JANDRA QUARRY EXTENSION

Environmental Impact Statement

APPENDICES

For:
CSR CONSTRUCTION MATERIALS

October 1999

38070RP2

Report No. 38070RP2

This report was prepared in accordance with the scope of services set out in the contract between ERM Mitchell McCotter Pty Ltd ACN 002 773 248 (ERMMM) and CSR Construction Materials. To the best of our knowledge, the proposal presented herein accurately reflects the Client's intentions when the report was printed. However, the application of conditions of approval or impacts of unanticipated future events could modify the outcomes described in this document. In preparing the report, ERMMM used data, surveys, analyses, designs, plans and other information provided by the individuals and organisations referenced herein. While checks were undertaken to ensure that such materials were the correct and current versions of the materials provided, except as otherwise stated, ERMMM did not independently verify the accuracy or completeness of these information sources.

Approved by:	*Tony McNamara*
Position:	Project Director
Signed:	A G McNamara
Date:	15/10/99

Prepared by:	*Murray Curtis*
Position:	Project Manager
Signed:	
Date:	14/10/99

ERM Mitchell McCotter Quality System

APPENDICES

JANDRA QUARRY

EXTENSION

CSR

New South Wales Government
Department of Urban Affairs and Planning

Mr Murray Curtis
Project Manager
ERM Mitchell McCotter Pty Ltd
PO Box 5279
PORT MACQUARIE NSW 2444

Contact: Jeyakumar Thangamani

Our Reference: G92/00678 Pt 2

Your Reference:

Dear Mr Curtis,

Proposed Extension to Jandra Gravel Quarry
Possum Brush, LGA Greater Taree

Thank you for your letter dated 9th November 1998 seeking consultation with the Director-General for the preparation of an environmental impact statement (EIS) for the above proposal.

You have identified that a licence, approval or a permit may be required if development consent is granted. Under these circumstances, the proposal would be "integrated development". Subsequently, the Department has sought the EIS requirements of the relevant agencies providing general terms of approval before determination. The requirements of the Department of Land and Water Conservation are outlined in the attached letter dated 17th December 1998. The Environment Protection Authority (EPA) has been unable to provide the Director General with their requirements for your EIS. As you may also require a licence and approval from the EPA, you must seek their requirements directly when preparing your EIS.

As an "integrated development", copies of the EIS and supporting documents should also be submitted with each of the relevant approval bodies (including a fee of $250) at the same time that you lodge them with the Council. I suggest that you contact the relevant approval bodies to determine how many copies they will require.

In accordance with clause 55 of the *Environmental Planning and Assessment Regulation 1994*, (the Regulation) you should consider the following key issue when preparing the EIS:

- examination of the proposal in relation to Hunter Regional Environmental Plan

Attachment No. 1 outlines the statutory matters that must be included in any EIS under clause 54 and 54A of the Regulation.

ERM Mitchell McCotter Quality System
Referred to: MC   Ref. No. 38070
Date Received: 7/1/99
Source: DVAP
Data suitability check required — Yes ☐ No ☑
Data is: Current — Yes ☐ No ☐
Applicable to project — Yes ☐ No ☐
Checked by:
Attach explanation for 'no' answers or data problems
Signature: .... Date: 7/1/99

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

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

The Department's EIS Guideline '**Extractive Industries – Quarries**' contains the type of information most likely to be relevant to your proposed development. Not all the matters it contains may be appropriate for consideration in your EIS; equally, it is not exhaustive. The Guideline is available for purchase from the Department's Information Centre, 1 Farrer Place, Sydney or by calling (02) 9391 2222.

You should consult with Greater Taree City Council and take into account any comments they may have in the preparation of the EIS. The EIS should also address other issues that emerge from consultations with relevant local, State and Commonwealth government authorities, service providers and community groups.

Please contact Chris Ritchie on (02) 9391 2085 or Jeyakumar Thangamani on (02) 9391 2176 if you require any further information regarding the Director-General's requirements for the EIS.

Yours sincerely

24/12/98

Chris Wilson
Acting Assistant Director
Development and Infrastructure Assessment
As delegate for the Director-General

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 54A 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 78A(8) 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 57 to 61 of the Regulation.

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

Note

If the development application to which the EIS relates is not exhibited within 2 years from the date of issue of the Director-General's requirements, under clause 55(7) of the Regulation the proponent is required to reconsult with the Director-General.

– ✧ –

ERM Mitchell McCotter Quality System			
Referred to	M.C.	Ref. No.	38070
Date Received:	22/12/98		
Source:	DLWC		

	Yes	No
Data suitability check required	☐	☒
Data is: Current	☐	☐
Applicable to project	☐	☐

Checked by:

Attach explanation for "no" answers or data problems

Signature: .... Date: 22/12/98

your ref: 38070
our ref: ER 1020

LAND & WATER CONSERVATION

MANAGER
ERM MITCHELL MCCOTTER (TAREE)
PO BOX 487
TAREE 2430

Thursday, 17 December, 1998

ATTENTION: Murray Curtis

faxed 17/12

Dear Sir

JANDRA QUARRY EXTENSION EIS

I refer to your letter dated 9 November 1998 requesting this department's comments in regard to the above proposal. The Department has now reviewed this matter and provides the following information on the principle issues.

STORMWATER

A stormwater management plan for the proposal must be included in the EIS. Stormwater should be managed in such a way as to reduce stormwater peak concentrations, by retarding or dispersing flows in detention basins and vegetated stormwater easements. The use of concrete drains should be minimised unless specific reason for their use is indicated. This will reduce erosion hazards on local watercourses, and reduce pollutant loads in stormwater leaving the site.

The stormwater management plan must include assessment of sedimentation control structures including detention basins. A detailed plan of site drainage must be included in the EIS, showing the location and dimensions of stormwater management structures. Vegetation should be maintained to allow the passage of stormwater, while allowing shrubs and trees to be installed on property boundaries fringing stormwater easements.

An assessment of surface water quality on the site, and any potential impacts on water quality must be included in the EIS. A detailed discussion of the management options available for management of stormwater must be included, and justification of stormwater and water quality controls included.

GROUNDWATER

The EIS should provide a description of the groundwater hydraulics of the aquifer system(s), with supporting data used for input to the total water balance of the activity. DLWC requirements include providing details on:
· detailed geologic mapping to identify adverse geologic conditions (e.g., fracture zones, out-of-slope bedding, fault zones, or other geologic discontinuity's) and any proposed remedial measures.
· different aquifer systems present in the area including their extent and inter-relationships,
· physical and chemical characteristics of aquifers,
· flow directions and rates of flow,
· any connections to surface water bodies or any dependent ecosystems.

The EIS should also include details of any potential changes to the existing groundwater regime as a result of the development, including:
· implementation of the progressive development (mine, landfill, quarry) plan showing predicted volume of groundwater flow into the mine over the lifetime of the mine, indication of changes in water levels and post mining recovery
· emplacements

[illegible] King Street Newcastle West NSW [illegible] PO Box [illegible] Gungan NSW 2309 DX 4335 Newcastle West
Telephone (02) 4929 4346 Facsimile (02) 4929 6364 Email www.dlwc.nsw.gov.au

· waste management
· impacts of dewatering on short term and long term changes to groundwater features, related surface water bodies, any dependent ecosystems, and existing and potential groundwater users
· long-term changes to groundwater quality, related surface water bodies and dependent ecosystems, and existing and potential groundwater users from the production of acid waters due to groundwater rising and leaching contaminants from spoil material following pit closure
· detailed descriptions of conceptual models

Under Part V of the Water Act (1912), all proposed groundwater works, including bores for the purpose of extraction, dewatering, testing or monitoring, must be licensed with DLWC prior to their installation. The EIS should include therefore information regarding:
· location and construction details of all proposed bores, including their purpose
· expected annual groundwater extractions from individual dewatering bores

Other general information should be provided on:
· details of the proposed monitoring programs, including water levels and quality data
· the reporting procedures for the monitoring program including mechanism for transfer of information
· details of the projected effects of any final void on the groundwater regime
· contingency plans for the rehabilitation of aquifers if there is any adverse impact on the beneficial use of the aquifer system as a result of development
· details of existing and/or potential groundwater users within and adjacent to the area of the development
· funding assurances covering the anticipated postclosure maintenance cost i.e.-going monitoring for the nominated period
· the hydraulic properties, strength and contaminant attenuation capacity of lining material to prevent leachate mobilisation

Any reports or documents on groundwater studies which are referenced in the EIS should be made available to the DLWC for review.

SOIL CONSERVATION

In relation to soil erosion, sedimentation and land degradation in general the Department advises that the EIS should address at least, but not be limited to the following issues:-

· topography and landform
· soil type and soil erodibility
· acid sulfate and potential acid sulfate soils
· vegetation management and Native Vegetation Conservation Act (1997), if applicable
· Protected Land (Native Vegetation Conservation Act 1997), if applicable
· erosion and sediment control strategy, including techniques

RIVERS AND FORESHORES IMPROVEMENT ACT

The Department of Land and Water Conservation (DLWC) has an approval role in relation to this development as follows:- a permit is required under the Rivers and Foreshores Improvement (RFI) Act, 1948 for the Jandra Quarry Extension which is within 40 metres of the Bungwahl Creek.

The EIS should include:

- material description, extraction rates, extraction methods and processing.
- description of site features such as topography and adjacent infrastructure.
- distance from the extraction site to watercourses and wetlands.
- extraction plan including site layout, stockpile processing and handling areas, topsoil removal and storage provisions, erosion control measures, site drainage, setbacks and buffer strips, access, flood hazard management provisions (if appropriate), protection of sensitive areas.
- operation plan showing staging or sequencing of extraction and stockpiling and processing areas.
- rehabilitation plan showing finished topography and landscaping.

The impact of the proposal should be assessed with regard to:

- changes to flood hydrodynamics.
- changes to drainage paths.
- water quality (including turbidity) of Bungwahl Creek

I trust the above information is of assistance in regard to your consideration of this proposal. Should there be any further enquiry in this matter, please contact Mr Jeff Hunt, Resource Planning Manager, at our Newcastle Office on 02 49299850.

Yours Faithfully

Jeff Hunt, Resource Planning Manager
Resource Assessment and Planning, Hunter Region

JANDRA QUARRY
EXTENSION

CSR

B. GOVERNMENT AUTHORITY RESPONES

Greater Taree
CITY COUNCIL

Administration Centre 2 Pulteney Street
PO Box 482, Taree NSW 2430
DX 7020, Taree

Phone 02 6591 3399
Fax 02 6591 3311

File No: PR 9730
Letter 150
BB:JW
Enquiries: Bruce Byatt

ERM Mitchell McCotter Quality
Referred to: MM/MC Ref. No.:
Date Received: 25/11/98
Source: GTCC
Data suitability check required Yes No
Data is: Current
Applicable to project
Checked by
Attach explanation for "no" answers or data problems
Signature: Date: 25/11/98

18 November 1998

Mr M Curtis
ERM Mitchell McCotter
DX 7005
TAREE

Dear Sir

RE: Jandra Quarry Extension - Environmental Impact Statement
Your Ref: 38070

I refer to your letter of 9 November advising that your firm has been commissioned to prepare a development application and EIS for a proposed extension to Jandra Quarry.

I advise that a Council representative will be available for a Planning Focus meeting and your early advice of a date, venue and time would be appreciated.

From Council's point of view the main issues which need to be addressed are visibility of the quarry from both the north and south, rehabilitation of the existing worked areas, all development being shielded from view from the Highway as far as practicable and the potential impacts on residents to the south, given that the proposed easterly extension is very close to the southern boundary.

Should you have any further enquiries please contact Bruce Byatt of Council's Planning and Building Department.

Yours faithfully

Bruce Byatt
Manager
DEVELOPMENT CONTROL

ERM Mitchell McCotter Quality System
Referred to 7M / MC Ref No. 38070
Date Received: 5/1/99
Source: EPA
Yes No
Data suitability check required
Data is: Current
Applicable to project
Checked by:
Attach explanation for "no" answers or data problems
Signature: ... Date: 5/1/99

EPA

Environment Protection Authority
New South Wales

NSW Government Offices
117 Bull Street Newcastle West NSW 2302
PO Box 488G Newcastle NSW 2300
Tel 02 4926 9971 Fax 02 4929 6712

The Manager
ERM Mitchell McCotter
PO Box 487
Taree NSW 2430

Our Reference: 271179A2 ST:ST

Your Reference: 38070

Attention: Murray Curtis

25 DEC 1998

Dear Sir,

JANDRA QUARRY EXTENSION EIS

I refer to your request for EPA's requirements for an EIS being prepared for the above proposal contained in your letter of 9 November 1998.

The EPA has considered the outline of the proposal as described at the Planning Focus held on site on 30 November 1998 and has identified the information it requires to assess the proposal and issue its general terms of approval. In an EIS prepared for the proposal as described to date the following matters will particularly need to be addressed.

1. Predicted noise, blasting and dust exposures at neighbouring residences for the life of the quarry and whether they will meet the EPA requirements.

2. The proposed asphalt plant will require the approval of the EPA and will need to meet the requirements of the Clean Air Act with respect to particulate and odour emissions. The EIS should follow the DUAP EIS Guidelines for Bitumen Plants.

2. All unsealed operational areas of the quarry must be drained through sediment ponds sized for a 1 in 10-year 2-hour storm. The sedimentation pond(s) must accommodate any increase in disturbed catchment throughout the life of the quarry.

3. Any new rock processing equipment to be installed on the site will require the approval of the EPA.

You are also advised of the following: -

4. The existing pollution control licence conditions will apply to the expanded quarry operation unless modified in response to unforeseen conditions at the premises. The licence will be varied to regulate the bitumen plant operations.

5. The proposal will require EPA approval under the Noise Control Act if construction starts prior to commencement of the Protection of the Environment Operations Act. We do not anticipate any construction related conditions being added to the licence held by the proponent, as the current licence conditions will adequately cover the expected expansion activities at the premises.

To assist the EPA in assessing the EIS it is requested that the EIS follow the format of DUAP's EIS guidelines.

The EPA requests that the applicant provide 2 copies of the EIS when lodging its application with EPA. These should be lodged with the Hunter Regional office of the EPA. If you have any further inquiries on these matters please contact Mr Shane Trengove on 0249 269966.

Yours sincerely

T Henderson

Trevor Henderson
A/Head Regional Operations Unit - Hunter.
for Director-General

426.5375;2
Mr B J Bradley
Tel: (02) 49 240 332
Fax: (02) 49 240 342
colin_nunn@rta.nsw.gov.au

Roads and Traffic Authority
New South Wales

RTA

www.rta.nsw.gov.au

Hunter Region
59 Darby Street
(Locked Bag 30)
Newcastle NSW 2300
Telephone (02) 4924 0240
Facsimile (02) 4924 0347
DX 7813 Newcastle

ERM Mitchell McCotter
DX 7005
TAREE

Attention: Murray Curtis

JANDRA QUARRY EXTENSION - ENVIRONMENTAL IMPACT STATEMENT.

Dear Sir

I refer to your letter dated 9 November 1998 (your reference 38070) regarding the proposed extension to Jandra quarry, south of Taree.

It is considered unnecessary for a representative from the RTA to attend the Planning Focus Meeting for the Jandra Quarry extension.

The Environmental Impact Statement should address the adequacy of the existing right-turn and left-turn facilities on the Pacific Highway for the ultimate traffic generated by the proposed quarry extension. The Environmental Impact Statement should also address the potential impacts on noise levels resulting from the additional traffic generated on along proposed haulage routes.

Further comments may be offered when the Environmental Impact Statement is completed.

Yours faithfully

24/11/98

C W Nunn
Development Manager
Hunter Region

ERM Mitchell McCotter Quality System			
Referred to	MC	Ref. No.	38070
Date Received:	2/12/98		
Source:	RTA		
		Yes	No
Data suitability check required		☐	☑
Data is: Current		☐	☐
Applicable to project		☐	☐
Checked by:			
Attach explanation for "no" answers or data problems			
Signature:		Date:	2/12/98

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MINERAL RESOURCES

NSW DEPARTMENT OF MINERAL RESOURCES
Level 2, ABS House 97-101 Faulkner Street
(P.O. Box 65), Armidale, NSW 2350, Australia
Phone (067) 70 2100 · Fax (067) 70 2121

The Regional Manager,
ERM Mitchell McCotter
Suite 6/221 Victoria Street
TAREE NSW 2430
Attn: Mr M. Curtis

OUR REF: L98/0421
YOUR REF: 38070

27th November, 1998

Dear Sir/Madam,

EIS for a proposed extension to Jandra Quarry, Greater Taree City

Thank you for your letter dated 9th November, 1998 concerning the subject proposal

The attached Departmental guidelines address specifically issues that the Department would want to see considered in an EIS. The Department of Urban Affairs and Planning's document *Extractive Industries Quarries - EIS Guidelines* provide additional information that you might need to consider.

Should you have any further enquiries, please do not hesitate to contact Mr Brian Olds (Tel 02 6770 2105) for information on quarry safety, or Mr Jeff Brownlow (Tel 02 6770 2113) for information on resources or land use in the Department's Armidale Office.

Yours faithfully,

S.R. LISHMUND
for Director-General

NSW Department of Mineral Resources - North-eastern Region

Resource and market assessments for EIS and SEE preparation

All Environmental Impact Statements (EISs) and Statements of Environmental Effects (SEEs) for extractive industries should contain resource and market assessments. These assessment should be sufficiently detailed and illustrated to establish:

- The characteristics of the deposit including location, geology, extent, and significant internal variations in grade/ quality.
- The quantity and type of material to be extracted.
- Whether the expected products are marketable in the district or region.
- The need for those products in the district or region, in the context of known alternative sources, their availability, and market acceptance.
- Mechanisms to ensure site rehabilitation (progressive or post quarrying, as appropritate) and funding of that rehabilitation.
- Whether other potentially recoverable commodities occur at the site, and a justification for not exploiting them or not stockpiling them for later recovery (where relevant), and

The extent of documentation in an EIS or SEE should be in keeping with the size and duration of the proposed operation, the nature of the operation and the environmental sensitivity of the site. Documentation could be provided in supporting documents accompanying an EIS or SEE, rather than in the EIS or SEE, provided that: (a) the EIS adequately summarises and cross-references data in the supporting documents; and (b) the documentation collectively meets all of the above requirements.

Warning - Expect close public scrutiny and prepare carefully

ERM ... System
Referred to: MC / EMC
Date Received: 4 12 98
Source: NPWS
Data suitab... | Yes | No ☑
Data is: C...
Checked by
Attach expla... data problems
Signature: ... 4/12/98

1 December, 1998

NSW NATIONAL PARKS AND WILDLIFE SERVICE

Murray Curtis
ERM Mitchell McCotter
PO Box 487
TAREE NSW 2430

Our reference: 1441/98.1514/sa
Your reference: 38070

Dear Mr Curtis

JANDRA QUARRY EXTENTION ENVIRONMENTAL IMPACT STATEMENT

Thankyou for your letter of requesting comments on those issues to be covered in the EIS for the above development. Those matters which the National Parks and Wildlife Service (NPWS) considers need to be addressed are detailed in the attachment. Please note that this attachment comprises a general list only, and that these issues may apply to a lesser or greater degree depending on site specifics. The NPWS is particularly interested in the following.

- Areas of native vegetation, with special reference to vegetation communities or plant species which are threatened or are of a local, regional or statewide significance (including ROTAP species).
- Areas of potential significance for native fauna with special reference to habitat likely to be significant for threatened fauna species or fauna of a local, regional or statewide significance.
- Areas of archaeological potential and Aboriginal heritage values as identified by the Aboriginal community.

If any areas within your study area possess attributes such as those identified above, the NPWS recommends that detailed surveys be undertaken to determine the natural and/or cultural values of the area and potential impacts on these values.

Also attached is a brochure which details how to access the Atlas of NSW Wildlife. The NPWS generally advises that both the Atlas and the Register of Aboriginal Sites are referred to during investigations into the natural and cultural heritage values of a site.

Should you wish to discuss any of these matters further, please contact Sonya Ardill, Environmental Planning Officer, on (02) 6659 8221.

Yours faithfully

Janelle Brooks
Manager Environmental Planning

Northern Zone
GIO House
24 Moonee Street
Coffs Harbour NSW
Australia
PO Box 914
Coffs Harbour 2450
Tel: (02) 6651 5946
Fax: (02) 6651 6187

Head Office
43 Bridge Street
Hurstville NSW
Australia
PO Box 1967
Hurstville 2220
Tel: (02) 9585 6444
Fax: (02) 9585 6555

NSW NATIONAL PARKS AND WILDLIFE SERVICE, NORTHERN ZONE

ENVIRONMENTAL ISSUES TO BE ADDRESSED

INTRODUCTION

The following list is provided to assist in the preparation of environmental impact assessment reports. The list details the type of information that is recommended by the New South Wales National Parks and Wildlife Service (NPWS) for inclusion in such assessments.

Please note that the provision of information in accordance with this list does not negate the applicant's obligations under any legislative or planning instruments. NPWS suggests that the applicant contact the relevant local council and the Department of Urban Affairs and Planning to ascertain these obligations.

GENERAL

1. Map(s) showing the locality of the proposed development in a regional and local context. Local context maps should be based on 1:25 000 topographic plans. Photographs of the site's key attributes may provide useful documentation.

2. A description of the existing environment on the subject land and surrounding land, the proposed development and ancillary works, and the manner in which the environment will be modified by the proposal (particularly with regard to the clearing of native vegetation and impacts on fauna habitat).

3. The area subject to development should be clearly identified on an appropriately scaled plan. This includes all ancillary works such as buildings and other structures, parking areas, loading/processing/treatment areas, access roads, and material stockpiling areas.

4. The applicability or otherwise of Local Environment Plans (LEP), Regional Environment Plans (REP) and State Environmental Planning Policies (SEPP) to the site should be determined and detailed. In particular, your attention is drawn to SEPP No. 14 - Coastal Wetlands, SEPP No. 26 - Littoral Rainforest, SEPP No. 44 - Koala Habitat Protection, and SEPP No. 46 - Protection and Management of Native Vegetation.

FLORA

1. A comprehensive description of the vegetation on the site. This will include an assessment of the condition of the plant communities present, including the designation of conservation significance at a local, regional and State level, and the identification of the presence of any threatened species, populations or ecological communities listed under Schedules 1 or 2 of the *Threatened Species Conservation Act 1995* and any Rare or Threatened Australian Plant (ROTAP) species

2. A plan showing the distribution of the Threatened and ROTAP species and the vegetation communities on the site, and the extent of vegetation proposed to be cleared. This plan should be at the same scale as the plan of the area subject to development in order to assist in the assessment of the impact of the proposal on the existing vegetation.

3. Where the assessment concludes that threatened species, populations or ecological communities, or their habitats, exist on or in proximity to the subject land, the effect of the proposed development should be determined in accordance with the eight point test described in Section 5A of the *Environmental Planning and Assessment Act* 1979. An assessment of the impact of the development on the plant communities and/or ROTAP species should also be provided.

4. A description of the measures proposed to mitigate and/or ameliorate the impact of the development on the plant communities and/or Threatened and ROTAP species.

FAUNA

1. A fauna survey to identify the distribution and abundance of fauna species known or likely to utilise the site, including a description of available fauna habitats and an assessment of the conservation status of each of the faunal components at a local, regional and State level.

2. A plan showing the results of the above survey. This plan should be at the same scale as the plan of the area subject to development to assist in the assessment of the impact of the proposal on fauna.

3. An assessment of the impact of the development on the identified fauna.

4. An assessment of the existence or likely occurrence of threatened species, populations or ecological communities, or their habitats on the subject land. Where the assessment concludes that threatened species, populations or ecological communities, or their habitats exist on or in proximity to the subject land, the effect of the proposed development should be determined in accordance with the eight point test described in Section 5A of the *Environmental Planning and Assessment Act* 1979.

5. A description of the measures proposed to mitigate and/or ameliorate the impact of the development on fauna.

CULTURAL

1. The presence or absence of Aboriginal sites should be identified and the significance of the area to the local Aboriginal community must be determined. Accordingly, a search of the NPWS Aboriginal sites register should be made and the local Aboriginal community should also be consulted with regard to any Aboriginal heritage issues associated with the proposed development.

2. Aboriginal sites and places of significance to the Aboriginal community are to be detailed on a plan. This plan should be at the same scale as the plan of the area subject to development to assist in the assessment of the impact of the proposal on the identified cultural components.

3. An assessment of the impact of the development on the identified cultural sites.

4. A description of the measures proposed to mitigate and/or ameliorate the impact of the development on the identified cultural sites.

5. A contingency plan that details the measures to be taken in the event that archaeological sites are discovered during the course of operations must be prepared.

NATIONAL PARKS ESTATE

1. Where the proposal may result in impacts on NPWS estate or is on land adjacent to NPWS estate, an assessment of the impact of the development on NPWS estate.

2. A description of the measures proposed to mitigate and/or ameliorate the impact of the development on NPWS estate.

NOTES

Surveys and Assessments

1. Fauna, flora and cultural surveys and assessments should be undertaken by suitably qualified persons and the qualifications and experience of the persons undertaking the work detailed.

2. Dates, site locations, design, methodology, analysis techniques, and weather conditions at the time of the assessments and surveys must be described. The limitations of surveys should be identified and the results interpreted accordingly.

3. Conclusions drawn in surveys and assessments should be substantiated by evidence resulting from those surveys and assessments. The document being supported by the surveys and assessments should reflect these conclusions and clearly state where recommendations of the surveys and assessments have been incorporated in the proposal.

NPWS Databases

4. The NPWS can provide records of flora and fauna held in the Wildlife Atlas and / or Rare or Threatened Australian Plants (ROTAP) databases. In addition NPWS has an Aboriginal Sites Register of which searches can be made. These services generally attract a fee. Enquires should be made to NPWS Hurstville office, telephone (02) 585 6444.

5. It should be noted that the above databases are not comprehensive and should only be used as a guide. They do not negate the need for specific site investigations.

ERM Mitchell McCotter Quality System
Referred to MC Ref. No 38070
Date Received: 15/12/98
Source: EPA
Data suitability check required Yes No
Data is: Current
Applicable to project
Checked by:
Attach explanation for "no" answers or data problems
Signature .... Date 16/12

EPA
Environment Protection Authority
New South Wales

NSW Government Offices
117 Bull Street Newcastle West NSW 2302
PO Box 488G Newcastle NSW 2300
Tel 02 4926 9971 Fax 02 4929 6712

The Manager
ERM Mitchell McCotter
PO Box 487
Taree NSW 2430

Our Reference: 271179A2 ST:ST

Your Reference: 38070

Attention : Murray Curtis

10 DEC 1998

Dear Sir,

JANDRA QUARRY EXTENSION EIS

I refer to your letter of 9 November 1998 and the Planning Focus held on site on 30 November 1998.

In an EIS prepared for the proposal as described to date the following matters would need to be addressed.

1. Predicted noise, blasting and dust exposures at neighbouring residences for the life of the quarry and whether they meet the existing EPA requirements.

2. All unsealed operational areas of the quarry must be drained through sediment basins sized for a 1 in 10 year 2-hour storm. The sedimentation pond(s) must accommodate any increase in disturbed catchment throughout the life of the quarry.

3. Any new rock processing equipment to be installed on the site will require the approval of the EPA.

4. The existing pollution control licence conditions will apply to the expanded quarry operation unless modified in response to changed conditions at the premises.

If you have any further enquires on these matters please contact Mr Shane Trengove on 0249 269966.

Yours sincerely

THenderson

Trevor Henderson
A/Head Regional Operations Unit - Hunter.
for Director General

NSW FISHERIES

Your Ref: 38070
Our Ref: TGF804001

November 12, 1998

Murray Curtis
ERM-Mitchell McCotter
PO Box 487
TAREE 2430

Dear Sir,

Re: Extension of Jandra Quarry - EIS

Thank you for giving NSW Fisheries the opportunity to comment on the proposal.

Find enclosed an copy of NSW Fisheries HPP1. This document outlines the issues that concern the department in relation to this development.

The main concern the Department has is the downstream effect of any quarrying works on fish habitat. This includes sedimentation and reduction in water quality.

For further information, please contact me on (02) 4980 4931.

Yours sincerely

Scott Carter
A/Senior Conservation Manager (Central)

ERM Mitchell McCotter Quality System			
Referred to	MC	Ref. No.	38070
Date Received:	17/11/98		
Source:	NSW Fisheries		
		Yes	No
Data suitability check required		☐	☑
Data is: Current		☐	☐
Applicable to project		☐	☐
Checked by:			
Attach explanation for 'no' answers or data problems			
Signature:		Date:	17/11/98

PORT STEPHENS RESEARCH CENTRE
Taylors Beach Road - Taylors Beach NSW 2316 - Australia
Telephone: (02) 4982 1232 • **Facsimile:** (02) 4982 1107

NSW

FISH HABITAT PROTECTION PLAN 1

MARCH 1995

FISHERIES

fish habitat protection plan
No. 1, March 1995

Introduction

1.1 The Fisheries Management Act 1994 (the Act) was proclaimed, and came into effect, on 16 January 1995.

1.2 The objectives of the Act are to conserve, develop and share the fisheries resources of the State for the benefit of present and future generations, and in particular:

- i) to conserve fish stocks and protect key fish habitats;
- ii) to promote viable commercial fishing and aquaculture industries;
- iii) to provide quality recreational fishing opportunities; and
- iv) to promote ecologically sustainable development.

1.3 To assist in the protection of key fish habitats, the Act enables the Minister to make Habitat Protection Plans for the protection of **any habitat of fish**, "whether the habitat is critical for the survival of the species or required to maintain harvestable populations of fish".

1.4 The Act requires the Minister to seek public comment on a Habitat Protection Plan before gazettal. Once gazetted, the Minister and Public Authorities must have regard to any Habitat Protection Plan that is relevant to the exercise of their functions.

1.5 This is the first Habitat Protection Plan to be developed under the Act. It deals broadly with dredging and reclamation activities, fish passage requirements, the protection of mangroves, seagrasses and other marine vegetation, and the importance of snags.

Objectives of this Plan

2.1 The objectives of this Plan are:

- i) to provide protection, where necessary, for all fish habitat, and in particular those habitat features which may be affected by the activities subject to this plan;
- ii) to restate the relevant requirements of the habitat provisions of the Act in a form which can be readily distributed to and understood by other Government agencies and the community;
- iii) to establish a requirement for public authorities who propose to remove snags from waterways to notify the Minister; and
- iv) to outline the process for individuals or agencies to follow when consent, notification or consultation is required, and to described how each application will be processed.

Definitions Relating to the Plan

3.1 In this Plan, *Minister* refers to the Minister responsible for the Fisheries Management Act 1994.

3.2 *Waters* and *fish* have the same meanings as they have in the Fisheries Management Act 1994. *Waters* includes all waters within the territorial limits of NSW, including those waters within three nautical miles of the coastline; *fish* means marine, estuarine or freshwater fish (or other aquatic animal life) at any stage of their life history, and includes aquatic molluscs, crustaceans, echinoderms and worms, but excludes mammals, birds, reptiles and amphibians.

3.3 *Notify* means advise the details of any proposal at least 28 days (or as otherwise mutually agreed) prior to the commencement of any development, works or activities.

Duration of the Plan

4.1 This Plan will be reviewed within five years of the date of gazettal, and at least every five years thereafter.

Habitats to Which this Plan Applies

5.1 This plan applies to all waters to which the Fisheries Management Act 1994 applies. The habitats and habitat features to which this Plan applies are those required for the spawning, nursery, shelter and feeding activities of fish and include:

i) quantity and quality of waters;
ii) mangroves;
iii) seagrasses;
iv) saltmarshes;
v) wetlands;
vi) mudflats;
vii) sand and gravel substrates;
viii) rocky reefs;
ix) reed beds, and other aquatic plants; and
x) snags, including primarily fallen trees and rocks.

5.2 All of these habitats have been shown by scientific research to be important in the life cycles of one or more species of fish. Further information on the importance of these habitats is available in a variety of publications (see reading list).

Activities to which this Plan Applies

6.1 This plan applies to the following developments, works or activities, each of which can impact on fish habitat:

(i) dredging and/or reclamation;
(ii) impeding fish passage;
(iii) damaging marine vegetation; and
(iv) desnagging.

Dredging and Reclamation

6.2 Dredging and reclamation can destroy fish habitat (e.g. seagrasses and mangroves), reduce habitat diversity (e.g. by removing deep holes) and affect water quality.

6.3 Under Sections 200 and 201 of the Act, **the Minister's consent is required for dredging or reclamation works carried out by any person or local government authority unless those works are authorised by a relevant public authority or under the Crown Lands Act 1989.**

6.4 If dredging or reclamation works are carried out in contravention of Sections 200 or 201 the Minister may, under Section 203 of the Act, order remedial works to be carried out to rectify any damage caused to fisheries or fish habitats.

6.5 Under Section 199 of the Act, the Minister is required to be consulted over any dredging or reclamation works carried out, or proposed to be authorised, by a public authority (other than a local government authority). This Section also establishes consultation and dispute resolution procedures.

6.6 Under Section 198, the Minister's consent is not required where the dredging or reclamation is for the purpose of mining; or is approved by Public Works and is for the restoration or maintenance of a navigation channel; or is on land vested in the Maritime Services Board and is for the passage or accommodation of seagoing vessels; or is for the removal of accumulated silt from a stormwater channel. All such works can affect fish habitat, however, and should not be carried out without carefully considering ways to minimise their impacts. **In order to facilitate these considerations, Public Authorities are hereby required to notify the Minister of any proposals for dredging or reclamation, whether they propose to undertake the work or merely to authorise it, and whether or not the Minister's consent is required.**

6.7 Where consultation with the Minister or NSW Fisheries is already required for such works under other legislation (as is the case, for example, in the Mining Act 1992, the Petroleum (Onshore) Act 1993 and SEPP35), or where an EIS is prepared and referred to NSW Fisheries, that consultation satisfies the notification requirement specified in Section 6.5 of this Plan.

Impeding Fish Passage

6.8 The construction of weirs, dams, bridges, roads, culverts, causeways and reservoirs has impeded the passage of fish, and has been one of the main causes of declines in populations of estuarine and freshwater fish and species with a migratory phase in their life cycle.

6.9 Under Section 218 of the Act, **the Minister may require any person who constructs, alters or modifies a dam, weir or reservoir to carry out works to enable the passage of fish; the Minister may also require the person responsible to maintain the fish passage facility.**

6.10 **Any public authority that proposes to construct, alter or modify a dam, weir or reservoir on a waterway (or to authorise any such construction, alteration or modification) is required to notify the Minister and, if the Minister so requests, to include a suitable fishway or fish by-pass in those works.**

Damaging Marine Vegetation

6.11 Mangroves and seagrasses are important fish nursery grounds, and sources of food and shelter for many species of fish and other aquatic organisms.

6.12 Under Section 205 of the Act, **the Minister's consent is required for any cutting, removal, damage or destruction of mangroves, seagrasses or any other prescribed marine vegetation (a) on Crown land, or (b) on land vested in a public authority (or trustees for public recreation or for any other public purpose), or (c) on an aquaculture lease, or (d) on the foreshore of any such land or lease.**

Desnagging

6.13 Snags provide essential habitat for some species of fish, offering them shelter and opportunities to feed and spawn. Desnagging operations destroy fish habitat and should not be conducted without carefully considering ways to minimise that impact.

6.14 **In order to facilitate these considerations, public authorities are hereby required to notify the Minister of any proposal to remove or relocate snags, in particular fallen trees or rocks, from any waterway, whether or not they propose to undertake the work or to authorise it under the legislation.**

6.15 Where a snag is causing a hazard to navigation or public safety, and needs to be removed or relocated as a matter of urgency, a Public Authority may do so without complying with the notification period, but must promptly inform the Minister of the work undertaken and the reasons for it.

What to Do

7.1 If you propose to carry out any development, works or activities which may require notice to, or consent by, the Minister then the process you should follow is:

a) Consult with your local NSW Fisheries Office over the proposed activity to determine whether any consent, notification or further consultation is required.

b) If the Minister's consent is required, provide the relevant information on an approved permit application form (these forms are available at NSW Fisheries Offices) and submit it, together with any fee required. Notification or consultation can be effected by a letter to the Minister. The completed form or letter must provide sufficient information to enable the Minister to assess the proposal and to give effect to the objects of the Act and plan. No work should be undertaken prior to notification or consent requirements being met.

sessment Process

8.1 Any forms received seeking the Minister's consent for a development, work or activity, will be processed as follows;

a) The completed form will first be assessed for completeness. If sufficient information is available, the Minister will respond within 28 days of the application being received. If the information provided is inadequate, the Minister may object to the development, works or activities proceeding until further information is provided.

b) In some cases, site inspections may be needed before a decision can be made. Any inspections necessary to assess an application will be carried out at a time agreed with the applicant and following the payment of any inspection fee required.

c) The Minister may attach conditions to any consent given. These conditions may relate to the term, area, or method of the development, work or activity; to the suspension or cancellation of the consent; or to any works required to restore, or compensate for any loss of, habitat; or to any other matter necessary for the Minister to give effect to the objects of the Act or Plan.

d) The conditions attached may also include a requirement for monitoring. Monitoring requirements may relate to any increase or decrease in fish populations, or seagrasses, or mangroves, or to water quality or any other thing relevant to the consent. Where the required monitoring is not carried out, or where monitoring indicates a significant impact on fish or fish habitat, the Minister may suspend or cancel any consent given, and may require restoration (or compensation) work to be carried out at the applicant's expense.

8.2 Any letters received notifying the Minister of, or consulting the Minister about, any development, work or activity, will be responded to within 28 days if sufficient information is available. If not, additional information may be requested.

8.3 Any application, approval, refusal or notice referred to in this Plan will be entered into a register which will be available for inspection at NSW Fisheries' Head Office, Sydney.

Further Reading

Billyard, R. (1993). Fishcare - our freshwater rivers and streams. Fishnote DF/33, NSW Fisheries, Sydney.

Burchmore, J.J. (1992). Fishcare - protecting fish habitats. Fishnote DF/20, NSW Fisheries, Sydney.

Harris, J.H. (1989). The conservation of threatened fishes and their habitats. Proceedings of a National Conference, Sydney, March 1987. Editors M. Hicks & P. Eiser. Australian Committee for IUCN, Canberra.

Larkum, A.W.D., McComb, A.J. & Shepherd, S.A. (eds) (1989). Biology of Seagrasses. Elsevier Science Publishers, Amsterdam.

Mallen-Cooper, M. (1994). How high can a fish jump? New Scientist. 16 April, pp. 32-37.

McDowall, R.M. (1980). Freshwater Fishes of South-Eastern Australia. Reed, Sydney.

NSW Fisheries (1992). Education kit: Why do we depend on estuaries? NSW Fisheries, Sydney.

NSW Fisheries (1993). Estuarine Habitat Management Guidelines. Edited by J.J. Burchmore, D.A. Pollard, M. J. Middleton & R.J. Williams. NSW Fisheries, Sydney.

NSW Fisheries (1993). Freshwater Habitat Management Guidelines. Edited by J.J. Burchmore. NSW Fisheries, Sydney.

State Pollution Control Commission and Division of Fisheries (undated). A Guide to Mangrove Transplanting.

West, R.J. (1985). Mangroves. Agfact F2.0.1. NSW Agriculture and Fisheries, Sydney.

West, R.J. (1989). Seagrasses. Agfact F2.0.2. NSW Agriculture and Fisheries, Sydney.

This Fish Habitat Protection Plan was released for public comment on 31 January 1995 and Gazetted on 10 March 1995.

JANDRA QUARRY
EXTENSION

CSR

HOW IMPORTANT IS THE QUARRY?

Jandra quarry produces crushed hard rock material for a market extending from Port Macquarie to Karuah and west to Gloucester.

The main customers are small and large civil contractors, local Councils, local concrete plants, the RTA and other government authorities.

The quarry has been in operation since 1986 and has been a significant contributor to the local economy as well as the building and construction industry.

WHAT CSR HAS DONE TO DATE.

Since CSR acquired Jandra quarry during 1996 a number of studies and actions have been undertaken to improve the amenity of the quarrying operation. These include:

- purchase of additional buffer land and reserves adjacent the Pacific Highway,
- monitoring background dust levels,
- monitoring background noise levels,
- assessing, monitoring and modifying blasting practices.

HAVE YOUR SAY?

You can be involved at two stages in the EIS preparation.

NOW: You can supply comments before the EIS is written;

or

LATER: You can comment on the EIS when it is exhibited for public comment prior to determination by the Council.

To have your say now contact:

CSR Construction Materials
Area Manager
PO Box 312
TAREE NSW 2430
Mr Mike Druce (02) 6552-1255

CSR Construction Materials
Manager Mining and Environment
PO Box 400
PARRAMATTA NSW 2124
Mr George M^c^Lellan (02) 9685-2245

CSR Construction Materials

JANDRA QUARRY

PLANS FOR THE FUTURE

To the Land Holder

WHAT'S GOING ON AT THE QUARRY?

CSR Construction Materials are planning the continued operation of their Jandra quarry. During 1999 approval will be sought:

- to extend the existing approved area east and west within the current hill;
- to extract another two bench levels below the existing quarry floor, and,
- to operate a mobile asphalt plant on a project basis.

Production will average 170,000 tonnes per annum, however, approval is being sought to increase the average allowable output to 250,000 tpa to accommodate higher volume jobs when required.

To continue extraction CSR Construction Materials require development approval from the Greater Taree City Council. A development application must be supported by an Environmental Impact Statement (EIS).

WHY PREPARE AN EIS?

The law requires that an EIS accompany any development application for a designated development. Extractive industries are a designated form of development.

HOW IS AN EIS PREPARED?

- Issues are identified through consultation with government authorities and the local community.
- Studies are undertaken to determine the significance of each issue.
- Analyses are undertaken to see how each issue interacts with other issues and how they will impact on the development.
- A report is prepared for review by professional environmental consultants.

WHAT ARE THE LIKELY IMPACTS?

The most significant change will be the gradual enlargement of the quarry zone to allow extraction of identified reserves. Even so, CSR Construction Materials must identify all possible environmental impacts and prepare a rehabilitation plan for the quarry. Areas of investigation are:

- water run-off
- water quality
- dust
- visual
- flora and fauna
- archaeology
- noise
- traffic

JANDRA QUARRY
EXTENSION

CSR™

ERM

D. JANDRA QUARRY GEOLOGICAL INVESTIGATION

CSR
Readymix

JANDRA HARD ROCK QUARRY

GEOLOGICAL INVESTIGATION

By: Ian Stenhouse
Quarry Support Geologist
April 1997

Distribution: G PRICE
M DRUCE
K WORTH
G M^{c}LELLAN \ GEOLOGY FILE

CONTENTS

* * *

APPENDICES

FIGURES

1.0 Introduction

CSR Readymix currently wins quality hard rock from its Jandra quarry, 17 kilometres south of Taree. Approved reserves are sufficient for approximately 9 years supply of material. CSR also own land to the east of the existing quarry area which contains an extension of the greywacke rock unit currently quarried.

CSR aims to secure access to the additional rock reserves by obtaining development approval from the Greater Taree City Council based in Taree. As the first step in pursuing this approval, a comprehensive geological investigation of the site was carried out. This included geological mapping of the land holdings, trenching (3 trenches), percussion drilling (6 holes) and finally diamond drilling (7 holes).

This report details the findings of these investigations.

2.0 Location

Jandra quarry is located on the eastern side of the Pacific Highway at Possum Brush, approximately 17 kilometres south of Taree. Foster-Tuncurry is located 27 kilometres from the quarry site (see Locality Map -- Figure 09-03-0003). Access to the site is from the Pacific Highway.

3.0 Land Title

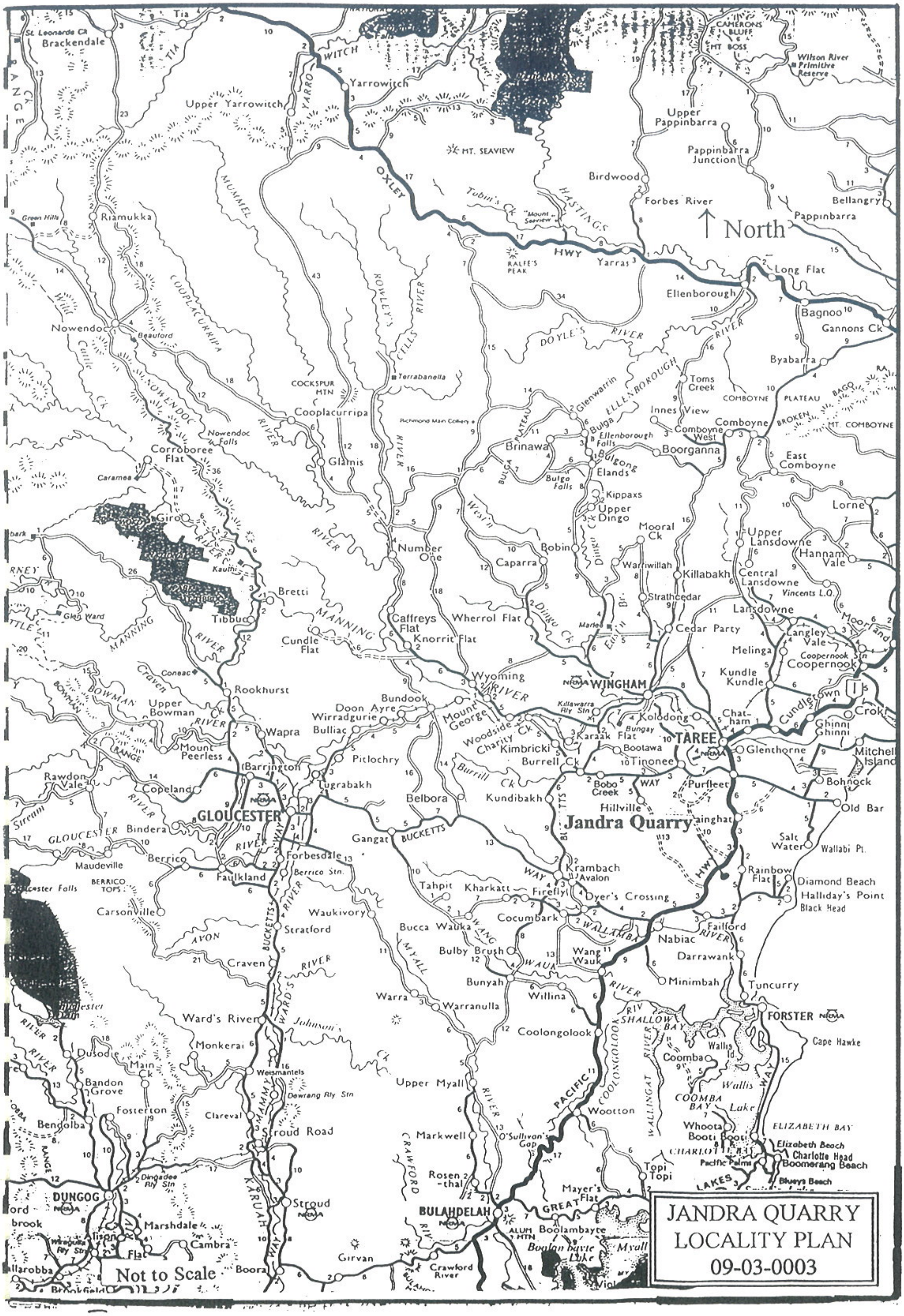
Jandra quarry comprises the following parcels of land (see Figure 09-03-00012):

Lot Number	Deposited Plan	Parish		Area
Lot 2	DP 255,621	Beryan		9.734
Lot 3	DP 255,621	Beryan		11.904
Lot 13	DP 790,056	Beryan		6.292
Lot 14	DP 790,056	Beryan		40.05
Lot 15	DP 790,056	Beryan		40.25
TOTAL				**108.23**

All land is in the County of Gloucester and within the Greater Taree City Council area.

4.0 Zoning

The Jandra land holdings are is zoned "1(a) Rural General". Extractive industry is a permissible use with development consent.



JANDRA QUARRY
LOCALITY PLAN
09-03-0003

5.0 Rock Type and Site Geology

Jandra quarry wins quality aggregate material from a hard meta-sedimentary rock termed ***greywacke*** (see Appendix 1 -- Petrographic Report). The greywacke is part of an undifferentiated bedded sedimentary sequence of Devonian rocks (between 345 and 395 million years old) which comprises mudstone, sandstone, conglomerate, tuff and chert.

In the quarry area the greywacke bed is overlain by an interbedded mudstone and sandstone sequence. Sparse randomly distributed shell fossils and river rounded granitic pebbles also occur.

In thin section the greywacke typically comprises finely micro-crystalline feldspar and quartz of devitrification origin (ranging from 58% to 72%), feldspar as silt, sand and finely crystalline grains (ranging from 10% to 22%), quartz as silt, sand and finely crystalline grains (ranging from 5% to 10%), chlorite (ranging from 7% to 10%), epidote (ranging from <1% to 4%), and opaque oxide, carbonaceous matter, sphene and calcite (all <1%).

The rock carries between 22% and 27% free silica. This, along with the presence of epidote, means that it will be very abrasive.

With regard to alkali-silica reactivity petrologist Dr S Joyce of Geochempet Services made the following qualitative remarks: *"the rock is predicted to be physically quite suitable for use in concrete, but appropriate design precautions are recommended to take account of its predicted potential for mild or slow deleterious alkali-silica reactivity in concrete. The perceived potential for reactivity relates to the presence of an estimated 15% of finely microcrystalline quartz of devitrification origin (within the silty, vitroclastic matrix and within devitrified lithic fragments of tuff)."*

Quantitative alkali aggregate reactivity tests are currently underway with the CSIRO in Melbourne.

6.0 Rock Quality

The physical properties of the rock recently extracted are as follows:

Test	Result
Bulk Density (SSD)	2.656 t/m^3
Stripping Test	Nil Strip
Polished Aggregate Friction Value	52 - 53
Water Absorption	0.4 - 0.5%
Dry Strength	415
Wet Strength	415
Wet/Dry Strength Variation	0%

* Rock characteristics taken from compliance testing dated 17/12/96. Rock sampled from RL 50.

7.0 Site Assessment Procedure

Geological assessment of the Jandra resource comprised four separate phases. These were:

- geological mapping
- trenching
- percussion drilling, and,
- diamond drilling

Percussion drilling was carried out using a Company owned hydraulic drill rig while diamond drilling was carried out by Groundtest Pty Limited. All investigations were carried out under the supervision of CSR Readymix geologist Ian Stenhouse.

Each phase of the assessment is detailed below.

7.1 Geological Mapping

Geological mapping of the Jandra land holdings was carried out between 17 and 19 September 1996. Mapping focused on determining the lateral extent of the greywacke resource across the property.

7.1.1 Mapping Technique

Geological mapping was carried out using a compass, a hip-chain to measure distance, and a clinometer to measure the angle of dip of rock beds. Observations were recorded on a 1:2000 topographic map generated by QASCO from aerial photography dated 4 October 1994.

Numerous traverses were made along internal roads and tracks -- float and rock exposures were mapped. Exposures of rock around dams and other excavations were also noted. Creeks and gullies were also traversed.

7.1.2 The Findings of Geological Mapping

Geological mapping identified 3 distinct bedded units. These are:

1	**Overlying Undifferentiated Meta-sediments**	This unit comprises an interbedded sequence of siltstones, fine hard grey siliceous argillite beds and fine to medium grained red and white sandstone. This sequence is well exposed on the haul road east of the primary boot up to the "hair pin" turn .
2	**Greywacke**	This unit is currently quarried. It consists of hard dark grey medium to coarse grained siliceous greywacke. This unit contains some minor shell fossils and also some minor rounded river gravel primarily of granitic composition.
3	**Underlying Undifferentiated Meta-sediments**	These sediments are poorly exposed on the southern portion of the property and consist of a soft argillaceous sequence of siltstones and mudstones.

7.1.3 Interpretation of Geological Mapping

Rock units strike east west at between 245° to 255° magnetic and dip towards the north at between 45° to 50° (this was confirmed by diamond drilling).

The overlying interbedded meta-sediments contain some hard argillite beds as well as some softer siltstone and mudstone interbeds. The overlying unit is thought to be suitable for blending with greywacke to produce road bases -- testing is required to prove this. If removal of some of the overlying sediments is possible this will allow greater utilisation of, and access to, the underlying greywacke resource.

The greywacke bed is considered to be continuous across site. Calculations suggest the greywacke bed is up to 190 metres thick.

The underlying meta-sediments cropping out on the southern side of the property will not be quarried due to environmental constraints.

Map 09-03-0022 (attached) shows the interpreted distribution of these rock units across the property. Sub-surface investigations confirmed these observations.

7.2 Trenching

Between 13 and 14 November 1996 3 trenches were dug across the greywacke unit in an effort to determine the location of the upper contact of the greywacke with the overlying undifferentiated meta-sediment unit. The location of these trenches is shown on Figure 09-03-0022 attached.

Mixed results were gained from trenching and a number of percussion holes were drilled to confirm observations made during trenching. Observations from each trench backed up by percussion drilling are described separately below. All measurements along trenches are taken from the southern end of the trench traversing north.

Trench 1 (63 m)	The most easterly trench was dug along the ridge line in the vicinity of the house currently occupied by Rod Wynter. This trench intersected hard greywacke for the first 13 metres and then entered an interbedded sequence of greywacke, argillite and shale. The exact location of the upper surface of the greywacke contact in this location is unclear. Percussion drill holes planned for this area were not drilled due to a rig break-down.
Trench 2 (45m)	Trench 2 was the most westerly trench dug to the east of the new haul road. Greywacke was intersected for the first 22.5 metres before entering indurated fine argillaceous rock similar to that overlying the greywacke and cropping out in the existing pit. Percussion holes drilled in the vicinity of this trench confirmed the location of the upper contact of the greywacke unit.
Trench 3 (75m)	This trench was dug in the central portion of what will be the extension to Jandra quarry. The trench was 75 metres long and intersected greywacke for its entire length. The trench was discontinued when it neared a creek. Notwithstanding this, a change in rock type appeared imminent (due to increasing overburden thickness and a different jointing regime) near the end of the trench. Attempts to drill percussion holes in this location were thwarted due to boggy ground and poor access.

In summary, the greywacke/meta-sediment contact was only definitively identified in Trench 2.

7.3 Percussion Drilling

A six hole percussion drilling programme followed trenching to confirm the location of the geological contacts identified (or interpreted) by trenching and mapping (hole locations are shown on Figure 09-03-0022). Percussion drill holes (PDH's) 1/96 and 2/96 confirmed the location of the greywacke contact in the vicinity of Trench 2.

PDH 6/96, drilled in the vicinity of the eastern most house (Rob Wynter's home), intersected a sequence of interbedded meta-sediments. Additional holes in this area were planned but, due to the mechanical failure of the percussion drill rig, were abandoned. Additional percussion drilling is required to the south of PDH 6/96 to define the exact location of the greywacke contact.

PDH's 3/96, 4/96 and 5/96, drilled along the ridge line, intersected quality greywacke for their entire length below a weathered zone.

Percussion drill logs are presented in Appendix 2.

7.4 Diamond Drilling

Diamond drilling was carried out from 12 February through to 4 March 1997. Seven NQ_3 diamond holes were drilled. These were designated (DDH) 1/97, 2/97, 3/97, 3a/97, 5/97, 5a/97 and 6/97. Initially all holes were to be drilled on an angle of 45°, that is perpendicular to the dip to the greywacke unit, however, DDH's 3/97 and 5/97 had to be abandoned due to the holes collapsing in highly fractured ground – these were re-drilled vertically. The location of drill holes is shown on Figure 09-03-0022.

DDH	Easting (m)	Northing (m)	Length (m)	Collar RL (m)	Base RL (m)	Azimuth
1/97	248,708	1,452,646	29.9	99.3	78.1	45° → 140°
2/97	248,752	1,452,757	29.9	73.8	52.6	45° → 180°
3/97	248,868	1,452,632	13.2	90.5	81.2	45° → 175°
3a/97	248,868	1,452,632	41.8	90.5	48.7	Vertical
4/97	Not drilled due to poor access.					
5/97	248,501	1,452,629	11.3	105.1	97.1	45° → 175°
5a/97	248,501	1,452,629	36.0	105.1	69.1	Vertical
6/97	248,551	1,452,798	30.0	48.7	18.7	Vertical
Total			**192.1**			

7.4.1 Discussion of Diamond Drilling Results

All holes (with the exception of DDH 6/97) intersected greywacke exhibiting varying degrees of weathering for their entire length. The quality of rock intersected in each drill hole is summarised in the table below.

Hole	Overburden (m)	Highly Weathered (m)	Moderately Weathered (m)	Slightly Weathered (m)	Fresh Greywacke (m)	Total Length (m)
1/97	0.5	5.5	6.0	11.8	6.2 +	30
2/97	0.4	2.7	2.35	6.55	19.8 +	30
3/97	0.4	1.3	10.35	1.15	-	13.2
3a/97	0.4	3.3	-	23.2	14.7	41.8
5/97	0.5	5.5	1.9	3.4	-	11.3
5a/97	0.5	2.5	3.0	21.8	8.9	36.0
6/97	0.0	-	-	13.4	16.6	30.0

This table shows that the depth of weathering, although variable, is almost totally confined to the upper 12 metres of the deposit. Below this level the rock is of aggregate quality.

DDH 6/97 was drilled into the floor of the current pit. This hole intersected the overlying meta-sediment unit before entering greywacke at 4.6 metres depth. The contact between the two units was intersected and preserved in the core and confirmed the contact to dip at approximately 45°. Fresh aggregate quality greywacke was intersected for the entire length of DDH 6/97 (below 4.6 metres), to a depth of 30 metres. This hole confirmed the presence of premium quality rock to at least two 15 metre bench levels below the existing quarry floor.

Visual observations of the fresh core confirm this material to be of similar quality to that hard rock currently quarried. Five lengths of core were taken for petrographic analysis from varying depths in the deposit.

Petrographic Sample Location	Depth of Sample (m)
DDH 2/97	28.6 to 28.7
DDH 3a/97	14.85 to 14.95
DDH 3a/97	37.85 to 37.95
DDH 5a/97	30.4 to 30.5
DDH 6/97	24.0 to 24.1

Petrographic analysis confirmed the rock to be suitable for all engineering purposes with the caution that there is a predicted potential for mild or slow deleterious alkali-silica reactivity in concrete due to the perceived potential for reactivity of finely microcrystalline quartz of devitrification origin within the silty, vitroclastic matrix and within devitrified lithic fragments of rock. The petrological composition of the greywacke is dealt with more fully in Section 5.0 – Rock Type and Site Geology.

Drill logs and photographs of the core are given in Appendix 3.

8.0 Reserves

Reserves in Jandra quarry were calculated using SURPAC mining software using digital topographic data supplied by Qasco from aerial photography dated 4 October 1994. The following assumptions were made based on consent conditions dated 2 June 1986 and 28 February 1992 and the respective EIS's and the findings of this geological exploration programme.

* Quarrying maintains a 75 metre stand-off from the western fence.
* Face heights are 12 metres, berms 10 metres wide and the angle of batter of quarry faces is 75°.
* Benches are pushed to the limit in the area of consent.
* Overburden is on average 1.0 metres thick (based on trench observations).
* The first 10 metres (the uppermost bench levels) is suitable only for use in pavement materials.
* All subsequent bench levels contains quality hard rock..
* The density of the rock is 2.65 t/m^3.
* The base level of quarrying in the consented area is RL50.
* The base level proven for quarry development is RL26 metres, however, geological evidence suggests the resource continues below this level.

An outline of the quarry down to RL26 is shown on Figure 09-03-0022. Rock reserves are as follows.

	Overburden (m^3)	**Road Gravel Quality (m^3)**	**Aggregate Quality (m^3)**	**Aggregate Quality (tonnes)**	**Status**
Existing Consent (to RL 50)	19,300	80,000	335,283	888,500	Proven with consent
Extension Area (to RL50)	92,100	921,000	1,162,900	3,081,685	Proven no consent
Between RL 50 and RL 38	-	-	767,395	2,033,596	Proven no consent
Between RL 38 and RL 26	-	-	678,632	1,798,374	Proven no consent
Between RL 26 and RL 14	-	-	409,092	1,084,093	Probable no consent
TOTAL	**111,400**	**1,001,000**	**3,053,302**	**8,886,248** *	

*Note: Should Ralph Williams' land be acquired, up to 1,000,000 tonnes of rock could be made available through a quarry extension to the west of the existing pit.

9.0 Conclusions

- Geological exploration has identified a large resource of greywacke (up to 8.9 million tonnes) suitable for all engineering applications.
- Quantitative tests are required to determine the rock's potential reactivity
- The north-western contact of the greywacke with the overlying sedimentary unit has not been fully identified – further percussion drilling in this area is required to better delineate the contact.
- The overlying meta-sedimentary unit is considered suitable for blending in road-base materials to improved plasticity and workability. Materials testing of this rock is required to determine the optimum blending ratios for varying product types.
- Rock reserves for the quarry extension area down to RL26 are in the order of: 92,100 m^3 of overburden, 921,000 m^3 of road pavement quality (weathered) greywacke and ***7,713,300 tonnes*** of fresh greywacke.
- Up to 1,000,000 tonnes of rock could be made available through a quarry extension to the west of the existing pit should Ralph Williams' land be acquired

10.0 Recommendations

- Carry out additional percussion drilling to determine the north-western contact of the greywacke with the overlying meta-sediment unit.
- Carry out rock quality determination on the overlying meta-sediment (currently exposed in the pit) and determine its usefulness for blending into road pavement products.
- Proceed with a development application to gain approval for a quarry extension to the east with an additional two 15 metre benches beneath the existing quarry floor.
- Acquire Williams' land to the west.

Ian Stenhouse
Quarry Support Geologist

FILE: IS\JANDRA\Geology Report 1.doc

APPENDIX 1

Petrographic Analyses

Geochempet Services

PETROLOGICAL and GEOCHEMICAL CONSULTANTS REGISTERED IN QUEENSLAND

Principal: A.S. Joyce B.Sc. (Hons), Ph.D.
62 Kings Lane
MALENY Q 4552

Telephone: (07) 5494 3288

Fax: (07) 5494 3288

PETROGRAPHIC REPORT
ON FIVE DRILL CORE SAMPLES
RELATING TO THE JANDRA QUARRY
NEAR TAREE, NSW

prepared for

CSR CONSTRUCTION MATERIALS

Invoice No: 036876

Ref: I. Stenhouse, Parramatta

Issued by

A.S. Joyce B.Sc. (Hons), Ph.D.
21st April, 1997.

GEOCHEMPET SERVICES, MALENY

Sample Label : Jandra DDH 2/97 28.6 - 28.7 m

Identification : Greywacke

Work Requested : Petrographic report and comment on suitability for use in sealing aggregate, use in the marine environment and use in concrete

Description :

The sample is a drill core specimen of hard, robust, medium grey, non-porous, unweathered rock, displaying several lithic pebbles (ranging up to 13 mm in intermediate diameter) and numerous smaller rock and mineral fragments dispersed through a finely fragmental matrix. One end of the core is terminated by a thinly calcite-coated joint. Sparse specks of pyrite can be discerned.

In thin section the rock displays moderately sorted, angular to rounded lithic and mineral clasts of sand and much less commonly pebble size dispersed abundantly through a muddy matrix which displays silt-sized mineral fragments and devitrified former vitric shards.

The lithic fragments are of varied type, including porphyritic acid volcanic rock and devitrified welded tuff (collectively about 12% of the rock) and intermediate volcanic rock (chloritized andesite and/or trachyte, amounting to about 4% of the rock). The mineral clasts are plagioclase (4%), quartz (6%) and sparse grains of opaque oxide and inferred mafic silicates (now completely altered to various combinations of chlorite, sphene, calcite and epidote). Within the muddy matrix there are silt grains of quartz and feldspar and numerous ghosts of simple curved and platy vitric shards (commonly about 0.05 mm long), now devitrified to finely microcrystalline feldspars and quartz (finer than 0.01 mm); finer components have recrystallized to very fine chlorite and epidote. There are also some specks of calcite, sparse wisps of black carbonaceous matter and a few fine pyrite grains and aggregates present.

An approximate mineralogical mode, based on a brief count of 100 widely spaced points in thin section, is:

65%	finely microcrystalline feldspars and quartz (of devitrification origin)
16%	feldspar as silt, sand and finely crystalline grains
6%	quartz as silt, sand and finely crystalline grains
7%	chlorite
4%	epidote
2%	calcite
<1%	opaque oxide
<1%	carbonaceous matter
<1%	pyrite

2/...

Comments and Interpretations :

This sample from 28.6 to 28.7 m in DDH 2/97 at the Jandra Quarry is considered to consist of greywacke, an immature sedimentary rock generated by erosion, rapid transport and only poor sorting of a mixture of detritus drawn from a range of acid to intermediate volcanic and tuffaceous sources. Diagenetic fine devitrification of formerly glassy components, coupled with recrystallization of muddy components to chlorite and epidote has indurated the rock, rendering it robust and non-porous. Texturally and compositionally the greywacke has similarities to reworked tuff.

For engineering purposes the rock may be summarised as unweathered, hard, strong, non-porous, indurated greywacke. It is predicted to be durable. It is predicted to have potential for mild or slow deleterious alkali-silica reactivity.

The rock is predicted to be suitable for use for use in sealing aggregate and suitable for use in the marine environment (presumably as marine armour and/or fill).

The rock is predicted to be physically quite suitable for use in concrete, but appropriate design precautions are recommended to take account of its predicted potential for mild or slow deleterious alkali-silica reactivity in concrete. The perceived potential for reactivity relates to the presence of an estimated 16% of finely microcrystalline quartz of devitrification origin (within the silty, vitroclastic matrix and within devitrified lithic fragments of tuff).

Free Silica Content :

The rock carries about 22% of free silica: 6% is plainly identifiable as quartz and an estimated additional 16% of free silica is present as finely microcrystalline quartz of devitrification origin.

GEOCHEMPET SERVICES, MALENY

Sample Label : Hole 3A/97 14.85 m

Identification : Greywacke

Work Requested : Petrographic report and comment on suitability for use in sealing aggregate, use in the marine environment and use in concrete

Description :

The sample is a drill core specimen of hard, robust, medium dark grey, non-porous rock, displaying coarse sand clasts dispersed through a finer fragmental matrix. Both ends of the core are terminated by brown, iron-stained, weathered joints, but the bulk of the specimen is unweathered.

In thin section the rock displays moderately sorted, angular to rounded lithic and mineral clasts of sand size (ranging up to about 3 mm) dispersed abundantly through a muddy matrix which displays silt-sized mineral fragments and devitrified former vitric shards.

The lithic fragments are of varied type, including porphyritic acid volcanic rock and devitrified welded tuff (collectively about 12% of the rock) and intermediate volcanic rock (chloritized and in some cases hematized andesite and/or trachyte, amounting to about 1% of the rock). The mineral clasts are plagioclase (11%), quartz (7%) and sparse grains of opaque oxide and inferred mafic silicates (now completely altered to various combinations of chlorite, sphene, calcite and epidote). Within the muddy matrix there are silt grains of quartz and feldspar and numerous ghosts of simple curved and platy vitric shards (commonly about 0.05 mm long), now devitrified to finely microcrystalline feldspars and quartz (finer than 0.01 mm); finer components have recrystallized to very fine chlorite and epidote. There are also some specks of calcite, sparse wisps of black carbonaceous matter and a few fine pyrite grains (some now oxidized) and aggregates present.

An approximate mineralogical mode, based on a brief count of 100 widely spaced points in thin section, is:

69%	finely microcrystalline feldspars and quartz (of devitrification origin)
13%	feldspar as silt, sand and finely crystalline grains
10%	quartz as silt, sand and finely crystalline grains
8%	chlorite
<1%	epidote
<1%	calcite
<1%	opaque oxide
<1%	carbonaceous matter
<1%	pyrite and derived iron oxides

2/...

Comments and Interpretations :

This sample from 14.85 m in Hole 3A/97 is considered to consist of greywacke, an immature sedimentary rock generated by erosion, rapid transport and only poor sorting of a mixture of detritus drawn from a range of acid to intermediate volcanic and tuffaceous sources. Diagenetic fine devitrification of formerly glassy components, coupled with recrystallization of muddy components to chlorite and epidote has indurated the rock, rendering it robust and non-porous. Texturally and compositionally the greywacke has similarities to reworked tuff.

For engineering purposes the rock may be summarised as hard, strong, non-porous, indurated greywacke with weathering essentially confined to the surfaces of joints. The rock is predicted to be durable. It is predicted to have potential for mild or slow deleterious alkali-silica reactivity.

The rock is predicted to be suitable for use for use in sealing aggregate and suitable for use in the marine environment (presumably as marine armour and/or fill). The presence of weathered joints might limit the size of available durable boulders for use as armour.

The rock is predicted to be physically quite suitable for use in concrete, but appropriate design precautions are recommended to take account of its predicted potential for mild or slow deleterious alkali-silica reactivity in concrete. The perceived potential for reactivity relates to the presence of an estimated 17% of finely microcrystalline quartz of devitrification origin (within the silty, vitroclastic matrix and within devitrified lithic fragments of tuff).

Free Silica Content :

The rock carries about 27% of free silica: 10% is plainly identifiable as quartz and an estimated additional 17% of free silica is present as finely microcrystalline quartz of devitrification origin.

APRIL, 1997

GEOCHEMPET SERVICES, MALENY

Sample Label : Hole 3A/97 37.85 m

Identification : Greywacke

Work Requested : Petrographic report and comment on suitability for use in sealing aggregate, use in the marine environment and use in concrete

Description :

The sample is a drill core specimen of hard, robust, medium dark grey, unweathered, non-porous rock, displaying a few coarse sand clasts and fewer pebbles (up to 15 mm) dispersed through a finer fragmental matrix. One very thin, light grey fracture vein is apparent in the 130 mm length of core.

In thin section the rock displays moderately sorted, angular to rounded lithic and mineral clasts of sand size and a few small pebbles dispersed through a muddy matrix which displays silt-sized mineral fragments and devitrified former vitric shards.

The lithic fragments are of varied type, including porphyritic acid volcanic rock and devitrified welded tuff (collectively about 14% of the rock) and intermediate volcanic rock (chloritized andesite and/or trachyte, amounting to about 4% of the rock). The mineral clasts are plagioclase (6%), quartz (1%) and sparse grains of opaque oxide and inferred mafic silicates (now completely altered to various combinations of chlorite, sphene, calcite and epidote). Within the muddy matrix there are silt grains of quartz and feldspar and numerous ghosts of simple curved and platy vitric shards (commonly about 0.05 mm long), now devitrified to finely microcrystalline feldspars and quartz (finer than 0.01 mm); finer components have recrystallized to very fine chlorite and epidote. There are also some specks of calcite, sparse wisps of black carbonaceous matter and a few fine pyrite grains and aggregates present. A fracture vein (about 0.1 mm wide) contains calcite and some anisotropic zeolite.

An approximate mineralogical mode, based on a brief count of 100 widely spaced points in thin section, is:

72%	finely microcrystalline feldspars and quartz (of devitrification origin)
10%	feldspar as silt, sand and finely crystalline grains
5%	quartz as silt, sand and finely crystalline grains
10%	chlorite
2%	epidote
1%	calcite
<1%	opaque oxide
<1%	carbonaceous matter
<1%	pyrite

2/...

Comments and Interpretations :

This sample from 37.85 m in Hole 3A/97 is considered to consist of greywacke, an immature sedimentary rock generated by erosion, rapid transport and only poor sorting of a mixture of detritus drawn from a range of acid to intermediate volcanic and tuffaceous sources. Diagenetic fine devitrification of formerly glassy components, coupled with recrystallization of muddy components to chlorite and epidote has indurated the rock, rendering it robust and non-porous. Texturally and compositionally the greywacke has similarities to reworked tuff.

For engineering purposes the rock may be summarised as unweathered hard, strong, non-porous, indurated greywacke. The rock is predicted to be durable. It is predicted to have potential for mild or slow deleterious alkali-silica reactivity.

The rock is predicted to be suitable for use for use in sealing aggregate and suitable for use in the marine environment (presumably as marine armour and/or fill). The supplied specimen carries a single zeolitic fracture vein which could be expected to part upon exposure to moisture changes.

The rock is predicted to be physically quite suitable for use in concrete, but appropriate design precautions are recommended to take account of its predicted potential for mild or slow deleterious alkali-silica reactivity in concrete. The perceived potential for reactivity relates to the presence of an estimated 18% of finely microcrystalline quartz of devitrification origin (within the silty, vitroclastic matrix and within devitrified lithic fragments of tuff).

Free Silica Content :

The rock carries about 23% of free silica: 5% is plainly identifiable as quartz and an estimated additional 18% of free silica is present as finely microcrystalline quartz of devitrification origin.

APRIL, 1997

GEOCHEMPET SERVICES, MALENY

Sample Label : Jandra DDH 5a/97 30.4 - 30.5 m

Identification : Greywacke

Work Requested : Petrographic report and comment on suitability for use in sealing aggregate, use in the marine environment and use in concrete

Description :

The sample is a drill core specimen of hard, robust, medium grey, non-porous, unweathered rock, displaying several lithic pebbles (ranging up to 10 mm in intermediate diameter) and numerous smaller rock and mineral fragments dispersed through a finely fragmental matrix. Both ends of the core are terminated by a joint, thinly coated with pinkish zeolite and specks of pyrite.

In thin section the rock displays moderately sorted, angular to rounded lithic and mineral clasts of sand and much less commonly pebble size dispersed abundantly through a muddy matrix which displays silt-sized mineral fragments and devitrified former vitric shards.

The lithic fragments are of varied type, including porphyritic acid volcanic rock and devitrified welded tuff (collectively about 13% of the rock) and intermediate volcanic rock (chloritized and in some cases hematized andesite and/or trachyte, amounting to about 2% of the rock). The mineral clasts are plagioclase (6%), quartz (3%) and sparse grains of opaque oxide and inferred mafic silicates (now completely altered to various combinations of chlorite, sphene, calcite and epidote). Within the muddy matrix there are silt grains of quartz and feldspar and numerous ghosts of simple curved and platy vitric shards (commonly about 0.05 mm long), now devitrified to finely microcrystalline feldspars and quartz (finer than 0.01 mm); finer components have recrystallized to very fine chlorite and epidote. There are also some specks of calcite, sparse wisps of black carbonaceous matter and a few fine pyrite grains and aggregates present. A set of quite thin fracture veins (0.01 to 0.1 mm wide and spaced 0.6 to at least 50 mm apart) contains some anisotropic zeolite.

An approximate mineralogical mode, based on a brief count of 100 widely spaced points in thin section, is:

58%	finely microcrystalline feldspars and quartz (of devitrification origin)
22%	feldspar as silt, sand and finely crystalline grains
8%	quartz as silt, sand and finely crystalline grains
8%	chlorite
2%	epidote
1%	calcite
1%	zeolite
<1%	opaque oxide
<1%	carbonaceous matter
<1%	pyrite

2/...

Comments and Interpretations :

This sample from 30.4 to 30.5 m in DDH 5A/97 at the Jandra Quarry is considered to consist of greywacke, an immature sedimentary rock generated by erosion, rapid transport and only poor sorting of a mixture of detritus drawn from a range of acid to intermediate volcanic and tuffaceous sources. Diagenetic fine devitrification of formerly glassy components, coupled with recrystallization of muddy components to chlorite and epidote has indurated the rock, rendering it robust and non-porous. Texturally and compositionally the greywacke has similarities to reworked tuff.

For engineering purposes the rock may be summarised as unweathered, hard, strong, non-porous, indurated greywacke. It is predicted to be durable. It is predicted to have potential for mild or slow deleterious alkali-silica reactivity.

The rock is predicted to be suitable for use for use in sealing aggregate.

The rock is predicted to be suitable for use in the marine environment as fill, but the presence of some zeolite-filled fracture veins may limit the size of durable boulders for use as marine armour. The zeolitic veins are expected to part upon exposure to moisture changes (marine or fresh water).

The rock is predicted to be physically quite suitable for use in concrete, but appropriate design precautions are recommended to take account of its predicted potential for mild or slow deleterious alkali-silica reactivity in concrete. The perceived potential for reactivity relates to the presence of an estimated 14% of finely microcrystalline quartz of devitrification origin (within the silty, vitroclastic matrix and within devitrified lithic fragments of tuff).

Free Silica Content :

The rock carries about 22% of free silica: 8% is plainly identifiable as quartz and an estimated additional 14% of free silica is present as finely microcrystalline quartz of devitrification origin.

GEOCHEMPET SERVICES, MALENY

Sample Label : Jandra DDH 6/97 24.0 - 24.1 m (Base of Quarry)

Identification : Greywacke

Work Requested : Petrographic report and comment on suitability for use in sealing aggregate, use in the marine environment and use in concrete

Description :

The sample is a drill core specimen of hard, robust, medium grey, non-porous, unweathered rock, displaying several lithic pebbles (ranging up to 20 mm in intermediate diameter) and numerous smaller rock and mineral fragments dispersed through a finely fragmental matrix. The ends of the 150 mm length of core display thin joint coatings of calcite and a few specks of pyrite.

In thin section the rock displays moderately sorted, angular to rounded lithic and mineral clasts of sand and much less commonly pebble size dispersed abundantly through a muddy matrix which displays silt-sized mineral fragments and devitrified former vitric shards.

The lithic fragments are of varied type, including porphyritic acid volcanic rock and devitrified welded tuff (collectively about 14% of the rock) and intermediate volcanic rock (chloritized and in some cases hematized andesite and/or trachyte, amounting to about 5% of the rock). The mineral clasts are plagioclase (6%), quartz (5%) and sparse grains of opaque oxide and inferred mafic silicates (now completely altered to various combinations of chlorite, sphene, calcite and epidote). Within the muddy matrix there are silt grains of quartz and feldspar and numerous ghosts of simple curved and platy vitric shards (commonly about 0.05 mm long), now devitrified to finely microcrystalline feldspars and quartz (finer than 0.01 mm); finer components have recrystallized to very fine chlorite and epidote. There are also some specks of calcite, sparse wisps of black carbonaceous matter and a few pyrite grains present. Calcite also forms a few vein thin, tight fracture veins.

An approximate mineralogical mode, based on a brief count of 100 widely spaced points in thin section, is:

62%	finely microcrystalline feldspars and quartz (of devitrification origin)
14%	feldspar as silt, sand and finely crystalline grains
8%	quartz as silt, sand and finely crystalline grains
9%	chlorite
4%	epidote
3%	calcite
<1%	opaque oxide
<1%	carbonaceous matter
<1%	pyrite

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<u>**Comments and Interpretations**</u> :

This sample from 24.0 to 24.1 m in DDH 6/97 at the Jandra Quarry is considered to consist of greywacke, an immature sedimentary rock generated by erosion, rapid transport and only poor sorting of a mixture of detritus drawn from a range of acid to intermediate volcanic and tuffaceous sources. Diagenetic fine devitrification of formerly glassy components, coupled with recrystallization of muddy components to chlorite and epidote has indurated the rock, rendering it robust and non-porous. Texturally and compositionally the greywacke has similarities to reworked tuff.

For engineering purposes the rock may be summarised as unweathered, hard, strong, non-porous, indurated greywacke. It is predicted to be durable. It is predicted to have potential for mild or slow deleterious alkali-silica reactivity.

The rock is predicted to be suitable for use for use in sealing aggregate and suitable for use in the marine environment (presumably as marine armour and/or fill).

The rock is predicted to be physically quite suitable for use in concrete, but appropriate design precautions are recommended to take account of its predicted potential for mild or slow deleterious alkali-silica reactivity in concrete. The perceived potential for reactivity relates to the presence of an estimated 15% of finely microcrystalline quartz of devitrification origin (within the silty, vitroclastic matrix and within devitrified lithic fragments of tuff).

<u>**Free Silica Content**</u> :

The rock carries about 23% of free silica: 8% is plainly identifiable as quartz and an estimated additional 15% of free silica is present as finely microcrystalline quartz of devitrification origin.

APPENDIX 2

Percussion Drill Logs

Jandra Quarry - Percussion Drilling
17 December 1996

DRILL HOLE	DEPTH (metres)	GEOLOGICAL DESCRIPTION
PDH 1/96		**Hole deliberately drilled onto overlying meta-sediments at the northern end of Trench 2 on the haul road.**
	0.0 - 18.0	**META-SEDIMENTS** - Alternating layers of fine argillaceous material. Greywacke from 5.0 to 6.5 metres then returning to softer alternating sediments. Generally light grey to light brown, some darker grey units. Relatively rapid penetration. Dust is somewhat clayey.
PDH 2/96		**Drilled into greywacke, 80 metres up haul road from PDH 1/96**
	0.0 - 4.0	**HIGHLY WEATHERED GREYWACKE** - soft, light brown.
	4.0 - 7.0	**SLIGHTLY WEATHERED GREYWACKE** - hard, limonite staining on joint planes, remainder grey.
	7.0 - 10.8	**FRESH GREYWACKE** - hard, grey/blue, fresh homogeneous greywacke.
PDH 3/96		**Drilled at the top of the haul road, 30 metres north-east of the abandoned house.**
	0.0 - 3.0	**HIGHLY WEATHERED GREYWACKE** - rippable, whitish with minor brown and grey chips, relatively soft.
	3.0 - 10.0	**SLIGHTLY WEATHERED GREYWACKE** - hard, limonite staining on joint planes, remainder grey, minor soft zone 6.5 to 7.0 metres.
	10.0 - 18.0	**FRESH GREYWACKE** - hard, grey/blue, fresh homogeneous greywacke.
PDH 4/96		**Drilled along ridge-line next to the gate approximately 100 metres west of the electricians hut.**
	0.0 - 0.5	**SOIL OVERBURDEN**
	0.5 - 10.0	**HIGHLY WEATHERED GREYWACKE** alternations of rock and extremely weathered zones grading into **SLIGHTLY WEATHERED** greywacke at the base of this split revealed by limonite staining on joint planes.
	10.0 - 14.4	**FRESH GREYWACKE** - hard, grey/blue, fresh homogeneous greywacke.

APPENDIX 3

Diamond Drill Logs and Photographs

JANDRA QUARRY EXTENTION
DIAMOND DRILLING KEY

Highly to Moderately Weathered Greywacke

Slightly Weathered Greywacke

Fresh Greywacke

Overlying Meta-Sediments

Abbreviations

C.W.	=	completely weathered
H.W.	=	highly weathered
M.W.	=	moderately weathered
S.W.	=	slightly weathered
g.m.	=	groundmass
jnt	=	joint
mnr	=	minor

JANDRA QUARRY
DIAMOND DRILL HOLE LOCATIONS

Hole	Easting	Northing	Collar RL (m)	Base RL (m)	Length (m)	Bearing	Inclination
DDH 1-97	248,708	1,452,646	99.3	78.1	30.0	140°	45°
DDH 2-97	248,752	1,452,757	73.8	52.6	30.0	180°	45°
DDH 3-97	248,868	1,452,632	90.5	81.2	13.2	175°	45°
DDH 3a-97	248,868	1,452,632	90.5	48.7	41.8	Vertical	Vertical
DDH 4-97	Not drilled due to poor access.						
DDH 5-97	248,501	1,452,629	105.1	97.1	11.3	175°	45°
DDH 5a-97	248,501	1,452,629	105.1	69.1	36.0	Vertical	Vertical
DDH 6-97	248,551	1,452,798	48.7	18.7	30.0	Vertical	Vertical

Project Jandra Quarry - Quarry extension		**Drilling Company**: Groundtest	**Page No**: 1
Locality:	Jandra Quarry near Taree	**Logged**: Ian Stenhouse	**Hole No**: DDH 1/97
Co-ordinates	248,708 E, 1,452,646 N	**Datum:** AHD	**Core Size**: NQ_3
Bearing:	140°	**RL Collar**: 99.3 metres	**Commenced:** 22. 2.97
Inclination:	45°	**RL Bottom**: 78.1 metres	**Completed**: 25. 2.97
		Depth: 30.0 metres	Drilled near overburden stockpile.

% Core Recovery	Depth (m)	Drill Time	Weath- ering	Structure	Symbol	Geological Description
	0 - 1 - 2 - 3 - 4 - 5 -		H W. H W. M W.			**0 to 6.0 Greywacke** Core loss – rock rollering. Highly weathered, highly jointed.
	6 - 7 - 8 - 9 - 10 - 11 -		M W. M W.	6.4 - 6.5 core loss		**6.0 to 12.0 Greywacke:** Highly to moderately weathered, grey grey brown. Limonite on joint planes. Highly weathered zones: 6.0 to 6.4 (rubble), 8.7 to 9.0, 9.1 to 9.5, 9.6 - 10.4 and 11.3 to 11.8 Main body of core seems rather disrupted. Quartz veins along previous joints in rock.
	12 - 13 - 14 - 15 - 16 - 17 - 18 - 19 - 20 - 21 - 22 - 23 -		S W S W S W M W	Between 6 to 8 joints per metre from 12 to 17 metres Sub-vertical joint 16.8 to 17.6 metres. 18.0 to 19.5, 8 to 12 j/m 19.5 - 22.8, 6 to 10 j/m 22.8 - 23.3, 6 to 10 j/m		**12.0 to 23.8 Greywacke** Slightly weathered light grey greywacke from 12.0 m. Limonite along joint places. Minor foliation 15.2 - 15.6 m. Minor granitic lithic inclusions Limonite on joint planes. Light grey, very hard, very strong. Aggregate quality. Calcite along joint planes. 23.3 to 23.8, moderately weathered, moderately strong.
	24 - 25 - 26		Fresh	Foliated zone from 24.5 to 25.7 metres, moderate strength, jointing parallel to core axis.		**23.8 to 30.0 Greywacke**, fresh, light grey, very hard, very strong. Granitic lithic fragments near base of hole.

Project: Jandra Quarry - Quarry extension				**Hole Number:** DDH 1/97		**Page No:** 2
% Core Recovery	**Depth (m)**	**Drill Time**	**Weath-ering**	**Structure**	**Symbol**	**Geological Description**
	- 27 - 28 - 29 - 30		Fresh Fresh	Joints per metre, 8 to 10.		**23.8 to 30.0 Greywacke**, fresh, light grey, very hard, very strong. Granitic lithic fragments near Base of hole.
						End of hole at 30.0 metres.

Box	Length
Box 1	6 to 12 metres
Box 2	12 to 18 metres
Box 3	18 to 24 metres
Box 4	24 to 30 metres

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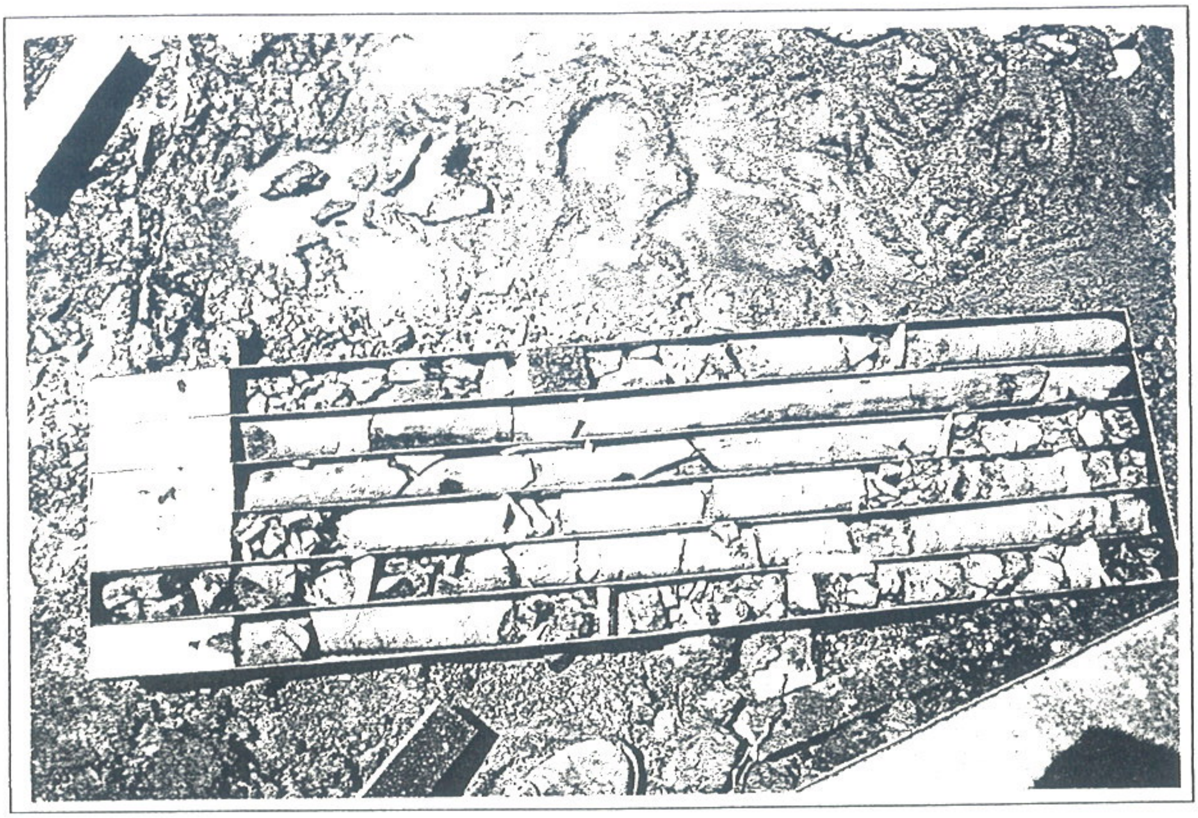
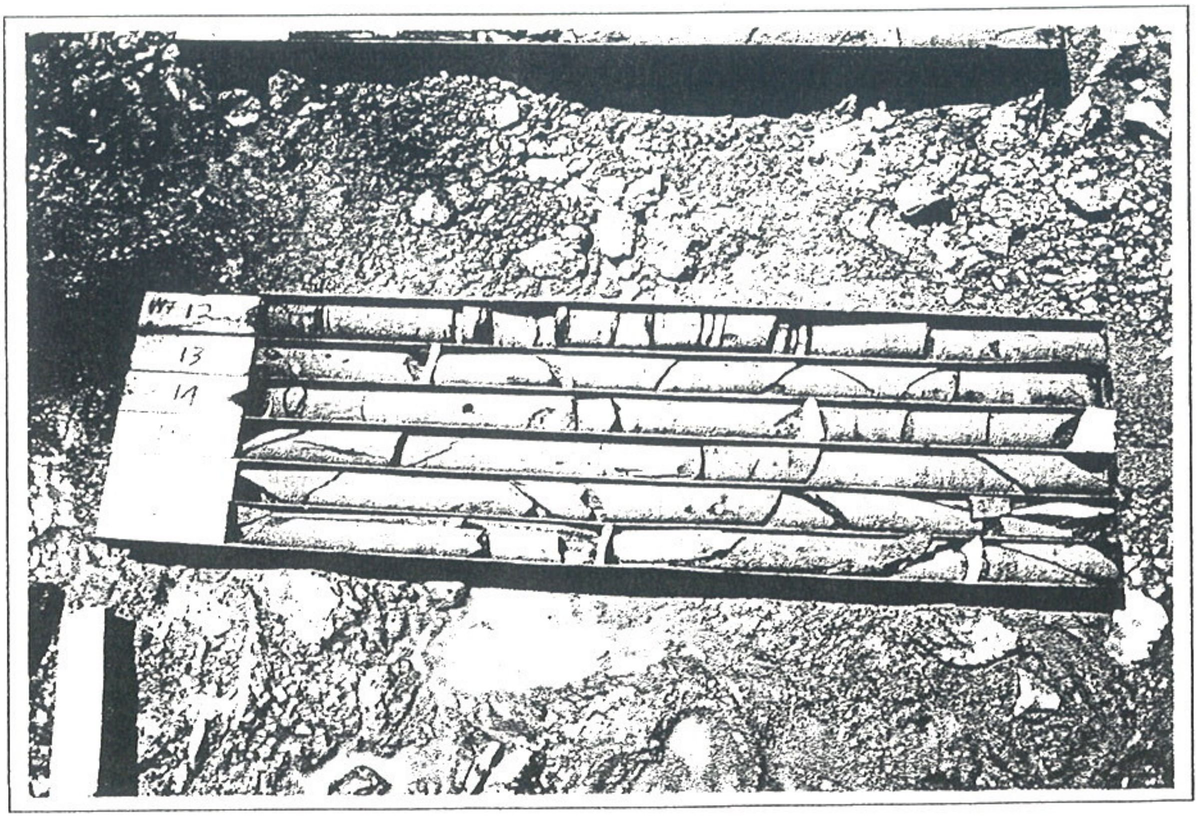
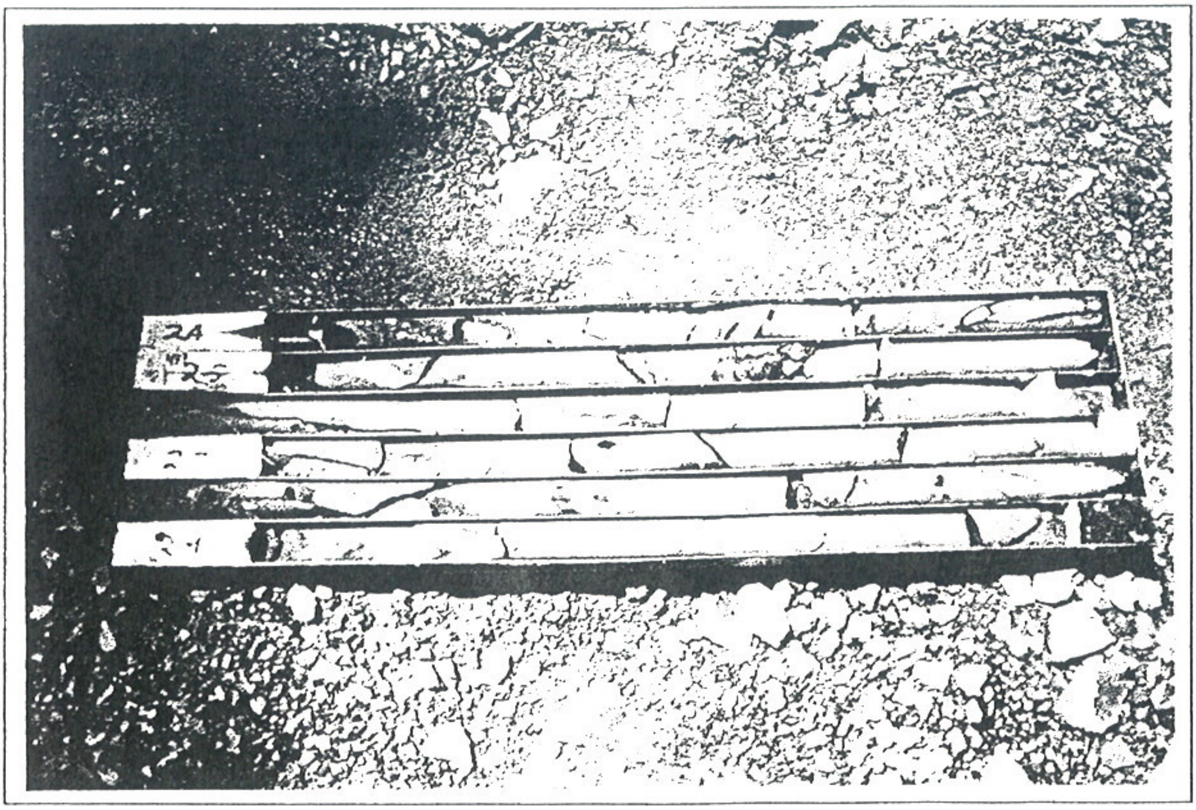


DDH 1/97 - Box 1 6.00 to 12.00 metres



DDH 1/97 - Box 2 12.00 to 18.00 metres

DDH 1/97 - Box 3 18.00 to 24.00 metres



DDH 1/97 - Box 4 24.00 to 30.00 metres

Project: Jandra Quarry - Quarry extension		Drilling Company: Groundtest	Page No: 1
Locality:	Jandra Quarry near Taree	Logged: Ian Stenhouse	Hole No: DDH 2/97 – Into Haul Road
Co-ordinates	248,752 E, 1,452,757 N	Datum: AHD	Core Size: NQ_3
Bearing:	180°	RL Collar: 73.8 metres	Commenced: 11.2.97
Inclination:	45°	RL Bottom: 52.6 metres	Completed: 17.2.97
		Length: 30.0 metres	

% Core Recovery	Depth (m)	Drill Time	Weathering	Structure	Symbol	Geological Description
	0 - 1 - 2 - 3 - 4 - 5		H.W. M.W.	Core Loss: 0 to 0.4, 0.8 to 1.0, 1.6 to 2.4, 3.2 to 3.5, 3.8 to 4.0, 4.45 to 4.9. Rotary drilled: 2.4 to 3.1.		**0 - 5.45 Greywacke:** Highly weathered to moderately weathered. Core is limonite stained, moderately strong, rubble.
	- 6 - 7 - 8 - 9 - 10		S W S W	Highly jointed. Joints per metre: 15 to 20		**5.45 to 10.2 Greywacke** Sl[illegible] eathered, grey to dark greywacke, fine grained, very hard, very strong, limonite on joint planes. 80 to 100% recovery
	- 11 - 12 - 13 - 14 - 15 - 16 - 17 - 18 - 19 - 20 - 21 - 22 - 23 - 24 - 25 - 26		Fresh Fresh Fresh	Joints cross core axis @ 45°		**10.2 to 30.0 Greywacke** Fresh, very hard, very strong, Calcite on joint planes, random lithic fragments. Homogeneous massive greywacke.

Project: Jandra Quarry - Quarry extension				Hole Number: DDH 2/97		Page No: 2
% Core Recovery	**Depth (m)**	**Drill Time**	**Weath-ering**	**Structure**	**Symbol**	**Geological Description**
	- 27 - 28 - 29 -		Fresh Fresh	Joints cross core axis @ 45° 28.6 to 28.7 sample taken for petrographic analysis.		**10.2 to 30.0 Greywacke:** Fresh, very hard, very strong, Calcite on joint planes, random lithic fragments. Homogeneous massive greywacke.
						End of Hole 30.0 metres

Box	Length
Box 1	0 to 6 metres
Box 2	6 to 12 metres
Box 3	12 to 18 metres
Box 4	18 to 24 metres
Box 5	24 to 30 metres

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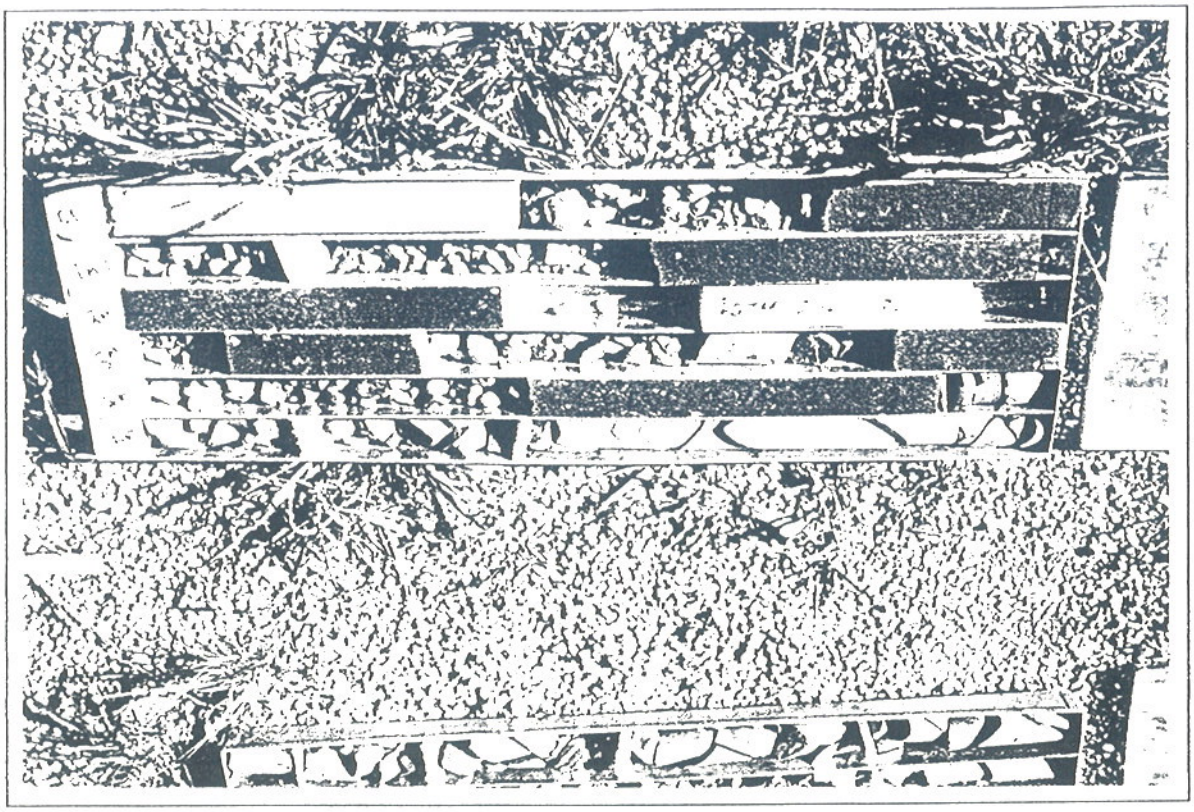
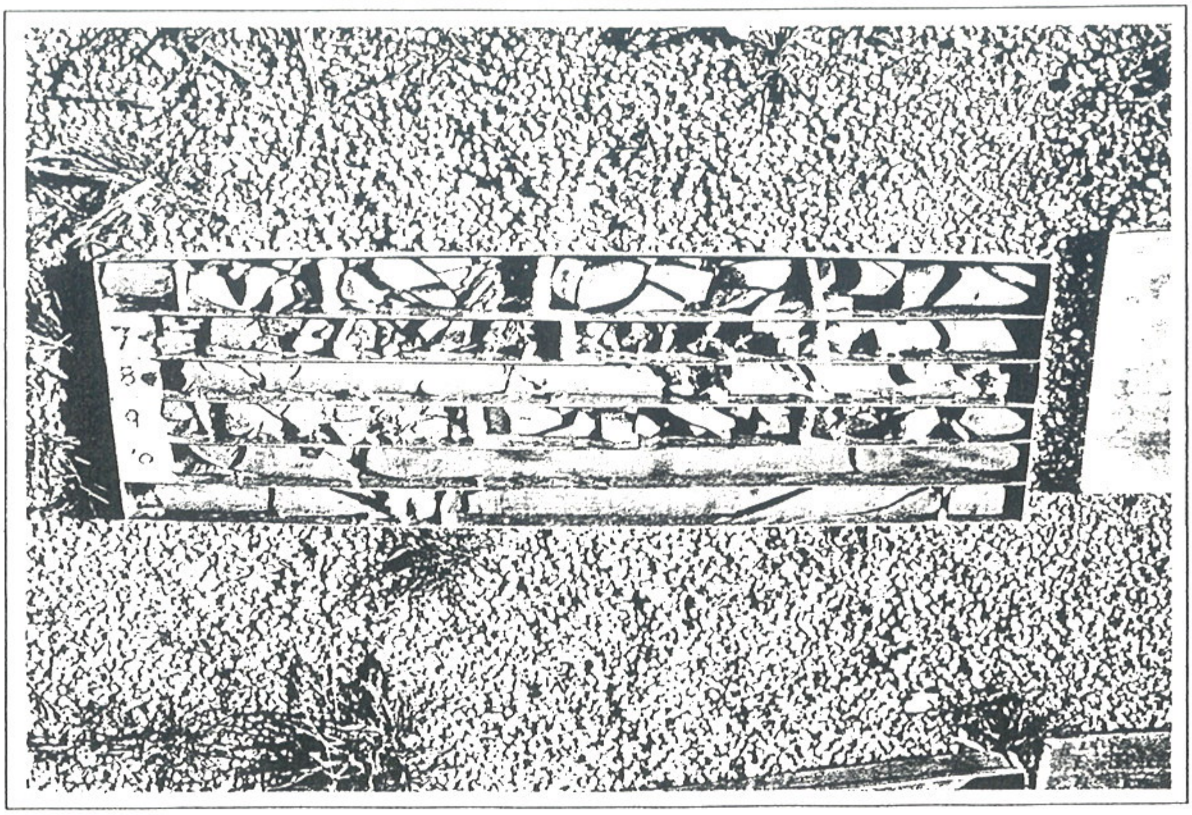
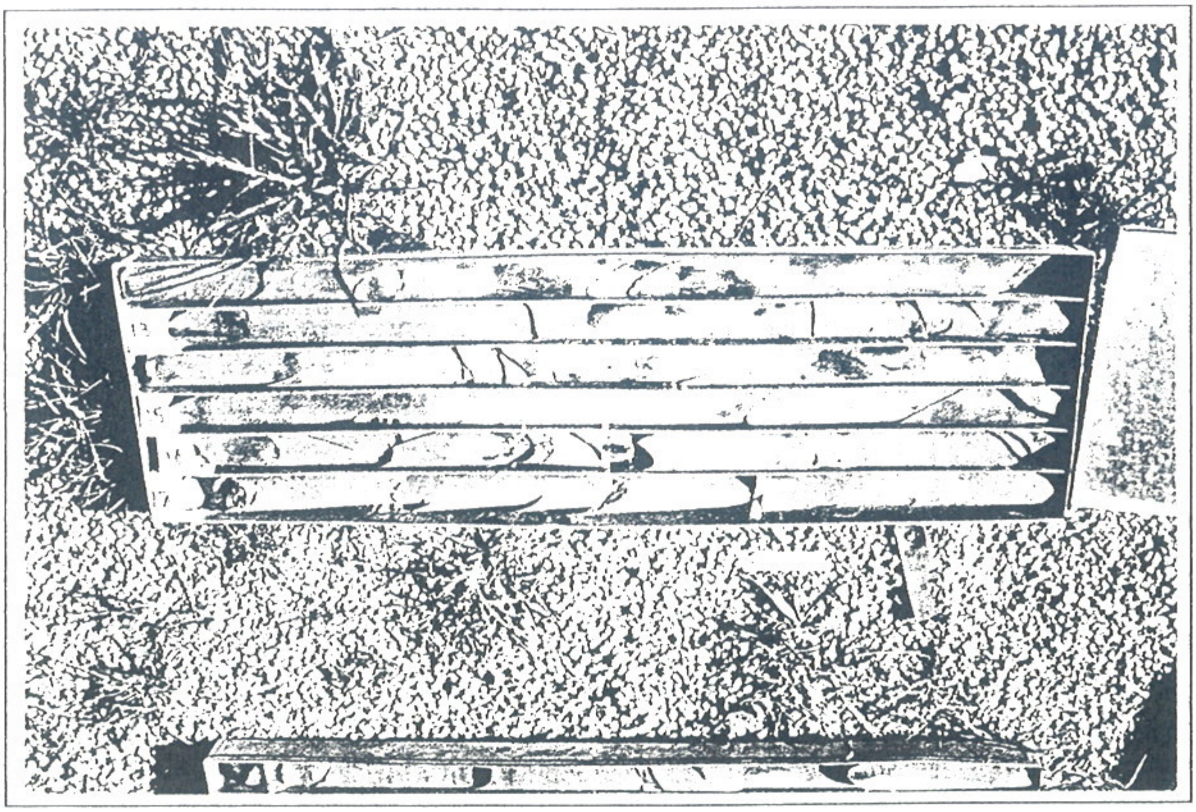


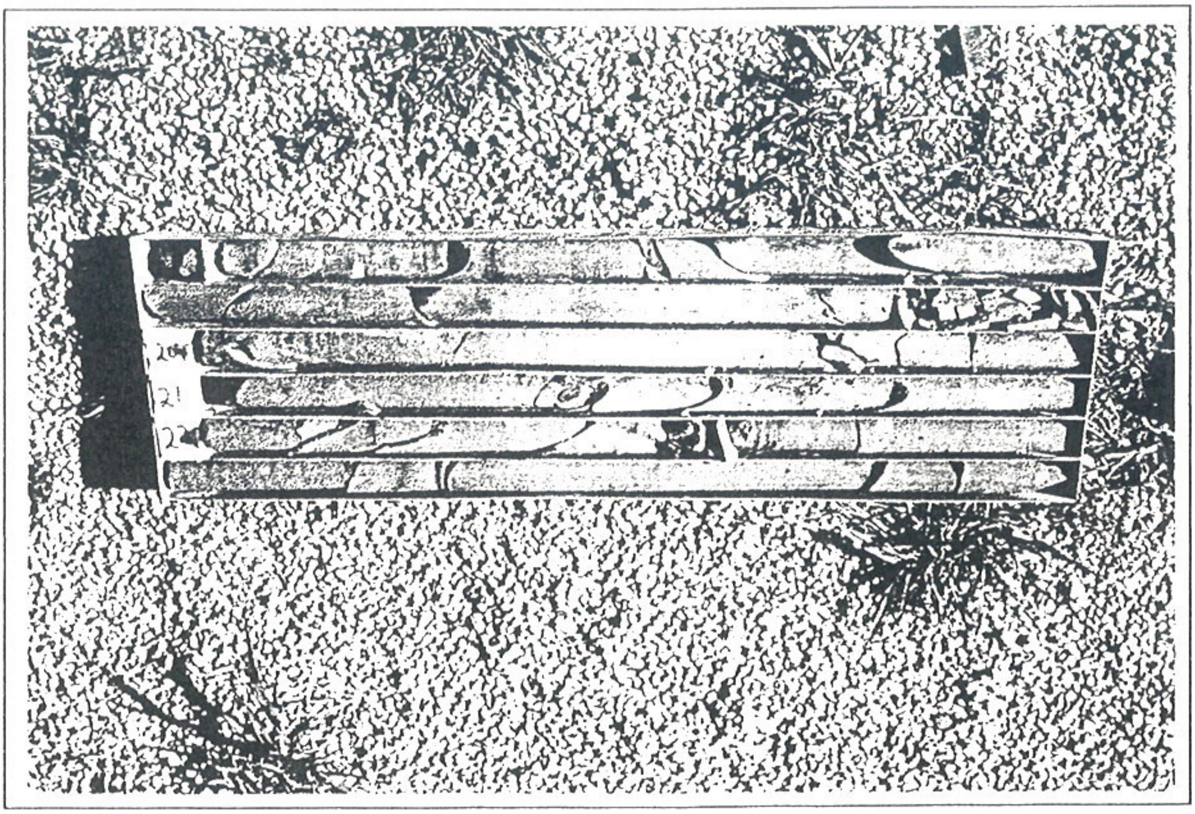
DDH 2/97 - Box 1 0.00 to 6.00 metres



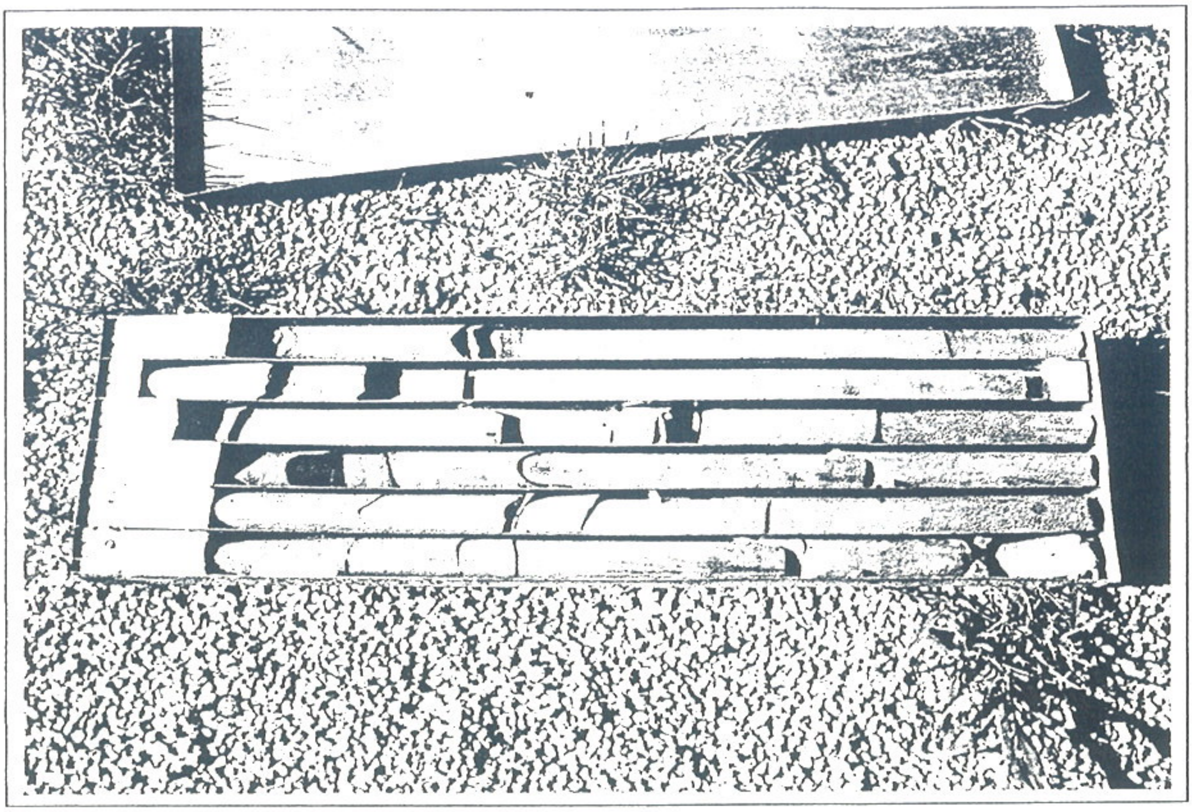
DDH 2/97 - Box 2 6.00 to 12.00 metres



DDH 2/97 - Box 3 12.00 to 18.00 metres



DDH 2/97 - Box 4 18.00 to 24.00 metres



DDH 2/97 - Box 5 24.00 to 30.00 metres

Project: Jandra Quarry - Quarry extension		**Drilling Company**: Groundtest	**Page No**: 1
Locality:	Jandra Quarry near Taree	**Logged**: Ian Stenhouse	**Hole No**: DDH 3/97
Co-ordinates	248,868 E, 1,452,632 N	**Datum**: AHD	**Core Size**: NQ_3
Bearing:	Vertical	**RL Collar**: 90.5 metres	**Commenced**: 19.2.97
Inclination:	Vertical	**RL Bottom**: 81.2 metres	**Completed**: 19.2.97
		Length: 13.2 metres	

% Core Recovery	Depth (m)	Drill Time	Weathering	Structure	Symbol	Geological Description
	0 - 1 -		H W			**0 - 1.7 Core Loss**
	2 -		S.W	Joints per metre, 10-12		**1.7 - 2.85 Greywacke** Slightly weathered, light grey, hard, strong.
	3 - 4 - 5 - 6 - 7 - 8 - 9 - 10 - 11 - 12 - 13		M.W	Core highly fractured like rubble. Highly fractured weathered zone Core loss 8.8 to 8.95m. 9.5 to 11.1 Core loss, rods jamming.		**2.85 - 13.2 Greywacke** Light grey, moderately strong, moderately weathered, limonite on joint planes, minor lithic granitic fragments
						End of Hole 13.2 metres.

Box	Length
Box 1	0 to 6 metres
Box 2	6 to 12 metres

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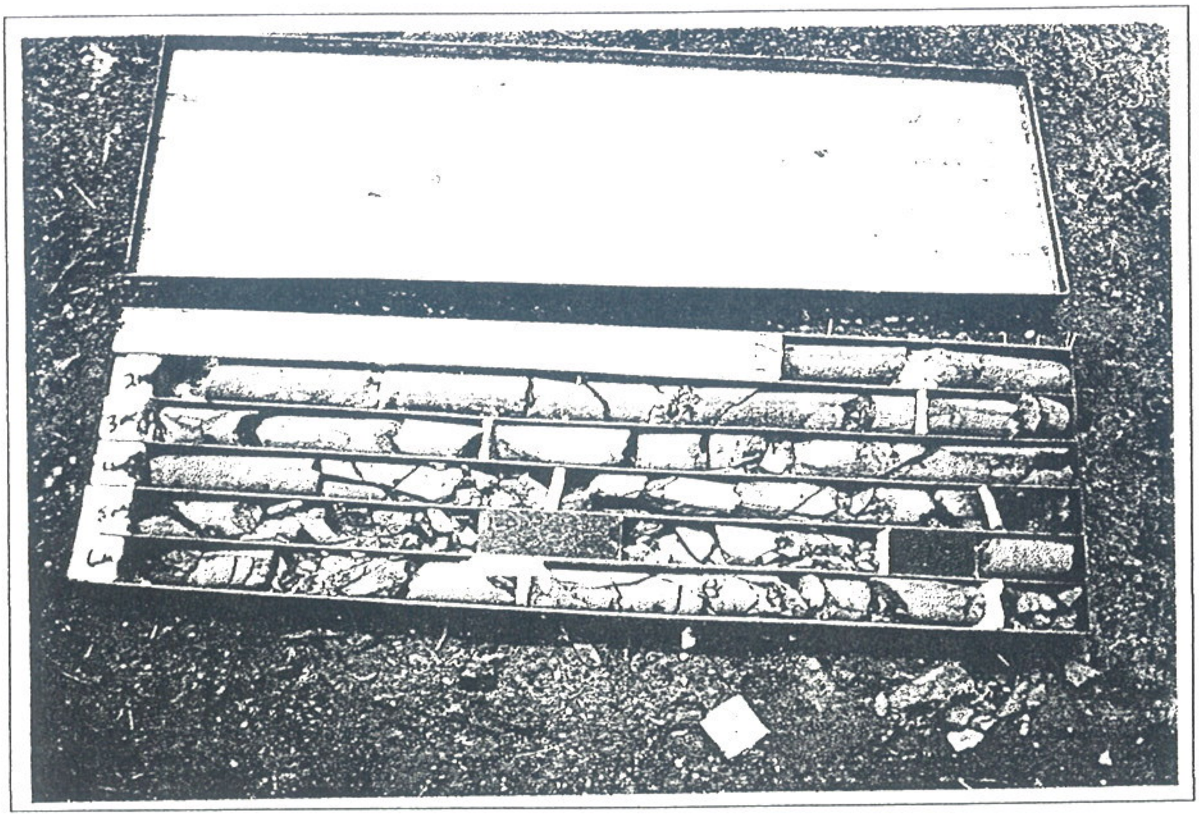
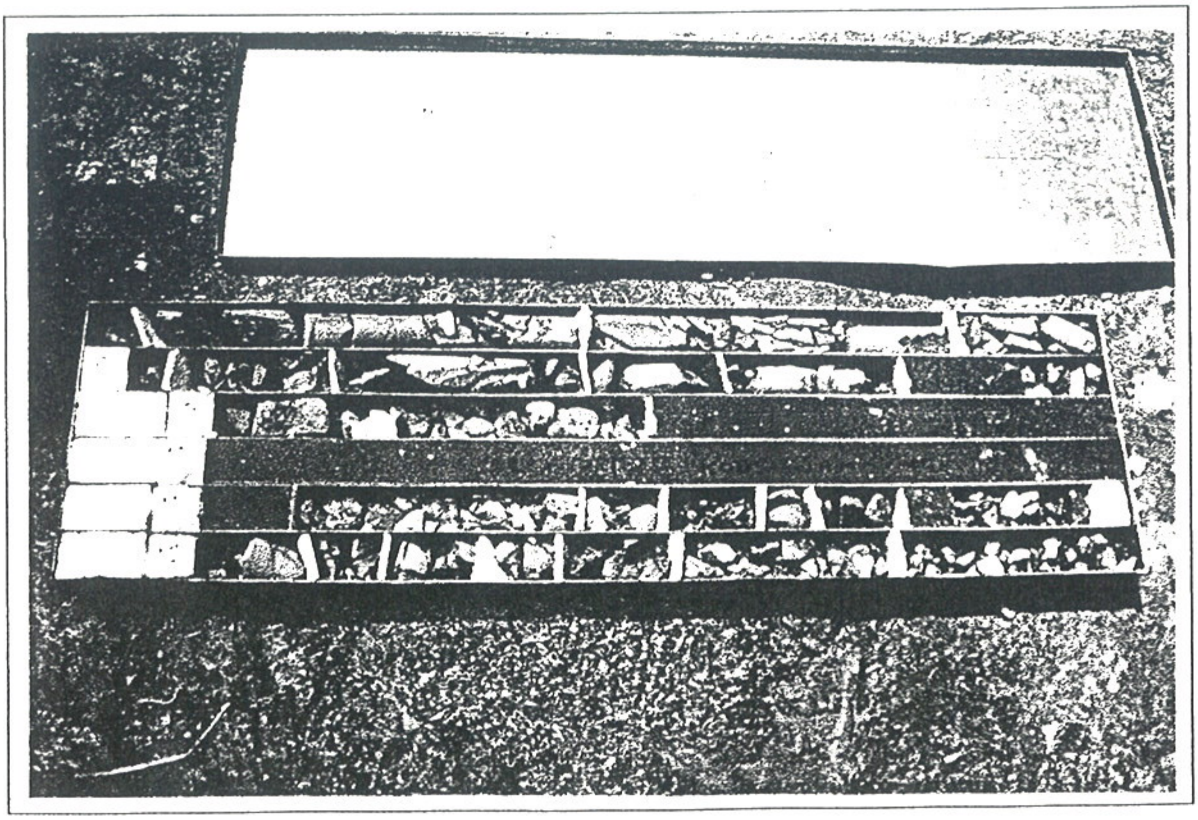


DDH 3/97 - Box 1 0.00 to 6.00 metres



DDH 3/97 - Box 2 6.00 to 12.00 metres

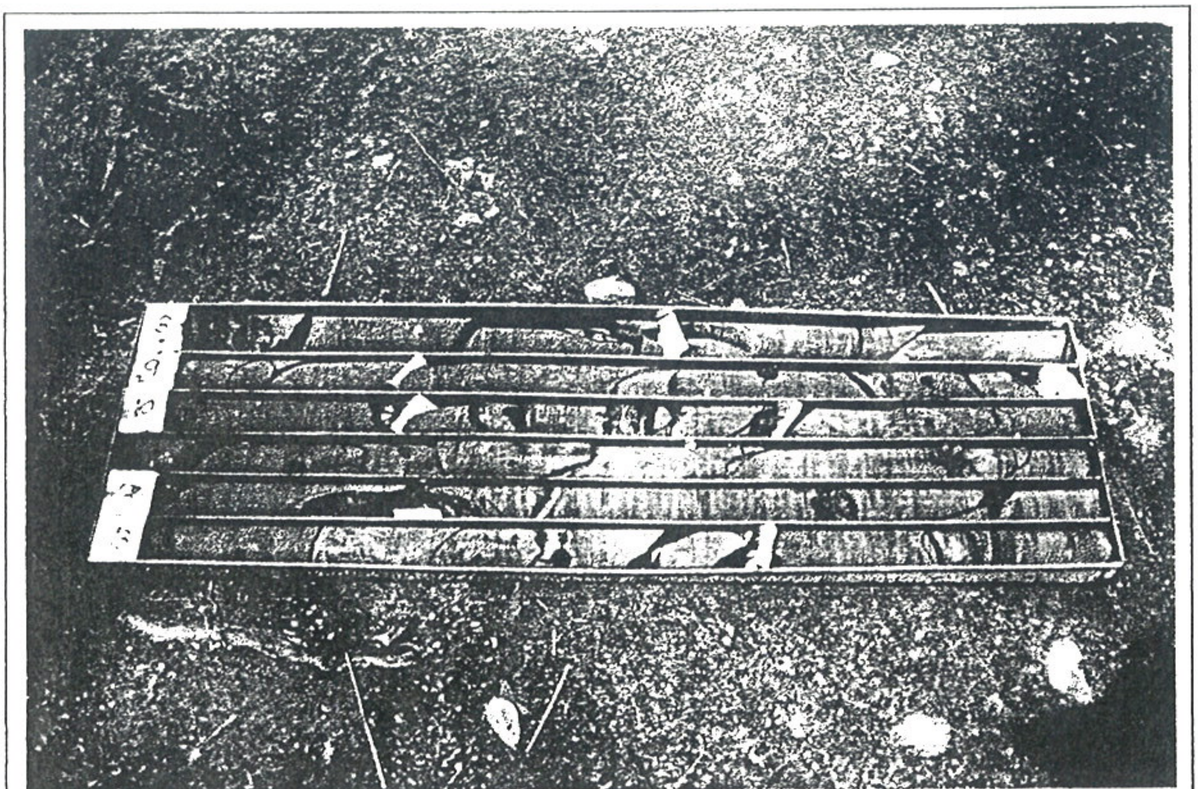
Project: Jandra Quarry - Quarry extension		Drilling Company: Groundtest	Page No: 1
Locality:	Jandra Quarry near Taree	Logged: Ian Stenhouse	Hole No: DDH 3a/97
Co-ordinates	248,868 E, 1,452,632 N	Datum: AHD	Core Size: NQ_3
Bearing:	Vertical	RL Collar: 90.5 metres	Commenced: 20.2.97
Inclination:	Vertical	RL Bottom: 48.7metres	Completed: 22.2.97
		Depth: 41.8 metres	

% Core Recovery	Depth (m)	Drill Time	Weathering	Structure	Symbol	Geological Description
	0					**0 - 2.2 Core Loss**
	-					
	1					
	-					
	2					
	-					**2.2 - 3.7 Greywacke** Highly weathered, light brown moderately weathered.
	3		H W	Joints per metre, 15 - 20		
	-					
	4					**3.9 - 27.1 Greywacke** Light grey, moderately strong, slightly weathered, limonite on joint planes, minor lithic granitic fragments , -
	-					
	5					
	-		S W	5 - 8 joints per metre		
	6					
	-					
	7					
	-					
	8					
	-					
	9					
	-					
	10					
	-					
	11					
	-					
	12		S W	5 - 8 joints per metre		
	-					
	13					
	-					
	14					
	-					
	15					
	-					
	16					
	-					
	17					
	-					
	18					
	-					
	19					
	-					
	20					
	-		S W	5 - 8 joints per metre		
	21					
	-					
	22					
	-					
	23					
	-					
	24					
	-					
	25		S W	25.1 to 26.1 core mildly foliated.		
	-					
	26					

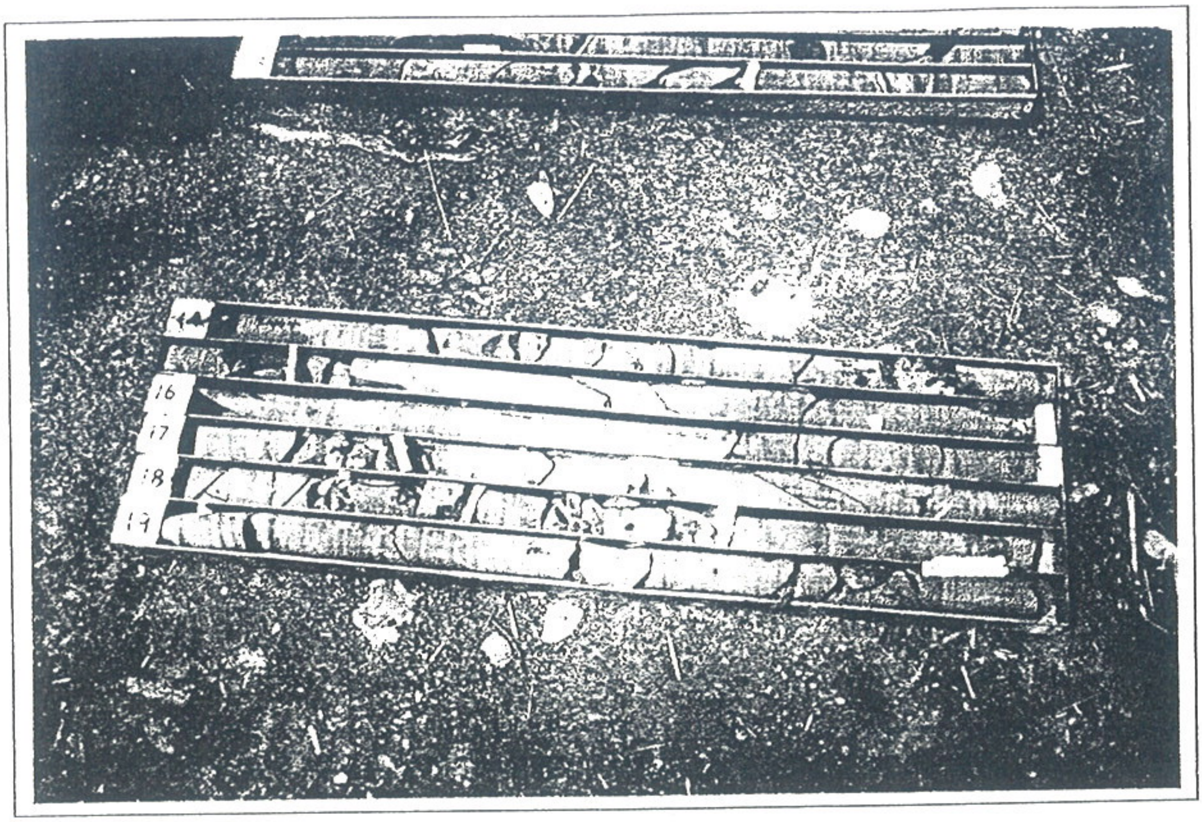
Project: Jandra Quarry - Quarry extension				Hole Number: DDH 3a/97		Page No: 2
% Core Recovery	**Depth (m)**	**Drill Time**	**Weath-ering**	**Structure**	**Symbol**	**Geological Description**
	-		S W			
	27					
	-					**27.1 - 41.8 Fresh Greywacke** Dark grey, very hard, very strong. Minor pyrite on some joint planes (ie @36.8 metres)
	28					
	-					
	29		Fresh			
	-			Joints cross core axis at 30° to vertical and horizontal joints.		
	30					
	-					
	31					
	-					
	32					
	-					
	33					
	-					
	34					
	-		Fresh			
	35					
	-					
	36					
	-					
	37					
	-					
	38					
	-					
	39					
	-					
	40					
	-		Fresh			
	41					
	-					
						End of Hole 41.8 metres

Box	**Length**
Box 1	2 to 8 metres
Box 2	8 to 14 metres
Box 3	14 to 20 metres
Box 4	20 to 26 metres
Box 5	26 to 32 metres
Box 6	32 to 38 metres
Box 7	38 to 41.8 metres

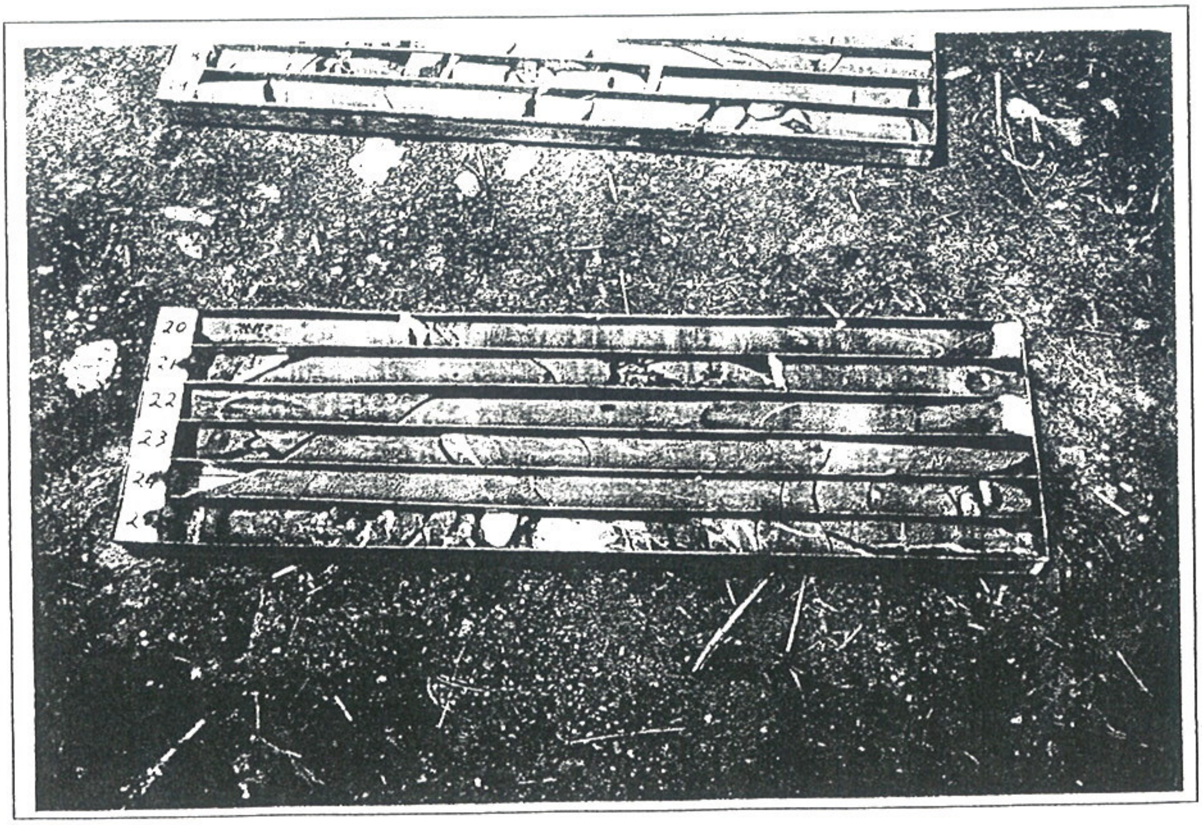
DDH 3a/97 - Box 1 2.00 to 8.00 metres



DDH 3a/97 - Box 2 8.00 to 14.00 metres

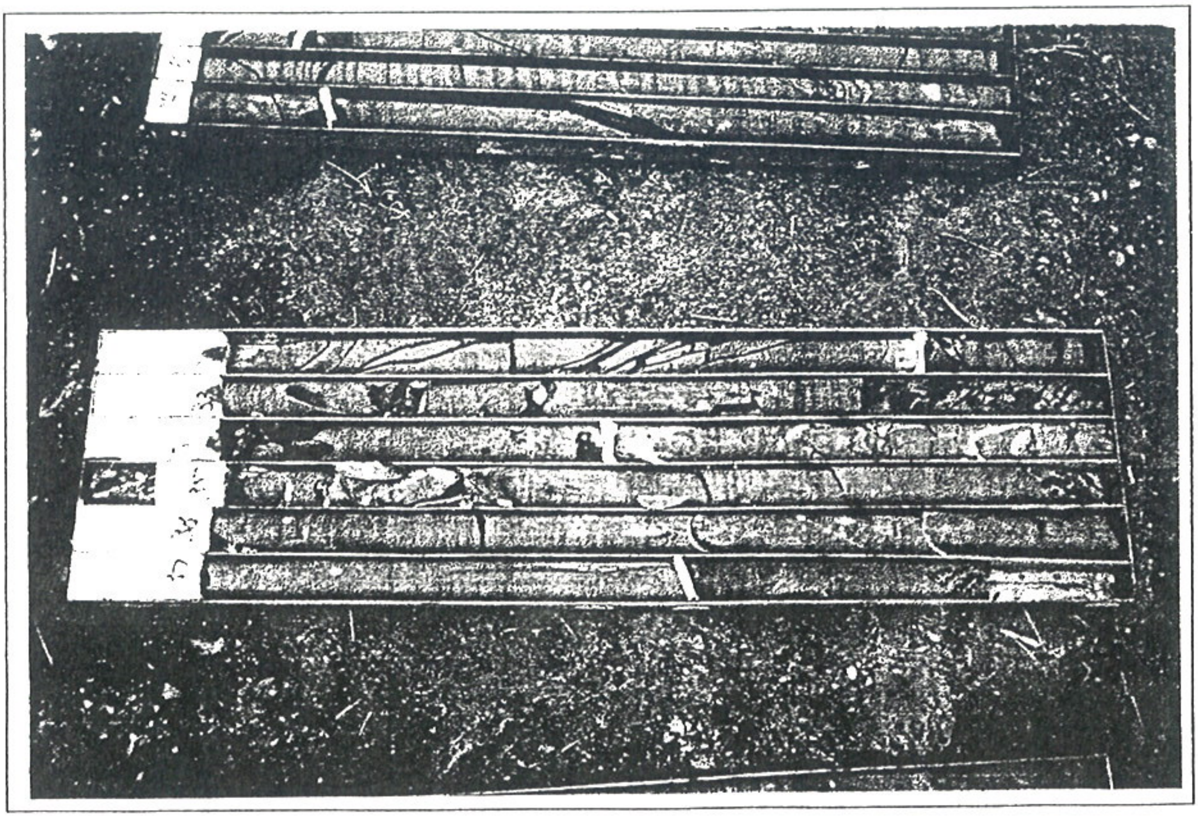


DDH 3a/97 - Box 3 14.00 to 20.00 metres

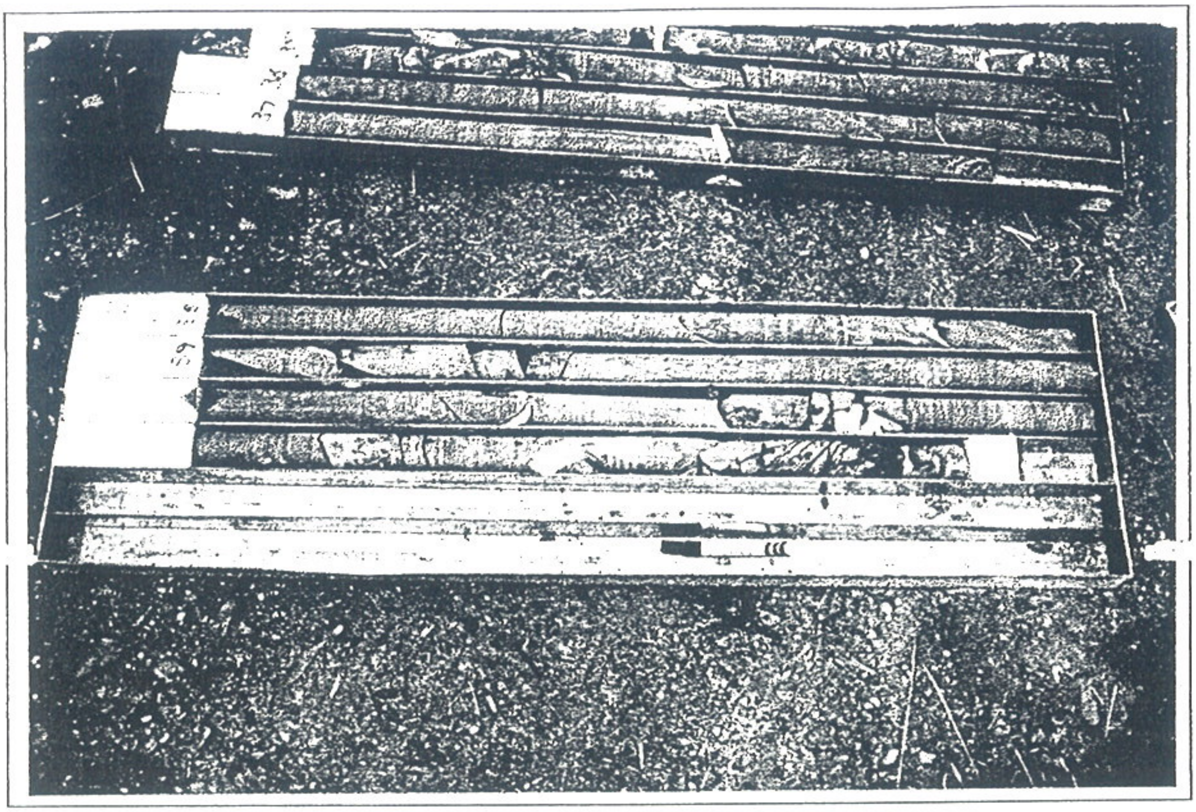


DDH 3a/97 - Box 4 20.00 to 26.00 metres

DDH 3a/97 - Box 5 26.00 to 32.00 metres



DDH 3a/97 - Box 6 32.00 to 38.00 metres



DDH 3a/97 - Box 7 38.00 to 41.80 metres

Project: Jandra Quarry -- Quarry extension		**Drilling Company:** Groundtest	**Page No:** 1
Locality:	Jandra Quarry near Taree	**Logged:** Ian Stenhouse	**Hole No:** DDH 5/97
Co-ordinates	248,501 E, 1,452,629 N	**Datum:** AHD	**Core Size:** NQ_3
Bearing:	175°	**RL Collar:** 105.1metres	**Commenced:** 26.2.97
Inclination:	45°	**RL Bottom:** 97.1 metres	**Completed:** 27.2.97
		Depth: 11.3 metres	

% Core Recovery	Depth (m)	Drill Time	Weath-ering	Structure	Symbol	Geological Description
	0					**0 to 6.0 Greywacke**
	-		H W	Highly fractured, joints per		Core Loss – Rock Roller
	1			metre 20⁺.		Highly jointed moderately
	-					strong.
	2					
	-		H W			
	3					
	-					
	4					
	-					
	5		M W			
	-					
	6					**6.0 to 7.9 Greywacke**
	-		M W	Highly jointed ≈ 20 30 p/m		Moderately weathered, brown
	7					moderately strong. Limonite
	-					on joint planes.
	8					**7.9 to 11.3 Greywacke**
	-					Core Loss – Rock Roller
	9		M W			Highly jointed moderately
	-					strong. Moderately to slightly
	10		S W			weathered.
	-					
	11					
						End of hole at 11.3 metres.

Box	Length
Box 1	6 to 11.3 metres

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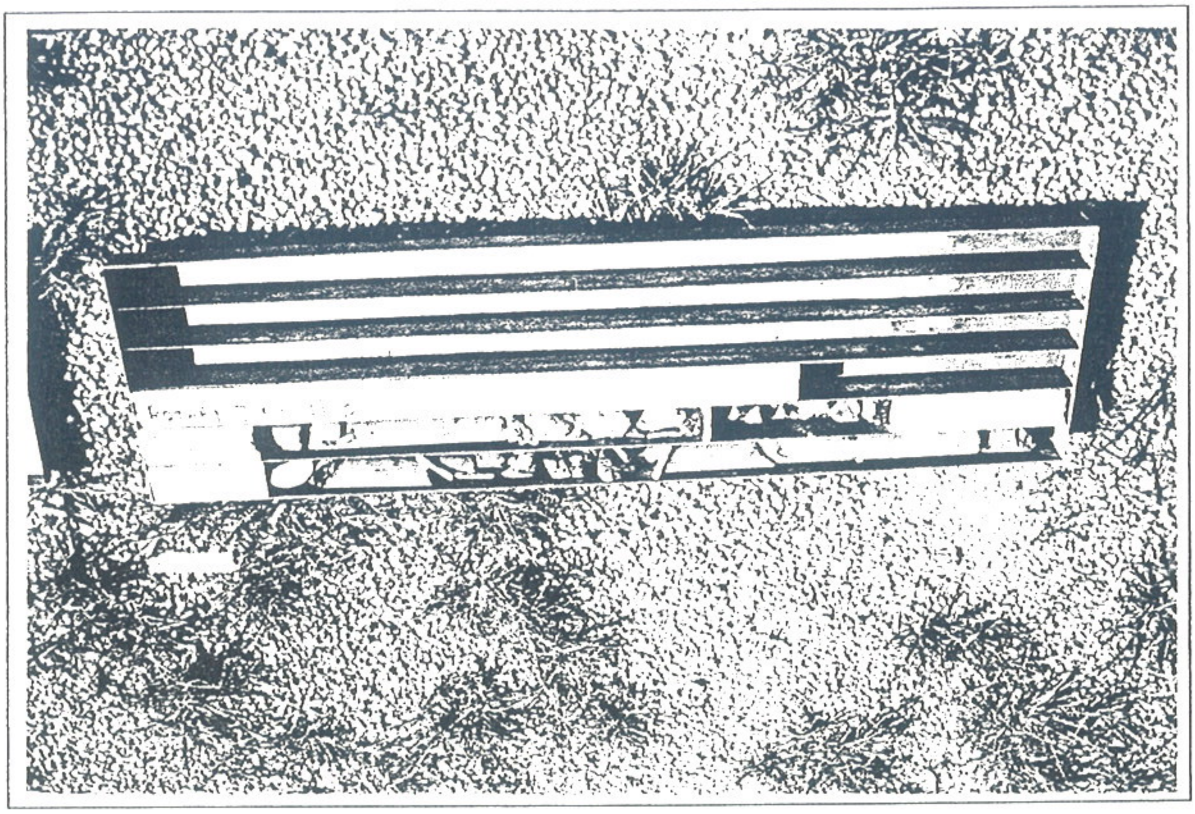

DDH 5/97 - Box 1 0.00 to 11.3 metres

Project: Jandra Quarry – Quarry extension		**Drilling Company:** Groundtest		**Page No:** 1	
Locality:	Jandra Quarry near Taree	**Logged:** Ian Stenhouse		**Hole No:** DDH 5a/97	
Co-ordinates	248,501 E, 1,452,629 N	**Datum:** AHD		**Core Size:** NQ_3	
Bearing:	Vertical	**RL Collar:** 105.1 metres		**Commenced:** 27.2.97	
Inclination:	Vertical	**RL Bottom:** 69.1 metres		**Completed:** 28.2.97	
		Depth: 36.0 metres		Drilled south of exiting approved quarry.	

% Core Recovery	Depth (m)	Drill Time	Weath-ering	Structure	Symbol	Geological Description
	0 - 1 - 2 - 3 - 4 - 5 -		H W M.W	Highly fractured, joints per metre 20^{+}.		**0 to 6.0 Greywacke** Core Loss – Rock Roller Highly weathered to grading to moderately weathered
	6 - 7 - 8 - 9 - 10 - 11 - 12 - 13 - 14 - 15 - 16 - 17 - 18 - 19 - 20 - 21 - 22 - 23 - 24 - 25 - 26		S W S W S W S W S W	Joints cross core axis @ 45° and 65°. Joints crossing core axis at about 45° are thought to be bedding planes and are quite dominant. Heavy limonite staining in upper two core trays. 14.5 metres highly fractured zone 19.4 to 19.8 metres, highly fractures core but not broken, calcite infill along joint these surfaces.		**6.0 to 27.8 Greywacke** Slightly weathered, light grey to grey core, limonite staining on joint planes. Granitic lithic fragments. 6.2 to 6.8 and 7.1 to 7.2 metres moderately weathered zones say 100mm wide grading into slightly weathered core. 24.65 to 24.85 metres is a wide joint plane with calcite growth into the void.

Project: Jandra Quarry Extension	Hole Number: DDH 5a/97	Page No: 2

% Core Recovery	Depth (m)	Drill Time	Weath-ering	Structure	Symbol	Geological Description
	-		S W			
	27					**27.1 to 36.0 Greywacke** Fresh, dark grey, very strong, very hard, calcite along joint planes, minor pyrite along some joint planes.
	-		Fresh			
	28			Dominant joints cut core axis ≈45°.		
	-					
	29					
	-					
	30					30.4 to 30.5 sample taken for petrographic assessment.
	-			5 to 10 fractures per metre		
	31		Fresh			
	-					
	32					
	-					
	33					
	-					
	34			34.1 to 34.4 core highly fractured, broken along previously healed fractures		
	-					
	35					
	-		Fresh			
						End of Hole 36.0 metres

Box	Length
Box 1	6 to 12 metres
Box 2	12 to 18 metres
Box 3	18 to 24 metres
Box 4	24 to 30 metres
Box 5	30 to 36 metres

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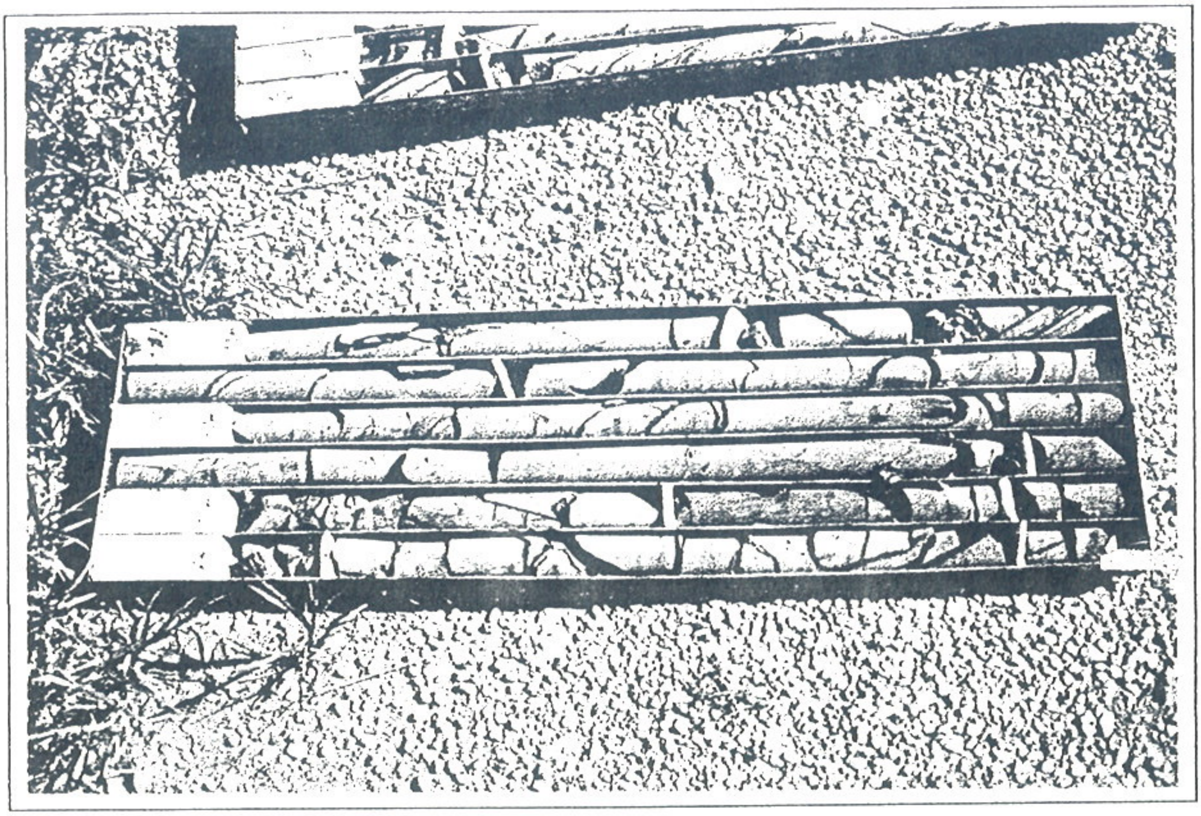
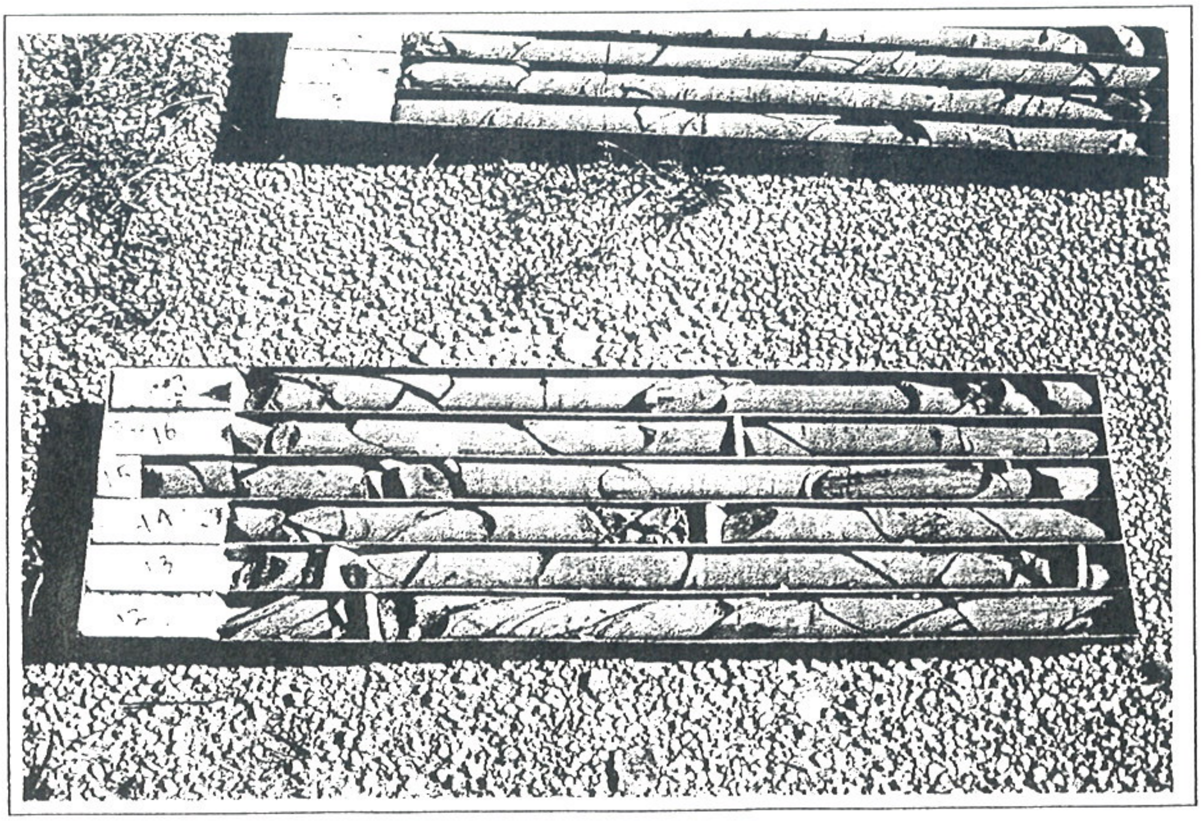
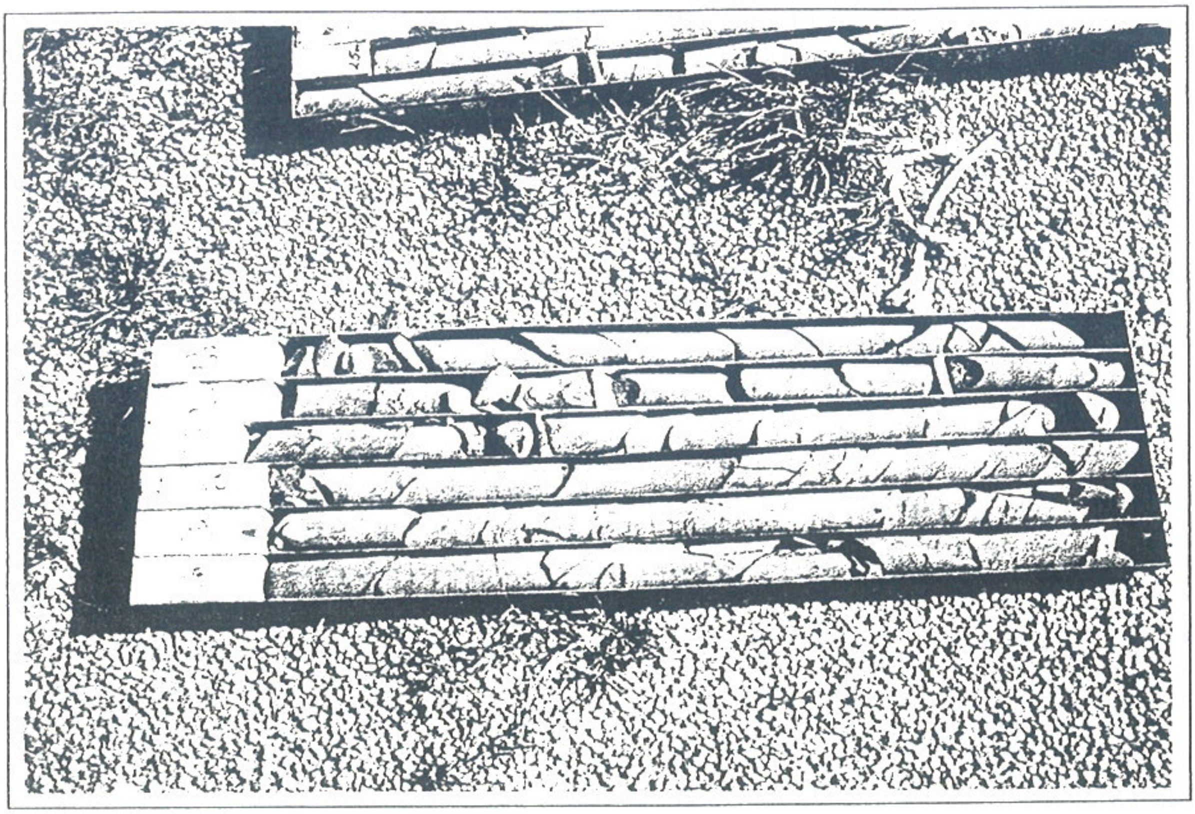


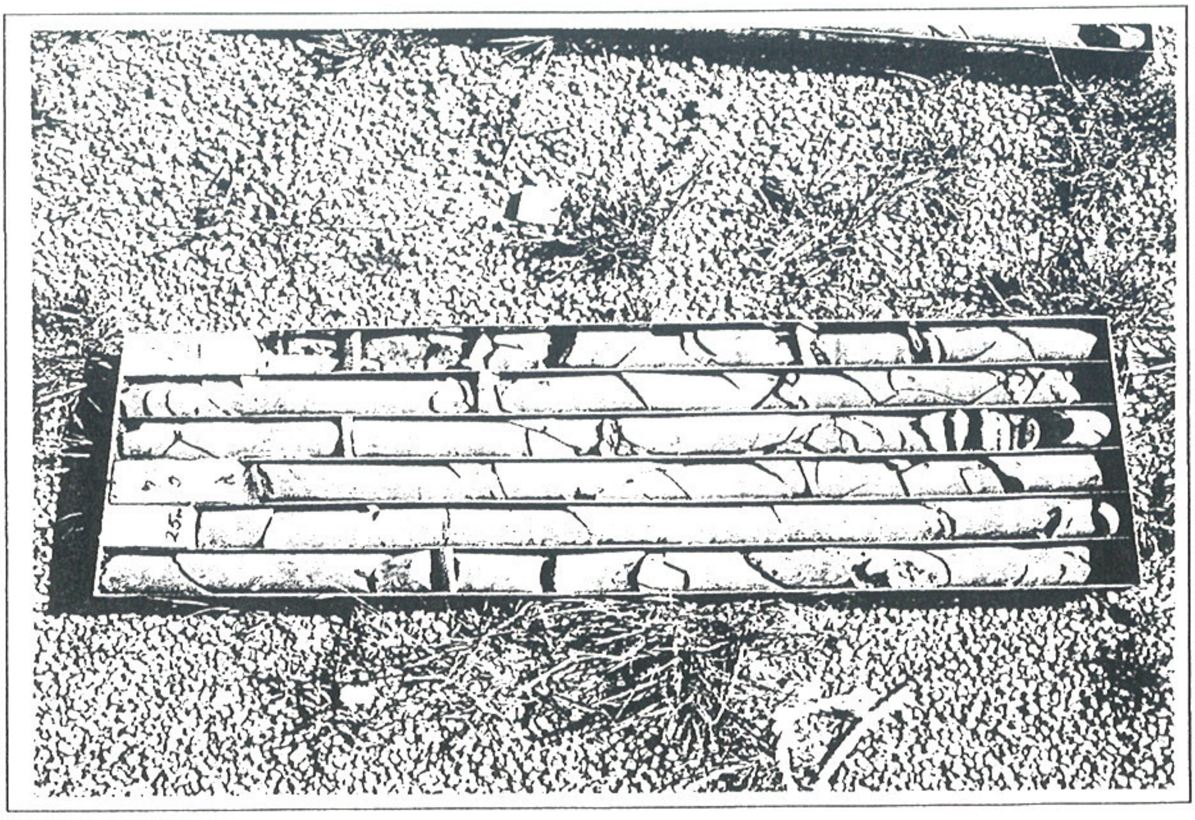
DDH 5a/97 - Box 1 6.00 to 12.00 metres



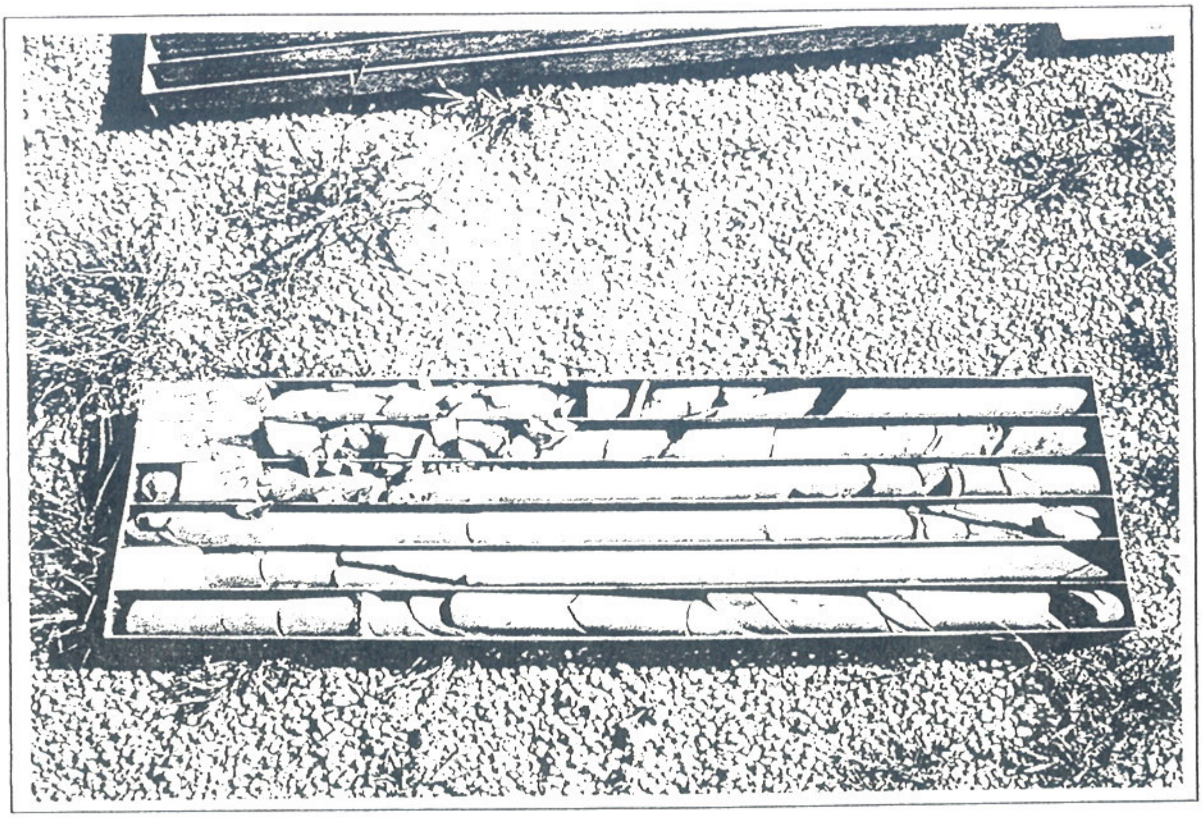
DDH 5a/97 - Box 2 12.00 to 18.00 metres



DDH 5a/97 - Box 3 18.00 to 24.00 metres



DDH 5a/97 - Box 4 24.00 to 30.00 metres



DDH 5a/97 - Box 5 30.00 to 36.00 metres

Project: Jandra Quarry – Quarry extension		**Drilling Company:** Groundtest	**Page No:** 1
Locality:	Jandra Quarry near Taree	**Logged:** Ian Stenhouse	**Hole No:** DDH 6/97
Co-ordinates	248,551 E, 1,452,798 N	**Datum:** AHD	**Core Size:** NQ_3
Bearing:	Vertical	**RL Collar:** 48.7 metres	**Commenced:** 28.2.97
Inclination:	Vertical	**RL Bottom:** 18.7 metres	**Completed:** 3.3.97
		Depth: 30.0 metres	Drilled into exiting quarry floor.

% Core Recovery	Depth (m)	Drill Time	Weathering	Structure	Symbol	Geological Description
	0 - 1 - 2 - 3		S W S W	Highly fractured, joints per metre 20^+.		**0 to 3.4 Meta-Sediments** Core Loss – Rock Roller Slightly weathered, moderately strong the weak.
	- 4		S W			**3.4 to 4.6 Meta-Sediments** dark brown, weak to moderately strong, siltstone, overlying rock grading into coarse greywacke.
	- 5 - 6 - 7 - 8 - 9 - 10 - 11 - 12 - 13		S W S W	Joints per metre 10 to 15. Joints cross core axis @ 45°. Limonite staining in slightly weathered rock. Joints per metre 5 to 10.		**4.6 to 13.4 Greywacke** Slightly weathered, light grey to grey core, limonite staining on joint planes. Granitic lithic fragments. 4.6 to 5.0 coarse greywacke, Sandier than the bulk of the greywacke unit.
	- 14 - 15 - 16 - 17 - 18 - 19 - 20 - 21 - 22 - 23 - 24 - 25 - 26		Fresh Fresh Fresh	Core quite fractured from 17.7 to 18.5 metres and 22.1 to 23.2 metres. Joints per metre 1 to 3.		**13.4 to 30.0 Greywacke** Fresh, very strong, very hard, calcite along joint planes, minor pyrite on some joint surfaces, becoming slightly coarser towards the base. 24.0 to 24.1 sample taken for petrographic analysis.

Project: Jandra Quarry Extension				Hole Number: DDH 6/97		Page No: 2
% Core Recovery	**Depth (m)**	**Drill Time**	**Weath-ering**	**Structure**	**Symbol**	**Geological Description**
	- 27 - 28 - 29 -		Fresh Fresh	Dominant joints cut core axis ≈45°.		**13.4 to 30.0 Greywacke** Fresh, very strong, very hard, calcite along joint planes, minor pyrite on some joint surfaces, becoming slightly coarser towards the base.
						End of Hole 30.0 metres

Box	Length
Box 1	3 to 9 metres
Box 2	9 to 15metres
Box 3	15 to 21 metres
Box 4	21 to 26 metres
Box 5	26 to 30 metres

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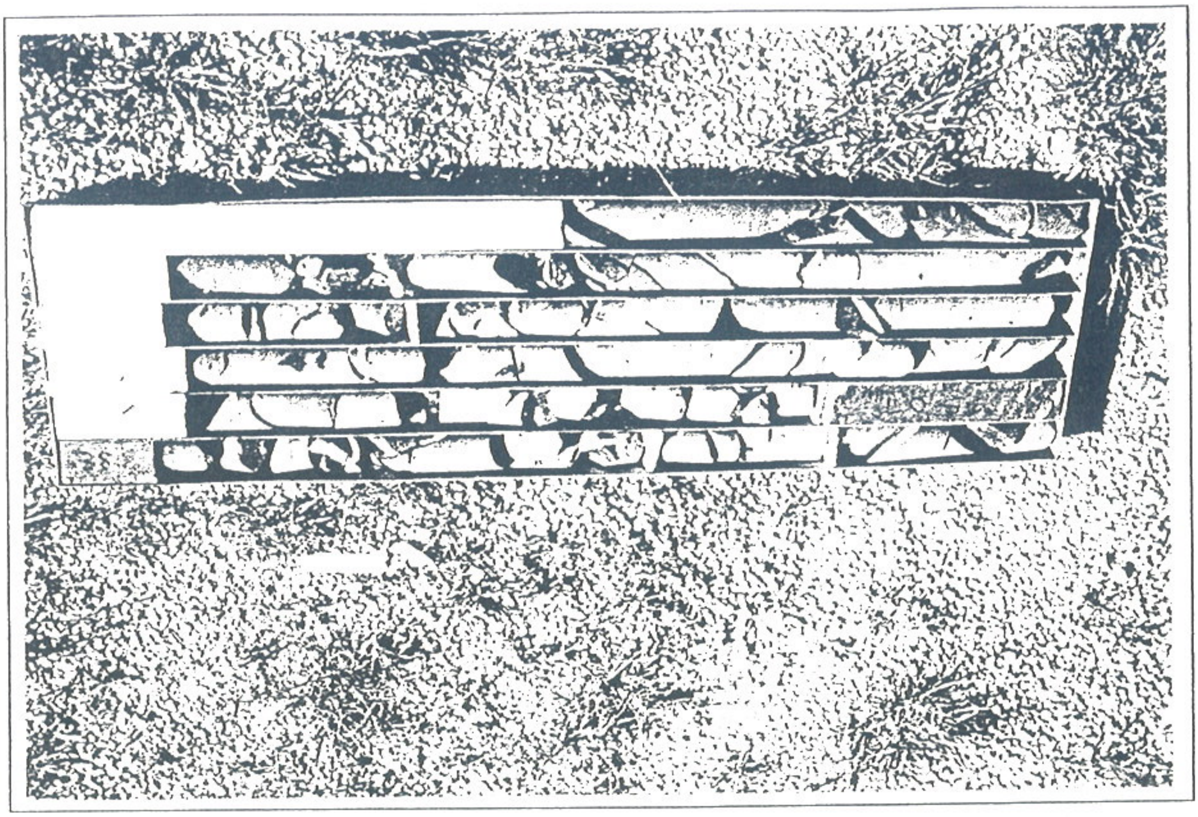
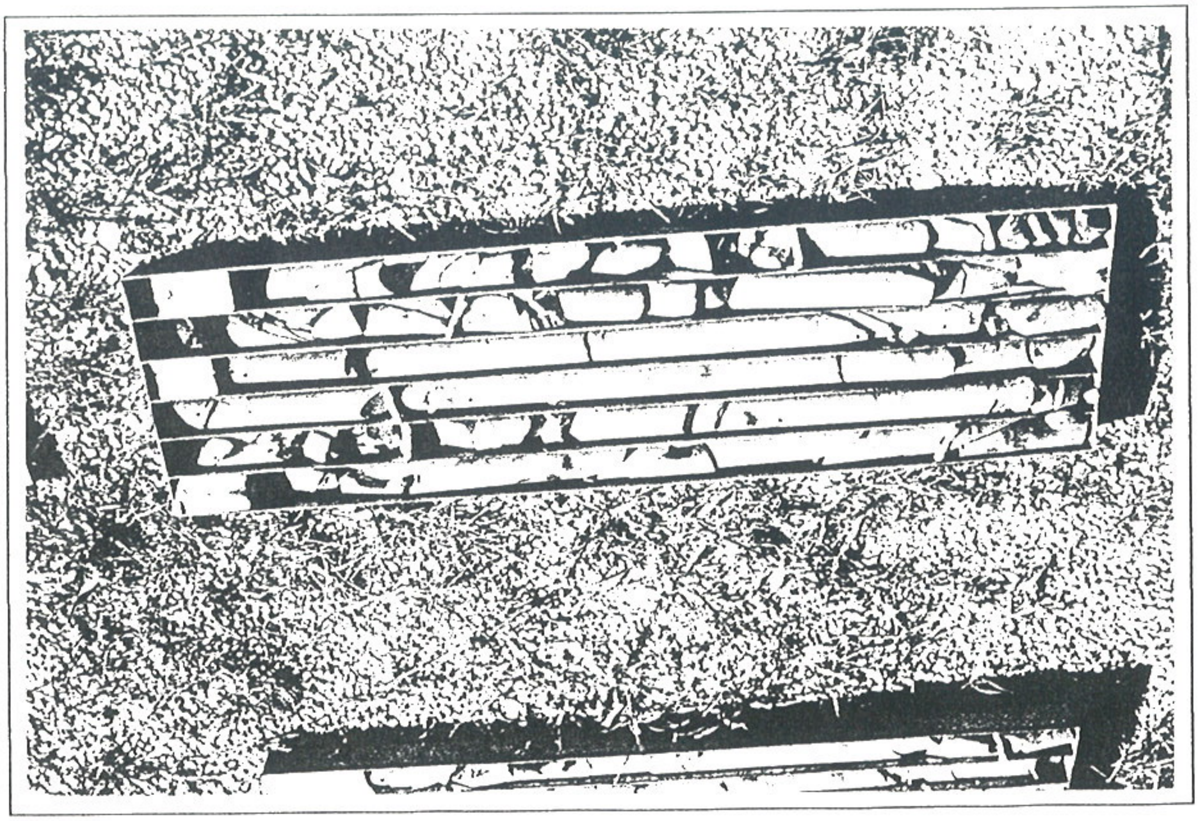
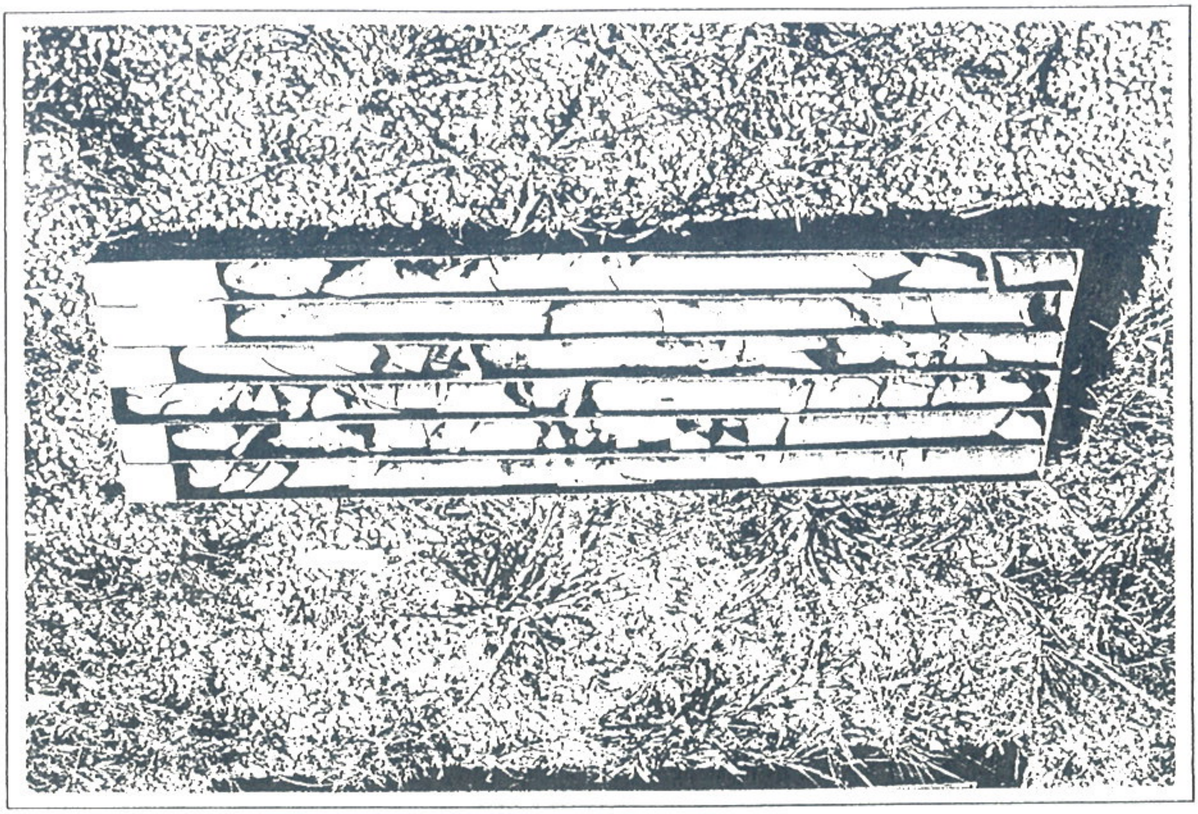


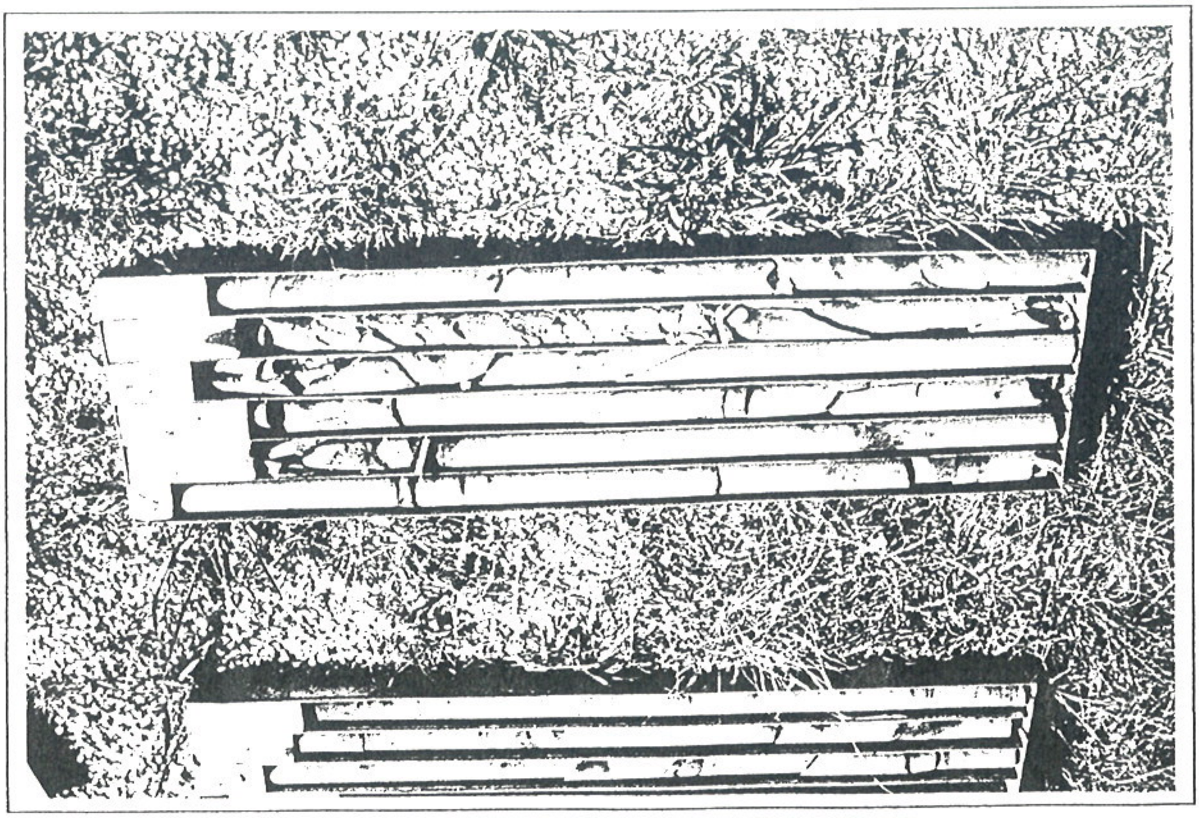
DDH 6/97 - Box 1 3.00 to 9.00 metres



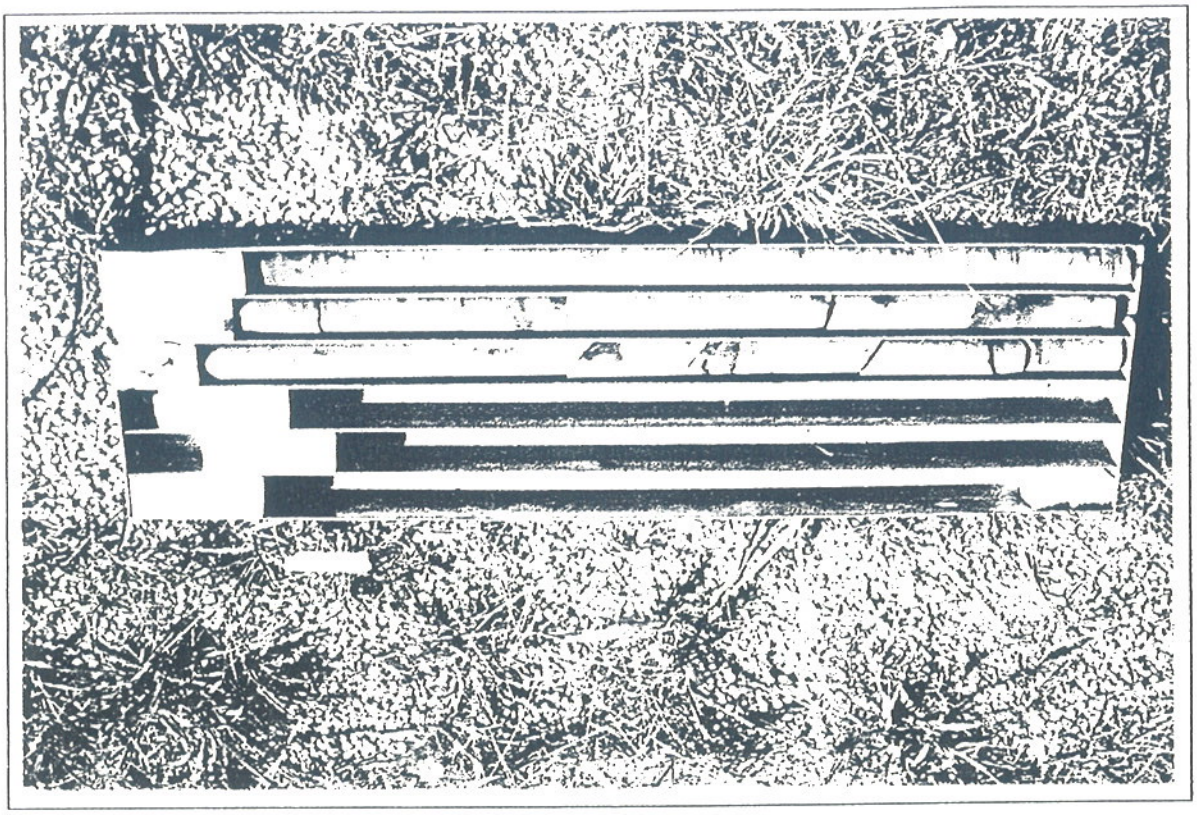
DDH 6/97 - Box 2 9.00 to 15.00 metres



DDH 6/97 - Box 3 15.00 to 21.00 metres

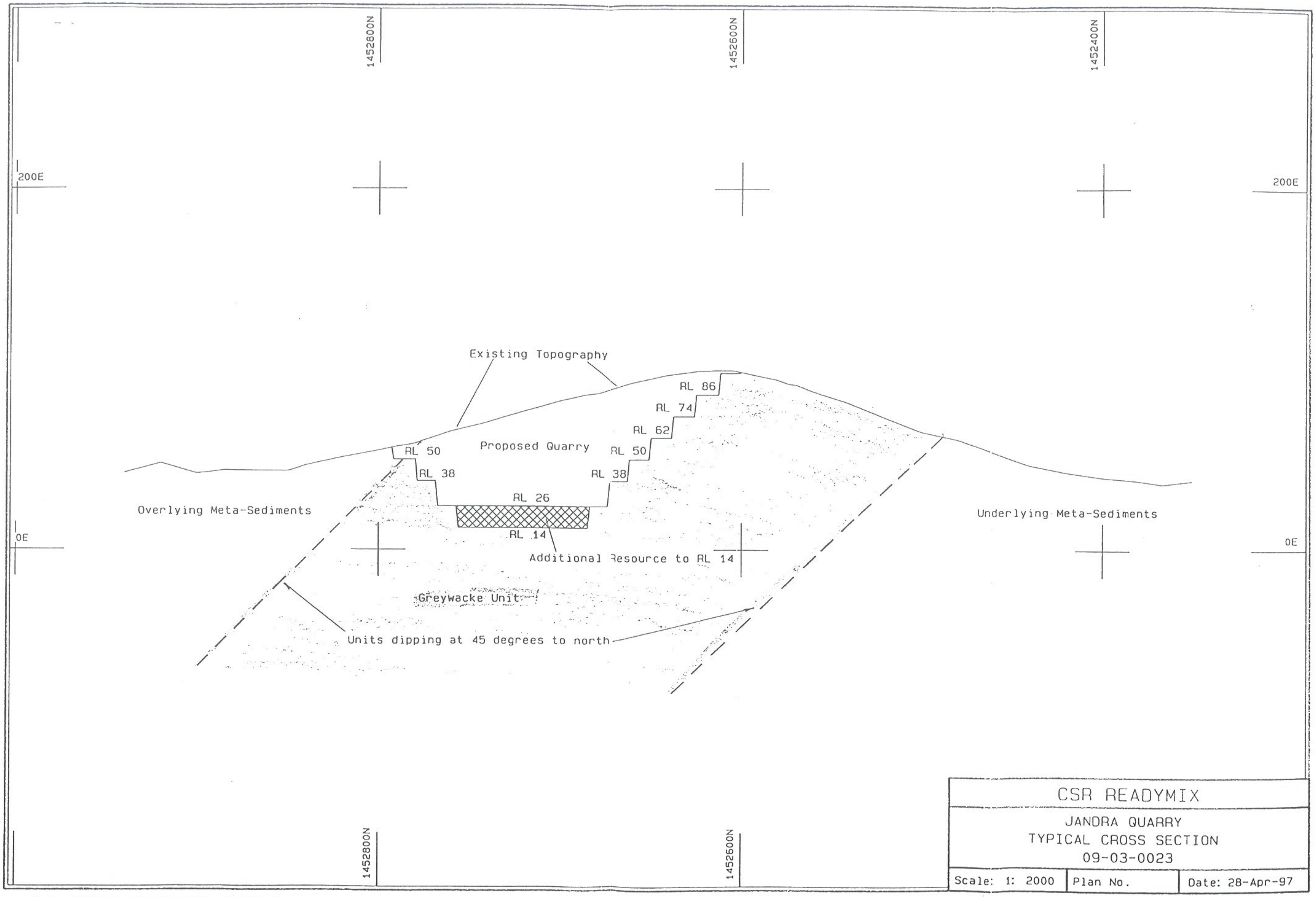


DDH 6/97 - Box 4 21.00 to 26.00 metres



DDH 6/97 - Box 5 26.00 to 30.00 metres

FIGURES



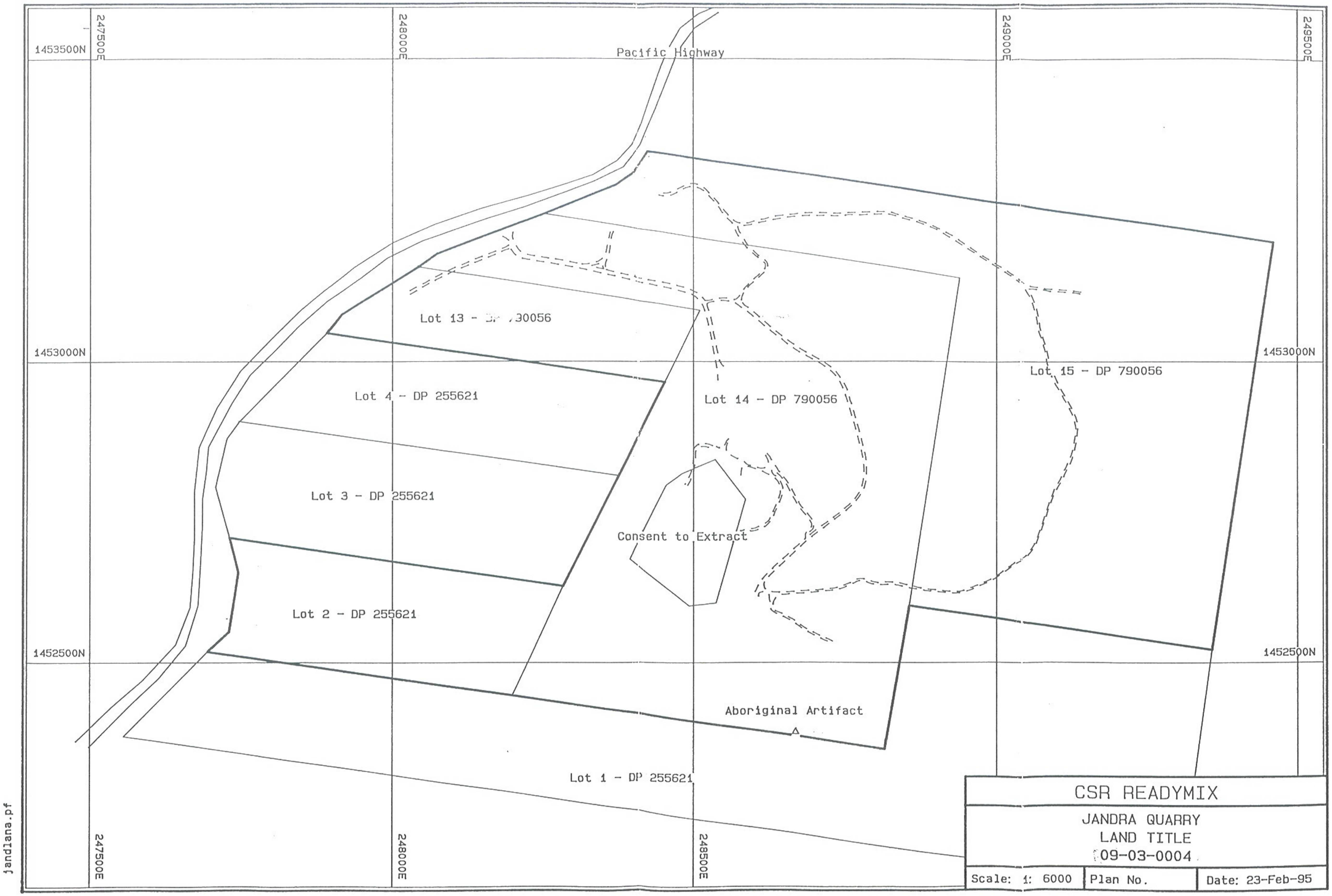
CSR READYMIX

JANDRA QUARRY
TYPICAL CROSS SECTION
09-03-0023

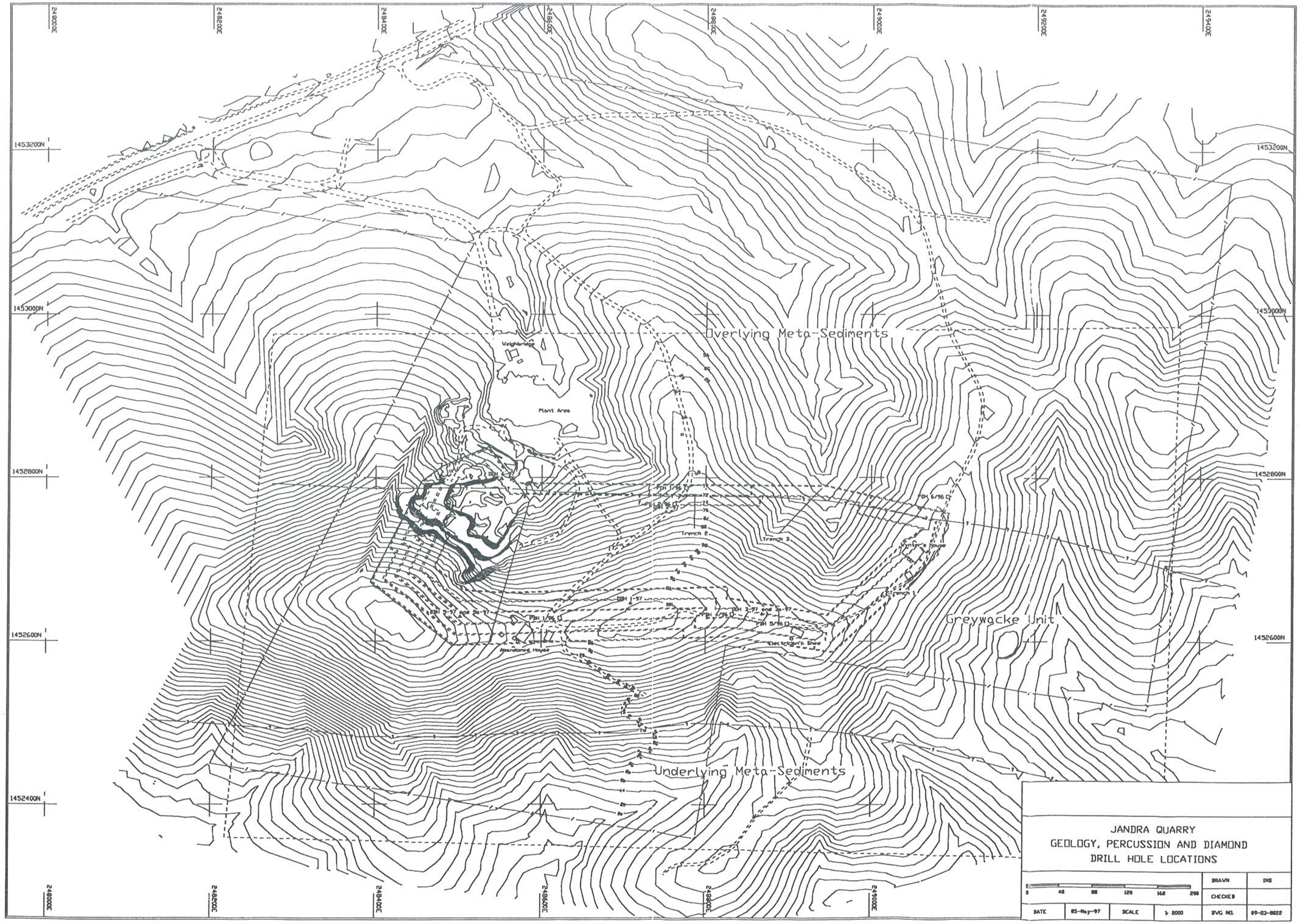
Scale: 1: 2000	Plan No.	Date: 28-Apr-97

jangeo5a.pf

SURPAC SOFTWARE INTERNATIONAL, AUSTRALIA



SURPAC SOFTWARE INTERNATIONAL, AUSTRALIA



Overlying Meta-Sediments
Weighbridge
Plant Area
Trench 2
Trench 3
Trench 1
Greywacke Unit
Abandoned House
Underlying Meta-Sediments
1453200N
1453000N
1452800N
1452600N
1452400N
JANDRA QUARRY
GEOLOGY, PERCUSSION AND DIAMOND
DRILL HOLE LOCATIONS
0
40
80
120
160
200
DRAWN
CHECKED
DATE
05-May-97
SCALE
1: 2000
DWG NO.
09-03-0822

JANDRA QUARRY
EXTENSION

CSR

E. JANDRA QUARRY DEVELOPMENT PLANS

JANDRA QUARRY
Quarry Development Plans – April 1999

Design Parameters

The quarry plans and rock volumes presented have been developed based on the following parameters:

- the existing approved face height of 12 metres is preserved to RL50 (the existing quarry floor),
- faces from RL50 to RL20 are 15 metres high,
- terminal quarry benches are half the face height, that is, benches at RL98, RL86, RL74, RL62 and RL50 are 6 metres wide and the bench at RL35 is 7.5 metres wide,
- the angle of repose of quarry faces is 75°,
- haul roads have a gradient of 1 in 10 and the haul road width is 15 metres,
- the density of the rock is 2.65 t/m^3,
- topsoil is on averages 1 metre thick,
- weathered rock averages 10 metres in thickness.

Stage 1 Development

Stage 1 comprises the westerly development of the quarry towards the Pacific highway. The western limit of extraction is 400 metres from the highway.

Bench levels developed will be RL98, RL86, RL74, RL62 and RL50. Development will be from the east towards the west.

Access to all benches will utilise the existing haul road system.

Development of the upper most benches is the main priority – RL98 will be the first bench level completed. Overburden and topsoil removed from stripping in other areas of the development will be placed on terminal benches and trees and grass established.

Rock won from western quarry development will be:

	Overburden (m^3)	**Weathered Rock (m^3)**	**Fresh Rock (m^3)**	**Tonnage (@ 2.65 t/m^3)**
Stage 1	61,900	619,300	1,685,800	4,467,400

Stage 2 Development

Stage 2 comprises the easterly development of bench levels developed will be RL98, RL86, RL74, RL62 and RL50. Development will be from the west towards the east. A drop-cut will be developed to access rock on RL35.

Upper benches will be rehabilitated as soon as access along them is no longer required.

Rock won from Stage 2 development will be:

	Overburden (m^3)	Weathered Rock (m^3)	Fresh Rock (m^3)	Tonnage (@ 2.65 t/m^3)
Stage 2	44,462	489,082	1,640,773	4,348,048

Stage 3 Development

Stage 3 comprises the easterly development of the quarry to the western limit of extraction. The quarry does not breach the ridgeline to the south or to the east.

Bench levels developed will be RL98, RL86, RL74, RL62, RL50 and RL35. Development will be from the west towards the east.

Again, speedy rehabilitation of completed upper benches is the main priority. As soon as a bench is not required for access to other areas of the quarry, overburden and topsoil removed from stripping in other areas of the property will be placed on these benches and trees and grass established.

Rock won from Stage 3 development will be:

	Overburden (m^3)	Weathered Rock (m^3)	Fresh Rock (m^3)	Tonnage (@ 2.65 t/m^3)
Stage 3	34,538	300,718	1,371,567	3,634,652

Stage 4 Development

Stage 4 comprises the development of the RL20 bench level and the northerly expansion of the western end of the pit.

Bench levels developed will be RL50, RL35 and RL20. A continuation of the drop-cut developed in Stage 2 will allow access to RL20.

Rock won from Stage 4 development will be:

	Overburden	Weathered	Fresh Rock	Tonnage

	(m^3)	Rock (m^3)	(m^3)	(@ 2.65 t/m^3)
Stage 4	4,512	45,100	1,537,600	4,074,600

End Use

Following the completion of Stage 4 two options will be available to CSR.

Deeper Development: Geological evidence suggests that the greywacke unit continues below RL20 (the base level of quarrying proposed in this development application). Deeper development is most likely.

Land Fill: The quarry will be ideally developed to allow for landfill.

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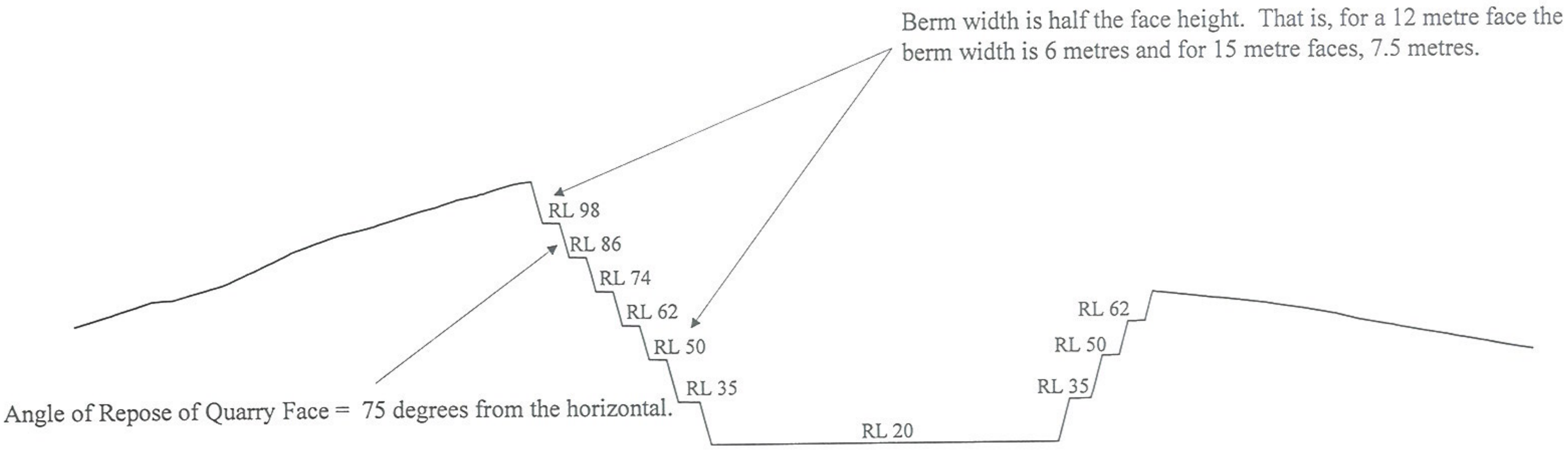
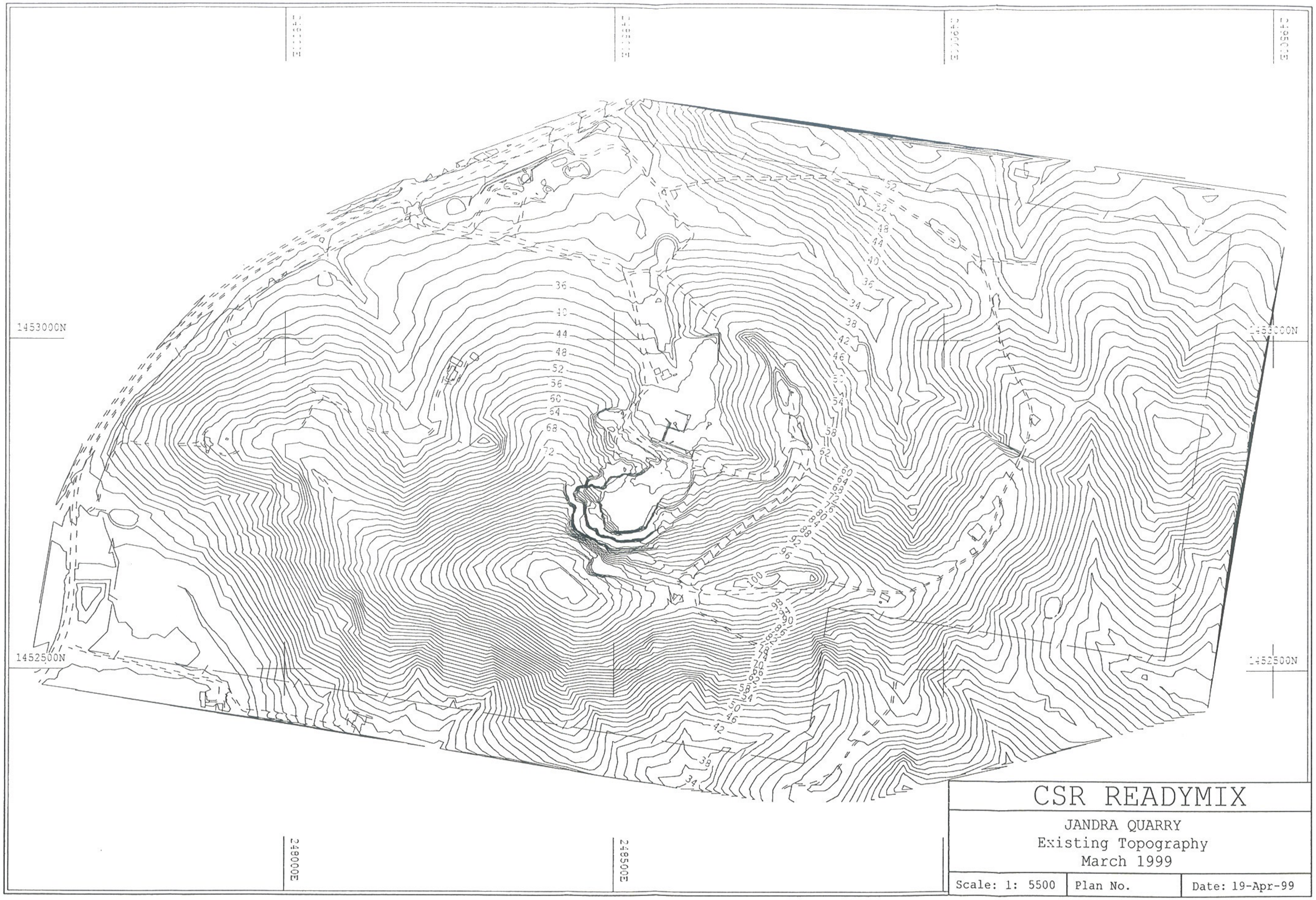
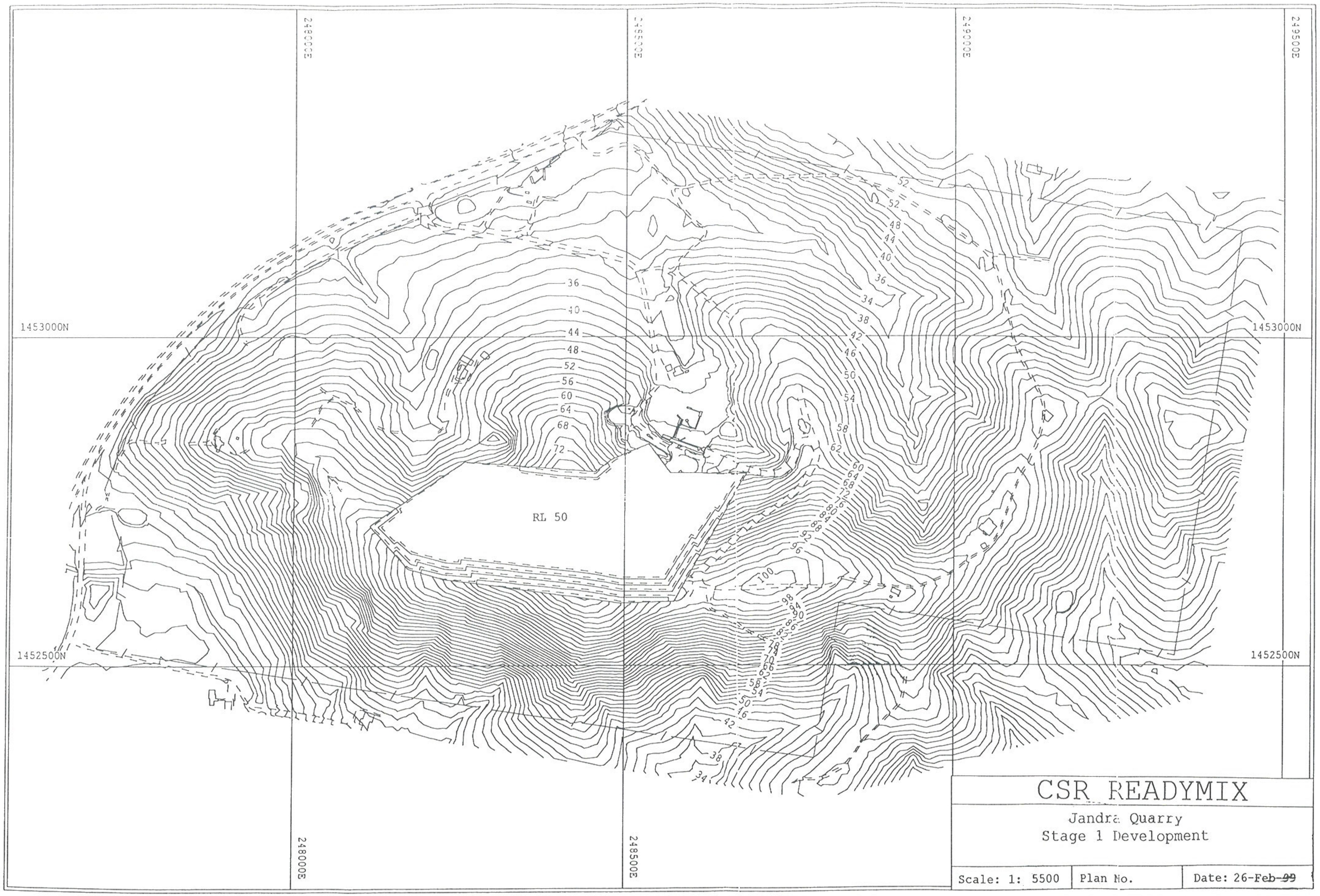


Jandra Quarry -- Section through bench design looking west.



SURPAC2000 - SURPAC Software International



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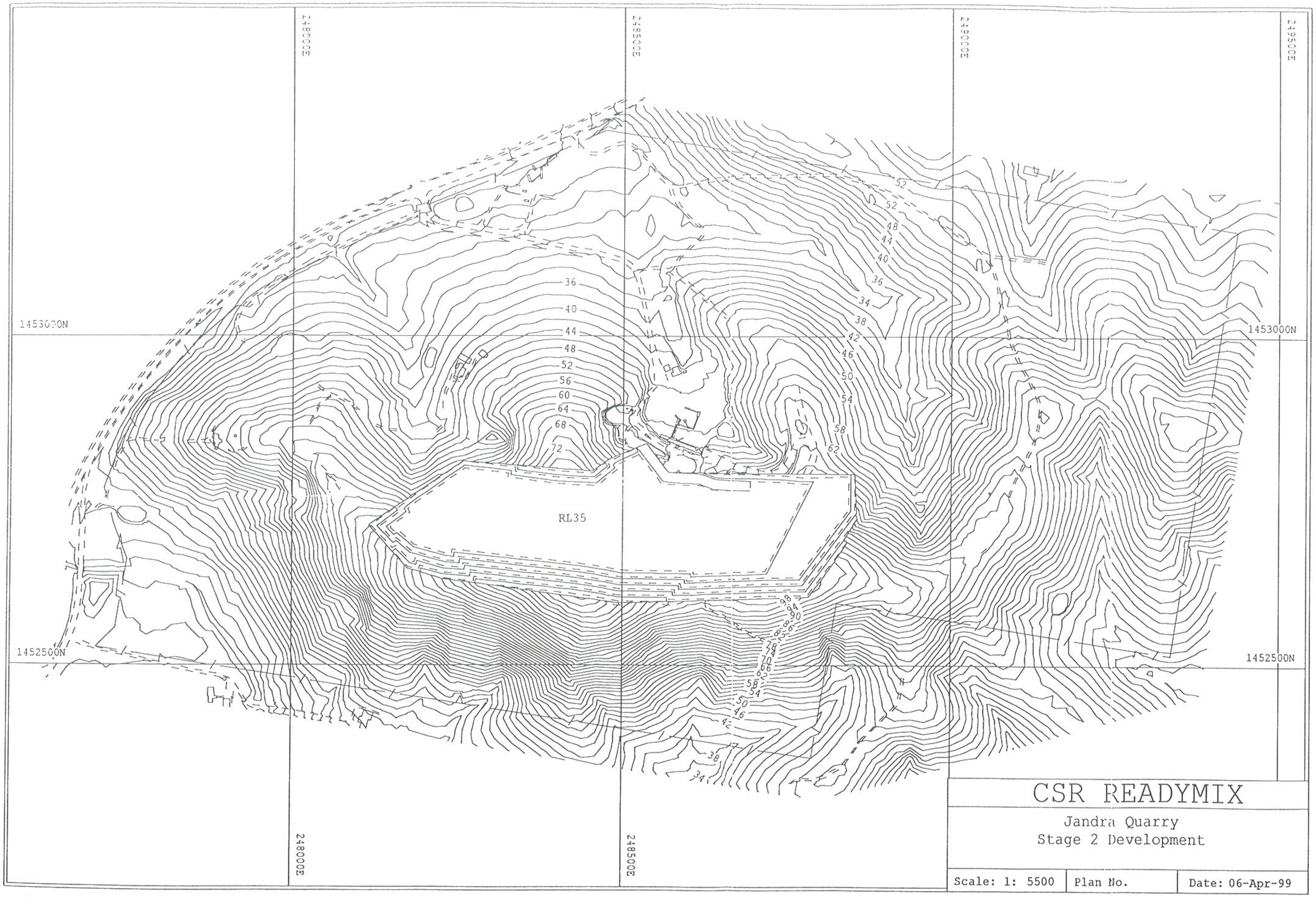

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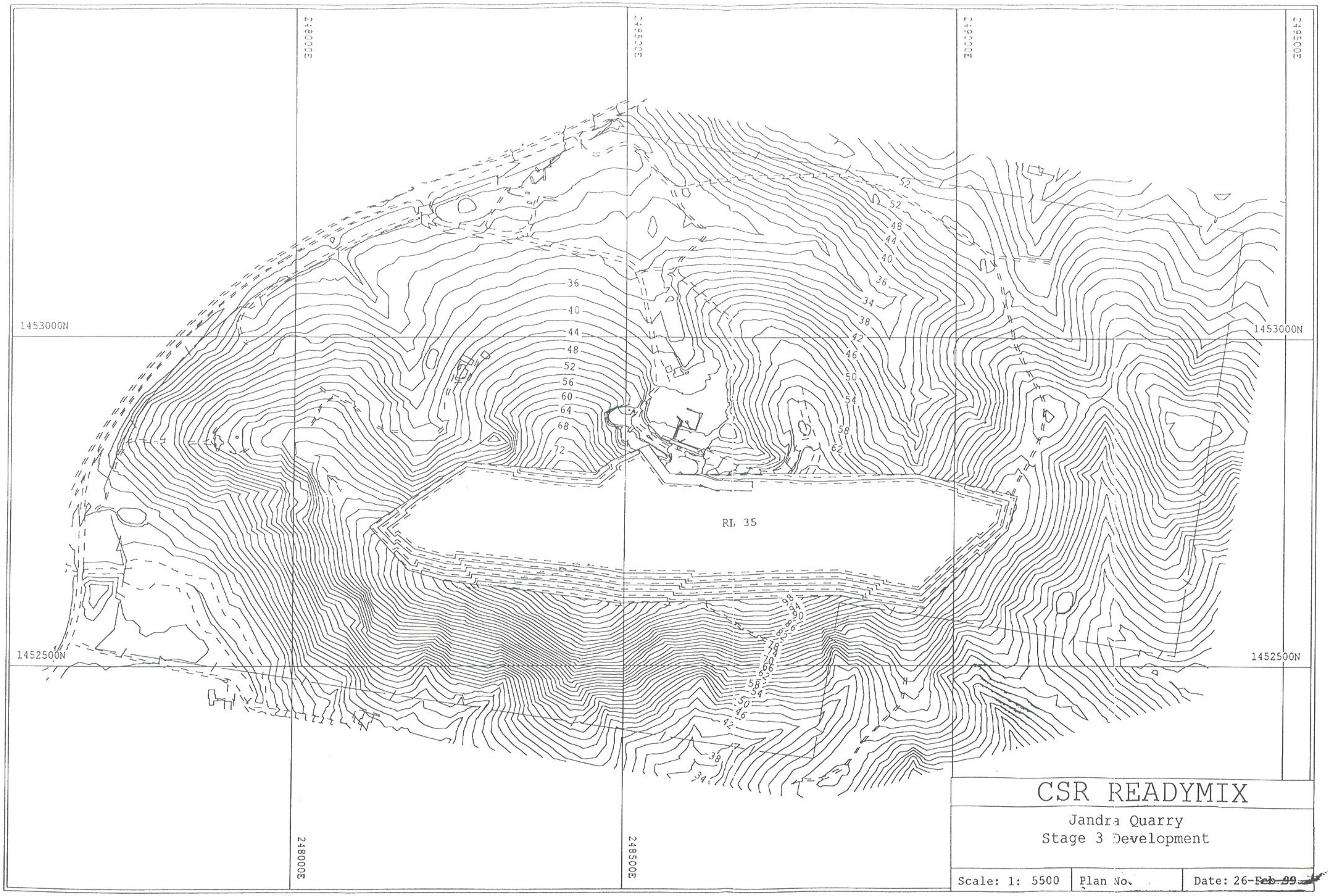


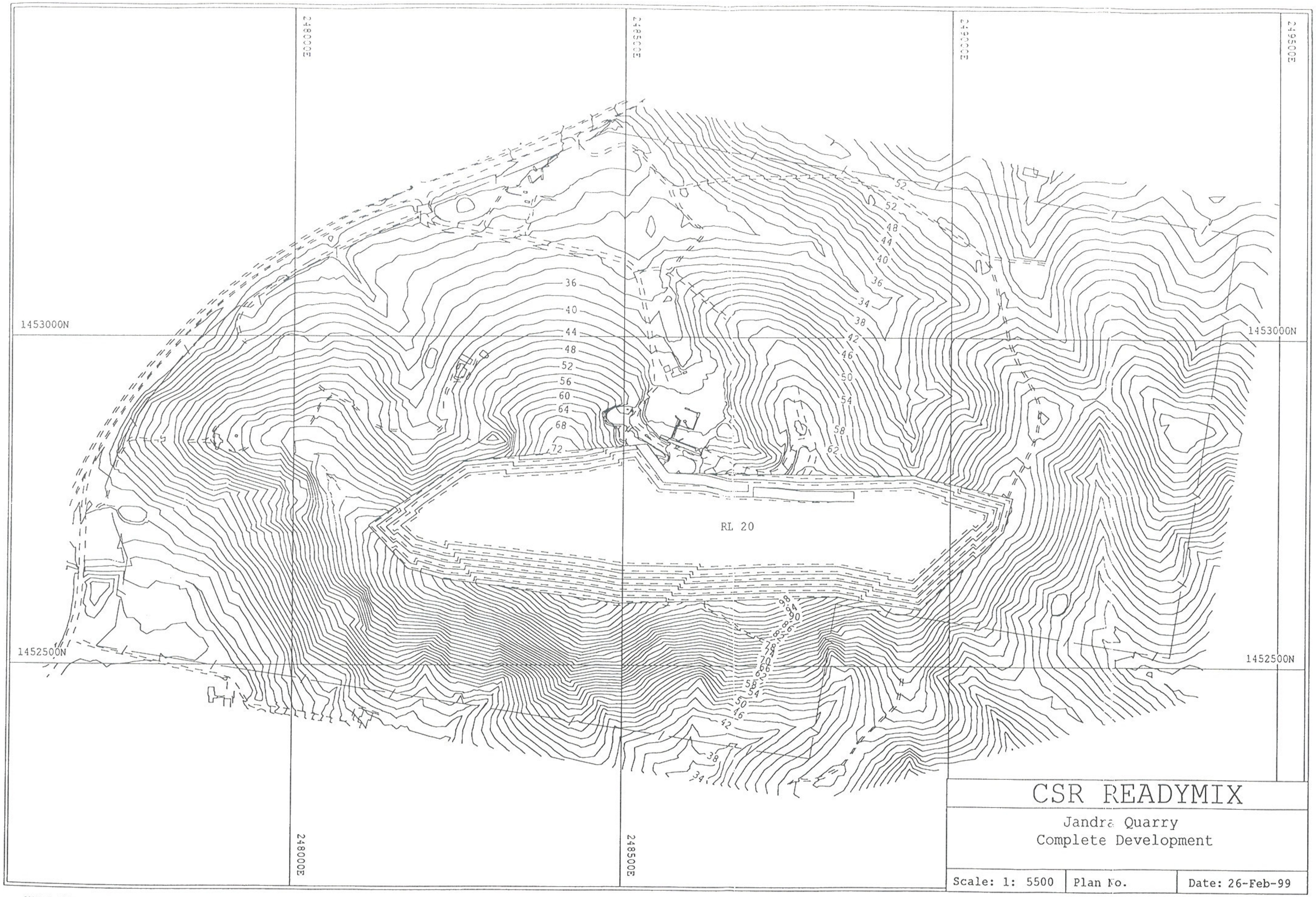
CSR READYMIX

Jandra Quarry
Stage 3 Development

Scale: 1: 5500	Plan No.	Date: 26-Feb-99

jan-eisb.pf

SURPAC2000 - SURPAC Software International



SURPAC2000 - SURPAC Software International

JANDRA QUARRY
EXTENSION

CSR

August 1999

Non-binding Letter of Intent

Proposed commercial terms in relation to our proposed Adjoining Owners Co-operation Agreement between Youth Care & Life Style Centre Incorporated as owners of Lot 10 DP 7900056 at 15194 Pacific Highway, Possum Brush (The Owner) and CSR as owners of Lots 14 &15 DP 7900056 Pacific Highway, Possum Brush (CSR).

SUBJECT TO AGREEMENT

1. The Owner will enter into a contractual agreement (rather than a lease) with CSR over the land described as Lot 10 DP 790056 at 15194 Pacific Highway Possum.

2. This agreement relates to the portion of the Owner's land described in Appendix 1 as buffer land or a "zone of exclusion".

3. The agreement term will be an initial 5 years with 4 x 5 year options for CSR to renew the agreement.

4. In year one of the agreement, CSR will pay The Owner $5,000 pa contractual fee payable by monthly instalments in advance.

5. Payments made in subsequent years of the initial term and any option to renew will be adjusted annually at the rate of CPI x previous year contractual fee to a maximum adjustment of 5%.

6. If cabins are constructed and used for accommodation in the "zone of exclusion" then CSR will pay an additional $800 contractual fee per cabin per annum. (This figure is based on quarry blasts coinciding with cabin occupancy on 10 occasions each year). Payment in subsequent years of the initial year of cabin occupancy will be adjusted annually at the rate of CPI x previous year contractual fee to a maximum adjustment of 5%.

7. The Owner and CSR agree to the following requirements applying to the "zone of exclusion" when CSR carries out the detonation of explosives (blasting)on the eastern extension to the existing approved area for quarry excavation on CSR's adjoining property:

   a) The Owner shall provide CSR with a copy of the proposed camp bookings at least one month in advance.

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b) CSR will verbally notify The Owner not less than 7 days prior to intended blasting.

c) CSR will verbally notify The Owner of the proposed time of blasting on the day before the intended blasting.

d) CSR will verbally notify The Owner of the proposed time of blasting before 9:30am on the day of the intended blasting.

e) The Owner will comply with CSR's instructions regarding safety procedures to be followed during the blasting. Such procedures require The Owner to ensure that no persons enter the "zone of exclusion" during blasting and that all persons move to a designated safe area. The "designated safe area" is also detailed in Appendix 1.

f) CSR will endeavour to exercise flexibility with the time of blasting so that The Owner's activities within the buffer land are not unreasonably interrupted. However, should CSR not be able to exercise such flexibility for any particular blast (eg due to weather conditions or product availability), then the designated time of detonation will take precedent over The Owner's activities program.

8. On receipt of a written request from the Owner, CSR will assist the Owner in its endeavour to construct a dam on the Owner's land by paying for the hire of a bulldozer to the maximum value of $10,000. CSR will have no further obligation in relation to the construction of the dam on the Owner's land

9. Should The Owner decide to sell the land, the Owner will give CSR a "first right of refusal" to buy the land on the same terms offered to someone else. If CSR chooses not to buy the land then the Owner would be obliged (if CSR so elects) to have any purchaser sign an agreement with CSR on the same terms as this one as a condition of the sale of the property.

   The reason for these requested conditions is that without them CSR wouldn't have any rights if the Owner sells the land to someone else.

10. The agreement will be stamped by CSR at CSR's cost. CSR will pay The Owner's legal costs and expenses in relation to this agreement to a maximum of $5,000 on receipt of itemised accounts.

11. If CSR does not obtain development consent for its quarry extension on both the eastern and western sides of the existing approved area on CSR's adjoining property, CSR will be entitled to terminate the agreement with 14 days prior notice in writing and without penalty. The proposed quarry extensions are also detailed in Appendix1.

12. CSR will not be bound by the agreement unless CSR formally executes the agreement on receipt of final terms which are acceptable to CSR. The terms of the proposal agreement and any subsequent agreement are to remain confidential between the parties, subject to disclosure required by law, even in the event that The Owner does not proceed to formal execution.

13. Both parties are required to carry public liability insurance. Details to be determined and agreed.

Signed by: ....

Authorised Representative of Youth Care & Life Style Centre Inc.

Date: ......29.9.99..........

Signed by: ....

Authorised Representative of CSR Limited

Date: ......27.8.99..........

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JANDRA QUARRY

EXTENSION

CSR

ORICA
QUARRY SERVICES

Technical Centre - Kurri Kurri

Orica Australia Pty Ltd
ACN 004 117 828
Technical Centre, George Booth Drive
PO Box 196, Kurri Kurri NSW 2327 Australia
Tel 02 4939 5200
Direct Tel 02 4939 5225 Fax 02 4939 3762

Facsimile

To	Ian Stenhouse	Facsimile	029 6852399
Company	CSR	Total Pages	1
From	Andrew Brodbeck	Date	7 April 1999
Subject	Jandra Quarry - EIS Information		

Ian

Following our phone conversation today, information regarding the above is detailed in the table below.

The data is based on an approximate blast size of 20,000 t (rock density 2.6 g/cc). These parameters would be a starting point and may be influenced by the local geology. They will require careful monitoring to achieve the optimum design.

Parameter	12 m Bench Height (Solid)	12 m Bench Height (Weathered)	15 m Bench Height
Blasthole Diameter (mm)	89	89	89
Burden (m)	3.2	3.6	3.3
Spacing (m)	3.7	4.1	3.8
Blasthole Depth (m)	13	13	16
Blasthole Angle (deg)	10	10	10
Stemming Length (m)	3	3	3
Number of Blastholes	54	44	41
Subdrill (m)	0.9	0.9	0.9
Explosive Density - Wet Blasthole (g/cc)	1.2	1.2	1.2
Explosive Density - Dry Blasthole (g/cc)	1.1	1.1	1.1
Explosive Charge per Blasthole - Wet (kg)	75	75	97

Could you pass this information to Murray Curtis and Mike Druce please. If you require further input please ring.

Regards

Andrew

JANDRA QUARRY
EXTENSION

CSR

H. CSR BLAST CONTROL STANDARDS

CSR CONSTRUCTION MATERIALS (COUNTRY NSW & VIC) - QUARRIES

DRILLING AND BLASTING PROCEDURES

FOR

JANDRA QUARRY

EDITION: 19-4-99
ISSUE NO.: 4

Distribution: Jandra Quarry
Taree Area Office
Orica Quarry Services
Gilbert Drilling and Blasting

CONTENTS

QUARRY:	JANDRA	PAGE NO.:	3 of 13
PROCEDURE NO.:	P 1	ISSUE NO.:	3
OPERATION:	**PLANNING & DESIGN**	ISSUE DATE:	18/8/97

PURPOSE: To ensure that all blasts are planned and designed to comply with development consent conditions and all safety and environmental requirements.

P1.1 The Quarry Manager will notify the blasting contractor three weeks in advance of when the next blast is required. The approximate quantity of rock required will also be advised.

P1.2 Prior to site inspection by blasting contractor the site is to be prepared for survey. All raw feed from the previous blast shall be loaded out from the face immediately in front of the blast area and benches shall be cleared of loose rocks and overburden.

P1.3 The blast is to be planned by the blasting contractor in conjunction with the Quarry Manager. The blasting contractor shall prepare a Blast Design consisting of a Drilling Plan and a Blast Initiation Plan (or Shot Plan).

P1.4 The planning will be conducted in accordance with the Quarry Development Plan.

P1.5 The planning will consider potential environmental and safety hazards including

- flyrock
- ground vibration
- blast overpressure
- noise
- dust
- quarry roads
- location of quarry plant, buildings
- location of neighbours
- warning siren
- authorised persons for all associated tasks
- monitoring requirements

QUARRY:	JANDRA	PAGE NO.:	4 of 13
PROCEDURE NO.:	P 1	ISSUE NO.:	3
OPERATION:	**PLANNING & DESIGN** (cont'd)	ISSUE DATE:	18/8/97

P1.6 The Blast Design must ensure that overpressure and ground vibration from the blast do not exceed the following limits at the point of measurement:

Overpressure Limit = 115dBL
Ground Vibration Limit = 5mm/sec

The overpressure and ground vibration caused by the blast will be measured at any point within one metre of any residential boundary or at any noise sensitive areas.

P1.7 The blasting contractor will provide an estimation of ground vibration and overpressure from the planned blast.

P1.8 At the completion of the design and prior to drilling, the blasting contractor and the Quarry Manager shall inspect the site and approve the compatibility of the design with the proposed blast site. The blasting contractor shall formally approve the design.

P1.9 Where any doubt exists that flyrock may occur, a protective cover shall be included in the design.

QUARRY:	JANDRA	PAGE NO.:	5 of 13
PROCEDURE NO.:	P 2	ISSUE NO.:	3
OPERATION:	**DRILLING**	ISSUE DATE:	18/8/97

PURPOSE: To ensure that all drilling is carried out safely and to design.

P2.1 The bench is to be cleared to enable access for the drill rig and explosives truck.

P2.2 The contractor shall mark out all holes to be drilled.

P2.3 The blasting contractor shall provide the driller with a Drilling Plan which will contain the following information:

- hole diameter
- depth of holes
- subgrade
- inclination of holes
- hole spacings
- hole burden

P2.4 The Driller shall measure the depth of each hole and confirm that it is the required depth before moving on. Where possible the front row of holes will be drilled first.

P2.5 The Driller shall advise the Quarry Manager when the front and side rows have been completed to ensure that the holes are surveyed before the drill rig leaves the site.

P2.6 All completed holes are to be sealed by plastic bags or the like to prevent accidental collapse or filling of the hole.

P2.7 The Driller is required to keep a daily log and shall include:

- final depth of hole
- angle of hole
- hard bands of rock
- presence of water
- stability of holes

The driller shall highlight any exceptions to the drilling plan.

A copy of the driller's log is to be given to the Quarry Manager and shotfirer.

P2.8 The front row of holes and any side holes are to be checked for accuracy using survey equipment.

P2.9 The Driller is responsible for the maintenance, breakdown and efficiency of the drill rig. All problems to be reported to the Quarry Manager at the earliest stage.

QUARRY:	JANDRA	PAGE NO.:	7 of 13
PROCEDURE NO.:	P 3	ISSUE NO.:	4
OPERATION:	**BLASTING**	ISSUE DATE:	19/4/99

PURPOSE: To ensure safe and efficient blasting practices.

P3.1 At least 48 hours prior to the blast, written notification of the proposed blast is to be given to the following neighbours:

Lot 10, DP790056 (YC & LS Centre)
Lot 11, DP790056 (CSR Tenant)
Lot 4, DP790058 (Loveday)
Lot 5, DP790058 (Mowbray)

The Jandra Quarry "Blast Notice" form is to be used for this purpose. This form will include the warning siren information outlined in P3.10 and P3.11.

P3.2 All blasting is to be fired and supervised by a certified shot firer in accordance with Mines Inspection Act 1901.

P3.3 Before loading holes the driller's log shall be reviewed by the blasting contractor and any modifications are to be made accordingly.

P3.4 Prior to loading a shot a blast initiation pattern and loading chart shall be drawn up by the blasting contractor and authorised by the Quarry Manager.

P3.5 Prior to actual blasting, the shot area is to be cleared, by CSR, of all materials that may contaminate raw feed, including plastic, boxes and used drilling consumables.

P3.6 All holes are to be double primed where bench height is over 10 metres.
Stemming is to be a minimum 3.0 metres.
Burden is to be a minimum 2.5 metres on the front and side holes.
Any variation to these must be approved by the Quarry Manager.

P3.7 The stemming material is to be 10mm or 14mm aggregate.

QUARRY:	JANDRA	PAGE NO.:	8 of 13
PROCEDURE NO.:	P 3	ISSUE NO.:	4
OPERATION:	**BLASTING (cont'd)**	ISSUE DATE:	19/4/99

P3.8 Quarry excavation plant shall not work within 15m of any loaded shot.

P3.9 Prior to blasting the shotfirer shall demand the removal of all persons from the quarry blast area. All access routes to the quarry area are to be closed off. A second check of the blast area shall be made.

P3.10 Before all blasts the warning siren shall be sounded as follows:

- 3 short sounds three minutes before firing
- 2 short sounds one minute before firing
- 1 short sound ten seconds before firing

P3.11 After the blast and prior to normal operations recommencing the Shotfirer shall inspect the shot site to ensure complete initiation. The result of the inspection is to be given to the Quarry Manager. The Manager shall then instruct the "all clear " signal to be sounded.

"All clear"signal: one long sound of the warning siren.

P3.12 Any misfires are to be reported to the Dept. of Mineral Resources Inspector. The procedure for dealing with any misfire shall be determined by the blasting contractor and Quarry Manager in consultation with the Mines Inspector in accordance with the Mineral Resources Regulations.

P3.13 If rock from blasting is projected outside the boundaries of the quarry, the Manager or Supervisor must notify the Dept. of Mineral Resources Inspector as soon as possible but no later than 24 hours after blasting. The contact number is (067) 702 100 or (02) 9901 8470 if local inspector is unavailable.

P3.14 Following any blasting a blast report shall be completed and signed off by the blasting contractor. The report shall include the results of any instructed blast monitoring referred to in Procedure P1.5

P3.15 Secondary blasting shall not be permitted.

QUARRY:	JANDRA	PAGE NO.:	10 of 13
PROCEDURE NO.:	P 4	ISSUE NO.:	1
OPERATION:	**REVIEW**	ISSUE DATE:	11/4/97

PURPOSE: To ensure that the drill and blast procedures are reviewed for effectiveness

P4.1 All complaints are to be immediately investigated.

P4.2 All complaints and their outcomes are to be recorded.

P4.3 The Drilling and Blasting Procedures are to be reviewed within one week of the blast by the Quarry Manager in consultation with the driller and blasting contractor.

P4.4 Results of monitoring are to be provided to:

- Environmental Protection Authority
- Greater Taree City Council

P4.5 The Jandra Quarry "Drilling and Blasting Check List" is to be completed for every blast by the Quarry Manager in consultation with the driller and blasting contractor.

CSR CONSTRUCTION MATERIALS (COUNTRY NSW & VIC) - QUARRIES

JANDRA QUARRY

DRILLING AND BLASTING CHECK LIST

(Issue No. 2)

To be completed by Manager in consultation with driller and blasting contractor.

tick box

P1 PLANNING AND DESIGN:

1. Has blasting contractor been given required notice of proposed blast and quantity of rock ? ☐

2. Has raw feed and loose material been removed from the front and top of the proposed shot prior to site inspection by blasting contractor? ☐

3. Has access been provided for the drill rig and explosives truck? ☐

4. Has blast design considered all safety and environmental hazards as outlined in Procedure P1.5? ☐

5. Provided by blasting contractor: Estimated overpressure ....dBL

   Estimated ground vibration ....mm/sec

6. Is a protective cover required to control flyrock? Yes ☐ No ☐

7. Has design been checked for compatibility with the site? ☐

DRILLING AND BLASTING CHECK LIST (cont'd)

P2 DRILLING:

8. Has blast design and drilling plan been explained to the driller? ☐

9. Have all drill holes been sealed adequately ? ☐

10. Has drill log been completed with all required details? (see P2.6) ☐

11. Are there any exception to the drilling plan? Yes ☐ No ☐

    If yes, comment: ....

12. Has drill hole accuracy been checked? ☐

BLASTING:

13. Have neighbours been given minimum 48 hour notification of the proposed blast as per Procedure P3.1 ☐

14. Has driller's log been reviewed by the blasting contractor? ☐

15. Stemming material used: 10mm agg. ☐ 14mm agg. ☐

16. Burden, spacing and stemming depths OK ? ☐

17. Has all contamination been removed from the blast area ? ☐

Prior to blast:

18. Has required monitoring been set up ? ☐

19. Are climatic conditions suitable ? ☐
    comments: ....

DRILLING AND BLASTING CHECK LIST (cont'd)

20. Have all personnel been briefed regarding the blast ? ☐

21. Has traffic control been arranged ? ☐

22. Has all plant and equipment been screened or relocated away from the blast ? ☐

23. Has quarry blast area been cleared ? ☐

24. Are all personnel accounted for ? ☐

25. Have all warning sirens been sounded as per procedure P3.9 ☐

After the shot:

26. Did blast go off ? ☐

27. Has shot area been inspected by shotfirer? ☐

28. Has plant and equipment been checked for damage ? ☐

    comments:..

29. Has the "All Clear" signal been given? ☐

30. OK given for road and area to be reopened for normal operation ? ☐

31. Have there been any complaints about the blast? No ☐ Yes ☐
    If yes, attach details.

Signed: ....
Quarry Manager

Date: ....

JANDRA QUARRY
EXTENSION

CSR

I. SOIL TEST RESULTS

ERM Mitchell McCotter Quality System

Referred to	NB	Ref. No.	38070

Date Received: 19·4·99
Source: Scone Soil Lab

	Yes	No
Data suitability check required	☑	☐
Data is: Current	☑	☐
Applicable to project	☑	☐

Checked by: NB
Attach explanation for "no" answers or data problems

Signature: .... Date: ....

SOIL TEST REPORT

Scone Research Service Centre

REPORT NO: SCO99/111R1

REPORT TO:
Nicky Barkwill
ERM Mitchell McCotter
P.O. Box 487
TAREE, 2430

REPORT ON:
Six soil samples
Job 38070 Jandra Quarry Ext.

PRELIMINARY RESULTS ISSUED: 6 April, 1999

REPORT STATUS: Final

DATE REPORTED: 8 April, 1999

METHODS: Information on test procedures can be obtained from Scone Research Service Centre

TESTING CARRIED OUT ON SAMPLE AS RECEIVED.
THIS DOCUMENT MAY NOT BE REPRODUCED EXCEPT IN FULL.

G Holman.

G. Holman
(Technical Officer)

Gundy Road Scone NSW 2337 P.O. Box 283 Scone NSW 2337 DX 4206
Telephone (02) 65451666 Facsimile (02)65452520

SOIL AND WATER TESTING LABORATORY
Scone Research Service Centre

Report No.: SCO99/111R1
Client Reference: Nicky Barkwill
ERM Mitchell McCotter
P.O. Box 487
TAREE, 2430

Lab. No.	Method	C1A/3	C2A/2	C6A/2	C8A/2	P9B/2	P8A/2	C5A/3 CEC & exch. cations (me/100g)					
	Sample Id.	EC (dS/m)	pH	OC (%)	P (mg/kg)	EAT	D (%)	CEC	Na	K	Ca	Mg	Al
1.	38070 Moist Forest H1	0.06	5.6	5.26	5	3(2)	29	12.7	0.4	0.4	4.2	4.0	1.9
2.	38070 Moist Forest H2	0.05	5.3	0.83	<1	5	15	16.2	0.5	0.2	1.0	3.7	8.8
3.	38070 DOF Site 1 H1	0.08	6.5	4.06	6	8/3(1)	34	17.7	0.3	0.5	10.3	4.4	nd
4.	38070 DOF Site 1 H2	0.06	6.5	2.31	4	3(1)	46	11.4	0.2	0.3	5.7	3.2	nd
5.	38070 DOF Site 2 H1	0.07	5.6	2.78	3	8/3(1)	40	9.1	0.2	0.5	3.7	2.7	0.2
6.	38070 DOF Site 2 H2	0.04	5.9	0.52	2	2(1)	67	8.3	0.2	0.4	1.3	3.8	0.7

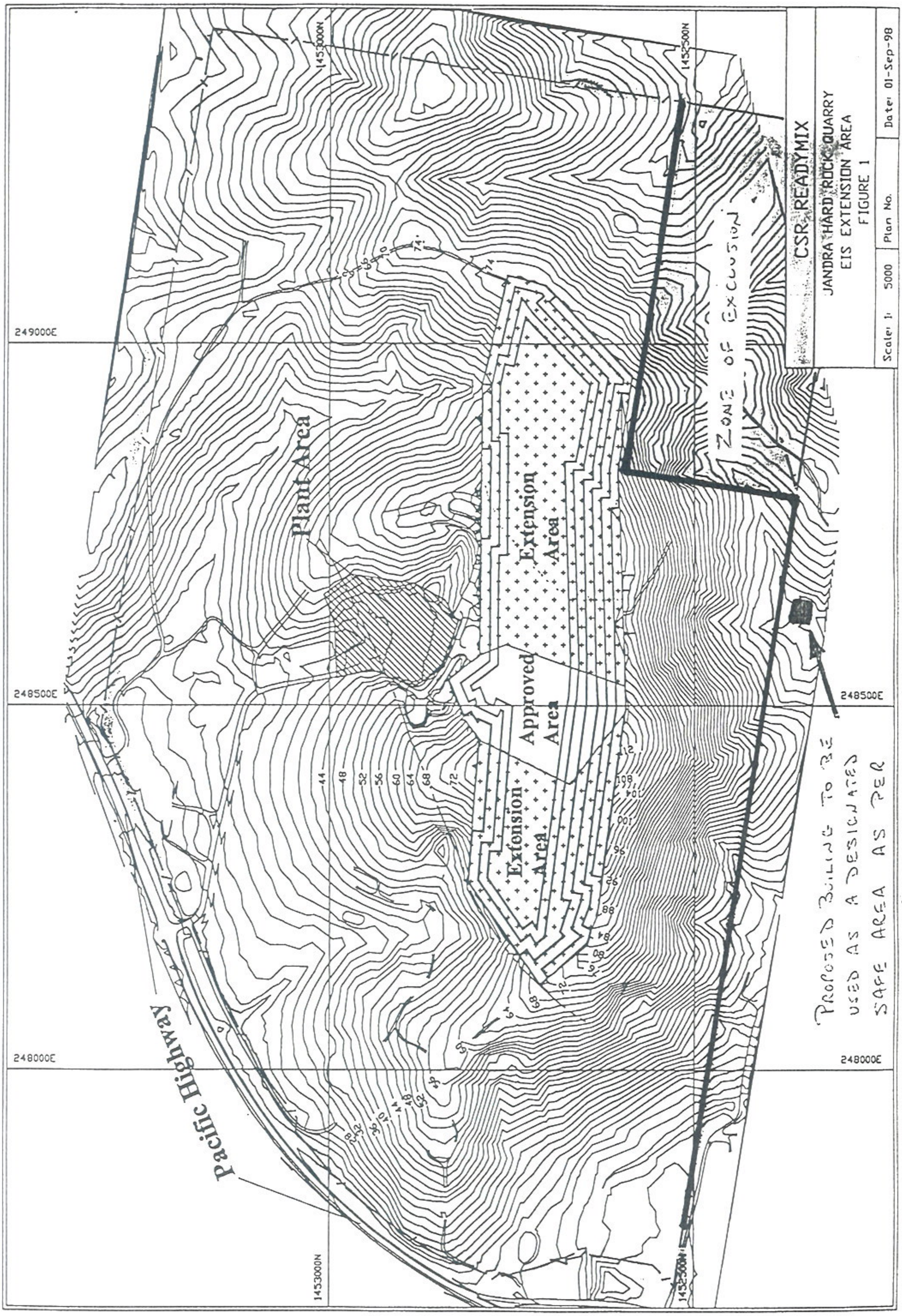
nd = not detected

Lab. No.	Method	P7B/1 Particle Size Analysis (%)					P7C/1 Particle Size Analysis - Mechanical Dispersion (%)				
	Sample Id.	clay	silt	f.sand	c.sand	gravel	clay	silt	f.sand	c.sand	gravel
1.	38070 Moist Forest H1	26	36	16	11	11	24	31	18	16	11
2.	38070 Moist Forest H2	68	20	2	4	6	22	27	32	13	6
3.	38070 DOF Site 1 H1	16	19	17	24	24	10	22	19	25	24
4.	38070 DOF Site 1 H2	20	19	18	18	25	12	27	17	19	25
5.	38070 DOF Site 2 H1	16	18	28	25	13	6	24	30	27	13
6.	38070 DOF Site 2 H2	17	16	26	22	19	7	23	27	24	19

G. Holman.

END OF TEST REPORT

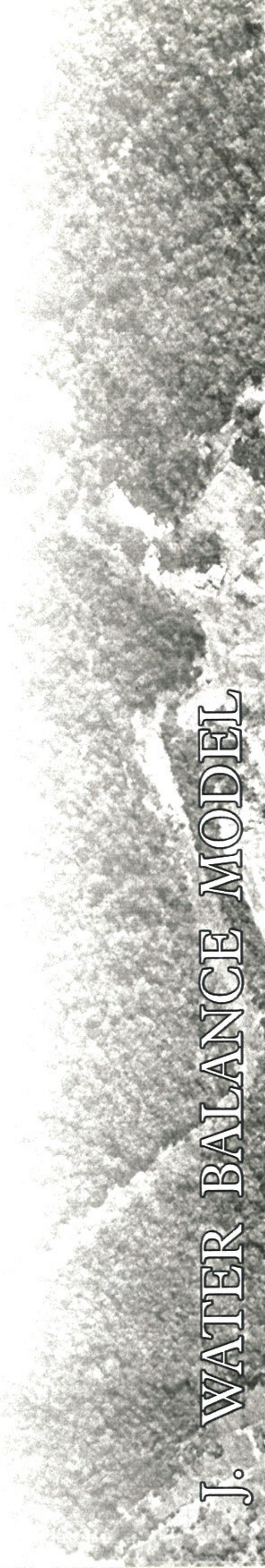
APPENDIX 1


CSR READYMIX
JANDRA HARD ROCK QUARRY
EIS EXTENSION AREA
FIGURE 1
Scale 1: 5000
Plan No.
Date: 01-Sep-98
Plant Area
Extension Area
Approved Area
Extension Area
Pacific Highway
ZONE OF EXCLUSION
PROPOSED BUILDING TO BE
USED AS A DESIGNATED
SAFE AREA AS PER
249000E
248500E
248000E
1453000N
1452500N

JANDRA QUARRY

EXTENSION

CSR



J. WATER BALANCE MODEL

JANDRA QUARRY - WATER BALANCE
DRY YEAR

Simple Water Balance

STAGE 1

Runoff Coeff's		Surf. Areas		
Quarry	0.35	0.09 km2	Assumed Storage	
Stockpile Area	0.30	0.07 km2	Volume	10.10 ML
Batching Area	0.30	0.02 km2	Surface Area	5050.00 m2
Haul Roads	0.45	1140.00 m	Assumed Production	
			Annual	250000.00 tonnes

	WATER SOURCES					WATER DEMANDS									
	Rainfall Dry	Quarry	Stockpile Area	Batching Area	TOTAL RUNOFF AVAIL (ML)	Haul Roads Dust Supp	Plant Dust Supp	Road Base	Truck Wash Demand	Dam Evapo. Loss	Pan Evap (mm)	TOTAL MONTHLY DEMAND	Storage	discharge	deficit
													5.05		
J	112.20	3.61	2.26	0.81	6.68	2.05	0.31	0.36	0.01	0.64	179.80	3.37	8.35	0.00	0.00
F	58.20	1.87	1.17	0.42	3.46	1.69	0.31	0.36	0.01	0.52	148.40	2.90	8.91	0.00	0.00
M	133.90	4.31	2.69	0.96	7.97	1.55	0.31	0.36	0.01	0.48	136.40	2.72	10.10	4.06	0.00
A	68.30	2.20	1.37	0.49	4.06	1.16	0.31	0.36	0.01	0.36	102.00	2.21	10.10	1.85	0.00
M	46.00	1.48	0.92	0.33	2.74	0.74	0.31	0.36	0.01	0.23	65.10	1.66	10.10	1.08	0.00
J	53.60	1.73	1.08	0.39	3.19	0.62	0.31	0.36	0.01	0.19	54.00	1.49	10.10	1.70	0.00
J	18.10	0.58	0.36	0.13	1.08	0.71	0.31	0.36	0.01	0.22	62.00	1.61	9.56	0.00	0.00
A	8.10	0.26	0.16	0.06	0.48	0.99	0.31	0.36	0.01	0.31	86.80	1.98	8.06	0.00	0.00
S	37.90	1.22	0.76	0.27	2.26	1.30	0.31	0.36	0.01	0.40	114.00	2.39	7.93	0.00	0.00
O	24.90	0.80	0.50	0.18	1.48	1.66	0.31	0.36	0.01	0.52	145.70	2.86	6.55	0.00	0.00
N	6.80	0.22	0.14	0.05	0.40	1.81	0.31	0.36	0.01	0.56	159.00	3.06	3.89	0.00	0.00
D	183.40	5.91	3.69	1.32	10.91	2.19	0.31	0.36	0.01	0.68	192.20	3.56	10.10	1.14	0.00
J	112.20	3.61	2.26	0.81	6.68	2.05	0.31	0.36	0.01	0.64	179.80	3.37	10.10	3.30	0.00
F	58.20	1.87	1.17	0.42	3.46	1.69	0.31	0.36	0.01	0.52	148.40	2.90	10.10	0.56	0.00
M	133.90	4.31	2.69	0.96	7.97	1.55	0.31	0.36	0.01	0.48	136.40	2.72	10.10	5.24	0.00
A	68.30	2.20	1.37	0.49	4.06	1.16	0.31	0.36	0.01	0.36	102.00	2.21	10.10	1.85	0.00
M	46.00	1.48	0.92	0.33	2.74	0.74	0.31	0.36	0.01	0.23	65.10	1.66	10.10	1.08	0.00
J	53.60	1.73	1.08	0.39	3.19	0.62	0.31	0.36	0.01	0.19	54.00	1.49	10.10	1.70	0.00
J	18.10	0.58	0.36	0.13	1.08	0.71	0.31	0.36	0.01	0.22	62.00	1.61	9.56	0.00	0.00
A	8.10	0.26	0.16	0.06	0.48	0.99	0.31	0.36	0.01	0.31	86.80	1.98	8.06	0.00	0.00
S	37.90	1.22	0.76	0.27	2.26	1.30	0.31	0.36	0.01	0.40	114.00	2.39	7.93	0.00	0.00
O	24.90	0.80	0.50	0.18	1.48	1.66	0.31	0.36	0.01	0.52	145.70	2.86	6.55	0.00	0.00
N	6.80	0.22	0.14	0.05	0.40	1.81	0.31	0.36	0.01	0.56	159.00	3.06	3.89	0.00	0.00
D	183.40	5.91	3.69	1.32	10.91	2.19	0.31	0.36	0.01	0.68	192.20	3.56	10.10	1.14	0.00

JANDRA QUARRY - WATER BALANCE
AVERAGE YEAR

Simple Water Balance

STAGE 1

Runoff Coeff's		Surf. Areas		Assumed Storage	
Quarry	0.35	0.09	km2		
Stockpile Area	0.30	0.07	km2	Volume	10.10 ML
Batching Area	0.30	0.02	km2	Surface Area	5050.00 m2
Haul Roads	0.45	1140.00	m	Assumed Production	
				Annual	250000.00 tonnes

	WATER SOURCES				TOTAL	Haul	WATER DEMANDS								
	Rainfall Average	Quarry	Stockpile Area	Batching Area	RUNOFF AVAIL (ML)	Roads Dust Supp	Plant Dust Supp	Road Base	Truck Wash Demand	Dam Evapo. Loss	Pan Evap (mm)	TOTAL MONTHLY DEMAND	Storage	discharge	deficit
													5.05		
J	19.00	0.61	0.38	0.14	1.13	2.05	0.31	0.36	0.01	0.64	179.80	3.37	2.81	0.00	0.00
F	215.70	6.95	4.34	1.55	12.83	1.69	0.31	0.36	0.01	0.52	148.40	2.90	10.10	2.64	0.00
M	44.00	1.42	0.88	0.32	2.62	1.55	0.31	0.36	0.01	0.48	136.40	2.72	9.99	0.00	0.00
A	183.00	5.89	3.68	1.32	10.89	1.16	0.31	0.36	0.01	0.36	102.00	2.21	10.10	8.57	0.00
M	264.20	8.51	5.31	1.90	15.72	0.74	0.31	0.36	0.01	0.23	65.10	1.66	10.10	14.06	0.00
J	28.00	0.90	0.56	0.20	1.67	0.62	0.31	0.36	0.01	0.19	54.00	1.49	10.10	0.17	0.00
J	16.00	0.52	0.32	0.12	0.95	0.71	0.31	0.36	0.01	0.22	62.00	1.61	9.44	0.00	0.00
A	6.40	0.21	0.13	0.05	0.38	0.99	0.31	0.36	0.01	0.31	86.80	1.98	7.84	0.00	0.00
S	6.80	0.22	0.14	0.05	0.40	1.30	0.31	0.36	0.01	0.40	114.00	2.39	5.85	0.00	0.00
O	102.70	3.31	2.06	0.74	6.11	1.66	0.31	0.36	0.01	0.52	145.70	2.86	9.10	0.00	0.00
N	190.80	6.14	3.84	1.37	11.35	1.81	0.31	0.36	0.01	0.56	159.00	3.06	10.10	7.29	0.00
D	72.10	2.32	1.45	0.52	4.29	2.19	0.31	0.36	0.01	0.68	192.20	3.56	10.10	0.73	0.00
J	19.00	0.61	0.38	0.14	1.13	2.05	0.31	0.36	0.01	0.64	179.80	3.37	7.86	0.00	0.00
F	215.70	6.95	4.34	1.55	12.83	1.69	0.31	0.36	0.01	0.52	148.40	2.90	10.10	7.69	0.00
M	44.00	1.42	0.88	0.32	2.62	1.55	0.31	0.36	0.01	0.48	136.40	2.72	9.99	0.00	0.00
A	183.00	5.89	3.68	1.32	10.89	1.16	0.31	0.36	0.01	0.36	102.00	2.21	10.10	8.57	0.00
M	264.20	8.51	5.31	1.90	15.72	0.74	0.31	0.36	0.01	0.23	65.10	1.66	10.10	14.06	0.00
J	28.00	0.90	0.56	0.20	1.67	0.62	0.31	0.36	0.01	0.19	54.00	1.49	10.10	0.17	0.00
J	16.00	0.52	0.32	0.12	0.95	0.71	0.31	0.36	0.01	0.22	62.00	1.61	9.44	0.00	0.00
A	6.40	0.21	0.13	0.05	0.38	0.99	0.31	0.36	0.01	0.31	86.80	1.98	7.84	0.00	0.00
S	6.80	0.22	0.14	0.05	0.40	1.30	0.31	0.36	0.01	0.40	114.00	2.39	5.85	0.00	0.00
O	102.70	3.31	2.06	0.74	6.11	1.66	0.31	0.36	0.01	0.52	145.70	2.86	9.10	0.00	0.00
N	190.80	6.14	3.84	1.37	11.35	1.81	0.31	0.36	0.01	0.56	159.00	3.06	10.10	7.29	0.00
D	72.10	2.32	1.45	0.52	4.29	2.19	0.31	0.36	0.01	0.68	192.20	3.56	10.10	0.73	0.00

JANDRA QUARRY - WATER BALANCE
WET YEAR

Simple Water Balance

STAGE 1

Runoff Coeff's		**Surf. Areas**		**Assumed Storage**	
Quarry	0.35	0.09	km2		
Stockpile Area	0.30	0.07	km2	Volume	10.10 ML
Batching Area	0.30	0.02	km2	Surface Area	5050.00 m2
Haul Roads	0.45	1140.00	m	**Assumed Production**	
				Annual	250000.00 tonnes

	WATER SOURCES				TOTAL RUNOFF AVAIL (ML)	WATER DEMANDS									
	Rainfall Wet	Quarry	Stockpile Area	Batching Area		Haul Roads Dust Supp	Plant Dust Supp	Road Base	Truck Wash Demand	Dam Evapo. Loss	Pan Evap (mm)	TOTAL MONTHLY DEMAND	Storage	discharge	deficit
													5.05		
J	245.20	7.90	4.93	1.77	14.59	2.05	0.31	0.36	0.01	0.64	179.80	3.37	10.10	6.17	0.00
F	51.10	1.65	1.03	0.37	3.04	1.69	0.31	0.36	0.01	0.52	148.40	2.90	10.10	0.14	0.00
M	104.80	3.37	2.11	0.75	6.24	1.55	0.31	0.36	0.01	0.48	136.40	2.72	10.10	3.51	0.00
A	448.50	14.44	9.01	3.23	26.69	1.16	0.31	0.36	0.01	0.36	102.00	2.21	10.10	24.48	0.00
M	295.20	9.51	5.93	2.13	17.56	0.74	0.31	0.36	0.01	0.23	65.10	1.66	10.10	15.91	0.00
J	8.90	0.29	0.18	0.06	0.53	0.62	0.31	0.36	0.01	0.19	54.00	1.49	9.14	0.00	0.00
J	112.40	3.62	2.26	0.81	6.69	0.71	0.31	0.36	0.01	0.22	62.00	1.61	10.10	4.11	0.00
A	47.60	1.53	0.96	0.34	2.83	0.99	0.31	0.36	0.01	0.31	86.80	1.98	10.10	0.85	0.00
S	23.30	0.75	0.47	0.17	1.39	1.30	0.31	0.36	0.01	0.40	114.00	2.39	9.10	0.00	0.00
O	79.60	2.56	1.60	0.57	4.74	1.66	0.31	0.36	0.01	0.52	145.70	2.86	10.10	0.87	0.00
N	26.80	0.86	0.54	0.19	1.59	1.81	0.31	0.36	0.01	0.56	159.00	3.06	8.63	0.00	0.00
D	249.00	8.02	5.00	1.79	14.82	2.19	0.31	0.36	0.01	0.68	192.20	3.56	10.10	9.79	0.00
J	245.20	7.90	4.93	1.77	14.59	2.05	0.31	0.36	0.01	0.64	179.80	3.37	10.10	11.22	0.00
F	51.10	1.65	1.03	0.37	3.04	1.69	0.31	0.36	0.01	0.52	148.40	2.90	10.10	0.14	0.00
M	104.80	3.37	2.11	0.75	6.24	1.55	0.31	0.36	0.01	0.48	136.40	2.72	10.10	3.51	0.00
A	448.50	14.44	9.01	3.23	26.69	1.16	0.31	0.36	0.01	0.36	102.00	2.21	10.10	24.48	0.00
M	295.20	9.51	5.93	2.13	17.56	0.74	0.31	0.36	0.01	0.23	65.10	1.66	10.10	15.91	0.00
J	8.90	0.29	0.18	0.06	0.53	0.62	0.31	0.36	0.01	0.19	54.00	1.49	9.14	0.00	0.00
J	112.40	3.62	2.26	0.81	6.69	0.71	0.31	0.36	0.01	0.22	62.00	1.61	10.10	4.11	0.00
A	47.60	1.53	0.96	0.34	2.83	0.99	0.31	0.36	0.01	0.31	86.80	1.98	10.10	0.85	0.00
S	23.30	0.75	0.47	0.17	1.39	1.30	0.31	0.36	0.01	0.40	114.00	2.39	9.10	0.00	0.00
O	79.60	2.56	1.60	0.57	4.74	1.66	0.31	0.36	0.01	0.52	145.70	2.86	10.10	0.87	0.00
N	26.80	0.86	0.54	0.19	1.59	1.81	0.31	0.36	0.01	0.56	159.00	3.06	8.63	0.00	0.00
D	249.00	8.02	5.00	1.79	14.82	2.19	0.31	0.36	0.01	0.68	192.20	3.56	10.10	9.79	0.00

JANDRA QUARRY - WATER BALANCE

DRY YEAR

Simple Water Balance

STAGE 2

Runoff Coeff's		Surf. Areas		
Quarry	0.35	0.130 km2	**Assumed Storage**	
Stockpile Area	0.30	0.067 km2	Volume	12.20 ML
Batching Area	0.20	0.024 km2	Surface Area	6100.00 m2
Haul Roads	0.45	1440.00 m	**Assumed Production**	
			Annual	250000.00 tonnes

	WATER SOURCES				TOTAL	Haul	WATER DEMANDS								
	Rainfall Dry	Quarry	Stockpile Area	Batching Area	RUNOFF AVAIL (ML)	Roads Dust Supp	Plant Dust Supp	Road Base	Truck Wash Demand	Dam Evapo. Loss	Pan Evap (mm)	TOTAL MONTHLY DEMAND	Storage	discharge	deficit
													6.10		
J	112.20	5.11	2.26	0.54	7.90	2.59	0.31	0.36	0.01	0.77	179.80	4.04	9.95	0.00	0.00
F	58.20	2.65	1.17	0.28	4.10	2.14	0.31	0.36	0.01	0.63	148.40	3.46	10.59	0.00	0.00
M	133.90	6.09	2.69	0.64	9.43	1.96	0.31	0.36	0.01	0.58	136.40	3.23	12.20	4.59	0.00
A	68.30	3.11	1.37	0.33	4.81	1.47	0.31	0.36	0.01	0.44	102.00	2.59	12.20	2.22	0.00
M	46.00	2.09	0.92	0.22	3.24	0.94	0.31	0.36	0.01	0.28	65.10	1.90	12.20	1.34	0.00
J	53.60	2.44	1.08	0.26	3.77	0.78	0.31	0.36	0.01	0.23	54.00	1.70	12.20	2.08	0.00
J	18.10	0.82	0.36	0.09	1.27	0.89	0.31	0.36	0.01	0.26	62.00	1.84	11.63	0.00	0.00
A	8.10	0.37	0.16	0.04	0.57	1.25	0.31	0.36	0.01	0.37	86.80	2.31	9.89	0.00	0.00
S	37.90	1.72	0.76	0.18	2.67	1.64	0.31	0.36	0.01	0.49	114.00	2.82	9.74	0.00	0.00
O	24.90	1.13	0.50	0.12	1.75	2.10	0.31	0.36	0.01	0.62	145.70	3.41	8.09	0.00	0.00
N	6.80	0.31	0.14	0.03	0.48	2.29	0.31	0.36	0.01	0.68	159.00	3.66	4.91	0.00	0.00
D	183.40	8.34	3.69	0.88	12.91	2.77	0.31	0.36	0.01	0.82	192.20	4.28	12.20	1.35	0.00
J	112.20	5.11	2.26	0.54	7.90	2.59	0.31	0.36	0.01	0.77	179.80	4.04	12.20	3.85	0.00
F	58.20	2.65	1.17	0.28	4.10	2.14	0.31	0.36	0.01	0.63	148.40	3.46	12.20	0.64	0.00
M	133.90	6.09	2.69	0.64	9.43	1.96	0.31	0.36	0.01	0.58	136.40	3.23	12.20	6.19	0.00
A	68.30	3.11	1.37	0.33	4.81	1.47	0.31	0.36	0.01	0.44	102.00	2.59	12.20	2.22	0.00
M	46.00	2.09	0.92	0.22	3.24	0.94	0.31	0.36	0.01	0.28	65.10	1.90	12.20	1.34	0.00
J	53.60	2.44	1.08	0.26	3.77	0.78	0.31	0.36	0.01	0.23	54.00	1.70	12.20	2.08	0.00
J	18.10	0.82	0.36	0.09	1.27	0.89	0.31	0.36	0.01	0.26	62.00	1.84	11.63	0.00	0.00
A	8.10	0.37	0.16	0.04	0.57	1.25	0.31	0.36	0.01	0.37	86.80	2.31	9.89	0.00	0.00
S	37.90	1.72	0.76	0.18	2.67	1.64	0.31	0.36	0.01	0.49	114.00	2.82	9.74	0.00	0.00
O	24.90	1.13	0.50	0.12	1.75	2.10	0.31	0.36	0.01	0.62	145.70	3.41	8.09	0.00	0.00
N	6.80	0.31	0.14	0.03	0.48	2.29	0.31	0.36	0.01	0.68	159.00	3.66	4.91	0.00	0.00
D	183.40	8.34	3.69	0.88	12.91	2.77	0.31	0.36	0.01	0.82	192.20	4.28	12.20	1.35	0.00

JANDRA QUARRY - WATER BALANCE
AVERAGE YEAR

Simple Water Balance

STAGE 2

Runoff Coeff's		**Surf. Areas**	**Assumed Storage**	
Quarry	0.35	0.130 km2		
Stockpile Area	0.30	0.067 km2	Volume	12.20 ML
Batching Area	0.20	0.024 km2	Surface Area	6100.00 m2
Haul Roads	0.45	1440.00 m	**Assumed Production**	
			Annual	250000.00 tonnes

	WATER SOURCES				TOTAL RUNOFF AVAIL (ML)	WATER DEMANDS						TOTAL MONTHLY DEMAND	Storage	discharge	deficit
	Rainfall Average	Quarry	Stockpile Area	Batching Area		Haul Roads Dust Supp	Plant Dust Supp	Road Base	Truck Wash Demand	Dam Evapo. Loss	Pan Evap (mm)				
													6.10		
J	19.00	0.86	0.38	0.09	1.34	2.59	0.31	0.36	0.01	0.77	179.80	4.04	3.39	0.00	0.00
F	215.70	9.81	4.34	1.04	15.19	2.14	0.31	0.36	0.01	0.63	148.40	3.46	12.20	2.92	0.00
M	44.00	2.00	0.88	0.21	3.10	1.96	0.31	0.36	0.01	0.58	136.40	3.23	12.06	0.00	0.00
A	183.00	8.33	3.68	0.88	12.88	1.47	0.31	0.36	0.01	0.44	102.00	2.59	12.20	10.16	0.00
M	264.20	12.02	5.31	1.27	18.60	0.94	0.31	0.36	0.01	0.28	65.10	1.90	12.20	16.70	0.00
J	28.00	1.27	0.56	0.13	1.97	0.78	0.31	0.36	0.01	0.23	54.00	1.70	12.20	0.28	0.00
J	16.00	0.73	0.32	0.08	1.13	0.89	0.31	0.36	0.01	0.26	62.00	1.84	11.48	0.00	0.00
A	6.40	0.29	0.13	0.03	0.45	1.25	0.31	0.36	0.01	0.37	86.80	2.31	9.62	0.00	0.00
S	6.80	0.31	0.14	0.03	0.48	1.64	0.31	0.36	0.01	0.49	114.00	2.82	7.29	0.00	0.00
O	102.70	4.67	2.06	0.49	7.23	2.10	0.31	0.36	0.01	0.62	145.70	3.41	11.11	0.00	0.00
N	190.80	8.68	3.84	0.92	13.43	2.29	0.31	0.36	0.01	0.68	159.00	3.66	12.20	8.69	0.00
D	72.10	3.28	1.45	0.35	5.08	2.77	0.31	0.36	0.01	0.82	192.20	4.28	12.20	0.80	0.00
J	19.00	0.86	0.38	0.09	1.34	2.59	0.31	0.36	0.01	0.77	179.80	4.04	9.49	0.00	0.00
F	215.70	9.81	4.34	1.04	15.19	2.14	0.31	0.36	0.01	0.63	148.40	3.46	12.20	9.02	0.00
M	44.00	2.00	0.88	0.21	3.10	1.96	0.31	0.36	0.01	0.58	136.40	3.23	12.06	0.00	0.00
A	183.00	8.33	3.68	0.88	12.88	1.47	0.31	0.36	0.01	0.44	102.00	2.59	12.20	10.16	0.00
M	264.20	12.02	5.31	1.27	18.60	0.94	0.31	0.36	0.01	0.28	65.10	1.90	12.20	16.70	0.00
J	28.00	1.27	0.56	0.13	1.97	0.78	0.31	0.36	0.01	0.23	54.00	1.70	12.20	0.28	0.00
J	16.00	0.73	0.32	0.08	1.13	0.89	0.31	0.36	0.01	0.26	62.00	1.84	11.48	0.00	0.00
A	6.40	0.29	0.13	0.03	0.45	1.25	0.31	0.36	0.01	0.37	86.80	2.31	9.62	0.00	0.00
S	6.80	0.31	0.14	0.03	0.48	1.64	0.31	0.36	0.01	0.49	114.00	2.82	7.29	0.00	0.00
O	102.70	4.67	2.06	0.49	7.23	2.10	0.31	0.36	0.01	0.62	145.70	3.41	11.11	0.00	0.00
N	190.80	8.68	3.84	0.92	13.43	2.29	0.31	0.36	0.01	0.68	159.00	3.66	12.20	8.69	0.00
D	72.10	3.28	1.45	0.35	5.08	2.77	0.31	0.36	0.01	0.82	192.20	4.28	12.20	0.80	0.00

JANDRA QUARRY - WATER BALANCE
WET YEAR

Simple Water Balance

STAGE 2

Runoff Coeff's		**Surf. Areas**	
Quarry	0.35	0.130 km2	
Stockpile Area	0.30	0.067 km2	
Batching Area	0.20	0.024 km2	
Haul Roads	0.45	1440.00 m	

Assumed Storage
Volume 12.20 ML
Surface Area 6100.00 m2

Assumed Production
Annual 250000.00 tonnes

	WATER SOURCES				TOTAL RUNOFF AVAIL (ML)	WATER DEMANDS									
	Rainfall Wet	Quarry	Stockpile Area	Batching Area		Haul Roads Dust Supp	Plant Dust Supp	Road Base	Truck Wash Demand	Dam Evapo. Loss	Pan Evap (mm)	TOTAL MONTHLY DEMAND	Storage	discharge	deficit
													6.10		
J	245.20	11.16	4.93	1.18	17.26	2.59	0.31	0.36	0.01	0.77	179.80	4.04	12.20	7.12	0.00
F	51.10	2.33	1.03	0.25	3.60	2.14	0.31	0.36	0.01	0.63	148.40	3.46	12.20	0.14	0.00
M	104.80	4.77	2.11	0.50	7.38	1.96	0.31	0.36	0.01	0.58	136.40	3.23	12.20	4.14	0.00
A	448.50	20.41	9.01	2.15	31.57	1.47	0.31	0.36	0.01	0.44	102.00	2.59	12.20	28.98	0.00
M	295.20	13.43	5.93	1.42	20.78	0.94	0.31	0.36	0.01	0.28	65.10	1.90	12.20	18.88	0.00
J	8.90	0.40	0.18	0.04	0.63	0.78	0.31	0.36	0.01	0.23	54.00	1.70	11.13	0.00	0.00
J	112.40	5.11	2.26	0.54	7.91	0.89	0.31	0.36	0.01	0.26	62.00	1.84	12.20	5.00	0.00
A	47.60	2.17	0.96	0.23	3.35	1.25	0.31	0.36	0.01	0.37	86.80	2.31	12.20	1.04	0.00
S	23.30	1.06	0.47	0.11	1.64	1.64	0.31	0.36	0.01	0.49	114.00	2.82	11.02	0.00	0.00
O	79.60	3.62	1.60	0.38	5.60	2.10	0.31	0.36	0.01	0.62	145.70	3.41	12.20	1.02	0.00
N	26.80	1.22	0.54	0.13	1.89	2.29	0.31	0.36	0.01	0.68	159.00	3.66	10.43	0.00	0.00
D	249.00	11.33	5.00	1.20	17.53	2.77	0.31	0.36	0.01	0.82	192.20	4.28	12.20	11.49	0.00
J	245.20	11.16	4.93	1.18	17.26	2.59	0.31	0.36	0.01	0.77	179.80	4.04	12.20	13.22	0.00
F	51.10	2.33	1.03	0.25	3.60	2.14	0.31	0.36	0.01	0.63	148.40	3.46	12.20	0.14	0.00
M	104.80	4.77	2.11	0.50	7.38	1.96	0.31	0.36	0.01	0.58	136.40	3.23	12.20	4.14	0.00
A	448.50	20.41	9.01	2.15	31.57	1.47	0.31	0.36	0.01	0.44	102.00	2.59	12.20	28.98	0.00
M	295.20	13.43	5.93	1.42	20.78	0.94	0.31	0.36	0.01	0.28	65.10	1.90	12.20	18.88	0.00
J	8.90	0.40	0.18	0.04	0.63	0.78	0.31	0.36	0.01	0.23	54.00	1.70	11.13	0.00	0.00
J	112.40	5.11	2.26	0.54	7.91	0.89	0.31	0.36	0.01	0.26	62.00	1.84	12.20	5.00	0.00
A	47.60	2.17	0.96	0.23	3.35	1.25	0.31	0.36	0.01	0.37	86.80	2.31	12.20	1.04	0.00
S	23.30	1.06	0.47	0.11	1.64	1.64	0.31	0.36	0.01	0.49	114.00	2.82	11.02	0.00	0.00
O	79.60	3.62	1.60	0.38	5.60	2.10	0.31	0.36	0.01	0.62	145.70	3.41	12.20	1.02	0.00
N	26.80	1.22	0.54	0.13	1.89	2.29	0.31	0.36	0.01	0.68	159.00	3.66	10.43	0.00	0.00
D	249.00	11.33	5.00	1.20	17.53	2.77	0.31	0.36	0.01	0.82	192.20	4.28	12.20	11.49	0.00

DRY YEAR

Simple Water Balance

STAGE 3

Runoff Coeff's		Surf. Areas		
Quarry	0.35	0.171 km2	Assumed Storage	
Stockpile Area	0.30	0.067 km2	Volume	14.50 ML
Batching Area	0.20	0.024 km2	Surface Area	7250.00 m2
Haul Roads	0.45	1740.00 m	Assumed Production	
			Annual	250000.00 tonnes

	WATER SOURCES					WATER DEMANDS									
	Rainfall Dry	Quarry	Stockpile Area	Batching Area	TOTAL RUNOFF AVAIL (ML)	Haul Roads Dust Supp	Plant Dust Supp	Road Base	Truck Wash Demand	Dam Evapo. Loss	Pan Evap (mm)	TOTAL MONTHLY DEMAND	Storage	discharge	deficit
													7.25		
J	112.20	6.72	2.26	0.54	9.51	3.13	0.31	0.36	0.01	0.91	179.80	4.73	12.03	0.00	0.00
F	58.20	3.48	1.17	0.28	4.93	2.58	0.31	0.36	0.01	0.75	148.40	4.02	12.94	0.00	0.00
M	133.90	8.01	2.69	0.64	11.35	2.37	0.31	0.36	0.01	0.69	136.40	3.75	14.50	6.04	0.00
A	68.30	4.09	1.37	0.33	5.79	1.77	0.31	0.36	0.01	0.52	102.00	2.98	14.50	2.81	0.00
M	46.00	2.75	0.92	0.22	3.90	1.13	0.31	0.36	0.01	0.33	65.10	2.15	14.50	1.75	0.00
J	53.60	3.21	1.08	0.26	4.54	0.94	0.31	0.36	0.01	0.27	54.00	1.90	14.50	2.64	0.00
J	18.10	1.08	0.36	0.09	1.53	1.08	0.31	0.36	0.01	0.31	62.00	2.08	13.95	0.00	0.00
A	8.10	0.48	0.16	0.04	0.69	1.51	0.31	0.36	0.01	0.44	86.80	2.64	12.00	0.00	0.00
S	37.90	2.27	0.76	0.18	3.21	1.98	0.31	0.36	0.01	0.58	114.00	3.25	11.96	0.00	0.00
O	24.90	1.49	0.50	0.12	2.11	2.54	0.31	0.36	0.01	0.74	145.70	3.96	10.11	0.00	0.00
N	6.80	0.41	0.14	0.03	0.58	2.77	0.31	0.36	0.01	0.81	159.00	4.26	6.43	0.00	0.00
D	183.40	10.98	3.69	0.88	15.54	3.34	0.31	0.36	0.01	0.98	192.20	5.01	14.50	2.47	0.00
J	112.20	6.72	2.26	0.54	9.51	3.13	0.31	0.36	0.01	0.91	179.80	4.73	14.50	4.78	0.00
F	58.20	3.48	1.17	0.28	4.93	2.58	0.31	0.36	0.01	0.75	148.40	4.02	14.50	0.91	0.00
M	133.90	8.01	2.69	0.64	11.35	2.37	0.31	0.36	0.01	0.69	136.40	3.75	14.50	7.60	0.00
A	68.30	4.09	1.37	0.33	5.79	1.77	0.31	0.36	0.01	0.52	102.00	2.98	14.50	2.81	0.00
M	46.00	2.75	0.92	0.22	3.90	1.13	0.31	0.36	0.01	0.33	65.10	2.15	14.50	1.75	0.00
J	53.60	3.21	1.08	0.26	4.54	0.94	0.31	0.36	0.01	0.27	54.00	1.90	14.50	2.64	0.00
J	18.10	1.08	0.36	0.09	1.53	1.08	0.31	0.36	0.01	0.31	62.00	2.08	13.95	0.00	0.00
A	8.10	0.48	0.16	0.04	0.69	1.51	0.31	0.36	0.01	0.44	86.80	2.64	12.00	0.00	0.00
S	37.90	2.27	0.76	0.18	3.21	1.98	0.31	0.36	0.01	0.58	114.00	3.25	11.96	0.00	0.00
O	24.90	1.49	0.50	0.12	2.11	2.54	0.31	0.36	0.01	0.74	145.70	3.96	10.11	0.00	0.00
N	6.80	0.41	0.14	0.03	0.58	2.77	0.31	0.36	0.01	0.81	159.00	4.26	6.43	0.00	0.00
D	183.40	10.98	3.69	0.88	15.54	3.34	0.31	0.36	0.01	0.98	192.20	5.01	14.50	2.47	0.00

JANDRA QUARRY - WATER BALANCE
AVERAGE YEAR

Simple Water Balance

STAGE 3

Runoff Coeff's		Surf. Areas		
Quarry	0.35	0.171 km2	**Assumed Storage**	
Stockpile Area	0.30	0.067 km2	Volume	14.50 ML
Batching Area	0.20	0.024 km2	Surface Area	7250.00 m2
Haul Roads	0.45	1740.00 m	**Assumed Production**	
			Annual	250000.00 tonnes

	WATER SOURCES				TOTAL	Haul	WATER DEMANDS								
	Rainfall Average	Quarry	Stockpile Area	Batching Area	RUNOFF AVAIL (ML)	Roads Dust Supp	Plant Dust Supp	Road Base	Truck Wash Demand	Dam Evapo. Loss	Pan Evap (mm)	TOTAL MONTHLY DEMAND	Storage	discharge	deficit
													7.25		
J	19.00	1.14	0.38	0.09	1.61	3.13	0.31	0.36	0.01	0.91	179.80	4.73	4.13	0.00	0.00
F	215.70	12.91	4.34	1.04	18.28	2.58	0.31	0.36	0.01	0.75	148.40	4.02	14.50	3.89	0.00
M	44.00	2.63	0.88	0.21	3.73	2.37	0.31	0.36	0.01	0.69	136.40	3.75	14.48	0.00	0.00
A	183.00	10.95	3.68	0.88	15.51	1.77	0.31	0.36	0.01	0.52	102.00	2.98	14.50	12.51	0.00
M	264.20	15.81	5.31	1.27	22.39	1.13	0.31	0.36	0.01	0.33	65.10	2.15	14.50	20.24	0.00
J	28.00	1.68	0.56	0.13	2.37	0.94	0.31	0.36	0.01	0.27	54.00	1.90	14.50	0.47	0.00
J	16.00	0.96	0.32	0.08	1.36	1.08	0.31	0.36	0.01	0.31	62.00	2.08	13.78	0.00	0.00
A	6.40	0.38	0.13	0.03	0.54	1.51	0.31	0.36	0.01	0.44	86.80	2.64	11.68	0.00	0.00
S	6.80	0.41	0.14	0.03	0.58	1.98	0.31	0.36	0.01	0.58	114.00	3.25	9.01	0.00	0.00
O	102.70	6.15	2.06	0.49	8.70	2.54	0.31	0.36	0.01	0.74	145.70	3.96	13.75	0.00	0.00
N	190.80	11.42	3.84	0.92	16.17	2.77	0.31	0.36	0.01	0.81	159.00	4.26	14.50	11.16	0.00
D	72.10	4.32	1.45	0.35	6.11	3.34	0.31	0.36	0.01	0.98	192.20	5.01	14.50	1.10	0.00
J	19.00	1.14	0.38	0.09	1.61	3.13	0.31	0.36	0.01	0.91	179.80	4.73	11.38	0.00	0.00
F	215.70	12.91	4.34	1.04	18.28	2.58	0.31	0.36	0.01	0.75	148.40	4.02	14.50	11.14	0.00
M	44.00	2.63	0.88	0.21	3.73	2.37	0.31	0.36	0.01	0.69	136.40	3.75	14.48	0.00	0.00
A	183.00	10.95	3.68	0.88	15.51	1.77	0.31	0.36	0.01	0.52	102.00	2.98	14.50	12.51	0.00
M	264.20	15.81	5.31	1.27	22.39	1.13	0.31	0.36	0.01	0.33	65.10	2.15	14.50	20.24	0.00
J	28.00	1.68	0.56	0.13	2.37	0.94	0.31	0.36	0.01	0.27	54.00	1.90	14.50	0.47	0.00
J	16.00	0.96	0.32	0.08	1.36	1.08	0.31	0.36	0.01	0.31	62.00	2.08	13.78	0.00	0.00
A	6.40	0.38	0.13	0.03	0.54	1.51	0.31	0.36	0.01	0.44	86.80	2.64	11.68	0.00	0.00
S	6.80	0.41	0.14	0.03	0.58	1.98	0.31	0.36	0.01	0.58	114.00	3.25	9.01	0.00	0.00
O	102.70	6.15	2.06	0.49	8.70	2.54	0.31	0.36	0.01	0.74	145.70	3.96	13.75	0.00	0.00
N	190.80	11.42	3.84	0.92	16.17	2.77	0.31	0.36	0.01	0.81	159.00	4.26	14.50	11.16	0.00
D	72.10	4.32	1.45	0.35	6.11	3.34	0.31	0.36	0.01	0.98	192.20	5.01	14.50	1.10	0.00

JANDRA QUARRY - WATER BALANCE
WET YEAR

Simple Water Balance

STAGE 3

Runoff Coeff's		Surf. Areas	Assumed Storage	
Quarry	0.35	0.171 km2	Volume	14.50 ML
Stockpile Area	0.30	0.067 km2	Surface Area	7250.00 m2
Batching Area	0.20	0.024 km2		
Haul Roads	0.45	1740.00 m	**Assumed Production**	
			Annual	250000.00 tonnes

	WATER SOURCES					WATER DEMANDS									
	Rainfall Wet	Quarry	Stockpile Area	Batching Area	TOTAL RUNOFF AVAIL (ML)	Haul Roads Dust Supp	Plant Dust Supp	Road Base	Truck Wash Demand	Dam Evapo. Loss	Pan Evap (mm)	TOTAL MONTHLY DEMAND	Storage	discharge	deficit
													7.25		
J	245.20	14.68	4.93	1.18	20.78	3.13	0.31	0.36	0.01	0.91	179.80	4.73	14.50	8.80	0.00
F	51.10	3.06	1.03	0.25	4.33	2.58	0.31	0.36	0.01	0.75	148.40	4.02	14.50	0.31	0.00
M	104.80	6.27	2.11	0.50	8.88	2.37	0.31	0.36	0.01	0.69	136.40	3.75	14.50	5.13	0.00
A	448.50	26.84	9.01	2.15	38.01	1.77	0.31	0.36	0.01	0.52	102.00	2.98	14.50	35.03	0.00
M	295.20	17.67	5.93	1.42	25.02	1.13	0.31	0.36	0.01	0.33	65.10	2.15	14.50	22.87	0.00
J	8.90	0.53	0.18	0.04	0.75	0.94	0.31	0.36	0.01	0.27	54.00	1.90	13.35	0.00	0.00
J	112.40	6.73	2.26	0.54	9.53	1.08	0.31	0.36	0.01	0.31	62.00	2.08	14.50	6.30	0.00
A	47.60	2.85	0.96	0.23	4.03	1.51	0.31	0.36	0.01	0.44	86.80	2.64	14.50	1.40	0.00
S	23.30	1.39	0.47	0.11	1.97	1.98	0.31	0.36	0.01	0.58	114.00	3.25	13.23	0.00	0.00
O	79.60	4.76	1.60	0.38	6.75	2.54	0.31	0.36	0.01	0.74	145.70	3.96	14.50	1.51	0.00
N	26.80	1.60	0.54	0.13	2.27	2.77	0.31	0.36	0.01	0.81	159.00	4.26	12.51	0.00	0.00
D	249.00	14.90	5.00	1.20	21.10	3.34	0.31	0.36	0.01	0.98	192.20	5.01	14.50	14.11	0.00
J	245.20	14.68	4.93	1.18	20.78	3.13	0.31	0.36	0.01	0.91	179.80	4.73	14.50	16.05	0.00
F	51.10	3.06	1.03	0.25	4.33	2.58	0.31	0.36	0.01	0.75	148.40	4.02	14.50	0.31	0.00
M	104.80	6.27	2.11	0.50	8.88	2.37	0.31	0.36	0.01	0.69	136.40	3.75	14.50	5.13	0.00
A	448.50	26.84	9.01	2.15	38.01	1.77	0.31	0.36	0.01	0.52	102.00	2.98	14.50	35.03	0.00
M	295.20	17.67	5.93	1.42	25.02	1.13	0.31	0.36	0.01	0.33	65.10	2.15	14.50	22.87	0.00
J	8.90	0.53	0.18	0.04	0.75	0.94	0.31	0.36	0.01	0.27	54.00	1.90	13.35	0.00	0.00
J	112.40	6.73	2.26	0.54	9.53	1.08	0.31	0.36	0.01	0.31	62.00	2.08	14.50	6.30	0.00
A	47.60	2.85	0.96	0.23	4.03	1.51	0.31	0.36	0.01	0.44	86.80	2.64	14.50	1.40	0.00
S	23.30	1.39	0.47	0.11	1.97	1.98	0.31	0.36	0.01	0.58	114.00	3.25	13.23	0.00	0.00
O	79.60	4.76	1.60	0.38	6.75	2.54	0.31	0.36	0.01	0.74	145.70	3.96	14.50	1.51	0.00
N	26.80	1.60	0.54	0.13	2.27	2.77	0.31	0.36	0.01	0.81	159.00	4.26	12.51	0.00	0.00
D	249.00	14.90	5.00	1.20	21.10	3.34	0.31	0.36	0.01	0.98	192.20	5.01	14.50	14.11	0.00

JANDRA QUARRY - WATER BALANCE
DRY YEAR

Simple Water Balance

STAGE 4

Runoff Coeff's		Surf. Areas		
Quarry	0.35	0.176 km2	**Assumed Storage**	
Stockpile Area	0.30	0.067 km2	Volume	14.80 ML
Batching Area	0.20	0.024 km2	Surface Area	7400.00 m2
Haul Roads	0.45	1740.00 m	**Assumed Production**	
			Annual	250000.00 tonnes

	WATER SOURCES					WATER DEMANDS									
	Rainfall Dry	Quarry	Stockpile Area	Batching Area	TOTAL RUNOFF AVAIL (ML)	Haul Roads Dust Supp	Plant Dust Supp	Road Base	Truck Wash Demand	Dam Evapo. Loss	Pan Evap (mm)	TOTAL MONTHLY DEMAND	Storage	discharge	deficit
													7.40		
J	112.20	6.91	2.26	0.54	9.71	3.13	0.31	0.36	0.01	0.93	179.80	4.75	12.36	0.00	0.00
F	58.20	3.59	1.17	0.28	5.03	2.58	0.31	0.36	0.01	0.77	148.40	4.04	13.35	0.00	0.00
M	133.90	8.25	2.69	0.64	11.58	2.37	0.31	0.36	0.01	0.71	136.40	3.77	14.80	6.37	0.00
A	68.30	4.21	1.37	0.33	5.91	1.77	0.31	0.36	0.01	0.53	102.00	2.99	14.80	2.92	0.00
M	46.00	2.83	0.92	0.22	3.98	1.13	0.31	0.36	0.01	0.34	65.10	2.16	14.80	1.82	0.00
J	53.60	3.30	1.08	0.26	4.64	0.94	0.31	0.36	0.01	0.28	54.00	1.91	14.80	2.73	0.00
J	18.10	1.11	0.36	0.09	1.57	1.08	0.31	0.36	0.01	0.32	62.00	2.09	14.28	0.00	0.00
A	8.10	0.50	0.16	0.04	0.70	1.51	0.31	0.36	0.01	0.45	86.80	2.65	12.33	0.00	0.00
S	37.90	2.33	0.76	0.18	3.28	1.98	0.31	0.36	0.01	0.59	114.00	3.26	12.35	0.00	0.00
O	24.90	1.53	0.50	0.12	2.15	2.54	0.31	0.36	0.01	0.75	145.70	3.98	10.53	0.00	0.00
N	6.80	0.42	0.14	0.03	0.59	2.77	0.31	0.36	0.01	0.82	159.00	4.28	6.84	0.00	0.00
D	183.40	11.30	3.69	0.88	15.86	3.34	0.31	0.36	0.01	1.00	192.20	5.03	14.80	2.87	0.00
J	112.20	6.91	2.26	0.54	9.71	3.13	0.31	0.36	0.01	0.93	179.80	4.75	14.80	4.96	0.00
F	58.20	3.59	1.17	0.28	5.03	2.58	0.31	0.36	0.01	0.77	148.40	4.04	14.80	1.00	0.00
M	133.90	8.25	2.69	0.64	11.58	2.37	0.31	0.36	0.01	0.71	136.40	3.77	14.80	7.82	0.00
A	68.30	4.21	1.37	0.33	5.91	1.77	0.31	0.36	0.01	0.53	102.00	2.99	14.80	2.92	0.00
M	46.00	2.83	0.92	0.22	3.98	1.13	0.31	0.36	0.01	0.34	65.10	2.16	14.80	1.82	0.00
J	53.60	3.30	1.08	0.26	4.64	0.94	0.31	0.36	0.01	0.28	54.00	1.91	14.80	2.73	0.00
J	18.10	1.11	0.36	0.09	1.57	1.08	0.31	0.36	0.01	0.32	62.00	2.09	14.28	0.00	0.00
A	8.10	0.50	0.16	0.04	0.70	1.51	0.31	0.36	0.01	0.45	86.80	2.65	12.33	0.00	0.00
S	37.90	2.33	0.76	0.18	3.28	1.98	0.31	0.36	0.01	0.59	114.00	3.26	12.35	0.00	0.00
O	24.90	1.53	0.50	0.12	2.15	2.54	0.31	0.36	0.01	0.75	145.70	3.98	10.53	0.00	0.00
N	6.80	0.42	0.14	0.03	0.59	2.77	0.31	0.36	0.01	0.82	159.00	4.28	6.84	0.00	0.00
D	183.40	11.30	3.69	0.88	15.86	3.34	0.31	0.36	0.01	1.00	192.20	5.03	14.80	2.87	0.00

JANDRA QUARRY - WATER BALANCE
AVERAGE YEAR

Simple Water Balance

STAGE 4

Runoff Coeff's		Surf. Areas		
Quarry	0.35	0.176 km2	Assumed Storage	
Stockpile Area	0.30	0.067 km2	Volume	14.80 ML
Batching Area	0.20	0.024 km2	Surface Area	7400.00 m2
Haul Roads	0.45	1740.00 m	Assumed Production	
			Annual	250000.00 tonnes

	WATER SOURCES					WATER DEMANDS									
	Rainfall Average	Quarry	Stockpile Area	Batching Area	TOTAL RUNOFF AVAIL (ML)	Haul Roads Dust Supp	Plant Dust Supp	Road Base	Truck Wash Demand	Dam Evapo. Loss	Pan Evap (mm)	TOTAL MONTHLY DEMAND	Storage	discharge	deficit
													7.40		
J	19.00	1.17	0.38	0.09	1.64	3.13	0.31	0.36	0.01	0.93	179.80	4.75	4.30	0.00	0.00
F	215.70	13.29	4.34	1.04	18.66	2.58	0.31	0.36	0.01	0.77	148.40	4.04	14.80	4.12	0.00
M	44.00	2.71	0.88	0.21	3.81	2.37	0.31	0.36	0.01	0.71	136.40	3.77	14.80	0.04	0.00
A	183.00	11.27	3.68	0.88	15.83	1.77	0.31	0.36	0.01	0.53	102.00	2.99	14.80	12.84	0.00
M	264.20	16.27	5.31	1.27	22.85	1.13	0.31	0.36	0.01	0.34	65.10	2.16	14.80	20.70	0.00
J	28.00	1.72	0.56	0.13	2.42	0.94	0.31	0.36	0.01	0.28	54.00	1.91	14.80	0.52	0.00
J	16.00	0.99	0.32	0.08	1.38	1.08	0.31	0.36	0.01	0.32	62.00	2.09	14.10	0.00	0.00
A	6.40	0.39	0.13	0.03	0.55	1.51	0.31	0.36	0.01	0.45	86.80	2.65	12.00	0.00	0.00
S	6.80	0.42	0.14	0.03	0.59	1.98	0.31	0.36	0.01	0.59	114.00	3.26	9.33	0.00	0.00
O	102.70	6.33	2.06	0.49	8.88	2.54	0.31	0.36	0.01	0.75	145.70	3.98	14.24	0.00	0.00
N	190.80	11.75	3.84	0.92	16.50	2.77	0.31	0.36	0.01	0.82	159.00	4.28	14.80	11.66	0.00
D	72.10	4.44	1.45	0.35	6.24	3.34	0.31	0.36	0.01	1.00	192.20	5.03	14.80	1.21	0.00
J	19.00	1.17	0.38	0.09	1.64	3.13	0.31	0.36	0.01	0.93	179.80	4.75	11.70	0.00	0.00
F	215.70	13.29	4.34	1.04	18.66	2.58	0.31	0.36	0.01	0.77	148.40	4.04	14.80	11.52	0.00
M	44.00	2.71	0.88	0.21	3.81	2.37	0.31	0.36	0.01	0.71	136.40	3.77	14.80	0.04	0.00
A	183.00	11.27	3.68	0.88	15.83	1.77	0.31	0.36	0.01	0.53	102.00	2.99	14.80	12.84	0.00
M	264.20	16.27	5.31	1.27	22.85	1.13	0.31	0.36	0.01	0.34	65.10	2.16	14.80	20.70	0.00
J	28.00	1.72	0.56	0.13	2.42	0.94	0.31	0.36	0.01	0.28	54.00	1.91	14.80	0.52	0.00
J	16.00	0.99	0.32	0.08	1.38	1.08	0.31	0.36	0.01	0.32	62.00	2.09	14.10	0.00	0.00
A	6.40	0.39	0.13	0.03	0.55	1.51	0.31	0.36	0.01	0.45	86.80	2.65	12.00	0.00	0.00
S	6.80	0.42	0.14	0.03	0.59	1.98	0.31	0.36	0.01	0.59	114.00	3.26	9.33	0.00	0.00
O	102.70	6.33	2.06	0.49	8.88	2.54	0.31	0.36	0.01	0.75	145.70	3.98	14.24	0.00	0.00
N	190.80	11.75	3.84	0.92	16.50	2.77	0.31	0.36	0.01	0.82	159.00	4.28	14.80	11.66	0.00
D	72.10	4.44	1.45	0.35	6.24	3.34	0.31	0.36	0.01	1.00	192.20	5.03	14.80	1.21	0.00

JANDRA QUARRY - WATER BALANCE
WET YEAR

Simple Water Balance

STAGE 4

Runoff Coeff's		Surf. Areas	Assumed Storage	
Quarry	0.35	0.176 km2	Volume	14.80 ML
Stockpile Area	0.30	0.067 km2	Surface Area	7400.00 m2
Batching Area	0.20	0.024 km2		
Haul Roads	0.45	1740.00 m	**Assumed Production**	
			Annual	250000.00 tonnes

	WATER SOURCES				TOTAL	Haul	WATER DEMANDS								
	Rainfall Wet	Quarry	Stockpile Area	Batching Area	RUNOFF AVAIL (ML)	Roads Dust Supp	Plant Dust Supp	Road Base	Truck Wash Demand	Dam Evapo. Loss	Pan Evap (mm)	TOTAL MONTHLY DEMAND	Storage	discharge	deficit
													7.40		
J	245.20	15.10	4.93	1.18	21.21	3.13	0.31	0.36	0.01	0.93	179.80	4.75	14.80	9.06	0.00
F	51.10	3.15	1.03	0.25	4.42	2.58	0.31	0.36	0.01	0.77	148.40	4.04	14.80	0.38	0.00
M	104.80	6.46	2.11	0.50	9.07	2.37	0.31	0.36	0.01	0.71	136.40	3.77	14.80	5.30	0.00
A	448.50	27.63	9.01	2.15	38.80	1.77	0.31	0.36	0.01	0.53	102.00	2.99	14.80	35.81	0.00
M	295.20	18.18	5.93	1.42	25.53	1.13	0.31	0.36	0.01	0.34	65.10	2.16	14.80	23.38	0.00
J	8.90	0.55	0.18	0.04	0.77	0.94	0.31	0.36	0.01	0.28	54.00	1.91	13.66	0.00	0.00
J	112.40	6.92	2.26	0.54	9.72	1.08	0.31	0.36	0.01	0.32	62.00	2.09	14.80	6.50	0.00
A	47.60	2.93	0.96	0.23	4.12	1.51	0.31	0.36	0.01	0.45	86.80	2.65	14.80	1.47	0.00
S	23.30	1.44	0.47	0.11	2.02	1.98	0.31	0.36	0.01	0.59	114.00	3.26	13.55	0.00	0.00
O	79.60	4.90	1.60	0.38	6.89	2.54	0.31	0.36	0.01	0.75	145.70	3.98	14.80	1.66	0.00
N	26.80	1.65	0.54	0.13	2.32	2.77	0.31	0.36	0.01	0.82	159.00	4.28	12.84	0.00	0.00
D	249.00	15.34	5.00	1.20	21.54	3.34	0.31	0.36	0.01	1.00	192.20	5.03	14.80	14.55	0.00
J	245.20	15.10	4.93	1.18	21.21	3.13	0.31	0.36	0.01	0.93	179.80	4.75	14.80	16.46	0.00
F	51.10	3.15	1.03	0.25	4.42	2.58	0.31	0.36	0.01	0.77	148.40	4.04	14.80	0.38	0.00
M	104.80	6.46	2.11	0.50	9.07	2.37	0.31	0.36	0.01	0.71	136.40	3.77	14.80	5.30	0.00
A	448.50	27.63	9.01	2.15	38.80	1.77	0.31	0.36	0.01	0.53	102.00	2.99	14.80	35.81	0.00
M	295.20	18.18	5.93	1.42	25.53	1.13	0.31	0.36	0.01	0.34	65.10	2.16	14.80	23.38	0.00
J	8.90	0.55	0.18	0.04	0.77	0.94	0.31	0.36	0.01	0.28	54.00	1.91	13.66	0.00	0.00
J	112.40	6.92	2.26	0.54	9.72	1.08	0.31	0.36	0.01	0.32	62.00	2.09	14.80	6.50	0.00
A	47.60	2.93	0.96	0.23	4.12	1.51	0.31	0.36	0.01	0.45	86.80	2.65	14.80	1.47	0.00
S	23.30	1.44	0.47	0.11	2.02	1.98	0.31	0.36	0.01	0.59	114.00	3.26	13.55	0.00	0.00
O	79.60	4.90	1.60	0.38	6.89	2.54	0.31	0.36	0.01	0.75	145.70	3.98	14.80	1.66	0.00
N	26.80	1.65	0.54	0.13	2.32	2.77	0.31	0.36	0.01	0.82	159.00	4.28	12.84	0.00	0.00
D	249.00	15.34	5.00	1.20	21.54	3.34	0.31	0.36	0.01	1.00	192.20	5.03	14.80	14.55	0.00

JANDRA QUARRY

EXTENSION

CSR

K. AIR QUALITY ASSESSMENT

JANDRA QUARRY
EXTENSION

Air Quality Assessment

For:
CSR CONSTRUCTION MATERIALS

October 1999
38070AIRRP2

Report No. 38070AIRRP2

This report was prepared in accordance with the scope of services set out in the contract between ERM Mitchell McCotter Pty Ltd ACN 002 773 248 (ERMMM) and CSR Construction Materials. To the best of our knowledge, the proposal presented herein accurately reflects the CSR's intentions when the report was printed. However, the application of conditions of approval or impacts of unanticipated future events could modify the outcomes described in this document. In preparing the report, ERMMM used data, surveys, analyses, designs, plans and other information provided by the individuals and organisations referenced herein. While checks were undertaken to ensure that such materials were the correct and current versions of the materials provided, except as otherwise stated, ERMMM did not independently verify the accuracy or completeness of these information sources.

Approved by:	*Tony McNamara*
Position:	Project Director
Signed:	
Date:	

ERM Mitchell McCotter Quality System

Prepared by:	*Murray Curtis*
Position:	Project Manager
Signed:	
Date:	14/10/99

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Chapter 1

INTRODUCTION

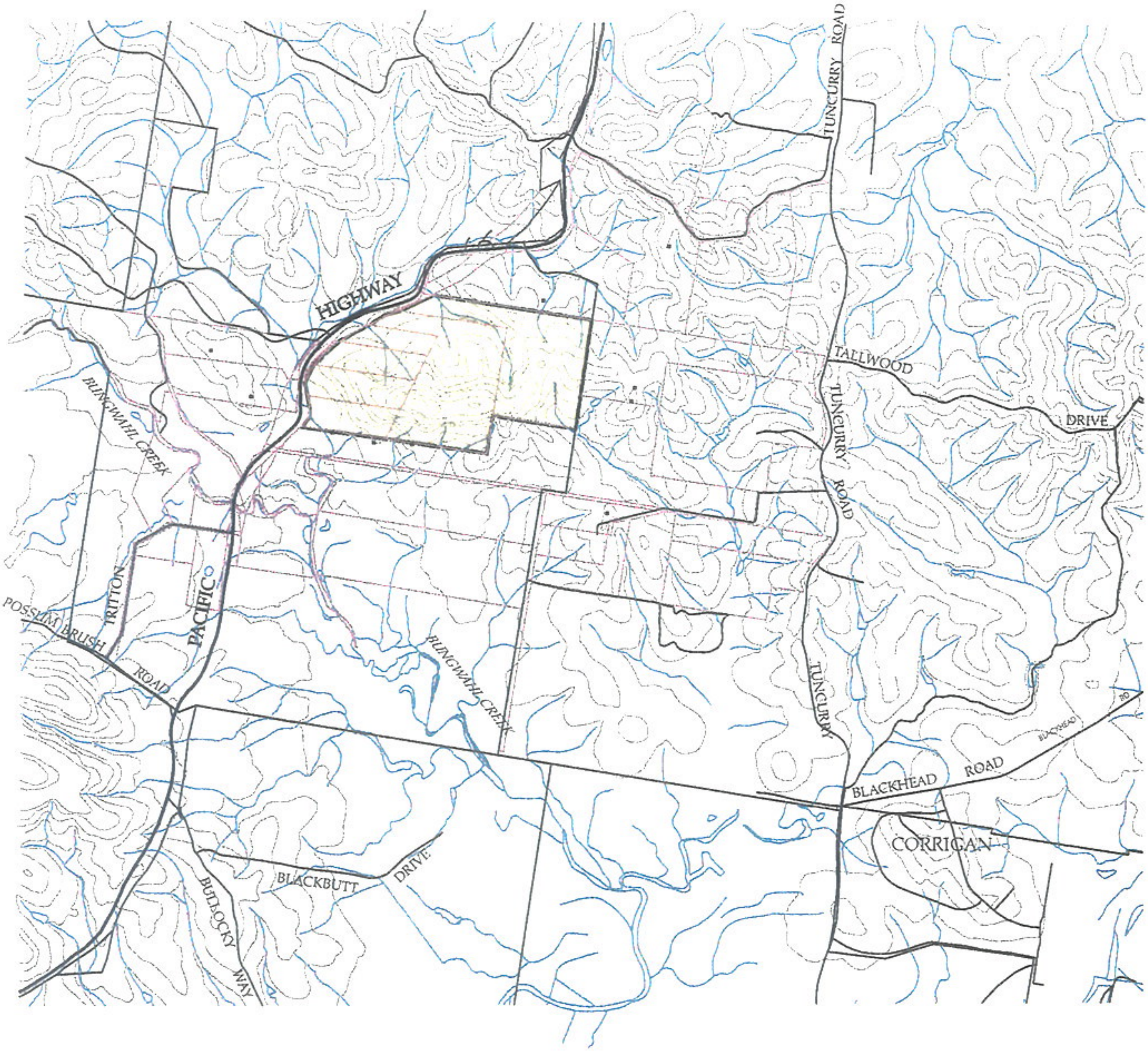
1.1 AN OVERVIEW

CSR Construction Materials (CSR) owns and operates a quarry situated on 118 ha of freehold land located adjacent to the Pacific Highway approximately 18 km south of Taree (see *Figure 1.1*). Current approvals allow for an extraction rate of 150,000 tonnes per annum (tpa), place some stringent controls on operating hours and blasting, and give reserves of around 560,000 tonnes. This equates to about four year's life. The present operation crushes and screens the material and provides a pre-coating facility for sealing aggregates.

CSR is seeking to gain approval to:

- expand operating hours from 6.00 am to 6.00 pm Monday to Friday and 6.00 am to 3.00 pm Saturdays. Ancillary operations such as refuelling, servicing and maintaining plant will be undertaken between 6.00 am and 9.00 pm Monday to Saturday;
- expand the existing site facilities area;
- lift approved production levels from 150,000 tpa to an average 250,000 tpa;
- significantly expand reserves to allow planning for the companies future. This includes extraction down to Relative Level (RL) 20 and will provide 16 million tonnes of fresh rock;
- remove the restrictions on blasting to enable the adoption of normal commercial blasting practices;
- locate on site, from time to time on an as needs basis, a mobile pugmill and/or a mobile asphalt plant; and
- construct a new weighbridge and office complex west of the current weighbridge.

Quarry practices will remain essentially the same, including the continuation of current dust mitigation procedures. The quarry processing plant will not be changed, the extra capacity required will be accommodated by the extension of the operating hours.



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SOURCE: CMA 1:25,000 TOPO NABIAC SHEET

CSR PROPERTY BOUNDARY

RESIDENCES

CADASTRAL BOUNDARIES

N

0 800m

ERM MITCHELL McCOTTER

Figure 1.1 SITE LOCALITY

1.2 QUARRY DEVELOPMENT

The main haul roads to the upper benches have been established on the eastern side of the existing quarry. To avoid disruption to the main haul roads it is proposed to initially quarry to the west.

Existing benches have been developed at 12 m heights and it is proposed to continue with 12 m separation down to RL 50. From this level it is proposed to develop two 15 m high benches. The quarry plan includes:

- terminal bench width of half the face height;
- final face angle of 75°;
- haul roads 15 m wide and at 1:10 grade;
- rock density of 2.65 t/m^3;
- topsoil 1 m thick; and
- weathered rock 10 m thick.

Four stages of development have been proposed as described below.

1.2.1 Stage 1.

This stage involves expanding the quarry to the west.

Where possible, the first action will be to develop an excavated slot along the southern rim of the quarry through the topsoil and weathered rock, leaving the final south face at a stable angle suitable for plant growth, and replanting. When the active quarry face extends south to meet this revegetated slot, much of the final visual impact will be mitigated. Where the development of the slot is not possible due to the location of the existing southern quarry face, revegetation will be commenced as soon as possible following completion of the final southern face. At the same time a sump will be put down into the floor of the quarry to trap all the water from disturbed areas. This will be enlarged from time to time.

Benches will be developed at RL 50, 62, 74, 84 and 96. It has been calculated that this development will generate 61,900 m^3 of overburden, 619,300 m^3 (1.64 million tonnes) of weathered rock and 1,685,800 m^3 (4.47 million tonnes) of fresh rock. It is expected that most of the weathered rock will be processed and sold as road base type product.

As terminal faces are developed on the southern and western limits overburden and topsoil will be placed on the benches and rehabilitated. This method has been used successfully at the Ferntree Gully Quarry (Melbourne) by CSR.

The prior rehabilitation of the top 10 m of overburden and the weathered rock along the southern slot and the ridge on the northern rim of the quarry, will assist to significantly reduce any further visual impact when the site is viewed from the north.

1.2.2 Stage 2

This stage involves the easterly development of the RL 50, 62, 74, 86 and 98 faces half way to the proposed eastern limit of the quarry and developing a new floor at RL 35 in the latter part.

Again, a preliminary slot will be cut along the southern rim, to enable rehabilitation of the top bench in weathered rock before it is exposed to view from the north. Terminal faces on the southern rim, not needed for access or the haul road, will be rehabilitated.

This stage will yield some 442,000 m^3 of overburden, 489,100 m^3 of weathered rock (1.29 million tonnes) and 1,640,800 m^3 of fresh rock (4.35 million tonnes).

Visual impact of this stage be diminished by prior rehabilitation of the weathered rock face.

Early in Stage 2 the existing haul roads will need to be relocated, and it is proposed that access from the RL 50 bench to the higher benches will be via a ramp developed along the northern and eastern faces. The higher sections of this ramp will be live and will have to be relocated from time to time.

All runoff from the disturbed area will be gathered either on the RL 35 level, or in a sump below RL 35. After settling, all water will be pumped out into the existing water management system.

Towards the end of this stage operations will come within 20 m of the south-east corner of the CSR property. A formal legal agreement between CSR and the owners of the adjoining property (YALA) restricting activities on the adjoining land during blasting is currently being negotiated.

1.2.3 Stage 3

This stage is the continued development east of the RL 35, 50, 62, 74 and 98 benches to their most eastern limit. At no stage will the eastern ridge be breached. Towards the end of this stage a drop cut to a new floor level at RL 20 will be developed.

Again the weathered rock profile along the southern rim will be rehabilitated, and after development all visible terminal faces will be rehabilitated.

During this stage the operation will extract 34,500 m^3 of overburden, 300,700 m^3 of weathered rock (751,700 tonnes) and 1,371,600 m^3 of fresh rock (3.6 million tonnes).

Completion of this stage will represent the end of any disturbance of the site, the quarry having practically reached its final rim position.

1.2.4 Stage 4

In this stage effort is concentrated on removing the bottom RL 20 bench, and some peripheral clean up. It will release 4,500 m^3 of overburden, 45,000 m^3 of weathered rock (112,700 tonnes) and 1,537,600 m^3 of fresh rock (4.1 million tonnes).

Other than maintenance of existing rehabilitation there will be little additional areas requiring rehabilitation.

At the end of this stage the floor will be approximately 750 metres long and 100 metres wide. This stage has the potential to yield in excess of 2.5 million tonnes of fresh rock. Approval for extraction of this additional resource is not part of this application.

Chapter 2

AIR QUALITY CRITERIA

2.1 AIR QUALITY CRITERIA

The effects of dust on health and amenity were assessed by comparing dust deposition rates and dust concentrations with recognised air quality criteria. These criteria were established from research in both New South Wales, Victoria and overseas. To include the full range of potential impacts, reference was made to criteria for long-term (annual average) and short-term (24 hour) periods, and to different particle sizes. The following sections detail appropriate criteria.

2.2 NATIONAL ENVIRONMENT PROTECTION MEASURE (NEPM)

Ambient air quality throughout Australia is the subject of *The National Environment Protection Council (Ambient Air Quality) Measure 1998* (NEPM). This is a Commonwealth initiative to achieve nominated standards of air quality within ten years. All states and territories have adopted the ten-year air quality goals for pollutants specified in Schedule 2 of NEPM.

In adopting the NEPM air quality goals, the State Government undertakes to conduct measurements of air quality at performance monitoring stations located in regions where greater than 25,000 people may be affected. Monitoring station locations are selected to represent exposure of a large proportion of the population rather than exposure of individual people. It is also important to note that the NEPM criteria are not to be compared solely to the emissions from one source, they are meant as regional air quality goals. NEPM criteria are therefore not considered in this assessment.

2.3 DUST DEPOSITION

Dust deposition criteria developed by the NSW Environment Protection Authority (NSW EPA) are given in *Table 2.1*. These set maximum increases above existing levels. For example, in residential areas with existing annual average deposition of between zero and two $g/m^2/month$, an increase of up to two $g/m^2/month$ would be permitted.

Table 2.1 ASSESSMENT CRITERIA FOR DUST DEPOSITION

Existing Deposition (g/m^2/month)	Maximum Acceptable Increase (g/m^2/month annual average)	
	Residential Suburban Land Use	Rural, Semi-Rural Urban, Commercial & Industrial Land Uses
2	2	2
3	1	2
4	0	1

Based on these criteria the permissible increase at properties around the quarry will be as shown in *Table 2.2.*

Table 2.2 GUIDELINES FOR INCREASES IN DUST DEPOSITION

Site	Annual Average Deposition for 1996 - 1997[1] (g/m^2/month)	Permissible increase in deposition (g/m^2/month)
1	1.90	2.0
2	1.76	2.0
3	2.62	2.0

Note: 1. Details provided in Section 3.6.

2.4 DUST CONCENTRATION

Concentration criteria for long-term annual averages and short-term 24 hour periods were considered. Two size ranges were also addressed: total solid particulate matter (TSP) or particles less than 50 microns (one millionth of a metre) and particles smaller than 10 microns (PM_{10}).

PM_{10} particle concentrations are of interest because they can reach the lower parts of the respiratory system and may have health as well as amenity impacts. Most PM_{10} particles are caused by combustion from motor vehicles, bushfires and industrial processes. Some PM_{10} particles are generated by evaporation of sea spray and from vegetation. Most quarrying dust consists of coarser particles which have amenity rather than health effects.

The assessment criteria are as follows.

2.4.1 *Short-term Criteria*

Based on United States Environmental Protection Agency (USEPA) standards, the NSW EPA adopts a 24 hour concentration criterion of 150 $\mu g/m^3$ for PM_{10} which should not be exceeded more than once per year.

2.4.2 *Long-term Criteria*

The National Health and Medical Research Council of Australia (NHMRC) recommends a maximum annual concentration of 90 $\mu g/m^3$ total suspended particulate in a residential environment, which is compared to in the absence of a more suitable standard. For particles smaller than 10 microns, the NSW EPA adopts the USEPA PM_{10} standard of 50 $\mu g/m^3$ annual average.

Chapter 3

DUST DISPERSION MODELLING

3.1 INTRODUCTION

The ISC dispersion model was chosen to predict dust deposition rates and airborne concentrations of respirable (PM_{10}) and inhalable (TSP) dust resulting from dust emissions. Calculated dust deposition rates were compared against available monitored data in the locality to validate the model's result. No measured values were available for TSP and PM_{10} concentrations in the locality.

3.2 ISC MODEL

The Industrial Source Complex (ISC) dispersion model is a gaussian plume dispersion model used to evaluate the air quality impact of emissions from industrial source complexes. It has been approved by most regulatory authorities nationally and internationally. The ISC model consists of two programs for short and long term analyses. The short-term model uses sequential hourly meteorological data to estimate deposition or concentration patterns from one hour to one year. The long-term model uses statistical wind data summaries to estimate seasonal and annual concentration and deposition patterns. For the purpose of this investigation only the short-term model has been used. It has been used to account for the short-term variability of the emissions from the quarry.

3.3 SELECTION OF MODEL OPTIONS

For modelling atmospheric dispersion of emissions from the quarry, the following options were selected:

- Unless otherwise stated, regulatory and/or default options were used as based on previous studies.
- Ground level concentrations are predicted at 14 discrete receptors corresponding to locations of sensitivity. A Cartesian receptor grid was also used with local grid coordinates and a resolution of 200 meters.

- As a conservative assumption, only dry deposition was considered. The effects of wet deposition would reduce the total dust impact of the quarry. Additionally an appropriate scavenging coefficient (for wet deposition) could not be determined with any confidence.

- Plume mass depletion was not included for deposition calculations.

The ISC plume dispersion model was used to determine the 24 hour and annual average ground level concentration of PM_{10} and the annual average ground level concentration of TSP. Monthly averages for dust deposition were also predicted.

3.4 METHODOLOGY

CSR proposes to extend their quarry operations at Jandra from 150,000 tonnes per annum to an average 250,000 tonnes per annum. Dust emissions from each quarrying activity were estimated and used in a short-term dust dispersion model. The model calculated average 24 hour concentrations for PM_{10} and TSP around the quarry based on emission rates and meteorological data.

There has been a wide and significant body of data that has been collected to demonstrate the accuracy of the ISC modelling process. For this assessment, 12 months of dust deposition monitoring data recorded at the quarry site boundary were available to verify modelling assumptions. This was performed to confirm that all assumptions in the model under current conditions are valid. The dust deposition monitoring results verified the assumptions of the model for the current stage.

Based on the verified model, levels of dust deposition and dust concentrations were predicted. Air quality impacts due to proposed quarry operations were determined by comparing the predicted levels with relevant criteria.

3.4.1 Existing Environment

Dispersion modelling requires good quality weather data, including wind speed, wind direction and atmospheric stability. This is incorporated into the model as a frequency distribution of wind speed and wind direction by stability class.

The ISC model requires specific meteorological (MET) data. Hourly information for a complete year is required for wind direction, winds speed, temperature, stability class, rural and urban mixing heights to complete calculations.

The Bureau of Meteorology installed an automatic weather station at the Taree airport. The information is a compilation of meteorological data at 9.00 am to 3.00 pm. The data includes rainfall, wind speed and wind frequency for the area. The information is insufficient for complete modelling of dust emission from the quarry and instead a compilation of statistical data, "Metsamp" was used. This meteorological file is used to calculate a worst case scenario and as such only the highest concentration value can be considered, as opposed to the NSW EPA regulations which allow for one exceedence of the short-term value.

Appendix A details the windrose summaries for wind speed and direction for the Taree region for each of the seasons. The roses are similar for each season and, wind direction and speed vary slightly with more than 50% of wind prevailing from the east in the mornings and from the north-west in the afternoon.

Calm conditions (less than 3 m/s) are experienced for approximately 30% of the mornings and the afternoon breeze creating less stable conditions later in the day.

Daily average temperatures from 28°C in the summer, 21°C in the autumn, 18°C in the winter and 23°C in the spring.

The number of rain days per year average 130 with approximately 1,184 mm of rain falling during an average year.

3.4.2 *Wind Data*

Wind speed influences the dust emitted from disturbed areas. Wind erosion of such areas mainly occurs at velocities of more than 5.4 metres per second, which were recorded approximately 15 per cent of the time in the Jandra area. For the meteorological file used, wind direction is allocated in 30 degree increments for the full 360 degrees. Wind speed ranged from 0.5 m/s to 20 m/s for all of the wind directions calculated.

3.4.3 *Stability Class*

Stability class is used to determine the rate at which a dust plume disperses by turbulent mixing. Each stability class is associated with a dispersion curve, which is used by the dispersion model to calculate plume dimensions and dust concentrations downwind of the source.

Stability classes are categorised from 1 to 6 or, A to F. Stability Class 1 applies under sunny conditions with light winds when dispersion of the plume is most rapid. Stability Class 4 applies under windy and/or overcast conditions when dispersion is moderately rapid, and stability Class 6 occurs at night when winds are light and the sky is clear. Classes 2, 3 and 5 are intermediate conditions between those described above.

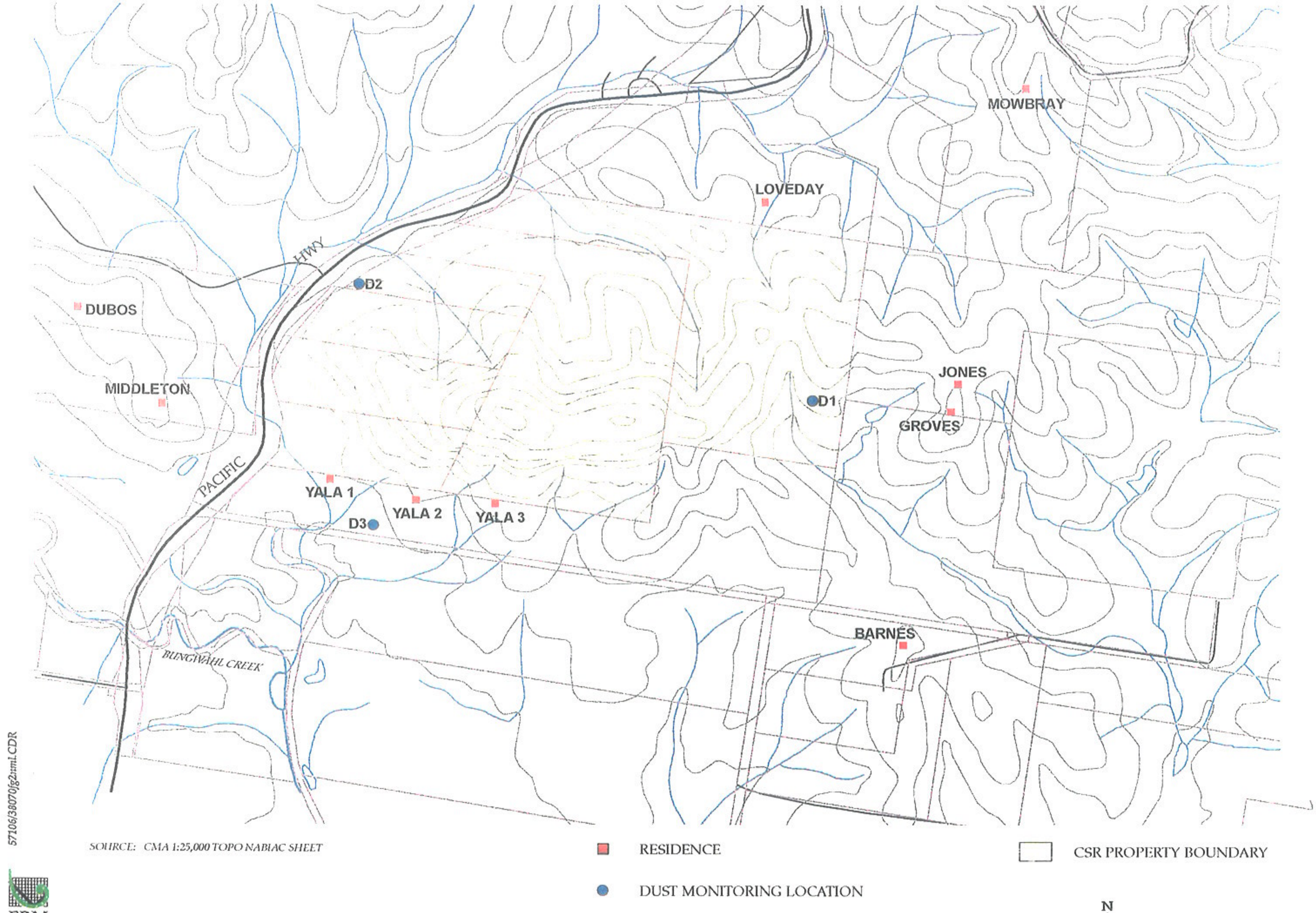
The meteorological data used covered all 6 stability classes.

3.4.4 Mixing Heights

Mixing Height refers to the height that fine dust particles will be ultimately mixed in the atmosphere. In this instance where most of the sources are non-buoyant ground level emissions, the predictions from the ISC model are not particularly sensitive to the mixing heights. Theoretical mixing height values have been used to cover both urban and rural mixing heights ranging from 1,000 to 2,250 metres.

3.5 DUST DEPOSITION MONITORING RESULTS

CSR has a network of dust gauges located around the quarry as shown on *Figure 3.1*. *Table 3.1* shows monthly dust deposition monitored at specific sites around the quarry.



ERM MITCHELL McCOTTER

Figure 3.1 DUST MONITORING LOCATIONS

Table 3.1 DUST MONITORING RESULTS

Site	Date	Dust Deposition[1]
1	02/01/96	2.37
2		2.55
3		2.54
1	02/11/96	0.116
2		0.445
3		0.189
1	02/12/96	5.53
2		4.44
3		4.62
1	30/01/97	3.62
2		2.38
3		2.31
1	04/03/97	1.74
2		13.38 *
3		2.40
1	01/04/97	1.39
2		1.81
3		3.45
1	29/04/97	1.15
2		1.69
3		2.46
1	02/06/97	1.56
2		1.73
3		4.04
1	30/07/97	2.06
2		1.09
3		3.68
1	02/08/97	0.67
2		0.74
3		2.11
1	02/09/97	0.69
2		0.74
3		1.06

Note 1 *g/m^2/month - grams per square metre per month (1996 to 1997).*

* *Suspect result.*

To predict dust dry deposition concentrations, the ISC model requires additional information in the MET data file. In addition to hourly data for a complete year on wind direction, speed, temperature, stability class, rural and urban mixing height, three other factors are required. These are friction velocity, Monin-obhikov length and surface roughness. It is difficult to accurately input statistical data for these variables. To obtain dry dust deposition predictions these variables have been input from an existing MET file.

The deposition values predicted from the current quarrying operations can be compared against the measured results, *Table 3.2.*

Table 3.2 COMPARISON OF DUST MONITORING SITES MEASUREMENTS VERSUS PREDICTED CONCENTRATIONS

Dust Monitoring Site	Measured Range (g/m^2/month)	Average (g/m^2/month)	Predicted Concentration (g/m^2/month)
1	0.116 - 5.53	1.90	0.94
2	0.445 - 4.44 (13.38) *	1.76	2.47
3	0.189 - 4.62	2.62	0.65

Note: * *Suspect result, averages calculated excluding 13.38 value.*

The predicted concentrations fall within the measured range of monitored dust levels. Drilling and blasting have not been included as sources in the modelling of dust deposition due to their episodic impacts. However even without these episodic impacts the predicted concentrations correlate to an acceptable level.

Chapter 4

DUST EMISSIONS

4.1 INTRODUCTION

Quarry operations generate dust from many sources. Initially sediment controls are implemented and then the area is cleared of vegetation. Next drilling and blasting takes place. This involves the drilling of a series of holes in a grid format to a depth dependant on the planned quarry face, in this instance either 13 or 16 m. Explosives are then placed down the holes. The holes are then capped with stemming, which at the time of the blast, results in the soil being ruptured and up-lifted minimising the dust emission significantly.

Drilling and in particular blasting has the greatest potential for dust emissions. A number of mitigation measures such as capping, not blasting during adverse wind speed and wind direction need to be considered during each blasting episode. Although the potential dust emissions from blasting are significant, appropriate measures can significantly reduce the impact. In addition drilling and blasting is an episodic emission which occurs approximately monthly at the quarry. The object of blasting is to open seams which are suitable for front-end loaders and excavators to access. As a dust control measure the shot rock is well watered down prior to loading and CSR guidelines for blasting are followed. The shot rock is loaded into dump trucks and transported to the processing plant.

The material is transported by dump truck to the crushing and screening plant where it is crushed and sorted according to size. After crushing and screening the product is stockpiled using front-end loaders, or dependant on the market, goes to the pre-coating or asphalt batching plants.

Dust sources include dust from construction of access roads, land clearing, drilling, blasting, loading and unloading, transport, crushing and screening, wind erosion from stockpiles and dumps. Each operation can produce dust in varying amounts projecting it into the air at different heights and falling at different distances from the source. For example truck movement generates small amounts of dust at low levels while uncontrolled blasting can project dust high into the atmosphere and dust particle size can vary depending on the blast size.

4.2 DUST EMISSIONS RATES

The amount of dust generated has been calculated by applying emission factors for the various processes. Emission factors have been obtained from published data by the former State Pollution Control Commission of New South Wales (SPCC), now the NSW EPA.

Emission factors for activities not listed in the SPCC report were taken from United States Environment Protection Agency (USEPA) studies. A list of individual quarrying activities, emission factors and data sources used in assessments are presented in *Table 4.1.*

Table 4.1 EMISSION RATES

Activity	Emission Rate	Reference
Overburden removal		
Excavator/Shovel	0.025 kg/t	SPCC et al (1988)
Dozer	5.1 kg/hr	USEPA (1988)
Drilling	0.6 kg/hole	SPCC (1983)
Blasting	550-4,334 kg/blast	SPCC (1983) modified
Quarrying		
Excavator/FEL	0.025 kg/t	SPCC et al (1988)
Dozers/Rubber tyred Dozers	3.1 kg/hr	USEPA (1988)
Rehabilitation		
Dumping	0.012 kg/t	SPCC et al(1988)
Dozer	5.1 kg/hr	USEPA (1988)
Haulage		
Overburden	2 kg/vkt	SPCC et al(1988)
Extraction	2 kg/vkt	SPCC et al(1988)
Wind Erosion		
Extraction	0.4 kg/ha/hr	SPCC (1983)
Overburden	0.4 kg/ha/hr	SPCC (1983)
Pre-Strip	0.4 kg/ha/hr	SPCC (1983)

Notes:

kg	*kilogram*	*vkt*	*vehicle kilometre travelled*
hr	*hour*	*km*	*kilometre*
ha	*hectares*	*t*	*tonne*
m3	*cubic metre*	*FEL*	*Front End Loaders*

4.3 DUST PARTICLE SIZE

PM_{10} emissions were estimated by adding the fine particles (FP) and a percentage of the inhalable particles (IP) fraction based on distributions provided by the USEPA.

A list of individual quarrying activities and the associated particle size distribution are presented in *Table 4.2*.

Table 4.2 PARTICLE SIZE DISTRIBUTION

Plant/Activity	FP (%)	IP (%)	CP (%)	Reference
Excavator/Shovel/FEL	7.0	50.0	43.0	Dames & Moore (1986)
Dozer/Rubber tyred	19.6	54.0	26.4	USEPA (1981)
Dumping	4.0	44.0	52.0	Dames & Moore (1986)
Conveyor	4.0	44.0	52.0	Dames & Moore (1986)
Dozer	19.6	54.0	26.4	USEPA (1981)
Haulage	6.0	53.0	41.0	Dames & Moore (1986)
Overburden - Wind Erosion	3.5	67.0	29.5	Dames & Moore (1986)

Notes:

FP *fine particles (0 to 2.5 microns)*

IP *Inhalable particles (2.5 to 15.0 microns)*

CP *Coarse particles (15 to 30.0 microns)*

Emissions were entered into the model as open pit and area sources. These sources were located at worst case locations as well as being representative of current quarrying operations. Consideration was also given to sources located on the pit floor and at elevations below the normal ground level.

Activities in the quarry that generate dust include:

- wind erosion;
- stockpile wind erosion;
- drilling;
- blasting;
- excavator during truck loading;
- haulage;

- dumping;
- crushing and screening;
- exhaust from vehicles;
- conveyor transfer points; and
- product stockpiling and loading with front-end loaders.

4.4 DUST EMISSION ESTIMATES

4.4.1 Wind Erosion

The annual average dust emission for exposed areas is 0.4 kg/ha/hr (SPCC 1983). Application of this annual average for all wind-speeds would overestimate emissions depending on the number of days when wind-speed was less than 5m/s. Examination of the wind roses concluded that in fact only 15% of wind speeds were above 5.4m/s.

Good quarry practice ensures that once exposed faces are no longer needed they are to be rehabilitated as quickly as possible, therefore the area within the quarry which has been cleared and exposed, but not rehabilitated, will be kept to a minimum.

Currently the maximum output of the quarry is 150,000 tonnes per annum. Based upon the maximum area exposed of 1.5 ha (Wilkinson-Murray 1986) for production of 50,000 tonnes per annum it has been calculated that the required face exposed to achieve the current output would be 4.5 ha. For the proposed increase in output to 250,000 tonnes per annum (Stages 1 - 4) the exposed face has been calculated at 7.5 ha.

The emissions for wind erosion have been modelled as an open-pit source. Based on this information we estimate that the current facility emissions for wind erosion is 15,768 kg/yr and emissions for each of the proposed Stages 1-4 are 26,280 kg/yr.

4.4.2 Stockpile Wind Erosion

The emission factor for stockpile erosion is the same as that for wind erosion (0.4 kg/ha/hr (SPCC 1983). It has been estimated that the current operations maximum required stockpile area is 0.648 ha (approximately 30m by 70m by 3m high). For Stages 1-4 this value has been calculated to be 1.08 ha (a ratio of 150,000:250,000 calculated from output (tpa)). It is proposed that the stockpiles will be sprayed with