Red Hill Quarry Development Proposal

Public Environmental Review

Prepared for
Hanson Construction Materials Pty Ltd
by Strategen

June 2008

Red Hill Quarry Development Proposal

Public Environmental Review

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Client: Hanson Construction Materials Pty Ltd

Report	Version	Prepared by	Reviewed by	Submitted to Client	
				Copies	Date
Preliminary Draft Report	V1	MC/JM/BS/JN	CWe/KO	1 x hardcopy 1 x CD	17/01/08
Draft Report to EPA	V2	JN	Client	4 x hardcopy 1 x CD	12/02/08
Draft Report	V3	JN	Client	1 x CD	08/05/08
Final Report to EPA	FINAL	JN	-	2 x hardcopy	13/05/08

AN INVITATION TO COMMENT ON RED HILL QUARRY DEVELOPMENT PROPOSAL

PUBLIC ENVIRONMENTAL REVIEW

Invitation to make a submission

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal. The environmental impact assessment process is designed to be transparent and accountable, and includes specific points for public involvement, including opportunities for public review of environmental review documents. In releasing this document for public comment, the EPA advises that no decisions have been made to allow this proposal to be implemented.

Hanson Construction Materials Pty Ltd (Hanson) propose to continue to develop the Red Hill Quarry pit to the north and west of the current quarry pit, to increase the area available for hard rock extraction and enable long-term continuation of quarry operations. The disturbance footprint of the proposed quarry development will be approximately 75 hectares (ha), which will be progressively cleared over the life of the quarry (around 100 years). Hanson also propose to extend the area of the existing stockpile and dispatch area by approximately 5 ha, relocate and/or upgrade existing crushers and/or add new crushers to the existing processing plant.

In accordance with the *Environmental Protection Act 1986*, a Public Environmental Review (PER) has been prepared which describes this proposal and its likely effects on the environment. The PER is available for a public review period of 8 weeks from **Monday 23 June 2008**, closing on **Monday 18 August 2008**.

Comments from government agencies and from the public will assist the EPA to prepare an assessment report in which it will make recommendations to government.

Where to get copies of this document

Printed and CD copies of this document may be obtained from:

Name: John Symonds

Address: Hanson Construction Materials Pty Ltd, 123 Burswood Road, VICTORIA PARK, WA 6100

Phone: (08) 9311 8852

e-mail: john.symonds@hanson.biz

Hard copies of the PER may be purchased at a cost of $10.00 per copy, or a CD-ROM version will be provided (no charge). The PER may also be accessed through the proponent's website at:
www.hansoncm.biz/corporateresponsibility/redhill.shtml

Why write a submission?

A submission is a way to provide information, express your opinion and put forward your suggested course of action – including any alternative approaches. It is useful if you indicate any suggestions you have to improve the proposal.

All submissions received by the EPA will be acknowledged. Electronic submission will be acknowledged electronically. The proponent will be required to provide adequate responses to points raised in submissions. In preparing its assessment report for the Minister for the Environment, the EPA will consider the information in submissions, the proponent's responses and other relevant information. Submissions will be treated as public documents unless provided and received in confidence, subject to the requirements of the *Freedom of Information Act*, and may be quoted in full or in part in each report.

Why not join a group?

If you prefer not to write your own comments, it may be worthwhile joining with a group or other groups interested in making a submission on similar issues. Joint submissions may help to reduce the work for an individual or group, as well as increase the pool of ideas and information. If you form a small group (up to ten people) please indicate the names of all participants. If your group is larger, please indicate how many people your submission represents.

Developing a submission

You may agree or disagree with, or comment on, the general issues discussed in the PER or with the specific proposals. It helps if you give reasons for your conclusions, supported by relevant data. You may make an important contribution by suggesting ways to make the proposal environmentally more acceptable.

When making comments on specific elements of the PER:

- clearly state your point of view
- indicate the source of your information or argument if this is applicable
- suggest recommendations, safeguards or alternatives.

Points to keep in mind

By keeping the following points in mind, you will make it easier for your submissions to be analysed:

- attempt to list points so that the issues raised are clear; a summary of the submission is helpful
- refer each point to the appropriate section, chapter or recommendation in the PER
- if you discuss different sections of the PER, keep them distinct and separate, so there is no confusion as to which section you are considering
- attach any factual information you wish to provide and give details of the source; make sure your information is accurate.

Remember to include:

- your name
- your address
- the date
- whether you want your submission to be confidential.

The closing date for submission is **Monday 18 August 2008**.

The EPA prefers submissions to be sent in electronically using one of the following:

- the submission fom on the EPA's website: www.epa.wa.gov.au/submissions.asp
- by email to submissions.eia@dec.wa.gov.au

Alternatively, submissions can be:

- posted to: Chairman, Environmental Protection Authority, Locked Bay 33, CLOISTERS SQUARE WA 6850, Attention: Ann Stubbs
- delivered to the Environmental Protection Authority, Level 4, The Atrium, 168 St Georges Tce, PERTH, Attention: Ann Stubbs
- faxed to (08) 6467 5562, Attention: Ann Stubbs.

If you have any questions on how to make a submission, please ring the EPA assessment officer, Ann Stubbs on (08) 6467 5409.

EXECUTIVE SUMMARY

INTRODUCTION

Hanson Construction Materials Pty Ltd (Hanson) is the proponent for the Red Hill Quarry Development proposal (the proposal). Hanson operates the existing Red Hill Quarry (Lot 11, Toodyay Road), which produces around 1,000,000 t/yr of granite and diorite/dolerite aggregate for the building and construction industries.

In order to provide long-term access to the onsite hard rock resource, Hanson proposes to continue to develop the quarry to the north and west of the current pit. The proposal also includes an extension to the existing stockpile and dispatch area and may also require the relocation and/or upgrade of existing crushers and/or installation of new crushers to the existing processing plant (including installation of additional support infrastructure as required [e.g. additional conveyors and screens and extension of processing buildings]).

Red Hill is Hanson's most significant capital investment in Western Australia and is an important supplier to the civil construction industry in the Perth Metropolitan Area. Some areas of Lot 11 are recognised as a 'Key Extraction Area' and as a 'Priority Resource Location' (as recognised by the Western Australian Planning Commission) that is considered essential in meeting the long-term supply requirements of basic raw materials for the Perth Metropolitan Area.

LOCATION

The Red Hill Quarry is located approximately 25 km north-east of Perth on the Darling Plateau, immediately east of the Darling Scarp, on Lot 11 Toodyay Road, Red Hill.

TENURE

Lot 11 is owned by Hanson and is around 800 ha in area. Lot 11 is located on freehold land within the City of Swan and is zoned Resource and Landscape 5 (extractive industry is a permitted land use) under the City of Swan Town Planning Scheme and Rural under the Metropolitan Region Scheme.

ASSESSMENT PROCESS AND EPA ADVICE

The Red Hill Quarry Development proposal was referred to the Environmental Protection Authority (EPA) under section 38 of the *Environmental Protection Act 1986* (EP Act), with a supporting Draft Environmental Scoping Document, on 2 February 2007. On 12 February 2007, the EPA advised the level of assessment for the project was a Public Environmental Review (PER) with an eight week public review period.

The proposal was referred on 27 April 2007 to the then Commonwealth Department for the Environment and Water Resources (now Department of Environment, Water, Heritage and the Arts) under the *Environment Protection and Biodiversity Conservation Act 1999*. On 28 May 2007, the Department advised that the action was not considered to be a controlled action.

THE PROPOSAL

The principal activities of the Red Hill Quarry Development proposal will be quarrying, crushing, screening and transportation of crushed granite and diorite/dolerite. The key components of the proposal (Table S1 and Figure S1) are described as:

- the area of quarry pit for hard rock extraction is proposed to be extended to the north and west of the existing quarry pit by approximately 75 ha over 100 years (or on average less than 1 ha/yr)
- throughput and number of haul truck movements is proposed to increase by approximately 50% in the short-term
- quarrying will continue to be undertaken using conventional drill and blast, load and haul and will utilise existing infrastructure and services at the Red Hill site
- blasted rock will continue to be hauled by truck from the quarry face to the processing plant for crushing and screening, whereafter the product will be hauled offsite for sale
- some of the existing crushers may be relocated as the pit expands and/or upgraded, and/or additional crushers may be added to the existing processing plant (including installation of additional support infrastructure as required [e.g. additional conveyors and screens and extension of processing buildings])
- product will continue to be stockpiled and dispatched from the existing stockpile and dispatch area, which is proposed to be increased in area by approximately 5 ha
- fines and other undesirable material will continue to be stockpiled for re-use, on-sale or disposal at the existing stockpile and dispatch area
- water consumption for the purposes of processing and dust suppression will increase by approximately 15% (which is less than the proposed short-term increase in throughput) and will continue to be supplied from onsite sources.

Table S1 Key characteristics of the Red Hill Quarry Development proposal

Element	Existing project	Proposed project
General		
Layout	Refer Figure S1	Refer Figure S1
Water consumption	100,000 kL/yr	Approximately 115,000 kL/yr
Water supply	Onsite: • two sedimentation dams • quarry pit sump • Herne Hill quarry pit sump (emergency supply)	Same sources as for existing project
Quarry		
Life of quarry	Approximately another 18 months	Approximately 100 years
Extraction method	Open pit using conventional drill and blast, and load and haul	As existing
Overburden disposal	In pit disposal, ramps, bunds, rehabilitation and stockpile	As existing
Topsoil	Direct onto areas undergoing rehabilitation or stockpiled	As existing
Processing facilities		
Throughput	Approximately 1,000,000 t/yr (2005/2006)	Up to 1,500,000 t/yr in the short-term

Element	Existing project	Proposed project
Processing plant	Primary, secondary and tertiary crushers and screens	Same as for existing project Some of the existing crushers may be relocated and/or upgraded, and/or additional crushers installed (including installation of additional support infrastructure as required [e.g. additional conveyors and screens and extension of processing buildings])
Product stockpiles	10 ha	15 ha (inc. area of existing product stockpile)
Disturbance area		
Quarry pit	Approximately 29 ha	Approximately 104 ha (inc. existing approved pit)
Infrastructure (processing and stockpile areas, offices, workshops, roads, dams)	Approximately 45 ha	Approximately 50 ha (inc. existing infrastructure areas)
Overburden dump	Approximately 7 ha	As existing
Total area disturbed	Approximately 81 ha	Approximately 161 ha (inc. existing disturbed areas)

Key: ha = hectares; kL/yr = kilolitres per year; t/yr = tonnes per year

STAKEHOLDER CONSULTATION

Hanson initiated a stakeholder consultation program for the Red Hill Quarry Development proposal towards the end of 2006, prior to submission of the referral of the project to the EPA in January 2007. The key stakeholders consulted before and during the preparation of the PER included:

- Government agencies
- non-government organisations
- local government authorities
- Members of Parliament
- range of community interest groups
- neighbours and local residents.

The level of stakeholder involvement in the consultation process varied between stakeholders depending on the interest of the stakeholder.

KEY ISSUES RAISED

The main issues raised by stakeholders related to:

- affects on amenity, including affects arising from noise and vibration, dust and visual impacts
- impacts on surface and groundwater quality and quantity
- affects on flora and fauna, including the spread of weeds, dieback and feral fauna
- movement of heavy vehicles on Toodyay Road and other roads
- rehabilitation and end-use
- Aboriginal heritage.

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EXISTING AND PROPOSED QUARRY OPERATIONS

Hanson Construction Materials Pty Ltd

RED HILL QUARRY DEVELOPMENT PROPOSAL

Figure S1

412 000mE

413 000mE

414 000mE

6 479 000mN

6 478 000mN

NORTH

0 100 200

METRES

REFERENCE

- Red Hill Quarry (Lot 11) site
- Approved pit area of existing operation
- Area of disturbance of existing operation
- Stockpile extension area of proposed operation
- Pit development area of proposed operation

Susannah Brook

Northern dam

Primary crusher

Conveyor

Red Hill Quarry pit

Secondary and tertiary crushers and screens.

Weighbridge

Site office / laboratory

Site entrance

ROAD

Herne Hill Quarry (former)

Overburden dump

Proposed stockpile extension

Stockpile and despatch area

Strelley Brook

South western dam

TOODYAY

The issues raised by stakeholders have been addressed in this PER, and specifically, the following studies investigated key areas of concern:

1. **Vegetation and flora studies** to assess potential impacts to the conservation status of those species known or likely to occur in the project area (Mattiske 2007; 2008).
2. **Dieback assessment** to assess the presence of *Phytophthora cinnamomi* in vegetated areas adjacent to operational areas on Lot 11 (Department of Environment and Conservation [DEC] 2008).
3. **Fauna (including short-range endemics) studies** to assess the potential impacts to the conservation status of those species known or likely to occur in the project area (Harris and Bamford 2007a, 2007b; Bancroft, Harris and Bamford 2007).
4. **Surface water studies** to assess potential impacts to surface hydrology regimes, including water quantity and quality (Aquaterra 2007a).
5. **Hydrogeological studies** to assess potential impacts to local and regional groundwater resources (Aquaterra 2007b).
6. **Noise and vibration studies** to determine the current noise emission and vibration levels and to assess potential noise and vibration impacts (SVT 2007).
7. **Visual amenity study** to assess the likely visibility and appearance of the proposed quarry development and the effect this will have on the landscape values of the area (John Cleary Planning 2007).
8. **Aboriginal heritage studies** investigating the presence and significance of Aboriginal heritage features of the project area (Clarke 2006, Mattner and Bergin 2007).

Hanson will continue to consult with the wider community regarding the proposal by providing information on their website and through regular newsletters. Hanson has also formed the Red Hill Quarry Stakeholder Reference Group and is progressing consultation with relevant Aboriginal groups.

ENVIRONMENTAL IMPACT ASSESSMENT AND MANAGEMENT

Environmental factors relevant to this proposal were identified through the scoping process and are presented in this document along with additional environmental considerations identified during the detailed assessment process. The key environmental factors that have been addressed in this PER are:

- vegetation and flora
- fauna
- visual amenity
- surface water (Susannah and Strelley brooks – water quantity and quality)
- groundwater
- noise and vibration
- air quality (dust)
- Aboriginal heritage
- public risk and safety
- greenhouse gases
- rehabilitation and closure.

Three environmental factors were not addressed in detail as they are considered to be minor factors given the existing management measures in place and the low probability of the proposal affecting these factors. These minor factors are:

- waste management
- light spill
- conservation areas.

VEGETATION AND FLORA

The proposed continued development of the Red Hill Quarry will result in the progressive clearing of approximately 80 ha of vegetation over the estimated 100 year life of the proposed development (or an average of less than 1 ha/yr). There is an increased risk of the introduction and/or spread of weeds and dieback; however, this will be mitigated through Hanson's weed and dieback control and hygiene management measures.

The proposal is unlikely to significantly affect local and regional vegetation values due to the affected vegetation complexes and site-vegetation types being relatively well represented locally (e.g. John Forrest National Park, Darling Range Regional Park) and regionally (e.g. northern Jarrah forest). None of the vegetation complexes will fall below 30% of their pre-European extent as a result of this proposal.

The proposed development will result in the disturbance of known occurrences of three Priority flora species; *Calothamnus ruprestris*, *Halgania corymbosa* and *Acacia oncinophylla* subsp. *oncinophylla*. All three species are known to occur outside of the proposed disturbance footprint on Lot 11, in the adjacent area of the Darling Range Regional Park, and are known from other sites within the northern Jarrah forest. No recorded Threatened Ecological Communities (TECs) or Declared Rare Flora (DRF) populations will be directly or indirectly affected by the proposal.

Consistent with EPA objectives, the abundance, species diversity, geographic distribution and productivity of flora at species and ecosystems levels will be maintained thereby conserving regional biological diversity. The implementation of the Environmental Management Plan addressing vegetation and habitat protection will ensure potential impacts are avoided wherever practicable.

FAUNA

Approximately 80 ha of fauna habitat will be progressively disturbed over the 100 year life of the proposed development (an average of less than 1 ha/yr). The disturbance will result in the direct loss of habitat, potentially leading to fragmentation and loss of connectivity. The habitats identified in the proposed survey area are not unique to the area with extensive areas containing similar habitats conserved in nearby John Forrest National Park, the Darling Range Regional Park and Walyungah National Park.

Hanson has made a commitment to retain and enhance (by rehabilitation of disturbed areas) north – south vegetated corridors on the east and western side of quarry operations and an approximate 100 m east – west vegetated corridor along either side of Susannah Brook to provide a buffer to quarrying operations. This will maintain the connection between John Forrest National Park and the Darling Range Regional Park, as well as retaining the riparian linkage along Susannah Brook from the east into the Darling Range Regional Park.

There is unlikely to be significant impacts to fauna of conservation significance at a local or regional level. Other potential impacts to fauna, including vehicle movements, noise, lighting and potential increase in feral fauna populations, will continue to be managed to avoid and minimise such impacts. Implementation of the Environmental Management Plan addressing habitat protection will ensure potential impacts are avoided or minimised. Therefore, consistent with EPA objective, the abundance, diversity, distribution and productivity of fauna at species and ecosystem levels will be maintained.

VISUAL AMENITY

The proposal will increase the area of the quarry pit visible to some residences with existing views and will also increase the number of residences with views to the quarry (i.e. opening up views to residences that do not currently have views of the existing quarry).

The modelling indicated that most changes to the identified landscape values resulting from the proposed development that will be visible from surrounding residences and public locations will be minor and significant changes will only be visible from a small number of residences (approximately 4 – 5 residences) to the north-east of the site. The main changes being:

- additional pit face being visible from locations with existing views
- new pit face being visible from locations that do not have existing views.

The modelling indicates that the potential visual affects of the proposed development will vary spatially between areas in the study area (i.e. the visibility and appearance of the proposed development will vary between sites). The natural ridgelines assist to make the proposed pit faces relatively unseen from the north-west and also reduce the extent of seen disturbed area so that less is generally seen from any one location. The western extent of the proposed development does not 'break-through' to the former Herne Hill Quarry, restricting any views into the proposed development from the west. The northern extent of the proposed development (towards Susannah Brook) is highly visible from localised areas to the north and to the north-east to a lesser extent.

The modelling also indicates that the potential visual affects of the proposed development will vary temporally between areas in the study area as the proposed quarry develops over the anticipated 100 year life of the proposal.

Hanson will continue to progressively rehabilitate terminal pit benches in accordance with the Red Hill Quarry Screening and Rehabilitation Program, which will reduce the contrast between the pit face and surrounding vegetation, and will continue to investigate opportunities to modify pit design to further reduce visual impacts. Hanson will also continue to consider visual screening for residences to the north and north-east of the quarry that are visually affected by the proposal.

Taking existing and proposed management measures into consideration, the proposal is regarded as being consistent with the objectives of the Landscape zoning (under the City of Swan Town Planning Scheme) and with the EPA objectives for visual amenity and landscape and landforms.

SURFACE WATER: SUSANNAH AND STRELLEY BROOKS – WATER QUANTITY AND QUALITY

The proposal will reduce the catchment area of Susannah and Strelley brooks by approximately 2% and 0.4% respectively and, as a result, may reduce the quantity of water entering these streams. The Susannah Brook stream stage height is estimated to drop by around 10 to 20 mm (based on the rating curve for the Brook) due to the reduction in catchment area. This drop will occur gradually over the 100 year life of the proposed development. Any reduction in stream flow as a result of the proposed

development is not expected to cause any significant impact to the two streams or any associated surface water-dependent ecosystems. There will be no direct physical disturbance either to Susannah Brook or within the 50 – 100 m buffer on both sides of Susannah Brook that will be maintained by Hanson.

The proposed development has the potential to affect water quality in Susannah and Strelley brooks through hydrocarbon spills or discharge of turbid runoff to the watercourses. Consistent with existing drainage management measures, all runoff from disturbed areas will be diverted to onsite sedimentation dams or the in-pit sump, sediment and grease and oil traps will continue to be used and storage and handling of hydrocarbons will continue to be in accordance with relevant legislation and standards.

Current monitoring results indicate that the existing quarry operations have had no effect on water quality and, therefore, continued implementation of existing management measures (detailed in the Environmental Management Plan) throughout the proposed development will ensure that water quality within Susannah and Strelley brooks is not adversely affected by the operation. Consistent with the EPA objective for this factor, the quantity and quality of water within Susannah and Strelley brooks will not be adversely affected by the proposed development and all existing and potential environmental values will be protected.

GROUNDWATER

The excavation of the proposed pit is not expected to result in any significant adverse impacts to local or regional hydrogeological regimes. Local groundwater receptors (including groundwater supplies, streams and/or groundwater-dependent ecosystems or users) would typically utilise the elevated perched aquifers which are isolated from any deeper aquifers the quarry may potentially excavate in to. Data from the adjacent Red Hill Waste Management Facility suggests any perched aquifers would be isolated and at most, have only local influence. The quarry area is also not thought to have any significant association with the groundwater aquifers of the Swan Coastal Plain. There is a low risk for contamination of groundwater resources in the event of spills of potentially hazardous materials due to onsite management measures. The EPA objective to maintain the quantity of groundwater so that environmental values are protected will be met.

NOISE AND VIBRATION

Noise emissions from the Red Hill Quarry were predicted for current and proposed operations and compliance with the Environmental Protection (Noise) Regulations 1997 (Noise Regulations) assessed. Noise emissions from the current operation were determined to be in compliance with the Noise Regulations.

Noise will be generated at the Red Hill Quarry throughout all stages of the proposed development by the drilling, blasting, crushing, processing, loading and transport of rock. The proposed quarry development will remove natural barriers to noise (i.e. hills and ridges) which may increase operational and blast noise levels by a small amount (but within assigned noise levels prescribed in the Noise Regulations) at noise-sensitive premises around the quarry. Predicted noise levels indicate that most stages of the proposed development will be in compliance with the Noise Regulations. Predicted noise levels will be within 5 dB of the assigned noise levels between 0600 and 0700 hours at one monitoring location during stages 5 – 8 (years 2032 – 2055). If the assigned noise level was found to be exceeded through monitoring, Hanson may be deemed to have significantly contributed to this exceedance if its predicted noise level was less than 5dB below the assigned noise level. Hanson will implement appropriate noise management measures during these times in order to maintain

compliance with the Noise Regulations. Adoption of improved technologies over the life of the proposal may also reduce noise emissions.

All blasts at the quarry are monitored for blast overpressure and ground-borne vibrations. Monitoring results indicate that current blasting activities are in compliance with the Noise Regulations. Maintenance of current blasting procedures and noise management measures (detailed in the Environmental Management Plan) will ensure that noise and vibration generated by blasting conforms to the requirements of the Noise Regulations.

The proposed Red Hill Quarry development will meet noise and vibration parameters prescribed in the Noise Regulations ensuring the proposed development meets the EPA objective for this factor.

AIR QUALITY (DUST)

Dust will potentially be generated by a number of activities associated with the quarry operation. Dust is unlikely to have a significant affect on nearby residences due to the dust management measures that will continue to be implemented during the development and operation of the quarry. Implementation of the proposed management actions (detailed in the Environmental Management Plan) will be sufficient to meet the EPA objective of not adversely affecting environmental values or the health, welfare and amenity of people and land uses.

ABORIGINAL HERITAGE

Hanson has investigated the likelihood of the presence of matters of Aboriginal heritage significance in the proposed development area and has analysed potential impacts to such sites as a result of the proposal. Hanson is also progressing consulting with the relevant Aboriginal groups.

No registered ethnographic or archaeological sites will be disturbed by the proposed development. Two registered ethnographic sites are in proximity to the project area; Susannah Brook and a white ochre deposit. Consistent with the EPA objective for this factor and the *Aboriginal Heritage Act 1972*, the biophysical environment of both sites will continue to be protected from disturbance using current management measures. A rock shelter was identified within the proposed development area, however, Mattner and Bergin (2007) advises that the rock shelter does not meet criteria for registration as a protected Aboriginal heritage site under the *Aboriginal Heritage Act 1972*.

PUBLIC RISK AND SAFETY

Increased vehicle movements of aggregate, hydrocarbons and explosives could potentially pose a road safety risk to the general public, in particular, users of Toodyay Road. The proposed development will result in an increase in the number of heavy vehicle movements on Toodyay Road. In addition, the road is recognised as a primary freight route and is utilised by heavy vehicles to access sites other than the quarry. Through the continued implementation of risk mitigation measures (detailed in the Environmental Management Plan), potential risk to road users will be minimised and the EPA objective of ensuring the risk associated with the proposal is as low as reasonably practicable is met.

GREENHOUSE GASES

Based on an increase in product throughput from 1,000,000 to 1,500,000 t/yr, the proposed development will result in a net increase in the annual greenhouse gas emission levels from approximately 5,513 tCO_2-e to approximately 7,240 tCO_2-e (from fuel, power and explosives consumption). This is an approximate 40% increase in emissions. Emissions resulting from clearing

approximately 80 ha of vegetation over the estimated 100 year life of the proposal will be approximately 15,000 tCO_2, or 150 tCO_2/yr. Implementation of Hanson's commitments made through the National Greenhouse Challenge Plus initiative and the company's Energy Management Policy, will enable the company to minimise emissions and provide a mechanism for continuous improvement in greenhouse gas emissions resulting from the proposed development. Commitments will be consistent with the EPA objective of minimising emission levels as low as practicable.

REHABILITATION AND CLOSURE

Hanson will continue to implement the existing Red Hill Quarry Screening and Rehabilitation Program, which will be amended as necessary to accommodate changes in industry best-practice and/or improved practices based on monitoring results. Hanson has prepared a Red Hill Quarry Conceptual Closure Plan and will update the Plan to incorporate technological and societal changes that are likely to occur throughout the expected 100 year life of the proposed operation. Review of the Screening and Rehabilitation Program and the Conceptual Closure Plan will be undertaken in consultation with relevant stakeholders to ensure that rehabilitation and closure issues are addressed at the earliest stage in the quarry-life and that they are managed appropriately to meet the EPA objective of ensuring rehabilitation achieves a stable and functioning landform consistent with surrounding landscape.

ENVIRONMENTAL MANAGEMENT FRAMEWORK

The environmental protection principles (listed in s4a of the EP Act) are reflected in Hanson's Environmental Policy and Environmental Management System (EMS). Hanson is also a member of the Commonwealth Greenhouse Challenge Plus and operates to an Energy Management Policy. Hanson also maintains an environmental management system consistent with ISO 14001, which is an international standard that encompasses all of its activities.

The environmental aspects of the proposal will be primarily managed through the implementation of the management actions in the Red Hill Quarry Environmental Management Plan (EMP) and the Screening and Rehabilitation Program, as well as under relevant licences. Hanson will ensure an acceptable closure outcome through the preparation of a Closure Management Plan for the Red Hill Quarry in consultation with relevant stakeholders.

ENVIRONMENTAL MANAGEMENT PLAN

The EMP will be implemented to specifically address management of environmental issues potentially arising from the operation of the Red Hill Quarry Development Project. The EMP addresses the following factors:

- vegetation and habitat protection
- fauna protection
- surface water quality management
- noise and vibration control
- dust control
- fire management
- traffic management.

A Conceptual Closure Plan is also detailed in the EMP.

The EMP includes details of monitoring that will be undertaken and will be regularly reviewed and revised as required.

SCREENING AND REHABILITATION PROGRAM

The Red Hill Quarry Screening and Rehabilitation Program reflects the current procedures for rehabilitation activities and management of weeds and dieback. The Program will continue to be updated as new methods become available in response to monitoring, site factors (e.g. location of the resource), environmental factors (e.g. soil stability and moisture), and visual observations.

KEY MANAGEMENT ACTIONS AND PROPOSED ENVIRONMENTAL CONDITIONS

Hanson has developed Key Management Actions and proposed Environmental Conditions to address key environmental aspects of the proposed development and so as not to duplicate management requirements of other regulatory controls. These Key Management Actions and Environmental Conditions are intended to be incorporated into the Ministerial Statement to apply to the whole operation (i.e. current and proposed operation) to replace existing conditions and proponent commitments of Ministerial Statements No. 199 and 705 that apply to the current operation.

OTHER APPLICABLE REGULATORY CONTROLS

Key environmental legislation or controls that apply to the Red Hill Quarry operation include:

- EP Act Part V Environmental Licence
- Development Approval and Excavation Licence
- *Wildlife Conservation Act 1950*
- *Aboriginal Heritage Act 1972*
- *Dangerous Goods Safety Act 2004* and associated regulations
- Environmental Protection (Noise) Regulations 1997.

ENVIRONMENTAL OFFSETS

The proposal will not affect any 'critical assets', as defined by EPA Position Statement No. 9 (EPA 2006b), as riparian vegetation and habitat is able to be completely avoided. A minimum 50 m buffer between quarrying operations and Susannah Brook will be maintained on both sides of the Brook; in most instances this buffer will be extended to 100 m. The proposed development will remain approximately 500 m from Strelley Brook.

Avoidance of all individuals of Priority flora and vegetation/habitat in the proposed development area is not possible and the level of vegetation/habitat clearing proposed may represent a residual impact to this 'high value asset' requiring some degree of offset.

Preliminary environmental offsets are proposed and include enhancing onsite ecological corridors and removing threats to remnant vegetation and native fauna.

RED HILL QUARRY STAKEHODLER REFERENCE GROUP

Hanson formed the Red Hill Quarry Stakeholder Reference Group (SRG) in early 2008 for a preliminary 12 month term. The continuation of the SRG post-2008 will be decided by the SRG members.

KEY MANAGEMENT ACTIONS

1. The proponent will assist DEC with feral fauna trapping and eradication programs undertaken in John Forrest National Park and the area of the Darling Range Regional Park adjacent to Lot 11. The level and type of assistance will be determined in consultation with DEC.
2. The proponent will conduct pre-clearing inspections for hollow-bearing trees that may be used for Black-Cockatoo nests. If a hollow is actively used a nest box will be installed in a suitable tree in adjacent vegetation not scheduled to be cleared.
3. The proponent will conduct pre-clearing searches for DRF and Priority flora if no surveys have been conducted in those areas for ten years or more.
4. If Priority flora is present in areas to be cleared, the proponent will either:
    - undertake collection of seed or other reproductive material (where viable) from the Priority flora plants for use in on-site rehabilitation
    - translocate the Priorty flora plants (where viable) for use in on-site rehabilitation.
5. The proponent will undertake annual weed inspections of operational areas (including internal access tracks and firebreaks) and adjacent vegetation on Lot 11 and carry out weed control if Declared Plants are found to be present.
6. The proponent will undertake annual visual inspections for dieback (*Phytophthora cinnamomi*) in vegetated areas adjacent to operational areas (including internal access tracks and firebreaks) on Lot 11 and will undertake a dieback assessment every five years (to include soil sampling) to assess the presence of dieback on Lot 11 and the effectiveness of on-site hygiene measures.
7. The proponent will undertake a visual assessment of the development every five years (post-2007) to assess the visual appearance of the operation in comparison to that predicted in the John Cleary Planning (2007) visual assessment report (*Red Hill Quarry Development, Toodyay Rd, Red Hill: Landscape and Visual Assessment*).

PROPOSED ENVIRONMENTAL CONDITIONS

Ecological corridors and buffers

1. The proponent shall not disturb, other than for rehabilitation purposes, the north – south vegetated corridors along the east and west boundaries of Lot 11, as shown in Figure S2.
2. The proponent shall not disturb or undertake quarrying activities within the vegetated area along Susannah Brook as shown in Figure S2.

Rehabilitation

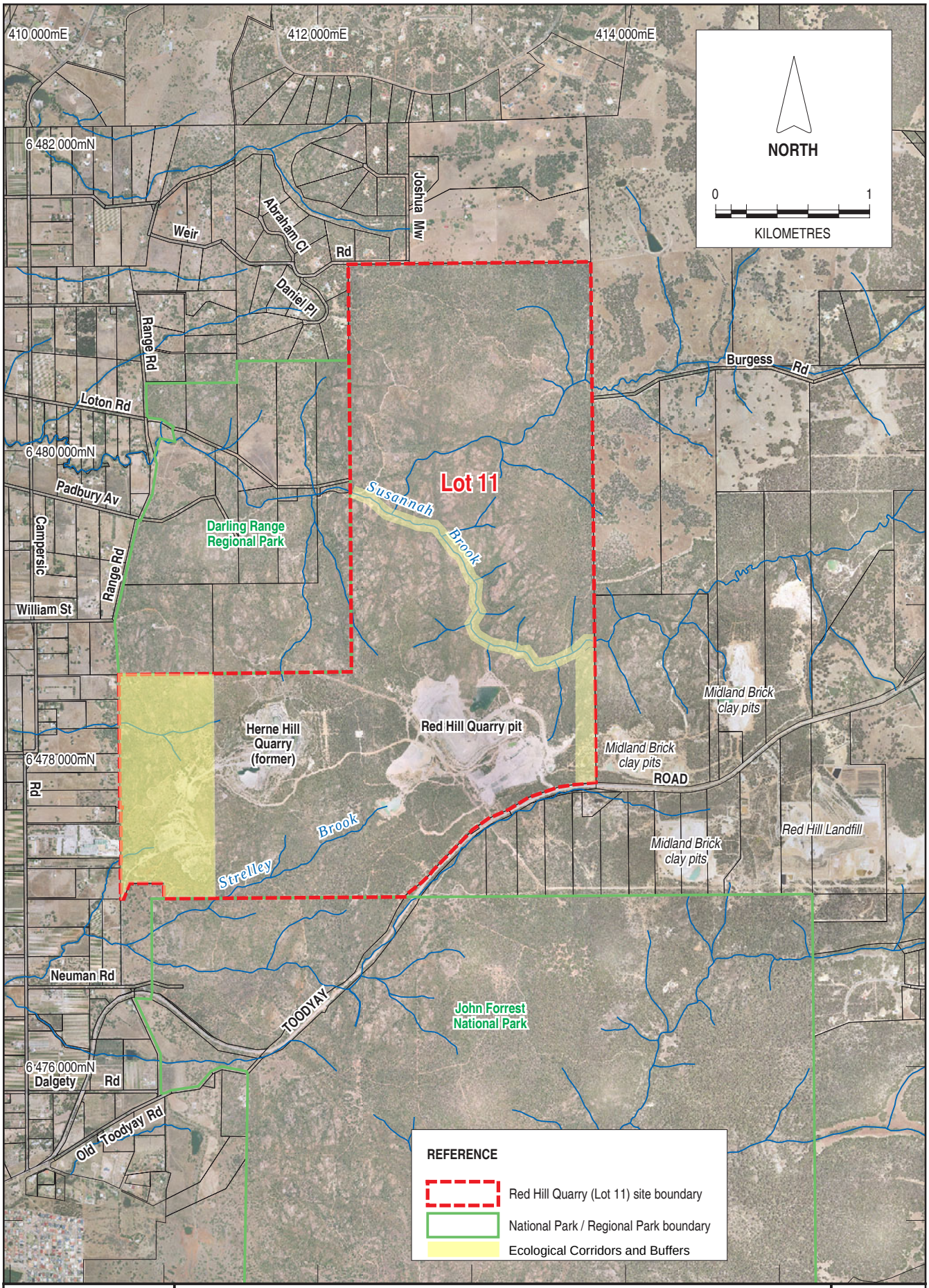
1. The proponent shall finalise the following preliminary rehabilitation completion criteria in consultation with DEC:
    - re-establishment of vegetation in rehabilitation areas shall be such that the following criteria are achieved within three years:
        - the land surface is non-eroding and stable
        - one native plant species per 1 m^2 (averaged over each rehabilitation area)
        - minimum of 600 native tree species per hectare
        - percentage weed cover is less than 10%.
2. The proponent shall monitor the performance of rehabilitation against criteria developed in 1 above based on an annual spring monitoring program.
3. An annual rehabilitation monitoring report shall be submitted to the CEO of DEC, made publicly available and its availability advertised in local newspaper, addressing:
    - progress towards meeting criteria developed in 1 above
    - contingency measures to be implemented where criteria are unlikely to be achieved.

Surveying for gecko species

1. The proponent shall undertake further survey work of the undescribed taxon of gecko (*Diplodactylus* aff. *polyophthalmus*) recorded on Lot 11 for the purposes of:
    - collecting additional specimens for the WA Museum to carry out genetic investigations to determine its relationship with recognised species
    - determining the distribution of the species on Lot 11 and in adjacent John Forrest National Park.
2. The results of the survey work shall be provided to DEC and the WA Museum.

Closure

1. The proponent shall develop closure completion criteria at least two years before closure, in consultation with relevant stakeholders and the requirements of the CEO of DEC.



stategen

Hanson Construction Materials Pty Ltd
RED HILL QUARRY DEVELOPMENT PROPOSAL

LOCATION OF ECOLOGICAL CORRIDORS & BUFFERS

Figure

S2

Environmental GIS (08) 9486 9222

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CONCLUSION

ENVIRONMENTAL IMPACTS AND MITIGATION

In summary, the anticipated environmental impacts of the proposal, their significance and proposed management measures are as follows:

- progressive removal of approximately 80 ha of vegetation over the 100 year life of the proposal (or on average less than 1 ha/yr), which is unlikely to significantly affect local and regional vegetation values; the affected vegetation complexes and site-vegetation types are relatively well represented locally and regionally (with greater than 30% of vegetation complexes remaining); with progressive rehabilitation of areas as they are no longer required
- disturbance of some individual plants of three species of Priority flora (*Calothamnus ruprestris* – P4, *Acacia oncinophylla* subsp. *oncinophylla* – P3 and *Halgania corymbosa* – P3), which is not expected to affect the conservation status of the species; efforts to restore the species to rehabilitated areas will be made through continual improvements of techniques described in the Screening and Rehabilitation Program
- potential risk of the introduction and/or spread of weeds and dieback will be managed through ongoing implementation of weed control and hygiene measures
- potential for habitat fragmentation, and consequent effects on fauna populations, will be reduced through the maintenance and enhancement of north – south and east – west vegetated ecological corridors on Lot 11
- an approximate 2% and 0.4% reduction in the catchment area of Susannah and Strelley brooks respectively, at the final extent of the proposed development, may reduce streamflow in the watercourses; however this is not expected to cause any significant impact to the watercourses or associated surface water-dependent ecosystems as the associated drop in stream stage height will not be significant (approximately 10 – 20 mm over the 100 year life of the proposal)
- potential for impact to water quality of Susannah and Strelley brooks will be managed through onsite stormwater management measures continuing to be implemented; current water quality monitoring results indicate that the existing quarry operation has had no effect on water quality in Susannah and Strelley brooks
- potential for dust generation will continue to be managed through ongoing implementation of dust control measures
- noise and vibration levels may increase at surrounding sensitive-premises as the proposed development of the pit extends towards these premises but will remain below noise and vibration levels prescribed in the Noise Regulations
- visual screening will continue to be utilised to screen aspects of the operation.

The proposal will not affect:

- riparian vegetation along Susannah and Strelley brooks as it will be protected from disturbance; a minimum 50 m buffer between operations and Susannah Brook (of the approximate 2.5 km length of Susannah Brook that traverses Lot 11, the proposed development will only come closer than 100 m [but not within 50 m] to the brook for approximately 250 m of its length) and an approximate 500 m buffer from Strelley Brook
- local or regional hydrogeological regimes through the excavation of the proposed pit

- registered Aboriginal heritage sites on Lot 11 as they will continue to be protected from disturbance.

Table S3 provides more detail of potential impacts, proposed management and the environmental outcome for each of the environmental factors assessed.

ENVIRONMENTAL RISKS AND MANAGEABILITY

The approach taken in this environmental review has been based on a risk assessment approach to characterise environmental factors, determine potential impacts and develop mitigation measures.

Hanson has extensive experience in managing the development, operation and environmental compliance of similar projects (including the existing Red Hill Quarry operation) and this experience is anticipated to lead to a greater certainty in achieving desirable environmental outcomes.

The environmental aspects of the proposal will be primarily managed through the Red Hill Quarry EMP and Screening and Rehabilitation Program, Hanson's EMS, relevant licences and the implementation of the proposed Key Management Actions and Environmental Conditions for the Red Hill Quarry proposed development. Hanson will also ensure an acceptable closure outcome through ongoing revision of the Conceptual Closure Plan for the Red Hill Quarry, which will include development of closure completion criteria in consultation with relevant stakeholders.

Hanson has consulted with stakeholders (including Government agencies, non-government organisations, community groups and neighbours/residents) to scope the potential impacts of the proposal and to determine the significance of environmental issues and the acceptability of mitigation. This process substantially improves the likelihood that all significant environmental issues have been identified, investigated and mitigated as far as practicable.

Table S3 Summary of key environmental issues, potential impacts and management

Environmental factor	EPA objective	Existing environment	Potential impacts	Potential management	Predicted outcomes
Biophysical					
1. Vegetation and flora	To maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.	• The vegetation of the proposed development area consists of three vegetation complexes (Helena 2, Dwellingup 2 and Darling Scarp), each of which has greater than 30% of their pre-European extent remaining. • Nine site-vegetation types were mapped, all of which have been previously recorded in the northern Jarrah forest and many are represented in remnant vegetation on Lot 11 to the north of Susannah Brook and the adjoining conservation areas (e.g. John Forrest National Park and Darling Range Regional Park). • The vegetation ranged in condition from degraded to excellent. Most of the area proposed to be disturbed is classified as very good to excellent with some degraded areas. • No Threatened Ecological Communities (TECs) were recorded in the proposed development area. • A total of 320 taxa were identified, 23 were introduced species; however, none of these were classified as a Declared Plant or Pest Plant. • No Declared Rare Flora (DRF) was recorded in the proposed development area.	• The clearing of approximately 80 ha of vegetation for the proposed quarry pit area and stockpile extension area will lead to the direct disturbance of vegetation communities and some individuals of Priority flora. • The 80 ha vegetation clearing requirement will be progressive, occurring over the estimated 100 year life of the proposal (or on average less than 1 ha/yr). • Vehicle movements and movement of soil could potentially introduce and/or spread weeds and dieback. • Disruption of surface hydrology may affect those vegetation communities that rely on surface water flows. • Dust generation could potentially smother vegetation, thereby retarding growth.	• Implement and regularly review the Environmental Management Plan, which includes a Vegetation and Habitat Protection Plan to ensure management measures to: - restrict clearing to approved areas - locate infrastructure on disturbed areas - undertake flora searches for DRF and Priority flora in areas before clearing, if no survey has been conducted in these areas for ten years or more - restrict access to remnant vegetation on Lot 11. • Implement and annually review/update the Screening and Rehabilitation Program to ensure management measures include: - use of Priority flora in rehabilitation - collection of seed or other reproductive material (where viable) from Priority flora within areas proposed for clearing - translocation of Priority flora within the disturbance footprint to rehabilitation areas, where viable - local collection of seed for use in onsite rehabilitation. • Implement and annually review/update the Dieback Management Plan and the Weed Management Plan (contained within the Screening and Rehabilitation Program) to ensure management measures include: - identification and mapping of the extent and distribution of priority weed species and dieback - staff inductions which include information on the identification and reporting of key weed species and procedures to prevent the spread of weeds and *Phytophthora* dieback	• Flora and vegetation of the proposed development area surveyed consistent with EPA Position Statement No. 3 and EPA Guidance Statement No. 51. • Progressive clearing of approximately 80 ha of vegetation over the estimated 100 year life of the project (or on average less than 1 ha/yr). • Risk of the introduction and/or spread of weeds and dieback will be mitigated through weed hygiene management measures. • No significant impact to regional or local vegetation values due to the wider representation of vegetation complexes and types. • No vegetation complex will fall below 30% of their pre-Eurpoean extent and no species of flora or vegetation association will cease to exist as a result of the proposal. • Disturbance to three Priority flora species, *Calothamnus ruprestris, Halgania corymbosa* and *Acacia oncinophylla* subsp. *oncinophylla* (all of which are known to occur elsewhere on Lot 11, in the adjacent area of Darling Range Regional Park and other sites within the northern Jarrah forest) will not significantly affect the occurrence or abundance of these species regionally or locally.

Environmental factor	EPA objective	Existing environment	Potential impacts	Potential management	Predicted outcomes
		• Three Priority flora species were identified (*Acacia oncinophylla* subsp. *oncinophylla, Halgania corymbosa* and *Calothamnus rupestris*) within the proposed development area, although none are restricted to this area.		- hygiene measure to prevent the spread of weeds and *Phytophthora* dieback - annual visual inspections for *Phytophthora* dieback - drainage measures - weed control program for priority weed species - prevention of unauthorised access to Lot 11. • Undertake a formal dieback assessment of the proposed development area and update the existing Dieback Management Plan accordingly. • Implement dust suppression measures, such as application of water to dust prone areas and restricting vehicle speeds, to minimise dust drift and settlement on nearby vegetation.	• No known TECs or DRF will be affected.
2. Fauna	To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.	• A total of 189 vertebrate fauna species may occur within the project area, of which 76 were recorded onsite. Five of the 76 species were introduced (i.e. feral fauna). • Birds, reptiles, mammals and amphibians accounted for around 49%, 29%, 18% and 4% respectively of the faunal assemblage recorded onsite. • Three species of invertebrates were also recorded in the proposed development area. • Of the 71 native vertebrate species recorded onsite, 25 were of conservation significance; two species listed under State and Commonwealth Acts (*Calyptorhynchus banksii naso* [Forest Red-tailed Black-cockatoo] and *Morelia spilota imbricate* [South-west Carpet Python]), one species listed as Priority by DEC (*Isoodon obesulus fusciventer* [Quenda])	• The clearing of approximately 80 ha of habitat (or on average less than 1 ha/yr) for the proposed quarry pit area and stockpile extension area will lead to the direct disturbance of fauna habitat and may result in the deaths of individual terrestrial fauna. • Vehicle movements during construction and operation could potentially lead to the occasional mortality of individual fauna, particularly less-mobile species. • Quarry development and operation could alter fauna behaviour due to lighting, noise and vibration. Feral fauna may also be advantaged, potentially affecting the abundance and distribution of native fauna.	• Implement and regularly review the Environmental Management Plan (which includes a Vegetation and Habitat Protection Plan and Fauna Management Plan) and Screening and Rehabilitation Program to ensure management measures to: - restrict clearing to approved areas - locate infrastructure in already cleared or disturbed areas - include Black-cockatoo food-plants in rehabilitation - undertake pre-clearing inspections of tall trees, should they be present, for Black-cockatoo nests (and install nest box in nearby vegetation if active hollows are present) - retain and enhance north – south vegetated corridors on the eastern and western side of Hanson's quarry operations and an east – west vegetated corridor along Susannah Brook - assist DEC with feral fauna control in adjacent conservation reserves - restrict vehicle speed limits to 40 km/hr on haul roads	• Terrestrial fauna of the proposed development area surveyed consistent with EPA Position Statement No. 3 and EPA Guidance Statement No. 56. • Loss of approximately 80 ha of potential fauna habitat over the estimated 100 year life of the project (or on average less than 1 ha/yr), potentially leading to habitat fragmentation and loss of connectivity, which may restrict fauna movement and limit genetic exchange. • No terrestrial verterbrate or invertebrate species will cease to exist as a result of the proposal. • No significant impact to regional or local fauna values due to the preservation of similar habitats in the nearby John Forrest National Park, Darling Range Regional Park and Walyungah National Park.

Environmental factor	EPA objective	Existing environment	Potential impacts	Potential management	Predicted outcomes
		and 22 species considered to be of local significance. • Of the 3 invertebrate species recorded within the project area, one is locally significant. An additional invertebrate species of conservation significance (Priority 2 species) may occur within the project area, but has not yet been recorded. • Five habitats types were identified within the project area; granite outcrops, eucalypt woodlands, heaths of gravely sands close to exposed granite, lower slopes of hills and temporary creeks. • The habitats are not unique to the project area and are expected to be well represented throughout adjacent areas including John Forrest National Park, Darling Range Regional Park and Walyungah National Park.		- include awareness of fauna issues in site inductions. • Undertake additional fauna investigations, specifically: - further field work to determine the relationship of the undescribed taxon of gecko (*Diplodactylus* aff. *polyophthalmus*) to other species and its distribution on and in the vicinity of the Hanson property. • Implement and regularly review the Environmental Management Plan, which includes a Fire Management Plan to ensure capacity to control fires and describe the education program for personnel with respect to fire risk.	• Retention and enhancement of the north – south vegetated corridors on the eastern and western sides of the quarry and the east – west vegetated corridor along Susannah Brook will maintain the connection between John Forrest National Park and the Darling Range Regional Park, as well as retaining the riparian linkage along the Susannah Brook from the east into the Darling Range Regional Park.
3. Surface water: Susannah and Strelley brooks – water quantity and quality	To maintain the quantity and quality of water so that existing and potential environmental values, including ecosystem maintenance, are protected.	• Significant waterways near the proposed development area are Susannah Brook to the north and Strelley Brook to the south. • The majority of the existing and proposed quarry is within the Susannah Brook catchment and a small portion is within the Strelley Brook catchment. • Susannah Brook is a relatively unmodified ephemeral stream in which flow occurs generally during June to November; flows are generated by surface water runoff. • Several well-defined drainage lines originate on Lot 11 and drain into Susannah Brook.	• Water harvesting and disruption of natural runoff and drainage through excavation of quarry pit, water usage at the quarry and construction of associated infrastructure may reduce downstream flows in Susannah and Strelley brooks. • Stormwater runoff from operational areas potentially affecting sedimentation and erosion of dam overflow and runoff from disturbed land (such as excavated areas, stockpiles and haul roads).	• Implement and regularly review the Environmental Management Plan that includes a Surface Water Management Plan to ensure management measures to: - rehabilitate disturbed areas as soon as practicable following disturbance - maintain a 50 to 100 m vegetated buffer along Susannah Brook; in most instances this buffer will be extended to 100 m (the proposed pit will only be within 100 m [but not within 50 m] of Susannah Brook for approximately 250 m of the 2.5 km length of the Brook that traverses Lot 11) - install bunds, or other stable drainage structures, to divert runoff from disturbed areas to onsite sedimentation dams or the in-pit sump	• Decreased area of Susannah and Strelley brooks catchments by approximately 2% and 0.4% respectively (at full extent of the proposed development), which may reduce the quantity of water entering these streams. • The Susannah Brook stream stage height is estimated to drop by around 10 to 20 mm (based on the rating curve for the Brook). This drop will occur gradually over the 100 year life of the proposed development. • Any reduction in the quantity of water entering Susannah or Strelley brooks is not expected to have significant impact on the two streams or any associated

Environmental factor	EPA objective	Existing environment	Potential impacts	Potential management	Predicted outcomes
		• Hanson undertakes water quality monitoring in Susannah and Strelley brooks, monitoring pH, total dissolved solids (TDS), total suspended solids (TSS), chlorides and oil and grease at six locations. • Recorded TDS, chloride and TSS levels have consistently remained below ANZECC/ARMCANZ levels and pH has remained within the ANZECC/ARCANZ range. Concentrations of oil and grease have consistently remained below detectable limits (i.e. 5 mg/L).	• Spillage of potentially hazardous substances, including hydrocarbons from workshop, plant and machinery potentially affecting the quality of stormwater runoff. • Excavation of the pit, in proximity to Susannah Brook, could potentially affect downstream flow in Susannah Brook by: - overflow of Susannah Brook into the proposed pit during high flow events - seepage of water flow from Susannah Brook into the proposed pit (i.e. through fractures in the rock).	- construct internally-draining dishes in stockpiles - maintain existing sediment and oil/grease traps, including cleaning and disposal as required - maintain existing hydrocarbon storage and handling measures in accordance with relevant legislation and standards - investigate the feasibility of bituminising areas that are subject to heavy traffic loads around the plant and stockpile areas - continue to monitor surface water at the six sampling stations and revising the water quality monitoring program as required throughout the proposed development - review the sediment and contaminant management regime if high levels are detected and implementing changes as required, such as installing additional sediment traps above the sedimentation dams and/or cleaning out the dams more frequently.	surface water-dependent ecosystems (e.g. riparian vegetation). • No direct physical disturbance to Susannah Brook or within a 50 – 100 m buffer on both sides of Susannah Brook. • No direct disturbance of Strelley Brook with operations remaining around 500 m from the stream. • Water quality in Susannah and Strelley brooks will be protected by diverting all runoff from disturbed areas to onsite sedimentation dams or the in-pit sump, as well as the use of sediment and grease and oil traps.
4. Groundwater	To maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance are protected.	• The lateritic soils of the proposed development area are underlain primarily by crystalline basement rocks, mainly granite-gneiss, of the Archaean Yilgarn Craton. In general, bore yields tend to be low and variable, and salinity levels also vary. • The adjacent Swan Coastal Plain aquifers are dependent on recharge from rainwater infiltration and not from the minor groundwater flow generated from the aquifer underlying the proposed development area. • The groundwater level contours broadly mimic surface topography and lie approximately 60 m below surface levels (as recorded at	• Excavation of the quarry pit may disrupt the local hydrogeological regime and cause groundwater drawdown. • Hydrocarbon spills may lead to contamination of groundwater.	• Continued implementation of onsite hazardous substances management measures in accordance with relevant legislation and standards. • Notify the Department of Water and initiate appropriate groundwater investigations, actions and monitoring program upon the advice of the Department if the characteristics of any deep aquifers encountered differ from expectations (e.g. significant groundwater inflows occur into the pit). • Implement and regularly review the Environmental Management Plan that includes management measures to: - reduce the risk of spills - ensure safe storage and handling of substances - implement corrective action in the event of a spill of leak.	• The excavation of the proposed pit will not adversely affect the local or regional hydrogeological regimes. • Any impact to groundwater in the vicinity of the Red Hill Quarry will not influence the groundwater aquifers of the adjacent Swan Coastal Plain. • Continued implementation of onsite management measures for hazardous substances will ensure that the risk of contamination of groundwater by spills of potentially hazardous materials remains low.

Environmental factor	EPA objective	Existing environment	Potential impacts	Potential management	Predicted outcomes
		the nearby Red Hill Waste Management Facility). • The existing Red Hill Quarry has not intercepted any significant groundwater pockets or aquifers even though the quarry has been excavated below the expected regional watertable level. • Susannah and Strelley brooks are both ephemeral streams that are fed by winter rains and discharge into the underlying groundwater system. Neither stream is dependent on groundwater discharge.			
Pollution management					
5. Noise and vibration	To protect the amenity of nearby residents from noise and vibration impacts resulting from activities associated with the proposal by ensuring the noise levels meet statutory requirements and acceptable standards.	• There are several sources of noise and vibration at the Red Hill Quarry, including: - drilling and blasting of hard rock - crushing and screening of rock at the processing plant, as well as operation of the conveyor and the dust collection unit - loading and transport of rock from the quarry pit to the processing facilities and stockpiles • Other main sources of noise in the area include: - operation of machinery and plant at the Red Hill Waste Management Facility and Midland Brick extractive clay pits - traffic movement on Toodyay Road and other local roads - operation of farm equipment on surrounding rural land. • The closest residence to the	Noise and vibration generated at the Red Hill Quarry has the potential to: • cause nuisance at nearby sensitive receptors • affect fauna behaviour.	• Implement and regularly review the Environmental Management Plan that includes noise and vibration management actions including: - restricting quarrying activities to operate between 0600 and 1800 hours Monday to Saturday (unless otherwise approved) - advising relevant stakeholders of the proposed blasting times, working schedule, current progress and any new developments - fitting and maintaining noise suppression features on all machinery, plant and equipment - planning blasting to reduce noise emissions - monitoring blasting noise and vibration - continually reviewing and improving blast design to reduce the required number of blasts - planning blasting to occur only between 0900 and 1800 hours (unless otherwise approved) to minimise noise impacts at noise-sensitive receptors - instructing truck drivers to utilise the main and designated roads within the City of Swan to prevent truck movements on local service roads	• Noise emissions from the Red Hill Quarry were predicted for current and proposed operations in accordance with EPA Guidance Statement No. 8 and compliance with the Noise Regulations assessed. • Noise will be generated at the Red Hill Quarry throughout all stages of the proposed development by the drilling, blasting, crushing, processing, loading and transport of rock. • The proposed development will remove natural barriers to noise (i.e. hills and ridges) which may increase noise levels by a small amount (but within assigned noise levels) at noise-sensitive premises around the quarry. • Modelling results indicate that most stages of the proposed development will be in compliance with the Noise Regulations. Predicted noise levels will be within 5dB of the assigned noise levels between 0600 and 0700 hours during

Environmental factor	EPA objective	Existing environment	Potential impacts	Potential management	Predicted outcomes
		existing quarry operation is approximately 2 km to the north. This will be reduced to approximately 1 km once the proposed pit extends to its full northward extent (assuming surrounding land uses remain unchanged); extent not expected to be reached within the next 50 years. • The current quarry operation is in compliance with the Noise Regulations. • All blasts at the quarry are monitored for overpressure and ground-borne vibrations at locations up to 2.4 km from the quarry; results indicate blasting activities are in compliance with the Noise Regulations.		- impose and enforce speed limits within the project area - regularly report blast results and assess compliance with the Noise Regulations.	stages 5 – 8 (years 2032 – 2055). Hanson will implement appropriate noise management measures during these times in order to maintain compliance with the Noise Regulations. Adoption of improved technologies over the life of the proposal may also reduce noise emissions. • Monitoring of blasting suggests that maintenance of current blasting procedures and noise management measures will ensure that noise and vibration generated by blasting at Hanson's Red Hill operation conforms to the requirements of the Noise Regulations.
6. Dust	To ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.	• There are several sources of dust at the Red Hill Quarry, including: - physical disturbance of the land surface during clearing and removal of topsoil and overburden - drilling and blasting - vehicle movement on unsealed roads - crushing and screening - wind erosion of exposed surfaces. • A number of land uses surrounding the quarry have the potential to generate dust and affect ambient air quality, including: - Midland Brick extractive clay pits to the immediate east - cropping and grazing farms to the north and further east	Dust has the potential to: • have physical effects on plants such as blockage and damage to stomata, shading and abrasion of leaf surface • affect health at elevated levels.	• Implement and regularly review the Environmental Management Plan that includes dust management actions including: - clearing vegetation in a staged manner and undertaking progressive rehabilitation to reduce the total exposed area - maintaining a substantial vegetated buffer between the project area and the nearest residents to act as a windbreak that will reduce wind velocity and facilitate dust settlement - design drilling and blasting to reduce dust generation through the consideration of climatic conditions and local geology - application of water or other dust suppressants to unsealed roads, stockpiles, truck loads and other exposed surfaces - maintaining water carts to deliver water to haul roads and other bare surfaces - maintaining a water sprinkler system to apply water to the surface of stockpiles	• Dust will be potentially generated by a number of activities associated with the quarry operation. • Implementation of dust management measures will ensure that dust emissions do not significantly affect nearby residences.

Environmental factor	EPA objective	Existing environment	Potential impacts	Potential management	Predicted outcomes
		- hobby farms to the north and north-west - Red Hill Waste Management Facility to the south-east. • Hanson monitors the effectiveness of dust suppression using permanent static and directional dust sampling stations.		- restricting speed limits to 40 km/hr on haul roads and 20 km/hr in the stockpile and plant area - wetting and/or covering truck loads of aggregate prior to leaving the site - maintaining current dust suppression practices related to crushing plants, including enclosed plants and conveyors, baghouses and wetting crusher feed - undertaking daily inspections during dust-prone conditions to visually assess dust generation - undertaking regular inspections of dust suppression equipment.	
7. Greenhouse gases	To minimise emissions to levels as low as practicable on an ongoing basis and consider offsets to further reduce cumulative emissions.	• Greenhouse gas emissions from the current Red Hill operation are estimated to be 5,160 tonnes of CO_2 equivalents (tCO_2-e) per year (direct and indirect emissions). • The majority (> 98%) of the greenhouse gas emissions from the project are as a result of fuel and electricity use by vehicles, the processing plant and conveyors. The remaining greenhouse gas emissions are from explosives. • The proposed development is predicted to increase greenhouse gas emissions by approximately 40% to around 7,240 tCO_2-e per year (assuming increase in throughput to 1.5Mt/yr).	Increase in greenhouse gas emissions from fuel and energy use requirements.	• Continue to implement Hanson's commitments made as part of the Greenhouse Challenge Plus Program, including to: - progressively update to energy-efficient light fittings - install intelligent controls (i.e. daylight and occupancy sensing or one-shot timers) and task-based lighting - shut down all non-essential equipment when an office is unoccupied - ensure all new equipment purchases be of high energy efficiency star rating - implement a site energy audit - ensure all replacement mobile plant equipment meets new emission standards - improve quarry fuel efficiency through smarter operational management (e.g. haul road design, stockpile locations, machine efficiency) - progressively replace the company truck fleet with new, more efficient electronic engines and lighter tare weights.	• An increase in the annual throughput from 1Mt to 1.5 Mt/yr will increase annual greenhouse gas emissions from fuel, electricity and explosives consumption by approximately 40% (i.e. from 5,200 to 7,240 tCO_2-e per year). • Emissions resulting from clearing approximately 80 ha of vegetation over the estimated 100 year life of the proposed operations will be approximately 15,000 tCO_2-e, or approximately 150 tCO_2-e/yr. • Implementation of Hanson's commitments made through the national Greenhouse Challenge Plus initiative and the company Energy Management Policy will enable continuous improvement in greenhouse gas emissions resulting from the proposed development.

Environmental factor	EPA objective	Existing environment	Potential impacts	Potential management	Predicted outcomes
				• Continued implementation of Hanson's corporate Energy Management Policy, including to: - measure and report the carbon dioxide footprint of operations through an energy management process - set sustainable emissions reduction targets - work with the supply chain (upstream and downstream) where possible to reduce carbon dioxide emissions associated with business operations - encourage employee awareness and the sharing of expertise and experience - seek to minimise impacts through work and management practices, continual improvement, training and the use of new technology - comply with all applicable energy management laws, Regulations and Codes of Practice in existing operations, new developments and upgrades - review energy objectives and targets - communicate the policy - consult within Hanson and with other relevant bodies, community groups and neighbours about energy matters of common concern.	
Social surrounds					
8. Visual amenity	To ensure that aesthetic values are considered and measures are adopted to reduce visual impacts on the landscape as low as reasonably practicable.	• The existing quarry operation is visible from several neighbouring residences and public use areas (e.g. public roads). • Landscape values of the area include: - natural features (e.g. Susannah Brook, ridgelines, native vegetation and rocky outcrops)	There will be detectable visual landscape change when the proposed development is viewed from a number of localised areas and will result in the proposed pit being seen from additional residences.	• Implement and regularly review the Environmental Management Plan and Screening and Rehabilitation Program, which include management measures to: - restrict clearing to approved areas - investigate further opportunities to reduce clearing requirements - visual amenity management - landform reconstruction and contouring of pit faces • Consider visual screening for residences to the north and north-east of the quarry that are visually affected by the proposal.	• The proposal will increase the area of quarry pit visible to some residences with existing views and also increase the number of residences with views to the quarry. • The modelling indicated that most changes to landscape values resulting from the proposed development will be minor and significant changes will only be visible to a small number of residences (approximately 4-5 residences).

Environmental factor	EPA objective	Existing environment	Potential impacts	Potential management	Predicted outcomes
		- landscape character, including semi-natural and rural character - views (e.g. views of the plain, scarp and plateau).	Vegetation clearing will alter the appearance of the natural environment and pit excavation will create a void in the landscape (with pit faces contrasting with surrounding vegetation).	• Investigate opportunities to further reduce visual impacts during the detail quarry design phase, including restricting the height of the proposed stockpiles to avoid stockpiles being visible above the treeline when viewed from Toodyay Road. • Undertake regular visual assessments of the development to assess the visual appearance of the operation in comparison to that predicted in the John Cleary Planning (2007) visual assessment report.	• The potential visual effects of the proposed development will vary spatially and temporally. • Terminal pit benches will continue to be rehabilitated to reduce contrast between pit face and surrounding vegetation and Hanson will also continue to consider visual screening for all residences to the north and north-east of the quarry that are visually affected by the proposal.
9. Aboriginal heritage	To ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant legislation.	• Two registered ethnographic sites are relevant to the proposed development area; the Susannah Brook mythological site (ID640) and a mythological ochre site (ID3433). Both sites are protected by Hanson from disturbance. • The pattern of archaeological sites occurring in and around the proposed development area indicates that Aboriginal activity was directed at the extraction of specific resources (e.g. ochre, water and shelter), rather than camping and hunting. • No definite Aboriginal archaeological sites are known from the project area. • A rock shelter was located within the proposed development area however it has been advised by archaeological consultants that the rock shelter does not meet criteria for registration as a protected Aboriginal heritage site under the *Aboriginal Heritage Act 1972*.	Physical disturbance of the land surface during clearing and removal of topsoil and overburden has the potential to disturb heritage sites and affect ethnographic values.	• Continue to protect registered ethnographic site ID3433 'Herne Hill Quarry' from any disturbance, including maintaining existing signage and further demarcating the site through use of appropriate fencing. • Continue to maintain the 50 m buffer between Susannah Brook (ID640) and quarrying activities and increase this buffer to 100 m for most of the stream length in Lot 11. • Implement and regularly review the Environmental Management Plan which includes management measures that prevent silt and other contaminants from the quarry operations entering Susannah Brook. • Inform all Red Hill Quarry personnel and contractors of their responsibilities and obligations to protect Aboriginal heritage sites known on Lot 11 under the *Aboriginal Heritage Act 1972*. • Report any Aboriginal cultural material that is uncovered or encountered in the course of operations and cease work in the area until it is determined if an archaeological site exists. • Progress consultation with relevant Aboriginal groups.	• The likelihood of the presence of matters of Aboriginal heritage significance in the proposed development area has been investigated in accordance with EPA Guidance Statement No. 41. • No registered ethnographic or archaeological sites will be disturbed by the proposed development. • Two registered ethnographic sites that are in proximity to the proposed development area will continue to be protected from disturbance using current management measures. • Archaeological consultants advised that the rock shelter identified within the proposed development area does not meet criteria for registration as a protected Aboriginal heritage site under the *Aboriginal Heritage Act 1972*.

Environmental factor	EPA objective	Existing environment	Potential impacts	Potential management	Predicted outcomes
10. Public risk and safety	To ensure that risk from the proposal is as low as reasonably achievable and complies with acceptable standards and EPA criteria.	• Onsite public risk at the quarry is minimal as access to Lot 11 is strictly prohibited. • Hanson maintains a perimeter fence with signage and a security company provides after-hours security patrols. Fences are inspected (and repaired as required) monthly to ensure that they are intact. • Heavy haulage trucks are used to transport aggregate from the quarry.	Aspects of the proposal that could potentially pose a risk to the safety of the public are restricted to offsite factors such as increased vehicle movements on public roads.	• Maintain current site security, including perimeter fencing, signage, lighting and patrols. • Maintain current measures in regards to vehicles, including signs to warn general road users of trucks entering, not overloading trucks, trucks using a low gear on hills and complying with standards for the transport of hydrocarbons. • Comply with standards for the transport of hydrocarbons and explosives. • Maintain existing hydrocarbon storage and handling measures in accordance with relevant legislation and standards.	• The project will result in an increase in vehicle movements of aggregate, hydrocarbons and explosives on roads in the vicinity of the quarry, which could potentially pose a road safety risk to the general public, in particular users of Toodyay Road. • Toodyay Road is recognised as a primary freight route and is utilised by heavy vehicles to access sites other than the quarry. • Continued implementation of existing risk management measures will ensure that risks to the public are minimised as far as practicable.
Other					
11. Rehabilitation and closure	To ensure, as far as practicable, that rehabilitation achieves a stable and functioning landform which is consistent with the surrounding landscape and other environmental values.	• Establishment of the existing Red Hill Quarry pit and associated infrastructure has disturbed a total of 81 ha of vegetation within Lot 11. • Several areas within Lot 11 are currently undergoing rehabilitation, including stockpile areas for the former Herne Hill Quarry, as well as some terminal benches and a significant portion of the overburden dump for the Red Hill Quarry. • The Red Hill Quarry Screening and Rehabilitation Program reflects current rehabilitation procedures at the quarry. The program is reviewed and updated regularly.	Quarrying and the establishment of associated infrastructure will result in clearing of vegetation and disturbance of soil profiles and landforms.	• Implement the Red Hill Quarry Screening and Rehabilitation Program, which may be periodically updated according to monitoring results and/or improvements in industry best-practice. Screening and Rehabilitation Program to include: - description of the rehabilitation process - completion criteria - use of local provenance seed and Priority flora in rehabilitation - monitoring of rehabilitation. • Undertake closure of the Red Hill Quarry operation to meet predetermined closure targets and completion criteria; preliminary closure targets are contained in the Conceptual Closure Plan; completion criteria to be developed in consultation with relevant stakeholders. • Undertake progressive backfilling of the quarry void. • Undertake progressive rehabilitation of disturbed areas that are no longer required for operations.	• The Red Hill Quarry Screening and Rehabilitation Program is consistent with EPA Guidance Statement No. 6. This program details procedures for rehabilitation activities at the quarry. • The Program will continue to be updated to accommodate changes in industry best-practice and/or improved practices based on monitoring results. • Disturbed areas are no longer required for operations will be progressively rehabilitated. • Hanson will prepare a Red Hill Quarry Closure Plan and will update the Plan to incorporate technological and societal changes that are likely to occur throughout the expected 100 year life of the quarry.

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PART 1 INTRODUCTION TO THE PROPOSAL

1. INTRODUCTION

This document is a Public Environmental Review (PER) for the Hanson Construction Materials Pty Ltd (Hanson) Red Hill Quarry Development Proposal and has been prepared in accordance with the Environmental Impact Assessment (Part IV Division 1) Administrative Procedures 2002 of the *Environmental Protection Act 1986* (EP Act). The Red Hill Quarry Development Proposal is located on Toodyay Road, approximately 25 kilometres (km) north-east of Perth.

Existing quarrying operations at Red Hill

1.1 PROPOSAL OVERVIEW

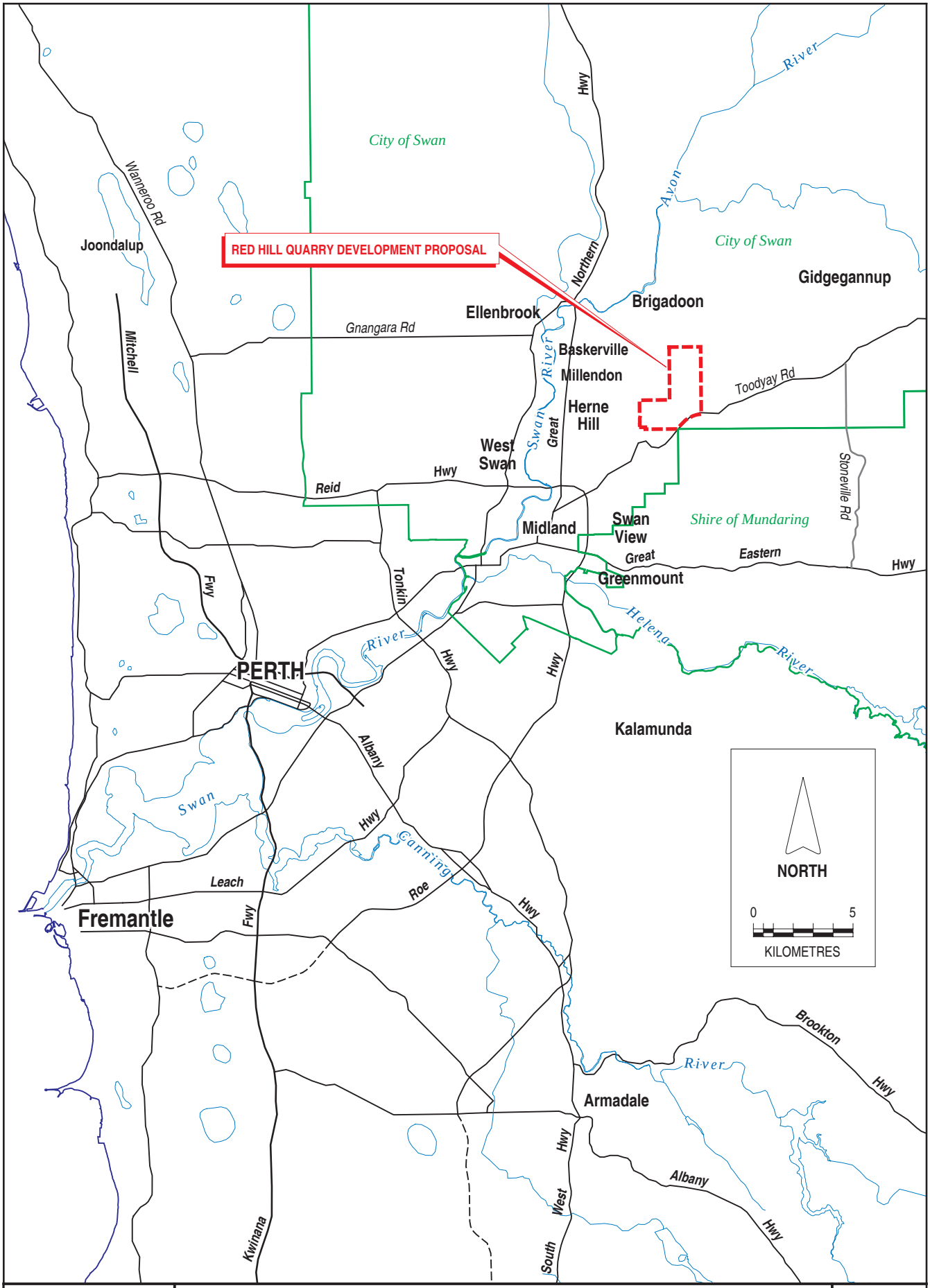
1.1.1 Location

The Red Hill Quarry is located on the Darling Plateau, immediately east of the Darling Scarp, on Lot 11 Toodyay Road, Red Hill (Figure 1 and Figure 2). Lot 11 is owned by the proponent and is approximately 800 hectares (ha) in area. Lot 11 is located on freehold land zoned 'Resource' and 'Landscape' (extractive industry is permitted if approval is granted by the City of Swan Council) within the City of Swan, approximately 25 km north-east of Perth. The Red Hill Quarry proposal is located entirely within the boundary of Lot 11.

1.1.2 Description

Hanson operates the Red Hill hard rock quarry and processing facilities, which comprise a quarry pit and supporting infrastructure; including primary, secondary and tertiary crushers, conveyors, workshops and offices. Quarrying operations at Herne Hill, approximately 900 m west of the current quarry, were moved to the current Red Hill Quarry location to reduce conflicting land use pressures from encroaching residential development (Dames and Moore 1990). The Environmental Protection Authority (EPA) determined that the relocation project warranted a PER level of assessment and following EPAs assessment of the project, the Minister for the Environment issued Ministerial Statement No. 199 on 5 December 1991 for the relocation. Construction of the current Red Hill Quarry commenced in February 1996 and operations commenced in 1998. The project as described in the PER, has been subsequently modified through assessments and approvals granted under section 45C and the conditions varied on the project under section 46 of the EP Act.

Hanson propose to continue to develop the Red Hill Quarry pit to the north and west, to increase the area available for hard rock extraction and enable long-term continuation of quarry operations. Hanson also proposes to extend the area of the existing stockpile dispatch area and may relocate and/or upgrade existing crushers and/or add additional crushers to the existing processing plant (which will require the installation of associated support infrastructure as required [e.g. additional conveyors and screens and extension to processing buildings]). The development will increase the disturbance footprint of the operation by about 80 ha over the estimated 100 year life of the proposal.



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Hanson Construction Materials Pty Ltd
RED HILL QUARRY DEVELOPMENT PROPOSAL

REGIONAL LOCATION OF THE RED HILL QUARRY DEVELOPMENT PROPOSAL

Figure 1

Environmental GIS (08) 9486 9222
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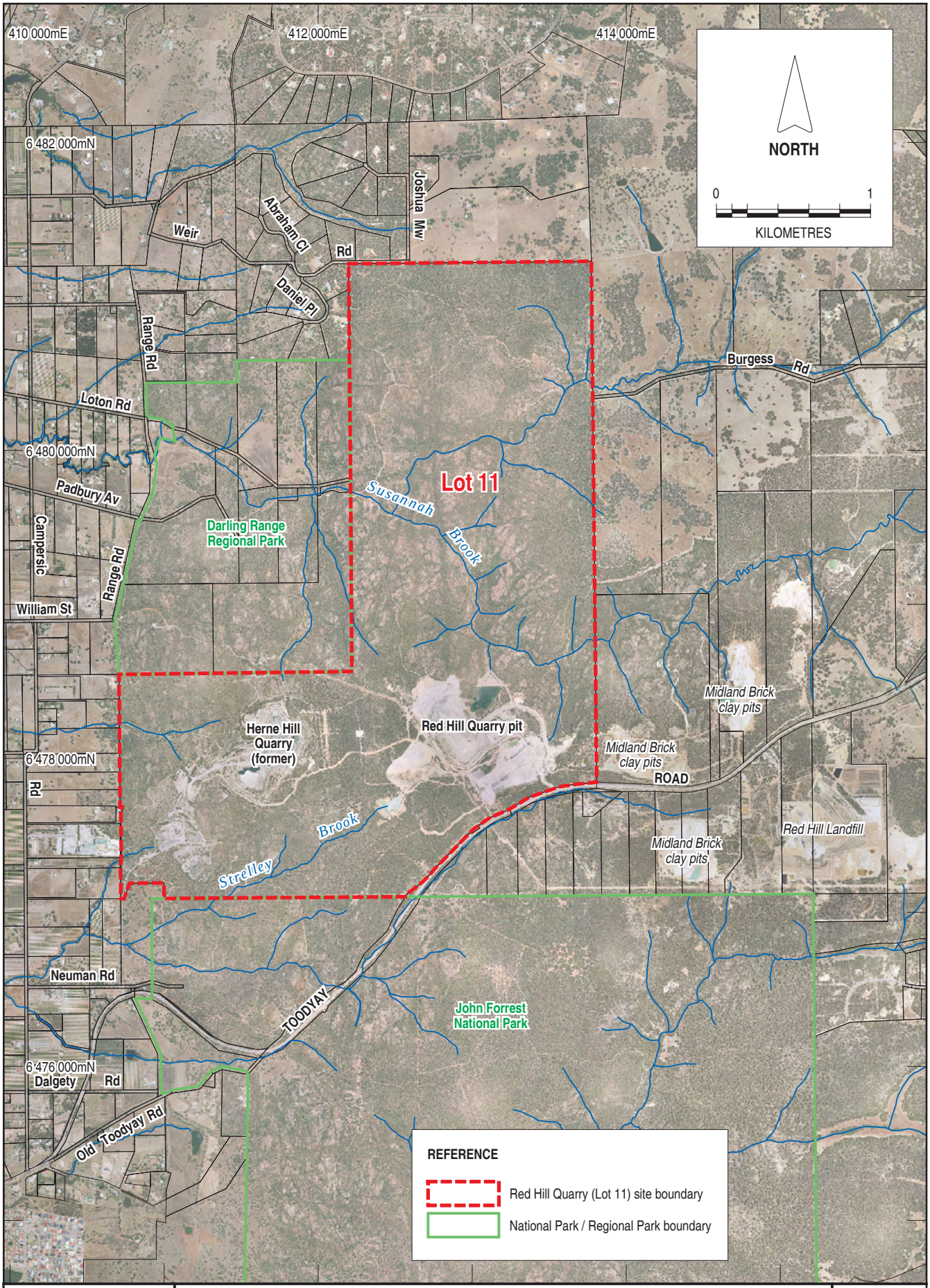

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Hanson Construction Materials Pty Ltd
RED HILL QUARRY DEVELOPMENT PROPOSAL

GENERAL LOCATION OF THE RED HILL QUARRY

Figure 2

Environmental GIS (08) 9486 9222
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1.2 THE PROPONENT

The proponent for the Red Hill Quarry proposal (and existing operation) is Hanson Construction Materials Pty Ltd (Hanson).

The contact for the project is:

John Symonds
Operations Manager - Metro
Hanson Construction Materials Pty Ltd
PO Box 187
VICTORIA PARK WA 6979

Phone: (08) 9311-8852
Fax: (08) 9311-8899
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1.3 JUSTIFICATION FOR PROPOSAL

Hanson currently extracts approximately 1,000,000 t/yr of crushed rock from the existing Red Hill Quarry (based on 2005/06 throughput). The currently approved pit will be quarried to its full extent by end of 2008 and the proposed further development of the quarry pit is required to increase the area available for hard rock extraction and to ensure the long-term viability of Hanson's business activities in the State.

Red Hill is Hanson's most significant capital investment in the State of Western Australia and an important supplier to the civil construction industry in the Perth Metropolitan Area. The proximity of the quarry to the Perth Metropolitan Area also enables product costs to remain low.

Statement of Planning Policy 2.4, Basic Raw Materials, recognises some areas of Lot 11 as a 'Key Extraction Area' and a 'Priority Resource Location'. The main objective of the Policy is to protect such areas from being developed for incompatible land uses, which could restrict access to future reserves. In accordance with the Policy, such areas are regional resources that provide for the long-term supply of basic raw materials. The Policy also states that such areas should be protected in relevant Town Planning Schemes. Key Extraction/Priority Resource areas are considered to be essential to the needs of the region, of a long-term nature and strategically located in relation to transport links (Western Australian Planning Commission [WAPC] 2000).

Lot 11 is also located within an area recognised and zoned by the City of Swan for its hard rock resources, with quarrying a permitted activity if approval granted by the City of Swan.

1.3.1 Need for security of tenure

The existing operations supply approximately 20% of the aggregates to the Perth Metropolitan Area, primarily to the pre-mixed concrete, asphalt and civil construction industries. The proximity of the quarry to the metropolitan region enables product costs to remain low.

Statement of Planning Policy 2.4 acknowledges that a ready supply of basic raw materials close to established and developing parts of the metropolitan region is essential in keeping down the costs of land development and contributing to affordable housing. Basic raw materials are also integral to

complete state and local infrastructure projects. The availability of competitively priced raw materials in sufficient quantities to meet a fluctuating demand is therefore critical to the local economy. Uncertainty of tenure can lead to opportunistic pricing whereas long-term security of tenure encourages price stability and competitive pricing of materials. Assurance of quarry reserves also promotes capital investment, innovation and employment confidence.

1.3.2 Alternative deposits considered

Hanson operates two hard rock quarries in the Perth Metropolitan Area. One is the Red Hill Quarry and the other is at Whitby, approximately 5 km south of Byford. Both are on freehold land owned by Hanson. The Whitby site has been in operation since 1976 and the Red Hill site since 1962/3.

Alternative options available to Hanson, with respect to continued access to rock reserves and to ensure the long-term viability of Hanson's business activities, are:

- supply all the Perth Metropolitan Area from the Whitby quarry
- locate a greenfield site to open a new quarry.

The Whitby site located approximately 40 km south of Perth, is a valuable supplier of construction material to the expanding southern corridor of the Perth Metropolitan Area. This site is considerably smaller in area than the Red Hill site and its economic life is projected on the basis of supply to the southern sector only. Its life would be reduced three-fold should it be Hanson's only source of construction materials in the Perth Metropolitan Area and an alternative replacement greenfield site would need to be determined in the very near future. Further development of Red Hill Quarry is considered to be more environmentally, socially and economically feasible to retain a supply of material, given the sensitivity and practicality of locating a viable greenfield alternative within similar proximity to the Perth Metropolitan Area.

The location of the Red Hill Quarry within proximity of its market and on a recognised freight route, meets the criterion of minimising road movements of heavy vehicles thereby enhancing community safety.

Transport from the Whitby site to the northern suburbs or from a greenfield site, should the development of the Red Hill Quarry not proceed, would affect truck movements on a number of additional major roads and generate further light and heavy vehicle interaction in these areas.

1.3.3 Benefits of proposal

The Red Hill Quarry returns approximately $10 million per annum to the community through wages, payment for goods and services and government taxes. The Red Hill Quarry directly employs 30 people and it is estimated that a further 200 people are indirectly reliant on the quarry for employment.

The continuation of the Red Hill Quarry will result in a number of benefits to the State:

- an assured continuation of supply of crushed aggregates to the local construction industry
- maintaining optimum low-cost sources of basic raw materials
- revenue to Local Government and the State Government in the form of taxes and fees
- continued surety of direct and indirect employment

- continued supply of concrete, bituminous asphalt and crushed rock to many private, community and Government projects at competitive rates
- avoids the need to establish an alternative greenfield site in the Perth Metropolitan Area or sensitive near-rural location.

The Red Hill Quarry generates substantial income for the local community and supports the local community through various forms of sponsorship and assistance programs. Examples include:

- ongoing provision of seedlings to the Gidgegannup Primary School for use in landcare projects
- sponsorship of the Gidgegannup Agricultural Show
- donation of materials and services to the Yagan Memorial
- donation of materials and services to the Gidgegannup BMX track
- donation of materials and services to Riverlands Montessori School
- donation of materials to Hills Community Support Group
- Gold Corporate Sponsor – Swan Chamber of Commerce and Industry
- naming sponsor of the annual 'Hanson Swan Business Awards'.

1.4 PURPOSE AND SCOPE OF THIS DOCUMENT

The purpose of this document is to present a description of the principal components of the Red Hill Quarry Development Proposal (including environmental impact assessment, mitigation and management measures) for the consideration of the EPA at the level of PER.

1.5 STRUCTURE OF THIS DOCUMENT

This document is structured as follows:

Part 1 – Introduction to the proposal

- Introduction
- Overview of existing environment
- Description of proposal.

Part 2 – Environmental impact assessment approach, environmental principles and sustainability

- Stakeholder consultation
- Environmental principles and sustainability
- Assessment of environmental impact of proposal.

Part 3 – Assessment of key environmental factors

- Factor by factor assessment of key environmental impacts.

Part 4 – Proposed environmental management program and environmental outcomes of project

- Other applicable regulatory controls
- Key Environmental Management Actions
- Proposed Environmental Conditions
- Summary of environmental impacts, mitigation and offsets.

1.6 WA ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

The Red Hill Quarry Development Proposal was referred to the EPA under section 38 of the EP Act, with a supporting Draft Environmental Scoping Document, on 2 February 2007. On 12 February 2007, the EPA advised the level of assessment for the proposal was a PER with an eight week public review period.

An Environmental Scoping Document was prepared for EPA approval of the scope of the assessment of the proposal as well as providing an indicative timeline for the assessment process. The draft Environmental Scoping Document was submitted to the EPA in April 2006 and included a summary of the potential environmental impacts, their significance and possible management response, proposed scope of work to obtain information for the PER, key legislation, stakeholder consultation program, proposal and assessment schedule, study team and peer review mechanisms. The Environmental Scoping Document was approved by the EPA in October 2007.

Hanson prepared the PER document in consultation with stakeholders and other interested parties. Once the document had been finalised it was submitted to EPA for review to ensure the document adequately addressed all of the environmental factors and studies identified in the Environmental Scoping Document.

The PER and Environmental Scoping Document were prepared in accordance with the Environmental Impact Assessment (Part IV Division 1) Administrative Procedures 2002 for environmental assessment prescribed under the EP Act.

The remaining part of the process involves release of the PER document for the eight week public review period during which members of the public can submit submissions on the proposal to the EPA. The submissions are provided to the proponent who responds to the issues raised in the submissions. The EPA then undertakes assessment of the PER document, submissions and proponent's responses to submissions. The EPA will provide an assessment report to the Minister for the Environment who will then decide whether or not the proposal should be implemented and if so, under what conditions.

Figure 3 outlines to procedure for a PER level of assessment.

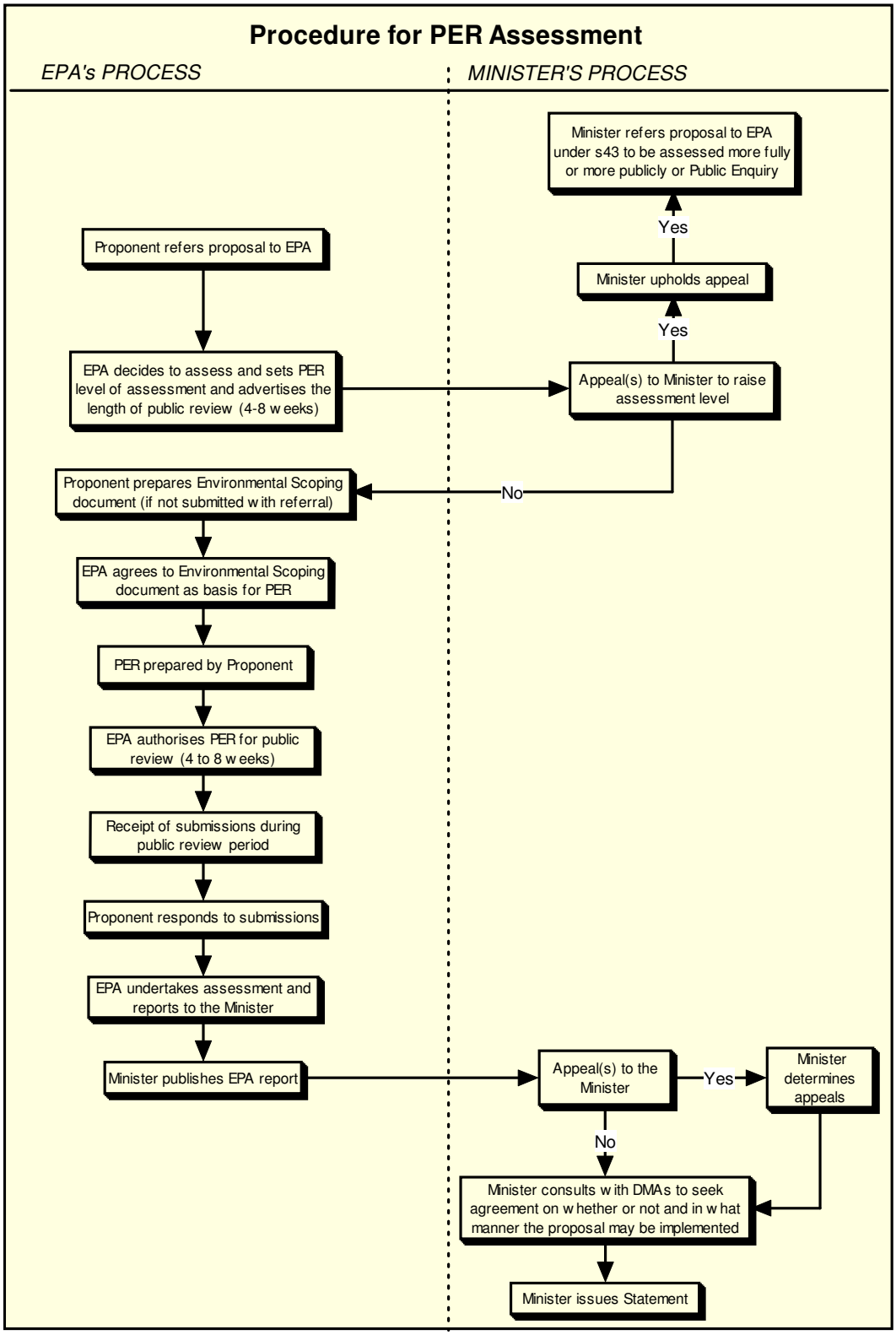


Figure 3 Flowchart of Public Environmental Review Procedure

1.7 COMMONWEALTH ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

Referral of the project to the then Commonwealth Department for the Environment and Water Resources (now Department of Environment, Water, Heritage and the Arts) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) was made as several nationally-listed threatened flora and fauna species and one migratory species have been identified as potentially occurring within the project area. These species are considered to be Matters of National Environmental Significance, and therefore the impact of the proposal on these matters may have required assessment under the EPBC Act.

The proposal was referred to the Department on 27 April 2007 to determine whether the project is considered to be a 'controlled action' and if so, what level of assessment would apply. On 28 May 2007, the Department advised that the action was not considered to be a 'controlled action' under the EPBC Act (Appendix 1).

1.8 RELEVANT ENVIRONMENTAL LEGISLATION AND POLICY

Western Australian legislation, policy and strategies

Western Australian legislation and Regulations relevant to the project includes the following:

- *Aboriginal Heritage Act 1972*
- *Bush Fires Act 1954*
- *Conservation and Land Management Act 1984*
- *Environmental Protection Act 1986*
- Environmental Protection (Noise) Regulations 1997
- *Dangerous Goods Safety Act 2004*
- *Heritage of Western Australia Act 1990*
- *Land Administration Act 1997*
- *Local Government Act 1995*
- *Metropolitan Region Town Planning Scheme Act 1959*
- *Metropolitan Water Supply Sewerage and Drainage Act 1909*
- *Occupational Safety and Health Act 1984*
- *Rights in Water and Irrigation Act 1914*
- *Planning and Development Act 2005*
- *Waterways Conservation Act 1976*
- *Wildlife Conservation Act 1950.*

In addition to existing legislation, the following Government agency strategies and policies are of relevance to the environmental assessment and management of this proposal:

- Western Australian State Sustainability Strategy
- Draft Greenhouse Strategy for Western Australia 2003
- 1987 State Conservation Strategy
- EPA Red Book recommendations for Conservation Reserves in Western Australia
- State Water Quality Management Strategy.

Commonwealth legislation, policy and strategies

Commonwealth legislation relevant to the project includes the following:

- *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (which operates concurrently with any existing State laws in so far as those laws would not be consistent with this Act)
- *Environment Protection and Biodiversity Conservation Act 1999*
- *Native Title Act 1993.*

The following national strategies may also be relevant to the proposal:

- National Strategy for Ecologically Sustainable Development
- Intergovernmental Agreement on the Environment
- National Greenhouse Strategy
- National Conservation Strategy for Australia
- National Strategy for Conservation of Australia's Biological Diversity.

International agreements or treaties

International agreements or treaties that may directly or indirectly affect this project include:

- Convention on Biodiversity
- United Nations Framework Convention on Climate Change and Kyoto Protocol (although not ratified by Australia).

2. OVERVIEW OF EXISTING ENVIRONMENT

2.1 PHYSICAL ENVIRONMENT OVERVIEW

2.1.1 Climate

The project area has a temperate Mediterranean climate experiencing warm, dry summers and mild, wet winters. The closest Bureau of Meteorology weather station in the Perth hills is at Kalamunda, located approximately 16 km to the south of the Red Hill Quarry. Winter daily mean minimum and maximum temperatures range between 8°C to 16°C and summer daily mean minimum and maximum temperatures range between 15°C and 30°C (Figure 4).

Average annual rainfall is approximately 1069 mm and average annual pan evaporation rate is approximately 2000 mm. Average monthly rainfall varies from 12 mm in January to around 217 mm in July (Figure 5). The mean number of rain days varies from around two in January to around 18 in July (Figure 5). A typical summer wind pattern starts with south-east/north-east winds in the morning, followed by often quite fresh south-west sea breezes in the afternoon followed by a return to easterly winds later in the day (CALM 1994). Winds during winter are predominantly westerly.

Climatic trends in the south west of Western Australia indicate widespread changes in rainfall and temperature throughout the region. Winter rainfall has decreased sharply since the mid-1970s, and temperatures have increased substantially, albeit it gradually, over the last 50 years. A combination of the enhanced greenhouse effect and natural climate variability has been presented by the Indian Ocean Climate Initiative (IOCI) as the most credible explanation of the climatic changes (IOCI 2002).

The expected trend for the south west of Western Australia is for rainfall and the number of cold days to decrease while evaporation and the number of hot days will continue to increase into the future. These changes will mean substantially reduced stream flow in Susannah Brook (a nearby watercourse).

2.1.2 Geology and soils

The project area is located on the Darling Plateau, to the east of the Darling Scarp. The Darling Plateau consists primarily of Archaean rocks and has an average elevation of 240 m above sea level; however, in the valley of Susannah Brook, elevation decreases to 110 m. The geology of the project area is typical of the edge of the Darling Scarp; lateritic plateau on the ridges and granite-gneiss rock in various stages of erosion on the Scarp face. Bands of diorite rock strike through the granite-gneiss varying between 2 – 30 m wide. Pegmatite and quartz veins also occur as bands from a few centimetres to 5 – 10 m wide and penetrate through the gneiss and diorite but do not enter the laterite. It is the reserves of granite and diorite/dolerite that occur onsite that are quarried and processed.

The Darling Scarp/Swan Coastal Plain interface is approximately 3 km to the west of the quarry. This represents the western edge of the Darling Plateau. In the vicinity of Red Hill, the Scarp rises to over 200 m above the Swan Coastal Plain.

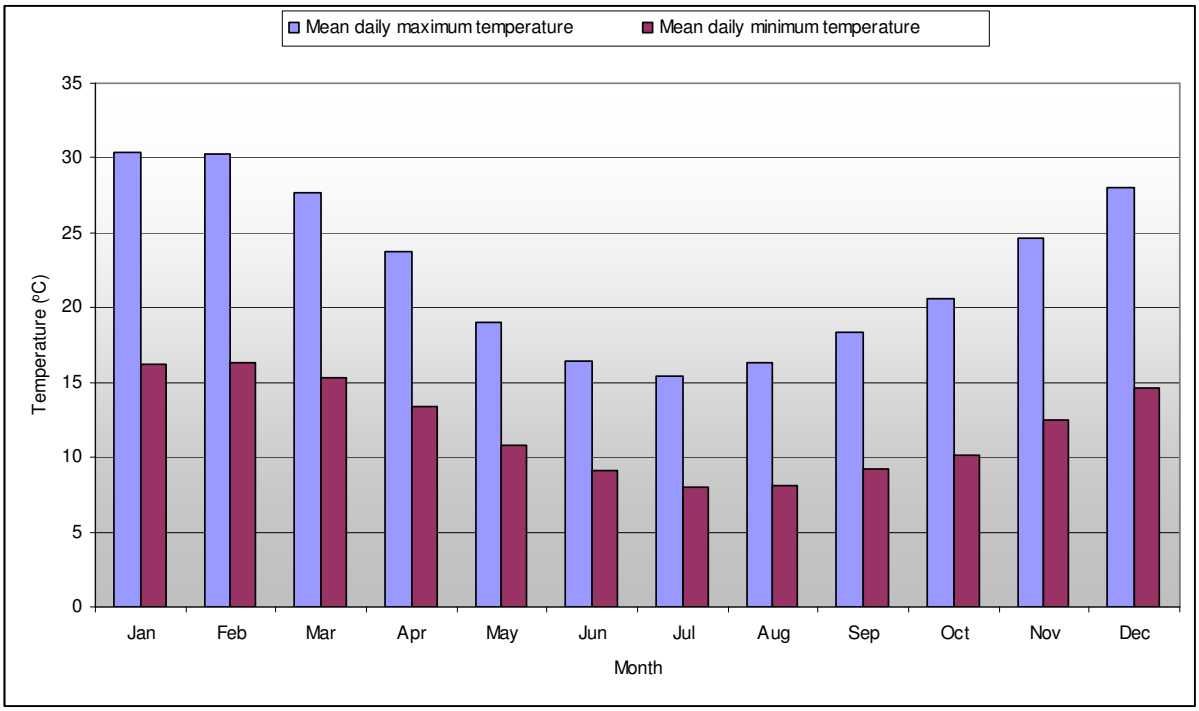


Figure 4 Mean monthly maximum and minimum temperatures as recorded at Kalamunda

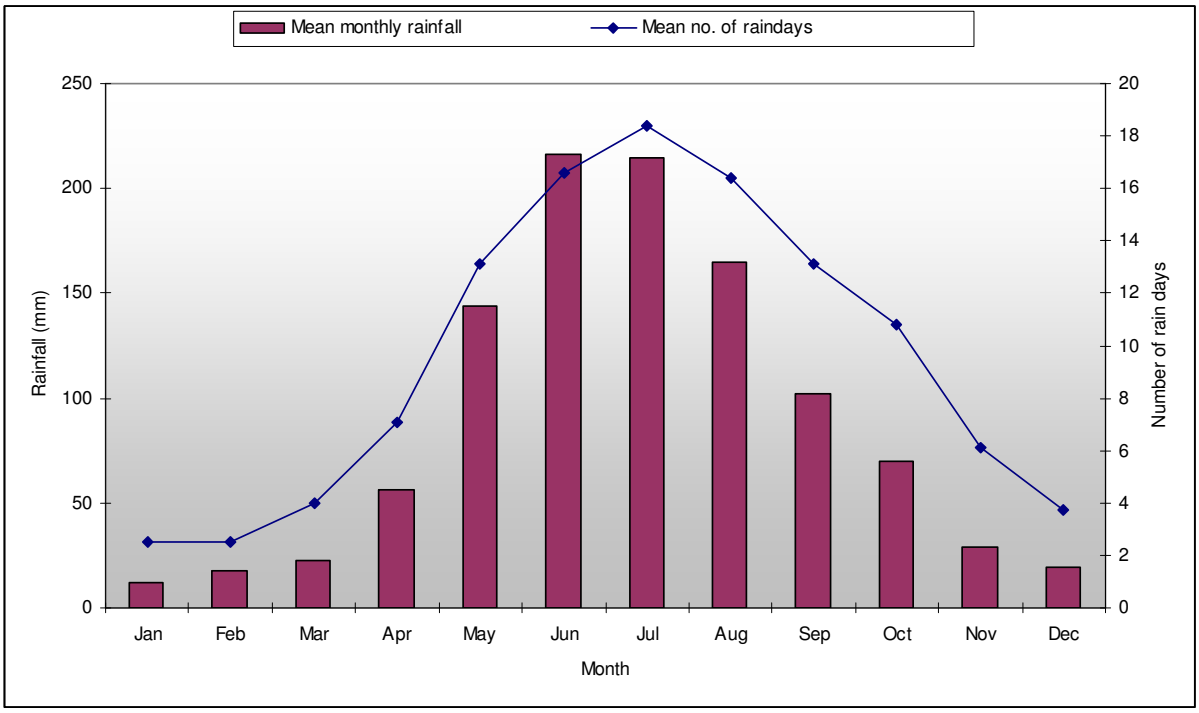


Figure 5 Monthly rainfall data as recorded at Kalamunda

Soil formation on the ridges and the plateau of the project area is influenced by the laterite mantle, while soil formation in the valleys depends upon a variety of factors including local relief, degree of stripping of the weathered mantle and the geological nature of the substrate. The soils of the lateritic plateau are mostly iron-rich silty clays or loams with a high proportion of laterite pebbles. Soils on laterite uplands have formed from weathering of the laterite duricrust and have been transported downslope by colluvial action. The colluvial material has accumulated on the lower slopes of the Darling Scarp and in the incised watercourses. This material consists of scree and rock fragments. Soil patterns on the valley slopes are variable and depend on the underlying rock types, slope, moisture and degree of weathering. Two types of soils dominate the slopes around Susannah Brook; granitic soils and diorite-derived soils. The broad soil formations of the project area are shown in Figure 6

2.1.3 Surface hydrology

Susannah Brook is the main watercourse in the project area (Figure 7). Susannah Brook has its origin near Stoneville to the north-east of the project area with the catchment draining generally from the east to west across the Darling Plateau. The ephemeral waterway discharges to the Swan River at Herne Hill. The Brook is primarily fed by surface runoff with numerous drainage lines to Susannah Brook; the northern sedimentation dam at the existing Red Hill Quarry is constructed on one of these drainage lines (Aquaterra 2007a).

The majority of the existing and proposed Red Hill Quarry operation is within the Susannah Brook catchment with the remainder located in the Strelley Brook catchment (Figure 7). The southern sedimentation dam is constructed at the head of this waterway. Strelley Brook flows in a south-westerly direction to its confluence with Jane Brook.

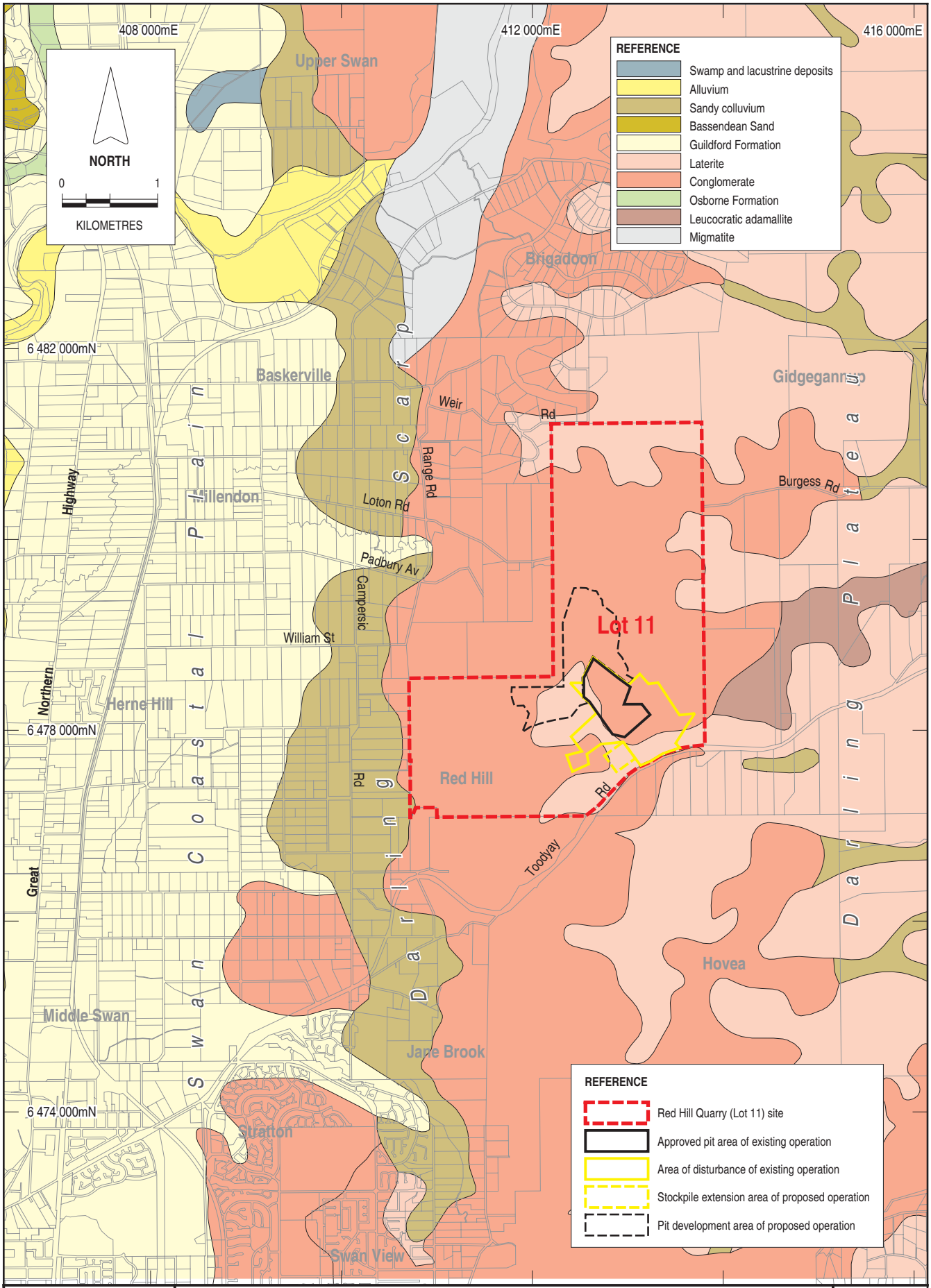
Section 10 contains a more detailed description of the hydrology of the project area.

2.1.4 Hydrogeology

The project area is located immediately east of the Darling Fault in an area of lateritic soils which are underlain primarily by crystalline basement rocks, mainly granite-gneiss, of the Archaean Yilgarn Craton. In general, fractured and weathered crystalline rocks have a poor groundwater potential; bore yields tend to be low and variable, and salinity levels also vary, both laterally and at depth. A seasonal local perched watertable system appears to exist in the wet season of the more permeable ferruginous lateritic soils which cap the quarry area. There are insufficient data from bore logs to assess the extent of this system, but data from the adjacent Red Hill Waste Management Facility suggest any perched aquifer would be isolated and at most, have only local influence (Aquaterra 2007b).

To the west of the project area, and west of the Darling Fault, is the groundwater aquifers of the Swan Coastal Plain. The Swan Coastal Plain aquifers are dependent on recharge from rainwater infiltration and not from the minor groundwater flow generated from the adjacent granite/dolerite aquifer (i.e. underlying the quarry site) (Aquaterra 2007b).

Section 11 contains a more detailed description of the hydrogeology of the project area.



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SOIL FORMATIONS OF THE PROJECT AREA

Source: Dep't of Industry and Resources, 2006

Figure 6

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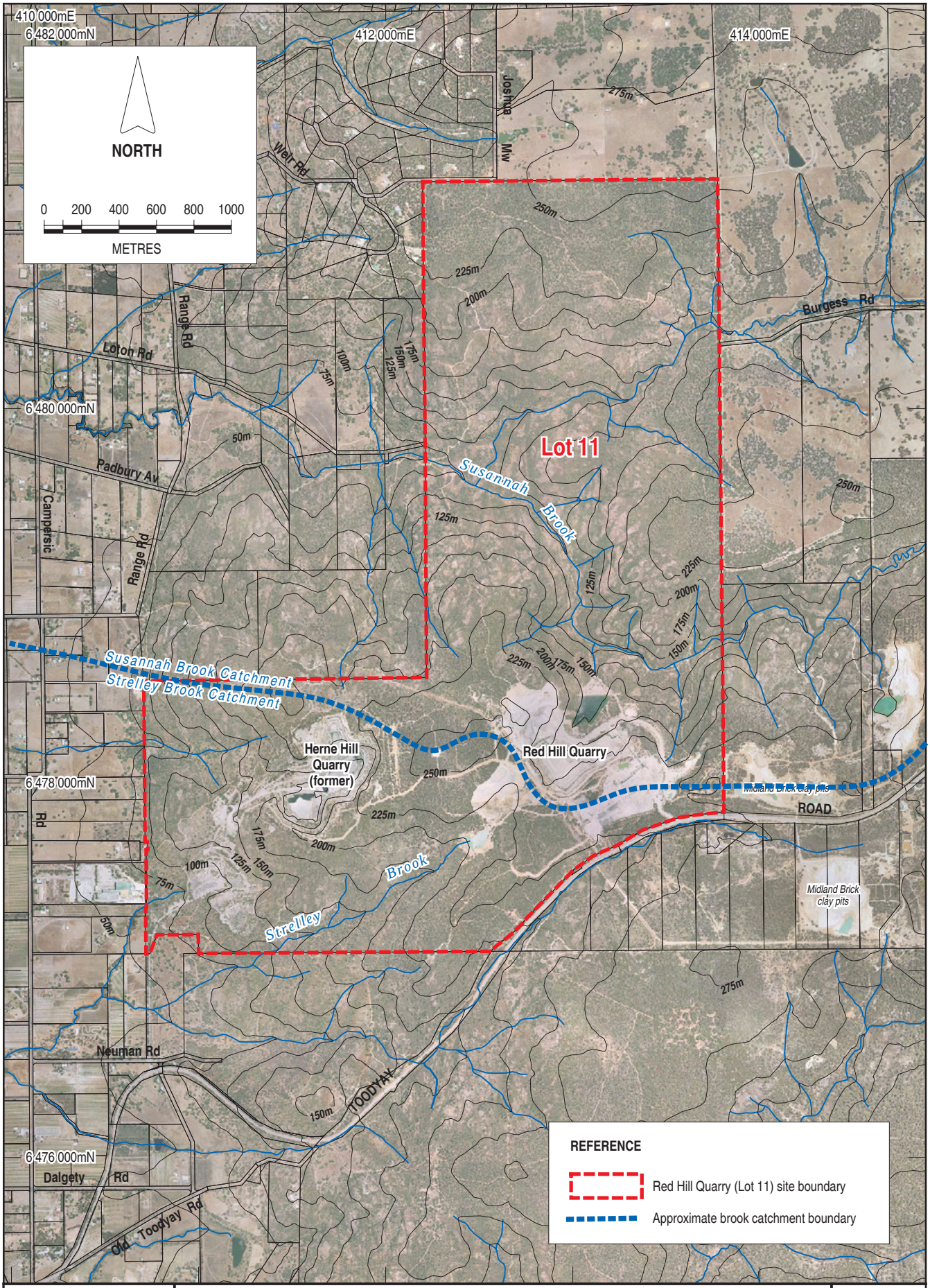

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TOPOGRAPHY AND DRAINAGE

Figure 7

2.2 BIOLOGICAL ENVIRONMENT OVERVIEW

2.2.1 Vegetation and flora

Vegetation of the project area

The majority of Hanson's Red Hill landholding (Lot 11 which encompasses the project area), is largely undisturbed native vegetation. The disturbed areas are generally as a result of current/previous quarrying activities (Red Hill Quarry and former Herne Hill Quarry) and associated access tracks.

Lot 11 occurs in the Darling Botanical District of the South-western Botanical Province as recognised by Diels (1906) and later developed by Gardner (1942) and Beard (1979, 1980). More recently the area has been categorised in the Northern Jarrah Forest subregion according to the Interim Biogeographic Regionalisation of Australia, which is characterised by Jarrah-Marri forest on laterite gravel with Bullich and Blackbutt in the valleys (Williams and Mitchell 2001).

The project area comprises three vegetation complexes (Mattiske 2007; 2008):

- **Darling Scarp:** Mosaic of open forest of *Eucalyptus marginata* subsp. *marginata – Corymbia calophylla*, with some admixtures with *Eucalyptus laeliae* in the north (subhumid zone), and *Corymbia haematoxylon* in the south (humid zone) on deeper soils adjacent to outcrops, woodland of *Eucalyptus wandoo* (subhumid and semiarid zones), low woodland of *Allocasuarina huegeliana* on shallow soils over granite outcrops, closed heath of Myrtaceae – Proteaceae species and lithic complex on near granite outcrops in all climate zones
- **Dwellingup 2:** Open forest of *Eucalyptus marginata* subsp. *marginata – Corymbia calophylla* on lateritic uplands in subhumid and semiarid zones
- **Helena 2:** Mosaic of open forest of *Eucalyptus marginata* subsp. *thalassica – Corymbia calophylla* and woodland of *Eucalyptus wandoo* with some *Eucalyptus accedens* and *Eucalyptus rudis* on the deeper soils ranging to closed heaths and lithic complex on shallow soils associated with granite on steep slopes of valleys in semiarid and arid zones.

A total of 320 taxa were recorded within the project area, which is comparative with the range of species recorded in the wider Jarrah forest (Mattiske 2007; 2008).

No Threatened Ecological Communities (TECs) or Declared Rare Flora (DRF) were recorded during surveys of the project area; however, the following Priority (P) flora species were recorded within the project area (Mattiske 2007; 2008):

- *Acacia oncinophylla* subsp. *oncinophylla* (P3)
- *Halgania corymbosa* (P3)
- *Calothamnus rupestris* (P4).

There are confirmed localised patches of dieback caused by *Phytophthora cinnamomi*; these patches are mainly in association with man-made influences such as tracks (DEC 2008).

Section 7 contains a more detailed description of the vegetation and flora of the project area.

2.2.2 Terrestrial fauna

The vertebrate assemblage of the project area includes a wide range of species due to the presence of Swan Coastal Plain species that are at the inland limit of their range in valleys of the western scarp, several species that are virtually restricted to the scarp and several species that are at the western limit of their range (Harris and Bamford 2007a). A number of significant habitats were identified within the area of the proposed development, including:

- granitic outcrops
- Eucalypt woodlands, especially those that include Wandoo
- heaths of gravely sands close to areas of exposed granite
- lower slopes of hills where water is concentrated
- temporary creeks including Susannah Brook.

A total of 189 fauna species could potentially occur within the project area, including 95 birds, 29 mammals, 52 reptiles and 13 amphibians. Of these species, 60 are considered to be of conservation significance, the majority of which are significant at the local scale. Conservation significant species recorded by Harris and Bamford (2007a), during surveys of the proposed development area, include:

Heleioporus barycragus (Hooting Frog) recorded in the project area

- *Antechinus flavipes* (Mardo)
- *Calyptorhynchus banksii naso* (Red-tailed Black-cockatoo)
- *Diplodactylus granariensis* (Wheatbelt Stone Gecko)
- *Malurus splendens* (Splendid Fairy-wren)
- *Phylidonyris novaehollandiae* (New Holland Honeyeater)
- *tarsipes rostratus* (Honey Possum).

One significant invertebrate, *Austromerope poultoni* (scorpion-fly), classified as a Priority 1 species by the Department of Environment and Conservation (DEC), could potentially occur in the area of the proposed development. One invertebrate species of local conservation significance, *Dinocambala ingens* (millipede), was recorded in the proposed development area under a rock on the edge of a granite outcrop (Harris and Bamford 2007a).

Section 8 contains a more detailed description of the terrestrial fauna of the project area.

2.3 SOCIAL ENVIRONMENT OVERVIEW

2.3.1 Socio-economic setting

The Red Hill Quarry is within City of Swan in the locality of Red Hill. The City of Swan is the largest local authority (land area) in the Perth Metropolitan Area and the fourth largest based on population. The resident population of the City is predicted to grow from around 100,000 (2006) to around 168,000 in 2021. The locality of Red Hill is currently one of the least populated localities of the City of Swan with a resident population of less than 600 people (City of Swan 2006).

The City of Swan has a diversified economic base with no dominant industry sector. Office and business, and shop/retail sectors are the largest industry sectors in the City based on total number of business establishments. Manufacturing and retail are the two largest industries of employment in the City (City of Swan 2006).

2.3.2 Land use and tenure

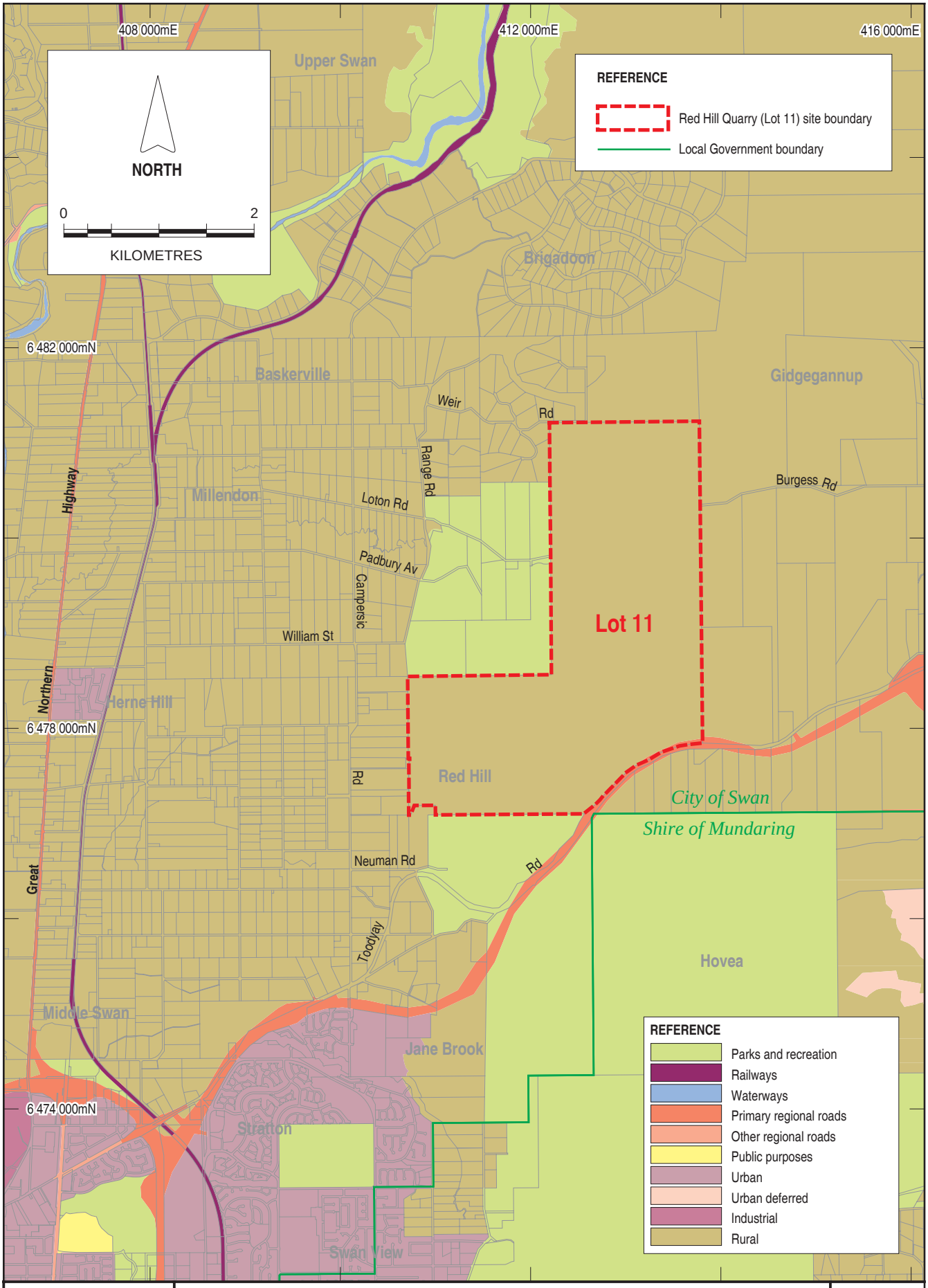
The Red Hill Quarry (Lot 11) is zoned 'Rural' under the Metropolitan Region Scheme (Figure 8) and zoned 'Resource' and 'Landscape' (extractive industry is permitted if approval is granted by the City of Swan) under the City of Swan Town Planning Scheme (Figure 9).

Statement of Planning Policy 2.4, Basic Raw Materials, also recognises some areas of Lot 11 as a 'Key Extraction Area' and as a 'Priority Resource Location'. This policy is adopted under the *Planning and Development Act 2005*. The key objective of the Policy is to protect Key Extraction/Priority Resource areas from being developed for incompatible land uses, which could limit future exploitation. In accordance with the Policy, such areas are regional resources that provide for the long-term supply of basic raw materials. The Policy also states that such areas should be protected in relevant Town Planning Schemes. Key Extraction/Priority Resource areas are considered essential to the needs of the region, of a long-term nature and strategically located in relation to transport links (WAPC 2000).

Prior to the formal establishment of the Herne Hill Quarry in 1961, Lot 11 was quarried for gravel. The Herne Hill Quarry operations were moved to the Red Hill Quarry location in 1996. The remainder of Lot 11 is remnant vegetation. The land use/tenure in the project area comprises:

- low-density residential to the west and north-west consisting mainly of hobby farm blocks
- rural land (cropping and grazing) mainly to the north and east
- John Forrest National Park to the south
- part of the Darling Range Regional Park to the north-west (this area, approximately 235 ha, was sold by Hanson to the State Government for the purpose of inclusion in the Regional Park)
- Midland Brick extractive clay pits to the immediate east
- Red Hill Waste Management Facility to the south-east.

The closest residence to the existing operation is approximately 2 km to the north. The closest residence to the proposed operation will be approximately 1 km once the proposed pit extends to its full northward extent (assuming surrounding land uses remain unchanged); this extent is not expected to be reached within the next 50 years.



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METROPOLITAN REGION SCHEME COVERING THE PROJECT AREA

Source: Western Australian Planning Commission

Figure 8

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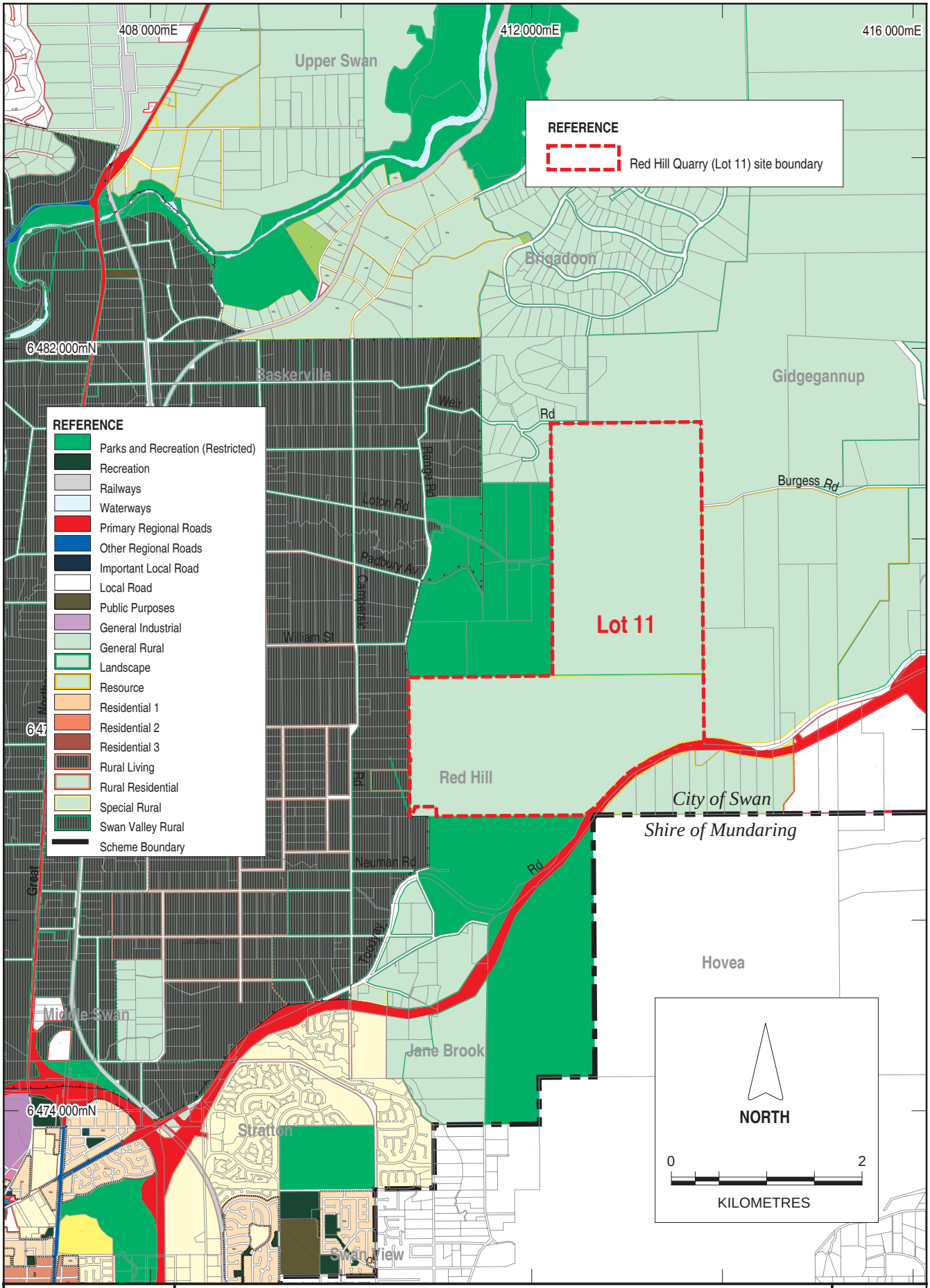

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TOWN PLANNING SCHEME COVERING THE PROJECT AREA

Source: City of Swan TPS 9

Figure 9

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2.3.3 Aboriginal heritage and native title

Archaeological and ethnographic surveys have been undertaken over the project area, with no definite archaeological sites identified. Ethnographic surveys identified two sites of mythological significance:

1. Susannah Brook, which is believed to be part of the Dreaming Track of the Waugal. This mythological association only applies to Susannah Brook and not to its tributaries.
2. White ochre deposit; the site on Lot 11 is associated with a much larger deposit on the opposite side of Toodyay Road.

Section 14 contains more detailed description of Aboriginal heritage values for the Red Hill Quarry area.

2.3.4 European heritage

Despite the long history of European settlement of the Swan Valley and surrounding areas, no items or sites of European heritage value have been identified in, or near the project area.

3. DESCRIPTION OF PROPOSAL

3.1 KEY CHARACTERISTICS OF PROPOSAL

The existing Red Hill Quarry produces aggregate for the building and construction industries. The quarry currently produces around 1,000,000 t/yr of granite and diorite/dolerite aggregate (based on 2005/2006 throughput). This production rate fluctuates annually based primarily on market demand for the product. The current reserves are expected to last up to approximately 18 months based on these production rates. In order to provide long-term access to the resource, Hanson propose to continue to develop the quarry to the north and west of the current pit. The proposal also includes an extension to the existing stockpile and dispatch area and the possible relocation and/or upgrade of existing crushers and/or installation of additional crushers to the existing processing plant (including installation of additional support infrastructure as required [e.g. additional conveyors and screens and extension of processing buildings]).

The key components of the proposal are:

- the area of quarry pit for hard rock extraction is proposed to be extended to the north and west of the existing quarry pit by approximately 75 ha over 100 years (or on average less than 1 ha/yr)
- throughput and number of haul truck movements is proposed to increase by approximately 50% in the short-term
- quarrying will continue to be undertaken using conventional drill and blast, load and haul and will utilise existing infrastructure and services at the Red Hill site
- blasted rock will continue to be hauled by truck from the quarry face to the processing plant for crushing and screening, whereafter the product will be hauled offsite for sale
- some of the existing crushers may be relocated as the pit expands and/or upgraded, and/or additional crushers may be added to the existing processing plant (including installation of additional support infrastructure as required [e.g. additional conveyors and screens and extension of processing buildings])
- product will continue to be stockpiled and dispatched from the existing stockpile and dispatch area, which is proposed to be increased in area by approximately 5 ha
- fines and other undesirable material will continue to be stockpiled for re-use, on-sale or disposal at the existing stockpile and dispatch area
- water consumption for the purposes of processing and dust suppression will increase by approximately 15% (which is less than the proposed short-term increase in throughput) and will continue to be supplied from onsite sources.

The key components of the proposal described below in Sections 3.2 to 3.9. Key characteristics of the proposal are detailed in Table 1. The layout of the existing and proposed Red Hill Quarry operation is shown in Figure 10.

Table 1 Key characteristics of the Red Hill Quarry Development Proposal

Element	Existing project	Proposed project
General		
Layout	Refer Figure 10	Refer Figure 10
Water consumption	100,000 kL/yr	Approximately 115,000 kL/yr
Water supply	Onsite: • two sedimentation dams • quarry pit sump • Herne Hill quarry pit sump (emergency supply)	Same sources as for existing project
Quarry		
Life of quarry	Approximately another 18 months	Approximately 100 years
Extraction method	Open pit using conventional drill and blast, and load and haul	As existing
Overburden disposal	In pit disposal, ramps, bunds, rehabilitation and stockpile	As existing
Topsoil	Direct onto areas undergoing rehabilitation or stockpiled	As existing
Processing facilities		
Throughput	Approximately 1,000,000 t/yr (2005/2006)	Up to 1,500,000 t/yr in the short-term
Processing plant	Primary, secondary and tertiary crushers and screens	Same as for existing project Some of the existing crushers may be relocated and/or upgraded, and/or additional crushers installed (including installation of additional support infrastructure as required [e.g. additional conveyors and screens and extension of processing buildings])
Product stockpiles	10 ha	15 ha (inc. area of existing product stockpile)
Disturbance area		
Quarry pit	Approximately 29 ha	Approximately 104 ha (inc. existing approved pit)
Infrastructure (processing and stockpile areas, offices, workshops, roads, dams)	Approximately 45 ha	Approximately 50 ha (inc. existing infrastructure areas)
Overburden dump	Approximately 7 ha	As existing
Total area disturbed	Approximately 81 ha	Approximately 161 ha (inc. existing disturbed areas)

Key: ha = hectares; kL/yr = kilolitres per year; t/yr = tonnes per year

3.2 THROUGHPUT

The throughout at the current Red Hill Quarry operation varies annually due mainly to market demand for the product. The existing quarry operation is licensed under Part V of the EP Act for a nominal throughput of more than 500,000 tonnes per year (t/yr). Throughput for 2005/2006 was approximately 1,000,000 t/yr. The throughput of the proposed operation is expected to be up to 1,500,000 t/yr in the short-term; however, as with the current operation, the rate is expected to vary annually (without exceeding licensed throughput) based on product demand.

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EXISTING AND PROPOSED QUARRY OPERATIONS

Hanson Construction Materials Pty Ltd

RED HILL QUARRY DEVELOPMENT PROPOSAL

Figure 10

3.3 STAGING OF PIT DEVELOPMENT

The proposed pit development will increase the quarry pit disturbance footprint by around 75 ha over the 100 year life of the project (or on average less than 1 ha/yr). Clearing will be progressive over this time as the pit is developed. The proposed pit development will initially progress in a northward direction towards Susannah Brook, reaching the northern extent in around 50 years (Figure 11). Development of the pit in a westward direction towards the former Herne Hill Quarry is anticipated to commence in around 70 years (Figure 11).

3.4 DESCRIPTION OF QUARRYING AND PROCESSING OPERATIONS

No changes to the quarrying operations are envisaged with the key quarrying processes being:

- topsoil and overburden stripping
- drilling and blasting
- loading and hauling
- crushing and screening.

3.4.1 Topsoil and overburden stripping

Quarrying is a 'top-down' process which requires clearing some way in front of working faces. Vegetation, topsoil and overburden will be progressively removed by dozers and excavators to expose the hard rock resource. The depth of topsoil and overburden varies with location. For example, overburden varies between 0 – 6 m at the current operations. Topsoil and overburden, where available, will be stockpiled separately for use in rehabilitation. The cleared vegetation may also be mulched for use in rehabilitation. In some instances, topsoil and overburden will be applied directly to areas undergoing rehabilitation or where overburden is required for the construction of landscape banks and access ramps, or bunding. Overburden will also progressively be returned to the pit as excavation progression permits.

3.4.2 Drilling and blasting

Quarrying will involve the drilling and blasting of hard rock to establish the quarry face and enable extraction of rock consistent with existing operations. Drill rigs will work the benches of the pit, typically drilling 12 to 18 m faces. Drill holes are typically between 89 and 102 mm, which are packed with explosives (mixed onsite) and fired with millisecond delay. The depth, amount of explosive, and delay will be individually determined based on factors such as climatic conditions and local geology to minimise over-blast pressure, noise and vibration. Blasting will typically occur every two to three weeks, but may be more frequent at times (depending on stage of pit development). The aim is to increase the size of shots in order to decrease the number required.

This drilling and blasting approach develops the typical 'stepped' quarry profile. This profile enables the digging from one bench whilst accessible alternate locations at other levels can be drilled. The collection of rainwater in the pit basement precludes working in the lower sections during the wetter months.

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RED HILL QUARRY DEVELOPMENT PROPOSAL

INDICATIVE STAGING OF PROPOSED QUARRY PIT DEVELOPMENT

Figure 11

3.4.3 Loading and hauling

Blasted rock will be retrieved from the face and loaded onto 50 to 70 tonne off-highway dump trucks by front end loaders or excavator for transport to the primary crusher for processing. Oversize material will be stored in the pit until the volume of material is sufficient to require the use of a rock-breaker, minimising the requirement for secondary blasting. Water carts will continue to be used on haul roads to suppress dust lift-off.

3.4.4 Crushing and screening

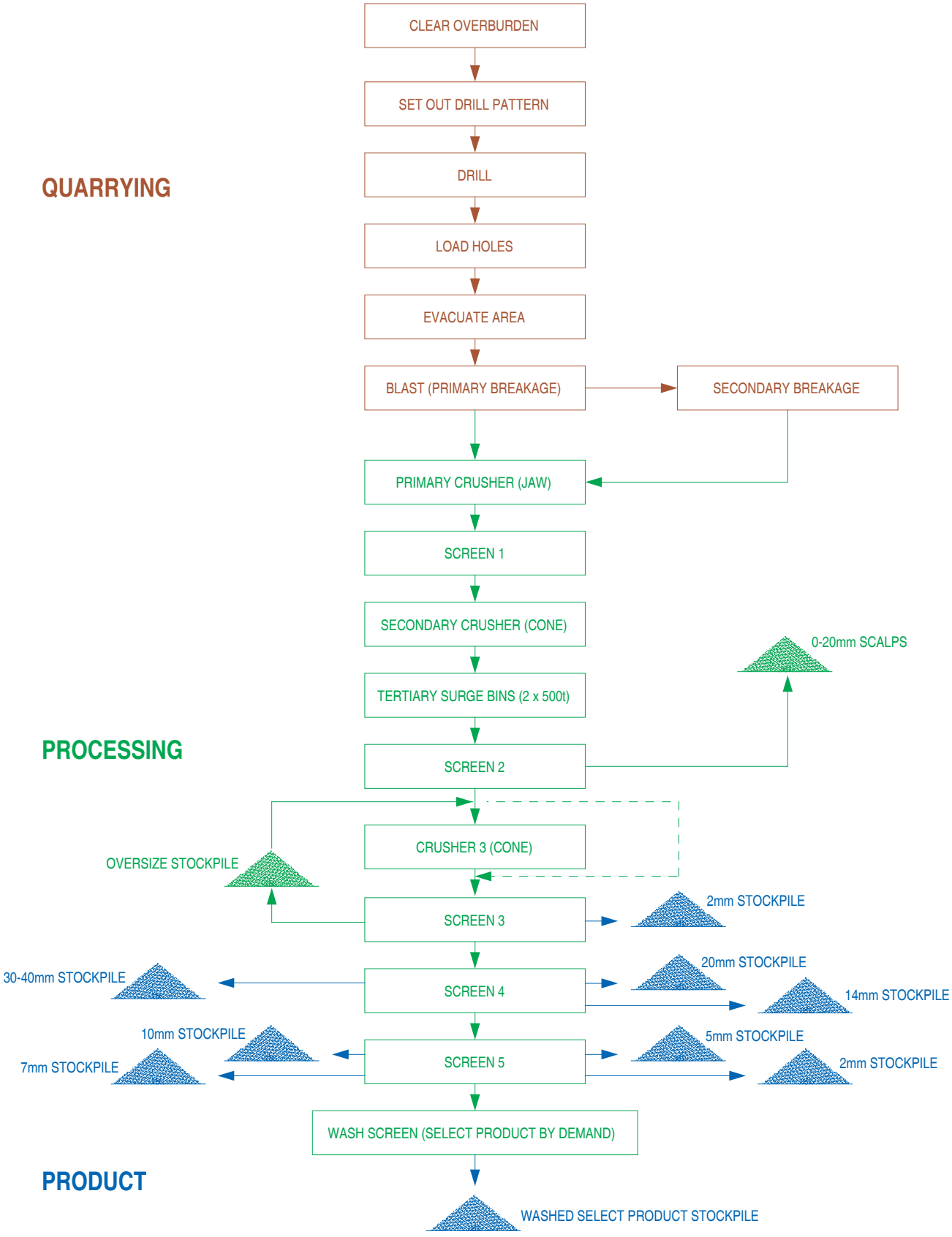
Existing processing plant at Red Hill

The three stage crushing and screening plant and other infrastructure used for processing material from the existing quarry will continue to be used to process material from the proposed operation (Figure 10). Over the life of the proposal (around 100 years) there may be a requirement to relocate and/or upgrade existing crushers and/or add new crushers to the existing plant (see below). Technological developments in processes over the life of the proposal may also see some changes to the operations as these technologies become available.

The primary crusher (jaw-type crusher) forms stage one of the aggregate processing plant. The blasted rock will be dumped into the hopper and will be crushed to around 175 mm. The output from the primary crusher will be transported to the secondary and tertiary crushers and screens along a covered conveyor system. Screening of crushed product provides the ability to grade aggregate for differing end-uses. Initially, the existing crushing and screening plant will remain in its present location; however, there may be a requirement to relocate or upgrade existing crushers as the pit extends, or add crushers as throughput or demand for smaller sized fractions of stone increases. For example, the primary crusher may be relocated within the pit floor as the pit extends; relocation of the primary crusher will require the existing conveyor to be extended, but will reduce the truck haulage distance. The secondary crusher may then be relocated to the site of the current primary crusher and/or an additional crusher added to the current plant, which may include a quaternary crusher. Such changes to the processing facilities will require installation of additional support infrastructure (e.g. additional converyors and screens and extension of processing buildings as required).

Fines and other undesirable material removed from the product will be stockpiled for re-use (during rehabilitation), on-sale (road base material) or disposal. The existing product stockpile area will continue to be used for the proposed operation. The aggregate product is loaded and dispatched from this area. The proposed operation will include extension of the product stockpile area by approximately 5 ha (from around 10 ha to 15 ha) to allow for storage of a greater tonnage of products as markets increase (Figure 10).

The existing secondary and tertiary crushing plant is fitted with baghouses, and water sprays wet the crusher feed and conveyors transfer points to minimise dust emissions. The existing crushing plant and conveyors are also enclosed to reduce dust emissions and water cannons are used to minimise dust lift-off from the product stockpiles. The quarrying and processing procedure at the Red Hill Quarry is shown diagrammatically in Figure 12.



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RED HILL QUARRY DEVELOPMENT PROPOSAL

QUARRYING AND PROCESSING FLOW CHART

Figure 12

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3.5 PRODUCT TRANSPORTATION

Entry to, and exit from the Red Hill Quarry will continue to be from Toodyay Road, including the offsite transport of product and onsite transport of consumables. Currently, there are around 650 loaded trucks that leave the quarry and around 650 empty truck returns to the quarry per week. The number of truck movements will increase as a result of the proposed development with the number of truck movements increasing proportionately to throughput increase.

Toodyay Road is a heavy haulage route, providing heavy vehicle access to a number of sites including the Red Hill Quarry, Midland Brick Quarry and the Red Hill Waste Management Facility. Toodyay Road is identified as a primary freight route under Main Roads jurisdiction in 'Statement of Planning Policy: Metropolitan freight network (Draft)', and has also been identified as forming part of the proposed Perth-Adelaide National Highway route (WAPC 2005).

3.6 WATER SUPPLY

The current Red Hill Quarry operation utilises approximately 100,000 kL/year of water (supplied from onsite sources) for processing and dust suppression in summer. This is expected to increase for some processes (e.g. washing of material) for the proposed development; however, it is not expected to increase significantly for dust suppression on roads. It is estimated that the percentage increase in water use will be approximately 15%.

Water for use in the quarrying and processing operations and for environmental management (e.g. dust suppression) will be obtained from onsite supplies (collected from surface runoff) at Red Hill, as for the current operation. Surface water runoff is collected and stored in onsite water supplies at Red Hill, which will continue to be used for the proposed development and include:

- two sedimentation dams; one to the north of the current pit (primary source) and the other to the south-west (secondary source) (Figure 10)
- storage basin in quarry pit (which is pumped to the primary sedimentation dam).

Northern sedimentation dam

The sump in the former Herne Hill Quarry pit will continue to be used as an emergency source if required and no water will be abstracted from Susannah Brook. Potable water for potable purposes will continue to be brought onsite in bottles or by bulk and stored in tanks as required. No new water supplies will be required for the proposed development.

3.7 SUPPORT FACILITIES

Current support facilities (e.g. offices, workshop, weighbridge and laboratory) will continue to be utilised in their current locations for the proposed quarry operation (Figure 10).

3.8 HOURS OF OPERATION

The hours of operation of the current Red Hill Quarry operations are detailed in Table 2. It is currently proposed that similar operating hours apply to the proposed quarry operation.

Table 2 Approved hours of operation for existing operations

Activity	Monday to Friday	Saturday*
Quarrying	0600 -1800	0600 -1800
Primary crusher	0600 -1800	0600 -1800
Secondary and tertiary crusher**	0600 - 1800	0600 -1800
Screening**	0600 - 1800	0600 -1800

* Although Hanson has approval to operate during the times specified in the table above, presently the quarry does not operate on Saturdays (only product sales occur).

** Hanson has had approval in the past to operate these activities up to 2000 hrs.

3.9 WORKFORCE

Hanson currently employs 30 people at the quarry and this is expected to remain the same for the proposed operation. A significant number of other contract carters, maintenance personnel and suppliers are indirectly employed by the operation.

PART 2 CONSULTATION, ENVIRONMENTAL IMPACT ASSESSMENT APPROACH, ENVIRONMENTAL PRINCIPLES & SUSTAINABILITY

4. STAKEHOLDER CONSULTATION

Hanson's commitment to community consultation is documented in their Environmental Policy (Hanson 2004), which states:

> "*Striving to meet Community Expectations through consultation within Hanson and with other relevant bodies, community groups and neighbours about environmental matters of concern.*"

4.1 IDENTIFICATION OF STAKEHOLDERS

Key stakeholders identified and consulted during the preparation of the PER were:

Government agencies

- Environmental Protection Authority Service Unit (EPASU)
- Department of Environment and Conservation (DEC)
- Department of Water
- Department of Indigenous Affairs
- Commonwealth Department of Environment and Water Resource (DEW)[1].

Members of Parliament

- State Member of Parliament for Swan Hills (Jaye Radisich).

Non-government organisations

- Wildflower Society (including the Eastern Hills Branch)
- Conservation Council of Western Australia
- Urban Bushland Council.

Local government

- City of Swan
- Eastern Metropolitan Regional Council (EMRC).

[1] The proposed development was referred to DEW under the EPBC Act on 27 April 2007. In accordance with requirements of the EPBC Act, the referral was made available for public comment on the DEW website for 10 working days. On 28 May 2007, DEW advised that the proposed action was not considered to be a controlled action under the EPBC Act (Section 1.7).

Community

- Brigadoon Progress Association
- Gidgegannup Progress Association
- Swan Valley Progress Association
- Stoneville Progress Association
- Susannah Brook Catchment Group
- Swan Valley Residents and Ratepayers Association
- neighbours and local residents.

Various forms of contact were made with these stakeholders (e.g. post, email, phone call) to provide an initial project briefing and to invite stakeholders to be involved in ongoing consultation throughout the PER process. The level of stakeholder involvement in the consultation process varied depending on the interest of the stakeholder.

4.2 FORM AND TIMING OF CONSULTATION

Hanson initiated a stakeholder consultation program for the Red Hill Quarry Development proposal towards the end of 2006, prior to submission of the environmental referral of the proposal to the EPA in February 2007 and the draft Environmental Scoping Document in April 2007. The timing of the consultation program enabled the issues raised to be taken into consideration in the formulation of the environmental investigations, the scope of the assessment and preparation of the PER. Key consultation activities undertaken included:

- conducting a public open day at the quarry
- distribution of project newsletters to neighbours and community groups
    - sent to approximately 180 immediate and near neighbours on three occasions; November/December 2006, March 2007, September 2007
    - 'Frequently Asked Questions' newsletter sent to around 40 interested residents
    - newsletters also sent to community groups for electronic distribution to members
- encouraging feedback through distribution of feedback forms with newsletters, and at meetings
- briefing stakeholders
- attending and addressing community group meetings
- maintaining a project webpage, which included documents to download (e.g. newsletters, feedback forms, specialist consultants reports)
- displaying project posters on community notice boards
- holding a resident information session where the majority of specialist consultants provided an overview of their work and results
- providing project team contact details on all materials distributed.

A summary of the consultation program is contained in Table 3.

Table 3 Summary of consultation undertaken to date

Date	Stakeholder	Purpose
Nov 06	Interested members of the public	Project webpage established on the Hanson website. Newsletter #1 and feedback form available to download and email link for providing feedback.
Nov 06	Immediate and near neighbours Local community groups	Newsletter #1 sent to approximately 250 neighbouring properties and local community groups to provide overview of the Red Hill Quarry Development Proposal. Recipients invited to complete and send back enclosed public feedback form to provide preliminary comments and raise any initial concerns (21 forms received).
17 Nov 06	EPASU	Briefing to provide information on the Red Hill Quarry Development Proposal.
18 Nov 06	Neighbours and wider community	Red Hill Quarry Open Day to provide tour of quarry and to provide overview of the Red Hill Quarry Development Proposal.
11 Dec 06	City of Swan	Briefing to provide information on the Red Hill Quarry Development Proposal.
12 Dec 06	Swan Valley Progress Association	Presentation to provide information on the Red Hill Quarry Development Proposal. Invitation extended to members to provide comment or participate further in consultation program.
13 Dec 06	Conservation Council of Western Australia	Briefing to provide information on the Red Hill Quarry Development Proposal.
18 Dec 06	Gidgegannup Progress Association	Presentation to provide information on the Red Hill Quarry Development Proposal. Invitation extended to members to provide comment or participate further in consultation program.
Jan 07	Local community	Project overview posters displayed at key community locations.
16 Jan 07	Eastern Metropolitan Regional Council (EMRC)	Phone briefing and provision of Newsletter #1.
24 Jan 07	DEC (Conservation Branch – Terrestrial Fauna)	Briefing to provide information on the Red Hill Quarry Development Proposal. Presentation of preliminary fauna survey results.
30 Jan 07	DEC (Conservation Branch – Terrestrial Flora and Vegetation)	Briefing to provide information on the Red Hill Quarry Development Proposal. Presentation of preliminary flora and vegetation survey results.
8 Feb 07	Susannah Brook Catchment Group	Briefing to provide information on the Red Hill Quarry Development Proposal. Discussion of possible opportunities for Hanson to fund revegetation projects undertaken by the group.
17 Feb 07	Neighbours and local community groups	Resident Information Session. Briefing to provide information on the Red Hill Quarry Development Proposal. Presentation of preliminary results by the following specialist consultants: noise and vibration; flora and vegetation; and, fauna.
19 Feb 07	Gidgegannup Progress Association	Presentation of preliminary results from the various environmental investigations being undertaken.
20 Feb 07	Department of Water	Phone briefing and discussion of buffer requirements along Susannah Brook.
Mar 07	Immediate and near neighbours Local community groups	Newsletter #2 sent to approximately 250 neighbouring properties and local community groups to provide preliminary results from environmental investigations. Recipients invited to complete and send back enclosed public feedback form to provide comments on environmental investigations (14 forms received).
Mar 07	Immediate and near neighbours Local community groups	Responses to Frequently Asked Questions (FAQs) document distributed to approximately 40 interested residents and local community groups.

Date	Stakeholder	Purpose
1 Mar 07	Swan Valley Progress Association	Presentation of preliminary results from the various environmental investigations being undertaken.
9 Mar 07	Wildflower Society Urban Bushland Council	Briefing to provide information on the Red Hill Quarry Development Proposal. Presentation of preliminary results from the flora and fauna investigations undertaken.
23 Mar 07	State Member of Parliament for Swan Hills (Jaye Radisich)	Briefing to provide information on the Red Hill Quarry Development Proposal. Presentation of preliminary results from the flora and fauna investigations undertaken.
31 Mar 07	Susannah Brook Catchment Group	Red Hill Quarry site tour and provision of additional information about the proposed development.
3 Apr 07	DEC (Regional Parks Branch)	Phone briefing and provision of Newsletter #2 and FAQs document.
17 May 07	DEC (Environmental Management Branch)	Briefing to provide information on the Red Hill Quarry Development Proposal. Presentation of preliminary results from the flora and fauna investigations undertaken.
24 May 07	DIA	Briefing to provide information on the Red Hill Quarry Development Proposal. Discussion relating to significance of the rock shelter identified onsite.
Sep 07	Immediate and near neighbours Local community groups	Newsletter #3 sent to approximately 250 neighbouring properties and local community groups to provide project update and to call for nominations for the Red Hill Quarry Stakeholder Reference Group (Section 4.4).
7 Feb 08	Stakeholder Reference Group (Section 4.4)	Inaugural meeting to confirm terms of reference, group processes, proposed timing for future meetings, project update and summary of key environmental investigations.
8 Mar 08	Stakeholder Reference Group	Site meeting and bus tour of areas around the quarry to discuss the visual impact assessment report.

4.3 STAKEHOLDER COMMENTS AND REPSONSES OF PROPONENT

The main issues raised by stakeholders related to:

- affects on amenity, including those arising from noise and vibration, dust and visual impacts
- impacts on surface and groundwater quality and quantity
- affects on flora and fauna, including the spread of weeds, dieback and feral fauna
- movement of heavy vehicles on Toodyay Road and other roads
- rehabilitation and end-use
- Aboriginal heritage.

Table 6 summarises the issues raised by stakeholders during consultation sessions and Hanson's responses to these issues.

Table 4 Key issues raised during consultation

Stakeholder	Key issues	Responses
Government agencies		
EPASU	Comprehensive community consultation needs to be undertaken.	See PER Section 4.2.
	Need to address closure and rehabilitation to meet community expectations.	A Screening and Rehabilitation Plan has been prepared. Hanson will also undertake closure planning. See PER Section 17.
	Need to ensure long-term protection of Susannah Brook.	A Surface Water Quality Management Plan has been prepared and is contained in the Environmental Management Plan (EMP). See PER Section 10.
	Accurate visual impact modelling must be undertaken.	See PER Section 9.
	Offsets should be considered.	See PER Section 19.
DEC Conservation Branch	Need to retain and enhance connectivity of corridors across the landscape.	A Vegetation and Habitat Protection Management Plan, which addresses ecological linkages, has been prepared and is contained in the EMP. See PER Section 17.3.3.
	Consider opportunities for locating stockpiles offsite to avoid the need to clear vegetation.	Some stockpiling is undertaken at cement plants, asphalt plants and road side dumps. Generally, these sites are themselves in confined sites. Environmental controls are better managed on the one site. Costs of handling products a multiple of times increases the cost to the end user.
	Need to investigate the potential for the proposal to influence groundwater resources.	See PER Section 11.
	Need to undertake further field work to investigate the unusual gecko species collected and short-range endemics.	Further field work is in progress. See PER Section 8.5.
	There will be a requirement to undertake additional flora investigations due to unusual spring season in 2006 and to compare with sites to the north of Susannah Brook.	Additional flora investigations undertaken in winter/spring 2007 by Mattiske Consulting Pty Ltd to expand the current coverage of the flora. Results included in PER Section 7.2.
	Floristic data should be compared with other data from Darling Range studies.	Floristic data has been compared to data from Armstrong (1993) – Darling Range bushland reserves in the Shire of Kalamunda – Mattiske (1991) – John Forrest National Park – Markey (1997) – northern Darling Scarp.
DEC Environmental Management Branch	Some Priority flora species likely to occur at the site germinate after fire, therefore, it would be advisable to review the fire history of the site.	See PER Section 7.2.1.
	Rehabilitation plan needs to include provision for using locally collected seed and using Priority flora in rehabilitation.	A Screening and Rehabilitation Plan has been prepared and contains provision for using locally collected seed and Priority flora in rehabilitation. See PER Section 17.3.2.
	Rehabilitation plan needs to clearly describe the final slopes and drop-offs of the pit and how erosion will be managed.	This is addressed in the Screening and Rehabilitation Program and summarised in PER Section 17.3.2.

Stakeholder	Key issues	Responses
	Need to address boundary operations due to conservation areas adjoining the site.	A minimum 100 m vegetated buffer will be maintained between the quarry operations and the adjoining Darling Range Regional Park. Proposed quarry operations will not come within 800 m of the John Forrest National Park to the south. See PER Section 6.3.3.
	A dieback assessment needs to be undertaken.	DEC Forest Management Branch has been undertaken a formal dieback assessment; see PER Sections 7.2.1 and 7.5.
	Weed, dieback and fire management need to be addressed.	Weed and Dieback Management Plans have been prepared and are contained in the Screening and Rehabilitation Program; see PER Section 7.5. A Fire Management Plan is contained in the EMP that has been prepared; see PER Section 18.3.
DIA	Aboriginal heritage consultant should clearly state their professional opinion on the archaeological significance of the rock shelter.	See PER Section 14.4.1.
	Advice/opinion of the DIA officer who has previously visited the site should be documented in the archaeological report.	See archaeological report contained in Appendix 2.
DoW	Buffer to be retained along Susannah Brook.	See PER Section 10.5.
Non-government organisations		
Wildflower Society	Consideration of offsets should include contributing to enhancing knowledge of Darling Range flora to provide a better understanding of regional floristics.	The flora and vegetation investigations commissioned by Hanson and undertaken on Lot 11 will contribute to an enhanced knowledge of Darling Range floristics. See PER Section 19.
	Advisable to consult directly with the Eastern Hills Branch of the Wildflower Society.	Eastern Hills Branch was contacted. See PER Section 4.1.
Urban Bushland Council	Protection of water quality in Susannah Brook (in particular, turbidity).	A Surface Water Quality Management Plan has been prepared and is contained in the Environmental Management Plan (EMP). See PER Section 10.
	Visual 'scarring' of the Darling Scarp is a big issue and needs to be addressed in landscape planning for the region.	See PER Section 9.
	Additional flora and fauna (in particular invertebrates and reptiles) studies should be undertaken in addition to the 2006 biological studies.	Additional flora (Mattiske 2008) and fauna (Bancroft, Harris and Bamford 2007; Harris and Bamford 2007a) investigations have been undertaken. Hanson also proposes to undertake additional survey work relating to the gecko species found onsite. See PER Section 8.5.
	Dieback management needs to be addressed.	Dieback Management Plan contained in the Screening and Rehabilitation Program. See PER Section 7.5.
	Groundwater impacts need to be addressed.	See PER Section 11.
	Consideration of offsets should include contributing to enhancing knowledge of Darling Range flora to provide a better understanding of regional floristics.	The flora and vegetation investigations commissioned by Hanson and undertaken on Lot 11 will contribute to an enhanced knowledge of Darling Range floristics. See PER Section 19.

Stakeholder	Key issues	Responses
	Management of the local landscape given the presence of the adjacent conservation areas.	A Screening and Rehabilitation Program has been prepared and contains provision for vegetative screening of operations. Vegetative buffers will also be maintained between quarry operations and adjacent conservation reserves. See PER Section 6.3.3.
Conservation Council of Western Australia	Previous commitments made by Hanson have not been met, in particular those relating to the views from Toodyay Road.	Hanson has always met its commitments. In addition, it has developed and is implementing a Screening and rehabilitation Program to address visibility concerns.
	The current operation does not comply with the current approval.	This is not correct; the current operation is fully compliant with current approvals.
	Need to progress rehabilitation for screening.	Hanson undertakes rehabilitation and screening in accordance with a Screening and Rehabilitation Program. Rehabilitation (and screening) is an ongoing activity at the quarry. See PER Section 17.3.
	Any commitments made during consultation need to be enacted/implemented.	Table 34 sets out the commitments that Hanson has made relating to the Red Hill Quarry Development Proposal. Hanson will implement all commitments made should the proposal receive environmental approval.
	There is a level of mistrust towards Hanson in the community.	Hanson has committed to the formation of the Red Hill Stakeholder Reference Group with one of the purposes being to develop a relationship between Hanson and the community based on trust, fairness and mutual benefit. See PER Section 4.4.
Local Government		
City of Swan	Traffic management on Toodyay Road.	A Traffic Management Plan is contained in the EMP for the operation. See PER Section 15.
	Comprehensive community consultation needs to be undertaken.	See PER Section 4.
Community		
Susannah Brook Catchment Group	Long-term protection of Susannah Brook and its tributaries, including buffers, water quality and quantity.	See PER Section 10.
	Heavy vehicle traffic on Toodyay Road is an ongoing problem.	A Traffic Management Plan is contained in the EMP for the operation. See PER Section 15.
Gidgegannup Progress Association	Heavy vehicle traffic on Toodyay Road, in particular debris and dust on road.	A Traffic Management Plan is contained in the EMP for the operation. See PER Section 15.
	Need to undertake additional flora and fauna investigations due to the unusually dry winter of 2006.	Additional flora (Mattiske 2008) and fauna (Bancroft, Harris and Bamford 2007; Harris and Bamford 2007a) investigations have been undertaken. Hanson also proposes to undertake additional survey work relating to the gecko species found onsite. See PER Section 8.5.
	Fauna movement will be impacted.	North-south and east-west vegetated ecological corridors on Lot 11 will be retained and enhanced. See PER Section 17.3.3.
	Making flora and fauna reports available to the public.	All consultants reports were made available on the Hanson Red Hill Quarry Development Proposal webpage and appended to the PER. See PER Appendix 2.

Stakeholder	Key issues	Responses
	Surface hydrology needs to be fully examined to address runoff and the capacity of existing dams to collect it, flooding potential, Susannah Brook draining into the pit, buffer requirements.	See PER Section 10.
	Indicative stages of the proposed development need to be shown on figures.	See PER Figure 11.
	The current operation does not comply with the current approval.	This is not correct; the current operation is fully compliant with current approvals.
	Any commitments made during consultation need to be enacted/implemented, in particular, those relating to visual amenity.	Table 34 sets out the commitments that Hanson has made relating to the Red Hill Quarry Development Proposal. Hanson will implement all commitments made should the proposal receive environmental approval.
	Closure needs to be addressed.	A Conceptual Closure Plan has been developed and is contained in the Environmental Management Plan (Appendix 2). See also PER Section 17.4.
	Extent of consultation needs to be much wider.	See PER Section 4.
	Night-time lighting detracts from the visual amenity of the area.	See PER Section 6.3.2.
	Dieback needs to be managed appropriately.	A Dieback Management Plan has been prepared and is contained in the Screening and Rehabilitation Program.
	Noise modelling needs to include the proposed quaternary crusher.	See PER Section 12.
	Offsets should consider rescinding the vegetated area to the north of Susannah Brook to be incorporated into the National Park.	Direct and indirect offsets have been proposed. See PER Section 19.
	Consultation needs to be undertaken with the relevant Aboriginal groups.	See PER Section 14.
	Environmental management at the site needs to be audited for compliance.	Hanson undertakes annual internal audits of the implementation of the project environmental management commitments and conditions. Results are reported in the Annual Environmental Summary Report and Audit Document, which is submitted to EPA, DEC and City of Swan. DEC Audit Branch is also likely to undertake regular audits to assess compliance with all relevant conditions and commitments.
Swan Valley Progress Association	Heavy vehicle traffic on Toodyay Road, in particular debris and dust on road and use of local roads by trucks.	A Traffic Management Plan is contained in the EMP for the operation. See PER Section 15.
	Dust suppression of the stockpile areas and dust in general.	See PER Section 13.
	Noise and vibration.	See PER Section 12.
	Groundwater implications need to be assessed, including potential impacts to groundwater-dependent vegetation.	See PER Section 11.
	Rehabilitation and closure.	See PER Section 17.
	Consultation needs to be undertaken with the relevant Aboriginal groups.	See PER Section 14.

Stakeholder	Key issues	Responses
	Need to undertake additional flora and fauna investigations due to the unusually dry winter of 2006.	Additional flora (Mattiske 2008) and fauna (Bancroft, Harris and Bamford 2007; Harris and Bamford 2007a) investigations have been undertaken. Hanson also propose to undertake additional survey work relating to the gecko species found onsite. See PER Section 8.5.
	The current operation does not comply with the current approval.	This is not correct; the current operation is fully compliant with current approvals.
	Visual impacts, particular to those residents on the Swan Coastal Plain.	See PER Section 9.
	Extent of consultation needs to be much wider.	See PER Section 4.
	Need to consider the impacts of local town planning and the expansion of the Midland CBD.	Lot 11 is recognised as a 'Key Extraction Area' under Statement of Planning Policy 2.4, *Basic Raw Materials*, and the operation is a consistent land use with the zoning of Lot 11 under the Metropolitan Region Scheme and the City of Swan Town Planning Scheme. See PER Section 2.3.2.
	Discrepancy in the communication of the proposed disturbance footprint – was originally communicated by Hanson as 140 ha and then as 75 ha.	The area of 140 ha was calculated by the Hanson Geologist based in Victoria. The Geologist based his calculation on an assumption that the disturbance footprint was going to include the former Herne Hill Quarry pit, which is not the case. This was an internal misunderstanding that stemmed from a number of different options that were being considered over time.
	Buffer along Susannah Brook.	See PER Section 10.5.
	Night-time lighting detracts from the visual amenity of the area.	See PER Section 6.3.2.
Neighbours and local residents (including the Stakeholder Reference Group)	Visual amenity impacts.	See PER Section 9.
	Dust.	See PER Section 13.
	Feral fauna, weeds and dieback.	Weed and Dieback Management Plans have been prepared and are contained in the Screening and Rehabilitation Program. Feral fauna are addressed in the Fauna Protection Plan contained in the EMP. See PER Sections 7.5 and 8.5.
	Heavy vehicle movements on Toodyay Road, dust and debris on road and use of local roads by trucks.	A Traffic Management Plan is contained in the EMP for the operation. See PER Section 15.
	Unauthorised access to Lot 11 and the risks this imposes (e.g. fire).	Perimeter fences are maintained. A Vegetation and Habitat Protection Plan and Fire Management Plan has been prepared and contained in the EMP which contains provisions for perimeter fencing and fire response. See PER Section 7.5.
	Surface water hydrology, quality and quantity.	See PER Section 10.
	Noise and vibration, effects on amenity and structures.	See PER Section 12.
	Extent of consultation needs to be much wider.	See PER Section 4.
	The current operation does not comply with the current approval.	This is not correct; the current operation is fully compliant with current approvals.
	Flora and fauna.	See PER Sections 7 and 8.
	Rehabilitation and closure.	See PER Section 17.
	Aboriginal heritage.	See PER Section 14.

The issues raised by stakeholders have been addressed in this PER, and specifically, the following studies investigated key areas of concern:

1. **Vegetation and flora studies** to assess potential impacts to the conservation status of those species known or likely to occur in the project area (Mattiske 2007; 2008).
2. **Dieback assessment** to assess the presence of *Phytophthora cinnamomi* in vegetated areas adjacent to operational areas on Lot 11 (Department of Environment and Conservation [DEC] 2008).
3. **Fauna (including short-range endemics) studies** to assess the potential impacts to the conservation status of those species known or likely to occur in the project area (Harris and Bamford 2007a, 2007b; Bancroft, Harris and Bamford 2007).
4. **Surface water studies** to assess potential impacts to surface hydrology regimes, including water quantity and quality (Aquaterra 2007a).
5. **Hydrogeological studies** to assess potential impacts to local and regional groundwater resources (Aquaterra 2007b).
6. **Noise and vibration studies** to determine the current noise emission and vibration levels and to assess potential noise and vibration impacts (SVT 2007).
7. **Visual amenity studies** to determine the likely visibility and appearance of the proposed quarry development and the effect this will have on the landscape values of the area (John Cleary Planning 2007).
8. **Aboriginal heritage** studies investigating the presence and significance of Aboriginal heritage features of the project area (Clarke 2006, Mattner and Bergin 2007).

The above mentioned studies are contained in Appendix 2.

4.4 ONGOING CONSULTATION

Hanson will continue to consult with the wider community regarding the proposal, by providing information on their website and through regular newsletters. Hanson has also formed the Red Hill Quarry Stakeholder Reference Group (SRG). The purpose of the SRG will be to:

- provide for open and accurate communication between Hanson and the local community
- develop a relationship between Hanson and the community based on trust, fairness and mutual benefit
- contribute to addressing environmental, social and economic issues in a proactive, timely and open manner.

The group will be the key avenue for ongoing consultation throughout the remaining PER assessment process and will also serve, in general, as the primary mechanism for communicating with the community with regard to quarry operations.

The SRG membership comprises representatives from the following:

- City of Swan
- Chamber of Commerce and Industry
- Brigadoon Progress Association

- Gidgegannup Progress Association
- Swan Valley Progress Association
- Susannah Brook Catchment Group
- Swan Valley Residents and Ratepayers Association
- Baskerville Rural Watch
- local residents (x4).

Other organisations/agencies and individuals (who did not nominate for membership) will be provided with minutes of meetings and other documentation that may result from the SRG.

Hanson has also engaged the services of a heritage consultant to progress consultation with relevant Aboriginal heritage groups.

Additionally, this PER document is subject to an eight-week public review period and at the end of this period, issues raised in written public submissions are provided to Hanson for an opportunity to provide responses to the submissions.

5. ENVIRONMENTAL PRINCIPLES AND SUSTAINABILITY

5.1 PRINCIPLES OF ENVIRONMENTAL PROTECTION

In 2003, The EP Act was amended to include a core set of Principles that are applied by the EPA in assessments (EPA 2004a). As listed in S4a of the EP Act, these environmental protection principles are:

- precautionary principle
- principle of intergenerational equity
- principle of the conservation of biological diversity and ecological integrity
- principles relating to improved valuation, pricing and incentive mechanisms
- principle of waste minimisation.

Hanson has considered these principles in its assessment of the environmental impacts associated with the Red Hill Quarry Development Project (Table 5).

Table 5 Principles of environmental protection

Principle	Consideration given in project	Section addressed in PER
1. Precautionary principle Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, decisions should be guided by: 1. careful evaluation to avoid, where practicable, serious or irreversible damage to the environment 2. an assessment of the risk-weighted consequences of various options.	Hanson includes a risk assessment process in the development of all new projects with the intention of identifying issues early in the process to enable planning for avoidance and/or mitigation. Part of this process includes undertaking detailed site investigations of the biological and physical environs. Where these investigations identify significant environmental issues, management measures will be incorporated into the project design to avoid or minimise potential impacts, where practicable. For example, all disturbed areas will be internally-draining to either one of two onsite sedimentation dams or to the in-pit sump. This will protect the water quality of Susannah and Strelley brooks from any potentially contaminated stormwater runoff from the operational areas.	See assessments of minor and major factors from PER Sections 6.3.1 to 6.3.3 and Sections 7 to 16.
2. Intergenerational equity The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.	Hanson integrates the principles of sustainable development into all aspects of its operations to contribute to sustainable development in Australia. These principles ensure that Hanson operations deliver more value with less impact. Integration of these sustainable development principles ensures the environment in which Hanson operates is maintained and, where possible, enhanced for future generations.	See PER Section 17 (rehabilitation and closure) and proponent commitments to conservation of biological diversity in Section 19.

Principle	Consideration given in project	Section addressed in PER
3. Conservation of biological diversity and ecological integrity Conservation of biological diversity and ecological integrity should be a fundamental consideration.	Conservation of biological diversity and ecological integrity is central to the environmental management approach at the Red Hill Quarry operation and is a major consideration for the proposal. Biological investigations were undertaken to provide sufficient local and regional information to assess the environmental significance of the proposal. Hanson has a well established Screening and Rehabilitation Program for restoring disturbed landscapes at the quarry, one aim of which is to restore vegetation cover and fauna habitat. In addition, the ongoing flora and fauna investigations will continue to improve the understanding and management of these biological aspects.	See PER Section 17 (rehabilitation and closure) and proponent commitments to conservation of biological diversity in Section 19.
4. Improved valuation, pricing and incentives mechanisms	Not considered relevant to this proposal.	NA
5. Waste minimisation All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.	Hanson's environmental policy includes the following statement relating to waste management: "*to minimise wastes, develop viable recycling opportunities, and ensure proper handling and disposal methods.*" For example, the Red Hill Quarry operation reduces waste through on-sale of fines (material unsuitable for use as aggregate) for alternate uses such as road base and fill. Other waste materials generated onsite are recycled where possible, for example waste oils, rubber and scrap metals. Hanson also controls: • offsite discharge of stormwater (i.e. all surface water runoff from disturbed areas is diverted to two onsite sedimentation dams or the in-pit sump) • noise emissions (i.e. enclosing processing plant, maintaining equipment in good working order) • emissions to air, such as dust (i.e. baghouses on processing plant, covered conveyor, dust suppression on roads and stockpiles).	See PER Section 6.3.1 (waste), 10 (surface water runoff), 12 (noise) and 13 (dust).

5.2 SUSTAINABILITY

Sustainable development is defined as:

> *"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs."*

In September 2003, the Western Australian State Government released the State Sustainability Strategy (Government of Western Australia 2003). The strategy establishes a high-level approach to applying sustainability principles across government operations. The strategy recognises that a number of key sustainability principles have been developed in the Western Australian resources sector, including land and water rehabilitation, eco-efficiency in processing and a range of social innovations.

Hanson undertakes all operations with consideration of the company Environmental Policy (Section 18.1) and Energy Management Policy (Section 16.5). Hanson also applies the principles of sustainable development in the development of all major projects.

6. ENVIRONMENTAL IMPACT ASSESSMENT OF PROPOSAL

6.1 SCOPING OF RELEVANT FACTORS

The Environmental Scoping Document was prepared in accordance with the Environmental Impact Assessment (Part IV Division I) Administrative Procedures 2002. The scoping process involved preliminary identification of environmental aspects and an environmental risk assessment to identify key issues and factors associated with the proposal. The scoping process utilised EPA guidelines, preliminary stakeholder consultation and a preliminary risk assessment to identify aspects of the proposal likely to have an environmental impact. This process highlighted environmental factors requiring detailed assessment and factors not requiring detailed investigation given existing or proposed environmental management and community input.

Once key environmental factors were identified, investigations required to evaluate these factors and predict impacts were developed. The resulting list of relevant environmental factors is shown in Table 6. These factors are addressed in detail in this PER.

Table 6 Environmental factors identified during project scoping

Category	Environmental factor
Biophysical	Vegetation and flora
	Fauna
	Surface water
	Groundwater
Pollution management	Greenhouse gases
	Noise and vibration
	Air quality – dust
Social surrounds	Aboriginal heritage
	Visual amenity
	Public safety and risk
Other	Rehabilitation and closure

6.2 REVIEW OF RELEVANT ENVIRONMENTAL FACTORS

The key environmental factors associated with the proposal are addressed in this PER in the following format:

- key statutory requirements, environmental policy and guidance relevant to the environmental factor or the proposal
- description of environmental factor
- potential sources of impact (environmental aspects)
- assessment of potential impact, mitigation and residual impact
- predicted environmental outcome.

6.3 MINOR ENVIRONMENTAL FACTORS NOT FURTHER ASSESSED

A number of environmental factors are addressed below, but not in detail, as they are considered to be minor factors given the existing management measures in place and the very low probability of the proposal significantly affecting these factors. These factors are:

- waste (waste management)
- light (light spill)
- conservation areas.

6.3.1 Waste

Wastes that will be generated by the proposal will be similar in composition to those generated by the existing operation, and include:

- domestic solid and liquid waste
- general office waste
- general quarry and processing waste (including scrap metal, drums, tyres, batteries)
- waste oils, lubricants and solvents
- liquid waste from dust scrubbing equipment.

Inappropriate disposal of waste may potentially affect surface water and groundwater quality, whether this be offsite or at the quarry. Hanson's established waste management procedures will continue to be implemented for the proposed operations to ensure inappropriate disposal of waste does not occur.

Domestic waste

Operation of the quarry will require disposal of solid wastes (e.g. domestic waste). All such wastes generated at the Red Hill Quarry will be collected and stored onsite in covered waste bins and collected for disposal at an approved landfill facility offsite.

Liquid waste

Liquid waste generated at the Red Hill Quarry will mainly consist of surface water runoff from disturbed areas, which may potentially be contaminated with sediment and/or hydrocarbons. All runoff from disturbed areas passes through grease and oil traps and is then directed to the two onsite sedimentation dams or the in-pit sump. Where necessary, drains direct flows to these points and sediment is allowed to settle in these dams before water is discharged to the environment. Refer to Section 10.5 for more information on surface water management at the quarry.

Hydrocarbon wastes

Hydrocarbons (such as oil and grease) are separated from runoff in grease and oil traps, which are cleaned every three months by licensed contractors. The oil and grease collected is transported offsite to be recycled. Hydrocarbons (fuel and oil) imported onto the site are currently managed in accordance with relevant State legislation and Australian Standards. All hydrocarbon storage facilities are bunded according to the Water Quality Protection Guideline No. 10: Above Ground Chemical and Fuel Storage (WRC 2000a). The storage and handling techniques implemented ensure that the risk of

contaminating natural watercourses is minimised. Refer to Section 10.5 for more information on hydrocarbon management at the quarry.

Other liquid waste generated by the proposal will mainly consist of slurry from the dust suppression equipment in the processing plant. The slurry solids are allowed to settle and the supernatant returned to the dust suppression circuit. Inert material originating from dust suppression is returned to a product collection bin and included in sales of <2 mm product.

Proposed management actions

Waste will continue to be managed at the Red Hill Quarry by implementation of the following proposed management actions:

- continue to collect domestic solid and general office waste in covered onsite disposal bins and regular removal to an approved landfill facility offsite
- install bunds and drainage lines to direct all surface water runoff from disturbance areas to the onsite grease and oil traps and sedimentation dams or in-pit sump (Section 10.5)
- maintain existing sediment and oil/grease traps, including cleaning and disposal of wastes, and installation of new traps as required (Section 10.5)
- maintain current storage practices for hydrocarbons according to relevant legislation and standards (Section 10.5)
- continue to collect and separate solids from slurry (resulting from dust suppression equipment) for incorporation into saleable product (Section 10.5).

6.3.2 Light

Lighting is currently utilised at the Red Hill Quarry to ensure safe operations and for security purposes, which will continue to operate for the proposed development. The existing Red Hill Quarry generally operates on weekdays (Monday – Friday) between the hours of 6 am and 6 pm. During the winter months, when there are fewer daylight hours, it may be necessary to utilise mobile lighting towers to maintain safe operations.

Potential impacts arising from light spill as a result of site lighting will depend on the extent of luminance diffusion, reflection from existing surfaces and atmospheric scattering. Illumination may:

- affect neighbouring dwellings
- create safety hazards on adjacent roads due to glare reducing the visibility of objects
- alter fauna behaviour (Section 8.4)
- reduce the overall visual amenity of the site.

The closest residence to the existing operation is approximately 2 km to the north. Lights from the existing quarry infrastructure can be seen from Roe Highway and Toodyay Road, as well as from some surrounding residences. The proposed development of the Red Hill Quarry does not involve any expansion of the site infrastructure and, as such, is not expected to result in an increase in lighting requirements at the site. If installation of additional lighting is deemed necessary, lighting will be designed to avoid and otherwise minimise light spill to the surrounding environment.

Management actions as part of Hanson's commitment to the national Greenhouse Challenge Plus Program are outlined in Section 16.5. Whilst primarily aimed at reducing greenhouse gas emissions from quarry operations, some of these management actions also serve to reduce the potential light spill to the surrounding environment by reducing the duration of lighting at the site.

Proposed management actions

The potential impact of light spill from the Red Hill Quarry development on the surrounding environment will be addressed by the following proposed management actions:

- locate lighting as close as possible to the target area
- direct light at targeted work areas, preferably in a downwards direction
- shield lights (e.g. by surrounding vegetation or other physical features) from neighbouring residences/roads and surrounding bushland/fauna habitat
- install intelligent lighting controls (i.e. daylight and occupancy sensing or one-shot timers) and task-based lighting wherever practicable.

6.3.3 Conservation areas

Lot 11 adjoins two conservation areas: John Forrest National Park and an area of the Darling Range Regional Park.

John Forrest National Park adjoins the southern boundary of Lot 11, separated by an approximately 1.5 km long common boundary fence. The National Park covers an area of approximately 2700 ha, with vegetation ranging from jarrah and marri/wandoo woodlands to scarp heathlands.

One species of DRF (*Anthocercis gracilis* [Slender Tailflower]) has been recorded within the National Park and other species of DRF may also occur within the Park. *Dasyurus geoffroii* (Chuditch) has previously been recorded within the Park. This species is listed as 'Vulnerable' under the EPBC Act and is considered 'rare and likely to become extinct' under Schedule 1 of the *Wildlife Conservation Act 1950* (Wildlife Act).

An area of approximately 235 ha of Darling Range Regional Park adjoins the north-western boundary of Lot 11, which was sold by Hanson to the State Government in 2003 for inclusion in the Regional Park. The small shrub *Halgania corymbose* is listed as a Priority 3 species in the Western Australian Priority species listing and has been recorded previously within the area of Darling Range Regional Park adjacent to Lot 11.

Hanson will maintain a 100 m buffer between the quarry development and the boundary of Lot 11 and the area of the Darling Range Regional Park to the north-west. This buffer will reduce the risk of movement of weeds and dieback (if present) from Lot 11 to the Park. The proposed development will not decrease the distance between the quarry and John Forrest National Park. The proposed development may increase the risk of feral fauna in the area and potentially within conservation areas (Section 8.4.3). Hanson will continue to implement management measures, such as proper waste disposal and education programs for quarry personnel (to reduce the risk of attracting feral fauna to the area) and assist with trapping and eradication programs undertaken by DEC in adjacent conservation reserves (Section 8.5).

Connectivity of vegetation in the landscape is important to minimise fauna habitat fragmentation and to ensure ecological linkages are maintained (Section 8.4.1). To minimise the effects of habitat fragmentation, Hanson will retain and enhance the connectivity of the Darling Range Regional Park, John Forrest National Park and other areas of remnant vegetation on Lot 11. The approximately 700 m wide north-south corridor on the western side of Lot 11 comprises intact native vegetation and an area undergoing rehabilitation; this corridor maintains a significant link between John Forest National Park and Darling Range Regional Park. The approximately 100 m wide north – south corridor on the eastern side of Lot 11 connects John Forrest National Park with riparian vegetation along Susannah Brook and native vegetation to the north of Lot 11. Refer to Section 17.3.2 for more detail on Hanson's commitment to retaining and enhancing these ecological linkages.

Proposed management actions

The potential impact of the Red Hill Quarry development on adjoining conservation areas will be addressed by the following proposed management actions:

- retain and enhance ecological linkages between John Forrest National Park, Darling Range Regional Park and remnant vegetation on Lot 11 (Section 17.3.3)
- retain and enhance the east – west corridor along Susannah Brook (Section 17.3.3)
- maintain a minimum 100 m buffer between the quarry operations and the boundary of Lot 11
- assist with trapping and eradication programs undertaken by DEC in adjacent conservation reserves (Section 8.5).

PART 3 ASSESSMENT OF KEY ENVIRONMENTAL FACTORS

7. VEGETATION AND FLORA

7.1 KEY STATUTORY REQUIREMENTS, ENVIRONMENTAL POLICY AND GUIDANCE

EPA objective for vegetation and flora

To maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.

National Strategy for Conservation of Australian Biodiversity

The State and Commonwealth Governments have endorsed the National Strategy for Conservation of Australian Biodiversity and the National Strategy for Ecologically Sustainable Development that protects biodiversity. The strategies address the conservation of Australia's biological diversity by defining guiding principles.

National Strategy for the Conservation of Australia's Biological Diversity

The principles of this Strategy are:

- biological diversity is best conserved in situ
- although all levels of government have clear responsibility, the cooperation of conservation groups, resource users, indigenous peoples, and the community in general is critical to the conservation of biological diversity
- it is vital to anticipate, prevent and attack at source the causes of significant reduction or loss of biological diversity
- processes for, and decisions about, the allocation and use of Australia's resources should be efficient, equitable and transparent
- lack of full knowledge should not be an excuse for postponing action to conserve biological diversity
- the conservation of Australia's biological diversity is affected by international activities and requires actions extending beyond Australia's national jurisdiction
- Australians operating beyond our national jurisdiction should respect the principles of conservation and ecologically sustainable use of biological diversity and act in accordance with any relevant national or international laws
- central to the conservation of Australia's biological diversity is the establishment of a comprehensive, representative and adequate system of ecologically viable protected areas integrated with the sympathetic management of all other areas, including agricultural and other resource production systems

- the close, traditional association of Australia's indigenous peoples with components of biological diversity should be recognised, as should the desirability of sharing equitably benefits arising from the innovative use of traditional knowledge of biological diversity.

National Strategy for Ecologically Sustainable Development

The principles of this Strategy are:

- decision-making processes should effectively integrate both short-term and long-term economic, environmental, social and equity considerations
- where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation
- the global dimension of environmental impacts of actions and policies should be recognised and considered
- the need to develop a strong, growing and diversified economy which can enhance the capacity for environmental protection should be recognised
- the need to maintain and enhance international competitiveness in an environmentally-sound manner should be recognised
- cost-effective and flexible policy instruments should be adopted, such as improved valuation, pricing and incentive mechanisms
- decisions and actions should provide for broad community involvement on issues which affect them.

EPA Position Statement No. 2

EPA Position Statement No. 2, "*Environmental Protection of Native Vegetation in Western Australia*" (EPA 2000), provides an overview of the EPA position on the clearing of native vegetation in Western Australia. Principles and related objectives and actions have been adopted from the above mentioned national strategies in the formation of this Position Statement. In assessing a proposal, the EPA consideration of biological diversity will include the following basic elements:

- comparison of development scenarios or options of biodiversity at the species and ecosystems level
- no known species of plant or animal is caused to become extinct as a consequence of the development and the risks to threatened species are considered to be acceptable
- no association or community of indigenous plants or animals ceases to exist as a result of the proposal
- there is a comprehensive, adequate and secure representation of scarce or endangered habitats within the project area and/or in areas which are biologically comparable to the project area, protected in secure reserves
- if the project is large (in the order of 10 ha – 100 ha or more, depending on where in the State) the project area itself should include a comprehensive and adequate network of conservation areas and linking corridors whose integrity and biodiversity are secure and protected
- the onsite and offsite impacts of the project are identified and the proponent demonstrates that these impacts can be managed.

EPA Position Statement No. 3

EPA Position Statement No. 3, "*Terrestrial Biological Surveys as an Element of Biodiversity Protection*" (EPA 2002a), discusses the principles which the EPA would apply when assessing proposals which may impact on biodiversity values in Western Australia. The outcomes sought by this Position Statement are intended to:

- promote and encourage all proponents and their consultants to focus their attention on the significance of biodiversity and therefore the need to develop and implement best-practice in terrestrial biological surveys
- enable greater certainty for proponents in the EIA process by defining the principles the EPA will use when assessing proposals which may impact on biodiversity values.

EPA Guidance Statement No. 51

EPA Guidance Statement No. 51, "*Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia*" (EPA 2004b), provides guidance on standards and protocols for terrestrial flora and vegetation surveys, particularly those undertaken for the environmental impact assessment of proposals.

Significance of vegetation

Vegetation is considered significant by the EPA (Guidance for the Assessment of Environmental Factors Draft February 2003) for a range of reasons including:

- scarcity
- unusual species
- novel combination of species
- a role as a refuge
- a role as a key habitat for threatened species, or large populations representing a significant proportion of the local or regional total population of a species
- being representative of the range of a unit
- a restricted distribution.

Threatened Ecological Communities (TECs), as listed by DEC and under the EPBC Act are of high significance.

Significant flora

The preservation and conservation of flora is covered primarily by the following statutes:

- *Wildlife Conservation Act 1950*
- *Conservation and Land Management Act 1984*
- *Environmental Protection Act 1986*
- *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth).

Recorded conservation flora can be DRF for which, under the Wildlife Act, it is illegal to remove or damage flora defined as Priority flora.

DRF are specifically scheduled for protection under the Wildlife Act and are species that have been adequately searched for, and are deemed to be either rare, in danger of extinction, or otherwise in need of special protection.

Priority species are those listed by DEC as potentially threatened. They range from Priority one to Priority four species, and are as follows:

- **Priority 1:** *Poorly Known Taxa*. Taxa, which are known from one or a few (generally <5) populations, which are under threat
- **Priority 2:** *Poorly Known Taxa*. Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat
- **Priority 3:** *Poorly Known Taxa*. Taxa which are known from several populations, at least some of which are not believed to be under immediate threat
- **Priority 4:** *Rare Taxa*. Taxa which are considered to have been adequately surveyed and which whilst being rare, are not currently threatened by any identifiable factors.

7.2 DESCRIPTION OF FACTOR

The Red Hill Quarry (Lot 11) is within the Darling Botanical District of the South-western Botanical Province as recognised by Diels (1906) and later developed by Gardner (1942) and Beard (1979, 1980). The project area is within the Northern Jarrah Forest sub-region of the Jarrah Forest Biogeographic Region as defined by the Interim Biogeographic Regionalisation for Australia (Williams and Mitchell 2001).

Example of vegetation of the survey area

Previous investigations

A vegetation and flora survey was undertaken over the existing Red Hill Quarry site in 1990 as part of the Herne Hill Relocation Project PER (Dames and Moore 1990). This survey mapped eight vegetation associations, which were considered common and widespread on the Darling Plateau and Scarp, and recorded 142 native flora species and seven weed species. Three Priority flora species were recorded; *Calothamnus ruprestris* (P4), *Darwinea pimelioides* (P4) and *Tetratheca pilifera* (P3) but no DRF were recorded.

A vegetation and flora survey was undertaken over a 5.6 ha area adjacent to the existing Red Hill Quarry pit in 2006 as part of an EP Act section 45C assessment (Mattiske 2006). This survey mapped four site vegetation types, which were considered well represented within the conservation estate, and recorded 68 native flora species and three weed species. One Priority flora species was recorded; *Calothamnus ruprestris* (P4), however, no DRF were recorded.

Recent investigations

Mattiske (2007; 2008) completed survey work (in April, October and December 2006 and winter 2007) over the proposed pit development area and stockpile extension area, including areas outside of the proposed development footprint (referred herein as 'survey area'). The survey work undertaken was consistent with:

- EPA Position Statement No. 3: "*Terrestrial Biological Surveys as an Element of Biodiversity Protection"*
- EPA Guidance Statement No. 51: "*Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia*."

The following description of vegetation and flora is based on Mattiske (2007; 2008). The full reports are contained within Appendix 2.

7.2.1 Vegetation

Vegetation complexes

The survey area crosses three vegetation complexes as defined in 1:250 000 mapping by Mattiske and Havel (1998). Refer to Table 7 and Figure 13.

The Darling Scarp vegetation complex is restricted to the western fringes of the Darling Ranges and has a relatively low representation of its pre-European area (but 23% of its current area) in the conservation estate. The Helena 2 vegetation complex is restricted to the deeply incised valley systems on the western fringes of the Darling Ranges and is relatively well represented (pre-European area) in the conservation estate. The Dwellingup 2 vegetation complex occurs on the upper lateritic hills and ranges and is relatively well represented (pre-European area) in the conservation estate (Table 7).

The objective of the EPA (2000) is to retain 30% or more of the pre-clearing extent of each vegetation type to protect biodiversity. The three vegetation complexes within the proposed development area have greater than 30% of their pre-European extent remaining (Table 7). The representation of the pre-European and extant area of Dwellingup 2 and Helena 2 vegetation complexes in reserves is reasonable; however, the representation of the pre-European area of the Darling Scarp vegetation complex is low (Table 7). The majority of the Darling Scarp vegetation complex (approximately 64%) is in private holdings.

Table 7 Description and representation of vegetation complexes

Vegetation complex	Description	Pre-European area (ha)*	Extant area (ha)*	Representation in Formal and Informal Reserves (ha)*	Area within proposed development area (ha)**
Darling Scarp (DS)	Mosaic of open forest of *Eucalyptus marginata* subsp. *marginata – Corymbia calophylla*, with some admixtures with *Eucalyptus laeliae* in the north (subhumid zone), and *Corymbia haematoxylon* in the south (humid zone) on deeper soils adjacent to outcrops, woodland of *Eucalyptus wandoo* (subhumid and semiarid zones), low woodland of *Allocasuarina huegeliana* on shallow soils over granite outcrops, closed heath of Myrtaceae – Proteaceae species and lithic complex on or near granite outcrops in all climate zones.	29,108	9,866 (34%)	2,284 Pre-European: 7.8% Extant: 23%	0.4
Dwellingup 2 (D2)	Open forest of *Eucalyptus marginata* subsp. *marginata – Corymbia calophylla* on lateritic uplands in subhumid and semiarid zones.	86,086	73,526 (85%)	19,832 Pre-European: 23% Extant: 26%	36
Helena 2 (H2)	Mosaic of open forest of *Eucalyptus marginata* subsp. *thalassica – Corymbia calophylla* and woodland of *Eucalyptus wandoo* with some *Eucalyptus accedens* and *Eucalyptus rudis* on the deeper soils ranging to closed heaths and lithic complex on shallow soils associated with granite on steep slopes of valleys in semiarid and arid zones.	16,341	11,817 (72%)	4891 Pre-European: 30% Extant: 41%	41

* Areas presented are based on data supplied by DEC from the Forest Management Plan as published by the Conservation Commission of WA 2004.

** Includes the proposed pit and stockpile development areas.

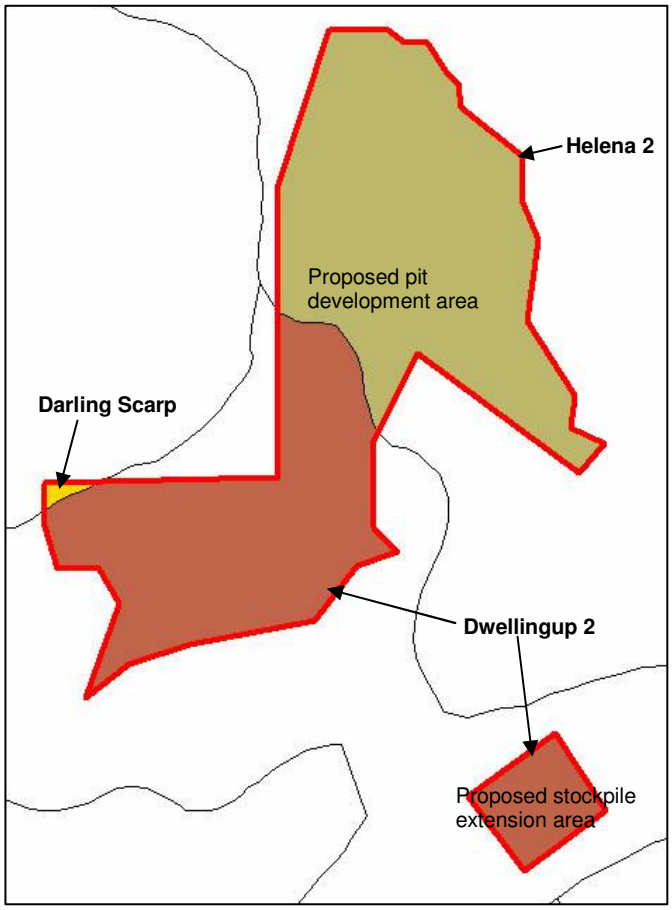


Figure 13 Vegetation complexes recorded within the proposed development footprint

Site-vegetation types

Nine site-vegetation types were described and mapped by Mattiske (2007; 2008) and are a combination of Havel's (1975a; 1975b) site-vegetation types (Figure 14). A description of each site-vegetation type along with its occurrence in the proposed development area is contained in Table 8. A more detailed description for each site-vegetation type is contained in Appendix 2 (Mattiske 2007; 2008). Site-vegetation type G2 was mapped by Mattiske (2007; 2008), but is not within the proposed development area.

All site-vegetation types recorded in the proposed development area are locally represented in nearby conservation reserves such as John Forrest National Park, Darling Range Regional Park, Julimar conservation areas and areas of nearby State Forest (Table 8).

Table 8 Description and representation of site-vegetation types

Site vegetation type	No. taxa	Area* (ha)	Description of vegetation	Representation in vegetation complexes	Representation in nearby reserves
G1	159	11.4	Mosaic of Lithic Complex on exposed granites to patches of Open to Closed Heath of Proteaceae – Myrtaceae species, including *Hakea incrassata*, *Hakea stenocarpa, Drayandra armata* var. *armata, Hakea undulata, Allocasuarina humilis* and *Hypocalymma agngustifolium* on exposed granites	Well represented in Cooke**	Locally present in John Forrest National Park and adjacent area of the Darling Range Regional Park
G2***	76	N/A	Open Woodland *Allocasuarina huegeliana* over patches of Lithic Complex and Open Heath of Proteaceae – Myrtaceae species on exposed granites	Relatively well represented in the Darling Scarp and Yalanbee**; lesser extent in Cooke**	Locally present in John Forrest National Park and adjacent area of the Darling Range Regional Park
GM	140	21.4	Open to Closed Heath of Proteaceae – Myrtaceae species, including *Hakea incrassata, Hakea stenocarpa, Dryandra armata var. armata, Hakea undulata, Melaleuca trichophylla, Allocasuarina humilis* and *Hypocalymma angustifolium* over granite outcropping	Relatively well represented in Darling Scarp and Yalanbee**; lesser representation in Cooke**	Locally present in John Forrest National Park and adjacent area of the Darling Range Regional Park
CG	76	0.5	Open Woodland of *Eucalyptus rudis, Eucalyptus wandoo, Corymbia calophylla* over *Trymalium floribundum* subsp. *Floribundum, Darwinia citriodora* over sedges on creeklines	Relatively well represented in Helena 2	Locally present in John Forrest National Park and adjacent area of the Darling Range Regional Park
M	48	1.4	Open Woodland of *Eucalyptus wandoo, Eucalyptus accedens, Corymbia calophylla* over low understorey including *Hibbertia hypericoides, Bossiaea eriocarpa, Phyllanthus calycinus* on clay-loams	Relatively well represented in Darling Scarp and Yalanbee**	Locally present in John Forrest National Park, adjacent area of the Darling Range Regional Park and Julimar conservation areas
MG	165	20.1	Open Woodland of *Eucalyptus wandoo* and *Eucalyptus accedens* with dense understorey including *Hakea incrassata, Allocasuarina humilis, Hakea undulata* and *Hakea trifurcata* on clay-loams over shallow granite	Relatively well-represented in Darling Scarp and Yalanbee**	Locally present in John Forrest National Park, adjacent area of the Darling Range Regional Park and Julimar conservation areas
R	165	9.5	Woodland to Open Woodland of *Eucalyptus marginata, Corymbia calophylla* over dense understorey including *Hakea incrassata, Allocasuarina humilis, Hakea undulata* and *Hakea trifurcata* on sandy-gravels over shallow granite	Relatively well represented in Darling Scarp and Cooke **	Locally present in John Forrest National Park and adjacent area of the Darling Range Regional Park
P	55	6.1	Open Forest of *Allocasuarina fraseriana, Eucalyptus marginata, Corymbia calophylla* over low understorey including *Grevillea wilsonii, Hibbertia hypericoides* and *Hakea lissocarpha* on sandy-gravels	Relatively well represented in Dwellingup	Locally present in the nearby State Forests, John Forrest National Park and adjacent area of the Darling Range Regional Park

Site vegetation type	No. taxa	Area* (ha)	Description of vegetation	Representation in vegetation complexes	Representation in nearby reserves
S	107	1.1	Open Forest of *Eucalyptus marginata, Corymbia calophylla* over low understorey including *Grevillea wilsonii, Hibbertia hypericoides* and *Hakea lissocarpha* on sandy-gravels	Relatively well represented in Dwellingup	Locally present in the nearby State Forests, John Forrest National Park and adjacent area of the Darling Range Regional Park
Rehabilitation areas		2.5			
Previously disturbed areas		3.3			
Total area		**77.3**			

Source: Mattiske (2007; 2008).

* Area of site-vegetation type within proposed development area (pit and stockpile areas).

** Cooke and Yalanbee vegetation complexes do not occur in project area, but contain these vegetation types.

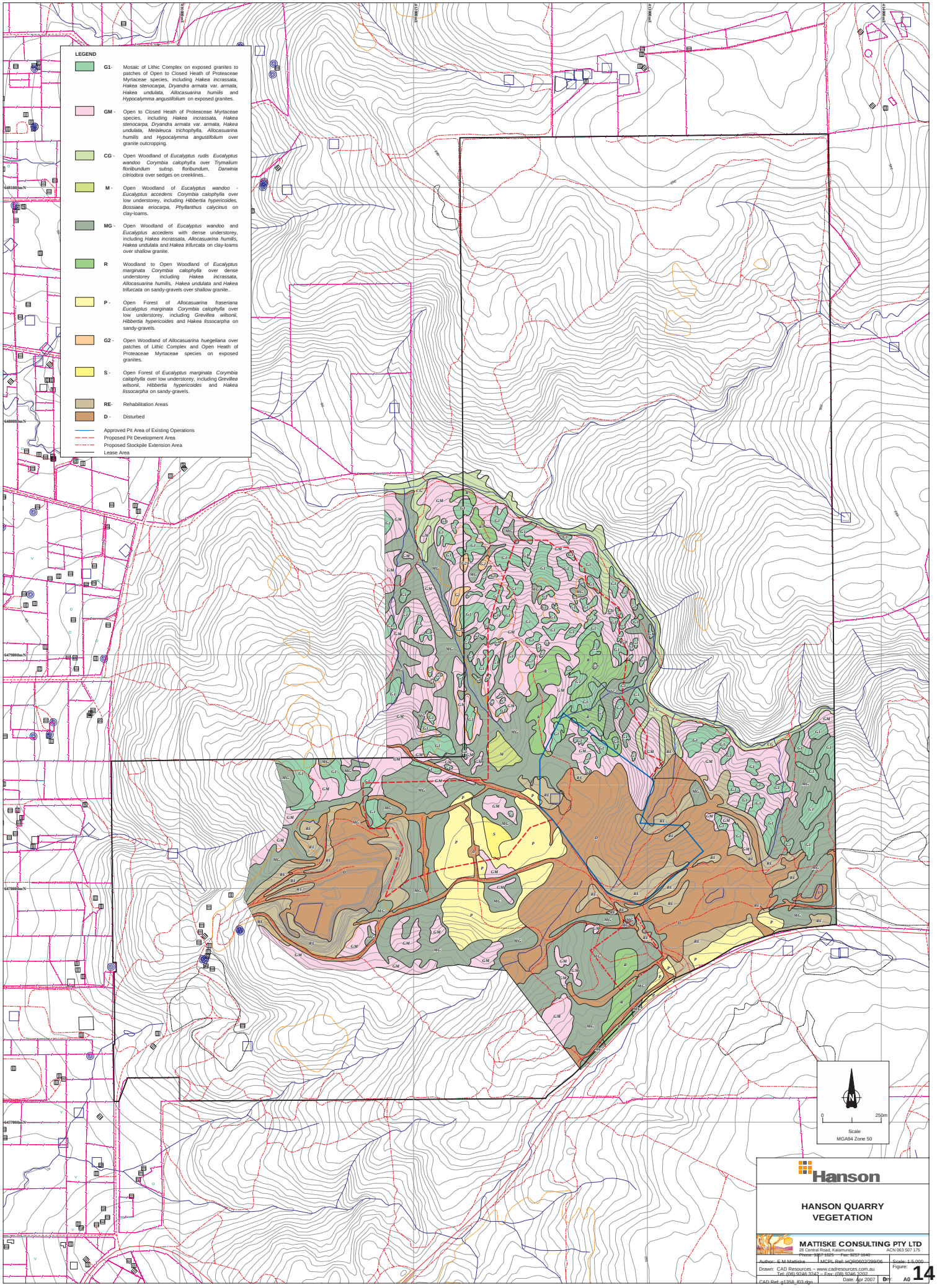
*** Site-vegetation type G2 mapped by Mattiske (2007; 2008) but not within the proposed development area.

Vegetation condition

Based on the condition scale developed by Keighery (1994) (Table 9), the condition of the vegetation within the survey area varies from degraded to excellent. Most of the area to be disturbed is classified as very good to excellent with some degraded areas. The degraded areas have resulted from clearing, track establishment, and human activities and weed infestation along Susannah Brook.

Table 9 Condition rating scale

Description	Explanation
Pristine	Pristine or nearly so, no obvious signs of disturbance.
Excellent	Vegetation structure intact, disturbance affecting individual species, and weeds are non-aggressive species.
Very good	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure covers repeated fire, aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure covers frequent fires, aggressive weeds at high density, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure includes frequent fires, presence of very aggressive weeds, partial clearing, dieback and grazing.
Completely degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas often described as cleared parklands with the flora comprising weed or crop species with isolated native trees or shrubs.


LEGEND
G1- Mosaic of Lithic Complex on exposed granites to patches of Open to Closed Heath of Proteaceae Myrtaceae species, including Hakea incrassata, Hakea stenocarpa, Dryandra armata var. armata, Hakea undulata, Allocasuarina humilis and Hypocalymma angustifolium on exposed granites.
GM - Open to Closed Heath of Proteaceae Myrtaceae species, including Hakea incrassata, Hakea stenocarpa, Dryandra armata var. armata, Hakea undulata, Melaleuca trichophylla, Allocasuarina humilis and Hypocalymma angustifolium over granite outcropping.
CG - Open Woodland of Eucalyptus rudis Eucalyptus wandoo Corymbia calophylla over Trymalium floribundum subsp. floribundum, Banwhia citriodora over sedges on creeklines..
M - Open Woodland of Eucalyptus wandoo - Eucalyptus accedens Corymbia calophylla over low understorey, including Hibbertia hypericoides, Bossiaea eriocarpa, Phyllanthus calycinus on clay-loams.
MG - Open Woodland of Eucalyptus wandoo and Eucalyptus accedens with dense understorey, including Hakea incrassata, Allocasuarina humilis, Hakea undulata and Hakea trifurcata on clay-loams over shallow granite.
R Woodland to Open Woodland of Eucalyptus marginata Corymbia calophylla over dense understorey including Hakea incrassata, Allocasuarina humilis, Hakea undulata and Hakea trifurcata on sandy-gravels over shallow granite..
P - Open Forest of Allocasuarina fraseriana Eucalyptus marginata Corymbia calophylla over low understorey, including Grevillea wilsonii, Hibbertia hypericoides and Hakea lissocarpha on sandy-gravels.
G2 - Open Woodland of Allocasuarina huegeliana over patches of Lithic Complex and Open Heath of Proteaceae Myrtaceae species on exposed granites.
S - Open Forest of Eucalyptus marginata Corymbia calophylla over low understorey, including Grevillea wilsonii, Hibbertia hypericoides and Hakea lissocarpha on sandy-gravels.
RE- Rehabilitation Areas
D - Disturbed
Approved Pit Area of Existing Operations
Proposed Pit Development Area
Proposed Stockpile Extension Area
Lease Area
N
0
250m
Scale
MGA94 Zone 50
Hanson
HANSON QUARRY
VEGETATION
MATTISKE CONSULTING PTY LTD
28 Central Road, Kalamunda
ACN 063 507 175
Phone: 9257 1625 Fax: 9257 1640
Author: E M Mattiske
MCPL Ref: MQR0602/299/06
Scale: 1:5,000
Drawn: CAD Resources – www.cadresources.com.au
Tel: (08) 9246 3242 – Fax: (08) 9246 2002
Date: Apr 2007
Rev:
CAD Ref: g1358_f03.dgn
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Dieback

The DEC Forest Management Branch undertook a *Phytophthora cinnamomi* (dieback) assessment of the proposed development area in September and December 2007 (DEC 2008). This assessment involved aerial photography and field interpretation (226.5 ha of Lot 11 were interpreted) and analysis of soil samples. The DEC (2008) dieback interpretation report is contained in full in Appendix 2.

The sections of the development area that lie on the steep slopes were uninterpretable[2] due to a lack of species that indicate dieback presence. Areas upslope, including ridges, had indicator species present and were therefore, able to be interpreted. The main area of dieback infestation is associated with the powerline easement and tracks. There is also dieback infestation associated with a former gravel pit, between the current Red Hill Quarry and the former Herne Hill Quarry. This pattern of infestation associated with manmade influences is typical in the Jarrah forest. Significant sections of the development area are uninfested. A summary of dieback occurrence in the areas interpreted on Lot 11 is indicated in Table 10 and Figure 15.

The disease expression ranged from subtle to obvious in the areas interpreted and the 12 soil samples collected yielded both postive and negative results. Seven of the samples returned a positive for *P. cinnamomi*; the majority of these results were expected based on field interpretation and observations.

Table 10 Summary of dieback occurrence for the areas interpreted on Lot 11

Category	Area (ha)
Uninfested	62.5
Infested	7.1
Uninterpretable	156.6
Total	**226.4**

Fire

There have been four large bushfires on Lot 11 since the mid 1980s; however, these have not affected the vegetation of the survey area. All have been to the south and south-west of the survey area, near the former Herne Hill Quarry and south-west dam. No controlled-burns have been undertaken within the proposed development area.

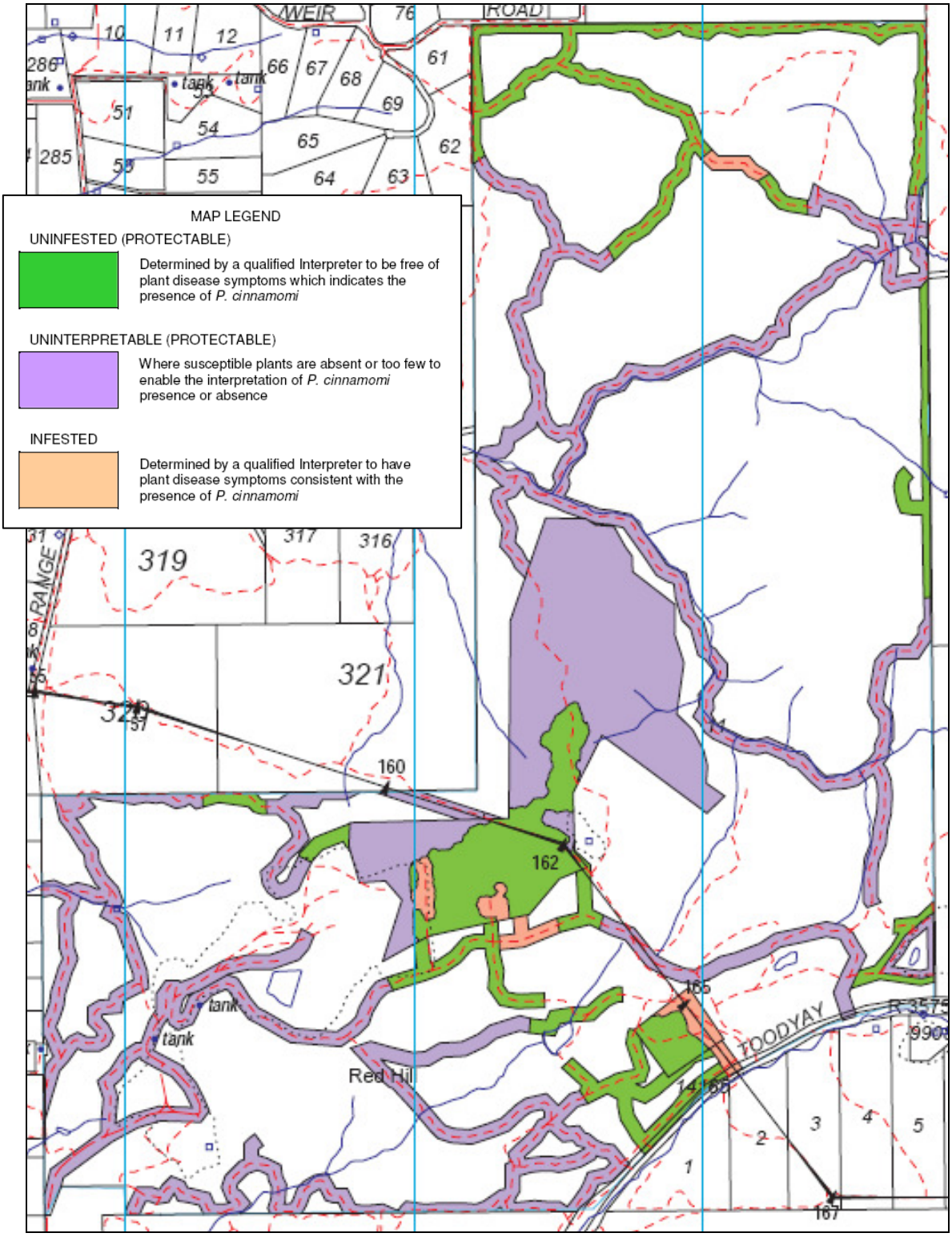
Threatened ecological communities

No plant communities listed as threatened under the EPBC Act or as TECs by DEC (2007a) were recorded within the survey area during by Mattiske (2007; 2008).

[2] Uninterpretable: insufficient indicator species present to be able to observe the presence or absence of *Phytophthora cinnamomi* (DEC 2008).

Infested: symptoms of the disease are present on plants (DEC 2008).

Unifested: no plant disease symptoms were observed that were consistent with the presence of *Phytophthora cinnamomi* (DEC 2008).



Source: DEC (2008)

Figure 15 Dieback occurrence map for Lot 11

7.2.2 Flora

Species representation

A total of 350 taxa (species, subspecies and varieties) from 55 families, 160 genera and species were recorded by Mattiske (2007; 2008). Approximatley 25% of these species occur in more than 10% of the sites. The most frequently recorded species, occurring in more than 35% of the sites, were:

- *Xanthorrhoea preissii*
- *Corymbia calophylla*
- *Hibbertia hypericoides*
- *Dryandra lindleyana* var. *lindleyana*
- *Hakea erinacea*
- *Hibbertia commutate*
- *Hibbertia subvaginata.*

There was substantial overlap of the species recorded from the survey area (Mattiske 2007; 2008) with species recorded in John Forrest National Park (Mattiske 1991), Darling Range bushland reserves in the Shire of Kalamunda (Armstrong 1993) and the northern Darling Scarp (Markey 1997). Of the taxon recorded in the survey area, approximately 50%, 60% and 60% respectively were also recorded in the John Forrest National Park, Darling Range (Shire of Kalamunda) reserves and northern Darling Scarp. Of these taxa in common, some were introduced species (11 in common with the proposed development area and John Forrest National Park; 14 in common with the survey area and Darling Range reserves of the Shire of Kalamunda).

Conservation significant flora

No DRF species, pursuant to the Wildlife Act and listed by DEC (2007b), or Threatened Flora species, pursuant to the Commonwealth EPBC Act, were recorded by Mattiske (2007; 2008) or in previous surveys of the Red Hill Quarry area (Dames and Moore 1990).

A search of DEC and WA Herbarium databases for the broad project area (i.e. an area covering the whole of Lot 11 as well as areas beyond Lot 11) indicated 11 DRF species may occur in the search area. None of these species have been recorded from Lot 11 (Figure 16). Ten of these species are also listed as Threatened Flora, pursuant to the EPBC Act. The 11 DRF species are listed in Table 11, including the probability of the species occurring in the proposed development area.

Three Priority flora species were recorded by Mattiske (2007; 2008) within the proposed development area (Figure 16). Two of these species, *Acacia oncinophylla* subsp. *oncinophylla* and *Calothamnus ruprestris*, were recorded on Lot 11 outside of the proposed development area by Mattiske (2007; 2008). Although not recorded by Mattiske (2007; 2008) outside the proposed development area, *Halgania corymbosa* has been previously recorded in the adjacent area of the Darling Range Regional Park (Figure 16). A description of the recorded Priority Flora species is contained in Table 12.

Table 11 Potential DRF and Threatened Flora species

Taxon	State conservation status	Commonwealth conservation status	Known distribution	Probability of occurring in proposed development area
Acacia aphylla	Rare	Vulnerable	Known from 35 records, mainly in the northern Jarrah Forest on the fringes of Helena Valley, Mundaring Weir and Clackline.	There is a high probability that this species may occur in the project area, however, as this species is very distinctive, had it been present, the species would have been located during surveys.
Anthocercis gracilis	Rare	Vulnerable	Known from 28 records, mainly in the northern Jarrah Forest on fringes of Helena Valley, Mundaring Weir and in John Forrest National Park.	There is a high probability that this species may occur in the proposed development area, however, as this species is very distinctive, had it been present, the species would have been located during surveys. It should be noted that on other sites, species from this genera often occur in higher numbers following a fire.
Caladenia huegelii	Rare	Endangered	Known from 30 records, mainly on the Swan Coastal Plain, predominantly on sandy dunes.	There is a low probability that this species occurs in the proposed development area as it does not support the habitats this species is known to prefer.
Calytrix breviseta subsp. *breviseta*	Rare	Endangered	Known from 10 records, mainly in heaths on palusplain on the Swan Coastal Plain.	There is a low probability that this species occurs in the proposed development area as it does not support the habitats this species is known to prefer.
Eleocharis keigheryi	Rare	Vulnerable	Known from 31 records, mainly on wet claypans on the Swan Coastal Plain.	There is a low probability that this species occurs in the proposed development area as it does not support the habitats this species is known to prefer.
Grevillea curviloba subsp. *curviloba*	Rare	Endangered	Known from 12 records, on sandplain, wet flats and palusplain of the Swan Coastal Plain.	There is a low probability that this species occurs in the proposed development area as it does not support the habitats this species is known to prefer.
Grevillea curviloba subsp. *incurva*	Rare	Endangered	Known from 39 records, on ironstone areas and wetlands, near Muchea.	There is a low probability that this species occurs in the proposed development area as it does not support the habitats this species is known to prefer.
Grevillea flexuosa	Rare	Vulnerable	Known from 43 records, mainly in gravely and outcrop areas supporting Wandoo in the northern Jarrah Forest.	There is a high probability that this species may occur in the proposed development area, however, as this species is very distinctive, had it been present, the species would have been located during surveys.
Hydatella dioica	Rare	Endangered	Known from 7 records, mainly on water-logged flats, near Ellenbrook and Midland on the Swan Coastal Plain.	There is a low probability that this species occurs in the proposed development area as it does not support the habitats this species is known to prefer.
Thelymitra dedmaniarium	Rare	Not listed	Known from 15 records on sandy, clay and gravely soils, extending from Arthur River to the Swan Coastal Plain.	There is a low probability that this species occurs in the proposed development area as it does not support the habitats this species is known to prefer.
Thelymitra stellata	Rare	Endangered	Known from 15 records on sandy, clay and gravely soils, extending from Arthur River to the Swan Coastal Plain.	There is a low probability that this species occurs in the proposed development area as it does not support the habitats this species is known to prefer.

A search of DEC and WA Herbarium databases for the broad project area (i.e. an area covering the whole of Lot 11 as well as areas beyond Lot 11) indicated an additional 56 Priority flora species that may occur in the area (see Mattiske 2007; 2008 in Appendix 2 for complete list). Of these species, the following have been recorded historically, in or near the proposed development area (Figure 16):

- *Halgania corymbosa* (P3)
- *Darwinia pimelioides* (P4)
- *Calothamnus rupestris* (P4)
- *Templetonia drummondii* (P4).

Halgania corymbosa and *Calothamnus rupestris* were recorded by Mattiske (2007; 2008) in the proposed development area and *Darwinia pimelioides* was recorded by Mattiske (2007; 2008) to the north of Susannah Brook and not within the proposed development area. The remaining species, *Templetonia drummondii,* is also likely to be present in the study area. *Tetratheca* sp. Granite (P3) was also recorded by Mattiske (2008) to the north of Susannah Brook and not within the proposed development area.

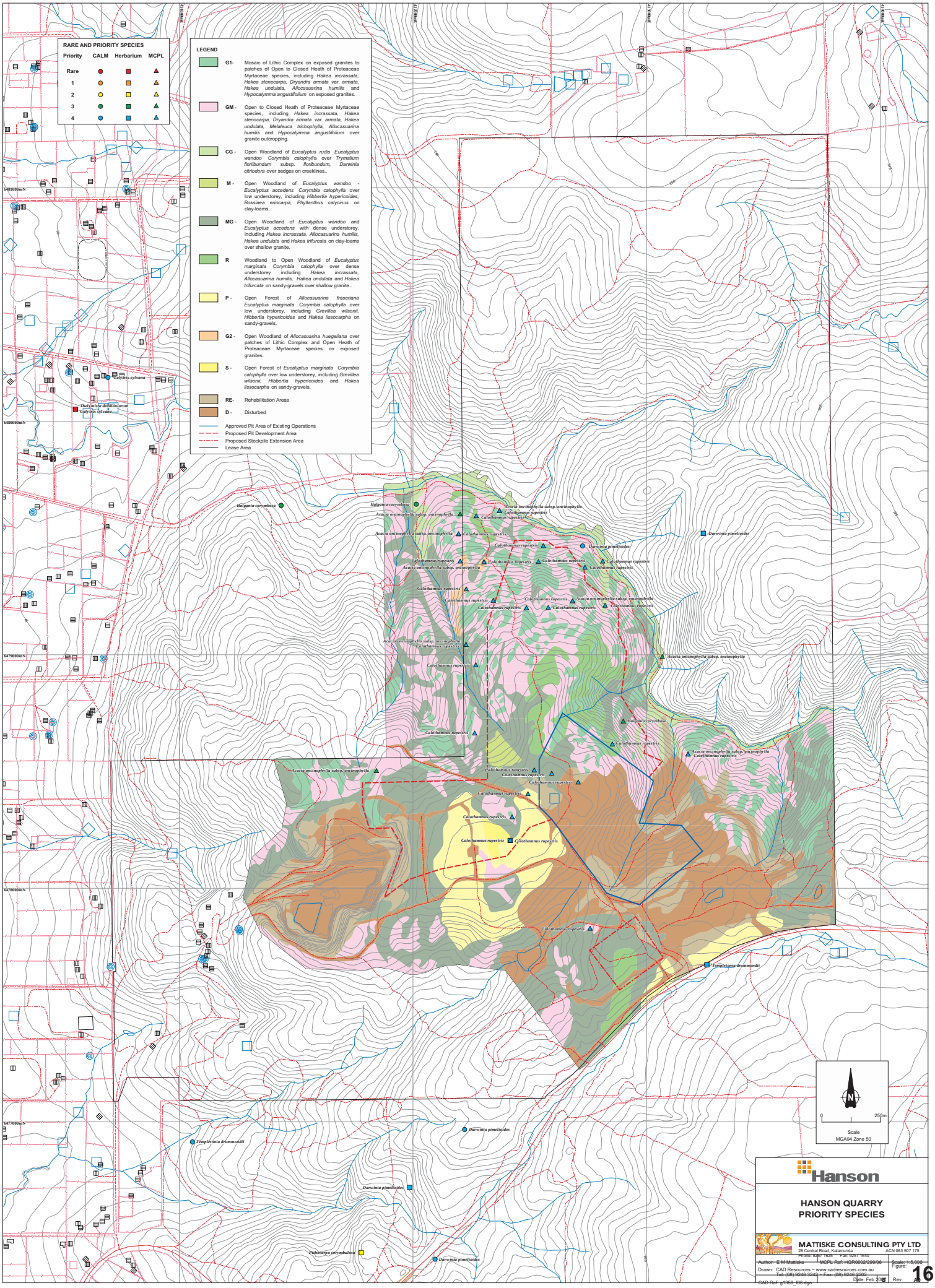
Many of the other species occur on the fringes of the Swan Coastal Plain and on the western fringes of the Darling Range.

Table 12 Priority flora recorded in the proposed development area

Species	Status	Regional distribution*	Site-vegetation types**	Description
Acacia oncinophylla subsp. *oncinophylla*	P3	South West: Avon Wheatbelt, Jarrah Forest and Swan Coastal Plain	CG, G1, G2, GM, MG (mainly in G1)	Recorded from nine sites by Mattiske (2007; 2008). This taxon has 35 records at the State Herbarium, ranging from Mogumber in the north to Serpentine in the south, along the Darling Range. This species is recorded as occurring in granitic soils in heath and open woodland (Maslin 2001). Collections in the survey area reflected previous collections in the State Herbarium.
Halgania corymbosa	P3	South West: Jarrah Forest and Swan Coastal Plain	MG	Recorded from one site by Mattiske (2007; 2008). It is known from 15 records at the State Herbarium. The records stretch from Millendon in the north-west to Gidgegannup in the north-east, to Gosnells in the south-west, and Karnet to the south-east. The collection in the survey area is not reflected by many previous collections in the State Herbarium.
Calothamnus rupestris	P4	South West: Avon Wheatbelt, Jarrah Forest and Swan Coastal Plain	CG, G1, G2, GM, MG, R and rehabilitated areas (mainly in G1 and GM)	Recorded from 27 sites by Mattiske (2007; 2008). This species is known from 46 records at the State Herbarium and is relatively widespread on granitic soils on the Darling Scarp and the northern Jarrah forest. This species has been used extensively in rehabilitation areas near the Darling Scarp and in gravel pits within the northern Jarrah forest.

* As described by Florabase and based on Thackwell and Creswell (1995) biogeographic regions.

** Site-vegetation types of the proposed development area as described and mapped by Mattiske (2007; 2008).


RARE AND PRIORITY SPECIES
Priority CALM Herbarium MCPL
Rare
1
2
3
4
LEGEND
G1- Mosaic of Lithic Complex on exposed granites to patches of Open to Closed Heath of Proteaceae Myrtaceae species, including Hakea incrassata, Hakea stenocarpa, Dryandra armata var. armata, Hakea undulata, Allocasuarina humilis and Hypocalymma angustifolium on exposed granites.
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RE- Rehabilitation Areas
D - Disturbed
Approved Pit Area of Existing Operations
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Lease Area
Eucalyptus sylvana
Eucalyptus sylvana
Halgania corymbosa
Halgania corymbosa
Acacia uncinophylla subsp. uncinophylla
Calothamnus rupestris
Darwinia pimelioides
Templetonia drummondii
Darwinia pimelioides
Darwinia pimelioides
Pultenaea corymbulosa
Darwinia pimelioides
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HANSON QUARRY
PRIORITY SPECIES
MATTISKE CONSULTING PTY LTD
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ACN 063 507 175
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Tel: (08) 9246 3242 ~ Fax: (08) 9246 2202
Date: Feb 2008
Figure: 16
Rev: A
CAD Ref: g1358_f06.dgn

Introduced flora

A total of 25 introduced (weed) taxa were recorded by Mattiske (2007; 2008). Three non-endemic native species, *Acacia iteaphylla*, *Eucalyptus microcorys* and *Melaleuca nesophila*, were also recorded in rehabilitation areas.

Of the introduced species the most common is *Briza maxima*. The majority of aggressive weed species occur within disturbed areas, either on road verges or along Susannah Brook. The more invasive species include *Gladiolus caryophyllaceus*, *Moraea flaccida*, *Watsonia meriana* and *Watsonia meriana* var. *bulbillifera*. *Moraea flaccida*, or One-leaf Cape Tulip, is listed by the Department of Agriculture and Food Western Australia (2007) as a Declared Plant, classed as P1 for the whole of the State. A P1 ranking prohibits movement of the plant or its seeds within the State and prohibits the movement of contaminated machinery and produce.

The Department of Conservation and Land Management (CALM now DEC) ranked known environmental weeds in Western Australia according to risk (CALM 1999). The rating allocated to each weed by CALM is based on three criteria:

1. **Invasiveness** – ability to invade natural bushland in good to excellent condition or ability to invade waterways.
2. **Distribution** – widespread current, or potential distribution, including consideration of known history of widespread distribution elsewhere in the world.
3. **Environmental Impacts** – ability to change the structure, composition and function of ecosystems. In particular, an ability to form a monoculture in a vegetation community.

The rating of each weed is indicated by the following scoring system:

1. **High** - scores 'yes' for all three criteria. Rating a weed species as high indicates it is a priority for control and/or research.
2. **Moderate** - scores 'yes' for two of the above criteria. Rating a weed species as moderate indicates that it should be monitored (reasonably high level of monitoring) and that control or research effort should be directed towards the species should funds be available.
3. **Mild** – scores 'yes' for one of the criteria. A mild rating indicates monitoring of the weed and implement control where appropriate.
4. **Low** – no score for any of the criteria. Requires a low level of monitoring.

Weeds recorded at the site by Mattiske (2007; 2008) have been ranked according to these criteria and management priorities are undertaken according to this ranking (Table 13). The 'distribution' criterion is not shown as this pertains more to risk of the species at a wider bio-regional level.

Table 13 Weeds recorded onsite ranked according to CALM (DEC) risk rating

Scientific name	Common name	CALM (DEC) rating	Invasiveness	Environmental impact
Moraea flaccida (syn. *Homeria flaccida*)	One-leaf Cape Tulip	High	✓	✓
Watsonia meriana var. *bulbifera*	Bulbil Watsonia	High	✓	✓
Watsonia meriana	Watsonia	Moderate	✓	✓
Aira caryophyllea	Silvery Hair Grass	Moderate	✓	
Aira cupaniana	-	Moderate	✓	
Anagallis arvensis	-	Moderate	✓	
Anagallis arvensis var. *caerulea*	-	Moderate?		
Avena barbata	Bearded Oat	Moderate	✓	
Bartsia trixago (syn. *Bellardia trixago*)	-	Moderate	✓	
Briza maxima	Blowfly Grass	Moderate	✓	
Briza minor	Shivery Grass	Moderate	✓	
Ehrharta longiflora	Annual Veldt grass	Moderate	✓	
Gladiolus caryophyllaceus	Wild Gladiolus	Moderate	✓	
Disa bracteata (syn. *Monadenia bracteata*)	South African Orchid	Moderate	✓	
Hypochaeris glabra	Smooth Cat's Ear Flat Weed	Moderate	✓	
Parentucellia latifolia	Common Bartsia	Moderate	✓	
Pentaschistis airoides	-	Moderate	✓	
Sonchus oleraceus	Common Sowthistle	Moderate	✓	
Ursinia anthemoides	Ursinia	Moderate	✓	
Vellereophyton dealbatum	White Cudweed	Moderate	✓	
Vulpia myuros	-	Moderate	✓	
Dittrichia graveolens	Stinkwort	Mild		
Brachypodium distachyon	False Broome	Low		
?*Bromus* sp.	-	Uncertain*		
Oxalis sp.	-	Uncertain (Mild to Low?)		

* Bromus species listed by CALM (1999) are rated from high to low, dependent on species

7.3 POTENTIAL SOURCES OF IMPACT

The following aspects of the proposal may impact upon vegetation and flora values:

- **vegetation clearing** for the quarry pit area, product stockpiles and establishment of infrastructure (such as haul roads) will lead to the direct disturbance of vegetation communities and have potential to impact significant flora species. This aspect is likely to be the most significant factor
- **vehicle movements** could potentially introduce and/or spread weeds and dieback
- **disruption of surface hydrology** may affect vegetation communities that rely on surface water flows
- **dust generation** could potentially smother vegetation, thereby retarding growth
- **movement of soil** could potentially increase the risk of spreading weeds.

7.4 ASSESSMENT OF POTENTIAL IMPACT, MITIGATION AND RESIDUAL IMPACT

7.4.1 Vegetation clearing

Approximately 80 ha of vegetation will be progressively cleared over the estimated 100 year life of the proposed development (which includes clearing requirements for the proposed pit and stockpile development areas). Hanson has designed the project to keep vegetation clearing to only that required for safe and efficient quarrying operations. Any opportunities to reduce the footprint will be taken into account during detailed design stages, for example, locating infrastructure on previously cleared areas.

The staged process and extended timeframe by which clearing (average of less than 1 ha/yr) and quarrying is proposed to take place will allow management measures to be implemented that will reduce the overall impact on vegetation and flora (in contrast to the total area being cleared in a short timeframe). Such measures will include protecting and propagating the genetic material of significant onsite flora (e.g. Priority flora species) and allowing comprehensive and adequate ecological linkages and habitats to be maintained until disturbance is required. In addition, disturbed areas no longer required for operations will be progressively rehabilitated.

All three vegetation complexes that will be affected by the proposal have greater than 30% of their pre-European extent remaining (Table 7). The long-term clearing requirements for the proposal will not significantly reduce the representation of these complexes, where:

- approximately 53% (or 41 ha) of the proposed development area (pit and stockpile area) is comprised of the Helena 2 vegetation complex, which represents around 0.3% of the extant area of this complex
- approximately 46% (or 36 ha) of the proposal area is comprised of the Dwellingup 2 vegetation complex, or around 0.05% of the extant area of this complex
- less than 1% (or 0.4 ha) of the proposed development area is comprised of the Darling Scarp vegetation complex, or less than 0.005% of the extant area of this complex.

None of the vegetation complexes will fall below 30% of their pre-European extent as a result of this proposal.

All site-vegetation types are either well, or relatively well represented in their parent vegetation complexes (Table 8). Therefore, the long-term clearing requirements for the proposal are not likely to significantly affect the local or regional representation of the site-vegetation types affected given their level of representation outside the proposal area (within, and outside of Lot 11).

The majority of the long-term clearing requirements will be in site-vegetation types GM (27% or 21.4 ha) and MG (26% or 20.1 ha). Both of these site-vegetation types are relatively well represented in the Darling Scarp and Yalanbee vegetation complexes and are also locally present in John Forrest National Park, the Darling Range Regional Park and elsewhere on Lot 11. Site-vegetation type MG is also locally present in the Julimar conservation area.

Three species of Priority flora will be directly affected by the proposed quarry development:

1. *Calothamnus rupestris* (P4).
2. *Acacia oncinophylla* subsp. *oncinophylla* (P3).
3. *Halgania corymbosa* (P3).

None of the Priority flora species are restricted to the proposed development area. These species have been recorded on Lot 11 outside of the proposed development area and also in the adjacent area of the Darling Range Regional Park (26 occurrences of *Calothamnus rupestris*, 9 occurrences of *Acacia oncinophylla* subsp. *oncinophylla* and 3 occurrences of *Halgania corymbosa*). All three species are known from other sites along the Darling Range, with *Calothamnus rupestris* being widely used in rehabilitation of gravel pits in the Jarrah forest (including rehabilitation at the Red Hill Quarry) (Mattiske 2007; 2008).

Most occurrences of the Priority flora species within the proposed development footprint were in two areas; towards the northern boundary and in a central location to the west of the existing quarry operations. The long timeframe and staged pit development approach will enable the collection of seed and other genetic material from these plants to be used in rehabilitation at the Red Hill Quarry. The Red Hill Quarry Screening and Rehabilitation Program (Appendix 2) promotes the use of Priority flora known to occur in the project area (where such species are viable). *Calothamnus ruprestris* is already widely used in rehabilitation at the Red Hill Quarry and has successfully re-established in rehabilitated areas.

7.4.2 Potential spread of dieback and weeds

The DEC Forest Management Branch has recently undertaken a formal *Phytophthora cinnamomi* (dieback) assessment of the proposed development area. The results from this assessment indicate localised patches of dieback infestation associated mainly with man-made influences (e.g. along tracks or the powerline easement). These results will be used to revise and update the Red Hill Quarry Dieback Management Plan in order to better manage the potential risks.

Hanson currently manages the Red Hill Quarry operations to minimise the risk of the introduction and spread of dieback in accordance with a Dieback Management Plan (contained within the Screening and Rehabilitation Program; Appendix 2). Management measures include:

- restricting vehicle access to designated roads
- managing stormwater runoff so that all water is diverted to the onsite dams or the pit sump.

Activities that could lead to the introduction of dieback to Lot 11 are not just limited to quarrying activities but also include unauthorised access to Lot 11 (e.g. vehicles, trail bikes and horses). Hanson maintains a perimeter fence with strategically placed signage to discourage unauthorised access (Section 15).

The management of the Red Hill Quarry site for dieback is similar to the management of weeds at the site and most activities that have the potential to introduce and/or spread dieback also applies to weeds. Of the 25 weeds recorded by Mattiske (2007; 2008) at the Red Hill Quarry, One-leaf Cape Tulip is listed as a Declared Plant (Department of Agriculture and Food Western Australia 2007). Other weed species are also considered particularly invasive and have the ability to change the structure, composition and function of local ecosystems, including Watsonia (Table 13).

Hanson currently manages the Red Hill Quarry operations to minimise the risk of the introduction and spread of weeds in accordance with a Weed Management Plan (contained within the Screening and Rehabilitation Program; Appendix 2). Management measures include:

- targeted weed spraying
- prohibiting plant, soil and fill material from being brought onsite unless demonstrated to be weed-free
- securing the site from illegal entry to reduce incidences of unauthorised access (e.g. vehicles, trail bikes and horses) and dumping of rubbish.

7.4.3 Disruption of surface hydrology

The proposed development, at its extent, is predicted to reduce the available Susannah Brook catchment by around 1.8% and the Strelley Brook catchment by around 0.4% (Aquaterra 2007a). This will result in a minor reduction in flow in both watercourses, which is expected to correlate to a drop in the order of 10-20 mm of the Susannah Brook stream stage. Such a drop is not expected to have any significant effect on downstream stages (Section 10). There is no information on the rating curve for Strelley Brook, but this stream is far less affected by the proposed development than Susannah Brook in terms of loss of catchment and is therefore not expected to experience any significant adverse alterations to flow regime (Aquaterra 2007a). Surface water-dependent vegetation in these catchments (e.g. riparian vegetation) are not expected to be significantly affected. Further mitigation of any loss of surface flows may arise from the occasional release of overflows from the two onsite sedimentation dams.

7.4.4 Dust fallout

Dust can be generated by various aspects of the quarrying process such as clearing, drilling, blasting, haulage and plant operation (Section 13). Dust may have physical effects on plants such as blockage and damage to stomata, shading, abrasion of leaf surface or cuticle and cumulative effects (e.g. drought stress on already stressed species). Vegetation located close to dust sources is more likely to be subject to such impacts. Vegetation adjacent to haul roads of the existing operation has experienced some dust deposition, however, this has not resulted in any vegetation death.

Hanson will continue to apply dust management measures, such as the application of water to dust-prone surfaces and limiting the movement of vehicles on unsealed roads (as described in Section 13.5) to mitigate dust impacts to vegetation.

7.5 PROPOSED MANAGEMENT ACTIONS

Potential impacts on vegetation and flora at the Red Hill Quarry will be mitigated by the following proposed management actions:

- implement and annually review/update the Screening and Rehabilitation Program (contained in Appendix 2; see also Section 17.5), which includes the following management actions:
    - use of Priority flora in rehabilitation:
        - collection of seed or other reproductive material (where viable) from Priority flora within areas proposed for clearing

        - translocation of Priority flora within the disturbance footprint to rehabilitation areas (where viable)
    - local collection of seed for use in onsite rehabilitation
- update the existing Dieback Management Plan based on the results of the dieback assessment
- continue to implement and annually review/update the Dieback Management Plan and the Weed Management Plan (contained within the Screening and Rehabilitation Program), which includes the following management actions:
    - identification and mapping of the extent and distribution of priority weed species and *Phytophthora* dieback
    - establishment and maintenance of a weed inventory recording the location of weed species in the project area
    - include in staff inductions, information on the identification and reporting of key weed species and hygiene procedures to prevent the spread of weeds and *Phytophthora* dieback
    - development and implementation of hygiene measures to prevent the spread of weeds and *Phytophthora* dieback
    - annual visual inspections for *Phytophthora* dieback, with regular dieback assessments (to include soil sampling)
    - collection of drainage water onsite in sumps
    - implementation of a weed control program for priority weed species
    - securing the site from illegal entry to reduce incidences of unauthorised access
- implement the Environmental Management Plan (Appendix 2), which includes a Vegetation and Habitat Protection Plan to include management actions to:
    - restrict clearing to approved areas
    - locate infrastructure on previously disturbed areas to minimise clearing
    - undertake flora searches for DRF and Priority flora if no surveys have been conducted in areas to be cleared for ten years or more
    - maintain perimeter fencing and restrict onsite vehicle access to designated roads to protect the values of remnant vegetation on Lot 11 from disturbances
- continue dust suppression practices to minimise dust lift-off and settlement on vegetation fringing dust-prone areas.

7.6 PREDICTED ENVIRONMENTAL OUTCOME

The vegetation and flora of the proposed development area has been surveyed consistent with EPA Position Statement No. 3 (EPA 2002a) and EPA Guidance Statement No. 51 (EPA 2004b). The proposed continued development of the Red Hill Quarry will result in the progressive clearing of around 80 ha of vegetation over the estimated 100 year life of the proposed development (or an average of less than 1 ha/yr). There is an increased risk of the introduction and/or spread of weeds and dieback; however, this will be mitigated through the Hanson's weed and dieback control and hygiene management measures.

The proposal will not contravene EPA Position Statement No. 2 (EPA 2000) as all potential onsite and offsite impacts have been identified and management measures proposed. No species of flora or vegetation association will cease to exist as a result of the proposal.

The proposal is unlikely to significantly affect local and regional vegetation values due to the affected vegetation complexes and site-vegetation types being relatively well represented locally (e.g. John Forrest National Park, Darling Range Regional Park) and regionally (e.g. northern Jarrah forest). None of the vegetation complexes will fall below 30% of their pre-European extent as a result of this proposal.

The proposed development will result in the disturbance of known occurrences of three Priority flora species; *Calothamnus ruprestris*, *Halgania corymbosa* and *Acacia oncinophylla* subsp. *oncinophylla*. However, there will be no significant impact on the occurrence and abundance of these species either regionally or locally. All three species are known to occur outside of the proposed disturbance footprint on Lot 11, in the adjacent area of the Darling Range Regional Park, and are known from other sites within the northern Jarrah forest. No recorded TECs or DRF populations will be directly or indirectly affected by the proposal.

Consistent with EPA objectives, the abundance, species diversity, geographic distribution and productivity of flora at species and ecosystems levels will be maintained thereby conserving regional biological diversity. The botanical studies undertaken by Hanson (and those proposed to be undertaken) have ensured a comprehensive understanding of the floristic elements of the site. The implementation of the Environmental Management Plan addressing vegetation and habitat protection will ensure potential impacts are avoided wherever practicable.

8. FAUNA

8.1 KEY STATUTORY REQUIREMENTS, ENVIRONMENTAL POLICY AND GUIDANCE

EPA objective for fauna

To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystems levels through the avoidance or management of adverse impacts and improvement of knowledge.

EPA Position Statement No. 3

EPA Position Statement No. 3, "*Terrestrial Biological Surveys as an Element of Biodiversity Protection*" (EPA 2002a), discusses the principles that the EPA would apply when assessing proposals that may have an impact on biodiversity values in Western Australia. The Position Statement intends to provide the following outcomes:

- promote and encourage all proponents and their consultants to focus their attention on the significance of biodiversity and therefore the need to develop and implement best-practice in terrestrial biological surveys
- enable greater certainty for proponents in the environmental impact assessment process by defining the principles the EPA will use when assessing proposals which may have an impact on biodiversity values.

EPA Guidance Statement No. 56

As described in the EPA Position Statement No. 3, the EPA determined that a series of guidance statements were warranted to provide an easy-to-use decision-making guide to the level of biological survey required. EPA Guidance Statement No. 56, "*Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia*" (EPA 2003), provides guidance on standards and protocols for terrestrial fauna surveys, particularly those undertaken for the environmental impact assessment of proposals.

State protection

In a legislative context, the preservation and conservation of fauna is covered primarily by the following Western Australian legislation:

- *Wildlife Conservation Act 1950*
- *Conservation and Land Management Act 1984.*

In WA, rare or endangered species are protected by the Wildlife Conservation (Specially Protected Fauna) Notice 2005, under the Wildlife Act. Schedules 1 and 4 in this notice are relevant to this assessment, providing a listing of those species protected by this Notice.

DEC Priority Fauna List also nominates conservation species from Priority one to four. It is expected that the potential impacts from a proposal on these Priority listed species should be managed so that the species do not meet the International Union for Conservation of Nature and Natural Resources (IUCN) criteria for threatened species.

Commonwealth protection

The Commonwealth EPBC Act protects species listed under Schedule 1 of the Act. In 1974, Australia signed the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). As a result, an official list of endangered species was prepared and is regularly updated. This listing is administered through the EPBC Act. The current list differs from the various State lists; however, some species are common to both.

International agreements

Australia is party to the Japan-Australia (JAMBA) and China-Australia (CAMBA) Migratory Bird Agreements. Most of the birds listed in these agreements are associated with saline wetlands or coastal shorelines and have little relevance to the proposed area; however, some migratory birds not associated with water are also listed on these international treaties.

Conservation significance of fauna

On the basis of the above discussion relating to mechanisms for the protection of fauna, three levels of conservation significance, developed by Harris and Bamford (2007a), are recognised in this assessment:

- *Conservation significance level 1* (CS1): species listed under State or Commonwealth Acts
- *Conservation significance level 2* (CS2): species not listed under State or Commonwealth Acts, but listed in publications on Threatened Fauna or as Priority species by DEC
- *Conservation significance level 3* (CS3): species not listed under Acts or in publications, but considered at least of local significance because of their pattern of distribution.

8.2 DESCRIPTION OF FACTOR

Previous investigations

A fauna survey was undertaken over the existing Red Hill Quarry site in 1990 as part of the Herne Hill Relocation Project PER (Ninox 1990). This survey recorded 46 bird, 6 mammal, and 12 amphibian and reptile species within the area. A further 39 bird, 23 mammal, and 42 amphibian and reptile species were identified from literature as expected to occur in the habitats present in the area.

Recent investigations

A fauna survey was conducted within, and adjacent to the proposed Red Hill Quarry development area (referred herein as 'survey area') during December 2006 by Harris and Bamford (2007a). This survey was in accordance with a Level 2 survey (which requires background research, reconnaissance survey and detailed or comprehensive field survey) as described by EPA Position Statement No. 3 (EPA 2002a) and included:

- literature review of available databases and publications, including Ninox (1990) and studies undertaken in John Forrest National Park
- reconnaissance and detailed field survey.

The survey work was undertaken in December 2006 and included trapping for frogs, reptiles and mammals, bird surveys, maintaining an annotated list of all bird records, spotlighting, and mist netting and acoustic surveys for bats. Short-range endemic invertebrate[3] and Threatened/Priority vertebrate fauna searching was also carried out and opportunistic observations were made throughout the survey work. Locations where sampling was undertaken are indicated in Figure 17.

A number of vertebrate fauna were excluded from the survey (native freshwater fish, vagrants, waterbirds and obligate marine animals) as they were not considered relevant or could not be surveyed (e.g. survey location does not encounter marine systems; watercourses virtually dry).

Subterranean fauna (troglofauna and stygofauna) were not sampled for as the site does not have suitable habitat to support subterranean fauna populations; granite is unlikely to provide suitable habitat even if it contains fractures (Stuart Halse, Bennlongia, pers. comm. 20 April 2008).

One species identified in these surveys, *Diplodactylus polyophthalmus* (a gecko), was considered to be unusual and not typically representative of the species. An intensive search was undertaken in both May and September 2007 to determine the abundance of this species across the site. The surveys involved hand searches under rocks, trees, litter, and other habitat that may have been suitable for this species.

The following description of the fauna of the survey area is mainly adapted from Harris and Bamford (2007a); however, information from the more recent intensive, targeted searches is also included (Harris and Bamford 2007b; Bancroft, Harris and Bamford 2007). The Harris and Bamford (2007a, 2007b) and Bancroft, Harris and Bamford (2007) reports are contained in Appendix 2.

8.2.1 Fauna habitat

Harris and Bamford (2007a) identified five significant habitats within the survey area, based on importance for significant species and/or biodiversity:

1. **Granitic outcrops**, particularly where rock formations and weathering processes are well developed to create micro-habitats which provide habitat for species such as Carpet Pythons, Ornate Dragons and possibly Dell's Skink.
2. **Eucalypt woodlands, especially those that include Wandoo** provide habitat for some mammals (e.g. Honey Possum) and feeding habitat for significant bird species such as Carnaby's Black-cockatoo, Baudin's Black-cockatoo and the Forest Red-tailed Black-cockatoo.
3. **Heaths of gravely sands close to areas of exposed granite** are important for many reptile, bird and mammal species, and potentially support short-range endemic invertebrates.
4. **Lower slopes of hills, where water is concentrated** create seasonal pools and facilitates dense vegetation growth which are important areas for a number of locally significant bird species.
5. **Temporary creeks, including Susannah Brook,** are important for frog breeding and have potential downstream influences.

[3] Short-range endemic invertebrates are species with restricted distributions. Harvey (2002) notes that the majority of species that have been classified as short-range endemics have common life history characteristics such as poor powers of dispersal or confinement to discontinuous habitats.

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FAUNA SAMPLING LOCATIONS

Figure

17

The survey area covers the main habitat types of granite outcrops with associated heaths on gravely sands, and eucalypt woodlands. These habitats are not considered unique to the survey area, as the area lies within a region that comprises a complex of granite outcrops and eucalyptus woodlands with interspersing heath. The survey area is located within the complex of the Darling Scarp and the species encountered onsite are expected to be well represented throughout adjacent areas, including John Forrest National Park, the Darling Range Regional Park and Walyungah National Park.

8.2.2 Summary of fauna abundance

A total of 189 vertebrate fauna species could potentially occur in the survey area, including 12 introduced species (Table 14). This vertebrate assemblage includes a wide range of species, typical of the Darling Scarp, and is mostly made up of widespread species. The fauna assemblage is very diverse owing to the presence of Swan Coastal Plain species that are at the inland limit of their range in valleys of the western scarp, several species that are virtually restricted to the scarp and several species that are at the western limit of their range.

Harris and Bamford (2007a, 2007b; Bancroft, Harris and Bamford 2007) recorded 69 native fauna species during the surveys and four introduced species (Table 14). An additional three species (two native and one introduced) were also reported by Red Hill Quarry personnel and nearby residents. This was compared to a survey conducted in John Forrest National Park during spring of 1990 and autumn 1991 by Ninox (1991), where 95 species were recorded (including eight introduced species). Whilst the two studies recorded different species for the various vertebrate groups, it was considered that the majority would occur in both areas given their proximity to each other.

Harris and Bamford (2007a), contained in Appendix 2, provides a complete list of fauna recorded/observed or expected to occur within the survey area.

Table 14 Vertebrates that may occur in the survey area

	Birds*	Mammals*	Amphibians	Reptiles	Total*
Potentially occurring	90 (5)	22 (7)	13	52	**177 (12)**
Recorded/observed in study area[1]	36 (1)	10[3] (4)[4]	3	22[5]	**71 (5)**
Recorded/observed in John Forrest National Park[2]	48 (2)	7 (6)	10	22	**87 (8)**

* Introduced fauna indicated in parenthesis.

[1] Recorded/observed by Harris and Bamford (2007a, 2007b; Bancroft, Harris and Bamford 2007).

[2] Recorded/observed by Ninox (1991).

[3] This count includes *Isoodon obesulus fusciventer* (Quenda), which was reported by nearby residents. This species was not recorded by Harris and Bamford (2007a).

[4] This count includes *Capra hircus* (Feral Goat), which was reported by nearby residents. This species was not recorded by Harris and Bamford (2007a).

[5] This count includes *Morelia spilota imbricate* (South-West Carpet Python), which was recorded by Red Hill Quarry personnel. This species was not recorded by Harris and Bamford (2007a).

Of the 189 species of vertebrates that may occur in the vicinity of the survey area, there are 59 species of conservation significance (Table 15). In addition, one invertebrate species of conservation significance was returned from the DEC database search and one was recorded by Harris and Bamford (2007a). Of the 62 species of conservation significance (59 vertebrate and two invertebrates) that may

occur in the survey area, 25 vertebrate and 1 invertebrate species were recorded by Harris and Bamford (2007a).

Table 15 Number of conservation significant (CS) vertebrate species potentially occurring in the survey area

	CS1*	CS2*	CS3*	Total	Recorded/observed in study area[1]
Birds	5	3	30	**38**	15
Mammals	2	4	5	**11**	5[2]
Amphibians	0	0	1	**1**	1
Reptiles	1	2	6	**9**	4[3]
Total	**8**	**9**	**42**	**59**	25

* See Section 8.1 for a description of Conservation Significance (CS) codes.

[1] Recorded/observed by Harris and Bamford (2007a).

[2] This count includes *Isoodon obesulus fusciventer* (Quenda), which was reported by nearby residents. This species was not recorded by Harris and Bamford (2007a).

[3] This count includes *Morelia spilota imbricate* (South-West Carpet Python), which was recorded by Red Hill Quarry personnel. This species was not recorded by Harris and Bamford (2007a).

An additional seven species were considered to be locally extinct[4], six of which are mammals (Table 16). High rates of local extinction amongst mammals is typical of mainland Australia and has been associated with a wide range of factors including: changes in fire regimes, introduced predators and competition with introduced herbivores (including livestock) (Burbidge and MacKenzie 1989; cited in Harris and Bamford 2007a).

Table 16 Species considered to be locally extinct

Species	Conservation status
Birds	
Burhinus grallarius (Bush Stone Curlew)	CS2 (Priority 4)
Mammals	
Bettongia penicillata (Woylie)	CS2 (Priority 5)
Macropus eugenii (Tammar)	CS2 (Priority 5)
Myrmecobius fasciatus (Numbat)	CS1 (Wildlife Act Schedule 1 [Vulnerable] and Vulnerable under EPBC Act)
Petrogale lateralis (Black-flanked Rock-Wallaby)	CS1 (Wildlife Act Schedule 1 [Vulnerable] and Vulnerable under EPBC Act)
Pseudocheirus occidentalis (Western Ring-tailed Possum)	CS1 (Wildlife Act Schedule 1 [Vulnerable] and Vulnerable under EPBC Act)
Setonix brachyurus (Quokka)	CS1 (Wildlife Act Schedule 1 [Vulnerable] and Vulnerable under EPBC Act)

CS = Conservation significance

[4] Species that no longer occur in the area but were present at time of European settlement.

8.2.3 Birds

Of the 95 bird species potentially occurring in the survey area[5], Harris and Bamford (2007a) recorded 37 during the survey and these were broadly typical of the western escarpment. A number of birds have specific habitat requirements fulfilled by the survey area, including heathland habitat (*Phylidonyris melanops* [Tawny-crowned Honeyeater] and *Stipiturus malachurus* [Southern Emu-wren]) and riparian vegetation (*Malurus elegans* [Red-winged Fairy-wren] and *Stagonopleura oculata* [Red-eared Firetail]). Of these species, only the Red-eared Firetail was observed by Harris and Bamford (2007a); however, the Southern Emu-wren has been previously recorded on the opposite side of Toodyay Road (M. Bamford, unpubl. data).

The dominant bird species recorded during the survey included the *Smicronis brevirostris* (Weebill), *Gerygone fusca* (Western Gerygone), *Malurus splendens* (Splendid Fairy-wren) and *Rhipidura fuliginosa* (Grey Fantail). In terms of individual trapping transects, notable sites included Site D (to the north of the existing pit – Jarrah and Wandoo forest with a shrubby understorey; some exposed granite) and Site B (to the west of the existing pit – Jarrah and she-oak forest with an understorey of *Dryandra sessilis* thicket) (Figure 17). Site D had the highest number of sightings and species richness, although only recording 21 of the 37 species recorded. Site B had the second highest number of sightings, although it recorded one of the lowest species richness.

Species of conservation significance

Harris and Bamford (2007a) recorded 15 of the 38 conservation significant bird species expected to occur in the survey area (Table 15). Most of the 15 species recorded are sedentary species of heathland and understorey. Eight bird species of higher conservation significance (i.e. CS1 and CS2) are also present or expected to occur:

- *Falco peregrinus* (Peregrine Falcon) (CS1)
- *Calyptorhynchus banksii naso* (Red-tailed Black-Cockatoo) (CS1)
- *C. latirostris* (Carnaby's Black-Cockatoo) (CS1)
- *C. baundinii* (Baudins's Black-Cockatoo) (CS1)
- *Ninox connivens* (Barking Owl) (CS2)
- *Tyto novaehollandiae* (Masked Owl) (CS2)
- *Merops ornatus* (Rainbow Bee-eater) (CS1)
- *Falcunculus frontatus* (Crested Shrike-tit) (CS2).

Only one of the black-cockatoos (the Forest Red-tailed Black-Cockatoo) was observed by Harris and Bamford (2007a). The other two black-cockatoo species (Baudin's Black-Cockatoo and Carnaby's Black-Cockatoo) are likely to be regular non-breeding visitors (e.g. transient visitors and possible use of the site for foraging). Refer also to Section 8.2.10.

[5] Harris and Bamford (2007a) has limited the list of bird species expected to occur in the project area to those species that make regular use of the site and for which, the site may be significant in supporting local populations. Therefore, species that may occur as vagrants (including most waterbirds) have been excluded.

8.2.4 Mammals

Harris and Bamford (2007a) recorded a total of 12 mammals during the survey (including three introduced species), from a potential 29 species expected to occur in the survey area (including seven introduced species). Native mammals not recorded but expected to occur are almost certainly present, albeit perhaps intermittently (e.g. *Hydromys chrysogaster* [Water Rat/ Rakali] may visit when Susannah Brook is flowing).

Approximately 41% of those species potentially occurring are bats; however, only two species were recorded by Harris and Bamford (2007a) in the survey area; *Chalinolobus gouldii* (Gould's Wattled Bat) and *Tadarida australis* (White-striped Freetail Bat). This could be due to sampling effort and/or the lack of large trees with hollows, which most bat species rely on.

Tarsipes rostratus (Honey Possum) was the dominant species (being recorded on 26 occasions) with *Antechinus flavipes* (Mardo) the next dominant (being recorded on 12 occasions). Small, non-flying native mammal species were well-represented given the survey area's close proximity to Perth, with both the *Cercartetus concinnus* (Western Pygmy-possum) and Honey Possum recorded.

Out of the five trapping sites (Figure 17) no site dominated in terms of both total mammal captures or species richness. Sites A, C and D had the highest species richness, whilst Sites B, C and D were highest in terms of total captures. Although Site B did not have a high species richness, it was the only site where the *Trichosurus vulpecular* (Brush-tailed Possum) was recorded, and also recorded the majority of the Mardo captures.

Species of conservation significance

Harris and Bamford (2007a) recorded four of the 11 conservation significant mammal species expected to occur in the survey area (Table 15); *Antechinus flavipes* (Mardo), *Sminthopis gilberti* (Dunnart), *Cercartetus concinnus* (Western Pygmy-Possum) and *Tarsipes rostratus* (Honey Possum). An additional species, *Isodoon obesulus fusciventer* (Quenda), was reported by nearby residents but not recorded by Harris and Bamford (2007). The presence of apparently large populations of Mardo, Dunnart, Western Pygmy-Possum and Honey Possum so close to Perth is locally significant. Mardo and Dunnart have been previously recorded from John Forrest National Park. Refer also to Section 8.2.10.

8.2.5 Amphibians

Whilst only three of the 13 potentially occurring frog species were recorded in the survey area by Harris and Bamford (2007a), it is considered that the majority of the remaining species would be present in alternative (i.e. wetter) seasonal conditions. *Heleioporus barycragus* (Hooting Frog) was recorded at Site A and D, whilst the two recorded tree frogs were observed along Susannah Brook. Most of the frog species are widespread in the south-west of Western Australia; however, some species are restricted to the Darling Scarp (e.g. *Crinia pseudinsignifera* [Bleating Frog], and the Hooting Frog).

Species of conservation significance

Of the 13 frog species expected to occur in the survey area, the Hooting Frog is the only frog species of conservation significance (CS3) in the survey area (Table 15).

8.2.6 Reptiles

Harris and Bamford (2007a, 2007b; Bancroft, Harris and Bamford 2007) recorded only 21 of the 52 reptile species expected to occur in the survey area. The low number is considered to be a result of the survey period and behaviour of reptiles (e.g. reptiles are often difficult to locate). The dominant species recorded included *Crenadactylus ocellatus* (Clawless Gecko) and to a lesser extent, the *Strophurus spinigerus* (Spiny-tailed Gecko). Site B (in Area B, Jarrah forest over *Dryandra sessilis* thicket) had the lowest numbers of species and captures of reptiles. There was a trend for more species and more individuals in Sites C, D and E, near the granitic areas. Site A had a similar number of species to the sites near granitic areas, but fewer individuals caught.

The reptile assemblage for the survey area is rich due to its location as a transitional area between the Swan Coastal Plain and Darling Plateau. Species recorded by Harris and Bamford (2007a) that are mostly, or typically, restricted to the coastal plain included:

- *Pletholax gracilis* (legless-lizard)
- *Ctenotus fallens* (skink).

Species recorded by Harris and Bamford (2007a) that are restricted to the scarp in the region included:

- *Ctenophorus ornatus* (Ornate Dragon)
- *Crenadactylus ocellatus* (Clawless Gecko)
- *Diplodactylus granariensis* (Wheatbelt Stone Gecko)
- *Diplodactylus polyophthalmus* (gecko)
- *Hemiergis intialis* and *Lerista distinguenda* (skinks).

Species of conservation significance

Harris and Bamford (2007a) recorded three of the nine conservation significant reptile species; *Ramphotyphlops pinguis* (blind snake), *Diplodactylus granariensis* (Wheatbelt Stone Gecko) and *Pletholax gracilis* (legless lizard). *Morelia spilota imbricata* (South-west Carpet Python) was also reported as being present by Red Hill Quarry personnel. Refer also to Section 8.2.10.

Morelia spilota imbricata (South-west Carpet Python)

The unidentified gecko *Diplodactylus* aff. *polyophthalmus* may be a species of conservation significance; however, further specimens are required in order to carry out genetic investigations to determine its relationship with recognised species (Section 8.5).

8.2.7 Freshwater fish

The fish fauna of streams of the Darling Scarp in the Perth area is well-known and include:

- *Geitria australis* (Pouched Lamprey)
- *Tandanus bostocki* (Freshwater Cobbler)

- *Galaxias occidentalis* (Western Minnow)
- *Bostockia porosa* (Nightfish)
- *Edelia vittata* (Western Pygmy Perch)
- *Pseudogobius olorum* (Swan River Goby)
- *Gambusia holbrooki* (Mosquito Fish)
- *Oncorhynchus mykis* (Rainbow Trout)
- *Perca fluviatilis* (Redfin Perch).

Of these species, the Mosquitofish, Rainbow Trout and Redfin Perch are introduced and probably only the Mosquitofish occurs in Susannah Brook.

Of the native species, the Pouched Lamprey is listed as Priority 1 by DEC and is unlikely to be present in Susannah Brook as it is thought to be extinct in the Swan/Canning system. The remaining native fish species likely to be present are all widespread in the south-west and have some tolerance of water quality, including salinity (Morgan *et al.* 1998). They can be expected to be present within Susannah Brook when the stream is flowing and to persist downstream (and upstream if any large pools remain upstream) at other times.

8.2.8 Invertebrates

Studies on invertebrates were restricted to species belonging to groups known to include short-range endemic species. The following invertebrates were collected during the survey:

- *Urodacus novaehollandiae* (scorpion)
- *Bothriembryon* sp. (snail)
- *Dinocambala ingens* (Iulomorphidae; millipede).

The scorpion and snail are widespread in the south-west of Western Australia; however, the millipede is mostly confined to the western Darling Scarp in the vicinity of Perth. The single live specimen collected, and a number of fragments of dead specimens, were all under rocks on the edge of granite outcrops near Site E (Figure 17).

Harris and Bamford (2007b) also observed three invertebrate species, including two millipedes and one snail, which are yet to be formally identified.

Species of conservation significance

One invertebrate species of conservation significance returned by the DEC database search, *Austromerope poultonii* (scorpion-fly), was not recorded by Harris and Bamford (2007a). This species is terrestrial and most commonly encountered in winter.

Dinocambala igens (millipede) was recorded by Harris and Bamford (2007a). This species is of local conservation significance (CS3) because of its restricted distribution in a region where development and high levels of disturbance can be expected. There may be other short-range endemic invertebrates associated with the granite outcrops and gravely soils; further searches for such species will be carried in winter 2007 (Section 8.5).

8.2.9 Introduced fauna

One introduced bird (*Dacelo novaeguinae* - Laughing Kookaburra) and three introduced mammals (*Mus musculus* – House Mouse, *Oryctolagus cuniculus* – European Rabbit and *Vulpes vulpes* – Fox) were recorded during the study. It is likely that a number of other introduced species occur in the area, including:

- *Columba livia* (Feral Pigeon)
- *Streptopelia chinensis* (Spotted Turtle-dove)
- *Streptopelia senegalensis* (Laughing Turtle-dove)
- *Trichoglossus haematodus* (Rainbow Lorikeet)
- *Felis catus* (Feral Cat)
- *Rattus rattus* (Black Rat)
- *Sus scrofa* (Feral Pig).

Nearby residents report that a small flock of feral goats inhabit the area.

Predation by introduced species has contributed to the local extinction of some mammal species across much of the region (Harris and Bamford 2007a); however, competition for habitat and food also affect native fauna.

8.2.10 Conservation significance of fauna

Under State and/or Commonwealth legislation several species that have been recorded from, or potentially occurring (or their habitat likely to occur) in the survey area, have been declared as rare, threatened or vulnerable (Table 17).

Table 17 Species of State and Commonwealth conservation significance potentially occurring in the survey area

Species	State level	Commonwealth level	Distribution within survey area	Likely presence in survey area
Calyptorhynchus baudinii (Baudin's Black-cockatoo)	Schedule 1	Vulnerable	Foraging mainly in *Eucalyptus*, but especially *Corymbia calophylla* (Marri).	Not recorded, but likely to visit regularly (e.g. transient visitor and possible use of the site for foraging). Breeding unlikely.
Calyptorhynchus latirostris (Carnaby's Black-cockatoo)	Schedule 1	Endangered	Foraging in range of habitats, including eucalypts and heaths.	Not recorded, but likely to visit regularly (e.g. transient visitor and possible use of the site for foraging). Breeding unlikely.
Dasyurus geoffroii (Chuditch)	Schedule 1	Vulnerable	May occur anywhere within survey area.	Not recorded, but likely to be present. Individuals have home ranges of several hundred hectares.
Calyptorhynchus banksii naso (Forest Red-tailed Black-cockatoo)	Schedule 1	NL	Foraging mainly in *Eucalyptus*, but especially *Corymbia calophylla* (Marri).	Small flock recorded (e.g. transient visitor and possible use of the site for foraging). Breeding unlikely.

Species	State level	Commonwealth level	Distribution within survey area	Likely presence in survey area
Phascogale tapoatafa (Brush-tailed Phascogale)	Schedule 1	NL	May occur anywhere within survey area.	Not recorded but likely to be present.
Falco peregrinus (Peregrine Falcon)	Schedule 4	NL	Forage widely over all habitats.	Not recorded, but survey area is very likely to be within feeding range of a pair. Nesting potential on abandoned quarry face, but unlikely.
Morelia spilota imbricata (South-west Carpet Python)	Schedule 4	NL	Located in granite areas.	Reported to occur onsite.
Ninox connivens (Barking Owl)	Priority 2	NL	Will forage widely.	Not recorded. May be a visitor (e.g. transient visitor and possible use of the site for foraging) but unlikely to be suitable nesting habitat.
Tyto novaehollandiae (Masked Owl)	Priority 3	NL	Will forage widely.	Not recorded. May be a visitor (e.g. transient visitor and possible use of the site for foraging) but unlikely to be suitable nesting habitat.
Acanthophis antarcticus (Common Death-adder)	Priority 4	NL	Could occur in any terrestrial habitat.	Not recorded. Survey area may be just outside range of species, which is to the south.
Austromerope poultoni (Scorpion-fly)	Priority 4	NL	Occurs in forest leaf-litter.	Status onsite unknown.
Ctenotus delli (Dell's Skink)	Priority 4	NL	Most likely in heath on gravely sand around granites.	Not recorded but very likely to be present.
Falcunculus frontatus (Crested Shrike-tit)	Priority 4	NL	Forages in *Eucalyptus*, particularly *E. wandoo*.	Not recorded, may be occasional visitor.
Falsistrellus mackenziei (Western False Pipistrelle)	Priority 4	NL	Most likely in forested areas.	Not recorded, but very likely to be present.
Hydromys chrysogaster (Rakali or Water Rat)	Priority 4	NL	Along Susannah Brook.	Not recorded, but likely to be a seasonal visitor along Susannah Brook (e.g. transient visitor and possible use of the site for foraging).
Macropus irma (Brush Wallaby)	Priority 4	NL	Could occur in all habitats.	Not recorded, but very likely to be present.
Isoodon obesulus fusciventer (Quenda)	Priority 5	NL	Reported elsewhere along Susannah Brook. May be limited suitable habitat, but animals may move through survey area.	Not recorded, but reported elsewhere along Susannah Brook. May be limited suitable habitat, but animals may move through survey area.

Source: Harris and Bamford (2007a).

NL = Not listed under the Commonwealth EPBC Act.

In addition to the above fauna, there are two migratory species that may occur in the survey area:

1. *Haliaeetus leucogaster* (White-bellied Sea-eagle) – habitat includes marine coasts and major river systems and is therefore very unlikely to be present in the survey area.
2. *Merops ornatus* (Rainbow Bee-eater) – protected by an international agreement with Japan (JAMBA). This species was not recorded; however, it is considered to be a widespread species most likely to occur along tracks and clearings and is likely to be a breeding visitor.

8.2.11 Survey limitations

The aim of fauna investigations as part of environmental impact assessment is to identify how fauna might be affected by a proposed development. The aim is not to produce a list of species confirmed to be present, but rather to identify:

- ecological processes that may be affected and in turn, how fauna dependent on these processes, might be affected (e.g. hydrology, fire)
- significant habitats (e.g. habitat distribution and linkage, rare habitats, habitats that support high or unusual biodiversity, habitats with a unique ecological role)
- significant species that occur in the area.

Also of interest are impacts upon regional biodiversity (EPA 2003).

Assessing potential impacts with respect to the above parameters requires familiarity with the landforms and vegetation types of a site, and sufficient information on the fauna to be able to predict what species might be present and how those species (especially significant species) might utilise the landscape. Harris and Bamford (2007a) listed the vertebrate fauna species likely to be present and confirmed the presence of many of those species during field investigations. Errors in relation to species likely to be present are likely to be a matter of inclusion rather than omission. Environmental preferences of many of these species are well documented in the literature, especially for significant species. Sufficient field work has been carried out in the general area for important habitats and processes to be recognised. The major limitations to these investigations relate to the lack of surveying in winter and early spring, when some seasonal species may be active (Section 8.5).

8.3 POTENTIAL SOURCES OF IMPACT

The following aspects of the proposal may affect fauna values:

- **habitat clearing** for the quarry pit area, product stockpiles and establishment of infrastructure, such as haul roads, will lead to the direct disturbance of fauna habitat and may result in the deaths of individual terrestrial fauna
- **vehicle movements** during construction and operation could potentially lead to the occasional death of individual fauna, particularly less mobile species
- **quarry development and operation** could alter fauna behaviour due to lighting, noise and vibration. Feral fauna are generally more adaptable to changes in the environment and so may be advantaged, thereby potentially affecting the abundance and distribution of native fauna.

Other minor potential impacts to fauna include personnel feeding selected species, bushfires, dust and changes to surface hydrology. Personnel will be discouraged from feeding fauna and an education program to this effect will be developed, which will also highlight the need to leave areas free of food

scraps. This information will also be communicated in site inductions. Dust settlement will not be significant to fauna.

The operation of machinery and equipment and presence of personnel in the proposed development area will increase the risk of fires. Unplanned fires are a special concern in fragmented landscapes where there is poor connectivity for animals to seek refuge and for later re-colonisation (Harris and Bamford 2007a). Hanson has committed to retaining and enhancing ecological corridors on their landholding to maintain connectivity (Section 17). Additionally, Hanson will continue to develop the capacity to control bushfires (Section 7.5).

The proposed development is expected to result in a flow reduction in Susannah and Strelley brooks due to reduced catchment areas (Section 10). Surface water-dependent vegetation (habitat) in these catchments (e.g. riparian vegetation) is not expected to be significantly affected (Section 7.4.3). The expected drop in water level in Susannah and Strelley brooks is not expected to have a significant effect on downstream stages and thus, alterations to surface hydrology due to the proposed development are not expected to have any significant impacts to fauna values.

The native fish fauna expected to be present in Susannah and Strelley brooks would be sensitive to major changes in water flows and water quality, however, such changes are not expected as a result of the Red Hill Quarry Development Proposal. The expected drop in water level in Susannah and Strelley brooks is not expected to have a significant effect on downstream stages and thus, alterations to surface hydrology due to the proposed development are not expected to have any significant impacts to fauna values, including fish (Section 10.4.1). Current water quality monitoring results indicate that the existing quarry operations have had no effect on water quality in Susannah and Strelley brooks and, similarly, water quality is not expected to be affected by the proposal given current water pollution control measures will continue to be implemented (Sections 10.4.2 and 10.4.3).

8.4 ASSESSMENT OF POTENTIAL IMPACT, MITIGATION AND RESIDUAL IMPACT

8.4.1 Vegetation clearing

Native fauna rely on native vegetation to provide food, shelter and breeding sites. The loss or degradation of native vegetation may reduce the capacity of the habitat to support the range of fauna it originally did (i.e. in an undisturbed state).

Approximately 80 ha of native vegetation will be progressively cleared over the 100 year life of the proposed development (or on average less than 1 ha/yr). The clearing will result in the progressive loss of habitat, potentially leading to fragmentation and loss of connectivity, which can reduce the capacity for fauna movement and ultimately genetic exchange within species (Harris and Bamford 2007a). As clearing will be progressive, occurring over the 100 year life of the proposed development, it is likely there will be sufficient time for fauna to adapt to reductions in available habitat.

Five significant habitats were identified within the survey area. Those that will be most affected by the proposal are areas of granite outcrops with associated heaths on gravely sands and eucalypt woodlands. The habitats identified in the proposed survey site are not unique to the area (Section 7.2.1) with extensive vegetated areas conserved in nearby John Forrest National Park, the Darling Range Regional Park and Walyungah National Park. These habitats are also locally present on Lot 11 to the north of Susannah Brook; habitat to the north of Susannah Brook will not be disturbed by the proposed development and will continue to be managed to protect biodiversity values.

To minimise the effect of fragmentation, it is important to maintain connectivity between vegetation remnants; this is particularly relevant to habitat surrounding the development area. Species most likely to be adversely affected by fragmentation are those that occur at low densities and/or have poor dispersal ability. Species that occur at low densities are liable to local extinction by the loss of a few individuals while those with poor dispersal abilities are liable to local extinction by lack of connectivity between remnants. Therefore, movement between habitat patches can be important for maintaining populations (e.g. *Antaresia stimsoni* [Stimson's Python] and *Morelia spilota imbricate* [South-west Carpet Python]). Other species that may be reliant upon connectivity of suitable habitat for the maintenance of populations include some reptiles, birds with limited dispersal abilities (e.g. *Stipiturus malachurus* [Southern Emu-wren]), small mammals and short-range endemic invertebrates (e.g. *Dinocambala ingens* [millipede species]).

Hanson has made a commitment to retain and enhance north – south corridors on the east and western side of the quarry operations and an east – west corridor along the Susannah Brook (provided by an approximate 100 m buffer either side of the Brook). This will maintain the connection between John Forrest National Park and the Darling Range Regional Park, as well as retaining the riparian linkage along the Susannah Brook from the east into the Darling Range Regional Park. Section 17.3 contains additional information relating to the corridors.

8.4.2 Vehicle movements

It is unlikely that the conservation status and distribution of any species will be affected by vehicle movement at the Red Hill Quarry site. Vehicle movements around the quarry operational areas have the potential to result in the mortality of some individuals, particularly those less mobile species (e.g. reptiles). This risk is increased during clearing activities when fauna may be relocating away from disturbance. An increase in mortality can be significant for some species that occur at low population densities (e.g. *Tachyglossus aculeatus* Echidna). However, the current operation has not recorded any road kills on haul roads.

The use of heavy machinery for clearing may potentially result in the mortality of some individuals; however, clearing will be staged over approximately 100 years, which should reduce the impact to whole populations. Additionally, vehicle speeds are limited on quarry roads, primarily for safety reasons, but also serve the purpose to reduce the risk of road kill. Education of quarry personnel will continue to be implemented onsite.

8.4.3 Quarry development and operation

Quarry development and operation could potentially disturb fauna and alter their behaviour or distribution through noise generation and lighting. Additionally, feral fauna, being better adapted to changes in the environment, may be advantaged in the disturbed area, which may, in turn, affect native fauna populations.

Noise

Noise generated from the proposed development will not increase above the noise levels already produced by the existing quarry operations (Section 12); however, the source of the noise will move as quarrying progresses. Noise may alter fauna behaviour and distribution; however, this is not expected to affect the viability of species populations. Studies by other resource companies indicate a similar presence of vertebrate fauna in areas adjacent to active mining areas, suggesting noise does not have an observable impact on fauna (Strategen 2005).

Lighting

Lighting will be utilised to ensure the safe operation and security of the quarry and processing facilities. Lighting may affect the behaviour of nocturnal fauna or some fauna that are attracted to lights could become disoriented and strike buildings. The death of very large numbers of invertebrates around lights is commonly observed and the impact of this mortality is not understood (Harris and Bamford 2007a). The affect of lighting is not expected to result in any significant impacts to vertebrate fauna. Lighting will continue to be selected and positioned in a manner that reduces impacts to fauna as far as practicable (i.e. directing lights at target work areas and shielding lights).

Feral fauna

The populations of introduced fauna at the quarry could potentially be increased via a number of means including availability of food scraps, feral fauna being deliberately encouraged by staff and improved access to habitat along tracks and roads. Foxes and cats have been recorded in the general area, and given the co-occurrence of sensitive native fauna (e.g. Brush-tailed Possum, Honey Possum and Pygmy Possum) management measures will be implemented to reduce the likelihood of personnel actions advantaging feral fauna (e.g. education of personnel, ensuring proper disposal of waste). Hanson will assist with feral fauna trapping and eradication programs undertaken by DEC in adjacent conservation reserves (Section 8.5).

8.4.4 Potential impact to conservation significant fauna

Although the status of *Diplodactylus* aff. *polyophthalmus* (a gecko) collected on Lot 11 is uncertain, the WA Museum consider it likely that it is possibly an aberrant *D. polyophthalmus*, however, the possibility of an undescribed taxon has not been dismissed. Further sampling for this gecko is proposed and will include sampling adjacent habitat areas, such as south of Toodyay Road and north of Susannah Brook (Section 8.5). The purpose of this sampling will be to collect additional specimens, in order for the WA Museum to carry out genetic investigations to determine its relationship with recognised species, and to determine its distribution in and outside Lot 11. It is likely that the distribution of this specimen, whether an aberrant *D. polyophthalmus* or an undescribed taxon, extends to areas outside the proposed disturbance footprint and outside Lot 11 due to the distribution of habitats. However, Hanson will apply an adaptive management approach with respect to the gecko species (i.e. appropriate management measures will be developed in response to the additional survey results, should gecko-specific management measures be required). The development of any such management measures will be undertaken in consultation with DEC.

The likelihood of impacts to those species of State or Commonwealth conservation significance is discussed below:

- *Calyptorhynchus baudinii* (Baudin's Black-cockatoo), *Calyptorhynchus latirostris* (Carnaby's Black-cockatoo) and *Calyptorhynchus banksii naso* (Forest Red-tailed Black-cockatoo): although Carnaby's Black-cockatoo and Baudin's Black-cockatoo have not been recorded during fauna surveys of the Red Hill Quarry site, they are likely to be regular non-breeding visitors for feeding in woodland and heath areas. A small flock of Forest Red-tailed Black-cockatoos was recorded on two occasions during the fauna surveys and though breeding is considered unlikely, they do forage in the area. There is likely to be some loss of foraging habitat; however, plants that provide food for Black-Cockatoos can be readily re-established in rehabilitation. The Black-cockatoo species is unlikely to breed in the survey area as there are few, if any, hollow-bearing trees.

Overall, the impact of the development proposal to Black-cockatoos will be minor given the minimal loss of potential nesting habitat, the extent of the surrounding reserved habitat of John Forrest National Park and the Darling Range Regional Park, and the partial compensation of loss of foraging habitat through rehabilitation (Section 17).

- *Dasyurus geoffroii* (Chuditch): although Chuditch has not been recorded during fauna surveys of the Red Hill Quarry site, it is likely to frequent the area utilising all the identified habitats and one or two individuals may be resident. This species is a highly mobile carnivorous marsupial and holds large home ranges; 55 ha to 120 ha for females and 400 ha or more for males. Whilst the species will lose some of its foraging habitat, it will be minor. The home ranges of this species overlap, which may result in a number of individuals losing part of their home ranges; however, within the context of the surrounding reserved habitat (e.g. John Forrest National Park – 2,700 ha and Darling Range Regional Park – 235 ha adjoins Lot 11), this impact will be minor (Harris and Bamford 2007a).

  Movement of Chuditch through the proposal development area may be important for sustaining the species' population in the general area. The ability of the species to utilise bush remnants and corridors means that the effect of fragmentation can be reduced by retaining or enhancing vegetation corridors around disturbance areas (Harris and Bamford 2007a). Hanson will maintain and enhance ecological corridors within Lot 11 to minimise potential impacts to this species (Section 17).

- *Phascogale tapoatafa* (Brush-tailed Phascogale): clearing will potentially lead to fragmentation of the population. Hanson will maintain and enhance ecological corridors within Lot 11 to minimise potential impacts to this species from fragmentation (Section 17).

- *Falco peregrinus* (Peregrine Falcon): the proposed survey area is likely to be within the feeding range of a pair of this species; however, the birds forage widely over all habitats. The proposal will have minimal impact on this bird as they have a very large home range (Harris and Bamford 2007a).

- *Morelia spilota imbricata* (South-west Carpet Python): clearing will potentially lead to loss of habitat and fragmentation of population, and the species may also be vulnerable to road kill. Population is likely to be small because the species is a top-order predator and will therefore be vulnerable to local extinction. Hanson will maintain and enhance ecological corridors within Lot 11 to minimise potential impacts to this species from fragmentation (Section 17). Additionally, speed limits will be restricted on quarry roads.

- *Ninox connivens* (Barking Owl): clearing will potentially result in minor loss of habitat; however, within the context of the surrounding habitat (e.g. John Forrest National Park and Darling Range Regional Park), the impacts on this species are not expected to be significant.

- *Tyto novaehollandiae* (Masked Owl): clearing will potentially result in minor loss of habitat; however, within the context of the surrounding habitat (e.g. John Forrest National Park and Darling Range Regional Park), this impact will be minor.

- *Acanthophis antarcticus* (Common Death-adder): clearing will potentially lead to loss of habitat and fragmentation of the population, and the species may also be vulnerable to road kill. Population is likely to be small because this species is a top-order predator and will therefore be vulnerable to local extinction. Hanson will maintain and enhance ecological corridors within Lot 11 to minimise potential impacts to this species from fragmentation (see Section 17). Speed limits will be restricted on quarry roads. It is considered however, that the survey area may be just outside the range of this species, which is to the south (Harris and Bamford 2007a).

- *Austromerope poultoni* (Scorpion-fly): clearing will potentially result in loss of habitat. Hanson will maintain and enhance ecological corridors within Lot 11 to maintain connections with surrounding reserved habitat (e.g. John Forrest National Park and Darling Range Regional Park).
- *Ctenotus delli* (Dell's Skink): clearing will potentially lead to loss of habitat and fragmentation of the population. Hanson will maintain and enhance ecological corridors within Lot 11 to minimise fragmentation, thereby maintaining connections with surrounding reserved habitat (e.g. John Forrest National Park and Darling Range Regional Park).
- *Falcunculus frontatus* (Crested Shrike-tit): clearing will potentially lead to loss of habitat; however, Hanson will maintain and enhance ecological corridors within Lot 11 to maintain connections with surrounding reserved habitat (e.g. John Forrest National Park and Darling Range Regional Park).
- *Falsistrellus mackenziei* (Western False Pipistrelle): clearing will potentially lead to loss of habitat and fragmentation of the population. Hanson will maintain and enhance ecological corridors within Lot 11 to minimise fragmentation, thereby maintaining connections with surrounding reserved habitat (e.g. John Forrest National Park and Darling Range Regional Park).
- *Hydromys chrysogaster* (Rakali or Water Rat): maintenance of a minimum 50 m buffer (sometimes up to 100 m) between the proposal development area and Susannah Brook will ensure the watercourse is not degraded, therefore the proposal will have minimal impact on the species (Harris and Bamford 2007a).
- *Macropus irma* (Brush Wallaby): clearing will potentially lead to loss of habitat and fragmentation of the population. Hanson will maintain and enhance ecological corridors within Lot 11 to minimise fragmentation, thereby maintaining connections with surrounding reserved habitat (e.g. John Forrest National Park and Darling Range Regional Park).
- *Isoodon obesulus fusciventer* (Quenda): clearing could potentially lead to fragmentation of the population. The survey area may provide limited suitable habitat for this species, though animals may move through the area. Hanson will maintain and enhance ecological corridors within Lot 11 to minimise fragmentation, thereby maintaining connections with surrounding reserved habitat (e.g. John Forrest National Park and Darling Range Regional Park).
- *Merops ornatus* (Rainbow Bee-eater): Although this species has not been recorded during fauna surveys of the Red Hill Quarry site, it is likely to be a regular breeding visitor in spring and summer (Harris and Bamford 2007). This species is a common, regular breeding visitor to the south-west of Western Australia, and breeds in burrows in sandy ground or banks. This species is widespread and often occurs in partly cleared habitats. The Rainbow Bee-eater could occur anywhere in the survey area, but often forages over clearings and low vegetation adjacent to forest.

  The proposal is likely to result in some loss of foraging habitat; however, within the context of surrounding habitats reserved in National and Regional Parks, this impact will be minor (Harris and Bamford 2007a).
- *Haliaeetus leucogaster* (White-bellied Sea-eagle): the White-bellied Sea-eagle is very unlikely to be present in the development proposal area (Harris and Bamford 2007a). This species was not recorded in the previous fauna survey for the Herne Hill Relocation Project (Dames and Moore 1990) or in the more recent fauna survey for the development proposal (Harris and Bamford 2007a). This species is common in coastal and near coastal areas and inland near large rivers, reservoirs and lakes. It is typically a sedentary bird, feeding mainly on aquatic animals with mating pairs occupying the same territory yearly. They nest high in trees or on cliffs. It is

anticipated that impacts will be negligible as this species is very unlikely to be present within the proposal development area.

8.5 PROPOSED MANAGEMENT ACTIONS

The management of impacts on fauna at the Red Hill Quarry will be addressed by the following proposed management actions:

- undertake further field work to collect additional speciemens of the undescribed taxon of gecko (*Diplodactylus* aff. *polyophthalmus*) for DNA analysis and determine the distribution of the species on Lot 11 and in the vicinity of Lot 11; appropriate management measures will be developed in response, should gecko-specific management measures be required
- implement the Environmental Management Plan (Appendix 2), which includes a Vegetation and Habitat Protection Plan and a Fauna Management Plan, containing management actions to:
    - restrict clearing to approved areas
    - locate infrastructure in already cleared or disturbed areas
    - undertake pre-clearing inspections of tall trees (should they be present) for Black-Cockatoo nests; if a hollow is actively used a nest box will be installed
    - retain and enhance north – south vegetated corridors on the eastern and western side of Hanson's quarry operations and an east – west corridor along the Susannah Brook (provided by an approximate 100 m buffer on both sides of the Brook)
    - assist with feral fauna trapping and eradication programs undertaken by DEC in adjacent conservation reserves
    - restrict speed limits to 40 km/hr on haul roads
    - design and/or position lighting in a manner that reduces impacts to fauna (e.g. directing lights at target work areas and shielding lights)
    - develop an education program for personnel in regards to discouraging feral fauna, awareness of fauna in the area (particularly conservation significant species) and the general sensitivity of the local environment
    - include awareness of fauna issues in inductions
- implement the Environmental Management Plan (Appendix 2), which includes a Fire Management Plan to ensure the capacity of Hanson to control fires and describes/outlines the education program for personnel with respect to fire risk
- implement and annually review/update the Screening and Rehabilitation Program (contained in Appendix 2; see also Section 17.5), which includes measures for the inclusion of Black-Cockatoo food plants in rehabilitation.

8.6 PREDICTED ENVIRONMENTAL OUTCOME

The terrestrial fauna of the proposed development area have been surveyed consistent with EPA Position Statement No. 3 (EPA 2002a) and EPA Guidance Statement No. 56 (EPA 2003). Approximately 80 ha of fauna habitat will be progressively disturbed over the 100 year life of the proposed development (an average of less than 1 ha/yr). The disturbance will result in the direct loss of habitat, potentially leading to fragmentation and loss of connectivity, which reduces the capacity for

fauna movement and ultimately genetic exchange within species. The habitats identified in the proposed survey area are not unique to the area with extensive areas containing similar habitats conserved in nearby John Forrest National Park, the Darling Range Regional Park and Walyungah National Park.

Hanson has made a commitment to retain and enhance (by rehabilitation of disturbed areas) north – south vegetated corridors on the east and western side of quarry operations and an approximate 100 m east – west vegetated corridor along either side of Susannah Brook to provide a buffer to quarrying operations. This will maintain the connection between John Forrest National Park and the Darling Range Regional Park, as well as retaining the riparian linkage along Susannah Brook from the east into the Darling Range Regional Park. Given the disturbance will be progressive there will be more than 100 m of intact habitat on either side of Susannah Brook for many years until the proposal is completely developed.

The proposal will not conflict with the Wildlife Act as no species of terrestrial vertebrate or invertebrate fauna will cease to exist as a result of the proposal. There is unlikely to be significant impacts to fauna of conservation significance at a local or regional level. Other potential impacts to fauna, including vehicle movements, noise, lighting and potential increase in feral fauna populations, will continue to be managed to avoid and minimise such impacts. The ecological studies undertaken by Hanson (and proposed to be undertaken) has ensured a comprehensive understanding of the faunal elements of the site and the implementation of the Environmental Management Plan addressing habitat protection will ensure potential impacts are avoided or minimised. Therefore, consistent with EPA objective, the abundance, diversity, distribution and productivity of fauna at species and ecosystem levels will be maintained.

9. VISUAL AMENITY

9.1 KEY STATUTORY REQUIREMENTS, ENVIRONMENTAL POLICY AND GUIDANCE

EPA objectives

Visual amenity

To ensure that aesthetic values are considered and measures are adopted to reduce visual impacts on the landscape as low as reasonably practicable.

Landscape and landforms

To maintain the integrity, ecological functions and environmental values of landscapes and landforms.

EPA Guidance Statement No. 33

EPA Guidance Statement No. 33, "*Environmental Guidance for Planning and Development*" (EPA 2005), provides guidance on land use planning and development processes to achieve environmentally sound outcomes. Part B of this Guidance Statement, *Biophysical factors*, provides advice in relation to 'landscape and landforms' and Part D, *Social surrounds*, provides advice in relation to 'visual amenity'. The Guidance Statement provides checklists for considering both of these factors during local area planning; checklist criteria which are relevant to this proposal being:

Landscape and landform

1. Consider any guidance and principles that have been developed for the broader area.
2. Carry out studies to describe and evaluate the existing landscape, landforms and visual resource.
3. Describe the potential impacts that a proposed development may have with respect to landscape and landforms and their associated values.
4. Consult with stakeholders and demonstrate how this has been incorporated into the project.
5. Employ sound design measures and propose management measures that mitigate as far as possible the potential adverse impacts of the development of the landscape.
6. Consider whether the location, design and management measures proposed are consistent with relevant objectives and pursue improvements where possible.
7. Ensure implementation of approved design and management measures.

Visual amenity

1. Retain natural landforms and vegetation in visually prominent places, as well as other parts of a site, in order to maintain local landscape character.
2. Avoid locating development where it would be visually obtrusive.
3. Adopt appropriate building design.
4. Rehabilitate disturbed natural areas.
5. Carry out landscaping works to meet completion criteria.

Statement of Planning Policy 2.4 – Basic Raw Materials

Statement of Planning Policy 2.4, Basic Raw Materials, recognises some areas of Lot 11 as a 'Key Extraction Area' and as a 'Priority Resource Location' (Section 2.3.2). The main objective of the policy is to protect such areas from being developed for incompatible land uses, which could restrict future reserves. The policy states that such areas should be protected in relevant Town Planning Schemes.

City of Swan Town Planning Scheme No. 9

Lot 11 is zoned 'Resource' and 'Landscape' (extractive industry is permitted if approval is granted by the City of Swan Council[6]) under the City of Swan Town Planning Scheme No. 9 (Section 2.3.2). The purpose and intent of the Resource zone is 'to provide opportunity for the extraction of basic raw materials with proper environmental safeguards'. The City of Swan typically has regard for the following criteria when taking into consideration development applications within areas zoned Resource:

- WAPC Basic Raw Materials Policy
- protection of water quality and watercourses
- strategic revegetation of cleared and/or degraded areas to screen development and/or rehabilitate excavated areas
- buffers to minimise visual and environmental impacts
- preservation of the opportunity to reuse the site.

The purpose and intent of the Landscape zone is to ensure development is 'compatible with and will enhance the landscape and environmental qualities of the locality'. The City of Swan typically has regard for the following criteria when taking into consideration development applications within areas zoned Landscape:

- compatibility of development with land capability and suitability, including visual and environmental qualities
- retention of remnant vegetation and linkage by corridors of vegetation of sustainable width
- protection of water quality and watercourses
- compatibility of land use and management practices with the protection of landscape quality
- strategic revegetation of cleared or degraded areas
- assessment of fire risk and development of a fire management program.

[6] Table 3B of the Town Planning Scheme indicates the permissibility of uses within the various zones. 'Industry – extractive' is permitted within the Landscape zone if special approval is granted by the City of Swan Council.

9.2 DESCRIPTION OF FACTOR

A landscape and visual assessment of the proposal was undertaken by John Cleary Planning (2007). A summary of the report is provided below and a full copy of the report is contained in Appendix 2.

The approach adopted for the visual impact assessment of the proposed development is based on methodologies used in other similar landscape studies (e.g. Cleary *et al.* 1999; CALM 1997; John Cleary Planning 2002). The first step in the assessment approach is to identify/determine the landscape values of the study area that may be affected by the proposal. The landscape values of the study area are described below in Section 9.2.1.

9.2.1 Landscape values

Landscape values include a wide range of human related values that stem from relationships between people and places. Landscape values for the immediate area of the proposed development (i.e. the proposed project footprint; referred herein as the 'project area'), and the broader area surrounding the project area (referred herein as the 'study area'), were assessed in terms of:

- community perceptions and values
- landscape character
- landscape significance
- community use
- views
- level of development/wilderness quality.

Community perceptions and values

Formal assessment of landscape values is based on knowledge of community perceptions and values. For this assessment, this knowledge was gained from two key sources:

1. Consultation with the local community.
2. Community perception research conducted as part of other projects.

Consultation with local community

The visual impact assessment also provided opportunities for the local community to be involved in addition to the community consultation that would normally be undertaken as part of the PER process. These opportunities included initial phone/email contact and discussions, meetings with some neighbours and two information sessions in May 2007. Comments relating to the landscape assessment obtained from this consultation elucidated information relating to:

- landscape features of the study area that are valued by the community; key features identified being Susannah Brook, rocky outcrops and the Darling Range Regional Park
- opportunities for reducing visual impacts of the quarry; key opportunities identified being the use of screening trees and rehabilitating terminal benches

- public use of the study area; key public use areas being public roads where the quarry may be visible from, use of tracks and fire breaks in the area for horse riding, wineries and the State Equestrian Centre on the Swan Coastal Plain
- perceptions of the visual appearance of the existing operation; key perceptions being an acceptance of the size and appearance of the existing quarry, however, there were concerns relating to the quarry becoming larger.

Community perception research

There is a large body of research not specific to the study area that allows assumptions about aesthetic values to be made (e.g. Fabos and McGregor 1979; Zube *et al.* 1982). These assumptions can be used as an indication of the sentiment of the general community (i.e. the broader community not necessarily living in the area). Much of this research focuses on visual aesthetic values to identify the relationships between environmental characteristics and a person's response. This research has determined that landscape significance increases with increased:

- topographic ruggedness
- naturalism
- land use compatibility
- presence of water forms
- presence of outstanding natural features
- legibility of features and spatial definition.

Key conclusions from this research, which can be applied to this proposal, include:

- people regard landscape values as extremely important
- people are more likely to regard places as important if they have first-hand experience of those places
- the attractions of an area are more likely to be landscape features rather than biological features
- impacts that are detectable but below a visual magnitude may not be recognised by people and may not affect their experience
- water features are valued highly, particularly if the water body is visually close.

Landscape character

Landscape character is classified and described in terms of broad patterns of environmental characteristics according to their relevance to human interaction. Typically, this classification focuses on natural and land use character.

Six landscape units have been identified based on the characteristics of the project area (Figure 18):

1. *Hills semi-natural unit*: includes the vegetation within and adjacent to Lot 11 (e.g. John Forrest National Park, Darling Range Regional Park and other blocks/patches of vegetation to the north-west and east). These areas are relatively natural but most are traversed in places by tracks and have views of the existing quarry operation.

2. *Hills farming unit*: includes the elevated, hilly areas to the north-east, east and south of the project area where the land is largely cleared and is used for farming.
3. *Hills rural living unit*: includes the foot-slopes of the scarp and includes the rural residential settlements of the Brigadoon and Baskerville areas, with some lots with substantial vegetation cover.
4. *Plains rural living unit*: includes rural residential lots on the Swan Coastal Plain on relatively flat and cleared terrain.
5. *Plains agricultural unit*: includes the large lots on the Swan Coastal Plain where agricultural activities dominate.
6. *Industrial unit*: includes the Red Hill and Herne Hill (former) quarry operations as well as clay extraction pits and the Red Hill Landfill Management Facility.

The project area is within the Hills semi-natural unit and lies adjacent to the Industrial unit. Natural land use character is the most threatened character as history shows that it is gradually being replaced by other character as development expands. The other landscape units are well represented in the study area.

Landscape significance

Landscape significance identifies the characteristics or features of the study area that are most important to the experience and enjoyment of people. The assessment of landscape significance in this study has focused on the aesthetic significance of natural features and rural use areas (settlement areas are also included if relevant). Aesthetically significant features of the study area include:

- steep vegetated slopes of the Darling Scarp and intersecting valleys
- ridge crests and high points
- major rock outcropping
- areas of diverse patterns of vegetation
- Susannah Brook and associated riparian vegetation
- recreation use associated with John Forrest National Park and Darling Range Regional Park (including the Wandoo Heights Nature Reserve visitor centre)
- recreation use of the State Equestrian Centre
- farming areas with good coverage of paddock trees or with good stands of remnant vegetation
- rural dams with surrounding trees
- the river features of the Swan River, including associated recreational use.

In the context of EPA Guidance Statement No. 33 (Part B), the study area can be considered a ‘valued’ landscape as it contains ridgelines, a riverscape and is part of the Darling Scarp.

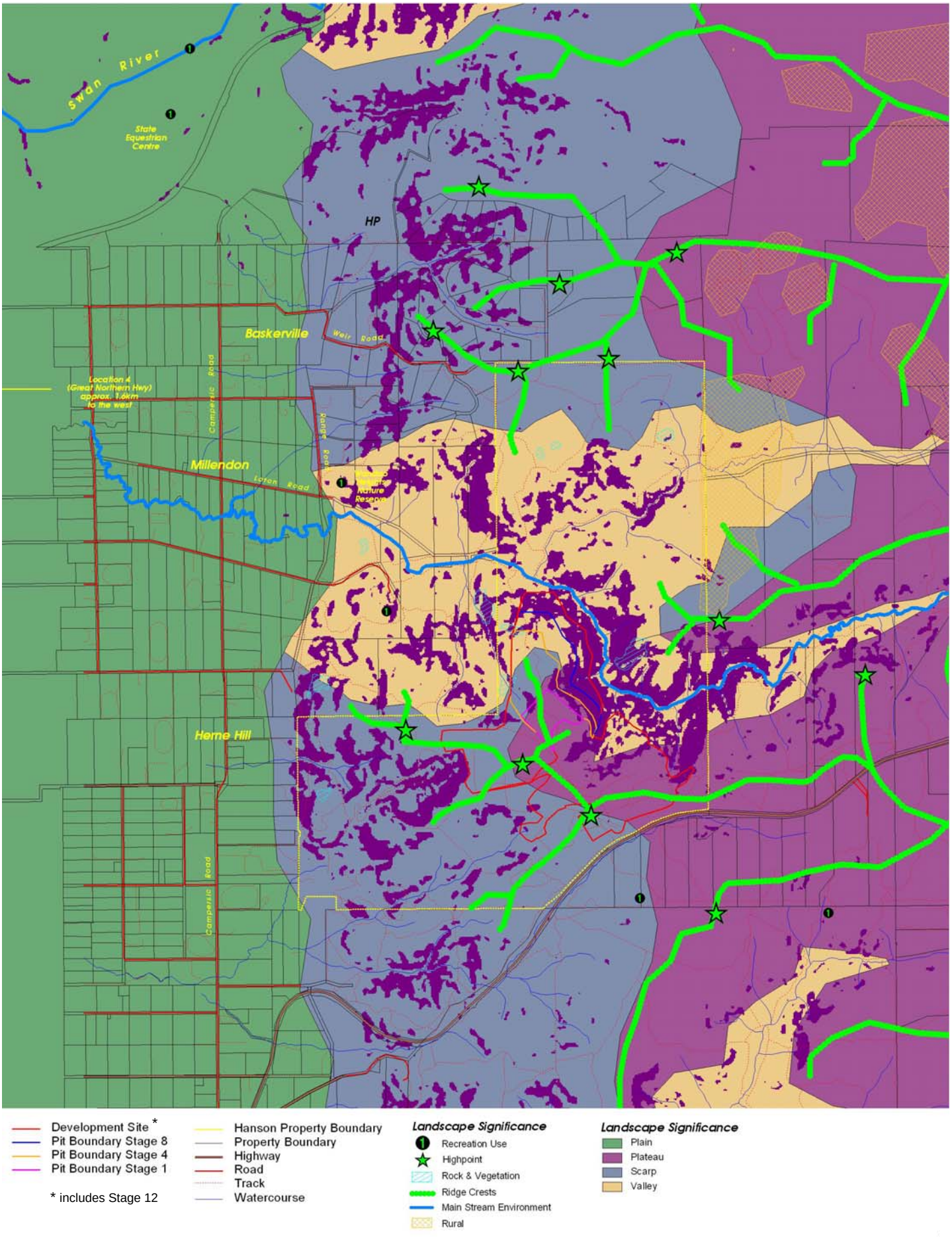


Figure 18 Landscape character units

Community use

An assessment of community use provides an indication of how people use an area and the likely importance of landscape values to their use. Three use patterns were identified for the study area:

1. Access routes: There is no public access through Lot 11 as public access is strictly prohibited and managed. Main access routes in the study area are Toodyay Road, Campersic Road, Great Northern Highway and local roads such as Williams Street, Range Road, Loton Road, Weir Road, Joshua Mews and Burgess Road.
2. Localised use: Public localised use is concentrated around the Wandoo Heights Nature Reserve within the Darling Range Regional Park to the north-west of the project area, the State Equestrian Centre to the north-north-west and wineries/breweries further to the west on the Swan Coastal Plain.
3. Neighbours: Residential neighbours are located to the west, north-west, north and north-east with the closest being in the Williams Street, Range Road, Loton Road, Weir Road, Joshua Mews and Burgess Road areas.

Sensitivity levels have been assigned to these use areas based on the volumes of and type of use (Table 18). The distance zone the project area is from the various use areas is also provided in Table 18, as distance is an important variable in determining the influence a feature has on experience of people visiting an area.

Table 18 Sensitivity levels and distance zones of use areas

Sensitivity level	Use area	Distance zone
Level 1 (highest)	Great Northern Highway	Distant middleground (3 – 6 km) and background (6 – 15 km)
Level 2	Toodyay Road, residences on the scarp that are positioned with major views, close neighbours and wineries/breweries with visitor facilities	Foreground (0 – 300 m) to middleground (1 – 3 km)
Level 3	Residential areas, local access roads, John Forrest National Park and Wandoo Heights Nature Conservation Reserve (within the Darling Range Regional Park)	Middleground (1 – 3 km)
Level 4 (lowest)	Local tracks	Distant background (>15 km)

Views

'Views' are the dominant sensory method by which people experience places. This assessment therefore, focuses on how people visually experience their setting (i.e. their ability to see and the configuration of what they see at particular locations).

General views of the study area can be categorised as:

1. Plains views: views across largely flat terrain.
2. Scarp views: views from elevated positions and are typically panoramic.
3. Plateau views: views tend to be more confined by the terrain and vegetation.

A number of key view locations[7] have been identified in the study area, and include:

- Toodyay Road to the east of the project area
- Toodyay Road to the south of the project area
- Toodyay Road to the south-west of the project area
- Great Northern Highway to the west of the project area
- Campersic Road to the north-west of the project area
- near the corner of Loton and Range Roads to the north-west of the project area
- Daniel Place to the north of the project area
- Joshua Mews to the north of the project area
- Burgess Road to the north-east of the project area.

These views cover a range of locations with available views towards the project area and they are representative of views in their respective locations. Examples of views looking towards the project area are provided in Plate 1 through Plate 8.

Level of development/wilderness quality

The level of development or wilderness quality provides an indication of the actual levels of disturbance or development rather than perceived naturalness of the area. Areas of high naturalness and low levels of development generally have high landscape values.

The project area has a low wilderness quality as it is adjacent to the existing Red Hill Quarry and the former Herne Hill Quarry. Neighbouring areas are variously affected by vegetation, roads and tracks, housing, vegetation clearing and the existing quarry. Areas such as John Forrest National Park and the Darling Range Regional Park have a moderate wilderness quality where there is good separation from surrounding development. Other areas in the study area can be classed as low to very low wilderness quality.

[7] In this assessment, key view locations are those that have good views of surrounding areas, are good examples of nearby views, and views that include the project area (e.g. proposed quarry development area).

Plate 1 Looking towards the quarry from Toodyay Road, 500 m east of the quarry

Plate 2 Looking towards the quarry from Great Northern Highway, 6 km west of the quarry

Plate 3 Looking towards the quarry from Campersic Rd, 2 200 m north-west of the quarry

Plate 4 Looking towards the quarry from Daniel Place, 1 400 m north of the quarry

Plate 5 Looking towards the quarry from Joshua Mews, 2 200 m north of the quarry

Plate 6 Looking towards the site from near the western end of Burgess Rd, 2 300 m north-east of the quarry

Plate 7 Looking towards the quarry from near the corner of Loton and Range Roads, 1 600 m north-west of the quarry

Plate 8 Looking towards the quarry from Toodyay Road, 100 m south of the quarry

9.3 POTENTIAL SOURCES OF IMPACT

The following aspects of the proposal may affect landscape values:

- **clearing vegetation** will alter the appearance of the natural environment
- **quarrying** will create a void in the landscape and the pit faces will contrast with the surrounding vegetation.

9.4 ASSESSMENT OF POTENTIAL IMPACT, MITIGATION AND RESIDUAL IMPACT

The second step in the visual impact assessment examines how the landscape values described in Section 9.2.1 might be affected by the proposal. The assessment describes the changes that the proposal will bring (see proposal description in Section 3), the visibility and appearance of these changes, and the effect of these visual changes on landscape values in the study area. The assessment is based on 3D modelling and analysis and some site-specific modelling/rendering, which included some example residences. The visibility and appearance described can be regarded as typical for each area, including individual residences. A discussion of the 3D modelling/rendering techniques and accuracy is contained in Appendix 5 of John Cleary Planning (2007) (contained in Appendix 2 of this document).

9.4.1 Visibility and appearance from key locations

There are a number of areas within the study area that have views to the existing and proposed quarry development. The areas potentially visually affected by the proposed development include all areas that are within the 'line of sight' of the project area[8] (Figure 19). Figure 19 also shows distance zones within the areas affected; as distance increases the visual effect of the proposed development on areas affected generally decreases. It is possible that at great distances, the proposed development may be within sight but not detectable because of small visual magnitude in the respective view and low contrast at great distances. These areas will be affected at different times and to different extents as the quarry develops over the anticipated 100 year life of the quarry. There are several factors that will determine the extent of the area potentially visually affected, including:

- screening ability of the vegetation and terrain
- size and contrast of the development elements
- stage of the development
- visual magnitude (i.e. distance).

[8] These areas have been generated regardless of vegetation cover and should be treated as indicative only. In areas of tall vegetation within this area affected, the proposed development will generally not be visible (i.e. the map shows a worst case scenario).

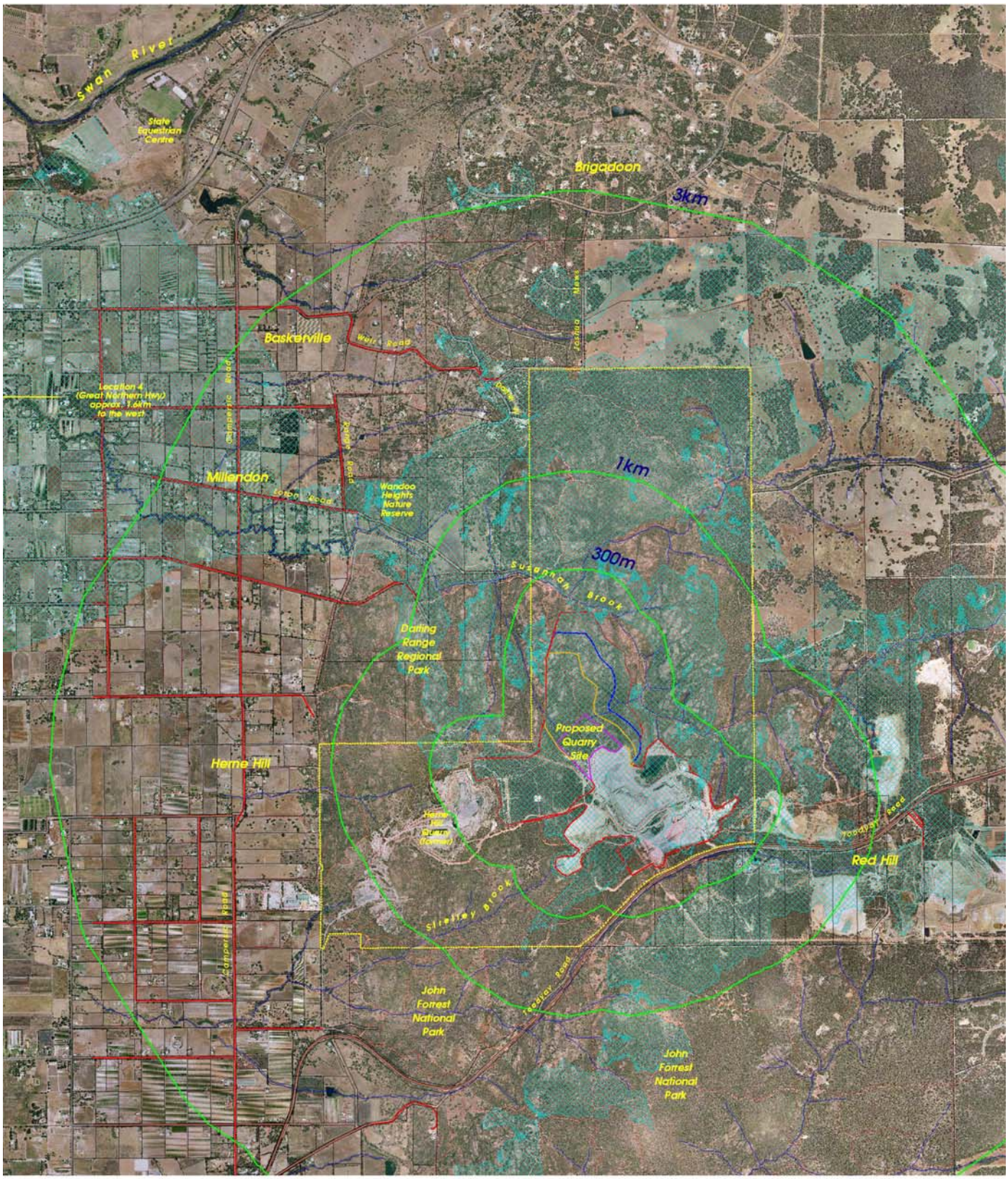


Figure 19 Areas potentially visually affected

There are four key areas supporting residences that may be potentially visually affected by the proposed development (Figure 19). A description of the potential visibility and appearance of the proposed development from these areas is provided below:

1. **Areas of the Susannah Brook valley**, to the west-north-west of Lot 11 and extending west on to the Swan Coastal Plain. Residences are scattered through this area and do not have views of the current operations. However, some of these residences (approximately 30) will gain views to the proposed development through the Susannah Brook valley where changes to the ridge lines will be seen and very small sections of the quarry faces may be detected (seen on the skyline). The area affected is relatively narrow in the 1 – 3 km distance zone but widens in a fan shape beyond that (to the west).

   The main changes will be the lowering of the crest of the northern and western ridges, in the order of two tree heights. Assuming the slopes on the observer sides of the pit are left in a natural state (i.e. vegetation cover remains) this change will less noticeable but may still be detectable at some locations. The lowering of the ridges will however, allow views to the opposite side of the quarry and sections of the upper quarry faces that face the observer (i.e. the eastern face of the proposed northern pit development and the northern face of the proposed western pit development). Where these faces are seen there will be a high visual contrast with the bushland setting but the visual magnitude will be relatively low due to the viewing distance.

   The appearance of the proposed quarry from this area is indicatively illustrated in Figure 20.

2. **Areas on the slopes of the northern side of the Susannah Brook valley**, including the ridge near the northern boundary of Lot 11 and Daniel Place/Weir Road/Abraham Close area. Some residences in this area look directly onto the existing quarry and will gain views to the upper section of the proposed northern development of the quarry (i.e. proposed pit development towards Susannah Brook). These are the most affected views in the study area, however, only a small number of houses are affected (approximately 4 – 5). The area affected is, at its closest, approximately 1 – 1.5 km from the most northern extent of the proposed development.

   The proposed northern development of the pit will open up views to the existing pit and will also add new pit face area. Smaller sections of the proposed western pit development (i.e. proposed pit development towards the former Herne Hill Quarry) will also be seen. Micro-landform variations and vegetation cover affect how much will be seen from individual residences.

   The appearance of the proposed quarry from this area is indicatively illustrated in Figure 21, Figure 22 and Figure 23.

3. **Areas at the northern end of Joshua Mews**. This area includes a small number (approximately 2 – 3) of scattered residences near Joshua Mews with views to the existing quarry. The area affected is approximately 1 km from the most northern extent of the proposed development. These residences will also have views to the proposed development (notwithstanding some filtering of views through trees); the proposed northern and western pit development will add new pit face area.

   The appearance of the proposed quarry from this area is indicatively illustrated in Figure 24.

4. **Areas to the north of the western end of Burgess Road and south of Brigadoon**, which are less affected than residences directly to the north. This area includes a small number of residences (approximately 4 – 5) with views of the existing and proposed development. The area affected is approximately 2 – 3.5 km from the proposed development.

   Residences in this area will have views of the upper sections of the northern and western pit development where these proposed development areas are closest to the existing pit. Some of

these proposed development areas will be seen as replacements for existing pit faces and some will be seen as new pit face area. As elevations increase towards Burgess Road, the extent of the proposed development visible decreases and will be a minor element in the view. The modelling indicates that the proposed development is unseen from areas closest to Burgess Road.

The appearance of the proposed quarry from this area is indicatively illustrated in Figure 25.

Areas to the east and south of the project area tend to be the high points that are of similar elevation to the higher part of the project area. There are few houses in these areas and it modelling indicates that none have views to the project area (existing and proposed).

There are three key public areas that may be visually affected by the proposed development:

1. Toodyay Road, where some small areas of the existing operation (e.g. processing plant infrastructure) are visible and an area of the proposed stockpile extension area will be visible.

   The area of the proposed stockpile extension area is naturally elevated in comparison to the existing stockpile area (Figure 26). Therefore, simulations of the proposed stockpile area with stockpiles at 10 m in height (the height of the existing stockpiles), or approximately 258 mAHD, indicate that the stockpiles will rise above the treeline (Figure 27). Simulations have been presented which assume some cutting and bunding to restrict the height of the stockpiles to 245, 243 and 241 mAHD (Figure 28, Figure 29 and Figure 30 respectively). At these height restrictions, the proposed stockpile area does not rise above the treeline.
2. Roads and public use areas on the Swan Coastal Plain, footslopes of the scarp in the Susannah Brook valley area and areas further to the west. The proposed development will result in changes to the ridgelines which may be visible from these areas and small sections of the proposed quarry face may be detectable.
3. Northern end of Joshua Mews, where some areas along the road have views to the existing quarry and upper sections of the proposed quarry may potentially be seen.

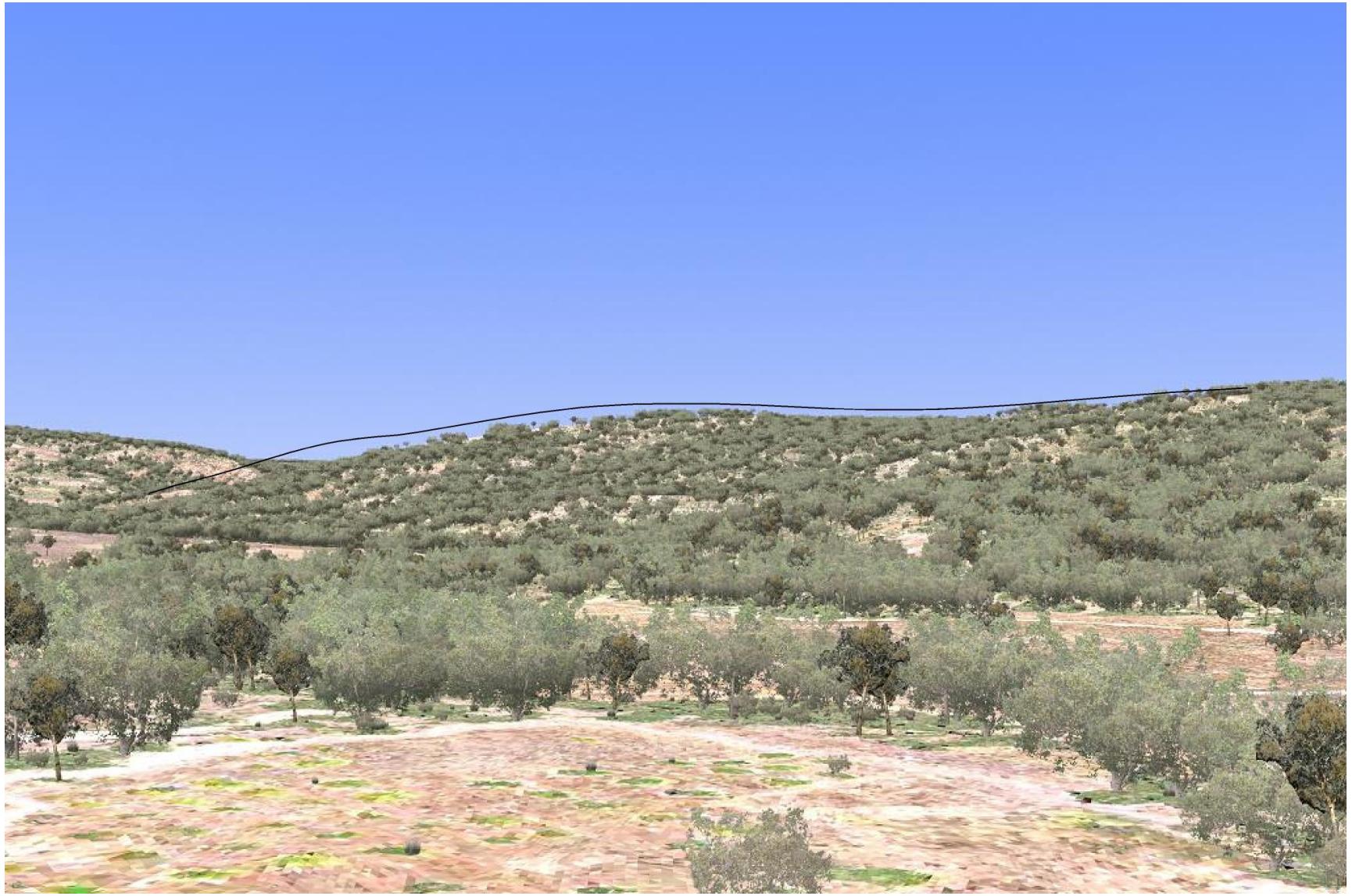


Figure 20 Simulation of the proposal looking towards the site from near the corner of Loton and Range Roads (Plate 7), with full extent of quarrying simulated (before rehabilitation) and showing the line of the existing ridge (foreground detail has been removed)

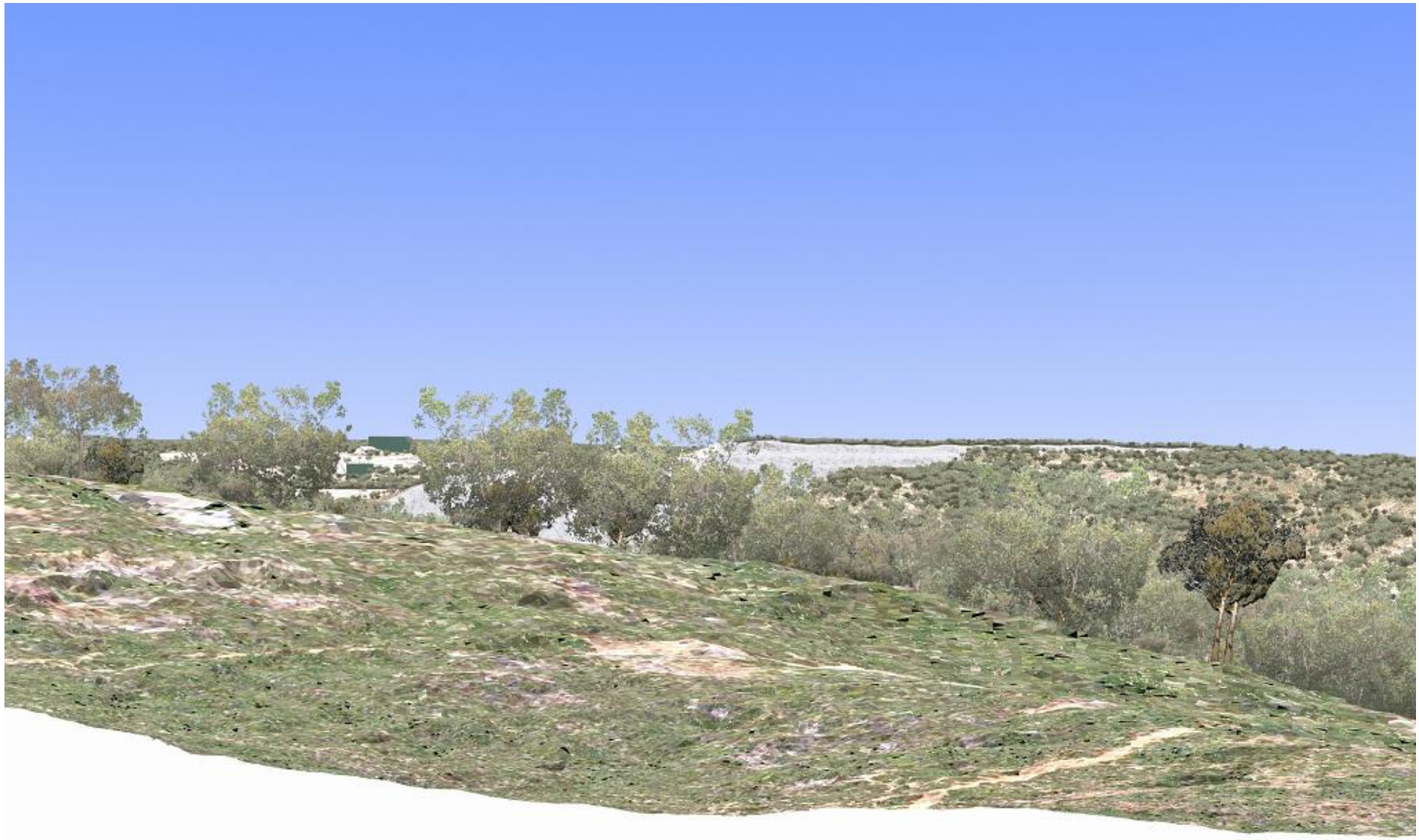


Figure 21 Simulation of the proposal looking towards the site from Daniel Place (Plate 4), with full extent of quarrying simulated before rehabilitation (foreground detail has been removed)

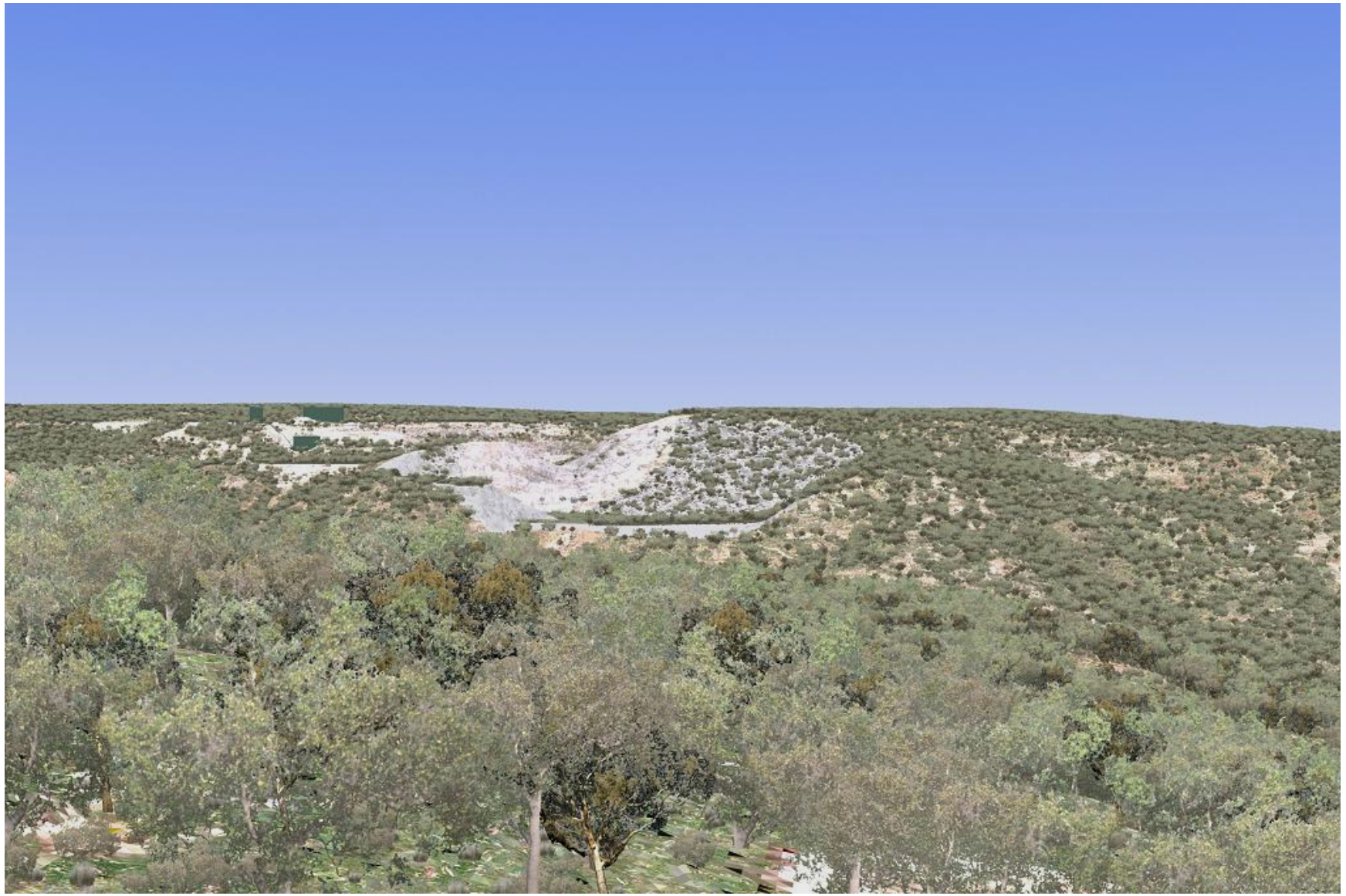


Figure 22 Simulation of the proposal looking towards the site from Daniel Place (Plate 4), with Stage 8 (approx. year 2055) of the proposal simulated and some semi-mature rehabilitation

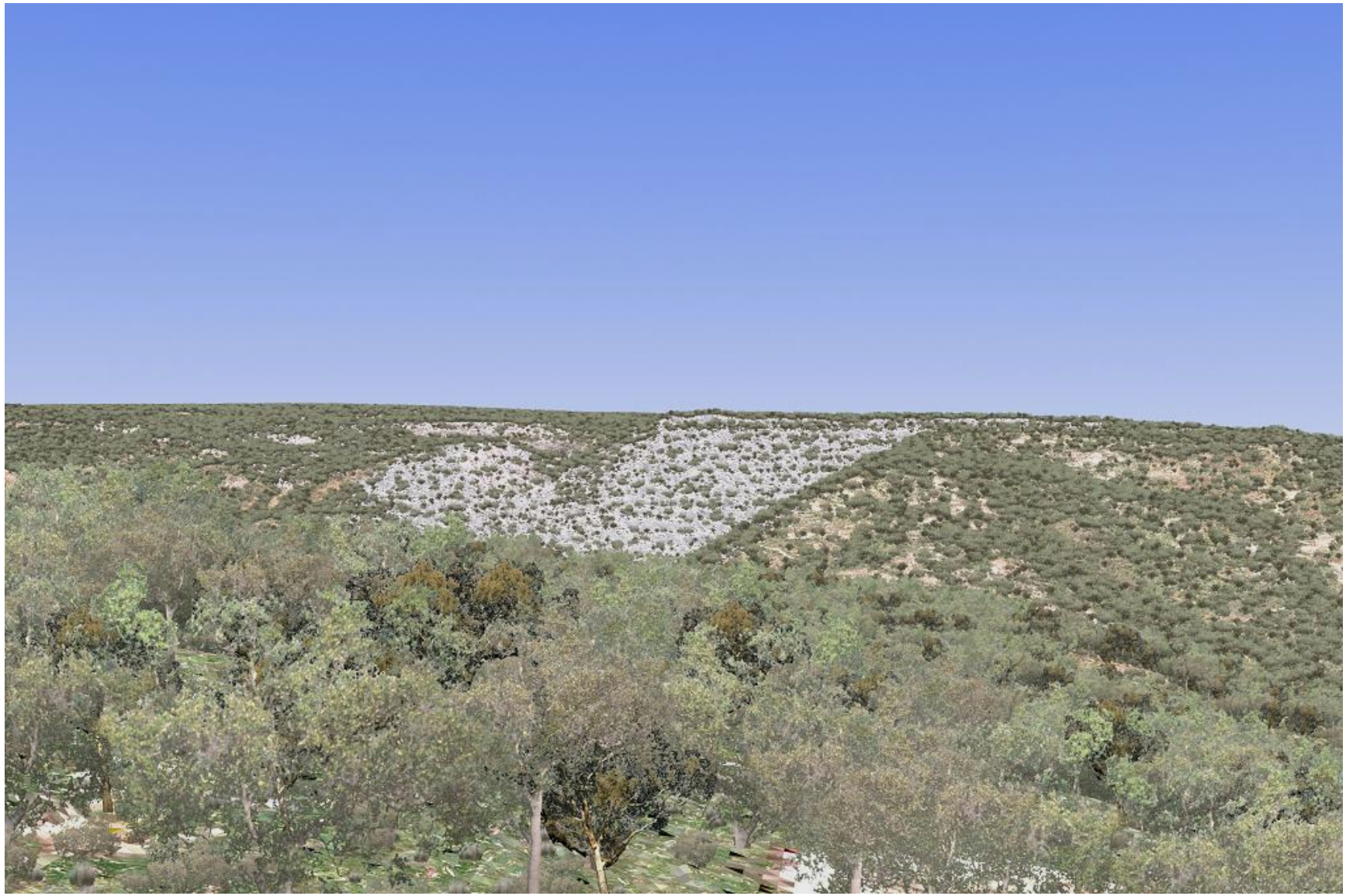


Figure 23 Simulation of the proposal looking towards the site from Daniel Place (Plate 4), with full extent of quarrying simulated and and the entire site shown with semi-mature rehabilitation (processing facilities buildings have been removed)

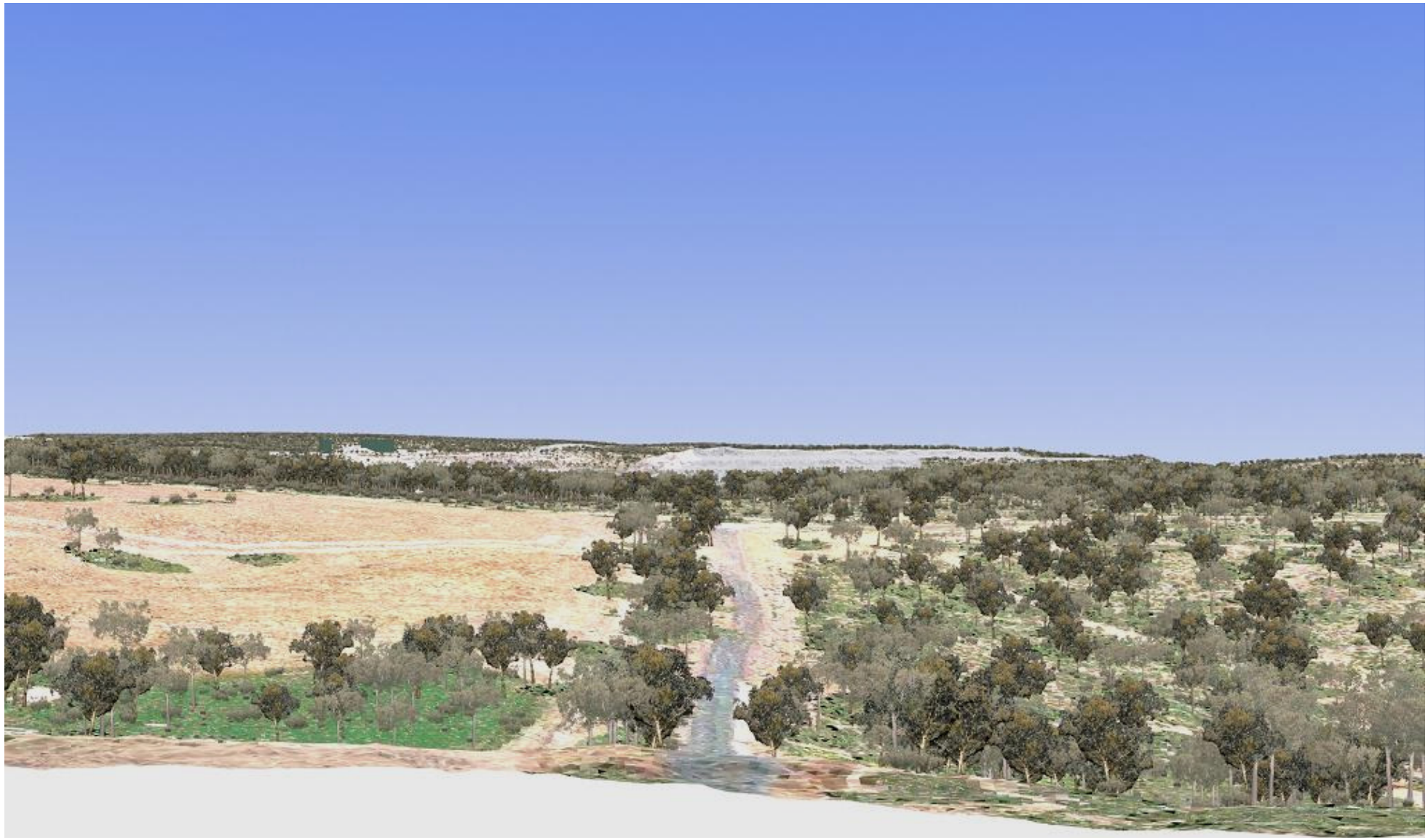


Figure 24 Simulation of the proposal looking towards the site from Joshua Mews (Plate 5), with full extent of quarrying simulated before rehabilitation (foreground detail has been removed)

Figure 25 Simulation of the proposal looking towards the site from south-east side of Brigadoon, with full extent of quarrying simulated before rehabilitation (foreground detail has been removed)

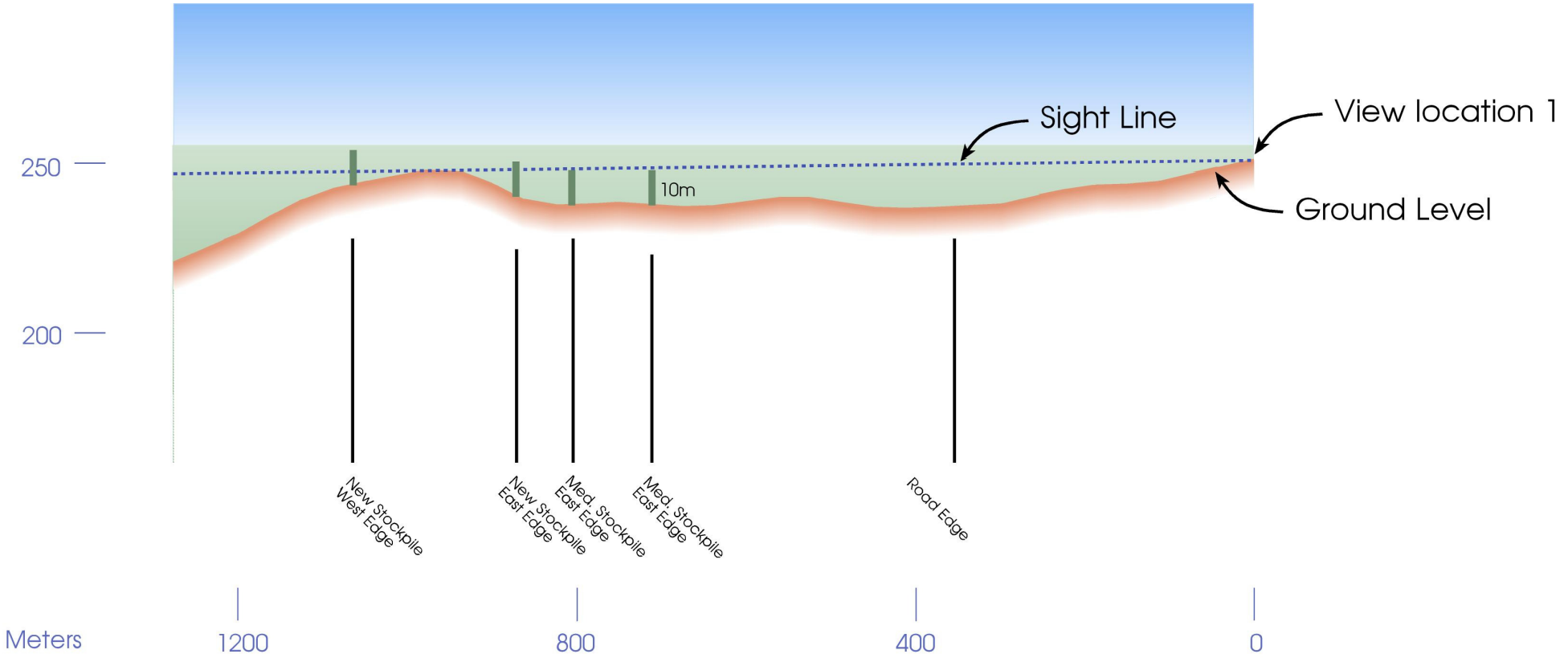


Figure 26 East – west profile along the existing and proposed stockpile area

Figure 27 Simulation of proposed stockpile extension area from Toodyay Road, 500 m east of the quarry (Plate 1), with stockpile extension area filled to 10 m above the existing groundlevel (~258 mAHD) (with no cutting or bunding)

Figure 28 Simulation of proposed stockpile extension area from Toodyay Road, 500 m east of the quarry (Plate 1), with stockpile extension area filled to 245 mAHD (assuming some cutting and bunding)

Figure 29 Simulation of proposed stockpile extension area from Toodyay Road, 500 m east of the quarry (Plate 1), with stockpile area filled to 243 mAHD (assuming some cutting and bunding)

Figure 30 Simulation of proposed stockpile extension area from Toodyay Road, 500 m east of the quarry (Plate 1), with stockpile area filled to 241 mAHD (assuming some cutting and bunding)

9.4.2 Summary of effect on landscape values

The effect on landscape values (described in Section 9.2.1) have been summarised in Table 19 based on the assessment of landscape values and the visibility and appearance of the existing and proposed development.

Table 19 Summary of effect on landscape values

Key question	Assessment outcomes
1. How much actual or perceived change will there be?	There will be detectable visual change when viewed from a number of localised areas: • minor change when viewed from roads and residences to the north-west from where the existing quarry is currently not seen • substantial change (e.g. doubling of size) when viewed from locations to the north and north-east of the site from where the existing quarry is currently seen (only approximately 4 – 5 residences) • some change when viewed from Toodyay Road where areas of the existing operation are currently seen A number of residences are orientated to take in views towards the project area; some of these residences have views of the existing operation and others do not currently have views. The progressive rehabilitation of terminal benches will reduce the contrast (between the pit faces and surrounding vegetation) of the change. The changes are largely changes to landscape character and significant landscape features. There is no public access through the site, the wilderness quality is low and the effect on views will result from any perceived change in landscape character and views to significant features.
2. Does the change affect the extent of the value, create rarity or affect rare features?	The landscape character of the project area will change from 'Hill Semi-natural with Industrial Influence' to 'Industrial'. This will affect the character as seen from key view areas (particularly to the north, north-east and north-west), with the balance between semi-natural character and industrial character becoming more dominant on the southern side of the Susannah Brook valley (on Lot 11). There are important landscape features that will be removed by the proposed development, including rock outcropping and native vegetation. These features are not unique to the project area; similar features occur in nearby areas of Lot 11 and adjacent conservation areas.
3. How does the change affect high sensitivity level use locations (as defined in Section 9.2.1)?	The change affects a Level 1 use area (Great Northern Highway; mainly distant-middleground distance), a Level 2 area (Toodyay Road, largely existing quarry development; 100 m – 1.5 km) and some residences (see below).
4. How does the change affect residences?	The anticipated changes will affect a small a small number of residences to the north-east (1.2 km – 2.4 km) to a large degree, and a greater number of residences to the north-west (1.6 km+) to a small degree.

9.4.3 Assessment of compliance with planning /policy framework

EPA objectives

EPA objectives for landscapes and visual amenity provide for protection of these factors as well as minimising impacts as far as reasonably practicable, with priority given to 'valued' landscapes. These objectives are reflected in the checklist criteria provided in EPA Guidance Statement No. 33 (Section 9.1). Therefore, the key questions in determining compliance are:

1. Has the proposed development been designed to minimise the impacts as far as reasonably practicable?
2. What special consideration has been given to the 'valued' landscape?

The location of the proposed development on the crest of two ridges assists to make the proposed pit faces relatively unseen from the north-west and also reduces the extent of seen disturbed area so that less is generally seen from any one location. The western extent of the proposed development does not 'break-through' to the former Herne Hill Quarry, restricting any views into the proposed development from the west. The northern extent of the proposed development (towards Susannah Brook) is highly visible from localised areas to the north and to the north-east to a lesser extent. It also descends to the ridge to a location close to the Susannah Brook 'riverscape' (a 50 to 100 m buffer will be maintained along both sides of Susannah Brook; Section 10.5).

Small modifications to pit design may be possible to further reduce visual impacts; such possibilities will be investigated during the detailed quarry design phase. Planting screening vegetation (typically trees) at appropriate locations (e.g. along boundaries with adjacent landholdings) may also be beneficial in reducing visual impacts; Hanson has recently provided screening plants to adjacent landholders and will continue to consider such plantings at other locations. Rehabilitation of disturbed areas, including terminal pit faces, also contributes to reducing visual impact; rehabilitation reduces the contrast between the pit faces and the surrounding vegetation. The Red Hill Quarry Screening and Rehabilitation Program reflects the current procedures for rehabilitation activities and will be applied to the proposed operations (Landform Research 2007). The Program is contained in Appendix 2 and is consistent with EPA Guidance Statement No. 6 (EPA 2006a).

The effort required for a 'valued' landscape is generally diminished in a situation where an existing development of the same type already dominates the setting (such as the case in this proposal). In addition, the 'valued' landscape of the project area has been adequately considered in the overall proposal design and development of management measures (as discussed above).

City of Swan Town Planning Scheme – Landscape zone objectives

The objectives of the Landscape zone are described in the City of Swan Town Planning Scheme (Section 9.1). The appropriate level of landscape value protection can be determined by the importance of the identified values and also by the community use. For this proposal, the landscape values are typical of the area and the community use is moderate; therefore, a moderate stringency in maintaining landscape values could apply to the proposal.

As described above, minimising visual impacts has been taken into consideration during the design phase of the proposal (and will continue throughout the detailed design phase) and in the development of management measures; therefore, protecting landscape values where possible. In addition, consistent with the objectives of the Landscape zone, remnant vegetation (including linkages) will be retained and enhanced on site (Section 17.3.3), Susannah Brook will be protected from disturbance and contamination (Section 10.5), and rehabilitation of cleared or degraded areas will be undertaken (Section 17.3).

Extractive industry objectives

The objectives of the WAPC Basic Raw Materials Policy and the Resource zone of the City of Swan Town Planning Scheme provide a counterpoint for consideration of landscape values as the objectives of both highlight the importance of the project area for quarrying. In addition, consistent with the objectives of the Resource zone, Susannah Brook will be protected from disturbance and contamination (Section 10.5), rehabilitation of cleared or degraded areas will be undertaken (Section 17.3), vegetative buffers will be maintained between operations and nearby residences, and preservation of significant slopes, ridgelines, flora and fauna habitat elsewhere on Lot 11 has been ensured (Sections 7.5 and 8.5).

9.5 PROPOSED MANAGEMENT ACTIONS

The management of visual amenity impacts will be addressed by the following proposed management actions:

- implement the Environmental Management Plan (Appendix 2), which includes a Vegetation and Habitat Protection Plan and a Surface Water Management Plan to include management actions to:
    - restrict clearing to approved areas
    - locate infrastructure on previously disturbed areas to minimise clearing
    - retain and enhance north – south vegetated corridors on the eastern and western side of Hanson's quarry operations and an east – west corridor along Susannah Brook (provided by an approximate 100 m buffer on both sides of the Brook)
    - maintain a 50 to 100 m buffer along both sides of Susannah Brook; in most instances this buffer will be extended to 100 m (the proposed pit will only be within 100 m [but not within 50 m] of Susannah Brook for approximately 250 m of the 2.5 km length of the Brook that traverses Lot 11)
- implement and annually review/update the Screening and Rehabilitation Program (contained in Appendix 2; see also Section 17.5) to ensure management measures include:
    - visual amenity management, including species selection
    - landform reconstruction and contouring of pit faces to ensure slope stability and suitability for rehabilitation
- investigate opportunities to further reduce visual impacts during the detail quarry design phase, including restricting the height of the proposed stockpiles to avoid stockpiles being visible above the treeline when viewed from Toodyay Road
- consider visual screening, designed for the nature of the impact, for residences to the north and north-east of the quarry that are visually affected by the proposal
- undertake regular visual assessments of the development to assess the visual appearance of the operation in comparison to that predicted in the John Cleary Planning (2007) visual assessment report.

9.6 PREDICTED ENVIRONMENTAL OUTCOME

The proposal will increase the area of the quarry pit visible to some residences with existing views and will also increase the number of residences with views to the quarry (i.e. opening up views to residences that do not currently have views of the existing quarry).

The key landscape values of the study area relate to natural features (e.g. Susannah Brook and rock outcrops), the semi-natural/rural character of the area, level and type of use of public areas (e.g. public roads, surrounding residences, and locations on the Swan Coastal Plain) and key views. The modelling indicated that most changes to the identified landscape values resulting from the proposed development that will be visible from surrounding residences and public locations will be minor and significant changes will only be visible from a small number of residences (approximately 4 – 5 residences) to the north-east of the site. The main changes being:

- additional pit face being visible from locations with existing views
- new pit face being visible from locations that do not have existing views.

The modelling indicates that the potential visual affects of the proposed development will vary spatially between areas in the study area (i.e. the visibility and appearance of the proposed development will vary between sites). The natural ridgelines assist to make the proposed pit faces relatively unseen from the north-west and also reduce the extent of seen disturbed area so that less is generally seen from any one location. The western extent of the proposed development does not 'break-through' to the former Herne Hill Quarry, restricting any views into the proposed development from the west. The northern extent of the proposed development (towards Susannah Brook) is highly visible from localised areas to the north and to the north-east to a lesser extent.

The modelling also indicates that the potential visual affects of the proposed development will vary temporally between areas in the study area as the proposed quarry develops over the anticipated 100 year life of the proposal.

Hanson will continue to progressively rehabilitate terminal pit benches in accordance with the Red Hill Quarry Screening and Rehabilitation Program, which will reduce the contrast between the pit face and surrounding vegetation, and will continue to investigate opportunities to modify pit design to further reduce visual impacts. Hanson will also continue to consider visual screening for all residences to the north and north-east of the quarry that are visually affected by the proposal.

Taking existing and proposed management measures into consideration, the proposal is regarded as being consistent with the objectives of the Landscape zoning (under the City of Swan Town Planning Scheme) and with the EPA objectives for visual amenity and landscape and landforms (as described in EPA Guidance Statement No. 33 [EPA2005]).

10. SURFACE WATER: SUSANNAH AND STRELLEY BROOKS – WATER QUANTITY AND QUALITY

10.1 KEY STATUTORY REQUIREMENTS, ENVIRONMENTAL POLICY AND GUIDANCE

EPA objective

To maintain the quantity and quality of water so that existing and potential environmental values, including ecosystem maintenance, are protected.

To maintain the integrity, ecological functions and environmental values of wetlands.

Regulatory framework

Prohibited discharges and potentially polluting activities affecting surface water are managed under work approvals and environmental licences issued to prevent environmental harm or pollution under Part V of the EP Act.

ANZECC/ARMCANZ Guidelines

In 1996, the Australian and New Zealand Environment and Conservation Council (ANZECC) and the Agricultural and Resource Management Council of Australia and New Zealand (ARMCANZ) developed the National Principles for the Provision of Water for Ecosystems (1996). These national principles aim to improve the approach to water resource allocation and management, and to incorporate the needs of the environment in the water allocation process. The overriding goal of the principles is to provide water for the environment to sustain and, where necessary, restore ecological processes and biodiversity of water-dependent ecosystems.

ANZECC and ARMCANZ have also released a set of water quality guidelines for recreational water quality and aesthetics (ANZECC/ARMCANZ 2000) (Table 20).

Table 20 Guidelines for recreational water quality and aesthetics

Parameter	Guideline value
pH	6.5 – 8.5
Total Dissolved Solids	1000 mg/L
Chloride	400 mg/L
Hardness	500 mg/L
Total Suspended Solids*	80 mg/L

* Taken from ANZECC/ARMCANZ (2000) Livestock Guidelines.

mg/L = milligrams per litre

10.2 DESCRIPTION OF FACTOR

The technical background for the assessment of potential impacts to Susannah and Strelley brooks (water quantity and quality) has been provided by Aquaterra (2007a). The summary of the report is provided below and a full copy of the report is contained in Appendix 2.

10.2.1 Hydrology

Susannah Brook

The main surface water drainage feature within the project area is Susannah Brook, located to the north of the existing Red Hill Quarry operation and flowing east to west across Lot 11 (Figure 7). Susannah Brook is an ephemeral stream (June to November) that originates at Stoneville and flows into the Swan River near Herne Hill. The Susannah Brook catchment covers an area of approximately 5,500 ha and the main channel of the Brook is approximately 20 km long (Swan River Trust 2005); approximately 2.5 km of the Brook traversing Lot 11. The majority of the Red Hill Quarry operation is within the Susannah Brook catchment.

The dominant land use in the Susannah Brook catchment is agriculture; the upper reaches support pasture while the lower reaches support horticulture (namely orchards and vineyards). Very little remnant vegetation is present on the upper and lower reaches, although some (of varying condition) remains along the middle reaches of the Brook (Swan River Trust 2005). There are several small private dams along the upper reaches (upstream of Lot 11) on the Brook.

Flow in Susannah Brook is mainly generated by surface water runoff, with groundwater providing only a relatively minor contribution. Flow rates recorded for the period 1997 – 2000 were approximately 30% greater at the River Road gauging station (downstream of the Red Hill Quarry) than at the further upstream Gilmours Farm station, indicating that runoff from areas downstream of the Gilmours Farm station (which includes the Red Hill Quarry) significantly contributes to flow in the Susannah Brook system (Aquaterra 2007a). Location of gauging stations shown in Figure 31.

There is a strong correlation between stream flow and rainfall, with flow peaking during periods of heavy rainfall (winter) and dropping to zero during summer months (Figure 32). The expected rainfall trend for the south west of Western Australia is for rainfall to decrease into the future; this change will mean substantially reduced stream flow in Susannah Brook.

Susannah Brook contributes less than 1% of the annual flow of the Swan River (Swan River Trust 2005). There are several well-defined drainage lines that originate on Lot 11 and drain into Susannah Brook, including one that forms part of the current storm water management system for the existing Red Hill operation. Runoff from the quarry and other disturbed areas is diverted to a sedimentation dam located to the north of the quarry. The dam allows for overflow to the drainage line, and hence also to Susannah Brook, but only in high rainfall events.

Strelley Brook

A small portion of the Red Hill Quarry is located within the Strelley Brook catchment, located to the south of the Susannah Brook catchment boundary (Figure 7). A branch of the Strelley Brook flows in a south-westerly direction from its origin on Lot 11 to its confluence with Jane Brook. The Strelley Brook catchment covers approximately 2,800 ha and is flanked mainly by horticulture, hobby farms and some urban development. The water storage dam to the south-west of the quarry pit was constructed on the head of a branch of Strelley Brook prior to 1970 and was expanded following the relocation of the quarry from Herne Hill to the current location at Red Hill in 1996 – 1998. Runoff from the overburden dump to the north of the dam and other disturbed areas is diverted to this dam via drainage lines that contain a number of sedimentation traps.

No flow volume data is available for Strelley Brook, however, the Brook is likely to exhibit similar flow trends to that of Susannah Brook (i.e. strong correlation between stream flow and rainfall).

10.2.2 Stream water quality

Hanson monitors the following water quality parameters on a monthly basis at six locations during times of stream flow (Table 21, Figure 31):

- pH: a measure of the alkalinity or acidity of the water
- Total Dissolved Solids (TDS): a measure of water salinity
- Total Suspended Solids (TSS): a measure of sediments and other particles suspended in the water
- Chlorides (Cl): a measure of salinity
- oil and grease levels.

Table 21 Location of water quality monitoring stations

Monitoring station	Location
W1	Susannah Brook at the eastern boundary of Lot 11 (down hill of the product stockpile area)
W2	Susannah Brook at base of spillway of the Northern Dam
W3	Susannah Brook at Padbury Avenue outside of Lot 11 (downstream of quarry operations)
W4	Below the workshop facilities at the former Herne Hill Quarry
W5	Strelley Brook (main southern branch) just upstream of quarry operations
W6	Strelley Brook at Herne Hill Access Road at the downstream boundary of Lot 11 (Swan Coastal Plain)

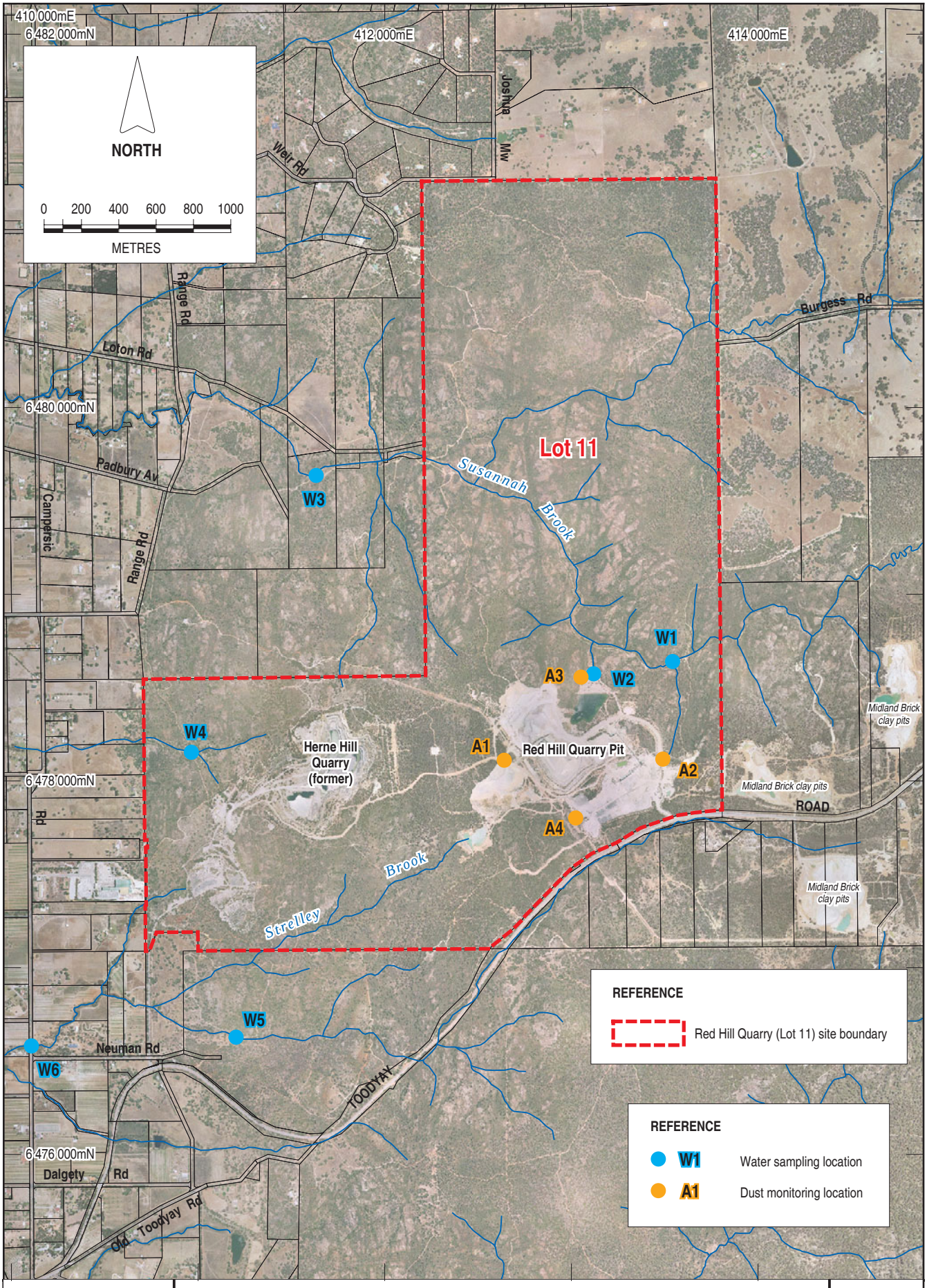
Hanson reports on results of water quality monitoring results in its Annual Environmental Summary Report and Audit Document, which is provided to EPA, DEC and City of Swan.

Data from monitoring stations W1 – W4 is used to characterise the water quality in the Susannah Brook subcatchment immediately downstream of the Red Hill Quarry. Data from monitoring station W6 is used to characterise the water quality in the Strelley Brook subcatchment immediately downstream of the quarry. Data from monitoring station W5 is used to characterise the upstream water quality in Strelley Brook.

Data obtained from the following monitoring stations has also been used to characterise water quality upstream of the Red Hill Quarry (Figure 31):

- Gilmours Farm: monitored by DoW for pH (1981 – 2001), TDS (1981 – 1992) and chloride (1981-2000); used to characterise water quality in Susannah Brook upstream of the quarry
- Red Hill Waste Management Facility: monitored by the Eastern Metropolitan Region Council (EMRC); used to characterise water quality in Strelley Brook upstream of the quarry.

Data from monitoring stations W1 – W6 are available from 2002 onwards; while, data sets from the Gilmours Farm and EMRC monitoring stations span approximately 10 – 20 years. Depending on rainfall, fluctuations in water quality may be expected to occur between years. In addition, surface water flows in ephemeral streams vary greatly within years and, therefore, the time between the most recent rainfall event and monitoring can influence recorded values for water quality parameters (particularly those that are dependent on runoff volume [such as TDS, TSS, pH and chlorides]). Further disturbance events, such as road works or land clearing, can cause short-term changes in runoff quality.



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Hanson Construction Materials Pty Ltd
RED HILL QUARRY DEVELOPMENT PROPOSAL

EXISTING WATER AND DUST SAMPLING SITES

Figure 31

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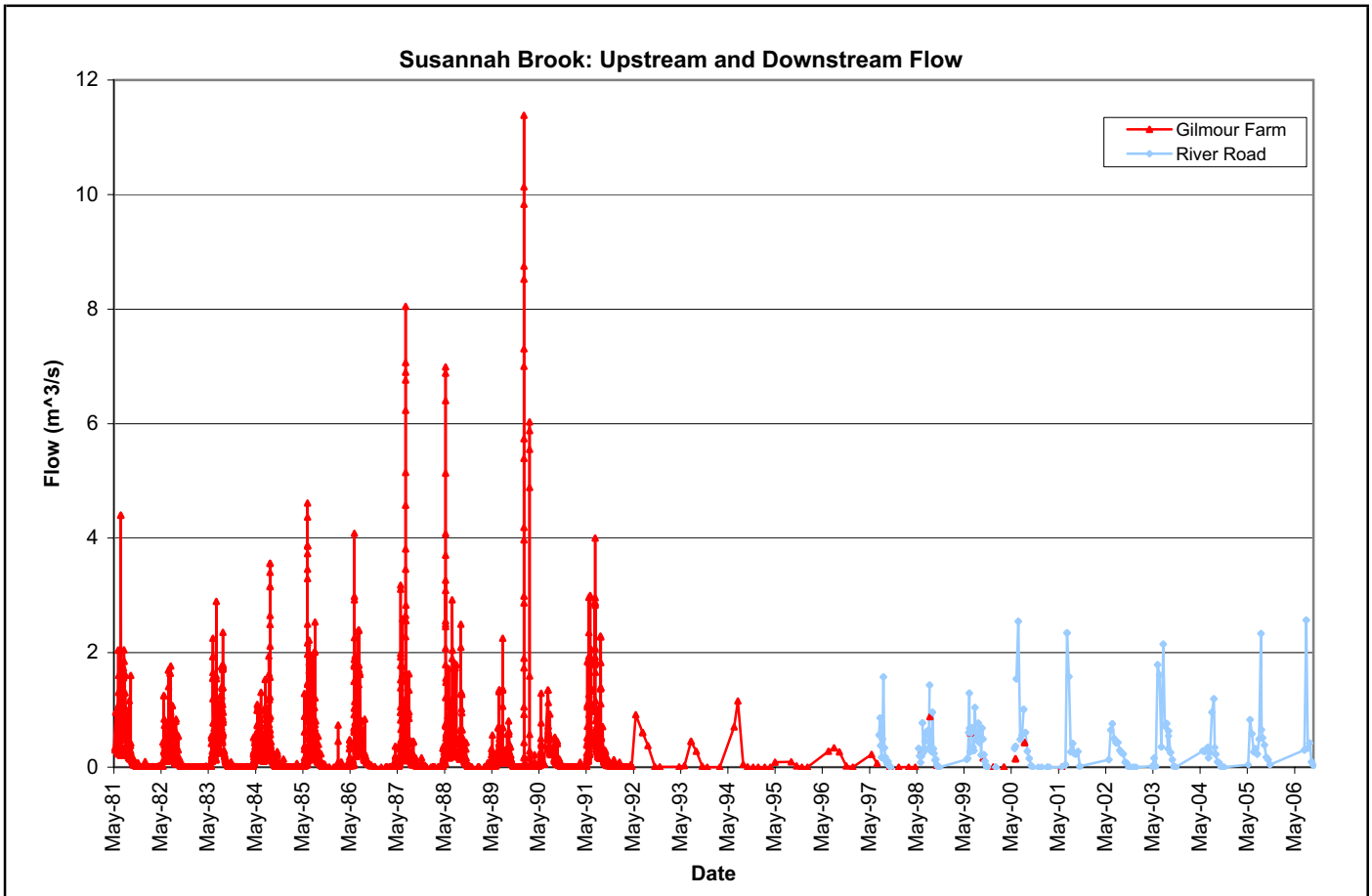

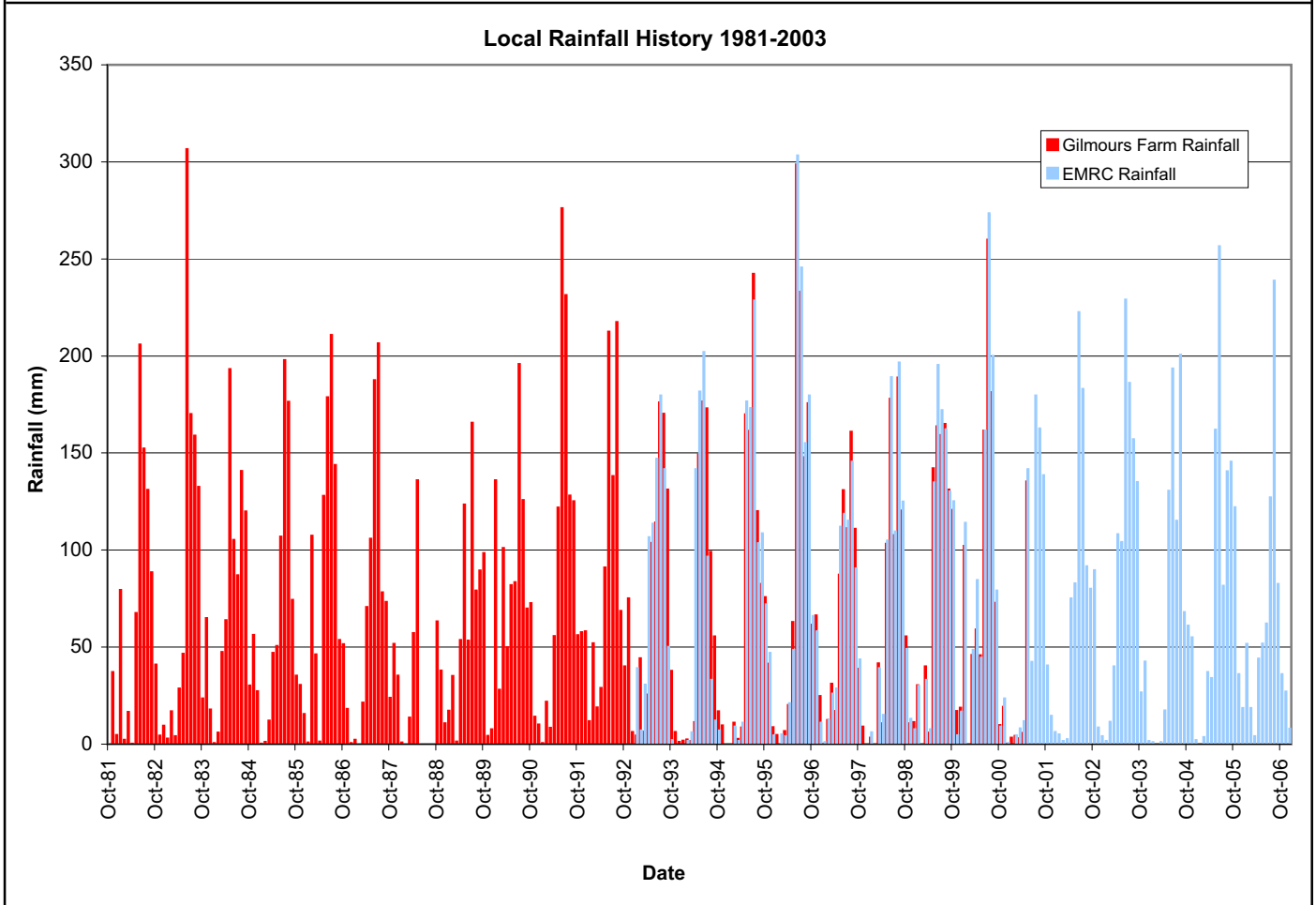

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aquaterra

Susannah Brook Historic Flow Data

Figure 32

Upstream water quality

Results of a hydrochemical analysis of the Gilmours Farm water quality data were consistent with the land use history of the region, showing an increase in salt loading into Susannah Brook since the inception of European settlement and agriculture. Over a more recent time frame (1981 – 2001), salinity levels at Gilmours Farm have remained statistically stable, with average annual TDS value of 634 mg/L, which is below the ANZECC guideline indicated in Table 20.

Large variations in TDS and hardness at the Gilmours Farm site reflect the typical flow characteristics of Susannah Brook. That is, during periods of low or zero-flow, TDS concentrations and hardness values tend towards maximums, however during and following rainfall events, levels of TDS and hardness are often 1 – 2 orders of magnitude less than the low or zero-flow scenario. These large variations suggest that Susannah Brook is well-flushed, as built-up contaminants that contribute to the high readings of TDS and hardness during periods of low-flow are quickly washed downstream into confluence with larger water bodies following rainfall events.

Data from the Red Hill Waste Management Facility monitoring station and Hanson's W5 monitoring station indicate that there has been no increase in TDS in Strelley Brook upstream of the Red Hill Quarry. The average annual TDS at both monitoring stations (258 mg/L and 349 mg/L[9] at the Red Hill Waste Management Facility and W5 respectively) were below the ANZECC guideline.

Downstream water quality

Salinity

TDS levels downstream of the Red Hill Quarry remained below the ANZECC guideline for the period 2002 – 2006 in both Susannah and Strelley brooks (Table 22).

Variations in salinity downstream of the Red Hill Quarry correlated with rainfall patterns, reaching maximum levels in the drier months and low levels during wetter months. There were no trends of increasing or decreasing TDS levels in Susannah Brook; however, there was a trend of increasing TDS levels at site W6 on Strelley Brook. These results have stemmed from analyses of relatively short-term data sets and should continue to be investigated over a longer timeframe.

Chloride levels at the five downstream monitoring sites have remained below the ANZECC guideline since 2002, ranging from an average of 140 mg/L at W2 to 199 mg/L at W3. There was a weak trend of increasing chloride levels at W6, reflecting a similar trend for TDS at this site. The W6 monitoring site is located on the Swan Coastal Plain, where interactions between groundwater and surface water are more likely, and the salinity (TDS) of groundwater in this area of the Swan Coastal Plain usually varies between 1500 and 3000 mg/L[10] (Aquaterra 2007a). There are no historic trends of increasing or decreasing chloride levels at monitoring sites W1 – W4 and there is little variation in chloride levels between each downstream subcatchment.

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[9] As monitored at the Red Hill Waste Management Facility over the period 1997 – 2006 and at W5 over the period 2002 – 2006.

[10] 1500 mg/L – World Health Organisation (WHO) upper permissible limit for human consumption; 30 000 mg/L – approximate salinity of sea water

Table 22 Average downstream water quality monitoring results (2002 – 2006)

Parameter	ANZECC guideline	W1	W2	W3	W4	W6
pH	6.5 – 8.5	6.9	6.8	7.0	6.8	7.2
TDS (mg/L)	1000	355	297	369	429	272
TSS (mg/L)	80	<5	<5	5.4	44.7	109.4
Chloride (mg/L)	400	191	140	199	160	163
Oil and grease (mg/L)	Visibility/odour[11]	<5	<5	<5	<5	<5

The marked decrease in salinity from the upstream Gilmours Farm (average TDS 634 mg/L) to the downstream monitoring sites on Susannah Brook (340 mg/L) suggests that surface water runoff generated by rainfall within the non-agricultural mid-section of the Susannah Brook catchment plays an important role in improving the water quality of the entire Brook system. There is no significant difference in salinity between upstream and downstream areas of Strelley Brook, with values for both areas remaining well below ANZECC guidelines.

Sediments

Levels of total suspended solids (TSS) were relatively low at the Susannah Brook upstream and downstream monitoring sites, averaging less than 5.4 mg/L (Table 22). This includes monitoring site W2 located on the northern dam spillway which flows into Susannah Brook.

The levels of TSS at site W6 on Strelley Brook display greater variation (Table 22) due to two high readings observed during the winter months of 2006. Similar TSS levels were also recorded at site W5 over the same period. It is therefore assumed that both high readings reflect the same event. As site W5 reflects a reach of Strelley Brook that is not directly downstream of the quarry, it is likely that the elevated sediment load was generated in a catchment that is not under the influence of the quarry (e.g. generated upstream).

There are no overall trends of increasing or decreasing levels of TSS in either Susannah or Strelley Brook.

pH

The average annual pH values at all Hanson monitoring sites ranged from 6.8 to 7.2 (Table 22), which is comparable to the range observed at the upstream locations (5.8 to 8.3). Fluctuations in pH were driven by seasonal climatic variations, with drier summer conditions tending to result in more acidic conditions in-stream.

Oil and grease

Concentrations of oil and grease have remained below 5 mg/L at all monitoring sites between 2002 and 2006, except during several sampling events in 2004. The elevated levels recorded during these

[11] ANZECC *Guidelines for Recreational Water Quality and Aesthetics* state "Oil and petrochemicals should not be noticeable as a visible film on the water nor should they be detectable by odour"

events were attributed to the use of plastic sampling bottles, which can contain traces of hydrocarbons left over from the manufacturing process. When the sampling was repeated using glass bottles, all samples returned levels below the detectable limits (i.e. <5 mg/L).

10.3 POTENTIAL SOURCES OF IMPACT

The following environmental aspects of the proposal may potentially affect the quantity and quality of surface water within the project area and in Susannah and Strelley brooks:

- **water harvesting and disruption of natural runoff and drainage** through excavation of quarry pit, water usage at the quarry and construction of associated infrastructure may potentially reduce downstream flows in Susannah and Strelley brooks
- **stormwater runoff from operational areas** potentially affecting sedimentation and erosion of dam overflow and runoff from disturbed land (e.g. excavated areas, stockpiles and haul roads)
- **spillage of potentially hazardous substances**, including hydrocarbons from workshop, plant and machinery potentially affecting the quality of stormwater runoff
- **excavation of the pit** in proximity to Susannah Brook, could potentially affect downstream flow in the Brook by:
    - overflow of Susannah Brook into the proposed pit during high flow events
    - seepage of water flow from Susannah Brook into the proposed pit (i.e. through fractures in the rock).

This last aspect is not expected to give rise to any significant impacts on Susannah Brook. At the northern-most extent of the proposed pit development, the bed of Susannah Brook will lie approximately 60 to 90 m above the quarry floor. Based on the calculated 100 year Average Recurrent Interval (ARI) flood flow for Susannah Brook of 200 m^3/s, Susannah Brook will reach a maximum flood depth of approximately 5 m. Maintaining a minimum 50 m buffer between the Brook and the pit, as well as a slope from top of the quarry to the Brook with a gradient of 1:2.5 to 1:3, will ensure that the top of the quarry remains at least 10 m above any 100 year ARI flood event, which would effectively and adequately protect the quarry from any flooding of Susannah Brook (Aquaterra 2007a).

A small portion of the flow in Susannah Brook is likely to infiltrate into the ground and move towards the regional groundwater approximately 60 m below the surface; however, as transmissivity[12] values at the site are low, this infiltration rate is also expected to be low (Section 11.2). The current quarry operation has not intercepted any significant groundwater resource, despite excavation below the expected regional groundwater. The proposed operation in proximity to Susannah Brook would have no further impact to the flows lost from the Brook to the ground (Aquaterra 2007a).

In some areas, the proposed development will extend to within 50 m of Susannah Brook, potentially affecting riparian vegetation and associated fauna values of the area (Sections 7 and 8). Ministerial Conditions from the 1990 approval provide for protection of Aboriginal heritage (mythological) values via the retention of a 50 m buffer on both sides of Susannah Brook and prohibition of any physical interference with the Brook itself. The proposed development will maintain this buffer as a minimum

[12] Transmissivity is the rate at which water is transmitted through a unit width of aquifer under a head of hydraulic gradient.

and, in most instances, will extend the buffer to 100 m. Of the approximate 2.5 km length of Susannah Brook that traverses Lot 11, the proposed development will only come closer than 100 m (but not within 50 m) to the Brook for approximately 250 m of its length.

The 50 to 100 m buffer proposed is consistent with the recommended 60 m buffer in the Forest Management Plan for 1st, 2nd and 3rd order streams in the jarrah forest (Conservation Commission 2004). Therefore, it is anticipated that the 100 m buffer will prove satisfactory in protecting the riparian vegetation of Susannah Brook. The retention of a 50 – 100 m buffer will also play a key role in maintaining ecological linkages through the project area (Section 8).

10.4 ASSESSMENT OF POTENTIAL IMPACT, MITIGATION AND RESIDUAL IMPACT

10.4.1 Disruption to drainage patterns and harvesting of runoff

Affects on catchment runoff

It is unlikely that there will ever be a need for Hanson to access alternative water sources (including from local groundwater reserves or nearby streams) and, therefore, onsite water use will not adversely affect streamflow in Susannah or Strelley Brooks. The existing quarry operation utilises water collected in the onsite sedimentation dams and pit sump for all non-potable purposes, such as dust suppression and processing. Drinking water is brought onsite in bottles and accounts for only a small fraction of onsite water use. These practices will continue throughout the proposed development and it is envisaged that the Red Hill Quarry will remain self-sufficient in terms of non-potable water.

The proposed development will remain entirely to the south of Susannah Brook on Lot 11, with approximately two-thirds (52 ha) of the proposed development located within the Susannah Brook catchment and the remainder (26 ha) located within the Strelley Brook catchment (Figure 7). Assuming that all water falling on the existing and proposed operational area is captured and used for the quarry operations, the effective catchment of Susannah Brook will be progressively reduced by approximately 2% and similarly, the Strelley Brook catchment by approximately 0.4% following clearing to the proposed full extent of the development.

This reduction in catchment area will result in decreased stream flow downstream of the proposal and an estimated drop in the Susannah Brook stream stage height by approximately 10 to 20 mm (based on the Susannah Brook rating curve). This drop will occur gradually over the estimated 100 year life of the proposed development and will not have a significant effect on typical stages downstream (Aquaterra 2007a). A rating curve is not available for Strelley Brook; however, with a considerably smaller proportion of its catchment potentially affected by the proposed development, it is unlikely that there will be any significant impact to downstream surface flows in this stream (Aquaterra 2007a). The expected stream stage drop in the watercourses should not significantly alter the natural pattern of break point exceedances (the point at which the stream spills over its banks) and should not adversely affect any riparian vegetation that may rely on these occurrences.

The potential impacts to the environment of reduced surface water runoff may also be mitigated by the release of excess water into Susannah and/or Strelley Brook that is captured within Hanson's onsite sedimentation dams, after sedimentation management measures have been enacted.

10.4.2 Stormwater runoff

Given the efficiency of the existing onsite drainage management measures, the sediment load within Susannah and Strelley brooks is not expected to be adversely affected by the proposed development. TSS levels in Susannah and Strelley Brooks downstream of the existing operation have remained relatively low (and well below the ANZECC guidelines) and indicate no trend of increasing levels of TSS in either brook.

Hanson will continue to implement existing onsite measures to manage drainage and stormwater runoff, which primarily involve diverting all surface water runoff within disturbed areas via constructed diversion bunds and channels to either of the two onsite sedimentation dams or to the pit sump. Some of this runoff will pass through silt traps before entering these basins, and the basins themselves allow the remaining suspended particles to settle. Diversion of surface runoff will result in a localised increase in flow velocities, with the potential to increase soil erosion if diversion structures are not designed correctly. Hanson will design these structures so as to ensure they are stable and that the risk of erosion is minimised. Consistent with current management, sedimentation dams will be cleaned when their storage capacity has been reduced by 30 – 40%. Surface water runoff within undisturbed areas (e.g. vegetated areas) will continue to follow natural drainage pathways.

The sedimentation basins will be used in conjunction with erosion minimisation strategies, which include:

- rehabilitating and revegetating bare areas not in use
- constructing internally-draining dishes in stockpiles.

It is likely that the sedimentation dams will overflow during large rainfall/flow events; however, runoff generated during these events will still be treated to some degree within the dams prior to discharging over the spillways. Current monitoring results indicate that TSS levels at site W2 (below the northern dam spillway) have remained relatively low (averaging less than 5 mg/L) which is well below the ANZECC guideline of 80 mg/L. In addition, during large rainfall/flow events, flow volumes in the watercourses will be high and any discharge of water from the dams will be relatively minor in relation to the existing flows, which will partially offset this lowered efficiency of sediment removal. In the event that an overflow from the sedimentation dams is found to be unacceptably turbid, the design of the dams and sediment traps will be reviewed and appropriate measures will be taken in order to prevent any reoccurrence.

10.4.3 Other water quality parameters

The proposed development is not expected to significantly increase salinity levels in Susannah or Strelley brooks. Salinisation of water courses can result from changes in hydrological regimes that are caused by the clearing of deep-rooted perennial native vegetation. Approximately 58% of the Susannah Brook catchment has been previously cleared; however, as the entire catchment lies within a high rainfall zone (over 1000 mm per annum), the risk of salinisation from over-clearing is relatively low, as high rainfall areas are generally associated with lower soil salt storages (Mayer *et al.* 2005).

Current monitoring results also indicate that the existing quarry operations have had no effect on TDS or chloride levels. Current TDS levels in Susannah and Strelley brooks upstream and downstream of the quarry are well below ANZECC guideline of 1000 mg/L. In addition, the area required for clearing over the life of the proposed development is a relatively small proportion of the total catchment area for either Susannah or Strelley Brook.

Current monitoring results indicate that there has been no oil or grease contamination of Susannah or Strelley brooks. Hanson will continue to manage hydrocarbons (fuel and oil) imported onto the site in accordance with relevant State legislation/Regulations and Australian Standards. All hydrocarbon storage facilities are bunded according to the *Water Quality Protection Guideline No. 10: Above Ground Chemical and Fuel Storage* (WRC 2000a). No explosives are stored onsite; all are transported onsite on the day that blasting is to occur. Grease and oil traps are installed onsite in the workshop areas and are cleaned every three months. Any contaminated fines are disposed offsite to a licensed waste facility. The existing hydrocarbon storage and contamination control measures will continue to be implemented throughout the proposed development to ensure that the risk of contaminating natural water courses is minimised.

Consistent with the current operations, the proposed development is not expected to adversely affect the pH within Susannah or Strelley brook.

Hanson will continue to implement the existing onsite water quality monitoring program throughout the proposed development.

10.5 PROPOSED MANAGEMENT ACTIONS

Surface water values at the Red Hill Quarry will be addressed through the implementation of an Environmental Management Plan (Appendix 2), which includes a Surface Water Management Plan, which addresses the following drainage management actions:

- minimising the area of disturbance by:
    - locating infrastructure on previously cleared areas
    - rehabilitating disturbed areas as soon as practicable following disturbance
- maintaining a 50 to 100 m buffer along both sides of Susannah Brook; in most instances this buffer will be extended to 100 m (the proposed pit will only be within 100 m [but not within 50 m] of Susannah Brook for approximately 250 m of the 2.5 km length of the Brook that traverses Lot 11)
- installing bunds, or other stable drainage structures, to divert runoff from disturbed areas to onsite sedimentation dams or the in-pit sump
- constructing internally-draining dishes in stockpiles
- maintaining existing sediment and oil/grease traps, including cleaning and disposal as required
- maintaining existing hydrocarbon storage and handling measures in accordance with relevant legislation and standards
- investigating the feasibility of bituminising areas that are subject to heavy traffic loads around the plant and stockpile areas
- continuing to monitor surface water at the six sampling stations and revising the water quality monitoring program as required throughout the proposed development
- reviewing the sediment and contaminant management regime if high levels are detected and implementing changes as required, such as installing additional sediment traps above the sedimentation dams and/or cleaning out the dams more frequently.

10.6 PREDICTED ENVIRONMENTAL OUTCOME

The proposal will reduce the catchment area of Susannah and Strelley brooks by approximately 2% and 0.4% respectively and, as a result, may reduce the quantity of water entering these streams. The Susannah Brook stream stage height is estimated to drop by around 10 to 20 mm (based on the rating curve for the Brook) due to the reduction in catchment area. This drop will occur gradually over the 100 year life of the proposed development. Any reduction in stream flow as a result of the proposed development is not expected to cause any significant impact to the two streams or any associated surface water-dependent ecosystems. There will be no direct physical disturbance either to Susannah Brook or within the 50 – 100 m buffer on both sides of Susannah Brook that will be maintained by Hanson.

The proposed development has the potential to affect water quality in Susannah and Strelley brooks through hydrocarbon spills or discharge of turbid runoff to the watercourses. Consistent with existing drainage management measures, all runoff from disturbed areas will be diverted to onsite sedimentation dams or the in-pit sump. Other measures to minimise any potential impact to the water quality within Susannah and Strelley brooks include the use of sediment and grease and oil traps, as well as storing and handling hydrocarbons in accordance with relevant legislation and standards.

Current monitoring results indicate that the existing quarry operations have had no effect on water quality and, therefore, continued implementation of existing management measures throughout the proposed development will ensure that water quality within Susannah and Strelley brooks is not adversely affected by the operation. Consistent with the EPA objective for this factor, the quantity and quality of water within Susannah and Strelley brooks will not be adversely affected by the proposed development and all existing and potential environmental values will be protected.

11. GROUNDWATER

11.1 KEY STATUTORY REQUIREMENTS, ENVIRONMENTAL POLICY AND GUIDANCE

EPA objective

To maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected.

Regulatory framework

The *Rights in Water and Irrigation Act 1914* (RWI Act) specifically provides for the management of water resources for the environment. The objects of the RWI Act include:

- to provide for management of water resources, and in particular –
  - for their sustainable use and development to meet the needs of current and future users
  - for the protection of water-dependent ecosystems and other environmental values, including the regulation of activities detrimental to them.

Potentially polluting activities are managed under environmental harm and pollution control provisions of the EP Act and licences are issued under the EP Act.

Other legislative devices pertinent to the handling and storage of potential (hazardous) contaminants such as hydrocarbons at the quarry include:

- *Dangerous Goods Safety Act 1961* and associated regulations
- Australian Standard AS 1940-1993 – The Storage and Handling of Flammable and Combustible Liquids.

Statewide Policy No. 5

The Waters and River Commission's *Statewide Policy No. 5* (2000b) describes the principles and processes to be applied in determining how much water should be retained for the environment when allocating and reviewing water use rights. It also identifies linkages to the State's statutory framework.

The primary objective of this policy is:

- *to provide for the protection of water-dependent ecosystems while allowing for the management of water resources for their sustainable use and development to meet the needs of current and future users.*

11.2 DESCRIPTION OF FACTOR

The technical background for the assessment of groundwater has been provided by Aquaterra (2007b). A summary of the report is provided below and a full copy of the report is contained in Appendix 2.

The Red Hill Quarry is located immediately east of the Darling Scarp in an area of lateritic soils underlain primarily by crystalline basement rocks (mainly granite-gneiss) of the Archaean Yilgarn Craton. In general, fractured and weathered crystalline rocks have a poor groundwater potential; bore yields tend to be low and variable, and salinity levels also vary, both laterally and at depth. Anecdotal evidence of high bore yields in the district have been unsubstantiated, as any high results from short-term airlifting are usually short-lived (Aquaterra 2007b).

To the west of the Darling Scarp is the groundwater aquifers of the Swan Coastal Plain. Generally, the superficial aquifer of the Swan Coastal Plain close to the Darling Scarp is relatively poorly developed and thin (approximately 8 m from watertable to rock base). The aquifer thickens rapidly as it moves westward away from the Darling Fault. The Swan Coastal Plain aquifers are dependent on recharge from rainwater infiltration and not from the minor groundwater flow generated from the adjacent granite/dolerite aquifer (i.e. underlying the quarry site) (Aquaterra 2007b).

There are no groundwater bores in the quarry area and thus, information for assessing groundwater resources in the area has been extrapolated from bores at the nearby Red Hill Waste Management Facility, DoW database of groundwater resources, and from a site visit to the project area (Aquaterra 2007b).

A seasonal, local perched watertable system appears to exist in the wet season of the more permeable ferruginous lateritic soils which cap the quarry area. There is insufficient data from bore logs to assess the extent of this system, but data from the adjacent Red Hill Waste Management Facility suggests any perched aquifer would be isolated and at most, have only local influence (Aquaterra 2007b).

The groundwater level contours broadly mimic surface topography and lie approximately 60 m below surface levels at the most elevated points (295 mAHD) of the Red Hill Waste Management Facility. Groundwater levels at the Red Hill Waste Management Facility dropped approximately one metre over the drier months from September 2005 to April 2006. The nearby former Herne Hill Quarry has been excavated to deeper than 60 m. It is partially filled with water, which may be attributed to a combination of both groundwater infiltration and rainfall runoff; however, as no active dewatering was required during quarrying operations at Herne Hill, groundwater infiltration is likely to have been very minor and exceeded by annual evaporation. There are two pools with a 4 m height difference separated by a dolerite dyke in the Herne Hill Quarry (Plate 9), suggesting the dolerite acts as an impermeable barrier which has led to compartmentalised groundwater aquifers (Aquaterra 2007b).

The existing Red Hill Quarry operation has not intercepted any significant groundwater pockets or aquifers even though the quarry has been excavated below the expected regional watertable level. A small quantity of seepage occurs from granite fractures (Plate 9), however, there is not enough inflow to warrant pit dewatering. Measurements taken at the Red Hill Waste Management Facility of average transmissivity[13], hydraulic gradient[14] and kinematic porosity[15] all supported this observation and thus any groundwater flow to the pits are likely be extremely minor (Aquaterra 2007b). The average groundwater flow rate was estimated by Aquaterra (2007b) to be between 0.0185 and 0.0015 m/day.

[13] Transmissivity: the rate at which water is transmitted through a unit width of aquifer under a unit head of hydraulic gradient.

[14] Hydraulic gradient: the change in elevation of a water table with respect to a change in distance over a given direction.

[15] Kinematic porosity: the ratio of the volume of spaces through which water can travel in a rock divided by the total volume of the rock.


Plate 9 Impermeable dyke at former Herne Hill Quarry (left) and seepage from granite fracture at Red Hill Quarry (right)

Twelve DoW groundwater sites are located within 5 km of the project site. Seven of these are bores (two of which are abandoned) and the others are soaks. Information on the bores is limited (Aquaterra 2007b). All of the remaining five bores appear to be shallow and therefore reliant on local perched water aquifer, not the deeper regional aquifer.

There are no known groundwater-dependent ecosystems in the catchment area of the quarry, east of the Darling Scarp. Susannah Brook, to the north, and Strelley Brook to the south-west of the project area are both ephemeral streams fed by winter rains. They are both unlikely to be fed by groundwater discharge due to their elevation above the regional deep weathered/fractured rock aquifer. Conversely, each stream discharges into the underlying groundwater system and as a result neither stream system is groundwater-dependent (Aquaterra 2007b).

11.3 POTENTIAL SOURCES OF IMPACT

The following aspects of the proposal may affect groundwater resources:

- **excavation of the quarry pit,** which may disrupt the local hydrogeological regime and cause groundwater drawdown
- **hydrocarbon spills,** which may lead to contamination of groundwater.

11.4 ASSESSMENT OF POTENTIAL IMPACT, MITIGATION AND RESIDUAL IMPACT

11.4.1 Impacts of pit excavation

The final pit base of the proposed development will be up to 100 m below the expected regional groundwater level (based on extrapolation from known groundwater levels at the Red Hill Waste Management Facility). However, pit dewatering is not expected to be required (or will be minor) as the rate and volume of seepage into the pit is likely to be very low (as observed at the former Herne Hill Quarry and the current Red Hill Quarry) due to the typically low yielding (low transmissivity) character of the Archaean basement aquifers in this area. If any dewatering does take place, the segregated nature of the deep groundwater aquifer will likely mean that any drawdown will be limited to the groundwater compartment(s) isolated by impermeable dolerite dykes at the quarry site.

Therefore, the risk of minor dewatering (if required) causing an adverse impact to the local and regional hydrogeological regime is considered to be low (Aquaterra 2007b).

Local groundwater receptors (including groundwater supplies [bores/wells/stock bores], streams and/or groundwater-dependent ecosystems or users) are not expected to be affected by the quarry development. These groundwater receptors typically utilise the elevated perched aquifers which are isolated from any deeper aquifers the quarry may potentially excavate in to. Data from the adjacent Red Hill Waste Management Facility suggests any perched aquifers would be isolated and at most, have only local influence (Aquaterra 2007b).

The quarry area is also not thought to have any significant association with the groundwater aquifers of the Swan Coastal Plain. If in the unlikely event disruption to the hydrogeological regime occurred it is not likely to affect production bores or other groundwater-related elements on the Swan Coastal Plain as the groundwater regime of the quarry area is not considered to be hydraulically connected to the aquifers of the Swan Coastal Plain.

11.4.2 Hydrocarbon spills

All potentially hazardous substances used onsite (e.g. fuels, lubricants and degreasers) are stored and handled in accordance with relevant Regulations and Australian Standards, thereby preventing spills and potential contamination of groundwater resources. Onsite management measures include maintaining grease traps and storing potentially hazardous substances in bunded areas. In addition, the existence of an approximate 10 m layer of laterite sediments at the site provides a natural means of attenuation in the event of a spillage or incident (Aquaterra 2007b). The pit will be excavated to below the expected watertable at some stage during the life of the proposed development and as such, spills of hazardous materials will have more potential to contaminate local groundwater. However, the risk of any spillage in the excavated pit will be prevented through onsite management measures, such as using designated refuelling areas, which are bunded. The potential for spills to become a pollution issue will also be prevented by the low volume of water in the aquifers, their compartmentalised nature and the disassociation of these deeper aquifers with surface ecosystems, streams and production bores in the area.

11.5 PROPOSED MANAGEMENT ACTIONS

No specific additional management or monitoring measures are proposed at this stage due to the proposed quarry development being unlikely to have any significant impact on regional groundwater. The DoW will be notified and appropriate groundwater investigations, actions and monitoring program will be initiated upon the advice of the Department if the characteristics of any deep aquifers encountered differ from expectations (i.e. significant groundwater inflows occur into the pit).

Hanson will continue to implement onsite hazardous substances management measures in accordance with Western Australian Regulations and Australian Standards. Hanson will also prepare and implement an Environmental Management Plan (Appendix 2), which includes management measures to:

- reduce the risk of spills
- ensure safe storage and handling of substances
- implement corrective action (e.g. containment and cleanup with absorbent materials) in the event of a spill or leak.

11.6 PREDICTED ENVIRONMENTAL OUTCOME

The excavation of the proposed pit is not expected to result in any significant adverse impacts to local or regional hydrogeological regimes. Local groundwater receptors (including groundwater supplies, streams and/or groundwater-dependent ecosystems or users) would typically utilise the elevated perched aquifers which are isolated from any deeper aquifers the quarry may potentially excavate in to. Data from the adjacent Red Hill Waste Management Facility suggests any perched aquifers would be isolated and at most, have only local influence. The quarry area is also not thought to have any significant association with the groundwater aquifers of the Swan Coastal Plain. There is a low risk for contamination of groundwater resources in the event of spills of potentially hazardous materials due to onsite management measures. The EPA objective to maintain the quantity of groundwater so that environmental values are protected will be met.

12. NOISE AND VIBRATION

12.1 KEY STATUTORY REQUIREMENTS, ENVIRONMENTAL POLICY AND GUIDANCE

EPA objectives

All potentially significant noise impacts are identified and addressed in the environmental review information submitted by the proponent in a consistent manner which is acceptable to the EPA.

The proposal can be managed to ensure that compliance with the Environmental Protection (Noise) Regulations 1997 and/or with relevant acceptable standards is substantially achieved.

The proposal will be designed and managed in accordance with the "continuous improvement" and "as low as reasonably practicable" principles as outlined in the Act.

Regulatory framework

Sections 51, 62(4), 65 and 74(3)/50, 51 and 75 of the EP Act provide the legislative framework for managing noise impacts. The noise limits cited by the Act are assigned in the Environmental Protection (Noise) Regulations 1997 (Noise Regulations) (Table 23) and further guidance exists in EPA Guidance Statement No.8 (EPA 2007a). Regulation 7 of the Noise Regulations requires that noise emitted from any premises must comply with assigned noise levels when received at any other premises and must be free of the intrusive characteristics of tonality, modulation and impulsiveness. In addition, the noise emissions must not "significantly contribute" to an exceedance of the assigned levels.

The assigned levels are specified under regulation 8 of the Noise Regulations, according to the type of premises receiving the noise. For noise-sensitive premises, the assigned levels recognise the time of day and the presence of commercial and industrial land use zonings and major roads within a 450 m radius of the receiver. The Noise Regulations also specify requirements relating to tonality, modulation and impulsiveness, and to emissions that may "significantly contribute" to an exceedance.

The "influencing factor" is calculated for each noise-sensitive premises receiving noise. It takes into account the amount of industrial and commercial land and the presence of major roads within a 450 m radius around the noise receiver.

Construction noise

Under regulation 13 of the Noise Regulations, construction noise is not required to meet the assigned levels if certain conditions are met. The EPA's interpretation of the definition of "construction noise" in relation to mining[16] operations, removal of topsoil to a maximum depth of 5 metres, and its storage, will be regarded as construction work, unless the topsoil is to be disposed of as a product; however, removal and/or dumping of overburden is not considered to be construction work. The Noise Regulations define construction sites as premises or public places on which the sole or principal activity is the carrying out of construction work. As construction work will be a relatively minor part of the total Red Hill Quarry operation, the quarry will generally not be viewed as a construction site.

[16] Here 'mining' is understood to include quarrying activities

Table 23 Assigned noise limits for industrial and noise-sensitive premises

Type of premises receiving noise	Time of day	Assigned level (dB)		
		L_{A10}	L_{A1}	$L_{A\ max}$
Industrial and utility premises[1]	All hours	65	80	90
Noise-sensitive[2]	0700 to 1900 hours Monday to Sunday	45 + Influencing factor	55 + Influencing factor	65 + Influencing factor
	0900 to 1900 hours Sunday and public holidays	40 + Influencing factor	50 + Influencing factor	65 + Influencing factor
	1900 to 2200 hours all days	40 + Influencing factor	50 + Influencing factor	55 + Influencing factor
	2200 hours on any day to 0700 hours Monday to Saturday	35 + Influencing factor	45 + Influencing factor	55 + Influencing factor
	2200 hours on any day to 0900 hours Sunday and public holidays	35 + Influencing factor	45 + Influencing factor	55 + Influencing factor
Noise-sensitive[3]	All hours	60 + Influencing factor	75 + Influencing factor	80 + Influencing factor

dB = decibel/s

Note:

LA_{max}: A noise level that is not to be exceeded at any time.

L_{A1}: A noise level that is not to be exceeded for more than 1% of the time.

L_{A10}: A noise level that is not to be exceeded for more than 10% of the time.

1. Industrial and utility premises: classification under Schedule 1, Part A (5) of the Regulations – any premises used for sand, gravel, clay, limestone, or rock excavation (i.e. a quarry).
2. Noise-sensitive: applies within 15 m of a building associated with a noise-sensitive use (e.g. residential premises).
3. Noise-sensitive: applies at locations further than 15 m from a building associated with a noise-sensitive use.

Blasting

Regulation 11 of the Noise Regulations specifies noise limits for airblast due to blasting (Table 24). Blasting must also comply with the requirements of the Department of Industry and Resources (DoIR) and the *Dangerous Goods Safety Act 2004* and the *Mining Act 1978*. The criteria generally used are based on avoidance of human annoyance, rather than structural damage, as follows:

- peak particle velocity is not to exceed 5 mm/s for 90% of all blasts
- peak particle velocity is not to exceed 10 mm/s for 100% of all blasts.

When undertaking blasting out of hours (i.e. 1800 to 0700 hours):

a) no vibration level resulting from blasting on any premises or public place, when received at any other premises, may exceed a peak particle velocity of 1.0 mm/s

b) the vibration levels for 9 in any 10 consecutive blasts (regardless of the interval between blasts) on any premises or public place, when received at any other premises, must not exceed 0.5 mm/s.

Table 24 Air blast criteria

Day	Time	Maximum level*	Level	Compliance frequency
Days other than Sundays and public holidays	0700 to 1800 hours	125 dB $L_{linear, peak}$	120 dB $L_{linear, peak}$	For nine in any 10 consecutive blasts, regardless of the interval between blasts
Sundays and public holidays	0700 to 1800 hours	120 dB $L_{linear, peak}$	115 dB $L_{linear, peak}$	For nine in any 10 consecutive blasts, regardless of the interval between blasts
Monday to Sunday	1800 to 0700 hours	90 dB $L_{linear, peak}$	NA	NA

dB = decibel/s

*Applies to all blasts.

Note: *Linear, peak* means the maximum reading in decibels (dB) obtained using the "P" time-weighting characteristic as specified in Australian Standard (AS) 1259.1 (1990) with all frequency-weighting networks inoperative and with sound level measuring equipment that complies with the requirements of Schedule 4 of the Noise Regulations.

Blast vibration criteria for structures are set by AS 2187.2 (1993) Part 2. Table 25 indicates the levels of peak particle velocity that are required before there is damage to a typical residential structure.

Table 25 Potential for damage and limits for ground vibration of structures

Peak particle velocity (mm/sec)	Level of damage	Structure
<5	No damage	-
5 – 10	Damage unlikely	-
10 – 20	Potential minor damage (plaster cracks)	Houses and low-rise residential structures may be damaged above 10 mm/sec
20 – 30	Minor damage (plaster cracks)	Commercial and industrial structures may be damaged above 25 mm/sec
30 – 50	Minor structural damage (concrete cracks)	-
>50	Potential major damage	-

12.2 DESCRIPTION OF FACTOR

The technical background for the assessment of noise and vibration has been provided by SVT Engineering Consultants (2007). A summary of the report is provided below and a full copy of the report is contained in Appendix 2.

12.2.1 Noise

Section 3 of the EP Act defines 'noise' as including '*vibration of any frequency, whether transmitted through air or any other physical medium*'. Based on this, noise at frequencies above ('ultrasound') or below ('infrasound') the audible frequency range should be considered along with the audible frequency range when assessing the noise impacts of a proposal, although in most situations, audible noise is the main problem.

All types of noise have the potential to disturb rest or recreational activities and to interfere with educational activities, communication or work. Noise that occurs at night is considered more likely to disturb a community than noise that occurs during the day.

There are several sources of noise from the Red Hill Quarry, including operational noise of the processing plant, machinery, equipment, and noise generated from blasting. Noise has the potential to affect the amenity of nearby residents. Other main sources of noise in the area include:

- operation of machinery and plant at the Red Hill Waste Management Facility and Midland Brick extractive clay pits
- traffic movement on Toodyay Road and other local roads
- operation of farm equipment on surrounding rural land.

The current quarry operation is in compliance with the Noise Regulations as demonstrated by results from noise monitoring undertaken at the Red Hill Quarry in November 2006 and in March and April of 2007. The noise levels L_{A10} (a noise level that is not to be exceeded for more than 10% of the time) measured at all monitoring sites under worst-case conditions were at least 5 dB less than the assigned noise levels prescribed in the Noise Regulations (Section 12.4.1).

12.2.2 Vibration

The airblast overpressure wave associated with blasting operations (often perceived as the shaking of a dwelling and/or rattling of windows) is an example of 'noise' outside the audible frequency range that may cause concern for those affected. Similarly, vibration can also cause discomfort for building occupants, whether in the form of an impulsive shock or as a continuous vibration (EPA 2007a). Some noises contain annoying characteristics that may increase their impact, such as tonality ('humming', 'whining'), modulation (regular changes in level or pitch, e.g. a siren), or impulsiveness ('hammering') (EPA 2007a).

Hanson typically performs two blasts per month at the Red Hill quarry as part of the current operations, which are monitored for blast overpressure and ground-borne vibrations at locations up to 2.4 km from the quarry. Monitoring undertaken in 2006 indicates current blasting activities are in compliance with the Noise Regulations with average and maximum blast overpressure levels and peak particle velocities below the limits prescribed in the Regulations Noise (Section 12.1). Hanson reports on results of blast monitoring in its Annual Environmental Summary Report and Audit Document, which is provided to EPA, DEC and City of Swan.

12.3 POTENTIAL SOURCES OF IMPACT

The following aspects of the Red Hill Quarry proposal have the potential to generate noise and vibration that could affect sensitive receptors:

- **drilling and blasting** of hard rock to establish the quarry face and enable extraction of rock, producing noise and vibration
- **crushing and screening** of unprocessed rock at the processing plant, as well as operation of the conveyor and the dust collection unit, leading to noise emissions
- **loading and transport** of rock from the quarry pit to the processing facilities and stockpiles, as well as transport of processed rock offsite, leading to noise emissions.

12.4 ASSESSMENT OF POTENTIAL IMPACT, MITIGATION AND RESIDUAL IMPACT

12.4.1 Noise monitoring

Site visits were undertaken in November 2006 and in March and April of 2007 to assess noise emissions from the existing Red Hill Quarry operations, whereby recorded noise levels from equipment operating at the quarry were compared against noise levels at nearby noise-sensitive premises. Continuous noise monitoring was undertaken at six locations for a 7 – 14 day period during each site visit (including one site at the quarry for reference) four sites at various positions surrounding the quarry and one site at the closest private residence (Table 26, Figure 33).

Noise levels at the reference site close to the quarry (L1) significantly increased when high-noise activities were occurring at the quarry, indicating that noise levels measured at this site provide a useful surrogate for actual noise emissions from the quarry. Noise emissions from the remaining five sites were, therefore, compared against noise emissions from site L1. Noise emissions at four of the remaining five sites did not correlate well with noise emissions from the quarry; however, there was a weak correlation between noise emissions from the quarry and the noise levels measured at site L3, although the L_{A10} noise levels were highly influenced by wind-generated noise.

Noise levels were also recorded for the majority of the equipment operating at the quarry during the site visits (including the primary, secondary and tertiary crushers, screening unit, dust collector, conveyors, dump trucks, drilling rig, excavators, front-end loader and haulage trucks). Based on these measurements, the L_{A10} sound power levels for existing equipment were evaluated and used as a basis for some of the assumptions of the noise modelling.

Table 26 Noise monitoring locations and duration

Reference	Location	Monitoring dates
L1	100 m north of Quarry Site (reference point close to quarry)	10 – 23 November 2006 16 – 30 March 2007 10 – 17 April 2007
L2	Loton Road, Millendon	16 – 28 March 2007
L3	North-east boundary of Lot 11	10 – 23 November 2006
L4	31 Daniel Place, Baskerville	10 – 17 April 2007
L5	Williams Street, Herne Hill	16 – 30 March 2007
L6	North-west boundary of Hanson Lot 11	10 – 23 November 2006

12.4.2 Noise modelling

Based on the results from noise monitoring, and in accordance with EPA Guidance Statement No. 8 "*Environmental Noise*" (EPA 2007a), a noise model was developed by SVT (2007) to generate noise contours for the area surrounding the quarry and to predict worst-case noise levels for the current and proposed Red Hill Quarry operations at nearby noise-sensitive locations (Figure 33, Table 27). The model assumed that:

- worst-case meteorological conditions (EPA 2007a) were occurring, including low to moderate winds blowing from the noise source towards the receiver, possibly combined with temperature inversion conditions at night

- all mobile equipment (haul trucks, excavator, water cart and drilling rig) were operating at high idle and located on high level benches, including movement of two haul trucks within the stockyard, to ensure that there was minimal shielding from the pit walls
- the crushing and screening plant was operating at full capacity and a truck was dumping at the crusher
- the dust collection unit and all conveyors were operating
- noise emissions over the estimated 100 year life of the proposed operations would remain the same as current levels, despite probable advances in technology, including improvements in noise mitigation, that are likely to occur during this time.

The conditions assumed by the model are unlikely to occur during normal quarrying operations resulting in predicted noise levels that are likely to be higher than those that will actually occur. The noise model was verified by comparison of noise emissions from the existing quarry operations with predictions of the model under similar conditions. The average error margin associated with the modelling predictions was well within the 0 – 5 dB error typically expected (SVT 2007).

Table 27 Locations around the Red Hill Quarry at which noise levels were predicted

Location	Description	Zoning	Sensitivity
P1	Corner of Stock Rd and Campersic Rd, Herne Hill	Rural	Residential dwelling (noise-sensitive)
P2	Corner of Williams Rd and Campersic Rd, Herne Hill	Rural	Residential dwelling (noise-sensitive)
P3	Loton Rd, Millendon	Rural	Residential dwelling (noise-sensitive)
P4	Daniel Pl, Baskerville	Rural	Residential dwelling (noise-sensitive)
P5	Burgess Rd, Gidgegannup (north of quarry)	Rural	Residential dwelling (noise-sensitive)
P6	Burgess Rd, Gidgegannup (north-east of quarry)	Resource	Commercial property owned by Boral

Throughout all stages of the proposed operations (Figure 11), the noise levels predicted at P1 – P6 were dominated by fixed plant noise, with a minor contribution from noise generated by mobile equipment. The proposed operations are predicted to result in only small increases in noise levels at five of the six locations; however, a significant increase is predicted at location P3 (but still below assigned noise levels specified in the Noise Regulations) as a result of the removal of the ridge between this location and the existing quarry pit (Table 28).

As the quarry development progresses, the area of impact (i.e. the extent of the noise emissions generated by the quarry) expands slightly, particularly to the west of the quarry during stages 1 – 11 (years 2007 – 2079) and then to the south of the quarry during stage 12 (years 2079 – 2130). These increases in noise levels in areas surrounding the quarry are primarily due to the removal of natural barriers to noise (i.e. hills and ridges) which would have otherwise attenuated the noise generated by the quarry activities.

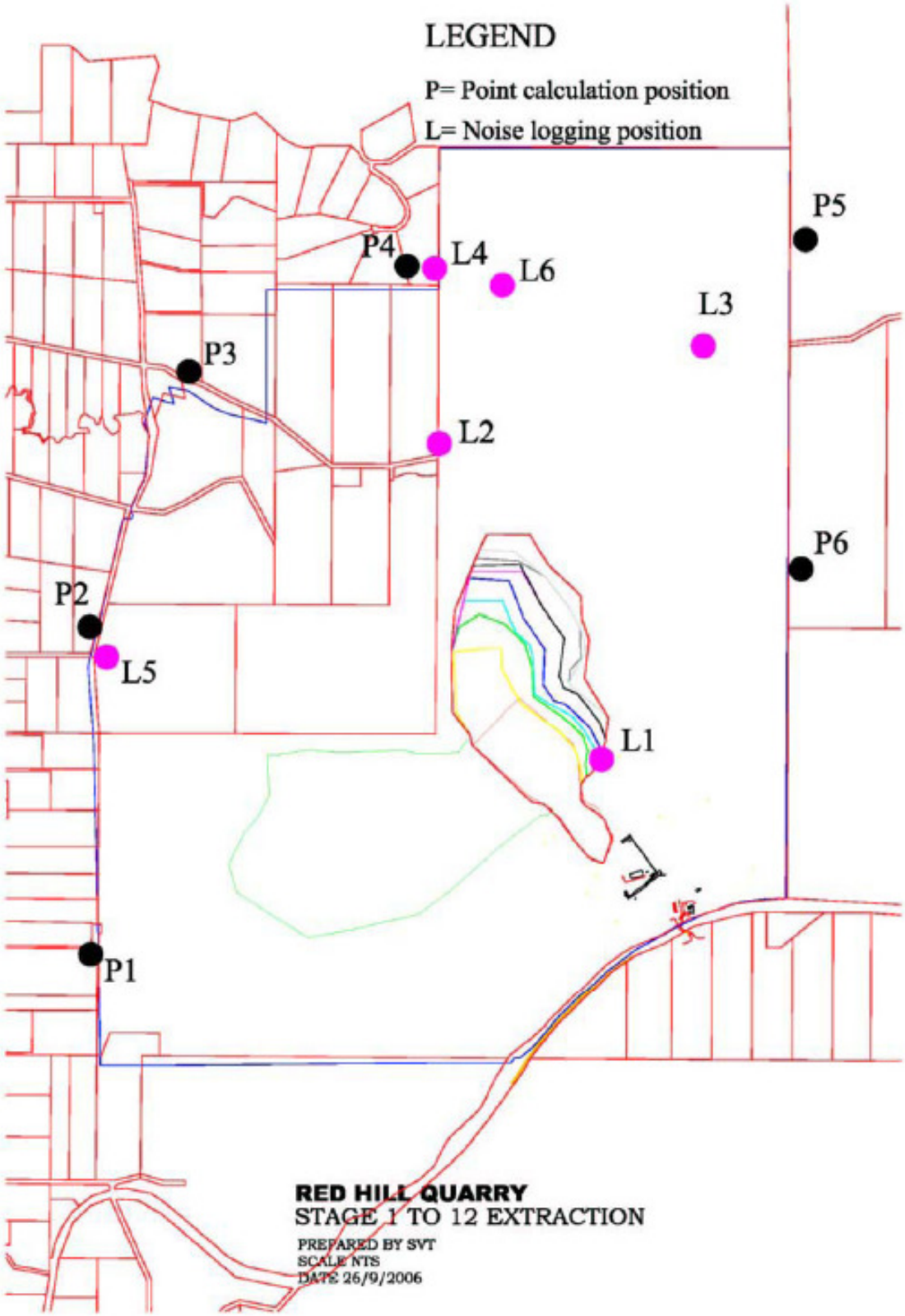


Figure 33 Noise monitoring locations (L1-L6) and noise modelling prediction locations (P1–P6)

12.4.3 Assessment of compliance with regulations and standards

Noise from operation

The L_{A10} noise levels that are prescribed in the Noise Regulations for noise-sensitive premises (Table 23) are the most-restrictive levels that must be met by the quarry. Noise levels recorded at the six monitoring locations surrounding the quarry (L1 – L6) showed no evidence of tonality, modulation or impulsiveness and, therefore, no additional penalties apply to noise emissions from the quarry operation. The area immediately surrounding the quarry is zoned 'Resource and Landscape 5' (with quarrying an accepted land use) under the City of Swan Town Planning Scheme (i.e. industrial); however, all other areas around the quarry would be considered noise-sensitive.

Table 28 presents the most-restrictive noise levels that must be met at premises P1 – P6 during the hours in which the quarry currently operates, after application of the influencing factor. As there is the potential for cumulative noise impacts to noise-sensitive premises near the quarry from other industries in the area (including other extractive industries) noise emissions from the quarry must be at least 5 dB less than the assigned noise levels (Table 28) in order for the quarry not to be considered a significant contributor under the Noise Regulations.

Table 28 Assigned noise levels and worst-case L_{A10} noise levels predicted for the current and proposed operations

	Noise levels at six locations around the quarry (dB(A))					
	P1	**P2**	**P3**	**P4**	**P5**	**P6**
Assigned L_{A10} noise levels						
0600 to 0700 hours	35	35	35	38	39	60
0700 to 1800 hours	45	45	45	48	49	60
Predicted L_{A10} noise levels						
Existing operations	12.7	11.8	6.1	31.3	31.9	41.6
Proposed operations (all stages)	12.6 – 15.4	12.6 – 14.5	16.6 – 30.2	30.9 – 34.7	31.8 – 33.5	42.8 – 43.1
Maximum increase in noise levels for the proposed operations	2.7	2.7	24.1	3.4	1.6	1.5

Modelling results indicate that stages 1 – 4 (years 2007 – 2032) and 9 – 12 (years 2055 – 2103) of the proposed development will be in compliance with the Noise Regulations. However, predicted noise levels will be within 5 dB of the assigned L_{A10} noise levels between 0600 and 0700 hours at P4 during stages 5 – 8 (years 2032 – 2055). At this site, and during these stages of development, there is the potential for other sources to contribute to noise levels. If, through monitoring, the assigned noise level was found to be exceeded, Hanson may be deemed to have significantly contributed to this exceedance if its predicted noise level was less than 5dB below the assigned noise level. To overcome this potential scenario, Hanson will restrict operations to 0700 – 1800 hours for stages 5 – 8, or otherwise reduce operation noise sources as follows:

- not operating the crushing plant
- not operating parts of the mobile fleet
- applying noise mitigation measures to various noise sources.

Adoption of improved technologies over the life of the proposal may also reduce noise emissions.

Blasting noise and vibration

The Noise Regulations require noise levels for nine out of any ten consecutive blasts, regardless of the interval between blasts, to be less than 120 dB(lin) and no blasts to produce noise levels greater than 125 dB(lin) for blasting conducted between 0700 and 1800 hours, Monday to Saturday. Noise levels generated by blasting must not exceed 90 dB(lin) during 0600 and 0700, hours Monday to Saturday. Vibration levels as a result of blasting must not exceed 5 mm/s peak particle velocity for 90% of blasts and must not exceed 10 mm/s peak particle velocity for 100% of blasts.

Blast monitoring undertaken in 2006 recorded average and maximum blast overpressure levels of 94.5 and 114 dB(lin) respectively, and average and maximum peak particle velocities of 0.65 and 1.77 mm/s respectively.

Monitoring results indicate that the blast overpressure levels at the Red Hill Quarry will comply with the Noise Regulations throughout all stages of the proposed development assuming that current charge sizes and delays are maintained and that blasting is conducted only between 0700 and 1800 hours, Monday to Saturday. Blast overpressure levels would exceed the assigned level of 90 dB(lin) if blasting were to be conducted between 0600 and 0700; however, Hanson will ensure that blasting is not conducted during these times. Adoption of improved blasting technologies over the life of the proposal may also reduce blast overpressure levels.

The predicted maximum peak particle velocity due to blasting from the proposed development at surrounding noise-sensitive premises is 3.23 mm/s at monitoring site P2. This is within the requirement for 90% of all blasts and indicates that the vibration levels associated with blasting activities will comply with the criteria to avoid human annoyance and damage to property.

12.5 PROPOSED MANAGEMENT ACTIONS

Noise and vibration issues at the Red Hill Quarry will be addressed through the implementation of an Environmental Management Plan (Appendix 2), which will include a Noise and Vibration Management Plan, that covers both construction and operational activities and includes the following noise and vibration management actions:

- restricting quarrying activities to between only 0600 and 1800 hours, Monday to Saturday (unless otherwise approved)
- advising relevant stakeholders of the proposed blasting times, working schedule, current progress and any new developments
- maintaining a substantial buffer between quarry activities and the nearest residence
- fitting and monitoring noise suppression features on all machinery, plant and equipment
- designing blasting to reduce noise emissions
- monitoring blast noise and vibration by qualified personnel
- continually reviewing and improving blast design to reduce the required number of blasts
- planning blasting to occur only between 0900 hours and 1800 hours (unless otherwise approved) to minimise noise impacts at noise-sensitive receptors
- instructing truck drivers to utilise the main and designated roads within the City of Swan to prevent truck movements on local service roads

- imposing and enforcing speed limits within the project area
- regularly reporting blast results and assessing compliance with the Noise Regulations.

12.6 PREDICTED ENVIRONMENTAL OUTCOME

Noise emissions from the Red Hill Quarry were predicted for current and proposed operations in accordance with EPA Guidance Statement No. 8 (EPA 2007a) and compliance with the Noise Regulations assessed. Noise emissions from the current operation were determined to be in compliance with the Noise Regulations.

Noise will be generated at the Red Hill Quarry throughout all stages of the proposed development by the drilling, blasting, crushing, processing, loading and transport of rock. The proposed quarry development will remove natural barriers to noise (i.e. hills and ridges) which may increase operational and blast noise levels by a small amount (but within assigned noise levels prescribed in the Noise Regulations) at noise-sensitive premises around the quarry. Predicted noise levels indicate that stages 1 – 4 (years 2007 – 2032) and stages 9 – 12 (years 2055 – 2103) of the proposed development will be in compliance with the Noise Regulations. Predicted noise levels will be within 5 dB of the assigned noise levels between 0600 and 0700 hours at one monitoring location during stages 5 – 8 (years 2032 – 2055). If the assigned noise level was found to be exceeded through monitoring, Hanson may be deemed to have significantly contributed to this exceedance if its predicted noise level was less than 5dB below the assigned noise level. Hanson will implement appropriate noise management measures during these times in order to maintain compliance with the Noise Regulations. Adoption of improved technologies over the life of the proposal may also reduce noise emissions.

All blasts at the quarry are monitored for blast overpressure and ground-borne vibrations. Monitoring results indicate that current blasting activities are in compliance with the Noise Regulations. Maintenance of current blasting procedures and noise management measures (detailed in the Environmental Management Plan) will ensure that noise and vibration generated by blasting at Hanson's Red Hill operation conforms to the requirements of the Noise Regulations.

The proposed Red Hill Quarry development will meet noise and vibration parameters prescribed in the Noise Regulations ensuring the proposed development meets the EPA objective for this factor.

13. AIR QUALITY (DUST)

13.1 KEY STATUTORY REQUIREMENTS, ENVIRONMENTAL POLICY AND GUIDANCE

EPA objective

To ensure that dust emissions do not adversely affect environmental values of the health, welfare and amenity of people and land users by meeting statutory requirements and acceptable standards.

National Environmental Protection Measure

In June 1998, a National Environmental Protection Measure (NEPM) for Ambient Air Quality was endorsed by the National Environment Protection Council (NEPC). The desired environmental outcome of this Measure is ambient air quality that allows for the adequate protection of human health and well-being (NEPC 1998). The Measure included standards for air quality, including for particulates as PM_{10}. In 2003, the NEPM was amended to include advisory reporting standards for particles as $PM_{2.5}$ (NEPC 2003).

The NEPM standards and goals for particulates are shown in Table 29.

Table 29 National Environmental Protection Measure for ambient air quality

Pollutant	Averaging period	Maximum concentration	Maximum allowable exceedences
Standards and goal for pollutants other than particulates as $PM_{2.5}$			
Particles as PM_{10}	1 day	50 µg/m^3	5 days a year
Advisory reporting standards and goal for particulates as $PM_{2.5}$			
Particles as $PM_{2.5}$	1 day	25 µg/m^3	Goal is to gather sufficient national data to facilitate a review of Advisory Reporting Standards
	1 year	8 µg/m^3	

µg/m^3 = micrograms per cubic metre

13.2 DESCRIPTION OF FACTOR

In the assessment of environmental impacts, dust is more conventionally referred to as 'particulates' or 'airborne particulates'. Airborne particulates are generated during quarrying mainly by mechanical disturbances (such as drilling, blasting, earthmoving and movement of road traffic on unsealed surfaces). In dry and windy conditions, particles can be lifted from open or disturbed areas, resulting in visible dust emissions. Most airborne particles that originate from these sources are larger than 10 µm (PM_{10}) and are associated more with nuisance than with public health problems. The larger particles tend to settle back to the ground within a short distance (<300 m) from the source.

13.2.1 Local dust sources

The Red Hill Quarry is located within an area recognised for its hard rock resources, with quarrying an accepted land use. There are a number of land uses surrounding the project area that have the potential to generate dust and affect ambient air quality, including:

- Midland Brick extractive clay pits to the immediate east
- cropping and grazing farms to the north and further to the east
- hobby farms to the north and north-west
- Red Hill Waste Management Facility to the south-east.

Dust emissions from the above mentioned sources would exhibit a marked seasonal trend as ground cover and soil moisture content change (i.e. low soil moisture and reduced vegetation cover [i.e [asture cover] in the summer months would contribute to higher levels of dust being generated). Dust emissions from forested areas around Lot 11 are expected to be negligible (except after fire when large areas of vegetated land are left bare).

13.2.2 Red Hill Quarry emissions of dust/particulates

The Red Hill Quarry operations consist of drilling and blasting of rock, loading and haulage to processing facilities, crushing and screening, stockpiling, and loading for offsite transport. All these phases of the operation will produce dust. The generation of dust from quarrying and processing operations will depend on:

- the frequency at which dust generating activities take place
- meteorological conditions, such as wind speed
- composition of dust, including particle size distribution (particle density and moisture content)
- the condition of the source.

The effectiveness of current dust suppression at the Red Hill Quarry is monitored monthly by four permanent static and directional dust sampling stations around the perimeter of the currently developed operational area (Figure 31). Data from the dust sampling is used to determine the source of dust.

As expected dust levels were higher at sampling stations closest to active operational areas, in particular adjacent to active haul roads and the product stockpiles. Dust levels also exhibited seasonal trends, in that measurements in all years dropped significantly during wetter months.

Dust levels were similar from 2002 to 2005, but were significantly lower in 2006 than previous years, with significantly lower and less frequent peaks. This reduction in dust levels was achieved in spite of increased throughput in 2006; this can be attributed to improvements in dust control measures implemented at the site.

Review of the Annual Environmental Summary Report and Audit Documents from 2002 – 2007 indicate that two public complaints relating to dust were formally received. The complaints were received in July 2005 and November 2007 and related to dust at the Red Hill Quarry Toodyay Road entrance (i.e. dust deposition on the road from movement of haulage trucks).

Dust emissions were raised as an issue of concern to some residents who participated in the public consultation program undertaken for the PER. In most instances, the dust emissions commented on related to dust (and debris) deposited on Toodyay Road at the quarry entrance. In some instances, it was the dust generated from a blast that was commented on (i.e. the 'cloud' of dust was visible after the blast). One participant commented on dust emissions from the exposed areas of the former Herne Hill Quarry. It could be assumed that where dust was of concern to residents it primarily related to road safety and amenity (visual), as opposed to health issues or dust deposition at residences (which were not raised as issues by participants of the stakeholder consultation program). Dust deposition from the current operations at nearby residences is unlikely (under most conditions) given the distance between the operation and nearby residences and the rapid fall-off in dust levels with distance. The nearest residence is currently around 2 km away[17] and buffer vegetation is provided by stands of native vegetation, including the Darling Range Regional Park (north and west) and John Forrest National Park (south).

In 2006, Hanson was in compliance with the quarry DEC Licence conditions relating to dust. Hanson reports on results of dust monitoring in its Annual Environmental Summary Report and Audit Document, which is provided to EPA, DEC and City of Swan.

13.2.3 Potential impacts from dust

Dust may have physical effects on plants such as blockage and damage to stomata, shading and abrasion of leaf surface or cuticle; vegetation located close to dust sources is more likely to be subject to such impacts (Section 7.4.4). Vegetation adjacent to haul roads of the existing operation has experienced some dust deposition, however, this has not resulted in any vegetation death. In addition, dust deposition on vegetation is observed not to extend beyond those areas adjacent to operational areas.

Dust also has the potential to affect health at elevated levels; however, the separation of the quarry and sensitive areas largely reduces these risks. Elevated dust levels can also detract from the amenity of the local area, as viewed from nearby residences. See discussion in Section 13.2.2 relating to public perception of dust emissions from the quarry.

13.3 POTENTIAL SOURCES OF IMPACT

Activities or aspects of the quarrying and processing operations that may potentially cause dust emissions include:

- **physical disturbance of the land surface** during clearing and removal of topsoil and overburden
- **drilling and blasting** of rock to establish the quarry face and enable extraction of rock
- **haulage and light traffic** on unsealed roads
- **crushing and screening** to grade aggregate
- **wind erosion** of exposed surfaces including dry, open pit areas, stockpiles and unsealed roads.

[17] This will be reduced to approximately 1 km once the proposed pit extends to its full northward extent (assuming surrounding land uses remain unchanged). This extent is not expected to be reached within the next 50 years.

13.4 ASSESSMENT OF POTENTIAL IMPACT, MITIGATION AND RESIDUAL IMPACT

Physical disturbance of land surface

A total of approximately 80 ha of vegetation will be progressively cleared over an estimated 100 years, thereby reducing the area exposed at any one time. The clearing of vegetation is unlikely to generate significant dust levels compared to the removal of topsoil and overburden. Water will be applied during these activities to reduce dust generation from the active earthworks area. Other management measures to be applied are summarised in Section 13.5 and detailed in the Environmental Management Plan (Appendix 2).

Drilling and blasting

Drilling and blasting activities are likely to occur once every two to three weeks and are potentially a significant source of dust from the quarry. Climatic conditions and local geology are taken into consideration when determining the depth, amount of explosive and the delay employed during drilling and blasting in order reduce dust emissions. Other management measures to be applied are summarised in Section 13.5 and detailed in the Environmental Management Plan (Appendix 2).

Haulage and light traffic

Dust monitoring at the quarry has indicated that vehicle movement along unsealed haul roads generate higher dust emissions than the open pit area. Frequent water applications have been sufficient to reduce the dust emissions from this source. Additionally, vehicles travelling on haul roads are restricted to the speed of 40 km/hr, and 20 km/hr in the stockpile and plant area in order to further reduce the potential for dust generation.

All dry loads leaving the site are wetted down and fine materials (<5 mm) loads are covered with dust-covers to limit drift during transport on public roads (Section 15.5).

Other management measures to be applied are summarised in Section 13.5 and detailed in the Environmental Management Plan (Appendix 2).

Crushing and screening

Primary, secondary and tertiary crushing plants are used to process the aggregate at the current quarry operation. As part of the proposal, Hanson may relocate some of these crushers, upgrade and/or install additional crushers to the existing plant. Throughput of the proposed operation is also expected to increase in the short-term. The changes proposed to the processing facilities could potentially generate more dust or alternate sources of dust.

Current measures to reduce dust generated from these processes include enclosing the crushing plant and conveyors, fitting baghouses to the crushing plants and wetting the crusher feed with water sprays. These measures will also be applied to any relocated, upgraded or new crushers thereby reducing dust emissions. Additional management measures to be applied are summarised in Section 13.5 and detailed in the Environmental Management Plan (Appendix 2).

Wind erosion of exposed surfaces

Wind erosion could potentially, under windy conditions, lift dust from exposed surfaces (including the open pit area, stockpiles and unsealed roads) particularly in summer when soil is drier. Dust

suppression measures (typically the application of water) will continue to be implemented during periods when dust is likely to be a problem. Water cannons are currently used to minimise dust lift-off from stockpiles.

Rehabilitation of disturbed areas will occur as soon as possible following disturbance to reduce the total exposed area. Other management measures to be applied are summarised in Section 13.5 and detailed in the Environmental Management Plan (Appendix 2).

Water cannon in operation at Red Hill

Affects on vegetation and amenity

The affects of dust deposition on vegetation adjacent to operational areas is unlikely to be exacerbated by the proposed development. Although the length of the interface between the operation and adjacent vegetation will progressively increase over the life of the development, dust deposition is expected not to extend beyond the adjacent vegetation. Should excessive dust accumulation on vegetation adjacent to areas of ground disturbance be observed, Hanson will undertake remedial action which may include hosing down of vegetation.

The separation distance between the quarry operation and the nearest residence will be reduced to approximately 1 km once the proposed pit extends to its full northward extent (assuming surrounding land uses remain unchanged). This extent is not expected to be reached within the next 50 years. It is expected that under most circumstances dust deposition at nearby residences will continue to be unlikely. There may be discrete instances where prevailing winds may result in some dust deposition; this scenario is more likely to result from blasting activities. As with current operations Hanson will continue to schedule blasts for favourable wind conditions and to adopt best practice blasting techniques.

Other management measures to be applied are summarised in Section 13.5 and detailed in the Environmental Management Plan (Appendix 2).

13.5 PROPOSED MANAGEMENT ACTIONS

The management of dust at Red Hill Quarry will be addressed through the implementation of an Environmental Management Plan (Appendix 2), which includes Dust Management Plan. Management actions include:

- clearing vegetation in a staged manner to reduce exposed area
- maintaining a buffer zone of vegetation between the project area and the nearest residences to act as a windbreak that will reduce wind velocity and facilitate dust settlement
- design drilling and blasting to reduce dust through the consideration of climatic conditions and local geology
- application of water or other dust suppressants to unsealed roads, stockpiles, truck loads and other exposed surfaces
- maintaining water carts to deliver water to haul roads and other bare surfaces

- maintaining a water sprinkler system to apply water to the surface of stockpiles
- restricting speed limits to 40 km/hr on haul roads and 20 km/hr in the stockpile and plant area
- wetting and/or covering truck loads of aggregate prior to leaving the site
- maintaining current dust suppression practices related to crushing plants, including enclosed plants and conveyors, bag-houses and wetting crusher feed
- undertaking daily inspections during dust-prone conditions to visually assess dust generation
- undertaking regular inspections of dust suppression equipment
- undertaking progressive rehabilitation to reduce the total exposed area.

13.6 PREDICTED ENVIRONMENTAL OUTCOME

Dust will potentially be generated by a number of activities associated with the quarry operation. Dust is unlikely to have a significant affect on nearby residences or surrounding vegetation due to the dust management measures that will continue to be implemented during the development and operation of the quarry. Implementation of the proposed management actions (detailed in the Environmental Management Plan) will be sufficient to meet the EPA objective of not adversely affecting environmental values or the health, welfare and amenity of people and land uses.

14. ABORIGINAL HERITAGE

14.1 KEY STATUTORY REQUIREMENTS, ENVIRONMENTAL POLICY AND GUIDANCE

EPA Objective

To ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.

State legislation

The Minister for Indigenous Affairs is responsible for the administration of the *Aboriginal Heritage Act 1972* (Aboriginal Heritage Act). Under section 17 of the Aboriginal Heritage Act, it is an offence to disturb any Aboriginal site without consent under section 18 of that Act.

The Minister considers recommendations from the Aboriginal Cultural Material Committee and the general interests of the community when making a decision on disturbance to a site and may also impose conditions on the approval.

The Registrar of Aboriginal Sites is responsible for maintaining the Register of Places and Objects. The Department of Indigenous Affairs (DIA) has a database of all recorded sites.

EPA Guidance Statement No 41

EPA Guidance Statement No. 41, "*Assessment of Aboriginal Heritage*" (EPA 2004c), provides guidance on the process for the assessment of Aboriginal heritage as an environmental factor. In its assessment of proposals the EPA will expect proponents to:

- report on the likelihood of the presence of matters of heritage significance to Aboriginal people
- analyse if the proposed biophysical changes will result in an impact on matters of heritage significance to Aboriginal people.

Based on this information, the EPA will make a determination on whether Aboriginal heritage is a relevant environmental factor. Where it is determined to be a relevant environmental factor, the EPA will expect the proponent to properly consider how to minimise any adverse impact of the proposal on heritage values.

This guidance statement also details those actions that may be pertinent to the factor of Aboriginal heritage, including:

- consultation with DIA staff and desktop review of sites
- undertaking an Aboriginal heritage and/or archaeological survey in consultation with relevant Aboriginal representatives
- inform relevant Aboriginal people of the proposal and conduct appropriate consultation
- demonstrate that any concerns raised by the Aboriginal people have been considered in the environmental management of the factor and that this is made known to the relevant Aboriginal people.

Native title

Native title, or indigenous land rights, is a concept in the law of Australia that recognises the continued ownership of land by local Australian Aborigines or Torres Strait Islanders. The colonisation of Australia was conducted under the false assumption that the land was unoccupied (*terra nullius*) and could therefore be claimed for the Crown and distributed to colonists by the Government. The legal concept of Native Title as it applies in Australia was recognised by the judicial system in 1992, and the Keating government later enacted the *Native Title Act 1993* (Commonwealth) to clarify the legal position of landholders and the processes that must be followed for Native Title to be claimed, protected and recognised through the courts.

14.2 DESCRIPTION OF FACTOR

Archaeological (Quartermaine 1990) and ethnographic (McDonald 1990) surveys were undertaken over the proposed development area as part of the Herne Hill Quarry Relocation PER and reported on in Dames and Moore (1990). More recent surveys addressing the proposed Red Hill Quarry development include:

- Clarke (2006): A review of the Aboriginal heritage aspects of a proposed expansion of the Hanson Red Hill Quarry
- Mattner and Bergin (2007): Archaeological survey of proposed Red Hill Quarry development area.

Both these reports are contained in Appendix 2.

The following descriptions of ethnographic and archaeological heritage as relevant to the proposed development area are from the abovementioned studies, unless otherwise stated.

14.2.1 Ethnographic heritage

McDonald (1990) identified two sites of mythological significance as occurring within, or near the project area:

1. Susannah Brook: believed to be part of the Dreaming Track of the Waugal. This mythological association only applies to Susannah Brook and not to its tributaries.
2. White ochre deposit: the expression of the deposit on Lot 11 is associated with a much larger deposit on the opposite side of Toodyay Road.

In a search of the Register of Aboriginal Sites, maintained by the Department of Indigenous Affairs (DIA), Clarke (2006) identified five registered mythological sites occurring over the broad project area (Lot 11 and surrounds). These sites included the two mythological sites identified above, as well as the two broad-coverage mythological sites of the Swan River Catchment and Darling Range. The remaining site related to a pool in Susannah Brook located west of Lot 11.

Ministerial Conditions from the 1990 approval provide for a 50 m buffer either side of Susannah Brook to protect Aboriginal mythological values associated with the watercourse and that quantities of white ochre are made available to Aborigines for their use (Ministerial Statement No. 199). Hanson will extend the buffer along Susannah Brook to around 100 m in most instances for the proposed development and will continue to protect an area of the white ochre deposit from disturbance (Section 14.5).

The McDonald (1990) report also specifically stated that "the informants did not identify any other sites of mythological or ceremonial significance within the development area [location of the existing Red Hill Quarry] or within the other parts of the Pioneer Quarries [now Hanson Construction Materials Pty Ltd] property [Lot 11]" (quoted in Clarke 2006; pg. 1).

14.2.2 Archaeological heritage

Ethnohistory and site patterning

Mattner and Bergin (2007) describe historical Aboriginal settlement patterns as being related to the six seasons recognised by the Noongar tribes, each coinciding with an abundance of particular food resources. The seasonal cycle of movement was between the coastal lowlands and the inland forests (Anderson 1984; Hammond 1933; Yates 2000). The general pattern involved moving inland during the winter months, to the jarrah forest and the zone between the forest and the coastal plain, travelling in small mobile groups. In summer, people returned to the coastal plains and wetlands, rivers and estuaries where larger social gatherings and longer periods of residence at campsites occurred.

Studies have been conducted in relation to the archaeological signature of the migration between the forested plateau and coastal plain. Hallam (1986) conducted a systematic study of the Swan Coastal Plain and concluded that Aboriginal occupation was focused around lakes and swamps of the Bassendean Sands and Pinjarra Plains ecological zones (Mattner & Bergin 2007). Anderson (1984) proposed a land use model for prehistoric exploitation of the Swan Coastal Plain, based on regional research into the relative proportions of surface artefact scatters and their associated artefact densities. This model suggests that, due to the variation in resources available in the three different environmental zones investigated, there was more intensive use of the coastal plain than either the Darling Scarp or Darling Plateau (jarrah forest), with the Darling Scarp used as a transitional zone.

Registered archaeological sites

Mattner and Bergin (2007) conducted a search of the DIA Register of Aboriginal Sites. This search identified seven registered archaeological sites, or sites with archaeological components, within 2 km of the project area. No registered archaeological sites are located within the proposed quarry pit development area; however, there is one registered site near the area of the proposed stockpile extension area – the aforementioned white ochre deposit (Section 14.2.1). The remaining sites identified on the Register of Aboriginal Sites, including an engraving (petroglyph), are located on land east of Lot 11.

The pattern of the registered sites indicates that Aboriginal activity in the Red Hill area was directed at the extraction of specific resources (e.g. ochre, water and shelter), rather than camping and hunting.

Archaeological survey findings

Mattner and Bergin (2007) undertook an archaeological survey in the project area in January 2007. No definite Aboriginal archaeological sites were identified and no archaeological material was observed in the vicinity of the white ochre deposit. Two isolated quartz artefacts were found on the

crest of the ridge north of the existing Red Hill Quarry; however, these do not constitute a site[18]. These isolated finds are likely associated with hunting and gathering or transient movement along the ridge. The scarcity of isolated finds observed during the survey indicates that there was little Aboriginal activity in the project area.

A rock shelter was identified within the proposed development area, though it is the professional opinion of Mattner and Bergin (2007) that the rock shelter does not meet the criteria for registration as a protected Aboriginal heritage site under Section 5 or 39 of the Aboriginal Heritage Act. A small basal grindstone was located immediately below the rock shelter and while its presence suggests past Aboriginal usage of the rock shelter, the provenance of the artefact is uncertain. It was noted (by Mr W. Macham; local resident) that the shelter has been visited on numerous occasions by various people so the artefact may have been brought to this shelter by non-Aboriginals in recent times. Mr Robert Reynolds, a senior heritage officer from DIA who has previously visited the shelter (approximately six years ago), advised he sought further information about the shelter from Aboriginal informants but did not receive anything and therefore did not proceed with reporting the rock shelter as a site because there was no conclusive evidence of Aboriginal usage. Aboriginal people shown the shelter by Mr Macham also did not report it to DIA (Mattner and Bergin 2007).

14.3 POTENTIAL SOURCES OF IMPACT

The primary aspects of the proposal that may potentially affect Aboriginal heritage values are:

- **physical disturbance of the land surface** during clearing and removal of topsoil and overburden has the potential to disturb heritage sites and affect ethnographic values
- **contaminated runoff** from operational area could potentially reach Susannah Brook and affect ethnographic values.

14.4 ASSESSMENT OF POTENTIAL IMPACT, MITIGATION AND RESIDUAL IMPACT

14.4.1 Disturbance of the land surface and potential runoff to Susannah Brook

Ethnographic values

No registered ethnographic sites will be disturbed by the proposed development of the Red Hill Quarry. Two registered ethnographic sites are in proximity to the project area (Susannah Brook and the white ochre deposit), both of which will continue to be protected by Hanson.

A minimum 50 m buffer will continue to be maintained along Susannah Brook, with this buffer being extended to 100 m in most instances. An area of the white ochre deposit is adjacent to the existing stockpile and dispatch area. This area is identified by signage and will continue to be protected from disturbance by Hanson (Section 14.5).

[18] For the purposes of this study, an archaeological "site" was defined as a place where "significant traces of human activity are identified" (Renfrew and Bahn 1991: 42). In other words, where there is substantial, in situ evidence of past Aboriginal occupation or activity. This is a scientific definition, not a legal definition (Mattner and Bergin 2007).

Additionally, the existing management measures implemented to prevent pollution of Susannah Brook will continue to be implemented, these include:

- directing surface runoff from operational areas to the onsite sedimentation dams or in-pit sump
- utilising sediment, grease and oil traps
- containing hydrocarbon spills in accordance with relevant State Regulations and Australian Standards
- ensuring all hydrocarbon storage facilities are bunded according to the *Water Quality Protection Guideline No. 10: Above Ground Chemical and Fuel Storage* (WRC 2000a).

Archaeological sites

No registered archaeological sites will be disturbed by the proposed development of the Red Hill Quarry. In addition, no definite archaeological sites were identified within the project area (Mattner and Bergin 2007). A rock shelter was identified within the proposed development area, however Mattner and Bergin (2007) advises that this rock shelter does not meet the criteria for registration as a protected site under Sections 5 or 39 of the Aboriginal Heritage Act. Therefore, the proposed development could proceed without the requirement for a Section 18 approval under this Act.

14.5 PROPOSED MANAGEMENT ACTIONS

Aboriginal heritage issues at the Red Hill Quarry will be addressed by the following proposed management actions:

- continue to protect an area of the white ochre deposit ethnographic site (DIA ID No. 3433) from any disturbance; this will include maintaining existing signage and further demarcating the site through use of appropriate fencing
- continue to maintain a minimum 50 m buffer between Susannah Brook (DIA ID No. 640) and the quarrying operations; this buffer will be extended to 100 m for most of the stream length in Lot 11
- prepare and implement an Environmental Management Plan, which includes a Water Quality Management Plan with management measures to prevent silt and other potential contaminants from the quarry operations entering Susannah Brook
- inform all Red Hill Quarry personnel and contractors of their responsibilities and obligations to protect the Aboriginal heritage sites known on Lot 11 under the Aboriginal Heritage Act
- if any Aboriginal cultural material is uncovered or encountered in the course of operations it will be reported and work in the area will cease until it is determined if an archaeological site exists
- undertake consultation with relevant Aboriginal heritage groups (in progress).

14.6 PREDICTED ENVIRONMENTAL OUTCOME

Hanson has investigated the likelihood of the presence of matters of Aboriginal heritage significance in the proposed development area and has analysed potential impacts to such sites as a result of the proposal in accordance with EPA Guidance Statement No. 41 (EPA 2004c). Hanson is also progressing consulting with the relevant Aboriginal groups.

No registered ethnographic or archaeological sites will be disturbed by the proposed development. Two registered ethnographic sites are in proximity to the project area; Susannah Brook and a white ochre deposit. Consistent with the EPA objective for this factor and the Aboriginal Heritage Act, the biophysical environment of both sites will continue to be protected from disturbance using current management measures. A rock shelter was identified within the proposed development area, however, Mattner and Bergin (2007) advises that the rock shelter does not meet criteria for registration as a protected Aboriginal heritage site under the Aboriginal Heritage Act.

15. PUBLIC RISK AND SAFETY

15.1 KEY STATUTORY REQUIREMENTS, ENVIRONMENTAL POLICY AND GUIDANCE

EPA objective

To ensure the risk from the proposal is as low as reasonably achievable and complies with acceptable standards and EPA criteria.

State legislation

The transportation of dangerous goods in Western Australia is managed in accordance with the *Dangerous Goods Safety Act 2004* and associated regulations. This Act and associated regulations aim to protect the community by minimising risks associated with the storage, transport and handling of dangerous goods.

The Resources Safety Division of the Department of Consumer and Employment Protection is responsible for administering the above mentioned legislation and associated Regulations, through licensing, assessment, inspection and advisory functions.

Australian standards

Various Australian Standards also apply to the transportation of dangerous goods, namely procedures for dealing with emergencies involving specific dangerous goods.

15.2 DESCRIPTION OF FACTOR

Onsite public risk at the quarry (existing and proposed operations) is minimal as public access to Lot 11 is strictly prohibited and managed. Hanson maintains a perimeter fence, which is inspected regularly and repaired as required. Signage is also displayed at regular intervals along the fence line in areas where public access is most likely. A security company also provides after-hours security patrols at the site.

Aspects of the proposed development that could potentially pose a risk to the safety of the general public (not including Hanson personnel) is restricted to offsite factors, such as movement of heavy haulage vehicles.

15.3 POTENTIAL SOURCES OF IMPACT

The primary aspect of the proposal that could potentially affect public risk and safety (not including Hanson personnel) is:

- **increased heavy vehicle movements** on public roads required for the distribution of aggregate, hydrocarbons and explosives could pose a road safety risk to the public.

Vibration is not likely to pose a risk to the public as monitoring of vibration (caused by blasting) in 2006 indicated the average peak particle velocity was 0.65 mm/sec (with the maximum level of 1.77

mm/sec), which is well below the 5 mm/sec EPA recommended level (EPA 2007). Refer to Section 11 for more detail of vibration from blasting.

Strategic fuel reduction burns are conducted within the perimeter of Lot 11. In the northern area of the site where nearby residents properties exist, rotational burns are also conducted. Public risk and safety in regards to these burns is limited as all burns are conducted onsite, in conjunction with the East Swan Volunteer Fire Brigade and the Fire Protection Officer at the City of Swan.

15.4 ASSESSMENT OF POTENTIAL IMPACT, MITIGATION AND RESIDUAL IMPACT

Heavy haulage trucks (six-wheeled rigid body, semi-trailers, truck and trailers) will continue to be utilised to transport aggregate from the quarry. Currently, there are around 650 loaded trucks that leave the quarry and around 650 empty truck returns to the quarry per week. The number of truck movements will increase as a result of the proposed development with the number of truck movements increasing proportionately to throughput increase.

The greatest risk to the public from transport of aggregate will be when the trucks are leaving the quarry site and turning east or west onto Toodyay Road (a heavy haulage route). The west turn onto Toodyay Road requires the trucks to cross two lanes of traffic; however, this is no different to what currently occurs with signs in place to inform road users of trucks entering. The relatively steep hill further west of this turn is navigated by the trucks in a low gear. Additionally, the risk posed by aggregate falling from or dust generated by trucks is reduced by:

- not overloading trucks
- checking loads for loose debris and sweeping if necessary
- covering fine materials loads
- wetting down dry loads.

Toodyay Road, at the quarry entrance is regularly swept (or as required) to remove any incidental debris or dust on the road.

Toodyay Road is a heavy haulage route, providing heavy vehicle access to a number of sites including the Red Hill Quarry, Midland Brick Quarry and the Red Hill Waste Management Facility. Toodyay Road is identified as a primary freight route under Main Roads jurisdiction in 'Statement of Planning Policy: Metropolitan freight network (Draft)', and has also been identified as forming part of the proposed Perth – Adelaide National Highway route (WAPC 2005).

At present, approximately 58 KL/month of diesel is used in the quarry operations and consequently there is a small number of truck movements per month associated with its delivery to the site. The number of truck movements transporting hydrocarbons and explosives may increase as a result of the proposed development. To mitigate risk to public safety, Hanson will ensure all hydrocarbons and explosives are transported, stored (no explosives stored onsite) and handled in accordance with relevant State legislation and Australian Standards. Requirements of the legislation and standards include, amongst others, vehicles and driver licensing and vehicle placarding.

15.5 PROPOSED MANAGEMENT ACTIONS

The management of public risk and safety at Red Hill Quarry will be addressed by the following proposed management actions:

- maintain current site security, including perimeter fencing, signage, lighting and after-hours security patrols
- implement the Environmental Management Plan (Appendix 2), which includes a Traffic Management Plan, to ensure management measures for:
    - roadside signage to inform road users of trucks entering
    - ensuring integrity of aggregate loads prior to leaving site
    - trucks using a low gear on hills
    - complying with standards for the transport of hydrocarbons
- continue to employ best-practice blasting techniques, such as minimising quantity of explosives used and employing appropriate drilling pattern
- continue to monitor ground vibration (Section 12.5)
- comply with standards for the transport of hydrocarbons.
- maintain existing hydrocarbon storage and handling measures in accordance with relevant legislation and standards.

15.6 PREDICTED ENVIRONMENTAL OUTCOME

Increased vehicle movements of aggregate, hydrocarbons and explosives could potentially pose a road safety risk to the general public, in particular, users of Toodyay Road. The proposed development will result in an increase in the number of heavy vehicle movements on Toodyay Road. In addition, the road is recognised as a primary freight route and is utilised by heavy vehicles to access sites other than the quarry. Through the continued implementation of risk mitigation measures (detailed in the Environmental Management Plan), potential risk to road users will be minimised and the EPA objective of ensuring the risk associated with the proposal is as low as reasonably practicable is met.

16. GREENHOUSE GASES

16.1 KEY STATUTORY REQUIREMENTS, ENVIRONMENTAL POLICY AND GUIDANCE

EPA Objective

To minimise emissions to levels as low as practicable on an ongoing basis and consider offsets to further reduce cumulative emissions.

Commonwealth legislation/policies

The National Greenhouse Strategy (NGS) was released by the Australian Greenhouse Office (AGO) in 1998, and was prepared by the Commonwealth Government, State and Territory Governments. It details the strategic framework for effective greenhouse response and for meeting current and future international commitments (AGO 1998). The NGS commits Australia to actively contribute to the global effort to stabilise greenhouse gas concentrations in the atmosphere.

The Greenhouse Challenge Program (now Greenhouse Challenge Plus) was established by the Commonwealth Government in 1995, and is a voluntary program between government and industry to abate greenhouse emissions. In 2004, following a review of the Greenhouse Challenge Program, the Commonwealth Government launched the Greenhouse Challenge Plus program. This program builds on the success of the original program and incorporates two industry-focussed measures (Generator Efficiency Standards and Greenhouse Friendly initiative), and changes in the Commonwealth Government's energy policy '*Securing Australia's Energy Future*' (2004).

In 2004, the Commonwealth Government released its new energy policy 'Securing Australia's Energy Future'. This policy recognised the importance of major energy users effectively managing greenhouse gases and indicated that the Greenhouse Challenge is to become a 'single entry point' for business reporting on greenhouse and energy.

The Kyoto Protocol is an international treaty designed to limit global greenhouse gas emissions. The agreement was reached in 1997 in Kyoto, Japan, and establishes individual quantified emissions limitations or reduction commitments (emissions targets) for each developed country based on 1990 emissions, for the commitment period of 2008 to 2012. The Commonwealth Government ratified the Kyoto Protocol in December 2007.

The *National Greenhouse and Energy Reporting Act 2007* (Cth) (NGER Act) establishes a single, national system for reporting greenhouse gas emissions, abatement actions, and energy consumption and production by corporations. The NGER Act also lays the foundation for the Australian Emissions Trading System. As from 1 July 2008 it will be mandatory for corporations emitting above 125,000 tonnes carbon dioxide equivalents per annum (t CO_2-e per annum), or 25,000 t CO_2-e per annum for a facility, to register and report annually under the NGER Act.

State legislation/policies

In October 2002, the EPA released a "*Guidance Statement for Reducing Greenhouse Gas Emissions*" (Guidance Statement No. 12) (EPA 2002b). The statement details objectives regarding the minimisation of greenhouse gas emissions from new or expanding operations.

Carbon rights legislation was passed by the Western Australian Parliament in 2003. The purpose of the Bill is to provide for the registration on land titles and a 'carbon right' and accompanying 'carbon covenant'. The Bill will give certainty to those wanting to trade in carbon rights and gain the credits or emission offsets which arise from sequestration.

The Western Australia Greenhouse Strategy was released in 2004 and details the State Government's response to climate change. Key components of the Strategy include government leadership, reducing emissions, Local Government and community involvement, and national and international representation.

16.2 DESCRIPTION OF FACTOR

The greenhouse effect is a natural phenomenon where light energy from the sun passes through the atmosphere and heats the earth's surface. Much of the heat energy is reflected by the earth's surface, but a portion is trapped by gases ('greenhouse gases', or 'GHGs') in the atmosphere, allowing temperatures to be maintained at a level which supports life.

Human activities have increased the amount of greenhouse gases in the atmosphere, enhancing the greenhouse effect, leading to climate change. The major GHG is carbon dioxide (CO_2), which has increased in concentration in the atmosphere by about 31% over the last 200 years (EPA 2002b). Other GHGs are methane (CH_4), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), sulphur hexafluoride (SF_6), and nitrous oxide (N_2O). As each of these gases has different warming potential they are usually combined according to their relative difference as 'CO_2equivalents' (CO_2-e) for comparative purposes.

Avoiding human-induced changes to climate is an important international goal that requires reduction in the emission of greenhouse gases. Actions are required to improve understanding of the problem and provide solutions for both adaptation and greenhouse gas emissions abatement. Addressing the challenge of climate change imposes costs for greenhouse gas abatement and necessitates a change in the way energy is used.

16.3 POTENTIAL SOURCES OF IMPACT

The following aspects of the proposed development have the potential to generate greenhouse gases:

- **combustion of fuels** by mobile plant, equipment and onsite vehicles
- **electrical power usage** by processing plants
- **use of explosives** for rock blasting
- **clearing of vegetation** will be undertaken progressively as the proposed quarry is developed and areas cleared will vary from year to year; similarly, the area of rehabilitation will also vary from year to year. Including these emissions/sinks would not give an accurate representation of average annual emissions from the current and proposed operations. Emissions resulting from vegetation clearing are addressed separately.

16.4 ASSESSMENT OF POTENTIAL IMPACT, MITIGATION AND RESIDUAL IMPACT

16.4.1 Current greenhouse gas emissions

Greenhouse gas emissions for current operations have been calculated using the methodology outlined in the AGO (2006) *Factors and Methods Workbook* for estimating greenhouse gas emissions.

Fuel used for vehicles at the current operations is nearly all diesel, with approximately 700 kL consumed annually. Based on the relevant formula[19] for transport fuel use, the consumption of 700 kL of diesel releases a total of approximately 2100 tCO_2-e per annum (1890 t of direct emissions [EF = 2.7] plus 210 t for indirect emissions [i.e. greenhouse gases emitted during the extraction, processing and transport of the fuel; EF = 0.3]).

The current quarry operation consumes approximately 3,200,000 kWh of electricity per annum, which is mainly used to power processing plant and conveyors. This represents an indirect source of emissions from the quarry operations as the direct emissions are associated with the operation of the power stations themselves. Under the AGO guidelines the amount of greenhouse gas emitted by electrical power consumption[20] is approximately 3000 tCO_2-e per annum. This total is comprised of emissions from fuel combustion at the power station and emissions associated with fuel extraction, production and transport and electrical transmission and distribution.

Explosives are also a source of greenhouse gas emissions and approximately 350 tonnes of emulsion explosive is used every year at the quarry. Emulsion explosives generate around 0.166 tonnes CO_2 per tonne of explosive used therefore there is currently around 60 tCO_2 emitted from this source annually.

The total annual emission of greenhouse gases by the current quarry operations is estimated to be approximately 5200 tCO_2-e (direct and indirect emissions). The carbon intensity of the current operation is approximately 5.1 kg of CO_2-e emitted per tonne of rock material processed.

Current product usage and resultant greenhouse gas emissions at the Red Hill Quarry are contained in Table 30.

[19] **Transport fuel use GHG emissions (t CO2-e) = Q (kL) x EF**; where: **Q** is the quantity of fuel in kilolitres; **EF** is the relevant emission factor. Emission factors comprise scope 1 (point source/fuel combustion) [**2.7 for diesel**] and scope 3 (indirect/fuel extraction) [**0.3 for diesel**]. Therefore emissions from fuel use = 700 x 2.7 + 700 x 0.3 = 2100 t CO2-e.

[20] **Electricity end use - Indirect GHG emissions (t CO2-e) = Q x EF / 1000** where: **Q** is the electricity consumed expressed in kWh, and **EF** is the relevant emission factor expressed in kg CO2-e/kWh. Emission factors are for scope 2 and scope 3. The emission factor for scope 2 covers emissions from fuel combustion at power stations associated with the consumption of purchased electricity from the grid (0.840 for WA). The emission factor for scope 3 covers both the emissions from the extraction, production and transport of fuels used in the production of the purchased electricity (i.e. fugitive emissions and stationary and mobile fuel combustion emissions) and also the emissions associated with the electricity lost in transmission and distribution on the way to the consumer (from both fuel combustion and fuel extraction) (0.096 for WA).

Table 30 Current annual product usage and greenhouse gas emissions at Red Hill Quarry

Product/ emission source	Current usage	Tonnes CO_2-e emitted
Fuel (diesel)	700 kL	2100
Power (electrical)	3,200,000 kWh	3000
Explosives (emulsion)	350 t	60
Total annual emissions	**-**	**5160**

16.4.2 Predicted greenhouse gas emissions

The proposed quarry development is expected, in the relative short-term, to increase by 50% to reach an annual throughput of 1.5 Mt of quarried material. It is expected that fuel use will not increase proportionally, but, instead, by around 20 to 25% of current use, which will result in approximately 2650 tCO_2-e of greenhouse gas emissions from 1.05 GL of diesel consumed. The consumption of power and explosives will increase in direct proportion to the increase in quarry production capacity. That is, there will be around 4,800,000 kWh of electrical power used and 525 tonnes of explosives detonated annually. This will result in emissions of approximately 4500 and 90 tCO_2-e respectively. The total annual emission of greenhouse gases by the proposed quarry development is therefore estimated to be approximately 7240 tCO_2-e (direct and indirect emissions).

This represents a total increase from current emissions of approximately 40%. This will be equivalent to around 4.8 kg of CO_2-e emitted per tonne of rock material processed once the proposed development reaches its expected production throughput of 1.5Mt/yr.

Predicted product usage and resultant greenhouse gas emissions at the Red Hill Quarry are contained in Table 31.

Table 31 Predicted annual product usage and greenhouse gas emissions at Red Hill Quarry

Emission source	Predicted usage	Tonnes CO_2-e emitted
Fuel consumption	1.05 GL	2650
Power consumption	4,800,000 kWh	4500
Explosives	525 t	90
Total annual emissions	**-**	**7240**

Emissions resulting from vegetation clearing will be produced progressively as the proposed quarry develops and will vary between years. A conservative estimate of clearing required for the proposed development is 80 ha, resulting in an emission of approximately 15,000 tCO_2[21] over the expected 100 year life of the proposed development (or an annual average of approximately 150 tCO_2). Sequestration by rehabilitation is not included in the above calculation as this sink is relatively small.

[21] Calculated using the NGO National Carbon Accounting Toolbox, which uses an above-ground biomass figure of 50.86 tCO_2/ha of vegetation.

16.5 PROPOSED MANAGEMENT ACTIONS

Management measures to reduce greenhouse emissions will be based on continuing Hanson's commitment to the National Greenhouse Challenge Plus; a voluntary and cooperative agreement with the Commonwealth Government. This is part of the Hanson's wider national operations, but includes the Red Hill Quarry operations, both current and proposed. The program encourages staff participation both at work and at home.

Under this agreement measures that have been committed to include an undertaking to:

- progressively update to energy-efficient light fittings
- install intelligent controls (i.e. daylight and occupancy sensing or one-shot timers) and task-based lighting
- shut down all non-essential equipment when an office is unoccupied
- ensure all new equipment purchases are of high energy-efficiency star rating
- implement a site energy audit
- ensure all replacement mobile plant equipment meets new emission standards
- improve quarry fuel efficiency through smarter operational management (e.g. haul road design, stockpile locations, machine efficiency)
- progressively replace the company truck fleet with new, more efficient electronic engines and lighter tare weights.

In addition to the Greenhouse Challenge Plus agreement, Hanson (2007) has a corporate Energy Management Policy aimed at abating the impact of its operations on climate. The policy commits Hanson to:

- measuring and reporting the carbon dioxide footprint of operations through an energy management process
- setting sustainable emissions reduction targets
- working with the supply chain (upstream and downstream) where possible to reduce carbon dioxide emissions associated with business operations
- encouraging employee awareness and encouraging the sharing of expertise and experience
- seeking to reduce impacts through work and management practices, continual improvement, training and the use of new technology
- complying with all applicable energy management laws, Regulations and Codes of Practice in existing operations, new developments and upgrades
- management review of energy objectives and targets
- communication of the policy
- consultation within Hanson and with other relevant bodies, community groups and neighbours about energy matters of common concern.

16.6 PREDICTED ENVIRONMENTAL OUTCOME

Based on an increase in product throughput from 1,000,000 to 1,500,000 t/yr, the proposed development will result in a net increase in the annual greenhouse gas emission levels from approximately 5,513 tCO_2-e to approximately 7,240 tCO_2-e (from fuel, power and explosives consumption). This is an approximate 40% increase in emissions. Emissions resulting from clearing approximately 80 ha of vegetation over the estimated 100 year life of the proposal will be approximately 15,000 tCO_2, or 150 tCO_2/yr. Implementation of Hanson's commitments made through the National Greenhouse Challenge Plus initiative and the company's Energy Management Policy, will enable the company to minimise emissions and provide a mechanism for continuous improvement in greenhouse gas emissions resulting from the proposed development. Commitments will be consistent with the EPA objective of minimising emission levels as low as practicable.

17. REHABILITATION AND CLOSURE

17.1 KEY STATUTORY REQUIREMENTS, ENVIRONMENTAL POLICY AND GUIDANCE

EPA objective

To ensure, as far as practicable, that rehabilitation achieves a stable and functioning landform that is consistent with the surrounding landscape and other environmental values.

EPA Guidance Statement No. 6

EPA Guidance Statement No. 6, "*Rehabilitation of Terrestrial Ecosystems*" (EPA 2006a), provides guidance on the rehabilitation of terrestrial ecosystems following disturbance. The Guidance Statement states that the key aims of rehabilitation are:

- to ensure the long-term stability of soils, landforms and hydrology required for the sustainability of sites
- to partially or fully repair the capacity of ecosystems to provide habitats for biota and services for people.

Actions relevant to rehabilitation planning and design include the identification of relevant rehabilitation objectives (in consultation with key stakeholders), as well as the development of clear targets for rehabilitation that can be effectively monitored and audited to confirm objectives are achieved. EPA (2006a) proposed standard objectives for rehabilitation are for rehabilitated sites to:

- include safe, stable and resilient landforms and soils
- include appropriate hydrology
- provide visual amenity
- retain heritage values
- be suitable for agreed land uses
- include resilient and self-sustaining vegetation comprised of local provenance species
- reach agreed numeric targets for vegetation recovery
- comprise habitats capable of supporting all types of biodiversity.

State legislation and guidelines

Ministerial conditions

Hanson prepared a Screening and Rehabilitation Program consistent with Condition 4-4 of Ministerial Statement No. 199 (as amended by Condition 2 of Ministerial Statement No. 705). Consistent with EPA Guidance Statement No. 6 (EPA 2006a), the Program contains:

- rehabilitation aims and key directions
- completion criteria for the final land surface

- rehabilitation program, including prescriptions for:
    - vegetation clearing
    - topsoil and overburden removal
    - landform reconstruction and contouring
    - soil reconstruction
    - erosion control
    - vegetation establishment
    - flora species lists for visual management and local community restoration
    - monitoring and review of rehabilitation program
- dieback management plan
- weed management plan
- review of rehabilitation performance.

The Program was distributed for comment to local residents and community groups in December 2006, and a meeting to discuss the Program was held in February 2007 with these residents and groups. Where relevant, the Program was amended to incorporate these comments. The Program was finalised in March 2007 and submitted for approval to the Minister for the Environment. A letter of receipt from the Minister was received on 2 April 2007. The Program is contained in Appendix 2 and more discussion provided in Section 17.3.

Other legislation and guidelines

In a legislative context, quarry rehabilitation and closure is governed by the following Western Australian legislation:

- *Environmental Protection Act 1986*
- *Mines Safety and Inspection Act 1994*
- *Conservation and Land Management Act 1984*
- *Planning and Development Act 2004.*

Several documents have been prepared at the State level relating to rehabilitation and closure of excavations (quarries and mines):

- Department of Minerals and Energy (1994) 'Environmental Management of Quarries: Development, Operation and Rehabilitation Guidelines'
- Australian and New Zealand Minerals and Energy Council (ANZMEC) and Mineral Council of Australia (MCA) (2000), 'Strategic Framework for Mine Closure'
- Chamber of Minerals and Energy (2000), 'Mine Closure Guidelines for Mineral Operations in Western Australia'.

Commonwealth guidelines

The Commonwealth Government, through Environment Australia (now Department for the Environment and Water Resources), have released a series of best-practice guidelines for environmental management in mining. These guidelines have been produced to assist mining companies in achieving acceptable standards of mine closure and rehabilitation, with some of the principles applicable to quarrying operations. The guidelines include:

- Environment Protection Agency (1995a), 'Environmental Monitoring and Performance'
- Environment Australia (1998), 'Landform Design for Rehabilitation'
- Environment Protection Agency (1995b), 'Rehabilitation and Revegetation'.

17.2 DESCRIPTION OF FACTOR

Quarrying and the establishment of associated infrastructure will result in clearing of vegetation and disturbance to soil profiles and landforms. Rehabilitation aims to restore disturbed landforms as rapidly as practical so they are sympathetic to surrounding areas and resemble the local environment as much as possible.

Hanson's environmental performance in relation to rehabilitation was recognised by being awarded a Greening Australia Award in 1992 for rehabilitation at the former Herne Hill Quarry site; the Hanson Byford Quarry was a finalist for this award in 1995. Rehabilitation of batters, benches, stockpiles, areas around site offices and other areas at the Red Hill Quarry has been undertaken since 1996.

General objectives for quarry closure are to prevent adverse environmental impacts and to create self-sustaining natural ecosystems or an alternative land use based on an agreed set of end-use objectives. Closure planning is a dynamic process that requires regular review and development throughout the life of an operation, to take into account changes in legal obligations, corporate requirements, community expectations and changes in technical knowledge.

17.3 REHABILITATION

The Red Hill Quarry Screening and Rehabilitation Program reflects the current procedures for rehabilitation activities and will be applied to the proposed operations (Landform Research 2007). The Program is contained in Appendix 2 and is consistent with EPA Guidance Statement No. 6 (EPA 2006a). The following overview of rehabilitation is based on information contained within this Program. The existing Program will continue to be updated as new methods become available in response to monitoring, site factors (e.g. location of the resource), environmental factors (e.g. soil stability and moisture), and visual observations.

Rehabilitated area of the overburden dump

Approximately 46,500 native plants and over 100 kg of native plant seed have been used in rehabilitation activities at the Red Hill Quarry to date. In some instances, direct return of topsoil has also been used as a method of rehabilitation. Monitoring of rehabilitated sites determines the success of rehabilitation works and provides information that can be used to improve practices.

17.3.1 Rehabilitation objectives

The proposed operations of the Red Hill Quarry development are expected to run for approximately 100 years; however, areas will be progressively rehabilitated during this time. The overall aim of rehabilitation is to restore disturbed areas to safe and stable landforms containing native plant communities that approximate those that existed prior to the commencement of activities.

The specific aims of Hanson's Red Hill Quarry Screening and Rehabilitation Program are to:

- enhance ecological linkages
- restore vegetation cover and fauna habitat
- utilise local plant species that are compatible with the particular microhabitat at each site
- utilise conservation significant plant species (should any have been cleared)
- minimise visual impacts
- restore soil and soil-based organisms
- minimise erosion and the potential for dust generation.

17.3.2 Rehabilitation procedures

Rehabilitation of areas disturbed for quarrying will be undertaken according to the procedures outlined in the Program. The current procedure involves:

- vegetation clearing
- topsoil and overburden removal
- landform reconstruction and contouring, soil reconstruction
- erosion control
- vegetation establishment.

Whilst vegetation clearing will be required to enable quarrying to proceed, the value of the vegetation in terms of success of future rehabilitation is acknowledged. The vegetation is a valuable source of local provenance seed, as well as potential fauna habitat and organic matter or mulch.

Following clearing, topsoil and overburden will be separately removed. As far as practicable, this material will be used immediately in areas where rehabilitation is imminent. Topsoil is generally considered to be the top 100 mm of the soil profile and is valuable as a source of local provenance seed, organic matter and soil micro-organisms.

Quarrying operations will produce a pit resembling an amphitheatre with rows of narrow benches separated by steep rock faces/slopes. Rehabilitation of the benches and slopes may be an interim measure, or may occur when quarrying ceases. In either case, the process is generally as follows:

- re-contour the land surface according to the post-excavation concept plans:
    - the 15º production angle of the slopes area is reduced, being pushed down or smoothed, to an angle of 25 – 45º (depending on the rock status, i.e. extremely weathered or fresh rock) to comply with the *Mines Safety and Inspection Act 1994*
    - compacted soils, gravels and clays are deep ripped in two directions at intervals of approximately one metre (where safe to do so)
    - contour furrows and undulations are created on slopes to assist water penetration and reduce water erosion (where safe to do so)
- where available, overburden is spread over the surface to a minimum depth of 500 mm
- topsoil is spread on top of overburden. Direct replacement of topsoil is the aim; however, the use of stockpiled material, or even direct revegetation of uncompacted overburden, occasionally occurs.

When rehabilitating dumps and batters, some of the above processes cannot be undertaken due to safety reasons. The core of dumps and batter slopes comprise rock to facilitate slope stability. Overburden is placed over the core and the surface is left sufficiently rough to reduce the likelihood of seed falling to the base of the slopes, to slow surface water runoff and to enhance water penetration. Surface water runoff is the primary cause of erosion, with control measures including the installation of cut-off drains and drainage networks.

Revegetation is conducted as soon as possible following the first winter after landform reconstruction and re-contouring. Revegetation techniques normally comprise utilisation of seed present within the topsoil, direct seeding and tubestock plantings. The tubestock planting rate is generally 500 – 1000 stems per hectare when combined with direct seeding.

Over 70 local native flora species are used during rehabilitation and the proportions of these vary according to the microclimate of the area (e.g. dry north facing slope compared to a damp area), the purpose of the rehabilitation and other factors. In those areas where visual management is a necessity, species richness is generally reduced to use those species that have higher growth rates and provide greater vertical and lateral coverage.

Local provenance species and Priority flora

Seed and tubestock used onsite in rehabilitation are obtained from commercial sources and utilise local provenance species[22]. Seeds specifically from the project area will be introduced via the reuse of topsoil on rehabilitation areas. Hanson will also undertake the local collection of seed for use in onsite rehabilitation.

One species of Priority flora, *Calothamnus rupestris*, known to occur on Lot 11 is already used in rehabilitation. This species was recorded as frequently occurring in rehabilitation areas in the 2002 review of rehabilitation at the Red Hill Quarry (Landform Research 2007) and was also recorded in

[22] 'Local provenance' typically means the Perth Hills region of the northern Jarrah Forest.

rehabilitation areas by Mattiske (2007; 2008). Hanson will continue to utilise *Calothamnus rupestris* in rehabilitation and will collect seed or other reproductive material (where viable) from other Priority flora species within areas to be cleared (e.g. *Acacia oncinophylla* subsp. *oncinophylla* and *Halgania corymbosa*). Hanson will also translocate Priority flora from within areas to be cleared to rehabilitation areas (where viable).

17.3.3 Maintaining and enhancing ecological linkages

Hanson is committed to retaining and enhancing the north – south corridors along the east and west boundaries of Lot 11 and the east-west corridor along Susannah Brook. This will maintain the connectivity between John Forrest National Park, Darling Range Regional Park, and the northern vegetated area of Lot 11, as well as retaining the riparian linkage along Susannah Brook into the Darling Range Regional Park. Hanson has proposed the retention of these corridors as Environmental Conditions (Section 19.3).

The north – south corridor on the western side of Lot 11 is approximately 700 m wide and comprises intact native vegetation as well as an area currently undergoing rehabilitation. The area currently being rehabilitated (approximately 28 ha) is associated with a stockpile site from the former Herne Hill Quarry operation. Rehabilitation is ongoing in this area and will continue with the aim of returning the vegetation to a state that resembles the surrounding native vegetation. This corridor will maintain a significant link between the Darling Range Regional Park to the north and John Forrest National Park to the south.

The north – south corridor on the eastern side of Lot 11 is approximately 100 m wide and connects John Forrest National Park (to the south) with native vegetation to the north of Lot 11 and the riparian vegetation along Susannah Brook. This area currently contains a number of disused and informal tracks that will be consolidated and rehabilitated to enhance its ecological linkage value. Tracks will remain open where they serve as required firebreaks.

Hanson will retain a buffer along Susannah Brook, which is, for the most part, approximately 100 m wide (the existing and proposed operations will remain to the south of Susannah Brook). Retention of this buffer will maintain the existing riparian vegetation and ecological linkage between the eastern and western parts of the Darling Plateau, including the Darling Range Regional Park.

17.3.4 Monitoring and performance indicators

Monitoring is essential to determine the success of rehabilitation and measure progression towards performance targets and completion criteria. It also allows planning for additional work to be undertaken in the coming season, when required. Monitoring at the Red Hill Quarry site is conducted frequently in an informal manner by way of drive-by visual inspections; formal monitoring is undertaken at least annually. Monitoring results are outlined in an Annual Environmental Summary Report and Audit Document, which is provided to EPA, DEC and City of Swan. Achievement of completion criteria is assessed approximately three years after the initial rehabilitation works were undertaken.

Formal monitoring generally involves surveying three sample plots (each approximately 9 m^2 [3 x 3 m]) in each area undergoing rehabilitation. The following parameters are considered when monitoring:

- species richness
- plant density (stems counted, lateral and vertical coverage)
- plant deaths
- growth rates
- weed infestation
- animal damage
- fire impact and sustainability
- visual protection.

Two formal reviews of rehabilitation at the Red Hill Quarry were undertaken in 2002 and 2006 and reported on by Landform Research (2007) (Appendix 1 of the Screening and Rehabilitation Program contained in Appendix 2 of this document). The first formal review (2002) involved areas at the Red Hill Quarry that were rehabilitated during 1996 – 1997 was undertaken in 2002. This review aimed to:

- compare species richness of the rehabilitated areas to the lists of species used
- determine the suitability of particular species for rehabilitation
- assess the effectiveness of the vegetation in providing cover of disturbed ground
- assess the density and sustainability of the vegetation.

Plant density in rehabilitated areas was lower than in undisturbed native plant communities, but was considered to provide acceptable ground cover given the types of plant species present were predominantly shrubs and trees. A total of 29 species were present in rehabilitated areas, including several that are thought to have originated from natural topsoil or seeding.

The following changes were made to rehabilitation procedures as a result of the 2002 assessment:

1. In visually-sensitive areas, the list of local species was restricted to those that have been proven to grow well in order to achieve better long-term lateral and vertical coverage; however, an increased species richness was recommended in areas adjacent to remnant vegetation.
2. Increased numbers of taller, long-lived tree species were included in the rehabilitation, particularly *Eucalyptus wandoo, E. calophylla* and *E. accedens*.
3. A target of 1300 stems of trees per hectare, with some long-lived, taller shrubs, was aimed for at establishment, together with a dense understorey and ground cover.
4. Both tubestock and seeding were used in rehabilitation.
5. Increased leguminous species were introduced.
6. The batter slopes and banks were left rough to increase water collection and provide a good substrate for seed establishment.

In 2006, a second review was conducted of the areas rehabilitated during 1996 – 1997, as well as areas that were rehabilitated during 2003 – 2005, including the south-western overburden dump. The 2006 review aimed to:

- re-assess the areas reviewed in 2002 to determine the sustainability of the vegetation
- assess whether the rehabilitated areas reviewed in 2002 continue to meet the aims of rehabilitation, particularly in regard to visual amenity
- determine the effectiveness of the modified rehabilitation procedures that resulted from the 2002 review.

More-recent rehabilitation has incorporated the changes recommended in the 2002 assessment and resulted in a higher average total number of stems, as well as higher lateral and vertical cover, than at similar stages in the 1996 – 1997 rehabilitation (Table 32). Some species were recognised to have established from existing seed in the topsoil as they are not included on species lists.

For areas rehabilitated in 1996 – 1997, vegetation cover did not change significantly between 2002 and 2006. Some shorter-lived species died, but were replaced by seedlings, indicating that the rehabilitation is self-sustaining.

Table 32 Comparison of flora parameters in rehabilitation areas of 1996 – 1997 and 2003 – 2005

Years of rehabilitation	Average total no. of stems	Average vertical cover	Average lateral cover
1996 – 1997[1]	0.96 plants/m^2	61%	94%
2003 – 2005[2]	2.52 plants/m^2	92%	96%

Source: Landform Research (2007)

[1] As reported by 2002 assessment.

[2] As reported by 2006 assessment.

17.3.5 Completion criteria

The existing completion criteria for the current Red Hill Quarry operations have been developed to apply to the final land surface and state that:

- the land surface is to be non-eroding and stable in compliance with the *Mines Safety and Inspection Act 1994* and DoIR *Guidelines for the abandonment of excavations*
- the land surface is to be consistent with the concept final contour plans
- rehabilitation is to follow the Key Directions of rehabilitation (as detailed in the Screening and Rehabilitation Program) wherever possible
- rehabilitation is to provide satisfactory visual screening and be self-sustaining to the number of plant stems and species
- a total of one native shrub or tree, averaged over each rehabilitation area, is to be present per 1 m^2 at 3 years post-rehabilitation
- rehabilitated areas are to have a minimum of 600 trees per hectare
- rehabilitated areas are to have ten local species per 100 m^2.

Some areas will be rehabilitated on an interim basis for visual enhancement, soil stabilisation and/or other purposes and, therefore, may not meet the completion criteria until quarry activities have ceased in the area.

Completion criteria for the proposed continued development of the Red Hill Quarry will be developed in consultation with DoIR and DEC (Nature Conservation Division & Environmental Management Division). The criteria will be directed towards the return of vegetation communities and habitat suitable for fauna typical of the area. The specific completion criteria may include (but not be limited to) flora and fauna species abundance, diversity and community composition and habitat characteristics.

17.4 CLOSURE

The proposed development will allow the Red Hill Quarry to continue operation for approximately 100 years. Consequently, planning for closure at this stage remains conceptual and flexible so that technological and societal changes that may ensue can be incorporated into the final closure plan. A Conceptual Closure Plan has been prepared for the Red Hill Quarry operation. The Plan is contained in the Environmental Management Plan (Appendix 2) and an overview provided below.

17.4.1 Industry guidelines

Regulatory agencies and industry bodies have established guidelines (industry best-practice) to assist quarrying companies to achieve acceptable standards of quarry closure and rehabilitation.

Whilst there is no legislative requirement to adhere to these guidelines, Hanson subscribe to the intent and advice of such guidelines. Industry best-practice guidelines include the following key documents:

- Department of Minerals and Energy (1994), 'Environmental Management of Quarries: Development, Operation and Rehabilitation Guidelines'
- Australian and New Zealand Minerals and Energy Council (ANZMEC) and Mineral Council of Australia (MCA) (2000), 'Strategic Framework for Mine Closure'
- Chamber of Minerals and Energy (2000), 'Mine Closure Guidelines for Mineral Operations in Western Australia'.

17.4.2 Closure objectives

Effective closure planning is required to ensure that the areas in which the company operates are left in a condition that minimises adverse impacts to the human and natural environment and that a legacy remains that makes a positive contribution to sustainable development.

The preliminary closure objective is to appropriately decommission the Red Hill Quarry operation in accordance with regulatory requirements and accepted best practice environmental management in order to relinquish to the community of a tidy, safe and uncontaminated site. This will be achieved through:

1. Construction of landforms that are stable, free-draining, non-polluting and aesthetically compatible with the surrounding landscape.

2. Establishment of sustainable endemic vegetation communities that are consistent with reconstructed landforms and surrounding vegetation and are suitable for the intended post-closure land use of the site.

17.4.3 Closure planning

The closure planning process is dynamic and will require regular review and further development throughout the expected 100 year life of the operation. This will be necessary to allow for changes to legal obligations, corporate requirements, community expectations, costs and the development of more detailed knowledge relating to technical issues.

Hanson's closure planning process will be ongoing with the ultimate aim of developing a Closure Management Plan. The closure planning process will include the following key tasks:

- reviewing and assessing available documentation and undertaking consultation to determine:
    - the existing environment
    - legal/regulatory requirements relevant to closure
    - existing and future environmental impacts relevant to closure
    - stakeholder expectations for closure
- undertaking comprehensive stakeholder consultation, which will be imparted via the Red Hill Quarry Stakeholder Reference Group that Hanson is in the process of establishing (Section 4.4)
- ensuring the likely cost of closure and other resources required to implement the closure plan are financially provided for
- determining accountability and responsibilities for closure
- developing acceptable completion criteria and indicators to measure the success of closure
- ensuring the community is not left with a liability.

Although the post-closure land use for the Red Hill Quarry has not yet been determined, there are several key scenarios that could apply:

- the quarry is left empty
- the quarry is used as a water catchment and storage area (with possible recreational uses)
- the quarry is filled with non-putrescible waste material such as rubble and waste rock.

These possible scenarios will be assessed throughout the development of the Closure Management Plan for the site.

Hanson recognises that one of the keys to achieving acceptable closure outcomes is the successful integration of closure concepts into ongoing and long-term quarry planning activities. The following considerations have been included in the current planning for the existing operation and proposed development to mitigate potential impacts of closure:

1. Progressive backfilling of the quarry void to improve post-quarrying landform; however, backfilling will be only partial due to limited quantities of backfill material available.
2. Identification of ecological linkages and:

- avoiding direct and indirect impacts to these linkages
- enhancing the ecological values of these linkages.

3. Retaining a vegetative buffer along Susannah Brook.
4. Progressive rehabilitation of disturbed areas no longer required for operations.
5. Establishment of rapid rehabilitation on terminal benches to reduce visual impacts.
6. Establishment of stormwater drainage structures to:
    - minimise erosion impacts on quarrying operations
    - provide protection of post-quarrying landforms from erosion.

17.5 PROPOSED MANAGEMENT ACTIONS

Rehabilitation and closure issues at the Red Hill Quarry will be addressed by the following proposed management actions:

- continue to implement and annually review/update the Screening and Rehabilitation Program (contained in Appendix 2) to ensure management measures include:
    - description of the rehabilitation process
    - completion criteria
    - use of local provenance seed and Priority flora in rehabilitation
    - monitoring of rehabilitation
- undertake closure of the Red Hill Quarry operation to meet predetermined closure targets and completion criteria; preliminary closure targets are contained in the Conceptual Closure Plan (contained in the Environmental Management Plan – Appendix 2); completion criteria to be developed in consultation with relevant stakeholders
- undertake progressive backfilling of the quarry void
- undertake progressive rehabilitation of disturbed areas no longer required for operations.

17.6 PREDICTED ENVIRONMENTAL OUTCOME

Hanson will continue to implement the existing Red Hill Quarry Screening and Rehabilitation Program (Appendix 2), which is consistent with EPA Guidance Statement No. 6 (EPA 2006a) and will be amended as necessary to accommodate changes in industry best-practice and/or improved practices based on monitoring results. Hanson has prepared a Conceptual Closure Plan for the Red Hill Quarry and will update the Plan to incorporate technological and societal changes that are likely to occur throughout the expected 100 year life of the proposed operation. Review of the Screening and Rehabilitation Program and the Conceptual Closure Plan will be undertaken in consultation with relevant stakeholders to ensure that rehabilitation and closure issues are addressed at the earliest stage in the quarry-life and that they are managed appropriately to meet the EPA objective of ensuring rehabilitation achieves a stable and functioning landform consistent with surrounding landscape.

PART 4 PROPOSED ENVIRONMENTAL MANAGEMENT PROGRAM & ENVIRONMENTAL OUTCOMES OF PROJECT

18. ENVIRONMENTAL MANAGEMENT FRAMEWORK

Hanson will minimise impacts to the environment and manage relevant aspects of their operation through the implementation of measures, of which are already in place. These include:

- maintaining an Environment Management System (EMS) (in place)
- preparing and implementing an Environmental Management Plan (EMP) for the Red Hill Quarry operation (prepared)
- implementation of the Red Hill Quarry Screening and Rehabilitation Program, which includes regular review and revision of the Program (prepared)
- progressing closure planning in consultation with stakeholders (ongoing)
- formation of a Stakeholder Reference Group to facilitate open and effective communication between Hanson and the local community (in progress)
- training quarry personnel and contractors in environmental requirements of their work (ongoing)
- regular reporting of environmental performance to stakeholders (ongoing)
- continual improvement of environmental management measures implemented onsite (ongoing).

Hanson seeks to abide by the environmental protection principles listed in s4a of the EP Act through its strong commitment to environmental management at its operations (Section 5). These principles are reflected in Hanson's Environmental Policy (Section 18.1) and EMS (Section 18.2).

Hanson is a member of the Commonwealth Greenhouse Challenge Plus and operates to an Energy Management Policy (Section 16.5).

18.1 PROPONENT'S ENVIRONMENTAL POLICY

The Hanson Environmental Policy was signed in July 2004 by the company's Chief Executive Officer. The Environmental Policy is the guiding document for driving environmental management and provides context and specific direction for continuous improvement.

Environmental policy

Hanson accepts the responsibility for environmental protection which is integral to the conduct of its commercial operations.

Hanson is committed to:

Operating practices which seek to minimise impacts, prevent pollution and minimise the likelihood of environmental harm through work and management practices, continual improvement, training and the use of new technology;

- *Compliance with all applicable environmental laws and regulations and Codes of Practice in existing operations, new developments and upgrades;*
- *Management review of environmental objectives and targets;*
- *Waste management to minimise wastes, develop viable recycling opportunities, and ensure proper handling and disposal methods;*
- *Product development which seeks to combine commercial viability and efficient use and conservation of resources;*
- *Environmental assessment of new projects, asset purchases, sales and existing operations;*
- *Environmental Incident Response – contingency plans to minimise health, safety and environmental risks;*
- *Rehabilitation of areas affected by business operations;*
- *Communication of the Hanson environmental policy; and*
- *Striving to meet Community Expectations through consultation within Hanson and with other relevant bodies, community groups and neighbours about environmental matters and common concern.*

Hanson will encourage concern and respect for the environment and will emphasise every employee's responsibility for environmental performance.

18.2 ENVIRONMENTAL MANAGEMENT SYSTEM (EMS)

Hanson maintains an environmental management system consistent with ISO 14001, which is an international standard that encompasses all of its activities. It sets environmental objectives and targets for potential significant aspects and ensures all employees with environmental responsibilities know what is required of them and are achieving the necessary standards. The key elements of the EMS include assessing environmental risk and legal requirements, developing objectives and targets for improvement, training, operational control, communication, emergency response, corrective actions, audits and review.

18.3 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

The EMP will be implemented to specifically address management of environmental issues potentially arising from the operation of the existing and proposed Red Hill Quarry operation. The draft Red Hill Quarry EMP is contained in Appendix 2. The draft EMP addresses the following factors:

- vegetation and habitat protection
- fauna protection
- surface water quality management
- noise and vibration control
- dust control
- fire management
- traffic management.

A Conceptual Closure Plan is also detailed in the EMP.

Rehabilitation is addressed in the Screening and Rehabilitation Program (Section 18.4). This Program also addresses the management of weeds and dieback. The EMP also includes details of monitoring that will be undertaken and the EMP will be regularly reviewed and revised where relevant.

18.4 SCREENING AND REHABILITATION PROGRAM

The Red Hill Quarry Screening and Rehabilitation Program reflects the current procedures for rehabilitation activities and management of weeds and dieback. This Program also addresses the management of weeds and dieback. The Program will continue to be updated as new methods become available in response to monitoring, site factors (e.g. location of the resource), environmental factors (e.g. soil stability and moisture), and visual observations.

19. KEY MANAGEMENT ACTIONS AND PROPOSED ENVIRONMENTAL CONDITIONS

19.1 OVERVIEW

Hanson has developed Key Management Actions and proposed Environmental Conditions (Section 19.2 and Section 19.3 respectively) to address the key environmental aspects of the proposed development and so as not to duplicate management requirements of other regulatory controls (e.g. DEC Licence for prescribed premises). It is proposed that these Key Management Actions and Environmental Conditions are incorporated into the Ministerial Statement to apply to the whole operation (i.e. current and proposed operation) to replace existing Conditions and proponent commitments of Ministerial Statements No. 199 and 705 that apply to the current operation.

In addition to approval under Part IV of the EP Act, other approvals are and will be required for the operation of the existing and proposed Red Hill Quarry development. A summary of these control instruments is contained in Section 19.1.1.

Hanson has also proposed environmental offsets (Section 19.1.2) and has recently formed the Red Hill Quarry Stakeholder Reference Group (Section 19.1.3).

19.1.1 Summary of likely environmental control instruments

Table 33 outlines the controls that exist or will be in place to ensure environmental compliance and appropriate environmental management of the Red Hill Quarry development in regard to each environmental factor and aspect. Key environmental requirements or controls are drawn from the following:

- Environmental Conditions and Key Management Actions (proposed for the Ministerial Statement)
- conditions of DEC Licence (under Part V of the EP Act) for prescribed premises (Category 12 – screening of materials)
- conditions of Development Approval and Excavation Licence (administered by City of Swan and Department of Planning and Infrastructure)

Hanson is also required to comply with relevant legislation and regulations as indicated in the relevant sections of this PER document. Key legislation (and regulations) that apply to the Red Hill Quarry operation includes:

- *Wildlife and Conservation Act 1950*: protection of DRF and rare or endangered fauna species
- *Aboriginal Heritage Act 1972*: protection of Aboriginal heritage sites
- *Dangerous Goods Safety Act 2004* (and associated regulations): specifies requirements for storage and handling of dangerous goods
- Environmental Protection (Noise) Regulations 1997: specifies noise levels and air blast criteria.

DEC licence

The Red Hill Quarry operation is licensed as a Category 12 prescribed premise under Part V of the EP Act; the proposed development is not expected to alter the prescribed premise category. Current licence conditions relate to:

- air pollution (dust) prevention measures:
    - requires prevention of dust through use of appropriate measures including water sprays, water trucks, dust collection systems, coverings on conveyors and transfer points
- water pollution control measures:
    - retention of contaminated stormwater: requires the premises are drained such that all contaminated stormwater generated is retained onsite
    - monitoring of surface water: prescribes frequency of sampling, sampling locations and parameters water samples are to be analysed for
    - suspended solids limit: prescribes an upper limit for TSS of 80 mg/L above ambient water samples taken at the same time
    - vehicle washdown areas: requires vehicle washdown areas to be fitted with oil/water interceptors and provisions to ensure contaminated wash-down water is not discharged to the environment
- noise pollution control measures:
    - air blast monitoring: requires monitoring of air-blast for all blasts
    - ground vibration monitoring: requires measuring peak particle velocity for all blasts and prescribes an upper limit of 10 mm/sec for peak particle velocity.

Development Approval and Excavation Licence

The Red Hill Quarry operates under a Development Approval (administered by the City of Swan and Department of Planning and Infrastructure) and an Excavation Licence (administered by the City of Swan). Current approval and licence conditions relate to:

- prescribing quarry operating hours
- blasting requirements:
    - to be carried out in accordance with DEC Licence
    - prescribing hours between which blasting can be undertaken
    - prescribing number of blasts that can occur per calendar week
    - blasting not to occur during adverse weather conditions that may increase noise emissions
- excavation and rehabilitation (to be undertaken in accordance with the Excavation and Rehabilitation Management Plan submitted by Hanson with the licence application)
- prescribing vehicle entry point to the quarry (e.g. restricting to the Toodyay Road entrance)
- maintaining the access road to the standards and specifications of the City of Swan.

19.1.2 Summary of proposed environmental offsets

The environmental offsets proposed for the Red Hill Quarry Development Proposal have been developed in accordance with EPA Position Statement No. 9 (EPA 2006b) and EPA Guidance Statement No.19 Guidance for Environmental Offsets (EPA 2007b) (Table 34).

Environmental assets were classified in terms of their relative value to allow application of the decision making matrix presented in Environmental Position Statement No. 9 (EPA 2006b). Each asset has been assessed in terms of the ability to mitigate the potential onsite impacts to the asset and the significance of any residual impact after mitigation measures are applied. Where there are impacts to environmental assets preliminary environmental offsets are proposed.

Under the decision making matrix, riparian vegetation/habitat is classified as a 'critical asset', while the remainder of vegetation/habitat and flora is classified as a 'high value asset'.

Riparian vegetation/habitat can be completely avoided; however, complete avoidance of vegetation/habitat and flora within the proposed development area is not possible due to resource yield requirements. The level of vegetation/habitat clearing proposed may represent a residual impact requiring some degree of offset (Table 34). In addition, a preliminary environmental offset is also proposed for riparian vegetation/habitat even though this critical asset will be completely avoided, as an environmental benefit arising from implementation of the proposal (Table 34).

Direct and contributing offsets have been proposed and include initiatives such as:

- enhancing riparian vegetation/habitat and undertaking weed control along Susannah Brook
- enhancing north – south and east – west ecological corridors on Lot 11
- managing remnant vegetation on Lot 11 to protect biodiversity values
- assisting DEC with feral fauna control in adjacent conservation reserves.

An area of approximately 235 ha of Darling Range Regional Park adjoins the north-western boundary of Lot 11. This area of land was sold by Hanson to the State Government in 2003 for inclusion in the Regional Park.

19.1.3 Red Hill Quarry Stakeholder Reference Group (SRG)

Hanson formed the Red Hill Quarry Stakeholder Reference Group (SRG) in early 2008 (Section 4.4). Initially, the SRG will meet quarterly during 2008, throughout the remainder of the environmental impact assessment/approval process. The continuation of the SRG post-2008 will be decided by the SRG members. Should the SRG members decide in favour of continuation of the SRG, the composition and function of the group will also be reviewed.

Table 33 Statutory and environmental management controls for the proposed Red Hill Quarry

Key environmental factors	Topic/aspect	Key Management Actions	Environmental Conditions*	DEC Licence	Development Approval** Excavation Licence**	Other relevant legislation and regulations***
Vegetation and flora	Protection of areas not approved to be cleared	✓				
	Protection of riparian vegetation		✓		✓	
	Protection of DRF					✓
	Weed management	✓			✓	
	Dieback management	✓			✓	
	Pre-clearing flora surveys	✓				
	Maintenance of ecological corridors		✓			
	Ongoing knowledge development (e.g. flora surveys)	✓				
Fauna	Protection of areas not approved to be cleared	✓				
	Protection of riparian habitat		✓		✓	
	Protection of rare and endangered fauna species					✓
	Pre-clearing inspection of tall trees	✓				
	Feral fauna management	✓				
	Maintenance of ecological corridors		✓			
	Ongoing knowledge development (e.g. gecko surveys)		✓			
Conservation areas	Boundary operations management (e.g. weed and dieback management)	✓			✓	
	Feral fauna management	✓				
Susannah and Strelley brooks	Protection of riparian vegetation (vegetative buffer)		✓		✓	
	Drainage management			✓	✓	
	Surface water quality monitoring			✓	✓	
	Prevention of surface water contamination			✓	✓	✓
Groundwater	Prevention of groundwater contamination					✓
Noise and vibration	Noise and vibration management			✓	✓	✓
Dust	Dust management			✓	✓	
Visual amenity	Regular visual assessments	✓				
Aboriginal heritage	Proection of Aboriginal heritage sites					✓
Rehabilitation and closure	Screening and Rehabilitation Program				✓	
	Onsite collection of seed or other reproductive material from Priority flora	✓				
	Translocation of Priority flora	✓				
	Develop rehabilitation completion criteria		✓			
	Undertake closure to meet pre-determined targets		✓			

Key environmental factors	Topic/aspect	Key Management Actions	Environmental Conditions*	DEC Licence	Development Approval** Excavation Licence**	Other relevant legislation and regulations***
Monitoring	-		✓	✓		
Reporting	-		✓	✓		
Auditing	-			✓		

* Environmental Conditions proposed by Hanson (Section 19.3).

** The current Development Approval and Excavation Licence require excavation and rehabilitation to be carried out in accordance with the Excavation and Rehabilitation Management Plan submitted by Hanson with the Approval/Licence application; this Management Plan contains management measures for most environmental factors.

*** Other relevant legislation and regulations are detailed in Section 19.1.1.

Table 34 Assessment of proposed environmental offsets against EPA Position Statement No. 9, Environmental Offsets (EPA 2006b)

Environmental assets	Onsite impact mitigation					
	Avoid	Minimise	Rectify	Reduce	Residual impact	Offsets offered
Critical assets						
Riparian vegetation/ habitat Susannah Brook (a tributary of the Swan River) flows in an east-west direction across Lot 11 and is to the north of the proposed development area. A branch of Strelley Brook (a tributary of Jane Brook) originates on Lot 11 and flows in a south-westerly direction. Strelley Brook is to the south of the proposed development area. The proposed development will not cross either watercourse.	Able to be avoided. A minimum 50 m buffer between quarrying operations and Susannah Brook will be maintained on both sides of the Brook. In most instances this buffer will be extended to 100 m. The proposed pit will only be within 100 m (but not within 50 m) of Susannah Brook for approximately 250 m of the 2.5 km length of the Brook that traverses Lot 11. Proposed development will remain approximately 500 m from Strelley Brook.	NA	NA	NA	No impact	Offset not required but Hanson will commit support to enhance the environmental value of this critical asset as an environmental benefit. **Direct** Enhancement of riparian vegetation on Susannah Brook Hanson will contribute to the rehabilitation of riparian along sections of Susannah Brook in cooperation with local community groups such as the Susannah Brook Catchment Group. **Contributing** Removing threats to Susannah Brook Hanson will assist where possible with weed control along Susannah Brook both onsite (on Lot 11) and offsite. Offsite weed control will be in cooperation with local community groups such as the Susannah Brook Catchment Group.

Environmental assets	Onsite impact mitigation					
	Avoid	**Minimise**	**Rectify**	**Reduce**	**Residual impact**	**Offsets offered**
High value assets						
Vegetation/habitat and flora Clearing of three vegetation complexes that have greater than 30% of their pre-European extent remaining. All vegetation complexes and site-vegetation types that will be disturbed are present elsewhere on Lot 11 and locally in nearby conservation reserves. Three Priority flora species are known to occur in the proposed development area; *Calothamnus rupestris* (P4), *Acacia oncinophylla* subsp. *oncinophylla* (P3) and *Halgania corymbosa* (P3). The project area contains habitat that is likely to be suitable for several fauna species of State and Commonwealth conservation significance. The level of likely use of the area by these species varies. For example Black-cockatoos are likely to be only present as visitors, passing over the area and using the area opportunistically for feeding (but not for breeding), whereas, the area is likely to be within the home range of Chuditch and could be used frequently.	Avoidance of all individuals of Priority flora and vegetation/habitat in the proposed development area is not possible.	Vegetation/habitat clearing has and will be minimised by site layout and design management, including: • utilising existing infrastructure areas and haul roads • strict clearing controls to ensure only approved areas are cleared • investigating opportunities to further reduce clearing requirements within the approved areas during the detailed quarry planning stage.	Areas no longer required for operation of the quarry will undergo progressive rehabilitation in accordance with the Red Hill Quarry Screening and Rehabilitation Program. Rehabilitation will aim to restore Priority species. *Calothamnus rupestris* has already been successfully returned to rehabilitation areas at the Red Hill Quarry. Rehabilitation will also utilise flora species known to be Black-cockatoo food-plants. Should pre-clearing inspections of tall trees (should they be present) identify the presence of hollows actively being used by Black-cockatoos, a nest box will be installed in a nearby vegetated area.	Will undertake review and continual improvement of rehabilitation techniques, including increasing the return of Priority flora species and flora species important for Black-cockatoo feeding.	Approximately 80 ha of vegetation will be progressively cleared over the 100 year life of the project (or on average less than 1 ha/yr). The long-term clearing requirements are not likely to significantly affect the local or regional representation of the site-vegetation types given the level of representation of the site-vegetation types outside the proposal area. The three Priority flora species will be directly affected by the proposed development, although none are restricted to the proposed development area and have been recorded elsewhere on Lot 11 and nearby conservation reserves. Habitat will be progressively removed as the proposal is developed and this may lead to habitat fragmentation.	**Direct** Enhancement of onsite ecological corridors Hanson will retain and enhance (i.e. rehabilitate where required) the north – south vegetated corridors along the east and west boundaries of Lot 11 and the east – west vegetated corridor along Susannah Brook. This will maintain the connection between John Forrest National Park, Darling Range Regional Park and the northern vegetated area of Lot 11, as well as retaining the riparian linkage along Susannah Brook into the Darling Range Regional Park. Enhancing the ecological corridors will include: • rehabilitating disturbed areas • consolidating roads/tracks and other disturbed areas that are no longer required for safe operation of the quarry. See also Section 17.3.3. **Contributing** Removing threats to remnant vegetation Hanson will continue to manage areas of remnant vegetation on Lot 11 consistent with DEC conservation area management practices to protect biodiversity values. This will include: • restricting unauthorised access (i.e. maintaining perimeter fencing) • active management of weeds • dieback monitoring. Removing threats to fauna Hanson will assist with trapping and eradication programs undertaken by DEC in adjacent conservation reserves.

19.2 KEY MANAGEMENT ACTIONS

Key Management Actions have been developed to address the key environmental aspects of the proposed development and to be incorporated in the Ministerial Statement (Table 35). The Key Management Actions do not duplicate management requirements imposed through other regulatory controls (e.g. DEC Licence for prescribed premises).

Table 35 Key Management Actions

No.	Key Management Action
1	The proponent will assist DEC with feral fauna trapping and eradication programs undertaken in areas of John Forrest National Park adjacent to Lot 11 and the area of the Darling Range Regional Park adjacent to Lot 11. The level and type of assistance will be determined in consultation with DEC.
2	The proponent will conduct pre-clearing inspections for hollow-bearing trees that may be used for Black-Cockatoo nests. If a hollow is actively used a nest box will be installed in a suitable tree in adjacent vegetation not scheduled to be cleared.
3	The proponent will conduct pre-clearing searches for DRF and Priority flora if no surveys have been conducted in those areas for ten years or more.
4	If Priority flora is present in areas to be cleared, the proponent will either: • undertake collection of seed or other reproductive material (where viable) from the Priority flora plants for use in on-site rehabilitation • translocate the Priorty flora plants (where viable) for use in on-site rehabilitation.
5	The proponent will undertake annual weed inspections of operational areas (including internal access tracks and firebreaks) and adjacent vegetation on Lot 11 and carry out weed control if Declared Plants are found to be present.
6	The proponent will undertake annual visual inspections for dieback (Phytophthora cinnamomi) in vegetated areas adjacent to operational areas (including internal access tracks and firebreaks) on Lot 11 and will undertake a dieback assessment every five years (to include soil sampling) to assess the presence of dieback on Lot 11 and the effectiveness of on-site hygiene measures.
7	The proponent will undertake a visual assessment of the development every five years (post-2007) to assess the visual appearance of the operation in comparison to that predicted in the John Cleary Planning (2007) visual assessment report (Red Hill Quarry Development, Toodyay Rd, Red Hill: Landscape and Visual Assessment).

19.3 PROPOSED ENVIRONMENTAL CONDITIONS

Hanson proposes the Environmental Conditions presented in Table 36 for the management of the Red Hill Quarry development for incorporation in the Ministerial Statement to apply to the whole operation (i.e. current and proposed operation). Similar to the Key Management Actions, these conditions have been proposed so as not to duplicate the requirements of other regulatory controls; Hanson do not consider it necessary to prescribe other outcomes for those factors covered by other regulatory controls.

Hanson has indicated in Table 36 where the proposed Environmental Conditions are intended to replace existing Conditions and/or proponent commitments of Ministerial Statements No. 199 and 705. Hanson considers the remaining Conditions and proponent commitments detailed in Ministerial Statements No. 199 and 705 (not replaced by the proposed Environmental Conditions) to:

- not be auditable and therefore not enforceable
- no longer be relevant (i.e. fulfilled)
- be prescriptive as opposed to outcome-based

- be adequately covered by/in:
  - Key Management Actions (Section 19.2)
  - other environmental control instruments (Section 19.1.1)
  - EMP (Section 18.3)
  - Screening and Rehabilitation Program (Section 18.4).

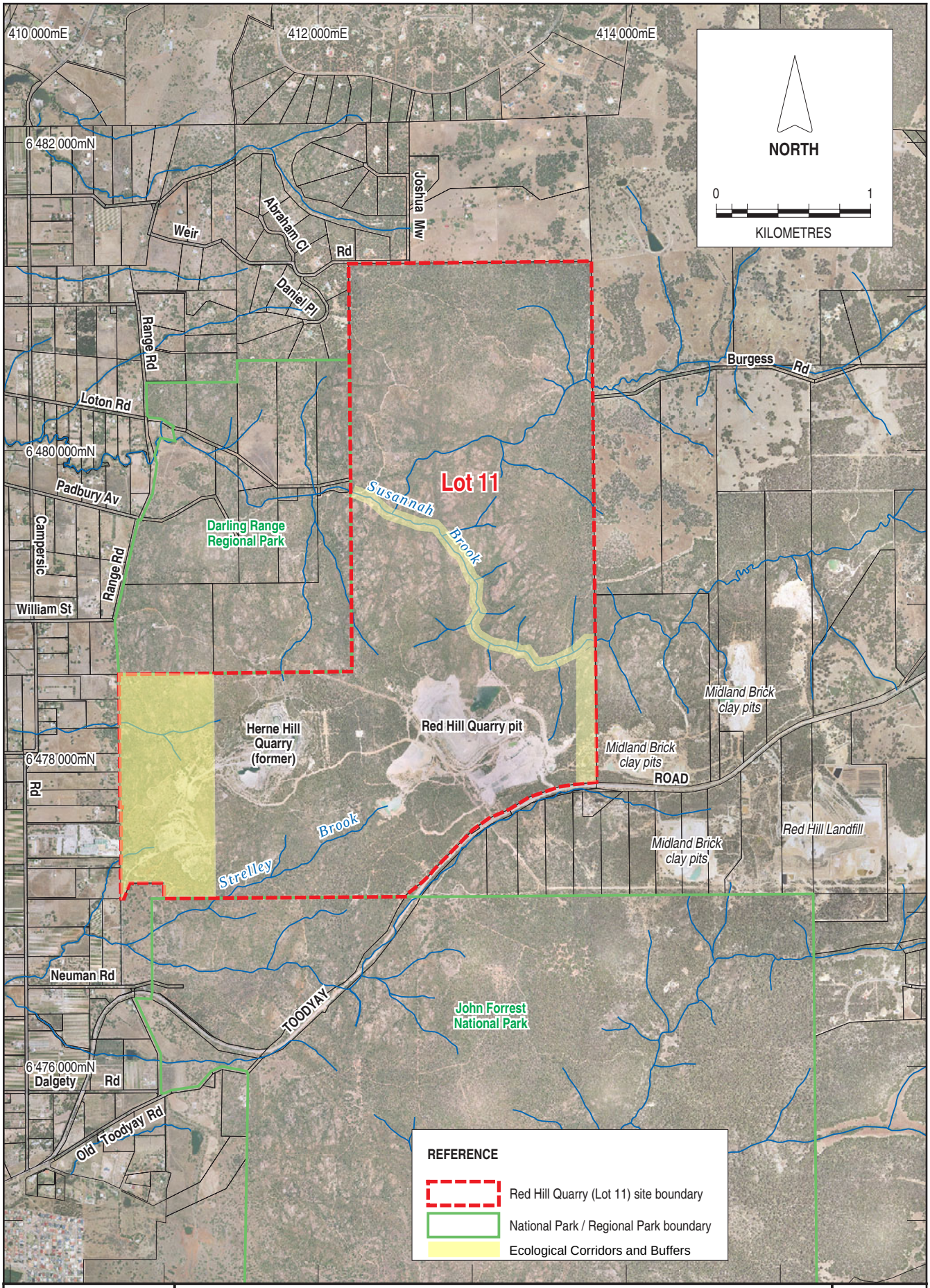
A summary of the how the existing Conditions and proponent commitments contained in Ministerial Statements No. 199 and 705 have been addressed/considered for the proposed development is presented in Appendix 3.

Table 36 Proposed environmental conditions

No.	Proposed Environmental Condition	Relationship to Ministerial Statements No. 199 and 705
1	**Ecological corridors and buffers**	Proposed Condition to replace:
1-1	The proponent shall not disturb, other than for rehabilitation purposes, the north – south vegetated corridors along the east and west boundaries of Lot 11, as shown in Figure 34.	• 199:P14 (as replaced by 705:P14) • 199:P3
1-2	The proponent shall not disturb or undertake quarrying activities within the vegetated area along Susannah Brook as shown in Figure 34.	
2	**Rehabilitation**	Proposed Condition to replace:

2-1	The proponent shall finalise the following preliminary rehabilitation completion criteria in consultation with DEC:
	• re-establishment of vegetation in rehabilitation areas shall be such that the following criteria are achieved within three years:
	  • the land surface is non-eroding and stable
	  • one native plant species per 1 m^2 (averaged over each rehabilitation area)
	  • minimum of 600 native tree species per hectare
	  • percentage weed cover is less than 10%.
		• 199:M4 (as amended by 705:M2)
		• 199:P10 (as replaced by 705:P10)
		• 199:P2
		• 199:P28
		• 199:P29
		• 199:P30

2-2	The proponent shall monitor the performance of rehabilitation against criteria developed in 1 above based on an annual spring monitoring program.	
2-3	An annual rehabilitation monitoring report shall be submitted to the CEO of DEC, made publicly available and advertised in local newspaper, addressing: • progress towards meeting criteria developed in 2-1 above • contingency measures to be implemented where criteria are unlikely to be achieved.	
3	**Surveying for gecko species**	New Environmental Condition
3-1	The proponent shall undertake further survey work of the undescribed taxon of gecko (*Diplodactylus* aff. *polyophthalmus*) recorded on Lot 11 for the purposes of: • collecting additional specimens for the WA Museum to carry out genetic investigations to determine its relationship with recognised species • determining the distribution of the species on Lot 11 and in adjacent John Forrest National Park.	
3-2	The results of the survey work shall be provided to DEC and the WA Museum	
4	**Closure**	Proposed Condition to replace:
4-1	The proponent shall develop closure completion criteria at least two years before closure, in consultation with relevant stakeholders and the requirements of the CEO of DEC.	• 199:M5 • 199:P7



strategen

Hanson Construction Materials Pty Ltd
RED HILL QUARRY DEVELOPMENT PROPOSAL

LOCATION OF ECOLOGICAL CORRIDORS & BUFFERS

Figure 34

Environmental GIS (08) 9486 9222

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20. CONCLUSION

The key environmental factors identified by Hanson, Government agencies and the community in relation to the Red Hill Quarry proposed development are:

1. Vegetation and flora: conservation of regional biodiversity.
2. Fauna: retention and enhancement of ecological linkages.
3. Public amenity (related to visual amenity, dust, noise and vibration, traffic): minimising impacts on public amenity.
4. Susannah and Strelley brooks: protection of water quantity and quality, and riparian vegetation.
5. Aboriginal heritage: protection of registered Aboriginal sites.
6. Rehabilitation and closure: progressive rehabilitation and closure planning.

20.1 ENVIRONMENTAL IMPACTS AND MITIGATION

In summary, the anticipated environmental impacts of the proposal, their significance and proposed management measures are as follows:

- progressive removal of approximately 80 ha of vegetation over the 100 year life of the proposal (or on average less than 1 ha/yr), which is unlikely to significantly affect local and regional vegetation values; the affected vegetation complexes and site-vegetation types are relatively well represented locally and regionally (with greater than 30% of vegetation complexes remaining); with progressive rehabilitation of areas as they are no longer required
- disturbance of some individual plants of three species of Priority flora (*Calothamnus ruprestris* – P4, *Acacia oncinophylla* subsp. *oncinophylla* – P3 and *Halgania corymbosa* – P3), which is not expected to affect the conservation status of the species; efforts to restore the species to rehabilitated areas will be made through continual improvements of techniques described in the Screening and Rehabilitation Program
- potential risk of the introduction and/or spread of weeds and dieback will be managed through ongoing implementation of weed control and hygiene measures
- potential for habitat fragmentation, and consequent effects on fauna populations, will be reduced through the maintenance and enhancement of north – south and east – west vegetated ecological corridors on Lot 11
- an approximate 2% and 0.4% reduction in the catchment area of Susannah and Strelley brooks respectively, at the final extent of the proposed development, may reduce streamflow in the watercourses; however this is not expected to cause any significant impact to the watercourses or associated surface water-dependent ecosystems as the associated drop in stream stage height will not be significant (approximately 10 – 20 mm over the 100 year life of the proposal)
- potential for impact to water quality of Susannah and Strelley brooks will be managed through onsite stormwater management measures continuing to be implemented; current water quality monitoring results indicate that the existing quarry operation has had no effect on water quality in Susannah and Strelley brooks
- potential for dust generation will continue to be managed through ongoing implementation of dust control measures

- noise and vibration levels may increase at surrounding sensitive premises as the proposed development of the pit extends towards these premises but will remain below noise and vibration levels prescribed in the Noise Regulations
- visual screening will continue to be utilised to screen aspects of the operation.

The proposal will not affect:

- riparian vegetation along Susannah and Strelley brooks as it will be protected from disturbance; a minimum 50 m buffer between operations and Susannah Brook (of the approximate 2.5 km length of Susannah Brook that traverses Lot 11, the proposed development will only come closer than 100 m [but not within 50 m] to the brook for approximately 250 m of its length) and an approximate 500 m buffer from Strelley Brook
- local or regional hydrogeological regimes through the excavation of the proposed pit
- registered Aboriginal heritage sites on Lot 11 as they will continue to be protected from disturbance.

20.2 ENVIRONMENTAL RISKS AND MANAGEABILITY

The approach taken in this environmental review has been based on a risk assessment approach to characterise environmental factors, determine potential impacts and develop mitigation measures.

Hanson has extensive experience in managing the development, operation and environmental compliance of similar projects (including the existing Red Hill Quarry operation) and this experience is anticipated to lead to a greater certainty in achieving desirable environmental outcomes.

The environmental aspects of the proposal will be primarily managed through the Red Hill Quarry EMP and Screening and Rehabilitation Program, Hanson's EMS, relevant licences and the implementation of the proposed Key Management Actions and Environmental Conditions for the Red Hill Quarry proposed development. Hanson will also ensure an acceptable closure outcome through ongoing revision of the Conceptual Closure Plan for the Red Hill Quarry, which will include development of closure completion criteria in consultation with relevant stakeholders.

Hanson has consulted with stakeholders (including Government agencies, non-government organisations, community groups and neighbours/residents) to scope the potential impacts of the proposal and to determine the significance of environmental issues and the acceptability of mitigation. This process substantially improves the likelihood that all significant environmental issues have been identified, investigated and mitigated as far as practicable.

21. REFERENCES

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22. SHORT TITLES, CONTRACTIONS AND ACRONYMS

Table 37 sets out the short titles and acronyms used in this report.

Table 37 Short titles and acronyms

Short title or acronym	Long title
˚C	Degrees Celsius
µm	Micrometres
µg/m3	Micrograms per cubic metre
Aboriginal Heritage Act	*Aboriginal Heritage Act 1972* (WA)
AGO	Australian Greenhouse Office
ANZECC	Australia and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
CALM	Department of Conservation and Land Management (former – WA)
CAMBA	China-Australia Migratory Bird Agreement
CITES	Convention on International Trade in Endangered Species
CO_2	Carbon dioxide
CO_2-e	Carbon dioxide equivalents
CS	Conservation significant
Cth	Commonwealth
dB	Decibel/s
DEC	Department of Environment and Conservation (WA)
DIA	Department of Indigenous Affairs (WA)
DoIR	Department of Industry and Resources (WA)
DoW	Department of Water (WA)
DRF	Declared Rare Flora
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMRC	East Metropolitan Regional Council
EMS	Environmental Management System
EPA	Environmental Protection Authority (WA)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
EPASU	Environmental Protection Authority Service Unit (WA)
EP Act	*Environmental Protection Act 1986* (WA)
GHG	Greenhouse gases
GL/yr	Gigalitres per year
ha	Hectares
Hanson	Hanson Construction Materials Pty Ltd
Hr/s	Hours
IOCI	Indian Ocean Climate Initiative
IUCN	International Union for Conservation of Nature
JAMBA	Japan-Australia Migratory Bird Agreement
kL/yr	Kilolitre/s per year
km	Kilometre/s

Short title or acronym	Long title
km/hr	Kilometre/s per hour
L	Litre/s
m	Metre/s
m^2	Square metre/s
mg/L	Milligram/s per litre
mm	Millimetre/s
mm/sec	Millimetre/s per second
MRWA	Main Roads Western Australia
NEPC	National Environmental Protection Council
NEPM	National Environmental Protection Measure
NGS	National Greenhouse Strategy
Noise Regulations	Environmental Protection (Noise) Regulations 1997 (WA)
No.	Number
P	Priority
PER	Public Environmental Review
PM_{10}	Particulate matter with an equivalent aerodynamic diameter 10 µm or less
$PM_{2.5}$	Particulate matter with an equivalent aerodynamic diameter 2.5 µm or less
s	Section
SRG	Stakeholder Reference Group
Subsp.	Subspecies
t	Tonne/s
t/yr	Tonne/s per year
TDS	Total dissolved solids
TEC	Threatened Ecological Community
TSS	Total suspended solids
WAPC	Western Australian Planning Commission
Wildlife Act	*Wildlife Protection Act 1950* (WA)

Appendix 1
DEW decision on controlled action

Australian Government

Department of the Environment and Water Resources

Mr John Symonds
Metropolitan Operations Manager
Hanson Construction Materials Pty Ltd
123 Burswood Road
VICTORIA PARK WA 6100

Date
20 May 2007
EPBC Ref
2007/3433
EPBC contact
Mrs Victoria Bartlett
02 6274 1101
Victoria.bartlett@environment.gov.au

Dear Mr Symonds

Decision on referral
Extension of Red Hill hard rock quarry, Lot 11 Toodyay Road

This proposed action, to undertake the expansion of the existing Red Hill hard rock quarry, has now been considered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

We have decided that the proposed action is not a controlled action and, as such, does not require assessment and approval by the Minister for the Environment and Water Resources before it can proceed.

A copy of the document recording this decision is enclosed.

Please note that this decision relates only to the potential for significant impact on the specific matters protected by the Australian Government under Chapter 4 of the EPBC Act.

There may be a need for separate State or Local Government environment assessment and approval to address potential impacts on state, regional or local environmental values.

The Department has an active audit program for proposals that have been referred or approved under the EPBC Act. The audit program aims to ensure that proposals are implemented as planned and that there is a high degree of compliance with any associated conditions. You should be aware that your project may be selected for audit by the Department at any time and all related records and documents may be subject to scrutiny. Information about the Department's Audit Strategy is enclosed.

If you have any questions about the referral process or this decision, please contact the EPBC project manager and quote the EPBC reference number shown at the beginning of this letter.

Yours sincerely

Ms Tania Rishniw
A/g Assistant Secretary
Environment Assessment Branch

Notification of
REFERRAL DECISION – not controlled action

Extension of Red Hill hard rock quarry, Lot 11 Toodyay Road (2007/3433)

This decision is made under Section 75 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Proposed action

person named in the referral	Hanson Construction Materials Pty Ltd
proposed action	The expansion and operation of the existing Red Hill hard rock quarry, and associated activities, at Lot 11 Toodyay Road, and as described in the referral received under the Act on 1 May 2007.

Referral decision: Not a controlled action

status of proposed action	The proposed action is not a controlled action.

Person authorised to make decision

Name and position	Ms Tania Rishniw A/g Assistant Secretary Environment Assessment Branch
date of decision	28.5.07

Appendix 2
Supporting documents

APPENDIX 2 SUPPORTING DOCUMENTS

The following supporting documents are contained on the CD inside the back cover of the PER:

Vegetation and flora

Mattiske Consulting Pty Ltd (Mattiske) 2007, *Flora and Vegetation Survey of the Proposed Clearing Area for Red Hill Quarry – Hanson*, report prepared for Hanson Construction Materials Pty Ltd.

Mattiske 2008, *Flora and Vegetation Survey of the Proposed Clearing Area for Red Hill Quarry – Hanson*, report prepared for Hanson Construction Materials Pty Ltd.

Fauna

Harris I. and Bamford M. 2007a, *Hanson's Quarry Red Hill: Assessment of Fauna Values*, report prepared for Hanson Construction Materials Pty Ltd.

Harris I. and Bamford M. 2007b, *Hanson's Quarry – Search for Geckos (May 2007)*, report prepared for Hanson Construction Materials Pty Ltd.

Bancroft, W., Harris I. and Bamford M. 2007, *Hanson's Quarry – Search for Geckos (September 2007)*, report prepared for Hanson Construction Materials Pty Ltd.

Dieback

Department of Environment and Conservation (DEC) 2008, *Dieback Interpretation Report: Red Hill Quarry, Herne Hill*, report prepared for Hanson Construction Materials Pty Ltd.

Surface hydrology and groundwater

Aquaterra Consulting Pty Ltd (Aquaterra) 2007a, *Red Hill Hard Rock Quarry Toodyay Road Surface Water Management*, report prepared for Hanson Construction Materials Pty Ltd.

Aquaterra 2007b, *Red Hill Hard Rock Quarry Toodyay Road Groundwater Management*, report prepared for Hanson Construction Materials Pty Ltd.

Rehabilitation

Landform Research 2007, *Updated Screening and Rehabilitation Program: Red Hill Quarry*, report prepared for Hanson Construction Materials Pty Ltd.

Aboriginal heritage

Clarke J. 2006, *A Review of the Aboriginal Heritage Aspects of a Proposed Expansion of the Hanson Red Hill Quarry*, report prepared for Hanson Construction Materials Pty Ltd.

Mattner J. & Bergin T. 2007, *Archaeological Survey of Proposed Red Hill Quarry Development Area*, report prepared for Strategen on behalf of Hanson Construction Materials Pty Ltd.

Noise and vibration

SVT Engineering Consultants (SVT) 2007, *Environmental Noise Impact Assessment of Proposed Red Hill Quarry Development*, document prepared for Hanson Construction Materials Pty Ltd.

Visual amenity

John Cleary Planning 2007, *Red Hill Quarry Proposed Development, Toodyay Rd Red Hill – Landscape and Visual Assessment*, document prepared for Hanson Construction Materials Pty Ltd.

Environmental Management Plan

Strategen (2007), *Red Hill Quarry Development Proposal Environmental Management Plan*, document prepared for Hanson Construction Materials Pty Ltd.

Appendix 3
Relationship of existing Environmental Conditions to the proposed development

APPRENDIX 3 RELATIONSHIP OF EXISTING ENVIRONMENTAL CONDITIONS TO THE PROPOSED DEVELOPMENT

Table A3.1 Summary of how existing environmental conditions and proponent commitments from Ministerial Statements No. 199 and 705 have been addressed/considered for the proposed development

Condition or proponent commitment No.	Topic	Detail	Addressed/considered in proposed development
199:M1-1 [as amended by 705:M1]	Proponent commitments	The proponent shall implement the environmental management commitments attached to Statement No. 199, except commitments numbers 10, 14, 16, 17, 22, 76, 32 and 33, to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.	Conditions not required as: • proponent commitments are no longer required due to EPA procedural changes • some proponent commitments are covered by the Environmental Conditions that have been proposed for inclusion in the Ministerial Statement • some proponent commitments are covered by the Key Management Actions that have been proposed for inclusion in the Ministerial Statement • some proponent commitments are covered by other regulatory controls (e.g. EP Act Part V environmental licence) • some proponent commitments are covered by the Red Hill Quarry EMP and Rehabilitation and Screening Program (which will be implemented by Hanson) • some proponent commitments are no longer relevant.
199:M1-2 [as inserted by 705:M1]	Proponent commitments	The proponent shall implement the environmental management commitments included in schedule A to this statement, to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.	
199:M2	Detailed implementation	Subject to these conditions, the manner of detailed implementation of the proposal shall conform in substance with that set out in any designs, specifications, plans or other technical material submitted by the proponent to the Environmental Protection Authority with the proposal. Where, in the course of that detailed implementation, the proponent seeks to change those designs, specifications, plans or other technical material in any way that the Minister for the Environment determines on the advice of the Environmental Protection Authority, is not substantial, those changes may be effected.	Condition to be replaced by current standard Condition wording for this topic.
199:M3	Susannah Brook	There shall be no unacceptable detrimental effects from drainage of the quarry site on the water quality of Susannah Brook.	Condition not required as: • condition not auditable • water quality protection measures to prevent surface water pollution covered by EP Act Part V environmental licence • Hanson will implement the Surface Water Quality Management Plan contained in the Red Hill Quarry EMP (detailing management actions, monitoring and contingencies).

Condition or proponent commitment No.	Topic	Detail	Addressed/considered in proposed development
199:M3-1	Susannah Brook	Prior to the commencement of productive mining, the proponent shall prepare a drainage management programme for the quarry operations to the satisfaction of the Minister for the Environment on advice from the Environmental Protection Authority and the Water Authority of Western Australia.	Condition not required as: • condition fulfilled (i.e. drainage design completed prior to construction) • condition not outcome-based • water quality protection measures to prevent surface water pollution covered by EP Act Part V environmental licence • Hanson will implement the Surface Water Quality Management Plan contained in the Red Hill Quarry EMP (detailing management actions, monitoring and contingencies).
199:M3-2	Susannah Brook	Subsequent to Condition 3-1, the proponent shall implement the approved drainage management programme to the satisfaction of the Environmental Protection Authority on advice from the Water Authority of Western Australia.	Condition not required as: • condition fulfilled (i.e. drainage design installed/implemented at the current quarry) • condition not outcome-based • water quality protection measures to prevent surface water pollution covered by EP Act Part V environmental licence • Hanson will implement the Surface Water Quality Management Plan contained in the Red Hill Quarry EMP (detailing management actions, monitoring and contingencies).
199:M4 [as amended by 705:M1]	Rehabilitation and screening	Pioneer No.1 and Pioneer No.2 quarries are to be rehabilitated.	Condition not required as: • outcome-based Environmental Conditions proposed to replace existing conditions relating to rehabilitation • Hanson will continue to implement and update the Rehabilitation and Screening Program (which covers the former Herne Hill Quarry and the Red Hill Quarry [Pioneer Quarries No. 1 and 2 respectively]).
199:M4-1 [as amended by 705:M2]	Rehabilitation and screening	Within twelve months of the date of this statement, the proponent shall prepare detailed plans for the on-going rehabilitation of Pioneer No.1 and quarry. These plans shall be to the satisfaction of the Environmental Protection Authority on advice from the City of Swan.	Condition not required as: • condition fulfilled; Hanson has already prepared and will continue to implement and update the Rehabilitation and Screening Program (which covers the former Herne Hill Quarry and the Red Hill Quarry [Pioneer Quarries No. 1 and 2 respectively]) • condition not outcome-based • outcome-based Environmental Conditions proposed to replace existing conditions relating to rehabilitation.

Condition or proponent commitment No.	Topic	Detail	Addressed/considered in proposed development
199:M4-2 [as amended by 705:M2]	Rehabilitation and screening	Subsequent to Condition 4-1, the proponent shall implement the approved plans, and updates as required by Condition 4-3, to the satisfaction of the Environmental Protection Authority on advice from the City of Swan.	Condition not required as: • outcome-based Environmental Conditions proposed to replace existing conditions relating to rehabilitation • Hanson will continue to implement and update the Rehabilitation and Screening Program (which covers the former Herne Hill Quarry and the Red Hill Quarry [Pioneer Quarries No. 1 and 2 respectively]).
199:M4-3 [as amended by 705:M2]	Rehabilitation and screening	Subsequent to Conditions 4-1 and 4-2, the proponent shall review the rehabilitation plans annually for the past two years and thereafter at five-yearly intervals. The reviews shall be to the satisfaction of the Environmental Protection Authority on advice from the City of Swan.	Condition not required as: • outcome-based Environmental Conditions proposed to replace existing conditions relating to rehabilitation, which includes requirement for annual reporting of rehabilitation performance.
199:M4-4 (a) [as inserted by 705:M2]	Rehabilitation and screening	Within 12 months of a notice being issued under section 45(7) of the *Environmental Protection Act 1986* in respect to Statement No.705, the proponent shall prepare a Screening and Rehabilitation Plan for all disturbed areas at Pioneer No. 2 quarry to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.	Condition not required as: • condition fulfilled: Hanson has already prepared and will continue to implement and update the Rehabilitation and Screening Program • condition not outcome-based • outcome-based Environmental Conditions proposed to replace existing conditions relating to rehabilitation.
199:M4-4 (b) [as inserted by 705:M2]	Rehabilitation and screening	The objective of this Plan is to ensure that rehabilitation of the Pioneer No.2 quarry achieves a stable and functioning landform which is consistent with the surrounding landscape and which minimises visual impacts of the quarry operations on other land.	Condition not required as: • condition fulfilled; Hanson has already prepared and will continue to implement and update the Rehabilitation and Screening Program (which meets the stated objective) • outcome-based Environmental Conditions proposed to replace existing conditions relating to rehabilitation.
199:M4-4 (c) [as inserted by 705:M2]	Rehabilitation and screening	The Plan shall: 1. identify land within a 5 kilometre radius of the Pioneer No.2 quarry from which the operations are visible; 2. detail the rehabilitation practices to be implemented over the life of the operations (which must include planting of indigenous vegetation) for all disturbed areas, including stockpiles, overburden dumps and quarry pits; 3. specify the short and long term measures to be taken to address visual impacts from the operations, particularly for land identified in subparagraph (1); and 4. include time frames for the implementation and completion of all screening and rehabilitation measures.	Condition not required as: • condition fulfilled; Hanson has already prepared and will continue to implement and update the Rehabilitation and Screening Program (which meets the requirements stated) • outcome-based Environmental Conditions proposed to replace existing conditions relating to rehabilitation.

Condition or proponent commitment No.	Topic	Detail	Addressed/considered in proposed development
199:M4-5 [as inserted by 705:M2]	Rehabilitation and screening	The Screening and Rehabilitation Plan referred to in condition 4-4 is to be prepared in consultation with owners and occupiers of the land referred to in condition 4-4(c)(1).	Condition not required as: • condition fulfilled; Hanson has already prepared and will continue to implement and update the Rehabilitation and Screening Program (which was developed in consultation with surrounding residents as stated – Hanson will continue to consult with these residents in ongoing review of the Program) • outcome-based Environmental Conditions proposed to replace existing conditions relating to rehabilitation.
199:M4-6 [as inserted by 705:M2]	Rehabilitation and screening	The proponent shall implement the Screening and Rehabilitation Plan referred to in condition 4-4 in accordance with the timeframes specified therein.	Condition not required as: • outcome-based Environmental Conditions proposed to replace existing conditions relating to rehabilitation • Hanson has already prepared and will continue to implement and update the Rehabilitation and Screening Program.
199:M4-7 (a) [as inserted by 705:M2]	Rehabilitation and screening	The proponent shall report to the Minister for the Environment on the compliance with the Screening and Rehabilitation Plan referred to in condition 4-4 every two years, commencing 31 December 2007.	Condition not required as: • outcome-based Environmental Conditions proposed to replace existing conditions relating to rehabilitation, which includes requirement for annual reporting of rehabilitation performance.
199:M4-7 (b) [as inserted by 705:M2]	Rehabilitation and screening	The compliance report is to be prepared by a consultant approved by the Minister for the Environment.	Condition not required as: • outcome-based Environmental Conditions proposed to replace existing conditions relating to rehabilitation, which includes requirement for annual reporting of rehabilitation performance.
199:M4-7 (c) [as inserted by 705:M2]	Rehabilitation and screening	The compliance report is to be provided to owners and occupiers of land referred to in condition 4-4(c)(1).	Condition not required as: • outcome-based Environmental Conditions proposed to replace existing conditions relating to rehabilitation, which includes requirement for annual reporting of rehabilitation performance (and making the report publicly available).
199:M4-8 [as inserted by 705:M2]	Rehabilitation and screening	The proponent is to review the Screening and Rehabilitation Plan referred to in condition 4-4 annually in consultation with owners and occupiers of land referred to in condition 4-4(c)(1) to the requirements of the Minister for the Environment.	Condition not required as: • outcome-based Environmental Conditions proposed to replace existing conditions relating to rehabilitation.
199:M4-9 [as inserted by 705:M2]	Rehabilitation and screening	The proponent shall make the Screening and Rehabilitation Plan required by condition 4-4 and any subsequent updates made under condition 4-8 publicly available, to the requirements of the Minister for the Environment.	Condition not required as: • outcome-based Environmental Conditions proposed to replace existing conditions relating to rehabilitation.

Condition or proponent commitment No.	Topic	Detail	Addressed/considered in proposed development
199:M5	Decommissioning	Plant and installations are to be removed from the site and its environs.	Conditions not required as: • outcome-based Environmental Condition proposed to replace decommissioning conditions • Conceptual Closure Plan contained in the Red Hill Quarry EMP, which will be regularly reviewed and updated by Hanson.
199:M5-1	Decommissioning	The proponent shall be responsible for decommissioning and removal of the plant and installations and rehabilitating the site and its environs, to the satisfaction of the Environmental Protection Authority.	
199:M5-2	Decommissioning	At least twelve months prior to final decommissioning, the proponent shall prepare a decommissioning and rehabilitation plan to the satisfaction of the Environmental Protection Authority on advice from the Shire of Swan.	Condition not required as: • condition not outcome-based • outcome-based Environmental Condition proposed to replace decommissioning conditions • Conceptual Closure Plan contained in the Red Hill Quarry EMP, which will be regularly reviewed and updated by Hanson.
199:M5-3	Decommissioning	Subsequent to Condition 5-2, the proponent shall implement the approved decommissioning and rehabilitation plan to the satisfaction of the Environmental Protection Authority on advice from the Shire of Swan.	Condition not required as: • outcome-based Environmental Condition proposed to replace decommissioning conditions • Conceptual Closure Plan contained in the Red Hill Quarry EMP, which will be regularly reviewed and updated by Hanson.
199:M6	Monitoring reports	Monitoring information is to be made freely available to the general public.	Conditions not required as: • annual monitoring reports are required as part of the EP Act Part V environmental licence (in relation to water quality, dust, noise and vibration) • annual reporting of rehabilitation monitoring required under the proposed Environmental Conditions.
199:M6-1	Monitoring reports	The proponent shall prepare an annual monitoring report for the project to the satisfaction of the Environmental Protection Authority.	
199:M6-2	Monitoring reports	Subsequent to Condition 6-1, the proponent shall provide copies of the annual report to the Environmental Protection Authority and the Shire of Swan for perusal by interested parties, to the satisfaction of the Environmental Protection Authority on advice from the Shire of Swan.	
199:M7	Proponent	No transfer of ownership, control or management of the project which would give rise to a need for the replacement of the proponent shall take place until the Minister for the Environment has advised the proponent that approval has been given for the nomination of a replacement proponent. Any request for the exercise of that power of the Minister shall be accompanied by a copy of this statement endorsed with an undertaking by the proposed replacement proponent to carry out the project in accordance with the conditions and procedures set out in the statement.	Condition to be replaced by current standard Condition wording for this topic.

Condition or proponent commitment No.	Topic	Detail	Addressed/considered in proposed development
199:M8	Time limit on approval	If the proponent has not substantially commenced the project within five years of the date of this statement, then the approval to implement the proposal as granted in this statement shall lapse and be void. The Minister for the Environment shall determine any question as to whether the project has been substantially commenced. Any application to extend the period of five years referred to in this condition shall be made before the expiration of that period, to the Minister for the Environment by way of a request for a change in the condition under Section 46 of the Environmental Protection Act. (On expiration of the five year period, further consideration of the proposal can only occur following a new referral to the Environmental Protection Authority).	Condition to be replaced by current standard Condition wording for this topic.
199:M9	Audit programme	The proponent shall prepare an audit programme for the proposal in, consultation with the Environmental Protection Authority which is to be satisfactory to the Minister for the Environment before any site works are commenced. The programme shall list the actions required by these conditions and the commitments and specify for each action its scope, how and when it will be performed and the process for verifying that it has been completed satisfactorily. The programme shall include periodic reporting to inform the Minister for the Environment on the progress of the proposal. Subsequently, the proponent shall adhere to the approved audit programme to the satisfaction of the Environmental Protection Authority.	Condition to be replaced by current standard Condition wording for this topic.
199:P1(a)	Quarry development and operation	Access to the Pioneer No.2 site will be direct from Toodyay Road. Aceessways will be designed to minimise noise generation and disruption to other traffic and will be constructed to the satisfaction of the Main Roads Department.	Proponent commitment no longer required/relevant as: • commitment fulfilled; site accessways have been constructed in accordance with this commitment • no new site accessways are proposed.
199:P1(b)	Quarry development and operation	Pioneer will take steps within its power to minimise usage of the local and rural roads by vehicles travelling to or from the Pioneer No.1 and No.2 quarries and promote the use of main roads (e.g. Toodyay Road, Great Northern Highway, Bishop Road) in order to avoid traffic conflict and ensure road safety.	Proponent commitment no longer required as: • Hanson is required to obtain and manage appropriate permits from Main Roads WA to enable travel on routes required to service the market • Hanson will implement the Traffic Management Plan contained in the Red Hill Quarry EMP which addresses controlling off-site truck movements.
199:P2	Quarry development and operation	Topsoil, vegetation and overburden will be stripped from areas to be developed. These will be used for the building of bunds and for rehabilitation purposes.	Proponent commitment not required as: • management of topsoil, vegetation and overburden is prescribed in the Rehabilitation and Screening Program, which Hanson will continue to implement and update.
199:P3	Quarry development and operation	No physical interference with Susannah Brook will be permitted at any stage during the development or operation of the quarry. To this end, a minimum 50 metre buffer zone will be maintained each side between the Brook and any quarrying activity, and allowing a total 100 metre buffer zone around the Brook.	Proponent commitment replaced by a proposed Environmental Condition which addresses the retention of the vegetated buffer along Susannah Brook.
199:P4	Quarry development and operation	Regional water mains, power, gas and telephone services will not he adversely affected by the development of the Pioneer No.2 site.	Proponent commitment not required as: • any disturbances required to such utilities requires authorisation from the relevant utility providers under their governing legislation/s and/or regulations.

Condition or proponent commitment No.	Topic	Detail	Addressed/considered in proposed development
199:P5	Quarry development and operation	Process water supplies will be drawn from the existing water storage in the Pioneer No.1 Quarry and from the other surface storages on Pioneer property, with possible occasional augmentation by Water Authority supplies. No water will be drawn from Susannah Brook. There is currently no planned use of groundwater in the proposed development, consequently there will be no effect on groundwater resources.	Proponent commitment not required as: • Hanson do not propose to abstract water from Susannah Brook • abstraction from Susannah Brook would require permitting under the *Rights in Water and Irrigation Act 1914* (and conditions applied) • no significant groundwater supplies are present onsite, therefore Hanson do not propose to abstract groundwater • construction of groundwater bores and abstraction from bores may require licensing under the *Rights in Water and Irrigation Act 1914* (and conditions applied).
199:P6	Quarry development and operation	Drilling and blasting will be conducted only during daylight hours. Blasting design will be aimed at achieving the required breakage of rock with minimum generation of noise, vibration and dirt.	Proponent commitment not required as: • blasting hours prescribed in the Development Approval/Excavation Licence • blasting noise levels prescribed in the EP Act Part V environmental licence • Hanson will implement the Noise and Vibration Management Plan contained in the Red Hill Quarry EMP.
199:P7	Quarry development and operation	Following the completion of development of Pioneer's No.2 pit and crushing plant, processing operations at Pioneer No. 1 will cease and the plant will be dismantled.	Proponent commitment no longer required/relevant as: • commitment fulfilled; processing plant at Pioneer No. 1 [former Herne Hill Quarry] has already been dismantled.
199:P8	Protection of vegetation	Site clearance and vegetation removal will be minimised by survey control and supervision of personnel engaged in clearing activities.	Proponent commitment not required as: • Hanson will implement the Vegetation and Habitat Protection Plan contained in the Red Hill Quarry EMP, which includes actions for marking clearing boundaries on plans and in the field.
199:P9	Protection of vegetation	All vehicles entering the site from regions identified as potentially contaminated with dieback disease will be thoroughly washed to remove adhering soil and weed seeds. All fill or soil used on the site will be obtained from uncontaminated sources. Procedures for preventing its introduction will follow those laid down in the CALM Dieback Manual.	Proponent commitment not required as: • Hanson will implement the Dieback and Weed Management Plans contained in the Rehabilitation and Screening Program which addresses dieback and weed hygiene measures.
199:P10 [as replaced by 705:P10]	Protection of vegetation	Local provenance plant species will be used in rehabilitation.	Proponent commitment not required as: • outcome-based Environmental Conditions relating to rehabilitation have been proposed • Hanson will continue to implement and update the Rehabilitation and Screening Program which prescribes the use of local provenance species.

Condition or proponent commitment No.	Topic	Detail	Addressed/considered in proposed development
199:P11	Protection of vegetation	Fire prevention measures as per relevant Shire and Brigade regulations will be enforced within the project area and on the rest of Pioneer's land holding.	Proponent commitment not required as: • fire prevention measures covered under other regulatory controls • Hanson will implement the Fire Management Plan contained in the Red Hill Quarry EMP • fire not considered a key environmental factor that warrants prescription of Environmental Conditions or Key Management Actions.
199:P12	Protection of vegetation	Unauthorised vehicular access to the Pioneer land holding will not be permitted and the current practice of using security guards to patrol the area will be continued.	Proponent commitment not required as: • Hanson will implement the Vegetation and Habitat Protection Management Plan contained in the EMP (which includes actions relating to perimeter fencing and signage) • security patrols will be ongoing as a matter of normal business operation • unauthorised access not considered a key environmental factor that warrants prescription of Environmental Conditions or Key Management Actions.
199:P13	Protection of vegetation	Pioneer will monitor the vegetation on its property to detect any outbreaks of dieback disease. If any is detected, Pioneer will consult with the Department of Conservation and Land Management to determine a suitable treatment strategy.	Proponent commitment not required as: • Key Management Action relating to regular monitoring for dieback has been proposed • Hanson will implement the Dieback Management Plan (contained in the Rehabilitation and Screening Program).
199:P14 [as replaced by 705:P14]	Protection of vegetation	The remainder of the proponent's property, other than those areas required for quarrying and infrastructure, will be maintained so as an undisturbed buffer zone for the operations.	Proponent commitment not required as: • an Environmental Condition has been proposed relating to the retention of the ecological corridors • Hanson will implement the Vegetation and Habitat Protection Management Plan contained in the Red Hill Quarry EMP.
199:P15	Noise, dust and odours	All emissions of noise, dust and odours from the operations will be within limits laid dawn in licence conditions by the Environmental Protection Authority or set out in the Environmental Protection Act 1986.	Condition not required/relevant as: • odour no longer relevant to the operation (i.e. asphalt plant not located on Lot 11) • noise and dust control measures covered by EP Act Part V environmental licence • Hanson will implement the Noise and Vibration Management Plan and Dust Management Plan contained in the Red Hill Quarry EMP (detailing management
199:P16 [as replaced by 705:P16]	Noise, blasting and dust	Further reduce emissions by a number of means, including enclosure of crushing and screening plans; watering of roads, stockpiles and product transfer points; and careful design of blasting.	
199:P17 [as replaced by 705:P17]	Noise, blasting and dust	(1) Monitor noise levels from blasting and processing, and dust deposition. (2) The results of this monitoring will be made available on an annual basis.	

Condition or proponent commitment No.	Topic	Detail	Addressed/considered in proposed development
199:P18	Noise, dust and odours	Occupational noise and dust levels will be monitored and the results reported to the Department of Mines. Pioneer will take any action necessary to ensure that the levels of occupational noise and dust comply with the provisions of the Mines Regulation Act 1946-1974.	actions, monitoring and contingencies) • occupational noise and dust exposure levels managed under other regulatory controls.
199:P19	Drainage and water quality	Pioneer will endeavour to minimise disruption to drainage patterns in areas outside those directly affected by quarrying activities. Rainfall runoff to disturbed areas will be prevented by the use of bunds and drains where necessary. Careful attention will be paid to the minimisation of erosion.	Proponent commitment not required as: • commitment is largely not auditable • stormwater management to prevent surface water pollution is covered under the EP Act Part V environmental licence • Hanson will implement the Surface Water Quality Protection Plan contained in the EMP.
199:P20	Drainage and water quality	No untreated runoff from disturbed areas of the Project Area will be permitted to enter any watercourse. All such runoff will first be treated by means of sedimentation basins or silt traps to remove excess suspended sediments. Any runoff likely to contain oil contamination will be treated to remove such contaminants.	Proponent commitment not required as: • stormwater management to prevent surface water pollution is covered under the EP Act Part V environmental licence • Hanson will implement the Surface Water Quality Protection Plan contained in the EMP.
199:P21	Drainage and water quality	The quality of water leaving the Project Area will be monitored by regular sampling.	Proponent commitment not required as: • surface water quality monitoring is covered under the EP Act Part V environmental licence • Hanson will implement the Surface Water Quality Protection Plan contained in the EMP.
199:P23	Aboriginal interests	Discussions will be held with representatives of the local Nyungar Aboriginal community regarding the protection of Susannah Brook and the future of the white “ochre” deposit in the vicinity of the tertiary crusher/stockpile site. Pioneer will take steps to ensure that quantities of the “ochre” are made available to Aborigines for their use.	Proponent commitment not required as: • requirements for consultation with and protection of Aboriginal heritage sites covered under the *Aboriginal Heritage Act 1972*.
199:P24	Waste disposal	Solid wastes, such as domestic waste, will be disposed of at an approved Council landfill site.	Proponent commitment not required as: • waste is not considered a key environmental factor to warrant prescription of an Environmental Condition or Key Management Action • general office waste is collected as part of the weekly City of Swan domestic waste collection service.

Condition or proponent commitment No.	Topic	Detail	Addressed/considered in proposed development
199:P25	Waste disposal	Oils and grease separated from contaminated runoff in the area of the workshops and asphalt plant will be collected and removed from the site, either for recycling or for disposal in a Council-approved liquid waste disposal site.	Proponent commitment not required as: • oil and grease pollution prevention is covered under the EP Act Part V environmental licence • Hanson will implement the Surface Water Quality Protection Plan contained in the EMP • waste is not considered a key environmental factor to warrant prescription of an Environmental Condition or Key Management Action.
199:P26 [as replaced by 705:P26]	Dust	Inert material originating from dust suppression collection in the crushing and screening plant will be returned to the plant and included in fine product sales or blended with other material to be used as a bunding or rehabilitation material.	Proponent commitment not required as: • commitment is prescriptive and not outcome-based • topic is not considered a key environmental factor to warrant prescription of an Environmental Condition or Key Management Action.
199:P27	Waste disposal	Sewerage facilities will be designed so as to prevent impacts on ground or surface waters in the area, and will conform to Health Department regulations.	Proponent commitment no longer required/relevant as: • commitment fulfilled; sewerage facilities have already been designed and installed onsite.
199:P28	Rehabilitation	A programme currently underway at Pioneer No. 1 will continue.	Proponent commitment not required as: • outcome-based Environmental Conditions proposed to replace existing conditions/commitment relating to rehabilitation.
199:P29	Rehabilitation	Pioneer will continue to take responsibility for rehabilitation and will investigate new developments in rehabilitation methods in order to optimise the rehabilitation of the Pioneer No. 1 and No. 2 Quarries.	Proponent commitment not required as: • outcome-based Environmental Conditions proposed to replace existing conditions/commitment relating to rehabilitation.
199:P30	Rehabilitation	The progress reports on rehabilitation works at the Pioneer Quarries will be made available to the Environmental Protection Authority as required.	Proponent commitment not required as: • outcome-based Environmental Conditions proposed to replace existing conditions relating to rehabilitation, which includes requirement for annual reporting of rehabilitation performance.
199:P31	Community liaison	Pioneer will continue to maintain a register of public complaints against its quarrying Operations at Herne Hill and will respond promptly and individually to each Complaint received.	Proponent commitment not required as: • very few public complaints are received (and the proposed development is not expected to change this situation) to warrant prescription of an Environmental Condition or Key Management Action.

Condition or proponent commitment No.	Topic	Detail	Addressed/considered in proposed development
199:P32 [as replaced by 705:P32]	Monitoring	(1) Monitor noise, dust, water quality, vegetation and public opinion at the Red Hill quarry site. (2) The results of this monitoring will be used by the proponent to optimise environmental management procedures at the Red Hill Quarry. (3) These results will available on an annual basis.	Proponent commitment not required as: • annual monitoring reports are required as part of the EP Act Part V environmental licence.
199:P33 [as replaced by 705:P33]	Research monitoring	Continue to monitor research, both within Australia and overseas, into new developments in blasting technology; and noise and dust control in the operations of the quarry.	Proponent commitment not required as: • commitment not auditable • noise and dust pollution prevention is covered under the EP Act Part V environmental licence • not considered a relevant topic to warrant prescription of an Environmental Condition or Key Management Action.