PROPOSED EXTENSION OF SAND EXTRACTION OPERATIONS

LOTS 1 AND 2 DP 547255

OLD NORTHERN ROAD
MAROOTA

Environmental Impact Statement

For:
DIXON SAND (PENRITH) PTY LTD

August 2001
500141EIS

PROPOSED EXTENSION OF SAND EXTRACTION OPERATIONS

LOTS 1 AND 2 DP 547255

OLD NORTHERN ROAD MAROOTA

Environmental Impact Statement

Report No. 500141EIS

This report was prepared in accordance with the scope of services set out in the contract between Environmental Resources Management Australia Pty Ltd ACN 002 773 248 (ERM) and the Client. 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, ERM 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, ERM did not independently verify the accuracy or completeness of these information sources.

Approved by:	*Mike Shelly*
Position:	Project Director
Signed:	
Date:	*20 August 2001*

Prepared by:	*Nicole Croker*
Position:	Project Manager
Signed:	
Date:	*20 August 2001*

Environmental Resources Management Australia Pty Ltd Quality System

SUBMISSION OF ENVIRONMENTAL IMPACT STATEMENT (EIS)

PREPARED UNDER THE ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979 - SECTION 77

EIS PREPARED BY

Name:	Michael Shelly
Qualifications:	BSc.
Address:	21 Waterloo Avenue, THORNTON NSW, 2322

in respect of:

DEVELOPMENT APPLICATION

Applicant Name:	Dixon Sand (Penrith) Pty Limited
Applicant Address:	PO Box 148 PENRITH NSW 2751
Land to be developed:	
Address	Lots 1 and 2 DP 547255 and Lots 29 and 196 DP 752025 Old Northern Road, Maroota
Lot No. DP/MPS, Vol/Fol etc.	
Proposed Development	Extension of sand extraction operations using existing infrastructure and haulage routes.

ENVIRONMENTAL IMPACT STATEMENT

An environmental impact statement (EIS) is attached.

CERTIFICATE

I certify that I have prepared the contents of this Statement and to the best of my knowledge

- it is in accordance with clauses 72 and 73 of the Environmental Planning and Assessment Regulation 2000;
- it contains all available information that is relevant to the environmental assessment of the development to which this statement relates; and
- it is true in all material particulars and does not, by its presentation or omission of information, materially mislead.

Signature: .....

Name: Michael Shelly.....

Date: ..... / ..... / .....

EXECUTIVE SUMMARY

The Proposal

Dixon Sand (Penrith) Pty Limited (Dixon Sand) currently extract and process mortar and concrete sand on Lots 29 and 196 DP 752025 Old Northern Road, Maroota. This operation has occurred since the early 1980's, with Dixon Sand operating the site since 1992. The current operation was granted consent by the Land and Environment Court on 7 July, 2000.

It is proposed to extend the existing sand quarry eastwards into Lots 1 and 2 DP 547255 Old Northern Rd, Maroota. Sand would be extracted and trucked to the existing processing plant on Lot 196. The proposed life of the development would be approximately twenty years. The total estimated tonnage to be extracted within Lots 1 and 2 is approximately 3 million tonnes.

The total amount of material leaving the site would be in accordance with the limits set in the previous consent, based on a maximum of 60 laden trucks per day.

The proposed development would include the staged clearing of specified areas, extraction by excavator of sand to within two metres of the wet weather groundwater level, loading and trucking to the existing processing plant, and processing, stockpiling and off-site removal of material in accordance with the previously issued consent. The extracted area will be rehabilitated with native plant species, integrating the final landform between the existing and proposed extraction areas.

Particular areas have been excluded from the extraction plan. These buffer and exclusion areas are generally in accordance with Baulkham Hills Shire Council's Development Control Plan 500, and include the area near Old Northern Road, towards Maroota Public School, the northern boundary area and an area of shallow groundwater on Lot 2. A population of *Tetratheca glandulosa* and an area of Shale-Sandstone Transition Forest on Lot 2 have been excluded, together with a buffer.

Environmental Assessment Studies

Land use and capability

Lots 1 and 2 are currently used for pasture and orchards, with an area of remnant native vegetation. The site is surrounded by other extractive industry, native vegetation and orchards. Maroota Public School is to the south-east of the site. The site contains Class 3 and 4 land, suitable to grazing and pasture improvement and

for cropping. The site will be rehabilitated to Class 4 land with native endemic plants to emulate local vegetation communities.

Geology and Soils

The site and surrounding area comprise Hawkesbury Sandstone overlain by a Tertiary deposit of fluvial sediments that are an important source of construction sand for the Sydney building industry. Results of drilling indicate that the weathered sandstone on the proposed extraction site is well suited for the intended purpose of ripping, crushing and use as construction sand.

Hydrogeology

Groundwater is widely used in the Maroota area for domestic, industrial and agricultural purposes. Monitoring wells were installed on the site to determine groundwater levels and quality. These wells will continue to be monitored and a two metre buffer zone will be maintained above the highest recorded groundwater level to prevent any contamination or interruption of the existing groundwater flow or quality.

Surface Water

There is minimal catchment upstream of the site which drains to the Hawkesbury River via Jacksons Swamp –s a wetland of regional significance in Sydney Regional Environmental Plan No. 20 (DUAP, 1997). Runoff from the proposed extraction area will be drained via a series of sediment controls to a large existing detention basin on Lot 29. This water will then join the existing water management system discharged via a monitored weir on the existing extraction site. Rediversion of surface water within the proposed quarry will marginally reduce flows into one ephemeral tributary, however, the catchment is relatively small. It is not expected that quarrying will significantly or measurably affect water flows into Jacksons Swamp.

Noise

Predicted noise from representative proposed extraction areas was modelled and found that during calm and adverse weather conditions noise levels did not exceed required criteria for the school. During calm weather all residences except one are expected to experience noise levels below required criteria. During adverse wind conditions, some exceedances were predicted at nearby residences, but these have been minimised by the use of vegetated bunding and the reduction of operations during adverse wind conditions. The operators will be alerted to cease operations during these adverse conditions by an alarm system connected to a wind speed and direction sensor at the weighbridge.

As haulage rates will not increase, traffic noise will not increase above existing approved levels.

Air Quality

Air quality modelling was undertaken and determined that dust deposition will not exceed EPA criteria under the conditions modelled. All discrete receptors will have a maximum increase of less than 2 g/m^2/month dust deposition. Depositional dust monitoring is currently undertaken around the existing site and will be continued for the proposed operation.

Total suspended solids and PM_{10} concentrations from the proposal are predicted to be lower than the relevant criteria at the nearest houses.

Current dust controls will continue to be used, including water spraying of haul roads, stockpiles and disturbed areas, minimal exposure of active extraction areas, vehicle speed reduction and progressive rehabilitation.

Flora and Fauna

Several threatened animals, the threatened plant *Tetratheca glandulosa* and the threatened shale/sandstone transition forest either occur or are likely to occur on site. Quarrying would remove approximately 4.5 hectares of open forest and 1.5 hectares of heath, but the *Tetratheca glandulosa* and shale/sandstone transition forest have been excluded from quarrying and further protected by a buffer.

A referral to Environment Australia in accordance with the *Environment Protection and Biodiversity Conservation Act 2000* has been separately lodged.

Archaeology

A field survey in 1988 found no Aboriginal archaeological sites or areas of potential archaeological deposit on the site. In the event any archaeological material is found during development, operations in the area will cease immediately and National Parks and Wildlife Service contacted.

Traffic and Access

The proposed road network will be the same as for the existing operation, using the existing weighbridge and internal access roads to the newly constructed intersection with Old Northern Road. Trucks generally travel southward along Old Northern Road towards Glenorie or Windsor.

The proposed development will not increase traffic on local roads as the proposed movements will not exceed limits approved under the current development consent,

being a maximum of 60 laden trucks per day. Specific conditions relating to the number of trucks permitted to enter the site at specific times of the day will be continued.

Visual Aspects

The site is in a rural environment on the Maroota Ridge. Views towards the proposed extraction site will be provided from Old Northern Road and residences adjacent to this road. Measures to minimise views of active extraction operations on Lots 1 and 2 and enhance the visual environment include the retention of vegetated buffers between the operation and Old Northern Road and Maroota School, provision of vegetated bunding (which will also provide noise shielding) to the east and north and progressive rehabilitation. The final landform, although lower than the existing landform, has been designed to blend with the surrounding landscape where possible to reduce long-term visual impact in the Maroota area from sand extraction operations.

Waste

Waste from the proposed development will include vegetative matter, overburden, tailings, used oils, filters and parts, wastewater and general office waste. Waste management procedures in place for the existing operation will be continued to ensure wastes are properly managed and minimised.

Socio-economic Aspects

Dixon Sand's existing environmental management strategy contains procedures for community relations and complaints management. The community has been involved in the quarry planning stages and the preparation of this EIS.

As the proposed quarry extension will service the same market as the existing operation, will employ the same number of staff and use the same ancillary industries, any impact on the local employment levels or economy is unlikely.

Ecologically Sustainable Development

The precautionary principle, social equity and intergenerational equity, conservation of biological diversity and ecological integrity and valuation of environmental resources has been considered. Proposed mitigative measures and controls will minimise potential impact and assist in providing a development in keeping with the examined principles.

Cumulative Aspects

The studies completed for this EIS have considered other extractive industries in the Maroota area in their assessment of impact, including noise, air quality and visual aspects. Integration of the final landform into the local landscape was noted as a common community concern and this has been considered in the development of the final landform and rehabilitation for this proposal.

Mitigation Measures and Environmental Management

A summary of mitigation measures, or environmental controls, and a framework for the proposed environmental management plan is provided in *Chapter 5*. An environmental management strategy has been prepared for the existing development and it is proposed to extend and modify this existing strategy to include the proposed development.

Justification for the Proposed Development

The various alternatives to the proposed development were investigated (refer *Chapter 2*) and the assessed quarry plan was selected due to its lesser impact on the environment and its ability to be progressively extracted and rehabilitated, thus reducing the total area of exposure during the life of the quarry. The use of the existing facilities, including plant and haulage road, reduces environmental impacts associated with these construction activities and operations.

Sydney Regional Environmental Plan No. 9 (SREP 9)– Extractive Industry aims to help develop extractive resources close to Sydney to reduce the cost of materials supply to the community. It aims to permit development for the purpose of extractive industries on certain lands, carried out in an environmentally acceptable manner. The proposed development is within the Maroota area identified by SREP 9 as containing a sand resource of regional significance.

The potential impacts associated with the proposed development have been assessed and mitigation measures introduced to minimise these impacts. It is considered that the proposed development will be able to operate with minimal impact on the surrounding environment, whilst extracting a regionally significant resource. After extraction, the site will be returned to native bushland providing increased flora and fauna habitat opportunities in the local area.

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Chapter 1

INTRODUCTION

1.1 BACKGROUND AND OBJECTIVES

1.1.1 Background

Dixon Sand (Penrith) Pty Limited (Dixon Sand) currently extract and process mortar, concrete and speciality sands on Lots 29 and 196 DP 752025 Old Northern Road, Maroota. This operation has occurred since the early 1980's, with Dixon Sand operating the site since 1992. The current operation was granted consent by the Land and Environment Court on 7 July, 2000.

It is proposed to extend the existing sand quarry eastwards into Lots 1 and 2 DP 547255 Old Northern Rd, Maroota. Sand would be extracted and trucked to the existing processing plant on Lot 196. The location of the site is shown on *Figures 1.1* to *1.3*.

The total amount of material leaving the site would be in accordance with the limits set in the previous consent, based on a maximum of 60 laden trucks per day. Therefore, although the total amount of material being transported from the site will remain the same, the areas available for extraction will increase, to provide Dixon Sand with resources for continuation of their operations and more options to meet market demands for different types of sand.

1.1.2 Objectives

The objectives of this proposed development are as follows:

- staged clearing of vegetation within specified areas on Lots 1 and 2 DP 547255 prior to extraction;
- staged extraction of sand to within two metres of the wet weather groundwater level on Lots 1 and 2 DP 547255, with no extraction within the required buffers and areas restricted by this EIS;
- loading and trucking of extracted material from Lots 1 and 2 DP 547255 across Lot 29 DP 752025 to the existing processing plant on Lot 196 DP 752025;

- processing and stockpiling of sand at the existing processing plant, in accordance with the previously provided consent for this operation, with an additional ten years of operation to enable processing of material from Lots 1 and 2 DP 547255;

- disposal of tailings from processed sandstone from Lots 1 and 2 into tailings dams on Lot 196;

- transport of processed material off-site in accordance with the previously provided consent, with an additional ten years of consent for operations associated with the removal of resource from Lots 1 and 2 DP 547255;

- use of the existing dam on Lot 29 DP 752025 to receive and detain runoff from the proposed extraction area; and

- rehabilitation of extracted areas with integration into Lot 29 and 196 DP 752025 to create an integrated, continuous landform across the extracted areas.

1.1.3 Relationship Between Existing and Proposed Developments

i. Development Consent

The existing quarry operates under development consent 796/00/HE issued by the Land and Environment Court of NSW on 7th July, 2000. This consent was granted for sand extraction, processing and rehabilitation on Lots 29 and 196 DP 752025 Old Northern Road, Maroota. Two items of the consent relate to the proposed development, being:

- Item 1.2, stating that *'The proponent is to lodge a separate application for any alterations and/or expansion to the approved extraction activities including vehicle ingress/egress arrangements and the erection of any signs'*; and

- Item 3.1, stating that *'Consent for the purpose of extraction of material and rehabilitation is limited to a period of ten years effective from the endorsed date of this consent...ie: consent lapses on 22 March 2010'*.

The proposed development, involving extraction within Lots 1 and 2 DP 547255, Old Northern Road Maroota, is adjacent to the existing operation. It is proposed to use the existing processing plant and ancillary facilities such as workshop, weighbridge and office, as well as the existing haul roads and recently constructed intersection with Old Northern Road. It is not proposed to increase the approved total number of trucks leaving the site, being 60 laden movements per day. Therefore, impacts on

the existing road system have not been assessed by this EIS (apart from the continuation of operations beyond 22 March, 2010).

As the existing consent is for ten years, and extraction and progressive rehabilitation within Lots 1 and 2 is proposed to take up to twenty years, parts of the existing operation will require a time extension on the consent. This extension of time is included in the objectives of this current development application that will be lodged with the Department of Urban Affairs and Planning.

The extension applies to the following existing areas and activities:

- processing plant and associated stockpile areas;
- ancillary areas such as tailings dams, weighbridge, office and workshop;
- internal haul roads between the plant, weighbridge and existing access to Old Northern Road;
- recently re-constructed intersection with Old Northern Road;
- 60 laden truck movements per day and associated truck entry and internal truck movements;
- the existing pond on Lot 29 to receive some runoff from Lots 1 and 2;
- use of the temporary access route across Lot 29 (required by item 2.22 of the previous consent); and
- some modification of the proposed final landform within Lot 29 to enable a more uniform landscape between the existing and proposed extraction areas, as well as existing operations on Portion 198 DP 752025 to the south.

ii. Operations and Landform

Extraction within Lot 29, which adjoins the western edge of Lots 1 and 2, will be slightly modified to provide access and water management for Lots 1 and 2. The existing development consent requires the final landform to be rehabilitated by the end of the ten year operation. It is proposed to extend the life of the pond on Lot 29 and the overflow dam until the completion of works on Lots 1 and 2, to receive runoff from this proposed development.

The quarry plan for Lot 29 provides for a downward slope towards Lot 196, linking the final landform with Lot 196. This landform will not be substantially altered by

the extraction of Lots 1 and 2, however, a haul road providing access to Lots 1 and 2 will be incorporated into the rehabilitated landform across Lot 29.

A three metre high bund wall on the boundary between Lot 29 and Lots 1 and 2 was required by Item 4.12 of the previous consent to reduce noise from the internal haul road crossing Lot 29. This wall will remain, with modification to enable haul road access Lots 1 and 2. The bund wall to be constructed along the northern boundary of Lot 29 will be extended along the northern boundary of Lot 1 progressively with the staging of extraction. Bunding for the proposed development is described in *Section 2.3.2.*

Integration of the final landform between the various local extraction areas is required to create a future uniform landscape. To assist this, the proposed rehabilitation plan for Lots 1 and 2 proposes to use the same species and rehabilitation techniques as the existing development. Extraction of Lot 1 and 2 will reduce the elevation of this area to that of Lot 29 to form a gentle slope towards the west. Haul roads and bunds will be graded to blend the boundaries of Lots 1, 2 and 29. Further detail on the final landform is provided in *Section 2.4*.

The proponent is involved in ongoing discussions with Baulkham Hills Shire Council regarding a suitable final landform between their operation and the neighbouring quarry to the south, currently operated by PF Formations. Initial plans to reduce the existing slope between the two operations are included for consideration in this EIS.

1.2 DETERMINATION PROCESS

In accordance with the *Environmental Planning and Assessment Act 1979*, the proposed development is state significant, designated and integrated development. Details of these categories are provided in *Chapter 3*.

This environmental impact statement (EIS) has been prepared to accompany a development application to the Department of Urban Affairs and Planning (DUAP). *Figure 1.4* illustrates the determination process for the proposed development.

The Minister for Urban Affairs and Planning is the consent authority for this application as it is state significant development. Once the EIS is lodged with DUAP, copies of the EIS are forwarded to the relevant authorities, including Environment Protection Authority and Department of Land and Water Conservation, who would issue a licence or approval. After consideration of the proposal, general terms of approval from these authorities would be forwarded to DUAP for inclusion in the Minister's determination.

As designated development, the EIS and development application would be placed on public exhibition for approximately one month prior to the Minister for Urban Affairs and Planning making his determination.

1.3 CONSULTATION

1.3.1 Authority Consultation

As required for state significant development, a planning focus meeting was held on site on 18 January 2001. The meeting participants discussed the proposed development and inspected the site. The meeting was attended by:

- Department of Urban Affairs and Planning;
- Baulkham Hills Shire Council;
- Environment Protection Authority;
- Department of Land and Water Conservation;
- Roads and Traffic Authority;
- National Parks and Wildlife Service;
- NSW Agriculture;
- Department of Mineral Resources;
- Hawkesbury Nepean Catchment Management Trust; and
- the applicant (Dixon Sand).

The various authorities were requested to provide their requirements for items to be addressed in the EIS. These letters, including the requirements of the Director-General of the Department of Urban Affairs and Planning, are provided in *Appendices A and B.*

1.3.2 Community Consultation

Dixon Sand regularly inform the Maroota community about their existing quarry and the proposed development through articles in *'Living Heritage',* the Maroota and District newspaper. *Figure 1.5* provides a copy of a February 2001 article.

The community is invited on an on-going basis to inspect the existing development. Since commencement of operations in July 2000, Dixon Sand has provided site tours and information to various community members and government officers, and has held a community open day.

Dixon Sand's policy of providing information to the local community on their existing development is part of their environmental management system procedures, and will be applied to the proposed development. In this way, the local community are able to contact Dixon Sand at any time to discuss any concerns they may have.

To discuss the proposed development with the local community, a public meeting was held on 15 February, 2001 at the Maroota Rural Resources Centre (Maroota Public School). This meeting was attended by approximately 25 people (generally from the Maroota and Glenorie areas) and involved a presentation on the proposed development, questions and general discussion. A presentation by the State Member for Hawkesbury (Mr Kevin Rozzoli) and the East Bend Rural Communications Group was also provided. A questionnaire sheet was handed to attendees to comment on the proposal. Twelve completed questionnaires were received. When asked if the respondent had any specific concerns regarding the expansion proposal, nine replies indicated *'yes'*. *Table 1.1* shows the number of respondents that indicated their concern for each prompted issue.

Table 1.1 PUBLIC MEETING – RESPONDENT'S ISSUES

Issue	No. of respondents concerned about issue
Air quality/dust	7
Archaeology	1
Flora and fauna	7
Groundwater quality	8
Noise	4
Planning issues	3
Surface water quality	8
Transport/traffic	4
Visual impact	5

When asked to indicate if there were other areas of concern not listed in *Table 1.1*, responses included the following:

- *'future interference of further land;*

- *need to consider that other land holders are likely to clear vegetation and habitat so an overall Maroota plan that is practical to all land holders needs to be developed;*

- *vegetation that is not listed as 'vulnerable', etc is important habitat for species – all vegetation is important in Maroota; and*

- *rehabilitation'.*

Table 1.1 shows that groundwater and surface water quality, flora and fauna and air quality are key areas of concern. An assessment of these issues and the other areas of concern is provided in *Chapter 4*.

Attendees at the meeting also focussed on the need to provide an holistic approach to planning in the Maroota area, as they believed that past quarry planning and approvals had been undertaken on an individual basis without addressing the environment of the whole Maroota area. This has been addressed in *Section 4.17*, being an assessment of cumulative aspects of the proposal.

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DESCRIPTION OF PROPOSED DEVELOPMENT

2.1 OVERVIEW

The proposed development includes construction of bund walls and vegetation clearing prior to the staged extraction of sand from within Lots 1 and 2 DP 547255 Old Northern Road, Maroota. Extraction would commence from the west adjacent to the existing development and progress eastwards towards Old Northern Road. Non-extraction buffers would exclude areas of shallow groundwater, ecological significance or areas adjacent to lot boundaries. Once extracted, material would be trucked to the existing processing plant for washing and screening as required, prior to off site haulage using existing haulage roads and facilities. No additional buildings or processing facilities are proposed.

2.2 RESOURCE

Lots 1 and 2 and surrounding areas comprise Hawkesbury Sandstone overlain by a Tertiary deposit of fluvial sediments. The site generally comprises the deeply weathered upper units of the Hawkesbury Sandstone, referred to as Eluvial Sand, which vary in thickness between two and fifteen metres, comprising soft and friable rock that is easily ripped and crushed. The Eluvial Sand on the site extends to the water table at approximately 20 metres below ground level. Site geology is detailed in *Chapter 4,* which indicates that there are two general types of sandstone on the site; the orange/yellow upper layer and the finer, whiter layer beneath. These two types of material influence the extraction plan, which needs to expose both at the same time.

A preliminary resource assessment was provided by ERM to assist in determining the boundary buffer areas and the groundwater table buffer zone. This preliminary assessment was validated and updated by VGT Consulting using SURPAC software, taking into account buffer zones as described in *Section 2.4.1.* The first one metre of topsoil and residual soil was not included in the calculations. The resource calculations used vertical batters.

A volume to tonnage relative density factor was sourced from the *Field Geologists Manual* (Australian Institute of Mining and Metallurgy, 1995) which indicates that for dry sandstone, the average density factor of 2.24 kilograms/cubic metre is applicable. The resource determination tables are presented in *Appendix C5,* a summary of which is provided in *Table 2.1*. The total estimated tonnage within Lots 1 and 2 able to be extracted is therefore approximately 3,038,500 tonnes.

Table 2.1 RESOURCE SUMMARY

Area	(m^3)	(tonnes)
Lot 1	1, 155, 020	2, 587, 245
Lot 2 (west of ecology exclusion area)	72, 556	162, 525
Lot 2 – East of ecology exclusion area)	128, 863	288, 653
Total	1, 356, 439	3, 038, 423

2.3 PROPOSED LIFE OF OPERATION

Material extracted from Lots 1 and 2 will be trucked to the existing processing area and handled together with the material extracted from the existing operation. However, it is not proposed to increase the amount of processing or off site product sales, which are currently limited to a maximum of 60 laden trucks from the site per day. Therefore, it is envisaged that a twenty year consent will be required to enable all available resource to be extracted from Lots 1 and 2.

The existing consent for the processing plant and haul road to Old Northern Road is for ten years, based on the ten years of reserves on Lots 29 and 196. As this development application requires 20 years to extract the total resource, an additional ten year consent is sought for the processing plant, office and amenities and haul road to Old Northern Road.

2.4 EXTRACTION, PROCESSING AND HAULAGE

2.4.1 Factors Influencing Extraction Plan

A number of factors have influenced the extraction plan, including setbacks, buffers, economic extraction limits, groundwater protection requirements and machinery and market requirements.

Baulkham Hills Shire Council's Extractive Industries Development Control Plan No. 500 (DCP 500) provides the following setbacks for quarries:

- 10 metres from adjoining property boundaries;
- 30 metres from Old Northern Road;
- 250 metres from the Maroota Public School;
- 100 metres from a residence not associated with extraction; and
- 50 metres from critical habitats or threatened species, populations, and ecological communities.

A population of *Tetratheca glandulosa* and an area of Shale-Sandstone Transition Forest are located on Lot 2. A 50 metre buffer has been reserved around these areas where relatively undisturbed native vegetation/woodland/heath forest abuts the threatened plants and community. Where the threatened plants and community abut grassland to the north in extraction strip 1 and 2, a 20 metre buffer from extraction is proposed. The purpose of the 20 metre buffer is to prevent direct impacts on the threatened plant and community from earthmoving plant and to minimise indirect effects such as dust and weeds, while still maximising sandstone available for extraction.

Dust modelling has predicted very small differences in PM_{10} dust concentrations for points 50 and 20 metres north of the northern end of the *Tetratheca* population and transition forest. The sixth highest 24 hour PM_{10} predictions are 62 and 65 micrograms per cubic metre respectively, indicating little effective difference in buffer dimensions regarding dust emissions. Similarly, dust deposition modelling predicts 1.275 and 1.321 grams per square metre per month due to quarrying at 50 and 20 metres respectively. Background monitoring indicates levels of 1.8 grams per square metre per month on average, which would indicate a total predicted deposition in the order of 3 grams per square metre per month. Mentor Consulting (1993) prepared a literature review of the impacts of mine generated dust on agriculture that cited Yang (1988, Effects of dust pollution from open-cut coal mining on farmland ecological environment. *Journal of Ecology China* 7(1):9-12), who noted

that there would be no adverse effects on plant production unless dust deposition exceeded 22 to 45 grams per square metre per month.

In addition, DCP 500 limits quarrying to two metres above the wet weather high groundwater level. In developing this quarry plan, it has been assumed that the top two metres of material would be overburden and therefore the minimum economic extraction depth would be approximately four metres above wet weather high groundwater level. That is, if the available depth of resource between the wet weather groundwater level and two metres below surface is less than four metres, extraction would not occur. The area excluded from extraction due to its shallow groundwater depth is to the east of the Shale-Sandstone Transition Forest, as shown on *Figure 2.1*.

A drilling program and resource assessment determined groundwater levels and resource depth. Ongoing groundwater depth monitoring would continue to ensure extraction did not occur below this level. This monitoring may also alter the proposed extraction areas in the future.

All the above buffers and exclusion areas are shown on *Figure 2.1*.

The other factor influencing the extraction plan is the desire to provide a uniform rehabilitated landscape. Although this extraction plan is not able to link all extraction areas together to provide a completely uniform landscape, as adjacent extraction areas are operated by other companies, this plan provides opportunities for future discussions with adjacent landowners to provide a uniform landscape.

The total area of Lots 1 and 2 is approximately 26 hectares. Approximately 10 hectares of this area is to be retained within buffers (including six hectares within the buffer to Maroota school).

2.4.2 Extraction Plan

The proposed extraction plan is shown on *Figures 2.2 and 2.3*. This plan shows required setbacks, buffers and areas of resource.

The plan shows a series of nominally 100 metre wide strips extending across Lots 1 and 2. Quarrying in sequential strips allows efficient quarrying with progressive clearing and rehabilitation, therefore limiting the area active at any one time and reducing various environmental impacts.

Each strip will be benched to allow progressive quarrying to the east and to expose the different resources available in the geological sequence. For instance the upper benches of strip 1 will expose the orange/yellow sandstone material while the lower benches will supply the white sandstone.

Figure 2.1 shows areas of the two lots that have no accessible resource due to the required buffers or shallow groundwater. Extraction in Lot 2 is restricted by the school buffer and threatened community and species area. Where the strips are not able to extend the full width of the two lots, quarrying would occur over a shorter time period than the longer strips.

Three to five metre high acoustic bunds will be constructed along the northern boundary of Lot 1, on the 250 metre Maroota school buffer boundary and on the 50 metre buffer from the Lot 1 residence near Old Northern Road.

The general quarry process in each strip will be:

- chainsaw down habitat trees outside threatened arboreal animal's roosting and breeding times;
- with dozer, strip and use or stockpile vegetation and groundcover for rehabilitation. Larger stumps, logs and branches will be shredded or mulched and used for rehabilitation as required. Areas of native vegetation will be stripped and used or stockpiled separately from grassed areas. Note that as habitat trees will already have been cut down outside roosting and brooding periods, no seasonal limitations will apply to this clearing;
- with dozer, excavator and trucks, strip and use or stockpile topsoil. Topsoil from areas of native vegetation will be stripped and used or stockpiled separately from topsoil form grassed areas;
- with dozer rip and push overburden into an acoustic bund at the eastern edge of the strip;
- with dozer, excavator and truck, rip and remove surplus overburden for shaping rehabilitation areas either on Lots 1 and 2 or 29; and
- commence quarrying with dozer, excavator and trucks. A dozer will rip, blend and stockpile either on the benches or the quarry floor. An excavator will load from these stockpiles into a single articulated dump truck for haulage to the processing plant. An additional dump truck may be used in the eastern strips due to the longer haul distances to the plant.

2.4.3 Plant and Equipment

The following major plant will be used on Lots 1 & 2. In some instances similar alternative plant may be used:

- one Komatsu 375A dozer;

- one Komatsu PC400-6 excavator;
- one 30 tonne articulated dump truck. In the eastern strips, an additional truck maybe used due to the increased haulage distance to the plant;
- one water cart;
- one Caterpillar 12G grader (irregularly); and
- one service vehicle (irregularly).

Additional mobile and fixed plant will be used at the processing plant, including crushers and screens, loaders, trucks and ancillary plant. No additional or alternative equipment is proposed at the processing plant, which will continue to operate in accordance with the existing development consent.

2.4.4 On-Site Haulage and Processing

Sandstone extracted from Lots 1 and 2 will be hauled by truck across Lot 29 to the existing processing plant on Lot 196. The haulage route and plant are shown on *Figure 1.2*. The haul road across Lot 29 will be extended eastwards within Lot 1 as quarrying progresses. The haul road will have an unsealed, graded surface with a drainage channel to the lower side. The channel will contain erosion control devices as required. Water management and erosion and sediment control are described in *Sections 2.5 and 2.7*.

Hauled material will be unloaded at the plant for crushing and screening. Approximately 80 percent of extracted material will be dry processed while the remainder will be washed to remove clay fines.

The processing plant has three dump hoppers, belt feeders and conveyors, vibrating screens, crushers, scrubbers, a radial stacker and cyclones. The processing plant has a maximum capacity of 250 tonnes per hour.

Approximately 15 percent of material that is washed is fine clays and silts that are removed as tailings and pumped to a tailings storage dam. This dam is dewatered and rehabilitated when full. Existing tailings dams and voids on Lot 196 will also be used for tailings disposal for material from Lots 1 and 2.

Adjacent to the processing plant are a raw material stockpile and five product stockpiles for washed sand, mortar or brickies' sand, yellow brickies' sand and concrete sand. Approximately two weeks production is stockpiled at any one time.

2.4.5 *Product Haulage*

Product is currently trucked from the quarry and all sales are made from the on-site weighbridge. Once loaded, trucks leave via the access road and Crown Reserve Road to Old Northern Road. Trucks generally travel south along Old Northern Road to the Wisemans Ferry Road intersection. From this intersection, approximately 65 percent continue south along Old Northern Road towards Glenorie and Dural, 35 percent turn right into Wisemans Ferry Road and travel towards Windsor, Richmond and Penrith.

It is proposed that sand extracted from Lots 1 and 2 will supply the same markets as the current operation and the same transport routes will be used. As it is not proposed to increase production rates from the quarry, the number of truck movements will remain the same. This is currently approved at 60 laden trucks per day (120 truck movements).

2.4.6 *Workforce and Hours of Operation*

The current workforce numbers will remain at ten to fifteen staff, depending on sales. Truck drivers contracted or employed by others would pick up loads from the plant site.

The hours of operation on Lots 1 and 2 will be in accordance with the approved hours of operation for the existing site, being:

- 5.45 am Monday to Saturday Site - gates open to allow entry of vehicles to site;
- 6.00am – 7.00 am Monday to Saturday (not including Public Holidays) - 30 truck movements (15 loaded vehicles) may enter or leave site;
- 7.00 am – 6.00 pm Monday to Saturday (not including Public Holidays) - extraction, transportation and processing or running of machinery for maintenance purposes permitted; and
- no extraction, transportation or processing on Sundays and Public Holidays.

2.5 SURFACE WATER MANAGEMENT

2.5.1 Existing Water Management

The existing quarry's surface water management system aims for:

- discharge of stormwater from the site is clear of sediment (<50 mg/litre total suspended solids);
- a base flow through a low flow pipe is provided to the downstream creek;
- downstream ecosystems are protected;
- on site re-use of water is maximised; and
- groundwaters are not breached or contaminated.

Water management structures include diversion banks, crushed sandstone check dams, sediment basins, catch ponds, tailings ponds and storage ponds.

The acidity of a small spring that discharges into an unnamed watercourse on Lot 196 has been measured for some time and generally ranges from 4 to 4.5 units as reported in the existing quarries environmental management plan (ERM, 2000).

Surface runoff from the southern sub-catchments on Lots 1 and 2 currently discharges to an ephemeral creek that flows across the southern boundary of Lot 2. This ephemeral creek is a tributary of an unnamed creek that discharges to the Hawkesbury River 4.5 kilometres north west of the site. The other sub-catchment on Lots 1 and 2 flows into a dam on the adjacent Lot 196 Lots 1 and 2 have no current active water management apart from two dams used for stock water.

2.5.2 Proposed Surface Water Management

i. Outline

It is proposed to direct surface water runoff from the extraction areas on Lots 1 and 2 to the existing pond on Lot 29. Surplus water will discharge to a creekline via a weir on Lot 196 (refer *Figure 2.4*). The proposed water system for two representative stages of quarrying is provided as follows.

ii. Stage 2 of Quarrying

Water management at stage 2 of quarrying is shown on *Figure 2.2*. Clean water from uphill of the stage 2 area will be diverted by a backpush bank into the buffer area around the threatened plant and community.

Lot 29 (which by then will have been extracted to about 15 metres below ground level) will drain west into the Lot 196 water management system. The large void on Lot 29 currently has a volume of about 65,000 cubic metres, but extraction on this lot will reduce this to approximately 2,500 cubic metres. Dirty water from the stage 2 quarry area will be directed through a constructed channel along the quarry floor into the Lot 29 void. Small silt traps as shown on *Figure 2.2* will be excavated into the floor along the channel.

Table 2.2 details calculations and design specifications for Stage 2 water management works.

Table 2.2 STAGE 2 WATER MANAGEMENT DESIGN

	Units	Lot 29 less void	stage 2 quarry	clean catch above stage 2
Catchment Area	sq.m	28,500	36,750	22,750
Time of Concentration, tc	min	11.8	13.0	10.8
Average Coefficient of Runoff		0.80	.80	0.30
Rainfall Intensity ARI 20 tc	mm/hr	121.00	120.00	124.00
Peak Discharge Flowrate, Q	c.m/sec	0.77	0.98	0.24
WATERWAY				
Friction Factor	Choice		4	
1. Long Grass, 2. Short Grass,	Material		Rocks	
3. Concrete, 4 Rocks, 5 Corrugated, 6 Earth	n		.04	
Bed Slope	mV/mH		0.0270	
Design Velocity	m/sec		2	
Average Batter Grade	mH/ mV		2	
Base Width	m		3.0	
Depth	m		0.22	
Wetted Perimeter	m		3.98	
Flow Cross Sectional Area	sq.m		0.76	

Table 2.2 STAGE 2 WATER MANAGEMENT DESIGN

	Units	Lot 29 less void	stage 2 quarry	clean catch above stage 2
Actual Velocity	m/sec		1.36	
Flow Comparison			105%	
Velocity Comparison			68%	
TRIANGULAR CHANNEL				
Left side slope	m H:V			37
Right side slope	m H:V			2.5
Manning's n	factor			.045
Channel slope	m/m			.1
Depth	m			.11
Discharge	c.m/sec			.24
CATCHMENT YIELD .25 1ARI tc				
Catchment Area	sq.m	28,500	36,750	
Time of Concentration, tc	min	11.8	13.0	
Average Coefficient of Runoff		0.80	0.80	
Rainfall Intensity .25 1ARI TC	mm/hr	13.00	12.00	
Peak Discharge Flowrate, Q	c.m/sec	0.08	0.10	
Catchment Yield	c.m	87	115	
TYPE C BASIN SURFACE AREA				
q	m3/sec	0.08	0.10	
settling velocity (Dept Housing table 6.2)	m/sec	0.00029	0.00029	
surface area	sq.m	284.14	338.20	
20 ARI tc				
Catchment Area	sq.m	28,500	36,750	
Time of Concentration, tc	min	11.8	13.0	
Average Coefficient of Runoff		0.80	0.80	
Rainfall Intensity 20 ARI tc	mm/hr	122.00	118.00	
Peak Discharge Flowrate, Q	c.m/sec	0.77	0.96	
Catchment Yield	c.m	821	1128	

The last column in *Table 2.2* details the catchment characteristics and backpush bank design for the clean catchment above the stage 2 quarry.

Table 2.2 also details characteristics and predicted water yields from the void and the stage 2 quarry floor. The design storm was chosen in accordance with the Department of Housing's Managing Urban Stormwater handbook (Section 6.3.3). This handbook recommends a type C sediment basin should be designed for coarse soils, such as exist at the quarry. These basins require calculation of the following:

- surface area based on a 0.25 ARI time of concentration storm with an assumed particle size of 0.02 millimetres;
- settling zone depth of 0.6 metres minimum;
- length to width ratio of 3:1 or more; and
- sediment storage zone volume the same as settling zone depth.

While the EIS requirements letter from the EPA suggested a 90 percentile five day event as the design storm, the Department of Housing's Managing Urban Stormwater handbook, page 6.19 suggests this is more appropriate to fine soils that take longer to settle. Particle size analysis of crushed sandstone from Lot 196 recorded only 12 percent finer than 0.02 millimetres (Southern Environmental, 1999). While there is no doubt that the Hawkesbury sandstone topsoils are highly erodible once disturbed, the same cannot be said of the friable sandstone below. This material is far less erodible, and in most cases is solid rock. A coarse type C basin is more appropriate.

To calculate the required basin, the following method was used in accordance with the Department of Housing's Managing Urban Stormwater handbook:

Surface area = design discharge/particle settling velocity

Where design discharge is calculated for a 0.25 ARI time of concentration storm (see *Table 2.2*). Peak discharge was calculated in accordance with Australian Rainfall and Runoff (Pilgrim, 1987) although runoff coefficients were estimated by the method described by Turner and reproduced in the Soil Conservation Service Design Manual for Soil Conservation Works (Aveyard, 1990) to consider land management and surface cover. Time of concentration was determined for each section of channel by $Tc = 0.76\ A^{0.38}$ as described in Pilgrim (1987).

Where settling velocity equals 0.00029 metres per second as per Table 6.2 of Department of Housing's Managing Urban Stormwater handbook.

The resulting required surface area is approximately 220 square metres. Therefore a basin to settle water from the stage 2 quarry floor would have a surface area of 220 square metres, a settling and sediment storage zone of 1.2 metres depth and a length to width ratio of three to one.

The remnant of the void on Lot 29 will have capacity of approximately 2,500 cubic metres, a surface area of 1500 square metres and a length to depth ratio of four to one when extraction on Lot 29 is complete. The void will therefore have excess capacity for settling and will be able to retain a single ARI 20 time of concentration storm yield from both the stage 2 quarry floor and the void itself (1100 plus 800 cubic metres respectively from *Table 2.2*). Additional capacity will be provided in the small silt traps to be excavated along the constructed drainage channel.

Overflows from the Lot 29 void will occur in prolonged wet weather when water usage is low and repeated flows from the quarry fill the void. Overflows will be piped from the pond into the overlfow dam. The pipe will be buried under the Crwon Road seperating the Lot 29 pond from the overflow dam as shown on Figure 2.4. The operation of the overflow dam is detailed in Appendix 5 of the Rehabilitation and Revegetation Strategy, Department of Land and Water Conservation, 2000). The overflow dam overflows into the current discharge point.

Table 2.2 details the constructed channel that will convey dirty water through the working quarry into the void. The channel will be three metres wide and has been designed with a bare channel grade. The channel will be slightly below quarry floor level, which will be graded to drain into the channel.

iii. Stage 5 of Quarrying

Stage 5 has been used to represent later quarrying. The overall management will remain the same as for stage 2, however, the clean water diversion is more complicated and the total flow volumes are higher, owing to the larger quarry floor. Separate diversion of clean water from rehabilitated sections of the quarry (for example strips 1 and 2) was considered, but while it is possible to divert this water direct through Lot 29 and off site, this would require floor regrading that would consequently require additional rehabilitation. The preferred option is to continue passing all water through the main quarry floor channel into the Lot 29 void.

Table 2.3 details catchment characteristics and design specifications for Stage 5 works.

Table 2.3 STAGE 5 WATER MANAGEMENT DESIGN

	Units	Lot 29 Void	school catchment	stage 5 quarry
Catchment Area	sq.m	16,500	53,000	110,750
Time of Concentration, tc	min	9.6	14.9	19.8
Average Coefficient of Runoff		1.00	0.30	0.80
Rainfall Intensity ARI 20 tc	mm/hr	125.00	115.00	90.00
Peak Discharge Flowrate, Q	c.m/sec	0.57	0.51	2.22
WATERWAY				
Friction Factor	Choice			4
1. Long Grass, 2. Short Grass,	Material			Rocks
3. Concrete, 4 Rocks, 5 Corrugated, 6 Earth	n			.04
Bed Slope	mV/mH			0.0244
Design Velocity	m/sec			2
Average Batter Grade	mH/ mV			2
Base Width	m			3.0
Depth	m			0.36
Wetted Perimeter	m			4.61
Flow Cross Sectional Area	sq.m			1.34
Actual Velocity	m/sec			1.71
Flow Comparison				103%
Velocity Comparison				86%
CATCHMENT YIELD .25 1ARI tc				
Catchment Area	sq.m	16,500	53,000	110,750
Time of Concentration, tc	min	9.6	14.9	19.8
Average Coefficient of Runoff		1.00	0.30	0.80
Rainfall Intensity .25 1ARI TC	mm/hr	13.75	11.85	9.95
Peak Discharge Flowrate, Q	c.m/sec	0.06	0.05	0.25
Catchment Yield	c.m	54	70	436

Table 2.3 STAGE 5 WATER MANAGEMENT DESIGN *(Cont.)*

	Units	Lot 29 Void	school catchment	stage 5 quarry
TYPE C BASIN SURFACE AREA				
q	m3/sec	0.06	0.05	0.25
settling velocity (Dept Housing table 6.2)	m/sec	0.00029	0.00029	0.00029
surface area	m2	217.49	180.62	845.09
20ARI tc				
Catchment Area	sq.m	16,500	53,000	110,750
Time of Concentration, tc	min	9.6	14.9	19.8
Average Coefficient of Runoff		1.00	0.30	0.80
Rainfall Intensity 20 ARI tc	mm/hr	125.00	107.00	90.00
Peak Discharge Flowrate, Q	c.m/sec	0.57	0.47	2.22
Catchment Yield	c.m	495	636	3943

Construction of the noise bund along the edge of the Maroota School buffer will separate approximately five hectares of clean water catchment. It is not desirable to have this water enter the pit, so an existing small dam within the buffer area will be used to hold the yield from two ARI 20 time of concentration storms. This 1,200 cubic metre dam will have a secondary earthen spillway that would discharge back into the quarry void, although most flows will be drained through a small diameter pipe. This pipe will be installed to drain the entire dam over several days to maintain storage capacity for the next design storm. The outlet pipe will discharge into the existing drainage depression in the centre of Lot 2 (see *Figure 2.3).* Catch banks will direct water from the northeast corner of Lot 1 and the southeast corner of Lot 2 into the dam.

By stage 5, the quarry floor will have expanded to about 11 hectares. The same three metre wide channel used for stage 2 will be adequate to take flow rates from an ARI 20 time of concentration storm from stage 5(see *Table 2.3).* By stage 5, three silt traps will have been excavated along the length of the channel to provide additional settling capacity. *Table 2.3* shows that the larger floor area of the stage 5 quarry requires additional settling area (850 square metres), although the Lot 29 void will still be adequate.

iv. Final Landform Surface Water Management

The proposed final landform is shown on *Figure 2.5* and it aims to mimic exisitng flow patterns where possible. The previous quarry floor will grade gradually southwest, following a level two metres above standing water level. The quarry face against the school buffer zone will be battered to three in one (vertical to horizontal) to join the quarry floor, as will the northern boundary and the threatened species and community area. While the quarry face against the school buffer zone will be pushed down from the buffer zone. The other faces will be backfilled with reject. The rehabilitation plan is detailed in *Section 2.8*.

After quarrying is complete, the school buffer zone catchment will continue to drain into the 1,200 cubic metres dam with pipe outlet. Once the quarry face is battered to the required angle, a rock flume will be built to accept water from the dam's secondary earthen spillway. This flume will discharge onto the quarry floor and into the main excavated channel. Minor flows from the small diameter pipe will continue to discharge into the unquarried drainage depression on Lot 2.

The undisturbed threatened species and community buffer area will continue to drain predominately south, although the backfilled batters against the buffer areas will drain onto the quarry floor.

The quarry floor will continue to drain via the constructed channel into the Lot 29 void with overflows passing along the spillway channel along the western boundary of Lot 29 and through Lot 196. Once revegetation of the batters and quarry floor is complete, desilting of the small silt traps in the constructed channel will cease and the traps are expected to revegetate with semi-aquatic and emergent plants.

2.6 SOIL MANAGEMENT

Topsoil will be stripped immediately prior to extraction and used in rehabilitation. In most cases the topsoil will be stripped and spread immediately over areas to be rehabilitated. In the event that a rehabilitation area is not ready for topsoil spreading, the topsoil will be stockpiled temporarily (less than 12 months) away from drainage lines. Silt fences around the base of the stockpiles will prevent soil loss off-site. The stockpiles will be no more than three metres high to preserve aerobic soil microbes and organic material.

In most cases, topsoil will be stripped and used directly for rehabilitation of a previously quarried area.

2.7 EROSION AND SEDIMENT CONTROL

Given the soils on site are highly erodible under concentrated flows, erosion and sediment controls have been proposed to control drainage on the site and minimise the area of soil exposed to surface water flows. Controls will include the following:

- maintain buffers/boundary setbacks and install silt fences where appropriate to prevent sediment transport and impact on adjoining land;
- minimise the area of disturbance by only clearing areas immediately prior to extraction within each stage or precinct and progressive rehabilitation of completed precincts (refer to rehabilitation strategy for soil stabilisation techniques);
- divert upslope drainage away from disturbed areas;
- diversion of dirty runoff to sediment basins; and
- regular inspection and maintenance of sediment controls.

The environmental management plan to be implemented for the works will detail these controls in more detail, including types, locations, inspections and monitoring.

2.8 REHABILITATION AND FINAL LAND USE

2.8.1 Rehabilitation Plan

Figure 2.5 show the conceptual final landform for the proposed quarry. The objectives of the rehabilitation plan are to:

- form a final landform similar to the surrounding landscape;
- ensure rehabilitation works are implemented progressively;
- enhance the scenic and environmental quality of the site;
- maintain existing flow paths wherever possible and reinstate the ephemeral watercourse through Lot 2;
- protect and enhance habitat for threatened species and communities; and
- continue agricultural land uses on Lots 1 and 2.

As the extractable resource approximately follows existing topography, the quarry floor would be similar in form to the current landform, but approximately three to twenty metres lower. Those parts of Lots 1 and 2 that are low lying and closer to the watertable and consequently not available for quarrying will remain at their current levels.

Buffers required to reduce noise around the school and protect threatened vegetation provide a useful role in rehabilitation in that they retain mature stands of vegetation on site. Disturbance to these buffers would be kept to a minimum and modified only to reduce differences in slope towards extracted areas. The buffer protecting the Shale-Sandstone Transition Forest and *Tetratheca glandulosa* will be higher than the extracted area. Development between this buffer and the final landform has attempted to integrate this area with the extraction area by backfilling to reduce batter grades and rehabilitation with similar species.

No buffer is provided along the southern boundary of Lot 2 as it adjoins the adjacent quarry.

The western edge of the quarry will blend into the floor of the quarried area on Lot 29. The quarry floor on the northern and eastern edges of Lots 1 and 2 will be backfilled and battered respectively up to the top of the existing landform.

After quarrying is complete, it is proposed to reinstate the ephemeral watercourse through Lot 2 as shown in *Figure 2.5*. As these works would be carried out about 15 years from now, details have not been designed. A conceptual plan will be formulated in consultation with DLWC as part of the environmental management plan, and as quarrying approaches its final extent, full specifications will be designed, using latest methodology proven at that time. An outline of sections of this rebuilt channel follow:

- the small existing dam will be retained to capture and release storm flows, although the pipe outlet will be shortened to discharge immediately downstream of the dam;
- flows from the dam and the rest of the catchment will be directed into a rock flume built on the quarry highwall;
- the flume will discharge into a stilling basin and then along a relatively flat grassed channel along the old quarry floor; and
- the floor channel will accept additional flows from the rehabilitated quarry and discharge into the undisturbed section of the watercourse and then through the southern boundary.

2.8.2 Rehabilitation Process

Extraction and rehabilitation would be undertaken in strips that progressively follow quarrying eastwards. Each strip would be cleared, extracted and then rehabilitated. Cleared vegetation and topsoil from one strip would be transferred directly for use in rehabilitation of another strip. This process requires a staged approach where a number of strips would be either cleared, extracted or rehabilitated concurrently. An example of this process follows, where strip 3 is being cleared prior to extraction, strip 2 is in the final stages of extraction and, strip 1 is being rehabilitated:

- fell large trees in strip 3 and temporarily stockpile on strip 1;
- clear remaining vegetation and topsoil on strip 3 with a dozer and stockpile on strip 3. Stockpiles would be small, less than three metres high and would not be left for more than three months to minimises decomposition of seeds, sticks and leaves;
- strip overburden from strip 3 and truck to backfill the vertical cuts on strip 1;
- truck topsoil stockpiled on strip 3 and spread over strip 1;
- cover topsoiled areas of strip 1 with large trees felled from strip 3 that had been temporarily stockpiled on strip 1.
- plant and maintain tubestock on strip 1. Weed and replace dead plants as necessary.

It should be noted that this is a summary of the rehabilitation process and that a comprehensive Rehabilitation Strategy would be prepared as part of the Environmental Management Plan. Other components of the Rehabilitation Strategy would minimise clearing or extraction to not more than two strip areas at any one time and include an ongoing weed control program.

2.8.3 Rehabilitation Species and Technique

Rehabilitation techniques will be similar to:

- those described in the Rehabilitation and Revegetation Strategy prepared by Soil Service, Department of Land and Water Conservation (DLWC, 2000); and
- those being undertaken for Lot 196.

Rehabilitation of Lot 196 involves a combination of brush-matting, sowing and transplanting. Seeds of species dependent on fire for germination would be heat-

treated before planting. Instead of manual brush-matting as used on Lot 196, the mixture of topsoil, leaf litter and brush stripped by dozer is expected to supply the main seed source.

Broad vegetation groups (genus level) to be used in rehabilitation of Lots 1 and 2, and their associated rehabilitation techniques, have been detailed in *Table 2.4*. It should be noted that this is not a comprehensive list and that more than one rehabilitation technique may be applied to one species to optimise germination. Species for each vegetation group would be selected from those currently occurring on Lots 1 and 2.

Table 2.4 REHABILITATION TECHNIQUES AND VEGETATION GROUPS

Rehabilitation Technique.	Broad Vegetation Group (genus)
Brush matting	*Allocasuarina, Banksia*, Hakea, Leptospermum*, Acacia** and *Eucalypt.*
Topsoil	*Grevillea, Pultenaea, Hibbertia, Bossiaea* and other native grasses and herbs
Transplanting	*Lomandra, Dillwinia, Pultanaea*
Broad Sowing	*Acacia*, Iosopogon, Banksia *, Hakea** and native grasses
Tubestock	*Persoonia, Eucalypt* and other small shrubs that do not germinate from topsoil.

* may require heat treatment

The rehabilitation program would also involve use of cleared logs and felled trees for ground fauna habitat and soil stabilisation.

2.9 ALTERNATIVES

2.9.1 Introduction

The Department of Urban Affairs and Planning Director-General's requirements for this EIS include a requirement to determine alternative sources of sand and alternative materials, and to justify the proposal in terms of local and regional context. Schedule 2 of the Environmental Planning and Assessment Regulation, 2000 also requires an analysis of any feasible alternatives to the carrying out of the development, having regard to its objectives, including the consequences of not carrying our the development.

The EPA has also requested consideration of alternatives and justification for the proposal, including alternatives sites and layouts, access modes and routes, materials handling and production processes, waste and water management, impact mitigation measures and energy sources.

Justification for the proposed development is discussed in the Executive Summary.

2.9.2 Alternative Sources and Materials

New South Wales requires around 11 million tonnes of construction sand per year, of which five to six tonnes are consumed in the Sydney Region. Currently around 15 percent of Sydney's construction sand is from outside the metropolitan region. It is estimated that as much as 50 percent of its sand will need to be sourced from outside the region within ten years (www.minerals.nsw.gov.au March, 2001). Sydney Regional Environmental Plan No.9 Extractive Industry (DUAP, 1994) recognises Maroota as a sand extraction area of regional significance, given its proximity to the Sydney market and the quality of the resource.

Other areas producing sand for the Sydney region include Penrith Lakes, Kurnell, Somersby Plateau and the Hunter River area.

The Penrith Lakes Scheme and existing extraction operations in the Hawkesbury-Nepean River contain 64.2 million tonnes of medium-course grained sand secured for extraction. These reserves are only sufficient to meet the Sydney region's requirement for approximately another ten years (DUAP, 1994). Maroota, Newnes Plateau, Somersby Plateau and the Richmond Lowlands have been identified in SREP 9 as long-term options to replace the Penrith Lakes Scheme. Transport costs are an important element in the sourcing sand as it is a high bulk, low unit price material. The Maroota sand resource has less constraint in terms of transport distance and cost than the Newnes Plateau resource.

There are few alternative materials to replace sand in the production of concrete. Fines generated in the crushing and screening of hard rock are used in some cases, however stocks cannot always be guaranteed. Other alternatives to construction sand include recycled building and demolition waste, granulated blast furnace slag and fly ash from coal-fired power stations. However these alternatives generally have inferior performance to sand, particularly in concrete making, and generally have high handling, transport and processing costs.

2.9.3 Alternative Extraction Methods and Plans

The proposed method of extraction is using a bulldozer, excavator and truck. An alternative to ripping the resource with a bulldozer would be to drill and blast before

loading or using scrapers to load ripped or blasted sandstone. The resource is soft enough to rip and blasting is generally more expensive. Scrapers could be used instead of excavators, however scrapers generally have a higher sound power level than excavators and would therefore have a greater noise impact. Also, as the haulage distance increases from the quarry to the plant, trucks are more efficient to run than scrapers.

The alternative to the proposed extraction plan, which involves extracting nominally 100 metre wide strips, is to have a much larger area of the quarry active at any one time. This alternative is not considered environmentally responsible as it would result in increased environmental impacts and would not allow progressive rehabilitation.

2.9.4 Alternative Processing and Handling Methods

It is proposed to process and handle the material at the existing processing plant. An alternative would be to use a mobile plant located within the proposed quarry floor. This is not considered a viable option as it would be more expensive, would not use existing infrastructure and may have a greater noise impact on the Maroota Public School and nearby residents along Old Northern Road.

2.9.5 Alternative Access

It is proposed that trucks will use the same access as the existing operation, via the access road and Crown Reserve Road to Old Northern Road. Alternative access to the site would involve the construction of a new haul road from the proposed quarry area directly to Old Northern Road. This would result in additional environmental impact, expense and safety concerns with trucks turning onto Old Northern Road near the Maroota Public School. Given these issues, the alternative access is not considered a viable or environmentally responsible option.

2.9.6 Alternative Waste and Water Management

There are no environmentally responsible alternatives to the waste and water management strategies proposed for the development.

2.9.7 Mitigation Measures and Energy Sources

The proposed mitigation measures have been designed with a comprehensive knowledge of the site and there are no feasible alternative energy sources.

2.9.8 Not Proceeding

Not proceeding with the proposed quarry extension would mean a regionally significant resource close to the Sydney market would not be used and eventually alternative sand resources at a greater distance outside the Sydney region will need to be sourced at a higher cost to consumers.

The Dixon Sand operation has already proven to be a high quality, viable sand resource. Not proceeding with the proposed extension would result in foregoing the opportunity to extract and process a high quality, high demand resource using existing plant and infrastructure.

Not proceeding with the proposal would also result in earlier closure of Dixon Sand's Maroota current operation, with discontinued employment of 10 to 15 quarry staff. A number of indirect jobs such as truck drivers involved in product transport and suppliers would also be foregone.

Chapter 3

STATUTORY REQUIREMENTS AND PLANNING FRAMEWORK

3.1 INTRODUCTION

The *Environmental Planning and Assessment Act, 1979* (EP&A Act) and Environmental Planning and Assessment Regulation, 2000 (EP&A Regulation) control the use and development of land in New South Wales. The EP&A Act establishes the hierarchy of planning instruments that apply to the proposed development. These instruments and associated legislation that apply to the proposed development are detailed in this chapter.

3.2 ENVIRONMENTAL PLANNING AND ASSESSMENT ACT, 1979

3.2.1 Development Consent

The proposed development requires development consent under Part IV of the EP&A Act. According to Schedule 3 of the EP&A Regulation, the proposed quarry is designated development because it involves the excavation of more than 30,000 cubic metres per year and will disturb more than two hectares. Consequently, an environmental impact statement (EIS) is required to accompany the development application.

3.2.2 Director-General's Requirements

The EP&A Regulation specifies matters to be addressed in an EIS, and requires the Director-General of the Department of Urban Affairs and Planning to be consulted regarding the specific form and content. The requirements of the Director General are attached in *Appendix A.*

3.2.3 State Significant Development

The Minister for Urban Affairs and Planning declared in the NSW Government Gazette in 1999 that an extractive industry is considered to be State significant

development if *"the resource has been identified as being of State or regional significance in a strategic plan adopted by the Director-General"*.

As the resource has been identified in Sydney Regional Environmental Plan No. 9 – Extractive Industry (No. 2) as being of regional significance, the proposed quarry is State significant development. The development application and EIS must therefore be lodged with the Department of Urban Affairs and Planning (DUAP) and will be placed on public exhibition for 30 days. During this time any member of the public can make submissions to DUAP in relation to the proposed development. The EIS will be circulated to relevant government and statutory authorities, directly affected landowners and others that may have an interest in the development. Notices will be sent to these authorities and individuals inviting written submissions to be lodged with DUAP.

3.2.4 Integrated Development

This proposal is integrated development under Section 91 of the EP&A Act as it requires licences and approvals from the Environment Protection Authority and the Department of Land and Water Conservation. The Minister for Urban Affairs and Planning will obtain from each approval body their general terms of approval. Following receipt of all terms of approval and other submissions, the Minister will determine the development application, unless the Minister decides a Commission of Inquiry needs to be held or is requested by Council.

The determination process for designated, integrated and State significant development is illustrated in *Figure 1.3*.

3.3 BAULKHAM HILLS LOCAL ENVIRONMENTAL PLAN, 1991

The Baulkham Hills Local Environmental Plan, 1991 (LEP 1991) governs land use in the Baulkham Hills local government area. LEP 1991 zones the quarry Rural 1(b) on which quarrying is permissible with development consent.

The objectives of the Rural 1(b) zoning are reproduced below in italics. Comments regarding the development in response to these objectives are also provided.

(a) To ensure that existing or potentially productive agricultural land is not withdrawn unnecessarily from agricultural production.

Parts of the proposed extraction area are currently used for growing peaches. Cleared areas have some potential for grazing, although there is no fencing to keep stock from the existing quarry. As identified in Sydney Regional

Environmental Plan No. 9 – Extractive Industry No. 2 (SREP 9) (DUAP, 1994) the sand, clay/shale and friable sandstone in these and surrounding lots has regional significance. SREP 9 takes precedence over local environmental planning instruments and therefore the use of the land for quarrying has greater value to the region than the use of the land for agriculture. Once the sand has been extracted parts of the rehabilitated site will be reverted to orchard production and grazing.

(b) To ensure that development is carried out in a manner that minimises risk from natural hazards and does not unreasonably increase demand for public services and public facilities.

The quarry is unlikely to increase risk from natural hazards, such as bushfire. If necessary, control burning and other fire management will minimise bushfire risk. Council would be consulted prior to any control burning being undertaken.

No additional facilities or services will be required to service the proposed development. Total output from the Dixon Sand's existing quarry and the proposed extension will not exceed the approved rate of 60 laden trucks per day off site. Therefore the proposal will not generate demand for improvements to the public road network in the area.

(c) To provide for urban support functions.

The proposed quarry expansion will enable the continued supply of mortar and concrete sand to Sydney markets for use in house building and other projects. As previously stated, the sand, clay/shale and friable sandstone in these and surrounding lots is recognised in SREP 9 as a regionally significant resource.

(d) To protect and enhance those areas of particular scenic and environmental value.

The proposed extraction area contains areas of native vegetation. The site also supports a community of the threatened plant *Tetratheca glandulosa* and the endangered ecological community shale/sandstone transition forest. These two areas have been excluded from extraction, with a 50 metre protection buffer placed around their known limits.

Jacksons Swamp is approximately 1.5 kilometres downstream and is identified in Sydney Regional Environmental Plan No. 20 – Hawkesbury-Nepean River as a wetland of regional significance (Wetland No. 88). Water quality and quantity is monitored at a weir on the existing extraction site. Runoff from the proposed extraction area will be linked to the existing water

management system and will therefore be included in the current monitoring program.

The rural qualities surrounding Old Northern Road will be retained through provision of a 30 metre vegetated buffer between the road and the proposed extraction area.

The area of disturbance from quarrying will be minimised by only clearing areas immediately prior to extraction and undertaking progressive rehabilitation using native seed collected from adjoining bushland.

These and other mitigation measures are discussed in more detail in *Chapters 4* and *5*.

(e) To maintain the rural character of the area without adversely affecting the carrying out of agricultural activities.

Although the proposed development will prevent horticulture and grazing in the short-term, it is proposed to use part of the rehabilitated land for these purposes once extraction has ceased. A buffer between the proposed extraction and Old Northern Road will assist in retaining rural qualities viewed along this road.

(f) To make provision for tourist facilities in appropriate locations.

The proposed quarry is not a tourist facility and given the proximity of Lots 1 and 2 to several quarries, it is unlikely that this land would be considered a desirable location for a tourist facility.

In light of the above assessment, the development is generally consistent with the objectives of the Rural 1(b) zone and is therefore permissible.

3.4 BAULKHAM HILLS COUNCIL DEVELOPMENT CONTROL PLANS

3.4.1 Development Control Plan No. 1 – Rural Land

Development Control Plan No. 1 – Rural Land (DCP 1) applies to land zoned Rural 1(a), 1(b) and 1(c) under LEP 1991. Its aim is to ensure that development in rural areas is sympathetic with environmental quality.

The objectives of DCP 1 are to:

- provide guidelines for the development of rural areas;

- ensure that development in rural areas has regard to the agricultural and environmental quality of the land; and

- accommodate development which is compatible with the rural environment, does not unreasonably increase the demand for services and minimises risks from natural hazards.

DCP 1 also provides development objectives and standards for development sites, dwellings, dual occupancies, setbacks to roads, development near the Hawkesbury River, rural industries, tourist facilities, reception establishments, restaurants, and developer contributions.

Development standards relevant to the proposed quarry extension are:

- the site must have a minimum area of 10 hectares and a road frontage of 60 metres; and

- a minimum building setback of 30 metres from Old Northern Road.

The proposed quarry complies with these development standards.

3.4.2 Development Control Plan No. 500 – Extractive Industries

Development Control Plan No. 50 – Extractive Industries (DCP 500) has been designed to assist applicants in the preparation, assessment and determination of extractive industry projects.

The objectives of DCP 500 are to:

- consider the social, economic and environmental issues in the assessment and management of extractive industries;

- implement the objectives of international and nationally recognised environmental standards;

- encourage community participation in all phases of extractive industry development;

- provide sound technical parameters to facilitate the orderly development of extractive resources within environmentally sensitive regions;

- conserve the biological and cultural diversity and quality of the Baulkham Hills Shire; and

- implement the requirements of the *Environmental Planning and Assessment Act, 1979* and other relevant environmental statutes.

DCP 500 also provides objectives, performance criteria and prescriptive measures for various environmental issues. Performance criteria and/or prescriptive measures relevant to the proposed development are listed in *Table 3.1* along with comments regarding the development in response to these measures.

Table 3.5 RELEVANT PERFORMANCE CRITERIA AND/OR PRESCRIPTIVE MEASURES OF DCP 500

Element	Performance Criteria or Prescriptive Measure	Comments
Community Participation	Community consultation should be undertaken in the preparation, assessment and management of extractive industries.	A community consultation meeting was held in February 2001. Ongoing consultation forms part of the existing operation, including information regarding the proposed development in local newspapers. An existing telephone complaint line will continue.
	Proponents are encouraged to promote a better understanding of links with local cultural history and diversity; natural features and bio-diversity; local economies; and local views, values and aspirations.	Two meetings are held per year with a review committee of Maroota residents, Council, EPA, DLWC, Hawkesbury Nepean Catchment Management Trust representatives, Dixon Sand and any others considered appropriate by Council. These meeting also address address issues relating to the proposed quarry. Annual community open days are held at the quarry and a monthly article in the local newspaper includes monthly monitoring results and sand mining issues. These open days and monthly articles will incorporate the proposed quarry.
Setbacks	Extraction should be set back no less than: - 10 m from adjoining property boundaries; - 30 m from a public road; - 40 metres from the top bank of a watercourse or otherwise to the requirements of the DLWC; - 100 metres from a public or community facility; and - 100 metres from a residence not associated with extraction.	The proposed quarry complies with these setback requirements (refer to ***Figure 2.1***).

Table 3.1 RELEVANT PERFORMANCE CRITERIA AND/OR PRESCRIPTIVE MEASURES OF DCP 500 *(Cont.)*

Element	Performance Criteria or Prescriptive Measure	Comments
Transport	Internal access roads should be: - no less than 20 m wide; - have a setback of at least 10 m from adjoining property boundaries; - have a setback of at least 50 metres from environmentally sensitive areas, including habitats of threatened species; and - have a setback of 100 m from residences not associated with extraction.	The proposed quarry will rely on the existing internal access roads and a new haul road that will be 5 m wide to adequately allow passage of a 3 metre wide haul truck.
Water Resources	A water management strategy should be prepared and submitted.	The surface water management strategy is in *Section 2.5*.
	Extraction should not occur within 2 m of the wet weather high groundwater level or otherwise to the requirements of the DLWC.	Extraction will not occur within 2 metres of the wet weather high groundwater level. Groundwater levels and quality will be regularly monitored.
Visual Amenity and Scenic Quality	A landscape site analysis must be submitted that identifies and assesses the scenic qualities, landscape constraints and options for landscape protection of the extraction site.	A visual assessment of the site satisfying these requirements is provided in *Chapter 4*.
	Visual pollution should be minimised through appropriate setbacks, perimeter screen plantings, and other measures.	Various measures will minimise the visual impact of the proposed quarry including the maintenance of vegetated buffers along the boundaries.

Table 3.1 RELEVANT PERFORMANCE CRITERIA AND/OR PRESCRIPTIVE MEASURES OF DCP 500 *(Cont.)*

Element	Performance Criteria or Prescriptive Measure	Comments
Visual (Cont.)	Extraction sites should be rehabilitated to a final landform compatible with the shape, grade, level, form, land use, landscape quality and biodiversity of the surrounding terrain.	A rehabilitation and revegetation strategy has been implemented for the existing quarry and the principles of this strategy will be applied to the proposed development (refer to *Chapter 2*).
Flora and Fauna	A flora and fauna assessment should be undertaken, including an 8 part test and SIS where required.	A flora and fauna assessment has been undertaken and is documented in *Chapter 4.*
	Extraction operations should provide a buffer zone of at least 50 m from critical habitats of threatened species, populations, ecological communities.	A buffer of 50 m has been retained around critical habitats of threatened species, populations and ecological communities (refer to *Figure 2.1*).
Heritage and Archaeological Resources	An archaeological study should be submitted which includes an assessment of the scientific, educational, landscape and cultural values of all Aboriginal and non-Aboriginal sites.	An archaeological study is documented in *Appendix G.*
	Extraction should not occur within 40 m of rock engravings, axe grinding grooves, open scatters of artefacts, stone arrangements, waterhole/well, and/or scarred trees; archaeological sites protected under the *National Parks & Wildlife Act, 1974* and listed in the Aboriginal Sites Register; and other requirements of NPWS.	No Aboriginal archaeological sites or areas of potential archaeological deposit were identified.
Soil Conservation	A sediment and erosion control plan should be submitted.	Sediment and erosion control measures are discussed in *Chapter 2*.

Table 3.1 RELEVANT PERFORMANCE CRITERIA AND/OR PRESCRIPTIVE MEASURES OF DCP 500 *(Cont.)*

Element	Performance Criteria or Prescriptive Measure	Comments
Acoustic Management	An acoustic impact assessment report must be submitted which identifies and assesses the range of noise levels within the locality and the impacts likely to generated by the proposal.	An acoustic assessment is provided in *Chapter 4*.
Air Quality Management	An air quality assessment report should be submitted.	An air quality assessment report is documented in *Appendix E.*
Extraction Program	An extraction plan should be submitted.	The proposed extraction plan is in *Chapter 2* and *Figures 2.2 and 2.3.*
Rehabilitation	A rehabilitation strategy should be submitted.	A rehabilitation and revegetation strategy has been implemented for the existing quarry and the principles of this strategy will be applied to the proposed quarry (refer to *Chapter 2).*
Social and Economic Assessment	An economic appraisal report and social impact assessment should be submitted.	A socio-economic profile of the area is provided in Chapter 4 along with details of the socio-economic costs and benefits of the proposed quarry.
Ecologically Sustainable Development	An ecologically sustainable development summary report should be submitted.	*Chapter 4* describes how the proposed development complies with the principles of ESD.
Post-Extraction Land Use	The extraction site should be rehabilitated to a useable and stable final landform that can support a variety of agricultural or other permissible land uses. A farm management plan should be submitted for agricultural post extraction land uses.	The rehabilitation and revegetation strategy for the proposed quarry and final land use details are provided in *Chapter 2.*

Table 3.1 RELEVANT PERFORMANCE CRITERIA AND/OR PRESCRIPTIVE MEASURES OF DCP 500 *(Cont.)*

Element	Performance Criteria or Prescriptive Measure	Comments
Maroota	The proposed development should comply with all provisions of DCP 500. Extractive industries set backs are provided. Those specific to the Maroota area are: - 40 m from Maroota State Forest, 50 m from known critical or potential habitats of Yellow Belly Glider, *Kunzea rupestris* and *Tetratheca glandulosa*, other threatened species, populations and ecological communities, and 250 m from the Maroota Public School.	The provisions of DCP 500 have been addressed in this table. The proposed quarry complies these setback requirements (refer to *Figure 2.1*)
Section 94 Contributions	Section 94 contributions may be required.	Section 94 contributions will be made as required.
Environmental Management Systems	An annual environmental management plan should be submitted to indicate the overall performance and management of the operation, to include an acoustic management plan, a rehabilitation management plan, a water management plan, a waste management plan and a social impact management plan.	Dixon Sand has developed an environmental management strategy for their existing quarry. Prior to quarrying on Lots 1 and 2, the environmental management strategy will be revised to incorporate the proposed development (refer to *Chapter 5*).

3.5 REGIONAL ENVIRONMENTAL PLANS

3.5.1 Sydney Regional Environmental Plan No. 9 – Extractive Industry

Sydney Regional Environmental Plan No. 9 – Extractive Industry (No. 2 - 1994), (SREP 9), was introduced to help develop extractive resources close to the Sydney metropolitan area so that the cost of supplying materials to the community could be kept to a reasonable level. SREP 9 takes precedence over local planning instruments.

The relevant aims of SREP 9 as they apply to the proposed development are:

> *'This plan aims:*
>
> *(a) to facilitate the development of extractive resources in proximity to the population of the Sydney Metropolitan Area by identifying land which contains extractive material of regional significance; and*
>
> *(b) to permit, with the consent of the council, development for the purpose of extractive industries on land described in Schedule 1 or 2; and*
>
> *(c) to ensure consideration is given to the impact of encroaching development on the ability of extractive industries to realise their full potential; and*
>
> *(d) to promote the carrying out of development for the purpose of extractive industries in an environmentally acceptable manner.'*

Clause 8 of SREP 9 requires Council to forward a copy of the development application to the Director-General of the Department of Mineral Resources with respect to land identified in Schedule 2 of the Plan. The subject land at Maroota is listed in Schedule 2 of the Plan therefore this clause applies to the proposed development.

Clause 9 of SREP 9 requires Council to consider planning recommendations for future resource extraction presented in the Extractive Industry Planning Report, when considering developments applications for extraction. The Planning Report states that in order to achieve objective (d) of SREP 9, Council should require that:

- noise and vibration levels are in accordance with EPA guidelines;
- a rehabilitation plan is prepared;

- rehabilitation measures are carried out in accordance with the guidelines in the Urban Erosion and Sediment Control Handbook (1992) prepared by the Department of Conservation and Land Management; and

- the impacts on groundwater and/or watercourses are assessed.

These requirements are also stipulated in Clause 7 of SREP 9.

A noise assessment, rehabilitation and revegetation strategy, surface and groundwater impact assessment have been completed as part of this EIS in accordance with the abovementioned guidelines and requirements.

Clause 11 of SREP 9 details special requirements for extractive industry at Maroota. Clause 11(2) is reproduced below in italics and comments regarding the proposed development are also provided.

'The council must not grant consent to the carrying out of development for the purpose of extractive industry on land to which this clause applies unless the council is satisfied that the proposed development:

(a) is unlikely to have a significant adverse impact on the Maroota groundwater resource or on other groundwater users in the region;

As discussed in *Chapter 4* and the groundwater assessment report provided in *Appendix C* the proposed quarry is unlikely to have a significant impact on the Maroota groundwater resource or on local groundwater users. Extraction will not occur below two metres above the wet weather groundwater level and groundwater levels and quality will be regularly monitored.

(b) will conserve the environmentally sensitive and significant areas and features of the Maroota locality, including the environment of threatened species, populations and ecological communities;

The proposed development will protect adjoining bushland through the maintenance of buffers, erosion and sediment controls, the removal of weeds and weed control. A 50 metre buffer will be provided around areas containing threatened species, populations and ecological communities.

(c) will involve controlled and limited access points to main roads; and

Sand from Lots 1 and 2 will be transported via a new internal haul road through to Lot 29, DP 752025, then onto Lot 196 where it will be processed and stockpiled. All product will then be trucked from Lot 196 to existing

internal access road and Crown access road. The previously approved and improved intersection with Old Northern Road will continue to be used.

(d) will result in a final landform capable of supporting sustainable agricultural production or other post-extraction land uses compatible with the established character and the landscape and natural quality of the Maroota locality.'

The final land use will be similar to the existing land use that includes, orchards, pasture and native vegetation.

3.5.2 Sydney Regional Environmental Plan No. 20 – Hawkesbury-Nepean River

Sydney Regional Environmental Plan No. 20 – Hawkesbury-Nepean River (No. 2 – 1997) (SREP 20) applies to the proposal and aims to *"protect the environment of the Hawkesbury-Nepean River system by ensuring that the impacts of future land uses are considered in a regional context"*.

SREP 20 contains general planning considerations, specific planning policies and recommended strategies that apply to development proposals. Those specific planning strategies that are applicable to the proposed development are reproduced below in italics and comments are provided in response to these.

'Total catchment management:

(b) consider the impact of the development concerned on the catchment; and

(c) consider the cumulative environmental impact of development proposals on the catchment.'

The Maroota area has numerous sand quarries and several studies have investigated the impact of these. Cumulative impacts on traffic, noise, air quality and issues such as flora and fauna corridors are assessed in *Chapter 4*.

'Environmentally sensitive areas:

(b) minimise adverse impacts on water quality, aquatic habitats, riverine vegetation and bank stability;

(d) protect wetlands (including upland wetlands) from future development and from the impacts of land use within their catchments; and

(g) consideration should be given to the impact of the development concerned on the water table and the formation of acid sulphate soils.'

The Hawkesbury River is 4.2 kilometres north west of the site and Jacksons Swamp is approximately 1.5 kilometres downstream of the quarry. This swamp is identified in SREP 20 as a wetland of regional significance (Wetland No. 88).

Erosion, sediment and stormwater controls described in *Chapter 2* will include the maintenance of buffers, staged extraction and rehabilitation, the diversion of clean runoff away from disturbed areas, and the diversion of dirty runoff into sediment basins and catch ponds.

'Water quality:

(a) quantify, and assess the likely impact of, any predicted increase in pollutant loads on receiving waters; and

(f) consider the need for an Erosion and Sediment Control Plan (to be in place at the commencement of development) where the development concerned involves the disturbance of soil.'

An assessment of the impact of the proposed development on the quality of receiving waters is provided in *Chapter 4.*

'Water quantity:

(b) ensure the amount of stormwater run-off from a site and the rate at which it leaves the site does not significantly increase as a result of development. Encourage on site stormwater retention, infiltration and (if appropriate) reuse; and

(d) consider the impact of development on the level and quality of the water table.'

As previously discussed in this chapter, all surface runoff from the site will be directed to a storage dam on Lot 196 via a series of sedimentation basins.

Extraction will not occur below two metres of the wet weather groundwater level and groundwater levels and quality will be regularly monitored.

'Cultural heritage:

(b) protect Aboriginal sites and places of significance; and

(c) consider an Aboriginal site survey where predictive models or current knowledge indicate the potential for Aboriginal sites and the development concerned would involve significant site disturbance.'

An archaeological study of the subject land has been carried out and is documented in *Appendix G*.

'Flora and fauna:

(a) conserve and, where appropriate, enhance flora and fauna communities, particularly threatened species, populations and ecological communities, aquatic habitats, wetland flora, rare flora and fauna, riverine flora, flora with heritage value, habitats for indigenous and migratory species of fauna, and existing or potential fauna corridors;

(c) minimise adverse environmental impacts, protect existing habitat and, where appropriate, restore habitat values by the use of management practices;

(e) consider the range of flora and fauna inhabiting the site of the development concerned and the surrounding land, including threatened species and migratory species, and the impact of the proposal on the survival of threatened species, populations and ecological communities, both in the short and longer terms;

(f) consider the need to provide and manage buffers, adequate fire radiation zones and building setbacks from significant flora and fauna habitat areas; and

(g) consider the need to control access to flora and fauna habitat areas.'

The site supports the threatened plant *Tetratheca glandulosa* and the endangered ecological community shale/sandstone transition forest which has been excluded from the extraction area, with a buffer retained.

3.6 STATE ENVIRONMENTAL PLANNING POLICIES

3.6.1 Traffic Generating Developments SEPP 11

State Environmental Planning Policy No. 11 – Traffic Generating Developments (SEPP 11), which applies to extractive industries, requires the Roads and Traffic Authority (RTA) to be made aware of the proposed quarry extension and be given an opportunity to make representations about the proposal. Correspondence from the RTA is included in *Appendix B*.

3.6.2 SEPP 33

State Environmental Planning Policy No. 33 Hazardous and Offensive Development (SEPP 33) ensures proposals are assessed in relation to off-site risk and offence. Two of the aims of SEPP 33 are:

> *'(d) to ensure that in determining whether a development is a hazardous or offensive industry, any measures proposed to be employed to reduce the impact of the development are taken into account; and*
>
> *(e) to ensure that in considering any applications to carry out potentially hazardous or offensive development, the consent authority has sufficient information to assess whether the development is hazardous or offensive and to impose conditions to reduce or minimise any adverse impact.'*

In order to determine whether a development is a hazardous, offensive or potentially hazardous or offensive industry Clause 8 of SEPP 33 refers to DUAP's *Hazardous and Offensive Development Application Guidelines*. On the basis of these guidelines the proposed quarry is likely to be considered to be a 'potentially offensive industry' because it requires a Environment Protection Licence from the EPA.

A potentially offensive industry is defined in SEPP 33 as:

> *'a development for the purposes of an industry which, if the development were to operate without employing any measures (including, for example, isolation from existing or likely future development on other land) to reduce or minimise its impact in the locality or on the existing or likely future development on other land, would emit a polluting discharge (including, for example, noise) in a manner which would have a significant adverse impact in the locality or on the existing or likely future development on other land, and includes an offensive industry and an offensive storage establishment.'*

The guidelines stipulate that:

> *'a key consideration in the assessment of a potentially offensive industry is that the consent authority is satisfied that there are adequate safeguards to ensure emissions from a facility can be controlled to a level at which they are not significant. An important factor in making this judgement is the view of the EPA (for those proposals requiring a pollution control licence under EPA legislation). If the EPA considers that its licence requirements can be met, then the proposal is not likely to be 'offensive industry'.'*

A preliminary hazard assessment is required for a potentially hazardous industry and one has been carried out for the proposed quarry (*Chapter 4*). This assessment and the findings of the technical studies included in this EIS regarding noise, flora and fauna, air quality, archaeology, surface water and groundwater demonstrate that the proposed quarry will not have a significant environmental impact as a result of the mitigation measures that will be employed.

3.7 OTHER STATE LEGISLATION

3.7.1 Threatened Species Conservation Act, 1995

Developments requiring approval from a Council or statutory authority of the NSW State Government are required to be assessed in accordance with the *Environmental Planning and Assessment Act 1979* (EP&A Act), as amended by the *Threatened Species Conservation Act 1995* (TSC Act).

Section 111(4) of the EP&A Act requires a determining authority to consider the effects of an activity on the following:

> *'(a) critical habitat, and*
>
> *(b) in the case of threatened species, populations and ecological communities, and their habitats, whether there is likely to be a significant effect on those species, populations or ecological communities, or those habitats, and*
>
> *(c) any other protected fauna or protected native plants within the meaning of the National Parks and Wildlife Act 1974.'*

Section 5A of the EP&A Act, outlines eight points to be considered to determine the significance of the impact of a development on the habitat of threatened species, population and ecological communities, known or considered likely to occur in the study area and environs. This assessment is commonly referred to as an 'eight part test'.

Where the proposed development is likely to significantly affect critical habitat of a threatened species, population or ecological community, or is in critical habitat, as defined by Part 3 of the TSC Act, a species impact statement must be prepared to accompany the development application. If the Director-General of NPWS assesses that the development will harm threatened species, populations or ecological communities, then a licence under section 92 of the TSC Act may be required. The Director-General of NPWS may apply conditions to this licence.

An eight part test is provided in *Chapter 4* with a discussion of the impacts of the proposed development on flora and fauna.

3.7.2 Protection of the Environment Operations Act, 1997

Schedule 1 of the *Protection of the Environment Operations Act, 1997* identifies developments that require an Environment Protection Licence under the Act. Included in Schedule 1 are:

'Extractive industries:

(1) that obtain extractive materials by methods including excavating, dredging, blasting, tunnelling or quarrying or that store, stockpile or process extractive materials, and

(2) that obtain process or store for sale or re-use an intended quantity of more than 30,000 cubic metres per year of extractive material.'

Since annual extraction from the proposed quarry will exceed 30,000 cubic metres per year the proposed development requires an Environment Protection Licence from the Environment Protection Authority.

3.7.3 Water Management Act, 2000

Clause 91(2) of the *Water Management Act, 2000* prescribes that a controlled activity approval is required to enable the carrying out of a *"specified controlled activity at a specified location in, on or under waterfront land"*. A 'controlled activity' is defined in the Act as follows:

(a) the erection of a building or the carrying out of a work (within the meaning of the Environmental Planning and Assessment Act, 1979), or

(b) the removal of material (whether or not extractive material) or vegetation from land, whether by way of excavation or otherwise, or

(c) the deposition of material (whether or not extractive material) on land, whether by way of landfill operations or otherwise, or

(d) the carrying out of any other activity that affects the quantity or flow of water in a water source.'

The definition of 'waterfront land' as specified in the Act includes:

'(a) the bed of any river or lake, and any land lying between the bed of the river or lake and a line drawn parallel to, and the prescribed distance inland of:

(i) in the case of non-tidal waters, the highest bank or shore above the river or lake.'

The definition of 'river' includes:

(a) any watercourse, whether perennial or intermittent and whether comprising a natural channel or a natural channel artificially improved, and

(b) any tributary, branch or otherwise into or from which a watercourse referred to in paragraph (a) flows'.

As the proposed quarry extension will involve the excavation of a creekline which transverses Lots 1 and 2 a controlled activity approval must be obtained from the Department of Land and Water Conservation.

3.8 COMMONWEALTH LEGISLATION

The *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) specifies that (subject to some exemptions) an approval from the Commonwealth Minister for the Environment is required in order to undertake 'controlled actions' that include an action on any land that is likely to have a significant impact on a matter of National Environmental Significance. Items of National Environmental Significance include particular threatened species.

One species that is listed as Vulnerable under the EPBC Act was identified on the site - *Tetrathecea glandulosa.* The impacts of the proposal on this species are addressed in Chapter 4.

As this species is located in the site, an EPBC referral has been prepared and referred separately to Environment Australia for consideration. If this Act applies, the Minister for the Environment will determine how the impacts of the controlled action will be assessed, and will then use the provided information to determine whether or not to approve the controlled action.

Chapter 4

ENVIRONMENTAL ASSESSMENT

4.1 LAND OWNERSHIP

Lots 1 and 2 DP 547255 Old Northern Road have an area of approximately 26 hectares, bound to the east by Old Northern Rd and to the west by Dixon Sand's current extraction operation. Maroota Public School adjoins the site in the south east corner.

Lot 1 DP 547255 is owned by Dixon Sand. Lot 2 DP 547255 is owned by M, M and F Taouk. Surrounding land ownership details are provided in *Figure 4.1*.

4.2 LAND USE AND CAPABILITY

Lots 1 and 2 are currently used for pasture and orchards. Both lots contain remnants of native vegetation.

Land uses in the surrounding area include agriculture, extractive industries, forestry, nature conservation and water reserve. Agricultural activities include orchards, market gardens and grazing and are restricted to the plateau area of Maroota Ridge, with the exception of grazing. Land use in the surrounding area can be seen on *Figure 4.1*.

Sand extraction has been an important land use in the Maroota area since the 1980's and has been designated for the supply of fine construction sand to the Sydney market since 1986 (Baulkham Hills Shire Council, 1997). There are a number of sand quarries both north and south of the site within the Sydney Regional Environmental Plan No. 9 (SREP 9) Extractive Industries Designated Area – Maroota (Department of Urban Affairs and Planning, 1994). The majority of this area is mapped as either currently proposed extraction, proposed 0 to 5 years commencement and assumed 0 to 5 years commencement, based on a 1995/1996 survey (SREP 9).

One residence associated with the development is located in the north eastern corner of the site. There are approximately 20 residences within one kilometre of the site, mostly along Old Northern Road and Old Telegraph Road, as shown on *Figure 4.1*.

Maroota Public School is recognised in Development Control Plan No. 500 (DCP 500) (Baulkham Hills Shire Council, 1997) and a 250 metre extraction setback is required to maintain the safety and amenity of the school.

Maroota State Forest is approximately two kilometres south east of the site. Marramarra National Park lies two kilometres to the east and Dharug National Park lies seven kilometres to the north north east. Maroota Nature Reserve is approximately 4.5 kilometres to the south east and the proposed Dryabbin Nature Reserve lies approximately 0.5 kilometre west of the site, adjoining Lot 196. This Reserve area is also the subject of a long-standing native title claim.

Two wetlands are downslope of the development site. Jacksons Swamp is a Sydney Regional Environmental Plan No. 20 Hawkesbury-Nepean River (SREP 20) (DUAP, 1997) recognised wetland, adjacent to the Hawkesbury River approximately 1.5 kilometres north west of the site. The Maroota Sands Swamp Forest, an endangered ecological community under the *Threatened Species Conservation Act, 1995* is approximately 650 metres south west of the site.

The Agricultural Land Classification Atlas (NSW Agriculture, 1995) maps the site as Class 3 and Class 4 land. Class 3 land is well suited to grazing and pasture improvement and may be cropped or cultivated in rotation with pasture. Soil conservation or drainage works may be required on this class of land due to erosion hazard and soil structural breakdown. The majority of Lot 1 is Class 3 land as is the western section of Lot 2. Class 4 land is suitable for grazing but not for cultivation and the overall production level is low because of environmental constraints. The central area of the site comprising the steeper slopes and the two dams are Class 4.

The majority of the area to be quarried will be rehabilitated with native endemic plants to emulate local vegetation communities. As post quarrying subsoil will be very shallow, most of the area would likely be regarded as Class 4 land.

4.3 GEOLOGY

4.3.1 Regional Geology

The geology and hydrogeology of Maroota and the site itself has been characterised in the following documents:

- *Maroota Groundwater Study - Stage 1* (Water Resources Consulting Services, 1996)*;*

- *Maroota Groundwater Study - Stage 2 Final Draft* (Department of Land and Water Conservation Technical Services Division, 1998); and

- *Maroota Groundwater Study – Draft Technical Status Report* (Department of Land and Water Conservation Resource Assessment and Planning, 2000).

The site and surrounding area comprise Hawkesbury Sandstone overlain by a Tertiary deposit of fluvial sediments. The only documented location of the Tertiary deposit on site is in the lower reaches of the valley line on Lot 2.

The Tertiary deposit, referred to as the Maroota Sand, comprises poorly sorted fine to coarse grained sand interbedded with clay lenses and gravel horizons. The deeply weathered upper units of the Hawkesbury Sandstone, referred to as Eluvial Sand, vary in thickness between 2 metres and 15 metres and comprise soft and friable rock which is easily ripped and crushed. The Eluvial Sand on the site extends to the water table at approximately 20 metres below ground level.

Both the Maroota Sand and Eluvial Sand are recognised as an important source of construction sand by the Department of Mineral Resources (DMR) and Department of Urban Affairs and Planning. In the Maroota area, the DMR has estimating the available resource to be in the order of 80 million tonnes (WRCS 1996). Sydney Regional Environmental Plan No. 9 (SREP 9) recognises the regional significance of the sandstone resource in the Maroota area. SREP 9 aims to help develop extractive resources close to Sydney to reduce the cost of supplying materials to the Sydney community, and ensure that extractive industries are carried out in an environmentally acceptable manner (DUAP, 1994).

4.3.2 Site Geology

Site geology has been determined from four cored boreholes drilled to below the water table at selected locations across the site. Two of the boreholes DS2 (MW3) and DS3 (MW4) were previously drilled by D.J. Douglas and Partners (and have since been used as groundwater monitoring wells), whereas the other two boreholes MW1 and MW2 were drilled in November 2000, under ERM's supervision.

Borehole locations are shown on *Figure 4.2*, and are described as:

- Borehole DS2 (MW3) - on the ridgeline adjacent to the northern boundary of Lot 1;

- Borehole DS3 (MW4) - on the south western slope of the ridge of Lot 2;

- Borehole MW2 - near the crest of the ridge adjacent to the north eastern boundary of Lot 1;

- Borehole MW1 - in the valley line adjacent to the southern boundary of Lot 2.

Details of the geology are indicated on the borehole/monitoring well logs provided in *Appendix C1.* Geological cross sections between each of the boreholes are shown on *Figures 4.3a* to *Figure 4.3c*. The different lithological units below the site are summarised as follows:

- light brown moderately permeable, fine to medium grained, residual clayey sand to a depth of approximately 1.0 metres below ground level, overlain by approximately 0.2 metres of dark grey colluvium comprising organic silty sand. This unit was only observed in boreholes MW1 and MW2, as there was core loss below this depth in the other two boreholes;

- fine to medium grained sandstone, weathered to maroon, orange or a reddish colour to depths varying between 2 and 7 metres below ground level;

- fine to medium grained white sandstone, with a number of upward fining sequences, was encountered to below the water table at each of the locations drilled. Each upward fining sequence is characterised by a basal coarse grained pebbly sandstone horizon up to 4m thick; and

- interbedded shale and sandstone of the Narrabeen group at approximately 30m below ground level in borehole DS2 (MW3).

The fracture frequency and rock quality designation (RQD) percentage, was recorded for each of the boreholes, and is indicated on the cored borehole logs in *Appendix C1*. Hard massive sandstone will generally have a fracture frequency of less than five and an RQD of between 80 and 100 per cent. The average fracture frequency for core to the water table, for all four boreholes logged, is greater than ten, whereas the RQD values were generally less than 60 percent. The results indicate that the weathered sandstone is generally well jointed bedrock of low strength, which is well suited for the intended purpose of ripping, crushing and use as construction sand.

4.4 HYDROGEOLOGICAL ASSESSMENT

4.4.1 Background

Groundwater is widely used in the Maroota area for domestic, industrial and agricultural purposes. In addition, the Maroota Sand and Hawkesbury Sandstone aquifers have been identified as a High Risk Aquifer in terms of risk of over-extraction and/or contamination (DLWC, 1998). As such, there is a potential for sand mining activities to adversely affect the groundwater resource in the following ways:

- sterilisation of the aquifer for domestic, livestock and agricultural use;
- long term changes to the groundwater quality; and
- unnatural fluctuations or lowering of the groundwater levels.

4.4.2 Assessment Methodology

The following investigation was undertaken:

- a review of existing regional hydrogeological data, including location of Department of Land and Water Conservation (DLWC) registered bores within a one kilometre radius of the site;
- installation of two monitoring wells into cored boreholes MW1 and MW2, hydraulically upgradient and downgradient of the proposed extraction zone respectively;
- inclusion of the two existing monitoring wells DS2 (MW3) and DS3 (MW4) into the monitoring program;
- development, gauging and surveying of all the monitoring wells;
- determination of groundwater gradient and flow direction;
- determination of field parameters and collection of water samples for laboratory analysis;
- beneficial use classification of the groundwater;
- assessment of potential impacts to the groundwater; and

- recommendations for long-term monitoring to determine if there are physical and chemical changes to the aquifer associated with extraction.

4.4.3 Local Users

A groundwater bore search conducted by DLWC indicated that there were 15 registered bores within one kilometre of the site. A plan showing the location of the bores in relation to the site, as well as the work summary sheet details, is provided in *Appendix C2*.

There are three registered bores within 100 metres of the site. The closest bore (GW034628) is within the schoolyard of Maroota Public School, adjacent to the southeastern corner of the site. This bore is 91.40 metres deep and has two water bearing zones, one at 5.40 metres and the other at 82.2 metres, both in yellow sandstone. This bore has an indicated yield of 0.36 litres per second and is licensed for domestic use purposes. Salinity and other water quality parameters were not recorded. The water bearing zone at 5.4 metres is seepage water at the base Maroota Sand perched above the underlying Hawkesbury Sandstone.

The mapped extent of the Maroota Sand lies outside and upgradient of the extraction area. As such, the potential for impact to this perched aquifer as a result of the proposed extraction activities is unlikely.

The next closest bore (GW048741) is immediately across Old Northern Road from the proposed development. This bore is 30.0 metres deep and has two water bearing zones, one at 7.8 metres in white clay and gravel at the base of the Maroota Sand, whereas the other is at 23.2 metres in the Hawkesbury Sandstone. This bore has an indicated yield of 0.03 litres per second and is licensed for domestic use purposes. Salinity and other water quality were not recorded for this bore.

The third closest bore (GW102133) is approximately 270 metres south of the site. This bore is 150.5 metres deep and has a water bearing zone at 130 metres in fractured sandstone. The bore has an indicated yield of 1.20 litres per second with a salinity of 234 milligrams per litre, and is licensed for domestic and stock watering purposes.

Due to the number of users and high risk classification of the aquifer, the DLWC in association with the Hawkesbury-Nepean Catchment Management Trust, Baulkham Hills Council, Hornsby Council and DUAP are in the process of developing a groundwater management plan for the Maroota area.

4.4.4 Monitoring Well Installation

Two monitoring wells (DS2 and DS3) were installed by D.J. Douglas & Partners as part of previous drilling program conducted by Dixon Sand. ERM installed an additional two monitoring wells (MW1 and MW2) in November 2000, using NMLC coring technique with a Bobcat mounted drill rig. These monitoring wells were installed within the Hawkesbury Sandstone aquifer. The construction details are shown in the bore logs, provided in *Appendix C2*. The locations of the monitoring wells are shown on *Figure 4.2*.

Monitoring well MW1 was installed adjacent to the valley line on the southern boundary and is down gradient of the proposed extraction area. The upgradient monitoring well MW2 was installed on the ridge line in the north eastern corner of the site. Monitoring well DS2 (MW3) is midway along the northern boundary along the crest of the ridge line. Monitoring well DS3 (MW4) is on the southern slope of the ridge line adjacent to the south western corner of the site.

Monitoring wells MW1 and MW2 were developed by pumping or bailing at least 30 litres of water from each well. Approximately one week after installation (5th December, 2000) all four wells were gauged, purged, the field parameters measured and water samples collected for laboratory analysis.

With the exception of MW1, which is in the valley line, all other wells were pumped or bailed intermittently dry during development and purging. The generally low yield of the Hawkesbury Sandstone observed during development and bailing is consistent with the data indicated in the DLWC (1996) report, which indicates that the Maroota Sandstone yields are typically low, and between 0.1 litres/second and 2.5 litres/second. The report also indicates that the water quality is generally good, with total dissolved solids of less than 1000 milligrams per litre, which is consistent with the laboratory results for the water samples collected.

4.4.5 Groundwater Hydraulics

There were two rounds of groundwater gauging. The first round on 5th December, 2000, with the second round on 14th May, 2001. The latter gauging event was after a period of heavy rain for the first few weeks of May 2001. The monitoring wells were surveyed and the corrected groundwater elevations were calculated in metres above Australian height datum (AHD) to determine the groundwater movement direction and gradient. The details are summarised in *Table 4.1*.

Table 4.1 GROUNDWATER LEVELS

Well Number	TOC Elevation (m)	TOC to GL (m)	Surface Elevation (m)	Depth to Water below TOC (m)	Depth to Water below GL (m)	Corr. Water Elevation (m)
			Sampled 5/12/00			
DS2 (MW3)	196.45	1.03	195.36	16.00	14.91	180.45
DS3 (MW4)	188.43	1.09	187.40	12.49	11.46	176.22
MW1	182.98	0.38	182.67	4.05	3.74	178.58
MW2	215.80	0.31	215.42	22.67	22.31	193.11
			Sampled 14/5/01			
DS2 (MW3)	196.45	1.03	195.36	16.42	15.33	180.03
DS3 (MW4)	188.43	1.09	187.40	13.14	12.11	175.29
MW1	182.98	0.38	182.67	3.52	3.21	179.46
MW2	215.80	0.31	215.42	21.73	21.35	194.07

Note: 1. TOC = top of casing height (approximate corrected survey level height above mean sea level)
2. GL = Ground Level
3. Corr. Water Elevation = Corrected water elevation in metres above mean sea level

The results indicate that the corrected groundwater elevations for DS2 (MW3) and DS3 (MW4) were higher for the first gauging event whereas they were higher for MW1 and MW2 for the second gauging event. The highest water levels for each well were used for the resource calculations. The groundwater elevation shown on the geological sections is based on the gauging results for the first round of sampling.

Groundwater levels vary across the site from 175.29 to 194.07 metres AHD. The inferred groundwater contours indicate that the direction of groundwater movement is in a west southwesterly direction. The groundwater gradient across the site is approximately 1.6 degrees (1:35) and is steepest in the east. The groundwater contour plan is shown on *Figure 4.4*.

4.4.6 Water Sampling and Field Parameter Measurement Results

Groundwater was sampled and analysed to establish baseline water quality. All groundwater samples were collected and preserved according to the '*Groundwater Sampling and Preservation Guidelines'* (EPA, 1998). The field and laboratory results were compared to the stock watering, irrigation, and protection of aquatic ecosystems fresh waters criteria, outlined in the '*Australian Water Quality Guidelines for Fresh and Marine Waters'* (ANZECC, 1992). Results were also assessed against the '*Australian Drinking Water Guidelines'* (NHRMC, 1996).

Groundwater samples were collected on 5th December, 2000 after pH and electrical conductivity (EC) had stabilised during purging. Field parameters, including pH, redox potential (Eh), dissolved oxygen (DO), EC, total dissolved solids (TDS), and temperature were measured using the 'Hydrolab' water quality meter. The field parameter results are summarised in *Table 4.2.* The pH and conductivity results for DLWC registered bores GW038147 and GW053898 (the closest bores with this information available) were supplied by Mr Matt Dasey of DLWC (Sydney and South Coast Region). The results were compared to ERM's field parameter results, and are shown in *Table 4.2*. The location of these bores is shown on the DLWC provided plan in *Appendix C2*.

Table 4.2 GROUNDWATER FIELD PARAMETER MEASUREMENTS

Well ID	pH	Conductivity (µs/cm)	DO (mg/L)	Temperature (^{0}C)	ORP (mV)
Monitoring wells					
DS2 (MW3)	4.63	144	5.39	22.76	342
DS3 (MW4)	4.37	60	6.19	22.31	324
MW1	4.17	236	1.45	18.17	364
MW2	3.90	731	6.04	20.91	412
Other Registered bores					
GW038147	2.6	790	-	-	
GW053898	5.08	186	-	-	

Notes: DO = dissolved oxygen; ^{0}C = degrees Celsius; mg/L = milligrams per litre
ORP = Oxidation Reduction Potential; mV = millivolts

The results indicate that:

- groundwater pH for the area is generally low and below the NHRMC (1996) drinking water criteria and ANZECC (1992) aquatic ecosystem criteria of 6.5 pH units for all wells on site;
- groundwater pH for DS2 (MW3) wells falls within the ANZECC (1992) irrigation criteria of 4.5 to 9.0 pH units. For the other wells on site, the pH of the groundwater is below the lower limit of 4.5 pH units; and
- There are no pH criteria for stockwatering and as such the water is suitable for stockwatering with respect of pH.

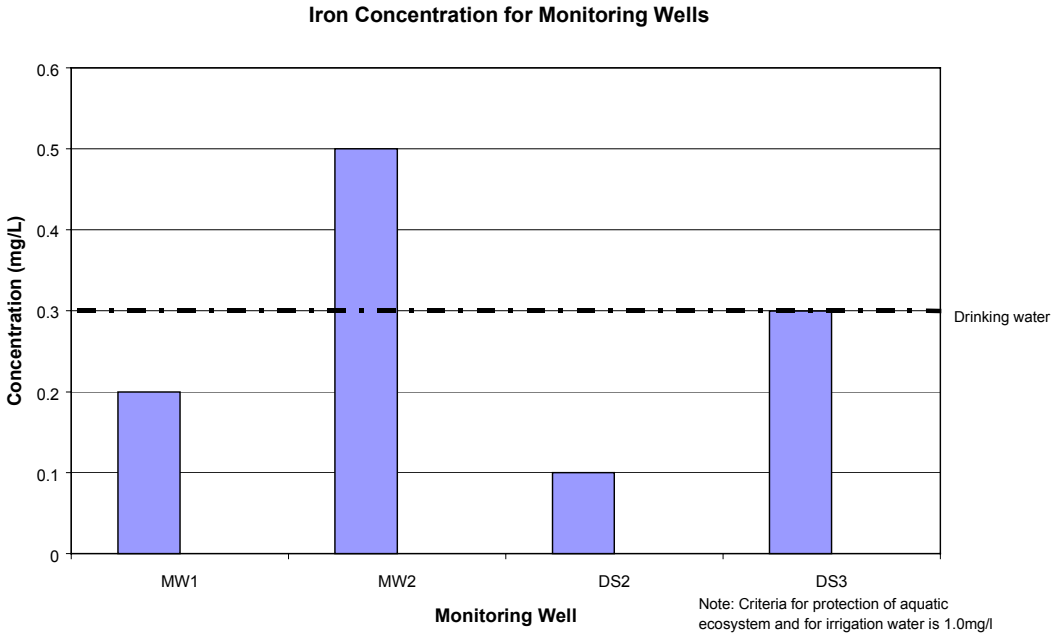
4.4.7 Laboratory Analysis Results

In addition to field testing, samples were analysed for a full suite of analytes at Australian Analytical Laboratories (Sydney, NSW). The laboratory reports are presented in *Appendix C3.*

A summary of the laboratory results indicating the beneficial use as a resource classification is provided in the Tables in *Appendix C4*. The analytes that exceed the criteria are shown in the bar graphs that follow, with a brief description for each.

i. Iron

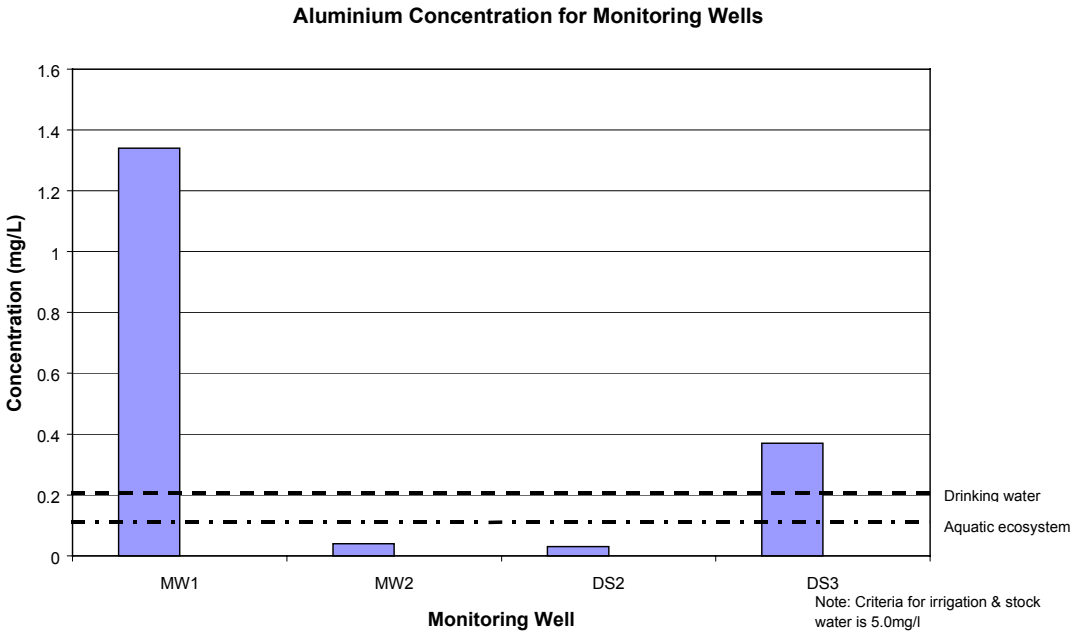
The total iron concentration results, shown on *Graph 1*, indicated a variation in concentrations across the site. The concentration in all wells is below the ANZECC (1992) protection of aquatic ecosystem criteria. The iron concentration is highest in the upgradient monitoring well MW2, and was the only result above the NHRMC (1996) drinking water critera. The iron concentration in the monitoring well DS3 (MW4) was at the NHRMC (1996) drinking water criteria. The water from all the wells is suitable for irrigation purposes. No stockwatering criteria are specified and as such the water from all wells is suitable for stockwatering purposes.



Graph 1: Total iron results for initial monitoring round

ii. Aluminium

Graph 2 indicates that aluminium concentrations were above the NHRMC (1996) drinking water criteria and the ANZECC (1992) protection of aquatic ecosystem criteria for the downgradient monitoring wells MW1 and DS3 (MW4). The results also indicate that the groundwater from all monitoring wells is suitable for stockwatering and irrigation purposes. Given that the mineralogy of the Hawkesbury Sandstone comprises predominantly quartz and feldspar minerals, the aluminium detected in the groundwater is likely to be derived from the weathered feldspar crystals in the bedrock, which are alumina-silicates. The trend of increasing concentration of aluminium with increasing distance downgradient of MW2, which is close to crest of the ridge that forms the groundwater divide, suggests that this may be the case.

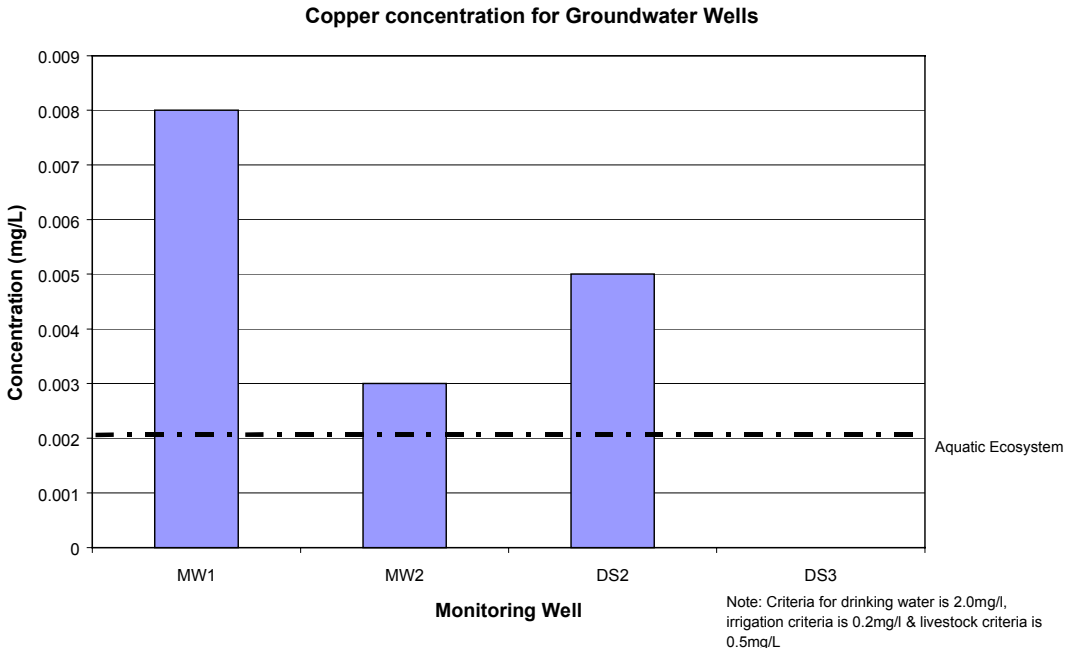


Graph 2: Aluminium results for initial monitoring round

iii. Copper

Graph 3 indicates that copper concentrations were above the ANZECC (1992) protection of aquatic ecosystem criteria in all wells except in downgradient monitoring well DS3 (MW4). Given that the site is located near the crest of a ridge and close to the groundwater divide, it is likely that the copper levels detected represent the natural background levels of the aquifer. The copper in the groundwater from all wells is

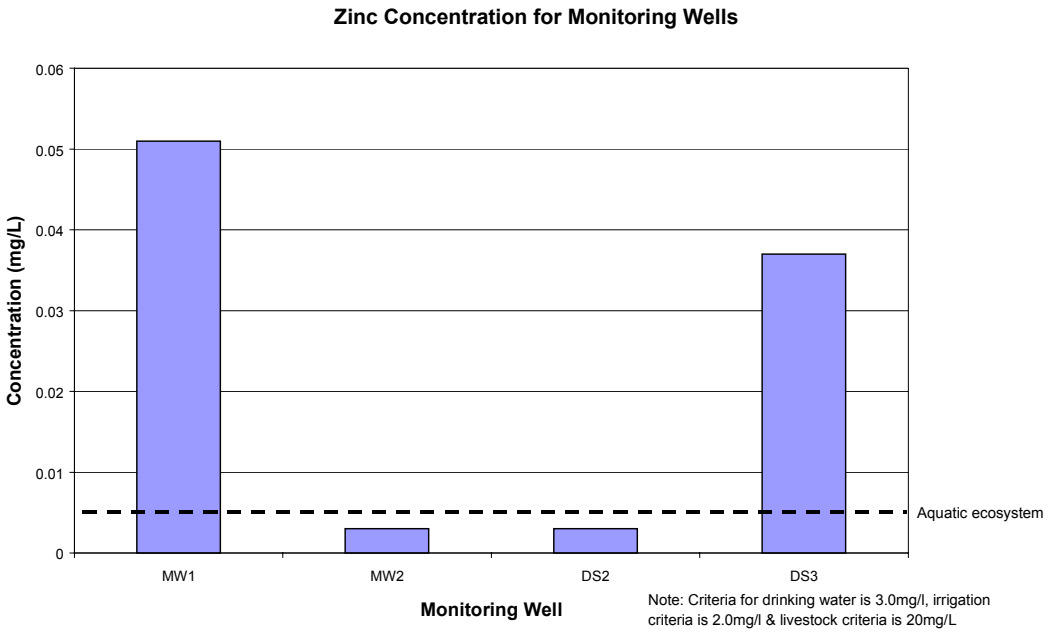
below the NHRMC (1996) drinking water criteria and the ANZECC (1992) livestock watering and irrigation water criteria.



Graph 3: Copper results for initial monitoring round

iv. Zinc

The zinc results are shown on *Graph 4*. The highest zinc concentrations were detected in the downgradient wells MW1 and DS3 (MW4), as was the case for aluminium concentrations. Only the zinc concentrations in these wells exceeded the ANZECC (1992) protection of aquatic ecosystem criteria. The groundwater from all wells is below the NHRMC (1996) drinking water criteria and the ANZECC (1992) livestock watering and irrigation water criteria. The concentrations of zinc in the monitoring wells is likely to represent the natural background conditions of the aquifer.



Graph 4: Zinc results for initial monitoring round

v. Summary

The results indicate the following:

- groundwater from all monitoring wells is not suitable for drinking purposes without treatment, because of the low pH, or concentrations of iron/aluminium exceeding the NHMRC (1996) criteria;
- groundwater from all wells is suitable for stockwatering;
- groundwater from all wells is suitable for irrigation of crops; and
- groundwater from all wells exceeds the ANZECC (1992) protection of aquatic ecosystem criteria, for either aluminium, copper, or zinc.

4.4.8 Potential Impacts to Groundwater

A two metre buffer zone will be maintained above the highest recorded groundwater levels. These levels have been established for the purpose of resource determination, but will require refining as more gauging data becomes available. Water levels are currently being monitored monthly. Prior to commencement of quarrying the final

high level of the groundwater level baseline conditions below the site will be established.

Given that quarrying is restricted to the top of the two metre buffer zone, the groundwater surface will not be exposed at any time during quarrying. As such, a lowering of the groundwater levels as a result of evaporation losses is unlikely to occur.

Potential impacts to the aquifer from contamination is likely to be restricted to hydrocarbon from refuelling and maintenance. As refuelling facilties and the workshop are outside and downgradient of the proposed extraction area, the potential for impact is low.

The DLWC bores are hydraulically upgradient of the site and impacts to these from the quarry are unlikely . In addition, the area to the west of the site is dense bushland on steeply dipping westward slopes, with low potential for agricultural or residential development.

Stripping the vegetation for quarrying may cause the recharge waters of the aquifer to be less acidic because of removal of humic material. This may result in the recharge waters having a slight increase in the pH of the naturally acidic groundwater system.

4.4.9 Proposed Monitoring Program

The baseline physical and chemical characteristics of the groundwater have been established for the ongoing groundwater monitoring program. The results of subsequent monitoring programs will be compared to the baseline results to determine whether any adverse changes to the aquifer have occurred as a result of proposed quarrying operations.

The ongoing monitoring program will include:

- monthly measurement of water levels and establishment of the high groundwater level prior to commencement of quarrying;
- collection of water samples from the four monitoring wells for field parameter measurements and laboratory analysis, twice per year; and
- preparation of an annual report for submission to the relevant authorities.

If monitoring notes a degradation of the groundwater resource, a contingency plan for the remediation of the aquifer will be prepared and implemented.

4.5 SOILS

4.5.1 Soil Landscapes

The majority of the site is in the Sydney Town soils landscape (Soil Landscape of the St Albans 1:100 000 Sheet, DLWC, 1997), which occurs on undulating to rolling hills and moderately inclined slopes on Hawkesbury Sandstone in the Macdonald Ranges. The soils are characterised as loose brown loamy sand overlying earthy bright brown sandy clay loam on crests and slopes. The topsoil is strongly acidic (pH 4.5) to slightly acidic (pH 6.0) and subsoils are moderately (pH 5.0) to slightly acidic, which can have implications for management of surface water quality. The topsoils and subsoils have high erodibility, low water holding capacity, very low fertility, high potential aluminium toxicity and strong sodicity. When subjected to concentrated flows the soil has a high erodibility, under non-concentrated flows erodibility is low to moderate. They have a low wind erodibility (DLWC, 1997).

The remainder of the site, upslope of the 200 metre contour near Old Northern Road, the soils are described as part of the Colo Heights soil landscape. Soils in this landscape are characterised by brownish black pedal clay loam topsoil overlying reddish brown light clay subsoil on well drained crests and sideslopes. Topsoil and subsoils are slightly to moderately acidic and have low fertility. Topsoils have a moderate erodibility to non-concentrated and concentrated flows. Subsoils have a moderate erodibility when subjected to non-concentrated flows and a very high erodibility under concentrated flows. Both topsoils and subsoils have a low wind erodibility.

4.6 SURFACE WATER

4.6.1 Local Hydrology

There is minimal catchment upstream of the site as Old Northern Road forms a catchment boundary. The catchment in which the proposed development lies drains to the Hawkesbury River. *Figure 4.5* shows local catchments draining to the Hawkesbury River.

Jacksons Swamp lies approximately 1.5 kilometres downstream of the site and is the point that any water from the site would enter the River. This wetland is identified in SREP 20 (DUAP, 1997) as a wetland of regional significance. It is a freshwater floodplain or reed swamp, with some brackish sections and supports wetland species of significance in the Hawkesbury area, including vulnerable populations of swamp

mahogany (*Eucalyptus robusta*). 25 hectares of the wetland is permanently saturated and 4.1 hectares ephemeral. It has high flora and fauna conservation values and high scenic quality values (Cattai Catchment Management Committee, 1999). The Plan of Management for the wetland highlights the need to preserve the current flow rates and water quality to maintain the wetlands' functions, in particular the need to prevent unnatural sedimentation of the wetland. No water quality monitoring has been undertaken at the Swamp, however, an investigation of active sedimentation (Groundtruth Consulting in Cattai Catchment Management Committee, 1999) has been carried out. This study found that there was sediment build up in a southern tributary of the swamp (the existing Dixon Sand extraction site drains to a northern tributary) but that this was a natural event and that the rate of sedimentation was less than it was forty years ago. The report noted that current extraction operations upstream had sediment traps and ponds in place, but that if these failed the fine sediment could reach Jacksons Swamp.

The Maroota Sands Swamp Forest, approximately 650 metres to the south west of the site, supports an Endangered Ecological Community listed by the *Threatened Species Conservation Act, 1995*. It is a freshwater swamp around two hectares in size, supporting *Eucalyptus robusta* (Swamp Mahogany). A Plan of Management for the Maroota Sands Swamp Forest has been prepared by the Cattai Catchment Management Committee (1999). *Figure 4.5* shows that this Swamp Forest is not within the catchment of the proposed development.

4.6.2 Site Hydrology

Lots 1 and 2 are on the Maroota Ridge and slope gently to the west from 222 metres AHD near Old Northern Road to 184 metres AHD at the western boundary. The Maroota Ridge is aligned north - south, falling away to the west and east of the plateau to the Hawkesbury River, which lies at 20 metres AHD.

A gully runs through the site from the south eastern corner of Lot 1 and through Lot 2. *Figure 4.1* shows two dams located in the drainage line, one at the eastern end of Lot 1 and the other, larger dam is in the centre of Lot 2. The majority of the site drains to the south west, via the gully to an unnamed tributary of the Hawkesbury River. The northern section of Lot 1 drains to the existing quarry. Runoff from this area enters the existing water management system and is discharged through the main storage dam weir via a sediment pond, to a natural creekline west of the site.

4.6.3 Existing Surface Water Quality

Water quality monitoring is undertaken in the local area as part of the Stream Watch program (www.streamwatch.org.au, May 2001). However, the nearest monitoring location, on Little Cattai Creek at Maroota, does not receive any runoff from the existing or proposed Dixon Sand extraction sites. No Stream Watch water quality monitoring results are available for Jacksons Swamp.

The creeks near the site, including the creek to which water is discharged from the current operation, are fed year round by springs. The Maroota Groundwater Study: Stage 1 (DLWC, 1996) indicates that springs in the Maroota area have a pH between 4.0 and 4.5, salinity between 50 and 120 mg/L total dissolved solids, with dominant dissolved species includes sodium, magnesium and chloride.

Water quality monitoring is currently undertaken four times per month during discharge at the weir downstream of the existing sand extraction operation on Lot 196. This monitoring is required by the EPA licence for the site, and includes pH, total suspended solids, turbidity and daily volume.

4.6.4 Hydrology Impacts

The water management system for the proposed development is detailed in *Section 2.5*. This system provides for drainage via a series of sediment controls to a sediment detention basin on Lot 29, downslope of the proposed extraction area. Surplus water from this void will discharge into the flood retention basin/overflow storage on Lot 196 and then via the weir which forms part of the controlled water management system on the existing extraction site.

Surface runoff from Lots 1 and 2 flows into two separate ephemeral drainage lines that join and discharge into Jacksons Swamp at the Hawkesbury River to the north west.

Rediversion of surface runoff within the quarry and onto Lot 196 will marginally reduce potential flows into one ephemeral tributary, although the total area to be disturbed by quarrying on Lots 1 and 2 is 11 hectares, relatively small compared to the total Jacksons Swamp's catchment of approximately 23,000 hectares. Quarrying is not expected to significantly or measurably affect water flows into Jacksons Swamp. Maroota Swamp Forest is not within the catchment of the proposed development, and therefore has no potential to experience change in water quality or quantity as a result of the proposed development.

4.6.5 Monitoring

Existing monitoring of water quantity, quality and erosion and sediment controls includes the following:

- daily measurement of water volume discharged at the weir;
- weekly monitoring of water quality (pH, turbidity and total suspended solids) during flow at the discharge point;
- monthly monitoring of a spring in an unnamed creek on Lot 196 (pH and EC);
- monthly inspections of all drainage and sediment controls with maintenance as required; and
- monthly groundwater quality monitoring from the three existing monitoring bores (ERM, 2000).

The weir will also measure volume, and the quality of water (pH, turbidity and total suspended solids) that may have been sourced from the proposed development area. Groundwater monitoring will be undertaken for the bores developed for the proposed development, and the monthly inspections will include the new extraction areas.

4.7 NOISE

4.7.1 Statistical Noise Descriptors

Environmental noise levels vary with time, and the following statistical descriptors are commonly used to characterise the noise environment:

- dB(A). Noise measurement units are decibels (dB). The "A" weighting scale is used to describe human response to noise;
- L_{max} , the maximum noise level during a measurement period;
- L_{10}, the noise level which is exceeded for ten percent of the time and is approximately the average of the maximum noise levels;
- L_{90}, the level exceeded for 90 percent of the time and is approximately the average of the minimum noise levels. The L_{90} level is often referred

to as the "background" noise level and is commonly used to determine noise criteria for assessment purposes;

- L_{eq}, the average noise energy during a measurement period;

- ABL, the Assessment Background Level is defined in the EPA's NSW Industrial Noise Policy as the single figure background level representing each assessment period (day, evening and night). It is determined by the tenth percentile method described by the EPA for the measured L_{90} statistical noise level; and

- RBL, the Rating Background Level is defined in the EPA's NSW Industrial Noise Policy as the overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used for determining the intrusiveness criterion for noise assessment purposes, and is the median value of the ABL.

4.7.2 Receptors and Background Noise

i. Receptors

The receptors nearest the site are shown on *Figure 4.1* and include:

- houses along Old Northern Road (R1 to R5); and

- Maroota Public School on Old Northern Road, school buildings and playground.

ii. Background Monitoring

Dick Benbow and Associates measured noise levels at two locations between 20 November and 30 November 1998 inclusive, using a noise data logger. Data was logged at 15 minute intervals at 167 Old Northern Road and 60 minute intervals at the school. Parameters calculated include L_{eq}, L_{10}, and L_{90} and are given in *Table 4.3*..

This data from the previous EIS is considered suitable for use in this assessment as no development has occurred in the area to change the ambient noise environment.

Rating background level (RBL) was calculated from the logged data as per the EPA's *Industrial Noise Policy* (INP)(EPA, 2000). RBL represents the background noise level for the area and is used in deriving 'intrusiveness criteria'.

Table 4.3 BACKGROUND NOISE

Date	Shoulder ABL	Daytime ABL
20/11/98	-	39.2
21/11/98	35.0	38.2
22/11/98	31.5	39.0
23/11/98	35.1	36.5
24/11/98	34.6	37.7
25/11/98	39.0	40.2
26/11/98	37.5	38.0
27/11/98	40.7	39.5
28/11/98	41.8	43.2
29/11/98	31.0	36.5
30/11/98	37.5	42.0
RBL	**37.5**	**39.2**

Notes: 1. Day: 7:00 to 18:00 ~ Shoulder 6:00 to 7:00;

Source: D. Benbow in Southern Environmental, 1999.

The quarry will operate between 5.45am and 6pm Monday to Saturdays with truck movements commencing at 6 am and operation of the plant and equipment starting at 7am.

4.7.3 Noise Criteria

i. Operational Noise

The INP is a guideline to assess noise from various sources and facilities and covers assessment of noise from 'stationary (industrial) sources', through the establishment of noise criteria. The sources covered include:

- facilities with many sound sources such as industrial or commercial premises;
- maintenance and repair facilities; and
- individual industrial sources such as heating, ventilating and air-conditioning equipment, rotating machinery and impacting mechanical sources.

The policy explicitly includes mobile plant and equipment, including vehicles, which are within the property boundary of industrial premises.

Two noise criteria are used in the INP - an 'intrusiveness criterion' and an 'amenity criterion'. For noise impacts to be acceptable, both must be met, with the more stringent of the two being the controlling condition. The 'intrusiveness criterion' is based on the traditional "background + 5 dB" concept. The 'amenity criterion' is based on a maximum L_{eq} noise level from *all* stationary sources, which depends on the type of receiver, and for residences, the type of area (rural, suburban or urban).

Amenity criterion is important in assessment of the cumulative impact of a proposal in conjunction with other proposed or existing industrial noise sources. Where background noise levels are high, for example due to traffic noise or industry, the amenity criterion is generally the determining factor in setting the project specific noise limit. The relevant amenity criteria are shown in *Table 4.4*.

Table 4.4 AMENITY CRITERIA FOR STATIONARY NOISE SOURCES

Type of Receiver	Area	Time of Day	Recommended Acceptable L_{eq} Noise Level, dB(A)
Residence	Rural	Day	50
	Rural	Evening	45
	Rural	Night	40
School classroom - internal	All	Noisiest one-hour period when in use	40*
Active recreation area – school playground	All	When in use	55
Industrial premises	All	When in use	70

Notes: 1. *Source: Table 2.1 Industrial Noise Policy.*

2. *Day: 7:00 to 18:00 ~ Evening: 18:00 to 22:00 ~ Night: 22:00 to 7:00.*

3. ** From Industrial Noise Policy, 'in the case where existing schools are affected by noise from existing industrial noise sources, the acceptable L_{eq} noise level may be increased to 40 dB $L_{eq\ (1hr)}$'.*

The acoustic environment of residences near the site is generally agricultural, with little road traffic. This area is defined by the INP as 'rural'.

Criteria based on these classifications and background noise levels have been determined and are detailed in *Table 4.5*.

Table 4.5 CRITERIA BASED ON RECEPTOR CLASSIFICATION

Type of Receiver	Period	Intrusiveness Noise Criteria, L_{eq} dB(A)	Acceptable Amenity Noise Criteria, L_{eq} dB(A)	Project-specific Criteria, L_{eq} dB(A)
Rural (residential)	Day	44	50	44
	Shoulder	42.5	45	42.5
School classroom - internal	When in use	-	40	40
Active Recreation – school playground	When in use		55	55
Industrial	When in use	-	70	70

Notes: 1. Day: 7:00 to 18:00 ~ Evening: 18:00 to 22:00 ~ Night: 22:00 to 7:00 ~ Shoulder 6.00 to 7.00.

Average L_{eq} values were calculated for the logging period, however, it was reported that all industrial noise sources in the area were inaudible during the logging period. As a result, the amenity criteria do not require modification.

From *Table 4.5*, a limiting L_{eq} criterion of 42.5 dB(A) at residential receptors applies between 6am and 7am. A limiting criterion of 44 dB(A) applies at residential receptors during daytime hours of operation. Given that the plant will be operating during daytime hours, noise levels will be assessed against the criterion of 44 dB(A).

An internal $L_{eq(1hr)}$ criterion of 40 dB(A) applies to school classrooms when they are in use. Note that internal noise levels with an open window are approximately 10 dB less than external noise levels. Therefore external levels of 50 dB(A) are acceptable.

An L_{eq} criterion of 70 dB(A) applies to neighbouring industrial premises during their hours of operation.

ii. Traffic Noise

Given that traffic movements from the site will not increase as a result of this proposal, traffic noise has not been assessed.

4.7.4 Results

i. Methodology

Operational scenarios were considered for quarrying in strip 2 and 6 with the processing plant at full capacity. It was assumed that when extraction is taking place in Lots 1 and 2, no extraction is carried out on Portion 29 or Lot 196. All extraction plant were modelled at ground level with a three metre bund positioned adjacent to the excavation.

Noise levels were predicted using the environmental noise model (ENM) that takes into account geometric spreading, atmospheric absorption, barriers and ground attenuation. It gives consistently reliable predictions of environmental noise.

Under various wind conditions and temperature gradients, noise may be increased or decreased compared with calm conditions. The INP has a procedure to assess the significance of adverse atmospheric conditions. If adverse conditions such as temperature inversions and/or a wind velocity gradient occur for more than 30 percent of the time and are expected to increase noise significantly (ie. by at least 3 dB) they are considered a feature of the area.

Levels were calculated for the range of possible combinations of wind speed and wind direction. The distributions of noise levels were calculated using the proportion of time each of these combinations occurred. In calculations, wind speeds greater than 1.5 metres per second were represented by three metres per second. This is required because the ENM model does not accurately predict turbulence effects associated with higher wind speeds. This cut-off value means the assessment is conservatively high.

This methodology provides a range of results. A single value is required for comparison with the limiting criterion. The ten percentile value is considered by the EPA as appropriate, they have stated '*The EPA accepts that this ten percentile of noise levels under all weather conditions is a reasonable representation of what would normally occur under adverse meteorological conditions …. but clearly does not and should not include all extreme or unusual conditions*'. (Submission in Reply by the Environment Protection Authority to the Commission of Inquiry into a proposal to establish the Mount Pleasant Open Cut Coal Mine, February 1999).

ii. Plant and Equipment

Noise generating equipment that was modelled includes:

- wet/dry central processing plant and associated loader;

- one dozer;
- one excavator;
- one water truck on the haul road;
- one haul truck on the PF Formations haul road; and
- one articulated dump truck (ADT).

The articulated dump truck will deliver raw materials from the quarry site to the processing stockpile area. The contribution to site noise emissions will be when they are travelling on site haul roads. It has been assumed that when the excavator is operating, the ADT will be at idle and vice versa, when the ADT is travelling along the haul road, the excavator will be at idle. It is expected that the ADT will have a higher sound power level (SWL) than an excavator, therefore only the ADT has been used in calculations. Sound power levels of equipment are detailed in *Table 4.6.*

Table 4.7 EQUIPMENT SOUND POWER LEVELS

Equipment	L_{eq} Sound Power Level (SWL)
Wet processing plant[1]	104.0
Dry processing plant[1]	104.9
Front end loader[1]	102.3
Water cart[1]	98.8
Haul Truck	99.0
Dozer[1]	107.5
Articulated dump truck	110.5

Source: 1. D. Benbow in Southern Environmental, 1999;

Note: All other sources from ERM database.

iii. Strip 2 Operational Noise Impacts

a. Non-Adverse Atmospheric Conditions

Modelling predications for calm atmospheric conditions for the nearest receivers are detailed in *Table 4.8*.

Table 4.8 PREDICTED NOISE LEVELS, STRIP 2 –CALM WEATHER

Receptor	Total Calculated L_{eq} (dB(A))	Relevant Criterion L_{eq} (dB(A))	Exceedance
R1	43	44	Nil
R2	40	44	Nil
R3	37	44	Nil
R4	35	44	Nil
R5	34	44	Nil
School Playground	36	55	Nil
School Building 1	36 (external) ~ 26 (internal)	40 (internal)	Nil
School Building 2	35 (external) ~ 25 (internal)	40 (internal)	Nil

As *Table 4.8* indicates, the resulting noise levels at all receivers satisfy relevant criteria.

A maximum external level of L_{eq} 36 dB(A) has been calculated for the school. It can be conservatively assumed that internal noise levels, with open windows for natural ventilation, are 10 dB less than external noise levels. This corresponds to an internal received level of approximately 26 dB(A) for the school. This is well below the recommended internal criterion of 40 dB(A).

b. Adverse Atmospheric Conditions, Strip 2

Noise levels calculated for adverse atmospheric conditions are detailed in *Table 4.9*. These results have been calculated for extraction operations in Lots 1 and 2 ceasing during wind speeds greater than 2 metres per second from 236 to 304 degrees.

Table 4.9 PREDICTED NOISE LEVELS, STRIP 2 – ADVERSE WEATHER

Receptor	Total Calculated L_{eq} Tenth Percentile (dB(A))	Relevant Criterion L_{eq} (dB(A))	Exceedance
R1	47	44	3
R2	42	44	Nil
R3	43	44	Nil
R4	41	44	Nil
R5	40	44	Nil

Table 4.9 PREDICTED NOISE LEVELS, STRIP 2 – ADVERSE WEATHER

Receptor	Total Calculated L_{eq} Tenth Percentile (dB(A))	Relevant Criterion L_{eq} (dB(A))	Exceedance
School Playground	40	55	Nil
School Building 1	40 (external) ~ 30 (internal)	40 (internal)	Nil
School Building 2	40 (external) ~ 30 (internal)	40 (internal)	Nil

iv. Strip 6 Operational Noise Impacts

a. Non-Adverse Atmospheric Conditions – Strip 6

Strip 6 modelling predictions for calm atmospheric conditions for the nearest receivers are detailed in *Table 4.10*. A five metre bund was added to the model along the northern edge of strip 6 between the quarry and Residence 1 to reduce received noise levels.

Table 4.10 PREDICTED NOISE LEVELS, STRIP 6 –CALM WEATHER

Receptor	Total Calculated L_{eq} (dB(A))	Relevant Criterion L_{eq} (dB(A))	Exceedance
R1	47	44	3
R2	41	44	Nil
R3	44	44	Nil
R4	40	44	Nil
R5	40	44	Nil
School Playground	39	55	Nil
School Building 1	40 (external) ~ 30 (internal)	40 (internal)	Nil
School Building 2	39 (external) ~ 29 (internal)	40 (internal)	Nil

As *Table 4.10* indicates, noise levels at R1 exceed the relevant criterion by 3 dB(A). All other receptors are below relevant criteria.

b. Adverse Atmospheric Conditions – Strip 6

Noise levels calculated for adverse atmospheric conditions are detailed in *Table 4.11*. These results have been calculated for extraction operations in strip 6 of Lots 1 and 2 ceasing during wind speeds greater than 2 metres per second from 214 to 326 degrees.

Table 4.11 PREDICTED NOISE LEVELS, STRIP 6 – ADVERSE WEATHER

Receptor	Total Calculated L_{eq} Tenth Percentile (dB(A))	Relevant Criterion L_{eq} (dB(A))	Exceedance
R1	50	44	6
R2	43	44	Nil
R3	44	44	Nil
R4	39	44	Nil
R5	39	44	Nil
School Playground	39	55	Nil
School Building 1	40 (external) ~ 30 (internal)	40 (internal)	Nil
School Building 2	40 (external) ~30 (internal)	40 (internal)	Nil

As *Table 4.11* indicates, resulting noise levels are exceeded at Residence 1 during adverse atmospheric conditions. Levels at the school are within the relevant criterion.

4.7.5 Cumulative Noise

Cumulative noise has been considered as part of this assessment as several other quarries operate in the vicinity of the proposed development. On two separate occasions site inspections were undertaken at the boundary of Maroota Public School to determine the audibility of various quarry operations. During these two periods, the main source of quarry noise audible was from reversing buzzers attributed to the existing operation. A low hum from PF Formation Quarry was also faintly audible on one occasion.

Given predicted noise levels for the proposed operation (which includes the processing component of the existing operation) are at times well below the criteria, there is the potential for neighbouring quarries to contribute to total noise levels without exceeding the criteria. In addition, due to the nature of the quarrying

operations, extraction does not constantly take place in the one pit, rather, the operations are cycled depending on demand for different types of sand.

4.7.6 Conclusion

Operational scenarios were considered for quarrying in strip 2 and 6 with the processing plant at full capacity. It was assumed that when extraction is taking place in Lots 1 and 2, no extraction is carried out on Portion 29 or Lot 196. All extraction plant were modelled at ground level with a three metre bund positioned adjacent to the excavation.

Noise levels calculated for strip 2 during calm weather were below criteria at all residential and school receivers. Levels at several residential receivers exceeded recommended criteria during adverse weather conditions. Ceasing extraction in Lots 1 and 2 during wind speeds greater than 2 metres per second from 236 to 304 degrees results in receivers meeting criteria with the exception of R1 which is 3 dB greater than the relevant criterion (see *Table 4.9*).

Worst case noise levels were calculated for the proposed quarry with equipment placed at ground level in strip 6. A five metre bund was added to the model along the northern edge of strip 6 between the quarry and Residence 1 to reduce received noise levels. Noise levels calculated during calm weather exceed the relevant criterion by 3 dB(A) at R1, however, levels calculated for all other receptors are below the criteria.

Noise levels calculated for strip 6 during adverse weather conditions exceeded recommended criteria. Further modelling was undertaken which showed ceasing extraction operations in strip 6 during wind speeds greater than 2 metres per second from 214 to 326 degrees would reduce noise levels to below the relevant criteria. The exception is R1 that would still exceed by 6dB.

In summary, initial modelling with quarry plant at ground level predicted numerous exceedances in adverse weather. Additional calculations with winds from the south west to north west removed, resulted in more acceptable noise emissions. To meet these new calculations, quarrying at ground level would need to cease when these winds are blowing. It is expected that quarrying at lower levels would be able to continue during these winds due to increased topographic shielding with depth.

Given that traffic movements from the site will not increase as a result of this proposal, traffic noise has not been assessed.

4.8 AIR QUALITY

An air quality assessment is attached in *Appendix D* and summarised in this section. The assessment encompasses the following:

- environmental performance objectives;
- identification of any potential sensitive receptors likely to be effected;
- description of existing air quality in the area;
- identification of activities likely to generate air impacts including all phases of construction and operation;
- identification of all potential dust sources;
- determination of the effects of pollutant concentrations on the environment, including human health and amenity with reference to relevant National and NSW goals;
- prediction of air quality impacts; and
- greenhouse gas assessment.

Sensitive receptors near the site include houses and a school, all to the east and north-east. These are shown on *Figure 4.1*.

4.8.1 Existing Air Quality

Total suspended particulates (TSP) and sub-ten micron particulates (PM_{10}). were sampled weekly between 24th January and 21st March 2001 on Lot 2 approximately thirty metres from the Maroota School boundary.

TSP data shows that the 24 hour average varies from 12 $\mu g/m^3$ to 35 $\mu g/m^3$; with the average of these concentrations for the sampling period being 22 $\mu g/m^3$. The nominated criteria for TSP is 90 $\mu g/m^3$ as an annual average (NSW EPA, NHMRC). The measured concentrations and the criteria are not directly comparable due to the different averaging times, however the highest sampled data (over a much shorter averaging period) is less than half the criteria. It is anticipated that the existing air quality is well within NSW EPA guidelines.

PM_{10} data shows that the 24 hour average varies from 5 $\mu g/m^3$ to 21 $\mu g/m^3$ sampled weekly on site between 24th January and 21st March 2001. This is less than half the nominated criteria of 50 $\mu g/m^3$ as a 24 hour average (NEPM).

Deposition data has been provided for the October/November and November/December 1998 sampling periods. Deposition gauges have been placed on the western boundary of the existing site, and the eastern boundary of the proposed extension, Lot 1. These gauges indicate that for the limited sampling period, deposition ranges from 0.5 to 3.2 $g/m^2/month$. The average concentration is 1.8 $g/m^2/month$. Gauges were placed along the eastern boundary of Lot 196, which is in close proximity to the off-highway haul roads and the internal access road for the other facility. These gauges provide an indication of peak deposition near these sources and deposition rates recorded a high of 33.4 $g/m^2/month$ and a low of 5.9 $g/m^2/month$.

4.8.2 Air Quality Criteria

The effects of dust on health and amenity has been assessed by comparing predicted modelling results with recognised New South Wales Environment Protection Authority (NSWEPA) air quality criteria. 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 different particle sizes. The following section details the criteria used for the assessment.

i. National Environment Protection Measure

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 in regions where greater than 25,000 people may be affected. It is 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.

ii. Dust Concentration

The NEPM 24 hour average air quality standard for PM_{10} is 50 $\mu g/m^3$ with five allowable exceedance days in a year. The NSW EPA cite the annual average concentration for PM_{10} as 30 $\mu g/m^3$ (Source: *NSW EPA, Action for Air*)

The NEPM does not specify TSP concentrations, however the National Health and Medical Research Council of Australia (NHMRC) recommends a maximum annual concentration of 90 $\mu g/m^3$ TSP in a residential environment. This criteria is has been nominated as the appropriate standard by the NSW EPA in the absence of a NEPM TSP standard.

iii. Dust Deposition

Dust deposition criteria developed by the NSW Environment Protection Authority is summarised in *Table 4.12*. The deposition criteria set maximum increases above existing levels. For example, in rural areas with existing annual average deposition of between zero and three $g/m^2/month$, an increase of up to two $g/m^2/month$ would be permitted.

Table 4.12 ASSESSMENT CRITERIA FOR DUST DEPOSITION

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

iv. Criteria Summary

Table 4.13 summarises the criteria used in this assessment.

Table 4.13 CRITERIA SUMMARY

Pollutant	Averaging Period	Objective	Allowable Exceedance
PM_{10}	24 hour	50 µg/m^3	5
PM_{10}	Annual	30 µg/m^3	NS
TSP	Annual	90 µg/m^3	NS
Deposition	Monthly	4 g/month/m^2	NS

Notes: NS Not Specified

4.8.3 Emission 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 from the State Pollution Control Commission of New South Wales (SPCC).

Emission factors for activities not listed in the SPCC report were taken from United States Environment Protection Agency (USEPA) and the New South Wales Mineral Council (NSWMC) studies. A list of individual mining activities, emission factors and data sources used in assessments is presented in *Appendix D.*

4.8.4 Modelling

The Industrial Source Complex Model (ISC) has been used to model potential impacts on the receptors listed in *Table 4.14*.

Table 4.14 DISCRETE RECEPTOR LOCATIONS (AMG)

No.	Discrete Receptor	X,Easting (m)	Y,Northing (m)	Z,Elevation (m)
1	Residence 1	313312	6296754	0
2	Residence 2	313428	6296732	0
3	Residence 3	313515	6296576	0
4	Residence 4	313527	6296351	0
5	Residence 5	313535	6296303	0
6	School Receptor 1	313398	6296301	0
7	School Receptor 2	313375	6296278	0

4.8.5 IMPACTS

i. Dust Deposition

Dust deposition (see *Table 4.15)* will not exceed EPA criteria under the conditions modelled. All discrete receptors will have a maximum increase of less than 2 $g/m^2/month$.

Table 4.15 DUST DEPOSITION PREDICTIONS

No.	Discrete Receptor	Deposition Monthly Average ($g/m^2/month$)
-	**Criteria**	**4**
-	**Existing Conditions**	**1.8**
1	Residence 1	1.1
2	Residence 2	0.8
3	Residence 3	0.5
4	Residence 4	0.4
5	Residence 5	0.4
6	School Receptor 1	0.6
7	School Receptor 2	0.4
	Highest Gridded Receptor Value	2.9

ii. PM_{10}

The appropriate NSW EPA criterion is 50 $\mu g/m^3$ for a 24 hour concentration. Annual criterion for PM_{10} noted by the NSW EPA is 30 $\mu g/m^3$. PM_{10} concentrations predicted at the discrete receptors are below the nominated criteria for both averaging times.

PM_{10} concentrations at 8 Cartesian receptors located outside the facility boundary do exceed the nominated criteria. These receptors are located within 50 metres of the Eastern boundary of Lot 176. The Eastern boundary of Lot 176 is in excess of 600 metres from the nearest discrete receptor. The meteorological conditions which cause the 24hr event are episodic and the impact is localised to within 50 metres of the boundary. The 24hr event is shown to be episodic given that one Cartesian receptor is slightly above the criteria for the annual averaging period with a credible worst-case emission profile.

Results for PM_{10} are summarised in *Table 4.16*.

Table 4.16 PM_{10} PREDICTIONS

No.	Discrete Receptor	6th Highest PM_{10} 24 Hour Average ($\mu g/m^3$)	PM_{10} Annual Average ($\mu g/m^3$)
-	**Criteria**	**50**	**30**
-	**Existing Conditions**	**13**	**12**
1	Residence 1	40	7
2	Residence 2	42	4
3	Residence 3	28	3
4	Residence 4	26	3
5	Residence 5	23	3
6	School Receptor 1	34	4
7	School Receptor 2	28	3
	Highest Gridded Receptor Value	77	31
	2nd Highest Gridded Receptor Value	75	26
	3rd Highest Gridded Receptor Value	70	25
	4th Highest Gridded Receptor Value	70	23
	5th Highest Gridded Receptor Value	68	23
-	6th Highest Gridded Receptor Value	67	23
-	7th Highest Gridded Receptor Value	54	23
-	8th Highest Gridded Receptor Value	51	22

iii. TSP

The NSW EPA note only annual criteria for TSP. The National Health and Medical Research Council recommend a maximum annual concentration of 90 $\mu g/m^3$. All receptors (discrete and Cartesian) located outside the boundary of the facility are below the nominated criteria. TSP predictions are listed in Table 4.17

Table 4.17 TSP PREDICTIONS

No.	Discrete Receptor	TSP Annual Average (µg/m^3)
-	**Criteria**	**90**
-	**Existing Conditions**	**25**
1	Residence 1	15
2	Residence 2	10
3	Residence 3	7
4	Residence 4	8
5	Residence 5	7
6	School Receptor 1	10
7	School Receptor 2	9
	Highest Gridded Receptor Value	74
	2nd Highest Gridded Receptor Value	62
	3rd Highest Gridded Receptor Value	59
-	4th Highest Gridded Receptor Value	54

iv. Summary

Predicted concentrations at discrete receptor locations (ie Residences and the nearby school) are below the nominated criteria for all pollutants and averaging times modelled.

PM_{10} concentrations at eight Cartesian receptors, predicted 24hour averaged concentrations in excess of the nominated PM_{10} 24 hour criteria. All of these Cartesian receptors were located within 50 metres of the boundary of Lot 196, and in excess of 500 metres from the nearest residence or school. The impacts at these locations is anticipated to be episodic, this is shown by all but one of the eight Cartesian receptors predicting annual concentrations below the nominated criteria.

Averaged measured impacts are included in each table, as existing conditions. The proposal is to change the area quarried, not the quantity quarried. The measured concentrations are well below the nominated criteria, and therefore provide evidence that the impacts modelled are 'worst case'.

4.8.6 Greenhouse Gas Assessment

The proposed extension of the Dixon Sand quarry will not alter the quarry capacity, but will extend the life of the quarry through increasing the extractable area. Annual

greenhouse gas emissions associated with the facility are therefore not expected to increase. Through the extended life of the quarry, it will contribute greenhouse gas emissions for a longer period.

Should the proposed extension not be granted, it is likely that some of the product, which would have been sourced from Dixon Sand, would be acquired from a quarry further away. Transportation of the sand would therefore have an increased greenhouse gas emission.

The proposed extension will remove some native sinks, however a considerable amount of vegetation is proposed to be maintained, and the carbon sequestered by this vegetation will not be released, except by natural processes.

The major greenhouse gas sources from the facility are fuel usage and electricity consumption. Substitution of these fuels and power sources for less greenhouse gas intensive sources is not considered viable at this time.

Greenhouse gas emissions from fuel usage is difficult to quantify as the major usage is in transportation of site which is not conducted by employees or vehicles from Dixon Sand. Diesel usage by vehicles owned and operated by Dixon Sands has been estimated at 100,000 litres of diesel per annum.

Electricity usage by the facility is estimated at approximately 120,000 kwh/yr, which if generated in NSW equates to approximately 129,064 kg of carbon dioxide equivalents emitted annually.

To minimise the quarry's greenhouse gas emissions in the future. Dixon Sands will undertake a review of equipment and machinery to assess them in terms of energy efficiency. This will include regular maintenance and tuning of vehicles which is anticipated to be a practical way of minimising greenhouse gas emissions.

4.9 FLORA AND FAUNA

The following flora and fauna assessment is for Lots 1 and 2 DP 547255 Old Northern Rd, Maroota. The assessment addresses the *Environmental Planning and Assessment Act 1979* (EP&A Act), *Threatened Species Conservation Act 1995* (TSC Act) and *Fisheries Management Act 1994* (FM Act) as amended by the *Fisheries Management Amendment Act 1997* (FMA Act). Impacts to flora and fauna of national significance have been addressed separately in a referral that will be lodged to Environment Australia. The referral is in accordance with the *Environment Protection and Biodiversity Conservation Act 1999 (*EPBC Act).

4.9.1 Background

An assessment by Gunninah Environmental Consultants (1998), reproduced in *Appendix E,* identified the occurrence of two vulnerable species, a plant *Tetratheca glandulosa* and the glossy black cockatoo, the endangered shale/sandstone transition forest, and the potential occurrence of the vulnerable red crowned toadlet (*Pseudophryne australis*) and giant burrowing frog (*Helioporus australiacus*) as constraints to the proposed extraction. An unidentified *Litoria* species was also tentatively recorded as either (Littlejohn's treefrog (*Litoria littlejohni*)or Jervis Bay tree frog (*Litoria jervisiensis*). The giant burrowing frog and *Tetratheca glandulosa* are also listed as vulnerable by the *Environmental Protection* and *Biodiversity Conservation Act*, 1999.

An eight – part test of significance for Lots 1 and 2 as required under section 5A of the EP&A Act was lodged in May 2001 to the Department of Urban Affairs and Planning (DUAP) by ERM (ERM 2001). This assessment was based on surveys undertaken by Gunninah Environmental Consultants and predicted that *Tetratheca glandulosa* and the shale/ sandstone transition forest would be significantly impacted by the proposed extraction. It also identified the giant burrowing frog, red-crowned toadlet and littlejohn's treefrog as having the potential to occur and to be significantly impacted. DUAP accordingly requested a species impact statement to be undertaken for the proposed extraction.

Prior to preparation of a species impact statement Dixon Sand proposed to modify the proposed extraction area to mitigate significant impacts identified by Gunninah Environmental Consultants (1998) and ERM (2001). Modifications involved:

- exclusion of extraction within 50 metres of the east and western boundaries of the *Tetratheca glandulosa* and shale/ sandstone transitional forest, and exclusion and rehabilitation of a 20 metre buffer along the northern boundary of the communities;

- further field assessment during suitable seasons to verify the presence of threatened frog species in the new extraction area; and

- preparation of an eight-part test of significance for the new extraction area to verify that the new proposal would have a reduced impact on threatened biota.

The following flora and fauna assessment addresses these modifications. Impacts to threatened species have been reassessed under the TSC Act. Further field investigations were carried out on 5 February, 14, 24 and 29 May and between the 16 and 20 July 2001. These were in order to complement surveys undertaken by Gunninah and fill gaps in data due to inappropriate survey seasons and or durations.

Survey effort of all surveys are summarised in *Table 4.18* and *Figure 4.6*. The following assessment is based on these field investigations and a review of Mount King Ecological Surveys (1992), Ecohort Consultants (2000), Cohn (1993) and the NPWS wildlife and Rare or Threatened Australian Plants (ROTAP) databases.

Table 4.18 FLORA AND FAUNA SURVEY EFFORT AND CONDITIONS

Survey Method	ERM	Gunninah Environmental Consultants
Targeted threatened plant search	14 May 2001 (4 hours by one person)	15 June 1998, 11 August 1998
Targeted searches for arboreal fauna roost/ nest trees (ie;threatened owls, bats, glossy black cockatoo and squirrel gliders).	14, 24 and 29 May 2001 (3-4 hours by one person)	25-27 June 1998
Targeted squirrel glider trapping	16-20 July 2001	Nil
Hair tube trapping for ground and some arboreal fauna	15-24 May 2001 (traps left for ten nights)	Nil
Opportunistic searches for breeding glossy black cockatoos	16-20 July 2001	Nil
Owl call play back	29 May 2001 (1.5 hours)	25-27 June 1998
Targeted frog searches	5 February 2001, 14, 24 and 29 May 2001 (15 hours by two persons)[2]	25-27 June 1998
Spotlighting	14, 24 and 29 May 2001 (4.5 hours by two persons)	25-27 June 1998[3]
Bat echolocation analysis	14, 24 and 29 May 2001 (4.5 hours by one person)	25-27 June 1998
Harp trap	Nil	25-27 June 1998
Opportunistic bird surveys	Nil	25-27 June 1998

1. *Weather conditions between 16 – 20 July 2001 were mild during the day and cool at night (between 14 and 16 degrees). This is considered a preferred time to survey for squirrel gliders as food resources are low (ie; limited to occasional Banksias) and they are more inclined to be attracted to baits used in traps (M Murray pers com); and*
2. *Weather conditions of 5 February were mild and humid due to a heavy thunderstorm that occurred that afternoon. Conditions between the 14 and 29 May 2001 ranged between 25 and 27 degrees during the evenings, were clear to slightly overcast and had little to no wind.*
3. *Weather conditions during surveys of the 25-27 June 1998 were clear, cool in the evenings and warm during the day with a slight breeze.*

4.9.2 Vegetation

Native vegetation covers approximately 12.5 hectares of the site. The remainder 13.5 hectares of the site is either cleared or covered by orchards. Gunninah Environmental Consultants (1998) identified vegetation communities on site (see *Figure 4.6*). These communities were:

- gully open forest;
- ridgetop open forest;
- woodland to ridgetop woodland;
- open woodland;
- shale / sandstone transition forest;
- ridgetop scrub heath to Maroota sands dry heath;
- freshwater wetlands; and
- cleared/disturbed vegetation.

A detailed description of these communities is provided in *Appendix E*.

The shale/sandstone transition forest community is listed as endangered on the TSC Act. One vulnerable plant *Tetratheca glandulosa* also occurs in parts of the shale/ sandstone transition forest as it merges into the ridgetop scrub heath (see *Figure 4.6*).

4.9.3 Fauna Habitat

i. Terrestrial

A number of stags and trees with small hollows, branches, narrow openings and shedding bark occur on site. These provide potential roost sites and shelter for tree roosting bats, small mammals, birds and some reptiles.

Mid-storey vegetation, particularly that of the heath communities provides potential foraging habitat for native birds and some arboreal mammals. The *Allocasuarina* of the open forest and woodland communities provides foraging habitat for the glossy black cockatoo. The large areas of disturbed grassland provide habitat for small mammals, reptiles and birds. The swamp wallaby (*Wallabia bicolor*) and long-nosed bandicoot (*Perameles nasuta)* have been recorded nearby in the area by Mount King

Ecological Surveys (1992) and their tracts and scats were observed during the May 2001 surveys.

Fallen timber, bark shelter, leaf litter and humus layer (0-2 centimetres deep) provide habitat for invertebrates, reptiles and other small terrestrial fauna. Leaf litter of the ridgetop open forest/ woodland, scrub heath and shale/ sandstone transitional forest also provides foraging habitat for amphibians, particularly the brown toadlet (*Pseudophryne bibronii)*. These areas did not contain suitable breeding habitat for frogs in the form of permanent soaks. Lichens in the south west corner of the site indicate a moist environment but do not appear to retain standing water after heavy periods of rain.

Sandstone ledges cover between 10 and 15 percent of the south-west corner of the site and bush rock approximately 10 percent of the shale/ sandstone transitional forest. This would provide habitat to reptiles and other amphibians.

Fauna habitat links to large tracts of adjoining vegetation is limited to a narrow corridor on the southern boundary. This corridor is separated from the site by a haul road approximately 10 metres wide and used frequently during the day. The corridor links to leasehold Crown land that continues north-west to the Hawkesbury River and then onto Wollemi National Park via Parr State Recreation Area.

ii. Aquatic

Aquatic habitat includes three permanent dams, an ephemeral drainage line and a groundcover of deep sand that forms temporary soaks in high rainfall.

The artificial dams provide habitat to frogs and aquatic birds. The three dams are regarded as class 3 waterways, they have a high sediment load, are moderately turbid, have a sand to silt substrate and serve as a sink for adjoining ephemeral drainage lines. Dam one is approximately 100 metres in length and 60 metres in width. Dam two is 40 metres in length and 30 metres in width. Dam three is approximately 25 by 25 metres. Aquatic vegetation, *Typha* and *Juncus* species cover between 20 and 40 percent of the banks. Fish breeding and refuge habitat occurs in the form of snags and reed beds.

The ephemeral drainage line extends from the east of the site towards dam two, it then re-emerges in the gully open forest before draining off site. The drainage line eventually flows into Jacksons wetland and then into the Hawkesbury River (see *Figure 4.6*). The section of the ephemeral drainage on site is at the top of the catchment and is regarded as a class 4 waterway. The eastern portion of the drainage line had high flows during heavy rainfall but did not appear to retain permanent pools

and soaks. It is possible that permanent soaks in a small portion of the eastern drainage line, approximately 50 metres in length, were overlooked due to infestation by blackberry (*Rubus sp.).* Banks of the eastern drainage line were dominated by blackberry with *Lomandra* species occurring in less disturbed areas. The western end of the drainage line was not as weed infested with banks being dominated by *Lomandra* species. The drainage line would be well suited to frogs during high rainfall.

4.9.4 Fauna

The woodland and forest communities provide suitable habitat for a number of fauna species. Species recorded on site during spotlighting, hair tube trapping and Elliott trapping of 2001 are detailed in *Table 4.19*. A single glossy black cockatoo (*Calyptorhynchus lathami*) was also observed flying over the site during habitat mapping. Fauna observed by Gunninah Environment Consultants (1998) are detailed in *Appendix E*.

Table 4.19 *F*AUNA OBSERVED DURING FEBRUARY AND MAY 2001

Common Name	Scientific Name	Habitats
little freetail bat	*Mormopterus* sp.	Forest/ woodland
Gould's wattled bat	*Chalinolobus gouldii*	Forest/ woodland
fishing bat	*Myotis adversus**	Dams
long-eared bat	*Nyctophilus* gouldii.	Forest/ woodland
common eastern toadlet	*Crinia signifera*	Dams/ adjoining vegetation
Peron's tree frog	*Litoria peronii*	Dams/ adjoining vegetation
broad palmed frog	*Litoria latopalmata*	Dams/ adjoining vegetation
Freycinet's frog	*Litoria freycineti*	Dams/ adjoining vegetation
brown-striped frog	*Limnodynastes peronii*	Dams/ adjoining vegetation
whistling tree frog	*Litoria verreauxii*	Dams
ornate burrowing frog	*Limnodynastes ornatus*	Heath
eastern banjo frog	*Limnodynastes dumerilii*	Heath
brown toadlet	*Pseudophryne bibroni*	Heath / Open Forest
smooth toadlet	*Uperoleia laevigata*	Dams/ Heath
cat	*Felis catus*	Woodland
dog	*Canis familiaris*	Woodland
brushtail possum	*Tichosurus* sp.	Open forest/ Woodland
common ringtail possum	*Pseudocheirus peregrinus*	Open forest/ Woodland

Table 4.19 *F*AUNA OBSERVED DURING FEBRUARY AND MAY 2001

Common Name	Scientific Name	Habitats
sugar glider	*Petaurus breviceps*	Open forest/ Woodland
swamp wallaby	*Wallabia bicolor***	Open forest/ Woodland
long-nosed bandicoot	*Perameles nasuta***	Open forest/ Woodland
brown antechinus	*Antechinus stuartii*	Open forest/ Woodland
bush rat	*Rattus fuscipes*	Open forest/ Woodland

Note. Only species observed during spotlighting and hair tube trapping investigations have been include in this Table.

* *Listed as threatened under the TSC ACT 1995.*

** *indirect evidence only.*

4.9.5 Impact Assessment and Mitigation Measures.

Potential impacts to flora and fauna of the site would occur from removal of approximately 4.5 hectares of open forest woodland and 1.5 hectares of heath. Vegetation, topsoil and sandstone would be removed to within two metres of the wet weather groundwater level.

Removal of open forest and woodland would include clearing of approximately 40 trees with potential roosting habitat for the sugar glider, common ring tail possum or forest bats. Foraging habitat for these species and others such as the swamp wallaby, long – nosed potoroo, brown antechinus and bush rat would also be removed. Impact to potential and known habitat for these species would be mitigated by:

- retention of open forest and woodland habitat in and adjoining threatened vegetation and the school (see *Figure 4.6*); and
- rehabilitation of native vegetation and fauna habitat in the form of logs and nest boxes.

Impacts on wildlife movement to adjoining areas would be minimal as the site acts as a sink rather than a wildlife corridor due to ridgetop development and the Old Northern Road.

Removal of topsoil and extraction of the sandstone to within two metres of the wet weather groundwater level would impact frogs. Targeted surveys for the threatened red crowned toadlet (*Pseudophryne australis)* and giant burrowing frog (*Helioporus australiacus)* were undertaken in suitable seasons. Surveys for the giant burrowing frog are best undertaken during summer to autumn and the red-crowned toadlet calls throughout the year. Surveys involved inspections of dams for tadpoles, call play

back for the red-crowned toadlet and intensive searches across the site for both species. Neither of these species were detected and due to an absence of preferred breeding habitat it is considered unlikely that they would occur.

Extraction of dams one and two would remove aquatic habitat. Off site impacts to aquatic habitat are not expected. As the ephemeral drainage line is small and collects little water, its removal would not significantly impact water volumes downstream.

4.9.6 Threatened Species

The TSC Act lists species, populations and ecological communities considered to be threatened in New South Wales. The likelihood of threatened species occurring on site is detailed *Table 4.20.* Species regarded as threatened nationally under the EPBC Act 1999 have also been detailed *Table 4.20*. No threatened populations were considered likely to occur on site. One threatened ecological community the shale/ sandstone transitional forest occurs on site.

Table 4.20 THREATENED SPECIES OCCURRENCE

Name	TSC Act	EPBC Act	Record in Region	Likelihood of Occurrence
Tetratheca glandulosa	V	V	Recorded on site (Gunninah Environmental Consultants, 1998). Wisemans Ferry- Port Jackson (Benson and Howell, 1994). Garigal National Parks (Briggs and Leigh 1996)	High. Occurs on site in the shale/sandstone transition forest and the ridgetop scrub heath (Gunninah Environmental Consultants 1998).
Olearia cordata	V		Within 10 kilometres of the site (NPWS Wildlife database). Wisemans Ferry to Wollombi (Harden, 1992).	Moderate to low based on presence of suitable habitat (dry sclerophyll and open shrubland). Not observed during targeted surveys by Gunninah Environmental Consultants (1998) or ERM.
Acacia bynoeana	E		Within 10 kilometres of the site (NPWS Wildlife database). Marramarra NP, Castlereagh NR, Lake Macquarie SRA, Blue Mountains NP and Ku-ring-gai Chase NP (NPWS Final Determination, 22.03.00). Cattai Creek (ERM Mitchell McCotter, 1999). Pennant Hills, Northbridge, Mosman, Cooks River (Benson and Howell, 1994).	Moderate to low based on suitable habitat (heath and dry sclerophyll forests on sand and sandy clay (Harden, 1991). Not observed by Gunninah Environmental Consultants (1998) or ERM.
Darwinia biflora	V		Within 10 kilometres of the site (NPWS Wildlife database). Known from 129 sites in the northern and north-east suburbs of Sydney, in the Ryde, Baulkham Hills, Hornsby and Ku-Ring-Gai local government areas (NPWS 1999). Hawkesbury River – Port Jackson (Benson and Howell, 1994).	Moderate to low based on suitable habitat (weathered shale-capped ridges that intergrade with Hawkesbury sandstone (Harden, 1991)) on site. Not observed by Gunninah Environmental Consultants (1998) or ERM.

Table 4.20 THREATENED SPECIES OCCURRENCE

Name	TSC Act	EPBC Act	Record in Region	Likelihood of Occurrence
Kunzea rupestris	V		Immediately adjoining the site (Gunninah Environmental Consultants, 1998). Cohn (1993) described the population as approx. 280 individuals over an area of 0.17 ha. Cohn (1993) identified 9 populations (approx. 2000 individuals) in the Sydney area occupying a total area of 2.7 ha. One population was in Ku-ring-gai NP, two in Marramarra NP, and another six on private and crown land in the vicinity of Marramarra NP (Cohn, 1993).	Moderate to low based on suitable habitat (sandstone rock platforms on ridge tops with a north/west aspect (Harden, 1991)). Not observed by Gunninah Environmental Consultants (1998), Cohn (1993) or ERM.
Asterolasia elegans	E		Within 10 kilometres of the site (NPWS Wildlife database). Moist forest, north of Maroota (Benson and Howell, 1994).	Low based on absence of suitable habitat on site (wet sclerophyll forest on moist hillsides (Harden, 1991)). Not observed by Gunninah Environmental Consultants (1998) or ERM.
Zieria involucrata	V		Within 10 kilometres of the site (NPWS Wildlife database). Marramarra Creek (Benson and Howell, 1994).	Low based on absence of suitable habitat (wet sclerophyll forest mainly in the lower Blue Mountains (Harden, 1991)). Not observed by Gunninah Environmental Consultants (1998) or ERM.
Micromyrtus blakelyi	V		Within 10 kilometres of the site (NPWS Wildlife database). Rocky ridges, Muogamarra NP (Benson and Howell, 1994).	Moderate to low based on suitable habitat on site (heath in depressions of sandstone rock platforms (Harden, 1991)) on site. Not observed by Gunninah Environmental Consultants (1998) or ERM.

Table 4.20 THREATENED SPECIES OCCURRENCE

Name	TSC Act	EPBC Act	Record in Region	Likelihood of Occurrence
Amperea xiphoclada var *pedicellata*	-		Within 10 kilometres of the site (NPWS Wildlife database).	Moderate to low based on suitable habitat on site (heath, woodland and forest on low-fertility sand (Harden, 1990)) on site. Not observed by Gunninah Environmental Consultants (1998) or ERM.
Dillwynia tenuifolia	V		Within 10 kilometres of the site (NPWS Wildlife database). Mainly between Windsor and Penrith at Darkeys Creek, Agnes Banks, Castlereagh, St Marys, Kemps Creek and Woodford (Benson and McDougall, 1996).	Moderate to low based on suitable habitat (woodland and open forest on sand to clay soil (Harden, 1991)). Not observed by Gunninah Environmental Consultants (1998) or ERM.
Leptospermum deanei	-		Within 10 kilometres of the site (NPWS Wildlife database). Marramarra Creek, Pennant Hills Park, Middle Harbour Creek (Benson and Howell, 1994).	Moderate to low based on suitable habitat on site (forested slopes (Harden, 1991)). Not observed by Gunninah Environmental Consultants (1998) or ERM.
common bent-wing bat *(Miniopterus schreibersii)*	V		Within 10 kilometres of the site (NPWS Wildlife database).	Moderate to high based on presence of foraging habitat. No roosting habitat (caves, old mines or a variety of structures such as buildings and stormwater drains).
fishing bat *(Myotis adversus)*	V		Recorded on site during May 2001 field investigations. Within 10 kilometres of the site (NPWS Wildlife database).	High, occurs on site. Potential foraging habitat over dams. No roosting habitat (caves, mines or tunnels, under bridges and buildings) on site.
yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*)	V		Within 10 kilometres of the site, Willunga and Fairview (NPWS Wildlife database).	Moderate to high based on presence of foraging habitat. Some roosting habitat in the form of tree hollows on site.

Table 4.20 THREATENED SPECIES OCCURRENCE

Name	TSC Act	EPBC Act	Record in Region	Likelihood of Occurrence
eastern false pipistrelle (*Falsistrellus tasmaniensis)*	V		Olney State Forest, near Wyong (Ferrier *et al*, updated). Distributed throughout eastern NSW extending from the highlands to the coast.	Moderate to high. Foraging and roost habitat in the form of tree hollows on site. It may also roost in caves and abandoned buildings (Klippel, 1992), this habitat type is not on site.
yellow-bellied glider (*Petaurus autralis)*	V		Immediately adjoining areas (Mt King Ecological Surveys, 1992). Recorded on crown land at O'Haras Creek, Maroota National Park, Cattai National Park (WSUBBS, 1997). Ourimbah and Koree (NPWS Wildlife database).	Moderate to low based on recent habitat reduction in the area and increased fragmentation of the site.
squirrel glider *(Petaurus norfolcensis)*	V		Within 10 kilometres of the site, Greengrove and Kooree (NPWS Wildlife database).	Moderate to high. Suitable foraging and roost trees on site. Likelihood of occurrence is reduced due to lack of detection during targeted Elliott and spotlighting surveys undertaken by ERM, recent habitat reduction in the area, increased fragmentation of the site and an apparent dominance of sugar gliders on site. Squirrel gliders tend to dominant sites where both sugar gliders and squirrel gliders co-exist (pers com. M. Murray).
koala (*Phascolarctos cinereus)*	V		On the outskirts of the Maroota sandmass adjoining Marramarra National Park, Somersby, Carinya and Bumble (NPWS Wildlife database).	Low. Based on presence of koala feed trees on site (*E. punctata*, *E. haemastoma*). Not recorded on site by Gunninah Environmental Consultants (1998) and limited by increased fragmentation of the site.

Table 4.20 THREATENED SPECIES OCCURRENCE

Name	TSC Act	EPBC Act	Record in Region	Likelihood of Occurrence
eastern chestnut mouse *(Pseudomys gracilicaudatus)*	V		Recorded in the WSUBBS (1997).	Low based on absence of suitable habitat (dense ground vegetation in wet swampy heathland or woodland).
spotted tailed quoll (*Dasyurus maculatus)*	V		Within 10 kilometres of the site, Killoren, Moppity Alexander and Lower Mangrove (NPWS Wildlife database).	Moderate to low based on presence of foraging habitat. Limited by increased fragmentation of the site.
glossy black cockatoo (*Calyptorhynchus lathami)*	V		Observed flying over site during the May 2001 surveys. Indirect evidence on site (Gunninah Environmental Consultants, 1998).	High based on suitable foraging habitat on site and indirect evidence (chewed cones) collected by Gunninah Environmental Consultants (1998). Limited suitable nest hollows on site.
powerful owl (*Ninox strenua*)	V		Within 10 kilometres of the site and Birdseye, Kooree, Hillview and Somersby (NPWS Wildlife database).	Moderate to high based on presence of suitable foraging habitat on site. No preferred nesting habitat identified on site.
masked owl (*Tyto novaehollandiae)*	V		Within 10 kilometres of the site and Peats Ridge, Bumble, Tindara (NPWS Wildlife database).	Moderate to high based on suitable foraging habitat on site. No preferred nesting habitat on site.
sooty owl (*Tyto tenebricosa)*	V		Within 10 kilometres of the site and Killoren, Peats Ridge, Milligans Ridge, Somersby, Glenworth Valley (NPWS Wildlife database).	Moderate to high. based on suitable foraging habitat on site although is more likely to forage in denser vegetation in steep gullies of the Hawkesbury River. No preferred nesting habitat on site.
turquoise parrot (*Neophema pulchella*)	V		Recorded in the east and west parts of Marroota (Ecohort, 2000). Within 10 kilometres of the site (NPWS Wildlife database).	Moderate based on suitable foraging habitat (open forest) on site. Limited roosting habitat (dead stump or eucalypt spout).

Table 4.20 THREATENED SPECIES OCCURRENCE

Name	TSC Act	EPBC Act	Record in Region	Likelihood of Occurrence
littlejohn's treefrog (*Litoria littlejohni*)	V		An unidentified *Litoria* sp. (either *L. littlejohni* or *L. jervisiensis*) was recorded around the dams on site (Gunninah Environmental Consultants, 1998). Tentative record within 1 kilometre of the site (resident, 2000). Watagan SF, Ourimbah SF and Barren Grounds NR, Morton NP, Budawang NP and Wadbilliga NP (NPWS Final Determination, 11.08.00*)*	Moderate to low. Targeted searches by ERM did not detect any evidence of this species on site. Rock habitat and ephemeral drainage lines previously thought potential habitat were found to be too dry.
red-crowned toadlet *(Pseudophryne australis*)	V		Tentatively identified from an area immediately to the west of the site, although no animals were captured for positive identification (Gunninah Environmental Consultants, 1998). Studies by Thumm (1999) show that 89 percent of red-crowned toadlets surveyed in the Sydney Basin were identified from Hawkesbury sandstone. It has been recorded at Ku-ring-gai Chase, Marramarra, Garrigal, Land Cove, Blue Mountains, Muogamarra, Sydney Harbour, Royal, Heathcote, Wollemi, Yengo and Brisbane Water NP's (NSW NPWS Wildlife Atlas) and Cattai Creek (ERM Mitchell McCotter, 1999).	Moderate to high. Preferred habitat under leaf litter and rocks occurs on site on site. *Pseudophrnye* calls were abundant in the south west corner of the site, whilst *Pseudophryne bibironi* was identified in this area and it is possible that it was responsible for all calls heard during targeted searches, it is not possible to rule out the occurrence of *Pseudophryne australis* as the two are known to co-exist. Rather *Pseudophryne australis* is considered unlikley to occur due to an absence of preferred habitat in the form of permanent soaks on site.

Table 4.20 THREATENED SPECIES OCCURRENCE

Name	TSC Act	EPBC Act	Record in Region	Likelihood of Occurrence
giant burrowing frog (*Heleioporus australiacus)*	V	V	Within 10 kilometres of the site, Galston and Marramarra National Park (NPWS Wildlife Atlas).	Moderate to high. Potential foraging habitat on site, preferred breeding habitat around sandy creek beds does not occur on site. This species was not detected despite targeted surveys by ERM.
heath monitor (*Varanus rosenbergi*)	V		Tentatively identified by NPWS (1997) in the area.	Moderate based on suitable foraging habitat (sclerophyll forest and heathland) on site. Not observed by Gunninah Environmental Consultants (1998) or ERM.
broad-headed snake (*Hoplocephalus bungaroides)*	E		Marramarra Ku-ring-gai, Lane Cove, Garigal, Blue Mountains, Heathcote, Morton, Royal, Wollemi and Yengo NPs and Parr SRA (NPWS Wildlife Atlas)	Moderate based on suitable foraging habitat (in the form of woodland or heath on exposed sandstone outcrops and benching occurs) on site. They utilise rock crevices and exfoliating sheets of weathered sandstone during the cooler months and tree hollows during the summer (Webb & Shine 1998). Not recorded by Gunninah Environmental Consultants (1998), not recorded in the area for the last 15 years.

4.9.7 Eight Part Test Assessment

The following assessment is based on the eight part test of significance established in section 5A of the EP&A Act. The test allows a determination of whether there is likely to be a significant effect on threatened species, populations or ecological communities or their habitats. Species assessed with a moderate/high to high likelihood of occurring on site are *Tetratheca glandulosa,* common bent-wing bat, fishing bat, yellow-bellied sheathtail-bat, eastern false pipistrelle, glossy black cockatoo, powerful owl, masked owl, sooty owl, squirrel glider, red-crowned toadlet and giant burrowing frog. The endangered shale/ sandstone transition forest community has also been assessed.

Potential impacts to these species and community occur from removal of approximately 7.5 hectares of native vegetation, including approximately six hectares of open forest woodland and 1.5 hectares of heath (see *Figure 4.6*). The dams one and two would also be removed. Approximately three hectares of vegetation will be left to retain the *Tetratheca glandulosa* population and shale/ sandstone transition forest community. A further two hectares of open forest/ woodland and dam three would also be retained as a buffer for the school (see *Figure 4.6*).

No threatened fish are likely to occur on site. Despite this the impact of the proposed extraction on threatened fish species was assessed in accordance with the *Fisheries Management Act 1994* using the eight-part test of significance.

i) In the case of threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

a. Flora

The *Tetratheca glandulosa* population and, the shale/sandstone transition forest would be retained and buffers left immediately adjoining them.

A 50 metre buffer around threatened communities is recommended in DCP 500 and is also applied to a number of threatened plant communities by State Forests (State Forests, 2000). Buffers protect communities from disturbances such as increased weed infestation, drainage alterations, erosion, rubbish dumping, predation by exotic species, impacts from increased dust deposition and alterations to micro climatic conditions due to changes in landform. They also provide some potential for the community to expand or disperse. A 50 metre buffer is to be retained along the east and west boundaries of the communities where undisturbed native vegetation exists. This width is expected to be sufficient to conserve the long-term

viability of this population provided batters around the buffers are graded and rehabilitated on completion of extraction. Batters and the stability of the community would also need to be monitored for the duration of extraction.

The northern boundary is currently adjoined by disturbed grassland and it is likely that edges of the community have served as a buffer to previous disturbance. For this reason and also because of the nature of extraction in this area the buffer width has been reduced to 20 metres (see Figure 4.6). The buffer would be intensely rehabilitated prior to extraction to mitigate any potential disturbance. Potential disturbances that were considered when determining the width of the buffer were:

- surface drainage; this would not be significantly altered in this area;
- increased dust during extraction. Minimising the extraction duration within 30 metres of this area and providing a native vegetation cover in the 20 metre buffer will help mitigate this potential impact. Dust modelling has predicted very small differences in PM10 dust concentrations for points 50 and 20 metres north of the northern end of the *Tetratheca* population and transition forest. The sixth highest 24 hour PM10 predictions are 62 and 65 micrograms per cubic metre respectively, indicating little effective difference in buffer dimensions regarding dust emissions. Similarly dust deposition modelling predicts 1.275 and 1.321 grams per square metre per month due to quarrying at 50 and 20 metres respectively. Background monitoring indicates levels of 1.8 grams per square metre per month on average, which would indicate a total predicted deposition in the order of 3 grams per square metre per month. Mentor Consulting (undated) prepared a literature review of the impacts of mine generated dust on agriculture that cited Yang (1988), who noted that there would be no adverse effects on plant production unless dust deposition exceeded 22 to 45 grams per square metre per month;
- increased weed infestation, this would be mitigated by a weed control program that would for part of the EMP; and
- community expansion or increased dispersal. The northern boundary has been cleared for at least 27 years and shows no sign of natural dispersal or regeneration by the shale/ sandstone transitional forest or *Tetratheca* community. The proposed revegetation is expected to provide a long term buffer to the preserved community. To assist in protection and or extension of the existing community, once quarrying is completed to the edge of the 20 metre buffer, overburden from later strips will be backfilled to re-create the pre-quarrying topography for 30 metres. The standard 3:1 batter

(horizontal to vertical) will be backfilled from this point northwards. *Figure 4.6* shows the final landform. The 30 metre backfill section will be rehabilitated and planted with elements of the shale/sandstone transition forest so that a long term 50 metre buffer is retained.

Impacts to these communities are not expected to be such that the local population is placed at risk of extinction.

b. Fauna

The yellow-bellied sheathtail-bat and eastern false pipistrelle roost under bark and tend to nest in hollows. Individual roost trees are not regarded as critical to survival of a local viable population as individuals change roosts frequently and are not dependent on a single tree. Trees with hollows have the potential to be critical to the survival of a viable local population as young are raised in the hollows and remain there until reared. During breeding periods the whole population often nest close to each other and breeding trees would be significant to the survival of a viable population. Potential impact to these bats from clearing of trees with potential breeding hollows has been assessed as unlikely to have a significant impact on a local viable population such that it is placed at risk of extinction as:

- the species have not been recorded directly on site despite targeted survey effort;
- clearing of potential habitat trees would be undertaken outside breeding seasons; and
- nest boxes would be erected in remaining habitat to compensate for clearing of potential habitat trees.

The common bent-wing bat may forage over woodland and open forest of the site and fishing bat over dams. Both these species roost in caves and other infrastructure, this habitat type does not occur on site. Reduction of foraging habitat for these species would not impact a local viable population such that it is placed at risk of extinction.

The glossy black cockatoo forages in eucalypt woodlands and forests where *Allocasuarina* and *Casuarina* species are abundant. They nest in tree hollows. Suitable *Allocasuarina* feed trees occupy approximately 30 percent of the foliage projective cover. Clearing of this habitat type would not significantly impact a viable local population as much of this habitat type is to be retained and feed trees would be used in rehabilitation. Potential nest trees have been identified on site.

Clearing of potential nest trees is not expected to significantly impact a viable local population such that it becomes extinct as:

- no glossy black cockatoos have been identified nesting on site during opportunistic surveys undertaken in July 2001. Glossy black-cockatoos breed between autumn and winter;
- clearing would be undertaken outside the breeding season;
- the number of potential nest trees proposed to be cleared is not regarded as sufficient to support a viable local population as populations consist of approximately 10 individuals; and
- nest boxes would be erected in remaining habitat to compensate for clearing of potential habitat trees.

The threatened owls have been recorded in the area and may forage over the site. Searches in 2001 did not detect suitable roost habitat for these species on site. The powerful owl and sooty owl tend to roost in tree hollows or dense vegetation (Debus, 1994) typically found in the steep forested gullies (Kavanagh and Peake, 1993). This preferred roost habitat was not identified on site. The masked owl also nests in large hollows, although there appears to be a preference for hollow tree trunks and vertical spouts of large trees. Suitable habitat hollows and spouts were not identified during targeted habitat searches of May 2001. Removal of approximately 7.5 hectares of foraging habitat, provided nest boxes for food species (ie; gliders and possums) are erected, would not disrupt a local population of masked, powerful or sooty owls such that they were placed at risk of extinction.

The squirrel glider has been recorded within ten kilometres of the site and potential habitat trees have been identified on site. Despite this squirrel gliders are not expected to occur on site as they were not detected during targeted trapping and spotlighting surveys, habitat on site has been reduced and fragmented and sugar gliders appeared abundant during targeted surveys. Squirrel gliders tend to dominate sites where both sugar gliders and squirrel gliders co-exist (pers com. M. Murray). Approximately 2.5 hectares with potential habitat trees is to be retained on site and approximately 4.5 hectares is to be cleared. As squirrel gliders are not expected to occur on site removal of this potential habitat would not impact a local population such that it is placed at risk of extinction.

The red crowned toadlet has been recorded with ten kilometres of the site. *Pseudophryne* species were heard calling from the south-west corner of the site; *Pseudophryne bibroni* was positively identified and it is possible the red crowned toadlet was also present. While the red-crowned toadlet has the potential to forage on site, breeding habitat in the form of permanent soaks does not occur. Clearing

would not impact a local viable population such that they are placed at risk of extinction, as there is no suitable breeding habitat on site.

The giant burrowing frog has been recorded within 10 kilometres of the site. The ornate burrowing frog was identified from the south-west corner of the site and is known to co-exist with the giant burrowing frog and is an indirect indication of suitable habitat for this species. Preferred habitat for the giant burrowing frog occurs along banks of small creeks. This habitat type is not available on site. The ephemeral drainage line and south-west corner of the site provides potential foraging habitat but would not provide breeding habitat as permanent stands of water do not occur. While it is possible that dams on site could be used by this species for breeding it is not the preferred habitat type and this species was not detected during targeted surveys. Clearing is not expected to impact a local viable population such that they are placed at risk of extinction as there is no suitable breeding habitat on site.

None of the fish species currently listed as endangered or vulnerable in the *Fisheries Management Act 1994* are likely to occur in the three dams or ephemeral drainage line. Therefore, the lifecycle of any threatened fish species will not be disrupted such that a viable local population of the species would be placed at risk of extinction.

ii) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the population is likely to be significantly compromised.

No endangered populations listed on Schedule 1 of the TSC Act occur in the local area.

There are currently no endangered fish populations listed on the *Fisheries Management Act 1994*.

iii) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

The site is within the Sydney Basin biogeographical region that extends south from the Hunter River and west to Dunedoo. Five to ten per cent of the region is reserved (Thackway and Cresswell, 1995) of this, most is sandstone vegetation.

Tetratheca glandulosa is listed as 2VC- by Briggs and Leigh (1995), meaning that it has a radial distribution of less than one hundred kilometre, it is vulnerable and known from conservation reserves however the conservation status is unknown. It is locally abundant but restricted regionally to the Hawkesbury Sandstone

formation. The community is unlikely to be significant locally but has the potential to be significant regionally. The community will be retained.

The shale/ sandstone community occurs on areas transitional between the clay soils derived from the Hawkesbury Sandstone on the margins of the Cumberland Plain. It occupies approximately 16260 hectares or 24 percent of the Cumberland Plain, 8345 hectares or approximately 50 percent of which are remnants of low quality. Populations are in the Bankstown, Baulkham Hills, Blue Mountains, Campbelltown, Hawkesbury, Liverpool, Parramatta, Penrith and Wollondilly local government areas. Habitat is likely to be significant in relation to the limited distribution of known regional habitat. This community will be retained.

The threatened owls, bats, glossy black cockatoo and squirrel glider have been recorded as occurring in the Hawkesbury region (see *Table 4.20*) and known habitat occurs for these species in national parks of the area such as Wollemi, Dharug, Marramarra and Blue Mountains. Removal of the 7.5 hectares of potential foraging habitat for these species would not be significant in relation to the regional distribution of known habitat. It is unlikely that potential nest trees for the bats, glossy black cockatoo and squirrel glider are significant regionally.

The red-crowned toadlet is found within a radius of approximately 160 kilometres of Sydney and is confined almost exclusively to the Hawkesbury Sandstone area (Cogger, 1992). The giant burrowing frog is distributed along the coast and ranges from central New South Wales to eastern Victoria (Cogger, 1994). No known breeding habitat for these species occurs on site. Removal of 7.5 hectares of potential foraging habitat is to be removed, it is unlikely that this is significant regionally.

No known habitat for fish species currently listed as threatened in the *Fisheries Management Act 1994* exists in or immediately adjoining the proposed extraction area.

iv) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

Development along the Old Northern Road has isolated the interconnectivity of large tracts of vegetation that exist to the east and west of the road. Potential to create habitat corridors between these two areas is limited by rural 1(b) zoning along the ridge and continued development.

Fauna habitat links to large tracts of adjoining vegetation is limited to a narrow corridor on the southern boundary. This corridor is separated from the site by a haul road approximately 10 metres wide and used frequently during the day. The corridor links to leasehold crown land that continues northwest to the Hawkesbury

River and then onto Wollemi National Park via Parr State Recreation Area. While mobile species may use this link, the site would serve as a sink rather than a corridor as Old Northern Road and rural development bar connectivity to eastern vegetation. Removal of habitat for extraction will not further isolate current interconnecting proximate areas of habitat for a threatened species, population or the ecological community.

The ephemeral drainage line flows into Jacksons wetland and then into the Hawkesbury River (see *Figure 4.5*). The development will not bar potential fish passage as the section of the ephemeral drainage line to be disturbed is at the top of the catchment.

v) Whether critical habitat will be affected.

At present, the Director-General of the National Parks and Wildlife Service maintains no register of critical habitat.

There are currently no areas of critical habitat listed in the *Fisheries Management Act 1994*.

vi) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region.

Tetratheca glandulosa occurs in national parks and nature reserves, including Garigal, Dharug, Lane Cove and Marramarra national parks as well as Muogamarra Nature Reserve, Berowra Valley Bushland Park and Manly Dam Memorial Park, sizeable populations occur in Ku-ring-gai Chase National Park. It is not known if these provide adequate regional protection.

Of approximately 7900 hectares of the shale/transitional forest surveyed in the Western Sydney Cumberland Plain, approximately 90 hectares, is protected in National Park Estates and a further 1000 hectares is zoned Environmental Protection (NSW NPWS, 2000). It is not known whether this is adequate regional protection for the population.

There are few records of the threatened bats from conservation reserves of the region however suitable habitat occurs in Ku-ring-gai Chase, Marramarra, Garigal, Dharug, Wollemi and Blue Mountains national parks. It is not known whether these habitats provide adequately regional protection for the species although it is probable.

The glossy black cockatoo occurs in various reserves throughout eastern and central NSW including Marramarra and Dharug NP. There are few records of the threatened owls and squirrel glider from conservation reserves although suitable

habitat occurs in Wollemi, Blue Mountains, Marramarra and Dharug National Parks. Due to the highly mobile nature of the owls and glossy black cockatoo and the availability of suitable habitat conserved in reserves, it is likely that habitat for these species is adequately protected in the region. It is not known if the squirrel glider is adequately conserved in the region.

Habitat for the red-crowned toadlet is patchy throughout the conservation reserves. However, the area of habitat for the frog in the reserves is significant. The red-crowned toadlet occurs in a number of conservation areas including Ku-ring-gai Chase, Marramarra, Garrigal, Blue Mountains, Heathcote, Wollemi, Yengo, Brisbane Water, Royal, Lane Cove and Muogamarra national parks, totalling approximately 940,000 hectares. More than 20 percent of the total original Hawkesbury Sandstone vegetation remain in these reserves (Robertson *et al.* 1996). It is not known if the the species is adequately conserved in conservation reserves.

The giant burrowing frog is known from several national parks including Marramarra, Ku-ring-gai, Wollemi, Blue Mountains, Brisbane Water, Heathcote, Morton, Royal and Ben Boyd. It is not known whether these habitats provide adequate regional protection for the species.

At present, NSW Fisheries have declared eight aquatic reserves and one marine protected area within NSW. These reserves cover predominantly marine and estuarine habitats.

vii) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.

At present there are eight threatening processes listed on Schedule 3 of the TSC Act, these are:

- predation by the fox (*Vulpes vulpes*);
- anthropogenic climate change;
- predation by mosquito fish (*Gambusia holbrooki)*;
- invasion of native plant communities by bitou bush (*Chrysanthemoides monilifera)*;
- removal of bushrock;
- high frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition;
- predation by the feral cat (*felis cattus)*; and

- predation from the ship rat (*Rattus rattus*) on Lord Howe Island.

Quarrying has the potential to reduce bush rock cover and may increase access by foxes and cats. These processes will be mitigated in an EMP so that any bush rock is retained and used in later rehabilitation. Bush rock to be retained and used in rehabilitation would only be surface rock that has the potential to provide habitat to ground dwelling fauna. Implementation of a fox and cat control program would also be implemented to mitigate the current problem. It is also noted that vegetation clearing has been given preliminary determination as a threatening process. The rehabilitation strategy is intended to mitigate this.

The development is not recognised as a key threatening process as listed on Schedule 3 of the TSC Act. The development will not cause any of the listed processes such as predation by the European fox to increase.

Currently no development or activity is listed as a key threatening process under schedule 6 of the *Fisheries Management Act, 1994*.

viii) Whether any threatened species or ecological community is at the limit of its known distribution.

Threatened species or ecological communities listed in the TSC Act that have a moderate/high to high likelihood of occurrence are not at the limit of their known distribution at the Dixon Sand Quarry.

Species currently listed as threatened under the *Fisheries Management Act, 1994* would not be within their known distribution if they were to occur within the site.

4.9.8 Conclusion To Eight Part Test

Inclusion of a buffer around the *Tetratheca glandulosa* and shale/sandstone transition forest populations would mitigate indirect impacts to the communities such that they are not significantly impacted.

The fishing bat, common bent-wing bat, powerful owl, masked owl and sooty owl, would not be significantly impacted by the proposed development.

The red-crowned toadlet is considered unlikely to occur due to an absence of preferred habitat in the form of soaks on site and a lack of detection during targeted surveys in February and May. The giant burrowing frog is also not expected to occur due to an absence of detection during targeted searches of February and May and an absence of preferred breeding habitat in the form of sandy creek beds.

Potential roost or nesting habitat occurs on site for the glossy black cockatoo, yellow-bellied sheath-tail bat, eastern false pipistrelle and squirrel glider. With the exception of the glossy black cockatoo, these species were not detected during targeted field surveys. Potential impacts to these species would be mitigated by development of an EMP that would include prescriptions for clearing outside breeding seasons, pre-clearance inspections, erection of compensatory habitat in the form of nest boxes and use of feed trees and shrubs in rehabilitation. The proposed extraction is not expected to place a viable local population of these species at risk of extinction.

4.10 ARCHAEOLOGY

4.10.1 Aboriginal Archaeology

A Survey for Aboriginal Archaeological Sites on the site was undertaken by Tessa Corkhill, Archaeological Consultant, in 1998. The report is provided in *Appendix F*. The following are excerpts from the study.

The aims of the study were to:

- search National Parks and Wildlife Service (NPWS) Register for recorded Aboriginal sites in the area and surveys previously carried out;
- undertake a field survey in collaboration with Aboriginal representatives to identify Aboriginal sites or potential sites in the development area; and
- make recommendations for management of any sites found.

Fifty seven Aboriginal archaeological sites are recorded in the NPWS Register within five kilometres of the proposed development area. One site is within about one kilometre of the boundaries of this area.

A field survey took place on 20 August, 1998, attended by the archaeologists (Tessa Corkhill and John Edgar). A Deerubbin Local Aboriginal Land Council (DLALC) representative inspected the site on 11 September, 1998 and provided a separate report (*Appendix F*). The archaeologists covered the entire area (approximately 27 hectares) on foot.

No Aboriginal archaeological sites or areas of potential archaeological deposit were identified although an unworked silcrete cobble and other potential artefact source materials were found.

Apart from a recommendation to consider preservation of a typical outcrop of Maroota Sands, Ms Corkhill found that no objection should be raised, on archaeological grounds, to the proposed quarry.

In the event that any archaeological material is found during development, operations in the area should cease immediately and National Parks and Wildlife Service should be contacted to expedite an assessment of the situation.

4.10.2 Historic Archaeology

There are no historical archaeological or heritage items on the proposed development site.

The nearest heritage items listed in Schedule 1 of the Baulkham Hills Shire Council Local Environmental Plan 1991 are at Wisemans Ferry, approximately seven kilometres north of the site. These items include a convict stockade site and the cable ferry. Old Northern Road, adjacent to the development site, is part of the convict constructed main route between Sydney and the Hunter Valley, built during the early 1800's.

The nearest heritage sites listed by the Register of the National Estate (Australian Heritage Commission) and the NSW State Heritage Inventory are at Maroota South (a drain and house sites and the Felton Matthew Marked Tree respectively).

Should any heritage material be found, work should cease in order to assess its significance and determine whether further action is necessary. Historical archaeological finds should be reported to the NSW Heritage Office.

4.11 TRAFFIC AND ACCESS

4.11.1 Existing Road Network And Conditions

The proposed road network to be used by the development included the quarry access road and Crown Reserve Road, Old Northern Road and Wisemans Ferry Road. Trucks will generally travel south from the site along Old Northern Road to the Wisemans Ferry Road intersection. From this intersection, approximately 65 percent continue south along Old Northern Road towards Glenorie and Dural and

35 percent will turn right into Wisemans Ferry Road and travel towards Windsor, Richmond and Penrith.

The quarry access road is a gravel road and is maintained by the Company. The Crown Reserve Road is in the process of being sealed from the intersection with Old Northern Road to the quarry access road. The Crown Reserve Road is not a designated public road and is generally used by quarry traffic only.

Old Northern Road (Main Road 120) is a sealed road, approximately 6.5 metres wide with gravel shoulders. The road pavement is generally in a good state of repair. Wisemans Ferry Road (Main Road 181) is a sealed road of similar width and condition as Old Northern Road. Based on Austroads Rural Road Design standards the sealed pavements of old Northern Road and Wisemans Ferry Road should be seven metres wide.

Daily traffic counts on Old Northern Road and Wisemans Ferry Road were made as part of the traffic impact assessment for the existing operation (Lyle Marshall & Associates Pty Ltd, 1999). The average weekday count on Old Northern Road, between the Crown Reserve Road and Wisemans ferry Road was 1905 (8% heavy vehicles) and south of Wisemans Ferry Road was 1685 (20% heavy vehicles). On Wisemans Ferry Road, just west of the intersection with Old Northern Road, the average weekday count was 1443 (20% heavy vehicles).

4.11.2 Haul Road and Intersection

The Crown Reserve Road is in the process of being upgraded from the quarry access road to the intersection with Old Northern Road including sealing to a pavement width of six metres with 0.5 metre sealed shoulders.

The intersection of Old Northern Road and Crown Reserve Road has recently been upgraded by the Company to a Type B intersection. Old Northern Road has also been upgraded to include a deceleration lane to the intersection with the Crown Reserve Road.

The quarry access road and Crown Reserve Road intersection has been signposted with Give Way signs, advance warning signs and a Heavy Machinery Crossing sign. The Old Northern Road and Crown Reserve Road intersection has been designed in accordance with RTA's Road Design Guide and signposted showing direction of traffic movement at the site entry.

The road and intersection upgrades satisfy the development consent for the existing quarry.

4.11.3 Proposed Traffic Movements

The proposed development will not increase traffic on local roads as the proposed movements will not exceed limits approved under the current development consent. Truck movements to and from the site will not exceed 120 per day (60 loaded trucks per day) between 7.00 am and 6.00 pm Monday to Saturday (not including public holidays).

Only 15 loaded trucks are permitted to enter or leave the site between 6:00am and 7:00am in accordance with the existing development consent and no trucks will leave the site before 6:00am. No loads will leave the quarry on Sundays or public holidays.

Product trucks will continue to travel the same routes as the existing operation with approximately 65 percent travelling along Old Northern Road towards Glenorie and Dural and 35 percent turning turn right into Wisemans Ferry Road and travelling towards Windsor, Richmond and Penrith.

Product will be transported from the quarry using rigid trucks (with or without trailers) and semi trailers.

4.11.4 Impact Assessment

Quarry generated traffic impact was assessed previously for the existing operation (Lyle Marshall & Associates Pty Ltd in Southern Environmental, 1999) based on a maximum of 120 truck movements per day. This assessment indicated that the quarry would result in:

- a 32.4 per cent weekly increase in heavy vehicles on Old Northern Road between the Crown Reserve Road and Wisemans Ferry Road;
- a 7.5 per cent weekly increase in heavy vehicles on Old Northern Road, south of Wisemans Ferry Road; and
- an 8.8 per cent increase on Wisemans Ferry Road west of the intersection with Old Northern Road.

Based on the 1999 traffic impact assessment a maximum of 120 truck movements per day was approved in July 2000 for a period of ten years, subject to improvements to the turning lane on Old Northern Road, the Crown Reserve Road and the intersection with Old Northern Road. It is proposed that the quarry will generate the currently approved traffic levels for a period of 20 years as a result of the proposed quarry extension. Assuming an annual growth rate of two percent on Old North Road (Lyle Marshall & Associates Pty Ltd, 1999), traffic volumes on Old

Northern Road could increase by 40 per cent over the next 20 years. This would mean that the proportion of quarry generated traffic on Old Northern Road would decrease over the next 20 years. Similarly, the proportion of quarry generated traffic on Wisemans Ferry Road would decrease as the general traffic volume increases.

Given the proposed development will not generate additional traffic or use different transport routes, it is not considered that there will be an adverse impact on the local road network and road users.

4.11.5 Mitigative Measures

The aims of the proposed traffic impact mitigative measures are to:

- minimise the impact of trucks on the local road network, local residents and the Maroota Public School;
- comply with approved access and vehicle movements under the existing development consent; and
- comply with the performance criteria for sand transport set out in DCP 500.

The existing quarry operates under an Environmental Management System (ERM, 2000), which includes an Environmental Procedure for Roads and Traffic Management. This procedure will be followed for the proposed operation and includes the following mitigative measures:

- all truck loads will be covered before leaving the site;
- the Crown Reserve Road, Old Northern Road/Crown Reserve Road intersection and haul roads will be inspected by Site Supervisor for damage to road surfaces on a monthly basis and damage repaired as required;
- the Old Northern Rd/Crown Road intersection to be inspected weekly by the Site Supervisor for accumulated sand and clay and maintained as necessary by removing the material;
- all new truck drivers to be provided with Site Induction for Drivers outlining site requirements and expected driver behaviour such as observing the 40 kph speed limit at Maroota School between 8:30am – 9:00am and 3:00 pm – 3:30pm on school days and not using exhaust brakes, especially during morning periods;

- yearly liaison with Maroota School to discuss the effectiveness of traffic management; and

- 20 km/hr speed limit on internal haul roads.

The road and intersection improvements outlined in Section *4.11.2* further improve the safety of the site entrance and haul road and minimise sediment being transported onto the main roads.

4.12 VISUAL

4.12.1 Objectives

This visual assessment has the following objectives:

- to describe the existing visual environment of the site and surrounds, including any scenic qualities identified by statutory authorities or advisory bodies and surrounding areas which are able to view the site (viewpoints);

- to describe the visual elements of the development and ameliorative measures that reduce visual impact; and

- to assess the visual impact of the development, taking into consideration ameliorative measures.

4.12.2 Existing Visual Environment

The site is in a rural environment on the Maroota Ridge which forms part of the Hornsby Plateau. The Hawkesbury River is north west of the site, in a deeply entrenched river valley with heavily vegetated steep hillsides.

The Maroota Ridge provides views to the Blue Mountains to the west. As the proposed development is on the western side of the ridgeline, views to the west are provided, however, views to the east are restricted to Old Northern Road and adjacent residences. The proposed development site is viewed from the ridge to the north (Lots 1, 2 and 3 DP 595538) and from the adjacent property in this direction (Lot 117 DP 752025).

The site is also viewed from Old Northern Road, which is adjacent to the eastern boundary of the site. Mature trees between the site and the Maroota Public School screen views into the site from this direction. Four residences on the eastern side of

Old Northern Road have potential views of the proposed development, depending on tree screening and elevation (some residences are two storey). The location of these residences is shown on *Figure 4.1.*

Photographs 1 to 9 illustrate the visual environment of the existing and proposed operations. Photograph 5 shows the range of local land uses, including orchards and extractive industry. Photographs 6 to 9 show the vegetated nature of Lots 1 and 2, with open pasture adjacent to Old Northern Road.

4.12.3 Scenic Quality Guidelines

The Department of Planning (1986) provides a system for the analysis and assessment of relative scenic quality and the identification of visually prominent areas. This system was developed to assist in determining visual quality objectives in relation to zoning and land use decision making. The system assumes that scenic quality increases as the following occurs:

- relief and topographic ruggedness increases;
- vegetation patterns become more diverse;
- natural and agricultural landscapes increase; and
- waterforms are present or water edges increase.

The Hawkesbury-Nepean Scenic Quality Study identifies the river corridor between Lower Portland and Wisemans Ferry as having high scenic quality of State significance (Department of Urban Affairs and Planning, 1996). The study recommends that visibility of all proposals from the water be assessed. The site is outside the river corridor designated as having State significant scenic quality.

Baulkham Hills Shire Council's Extractive Industries Development Control Plan No. 500 (DCP 500) addresses visual amenity and scenic quality and provides the following performance criteria for extractive industries to protect the scenic and landscape quality of the Shire:

- provide setbacks capable of minimising visual impact when viewed from private and public places;
- protect/retain visible features of local historical, archaeological or geological significance;
- protect the surrounding natural and/or rural landscape;

- minimise sources of visual pollution; and
- rehabilitate sites to a final landform that will integrate physical elements and land use patterns contributing to the high scenic quality and diversity of the catchment.

4.12.4 Visual Elements of Proposed Development

The proposed development would remove vegetation, topsoil and the available sandstone resource from the majority of Lots 1 and 2. During active extraction, the area would be exposed, although progressive rehabilitation would return the site to a vegetated state as soon as possible. This process is illustrated on Photographs 1 and 2.

Other visual elements of the proposal would include the construction of bunds along the boundaries of extraction, including along the northern site boundary, the haul road (although this would probably be hidden from view by the bund when viewed from the north and north east).

4.12.5 Mitigation Measures

The 30 metre buffer between the site and Old Northern Road (refer Photographs 6, 8 and 9) is vegetated in parts and this existing screening will be enhanced by planting trees and shrubs (selected from the rehabilitation species listed in *Chapter 2*) within the buffer area. Due to the 250 metre buffer to the school and the maturity of vegetation existing in this area, no additional planting is required. The mature vegetation within the 250 metre buffer can be seen on Photograph 7.

Bunds, particularly the bund along the northern boundary, would be visible features of the proposed development, and these would be constructed so that their visible (outside) face was 3:1 (vertical:horizontal). The bunds will be topsoiled and revegetated in accordance with rehabilitation procedures detailed in *Chapter 2*. The location of the haul road next to the bund on the northern boundary and on the quarry floor will screen this road from most viewpoints.

The use of a strip method for progressive extraction and rehabilitation will reduce the visual impact of the proposal, as only the active strip will be exposed, whilst the strip in front is being cleared and the strip behind is rehabilitated.

4.12.6 Assessment of Visual Impact

Based on the assumptions provided by the Department of Planning guidelines (1986), the site has a moderate scenic quality, based on the rural setting and the presence of water bodies and views towards the Blue Mountains. The scenic quality of the area is reduced by the presence of a number of different land uses, such as extractive industry, agriculture and native vegetation.

Visual impact of the proposal on views from the Hawkesbury River corridor will be minimal, given the site is approximately four kilometres from the river and views are obscured by distance and intervening vegetation. Rehabilitation of the existing site will assist in screening views of the proposed development from the west.

Visual impact from the north will be reduced by the construction of the acoustic bund along the northern boundary of the site. One residence on the ridgeline to the north of the site has potential to view the site, in conjunction with existing extractive industry areas to the north, south and south west.

Views from Old Northern Road to the extraction area will be screened by planting trees and shrubs within the 30 metre buffer between the site the road. This planting will also assist in screening views into the site from the residences on the eastern side of Old Northern Road.

Views of extraction activities from Maroota Public School are highly unlikely, given the intervening mature trees and shrubs within the buffer between the school and the proposed extraction area.

The mitigation measures proposed will minimise the potential for views of the proposed extraction area. Setbacks, bunding and planting will screen views from the majority of directions. Progressive rehabilitation will return the landscape to a similar vegetative cover to that currently on the site. The final landform, although lower than existing, has been designed to blend with the surrounding landscape where possible to reduce long-term visual impact in the Maroota area from sand extraction operations.

4.13 HAZARD

4.13.1 Assessment of Hazard

State Environmental Planning Policy No. 33 - Hazard and Offensive Development (SEPP 33) ensures that the safety and pollution impacts of a proposal are addressed at an early stage of the development application process. Through the policy, an

assessment procedure is introduced which links the permissibility of a proposal to its safety and pollution control performance.

Applying SEPP 33 (DUAP, 1994) provides a methodology to determine whether a proposal is a potentially hazardous or potentially offensive development. If a proposal is either potentially hazardous and/or potentially offensive, SEPP 33 will apply, and an assessment of off-site risks and offence is required. This section determines whether the proposed development is a potentially hazardous or potentially offensive development according to the criteria outlined in *Applying SEPP 33.*

SEPP 33 defines 'hazardous materials' as substances falling within the classification of the *Australian Code for the Transport of Dangerous Goods by Road or Rail*, otherwise referred to as the *Australian Dangerous Goods Code* (Federal Office of Road Safety, 1992).

Raw materials to be extracted, processed and stockpiled on the site are not classified as hazardous substances under the *Australian Dangerous Goods Code*. Diesel fuel and lubricating oil are stored at the existing site in bunded compounds and will not be stored on the proposed development area. Both diesel and lubricating oil are combustible liquids, classes C1 and C2 respectively and are not classified as hazardous substances under the *Australian Dangerous Goods Code*.

To assess the potential hazard of a proposal, SEPP 33 specifies screening thresholds based on the quantity of a potentially hazardous substance or based on the quantity of the substance relative to the distance from where it will be stored to the nearest site boundary. If the storage quantity proposed exceeds the relevant threshold, then the proponent is required to prepare a preliminary hazard analysis (PHA).

The risk screening procedure outlined in Applying SEPP 33 (Department of Planning, 1994) was followed in determining whether the proposed development is considered a potentially hazardous industry. Given there are no hazardous materials as defined by the *Australian Dangerous Goods Code* (Federal Office of Road Safety, 1992) stored on site, the development is not classified as potentially hazardous and is not affected by SEPP 33.

4.13.2 Assessment of Offence

A development is potentially offensive if, in the absence of safeguards, it would emit a polluting discharge resulting in significant offence. *Applying SEPP 33* recommends the following be considered when assessing whether a proposal is potentially offensive:

- does the proposal require a licence under any pollution control legislation administered by the EPA? If so, the proposal should be considered potentially offensive;
- does the proposal require any pollution control approval pursuant to any legislation or by-law administered by the council?; and
- if such a pollution control licence or approval is not required, does the proposal cause offence having regards to the sensitivity of the receiving environment?

In assessing the potential offence of a proposal, the consent authority should use information on the quantity and nature of any discharges capable of causing significant offence. In the assessment, the nature of surrounding land use and proposed safeguards should also be considered.

The key issue in assessing the potential offence of a proposal is the presence of adequate safeguards to ensure control of emissions from a facility. In the majority of cases, compliance with a pollution control licence under EPA legislation is sufficient to demonstrate that a proposal is not offensive. Where the proposal does not require an EPA licence, additional licence requirements under other consent authorities need to be considered.

The development requires an environmental protection licence with the EPA under the *Protection of the Environment Operations Act,* 1997 as scheduled works or activities are to be carried out on the premises. Compliance with the conditions of this licence will ensure minimal offence.

The implementation of safeguards and compliance with the EPA Environment Protection Licence will ensure that the proposal is not offensive.

4.14 WASTE MANAGEMENT

Waste from the proposed development would consist of:

- vegetative matter from clearing;

- overburden from extraction works;
- tailings from the washing plant;
- used oils, filters and machinery parts;
- wastewater from the existing amenities; and
- general office and administrative waste.

The waste management objective is to minimise waste generated, maximise recycling and ensure wastes are managed effectively to minimise impact on the environment.

Trees, shrubs and grass stripped during clearing will be re-used on rehabilitation areas to provide a seed source, organic matter and animal refuges.

All overburden will be used in rehabilitation of the previous strip, buffers or other nearby areas. Tailings waste, the fine clays and silts that are removed from the sand during washing will be disposed in tailings dams on the existing extraction site. These dams are capped and rehabilitated after filling. It is not proposed to dispose of any tailings on Lots 1 and 2 as there are enough voids remaining on the existing extraction site to receive tailings from material sourced from Lots 1 and 2.

General waste will be managed at the existing quarry site, which currently has separate receptacles for paper, aluminium, glass, plastic and general domestic waste provided near the office and weighbridge on Lot 196, with recyclables (paper, aluminium, glass and plastic) collected by a licensed recycling contractor. Non-recyclable domestic waste from office, amenity and workshops are disposed by a licensed disposal contractor.

Sewage treatment and disposal is via an 'enviro-cycle' type plant on Lot 196. It is not proposed to install any additional office facilities or amenities on the Lots 1 and 2.

Waste oil and grease is collected and stored in a bunded tank and removed by a licensed waste oil recycling contractor. No building wastes or putrescible material is disposed on site and these procedures will apply to the proposed development site.

Waste management is reported in an annual environmental management plan submitted to Baulkham Hills Shire Council. This report includes information on the type, composition and quantity of material recycled and removed, and the destination of materials removed.

4.15 SOCIO-ECONOMICS

4.15.1 Population Profile and Projections

Information on the population of Baulkham Hills Shire has been sourced from the Baulkham Hills Demographic Profile (Nexus Learning Systems, 1999) and Australian Bureau of Statistics 1996 Census data. Maroota is in the Wisemans Ferry Planning District of the Shire.

In 1996 the population of Baulkham Hills Shire was 119, 545. The age structure of the population compared to the Sydney Statistical Division and NSW, is shown in *Table 4.21*. The table also shows 1991 data so that trends in the population composition can be seen.

Table 4.21 AGE PROFILE

Age	Baulkham Hills LGA 1991 %	Baulkham Hills LGA 1996 %	Sydney 1996%	NSW 1996 %
0-4	6.5	5.8	7.0	7.1
5-11	11.5	10.5	9.5	10.0
12-17	12.6	11.1	8.2	8.5
18-24	12.2	11.8	10.7	10.0
25-39	18.5	18.4	24.6	23.3
40-54	25.5	26.1	20.1	19.9
55-64	7.0	8.6	8.1	8.5
65-74	4.1	4.7	6.8	7.5
75+	2.4	2.9	5.1	5.3
TOTAL	**100**	**100**	**100**	**100**

Source: Australian Bureau of Statistics, 1996

In 1994 the Department of Urban Affairs and Planning projected that the population of Baulkham Hills Shire would be 180,200 by 2021. The annual growth rate was projected to be 1.4 percent between 1996 and 2021. However, the demographic profile states that these projections should not be relied on as the actual growth at the 1996 census was lower than the projected figure.

There are no proposed urban growth areas to the north of the proposed development, which is relatively close to the escarpment leading down to Wisemans Ferry on the Hawkesbury River. Population growth in this area is restricted by the

current road network, steep topography and protective land uses such as national parks that surround Old Northern Road to the east and west.

4.15.2 Employment

In 1996, 67.4 percent of Baulkham Hills residents over the age of 15 were employed. This was higher than for the Sydney Statistical Division (56.3 percent), or for NSW (53.9 percent). The unemployment rate for the LGA is significantly lower (2.5 percent) than the Sydney Statistical Division (4.5 percent)or NSW (5.2 percent). The number of people employed in different industries is provided in *Table 4.22* and is compared to the Sydney Statistical Division and NSW.

Table 4.22 PERCENTAGE OF PEOPLE EMPLOYED BY INDUSTRY

Industry	Baulkham Hills LGA % 1996	Sydney Statistical Division % 1996	NSW % 1996
Agriculture, forestry and fishing	1.3	0.7	3.6
Mining	0.1	0.2	0.8
Manufacturing	11.2	12.8	12.2
Electricity, gas, and water supply	0.6	0.7	0.9
Construction	7.6	6.4	6.4
Wholesale Trade	9.4	7.1	6.3
Retail Trade	14.1	12.7	13.3
Accommodation, cafes and restaurants	3.3	4.4	5.0
Transport and Storage	3.4	5.2	4.7
Communication services	1.5	2.4	2.1
Finance and Insurance	6.1	6.0	4.8
Property and business services	13.0	12.6	10.6
Govt admin and defence	2.8	3.9	4.3
Education	7.9	6.4	6.8
Health and Community Services	9.2	9.1	9.3
Cultural and Recreational Services	2.2	2.7	2.3
Personal and other services	3.4	3.6	3.6
Non-classifiable or not stated	2.9	3.11	3.0
TOTAL	100	100	100

Source:ABS Census,1996

The industries with the highest participation in 1996 in Baulkham Hills LGA were the retail trade, property and business, and manufacturing. In relation to the Sydney Statistical Division or NSW, Baulkham Hills Shire had more employed in wholesale trade, construction and education and less employed in government administration and defence, accommodation, cafes and restaurants, and transport and storage. Only 0.1 percent of employed persons were in the mining industry, in which Dixon Sand would be included. This compares to a State figure of 0.8 percent.

4.15.3 Mitigation Measures

Dixon Sand's Environmental Management Strategy for their existing quarry outlines management procedures for community relations and complaints management to effectively manage, minimise and monitor social impacts. These procedures will be followed for the proposed quarry extension and include the following measures:

- biannual liaison and review committee meetings involving two Council approved, permanent Maroota residents not associated with the company, two Council representatives, one representative each from EPA, DLWC, Hawkesbury Nepean Catchment Management Trust, Dixon Sand and any other persons considered appropriate by Council;

- telephone complaints line open during quarry operating hours, with the telephone number advertised on the site gate and in the local newsletter;

- all complaints/concerns raised by local community/relevant authorities recorded on Complaints Register, retained at the site office on Lot 196. All complaints are bought to the attention of the site supervisor within 24 hours of receiving the complaint. The site supervisor is responsible for initiating appropriate action in response to complaint and follow-up contact with complainant;

- annual community open days/ field days held on site to explain operations and provide the community with an opportunity to ask questions and gain an understanding of the operations;

- a monthly article in the local community newspaper (Living Heritage) including monthly monitoring results and local sand mining issues; and

- annual environmental management plan are to be made available for inspection by the public.

The community has been involved in the quarry planning stages and the preparation of this EIS. A newsletter outlining the proposed quarry extension was distributed to the local community providing them a telephone information line and e-mail address to enable people to voice concerns, discuss issues and obtain further information. As described in *Chapter 1*, a public meeting was held in February, 2001 to present the proposed development with the local community and discuss any concerns.

These initiatives enabled issues of community concern to be identified early and social impact to be reduced.

4.15.4 Impacts

As this proposed quarry extension will service the same market as the existing operation, will employ the same number of staff and will use the same ancillary industries, negative impacts on the local employment levels and economy are unlikely.

Socio-economic benefits of the proposal include continued local employment of ten to fifteen staff, continued supply of a high quality sand resource to the Sydney regional market and continued economic flow-on effects to local and regional businesses and industries.

4.16 SUSTAINABILITY

4.16.1 Assessment Methodology

Ecological sustainable development (ESD) is the use, conservation and enhancement of community resources so that ecological processes, and hence the quality of life, are sustained and improved for present and future generations.

ESD is based on four principles, these are;

(i) the precautionary principle;

(ii) social equity and intergenerational equity;

(iii) conservation of biological diversity and ecological integrity; and

(iv) improved valuation and pricing of environmental resources.

Applying the principles of ESD to the proposed quarry extension on Lots 1 and 2 involves:

- minimising environmental degradation through sensitive planning and implementation of appropriate management practices;
- promoting community well-being by providing local employment and contributing to the local and regional economy; and
- maximising efficient resource recovery.

Implications of the four ESD principles for the quarry have been outlined as follows.

4.16.2 Precautionary Principle

i. Interpretation

The precautionary principle advises that threats of serious or irreversible damage, which lack full scientific certainty, are not to be used as a reason for postponing measures to prevent environmental degradation (Environmental Planning & Assessment Regulation, 1994). In the application of this principle, decisions should be guided by careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment and an assessment of the consequences of various options (IGAE, 1992).

To satisfy this principle emphasis must be placed on anticipation and prevention of environmental damage and the environmental consequences of all site procedures. Any action likely to involve serious or irreversible environmental damage should be avoided and other options assessed.

ii. Justification

A team of specialist consultants was engaged to examine the existing environment, predict potential impacts and design mitigation measures to ensure environmental protection to the satisfaction of statutory requirements and reasonable community expectations.

In order to avoid serious or irreversible damage to the environment all facets of the development have been carefully evaluated and environmental management techniques proposed. Environmental monitoring was undertaken as part of background research for the preparation of this EIS. The environmental safeguards have been planned with a comprehensive knowledge of the existing environment

and an appreciation of potentially harmful environmental impacts. Relevant Government authorities were consulted in the preparation of this EIS to enable interested parties to comment on activities that had the potential to be environmentally degrading.

Where results may alter over time, influencing the extraction operation, these will continue to be monitored during the operation. For example, groundwater levels will be monitored to ensure extraction does not reach the groundwater table. Annual flora and fauna surveys will be undertaken to monitor the condition of the threatened plant population and community. Noise and air quality monitoring will continue throughout the life of the development.

4.16.3 Social Equity and Intergenerational Equity

i Interpretation

Social equity involves fairer distribution of costs and benefits to improve the well being and welfare of the community. Social equity also includes intergenerational equity, which requires that the present generation ensures the health, diversity and productivity of the environment is maintained or enhanced, for the benefit of future generations.

To achieve equity within the current generation it is necessary that the economic and social benefits of the proposed development be distributed appropriately among all members of the community. It is also necessary that environmental safeguards against degradation of flora and fauna, groundwater, surface water, cultural heritage, socio-economics, visual, acoustic and air amenity be implemented to ensure that no part of the community would be unacceptably disadvantaged.

ii. Justification

The potential adverse impacts on environmental resources likely to affect social equity have been assessed and mitigation measures recommended. These measures relate to erosion and sediment control, surface and groundwater management, air quality controls, noise controls, traffic and waste management. Implementation of the mitigation measures will ensure effects on social and intergenerational equity are reduced.

The proposed development will provide for efficient resource recovery and will contribute to local and regional economic growth and promote community well being through provision of income, employment and construction resources. It is anticipated that the quarry will continue to contribute to the local and regional economy. The final landform will be integrated as much as possible into the local

landscape, considering the needs of the future community and fauna populations in the Maroota area.

Social impacts of the proposal have been assessed in *Section 4.15* and community relation strategies outlined to ensure the community is well informed of the project and has an effective means of voicing concerns and receiving feedback.

The sand would be used to produce high quality sand with a wide range of uses in the construction and building industries. The products used in the construction of roads and infrastructure benefit both present and future generations given the life of infrastructure such as roads and buildings is typically 50 to 100 years. In addition the conversion of construction materials such as sand into finished infrastructure is a process of value adding to the resource and can be seen as a long-term investment in the materials.

4.16.4 Conservation of Biological Diversity and Ecological Integrity

i. Interpretation

Biological diversity refers to the variety of genes, species, populations, communities and ecosystems and the linkages between them. Biological resources provide food, many medicines, fibres and industrial products. They are also responsible for vital ecological functions such as maintaining soil fertility and the supply of clean and fresh water. Maintenance of biodiversity will ensure life support functions and the provision of environmental resources for future generations.

ii. Justification

The quarry plan aims to maximise the protection of biological diversity and ecological integrity by the following:

- exclusion of the threatened *Tetratheca glandulosa* population and Shale-Sandstone Transition Forest community from the extraction area;
- progressive rehabilitation of the extracted areas;
- rehabilitation of the site with native species to maximise native fauna habitats and encourage their return to the site after quarrying;
- implementation of hazard controls to ensure risks such as fire on the site are minimised;

- ongoing monitoring of flora and fauna communities on the site to monitor viability; and

- providing a final landform that integrates elements of the local area.

4.16.5 Improved Valuation of Environmental Resources

i. Interpretation

This principle involves consideration of all environmental resources, which may be affected by the proposal, including air, water, land and living things. It is a component of `Intergenerational Equity' as improved valuation and pricing of resources is paramount in achieving conservation of the natural environment for future generations. Applying standard methods of valuation and pricing to environmental resources is a difficult process given the intangible nature of much of the natural environment, for example visual amenity, cultural values and the atmosphere's ability to receive gaseous emissions. The environment has conventionally been considered a free resource and environmental factors have been excluded from determining the real cost of an activity. Through improved valuation and pricing the real cost to the environment will be apparent and thus included within the real costs of any development.

ii. Justification

The value placed on environmental resources on and around the site is evident in the extent of environmental investigations, planning and design of impact mitigation measures to prevent irreversible damage of those resources. Dixon Sand currently undertake environmental monitoring of their existing development and this will continue for the proposed development. The cost of this monitoring, ongoing investigations, planning, design and implementation of the mitigation measures has been factored into the company's economic analysis for the project.

4.17 CUMULATIVE ASPECTS

Cumulative aspects of the proposed development are those aspects that should be considered in conjunction with other developments in the local area. As can be seen on *Figure 4.1*, the Maroota area has a number of sand extraction operations, and as a SREP 9 area, more extraction areas may occur in the future. The cumulative aspects of extractive industries may include cumulative increases in noise or dust, cumulative decreases in surface and groundwater quality or quantity, a cumulative reduction in flora and fauna species and habitat, increased traffic and a reduction in visual amenity.

The studies completed for this EIS have considered other extractive industries in the area in their assessment of impact. The use of the neighbouring quarry's haul trucks across Dixon Sand's existing development site has been factored into models for noise and air quality. The visibility of other extractive industries in the local area has been considered in the visual assessment. It is not expected that any new quarry development would impact on groundwater quality or quantity due to the requirement to not extract within two metres of the high wet weather groundwater level.

Integration of the final landform into the local landscape was a common community concern noted at the public meeting (refer *Section 1.3.*). The final landform, although lower than the existing landform, will have backfilled batters to reduce slopes, and will be rehabilitated with native species to integrate the existing vegetation areas with rehabilitation areas.

Chapter 5

ENVIRONMENTAL MANAGEMENT

5.1 SUMMARY OF MITIGATION MEASURES

This chapter provides a summary of mitigation measures, as required by the Department of Urban Affairs and Planning Director–General requirements. The following information on mitigation measures has been drawn from the various sections of this EIS.

Mitigation measures have been implemented for each stage of development, categorised here as pre-extraction, extraction and rehabilitation.

5.1.1 Pre-Extraction

Prior to any works commencing on Lots 1 and 2, the following mitigation measures will be implemented.

i. Environmental Monitoring System

The current environmental monitoring system will be reviewed to ensure that any additional sites or parameters required to monitor extraction within Lots 1 and 2 are included, in accordance with the consent conditions. This could include installation of any additional dust gauges or samplers required by the EPA, acoustic checks on equipment (for example, to measure sound power levels to validate predictions), and any flora and fauna monitoring required prior to extraction. Groundwater wells installed in early 1998 have been regularly monitored to gather background information on the groundwater depth. No additional monitoring systems or groundwater wells are proposed for Lots 1 and 2, however, existing gauges, wells and other systems will be checked to ensure they are operational.

ii. Water Management and Erosion/Sedimentation Control

Prior to extraction, the initial water management controls will be constructed for stage 1 works. These include construction of the clean water diversion drain around strip 1, and implementation of temporary sediment controls in drainage lines to catch any sediment laden runoff from clearing works.

Groundwater wells will be checked to ensure they are functional and their location reviewed in terms of the latest extraction plan, to check whether they require relocation prior to extraction.

iii. Community Notification and Complaints Management

The local community will be notified of the commencement of works within Lots 1 and 2 and a reminder of the current complaints procedure will be provided.

iv. Flora and Fauna

The buffer area surrounding the *Tetratheca glandulosa* community and the transitional forest will be surveyed and permanently staked to identify the boundaries. Permanent staking around the ecological area will ensure vehicles do not encroach on the buffer area. The 250 metre buffer boundary from the Maroota Public School will also be fenced to ensure extraction does not encroach into this buffer.

The 20 metre buffer north of the *Tetratheca glandulosa* and Shale-Sandstone Transition Forest buffer will be revegetated as described in the rehabilitation plan described in *Chapter 2*.

v. Noise Bunding

A three metre high noise bund is proposed along the northern boundary of Lot 1. It is proposed to build this bund progressively with each extraction stage. However the bund for the full length of strip 1 will be constructed prior to extraction of this strip. The bund will be built from overburden from strip 1. Temporary erosion control will be used during construction. The northern side of this bund will be seeded with pasture species to improve its appearance from the north.

A five metre high bund on the eastern buffer boundary will be built in the same manner as the northern bund, with the eastern face shaped and seeded. Trees and shrubs will be planted between this bund and Old Northern Road to reduce its visibility from the road.

vi. Tree Screening

The 30 metre buffer from Old Northern Road will be planted with trees and shrubs from the rehabilitation list to assist in screening views to the quarry from this direction. This planting will occur on commencement of strip 1 extraction, to

provide maximum growing time for the screen so that it is effective when extraction is occurring closer to the road.

vii. Staff Training

Staff will receive training on particular environmental protection requirements for Lots 1 and 2, including instructions on the buffer areas, bunding, screening and any noise restrictions.

viii. Traffic

No additional traffic controls are required as all traffic will enter and leave the site via the existing Crown Road from Lot 196 to Old Northern Road.

5.1.2 Extraction

During extraction on Lots 1 and 2, the following mitigation measures will be implemented. Extraction includes topsoil and overburden stripping, extraction of resource, trucking to the plant and back-filling for rehabilitation.

i. Water Management and Erosion/Sediment Control

Water management and erosion/sediment controls will be implemented as described in *Chapter 2*. These include clean water diversion drains around the eastern side of the extraction strips. A drainage channel will be formed in the extracted floor of the quarry, which will be directed to a void on Lot 29. Silt traps will be excavated into this channel at intervals.

A detailed water management strategy will be developed for each strip prior to its extraction, locating all required water management and erosion/sediment controls.

Regular surveys of extraction depth, combined with monthly groundwater level monitoring will ensure extraction does not occur within two metres of the wet weather high groundwater level.

The majority of groundwater monitoring wells are within buffer areas. One well is within the active extraction area of strip 6 and one is close to the western boundary of the Shale-Sandstone Transition Forest buffer. These wells will be removed as extraction occurs within these strips.

ii. Noise Mitigation

The selected extraction method requires the excavator to dig into the sandstone as quickly as possible so that it can work on a bench below natural ground surface. The face then reduces noise from further extraction works. The amount of time the excavator works at natural ground level will therefore be minimised.

Other noise mitigation measures include:

- construction of a three metre high stabilised bund to the east and north of each strip prior to its extraction;
- annual monitoring of noise levels to check compliance with predicted levels and that works are below required levels; and
- monitoring of truck movements in accordance with the consent for the existing development.

iii. Air Quality

Air quality mitigation measures include:

- the use of a water truck on all active extraction areas and the haul road to suppress dust;
- ongoing air quality monitoring; and
- minimising the active extraction area through progressive clearing and rehabilitation in the strips before and after the active extraction area.

iv. Flora and Fauna

Mitigation measures include:

- the buffer areas to be excluded from extraction will be located and the boundaries staked prior to extraction commencing;
- rehabilitation of the grass area in the northern section of the *Tetratheca glandulosa*/Transition Forest buffer;
- felled trees, logs and rocks will be removed from the strip being cleared and either stockpiled or immediately used in rehabilitation of previous strips, where they will be laid on the surface to provide habitat opportunities;

- species native to the local area will be used in rehabilitation to encourage long term use of the site by native fauna; and
- training of staff in threatened flora and fauna identification and reporting procedures.

v. Archaeology

No archaeological items were located on Lots 1 and 2, however, if any are identified work in the vicinity of the item will stop until National Parks and Wildlife Service or the NSW Heritage Office are notified and advice sought.

vi. Traffic

No additional traffic controls are required as all traffic will enter and leave the site via the existing Crown Road from Lot 196 to Old Northern Road.

vii. Waste Management

All general office/amenity waste is handled on the existing site. Overburden from Lots 1 and 2 will be used in rehabilitation works in nearby strips and buffers. Tailings from material sourced from Lots 1 and 2 will be disposed in the existing voids on the existing development.

viii. Hazard

All fuels and oils will be stored on Lot 196 within the approved bunded storage areas. No refuelling of equipment will be undertaken on Lots 1 and 2. Fire extinguishers will be carried by all machinery used in Lots 1 and 2. In the event of fire, the water cart is able to access Lots 1 and 2 to assist with fire fighting.

5.1.3 Rehabilitation

Rehabilitation works include backfilling, topsoil spreading, seeding and planting and maintenance, such as weed control and watering until establishment. Mitigation measures to be implemented during the progressive rehabilitation stages include:

- retention of erosion and sediment controls until rehabilitation works complete, with specific controls put in place where required for rehabilitation works;

- completion of an annual survey of rehabilitation to assess floristic structure and diversity, robustness and fauna species diversity;
- continued use of the water cart to water areas where earthmoving is occuring as part of rehabilitation works (eg: backfilling);
- maintenance of rehabilitation areas until sufficiently established, including watering, weed control and feral animal protection; and
- noise and air monitoring to continue during rehabilitation works involving earthworks.

5.2 ENVIRONMENTAL MANAGEMENT PLAN FRAMEWORK

5.2.1 Introduction

An environmental management strategy has been prepared for the existing development on Lots 29 and 196 (ERM, 2000) and it is intended to extend this strategy to incorporate environmental management requirements for the proposed development area.

5.2.2 Environmental Objectives

The existing environmental management strategy has the following objectives:

- to satisfy Baulkham Hills Shire Council and other relevant authorities of the environmental management and performance of the operation and compliance with the conditions of consent;
- to provide a system to manage the site environment to minimise potential environmental impacts;
- to ensure all site users are aware of environmental protection measures and their own environmental responsibilities;
- to monitor site actions and environmental performance to determine compliance with required actions; and
- to provide a system to quickly identify and correct environmental degradation or non-compliance with consent requirements.

The environmental objectives for the proposed development are generally the same as those stated above, however, as State Significant Development, the proposed development works will also need to satisfy the requirements of the Director – General of Urban Affairs and Planning.

5.2.3 Environmental Procedures

Environmental procedures have been developed for the existing development. These procedures each provide:

- reference information for the operator, including relevant consent conditions and EIS reference sections;
- objectives;
- actions, or procedures, to be completed;
- monitoring requirements;
- reporting requirements;
- persons responsible for carrying out the required actions; and
- any plans, tables or schedules that illustrate or locate required actions.

Environmental procedures for the existing development have been developed for:

- Induction and Training;
- Incident Management;
- Complaints Management;
- Environmental Review and Reporting;
- Roads and Traffic Management;
- Hours of Operation;
- Permissible Extraction Program;
- Buffer Zones and Protection of Adjoining Lands;
- Water Management;

- Erosion and Sediment Control;
- Heritage Management;
- Noise and Vibration Management;
- Air Quality Management;
- Flora and Fauna Management;
- Rehabilitation and Revegetation;
- Community Relations; and
- Waste Management.

The strategy will be revised to incorporate additional environmental management requirements for the proposed development area and will include the mitigation measures provide in *Section 5.1* as well as any additional requirements provided by the consent conditions.

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STUDY TEAM

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