the local flooding attributable to the existing system. The extension of the bund along the eastern property boundary will likewise prevent local flooding of the neighbouring properties. There will be little or no impact on the local municipal drainage system, particularly in times of heavy rainfall.

Should neighbouring property owners wish to fill their dams it is suggested that they be permitted, by arrangement, to install their own pump in one of the existing ponds in the northern section (later Dam 2) of the property and to operate it when required.

3.5.2.3 Comments on Revised Drainage System

Based on the design criteria provided in Section 3.6.1, the following comments on the recommended upgrading of the drainage system are provided:

- On-site drainage will be fully controlled with adequately designed sedimentation ponds on both sides of Meadow Road provided as part of the redevelopment works;

- By restricting the number of drainage outlets from the property (only one from eastern site area), water management will be improved. Only one EPA licenced discharge point will apply;

- By piping the flow wherever possible the ingress of sediment from external sources will be greatly reduced;

- The existing outlet structure in Dam 1 as well as the outlet pipe may need desilting prior to construction of the new works. Dam 1 may also need desilting;

- New drainage pits will be precast wherever possible for ease of installation;

- Engineering designs for the drainage within the road reserve, as well as the drainage within the eastern site area, will need to be submitted to Council for approval. Council requirements for cover and pipe materials will need to be met; and

- The existing road culvert will remain, however, it will be necessary for it to be desilted so that it can function as intended. Failure to do so will only result in continued minor flooding.

3.5.3 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:

$Q_{10} = 0.00278 \times C \times I \times A$

where: $C_{10} = 0.8$ (co-efficient of run-off for a 1 in 10 year storm)
$I_{10/6} = 14.85$ 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 2) are:

Table 3.3 CATCHMENT DISCHARGES (m^3/sec)

	CATCHMENT AREA 1	CATCHMENT AREA 2	CATCHMENT AREA 3	CATCHMENT AREA 4
Catchment Area (Ha)	8.03	7.49	27.00	18.00
Design Discharge (m^3/sec)	0.27	0.25	0.89	0.59

It should be noted that Catchment Area 4 (see Figure 3) does not include all of the eastern site area. Only the area proposed for extraction/landfilling activities has been included.

3.5.4 Design of Sedimentation Ponds

As previously mentioned, the settlement ponds for the Schofields site have been designed in accordance with the Department of Land and Water Resources (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 ponds 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 Schofields site.

Table 3.4 DETAILS - SEDIMENTATION DAMS

	DAM 1	DAM 2	DAM 3	DAM 4
Catchment Area (Ha)	8.03	7.49	27.00	18.00
Storage Volume (m^3)	1 692	1 520	5 476	3 632
Surface Area (m^2)	1 200	1 027	3 675	2 438
Total Depth (m)	1.41	1.48	1.49	1.49
Typical Surface Dimensions (m)	20 x 60	18.5 x 55.5	35 x 105	28.5 x 85.5
Detention Time (hrs)	1.74	1.69	1.71	1.71

Discharge from the settlement ponds will be by means of an outlet pipe to a drainage channel which will discharge the treated water either directly or indirectly to the natural watercourse. The outlet of Dam 4 is the only location where there will be a direct discharge to the natural watercourse. Dam 4 will also receive the discharge from Catchment 4 when development of the eastern area occurs. Its capacity has been based on treating the run-off from Catchment 4 only as the water in the open channel has already been treated. See Figure 6 for drain and dam locations.

A typical settlement pond arrangement is shown in Figure 8.

3.5.5 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, 2, 3 and 4, will be located in the lowest corner of the respective catchment areas (see Figure 3 for indicative locations).

The development of Catchment Area 2 will require the construction of Dam 2 which will collect all sediment laden run-off from this area. The outlet from this dam will be directed in a southerly direction via a vee drain along the toe of the earthen bund into Dam 1. All water stored will, after treatment, be discharged into the new pipe culvert under Meadow Road from where it will discharge into the open channel which follows the northern boundary of

the eastern site area. See Figures 10 and 11 for details of the discharge arrangements. To compensate for the increase in flow, Dam 1 will need to be increased in size (from that shown in Table 3.4) to be capable of treating the additional volume of stormwater run-off. The amended dimensions to accept the additional flow are:-

Volume	3 270 m^3
Dimensions	29 x 80 x 1.41 (depth)

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 the closest stormwater settlement pond by means of pipes and/or open channels.

3.5.6 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 9 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 landfill cell. 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 7 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.

3.5.7 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.

3.5.8 Dirty Water/Leachate Collection Ponds

These ponds have been nominally sized at 40 m^3 to allow sufficient storage capacity for irrigation purposes. They will generally be located in a convenient location 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 appropriate. 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.

Possible locations for the dirty water/leachate collection ponds for the various stages of extraction/landfilling are shown on Figures 5 and 6.

3.5.9 Water Management Plan

This Water Management Plan, to be incorporated in the development proposal for the Schofield's 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 a collection sump. In the case of the quarry the collected water will be directed to the applicable sediment dam on the surface whereas water pumped from the landfill areas will be stored in the dirty water/leachate collection pond.

A series of figures have been produced to provide a clear indication of the intentions of the Water Management Plan for the proposed Schofield's development.

Figures 2 and 3 show the existing and final site features and water management structures. Figure 4 shows the first stage extraction and water management structures while Figures 5 and 6 show the water management features for the subsequent stages.

The plans show the sequence of construction of the various structures as well as the approximate location of all diversion drains protecting the disturbed areas. It should be noted that 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.

Also shown on the plans are 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 Clay Extraction Pits

The large extraction pit currently being worked has had the clay extracted to the underlying sandstone base at an approximate RL of 15 mAHD. The pit is, therefore, approximately 30 metres deep. It is proposed to extract all clay to the sandstone base material.

Apparently the sandstone is part of the upper face of a six metre thick sandstone lens overlaying further clay horizons, however, as the underlying clay is not of a suitable high quality or of a unique colour, it was considered inappropriate by PGH to excavate the sandstone lens.

The base of the landfill will, therefore, be founded on the sandstone base material.

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} m/sec.*

- *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 landfill at Schofields is sandstone it will be covered by a compacted clay liner 90 cm thick. The specified EPA liner criteria will be considered when preparing final designs for the lining system. Figure 7 shows the proposed base liner details.

At this stage it is proposed to extend the clay lining system approximately two metres up the walls of the quarry so as to effectively seal the base of the landfill. The actual extent of the clay liner up the walls of the quarry may vary depending on the location and will be confirmed once the characteristics of the natural material is known.

As part of a recent program in which a number of groundwater monitoring wells were installed at the Schofield's site, 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.

The results indicated an average value over three tests of 6.1×10^{-10} metres per second. 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 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 values is 1.2×10^{-7} metres per second. The measured permeability is in the low range and would suggest that groundwater recovery will be slow and is not expected to interfere with the landfilling activities.

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 Schofields, 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.

- Each 10 m cell of the landfill will comprise four 2 m lifts.
- Each lift will be covered with 15 cm of cover material.

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[1] Environment Protection Authority. 1996. *Environmental Guidelines: Solid Waste Landfills.*

- The initial thickness of each cell will be approximately 10 m.

Figure 7 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. Recent permeability testing of on-site clay material indicated an average value of K over three tests of 6.1×10^{-10} metres per second. 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 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 Schofield's 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. Figure 7 shows the proposed capping details.

As defined by the EPA, the final sealing layers for the landfills will comprise compacted clay with a co-efficient of 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 Schofields 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 Schofields 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.

5.1.2 Leachate Generation

In a landfill, there are three principal mechanisms by which the refuse mass is transferred to water percolating through it, i e.,- 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 non-putrescible landfill (Class 2 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 Schofields 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.

5.1.3 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.

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 8.

To assist in the early identification and management of leachate, as previously mentioned in Section 3.6.4, 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.

5.1.6 Impact of Leachate on Groundwater

The interaction between the landfill cells and the groundwater flow system at Schofields 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 Schofields 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 will also 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 Schofields landfills is low and will be managed through passive venting of the gas through the landfill cover layers. Monitoring of gas generation will be carried out as landfilling proceeds and post closure from the concrete riser. Passive gas venting will allow the continuous escape of the gas.

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 Bells Creek coincident with the groundwater monitoring program. 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 include monitoring of leachate throughout the landfilling and into the post closure period, 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. Monitoring of the landfill leachate (i.e. analytical testing) will be undertaken at three monthly intervals (i.e. at the same time as groundwater monitoring) to enable characterisation of the leachate.

6.3 AIR QUALITY MONITORING

Currently, there are several dust deposition gauges installed at Schofields which are monitored monthly. These will continue to be used and will be incorporated in all future monitoring programs. The dust deposition gauges have been installed 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).

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 in 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 Schofields, 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 will be at RL 15 m AHD.

- a limited investigation (one sample) 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 sample tested was measured as 6.1×10^{-10} metres per second. 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 to inhibit the potential vertical migration of leachate from the landfill.

- Our review of the site water management strategy has indicated that the existing surface drainage system will need to be upgraded to control surface run-off and prevent local flooding of neighbouring properties.

- A preliminary review of the 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.

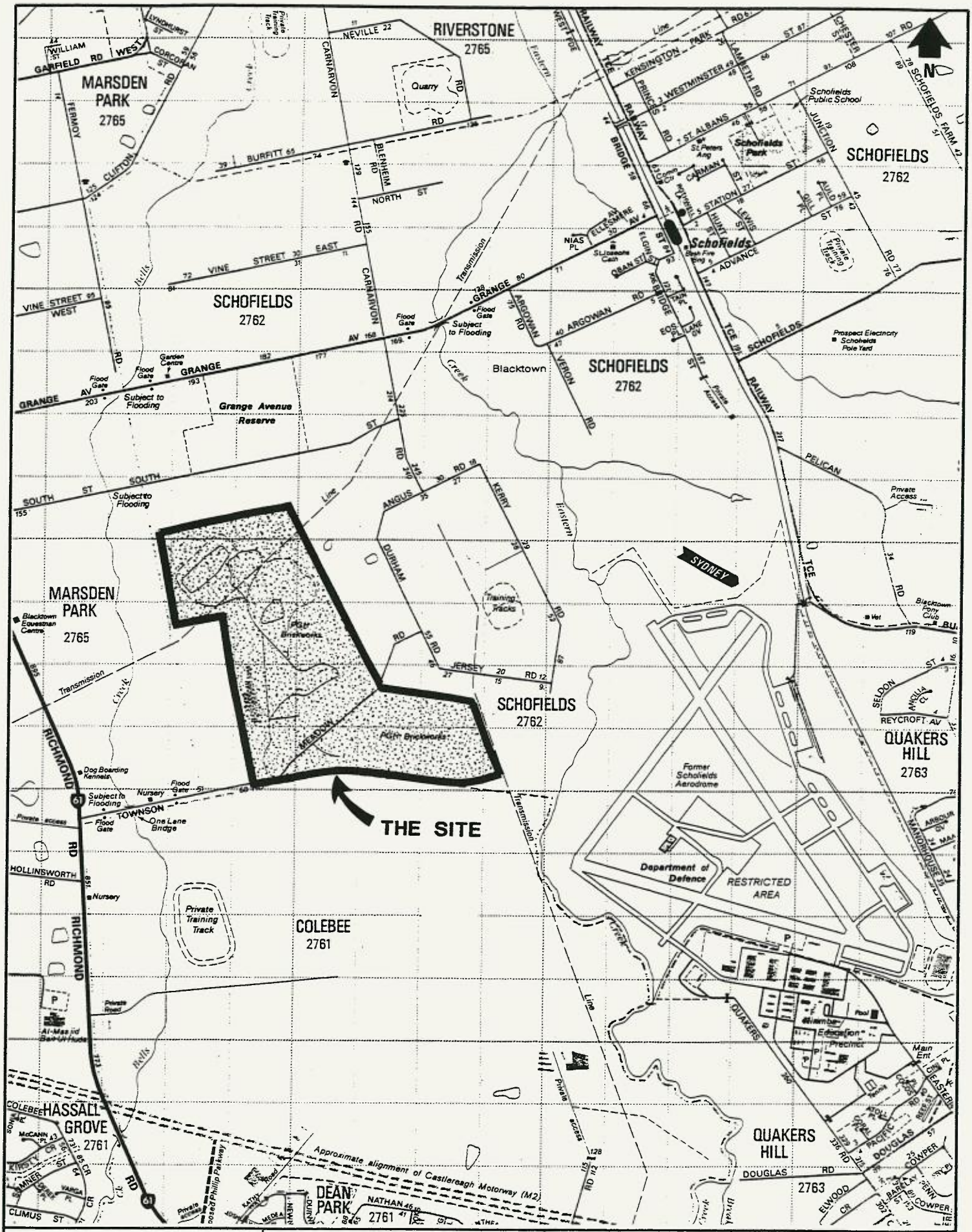
10.0
REFERENCES

AGC Woodward-Clyde, *"PGH Quarry Schofields 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



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Woodward Clyde

CLIENT
CSR CONSTRUCTION MATERIALS

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SCHOFIELDS PGH QUARRY

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DRAWING No: AS6 819/02/G002	CHECKED:
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FIGURE
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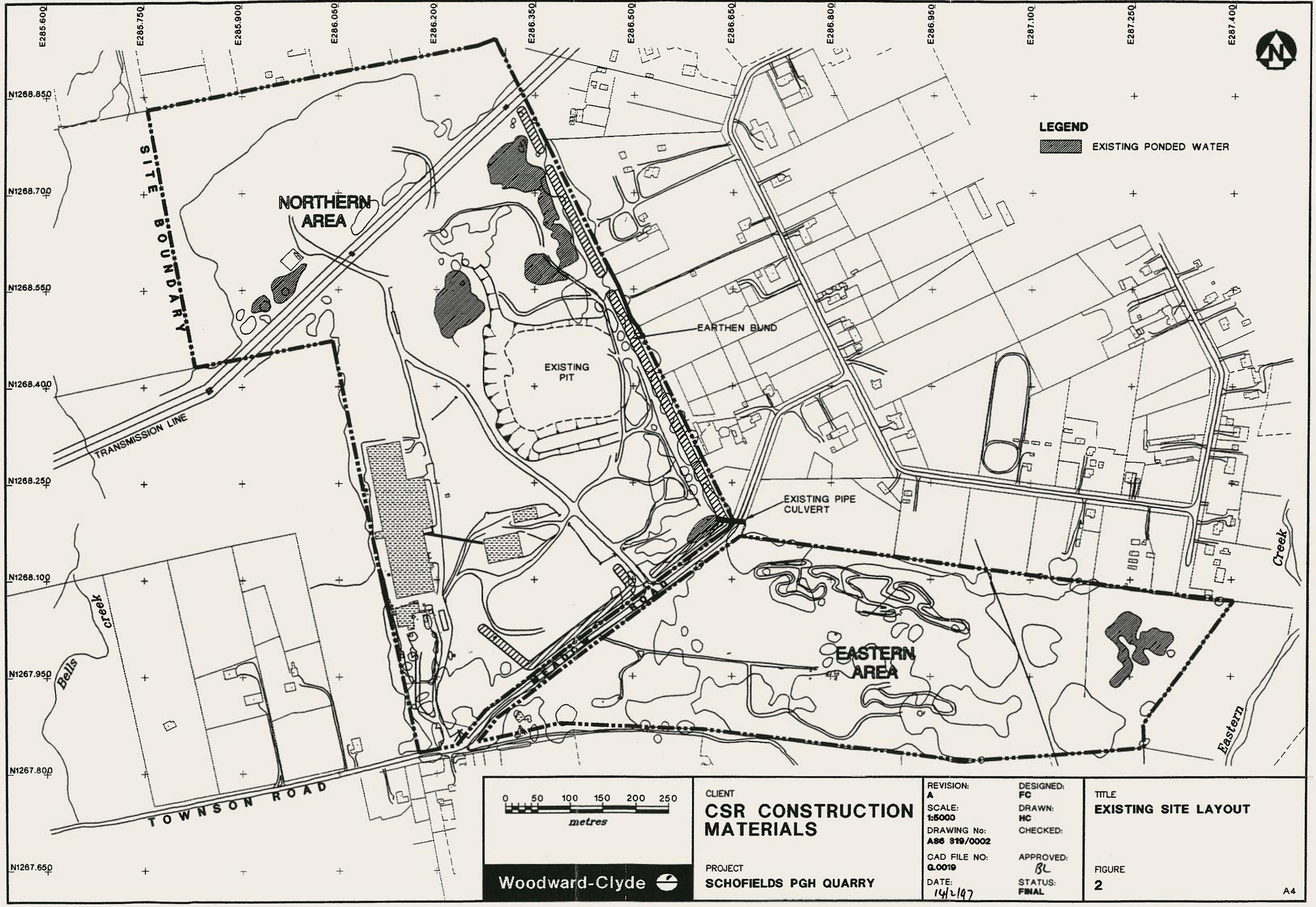
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NORTHERN AREA
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TRANSMISSION LINE
EXISTING PIPE CULVERT
EASTERN AREA
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Woodward-Clyde
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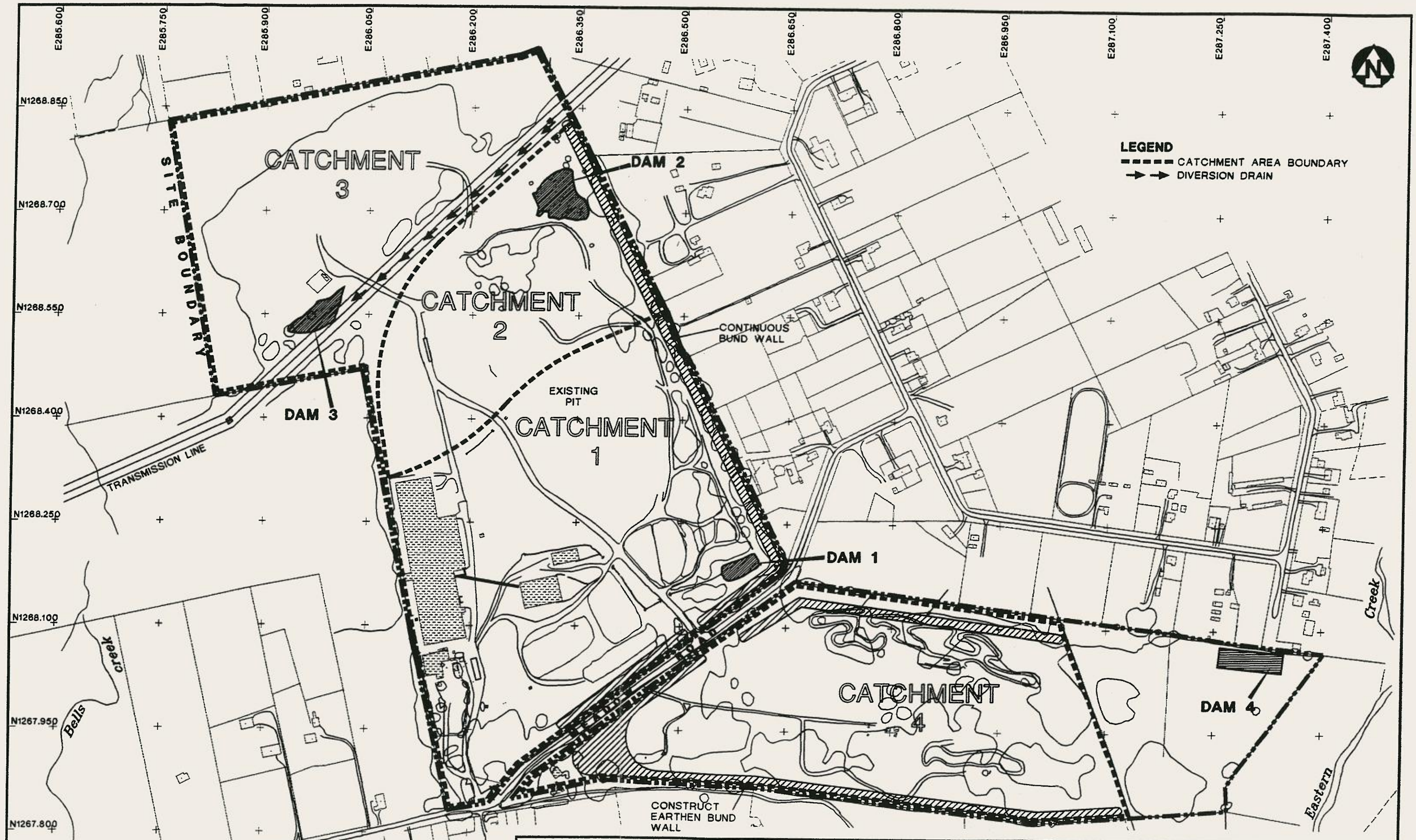

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Woodward-Clyde

CLIENT
CSR CONSTRUCTION MATERIALS

PROJECT
SCHOFIELDS PGH QUARRY

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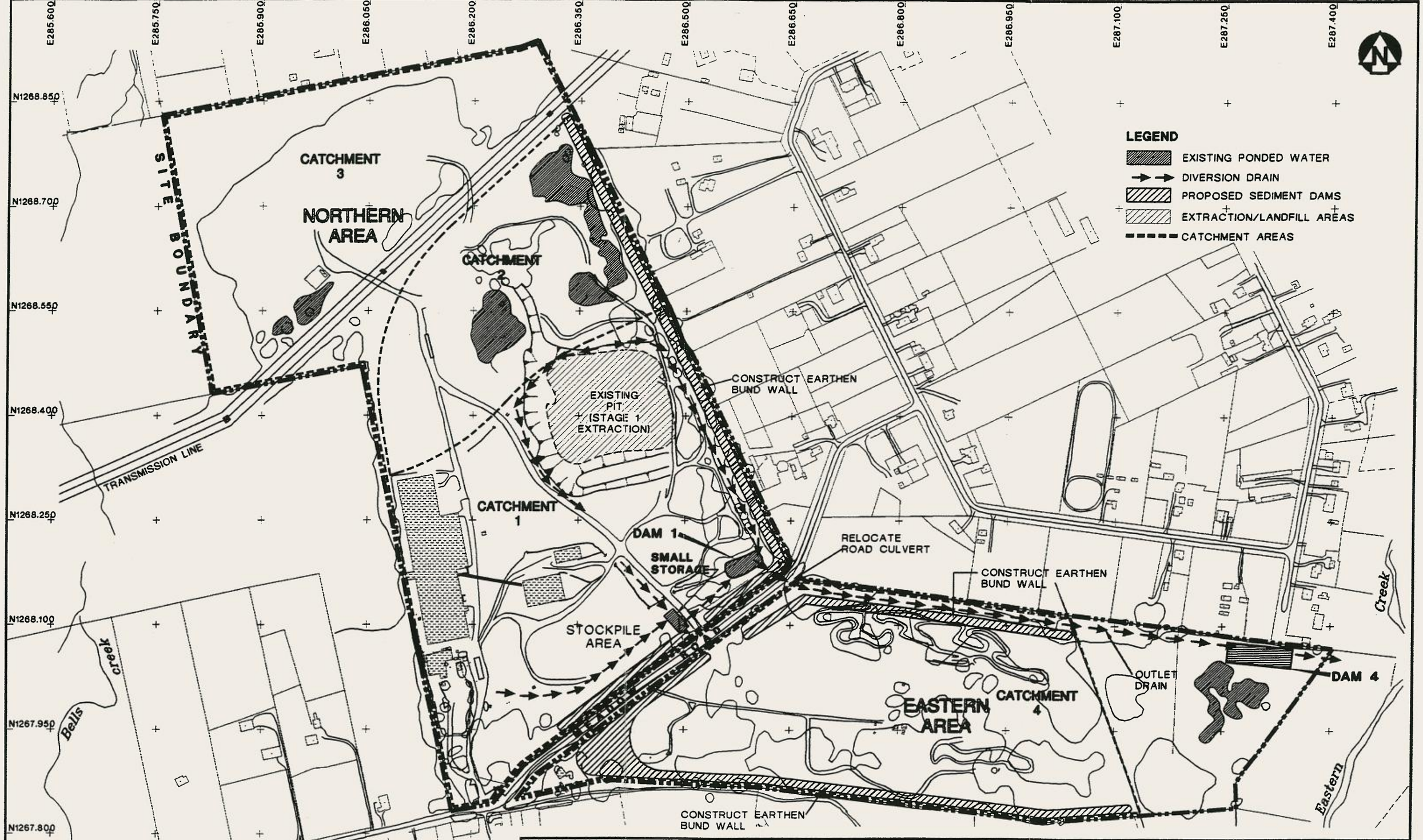
DATE: 20/3/97	STATUS: FINAL

TITLE
PROPOSED SITE LAYOUT AND CATCHMENT AREA PLAN

FIGURE
3

A4



0 50 100 150 200 250
metres

Woodward-Clyde

CLIENT
CSR CONSTRUCTION MATERIALS

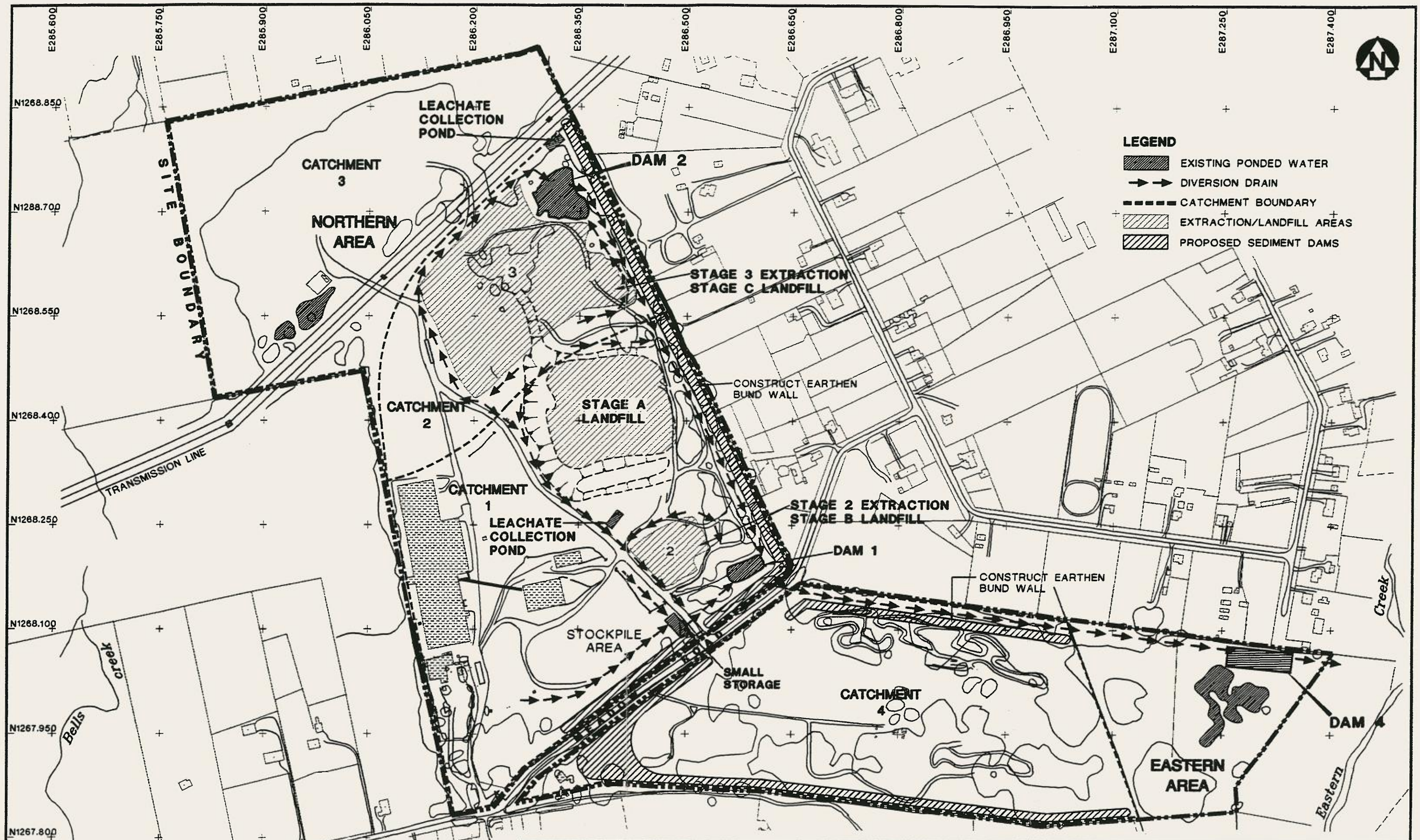
PROJECT
SCHOFIELDS PGH QUARRY

REVISION: B	DESIGNED: BL
SCALE: 1:5000	DRAWN: HC
DRAWING No: A86 819/0002	CHECKED:
CAD FILE NO: G.021	APPROVED: BL
DATE: 20/3/97	STATUS: FINAL

TITLE
SURFACE WATER MANAGEMENT STAGE 1 EXTRACTION (YEARS 1 TO 3)

FIGURE
4

A4



0 50 100 150 200 250
metres

Woodward-Clyde

CLIENT
CSR CONSTRUCTION MATERIALS

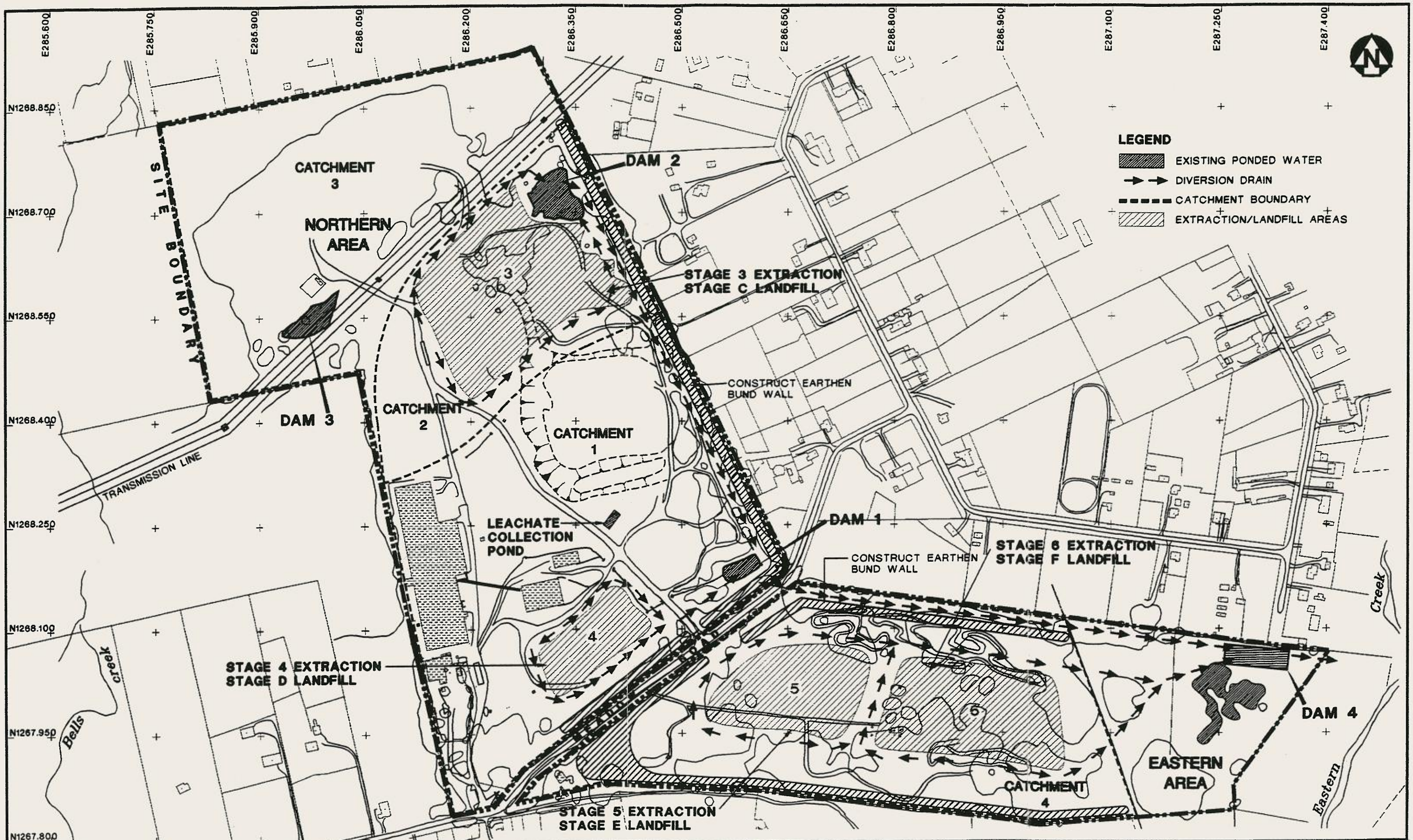
PROJECT
SCHOFIELDS PGH QUARRY

REVISION: B	DESIGNED: BL
SCALE: 1:5000	DRAWN: HC
DRAWING No: A86 819/0002	CHECKED:
CAD FILE NO: G.022	APPROVED: BL
DATE: 20/3/97	STATUS: FINAL

TITLE
SURFACE WATER MANAGEMENT STAGES 2 TO 3 EXTRACTION (YEARS 3 TO 16)

FIGURE
5

A4



CLIENT
CSR CONSTRUCTION MATERIALS

PROJECT
SCHOFIELDS PGH QUARRY

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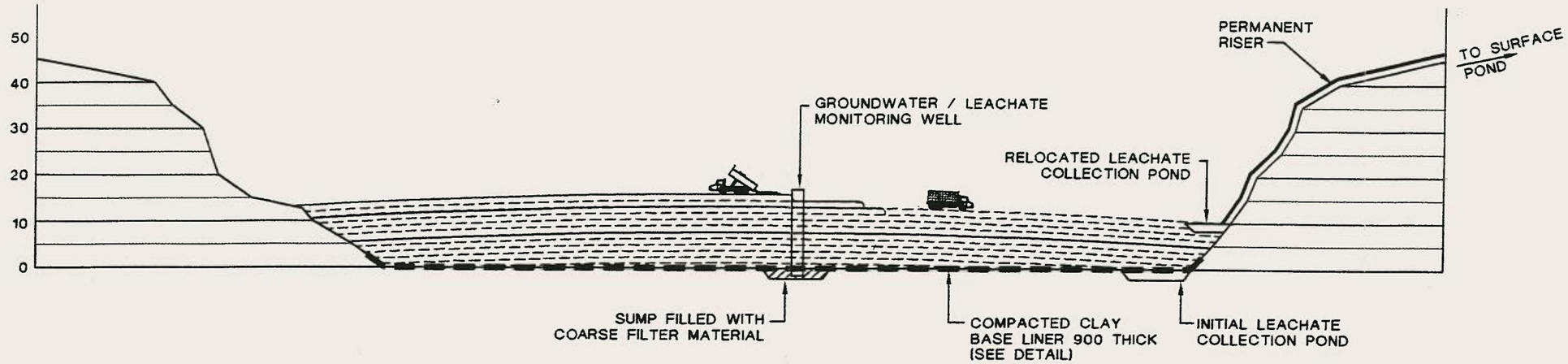
CAD FILE NO: G.020	APPROVED: BL
DATE: 20/3/97	STATUS: FINAL

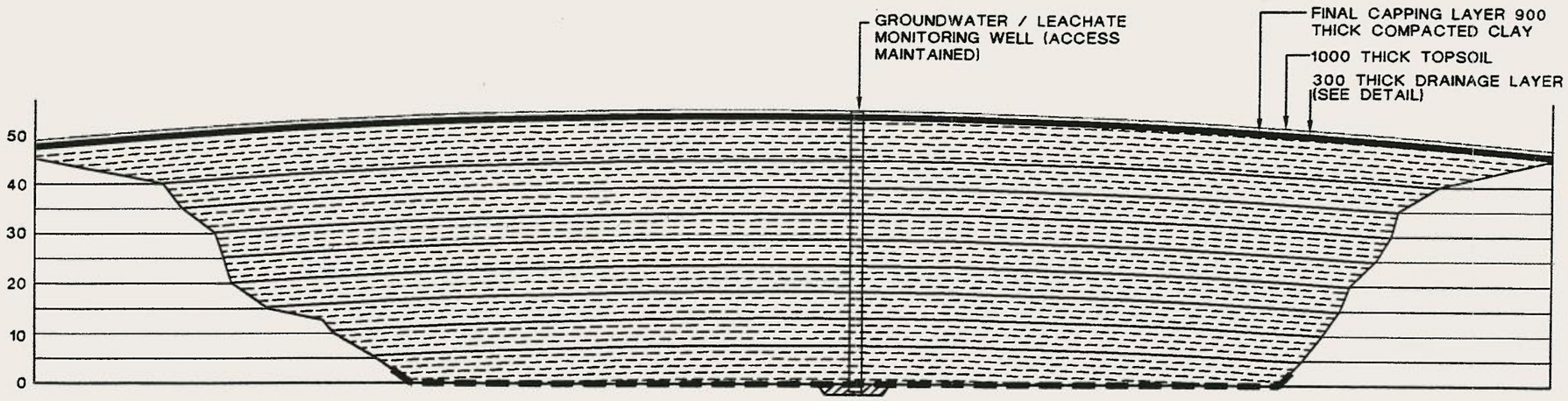
TITLE
SURFACE WATER MANAGEMENT STAGES 4 TO 6 EXTRACTION (YEARS 10 TO 25)

FIGURE
6

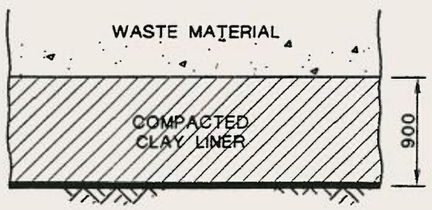
A4



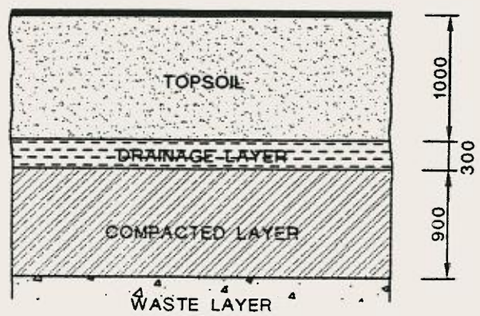
DURING FILLING



FILLING COMPLETED



BASE LINER DETAIL



LANDFILL CAPPING DETAILS

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DRAWING No:	A86 819/0002	CHECKED:	BL
CAD FILE NO:	G.023	APPROVED:	BL
DATE:	14/2/97	STATUS:	FINAL

CLIENT
CSR CONSTRUCTION MATERIAL

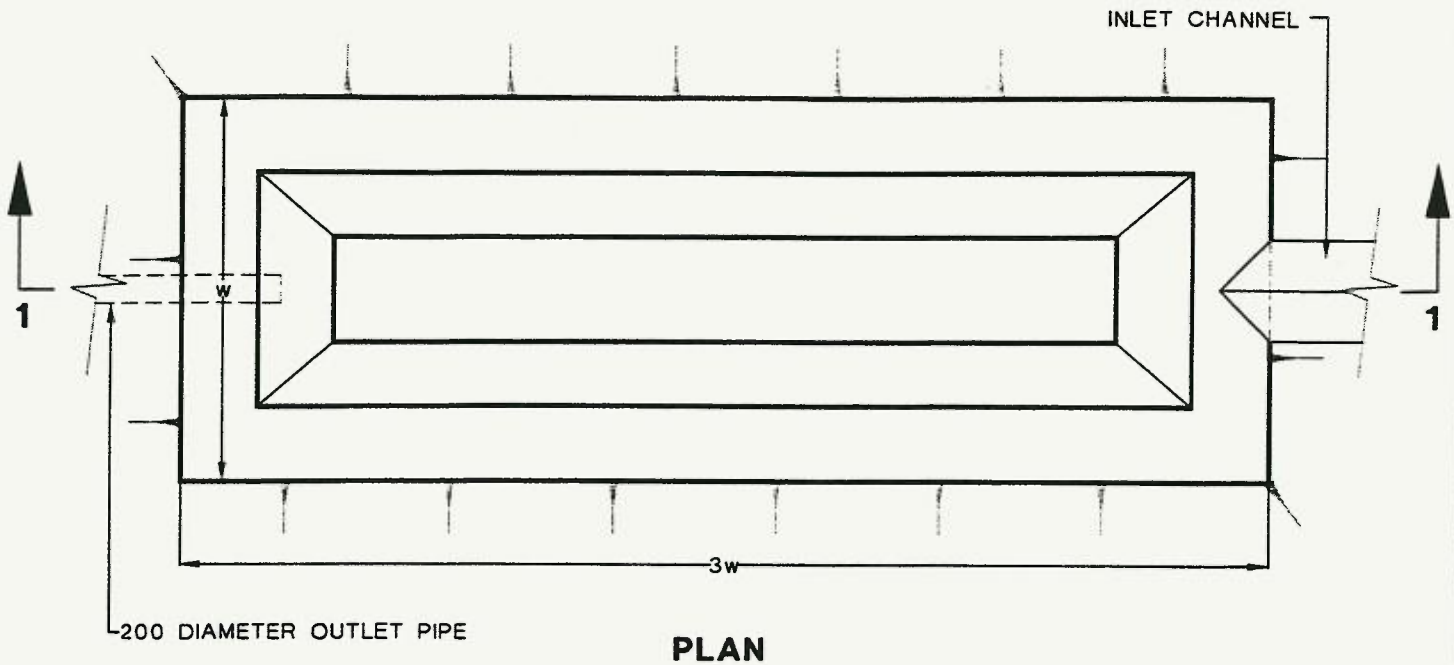
PROJECT
SCHOFIELDS PGH QUARRY

TITLE
TYPICAL LANDFILL CROSS-SECTION SHOWING LEACHATE COLLECTION

FIGURE
7

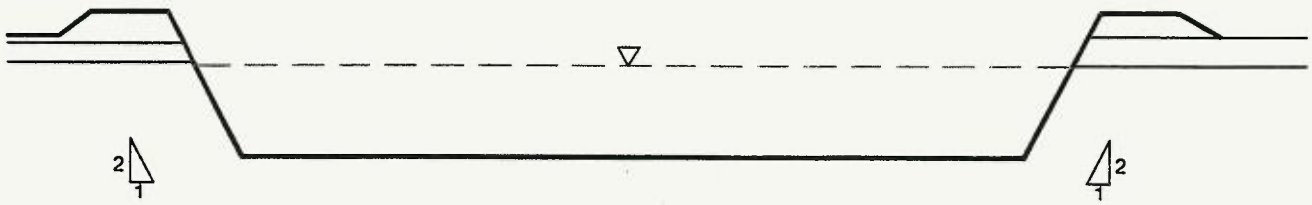
A3

Woodward-Clyde



PLAN

N.T.S.

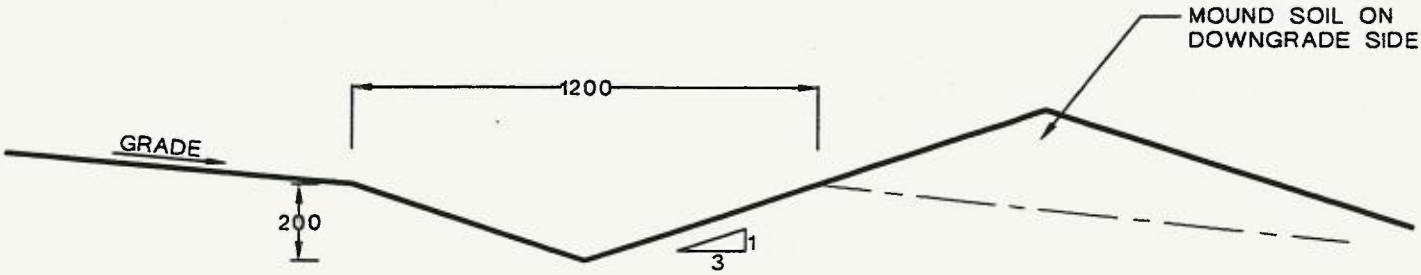


SECTION 1 - 1

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

SCHOFIELDS PGH QUARRY

REVISION: A	DESIGNED: BGL
SCALE: AS SHOWN	DRAWN: HC
DRAWING No: A86 819/0002	CHECKED:
CAD FILE NO: G.011	APPROVED: BL
DATE: 11/2/97	STATUS: FINAL

TITLE

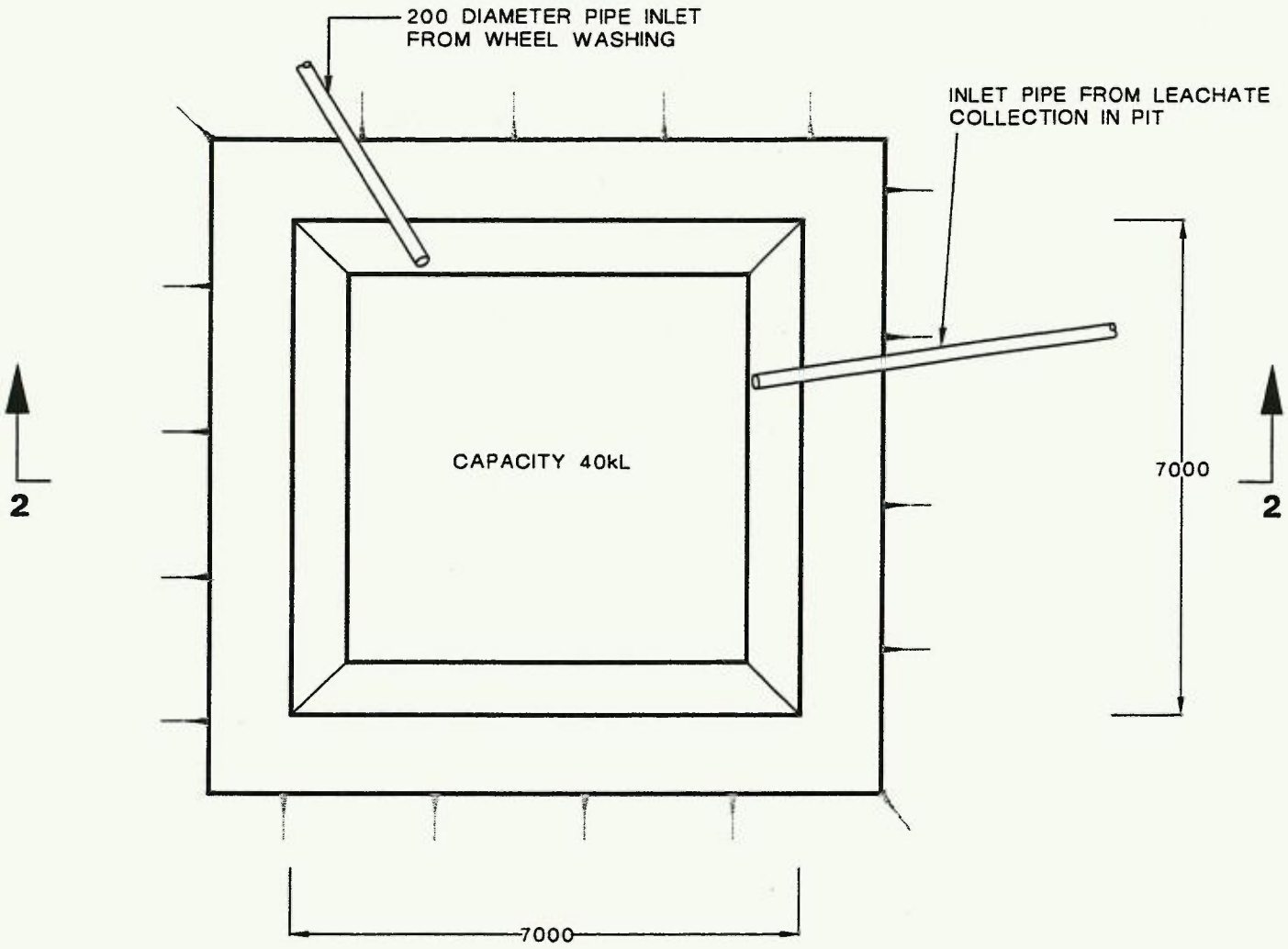
TYPICAL SETTLEMENT POND DETAILS

FIGURE

8

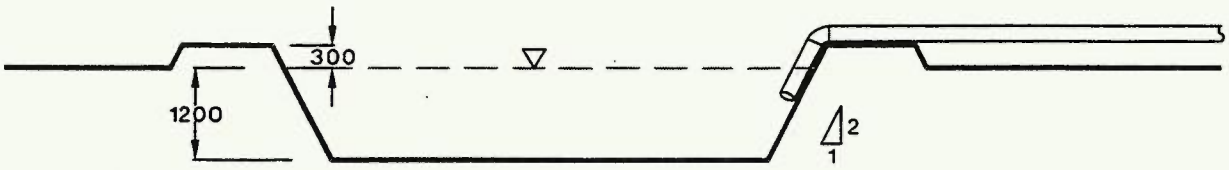
A4

STD/UE/9-85



PLAN

SCALE 1:100



SECTION 2 - 2

DIRTY WATER/LEACHATE SURFACE COLLECTION POND

SCALE 1:100

0 200 400 600 800

(SCALE 1:20)

Woodward-Clyde

CLIENT

CSR CONSTRUCTION MATERIALS

PROJECT

SCHOFIELDS PGH QUARRY

REVISION: A	DESIGNED: BGL
SCALE: AS SHOWN	DRAWN: HC
DRAWING No: AS6 819/0002	CHECKED:
CAD FILE NO: G.012	APPROVED: BL
DATE: 11/2/97	STATUS: FINAL

TITLE

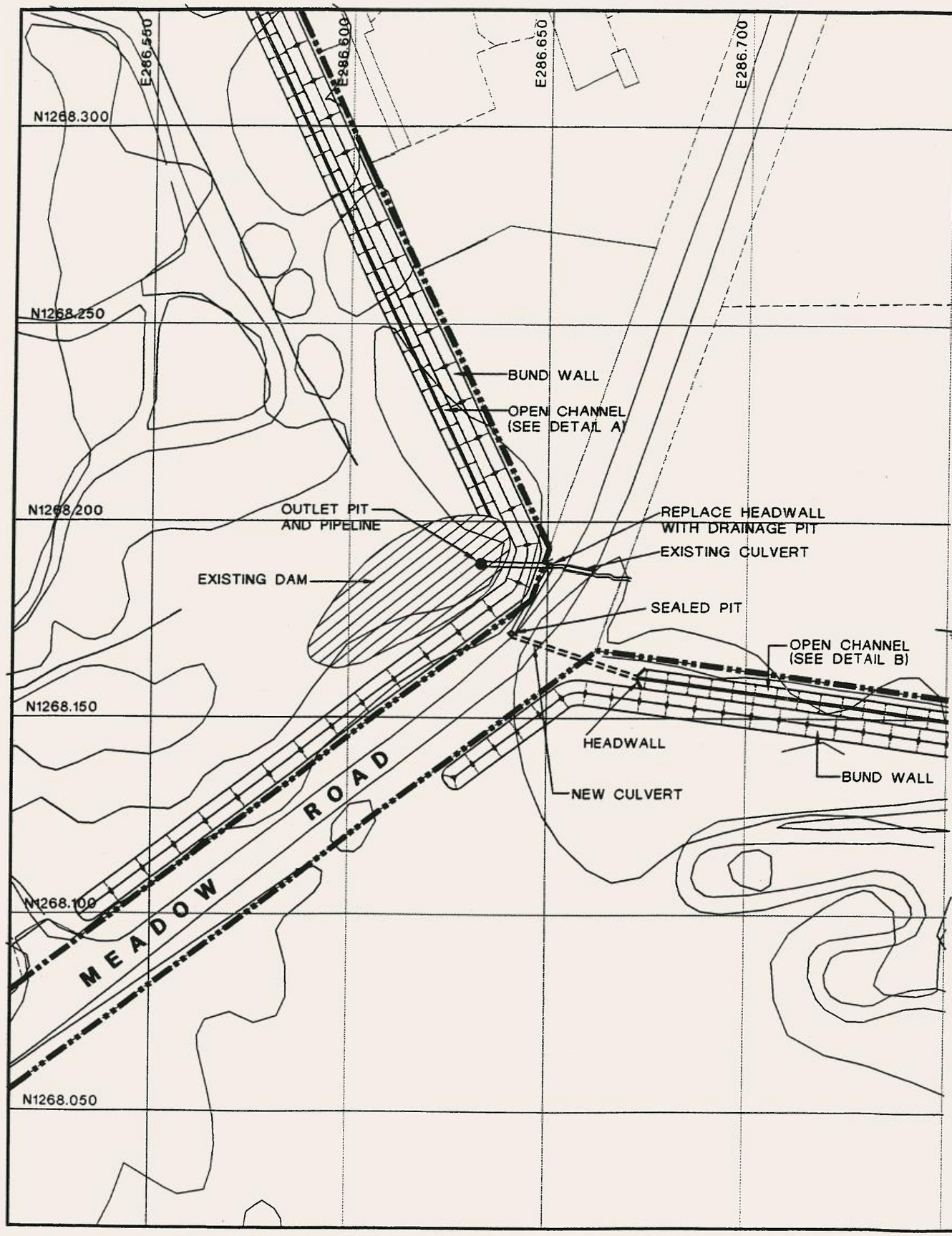
SURFACE LEACHATE COLLECTION POND DETAILS

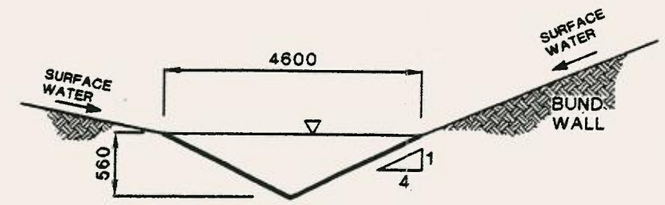
FIGURE

9

A4

STD/LIE/9-95

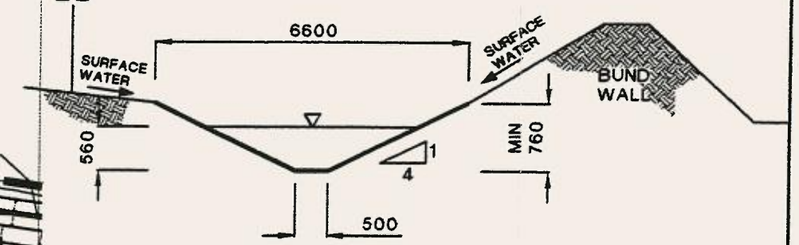




DETAIL A

MAX. X-SECTION OF NORTHERN AREA V-DRAIN

NOT TO SCALE



DETAIL B

TYPICAL X-SECTION OF EASTERN AREA OPEN CHANNEL

NOT TO SCALE

0 10 20 30 40 50

metres

REVISION:	B	DESIGNED:	BGL
SCALE:	AS SHOWN	DRAWN:	HC
DRAWING No:	AS6 S19/0002	CHECKED:	
CAD FILE NO:	G.027	APPROVED:	BL
DATE:	5/3/97	STATUS:	FINAL

CLIENT

CSR CONSTRUCTION MATERIALS

PROJECT

SCHOFIELDS PGH QUARRY

TITLE

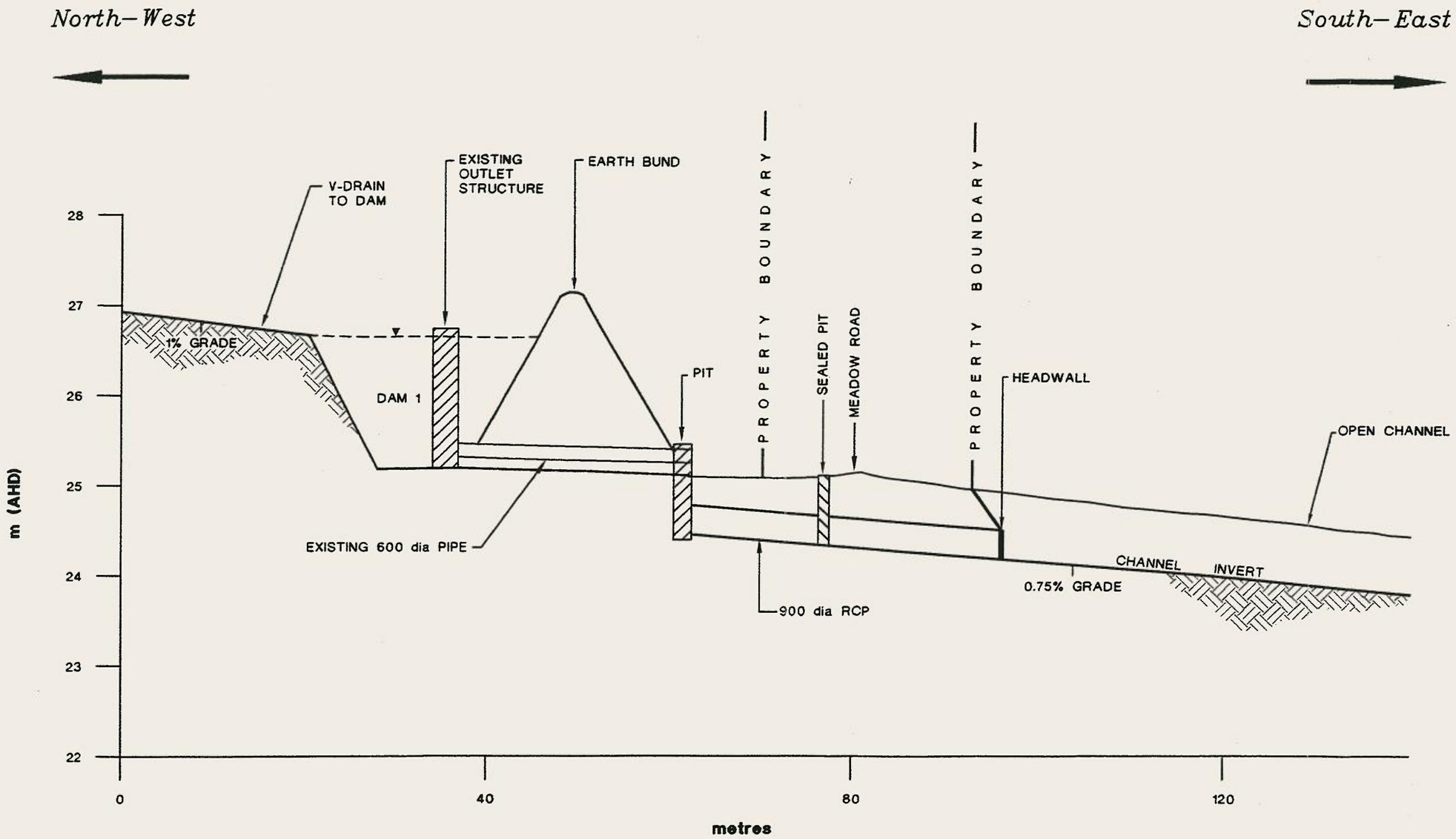
SURFACE WATER MANAGEMENT PROPOSED REVISED DRAINAGE LAYOUT - PLAN AND DETAILS

FIGURE

10

A3

Woodward-Clyde



LONGITUDINAL SECTION OF REVISED DRAINAGE SYSTEM

REVISION:	A	DESIGNED:	JP
SCALE:	AS SHOWN	DRAWN:	LJE
DRAWING No:	ASS 819/0002	CHECKED:	
CAD FILE NO:	Q.025	APPROVED:	BL
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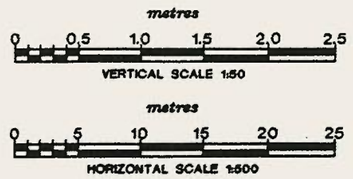


CLIENT
CSR CONSTRUCTION MATERIALS

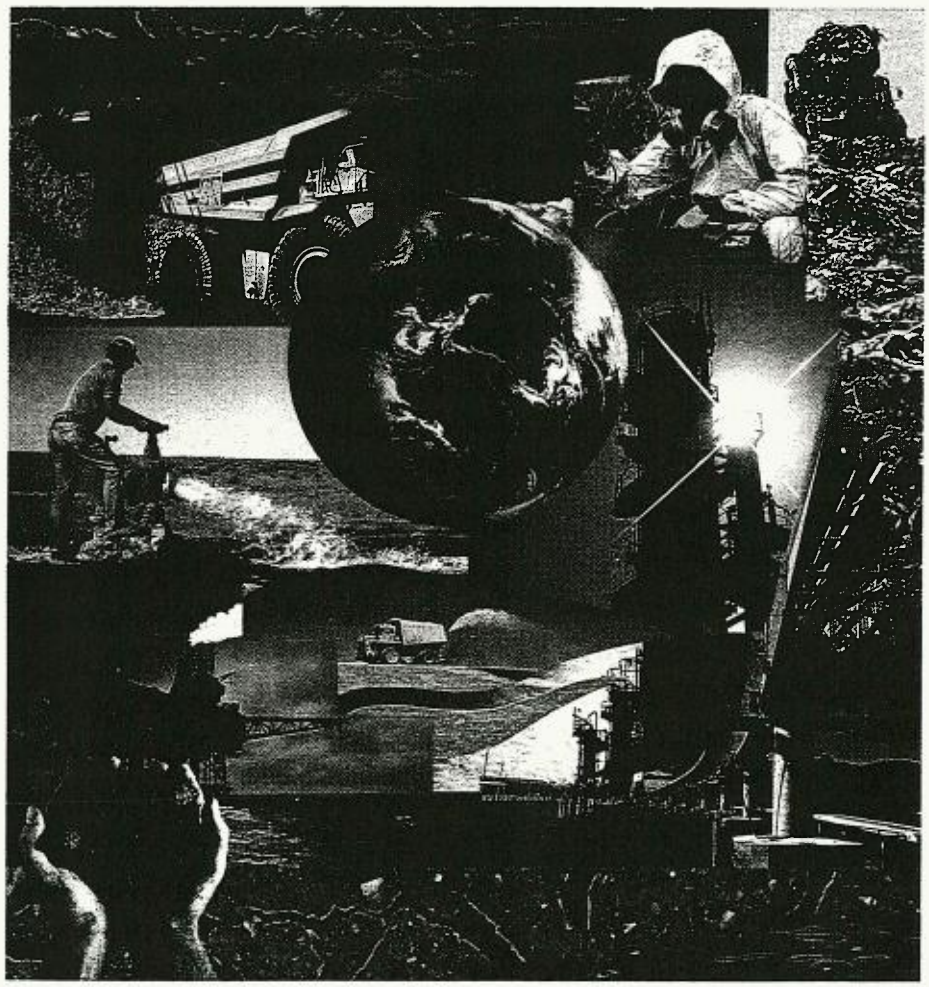
PROJECT
SCHOFIELDS PGH QUARRY

TITLE
SURFACE WATER MANAGEMENT PROPOSED REVISED DRAINAGE LAYOUT - LONGITUDINAL SECTION

FIGURE
11

A3

Woodward-Clyde



PGH QUARRY

SCHOFIELDS

INSTALLATION OF MONITORING WELLS AND GROUNDWATER SAMPLING

PREPARED FOR:
CSR CONSTRUCTION MATERIALS

DECEMBER 1996
Project No. A8600819/2
Document REP041-A.DOC

Woodward-Clyde

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ACN 000-691-690

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1.0 INTRODUCTION

1.1 GENERAL

CSR Construction Materials (CSR) expansion plans at its PGH Quarry at Schofields requires the preparation of an Environmental Impact Statement (EIS) to cover a staged clay extraction programme, which will be carried out concurrently with solid waste landfilling in the exhausted extraction cells. As part of the information necessary to fulfil the requirements of the EIS, CSR is required to collect data on the status of the groundwater in the rockmass underlying the site.

CSR has retained AGC Woodward-Clyde Pty Limited (Woodward-Clyde) to carry out all necessary investigations for the establishment of groundwater bores, additional to those already available around the rehabilitated landfill and in the general area.

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 planned final depth of the clay pits;
- the collection of groundwater samples to be analysed for the same analytes as previous investigations;
- carrying out permeability tests to determine the hydrogeological parameters; and
- the collection of a sample of natural clay material for the determination of its geotechnical properties as a possible clay liner material for the landfill cells.

2.0
INVESTIGATION RESULTS

2.1 GENERAL

Four monitoring wells were installed at sites shown in Figure 2. The drilling contractor was Intertech Drilling Services under the supervision of Woodward-Clyde. The work was carried out on the 6 and 7 November, 1996

Drilling was carried out using air rotary methods, blade bits were used in the upper section of the profile and down-the-hole hammer into the fresher rock. The target depth of the bores was set at approximately four metres below the expected final depth of the clay pits in order to evaluate the groundwater conditions across this profile and to collect samples of groundwater that may have come into contact with leachate from the completed Camide landfill cells.

Details of the bore construction are given in Appendix A and a summary of the existing bores within the PGH Schofields site are given in Table 1. Data from the previous bores have been obtained from reports prepared by Golder Associates (Ref. 1 and 2) and made available to Woodward-Clyde by CSR.

2.2 GEOLOGY

The PGH Quarry at Schofields is underlain by metasediments belonging to the Bringelly Shale, which is the uppermost formation of the Wianamatta Group of mid Triassic age. This Group occupies a central position within the Sydney Basin and is overlain by localised thin deposits of Quaternary alluvium, mostly associated with water courses and flood plains of streams and rivers. The Bringelly Shale sediments were deposited on the Hawkesbury Sandstone alluvial plain during a single regressive episode, on a broad, low lying coastal plain, intersected by meandering estuarine and alluvial channels.

The thickness of the Bringelly Shale varies around the area according to the topography, this formation being the exposed upper unit of the Group and, therefore, subject to erosion.

The Bringelly Shale is made of variable sub-horizontal sequences of carbonaceous claystones, siltstones, sandstones, mostly lensiform, and thin lenses of bright coal.

The exposed materials of the Bringelly Shale have been weathered to dense, mottled clays with siderite nodules. This is the material principally sought after by the brick-making industry and exposed in the quarry pit. The upper clay layer at the site is generally 2 to 3m thick and the depth of weathered material ranges up to 14 m.

The central part of the site is located at the northern end of a north-south extending ridge capped by a thin cover of Tertiary sediments known as the St Marys Formation. These sediments, of fluvial origin, consist of laterised sand and clay with ferricrete bands and sandstone and shale boulders.

2.3 HYDROGEOLOGY

The structural and textural characteristics of the Bringelly Shale, and of the Wianamatta Group in general, determines the hydrogeological regime of the area. The claystones, siltstones and sandstones underlying the site are rocks of negligible primary porosity and permeability because of their fine grained nature and the degree of their intergranular cementation. Groundwater in these formations is stored and migrates principally in fractures and joints and, to the extent that such joints are open and interconnected, the rock will exhibit secondary permeability.

Surface clays derived from the weathering and alteration of the Bringelly Shale form a capping layer over the underlying and less weathered rockmass and restrict rainfall infiltration and groundwater recharge. The limited groundwater recharge and the low permeability result in a poor flushing from the rockmass of the connate salts trapped in the sediments at the time of their deposition. High salinity and low yields are a common trait of the groundwater from the Wianamatta Group formations.

2.3.1 Groundwater levels

The bores well heads have been surveyed and levelled in order to obtain an accurate definition of the water table around the site. A summary of past and recently measured water levels is presented in Table 1, including levels pertaining to bores which have been destroyed by quarrying activities (G5 and G6).

The water levels indicated an uneven head distribution around the site, a fact interpreted as being the result of the quarrying activities around the site. The effect of the current pit on the water table in its immediate vicinity is possibly reflected in the water level in bore BH12. In general, it appears that a small depression in the water table is present at the site superimposed to an overall hydraulic gradient towards the east and northeast, in the direction of Eastern Creek.

Some of the bores installed during previous investigations have been located on the ground by PGH staff. However, the bores are padlocked and no keys were available at the time of the recent field work. These bores should be checked and assessed as to their suitability as on-going monitoring bores.

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 these 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.

Rising head (recovery) tests were carried out in each of the new bores and the results compared with those obtained from previous investigations. Results of the current and past tests are summarised in Table 2 and the plots are presented in Appendix B.

The geometric mean of the values presented in Table 2 is 1.2×10^{-7} m/sec, which is an order of magnitude lower than that calculated for Horsley Park and other sites around western Sydney. The measured permeability is, nonetheless, still in the low range and does not exclude the hydrogeological viability of the site as a landfill facility. Further

measurements would be required, however, on a location specific basis within the property, in association with the individual cells.

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 for total coliforms and to Levay and Co. Environmental Services for a halogens AOX scan. A number of parameters were measured at the well head and these are summarised and presented in Table 3.

3.2 CHEMICAL ANALYTICAL RESULTS

The chemical analytical results are tabulated in Table 4 and the laboratory certificates are presented in Appendix D.

The water in the Bringelly Shale is saline and its chemical composition and general ionic proportions reflect the character of sea water as shown in the Piper 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. In this instance, the area occupied by the points in the diamond is typical of sea water and this is considered to reflect the leaching of residual salts trapped in the rocks at the time of deposition of the sediments in a coastal and marine environment and not fully flushed away as discussed in Section 2.3.

3.2.1 General Parameters

The groundwater under the site is neutral to slightly alkaline and is consistent under the site

The total dissolved solids (TDS) ranges between 13 800 mg/L and 18 500 mg/L which is typical of the Bringelly Shale groundwater salinity. The range of values encountered may

be the results of quarry operations that have opened a window into the water table into which rainfall occurs and, consequently, possible dilution.

BH12 has a lower TDS that the other bores and is also lower than the average values measured in previous investigations. Its location near the current pit may be responsible for this difference. Regular purging, sampling and analysis will identify any trend in water quality at this location.

Typically, the water has high levels of sodium, chloride and bicarbonate. Recorded sulphate concentrations display a wide range of values (114 mg/L to 1 040 mg/L). This could possibly be due to the nature of the sediments encountered in each bore, given their variable carbonaceous and pyritic content, in accord with their depositional history, as mentioned earlier.

The groundwater, because of its salinity and because of the low permeability of the rockmass, has no exploitable common application.

3.2.2 Metals

Metals are present in generally low levels and are considered to be of natural origin.

3.2.3 Cyanide

The cyanide amenable to chlorination has not been detected in any of the samples collected. This parameter offers an indication of the presence of readily dissociated cyanides that could be treated by alkaline chlorination, should the need arise.

3.2.4 Phenols

Phenolic compounds have not been detected in any of the samples collected and analysed.

3.2.5 TPH - BTEX

No petroleum hydrocarbons 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 (Levay), which is associated with the Ian Wark Research Institute, University of South Australia. Levay was selected as it is the only laboratory in Australia capable of performing the AOX analysis. Levay is not NATA registered for the AOX analysis. There are no other laboratories in Australia that offer AOX testing on a commercial basis.

Detected AOX levels were generally low, ranging from 18 µg/L to 46 µg/L. Monitoring well BH12, which recorded an AOX concentration of 40 µg/L, also recorded slightly elevated values of ammonia and BOD_5. This may be considered as an indication of contamination from a landfill source. However, further sampling and testing will be necessary before this can be confirmed.

3.2.7 Total Coliforms

Total colony forming coliforms have been detected in all samples. Total coliforms counts in the carbonaceous shales of the Bringelly Shale are common and do not necessarily indicate contamination from septic tanks, organic matter, etc. However, bore BH09 has a higher count than the others. The reason for this high count is not clear and future sampling and monitoring will show whether this measurement was an isolated occurrence or otherwise.

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 6.1×10^{-10} 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 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 BH12. 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 indicated 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

The field investigations carried out at the PGH Schofields Quarry have concluded that:

- the groundwater underlying the site is saline and does not have any potential use for irrigation or stock watering;
- the permeability of the formation is low and is in general agreement with many other measurements of similar material, albeit somewhat higher, sampled at different sites (including several landfill sites) around the western Sydney area;
- the water table is poorly defined, but on present indication it would appear to slope towards Eastern Creek;
- based on the current investigation results, there is no obvious contamination of the groundwater due to organic or inorganic compounds; and
- the permeability tests carried out on the natural clay material indicated that, with proper compaction, the clay is suitable as a landfill liner material.

6.0
RECOMMENDATIONS

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 determine current and background conditions prior to the establishment of landfilling operations; and
- bores drilled during previous investigations should be unlocked and sampled to assess their suitability as on-going monitoring bores for the landfilling operation.

7.0
LIMITATIONS

This report has been prepared based on data from the indicated site sampling and analysis results performed by Woodward-Clyde at the subject site. Laboratory analyses at sample points 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.

8.0
REFERENCES

1) Golder Associates Pty Ltd. *"Report on Groundwater Contamination Study, Quarry Landfill, Schofields"* May 1992, 91620167

2) Golder Associates Pty Ltd. *Report on Hydrogeological Investigation For A Proposed Landfill, PGH Quarry Site, Townson Road, Schofields, NSW"* November 1994, 94623132A

3) Geological Survey of New South Wales. *Penrith Geological Map, Sheet 9030. 1: 100 000"* 1991

TABLES

TABLE - 1 SCHOFIELDS - 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 10.17.94 m b.d.	SWL 3.27.96 m b.d.	SWL 12.4.96 m b.d.	SWL 1.2.97 m b.d.	SWL 1.2.97 m AHD
GA1			15	34.78	20	14.78	17-20	16.13	0.41	33.00	11.16	-	-	11.6	21.40
GA2			15	28.56	19.2	9.36	15.5-19.2	13.1-9.4	0.4	28.66	7.16	-	-	7.42	21.24
GA3	destroyed		15	24.43	7.6	16.83	4.6-7.6	19.83-16.83		-	-	-	-	-	-
GA4	destroyed		15	24.37	6.1	17.27	2.9-5.9	21.47-18.47		-	-	-	-	-	-
GA5			15	28.38	20	8.38	17-20	11.38-8.38		28.38	-	8.6	destroyed	-	-
GA6			15	31.88	20	11.88	17-20	14.88-11.88		31.88	-	12.35	destroyed	-	-
BHA1			15	31.27	20	11.27	no details		0.61	31.88	10.29	-	-	11.24	20.64
SRC1			15	26.29	30	-3.71	no details			26.29	5.32	-	-	not found	
BH1			15	40.96	29.7	11.26	26.5-29.5	14.46-11.46	0.22	41.18	13.46	-	-	14.09	27.09
BH2			15	29.27	24	5.27	18-24	11.27-5.27	0.21	29.48	8.88	-	-	9.75	19.73
BH3			15	39.55	23.7	15.85	17.7-23.7	21.85-15.85	0.26	39.81	14.4	-	-	16.06	23.75
BH4			15	38.72	30	8.72	24.1-27.1	14.62-17.62	0.25	38.97	20.8	-	-	21.59	17.38
BH09	286506.13	1268124.73	15	27.51	17.4	10.11	10.9-16.9	16.61-10.61	1.01	28.52		-	4.50	4.48	24.04
BH10	286074.24	1268328.65	15	39.90	30.1	9.8	23.1-29.1	16.8-10.8	0.98	40.88	-	-	21.04	20.66	20.23
BH11	286033.88	1268625.12	15	33.23	25	8.23	18-24	15.23-9.23	0.86	34.09	-	-	12.53	12.64	21.46
BH12	286440.64	1268527.33	15	30.97	21	9.97	14-20	16.97-10.97	0.94	31.91	-	-	14.40	14.49	17.42

Note:

* estimated from surface contours

NOTE: Co-ordinates of BH09, BH10, BH11 and BH12 to be confirmed.

m b.s = Metres below surface

m AHD = m Australian Height Datum

m a.s = Metres above surface

m b.d = Metres below datum

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Prepared by: FC
Checked by:..BL

TABLE - 2 SCHOFIELDS - PERMEABILITY TESTS SUMMARY

Bore	Date of test	Interval Tested m AHD	K m/sec	Type of test
GA1	May-92	16-13	1.4×10^{-7}	Rising head
GA2	May-92	13.1-9.4	7.7×10^{-8}	Rising head
GA3			NA	
GA4			NA	
GA5	May-92	11.9-8.4	1.6×10^{-7}	Rising head
GA6	May-92	15.4-11.9	1×10^{-7}	Rising head
BHA1		NA	NA	
SRC1	Nov-94	1.99/-3.51	1.4×10^{-6}	Rising head
BH1	Nov-94	15.96-11.26	2.8×10^{-7}	Rising head
BH2	Nov-94	13.97-5.27	8.8×10^{-9}	Rising head
BH3	Nov-94	23.55-15.85	1.3×10^{-8}	Rising head
BH4	Nov-94	14.62-11.62	4.7×10^{-8}	Rising head
BH9	Nov-96	16.61-10.61	1.4×10^{-7}	Rising head
BH10	Nov-96	16.8-10.8	2.4×10^{-6}	Rising head
BH11	Nov-96	15.23-9.23	5.4×10^{-8}	Rising head
BH12	Nov-96	16.97-10.97	1.9×10^{-7}	Rising head

Prepared by: FC
Checked by: BL

TABLE - 3 SCHOFIELDS - 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
BH-09	20/11/96	68	30800	6.57	25.8	2.34	290.6	21.12	140	Slight grey-brown discolouration
BH-010	25/11/96	110	23400	6.78	36	3.02	322	23	50	Slight brown discolouration
BH-011	6/12/96	53	22000	6.99	43.8	3.77	232	17.9	50	Brown discolouration
BH-012	21/11/96	130	23600	6.71	65.1	5.57	312.7	21.1	50	Brown discolouration

Note:
- = Not measured
Eh= Redox potential (corrected values)
EC= Electrical conductivity
DO= Dissolved oxygen

Prepared by: DP
Checked by: BL

TABLE - 4 SCHOFIELDS - LABORATORY ANALYTICAL RESULTS

Parameter	Units	LOR	BH 09	BH10	BH11	BH12
Date			20/11/96	25/11/96	9/12/96	21/11/96
pH		0.01	7.13	7.35	7.10	7.32
Total Dissolved Solids (TDS)	mg/L	1	18500	15600	16300	13800
Calcium	mg/L	1	373	410	1100	370
Magnesium	mg/L	1	929	775	969	635
Sodium	mg/L	1	4900	3800	2740	3160
Potassium	mg/L	1	39	62	12	45
Bicarbonate as $CaCO_3$	mg/L	1	869	594	371	670
Sulphate	mg/L	1	114	1040	564	627
Chloride	mg/L	1	10100	7630	8270	6460
Iron	mg/L	1	3	1	1	1
Arsenic	mg/L	0.01	<0.01	<0.01	0.01	<0.01
Cadmium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	0.014	0.009	0.012	0.008
Manganese	mg/L	0.001	0.258	0.275	0.140	0.392
Lead	mg/L	0.001	0.014	0.027	0.005	0.024
Zinc	mg/L	0.001	0.143	0.060	0.023	0.06
Cyanide (amenable to chlorination)	mg/L	0.005	<0.005	<0.005	<0.005	<0.005
Ammonia as N	mg/L	0.01	0.76	1.61	2.22	1.58
Nitrate as N	mg/L	0.01	<0.01	<0.01	0.08	<0.01
Sulphide	mg/L	0.1	<0.1	<0.1	<0.1	<0.1
Biochemical Oxygen Demand (BOD_5)	mg/L	2	2	<2	<2	4
Phenols	mg/L	0.2	<0.2	<0.2	<0.2	<0.2
Total Coliforms	cfu/100 mL		1.3×10^3	160	20	54
Total Petroleum Hydrocarbons						
C6 - C9 fraction	µg/L	20	<20	<20	<20	<20
C10 - C14 fraction	µg/L	50	<50	<50	<50	<50
C15 - C28 fraction	µg/L	100	<100	<100	<100	<100
C29 - C36 fraction	µg/L	50	<50	<50	<50	<50
BTEX						
Benzene	µg/L	1	<1	<1	<1	<1
Toluene	µg/L	2	<2	<2	<2	<2
Chlorobenzene	µg/L	2	<2	<2	<2	<2
Ethylbenzene	µg/L	2	<2	<2	<2	<2
meta- & para-Xylene	µg/L	2	<2	<2	<2	<2
ortho-Xylene	µg/L	2	<2	<2	<2	<2
Halogens AOX	µg/L		18	26	46	40

Prepared by: FC
Checked by:...B.L

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TABLE - 5 SCHOFIELDS - QUALITY CONTROL ANALYSES

Parameter	Units	LOR	DUP01	Rinsate Blank	BH09	BH10	BH11	BH12
Date				21/11/96				21/11/96
pH		0.01	7.17	7.69				
Total Dissolved Solids (TDS)	mg/L	1	19500	4				
Calcium	mg/L	1	354	<1				
Magnesium	mg/L	1	936	<1				
Sodium	mg/L	1	4860	<1				
Potassium	mg/L	1	40	<1				
Bicarbonate as $CaCO_3$	mg/L	1	860	5				
Sulphate	mg/L	1	116	<1				
Chloride	mg/L	1	10100	<1				
Iron	mg/L	1	3	<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	0.01	<0.001				
Manganese	mg/L	0.001	0.255	<0.001				
Lead	mg/L	0.001	0.006	<0.001				
Zinc	mg/L	0.001	0.041	0.006				
Cyanide (amenable to chlorination)	mg/L	0.005	<0.005	<0.005				
Ammonia as N	mg/L	0.01	0.76	<0.01				
Nitrate as N	mg/L	0.01	0.01	<0.01				
Sulphide	mg/L	0.1	<0.1	<0.1				
Biochemical Oxygen Demand (BOD_5)	mg/L	2	4	2				
Phenols	mg/L	0.2	0.2	<0.2				
Total coliforms	cfu/100mL		8.1×10^3	0				
Total Petroleum Hydrocarbons								
C6 - C9 fraction	µg/L	20	<20	<20				
C10 - C14 fraction	µg/L	50	<50	<50				
C15 - C28 fraction	µg/L	100	<100	<100				
C29 - C36 fraction	µg/L	50	<50	<50				
BTEX								
Benzene	µg/L	1	<1	<1				
Toluene	µg/L	2	<2	<2				
Chlorobenzene	µg/L	2	<2	<2				
Ethylbenzene	µg/L	2	<2	<2				
meta- & para-Xylene	µg/L	2	<2	<2				
ortho-Xylene	µg/L	2	<2	<2				
Halogens AOX								
VOLATILE TPH/BTEX COMPOUND SURROGATE								
1,2-Dichloroethane-D4	%	1	106	97	103	102		95
Toluene-D8	%	1	96	97	96	89		94
4-Bromofluorobenzene	%	1	98	99	98	93		97
Halogens AOX			14	19				

Note: DUP01 is a duplicate sample of BH09

Prepared by: FC
Checked by:...BL

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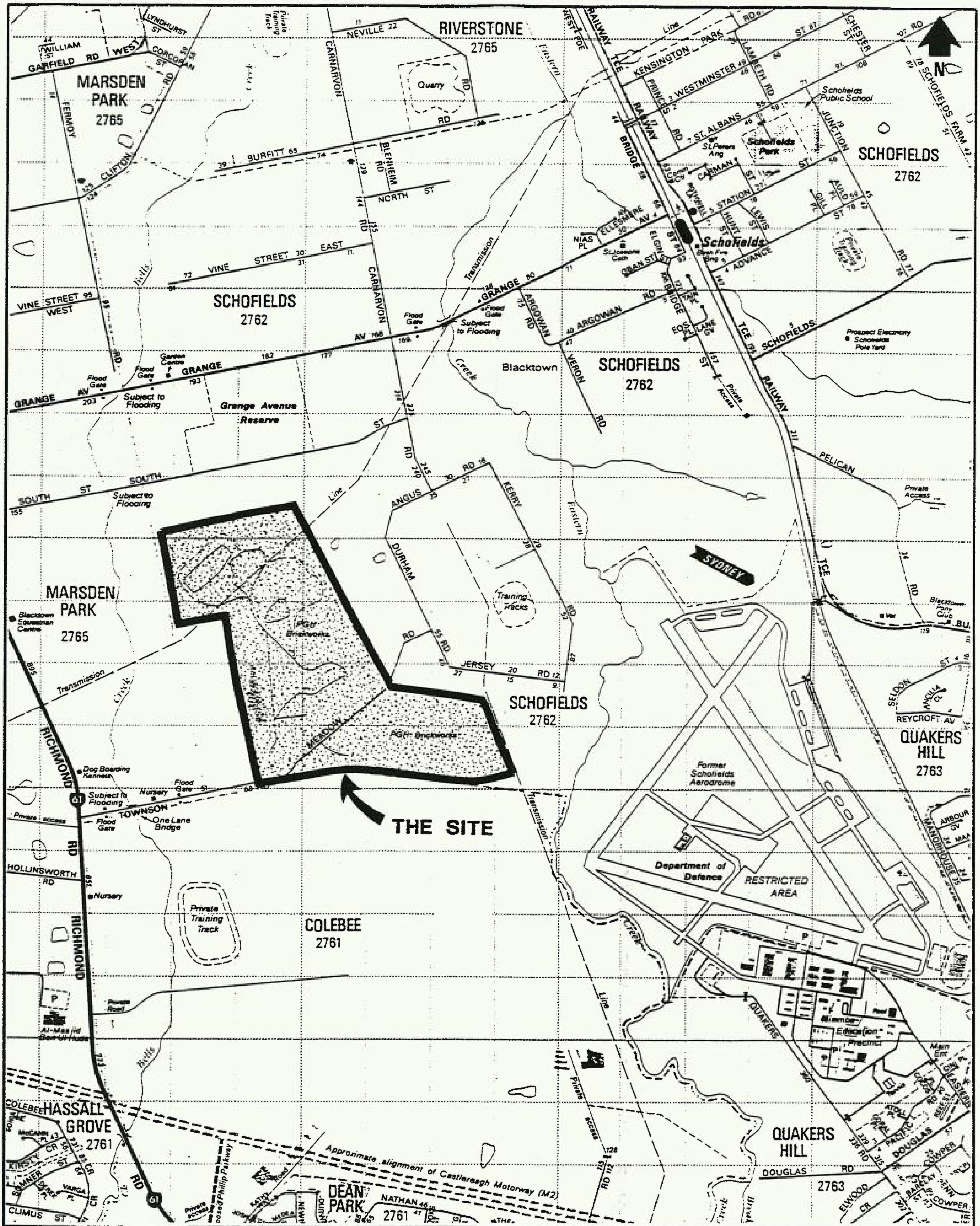
FIGURES



0 250 500 750 metres	CLIENT **CSR CONSTRUCTION MATERIALS**	REVISION: B SCALE: AS SHOWN DRAWING No: A36 319/02/G002 CAD FILE NO: G.002 DATE: 11/2/97	DESIGNED: FC DRAWN: HC CHECKED: APPROVED: BL STATUS: FINAL
Woodward Clyde	PROJECT **SCHOFIELDS PGH QUARRY**	TITLE **SITE LOCATION PLAN**	FIGURE 1 A4

0 50 100 150 200 250
metres

Woodward-Clyde

CLIENT
CSR CONSTRUCTION MATERIALS

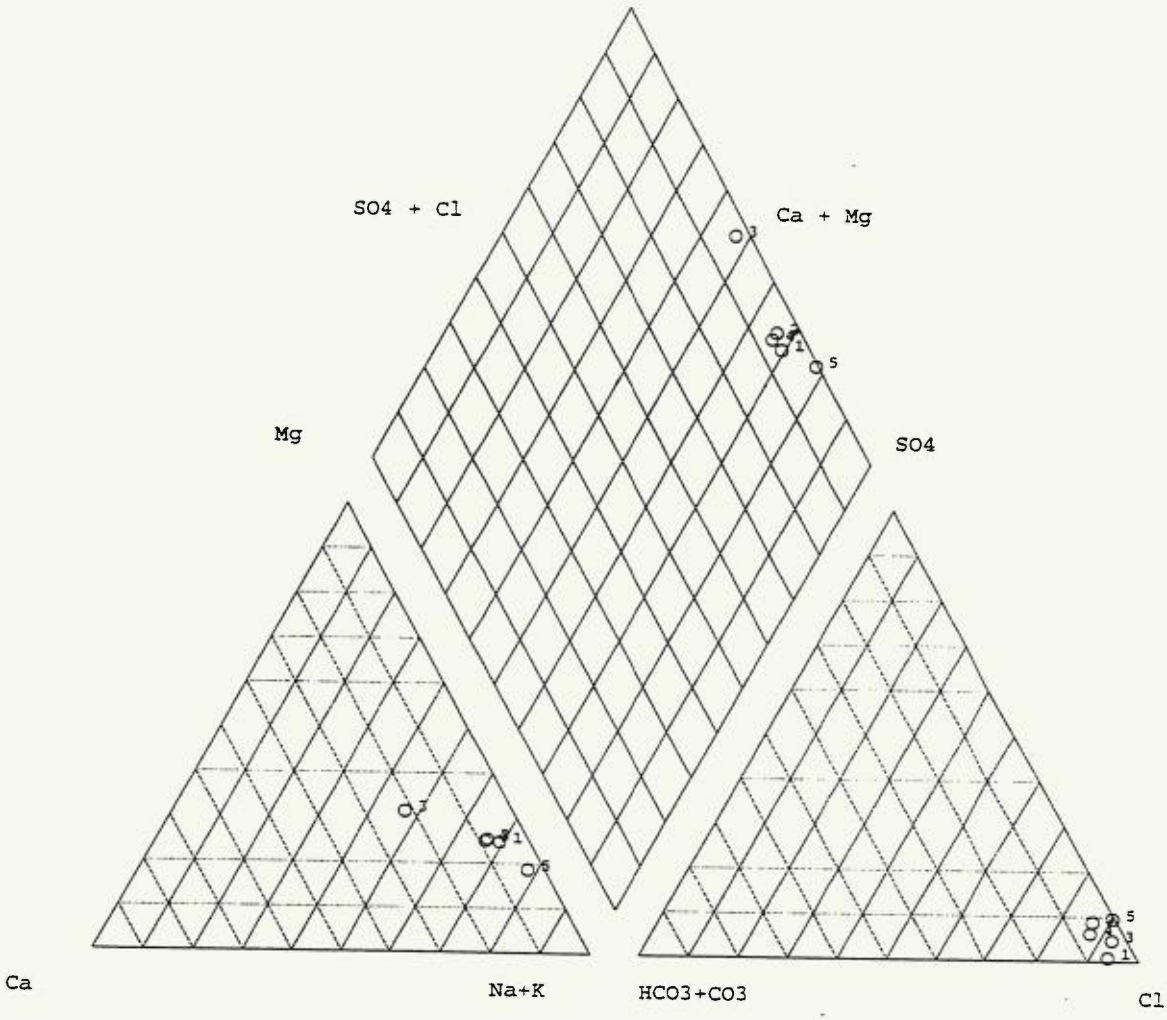
PROJECT
SCHOFIELDS PGH QUARRY

REVISION: A	DESIGNED: FC
SCALE: 1:5000	DRAWN: HC
DRAWING No: A86 819/0002	CHECKED:
CAD FILE NO: G.006	APPROVED: BL
DATE: 11/2/97	STATUS: FINAL

TITLE
SITE PLAN AND MONITORING WELL LOCATIONS

FIGURE
2

A4



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	BH09	4900	39	373	929	10100	1060		114	18500
2	BH10	3800	62	410	775	7630	725		1040	15600
3	BH11	2740	12	1100	969	8270	453		564	16300
4	BH12	3160	45	370	635	6460	817		627	13800
5	SEA	10500	390	410	1350	19000	173		2700	35000

Woodward-Clyde

CLIENT
CSR CONSTRUCTION MATERIALS

PROJECT
SCHOFIELDS PGH QUARRY

REVISION: A
SCALE: AS SHOWN
DRAWING No: ASS 819/0002
CAD FILE NO: G.010
DATE: 11/2/97

DESIGNED: FC
DRAWN: HC
CHECKED:
APPROVED: BL
STATUS: FINAL

TITLE
PIPER DIAGRAM

FIGURE
3

A4

APPENDIX A

BORE CONSTRUCTION LOGS

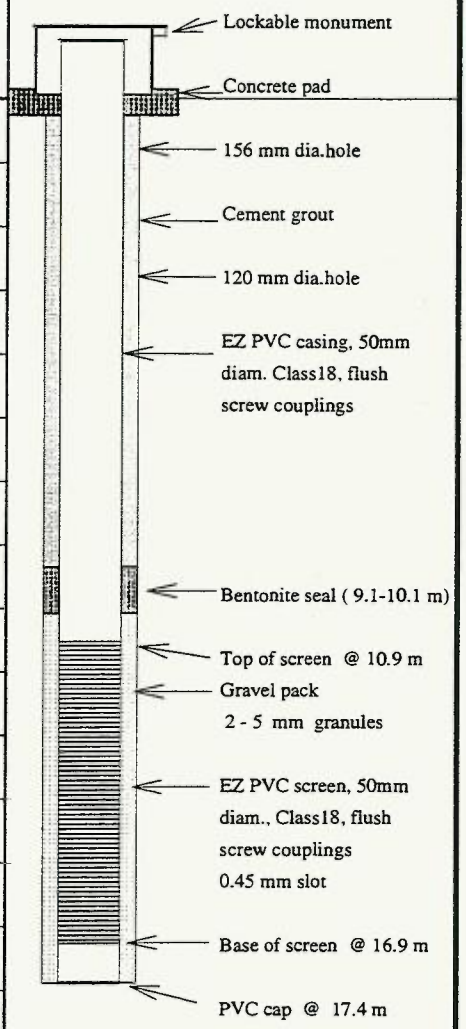
WOODWARD - CLYDE

PROJECT : CSR - Construction Materials		JOB NO:	A8600819/002
LOCATION: Schofields		DATE STARTED:	6.11.96
SUPERVISOR: Dino Parisotto		DATE COMPLETED:	6.11.96
INSTALLED BY: Intertech Drilling	METHOD: RAB/ Down hole hammer	DIAMETER:	156 mm, 120 mm
RIG: Intertech 650	TOTAL DEPTH : 17.4 m	R.L. GROUND:	27.51m AHD
DATUM: 1.01m top of monument a.s.	SWL: 4.50 m (b.d. 4/12/96)	R.L. SWL :	24.02 m AHD

BORE NUMBER: BH-09

Lithological Log	Remarks	Depth (m)
0 -4 m SILTY CLAY: brown-red, ~ 10 % shale fragments, firm, plastic, slight moisture. @ 1-3 m ~ 10 % lateritic nodules @ 2-4 m trace of highly weathered shale	Blade bit 156 mm Hammer 120 mm	2.5
4-6 m SHALE/SILTSTONE: grey/brown, highly weathered, carbonaceous in parts, friable-soft, slight moisture. @ 6-7 m moderately weathered, harder material @ 7-11 m slightly weathered, grey shale, finely laminated.		5 7.5 10
11 m base of weathering 11-17.4 m SHALE: dark grey, carbonaceous, massive, hard. @ 13-14 m some calcite veining and lighter grey siltstone @ 14-17.4 m finely laminated @ 15-17 m some lighter grey siltstone		12.5 15
17.4 m **Bottom of the hole**	Dusty drilling no water upon airlift	17.5 20 22.5 25

Bore Construction



Prepared by: DP
Checked by: BL

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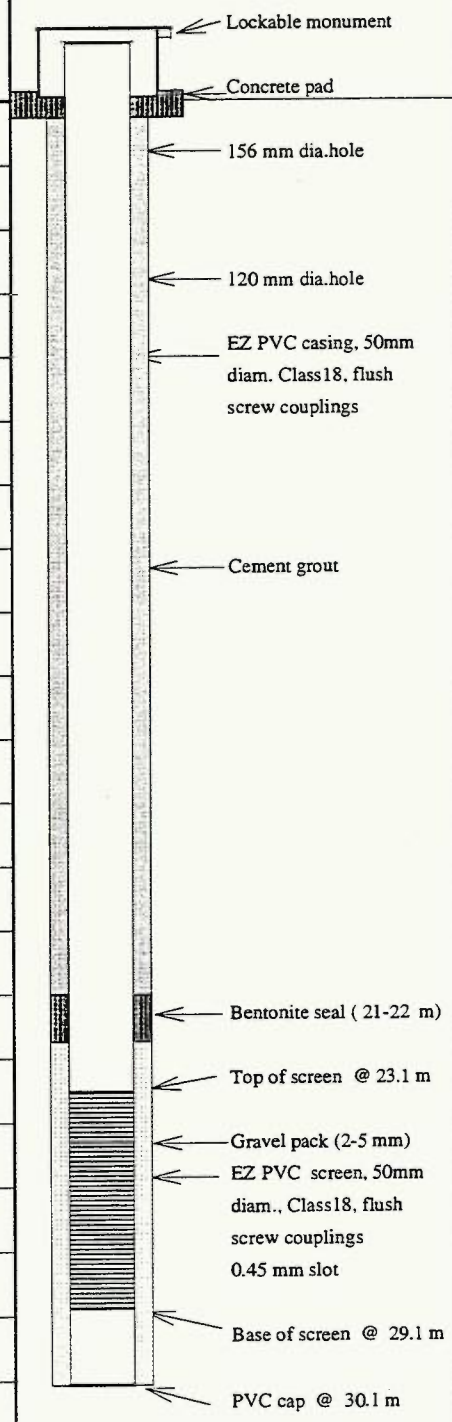
WOODWARD - CLYDE

PROJECT : CSR - Construction Materials		JOB NO:	A8600819/002
LOCATION: Schofields		DATE STARTED:	7.11.96
SUPERVISOR: Dino Parisotto		DATE COMPLETED:	7.11.96
INSTALLED BY: Intertech Drilling	METHOD: RAB/ Down hole hammer	DIAMETER:	156 mm, 120 mm
RIG: Intertech 650	TOTAL DEPTH : 30.1 m	R.L. GROUND:	39.90 m AHD
DATUM: 0.98 m top of monument a.s.	SWL: 21.04 m (b.d. 4/12/96)	R.L. SWL :	19.85 m AHD

BORE NUMBER: BH-010

Lithological Log	Remarks	Depth (m)
0 -3 m FILL: brown clay, brown loam, variety of clay bricks, firm, slight moisture.	Blade bit 156 mm	
	Blade bit 120 mm	3
3-6 m CLAY: grey some red/brown (Fe stained joints), firm plastic, slight moisture.		
@ 5-6 m trace of highly weathered shale		6
6-30 m SHALE/SILTSTONE: grey/brown, highly weathered, carbonaceous in parts, friable-soft, slight moisture.		
@ 8-9 m grey, slightly weathered, harder material		9
9 m base of weathering		
@ 9-30.1m dominantly grey shale/siltstone, massive, carbonaceous in parts, moderately hard.	Hammer 120 mm	
@ 11-11.5 m softer, clayey, Fe stained		12
@ 13-14 m softer, clayey		
		15
@ 17-18 m some brown-grey claystone		18
@ 18-21 m med-dark grey carbonaceous shale/siltstone, trace of brown/grey claystone		
		21
@ 21-23 m med-dark grey carbonaceous shale/siltstone,		
@ 23-24 m lighter grey siltstone/shale, carbonaceous in parts, slightly clayey.		24
@ 23-30 m light to dark grey siltstone/shale, carbonaceous in parts, finely laminated.		
		27
	Dusty drilling no water upon airlift	
@ 29-30 m minor brown-grey claystone		30
30.1 m Bottom of the hole		

Bore Construction



Prepared by: DP
Checked by: BL

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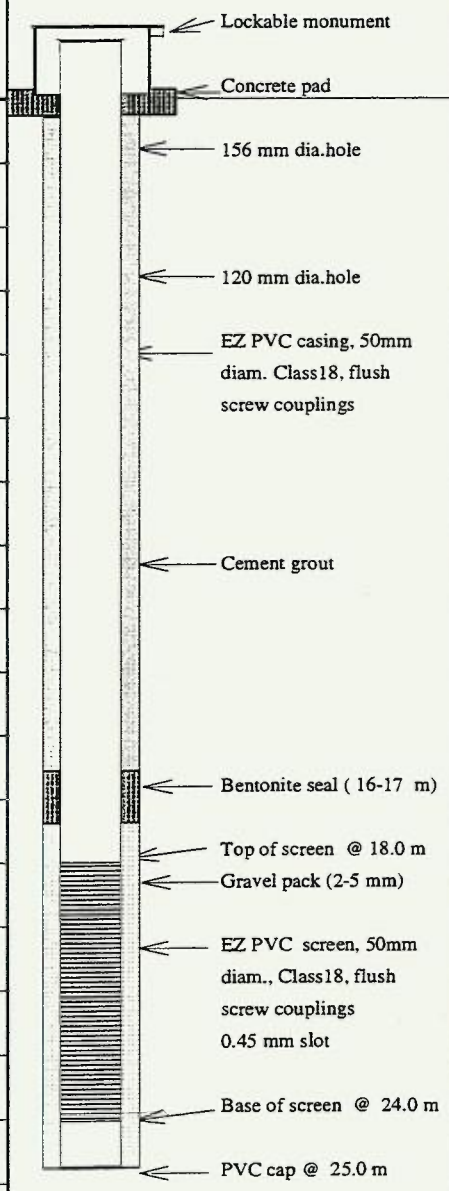
WOODWARD - CLYDE

PROJECT : CSR - Construction Materials		JOB NO:	A8600819/002
LOCATION: Schofields		DATE STARTED:	6.11.96
SUPERVISOR: Dino Parisotto		DATE COMPLETED:	6.11.96
INSTALLED BY: Intertech Drilling	METHOD: RAB	DIAMETER:	156 mm, 120 mm
RIG: Intertech 650	TOTAL DEPTH : 25.0 m	R.L. GROUND:	33.23 m AHD
DATUM: 0.86 m top of monument a.s.	SWL: 12.53 m (b.d. 4/12/96)	R.L. SWL :	21.56 m AHD

BORE NUMBER: BH-011

Lithological Log	Remarks	Depth (m)
0 -3 m FILL: brown and grey clay, minor bricks and shale, firm, slight moisture.	Blade bit 156 mm	
	Blade bit 120 mm	3
3-4 m CLAY: grey some red/brown (Fe stained joints), firm homogenous, plastic, slight moisture.		
4-25 m SHALE/SILTSTONE: grey/brown, highly weathered, carbonaceous in parts, friable-soft, slight moisture.		6
@ 5-6 m moderately weathered		
@ 6-14 m grey, slight weathering, harder material		
@ 6-7 m brown siltstone		
@ 7-8 m minor fine grained sandstone- light grey		9
@ 8-9 m dark grey carbonaceous shale/siltstone		
@ 11-12 m dark grey carbonaceous shale/ coal in parts		12
14 m base of weathering		
@ 14-25 m dominantly massive grey shale/siltstone carbonaceous in parts, moderately hard.		15
@ 17-18 m some brown-grey claystone		18
@ 18-19 m dominantly siltstone and fine grained sandstone, lighter grey, massive, hard.		
@ 21-23 m dominantly siltstone and fine grained sandstone, lighter grey, massive, hard.		21
@ 23-24 m dominantly fine grained sandstone, minor carbonaceous shale/siltstone- dark grey.	Dusty drilling no water upon airlift	24
@ 24-25 m dominantly carbonaceous shale/siltstone, minor lighter grey fine grained sandstone.		
25 m **Bottom of the hole**		27
		30

Bore Construction



Prepared by: DP
Checked by: BL

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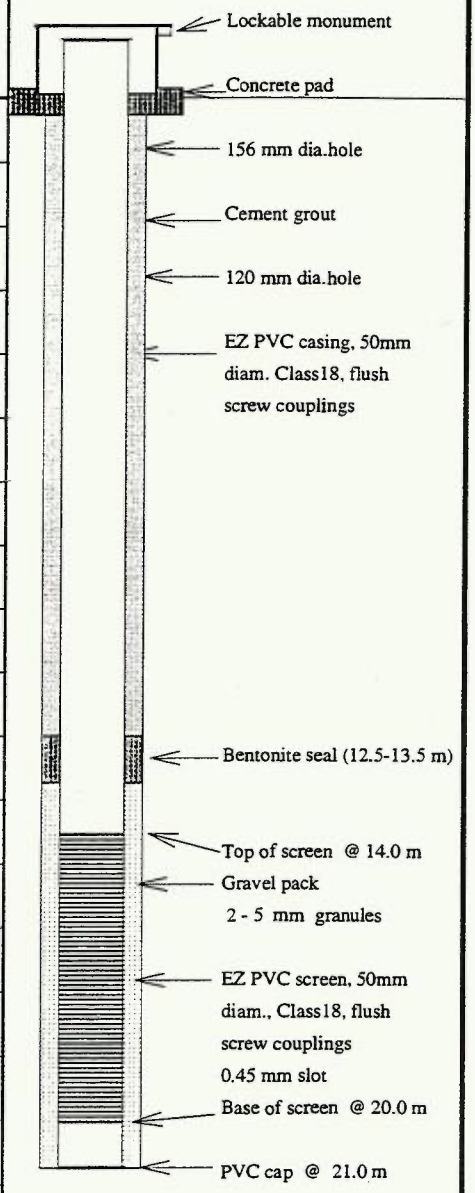
WOODWARD - CLYDE

PROJECT : CSR - Construction Materials		JOB NO:	A8600819/002
LOCATION: Schofields		DATE STARTED:	7.11.96
SUPERVISOR: Dino Parisotto		DATE COMPLETED:	7.11.96
INSTALLED BY: Intertech Drilling	METHOD: RAB/ Down hole hammer	DIAMETER:	156 mm, 120 mm
RIG: Intertech 650	TOTAL DEPTH : 21.0 m	R.L. GROUND:	30.97 m AHD
DATUM: 0.94 m top of monument a.s.	SWL: 14.40 m (b.d. 4/12/96)	R.L. SWL :	17.51 m AHD

BORE NUMBER: BH-012

Lithological Log	Remarks	Depth (m)
0 -1 m CLAY: mottled brown-red and grey, some shale fragments, firm, slight moisture.	Blade bit 156 mm	
@ 1-3 m grey clay, some Fe staining on joints		
	Blade bit 120 mm	2.5
3-21 m SHALE/SILTSTONE: grey/brown, highly weathered, Fe stained, friable, slight moisture.		
@ 4-6 m low-mod weathered, partly carbonaceous		5
@ 6-11 m grey, slightly weathered, harder material		7.5
		10
11 m base of weathering	Hammer 120 mm	
@ 11-14 m dark grey carbonaceous shale/siltstone		12.5
@ 14-16 m dark grey carbonaceous siltstone and lighter grey fine grained sandstone		15
@ 16-17 m dark grey carbonaceous siltstone/shale, minor brown-grey claystone.		
@ 17-21 m dark grey carbonaceous siltstone/shale, massive.		17.5
@ 17-19 m minor fine grained sandstone		
@ 19-20 m minor brown-grey claystone	Dusty drilling no water upon airlift	20
21.0 m Bottom of the hole		22.5
		25

Bore Construction



S:\A8600819.002\BH012.XLS\16/12/96\DP

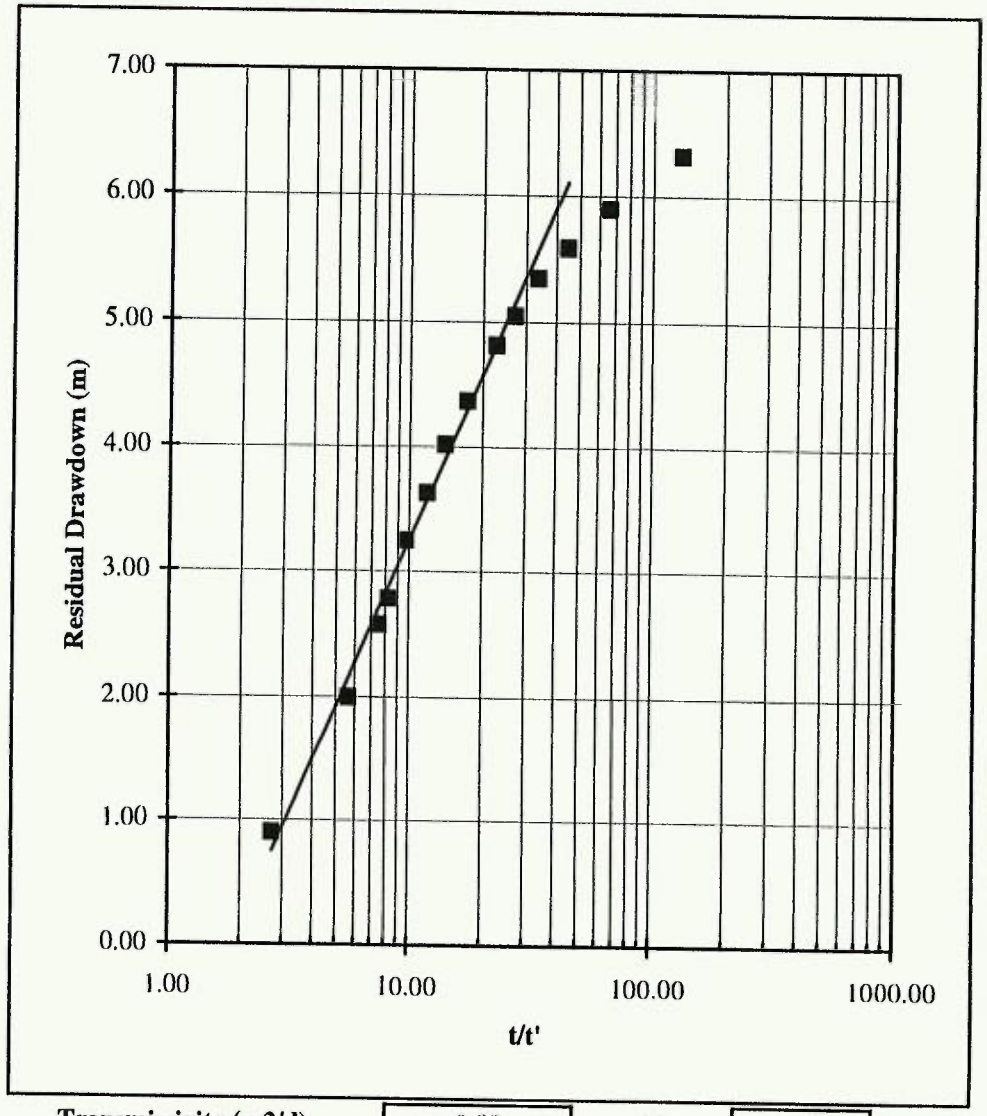
Prepared by: DP
Checked by: BL

APPENDIX B

PERMEABILITY TEST PLOTS

Test Date	19.11.96
Pumping Duration (min)	65.00
Standing Water Level (m)	5.10
Time Pumping Started	2:30 PM
Volume Removed (L)	95.00
Discharge Rate (m3/d)	2.10

Time Since Pumping Started, t (min)	Time Since Pumping Stopped, t' (min)	t/t'	Water Level (m)	Residual Drawdown s' (m)
65.50	0.5	131.00	11.42	6.32
66.00	1	66.00	11	5.90
66.50	1.5	44.33	10.69	5.59
67.00	2	33.50	10.45	5.35
67.50	2.5	27.00	10.15	5.05
68.00	3	22.67	9.92	4.82
69.00	4	17.25	9.47	4.37
70.00	5	14.00	9.12	4.02
71.00	6	11.83	8.73	3.63
72.50	7.5	9.67	8.35	3.25
74.00	9	8.22	7.88	2.78
75.00	10	7.50	7.67	2.57
79.00	14	5.64	7.1	2.00
103.00	38	2.71	6	0.90



Aquifer section Tested (m) 7.3

Transmissivity (m2/d) 0.09

Hydraulic conductivity (m/day) 1.20E-02

^S 4.41

Y Intercept -1.16

Woodward-Clyde

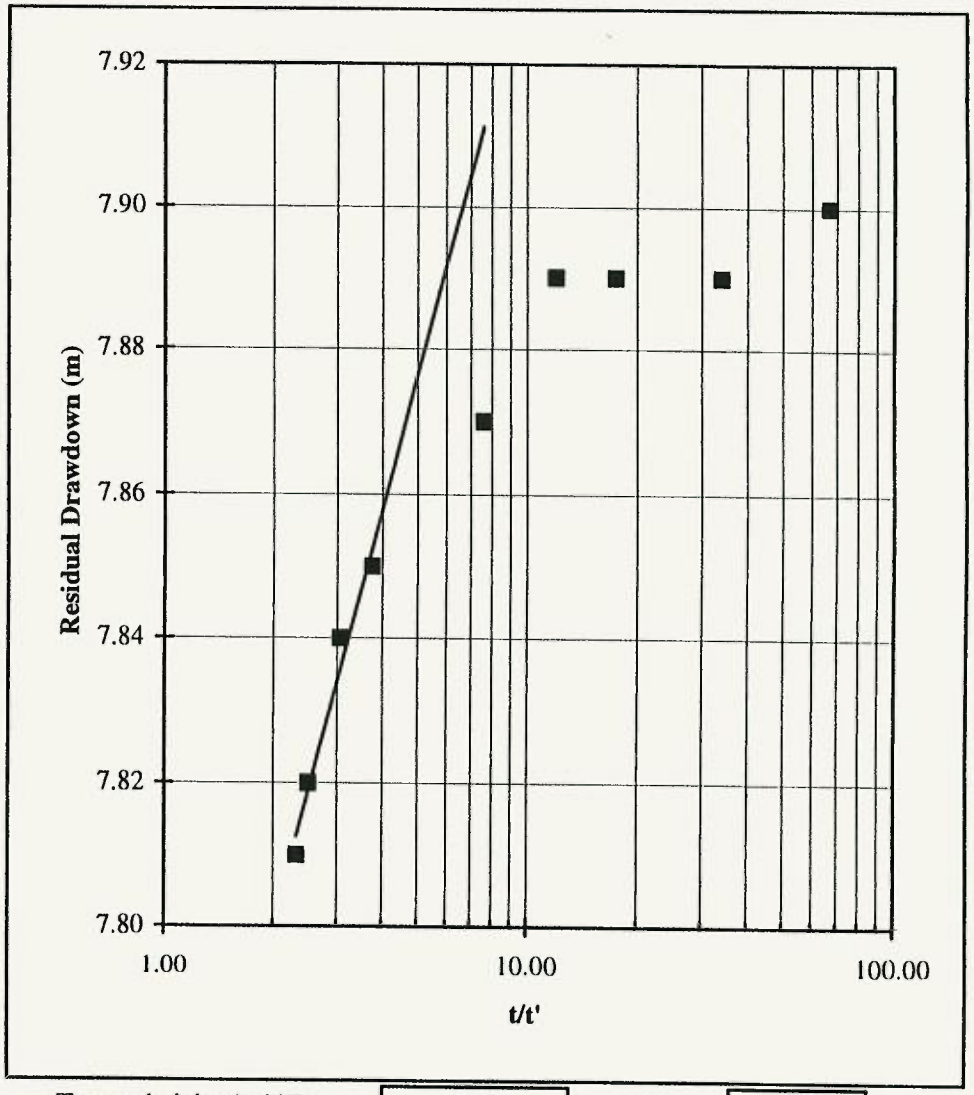
CSR : Schofields
RECOVERY TEST
BORE BH-09

S:a8600819/002.XLS.RECOVY09.NOV96.DP

PREPARED BY: DP
CHECKED BY: BL
APPROVED BY:

Test Date	23.11.96
Pumping Duration (min)	33.00
Standing Water Level (m)	20.81
Time Pumping Started	4:45 PM
Volume Removed (L)	50.00
Discharge Rate (m3/d)	2.18

Time Since Pumping Started, t (min)	Time Since Pumping Stopped, t' (min)	t/t'	Water Level (m)	Residual Drawdown s' (m)
33.50	0.5	67.00	28.71	7.90
34.00	1	34.00	28.7	7.89
35.00	2	17.50	28.7	7.89
36.00	3	12.00	28.7	7.89
38.00	5	7.60	28.68	7.87
45.00	12	3.75	28.66	7.85
49.00	16	3.06	28.65	7.84
55.00	22	2.50	28.63	7.82
58.00	25	2.32	28.62	7.81



Aquifer section Tested (m)	6	Transmissivity (m2/d)	2.09	^S	0.19
		Hydraulic conductivity (m/day)	3.48E-01	Y Intercept	7.74

Woodward-Clyde

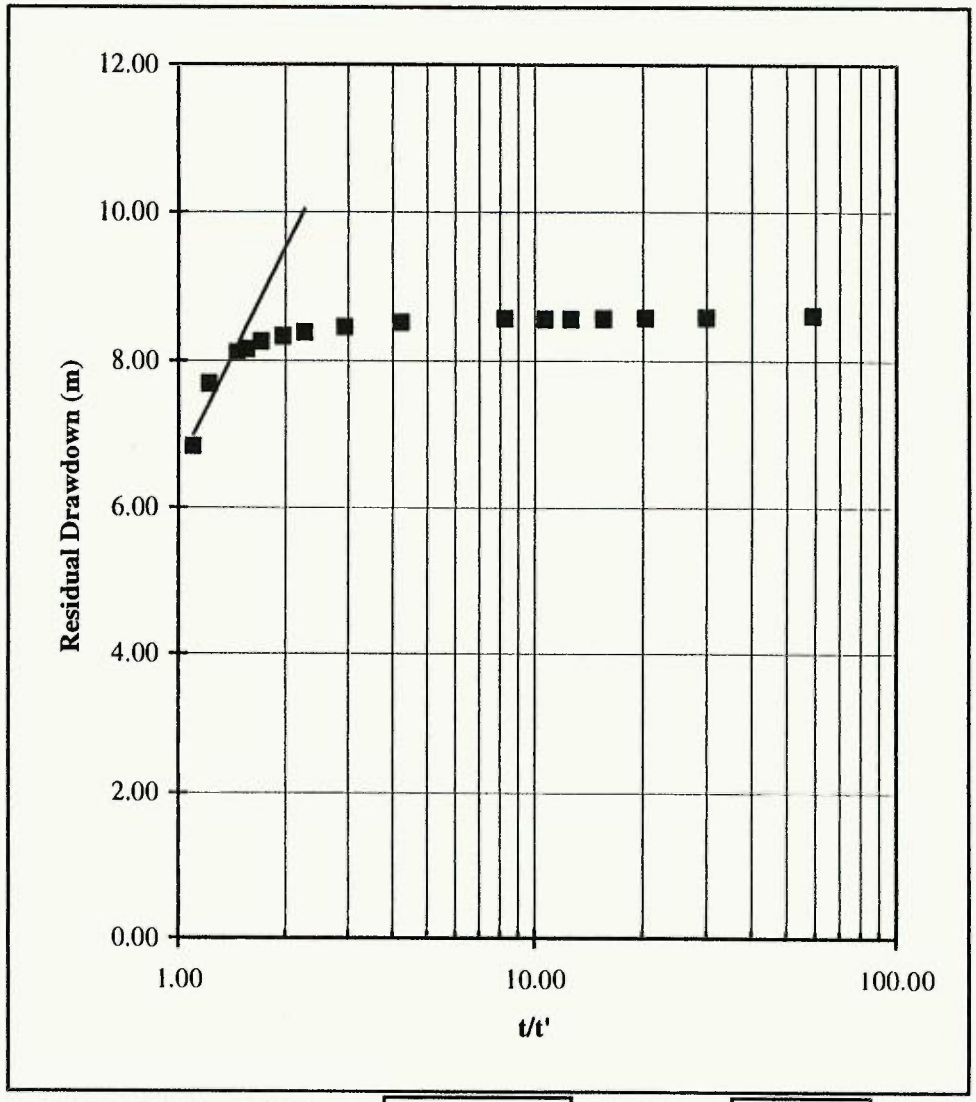
CSR : Schofields
RECOVERY TEST
BORE BH-010

a8600819/002.xls.RECOVY10a.NOV96.DP

PREPARED BY: DP
CHECKED BY: B.C.
APPROVED BY:

Test Date	20.11.96
Pumping Duration (min)	29.00
Standing Water Level (m)	12.19
Time Pumping Started	11:07 AM
Volume Removed (L)	40.00
Discharge Rate (m3/d)	1.99

Time Since Pumping Started, t (min)	Time Since Pumping Stopped, t' (min)	t/t'	Water Level (m)	Residual Drawdown s' (m)
29.50	0.5	59.00	20.8	8.61
30.00	1	30.00	20.78	8.59
30.50	1.5	20.33	20.77	8.58
31.00	2	15.50	20.76	8.57
31.50	2.5	12.60	20.75	8.56
32.00	3	10.67	20.75	8.56
33.00	4	8.25	20.76	8.57
38.00	9	4.22	20.71	8.52
44.00	15	2.93	20.65	8.46
52.00	23	2.26	20.57	8.38
59.00	30	1.97	20.52	8.33
70.00	41	1.71	20.45	8.26
81.00	52	1.56	20.35	8.16
92.00	63	1.46	20.3	8.11
162.00	133	1.22	19.89	7.70
325.00	296	1.10	19.03	6.84



Transmissivity (m2/d)	0.04	^S	9.69
Aquifer section Tested (m)	8	Hydraulic conductivity (m/day)	4.69E-03	Y Intercept	6.61

Woodward-Clyde

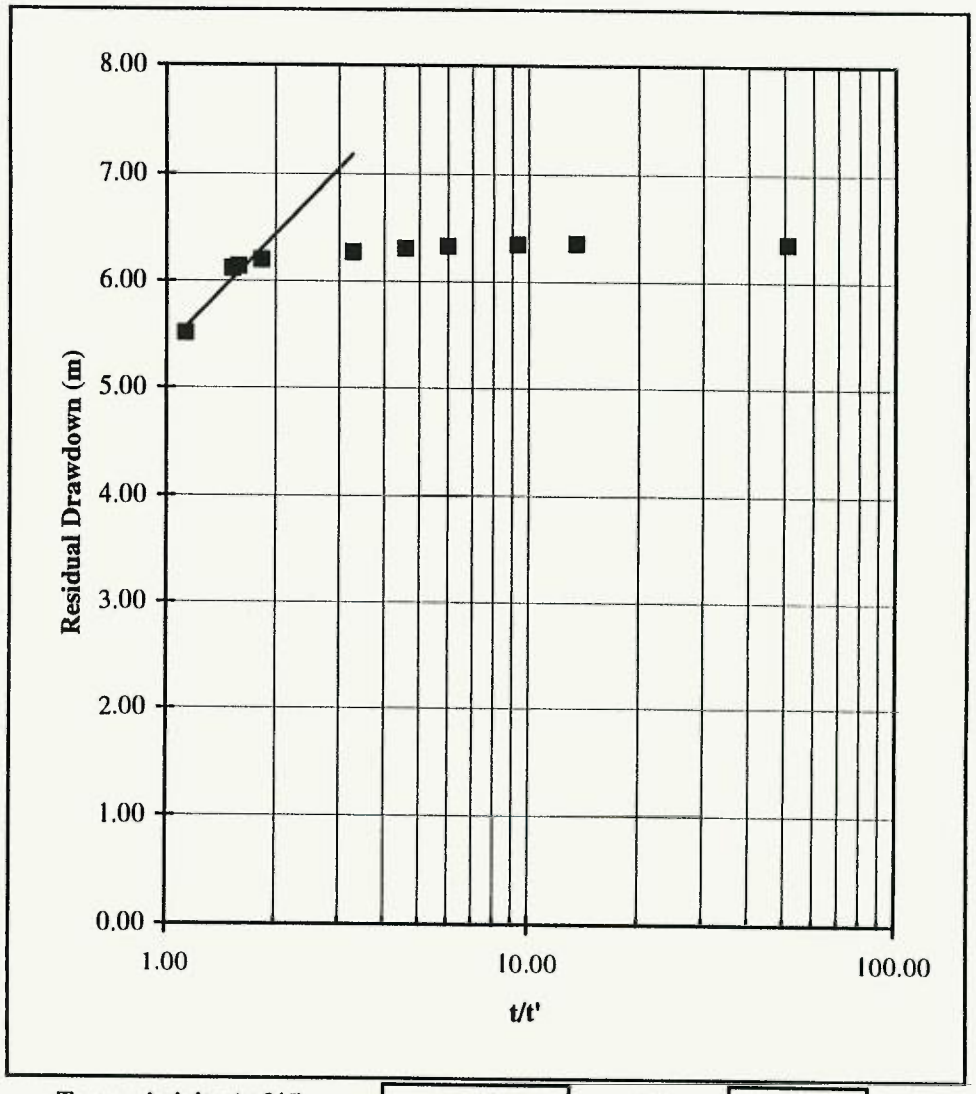
CSR : Schofields
RECOVERY TEST
BORE BH-011

PREPARED BY: DP
CHECKED BY: BL
APPROVED BY:

a8600819/002.XLS.RECOV11.NOV96.DP

Test Date	20.11.96
Pumping Duration (min)	25.00
Standing Water Level (m)	14.29
Time Pumping Started	12:50 PM
Volume Removed (L)	40.00
Discharge Rate (m3/d)	2.30

Time Since Pumping Started, t (min)	Time Since Pumping Stopped, t' (min)	t/t'	Water Level (m)	Residual Drawdown s' (m)
25.50	0.5	51.00	20.65	6.36
27.00	2	13.50	20.65	6.36
28.00	3	9.33	20.64	6.35
30.00	5	6.00	20.62	6.33
32.00	7	4.57	20.6	6.31
36.00	11	3.27	20.56	6.27
55.00	30	1.83	20.49	6.20
68.00	43	1.58	20.43	6.14
73.00	48	1.52	20.41	6.12
219.00	194	1.13	19.8	5.51



Aquifer section Tested (m)	7.5	Transmissivity (m2/d)	0.12	^S	3.50
		Hydraulic conductivity (m/day)	1.61E-02	Y Intercept	5.38

Woodward-Clyde

CSR : Schofields
RECOVERY TEST
BORE BH-012

a8600819/002.XLS.RECOVY12.NOV96.DP

PREPARED BY: DP
CHECKED BY: BL
APPROVED BY:

APPENDIX C

LABORATORY CERTIFICATES

SERVICES P/L
A.C.N. 009 936 029

ANALYTICAL REPORT

LABORATORY: ENV SYDNEY
BATCH NUMBER: ES4029
SUB BATCH: 0
No. OF SAMPLES: 1
DATE RECEIVED: 09/12/96
DATE COMPLETED: 21/12/96

CONTACT: MR F CAROSONE
CLIENT: AGC WOODWARD-CLYDE (NSW)
ADDRESS: LEVEL 6, 486-494 PACIFIC H'WAY
ST LEONARDS NSW 2065

ORDER No.: A8600819/002 SAMPLE TYPE: WATER PROJECT:

Method	Analysis description	Units	LOR	BH-11 06/12/96
EA-005	pH Value		0.01	7.10
EA-015	Total Dissolved Solids (TDS)	mg/L	1	16300
ED-005F	Calcium - Filtered	mg/L	1	1100
ED-010F	Magnesium - Filtered	mg/L	1	969
ED-015F	Sodium - Filtered	mg/L	1	2740
ED-020F	Potassium - Filtered	mg/L	1	12
ED-035	Bicarbonate as CaCO3	mg/L	1	371
ED-040F	Sulphate - Filtered	mg/L	1	564
ED-045	Chloride	mg/L	1	8270
EG-005F	Iron - Filtered	mg/L	1	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	0.012
	Manganese - Filtered	mg/L	0.001	0.140
	Lead - Filtered	mg/L	0.001	0.005
	Zinc - Filtered	mg/L	0.001	0.023
EK-030	Cyanide amenable to chlorination	mg/L	0.005	<0.005
EK-055A	Ammonia as N	mg/L	0.01	2.22
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	254
EZ-010	Total Anions	me/L	0.01	252
EZ-015	Actual (Anion / Cation) Difference	me/L	0.01	1.66
EZ-020	Allowed (Anion / Cation) Difference	me/L	0.01	4.02

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COMMENTS:

LOR for Iron raised (x10) due to high dissolved salts.

This 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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Melbourne
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SERVICES P/L
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ANALYTICAL REPORT

LABORATORY: ENV SYDNEY
BATCH NUMBER: ES4029
SUB BATCH: 0
No. OF SAMPLES: 1
DATE RECEIVED: 09/12/96
DATE COMPLETED: 21/12/96

CONTACT: MR F CAROSONE
CLIENT: AGC WOODWARD-CLYDE (NSW)
ADDRESS: LEVEL 6, 486-494 PACIFIC H'WAY
ST LEONARDS NSW 2065

ORDER No.: A8600819/002 SAMPLE TYPE: QUALITY CONTROL PROJECT:

Method	Analysis description	Units	LOR	BH-11 %SPK REC 06/12/96	BH-11 CHK 06/12/96	BLANK
EA-005	pH Value		0.01	----	7.11	----
EA-015	Total Dissolved Solids (TDS)	mg/L	1	----	15400	<1
ED-005F	Calcium - Filtered	mg/L	1	----	1100	<1
ED-010F	Magnesium - Filtered	mg/L	1	----	973	<1
ED-015F	Sodium - Filtered	mg/L	1	----	2810	<1
ED-020F	Potassium - Filtered	mg/L	1	----	12	<1
ED-035	Bicarbonate as CaCO3	mg/L	1	----	368	----
ED-040F	Sulphate - Filtered	mg/L	1	----	567	<1
ED-045	Chloride	mg/L	1	79.0 %	8320	<1
EG-005F	Iron - Filtered	mg/L	1	89.0 %	1	<1
EG-020F	Arsenic - Filtered	mg/L	0.01	100 %	0.01	<0.01
	Cadmium - Filtered	mg/L	0.001	98.0 %	<0.001	<0.001
	Copper - Filtered	mg/L	0.001	106 %	0.013	<0.001
	Manganese - Filtered	mg/L	0.001	105 %	0.145	<0.001
	Lead - Filtered	mg/L	0.001	98.0 %	0.005	<0.001
	Zinc - Filtered	mg/L	0.001	105 %	0.020	<0.001
EK-030	Cyanide amenable to chlorination	mg/L	0.005	----	<0.005	<0.005
EK-055A	Ammonia as N	mg/L	0.01	110 %	2.19	<0.01
EK-058A	Nitrate as N	mg/L	0.01	102 %	0.08	<0.01
EK-085	Sulphide	mg/L	0.1	----	<0.1	<0.1
EP-030	Biochemical Oxygen Demand	mg/L	2	----	----	----
EP-035	Phenols	mg/L	0.2	----	<0.2	<0.2
EZ-005	Total Cations	me/L	0.01	----	258	----
EZ-010	Total Anions	me/L	0.01	----	254	----
EZ-015	Actual (Anion / Cation) Difference	me/L	0.01	----	3.62	----
EZ-020	Allowed (Anion / Cation) Difference	me/L	0.01	----	4.04	----

COMMENTS:

Results which appear on this report are for laboratory QUALITY CONTROL purposes.

This 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: ENV SYDNEY
BATCH NUMBER: ES4029
SUB BATCH: 1
No. OF SAMPLES: 2
DATE RECEIVED: 09/12/96
DATE COMPLETED: 21/12/96

CONTACT: MR F CAROSONE
CLIENT: AGC WOODWARD-CLYDE (NSW)
ADDRESS: LEVEL 6, 486-494 PACIFIC H'WAY
ST LEONARDS NSW 2065

ORDER No.: A8600819/002 SAMPLE TYPE: WATER PROJECT:

Method	Analysis description	Units	LOR	BH-11 06/12/96	TRIP-02 06/12/96
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	<1
	Toluene	ug/L	2	<2	<2
	Chlorobenzene	ug/L	2	<2	<2
	Ethylbenzene	ug/L	2	<2	<2
	meta- & para-Xylene	ug/L	2	<2	<2
	ortho-Xylene	ug/L	2	<2	<2
EP-080S-WS	VOLATILE TPH/BTEX COMPOUND SURROGATES				
	1,2-Dichloroethane-D4	%	1	105	93
	Toluene-D8	%	1	103	95
	4-Bromofluorobenzene	%	1	101	94

COMMENTS:

This 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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ORGANICS QUALITY CONTROL REPORT

BATCH NO : ES4029

DATE BATCH RECEIVED : 9/12/96

CLIENT : WOODWARD-CLYDE

DATE BATCH COMPLETED : 20/12/96

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 102	N/A	18/12/96
	-Semivolatile	Water	USEPA 3510B	USEPA 8015A	NTPHW 94	10/12/96	12/12/96
EP-080	BTEX	Water	USEPA 5030 A	USEPA 8260A	NVOCW 102	N/A	18/12/96

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BATCH QUALITY CONTROL

ALS EP-071 : Total Petroleum Hydrocarbons by Fractions

QC Lot No. : NVOCW102 ANALYST: S. Asre
MATRIX: Water

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	190	194	96.1	2	83	113	20
C10	20	<LOR	50	42	43	85.7	3	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.: NTPHW94

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	193	197	141	88	33	56	117	20
C15-C28	25	<LOR	505	435	415	84	5	76	128	20
C29-C36	25	<LOR	200	201	172	93	16	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. : NVOCW102
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	10.72	12.82	118	18	72	128	20
Toluene	<LOR	10	9.65	10.53	101	9	76	125	20
Chlorobenzene	<LOR	10	9.81	11.62	107	17	86	115	20
Ethylbenzene	<LOR	10	9.86	10.75	103	9	86	114	20
m- & p-Xylene	<LOR	10	9.77	10.75	103	10	86	115	20
o-Xylene	<LOR	10	9.75	11.21	105	14	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.

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Job No. L&C-96-138

17th December, 1996

Australian Laboratory Services Pty. Ltd.,
Attn. Mr. BRIAN WILLIAMS.
P.O. Box 63,
Rydalmere. NSW 2116.

Dear Brian,

REPORT

RE: MEASUREMENT OF HALOGENATED ORGANICS

Purchase Order No. 58342
Ref. No. ES4029

I refer to your request regarding AOX analysis of aqueous sample received on 10th December, 1996.

The result is now attached.

Yours sincerely,

George Levay
Managing Director

Enc.

DATE RECEIVED 24-12 FAX / COURIER
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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-96-138			
	AUSTRALIAN LABORATORY		
	SERVICES PTY. LTD.		
	New South Wales		
Sample	Sample	Date	AOX
No.	Description		(ppb)
	AOX Analyses		
	Purchase Order. No. 58342		
	Ref. No. ES4029		
1	BH-011	06/12/96	46

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

AUSTRALIAN LABORATORY SERVICES P/L

A.C.N. 009 936 029

ANALYTICAL REPORT

CONTACT:	MR B LIDDLE	LABORATORY:	ENV SYDNEY
CLIENT:	AGC WOODWARD-CLYDE (NSW)	BATCH NUMBER:	ES3807
ADDRESS:	LEVEL 6, 486-494 PACIFIC H'WAY ST LEONARDS NSW 2065	SUB BATCH:	0
		No. OF SAMPLES:	2
		DATE RECEIVED:	21/11/96
		DATE COMPLETED:	10/12/96

ORDER No.: A8600819/002 SAMPLE TYPE: WATER PROJECT:

Method	Analysis description	Units	LOR	BH-012 21/11/96	BLANK 21/11/96
EA-005	pH Value		0.01	7.32	7.69
EA-015	Total Dissolved Solids (TDS)	mg/L	1	13800	4
ED-005F	Calcium - Filtered	mg/L	1	370	<1
ED-010F	Magnesium - Filtered	mg/L	1	635	<1
ED-015F	Sodium - Filtered	mg/L	1	3160	<1
ED-020F	Potassium - Filtered	mg/L	1	45	<1
ED-035	Bicarbonate as CaCO3	mg/L	1	670	5
ED-040F	Sulphate - Filtered	mg/L	1	627	<1
ED-045	Chloride	mg/L	1	6460	<1
EG-005F	Iron - Filtered	mg/L	0.1	1.0	<0.1
EG-020F	Arsenic - Filtered	mg/L	0.01	<0.01	<0.01
	Cadmium - Filtered	mg/L	0.001	<0.001	<0.001
	Copper - Filtered	mg/L	0.001	0.008	<0.001
	Manganese - Filtered	mg/L	0.001	0.392	<0.001
	Lead - Filtered	mg/L	0.001	0.024	<0.001
	Zinc - Filtered	mg/L	0.001	0.060	0.006
EK-030	Cyanide amenable to chlorination	mg/L	0.005	<0.005	<0.005
EK-055A	Ammonia as N	mg/L	0.01	1.58	<0.01
EK-058A	Nitrate as N	mg/L	0.01	<0.01	<0.01
EK-085	Sulphide	mg/L	0.1	<0.1	<0.1
EP-030	Biochemical Oxygen Demand	mg/L	2	4	2
EP-035	Phenols	mg/L	0.2	<0.2	<0.2
EZ-005	Total Cations	me/L	0.01	209	<0.01
EZ-010	Total Anions	me/L	0.01	209	0.10
EZ-015	Actual (Anion / Cation) Difference	me/L	0.01	0.64	0.10
EZ-020	Allowed (Anion / Cation) Difference	me/L	0.01	3.34	0.11

RECEIVED 12 DEC 1996 BGL

OMMENTS:

Metal detection limits raised for Iron (x10) due to high concentration of dissolved salts. This report supersedes any previous preliminary reports of the same batch number.

Chris Janoliuk

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A.C.N. 009 936 029

ANALYTICAL REPORT

CONTACT:	MR B LIDDLE	LABORATORY:	ENV SYDNEY
CLIENT:	AGC WOODWARD-CLYDE (NSW)	BATCH NUMBER:	ES3807
ADDRESS:	LEVEL 6, 486-494 PACIFIC H'WAY ST LEONARDS NSW 2065	SUB BATCH:	0
		No. OF SAMPLES:	2
		DATE RECEIVED:	21/11/96
		DATE COMPLETED:	10/12/96

ORDER No.: A8600819/002 SAMPLE TYPE: QUALITY CONTROL PROJECT:

Method	Analysis description	Units	LOR	BH-012 %SPK REC 21/11/96	BLANK CHK 21/11/96	METHOD BLANK
EA-005	pH Value		0.01	----	7.70	----
EA-015	Total Dissolved Solids (TDS)	mg/L	1	----	2	<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	----	5	----
ED-040F	Sulphate - Filtered	mg/L	1	----	<1	<1
ED-045	Chloride	mg/L	1	----	<1	<1
EG-005F	Iron - Filtered	mg/L	0.1	100 %	<0.1	<0.1
EG-020F	Arsenic - Filtered	mg/L	0.01	105 %	<0.01	<0.01
	Cadmium - Filtered	mg/L	0.001	94.0 %	<0.001	<0.001
	Copper - Filtered	mg/L	0.001	88.0 %	<0.001	<0.001
	Manganese - Filtered	mg/L	0.001	78.0 %	<0.001	<0.001
	Lead - Filtered	mg/L	0.001	86.0 %	<0.001	<0.001
	Zinc - Filtered	mg/L	0.001	98.0 %	0.007	<0.001
EK-030	Cyanide amenable to chlorination	mg/L	0.005	----	<0.005	<0.005
EK-055A	Ammonia as N	mg/L	0.01	93.0 %	<0.01	<0.01
EK-058A	Nitrate as N	mg/L	0.01	88.0 %	<0.01	<0.01
EK-085	Sulphide	mg/L	0.1	----	<0.1	<0.1
EP-030	Biochemical Oxygen Demand	mg/L	2	----	----	----
EP-035	Phenols	mg/L	0.2	80.0 %	<0.2	<0.2
EZ-005	Total Cations	me/L	0.01	----	<0.01	----
EZ-010	Total Anions	me/L	0.01	----	0.10	----
EZ-015	Actual (Anion / Cation) Difference	me/L	0.01	----	0.10	----
EZ-020	Allowed (Anion / Cation) Difference	me/L	0.01	----	0.11	----

OMMENTS:

Results which appear on this report are for laboratory QUALITY CONTROL purposes.

Ched Jandrisich

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ANALYTICAL REPORT

CONTACT:	MR B LIDDLE	LABORATORY:	ENV SYDNEY
CLIENT:	AGC WOODWARD-CLYDE (NSW)	BATCH NUMBER:	ES3807
ADDRESS:	LEVEL 6, 486-494 PACIFIC H'WAY ST LEONARDS NSW 2065	SUB BATCH:	1
		No. OF SAMPLES:	2
		DATE RECEIVED:	21/11/96
		DATE COMPLETED:	10/12/96

ORDER No.: A8600819/002 SAMPLE TYPE: WATER PROJECT:

Method	Analysis description	Units	LOR	BH-012 21/11/96	BLANK 21/11/96
EP-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	<100
	C29 - C36 Fraction	ug/L	50	<50	<50
EP-080-WS	BTEX				
	Benzene	ug/L	1	<1	<1
	Toluene	ug/L	2	<2	<2
	Chlorobenzene	ug/L	2	<2	<2
	Ethylbenzene	ug/L	2	<2	<2
	meta- & para-Xylene	ug/L	2	<2	<2
	ortho-Xylene	ug/L	2	<2	<2
EP-080S-WS	VOLATILE TPH/BTEX COMPOUND SURROGATES				
	1,2-Dichloroethane-D4	%	1	95	97
	Toluene-D8	%	1	94	97
	4-Bromofluorobenzene	%	1	97	99

OMMENTS:

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ORGANICS QUALITY CONTROL REPORT

BATCH NO : ES3807

DATE BATCH RECEIVED : 21/11/96

CLIENT : AGC Woodward-Clyde

DATE BATCH COMPLETED : 06/12/96

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	NVOCW95	N/A	03/12/96
	-Semivolatile	Water	USEPA 3510B	USEPA 8015A	NTPHW88	29/11/96	01/12/96
EP-080	BTEX	Water	USEPA 5030 A	USEPA 8260A	NVOCW95	N/A	03/12/96

BATCH QUALITY CONTROL

ALS EP-071 : Total Petroleum Hydrocarbons by Fractions

QC Lot No. : NVOCW95 ANALYST: R. DAUBNEY
MATRIX: Water

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	170	167	84.4	2	83	113	20
C10	20	<LOR	50	47	47	93.4	1	71	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: M.NGUYEN

QC LOT No.: NTPHW88

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	204	217	101	6	56	117	20
C15-C28	25	<LOR	530	529	489	96	8	76	128	20
C29-C36	25	<LOR	304	254	231	80	9	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. : NVOCW95
MATRIX: Water

ANALYST: R. DAUBNEY

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	8.79	8.87	88	1	72	128	20
Toluene	<LOR	10	7.71	7.68	77	0	76	125	20
Chlorobenzene	<LOR	10	9.12	9.09	91	0	86	115	20
Ethylbenzene	<LOR	10	9.00	9.08	90	1	86	114	20
m- & p-Xylene	<LOR	10	9.08	9.99	95	10	86	115	20
o-Xylene	<LOR	10	9.13	9.20	92	1	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.

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A.C.N. 009 936 029

ANALYTICAL REPORT

LABORATORY: ENV SYDNEY
BATCH NUMBER: ES3807
SUB BATCH: 0
No. OF SAMPLES: 2
DATE RECEIVED: 21/11/96
DATE COMPLETED: 10/12/96

CONTACT: MR F CAROSONE
CLIENT: AGC WOODWARD-CLYDE (NSW)
ADDRESS: LEVEL 6, 486-494 PACIFIC H'WAY
ST LEONARDS NSW 2065

ORDER No.: A8600819/002 SAMPLE TYPE: WATER PROJECT:

Method	Analysis description	Units	LOR	BH-012 21/11/96	BLANK 21/11/96
EA-005	pH Value		0.01	7.32	7.69
EA-015	Total Dissolved Solids (TDS)	mg/L	1	13800	4
ED-005F	Calcium - Filtered	mg/L	1	370	<1
ED-010F	Magnesium - Filtered	mg/L	1	635	<1
ED-015F	Sodium - Filtered	mg/L	1	3160	<1
ED-020F	Potassium - Filtered	mg/L	1	45	<1
ED-035	Bicarbonate as CaCO3	mg/L	1	670	5
ED-040F	Sulphate - Filtered	mg/L	1	627	<1
ED-045	Chloride	mg/L	1	6460	<1
EG-005F	Iron - Filtered	mg/L	0.1	1.0	<0.1
EG-020F	Arsenic - Filtered	mg/L	0.01	<0.01	<0.01
	Cadmium - Filtered	mg/L	0.001	<0.001	<0.001
	Copper - Filtered	mg/L	0.001	0.008	<0.001
	Manganese - Filtered	mg/L	0.001	0.392	<0.001
	Lead - Filtered	mg/L	0.001	0.024	<0.001
	Zinc - Filtered	mg/L	0.001	0.060	0.006
EK-030	Cyanide amenable to chlorination	mg/L	0.005	<0.005	<0.005
EK-055A	Ammonia as N	mg/L	0.01	1.58	<0.01
EK-058A	Nitrate as N	mg/L	0.01	<0.01	<0.01
EK-085	Sulphide	mg/L	0.1	<0.1	<0.1
EP-030	Biochemical Oxygen Demand	mg/L	2	4	2
EP-035	Phenols	mg/L	0.2	<0.2	<0.2
EZ-005	Total Cations	me/L	0.01	209	<0.01
EZ-010	Total Anions	me/L	0.01	209	0.10
EZ-015	Actual (Anion / Cation) Difference	me/L	0.01	0.64	0.10
EZ-020	Allowed (Anion / Cation) Difference	me/L	0.01	3.34	0.11

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12 DEC 1996
FC LAB046

OMMENTS:

Metal detection limits raised for Iron (x10) due to high concentration of dissolved salts. This report supersedes any previous preliminary reports of the same batch number.

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• 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:	ENV SYDNEY
BATCH NUMBER:	ES3807
SUB BATCH:	0
No. OF SAMPLES:	2
DATE RECEIVED:	21/11/96
DATE COMPLETED:	10/12/96

ORDER No.: A8600819/002 SAMPLE TYPE: QUALITY CONTROL PROJECT:

Method	Analysis description	Units	LOR	BH-012 %SPK REC 21/11/96		BLANK CHK 21/11/96	METHOD BLANK
EA-005	pH Value		0.01	----		7.70	----
EA-015	Total Dissolved Solids (TDS)	mg/L	1	----		2	<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	----		5	----
ED-040F	Sulphate - Filtered	mg/L	1	----		<1	<1
ED-045	Chloride	mg/L	1	----		<1	<1
EG-005F	Iron - Filtered	mg/L	0.1	100	%	<0.1	<0.1
EG-020F	Arsenic - Filtered	mg/L	0.01	105	%	<0.01	<0.01
	Cadmium - Filtered	mg/L	0.001	94.0	%	<0.001	<0.001
	Copper - Filtered	mg/L	0.001	88.0	%	<0.001	<0.001
	Manganese - Filtered	mg/L	0.001	78.0	%	<0.001	<0.001
	Lead - Filtered	mg/L	0.001	86.0	%	<0.001	<0.001
	Zinc - Filtered	mg/L	0.001	98.0	%	0.007	<0.001
EK-030	Cyanide amenable to chlorination	mg/L	0.005	----		<0.005	<0.005
EK-055A	Ammonia as N	mg/L	0.01	93.0	%	<0.01	<0.01
EK-058A	Nitrate as N	mg/L	0.01	88.0	%	<0.01	<0.01
EK-085	Sulphide	mg/L	0.1	----		<0.1	<0.1
EP-030	Biochemical Oxygen Demand	mg/L	2	----		----	----
EP-035	Phenols	mg/L	0.2	80.0	%	<0.2	<0.2
EZ-005	Total Cations	me/L	0.01	----		<0.01	----
EZ-010	Total Anions	me/L	0.01	----		0.10	----
EZ-015	Actual (Anion / Cation) Difference	me/L	0.01	----		0.10	----
EZ-020	Allowed (Anion / Cation) Difference	me/L	0.01	----		0.11	----

COMMENTS:

Results which appear on this report are for laboratory QUALITY CONTROL purposes.

Chad Jerolimek

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ANALYTICAL REPORT

CONTACT:	MR F CAROSONE	LABORATORY:	ENV SYDNEY
CLIENT:	AGC WOODWARD-CLYDE (NSW)	BATCH NUMBER:	ES3807
ADDRESS:	LEVEL 6, 486-494 PACIFIC H'WAY ST LEONARDS NSW 2065	SUB BATCH:	1
		No. OF SAMPLES:	2
		DATE RECEIVED:	21/11/96
		DATE COMPLETED:	10/12/96

ORDER No.: A8600819/002 SAMPLE TYPE: WATER PROJECT:

Method	Analysis description	Units	LOR	BH-012 21/11/96	BLANK 21/11/96
EP-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	<100
	C29 - C36 Fraction	ug/L	50	<50	<50
EP-080-WS	BTEX				
	Benzene	ug/L	1	<1	<1
	Toluene	ug/L	2	<2	<2
	Chlorobenzene	ug/L	2	<2	<2
	Ethylbenzene	ug/L	2	<2	<2
	meta- & para-Xylene	ug/L	2	<2	<2
	ortho-Xylene	ug/L	2	<2	<2
EP-080S-WS	VOLATILE TPH/BTEX COMPOUND SURROGATES				
	1,2-Dichloroethane-D4	%	1	95	97
	Toluene-D8	%	1	94	97
	4-Bromofluorobenzene	%	1	97	99

COMMENTS:

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• Results apply to sample(s) as submitted by client.

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ORGANICS QUALITY CONTROL REPORT

BATCH NO : ES3807

DATE BATCH RECEIVED : 21/11/96

CLIENT : AGC Woodward-Clyde

DATE BATCH COMPLETED : 06/12/96

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	NVOCW95	N/A	03/12/96
	-Semivolatile	Water	USEPA 3510B	USEPA 8015A	NTPHW88	29/11/96	01/12/96
EP-080	BTEX	Water	USEPA 5030 A	USEPA 8260A	NVOCW95	N/A	03/12/96

ALS EP-071 : Total Petroleum Hydrocarbons by Fractions

QC Lot No. : NVOCW95
MATRIX: Water

ANALYST: R. DAUBNEY

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	170	167	84.4	2	83	113	20
C10	20	<LOR	50	47	47	93.4	1	71	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: M.NGUYEN

QC LOT No.: NTPHW88

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	204	217	101	6	56	117	20
C15-C28	25	<LOR	530	529	489	96	8	76	128	20
C29-C36	25	<LOR	304	254	231	80	9	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. : NVOCW95 ANALYST: R. DAUBNEY
MATRIX: Water

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	8.79	8.87	88	1	72	128	20
Toluene	<LOR	10	7.71	7.68	77	0	76	125	20
Chlorobenzene	<LOR	10	9.12	9.09	91	0	86	115	20
Ethylbenzene	<LOR	10	9.00	9.08	90	1	86	114	20
m- & p-Xylene	<LOR	10	9.08	9.99	95	10	86	115	20
o-Xylene	<LOR	10	9.13	9.20	92	1	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-96-126

27th November, 1996

Australian Laboratory Services Pty. Ltd.,
Attn. Mr. BRIAN WILLIAMS.
P.O. Box 63,
Rydalmere. NSW 2116.

Dear Brian,

REPORT

RE: MEASUREMENT OF HALOGENATED ORGANICS

Purchase Order No. 58327
Ref. No. ES3807

I refer to your request regarding AOX analysis of aqueous samples received on 21st November, 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

LEVAY AND CO. - ENVIRONMENTAL SERVICES

Water Quality, Water Treatment and Environmental Pollution Research Laboratories

Job No.
L&C-96-126

AUSTRALIAN LABORATORY SERVICES PTY. LTD.
New South Wales

AOX Analyses

Purchase Order. No. 58327
Ref. No. ES3807

Sample No.	Sample Description	Date	AOX (ppb)
1	BH-012	21/11/96	40
2	Blank	"	19

A8600819-002
LAB 051
17-12 96

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

EML

EML CONSULTING SERVICES PTY LTD
A.C.N 006 308 774
Unit 6, 1 River Road West, Parramatta, NSW 2150
Telephone (02) 9893 9366 • Facsimile (02) 9893 8717

EML Reference: 96/09147

Order No:

ISO 9002

Report Date: 09 Dec 96

AGC Woodward Clyde Pty Ltd
Level 6, 486-494 Pacific Hwy
ST LEONARDS NSW 2065

Attention: Dino Parisotto

CERTIFICATE OF ANALYSIS

Date Received: 05 Dec 96 at 04:45 pm

Date Tested: 05 Dec 96 at 05:10 pm

Sample No:	96/09147- 1	
Sample Markings:	BH-011	
RESULT:	Coliforms	20 / 100ml
EML Method:	3.3.2.3	

cfu: Colony Forming Units
est: Estimated count below level regarded as statistically significant.

DATE RECEIVED 10-12
PROJECT No. 1SC819/002
DOCUMENT No LAB 042
DISTRIBUTION DP

Yours faithfully,
EML Consulting Services Pty Ltd,

Cheryl Newton BSc MASM AAIFST
Microbiologist

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EML

EML CONSULTING SERVICES PTY LTD
A.C.N 006 308 774
Unit 6, 1 River Road West, Parramatta, NSW 2150
Telephone (02) 9893 9366 • Facsimile (02) 9893 8717

EML Reference: 96/08786 Order No: 58326

Report Date: 25 Nov 96

QUALITY SYSTEM NATA CERTIFIED ISO 9002

Australian Laboratory Services Pty Ltd
Unit 28, Metrocentre
38-46 South Street
RYDALMERE NSW 2116

Attention: Mr.Brian Williams

Certificate of Analysis

Samples Received: 21 Nov 96 at 04:30 pm
Samples Tested: 21 Nov 96 at 04:35 pm

Overall Sample Marking:

EML	Sample Markings	Coliforms
1	1 BH-012 ES3807	54
2	2 Blank ES3807	0

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

DATE RECEIVED 27-12 FAX MAIL COURIER
PROJECT No. A86 0089.2 FILE No.
DOCUMENT No. LAB 050
DISTRIBUTION RGL.

Yours faithfully,
EML Consulting Services Pty. Ltd.

Cheryl Newton BSc (Hons) MASM AAIFST
Microbiologist

NATA

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EML GROUP OF LABORATORIES
Consulting Chemists & Microbiologists Sydney • Melbourne

SAMPLE SOURCE	:	Schfd–01
SAMPLE DESCRIPTION	:	GRAVELLY SILTY CLAY:mottled white–grey & red–brown,medium plasticity, fine to coarse grained gravel.
SAMPLE No	:	15232
INITIAL MOISTURE CONTENT	:	14.5 %
DRY DENSITY	:	1.83 t/c.m.
FINAL MOISTURE CONTENT	:	– %

COEFFICIENT OF PERMEABILITY

k : 6.1 x 10^–8 cm/sec.

being the average of 3 tests having a range 3.2 x 10^–8 to 8.6 x 10^–8 cm/sec

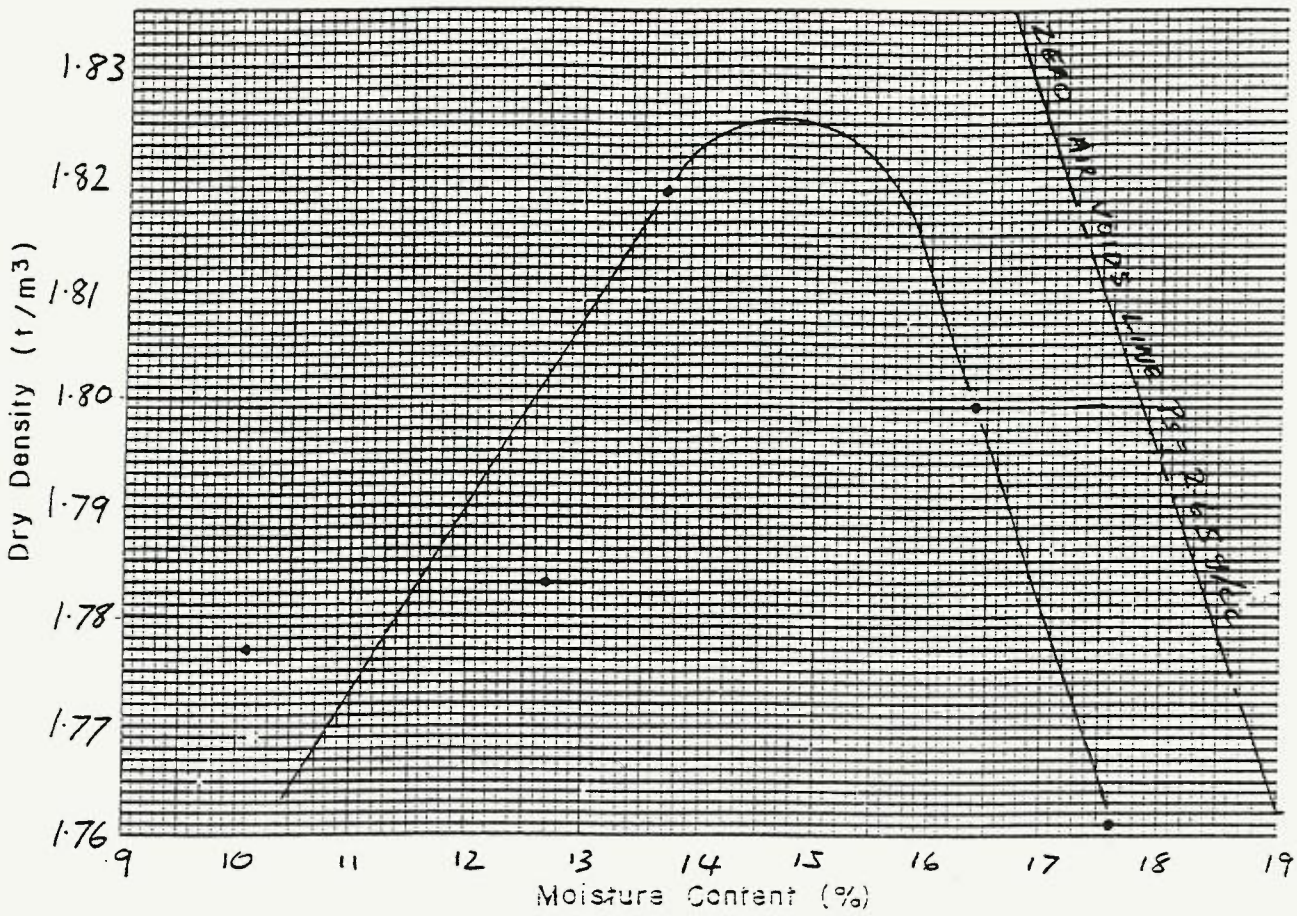
DATE TESTED	:	13/12/96
SAMPLED BY	:	CLIENT
COMMENTS	:	–

DATE RECEIVED 24-12 FAX MAIL COURIER
PROJECT No. FILE No.
DOCUMENT No.
DISTRIBUTION

Tested in accordance with Lambe & Whitman ch 19.

Form C3 File : FHPRPT

PROJECT WOODWARD CLYDE PTY LTD JOB NO. A86819/001/002	FALLING HEAD PERMEABILITY TEST REPORT AUSTRALIAN SOIL TESTING P/L 338 BOTANY RD, ALEXANDRIA NSW 2015. Telephone 3192111.



SAMPLE NO.:	15232	
SAMPLE SOURCE:	Schfd–01	

SAMPLE DESCRIPTION : **GRAVELLY SILTY CLAY:mottled white–grey & red–brown,** medium plasticity,fine to coarse grained gravel,

MAXIMUM DRY DENSITY:	1.83	t/c.m
OPTIMUM MOISTURE CONTENT:	14.5	%
MATERIAL RETAINED ON 19mm Sieve	9	%

COMPACTIVE EFFORT (STANDARD)

No of layers	3	
Blows per layer	25	
Mass of rammer	2.7	kg
Drop of rammer	300	mm

COMMENTS

Tested in accordance with:
AS1289.5.1.1; Standard Laboratory Compaction

THIS LABORATORY IS REGISTERED BY THE NATIONAL ASSOCIATION OF TESTING AUTHORITIES AUSTRALIA THE TESTS DESCRIBED HEREIN HAVE BEEN PERFORMED IN ACCORDANCE WITH ITS TERMS OF REGISTRATION. THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

SIGNED BY DATE 23/10/95

AUST SOIL TESTING P/L, 1ST FLOOR, 338 BOTANY ROAD, ALEXANDRIA 2015

Form E4:File COMPNRPT

PROJECT
WOODWARD–CLYDE PTY LTD
JOB NO. A86819/001/002

COMPACTION TEST REPORT

AUSTRALIAN SOIL TESTING P/L
338 BOTANY RD, ALEXANDRIA
NSW 2015. Telephone 319 2111

APPENDIX H
ARCHAEOLOGICAL REPORTS

(i) National Heritage Studies (September 1989)
(ii) National Heritage Studies (June 1990)
(iii) National Heritage Studies (August 1990)
(iv) National Parks and Wildlife Service (August 1991)

DRAFT

AN ARCHAEOLOGICAL SURVEY AT SCHOFIELDS, NSW

A Report to R.W. Corkery and Co

by

Annie Nicholson

National Heritage Studies
PO Box 92
HALL ACT 2618

September 1989

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Bibliography

1. INTRODUCTION

National Heritage Studies Pty Ltd was commissioned by R.W. Corkery to conduct an archaeological survey of a proposed quarry and brickworks site at Schofields, western Sydney (Figure 1).

PGH Bricks (NSW) is planning to extend their operations and propose to establish a quarry and associated brick manufacturing plant on an area of land to the south of the present brickworks (Figure 2). An archaeological investigation was required as numerous archaeological sites have been recorded in the vicinity. In particular, Aboriginal quarry/extraction sites have been recorded at several locations along the ridge on the western side of the development area.

Fieldwork for this project was carried out between 1 - 3 September 1989. National Parks and Wildlife Service in Sydney was visited prior to this to obtain details of previous archaeological work conducted in the area and to compile a list of archaeological sites. A summary of this information is presented in this report to provide a context within which to assess the findings of this investigation.

2. ARCHAEOLOGICAL CONTEXT

The last 10 years has seen the accumulation of a considerable amount of archaeological information about Aboriginal occupation on the Cumberland Plain. Work relating to the western part of the Plain began with Kohen's research work in the early 1980's (Kohen 1981). This was followed by numerous site surveys, many of which were associated with land developments in the region (Brayshaw 1982a, 1982b; Dallas 1982, 1983; Dallas and Witter 1983; Haglund 1980, 1982, and 1983; Koettig and Hughes 1983; Kohen 1981, 1984a, 1984b, 1985; McDonald 1984, 1986; Smith 1985).

Most of the Aboriginal sites recorded on the western Cumberland Plain are open camp sites. To the north-west, the Hawkesbury Sandstone provides the environment for different types of sites including rockshelters with art and/or deposit, grinding grooves and engraving sites. On the Plain itself there is very little opportunity for identifying datable, stratified deposits. Several open camp sites have been excavated (Kohen 1981, 1984; Dallas and Witter 1983; McDonald 1986).

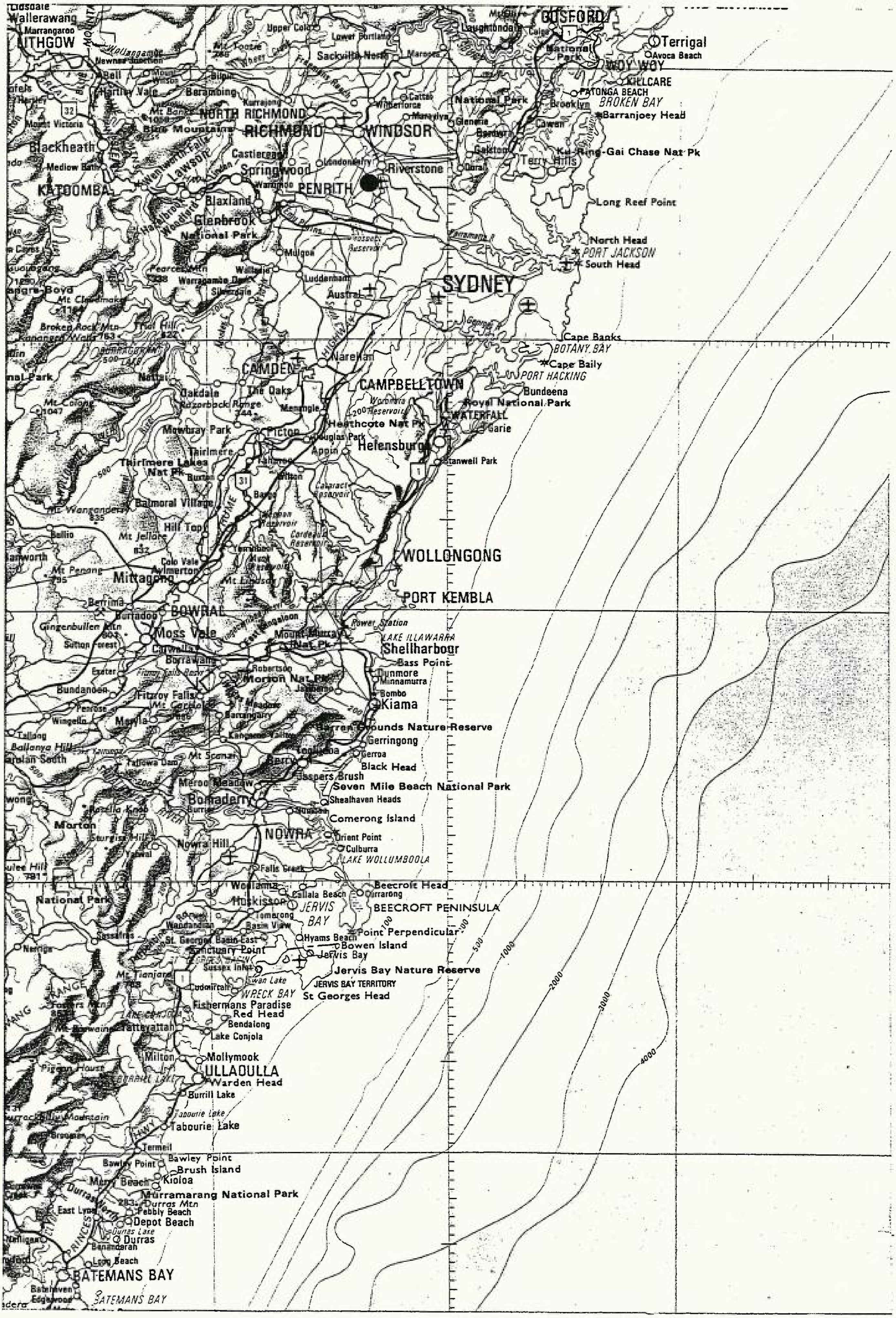

Figure 1: Location of Study Area.

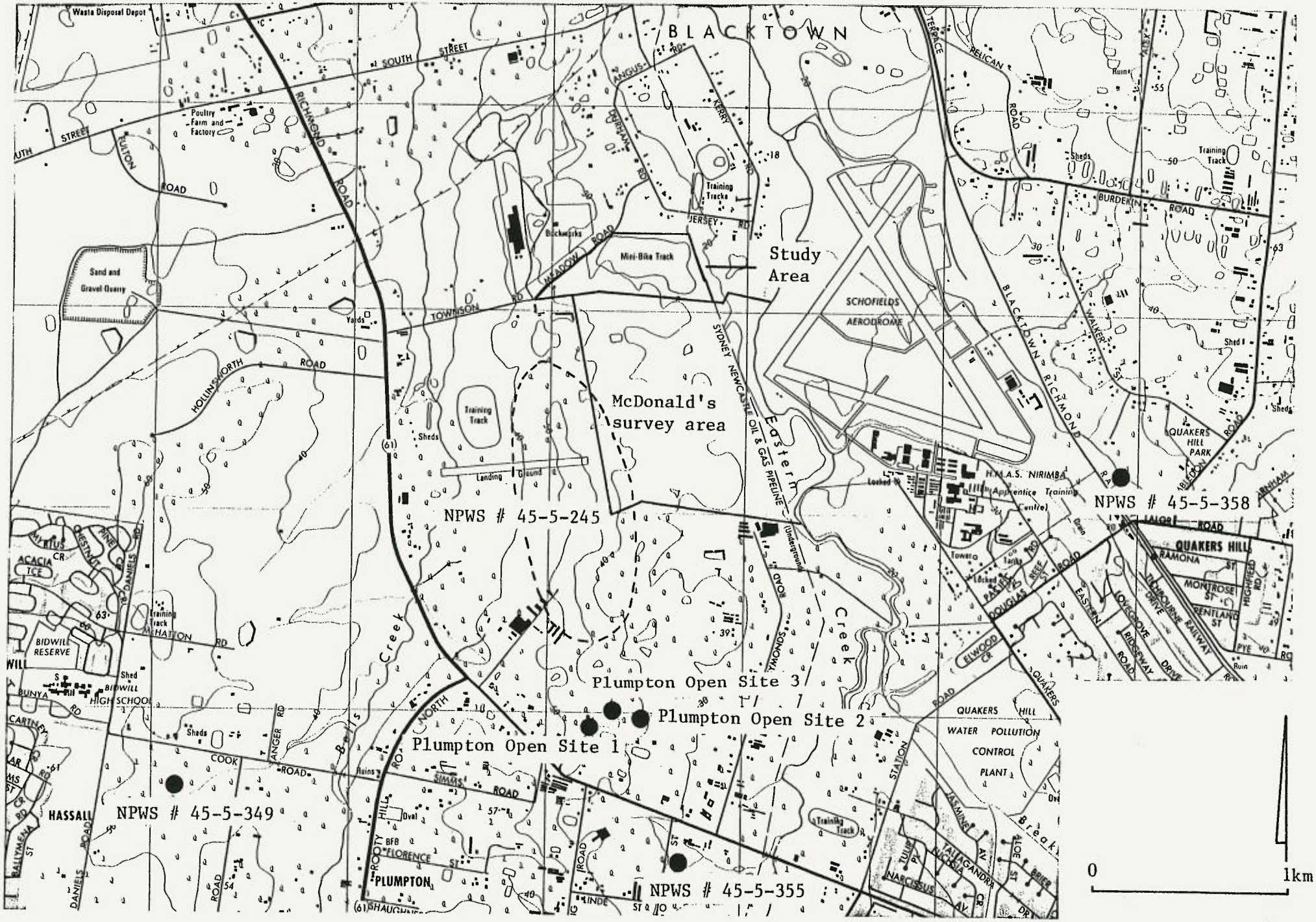

Figure 2: Location of Survey Area and other Sites in the vicinity.

The oldest data obtained so far is from a site called Jamisons Creek at Emu Plains. This site has a basal date of 7,000 BP and was occupied up to European contact (Kohen 1981).

The National Parks and Wildlife Service Aboriginal Sites Register has 83 sites listed for the 100 square kilometres around the study area, giving a site density of 1 site/1.2km2. Of these, 80 are camp sites represented by artefact scatters. The remaining three sites include a scarred tree, a quarry/extraction site (Plumpton Ridge), and an Aboriginal/historic contact site. The contact site is located between Rooty Hills Road North and Bells Creek. It is the site of a land grant of 30 acres made by Governor Macquarie in the early 1800's to the local Aboriginal people (Bickford 1981).

2.1 Sites on Plumpton Ridge

Several archaeological sites have been recorded on Plumpton Ridge in recent years (Figure 2; Brayshaw 1982a, 1982b; Dallas 1982, 1983; McDonald 1986). These studies have generated discussions about Aboriginal occupation patterns in this region with particular respect to the exploitation of the silcrete cobbles exposed on the ridgeline.

Kohen 1981

Kohen (1981) carried out the first archaeological survey on Plumpton Ridge and located an extensive open site between the 30 and 50m contours (NPWS Site 45-5-245, see Figure 2). This site was found to contain red silcrete flakes, flaked pieces and cores. It was the first identification of Aboriginal exploitation of the silcrete cobbles along the ridgeline. Other raw materials were also recorded including quartz, silicified wood, chert and basalt. This site was predicted to extend for several hectares, however the exact boundaries were not defined due to dense vegetation which hindered visibility.

Brayshaw 1982

In February 1982, Brayshaw (1982a, 1982b) conducted two surveys of an area at the southern end of Plumpton Ridge which was being subdivided for housing developments. Two open sites were recorded during these surveys, Plumpton Open Sites 1 and 2 (Figure 2). Site 2 was directly threatened by the development and Brayshaw recommended that further

archaeological investigations were necessary if any part of the site was to be destroyed (Brayshaw 1982b:11).

Brayshaw (1982:9) recorded Site 2 as consisting of about 70 artefacts made of red or yellow silcrete, 40% of which were either cores, flakes or utilised pieces.

Dallas 1983

More detailed investigations by Dallas (1983) revealed that the site extended over a larger area and contained artefact densities site comparable to other sites in the region (Dallas 1983:13).

The spur upon which Site 2 was located has been subjected to considerable disturbance associated with both farming activities and housing construction. The site itself had been disturbed by past European quarrying activities and the proportion of the spur covered by the site prior to disturbance could not be estimated. Consequently it was concluded that further investigations of this site were "unwarranted" (Dallas 1983:14). Instead, Dallas carried out a reconnaissance of the south eastern section of the ridge between Plumpton Open Sites 1 and 2 and NPWS Site 45-5-245. This was done to provide a context within which to assess the archaeological significance of the Plumpton Sites and to enable the implementation of appropriate management strategies.

Outcrops and surface scatters of silcrete were identified in exposed areas along the length of the ridge south to Plumpton Sites, between the 30 and 50m contours. The area of greatest archaeological potential was identified approximately 700m north of Plumpton Open Site 2. A large number of both silcrete cobbles and nodules, cores and flakes were found here. This area was located within the boundary delineated by Kohen for NPWS Site 45-5-245.

Dallas recorded an additional site in the vicinity of Plumpton Open Sites 1 and 2. This site (Plumpton Open Site 3) was found to consist of an undisturbed scatter of silcrete artefacts extending over an area of 80 x 20m (Dallas 1983:18). Evidence of both extraction and stone tool manufacturing activities was identified at this site. Its preservation was considered to be important as undisturbed sites are rare in this

region (Dallas 1983: 18). It was therefore recommended that Plumpton Open Site 3 be preserved. Dallas also recommended that the remaining intact sections of Plumpton Open Site 2 be given a consent to destroy as no additional information could be gained by further investigations at this site. Dallas concluded that at this stage the entire ridge should be treated as archaeologically sensitive and that further archaeological investigations should assess any site located in relation to the archaeological context of the entire ridge (Dallas 1983:22).

Further investigations by Brayshaw in the southern section of the ridge revealed a further three sites (Plumpton Open Sites 4 to 6), all of which had been greatly disturbed by European activities (Conyers 1983:5). In addition to the archaeological work at Plumpton Ridge test excavations have been carried out at several sites in the vicinity; Hassal Open Site (45-5-349), Owens Street (45-5-355), Second Ponds Creek (45-5-429) and Quakers Hill (45-5-358). These sites are all with 2km radius of the study area.

Hassal Open Site 1, was described as an important site because assemblage may provide useful additional information regarding the spatial patterning (Dallas and Witter 1983:44). A salvage program was therefore recommended involving the collection of surface artefacts from this site.

Conyers 1983

As a result of the growing body of information about archaeological sites on Plumpton Ridge, the National Parks and Wildlife Service decided to undertake a survey of the ridge to ascertain the overall distribution of archaeological material. This was done to provide a basis upon which to assess the significance of archaeological sites currently known in the region to ensure that appropriate management strategies are adopted for these and future archaeological discoveries.

This regional study (Conyers 1983) outlines the relative archaeological significance of different sections of the ridgeline. It concludes that the most concentrated source of silcrete occurs just below the ridge top and extends down to approximately the 30m contour. The greatest evidence of Aboriginal activities on the ridge was recorded in the area south-west

of the present survey area, including the area delineated as NPWS Site 45-5-245 by Kohen (1981). This was also the most undisturbed area. As such it was recommended that this area be preserved to ensure that a range of archaeological sites were protected. Continued development was considered acceptable in other sections of the ridgeline where extensive disturbance had already occurred.

McDonald 1983

In 1986 plans were put forward by the Metropolitan Waste Disposal Authority to develop an area of land adjacent to the southern boundary of the present study area. An archaeological investigation of this area was carried out by McDonald (1986). Surface scatters of artefacts were recorded across the entire area but artefact densities remained low away from the ridge (McDonald 1986:8). Artefacts were collected from a series of Sample Areas and five test pits were excavated along the ridge. The results of this investigation indicated that Aboriginal occupation occurred across the entire area and was characteristic of intensive Aboriginal occupation. The density of surface material on the ridge is described as being the highest recorded anywhere on the Cumberland Plain (McDonald 1986:102). However this is expected given that the location functioned as an extraction site, and that high quantities of fractured rock are characteristic of such sites. From the type of artefactual material recovered it appears that the ridge area functioned mainly as a source of raw material. In addition a high proportion of retouch/usewear at some sites suggests that domestic activities such as wood working was also occurring on the ridge (Dallas and Witter 1983). Limited evidence of heat treatment in artefact manufacture was also recorded. The use of heat had been suggested previously to explain some of the colour variation in the silcrete; yellow silcrete turns red or pink/grey with heat (Dallas 1983:20). The artefacts recovered suggest that quarrying activities, and possibly stone tool manufacture were also occurring in the adjacent gullies and spurs. The artefacts collected from the sample area on the banks of Eastern Creek include formal tool types and with morphological tool characteristics of the micro-blade industry (McDonald 1986:102).

In addition, McDonald (1986:102) found that surface exposures did not necessarily correctly reflect the subsurface extent of the site. For example, in some areas where artefacts were absent, high proportions of subsurface artefactual material was recorded. The results of this investigation led McDonald to conclude that the area has "enormous scientific significance".

Summary

Over the last decade several major archaeological studies have been conducted in the Plumpton Ridge/Cumberland Plain area. These have made a series of fundamental archaeological discoveries.

1. The location of a series of silcrete extraction sites on Plumpton Ridge.
2. The identification of a series of culturally and geographically related sites displaying prehistory wood working, microblade production, heat treatment and domestic camp site activities.

The archaeological significance of the area has led National Parks and Wildlife Service to develop conservation strategies for areas where the archaeological record is still intact and may have temporal depth.

3. ENVIRONMENTAL SETTING

The survey area is located on the Cumberland Plain at Schofields (Figure 1). The Cumberland Plain has a long history of European settlement. Over the last century most of the Plain has been cleared and ploughed for grazing and agricultural activities. In recent years the expansion of Sydney has led to an increase in industrial and housing developments in this area. As a result of this the survey area has been very disturbed.

The development is proposed on a triangular shaped block of land on the southern side of Meadows Road. It is located on the eastern side of the ridge which runs north-south between Bells Creek and Eastern Creek. The ridge, which has become known as Plumpton Ridge in the archaeological literature, consists of Tertiary deposits of poorly consolidated sandstones, siltstones and conglomerates. On the top of the ridge, down to the 30m contour, cobbles of fine-grained silcrete have eroded out of the underlying sediments. These cobbles vary in size from small nodules

through to cobbles 30cm in diametre. Cobbles as large as 60cm in diametre have also been recorded in some areas (McDonald 1986:9).

In many places the ridge has been severely disturbed by European activities. A rubbish tip and a brickworks are located to the north and there are numerous housing developments to the south. The top of the ridge has escaped development to a certain extent due to its unsuitability for agriculture. The ridge retains some vegetation cover of dry sclerophyll Eucalypt forest with an understory of various heath species including Acacia and Grevillea.

The area proposed for development is also extremely disturbed through its use as a trail bike circuit. A large area of approximately 6000m2 is riddled with bike tracks and jumps. The bike circuit is virtually devoid of trees and the open ground between the tracks is covered by grass.

The higher ground in the south-west corner of the development site is the least disturbed. More extensive stands of trees exist in this area but it is also riddled with bike tracks. There is very little soil development and, in eroded areas, a layer of coarse gravel is exposed on a hard clay surface.

The eastern margin of the development area has been cleared during the installation of the Sydney-Newcastle gas pipeline. In the south-east corner quarrying activities have occurred over an area 50m x 100m. The original land surface has been obliterated and the sediment removed has been dumped in spoil heaps adjacent to the quarried hole.

4. SURVEY METHODS

The study area is known to be within a sensitive archaeological area and this necessitated a very detailed investigation of the archaeological resources. As a result a series of closely spaced archaeological transects were examined across the development area. Areas clear of vegetation were also identified and examined closely for evidence of Aboriginal occupation.

The largest area of exposed ground is in the centre of the development area. Tracks made by trail bikes criss-cross this area and the bike activities have caused the tracks to become rutted below the surface of the surrounding ground.

Numerous bike tracks also dissect the high ground within the survey area. These tracks expose the coarse gravel of sandstone, shale, conglomerate and silcrete which covers eroded surfaces in these higher areas. Visibility is between 90-100% on these tracks and in small clear areas associated with them. Away from these areas Eucalypt forest and its dense understory obscures the ground surface and visibility is nil.

An access track runs east-west across the development area at the base of the raised ground. This track also exposes the natural gravel surface which provides an opportunity for the identification of archaeological material in a transect across the development area. Visibility in this area is high (90-100%).

Visibility is also high along a gas pipeline easement on the eastern margin and southern portion of the area and in the south-east corner where quarrying activities have occurred. Visibility conditions vary between 90 and 100% however the quarrying activities have caused considerable disturbance.

5. SURVEY RESULTS

Seven archaeological sites were recorded during the survey (Figure 3). All of the sites are located in the southern portion of the development area. The sites vary in size from a couple of isolated artefacts (Sites 2 and 3) to a continuous background scatter across the raised ground to the south of the main trail bike circuit.

Site 1

This site consists of a scatter of artefacts, recorded along the southern part of the Natural Gas Pipeline easement (Figure 3, Plate 1). Fifteen artefacts were recorded over an area measuring 105m x 4m. The overall artefact density is low, with approximately 1 artefact/30m2. In four areas along the easement the density increases to 2 artefacts /m2.

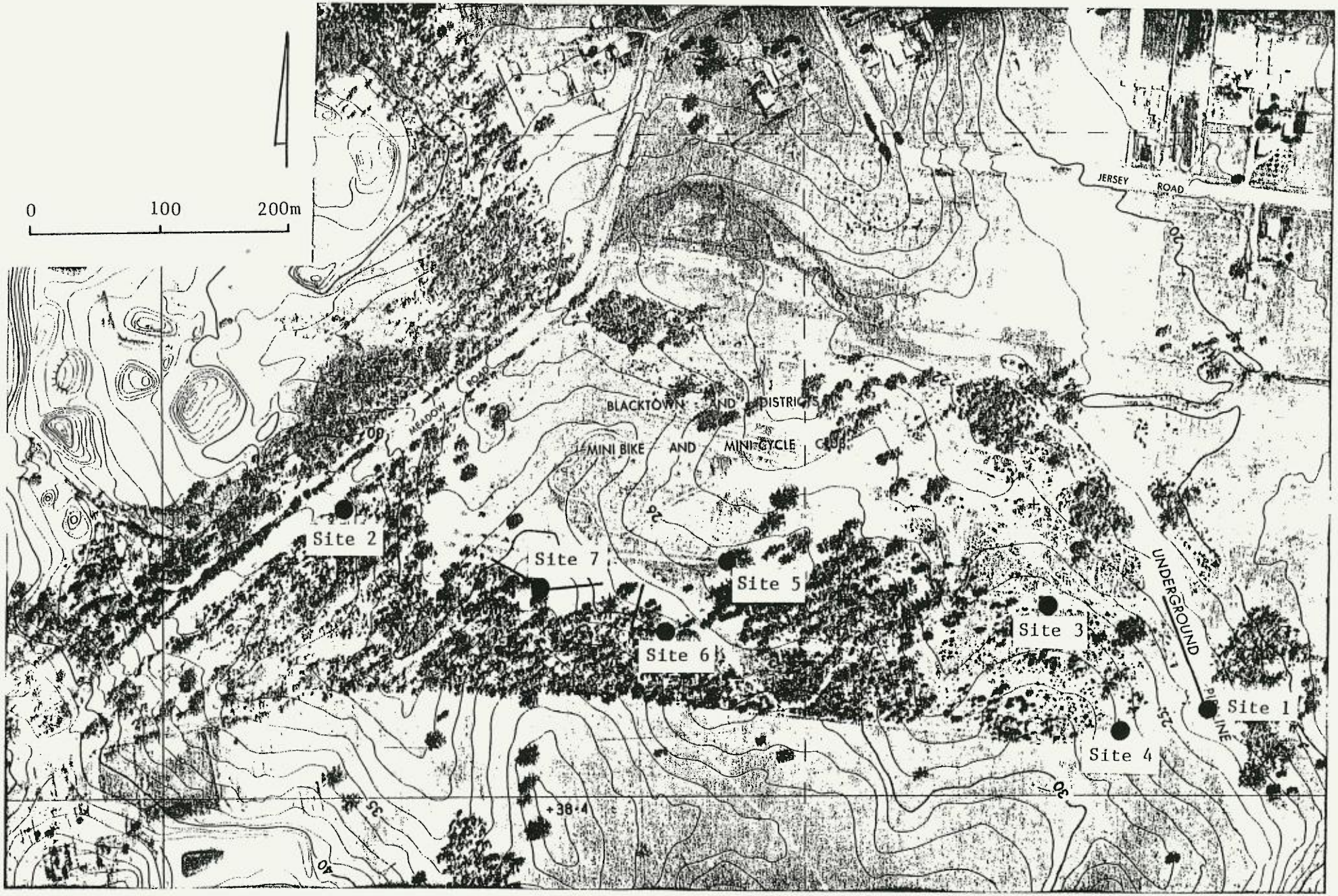

Figure 3: Sites located during the survey

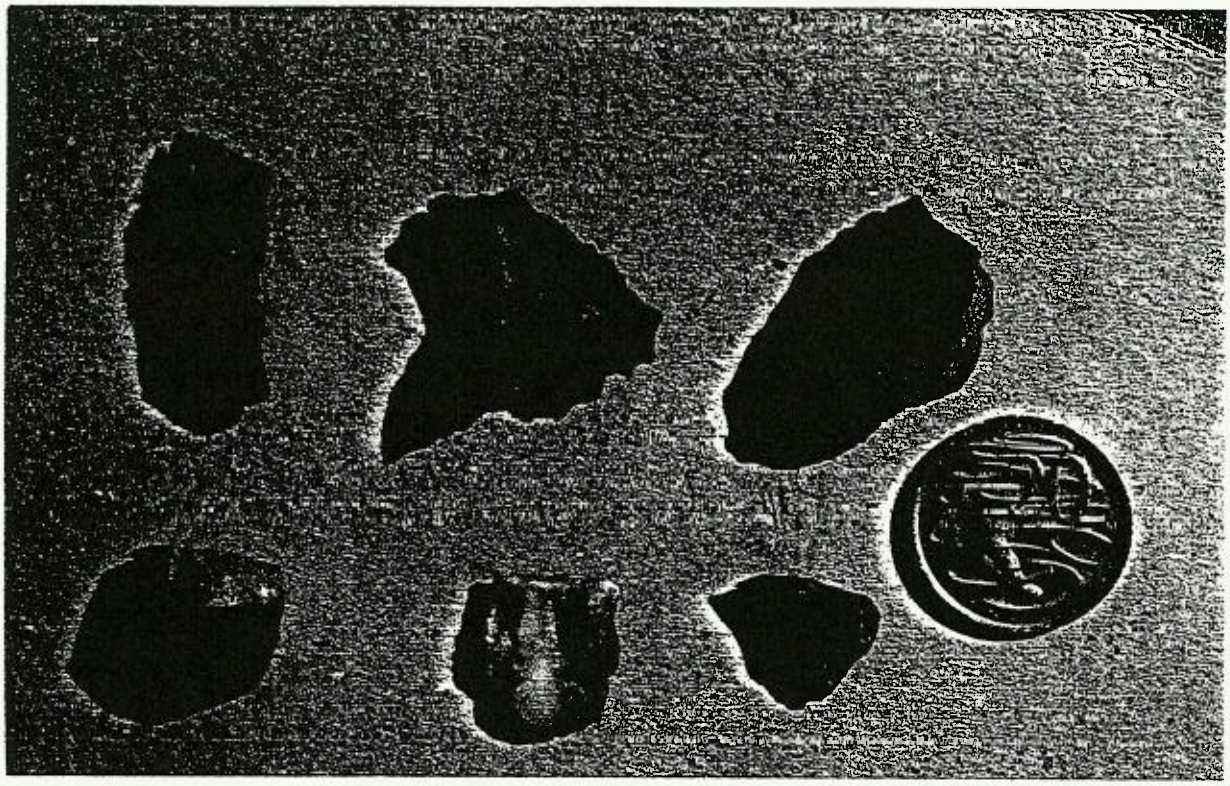

Plate 1: Artefacts from Site 1 (nos. 1-6).

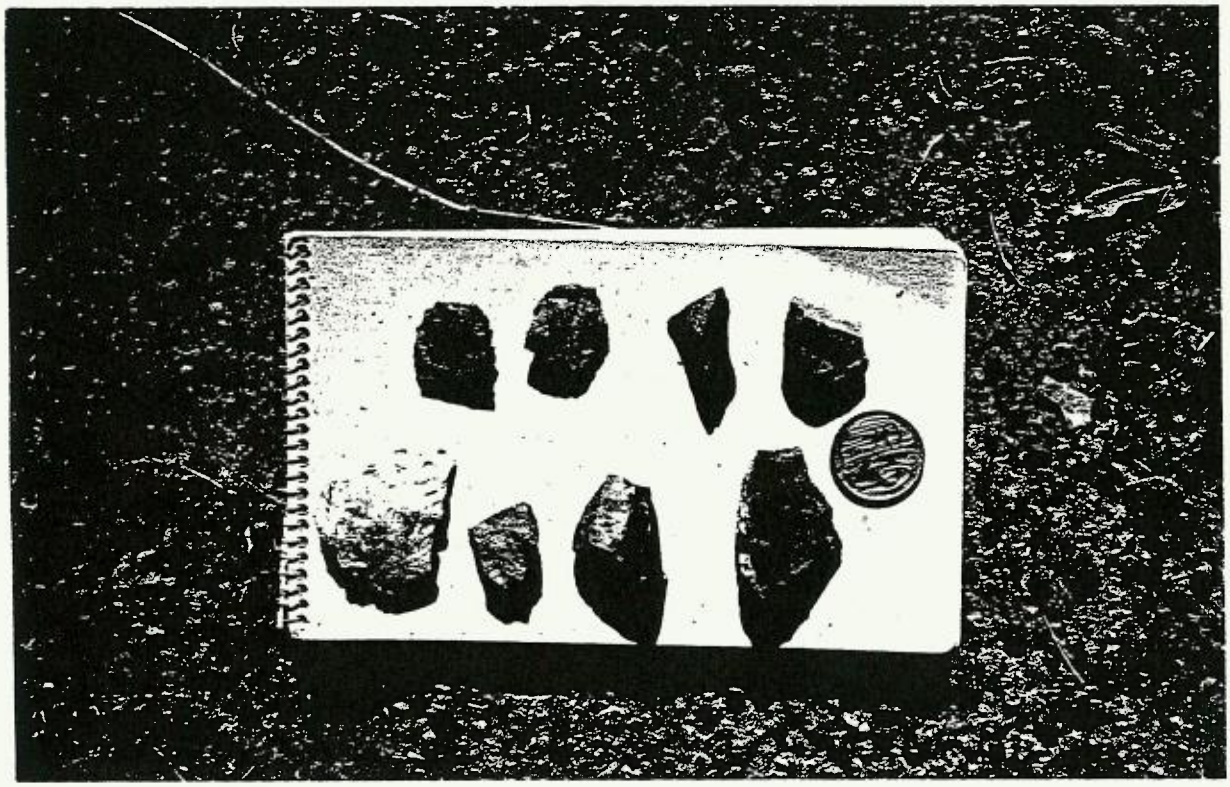

Plate 2: Artefacts from Site 5 (nos. 1-8).

Most of the artefacts at the site are made of silcrete (80%) (Table 1). A number of different coloured silcretes were identified; dark red (6), yellow (3), red (2), and purple (1). Other raw materials present at this site are black chert (2) and quartz (1). The majority of the artefacts are unretouched flakes (10) or flaked pieces (3) (Figure 4). One core (yellow silcrete) and a single utilised flake (dark red silcrete) are also present. Seven of the artefacts have cortex, ranging from covering of 5% to 25%.

The site has been severely disturbed by the installation of the gas pipeline and the artefacts are no longer in situ. Use of this section of the easement as an access track has caused the artefactual material and natural gravel to become compacted into the hard clay surface. Away from the easement visibility is reduced to 0-5% by a dense cover of introduced grasses and native shrubs. This hindered the identification of the actual boundaries of the site. It is thought however that the site may be more extensive. This is supported by the presence of artefacts along the pipeline easement to the south of the present survey area. This artefact scatter was recorded by McDonald (1986) during earlier survey work on the adjacent land (Sample Area II). This site was also described as severely disturbed and the artefacts recorded correspond both in raw material and type to those recorded in the survey. McDonald (1986:37) recorded a total of 35 artefacts scattered over an area measuring 17m x 2m. This higher density suggests that the main part of the site lies to the south of the present survey area with Site 1 representing the eastern margin of the site.

Site 2

This site is located on a patch (6 x 6m) of open ground at the junction of two tracks just inside the main access gate on Meadows Road (Figure 3). Two artefacts were recorded in this area and both are flaked pieces made of pink-cream silcrete (Table 2, Figure 5). Several broken silcrete pebbles were also found, however the fracture marks on these appear to be recent, and were probably caused by vehicular traffic rather than Aboriginal activities.

Table 1: Artefact Content of Site 1

Artefact No.	Artefact Type	Raw Material	Dimensions (cm) LxW	Comments
1	Unretouched flake	red silcrete	3.0 x 1.0	
2	Flaked piece	dark red silcrete	3.0 x 2.8	5% cortex
3	Flaked piece	black chert	2.4 x 2.3	10% cortex
4	Core	yellow silcrete	1.8 x 1.7	
5	Unretouched flake	quartz	2.0 x 1.4	
6	Unretouched flake	black chert	1.4 x 1.5	
7	Flake	dark red silcrete	2.6 x 1.8	25% cortex, usewear
8	Unretouched flake	dark red silcrete	4.2 x 3.0	15% cortex
9	Unretouched flake	yellow silcrete	3.8 x 1.8	25% cortex, platform preparation
10	Unretouched flake	yellow silcrete	2.2 x 1.1	
11	Flaked piece	red silcrete with yellow patches	2.0 x 1.1	
12	Unretouched flake	dark red silcrete	2.0 x 1.0	
13	Unretouched flake	dark red silcrete	2.3 x 1.4	
14	Unretouched flake	purple silcrete	3.3 x 3.1	40% cortex
15	Unretouched flake	dark red silcrete	4.3 x 3.4	12% cortex

Table 2: Artefact Content of Sites 2 and 3

Artefact No.	Artefact Type	Raw Material	Dimensions (cm) LxW	Comments
Site 2				
1	Flaked piece	pink/cream silcrete	2.5 x 2.3	
2	Flaked piece	pink/cream silcrete	2.0 x 1.4	
Site 3				
1	Flaked piece	dark red silcrete	4.2 x 4.1	45% cortex
2	Core	red silcrete	2.6 x 2.5	platform preparation

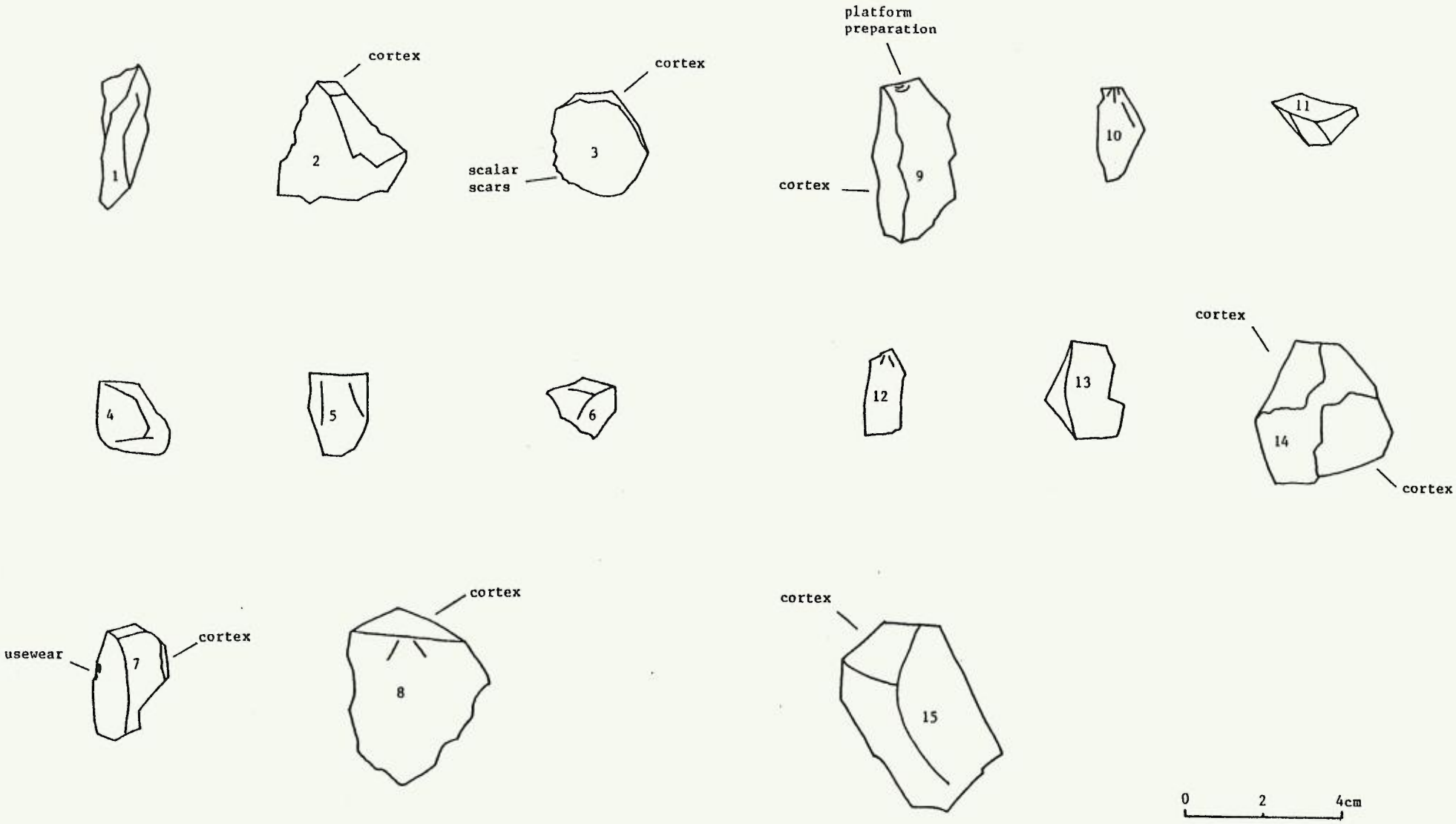

Figure 4: Artefact content of Site 1.

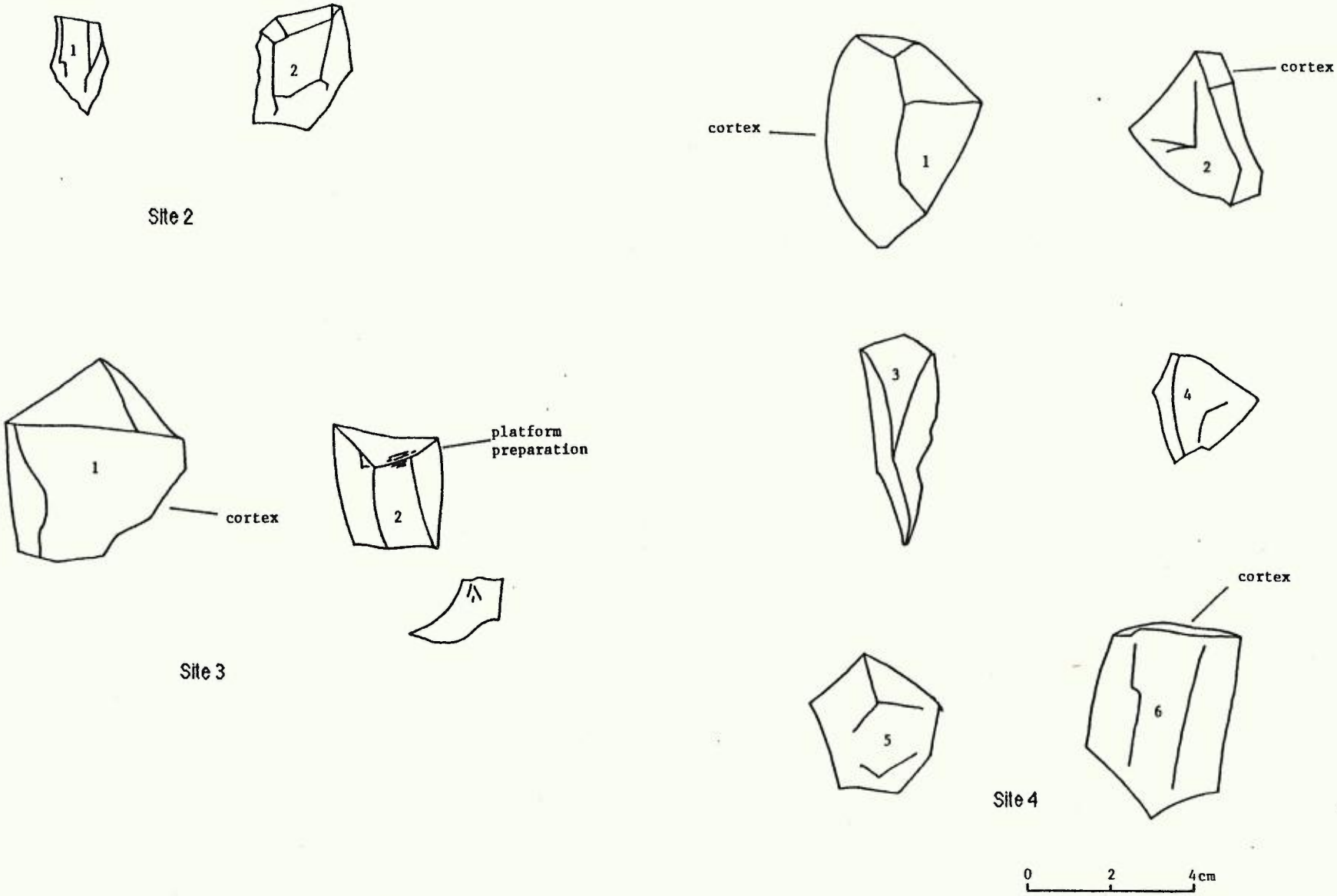

Figure 5: Artefacts recorded at Sites 2, 3 and 4.

Site 3

Site 3 is again small, consisting of two artefacts recorded on two tracks which run east-west across the eastern part of the survey area (Figure 3). One of the artefacts is a flaked piece made of dark red silcrete and has cortex covering 45% of its surface. The other artefact is a red silcrete core slightly embedded in the surface of the track. A small fragment of the stone had flaked off and was resting in place next to the core illustrating the flaking action of vehicle traffic. If these fragments of rock had been separated and only the smaller flake recovered, it would most likely have been interpreted as an Aboriginal artefact.

Site 4

This site is located 100m west of Site 1 (Figure 3). It consists of five artefacts scattered over an area measuring 15m x 1m and a sixth artefact located approximately 30m to the north-west. The main part of the site is positioned on a narrow strip of high ground adjacent to the fenceline that runs along the southern boundary of the survey area. The site extends across the only remaining area of undisturbed ground. Away from the fence quarrying activities have caused considerable disturbance with the ground being excavated to a depth of about 3m.

All of the artefacts at this site are made of silcrete (Table 3). Several different coloured silcretes are present; dark red silcrete (3), pink-cream silcrete (2) and yellow silcrete (1). The artefacts consist of four flaked pieces, a single unretouched flake made of yellow silcrete and a core made of pink/cream silcrete (Figure 5). Cortex is present on two of the flaked pieces. The core also still has a small degree of cortex.

This site is located in the vicinity of an artefact scatter recorded during a previous survey on the adjacent land. McDonald (1986:37) recorded 15 artefacts scattered over an area of 10m x 10m across the access track that runs along the southern side of the fenceline. All of the artefacts recorded by McDonald (Sample Area 12) were made of silcrete and no diagnostic artefacts were observed. Field investigations suggest that Site 4 is an extension of this site.

Table 3: Artefact Content of Site 4

Artefact No.	Artefact Type	Raw Material	Dimensions (cm) LxW	Comments
1	Flaked piece	dark red silcrete	4.7 x 3.6	55% cortex
2	Flaked piece	pink/cream silcrete	3.3 x 2.8	5% cortex
3	Unretouched flake	yellow silcrete	4.6 x 1.4	
4	Flaked piece	dark red silcrete	2.4 x 2.4	
5	Flaked piece	dark red silcrete	3.2 x 3.2	
6	Core	pink/cream silcrete	4.4 x 3.3	12% cortex

Table 4: Artefact Content of Site 5

Artefact No.	Artefact Type	Raw Material	Dimensions (cm) LxW	Comments
1	Unretouched flake	yellow silcrete	2.4 x 2.3	platform preparation snapped
2	Unretouched flake	dark red silcrete	2.6 x 2.0	40% cortex
3	Flaked piece	dark red silcrete	2.8 x 1.5	triangular
4	Flaked piece	yellow silcrete	2.9 x 2.8	
5	Flaked piece	yellow silcrete	4.5 x 4.4	50% cortex
6	Flaked piece	dark red silcrete	2.5 x 2.1	40% cortex
7	Flaked piece	dark red silcrete	3.1 x 2.8	30% cortex
8	Core	dark red silcrete	4.8 x 3.6	30% cortex
9	Unretouched flake	dark red silcrete	4.2 x 2.2	
10	Unretouched flake	volcanic	2.7 x 1.6	
11	Flaked piece	light grey silcrete	2.1 x 1.5	
12	Unretouched flake	red silcrete	3.6 x 1.4	
13	Flaked piece	pink/cream silcrete	3.9 x 2.7	
14	Unretouched flake	black chert	1.5 x 1.2	snapped

Site 5

This site is located in the open area in front of the trail bike clubhouse. Fourteen artefacts were recorded scattered over an area measuring 20m x 15m. Overall the artefact density at the site is low, approximately 1 artefact/20m2, however a maximum density of 3 artefacts/m2 was recorded in the northern part of the site.

These artefacts are scattered over an area used for recreational activities associated with the trail bike circuit as well as areas used for parking and maintaining the bikes. Visibility conditions are excellent as this area has been cleared of vegetation except for one large tree. However this also means that the site has been disturbed and the original positioning of the artefacts altered. The ground is slightly deflated and coarse gravel extends across the open area. To the north of the site ground visibility deteriorates due to a dense grass cover over the area adjacent to the main circuit.

The majority of the artefacts at this site are made of silcrete (86%) (Table 4, Plate 2). Various different coloured silcretes are represented; dark red (6), yellow (3), red (1), pink-cream (1), and light grey (1). A single volcanic artefact and a single black chert artefact are also present. Except for a single core made of dark red silcrete all of the artefacts are either unretouched flakes (6) or flaked pieces (7) (Figure 6). Cortex is present on five artefacts.

Site 6

This site is located 100m south-west of Site 5 (Figure 3). It consists of an artefact scatter recorded on a track running through the northern margin of the Eucalypt scrub. Initially eight artefacts were found scattered over an area that had been cleared to make a bike trail and jump (Plate 3). Additional artefacts were then located further along the track, 20m to the west. The site extends for about 50m north along the track and in adjacent clear areas (Plate 4). Fourteen artefacts were recorded in this area making a total of 22 for the site. The average density of artefacts is 1 artefact /8m2, but in the two main clusters of artefacts densities are as high as 3 artefacts/m2.

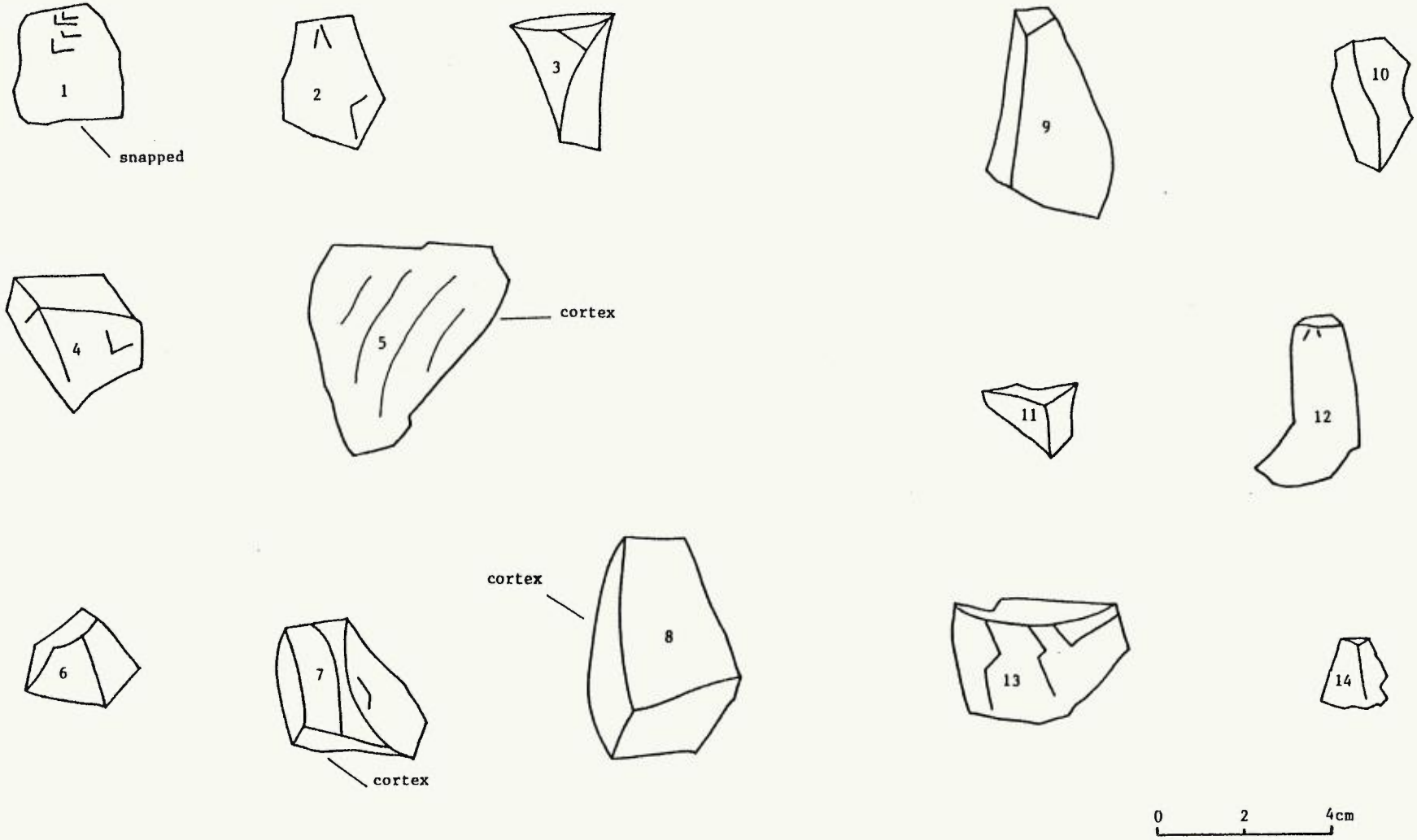

Figure 6: Artefact content of Site 5.

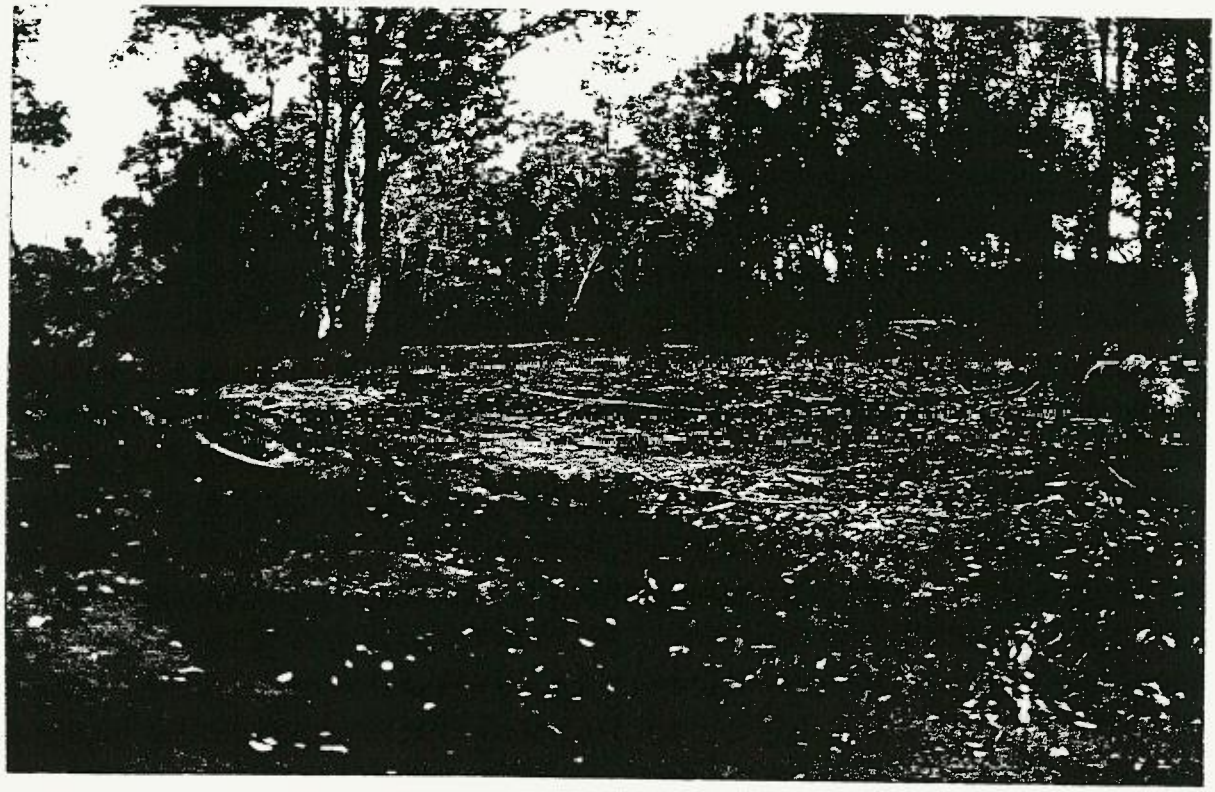

Plate 3: Site 6 (southern section)-artefacts scattered over open gravel covered ground.

Plate 4: Site 6 (northern section)-artefacts scattered over track junction.

Table 5: Artefact Content of Site 6

Artefact No.	Artefact Type	Raw Material	Dimensions (cm) LxW	Comments
1	Unretouched flake	red silcrete	4.3 x 1.7	
2	Flaked piece	red silcrete	3.8 x 2.9	10% cortex
3	Unretouched flake	red silcrete	3.1 x 1.3	50% cortex
4	Unretouched flake	red silcrete	2.4 x 1.8	snapped
5	Unretouched flake	red silcrete	1.8 x 1.0	
6	Flaked piece	red silcrete	3.5 x 1.3	25% cortex
7	Flaked piece	red silcrete	2.7 x 1.4	30% cortex
8	Flaked piece	red silcrete	5.8 x 3.4	
9	Unretouched flake	red silcrete	2.1 x 1.3	
10	Unretouched flake	red silcrete	1.9 x 0.9	
11	Flake	red silcrete with grey inclusions	3.4 x 2.3	usewear
12	Unretouched flake	red silcrete	6.5 x 2.6	25% cortex
13	Flaked piece	red silcrete	2.6 x 0.9	
14	Flaked piece	red silcrete	2.5 x 1.7	
15	Unretouched flake	dark red silcrete	2.4 x 1.9	snapped
16	Unretouched flake	red silcrete	3.4 x 3.0	
17	Flaked piece	red silcrete	1.6 x 1.5	
18	Unretouched flake	dark grey/red silcrete	2.0 x 2.1	
19	Flaked piece	red silcrete	3.5 x 2.1	15% cortex
20	Flaked piece	red silcrete	4.5 x 2.4	50% cortex
21	Core	red silcrete	5.8 x 3.3	
22	Flaked piece	red silcrete	6.4 x 4.1	20% cortex

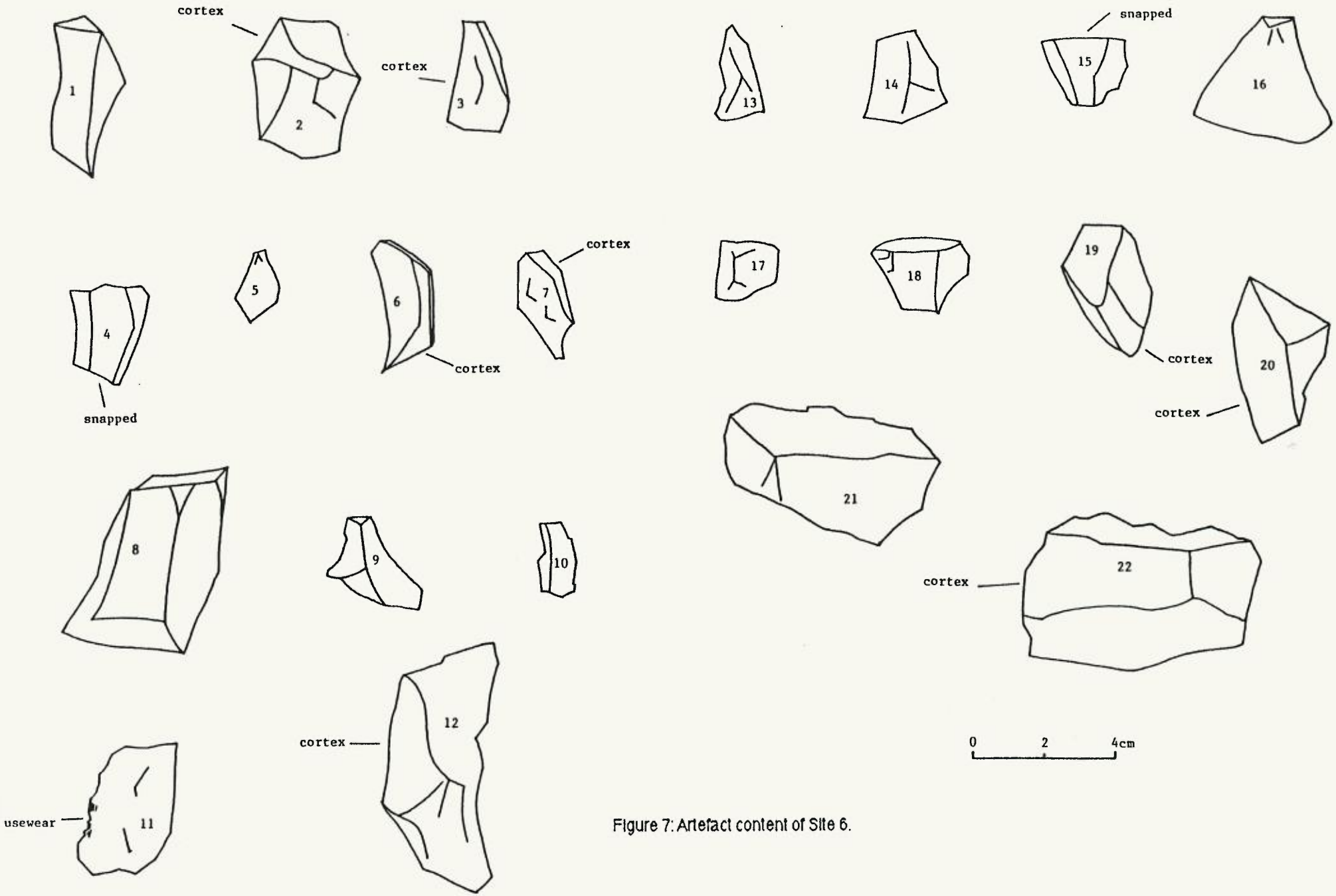

Figure 7: Artefact content of Site 6.

All of the artefacts at this site are made of silcrete, one grey, one dark red and the remainder of red silcrete. The majority of the artefacts are either unretouched flakes (10) of flaked pieces (10) (Figure 7). One core and a single utilised flake both made of red silcrete are also present. Cortex is present on seven of the artefacts.

The maximum extent of the site was difficult to determine both because of reduced visibility at the southern end of the site and the high degree of disturbance. The track appears to have been constructed straight through the site. The surface of the track and the clear areas to the north are covered by gravel and visibility is high (90-100%). Away from these areas shrubs and grass reduce visibility to less than 30%.

Site 7

This is a scatter of artefacts recorded adjacent to Site 6 (Figure 3). Site 7 consists of 51 artefacts scattered over approximately 150m x 30m. Artefact densities within the main scatter of artefacts (60m x 30m) are as high as 8 artefacts/m2 but over the site as a whole densities are much lower, approximately 1 artefact/90m2. To the west the site extends to the main access track which runs east-west across the survey area. To the north the artefacts peter out.

The majority of the artefacts at this site are made of silcrete (96%). The most frequently occurring colour is red silcrete (88%). Of these there are 10 dark red and 35 red silcrete artefacts (Table 6). A number of additional colour variations occur on these artefacts. A single artefact of black chert and one of a volcanic material are also present. Most of the artefacts are either unretouched flakes (29) or flaked pieces (18) (Figure 8). The remaining artefacts are four cores; three red silcrete cores and one small pink nodular silcrete core. Cortex is present in varying proportions on 20 of the artefacts.

Table 6: Artefact Content of Site 7

Artefact No.	Artefact Type	Raw Material	Dimensions (cm) LxW	Comments
1	Unretouched flake	dark red silcrete	5.3 x 2.5	
2	Unretouched flake	yellow silcrete	3.6 x 2.4	
3	Flaked piece	red silcrete	4.3 x 3.4	30% cortex
4	Unretouched flake	red silcrete	4.4 x 2.3	
5	Flaked piece	red silcrete	2.7 x 2.5	
6	Unretouched flake	red silcrete	5.2 x 4.6	
7	Flaked piece	red silcrete with yellow patches	1.9 x 1.8	
8	Unretouched flake	red silcrete	1.2 x 1.2	snapped
9	Flaked piece	red silcrete	1.9 x 1.6	
10	Unretouched flake	red silcrete	2.0 x 1.2	
11	Flaked piece	red silcrete	2.0 x 1.9	triangular
12	Unretouched flake	red silcrete	2.3 x 2.2	
13	Unretouched flake	red silcrete	3.1 x 2.0	2% cortex
14	Flaked piece	red silcrete	2.3 x 1.9	triangular
15	Unretouched flake	red silcrete with yellow patches	1.2 x 1.5	5% cortex
16	Flaked piece	dark red silcrete	2.1 x 1.5	
17	Flaked piece	dark red silcrete	2.1 x 2.0	30% cortex
18	Flaked piece	red silcrete	3.5 x 3.4	30% cortex
19	Flaked piece	red silcrete	3.9 x 3.6	50% cortex
20	Core	red silcrete	5.6 x 4.9	50% cortex
21	Flaked piece	red silcrete	2.5 x 1.0	
22	Core	red silcrete	4.0 x 3.8	30% cortex
23	Flaked piece	red silcrete	3.2 x 2.6	5% cortex
24	Unretouched flake	red silcrete	2.0 x 1.8	
25	Unretouched flake	red silcrete	1.6 x 1.3	
26	Unretouched flake	red silcrete	1.5 x 1.9	
27	Flaked piece	red silcrete	2.8 x 2.8	5% cortex
28	Unretouched flake	red silcrete	2.1 x 2.0	50% cortex
29	Unretouched flake	red silcrete	1.8 x 1.4	40% cortex
30	Core	red silcrete	3.1 x 2.9	multiplatform, 10% cortex

Artefact No.	Artefact Type	Raw Material	Dimensions (cm) LxW	Comments
31	Unretouched flake	red silcrete with white inclusions	3.3 x 2.8	
32	Unretouched flake	yellow silcrete	6.6 x 4.6	
33	Flaked piece	dark red silcrete	4.0 x 3.5	
34	Unretouched flake	dark red silcrete	2.7 x 2.1	
35	Flaked piece	dark red silcrete with white inclusions	2.7 x 3.5	
36	Unretouched flake	black chert	1.6 x 1.6	50% cortex
37	Core	pink silcrete	2.6 x 2.3	nodular
38	Unretouched flake	dark red silcrete	3.1 x 2.3	
39	Flaked piece	red silcrete	4.1 x 3.5	
40	Unretouched flake	red silcrete	2.2 x 1.3	50% cortex
41	Unretouched flake	yellow silcrete	5.1 x 3.6	50% cortex
42	Unretouched flake	volcanic	2.3 x 2.1	
43	Unretouched flake	red silcrete	1.5 x 1.3	
44	Flaked piece	red silcrete	2.3 x 2.1	30% cortex
45	Unretouched flake	red silcrete	3.6 x 2.1	
46	Unretouched flake	red silcrete	3.7 x 3.1	25% cortex
47	Unretouched flake	red silcrete	3.6 x 2.1	
48	Unretouched flake	red silcrete with yellow patches	2.8 x 4.0	40% cortex
49	Unretouched flake	dark red silcrete	1.6 x 2.0	
50	Flaked piece	dark red silcrete	3.8 x 2.5	
51	Unretouched flake	dark red silcrete	3.8 x 2.8	25% cortex

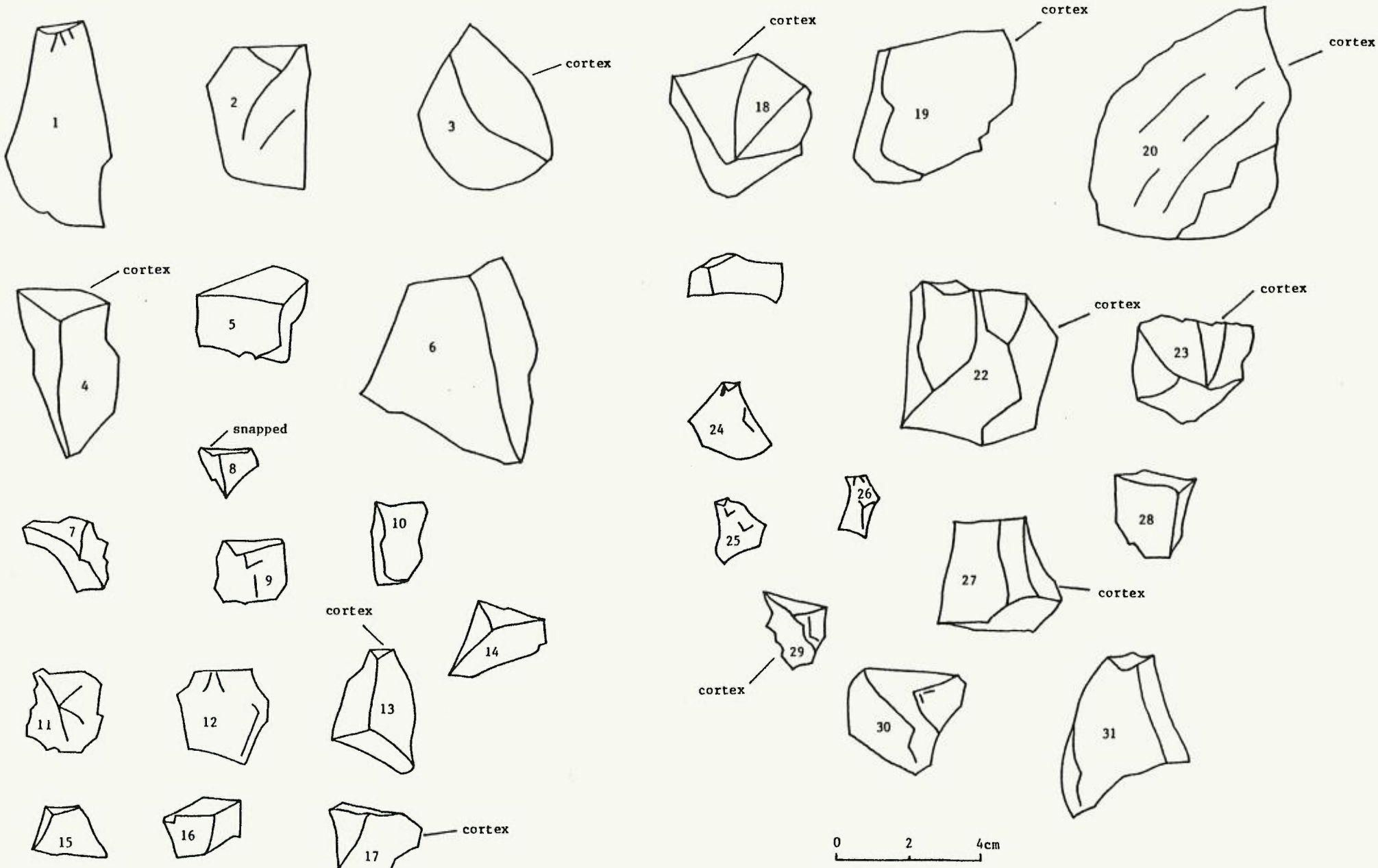

Figure 8: Artefact content of Site 7.

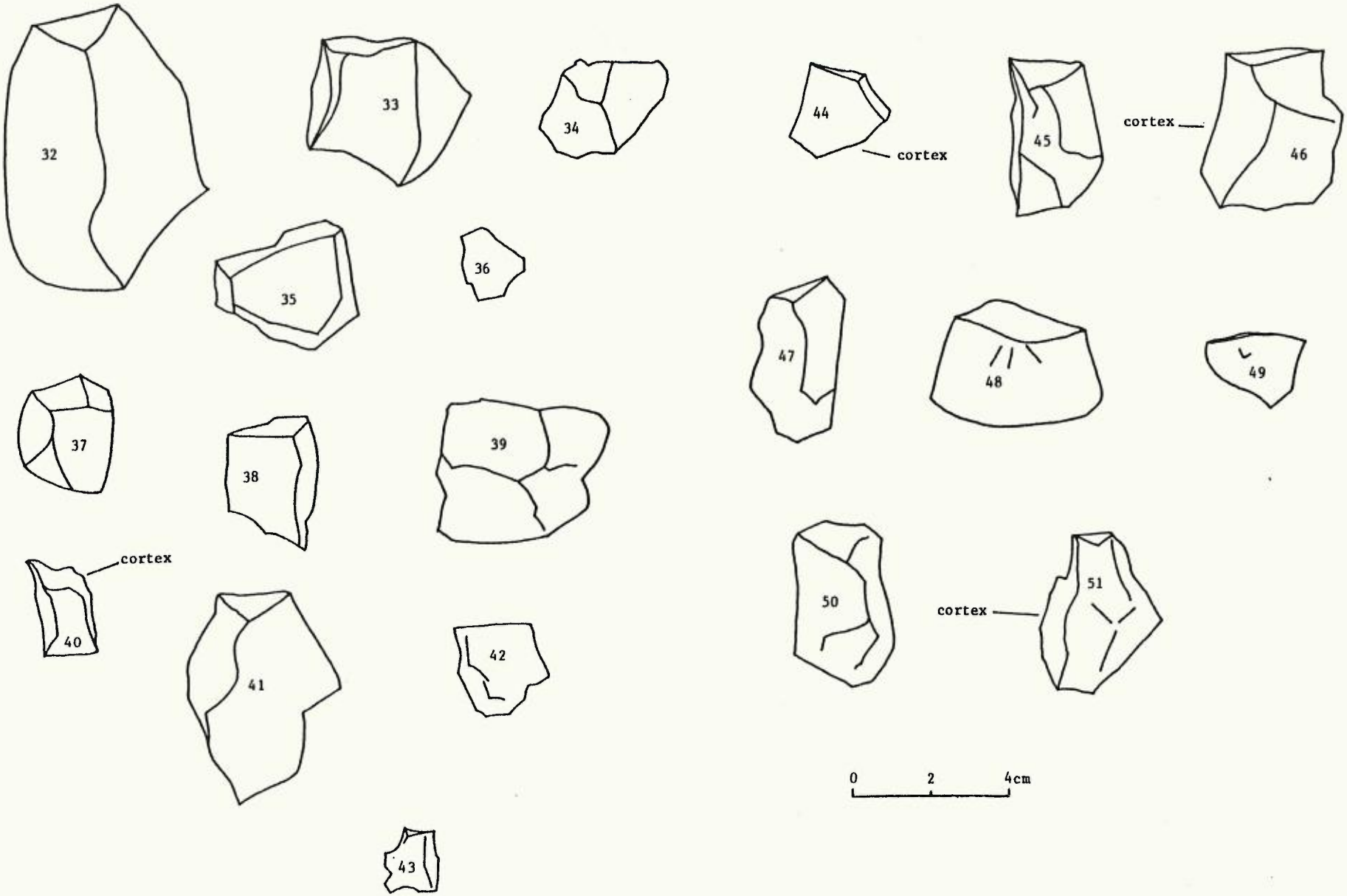

Figure 8 (cont): Artefact content of Site 7.

6. ABORIGINAL INTEREST

Due to the amount of archaeological work done in the vicinity of Plumpton Ridge Aboriginal interests in this area have been well documented. The local Aboriginal people have a general preference for sites to be protected from destruction as they view them as indicators of past Aboriginal activities in the area, and an integral part of their cultural heritage. However they recognise that some sites are already considerably disturbed and do not warrant protection. In these instances certain compromises can be reached. This has been demonstrated in the management of archaeological sites in the vicinity of Plumpton Ridge where debate over six sites in the East Plumpton Development Area, Symonds Road (Conyers 1983:7) led to the destruction of two sites, the avoidance of two other sites and the protection of two sites.

The survey of Plumpton Ridge conducted by National Parks and Wildlife Service in 1983 was motivated partially as a result of Aboriginal interests in the area however attempts made to involve the relevant Aboriginal people in the survey were not successful. Apparently all interested people has seen the Plumpton sites and were not interested in visiting the area again (Conyers 1983:7).

Prior to the commencement of fieldwork for this project numerous attempts were made to contact the Gandangara Aboriginal Land Council over an 8 day period. As the Land Council office was repeatedly unattended, the NSW Aboriginal Land Council was contacted. The consultant was advised to contact the chairman, Cliff Foley, at NPWS Head Office. Following initial contact, Mr Foley was unavailable to reply to the request for Aboriginal field assistance. Consultation then turned to Mr Robert Clegg, also of NPWS. He provided several contacts but attempts to contact these people failed. As a result it was arranged that Mr Clegg would visit the development area with the consultant. Unfortunately at the last minute this arrangement fell through. As a consequence a draft copy of this study was sent to the Gandangara Land Council, Robert Clegg and Cliff Foley to provide an opportunity for Aboriginal comment.

7. DISCUSSION

Plumpton Ridge has provided a focus for archaeological investigations over the last decade. Over the years a picture of Aboriginal exploitation patterns in this region has been constructed. The results of this work provides a framework within which the sites located during this survey can be evaluated, their significance assessed and appropriate management strategies implemented.

7.1 Site Characteristics

The sites recorded during this survey were all located on the raised ground in the southern portion of the development area. This area corresponds to the eastern slopes of the main ridge and has a height of between 25 and 30m. The sites range from small sites comprising a couple of artefacts (Sites 2 and 3) to an relatively extensive scatter of artefacts extending over about 200m (Sites 6 and 7). Artefact densities are generally low with the highest density of 8 artefacts /m2 being recorded at Site 7. This figure is significantly lower than densities recorded by McDonald (1986) at sites on the main part of the ridge. Densities as high as 145 artefacts /m2 have been recorded in this area.

Site size documented in this survey relates to topographic location and visibility conditions and the degree of disturbance. The two smallest sites were identified on exposed areas on tracks. Site two for example is located at the entrance to the trail bike circuit. The clear area of the track junction is surrounded by dense scrub which restricted archaeological investigations and the site may well extend beyond it. Site 3, on the other hand, is located on flat ground at the edge of one of the small bike circuits. Disturbance in this case has been less extreme and it would appear that this site is confined to the margin of the raised ground where the artefacts were recorded. Of the other sites recorded, two (Sites 1 and 4) have been severely disturbed and contain small numbers of artefacts. Only six artefacts were recorded at Site 4 and although Site 1 was larger (containing 15 artefacts) the artefacts were scattered over a large area and artefact densities were low. Both sites were found to extend south beyond the present survey area with their southern extent corresponding to two sites recorded during an earlier survey of the southern area (McDonald 1986). The artefacts recorded

during this survey are therefore thought to be part of a more extensive, low density scatter extending across this southern raised ground.

The remaining sites recorded during the survey (Sites 5, 6 and 7) were located in adjacent areas on the open ground to the south of the main trail bike circuit. Sites 6 and 7 are close together and may represent a single, continuous scatter of artefacts. Site 5 is set slightly apart but may also be part of a continuous, moderate to low density artefact scatter that exists across the ridgeline. This pattern of site location corresponds with the results of previous work in the adjacent area in which a continuous background scatter of artefacts was recorded (McDonald 1986:29).

7.2 Artefact Characteristics

Most of the artefacts recorded during the survey are made of silcrete (94%). A variety of different coloured silcretes were recorded. Light red silcrete is the most frequently occurring raw material, representing 56% of all artefacts recorded. This material is particularly prolific at Sites 6 and 7, where it represents 90% and 69% of the assemblage respectively (Table 7). Large red silcrete cobbles are located in the vicinity of these sites and the high proportion of red silcrete artefacts reflects the stone procurement activities that occurred at these sites.

The high proportion of red silcrete at these sites corresponds with the findings of other surveys. Other patterns which emerged include the tendency for the light pink and grey silcretes to have the finest grain and exhibit a glossy lustre characteristic of heating. It has been suggested that heating may cause yellow silcretes to become red or pink (Witter in Dallas 1983:12). However as cobbles and nodules of both red and yellow silcretes occur it is difficult to use this criteria to identify evidence of heat treatment.

Other raw materials recorded at the sites include black chert, a fine-grained grey volcanic and quartz (Table 7). Artefacts made of these materials make up 6% of the total artefacts. The presence and proportional representation of these materials is consistent with the findings of other surveys in the region. Silcrete is always the

Table 7: Relative proportions of raw materials at Sites 1-7

Site	Total No.	Total Silcrete	Light Red Silcrete	Dark Red Silcrete	Yellow Silcrete	"dark" Silcrete	"light" Silcrete	Black Chert	Volcanic	Quartz
1	15	12(80%)	6(40%)	2(13%)	3(20%)	1(7%)		2(13%)		1(7%)
2	2	2(100%)					2(100%)			
3	2	2(100%)	1(50%)	1(50%)						
4	6	6(100%)		3(50%)	1(17%)		2(33%)			
5	14	12(86%)	1(7%)	6(44%)	3(21%)		2(14%)	1(7%)	1(7%)	
6	22	22(100%)	20(90%)	1(5%)		1(5%)				
7	51	49(96%)	35(69%)	10(19%)	3(6%)		1(2%)	1(2%)	1(2%)	

Table 8: Relative proportions of artefact types at Sites 1-7

Site	Total No.	Unretouched Flake	Flaked Piece	Core	Utilised Flake
1	15	10 (66%)	3 (20%)	1 (7%)	1 (7%)
2	2		2 (100%)		
3	2		1 (50%)	1 (50%)	
4	6	1 (17%)	4 (66%)	1 (17%)	
5	14	6 (43%)	7 (50%)	1 (7%)	
6	22	10 (46%)	10 (45%)	1 (5%)	1 (4%)
7	51	29 (57%)	18 (35%)	4 (8%)	

predominant rock type with other materials representing only small fractions of the assemblages.

The artefactual material identified in the development area consists mainly of either unretouched flakes (56/50%) or flaked pieces (45/40%). The remainder of the assemblage consists of a small proportion of cores (9/8%) and two utilised flakes (2/2%). The high proportion of unretouched flakes and flaked pieces reflects the use of this location as a procurement site. These artefacts represent the debitage produced during the flaking of silcrete cobbles to obtain material suitable for stone tool manufacture. The silcrete cobbles appear to fracture along flaws in the rock, producing block-fractured pieces which lack a bulb of percussion (Dallas and Witter 1983:39). This hinders the identification of Aboriginal stone procurement activities as distinct from rock fractured either naturally or as a result of European activities. It also causes problems for the identification of site boundaries as this is generally based on the distribution of diagnostic implement types. The large size of many artefacts is consistent with the use of the site as a procurement location for raw materials for stone tool production.

7.3 Inter Site Comparison

The content of the sites recorded in this survey corresponds to assemblages recorded at other locations in adjacent areas. These sites have also been identified as evidence of silcrete and extractions of artefact manufacture. Some of the other sites in the vicinity contain a higher proportion of small undiagnostic pieces and a high proportion of utilised pieces. This has been interpreted as a) evidence of quarrying along the ridge, b) stone tool manufacturing activities, c) other domestic camp site activities and wood working (Dallas and Witter 1983; McDonald 1986).

The low number of utilised flakes recorded during this survey contrasts this data and suggests that the study area was used solely for the extraction of silcrete for stone tool manufacture. The size of the artefacts also reinforces this interpretation. In this study a significant proportion of the flakes are larger than those recorded in other surveys. In this survey high proportion (approximately 50%) of the assemblage are larger than 3cm in length.

8. CONCLUSIONS AND RECOMMENDATIONS

1. Archaeological studies in this region have recognised the need for extensive undisturbed sites to be identified for future protection and investigation. Such areas are rather scarce because of the high degree of disturbance in the area.

2. The sites located during this survey have all been altered to some extent by European activities. The sites within the study area have been subjected to more intensive disturbance than some of the sites in the adjacent southern area. The latter area has been cleared for pasture but the ground surface has not been disturbed further. In contrast, the survey area has been subjected on trail bike activities that have led to the deflation of much of the area.

3. These activities have also caused large patches of ground to become eroded. Consequently, all the sites have been disturbed and the original arrangement of the artefacts altered. Sites 1-4 are all heavily disturbed, fragmented sites. Sites 5-7 are more extensive and represent a discontinuous scatter of artefacts across the raised ground on the eastern slopes of the main ridge. This pattern of artefact distribution is similar to that recorded in other areas of the ridgeline. The erosion of the ground surface in these areas has destroyed any likelihood of identifying sub-surface artefactual material.

4. These sites are part of a large archaeological complex that extends across the whole of Plumpton Ridge. They contain low numbers of artefacts, often accumulated in dense scatters. The sites contain a high proportion of unretouched flakes and flaked pieces but formal tool types are rare. Silcrete derived from local sources is the dominant material. These assemblages represent the use of the area for the extraction of silcrete and the manufacture of artefacts.

5. Similar, but more extensive, less disturbed sites are located on the raised ground south, outside of the development area. To the south the variety of sites exist representing a range of Aboriginal activities. As a result sites in the adjacent southern area have been proposed by NPWS for protection. This has been defined as a Conservation Area inorder to preserve a representative sample of the archaeological resources in this area.

6. Because of this and, the disturbed nature of the sites located within the development area it is recommended that a Consent to Destroy be applied for and the development be allowed to proceed.

7. Their is a rapid rate of development in the vicinity of the development area. This creates an urgent need for a representative sample of the archaeological resource to be preserved. However, the sites located in this study are small and heavily disturbed and do not represent a significant or valuable representative component of the archaeological resources of the area. These sites have been sufficiently recorded during this survey and no further archaeological work is thought necessary prior to the commencement of the development.

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1. INTRODUCTION

Between 1 - 3 September 1989 an archaeological survey was carried out on an area of proposed extension by PGH Bricks (NSW) at Scholfields, NSW. The archaeologist was Ms. Annie Nicholson of National Heritage Studies. Aboriginal consultation regarding the survey area was carried out with representatives of the Gandangara Land Council, which was later found to be the wrong Aboriginal council to deal with in this area. This report outlines further Aboriginal consultation with the newly reformed Daruk Land Council which is responsible for the area of concern.

Mr Steven Lalor, Sites Co-ordinator for the Daruk Land Council was contacted by me on Monday 29th May, and it was arranged that we meet at his office at Mount Druitt on Wednesday 30th. At this meeting I gave Mr Lalor the details surrounding the survey at Scholfields, what was found by the archaeologist, the recommendations made regarding a Consent to Destroy and the problems surrounding the Aboriginal consultations. It was mutually agreed that we should visit the survey area that day, relocate the sites, and reassess the recommendations that had been made in accordance with the wishes of the Daruk Land Council.

Sites 2, 5, 6 and 7 were relocated and examined. The remaining sites on the eastern boundary discovered by Nicholson were not located due to heavy rains and run-off making access and site recognition difficult.

Mr Lalor recognizes the cultural significance and Archaeological sensitivity of the western Cumberland Plain and in particular the Plumpton Ridge sites that have been located and described by several archaeologists in the past decade. The area around Plumpton ridge also has a strong historical significance to the Daruk Land Council. The Schofields sites are approximately 3km north-east of the remains of the Blacktown Institute (Lot 160) and two nearby blocks of land were granted to two Daruk Aboriginals last century; the first land granted to Aborigines in this area.

2. RECOMMENDATIONS

The newly reformed Daruk Land Council has not as yet completed a site policy, but in his position as site co-ordinator Mr Lalor informed me that, in regard to the open sites found on the Cumberland Plain, the council's general view will be:

1. Sites that are found *in situ* on undisturbed or marginally disturbed surfaces should be protected.

2. Surface sites that appear highly disturbed may be given a consent to destroy, except when it is thought possible that *in situ*, sub-surface artefacts are present.

Mr Lalor has requested that test excavation be carried out at Scholfields on the immediate vicinity of sites 5, 6 and 7.

The reason these sites were selected is that it was suspected that they may be part of a large sub-surface artefact scatter. Eighteen artefacts were counted at site 5 as opposed to fourteen counted by Nicholson in September 1989. It is suspected that the extra number have since been exposed by trail bike activity and the swift water run-off observed at the time of this re-examination.

Mr Lalor, or a representative of the Daruk land Council, would like to be present for the test excavations of these sites. The cultural significance of these sites would then be assessed on the basis of what artefacts if any, were revealed under the surface.

In my opinion, and with regard to the archaeological sensitivity of the Plumpton Ridge area, test excavations at Scholfields sites 5, 6 and 7 should be conducted.

Mr Lalor will be writing to National Parks and Wildlife and National Heritage Studies regarding this consultation and his recommendations.

REPORT ON TEST EXCAVATIONS AT SCHOLFIELDS, N.S.W.

A Report to
R.W. Corkery and Co.

National Heritage Studies Pty Ltd
PO Box 92
HALL ACT 2618

August 1990

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1. INTRODUCTION

PGH Bricks (NSW) is planning to extend their current Schofields operations and establish a brick manufacturing plant and quarry on an area of land to the southeast of their present operations (Figures 1 and 2). The area is currently used as a trail bike circuit and cattle agistment. As part of the environmental impact assessment for the development a series of archaeological and anthropological investigations have been undertaken in the area. Specifically, the excavations conducted for this study should be seen in the context of a previous archaeological survey of the area conducted in September 1989 (Nicholson 1990) and a later on-site consultation with Mr Steven Lalor of the Daruk Local Aboriginal Land Council (Dowling 1990).

The fieldwork for this study was conducted between 15-17 August 1990. The work was directed by Mr Peter Dowling from National Heritage Studies Pty Ltd. Assistance was given by Ms Prue Gaffey (National Heritage Studies), Ms Judith Littleton (Department of Prehistory and Anthropology, Australian National University) and Mr Steven Lalor (Sites Co-ordinator, Daruk Local Aboriginal Land Council).

2. BACKGROUND

The initial archaeological survey of the study area was carried out between 1st and 3rd September 1989 by Ms Annie Nicholson from National Heritage Studies Pty Ltd. This investigation was required by the New South Wales National Parks and Wildlife Service as numerous archaeological sites have been recorded in the vicinity. In particular, Aboriginal surface artefact scatters and quarry/extraction sites have been recorded at several locations higher up along Plumpton Ridge on the western side of the study area (e.g. Brayshaw 1982; Dallas 1983; Conyers 1983; McDonald 1983) (see Nicholson 1990 for a review of these investigations). The archaeological significance of the Plumpton Ridge area has led National Parks and Wildlife Service to develop conservation strategies for areas where the archaeological record is still intact and may have stratigraphic depth.

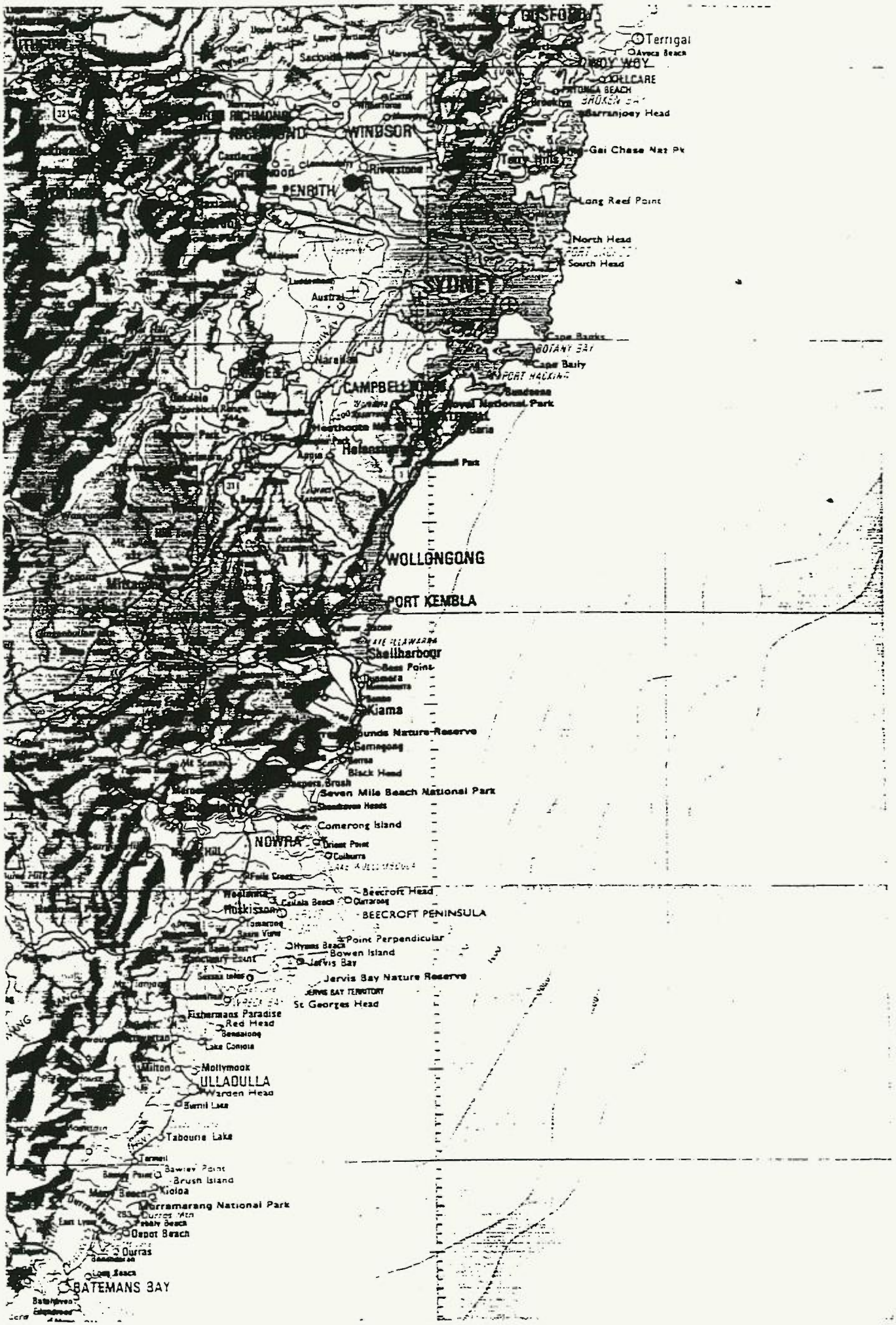

FIGURE 1: Location of Study Area.

FIGURE 2: Location of Survey Area and other Sites in the vicinity.

Nicholson (1990) recorded seven archaeological sites, all of which were located in the higher southern portion of the study area (Figure 3). The sites varied in size from a couple of isolated artefacts (sites 2 and 3) to a relatively extensive scatter of artefacts extending over about 200m (sites 6 and 7) across the raised ground to the south of the main trail bike circuit. The artefacts consisted of a high proportion of unretouched flakes and flaked pieces with formal tool types being rare. Silcrete derived from local sources on Plumpton Ridge was the dominant raw material.

Because of the low density of artefacts in the sites and the intensive disturbance by land clearing and motor-cycle activities together with the presence of more extensive and less disturbed sites located on higher ground just outside of the proposed area, Nicholson recommended that a Consent to Destroy be applied for to allow the development to go ahead.

As a result of Nicholson's survey and recommendations the New South Wales National Parks and Wildlife Service raised several specific questions:

1. Was the absence of sites in the northern part of the survey area due to lack of surface visibility at the time of the survey or lack of sites?
2. Were the sites found exposures of larger sites with sub-surface material?
3. Are other sites likely to occur in the area but, due to the poor surface visibility, obscured during the survey?

Following this advice from the National Parks Wildlife Service with, National Heritage Studies arranged a meeting with Mr Steven Lalor from the Daruk Local Aboriginal Land Council to ascertain the Land Councils views. During an on-site inspection with Mr Lalor several of the recorded sites were examined. The council's general view on open sites on the Cumberland Plain is that:

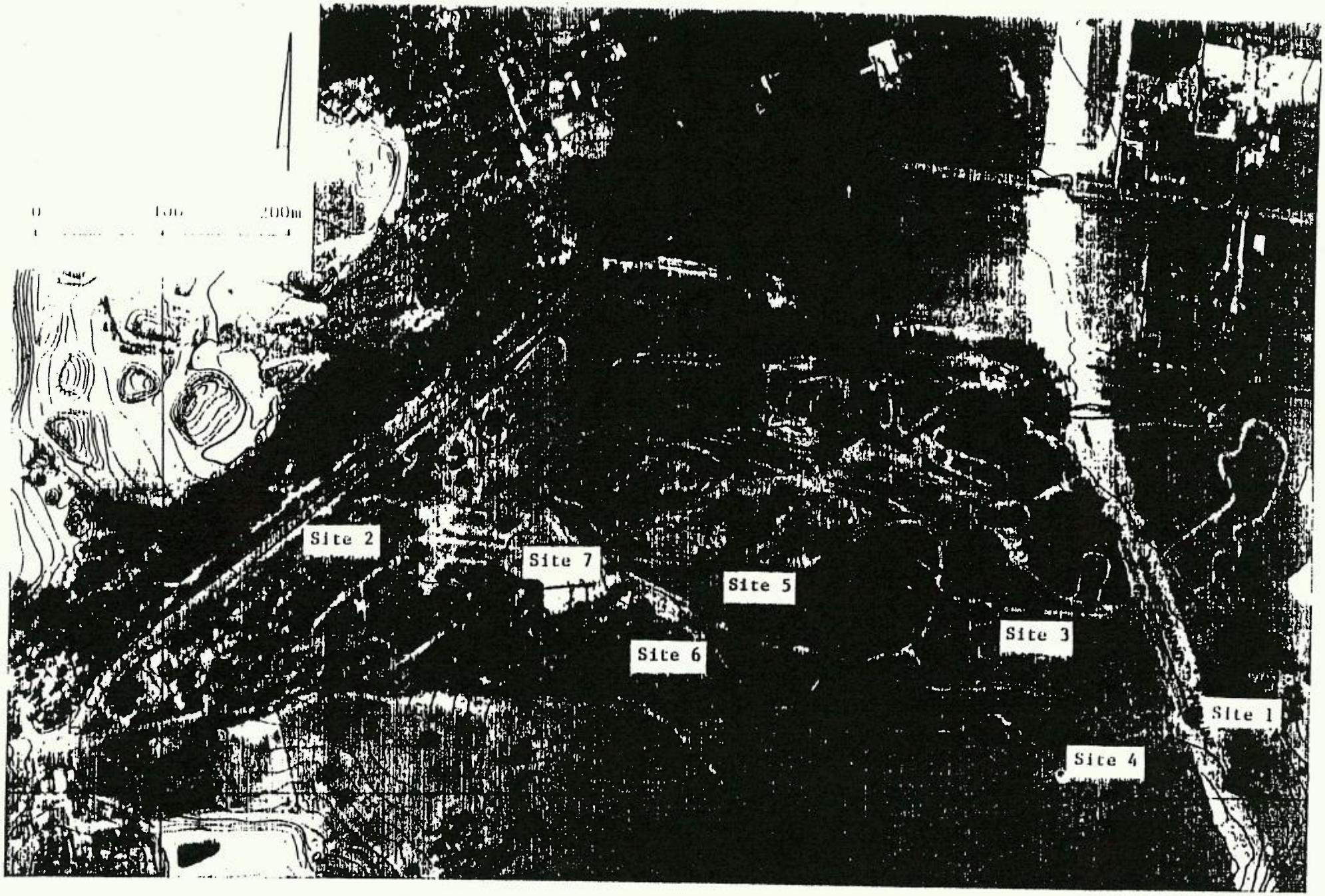

Figure 3: Sites located during the survey

1. Sites that are found *in situ* on undisturbed or marginally disturbed surfaces should be protected.
2. Surface sites that appear highly disturbed may be given a Consent to Destroy, except when it is thought possible that *in situ* sub-surface artefacts are present.

It was agreed that *in situ* sub-surface artefacts may be present, particularly on the higher slope. It was therefore recommended that test excavations be carried out in, and around, the larger sites 5, 6 and 7.

This current investigation and excavation was conducted to address the issues raised by NPWS and to reassess the cultural significance of the sites in the proposed extension area.

3. STRATEGY

In order to address the queries made by NPWS sites 5, 6 and 7 were selected for test excavation for the following reasons:

1. Together they constitute a large area of artefact scatter, containing 87 surface artefacts or 77.7% of the total amount of surface artefacts recorded by Nicholson in 1989.

2. Although artefact densities recorded over the entire study area were low compared to other sites in the immediate vicinity, sites 7 had the highest recorded density of 8 artefacts/m^2.

3. Sites 6 and 7 are close together and may represent a single, continuous scatter of artefacts.

4. Site 5 is set slightly apart but may also be part of a continuous, moderate to low density artefact scatter that exists across the ridgelines (Nicholson 1990).

5. In a survey and excavation of the ridge adjacent to the present study area, McDonald (1986) found that in areas of low or no surface artefacts, high proportions of sub-surface artefactual material existed. The area between and over which sites 5 and 6 are located was, in places, relatively undisturbed and covered with vegetation and leaf litter. It seemed likely that this area would provide a high chance of finding *in situ*, sub-surface artefacts.

This pattern of site location corresponds with the results of McDonald's previous survey higher up the ridge in which a continuous background scatter of surface artefacts was recorded.

4. METHOD

An east/west base line was laid from site 7 extending over that site, through the northern section of site 6 and terminating adjacent and to the south of site 5. A series of fourteen 50cm x 50cm test pits were excavated in areas selected for their potential to reveal sub-surface artefacts north and south of the base line (Figure 4). The excavations were dug by hand-trowel in 10cm spits. In several cases a geology pick was used to break up compacted soil. The contents of each square was sieved through a 5mm sieve.

In addition to the test pits three series of auger holes were excavated. The first series was along the base line extending east from site 7 for a distance of 88m. A 10cm auger was used at irregular intervals. Adjacent to these holes, and within 2m distance north and south, 5cm auger holes were excavated (Figure 5). A second series of 10cm auger holes was dug on a north/south axis and over a grassed mound between squares 3 and 4 on site 5 (Figure 6). A third series of 10cm auger holes was excavated at 2m intervals on a 315° axis extending 28m from site 7 (Figure 7). The contents in all three series of holes were sieved through a 5mm sieve.

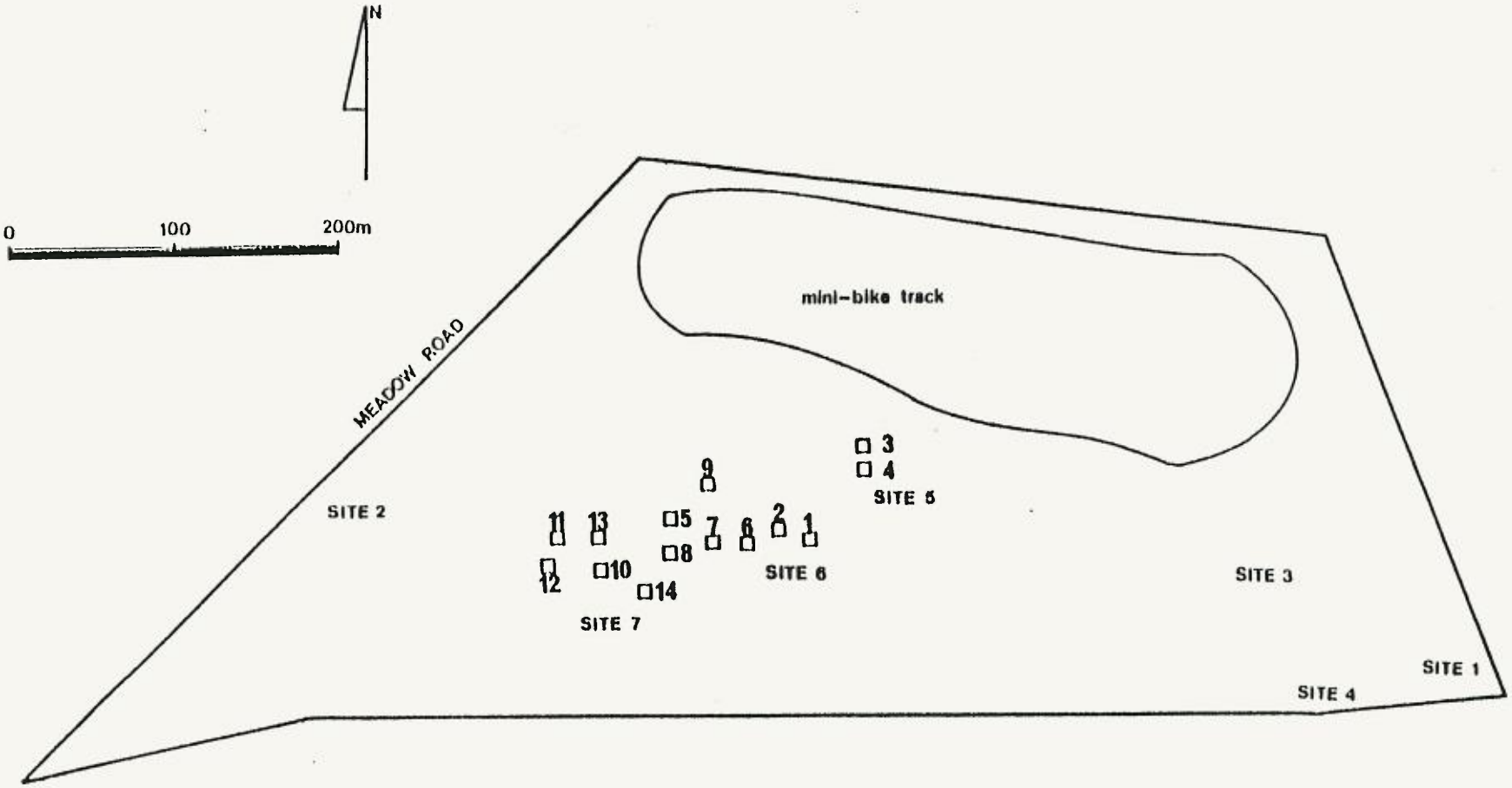

FIGURE 4: Location of 50 x 50cm squares excavated over sites 5, 6 and 7.

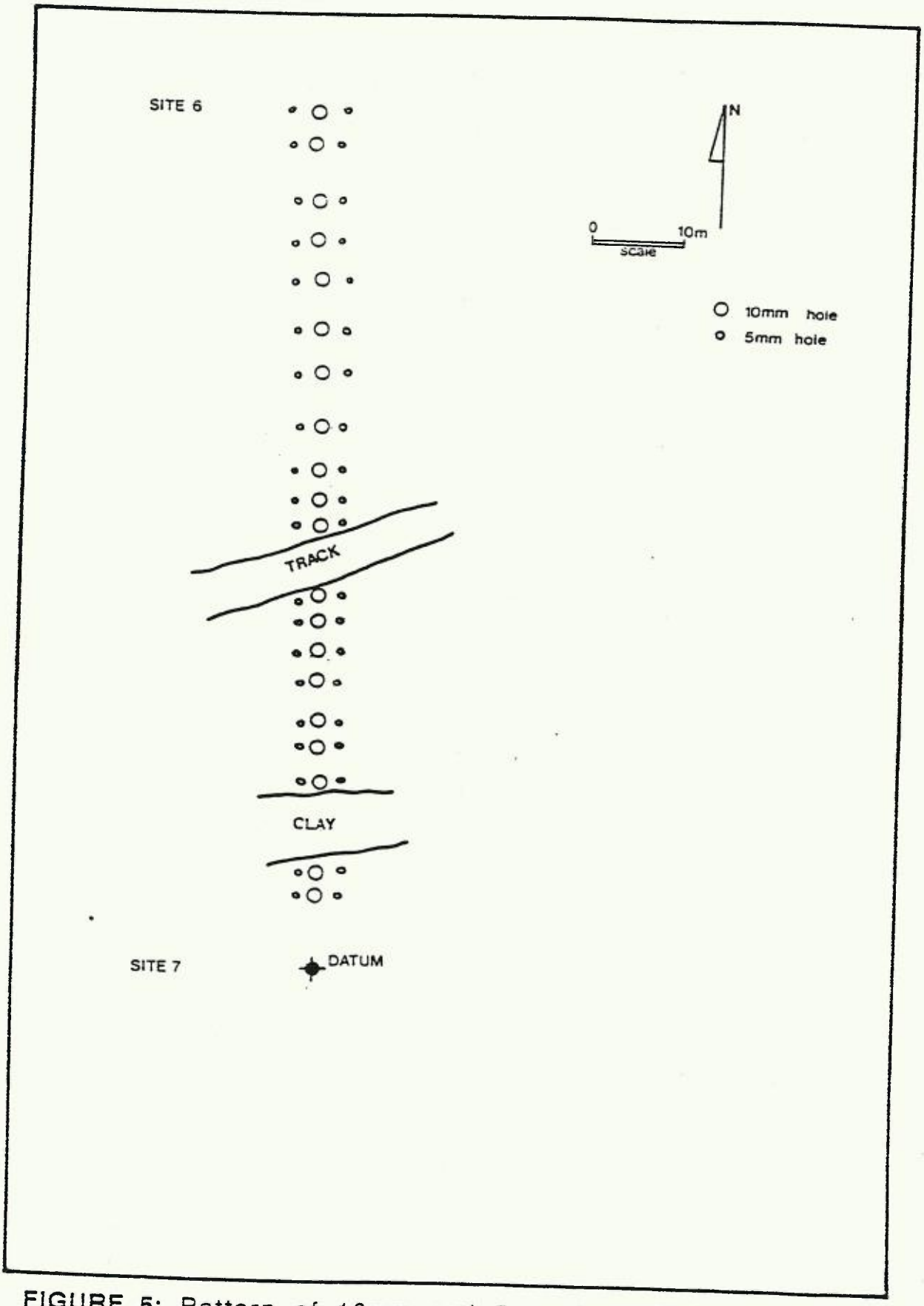

FIGURE 5: Pattern of 10mm and 5mm Auger Holes excavated between sites 6 and 7.

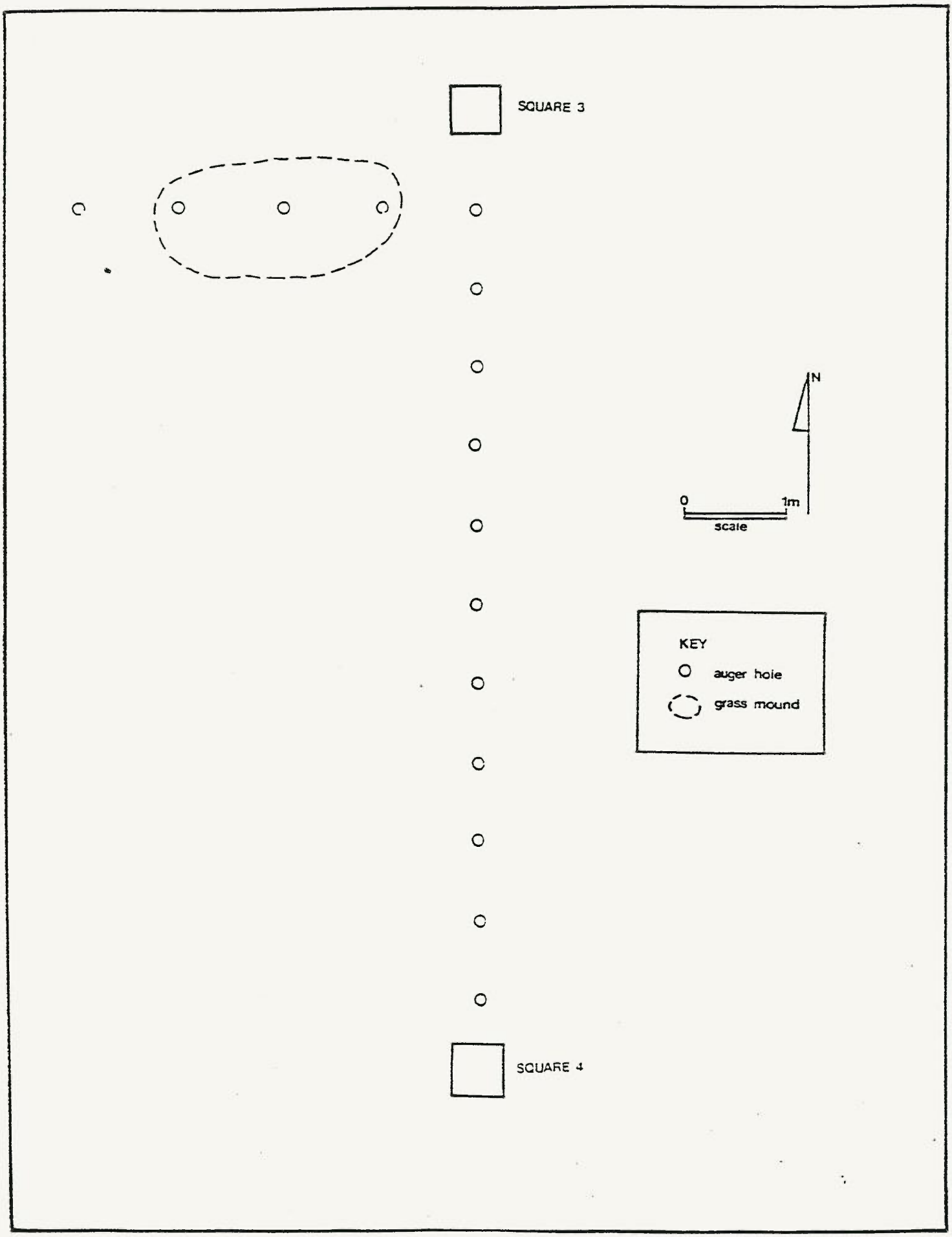

FIGURE 6: Pattern of 10mm Auger Holes excavated over site 5.

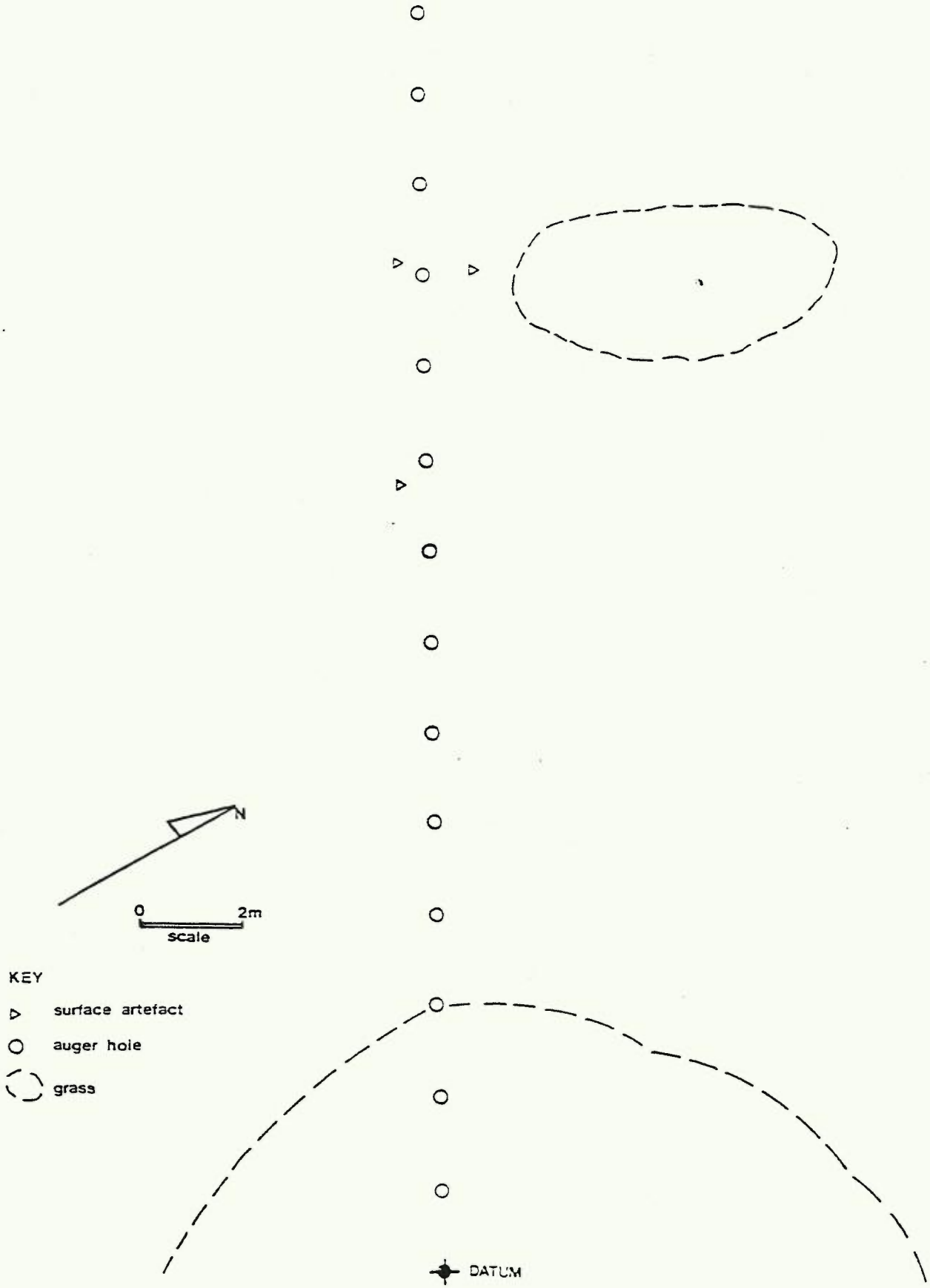

FIGURE 7: Pattern of 10mm Auger Holes excavated over site 7.

While the excavations were taking place, the study area was re-investigated on foot an attempt to fine any further sites not located in the initial survey. Particular attention was given to the lower northern section of the area.

5. RESULTS

See Annex A for excavation notes and Annex B for photographic record of selected excavation squares.

Only two of the 14 squares produced sub-surface artefacts. Square 1, located between sites 5 and 6 produced a single flaked piece of brown silcrete (24 x 20 x 5cm) from the surface-scrape. Even though this piece was not visible on the grass surface of the square it is doubtful whether it was in fact below the soil surface. In all probability it was lodged on the topsoil surface among the roots of the grass. No other artefacts were found in this square.

Square 12 on site 7 produced the only definite sub-surface artefact. One yellow silcrete flake (25 x 17 x 11mm) was found at a depth of 3cm. This area was and still is, subjected to erosion from water run-off after rain and it is therefore unlikely that the silcrete flake was *in situ*.

No further surface sites were found during the period of investigation.

6. DISCUSSION

The archaeological excavations of the study area revealed that there were no in situ sub-surface artefacts across or between the sites investigated. This result is in direct contrast with MacDonald's reconnaissance immediately to the south of the study area, which revealed widespread surface and sub-surface archaeological evidence.

One or more of the following factors may account for the discrepancy between Nicholson's and McDonald's findings:

1. The depth of topsoil across sites 5, 6 and 7 was thin ranging from 2-13cm, but in most cases less than 10cm, with an underlying base of compacted and sterile red-brown clay. It appears that much of the topsoil has been disturbed by European activities and then washed away leaving the artefacts exposed on the surface as a lag deposit.

2. Alternatively, sites 5, 6 and 7 may be more recent than those higher up the slope and have not had the time, nor the chance, to be buried under topsoil before European disturbance.

3. The densities of surface and sub-surface artefactual material is much higher further up the slope of the ridge outside of the study area. This suggests that this area was much more intensely used for manufacturing stone implements than the lower slopes. Indeed, all the sites located by Nicholson are of low density and probably represent the less used periphery of a large area used for stone extraction and tool manufacture. If this is the case then the results obtained by both Nicholson and by this series of excavations is to be expected.

The absence of sites found in the northern section of the study area can be explained in a similar manner. If the sites in the southern portion of the study area do represent the periphery of a large stone manufacturing area on Plumpton Ridge, then sites further down slope, if they existed at all, would be expected to be less dense, further apart, and representing sites of single use activities.

The northern section of the study area has been more severely disturbed by motorcycle activities than the southern section. It has little remaining topsoil left with over 90% of its surface reduced to the clay level. Therefore, if surface or sub-surface sites did exist in this section they would have long since been destroyed.

7. ABORIGINAL CONSULTATION

Mr Steven Lalor, Sites Co-ordinator for Daruk Land Council was consulted in May 1990 and together with the author jointly recommended that sites 5, 6 and 7 be test excavated to determine the presence of sub-surface artefacts (Dowling 1990).

Although Mr Lalor was committed to another archaeological investigation at Prospect Reservoir during the same period as these excavations, he was able to assist on the first two afternoons.

On Thursday 23rd August further discussions on the study area were conducted with Mr Tony Kondek, Cultural Sites Officer for the Daruk Local Aboriginal Land Council by telephone. He was briefed on Nicholson's initial survey and the nature of the sites she recorded. The results of the current excavations and the recommendations to be made were then discussed with Mr Kondek. He raised no initial objections, but wished to be sent a copy of this report for consideration, and to table at a future committee meeting of the Daruk Local Aboriginal Land Council.

8. CONCLUSIONS

The surface sites located within the study area are part of a large archaeological complex that extends across Plumpton ridge. Sites 5, 6 and 7, together with the remainder of the sites not excavated, represent the lower extent of this complex.

While the more extensive, less disturbed sites, located on higher ground to the south of the study area have revealed a high proportion of sub-surface artifactual material, sites 5, 6 and 7 revealed none. This is because of the lack of topsoil over the study area and/or because this section of the Plumpton Ridge complex was not often used for the manufacture of stone artefacts.

9. SIGNIFICANCE

Over the last decade several major archaeological studies have been conducted in the Plumpton Ridge and Cumberland Plain area of western Sydney. These have made several fundamental discoveries.

1. The location of a series of silcrete extraction sites on Plumpton Ridge.

2. The identification and recording of a series of culturally and geographically related sites displayed wood-working, micro-blade production, heat treatment in the manufacture of blades, and domestic camp activities.

These sites are of great value to the Daruk Local Aboriginal Land Council as well as being highly significant to future archaeological research.

The sites in the present study area, however, contain low numbers of artefacts with few formal and recognisable tool types, have been subjected to more intensive disturbance than sites on higher ground, and have no depth. Similar, but more extensive, less disturbed sites with sub-surface material are located immediately south of the study area. As a result this area has been defined as a Conservation Area in order to preserve a representative sample of the past cultural activities of the Daruk people.

This should of the previous paragraphic, the sites in the current study area can contribute little to further cultural or scientific knowledge.

10. RECOMMENDATIONS

Because of the nature of the sites 5, 6 and 7 as well as the other sites in the study area it is recommended that:

1. The Daruk Local Aboriginal Land Council apply to collect the artefacts from all of the recorded sites. It is the opinion of both Mr Lalor and the author that the artefacts would be of more value to the Daruk Land Council as part of an exhibit, rather than to remain where they are.

2. Following this, no further archaeological work is thought necessary prior to the commencement of the proposed development by PGH Bricks (NSW).

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Dowling, P. 1990 'An Archaeological Survey at Scholfields, NSW. Consultation with Daruk Land Council', National Heritage Studies, Hall, ACT.

McDonald, J. 1986 'Preliminary Archaeological Reconnaisance of the Proposed Schofields Regional Depot, Plumpton, NSW', NPWS.

Nicholson, A. 1990 'An Archaeological Survey at Scholfields, NSW', National Heritage Studies, Hall, ACT.

ANNEX A
EXCAVATION NOTES

Square 1 South of site 5 - 130m E - 10m S
One artefact removed from surface scrape.
0-10 black humic soil
10-20 clay, sterile.

Square 2 South of site 5 - 100m E - 15m S
Surface scrape.
0-10 black humic soil
10-20 orange clay, sterile.

Square 3 Site 5 - 173m E - 77m S
One cream silcrete flake 150cm S of square.
Two pieces of red silcrete 50cm E of square.
Soil extremely compacted by vehicle and foot traffic.
0-10 several medium nodules of nepean gravel, sterile.
10-20 traces of charcoal (root), clay, sterile.

Square 4 Site 5 - 173m E - 65m S
0-10 Nepean gravel, sterile.
10-20 Nepean gravel, clay, sterile.

Square 5 Site 6 - 49m E - 39m N
Located at track junction in grassed area directly adjacent to area of high density artefacts - 1 core of yellow silcrete on surface, 1 flake of same, 1 red silcrete flakes and 3 pieces of broken red chert (non-artefactual) also in general area.
Grassed undisturbed area.
0-10 small gravel pieces, clayey compacted soil, sterile.
10-20 brown clayey compacted soil, no stone or gravel, sterile.

Square 6 Site 6 - 90m E - 15m S
All topsoil gone, gravel surface.
0-10 sticky red clay at 3cm. Extremely hard to dig even with pick, sterile. Closed at 3cm depth.

Square 7 Site 6 - 75m E - 20m S

Selected to check extent of site.

0-10 gravel, clay appears at 2-4cm, sterile.

Square 8 Site 6 - 50m E - 0.5m S

Grassed area, selected to check stabilised part of site and extent of site.

0-10 surface topsoil and then down to clay at 7-9cm. Used pick. The S W corner has gravel and clay soil overlying harder clay. Possibly a deposit of gravel run-off from heavy rain, settling on clay and later grassed over. If so, then even this topsoil is disturbed.

Square 9 Site 6 - 67.5m E - 68m S

Stabilised surface, undisturbed?

0-10 fine brown topsoil, easy to dig. More pebbly gravel, larger pieces of red conglomerate. Clay at 8cm.

10-20 clay at 13cm, sterile.

Square 10 Site 7 - 0m E - 4m N

Located due N or datum. Grass cover sparse.

0-10 no stone but large amount of Nepean gravel, including the larger clumps of ironstone(?) conglomerate. Clay at 9cm, sterile.

Square 11 Site 7 - 22m at 315° W of datum

Edge of site 7.

Disturbed surface, 1 silcrete flaked piece on surface.

0-10 very thin topsoil, gravel and brown clayey soil. Clay at 4-6cm.

Square 12 Site 7 - 22m W - 2m N

Surface partly eroded by run-off and partly grassed but looks disturbed.

1 yellow silcrete flaked piece, 1 red silcrete flaked piece on surface.

0-10 dark brown clayey soil on western half of square, on eastern half gravel in dark brown looser soil.

At 3cm 2 pieces of non-artiffactual red silcrete,
2 pieces of artifactual (?) chips,
1 yellow silcrete flake, definite artefact.

At 5cm 1 small piece of cortex from yellow silcrete.

10-20 at 17cm light grey clay with gravel pieces, probably runnel bed. Stopped at 20cm because of sterile mixture of clay with gravel.

Augered down a further 20cm, more of the same, sterile.

Square 13 Site 7 - 15m E - 15m S

Rubble surface, no artefacts.

0-10 brown rubble topsoil, clay at 5cm, sterile.

Square 14 Site 7 - 30m E - 12m S

One artefact removed from surface scrape.

0-10 clay at 409cm. One piece of degrading sandstone (3x2cm) in N E corner.

10-20 abandoned at 15cm, clay, sterile.

ANNEX B

PHOTOGRAPHIC RECORD

Plate 1: Site 6 - Lower Northern Section.

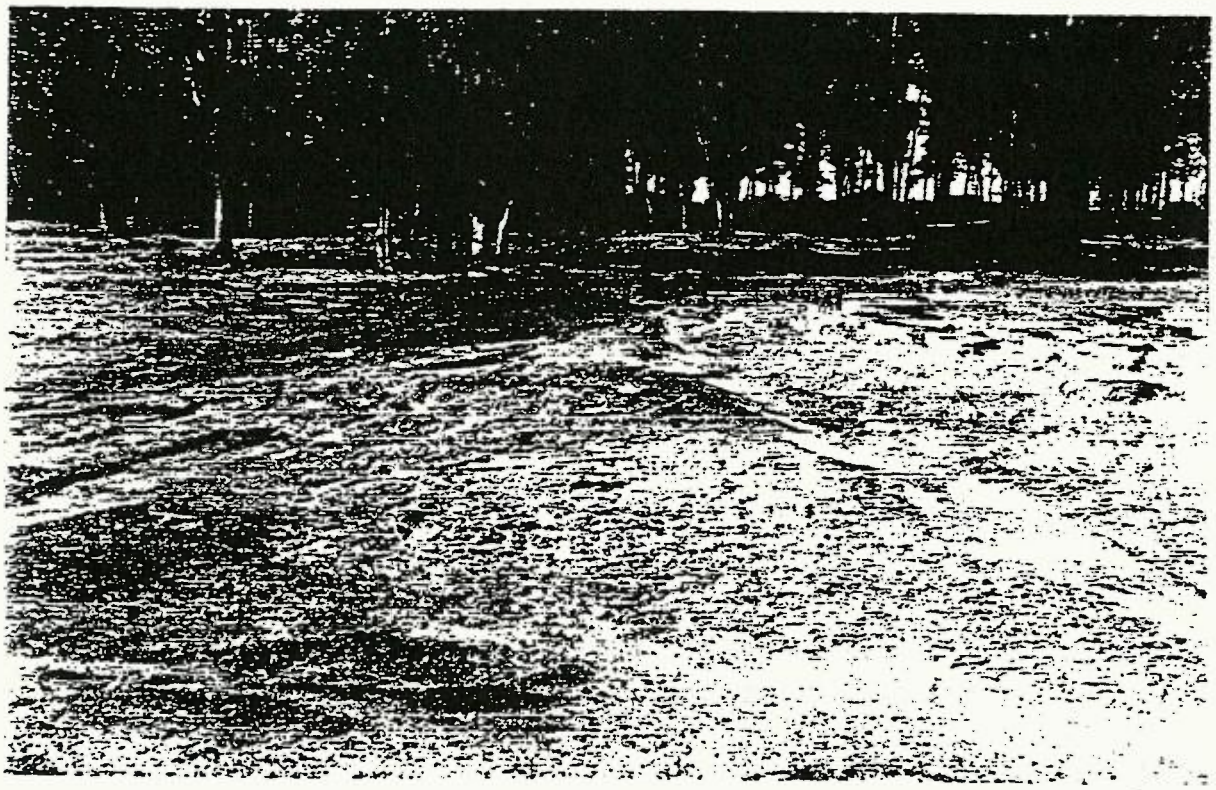


Plate 2: Site 6 - North west section square 5 excavated centre left.

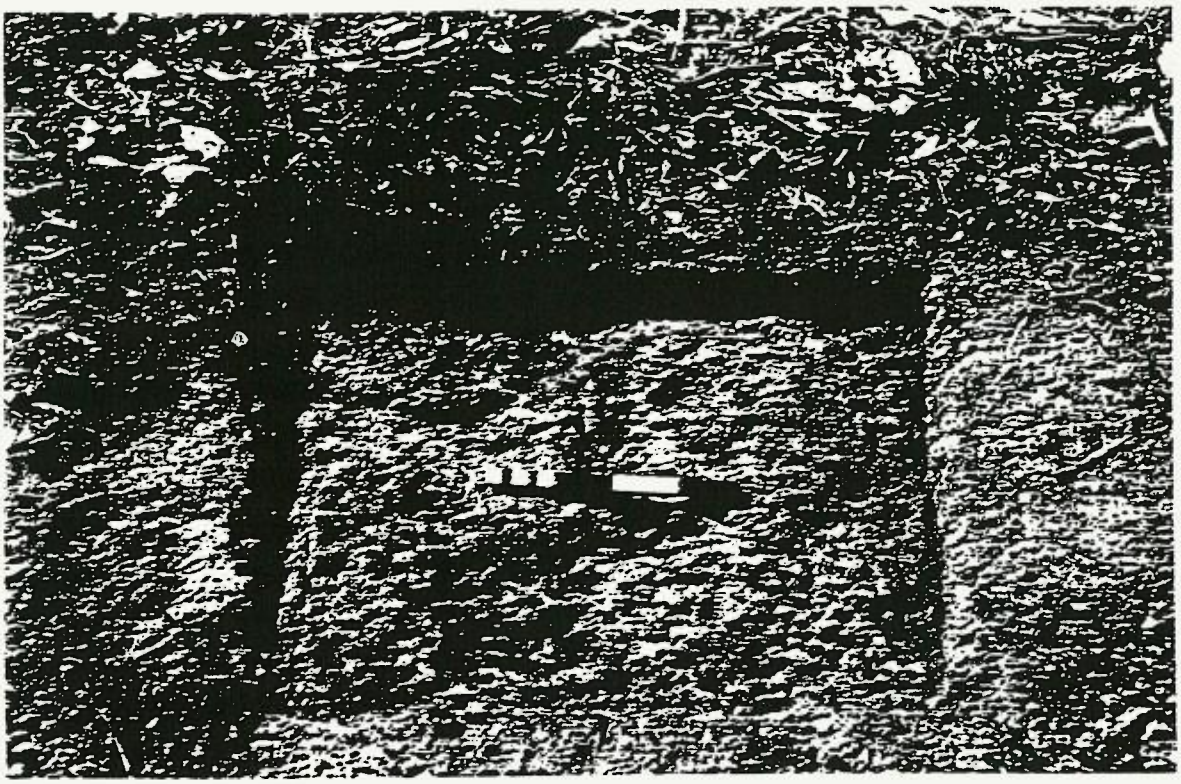


Plate 3: Square 6, Site 6 - Sticky red clay at 3cm.

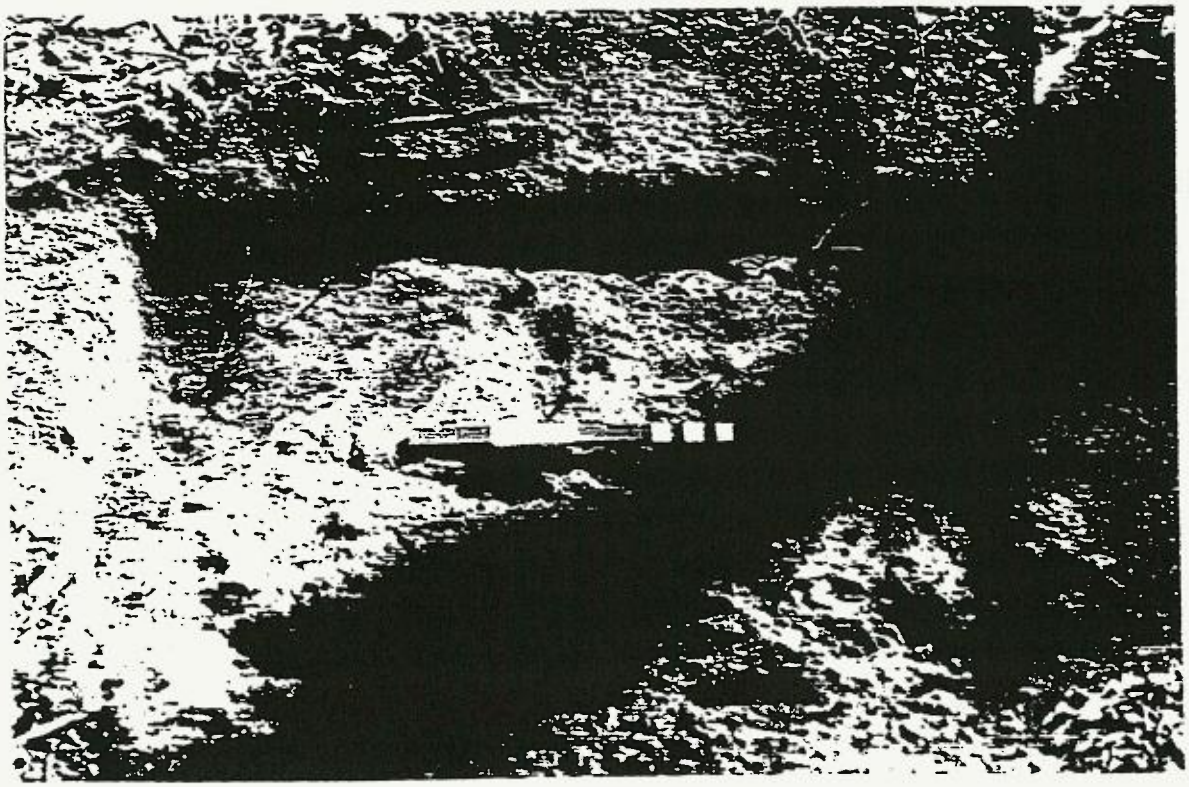


Plate 4: Square 7, Site 6 - Clay appeared at 2-4cm.

Plate 5: Square 8, Site 6 - Topsoil up to 7cm thick then clay.

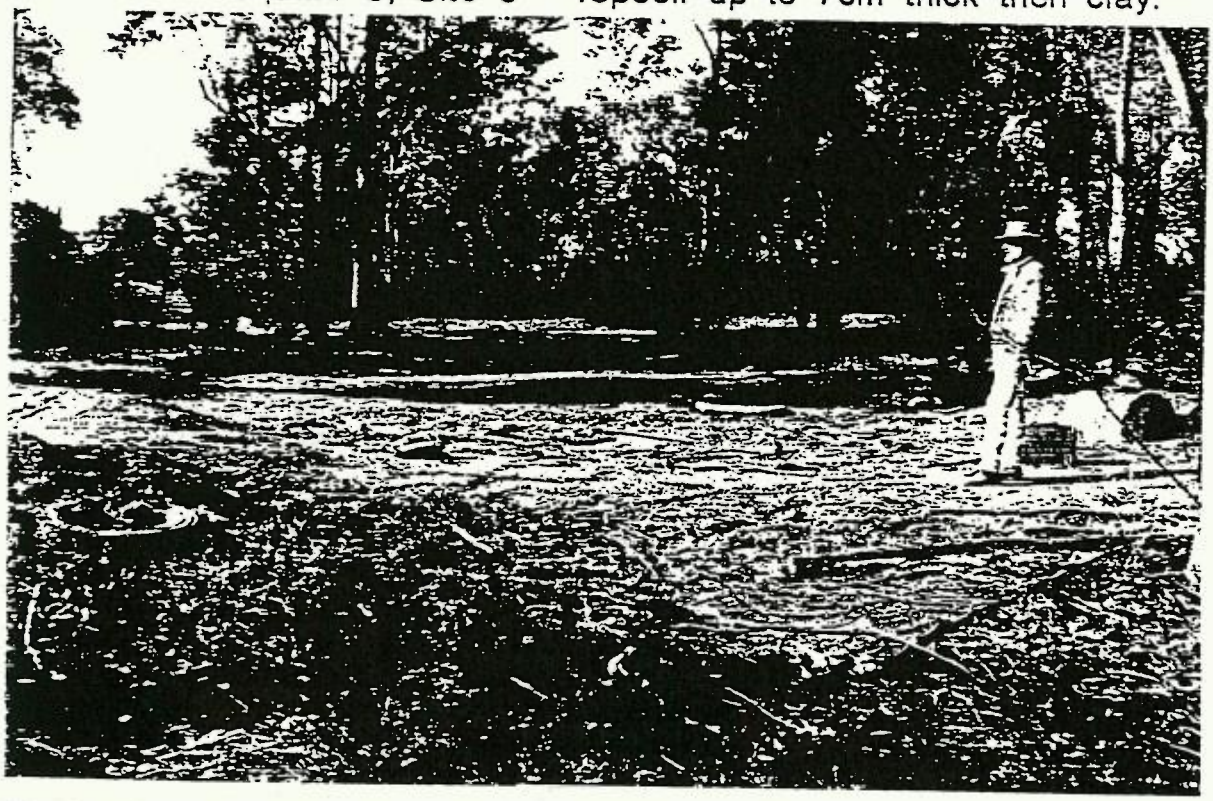


Plate 6: Site 6 (southern section). Square 6 localised in centre.

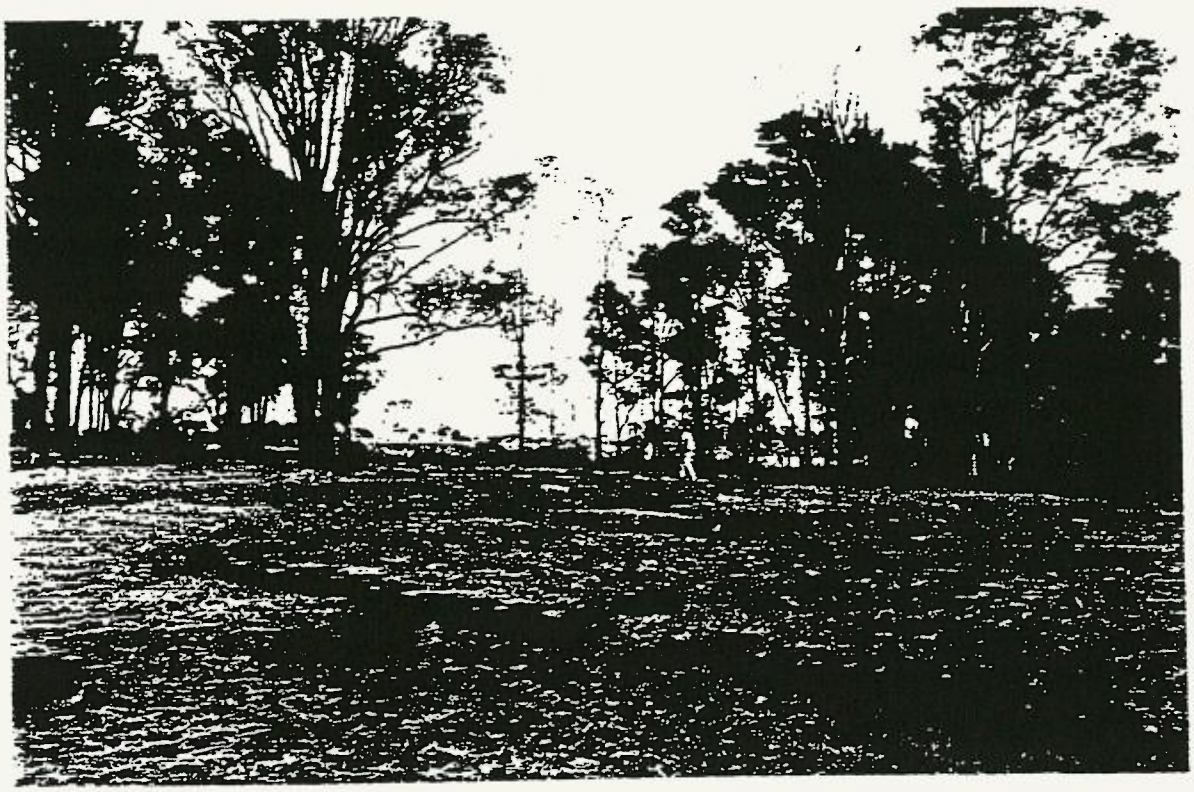


Plate 7: Site 7 - Looking south towards upper slopes.

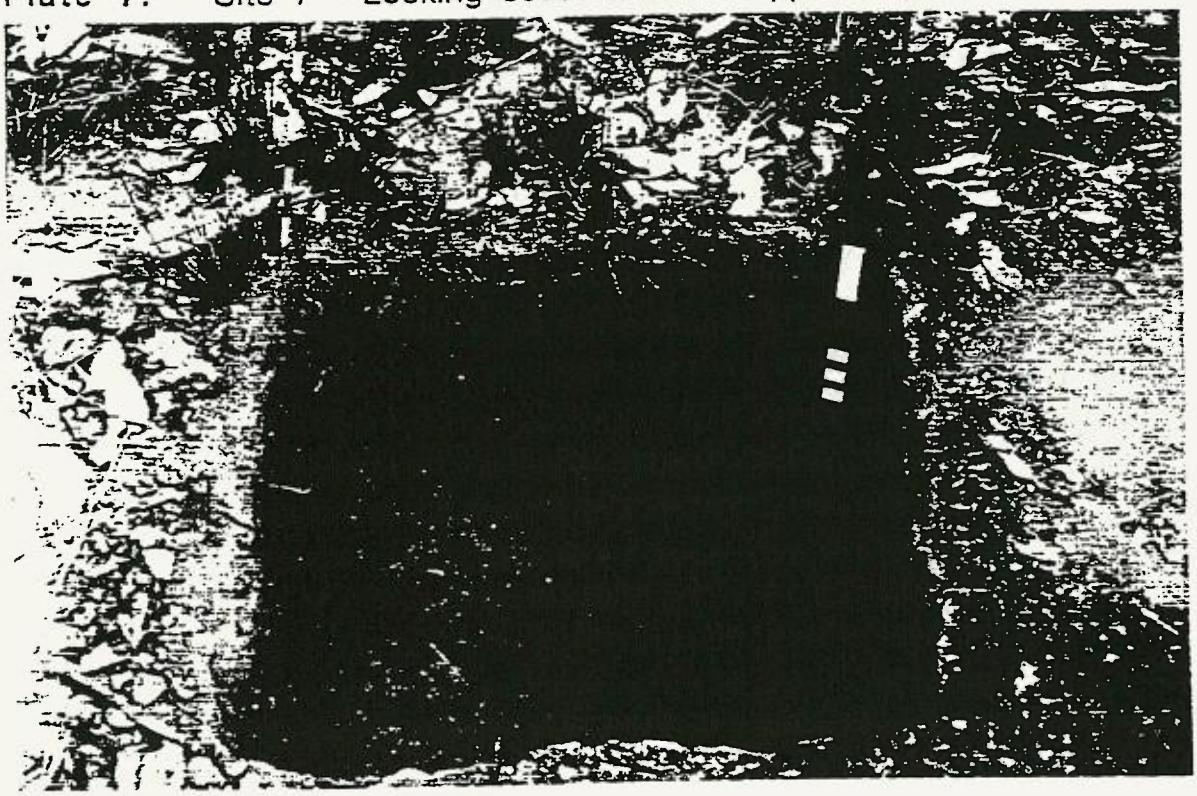


Plate 8: Square 12. Site 7 - One yellow silcrete flake and 4 chipped pieces of silcrete found at 3cm.

Plate 9: Site 7 - Datum point visible at base of tree second

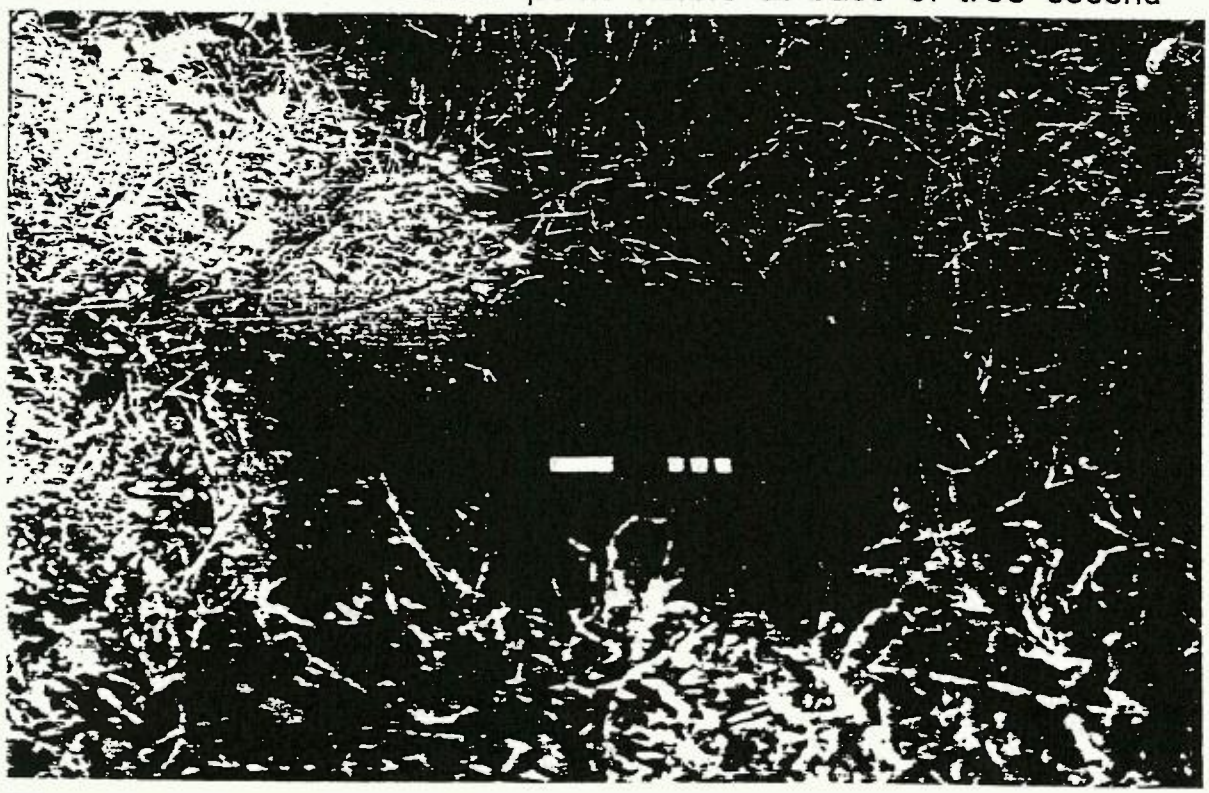


Plate 10: Square 11. Site 7 - Very thin topsoil then clay at 4-6cm.

SITE RECORDS AND SITES REGISTER
SCHOFIELDS, NSW

National Parks and Wildlife Service

August 1991

[✓] New recording [ ] Additional Info

National Parks and Wildlife Service

Box 1967, Hurstville NSW 2220. Tel: (02) 585 6444

Standard Site Recording Form Revised 5/88

NPWS Code

1:250,000 map sheet: Sydney

AMG Grid reference (Full reference - please include leading digits): 250K X 3 0 1 8 0 mE (25K) 250K X 6 2 6 7 1 0 mN (25K) 5/6

Scale of map used for grid reference (Please use largest scale available): [x] 25K, 50K (preferred) [ ] 100K [ ] 250K

1:25K, 50K, 100K map name: Riverstone

HEAD OFFICE USE ONLY:

NPWS Site no: 45-5-826

Site types: open -2

Accessioned by: AS Date: 20/8/91

Data entered by: S Fields Date: 20/8/91

Owner/Manager: Monier PGH Pty Ltd

Address: Meadows Rd, Schofields.

Site name: Schofields 1 Locality/property name:

NPWS District: Parramatta Region: Central

Reason for investigation

Proposed quarry and associated brick manufacturing plant development.

Portion no: Lot 3, DP 232 574

Parish: Gidley

Photos taken? Yes

How many attached? —

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.)

Turn right down Townson St from Richmond Rd just north of Plumpton. Continue down Meadows Rd for approx. 300m to gate into trail bike area. This site is located in the south-east corner of this area, adjacent to the fenceline.

Other sites in locality? Yes Site Types include: Artefact scatters

Are sites in NPWS Register? No

Have artefacts been removed from site? No When?

By whom? Deposited where?

Is site important to local Aborigines? Some people are interested but despite attempts to contact the relevant people (over the last 6 months) the consultant received no response regarding these Schofield sites.

Give contact(s) name(s) + address(es)

Contacted for this recording? Chairman Gandangara Land Council, Cliff Foley, 15 Dellamere St, Canly Val

(Attach additional information separately) If not, why not? or c/- Head Office NPWS, Hurstville.

Verbal/written reference sources (including full title of accompanying report).

Nicholson, A.F. 1990 An Archaeological Survey at Schofields, NSW. A Report to R.W. Corkery and Co. Pty Ltd.

NPWS Report Catalogue # +C-2081 C-2080

Checklist: surface visibility, damage/disturbance/ threat to site

Condition of site: Small, highly disturbed scatter of artefacts along natural gas pipeline easement. Surface visibility 100%.

Recommendations for management & protection (attach separate sheet if necessary):

A Consent to Destroy has been applied for this site.

Site recorded by: Annie Nicholson Date: 2/9/89

Address/institution: c/- National Heritage Studies Pty Ltd P.O. Box 92, Hall 2618 ACT

SITE POSITION & ENVIRONMENT

OFFICE USE ONLY: NPWS site no: 45-5-826

1. Land form a. beach/hill slope/ridge top/etc: b. site aspect: c. slope:

d. mark on diagram provided *or* on your own sketch the position of the site:

e. Describe briefly: Site is located on flat ground adjacent to eastern side of major ridgeline. (See attached map showing site location.)

f. Local rock type: Sandstone/Siltstone

g. Land use/effect: Trail bike circuit-deflation

2. Distance from drinking water: 300m Source: Eastern Creek (permanent creek)

3. Resource Zone associated with site (estuarine, riverine, forest etc): Forest

4. Vegetation: Eucalypt forest where clearance has not occured

5. Edible plants noted:

6 Faunal resources (include shellfish): Small marsupials

7 Other exploitable resources (river pebbles, ochre, etc). Silcrete outcrop

Site type:

Artefact Scatter

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.

Site consists of 15 artefacts scattered over section of Natural Gas Pipeline easement.

10 unretouched flakes
3 flaked pieces
1 core
1 utilized flake

Raw Materials- 12 silcrete (6 dark red, 3 yellow, 2 red, 1 purple)
2 chert (black)
1 quartz

Artefacts are scattered over an area measuring 105m x 4m. Site has been heavily disturbed during the construction of the pipeline. Artefacts are not 'in situ' and there is no possibility of sub-surface deposit.

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 Revised 5/88

1:250,000 map sheet: Sydney (NPWS Code)

AMG Grid reference (Full reference - please include leading digits): 250K [X] 3 0 1 1 0 mE (25K) — 250K [X] 6 2 6 7 2 0 mN (5/6, 25K)

Scale of map used for grid reference (Please use largest scale available): [x] 25K, 50K (preferred) [ ] 100K [ ] 250K

1:25K, 50K, 100K map name: Riverstone

HEAD OFFICE USE ONLY:

NPWS Site no: 45-5-827

Site types: open-2

Accessioned by: AJ Date: 20/8/91

Data entered by: S Fields Date: 20/8/91

Owner/Manager: Monier PGH Pty Ltd

Address: Meadows Rd, Schofields.

Site name: Schofields 2 Locality/property name:

NPWS District: Parramatta Region: Central

Reason for investigation

Proposed quarry and associated brick manufacturing plant development.

Portion no: Lot 3, DP 232 574

Parish: Gidley

Photos taken? Yes

How many attached? -

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.)

Turn right down Townson St from Richmond Rd just north of Plumpton. Continue down Meadows Rd for approx. 300m to gate into trail bike area. This site is located in the clear area immediately inside the gate.

Other sites in locality? Yes

Are sites in NPWS Register? No

Site Types include: Artefact scatters

Have artefacts been removed from site? No

By whom?

When?

Deposited where?

Is site important to local Aborigines? Give contact(s) name(s) + address(es)

Some people are interested but despite attempts to contact the relevant people (over the last 6 months) the consultant received no response regarding these Schofield sites.

Contacted for this recording? (Attach additional information separately) If not, why not?

Chairman, Gandangara Land Council, Cliff Foley, 15 Dellamere St, Canly Va or c/- Head Office NPWS, Hurstville.

Verbal/written reference sources (including full title of accompanying report).

Nicholson, A.F. 1990 An Archaeological Survey at Schofields, NSW. A Report to R.W. Corkery and Co. Pty Ltd.

NPWS Report Catalogue # +C-2081 C-2080

Checklist: surface visibility, damage/disturbance/ threat to site

Condition of site: Very small, highly disturbed site located at track junction inside main gate.

Recommendations for management & protection (attach separate sheet if necessary):

A Consent to Destroy has been applied for this site.

Site recorded by: Annie Nicholson Date: 2/9/89

Address/institution: c/- National Heritage Studies Pty Ltd P.O. Box 92, Hall ACT 2618

SITE POSITION & ENVIRONMENT

OFFICE USE ONLY: NPWS site no: 45-5-827

1. Land form a. beach/hill slope/ridge top/ etc:

b. site aspect:

c. slope:

d. mark on diagram provided *or* on your own sketch the position of the site:

e. Describe briefly: Site is located on flat ground adjacent to the eastern side of major ridgeline. (See attached map showing site location.)

f. Local rock type: Sandstone/Siltstone

g. Land use/effect: Trail bike circuit - deflation

2. Distance from drinking water: 300m

Source: Eastern Creek (permanent creek)

3. Resource Zone associated with site (estuarine, riverine, forest etc): Forest

4. Vegetation:
Eucalypt forest where clearance has not occurred.

5. Edible plants noted:

6 Faunal resources (include shellfish): Small marsupials

7 Other exploitable resources (river pebbles, ochre, etc) Silcrete outcrop

Site type:
Artefact Scatter

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.

Site contains only two artefacts located on clear ground at track junction just inside the main gate.
2 flaked pieces

Raw Materials - 2 silcrete (pink/cream)

Several broken silcrete pebbles also present. Likely to be related to vehicle traffic rather than Aboriginal activities.

Site is very small and disturbed.

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.

D. WEST, GOVERNMENT PRINTER N.S.W.

[✓] New recording [ ] Additional Info

National Parks and Wildlife Service

Box 1967, Hurstville NSW 2220. Tel: (02) 585 6444

Standard Site Recording Form Revised 5/88

1:250,000 map sheet: Sydney (NPWS Code)

AMG Grid reference (Full reference - please include leading digits): 250K [X]30160 mE (25K) — 250K [X]62672 0 mN (5/6, 25K)

Scale of map used for grid reference (Please use largest scale available): [X] 25K, 50K (preferred) [ ] 100K [ ] 250K

1:25K, 50K, 100K map name: Riverstone

HEAD OFFICE USE ONLY:
NPWS Site no: 45-5-828
Site types: Open - 2
Accessioned by: AJ Date: 20/8/91
Data entered by: S fields Date: 20/8/91

Owner/Manager: Monier PGH Pty Ltd
Address: Meadows Rd, Schofields.

Site name: Schofields 3 Locality/property name:

NPWS District: Parramatta Region: Central

Reason for investigation
Proposed quarry and associated brick manufacturing plant development.

Portion no: Lot 3, DP 232 574
Parish: Gidley

Photos taken? Yes
How many attached?-

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.)
Turn right down Townson St from Richmond Rd just north of Plumpton. Continue down Meadows Rd for approx. 300m to gate into trail bike area. Site is located on track on eastern side of the area. (see attached map)

Other sites in locality? Yes Site Types include: Artefact scatters
Are sites in NPWS Register? No

Have artefacts been removed from site? No When?
By whom? Deposited where?

Is site important to local Aborigines? Some people are interested but despite attempts to contact the relevant people (over the last 6 months) the consultant received no response regarding the Schofield sites.
Give contact(s) name(s) + address(es)
Contacted for this recording? Chairman, Gandangara Land Council, Cliff Foley, 15 Dellamere St, Canly Vale. ~~or c/- Head Office NPWS, Hurstville.~~
(Attach additional information separately) If not, why not?

Verbal/written reference sources (including full title of accompanying report).
Nicholson, A.F. 1990 An Archaeological Survey at Schofields, NSW. A Report to R.W. Corkery and Co. Pty Ltd.
NPWS Report Catalogue # C-2081 C-2080

Checklist: surface visibility, damage/disturbance/ threat to site
Condition of site: Very small, highly disturbed scatter of artefacts on track.

Recommendations for management & protection (attach separate sheet if necessary):
A Consent to Destroy has been applied for this site.

Site recorded by: Annie Nicholson Date: 2/9/89
Address/institution: c/- National Heritage Studies Pty Ltd, P.O. Box 92, Hall 2618 ACT

SITE POSITION & ENVIRONMENT

OFFICE USE ONLY: NPWS site no: 45-5-828

1. Land form a. beach/hill slope/ridge top, etc:

b. site aspect:

c. slope:

d. mark on diagram provided *or* on your own sketch the position of the site:

e. Describe briefly: Site is located on flat ground adjacent to the eastern margin of major ridgeline. (See attached map showing site location.)

f. Local rock type: Sandstone/Siltstone

g. Land use/effect: Trail bike circuit - Deflation

2. Distance from drinking water: 300m

Source: Eastern Creek (permanent creek).

3. Resource Zone associated with site (estuarine, riverine, forest etc): Forest

4. Vegetation:
Eucalypt forest where clearance has not occurred.

5. Edible plants noted:

6 Faunal resources (include shellfish): Small marsupials.

7 Other exploitable resources (river pebbles, ochre, etc). Silcrete outcrop

Site type:

Artefact Scatter

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.

Site contains only two artefacts located on a track.

1 flaked piece, dark red silcrete
1 core, red silcrete

Site is small and highly disturbed.

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.

GOVERNMENT PRINTER N.S.W.

[✓] New recording [ ] Additional Info

National Parks and Wildlife Service

Box 1967, Hurstville NSW 2220. Tel: (02) 585 6444

Standard Site Recording Form Revised 5/88

1:250,000 map sheet: Sydney (NPWS Code)

AMG Grid reference (Full reference - please include leading digits): 250K [X] 3 0 1 7 0 mE (25K); 250K [X] 6 2 6 7 1 0 mN (5/6, 25K)

Scale of map used for grid reference (Please use largest scale available): [X] 25K, 50K (preferred) [ ] 100K [ ] 250K

1:25K, 50K, 100K map name: Riverstone

HEAD OFFICE USE ONLY:

NPWS Site no: 45-5-829

Site types: open-2

Accessioned by: AJ Date: 20/8/91

Data entered by: S fields Date: 20/8/91

Owner/Manager: Monier PGH Pty Ltd

Address: Meadows Rd, Schofields

Site name: Schofields 4 Locality/property name:

NPWS District: Parramatta Region: Central

Reason for investigation

Proposed quarry and associated brick manufacturing plant development.

Portion no: Lot 3, DP 232 574

Parish: Gidley

Photos taken? Yes

How many attached?

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.)

Turn right down Townson St from Richmond Rd just north of Plumpton. Continue down Meadows Rd for approx. 300m to gate into trail bike area. Site is located on fenceline which forms the southern boundary of this area (see attached map).

Other sites in locality? Yes

Are sites in NPWS Register? No

Site Types include: Artefact scatters

Have artefacts been removed from site? No

By whom?

When?

Deposited where?

Is site important to local Aborigines? Some people are interested but despite attempts to contact the relevant people (over the last six months) the consultant received no response regarding the Schofields sites.

Give contact(s) name(s) + address(es)

Contacted for this recording? Chairman, Gandangara Land Council, 15 Dellamere St, Canly Vale.

(Attach additional information separately) If not, why not? (Cliff Foley)

Verbal/written reference sources (including full title of accompanying report).

Nicholson, A.F. 1990 An Archaeological Survey at Schofields, NSW. A Report to R.W. Corkery and Co. Pty Ltd.

NPWS Report Catalogue # +C-2081 C-2080

Checklist: surface visibility, damage/disturbance/ threat to site

Condition of site: Site is small and highly disturbed being located on cleared land adjacent to a quarried area.

Recommendations for management & protection (attach separate sheet if necessary):

A Consent to Destroy has been applied for this site.

Site recorded by: Annie Nicholson Date: 2/9/89

Address/institution: c/- National Heritage Studies Pty Ltd
P.O. Box 92, Hall ACT 2618

SITE POSITION & ENVIRONMENT

OFFICE USE ONLY: NPWS site no: 45-5-829

1. Land form a. beach / hill slope / ridge top, etc:

b. site aspect:

c. slope:

d. mark on diagram provided *or* on your own sketch the position of the site:

e. Describe briefly: Site is located on gently sloping ground on the eastern margin of major ridgeline. (See attached map showing site locations.)

f. Local rock type: Sandstone/Siltstone

g. Land use/effect: Quarry - removal of original ground surface.

2. Distance from drinking water: 300m

Source: Eastern Creek (permanent creek)

3. Resource Zone associated with site (estuarine, riverine, forest etc): Forest

4. Vegetation:
Eucalypt forest where clearance has not occurred.

5. Edible plants noted:

6. Faunal resources (include shellfish): Small marsupials.

7. Other exploitable resources (river pebbles, ochre, etc). Silcrete outcrop

Site type:

Artefact Scatter

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.

Site consists of 6 artfacts scattered across a narrow strip of high ground between a fenceline and a quarried area.

1 unretouched flake
4 flaked pieces
1 core

Raw Materials - 6 silcrete (3 dark red, 2 pink/cream, 1 yellow)

5 artefacts are scattered over an area measuring 15m x 1m with the other artefact located 30m to the north-west.
The site has been heavily disturbed by clearing and quarrying activities with the area adjacent to the artefact scatter having been excavated to a depth of about 3m. The artefacts are not 'in situ' and there is no likelihood of sub-surface material.

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.

D. WEST, GOVERNMENT PRINTER N.S.W.

[✓] New recording [ ] Additional Info

National Parks and Wildlife Service

Box 1967, Hurstville NSW 2220. Tel: (02) 585 6444

Standard Site Recording Form Revised 5/88

NPWS Code

1:250,000 map sheet: Sydney

AMG Grid reference (Full reference - please include leading digits): 250K X 3 0 1 5 0 mE (25K) — 250K X 6 2 6 7 2 0 mN (5/6, 25K)

Scale of map used for grid reference (Please use largest scale available): [x] 25K, 50K (preferred) [ ] 100K [ ] 250K

1:25K, 50K, 100K map name: Riverstone

HEAD OFFICE USE ONLY:

NPWS Site no: 45-5-830

Site types: open-2

Accessioned by: AJ Date: 20/8/91

Data entered by: S Fields Date: 20/8/91

Owner/Manager: Monier PGH Pty Ltd

Address: Meadows Rd, Schofields

Site name: Schofields 5 Locality/property name:

NPWS District: Parramatta Region: Central

Reason for investigation

Proposed quarry and associated brick manufacturing plant development.

Portion no: Lot 3, DP 232 574

Parish: Gidley

Photos taken? Yes

How many attached? -

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.)

Turn right down Townson St from Richmond Rd just north of Plumpton. Continue down Meadows Rd for approx. 300m to gate into trail bike area. Site is located on clear area infront of clubhouse.

Other sites in locality? Yes

Are sites in NPWS Register? No

Site Types include: Artefact scatters

Have artefacts been removed from site? No

By whom?

When?

Deposited where?

Is site important to local Aborigines? Some people are interested but despite attempts to contact the relevant people (over the last 6 months) the consultant received no respose regarding the Schofields sites.

Give contact(s) name(s) + address(es)

Contacted for this recording? Chairman, Gandangara Land Council, Cliff Foley, 15 Dellamere St, Canly Vale.

(Attach additional information separately) If not, why not? (or c/- Head Office NPWS, Hurstville)

Verbal/written reference sources (including full title of accompanying report).

Nicholson, A.F. 1990 An Archaeological Survey at Schofields, NSW. A Report to R.W. Corkery and Co. Pty Ltd.

NPWS Report Catalogue # C-2081 C-2080

Checklist: surface visibility, damage/disturbance/ threat to site

Condition of site: Artefacts scattered over an open area used for viewing the actual trail bike circuit. Visibility 100%. Ground eroded.

Recommendations for management & protection (attach separate sheet if necessary):

A Consent to Destroy has been applied for this site.

Site recorded by: Annie Nicholson Date: 2/9/89

Address/institution: c/o National Heritage Studies Pty Ltd P.O. Box 92, Hall ACT 2618

SITE POSITION & ENVIRONMENT

OFFICE USE ONLY: NPWS site no: 45-5-

1. Land form a. beach/hill slope/ridge top, etc:

b. site aspect:

c. slo

d. mark on diagram provided *or* on your own sketch the position of the site:

e. Describe briefly: Site is locate gently sloping ground on eastern margin of major ri (See attached map showing si location.)

f. Local rock type: Sandstone/Siltstone

g. Land use/effect: Trail bike circuit - deflation

2. Distance from drinking water: 300m Source: Eastern Creek (permanent creek)

3. Resource Zone associated with site (estuarine, riverine, forest etc): Forest

4. Vegetation:
Eucalypt forest where clearance has not occurred.

5. Edible plants noted:

6 Faunal resources (include shellfish): Small marsupials.

7 Other exploitable resources (river pebbles, ochre, etc). Silcrete outcrop

Site type:
Artefact Scatter

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.

Site consists of 14 artefacts scattered over an area measuring 20m x 15m

6 unretouched flakes
7 flaked pieces

Raw Materials - 12 silcrete (6 dark red, 3 yellow, 1 red, 1 pink/cream, 1 light grey)

These artefacts are scattered over an area used for recreational activities associated with trail bike circuit. The ground surface in this area has been heavily deflated and the artefacts are no longer 'in situ'. There is no likelihood of sub-surface material being present at this site.

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

Revised 5/88

NPWS Code

1:250,000 map sheet: Sydney

AMG Grid reference (Full reference - please include leading digits): 250K [X] 3 0 1 4 0 mE (25K) — 250K [X] 6 2 6 7 2 0 mN (25K, 5/6)

Scale of map used for grid reference (Please use largest scale available): [X] 25K, 50K (preferred) [ ] 100K [ ] 250K

1:25K, 50K, 100K map name: Riverstone

HEAD OFFICE USE ONLY:

NPWS Site no: 45-5-831

Site types: Open - 2

Accessioned by: AJ Date: 20/8/91

Data entered by: S fields Date: 20/8/91

Owner/Manager: Monier PGH Pty Ltd

Address: Meadows Rd, Schofields

Site name: Schofields 6 Locality/property name:

NPWS District: Parramatta Region: Central

Reason for investigation

Proposed quarry and associated brick manufacturing plant development.

Portion no: Lot 3, DP 232 574

Parish: Gidley

Photos taken? Yes

How many attached?

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.)

Turn right down Townson St from Richmond Rd north of Plumpton. Continue down Meadows Rd for approx. 300m to gate into trail bike area. Site is located on raised deflated area on margin of bike circuit.

Other sites in locality? Yes Site Types include: Artefact scatters

Are sites in NPWS Register? No

Have artefacts been removed from site? No When?

By whom? Deposited where?

Is site important to local Aborigines? Some people are interested but despite attempts to contact the relevant people (over the last 6 months) the consultant received no response regarding the Schofields sites.

Give contact(s) name(s) + address(es)

Contacted for this recording? Chairman, Gandangara Land Council, Cliff Foley, 15 Dellamere St, Canly Vale.

(Attach additional information separately) If not, why not? (or c/- Head Office NPWS, Hurstville)

Verbal/written reference sources (including full title of accompanying report).

Nicholson, A.F. 1990 An Archaeological Survey at Schofields, NSW. A Report to R.W. Corkery and Co. Pty Ltd.

NPWS Report Catalogue # + C-2081 C-2080

Checklist: surface visibility, damage/disturbance/ threat to site

Condition of site: Site consists of artefacts scattered over a deflated area adjacent to the main bike circuit. Heavily disturbed by vehicle traffic. Visibility is high on site (90-100%), but low on adjacent areas (less than 30%).

Recommendations for management & protection (attach separate sheet if necessary):

A Consent to Destroy has been applied for this site.

Site recorded by: Annie Nicholson Date: 2/9/89

Address/institution: c/o National Heritage Studies Pty Ltd P.O. Box 92, Hall 2618 ACT

SITE POSITION & ENVIRONMENT

OFFICE USE ONLY: NPWS site no: 45-5-831

1. Land form a. beach/hill/slope/ridge top, etc: b. site aspect: c. slope:

d. mark on diagram provided *or* on your own sketch the position of the site:

e. Describe briefly: Site is located on gently sloping ground on the margin of major ridgeline. (See attached map showing site location.)

f. Local rock type: Sandstone/Siltstone

g. Land use/effect: Trail bike circuit - deflated

2. Distance from drinking water: 300m Source: Eastern Creek (permanent creek)

3. Resource Zone associated with site (estuarine, riverine, forest etc): Forest

4. Vegetation: Eucalypt forest where clearing has not occurred.

5. Edible plants noted:

6 Faunal resources (include shellfish): Small marsupials

7 Other exploitable resources (river pebbles, ochre, etc). Silcrete outcrop.

Site type:

Artefact Scatter

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.

Site consists of 22 artefacts scattered over on area adjacent to the main trail bike circuit.

10 unretouched flakes
10 flaked pieces
1 core
1 utilised flake

Raw Materials - 22 silcrete (20 red, 1 dark red, 1 grey)

Artefacts are scattered over an area which has been cleared to make a bike trail and jump and over a track. The site has been considerably disturbed by these construction activities and the artefacts are no longer 'in situ'.

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 Revised 5/88

NPWS Code

1:250,000 map sheet: Sydney

AMG Grid reference (Full reference - please include leading digits): 250K [X] 3 0 1 3 0 mE (25K) — 250K [X] 6 2 6 7 2 0 mN (5/6, 25K)

Scale of map used for grid reference (Please use largest scale available): [X] 25K, 50K (preferred) [ ] 100K [ ] 250K

1:25K, 50K, 100K map name: Riverstone

HEAD OFFICE USE ONLY:

NPWS Site no: 45-5-832

Site types: open-2

Accessioned by: AJ Date: 20/8/91

Data entered by: S fields Date: 20/8/91

Owner/Manager: Monier PGH Pty Ltd

Address: Meadows Rd, Schofields

Site name: Schofield 7 Locality/property name:

NPWS District: Parramatta Region: Central

Reason for investigation

Proposed quarry and associated brick manufacturing plant development

Portion no: Lot 3, DP 232 574

Parish: Gidley

Photos taken? Yes

How many attached?

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.)

Turn right down Townson St from Richmond Rd just north of Plumpton. Continue down Meadows Rd for approx. 300m to gate into trail bike area. Site is located on raised deflated area on margin of bike track circuit.

Other sites in locality? Yes Site Types include: Artefact scatters

Are sites in NPWS Register? No

Have artefacts been removed from site? No When?

By whom? Deposited where?

Is site important to local Aborigines? Some people are interested but despite attempts to contact the relevant people (over the last 6 months) the consultant received no response regarding the Schofield sites.

Give contact(s) name(s) + address(es)

Contacted for this recording? Chairman, Gandangara Land Council. Cliff Foley, 15 Dellamere St, Canly Vale.

(Attach additional information separately) If not, why not? (or c/- Head Office NPWS, Hurstville.)

Verbal/written reference sources (including full title of accompanying report).

Nicholson, A.F. 1990 An Archaeological survey at Schofields, NSW. A Report to R.W. Corkery and Co. Pty Ltd.

NPWS Report Catalogue # +C-2081 C-2080

Checklist: surface visibility, damage/disturbance/ threat to site

Condition of site: Site consists of artefacts scattered over a deflated area adjacent to the main bike circuit. Heavily disturbed by vehicle traffic. Visibility is 100%.

Recommendations for management & protection (attach separate sheet if necessary):

A Consent to Destroy has been applied for this site.

Site recorded by: Annie Nicholson Date: 2/9/89

Address/institution: c/- National Heritage Studies Pty Ltd

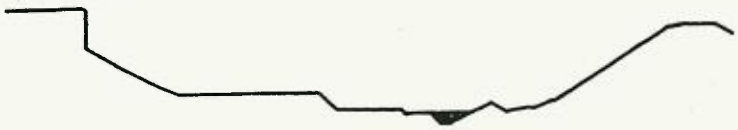
P.O. Box 92, Hall ACT 2618

SITE POSITION & ENVIRONMENT

OFFICE USE ONLY: NPWS site no: 45-5-832

1. Land form a. beach/hill ~~slope/ridge top~~, etc: b. site aspect: c. slope:

d. mark on diagram provided *or* on your own sketch the position of the site:



e. Describe briefly: Site is located on gently sloping ground on the margin of major ridgeline. (See attached map showing site location.)

f. Local rock type: Sandstone/Siltstone

g. Land use/effect: Trail bike circuit - deflation

2. Distance from drinking water: 300m Source: Eastern Creek (permanent creek)

3. Resource Zone associated with site (estuarine, riverine, forest etc): Forest

4. Vegetation: Eucalypt forest where clearing has not occurred.

5. Edible plants noted:

6. Faunal resources (include shellfish): Small marsupials.

7. Other exploitable resources (river pebbles, ochre, etc): Silcret outcrop

Site type: Artefact Scatter

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.

Site consists of 51 artefacts scattered over an area approx. 150m x 30m.

29 unretouched flakes
18 flaked pieces
4 cores

Raw Materials - 49 silcrete (35 red, 10 dark red, 3 yellow, 1 pink)
1 chert (black)
1 volcanic

The site extends from the main access track which runs east-west accross the survey area. The artefacts peter out as the ground becomes flatter to the north. This scatter of artefacts is adjacent to Schofield 6. The ground surface has been deflated and the artefacts are no longer 'in situ'.

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.

LICENSED IN AUSTRALIA
D. WEST, GOVERNMENT PRINTER N.S.W.

National Parks and Wildlife Service

BOX N189, GROSVENOR STREET POST OFFICE, SYDNEY, NSW 2000. TEL (02) 237 6500

Standard Site Recording Form

REGISTER COPY

MAP NAME	EDITION	SCALE	REFERENCE	HEAD OFFICE USE ONLY:
Riverstone	9030-1-S	1:25,000	3 0184 62 6702	NWPS site no: 45-5-547
Sydney	1-AAS	1:250,000	3861 8342	Site types: OPEN SITE. File nos: Date 15-10-86 Filed by: [illegible]

Site name: SA 11 Locality/property name: Owner/Manager:

Local post office: Schofields Address:

NPWS District: Nth Met Region: Central

Reason for investigation (give R.O. instruction no. where applicable):

EIS prior to proposed development by MWDA.

Portion no: DP 232574 Other land category: Lot 2 Plan/sketch/section of site attached? ~~Yes~~/No.

Parish: County: How many?

Air photo refs. (for stereo pair) Photos taken? ~~Yes~~/No

How many attached?

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.)

see attached map

Other sites in locality? Yes/~~No.~~ Site Types include: open camp, quarry

Are sites in NPWS Register? Yes/~~No.~~ Some Unregistered sites — plans for future recording? ~~Yes~~/No.

Have artefacts been removed from site? ~~Yes/No~~/don't know. When?

By whom? Deposited where?

Is site important to local Aborigines? Yes/~~No/don't know~~.

Give contact(s) name(s) + address(es) Dharok L.A.L.C. St Marys. (02) 623 7574.

Contacted for this recording? Yes/No.

(Attach additional information separately) If not, why not?

Verbal/written reference sources (including full title of accompanying report).

McDonald J (1986) Preliminary Archaeological Reconnaissance of Proposed Regional Depot, Plumpton, NSW C-1018

Checklist: surface visibility, damage/disturbance/ threat to site

Condition of site: poor

Recommendations for management & protection (attach separate sheet if necessary):

see report

Site recorded by: J McDonald + team Date: October, 1985

Address/institution: 40 Railway Ave Stanmore 2048

SITE POSITION & ENVIRONMENT

OFFICE USE ONLY: NPWS site no: 45-5-547

1. Land form a. beach/hill slope/ridge top, etc: creek banks b. site aspect: open c. slope:

d. mark on diagram provided *or* on your own sketch the position of the site: e. Describe briefly:

f. Local rock type: shales Tertiary undifferentiated Land use/effect: grazing, clearing, gas pipeline

2. Distance from drinking water: 250m Source: Eastern Creek

3. Resource Zone associated with site (estuarine, riverine, forest etc):

4. Vegetation:

5. Edible plants noted:

6. Faunal resources (include shellfish):

7. Other exploitable resources (river pebbles, ochre, etc):

Site type: open site

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, densit & 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.

SA 11

This concentration was also located on the Natural Gas Pipeline easement, and has been severely disturbed by the pipeline's installation. The sample area was defined as an area measuring 17 m x 2 m, and 35 artefacts were observed in this area.

The average density for this area is 2 artefacts/m^2, while the observed maximum was 10 artefacts/m^2.

Silcrete predominated, but several artefacts of FGS, quartz and tuff? were also observed. No diagnostic artefacts were observed in this 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.

NATIONAL PARKS AND WILDLIFE SERVICE

Cultural Resources

Database Update Sheet

[ ] REGISTER Site register

[ ] CATALOG Reports catalogue

[ ] FOTODEX Photographic catalogue

Record ID	Field/variable	New or revised value(s)
45-5-0547		
	1 SITENAME	SA 11
	2 SITENAME	Riverstone
	3 SITETYPE	2 = Open camp site
	4 RECTYPE	2 = Standard site record
	5 RECORDER	McDonald, J.
	6 RECDATE	00Oct1984
	7 ASSOCREP	C-1018
	8 CONDITN	3 = Very disturbed
	9 DISTRICT	2 = North Metropolitan
	10 STATUS	1 = Present in H.O.
	11 ZONE	56 = AMG Zone 56
	12 AMG_E	301840
	13 AMG_N	6267020
	14 MAPSCALE	7 = 1:25/50/100K convrt
	15 DATEUPD	22Aug1991
	16 <Sub-rec>	

Filled in by: _____ Date: _____

Entered by: _____ Date: _____

LJ: Feb 89

National Parks and Wildlife Service

BOX N189, GROSVENOR STREET POST OFFICE, SYDNEY, NSW 2000. TEL (02) 237 6500

Standard Site Recording Form

REGISTER COPY

MAP NAME	EDITION	SCALE	REFERENCE	HEAD OFFICE USE ONLY:
Riverstone	9030-1-S	1:25,000	3 0165 6703	NWPS site no: 45-5-548
Sydney	1-AAS	1:250,000	3859 8341	Site types: OPEN SITE; File nos: Date 15-10-86; Filed by: GW

Site name: SA 12

Locality/property name:

Owner/Manager:

Address:

Local post office: Schofields

NPWS District: Nth Met

Region: Central

Reason for investigation (give R.O. instruction no. where applicable):

EIS prior to proposed development by M.W.D.A.

Portion no: DP 232574

Parish:

Other land category: Lot 2

County:

Plan/sketch/section of site attached? ~~Yes~~/No.

How many?

Air photo refs. (for stereo pair)

Photos taken? ~~Yes~~/No

How many attached?

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.)

see attached map

Other sites in locality? Yes/~~No.~~

Are sites in NPWS Register? Yes/~~No.~~ Same

Site Types include: open camp, quarry

Unregistered sites — plans for future recording? ~~Yes~~/No.

Have artefacts been removed from site? ~~Yes/No/don't~~ know. When?

By whom?

Deposited where?

Is site important to local Aborigines? Yes/~~No/don't know~~.

Give contact(s) name(s) + address(es) Dharuk L.A.L.C. St Marys 02 623 7574

Contacted for this recording? Yes/No.

(Attach additional information separately) If not, why not?

Verbal/written reference sources (including full title of accompanying report).

C-1018

McDonald, J. (1986) Prelim. Arch. Reconnaissance of Proposed Schofields Regional Depot, Plumpton, NSW

Checklist: surface visibility, damage/disturbance/ threat to site

Condition of site: poor

Recommendations for management & protection (attach separate sheet if necessary):

see report

Site recorded by: J McDonald + team

Address/institution: 40 Railway Ave Stanmore 2048

Date: October, 1985

SITE POSITION & ENVIRONMENT

OFFICE USE ONLY: NPWS site no: 45-5-548

1. Land form a. beach/hill slope/ridge top, etc: spur b. site aspect: open c. slope:

d. mark on diagram provided *or* on your own sketch the position of the site: e. Describe briefly:

f. Local rock type: Shales Tertiary undifferentiated Land use/effect: grazing, clearing

2. Distance from drinking water: 400 m Source: Eastern Creek

3. Resource Zone associated with site (estuarine, riverine, forest etc):

4. Vegetation: mostly cleared, some casuarinas along creek

5. Edible plants noted:

6. Faunal resources (include shellfish):

7. Other exploitable resources (river pebbles, ochre, etc):

Site type: open site

DESCRIPTION OF SITE & CONTENTS.
Note state of preservation of site & contents. Do NOT dig, disturb, damage site or contents.

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

SA 12

This concentration was located on the access track which runs along the northern boundary of the Site. An area of 10 m x 10m represented the extent of this concentration, and 15 artefacts were located in this area.

The maximum concentration observed was 2 artefacts/m^2, while the calculated average density is in the order of 1 artefact/7 m^2.

Only silcrete was observed in this area, and no diagnostic implements were seen.

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.

BLACKTOWN
SCHOFIELDS
SCHOFIELDS PARK STATION
SCHOFIELDS AERODROME
H.M.A.S. NIRIMBA (Apprentice Training Centre)
QUAKERS HILL WATER POLLUTION CONTROL PLANT
PLUMPTON
DOONSIDE
Bells Creek
Eastern Creek
SYDNEY NEWCASTLE OIL & GAS PIPELINE (Underground)
"Newhaven"
HOLY FAMILY HIGH SCHOOL
Training Track
Sheds
Brickworks
Mini-Bike Track
Landing Ground
Locked Gate
Ruins
Yards
Tanks
Towers
Oval
BFB
KH LH
ROOTY HILL 3km
ROOTY HILL 4km
DOONSIDE 2km
BLACKTOWN 3km
45-5-548
02
03
04

NATIONAL PARKS
AND
WILDLIFE SERVICE

Cultural Resources

Database Update Sheet

[ ] REGISTER Site register

[ ] CATALOG Reports catalogue

[ ] FOTODEX Photographic catalogue

Record ID	Field/variable	New or revised value(s)

45-5-0548

1	SITENAME	SA 12
2	SITENAME	Riverstone
3	SITETYPE	2 = Open camp site
4	RECTYPE	2 = Standard site record
5	RECORDER	McDonald, J.
6	RECDATE	00Oct1986
7	ASSOCREP	C-1018
8	CONDITN	3 = Very disturbed
9	DISTRICT	2 = North Metropolitan
10	STATUS	1 = Present in H.O.
11	ZONE	56 = AMG Zone 56
12	AMG_E	301650
13	AMG_N	6267030
14	MAPSCALE	7 = 1:25/50/100K convrt
15	DATEUPD	22Aug1991
16	<Sub-rec>	

Filled in by: _____ Date: _____

Entered by: _____ Date: _____

LJ: Feb 89

NATIONAL PARKS AND WILDLIFE SERVICE - SEARCH OF ABORIGINAL SITES REGISTER

Schofields Quarry
****

MINARK D.B.M.S. V4.12

Database name: Z56
This retrieval performed: 11Dec96 11:20
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: 19

Selection criteria:
All sites selected

Minark Report Page 1 Printed 11Dec96 11:21

Site Number	Location and Sitename		Amg E	Amg N	Date Recorded	Recorder	Assoc Report	Sitetype
45-5-0543	SA 6	Riverstone	301280	6266490	000CT1986	M'Donald J	C-1018	Open camp site
45-5-0544	SA 8	Riverstone	301900	6266860	000CT1986	McDonald J	C-1018	Open camp site
45-5-0545	SA 9	Riverstone	301770	6266930	000CT1986	McDonald J	C-1018	Open camp site
45-5-0546	SA 10	Riverstone	301850	6266960	000CT1986	McDonald, J.	C-1018	Open camp site
45-5-0547	SA 11	Riverstone	301640	6267020	000CT1984	McDonald, J.	C-1018	Open camp site
45-5-0548	SA 12	Riverstone	301650	6267030	000CT1986	McDonald, J.	C-1018	Open camp site
45-5-0549	SA 2	Riverstone	301200	6266750	000CT1986	McDonald, J.	C-1018	Open camp site
45-5-0550	SA 3	Riverstone	301200	6266670	000CT1986	McDonald, J.	C-1018	Open camp site
45-5-0551	SA 4	Riverstone	301290	6266650	000CT1986	McDonald, J.	C-1018	Open camp site
45-5-0552	SA 5	Riverstone	301600	6266500	000CT1986	McDonald, J.	C-1018	Open camp site
45-5-0553	SA 7	Riverstone	301330	6266380	000CT1986	McDonald, J.	C-1018	Open camp site
45-5-0554	SA 1	Riverstone	301240	6266500	000CT1986	McDonald, J.	C-1018	Open camp site
45-5-0826	Schofields 1		301800	6267100	02SEP1989	Nicholson, A.	C-2081	Open camp site
45-5-0827	Schofields 2		301100	6267200	02SEP1989	Nicholson, A.	C-2081	Open camp site
45-5-0828	Schofields 3		301600	6267200	02SEP1989	Nicholson, A.	C-2081	Open camp site
45-5-0829	Schofields 4		301700	6267100	02SEP1989	Nicholson, A.	C-2081	Open camp site
45-5-0830	Schofields 5		301500	6267200	02SEP1989	Nicholson, A.	C-2081	Open camp site
45-5-0831	Schofields 6		301400	6267200	02SEP1989	Nicholson, A.	C-2081	Open camp site
45-5-0832	Schofields 7		301300	6267200	02SEP1989	Nicholson, A.	C-2081	Open camp site

Number of sites in printout: 19
£ of sites excluded by security rating: 0

Output completed: 11Dec96 11:21

APPENDIX I
FLORA AND FAUNA REPORT

(i) Clements and Stephens (1989)
(ii) Mitchell McCotter (July 1996)

FLORA/FAUNA SURVEY AT SCHOFIELDS

Clements and Stephens

1989

Flora/Fauna Survey at Schofields

PGH Bricks Pty Limited intend to establish a quarry and brick manufacturing plant on the 26 hectare site with approximately 8 hectares of woodland and about 0.8 hectares of *Casuarina cunninghamiana* river forest.

Area

The area has been largely cleared (Figure 1). It is fenced and shows signs of heavy grazing use, as well as use as a minibike and minicycle track. There are patches of trees in the cleared and mown areas. There is a large patch of woodland adjoins the fences in the south-western corner with trees on average about 13m in height. The woodland vegetation has also been heavily grazed.

The country is gently undulating and dissected by an ephemeral drainage channel flowing north-easterly and then easterly to join Eastern Creek on the eastern boundary of the site. The drainage channel ponds into two small swamps. There is also a reed swamp in the eastern paddock. Elevation ranges from less than 20m along Eastern Creek to 40m in the south-west boundary.

The area is within the 800mm annual isohyet.

Geologically, the site is mainly on Wianamatta Shale with the southern hilltop of the site being on transitional zone between Wianamatta Shale and Tertiary Alluvium as evident from the increased frequency of *Eucalyptus fibrosa* ssp. *fibrosa* (Benson 1981). The soils are classified as of the Blacktown series and described as hardsettling mottled texture contrast soils, red and brown podzolic soils (Dr3.21, Dr3.31, Db2.11, Db2.21) on crests grading to yellow podzolic soils (Dy2.11, Dy3.11) on lower slopes and in drainage lines (Bannerman and Hazelton 1989).

Along Eastern Creek especially, the soil landscape comprises the present active flood plain of many drainage networks of the Cumberland Plain. Geologically, the Quaternary alluvium is derived from Wianamatta group shales. The dominant soil material is a brown clay loam of the 'South Creek'soil series (Bannerman and Hazelton 1989).

Vegetation

The vegetation boundaries (Figure 1) were assessed from the aerial photographs and all boundaries were checked in the field. The relative abundance of species was assessed by transects consisting of ten contiguous 10m x 10m quadrats with the species present, the number and height of trees recorded in each 10m x 10m quadrat and presence of shrub and herbs recorded in 5m x 5m subquadrats (Appendix 1). In small vegetation patches (shown on Figure 1), vegetation species were recorded (Appendix 1).

The predominant uncleared vegetation is a woodland of *Eucalyptus moluccana*, *E. tereticornis*, *E. fibrosa* ssp. *fibrosa* with shrubby understorey of *Dillwynia juniperium*, *Grevillea*

juniperina, Bursaria spinosa and grasses including Themeda australis and Eragrostis leptostahya. The southern hilltop supports predominantly Eucalyptus fibrosa ssp. fibrosa, whereas the woodland of the western area has a E. molucanna - E. tereticornis dominance.

Along Eastern Creek is a continuous band Casuarina cunninghamiana with Melaleuca decora, Angophora subvelutina as well as Ligustrum sinensis and understorey of Tradescantia albiflora, Sida rhombifolia.

Fauna

Although fauna survey is not possible in a such short term study on a restricted area, the following species were encountered, despite the noise of minibike riders, while surveying the vegetation on the site :

Common Name	Scientific Name	Habitat
Birds		
Little pied cormorant	Phalacrocorax melanoleucos	G/A
Cattle egret	Ardeola ibis	G/A
Black duck	Anas superciliosa	G/A
Swamphen	Porphyrio porphyrio	G/A
Eastern rosella	Platycercus eximius	W
Welcome swallow	Hirundo neoxena	G
Yellow thornbill	Acanthiza nana	W
Noisy miner	Manorina melanocephala	W/G
Spotted pardalote	Pardolotus quadragintus	W
*Starling	Sturnus vulgaris	W/G
*Indian myna	Acridotheres tristis	W/G
Magpielark	Grallina cyanoleuca	G
Grey Butcherbird	Cracticus mentalis	W
Australian magpie	Gymnorhina tibicien	G
Australian raven	Corvus coronoides	G
Reptile		
Long-necked tortoise	Chelodina longicollis	
Mammals		
*Cattle	Bos taurus	
*Hare	Lepus capensis	

* introduced species

These species represent a subset of the species using the site. Appendix 2 lists the vertebrate species that could be expected to utilize this site and adjacent areas. The invertebrate groups would also be well represented, but being less known, they are beyond the scope of this survey.

Impact of Europeans

Human impact since settlement has caused major alteration to the original habitats of this area. Native mammals are the animal species most obviously eliminated by habitat loss or alteration, and only a few of the species originally native to the area could be expected to still occur (Appendix 2). As bats are very mobile mammals, they can move between areas of suitable habitat - hence they are relatively well represented in this list. Other mammals are much more restricted, and

several groups including kangaroos and wallabies, sugar and other small gliders, small carnivorous marsupials such as antechines and quolls, as well as bandicoots and native rodents have suffered great declines in this region since European settlement.

Human impact would also have reduced the numbers and types of birds inhabiting the site, again by loss and alteration of habitat. However, as birds are much more mobile than most mammals, many species are still able to use remnant areas such as this site, particularly if there are relatively intact bushland areas within reach. The alteration of habitat favours certain species over others, and the introduction of exotic species increases competition for feeding and nesting areas. Reptiles are less well studied than birds and mammals, but many species could still be represented in this site, as indicated in Appendix 2. Certain groups such as snakes have been actively eliminated, but smaller and more cryptic reptiles have perhaps not suffered too badly, though cats are notorious lizard hunters.

The introduction of exotic species such as cats, dogs and foxes, has contributed significantly to the loss of native animal species throughout Australia. Domestic cats in urban and semi-urban areas are a particular problem as they continue to hunt even when well fed (Stephens,1978), and they can therefore continue to exert predation pressure on native species even when the latter are greatly depleted (as the cats have an alternative food source at home).

Exotic species such as cattle and rabbits cause habitat change and loss of plant species essential for native animals. In this site, there has been some clearing for grazing as well as the construction of fences and dams and disturbance from the motor cross track.

Eucalyptus moluccanna and E. tereticornis woodlands of the Cumberland Plain on soils derived from Wianamatta shales have been felled extensively for orchards, vineyards and to provide grazing land for cattle and horses. This has resulted in fragmentation of the native habitats of the Cumberland Plain.

An initial effect of tree removal appears to be an increase in the density of the native shrub, Bursaria spinosa (Forster et al. 1977). The increase in B. spinosa may be due to cattle selective eating the less spiny vegetation species. Due to the extensive clearing of the woodland and grazing pressure, few understorey species now remain. The understorey species recorded by Phillips (1947 cited Forster et al. 1977) are Acacia decurrens, A. glaucescens, A. implexa, A. pubescens, Brachychiton populneum, Callistemon pinifolium, Melaleuca decora, M. linearifolia, M. nodosa, M. stypheloides and Phyllanthus gasstroemii.

The prominant weed species of the area is Senecio madagascariensis, a species not eaten by cattle. The weed species along the river are probably introduced from upstream

at times of flooding.

Assessment

- The plant communities are heavily disturbed by cattle grazing, clearing and current usage as a motor cross track. The only surviving understorey shrubs were prickly, thorny and spiny -- grazing resistant. Seedling and heavily grazed non-spiny species were recorded but their height was less than 50mm. Grazing weed such as Conzya sp and Paspalium dilatatum were also common.

- The woodland trees in the SW corner have not been extensively cleared and seedlings of some of the less prickly species were found. These seedlings are unlikely to become part of the shrub layer due to grazing. Also there were no seedlings of Eucalyptus sp. observed and the trees showed little variation in height (Appendix 1) which implies the seedlings have been trampled or grazed for at least the past ten years.

  As large areas of undisturbed bushland are increasingly rare, such remnant habitat areas as do remain are of vital importance, not only as representatives of the original vegetation, but also as refuge and corridor habitats for the native animal species of the area.

- The diversity of habitat type and structure within the site is also of value. The grassland, woodland and aquatic habitats support a variety of vertebrate and invertebrate fauna, dependent on the associated vegetation. Eastern Creek is part of a continuous green corridor that links this with other bushland regions.

Recommendations

- The stands of trees along the south-western area of the site should be retained and grazing be excluded with the reintroduction of some non-spiny species through plantings. At least one wetland - dam along the water course should be retained as bird breeding/feeding area preferrably in an area away from quarry works. If the wetland near the western boundary is to be only wetland retain it should enlarged. It would desirable to also retain the larger wetland along the natural water course which has a larger water catchment area.

- It would desirable to screen plant the boundaries of the entire site with non-spiny vegetation species, native to the area. Grazing by cows should be minimised.

With retention and replanting of suitable plant species, and provision of diverse habitat structures, an increase in animal species utilising the site would be expected. Many of these species would use the site as corridors for feeding and shelter while migrating between seasonal breeding sites, while others would be permanent residents.

Appendix 1A

Vegetation species present in:

- transects with the number 1-10 representing the numbers of quadrats (maximum 10) in each transect that the species were found.
- species found in vegetation clumps

Transects 1 and 2, and locations shown on Figure 1.

(Authorities mainly as given in Beadle *et al.* 1986, Boland *et al.* 1984)

	Transects 1	Transects 2	Locations
PTERIDOPHYTA			
Adiantaceae			
Cheilanthes sieberi		1	
ANGIOSPERMS-Monocotyledons			
Commelinaceae			
* *Tradescantia albiflora*			C
Cyperaceae			
Eleocharis sphacelata			D
Scirpus validus			D,J
Dianellaceae			
Dianella revoluta	-	1	
Hydrocharitaceae			
Ottelia ovalifolia			E
Iridaceae			
**Romulea rosea* var. *australis*			J
Juncaceae			
Juncus usitatus			E,J,K
Lomandraceae			
Lomandra filiformis		9	
L. gracilis		2	
L. micrantha		4	
Poaceae			
Echinopogon caespitosus		1	
Eragrostis leptostahya	6	10	
* *Paspalum dilatatum*	3	1	
Pseudoraphis spinescens			J
Themeda australis	8	10	F
Potamogetonaceae			
Potamogeton tricarinatus			J
Typhaceae			
Typha orientalis			D,E,J,
ANGIOSPERMS-Dicotyledons			
Asteraceae			
* *Conzya albida*	2	1	
Cotula australis		2	
* *Senecio madagascariensis*	7	6	
* *Sonchus oleraceus*	3	10	
* *Taraxacum officinale*	6	5	
Caprifoliaceae			
* *Lonicera japonica*			C
Casuarinaceae			
Casuarina cunninghamiana			C,E
A. torulosa	-	3	A
Epacridaceae			
Lissanthe strigosa (?)seedling	-	1	

Euphorbiaceae			
* Euphorbia peplus		1	
Gentianaceae			
* Centaurium erythraea		1	
Fabaceae-Faboideae			
Daviesia ulicifolia		1	
Dillwynia juniperina	7	6	
Glycine tabacina	2	1	
Indigofera australis	2		
Pultenaea microphylla	2	1	
P. villosa			A
Fabaceae-Mimosoideae			
Acacia floribunda			C,E
Haloragaceae			
Myriophyllum propinquum			J,H
Lobeliaceae			
Pratia purpuraceae	10	6	C
Myrtaceae			
Angophora subvelutina			B,C,G
Eucalyptus moluccana	6		A
E. tereticornis	6	1	A,B,F,I
E. fibrosa ssp. fibrosa	3	9	G,H,I
Kunzea ambigua			A
Melaleuca decora			C
Oleaceae			
Ligustrum lucidum			C(other side of creek)
Pittosporaceae			
Bursaria spinosa	10	3	C(in open patches),F
Proteaceae			
Grevillea juniperina	10	6	I
Sapindaceae			
Dodoneae viscosa(?)		1	
D. falcata			C
Violaceae			
Viola sp.	3		C

Appendix 1B

The abundance and height of the tree species

Transect 1

Eucalyptus moluccana, present in 6/10 quadrats, 7 individuals observed, height (m) x=11.4 (sd=3.4), average number/quadrat x=0.7 (sd=0.7, n=10)

E. tereticornis, present in 6/10 quadrats, 20 individuals observed, height (m) x=12.1 (sd=5.2), average number/quadrat x=2.0 (sd=2.2, n=10)

E. fibrosa ssp. fibrosa, present in 3/10 quadrats, 3 individuals observed, height (m) x=9.3 (sd=6.7), average number/quadrat x=0.3 (sd=0.5)

Transect 2

E. tereticornis, present in 1/10 quadrats, 1 individual observed, height 14m

E. fibrosa ssp. fibrosa, present in 9/10 quadrats, 67 individuals observed, height (m) x=13.9 (sd=1.6), average number/quadrat x=7.4 (sd=4.5)

Allocasuarina torulosa, present in 3/10 quadrats, 8 individuals observed, height (m) x=10 (sd=1)

Appendix 2

Vertebrate species recorded in the Cumberland Plain region. These species could occur within the study site. Most amphibian and reptile data from Wells and Wellington (1989), adjusted to currently accepted nomenclature (Cogger, 1986).

Common Name	Scientific Name	Habitat
AMPHIBIANS		
Ground Frogs: Family Myobatrachidae		
Yellow-spotted toadlet	Uperoleia marmorata	temp swamps
Brown-striped frog	Limnodynastes peronii	perm water
Spotted grass frog	L.tasmaniensis	perm. & temp. water
Ornate burrowing frog	L.ornatus	var. habitats
Eastern banjo frog	L.dumerilli	perm water
-	Pseudophryne australis	soaks/urban
Common eastern froglet	Crinea signifera	variety habitats
Tree Frogs: Family Hylidae		
Desert tree frog	Litoria rubella	var. habitats
Eastern tree frog	L.fallax	aqu. veg/reeds
Leaf-green tree frog	L.phyllochora	aqu. veg
Broad-palmed frog	L.latopalmata	forest veg
Green tree frog	L.caerula	var. habitats
Perons tree frog	L.peroni	var. habitats
Green & golden bell frog	L.aurea	perm. water
Bleating tree frog	L.dentata	swamps/Melaleuca
REPTILES		
Tortoises: Family Chelidae		
Eastn.long-necked tortoise	Chelodina longicollis	swamps, slow rivers
Lizards		
Geckos: Family Gekkonidae		
Wood gecko	Diplodactylus vittatus	logs, litter
Legless Lizards: Family Pygopodidae		
Common scaly-foot	Pygopus lepidopus	var. habitats
Dragon Lizards: Family Agamidae		
Jacky lizard	Amphibolurus muricatus	var. habitats
Bearded dragon	Pogona barbata	var. habitats
Eastern water dragon	Physignathus lesueurii	near creeks / rivers
Goannas: Family Varanidae		
Lace monitor	Varanus varius	var. habitats arboreal
Skinks: Family Scincidae		
Fence skink	Cryptoblepharus virgatus	arboreal
-	Ctenotus robustus	var.habitats
Copper-tailed skink	C.taeniolatus	rocky areas
Eastern water skink	Eulamprus quoyii	cks./ rivers

_	E.tenuis	tree trunks
Garden skink	Lampropholis guichenoti	var.habitats
Weasel skink	L.mustelinus	var.habitats
_	Lygisaurus foliorum	
_	Saiphos equalis	burrowing/litter
Eastn blue-tongue	Tiliqua scincoides	var.habitats

Snakes

Blind Snakes: Family Typhlopidae

_	Ramphotyphlops nigrescens	underground

Pythons: Family Boidae

Diamond python	Morelia spilota	var.habitats

Colubrid Snakes: Family Colubridae

Common tree snake	Dendrelaphis punctata	var.habitats

Venomous Snakes: Family Elapidae

Common death adder	Acanthophis antarcticus	var.habitats
Yellow-faced whip snake	Demansia psam	scarletmophis var.habitats
Red-naped snake	Furina diadema	under cover/in ant/term nests
Eastern tiger snake	Notechis scutatus	var.habitats
Black-headed snake	Unechis spectabilis	logs/litter
Red-bellied snake	Pseudechis porphyricus	near water
East brown snake	Pseudonaja textilis	var.habitats

BIRDS

Hoary-headed Grebe	Poliocephalus poliocephalus
Australasian Grebe	Tachybaptus novaehollandiae
Australian Darter	Anhinga melanogaster
Little Black Cormorant	Phalacrocorax sulcirostris
Little Pied Cormorant	P. melanoleucus
Great Cormorant	P. carbo
Pied Cormorant	P. varius
Cattle Egret	Ardeola ibis
Little Egret	Egretta garzetta
Intermediate Egret	E. intermedia
Great Egret	E. alba
White-faced Heron	Ardea novaehollandiae
Pacific Heron	A. pacifica
Royal Spoonbill	Platalea regia
Yellow-billed Spoonbill	P. flavipes
Straw-necked Ibis	Threskiornis spinicollis
Sacred Ibis	T. aethiopica
Maned Duck	Chenonetta jubata
Pacific Black Duck	Anas superciliosa
Mallard	A. platyrhynchos
Australian Grey Teal	A. gracilis
Chestnut Teal	A. castanea
Collared Sparrowhark	Accipiter cirrhocephalus
Brown Goshawk	A. fasciatus
Black-shouldered Kite	Elanus notatus
Whistling Kite	Haliastur sphenurus
Little Eagle	Hieraaetus morphnoides

Brown Falcon	Falco berigoria
Australian Kestrel	F. cenchroides
Australian Hobby	F. longipennis
Painted Button-Quail	Turnix varia
Brown Quail	Coturnix australis
Eurasian Coot	Fulica atra
Dusky Moorhen	Gallinula tenebrosa
Purple Swamphen	Porphyrio porphyrio
Masked Lapwing	Vanellus miles
Black-fronted Plover	Charadrius melanops
Black-winged Stilt	Himantopus himantopus
Silver Gull	Larus novaehollandiae
Crested Pigeon	Ocyphaps lophotes
Feral Pigeon *	Columba livia
Peaceful Dove	Geopelia striata
Spotted Turtle-Dove *	Streptopelia chinensis
Common Bronzewing	Phaps chalcoptera
Yellow-tailed Black Cockatoo	Calyptorhynchus funereus
Glossy Black Cockatoo	C. lathami
Galah	Cacatua roseicapilla
Sulphur-crested cockatoo	C. galenta
Rainbow lorikeet	Trichoglossus haematodus
Scaly-breasted lorikeet	T. chlorolepidotus
Little lorikeet	Glossopsitta pusilla
King parrot	Aprosmictus scapularis
Crimson rosella	Platycercus elegans
Eastern rosella	P. eximus
Fan-tailed cuckoo	Cuculus pyrrhophanus
Brush cuckoo	C. variolosus
Pallid cuckoo	C. pallidus
Shining Bronze-cuckoo	Chrysococcyx plagosus
Horsfield's Bronze-cuckoo	C. basalis
Common Koel	Eudynsmys scolopacea
Laughing kookaburra	Dacelo novaeguineae
Sacred kingfisher	Halcyon sancta
Azure kingfisher	Ceyx azurea
Rainbow Bee-eater	Merops ornatus
Dollar bird	Eurystomus orientalis
Barn Owl	Tyto alba
Southern Boobook	Ninox novaeseelandiae
Barking Owl	N. connivens
Tawny Frogmouth	Podargus strigoides
Welcome Swallow	Hirundo neoxena
Fairy Martin	Cecropis ariel
Tree Martin	C. nigricans
Richard's Pipit	Anthus novaeseelandiae
Black-faced cuckoo-shrike	Coracina novaehollandiae
Cicadabird	C. tenuirostris
Red-whiskered Bulbul *	Pycnonotus jocosus
Blackbird	Turdis merula
Scarlet Robin	Petroica multicolor
Rose Robin	P. rosea
Eastern Yellow Robin	Eopsaltria australis
Jacky Winter	Microeca leucophaea
Crested Shrike-tit	Falcunculus frontatus
Golden Whistler	Pachycephala pectoralis
Rufous Whistler	P. rufiventris
Grey Shrike-thrush	Colluricincla harmonica

Australian Birds' (Rigby,1986).

MAMMALS

Monotremes:
Order Monotremata

Echidna	Tachyglossus aculeatus	wood-/grassland

Marsupials:
Possums: Order Petauridae

Brushtail possum	Trichosurus vulpecula	woodland
Ringtail possum	Pseudocheirus peregrinus	woodland with dense shrubs

Placentals:
Rodents:Order Rodentia

Water rat	Hydromys chrysogaster	creeks

Fruitbats: Order Chiroptera,Sub-order Megachiroptera

Grey-headed flying-fox	Pteropus poliocephalus	soft-fruiting trees

Small bats:Order Chiroptera,Sub-order Microchiroptera

Gould's long-eared bat	Nyctophilus gouldii	
Gould's wattled bat	Chalinolobus gouldii	insectfeeders
Little forest eptesicus	Eptesicus vulturnus	
Common bent-winged bat	Miniopterus schreibersii	

Introduced Mammals

Domestic cat	Felis catus
Domestic dog	Canis familiaris
Fox	Vulpes vulpes
Rabbit	Oryctolagus cuniculus
Hare	Lepus capensis
Cattle	Bos taurus

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FLORA AND FAUNA REPORT

Mitchell McCotter

July 1996

INTRODUCTION

The aim of this survey was to verify previous studies conducted by Clements and Stephens (1989) and to undertake ecological investigations on the proposed PGH quarry expansion site, Schofields.

On Site 1, located north of Meadow Road, previous quarrying activities have extensively disturbed the local ecology and remnant vegetation is generally restricted along the perimeter of the property. Site 2, located south of Meadow Road is less disturbed and several stands of native vegetation remain throughout.

The following details methodology adopted for investigations, describes flora, fauna and fauna habitats present on the property and assesses potential impacts of the proposal.

1 Flora

i. Methodology

A flora survey was undertaken on 18 March 1996 to examine and describe vegetation communities affected by the proposed development. The methodology adopted included aerial photograph interpretation, literature review and field investigations. The National Parks and Wildlife Service (NPWS) Rare or Threatened Australian Plant (RoTAP) database was searched to highlight the potential for rare plants to occur on the property. During field investigations, the dominant flora species were recorded. Species names follow Harden (1990-1993).

ii. Vegetation Communities

Vegetation communities were classified by height, percentage cover (Specht, 1981) and the dominant species and are described by structural and floristic characteristics. Vegetation communities on the property include:

- grey box woodland;
- ironbark/*Melaleuca* woodland;
- *Casuarina* open forest; and
- reed swamp.

The structural and floristic characteristics of the communities found on the property are described below and their distribution shown in *Figure 1.*

a. Grey Box Woodland 10c

Structure: This is a woodland reaching 15 metres in height. The understorey ranges from scattered clumps to being absent, and the ground cover ranges from a mixture of grasses and weeds to bare ground.

Description: This woodland has been described by Benson (1992) on his map of the natural vegetation of the Penrith area as grey box woodland map unit 10c with grey box (*Eucalyptus moluccana*) and forest red gum (*E. tereticornis*) being the main canopy species. During recent field investigations broad-leaved ironbark (*E. fibrosa*) was found to also occur as a dominant species. Woollybutt (*E. longifolia*) and thin-leaved stringybark (*E. eugenioides*) occur to a lesser extent.

The sparse shrub layer is dominated by blackthorn (*Bursaria spinosa*), with other species including sweet-scented wattle (*Acacia suaveolens*), Parramatta green wattle (*Acacia parramattensis*), *Callitris* sp., *Dillwynia sieberi*, and *Grevillea junperina*. Groundcover species include kangaroo grass (*Themeda australis*), *Eragrostis leptostachya* and wallaby grass (*Danthonia* sp.), with weed species such as cobbler's peg (*Bidens pilosa*), *Conyza* sp., paspalum (*Paspalum dilatatum*) and *Senecio* sp.

Occurrence: This community occurs along the perimeter of Site 1 and in patches throughout Site 2.

b. Ironbark/ *Melaleuca* Woodland

Structure: This woodland community reaches up to 13 metres high, with a dense understorey of *Melaleuca* species reaching 10 metres. The groundcover is sparse with areas of bare soil.

Description: Broad-leaved ironbark (*E. fibrosa*) occurs as the canopy species with grey box (*E. moluccana*) and forest red gum (*E. tereticornis*) occurring to a lesser extent. Ball honeymyrtle (*Melaleuca nodosa*) and white feather honeymyrtle (*Melaleuca decora*) dominate the understorey with other species including black she-oak (*Allocasuarina littoralis*) and blackthorn (*Bursaria spinosa*). Where present, the groundcover is dominated by kangaroo grass (*Themeda australis*), cobbler's peg (*Bidens pilosa*) and *Senecio* sp.

Occurrence: This community occurs in the north-east corner of Site 1 near the transmission line.

c. *Casuarina* Open Forest

Structure: This forest community forms a continuous band reaching up to 15 metres high. The understorey is absent and groundcover moderate.

Description: River she-oak (*Casuarina cunninghamiana*) dominates this forest, with white feather honeymyrtle (*Melaleuca decora*), broad-leaved apple (*Angophora subvelutina*) and small-leaved privett (*Ligustrum sinense*) also present. The groundcover is dominated by wandering jew (*Tradescantia albiflora*) and Paddy's lucerne (*Sida rhombifolia*).

Occurrence: This open forest community forms part of a continuous band along Eastern Creek on the eastern boundary of Site 2.

d. Reed Swamp

Structure: This is a reed swamp community varying in species composition and abundance. Tallest species reach up to 2 metres, however, species generally reach up to 0.75 metres.

Description: Bull-rush (*Typha orentalis*) dominates, with other reed species occurring to a lesser extent.

Occurrence: Several reed swamps occur throughout both Sites 1 and 2.

iii. Rare and Endangered Plant Species

Rare or threatened Australian plants (RoTAPs) are listed by Briggs and Leigh (in prep). Species listed are given a conservation ranking based on their status, distribution, number of populations and conservation status in reserves.

Plant species considered threatened in New South Wales are listed in Schedules 1 and 2 of the Threatened Species Conservation (TSC) Act 1995. While there is some degree of overlap, not all species listed on the TSC Act are listed by Briggs and Leigh (in prep) and vice versa.

The NPWS database of rare or threatened plants was consulted. Records for the Penrith 1:100,000 topographic map on which the property is located were obtained. One species of conservation value, *Pultenaea parviflora*, has been recorded in close proximity to the property and has been considered for this report. The record for this species on the property was made in 1967.

Pultenaea parviflora is a small, erect shrub which can grow to one metre high. The stems are densely covered by short, soft hairs. Yellow flowers with red markings

emerge during spring. It is restricted to the Cumberland Plain and occurs in dry sclerophyll forest on Wianamatta Shale, laterite or alluvium. It is listed as 2E by Briggs and Leigh (in prep.) indicating that the species has a restricted distribution and is considered endangered with a serious risk of disappearing.

The TSC Act 1995 lists this species on Schedule 1 Part 1 as endangered. *Pultenaea parviflora* was not observed during field investigations nor by Clements and Stephens (1989).

Acacia pubescens has previously been recorded for the area by Phillips (1947 cited in Clements and Stephens, 1989). *Acacia pubescens* is a spreading shrub which can grow from one to four metres high. It is recognised by its densely hairy branchlets. Golden yellow flowers emerge during spring and it usually occurs in open sclerophyll forest and woodland on clay soils, from Bilpin to Georges River area. It is listed as 3VCa by Briggs and Leigh (in prep.) indicating that the species is considered adequately reserved occurring in small populations which are mainly restricted to highly specific localised habitats, and is considered vulnerable with a risk of disappearing.

The TSC Act 1995 lists this species on Schedule 2 as vulnerable. *Acacia pubescens* was not observed during recent field investigations and it does not appear to have been recorded there since 1947. It is not listed for the area on NPWS RoTAP records.

Dillwynia tenuifolia is another species of significance which has been recorded in the region at Marsden Park and Berkshire Park and may occur at the site. *D. tenuifolia* is an erect shrub growing to one metre high with yellow and orange pea flowers in spring. It is endemic to the Sydney area, growing in dry sclerophyll woodland on sandstone, shale, laterite or Tertiary alluvial sediment from the Cumberland Plain, Blue Mountains to Howes Valley area (Harden, 1991; Benson and McDougall, 1991).

It is listed as 2RCa by Briggs and Leigh (in prep.) indicating that the species is considered adequately reserved, with a very restricted distribution in Australia and with a maximum geographic range of less than 100km, and is considered rare, but not currently endangered or vulnerable. The TSC Act 1995 lists this species on Schedule 2 as vulnerable.

Persoonia nutans is listed on Schedule 1 of the TSC Act as endangered. Briggs and Leigh (in prep.) list this species as 2ECi indicating it is considered inadequately reserved, with a very restricted distribution in Australia and with a maximum geographic range of less than 100km, and is considered endangered with a serious risk of disappearing within one or two decades. *Persoonia nutans* is a spreading shrub to one metre high with yellow flowers in summer. It grows in woodland to dry sclerophyll forest on laterite and alluvials and is confined to the Cumberland

Plain. It has been recorded at Scheyville. This species is considered to have a remote possibility of occurring on site (R. Lembit, pers. Comm.).

None of these threatened species were recorded on site during recent field investigations nor by surveys conducted by Clements and Stephens (1989). The sites have been disturbed from previous quarrying activities, cattle grazing and motor cross tracks resulting in a sparse understorey dominated by weeds. It is therefore considered unlikely that these species occur on site.

Several regionally significant species including those considered vulnerable in western Sydney have been recorded near the property west of Cudgegong Road, Rouse Hill. Only one species, *Pultenaea microphylla*, has been recorded on site.

2 *Fauna*

iv. Fauna Survey Methodology

A survey of fauna and habitats was undertaken on 18 March 1996. The survey included habitat assessment, bird surveying, searches for amphibians and reptiles and searches for evidence of mammal presence. Information relevant to fauna in and around the property was obtained and NPWS Wildlife Atlas database records for the Penrith 1:100,000 topographic map sheets were obtained to gain information on the potential occurrence of threatened fauna species were reviewed.

The structural and floristic attributes of vegetation communities determine their use as fauna habitat. Each habitat was traversed, fauna species observed and indicators of fauna presence recorded. The following criteria were assessed for each habitat:

Mammals: The amount of ground cover, extent of shrub layer or tree canopy, occurrence of old trees with hollows and type of substrate (for burrowing, etc) were noted. Signs of various species such as droppings, diggings, footprints, scratches on trees, nests, burrow paths and runways were sought.

Birds: Structural features such as the extent and nature of understorey and ground stratum, extent of the canopy and flowering characteristics of vegetation species were recorded and bird species present were noted.

Reptiles and Amphibians: Cover, shelter, suitable substrate, basking sites, breeding site (free water). Reptiles and frogs were sought in their likely sheltering places.

Opportunistic sightings of all fauna species during field investigations were noted. Special effort was made to locate fauna species listed on Schedule 1 and 2 of the TSC Act 1995, by observation or secondary faunal evidence such as known habitat requirements.

v. Fauna Habitats

The vegetation communities previously described reflect differences in plant species composition. Many native fauna species do not detect floristic differences but choose habitat based on structural characteristics, such as the number of layers, vegetation density and height. For some specialised species, the ability to survive may depend upon water availability, a certain tree species or microclimate. Any activity altering the habitat characteristics may lead to changes in faunal assemblages.

- Fauna habitats which could be affected by the proposed development are described below.

a. Habitat 1: Woodland

Vegetation Communities: Grey Box Woodland, Ironbark/ *Melaleuca* Woodland

Description: This woodland community reaches 15 metres high, with a scattered to absent understorey and ground cover ranging from a mixture of grasses and weeds to bare ground. The canopy is dominated by *Eucalyptus* species such as grey box (*Eucalyptus moluccana*), forest red gum (*E. tereticornis*) and broad-leaved ironbark (*E. fibrosa*). Woollybutt (*E. longifolia*) and thin-leaved stringybark (*E. eugenioides*) occur to a lesser extent. Blackthorn (*Bursaria spinosa*), dominates the shrub layer with other species including sweet-scented wattle (*Acacia suaveolens*), Parramatta green wattle (*Acacia parramattensis*) and *Callitris* sp. Groundcover species include kangaroo grass (*Themeda australis*) and wallaby grass (*Danthonia* sp.), with weed species such as cobbler's peg (*Bidens pilosa*) and *Senecio* sp.

Habitat Elements: This community type may provide habitat for small mammals, particularly mice, rats and rabbits as well as foraging sites for bats. No hollow-dependent species would be expected as these are unavailable. Suitable reptile habitat in the form of rocks, logs and leaf litter is present.

Human Elements: This habitat has been disturbed by previous quarrying and grazing activities and as a result much of the vegetation has been cleared and weed species occur.

b. Habitat 2: Open Forest

Vegetation Communities: *Casuarina* Open Forest

Description: This open forest community forms a continuous band along Eastern Creek reaching up to 15 metres high. The understorey is absent and groundcover moderate. River she-oak (*Casuarina cunninghamiana*) dominates this forest, with white feather honeymyrtle (*Melaleuca decora*), broad-leaved apple (*Angophora subvelutina*) and small-leaved privett (*Ligustrum sinense*). The groundcover is dominated by wandering jew (*Tradescantia albiflora*) and Paddy's lucerne (*Sida rhombifolia*).

Habitat Elements: This community type may provide habitat for small mammals, particularly mice, rats and rabbits and some avifauna

Human Elements: Several weed species occur throughout this habitat both in the canopy and groundcover.

c. Habitat 3: Reed Swamp

Vegetation Communities: Reed Swamp

Structure: Reeds to one metre tall form a band around and within small water bodies. The dominating species is bull-rush (*Typha orientalis*) with other species occurring.

Habitat Elements: This community provides habitat for aquatic birds and amphibians. The tall reeds and water provide foraging and sheltering sites for numerous birds. While no amphibian species were observed on site, several species are expected to utilise these aquatic environments for foraging, shelter and breeding.

Human Elements: These water bodies, which become inundated following heavy rain are surrounded by land generally disturbed from previous quarrying and grazing activities. Vegetation at some areas is sparse and siltation has occurred.

vi. Fauna Species

No detailed fauna surveys have been conducted on site. However, several bird species have been observed and numerous other fauna species are listed which may utilise the site and adjacent areas (Clements and Stephens, 1989).

a. Avifauna

Avifauna were the most commonly observed fauna in both the number of species and individuals observed. *Table E.1* lists the birds observed during recent field investigations and those observed by Clements and Stephens (1989).

Table E.1 BIRDS OBSERVED ON THE PROPERTY

Scientific Name	Common Name
Chenonetta jubata	Australian wood duck
Anas superciliosa	Black duck
Phalacrocorax melanoleucos	Little pied cormorant
Ardea ibis	Cattle egret
Porphyrio porphyrio	Swamphen
Platycercus eximius	Eastern rosella
Pardalotus punctatus	Spotted pardalote
Acanthiza nana	Yellow thornbill
Manorina melanocephala	Noisy miner
Grallina cyanoleuca	Magpie lark
Cracticus torquatus	Grey butcherbird
Gymnorhina tibicien	Australian magpie
Corvus coronoides	Australian raven
Hirundo neoxena	Welcome swallow
Sturnus vulgaris *	Common Starling
Acridotheres tristis *	Common myna

Note: * = *Introduced*

b. Mammals

Fox (*Vulpes vulpes*) and rabbit (*Oryctolagus cuniculus*) scats were collected during recent field investigations, while cattle (*Bos taurus*) and hare (*Lepus capensis*) were observed. *Table E.2* lists mammal species expected to utilise the property and adjacent areas.

Table E.2 MAMMALS EXPECTED TO UTILISE THE PROPERTY

Common Name	Scientific Name
Tachyglossus aculeatus	Short-beaked echidna
Trichosurus vulpecula	Common brushtail possum
Pseudocheirus peregrinus	Common ringtail possum
Pteropus poliocephalus	Grey-headed flying-fox
Nyctophilus gouldi	Gould's long-eared bat
Miniopterus schreibersii	Common bent-wing bat (V)
Chalinolobus gouldii	Gould's wattled bat
Vespadelus vulturnus	Little forest bat
*Lepus capensis**	Brown hare
*Oryctolagus cuniculus**	Rabbit
Hydromys chrysogaster	Water rat
*Canis familiaris**	Dog
*Vulpes vulpes**	Fox
*Felis catus**	Feral cat
*Bos taurus**	Cattle

Note: ** = Introduced.*

V = Listed on Schedule 2 of Threatened Species Conservation Act 1995 as Vulnerable.

Source: *Clements and Stephens (1989).*

c. Reptiles and Amphibians

No reptiles or amphibians were observed during recent investigations however suitable habitat occurs. Clements and Stephens (1989) observed the long-necked tortoise (*Chelodina longicollis*). *Table E.3* lists reptile and amphibian species expected to utilise the property and adjoining areas.

Table E.3 REPTILES AND AMPHIBIANS EXPECTED TO UTILISE SITE

Scientific Name	Common Name
Reptiles	
Chelodina longicollis	Long-necked tortoise
Diplodactylus vittatus	Wood gecko
Pygopus lepidopodus	Common scaly-foot
Amphibolurus muricatus	Jacky lizard
Pogona barbata	Bearded dragon
Physignathus lesueurii	Eastern water dragon
Varanus varius	Lace monitor
Cryptoblepharus virgatus	
Ctenotus robustus	
Eulamprus quoyii	Eastern water skink
Eulamprus tenuis	
Lampropholis guichenoti	
Lygisaurus foliorum	
Saiphos equalis	
Tiliqua scincoides	Eastern blue-tongued lizard
Ramphotyphlops nigrescens	
Morelia spilota	Diamond python
Dendrelaphis punctulata	Common tree snake
Acanthophis antarcticus	Common death adder
Demansia psammophis	Yellow-faced whip snake
Furina diadema	Red-naped snake
Notechis scutatus	Eastern tiger snake
Suta spectabilis	Black-headed snake
Pseudechis porphyriacus	Red-bellied black snake
Pseudonaja textilis	Eastern brown snake
Amphibians	
Crinia signifera	Common eastern froglet
Limnodynastes dumerilli	Eastern banjo frog
Limnodynastes ornatus	Ornate burrowing frog
Limnodynastes peronii	Brown-striped frog
Limnodynastes tasmaniensis	Spotted grass frog
Litoria aurea	Green and golden bell frog (E)
Littoria caerulae	Green tree frog
Litoria dentata	Bleating tree frog
Litoria fallax	Eastern tree frog
Litoria latopalmata	
Litoria peronii	Peron's tree frog
Litoria phyllochroa	Leaf-green tree frog
Litoria rubella	Desert tree frog

Note: *E = Listed Schedule 1 Part 1 on Threatened Species Conservation Act 1995 as Endangered.*

Source: *Clements and Stephens (1989).*

vii. Rare and Endangered Fauna

No fauna species listed on the Threatened Species Conservation Act 1995, were observed on the property during recent field investigations. NPWS database records were sought, however, no species have been recorded on site. Several fauna species, identified by Clements and Stephens (1989), as recorded on the Cumberland Plain, may utilise the site. These include the green and golden bell frog (*Litoria aurea*) and common bent-wing bat (*Miniopterus schreibersii*). The site may also provide habitat for two other bat species listed as threatened such as yellow-bellied sheathtail bat (*Saccolaimus flaviventris*) and large-eared pied bat (*Chalinolobus dwyeri*). A road kill of the powerful owl (*Ninox strenua*) has recently been recorded on the edge of Windsor Road at Rouse Hill. This species may use the site as part of its home range.

3 *Assessment of Conservation Value*

The conservation value of vegetation communities and fauna habitats has been determined by reference to the following criteria:

- *Representativeness*, whether the vegetation communities are unique, typical or common with regard to occurrence in the region. In addition, it takes into account whether or not such vegetation units are presently held in reserves;

Grey box (*Eucalyptus moluccana*) and forest red gum (*E. tereticornis*) woodlands of the Cumberland Plain on soils derived from Wianamatta Shales have been felled extensively for orchards, vineyards and to provide grazing land for cattle and horses. This has resulted in fragmentation of native habitats of the Cumberland Plain (Clements and Stephens, 1989). As such, grey box and ironbark woodland communities are becoming so increasingly rare that they are to be listed in the near future on Schedule 1 part 3 of the Threatened Species Conservation Act 1995 as an endangered ecological community.

As large areas of undisturbed bushland are increasingly rare, remnant habitat areas are of vital importance as representatives of the original vegetation, and as refuge and corridor habitats for native fauna species of the area (Clements and Stephens, 1989).

Several areas of this vegetation type remaining near the property on the Cumberland Plain exist at Marsden Park in the north, larger patches at Shanes Park to the west and some small patches to the north near Doonside.

- the existence of *Rare and Restricted Species* would add to an area's conservation value. Particular classified species or species of special

conservation significance to the area might be present which would warrant protection;

Two plant species *Pultenaea parviflora* and *Acacia pubescens* have previously been recorded in the area, however, they have not been recorded there in recent years. *Acacia pubescens* has been recorded at Scheyville. *Dillwynia tenuifolia* and *Persoonia nutans* have been recorded in the region but have not been recorded on site. One regionally significant species, *Pultenaea microphylla,* has been recorded on site (Clements and Stephens, 1989).

The green and golden bell frog (*Litoria aurea*), common bent-wing bat (*Miniopterus schreibersii*), yellow-bellied sheathtail bat (*Saccolaimus flaviventris*), large-eared pied bat (*Chalinolobus dwyeri*) and powerful owl (*Ninox strenua*) may use the site.

- the *Degree of Naturalness,* is used to indicate the extent of human influence and to identify the condition of vegetation;

Overall the property is significantly disturbed with human influence evident. Much of the vegetation on Site 1 is restricted to the property boundaries. This area has been disturbed by quarrying activities, vehicle tracks, fencing and transmission lines. Site 2 has been largely cleared and is used for grazing and the use of a minibike and minicycle track. As a result of human influences several weed species have established, understorey species abundance and diversity has declined and introduced fauna are present.

- the presence of *Special Natural Features* is used to indicate uniqueness in that unusual natural features might be present which may not be associated with a particular vegetation unit;

The potential use of the site by the powerful owl is considered to be unique in that this species occurs in wet and dry sclerophyll forest (Schodde and Tidemann, 1986, Schodde and Mason, 1980) which do not occur in the area.

- *Size* of an area has implications for the area's ability to absorb disturbance and its carrying capacity for fauna populations; and

The site has already been extensively disturbed from quarrying activities, roads, grazing, fencing and minibike and minicycle track racing. As a result vegetation on the property is patchy and further disturbance to the vegetation communities and habitats would not be readily absorbed and their ability to contain fauna populations which may exist would be altered.

- *Links* to other natural areas provide corridors for the dispersal of plants and animals and increase an area's significance.

The vegetation on the property is indirectly linked to other natural areas in the region including west to Shanes Park. The *Casuarina* open forest habitat forms part of a narrow corridor link extending along Eastern Creek. These disjoint links provide corridors for the movement of fauna species and dispersal of flora throughout the region. Other natural areas nearby include pockets of vegetation at Marsden Park in the north and to the south near Doonside.

The vegetation communities and fauna habitats on site are considered to have a high conservation significance. Large areas of undisturbed bushland are increasingly rare on the Cumberland Plain. Such remnant habitat areas are of vital importance as representatives of the original vegetation on the Cumberland Plain and as refuge and corridor habitats for native fauna species of the area. The sites also have the potential to provide habitat for several threatened fauna species, and one regionally vulnerable flora species, *Pultenaea microphylla*, occurs on site. However, the site has been degraded by human influences such as clearing, grazing, quarrying activities and invasion of weeds.

Table E.4 summarises the conservation value of the property.

Table E.4 ASSESSMENT OF CONSERVATION VALUE

Vegetation Community	Fauna Habitat	Representativeness	Rare and Endangered Species	Degree of Naturalness	Special Natural Features
Grey Box Woodland	Woodland	Restricted to perimeter of site 1 and in patches throughout site 2. This community is noted as occurring on the Cumberland Plain by Benson (1992) as map unit 10c, but is becoming increasingly rare and considered endangered.	None observed however several threatened bat species and the powerful owl may utilise this site for foraging. One regionally significant flora species *Pultenaea microphylla* occurs.	Disturbance from quarrying activities, grazing, minibike and minicycle track and weed invasion.	May provide habitat for several threatened fauna species including the powerful owl.
Ironbark/ *Melaleuca* Woodland	Woodland	Present in north-east section of site 1. This community is becoming increasingly rare on the Cumberland Plain and is considered endangered.	None observed, however several threatened bat species and the powerful owl may utilise this site for foraging.	Disturbed from quarrying operations, grazing activities and weed invasion.	May provide habitat for avifauna and mammal species.
Casuarina Open Forest	Open Forest	Restricted to the eastern section along Eastern Creek.	None observed or expected.	This forest is in a relatively natural condition with evidence of some weed species.	This band of forest forms part of a continuous corridor along Eastern Creek.
Reed Swamp	Reed Swamp	Several reed swamps are scattered throughout the site.	None observed although the green and golden bell frog (*Litoria aurea*) may utilise this habitat.	Sedimentation disturbance evident from surrounding quarry activities.	Provides habitat for several aquatic avifauna and perhaps amphibians.

4 *Impacts and Mitigation Measures*

viii. Impacts

Monier PGH proposes to extend quarrying operations over most of the property and then progressively rehabilitate quarry voids with non-putrescible waste. Initially Site 1, the portion of the property north of Meadow Road which is currently being worked, will continue to be quarried and rehabilitated. During this time overburden will be used to construct earth mounds around the periphery of Site 2, the area south of Meadow Road, in preparation for quarrying on that site at a later date.

No impacts are expected on site 1 as proposed works will continue in areas already disturbed. However, the proposed quarry expansion works will involve the removal of vegetation along the perimeter of site 2. This would result in the loss of 2.3 hectares of the grey box woodland. The woodland may provide habitat for several threatened bat species including the common bent-wing bat (*Miniopterus schreibersii*), yellow-bellied sheathtail bat (*Saccolaimus flaviventris*) and large-eared pied bat (*Chalinolobus dwyeri*) and may also form part of the home range for the powerful owl (*Ninox strenua*). However, impacts are not considered to be significant as the amount of tree removal is minimal and the site does not provide essential roosting sites for these species. The proposal will impact on *Pultenaea microphylla* which is vulnerable in western Sydney.

The reed swamp may provide habitat for numerous avifauna and amphibian species which utilise the ponds for breeding and feeding, as well as roosting sites for birds. The green and golden bell frog (*Litoria aurea*) may utilise this habitat for such purposes. However, the proposed development will not impact on these habitats.

ix. The Need for an SIS

In order to determine whether development will have a significant effect on threatened species, populations or ecological communities, or their habitats, the eight point test of significance established under Section 5A of the Environmental Planning and Assessment (EPA) Act 1979 is considered.

The test is applied to the threatened bat species and the powerful owl only as threatened flora species identified are not expected to occur on site due to the lack of observation and disturbance to the property. The green and golden bell frog is not considered as the proposed works will not affect the habitat of this species.

a) *in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction;*

It is unknown whether *Miniopterus schreibersii, Saccolaimus flaviventris, Chalinolobus dwyeri or Ninox strenua* inhabit the property. Suitable foraging habitat may occur for these species on the property. However, if these species use the site it is unlikely that the proposal will disrupt any local populations of these threatened species as the site would only provide foraging habitat and not essential roosting habitat.

b) *in the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised;*

Endangered populations have not been identified on Schedule 1 Part 2 of the Threatened Species Conservation Act 1995 and therefore this factor cannot be addressed.

c) *in relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed;*

Vegetation on the Cumberland Plain is patchy and few natural areas remain. However, the habitats to be removed on site are not considered significant roosting habitats for any threatened species.

d) *whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community;*

It is not expected that the proposal will isolate areas of potential threatened species habitat from nearby areas of similar habitat as the site is indirectly linked to these areas.

e) *whether critical habitat will be affected;*

Critical habitat as defined by the TSC Act is *"the whole or any part or parts of an area or areas of land comprising the habitat of an endangered species, population or ecological community that is critical to the survival of the species, population or ecological community"*. No *"critical habitat"* has been declared pursuant to sections 47 and 48 of the TSC Act at the time this report was prepared.

The site does not provide essential roosting habitat important for the survival of threatened species listed which may inhabit the site.

f) *whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region;*

It is unknown whether any of the listed threatened species are adequately represented in conservation reserves in the region.

g) *whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process;*

Key threatening process have not been identified on Schedule 3 of the TSC Act 1995 and therefore this factor cannot be addressed.

h) *whether any threatened species, population or ecological community is at the limit of its known distribution.*

None of the threatened species listed are at the limit of their known distribution.

The common bent-wing bat (*Miniopterus schreibersii*) occurs along the entire eastern seaboard from the Great Dividing Range to the coast, from Cape York Peninsula, Queensland round to South Australia (Dwyer, 1991). The yellow-bellied sheathtail bat (*Saccolaimus flaviventris*) is very widely distributed across central and northern Australia (Richards, 1991). The distribution of the large-eared pied bat (*Chalinolobus dwyeri*) is central-eastern and northern New South Wales and inland and eastern southern Queensland (Strahan, 1992). The powerful owl is distributed throughout south-eastern South Australia, near Rockhampton, mostly in wet sclerophyll forest along coast hills and great Dividing Range (Schodde and Tidemann, 1993).

In view of the above factors it is concluded that a species impact statement (SIS) is not required to accompany the environmental impact statement (EIS), as the threatened species listed will not be significantly impacted by the proposal.

x. *Safeguards*

To minimise potential impacts of the proposal on fauna and flora, the following amelioration measures are recommended:

- minimise tree removal on the property;
- a replanting program be implemented to plant species of the grey box woodland in appropriate locations, including the regionally vulnerable species *Pultenaea microphylla*; and
- the program should use only species endemic to the area, preferably germinated from locally collected seed.

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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
67 Albert Avenue
CHATSWOOD NSW 2067

DEVELOPMENT APPLICATION

Applicant Name:	Monier PGH Holdings Pty Ltd
Applicant Address:	Level 5, 9 Help Street CHATSWOOD, NSW 2-67
Land to be developed: Address	Townson Road, Schofields
Lot No. DP/MPS, Vol/Fol etc.	Lot 3 DP232474
Proposed Development	Proposed continuation of clay/shale quarrying, landfilling and site rehabilitation

ENVIRONMENTAL IMPACT STATEMENT ☑ an environmental impact statment (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: 4/5/97

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

Tim Macoun/John Yeates	*Project Directors*
Stephen Hills	*Project Manager*
David Fingland	*Environmental Planner*
Michelle Kelsey	*Environmental Scientist*
Felicity Stening	*Environmental Scientist*
Duncan Appleby	*Traffic Engineer*
Kate Wingrove	*Environmental Engineer*
Steven Beletich	*Environmental Engineer*
Andrew Rose	*Environmental Engineer*
Shane Rigney	*Graphic Designer*
Yvette Worboys	*Graphic Designer*
Trish Foster	*Word Processor*

SPECIALIST STUDIES

Stuart Dever	*Senior Engineer (Waste Management)*
Bryan Liddle	*Woodward Clyde (Geotechnical/Landfill Technical)*
Dr Peter Georgiou	*Vipac (Acoustical Consultants)*
Dick Godson	*Richard Heggie Associates Pty Ltd (Acoustical Consultant)*
John Wasserman	*ANW Consultants (Air Quality)*
Ken Wallace	*Woods Bagot (Landscape Architect)*

SPECIALIST STUDIES UNDERTAKEN BY ORIGINAL ERM MITCHELL McCOTTER TEAM

Dr Robert Bullen	*Acoustical Engineer*
Tapash Das	*Acoustical Engineer*
Tim Rogers	*Transportation Analyst*
Rachel Morse	*Ecologist*

SUB-CONSULTANT (TO ERM STUDY)

Golder Associates	*Geotechnical Investigations*