W.A. LIMESTONE

EXCAVATION MANAGEMENT PLAN

Wattle Avenue (West) Quarry

259 (Lot 8) Wattle Avenue, Nowergup

PMR Quarries Pty Ltd T/A WA Limestone

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9 May 2024

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Prepared By:

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1.0 INTRODUCTION

1.1 Purpose and Scope

The Wattle Avenue (West) Quarry is a limestone quarry, which has operated since 2008. The quarry produces a range of limestone aggregate products for construction materials supply.

No significant changes to the excavation or operational management are proposed or required.

Dependent on market demand and regulatory approvals, the project has a remaining life of mine 20 years at anticipated excavation rates.

This management plan outlines the continued excavation of sand and limestone within Lot 8 Wattle Avenue, Nowergup, and provides a summary of:

- The existing environment and surrounding land uses;
- Relevant regulatory framework;
- Project description and operational management; and
- Environmental management.

1.2 Ownership and Project Operator

The project proponent is PMR Quarries Pty Ltd (WA Limestone). WA Limestone is the landowner of the subject land and will additionally be the quarry operator.

LOT	PLAN / DIAGRAM	VOLUME	FOLIO	OWNER(S)	AREA (ha)
8	D 53380	2132	850	PMR Quarries Pty Ltd	52.5

Table 1: Land Ownership

Proponent: PMR Quarries Pty Ltd T/A WA Limestone
Street Address: 401 Spearwood Avenue BIBRA LAKE WA 6163
Postal Address: PO Box 1404 BIBRA LAKE DC WA 6965
Phone: 08 9434 7777
Email: reception@walimestone.com

1.3 Requested Approval

Renewal of existing planning approvals for the project are requested, to excavate sand and limestone from the premises for construction materials use within the Perth Metropolitan Area.

An approval term of 20 years is sought to align with the timeframe required to excavate the resource. This term is necessary to provide certainty to the project operators, avoid the duplication of assessments and avoid further regulatory delays to the project.

1.4 Justification

Basic Raw Materials such as the sand and limestone produced by the Wattle Avenue (West) Quarry are critical construction materials to virtually all development within the Perth and Peel regions.

Basic Raw Materials are a finite resource constrained by geology, limiting the location of basic raw materials extraction uses. BRM extraction sites are further constrained by numerous environmental factors and existing development constraints. The result of these constraints the availability of basic raw materials within the Perth and Peel regions is increasingly limited and under threat, particularly for limestone as extracted by the Wattle Avenue (West) quarry.

Transport is the most significant cost component to basic raw materials supply and basic raw materials are one of the most significant costs for development such as the construction of roads, housing, schools, hospitals, etc. It is imperative that basic raw material supply sources be located as close to the point of demand as possible to minimise costs to development and the community. This is particularly pertinent in the current economic climate of affordable housing and cost of living pressures.

The factors impacting the availability and cost of basic raw materials are only anticipated to worsen in the future, presenting a significant risk to future development requirements for Perth's growing population and inter-generational equity of access to affordable construction materials.

It is therefore critical that current basic raw material extraction sites and remaining future materials reserves that have not already been permanently sterilised by conservation or development, are protected and the resource allowed to be extracted.

1.5 Stakeholder Consultation

Extensive stakeholder consultation has occurred for the Wattle Avenue (West) Quarry project over many years through various statutory approval and renewal processes.

WA Limestone has formal communication strategies in place for the project with the Department of Energy, Mines Industry Regulation and Safety (DEMIRS), Department of Water and Environmental Regulation (DWER) and the City of Wanneroo through the various statutory approvals and legislative requirements.

WA Limestone additionally maintains a community feedback and complaints management system for all sites and projects. No complaints have been received in relation to WA Limestone's Wattle Avenue (West) Quarry operations in recent years.

1.5.1 Stakeholder Identification

The following relevant stakeholders have been identified:

Internal Stakeholders

- WA Limestone Board of Directors and Senior Management
- Wattle Avenue Quarry Manager & operations personnel
- WA Limestone environment staff

External Stakeholders

- Department of Energy, Mines, Industry Regulation and Safety (DEMIRS)
- Department of Water and Environmental Regulation (DWER)
- City of Wanneroo
- Traditional land owners

1.5.2 Stakeholder engagement strategy

The stakeholder engagement strategy is based on a combination of regular reporting to relevant stakeholders and inspections of the mining operations by stakeholders. The frequency of inspections is at the discretion of the stakeholder.

In the event that any significant changes occur or are proposed to occur to the project, relevant stakeholders will be separately notified and consulted with as required.

Stakeholder	Description of Consultation	Consultation Frequency
Department of Energy, Mines, Industry Regulation and Safety (DEMIRS)	• Mines safety • Resource information	• As required
Department of Water and Environmental Regulation (DWER)	• Processing plant licensing • Clearing of native vegetation • Noise • Dust • Groundwater • Waste	• As required
Department of Climate Change, Energy, the Environment and Water (DCCEEW) (Commonwealth)	• Clearing of native vegetation	• As required
City of Wanneroo	• Development Approval • Traffic	• As required
Traditional landowners	• Heritage	• As required
Local community & general public	• Complaints management	• As required

Table 2: Consultation Schedule

2.0 EXISTING ENVIRONMENT

2.1 Location

The subject site is located at 259 Wattle Avenue Road West, Nowergup, approximately 35 kilometres north of Perth. The property is located at the end of Wattle Avenue West with no public through-access to Wattle Avenue East. See Figure 1.

The site is located on the western edge of a limestone ridge with undulating topography across the site. Elevations across the site range from approximately RL 50m in the southwest to RL 95m AHD in the northeast.

Limestone quarrying has occurred within the subject land since 2008. Prior to this the site was undeveloped, containing predominately native vegetation with evidence of historical grazing.

2.2 Surrounding Landscape

The project is relatively small and isolated. The site is surrounded to the north, east and south by native vegetation, other extractive industry uses and Wanneroo Raceway. Land uses to the west consist of intensive horticulture and agriculture (intensive poultry), extractive industry and quasi rural-industrial transport uses.

Two dwellings associated with intensive poultry farming and extractive industry uses are located approximately 650 metres from the project site. The nearest sensitive residence is located approximately 1,100 metres from the project site. See Figure 2.

EPA Guidance Statement No.3 (Separation Distances between Industrial and Sensitive Land Uses) (2005) defines the level of assessment required for industrial uses based on their separation to sensitive receptors (EPA (WA), 2005). For industrial uses with lesser separation distances than specified, that site specific investigations for the identified potential impacts are required to demonstrate that the sensitive receptors will not be adversely affected. Beyond the separation distance defined the EPA considers the industrial use to be unlikely to adversely affect sensitive receptors and a lesser level of assessment is required.

For Sand and Limestone extraction EPA Guidance No. 3 defines an assessment separation distance of 300-500 metres (dependant on the size of the operation). With an annual production of less than 200,000 tonnes, comparatively the quarry is less than 20% of the size of other currently operating limestone quarries on the Swan Coastal Plain and therefore with respect to EPA guidance, is considered a small operation.

The project exceeds EPA Guidance Statement No.3 recommendations for separation distances to sensitive receptors and the level of assessment undertaken.

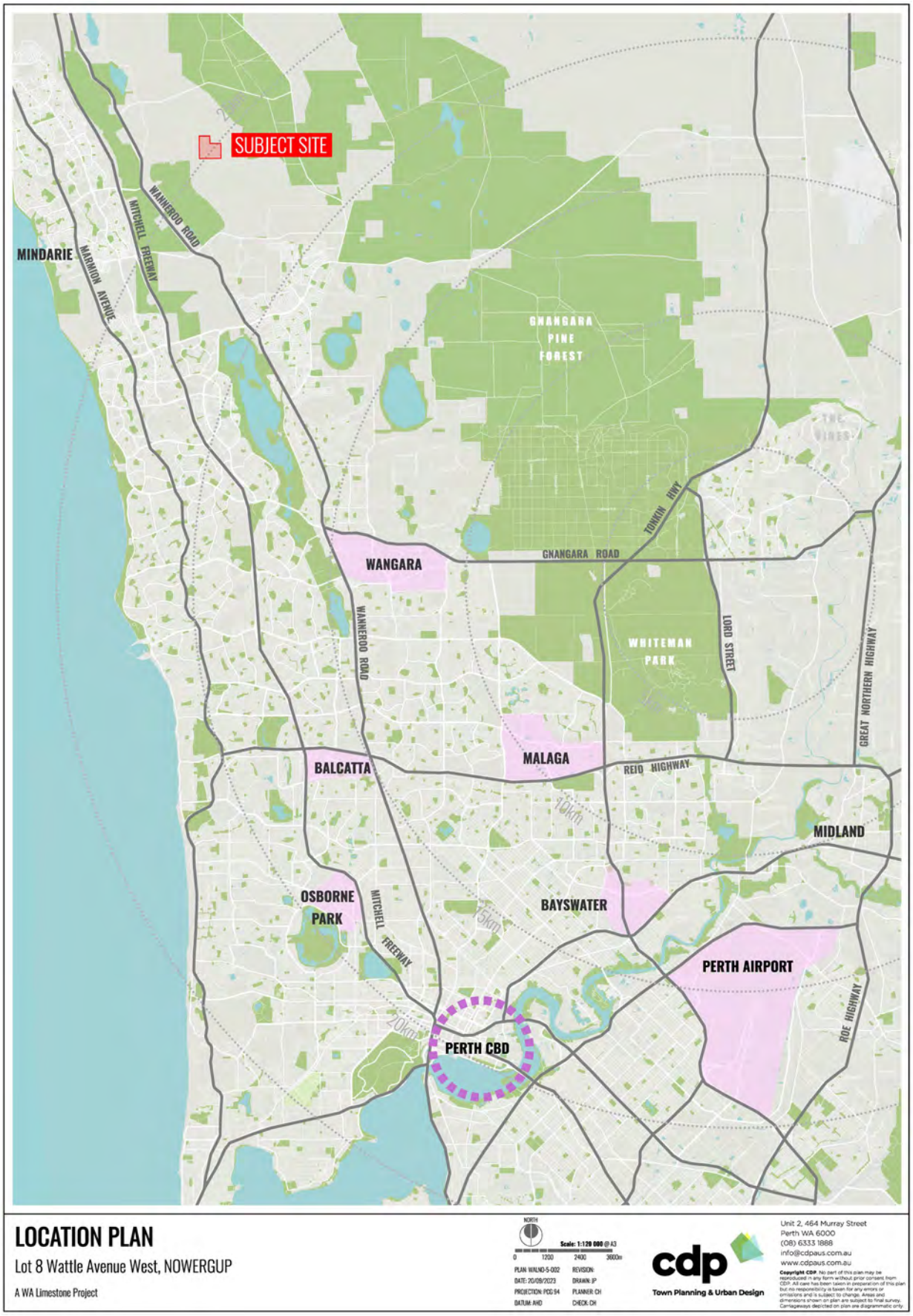

Figure 1: Project location

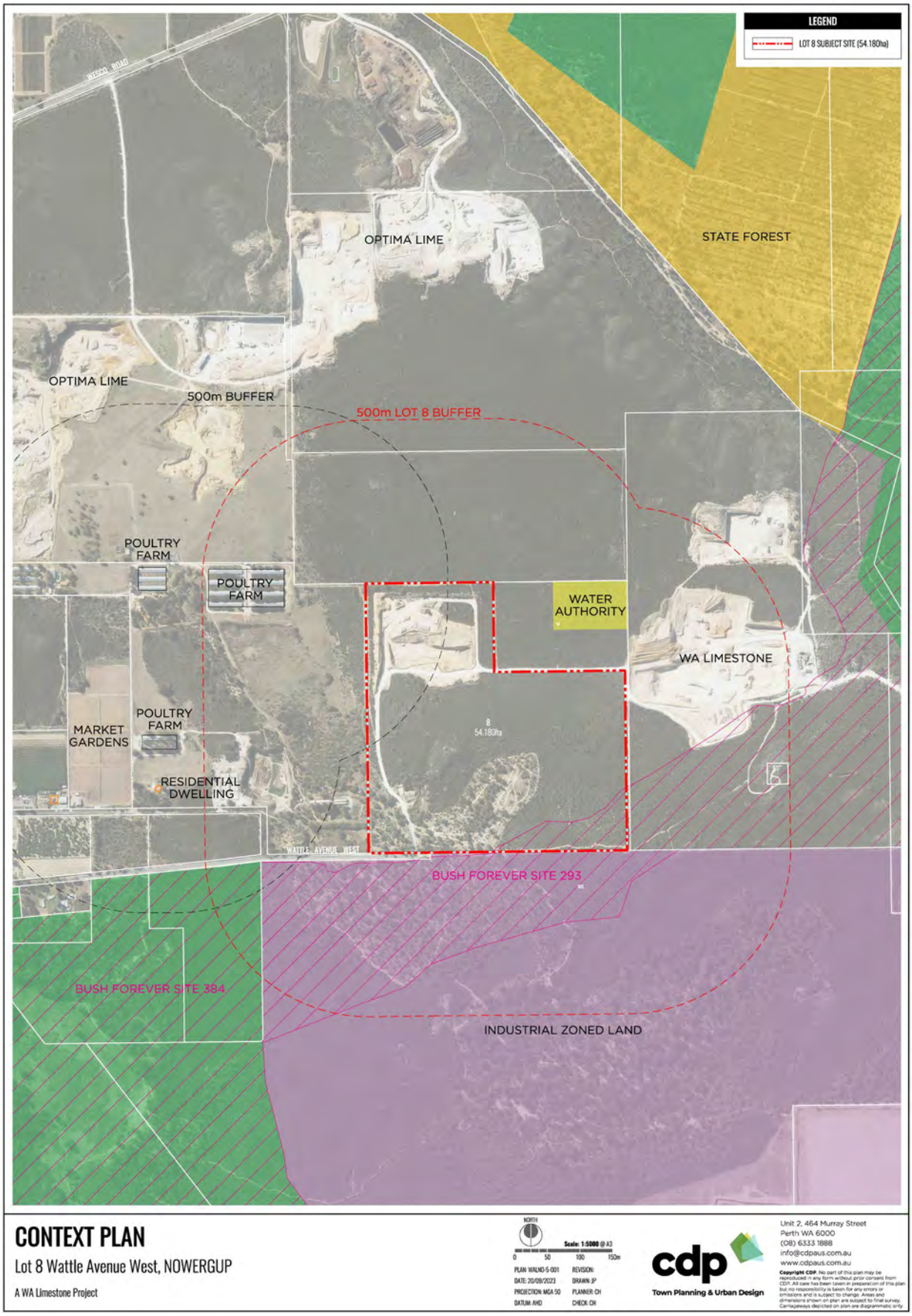

Figure 2: Surrounding landscape and buffers

2.3 Climate

The climate of the area is warm Mediterranean with cool wet winters and hot dry summers. The summer months are controlled by the low pressure heat troughs which develop southwards between the highs.

Rain falls mainly in winter with 80% falling between May to September inclusive. Evaporation exceeds rainfall in all but the four wettest months May to September.

In summer the prevailing winds are easterly in the morning and south-westerly in the afternoon. In winter the dominant wind direction is less distinct.

Statistic	**Perth Airport** BOM Site ID: 009021 (5.3km ESE)
Mean annual max. temp. (°C)	24.6
Highest max. temp. recorded (°C)	46.7 (23 Feb 1991)
Mean annual min. temp. (°C)	12.2
Lowest min. temp. (°C)	-1.3 (17 June 2006)
Mean annual rainfall (mm)	759.7

Table 3: Climate Statistics
Source: (BoM, 2024)

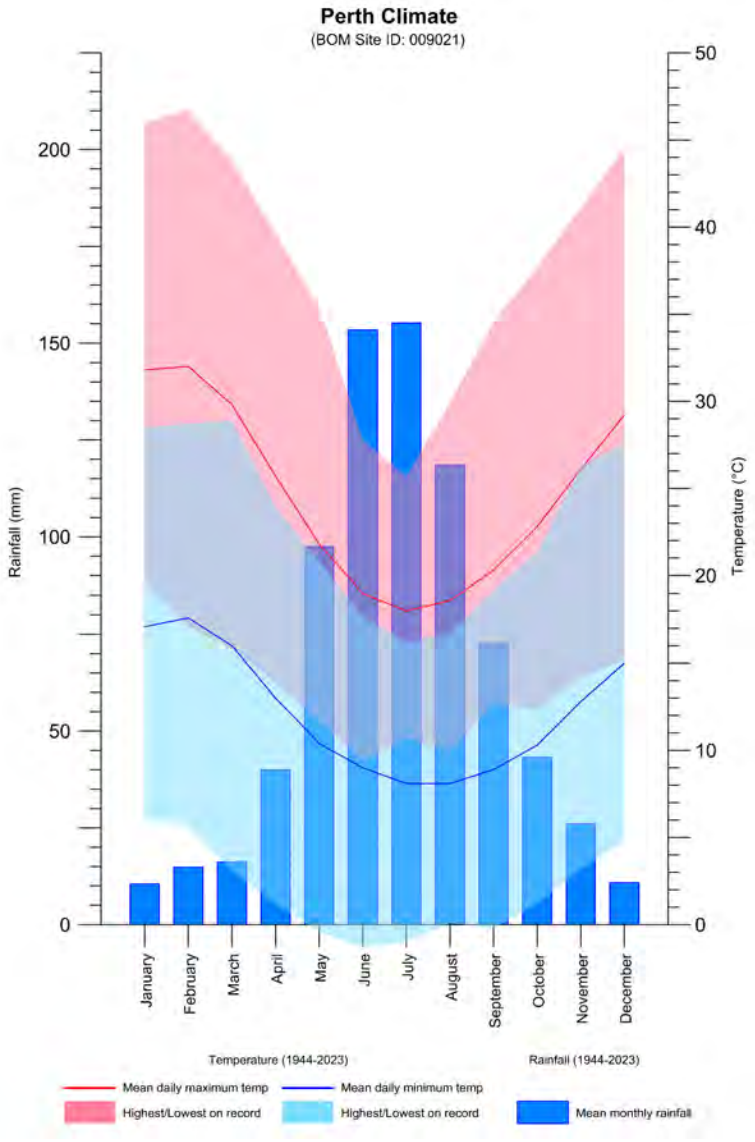

Figure 3: Climate Statistics
Source: WA Limestone; (BoM, 2024)

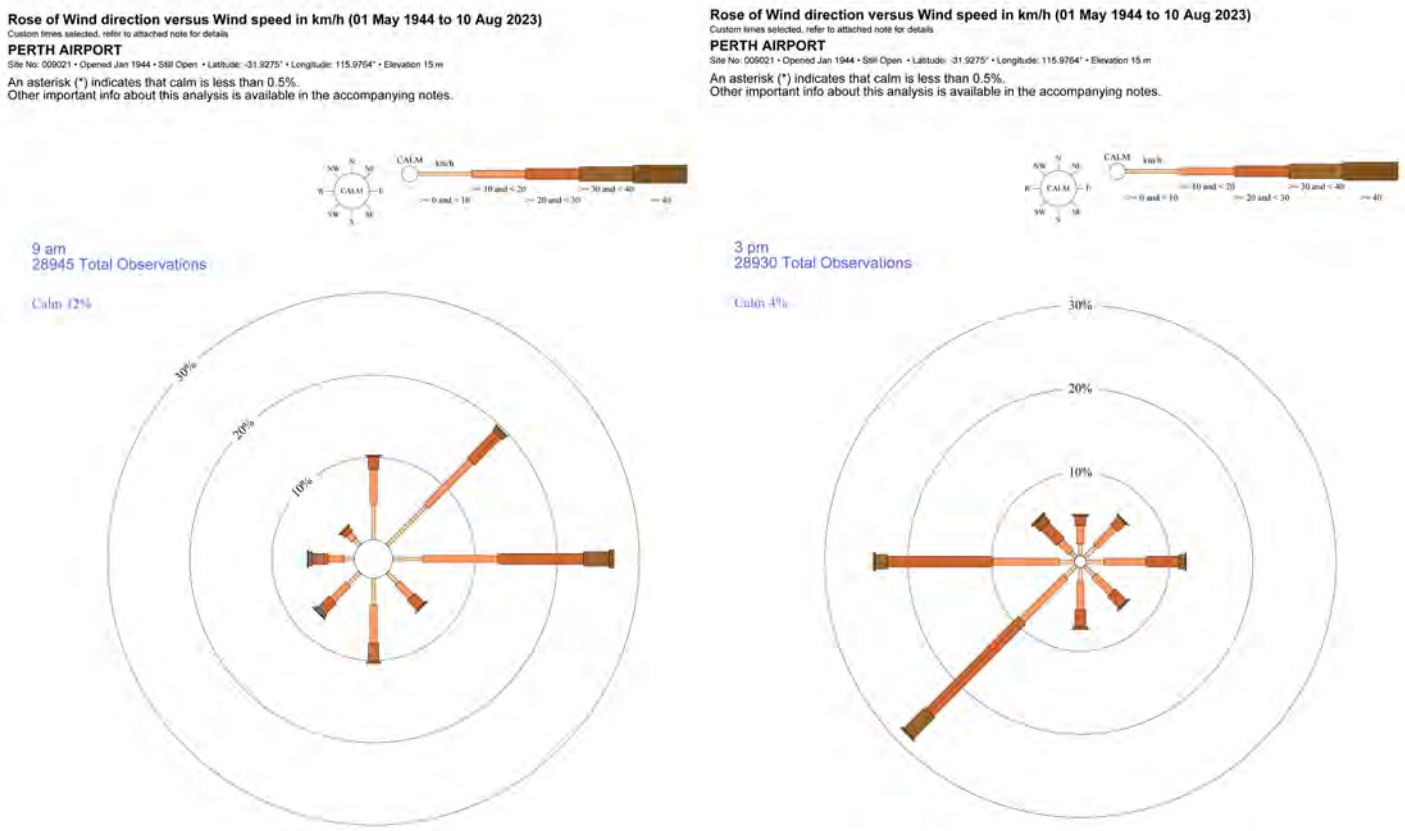

Figure 4: Wind Rose Plots
Source: (BoM, 2024)

2.4 Geology and Soils

Tamala Limestone, which outcrops along the southwestern coast of Western Australia, is an Aeolian calcarenite (formed from windblown calcareous sands) derived from beach sands. It consists of foraminifer, shell fragments and quartz grains, and therefore variation in the quality of the stone is normal both laterally and vertically.

The subject site contains a substantial resource of high-grade limestone with $CaCO_3$ concentrations of up to 87% (Gozzard, 1987), with quarrying of the resource occurring since 2008.

Previous excavation within the site has found the site to consist predominantly of yellow brown sands over limestone outcrop/bedrock. On the ridge the soil can vary from 200mm to over 3 metres where sand occurs between the limestone pinnacles. Topsoil horizons are generally thin, typically 100-200mm.

Soils of the ridges are typically classified as Ucl.23 “Cottesloe Soils” (Department of Conservation and Environment, 1980).

2.4.1 Problematic Materials

All materials extracted are processed into saleable materials. Overburden is retained for safety bunding, screening and rehabilitation of the site. No waste rock or tailings is produced by the operation.

No problematic materials have been encountered by WA Limestone's existing operations within the subject site and nearby operations. Based on the soils and geology of the site, site history, proposed pit design and excavation methods employed, there is no potential for problematic materials to be encountered by the operation.

Type	Comment	Treatment
Acidic materials and drainage	Not present	N/A
Sodic or dispersive materials	Not present	N/A
Asbestos – asbestiform minerals	Not present	N/A
Radioactive materials	Not present	N/A
Metallic or chemical materials	Not present	N/A

Table 4: Materials Characterisation Inventory

2.5 Flora and Vegetation

Native vegetation currently occurs over the majority of the subject site. The site was partially cleared in the 1960's for agriculture and mining exploration. More recently, significant areas of the site were cleared between 2006-2010 by the previous landowner for the commencement of the quarry. Some of the cleared areas were not immediately required by the quarry operations and have been allowed to regenerate. This has been undertaken to provide additional environmental benefit until such time as clearing is necessary to sustain the quarrying operations.

The vegetation within the subject site has been regularly assessed since 2006, most recently in 2022 by PGV Environmental.

Within the proposed disturbance area PGV recorded 129 (105 native, 24 introduced) plant species. No species of conservation significance were identified. Species richness ranged from 29-43, which is considered consistent for vegetation on shallow soil over limestone.

The vegetation was found to be most similar to Floristic Community Type (FCT) 28 'Spearwood *Banksia attenuata* or *Banksia attenuata – Eucalyptus marginata* woodlands'. No 'Threatened' or 'Priority' Ecological communities were recorded.

Bamford identified that approximately 32.16% of the pre-European extent of FCT28 remains, with 14.58% in secure reservation. This significantly exceeds the Environmental Protection Authority's retention targets the Perth and Peel Region (10%) and statewide (30%). The project's clearing requirements (14.9ha) involve a reduction to the extent of FCT28 of approximately 0.09%.

2.6 Fauna

Fauna within the subject site has been regularly assessed since 2006, most recently by Bamford Consulting Ecologists in 2022.

Database searches identified 173 vertebrate fauna species as potentially occurring within the project area. The presence of 23 species (20 bird and 3 mammal) was confirmed by Bamford during site investigations. Fauna assemblage was considered to be typical for near-coastal shrublands of the coastal plain north of Perth.

46 species of conservation significance (2 reptile, 35 bird, 5 mammal, and 4 invertebrate) were considered to potentially occur within the subject site.

Impacts to fauna were assessed by Bamford Consulting in 2022 (Bamford, 2022) and summarised at Table 6 below.

Aspect	Assessed Impact
Habitat loss leading to population decline	Negligible to minor
Habitat loss leading to habitat fragmentation	Minor
Degradation of habitat due to weed invasion	Minor
Mortality during construction	Negligible to minor
Ongoing mortality	Negligible
Species interactions	Negligible to minor
Hydrological change	Negligible
Altered fire regimes	Negligible
Disturbance (dust, noise, light)	Minor

Table 5: Fauna Impact Assessment
Source: (Bamford, 2022)

2.6.1 Carnaby's Cockatoo

Bamford separately considered to Carnaby's Cockatoo and determined the species to be a regular non-breeding migrant to the site in moderate numbers.

No trees that meet potential nesting or roosting criteria were found to occur within the project area and therefore was determined the subject site does not provide suitable habitat for breeding or roosting.

In considering the foraging habitat value of the subject site, Bamford identified the subject site as containing several Proteaceae species of varying calorific value and preference to Carnaby's Cockatoos. In terms of regional significance, Bamford identified the regional significance of the site as comprising 0.03% of available foraging habitat within a 15 kilometre radius.

Overall habitat quality was determined to be of low to moderate foraging value in terms of vegetation composition, animal carrying capacity and regional significance.

2.7 Hydrology

2.7.1 Surface Water

No surface water features occur within the subject site due to the high permeability of the soils and geology, and elevated position of the site. No significant surface water flow occurs with all rainfall infiltrating to the water table.

Surface drainage in the region is notably absent (Hill, Semeniuk, Semeniuk, & Del Marco, 1996). Underlying soils comprise sand and limestone with a high infiltration capacity (Davidson, 1995). The groundwater table is generally deep and surface water only occurs where ground surface elevations intersect the water table.

2.7.2 Wetlands

No RAMSAR or ANCA listed wetlands exist within 1,000 metres of the project site. No "Conservation" or "Resource Enhancement" category wetlands as described in DEC Geomorphic Wetlands – Swan Coastal Plan (24/11/2010), exist within 1,000 metres of the project site (Landgate, 2024).

2.7.3 Groundwater

The subject site overlies the Perth – Superficial Swan groundwater aquifer, with maximum groundwater levels ranging from RL 21 - 24m AHD, with groundwater flow from east to west across the site (DWER, 2024).

Ground elevations within the subject site range from RL 45m to RL 95m AHD, with depth to groundwater ranging from 23 - 71 metres. Groundwater salinity levels are fresh, varying from 250-500mg/L total dissolved solids (TDS) (Davidson, 1995).

The subject site is not located within a public drinking water or groundwater protection area.

2.8 Karst

The City of Wanneroo Local Planning Policy 4.13 Caves and Karstic Features (2022) identifies the subject site as “Low Risk”. No significant caves or karstic features have been identified or encountered by the quarrying operations to date. The nearest caves known to occur are on the western side of Neerabup Lake, approximately 1km southwest of the subject site.

2.9 Cultural Heritage

2.9.1 Aboriginal Cultural Heritage

The DPLH Aboriginal Cultural Heritage Inquiry System (ACHIS) contains records of one undetermined heritage site application intersecting the project site (DPLH, 2024). ACHIS records deliberately cover a significantly large area to obfuscate the precise location of the site, however the actual locations is more than 1,000 metres from the project site.

Place Number	Name	Status	Assessment
3693	Lake Neerabup	Lodged (undetermined) Site	Lake Neerabup is not located within the subject property and over 1,000 metres from the Wattle Avenue (West) Quarry footprint. The separation distance to the site exceeds all guidelines and therefore no impact from the continued operation of the Wattle Avenue (West) Quarry will occur.

Table 6: Recorded aboriginal cultural heritage sites
Source: (DPLH, 2024)

In accordance with the Aboriginal Heritage Due Diligence Guidelines, and based on the topography and absence of karst features within the subject property, the likelihood of unidentified aboriginal cultural heritage occurring is considered to be remote (DAA, 2013).

2.9.2 European Heritage

There are no registered sites of European heritage within the project area. There are no existing structures or significant evidence of historical European occupation of the site therefore the likelihood of any significant unidentified European heritage sites is remote.

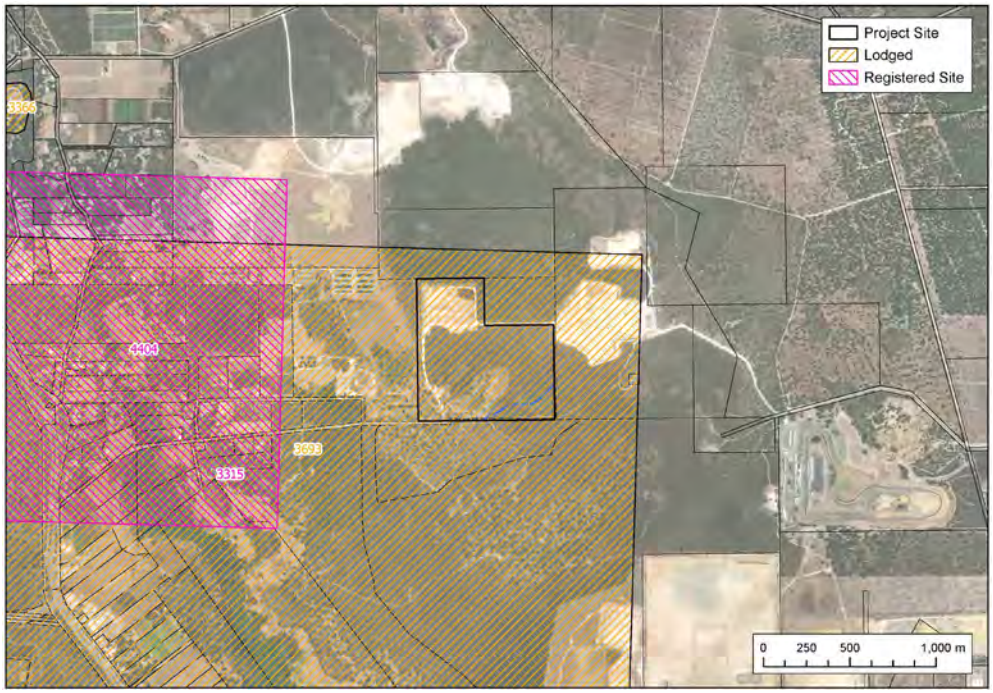

Figure 5: Aboriginal heritage
Source: (DPLH, 2024)

3.0 REGULATORY FRAMEWORK

3.1 Metropolitan Region Scheme

The subject site is zoned “Rural” under the Perth Metropolitan Region Scheme (MRS).

Extractive industry has been deemed to be a land use of state significance under the MRS (Clause 32), and where the use is undertaken on “Rural” zoned, land, development approval from the Western Australian Planning Commission (WAPC) is required.

The continued operation of the Wattle Avenue (West) Quarry is consistent with the objectives of the MRS and previous development approvals by the WAPC.

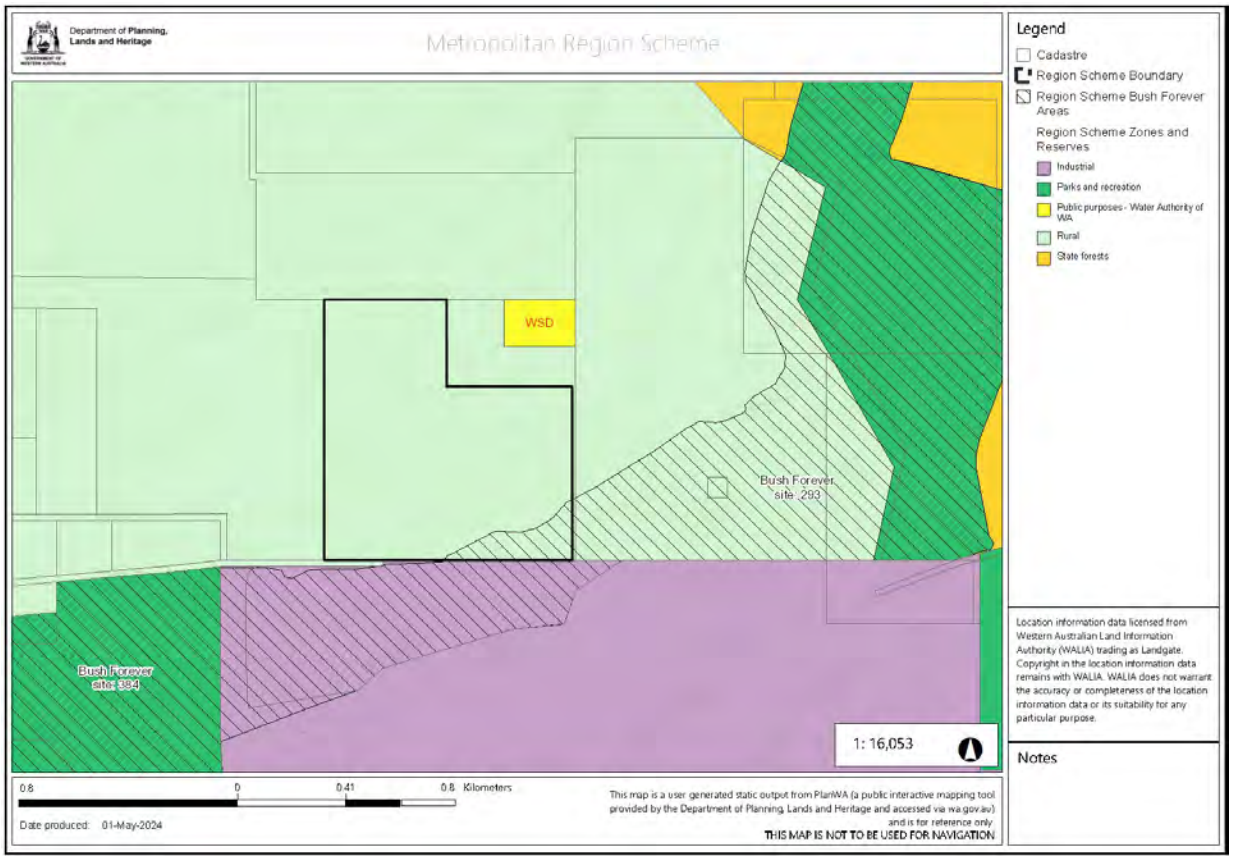

Figure 6: Metropolitan Region Scheme
Source: (DPLH, 2024)

3.2 City of Wanneroo District Planning Scheme No.2

The subject site is zoned “Rural Resource” under the City of Wanneroo District Planning Scheme No.2 (DPS2), with the zoning objectives defined as:

- To protect from incompatible uses or subdivision, intensive agriculture, horticultural and animal husbandry areas with the best prospects for continued or expanded use.
- To protect from incompatible uses or subdivision basic raw materials priority areas and basic raw materials key extraction areas.

The Wattle Avenue (West) Quarry is consistent with the DPS2 definition of “Industry-Extractive”:

Industry – extractive *means premises, other than premises used for mining operations, that are used for the extraction of basic raw materials including by means of ripping, blasting or dredging and may include facilities for any of the following purposes –*

(a) The processing of raw materials including crushing, screening, washing, blending or grading;
(b) Activities associated with the extraction of basic raw materials including wastewater treatment, storage, rehabilitation, loading, transportation, maintenance and administration;

The continued operation of the Wattle Avenue (West) Quarry is consistent with DPS2 and previous development approvals by the City of Wanneroo.

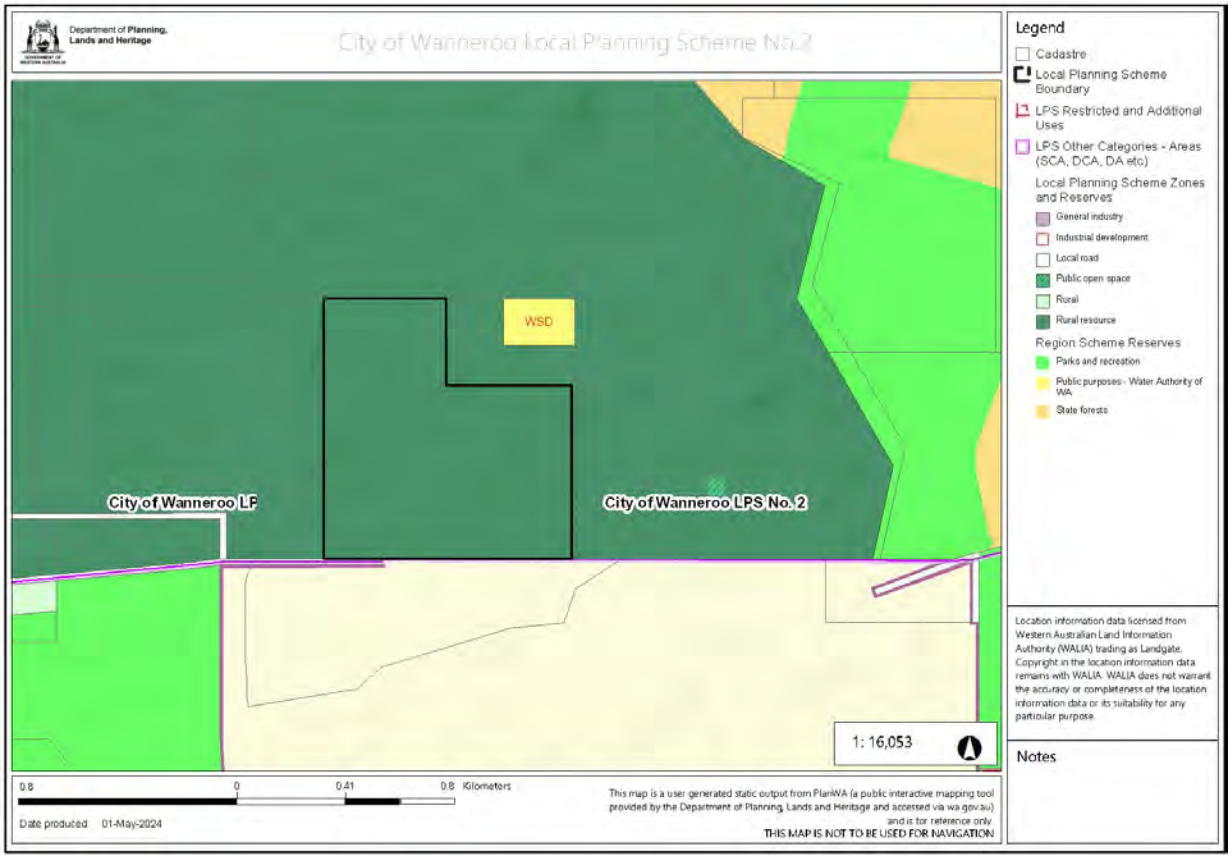

Figure 7: City of Wanneroo Local Planning Scheme No.2
Source: (DPLH, 2024)

3.3 State Planning Policy 2.4 Basic Raw Materials

The availability and supply of basic raw materials has been identified by the state as a finite resource essential for the construction of buildings, roads, infrastructure and agricultural production.

State Planning Policy 2.4 Basic Raw Materials (SPP2.4) sets out a series of planning objectives to identify, protect and ensure the efficient use of BRM.

SPP2.4 identifies the subject site as a “Significant Geological Supply (Limestone) Area”, being the highest level of identification and protection afforded under SPP 2.4.

The 2021 revision of SPP 2.4 sterilised 14.7 hectares of the subject land from Basic Raw Materials excavation as an “Exclusion Area”. The “Exclusion Areas” were derived from the defunct State Strategic Assessment of the Perth and Peel Regions (SAPPR). The intent of the exclusion areas under SAPPR was to provide environmental offsets to allow the extraction of Basic Raw Materials within the Significant Geological Supply Areas.

However SPP 2.4 (2021) provides no recognition of the original intent or purpose of the “Exclusion Areas” and simply sterilises significant areas of Basic Raw Material Resource. The rationale and justification for the imposition of the exclusion areas has not been publicly released by the state, nor was any direct landowner consultation undertaken prior to its imposition. Furthermore and unlike State Planning Policy 2.8, SPP 2.4 (2021), provides no mechanism for review, negotiation or appeal by injuriously affected landowners.

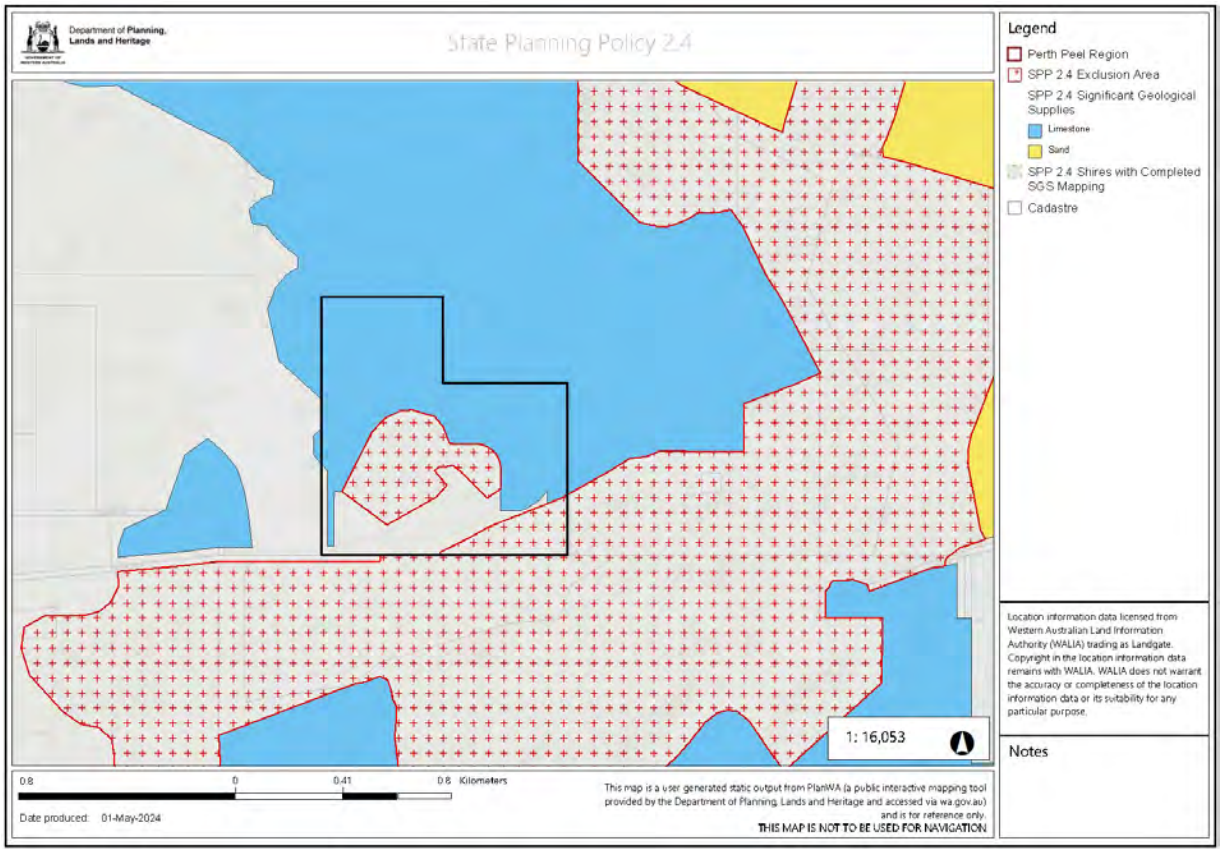

Figure 8: State Planning Policy 2.4
Source: (DPLH, 2024)

3.4 State Planning Policy 2.8 Bush Forever

State Planning Policy 2.8 Bush Forever was developed to establish a conservation system to adequately preserve the ecological communities of the Swan Coastal Plain within the Perth Metropolitan Area.

3.6 hectares of the subject site is constrained by Bush Forever Site 293 under State Planning Policy 2.8. A “Negotiated Planning Solution” (NPS) was completed by the previous landowner (City of Wanneroo) and the Western Australian Planning Commission.

The intent of the NPS was to preserve 3.6 hectares of the subject land for conservation to allow the remainder of the subject land to be developed. However in 2021, the WAPC sterilised an additional 14.1 hectares of the subject land for conservation under State Planning Policy 2.4.

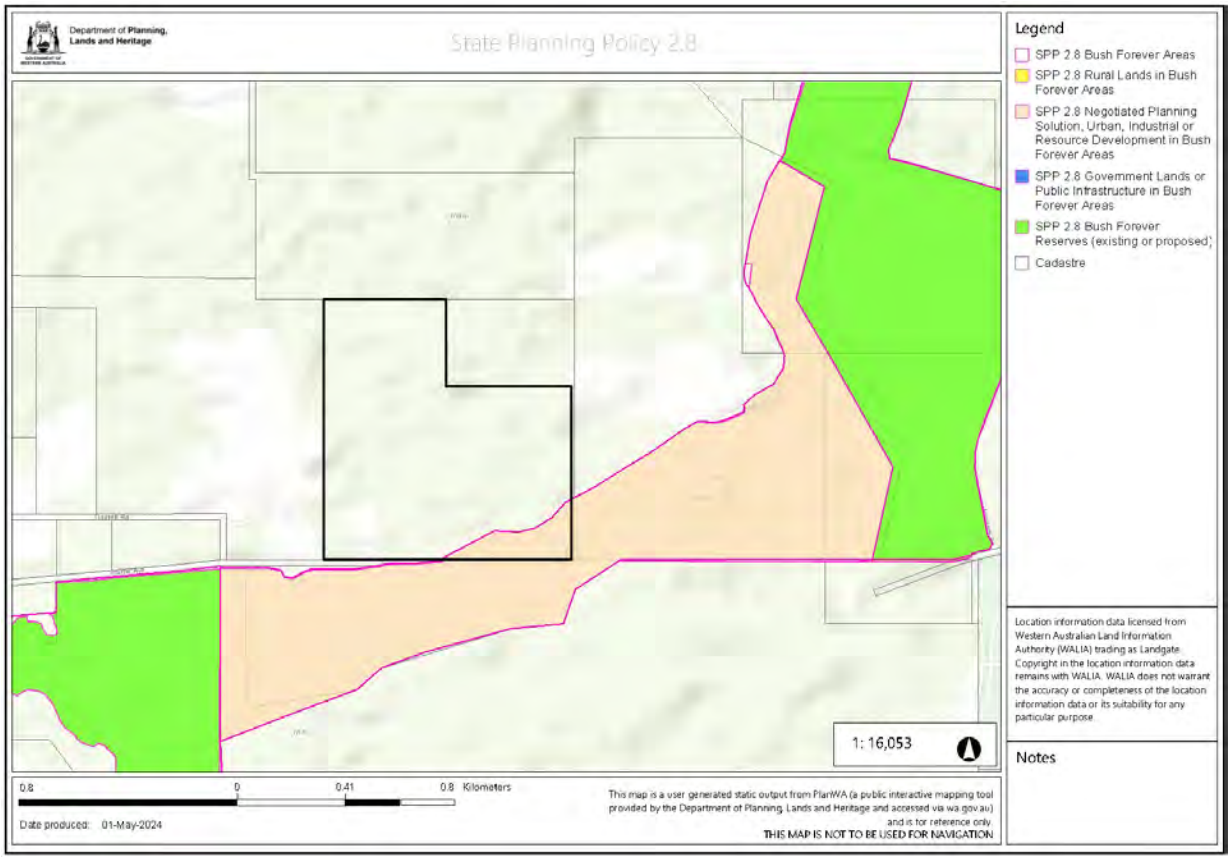

Figure 9: State Planning Policy 2.8
Source: (DPLH, 2024)

3.5 State Planning Policy 3.7 Planning in Bushfire Prone Areas

The continued operation of the Wattle Avenue (West) Quarry does not involve the intensification of land use or development, and the project does not increase the bushfire threat to surrounding areas.

The project consists of an open-air quarry with excavation undertaken within cleared areas. No habitable buildings exist within the site or are proposed.

WAPC Guidelines for Planning in Bushfire Prone Areas (2021) identifies extractive industry uses such as the Wattle Avenue (West) Quarry as low risk and recommends exemption from the requirements of State Planning Policy 3.7 (WAPC, 2021).

3.6 Other Approvals

3.6.1 Environmental Protection Act 1986 – Part V (Prescribed Premises)

The operation of crushing and screening plant is regulated by the Department of Water and Environmental Regulation (DWER) under *Part V (Prescribed Premises) Environmental Protection Act 1986*. Under this framework a Category 12 (Screening, etc. of material) Works Approval and Licence is required.

As a "Prescribed Premises" the principal regulator of environmental matters (e.g. noise, dust, water management, etc.) for the project is DWER.

WA Limestone holds a Category 12 licence (L8605/2011), for the processing of 200,000 tonnes of material per year. No change to the method of processing or the licenced quantity of material is proposed or required.

3.6.2 Environmental Protection Act 1986 – Part V (Clearing of Native Vegetation)

The clearing of native vegetation within Western Australia is regulated by the Department of Water and Environmental Regulation (DWER) under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*. DWER is the principal regulator for the clearing of native vegetation.

As a responsible corporate citizen, WA Limestone undertakes the minimum clearing required to sustain its operations. As a consequence the majority of the site has remained uncleared to date.

Clearing of the vegetation within the subject site has been assessed and approved multiple times by the department since 2008.

DWER have completed assessment for the most recent clearing permit (CPS 9197/1) with the permit to be issued following renewal of planning approval by the City of Wanneroo.

3.6.3 Environmental Protection and Biodiversity Conservation Act (1999) (Cwth)

Clearing of native vegetation requires dual approval from the commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW), under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Approval under the EPBC Act was granted in 2014 (EPBC 2013/6767) and remains in place. Implementation of the relevant management conditions under this approval will occur following formal commencement of the project following renewal of planning approval by the City of Wanneroo.

3.6.4 Rights in Water and Irrigation Act 1914

The abstraction of groundwater is regulated by the Department of Water and Environmental Regulation (DWER) under the *Rights in Water and Irrigation Act 1914*.

Groundwater abstraction does not currently occur within the subject site, with water currently being sourced from offsite sources. Should it become necessary to source groundwater from within the subject site, a groundwater licence will be obtained by the project.

3.6.5 Aboriginal Heritage Act 1972

There are no registered or identified sites of aboriginal heritage within the project area.

WA Limestone recognises that it has obligations under Section 15 of the *Aboriginal Heritage Act 1972* to inform the Department of Aboriginal Affairs should any archaeological material be encountered during ground disturbance.

4.0 PROJECT DETAILS AND OPERATIONAL MANAGEMENT

The Wattle Avenue (West) Quarry is a sand and limestone quarry, which has operated since 2008. No significant changes to the excavation or operational management are proposed or required.

The Wattle Avenue Road project is for the quarrying of sand and limestone for construction materials supply. Sand is typically sold for concrete manufacture and civil projects, with the limestone quarried to produce a range of products including road base, breakwater armour and core material.

Dependent on market demand and regulatory approvals, the project has a remaining life of mine 20 years at anticipated excavation rates.

No waste rock is produced by the operation, only overburden which will be used for safety bunds and stockpiled for later use in rehabilitation.

4.1 Project Description

Excavation is undertaken as a sequential operation, with the quarry to progressively move south and southeast across the site (see Figure 8).

A screening bund has been constructed along the western boundary to provide noise and visual screening of the site.

It is proposed to excavate 50,000 to 200,000 tonnes per year dependent on market demand.

The quarry produces a variety of sand and limestone products with the method of mining varying depending on the product(s) being produced. Not all products require processing by crushing and screening plant (e.g. armour stone and sand excavation).

Machinery used by the mining operations consists of Caterpillar 980, 988 or similar wheel front-end loaders, Caterpillar D10, D11 or similar bulldozer, service/fuel truck, water truck and associated light vehicles. Mobile crushing and screening plant is used to process the excavated sand and limestone.

Small scale and limited blasting may be used for the production of armour rock (large >1 tonne rocks) products for breakwater and other marine projects.

All plant and equipment is maintained to a high quality to ensure efficient, safe and environmentally conscious operation of the site.

4.2 Staging and Timing

Excavation is undertaken as a sequential operation, with the quarry to progressively move south and southeast across the site over a period of approximately 20 years (subject to market demand and regulatory approvals), generally in accordance with Figure 10.

Up to 200,000 tonnes of sand and limestone products are estimated to be excavated annually. Completed areas of excavation will be formed to final levels suitable for post-excavation development as provided at Appendix 2.

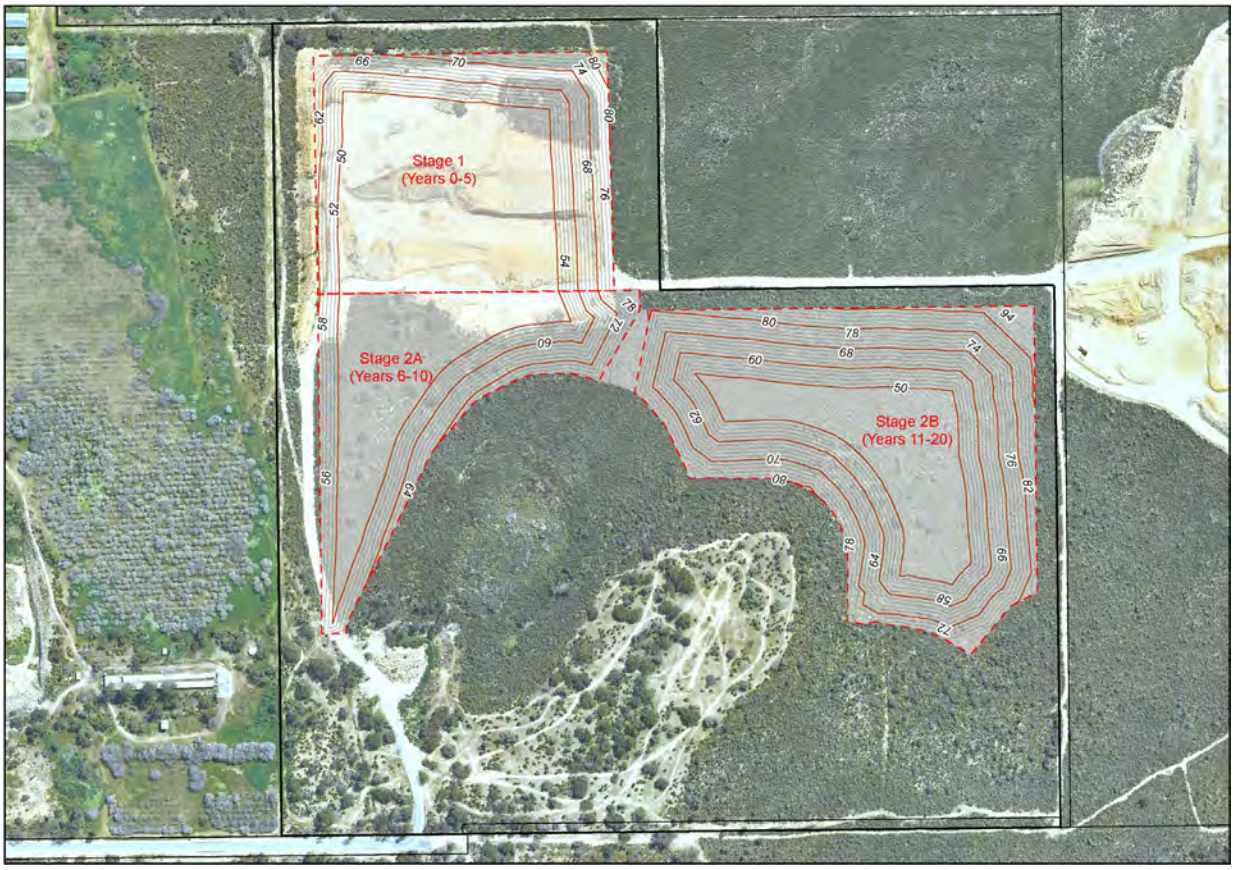

Figure 10: Indicative Excavation Staging

4.3 Operating Hours

Operating hours are proposed to remain as 7:00am-5:00pm Monday to Friday and 7:00am-12:00pm Saturdays, excluding public holidays. Operations outside of these hours will be subject to prior approval by the City of Wanneroo.

4.4 Quarry Design

Current and indicative quarry design levels are provided at Appendix 2. Based on current estimates the remaining recoverable resource is sufficient to sustain operations for a further 20 years.

The excavation levels are designed to maximise the recoverable resource, minimise impact to environmental values, and be compatible for the post-quarrying land use (to be determined). Given these design constraints and the significant remaining life of the project, the design levels should be considered indicative at this time.

4.5 Excavation

The quarry has operated since 2008 and no changes to the excavation methodology is required or proposed. Excavation of the quarry is undertaken as a sequence:

(a) A bulldozer is used to remove any vegetation cover by pushing it into windrows. Where practicable this material is used to minimise soil erosion or preserved for future rehabilitation. If possible it is preferable to directly transfer the cleared vegetation to an area being rehabilitated.

(b) Topsoil is pushed to the edge of the excavation area and formed into perimeter bunds, which provide additional screening for the quarry. Storing topsoil in bunds as opposed to stockpiles increases the surface area and minimises the depth of material, maximising the preservation of the stored seed bank within the topsoil.

(c) Overburden as yellow and brown sand and low grade limestone is pushed to the edge of the excavation area to expose the underlying limestone. Surplus overburden not required for future rehabilitation is sold as fill. Any deposits of higher grade sand may be screened and sold for higher value sand products.

(d) Limestone is excavated by deep ripping with a bulldozer, which is pushed down sloping faces to the floor of the pit. In this process the bulldozer moving over the limestone “track rolls” the material which crushes the limestone into rubble.

(e) Blasting may occasionally be required. This will involve the use of small charges with millisecond delays to reduce air blast overpressure and ground vibration. Blasting will be undertaken in accordance with the current approved blast management plan (Appendix 5). The storage of explosives within the site is not required or proposed.

(f) The limestone rubble is pushed into a stockpile where it is either loaded onto road trucks for taking offsite and sold or used as raw feed for the crushing plant.

(g) A front-end loader takes the raw feed from the stockpile and loads it into mobile crushing and screening plant where the material is reduced to smaller sized rocks, which are then sorted by screens into various sized aggregate products.

(h) Processing plant will be located below natural ground level providing additional visual and acoustic screening.

(i) Water is used for dust suppression to reduce the potential for dust generation from the movement of machinery and wind erosion.

(j) At the completion of excavation the site is prepared for the subsequent land use in accordance with any relevant closure requirements and commitments.

Figure 11: Current Quarry
Source: Nearmap (April 2024)

4.6 Material Processing

All materials extracted are processed into saleable materials. Overburden is retained for safety bunding, screening and rehabilitation of the site. No waste rock or tailings are produced by the operation.

The majority of limestone excavated is sold as aggregate products are produced for roadbase and other construction purposes. These products are produced by processing the raw excavated limestone through a mobile crushing plant and various sized screens to separate the limestone rock into various size classes.

The mobile crushing and screening equipment used is modular and interchangeable. Production of different quarry products requires different configurations of the crusher and screens. Similarly geological variation in the sand and limestone resource requires different equipment configurations.

Armour stone, which are large boulders of varying size used in coastal construction works. Market for armour stone is limited and intermittent however this product is critical for the construction and maintenance of seawalls and breakwaters. Occasionally larger rocks may be “popped” by small explosive charges or broken with a rock breaker.

Any surplus sand excavated will either be loaded directly to a road truck for use as fill sand, or if the sand is of sufficient quality it may be screened and sold for higher uses such as brickies, plasterers or concrete sand.

4.7 Access and Transport

At maximum production, traffic from the quarry is anticipated to be up to 172 movements per day with a peak of 28 movements per hour (KCTT, 2024).

The primary access is via Wattle Avenue West onto Wanneroo Road. In accordance with previous project approvals, Wattle Avenue West was upgraded by WA Limestone in 2020. Vehicles travelling along Wattle Avenue West are restricted to single trailer configurations.

Secondary access to the site is provided by the existing private haul road to the east through WA Limestone's adjacent operations onto Wattle Avenue East. No changes are proposed or required to this access. Wattle Avenue East was separately upgraded by WA Limestone in 2020 and Main Roads approval issued for RAV4 road train access.

The provision of two access points reduces the reliance on Wattle Avenue West and possible impacts to local residences. It additionally provides emergency access/egress in the event of bushfire for both WA Limestone's quarry operations and the nearby Wanneroo Raceway.

All transport vehicles utilised by the operation are road-registered, maintained in good working condition, and adhere to all relevant legislation and standards. All trailers are fitted with tarpaulins and all loads are covered prior to departing the site.

The site is fenced and signposted to prevent inadvertent and unauthorised entry. Locked gates, large boulders and logs are used to discourage four wheel drive and motorbike access. Surveillance cameras are also installed across the site to monitor access.

Figure 12: Figure 5: Project access routes
Source: (KCTT, 2024)

4.8 Workforce

The quarry requires a workforce of 3-5 personnel, depending on production rates. In addition a number of specialised contractors and WA Limestone support personnel will periodically be required for short periods. Site personnel are locally employed and operate on a daily drive-in drive-out basis (DIDO).

4.9 Facilities

In accordance with previous approvals, no buildings or facilities currently exist with the subject site. Ablution and crib facilities continue to be shared with WA Limestone's adjacent quarrying operations to

the east. No additional infrastructure or support facilities are proposed or required for the continued quarrying of the subject site.

4.10 Resource Requirements and Regional Infrastructure

4.10.1 Water

Project water requirements are principally for dust suppression. The volume of water required is highly dependent on the level of activity occurring and meteorological conditions.

Groundwater abstraction from the project site does not currently occur or is proposed, with water for the project imported by tanker from offsite licensed bores held by WA Limestone.

4.10.2 Energy

There is no current connection to the Western Power electricity grid. All power requirements within the subject site are serviced with on-site portable generators.

Power requirements will vary depending on the rate of excavation and machinery in-use at any point in time. All generators used are maintained in good working condition by WA Limestone's in-house maintenance staff.

4.10.3 Machinery and Equipment

The following equipment is likely to be used by the mining operation. No significant changes to machinery or equipment are proposed or required from that previously used by the quarrying operations.

Item	Description
Bulldozer	• Bulldozer (CAT D11 or equivalent) • Used for pushing and movement of overburden and limestone, track rolling, and land clearing and reinstatement.
Loader	• Rubber-tyred wheel front end loader (CAT 980 or equivalent) • Used for movement of sand and limestone, feeding of crushing and screening plant and loading of trucks. • At times 2 or more loaders may operate within the site.
Excavator	• An excavator is used from time to time to move sand and limestone, particularly limestone armour rock.
Dump Truck	• CAT 740 or 777 or equivalent • Used to move material within the site.
Drill	• If blasting is undertaken then a small excavator mounted drill is required.
Water Cart	• A water cart of 10,000-14,000L capacity will be used for dust suppression on the access road and active working area.
Service Truck	• For refuelling, servicing and light mechanical repairs of site machinery.
Light Vehicles	• 4WD Utilities and wagons for site personnel, management and visitors.
Mobile Generator	• Mobile generators are required for the site office and weighbridge and for the operation of electric screening plant.
Mobile crushing and screening plant	• Mobile jaw crusher and electric screens are used for the preparation of various sized limestone aggregate products. The screens may also be used to separate sand from limestone.

Table 7: Plant and Equipment Requirements

4.11 Project Closure and Post-Quarrying Land Use

4.11.1 Post Quarrying Land Use

The quarrying operations have an estimated remaining life of 20 years, with the project currently in an "Operational" phase. Detailed planning for the post-quarrying land use is anticipated to occur approximately 5 years from the completion of excavation, with separate applications and approvals to be obtained for the post-quarrying use.

As privately-owned land there is an expectation that following completion of quarrying, use of the land will continue with the site developed for an alternative beneficial use. What this use entails will be guided by the relevant town planning framework and consultation with key stakeholders closer to the time of closure. At this stage of the project the post-quarrying land use is:

"Development of an alternative land use with beneficial uses"

4.11.2 Indicative Completion Criteria

Indicative completion criteria have been developed to ensure that relevant statutory requirements are met and the site is left in a safe, stable and non-polluting condition capable of supporting the post-quarrying land use (Table 12).

With an anticipated project life of 20 years, the specified completion criteria are to be considered "indicative". These criteria will be regularly reviewed over the remaining life of the project and refined when project closure is imminent (within 5 years).

Closure Objective	Indicative Completion Criteria	Completion Criteria	Measurement Tools
Compliance All legally binding conditions and commitments relevant to the project are met	• Regulatory conditions and obligations relevant to project closure • Commitments made by WA Limestone relevant to project closure	• Reaching compliance with relevant regulatory obligations. • Meeting commitments made	• Audit of project against relevant regulatory obligations and commitments
Landform The completed landform of disturbed areas to be compatible with the post-project land use	• Approval of final landform design	• Reaching final landform surface	• Post-completion survey and comparison against approved final landform design
Rehabilitation Disturbed areas to be rehabilitated to a condition compatible with the post-project land use	• Stabilisation of disturbed areas to minimise erosion	• Treatment of disturbed areas with stabilisation medium (e.g. hydomulch, native grasses)	• Post-completion survey to confirm treatment of disturbed areas
Water Surface and ground water hydrological pattens/flows not adversely impacted	• No substantial change to surface and subsurface hydrological pattens and flows	• Reaching final landform surface	• Post-completion survey and comparison against approved final landform design
Infrastructure and Waste All plant, equipment and infrastructure (as relevant) to be removed from the site unless required by the post-project land use	• All redundant plant, equipment and infrastructure to be re-used, recycled or disposed of appropriately	• All redundant plant, equipment and infrastructure removed from the site.	• Post-completion survey to verify removal.

Table 8: Indicative project completion criteria

4.12 Complaints Management

WA Limestone maintains an ISO 14001:2015 compliant complaints register for all sites and operations. Contact details will be sign posted at the entrance to the site.

All complaints are to be investigated immediately upon receipt of a complaint. If the complaint is substantiated, WA Limestone will undertake measures as necessary to ensure compliance with relevant statutory requirements. Details of complaints received and actions taken will be provided to relevant authorities upon request.

5.0 ENVIRONMENTAL MANAGEMENT

The identification of significant environmental aspects and risks associated with the project has been completed in accordance with the principles of AS/NZS ISO 31009:2018 Risk Management – Principles and Guidelines. (Appendix 1)

Project environmental risk are to be reduced to As Low As Reasonably Practicable (ALARP) by working through the control methodologies defined in the Hierarchy of Control (Figure 5).

The appropriateness and effectiveness of management controls shall be periodically reviewed and revised as necessary.

Compliance with management controls requires the effective awareness and compliance by all WA Limestone personnel and subcontractors for the environmental operating requirements relevant to their role and/or tasks performed. This shall be conducted and managed in accordance with the management controls set out in this section.

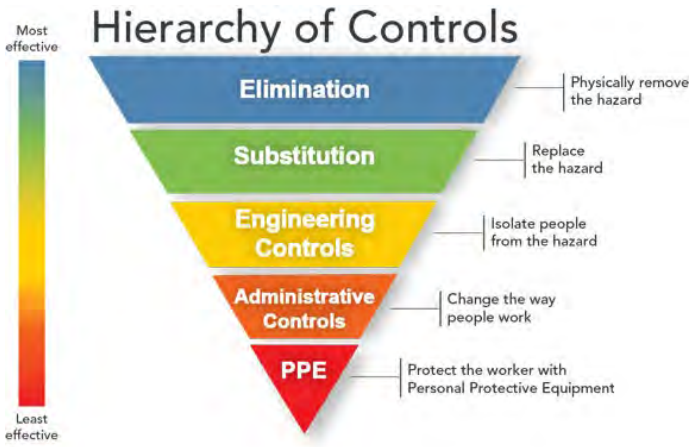

Figure 13: Hierarchy of Control

5.1 Visual

5.1.1 Assessment

Visual impacts can occur in a number of circumstances, by the development being too high in the landscape, by being too close to neighbours and/or by insufficient visual protection. Perception of a visual feature and its impact to the observer is highly individualistic and difficult to quantify. A feature may appear visually appealing to one person and offensive to another.

The context of the feature in the landscape is also a significant factor in considering its visual acceptability. Sand and limestone has continuously occurred in Nowergup area for more than 100 years and is an integral aspect of the economic, social and historical fabric of the locality. With the use occurring since before living memory, it has become normalised within the visual landscape of the area.

The project site is isolated and surrounded by native vegetation, intensive poultry uses and other extractive industry uses. The project is not visible from any publicly accessible vantage point.

Notwithstanding this, a screening bund has been constructed on the western edge of the site to provide further visual and noise screening.

5.1.2 Objectives and Targets

Objective	Target	Performance Indicator
Minimise the visibility of the project from publicly accessible vantage points	Project not visible from publicly accessible vantage points	• Visibility of the project from nearby public vantage points (e.g. Wattle Avenue West). • Results of regular aerial survey of the project site. • Number of substantiated complaints relating to visual impact.

5.1.3 Management controls

Aspect	Management Control
Quarry Operation	Installation of screening bund along the western boundary of the site
	Limit operations to daytime hours.
	Security lighting (if used) to be located and directed away from sensitive receptors
	Location and height of stockpiles to be managed such as they are not visible from publicly accessible vantage points.

5.1.4 Monitoring

- Regular visual inspection of the site by environmental personnel
- Annual survey of the project to monitor ground disturbance and height of features

5.1.5 Reporting and Records

- Reporting to regulators in accordance with statutory requirements
- Complaints received recorded and provided to regulators as required.

5.2 Flora and vegetation

5.2.1 Assessment

The clearing of native vegetation and impacts to flora and fauna are regulated by the Department of Water and Environmental Regulation (DWER) under the Envir*onmental Protection Act 1986*, and the commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) under the *Environmental Protection and Biodiversity Conservation Act 1999*.

The continued operation of the project requires the disturbance of approximately 14.7 hectares of native vegetation (Figure 4). The clearing has been assessed by DWER and DCCEEW who have both determined the project will not cause significant environmental impact if undertaken in accordance with the management actions outlined at Section 5.3.4.

With baseline environmental values and impacts quantified, appropriate management actions have been developed in accordance with the Offsets Mitigation Hierarchy of “Avoid – Mitigate – Offset” to ensure the project provides an overall nett gain to the environment.

Avoidance

The siting of Basic Raw Materials excavation is restricted by a number of constraints including geology, zonings, and existing development which limit the ability to avoid the clearing of native vegetation. The excavation area has been carefully designed to limit clearing of native vegetation to areas of lower environmental values.

The flora and vegetation to be cleared was surveyed by PGV Environmental in 2022 confirming the disturbance area does not contain any flora species or vegetation communities of conservation significance (PGV Environmental, 2022).

To achieve this and in recognition of recent changes to conservation listings, the disturbance footprint has been reduced by 0.6 hectares from the previous approved quarry footprint to avoid disturbance to Banksia Woodland ecological community vegetation (Figure 4).

14.6 hectares of the subject site is sterilised from excavation by State Planning Policy 2.4 (Basic Raw Materials), and 3.7 hectares sterilised by State Planning Policy 2.8 (Bush Forever) (Figure 4).

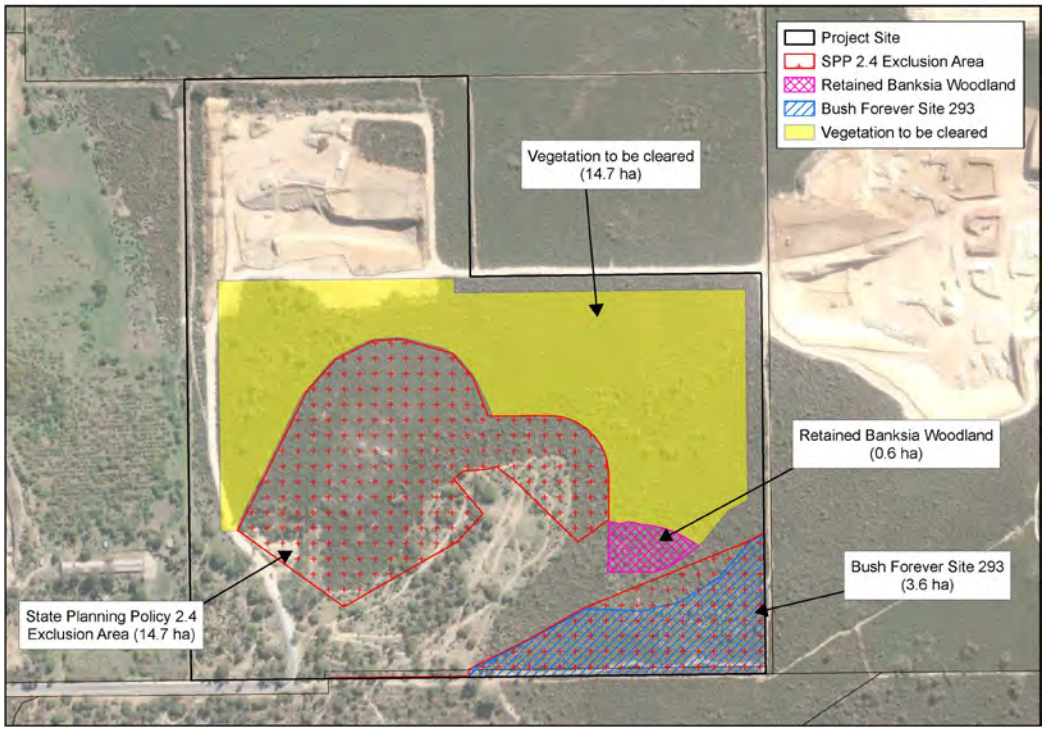

Figure 14: Flora and vegetation avoidance areas
Source: WA Limestone; (Landgate, 2024)

Mitigation
The continued sharing of infrastructure with WA Limestone's nearby operations allows for the reduction in the disturbance area within the project site to mitigate the overall environmental impacts by the project.

Post-mining rehabilitation of the site was previously proposed for the project however due to policy changes within both DWER and DCCEEW, neither department considers post-mining rehabilitation to provide significant mitigation value on the grounds of the lag period between vegetation loss and restoration of environmental values, and the risk of rehabilitation not achieving the required environmental values. Further to this, neither department considers rehabilitation costs to implement or in the case of privately held land, the sterilisation and loss of future use of the land.

In response to the position taken by DWER and DCCEEW and to address the uncertainty and risk raised, post-quarrying rehabilitation is no longer proposed. Instead, residual environmental impacts are to be addressed by increasing the environmental offset package for the project to provide certainty of outcomes and overall nett environmental gain.

Offsets
The determination and administration environmental offsets is regulated by DWER and DCCEEW and a comprehensive offset proposal has been developed for the project.

The project offset package will involve the acquisition of land of high-quality native vegetation with "like for like" environmental values of the disturbance site, and transfer to the state for management by the Department of Biodiversity Conservation and Attractions (DBCA) and inclusion into the state conservation estate.
The offset package has been approved by DCCEEW, and is currently pending final approval by DWER, which will occur following renewal of planning approval by the City of Wanneroo.

5.2.2 Objectives and Targets

Objective	Target	Performance Indicator
Limit the clearing of native vegetation	Clearing of native vegetation limited to the minimum necessary to sustain the project.	• Approval of native vegetation clearing by state and commonwealth regulators.
Where the clearing of native vegetation cannot be avoided, mitigate and/or offset impacts to significant flora and fauna.	No residual impact to the environment as a result of project clearing activities.	• Approval of native vegetation clearing by state and commonwealth regulators.
Comply with state and commonwealth legislation for the clearing of native vegetation.	Zero incidents of clearing outside of approved areas by project activities.	• Results of regular aerial survey of the project site. • Number of incidents of clearing outside of approved areas by project activities.
Limit impacts to adjacent native vegetation as a result of project activities.	Zero disturbance / degradation of adjacent native vegetation.	• Results of regular aerial survey of the project site. • Periodic inspection of adjacent native vegetation to review species abundance, density, and weed levels.

5.2.3 Management controls

Aspect	Management Control
Management	• Referral of proposed clearing to DWER and DCCEEW for assessment, and approvals obtained (if required) prior to clearing occurring. • Physical demarcation of clearing areas by surveyor prior to clearing occurring. • Regular aerial survey of project area to monitor for disturbance outside of approved areas.
Quarry Operations	• Limiting the clearing of native vegetation to areas which do not contain flora species or vegetation communities of conservation significance. • Reduction of the quarry footprint by 0.6 hectares to avoid disturbance to Banksia Woodland ecological community vegetation. • Sterilisation of 3.7 hectares of the subject land from development by Bush Forever Site 293. • Provision of offset land package to offset the residual environmental impacts caused by the clearing of native vegetation. • Offset land package increased to address potential impacts from rehabilitation lag periods and risk of rehabilitation completion criteria not being met.

5.2.4 Monitoring

- Regular aerial survey of the project to identify disturbance to native vegetation.
- Regular site inspection by WA Limestone environmental personnel to monitor for vegetation degradation by project activities, weed levels, etc.
- Periodic assessment of native vegetation within the project site.

5.2.5 Reporting and Records

- Disturbance of native vegetation outside of approved areas to be reported as an environmental incident.
- Statutory reporting obligations in accordance with DWER and DCCEEW approvals.

5.3 Fauna

5.3.1 Assessment

Potential impacts to fauna by the project were assessed by Bamford Consulting in 2022 (Bamford, 2022) and summarised at Table 6 below.

Aspect	Assessed Impact
Habitat loss leading to population decline	Negligible to minor
Habitat loss leading to habitat fragmentation	Minor
Degradation of habitat due to weed invasion	Minor
Mortality during construction	Negligible to minor
Ongoing mortality	Negligible
Species interactions	Negligible to minor
Hydrological change	Negligible
Altered fire regimes	Negligible
Disturbance (dust, noise, light)	Minor

Table 9: Fauna Impact Assessment
Source: (Bamford, 2022)

Notwithstanding the efforts made by the project to minimise the clearing of native vegetation and avoid areas of higher conservation significance, it is recognised that the clearing of native vegetation by the project will reduce the availability of fauna habitat. To address this, a package of environmental offsets are to be provided by WA Limestone as determined by DWER and DCCEEW to be appropriate to the risk and potential impact by the project.

Additional fauna management is to be implemented during higher risk activities such as the clearing of native vegetation, including pre-clearing fauna relocation.

The ongoing quarry operations present a risk of injury to native fauna through vehicle movements and fauna becoming trapped in trenches and pits. Existing management controls to prevent injury to fauna have been effective to date with no reported incidents of fauna injury by the project.

5.3.2 Objectives and Targets

Objective	Target	Performance Indicator
Limit accidental or intentional impacts to terrestrial fauna and their habitat	Zero incidents of injury or death to significant native fauna as a result of project activities.	• Number of reported incidents of injury or death of significant native fauna.
	Zero incidents of unauthorised clearing of significant fauna habitat.	• Results of regular aerial survey of the project site. • Number of incidents of clearing outside of approved areas by project activities.
	Zero disturbance / degradation of adjacent significant fauna habitat.	• Results of regular aerial survey of the project site. • Periodic inspection of adjacent native vegetation to review species abundance, density, and weed levels.

5.3.3 Management Controls

Aspect	Management Control
Clearing of native vegetation	• Referral of proposed clearing to DWER and DCCEEW for assessment, and approvals obtained (if required) prior to clearing occurring. • Pre-clearing fauna relocation • Clearing of native vegetation to be systematic to allow any remaining fauna to self-relocate to surrounding native vegetation. • Machine operators to monitor for distressed or injured fauna and to stop activity if found and report to the Quarry Manager. • Demarcation of approved clearing areas by surveyor prior to clearing.
Quarry Operations	• Prohibit the feeding, harming or disturbance of native fauna by site personnel. • Construction of fauna egress points from trenches, pits and deep excavations (where required). • Enforcement of 20 km/hour speed limit on internal roads.

5.3.4 Monitoring

- Regular aerial survey of project to inspect for disturbance outside of disturbed areas.
- Daily inspection of open trenches and pits for trapped fauna.

5.3.5 Reporting and Records

- Sightings of feral animals within the project area to be reported to WA Limestone environmental personnel.
- Injury of native fauna to be recorded as an environmental incident.

5.4 Erosion

5.4.1 Assessment

Soils and geology within the project site consist predominantly of yellow brown sands over limestone outcrop/bedrock, varying from 200mm to over 3 metres where sand occurs between the limestone pinnacles. The soils within the site are highly porous with minimal surface water flow occurring except during exceptional rainfall events.

The risk of water erosion is low and managed through the appropriate design of operating surfaces, and strategic placement of erosion control devices (if required).

Wind erosion of friable material producing dust emissions is a risk. For limestone surfaces, once treated with water, limestone typically forms a hard crust of precipitated calcium carbonate which stabilises the surface. Fine particles are washed below the surface, leaving only coarse material behind which is less susceptible to wind erosion and dust lift off. If left undisturbed, dust emissions from wind erosion is greatly reduced.

5.4.2 Objectives and Targets

Objective	Target	Performance Indicator
Minimise erosion and sedimentation attributable to project activities	Zero off-site impacts as a result of erosion or sedimentation attributable to project activities.	• Results of regular aerial survey of the project site. • Number of incidents of erosion or sedimentation reported.

5.4.3 Management Controls

Aspect	Management Control
Vegetation clearing	Quarry pit, roads and laydown areas designed to prevent excessive pooling and stormwater runoff from adversely affecting the surrounding environment.
Overburden stripping	Disturbed areas no longer required by the project are to be suitably stabilised to prevent significant erosion.
Road and infrastructure construction	Sediment and erosion controls to be installed (as required).

5.4.4 Monitoring

- Disturbed areas, and sediment and erosion controls (where installed) are to be inspected regularly by environmental personnel and following significant rainfall events.

5.4.5 Reporting and Records

- Significant erosion or sedimentation to be recorded as an environmental incident.

5.5 Weeds

5.5.1 Assessment

No evidence of significant weed infestations as a result of the quarry operations have been reported in the routine inspections of the site by WA Limestone environmental personnel, and weed levels across the site have remained low since the quarry commenced.

The Wattle Avenue (West) Quarry has operated since 2008. No evidence of significant weed infestations as a result of the quarry operations have been reported in the routine inspections of the site by WA Limestone environmental personnel, and weed levels across the site have remained low since the quarry commenced.

Weed levels within the surrounding vegetation have been routinely assessed as part of flora and vegetation assessments. The most recent assessment by PGV Environmental in 2023, identified 24 introduced species and 105 native species within the project site. This is an increase in introduced species compared to the previous vegetation assessment by Regeneration Technologies in 2006 which recorded 75 native species and 9 introduced species (PGV Environmental, 2022).

The higher number of introduced species recorded in 2022 compared to 2006 is considered to be a result of improved assessment methodology rather than an increase in weed levels, which is supported by changes to vegetation assessment guidelines, the number of native species identified in 2006 and 2022, and the vegetation condition in 2022, which was assessed by PGV as being in “Excellent” condition under the Keighery system.

5.5.2 Objectives and Targets

Objective	Target	Performance Indicator
Prevent the introduction of weeds and control existing weed populations within the project site as a result of project activities.	Zero new weed outbreaks as a result of project activities.	• Results of regular aerial survey of the project site. • Results of regular site inspections.
	Zero spread in area or increase in density of existing weed populations	• Results of regular aerial survey of the project site. • Results of regular site inspections.

5.5.3 Management Controls

Aspect	Management Control
Quary Operation	Earth engaging plant and equipment to be cleaned of plant and soil material prior to arrival at site.
	Regular site inspections by environmental personnel to identify weed infestations.
	Where necessary, undertake weed control activities (e.g. spraying) as dictated by the problem.
	Prohibit the importation of soil and plant material except where required for rehabilitation and obtained from weed free source.

5.5.4 Monitoring

- Regular site inspections by environmental personnel and recording of weed infestations.

5.5.5 Reporting and Records

- Site inspection reports to be retained.
- Records of any equipment failing hygiene requirements to be reported as an environmental incident.

5.6 Dieback

5.6.1 Assessment

No evidence of Phytophthora dieback has been recorded by any of the vegetation assessments of the project site conducted since 2006.

Regular testing for Phytophthora dieback within quarry products is undertaken by the project. No evidence of dieback has ever been recorded within the project site.

Phytophthora Dieback is recognised as being unlikely to occur or impact vegetation on limestone soils and Spearwood/Cottesloe Land systems (EPA, 2000), (Podger, 1998).

Limestone such as is produced by the project is a recommended treatment to suppress Phytophthora dieback due to the high pH of the material (Dieback Working Group, 2005).

5.6.2 Objectives and Targets

Objective	Target	Performance Indicator
Prevent new Phytophthora dieback infestations, or spread of existing infestations as a result of project activities.	Zero new Phytophthora dieback infestations within the project site, attributable to project activities.	• Routine dieback testing of quarry products.
	Zero increase in the spread of existing dieback infestations (if present) within the project site, attributable to project activities.	• Periodic assessment of the vegetation within the project site for evidence of dieback infestation (where possible).

5.6.3 Management Controls

Aspect	Management Control
Quarry Operation	Inspect earth engaging equipment prior to entering and departing the site for soil and plant material.
	Routine testing for Phytophthora in quarry products.
	Prohibit the importation of soil and plant material except where required for rehabilitation and obtained from dieback free source.
	Segregation of vegetation clearing and other earth-engaging activities.
	Unauthorised access to the site to be restricted, and any illegally dumped rubbish is to be promptly removed from the site.

5.6.4 Monitoring

- Routine testing for Phytophthora dieback in quarry products.
- Periodic vegetation assessments and evidence of Phytophthora dieback infestation

5.6.5 Reporting and Records

- Phytophthora dieback test results to be retained.
- Records of any equipment failing hygiene requirements to be reported as an environmental incident.

5.7 Water

5.7.1 Assessment

The Wattle Avenue (West) Quarry has operated since 2008. No changes to the quarry are proposed or required which have the potential to increase the risk of impacts to surface or groundwater.

The Wattle Avenue (West) Quarry project is classified as a "Prescribed Premises" by Schedule 1 *Environmental Protection Regulations 1987*, with environmental management approved and regulated by the Department of Water and Environmental Regulation (DWER). This includes water management.

The project site is not located a surface or groundwater protection area or in proximity to any environmentally sensitive water features.

The quarry operations are consistent with DWER *Water Quality Protection Note (WQPN) 15 – Extractive industries near sensitive water resources (2019),* which identifies Basic Raw Material excavation as an acceptable land use with low risk to surface and groundwater features.

No surface water features occur within 1,000 metres of the project area and there is no surface water flow within the site due to the porosity and permeability of the sand and limestone soils. Surface water typically only occurs where ground elevations intersect the water table. Minimal water run-off occurs within the site with stormwater runoff disposed of by infiltration into the porous limestone soils.

The subject site overlies the Perth – Superficial Swan groundwater aquifer, with maximum groundwater levels ranging from RL 21 - 24m AHD, with groundwater flow from east to west across the site (DWER, 2024).

Natural ground elevations across the subject site range from RL 45m to RL 95m AHD, with an indicative final quarry pit floor level of RL 50-52m. This provides a separation to groundwater of more than 20 metres, which substantially exceeds WQPN 15 recommendations.

Groundwater salinity levels in the locality are fresh, varying from 250-500mg/L total dissolved solids (TDS) (Davidson, 1995) and suitable for continued dust suppression use by the project.

Groundwater abstraction within the project site does not current occur nor is proposed. DWER Water Register identifies the groundwater resources within the Nowergup as "Fully Allocated" (DWER, 2024). Accordingly, WA Limestone will continue to source water from its existing network of licensed bores within the locality.

5.7.2 Objectives and Targets

Objective	Target	Performance Indicator
Minimise short and long term impacts to regional drainage and water quality	Zero short or long term impacts to regional drainage and water quality.	• Compliance of project activities with DWER WQPN 15. • Number of incidents reported relating to water pollution.

5.7.3 Management Controls

Aspect	Management Control
Quarry Operation	Excavation to maintain a minimum 2 metre separation to groundwater (>20 metres currently proposed).
	All stormwater to be contained within the project site with erosion control devices constructed as required.
	Maintenance of all plant and equipment in good working condition in accordance with manufacturers specifications.
	Construction of roads and hardstand areas with suitable grades to prevent water pooling and direct stormwater to appropriate runoff points.
	Maintain roads and hardstand areas in good condition free of significant potholes, rills and product spillages.
	Provision of hydrocarbon spill kits on service and refuelling vehicles.
	Secure access to the site to restrict unauthorised access and illegal dumping.

5.7.4 Monitoring

- Regular inspections to identify potential water contamination
- Regular inspection of stormwater and surface water controls (if installed).
- Inspection for erosion and sedimentation following significant rainfall events.
- Monitoring of project water consumption.

5.7.5 Reporting and Records

- Project water consumption to be recorded and records retained.
- Water pollution, significant erosion or sedimentation to be reported as an environmental incident.
- Any breach of water abstraction licenses and permits (if relevant) to be reported as an environmental incident.

5.8 Waste

5.8.1 Assessment

The Wattle Avenue (West) Quarry project is classified as a "Prescribed Premises" by Schedule 1 *Environmental Protection Regulations 1987*, with environmental management approved and regulated by the Department of Water and Environmental Regulation (DWER). This includes waste management.

Extraction of sand and limestone is a clean operation, which does not produce waste. No chemicals are used apart from normal lubricants for machinery. The principal risk of waste is from unauthorised access and illegal dumping.

Vehicle maintenance on-site is limited to minor servicing and light mechanical repairs as part of normal operating procedures. Service trucks are equipped with waste fluids recovery equipment and storage tanks. Any waste chemicals or fluids derived from routine maintenance activities are collected by the service truck and taken from site and disposed of at an approved facility.

Unauthorised Access and Illegal Dumping

Unauthorised access and illegal dumping is a significant issue within the local area. WA Limestone works with the City of Wanneroo, DBCA, DevelopmentWA and other stakeholders to control access and prevent illegal dumping within WA Limestone's land and adjacent areas.

Any illegally dumped material is promptly removed to an approved landfill or other suitable site, depending on the nature of the material.

Access to the subject land is restricted by fencing, signage, locked gates, the strategic placement of logs and boulders, and security cameras installed.

5.8.2 Objectives and Targets

Objective	Target	Performance Indicator
Abide by all regulatory requirements and industry best practice for waste management.	Zero non-compliances with regulatory requirements	Number of incidents relating to the disposal of waste.
Waste produced by the site to be reused and recycled as far as practicable.	100% of recyclable wastes recycled	Number of non-conformances reported relating to the segregation, storage and disposal of wastes.
Maintenance of the site in a clean and tidy condition at all times.	Site maintained in a clean and tidy condition at all times.	Number of non-conformances reported relating to site housekeeping.

5.8.3 Management Controls

Aspect	Management Control
Quarry Operation	Provision of adequate and appropriate waste receptacles for the types and quantities of waste generated.
	Waste receptacles to be covered to keep out animals and prevent windblown litter.
	Controlled waste (if generated) to be separated from non-controlled waste to avoid the potential for contamination.
	Controlled waste (if generated) to be disposed of by a licenced waste carrier to an appropriately licensed facility.
	Site access restricted by fencing, signage, locked gates, boulders and logs to prevent unauthorised access and illegal dumping.

5.8.4 Monitoring

- Daily inspection by quarry personnel for:
  - Litter in work areas
  - Waste receptacles nearing capacity and requiring disposal

5.8.5 Reporting and Records

- Waste management breaches to be reported as an environmental incident
- Illegal dumping incidents to be reported as an environmental incident
- Records of hydrocarbon waste disposal by appropriately licensed contractor to be retained.

5.9 Bushfire

5.9.1 Assessment

Bushfire within the surrounding vegetation and rural area is a risk to the project.

The project consists of an open-air quarry with excavation undertaken within cleared areas. No habitable buildings exist within the site or are proposed. The continued operation of the quarry does not involve the intensification of land use or increase the bushfire threat.

Quarry activities are undertaken in accordance with the *Bushfire Regulations 1954*, *Work Health and Safety (Mines) Regulations 2022*, and any notices or directions issued by the Department of Fire and Emergency Services (DFES) and the City of Wanneroo.

Firebreaks are maintained annually in accordance with City of Wanneroo standards and the quarry itself forms a natural firebreak.

The risk of potential bushfire caused by the project quarrying operations is low as project activities within vegetated areas are rare and infrequent. These activities are to be avoided during periods of elevated bushfire risk as far as practicable and appropriate bushfire controls are to be implemented if these activities are undertaken.

5.9.2 Objectives and Targets

Objective	Target	Performance Indicator
Prevent bushfires from occurring as a result of project activities	Zero bushfires occurring as a result of project activities	Number of bushfire incidents occurring as a result of project activities.
Protect the project from bushfires.	Zero damage to project plant, equipment, and infrastructure from bushfires.	Incident reports relating to damage to plant, equipment and infrastructure from bushfire.

5.9.3 Management Controls

Aspect	Management Control
Quarry Operation	• Maintenance of site firebreaks in accordance with government regulations and standards. • Securing of the site from unauthorised access. • Prohibition of activities within vegetated areas during Total Fire Ban and Vehicle Movement Ban periods. • Provision of fire-fighting appliance (water cart) for activities within vegetated areas during periods of elevated bushfire risk. • Provision of strategic water supply point for potential use in extinguishing fires. • Establishment of emergency muster point, communication protocols, inductions and training (as required) for site personnel.
Bushfire Event	• Immediate reporting of bushfires to authorities • Provision of assistance to bushfire suppression activities (e.g. use of earth-moving equipment) under the direction and supervision of bushfire control officers.

5.9.4 Monitoring

- Visual monitoring for bushfires by quarry personnel.

5.9.5 Reporting and Records

- Bushfire events caused by or impacting the project site to be recorded as an environmental incident.
- Provision of records as required to relevant authorities in the event of bushfire.

5.10 Heritage

5.10.1 Assessment

Non-indigenous heritage

Non-indigenous heritage is regulated by the Department of Planning, Lands and Heritage (DPLH) under the *Heritage Act 2018*.

The State Heritage Register (searched 9 April 2024) does not record any sites within the project area. There are no existing structures or significant evidence of historical non-indigenous occupation of the site therefore the likelihood of any significant unidentified heritage sites is remote.

Aboriginal heritage

Aboriginal Cultural Heritage is regulated by the Department of Planning, Lands and Heritage (DPLH) under the *Aboriginal Heritage Act 1972*.

WA Limestone recognises that it has obligations under Section 15 of the *Aboriginal Heritage Act 1972* to inform the Department of Planning, Lands and Heritage. should any archaeological material be encountered during ground disturbance.

The DPLH Aboriginal Cultural Heritage Inquiry System (ACHIS) contains records of one undetermined heritage site application intersecting the project site (DPLH, 2024). ACHIS records deliberately cover a significantly large area to obfuscate the precise location of the site, however the actual locations is more than 1,000 metres from the project site.

In accordance with the Aboriginal Heritage Due Diligence Guidelines, and based on the topography and absence of karst features within the subject property, the likelihood of unidentified aboriginal cultural heritage occurring is considered to be remote (DAA, 2013).

5.10.2 Objectives and Targets

Objective	Target	Performance Indicator
Avoid disturbance to identified heritage sites	Zero disturbance to known heritage sites.	• Compliance with relevant heritage legislation. • Number of incidents relating to the disturbance of heritage sites.
Report the discovery of suspected heritage sites	All suspected heritage sites reported.	• Compliance with relevant heritage legislation.

5.10.3 Management Controls

Aspect	Management Control
Existing / Known Heritage	If present, known heritage sites within the project area are to be demarcated by appropriate fencing, signage, etc.
Unidentified Heritage	Quarry personnel involved in ground disturbance to be inducted and/or trained to identify potential aboriginal heritage sites.
	Should a suspected heritage site be identified: • all works potentially impacting the site are to cease immediately and the area cordoned off • WA Limestone management are to be notified who will direct actions as appropriate to the discovery. • Work in the area is not to recommence until the suspected heritage site has been investigated and any requisite authorisations obtained.

5.10.4 Monitoring

- Monitoring and maintenance of demarcation fencing surrounding known heritage sites (where present).
- Visual monitoring for potential heritage sites by quarry personnel when undertaking ground disturbance.

5.10.5 Reporting and Records

- Discovery of a suspected heritage site to be reported in accordance with DPLH requirements.
- Damage to a known heritage site (where present) to be recorded as an environmental incident and reported in accordance with DPLH requirements.

5.11 Noise

5.11.1 Assessment

The Wattle Avenue (West) Quarry project is classified as a "Prescribed Premises" by Schedule 1 *Environmental Protection Regulations 1987*, with environmental management approved and regulated by the Department of Water and Environmental Regulation (DWER). This includes noise management.

The Wattle Avenue (West) Quarry is located approximately 650 metres to the nearest dwelling and noise has been regularly assessed throughout the life of the quarry, most recently in 2023 by Herring Storer Acoustics.

The 2023 assessment involved continuous noise monitoring over a period of 6 days whilst the quarry was operating and included blasting. These results were used to confirm previously modelling and calculate noise levels at the two closest dwellings to the project.

The assessment determined a maximum (worst case) noise level received by the dwellings from the quarry operations of 39dB(A), compared against the assigned noise level criteria of 59dB(A), which complies with the requirements of the *Environmental Protection (Noise) Regulations 1997*.

In regard to noise from blasting (air blast overpressure) the *Environmental Protection (Noise) Regulations 1997* stipulate that noise levels received at noise sensitive receptors must be 115dB or less for 9 out of 10 consecutive blasts, with no blast exceeding 120dB. For non-sensitive premises the limits are 120dB and 125dB respectively. Note: these limits only apply where the blaster reasonably believes that person(s) are present within the receptor locations at the time of the blast.

Blasting is undertaken infrequently for short duration campaigns. Limestone is a comparatively soft rock and basting is not normally required, except for the production of armour stone. Blasting for limestone is not inherently noisy. Blast designs for limestone are small in size, require small explosive charges and utilise microsecond delays. The 2023 noise monitoring by Herring Storer included multiple blasts that are within the 39 dB(A) noise level at the nearest dwellings.

WA Limestone notes the two dwellings considered by Herring Storer are associated and located within a large industrial poultry rearing use. As such the dwellings likely meet the definition of "caretakers residences" under Schedule 1 of the Noise Regulations, which are not classified as sensitive premises.

With a confirmed margin of compliance of at least 20 decibels, noise emissions from the quarry are considered to be insignificant and low risk.

5.11.2 Objectives and Targets

Objective	Target	Performance Indicator
Maintain compliance with the *Environmental Protection (Noise) Regulations 1997*	Zero non-compliances	Noise assessment to confirm project noise emissions and compliance with the noise regulations.
Limit disturbance from noise generated by the project to nearby receptors	Zero substantiated noise complaints relating to project activities	Number of substantiated complaints received.

5.11.3 Management Controls

Aspect	Management Control
Quarrying Operation	Excavation and processing to be undertaken below natural ground level as far as practicable.
	Construction of a perimeter screening bund along the western edge of the project area.
	Trafficable areas to be maintained in good condition free of potholes and rills.
	Quarry operations to be conducted within the project operating hours specified at Section 4.3.
	Low frequency (Croaker) reversing alarms fitted where safely practicable
	Plant alarms to utilise warning lights rather than audible alarms where safety practicable
	Drivers instructed to avoid the use of engine braking where safely practicable
	Blasting to be undertaken in accordance with the approved Blast Management Plan (Appendix 5)

5.11.4 Monitoring

- Commissioning noise assessment to confirm project noise levels (completed in 2023) (Herring Storer, 2023).
- Re-assessment of noise levels to be undertaken if significant changes are made to project activities

5.11.5 Reporting and Records

- Plant and equipment maintenance records to be retained.
- Details of complaints received to be provided to relevant authorities in accordance with statutory requirements.

5.12 Dust

5.12.1 Assessment

The Wattle Avenue (West) Quarry project is classified as a "Prescribed Premises" by Schedule 1 *Environmental Protection Regulations 1987*, with environmental management approved and regulated by the Department of Water and Environmental Regulation (DWER). This includes dust management.

There is potential for dust emissions to be generated by the project activities, however based on the size, nature and operating history of the site, emissions are not anticipated to be significant. There is no history of dust complaints being received and there are no sensitive receptors in proximity to the site.

All workers and site personnel are instructed in the use of dust management equipment and provided with appropriate personal protective equipment (PPE) as required. Site personnel are also instructed to monitor for dust entering the subject site from offsite sources. In such an event the site supervisor is to contact the relevant landowner and/or local government and notify them of the issue.

It is the experience of WA Limestone in operating sand and limestone quarries for more than 50 years that dust emissions are a relatively minor issue that is principally resolved by the use of water.

DWER Guidance *'A guideline for managing the impacts of dust and associated contaminants from land development sites, contaminated sites remediation and other related activities'* provides an assessment methodology for dust impacts (see completed assessment below) and provides recommendations for dust management controls based on the assessed risk (DEC, 2011).

The assessment has conservatively considered the 2 caretakers residences associated with the nearby industrial poultry use approximately 650 metres from the project as sensitive receptors. The nearest dust sensitive residence is located more than 1,100 metres from the project site.

Part A. Nature of site

Item	Score Options				Allocated Score
1. Nuisance potential of soil, when disturbed	Very Low.....**1**	Low.....**2**	Medium.....**4**	High.....**6**	4
2. Topography and protection provided by undisturbed vegetation	Sheltered and screened.....**1**	Medium screening.....**6**	Little screening.....**12**	Exposed and wind prone.....**18**	6
3. Are of site disturbed by the works	Less than 1ha.....**1**	Between 1 and 5ha.....**3**	Between 5 and 10ha.....**6**	More than 10ha.....**9**	9
4. Type of work being done	Roads or shallow trenches **1**	Roads, drains and medium depth sewers...**3**	Roads, drains, sewers and partial earthworks.....**6**	Bulk earthworks and deep trenches.....**9**	9
				TOTAL score for Part A	**28**

Part B. Proximity of site to other land uses

Item	Score Options				Allocated Score
1. Distance of other land uses from site	More than 1km.....**1**	Between 1km and 500m.....**6**	Between 100m and 500m.....**12**	Less than 100m.....**18**	6
2. Effect of prevailing wind direction (at time of construction) on other land uses	Not affected.....**1**	Isolated land uses affected by one wind direction.....**6**	Dense land uses affected by one wind direction.....**9**	Dense/sensitive land uses highly affected by prevailing winds...**12**	6
				TOTAL score for Part B	**12**

Site Classification = 336 (Low Risk)

Compliance with DWER Recommendations

Recommendation	Compliance
Provisions	
The developer shall supply a contingency plan to the local government, which shall detail the activities to be undertaken should dust impacts occur.	**Yes** • This document.
Contingency arrangements	
Include an allowance for water-cart operation, wind fencing and surface stabilisation during the construction period for the purposes of dust suppression.	**Yes** • WA Limestone maintains a fleet of water carts, which will be mobilised to the project site as-required.. • A screening bund has been constructed along the western edge of the site. • Surface stabilisation of completed areas to be undertaken as soon as practicable following completion of earthworks.
All areas of disturbed area should be stabilised to ensure that the disturbed area exposed at any time is kept to a practical minimum.	**Yes** Surface stabilisation will be applied on completed areas as soon as practicable following earthworks.
Monitoring requirements	
Complaints management system in place (complaints recorded and acted upon promptly).	**Yes** An ISO 14001:2015 certified complaints management system is in place.
Notice to be erected at the site, providing contact details of the person to be contacted and works.	**Yes** Signage with contact details are installed at the site entrance.

5.12.2 Objectives and Targets

Objective	Target	Performance Indicator
Minimise excessive visible dust generation by project activities.	Zero incidents of excessive dust generation by project activities.	• Number of incidents of excessive visible dust escaping the project site boundary. • Number of substantiated complaints received relating to dust.
Ensure that nuisance or injury from dust emissions is not experienced by site personnel or sensitive receptors.	Zero incidents of excessive dust generation by project activities.	• Number of incidents of excessive visible dust escaping the project site boundary. • Number of substantiated complaints received relating to dust.

5.12.3 Management Controls

Aspect	Management Control
Management	Provide enclosed air-conditioned cabins on plant.
	Continuous visual dust monitoring by quarry personnel.
	Implementation of the following trigger conditions to determine when additional dust management is required: • Visible dust – Visual observation of excessive visible dust being generated by project activities with the potential to escape the site boundary. • Adverse weather – Meteorological conditions which cause excessive dust emissions from the project that are unable to be managed by standard dust management controls. In the event that trigger conditions are reached, the Site Supervisor is to implement additional dust management measures proportionate to the increased risk. This may include additional water cart operation, or modification / suspension of site operations until such time as the adverse conditions have abated and dust can be maintained within acceptable levels.
	Site inductions to include dust minimisation practices.
Excavation	Schedule vegetation clearing and topsoil/overburden stripping to times of favourable meteorological conditions.
	Areas of open disturbed ground to be kept to a practicable minimum.
	Plant and equipment to be shut down when not in use.
	Quarry operations are to be located below ground level and/or screening bunds constructed around operating areas.
	Crushing and screening plant conveyors to be enclosed and water sprays fitted to transfer points (where practicable).
	A water cart with a minimum capacity of 10,000 L to be maintained for use by the quarry on an as-required basis.
	Where required, disturbed areas no longer required by the quarry operations to be treated with Hydromulch or similar stabilisation agent containing an appropriate seed mix to establish vegetation to improve stabilisation of the ground.

Transport	Sealing of site entrance and access (1,100 metres) to prevent dust and mud on Wattle Avenue West.
	Maintain access roads in good condition free of potholes and product spillages.
	Wet down and/or cover loads on trucks that are likely to blow during transport.
	Drivers to inspect loads prior to leaving the site. Any spillage of product on public roads to be reported to the Site Supervisor.

5.12.4 Monitoring

- Visual monitoring of site conditions and activities by site personnel is used to regulate the preventative dust management measures, to maintain acceptable levels of dust during site operations.
- Video surveillance is also employed to monitor site conditions.
- When not operating, the risk of dust emissions from the project is greatly diminished however after hours monitoring will continue through video surveillance.

5.12.5 Reporting and Records

- Excessive dust emissions crossing the premises boundary is to be recorded as an environmental incident.
- Reporting of dust emissions to be undertaken in accordance with relevant statutory requirements.

5.13 Traffic

5.13.1 Assessment

Primary access to the project is via Wattle Avenue West, following extensive upgrades of the public road by WA Limestone in 2020. Secondary access is via Wattle Avenue East, which was also upgraded by WA Limestone in 2020 and approved by Main Roads WA for RAV4 heavy vehicles. There is no public access connecting Wattle Avenue West and East.

The provision of two access points reduces the reliance on Wattle Avenue West and reduces project traffic volumes past local residences. It additionally provides emergency access/egress in the event of bushfire for both WA Limestone's quarry operations and the nearby Wanneroo Raceway.

All transport vehicles utilised by the operation are road-registered, maintained in good working condition, and adhere to all relevant legislation and standards. All trailers are fitted with tarpaulins and all loads are covered prior to departing the site.

A Traffic Impact Assessment by KC Traffic and Transport (KCTT) was undertaken in 2024 to review the road network and potential impacts by the continued operation of the Wattle Avenue (West) Quarry (Appendix 3).

With the eastern transport route shared by WA Limestone's Wattle Avenue (East) Quarry, KCTT adopted a conservative approach and considered the cumulative traffic from both quarries. It should be noted that the Wattle Avenue (East) Quarry operates under Mining Act tenure and approvals.

KCTT considered a combined traffic generation of both quarries of up to 172 vehicle movements per day, with a peak of up to 28 movements per hour.

Total vehicle movements on Wattle Avenue West and East including the contribution by WA Limestone were assessed as being well under the maximum desirable volume of 6,000 vehicles per day (VPD).

Overall, KCTT concluded the continued operation of the Wattle Avenue (West) Quarry will not negatively impact the surrounding road network (KCTT, 2024).

Figure 15: Site Entrance (west)

5.13.2 Objectives and Targets

Objective	Target	Performance Indicator
Compliance with all road traffic laws	Zero non-conformances with applicable traffic legislation.	Number of traffic offences received by vehicles undertaking project activities.
Limit disturbance to the community from traffic associated with the project	Zero substantiated complaints relating to traffic associated with the project	Number of substantiated complaints received.

5.13.3 Management Controls

Aspect	Management Control
Transport	Wattle Avenue West and East to be upgraded to suitable standard for project use (completed).
	Vehicles to be maintained in good working condition in accordance with manufacturers specifications.
	WA Limestone vehicles to be fitted with IVMS to monitor compliance.

5.13.4 Monitoring

- WA Limestone vehicles to be fitted with In-Vehicle Monitoring Systems (IVMS).
- Register of WA Limestone vehicle maintenance.

5.13.5 Reporting and Records

- Vehicle maintenance records to be retained.
- Details of traffic incidents to be provided to relevant authorities upon request.

5.14 Dangerous Goods and Hazardous Substances

5.14.1 Assessment

The storage, use and handling of dangerous goods and hazardous substances is regulated by the Department of Energy Mines Industry Regulation and Safety (DEMIRS).

No on-site bulk fuel storage does occur nor is proposed. Machinery is refuelled by mobile service trucks, equipped with spill kits and drip trays.

Small quantities of machinery fluids (oil, radiator fluid, etc) may be stored on site within the locked storage enclosure. All hydrocarbons are stored in accordance with relevant Australian Standards and government guidelines.

Mobile service trucks are used to remove waste fluids from vehicles during routine maintenance, which are taken off-site for disposal at an appropriate licensed facility. No major servicing or repairs are undertaken on-site.

The storage of explosives is not required or proposed. Explosives (if required) will be stored offsite at appropriately licensed facilities and brought to site immediately prior to blasting occurring.

No other dangerous goods or hazardous substances are used or required by the project.

The application of limestone is a recommended containment treatment for spills and the project will maintain a minimum 20 metre separation to groundwater.

5.14.2 Objectives and Targets

Objective	Target	Performance Indicator
Minimise the likelihood and potential impact of environmental contamination from hydrocarbons, dangerous goods and hazardous substances by the project.	Zero incidents involving dangerous goods and hazardous substances.	• Number of incidents occurring as a result of non-compliant transportation, handling, storage, use and disposal of hydrocarbons, dangerous goods and hazardous substances. • Compliance with regulatory requirements relating to the transportation, handling, storage, use and disposal of hydrocarbons, dangerous goods and hazardous substances.

5.14.3 Management Controls

Aspect	Management Control
Procurement	• A register of dangerous goods and hazardous substances used by the project to be maintained. • Compliant Safety Data Sheets (SDS) and labelling for all controlled substances.
Storage	• Hydrocarbons to be stored in bunded area of self-bunded container(s), compliant with relevant Australian Standards. • Spill kits provided at all locations where hydrocarbons are stored and handled. • Spill kits to be clearly labelled and inspected regularly.
Handling and Use	• Risk assessment and Safe Work Method Statement completed for the handling and use of dangerous goods and hazardous substances. • Provision of personnel protective equipment (PPE) as required. • Refuelling of plant and equipment to be undertaken within appropriate areas and drip tray used. • Refuelling and service vehicles to be equipped with spill kits and drip trays.
Disposal	• Used hydrocarbons and contaminated waste (e.g. oily rags, used filters, etc.) to be removed from site in appropriate storage containers by a licensed waste carrier. • Hydrocarbon contaminated soil to be collected and disposed of at an appropriately licensed facility.

5.14.4 Monitoring

- Regular inspections and audits to confirm compliance with relevant transportation, storage, handling, use and disposal regulatory requirements and standards.

5.14.5 Reporting and Records

- Hydrocarbon and chemical spills to be reported as an environmental incident.
- Quantities and use of controlled substances by the project to be tracked and records retained.
- Hydrocarbon disposal receipts to be provided by the licensed waste carrier and retained by the project.

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Appendix 1
Risk Assessment

Aspect	Impact	Inherent Risk			Closure Controls	Residual Risk		
		Likelihood	Consequence	Risk Score		Likelihood	Consequence	Risk Score
Quarry Development								
Clearing of native vegetation	Excessive dust emissions	Likely	Moderate	13	• Provision of water cart • Monitor meteorological conditions and avoid activities during adverse weather conditions (where practicable)	Unlikely	Moderate	5
	Excessive noise emissions	Possible	Minor	4	• Completion of noise assessment to confirm compliance with the *Environmental Protection (Noise) Regulations 1997* • Minimise works prior to 7am where practicable	Unlikely	Minor	2
	Loss and/or damage to significant native flora	Possible	Moderate	8	• Physical demarcation of areas to be cleared by surveyor prior to works commencing • Provision of mitigation and/or offsets to reduce the impact of clearing on flora • Provision of fire-fighting appliance (e.g. water cart) if clearing undertaken during elevated bushfire danger rating period.	Rare	Moderate	3
	Injury or mortality of significant fauna	Possible	Serious	13	• Undertake fauna relocation prior to clearing (where appropriate) • Enforcement of speed limit for vehicles and mobile equipment • Provision of fire-fighting appliance (e.g. water cart) if clearing undertaken during elevated bushfire danger rating period.	Rare	Serious	6
	Loss of significant fauna habitat	Possible	Serious	13	• Physical demarcation of areas to be cleared by surveyors prior to works commencing • Provision of mitigation and/or offsets to provide net gain to the environment • Provision of fire-fighting appliance (e.g. water cart) if clearing undertaken during elevated bushfire danger rating period.	Rare	Serious	6
	Destruction / damage to aboriginal heritage	Unlikely	Serious	9	• Assessment of project against the Aboriginal Heritage Due Diligence Guidelines	Rare	Serious	6
	Introduction and/or spread of dieback	Rare	Serious	6	• Enforce vehicle hygiene protocols and operate in a segregated manner to avoid contamination of uninfected	Rare	Serious	6

Aspect	Impact	Inherent Risk			Closure Controls	Residual Risk		
		Likelihood	Consequence	Risk Score		Likelihood	Consequence	Risk Score
					areas and transport of infested material			
	Introduction and/or spread of weeds	Likely	Moderate	12	• Enforce vehicle hygiene protocols and operate in a segregated manner to avoid contamination of uninfected areas and transport of infested material • Regular inspection of vegetation for weeds and weed control (as required).	Rare	Moderate	3
	Surface water contamination	Possible	Minor	4	• Construction of stormwater diversion drains, detention basins, sediment traps, etc. as required.	Unlikely	Minor	2
	Ground water contamination	Unlikely	Moderate	5	• Excavation to be undertaken in accordance with the pit design plan and maintain a minimum separation to groundwater of 3 metres.	Unlikely	Minor	2
	Land degradation from erosion	Possible	Minor	8	• Stabilisation of cleared areas to minimise erosion (as required).	Unlikely	Minor	2
Stripping and stockpiling topsoil	Excessive dust emissions	Likely	Moderate	12	• Provision of water cart • Monitor meteorological conditions and avoid activities during adverse weather conditions (where practicable)	Possible	Moderate	8
	Excessive noise emissions	Possible	Minor	4	• Completion of noise assessment to confirm compliance with the *Environmental Protection (Noise) Regulations 1997* • Minimise works prior to 7am where practicable	Unlikely	Minor	2
	Introduction and/or spread of dieback	Rare	Serious	6	• Enforce vehicle hygiene protocols and operate in a segregated manner to avoid contamination of uninfected areas and transport of infested material	Rare	Serious	6
	Introduction and/or spread of weeds	Likely	Moderate	12	• Enforce vehicle hygiene protocols and operate in a segregated manner to avoid contamination of uninfected areas and transport of infested material	Unlikely	Moderate	5
	Inadequate stripping and/or stockpiling of topsoil reducing quantity available for rehabilitation	Possible	Serious	13	• All viable topsoil to be stripped and separately stockpiled for future use (where practicable) • Topsoil to be stored in low height stockpiles to maximise the preservation of the native seed bank	Rare	Serious	6

Aspect	Impact	Inherent Risk			Closure Controls	Residual Risk		
		Likelihood	Consequence	Risk Score		Likelihood	Consequence	Risk Score
Burning vegetation windrows	Excessive smoke emissions	Possible	Minor	4	• Burning to be undertaken only during favourable meteorological conditions	Unlikely	Minor	2
	Fire escaping the site impacting surrounding flora and fauna	Unlikely	Major	14	• Construction and maintenance of firebreaks • Provision of fire fighting appliance (e.g. water cart) during controlled burning operations • Burning to be undertaken only during favourable meteorological conditions	Rare	Moderate	3
Overburden excavation and stockpiling	Excessive dust emissions	Likely	Moderate	12	• Provision of water cart • Monitor meteorological conditions and avoid activities during adverse weather conditions (where practicable)	Possible	Moderate	8
	Excessive noise emissions	Possible	Minor	4	• Completion of noise assessment to confirm compliance with the *Environmental Protection (Noise) Regulations 1997* • Minimise works prior to 7am where practicable	Unlikely	Minor	2
	Land degradation from erosion	Possible	Moderate	8	• Stabilisation of cleared areas to minimise erosion (as required).	Unlikely	Moderate	5
	Introduction and/or spread of dieback	Rare	Serious	6	• Enforce vehicle hygiene protocols and operate in a segregated manner to avoid contamination of uninfected areas and transport of infested material	Rare	Serious	6
	Introduction and/or spread of weeds	Likely	Moderate	12	• Enforce vehicle hygiene protocols and operate in a segregated manner to avoid contamination of uninfected areas and transport of infested material	Unlikely	Moderate	5
	Surface water contamination from runoff	Possible	Minor	4	• Construction of stormwater diversion drains, detention basins, sediment traps, etc. as required.	Unlikely	Minor	2
	Visual impact from improper overburden stockpiling	Unlikely	Major	14	• Overburden to be stockpiled in a manner where it is not visible from external vantage points (as far as practicable) • Construction of western screening bund.	Rare	Moderate	3

Aspect	Impact	Inherent Risk			Closure Controls	Residual Risk		
		Likelihood	Consequence	Risk Score		Likelihood	Consequence	Risk Score
Road and infrastructure construction	Excessive dust emissions	Likely	Moderate	12	• Provision of water cart • Monitor meteorological conditions and avoid activities during adverse weather conditions (where practicable)	Unlikely	Moderate	5
	Excessive noise emissions	Possible	Minor	4	• Completion of noise assessment to confirm compliance with the *Environmental Protection (Noise) Regulations 1997* • Minimise works prior to 7am where practicable	Unlikely	Minor	2
	Land degradation from erosion	Possible	Moderate	8	• Construction of stormwater division drains, detention basins, etc. as required. • Appropriate surface treatment of roads and hardstand areas to minimise erosion • Design of roads and infrastructure to minimise surface water flow, pooling, etc.	Unlikely	Moderate	5
	Waste generated from construction works	Likely	Minor	7	• Wastes generated from construction activities to be recycled where practicable, or disposed of to appropriately licensed waste facility	Unlikely	Minor	2
Drilling and Blasting								
Drilling	Excessive dust emissions	Likely	Minor	7	• Dust suppression equipment fitted to drill	Possible	Minor	4
	Excessive noise emissions	Possible	Minor	4	• Completion of noise assessment to confirm compliance with the *Environmental Protection (Noise) Regulations 1997* • Minimise works prior to 7am where practicable	Unlikely	Minor	2
Blasting	Excessive dust emissions	Possible	Moderate	8	• Blast design to utilise microsecond delays. • Avoid blasting during unfavourable meteorological conditions (where practicable)	Unlikely	Minor	2

Aspect	Impact	Inherent Risk			Closure Controls	Residual Risk		
		Likelihood	Consequence	Risk Score		Likelihood	Consequence	Risk Score
	Excessive noise and vibration	Possible	Moderate	8	• Completion of noise assessment to confirm compliance with the *Environmental Protection (Noise) Regulations 1997* • Blast design to utilise microsecond delays • Notification of blasts to nearby receptors (where appropriate) • Avoid blasting during unfavourable meteorological conditions (where practicable)	Unlikely	Moderate	5
	Air quality impacts from explosives burn	Possible	Minor	4	• Blast design and explosives selection by appropriately qualified and experienced persons to minimise explosives use	Possible	Minor	4
	Uncontrolled fly rock causing damage	Unlikely	Major	14	• Blast design to utilise microsecond delays • Blasting undertaken by appropriately qualified and experienced persons	Unlikely	Serious	9
Explosives storage	Waste generation	Nil	Minor	0	• On-site explosives storage is not required or proposed	Nil	Minor	0
Excavation								
Excavation of raw feed	Excessive dust emissions	Likely	Moderate	12	• Provision of water cart • Monitor meteorological conditions and avoid activities during adverse weather conditions (where practicable)	Possible	Minor	4
	Excessive noise emissions	Possible	Minor	4	• Completion of noise assessment to confirm compliance with the *Environmental Protection (Noise) Regulations 1997* • Minimise works prior to 7am where practicable	Unlikely	Minor	2
Materials transfer of raw feed	Excessive dust emissions	Likely	Moderate	12	• Provision of water cart • Monitor meteorological conditions and avoid activities during adverse weather conditions (where practicable)	Possible	Minor	4
	Excessive noise emissions	Possible	Minor	4	• Completion of noise assessment to confirm compliance with the *Environmental Protection (Noise) Regulations 1997* • Minimise works prior to 7am where practicable	Unlikely	Minor	2

Aspect	Impact	Inherent Risk			Closure Controls	Residual Risk		
		Likelihood	Consequence	Risk Score		Likelihood	Consequence	Risk Score
Internal haulage of raw feed	Excessive dust emissions	Likely	Moderate	12	• Provision of water cart • Monitor meteorological conditions and avoid activities during adverse weather conditions (where practicable)	Possible	Minor	4
	Excessive noise emissions	Possible	Minor	4	• Completion of noise assessment to confirm compliance with the *Environmental Protection (Noise) Regulations 1997* • Minimise works prior to 7am where practicable	Unlikely	Minor	2
Stockpiling of raw feed	Excessive dust emissions	Possible	Minor	4	• Provision of water cart • Stabilisation of stockpiles (where required)	Unlikely	Minor	2
	Visual impact from improper stockpiling	Unlikely	Moderate	5	• Stockpiles to be managed in a manner where it is not visible from external vantage points (where practicable) • Construction of western screening bund	Rare	Moderate	3
Crushing and Screening								
Operation of crushing and screening plant	Excessive dust emissions	Likely	Moderate	12	• Provision of water cart • Fitment of water sprays and enclosures (where appropriate) • Monitor meteorological conditions and avoid works during adverse conditions (where practicable)	Possible	Minor	4
	Excessive noise emissions	Likely	Minor	7	• Completion of noise assessment to confirm compliance with the *Environmental Protection (Noise) Regulations 1997* • Maintain plant and equipment in good working condition • Locate crushing and screening plant below natural ground level where possible • Construction of noise screening bunds (where required)	Possible	Minor	4
	Excessive power consumption	Possible	Minor	4	• Turn off plant and equipment when not in use • Monitor power consumption	Possible	Minor	4
	Waste generation	Likely	Minor	7	• Segregation of wastes • Recycle wastes where possible, if not then disposal at appropriately licensed facility	Unlikely	Minor	2

Aspect	Impact	Inherent Risk			Closure Controls	Residual Risk		
		Likelihood	Consequence	Risk Score		Likelihood	Consequence	Risk Score
Materials transfer of processed materials	Excessive dust emissions	Likely	Minor	7	• Provision of water cart • Enforcement of speed limits	Possible	Minor	4
	Excessive noise emissions	Possible	Minor	4	• Completion of noise assessment to confirm compliance with the *Environmental Protection (Noise) Regulations 1997* • Construction of noise screening bunds (where required)	Unlikely	Minor	2
Stockpiling of processed materials	Excessive dust emissions	Possible	Minor	4	• Provision of water cart • Stabilisation of stockpiles (where required)	Unlikely	Minor	2
	Visual impact from improper stockpiling	Unlikely	Moderate	5	• Stockpiles to be managed in a manner where it is not visible from external vantage points • Construction of western screening bunds	Rare	Moderate	3
Material Loadout and Dispatch								
Quarry products loading	Excessive dust emissions	Possible	Minor	4	• Provision of water cart • Enforcement of speed limits	Unlikely	Minor	2
	Excessive noise emissions	Unlikely	Minor	2	• Completion of noise assessment to confirm compliance with the *Environmental Protection (Noise) Regulations 1997* • Construction of noise screening bunds (where required) • Maintain plant and equipment in good working condition	Unlikely	Minor	2
Internal vehicle movements within site	Excessive dust emissions	Likely	Minor	7	• Provision of water cart • Enforcement of speed limits	Unlikely	Minor	2
	Excessive noise emissions	Unlikely	Minor	2	• Completion of noise assessment to confirm compliance with the *Environmental Protection (Noise) Regulations 1997* • Construction of noise screening bunds (where required) • Maintain vehicles in good working condition	Unlikely	Minor	2
External vehicle movements (on public roads)	Excessive dust emissions	Possible	Moderate	8	• All loads covered prior to departing the site • Sealing of quarry entrance road to prevent dust being carried onto public roads	Unlikely	Minor	2

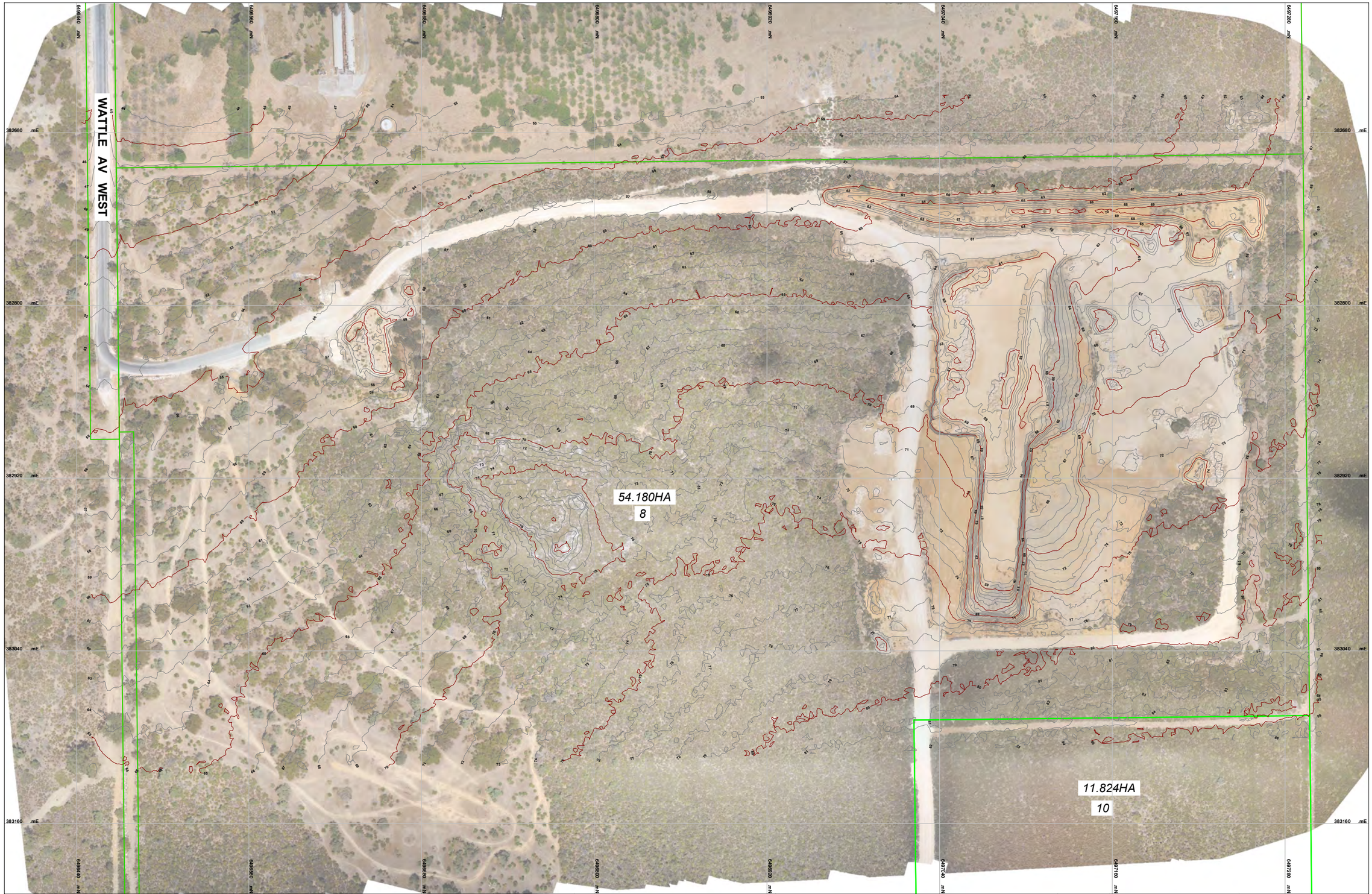
Aspect	Impact	Inherent Risk			Closure Controls	Residual Risk		
		Likelihood	Consequence	Risk Score		Likelihood	Consequence	Risk Score
Plant, Equipment and Infrastructure								
Fuel storage	Contamination of land and/or water	Nil	Serious	0	• Nil – Fuel storage not required or proposed	Nil	Moderate	0
Refuelling	Contamination of land and/or water	Possible	Moderate	8	• Mobile fuel truck equipped with spill kit and drip tray	Possible	Minor	4
Vehicle and plant washing	Contamination of land and/or water	Possible	Moderate	8	• Washing of vehicles and equipment undertaken in designated areas	Possible	Minor	4
Plant and equipment breakdown / malfunction	Contamination of land and/or water	Possible	Moderate	8	• Mobile fuel truck equipped with spill kit and drip tray • Maintenance of plant and equipment in good working condition	Possible	Minor	4
	Waste generation	Likely	Minor	7	• Segregation of wastes • Recycle wastes where possible, if not then disposal at appropriately licensed facility	Possible	Minor	4
Crib & ablution facilities	Waste generation	Nil	Minor	0	• Not on-site	Nil	Minor	0
	Contamination of land and/or water (sewerage)	Nil	Moderate	0	• Not on-site	Nil	Minor	0
Rehabilitation and Closure								
Inadequate understanding of the existing environment and impact of the operations	Poor rehabilitation success	Unlikely	Serious	9	• Completion of baseline environmental assessments • Development of closure design and criteria • Consultation with relevant stakeholders	Rare	Serious	6
Inadequate understanding of the post-quarrying land use	Poor rehabilitation success	Unlikely	Serious	9	• Development of closure design and criteria • Consultation with relevant stakeholders	Rare	Serious	6
Other								
Temporary project closure	Excessive dust emissions	Likely	Minor	7	• Stabilisation of open ground (where necessary)	Unlikely	Moderate	5
	Waste generation	Possible	Minor	4	• Removal of plant and equipment from site	Unlikely	Moderate	5
Unexpected project closure	Closure objectives not achieved	Unlikely	Serious	9	• Closure design and criteria to include provisions for unexpected closure	Rare	Serious	6
Unauthorised public access, vandalism	Land and/or water contamination	Likely	Moderate	12	• Secure potential access points through fencing, bunding, etc. • Signage around the perimeter of the site • Security cameras installed	Unlikely	Moderate	5

Aspect	Impact	Inherent Risk			Closure Controls	Residual Risk		
		Likelihood	Consequence	Risk Score		Likelihood	Consequence	Risk Score
	Waste generation	Likely	Moderate	12	• Secure potential access points through fencing, bunding, etc. • Signage around the permitter of the site • Security cameras installed • Regular inspection of site and removal of illegally dumped waste	Unlikely	Moderate	5
Changes to regulatory requirements	Changes to legislative and/or approvals requirements result in existing operations are no longer compliant	Likely	Serious	17	• Consultation with relevant stakeholders • Maintain awareness of legislative changes and make submissions on potentially adverse changes • Support industry associations	Likely	Serious	17
Encroachment by incompatible land uses	Encroachment by incompatible land use results in compliance not able to be achieved	Possible	Serious	13	• Consultation with relevant stakeholders • Maintain awareness of legislative changes and development proposals, and make submissions on potentially adverse changes • Support industry associations	Possible	Serious	13

			Effect / Consequence					
Type			Nil	Minor	Moderate	Serious	Major	Critical
Environmental Impact			No impact	No discernible, adverse impact, individuals of species may be affected locally.	Discernible effect on the environment but no adverse impact, minor number of individuals of species may be affected locally	Minor adverse effect to the environment (including public amenity), moderate loss of individuals of species locally.	Moderate damage to ecosystem function, major loss of individuals of species locally, loss of public amenity.	Significant long-term damage/loss to ecosystem function, extinction of a species locally
Likelihood	Almost Certain	Likely that the unwanted event could occur often (once per week) during the life of an individual item or system	Nil **0**	Medium **11**	High **16**	High **20**	Very High **23**	Very High **25**
	Likely	Likely that the unwanted event could occur several times per year during the life of an individual item or system.	Nil **0**	Medium **7**	Medium **12**	High **17**	High **21**	Very High **24**
	Possible	Likely that the unwanted event could occur sometime (once per year) during the life of an individual item or system.	Nil **0**	Low **4**	Medium **8**	High **13**	High **18**	High **22**
	Unlikely	Unlikely, but possible for the unwanted event to occur once in the life of an individual item or system.	Nil **0**	Low **2**	Low **5**	Medium **9**	High **14**	High **19**
	Rare	Highly unlikely that the unwanted event could ever occur in the life of an individual item or system.	Nil **0**	Low **1**	Low **3**	Medium **6**	Medium **10**	High **15**
	Nil	No possibility of the event occuring	Nil **0**	Nil **0**	Nil **0**	Nil **0**	Nil **0**	Nil **0**

Risk Matrix

Appendix 2
Development Plans



TITLE:

UAV-RTK Feature Survey at 15th Jan 2024
Wattle Ave West
Nowergup

CLIENT: **WA Limestone**

DISCLAIMER:

This Drawing has been prepared for designing new constructions on the land and should not be used for any other purpose. Boundaries on this plan were not re-established as part of this survey. This plan does therefore not guarantee their accuracy. For any proposed works on or near existing boundaries, cadastral boundaries should be re-established. Only show visible services have been located. Prior to any demolition, construction, or excavation, a Dial before you Dig must be completed. The position of the sewer lines is indicative ONLY. Users of this plan should verify plan accuracy by contacting WA Limestone.

REV	DATE	SURVEYOR	REVISION COMMENTS
1	16/01/2024	Deng	GPS-RTK Feature Survey at 15 Jan 2024

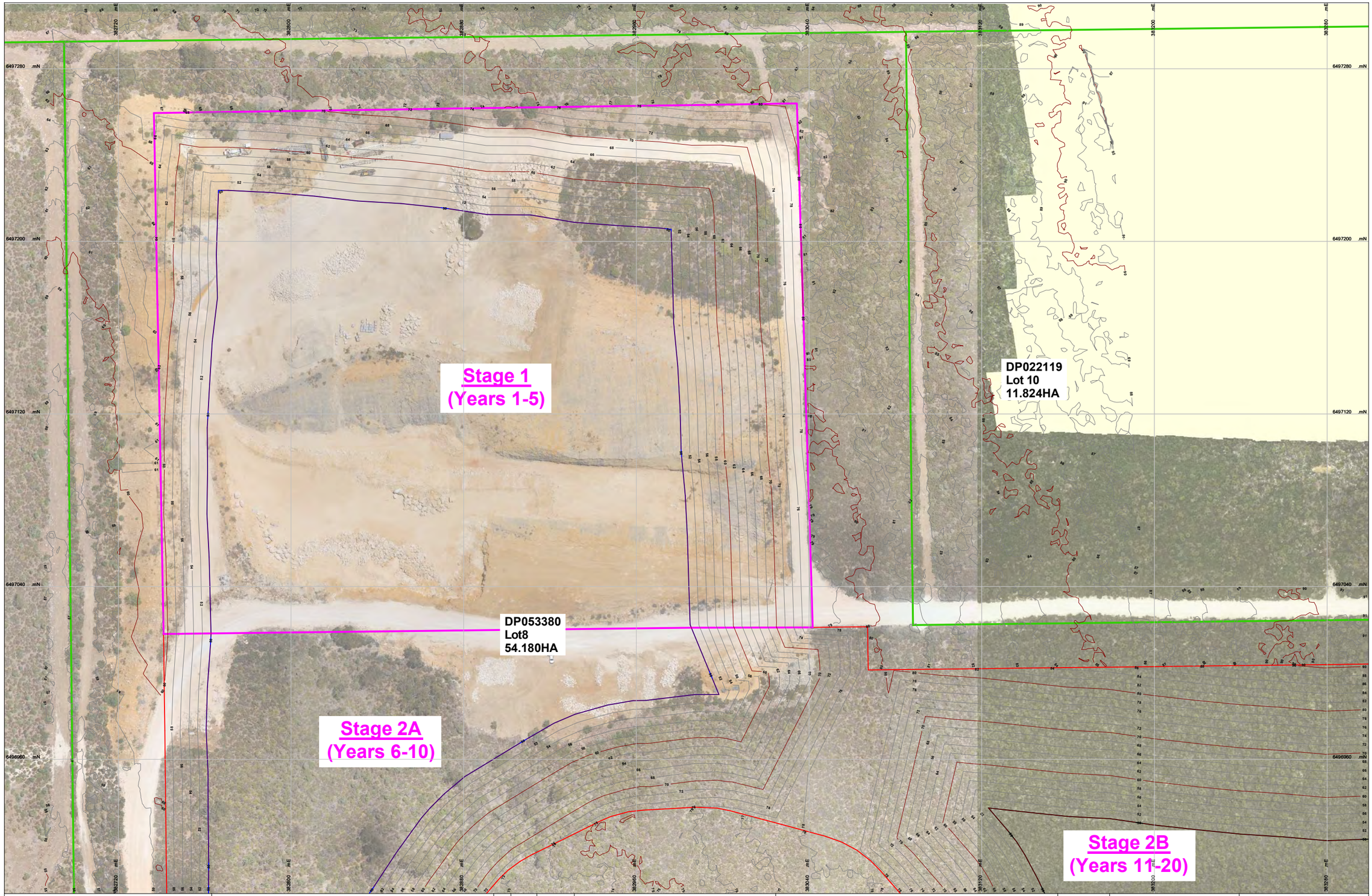
SCALE @ A1: **1:1200**

0 30 60 90 120 150 180

MAGNET FILE : 295 UAV_20240115 v2 - A1 PDF

HORIZONTAL DATUM:	MGA94
VERTICAL DATUM:	AHD
CONTOUR INTERVAL:	1.0 m
SHEET:	PAGE 1 OF 1

W.A. LIMESTONE



TITLE:

Wattle West Quarry Stage 1 of Approved Finish Level
Lot 8, WAttle Avenue West, Nowergup

CLIENT: **WA Limestone**

DISCLAIMER:

This Drawing has been prepared for designing new constructions on the land and should not be used for any other purpose.
Boundaries on this plan were not re-established as part of this survey. This plan does therefore not guarantee their accuracy.
For any proposed works on or near existing boundaries, cadastral boundaries should be re-established.
Only show visible services have been located. Prior to any demolition, construction, or excavation, a Dial before you Dig must be completed. The position of the sewer lines is indicative ONLY.
Users of this plan should verify plan accuracy by contacting WA Limestone.

REV	DATE	SURVEYOR	REVISION COMMENTS
1	19/01/2024	Deng	GPS-RTK Feature Survey at 15 Jan 2024

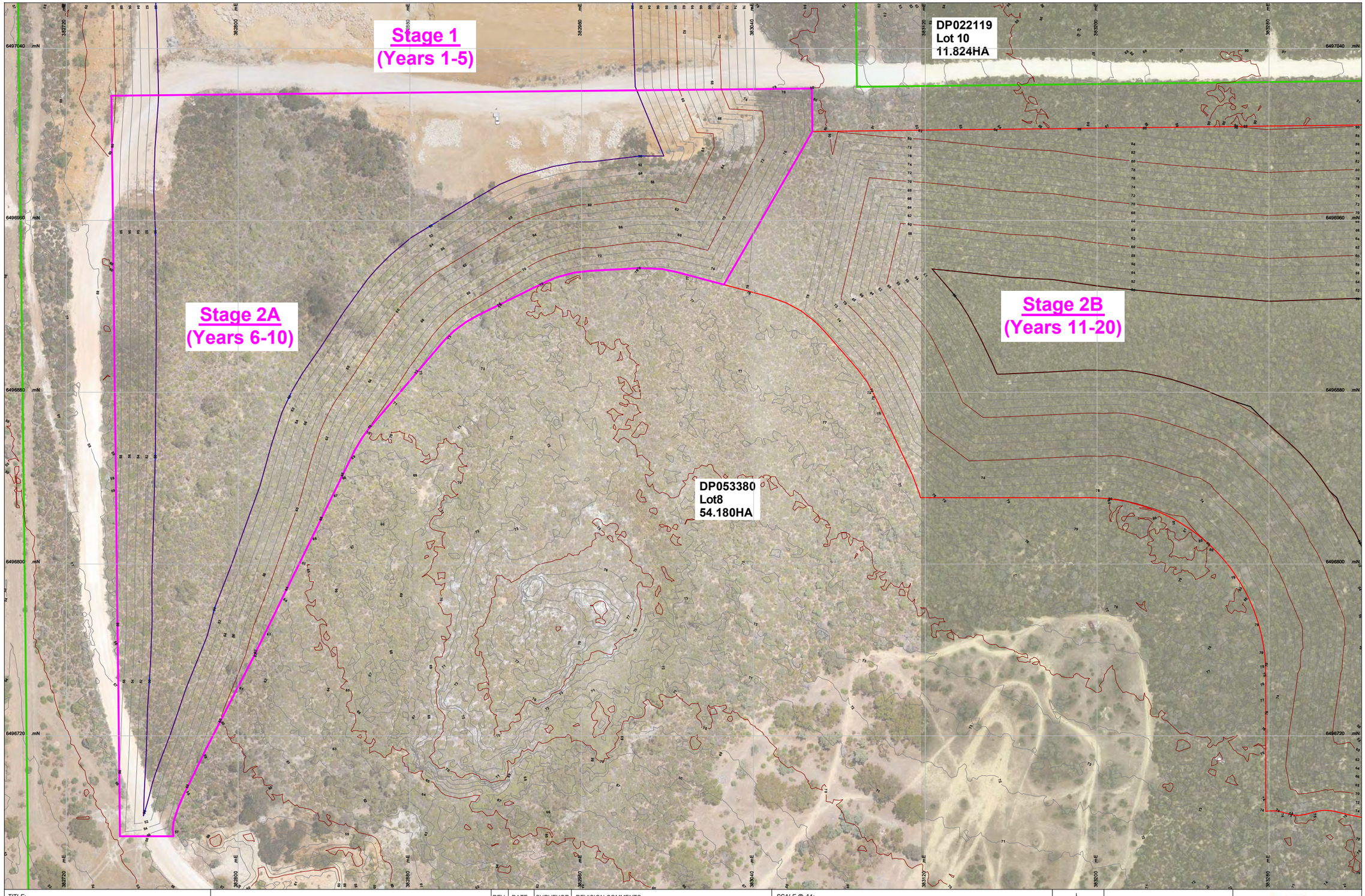
SCALE @ A1: **1:800**

0 20 40 60 80 100 120

MAGNET FILE : 295 Approved FL Design_Stage1 - A1 PDF

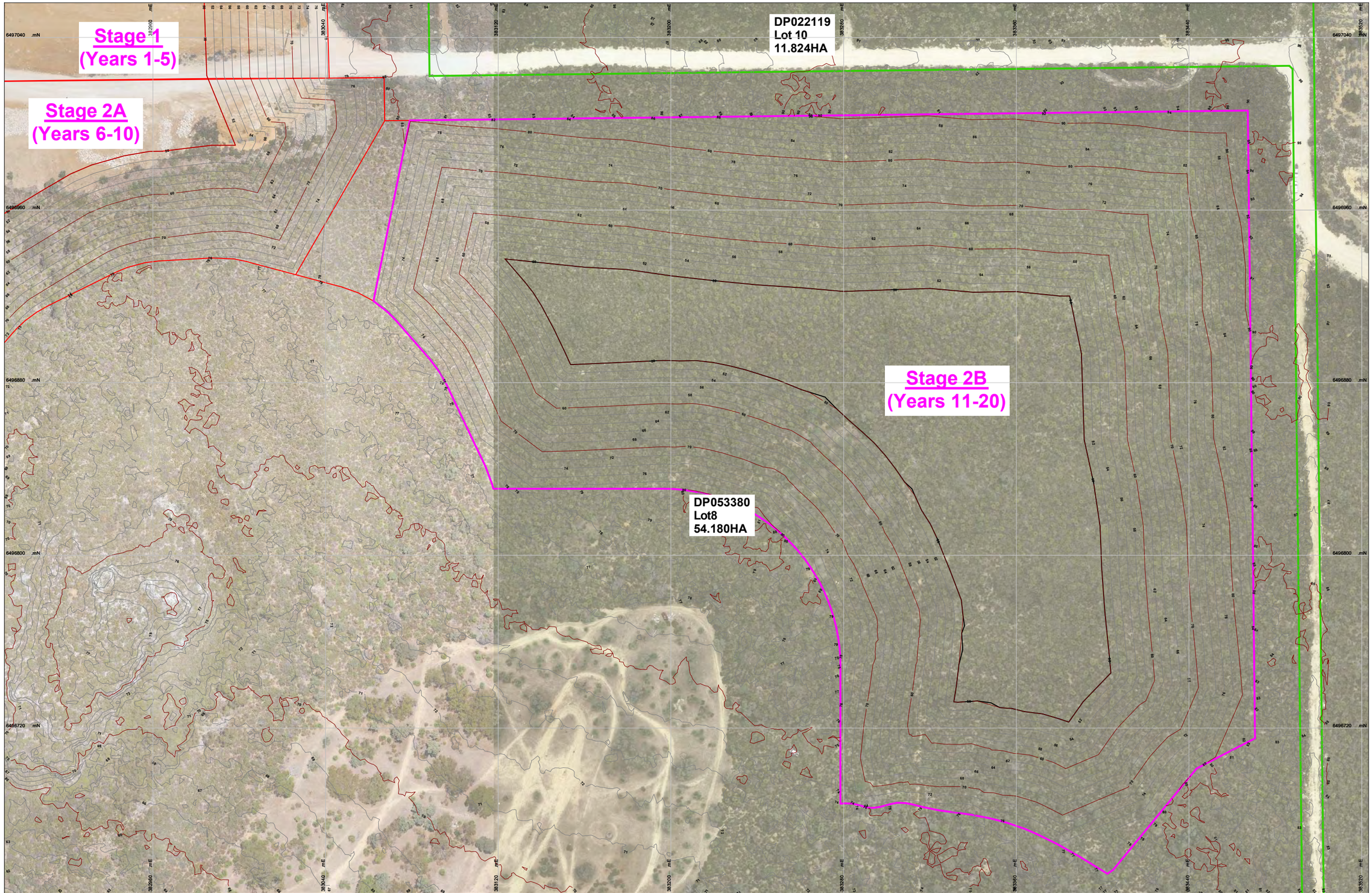
HORIZONTAL DATUM:	**MGA94**
VERTICAL DATUM:	**AHD**
CONTOUR INTERVAL:	**2.0 m**
SHEET:	**PAGE 1 OF 1**

W.A. LIMESTONE



TITLE: **Wattle West Quarry Stage 2A of Approved Finish Level Lot 8, WAttle Avenue West, Nowergup**	DISCLAIMER: This Drawing has been prepared for designing new constructions on the land and should not be used for any other purpose. Boundaries on this plan were not re-established as part of this survey. This plan does therefore not guarantee their accuracy. For any proposed works on or near existing boundaries, cadastral boundaries should be re-established. Only show visible services have been located. Prior to any demolition, construction, or excavation, a Dial before you Dig must be completed. The position of the sewer lines is indicative ONLY. Users of this plan should verify plan accuracy by contacting WA Limestone.	REV	DATE	SURVEYOR	REVISION COMMENTS	*SCALE @ A1:* **1:800** 0 20 40 60 80 100 120		HORIZONTAL DATUM: **MGA94**
CLIENT: **WA Limestone**		1	19/01/2024	Deng	GPS-RTK Feature Survey at 15 Jan 2024	MAGNET FILE : 295 Approved FL Design_Stage2A - A1 PDF		VERTICAL DATUM: **AHD** CONTOUR INTERVAL: **2.0 m** SHEET: **PAGE 1 OF 1**

W.A. LIMESTONE



TITLE:

Wattle West Quarry Stage 2B of Approved Finish Level
Lot 8, WAttle Avenue West, Nowergup

CLIENT:

WA Limestone

DISCLAIMER:

This Drawing has been prepared for designing new constructions on the land and should not be used for any other purpose. Boundaries on this plan were not re-established as part of this survey. This plan does therefore not guarantee their accuracy. For any proposed works on or near existing boundaries, cadastral boundaries should be re-established. Only show visible services have been located. Prior to any demolition, construction, or excavation, a Dial before you Dig must be completed. The position of the sewer lines is indicative ONLY. Users of this plan should verify plan accuracy by contacting WA Limestone.

REV	DATE	SURVEYOR	REVISION COMMENTS
1	19/01/2024	Deng	GPS-RTK Feature Survey at 15 Jan 2024

SCALE @ A1:

1:800

0 20 40 60 80 100 120

MAGNET FILE : 295 Approved FL Design_Stage2B - A1 PDF

HORIZONTAL DATUM:	**MGA94**
VERTICAL DATUM:	**AHD**
CONTOUR INTERVAL:	**2.0 m**
SHEET:	**PAGE 1 OF 1**

W.A. LIMESTONE

FIGURE 5 - INDICATIVE FINISHED LEVELS

Lot 8 Wattle Avenue West, NOWERGUP

A WA Limestone Project

NORTH

Scale: 1:4000 @ A3

0 40 80 120m

PLAN: WALNO-5-008 REVISION: A

DATE: 23/01/2024 DRAWN: JP

PROJECTION: MGA 50 PLANNER: CH

DATUM: AHD CHECK: CH

cdp
Town Planning & Urban Design

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Perth WA 6000
(08) 6333 1888
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Appendix 3
Traffic Assessment

TRANSPORT IMPACT STATEMENT

Lot 8 Wattle Avenue

Nowergup

January 2024

Rev B

kctt

PART OF Premise

HISTORY AND STATUS OF THE DOCUMENT

Revision	Date issued	Reviewed by	Approved by	Date approved	Revision type
Rev A Draft	17.10.2023	M Kleyweg	M Kleyweg	17.10.2023	Issued for Review
Rev A	1.12.2023	M Kleyweg	M Kleyweg	1.12.2023	Amended in Accordance with the Received Comments
Rev B	19.01.2024	M Kleyweg	M Kleyweg	19.01.2024	Amended in Accordance with the Received Comments

DISTRIBUTION OF COPIES

Revision	Date of issue	Quantity	Issued to
Rev A Draft	18.10.2023	1 (PDF)	Roger Stephens (WA Limestone)
Rev A	1.12.2023	1 (PDF)	Roger Stephens (WA Limestone)
Rev B	19.01.2024	1 (PDF)	Roger Stephens (WA Limestone)

Document Printed	19/01/2024 11:39 AM
File Name	C:\Users\Nemanja\Box\KCTT Projects\KC00000 Current Projects\KC01721.000 Lot 8 Wattle Ave, Nowergup TIS\Outgoing\Report\240119 Rev B\KC01721.000 Lot 8 Wattle Ave, Nowergup, TIS Rev B.docx
Author of the Rev A Draft	Nemanja Marijanovic
Author of the Current Revision	Nemanja Marijanovic
Project Team	/
Project Director / Project Manager	Marina Kleyweg
Name of Project	KC01721.000 Lot 8 Wattle Avenue, Nowergup
Name of the Document	KC01721.000 Lot 8 Wattle Avenue, Nowergup - Transport Impact Statement
Document Version	KC01721.000_R01_ Rev B

Prepared by: **KCTT (Trading as KC Traffic and Transport Pty Ltd)**
ABN 35 148 970 727 |
Postal address: PO Box 1456, Scarborough WA 6922 |
Website: www.kctt.com.au |

Table of Contents

Appendices

1. Executive Summary

Site Context

- The subject site is located at Lot 8 Wattle Avenue, Nowergup.
- The existing quarry includes approximately 35 truckloads per day.
- The purpose of this project is renewal of planning approval for the existing quarry on Lot 8.
- The adjacent Lot 501 quarry is not a part of this application. However, Lot 501 quarry is included in the traffic generation calculations to assess the full traffic impact on Wattle Avenue West and Wattle Avenue East.

Technical Findings

- The combined traffic generation from both quarries will be up to 172 vehicle trips per day and 28 vehicle trips per hour in peak hours.
- According to the WAPC Guidelines, this moderately impacts the surrounding network.
- Two major routes are expected to be utilised for access/egress to/from the site:
  - To/from the west via Wattle Avenue
  - To/from the east via Wattle Avenue

Relationship with Policies

- Given there are no requirements set out in DPS No. 2 for the land use – Quarry, KCTT suggested a rate of 1 parking bay per staff member and 0.2 bays per staff member for visitors.
- This would calculate to a 10 parking bays requirement.
- There will be an informal parking area for staff members, with enough capacity for 10 vehicles.
- Building Code of Australia ACROD Provision – KCTT believe that ACROD bay is not required because of the specific conditions of the development

Conclusion

- As stated above a maximum of 172 vehicular trips per day and 28 vehicular trips in the peak hour will be generated from both quarries.
- Wattle Avenue is classified as Local Distributor as per MRWA classification with the maximum desirable volume of 6,000 vehicles per day. Given that Wattle Avenue West and Wattle Avenue East are not connected via sealed road, it is expected that the only traffic at the beginning of sealed road sections would be from the subject quarries and from the existing WA Sporting Club at Wattle Avenue East. Therefore, Wattle Avenue would remain well under the maximum desirable traffic volume of 6,000 VPD for Local Distributor roads.
- Other surrounding roads would absorb significantly less traffic than Wattle Avenue, moreover, the traffic would be dispersed so that the impact can be considered negligible.
- In summary, KCTT believe that the proposed development will not negatively impact the surrounding road network.

2. Transport Impact Statement

2.1 Proposal

WA Limestone engaged KCTT to prepare a Transport Impact Statement (TIS) for the planning approval renewal for the existing quarry at Lot 6 Wattle Avenue Nowergup.

The quarry is connected to the road network via private road which has connections to Wattle Avenue West and Wattle Avenue East.

The purpose of this project is renewal of planning approval for the existing quarry on Lot 8. Lot 501 quarry is not a part of this application. However, the adjacent Lot 501 quarry will be included in the traffic generation calculations to assess the full traffic impact on Wattle Avenue West and Wattle Avenue East.

2.2 Location

Lot Number	Lot 8
Street Number	No.259
Road Name	Wattle Avenue
Suburb	Nowergup
Description of Site	The subject site is located at Lot 8 Wattle Avenue, Nowergup. The existing quarry includes approximately 35 truckloads per day.

2.3 Technical Literature Used

Local Government Authority	City of Wanneroo
Type of Development	Individual Development
Is the NSW RTA Guide to Traffic Generating Developments Version 2.2 October 2002 (referenced to determine trip generation / attraction rates for various land uses) referenced?	YES
Which WAPC Transport Impact Assessment Guideline should be referenced?	Volume 4 - Individual Developments
Are there applicable LGA schemes for this type of development?	YES
If YES, Nominate:	
Name and Number of Scheme	District Planning Scheme No. 2
Are Austroads documents referenced?	YES

2.4 Land Uses

Are there any existing Land Uses	YES
If YES, Nominate:	Quarry – a maximum of 35 truckloads per day
Proposed Land Uses	
	There are no proposed land uses;
Are the proposed land uses complementary with the surrounding land-uses?	YES

2.5 Local Road Network Information

How many roads front the subject site?	One private unsealed road; No gazetted roads
Name of Other Roads within 400m radius of site, or roads likely to take increased traffic due to the development:	
Road Name	Wattle Avenue
Number of Lanes	two way, one lane (no linemarking), undivided
Road Reservation Width	20m
Road Pavement Width	9m
Classification	Local Distributor
Speed Limit	50kph or State Limit
Bus Route	NO
On-street parking	NO

2.6 Traffic Volumes

Road Name	Location of Traffic Count	Vehicles Per Day (VPD)	Vehicles per Peak Hour (VPH)				Heavy Vehicle %	Date of Traffic Count	*If older than 3 years multiply with a growth rate*
			AM Peak Time	AM Peak VPH	PM Peak Time	PM Peak VPH	*If HV count is Not Available, are HV likely to be in higher volumes than generally expected?*		
Wanneroo Road	North of Gibbs Road	15,255	06:00	1,117	15:15	1,210	13.8%	2021/ 2022	–
	South of Hester Avenue	14,530	07:30	1,179	16:30	1,570	12.6%	2021/ 2022	–

2.7 Vehicular Crash Information

Is Crash Data Available on Main Roads WA website?	NO
If YES, nominate important survey locations:	
Location 1	Wattle Avenue [SLK 0.94 – 6.19]
Period of crash data collection	01/01/2018 - 31/12/2022
Comment	No crashes were reported at the above section of Wattle Avenue in the 5-year period. The above section includes both sealed and unsealed sections between Dayrell Road and Old Yanchep Road.

2.8 Vehicular Parking

Local Government: City of Wanneroo

Local Government Document Utilised: District Planning Scheme No. 2

Description of Parking Requirements in accordance with Scheme:

There are no requirements set out in the DPS No. 2 for the land use - Quarry.

KCTT suggest 1 parking bay per staff member and 0.2 bays per staff member for visitors.

Calculation of Parking

Land Use	Requirements	Yield	Total Parking
Quarry	1 per staff member; 0.2 per staff member for visitors	A maximum of 8 staff members expected	10
		Total Car Parking Requirement	**10**
		Total Volume of Parking Provided by Proponent	**N/A**

Justification

There will be an informal parking area for staff members, with enough capacity for 10 vehicles.

2.9 Bicycle Parking

Local Government	City of Wanneroo
Reference Document Utilised	District Planning Scheme No. 2

There are no bicycle parking requirements stipulated in DPS No. 2.

Justification

Given the location and the nature of the proposed development (quarry), KCTT believe that bicycle bays are not required.

2.10 ACROD Parking

Class of Building	Class 5
Does this building class require specific provision of ACROD Parking?	YES
Reference Document Utilised	Building Code of Australia

Description of Parking Requirements:

Class 5 — 1 space for every 100 carparking spaces or part thereof.

Parking Requirement in accordance with regulatory documents

Land Use	Requirements	Yield	Total Parking
Office	*1 space for every 100 carparking spaces or part thereof*	10 bays required	1
		Total Volume of ACROD Parking Required	**1**
		Total Volume of ACROD Parking Provided by Proponent	N/A

Justification

Given there will be no formal parking area, KCTT believes that an ACROD bay will be required only if it is required by one of the future employees of the quarry.

However, the future designated parking area is expected to be large and will cater for ACROD bays if necessary.

2.11 Delivery and Service Vehicles

Guideline Document used as reference	NSW RTA Guide to Traffic Generating Developments

Requirements

Wholesale, Industrial (> 8,000m2 GFA)- 10 + 1 space per 1,000m2 over 8,000 m2

Total Volume of Service and Delivery Parking Provided by Proponent	N/A

Justification

The requirement refers to buildings with industrial land use. No industrial buildings are proposed within the subject site. Access point will cater for vehicles up to B-double (27.5m). No required parking for trucks, as large vehicles will not be parked at the site. Only excavating machines will be stored at site.

2.12 Calculation of Development Generated / Attracted Trips

What are the likely hours of operation?	07:00 to 17:00 Monday to Friday, 07:00 to 12:00 Saturday
What are the likely peak hours of operation?	07:00 – 08:00 AM Peak 14:00 – 15:00 PM Peak
Do the development generated peaks coincide with existing road network peaks?	N/A

Traffic Generation

Since this is a development with specific conditions of operation, KCTT have used the information from the proponent to calculate the expected traffic generation.

The proponent has advised that there will be a maximum of 70 loads per day across both quarries; and 10 loads in peak hours. This will be the maximum traffic generation. The average operation will include 20 loads per day; 3 loads per hour.

1 load will include a vehicle entering the site, loading and leaving the site – therefore, 2 vehicular movements per load.

Similarly, staff members will make 1 vehicle movement when arriving to work and 1 vehicle movement when leaving work. Additional traffic for both stages is expected from the employees with a rate of 2 VPD and 1 VPH per employee (*0.5 VPH per employee is expected to coincide with the truck movements).

Land Use Type	Rate above	Yield	Daily Traffic Generation	Peak Hour Traffic Generation	
				AM	PM
Lot 8 Quarry and Lot 501 Quarry combined	Daily - 2 VPD per daily truckload; Peal – 2 VPH per hourly truckload;	35 daily truckloads per quarry = 70 per day; 5 hourly truckloads per quarry = 10 per hour	140	20	20
	2 VPD per employee; 0.5 VPH per employee*	16 employees	32	8	8
		Total:	**172**	**28**	**28**

Does the site have existing trip generation/attraction?	YES
What is the total impact of the new proposed development?	The subject development generates up to 172 vehicle trips per day and 28 vehicle trips per hour in peak hours. According to the WAPC Guidelines, this moderately impacts the surrounding network.

2.13 Traffic Flow Distribution

How many routes are available for access/egress to the site?	Two (2) KCTT have assumed that the trucks (both quarries combined) would equally use the west and east connection for access/egress to/from the site (with B-doubles exclusively using the Wattle Avenue East connection and semi-trailers using both connections). Additionally, it is assumed that all staff members would arrive via Wattle Avenue West, given the subject site location. Therefore, the below traffic distribution is applied.
Route 1 / Movement 1	
Provide details for Route No 1	To the west via private road > Wattle Avenue West > Wanneroo Road
Percentage of Vehicular Movements via Route No 1	60% [103 VPD; AM 17 VPH; PM 17 VPH]
Route 2 / Movement 2	
Provide details for Route No 2	To the east via private road > Wattle Avenue West > Wattle Avenue East > Old Yanchep Road
Percentage of Vehicular Movements via Route No 2	40% [69 VPD; AM 11 VPH; PM 11 VPH]

Note - For more detailed plans of the estimated vehicular traffic volumes and distribution, please refer to the plans provided in Appendix 2.

2.14 Access to the RAV Network

Reference Document Utilised: MRWA - Heavy Vehicle Services Standard Restricted Access Vehicle (RAV) Route Assessment Guidelines

RavNetworkMap

Description of RAV Networks:

The Restricted Access Vehicle Network (RAV) is a network of roads approved by Main Roads Western Australia that can cater for the safe movement of certain heavy vehicles. There are 10 different RAV networks in Western Australia that cater for different heavy vehicle categories.

Are there are existing RAV Networks in the surrounding area: YES

Nominate RAV Networks in vicinity of the subject site: Wattle Avenue sealed road section east of the proposed development is classified as RAV 4 network and could accommodate vehicles up to 27.5m in length.

The requirement of the proposed development will be RAV 4.

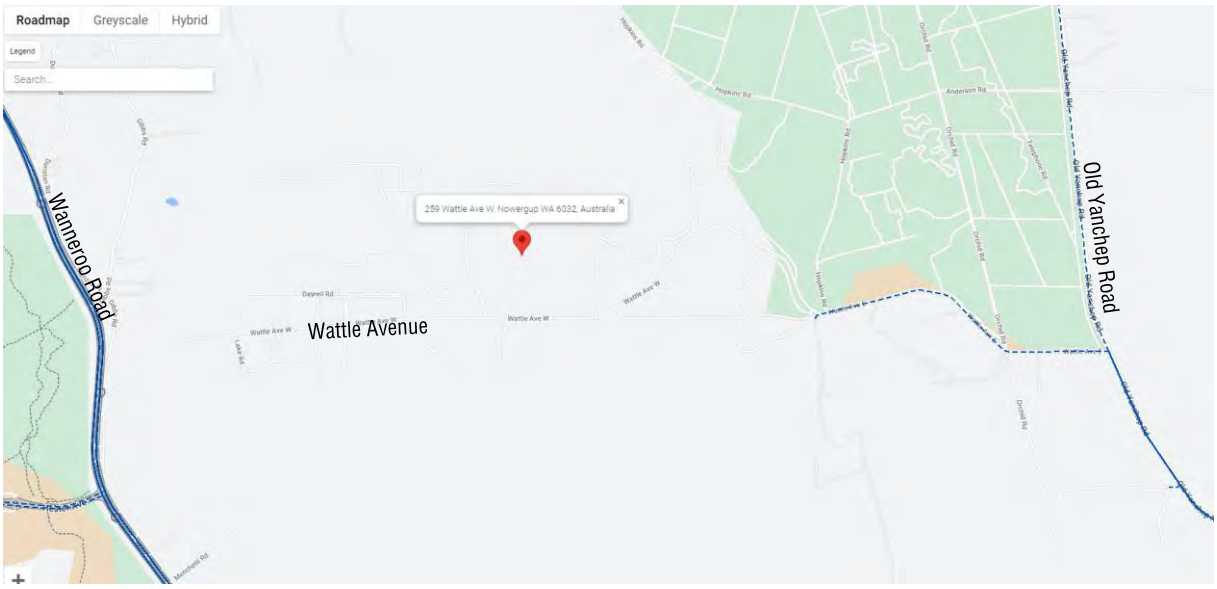
Table below shows a summary of the characteristics for each RAV network and their permissible vehicles.

The RAV Network map does not show any RAV Network for Wattle Avenue West. This route is expected to be utilised by semi-trailers as the largest vehicle.

RAV Network Number	Supported Vehicle Characteristics			
	Maximum Length	Maximum Height	Maximum Weight	Number of Axels
1	20.0m	4.6m	50t	3-4
2	**27.5m**	**4.6m**	**87.5t**	**3-5**
3	**27.5m**	**4.6m**	**84t**	**5**
4	**27.5m**	**4.6m**	**87.5t**	**5**
5	36.5m	4.6m	84t	5-6
6	36.5m	4.6m	87.5t	5-6
7	36.5m	4.6m	107.5t	6
9	53.5m	4.6m	120.5t	6-7
10	53.5m	4.6m	147.5t	6-8

Provide surrounding RAV network map:

*Screenshot provided on the following page



RAV 4 network

As seen from the above screenshot, Wattle Avenue provides access to RAV network of 4 and lower. Therefore, it will cater for the requirements of the development.

Semi-trailers will use the section of Wattle Avenue West towards Wanneroo Road as the largest vehicles.

Nominate the RAV 4 Road Requirements.

Appendix A: Rural Road Minimum Width

	60 to 70 km/h		80 to 100 km/h	
	Carriageway Width (m)	Sealed Width (m)	Carriageway Width (m)	Sealed Width (m)
0 to 150 AADT / VPD* **				
RAVs Categories 2-4	7.6	3.3	7.9	3.4
RAVs Categories 5-7	7.7	3.4	8.0	3.5
RAVs Categories 8-10	8.2	3.8	8.6	3.9

According to the above table, the unsealed road leading from Wattle Avenue East to the subject site would have to be 7.6m wide (*Appendix A of the Standard Restricted Access Vehicle Route Assessment Guidelines*). Based on the measurements over the latest aerial imagery, the required widths are achieved for the unsealed road connecting the subject quarries and Wattle Avenue East.

2.15 Sightlines

Have the sightlines been checked at access points?

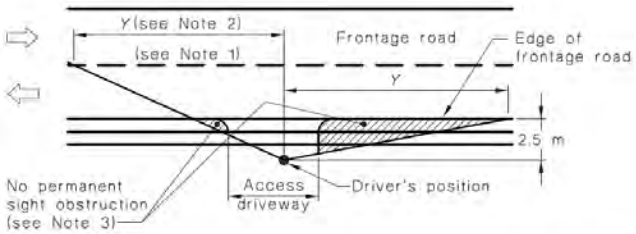
YES

At the Wattle Avenue west connection with the unsealed road, the sightlines are not required to be checked as there is only a bend and there are no intersecting roads (screenshot below). At this bend, only traffic from the quarries is expected to be present.

At the Wattle Avenue East connection with the unsealed road, there is an intersection formed with a private driveway to a commercial development. The trucks' route is a major route at this intersection.

Therefore, the below analysis was conducted from the private driveways perspective.

*" **Entering sight distance***
Unsignalized access driveways shall be located so that the intersection sight distance along the frontage road available to drivers leaving the car park or domestic driveway is at least that shown in Figure 3.2."



Frontage road speed (Note 4) km/h	Distance (Y) along frontage road m		
	Access driveways other than domestic (Note 5)		Domestic property access (Note 6)
	Desirable 5 s gap	Minimum SSD	
40	55	35	30
50	69	45	40

Sight distance requirements at access driveways	The above screenshots shows sight distance in excess of the required 69m. Additionally, based on the street view imagery, the wall located on the northern side of the private driveway is low and does not interfere with the sightlines.

2.17 Public Transport Accessibility

How many bus routes are within 400 metres of the subject site?	None
How many rail routes are within 800 metres of the subject site?	None

Walk Score Rating for Accessibility to Public Transport

N/A

2.18 Pedestrian Infrastructure

Describe existing local pedestrian infrastructure within a 400m radius of the site:

Classification	Road Name

Given this is a rural, unbuilt area. No pedestrian paths are available.

What is the Walk Score Rating?

0 | Car-Dependent. Almost all errands require a car.

2.19 Cyclist Infrastructure

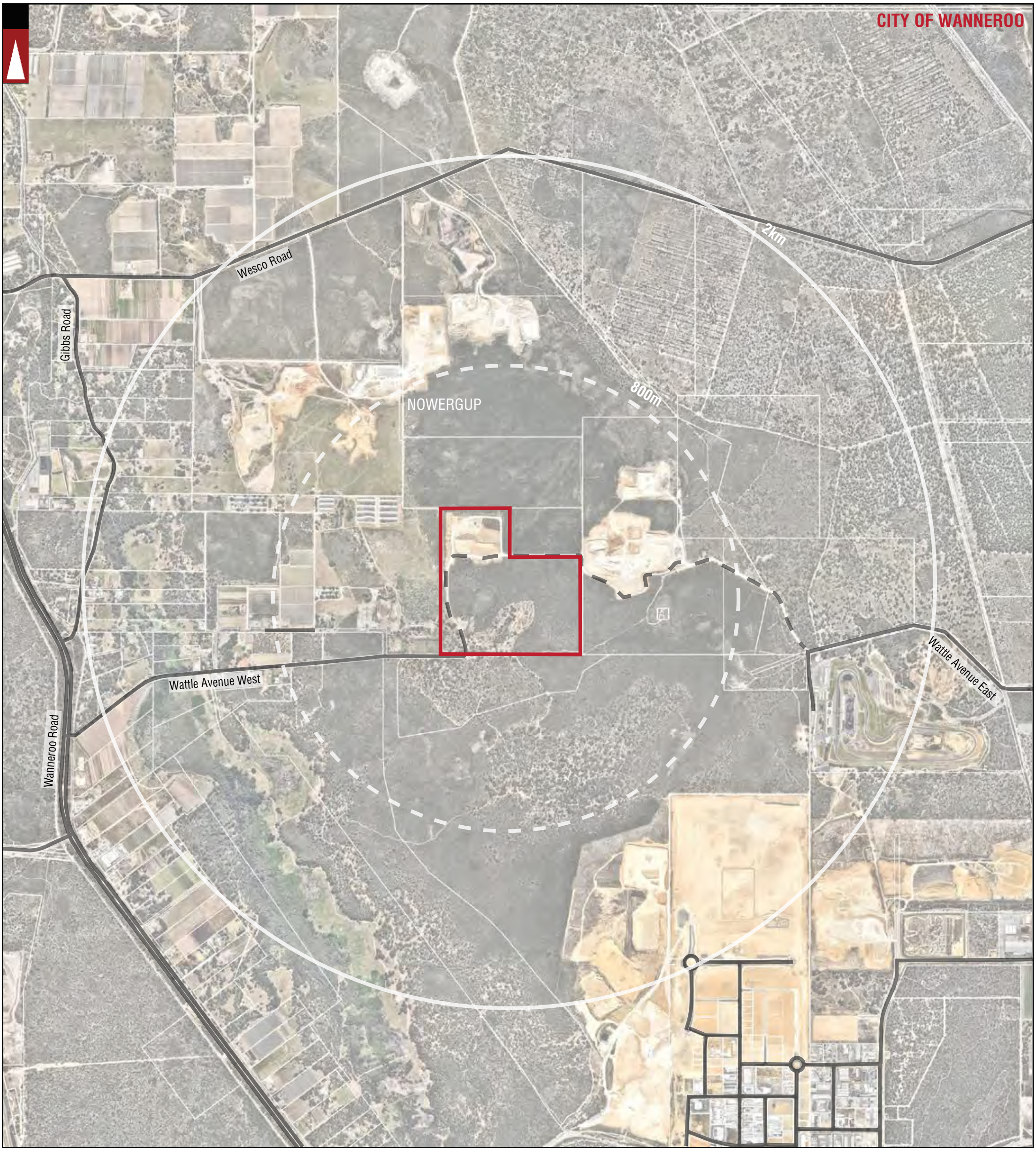
Are there any PBN Routes within an 800m radius of the subject site?	NO
Are there any PBN Routes within a 400m radius of the subject site?	NO
Does the site have existing cyclist facilities?	NO
Does the site propose to improve cyclist facilities?	NO

2.20 Site-Specific Issues and Proposed Remedial Measures

How many site-specific issues need to be discussed?	One (1)
Site-Specific Issue No 1	**Traffic Impact**
Remedial Measure / Response	The subject development generates up to 172 vehicle trips per day and 28 vehicle trips per hour in peak hours. According to the WAPC Guidelines, this moderately impacts the surrounding network. Wattle Avenue is classified as a Local Distributor as per MRWA classification with the maximum desirable volume of 6,000 vehicles per day. Given that Wattle Avenue West and Wattle Avenue East are not connected via sealed road, the only traffic at the beginning of sealed road sections is expected to be from the subject quarries. Therefore, Wattle Avenue would remain well under the maximum desirable traffic volume for Local Distributor roads.

Appendix 1

Transport Planning and Traffic Plans



PARKS AND RECREATION
ROAD
UNSEALED ROAD
Hay Street STREET NAME
LOCATION BOUNDARY
DISTANCE FROM LOCATION
CITY OF WANNEROO LOCAL GOVERNMENT NAME
NOWERGUP SUBURB NAME

LEGEND

No	DATE	AMENDMENT
A	17-10-2023	ISSUED FOR REVIEW

PROJECT: LOT 8 WATTLE AVENUE, NOWERGUP

TITLE: LOCALITY PLAN - 800M RADIUS

DRAWING NUMBER: KC01721.000_ S01

DRAWN BY: N.M.

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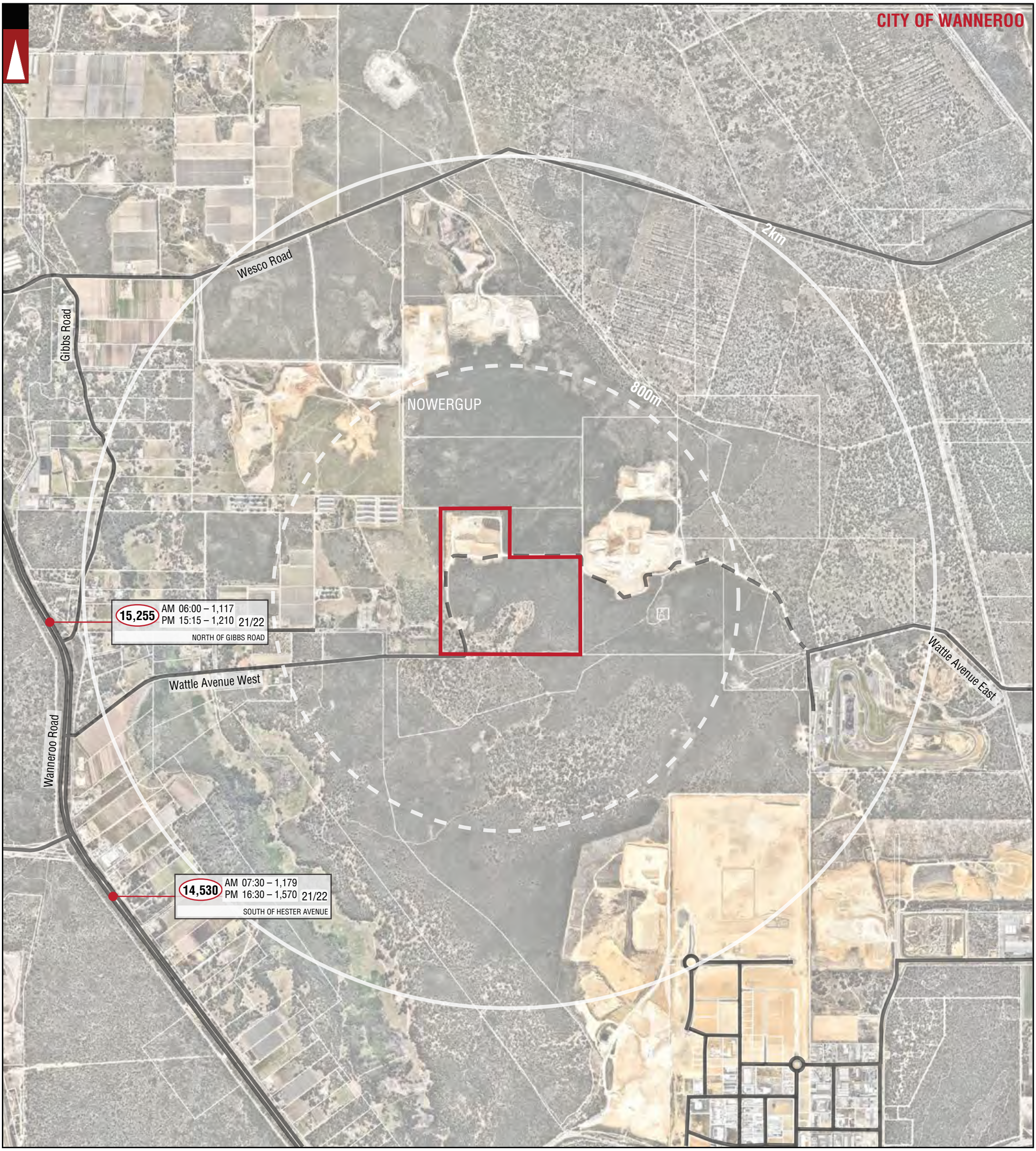
KCTT (Trading as KC Traffic and Transport Pty Ltd)
PO Box 1456 Scarborough WA 6922
PH: 08 9441 2700
WEB: www.kctt.com.au



PARKS AND RECREATION
ROAD
UNSEALED ROAD
Hay Street — STREET NAME
LOCATION BOUNDARY
DISTANCE FROM LOCATION
CITY OF WANNEROO — LOCAL GOVERNMENT NAME
NOWERGUP — SUBURB NAME
5,512 — NUMBER OF VEHICLES PER DAY
AM 1145 – 381
PM 1630 – 480
NUMBER OF VEHICLES PER AM PEAK HOUR
NUMBER OF VEHICLES PER PM PEAK HOUR
2014 — YEAR
EAST OF HARLOW ROAD — LOCATION

LEGEND

No	DATE	AMENDMENT
A	17-10-2023	ISSUED FOR REVIEW

PROJECT: LOT 8 WATTLE AVENUE, NOWERGUP

TITLE: EXISTING TRAFFIC COUNTS - 800M RADIUS

DRAWING NUMBER: KC01721.000_ S05

DRAWN BY: N.M.

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PARKS AND RECREATION
ROAD
UNSEALED ROAD
Hay Street — STREET NAME
CITY OF WANNEROO — LOCAL GOVERNMENT NAME
NOWERGUP — SUBURB NAME
LOCATION BOUNDARY
DISTANCE FROM LOCATION
1,389 — Total Expected Traffic Generation from the proposed development
503 — Total Expected Traffic Generation from Subject Site on the specific section of road - **IN and OUT direction**
Traffic Flow IN Direction
Traffic Flow OUT Direction

LEGEND

No	DATE	AMENDMENT
A	17-10-2023	ISSUED FOR REVIEW

PROJECT: LOT 8 WATTLE AVENUE, NOWERGUP

TITLE: TRAFFIC FLOW DIAGRAM

DRAWING NUMBER: KC01721.000_ S06

DRAWN BY: N.M.

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CITY OF WANNEROO

Wesco Road

Gibbs Road

2km

800m

NOWERGUP

14

14

17

11

Wattle Avenue West

Wattle Avenue East

Wanneroo Road

LEGEND

PARKS AND RECREATION	LOCATION BOUNDARY
ROAD	DISTANCE FROM LOCATION
UNSEALED ROAD	LOCAL GOVERNMENT NAME
Hay Street — STREET NAME	NOWERGUP — SUBURB NAME

1,389 — Total Expected Traffic Generation from the proposed development - AM Peak

503 — Total Expected Traffic Generation from Subject Site on the specific section of road - **IN and OUT direction - AM Peak**

Traffic Flow IN Direction

Traffic Flow OUT Direction

No	DATE	AMENDMENT
A	17-10-2023	ISSUED FOR REVIEW

PROJECT: LOT 8 WATTLE AVENUE, NOWERGUP

TITLE: TRAFFIC FLOW DIAGRAM - AM PEAK

DRAWING NUMBER: KC01721.000_ S07

DRAWN BY: N.M.

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PARKS AND RECREATION
ROAD
UNSEALED ROAD
Hay Street — STREET NAME
CITY OF WANNEROO — LOCAL GOVERNMENT NAME
NOWERGUP — SUBURB NAME
LOCATION BOUNDARY
DISTANCE FROM LOCATION
1,389 — Total Expected Traffic Generation from the proposed development - PM Peak
503 — Total Expected Traffic Generation from Subject Site on the specific section of road - **IN and OUT direction - PM Peak**
Traffic Flow IN Direction
Traffic Flow OUT Direction

LEGEND

No	DATE	AMENDMENT
A	17-10-2023	ISSUED FOR REVIEW

PROJECT: LOT 8 WATTLE AVENUE, NOWERGUP

TITLE: TRAFFIC FLOW DIAGRAM - PM PEAK

DRAWING NUMBER: KC01721.000_ S08

DRAWN BY: N.M.

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Appendix 4
Noise Assessment

WA LIMESTONE

EXTRACTIVE INDUSTRY
LOT 8 WATTLE AVENUE WEST
NOWERGUP

COMMISSIONING
ACOUSTIC ASSESSMENT

OCTOBER 2023

OUR REFERENCE: 31696-1-23229

Rochdale Holdings Pty Ltd A.B.N. 85 009 049 067 trading as:
HERRING STORER ACOUSTICS
P.O. Box 219, Como, W.A. 6952
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DOCUMENT CONTROL PAGE

ACOUSTIC ASSESSMENT
NOWERGUP

Job No: 23229

Document Reference: 31696-1-23229

FOR

WA LIMESTONE

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Date of Issue:	10 October 2023		

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Copy No.	Version No.	Destination	Hard Copy	Electronic Copy
1	1	WA Limestone Att: Farooque Ahmed Email: farooque.a@walimestone.com		✓

CONTENTS

APPENDICIES

1. INTRODUCTION

Herring Storer Acoustics have been commissioned by WA Limestone to undertake an acoustic assessment of noise emissions from the limestone extraction operations located at Lot 8 Wattle Avenue West, Nowergup.

Approval has been previously granted for extractive industry on this site as per DA2013/663. As a part of the approval and subsequent supporting Noise Management Plan, a post commissioning acoustic assessment has been undertaken.

Noise level measurements of the processing plant and extractive operations have been undertaken in both near and far field locations. The resultant noise levels have been assessed for compliance against the criteria contained in the Environmental Protection (Noise) Regulations 1997.

The main access road to Wattle Avenue West is shown in Figure 1.1, along with the existing and proposed operations in the various stages.

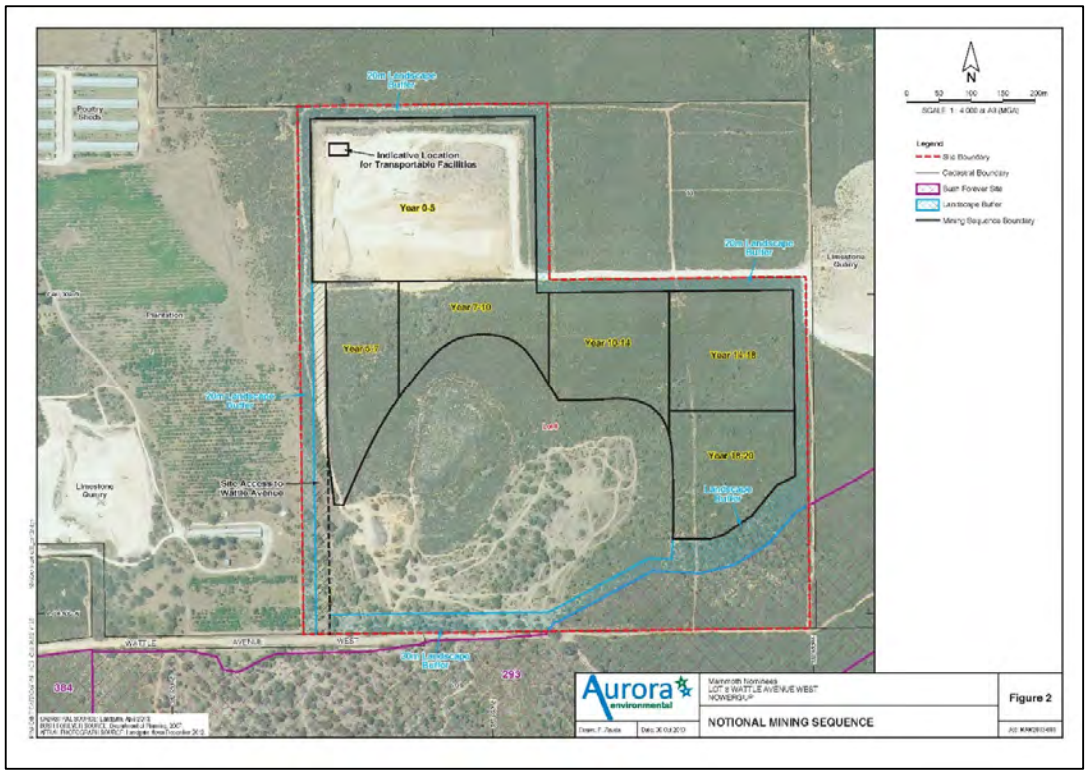


FIGURE 1.1 –EXTRACTION OPERATIONS

This assessment is provided to confirm the regulatory approvals processes and show that compliance with the requirements of the Environmental Protection (Noise) Regulations 1997 has been achieved.

As part of the study, the following was carried out:

- Measurement of noise levels using noise monitors over a week long period.
- Assess the measured noise levels at the nearest surrounding noise sensitive premises for compliance with the appropriate criteria.
- If exceedances are predicted, comment on possible noise amelioration options for compliance with the appropriate criteria.

For information, a locality plan is shown in Appendix A.

2. SUMMARY

Assessment has been conducted on the limestone extraction operations for Lot 8 Wattle Avenue west, Nowergup.

The facility only operates during the day period (being Monday to Friday 0700 to 1900 hours and 0700 to 1600 on Saturdays). Therefore, at the neighbouring residences, the applicable acoustic criteria for this assessment are the assigned L_{A10} day period noise level of 59 dB(A).

Noise received at the nearest residential premises has been determined, to be 39 dB(A) for the limestone operations for the highest noise level at the commencement of operations. This can be compared to the applicable assigned noise level criteria of 59 dB(A).

The above assessable noise levels have been considered to contain tonal characteristics and therefore, contains a +5 dB(A) penalty.

Given these operating parameters, noise levels received at the nearest premises has been calculated to comply with the *Environmental Protection (Noise) Regulations 1997* for the operating times as outlined in this assessment, even with the inclusion of a +5 dB(A) penalty for tonality.

3. CRITERIA

The allowable noise level for noise sensitive premises in the vicinity of the proposed site is prescribed by the *Environmental Protection (Noise) Regulations 1997*. Regulations 7 and 8 stipulate maximum allowable external noise levels or assigned noise levels that can be received at a premise from another premises. For residential premises, this noise level is determined by the calculation of an influencing factor, which is then added to the base levels shown below. The influencing factor is calculated for the usage of land within two circles, having radii of 100m and 450m from the premises of concern. The base noise levels for residential premises are listed in Table 3.1.

TABLE 3.1 - BASELINE ASSIGNED OUTDOOR NOISE LEVEL

Premises Receiving Noise	Time of Day	Assigned Level (dB)		
		$L_{A\ 10}$	$L_{A\ 1}$	$L_{A\ max}$
Noise sensitive premises	0700 - 1900 hours Monday to Saturday (Day)	45 + IF	55 + IF	65 + IF
	0900 - 1900 hours Sunday and Public Holidays (Sunday / Public Holiday Day Period)	40 + IF	50 + IF	65 + IF
	1900 - 2200 hours all days (Evening)	40 + IF	50 + IF	55 + IF
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and Public Holidays (Night)	35 + IF	45 + IF	55 + IF

Note: L_{A10} is the noise level exceeded for 10% of the time.
L_{A1} is the noise level exceeded for 1% of the time.
L_{Amax} is the maximum noise level.
IF is the influencing factor.

It is a requirement that received noise be free of annoying characteristics (tonality, modulation and impulsiveness), defined below as per Regulation 9.

"impulsiveness" means a variation in the emission of a noise where the difference between L_{Apeak} and $L_{Amax\ Slow}$ is more than 15 dB when determined for a single representative event;

"modulation" means a variation in the emission of noise that –

(a) is more than 3dB $L_{A\ Fast}$ or is more than 3 dB $L_{A\ Fast}$ in any one-third octave band;
(b) is present for more at least 10% of the representative assessment period; and
(c) is regular, cyclic and audible;

"tonality" means the presence in the noise emission of tonal characteristics where the difference between –

(a) the A-weighted sound pressure level in any one-third octave band; and
(b) the arithmetic average of the A-weighted sound pressure levels in the 2 adjacent one-third octave bands,

is greater than 3 dB when the sound pressure levels are determined as $L_{Aeq,T}$ levels where the time period T is greater than 10% of the representative assessment period, or greater than 8 dB at any time when the sound pressure levels are determined as $L_{A\ Slow}$ levels.

The nearest potential noise sensitive premises to the proposed development have been identified using the area map in Figure 3.1.

The usage of the surrounding land use varies from intensive poultry live stocking, to extractive industry, and is zoned Rural Resource. Due to the various landholdings, the influencing factor for industrial has been assigned to these receivers, as expectations are the receivers considered in this assessment would be subjected to higher noise levels than general rural operations. Therefore, the assigned noise levels for operational times are as noted in Table 3.2.

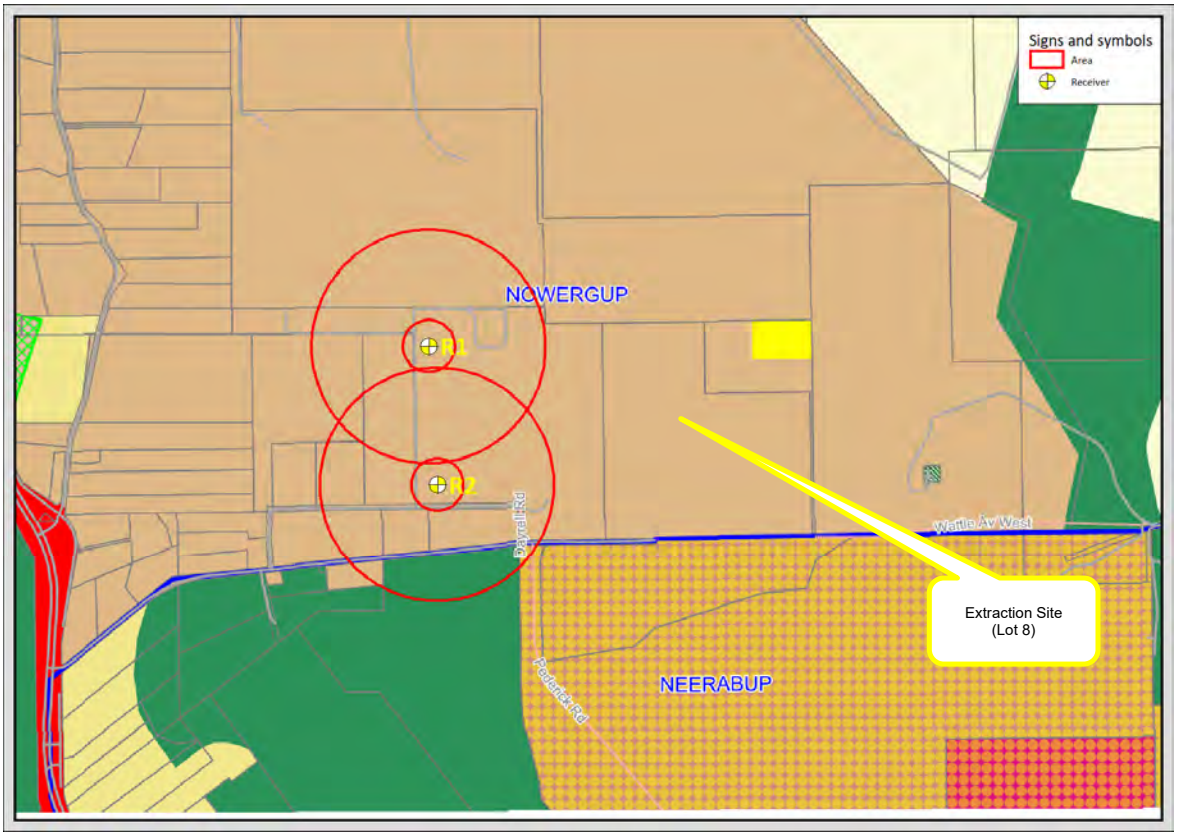


FIGURE 3.1 – RECEIVER LOCATION MAP

TABLE 3.2 – ASSIGNED NOISE LEVELS

Premises Receiving Noise	IF dB	Time of Day	Assigned Level (dB)		
			$L_{A\ 10}$	$L_{A\ 1}$	$L_{A\ max}$
Receiver 1 and 2	14	0700 - 1900 hours Monday to Saturday (Day)	59	69	79

4. MONITORING

To measure the noise emissions from the operating extractive industry, noise monitors, capable of continuous noise level measurement were utilised.

Two noise monitors (Svan307A) were deployed on Friday 11th August 2023.

The first noise monitor was located at the highest noise area identified during the site visit, being the active processing area where the loader and screen were positioned. This monitor captured continuous noise levels and provided a baseline for comparison to the other far field monitors.

The other monitoring unit was placed towards the west, being the direction of the nearest noise sensitive residence.

Figure 4.1 details the locations of the monitors, and Figure 4.2 shows them in situ.

FIGURE 4.1 - CONTINOUS MONITORING LOCATIONS

FIGURE 4.2 - MONITORS IN SITU

5. RESULTS / ANALYSIS

Monitored noise levels have been compared to periods of activity in the area, as well as against weather conditions. During the 11-day monitoring period, operations within the first stage were conducted on the 18th, 21st and 22nd August 2023. Whilst there were other periods of operations prior to this, they were generally influenced by rain, hence were discounted from the analysis.

Figure 5.1 shows the monitoring period comparison between the two noise monitors from the 18th onwards.

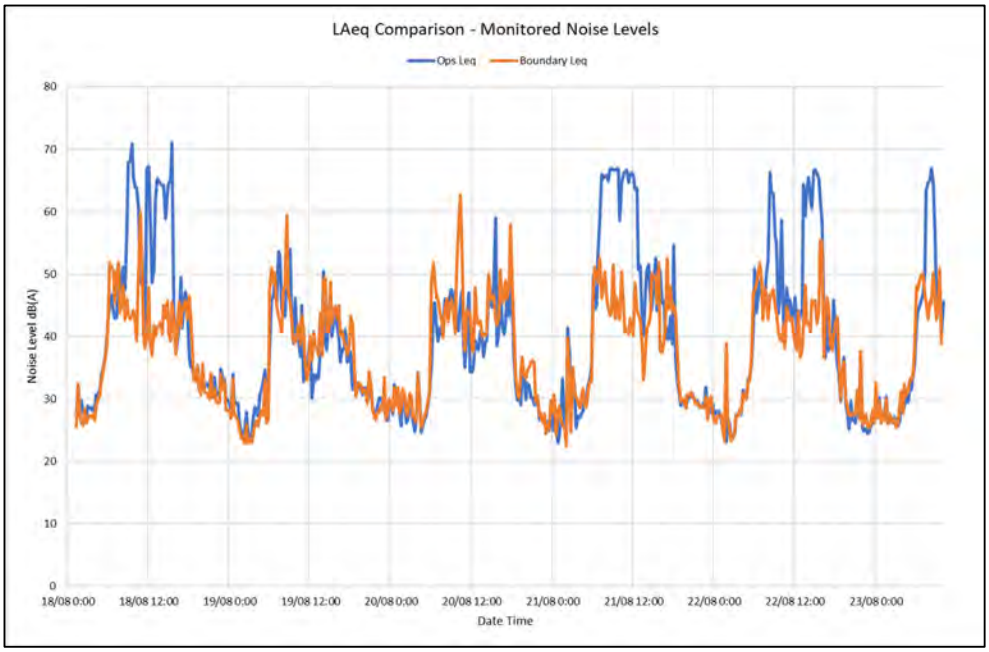


FIGURE 5.1 –MONITORING PERIOD 18th to 23rd AUGUST 2023

Of the periods noted above, generally winds were propagating from the source to receiver (Easterly winds) on Thursday 21st August 2023. Figure 5.2 details the comparison noise levels between the two monitors for this day.

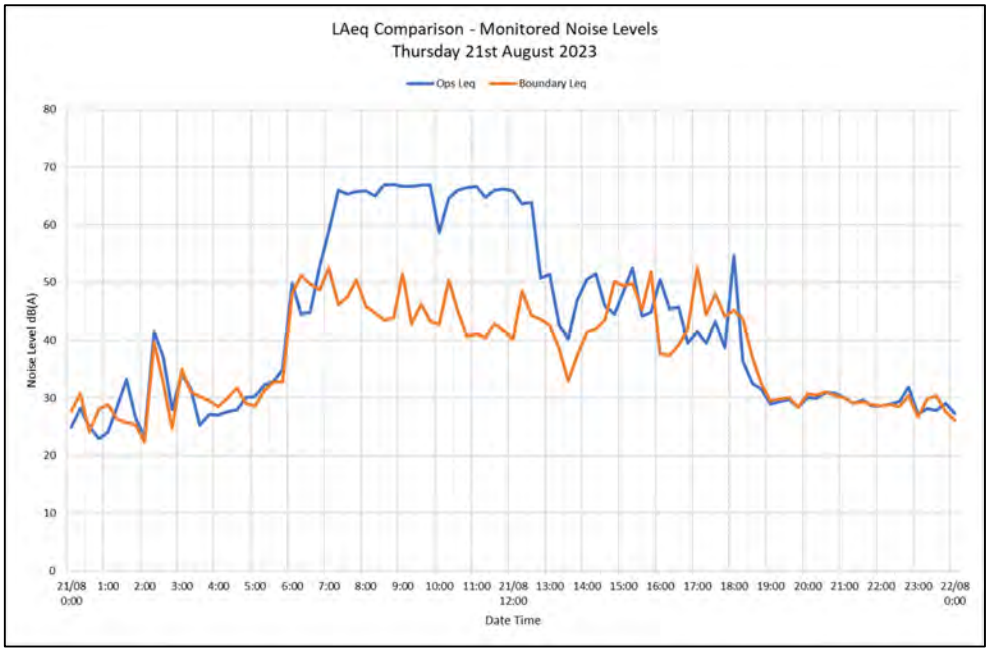


FIGURE 5.2 –MONITORING PERIOD 21st AUGUST 2023

Based on the comparison of noise level between the two monitors, the base operations were generally around 65 dB(A) within the pit, with the resultant highest noise level at the boundary of 50 dB(A).

Whilst the higher noise level of 50 dB(A) has been used at the boundary, this occurred for short periods and did not correlate with the consistent operations at the pit.

6. ASSESSMENT

To calculate the noise level at the nearest receiver, the distance between the measured noise level and the receiver needs to be adjusted. The First monitor was approximately 100m from the boundary monitor. The boundary monitor was 670m from the receiver. Based on this, the calculated reduction of noise between the boundary monitor and the receiver would be 16 dB.

For the daytime operations, based on measured noise level at the boundary monitor for periods of operations in the pit, and idea propagation towards the receiver was 50 dB(A). Noise levels at the nearest premises would be reduced by 16 dB. Therefore, the calculated noise level at the receiver would be 34 dB(A).

As noise levels could be considered as being tonal in characteristics, a +5 dB(A) penalty has been included to allow for a tonal component for the residence.

Hence, Table 6.1 summarises the applicable Assigned Noise Levels, and assessable noise level.

TABLE 6.1 – APPLICABLE ADJUSTMENTS AND ASSESSABLE LEVEL OF NOISE EMISSIONS, dB(A)

Receiver	Calculated Noise Level, dB(A)	Applicable Adjustments to Measured Noise Levels, dB(A)			Assessable Noise Level, dB(A)
		Where Noise Emission Is Not Music			
		Tonality	Modulation	Impulsiveness	
R1	34	+5	-	-	39

Based on the assessable noise levels above, comparison against the relevant assigned noise level is contained in Table 6.2

TABLE 6.2 – ASSESSMENT OF NOISE LEVELS

Receiver	Premises Receiving Noise Assessable Noise Level dB(A)	Time of Day	Assigned Level (dB)	Compliance
R1	39	0700 - 1900 hours Monday to Saturday (Day)	59	Complies

7. CONCLUSION

Assessment has been conducted on the limestone extraction operations for Lot 8 Wattle Avenue west, Nowergup.

The facility only operates during the day period (being Monday to Friday 0700 to 1900 hours and 0700 to 1600 on Saturdays). Therefore, at the neighbouring residences, the applicable acoustic criteria for this assessment are the assigned L_{A10} day period noise level of 59 dB(A).

Noise received at the nearest residential premises has been determined, to be 39 dB(A) for the limestone operations for the highest noise level at the commencement of operations. This can be compared to the applicable assigned noise level criteria of 59 dB(A).

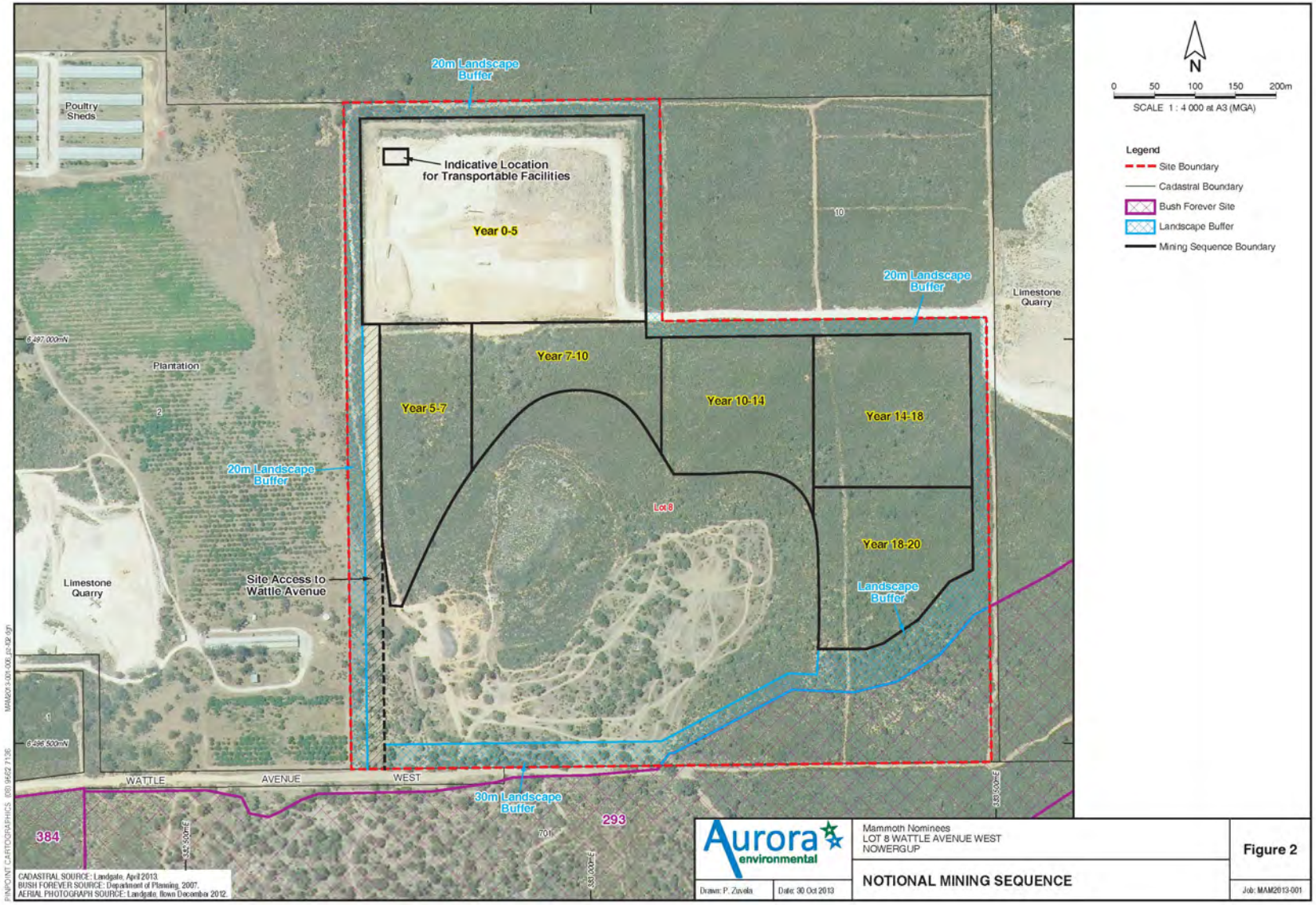
The above assessable noise levels have been considered to contain tonal characteristics and therefore, contains a +5 dB(A) penalty.

Given these operating parameters, noise levels received at the nearest premises has been calculated to comply with the *Environmental Protection (Noise) Regulations 1997* for the operating times as outlined in this assessment, even with the inclusion of a +5 dB(A) penalty for tonality.

APPENDIX A

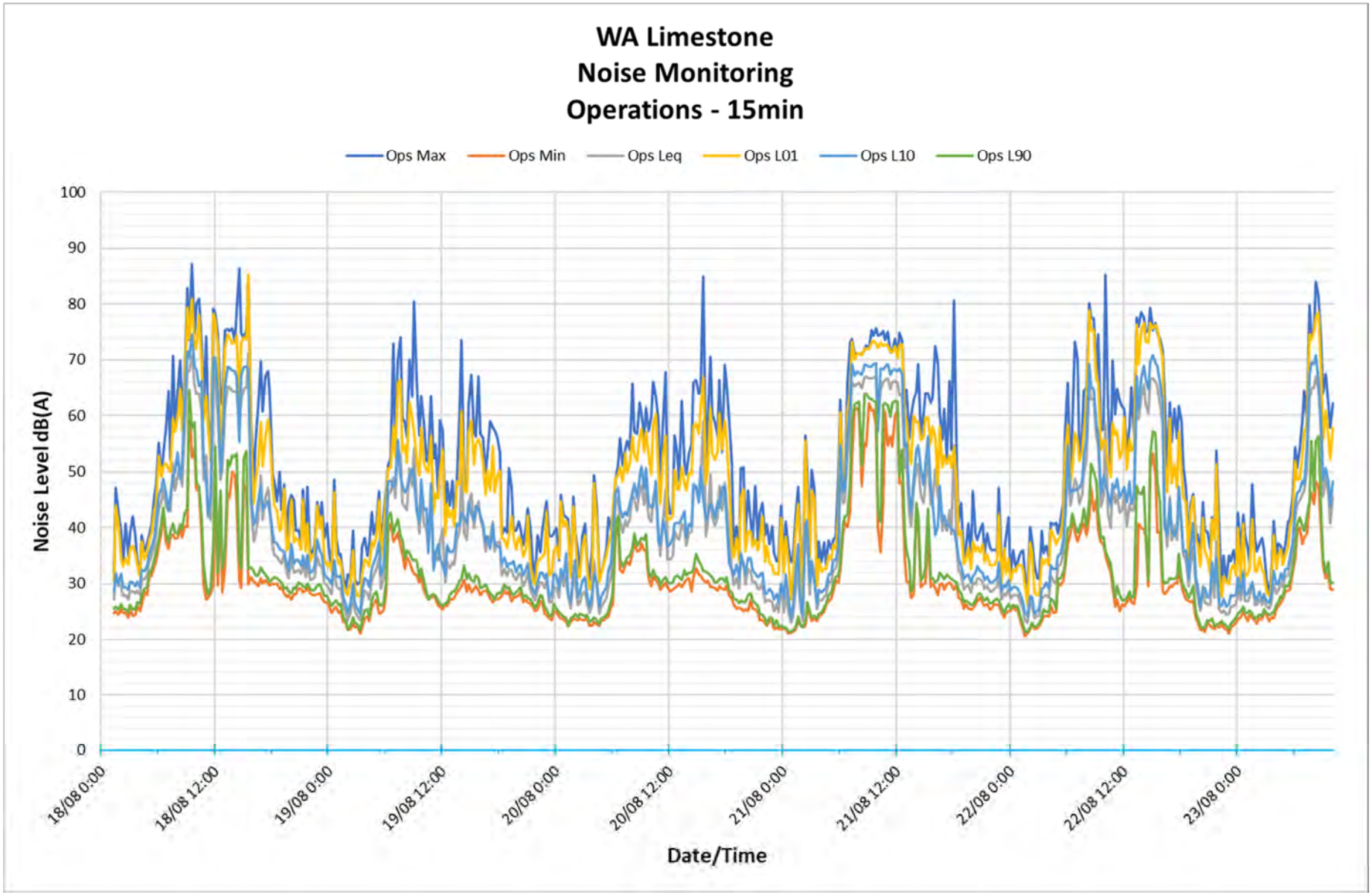
FIGURE A1 – LOCATION MAP

FIGURE A1 – SITE LAYOUT



APPENDIX B

Monitored Noise Level Charts


WA Limestone
Noise Monitoring
Operations - 15min
Ops Max
Ops Min
Ops Leq
Ops L01
Ops L10
Ops L90
Noise Level dB(A)
100
90
80
70
60
50
40
30
20
10
0
18/08 0:00
18/08 12:00
19/08 0:00
19/08 12:00
20/08 0:00
20/08 12:00
21/08 0:00
21/08 12:00
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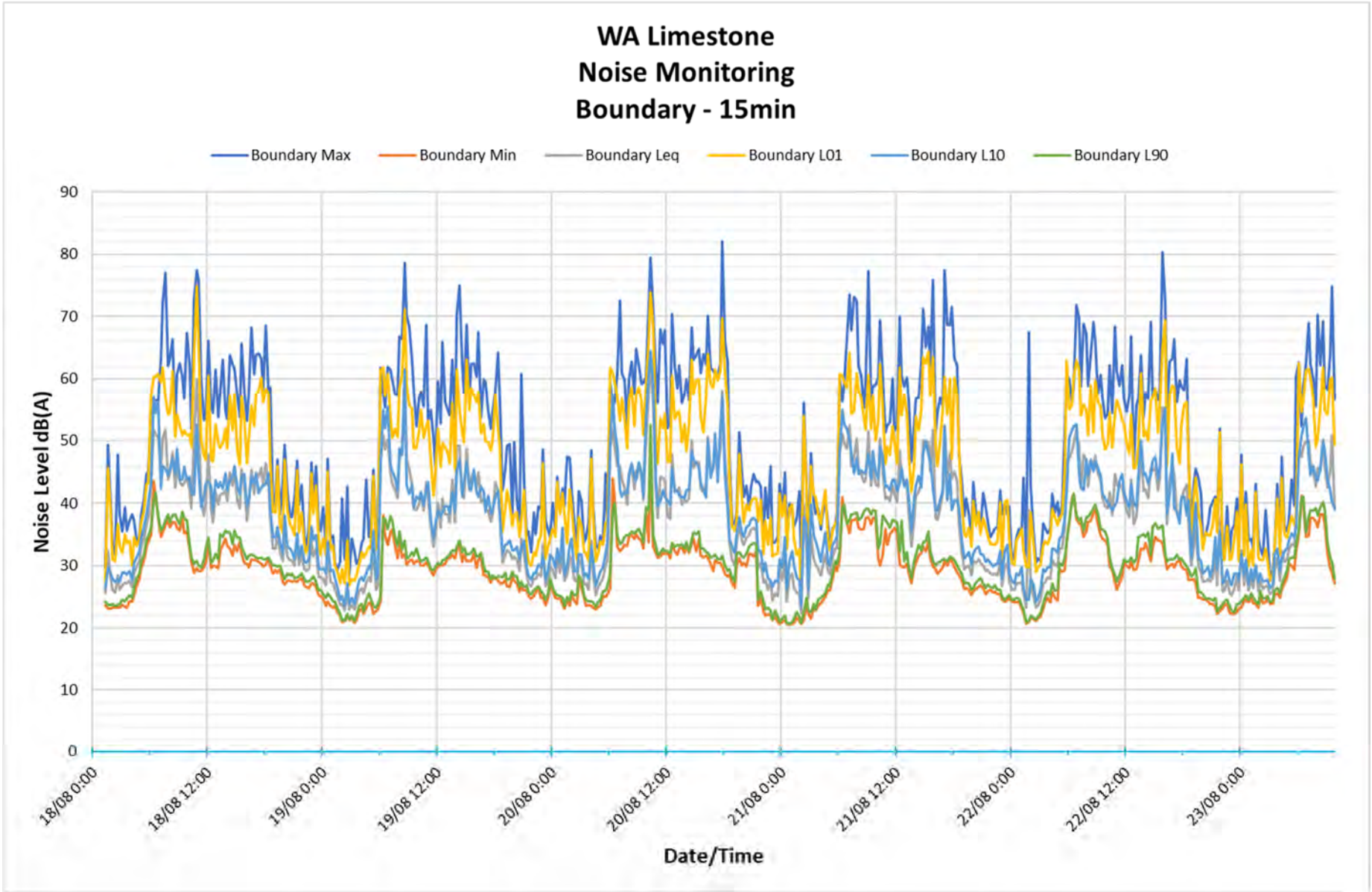
22/08 12:00
23/08 0:00
Date/Time


WA Limestone
Noise Monitoring
Boundary - 15min
Boundary Max
Boundary Min
Boundary Leq
Boundary L01
Boundary L10
Boundary L90
Noise Level dB(A)
90
80
70
60
50
40
30
20
10
0
18/08 0:00
18/08 12:00
19/08 0:00
19/08 12:00
20/08 0:00
20/08 12:00
21/08 0:00
21/08 12:00
22/08 0:00
22/08 12:00
23/08 0:00
Date/Time

Appendix 5
Blast Management Plan

City of Wanneroo

File Ref: DA2013/663 (20/520462)
Your Ref:
Enquiries: Josh Coppola – Ph: 9405 5474

20 November 2020

PMR Quarries Pty Ltd T/A WA Limestone
PO Box 1404
BIBRA LAKE WA 6965

PERMISSION TO CONDUCT BLASTING
WA LIMESTONE – LOT 8 (259) WATTLE AVENUE, NOWERGUP

I refer to your email dated 29 October 2020, and the additional information received on 17 November 2020, seeking the City's approval for to conduct blasting at Lot 8 (259) Wattle Avenue, Nowergup (Lot 8).

I acknowledge that WA Limestone is seeking written approval from the City's Manager Approval Services to conduct blasting, pursuant to:

- Condition 27 of the City's 31 January 2014 development approval (DA2013/663), for extractive industry to be carried out on Lot 8. Condition 27 is as follows:

  No explosives shall be stored on the site and no blasting shall be carried out without the approval of the appropriate State Government authority and the Manager Planning Implementation.

- Condition 9 of the City's Extractive Industry Licence dated 3 June 2020, granted to WA Limestone to carry out extractive industry on Lot 8. Condition 9 is as follows:

  No blasting or storage of explosives shall be permitted on site without the prior approval of the City and other appropriate authorities.

- Clause 17(3)(a) of the City's Extractive Industries Local Law 1998, which prescribes as follows:

  the local government has otherwise given approval in respect of blasting generally or in the case of each blast;

I advise that written approval is now granted for WA Limestone to conduct blasting on Lot 8, 'generally' in the context of Clause 17(3)(a) of the Local Law. Approval to conduct blasting is subject to the following conditions and parameters:

1. Blasting activities on Lot 8 shall be carried out in accordance with WA Limestone's document titled 'Blast Management Plan: Wattle Avenue Quarry, Lot 8 (No. 259) Wattle Avenue, Nowergup' (Blast Management Plan), dated October 2020.

2. Blasting activities shall conform to the City's development approval for extractive industry, issued on 31 January 2014 (DA2013/663) (**City's development approval**), and to the City's Extractive Industry Licence granted on 3 June 2020.

3. Blasting on Lot 8 shall only be carried out by WA Limestone or their appointed persons as referred to in the Blast Management Plan.

4. The term of this written approval to carry out blasting on Lot 8 coincides with the term of the City's development approval. This written approval will not apply outside the term of that development approval (i.e. after 31 January 2024).

5. This approval does not permit the storage of explosives on Lot 8, unless further written approval is obtained by the City and other relevant government agencies.

6. Blasting activities shall be carried out within the parameters prescribed in the City's *Extractive Industries Local Law 1998*.

7. Well in advance to any blasting being undertaken on Lot 8 (or series of blasts), WA Limestone shall provide adequate notification to landowners and occupiers of all surrounding and affected properties.

8. Blasting activities shall be confined to the cleared portions of Lot 8 until such time that all environmental approvals are in place to permit the clearing of vegetation and the expansion of operations. Blasting activities shall be carried out so as to not disturb uncleared vegetation.

9. WA Limestone shall control dust generated from blasting activities in accordance with the City's development approval and principles for Dust Management Plan provided in the document titled 'Approval for Extractive Industry, Lot 8 Wattle Avenue, Nowergup', prepared by Aurora Environmental and dated 14 May 2013.

The City reserves the right to withdraw its approval to conduct blasting on Lot 8, should it consider the above conditions and parameters are not being adhered to.

Should you have any queries or wish to discuss this matter, please contact Josh Coppola from the City's Approval Services Unit on 9405 5474.

Yours sincerely

Gregory Bowering
MANAGER APPROVAL SERVICES
City of Wanneroo

W.A. LIMESTONE

BLAST MANAGEMENT PLAN

Wattle Avenue Quarry

Lot 8 (No. 259) Wattle Avenue, Nowergup

PMR Quarries Pty Ltd T/A WA Limestone
401 Spearwood Ave, Bibra Lake WA
PO Box 1404 Bibra Lake WA 6595

Report: Rev 1 October 2020

BLAST MANAGEMENT PLAN

Wattle Avenue Quarry

Lot 8 (No. 259) Wattle Avenue, Nowergup

Prepared By:

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E: admin@walimestone.com www.walimestone.com

Document Control

Status	Date	Prepared	Checked	Authorised
Rev 0	11/08/2020	R Koufakis	R Stephens	
Rev 1	28/10/2020	C Sinclair	R Stephens	R Stephens

CONTENTS

APPENDICES

1.0 PURPOSE

1.1 Background

PMR Quarries Pty Ltd T/A WA Limestone took ownership of Lot 8 (No. 259) Wattle Avenue, Nowergup in January 2018, with the intention of continuing quarry activities onsite in accordance with currently approvals granted for the site:

- Planning Approval - Extractive Industry, DA2013/663
  City of Wanneroo (31 January 2014)
- Extractive Industry Licence
  City of Wanneroo (3 June 2020)
- Approval to Commence Development - Extractive Industry, Limestone
  WA Planning Commission (13 March 2014)

The site has been operated previously on a campaign basis by a basic raw material contractor however is currently under care and maintenance while the transfer of land titles and various statutory approvals are taking place.

Previously, blasting was permitted (pending approval from the City of Wanneroo under the Development Application for the breaking up of caprock); however, with the need for limestone boulders for the construction of seawalls and groynes for future marine projects in the north of Perth, blasting approval is required to create large limestone boulders.

WA Limestone is a family owned business and has operated a significant number of sand and limestone quarries across the Perth metropolitan area over the past 40 years. The company is accredited to international ISO standards 4801 (Health & Safety Management), 9001 (Quality Management) and 14001 (Environmental Management), and implements these recognised practices across all extractive industry sites.

When proposed activities recommence at the Wattle Avenue Quarry the site will be managed and operated in accordance with WA Limestone's independently audited ISO 14001:2015 Environmental Management System (EMS), as well as relevant health and safety, and quality management system requirements.

WA Limestone commits to conduct extractive operations at this site in accordance with all relevant planning approval and extractive industry licence conditions, licences and permits issued under the *Environmental Protection Act 1986* as well as the company's internal ISO accredited standards.

1.2 Introduction

It is a requirement to develop and implement a formal "Blast Management Plan" under Australian Standards AS2187.2 2006 section 4.2 Appendix A "Blast Management Plan and Records". It is also a requirement of the City of Wanneroo Local law for Extractive Industry to comply with Australian Standards on the storage and use of explosives.

WA Limestone recognises these requirements and has adopted it to meet its operational requirements for the Lot 8 (259) Wattle Avenue, Nowergup Quarry project when using and handling explosives on site.

The standards and protocol set out in the Blast Management Plan (BMP) is to minimise injury and prevent fatalities from the use of explosives and to achieve best practices in the design process, use and handling of explosives at all operations where explosives are used. A Risk Assessment has been included Appendix 4 to consider all aspects associated with blasting at

1.3 Purpose

The purpose of this BMP is not only to provide a detailed description of how explosives are transported, stored, handled, used and disposed of, in open pit mining operations and / or Civil Works but also be utilised in the day to day operations as an active management tool. This includes drill and blast design to maintain the stability of excavations.

It therefore provides management with the "how-to-do" information to enable them to safely manage explosives within their area of responsibility. Accordingly, this document is primarily a management document and is supported by a number of other workplace documents.

1.4 Scope

The requirements of the BMP apply to all personnel who operate in areas under the control of WA Limestone. This includes all relevant clients and sub-contractor personnel, including any third parties and their facilities, infrastructure, equipment and supplies. The BMP shall be read in conjunction with current statutory Acts and Regulations.

1.5 Document Information

The Blast Management Plan links the design process and relevant blasting standards that is highlighted in the Safe Work Procedures; a Blast Management Plan (BMP) is required for each operation or mine. The BMP is to be compiled by an appropriately qualified and competent delegate in conjunction with the Site Manager for WA Limestone.

This document contains information that is important to the safety of everyone associated with the mining / construction operations where explosives are used. This information shall be communicated to new personnel who have responsibility for the transport, storage, handling / use and disposal of explosives or the design and implementation of drilling and blasting plans.

1.6 Blast Management Information Review

The documentation is dynamic in nature and further information will be added through management input following changes or on-going reviews e.g. following incident investigations, Managers Specific Instructions (MSIs). Changes made shall be recorded in the Register of Changes.

A formal review of the BMP will be conducted annually during the last quarter of each calendar year. The purpose of this review is to ensure that the BMP is effective in managing explosives and ensuring the safety of personnel.

1.7 Document Control

The persons responsible for maintaining this document so that it remains current, is the WA Limestone Operations Manager in conjunction with the WA Limestone Site Manager / Blast Manager who has ownership of the drilling and blasting responsibilities.

1.9 Location

Name of property	Lot 8 Wattle Avenue Quarry (Freehold Land)
Address of property	Lot 8 (259) Wattle Avenue, Nowergup WA
GPS or grid reference of secure store (if available)	See Figure 1, below.

Figure 1: Location plan, Lot 8 (259) Wattle Avenue, Nowergup

1.8 Explosives Flow Chart

The supply, transport, storage, use, handling and disposal of explosives on sites is primarily governed by the explosive standards set out in the Safe Work Procedures and "Part 8 - Explosives" of the WA Mines Safety and Inspection Regulations 1995. As no explosives will be stored on site the flow chart has been changed to reflect this,

A flow-chart showing the various stages in the use of explosives is shown in Figure 2"Explosives Flow-chart" below. There will be no explosives stored at Lot 8.

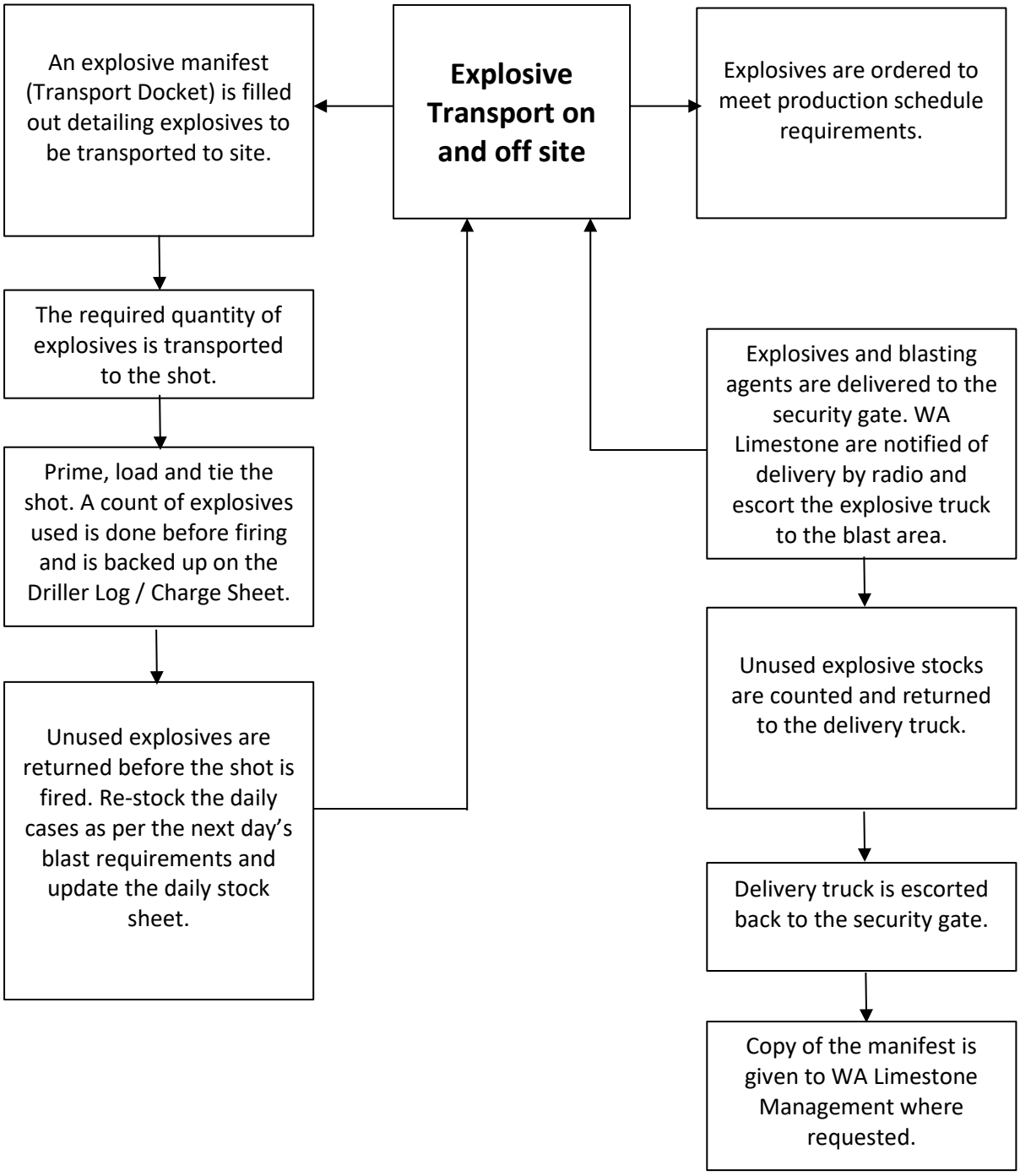

Figure 2: Explosives Flow Chart

2.0 DRILL AND BLAST PHILOSOPHY

Under the WA Limestone Safety Management System, Safe Work Procedures have been developed separately for drilling and blasting operations, in a bid to provide standards and training on how to conduct drill and blast operations in an efficient and safe method.

2.1 Drill and Blast Design Process

Proper drill and blast designs are essential to achieve efficient and safe blasting. The WA Limestone blasting standards require drilling and blasting to be properly planned and carried out to minimise any adverse impact on the environment (i.e. fly-rock, air-blast, ground vibration) as well as ground stability and rock fragmentation.

2.1.1 Drilling and Design Process:

- An agreement on rock to be blasted "Rock Horizon" shall be decided by the WA Limestone Site Manager
- Survey shall peg crest and toe lines and pick up the area (rock horizon), to determine agreed volume and bench height. Survey shall produce a plan of the area.
- Consultation with the WA Limestone Quarry Manager on desired blast parameters e.g. wall and face control, powder factors, blast orientation and timing. A Blast Master Plan shall be set up for every mining level / cutting.
- Examine the ground conditions, (Geological constraints).
- WA Limestone Blast Designer / Blasting Manager prepares a Drill Design Proposal Sheet.
- A copy of the approved Drill Design Proposal Sheet is given to the Shotfirer who marks up the drill pattern in accordance with the Drill Design Proposal Sheet.
- The Surveyor picks up the hole locations and depths and develops a drill plan. On the drill plan the surveyor places reference points which correspond with pegs placed on the ground which gives the chainage for locating drill lines and correct pattern orientation. Hole number and depths to design are placed on the drill plan.
- The drill plan is checked by the Blast Designer / Blast Manager for correct depths. Adjustments are made where required.
- The drill pattern is drilled to the depths on the plan with the driller dipping their own holes. The driller records each hole depth on the Driller Log / Charge Sheet. All holes shall be drilled with water irrespective of suspected fibrous minerals that may be in the area or not. Where there is a change of ground conditions i.e. cavities, distinct change in hardness, the driller shall record the hole number, depth, ground type and hardness on the Driller Log / Charge Sheet.
- Once the pattern is complete, the Driller notifies the Shotfirer, Blast Manager or Blast Designer and gives them the Driller Log / Charge Sheet. The Shotfirer is given a copy of the Drillers Log / Charge Sheet to use the information documented by the driller to carry out the Quality Control (QA) i.e. dipping and backfilling the holes to depth. The Drillers Log / Charge Sheet forms part of the blast records which is filed with other relevant blast documentation for that blast.
- The Driller Log / Charge Sheets are viewed by the Blast Designer for anomalies (cavities, change in ground hardness). Information pertinent to loading is adjusted on the computer and a reprinted of the Driller Log / Charge Sheet is completed. On the bottom of the Driller Log

Charge Sheet are the vibration calculations which show the estimated vibration for up to 10 rows closest to the structure being measured and protected.

- The Blast Designer completes the Driller Log / Charge Sheet and gives it to WA Limestone Quarry Manager for approval to load and fire the blast. Once approved a copy is made and given to the Shotfirer so loading preparation can commence.
- A copy of the Blast Notification Sheet shall be distributed to all relevant personnel and contractors on site.
- A Blast Package Summary Sheet is used to summarise the blasting stages.

2.1.2 Loading Process:

- All holes will be re-dipped by the Shotfirer or person appointed for hole quality control.
- Before any holes are primed up, the Blast Controller must liaise with the WA Limestone Supervisor in charge to ensure blasting is still scheduled for the day. This is normally confirmed after the pre-start safety meeting.
- The Blast Controller will hand to the Shotfirer a copy of the signed off Blast Notification Sheet and a copy of the approved Driller Log / Charge Sheet. Loading will not commence until the Shotfirer has both documents in their possession.
- Once the pattern has been dipped, re-drilled where required, backfilled to design and recorded, the holes will be primed as per the Driller Log / Charge Sheet.
- Where wet holes are encountered, the backfilling of holes shall be carried out using crushed aggregate in place of localised drill cuttings.
- In the event that wet holes or cavities / broken ground is encountered the holes will be loaded with Emulsion based packaged product.
- The holes will be loaded to design charge weights and be checked using a stemming height dip stick (Stemming Stick) and recorded onto the Driller Log / Charge sheet. The design weight of explosives shall always be used / followed first for loading purposes but in the event that the designed charge height is reached before design weight, then loading of the hole will be terminated.
- Where cavities are encountered, the hole shall be bagged off above the cavity stemmed up 300-800mm of dirt to create a plug and loaded. This is dependent on the depth of the cavity and the number of cavities per hole.
- Any holes that are found to be overloaded when loading blast holes using the stemming stick for charge height control shall have the product removed or diluted. This can be achieved by pouring water down the hole until the required stemming height is reached.
- Where a hole has been primed and the primer has jammed in the hole within the height of the normal stemming column, the hole shall be stemmed up and an artificial burden shall be placed on top of the hole to a height that is greater than the normal designed stemming column to contain the energy released when the primer is initiated. Care must be taken to protect the signal tube when placing the artificial burden on top of the stemming.
- Once the pattern has been loaded and all charge weights and stemming heights / charge heights recorded, the pattern will be ready for stemming.
- 10mm crushed aggregate (10% of the blast hole diameter) will be used to stem the blast holes. When stemming the hole, the stemming material should be slowly poured / shovelled into the hole to reduce bridging the hole prematurely. Large rocks shall not be used as stemming material.
- To maintain zero fly-rock where required a minimum of 27 drill bit diameters will be used as the minimum stemming height to contain fly-rock. General blasting with no restrictions shall have the stemming heights brought up to 23-25-bit diameters of stemming height.

- Once the blast pattern is stemmed, it can be clipped / tied in as per the tie diagram on the Blast Design Proposal Sheet (Generic tie) or the tie-in set up by the Blast Designer using the drill plan which shows actual holes to be fired.
- There will be no pre-loading of blast patterns and sleeping shots overnight unless approved by the Construction / Registered Manager in which case a blast guard will remain on site until the blast is fired.

2.1.3 Blast Firing:

Note: Special attention needs to be given when clearing out the roadways and creeks areas for blasting. It is recommended that the WA Limestone Blasting Procedure be used. All old tracks not being used shall be barricaded off with a sizable windrow.

General Overview of Blasting Procedure
With a confirmed blast time set, the Blast Controller after complying with the agreed blast clearance and site approved:

- Position blast guards and blocks off and clears the blast zone area.
- Calls up each individual blast guard for confirmation that the road is blocked and area secured.
- Asks the shotfirer if the remote firer receiver is turned on. The shotfirer confirms this over the radio.
- The Blast Controller asks the shotfirer to commence the siren run.
- The Shotfirer carries out a siren run, goes back to a safe firing position.
- The shotfirer notifies the blast controller that they are in position and awaiting confirmation to initiate the shot.
- The blast controller completes the final call up of the blast guards and gives the shotfirer approval to arm the remote firer sender unit and fire the shot.
- The shotfirer arms the unit, makes a call on the radio “firing in 10 seconds” and initiates / fires the shot.
- Once the shot has been fired and fumes and dust have dispersed, the Shotfirer checks the shot and gives the all clear.
- If the shot has misfired and the misfire can be re-connected and fired safely within an acceptable time frame (15 minutes), the Blast Controller will give permission to re-fire the shot while all Blast Guards are still in place.
- Once the shot has been cleared and Blast Guards have been stood down and roads opened, the Blast Controller can pick up the video cameras, vibration monitor (where required), and remote receiver and inspect the blast.
- In the event that the misfire cannot be re-fired on the day the Shotfirer will barricade the shot and notify the Quarry Manager / Construction / Registered Manager as per misfire clearing procedures. The misfired blast will be guarded overnight by security to ensure that it is safe.

2.1.4 Blast Records:

- A Blast Performance Summary Sheet, which is designed to communicate information on items such as blast movements, blast events, dig rates, and final floors are handed to the relevant personnel to be completed. By using the blast monitoring sheet and the information gathered, blast patterns can be modified where required to promote better blasts in the future. Any deviation from design shall be noted on the applicable charge sheet or Blast Performance Summary Sheet.
- All blasts are mapped out on a blast master plan which shows how all blasts are situated in relation to each other for each individual work area.

2.2 FLYROCK MANAGEMENT

The control of fly-rock is essential when firing close to sensitive structures.

A summary of criteria for the control fly-rock for safe blasting are:

- There shall be no blasts fired to a free face unless adequate solid burden can be clearly identified.
- Blasts will be fired along the strike of the cutting and timed to pull the burden / rock away from the batters and drains. Blasts shall be fired into the blasted ground of the previous blast;
- Holes shall only be loaded to design charge weight or design stemming height, whichever comes first;
- Care will be taken when stemming not to bridge the hole and create unwanted fly-rock. The stemming which is shovelled out of a stemming bucket is slowly poured down the blast hole to prevent bridging;
- Holes that are bridged shall have an artificial burden placed on top of the blast hole;
- The stemming height will always be greater than the burden on confined and choked style blasting. As a general rule 25-27 x drill bit diameter will be the minimum stemming height for competent rock and up to 30 drill bit diameters if the surface rock is weathered, dilated or weak;
- When blasting close to structures or rail, the stemming ratio will be increased to 27-30-bit diameters to suit the rock type and hardness. Where required, an artificial burden of 300-500mm of fine fill dirt shall be placed on top of the proposed drill area by a dozer/ loader before drilling commences. The fill dirt will be watered in to help compaction. Holes will be loaded and stemmed to the natural surface only;
- Blast patterns will be designed to ensure that the timing between holes and rows promotes adequate burden relief;
- The depth of blast patterns shall be designed so the pattern length terminates before forward movement relief is lost. This will eliminate choking of the shot and minimise fly-rock through holes not cratering and venting;
- Timing on shots will be checked against the approved design tie to minimise holes firing out of sequence;
- Burden relief shall be kept above 20-25 milliseconds per metre of burden to ensure choking and unwanted cratering of blast holes is minimised;
- Overloaded holes shall have the excess product removed to design stemming height. Where the product cannot be removed, an artificial burden shall be placed on the hole;
- Hole location, depths, rock type will be accurately drilled and recorded;
- Pattern timing and direction will be such that the timing will give adequate relief away from sensitive structures.

2.3 BLASTING NEAR STRUCTURES

Where blasting is required and impinges on existing structures, special blasting techniques have been developed to minimise ground vibration to concrete structures.

A summary of criteria for the control of blast induced vibrations are:

- Blast designs shall be tailored around maximum instantaneous charge weights to help control charge weight fired per delay;
- Blasts shall be fired into a blasted choked face;

- Blasts shall be fired where possible in a direction that follows the natural dip of the rock;
- Timing shall be used to maximise inter-hole delays for the patterns being used;
- Holes shall be loaded as per the designed charge weight on the Driller Log / Charge Sheet;
- Hole location, depths shall be accurately drilled.

3.0 EXPLOSIVES USED

A commercial supplier provides explosives (i.e. blasting agents and accessories) to WA Limestone. WA Limestone also has a purpose built anfo/auger plant for explosive mixing.

3.1 Explosives Proposed

The types of explosives and accessories being provided are summarised in the following table:

Table 1: Types of explosives and accessories being used

Description	Order Unit (per)	Typical Use
Bulk Blasting Agent		
Ammonium Nitrate or pre-blended bulk emuslions/water-gels	9 tonne	Blast hole loading
Boosters/ Packaged Explosive		
Megaprime 150 gram	Case (96)	Blast hole priming
Maxidrive 65mm x 400mm	Case (17)	Blast hole priming
Megadrive 65mm x 300mm	Case (22)	Blast hole priming
Detonators		
4.8m x 67 ms Interdet	Case (150)	Down the hole detonator
4.8m x 42 ms Interdet	Case (150)	Down the hole detonator
4.8m x 25 ms Interdet	Case (150)	Down the hole detonator
15m Downhole Megadet	Case (50)	Down the hole detonator
Connectadet 67ms x 4.8m	Case (150)	Surface delay timing
Shockline	Case (1800m)	Signal Tube Initiation line

A description of equipment used in blasting, including blasting accessories, is contained in Section 10 “Equipment”.

3.2 Supply Contracts

The supply of Dynamic Drill and Blast products to WA Limestone is controlled by the WA Limestone contract. The formal contracts are required to ensure that the delivery of all explosives meets the WA Limestone safety requirements and that the supplied explosives are of a high quality and reliability of supply is essential.

3.3 Material Safety Data Sheets (MSDS)

All contracts to supply explosives include a requirement for the supplier to provide up-to-date Material Safety Data Sheets (MSDS) on all products. It is a "Duty of Care" obligation of suppliers of explosives to provide this information under Section 14 (4) of the WA *Mines Safety and Inspection Act 1994.*

Regulation 7.21 of the WA *Mines Safety and Inspection Regulations 1995* requires each responsible person at a mine is to ensure that MSDS are provided and made readily accessible to employees.

On site, the MSDS for explosive products are kept in the WA Limestone Office and a copy is also kept in the explosive accessory vehicle. WA Limestone maintains the MSDS.

3.4 Technical Data Sheets (TDS)

All contracts to supply explosive include a requirement for the supplier to provide up-to-date Technical Data Sheets (TDS) on all explosive products.

Copies of the Dynamic Drill and Blast TDS are kept in the WA Limestone Office and a copy is also kept in the explosive accessory vehicle.

The WA Limestone Site Supervisor / Blast Manager is responsible for ensuring that all TDS criteria are kept up-to-date.

4.0 OPERATIONAL RISK ASSESSMENT

A hazard identification process / Contractor Risk Assessment Workshop (CRAW) will be conducted for each work area / siding with regards to drilling and blasting hazards, including transport of the MPU between sites. This will be carried out on site before starting any work on site. Items of risk highlighted by the CRAW will be addressed before work starts.

Where a hazard is identified using the TAKE 5 system and general observations that is not covered in the Safe Work Procedure, a JHA will be conducted to determine the risk.

The JHA shall be complete by the Driller, Shotfirer, Crew and Supervisor for all activities of work on site. Completed JHA sheets are copied and handed in to the WA Limestone office for filing.

5.0 APPOINTED PERSONS

The Construction Manager / Registered Manager shall appoint a Quarry Manager responsible for drill and blast operations who signs each appointment.

A Quarry Manager, Blast Engineer / Blast Manager, Shotfirer and Magazine Keeper will be appointed to carry out the daily responsibilities. All appointed persons will carry out the responsibilities as assigned to them in section 6 of this plan.

The purpose of the appointed person protocol is to ensure a formal process exists for the appointment of statutory positions under the Mines Safety and Inspections Regulations 1995 and the Mines Safety and Inspections Act 1994. This will help ensure that all Managers and Supervisors are fully aware of their statutory responsibilities and that appointments are made in accordance with the WA *Mine Safety and Inspection Regulations 1995* and the Mines Safety and Inspections Act 1994.

5.1 List of Statutory Appointed Persons

To comply with Mine Safety and Inspection Regulations 1995, the following appointed persons have been established:

- Quarry Manager (Section 44 of the Mines Safety and Inspection Act 1994)
- Main Magazine Controller (Reg 8.6 of MSIR)
- Appointed Person / Shotfirer (Reg 8.12 of MSIR)

5.2 Location of Appointed Persons Information

A Copy of the “Appointed Persons form for Shotfirers and Magazine Keepers” can be found in the WA Limestone Safe Work Procedures.

Copies of appointed personnel can be found in the WA Limestone Training Folder.

6.0 RESPONSIBILITIES

Various responsibilities have been assigned to personnel at WA Limestone to help ensure the safe and efficient transport, handling, use and disposal of explosives.

Many of these responsibilities are contained within other documents. For example, most of the Explosives Safe Work Procedures contain specific responsibilities for operators involved in the use of explosives.

Employees will be trained in the various generic responsibilities and accountabilities under the requirements of the Dangerous Good Explosives regulations contained in this Explosives Management Plan.

6.1 Quarry Manager

The Quarry Manager is in charge of the magazine and must ensure that:

- The Explosives Management Plan (EMP) and all regulatory requirements contained within Part 8 of the WA *Mines Safety and Inspection Act 1995* are met; and
- Adequate resources are allocated and competent technical and operational personnel are appointed.

- All personnel involved in drill and blast operations on the project are properly trained.
- Unauthorised people are supervised at all times
- Any hazards that are sighted or reported are actioned upon
- Ensure appropriate inductions for the magazines are undertaken, including the appropriate training and duties related to maintaining the magazines and house keeping
- Shall liaise with all WA Limestone personnel in an open professional manner that promotes good communication between all parties concerned;
- Drilling plans are prepared using all available geological and technical information;
- Blasting plans (which set out blast guard locations) are developed using all available information, including survey and geotechnical input when required;
- All drill and blast plans are reviewed and properly authorised before being issued for implementation;
- Blast results are formally reviewed and any appropriate changes made to improve blasting effectiveness;
- The effectiveness of the EMP is reviewed at least annually or whenever significant changes are made (e.g. change in explosives supplier, change in blasting methods, incidents, etc) that are likely to impact employee safety or health;
- The information in the BMP is kept up-to-date and site personnel comply with responsibilities listed on the Appointed Person Form.
- Ensure that explosive usage and stock requirements are kept up to date to ensure that weekly stock-takes and inspection of the magazines are carried out by WA Limestone.

6.2 Drill and Blast Site Manager / Blast Manager

The Drill and Blast Site Manager / Blast Manager must ensure that:

- The BMP is implemented and complied with, and all the requirements are being met;
- Suitably trained and qualified persons are formally appointed to the positions of Magazine Controllers and Shotfirers;
- Up-to-date technical information on explosive products is available and included in drill and blast designs;
- All personnel involved in drill and blast operations on the project are properly trained;
- Any hazards that are sighted or reported are actioned upon;
- Drilling plans are prepared using all available geological and technical information;
- Blasting plans are developed using all available information, including geotechnical input when required;
- All drill and blast plans are reviewed and properly authorised before being issued for implementation;

- Blast results are formally reviewed and any appropriate changes made to improve blasting effectiveness;
- The effectiveness of the EMP is reviewed at least annually or whenever significant changes are made (e.g. change in explosives supplier, change in blasting methods, incidents, etc) that are likely to impact employee safety or health;
- The information in the EMP is kept up-to-date and site personnel comply with responsibilities listed on the Appointed Person Form.
- Ensure that explosive usage and stock requirements are kept up to date and will carry out a weekly stock take and inspection of the magazines.
- Standard Safe Work Procedures (i.e. “Best Practices and Safe Operating Procedures”) are implemented and work practices regularly monitored;
- Ensure that a Job Hazard Analysis (JHA) is completed for all work activities.
- Ensure that Take 5 Risk Assessments are completed at the start of every shift / new task;
- Suitable equipment is supplied and maintained to the specifications required for safe and efficient drilling and blasting;
- That all equipment, storage facilities etc. complies with the applicable requirements of the blasting standards and site personnel complies with responsibilities listed on the Appointed Person Form.
- **Note:** On small operations, the Site Manager may carry out the role of Blast Controller / Drill and Blast Engineer and Quarry Manager.

6.3 Drill & Blast Designer / Supervisor

The Drill and Blast Designer must ensure that:

- The BMP is implemented and complied with, and all the requirements are being met;
- They have the experience to design shots that will cover all requirements of the specifications that will ensure the protection of WA Limestone assets.
- Up-to-date technical information on explosive products is available and included in drill and blast designs;
- Drilling plans are prepared using all available geological and technical information;
- Blasting plans are developed using all available information, including geotechnical input when required;
- All drill and blast plans are reviewed and properly authorised before being issued for implementation;
- Blast results are formally reviewed and any appropriate changes made to improve blasting effectiveness;
- Blast patterns are designed to minimise fly-rock and reduce blast induced vibrations;
- Blast designs are planned in conjunction with site specification and meet production requirements;
- Ensure that explosive usage and stock requirements are kept up to date and will carry out a weekly stock take and inspection of the magazines

- Standard Safe Work Procedures (i.e. “Best Practices and Safe Operating Procedures”) are implemented and work practices regularly monitored;
- Suitable equipment is supplied and maintained to the specifications required for safe and efficient drilling and blasting;

6.4 Blast Controller

The Blast Controller must ensure that:

- Prior to setting the blast time, the blast controller shall check with the Shotfirer to ensure that the shot will be ready at the required time. This is to eliminate the need to hurry work on the shot. This will minimise the chance of something being missed that could create a misfire;
- Blast Guard locations are appropriately sourced along with appropriate training for all personnel involved with the firing and guarding of blasts;
- Ensure that all drill and blast documentation including video and monitoring records is backed up and stored;
- Inspect and coordinate Blast Guard locations for correct distances and location to the shot being fired;
- Carrying out the Blast clearance process and related procedures to ensure that no personnel are left inside the blast zone when firing.
- Liaise with and direct the Responsible Shotfirer in all matters relating to the safe initiation of the blast;
- Complete the Blast Controller Checklist for each blast.

These responsibilities apply to any person (e.g. Blast Supervisor / Blasting Engineer / Blast Superintendent) who undertakes Blast Controller responsibilities or who acts in a relief capacity.

6.5 Designated Shotfirer

The Designated Shotfirer must ensure that:

- They are appointed;
- They perform all duties in accordance with the role of an appointed person;
- All explosives are transported and stored according to the requirements of Part 8 of the Western Australia Mines *Safety and Inspection Act 1995* (MSIR)
- The drilling and blasting work sites and the travel ways are inspected and maintained to ensure employee safety;
- All blast areas are effectively checked and cleared prior to firing;
- Blast clearance and firing is done according to the approved firing procedures;
- Any hazards identified during blast clearance or firing are reported immediately to the Blast Controller;
- All appropriate Safe Work Procedures are understood by the relevant blasting personnel and followed;

- Ensure compliance to Safe Work Procedures to ensure so far as is practicable, the safest work environment possible at all times.
- All equipment used in the transport of charging and firing of explosives is properly checked prior to use and the Shotfirer complies with responsibilities listed on the Appointed Person Form**.**
- Direct supervision of equipment and co-ordination of labour to ensure that work is carried out in a safe and efficient manner;
- Carrying out of inspections in relation to management and authorising continuation of work where appropriate;
- The WA Limestone Site Manager is notified of any non-conformance associated with any aspect of the project;

6.6 Magazine Controller

There will be no storage of explosives on site. All explosives will be delivered and/or mixed on site for that day.

6.7 Employees

All employees involved in the transport, handling, use or disposal of explosives must ensure that:

- They are trained and approved to handle explosives;
- No drilling or blasting work is undertaken without an approved plan;
- No attempt is made to initiate any blast unless duly authorised;
- All appropriate Safe Work Procedures are understood and strictly followed;
- All equipment used in the transport of charging and initiating of explosives is properly checked prior to use;
- Every work site is inspected;
- A take 5 and JHA is carried out and signed on by all personnel involved in that task, and
- Any defects or hazards identified during equipment checks or inspections are reported immediately to the shift Supervisor.

7.0 HANDLING & TRANSPORT

The handling and transport of explosives on site is undertaken according to the WA Limestone Blasting Safe Work Procedures.

The process for handling and transporting of explosives, including precautions and special procedures is summarised in the following sub-sections:

7.1 Delivery to Site

All explosives delivered to site are the responsibility of the supplier or WA Limestone if producing/mixing own explosives. All delivery vehicles must comply according to the requirements of Part 8 of the Western Australia Mines Safety and Inspection Regulations 1995 (MSIR)

Only the Blast Manager can order explosives. All explosives ordered must be on the list of explosives section 3.1 of this EMP, which are approved for use.

The explosive delivery operator calls up at the security gate and carries out the visitor induction while they wait for the escort. The Shotfirer is notified by radio and them or an approved designated driver, escorts the delivery operator to the blast area. When escorting the explosive delivery truck, an announcement is made on the radio.

7.2 Handling & Transport of Explosives Following Delivery

All equipment used in the transport of explosives must comply according to the requirements of Part 8 of the Western Australia Mines Safety and Inspection Regulations 1995 (MSIR) and be fitted with appropriate signage and flashing lights to clearly identify its usage. Explosives shall be carried in approved containers e.g. package explosives in original cases, detonators are transported in a separate compartment on the explosive accessory delivery truck.

7.3 Handling & Transport of Explosives from Main Magazine to Charging Site

The explosives accessory vehicle, MPU truck / trailer shall have a pre-start check carried out prior to loading any explosives into the explosive receptacles. The Wilden PX-15 diaphragm pump for the ANE tanks will also have a pre-start check carried out prior to starting.

The Shotfirer will follow the approved route around site. Packaged explosives and accessories are picked-up from the delivery truck by the Shotfirer and Blast Crew and then transported to the blast site for charging.

Detonators and other blasting accessories are transported in separate “approved” containers fitted to the WA Limestone explosive accessory vehicle. All equipment is clearly identified as being used in the transport of explosives, and is fitted with appropriate signage and flashing light.

The explosive accessory vehicle which is used for the purpose of carrying explosives shall have the following features as well as having a current Western Australian vehicle licensed driver and current MR1 inspection (or equivalent):

- Explosives and detonators shall be transported in the approved portable magazine boxes secured on the rear of the vehicle. Explosive transportation boxes shall be marked with maximum load bearing capacity. (Explosives boxes are marked with “Maximum 250 kg” and detonator boxes are marked “Maximum 1000 detonators”). All explosives transport boxes are fully enclosed and adequately secure the load during transport.
- There is an internal gap lined with 75mm hardwood and double-sided plate that separates the explosives from the detonators.
- Brackets shall be fitted to the vehicle to allow display of the following signage:

1. "Class 1 diamond" placard front and rear
2. "Explosives" Front rear and both sides

- The general condition and maintenance of the explosives transport vehicle is monitored on a daily basis using pre-start inspection checklists, regular preventative servicing and maintenance and an annual MR1 inspection conducted by suitably qualified and endorsed personnel.

7.4 Bulk ANFO Explosive Delivery

Bulk Ammonium Nitrate is loaded into the MPU at the Ammonium Nitrate Emulsion Storage Facility which is located on site and transported to the shot. The Ammonium Nitrate is mixed at the shot to produce ANFO which is augured into buckets and poured down the blast hole to the designed quantity / stemming height.

7.5 Bulk ANE Explosive Delivery

Bulk Ammonium Nitrate is loaded into the MPU at the Ammonium Nitrate Storage Facility which is located on site and transported to the shot.

8.0 STORAGE

There will be no storage of explosives on site. All explosives will be delivered by WA Limestone to mix on site or by an approved contractor.

9.0 DISPOSAL OF EXPLOSIVES

Old stock nearing its shelf life date that cannot be used are returned to the manufacturer for destruction, in the event of deteriorated explosives, the disposal method will be risk assessed by the use of a Job Hazard Analysis Sheet (JHA) prior to carrying out the procedure. The JHA will be carried out by the Magazine Controller and / or Shotfirer.

The Notes for the Shotfirer Training Manual and Australian Standards 2187.2 – 2006 – Explosive – Storage, transport and use part 2 – use of explosives (appendix G & H) give procedures to follow for the destruction of old deteriorated or faulty explosives.

There will be no explosive products destroyed on site without the approval of the Registered Manager.

10.0 EQUIPMENT

The use of equipment that is well maintained is essential to help ensure efficient and safe drilling and blasting practices.

The type of equipment used for transporting and handling explosives is undertaken according to the specific requirements on site.

The types of equipment in use and details of the respective maintenance programs are included in the following sections.

10.1 Main Equipment Used

The type of equipment used in drilling and blasting operations are listed in Table 2.

Table 2: Type of equipment used in drilling and blasting operations

Equipment Type	Equipment Model
Drill Rig	Komatsu PC400
Supervisor Vehicle	Toyota Hilux Utility
Explosive Accessory Vehicle	Toyota Land Cruiser 4wd
Driller / Fitter Vehicle	Toyota Land Cruiser 4wd
Loader for stemming	Cat 988 Loader

The maintenance requirements of this equipment are given in Section 10.2 of the EMP.

10.2 Maintenance Program

10.2.1 Special Maintenance Precautions

Prior to commencing work on any equipment used to transport or handle explosives:

- The equipment must be shut down and properly parked;
- All explosives must be removed (i.e. “sterilised”) and the vehicle washed (A Site Hot Work Permit shall be used);
- A “Hot Work Permit” completed for any welding, cutting or burning; and
- An inspection must be conducted to ensure that the equipment is safe to work on, including proper isolation and tag-out.

These precautions must be included with any maintenance or inspection checklists.

10.2.2 Inspection & Testing

The inspection and testing of equipment used in the transportation and handling of explosives are the responsibility of the WA Limestone Site Supervisor / Manager. A pre-start inspection of the explosive accessory vehicle will be carried out at the start of every shift.

10.2.3 Preventive Maintenance

The MPU shall be serviced monthly or every 250 hours, whichever comes first. Any defects found on the daily pre-start check sheet shall be fixed immediately. The MPU will be kept clean at all times. The on-site mechanic shall keep a record of the maintenance schedule and ensure all machine / unit services are completed in a timely manner. The servicing program and the critical equipment for the MPU is identified in the operations manual, which is mandatory for all maintenance personnel to have read prior to working on the MPU.

The maintenance schedule will be complete as per the manufacturer’s specification; the qualified mechanic will carry out all maintenance on the trailer. Daily inspections will be carried out by the competent operator before using the trailer. A maintenance register of any work carried out on the trailer will be kept in the site office and kept up to date daily. The quarry manager or appointed shotfirer will carry out weekly inspections on the equipment also.

11.0 BLAST DESIGN PARAMETERS

The blast design parameters used have been determined through a combination of previous practical experience in blasting and input from technical experts.

The blast design parameters are contained in the Blast Design Proposal Sheets and Blast Master Plans.

The WA Limestone Site Manager will determine these blast design parameters through consultation and assessment of the effectiveness of blast designs previously used throughout the company's quarry operations

12.0 PROCEDURES

The development of Safe Work Procedures (SWP's) is undertaken to ensure a standard is maintained that allows the continuous safety of personnel and plant while achieving a satisfactory outcome with regards to productivity.

The SWP's have been developed using input from industry best standards and techniques. Input from both management and operational personnel continuously keep the SWP'S current to work tasks. To date, SWP's have been developed to cover all perceivable aspects of drilling and blasting.

13.0 SIGNS & GUARDING

13.1 Drilling Signs

The signage and guarding of drill areas is undertaken according to the WA Limestone SWP;

These procedures detail a safe and systematic process for barricading areas within the work area, using a standard set of signs.

13.1.1 DANGER – Drilling in Progress – Keep Out

When a pattern has been marked up and barricaded using Yellow Traffic cones, the shotfirer will place the signs "DANGER – Drilling in Progress – Keep Out" every 30m along the perimeter of the pattern.

13.2 Blasting Signs

The signage and guarding of drill areas is undertaken according to the WA Limestone SWP;

These procedures detail a safe and systematic process for barricading areas within the work area, using a standard set of signs.

They have been implemented to help ensure compliance with the following standards and statutory requirements:

- Regulation 8.26 "Firing warnings – Surface mining operations" of the WA Mines Safety and Inspection Regulations 1995.

The following signs are used to control charging and firing operations.

13.2.1 DANGER - Explosives - Keep Out

This sign must be installed when charging is in progress (it shall be erected a minimum of 8 metres from the charging equipment or charged hole) and is used to barricade all entrances to the blasting area.

Blast signs "Danger – Explosives - Keep Out" will be placed 8.0m from the charged shot and placed no greater than 30m apart. On prominent used vehicle track foot prints a blast sign shall be placed between the traffic cones but in the centre of the track.

The "Danger – Explosives - Keep Out" signs are also placed in conjunction with the yellow traffic cones around the explosive vehicle. This is to create an 8.0m exclusion zone around the explosive vehicle when it is carrying explosives on board.

Barricades and signage will control the guarding of shots. The yellow traffic cones (barricades) will be placed 8.0m from the charged shot and placed no greater than 10m apart on faces where vehicles cannot access. On accesses where vehicles can access the blast, the yellow traffic cones shall be close enough to prevent a vehicle from accessing the pattern.

The Shotfirer is responsible to ensure that a "Danger – Explosives - Keep Out" sign is erected whenever the explosive vehicle is parked on site while carrying explosives on board and when charging. The sign remains in place whenever charging is being undertaken and kept in place until the work area is cleared after firing.

13.2.2 DANGER – Blasting in Progress – Keep Out

The "DANGER – Blasting in Progress – Keep Out" sign when used in conjunction with the yellow traffic cones on a blast guard location indicates that access to the area is prohibited while blasting initiation procedures and the firing of the blast is being carried out. This sign is erected at road blocks at a minimum distance of 700m from the blast area to be fired. In addition to the signs and traffic cones, sentries are posted at all road blocks.

The Designated Blast Controller is responsible to ensure that the "DANGER – Blasting in Progress – Keep Out" signs are installed. This is done by means of a visual and radio check with the Blast Guards.

The Designated Blast Guard is responsible to ensure that personnel do not enter beyond the "DANGER – Blasting in Progress – Keep Out" sign at any time. The Designated Blast Guard is authorised to remove this sign after permission to stand down has been given from the Blast Controller.

The generic procedure for setting up blast guard positions are contained within WA Limestone Safe Work Procedures.

In the event that a blast is not fired:

- The initiation device shall be removed;
- The shot shall be un-clipped:
- Flashing lights / bunting / tape will be placed along the barricades to highlight a "Sleeping Shot".
- A Security / Blast Guard shall watch over the loaded shot:
- The Registered Manager and Quarry Manager shall be notified.

14.0 FIRING

14.1 Signal Tube Initiation

Signal tube initiation will be conducted as per WA Limestone Safe Work Procedures.

14.2 Blast Control Procedure

The procedure to safely guard and fire a blast can be found in WA Limestone Blasting Safe Work Procedures. The Blast Controller is responsible for all aspects of guarding and firing of the blast.

14.3 Firing Board Specification

All blast boards must contain on the board;

- Date
- Day
- Firing Time
- Blast Location / Chainage

14.4 Normal Firing Times

Blasting will occur between 08:00hrs and 17:00hrs, Monday to Friday as per Part 6 (3) (c) Extractive Industries Local Law 1998. There will be no blasting on the weekend without prior approval from the City of Wanneroo.

14.5 Designated Blast Controller & Sentries

The Blast Manager / Blast Controller are appointed personal who will be responsible for authorising the shot to be fired and for ensuring the blast areas are cleared before firing.

The Blast Manager will organise designated Blast Guards. These persons must be trained and deemed competent to act as sentries. The designated blast guards, Shotfirer and crew will have their names recorded on the Blast Controllers procedural checklist. All appointed blast guards shall be recorded on the Blast Guard Appointment Register.

Only the Appointed Shotfirer is permitted to initiate a charge following authorisation from the Blast Controller.

14.6 Firing Procedures

For full details of the process for firing refer to WA Limestone Procedures.

14.7 Misfires

The treatment of misfires is undertaken according to the WA Limestone Blasting Safe Work Procedures. As per the blasting procedure, the Construction / Registered Manager shall be notified of the misfire and an entry shall be recorded in the Mines Record Book.

15.0 COMMUNICATIONS

Effective and reliable communications is essential for safe and efficient blasting. This not only includes the communications systems used at the work site, but also the process for investigating explosives-related incidents and communicating important information to both site employees and site operations.

A document-controlled process to control the issuing, distribution and updating of all drilling and blasting documentation is also important to ensure accurate information is provided to relevant personnel.

The following sub-sections provide an overview of the communications systems and processes in place.

15.1 Work Area Radio System

All radio communications will be carried out on UF 12. Paramedic/emergency will also utilize UHF 12.

15.2 Drill & Blast Plans

As previously described in Sections 2 and 11, the WA Limestone Drill and Blast Manager will develop drilling and blasting plans for issuing to drilling and charging operators. This will be discussed verbally on-site issues and then by means of the following:

The process of developing drilling and blasting plans is;

- The WA Limestone Drill and Blast Manager will develop a draft Blast Design Proposal Sheet.
- Any changes to the approved design must be re-signed by the all parties concerned.

15.3 Task Assignment

The Blast Manager assigns employees involved in drilling and blasting operations their tasks at the start of each shift by passing out copies of drill and blast plans and verbally discussing with the employees how the tasks are to be carried out.

15.4 Explosives Incident Reporting

All employees are required to report all incidents, including those involving the transport, storage, handling, use or transport of explosives, to their Shift Supervisor.

All incidents / damage involving explosives are considered as “Serious Potential Incidents” or “SPIs”. They are also considered as “reportable” incidents under Section 79 (“Manager to report potentially serious occurrences”) of the WA Mines Safety and Inspection Act 1994. All explosive incidents shall be recorded in the Mine Record Book.

15.5 Incident Reporting

- All incidents will be brought to the attention of WA Limestone Management as early as possible after the event.
- WA Limestone has procedures and systems in place to communicate details of incidents and hazards throughout the organisation. All incidents will be reviewed in an open forum during pre-shift meetings.
- WA Limestone will ensure that all relevant parties are available to participate in the investigation of any incident involving explosives.
- WA Limestone as part of our procedures is to report all incidents involving explosives to the DMIRS Chief Officer and Police.

16.0 TRAINING

All employees shall receive an induction prior to coming to site. Once on site a site-specific induction and “Explosive Workshop” (administered by the registered Quarry Manager on the site) is undertaken to highlight the operation requirements and safety standards that are required while working on site. Employees will be trained in the various generic responsibilities and accountabilities under the requirements of the Dangerous Good Explosives regulations contained in this Explosives Management Plan.

The training of operators in the transport, storage, handling, use and disposal of explosives is undertaken through the use of Safe Work Procedures. The WA Limestone Drilling and Blasting Safe Work Procedures are given to the employee to read and sign off on.

All Shotfirers involved with the handling of explosives shall be the holder of a Western Australia Shotfirers Permit. This will ensure that all explosive handlers comply with statutory requirements:

Blast crew shall be tested via Questionnaires on core Safe Work Procedures to ensure that they have the knowledge to handle explosives.

- Regulation 8.12 “Users of explosives or blasting agents must be competent” of the WA Mines Safety and Inspection Regulations 1995.

Training the operator to use the MPU trailer will be completed as per the training manual supplied by the manufacturer. All training will be carried out by the registered quarry manager or his appointed person on site. Competency assessments will be carried out on all appointed personnel who will be operating the trailer.

The above training will take approximately 3 days to complete, and records of their completion are stored on the WA Limestone training matrix.

17.0 SECURITY

The security of explosives is primarily achieved by restricting access and allowing access to explosives ONLY to authorised persons only. These authorised persons are the Quarry Manager, Blast Engineer / Blast Manager, Shotfirer and Magazine Keeper. All other personnel MUST be escorted by an authorised person at all times.

- **Vehicles and Explosive Compartments on the vehicles;** containing explosives are required to be locked while they are being left unattended.
- **Keys;** all padlock keys used on vehicle explosive compartments have registered numbers and are have a unique one locksmith template.

No persons other than those directly engaged in the use of explosives have access to the bomb delivery truck without being escorted at all times. The escort must be from that who is an authorised person. These authorised persons are the Quarry Manager, Blast Engineer / Blast Manager, Shotfirer.

Deliveries to site are made by approved delivery drivers but must also be escorted by an authorised person.

All explosives used are counted and checked against the Drill Design Proposal Sheet, Drill log / Charge Sheet, Blast Performance Summary Sheet and Explosive Shipping Document for correct usage.

All HR records are maintained at the WA Limestone Head office. These records contain identification, names and addresses of personnel employed to work at the Byford quarry site.

18.0 EMERGENCY PREPAREDNESS

Emergency situations including those involving explosives are managed according to the site emergency plan. In the event of an emergency contact shall be made by calling Mayday, Mayday, Mayday on the following radio channels UHF 12.

MSDS sheets which contain the site emergency contact number, technical adviser details and all relevant product information shall be available in the WA Limestone Site Office and the Shotfirers explosive accessory vehicles.

located so that any such fire or explosion has minimal impact on the safety and health of personnel within the work area or mine operations.

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19.0 REVIEW

In order to ensure that the information contained within the Explosive Management Plan continues to form the basis of industry best practices an annual review will be completed.

The annual review will include an evaluation of the security risk assessment (Attachment 2).

This will be scheduled on WA Limestone management system data base to ensure the task is officially delegated and completed.

20.0 INSPECTION

Regular Inspections will form part of the management system and focus on accessing the level of compliance associated with the transport, storage, handling use and disposal of explosives.

21.0 REFERENCE INFORMATION

The following is a list of other documents that contain information relevant to the management of explosives:

- Australian Standards – AS 2187.2 – 2006. Storage and use – Part 2: Use of Explosives
- Australian Standards – AS 2187.1 – 1998-Explosive Storage and transport Part 1: Storage
- Western Australian Notes for the Shotfirer
- Western Australian Mines Safety and Inspection regulations 1995
- Western Australian Mines Safety and Inspection Act 1994
- Western Australian Dangerous Goods Act 1961
- Western Australian Dangerous Goods Act 2004 - Dangerous Goods Safety (Security Sensitive Ammonium Nitrate) Regulations 2007

22.0 CURRENT STATUS

The site is currently under care and maintenance, while the transfer of land titles and various statutory approvals has been taking place, with the intention to recommence activities in late 2020.

The site survey (Attachment 1) was completed in October 2018 to show areas of previous activity and current ground contours, in particular the depth of excavations to date. This image provides detail of the various areas used for quarrying activities, including:

- excavation - open pit
- hardstand area - for crushing/processing activities
- laydown and storage area - for the storage of associated plant and equipment
- tracks - internal access roads

Figures 3 and 4 below are photos taken recently onsite.

Figure 3. Hardstand Area

Figure 4. Excavation pit

23.0 FUTURE WORKS PROGRAM

WA Limestone intends to develop and operate the site in 2020. No changes to operations are proposed at this time and all ongoing future works will be undertaken in accordance with:

- Planning Approval - Extractive Industry, DA2013/663
  City of Wanneroo
- Extractive Industry Licence
  City of Wanneroo
- Approval to Commence Development - Extractive Industry, Limestone
  WA Planning Commission
- Extractive Industries Local Law 1998
  City of Wanneroo
- Prescribed Premises Licence (Licence No. L8605)
  Department of Water and Environmental Regulation
- Vegetation Clearing Permit (Permit No. CPS 4924/2) (as amended)
  Department of Water and Environmental Regulation
- All other relevant legislative requirements where applicable

The Compliance Table in Appendix 1 provides detail for each condition of the Planning Approval for the site.

As outlined above, WA Limestone is an experienced operator of limestone quarries in the Perth area. Wattle Avenue Quarry will be managed and operated in accordance with the company's ISO 14001 accredited Environmental Management System which assists in ensuring that all statutory approvals and legislative requirements are monitored and complied with on an ongoing basis.

24.0 ACCESS AND FENCING

To date access to the site has been from Wattle Ave East as per the Development Approval (DA2013/663) advice note No.3. The first 100 metres of the access road from the intersection on Wattle Avenue East has been sealed with bitumen. Furthermore, widening plans for Wattle Ave East have been completed.

The Wattle Ave West upgrade will be completed by September 2020. The upgrade works to Wattle Ave West will be undertaken in accordance with the City's Extractive Industry. PMR Quarries intend to construct the upgrade according to the geometric road layout plans approved by the City 30 June 2009 (File Ref: R24/0008V01 (817711).

Suitable boundary fencing is in place on the western boundary of the site (see figure 6). The southern boundary was recently surveyed to install a new fence to an extent indicted on the fence site plan (to be installed early 2020), existing armour rock will also be maintained as a secondary barrier along this boundary line (figure 7). As shown on the photos labelled north boundary (figure 8), it is evident that a thick buffer of vegetation restricts access including a wall of armour rock, similarly, to the north east and eastern boundary dense vegetation with large scattered naturally occurring limestone rocks will inhibit access from vehicles and pedestrians. It is worth noting any fencing installation to the north,

north east and eastern boundary would require unnecessary clearing of good quality native vegetation.

Figure 5 – Site Boundary

Figure 6 confirms the existing fence on the western boundary is in place and adequate for its purpose (photo taken 3 December 2019).

Figure 6 – Western Boundary Fence

Figure 7: Southern boundary fence survey peg.

The North boundary of the site is shown in the below figures, a thick buffer of vegetation and a high wall of armour rock will prevent access from pedestrians and vehicles.

Figure 8: Northern boundary – photo taken facing south

Figure 9: Northern boundary – photo taken facing north

Figure 10: Dense vegetation extends from the north east –east boundary

25.0 ENVIRONMENTAL IMPACTS

25.1 GROUND VIBRATION AND AIRBLAST OVERPRESSURE.

WA Limestone commissioned a comprehensive operational noise study for Lot 8 Wattle Avenue for the Development Application. Blasting was not included in the assessment as air blast over pressure and ground vibration can be extremely variable in nature due to the composition of the rock, type of explosive used, blast pattern and atmospheric conditions at the time of blast. It can be difficult to accurately model the affects of blasting due to these variabilities. The operational noise study concluded that the Quarry would comply with the *Environmental Protection (Noise) Regulations 1997*

WA Limestone will ensure all blasting is in accordance with Australian Standard AS2187.2- 2006 Explosive Storage and Use and the *Environmental Protection (Noise) Regulations 1997* which detail monitoring considerations and allowable noise levels and ground vibration during the hours of operation.

WA Limestone will ensure all records of blasting operations are kept in accordance with Australian Standard AS2187.2- 2006 Explosive Storage and Use. At a minimum this includes the blast location, blast geometry, the explosives loaded, the initiation design and location of any man-made or natural structures which may be affected by the blast.

25.2 DUST

Drilling and blasting can result in generation of dust depending on the nature of the material being blasted and the current environmental conditions. During blasting the prevailing wind conditions will be considered in conjunction with blasting activities that day and the location of the nearest sensitive receptor.

Appendix 1 Site Survey


EDGE OF CLEARING
LIMESTONE EXCAVATION PIT
LIMESTONE ROAD
EDGE OF CLEARING
Lot 8
54.18ha
Site Survey
Wattle Avenue (West) Quarry
Lot 8 Wattle Avenue West, Nowergup
DATE: 25 October 2018
DATUM: GDA 1994 MGA Zone 50 / AHD
W.A. LIMESTONE
NORTH
Scale at A3: 1:1,500

Appendix 2 Compliance Table

CITY OF WANNEROO PLANNING APPROVAL: EXTRACTIVE INDUSTRY - LOT 8 WATTLE AVENUE, NOWERGUP

REF: DA2013/663

Commencement Date: 31 January 2014; Expiry Date: 31 January 2024

Condition No.	Condition	Management Strategy	Actions undertaken previously	Actions proposed for future activities
1	Subject to the following paragraphs (a) and (b), this approval shall be for a total period of 10 years expiring on 31 January 2024, consisting of two consecutives five year periods from the date of issue.	• City's approval currently being sought to continue activities onsite for the second five year approval period, to 31 January 2024.	• None to date (by current landholder, WA Limestone).	• Future ongoing Planning Approvals to be applied for as needed.
1 a)	At least 12 months (but not more than 18 months) prior to the end of the first five year period of this approval (expiring on 31 January 2019), the landowner shall submit to the City of Wanneroo a report (Compliance Report) outlining compliance with the conditions subject to this approval.	• This Compliance Report is provided to meet the requirements of this condition.	• NA	• Future reporting requirements to be completed in accordance with Planning Approval conditions.
1 b)	With the aid of the Compliance Report (referred to in (i) above), the City shall within six months of receiving the Compliance Report, review the landowner's general compliance with these conditions (including compliance with any associated plan, permit or direction). If the Compliance Report is found to be satisfactory, or if the City does not complete a review within six months of receiving the Compliance Report, the second five year period of this approval will commence from the later date of either: • the expiry of the first five year period; or • the date 6 months from when the Compliance Report is submitted.	• This Compliance Report is provided to meet the requirements of this condition.	• NA	• Future reporting requirements to be completed in accordance with Planning Approval conditions.
2	Should the City form the view that the Compliance Report is not satisfactory or that the landowners compliance with these conditions is unsatisfactory, then the second 5 year period referred to in condition (1) above will not commence and all structures, plant, machinery, equipment and other material erected on the subject site shall be removed no later than 31 July 2016 (*date 5.5 years from approval*).	• Liaise with City with regard to the Compliance Report to ensure all requirements are fulfilled.	• NA	• Maintain ongoing communication with the City to meet all reporting and compliance requirements.

Condition No.	Condition	Management Strategy	Actions undertaken previously	Actions proposed for future activities
3	Notwithstanding conditions (1) and (2) above, if the development the subject of this approval is not substantially commenced within a period of 24 months from the date of approval, the approval shall lapse and be of no further effect. Where an approval has lapsed, no further development shall be carried out without the further approval of the City having first been sought and obtained.	• Development has substantially commenced.	• Site developed in accordance with relevant approval conditions.	• All future development onsite in compliance with conditions of Planning Approval.
4	Unless alternative hours are agreed to in writing by the City, the hours of operation for the approved development shall be as follows: a) Crushing shall be limited to 0700 - 1700 hours, Monday to Friday (excluding public holidays); b) Loading and movement of trucks into and out of the Site shall be limited to 0700 - 1700 hours, Monday to Friday and 0700 - 1200 on Saturday (excluding public holidays); and c) Clearing, establishment, excavation works and all other operations not referred to in paragraphs (a) and (b) shall be limited to 0700 - 1700 hours, Monday to Friday and 0700 - 1200 on Saturday (excluding public holidays). If at any time compliance with the *Environmental Protection (Noise) Regulations 1997* cannot be maintained; the operations on site shall immediately cease until such time that operations can comply with the aforementioned Regulations and (a) to (c) above.	• Operations conducted in accordance with approved Management Plans.	• Noise management strategies implemented by previous operator. • Not aware of any previous complaints received in relation to noise.	• Compliance with operational hours stated in this condition.
5	Within 3 months from the date of this approval (or an alternative time as agreed to in writing by the City), a revised Program and Operation Management Plan, Environmental Management Overview and Rehabilitation and Decommissioning Management Plan shall be submitted for endorsement by the City to supersede those previously provided. The revised Program and Operation Management Plan, Environmental Management Overview and Rehabilitation and Decommissioning Management Plan shall incorporate all additional plans and information required by the conditions outlined in this approval.	• Operations conducted in accordance with approved Management Plans.	• Operations conducted by previous operator.	• Management Plans are reviewed on a regularly basis to align with WA Limestone's (WAL's) ISO accredited Environmental Management System. • Operations conducted in accordance with approved Management Plans.

Condition No.	Condition	Management Strategy	Actions undertaken previously	Actions proposed for future activities
6	Development on the subject site shall comply in all respects and at all times with the Program and Operation Management Plan, Environmental Management Overview and Rehabilitation and Decommissioning Management Plan (appended to this approval) and the conditions of this approval. In the event of any inconsistency between these conditions and the Management Plans, the conditions of Planning Approval will prevail to the extent of any inconsistency.	• Development and operations conducted in accordance with approved Management Plans.	• Operations conducted by previous operator.	• Management Plans are reviewed on a regularly basis to align with WAL's ISO accredited Environmental Management System. • Operations conducted in accordance with approved Management Plans.
7	The approved extent of the development is denoted by the solid black line shown on the 'Disturbance and Excavation' plan prepared by Aurora Environmental (drawing dated 30 October 2013 attached to this approval) (Disturbance Area).	• Development of site to occur within area defined on the approved *'Disturbance and Excavation'* plan.	• Development of the site has occurred to date within the area defined on the approved *'Disturbance and Excavation'* plan.	• Site development and operations in accordance with approved Management Plans.
8	The mining sequence shall be in accordance with the 'Notional Mining Sequence' plan prepared by Aurora Environmental (drawing dated 30 October 2013 attached to this approval) and comprises a maximum footprint (Development Footprint) at any one time, of one Mining Sequence Boundary area (denoted by the solid black line) unless agreed to in writing by the City. Relative to this condition, Development Footprint shall mean the area under excavation at any given time, where works are occurring to extract, grade, stockpile, process and otherwise handle the earthwork material, but shall exclude the access road into the Disturbance Area and other areas formerly comprising the Development Footprint, but which have since or are now undergoing rehabilitation, revegetation and/or re- contouring to achieve the approved finished contour levels.	• Excavation works to be planned and undertaken in accordance with the *'Notional Mining Sequence'* plan dated 30 October 2013 (attached to the Planning Approval).	• Excavation works to date have occurred within the 'Year 0-5' area as indicated on the *'Notional Mining Sequence'* plan.	• Site development and operations in accordance with approved Management Plans.
9	The intended depth and direction of excavation and extent of rehabilitation shall be in accordance with condition 1 of this approval and shall be consistent with the indicative finished level contour shown on the 'Indicative Finished Level' plan prepared by Aurora Environmental (drawing dated 15 May 2013 attached to this approval). Finished contour levels shall be coordinated with surrounding areas.	• Excavation depth and the extent of rehabilitation works to be planned and undertaken in accordance with the *'Indicative Finished Level'* plan dated 15 May 2013 (attached to the Planning Approval).	• Excavation to date has been in accordance with approved plans.	• Site development and operations in accordance with approved Management Plans.

Condition No.	Condition	Management Strategy	Actions undertaken previously	Actions proposed for future activities
10	The Disturbance Area shall be progressively rehabilitated when final contour levels and grades for each stage are achieved and within 18 months of the closure of each sequence referred to in condition 8, with such rehabilitation being in accordance with the Rehabilitation and Decommissioning Management Plan.	• Rehabilitation works to be completed within 18 months of the closure of each sequence, in accordance with the requirements of the *Rehabilitation and Decommissioning Management Plan*.	• No areas completed or available yet for rehabilitation works.	• Site rehabilitation works in accordance with approved Management Plans.
11	Notwithstanding anything contained within a submitted Management Plan: (a) no excavation is to occur within 4 metres of the winter maximum groundwater level, as will be determined using the bores described at condition 27; and (b) excavation is not to continue if at any stage it becomes reasonably apparent to the landowner or to the City that to proceed would be detrimental to below ground karstic features on the Site.	• No excavation within 4 metres of the maximum groundwater level or if risk to karstic features becomes known.	• Refer to attached Site Survey. • No evidence of Karstic features.	• Excavation to be monitored by regular site surveys.
12	With exception of vehicular access and revegetation, all operations relating to this approval shall be confined within the Disturbance Area. No other areas of the site shall be utilised in a manner subject to this approval without the further planning approval of the City.	• All operations to occur within approved disturbance areas in accordance with approved plans.	• Refer to attached Site Survey.	• Future operations conducted in accordance with approved Management Plans.
13	A perimeter security fence, to an appropriate standard sufficient to prevent sheep and livestock entry and restrict vehicle and pedestrian access to the site shall be constructed prior to commencement of any works.	• Suitable boundary buffers, barriers fencing and gates to be maintained to prevent access to the site for livestock, vehicles and pedestrians.	• Refer to Section 24 'Access and Fencing' of this Compliance Report for details	• Site to be made secure in accordance with the requirements of the *Mine Safety and Inspection Act 1994.*
14	All ancillary facilities, such as (but not limited to) ablution and lunchroom facilities shall be provided on the site prior to the commencement of operations, to the satisfaction of the City.	• Suitable facilities to be provided for staff in accordance with the City's *Health Local Law 1999* and other relevant requirements when the site is operational.	• Staff facilities not currently provided as the site is not operational.	• Facilities are provided on an adjoining site operated by WAL and will be available at all times while this site is operational.
15	Upgrading of Wattle Avenue, and its extension to Lot 8, is to be designed constructed and maintained to the satisfaction of the City.	• Upgrade to commence once all necessary approvals, design and engineering plans are agreed.	• Refer to Section 24 'Access and Fencing' of this Compliance Report for details	• Wattle Ave will be upgraded in accordance with the City's requirements late 2020.

Condition No.	Condition	Management Strategy	Actions undertaken previously	Actions proposed for future activities
16	Access to the site shall be from Wattle Avenue, where indicated on the site plan, once condition 15 is satisfied, via a sealed crossover designed and constructed to the City's specifications.	• Subject to future design and approval.	• To date access to the site has been from Wattle Ave East, engineering plans for Wattle Ave East have been submitted to the City's Engineering Department who support the proposed widening design. Construction of the Eastern upgrade is planned to be completed by late 2020.	• The Wattle Ave West upgrade to access Lot 8 can commence when the necessary Extractive Industry licence to operate is approved and design and engineering plans are satisfied by both parties. The upgrade works to Wattle Ave West will be undertaken in accordance with the City's requirements late 2020.
17	With regard to condition 16, the first 100 metres of the access road from the intersection with Wattle Avenue shall be sealed in bitumen, with the remainder of the access road being constructed to ensure dust emissions from machinery and traffic are minimised.	• Subject to future design and approval.	• To date access to the site has been from Wattle Ave East, the first 100 metres of the access road from the intersection on Wattle Avenue East has been sealed with bitumen. Furthermore, engineering plans for Wattle Ave East have been submitted to the City's Engineering Department who has confirmed support of the proposed widening design. Construction of the Eastern upgrade is planned to be completed by late 2020.	• If required upgrades to the access road to be considered, however dust emissions are managed more effective by an on-site water cart and traffic speed • Maintain 100m of road seal, as required.
18	Once access is gained from Wattle Avenue in accordance with condition 16, the haulage route for all trucks entering and leaving the site shall be via Wattle Avenue.	• Access to site from Wattle Ave when required.	• To date access to the site has been from the east therefore upgrade works to Wattle Ave have not yet been required.	• When access from the west is proposed, upgrade works to Wattle Ave will be undertaken in accordance with the City's requirements late 2020.
19	The City may deem, at any time, that operations on the site are generating an unreasonable amount of dust or that the operations are not compliant with condition (6) above. Should that occur, the Manager Planning Implementation may direct in writing that: (i) An amended dust management plan be submitted and endorsed; or	• Condition noted • Dust control measures to be implemented in accordance with approved Management Plans.	• Dust control strategies implemented by previous operator. • Not aware of any previous complaints received in relation to dust.	• Dust control measures will be implemented in accordance with the approved Management Plan and in accordance with WAL's ISO accredited EMS.

Condition No.	Condition	Management Strategy	Actions undertaken previously	Actions proposed for future activities
	(ii) The activities on the site are brought into compliance with this approval.			
20	Any cutting, grinding, chipping or mulching of trade waste vegetation to be utilised for soil stabilisation or dust suppression on the site shall at all times occur within the Disturbance Area. Unless agreed to in writing by the Manager Planning Implementation, trade waste vegetation not utilised on the site shall be disposed of at a landfill site that is in the opinion acceptable of the Manager Planning Implementation.	• Waste vegetation to be processed within approved disturbance area and utilised onsite for stabilising soil or supressing dust where possible. • Disused vegetation material to be stored or disposed of in an approved manner.	• Waste management implemented by previous operator. • There appears to be no significant accumulation of waste material onsite.	• Waste management measures will be implemented in accordance with the approved Management Plan and in accordance with WAL's ISO accredited EMS.
21	The proponent shall plant a line of appropriate vegetation along the western boundary of the subject site to provide a visual barrier between the subject site and the adjoining dwelling to the satisfaction of the Manager, Planning Implementation. This vegetation must be maintained for the life of the approval.	• Revegetation to be undertaken in accordance with approved Management Plan and regulatory approvals.	• Established vegetation exists along the western boundary.	• Ongoing monitoring and maintenance of vegetation.
22	The landowner shall ensure that all approved activities in accordance with the noise management, suppression and mitigation measures contained in the Noise Management Plan and ensure that the requirements of the Environmental Protection (Noise) Regulations 1997 are complied with at all times.	• Management of noise in accordance with the approved Management Plan and *Environmental Protection (Noise) Regulations 1997*.	• Noise management strategies implemented by previous operator. • Not aware of any previous complaints received in relation to noise.	• Noise management measures will be implemented in accordance with the approved Management Plan and in accordance WAL's ISO accredited EMS.
23	Within three months from the commencement of excavation, the landowner shall construct bunds and/or 'excavation walls' are constructed where required to ensure noise emissions satisfy the requirements of condition (22) above.	• Implementation of noise management strategies as required in accordance with the approved Management Plan.	• Noise management strategies implemented by previous operator. • Not aware of any previous complaints received in relation to noise.	• Noise screening bunds will be created where required to meet this requirement.
24	Crushing and all activities associated with reconstituted limestone block manufacturing shall only occur in the Extraction Area, which shall be shielded by one or more of the following:	• Implementation of noise management strategies as required in accordance with the approved Management Plan.	• Noise management strategies implemented by previous operator.	• Noise screening bunds and other noise management strategies will be utilised where required to meet this requirement.

Condition No.	Condition	Management Strategy	Actions undertaken previously	Actions proposed for future activities
	(i) the slopes of natural landforms as they exist prior to the proponent commencing the development subject to this approval ; and/or (ii) the bunds described in condition (23).		• Not aware of any previous complaints received in relation to noise.	
25	The City may deem at any time that operations on the site are generating an unreasonable amount of noise or that the operations are not compliant with the conditions of this approval. Should that occur, the Manager Planning Implementation may direct in writing that: (i) An amended Noise Management Plan be submitted and endorsed; or (ii) The activities on the site are brought into compliance with this approval.	• Implementation of noise management strategies as required in accordance with the approved Management Plan. • Amendment of Noise Management plan as required.	• Noise management strategies implemented by previous operator. • Not aware of any previous complaints received in relation to noise.	• Noise management strategies to be implemented and/or amended where required to meet this requirement.
26	All activities pertaining to any vehicle or equipment wash-down or servicing shall be confined to a wash down area with a pollutant trap, which shall be provided within three months from the commencement of excavation.	• Any vehicle and equipment wash-down and servicing onsite to occur within an approved area consisting of a pollutant trap.	• It is understood that the previous contractor did not conduct any vehicle or equipment washing/servicing onsite and therefore no wash-down area or pollutant trap has been installed.	• No vehicle or equipment wash-down or servicing proposed onsite.
27	No explosives shall be stored on the site and no blasting shall be carried out without the approval of the appropriate State Government authority and the Manager Planning Implementation.	• Explosives will not be stored onsite. Blasting carried out with prior approval from State Government authorities (where required) and the City's Manager Planning Implementation.	• Blast management practices implemented by previous operator. • Not aware of any previous complaints received in relation to blasting.	• Blast management practices will be implemented in accordance with the approved Blast Management Plan and in accordance WAL's ISO accredited EMS.
28	At six monthly intervals, the landowner shall carry out the monitoring of: (i) Noise emissions to ensure that noise outputs are consistent with the noise output described in the Noise Management Plan; and (ii) Water extracted from bores. The results of the monitoring prescribed in (i) and (ii) above shall thereafter be provided to the City within 28 days from the day of the intervals.	• Noise managed in accordance with approved Management Plan. • Water extracted from bores onsite to be monitored on a six-monthly basis while the site is operational.	• WAL has not been provided with any previous monitoring records.	• Noise will be managed in accordance with approved Management Plan. • Groundwater monitoring will be conducted on a six-monthly basis while the site is operational (when a licensed bore has been installed).

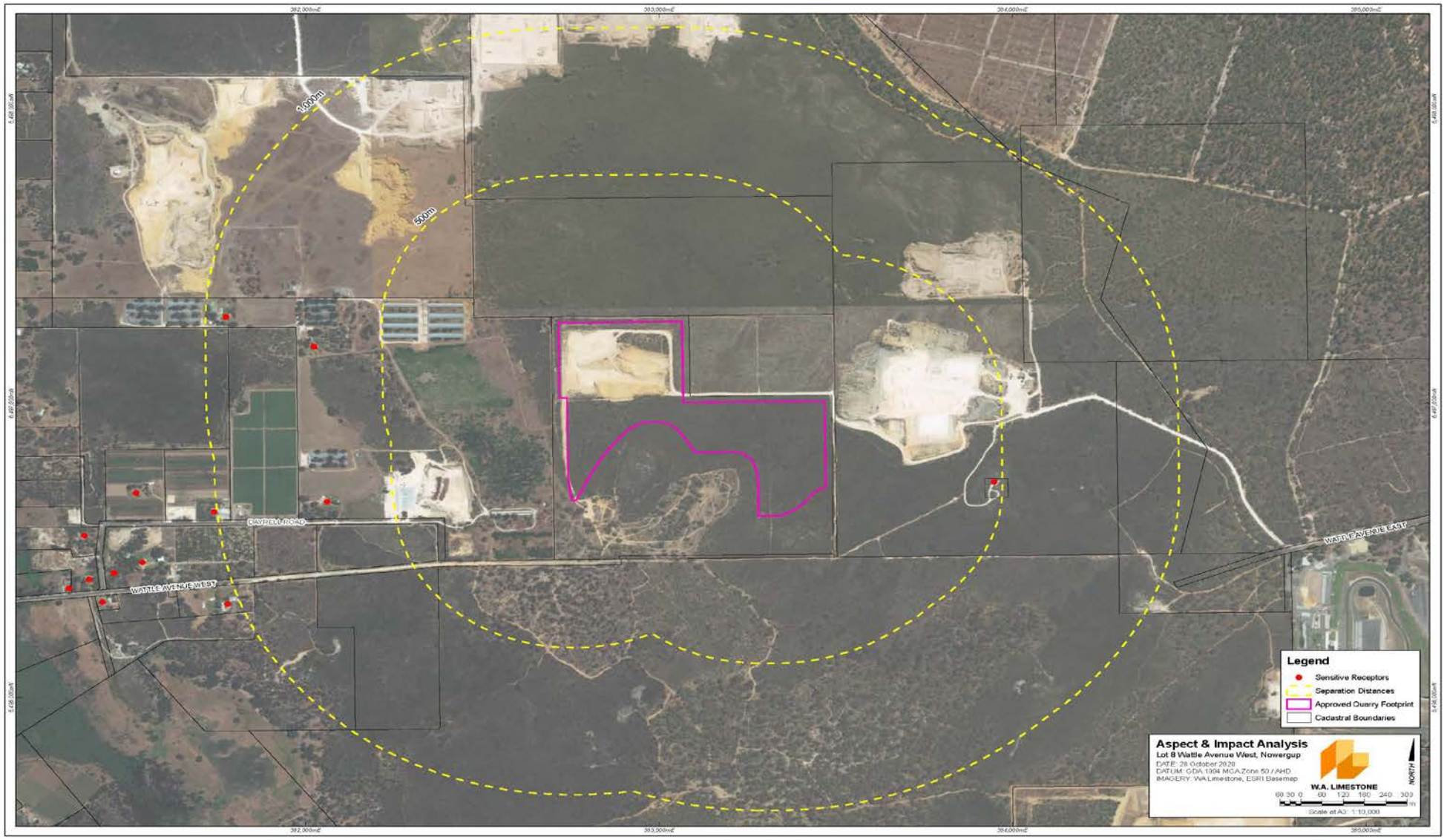
Condition No.	Condition	Management Strategy	Actions undertaken previously	Actions proposed for future activities
29	The landowner shall: (i) keep a complaints log in which the following is to be recorded: • the date and time, where relevant, of each complaint made and received; • the means (telephone, email or mail) by which the complaint was made; • any personal details of the complainant that were provided or, if no details were provided, a note to that effect; • the nature of the complaint (including a description of the operations and the equipment to which the complaint relates); • the steps or actions taken in, and the timing of, the response to each complaint, including any follow up contact with the complainant; and • if no actions or steps were taken in relation to the complaint/enquiry, the reason(s) why no actions or steps were taken; (ii) immediately notify the City of any complaint received; (iii) respond as soon as possible, and in any event within three working days, to any complaint received and provide the City with a copy of the response; (iv) provide the complaints' log to the City upon request; and (v) cause to be provided to the City, concurrently with any reports being provided to the Department of Environment and Conservation (DEC), all reports prepared and submitted to the DEC as required by and forming part of the landowner's monitoring and reporting requirements contained in any licences/permits issued by the DEC in accordance with the *Environmental Protection Act 1986*.	• All complaints from the community to be recorded and managed in accordance with an appropriate system. • The City will be notified of complaints received from the community and provided with a complaints log as required.	• Complaint management implemented by previous operator. • Not aware of any complaints received previously.	• All complaints from the community will be recorded and managed in accordance with WAL's ISO accredited EMS. • The City will be notified immediately of any compliant received from the community and provided with a complaints log as required.
30	By 31 January each year, the proponent shall submit to the City a report (Report) that includes: (a) the progress of the excavation activities; (b) production levels; (c) the progress of rehabilitation undertaken and completed;	• Annual report to be provided to the City by 31 January each year, providing detail as listed under Condition 30.	• Previous reporting was the responsibility of the previous operator	• WAL commits to prepare and submit an annual report to the City by 31 January each year providing all detail as listed under Condition 30.

Condition No.	Condition	Management Strategy	Actions undertaken previously	Actions proposed for future activities
	(d) the measures taken to suppress and minimise dust and noise; (e) the number and type of community complaints and responses, and whether and how such complaints have been resolved; (f) results of noise, dust and bore monitoring; and (g) traffic movements. The City may provide to the landowner direction as to how the development on the site should be changed in order to address any matter identified in the Report referred to in this condition. The landowner shall alter the operation shall direction be prescribed in writing by the City and the operation shall thereafter be carried out in accordance with the written direction.			
31	No peat, landfill, soil, chemical or any other substance or material is to be brought into the site for the purposes of: i) filling the land to achieve the approved finished contour levels, or ii) blending it with the limestone extracted; or iii) manufacturing products or materials from the limestone extracted; or iv) storage or stockpiling.	• Management of externally sourced materials in accordance with the approved Management Plan.	• Management of externally sourced materials by previous operator	• Operations will be conducted in accordance with the approved Management Plan and in accordance WAL's ISO accredited EMS.

CITY OF WANNEROO EXTRACTIVE INDUSTRY LOCAL LAW 1998 PART 6 SECTION 3 - MUST NOT CARRY OR PERMIT TO BE CARRIED OUT ANY BLASTING IN THE COURSE OF EXCAVATING UNLESS

Sub Section	Condition	Management Strategy	Actions undertaken previously	Actions proposed for future activities
(a)	The local government has otherwise given approval in respect of blasting generally or in the case of each blast	Seek prior approval for blasting at Lot 8 from the City of Wanneroo	No quarrying has been undertaken by WA Limestone at Lot 8	Provide blast management plan for review and seek approval to blast during quarrying operations.
(b)	subject to sub-clause (2), the blasting takes place only between the hours of 8.00 am and 5.00pm, or as determined by the local government, on Mondays to Fridays inclusive;	The Blast Management Plan will reflect the operational requirements of the local law.	No quarrying has been undertaken by WA Limestone at Lot 8	Provide blast management plan reflecting DA and Local Law
(c)	the blasting is carried out in strict accordance with the AS2187 SAA Explosives Code, the Mines Safety and Inspection Act 1994, the Environmental Protection Act 1986, and all relevant local laws of the local government; and	AS2187 SAA Explosives Code has been superseded by AS2187.2.2006 Explosive Storage and Use. The Blast Management Plan will reflect this this standard and other applicable legislation	No quarrying has been undertaken by WA Limestone at Lot 8	Blast Management Plan reflecting AS2187 and applicable legislation
(d)	in compliance with any other conditions imposed by the local government concerning - (i) the time and duration of blasting; (ii) the purposes for which the blasting may be used; (iii) the methods of detonation and blasting; (iv) the types of explosives to be used; and (v) such other matters as the local government may reasonably require in the interests of the safety and protection of members of the public and of property within the district.	The Blast Management Plan will reflect the operational requirements of the Extractive Licence and Development Approval	No quarrying has been undertaken by WA Limestone at Lot 8	Provide blast management plan reflecting DA and Local Law
SECTION 4	must not carry out or permit to be carried out any blasting on a Saturday, Sunday or public holiday except with the prior approval of the local government	WA Limestone will not undertake blasting on Weekends and Public Holidays without prior approval of the CoW.	No quarrying has been undertaken by WA Limestone at Lot 8	Blast Management Plan will reflets this requirement.

Appendix 3 Distance to Sensitive Receptors


382,300mE
383,000mE
384,000mE
385,000mE
1,000m
500m
DAYRELL ROAD
WATTLE AVENUE WEST
WATTLE AVENUE EAST
Legend
Sensitive Receptors
Separation Distances
Approved Quarry Footprint
Cadastral Boundaries
Aspect & Impact Analysis
Lot 8 Wattle Avenue West, Nowergup
DATE: 28 October 2020
DATUM: GDA 1994 MGA Zone 50 / AHD
IMAGERY: WA Limestone, ESRI Basemap
W.A. LIMESTONE
60 30 0 60 120 180 240 300
Scale at A3: 1:10,000
NORTH

Appendix 4 Risk Assessment

Risk Assessment Worksheet –Explosives and Blasting

Location:	Wattle Avenue Lot 8	Date:	28/10/2020	Subject of Review:	Blasting at Wattle Avenue Lot 8 Quarry
Review Team:	Campbell Sinclair, Roger Stephens				
Context:	Identify the risks associated with conducting blasting at Lot 8 Wattle Avenue Limestone Quarry				

Ref No.	Aspect Risk Scenario	How could it happen (Causes)	Impacts on Business	What could happen? (Effects/consequences)	Inherent Risk			Control Description	Residual Risk			Action Description	Assigned To
					Conseq.	Likelihood	Ranking		Conseq.	Likelihood	Ranking		
Regulatory													
1	Blasting without obtaining approval under Planning Approval from City of Wanneroo (CoW)	Failing to obtain written approval to City of Wanneroo	Financial/Legal	Prosecution and or fines, delays to project causing financial issues	Minor	Unlikely	L7	Obtain permission from City of Wanneroo by submitting a Blast Management Plan	Insignificant	Unlikely	L2	Develop blast management plan and submit to City of Wanneroo for approval	
2	Noncompliance with CoW Extractive Industry Local Law for blasting	Blast management plan does not address requirements of the EI Local Law	Financial/legal	Prosecution and or fines, delays to project causing financial issues	Minor	Unlikely	L7	Incorporate industry local law into the blast management plan and procedures	Insignificant	Unlikely	L2	Ensure EI local law requirements are incorporated into the blast management plan	
3	Not blasting to Australia Standards Explosives Storage and Use AS2187.2-2006 Part II Use of Explosives causing impacts as required by Local	AS2187.2.2006 not reflected in the blast management plan	Health and Safety/Financial	Prosecution and or fines, delays to project causing financial and health and safety issues	Minor	Unlikely	L7	Incorporate AS2187Part II into the blast management plan	Insignificant	Unlikely	L2	Ensure the blast management plan reflects AS2187	
Environmental – Noise and Vibration													
4	Excessive vibration to a sensitive receptor	AS2187.2.2006 not reflected in the blast management plan	Health and Safety	Ground vibration Impacts sensitive receptors	Moderate	Unlikely	M12	AS2187 has specific sections on vibration limits for buildings and human comfort. Were issues arise monitoring will be undertaking at the nearest sensitive receptor	Moderate	Unlikely	L2	Monitoring of blast ground vibration for first blast. Distance to sensitive receptor map produced in Appendix 3	
5	Air blast overpressure to sensitive receptors	Breaching maximum air blast levels as described in the *Environmental Protection (Noise) Regulations 1997* (the Regulations)	Complaints to CoW and DWER causing legal issues, delays to blasting causing financial impacts	Blasting, exceeding maximum allowable day time blasting levels between 7am and 6pm any other premise.	Minor	Unlikely	M11	Monitor placed at nearest sensitive receptor to ensure compliance with the regulations. Blasting occurring within the quarry. Batters have been placed on the western edge to mitigate noise.	Insignificant	Unlikely	L2	Monitor air blast levels during first blast, adjust accordingly. Distance to sensitive receptor map produced in Appendix 3	
7	Fly rock impacts to sensitive receptors causing damage	Fly rock impacting nearest sensitive receptor, potential damage and or safety issue	Health and safety/Financial/Legal	Uncontrolled blasting Fly rock damaging public and personal property at nearest sensitive receptors	Major	Unlikely	E19	Blasting for rock armour utilizes enough to crack limestone deposit to extract boulders for armour. Fly rock generation is minimal and not excepted past the premise boundary.	Insignificant	Unlikely	L2	Ensure blast management plan addresses fly rock controls.	

Regulatory													
Ref No.	Aspect Risk Scenario	How could it happen (Causes)	Impacts on Business	What could happen? (Effects/consequences)	Inherent Risk			Control Description	Residual Risk			Action Description	Assigned To
					Conseq.	Likelihood	Ranking		Conseq.	Likelihood	Ranking		
												Distance to sensitive receptor map produced in Appendix 3	
8	Impacts to service utilities	Ground vibration. air blast impacting any services	Financial/Legal	Uncontrolled air blast /vibration impacting on service utilities causing damage	Moderate	Rare	M5	No utilities are located withing 500m of the blasting activities. Confirm with dial before you dig.	Insignificant	Rare	L1	Dial a dig has confirmed no assets in the area for Telstra, ATCO, Western Power, Water Corporation therefore risk is considered minimal.	
Environmental - Dust Emissions													
9	Dust emissions from drilling blast holes	Generation of dust plumes from drilling the blast pattern	Health and Safety	Cumulative generation of dust clouds from drilling the blast pattern driving over sensitive recepto4s	Minor	Possible	M11	Drilling for short periods at a time if large amounts of dust is generated to allow dust to disperse.	Insignificant	Unlikely	L2	Distance to sensitive receptor map produced in Appendix 3	
10	Dust clouds impacting sensitive receptors	Dust clouds drifting over sensitive receptors such as dwellings	Health and Safety	Potential complaints	Minor	Possible	M11	Blasting when prevailing wind is away from sensitive receptors	Insignificant	Unlikely	L2	Distance to sensitive receptor map produced in Appendix 3	

Safety - Drilling and Blasting													
Ref No.	Aspect Risk Scenario	How could it happen (Causes)	Impacts on Business	What could happen? (Effects/consequences)	Inherent Risk			Control Description	Residual Risk			Action Description	Assigned To
					Conseq.	Likelihood	Ranking		Conseq.	Likelihood	Ranking		
11	Back injury	Manual handling of drill rods	Health and safety	Long term back injury/workers compensation	Major	Possible	E19	Site specific rod handling procedure, signed off by relevant personnel Safe Working Procedures	Minor	Unlikely	L7	No current actions	
12	Exposure to high blast noise	In proximity to blast	Health and safety	Hearing loss	Major	Possible	E19	PPE – heating protection, safe distance from blast	Minor	Unlikely	L7	No current actions	
13	Exposure to respiratory dust particles	In the vicinity of the dust cloud	Health and safety	Inhalation of fine dust particles PM2.5	Major	Unlikely	H11	PPE – masks, safe distance from blast area reducing dust exposure	Minor	Rare	L3	No current actions	
14	Drilling in vicinity of primed holes	Danger of premature detonation	Health and safety/Legal/Financial	Long term injury or death to workers, legal prosecution, brand damage	Major	Rare	H8	Qualified shotfirer Drill plan, drilling pattern exclusion zone Competence testing off all operators	Major	Rare	H8	No current actions	
15	Hydrocarbon spills from mobile plant	Blown hydraulic hoses Servicing mobile plant	Environmental	Short term contamination of a small area of land	Minor	Possible	M11	Servicing done in designated areas Hydrocarbon spills to be cleaned up immediately Use of drip trays Preventative maintenance	Minor	Rare	L3	No current actions	

Safety - Drilling and Blasting													
Ref No.	Aspect Risk Scenario	How could it happen (Causes)	Impacts on Business	What could happen? (Effects/consequences)	Inherent Risk			Control Description	Residual Risk			Action Description	Assigned To
					Conseq.	Likelihood	Ranking		Conseq.	Likelihood	Ranking		
16	Fire and or explosion	Incorrect storage of explosive	Health and safety/legal/financial	Severe injury or death of workers, project delays, brand name damage by prosecution	Major	Unlikely	H8	Explosives ate not stored at Lot 8	Rare	Insignificant	L1	No current actions.	
17	S.M.E. collision	Transporting explosives	Health and safety	Severe injury or death of workers, damage to mobile plant	Major	Possible	H15	Traffic management plan Pre start checks Operator competency	Minor	Unlikely	L7	No current actions.	
18	Personal caught in the vicinity of a blast	Personal, unaware of a blast – poor communication, no blast exclusion zone, no signage	Health and safety	Severe injury or death of workers, damage to mobile plant, vehicles	Major	Unlikely	H8	Blast management plan Qualified shot firer	Minor	Unlikely	L7	No current actions.	
19	Losing an explosive primer down a shot hole	Charging drill holes	Health and safety	Severe injury or death of workers	Major	Possible	H15	Blast management plan Qualified shot firer	Extreme	Rare	H10	No current actions.	
20	Loss of production	Inadequate stemming of drill holes	Financial	Inadequate blasting of limestone	Major	Unlikely	H8	Qualified shot firer	Minor	Unlikely	L7	No current actions.	
21	Missing holes	Inadequate tie in of shot	Financial	Inadequate blasting of limestone	Minor	Possible	M11	Qualified shot firer	Minor	Unlikely	L7	No current actions.	
22	Misfire	Premature initiation	Health and safety	Severe injury or death of workers, damage to mobile plant, vehicles	Moderate	Possible	H15	Blast management plan Qualified shot firer Misfire procedure Authorised personal in shot area	Minor	Rare	L3	No current actions.	
23	Premature initiation	Connecting fire line	Health and safety	Severe injury or death of workers, damage to mobile plant, vehicles	Major	Possible	E19	Blast management plan Qualified shot firer Misfire procedure Authorised personal in shot area	Major	Rare	H10	No current actions.	
24	Failure to clear blasting area resulting in personal walking/driving on loaded shot or caught in blast	Lack of communication, no demarcation, signage	Health and safety	Severe injury or death of workers, damage to mobile plant, vehicles	Major	Unlikely	H14	Pit cleared by blast controller, shot firer Blast guards in place	Major	Rare	H8	No current actions.	
25	Unauthorised access to blast exclusion area and loaded shot causing health and safety issues	Lack of security or signage	Health and safety/legal	Members of the public accessing the blast exclusion area	Major	Unlikely	H14	Loaded drill patters are not left overnight. Explosives are not stored on site. Signage warning active quarry entry hazard	Major	Rare	H8	Blast management plan will address security.	
26	Fly rock injuring personal	Design of drill pattern, types of explosives	Health and safety	Severe injury or death of workers, damage to mobile plant, vehicles	Major	Unlikely	H14	Qualified shot firer to supervise initiation of blast	Major	Rare	H8	No current actions.	

Appendix 6
Flora Assessment

LOT 8 WATTLE AVENUE WEST, NOWERGUP

FLORA AND VEGETATION SURVEY CPS 9197/1

Prepared for:	WA Limestone
Report Date:	1 March 2022
Version:	1
Report No.	2021-658

pgv ENVIRONMENTAL

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1 INTRODUCTION

1.1 Background

Lot 8 Wattle Avenue West, Nowergup is located approximately 33km north-north-west of the Perth Central Business District in the City of Wanneroo (Figure 1). PMR Quarries Pty Ltd's have applied for a clearing permit (CPS 9197/1) for part of the lot (15.54ha) (hereafter referred to as 'the site' – Figure 2) for the purpose of Extractive Industry.

The site has previously been granted a Clearing Permit on 14 December 2012 (CPS 4924/2) to Oakford Land Company Pty Ltd. A request for the clearing permit to be extended was granted in 2019 (CPS 4924/3), however the granting of the permit was revoked by the Minister on appeal due to the ownership of the land having been transferred and the Purpose Permit was unable to be transferred to the proponent. As a result, the new application CPS 9197/1 has been applied for by PMR Quarries Pty Ltd over the same area of land.

In response to the clearing permit application the Department of Water and Environmental Regulation (DWER) commented on the original flora and vegetation survey undertaken on the site by Regeneration Technology in 2006. DWER considered the 2006 survey was old and may not reflect the current species presence or condition of the vegetation in the application area, including the possible presence of the Banksia Woodlands of the Swan Coastal Plain ecological community which was listed as a Threatened Ecological Community (TEC) after the 2006 survey was done. DWER also made a number of comments on the methodology used in the survey and the adequacy of the survey in assessing the possible presence of the following conservation significant flora species:

- *Eucalyptus argutifolia* (Threatened);
- *Melaleuca* sp. Wanneroo (Threatened);
- *Baeckea* sp. Limestone (Priority 1);
- *Haloragis luminosa* (Priority 1); and
- *Acacia benthamii* (Priority 2).

This Flora and Vegetation Survey was commissioned by WA Limestone to provide an updated survey of the flora and vegetation on the site.

1.2 Scope of Works

The Flora and Vegetation Survey was undertaken in alignment with EPA Technical Guidance *Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA, 2016) with a targeted component for identified species that may be present on the site (as per Section 4.2 of the guidance) as well as a detailed survey of the flora and vegetation (as per Section 4.3 of the Guidance). The survey included the following:

- Review of all previous studies undertaken on the site including:
  - *Lot 8 Wattle Ave Nowergup Flora and Vegetation Assessment* (Regeneration Technology Pty Ltd, 2006); and
  - Clearing Permit Report for CPS 4924/3 (DWER, 2019).

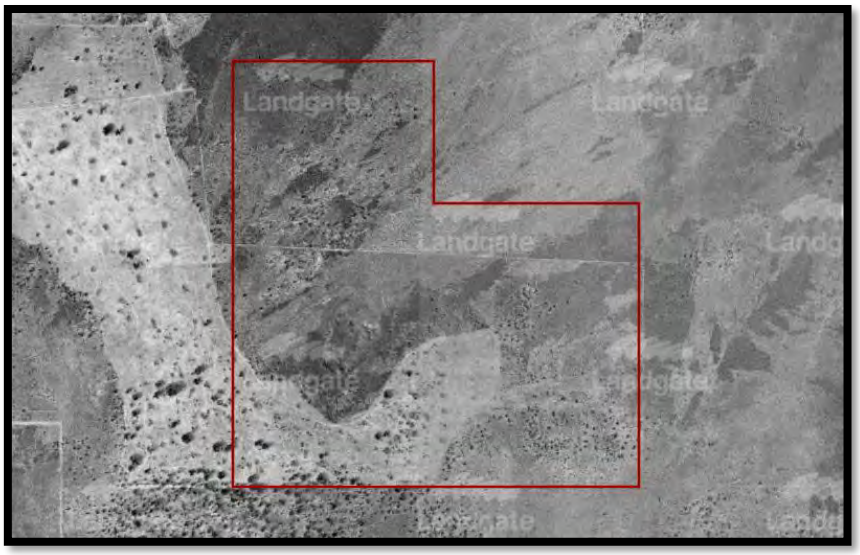
- Examination of historic and recent aerial photography and contour and soil maps to provisionally identify vegetation types and condition;
- Field survey using quadrats to record native and introduced species;
- A thorough site walkover of any areas of native vegetation at approximately 40m spacing;
- Recording of any significant plant species using a hand-held GPS;
- Description and mapping of vegetation types and vegetation condition;
- Compilation of a flora list; and
- Analysis of the conservation values of the flora and vegetation on the site.

2 EXISTING ENVIRONMENT

2.1 Land Use

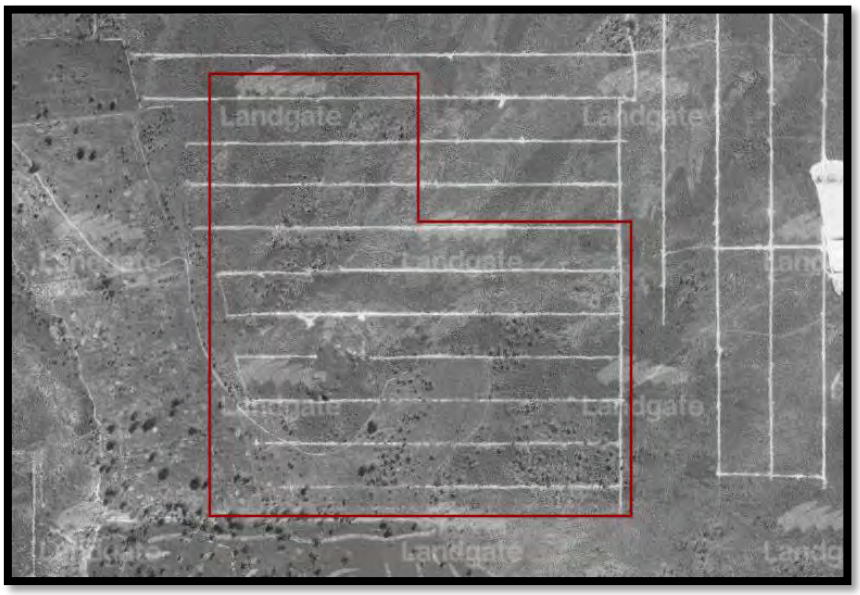
The earliest available historic aerial photograph on-line from 1965 shows that the site contains native vegetation over most of the area with some partial clearing in the south-west quarter (Plate 1) (Landgate, 2022).

Plate 1: Aerial Photograph 1965 (Landgate, 2022)



Exploration for limestone resource is apparent in the aerial photograph from 1970 (Plate 2) (Landgate, 2022).

Plate 2: Aerial Photograph 1970 (Landgate, 2022)



Limestone quarrying commenced to the north-east of the site before 2000 and immediately north of the site in 2010 and remain active to the current time (Plate 3). The site itself remains naturally vegetated.

Plate 3: Aerial Photograph 2021 (Landgate, 2022)

2.2 Topography

The site is undulating and generally slopes down from the north-east at 94m Australian Height Datum (AHD) down to the south-west at 58 mAHD (Figure 2).

2.3 Geology and Soils

The site is mapped as part of the Spearwood System which has the highest relief of the dune systems on the Swan Coastal Plain (Bolland, 1998). The Spearwood system consists of slightly calcareous Aeolian sand remnant from leaching of the underlying Pleistocene Tamala limestone (Davidson, 1995).

The Spearwood soil unit mapped on the site is described as follows:

- Karrakatta shallow soils Phase (211Sp__Kls) which are on low hills and ridges with bare limestone or shallow siliceous or calcareous sand over limestone. Typically, these soils have dense low shrub dominated by *Banksia sessilis, Melaleuca huegelii* and species of *Grevillea* (DPIRD, 2022).

2.4 Hydrology

The maximum groundwater level beneath the site is approximately 21-25m AHD which is 40m to 69m below the surface level. Groundwater generally flows to the south-west (DWER, 2022). There are no wetlands or creeks mapped on the site according to the DBCA's Geomorphic Wetlands of the Swan Coastal Plain database (National Map 2022).

3 METHODOLOGY

3.1 Previous Surveys

A flora and vegetation survey of the whole of Lot 8 has previously been conducted by Regeneration Technology Pty Ltd in 2006 (Regeneration Technology Pty Ltd, 2006). The results of that survey were used to prepare a survey report in 2016 just for the clearing permit application area. No specific additional survey of the clearing permit application area has been seen by PGV Environmental. The clearing permit report does not include a reference for any survey other than the 2006 report.

As part of the clearing permit assessment for CPS 4924/2 a site survey was undertaken by DWER in 2018 (DWER, 2019).

The results of the 2006 survey and 2018 DWER survey were reviewed as part of this assessment.

3.2 Spring Survey

A detailed spring flora and vegetation survey of the site was conducted by Dr Paul van der Moezel on 10 October 2021. The site was thoroughly walked to record all species observed within the survey area (see Plate 4 for track log). Information on flora composition and vegetation structure was recorded in six 10 m x 10 m non-permanent quadrats in representative vegetation types.

Most plant species were identified in the field. Some specimens were photographed or samples collected for identification at the Perth Reference Herbarium or office using standard reference guides.

Plate 4: Track Log

3.2.1 Targeted Species

As part of the clearing permit application for CPS 9197/1 DWER listed five conservation significant species that they considered might occur on the site and should be specifically surveyed for. The species identified by DWER to have potential to occur on the site and associated notes are as follows:

- *Eucalyptus argutifolia* (Threatened) - *can be confused with E. petrensis, when not in flower especially if plants are sterile. Surveys for this species should be conducted during the flowering period, from December through to April*
- *Melaleuca sp. Wanneroo* (Threatened) - *can be confused with M. systena when not in flower. Surveys for this species should be conducted during the flowering period, late November through to January*
- *Baeckea sp. Limestone* (Priority 1) - *recommended that this species be targeted during its flowering period, which is described as late spring as myrtaceous shrubs may be mis-identified when not in flower*
- *Haloragis luminosa* (Priority 1) - *this species is most conspicuous in spring when growing vigorously however fruit is required for accurate determination. Preliminary surveys should therefore be conducted in spring, with follow up surveys of suspected in summer. If suspected to be present, it is recommended that specimens be submitted to the WA Herbarium for confirmation*
- *Acacia benthamii* (Priority 2) – *most collections for this species have occurred from late July though to early October. The flowering period is listed as listed as August/September. It is recommended that surveys be conducted during the flowering period where possible.*

These species were specifically targeted in the spring flora survey.

3.2.2 Survey Conditions

The conditions that the survey was undertaken in are presented in Table 1 in order to assess the adequacy of the survey. Rainfall for Nowergup (Measured at Tamala Park, Site Number 009264, approximately 8 km from the site) was above average for July in 2021 being 245.9.0 mm and below average in August being 71.7 mm compared to mean values of 123.0 mm and 106.1 mm (BOM, 2021). The rainfall in September was 29.7 mm compared to an average of 59 mm, however October was above average with 99.7 mm compared to 33.4 mm (BOM, 2021). The above average rainfall in July is likely to have compensated for the low rainfall in August and September and is not considered to be a constraint on the survey.

Table 1: Statement of Botanical Survey Conditions

Issue	Constraints (Y/N)*	Comment
Competency/experience of the consultant conducting the survey	No	Dr Paul van der Moezel has extensive botanical survey experience on the Swan Coastal Plain, including the Nowergup area
Proportion of the flora identified^	No	The timing of the survey in October was optimal to identify most flora species on the site including all potential Threatened and Priority Flora. No follow-up survey required.

Issue	Constraints (Y/N)*	Comment
Sources of information (historic/recent or new data)	No	The flora of the Swan Coastal Plain is well documented. Previous survey by Regeneration Technology and DWER provided additional context.
Proportion of the task achieved and further work that may need to be undertaken	No	No follow-up survey required as no Threatened Flora expected to occur in other seasons.
Timing/weather/season/cycle	No	The spring survey was optimal for most flora species. 2021 was a good year for ephemeral species.
Disturbances (Fire)	No	The fire age of the vegetation was greater than 5 years.
Intensity of survey (e.g. In retrospect was the intensity adequate)	No	The time spent on the site was considered appropriate for the low diversity of vegetation types. Thick Parrot Bush vegetation prevented a closer spacing of traverses over the whole site.
Completeness (e.g. was relevant area fully surveyed)	No	
Resources (e.g. degree of expertise available for plant identification)	No	Experienced botanist undertook most plant identifications on site.
Remoteness and/or access problems	No	Easily accessible site in the Perth Metropolitan Region
Availability of contextual (e.g. bioregional) information for the study area.	No	Bush Forever

*Constraints have been rated as Significant, Moderate or No constraints

^Fungi and nonvascular flora (e.g. algae, mosses and liverworts) were not specifically surveyed for during the survey.

4 RESULTS

4.1 Flora

A total of 129 plant species were recorded in the survey area by PGV Environmental (Appendix 1). The total included 105 native and 24 introduced species (18.6%). The number of native species is higher than the number recorded by Regeneration Technology Pty Ltd in 2006 who recorded 85 plant species in the clearing permit area, including 76 native and 9 introduced species (cited in DWER 2019).

The plant Families with the highest representation of species were the Proteaceae (Banksia family - 13 species, all native), Asteraceae (Daisy family – 13 species, including 8 native and 5 introduced), Fabaceae (Pea and Wattle family – 12 species, all native) and the Poaceae (Grass family – 11 species, including 4 native and 7 introduced).

No conservation significant species were recorded during the survey.

Species richness in the six quadrats ranged from 29-43 (average34.7) (Appendix 2). This is considered consistent for the vegetation type on shallow soil over limestone in Excellent condition.

4.2 Vegetation

4.2.1 Vegetation Complex

Vegetation complexes are a broad level of vegetation description which is based on the underlying geomorphology and rainfall (Heddle *et al*., 1980). The areas of remnant native vegetation on the site are part of the Cottesloe Complex – Central and South which is described as:

> Cottesloe Complex-Central and South - Mosaic of woodland of *Eucalyptus gomphocephala* (Tuart) and open forest of *E. gomphocephala* – *E. marginata* (Jarrah) – *Corymbia calophylla* (Marri), closed heath on the limestone outcrops (Heddle *et al.,* 1980).

The general description of the vegetation complex matches the different types of native vegetation on the site.

4.2.2 Vegetation Types

Vegetation complexes are a very broad mapping unit used to map the vegetation at the scale of the Swan Coastal Plain for example. For small scale sites, such as the survey area, vegetation mapping can be further refined by using vegetation types which are based on the composition and structure of the dominant species rather than based on geomorphology.

Three vegetation types were described and mapped on the site. The vegetation types are described in Table 2 and mapped in Figure 3.

Table 2: Vegetation Types on the Site

Vegetation Type		Description	Photograph
Bs	*Banksia sessilis* Tall Shrubland to Tall Open Scrub over *Xanthorrhoea preissii/Hibbertia hypericoides/Melaleuca systena/Calothamnus quadrifidus* Closed Low Heath	This was the main vegetation type on the site occurring over about 90% of the site. *Banksia sessilis* was up to 2m high but never more than 25-30% cover. Other tall shrubs to 2m were *Xanthorrhoea preissii* and *Hakea trifurcata*. Smaller common species included *Melaleuca systena, Calothamnus quadrifidus, Hibbertia hypericoides, Mesomelaena pseudostygia, Lomandra maritima, Desmocladus flexuosus* and *Trachymene pilosa.* The soils are orange-brown sand with some surface limestone. Quadrats WA2, 3 and 6 are representative of this vegetation type.	
EdBs	*Eucalyptus decipiens* Low Open Woodland over *Banksia sessilis* Shrubland over *Xanthorrhoea preissii/Hibbertia hypericoides* Open Low Heath	This vegetation type is very similar to the Bs type but with *Eucalyptus decipiens* as a tree mallee 7-8m high. Occurred as scattered patches on the site. Similar understorey species to Bs. The soils are orange-brown sand with some surface limestone. Quadrats WA1 and 4 are representative of this vegetation type.	

Vegetation Type	Description	Photograph
BaBg *Banksia attenuata/B. grandis* Low Open Woodland over *Xanthorrhoea preissii/Hibbertia hypericoides* Open Low Heath	One small area of this vegetation type occurred in the south-east corner of the site. The patch is continuous with other Banksia woodland vegetation on Lot 8 but outside the clearing permit application area. *Banksia attenuata* and *B. grandis* were sparse at around 10% cover and 3-4m high. Common shrub species included *Xanthorrhoea preissii, Hibbertia hypericoides, Mesomelaena pseudostygia, Calothamnus quadrifidus, Desmocladus flexuosus* and *Xanthorrhoea brunonis.* The soils are orange-brown sand with some surface limestone. Quadrat WA5 is representative of this vegetation type.	

4.2.3 Floristic Community Type

Analysis of the quadrat data using the spreadsheet method resulted in all the vegetation types being most similar to Floristic Community Type (FCT) 28 'Spearwood *Banksia attenuata* or *Banksia attenuata* – *Eucalyptus marginata* woodlands'.

4.2.4 Vegetation Condition

The condition of the vegetation was assessed according to the system of Keighery as described in Bush Forever (Government of Western Australia, 2000) (Table 3).

Table 3: Vegetation Condition Rating Scale

Condition	Description
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. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more 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 to it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very 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. For example, disturbance to vegetation structure caused by very frequent fires, the 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 are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

All of the vegetation was rated as Excellent (Figure 4). Regeneration Technology Pty Ltd also rated all the vegetation as Excellent in 2006.

4.3 Conservation Significance of Flora and Vegetation

4.3.1 Flora

No Threatened or Priority flora species were recorded on the site.

Regeneration Technology Pty Ltd recorded the Priority species *Jacksonia sericea* on Lot 8 in the 2006 survey. The species identification was changed to *Jacksonia gracillima,* another Priority species, in the 2016 survey report for the clearing permit application area. The clearing permit decision report for CPS 4924/2 states that four individuals of *Jacksonia gracillima* were recorded in the Banksia/Jarrah woodland in the south-east corner of Lot 8 and five other individuals were recorded elsewhere on Lot 8 outside the application area. No precise co-ordinates of the individuals are given, or locations mapped in the report. No The plants resembling *J. gracillima* or *J. sericea* were recorded on the site by PGV Environmental. PGV Environmental recorded *Jacksonia calcicola* on the site in Banksia sessilis Heath. Regeneration Technology did not record *J. calcicola* anywhere on Lot 8. The identification of

Jacksonia gracillima is considered by PGV Environmental as an error as *J. gracillima* usually occurs on the Bassendean Dune system on winter-wet flats. Nevertheless, DWER considered that the potential clearing of *Jacksonia gracillima* was "not likely to impact on the conservation of this species".

Table 4 summarise the results of the survey with respect to the five Threatened and Priority species identified by DWER as potentially occurring on the site.

In summary, the survey in October by an experienced botanist was considered adequate to have been able to identify all five species if they had occurred on the site.

Table 4: Summary of Targeted Species Survey

Species	Flowering	Survey Timing
Eucalyptus argutifolia	March-April (Grayling and Booker, 1992)	No shrub mallee eucalypts were recorded on the site by PGV Environmental, therefore the flowering time is not relevant. *Eucalyptus argutifolia* was surveyed by DWER in 2018. The Clearing Permit Decision report for CPS 4924/3 states: *Additionally, after an intensive site inspection by DWER in September 2018 and review of the flora survey, it is considered for the flora survey undertaken in 2006 to be adequate in identifying this species. Therefore, it is not considered for the proposed clearing to impact on habitat for this threatened flora species.*
Melaleuca sp. Wanneroo	November-January	Differentiated from *Melaleuca systena* by its flatter and longer leaves. Identifiable by experienced botanist when not in flower. Dr Paul van der Moezel surveyed and identified *Melaleuca* sp. Wanneroo on several nearby mining leases in 2021 and is therefore familiar with its identification.
Baeckea sp. Limestone	Late Spring	The survey was undertaken in the flowering period for this species. No Baeckea species have been recorded on the site in either the 2006 or 2021 surveys.
Haloragis luminosa	September	*Haloragis luminosa* is known from a single locality near Yanchep where it grows on a limestone ridge with TEC 26a vegetation with a tall shrubland of *Acacia rostellifera* with *Banksia sessilis*, *Melaleuca systena* and *M. huegelii* over *Xanthorrhoea preissii* and *Hibbertia hypericoides* (Wege and Orchard, 2020). The survey on Lot 8 was undertaken in spring during the flowering period. No FCT 26a vegetation or limestone ridges occur in the survey area. No *Haloragis* species have been recorded on the site in either the 2006 or 2021 surveys.
Acacia benthamii	August - September	The survey was just outside of the flowering time for this species, however is recognisable by its horizontal rigid and pungent phyllodes which are similar to *A. cochlearis* in appearance. *A. cochlearis* has not been recorded on the site in either the 2006 or 2021 surveys.

4.3.2 Vegetation

4.3.2.1 Vegetation Complex

The vegetation is part of the Cottesloe - Central and South Vegetation Complex. There is approximately 32.16% of the pre-European extent of the Cottesloe Complex-Central and South remaining on the Swan Coastal Plain portion of the Perth Metropolitan Region (DBCA, 2018). There is 14.58% of the original extent of the complex in secure reserves (DBCA, 2018).

The percentage retention is above EPA's target for minimum 30% retention of vegetation complexes State-wide in the Perth and Peel Region Constrained Areas and the area in protection is above the 10% minimum criteria for vegetation complexes.

4.3.2.2 Threatened and Priority Ecological Communities

All of the vegetation was assessed as being Floristic Community Type (FCT) 28 'Spearwood *Banksia attenuata* or *Banksia attenuata – Eucalyptus marginata* woodlands'. FCT 28 is not a TEC or PEC at State or Commonwealth level.

One very small area containing *Melaleuca huegelii* with *Banksia sessilis, Xanthorrhoea preissii* and *Hibbertia hypericoides* was recorded on the site but was too small to map. Areas with *Melaleuca huegelii* have potential to be the State listed TEC 26a '*Melaleuca huegelii-M. systena* shrublands on limestone ridges'. However, the very small size of the area containing *M. huegelii* and the absence of a limestone ridge meant the vegetation was not representative of the TEC. DWER (2019) also concluded that the clearing permit application area did not contain the State listed TEC 26a.

4.3.2.3 Banksia Woodlands of the Swan Coastal Plain Assessment.

The vegetation type (BaBg) containing *Banksia attenuata* trees in the south-east corner of the site has potential to be part of the Banksia Woodlands of the Swan Coastal Plain ecological community (Banksia Woodland TEC), which is listed as an Endangered TEC under the Commonwealth EPBC Act. However, the presence of *Banksia attenuata* trees is not of itself sufficient for the area of Banksia trees to meet the requirements of the Banksia Woodland TEC. The vegetation needs to meet specific criteria to be considered the TEC as follows.

The *Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community* (Conservation Advice) describes the Banksia Woodland TEC as follows:

> *The ecological community is a woodland associated with the Swan Coastal Plain of southwest Western Australia. A key diagnostic feature is a prominent tree layer of Banksia, with scattered eucalypts and other tree species often present among or emerging above the Banksia canopy. The understorey is a species rich mix of sclerophyllous shrubs, graminoids and forbs. The ecological community is characterised by a high endemism and considerable localised variation in species composition across its range*.

The size and condition of the patch of Banksia woodland is also important. The Banksia Woodland TEC must include vegetation that is in Good condition or more and at least 0.5ha in size.

The area of BaBg vegetation in the application area is around 0.36ha. The Banksia woodland vegetation extends outside the application area and covers around 2.7ha. The condition of the

Banksia woodland vegetation is rated as Excellent. A patch of Banksia woodland in Excellent condition needs to be at least 0.5ha to be the Banksia Woodland TEC. Therefore, the BaBg vegetation type meets the definition of the Banksia Woodland TEC as it is part of a continuous, larger patch of similar Banksia vegetation outside the application area.

DWER (2019) also concluded that the application area contained a small area (0.42ha) of the Banksia Woodlands of the Swan Coastal Plain TEC in the south-east corner.

5 SUMMARY AND CONCLUSIONS

The 2021 detailed flora and vegetation survey of the clearing permit application area (CPS 9197/1) on Lot 8 Wattle Avenue West, Nowergup resulted in the following findings:

- Remnant native vegetation occurs on about 15ha of the site;
- Three vegetation types were recorded with *Banksia sessilis* Tall Shrubland to Tall Open Scrub the most common type. Stands of *Eucalyptus decipiens* over *Banksia sessilis* were scattered throughout the site. One small area of *Banksia attenuata/B. grandis* Low Open Woodland was recorded in the south-east corner;
- The vegetation is all in Excellent condition;
- A total of 129 plant species was recorded on the site, including 105 native and 24 introduced species;
- No Threatened or Priority flora species were recorded on the site. The timing of the survey and experience of the botanist was considered adequate to have been able to identify all five species listed by DWER as potentially occurring on the site, if they had occurred there;
- The main vegetation types were all assessed as being FCT 28 'Spearwood *Banksia attenuata* or *Banksia attenuata – Eucalyptus marginata* woodlands' which is not a Threatened or Priority Ecological Community at State or Commonwealth level;
- The small area of *Banksia attenuata/B. grandis* Low Open Woodland in the south-east corner of the site (0.4ha) is part of a larger stand measuring 2.7ha and was assessed as being a part of the Banksia Woodlands of the Swan Coastal Plain ecological community which is a Priority Ecological Community at State level and a Threatened Ecological Community under the EPBC Act.

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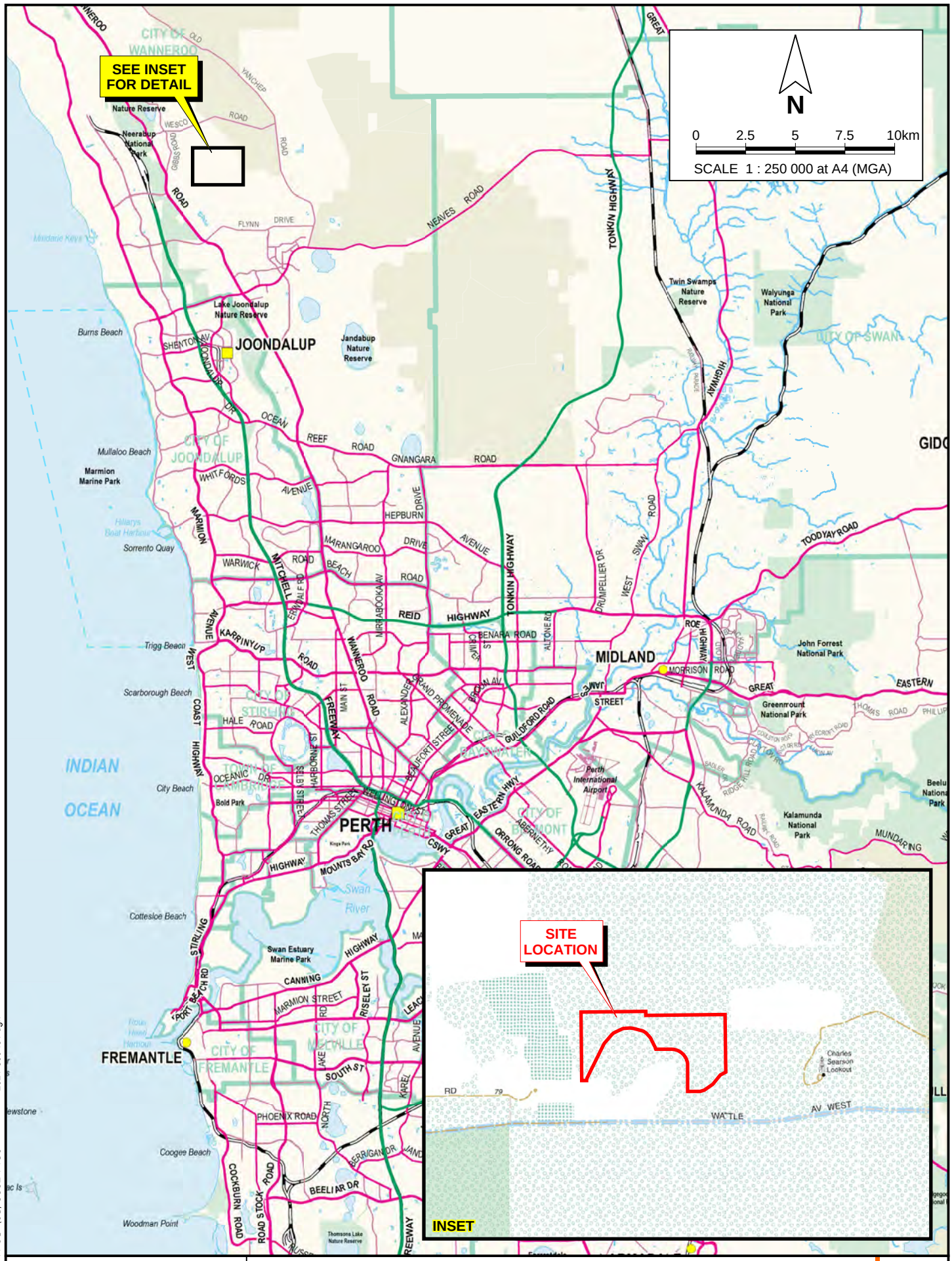
FIGURES



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Drawn: P. van der Moezel	Date: 28 Feb 2022
Job: 10398 Rpt: 2021-658	Revision: A

WA Limestone
FLORA AND VEGETATION SURVEY CPS 9197/1
LOT 8 WATTLE AVENUE WEST, NOWERGUP

SITE LOCATION

Figure 1

382 750mE
383 000mE
383 250mE
385 500mE
6 497 000mN
6 496 750mN
6 496 500mN
Lot 8
10
2
50
60
70
80
90
50 VC

N

0 25 50 75 100m

SCALE 1 : 2 500 at A3 (MGA)

Legend

- Site Boundary
- Cadastral Boundary
- Easement Boundary
- Topographic Contour

CONTOUR SOURCE: Dept. of Agriculture, 2000.
CADASTRAL SOURCE: Landgate, February 2022.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown January 2022.

pgv ENVIRONMENTAL

WA Limestone
FLORA AND VEGETATION SURVEY CPS 9197/1
LOT 8 WATTLE AVENUE WEST, NOWERGUP

Drawn: P. van der Moezel	Date: 28 Feb 2022
Job: 10398 Rpt: 2021-658	Revision: A

SITE BOUNDARY AND TOPOGRAPHY

Figure 2

2021-658-f02.dgn

PINPOINT CARTOGRAPHICS (08) 9562 7136

382 750mE
383 000mE
383 250mE
385 500mE
6 497 000mN
6 496 750mN
6 496 500mN
10
50
VC
2
Lot 8

Cleared
EdBs
Cleared
Bs
EdBs
EdBs
WA1
EdBs
WA2
Bs
Cleared
Bs
WA3
WA6
EdBs
WA4
WA5
BaBg
Bs

N

0 25 50 75 100m

SCALE 1 : 2 500 at A3 (MGA)

Legend

- Site Boundary
- Cadastral Boundary
- Easement Boundary
- Quadrat Location
- Vegetation Type Boundary
- Bs Vegetation Type

Vegetation Types

Bs
Banksia sessilis Tall Shrubland to Tall Open Scrub over *Xanthorrhoea preissii/Hibbertia hypericoides/Melaleuca systena/Calothamnus quadrifidus* Closed Low Heath

EdBs
Eucalyptus decipiens Low Open Woodland over *Banksia sessilis* Shrubland over *Xanthorrhoea preissii/Hibbertia hypericoides* Open Low Heath

BaBg
Banksia attenuata/B. grandis Low Open Woodland over *Xanthorrhoea preissii/Hibbertia hypericoides* Open Low Heath

CADASTRAL SOURCE: Landgate, February 2022.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown January 2022.

PINPOINT CARTOGRAPHICS (08) 9562 7136
2021-658-f03.dgn

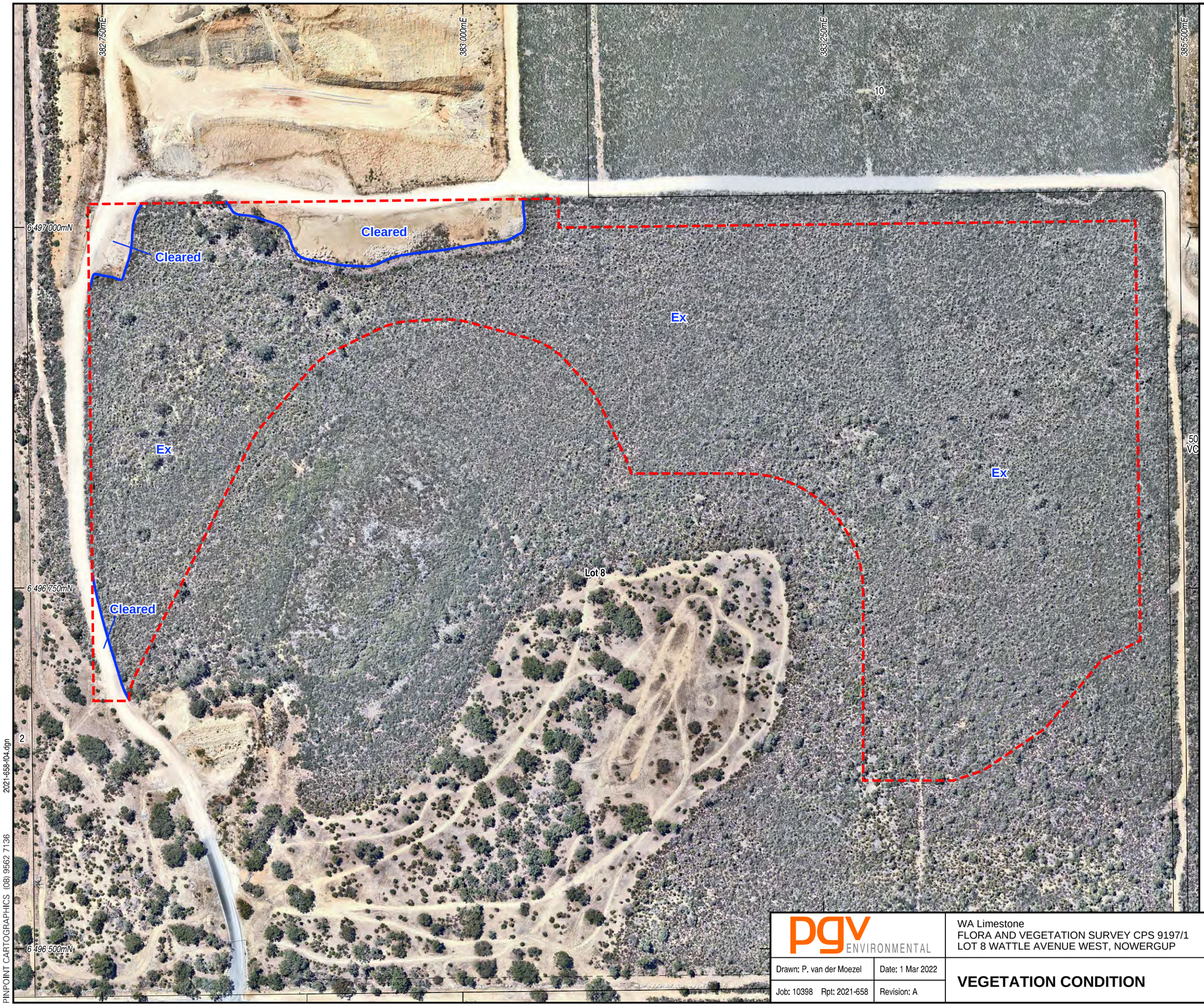
pgv ENVIRONMENTAL

WA Limestone
FLORA AND VEGETATION SURVEY CPS 9197/1
LOT 8 WATTLE AVENUE WEST, NOWERGUP

Drawn: P. van der Moezel | Date: 1 Mar 2022
Job: 10398 Rpt: 2021-658 | Revision: A

VEGETATION TYPES

Figure 3



N

0 25 50 75 100m

SCALE 1 : 2 500 at A3 (MGA)

Legend

- Site Boundary
- Cadastral Boundary
- Easement Boundary
- Vegetation Condition Boundary
- Ex — Vegetation Condition

Vegetation Condition
(SOURCE: Bush Forever, Govt. of W.A., 2000)

P - Pristine
Pristine or nearly so, no obvious signs of disturbance.

Ex - Excellent
Vegetation structure intact, disturbance affecting individual species and weeds are non aggressive species.

VG - Very Good
Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.

G - Good
Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.

D - Degraded
Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.

CD - Completely Degraded
The structure of the vegetation is no longer intact and the areas is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora composing weed or crop species with isolated native trees or shrubs.

Cl - Cleared
No native vegetation remaining.

CADASTRAL SOURCE: Landgate, February 2022.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown January 2022.

PINPOINT CARTOGRAPHICS (08) 9562 7136 2021-658-f04.dgn

pgv ENVIRONMENTAL

WA Limestone
FLORA AND VEGETATION SURVEY CPS 9197/1
LOT 8 WATTLE AVENUE WEST, NOWERGUP

Drawn: P. van der Moezel | Date: 1 Mar 2022
Job: 10398 Rpt: 2021-658 | Revision: A

VEGETATION CONDITION

Figure 4

382 750mE
383 000mE
383 250mE
385 500mE
6 497 000mN
6 496 750mN
6 496 500mN
10
50
VC
2
Lot 8

N

0 25 50 75 100m

SCALE 1 : 2 500 at A3 (MGA)

Legend

- Site Boundary
- Cadastral Boundary
- Easement Boundary
- Banksia Woodland TEC

CADASTRAL SOURCE: Landgate, February 2022.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown January 2022.

PINPOINT CARTOGRAPHICS (08) 9562 7136 2021-658-f05.dgn

pgv ENVIRONMENTAL

WA Limestone
FLORA AND VEGETATION SURVEY CPS 9197/1
LOT 8 WATTLE AVENUE WEST, NOWERGUP

Drawn: P. van der Moezel | Date: 28 Feb 2022
Job: 10398 Rpt: 2021-658 | Revision: A

BANKSIA WOODLAND TEC

Figure 5

APPENDIX 1

Flora Species List

SPECIES LIST –Wattle Ave West CPS 9197

GYMNOSPERMS

CYCADACEAE
Macrozamia riedlei

MONOCOTYLEDONS

ASPARAGACEAE
Acanthocarpus preissii
**Asparagus asparagoides*
Lomandra maritima
Lomandra sp
Sowerbaea laxiflora
Thysanotus patersonii
Thysanotus thyrsoideus

COLCHICACEAE
Burchardia congesta

CYPERACEAE
Caustis dioica
Lepidosperma pubisquameum
Mesomelaena pseudostygia
Morelotia octandra
Schoenus clandestinus

HAEMODORACEAE
Anigozanthos humilis
Conostylis aculeata subsp. *aculeata*
Conostylis candicans subsp. *calcicola*
Conostylis setigera
Haemodorum laxum

HEMEROCALLIDACEAE
Dianella revoluta var. *divaricata*
Tricoryne elatior

IRIDACEAE
**Gladiolus caryophyllaceus*
**Moraea flaccida*
Patersonia occidentalis
**Romulea rosea*

ORCHIDACEAE
Caladenia flava
Eriochilus dilatatus
Microtis media
Pyrorchis nigricans
Thelymitra benthamiana
Thelymitra sp

POACEAE
Austrostipa elegantissima
Austrostipa flavescens
Austrostipa sp
**Briza maxima*
**Briza minor*
**Bromus diandrus*
**Ehrharta calycina*
**Ehrharta longiflora*
**Pentameris airoides* subsp. *airoides*
Poa porphyroclados
**Vulpia myuros*

RESTIONACEAE
Desmocladus flexuosus

XANTHORRHOEACEAE
Xanthorrhoea brunonis
Xanthorrhoea preissii

DICOTYLEDONS

APIACEAE
Daucus glochidiatus
Xanthosia huegelii

ARALIACEAE
Trachymene pilosa

ASTERACEAE
**Arctotheca calendula*
Hyalosperma cotula
**Hypochaeris glabra*
Lagenophora huegelii
Olearia axillaris
Podolepis gracilis
Podotheca gnaphalioides

Pterochaeta paniculata
Siloxerus humifusus
**Sonchus oleraceus*
**Urospermum picroides*
**Ursinia anthemoides*
Waitzia suaveolens var. *suaveolens*

BRASSICACEAE
**Heliophila pusilla*
**Raphanus raphanistrum*

CAMPANULACEAE
Isotoma hypocrateriformis

CARYOPHYLLACEAE
**Petrorhagia dubia*
**Spergula arvensis*

CASUARINACEAE
Allocasuarina fraseriana
Allocasuarina humilis

DILLENIACEAE
Hibbertia hypericoides
Hibbertia racemosa

ERICACEAE
Leucopogon parviflorus
Styphelia erubescens
Styphelia polymorpha

FABACEAE
Acacia lasiocarpa
Acacia pulchella
Bossiaea eriocarpa
Gastrolobium capitatum
Gompholobium tomentosum
Hardenbergia comptoniana
Hovea trisperma var. *trisperma*
Jacksonia calcicola
Jacksonia sternbergiana
Kennedia prostrata
Mirbelia spinosa
Templetonia retusa

GENTIANACEAE
**Centaurium erythraea*

GERANIACEAE
**Pelargonium capitatum*

GOODENIACEAE
Dampiera linearis

LAMIACEAE
Hemiandra pungens

LAURACEAE
Cassytha flava
Cassytha racemosa

LORANTHACEAE
Nuytsia floribunda

MONTIACEAE
Calandrinia corrigioloides
Calandrinia liniflora

MYRTACEAE
Calothamnus quadrifidus
Calothamnus sanguineus
Eucalyptus decipiens
Kunzea glabrescens
Melaleuca huegelii
Melaleuca systena

OROBANCHACEAE
**Orobanche minor*

PHYLLANTHACEAE
Phyllanthus calycinus
Poranthera microphylla

POLYGALACEAE
Comesperma confertum
Comesperma integerrimum

PRIMULACEAE
**Lysimachia arvensis*

PROTEACEAE
Banksia attenuata
Banksia dallanneyi
Banksia grandis
Banksia sessilis
Grevillea preissii
Hakea lissocarpha
Hakea prostrata
Hakea ruscifolia
Hakea trifurcata
Petrophile linearis
Petrophile macrostachya
Petrophile serruriae
Templetonia retusa

RHAMNACEAE
Spyridium globulosum

RUBIACEAE
Opercularia vaginata

RUTACEAE
Philotheca spicata

STYLIDIACEAE
Levenhookia pusilla
Stylidium brunonianum
Stylidium calcaratum
Stylidium diuroides
Stylidium repens
Stylidium scariosum

VIOLACEAE
Hybanthus calycinus

APPENDIX 2

Quadrat Data

QUADRAT WA1

50 382840 E 6496929 N

Vegetation: *Eucalyptus decipiens* Low Open Woodland over *Banksia sessilis* Shrubland over *Xanthorrhoea preissii/Hibbertia hypericoides* Open Low Heath

Condition: Excellent

Soil Type: Orange-brown sand, some surface limestone

Landform: Gentle slope

Date: 10.11.21

Recorder: Paul van der Moezel

QUADRAT (10 x 10m)

SPECIES	HEIGHT (m)	COVER (%)
Eucalyptus decipiens	7	10
Banksia grandis	2	1
Banksia sessilis	1-2	20
Allocasuarina humilis	1.7	2
Xanthorrhoea preissii	1	3
Banksia attenuata	1	<1
Calothamnus quadrifidus	0.7	2
Acacia pulchella	0.7	1
Hibbertia hypericoides	0.6	30
Melaleuca systena	0.5	2
**Ehrharta longiflora*	0.5	<1
**Gladiolus caryophyllaceus*	0.5	<1
Austrostipa flavescens	0.5	<1
Morelotia octandra	0.4	2
**Briza maxima*	0.4	1
Haemodorum laxum	0.3	<1
Hakea trifurcata	0.3	<1

SPECIES	HEIGHT (m)	COVER (%)
**Bromus diandrus*	0.3	<1
Waitzia suaveolens	0.2	<1
Bossiaea eriocarpa	0.2	<1
Isotoma hypocrateriformis	0.2	<1
Desmocladus flexuosus	0.1	1
Stylidium calcaratum	0.1	<1
Conostylis setigera	0.1	<1
Xanthosia huegelii	0.1	<1
Eriochilus dilatatus	0.1	<1
Trachymene pilosa	0.1	<1
**Pentameris airoides* subsp. *airoides*	0.1	<1
**Lysimachia arvensis*	0.1	<1
Kennedia prostrata	<0.1	<1
**Hypochaeris glabra*	Flat	<1
Pyrorchis nigricans	Flat	<1
Cassytha racemosa	Climber	2

* introduced species

QUADRAT WA2

50 382820 E 6496816 N

Vegetation: *Banksia sessilis* Tall Open Scrub over *Xanthorrhoea preissii/Hibbertia hypericoides/Melaleuca systena/Calothamnus quadrifidus* Closed Low Heath
Condition: Excellent
Soil Type: Orange-brown sand, some surface limestone
Landform: Gentle slope
Date: 10.11.21
Recorder: Paul van der Moezel

QUADRAT (10 x 10m)

SPECIES	HEIGHT (m)	COVER (%)
Banksia sessilis	1-2	30
Melaleuca systena	1.9	25
Xanthorrhoea preissii	1.9	25
Xanthorrhoea brunonis	1	1
Calothamnus quadrifidus	0.9	3
Leucopogon parviflorus	0.8	<1
**Gladiolus caryophyllaceus*	0.7	<1
Hakea lissocarpha	0.6	<1
**Gladiolus caryophyllaceus*	0.6	<1
Hibbertia hypericoides	0.5	60
Bossiaea eriocarpa	0.5	<1
Poa drummondiana	0.5	<1
Thysanotus thyrsoideus	0.5	<1
Mesomelaena pseudostygia	0.4	4
Calothamnus sanguineus	0.4	<1
Lepidosperma pubisquameum	0.4	<1

SPECIES	HEIGHT (m)	COVER (%)
Acacia lasiocarpa	0.4	<1
Morelotia octandra	0.4	<1
Lomandra maritima	0.3	<1
Stylidium brunonianum	0.3	<1
**Ursinia anthemoides*	0.2	1
Waitzia suaveolens	0.2	<1
**Petrorhagia dubia*	0.2	<1
**Vulpia myuros*	0.2	<1
Haemodorum laxum	0.2	<1
Conostylis aculeata	0.2	<1
Banksia dallanneyi	0.2	<1
**Bromus diandrus*	0.2	<1
**Lysimachia arvensis*	0.2	<1
Desmocladus flexuosus	0.1	<1
Trachymene pilosa	0.1	<1
Stylidium calcaratum	0.1	<1
**Pentameris airoides* subsp. *airoides*	0.1	<1
**Sonchus oleraceus*	0.1	<1
Conostylis setigera	0.1	<1
**Hypochaeris glabra*	Flat	<1
Cassytha flava	Climber	<1
Cassytha racemosa	Climber	<1

* introduced species

QUADRAT WA3

50 383211 E 6496908 N

Vegetation: *Banksia sessilis* Tall Shrubland over *Xanthorrhoea preissii/Hibbertia hypericoides/Melaleuca systena* Closed Low Heath
Condition: Excellent
Soil Type: Orange-brown sand, some surface limestone
Landform: Gentle slope
Date: 10.11.21
Recorder: Paul van der Moezel

Quadrat (10 x 10m)

SPECIES	HEIGHT (m)	COVER (%)
Banksia sessilis	1.5-2	25
Xanthorrhoea preissii	2	5
Hakea trifurcata	1.9	1
Hakea prostrata	1.4	1
Comesperma confertum	1.2	<1
Xanthorrhoea brunonis	1	2
Acacia pulchella	1	1
**Gladiolus caryophyllaceus*	1	<1
Melaleuca systena	0.6	10
Hibbertia hypericoides	0.5	30
Calothamnus sanguineus	0.4	1
Lomandra maritima	0.4	1
Lepidosperma pubisquameum	0.4	1
Hakea lissocarpha	0.4	<1
Morelotia octandra	0.4	<1
Bossiaea eriocarpa	0.3	1
Mesomelaena pseudostygia	0.3	1
Leucopogon parviflorus	0.3	<1

SPECIES	HEIGHT (m)	COVER (%)
Hibbertia racemosa	0.3	<1
Acacia lasiocarpa	0.3	<1
Haemodorum laxum	0.3	<1
Desmocladus flexuosus	0.2	1
**Briza maxima*	0.2	<1
Gompholobium tomentosum	0.2	<1
**Ehrharta longiflora*	0.2	<1
Trachymene pilosa	0.1	<1
Stylidium calcaratum	0.1	<1
**Hypochaeris glabra*	Flat	<1
Lagenophora huegelii	Flat	<1
Cassytha racemosa	Climber	<1

* introduced species

QUADRAT WA4

50 383299 E 6496821 N

Vegetation: *Eucalyptus decipiens* Low Open Woodland over *Banksia sessilis* Shrubland over *Xanthorrhoea preissii/Hibbertia hypericoides* Open Low Heath

Condition: Excellent

Soil Type: Orange-brown sand, some surface limestone

Landform: Gentle slope

Date: 10.11.21

Recorder: Paul van der Moezel

QUADRAT (10 x 10m)

SPECIES	HEIGHT (m)	COVER (%)
Eucalyptus decipiens	8	5
Banksia sessilis	1.5-2	25
Calothamnus quadrifidus	1.9	2
Kunzea glabrescens	1.8	1
Xanthorrhoea preissii	1.5	8
Acacia pulchella	1.4	1
Xanthorrhoea brunonis	0.8	1
**Gladiolus caryophyllaceus*	0.6	<1
Hibbertia hypericoides	0.5	40
Morelotia octandra	0.5	2
Mesomelaena pseudostygia	0.5	1
Burchardia congesta	0.5	<1
Calothamnus sanguineus	0.4	5
Haemodorum laxum	0.4	<1
Hakea lissocarpha	0.4	<1
Austrostipa compressa	0.4	<1
Thysanotus thyrsoideus	0.4	<1

SPECIES	HEIGHT (m)	COVER (%)
Desmocladus flexuosus	0.3	1
Hovea trisperma	0.3	<1
Thelymitra benthamiana	0.3	<1
**Briza maxima*	0.3	<1
**Centaurium erythraea*	0.2	<1
**Pentameris airoides* subsp. *airoides*	0.2	<1
Microtis media	0.2	<1
Waitzia suaveolens	0.2	<1
Conostylis aculeata	0.2	<1
Isotoma hypocrateriformis	0.2	<1
**Ursinia anthemoides*	0.2	<1
**Aira caryophyllea*	0.1	<1
Dampiera linearis	0.1	<1
**Orobanche minor*	0.1	<1
Stylidium brunonianum	0.1	<1
Tricoryne elatior	0.1	<1
Stylidium diuroides	0.1	<1
**Vulpia myuros*	0.1	<1
Pterochaeta paniculata	0.1	<1
Trachymene pilosa	<0.1	<1
Levenhookia pusilla	<0.1	<1
Schoenus clandestinus	<0.1	<1
Kennedia prostrata	<0.1	<1
Pyrorchis nigricans	Flat	<1
**Hypochaeris glabra*	Flat	<1
Cassytha racemosa	Climber	<1

* introduced species

QUADRAT WA5

50 383304 E 6496656 N

Vegetation: *Banksia attenuata/B. grandis* Low Open Woodland over *Xanthorrhoea preissii/Hibbertia hypericoides* Open Low Heath
Condition: Excellent
Soil Type: Orange-brown sand, some surface limestone
Landform: Flat
Date: 10.11.21
Recorder: Paul van der Moezel

QUADRAT (10 x 10m)

SPECIES	HEIGHT (m)	COVER (%)
Banksia attenuata	4	10
Banksia grandis	3	5
Xanthorrhoea preissii	1.7	5
Acacia pulchella	1.1	1
Calothamnus quadrifidus	1.1	1
Xanthorrhoea brunonis	0.8	1
Hibbertia hypericoides	0.6	70
Petrophile macrostachya	0.6	<1
**Gladiolus caryophyllaceus*	0.6	<1
Austrostipa flavescens	0.6	<1
Gompholobium tomentosum	0.5	<1
Mesomelaena pseudostygia	0.4	1
Stylidium brunonianum	0.4	<1
Sowerbaea laxiflora	0.4	<1
Austrostipa flavescens	0.4	<1
Desmocladus flexuosus	0.3	1
Styphelia erubescens	0.3	<1
Opercularia vaginata	0.3	<1

SPECIES	HEIGHT (m)	COVER (%)
**Ursinia anthemoides*	0.3	<1
Haemodorum laxum	0.3	<1
**Ehrharta longiflora*	0.3	<1
**Briza maxima*	0.2	<1
**Lysimachia arvensis*	0.1	1
Stylidium diuroides	0.1	<1
Podolepis gracilis	0.1	<1
Stylidium calcaratum	0.1	<1
Trachymene pilosa	0.1	<1
**Pentameris airoides* subsp. *airoides*	0.1	<1
Schoenus clandestinus	<0.1	<1
Poranthera microphylla	<0.1	<1
Siloxerus humifusus	<0.1	<1
Levenhookia pusilla	<0.1	<1
**Hypochaeris glabra*	Flat	1
Pyrorchis nigricans	Flat	<1
Lagenophora huegelii	Flat	<1

* introduced species

QUADRAT WA6

50 383423 E 6496945 N

Vegetation: *Banksia sessilis* Tall Shrubland over *Xanthorrhoea preissii/Hibbertia hypericoides/Melaleuca systena/Calothamnus quadrifidus* Closed Low Heath

Condition: Excellent

Soil Type: Orange-brown sand, some surface limestone

Landform: Gentle slope

Date: 10.11.21

Recorder: Paul van der Moezel

QUADRAT (10 x 10m)

SPECIES	HEIGHT (m)	COVER (%)
Xanthorrhoea preissii	2.1	5
Banksia sessilis	1-2	25
Hakea trifurcata	2	1
Xanthorrhoea brunonis	1	1
Acacia pulchella	0.8	2
Acacia lasiocarpa	0.7	2
Melaleuca systena	0.6	10
Calothamnus quadrifidus	0.6	4
Allocasuarina humilis	0.6	1
Hibbertia hypericoides	0.5	75
Jacksonia calcicola	0.4	1
Austrostipa flavescens	0.4	<1
**Gladiolus caryophyllaceus*	0.4	<1
Lomandra maritima	0.4	<1
Opercularia vaginata	0.3	1
Desmocladus flexuosus	0.3	1
Banksia dallanneyi	0.2	<1

SPECIES	HEIGHT (m)	COVER (%)
**Ehrharta longiflora*	0.2	<1
**Urospermum picroides*	0.2	<1
**Centaurium erythraea*	0.2	<1
Trachymene pilosa	0.1	1
Conostylis candicans var. *calcicola*	0.1	<1
Hovea trisperma	0.1	<1
Daucus glochidiatus	0.1	<1
Stylidium calcaratum	0.1	<1
**Briza minor*	0.1	<1
**Pentameris airoides* subsp. *airoides*	0.1	<1
**Lysimachia arvensis*	<0.1	<1
Lagenophora huegelii	Flat	<1

* introduced species

Appendix 7
Fauna Assessment

WA Limestone
Wattle Avenue West Project
Fauna Assessment

View over the Wattle Avenue West site. Photo: Wes Bancroft.

Prepared for: WA Limestone
401 Spearwood Avenue
BIBRA LAKE WA 6163

Prepared by: Wes Bancroft and Mike Bamford
M.J. & A.R. BAMFORD CONSULTING ECOLOGISTS
23 Plover Way
KINGSLEY WA 6026

23rd February 2022

Executive Summary

Bamford Consulting Ecologists (BCE) was commissioned by WA Limestone to conduct a Basic (*sensu* EPA 2020) fauna assessment (desktop review and site inspection) of their proposed Wattle Avenue West quarry expansion in Nowergup. The purposes of this report are to provide information on the fauna values of the project area, an overview of the ecological function of the site within the local and regional context, and to provide discussion on the interaction of proposed development on the site with these fauna values and functions.

BCE uses a 'values and impacts' assessment process with the following components:

- The identification of **fauna values**:
  - Assemblage characteristics: uniqueness, completeness and richness;
  - Species of conservation significance;
  - Recognition of ecotypes or vegetation/substrate associations (VSAs) that provide habitat for fauna, particularly those that are rare, unusual and/or support significant fauna;
  - Patterns of biodiversity across the landscape; and
  - Ecological processes upon which the fauna depend.
- The review of **impacting processes** such as:
  - Habitat loss leading to population decline;
  - Habitat loss leading to population fragmentation;
  - Degradation of habitat due to weed invasion leading to population decline;
  - Ongoing mortality from operations;
  - Species interactions including feral and overabundant native species;
  - Hydrological change;
  - Altered fire regimes; and
  - Disturbance (dust, light, noise).
- The **recommendation** of actions to mitigate impacts (if requested).

Description of project area

The proposed location ('project area') for the 'Wattle Avenue West' quarry expansion is Lot 8, 259 Wattle Ave, in the suburb of Nowergup, approximately 34 km north of the Perth CBD. The project area is c. 15.5 ha, of which at c. 1.2 ha has previously been cleared (as per DPIRD 2022). The 'development footprint' of the expansion is not expected to take up the entire 14.3 ha of undeveloped lands within the project area.

The project area is within the Swan Coastal Plain 2 (SWA02) subregion of the Swan Coastal Plain bioregion and falls within the 'Cottesloe Complex – Central and South' of Heddle *et al.* (1980) and Webb *et al.* (2016). Bush Forever Site number 293 (Shire View Hill and adjacent bushland, Nowergup, Neerabup) sits just to the south of the project area, with at least one additional Environmentally Sensitive Area extending over the project area. The project area also sits within the 'Northern Swan Coastal Plain' Key Biodiversity Area. There are no known Ramsar Sites or Important Wetlands within the project area.

Key fauna values

Vegetation and Substrate Associations (VSAs) that provide habitat for fauna. Five major Vegetation and Substrate Associations were identified in the project area: Proteaceous heath (VSA 1), Banksia woodland (VSA 2), Limestone Marlock woodland (VSA 3), Rehabilitation (VSA 4), and Cleared (VSA 5).

Fauna assemblage. The desktop study identified 173 vertebrate fauna species as potentially occurring in the project area: no fish, eight frogs, 46 reptiles, 100 birds and 19 mammals. The presence of at least 23 species (20 birds and three mammals) was confirmed during the 2021 site inspection. The fauna assemblage is probably typical of the near-coastal shrublands of the coastal plain north of Perth. The assemblage is likely to be substantially complete except for the mammal component, which is depauperate in both medium-sized and small species. The assemblage is likely to be only moderately rich in a regional context as the environment consists largely of shrublands and lacks the banksia and eucalypt woodlands of the coastal plain slightly further east.

Species of conservation significance. Three broad levels of conservation significance are used in this report:

- Conservation Significance 1 (CS1) – species listed under State or Commonwealth Acts.
- Conservation Significance 2 (CS2) – species listed as Priority by DBCA but not listed under State or Commonwealth Acts.
- Conservation Significance 3 (CS3) – species not listed under Acts or in publications, but considered of at least local significance because of their pattern of distribution.

The majority of the 46 conservation significant species (including two reptiles, 35 birds, five mammals and four invertebrates) expected in the project area are likely to be residents or regular visitors/migrants visitors. Only five of the expected conservation species are listed under WA State and/or Commonwealth legislation (category CS1; four bird and one mammal), with seven listed as Priority by DBCA (category CS2; one reptile, two mammals and four invertebrates) and the remaining 34 considered locally significant (category CS3; one reptile, 31 birds and two mammals). Of most concern are Carnaby's Black-Cockatoo (CS1, known to be a regular migrant to the area and to use the project area for foraging), and Quenda (CS2, known to occur within the project area and expected to be resident).

Patterns of biodiversity. The three intact native VSAs can be expected to be richer in species than the rehabilitation and cleared areas. Differences in the fauna assemblage between these three VSAs might be slight, as they contain many of the same plant species and have broadly similar substrates. VSA 1 (proteaceous heath) and VSA 2 (banksia woodland) are notable for high nectar production important for a range of nectarivores (*Banksia* species) and supply of food for Carnaby's Black-Cockatoo. VSA3 (Limestone Marlock woodland) may be less productive in this respect. VSA 3 is notable as having the only eucalypts in the project area and thus may support some birds and invertebrates that are eucalypt specialists.

Key ecological processes. The ecological processes that currently have major effects upon the fauna assemblage include landscape permeability, hydrology, fire, and the presence of feral species.

Potential impacts upon fauna

Threatening processes reviewed in relation to the proposed development included: habitat loss, habitat fragmentation, degradation due to weed invasion, direct mortality during construction, ongoing mortality, impacts of feral and overabundant native species, hydrological change, fire and disturbance (dust, noise and light). Potential impacts are considered to be negligible to minor because of the small areas involved, the low number of conservation significant species expected to be regularly present within, and wholly reliant on, the project area (and the low likelihood of their disruption), and the general fauna assemblage being well-represented in the general region. The cumulative impact of habitat loss due to the proposed Wattle Avenue West quarry expansion project is not expected to be significant (clearing is expected to contribute less than a further 0.03% to the c. 55.2% of the cleared lands in the region).

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1 Introduction

WA Limestone is proposing to expand operations at its 'Wattle Avenue West' quarry within on Lot 8 - 259 Wattle Ave, in the suburb of Nowergup on the outskirts of the Perth Metropolitan area (see Figure 1).

Bamford Consulting Ecologists (BCE) was commissioned by WA Limestone to conduct a Basic (*sensu* EPA 2020) fauna assessment (desktop review and site inspection) of the proposed Wattle Avenue West quarry expansion. This report presents the results of that fauna desktop review and site inspection.

1.1 General approach to fauna impact assessment

The purpose of impact assessment is to provide government agencies with the information they need to decide upon the significance of impacts of a proposed development, and to provide information to proponents to help them to develop appropriate strategies for avoiding and minimising impacts of their activities. This relies on information on the fauna assemblage and its environment, and BCE uses an approach with the following components:

- The identification of **fauna values**:
  - Assemblage characteristics: uniqueness, completeness and richness;
  - Species of conservation significance;
  - Recognition of ecotypes or vegetation/substrate associations (VSAs) that provide habitat for fauna, particularly those that are rare, unusual and/or support significant fauna;
  - Patterns of biodiversity across the landscape; and
  - Ecological processes upon which the fauna depend.
- The review of **impacting processes** such as:
  - Habitat loss leading to population decline;
  - Habitat loss leading to population fragmentation;
  - Degradation of habitat due to weed invasion leading to population decline;
  - Ongoing mortality from operations;
  - Species interactions including feral and overabundant native species;
  - Hydrological change;
  - Altered fire regimes; and
  - Disturbance (dust, light, noise).
- The **recommendation** of actions to mitigate impacts (if requested).

Based on the impact assessment process above, the objectives of the study are therefore to:

1. Conduct a literature review and searches of Commonwealth and State fauna databases;
2. Review the list of fauna expected to occur on the site in the light of fauna habitats present, with a focus on investigating the likelihood of significant species being present;
3. Identify significant or fragile fauna habitats within the project area;
4. Identify any ecological processes in the project area upon which fauna may depend;
5. Identify general patterns of biodiversity within or adjacent to the project area, and
6. Identify potential impacts upon fauna and propose recommendations to minimise impacts.

Descriptions and background information on these values and processes can be found in Appendices 1 to 4. Based on this impact assessment process, the objectives of investigations are to: identify fauna values; review impacting processes with respect to these values and the proposed development; and provide recommendations to mitigate these impacts.

1.2 Description of project area and background environmental information

1.2.1 Project area

For spatial terminology (i.e. definitions of project, survey and study areas) see Section 2.1.1 below.

The proposed location ('project area') for the 'Wattle Avenue West' quarry expansion location is Lot 8, 259 Wattle Ave, Nowergup, adjacent to existing quarries within Mining Tenement M70/143, approximately 34 km north of the Perth CBD. The project area is c. 15.5 ha, of which at c. 1.2 ha has previously been cleared (as per DPIRD 2022). The 'development footprint' of the expansion is not expected to take up the entire 14.3 ha of undeveloped lands within the project area.

The field investigations in this environmental impact assessment were conducted within the project area only and, therefore, the 'survey area' and project area are treated as synonymous from hereon.

1.2.2 Interim Biogeographic Regionalisation of Australia (IBRA) and landscape characteristics

The Interim Biogeographic Regionalisation of Australia (IBRA) has identified 26 bioregions in Western Australia which are further divided into subregions (DAWE 2022b). Bioregions are classified on the basis of climate, geology, landforms, vegetation and fauna (Thackway and Cresswell 1995). IBRA Bioregions are affected by a range of different threatening processes and have varying levels of sensitivity to impact (EPA 2016c). The project area is within the Swan Coastal Plain 2 (SWA02) subregion of the Swan Coastal Plain bioregion, as mapped in Figure 2. This bioregion falls within the Bioregion Group 1 (South-West Botanical Province) classification of EPA (2016c) where native vegetation is "extensively cleared for agriculture".

The Swan Coastal Plain 2 subregion was described by Mitchell *et al.* (2003) and a summary of their work follows here. The Swan Coastal Plain is a low lying coastal plain, mainly covered with woodlands. It is dominated by Banksia or Tuart on sandy soils, *Casuarina obesa* on outwash plains, and paperbark in swampy areas. In the east, the plain rises to duricrusted Mesozoic sediments dominated by Jarrah woodland. The climate is Warm Mediterranean. Three phases of marine sand dune development provide relief. The outwash plains, once dominated by *C. obesa*-Marri woodlands and Melaleuca shrublands, are extensive only in the south. The Perth subregion is composed of colluvial and aeolian sands, alluvial river flats, coastal limestone. Heath and/or Tuart woodlands on limestone, Banksia and Jarrah-Banksia woodlands on Quaternary marine dunes of various ages, Marri on colluvial and alluvials. Includes a complex series of seasonal wetlands and also includes Rottnest, Carnac and Garden Islands etc. Rainfall ranges between 600 and 1000 mm annually and the climate is Mediterranean.

1.2.3 Land systems and vegetation complexes

Heddle *et al.* (1980) and Webb *et al.* (2016) have defined and described broad vegetation complexes for the Swan Coastal Plain and the mapping of these is provided by DBCA (2022h). The project area is located wholly within one of these:

- Cottesloe Complex – Central and South: Mosaic of woodland of *Eucalyptus gomphocephala* (Tuart) and open forest of *Eucalyptus gomphocephala* (Tuart) - *Eucalyptus marginata* (Jarrah) - *Corymbia calophylla* (Marri); closed heath on the Limestone outcrops.

Heddle vegetation complexes in the vicinity of the project area are mapped in Figure 3 (data provided by DBCA 2022h).

1.2.4 Land use and tenure

The dominant land uses within the Swan Coastal Plain 2 (SWA02) subregion are cultivation – dry land agriculture, conservation, UCL and Crown reserves, urban, rural residential, cultivation – irrigated horticulture, agriculture and plantations, forestry-plantations, roads and other easements and infrastructure, and grazing – Improved pastures, with smaller areas of mining, and defence lands (Mitchell *et al.* 2003). The project area lies in the central sector of the subregion. At the local scale, the project area is surrounded by areas of agriculture, plantations and mining.

1.2.5 Recognised sensitive sites

Bush Forever Site number 293: Shire View Hill and adjacent bushland, Nowergup, Neerabup (Dell and Banyard 2000) sits just to the south project area, as shown in Figure 4 (data provided by DPLH 2022). This Bush Forever listing is also captured in the database of Environmentally Sensitive Areas (DWER 2022a, b), with other sensitive areas extending over the project area as shown in Figure 5. The project area also sits within the 'Northern Swan Coastal Plain' Key Biodiversity Area (KBA 2022), listed because "supports a considerable portion of the non-breeding population of the endangered Carnaby's Black-Cockatoo and a small number of breeding pairs" (KBAP 2020). There are no known Ramsar Sites (DBCA 2022f) or Important Wetlands (DBCA 2022c), within the project area.

1.2.6 Climate information

The project areas falls within the Köppen climate classification of 'Hot-summer Mediterranean climate (*Csa*)', which is characterised by s characterized by dry summers and mild, wet winters. They usually occur on the western sides of continents between the latitudes of 30° and 45°. Hot-summer Mediterranean climates are in the polar front region in winter, and thus have moderate temperatures and changeable, rainy weather. Summers are hot and dry, due to the domination of the subtropical high pressure systems, except in the immediate coastal areas, where summers are milder due to the nearby presence of cold ocean currents that may bring fog but prevent rain (Anon. 2022; BOM 2022a).

For the Swan Coastal Plain 2 (SWA02) subregion, climate is "Warm Mediterranean" (Mitchell *et al.* 2003).

Climate averages (temperate, rainfall, sunshine) for the project area, as provided by BOM (2022b), are presented in Table 1.

Table 1. Climate averages for the project area.

Data from BOM (2022b) for:
Site name = GINGIN AERO
Site number = 009178

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years		Plot	Map
Temperature																	
Mean maximum temperature (°C)	33.1	33.0	30.8	26.8	22.8	19.7	18.4	19.1	20.8	24.4	28.1	30.9	25.7	25	1996 2021		
Mean minimum temperature (°C)	16.4	17.0	15.4	12.0	8.9	7.2	6.4	6.6	7.4	9.3	12.0	14.4	11.1	25	1996 2021		
Rainfall																	
Mean rainfall (mm)	15.7	15.5	19.1	27.1	73.1	109.3	129.1	108.6	77.3	33.9	19.4	10.1	620.7	20	1996 2021		
Decile 5 (median) rainfall (mm)	1.6	3.0	11.4	23.6	70.0	113.0	123.2	116.8	82.4	29.6	12.2	4.2	605.5	25	1996 2021		
Mean number of days of rain ≥ 1 mm	1.2	1.4	2.5	4.2	8.6	10.3	13.9	12.1	10.1	5.4	3.3	1.9	74.9	24	1996 2021		

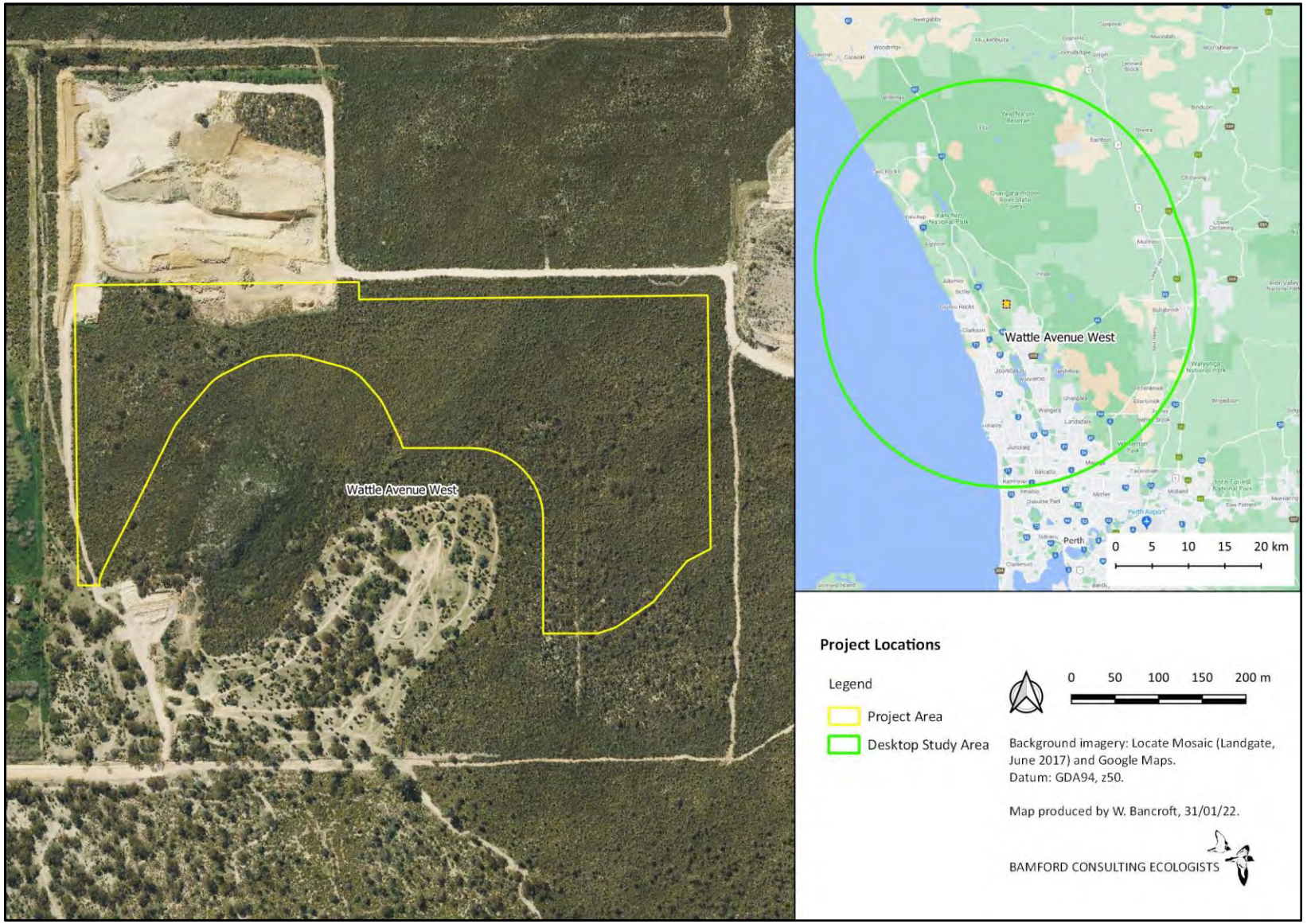

Figure 1. Location of the Wattle Avenue West Project.

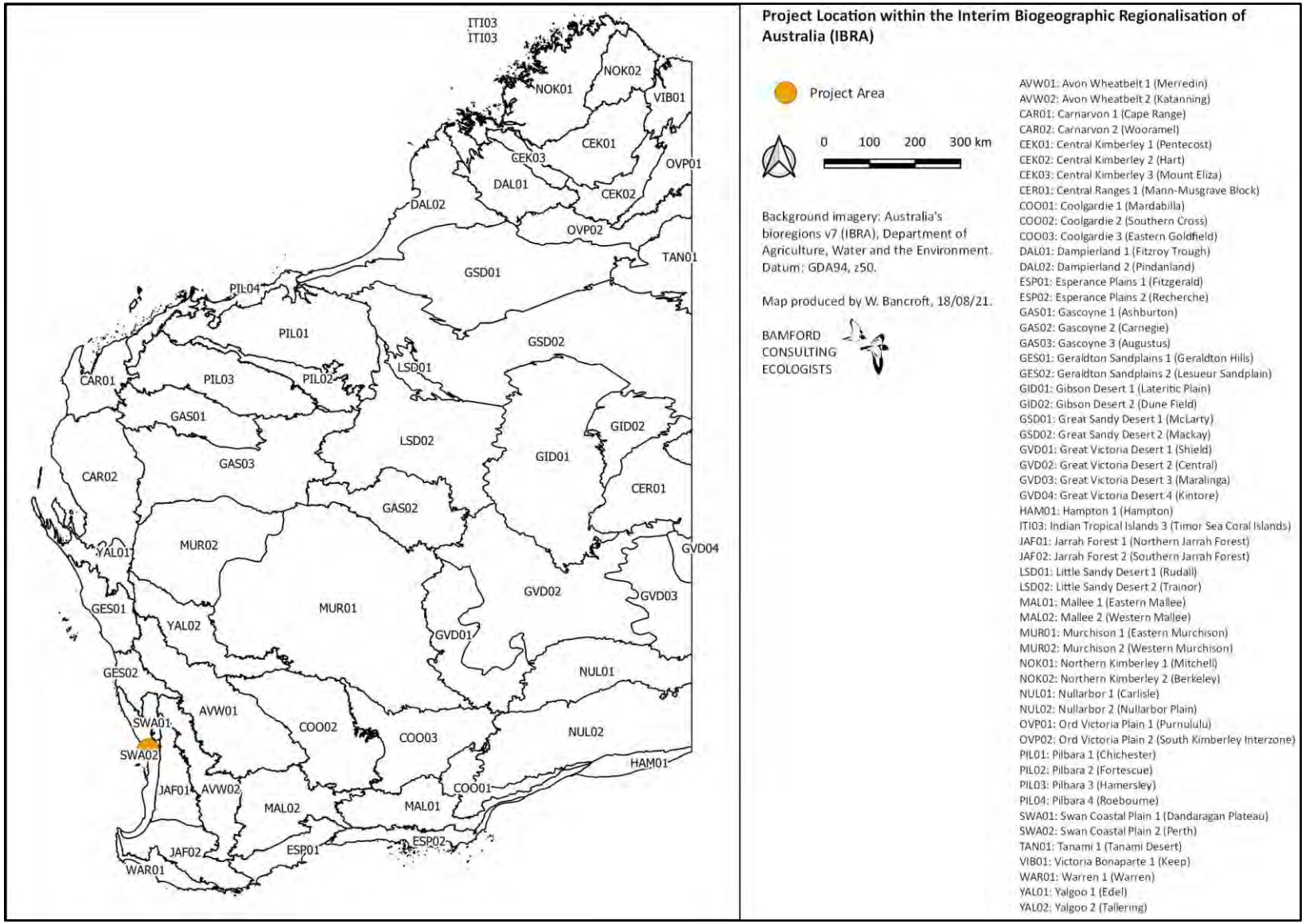

Figure 2. Project location within the Interim Biogeographic Regionalisation of Australia (IBRA).

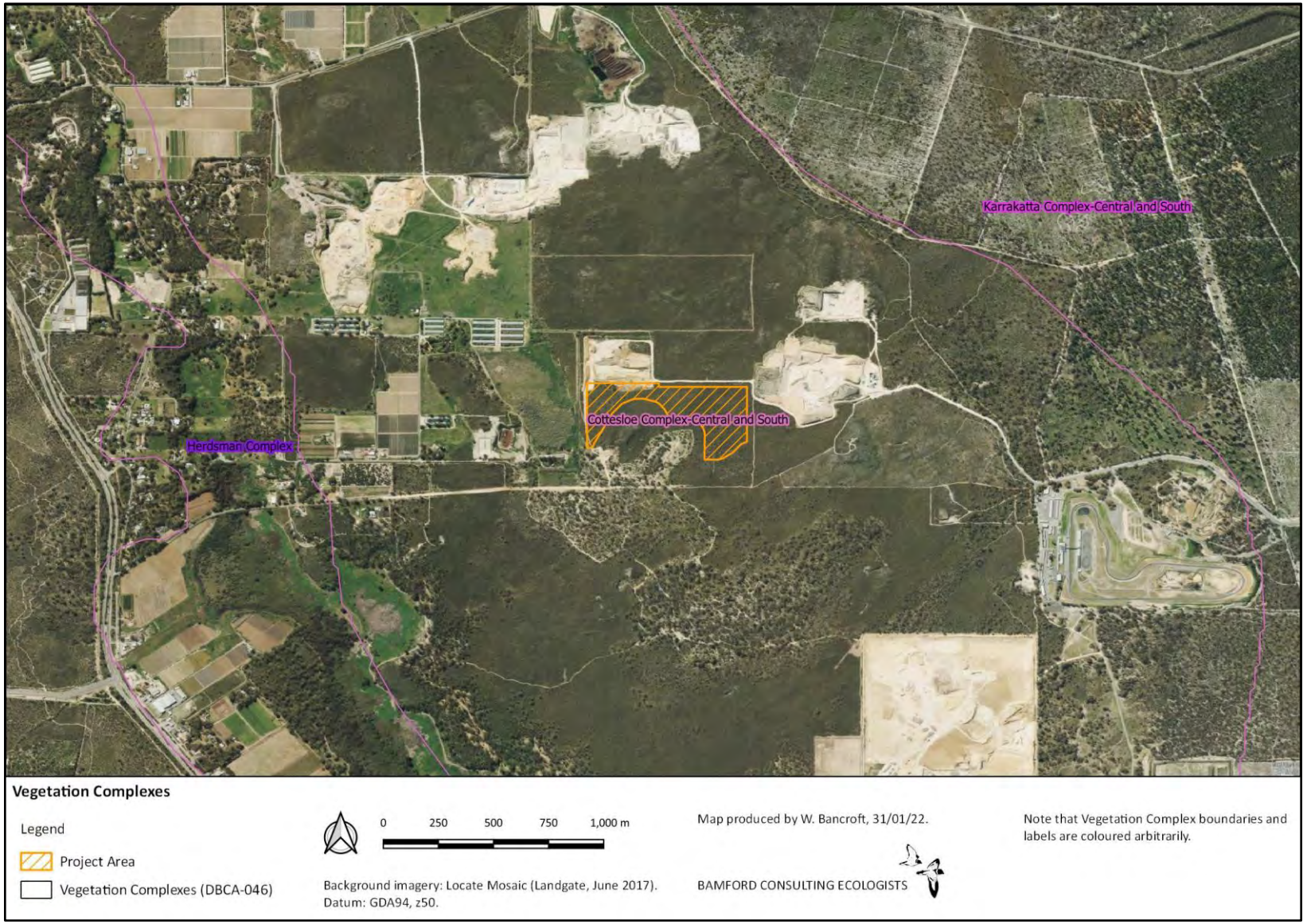

Figure 3. Vegetation Complexes (Heddle *et al*. 1980) in the vicinity of the Wattle Avenue West Project.

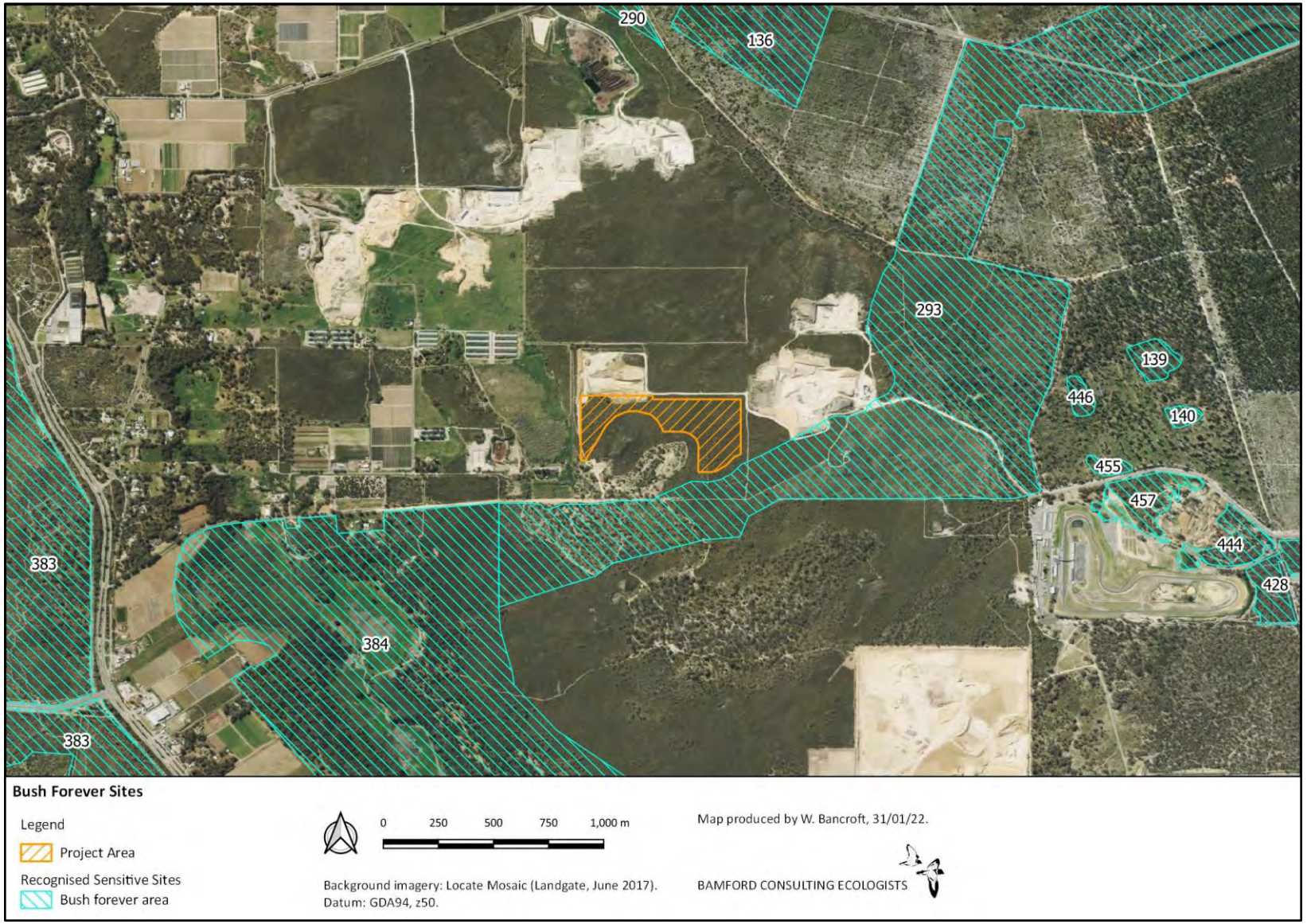

Figure 4. Bush Forever Sites (Dell and Banyard 2000) in the vicinity of the Wattle Avenue West Project.

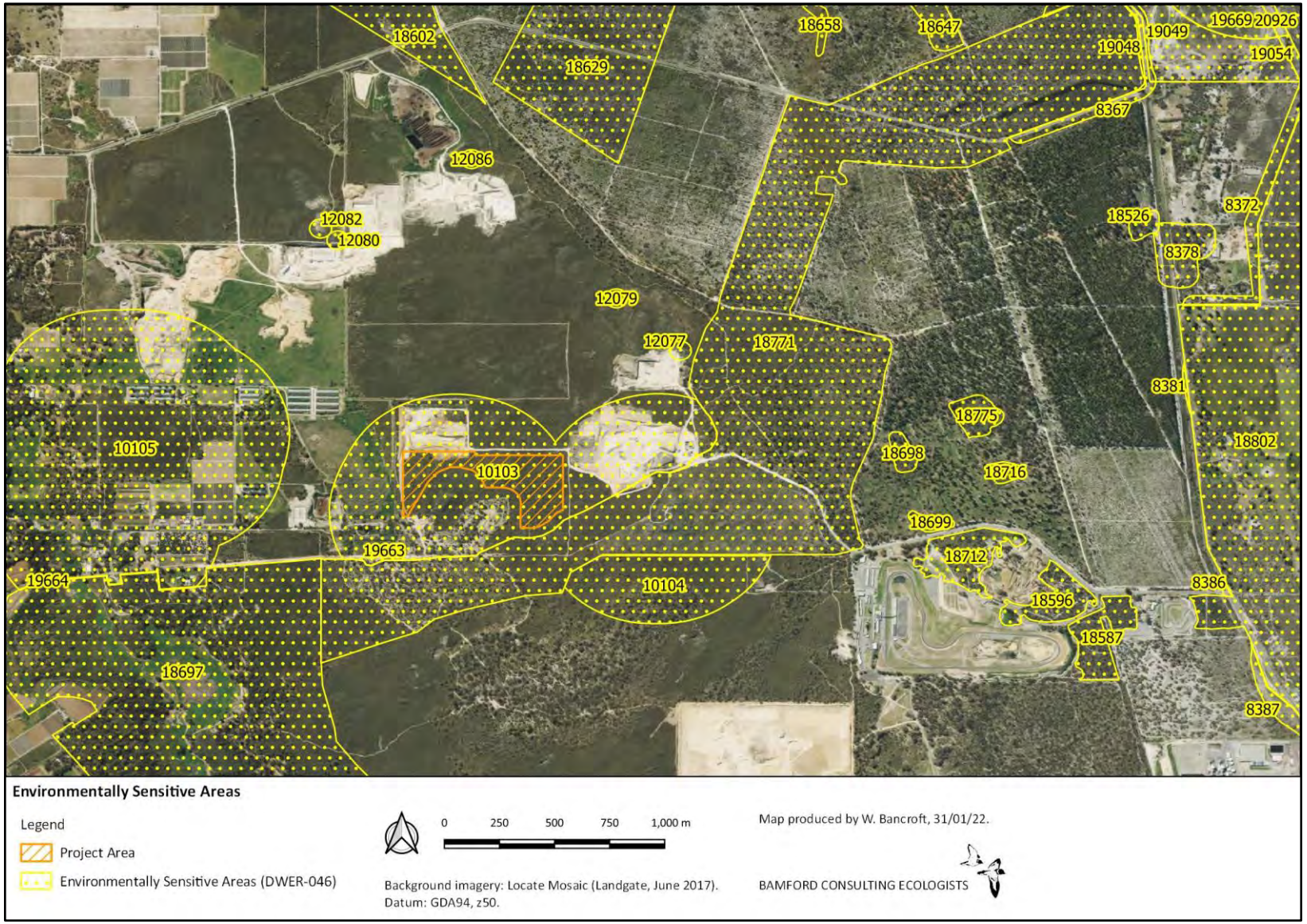

Figure 5. Environmentally Sensitive Areas (DWER 2022 a,b) in the vicinity of the Wattle Avenue West Project.

2 Methods

2.1 Overview

This approach to fauna impact assessment has been developed with reference to guidelines and recommendations set out by the Western Australian Environmental Protection Authority (EPA) on fauna surveys and environmental protection (EPA 2002, 2016c, b, 2020), and Commonwealth biodiversity legislation (DotE 2013; DSEWPaC 2013a). The EPA (2020) recommends three levels of investigation that differ in their approach for field investigations:

- Basic – a low-intensity survey, conducted at the local scale to gather broad fauna and habitat information (formerly referred to as 'Level 1'). The primary objectives are to verify the overall adequacy of the desktop study, and to map and describe habitats. A basic survey can also be used to identify future survey site locations and determine site logistics and access. The results from the basic survey are used to determine whether a detailed and/or targeted survey is required. During a basic survey, opportunistic fauna observations should be made and low-intensity sampling can be used to gather data on the general faunal assemblages present. While referred to as 'basic', this level of survey is involved and powerful, and should be considered the primary level of assessment. Other levels of assessment (where deemed necessary) add information to inform this primary level.
- Detailed – a detailed survey to gather quantitative data on species, assemblages and habitats in an area (formerly referred to as 'Level 2'). A detailed survey requires comprehensive survey design and should include at least two survey phases appropriate to the biogeographic region (bioregion). Surveys should be undertaken during the seasons of maximum activity of the relevant fauna and techniques should be selected to maximise the likelihood that the survey will detect most of the species that occur, and to provide data to enable some community analyses to be carried out.
- Targeted – to gather information on significant fauna and/or habitats, or to collect data where a desktop study or field survey has identified knowledge gaps. Because impacts must be placed into context, targeted surveys are not necessarily confined to potential impact areas. A targeted survey usually requires one or more site visits to detect and record significant fauna and habitats. For areas with multiple significant species there may not be a single time of year suitable to detect all species. In these cases, multiple visits, each targeting different species or groups, should be conducted.

The level of assessment recommended by the EPA (2020) is determined by geographic position, with a generic statement that detailed surveys are expected across all of the state except the south-west, but also recommending that site and project characteristics be considered, such as the survey objectives, existing available data, information required, the scale and nature of the potential impacts of the proposal and the sensitivity of the surrounding environment in which the disturbance is planned. These aspects should be considered in the context of the information acquired by the desktop study. When determining the type of survey required, the EPA (2020) suggested that the following be considered:

- level of existing regional knowledge
- type and comprehensiveness of recent local surveys
- degree of existing disturbance or fragmentation at the regional scale
- extent, distribution and significance of habitats

- significance of species likely to be present
- sensitivity of the environment to the proposed activities
- scale and nature of impact.

Guidance for field investigations methods is provided by the EPA (2016c, 2020) and by Bamford *et al.* (2013).

A 'basic' level survey (desktop review, fauna habitat identification and a site inspection) is considered appropriate for the current project. This is based upon the level of existing knowledge (see Section 2.3 below), the extent, distribution and significance of habitats (widespread) and the significance of species likely to be present (generally a limited assemblage of significant species).

The approach and methods utilised in this report are divided into three groupings that relate to the stages and the objectives of impact assessment:

- **Desktop assessment.** The purpose of the desktop review is to produce a species list that can be considered to represent the vertebrate fauna assemblage of the project area based on unpublished and published data using a precautionary approach.
- **Field investigations.** The purpose of the field investigations carried out for a Basic assessment is to gather information on the vegetation and soil associations ('habitats') that support the fauna assemblage and place the list generated by the desktop review into the context of the environment of the project area. The brief field investigations that form part of a Basic assessment also allow for some fauna observations to be made and assist the consultant to develop an understanding of the ecological processes that may be operating in the project area.
- **Impact assessment.** Determine how the fauna assemblage may be affected by the proposed development based on the interaction of the project with a suite of ecological and threatening processes.

2.1.1 Spatial terminology

A range of terms are used through the report to refer to the spatial environment around the proposed project, and these are defined below:

- Study area – the outermost boundary of the desktop assessment that is almost always a specified buffer distance (see Section 2.3.1 below) around the *survey area*. The study area thus encompasses the *survey area* but includes the area from which databases are sourced.
- Survey area – the *survey area* is the area to which the results of the desktop analysis are directed and/or the area within which field investigations are conducted. Note that while the term '*survey area*' is used throughout the guidance provided by EPA (2020), it does not appear to be explicitly defined and, therefore, the above definition has been developed with interpretation of both the guidance and BCE report structure.
- Project area – this may be equivalent to the *survey area* but is strictly the land over which the proponent has tenure or some control and within which on-site impacts may occur.
- Development footprint – the expected extent of land clearing and/or development.

Where available, these spatial boundaries are mapped in Figure 1.

2.2 Identification of vegetation and substrate associations (VSAs)

Vegetation and substrate associations (VSAs) combine vegetation types, the soils or other substrate with which they are associated, and the landform. In the context of fauna assessment, VSAs are the environments that provide habitats for fauna.

BCE deliberately makes the distinction between 'habitat' (a species-specific term that may encompass the whole or part of one or more VSAs and is the physical subset of an ecosystem that a given species, or species group, utilises) and 'VSA' (a general, discrete and mutually exclusive spatial division of a target area, based on soil, vegetation and topography). It is recognised, however, that, within the broader EIA literature/guidance, the former term is used more or less synonymously to indicate the latter (e.g.' habitat assessment' used by EPA 2020). Further discussion is provided in Appendix 1.

For the current assessment, VSAs were identified based on the consultant's previous experience in the area, a vegetation assessment of the site (by RPS), and on observations made during the field investigations.

2.3 Desktop assessment of expected species

2.3.1 Sources of information

As per the recommendations of EPA (2020), information on the fauna assemblage of the project area was drawn from a range of sources including databases (as listed in Table 2) and reports from other fauna surveys in the region (as listed in Table 3). Information from these sources was supplemented with species expected in the area based on general patterns of distribution. Sources of information used for these general patterns are listed in Table 4.

2.3.2 Previous fauna surveys

Bamford Consulting Ecologists has undertaken multiple previous fauna investigations in the region of the current study area (Table 3). These indicate the local experience of the Bamford Consulting team in the region. Fauna records from almost all these investigations would have been added to NatureMap, and NatureMap will also contain records from other consultants who have worked in the region.

Table 2. Databases searched for the desktop review; accessed August 2021.

Database	Type of records held in database	Area searched
BCE Database	Fauna recorded by BCE in the vicinity of the project area.	25 km buffer around the centroid of the project area (383155E, 6496874N; or 31.657° S, 115.768° E).
Atlas of Living Australia (ALA 2022)	Fauna records from Australian museums and conservation/research bodies, including records from BirdLife Australia's Atlas (Birdata) Database.	25 km buffer around the centroid of the project area (383155E, 6496874N; or 31.657° S, 115.768° E).
NatureMap (DBCA 2022e)	Records from the Western Australian Museum (WAM) and Department of Biodiversity, Conservation and Attractions (DBCA) databases, including historical data and Threatened and Priority species in WA.	25 km buffer around the centroid of the project area (383155E, 6496874N; or 31.657° S, 115.768° E).
EPBC Protected Matters Search Tool (DAWE 2022g)	Records on MNES protected under the EPBC Act.	25 km buffer around the centroid of the project area (383155E, 6496874N; or 31.657° S, 115.768° E).
Index of Biodiversity Surveys for Assessment (IBSA) (DWER 2022c)	Flora and fauna data contained in EIA biodiversity survey reports.	25 km buffer around the centroid of the project area (383155E, 6496874N; or 31.657° S, 115.768° E).

Table 3. Literature sources for the desktop review.

Author	Title
Syrinx Environmental and Bamford Consulting Ecologists (2011)	Yellagonga Regional Park Fauna Baseline Survey. Level 2 (Detailed) fauna survey. Unpubl. report to City of Joondalup.
Basnett, G. and Bamford, M. (2013).	Fauna Survey of the Hepburn Heights Conservation Area, Padbury. Unpubl. report to Syrinx Environmental and City of Joondalup. Level 2 (Detailed) fauna survey.
Bamford, M. (2006).	Jindee Fauna Assessment. Unpubl. report to RPS Bowman Bishaw Gorham. Level 2 (Detailed) fauna survey.
Bamford, M. and Everard, C. (2017)	Capricorn Coastal Reserve Fauna Assessment. Level 1 and targeted survey. Unpubl. report to strategen environmental (jbs&g).
Bamford, M (2020)	Neerabup Industrial Estate pre-clearing fauna survey and translocation. Unpubl. notes to EcoLogical Australia. Level 2 (Detailed) fauna survey.
McKenzie *et al.* (2009)	Neerabup Road Fauna Underpass Monitoring Project. Unpubl. report to Main Roads WA. Targeted survey.
Bamford, M., Gamblin, T., McCreery, A. and Huang, N. (2019).	Fauna Assessment for VRX Silica Muchea Silica Sands Project. Unpubl. report to VRX Silica. Level 2 (Detailed) fauna survey.
Valentine, L., Wilson, B., Johnson, B., Huang, N and Reaveley, A. (2008).	Gnangara Sustainability Strategy. Comprehensive survey of fauna and other environmental factors, including chapters on vertebrate fauna and black-cockatoos.
Wadey, J., Huang, N. and Bamford, M. (2022).	Fauna Assessment for Lots 5324 and 8037 Duringen Road, Cowalla. Unpubl. report to Focussed Vision Consulting Pty Ltd. Level 1 ('Basic') fauna investigation and targeted assessment for black-cockatoos.

Table 4. Sources of information used for general patterns of fauna distribution.

Taxa	Sources
Fish	Morgan *et al.* (1998), Allen *et al.* (2003), Morgan *et al.* (2014), DoF (2022).
Frogs	Tyler and Doughty (2009), Anstis (2017).
Reptiles	Storr *et al*. (1983, 1990, 1999, 2002), Bush and Maryan (2011), Wilson and Swan (2021).
Birds	Johnstone and Storr (1998, 2005), Menkhorst *et al*. (2017).
Mammals	Van Dyck and Strahan (2008), Churchill (2009), Menkhorst and Knight (2011).

2.3.3 Nomenclature and taxonomy

As per the recommendations of the EPA (2020), the nomenclature and taxonomic order presented in this report are generally based on the Western Australian Museum's (WAM) Checklist of the Fauna of Western Australia 2021. The authorities used for each vertebrate group were: fish (Morgan *et al.* 2014), frogs (Doughty 2021a), reptiles (Doughty 2021b), birds (BirdLife Australia 2019; Gill *et al.* 2022), and mammals (Travouillon 2021). In some cases, more widely-recognised names and naming conventions have been followed, particularly for birds where there are national and international naming conventions in place (e.g. the BirdLife Australia working list of names for Australian Birds, and the International Ornithological Congress' 'World Bird List'). Similarly, the group name 'black-cockatoo' is consistently used for all three taxa in the South-West. English common names of species, where available, are used throughout the text; Latin names are presented with corresponding English names in tables in the appendices. The use of subspecies is limited to situations where there is an important (and relevant) geographically distinct population, or where the taxonomic distinction has direct relevance to the conservation status or listing of a taxon.

2.3.4 Interpretation of species lists

2.3.4.1 Expected occurrence

Species lists generated from the review of sources of information are generous as they include records drawn from a large region (the study area, see Figure 1) and possibly from environments not represented in the project area. Therefore, some species that were returned by one or more of the database and literature searches have been excluded because their ecology, or the environment within the project area, determine that it is highly unlikely that these species will be present. Such species can include, for example, seabirds that might occur as extremely rare vagrants at a terrestrial, inland site, but for which the site is of no importance. Species returned from the databases and not excluded on the basis of ecology or environment are therefore considered potentially present or expected to be present in the project area at least occasionally, whether or not they were recorded during field surveys, and whether or not the project area is likely to be important for them. This list

of expected species is therefore subject to interpretation by assigning each a predicted status, the expected occurrence, in the project area. The status categories used are:

- **Resident:** species with a population permanently present in the project area;
- **Regular migrant or visitor:** species that occur within the project area regularly in at least moderate numbers, such as part of an annual cycle;
- **Irregular Visitor:** species that occur within the project area irregularly such as nomadic and irruptive species. The length of time between visitations could be decades but when the species is present, it uses the project area in at least moderate numbers and for some time;
- **Vagrant:** species that occur within the project area unpredictably, in small numbers and/or for very brief periods. Therefore, the project area is unlikely to be of importance for the species; and
- **Locally extinct:** species that would have been present but has not been recently recorded in the local area and therefore is almost certainly no longer present in the project area.

These status categories make it possible to distinguish between vagrant species, which may be recorded at any time but for which the site is not important in a conservation sense, and species which use the site in other ways but for which the site is important at least occasionally. This is particularly useful for birds that may naturally be migratory or nomadic, and for some mammals that can also be mobile or irruptive, and further recognises that even the most detailed field survey can fail to record species which will be present at times. The status categories are assigned conservatively based on the precautionary principle. For example, a lizard known from the general area is assumed to be a resident unless there is very good evidence the site will not support it, and even then it may be classed as a vagrant rather than assumed to be absent if the site might support dispersing individuals. It must be stressed that these status categories are predictions only and that often very intensive sampling would be required to confirm a species' status.

The results of the database searches were reviewed and interpreted, and obvious errors and out of date taxonomic names were deleted.

2.3.4.2 Conservation significance

All expected species were assessed for conservation significance as detailed in Appendix 1. Three broad levels of conservation significance are used in this report:

- Conservation Significance 1 (CS1) – species listed under State or Commonwealth Acts such as the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the Western Australian *Biodiversity Conservation Act 2016* (BC Act);
- Conservation Significance 2 (CS2) – species listed as Priority by DBCA but not listed under State or Commonwealth Acts; and
- Conservation Significance 3 (CS3) – species not listed under Acts or in publications, but considered of at least local significance because of their pattern of distribution.

See Appendix 1 for an expanded discussion of these categories and Appendix 2 for a description of the categories used in the legislation (EPBC and BC Acts) and by the DBCA.

2.4 Field investigations

2.4.1 Overview

A site inspection was conducted to familiarise the consultants with the project area. This involved looking around as much of the project area as possible; including walking through areas that did not have direct vehicle access. This enabled:

- identification of VSAs (that provide fauna habitats);
- targeted searches for significant fauna and an assessment of their likelihood of occurrence based on VSAs present;
- continuous recording of bird species encountered; and
- opportunistic fauna observations.

2.4.2 Dates

The project area was visited on the 15th June 2021.

2.4.3 Black-cockatoo habitat analysis

2.4.3.1 Guidelines

The Commonwealth Department of Agriculture, Water and the Environment (DAWE) provides guidelines for the referral of actions that may result in impact to black-cockatoos (for assessment under the EPBC Act). The survey and analysis reported here have been conducted with strong reference to both the existing guidelines (DSEWPaC 2012) as well as the recently revised draft guidelines (DEE 2017). This includes application of the foraging habitat scoring tool in DEE (2017). In addition, survey methodology followed the recommendations listed on the DAWE's Species Profile and Threats Database (DAWE 2022c, d, e). Ecological values for black-cockatoos within the site were based on the definitions of breeding, foraging and roosting habitat as per the EPBC Act referral guidelines for black-cockatoos (DSEWPaC 2012).

The DBCA has also indicated that the methodology developed and applied previously by BCE (e.g. Bancroft and Bamford 2021), and as described below, to score nesting value and foraging habitat is an acceptable approach.

2.4.3.2 Breeding

The aim of the breeding surveys was to record all potential hollow-bearing trees (suitable for black-cockatoo nesting) within the project area. The entire project area (see Figure 1), was examined for the presence of these trees. The following information was recorded for every suitable tree[1] with a diameter at breast height (DBH) equal to or greater than 500 mm:

- tree location;
- tree species;
- life status;
- DBH; and

[1] the draft revised EPBC Act study guidelines (DEE 2017) stress that any tree species may provide suitable hollows. Note that trees where the DBH criterion is >300mm do not occur at Lowlands.

- nest-tree rank: trees were assessed (from the ground) for the potential presence/quality of nest-hollows and allocated a nesting rank (developed by BCE) as described in Table 5.

The BirdLife Australia database of black-cockatoo breeding surveys was also searched for relevant local records (see Peck 2019).

Table 5. Ranking system for the assessment of potential nest-trees for black-cockatoos (revised 08/01/2021).

As per (DAWE 2022c, d, e) guidance, a potential nest-tree is any tree with a diameter at breast height >500 mm (or >300 mm for *Eucalyptus salmonophloia* and *E. wandoo*). Note that black-cockatoos favour vertical hollows for the nest chamber, but the hollow entrance may be vertical (a chimney hollow), have a side entrance or have a horizontal spout entrance.

Rank	Description of tree and hollows/activity
1	Activity at hollow observed; adult (or immature) bird seen entering or emerging from hollow. Can also be used for a known nest tree active in the previous 12 months (although this should be noted in the description). Note that activity at a hollow does not absolutely mean that breeding is occurring unless a young bird in hollow is observed.
2	Hollow of suitable size visible with chew marks around entrance. Record if chew-marks are recent or old.
3	Potentially suitable hollow visible but no chew marks present at entrance; or potentially suitable hollow suspected to be present - as suggested by structure of tree, such as large, vertical trunk broken off at a height of >8m; but note that hollow height is contextual. Carnaby's Black-Cockatoo will nest in hollows <5m so in a Wheatbelt breeding site a lower criterion may be more appropriate.
4	Tree with large hollows or broken branches that might contain large hollows, but hollows or potential hollows (nest chamber) are not vertical or near-vertical; thus a tree with or likely to have hollows of sufficient size but not to have hollows of the angle preferred by Black-Cockatoos. Trees with low but otherwise suitable hollows can also be assigned a rank or 4, depending on the species of black-cockatoo likely to be present.
5	Tree lacking large hollows or broken branches that might have large hollows; a tree with more or less intact branches and a spreading crown.

2.4.3.3 Foraging

The foraging value of the study area was assessed by calculating a foraging score for areas of similar vegetation type/condition (see Appendix 5). The foraging score provides a numerical value that reflects the significance of vegetation as foraging habitat for black-cockatoos, and this numerical value is designed to provide the sort of information needed by DAWE, Department of Water and Environmental Regulation (DWER) and the Environmental Protection Authority (EPA) to assess impact significance and offset requirements. The foraging value of the vegetation depends upon the type, density and condition of trees and shrubs in an area, and can be influenced by the context such as the availability of foraging habitat nearby. The BCE scoring system for value of foraging habitat has three

components as detailed in Appendix 5. These three components are drawn from the DAWE offset calculator but with the scoring approach developed by BCE:

- A score out of six for the vegetation composition, condition and structure.
- A score out of three for the context of the site.
- A score out of one for species density.

Foraging value can thus be assigned a score out of six, based upon site vegetation characteristics, or a score out of 10 if context and species density are also considered. A higher score represents better foraging value. A score out of 10 is presented for the purposes of aiding offset calculations. The approach to assigning scores for vegetation, context and species density are outlined in Appendix 5. Foraging value scores are calculated differently for the three black-cockatoo species (Appendix 5) depending upon the vegetation present; thus a separated score is given for each VSA for each species.

Black-cockatoo foraging signs were also recorded in conjunction with the breeding tree surveys (see Section 2.4.3.2) and general site inspections. When observed, the location, tree species and approximate age of the foraging evidence were recorded. Black-cockatoo foraging evidence may persist for some months or years after the foraging event. There is currently no published evidence documenting the deterioration process of forage. Factors that help to establish the time since foraging include: the colour of nuts/foliage, the degree of weathering or decay of debris, the presence of small fragments of nut debris, the position/compression of the foraging debris relative to surrounding vegetation and leaf litter, and the strength of the eucalypt smell emitted. Despite the absence of empirical data, four categories of foraging activity were recognised, based on the time since foraging:

(i) Active – where birds were observed in the act of foraging;
(ii) Recent – foraging signs (e.g. chewed nuts or vegetation) were 'fresh' (i.e. foraging was likely to have occurred within days to weeks). Recent foraging signs were typically green and/or with very little sign of weathering. Approximately less than four weeks old;
(iii) Intermediate – foraging was likely to have occurred within weeks to months previously. Approximately one to six months old; and
(iv) Old – foraging was likely to have occurred months to years previously. Approximately more than six months old.

As an indication, Appendix 6 shows examples of Forest Red-tailed Black-Cockatoo foraging signs across the range of these categories (note that it is uncertain as to the exact time frame for each stage).

2.4.3.4 Roosting

As the breeding and foraging surveys were conducted, areas likely to be used as roosting sites (e.g. sites adjacent to watercourses with large trees) or areas that had cockatoo activity in the late-afternoon were noted.

The BirdLife Australia Great Cocky Count (GCC) database of roost sites was also searched for relevant local records (see Peck *et al.* 2019).

2.5 Personnel

Personnel involved in the field investigations and report preparation (including desktop review) are listed in Table 6.

Table 6. Personnel involved in the field investigations and report preparation.

Personnel	EIA Experience	Field Investigations	Report Preparation
Dr Wes Bancroft *BSc (Zoology/Microbiology), Hons (Zoology), PhD (Zoology)*	24 years	+	+
Dr Mike Bamford *BSc (Biology), Hons (Biology), PhD (Biology)*	40 years		+

2.6 Survey limitations

The EPA Guidance Statement 56 (EPA 2004) and the EPA (2020) outline a number of limitations that may arise during field investigations for Environmental Impact Assessment. These survey limitations are discussed in the context of the BCE investigation of the project area in Table 7. No limitations were identified.

The lack of detailed survey (i.e. intensive sampling of the fauna assemblage) is not considered a limitation as this assemblage is well-understood in the area due to multiple previous field investigations. Furthermore, EPA guidance does not consider limitations related to the effectiveness of field sampling for fauna but appears to make an assumption that the purpose of such sampling is to confirm the fauna assemblage. This is implicit in the EPA (2020) technical guidance that does provide suggestions for sampling techniques, but the level of field investigations suggested cannot confirm the presence of an entire assemblage, or confirm the absence of a species. This requires far more work than is possible (or recommended) for studies contributing to the EIA process because fauna assemblages vary seasonally and annually, and often have high levels of variation even over short distances (Beta diversity). For example, in an intensive trapping study, How and Dell (1990) recorded in any one year only about 70% of the vertebrate species found over three years. In a study spanning over two decades, Bamford *et al.* (2010) found that the vertebrate assemblage varies over time and space, meaning that even complete sampling at a set of sites only defines the assemblage of those sites at the time of sampling. The limited effectiveness of short periods of fauna sampling is not a limitation for impact assessment *per se*, as long as database information is interpreted effectively and field investigations are targeted appropriately. That is the approach taken by BCE.

Table 7. Survey limitations as outlined by EPA (2020).

EPA Survey Limitations	BCE Comment
Availability of data and information	Sufficient information from databases and previous studies (see Section 2.3.1). Not a limitation.
Competency/experience of the survey team, including experience in the bioregion surveyed	The ecologists have had extensive experience in conducting desktop reviews and reconnaissance surveys for environmental impact assessment fauna studies, and have undertaken a number of studies within the region. See also Table 6 for further details. Not a limitation.
Scope of the survey (e.g. were faunal groups were excluded from the survey)	The survey focused on terrestrial vertebrate fauna and fauna values. Some information on threatened invertebrates was available from databases. Not a limitation.
Timing, weather and season	Timing is not of great importance for Basic level field investigations in this region. Not a limitation.
Disturbance that may have affected results	None. Not a limitation.
The proportion of fauna identified, recorded or collected	All fauna observed were identified. Not a limitation.
Adequacy of the survey intensity and proportion of survey achieved (e.g. the extent to which the area was surveyed)	The site was adequately surveyed to the level appropriate for a Basic level assessment. Fauna database searches covered a 25 km radius beyond the centroid of the project area. The Basic level assessment was completed. Not a limitation.
Access problems	There were no access problems encountered. Not a limitation.
Problems with data and analysis, including sampling biases	There were no data problems. Not a limitation.

2.7 Presentation of results for Impact Assessment

While some impacts are unavoidable during a development, of concern are long-term, deleterious impacts upon biodiversity. This is reflected in documents such as the Significant Impact Guidelines provided by DSEWPaC (2012), as summarised in Appendix 4. Significant impacts may occur if:

- There is direct impact upon a VSA and the VSA is rare, a large proportion of the VSA is affected and/or the VSA supports significant fauna.
- There is direct impact upon conservation significant fauna.
- Ecological processes are altered and this affects large numbers of species or large proportions of populations, including significant species.

The impact assessment process therefore involves reviewing the fauna values identified through the desktop assessment and field investigations with respect to the project and impacting processes. The severity of impacts on the fauna assemblage and conservation significant fauna can then be quantified on the basis of predicted population change.

The presentation of this assessment follows the general approach to impact assessment as given in Section 1.1, but modified to suit the characteristics of the site. Key components to the general approach to impact assessment are addressed as follows:

Fauna values

This section presents the results of the desktop and field investigations in terms of key fauna values (described in detail in Appendix 1) and includes:

- Recognition of ecotypes or vegetation/substrate associations (VSAs);
- Assemblage characteristics (uniqueness, completeness and richness);
- Species of conservation significance;
- Patterns of biodiversity across the landscape; and
- Ecological processes upon which the fauna depend.

Impact assessment

This section reviews impacting processes (as described in detail in Appendix 3) with respect to the proposed development and examines the potential effect these impacts may have on the faunal biodiversity of the project area. It thus expands upon Section 1.1 and discusses the contribution of the project to impacting processes, and the consequences of this with respect to biodiversity. A major component of impact assessment is consideration of threats to species of conservation significance as these are a major and sensitive element of biodiversity. Therefore, the impact assessment section includes the following:

- Review of impacting processes; will the proposal result in:
    - Habitat loss leading to population decline, especially for significant species;
    - Habitat loss leading to population fragmentation, especially for significant species;
    - Weed invasion that leads to habitat degradation;
    - Ongoing mortality;
    - Species interactions that adversely affect native fauna, particularly significant species;
    - Hydrological change;
    - Altered fire regimes; or
    - Disturbance (dust, light, noise)?
- Summary of impacts upon significant species, and other fauna values.

The impact assessment concludes with recommendations for impact mitigation, based upon predicted impacts. Note that the terms direct and indirect impacts are not used in this report; for further explanation see Appendix 3.

2.7.1 Criteria for impact assessment

Impact assessment criteria are based on the severity of impacts on the fauna assemblage and conservation significant fauna, and quantified on the basis of predicted population change (Table 8). Population change can be the result of direct habitat loss and/or impacts upon ecological processes.

The significance of population change is contextual. The EPA (2016c) suggested that the availability of fauna habitats within a radius of 15 km can be used as a basis to predict low, moderate or high impacts. In this case, a high impact is where the impacted environment and its component fauna are

rare (less than 5% of the landscape within a 15 km radius or within the Bioregion), whereas a low impact is where the environment is widespread (e.g. >10% of the local landscape). Under the Ramsar Convention, a wetland that regularly supports 1% of a population of a waterbird species is considered to be significant. These provide some guidance for impact assessment criteria. In the following criteria (Table 8), the significance of impacts is based upon percentage population decline within a 15 km radius (effectively local impact) and upon the effect of the decline upon the conservation status of a recognised taxon (recognisably discrete genetic population, sub-species or species). Note that percentage declines can usually only be estimated on the basis of the distribution of a species derived from the extent of available habitat while for a few species, such as the Black-Cockatoos, there is guidance for the assessment of impact significance.

The impact assessment concludes with recommendations based upon predicted impacts and designed to mitigate these.

Table 8. Assessment criteria for impacts upon fauna.

Impact Category	Observed Impact
Negligible	Effectively no population decline; at most few individuals impacted and any decline in population size within the normal range of annual variability.
Minor	Population decline temporary (recovery after end of project such as through rehabilitation) or permanent, but < 1% within 15 km radius of centre-point of impact area (or within bioregion if this is smaller). No change in viability or conservation status of taxon.
Moderate	Permanent population decline 1-10% within 15 km radius. No change in viability or conservation status of taxon.
Major	Permanent population decline 10-50% within 15 km radius. No change in viability or conservation status of taxon.
Critical	Taxon decline > 50% (including local extinction) within 15 km and/or change in viability or conservation status of taxon.

2.8 Mapping

Low resolution maps have been provided within the body this report. Higher resolution maps and GIS files can be supplied if required. As per the recommendation of EPA (2020), maps use the GDA94 datum and are projected into the appropriate Map Grid of Australia (MGA94) zone.

3 Fauna values

3.1 Vegetation and substrate associations (VSAs) ['Habitat assessment']

Vegetation and substrate associations within the project area are a complex mosaic, largely reflecting soil types. A full vegetation assessment of an adjacent site (Wattle Avenue East) was conducted by PGV (2021). From this, and observations made during the field investigations here, five major vegetation and substrate associations (VSAs) were identified in relation to fauna in the project area:

VSA 1. Proteaceous heath. Heath dominated by proteaceous species, particularly *Banksia sessilis*, on orange-brown sands with some limestone outcropping. VSA 1 corresponds to the PGV (2021) vegetation category 'BsXpCq': *Banksia sessilis*/*Xanthorrhoea preissii*/*Calothamnus quadrifidus* Closed Tall Scrub over *Hibbertia hypericoides*/*Melaleuca systena*/*Jacksonia calcicola* Low Shrubland to Closed Low Heath. See Plate 1.

VSA 2. Banksia woodland. Woodland dominated by tree banksias, particularly *B. grandis*, and Christmas Trees (*Nuytsia floribunda*) over shrubland on pale sands. VSA 2 corresponds in part to the PGV (2021) vegetation category 'BsAf': *Banksia attenuata*/*Allocasuarina fraseriana* Low Open Woodland over *Jacksonia sternbergiana* Tall Shrubland over *Xanthorrhoea preissii*/*Hibbertia hypericoides* Open Low Heath. See Plate 2.

VSA 3. Limestone Marlock woodland. Woodland dominated by Limestone Marlock (*Eucalyptus decipiens*) on orange-brown sands with some limestone outcropping. VSA 3 corresponds to the PGV (2021) vegetation category 'Ed': *Eucalyptus decipiens* Low Open Woodland over *Xanthorrhoea preissii*/*Banksia sessilis* Open Shrubland to Tall Open Scrub. This occupies only a small area near the exiting quarry (Figure 6). See Plate 3.

VSA 4. Rehabilitation. Disturbed areas, with limestone substrate, that have undergone some rehabilitation of vegetation. VSA 4 corresponds to the PGV (2021) vegetation category 'Rehabilitation area': *Olearia axillaris*/*Cenchrus setaceus* Low Shrubland.

VSA 5. Cleared. Cleared or largely disturbed areas (e.g. roads, or where quarrying is being undertaken, or has taken place), or roads, tracks or drains. VSA 5 corresponds to the PGV (2021) vegetation category 'Cleared': cleared.

The extent of the VSAs in the project area is mapped in Figure 6.

Plate 1. VSA 1: Proteaceous heath.

Plate 2. VSA 2: Banksia woodland.

Plate 3. VSA 3: Limestone Marlock woodland.

Figure 6. The distribution of VSAs in the project area.

3.1.1 Regional development

The project area is located within a highly fragmented natural landscape that has been largely cleared for housing, agriculture or plantations. Figure 7 illustrates the existing extent of development in a 15 km buffer around the project area. Existing developments (c. 31,484 ha) impact c. 55.2% of the total land area within this buffer (c. 57,041 ha). The proposed Wattle Avenue West site has a total area of c. 15.5 ha, of which at c. 1.2 ha has been cleared. Therefore, up to an additional 14.3 ha may be impacted and this would, at most, contribute 0.03% to the land clearing within the region, taking the total developments in the region to c. 55.23% of the area. It should be noted that the development footprint (see Section 2.1.1) of the Wattle Avenue West quarry within the project area may be less than this figure.

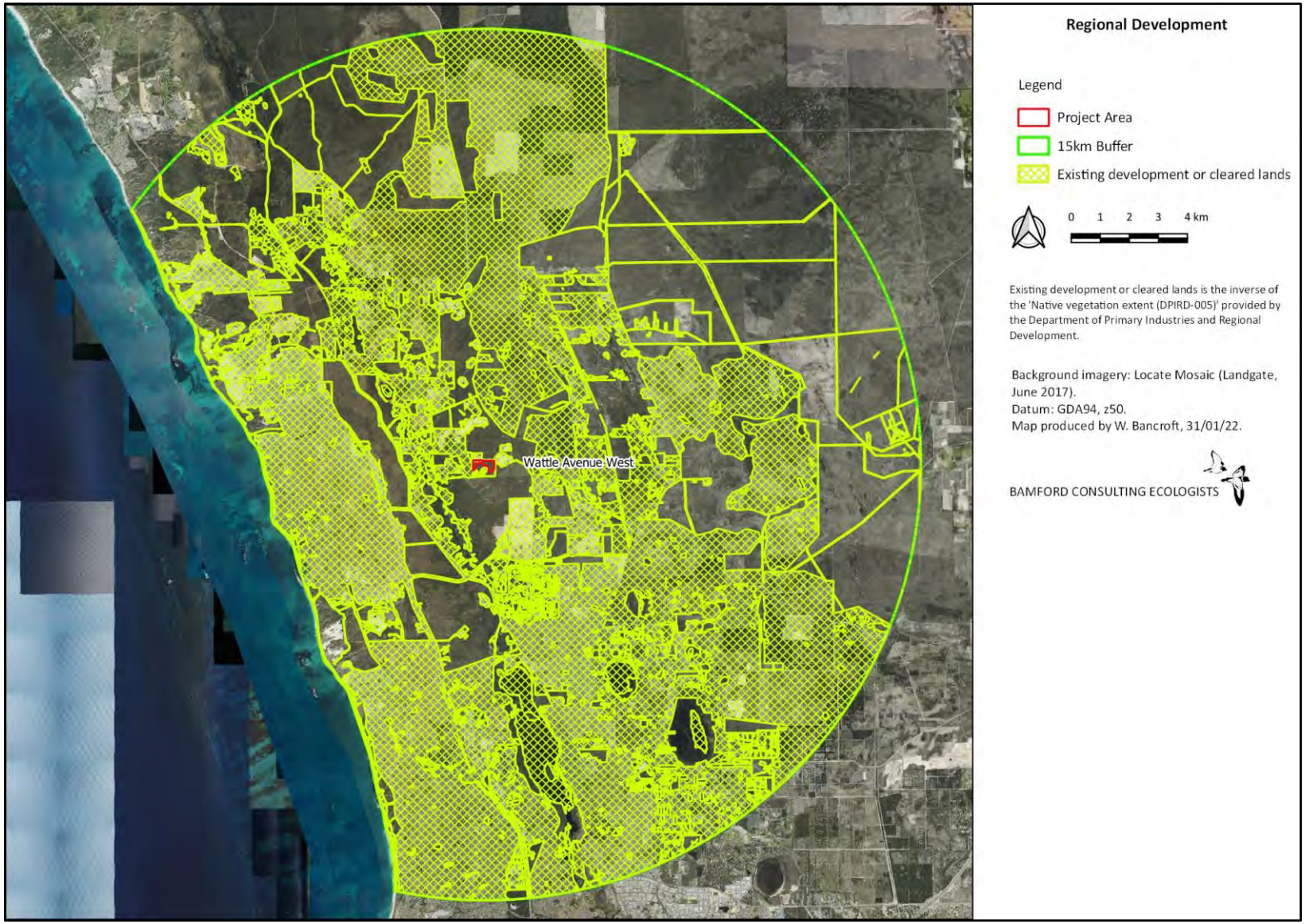

Figure 7. Estimated existing development within the region (15 km).

3.2 Fauna assemblage

3.2.1 Overview of vertebrate fauna assemblage

The desktop study identified 173 vertebrate fauna species as potentially occurring in the project area: no fish, eight frogs, 46 reptiles, 100 birds and 19 mammals. These species are listed in Appendix 7. The presence of at least 23 species (20 birds and three mammals) was confirmed during the 2021 site inspection (as presented in Appendix 8, but also indicated in Appendix 7).

Two hundred and forty-seven species (six fish, nine frogs, 30 reptiles, 174 birds and 28 mammals) that were returned by the database searches and/or literature review have been omitted from the expected species list because of habitat or range limitations, or because they are considered to be locally extinct in the project area. These species are listed in Appendix 9.

The composition of the vertebrate fauna is summarised in Table 9.

Table 9. Composition of vertebrate fauna assemblage of the project area.

The number of non-native species is shown in parentheses.

Taxon	Expected Species	Recorded Species	Number of species in each status category				
			Resident	Migrant or regular visitor	Irregular visitor	Vagrant	Locally extinct
Fish	0	0	0	0	0	0	0
Frogs	8	0	4	0	4	0	0
Reptiles	46	0	44	1	1	0	0
Birds	100 (6)	23	39	36	20	5	4
Mammals	19 (5)	3	11	7	0	1	9
Total	173 (11)	**23**	**98**	**42**	**27**	**6**	**13**

There is limited information on invertebrate fauna in the area; this fauna is discussed in Section 3.2.3.

3.2.2 Expected vertebrate fauna

While freshwater fish are known from the region, there was no suitable habitat for this group within the project area.

The eight frog species include four that are considered to be residents within the project area. These species spend much, or all, of their life cycle away from wetlands/damplands and may be wide-ranging through woodlands and heathlands. The remaining four species are more dependent on regular seasonal or permanent standing fresh water and are expected to be irregular visitors to the site; passing through when suitable conditions prevail and/or in very low numbers. There are no introduced species of frog expected.

The 46 reptile species are all considered to be residents with the exception of *Lerista lineopunctulata* and the Carpet Python which may occur as irregular or regular visitors. There are no introduced species of reptiles expected.

The bird assemblage of 100 species is much smaller than would be expected in the broader region. This is due to a limited range of VSAs present and, notably, the absence, or all-but-absence, of eucalypt woodlands, Banksia woodlands and wetlands. Thirty-nine of the bird species are considered to be resident in the project area, with a further 36 that are regular visitors or migrants. A further 20 are expected to be irregular visitors and there are five vagrant species. There are six introduced species of birds expected to occur within the project area (three pigeons/doves, the Laughing Kookaburra, the Long-billed Corella and the Rainbow Lorikeet).

Most of the 19 mammal species are considered to be residents (11) or regular visitors (7), with the Chuditch considered to be a vagrant to the area. A large proportion of the original indigenous local mammal fauna has become extinct (9 species), as listed in Appendix 9, although several of these (e.g. dunnarts, pygmy-possum, Ash Grey Mouse) persist in less developed/impacted areas of the Swan Coastal Plain (e.g. well to the north of the project area). There are five introduced species of mammal expected to occur within the project area including two feral predators, two rodents and the Rabbit.

The key features of the fauna assemblage expected in the project area are:

- **Uniqueness:** The fauna assemblage is probably typical of the near-coastal shrublands of the coastal plain north of Perth. This assemblage is only moderately well-represented due to extensive clearing.
- **Completeness:** The assemblage is likely to be substantially complete except for the mammal component, which is depauperate in both medium-sized and small species.
- **Richness:** The assemblage is likely to be only moderately rich in a regional context as the environment consists largely of shrublands and lacks the banksia and eucalypt woodlands of the coastal plain slightly further east.

3.2.3 Invertebrate fauna of conservation significance

The project area sits within DBCA's Swan management region (DBCA 2022b). DBCA (2022g) listed 21 threatened or priority invertebrate fauna in this region, as outlined in Appendix 10. At least nine of these species can be immediately ruled out from occurring within the project area and the reasons for exclusion are presented in Appendix 10 (e.g. wholly or locally extinct, absence of suitable habitat in the project area, distance from known populations). To help ascertain the status of the remaining 12 species, all location records from ALA (2022) and WAM (2022) were compiled, collated and mapped in relation to the project area. A map of these DBCA-listed threatened and priority species is provided in Figure 8. Note that no records for *Australotomurus morbidus* (Cemetery Springtail) were available.

There are no records of threatened invertebrate fauna within the project area. Six species have been recorded from within the regional (15 km) buffer:

(i) *Austrosaga spinifer* (Spiny Katydid [Swan Coastal Plain]) – known from only a few records in 'heath habitats' (Rentz 1993) from Cervantes to Boya (ALA 2022). Habitat that is potentially suited to this species exists within the project area, therefore this species may be present.

(ii) *Hesperocolletes douglasi* (Douglas's Broad-headed Bee) – known only from one or two records in the Pinjar/Muchea area (Arnold *et al.* 2019). A single female specimen was collected with a sweep net by Arnold *et al.* (2019) in a Banksia woodland remnant, c. 15km west of Muchea. While this record is only c. 7 km from the project area there is a low prevalence of this habitat type within the project area. Therefore, it is difficult to ascertain the likelihood of this species' occurrence. It is probably not present.

(iii) *Hylaeus globuliferus* (Woollybush Bee) – there have been a number of records of this species within 15 km of the project area, all of which are to the south. The Woollybush Bee occurs across a fairly broad region of south-western Australia, north to about Eneabba, east to the eastern edge of the wheatbelt and along the southern coast to Fitzgerald National Park near Hopetoun (ALA 2022). Houston (2018) notes that this species is known to forage on the flowers of Woollybush (*Adenanthos cygnorum*) and Candlestick Banksia (*Banksia attenuata*) which are very limited, if not absent, in occurrence within the project area. Therefore, it is unlikely that the project area would support the Woollybush Bee and that it is probably absent.

(iv) *Idiosoma sigillatum* (Swan Coastal Plain Shield-backed Trapdoor Spider) – there are several records of this species within 15 km of the project area, and tens of records to the south. Rix *et al.* (2017) noted that this species has a "relatively widespread although strictly … substrate-specific distribution along the Swan Coastal Plain of south-western Western Australia, from Dalyellup north to at least Ledge Point (including Rottnest Island and Garden Island)". While much of its previous range has been developed (as part of the greater Perth Metropolitan area) it still persists in areas of remnant bushland with "Banksia woodland and heathland on sandy soils". These habitats are present within the project area and, therefore, it is likely that Swan Coastal Plain Shield-backed Trapdoor Spider is present.

(v) *Leioproctus contrarius* (a short-tongued bee) – several historical records of this species occur within 15 km of the project area, to the east. Moulds (2019) suggested *L. contrarius* that prefers areas where the plant species *Scaevola repens* var. *repens* and *Lechenaultia* spp. are present. While *Scaevola* is present in the project area it is a different species and it is uncertain

as to whether this will be used by *L. contrarius*. Therefore, the occurrence of this species is uncertain but it may be present.

(vi) *Synemon gratiosa* (Graceful Sun-Moth) – a number of records of this species are known from within 15 km of the project area, to the south. The Graceful Sun-Moth was previously listed as specially protected fauna under the WA Wildlife Conservation Act 1950 (rare or likely to become extinct) and also as Endangered under the EPBC Act (Bishop *et al.* 2010a; Bishop *et al.* 2010b) but extensive surveys between 2009 and 2018 dramatically increased the known range of this species and it has been subsequently re-evaluated as a priority-listed species (Williams *et al.* 2021; ALA 2022). The moth is now known from a series of disjunct subpopulations between Binningup and Kalbarri, a range of 625 km, where it is mainly restricted to coastal and near-coastal sand dunes but extends into Banksia woodlands near Perth (Williams *et al.* 2021). Larvae feed on two host plants, *Lomandra maritima* (on coastal dunes) and *L. hermaphrodita* (in Banksia woodlands), the former of which is known from the project area (PGV 2021). It is therefore likely that this species is present.

Therefore, four known invertebrate species of conservation significance are most likely to occur in the vicinity of the project area:

- Spiny Katydid [Swan Coastal Plain] – CS2 (P2)
- Swan Coastal Plain Shield-backed Trapdoor Spider – CS2 (P3)
- *Leioproctus contrarius* (a short-tongued bee) – CS2 (P3)
- Graceful Sun-Moth – CS2 (P4)

It should be noted that the ecology and distribution of short-range endemic invertebrates is often poorly understood or documented, and the project area occurs in a region that is remote and likely to be poorly-surveyed for these groups. Thus there may be undetected SRE species present.

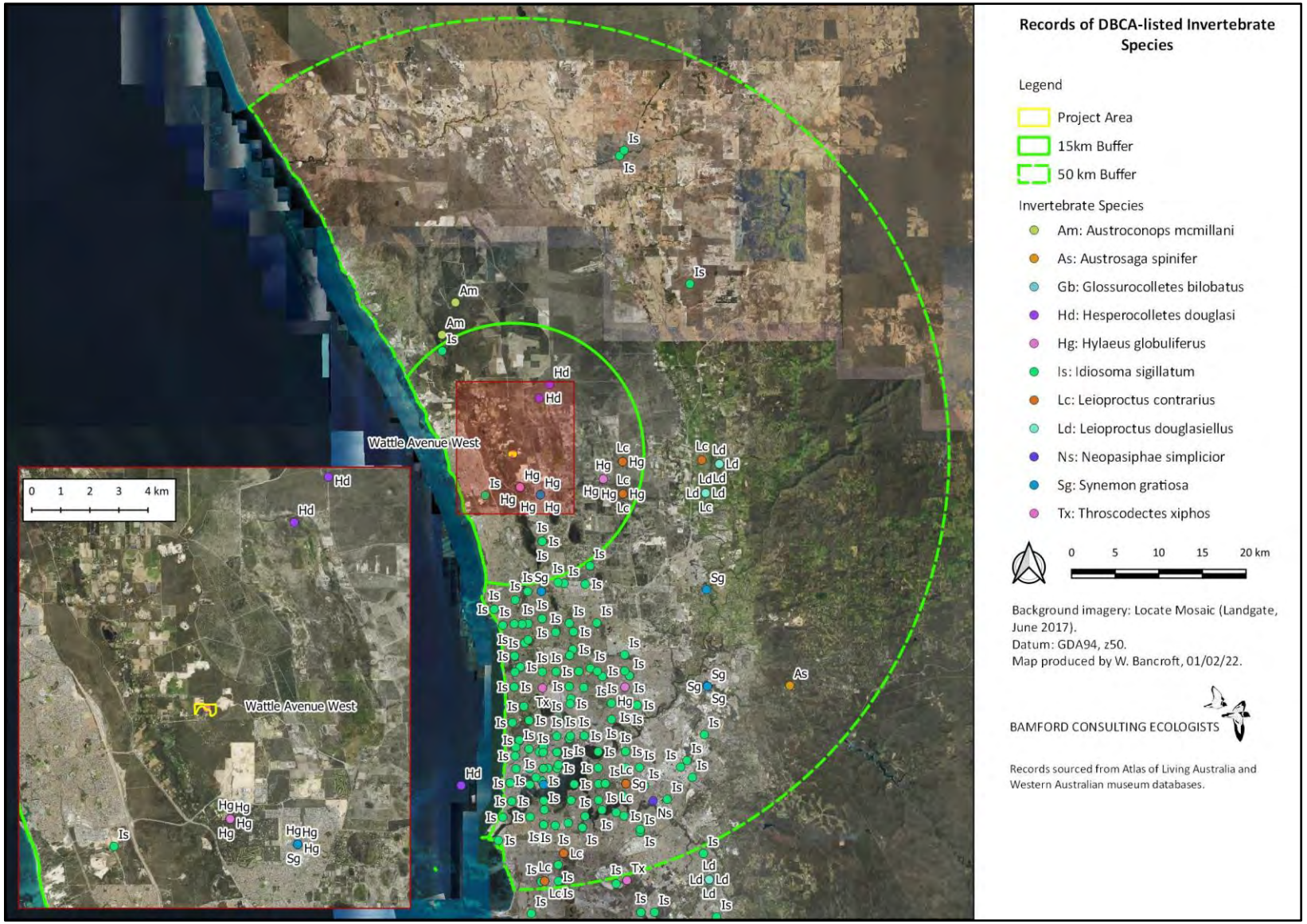

Figure 8. Records of DBCA-listed (threatened or priority) invertebrate species within 50 km of the project area.

3.2.4 Vertebrate fauna of conservation significance

Of the 173 species of vertebrate fauna that are expected to occur in the project area (Section 3.2.1 above), 42 are considered to be of conservation significance (five CS1, three CS2 and 34 CS3; see Appendix 1 for descriptions of these CS (conservation significance) levels). A summary of the numbers in each vertebrate class is presented in Table 10. These species of conservation significance are indicated in the complete species list (Appendix 7) but are also listed with details of their conservation significance in Table 11. The majority of conservation significant species are expected as residents or regular visitors/migrants visitors (30 species), with some irregular visitors (9 species) or vagrants (3 species).

Table 10. The number of conservation significant species in each vertebrate class.

See Appendix 1 for full explanation of Conservation Significance (CS) levels: CS1 = listed under WA State and/or Commonwealth legislation; CS2 = listed as Priority by DBCA; CS3 = considered locally significant.

CLASS	CONSERVATION SIGNIFICANCE			
	CS1	CS2	CS3	Total
Fish	0	0	0	**0**
Frogs	0	0	0	**0**
Reptiles	0	1	1	**2**
Birds	4	0	31	**35**
Mammals	1	2	2	**5**
Total	**5**	**3**	**34**	**42**

Table 11. Conservation significant fauna species expected to occur within the project area.

Species are listed in taxonomic order.
CS1, CS2, CS3 = (summary) levels of conservation significance. See Appendix 1 for full explanation.
EPBC Act listings: C = Critically Endangered, E = Endangered, V = Vulnerable, M = Migratory (see Appendix 2).
WA *Biodiversity Conservation Act 2016* (BC Act) listings: S1 to S7 = Schedules 1 to 7 (see Appendix 2).
DBCA Priority species: P1 to P4 = Priority 1 to 4 (see Appendix 2).
Bush Forever (Dell and Banyard 2000) status: HS = habitat specialists with a reduced distribution on the Swan Coastal Plain, WR = wide ranging species with reduced populations on the Swan Coastal Plain.
LS = considered by BCE to be of local significance (see Appendix 1).

SPECIES	COMMON NAME	STATUS	EXPECTED OCCURRENCE
Morelia spilota imbricata	Carpet Python (southwest)	CS3 (LS)	Regular visitor
Neelaps calonotos	Black-striped Snake	CS2 (P3)	Resident (if present)
Dromaius novaehollandiae	Emu	CS3 (WR)	Regular visitor
Phaps chalcoptera	Common Bronzewing	CS3 (HS)	Resident
Phaps elegans	Brush Bronzewing	CS3 (HS)	Irregular visitor
Apus pacificus	Fork-tailed Swift	CS1 (M,Mar,S5)	Vagrant
Turnix varius	Painted Button-quail	CS3 (WR)	Resident
Lophoictinia isura	Square-tailed Kite	CS3 (WR)	Regular visitor
Aquila audax	Wedge-tailed Eagle	CS3 (WR)	Regular visitor
Hieraaetus morphnoides	Little Eagle	CS3 (WR)	Regular visitor
Accipiter fasciatus	Brown Goshawk	CS3 (WR)	Regular visitor
Accipiter cirrocephalus	Collared Sparrowhawk	CS3 (WR)	Regular visitor
Haliastur sphenurus	Whistling Kite	CS3 (WR)	Regular visitor
Falco peregrinus	Peregrine Falcon	CS1 (S7)	Regular visitor
Calyptorhynchus banksii naso	Forest Red-tailed Black-Cockatoo	CS1 (V,S3)	Irregular visitor
Calyptorhynchus latirostris	Carnaby's Black-Cockatoo	CS1 (E,S2)	Regular migrant
Malurus assimilis	Purple-backed Fairy-wren	CS3 (HS)	Resident
Malurus splendens	Splendid Fairy-wren	CS3 (HS)	Resident
Malurus leucopterus	White-winged Fairy-wren	CS3 (HS)	Regular visitor
Stipiturus malachurus	Southern Emu-wren	CS3 (HS)	Regular visitor
Phylidonyris novaehollandiae	New Holland Honeyeater	CS3 (WR)	Resident
Phylidonyris niger	White-cheeked Honeyeater	CS3 (WR)	Resident
Glyciphila melanops	Tawny-crowned Honeyeater	CS3 (WR)	Regular visitor
Anthochaera lunulata	Western Wattlebird	CS3 (WR)	Regular visitor
Manorina flavigula	Yellow-throated Miner	CS3 (WR)	Irregular visitor
Smicrornis brevirostris	Weebill	CS3 (HS)	Resident
Sericornis frontalis	White-browed Scrubwren	CS3 (HS)	Resident
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	CS3 (HS)	Resident

SPECIES	COMMON NAME	STATUS	EXPECTED OCCURRENCE
Acanthiza apicalis	Inland Thornbill	CS3 (HS)	Resident
Acanthiza inornata	Western Thornbill	CS3 (HS)	Irregular visitor
Daphoenositta chrysoptera	Varied Sittella	CS3 (HS)	Irregular visitor
Colluricincla harmonica	Grey Shrike-thrush	CS3 (HS)	Resident
Strepera versicolor	Grey Currawong	CS3 (WR)	Irregular visitor
Artamus personatus	Masked Woodswallow	CS3 (WR)	Vagrant
Artamus cyanopterus	Dusky Woodswallow	CS3 (WR)	Regular visitor
Petroica boodang	Scarlet Robin	CS3 (HS)	Regular visitor
Quoyornis georgianus	White-breasted Robin	CS3 (HS)	Irregular visitor
Dasyurus geoffroii fortis	Chuditch	CS1 (V,S3)	Vagrant
Isoodon fusciventer	Quenda	CS2 (P4)	Resident
Tarsipes rostratus	Honey Possum, Noolbenger	CS3 (LS)	Resident
Notamacropus irma	Brush Wallaby	CS2 (P4)	Regular visitor
Rattus fuscipes fuscipes	Western Bush Rat, Moodit	CS3 (LS)	Resident
Austrosaga spinifer	Spiny Katydid [Swan Coastal Plain]	CS2 (P2)	Resident (if present)
Idiosoma sigillatum	Swan Coastal Plain Shield-backed Trapdoor Spider	CS2 (P3)	Resident
Leioproctus contrarius	a short-tongued bee	CS2 (P3)	Resident (if present)
Synemon gratiosa	Graceful Sun-Moth	CS2 (P4)	Resident

3.2.5 Conservation significant species accounts

A list of all conservation significant species expected within the project area is provided in Table 11; these comprise four invertebrates (see also Section 3.2.3) and 42 vertebrates (see also Section 3.2.4). Information on the conservation status, distribution and habitat, salient ecology and expected occurrence within the project area if provided for each of these species is below (and, for invertebrates, in Section 3.2.3).

3.2.5.1 Conservation Significance 1

Fork-tailed Swift (*Apus pacificus*) CS1 (M,S5)

Conservation status: Migratory under the EPBC Act and Schedule 5 under the BC Act.

Distribution and habitat: The swift is a largely aerial species of unpredictable occurrence in Western Australia. There are scattered records from the south coast, widespread in coastal and subcoastal areas between Augusta and Carnarvon, scattered along the coast from south-west Pilbara to the north and east Kimberley region. Sparsely scattered inland records, especially in the Wheatbelt, but more common in the north and north-west Gascoyne Region, north through much of the Pilbara Region, and the south and east Kimberley (Higgins 1999; DAWE 2022a). Aerial, usually flying from as low as one metre to in excess of 300 m above the ground.

Ecology: A diurnal, aerial insectivore, this species often forages along the edge of low pressure systems in flocks of ten to 1000 birds (Higgins 1999; DAWE 2022a). Breeds in Siberia (April to July) and spends the non-breeding season (October to mid-April) in Australia. Being aerial, it is effectively independent of terrestrial ecosystems when in Australia.

Expected occurrence: Vagrant. Likely to be regularly present, unpredictably, within the region and to pass over the project area on an occasional basis.

Peregrine Falcon (*Falco peregrinus*) CS1 (S7)

Conservation status: Schedule 7 under the BC Act.

Distribution and habitat: More or less cosmopolitan throughout Australia (Menkhorst *et al.* 2017). This species occurs in a variety of habitats but is usually reliant on cliff faces or tall trees for nesting (Debus 2019).

Ecology: A highly adept aerial predator that predominantly forages on birds, although will also occasionally take invertebrates, fish, reptiles and mammals (Debus 2019). Mostly diurnal or crepuscular.

Expected occurrence: Regular visitor. Wide-ranging and likely to pass over the project area on a regular basis.

Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*) CS1 (V,S3)

Conservation status: Vulnerable under the EBPC Act and Schedule 3 under the BC Act.

Distribution and habitat: Endemic to the deeper south-west of Western Australia, from around Gingin in the north, east to Mount Helena, North Bannister and Mount Saddleback, and south to around Albany (Johnstone and Storr 1998). In recent years there appears to have been a distinct expansion of the range of this species on to the Swan Coastal Plain, including many suburbs within the Perth metropolitan area. Generally restricted to areas of Jarrah-Marri forest, farmlands with remnant trees and urban landscapes. Forest Red-tailed Black-Cockatoos are currently considered not to undergo regular migration (DAWE 2022c). Two other sub-species occur in Western Australia: *C. b. escondidus* in the western mid-west and Pilbara, and *C. b. macrorhynchus* in the Kimberley (Johnstone and Storr 1998). Neither of these is a conservation significant taxon.

Ecology: Diurnal granivore, feeding predominantly on the seeds of Jarrah and Marri (Johnstone and Kirkby 1999; Johnstone *et al.* 2013b) but is also adapting to foraging on urban (introduced) plant species. Reliant on large tree-hollows in eucalypts (especially Marri) for breeding (Johnstone *et al.* 2013a; DAWE 2022c). Threatened by habitat loss, habitat degradation, nest hollow shortage, and competition for available nest hollows from other parrots and feral Honeybees (DAWE 2022c).

Expected occurrence: Irregular visitor. The project area is at the limit of this species' range and supports very little suitable foraging or breeding habitat but, given the expansion of this species' distribution on the Swan Coastal Plain, irregular occurrence cannot be ruled out.

Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) CS1 (E,S2)

Conservation status: Endangered under the EPBC Act and Schedule 2 under the BC Act.

Distribution and habitat: Endemic to south-western Western Australia, from Kalbarri in the north, east to Merredin and Ravensthorpe, and then further east along the south coast to the Esperance area (Johnstone and Storr 1998; DAWE 2022e). Breeds (July to December) predominantly in the east of its range with a migration to coastal areas in the non-breeding period. In recent years, however, the species has expanded its breeding range westward and south into the Jarrah-Marri forests of the Darling Scarp and into the Tuart forests of the Swan Coastal Plain (DAWE 2022e). Heavily reliant on areas of Banksia woodland and proteaceous shrubland/heath for foraging (Johnstone and Storr 1998; DAWE 2022e).

Ecology: Diurnal granivore, feeding predominantly on the seeds of the Proteaceae (especially banksias) but also known to feed on a very wide variety of plants, including non-native ornamentals and plantation species such as pine (Valentine and Stock 2008; Groom 2011; DPaW 2013; Johnston *et al.* 2016; DAWE 2022e). Reliant on large tree-hollows in eucalypts (especially smooth-barked species such as Wandoo and Salmon Gum) for breeding (Saunders 1974; Johnstone and Storr 1998; Morgan *et al.* 1998; DAWE 2022e). Threatened by habitat loss, habitat degradation, nest hollow shortage, and competition for available nest hollows from other parrots and feral Honeybees, illegal shooting and illegal trade (Burbidge 2004; DAWE 2022e).

Expected occurrence: Regular migrant. Known to occur within the project area with some foraging plants available (in particular *Banksia sessilis*). Foraging and nesting values of the project area for the species are assessed in section 3.3.

Chuditch (*Dasyurus geoffroii fortis*) CS1 (V,S3)

Conservation status: Vulnerable under the EBPC Act and Schedule 3 under the BC Act.

Distribution and habitat: The Chuditch is a wide-ranging resident in Marri-Jarrah forest of the south-west of Western Australia and also in heaths and eucalypt woodlands of the eastern wheatbelt and goldfields (Van Dyck and Strahan 2008). This species was formerly distributed throughout much of western and inland Australia but its range has contracted to the region approximately south-west of a line between Shark Bay and Esperance (Burbidge 2004; Van Dyck and Strahan 2008; DAWE 2022f).

Ecology: The Chuditch is a nocturnal, terrestrial carnivore, feeding mainly on smaller vertebrates (e.g. reptiles, birds and mammals) and large invertebrates (Burbidge 2004; Van Dyck and Strahan 2008). During the day Chuditch shelter in dens; predominantly hollow logs and earth burrows (Van Dyck and Strahan 2008). Chuditch have a large home range, with females in the deeper south-west occupying 55-120 ha and males ranging over 400 ha or more (Van Dyck and Strahan 2008). Further east, Rayner *et al.* (2012) found that Chuditch in the Forrestania area occurred at an average density of 0.039 individuals/km^2, with home ranges as small as 189 ha (a female) and as large as 2,125 ha (a male).

Expected occurrence: Vagrant. Wide-ranging and likely to be present in the project area only as a vagrant. A juvenile male was caught about 10km to the east in 2004, in dense riparian vegetation in the Gnangara pine plantation (M. Bamford pers obs.).

3.2.5.2 Conservation Significance 2

Black-striped Snake (*Neelaps calonotos*) CS2 (P3)

Conservation status: Listed as Priority 3 by DBCA.

Distribution and habitat: Restricted to coastal sandplains from near Dongara to Mandurah (Bush *et al.* 2010). Appears to be absent from the eastern coastal plain (M. Bamford pers. obs.). Within the Perth Metropolitan area this species may be restricted to large reserves (How and Shine 1999).

Ecology: A fossorial species that preys upon small, fossorial skinks in the upper layers of loose sand (Bush *et al.* 2010).

Expected occurrence: Resident (if present). Some suitable habitat is present within the project area.

Quenda (*Isoodon fusciventer*) CS2 (P4)

Conservation status: Listed as Priority 4 by DBCA.

Distribution and habitat: The Quenda formerly occurred across the south-west of Western Australia from Geraldton to east of Esperance, including the wheatbelt, but it now has a much-reduced range, with few records north of Yanchep/Muchea on the coastal plain, and it is more or less extinct across the Wheatbelt (Van Dyck and Strahan 2008; Travouillon and Phillips 2018). It persists around Perth, particularly in areas of dense vegetation around wetlands, and it remains locally common in suitable environments (Howard *et al.* 2014).

Ecology: Omnivorous and cathemeral (active throughout the day and night) Quenda feed on invertebrates, plant material and fungi (Van Dyck and Strahan 2008). It is one of the few native, terrestrial mammals to persist in semi-urban landscapes in the south-west. Populations of this species have declined due to ongoing threats from feral predators and land-clearing (Van Dyck and Strahan 2008; Howard *et al.* 2014).

Expected occurrence: Resident. Known to occur within the project area and suitable habitat present.

3.2.5.3 Conservation Significance 3

Carpet Python (southwest) (*Morelia spilota imbricata*) CS3 (LS)

Conservation status: This subspecies was formerly listed under the Western Australian *Wildlife Conservation Act 1950* as 'other specially protected fauna' but that status has, more recently, been removed in the WA *Biodiversity Conservation Act 2016* (DBCA 2022g). It is likely to remain uncommon or at risk in the proximity of development.

Distribution and habitat: Patchily distributed through south-west Western Australia in a wide range of habitats including woodlands, heaths and rock outcrops (Bush *et al.* 2010; Wilson and Swan 2021). It is particularly common in areas of exposed limestone, including offshore islands (Bush *et al.* 2010).

Ecology: Predominantly a nocturnal carnivore, the Carpet Python preys mainly on birds and mammals, although reptiles are occasionally taken (Bush *et al.* 2010).

Expected occurrence: Regular visitor. Parts of the project area are well suited to this species and it is known to occur in nearby Neerabup National Park, so individuals can at least be expected as regular visitors.

Habitat specialist or wide-ranging bird species with reduced populations on the Swan Coastal Plain (31 species; see Table 11) CS3 (LS)

Conservation status: These species have all been noted by Dell and Banyard (2000) as either habitat specialists or wide ranging species with a reduced population on the Swan Coastal Plain and are, therefore, considered locally significant.

Distribution and habitat: Generally species that require larger areas of intact native remnants to persist.

Ecology: There is a wide range of foraging strategies in this group but the majority of the species are small insectivores or honeyeaters. Also includes ground-foraging granivores (e.g. Emu, bronzewings, button-quail) and nectarivores (honeyeaters).

Expected occurrence: Most species are expected to be residents or regular visitors, although a number are expected as irregular visitors or vagrants (see Table 11).

Honey Possum (*Tarsipes rostratus*) CS3 (LS)

Conservation status: While locally abundant in good seasons in suitable habitat, this species is struggling to persist on the Swan Coastal Plain in the vicinity of development (e.g. urban areas, agriculture, plantations etc.).

Distribution and habitat: Occurs in sandplain heaths and woodlands of south-western Australia (south-west from Kalbarri area to Esperance) and along the south-eastern coast (Van Dyck and Strahan 2008; ALA 2022).

Ecology: A nocturnal nectarivore, the Honey Possum is dependent on a high diversity of nectar-producing plants that can provide year-around food resources (Van Dyck and Strahan 2008).

Expected occurrence: Resident. Suitable habitat, with good nectar supply, exists within the project area. The Honey Possum persists in moderate numbers in suitable habitat on the northern margins of Perth, with records within a few kilometres of the Wanneroo City Centre (M. Bamford pers. obs.).

Moodit or Western Bush Rat (*Rattus fuscipes fuscipes*) CS3 (LS)

Conservation status: While locally common in suitable habitat, this species is struggling to persist on the Swan Coastal Plain in the vicinity of development (e.g. urban areas, agriculture, plantations etc.).

Distribution and habitat: The Bush Rat (*R. fuscipes*) occurs along the south-west, southern and eastern coastlines of Australia in coastal scrubs, heaths, eucalypt forests and rainforests that provide dense cover (Van Dyck and Strahan 2008). The western subspecies, the Western Bush Rat, occurs generally within 100 km of the coast between Geraldton and Israelite Bay, east of Esperance, in Western Australia (ALA 2022).

Ecology: The Western Bush Rat is nocturnal and secretive omnivore, feeding on fungi, seeds, fruits and invertebrates (Van Dyck and Strahan 2008). The availability of food through the winter appears to limit populations of this species (Van Dyck and Strahan 2008).

Expected occurrence: Resident. Suitable habitat exists within the project area. The species was recorded in Neerabup in 2020 during fauna translocation prior to clearing in the nearby Neerabup industrial area (M. Bamford pers obs).

3.3 Black-cockatoo habitat analysis

3.3.1 Black-cockatoo presence

Only one of the three species of black-cockatoo known to occur in the south-west of Western Australia was directly recorded on the site during the site inspection: Carnaby's Black-Cockatoo. This was outside of the project area; two birds were seen perched in trees to the north of the project area. Anecdotal evidence suggested a number of Carnaby's Black-Cockatoos had been seen in the project in the previous weeks and this is supported by the indirect (foraging) evidence presented in Section 3.3.3 below.

Given these direct observations, indirect (foraging) records (see Section 3.3.3 below), roosting data (see Section 3.3.4 below) and the literature review (including current species distributions), it is considered that, currently:

- Carnaby's Black-Cockatoo is likely to be a regular non-breeding migrant to the site in moderate numbers.
- Forest Red-tailed Black-Cockatoo is likely to be an irregular visitor to the site. The project area is at the limit of this species' range and supports very little suitable foraging or breeding habitat but, given the expansion of this species' distribution on the Swan Coastal Plain, irregular occurrence cannot be ruled out.
- Baudin's Black-Cockatoo is unlikely to use the site as it is outside its normal/expected range.

3.3.2 Black-cockatoo breeding habitat

No trees that met the potential nest-tree criteria of (DAWE 2022c, d, e) and DEE (2017) were recorded within the project area.

3.3.3 Black-cockatoo foraging habitat

3.3.3.1 Carnaby's Black-Cockatoo

Foraging habitat for the Carnaby's Black-Cockatoo was present throughout the Wattle Avenue West site. This is predominantly due to the presence of two tree species and one shrub species known to be mainstays of the Carnaby's Black-Cockatoo diet: *Banksia attenuata, B. grandis* and *B. sessilis* (Groom 2011). Where it occurred, the most widespread of these was *B. sessilis* and, where it occurred, it was generally in moderate to high density. There were also some areas of low to no *B. sessilis* density. Based upon guidance on the assessment of foraging values of vegetation (Appendix 5), the areas of moderate density *B. sessilis* are assigned a vegetation score of 4 out of 6. There were also some small pockets of the tree banksias (see Figure 6) that were also scored 4 out of 6. The areas (and percentages) of each vegetation score for each VSA are shown for the Carnaby's Black-Cockatoo in Table 12. A map of vegetation scores for Carnaby's Black-Cockatoo foraging within the project area is presented in Figure 9.

There are approximately 25,558 ha of remnant native vegetation (as assessed by DPIRD 2022) within 15 km of the project area, which itself has c. 14.3 ha of native vegetation. Therefore, the site comprises c. 0.03% of the native vegetation in the 'local area' (as per the methods outlined in Appendix 5). It is likely that the Carnaby's Black-Cockatoo breeds within the local area, given the proximity to Tuart forests in the region. Thus, a 'context' score of 1 (out of 3) has been assigned to the project area for this species (see Appendix 5). This low context score is assigned because despite the high quality of foraging habitat and the presence of breeding nearby, the area of habitat is small and foraging habitat is widespread nearby.

There was extensive evidence of foraging by the Carnaby's Black-Cockatoo throughout the project area. This was almost entirely foraging on *B. sessilis* (with recent and intermediate-aged signs noted); wherever this plant species occurred there was evidence of foraging by Carnaby's Black-Cockatoo. There were also several records of Carnaby's Black-Cockatoos pruning Nuytsia floribunda trees (and possibly using this as a food source). The locations of these records is shown in Figure 10. It is expected that Carnaby's Black-Cockatoo will occur regularly (including foraging) within the project area. Therefore the project area was assigned a species 'density' score for Carnaby's Black-Cockatoo of 1 (out of 1; see Appendix 5).

The context and density values have been added on to the vegetation scores to yield the overall foraging value scores (with areas and percentages) that are also presented in Table 12.

The project area is, generally, of moderate value for foraging by the Carnaby's Black-Cockatoo and there was evidence to show that this species has previously used the site for feeding.

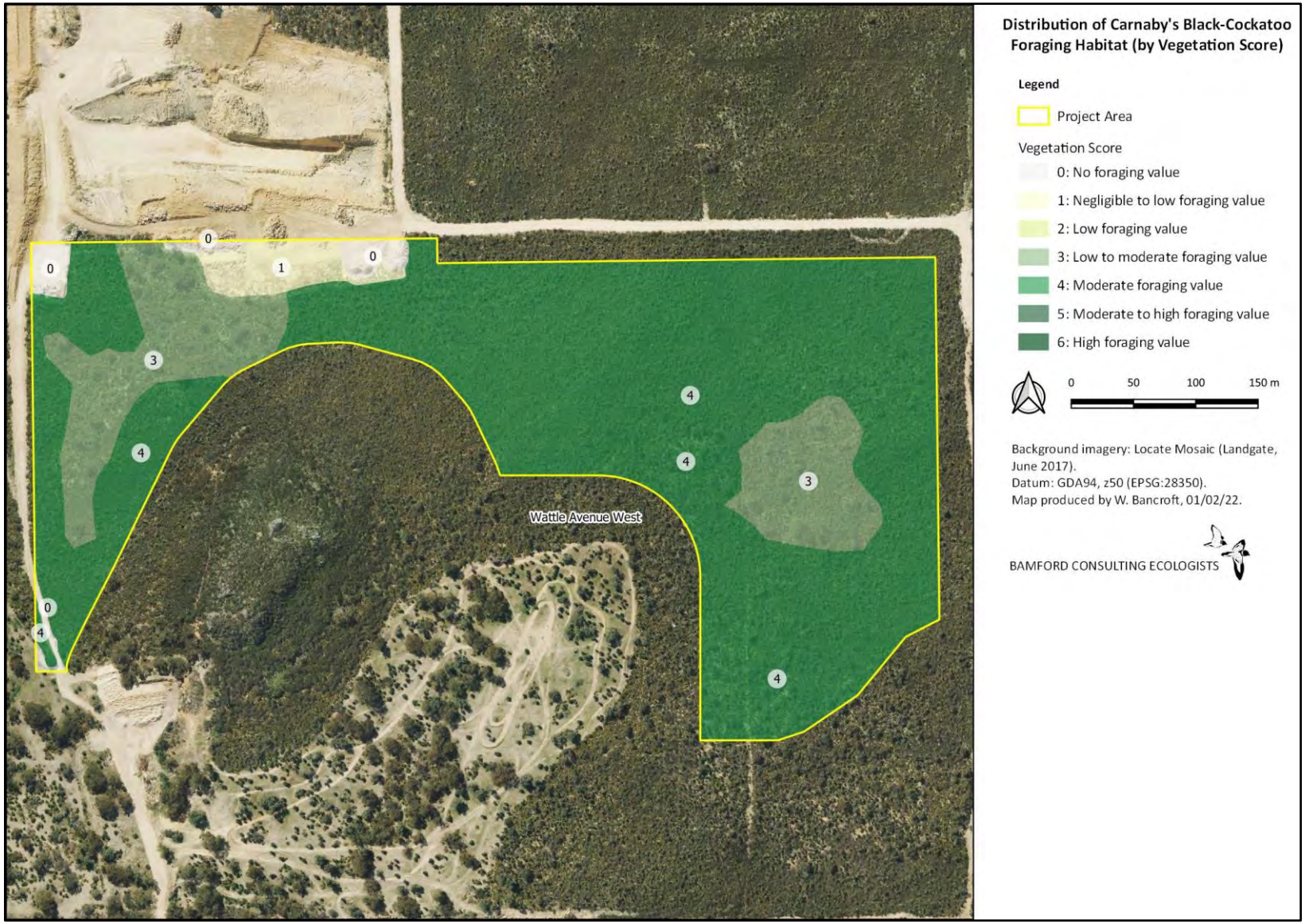

Figure 9. Distribution of Carnaby's Black-Cockatoo vegetation scores within the project area.

Table 12. Areas (ha) and proportions (%) of each category (vegetation score, combined foraging score) of foraging habitat at the survey area for Carnaby's Black-Cockatoo and Forest Red-tailed Black-Cockatoo.

See Section 2.4.3.3 and Appendix 8 for explanation of vegetation, context, species density and (combined) foraging scores.

	Carnaby's Black-Cockatoo		Forest Red-tailed Black-Cockatoo	
Vegetation Score/Value	**Area (ha)**	**%**	**Area (ha)**	**%**
6: High	0.0	0.0	0.0	0.0
5: Moderate to High	0.0	0.0	0.0	0.0
4: Moderate	12.0	77.1	0.0	0.0
3: Low to Moderate	2.7	17.5	0.0	0.0
2: Low	0.0	0.0	0.0	0.0
1: Negligible	0.4	2.7	0.0	0.0
0: Nil	0.4	2.7	15.5	100.0
TOTAL	15.5	100.0	15.5	100.0
Context Score	1		0	
Species Density Score	1		0	
Foraging Score				
10	-	-	-	-
9	-	-	-	-
8	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0
6	12.0	77.1	0.0	0.0
5	2.7	17.5	0.0	0.0
NA (Vegetation Score < 3)	0.8	5.4	15.5	100.0
TOTAL	15.5	100.0	15.5	100.0

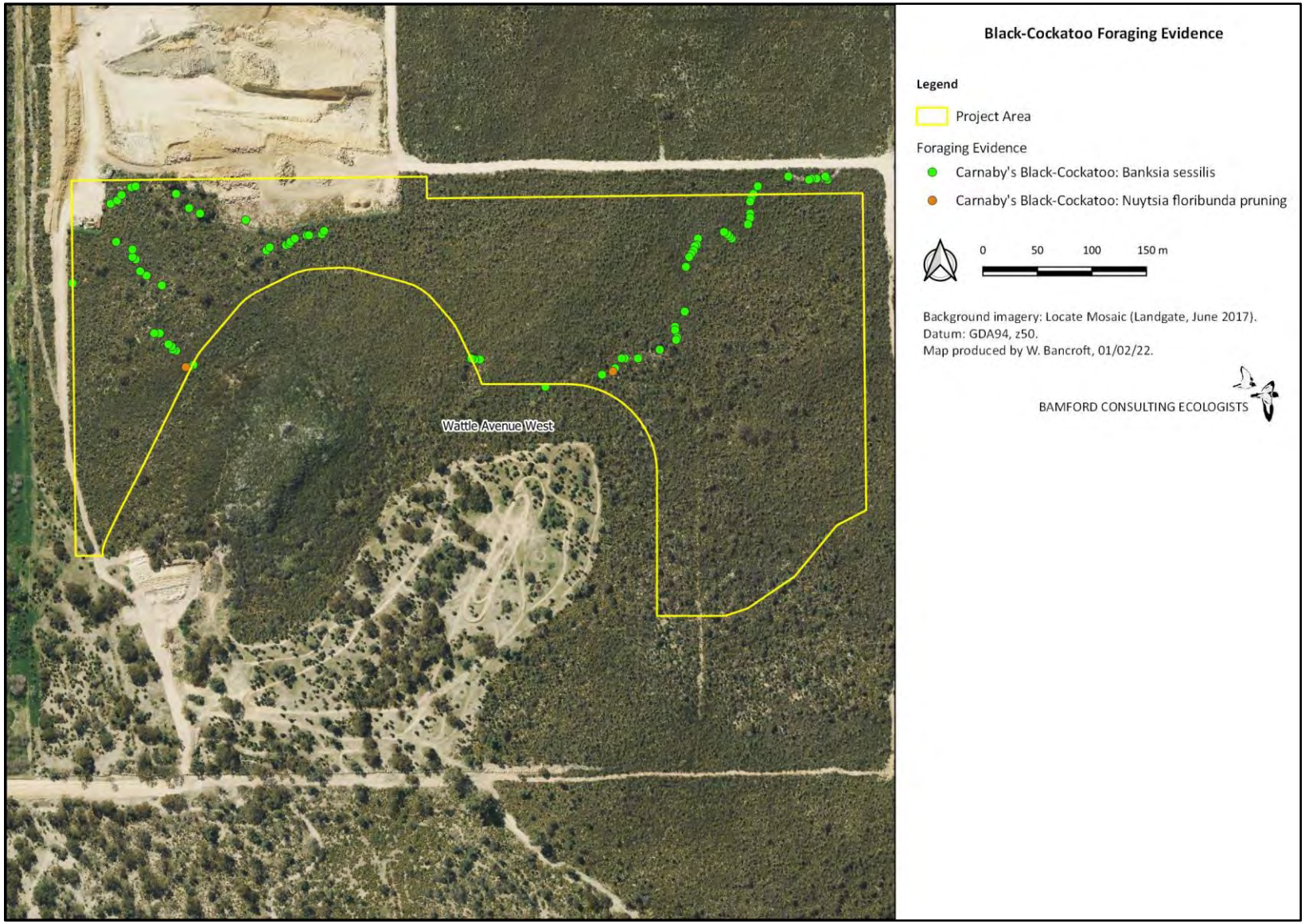

Figure 10. Location of black-cockatoo foraging records (from the June 2021 inspection) within the project area.

3.3.3.2 Forest Red-tailed Black-Cockatoo

Foraging habitat for the Forest Red-tailed Black-Cockatoo was all but absent within the Wattle Avenue West site. This is due to the absence of plant species known to be a mainstays of the Forest Red-tailed Black-Cockatoo diet, such as Marri, Jarrah and She-oak (Groom 2011). Some of these species are present in areas near to the project area (e.g. to the east of the project area) but these were not investigated as part of this assessment. The areas (and percentages) of each vegetation score for each VSA are shown for the Forest Red-tailed Black-Cockatoo in Table 12. No map of the vegetation scores for Forest Red-tailed Black-Cockatoo foraging within the project area is provided, as the entire project area was assessed as 'no value'.

There are approximately 25,558 ha of remnant native vegetation (as assessed by DPIRD 2022) within 15 km of the project area, which itself has c. 14.3 ha of native vegetation. Therefore, the site comprises c. 0.03% of the native vegetation in the 'local area' (as per the methods outlined in Appendix 5). It is unlikely that the Forest Red-tailed Black-Cockatoo breeds within the local area. Thus, a 'context' score of 0 (out of 3) has been assigned to the project area for this species (see Appendix 5).

There was no evidence of foraging by Forest Red-tailed Black-Cockatoo within the project area. Therefore the project area was assigned a species density score for Forest Red-tailed Black-Cockatoo of 0 (out of 1; see Appendix 5).

The context and density values have been combined with the vegetation scores to yield the overall foraging value scores (with areas and percentages) that are also presented in Table 12.

The project area is, generally, of no value for foraging by the Forest Red-tailed Black-Cockatoo and there was no evidence to suggest that this species has previously used the site for feeding.

3.3.4 Black-cockatoo roosting habitat

The area around the project area is known to support black-cockatoo roosting, however there are no records of roost sites within the project area itself. Previously known roost locations (provided by DBCA (2022a) and that reflect data collected in BirdLife Australia's Great Cocky Counts) and are within 12 km of the project area are mapped in Figure 11. The nearest of these known roosts are within c. 1 km of the project area boundary.

The absence of roosts within the project area is reasonable; there is little, if any, suitable roosting habitat. There is an almost complete absence of taller trees (e.g. eucalypts, pines) preferred by black-cockatoos as roost locations. It is highly unlikely that either of the black-cockatoo species expected in the region (Carnaby's and Forest Red-tailed Black-Cockatoos) are dependent on the project area for roosting habitat.

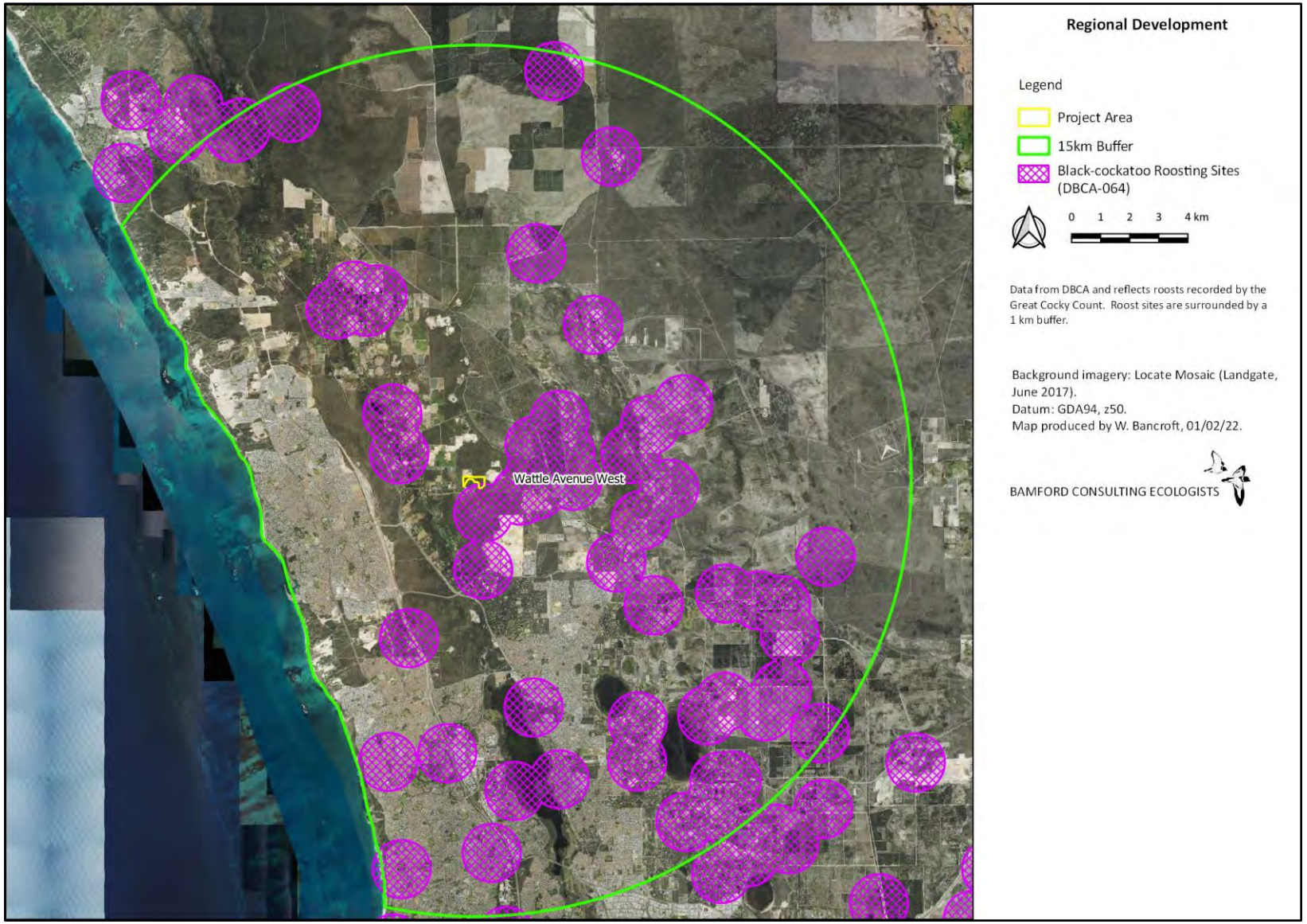

Figure 11. Known black-cockatoo roost locations within 12 km of the project area.

3.4 Patterns of biodiversity

Investigating patterns of biodiversity can be complex and are often beyond the scope even of detailed or targeted investigations (see Section 2.1 above), but it is possible to draw some general conclusions based upon the different landscapes in the project area. The three intact native VSAs (VSA 1 – proteaceous heath; VSA 2 – banksia woodland; and VSA 3 – Limestone Marlock woodland) can be expected to be richer in species than the rehabilitation and cleared areas. Differences in the fauna assemblage between these three VSAs might be slight, as they contain many of the same plant species and have broadly similar substrates. VSAs 1 and 2 are notable for high nectar production important for a range of nectarivores (*Banksia* species) and supply of food for Carnaby's Black-Cockatoo. VSA 3 may be less productive in this respect. VSA 3 is notable as having the only eucalypts in the project area and thus may support some birds and invertebrates that are eucalypt specialists.

3.5 Ecological processes

The nature of the landscape and the fauna assemblage indicate some of the ecological processes that may be important for ecosystem function (see Appendix 1 for descriptions and other ecological processes). These include the aspects discussed below.

Connectivity and landscape permeability. The project area is part of a larger area of native vegetation that is itself surrounded by development. This makes it likely that the fauna assemblage is already affected by fragmentation and loss of connectivity. This is likely to have resulted in the loss of some mammal species. It also makes the larger area vulnerable to further fragmentation (see Section 4 below).

Local hydrology. The project area contains no wetlands, but elements of the native vegetation are likely to have some reliance on groundwater. The limestone topography suggests that a subterranean fauna assemblage is present, and this may include species that occur in the groundwater (Stygofauna).

Fire. Native vegetation throughout the project area is subject to fire and is likely to be burnt on a regular basis. While appropriate fire regimes can benefit biodiversity, inappropriate regimes can lead to a loss of biodiversity. Most of the project area was burnt in 2015, with the south-eastern corner burnt in 2017 (PGV 2021). The project area (and surrounds) is part of a DBCA-managed fire regime, and a prescribed burn appears to be planned (SWC_081) but no timing is available (DBCA 2022d).

Feral species and interactions with over-abundant native species. Feral species occur throughout Western Australia and are a considerable component of the current mammal fauna of the project area (see Section 3.2.1). They have contributed to local extinctions (see Appendix 9) and may be affecting populations of extant species. Feral Cats, Foxes and Rabbits, and to a lesser extent the Rainbow Lorikeet, are likely to be placing considerable pressure on the native fauna in the region. Feral Bees may be competing with native nectarivores.

3.6 Summary of fauna values

The desktop study identified 173 vertebrate fauna species as potentially occurring in the project area: no fish, eight frogs, 46 reptiles, 100 birds and 19 mammals. The presence of at least 23 species (20 birds and three mammals) was confirmed during the 2021 site inspection.

Fauna assemblage. The fauna assemblage is probably typical of the near-coastal shrublands of the coastal plain north of Perth. The assemblage is likely to be substantially complete except for the mammal component, which is depauperate in both medium-sized and small species. The assemblage is likely to be only moderately rich in a regional context as the environment consists largely of shrublands and lacks the banksia and eucalypt woodlands of the coastal plain slightly further east.

Species of conservation significance. The majority of the 46 conservation significant species (including two reptiles, 35 birds, five mammals and four invertebrates) expected in the project area are likely to be residents or regular visitors/migrants. Only five of the expected conservation species are listed under WA State and/or Commonwealth legislation (category CS1; four bird and one mammal), with seven listed as Priority by DBCA (category CS2; one reptile, two mammals and four invertebrates) and the remaining 34 considered locally significant (category CS3; one reptile, 31 birds and two mammals). Of most concern are Carnaby's Black-Cockatoo (CS1, known to be a regular migrant to the area and to use the project area for foraging), and Quenda (CS2, known to occur within the project area and expected to be resident).

Vegetation and Substrate Associations (VSAs). The project area encompasses five VSAs which reflect landscape position and soil type: Proteaceous heath (VSA 1), Banksia woodland (VSA 2), Limestone Marlock woodland (VSA 3), Rehabilitation (VSA 4), and Cleared (VSA 5). The three intact (i.e. not-disturbed) native VSAs are regionally widespread.

Patterns of biodiversity. The three intact native VSAs can be expected to be richer in species than the rehabilitation and cleared areas. Differences in the fauna assemblage between these three VSAs might be slight, as they contain many of the same plant species and have broadly similar substrates. VSA 1 (proteaceous heath) and VSA 2 (banksia woodland) are notable for high nectar production important for a range of nectarivores (*Banksia* species) and supply of food for Carnaby's Black-Cockatoo. VSA3 (Limestone Marlock woodland) may be less productive in this respect. VSA 3 is notable as having the only eucalypts in the project area and thus may support some birds and invertebrates that are eucalypt specialists.

Key ecological processes. The ecological processes that currently have major effects upon the fauna assemblage include landscape permeability, hydrology, fire, and the presence of feral species.

4 Impact assessment

Threatening processes have to be considered in the context of fauna values, the surrounding landscape and the nature of the proposed action, and are examined below. Landscape context is important, as the project area contains areas of previously cleared or disturbed lands and is in a local, and regional, landscape that is relatively continuous and intact. Impact categories are defined in Table 8.

Habitat loss leading to population decline. *Negligible to Minor*

The area to be cleared is small and is already partly disturbed. The 14.3 ha of native vegetation to be cleared represents 0.03% of native vegetation within the region (15 km radius) and would bring the total regional clearing to 55.23%. Population decline due to habitat loss is therefore very small.

Habitat loss leading to population fragmentation. *Minor*

The development footprint is expected to be compact and expands on existing developed areas, with native vegetation surrounding. However, the project area is within a region with multiple other small developments (see Figure 5), so the potential exists for these multiple areas to coalesce over time with further approvals, which could result in the fragmentation of the large area of native vegetation that aligns north-south, and within which the current project area and nearby developments lie.

Degradation of habitat due to weed invasion. *Minor*

The level of weed invasion is low in the native vegetation, but weeds are present in degraded areas. There is potential for development to increase the spread of weeds (particularly during clearing), but standard hygiene measures are likely to be in place to reduce this risk.

Mortality during construction. *Negligible to Minor*

This is a concern mostly on animal welfare grounds, as the development footprint is small in the context of the overall landscape. Animals will inevitably be killed during clearing but there are standard practices for reducing fauna mortality during such activities. Removal trapping and relocation of species such as Quenda and large reptiles, while avoiding clearing during spring reduces impact on breeding birds.

Ongoing mortality. *Negligible*

This results mainly from roadkill due to vehicle movements close to native vegetation, fauna striking infrastructure and effects of lighting. The numbers of animals affected are likely to be very small although the long-term impacts of lighting close to native vegetation is poorly understood.

Species interactions. *Negligible to Minor*

Feral species are already present on the site, but feral species may be attracted to work-sites and increase in abundance. Impacts to native fauna can be kept to Negligible/Minor through standard practices such as not feeding wildlife, managing waste and even implementing some feral species control.

Hydrological change. *Negligible*

There is no surface water and activities will not interact with groundwater, so hydrological change should be minimal. If drainage and runoff management of work areas is required, this should not be diverted into native vegetation but should be infiltrated into groundwater.

Altered fire regimes. *Negligible*

The vegetation of the project area is tolerant of and to some extent dependent on fire, but the fire regime is important. There have been recent fires that are likely to have affected the fauna, and any increase in fire frequency is likely to have adverse impacts. The proposed development has the potential to lead to increased fire frequency, but given the small areas involved this risk should be readily managed.

Disturbance (dust, noise, light). *Minor*

The level of dust, noise and light during development and operation has the potential to result in some impacts, but there are standard management procedures to minimise these. There is also existing activity so these forms of disturbance will not be new to the location. As noted above, impacts of additional lighting upon invertebrates is largely unknown.

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6 Appendices

Appendix 1. Explanation of fauna values.

Fauna values are the features of a site and its fauna that contribute to biodiversity, and it is these values that are potentially at threat from a development proposal. Fauna values can be examined under the five headings outlined below. It must be stressed that these values are interdependent and should not be considered equal, but contribute to an understanding of the biodiversity of a site. Understanding fauna values provides opportunities to predict and therefore mitigate impacts.

Assemblage characteristics

Uniqueness. This refers to the combination of species present at a site. For example, a site may support an unusual assemblage that has elements from adjacent biogeographic zones, it may have species present or absent that might be otherwise expected, or it may have an assemblage that is typical of a very large region. For the purposes of impact assessment, an unusual assemblage has greater value for biodiversity than a typical assemblage.

Completeness. An assemblage may be complete (i.e. has all the species that would have been present at the time of European settlement), or it may have lost species due to a variety of factors. Note that a complete assemblage, such as on an island, may have fewer species than an incomplete assemblage (such as in a species-rich but degraded site on the mainland).

Richness. This is a measure of the number of species at a site. At a simple level, a species rich site is more valuable than a species poor site, but value is also determined, for example, by the sorts of species present.

Vegetation and substrate associations (VSAs)

VSAs combine broad vegetation types, the soils or other substrate with which they are associated, and the landform. In the context of fauna assessment, VSAs are the environments that provide habitats for fauna. The term habitat is widely used in this context, but by definition an animal's habitat is the environment that it utilises (Calver *et al.* 2009), not the environment as a whole. Habitat is a function of the animal and its ecology, rather than being a function of the environment. For example, a species may occur in eucalypt canopy or in leaf-litter on sand, and that habitat may be found in only one or in several VSAs. VSAs are not the same as vegetation types since these may not incorporate soil and landform, and recognise floristics to a degree that VSAs do not. Vegetation types may also not recognise minor but often significant (for fauna) structural differences in the environment. VSAs also do not necessarily correspond with soil types, but may reflect some of these elements.

Because VSAs provide the habitat for fauna, they are important in determining assemblage characteristics. For the purposes of impact assessment, VSAs can also provide a surrogate for detailed information on the fauna assemblage. For example, rare, relictual or restricted VSAs should automatically be considered a significant fauna value. Impacts may be significant if the VSA is rare, a large proportion of the VSA is affected and/or the VSA supports significant fauna. The disturbance of even small amounts of habitat in a localised area can have significant impacts to fauna if rare or unusual habitats are disturbed.

VSA assessment was made with reference to the key attributes provided by (EPA 2020):

- soil type and characteristics
- extent and type of ground surfaces and landforms
- height, cover and dominant flora within each vegetation stratum
- presence of specific flora or vegetation of known importance to fauna
- evidence of fire history including, where possible, estimates of time since fire
- evidence and degree of other disturbance or threats, e.g. feral species
- presence of microhabitats and significant habitat features, such as coarse woody debris, rocky
- outcrops, tree hollows, water sources and caves
- evidence of potential to support significant fauna
- function of the habitat as a fauna refuge or part of an ecological linkage.

Patterns of biodiversity across the landscape

This fauna value relates to how the assemblage is organised across the landscape. Generally, the fauna assemblage is not distributed evenly across the landscape or even within one VSA. There may be zones of high biodiversity such as particular environments or ecotones (transitions between VSAs). There may also be zones of low biodiversity. Impacts may be significant if a wide range of species is affected even if most of those species are not significant per se.

Species of conservation significance

Species of conservation significance are of special importance in impact assessment. The conservation status of fauna species in Australia is assessed under Commonwealth and State Acts such as the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the Western Australian *Biodiversity Conservation Act 2016* (BC Act). In addition, the Western Australian Department of Biodiversity, Conservation and Attractions (DBCA) recognises priority levels, while local populations of some species may be significant even if the species as a whole has no formal recognition. Therefore, three broad levels of conservation significance can be recognised and are used for the purposes of this report, and are outlined below. A full description of the conservation significance categories, schedules and priority levels mentioned below is provided in Appendix 2.

<u>Conservation Significance (CS) 1: Species listed under State or Commonwealth Acts</u>.

Species listed under the EPBC Act are assigned to categories recommended by the International Union for the Conservation of Nature and Natural Resources (IUCN 2012), or are listed as migratory. Migratory species are recognised under international treaties such as the China Australia Migratory Bird Agreement (CAMBA), the Japan Australia Migratory Bird Agreement (JAMBA), the Republic of South Korea Australia Migratory Bird Agreement (ROKAMBA), and/or the Convention on the Conservation of Migratory Species of Wild Animals (CMS; also referred to as the Bonn Convention). The *Wildlife Conservation Act 1950* uses a series of seven Schedules to classify conservation status that largely reflect the IUCN categories (IUCN 2012).

Conservation Significance (CS) 2: Species listed as Priority by DBCA but not listed under State or Commonwealth Acts.

In Western Australia, DBCA has produced a supplementary list of Priority Fauna, being species that are not considered threatened under the *Wildlife Conservation Act 1950* but for which DBCA feels there is cause for concern.

Conservation Significance (CS) 3: Species not listed under Acts or in publications, but considered of at least local significance because of their pattern of distribution.

This level of significance has no legislative or published recognition and is based on interpretation of distribution information, but is used here as it may have links to preserving biodiversity at the genetic level (EPA 2002). If a population is isolated but a subset of a widespread (common) species, then it may not be recognised as threatened, but may have unique genetic characteristics. Conservation significance is applied to allow for the preservation of genetic richness at a population level, and not just at a species level. Species on the edge of their range, or that are sensitive to impacts such as habitat fragmentation, may also be classed as CS3, as may colonies of waterbirds. The Western Australian Department of Environmental Protection, now DBCA, used this sort of interpretation to identify significant bird species in the Perth metropolitan area as part of the Perth Bushplan (Dell and Banyard 2000).

Marine-listed species

Some conservation significant species may also be listed as 'Marine' under the EPBC Act. This listing protects these species in 'Commonwealth areas' which include "marine areas beyond the coastal waters of each State and the Northern Territory, and includes all of Australia's Exclusive Economic Zone (EEZ)" (DAWE 2020b). The EEZ extends to 200 nautical miles (approximately 350 kilometres) from the coast (DAWE 2020b). This may mean that the 'Marine' listing does not apply to the project/survey area (depending on its location). Therefore, when a species is otherwise protected (under the EPBC Act or BC Act) or priority-listed (by the DBCA) then the Marine listing is also noted but it does not have site-specific relevance. In cases where a species is solely Marine-listed (for a list see DAWE 2020a) and a project/survey area is not within a Commonwealth area then it is treated like all other fauna.

Invertebrates

Invertebrate species considered to be short range endemics (SREs) also fall within the CS3 category, as they have no legislative or published recognition and their significance is based on interpretation of distribution information. 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. Several groups, therefore, have particularly high instances of short-range endemic species: Gastropoda (snails and slugs), Oligochaeta (earthworms), Onychophora (velvet worms), Araneae (mygalomorph spiders), Pseudoscorpionida (pseudoscorpions), Schizomida (schizomids), Diplopoda (millipedes), Phreatoicidea (phreatoicidean crustaceans), and Decapoda (freshwater crayfish). The poor understanding of the taxonomy of many of the short-range endemic species hinders their conservation (Harvey 2002).

Introduced species

In addition to these conservation levels, species that have been introduced (INT) are indicated throughout the report. Introduced species may be important to the native fauna assemblage through effects by predation and/or competition.

Ecological processes upon which the fauna depend

These are the processes that affect and maintain fauna populations in an area and as such are very complex; for example, populations are maintained through the dynamic of mortality, survival and recruitment being more or less in balance, and these are affected by a myriad of factors. The dynamics of fauna populations in a project area may be affected and effectively determined by processes such as:

- fire regime.
- landscape patterns (such as fragmentation and/or linkage).
- the presence of feral species.
- hydrology.

Some of the threatening processes as outlined in Appendix 3 are effectively the ecological processes that can be altered to result in impacts upon fauna.

Appendix 2. Categories used in the assessment of conservation status.

IUCN (International Union for the Conservation of Nature) categories, as outlined by IUCN (2012), and as used for the *Environment Protection and Biodiversity Conservation Act 1999* and the Western Australian *Biodiversity Conservation Act 2016*.

Extinct	Taxa not definitely located in the wild during the past 50 years.
Extinct in the Wild (Ex)	Taxa known to survive only in captivity.
Critically Endangered (CR)	Taxa facing an extremely high risk of extinction in the wild in the immediate future.
Endangered (E)	Taxa facing a very high risk of extinction in the wild in the near future.
Vulnerable (V)	Taxa facing a high risk of extinction in the wild in the medium-term future.
Near Threatened	Taxa that risk becoming Vulnerable in the wild.
Conservation Dependent	Taxa whose survival depends upon ongoing conservation measures. Without these measures, a conservation dependent taxon would be classed as Vulnerable or more severely threatened.
Data Deficient (Insufficiently Known)	Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information.
Least Concern.	Taxa that are not Threatened.

Schedules used in the WA *Biodiversity Conservation Act 2016*

Schedule 1 (S1)	Critically Endangered fauna.
Schedule 2 (S2)	Endangered fauna
Schedule 3 (S3)	Vulnerable Migratory species listed under international treaties.
Schedule 4 (S4)	Presumed extinct fauna
Schedule 5 (S5)	Migratory birds under international agreement
Schedule 6 (S6)	Conservation dependant fauna
Schedule 7 (S7)	Other specially protected fauna

WA DBCA Priority species (species not listed under the *WA Biodiversity Conservation Act 2016*, but for which there is some concern).

Priority 1 (P1)	Taxa with few, poorly known populations on threatened lands.
Priority 2 (P2)	Taxa with few, poorly known populations on conservation lands; or taxa with several, poorly known populations not on conservation lands.
Priority 3 (P3)	Taxa with several, poorly known populations, some on conservation lands.
Priority 4. (P4)	Taxa in need of monitoring. Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be if present circumstances change.
Priority 5 (P5)	Taxa in need of monitoring. Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years (IUCN Conservation Dependent).

Appendix 3. Explanation of threatening processes.

Potential impacts of proposed developments upon fauna values can be related to threatening processes. This is recognised in the literature and under the EPBC Act, in which threatening processes are listed (see Appendix 4). Processes that may impact fauna values are discussed below. Rather than being independent of one another, processes are complex and often interrelated. They are the mechanisms by which fauna can be affected by development. Impacts may be significant if large numbers of species or large proportions of populations are affected.

Note that the terms direct and indirect impacts are used by the DotE (2013), DSEWPaC (2013c) and EPA (2016a), but there is some inconsistency in how these are defined. The federal guidance does not define direct impact but has a very broad definition of indirect, and makes the statement (DotE 2013) '*Consideration should be given to all adverse impacts that could reasonably be predicted to follow from the action, whether these impacts are within the control of the person proposing to take the action or not. Indirect impacts will be relevant where they are sufficiently close to the proposed action to be said to be a consequence of the action, and they can reasonably be imputed to be within the contemplation of the person proposing to take the action*.' Indirect impacts therefore can even include what the DotE (2013) calls facilitated impacts, which are the result of third party actions triggered by the primary action. In contrast, the EPA (2016a) defines direct impacts to '*include the removal, fragmentation or modification of habitat, and mortality or displacement of individuals or populations.*' This document then lists as indirect impacts what in many cases are the consequences of the removal, fragmentation or modification of habitat. For example, '*disruption of the dispersal of individuals required to colonise new areas inhibiting maintenance of genetic diversity between populations'* is a consequence of habitat fragmentation. Impacts of light, noise and even roadkill are defined as indirect but they are clearly the result of the action and in control of the person taking the action. Roadkill is as direct a form of mortality as can be observed, but it is considered as an indirect impact in the context of a development presumably because it is not directly linked to land clearing. The EPA (2016a) makes a strong distinction between removal of vegetation (direct impact) and the consequences of such clearing and other aspects of a development (indirect impacts). It is not obvious how this distinction between direct and indirect impacts is helpful in the EIA process, as the key aim is to ensure that all impacts that result from a project are addressed in this assessment process. Interestingly, Gleeson and Gleeson (2012), in a major review of impacts of development on wildlife, do not use the terms direct or indirect. In the following outlines of threatening processes that can cause impacts, the emphasis is upon interpreting how a threatening process will cause an impact. For example, loss of habitat (threatening process) can lead to population decline and to population fragmentation, which are two distinct impacts, with population decline considered a direct impact and fragmentation an indirect impact by the EPA (2016a).

Loss of habitat affecting population survival

Clearing for a development can lead to habitat loss for a species with a consequent decline in population size. This may be significant if the smaller population has reduced viability. Conservation significant species or species that already occur at low densities may be particularly sensitive to habitat loss affecting population survival.

Loss of habitat leading to population fragmentation

Loss of habitat can affect population movements by limiting movement of individuals throughout the landscape as a result of fragmentation (Soule *et al.* 2004; Gleeson and Gleeson 2012). Obstructions associated with the development, such as roads, pipes and drainage channels, may also affect movement of small, terrestrial species. Fragmented populations may not be sustainable and may be sensitive to effects such as reduced gene flow.

Degradation of habitat due to weed invasion leading to population decline

Weed invasion, such as through introduction by human boots or vehicle tyres, can occur as a result of development and if this alters habitat quality, can lead to effects similar to habitat loss.

Increased mortality

Increased mortality can occur during project operations; for example from roadkill, animals striking infrastructure and entrapment in trenches. Roadkill as a cause of population decline has been documented for several medium-sized mammals in eastern Australia (Dufty 1989; Jones 2000). Increased mortality due to roadkill is often more prevalent in habitats that have been fragmented (Scheick and Jones 1999; Clevenger and Waltho 2000; Jackson and Griffin 2000).

Increased mortality of common species during development is unavoidable and may not be significant for a population. However, the cumulative impacts of increased mortality of conservation significant species or species that already occur at low densities may have a significant impact on the population.

Species interactions, including predation and competition

Changes in species interactions often occur with development. Introduced species, including the feral Cat, Red Fox and Rabbit may have adverse impacts upon native species and development can alter their abundance. In particular, some mammal species are very sensitive to introduced predators and the decline of many mammals in Australia has been linked to predation by the Red Fox, and to a lesser extent the feral Cat (Burbidge and McKenzie 1989). Introduced grazing species, such as the Rabbit, Goat, Camel and domestic livestock, can also degrade habitats and deplete vegetation that may be a food source for other species.

Changes in the abundance of some native species at the expense of others, due to the provision of fresh watering points, can also be a concern. Harrington (2002) found the presence of artificial fresh waterpoints in the semi-arid mallee rangelands to influence the abundance and distribution of certain bird species. Common, water-dependent birds were found to out-compete some less common, water-independent species. Similarly, Read *et al.* (2015) found a decline in some bird species but an increase in others in the vicinity of active mines and concluded this was due to the mine attracting large and aggressive species that displaced other species. Over-abundant native herbivores, such as kangaroos, can also adversely affect less abundant native species through competition and displacement.

Hydroecology

Interruptions of hydroecological processes can have major effects because they underpin primary production in ecosystems and there are specific, generally rare habitats that are hydrology-dependent. Fauna may be impacted by potential changes to groundwater level and chemistry and

altered flow regime. These changes may alter vegetation across large areas and may lead to habitat degradation or loss. Impacts upon fauna can be widespread and major.

Changes to flow regime across the landscape may alter vegetation and may lead to habitat degradation or loss, affecting fauna. For example, Mulga has a shallow root system and relies on surface sheet flow during flood events. If surface sheet flow is impeded, Mulga can die (Kofoed 1998), which may impact on a range of fauna associated with this vegetation type.

Fire

The role of fire in the Australian environment and its importance to vertebrate fauna has been widely acknowledged (Gill *et al.* 1981; Fox 1982; Letnic *et al.* 2004). It is also one of the factors that has contributed to the decline and local extinction of some mammal and bird species (Burbidge and McKenzie 1989). Fire is a natural feature of the environment but frequent, extensive fires may adversely impact some fauna, particularly mammals and short-range endemic species. Changes in fire regime, whether to more frequent or less frequent fires, may be significant to some fauna. Impacts of severe fire may be devastating to species already occurring at low densities or to species requiring long unburnt habitats to survive. In terms of conservation management, it is not fire *per se* but the fire regime that is important, with evidence that infrequent, extensive and intense fires adversely affect biodiversity, whereas frequent fires that cover small areas and are variable in both season and intensity can enhance biodiversity. Fire management may be considered the responsibility of managers of large tracts of land, including managers of mining tenements.

Dust, light, noise and vibration

Impacts of dust, light, noise and vibration upon fauna are difficult to predict. Some studies have demonstrated the impact of artificial night lighting on fauna, with lighting affecting fauna behaviour more than noise (Rich and Longcore 2006). Effects can include impacts on predator-prey interactions, changes to mating and nesting behaviour, and increased competition and predation within and between invertebrates, frogs, birds and mammals.

The death of very large numbers of insects has been observed around some remote mine sites and attracts other fauna, notably native and introduced predators (M. Bamford pers. obs). The abundance of some insects can decline due to mortality around lights, although this has previously been recorded in fragmented landscapes where populations are already under stress (Rich and Longcore 2006). Artificial night lighting may also lead to disorientation of migratory birds. Aquatic habitats and open habitats such as grasslands and dunes may be vulnerable to light spill.

Appendix 4. Ecological and threatening processes identified under legislation and in the literature.

Ecological processes are processes that maintain ecosystems and biodiversity. They are important for the assessment of impacts of development proposals, because ecological processes make ecosystems sensitive to change. The issue of ecological processes, impacts and conservation of biodiversity has an extensive literature. Following are examples of the sorts of ecological processes that need to be considered.

Ecological processes relevant to the conservation of biodiversity in Australia (Soule *et al.* 2004):

- Critical species interactions (highly interactive species);
- Long distance biological movement;
- Disturbance at local and regional scales;
- Global climate change;
- Hydroecology;
- Coastal zone fluxes;
- Spatially-dependent evolutionary processes (range expansion and gene flow); and
- Geographic and temporal variation of plant productivity across Australia.

Threatening processes (EPBC Act)

Under the EPBC Act, a key threatening process is an ecological interaction that threatens or may threaten the survival, abundance or evolutionary development of a threatened species or ecological community. There are currently 20 key threatening processes listed by the federal Department of the Environment (DotE 2014b):

- Competition and land degradation by rabbits.
- Competition and land degradation by unmanaged goats.
- Dieback caused by the root-rot fungus (*Phytophthora cinnamomi*).
- Incidental catch (bycatch) of Sea Turtle during coastal otter-trawling operations within Australian waters north of 28 degrees South.
- Incidental catch (or bycatch) of seabirds during oceanic longline fishing operations.
- Infection of amphibians with chytrid fungus resulting in chytridiomycosis.
- Injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris.
- Invasion of northern Australia by Gamba Grass and other introduced grasses.
- Land clearance.
- Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants.
- Loss of biodiversity and ecosystem integrity following invasion by the Yellow Crazy Ant (*Anoplolepis gracilipes*) on Christmas Island, Indian Ocean.
- Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases.
- Novel biota and their impact on biodiversity.
- Predation by European red fox.
- Predation by exotic rats on Australian offshore islands of less than 1000 km^2 (100,000 ha).
- Predation by feral cats.
- Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs.
- Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species.
- The biological effects, including lethal toxic ingestion, caused by Cane Toads (*Bufo marinus*).
- The reduction in the biodiversity of Australian native fauna and flora due to the red imported fire ant, *Solenopsis invicta* (fire ant).

General processes that threaten biodiversity across Australia (The National Land and Water Resources Audit):

- Vegetation clearing;
- Increasing fragmentation, loss of remnants and lack of recruitment;
- Firewood collection;
- Grazing pressure;
- Feral animals;
- Exotic weeds;
- Changed fire regimes;
- Pathogens;
- Changed hydrology—dryland salinity and salt water intrusion;
- Changed hydrology— such as altered flow regimes affecting riparian vegetation; and
- Pollution.

In addition to the above processes, the federal Department of Agriculture, Water and the Environment (DAWE) produced Significant Impact Guidelines that provide criteria for the assessment of the significance of impacts. These criteria provide a framework for the assessment of significant impacts. The criteria are listed below.

- Will the proposed action lead to a long-term decrease in the size of a population?
- Will the proposed action reduce the area of occupancy of the species?
- Will the proposed action fragment an existing population?
- Will the proposed action adversely affect habitat critical to the survival of a species?
- Will the proposed action disrupt the breeding cycle of a population?
- Will the proposed action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?
- Will the proposed action result in introducing invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat?
- Will the proposed action introduce disease that may cause the species to decline?
- Will the proposed action interfere with the recovery of the species?

Appendix 5. Scoring system for the assessment of foraging value of vegetation for Black-Cockatoos.

Bamford Consulting Ecologists
Revised 4th April 2021

Introduction

Application of the Offset Assessment Guide (offsets guide) developed by the federal environment department for assessing Black-Cockatoo foraging habitat requires the calculation of a score out of 10. The following system has been developed by Bamford Consulting Ecologists (BCE) with assistance from Quessentia Consulting to provide an objective scoring system that is practical and can be used by trained field zoologists with experience in the environments frequented by the species.

The foraging value score provides a numerical value that reflects the significance of vegetation as foraging habitat for Black-Cockatoos, and this numerical value is designed to provide the information needed by the Federal Department of Agriculture, Water and the Environment (DAWE) to assess impact significance and offset requirements. The foraging value of the vegetation depends upon the type, density and condition of trees and shrubs in an area and can be influenced by the context such as the availability of foraging habitat nearby. The BCE scoring system for value of foraging habitat has three components as detailed above. These three components are drawn from the DAWE offsets guide but the scoring approach was developed by BCE and includes a fourth (moderation) component. Note that the scoring system can only be applied within the range of the species or at least where the species could reasonably be expected to occur based upon existing information.

Calculating the total score (out of 10) requires the following steps:

A. Site condition. Determining a score out of six for the vegetation composition, condition and structure; plus
B. Site context. Determining a score out of three for the context of the site; plus
C. Species stocking rate. Determining a score out of one for species density.
D. Determining the total score out of 10, which may require moderation for context and species density with respect to the site condition (vegetation) score. Moderation also includes consideration of pine plantations as a special case for foraging value.

The BCE scoring system places the greatest weight on site condition (scale of 0 to 6) because this has the highest influence on the foraging values of a site, which in turn is the fundamental driver in meeting ecological requirements for continued survival.

Site context has a lower weight (scale of 0 to 3) in recognition of the mobility of the species, which means they can access good foraging habitat even in fragmented landscapes, but allowing for recognition of the extent of available habitat in a region and context in relation to activity (such as breeding and roosting). The application of scoring site context is further discussed below.

Species stocking rate is given a low weight (0 to 1) as it is a means only of recognising that a species may or may not be abundant at a site, but that abundance is dependent upon site condition and context and is thus not an independent variable. The abundance of a species is also sensitive to

sampling effort, and to seasonal and annual variation, and is therefore an unreliable indicator of actual importance of a site to a species.

Calculation of scores and the moderation process are described in detail below.

A. Site condition. Vegetation composition, condition and structure scoring

Site Score	Description of Vegetation Values		
	Carnaby's Black-Cockatoo	**Baudin's Black-Cockatoo**	**Forest Red-tailed Black-Cockatoo**
0	No foraging value. No Proteaceae, eucalypts or other potential sources of food. Examples: • Water bodies (e.g. salt lakes, dams, rivers); • Bare ground; • Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits) or with vegetation of no food value, such as some suburban landscapes. • Mown grass	No foraging value. No eucalypts or other potential sources of food. Examples: • Water bodies (e.g. dams, rivers); • Bare ground; • Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits).	No foraging value. No eucalypts or other potential sources of food. Examples: • Water bodies (e.g. dams, rivers); • Bare ground; • Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits).
1	Negligible to low foraging value. Examples: • Scattered specimens of known food plants but projected foliage cover of these is < 2%. This could include urban areas with scattered foraging trees; • Paddocks that are lightly vegetated with melons or other known food-source weeds (e.g. *Erodium* spp.) that represent a short-term and/or seasonal food source; • Blue Gum plantations (foraging by Carnaby's Black-Cockatoos has been reported but appears to be unusual).	Negligible to low foraging value. Scattered specimens of known food plants but projected foliage cover of these < 1%. This could include urban areas with scattered foraging trees.	Negligible to low foraging value. Scattered specimens of known food plants but projected foliage cover of these < 1%. Could include urban areas with scattered foraging trees.

Site Score	Description of Vegetation Values		
	Carnaby's Black-Cockatoo	**Baudin's Black-Cockatoo**	**Forest Red-tailed Black-Cockatoo**
2	Low foraging value. Examples: • Shrubland in which species of foraging value, such as shrubby banksias, have < 10% projected foliage cover; • Woodland with tree banksias 2-5% projected foliage cover; • Woodland with tree banksias (of key species *B. attenuata* and *B. menziesii*) with <10% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths; • Open eucalypt woodland/mallee of small-fruited species; • Paddocks that are densely vegetated with melons or other known food-source weeds (e.g. *Erodium* spp.) that represent a short-term and/or seasonal food source.	Low foraging value. Examples: • Woodland with scattered specimens of known food plants (e.g. Marri and Jarrah) 1-5% projected foliage cover; • Marri-Jarrah Woodland with <10% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths; • Parkland-cleared Eucalypt Woodland/Forest with known food plants <10% projected foliage cover (poor long-term viability without management); • Younger areas of (managed) revegetation with known food plants <10% projected foliage cover (establishing food sources with good long-term viability); • Urban areas with scattered foraging trees.	Low foraging value. Examples: • Woodland with scattered specimens of known food plants (e.g. Marri, Jarrah) 1-5% projected foliage cover; • Marri-Jarrah Woodland with <10% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths; • Sheoak Woodland with <10% projected foliage cover; • Parkland-cleared Eucalypt Woodland/Forest with known food plants <10% projected foliage cover (poor long-term viability without management); • Younger areas of (managed) revegetation with known food plants <10% projected foliage cover (establishing food sources with good long-term viability); • Urban areas with scattered food plants such as Cape Lilac, *Eucalyptus caesia* and *E. erythrocorys*.

Site Score	Description of Vegetation Values		
	Carnaby's Black-Cockatoo	**Baudin's Black-Cockatoo**	**Forest Red-tailed Black-Cockatoo**
3	Low to Moderate foraging value. Examples: • Shrubland in which species of foraging value, such as shrubby banksias, have 10-20% projected foliage cover; • Woodland with tree banksias 5-20% projected foliage cover; • Woodland with tree banksias (of key species *B. attenuata* and *B. menziesii*) with 10-40% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths; • Eucalypt Woodland/Mallee of small-fruited species; • Eucalypt Woodland with Marri < 10% projected foliage cover.	Low to Moderate foraging value. Examples: • Eucalypt Woodland with known food plants (especially Marri) 5-20% projected foliage cover; • Marri-Jarrah Woodland with 10-40% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths; • Parkland-cleared Eucalypt Woodland/Forest with known food plants 10-40% projected foliage cover (poor long-term viability without management); • Younger areas of (managed) revegetation with known food plants 10-40% projected foliage cover (establishing food sources with good long-term viability).	Low to Moderate foraging value. Examples: • Eucalypt Woodland with known food plants (especially Marri and Jarrah) 5-20% projected foliage cover; • Marri-Jarrah Woodland with 10-40% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths; • Sheoak Forest with 10-40% projected foliage cover; • Parkland-cleared Eucalypt Woodland/Forest with known food plants 10-40% projected foliage cover (poor long-term viability without management); • Younger areas of (managed) revegetation with known food plants 10-40% projected foliage cover (establishing food sources with good long-term viability).

Site Score	Description of Vegetation Values		
	Carnaby's Black-Cockatoo	**Baudin's Black-Cockatoo**	**Forest Red-tailed Black-Cockatoo**
4	Moderate foraging value. Examples: • Woodland/low forest with tree banksias (of key species *B. attenuata* and *B. menziesii*) 20-40% projected foliage cover; • Woodland/low forest with tree banksias (of key species *B. attenuata* and *B. menziesii*) with 40-60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths; • Kwongan/ Shrubland in which species of foraging value, such as shrubby banksias, have 20-40% projected foliage cover; • Eucalypt Woodland/Forest with Marri 20-40% projected foliage cover.	Moderate foraging value. Examples: • Marri-Jarrah Woodland/Forest with 20-40% projected foliage cover; • Marri-Jarrah Forest with 40-60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths; • Parkland-cleared Eucalypt Woodland/Forest with known food plants 40-60% projected foliage cover (poor long-term viability without management); • Younger areas of (managed) revegetation with known food plants 40-60% projected foliage cover (establishing food sources with good long-term viability); • Orchards with highly desirable food sources (e.g. apples, pears, some stone fruits).	Moderate foraging value. Examples: • Marri-Jarrah Woodland/Forest with 20-40% projected foliage cover; • Marri-Jarrah Forest with 40-60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths; • Sheoak Forest with 40-60% projected foliage cover; • Parkland-cleared Eucalypt Woodland/Forest with known food plants 40-60% projected foliage cover (poor long-term viability without management); • Younger areas of (managed) revegetation with known food plants 40-60% projected foliage cover (establishing food sources with good long-term viability).

Site Score	Description of Vegetation Values		
	Carnaby's Black-Cockatoo	**Baudin's Black-Cockatoo**	**Forest Red-tailed Black-Cockatoo**
5	Moderate to High foraging value. Examples: • Banksia Low Forest (of key species *B. attenuata* and *B. menziesii*) with 40-60% projected foliage cover; • Banksia Low Forest (of key species *B. attenuata* and *B. menziesii*) with > 60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths; • Kwongan/ Shrubland in which species of foraging value, such as shrubby banksias, have 40-60% projected foliage cover; • Marri-Jarrah Forest with 40-60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium term). • Pine plantations with trees more than 10 years old (but see pine note below in moderation section).	Moderate to High foraging value. Examples: • Marri-Jarrah Forest with 40-60% projected foliage cover; • Marri-Jarrah Forest with > 60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths; • Parkland-cleared Eucalypt Woodland/Forest with known food plants >60% projected foliage cover (poor long-term viability without management); • Younger areas of (managed) revegetation with known food plants >60% projected foliage cover (establishing food sources with good long-term viability).	Moderate to High foraging value. Examples: • Marri-Jarrah Forest with 40-60% projected foliage cover; • Marri-Jarrah Forest with > 60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths; • Sheoak Forest with > 60% projected foliage cover; • Parkland-cleared Eucalypt Woodland/Forest with known food plants >60% projected foliage cover (poor long-term viability without management); • Younger areas of (managed) revegetation with known food plants >60% projected foliage cover (establishing food sources with good long-term viability).

Site Score	Description of Vegetation Values		
	Carnaby's Black-Cockatoo	**Baudin's Black-Cockatoo**	**Forest Red-tailed Black-Cockatoo**
6	High foraging value. Example: • Banksia Low Forest (of key species *B. attenuata* and *B. menziesii*) with > 60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium term). • Kwongan/ Shrubland in which species of foraging value, such as shrubby banksias, have >60% projected foliage cover; • Marri-Jarrah Forest with > 60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium term).	High foraging value. Example: • Marri-Jarrah Forest with > 60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium term).	High foraging value. Example: • Marri-Jarrah Forest with > 60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium term).

Vegetation structural class terminology follows Keighery (1994).

B. Site context.

Site Context is a function of site size, availability of nearby habitat and the availability of nearby breeding areas. Site context includes consideration of connectivity, although Black-Cockatoos are very mobile and will fly across paddocks to access foraging sites. Based on BCE observations, Black-Cockatoos are unlikely to regularly go over open ground for a distance of more than a few kilometres and prefer to follow tree-lines.

The maximum score for site context is 3, and because it is effectively a function of presence/absence of nearby breeding and the distribution of foraging habitat across the landscape, the following table, developed by Bamford Consulting in conjunction with the Department of the Environment and Energy (DEE), provides a *guide* to the assignation of site context scores. Note that 'local area' is defined as within a 15 km radius of the centre point of the study site. This is greater than the maximum distance of 12km known to be flown by Carnaby's Black-Cockatoo when feeding chicks in the nest.

Site Context Score	Percentage of the existing native vegetation within the 'local' area that the study site represents.	
	'Local' breeding known/likely	'Local' breeding unlikely
3	> 5%	> 10%
2	1 - 5%	5 - 10%
1	0.1 - 1%	1 - 5%
0	< 0.1%	< 1%

The table above provides weighting for where nearby breeding is known (or suspected) and for the proportion of foraging habitat within 15 km represented by the site being assessed. Some adjustments may be needed based on the judgement of the assessor and in relation to the likely function of the site. For example, a small area of foraging habitat (e.g. 0.5% of such habitat within 15 km) could be upgraded to a context of 2 if it formed part of a critical movement corridor. In contrast, the same sized area of habitat, of the same local proportion, could be downgraded if it were so isolated that birds could never access it.

C. Species density (stocking rate).

Species stocking rate is described as "the usage and/or density of a species at a particular site" in the offsets guide. The description also implies that a site supports a discrete population, which is unlikely in the case of very mobile black-cockatoos. Assignation of the species density score (0 or 1) is based upon the black-cockatoo species being either abundant or not abundant. A score of 1 is used where the species is seen or reported regularly and/or there is abundant foraging evidence. Regularly is when the species is seen at intervals of every few days or weeks for at least several months of the year. A score of 0 is used when the species is recorded or reported very infrequently and there is little or no foraging evidence. Where information on actual presence of birds is lacking, a species density score can be assigned by interpreting the landscape and the site context. For example, a site with a moderate condition score that is part of a network of such habitat where a black-cockatoo species is

known would get a species density score of 1 even without clear presence data, while a species density score of 0 can be assigned to a site where the level of usage can confidently be predicted to be low.

D. Moderation of scores for the calculation of a value out of 10.

The calculation out of 10 requires the vegetation characteristics (out of 6) to be combined with the scores given for context and species density. It is considered that the context and density scores are not independent of vegetation characteristics; otherwise habitat of absolutely no value for black-cockatoo foraging (such as concrete or a wetland) could get a foraging score out of 10 as high as 4 if it occurred in an area where the species breed (context score of 3) and are abundant (species density score of 1). Similarly, vegetation of negligible or low characteristics which could not support black-cockatoos could be assigned a score as high as 6 out of 10. In that case, the score of 6 would be more a reflection of nearby vegetation of high characteristics than of the foraging value of the negligible to low scoring vegetation. The Black-Cockatoos would only be present because of vegetation of high characteristics, so applying the context and species density scores to vegetation of low characteristics would not give a true reflection of their foraging value.

For this reason, the context and species density scores need to be moderated for the vegetation characteristic score to prevent vegetation of little or no foraging value receiving an excessive score out of 10. A simple approach is to assign a context and species density score of zero to sites with a Condition score of low (2), negligible (1) or none (0), on the basis that birds will not use such areas unless they are adjacent to at least low-moderate quality foraging habitat ($\geq$3). The approach to calculating a score out of 10 can be summarised as follows:

Vegetation composition, condition and structure score	Context score	Species density score
3-6 (low/moderate to high value)	Assessed as per B above	Assessed as per C above
0-2 (no to low value)	0	0

Note that this moderation approach may require interpretation depending on the context. For example, vegetation with a condition score of 2 could be given a context score of 1 under special circumstances. Such as when very close to a major breeding area or if strategically located along a movement corridor.

Pine plantations

Pine plantations are an important foraging resource for Carnaby's Black-Cockatoo (only) but are not directly comparable with native vegetation. In comparing native vegetation with pine plantations for the purpose of calculating offsets, the following should be noted:

- Pine plantations are a commercial crop established with the intention of being harvested and thus have short-term availability (30-50 years), whereas native vegetation is available indefinitely if protected. Due to the temporary nature of pines as a food source, site condition and context differs between pines and native vegetation.
- Although pines provide a high abundance of food in the form of seeds, they are a limited food resource compared with native vegetation which provides seeds, insect larvae, flowers and nectar. The value of insect larvae in the diet of Carnaby's Black-Cockatoo has not been quantified, but in the vicinity of Perth, the birds forage very heavily on insect larvae in young cones of *Banksia attenuata* in winter, ignoring the seeds in these cones and seeds in older cones on the same trees (Scott and Black 1981; M. Bamford pers. obs.). This suggests that insect larvae are of high nutritional importance immediately prior to the breeding season.
- Pine plantations have very little biodiversity value other than their importance as a food source for Carnaby's Black-Cockatoos. They inhibit growth of other flora. While this is not a factor for direct consideration with respect to Carnaby's Black-Cockatoo, it is a factor in regional conservation planning of which offsets for the cockatoos are a part.

Taking the above points into consideration, it is possible to assign pine plantations a foraging value as follows:

- Site condition. The actual foraging value of pines is high. Stock *et al.* (2013) report that it takes nearly twice as many seeds of *Pinus pinaster* to meet the daily energy requirements for Carnaby's Black-Cockatoo compared with Marri, and three times as many *P. pinaster* seeds compared with Slender Banksia. However, pines are planted at a high density so the food supply per hectare can be high. Taking account of the lack of variety of food from pines, this suggests a site condition score of 4 or 5 out of 6 (5 is used in Section A above). As a source of food, pines are thus comparable to the best banksia woodland. This site condition score then needs to be adjusted to take account of the short-term nature of the food supply (for pine plantations to be harvested. Where pines are 'ornamental, such as in some urban contexts, they can be treated as with other trees in urban landscapes). The foraging value of a site after pines are harvested will effectively be 0, or possibly 1 if there is some retention. It is proposed that this should approximately halve the site condition score; young pine plantations could be redacted slightly less than old plantations on the basis that a young plantation provides a slightly longer term food supply. If a maximum site condition score of 5 is given, then a young plantation (>10 but <30 years old) could be assigned a score of 3, and an old plantation (>30 years old) could be assigned a score of 2. Plantations <10 years old and thus not producing large quantities of cones could also get a score of 2, but recognising they may increase in value.
- Site context. Although a temporary food source, pines can be very important for Carnaby's Black-Cockatoo in some contexts; they could be said to carry populations in areas where there is little native vegetation. The system for assigning a context score as outlined above (Section B) also applies to pines. Thus, a context score of 3 can be given where pines are a significant

proportion of foraging habitat (>5% if breeding occurs; >10% if no breeding), but where pines are a small part of the foraging landscape they will receive a context score of less than this.

- Species density. As outlined above (Section C), pines will receive a species density score of 1 where Carnaby's Black-Cockatoo are regular visitors. This is irrespective of an old plantation having a moderated condition score of 2.

Based on the above, pine plantations that represent a substantial part of the foraging landscape, such as in the region immediately north of Perth, would receive a total score (out of 10) of 6; young plantations in this area would receive a score of 7. In contrast, isolated and small plantations in rural landscapes could receive a score of just 2 if they are only a small proportion of foraging habitat and Carnaby's Black-Cockatoos are not regularly present.

Appendix 6. Examples of Forest Red-tailed Black-Cockatoo foraging signs across the range of age categories used in this study.

Active/Recent ↔ Intermediate ↔ Old

Jarrah nuts

Jarrah leaves

Marri nuts

Appendix 7. Vertebrate fauna expected to occur in the project area.

Status codes:

CS1, CS2, CS3 = (summary) levels of conservation significance. See Appendix 1 for full explanation.

EPBC Act listings: E = Endangered, V = Vulnerable, M = Migratory, Mar = Marine (see Appendix 2).

Biodiversity Conservation Act 2016 listings: S1 to S7 = Schedules 1 to 7 (see Appendix 2).

DBCA Priority species: P1 to P4 = Priority 1 to 4 (see Appendix 2).

Bush Forever (Dell and Banyard 2000) status: HS = habitat specialists with a reduced distribution on the Swan Coastal Plain, LE = locally extinct, WR = wide ranging species with reduced populations on the Swan Coastal Plain.

LS = considered to be of local significance by Bamford Consulting Ecologists (see Appendix 1).

Int = introduced species.

Expected Occurrence categories:

See Section 2.3.4 for explanation of expected occurrence categories.

Source:

1 = Atlas of Living Australia (ALA 2022), 2 = NatureMap (DBCA 2022e), 3 = Protected Matters Search Tool (DAWE 2022g), 4 = general literature (see Table 4).

Recorded:

'+' = recorded directly, D = diggings, F = foraging signs, S = scats, T = tracks.

Wetland dependence:

~ = species is dependent on wetland environments for the entirety its lifecycle.

w = species is dependent on wetland environments for the majority of its lifecycle.

w† = species is dependent on wetland environments for some its lifecycle (often breeding) but can spend a substantial portion of time in dryland environments.

o = species is dependent on oceanic environments (including coastlines and islands).

Species	Status	Expected Occurrence	Source	Recorded
Hylidae (Tree frogs)				
Litoria adelaidensis w	Slender Tree Frog	Irregular visitor	1, 2	
Litoria moorei w	Motorbike Frog	Irregular visitor	1, 2	
Limnodynastidae (Burrowing frogs)				
Heleioporus eyrei w†	Moaning Frog	Resident	1, 2	
Limnodynastes dorsalis w†	Western Banjo Frog	Resident	1, 2	
Myobatrachidae (Ground frogs)				

Species		Status	Expected Occurrence	Source	Recorded
Crinia glauerti [w†]	Clicking Frog		Irregular visitor	1, 2	
Crinia insignifera [w†]	Squelching Froglet		Irregular visitor	1, 2	
Myobatrachus gouldii	Turtle Frog		Resident	1, 2	
Pseudophryne guentheri [w†]	Crawling Toadlet		Resident	1, 2	
Carphodactylidae (Carphodactylid geckos)					
Underwoodisaurus milii	Southern Barking Gecko		Resident	1, 2	
Diplodactylidae (Diplodactylid geckos)					
Crenadactylus ocellatus	South-western Clawless Gecko		Resident	1, 2	
Diplodactylus polyophthalmus	Spotted Sandplain Gecko		Resident	1, 2	
Lucasium alboguttatum			Resident	2	
Strophurus spinigerus spinigerus			Resident	1, 2	
Gekkonidae (Gekkonid geckos)					
Christinus marmoratus	Marbled Gecko		Resident	1, 2	
Pygopodidae (Legless lizards)					
Aprasia repens			Resident	1, 2	
Delma concinna concinna			Resident	2	
Delma fraseri			Resident	1, 2	
Delma grayii			Resident	1, 2	
Lialis burtonis	Burton's Legless-Lizard		Resident	1, 2	
Pletholax gracilis gracilis			Resident	1, 2	
Pygopus lepidopodus	Common Scaly Foot		Resident	1, 2	
Agamidae (Dragons)					
Ctenophorus adelaidensis	Western Heath Dragon		Resident	1, 2	

Species		Status	Expected Occurrence	Source	Recorded
Pogona minor minor	Western Bearded Dragon		Resident	1, 2	
Scincidae (Skinks)					
Acritoscincus trilineatus			Resident	1, 2	
Cryptoblepharus buchananii	Fence Skink		Resident	1, 2	
Ctenotus australis			Resident	1, 2	
Ctenotus fallens			Resident	2	
Ctenotus impar			Resident	1, 2	
Cyclodomorphus celatus			Resident	1, 2	
Egernia kingii	King's Skink		Resident	1, 2	
Egernia napoleonis			Resident	1, 2	
Hemiergis quadrilineata			Resident	1, 2	
Lerista elegans			Resident	1, 2	
Lerista lineopunctulata			Irregular visitor	1, 2	
Lerista praepedita			Resident	1, 2	
Menetia greyii			Resident	1, 2	
Morethia lineoocellata			Resident	1, 2	
Morethia obscura			Resident	1, 2	
Tiliqua occipitalis	Western Bluetongue		Resident	1, 2	
Tiliqua rugosa rugosa	Bobtail		Resident	1, 2	
Varanidae (Monitors and goannas)					
Varanus gouldii	Bungarra or Sand Goanna		Resident	1, 2	
Varanus tristis tristis	Tree Goanna		Resident	1, 2	
Typhlopidae (Blind snakes)					

Species		Status	Expected Occurrence	Source	Recorded
Anilios australis			Resident	1, 2	
Pythonidae (Pythons)					
Morelia spilota imbricata	Carpet Python (southwest)	CS3 (LS)	Regular visitor	1, 2	
Elapidae (Venomous land snakes)					
Brachyurophis fasciolatus fasciolatus			Resident (if present)	1, 2	
Brachyurophis semifasciatus			Resident	1, 2	
Demansia psammophis psammophis	Yellow-faced Whipsnake		Resident	1, 2	
Echiopsis curta	Bardick		Resident	1, 2	
Neelaps bimaculatus	Black-naped Snake		Resident	1, 2	
Neelaps calonotos	Black-striped Snake	CS2 (P3)	Resident (if present)	1, 2	
Pseudonaja affinis affinis	Dugite		Resident	1, 2	
Simoselaps bertholdi	Jan's Banded Snake		Resident	1, 2	
Suta gouldii	Gould's Hooded Snake		Resident	1, 2	
Suta nigriceps			Resident	2	
Casuariidae (Emus and Cassowaries)					
Dromaius novaehollandiae	Emu	CS3 (WR)	Regular visitor	1, 2	
Anatidae (Ducks, Geese and Swans)					
Tadorna tadornoides [w]	Australian Shelduck		Irregular visitor	1, 2	
Anas superciliosa [w]	Pacific Black Duck		Irregular visitor	1, 2	
Chenonetta jubata [w]	Australian Wood Duck		Irregular visitor	1, 2	
Phasianidae (Pheasants and Quail)					
Coturnix pectoralis	Stubble Quail		Vagrant	1, 2	

Species		Status	Expected Occurrence	Source	Recorded
Synoicus ypsilophorus	Brown Quail		Resident	1, 2	
Columbidae (Pigeons and Doves)					
Columba livia	Rock Dove/Feral Pigeon	Int	Irregular visitor	1, 2	
Streptopelia chinensis	Spotted Dove	Int	Resident	1, 2	
Spilopelia senegalensis	Laughing Dove	Int	Resident	1, 2	
Phaps chalcoptera	Common Bronzewing	CS3 (HS)	Resident	1, 2	
Phaps elegans	Brush Bronzewing	CS3 (HS)	Irregular visitor	1, 2	
Ocyphaps lophotes	Crested Pigeon		Resident	1, 2	
Cuculidae (Cuckoos)					
Chalcites basalis	Horsfield's Bronze-Cuckoo		Regular migrant	1, 2	
Chalcites lucidus	Shining Bronze-Cuckoo		Regular migrant	1, 2	
Cacomantis flabelliformis	Fan-tailed Cuckoo		Regular migrant	1, 2	+
Heteroscenes pallidus	Pallid Cuckoo		Regular migrant	1, 2	
Podargidae (Frogmouths)					
Podargus strigoides	Tawny Frogmouth		Resident	1, 2	
Eurostopodidae (Eared Nightjars)					
Eurostopodus argus	Spotted Nightjar		Vagrant	1, 2	
Aegothelidae (Owlet-nightjars)					
Aegotheles cristatus	Australian Owlet-nightjar		Regular visitor	1, 2	
Apodidae (Swifts and Swiftlets)					
Apus pacificus	Fork-tailed Swift	CS1 (M,Mar,S5)	Vagrant	1, 2, 3	
Turnicidae (Button-quail)					
Turnix varius	Painted Button-quail	CS3 (WR)	Resident	1, 2	

Species		Status	Expected Occurrence	Source	Recorded
Turnix velox	Little Button-quail		Irregular visitor	1, 2	
Accipitridae (Eagles, Kites, Goshawks)					
Elanus axillaris	Black-shouldered Kite		Regular visitor	1, 2	
Lophoictinia isura	Square-tailed Kite	CS3 (WR)	Regular visitor	1, 2	
Aquila audax	Wedge-tailed Eagle	CS3 (WR)	Regular visitor	1, 2	
Hieraaetus morphnoides	Little Eagle	CS3 (WR)	Regular visitor	1, 2	
Circus assimilis	Spotted Harrier		Irregular visitor	1, 2	
Accipiter fasciatus	Brown Goshawk	CS3 (WR)	Regular visitor	1, 2	
Accipiter cirrocephalus	Collared Sparrowhawk	CS3 (WR)	Regular visitor	1, 2	
Haliastur sphenurus	Whistling Kite	CS3 (WR)	Regular visitor	1, 2	
Tytonidae (Masked Owls)					
Tyto alba	Barn Owl		Regular visitor	1, 2	
Strigidae (Hawk-Owls)					
Ninox novaeseelandiae	Southern Boobook		Regular visitor	1	
Meropidae (Bee-eaters)					
Merops ornatus	Rainbow Bee-eater		Regular migrant	1, 2, 3	
Alcedinidae (Kingfishers)					
Todiramphus sanctus	Sacred Kingfisher		Regular migrant	1, 2	
Dacelo novaeguineae	Laughing Kookaburra	Int	Resident	1, 2	
Falconidae (Falcons)					
Falco cenchroides	Nankeen Kestrel		Resident	1, 2	
Falco longipennis	Australian Hobby		Regular visitor	1, 2	
Falco berigora	Brown Falcon		Irregular visitor	1, 2	

Species		Status	Expected Occurrence	Source	Recorded
Falco peregrinus	Peregrine Falcon	CS1 (S7)	Regular visitor	1, 2	
Cacatuidae (Cockatoos and Corellas)					
Calyptorhynchus banksii naso	Forest Red-tailed Black-Cockatoo	CS1 (V,S3)	Irregular visitor	1, 2, 3	
Calyptorhynchus latirostris	Carnaby's Black-Cockatoo	CS1 (E,S2)	Regular migrant	1, 2, 3	F
Eolophus roseicapilla	Galah		Resident	1, 2	+
Cacatua tenuirostris	Long-billed Corella	Int	Regular visitor	1, 2	
Cacatua sanguinea	Little Corella		Regular visitor	1, 2	
Psittaculidae (Parrots, Lorikeets and Rosellas)					
Purpureicephalus spurius	Red-capped Parrot		Regular visitor	1, 2	+
Barnardius zonarius	Australian Ringneck		Resident	1, 2	+
Neophema elegans	Elegant Parrot		Resident	1, 2	
Trichoglossus haematodus	Rainbow Lorikeet	Int	Resident	1, 2	
Maluridae (Fairy-wrens, Emu-wrens and Grasswrens)					
Malurus assimilis	Purple-backed Fairy-wren	CS3 (HS)	Resident	1, 2	
Malurus splendens	Splendid Fairy-wren	CS3 (HS)	Resident	1, 2	+
Malurus leucopterus	White-winged Fairy-wren	CS3 (HS)	Irregular visitor	1, 2	+
Stipiturus malachurus	Southern Emu-wren	CS3 (HS)	Irregular visitor	4	
Meliphagidae (Honeyeaters and Chats)					
Lichmera indistincta	Brown Honeyeater		Resident	1, 2	
Phylidonyris novaehollandiae	New Holland Honeyeater	CS3 (WR)	Resident	1, 2	+
Phylidonyris niger	White-cheeked Honeyeater	CS3 (WR)	Resident	1, 2	+
Glyciphila melanops	Tawny-crowned Honeyeater	CS3 (WR)	Regular visitor	1, 2	
Acanthorhynchus superciliosus	Western Spinebill		Resident	1, 2	

Species		Status	Expected Occurrence	Source	Recorded
Epthianura albifrons	White-fronted Chat		Irregular visitor	1, 2	
Anthochaera lunulata	Western Wattlebird	CS3 (WR)	Regular visitor	1, 2	
Anthochaera carunculata	Red Wattlebird		Regular visitor	1, 2	
Gavicalis virescens	Singing Honeyeater		Resident	1, 2	
Manorina flavigula	Yellow-throated Miner	CS3 (WR)	Irregular visitor	1, 2	
Pardalotidae (Pardalotes)					
Pardalotus punctatus	Spotted Pardalote		Irregular visitor	1, 2	
Pardalotus striatus	Striated Pardalote		Resident	1, 2	
Acanthizidae (Thornbills and Gerygones)					
Gerygone fusca	Western Gerygone		Resident	1, 2	
Smicrornis brevirostris	Weebill	CS3 (HS)	Resident	1, 2	
Calamanthus campestris	Rufous Fieldwren		Irregular visitor	1	+
Sericornis frontalis	White-browed Scrubwren	CS3 (HS)	Resident	1, 2	+
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	CS3 (HS)	Resident	1, 2	
Acanthiza apicalis	Inland Thornbill	CS3 (HS)	Resident	1, 2	
Acanthiza inornata	Western Thornbill	CS3 (HS)	Irregular visitor	1, 2	
Neosittidae (Sittellas)					
Daphoenositta chrysoptera	Varied Sittella	CS3 (HS)	Irregular visitor	1, 2	
Campephagidae (Cuckoo-shrikes and Trillers)					
Coracina novaehollandiae	Black-faced Cuckoo-shrike		Regular visitor	1, 2	+
Lalage tricolor	White-winged Triller		Regular visitor	1, 2	
Pachycephalidae (Whistlers, Shrike-thrushes and allies)					
Pachycephala rufiventris	Rufous Whistler		Resident	1, 2	

Species		Status	Expected Occurrence	Source	Recorded
Colluricincla harmonica	Grey Shrike-thrush	CS3 (HS)	Resident	1, 2	+
Oreoicidae (Australo-Papuan Bellbirds)					
Oreoica gutturalis	Crested Bellbird		Vagrant	1	
Artamidae (Woodswallows, Currawongs, Butcherbirds and Magpie)					
Strepera versicolor	Grey Currawong	CS3 (WR)	Irregular visitor	1, 2	
Gymnorhina tibicen	Australian Magpie		Resident	1, 2	+
Cracticus torquatus	Grey Butcherbird		Resident	1, 2	
Artamus personatus	Masked Woodswallow	CS3 (WR)	Vagrant	1, 2	
Artamus cyanopterus	Dusky Woodswallow	CS3 (WR)	Regular visitor	1, 2	
Artamus cinereus	Black-faced Woodswallow		Resident	1, 2	+
Rhipiduridae (Fantails)					
Rhipidura leucophrys	Willie Wagtail		Resident	1, 2	
Rhipidura albiscapa	Grey Fantail		Resident	1, 2	+
Corvidae (Crows and Ravens)					
Corvus coronoides	Australian Raven		Resident	1, 2	+
Monarchidae (Monarch and Flycatchers)					
Grallina cyanoleuca	Magpie-lark		Resident	1, 2	+
Petroicidae (Australian Robins)					
Petroica boodang	Scarlet Robin	CS3 (HS)	Regular visitor	1, 2	
Petroica goodenovii	Red-capped Robin		Irregular visitor	1, 2	
Quoyornis georgianus	White-breasted Robin	CS3 (HS)	Irregular visitor	1, 2	
Melanodryas cucullata	Hooded Robin		Irregular visitor	1	
Dicaeidae (Flowerpeckers)					

Species		Status	Expected Occurrence	Source	Recorded
Dicaeum hirundinaceum	Mistletoebird		Regular visitor	1, 2	
Motacillidae (Pipits and Wagtails)					
Anthus novaeseelandiae	Australasian Pipit		Resident	1, 2	
Locustellidae (Grassbirds)					
Cincloramphus cruralis	Brown Songlark		Regular visitor	1	
Cincloramphus mathewsi	Rufous Songlark		Regular visitor	1	
Hirundinidae (Swallows and Martins)					
Cheramoeca leucosterna	White-backed Swallow		Regular visitor	1, 2	
Petrochelidon ariel	Fairy Martin		Irregular visitor	1, 2	
Petrochelidon nigricans	Tree Martin		Resident	1, 2	
Hirundo neoxena	Welcome Swallow		Resident	1, 2	+
Zosteropidae (White-eyes)					
Zosterops lateralis	Silvereye		Resident	1, 2	+
Tachyglossidae (Echidnas)					
Tachyglossus aculeatus acanthion	Short-beaked Echidna		Resident	1, 2	
Dasyuridae (Dasyurids)					
Dasyurus geoffroii fortis	Chuditch	CS1 (V,S3)	Vagrant	1, 2, 3	
Peramelidae (Bandicoots)					
Isoodon fusciventer	Quenda	CS2 (P4)	Resident	1, 2	D
Tarsipedidae (Honey Possum)					
Tarsipes rostratus	Honey Possum, Noolbenger	CS3 (LS)	Resident	1, 2	
Phalangeridae (Brushtail possums)					
Trichosurus vulpecula hypoleucus	Brushtail Possum		Resident	1, 2	

Species		Status	Expected Occurrence	Source	Recorded
Macropodidae (Kangaroos)					
Macropus fuliginosus melanops	Western Grey Kangaroo		Resident	1, 2	S,T
Notamacropus irma	Brush Wallaby	CS2 (P4)	Regular visitor	1, 2	
Muridae (Rats and mice)					
Mus musculus	House Mouse	Int	Resident	1, 2	
Rattus fuscipes fuscipes	Western Bush Rat, Moodit	CS3 (LS)	Resident	1, 2	
Rattus rattus	Black Rat	Int	Resident	1, 2	
Leporidae (Rabbits and hares)					
Oryctolagus cuniculus	Rabbit	Int	Resident	1, 2	D,S
Molossidae (Freetail bats)					
Austronomus australis	White-striped Free-tailed Bat		Regular migrant	1	
Vespertilionidae (Vespertillionid bats)					
Chalinolobus gouldii	Gould's Wattled Bat		Regular visitor	1, 2	
Chalinolobus morio	Chocolate Wattled Bat		Regular visitor	1, 2	
Nyctophilus geoffroyi geoffroyi	Lesser Long-eared Bat		Regular visitor	1, 2	
Nyctophilus holtorum (formerly gouldi)	Holt's Long-eared Bat		Regular visitor	1, 2	
Vespadelus regulus	Southern Forest Bat		Regular visitor	1, 2	
Canidae (Dogs)					
Vulpes vulpes	Red Fox	Int	Resident	1, 2	
Felidae (Cats)					
Felis catus	Cat	Int	Resident	1, 2	

Appendix 8. Species recorded in the field investigations.

Species	Annotations
Cacomantis flabelliformis (Fan-tailed Cuckoo)	Heard from site.
Calyptorhynchus latirostris (Carnaby's Black-Cockatoo)	Extensive foraging evidence throughout site.
Eolophus roseicapilla (Galah)	One or two birds seen.
Purpureicephalus spurius (Red-capped Parrot)	Heard from site.
Barnardius zonarius (Australian Ringneck)	Heard from site.
Malurus splendens (Splendid Fairy-wren)	Heard from site.
Malurus leucopterus (White-winged Fairy-wren)	Heard from site.
Phylidonyris novaehollandiae (New Holland Honeyeater)	Several birds throughout site.
Phylidonyris niger (White-cheeked Honeyeater)	Heard from site.
Calamanthus campestris (Rufous Fieldwren)	Heard from site.
Sericornis frontalis (White-browed Scrubwren)	Heard from site.
Coracina novaehollandiae (Black-faced Cuckoo-shrike)	One or two birds seen.
Colluricincla harmonica (Grey Shrike-thrush)	Heard from site.
Gymnorhina tibicen (Australian Magpie)	Heard from site.
Artamus cinereus (Black-faced Woodswallow)	Several birds passing overhead.
Rhipidura albiscapa (Grey Fantail)	Heard from site.
Corvus coronoides (Australian Raven)	Heard from site.
Grallina cyanoleuca (Magpie-lark)	Heard from site.
Hirundo neoxena (Welcome Swallow)	Several birds passing overhead.
Zosterops lateralis (Silvereye)	Heard from site.
Isoodon fusciventer (Quenda)	Several diggings noted.
Macropus fuliginosus melanops (Western Grey Kangaroo)	Tracks and scats seen throughout site.

Species	Annotations
Oryctolagus cuniculus (Rabbit)	Diggings and scats seen throughout site.

Appendix 9. Species returned from the literature review that have been omitted from the expected species list because of habitat or range limitations, or because they are now considered locally extinct.

Note that some birds could still occur as extremely rare vagrants.

Status codes:

CS1, CS2, CS3 = (summary) levels of conservation significance. See Appendix 1 for full explanation.

EPBC Act listings: E = Endangered, V = Vulnerable, M = Migratory, Mar = Marine (see Appendix 2).

Biodiversity Conservation Act 2016 listings: S1 to S7 = Schedules 1 to 7 (see Appendix 2).

DBCA Priority species: P1 to P4 = Priority 1 to 4 (see Appendix 2).

Bush Forever (Dell and Banyard 2000) status: HS = habitat specialists with a reduced distribution on the Swan Coastal Plain, LE = locally extinct, WR = wide ranging species with reduced populations on the Swan Coastal Plain.

LS = considered to be of local significance by Bamford Consulting Ecologists (see Appendix 1).

Int = introduced species.

Exclusion categories:

Locally extinct =species is locally extinct in the vicinity of the project area, Habitat = insufficient suitable habitat for the species occurs within the project area, Range = project area falls outside the known range of the species.

Source:

1 = Atlas of Living Australia (ALA 2022), 2 = NatureMap (DBCA 2022e), 3 = Protected Matters Search Tool (DAWE 2022g).

Wetland dependence:

~ = species is dependent on wetland environments for the entirety its lifecycle.

w = species is dependent on wetland environments for the majority of its lifecycle.

w† = species is dependent on wetland environments for some its lifecycle (often breeding) but can spend a substantial portion of time in dryland environments.

o = species is dependent on oceanic environments (including coastlines and islands).

Species		Status	Expected Occurrence	Source
Galaxiidae (Galaxiids)				
Galaxias occidentalis ~	Western Minnow		Habitat	1, 2
Galaxiella munda ~	Western Mud Minnow	CS1 (S3)	Habitat	1, 2
Galaxiella nigrostriata ~	Black-stripe Minnow	CS1 (S2)	Habitat	3
Gobiidae (Gobies)				
Pseudogobius olorum ~	Blue-spot Goby		Habitat	1, 2

Species		Status	Expected Occurrence	Source
Cyprinidae (Cyprinids)				
Carassius auratus [~]	Goldfish	Int	Habitat	2
Poeciliidae (Livebearers)				
Gambusia holbrooki [~]	Eastern Mosquitofish	Int	Habitat	1
Hylidae (Tree frogs)				
Litoria rothii [w]	Northern Laughing Tree Frog		Range	1
Limnodynastidae (Burrowing frogs)				
Heleioporus albopunctatus [w†]	Western Spotted Frog		Range	1, 2
Heleioporus barycragus [w†]	Hooting Frog		Range	1, 2
Heleioporus inornatus [w†]	Whooping Frog		Range	1, 2
Heleioporus psammophilus [w†]	Sand Frog		Range	2
Neobatrachus pelobatoides [w†]	Humming Frog		Range	1, 2
Myobatrachidae (Ground frogs)				
Crinia bilingua [w†]	Bilingual Froglet		Range	2
Crinia georgiana [w†]	Quacking Frog		Habitat	1, 2
Geocrinia leai [w†]	Ticking Frog		Habitat	1
Cheloniidae (Hard-shelled sea turtles)				
Caretta caretta [o]	Loggerhead Turtle	CS1 (E,Mar,S2)	Habitat	1, 2
Chelonia mydas [o]	Green Turtle	CS1 (V,Mar,S3)	Habitat	2
Natator depressus [o]	Flatback Turtle	CS1 (V,Mar,S3)	Habitat	1, 2
Dermochelyidae (Leathery Sea Turtle)				
Dermochelys coriacea [o]	Leatherback Turtle	CS1 (E,Mar,S3)	Habitat	1, 2
Chelidae (Side-necked freshwater turtles)				

Species		Status	Expected Occurrence	Source
Chelodina oblonga [w]	Oblong Tortoise		Habitat	1, 2
Pseudemydura umbrina [w]	Western Swamp Tortoise	CS1 (C,S1)	Habitat	1, 2
Diplodactylidae (Diplodactylid geckos)				
Diplodactylus granariensis granariensis			Range	2
Strophurus michaelseni			Range	2
Gekkonidae (Gekkonid geckos)				
Hemidactylus frenatus	Asian House Gecko	Int	Range	1
Agamidae (Dragons)				
Chlamydosaurus kingii	Frill-necked Lizard		Range	1
Ctenophorus ornatus	Ornate Crevice Dragon		Range	1
Scincidae (Skinks)				
Cryptoblepharus plagiocephalus			Range	2
Ctenotus gemmula		CS2 (P3)	Range	1, 2
Ctenotus inornatus			Range	1
Cyclodomorphus melanops melanops			Range	1
Hemiergis initialis initialis			Range	2
Hemiergis peronii peronii			Range	1, 2
Lerista christinae			Range	1, 2
Lerista distinguenda			Range	2
Varanidae (Monitors and goannas)				
Varanus rosenbergi	Heath Goanna		Range	2
Typhlopidae (Blind snakes)				

Species		Status	Expected Occurrence	Source
Anilios [w] aitii			Range	1
Pythonidae (Pythons)				
Antaresia childreni	Children's Python		Range	2
Elapidae (Venomous land snakes)				
Elapognathus coronatus	Crowned Snake		Range	1, 2
Notechis scutatus	Tiger Snake		Habitat	1, 2
Pseudechis australis	Mulga Snake		Range	1, 2
Pseudonaja mengdeni	Gwardar; Western Brown Snake		Range	1, 2
Simoselaps littoralis	West Coast Banded Snake		Range	1
Aipysurus pooleorum [o]			Habitat	1
Hydrophis elegans [o]			Habitat	1
Hydrophis platurus platurus [o]	Yellow-bellied Sea-snake		Habitat	1, 2
Anatidae (Ducks, Geese and Swans)				
Dendrocygna eytoni [w]	Plumed Whistling-Duck		Range	1, 2
Dendrocygna arcuata [w]	Wandering Whistling-Duck		Range	1
Oxyura australis [w]	Blue-billed Duck	CS2 (P4)	Habitat	1, 2
Malacorhynchus membranaceus [w]	Pink-eared Duck		Habitat	1, 2
Cygnus atratus [w]	Black Swan		Habitat	1, 2
Cygnus olor [w]	Mute Swan	Int	Range	1
Aythya australis [w]	Hardhead		Habitat	1, 2
Spatula rhynchotis [w]	Australasian Shoveler		Habitat	1, 2
Anas platyrhynchos [w]	Northern Mallard		Range	1, 2
Anas gracilis [w]	Grey Teal		Habitat	1, 2

Species		Status	Expected Occurrence	Source
Anas castanea [w]	Chestnut Teal		Habitat	1, 2
Stictonetta naevosa [w]	Freckled Duck		Habitat	1, 2
Biziura lobata [w]	Musk Duck		Habitat	1, 2
Nettapus pulchellus [w]	Green Pygmy-goose		Range	1
Megapodiidae (Megapodes)				
Leipoa ocellata	Malleefowl	CS1 (V,S3)	Range	3
Phasianidae (Pheasants and Quail)				
Pavo cristatus	Indian Peafowl	Int	Range	1
Podicipedidae (Grebes)				
Tachybaptus novaehollandiae [w]	Australasian Grebe		Habitat	1, 2
Poliocephalus poliocephalus [w]	Hoary-headed Grebe		Habitat	1, 2
Podiceps cristatus [w]	Great Crested Grebe		Habitat	1, 2
Columbidae (Pigeons and Doves)				
Geopelia cuneata	Diamond Dove		Range	1
Cuculidae (Cuckoos)				
Eudynamys orientalis	Eastern Koel		Range	1
Chalcites osculans	Black-eared Cuckoo		Range	1
Otididae (Bustards)				
Ardeotis australis	Australian Bustard		Range	1
Rallidae (Crakes, Rails and Swamphens)				
Hypotaenidia philippensis [w]	Buff-banded Rail		Habitat	1, 2
Porzana fluminea [w]	Australian Spotted Crake		Habitat	1, 2
Zapornia pusilla [w]	Baillon's Crake		Habitat	1, 2

Species		Status	Expected Occurrence	Source
Zapornia tabuensis [w]	Spotless Crake		Habitat	1, 2
Porphyrio porphyrio [w]	Purple Swamphen		Habitat	1, 2
Gallinula tenebrosa [w]	Dusky Moorhen		Habitat	1, 2
Tribonyx ventralis [w]	Black-tailed Native-hen		Habitat	1, 2
Fulica atra [w]	Eurasian Coot		Habitat	1, 2
Burhinidae (Stone-curlews)				
Burhinus grallarius	Bush Stone-curlew		Locally extinct	1, 2
Haematopodidae (Oystercatchers)				
Haematopus longirostris [w]	Australian Pied Oystercatcher		Habitat	1, 2
Haematopus fuliginosus [o]	Sooty Oystercatcher		Habitat	1, 2
Recurvirostridae (Stilts and Avocets)				
Cladorhynchus leucocephalus [w]	Banded Stilt		Habitat	1, 2
Recurvirostra novaehollandiae [w]	Red-necked Avocet		Habitat	1, 2, 3
Himantopus leucocephalus [w]	Pied Stilt		Habitat	1, 2, 3
Charadriidae (Plovers, Dotterel and Lapwings)				
Pluvialis squatarola [w]	Grey Plover	CS1 (M,Mar,S5)	Habitat	1, 2
Pluvialis fulva [w]	Pacific Golden Plover	CS1 (M,Mar,S5)	Habitat	1, 2
Charadrius ruficapillus [w]	Red-capped Plover		Habitat	1, 2, 3
Charadrius bicinctus [w]	Double-banded Plover	CS1 (M,Mar,S5)	Habitat	1
Charadrius leschenaultii [w]	Greater Sand Plover	CS1 (M,Mar,S3, S5)	Habitat	1, 2
Thinornis cucullatus [w]	Hooded Plover	CS2 (Mar,P4)	Habitat	1
Elseyornis melanops [w]	Black-fronted Dotterel		Habitat	1, 2
Vanellus tricolor	Banded Lapwing		Habitat	1, 2

Species		Status	Expected Occurrence	Source
Vanellus miles	Masked Lapwing		Habitat	1, 2
Erythrogonys cinctus [w]	Red-kneed Dotterel		Habitat	1, 2
Rostratulidae (Painted Snipe)				
Rostratula australis [w]	Australian Painted-snipe	CS1 (E,Mar,S2)	Habitat	2, 3
Scolopacidae (Snipe, Sandpipers, Godwits, Curlew, Stints and Phalaropes)				
Numenius phaeopus [w]	Whimbrel	CS1 (M,Mar,S5)	Habitat	1
Numenius madagascariensis [w]	Eastern Curlew	CS1 (C,M,Mar,S3,S5)	Habitat	1, 3
Limosa lapponica [w]	Bar-tailed Godwit	CS1 (M,Mar,S5)	Habitat	1, 2, 3
Limosa limosa [w]	Black-tailed Godwit	CS1 (M,Mar,S5)	Habitat	1, 2
Arenaria interpres [w]	Ruddy Turnstone	CS1 (M,Mar,S5)	Habitat	1, 2
Calidris tenuirostris [w]	Great Knot	CS1 (M,Mar,S3,S5)	Habitat	2
Calidris canutus [w]	Red Knot	CS1 (M,Mar,S5)	Habitat	2, 3
Calidris acuminata [w]	Sharp-tailed Sandpiper	CS1 (M,Mar,S5)	Habitat	1, 2, 3
Calidris ferruginea [w]	Curlew Sandpiper	CS1 (C,M,Mar,S3,S5)	Habitat	1, 2, 3
Calidris subminuta [w]	Long-toed Stint	CS1 (M,Mar,S5)	Habitat	1, 2, 3
Calidris ruficollis [w]	Red-necked Stint	CS1 (M,Mar,S5)	Habitat	1, 2, 3
Calidris alba [w]	Sanderling	CS1 (M,Mar,S5)	Habitat	1, 2
Calidris melanotos [w]	Pectoral Sandpiper	CS1 (M,Mar,S5)	Habitat	1, 2, 3
Xenus cinereus [w]	Terek Sandpiper	CS1 (M,Mar,S5)	Habitat	1, 2
Actitis hypoleucos [w]	Common Sandpiper	CS1 (M,Mar,S5)	Habitat	1, 2, 3
Tringa brevipes [w]	Grey-tailed Tattler	CS1 (M,Mar,S5,P4)	Habitat	1, 2
Tringa nebularia [w]	Common Greenshank	CS1 (M,Mar,S5)	Habitat	1, 2, 3

Species		Status	Expected Occurrence	Source
Tringa glareola [w]	Wood Sandpiper	CS1 (M,Mar,S5)	Habitat	1, 2, 3
Tringa stagnatilis [w]	Marsh Sandpiper	CS1 (M,Mar,S5)	Habitat	1, 2
Glareolidae (Pratincoles)				
Glareola maldivarum	Oriental Pratincole	CS1 (M,Mar,S5)	Habitat	1
Stercorariidae (Skuas and Jaegers)				
Stercorarius parasiticus [o]	Arctic Jaeger	CS1 (M,Mar,S5)	Habitat	1
Stercorarius pomarinus [o]	Pomarine Jaeger	CS1 (M,Mar,S5)	Habitat	1
Catharacta antarcticus [o]	Brown Skua		Habitat	1
Laridae (Gulls, Terns and Noddies)				
Anous stolidus [o]	Common Noddy	CS1 (M,Mar,S5)	Habitat	3
Anous tenuirostris [o]	Lesser Noddy	CS1 (V,Mar,S2)	Habitat	1, 2, 3
Chroicocephalus novaehollandiae	Silver Gull		Habitat	1, 2, 3
Larus pacificus [w]	Pacific Gull		Habitat	1, 2, 3
Onychoprion fuscatus [o]	Sooty Tern		Habitat	1, 2
Onychoprion anaethetus [o]	Bridled Tern	CS1 (M,Mar,S5)	Habitat	1, 2, 3
Sternula albifrons [w]	Little Tern	CS1 (M,Mar,S5)	Habitat	1
Sternula nereis [w]	Fairy Tern	CS1 (V,Mar,S3)	Habitat	1, 2, 3
Gelochelidon nilotica [w]	Common Gull-billed Tern	CS1 (M,Mar,S5)	Habitat	1
Hydroprogne caspia [w]	Caspian Tern	CS1 (M,Mar,S5)	Habitat	1, 2, 3
Chlidonias hybrida [w]	Whiskered Tern		Habitat	1, 2
Chlidonias leucopterus [w]	White-winged Black Tern	CS1 (M,Mar,S5)	Habitat	1, 2
Chlidonias niger [o]	Black Tern		Habitat	1
Sterna dougallii [o]	Roseate Tern	CS1 (M,Mar,S5)	Habitat	1, 2, 3

Species		Status	Expected Occurrence	Source
Sterna paradisaea [o]	Arctic Tern		Habitat	1, 2
Thalasseus bergii [w]	Crested Tern		Habitat	1, 2
Spheniscidae (Penguins)				
Eudyptula minor [o]	Little Penguin		Habitat	1, 2
Oceanitidae (Southern Storm-Petrels)				
Oceanites oceanicus [o]	Wilson's Storm-Petrel	CS1 (M,Mar,S5)	Habitat	1, 2
Pelagodroma marina [o]	White-faced Storm-Petrel		Habitat	1
Diomedeidae (Albatrosses)				
Thalassarche chrysostoma [o]	Grey-headed Albatross	CS1 (E,M,Mar,S3,S5)	Habitat	1
Thalassarche melanophris [o]	Black-browed Albatross		Habitat	1
Thalassarche cauta [o]	Shy Albatross	CS1 (V,M,Mar,S3,S5)	Habitat	1, 2
Procellariidae (Petrels and Shearwaters)				
Macronectes giganteus [o]	Southern Giant-Petrel	CS1 (E,M,Mar,S5)	Habitat	1, 2
Daption capense [o]	Cape Petrel		Habitat	1, 2
Halobaena caerulea [o]	Blue Petrel	CS1 (V,Mar)	Habitat	1, 2
Pachyptila salvini [o]	Salvin's Prion		Habitat	1
Pachyptila desolata [o]	Antarctic Prion		Habitat	1, 2
Pachyptila belcheri [o]	Slender-billed Prion		Habitat	1, 2
Pachyptila turtur [o]	Fairy Prion		Habitat	1, 2
Pterodroma mollis [o]	Soft-plumaged Petrel	CS1 (V,Mar)	Habitat	1
Pterodroma lessonii [o]	White-headed Petrel		Habitat	1, 2
Pterodroma macroptera [o]	Great-winged Petrel		Habitat	1, 2

Species		Status	Expected Occurrence	Source
Procellaria aequinoctialis [o]	White-chinned Petrel	CS1 (M,Mar,S3,S5)	Habitat	2
Ardenna pacifica [o]	Wedge-tailed Shearwater	CS1 (M,Mar,S5)	Habitat	1
Ardenna carneipes [o]	Flesh-footed Shearwater	CS1 (M,Mar,S3,S5)	Habitat	1
Puffinus huttoni [o]	Hutton's Shearwater	CS1 (Mar,S2)	Habitat	1
Puffinus assimilis [o]	Little Shearwater		Habitat	1, 2
Pelicanidae (Pelican)				
Pelecanus conspicillatus [w]	Australian Pelican		Habitat	1, 2
Ardeidae (Herons, Egrets and Bitterns)				
Botaurus poiciloptilus [w]	Australasian Bittern	CS1 (E,S2)	Habitat	1, 2, 3
Ixobrychus dubius [w]	Australian Little Bittern	CS2 (P4)	Habitat	1, 2
Nycticorax caledonicus [w]	Nankeen Night-Heron		Habitat	1, 2
Bubulcus coromandus	Eastern Cattle Egret		Habitat	1, 2, 3
Ardea pacifica [w]	White-necked Heron		Habitat	1, 2
Ardea alba [w]	Great Egret		Habitat	1, 2
Ardea intermedia [w]	Intermediate Egret		Habitat	1, 2
Egretta novaehollandiae [w]	White-faced Heron		Habitat	1, 2
Egretta garzetta [w]	Little Egret		Habitat	1, 2
Egretta sacra [o]	Eastern Reef Egret		Habitat	1
Threskiornithidae (Ibis and Spoonbills)				
Threskiornis moluccus	Australian White Ibis		Habitat	1
Threskiornis spinicollis	Straw-necked Ibis		Habitat	1, 2
Platalea flavipes [w]	Yellow-billed Spoonbill		Habitat	1, 2
Platalea regia [w]	Royal Spoonbill		Habitat	1, 2

Species		Status	Expected Occurrence	Source
Plegadis falcinellus [w]	Glossy Ibis	CS1 (M,Mar,S5)	Habitat	1, 2
Sulidae (Gannets and Boobies)				
Morus serrator [o]	Australasian Gannet		Habitat	1, 2
Phalacrocoracidae (Cormorants and Shags)				
Microcarbo melanoleucos [w]	Little Pied Cormorant		Habitat	1, 2
Phalacrocorax carbo [w]	Great Cormorant		Habitat	1, 2
Phalacrocorax sulcirostris [w]	Little Black Cormorant		Habitat	1, 2
Phalacrocorax varius [w]	Pied Cormorant		Habitat	1, 2
Anhingidae (Darter)				
Anhinga novaehollandiae [w]	Australasian Darter		Habitat	1, 2
Pandionidae (Osprey)				
Pandion cristatus [w]	Eastern Osprey	CS1 (M,Mar,S5)	Habitat	1, 2, 3
Accipitridae (Eagles, Kites, Goshawks)				
Circus approximans [w]	Swamp Harrier		Habitat	1, 2
Haliaeetus leucogaster [w]	White-bellied Sea-Eagle		Habitat	1, 2, 3
Milvus migrans	Black Kite		Range	1
Tytonidae (Masked Owls)				
Tyto novaehollandiae	Masked Owl		Locally extinct	1, 2
Strigidae (Hawk-Owls)				
Ninox connivens	Barking Owl		Locally extinct	1, 2
Cacatuidae (Cockatoos and Corellas)				
Nymphicus hollandicus	Cockatiel		Range	2
Calyptorhynchus baudinii	Baudin's Black-Cockatoo	CS1 (V,S2)	Range	1, 2

Species		Status	Expected Occurrence	Source
Cacatua leadbeateri	Major Mitchell's Cockatoo		Range	1
Cacatua pastinator	Western Corella		Range	1, 2
Cacatua galerita	Sulphur-crested Cockatoo	Int	Range	1, 2
Psittaculidae (Parrots, Lorikeets and Rosellas)				
Polytelis anthopeplus	Regent Parrot		Range	1, 2
Platycercus icterotis	Western Rosella		Habitat	1, 2
Neophema petrophila	Rock Parrot		Habitat	1
Glossopsitta porphyrocephala	Purple-crowned Lorikeet		Habitat	1
Melopsittacus undulatus	Budgerigar		Range	1
Climacteridae (Treecreepers)				
Climacteris rufus	Rufous Treecreeper		Range	1
Maluridae (Fairy-wrens, Emu-wrens and Grasswrens)				
Malurus elegans	Red-winged Fairy-wren		Range	1, 2
Malurus pulcherrimus	Blue-breasted Fairy-wren		Range	1, 2
Meliphagidae (Honeyeaters and Chats)				
Nesoptilotis leucotis	White-eared Honeyeater		Range	1, 2
Melithreptus brevirostris	Brown-headed Honeyeater		Range	1, 2
Melithreptus chloropsis	Gilbert's Honeyeater		Range	1
Acanthagenys rufogularis	Spiny-cheeked Honeyeater		Range	1, 2
Ptilotula ornata	Yellow-plumed Honeyeater		Range	1
Ptilotula penicillata	White-plumed Honeyeater		Range	1
Purnella albifrons	White-fronted Honeyeater		Range	1
Falcunculidae (Shriketits)				

Species		Status	Expected Occurrence	Source
Falcunculus frontatus leucogaster	Crested Shrike-tit (race leucogaster)		Range	1, 2
Psophodidae (Whipbirds and Wedgebills)				
Psophodes nigrogularis	Western Whipbird	CS1	Locally extinct	1
Artamidae (Woodswallows, Currawongs, Butcherbirds and Magpie)				
Cracticus nigrogularis	Pied Butcherbird		Range	1, 2
Corvidae (Crows and Ravens)				
Corvus bennetti	Little Crow		Range	1, 2
Monarchidae (Monarch and Flycatchers)				
Myiagra inquieta	Restless Flycatcher		Range	1, 2
Petroicidae (Australian Robins)				
Microeca fascinans	Jacky Winter		Range	1, 2
Eopsaltria griseogularis	Western Yellow Robin		Range	1, 2
Estrildidae (Weaver Finches)				
Lonchura castaneothorax	Chestnut-breasted Mannikin		Range	1, 2
Stagonopleura oculata	Red-eared Firetail		Range	1, 2
Taeniopygia guttata	Zebra Finch		Range	1
Passeridae (Weaver Finches)				
Passer domesticus	House Sparrow	Int	Range	1, 2
Passer montanus	Eurasian Tree Sparrow	Int	Range	1, 2
Motacillidae (Pipits and Wagtails)				
Motacilla cinerea	Grey Wagtail	CS1 (M,Mar,S5)	Range	3
Motacilla alba	White Wagtail		Range	1

Species		Status	Expected Occurrence	Source
Fringillidae (Old World Finches)				
Carduelis carduelis	European Goldfinch	Int	Range	1
Locustellidae (Grassbirds)				
Poodytes gramineus [w]	Little Grassbird		Habitat	1, 2
Acrocephalidae (Reed-Warblers)				
Acrocephalus australis [w]	Australian Reed-Warbler		Habitat	1, 2
Turdidae (Thrushes)				
Turdus merula	Common Blackbird		Range	1
Dasyuridae (Dasyurids)				
Phascogale calura	Red-tailed Phascogale	CS1 (E,S6)	Range	1
Phascogale tapoatafa [w] *ambenger*	Brush-tailed Phascogale, Wambenger	CS1 (S6)	Locally extinct	1
Sminthopsis crassicaudata	Fat-tailed Dunnart		Locally extinct	1, 2
Sminthopsis fuliginosus fuliginosus	Grey-bellied Dunnart	CS3 (LS)	Locally extinct	2
Sminthopsis gilberti	Gilbert's Dunnart		Range	2
Burramyidae (Pygmy possums)				
Cercartetus concinnus	Western Pygmy-possum, Mundarda	CS3 (LS)	Locally extinct	1, 2
Pseudocheiridae (Ringtail possums)				
Pseudocheirus occidentalis	Western Ringtail Possum	CS1 (V,S1)	Locally extinct	3
Potoroidae (Potoroos and bettongs)				
Bettongia lesueur graii	Burrowing Bettong, Boodie	CS1 (Ex,S4)	Locally extinct	2
Bettongia penicillata ogilbyi	Brush-tailed Bettong, Woylie	CS1 (E,S1)	Locally extinct	2, 3
Macropodidae (Kangaroos)				

Species		Status	Expected Occurrence	Source
Osphranter rufus	Red Kangaroo, Marlu		Range	1
Muridae (Rats and mice)				
Hydromys chrysogaster [w]	Water-rat, Rakali	CS2 (P4)	Habitat	1, 2
Pseudomys albocinereus albocinereus	Ash-grey Mouse, Noodji	CS3 (LS)	Locally extinct	1, 2
Otariidae (Eared seals)				
Neophoca cinerea [o]	Australian Sea Lion	CS1 (V,Mar,S3)	Habitat	1, 2
Phocidae (True' seals)				
Hydrurga leptonyx [o]	Leopard Seal		Habitat	1, 2
Mirounga leonina [o]	Southern Elephant Seal	CS1 (V,Mar)	Habitat	1, 2
Canidae (Dogs)				
Canis familiaris dingo	Dingo		Locally extinct	1, 2
Mustelidae (Ferrets)				
Mustela putorius	European Polecat, Ferret	Int	Range	2
Equidae (Horses)				
Equus asinus	Donkey	Int	Range	1
Camelidae (Camels)				
Camelus dromedarius	Dromedary, Camel	Int	Range	2
Bovidae (Horned ruminants)				
Bos taurus	European Cattle	Int	Range	1, 2
Ovis aries	Sheep	Int	Range	1, 2
Balaenidae (Right whales)				
Eubalaena australis [o]	Southern Right Whale	CS1 (E,S3)	Habitat	1, 2

Species		Status	Expected Occurrence	Source
Balaenopteridae (Rorquals)				
Balaenoptera acutorostrata [o]	Dwarf Minke Whale		Habitat	1, 2
Physeteridae (Sperm Whale)				
Physeter macrocephalus [o]	Sperm Whale	CS1 (S3)	Habitat	2
Kogiidae (Pygmy sperm whales)				
Kogia breviceps [o]	Pygmy Sperm Whale		Habitat	1, 2
Ziphiidae (Beaked whales)				
Mesoplodon bowdoini [o]	Andrew's Beaked Whale		Habitat	2
Mesoplodon densirostris [o]	Blainville's Beaked Whale		Habitat	1
Deliphinidae (Dolphins, pilot whales and Killer Whale)				
Tursiops aduncus [o]	Indo-Pacific Bottlenose Dolphin		Habitat	1

Appendix 10. Conservation significant invertebrate fauna species expected to occur in the Swan management region (as per DBCA 2022b, g), including conservation status and likely residency status in the project area.

Status codes:

CS1, CS2, CS3 = (summary) levels of conservation significance. See Appendix 1 for full explanation.

EPBC Act listings: E = Endangered, V = Vulnerable, M = Migratory, Mar = Marine (see Appendix 2).

Biodiversity Conservation Act 2016 listings: S1 to S7 = Schedules 1 to 7 (see Appendix 2).

DBCA Priority species: P1 to P4 = Priority 1 to 4 (see Appendix 2).

Species *immediately* considered as unlikely to occur in the project area are listed in grey font.

Other exclusions (plain black text) followed spatial analysis of current records.

Expected species are highlighted.

Species	Common Name	Status	Expected Occurrence
Australotomurus morbidus	Cemetery Springtail, Guildford Springtail	CS2 (P3)	Probably absent. The Cemetery Springtail is known from four urban remnants within the Perth region, where it occurs in Banksia heath (Greenslade and Jordana 2014).
Austroconops mcmillani	McMillan's Biting Midge (Swan Coastal Plain)	CS2 (P2)	Probably absent. Known from only a small number of very localised populations between Yanchep and Darkan where it appears to be associated with areas of damp soil or open water (Borkent and Craig 2004).
Austrosaga spinifer	Spiny Katydid (Swan Coastal Plain)	CS2 (P2)	Possibly present.
Euoplos inornatus	Inornate Trapdoor Spider (northern Jarrah Forest)	CS2 (P3)	Absent. Restricted to the western Darling Range east of Perth, with two outlying populations on the Swan Coastal Plain at Kings Park (Mt Eliza) and on the Mount Henry Peninsula (Rix *et al.* 2017), where it prefers "consolidated banks". Project area more than 30 km outside of the species' known range.
Glacidorbis occidentalis	Jarrah Forest Freshwater Snail	CS2 (P3)	Absent. No wetland habitat.

Species	Common Name	Status	Expected Occurrence
Glossurocolletes bilobatus	a short-tongued bee (southwest)	CS2 (P2)	Absent. Survey area more than 40 km outside of species known range that is described by Houston (2018) as "the Perth region east to York". Museum records on the Swan Coastal Plain are all south of the Swan River.
Hesperocolletes douglasi	Douglas's Broad-headed Bee	CS1 (S1)	Uncertain; probably absent.
Hurleya sp. (WAM C23193)	Crystal Cave Crangonyctoid, cave shrimp	CS1 (S1)	Absent. Known only from cave systems in the Yanchep National Park where "critical habitat for … the Crystal Cave Crangonyctoid is composed of the seven individual caves, the seven cave steams, the trees that have roots in each of the caves, and the catchments for the streams that flow through the caves" (English *et al.* 2003; Horwitz *et al.* 2009), none of which occur within the survey area.
Hylaeus globuliferus	Woollybush Bee	CS2 (P3)	Probably absent.
Idiosoma dandaragan	Dandaragan Plateau Shield-backed Trapdoor Spider	CS2 (P2)	Absent. Survey area more than 100 km outside of species known range, and preferred habitat (Rix *et al.* 2018) not within the survey area.
Idiosoma mcclementsorum	Julimar Shield-backed Trapdoor Spider	CS2 (P2)	Absent. Survey area more than 40 km outside of species known range, and preferred habitat (Rix *et al.* 2018) not within the survey area.
Idiosoma nigrum	Shield-backed Trapdoor Spider	CS1 (S2, V)	Absent. Survey area more than 80 km outside of species known range, and preferred habitat (Rix *et al.* 2018) not within the survey area.

Species	Common Name	Status	Expected Occurrence
Idiosoma sigillatum	Swan Coastal Plain Shield-backed Trapdoor Spider	CS2 (P3)	Present.
Kawaniphila pachomai	Grey Vernal Katydid (southwest)	CS2 (P1)	Absent. Known only from only two records, near Witchcliffe and Armadale, where it is thought to occur in moist, shaded uncleared forests and gullies (Harewood 2017; Moulds 2019).
Leioproctus contrarius	a short-tongued bee	CS2 (P3)	Possibly present.
Leioproctus douglasiellus	a short-tongued bee	CS1 (S2, C)	Absent. Survey area more than 50 km outside of species known range. Known only from three locations within the Perth metropolitan area ranging from Cannington to Forrestdale, where it has been found in association with the yellow flowers of *Goodenia pulchella* within clay plans (DSEWPaC 2013b; CoA 2017).
Neopasiphae simplicior	a short-tongued bee	CS1 (S2, C)	Absent. Survey area more than 40 km outside of species known range. Known only from a single location in Forrestdale Lake Nature Reserve where it has been associated with the flowers of *Goodenia filiformis*, *Lobelia tenulor*, *Angianthus preissianus* and *Velleia* sp (Houston 2000; DEWHA 2008).
Synemon gratiosa	Graceful Sun-Moth	CS2 (P4)	Possibly present.
Throscodectes xederoides	Mogumber Bush Cricket, Northern Throsco	CS2 (P3)	Absent. Survey area more than 70 km outside of species known range.
Throscodectes xiphos	Stylet Bush Cricket, stylet Throsco (Jandakot)	CS2 (P1)	Absent. Survey area more than 40 km outside of species known range. Known only from the Jandakot

Species	Common Name	Status	Expected Occurrence
			area on the Swan Coastal Plain, it is associated with *Xanthorrhoea preissei* grass trees (Moulds 2019).
Westralunio carteri	Carter's Freshwater Mussel	CS1 (S3, V)	Absent. No wetland habitat.

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