VOLUME 1: EXECUTIVE SUMMARY

PROPOSED RELOCATION OF THE VOYAGER QUARRY

LAND CLEARING AND QUARRY EXPANSION, AVON LOC 1881, LOT 14 HORTON ROAD, THE LAKES

(EPA Assessment Number 1413)

January 2003

BGC

URS

PUBLIC ENVIRONMENTAL REVIEW
(Volume 1 - Executive Summary)

Land Clearing and Quarry Expansion, Avon Loc 1881, Lot 14 Horton Road, The Lakes

(EPA Assessment Number 1413)

Prepared for

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This document presents a summary of a Public Environmental Review (PER) prepared by BGC (Australia) Pty Ltd (the Proponent), for its proposal to relocate the Voyager Quarry to the west of its existing site. The proposed Project Area is land owned by the Proponent.

OBJECTIVES AND PLANNING FRAMEWORK FOR THE PROPOSAL

The Voyager Quarry is located on Great Southern Highway approximately 47 km southwest of the town of Northam and 16 km east of the town of Mundaring, Western Australia (Figure ES1 and Plate ES1). The Proponent has been operating the quarry since 1990 to provide crushed granite rock for the manufacture of concrete, road base and sealant, and other building products.

Plate ES1 The existing Voyager Quarry pit

The Voyager Quarry has a nominal rated throughput of 900,000 tpa and provides 35% to 40% of crushed rock required by the building and construction industries in the Perth Metropolitan Region and surrounding areas. The existing quarry only contains sufficient economically winnable resources to operate for another six years. To ensure that there is a continuous supply of crushed rock to current and future markets, the development of a new resource is required.

The nearest available resource is situated on land owned by the Proponent and located immediately to the west of the existing quarry. This resource has been designated a Key Extraction Area by the Basic Raw Materials Planning Policy Statement (Western Australian Planning Commission, 2000). The Policy was established to protect the availability of basic raw material resources close to Perth. It defines "Key Extraction Areas" as "recognised regional resources providing for the long term supply of basic raw materials", and indicates such areas should be protected in relevant town planning schemes, because of their regional importance.

The proposed quarry site is located on Lot 14 Horton Road, in the Shire of Northam and adjacent to the Shire of Mundaring (Figure ES2). The zoning classification for this lot is Rural Zone 3. Under the current Town Planning Scheme No. 2 for the Shire of Northam, the Rural Zone 3 classification means that Council will not support further subdivision of the land, but that a wide range of rural uses, including sand and rock extraction, are permissible uses of the land. A planning approval is required for the extraction of hard rock.

HISTORY OF QUARRY OPERATIONS AND BACKGROUND TO PROPOSAL

The existing Voyager Quarry site was identified after conducting exhaustive investigations into finding a suitable location during the 1980s. This search lasted for three years and involved extensive discussions with various local and State government departments anf agencies (including the Environmental Protection Authority [EPA]), who eventually recommended site selection criteria. Many sites were investigated and deemed to be unsuitable as they were located within the Metropolitan Area. Subsequently, BGC identified the current location, which is outside the Metropolitan Area and met the recommended criteria. BGC negotiated with the owner of the Voyager Farm and obtained a lease agreement to establish a quarry on a portion of the farm. Following the issue

of a Works Approval by the EPA, and an Extractive Industries Licence from the Shire of Northam, the Voyager Quarry became fully operational in 1991.

The quarry utilises a conventional three-phase process. This conprises drilling and blasting the rock, loading it onto dump trucks and hauling it out of the pit, and dumping the fractured rock into a primary crushe. A series of crushers and screens are used to produce crushed rock aggregate of varying dimensions (Plates ES2 and ES3).

Plate ES2 Primary crusher and stockpiles

Plate ES3 Secondary and tertiary crushers and screens

The aggregate is then stockpiled and loaded onto trucks for transport to market. The quarry has a nominal rated throughput of 900,000 t of aggregate per year. The quarry uses about 380 kL/day of water for processing and dust suppression during summer, and about 80 kL/day during winter. This water is sourced from rainfall runoff collected in the surface water storage dam located to the east of the quarry and groundwater seepage collected in the sump located at the base of the quarry pit.

Since 1991, Voyager Quarry has operated largely in compliance with licence conditions imposed by the Department of Environmental Protection (Licence Number 5356/5) and the Shire of Northam (Extractive Industries Licence Number 6). In accordance with licence conditions, BGC has monitored noise and ground vibration resulting from blasting activities at the quarry since January 1993 (and been compliant in all but one instance in December 1998). Dust emissions have also been controlled.

Prior to December 2001, there had been a total of only three complaints lodged regarding the noise and vibration associated with operations at the existing Voyager Quarry since it became fully operational in 1991.

On Sunday 15 December 2001, the Proponent undertook clearing activities in Lot 14, unaware that such action was in contravention of the *Soil and Land Conservation Act* 1945, which requires a Notification of Intention to Clear to be submitted to the Commissioner of Soil Conservation, and approved prior to clearing taking place. This action attracted the attention of nearby residents, plus an officer from the Department of Agriculture, who endeavoured to stop the clearing operations. The officer was unfortunately injured in this endeavour when the bulldozer driver inadvertently knocked a tree down which fell close to him. The subsequent community outrage resulted in the clearing operations being stopped by the Commissioner for Soil Conservation, who subsequently referred the proposed quarry relocation to the Western Australian EPA on 19 December 2001. The EPA elected to formally assess the proposal as a PER.

Since then, nearby residents have formed the Lakes Action Group to campaign against the proposed Project, and a large number of complaints have been lodged with the Shire and the Proponent

regarding the current operations of the Voyager Quarry. The majority of the complaints have been related to noise, vibration, flyrock and dust impacts associated with blasting operations and crushing and screening operations at the existing quarry.

In response to these complaints, the Proponent has undertaken a wide range of improvements to the operations to address the issues raised. These include:

- Sealing of the access road to reduce dust emissions.
- Replacing existing earthmoving machines with new and larger excavators, loaders and dump trucks to reduce the number of machinery movements and thereby reduce dust and noise emissions.
- Reducing the frequency of blasting operations from weekly to fortnightly to halve noise and vibration emissions.
- Videotaping of all blasting operations to confirm that flyrock has fallen into the pit as planned.
- Increased noise monitoring of blasting operations to confirm that noise levels are within defined limits.
- Construction of rubber backed frames and earthen bund walls around the primary crusher to significantly reduce noise.
- Modified nightshift activities to reduce noise.
- Reduced operating hours of the primary crusher from 21 hours to 15 hours between the hours of 0700 and 2200.

In addition, the Proponent is enclosing the primary crushing plant, and replacing the existing drilling machine with new, quieter "down hole" drilling technology.

Furthermore, the Proponent has offered to establish a community liaison group to regularly meet and discuss quarry operations. However, to date, no residents have taken up this offer.

THE PROPOSAL

The existing quarry comprises an open pit, a crushing plant, noise attenuation bunds, product stockpiles, topsoil stockpiles, a workshop and office facilities, which are located on land leased by the Proponent from the owner of the Voyager Farm. Access to the site is via a sealed road from Great Southern Highway (Figure ES3).

The proposal involves the development of a second open pit to the west of the existing pit on Lot 14 (the Project Area) and the construction of state-of-art crushing and screening plant within the new pit at some 30 m below ground level to minimise the potential for off-site noise, dust and light emissions. Some components of the existing crushing plant (which is located to the east of the existing quarry) will be used in the construction of the new plant and the remainder of the plant will be decommissioned and sold. The existing operations will be decommissioned and rehabilitated to the landowner's requirements.

It will take approximately five years to bring the new quarry into production. This time is required for clearing the land, removal of the overburden and construction of a new crushing and screening plant, workshops and administration buildings.

The key characteristics of the proposed quarry relocation are summarised and compared to those of the existing quarry in Table ES1.

Table ES1
Key Characteristics

Characteristic	Existing Project	Expanded Project (once the proposed quarry expansion has been implemented)
Project Life	Currently six years left of existing quarry life.	Approximately 50 years.
Land Tenure	Leased from private landowner.	Area proposed for expansion owned by the Proponent.
Rate of Extraction	Approximately 6,000 – 10,000 t/day	Approximately 6,000 - 10,000 t/day
Extraction Method	Extraction from an open-pit using conventional drilling, blasting, loading and hauling techniques.	Extraction from an open-pit using conventional drilling, blasting, loading and hauling techniques.
Location of Crushing and Screening Operations	East of the existing quarry pit on ground surface.	Within the proposed quarry pit, 30 m below ground surface.
Age of Crushing and Screening Equipment	>10 years	New improved technology. Primary crusher to be housed within noise reduction structure.
Final Quarry Dimensions	600 m long 350 m wide 50 m deep	900 m long 450 m wide 50 m deep
Footprint of Quarry	55 ha	61 ha
Footprint of All Disturbance	55 ha	85 ha
Quarry Operation Hours	0700 – 0400 hours Monday to Friday, 0700 – 1300 hours Saturday	0700 – 0400 hours Monday to Friday, 0700 – 1300 hours Saturday
List of Major Components	• Quarry • Product stockpiles • Topsoil stockpiles • Water storage dam • Infrastructure (processing plant, administration buildings, workshop, roads)	• Quarry • Product stockpiles • Topsoil stockpiles • Water storage dam • Infrastructure (processing plant, administration buildings, workshop, roads)
Water Storage Dam Capacity	100,000 kL	150,000 kL
Water Supply Source	Surface runoff and groundwater seepage.	Surface runoff and groundwater seepage.
Average Daily Water Requirements	Approximately 377 kL (summer) Approximately 77 kL (winter)	Approximately 377 kL (summer) Approximately 77 kL (winter)
Maximum Annual Water Requirement	Approximately 94,250 kL	Approximately 94,250 kL

As shown in Table ES1 above, the proposed new pit will operate in much the same fashion, and at the same production rates and water requirements as the existing quarry. The main difference is that the new quarry has been designed to be much less intrusive from a noise and visual perspective.

IDENTIFICATION OF ENVIRONMENTAL ISSUES

The environmental issues that may arise from the implementation of the proposed quarry relocation, and the range and scope of studies required to adequately address these issues, were identified through a two-phase process. The first phase comprised:

- a workshop with staff of BGC to identify the key environmental issues of importance to the proposed operation and to identify whether existing procedures or controls were in place to manage potential environmental impacts;
- a review of the environmental data and other information on the Project Area and surrounds; and

- consultation with relevant State government agencies including Department of Environmental Protection (DEP), Department of Conservation and Land Management (CALM), Water and Rivers Commission (WRC), and Department of Agriculture as well as local government, community groups and individuals during the period February to May 2002.

A summary of the issues raised during each consultation session was prepared and provided to the relevant stakeholder(s) with a request for confirmation of the list of issues. The stakeholders were also invited to provide further input in the event that additional concerns or issues had been identified following the consultation session.

All the issues identified during the consultation programme are listed in Table 5.1 of the PER. The key issues raised were:

- the potential for impacts on nearby residents due to noise, ground vibration, light overspill, dust and flyrock during construction and operation of the Project;
- the potential for impacts due to clearing of vegetation within the Project Area (such as impacts on groundwater levels, surface drainage and catchment salinisation downstream from the Project Area);
- the potential for impacts on groundwater and surface water quality and quantity as a result of the Proposal;
- the potential for impacts on biodiversity of fauna and flora (particularly *Hemigenia viscida* - a Priority 4 flora species known to occur in the area) due to clearing of vegetation and other construction and operational activities; and
- the proposed rehabilitation and closure strategy for the Project and future land use of the area.

The findings of the workshop and consultations were summarised in a Briefing Paper (URS, 2002) that was submitted to the DEP in May 2002 as the project referral.

The second phase of the process comprised updating information on the potential environmental effects of the proposed quarry relocation through:

- a review of the draft and final EPA Guidelines for the environmental assessment of the proposal (NB: The EPA Guidelines are presented in Appendix A, Volume 2 of the PER)
- community and government consultation conducted subsequent to the submission of the Briefing Paper;
- review and modification of the project design; and
- additional desktop and field investigations.

SUMMARY OF ENVIRONMENTAL EFFECTS AND MANAGEMENT PROPOSALS

The work undertaken by BGC to address the requirements of the EPA Guidelines is summarised in Table 6.1 of the PER (and reproduced here as Table ES2), which is structured as follows:

- Column 1 lists the environmental factors (issues) identified in the EPA Guidelines as relevant to the proposed quarry relocation.
- Column 2 identifies the work that the EPA considers would be required for the environmental review of the proposal, based on input from regulatory agencies and community groups.
- Column 3 outlines the investigations and other studies conducted by BGC to address the EPA's objectives and work requirements, the key outcomes of this work, and the predicted environmental impacts that may occur as a result of proposal implementation.

- Column 4, provides an overview of the measures proposed by BGC to mitigate or manage the predicted environmental impacts.
- Column 5, describes the outcome that is predicted to occur if the mitigation and management measures are implemented successfully.

Table ES2 summarises the outcome of PER studies, investigations and outcomes for each of the environmental factors identified in the EPA Guidelines. Further detail on the key issues outlined in the preceding section is provided below.

Impact of Noise, Ground Vibration, Flyrock, Dust and Light on Nearby Residents

The potential for impact due to noise, ground vibration, flyrock, dust and light overspill are important issues associated with the Project for nearby residents.

There are some six residences located within a 2 km radius of the existing Voyager Quarry. The properties to the north and east of the existing quarry are situated within the Shire of Northam and classified as Rural Zone 3. The property to the west is within the Shire of Mundaring and is classified as General Rural. This property is the nearest to the existing quarry (at approximately 1.1 km), and will be the closest to the new quarry at approximately 0.6 km. There is no direct line of sight between these residences and the existing quarry, nor will there be for the new quarry.

Noise

Noise-sensitive premises are located in the vicinity of the proposed Project Area and the potential impact of noise from quarry construction and operation is of significant concern to local residents. Noise is the main issue raised in public complaints made to the Shire of Northam and BGC about the existing Voyager Quarry.

An assessment of the potential for noise impacts was conducted by Herring Storer Acoustics (2002). The findings of this assessment are summarised below.

As BGC proposes a staged implementation of the proposed quarry relocation, Herring Storer Acoustics investigated three scenarios, as follows:

- Scenario 1 – Overburden removal and site construction occurs whilst the existing Voyager Quarry continues to operate.

- Scenario 2 – During the transition between the existing and new operations, extraction of hard rock from the new quarry commences whilst crushing continues at the existing Voyager Quarry.

- Scenario 3 – Quarry relocation has been completed, with operations occurring only with the proposed Project Area. No operations occur at the existing Voyager Quarry.

The results of modelling the proposed operations indicate that, during construction of the proposed quarry within Lot 14 (Scenario 1), the major noise source during the day will continue to be the existing primary crusher followed by scrapers used for clearing within the proposed quarry footprint. During the night, the main noise source will continue to be mobile equipment and the tertiary crushing system. No construction of the new quarry will occur at night.

During the day, slightly elevated noise levels of around 2 dB(A) may occur compared to the existing noise levels due to the use of scrapers and dozers for overburden removal. Worst case noise imission levels at residential locations are predicted to be up to 50 dB(A). The scrapers, which result in individual levels of up to 44 dB(A), add to the overall level of 47 dB(A) from existing crushing operations, resulting in the overall level of 50 dB(A).

Overburden removal and associated activities will only occur during the day time. Although there are no specific

criteria to be met for construction noise, BGC will make every reasonable effort to minimise construction noise emissions.

During the transition from the existing operations to the relocated operations (Scenario 2), the noise imission levels at noise-sensitive premises will be similar to the existing levels. Consequently, there is potential for exceedances to occur. However, as part of BGC's commitment to its noise reduction programme, the existing primary crusher is being enclosed. This will lower the risk of exceedeances from this source. However, the most effective means to achieve compliance is to expedite the relocation of the crusher to the proposed quarry site, where it will be located below ground level.

Once the operation has been fully relocated (Scenario 3) and mining is occurring at a level of 15 m or more below natural ground level, noise imission levels are expected to comply with the overall assigned levels at all locations and at all times. Operational noises will be reduced further as mining progresses to lower levels.

Airblast and Ground Vibration

The two significant factors resulting from blasting are the air-borne pressure wave and ground-borne vibration (Herring Storer Acoustics, 2002).

Australian Standard 2187.2-1993 recommends that vibrations be $\leq$10 mm/s for houses. The study by Herring Storer Acoustics indicates that ground vibration levels of around 3.4 mm/s can be expected at the nearest residence following blasting at the proposed quarry, based on Maximum Instantaneous Charges (MICs) of around 130 kg.

It should be noted that the Australian standard is conservative. Many European standards allow peak particle velocity values of between 20 mm/s and 50 mm/s. Data from the United States Bureau of Mining indicate that structural damage does not occur at peak particle velocity levels of $\leq$50 mm/s.

Airblast levels can be estimated using a formula presented in Orica (1995), however the most accurate prediction graph is generated from airblast measurements at the site. The results generated from the prediction graph indicated that the blasts at the existing quarry are well confined. The predicted airblast levels were within, but at the upper limit, of the statutory levels based on MICs of around 130 kg.

The study has shown that blasting can be managed to comply with comfort criteria and be well below any criteria relative to damage risk (Herring Storer Acoustics, 2002).

Flyrock

Prior to the change in blasting practices implemented in 1999, there were occurrences of flyrock being projected some distance (up to 100 m) from the existing quarry pit. BGC has acknowledged that this was not acceptable and has since implemented significant improvements in blasting practices at the existing quarry to eliminate flyrock.

The Lakes Action Group has indicated that rocks found on a track located to the western edge of the existing pit were flyrock from the existing pit. The track is located approximately 150-300 m west of the pit and BGC contends that it is not possible that flyrock has travelled this distance since implementation of the improved blasting practices in 1999. Plates ES4a – ES4c show the sequence of a blast conducted at the existing Voyager Quarry on 8 October 2002. The plates show that rock was forced inwards towards the pit and no flyrock occurred.

Plate ES4a Before the blast conducted on 8 October 2002

Plate ES4b During the blast conducted on 8 October 2002

Plate ES4c After the blast conducted on 8 October 2002. All rock landed within the pit as the blast was designed to force the material inwards towards the pit.

To support this contention, BGC has videotaped all blasts at the existing Voyager Quarry since August 2002. The tapes are reviewed to verify where flyrock is landing, and are stored for future review by regulatory authorities. All tapes collected to date confirm that flyrock is contained within the confines of the pit as planned by the drilling pattern. The absence of flyrock outside of the existing quarry pit is attributed to the improved blasting practices employed at the site since 1999.

BGC proposes to employ the same blasting practices at the new quarry as are currently employed at the existing quarry. The risk of flyrock exiting the pit will be minimal, as blasts will be designed to ensure that all flyrock is contained within the site boundaries.

Dust

Dust will be generated by the proposed Project primarily through:

- construction activities;
- drilling and blasting;
- loading and transportation of material;
- vehicular movement, and
- windblow off stockpiles.

Dust suppression measures such as the use of heavy duty sprinklers and water trucks will be used to minimise dust emissions from the quarry operations, as per current practice. Locating much of the project infrastructure within the quarry pit further reduces the risk of dust impacts. Therefore, the potential for offsite dust impacts is extremely low.

Visual Impact

A viewshed model was used to predict the visual impact of the proposed quarry to the neighbouring residents. Three viewing points were selected, being the nearest residences to the north, east and west of the Project Area. The results provided by the viewshed analysis can be considered as the worst case scenario as an assumption of the model is that all vegetation between the viewing points and the Project Area had been cleared.

According to the results provided by the viewshed model, the proposed quarry would be visible from the residence located to the east. However there is a vegetation buffer in close proximity to the viewing point, which is likely to obscure the visibility of the proposed project. Distance is another factor that will influence the visual impact experienced from the residence to the east, as it is

located approximately 2.4 km from the Project Area.

It was predicted from the viewshed model that the proposed quarry would be partially visible from the residence to the north. The model predicted that the south-east corner of the proposed quarry pit would be visible if there was an absence of screening vegetation, but it is likely that the remnant vegetation within Lot 14 will obscure the view from this residence. As structures were modelled at ground level (0 m) and the processing plant and other infrastructure are to be placed approximately 15-30 m below ground level, these structures will be screened by the walls of the quarry pit.

The viewshed model predicted that there would be no visual impact on the nearest residence to the west. The topographic features of the landscape naturally screen the proposed operations from this viewing point.

The Project Area will not reduce public amenity, as the proposed operations will not be visible from public roads, (Great Southern Highway and Horton Road). There will be an adequate vegetative screen to prevent the proposed project from being visible from these public roads.

During the night-time operation of the despatching facilities or during evening operations of the tertiary crusher circuit, lighting is required to allow for safe operation. The areas requiring lighting are the plant facilities, which are to be located approximately 15-30 m below ground level in the south-east corner of the pit. Therefore, it is considered that there will be an extremely low potential for neighbouring residents to experience lighting impacts as the plant facilities would be screened by the walls of the pit.

Impacts on Surface Water Drainage and Quality, Catchment Salinisation, and Groundwater Levels and Quality Downstream from the Project Area

These issues were primarily raised by the government departments responsible for land and water resource management, the Lakes Action Group and the Wooroloo Brook Land Conservation District Committee.

Hydrology and Surface Water

The Project Area is located in the Swan-Avon catchment and in the southeast corner of the Wooroloo Brook catchment. This area is a proposed Priority 3 Drinking Water Source Area and the catchment is proclaimed under the *Rights in Water and Irrigation Act* 1914.

Drainage to the Avon River is via several unnamed streams and Wooroloo Brook. The confluence of Wooroloo Brook with the Avon River marks the change in name from the Avon to the Swan River. At the point of entry to the Swan-Avon River, Wooroloo Brook has a catchment area of 266 km^2. The area of the quarry and infrastructure (approximately 85 ha) is extremely small compared to the area of the Wooroloo Brook and the wider Swan-Avon catchments.

The potential issues related to hydrology and surface water runoff from the quarry relocation are:

- erosion during establishment of the new quarry;
- runoff diversion and concentration on-site;
- impact on the quantity and quality of downstream flow; and
- implications for downstream salinity.

Clearing of the existing vegetation to leave bare soil or rock could substantially increase local runoff rates and exposed soil or soil stockpiles may be susceptible to erosion. Problems with erosion are only likely during the wet months of the year (May to September). Erosion risk

can be managed using well-recognised soil conservation techniques and by collecting all runoff water from the site in a pit sump before release. Accordingly, on-site erosion is not expected to impact on the water quality of downstream flow.

Runoff in the area of the proposed quarry and plant area will be affected to some degree, but this is not expected to have any significant effects on-site or at the controlled release point. All on-site diversion drains will be constructed to be non-erosive and silt-traps and other soil conservation works will be used to control stormwater flows. Runoff from the site will be directed into sumps and stored temporarily before use in processing operations. Excess water will only be released after testing to ensure water quality meets release criteria. The release point from the quarry and the receiving stream will be modified to accommodate the expected flows and will be non-erosive.

The proposed quarry will increase streamflow in the local catchment. This increased streamflow is not likely to have an adverse effect on the downstream environment or water users as erosion and turbidity on-site will be minimised; the water released will have low salinity; and water will be released in a controlled, low-impact fashion during the wetter months of the year. This release will cease after closure of the proposed new quarry because water will no longer be pumped from the pit. Streamflows in the local catchment are then likely to return to near the levels that occurred prior to the development of either of the quarries.

The proposed quarry will not contribute to salinisation in the local catchment, and may in fact help ameliorate downstream salinity. For the majority of the quarry life and most likely after closure, groundwater in the vicinity of the quarry will seep into the pit, not out. Accordingly, groundwater levels downstream will not rise as a result of the quarry, and may in fact fall in a small area immediately adjacent to the quarry. As water discharged from the site will have a low salt load, this controlled release will, on average, reduce streamflow salinity downstream of the quarry.

Groundwater

The proposed quarry occurs in the upper-most reaches of the Wooroloo Brook catchment, immediately adjacent to the catchment divide. Groundwater yield to bores is therefore very small and groundwater salinities are between 1200 and 3700 mg/L TDS.

Due to low bore yields and generally poor groundwater quality, the area containing the existing and proposed quarry is not within a proclaimed groundwater area under the *Rights in Water and Irrigation Act* 1914. A licence is therefore not required to extract groundwater in this area.

There is the potential for the proposed quarry to intersect steeply dipping fractures containing minor amounts of groundwater which will be pumped from a sump formed at the base of the quarry pit. This may decrease groundwater levels near the proposed quarry.

There is not expected to be any impact from dewatering on other groundwater users, outside of the proposed quarry operations as the fractured rocks are of low permeability and the cone of depression will be of limited extent. Based on recent drilling results, the amount of additional groundwater flow to the quarry, due to the proposed quarry relocation will be low and limited to steep fractures in fresh granite and direct rainfall recharge to the saprolite zone.

On-site water movement and any releases to the environment will be managed under a site surface water management and monitoring plan. Any groundwater seepage, direct rainfall and stormwater runoff occurring in the quarry pit will be stored for use in processing and dust suppression, and little groundwater recharge is expected to occur. Excess

water will only be released if stringent water quality criteria are met, and will be discharged only during the wetter months when natural flow is occurring or likely to occur.

Impacts on Biodiversity, Fauna, Flora (particularly *Hemigenia viscida*) and Vegetation

These issues were also principally raised by State Government departments, but were also of concern to local residents, community groups and the Shire of Northam.

Clearing of Native Vegetation

Approximately 85 ha of native vegetation will be cleared as a result of proposal implementation. The vegetation consists predominantly of jarrah (*E. marginata* subsp. *thalassica*) and marri (*C. calophylla*) woodlands with limited occurrences of wandoo (*E. wandoo*) woodlands.

The EPA expects land clearing proposals to demonstrate that vegetation removal would not compromise any vegetation type by taking it below the "threshold level" of 30% of the pre-clearing extent of the vegetation type (Position Statement No. 2 [December 2000], Environmental Protection of Native Vegetation in Western Australia. Clearing of vegetation with particular reference to the agriculture area).

The proposed Project Area is located in the Shire of Northam where there is only approximately 16.4% of relatively intact native vegetation (Weaving, 1999). Consequently, under the MoU for "The Protection of Remnant Vegetation on Private Land in the Agricultural Region of Western Australia" (Agriculture Western Australia, 1997), there is a presumption against clearing unless it can be demonstrated that loss of biodiversity will not occur.

Since this represents a potential "fatal flaw" for the proposal, the impacts of the project on biodiversity conservation have been thoroughly assessed in accordance with the evaluation criteria described in the MoU for "The Protection of Remnant Vegetation on Private Land in the Agricultural Region of Western Australia", September 1997.

The site-vegetation types present in the survey area also occur in sections of the areas previously known as Mt Cooke, Windsor, Russell, Lupton, Wandering and Sullivan. Several of these areas were merged into reserves or proposed reserves as part of the updating of the forest management planning process, the Regional Forest Agreement process and more recently the updating of the Forest Management Plan by the Conservation Commission of Western Australia (Mattiske Consulting Pty Ltd, 2002). Therefore, at the site-vegetation type level of vegetation community definition, there is no site-vegetation type present that is not represented in the wider conservation estate.

To compensate for the loss of 85 ha of native vegetation within the Shire of Northam, BGC has committed to revegetate 170 ha of disturbed areas of remnant vegetation within the Wooroloo Brook Catchment (which has been historically cleared for largely agricultural activities). This revegetation will be undertaken over a five year programme, with a commitment to complete 50 ha of revegetation within two years from the approval date for the Project and the remainder by the time that operations at the existing quarry cease.

The revegetation projects will be located on cleared Crown land and where feasible, private land through a commitment to allocate support through the Landcare and Catchment groups.

Revegetation within the Wooroloo Brook catchment provides the potential to link remnant areas of vegetation and riparian zones with native vegetation on crown land and state forest areas.

The proposed revegetation will assist in both catchment management issues and assist in the re-establishment of biodiversity values through the planting and seeding of local native species and also through the establishment of corridors and linkages for native fauna movement between areas of remnant vegetation.

Flora

The baseline and follow-up spring surveys conducted in 2002 recorded a total of 223 vascular plant taxa from 42 plant families and 112 genera. No DRF species gazetted under the Wildlife Conservation Act 1950-1980 were located during the 2002 surveys. One species, *Hemigenia viscida*, is classified as Priority 4 (Rare Taxa) on the State Declared Rare Flora (DRF) and Priority Flora (PF) List and as Vulnerable under the Commonwealth *Environmental Protection and Biodiversity Conservation Act* 1999 (EPBC Act).

Hemigenia viscida was previously classified as DRF by the State, which resulted in listing under the EPBC Act. However, the conservation status of this species has been downgraded to Priority 4 (Rare Taxa) on the State DRF and PF List and it is reasonable to assume that its classification under the EPBC Act will be reviewed in due course.

The proposed quarry relocation will result in clearing of approximately 5% of the *Hemigenia viscida* population. However, BGC has made a commitment to protect heath community H5 which contains 95% of the *Hemigenia viscida* population present within the Project Area. This includes the establishment of a 50 m wide buffer around the community.

Vertebrate Fauna

A desktop vertebrate fauna review and brief site inspection undertaken by Ninox Wildlife Consulting in January 2002 identified that 80 birds, 17 native mammals (including seven bats), nine frogs and 31 reptiles may occur in the area. Introduced fauna species also expected to occur in the area include the Black Rat (*Rattus rattus*), House Mouse (*Mus musculus*), Red Fox (*Vulpes vulpes*), Feral Cat (*Felis catus*), Rabbit (*Oryctolagus cuniculus*) and the Kookaburra (*Dacelo novaeguineae*). Most of the animals that are expected to occur in the Project Area have widespread distributions throughout the South-west forested area and are not restricted to individual habitats.

The major impact of the Project on vertebrate fauna relates to the loss of faunal habitat due to clearing. Vegetation occurring in the area proposed for clearing consists predominantly of heath, Jarrah (*E. marginata*) and Marri (*E. calophylla*) woodland with restricted occurrences of Wandoo (*E. wandoo*). The area has few mature habitat trees present with suitable hollows for nesting or refuge. The relative lack of suitable habitat trees, which can be attributed to historical logging operations, reduces the likelihood that the project would have a significant impact on threatened or migratory species that may occur in the area. Moreover, mobile species such as the Chuditch and Western Brush Wallaby would be able to move away from the impacted area and attempt to relocate in suitable habitat nearby. There is suitable habitat in the Wandoo woodland with a heath understorey on the western boundary of Lot 11. This movement inevitably increases competition in adjacent areas. When conflicts are resolved, territorial competition eventually reaches a position of stability. Some deaths may take place as displaced animals move across roads to find new habitat.

The habitats in the southern portion of the Project Area (mainly vegetation types HG, H, P, PG HS, G and D) while separated by Great Southern Highway, are linked to State Forest through native vegetation on private land. This road will form a barrier to the movement of very small terrestrial vertebrates, such as reptiles and mammals, but are unlikely to inhibit the movement of the majority of birds and larger vertebrates. The habitats within the south-

eastern corner of the Project Area contains a link with a catchment protection reserve and native vegetation on private land to the east. Wariin Road bisects this link approximately three kilometres to the east of the Project Area, which may form a barrier to small terrestrial vertebrates.

Clearing of vegetation within the Project Area will result in the localised loss of habitat for vertebrate and invertebrate fauna. This will have an initial impact in terms of the loss of non-mobile and/or poorly dispersing species occupying the site, such as reptiles, small mammals and invertebrates. However, the retention and protection of some of the heath habitats in the Project Area will reduce the impact on poorly dispersing species such as the Honey Possum. Mobile species such as the Chuditch and Western Brush Wallaby are expected to move away from the impacted area and relocate in suitable habitat nearby. During the relocation process some territorial conflicts associated with competition for food resources, shelter and breeding sites may result, but populations would be expected to stabilise once conflicts are resolved.

Overall, impacts on the vertebrate fauna as a result of the Project are expected to be minor considering the limited distribution of suitable habitat for many species within the site. Moreover, most of the animals expected to occur at the project site have widespread distributions throughout the south-west forested area of Western Australia and are not restricted to individual habitats.

Invertebrate Fauna

Field surveys were conducted by the WA Museum in July and August 2002 to determine the impact of the Project on trapdoor spiders and land snails. Visual searches for spider burrows were conducted at 59 sites. Several old webs and trapdoors were observed. Three species of trapdoor spiders were collected, with *Gaius* sp. being of scientific interest as it has not previously been recorded in the Darling Range. Eleven *Gaius* sp. burrows have been recorded within the proposed area to be cleared and it is likely that these will be destroyed during the clearing activities, unless the burrows can be successfully relocated to a suitable habitat. Advice will be sought from the WA Museum on this issue. However, approximately two thirds of the population will not be affected, as a total of 24 burrows are located within Lot 14 and Lot 11 in areas that will not be cleared or disturbed.

The land snail survey revealed that the species diversity was low and there was an impoverished terrestrial molluscan population within the Project Area.

Decommissioning and Closure Strategy for the Project

This issue is of particular concern to adjacent residents.

The Proponent recognises that appropriate planning and adequate provisioning for rehabilitation and closure is essential to ensure that the process occurs in an orderly, cost-effective and timely manner. The closure plan for the proposed quarry will be based on the objectives and principles presented in the guidelines developed by Australian and New Zealand Minerals and Energy Council (ANZMEC) and Minerals Council of Australia (MCA) (2000) and The Chamber of Minerals and Energy of Western Australia (1999). BGC has developed a draft closure strategy to ensure that the closure of the Project is conducted in an environmentally and socially acceptable manner. The draft closure strategy is presented below.

Voyager Quarry Relocation
Draft Closure Strategy

The desired closure outcome is to prevent adverse long-term environmental impacts and to create self-sustaining natural ecosystems or land uses, which are acceptable to the community and other stakeholders. In conducting our activities, during planning, construction, operational, decommissioning and closure phases, we will aim to:

- Conduct comprehensive consultation with all stakeholders during the closure decision-making process;
- Ensure effective planning is undertaken so that closure occurs in an orderly, cost-effective and timely manner;
- Ensure that the company accounts have adequately reflected the cost of closure and financial provisions are set aside;
- Ensure there is clear accountability and adequate resources for the implementation of the closure plan;
- Establish a set of acceptable criteria and indicators, which will demonstrate the successful completion of the closure project;
- Achieve successful completion where the agreed completion criteria have been met to the satisfaction of the Responsible Authority; and
- Ensure that the community is not left with a liability.

The post-operational land use for the proposed quarry operation has not yet been selected. Following the cessation of operations, the quarry could:

1. be left empty;
2. be allowed to fill with water; or
3. be filled with non-putrescible waste materials, such as waste rock or building rubble.

The post-operational land use will depend on which of these three scenarios is selected. Once post-operational land use is determined and approved by regulatory authorities in consultation with other stakeholders including nearby residents, a closure and rehabilitation plan will be prepared for the quarry that will describe:

- the closure option selected for the pit;
- how the closure and decommissioning will be implemented;
- the rehabilitation objectives and completion criteria relevant to the closure options; and
- the monitoring programme that will be implemented to determine progress made towards achieving the rehabilitation objectives.

This plan will be submitted to the regulatory authorities and other relevant stakeholders for review at least two years prior to site closure.

ENVIRONMENTAL MANAGEMENT

The Proponent will develop an Environmental Management System (EMS) prior to the commencement of operations. The development and implementation of the EMS will be focused on continual improvement of environmental performance.

The Proponent's environmental management commitments are summarised in Table 9.1 of the PER and represented here as Table ES3. This table summarises the commitment (Column 1), defines the objective of the commitment (Column 2), outlines the actions to be undertaken and their timing (Columns 3 and 4), and identifies whose advice will be obtained to confirm compliance with the commitment has been achieved. (Columns 4 and 5).

The Proponent's environmental performance and its compliance with the environmental management commitments made for this Project (Table ES3), and the Ministerial conditions of approval will be reviewed on an annual basis. The mechanism through which this will be achieved is an Annual Environmental Report (AER) to the DEP. This will include:

- a review of the development of the Project during the previous 12 months;

- the results of internal audits for the Environmental Management Plans (EMPs);
- water quality monitoring results for discharge water; and
- results of any studies such as implementation of the revegetation strategy.

CONCLUSION

Given the above environmental management commitments, and the environmentally sensitive design of the Proposal it is considered that the only environmental "costs" of the project will be the loss of 85 ha of remnant regrowth jarrah and marri woodland from land owned by the Proponent, plus the loss of associated fauna habitat and disturbance of the trapdoor spider, *Gaius* sp.

Overall, the impact on the vertebrate and invertebrate fauna as a result of the Project is expected to be minor considering the limited distribution of suitable habitat for many species within the site. The area has few mature habitat trees present with suitable hollows for nesting or refuge. The relative lack of suitable habitat trees reduces the likelihood that the project would have a significant impact on threatened or migratory species that may occur in the area.

Therefore there will be no loss of biodiversity as a result of the project, and there will be an increase in the amount of native vegetation within the Shire of Northam once the Proponent's revegetation commitment is completed within the first five years of operation. This offset will have wider benefits than just increasing vegetation cover through decreased risk for salinisation of Wooroloo Brook, and increased provision for fauna corridors within the catchment.

Concern has been raised that clearing of vegetation in the Project Area will result in increased salinisation of the Upper Wooroloo Catchment. However, the surface water assessment and water balance conducted for the proposed quarry indicates that this is highly unlikely to occur. BGC's commitment to revegetate areas within the catchment will also help reduce the risk of land degradation due to this or other land uses in the area. The revegetation programme also represents a significant environmental benefit to the Upper Wooroloo Brook catchment which is experiencing increasing encroachment of dryland salinity.

There are few, if any, social costs of the Proposal and many potential benefits. Sensitive quarry design and implementation of best-practice management will ensure that adjacent residents are not adversely affected by the operations of the new quarry. Management of noise, airblast and ground vibration are critical issues that will require vigilance and responsive management. To minimise the potential for offsite emissions of noise and dust, the plant required for the proposed new quarry will be located within the proposed quarry pit approximately 30 m below ground surface, and will be upgraded to minimise potential sources of noise.

BGC will carry its commitment to continual improvement in environmental practices through to the proposed new quarry through the development and implementation of an EMS as part of its Quality System, which has been developed in accordance with ISO 9002. In addition, BGC is establishing a Community Liaison Group as a key mechanism for continuing government and community consultation and liaison regarding site operations.

Implementation of the proposed quarry relocation, which is proposed for an area identified under the State's Basic Raw Materials Planning Policy as a Key Extraction Area, will result in substantial benefits to:

- the State (through royalties and taxes);
- the local community (through financial support for local businesses and income for the Shire);

- the Perth metropolitan community (through the maintenance of low costs for building and housing materials); and
- BGC owners and employees (through the provision of jobs and profits).

There would be significant consequences if the proposed quarry relocation does not proceed and these are likely to have widespread ramifications that could adversely impact the Perth Metropolitan Region and elsewhere within WA. These include:

- Market implications, as a shortage of crushed rock to meet the demand in the Perth Metropolitan Region will result in a price increase for the product, which in turn will lead to increased costs for housing.

- Increased pressure for existing quarries to expand to provide the quantities of crushed rock that is required for the Perth metropolitan region. The expansion of quarry operations on the Darling Scarp, which are more visible from the Swan Coastal Plain, will reduce the visual amenity of the Scarp.

- A loss of social and financial opportunities within the local community, particularly for those local businesses, sporting clubs and community projects supported by BGC.

- A loss of jobs within BGC and potentially within the suppliers that service the operation.

The findings of the technical and other studies conducted in relation to the assessment of the proposed quarry relocation indicate that, subject to the successful implementation of the environmental management strategies, programmes and commitments documented in this PER, all project activities and environmental impacts are manageable, and that the proposed quarry relocation will not cause significant adverse environmental impact. Therefore, it is submitted that the proposed quarry relocation should be approved.

Table ES2
Identification of Environmental Factors

Environmental Issues	Objectives and Work Required for the Environmental Review of the Project (as identified by the EPA Guidelines)	Existing Environmental Conditions and Predicted Environmental Impacts	Proposed Mitigation and Management Measures	Predicted Outcome
BIOPHYSICAL				
Vegetation (plant communities)	The EPA Guidelines require that the Proponent maintain the abundance, species diversity, geographic distribution and productivity of plant communities. Work required: • Baseline studies to identify existing flora species and vegetation communities present. • Detail the conservation values, at a local and regional level, of plant communities of the proposal area. • Assess potential impacts (direct and indirect, including from weeds and dieback) on plant communities as a result of development activities. • Propose measures to reduce impacts.	A baseline flora and vegetation survey was conducted in Lots 11 and 14 in January 2002 and a follow-up survey was conducted in Spring 2002. Eleven plant communities have been defined and mapped in the proposed Project Area. The site-vegetation type G (open to closed heath of Proteaceae) is locally significant as includes the Priority 4 species, *Hemigenia viscida.* All of the site-vegetation types present in the proposed Project Area are represented in the wider conservation estate (Mattiske Consulting Pty Ltd, 2002). In general, vegetation occurring in the area proposed for clearing consists predominantly of Jarrah (*E. marginata* subsp. *thalassica*) and Marri (*C. calophylla*) woodland with restricted occurrences of Wandoo (*E. wandoo*). The Project will result in the clearing of approximately 85 ha of native vegetation within Lot 14. Te majority of the proposed Project Area is free from the symptoms associated with *Phytophthora* sp. The main area of infestation is along Great Southern Highway and measures will be implemented to ensure that the spread of the disease does not occur. It is unlikely that the Project will have any further impact on the spread of weeds in the area.	Revegetation of approximately 170 ha within the Wooroloo Brook catchment will be conducted according to the strategy presented in Section 7.8.4 to off-set the clearing. A 50 m buffer will be maintained around Heath community H5, which contains 95% of the *H. viscida* population recorded in the Project Area. This community will be monitored to ensure that it is not adversely affected by the Project. Native vegetation within Lot 14 that will not be cleared during project development, particularly in the northern and southern sections, will be maintained to ensure that the productivity of the remaining vegetation is not adversely affected by the Project. One of the main management measures for the control of *Phytophthora* sp. is to provide training for all personnel to raise awareness of dieback, the areas where it is present and the management practices to be implemented. Signage demarcating the area of infestation will also be erected and the machinery used on-site will be 'clean' (free of mud and soil) prior to entering the site.	The abundance and geographic distribution of vegetation in the region will not be compromised as the revegetation strategy involves the planting of 170 ha of native vegetation within the Wooroloo Brook catchment. It is proposed that native species that are most suited to the site conditions be used for the revegetation projects. The results from the study conducted by Mattiske Consulting Pty Ltd (2002) will provide useful information for species selection. The productivity of the vegetation remaining within the Project Area will be maintained as the disturbance will be contained to the proposed project footprint. Diversity will not be adversely affected by the Project as the plant communities and individual species are well represented in the surrounding areas. The potential for spreading *Phytophthora* sp. is low, particularly as the majority of the Project Area is free from the symptoms associated with the disease. No increase in the spread of weeds is expected as the site has previously been disturbed by logging and fire.
Declared Rare Flora (DRF) and Priority flora; flora of particular conservation significance	The EPA Guidelines require that the Proponent: • Protect DRF and Priority Flora, consistent with the provisions of the *Wildlife Conservation Act* 1950; and • Protect other flora species of particular conservation significance (eg. undescribed taxa, range extensions, outliers). Work required: • Baseline studies, at appropriate seasons (including a Spring flora survey) to identify DRF, Priority Flora or other species of particular conservation significance (including location and number of individuals). • Assess potential impacts (direct and indirect) of the proposal on any DRF, Priority Flora and flora of particular conservation significance in the proposal area. Outline the significance of these potential impacts at a regional level. • Consult with the Department of Conservation and Land Management on impacts to, and management of, DRF, Priority flora, and other flora of particular conservation significance. • Propose measures to ensure protection/rehabilitation of DRF, Priority Flora and other flora species of particular conservation significance.	A baseline flora survey of Lots 11 and 14 was conducted by Mattiske Consulting Pty Ltd in January 2002 and a follow-up survey was conducted in Spring 2002. A Priority 4 species, *Hemigenia viscida,* has been recorded in four of the 17 heath communities in the Project Area, with approximately 95% of the *H.viscida* individuals occurring in one heath community (H5). No other DRF, Priority Flora or other species of conservation significance were identified. A survey to identify potential locations for *Hemigenia viscida* populations beyond the immediate Project Area conducted in February 2002 (Figure 4.13) identified a population of at least 110 plants occurring within a heath community on the Shire of Mundaring land to the west of Horton Road, and south of a Shire of Mundaring gravel quarry pit. The Priority 4 species, *Hemigenia viscida* will not be adversely affected by the Project as the majority of the *H. viscida* population (95%) is located within heath community H5, which will be protected by a 50 m buffer. A briefing meeting was held with representatives from the CALM in March 2002. In addition, two CALM representatives conducted a site visit in April 2002. CALM supports the protection of heath community H5, which contains approximately 95% of the *Hemigenia viscida* population.	Heath community H5, which contains approximately 95% of the population within the Project Area, will be protected. There will be a 50 m buffer of undisturbed vegetation surrounding this community.	A small reduction in the number of individuals of *Hemigenia viscida* will occur as a result of proposal implementation. Heath community H5, which contains approximately 95% of the population within the Project Area, will be protected.

Table ES2 (continued)

Environmental Issues	Objectives and Work Required for the Environmental Review of the Project (as identified by the EPA Guidelines)	Existing Environmental Conditions and Predicted Environmental Impacts	Proposed Mitigation and Management Measures	Predicted Outcome
Native Fauna	The EPA Guidelines require that the Proponent maintain the abundance, species diversity and geographical distribution of fauna. Work required: • Baseline studies to identify and map fauna habitat on, and adjacent to the proposal area. • Appropriate field surveys to identify fauna present. This should include poorly dispersing invertebrate groups, such as native land snails and trapdoor spiders, as endemic species may be associated with granite outcrops in this area. Outline the conservation values, at a local and regional level, of the fauna present, or likely to be present. The overall assessment should: • assess potential impacts (direct and indirect) on native fauna; • include an assessment of ecological linkages between the proposal area and adjacent vegetated areas (at both a local and regional level), and the effectiveness/viability of the remaining vegetation to provide habitat and linkages; and • propose measures to manage impacts, including to ensure protection (or, if necessary, relocation) of fauna.	A vertebrate fauna study was conducted by Ninox Wildlife Consulting, after an initial site inspection in January 2002 (Section 4.6). The fauna habitats have been mapped (see Figure 4.14) and field survey was completed recently. In addition, consultation with CALM has ben conducted. A list of the fauna species that could potentially occur in the Project Area has been developed. The species likely to occur in the Project Area have recorded elsewhere in the south-west forested area of Western Australia and are not restricted to individual habitats. Therefore, the Project will not result in the loss of any vertebrate fauna species or populations inhabiting the area. The main impact on fauna will be the loss of habitat through vegetation clearing. However, ecological linkages have been considered (Section 4.6) and the creation of a native vegetation corridor to the east of the Project Area will greatly increase the value of the remaining habitats within the Project Area. Field surveys were conducted by the WA Museum in July 2002 to determine the impact of the Project on trapdoor spiders and land snails (Sections 4.7.2 and 4.7.3). Visual searches for spider burrows were conducted at 59 sites (Figure 4.16). Several old webs and trapdoors were observed. Three species of trapdoor spiders were collected, with *Gaius* sp. being of interest, as it has not previously been recorded in the Darling Range. There were approximately 11 *Gaius* sp. burrows within the proposed area to be cleared. Approximately 22 burrows were recorded in the northern section of the Project Area (Lot 14) and will not be cleared or disturbed. Other populations of *Gaius* sp. are located on the western and eastern sides of Lot 11 and will not be disturbed by proposal implementation. The land snail survey revealed that the species diversity was low and there is an impoverished terrestrial molluscan population within the Project Area.	The establishment of a vegetation corridor linking the remaining vegetation within the Project Area to remnant vegetation to the east of Project Area on privately owned land, will be investigated. The impact on the *Gaius* sp. population within the Project Area will be managed by ensuring that the vegetation in the northern section of Lot 14 is not disturbed.	The general abundance and geographic distribution of fauna will not be adversely affected by the Project, as the habitats within the Project Area are well represented in the surrounding areas. Species diversity of vertebrate fauna will not be adversely affected, as the Project will not result in the loss of any vertebrate fauna. Some populations of the trapdoor spider species, *Gaius* sp. (which is a species of scientific interest) will be affected by the clearing operations but viable populations will remain in undisturbed areas of Lots 11 and 14.
Native Fauna – Specially Protected (Threatened) and Priority Fauna, and other fauna species of particular conservation significance.	The EPA Guidelines require that the Proponent: • Protect Specially Protected (Threatened) and Priority Fauna and their habitats, consistent with the provisions of the *Wildlife Conservation Act* 1950; and • Protect other fauna species of particular conservation significance (eg. undescribed taxa, range extensions, outliers). Work required: • Scope of work as for "native fauna" (see above), including consultation with the Department of Conservation and Land Management, and in regard to trapdoor spiders and land snails, the Western Australian Museum, on any impacts to, and management of, Threatened Fauna species and Priority Fauna species.	The work conducted in relation to the assessment of vertebrate and invertebrate fauna is described above. A number of vertebrate fauna listed as threatened or vulnerable under the EPBC Act 1999 or the State *Wildlife Conservation Act* 1950 (see Section 4.6) may occur in the Project Area. These animals are generally mobile and able to move away from the Project Area. Therefore, the Project will not result in the loss of any vertebrate fauna species or populations inhabiting the area. Some populations of the trapdoor spider species, *Gaius* sp. (which is a species of scientific interest) will be affected by the clearing operations but viable populations will remain in undisturbed areas of Lots 11 and 14.	The establishment of a vegetation corridor linking the remaining vegetation within the Project Area to remnant vegetation to the east of Project Area on privately owned land, will be investigated. The impact on the *Gaius* sp. population within the Project Area will be managed by ensuring that the vegetation in the northern section of Lot 14 is not disturbed.	The impact on the vertebrate and invertebrate fauna in the Project Area is likely to be low. The main impact will results from the loss of faunal habitat due to the clearing, however it is expected that mobile fauna will be able to move away.

Table ES2 (continued)

Environmental Issues	Objectives and Work Required for the Environmental Review of the Project (as identified by the EPA Guidelines)	Existing Environmental Conditions and Predicted Environmental Impacts	Proposed Mitigation and Management Measures	Predicted Outcome
Mine planning, decommissioning and rehabilitation	The EPA Guidelines require that the Proponent: • Ensure that mine planning, decommissioning and rehabilitation are carried out in a planned sequential manner consistent with best practice and proposed final land use; • Ensure ecosystem function is maintained following mine closure; and • Avoid State liability. Work required: • Present an integrated mining, decommissioning, and rehabilitation strategy (which, among other things, addresses the issues of monitoring and progressive rehabilitation of disturbed areas); • Present appropriate final land uses for all areas affected by the proposal; and, • Present a description of how the above strategy is consistent with the ANZMEC/Minerals Council of Australia Strategic Framework for Mine Closure, 2000.	The Proponent recognises that appropriate planning and adequate provisioning for rehabilitation and closure is essential to ensure that the process occurs in an orderly, cost-effective and timely manner. A draft closure strategy has been developed. The desired closure outcome is to prevent adverse long-term environmental impacts and to create self-sustaining natural ecosystems or land uses, which are acceptable to the community and other stakeholders. The closure strategy for the proposed quarry relocation is based on the frameworks developed by ANZMEC and MCA (2000) and The Chamber of Minerals and Energy of Western Australia (1999) (Section 3.8). A closure and rehabilitation plan will be prepared for the proposed quarry relocation. It will be submitted to the regulatory authorities and other relevant stakeholders for review prior to site closure.	The mine closure strategy will be continually reviewed and revised. The strategy will include cost estimates for decommissioning and rehabilitation of the Project. A rehabilitation budget will be established to ensure that there are sufficient funds available to conduct the rehabilitation and monitoring.	The State will not be left with a liability following the closure of the Project, as there will be sufficient funds available for rehabilitation and closure.
Landform	The EPA Guidelines require that the Proponent ensure that the post-mining landform is safe, stable, non-erodible, and is, as far as is practicable, integrated into the surrounding environment. Work required: • Assess potential impacts of the proposal on existing landforms, including from erosion caused by run-off and other surface water leaving the site (eg. from dust suppression and dewatering). • Evaluation of the landscape values in the project area and how these will be affected by the proposal and any measures to manage such impacts, including for surface water management. • Propose measures to rehabilitate the impacted areas to an acceptable standard, and that will integrate the post-mining landform with the surrounding environment.	The major land units and soil types present in the Project Area have been identified (Section 4.2). The Project will result in the disturbance of approximately 60 ha of Yalanbee land unit and 15 ha of the Pindalup land unit. The disturbance will involve the clearing of vegetation, the removal of overburden and excavation of the quarry. Most or all of the gravel and clay material will be transported off-site to be sold. Topsoil harvested from the area of disturbance will be stockpiled for rehabilitation of construction phase disturbances and the existing quarry site. Any surplus topsoil will be made available for rehabilitation of off-site areas to ensure that the viability of the seed bank is maximised. In terms of the geotechnical stability of the pit walls, granite is a competent rock that is able to stand at vertical or near vertical angles for significant periods of time, depending upon the intensity of fracturing. During the installation of two groundwater monitoring bores within the Project Area (BGC1 and BGC2, see Section 4.4.3), fracturing was noted in the top 18 m of each bore. This main fractured zone corresponded to the saprolitic zone of the weathered granite profile, a zone which is expected to exist over the entire quarry site. Consequently, there is potential for some surface slumping or slippage to occur at the edge of the open pit edge and within this zone if the pit is not backfilled. The risk of this occurring, and any management measures required, will be assessed during the preparation of the site decommissioning and closure plan.	Any longterm topsoil stockpiles will be revegetated or protected with an appropriate cover material to ensure that erosion does not occur. Following site closure, rehabilitation of disturbed areas within the Project Area will be conducted. In the event that the quarry void is to be left open, BGC will assess the long-term stability of the pit edge and fractured zone as part of its closure process.	Depending on the closure strategy adopted for the Project, the quarry void will remain open, be partially backfilled or fully backfilled. Any remaining stockpiled material will be sold or used for rehabilitation purposes. Surface disturbances such as roads and infrastructure areas will be rehabilitated.

Table ES2 (continued)

Environmental Issues	Objectives and Work Required for the Environmental Review of the Project (as identified by the EPA Guidelines)	Existing Environmental Conditions and Predicted Environmental Impacts	Proposed Mitigation and Management Measures	Predicted Outcome
Watercourses (Surface Water)	The EPA Guidelines require that the Proponent maintain the integrity, functions and environmental values of watercourses. Work required: • Identify catchments, watercourses, surface lakes and types of surface water flow throughout the areas to be affected by the proposal. • Assess the potential impacts on surface water flow rates, drainage patterns, sediment transport and any dependent vegetation as a result of the proposal. • Propose measures to manage and/or mitigate impacts.	The Project Area is located near the top of the local catchment divide, in the south-east corner of the Wooroloo Brook catchment. There are no substantial drainage lines, wetlands or sensitive water bodies in the Project Area. A small stream passes to the east of the existing quarry pit ("eastern stream"), joining with a small stream from the west ("western stream"). The streams are ephemeral, flowing mainly during winter as a result of seepage from local groundwater or surface runoff. The proposed quarry will increase streamflow in the local catchment but the water discharged will have a low salt load. There will not be any adverse effect on the downstream environment or water users because erosion and turbidity on-site will be minimised and water will be released in a controlled, low-impact fashion during the wetter months of the year. The controlled release should, on average, reduce streamflow salinity downstream of the quarry. Modifications to the "western stream" will be necessary should the Project be approved. At present, the existing "western stream" appears to have been narrowed and straightened by the agricultural land managers. The hydraulic capacity of the stream channel is reduced and appears to be erosionally unstable. The channel should be reconstructed from the base of the existing quarry to the confluence with the "eastern stream". The channel will be restored to its natural hydraulic capacity and be more stable.	The stream that receives discharge water from the proposed quarry will be reconstructed to accommodate the increased flows. This stream has been extensively modified in the past by the agricultural land managers and is currently erosionally unstable. The modifications will result in the restoration of the channel's original hydraulic capacity and improve its stability.	Average salinities in the nearby streams will decrease as a result of dilution with fresh water discharged from the quarry. The quantities of water flow will increase during winter, potentially increasing water supply to downstream water users and the environment. The "western stream", which is erosionally unstable will be stabilised. This is a significant benefit of the proposed Project.
Groundwater Quantity	The EPA Guidelines require that the Proponent ensure that the beneficial uses of groundwater can be maintained. Work required: • Provide details and justification of water requirements for the proposal. • Provide details of the hydrogeological systems of areas that may be affected, existing and potential future uses of groundwater. • Assess implications of planned abstraction on groundwater systems, existing and potential future uses of groundwater, and any groundwater dependent environmental systems. • Address the potential for water recycling and other water minimisation strategies. • Consult with the Water and Rivers Commission regarding groundwater allocation in the area and effects of groundwater drawdown (e.g. on salinity levels) from the proposal. • Propose measures to manage and/or mitigate impacts.	A water balance was developed for the proposed operations. It was predicted that there would be an increase in runoff, which will be collected in the pit. The water will be used for processing, dust suppression and allowed to evaporate. Most of the water will be discharged from the site during five months of the year (likely to be during May and September). The water requirements for the Project are similar to those for the existing operations, which is approximately 377 kL in summer and 77 kL in winter. The water supply source will consist of surface runoff and groundwater seepage. A semi-confined aquifer is located within the Project Area. The salinity of the groundwater in the upper parts of the Wooroloo Brook catchment ranges from 1,000 to 7,000 mg/L TDS. Small amounts of groundwater are available from bores which intersect fractures in the granite bedrock, however yields are low (generally less than 15 kL/day).	To monitor any decline in groundwater levels, the Proponent will measure groundwater levels on a monthly basis. A new monitoring bore will also be installed on the down slope side of the proposed quarry pit to adequately monitor the impact of dewatering on the down gradient portion of the catchment.	There is not expected to be any impact from the dewatering activities on other groundwater users outside of the quarry operations, as the fractured rocks are of low permeability and the cone of depression will be of limited extent. Therefore the groundwater quantity available for other groundwater users will not be affected by the Project.

Table ES2 (continued)

Environmental Issues	Objectives and Work Required for the Environmental Review of the Project (as identified by the EPA Guidelines)	Existing Environmental Conditions and Predicted Environmental Impacts	Proposed Mitigation and Management Measures	Predicted Outcome
Groundwater Quantity (continued)		The proposed quarry pit will be dewatered using in-pit sumps, as per current practice. Dewatering requirements will be similar to the existing quarry. The proposed quarry pit may intersect steeply dipping fractures containing minor amounts of groundwater, which will be collected in a sump at the base of the pit. A steep cone of drawdown will develop immediately around the proposed quarry as groundwater levels are lowered. A briefing meeting was held with representatives from the WRC in April 2002. A site visit was conducted in September 2002. Due to the low bore yields and generally poor groundwater quality, the Project Area is not within a proclaimed groundwater area under the *Rights in Water and Irrigation Act* 1914. Therefore, there is no requirement to obtain a groundwater well licence to extract groundwater from the area. A survey of private groundwater bores on six properties was conducted in September and November 2002. The results of bore census are provided in Table 4.5.		
POLLUTION MANAGEMENT				
Surface Water Quality	The EPA Guidelines require that the Proponent maintain or improve the quality of surface water to ensure that existing and potential uses, including ecosystem maintenance are protected, consistent with the *Australian and New Zealand Water Quality Guidelines* (ANZECC, 2000). Work required: • Details of site drainage, hydrocarbon use, disposal of plant site waste (including sewage), water use for dust suppression, dewatering, and fate and quality of water used/pumped. • Assess the implications the proposal may have on local surface water quality and salinity, in particular in the Wooroloo Brook catchment. • Propose measures to manage and/or mitigate impacts, including any proposed environmental mitigation measures.	Runoff diversion structures will be designed and constructed so they are stable and do not cause downstream erosion. The drainage system will be adequately designed to cater for intense rainfall events. On-site pollution management will prevent spillages of fuel, oil or other pollutants from being transported to clean runoff water. Excess runoff water will be released only if it meets water quality criteria. The quality of water in streams below the proposed quarry should improve, on average, as a result of dilution with fresh water released from the quarry. There should be no uncontrolled release of polluted water from the quarry because all operations will be located in the quarry, below ground level. The only discharge from the quarry will be in controlled releases by pumping.	A management plan, including regular and strategic monitoring, will be implemented to manage on-site water movement and quality and control the timing and conditions of water release from the site.	There will be a net improvement in downstream water quality.

Table ES2 (continued)

Environmental Issues	Objectives and Work Required for the Environmental Review of the Project (as identified by the EPA Guidelines)	Existing Environmental Conditions and Predicted Environmental Impacts	Proposed Mitigation and Management Measures	Predicted Outcome
Groundwater Quality	The EPA Guidelines require that the Proponent: • Maintain or improve the quality of groundwater to ensure that existing and potential uses, including ecosystem maintenance are protected, consistent with the *Australian and New Zealand Water Quality Guidelines* (ANZECC, 2000); and • Ensure that land clearing and quarrying does not cause, or significantly increase, the salinisation of groundwater. Work required: • Describe the water requirements for the proposal. • Describe baseline monitoring of bores, licensing requirements, drainage and fate of water used in on-site processing and quarry operations. • Describe how quarrying and eventual decommissioning and rehabilitation of the site will be undertaken to avoid creating an in-pit saline water body, which may affect the surrounding environment. • Assess impact from any change in groundwater quality, including any salinisation, on the surrounding environment. • Assess potential impacts on regional groundwater quality and other users of the groundwater resource. • Propose measures to manage and/or mitigate impacts.	The water requirements for the Project are similar to those for the existing operations, which is approximately 377 kL in summer and 77 kL in winter. The water supply source will consist of surface runoff and groundwater seepage. Two bores were installed in March 2002, to the west of the existing quarry. One is located in Lot 14, in the middle of the proposed quarry pit and the other is in Lot 11. These were drilled to a depth of 50 m and 60 m, respectively. There was essentially no groundwater intersected by the two new bores drilled in the proposed quarry. Groundwater will be drawn towards the quarry operations as dewatering proceeds. It is then consumed by the plant for mainly dust suppression and washing the rock product. Quarry dewatering operations will lower the level of groundwater in the Project Area. This will offset any soil salinisation which is normally caused by rising groundwater levels. There is not expected to be any impact from dewatering on the water quality for other groundwater users outside of the quarry operations, as the fractured rocks are of low permeability and the cone of depression will be of limited extent. After closure, if the void is deep, salt is likely to accumulate in the void as a result of seepage inflows and concentration by evaporation. This will be confined in the void as there is no seepage outflow. The average increase in salinity will be 22 mg/L/year. If the void is backfilled to a final depth shallower than the local watertable, some seepage outflow could occur. It is likely that the amount of outflow would be small and not contribute to any significant extent on downstream salinity compared to the impact of the widespread clearing for agriculture in the local catchment. Salt accumulation in the pit was predicted to average about 10 mg/L/year. If the void is backfilled to the surface and rehabilitated back to forest, the seepage and runoff rates are likely to return to close to the forested, pre-quarry condition.	The salinity of groundwater discharging to the proposed quarry will be measured twice per year. A bore will be drilled down the catchment slope from the proposed quarry to adequately monitor groundwater levels.	No adverse impact on groundwater quality. Soil salinisation potential in the catchment will be reduced due to lowering of groundwater levels by the quarry dewatering process.

TableES2 (continued)

Environmental Issues	Objectives and Work Required for the Environmental Review of the Project (as identified by the EPA Guidelines)	Existing Environmental Conditions and Predicted Environmental Impacts	Proposed Mitigation and Management Measures	Predicted Outcome
Noise and Vibration	The EPA Guidelines require that the Proponent protect the amenity of nearby residents from noise, airblast overpressure and vibration impacts resulting from activities associated with the proposal by ensuring that noise, airblast overpressure and vibration levels meet statutory requirements and acceptable standards. Work required: • Ensure that noise and airblast overpressure levels meet the criteria in the *Environmental Protection (Noise) Regulations* 1997. • Estimation of the noise and vibration levels at sensitive premises arising from the proposal. • In consultation with the DEP, establish best practical measures to manage and/or mitigate noise emissions from the proposal. • Propose measures to manage and/or mitigate noise impacts.	Noise-sensitive premises occur in the vicinity of the existing Voyager Quarry and proposed site for quarry relocation. Complaints regarding impacts due to noise and vibration from the existing operations have been lodged by local residents with the Proponent and the Shire of Northam. Herring Storer Acoustics (2002) has conducted a study of the existing quarry noise emissions and used these data to predict noise propagation from the relocated operations, under various atmospheric conditions. A study was also conducted of overpressure and ground-borne vibration due to blasting. The study conducted by Herring Storer Acoustics found that the proposed quarry operations can comply with regulatory criteria for all conditions and at all times once all operations have been relocated. The study also concluded that blasting can be managed to comply with the comfort criteria set down and be well below any criteria relative to damage risk (Herring Storer Acoustics, 2002).	Noise will primarily be managed by locating the plant site within the proposed quarry pit (approximately 30 m below ground surface) and housing the primary crusher (if required). Airblast overpressure and ground vibration will be monitored for each blast. Good blasting practices will be implemented to ensure that all blasts are confined and meet acceptable standards.	Noise and airblast overpressure levels will meet the criteria in the *Environmental Protection (Noise) Regulations* 1997. Ground vibration levels will also fulfill statutory requirements.
Particulates/Dust	The EPA Guidelines require that the Proponent ensure that particulate/dust emissions, both individually and cumulatively, meet appropriate criteria and do not cause any environmental or human health problem. Work required: • Identify sources of particulates/dust and estimates of project-wide emissions. • Analyse the significance of these emissions with regard to human health and environmental impacts. • Propose measures to manage and/or mitigate impacts.	Dust will be generated by the vegetation clearing activities during the construction of the proposed quarry. During the operational phase of the Project, dust will be generated during blasting and vehicular movement on unsealed roads. Dust may also occur from exposed product stockpiles, however these will be located within the confines of the proposed pit and the dust will not leave the site boundary. The dust generated by the Project will not cause a human health problem or have any adverse effects on the vegetation. Monitoring is conducted for dust levels experienced by site personnel to ensure that the levels do not cause an occupational health hazard. With regards to the health of the surrounding neighbours, dust generated from the site will not cause human health problems, as dust will not cross the site boundary. The Proponent will comply with the DEP licence conditions with respect to this issue. It is unlikely that dust generated from the Project will cause any adverse effects on the vegetation communities.	The main access road is sealed to reduce dust generation. Atmospheric conditions will be considered prior to blasting, so that blasting is conducted when the prevailing winds are away from residential areas. The shotrock is also watered in the pit prior to the being loaded and hauled to he crushing plant. Dust suppression measures, such as the use of water trucks, will be implemented for unsealed roads and within the pit. Sprinklers will be installed for the product stockpiles to reduce dust generation from these exposed surfaces. The Proponent will monitor vegetation condition within the Project Area during the construction and operational phases of the Project. The results from the monitoring programme will provide information on whether dust is adversely affecting the vegetation.	Dust will not adversely affect the environment or cause human health problems.
Visual Amenity	The EPA Guidelines require that the Proponent ensure visual amenity of the area adjacent to the project is not unduly affected by the proposal. Work proposed: • Assess potential impacts on visual amenity of the project area and surrounds from the proposal. • Propose measures to manage impacts.	A viewshed analysis was conducted to assess the visual impact of the Project. Results are presented in Section 8.5. The Project will not be visible from the residence to the west and is unlikely to be visible from residences to the north and east. Vegetation between the residence and the Project and the construction of infrastructure within the confines of the pit will greatly contribute to minimising visibility of the Project. Lighting impacts from the Project were also considered (Section 8.5.3). Light overspill will not occur under normal atmospheric conditions.	Infrastructure will be located within the confines of the pit (below ground level). Appropriate lighting technology will be investigated and implemented at the site.	The visual amenity of the area adjacent to the project will not be unduly affected by the Project.

Table ES2 (continued)

Environmental Issues	Objectives and Work Required for the Environmental Review of the Project (as identified by the EPA Guidelines)	Existing Environmental Conditions and Predicted Environmental Impacts	Proposed Mitigation and Management Measures	Predicted Outcome
SOCIAL SURROUNDINGS				
Aboriginal Culture and Heritage	The EPA Guidelines require that the Proponent: • Ensure that the proposal complies with the requirements of the *Aboriginal Heritage Act* 1972; and • Ensure that changes to the biological and physical environment resulting from the project do not adversely affect cultural associations with the area. Work proposed: • Identify Aboriginal cultural and heritage sites of significance, through consultation with local Aboriginal groups and/or the Department of Indigenous Affairs, and as required, through archaeological and ethnographic surveys of the project area. • Propose measures to manage and/or mitigate impacts.	An archaeological investigation of the proposed quarry relocation area was conducted in July 2002. No archaeological sites were located during the investigation (Section 4.11). Consultation with the Combined Metropolitan Working Group of native title claimants and the Ballaruk Aboriginal Corporation was conducted in July 2002 (Section 4.11). As a result of the consultation process, it was determined that there are no known burial sites, sacred areas or other areas of significance to the Aboriginal people, in the Project Area.	In the event that artefacts or other archaeological material is unearthed during clearing and overburden excavation, the Proponent will seek advice from the DIA.	No impact on Aboriginal culture and heritage anticipated.
Public Health and Safety (Transport)	The EPA Guidelines require that the Proponent ensure that traffic activities resulting from the project can be managed to an adequate level of public safety. Work required: • Describe the types, quantities, and methods of transport for various inputs and products of the quarry and crushing plant, in particular, any hazardous goods. • Assess transport heavy haulage routes, and the implications these may have on public health and safety. • Propose measures to manage and/or mitigate impacts.	Traffic intensity and traffic loading on the surrounding road network is not proposed to change. Access onto Great Southern Highway will remain unchanged (Section 8.4). The traffic conditions resulting from the Project will be similar to those for the existing quarry and will be managed to ensure that an adequate level of public safety is maintained.	No new management measures will be required.	No significant impacts on the level of public safety will be experienced with respect to traffic activities, as traffic is unlikely to change as a result of the Project.
Public Health and Safety (Flyrock)	The EPA Guidelines require that the Proponent ensure that public risk associated with implementation of the proposal is as low as is reasonably achievable; and, is managed to meet the Department of Mineral and Petroleum Resources' requirement in respect of public safety. Work required: • Describe the type, size, and method of blasting conducted at the site. • Assess blasting conducted at the site and the implications this may have on public health and safety. • Propose measures to manage and/or mitigate impacts.	A predetermined drill pattern is marked out on a selected area within the quarry. An average-sized blast consists of approximately 80 to 100 holes. The holes are 102 mm in diameter and are generally 16 m deep (to allow for a 15 m bench height and 1 m for sub drill into the floor to provide an even finish on the quarry floor). The holes are drilled at a rate of approximately 20 holes per ten-hour shift using a hydraulic drill rig. On completion of drilling, the depth of the holes is checked and the holes are loaded with explosives. After the safety checks have been completed, the blast is initiated by a shot-firer. The average amount of explosive used in each blast hole is approximately 120-130 kg. The risk of flyrock will be minimal, as blasts will be designed to ensure that all flyrock is contained within the site boundaries. There is a possibility that flyrock may be projected some distance from the pit if excessive amounts of explosives are used and the drilling pattern is poorly planned. However, the implementation of good blasting practices will prevent this from occurring. BGC has been videotaping every blast at the existing operations since August 2002 to confirm that flyrock is being contained within the site boundaries.	The shot-firer will be properly trained and hold the appropriate qualifications to conduct the blasting. The blasting practices will take into account the burden spacing required for the particular rock type and ensure that the blast pattern is well designed so that the explosives are evenly distributed. The correct blasthole diameters and an effective stemming column will be used for each blast (Orica, 1995). All care will be taken to ensure that there are few misfired shots by using good priming and charging practices. BGC will monitor blasting by videotaping every blast over a 12-month period. The tapes will be reviewed to confirm that all flyrock is being contained within the site boundary.	Flyrock will be contained within the site boundaries and will not adversely affect public health and safety.

Table ES3
Summary of the Proponent's Environmental Management Commitments

Environmental Factor	Commitment	Objective	Action	Timing (Phase)	Whose Advice	Measurement/Compliance Criteria
Environmental Management	1. Prior to the commencement of operations, the Proponent will develop an Environmental Management System (EMS) that will address the environmental issues associated with quarrying activities.	To ensure sound and systematic environmental management of the construction, operation and closure of the Project.	The Proponent will prepare an EMS as part of the company's business management strategy. The EMS will include plans for the environmental management of relevant environmental aspects such as: • groundwater; • surface water; • topsoil; • vegetation; • dieback; • fauna; • dust; • noise • airblast and ground vibration; and • visual amenity.	Prior to the commencement of operations.	-	Comments and feedback received from the regulatory authorities.
	2. The Proponent will ensure that all employees and contractors have completed the environmental, health and safety induction training.	To increase the environmental awareness of the personnel on site.	A training programme will be developed and formal inductions will occur for all new employees and contractors. The induction will cover safety, and environmental issues and management.	Development and implementation of the training programme will occur prior to the commencement of operations. Personnel will be required to complete the induction prior to commencing work at the site.	-	-
	3. The Proponent will establish a community liaison group to facilitate two-way communication about the site operations.	To facilitate communication between the Proponent, community and other key stakeholders.	Discussions with members of the Lakes Action Group and the relevant government agencies will facilitate confirmation of the structure of the group. Meetings will be held on a regular basis to ensure that all participants are aware of, and can discuss, the Proponent's plans for the Project.	Commence during the public review period of the PER and continue through life of the Project.	Shire of Northam and other relevant stakeholders	Key aspects of the discussions will be presented in the site's newsletter (Quarry Update).
Vegetation	4. The Proponent will monitor vegetation condition within the Project Area during the construction and operational phases of the Project, as recommended by Environment Australia. The monitoring programme will encompass both woodland and heath communities.	To ensure that the vegetation within the Project Area is adequately protected.	A monitoring programme will be developed to identify any changes in vegetation condition as a result of the proposed operations.	During the operational phase of the Project.	CALM	The results of the monitoring will be reported in the Annual Environmental Report (AER) to the DEP.
	5. The Proponent will not disturb heath community H5 and will maintain a 50 m buffer around this community during all phases of the Project.	To protect the *Hemigenia viscida* within the Project Area is a significant plant species, particularly heath community H5 (which contains 95% of the population with the Project Area)	Avoid disturbing heath community H5 and monitor the health of this community.	Throughout the Project life.	CALM	Internal audits will be conducted and the results from these audits will be reported to the DEP in the AER.
	6. The Vegetation Management Plan will be finalised with consideration of comments received during the public review period of the PER and in consultation with relevant stakeholders. The Proponent will implement the Vegetation Management Plan during the construction and operational phases of the Project.	To ensure that vegetation within the Project Area is adequately protected and that significant loss of priority flora does not occur.	The Proponent will adhere to the Vegetation Management Plan.	Throughout the construction and operational phases of the Project.	CALM and other relevant stakeholders	Internal audits will be conducted and the results from these audits will be reported to the DEP in the AER.

Table ES3 (continued)

Environmental Factor	Commitment	Objective	Action	Timing (Phase)	Whose Advice	Measurement/Compliance Criteria
Fauna	7. The preliminary Fauna Management Plan will be further developed in consultation with CALM and other relevant stakeholders once the results of the vertebrate fauna field survey are available. The Proponent will implement the Fauna Management Plan during the construction and operational phases of the Project.	To minimise adverse impacts on fauna assemblages in the Project Area as a result of proposal implementation.	The Proponent will be reviewed and finalised. The Proponent will adhere to the Fauna Management Plan.	Throughout the construction and operational phases of the Project.	CALM and other relevant stakeholders	Internal audits will be conducted and the results from these audits will be reported to the DEP in the AER.
	8. The Proponent will conduct a follow-up trapdoor spider survey in topographically similar areas, particularly Mt Dale.	To determine whether *Gaius* sp. population exists in other topographically similar areas.	A field trapdoor spider survey will be conducted in areas that are topographically similar to the Project Area, so determine if *Gaius* sp. occurs in these areas.	Prior to the construction of the Project.	WA Museum	The results of these investigations will be reported to the DEP in the AER.
Biodiversity	9. The Revegetation Strategy will be finalised with consideration of comments received during the public review period of the PER and in consultation with relevant stakeholders. The Proponent will implement the Revegetation Strategy after the commencement of construction activities.	To off-set the clearing of vegetation as a result of the Project and maintain biodiversity within the catchment.	The Proponent will investigate options for revegetation based on the draft strategy and implement the revegetation projects in consultation with stakeholders.	Complete 50 ha of revegetation within two years from the approval date for the Project and the remainder by the time that operations at the existing quarry cease.	CALM	The results of the strategy will be reported to the DEP in the AER.
Landform and Soil	10. The Soil Management Plan will be finalised with consideration of comments received during the public review period of the PER and in consultation with relevant stakeholders. The Proponent will implement the Soil Management Plan during the construction and operation of the proposed quarry.	To minimise the risk of land degradation and maintain or improve landscape functionality.	The Soil Management Plan will be reviewed and finalised, and the Proponent will adhere to the plan.	The plan will be finalised prior to construction and implemented throughout the construction and operational phases of the Project.	Department of Agriculture, WRC and other relevant stakeholders	Internal audits will be conducted and the results from these audits will be reported to the DEP in the AER.
Surface Water	11. The Surface Water Management Plan will be finalised with consideration of comments received during the public review period of the PER and in consultation with relevant stakeholders. The Proponent will implement the Surface Water Management Plan during the construction and operational phases of the Project.	To minimise erosion on site, particularly during the construction phase of the Project, and to ensure that water in excess of quarry requirements is of suitable quality so that it does not adversely impact downstream flows or water quality.	The Surface Water Management Plan will be reviewed and finalised, and the Proponent will adhere to the plan.	The plan will be finalised prior to construction and implemented throughout the construction and operational phases of the Project.	Department of Agriculture, WRC and other relevant stakeholders	Internal audits will be conducted and the results from these audits will be reported to the DEP in the AER.
	12. The Proponent will obtain a permit from the WRC to modify the bed and banks of the western stream.	To ensure that the modifications to the western stream are acceptable and conducted according to WRC requirements.	The Proponent will liaise with members of Swan Goldfields Agricultural Region (Northam) office to obtain a permit to modify the western stream.	Prior to the commencement of operations.	WRC	The results of the modifications will be reported to the DEP and WRC in the AER.
	13. The Proponent will sample the water in the pit sump and plant storage for TDS, TSS and EC, prior to release. The water quality results for the samples will meet the criteria in the DEP licence prior to release.	To ensure that the quarry operations do not adversely impact on downstream flows or water quality.	The pit water will be sampled and analysed by a National Association of Testing Authorities (NATA) accredited laboratory prior to release to the environment.	Prior to the release of excess water to the environment.	WR	Records of laboratory results will be internally audited on six monthly basis or as required under the DEP licence.

Table ES3 (continued)

Environmental Factor	Commitment	Objective	Action	Timing (Phase)	Whose Advice	Measurement/Compliance Criteria
Groundwater	14. The Groundwater Management Plan will be finalised with consideration of comments received during the public review period of the PER and in consultation with relevant stakeholders. The Proponent will implement the Groundwater Management Plan during the construction and operational phases of the Project.	To protect the quality and quantity of groundwater available to other users, including the environment.	The Groundwater Management Plan will be reviewed and finalised, and the Proponent will adhere to the plan.	The plan will be finalised prior to construction and implemented throughout the construction and operational phases of the Project.	Department of Agriculture, WRC and other relevant stakeholders.	Internal audits will be conducted and the results from these audits will be reported to the DEP and WRC in the AER.
	15. The Proponent will monitor quantity and quality of seepage inflow and the depth of water in monitoring bores.	To develop a sound understanding of the site water balance during various stages of the Project.	Sample any seepage inflow in the pit to characterise flows.	Operational phase.	-	Internal audits will be conducted and the results from these audits will be reported to the DEP in accordance with licence requirements.
	16. The Proponent will install a monitoring bore between the proposed quarry and the nearest private bore.	To monitor variations in groundwater levels within the cone of drawdown and outside the cone-of drawdown.	Install a monitoring bore at a suitable location between the proposed quarry and nearest private bore. Monitor the groundwater levels on a monthly basis.	Install the bore prior to the commencement of construction activities. Monitor water levels throughout the life of the Project.	-	Records of the monitoring data will be kept on site and reviewed on a six monthly basis. Data will be reported to the DEP in the AER.
	17. The Proponent will monitor the amount of groundwater abstracted from the quarry sump and from any pumps placed in the two south-eastern bores.	To provide additional information for the determination of the site water balance during the various stages of the Project.	Record the volumes of water abstracted from the quarry sump.	Operational phase.	WRC	Records of the monitoring data will be kept on site and reviewed on a six monthly basis. Data will be reported to the DEP in the AER.
Noise and Vibration	18. BGC will undertake building surveys of nearest residences prior to the commencement of the proposed operation to provide a baseline against which claims of damage due to ground vibration can be evaluated. A copy of the results will be provided to the relevant residents.	To evaluate damage caused by ground vibration as a result of the blasting conducted at the existing quarry operations.	The Proponent will conduct the building surveys prior to the commencement of the proposed operations and provide a copy of the results to the residents.	Prior to the commencement of operations.	-	Results of the surveys will be provided to the DEP in the AER.
	19. The Airblast and Ground Vibration Management Plan will be finalised with consideration of comments received during the public review period of the PER and in consultation with relevant stakeholders. The Proponent will implement the Airblast and Ground Vibration Management Plan during the construction and operational phases of the Project.	To ensure that noise and vibration levels comply with statutory requirements.	The Airblast and Ground Vibration Management Plan will be reviewed and finalised, and the Proponent will adhere to the plan.	The plan will be finalised prior to construction and implemented throughout the construction and operational phases of the Project.	-	Internal audits will be conducted and the results from these audits will be reported to the DEP in accordance with licence conditions.
Dust and Particulates	20. The Dust Management Plan will be finalised with consideration of comments received during the public review period of the PER and in consultation with relevant stakeholders. The Proponent will implement the Dust Management Plan during the construction and operational phases of the Project.	To ensure the levels of dust and particulate emissions are miniised.	The Dust Management Plan will be reviewed and finalised, and the Proponent will adhere to the plan.	The plan will be finalised prior to construction and implemented throughout the construction and operational phases of the Project.	-	Internal audits will be conducted and the results from these audits will be reported to the DEP in the AER.
Flyrock	21. BGC will monitor blasting over a 12-month period by videotaping each blast. The tapes will be reviewed to confirm that flyrock is being contained within the site boundaries.	To ensure that flyrock is confined within the quarry pit.	The Proponent will videotape and review the tape for every blast for a 12-month period.	During the fist 12 months of the operational phase of the Project.	MPR	Tapes will kept on record. Results will be reported to the DEP in the AER.

Table ES3 (continued)

Environmental Factor	Commitment	Objective	Action	Timing (Phase)	Whose Advice	Measurement/Compliance Criteria
Visual Amenity	22. The Visual Impact Management Plan will be finalised with consideration of comments received during the public review period of the PER and in consultation with relevant stakeholders. The Proponent will implement the Visual Impact Management Plan during the construction and operational phases of the Project.	To minimise the visual impact of the Project.	The Proponent will adhere to the Visual Impact Management Plan.	Throughout the construction and operational phases of the Project.	-	Internal audits will be conducted and the results from these audits will be reported to the DEP in the AER.
	23. The Proponent will investigate and install appropriate lighting technology to minimise light overspill.	To ensure that the most suitable lighting technology is used for the Project.	The Proponent will investigate and implement the most appropriate lighting technology for the site.	Prior to the commencement of operations.	-	The results of the investigation will be reported to the DEP in the AER.
Site Decommissioning and Closure	24. Prior to closure of the Project, the Proponent will review its planning for the closure, decommissioning and rehabilitation of the Project. This review will address, but will not necessarily be limited to, the following: • the removal of infrastructure; • the rehabilitation of disturbed areas in the Project Area; • the development of a closure solution for the quarry pit, which is acceptable to regulatory authorities; and • the identification and remediation of any contaminated areas (if any exist at the time).	To ensure that the Project Area is left in a safe and stable condition, so there is no future liability for the Proponent or the State.	Planning for the closure, decommissioning and rehabilitation of the Project will be reviewed by the Proponent in consultation with relevant government agencies and other stakeholders.	During the operational phase of the Project.	WRC, CALM and other relevant stakeholders	The findings of the review will be reported through the AER to the DEP.
	25. In the event that the quarry pit is to be left open (i.e. not backfilled), BGC will assess the long-term stability of the pit edge and fractured rock zone as part of its closure planning process. The findings of this assessment and any management measures required to ensure that any risk to public safety is minimised, will be documented in the site's decommissioning and closure plan.	To ensure that the post-mining landform is safe, stable and non-erodible.	If the quarry pit is to be left open, the Proponent will conduct appropriate geotechnical investigations to determine the potential zone of instability and will investigate the management measures (such as construction of an abandonment bund and installation of signage) that would be required.	During the operation of the Project.	DMPR and other relevant stakeholders	Comments from stakeholders on the site's draft decommissioning and closure plan.

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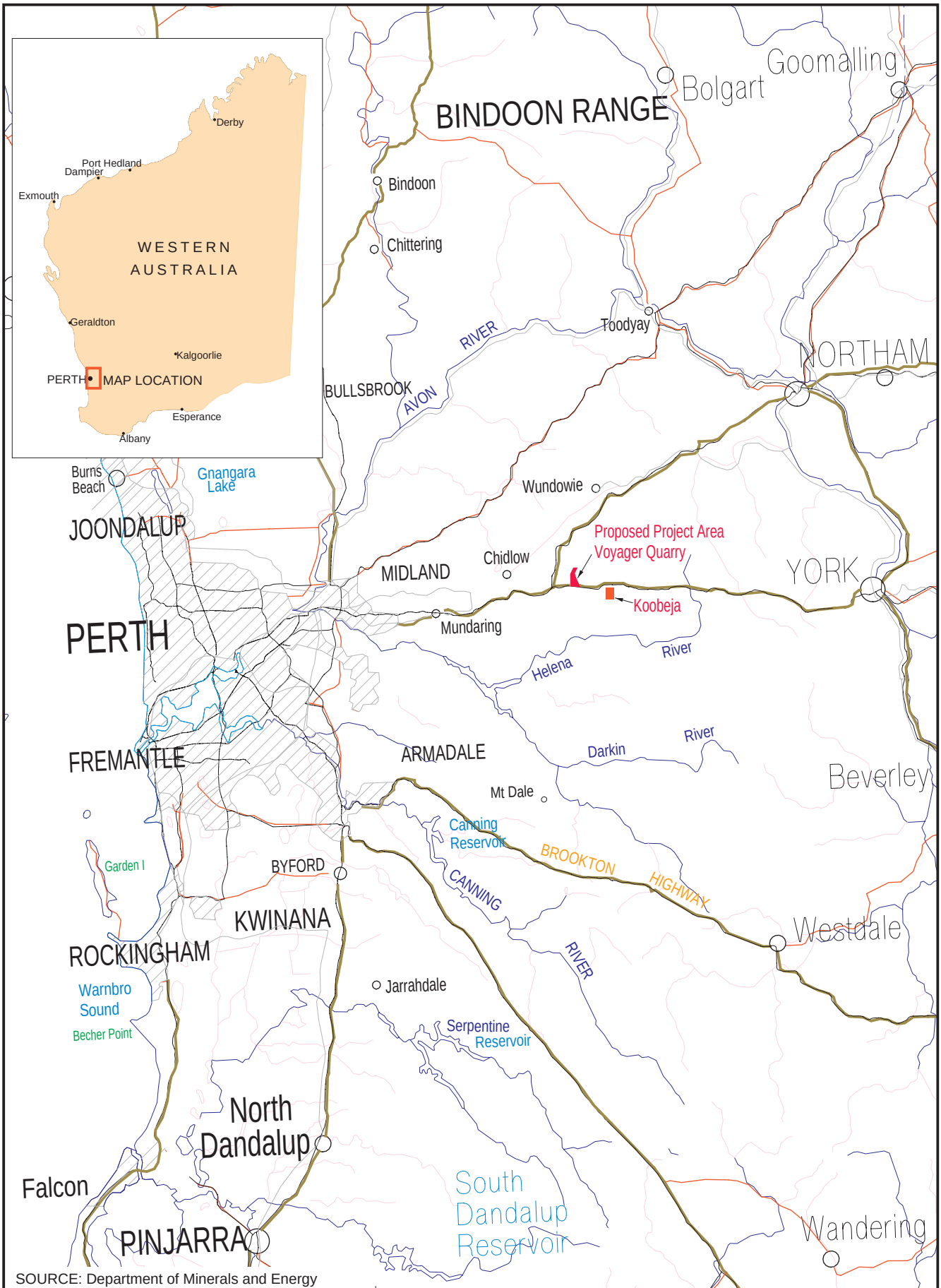

SOURCE: Department of Minerals and Energy

Figure ES 1

PUBLIC ENVIRONMENTAL REVIEW
PROPOSED RELOCATION OF THE VOYAGER QUARRY

REGIONAL LOCATION MAP

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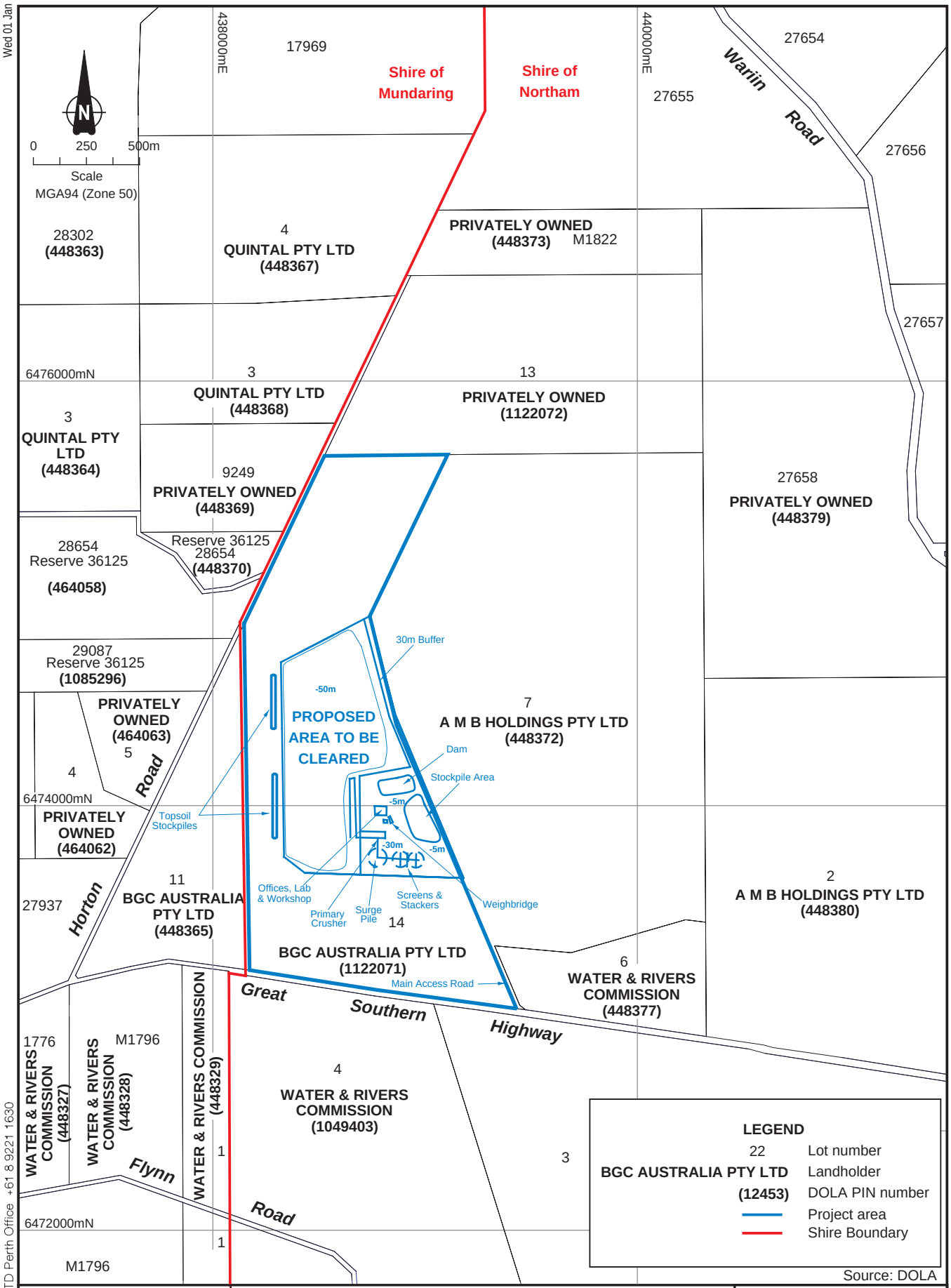

PUBLIC ENVIRONMENTAL REVIEW
PROPOSED RELOCATION OF THE VOYAGER QUARRY

LAND TENURE

Figure ES 2

URS AUSTRALIA PTY LTD Perth Office +61 8 9221 1630

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Wed 01 Jan 03

436000 mE
438000 mE
440000 mE
442000 mE
6476000 mN
6474000 mN

N

0 500 1000 m

Scale
MGA94 (Zone 50)

Residence A
Residence B
Residence C
Residence D
Residence E
Residence F

30m Buffer
Existing Bund
Primary Crusher
Dam
Stockpile Area
Tertiary Crusher
Office
Existing Bund
Weighbridge
Screens & Stackers
Surge Pile
Primary Crusher
Offices, Lab & Workshop
Topsoil Stockpiles
Main Access Road

-50m
-5m
-30m
-5m

CATCHMENT BOUNDARY

SOURCE: DOLA, Water and Rivers

BGC

PUBLIC ENVIRONMENTAL REVIEW
PROPOSED RELOCATION OF THE VOYAGER QUARRY

LAYOUT OF EXISTING AND PROPOSED OPERATIONS

Figure ES 3

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