Lots 2 and 10 Rowley Road Mandogalup

Section 38 referral

Prepared for
Questdale Holdings Pty Ltd
by Strategen

January 2019

strategen
ENVIRONMENTAL

Lots 2 and 10 Rowley Road Mandogalup

Section 38 referral

Strategen is a trading name of
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January 2019

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Environmental conclusions

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Client: Questdale Holdings Pty Ltd

Report Version	Revision No.	Purpose	Strategen author/reviewer	Submitted to Client	
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1. Introduction

1.1 Purpose and scope

Questdale Holdings Pty Ltd (the proponent) (in association with Frankland Sand Supplies) are proposing to clear vegetation for bushfire fuel reduction and to extend an existing sand quarry extraction operation on Lots 2 and 10 Rowley Road, Mandogalup, Western Australia ('the Proposal Area').

The Proposal Area is located approximately 33 km south of Perth and is enclosed within an area bounded by the Kwinana Freeway to the east, Anketell Rd to the south, Mandogalup Rd to the west, and Rowley Rd to the north (Figure 1).

1.2 Proponent

The Proponents for the Proposal is Questdale Holdings Pty Ltd (proponent) (in association with Frankland Sand Supplies).

Proponent details:	Key contact:
37-41 Burlington Street	Livia Ronci (Director)
Naval Base WA 6165	

1.3 Other approvals and regulation

The Proposal Area is zoned Rural under the Metropolitan Regional Scheme (MRS) and 'Rural A' City of Kwinana Town Planning Scheme No. 2 (TPS) and is within the City's Development Contribution Plan No. 8. The MRS identifies other regional road zone which intersects Lots 2 and 10 (Figure 2).

Under 'Rural A' zoning-Extractive Industry use class is a land-use which the City's Council exercising the discretionary powers available to it may approve under the TPS after notice of application has been given in accordance with advertising requirement (TPS No. 2 clause 2). There is an existing Extractive Industry Licence (2014) (Frankland Sand Supplies) associated with Lot 1 Rowley Road, Mandogalup (Appendix 1). An application to extend the operation or an additional licence to cover Lot 2 will be required under the City of Kwinana Extractive Industries Local Law (as amended 2016).

Table 1: Other approvals and regulation

State and Local Government approvals			
Is rezoning of any land required before the proposal can be implemented? If yes, please provide details.			No
If this proposal has been referred by a decision-making authority, what approval(s) are required from you?			N/A
Proposal activities	**Land tenure/access**	**Type of approval**	**Legislation regulating the activity**
Clearing of native vegetation	Freehold	Part IV assessment	Environmental Protection Act 1986 – *Part IV*
		EPBC assessment	Environment Protection and Biodiversity Act 1999
Extraction of sand	Freehold	Extractive Industry Licence	City of Kwinana Extractive Industries Local Law

1.3.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is administered by the Department of the Environment and Energy (DEE). The EPBC Act aims to protect and manage nine Matters of National Environmental Significance (MNES) throughout Australia including:

- World Heritage Properties
- National Heritage Places
- wetlands of international importance (listed under the Ramsar Convention)
- listed threatened species and ecological communities
- migratory species protected under international agreements
- Commonwealth Marine Areas
- the Great Barrier Reef Marine Park
- nuclear actions (including uranium mines).

The Proposal was referred to the Commonwealth Department of the Environment and Energy (DEE) on 6 April 2018. DEE advised on 19 June 2018 that the Proposal was determined to be a Controlled Action under the *Environment Protection and Biodiversity Act* (EPBC Act) (EPBC 2018/8182). The proponent wishes to seek a bilateral assessment from the Environmental Protection Authority (EPA) and DEE on the environmental aspects of the Proposal.

It is worthwhile to note that following referral of the Proposal to the DEE, the development envelope for the proposal was revised to include 4.10 ha to be set aside for conservation (Figure 1), of which 3.74 ha contains native vegetation in very-good to excellent condition. Further detail on the key environmental attributes of the proposed conservation reserve is provided in Section 2 of this report.

1.3.2 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) has now replaced the *Wildlife Conservation Act 1950* (WC Act). On 3 December 2016, several parts of the new Act were enacted by the State Governor. The remaining parts of the Act and the associated Regulations came into effect on 1 January 2019.

In addition to providing for the protection of flora and fauna, the BC Act includes provisions for threatened ecological communities, threatening processes, critical habitats and environmental pests.

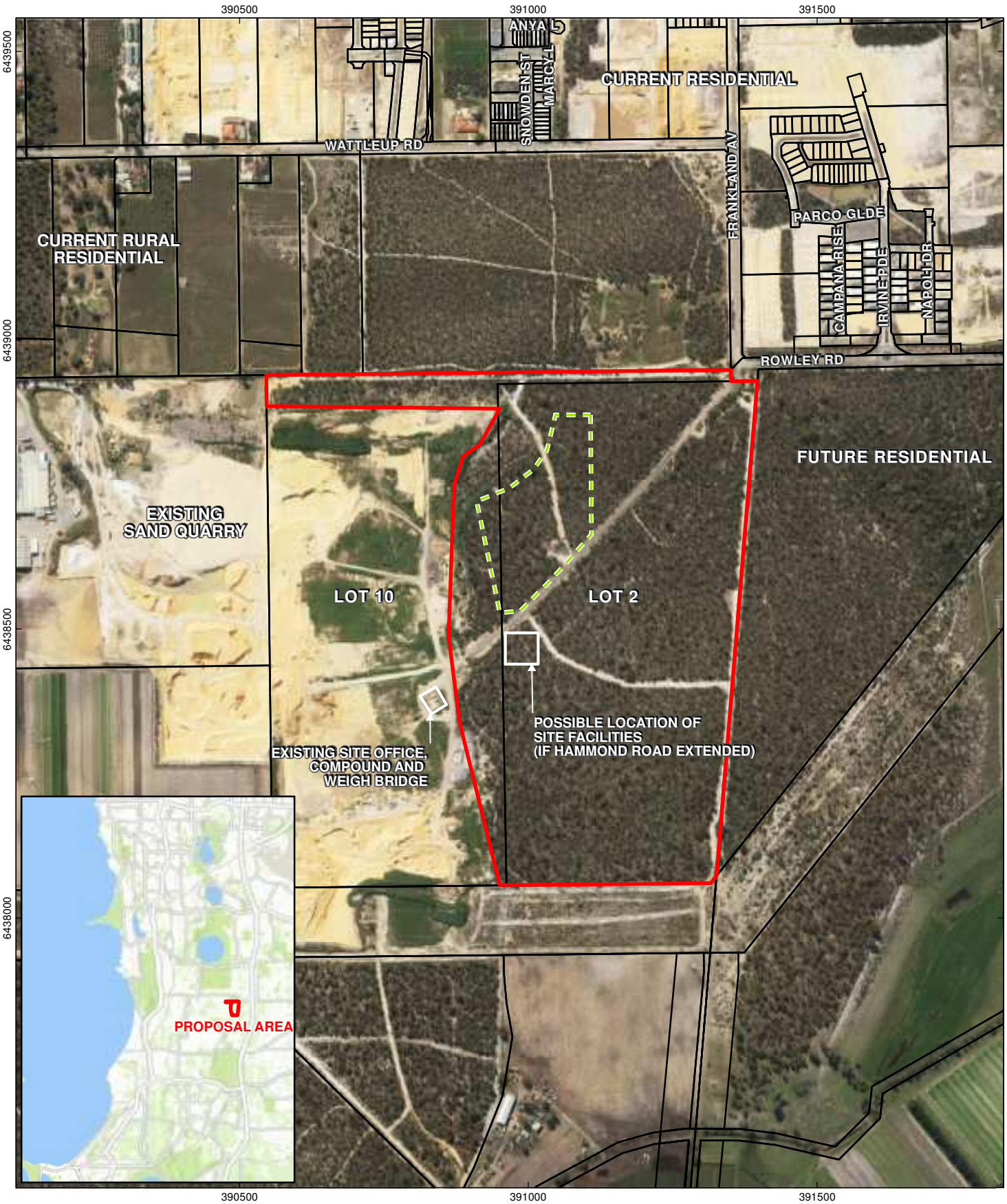

Figure 1: Proposal area

N

Scale 1:9,000 at A4

0 100 200 m

Coordinate System: GDA 1994 MGA Zone 50

Date: 29/01/2019

Legend

- Existing cadastre
- Proposal area
- Bushland to be retained

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Data source: Aerial Image - SLIP Public Services 2018. Landgate: Cadastre, 11/2017. Client: Qube Property Group. Development layout, 08/2018. Created by: c.thatcher

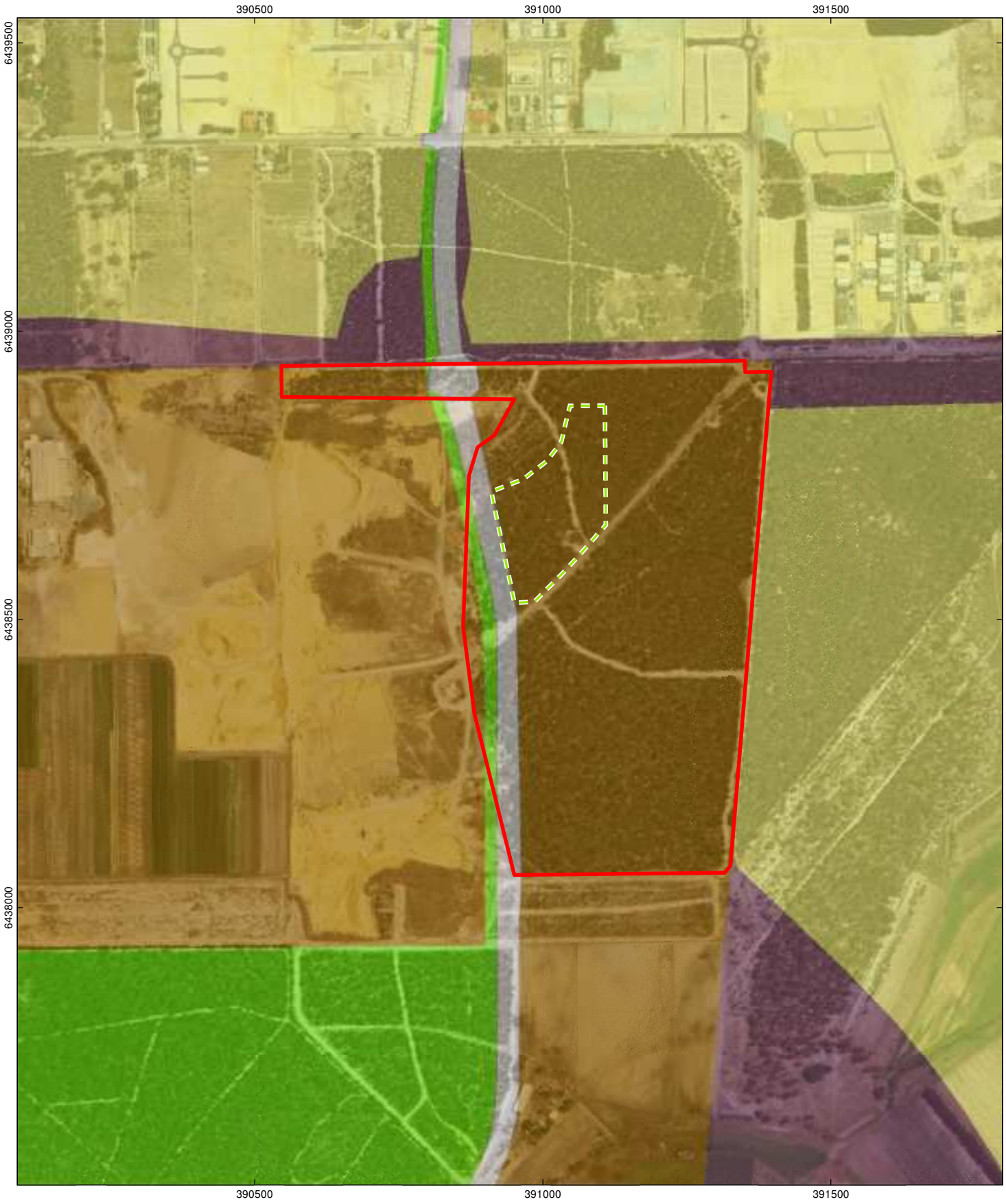

Figure 2: Metropolitan Region Scheme zoning

N

Scale 1:9,000 at A4

0 50 100 150 m

Coordinate System: GDA 1994 MGA Zone 50

Date: 19/10/2018

Legend

- Proposal area
- Bushland to be retained

Reserves and Zoning

- Other regional roads
- Parks and recreation
- Rural
- Urban
- Urban deferred

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Data source: Client: Qube Property Group. Development layout, 08/2018. Created by: c.thatcher

2. Proposal

Questdale Holdings Pty Ltd (proponent) (in association with Frankland Sand Supplies) are proposing to extend an existing sand quarry extraction operation on Lots 2 and 10 Rowley Road, Mandogalup ('the Proposal Area') and clear vegetation for bushfire risk management. The Proposal Area consists of 43.67 ha within Lots 2 and 10.

The Proposal Area is located approximately 33 km south of Perth and is enclosed within an area bounded by the Kwinana Freeway to the east, Anketell Rd to the south, Mandogalup Rd to the west, and Rowley Rd to the north (Figure 1).

2.1 Background

Based on Historical aerial photography, sand extraction activities commenced in Lot 10 between 1977 and 1979, by 1995 extraction activities were significantly progressed on Lot 10.

2.2 Justification

In the State Planning Policy (SPP) 2.4 Basic Raw Materials (WAPC 2000) Lot 10 was identified as an extraction area. This SPP is applicable for sand extraction projects within the City of Kwinana.

The draft Perth and Peel @3.5 million (Green Growth Plan) (or also known as SAPPR) and draft planning frameworks for four sub-regions were released in 2015. Under the SAPPR, most of Lot 10 is within the Industrial class of action (future resource extraction area). Within Lot 2, the lot has been divided into an area not within an action class with the remainder of the lot within the Industrial class of action with Broad Commitment and Values (Figure 3).

While the Project Area was not identified as a Basic Raw Materials (BRM) significant geological supply (SGS) nodes, it is noted within the SAPPR- Action D- Basic Raw Materials (Department of the Premier and Cabinet 2015, 13) that *existing quarries outside of SGS Nodes were identified as the second highest priority BRM resources. Whilst smaller in size these quarries provide important local supplies of BRM and in some cases, provide for a specific market niche*. The latter may be applicable for Lot 2.

Since the release of the SAPPR and draft planning frameworks, the South Metropolitan Peel Sub-Regional Planning Framework (the Framework) has been finalised and was released in March 2018. Under the Frameworks, Lot 10 and most of Lot 2 is within the Industrial Investigation land use and the remaining eastern portion of Lot 2, is mapped within the Urban Expansion land use (WAPC 2018) (Figure 4).

It is worthwhile to note in 2017, the EPA released a report, *Consideration of Potential Health and Amenity Impacts of Dust in Determining the Size of a Buffer for Urban Development in the Mandogalup Area*, with the objective of identifying health and amenity impacts of dust, now and into the future, with respect of potential urban development in the Mandogalup Area. The outcome of this study informed the final draft of the Framework and led to the current demarcation of Industrial Investigation and Urban Expansion within the Proposal Area. Further discussion on regional air quality is provided in Section 4.6.3.

With respect to the SAPPR, the State Government suspended work on 6 April 2018 to revaluate the SAPPR through an independent review. The State Government has advised that "SAPPR sought to secure up front environmental approval for future development and raw materials extraction for an identified development footprint for a 30-year period. It represents the largest and most complex land use reconciliation work, attempting to balance certainty for development and long term environmental protection" (Department of the Premier and Cabinet, 2018). While the SAPPR has been suspended, the Broad Commitments and Values mapping was reviewed and given due regard in formulating the development design which seeks to retain an area of native vegetation on site (Figure 2).

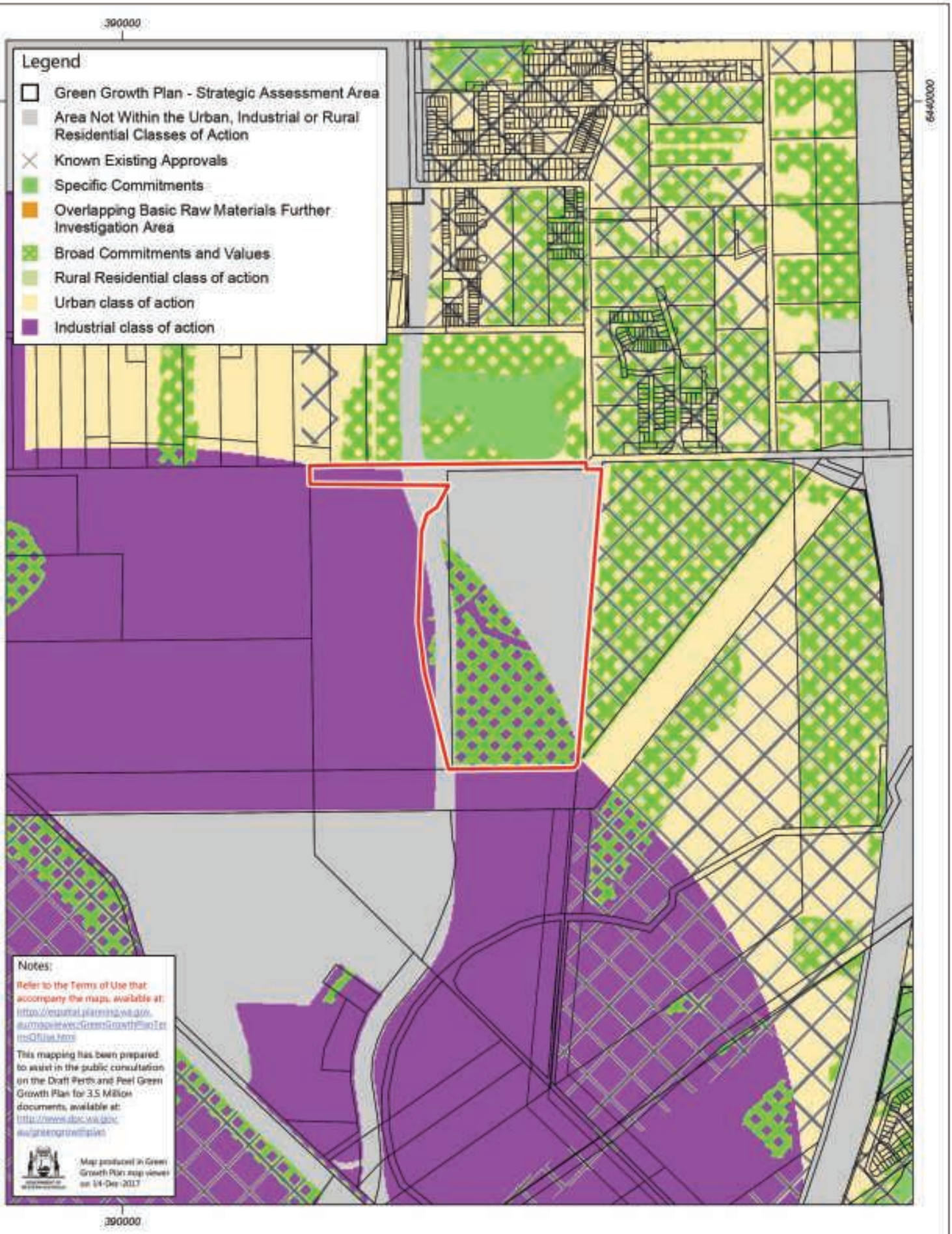

Figure 3: Perth and Peel @3.5 Million (Green Growth Plan)

Scale: 1:15,000 @ A4

0 100 200 300 400 500 m

Coordinate System: GDA 1994 MGA Zone 50
Note: Position errors may occur in some areas
Date: 14/12/2017
Author: ENVIRONMAPS
Source: Cadastre - Landgate, 2016
MRS - DoP, 13.12.17

Legend

- Survey area
- Cadastre

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Path: C:\GIS\Jobs\Strategen\QPG17054.01 R003 - Lots 2 and 10 Rowley Road Mandogalup- EPBC Referral\Figures\QPG17054-01_R003_RevA_F03_171214.mxd

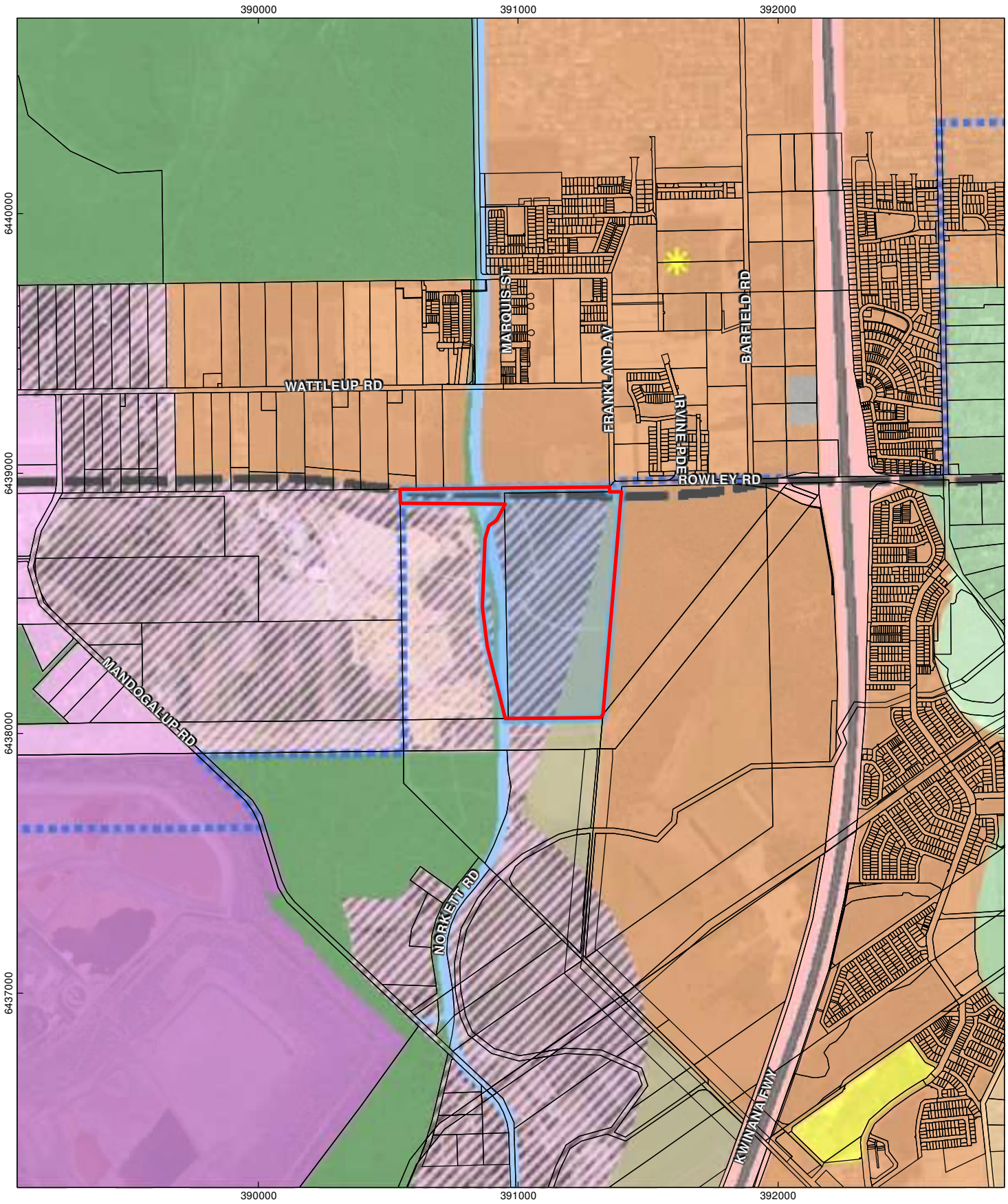

Figure 4: South Metropolitan Peel Sub-Regional Frameworks

N

Scale 1:20,000 at A4

0 250 500 m

Coordinate System: GDA 1994 MGA Zone 50

Date: 22/10/2018

Legend

- Proposal area
- Existing cadastre
- Industrial
- Industrial Expansion
- Industrial Investigation
- Railway
- Urban
- Urban Deferred
- Urban Expansion
- Rural Residential
- Rural
- Open Space
- Public Purposes

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Data source: Nearmap: Aerial image, flown 06/2018. Landgate: Cadastre, 11/2017. Client: Qube Property Group. Development layout, 08/2018. Created by: c.thatcher

The site is located within a large coastal sand ridge of degraded Spearwood dune system and sands derived from Tamala Limestone. The materials are highly sought after by the building and construction industry. The adjacent site to the west has been mined for over 30 years for sand with the ultimate land use likely urban development.

The volume of raw material is approximately 1,740,000m^3.

2.3 Description of proposal elements

The Proposal Area is located at Lot 2 and 10 Rowley Road, the proposed extension of operations is to be within Lot 2 (Project Area) (43.67ha) and is bounded by the Kwinana Freeway to the east, Anketell Rd to the south, Mandogalup Rd to the west, and Rowley Rd to the north (Figure 1).

The Project Area contains a mixture of relatively undisturbed land, as well as areas which show signs of having been degraded through clearing for firebreaks, roads and other activities, as well as weed invasion, particularly along the western boundary adjacent to an area cleared for sand mining. There are no geomorphic wetland or Bush Forever sites within the Proposal Area. Bush Forever site 268 is located approximately 115m south of the Proposal Areas cadastral boundary (Figure 5).

2.3.1 Clearing

The Proposal Area (43.67 ha) involves the clearing of approximately 33.74 ha Banksia Woodlands of the Swan Coastal Plan (Floristic Community Type -FCT 28), 35.64 ha of potential Black cockatoo foraging habitat and 54 potential nesting habitat trees (>500mm DBH, *Eucalyptus marginata*). Approximately 79% of the vegetation within the Proposal Area is in good - excellent condition (Strategen 2017).

Following sand mining, it is anticipated that the Proposal Area will be utilised for rural residential or urban land uses, consistent with the surrounding land uses. The future land use will be subject to future planning applications through the MRS and TPS.

2.3.2 Onsite-vegetation retention

Within the Proposal Area 4.10 ha is proposed to be set aside for conservation (Figure 1). The proposed conservation area captures the following key environmental attributes:

- 3.74 ha of vegetation in very-good to excellent condition
- Banksia woodland vegetation
- Good quality Black cockatoo foraging habitat
- 10 potential Black cockatoo nesting habitat trees.

2.3.3 Sand extraction and processing

Sand extraction is carried out using front end loaders, track dozers and mechanized screening machines. Excavated material is screened where required to remove organic and deleterious materials prior to loading. Transport consists of rigid and semi-trailer trucks moving to and from the site on a consistent basis. Site access is directly from Rowley Road with major distribution via the Kwinana Freeway. The sand extraction rate is predicted to be around 150,000m^3 per year with a mine life of around 10 years. The sand extraction rate, and therein the life of the mine, is highly variable based on industry demand.

2.3.4 Additional infrastructure

Facilities required on the site include:

- overhead diesel fuel tank and water tank
- weighbridge and small office
- portable ablution units
- secure site compound
- cyclone wire perimeter fencing.

Local Tamala Limestone will be imported to construct access tracks as and when required. This material is recovered and reused onsite and reused as required and ultimately disposed off site.

In the shorter term and prior to Hammond Road being extended, the existing compound area will remain in its current location (Figure 1). Once Hammond Road is constructed and extended, the compound area will be shifted and reinstalled in Lot 2 (Figure 1). The exact location of the future compound will be determined as part of an overall quarry management plan process.

2.3.5 Proposed approval

Approval will be sought from the Western Australian Planning Commission (WAPC), the City of Kwinana and the Department of Mine, Industry Regulation and Safety.

2.3.6 Key proposal characteristics

Table 2, provides an overview of the key characteristic associated with the proposal. The proposal is presented in Figure 1.

Table 2: Key Proposal characteristics

Proposal title	Expansion of current Sand Extraction operations
Proponents name	Questdale Holdings Pty Ltd (in associated with Frankland Sand Supplies).
Short description	The proposal will expand existing sand extraction activities in Lot 10 Rowley Road (adjacent to Lot 2) for approximately 10 years.

Element	Location	Approved extent (existing project under extraction licence 14)	Proposed change (this Proposal)	Proposed extent (revised Proposal)
Quarry and associated infrastructure				
Quarry pit		24 ha	+34.64 ha	58.64 ha
Site compound including: • 4000l overhead diesel fuel tank within a fully lined containment bund. • Weighbridge and small office • Portable ablutions unit • Other		0.5 ha	0 ha	0.5 ha
Total		**24.5 ha**	**+34.64 ha**	**59.14 ha**
Operational elements				
Rate of mining		Up to 64,000 tonnes per year	+131,000 tonnes/year	195,000 tonnes/year
Process plant				
Front-end loader		1	+2	3
Track dozer		1	0	1

Element	Location	Approved extent (existing project under extraction licence 14)	Proposed change (this Proposal)	Proposed extent (revised Proposal)
Screening machine		1	0	1
Rigid and semi-trailer trucks		Various	Various	Various
Retention Area				
Onsite-vegetation retention within future conservation area	Proposal Area Figure 1	N/A	Conservation area of 4.10 ha	No less than 3.74 ha of vegetation within conservation area of 4.10 ha

2.4 Local and regional context

2.4.1 Physical environment

The Proposal Area is located in Mandogalup in the City of Kwinana. Figure 1 represents the local context of the Proposal. The Proposal lies on the Swan Coastal Plain, on the Spearwood Dunes land system.

Surrounding land uses include:

- North: Frankland Park Bushland, then rural residential and residential development
- East: proposed Apsley Estate (residential development) and Western Power Transmission Corridor
- South: Bushland and market garden
- West: existing sand mine (Figure 1).

The nearest residential property is 50 m northeast of the Proposal Area. There are no Conservation Category Wetlands within 1 km of the Proposal Area.

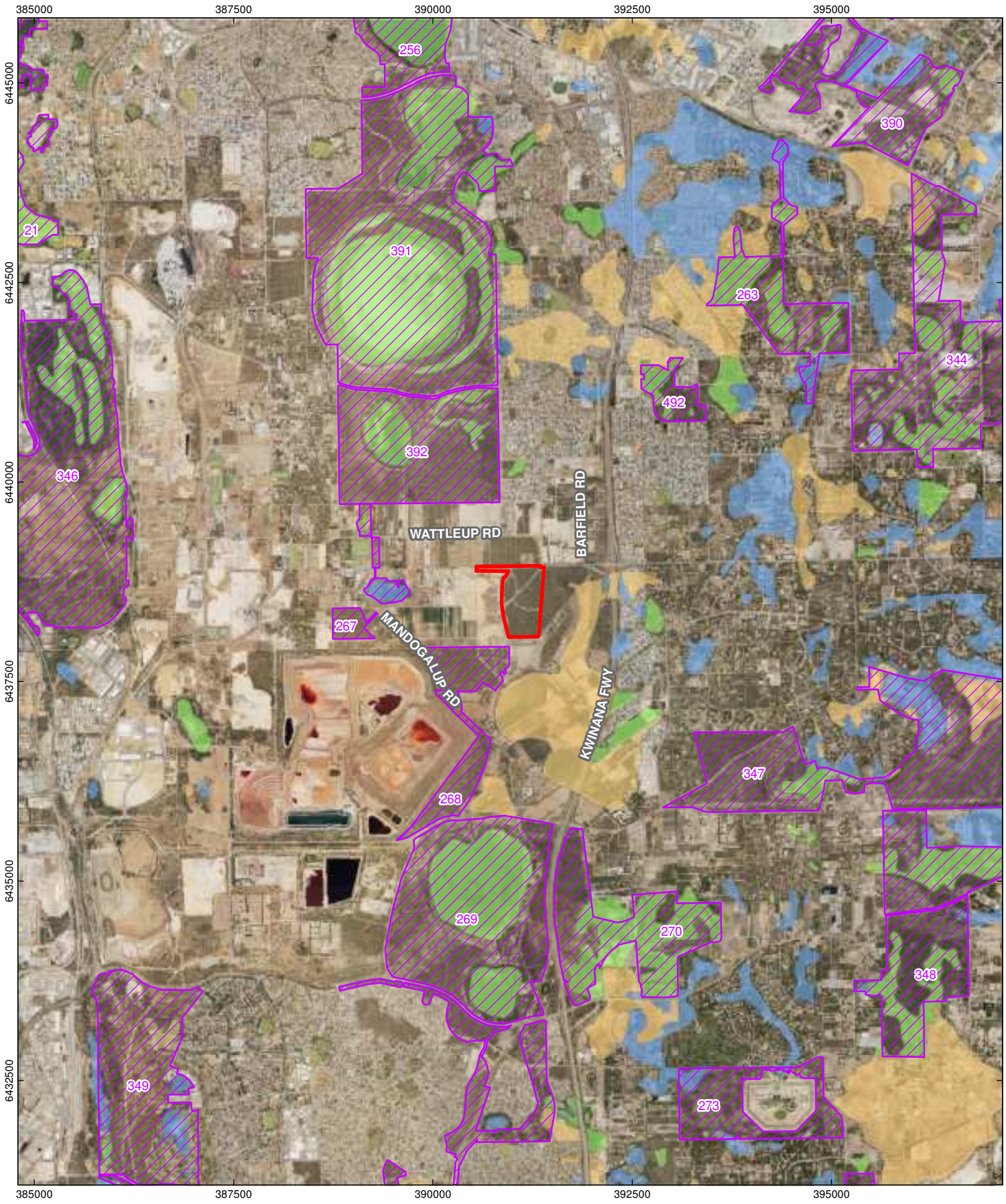

Figure 5: Wetlands and Bush Forever sites

Legend

- Proposal area
- Bush Forever sites

Wetlands

- Conservation
- Multiple Use
- Resource Enhancement

N

Scale 1:65,000 at A4

0 0.5 1 1.5 km

Coordinate System: GDA 1994 MGA Zone 50

Date: 1/11/2018

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Data source: Aerial Image - SLIP Public Services 2018. Landgate: Cadastre, 11/2017. Client: Qube Property Group. Development layout, 08/2018. Created by: c.thatcher

3. Stakeholder engagement

3.1 Key stakeholders

The key stakeholders associated with the procession of the proposal include the following:

- Department of the Environment and Energy (DEE)
- Department of Water and Environmental Regulation (DWER)
- Department of Biodiversity, Conservation and Attractions (DBCA)
- City of Kwinana (CoK).

3.2 Stakeholder engagement and consultation process

Stakeholder consultation undertaken so far has been in relation to:

- the proposal's referral under the EPBC Act to the DEE in April 2019
- preliminary discussions with the Department of Water and Environmental Regulation (DWER) regarding referral of the proposal under section 38 of the EP Act.

As previously advised and considering the DEE determined that the proposal is a controlled action (EPBC 2018/8182), the proponent wishes to seek a bilateral assessment from the Environmental Protection Authority (EPA) and DEE on the environmental aspects of the Proposal.

As a requirement of the environmental impact assessment process, consultation with key stakeholders will be undertaken and submissions will be received during the public comment period.

4. Environmental principles and factors

4.1 Principles

The EP Act identifies a series of principles for environmental management. The environmental principles are the highest-level goals that a proposal must meet to be found environmentally acceptable by the EPA. The proponent has considered these principles in relation to the development and implementation of the Proposal. Table 3 outlines how the principles relate to the Proposal.

Table 3: EP Act principles

Principle	Consideration
Precautionary principle Where there are threats of serious irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, decisions should be guided by: • careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and • an assessment of the risk-weighted consequences of various options.	The Proponent used existing environmental data during design to identify appropriate areas of vegetation for retention. Consultation has been undertaken with key stakeholders to identify potential environmental impacts and appropriate management for the Proposal, including project staging to minimise impacts to adjacent land uses.
Intergenerational equity The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.	The Proposal can be developed without significant impacts on the health, diversity or productivity of the environment.
Conservation of biological diversity and ecological integrity Conservation of biological diversity and ecological integration should be a fundamental consideration.	The Proposal includes the retention of 3.74 ha of vegetation in very good to excellent condition within the Proposal Area.
Improved valuation, pricing and incentive mechanisms 1. Environmental factors should be included in the valuation of assets and services. 2. The polluter pays principle – those who generate pollution and waste should bear the cost of containment, avoidance or abatement. 3. The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste. Environmental goals, having been established, should be pursued in the most cost-effective way, by establishing incentive structures, including market mechanisms, which benefit and/or minimise costs to develop their own solutions and responses to environmental problems.	Environmental constraint avoidance and management costs have been considered in the planning and design of the Proposal. The Proponent will be responsible for funding the cost of environmental avoidance and management.
Waste minimisation All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.	Waste will be minimised by adopting the hierarchy of waste controls; avoid, minimise, reuse, recycle and safe disposal.

4.2 Key environmental factors

Table 4 provides a preliminary assessment of the environmental factors established by the EPA for the purposes of environmental impact assessment and is used as a basis for assessing whether a Proposal's impact on the environment is acceptable or may be considered significant.

Based on the assessment, the following key environmental factors have been identified:

- Flora and vegetation (Section4.3)
- Terrestrial fauna (Section 4.4)
- Landforms (Section 4.5)
- Air quality (Section 4.6)
- Social surroundings (Section 4.7).

Table 4: Preliminary assessment of environmental factors

Theme	Environmental factor	Environmental Objective	Significance of impact
Sea	Benthic Communities and Habitat	To protect benthic communities and habitats so that biological diversity and ecological integrity are maintained.	The Proposal is not located adjacent or nearby coastal areas.
	Coastal Processes	To maintain the geophysical processes that shape coastal morphology so that the environmental values of the coast are protected.	The Proposal is not located adjacent or nearby coastal areas.
	Marine Environmental Quality	To maintain the quality of water, sediment and biota so that environmental values are protected.	The Proposal is not located adjacent or nearby marine areas.
	Marine Fauna	To protect marine fauna so that biological diversity and ecological integrity are maintained.	The Proposal is not located adjacent or nearby marine areas.
Land	Flora and Vegetation	To protect flora and vegetation so that biological diversity and ecological integrity are maintained.	The Proposal is expected to cause significant impacts to flora and vegetation. It will involve clearing of 35.64 ha of native vegetation, of which 33.74 ha is Banksia woodlands of the Swan Coastal Plain ecological community (Section 4.3).
	Landforms	To maintain the variety and integrity of significant physical landforms so that environmental values are protected.	The Proposal is expected to cause significant impacts to landform. It will involve large scale earthworks due the expansion of the current quarry (Section 4.5).
	Terrestrial Fauna	To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.	The Proposal is expected to cause significant impacts to terrestrial fauna. It will involve clearing of 35.64 ha fauna habitat, which includes Black cockatoo foraging habitat and removal of 54 potential Black cockatoo nesting habitat trees (Section 4.4).
	Subterranean Fauna	To protect subterranean fauna so that biological diversity and ecological integrity are maintained.	The Proposal will not involve below water table excavation or dewatering and is therefore, not expected to cause significant impacts to subterranean fauna.
	Terrestrial Environmental Quality	To maintain the quality of land and soils so that environmental values are protected.	The Proposal is not expected to cause significant impact to terrestrial environmental quality. Erosion and sedimentation may occur during quarry operations, but these impacts are not expected to be significant.

Theme	Environmental factor	Environmental Objective	Significance of impact
Water	Inland Waters	To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.	The Proposal may cause potential impacts on inland waters through accidental spills of fuels and chemicals during operation, erosion and sedimentation during operation, but these impacts are not expected to be significant.
Air	Air Quality	To maintain air quality and minimise emissions so that environmental values are protected.	The Proposal may cause potential impacts on air quality due to dust emissions during operation (Section 4.6).
People	Social Surroundings	To protect social surroundings from significant harm.	The Proposal may cause potential impacts on amenity, due to noise and dust emissions during operation. Potential impacts due to dust emissions are addressed under the Air Quality factor. Noise emissions are not anticipated to be significant and can be managed through the Extractive Industries Licence.
	Human Health	To protect human health from significant harm.	The Proposal will not result in significant impacts to human health.

4.3 Key Environmental Factor 1- Flora and Vegetation

4.3.1 EPA objectives

The EPA's Statement of Environmental Principles, Factors and Objectives (EPA 2018b) identifies the following objective for flora and vegetation:

- To protect flora and vegetation so that biological diversity and ecological integrity are maintained.

4.3.2 EPA policy and guidelines

Flora and Vegetation surveys that have informed planning for the Proposal have been conducted in accordance with the T*echnical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016a) and the *Environmental Factor Guideline: Flora and Vegetation* (EPA 2016b).

4.3.3 Receiving environment

General

In 2017, Strategen completed a flora and vegetation survey which involved a desktop assessment and field surveys (July 2017 and October 2017) within the Proposal Area, consistent with the requirements of *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016a). A copy of this report is provided in Appendix 2.

The objectives were to:

- conduct a desktop survey for Threatened and Priority flora which have been identified as being present in or around the Proposal Area
- collect and identify the vascular plant species present within the Proposal Area
- search areas of suitable habitat for Threatened and/or Priority flora
- define and map the native vegetation communities present within the Proposal Area
- map vegetation condition within the Proposal Area
- provide recommendations on the local and regional significance of the vegetation communities
- prepare a report summarising the findings.

In 2018, a follow up targeted spring flora survey was undertaken in August 2018 and October 2018. A copy of the memo reporting on the outcome of the August and October 2018 surveys is provided in Appendix 3.

The Proposal Area is located within the Swan Coastal Plain 2 (SWA2 – Swan Coastal Plain subregion) of Western Australia (Mitchell et al. 2002). The Proposal Area is located within the Bassendean Dune system (Churchward & McArthur 1980) and occurs within the Swan Coastal Plain 2 IBRA subregion which is dominated by Banksia or Tuart on sandy soils, *Casuarina obesa* on outwash plains and paperbark (Melaleuca) in swampy areas (Mitchell et al. 2002).

The Proposal Area occurs within the Drummond Botanical Subdistrict which is characterised by low Banksia woodlands on leached sands; Melaleuca swamps on poorly-drained depressions; and *Eucalyptus gomphocephala* (Tuart), *Eucalyptus marginata* (Jarrah) and *Corymbia calophylla* (Marri) woodlands on less leached soils (Beard 1990).

Regional mapping indicates that the Proposal Area is mapped within vegetation association (Beard) 1001, which is characteristic of Medium very sparse woodland; jarrah, with low woodland; banksia & casuarina. Within the Heddle vegetation complex, the Proposal Area is mapped within the Bassendean Complex - central and south vegetation, which consists of woodland of jarrah-sheoak-banksia on the sand dunes, to a low woodland of *Melaleuca* spp., and sedgelands on the low-lying depressions and swamps (Heddle et.al. 1980).

Table 5 presents the estimated pre-European and current (as at 2017) extent remaining of the Bassendean Complex - central and south. The remnant and regrowth native vegetation within the Proposal Area represents approximately 0.16% of the current extent of the Bassendean Complex - central and south.

Table 5: Extent of Bassendean Complex central and south

Vegetation complex (Swan Coastal Plain dataset)	Description	Pre-European extent (ha)	Current extent (ha) as at 2017	% Remaining of pre-European extent
Bassendean Complex - central and south	Vegetation ranges from woodland of *Eucalyptus marginata* (Jarrah) - *Allocasuarina fraseriana* (Sheoak) - Banksia species to low woodland of Melaleuca species, and sedgelands on the moister sites. This area includes the transition of *Eucalyptus marginata* (Jarrah) to *Eucalyptus todtiana* (Pricklybark) in the vicinity of Perth.	87,476	23,533	26.90

Site Assessment

A total of 74 native vascular plant taxa from 25 plant families were recorded within the Proposal Area. No Threatened flora species as listed under section 178 of the EPBC Act were recorded within the Proposal Area. No Threatened flora species pursuant to Schedule 1 of the BC Act and as listed by Parks and Wildlife (2015) and no Priority flora species as listed by Western Australian Herbarium (1998-) were recorded within the Proposal Area (Strategen 2017) (Appendix 1).

A total of 15 introduced (exotic) taxa were recorded within the Proposal Area, of which one species (*Zantedeschia aethiopica*) is a Declared Plant species in Western Australia pursuant to section 22 of the *Biosecurity and Agriculture Management Act 2007* (BAM Act) according to the Western Australian Department of Agriculture and Food (DAFWA 2017).

Three vegetation types (VTs) were defined and mapped within the Proposal Area. The total area mapped was 43.67 ha which includes cleared areas (Figure 6, Table 6).

Table 6: Vegetation types

Vegetation Type	Description	Area (ha)	Percentage of the Proposal Area
1	Low woodland of *Banksia menziesii* and *B. attenuata* over open heath of *Xanthorrhoea preissii*, *Hibbertia hypericoides* and *Mesomelaena pseudostygia* with emergent *Eucalyptus marginata*.	37.48	85.82
2	Closed scrub of *Acacia saligna* over mixed introduced species.	1.28	2.92
3	Closed herbland of mixed introduced species with emergent *Eucalyptus marginata*, *Allocasuarina fraseriana* and *Acacia saligna*.	0.62	1.41
C	Cleared areas with exotic grasses and herbs.	4.30	9.84
Total		**43.67**	**100**

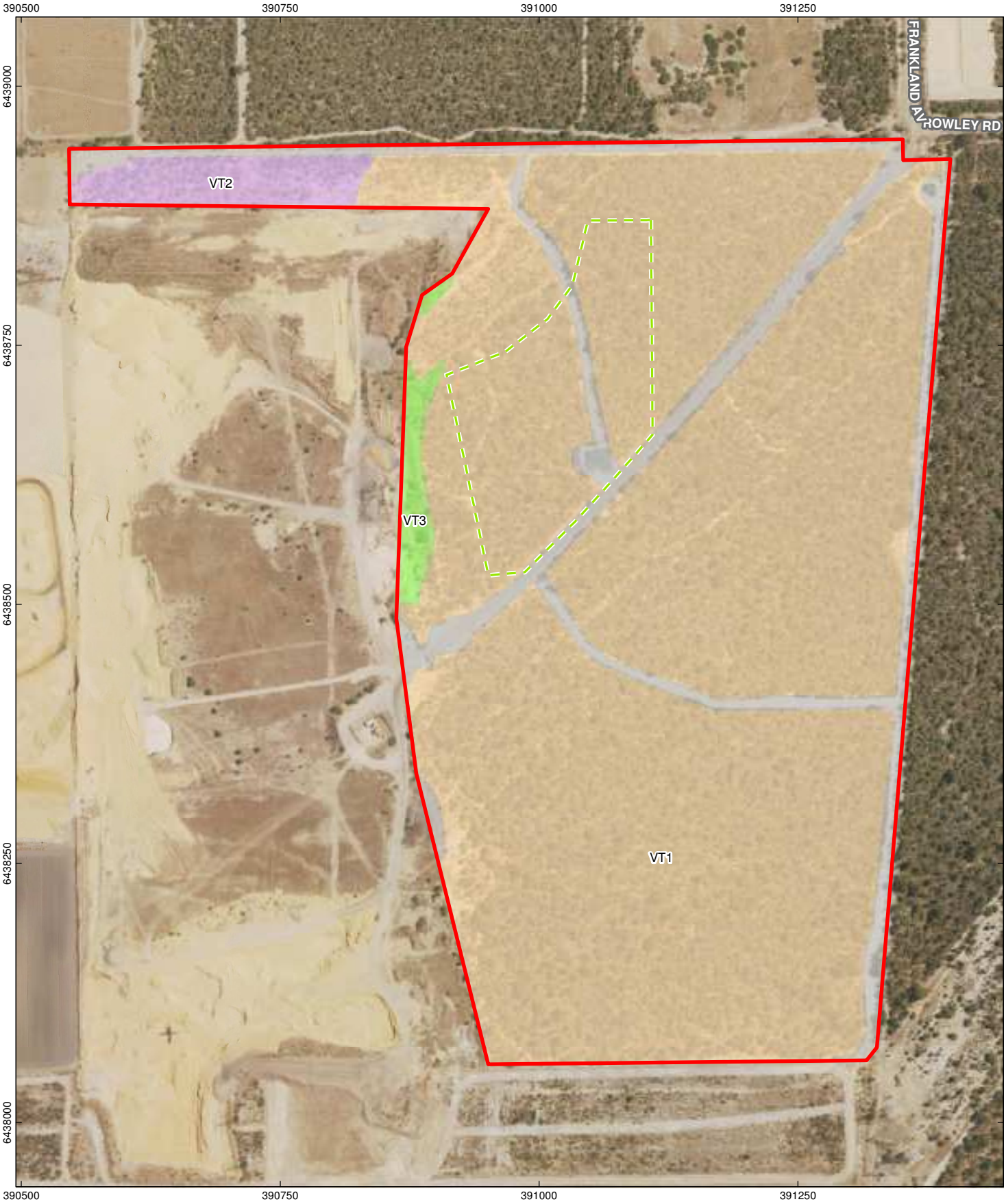

Figure 6: Vegetation types

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Scale 1:5,000 at A4

0 50 100 150 m

Coordinate System: GDA 1994 MGA Zone 50

Date: 1/11/2018

Proposal area

Bushland to be retained

Vegetation type

VT1: Low woodland of Banksia menziesii and B. attenuata over open heath of Xanthorrhoea preissii, Hibbertia hypericoides and Mesomelaena pseudostygia with emergent Eucalyptus marginata.

VT2: Closed scrub of *Acacia saligna* over mixed introduced species

VT3: Closed herbland of mixed introduced species with emergent *Eucalyptus maginata*, *Allocasuarina fraseriana* and *Acacia saligna*

Cleared

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Data source: Aerial Image - SLIP Public Services 2018. Landgate: Cadastre, 11/2017. Client: Qube Property Group. Development layout, 08/2018. Created by: c.thatcher

Vegetation condition within the Proposal Area ranged from Completely Degraded to Excellent (Keighery 1994; Figure 7). Table 7 gives a numerical breakdown of the area occupied by each vegetation condition rating within the Proposal Area.

Table 7: Area (ha) covered by each vegetation condition category within the Proposal Area

Vegetation Condition	Area (ha)	Percentage of the Survey area
Very Good – Excellent	34.61	79.25
Good – Very Good	1.83	4.18
Degraded – Good	1.04	2.38
Completely Degraded	1.84	4.21
Cleared	4.35	9.95
Total	**43.67**	**100**

The Vegetation Type (VT1) is associated with the Banksia Woodlands of the Swan Coastal Plain ecological community. Statistical analysis of the species composition of VT1 showed strong linkage of this VT to Floristic Community Type (FCT) 28, which is described as Spearwood *Banksia attenuata* or *Banksia attenuata - Eucalyptus* woodlands (Strategen 2017). All vegetation mapped as VT1 within the Survey Area met diagnostic criteria provided in the approved conservation advice for the Banksia woodlands of the Swan Coastal Plain TEC (Strategen 2017).

While FCT 28 forms part of the Banksia woodlands of the Swan Coastal Plain Threatened Ecological Community (TEC), it is not listed as a TEC or as a Priority Environmental Community (PEC) by DBCA. The Approved DEE Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community (TSSC 2016) states that one of the indicators to be considered when assessing the impacts of proposed actions under the EPBC Act is whether the occurrence of the patch of Banksia woodland is part of a 'sub-community' / FCT that is recognised as a threatened or priority ecological community by the West Australian Government (TSSC 2016). The absence of a listing by the West Australian Government indicates that this FCT type remains a relatively common component of the Banksia Woodlands TEC on the Swan Coastal Plain.

No Threatened flora species as listed under section 178 of the EPBC Act or pursuant to Schedule 1 of the BC Act and as listed by Parks and Wildlife (2015) were recorded within the Survey Area. Additionally, no Priority flora species as listed by Western Australian Herbarium (1998-), including those listed above, were recorded.

4.3.4 Potential impacts

The potential impacts of the Proposal include:

Direct impacts

The Proposal will result in clearing of approximately 35.64 ha of native vegetation and retention of 3.74 ha (approximately 9.4% of the Proposal Area) within a conservation area (Table 8).

Table 8: Proposed area to be cleared and retained by vegetation type

Vegetation Type	Proposal area (ha)	Retained (ha)	Clearing (ha)
VT1	37.48	3.74	33.74
VT2	1.28	0.00	1.28
VT3	0.62	0.00	0.62
Cleared	4.30	0.36	3.94
Total area	**43.67**	**4.10**	**39.57**

Figure 7: Vegetation condition

Legend

- Proposal area
- Bushland to be retained

Vegetation condition

- Very good - Excellent
- Good - very good
- Degraded - good
- Completely degraded
- Cleared

N

Scale 1:5,000 at A4

0 50 100 150 m

Coordinate System: GDA 1994 MGA Zone 50

Date: 1/11/2018

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Data source: Aerial Image - SLIP Public Services 2018. Landgate: Cadastre, 11/2017. Client: Qube Property Group. Development layout, 08/2018. Created by: c.thatcher

The breakdown of this area by vegetation condition is outlined in Table 9.

Table 9: Proposed area to be cleared and retained by vegetation condition

Condition	Proposal area (ha)	Retained (ha)	Clearing (ha)
Very Good – Excellent	34.61	3.74	30.87
Good – Very Good	1.83	0	1.83
Degraded – Good	1.04	0	1.04
Completely Degraded	1.84	0	1.84
Cleared	4.35	0.36	3.99
Total area	**43.67**	**4.10**	**39.57**

The Proposal will result in clearing of 33.74 ha of State listed 'Banksia Woodlands of the Swan Coastal Plain' PEC, expected to comprise FCT28 Spearwood *Banksia attenuata* or *Banksia attenuata – Eucalyptus* woodlands.

The Proposal is not expected to directly impact on any State listed TECs. The Proposal will result in clearing of 33.74 ha of the Federally listed 'Banksia Woodlands of the Swan Coastal Plain' TEC.

The Proposal is not expected to directly impact on any threatened or priority flora species listed under Commonwealth or State legislation.

Indirect impacts

Sand mining activities have potential to impact on adjacent native vegetation through erosion, uncontrolled access, dust deposition, and through the spread of weeds.

4.3.5 Mitigation

Impacts to flora and vegetation will be mitigated through the following:

Onsite vegetation retention

Within the Proposal Area, 4.10 ha is proposed to be set aside for conservation. The proposed conservation area captures the following key environmental attributes:

- 3.74 ha is vegetation in very-good to excellent condition
- Banksia woodland vegetation
- Good quality Black cockatoo foraging habitat
- 10 potential Black cockatoo nesting habitat trees.

Conservation Area Management Plan (CAMP)

Development and implementation of a CAMP to ensure the future retention and management of flora and vegetation by:

- providing measures to avoid and mitigate impact on flora and vegetation prior to, during and post construction
- identifying objectives, interim targets, performance indicators and completion criteria
- providing timeframes for the implementation and completion of the above objectives
- developing a monitoring and reporting program for flora and vegetation
- identifying contingency measures
- establishing roles and responsibilities
- providing a map clearly illustrating the area of flora and vegetation and to be cleared and retained.

Environmental Management Plan (EMP)

Development and implementation of an Environmental Management Plan (EMP) including management measures such as:

- clearing and access control measures (such as demarcation of clearing boundaries)
- weed management
- post-mining rehabilitation
- erosion and sediment control
- waste and fire management
- topsoil management
- dust control.

Offset Strategy

An Offset Strategy will be developed and implemented with the aim to acquire land to add to the State's conservation system to offset any residual impact from the proposed development and will contain Banksia woodland vegetation. The proposed offset strategy will be developed in line with the following key policies and guidelines:

- WA Environmental Offsets Policy (Government of Western Australia 2011)
- WA Environmental Offsets Guidelines (Government of Western Australia 2014)
- EPBC Act Environmental Offsets Policy (DSEWPaC 2012b).

The DEE Offset calculator was consulted to provide an offset assessment guide (parameters) associated with the clearing of the Project Area calculator values used are provided below. The likely area of offsets required would be as follows:

- Banksia Woodlands TEC (FCT 28) approximately 101 ha.

Offset calculator values for Banksia Woodland TEC include the following:

Offset parameter	Values used in calculator	Justification of value
Start quality (proposed action)	8	Most (79.25%) of the 33.74ha of FCT 28 is in Very Good to Excellent Condition.
Time over which loss is averted	20	The offset site would be protected as a Conservation Reserve, vested in the Conservation Commission.
Time until ecological benefit	1	Ecological benefit would be realised immediately as a direct offset would be provided.
Start quality	7	The proposed offset site would comprise of an area of high quality Banksia low woodland (101 ha approximate habitat quality scope of 7). The offset site would provide a foraging resource within the Gingin area.
Risk of loss (%) without offset	60%	Depending on the current tenure of the proposed site, if it was not land banked for the purpose of offset there would be no formal protection mechanisms or active conservation management (i.e. weed control, fire management and access management).
Future quality without offset	6	Quality of the offset site would likely decline without any protection measures, resulting in a reduction of available foraging resources in the area.
Risk of loss (%) with offset	5%	Formal protection of the offset site will ensure that the risk of loss is minimised as much as possible.
Future quality with offset	7	Vegetation types of the proposed site the future quality is unlikely to increase.
Confidence in result (habitat quality)	80%	Protection mechanisms, once established, will provide a higher level of certainty that the offset will be conserved.

Recent consultation with the DBCA acquisitions offset manager regarding potential offset sites that the DBCA may acquire either in the immediate vicinity or broader region surrounding the site has indicated that while there may be isolated remnant Banksia Woodland areas (>2ha) within the local regions they would be unfeasible (i.e. site available for purchase and/or large enough to meet offset requirement). Therefore, it appears that there are no viable patches of Banksia Woodland of the Bassendean Complex within the southern metropolitan area available for a local offset in the vicinity of the site.

The DBCA has confirmed that its key focus in terms of Bassendean Complex, Conservation acquisitions are within the Gingin area and the Department has several properties that it is looking to acquire for this purpose. The proponent has also commenced investigations on potential suitable sites within the Mindarra area which is also near existing DBCA regional parks.

Further to the above in this instance the State and Federal Environmental Offsets Policies can be addressed through the provision of funds for the acquisition of approximately 106 ha Banksia Woodlands within the broader Gingin area. That is, based on the DEE offset calculator and aim to address both Banksia Woodlands TEC and Black cockatoo foraging habitat in the same offset site (see Section 4.4.5).

Key justifications used in the determination of this offset are firstly that the existing Banksia Woodland within the Project Area is under significant threat because of surrounding land use of urban and industrial development as well as quarry activities.

On this basis, it is considered that this approach is consistent with the principles of the State and Federal Environmental Offsets Policies with averting the loss of habitat by secreting an offset area for future conservation purposes.

4.3.6 Predicted outcome

The Proposal will result in clearing an area of native vegetation, comprising 0.16% of the current extent of the Bassendean Complex - central and south vegetation complex. No State listed TECs, conservation / resource enhancement category wetland vegetation or conservation significant flora species are expected to be impacted by the Proposal. The Proposal will result in clearing an area of State listed PEC, well reserved with a ‘low risk’ conservation status, with most of the PEC patch left intact in a contiguous area.

The Proposal does not lie near conservation reserves, Bush Forever sites, TECs or conservation category wetlands or their associated buffer. Thereby, reducing the potential for significant indirect impacts.

The Proposal will retain 3.74 ha of Banksia Woodlands TEC in Excellent condition and implement an EMP, CAMP and Offset Strategy to minimise direct and indirect impacts to flora and vegetation. Accordingly, it is expected that the EPA’s objective for flora and vegetation will be met.

4.4 Key Environmental Factor 2 - Terrestrial Fauna

4.4.1 EPA objectives

The EPA's Statement of Environmental Principles, Factors and Objectives (EPA 2018b) identifies the following objective for terrestrial fauna:

- To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.

4.4.2 EPA policy and guidelines

Terrestrial fauna surveys that have informed planning for the Proposal have been conducted in accordance with the T*echnical Guidance - Terrestrial Fauna Surveys for Environmental Impact Assessment* (EPA 2016c) and the *Environmental Factor Guideline: Terrestrial Fauna* (EPA 2016d).

4.4.3 Receiving environment

Conservation significant fauna

The EPBC Act Protected Matters Search Tool and DBCA Nature Map Database was searched (2017) for conservation significant species recorded within the vicinity of the Project Area.

- *Calyptorhynchus banksii naso* (FRTBC)- (Vulnerable-EBPC, Threatened- BC Act) Habitat present
- *Calyptorhynchus latirostris* (CBC)- (Endangered- EPBC, Threatened- BC Act); Habitat present
- *Dasyurus geoffroii* (Chuditch, Western Quoll) (Vulnerable-EBPC) Habitat associated with jarrah (*Eucalyptus marginata*) forests and woodlands and mallee shrublands and heaths. Unlikely occurrence (DEC 2012)
- *Falsistrellus mackenziei* (Western False Pipistrelle, Western Falsistrellus) (P4- BC Act)- habitat Western False Pipistrelles live mainly in wet sclerophyll forests of Karri, Jarrah and Tuart eucalypts. Unlikely occurrence (Australian Museum 2009)
- *Isoodon obesulus* subsp. *fusciventer* (Quenda, Southern Brown Bandicoot) (P4- BC Act)- Scrubby, often swampy, vegetation with dense cover up to 1 m high, often feeds in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover. Has been recorded within Bush Forever Sites No. 268 and 392, which are located within the vicinity of the Proposal Area (Government of Western Australia 2000)
- *Macropus irma* (Western Brush Wallaby) (P4-BC Act) Habitat- habitats, including open forest and woodland, mallee, heathland, low open grasses, and scrubby thickets, but favour open, grassy areas (International Union for Conservation of Nature and Natural Resources 2017). Unlikely to occur on Proposal Area
- *Synemon gratiosa* (Graceful Sunmoth) (P4- BC Act) common in sedgelands, heathlands, woodlands associated with Lomandra (*L. maritima* and *L. hermaphrodita*) species. *L. hermaphrodita* was recorded in the PGV Environmental (2011) and Strategen (2017) surveys as being present within Lot 2. Potential habitat present
- Lerista lineata (Perth Slider, Lined Skink) (P3-BC Act). Potential habitat present.

While a Level 1 Fauna survey has not been undertaken for the Proposal Area, PGV Environmental (2015) discusses that the fauna values associated with the Project Area are likely to be:

- fauna assemblage: depauperate, limited medium and small mammals and some bird species reptiles and vertebrates
- species of significance include Quenda and Black cockatoos (CBC and FRTBC)
- ecological processes affecting fauna assemblage includes limited connectivity, influences in hydrology, fire and degradation processes.

Black cockatoo

In 2017, Strategen undertook a Black cockatoo habitat survey, which included a desktop assessment and field assessment within the Proposal Area. The survey was done in accordance with the EPBC Act Referral guidelines for three threatened black cockatoo species (DSEWPaC 2012a). A copy of this report is provided in Appendix 2.

The objectives were to:

- determine whether vegetation communities within the Proposal Area are suitable as black cockatoo habitat, and describe and map quality of each area of habitat
- search for any potential nesting habitat trees for any of the threatened black cockatoo species (eucalypts with diameter at breast height [DBH] >500 mm)
- record and map locations of potential nesting habitat trees
- map vegetation condition within the Proposal Area
- provide recommendations on the local and regional significance of the vegetation communities
- prepare a report summarising the findings.

A total of 64 potential nesting habitat trees were recorded within the Proposal Area (*Eucalyptus marginata*) (Figure 8).

Using the scale described in Table 10 foraging habitat quality of each vegetation type was determined and is shown in Table 11.

Table 10: Definitions of black cockatoo foraging habitat quality

Foraging quality	Justification
Excellent	High density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species >60%) and presence of food sources at several strata (i.e. canopy, midstorey and understorey).
Good	High density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species >60%) but food sources only present at one or two strata (i.e. canopy and midstorey).
Moderate	Moderate foraging value density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species 20-40%) and food sources only present at one or two strata (i.e. canopy and midstorey).
Poor	Low density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species 10-20%) and presence of food sources at only one stratum (i.e. canopy).
Very poor	Very low density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species <10%) and presence of food sources at only one stratum (i.e. canopy).
Nil	Cleared areas - no suitable vegetation present.

Table 11: Vegetation types and black cockatoo foraging species within the Survey Area

Vegetation type	Black cockatoo foraging species	Foraging quality	Area (ha)
VT1	CBC – *Acacia saligna, Allocasuarina fraseriana, Banksia attenuata, B. dallanneyi, B. menziesii, Eucalyptus marginata, Hakea lissocarpha, Mesomelaena pseudostygia, Xanthorrhoea preissii* FRTBC - *Allocasuarina fraseriana, Eucalyptus marginata*	• Moderate - Good (CBC) • Very poor (FRTBC)	37.48
VT2	CBC – *Acacia saligna* FRTBC – Nil	• Good (CBC) • Nil (FRTBC)	1.28
VT3	CBC – *Allocasuarina fraseriana, Eucalyptus marginata, Acacia saligna* FRTBC – *Allocasuarina fraseriana, Eucalyptus marginata.*	• Very poor (CBC) • Very poor (FRTBC)	0.62
C	CBC – Nil FRTBC – Nil	Nil	4.30
TOTAL			**43.67**

Baudin's black cockatoo was considered unlikely to be present as the Proposal Area is beyond the range of its known distribution (Johnstone and Kirkby undated); as such, foraging habitat quality has been assessed for only Carnaby's Black Cockatoo (CBC) and Forest Red-tailed Black Cockatoo (FRTBC).

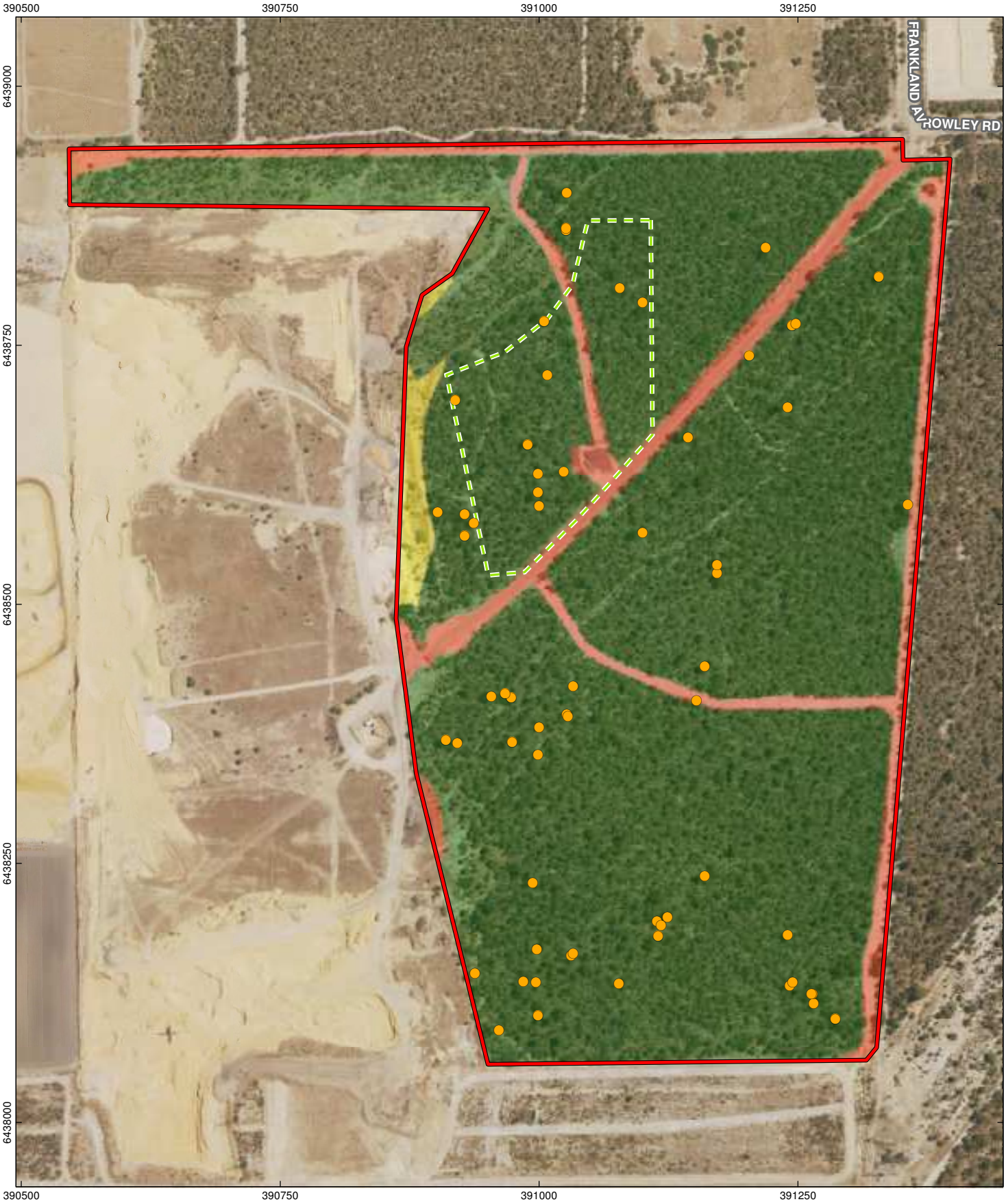

Figure 8: Black Cockatoo habitat

Legend

- Proposal area
- Bushland to be retained
- Significant trees

Black cockatoo foraging habitat

- Moderate - good
- Poor
- Cleared areas - no suitable habitat present

N

Scale 1:5,000 at A4

0 50 100 150 m

Coordinate System: GDA 1994 MGA Zone 50

Date: 1/11/2018

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Data source: Aerial Image - SLIP Public Services 2018. Landgate: Cadastre, 11/2017. Client: Qube Property Group. Development layout, 08/2018. Created by: c.thatcher

VT1 contained 37.48 ha of moderate – good quality foraging habitat for CBC, largely due to the presence of *Banksia* species, *Allocasuarina fraseriana* and *Eucalyptus marginata*, as well as smaller understorey species (Table 11).

Despite being heavily degraded and comprising one native species over weed species, vegetation in VT2 was rated as good quality foraging habitat (1.28 ha) for CBC due to its high foliage cover of *Acacia saligna*. VT3, in which occasional large native species were present (*Allocasuarina fraseriana*, *Eucalyptus marginata* and *Acacia saligna*) contained 0.62 ha of very poor quality foraging habitat for both CBC and FRTBC.

Black Cockatoo foraging habitat within the Proposal Area includes:

- 38.76 ha of moderate – good quality foraging habitat
- 0.62 ha of poor quality foraging habitat.

4.4.4 Potential impacts

The Proposal will result in direct and indirect impacts to terrestrial fauna as result of:

- clearing of 35.64 ha of native vegetation that provides habitat for an array of fauna, of which includes the following Black cockatoo foraging habitat:
  - moderate – good- 35.02 ha
  - poor – 0.62 ha
- removal of 54 potential Black cockatoo nesting habitat trees, with retention of 10 potential nesting habitat trees.

No other conservation significant species are considered likely to be significantly affected by the Proposal.

Sand mining activities have potential to impact on adjacent native vegetation and consequently fauna habitat through erosion, uncontrolled access, dust deposition, and through the spread of weeds.

4.4.5 Mitigation

Impacts to terrestrial fauna will be mitigated through the following:

Onsite vegetation and fauna habitat retention

Within the Proposal Area 4.10 ha is proposed to be set aside for conservation (Figure 1). The proposed conservation area captures the following key environmental attributes:

- 3.74 ha is vegetation in very-good to excellent condition
- Banksia woodland vegetation
- Good quality Black cockatoo foraging habitat
- 10 potential Black cockatoo nesting habitat trees.

Conservation Area Management Plan (CAMP)

Development and implementation of a CAMP to ensure the future retention and management of vegetation and fauna habitat by:

- providing measures to avoid and mitigate impacts on vegetation and fauna habitat prior to, during and post construction
- identifying objectives, interim targets, performance indicators and completion criteria
- providing timeframes for the implementation and completion of the above objectives
- developing a monitoring and reporting program for vegetation and associated fauna habitat
- identifying contingency measures
- establishing roles and responsibilities
- providing a map clearly illustrating the area of vegetation and to be cleared and retained.

Environmental Management Plan (EMP)

Development and implementation of an EMP including management measures such as:

- providing measures to avoid and mitigate impact on Black cockatoo and its habitat following commencement of the action (during construction). Particularly if clearing is proposed during Black Cockatoo breeding season, i.e. potential breeding trees inspected by a suitably qualified ecologist prior to clearing if clearing is undertaken during the breeding season
- clearing and access control measures (such as demarcation of clearing boundaries)
- weed management
- post-mining rehabilitation
- erosion and sediment control
- waste and fire management
- topsoil management
- dust control.

Offset Strategy

An Offset Strategy will be developed and implemented with the aim to acquire land to add to the State's conservation system to offset any residual impact from the proposed development and will contain Banksia woodland vegetation and Black cockatoo foraging habitat. The proposed offset strategy will be developed in line with the following key policies and guidelines:

- Principles of the WA Environmental Offsets Policy (Government of Western Australia 2011)
- WA Environmental Offsets and Guidelines (Government of Western Australia 2014)
- EPBC Act Environmental Offsets Policy (DSEWPaC 2012b).

The DEE Offset calculator was consulted to provide an offset assessment guide (parameters) associated with the clearing of the Project Area calculator values used are provided below. The likely area of offsets required would be as follows:

- Black cockatoo foraging habitat approximately 106 ha.

Offset calculator values for Black cockatoo foraging habitat

Offset parameter	Values used in calculator	Justification of value
Start quality (proposed action)	8	The proposed action comprises moderate to good quality foraging and potential breeding habitat for CBC and FRTBC.
Time over which loss is averted	20	The offset site will need to be protected as a Conservation Reserve, vested in the Conservation Commission.
Time until ecological benefit	1	Ecological benefit would be realised immediately as a direct offset would be provided.
Start quality	7	The proposed offset area would need to comprise an area of high quality Banksia low woodland. The offset site would provide a foraging resource to surrounding areas.
Risk of loss (%) without offset	60%	Depending on the current tenure of the proposed site, if it was not land banked for the purpose of offset there would be no formal protection mechanisms or active conservation management (i.e. weed control, fire management and access management).
Future quality without offset	6	Quality of the offset site is likely to decline without any protection measures, resulting in a reduction of available foraging resources in the area.
Risk of loss (%) with offset	5%	Formal protection of the offset site will ensure that the risk of loss is minimised as much as possible.
Future quality with offset	7	Vegetation types of the site the future quality is unlikely to increase.
Confidence in result (habitat quality)	80%	Protection mechanisms, once established, will provide a higher level of certainty that the offset will be conserved.

As previously advised, the proponent has commenced investigations on potential suitable sites within the Mindarra area which is also near existing DBCA regional parks.

Further to the above in this instance the State and Federal Environmental Offsets Policies can be addressed through the provision of funds for the acquisition of approximately 106 ha Banksia Woodlands within the broader Gingin area. That is, based on the DEE offset calculator and aim to address both Banksia Woodlands TEC and Black cockatoo foraging habitat in the same offset site.

Key justifications used in the determination of this offset are firstly that the existing Banksia Woodland and Black cockatoo foraging habitat within the Project Area is under significant threat because of surrounding land use of urban development and quarry activities.

On this basis, it is considered that this approach is consistent with the principles of the State and Federal Environmental Offsets Policies with averting the loss of habitat by secreting an offset area for future conservation purposes.

4.4.6 Predicted outcome

The Proposal will result in clearing of 35.64 ha of fauna habitat, including Black cockatoo foraging habitat and the removal of 54 potential Black cockatoo nesting habitat trees. No other conservation significant species are considered likely to be significantly affected by the Proposal.

The Proposal will retain 3.74 ha of fauna and Black cockatoo foraging habitat and implement an EMP, CAMP and Offset Strategy to minimise direct and indirect impacts to terrestrial fauna. Accordingly, it is expected that the EPA's objective for terrestrial fauna will be met.

4.5 Key Environmental Factor 3 - Landforms

4.5.1 EPA objective

The EPA's Statement of Environmental Principles, Factors and Objectives (EPA 2018b) identifies the following objective for landforms:

- To maintain the variety and integrity of significant physical landforms so that environmental values are protected.

4.5.2 EPA policy and guidelines

Investigations that have informed the planning of the Proposal have been conducted in accordance with the *Environmental Factor Guidance- Landforms* (EPA 2018c).

4.5.3 Receiving environment

The Proposal Area varies in height from 41 mAHD in the northeast to approximately 30 mAHD within the vegetation to be retained on site (Figure 9). Similar topography extends to the north of the Proposal Area, where the landform has been impacted by urban development.

Regional geology indicates that the Proposal Area consists of Tamala Limestone: Aeolian calcarenite, variably lithified, leached quartz sand, and S_8 (Bassendean Sand) (DWER 2017) (Figure 9). The Proposal Area is mapped as not having a risk of acid sulfate soil (ASS) occurring within 3 m of natural soil surface.

The landform is not considered to be significant because:

- the landform is of a Spearwood Dune type, a common type extends in a continuous belt throughout the Metropolitan Region, north to Lancelin and south to near Dunsborough (DWER 2017)
- the Spearwood Dunes are reserved within natural areas including Frankland Park to the north of the Proposal Area, Bush Forever Site 268 (approximately 250 m south of the Proposal Area) and Harry Waring Reserve, approximately 1 km north of the Proposal Area
- the Proposal Area is on the eastern edge of the Spearwood Dune system has been impacted by urbanisation to the north and sand mining to the west and is not a particularly important example of its' type
- the landform is not considered to have a distinctive or exclusive role in maintaining existing ecological or physical processes
- the landform is not considered to be of particular scientific or social importance.

4.5.4 Potential impacts

The potential impacts of the Proposal include:

- alteration of landform by removal of 1,740,00 m^3 of sand from the Proposal Area
- potential for offsite impacts due to soil being blown or washed from the land.

4.5.5 Mitigation

Sand mining will be undertaken in a manner consistent with the Environment Management Plan (EMP) for the Proposal. This will include:

- staged clearing and rehabilitation of the site to minimise the risk of erosion
- use of dust suppression measures such as water carts and wind fencing to reduce erosion
- ensuring that the final landform is of a stable geometry and rehabilitated to promote stabilisation after mining.

4.5.6 Predicted outcome

The existing landform of the Proposal Area is not considered to be significant and consequently no significant impacts are anticipated as a result of this Proposal. Accordingly, it is expected that the EPA's objective for landform will be met.

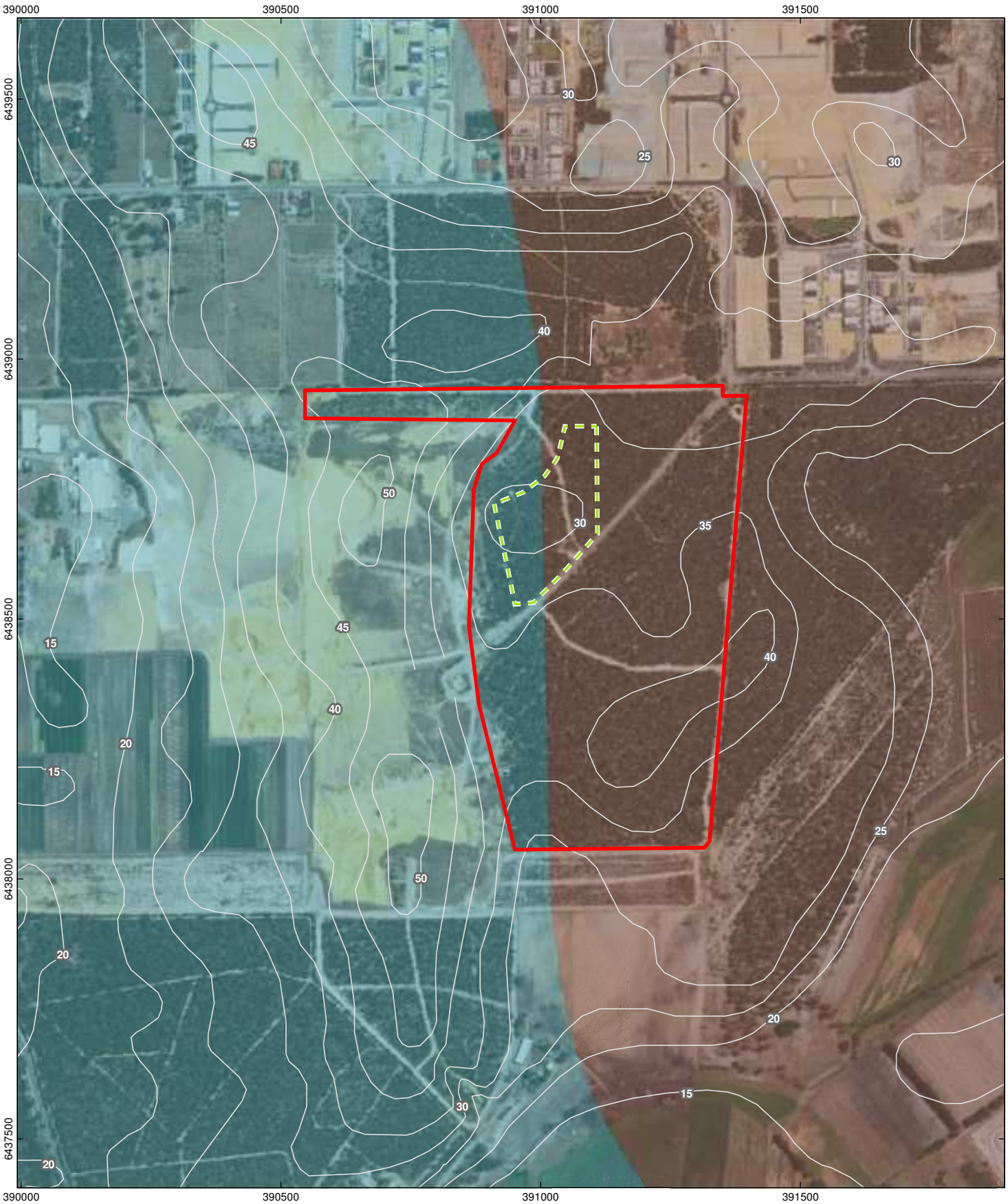

Figure 9: Topography, geology and soils

N

Scale 1:10,000 at A4

0 100 200 300 m

Coordinate System: GDA 1994 MGA Zone 50

Date: 22/10/2018

Legend

- Proposal area
- Bushland to be retained
- Contours (mAHD)

Geology and soils

- Qdc / coastal dunes 38488 / regolith
- Qdcb / Bassendean Sand / regolith

Q:\Consult\2017\QPG\QPG17054\ArcMap_documents\QPG17054_G013_RevB.mxd

info@strategen.com.au | www.strategen.com.au

Data source: Client: Qube Property Group. Development layout, 08/2018. Created by: c.thatcher

4.6 Key Environmental Factor 4- Air quality

4.6.1 EPA objective

The EPA's Statement of Environmental Principles, Factors and Objectives (EPA 2018b) identifies the following objective for air quality:

- To maintain air quality and minimise emissions so that environmental values are protected.

4.6.2 EPA policy and guidelines

The social surroundings investigations that have informed the planning of the Proposal have been conducted in accordance with the *Environmental Factor Guideline: Air Quality* (EPA 2016g). The EPA's primary focus is maintaining air quality and minimising emissions for human health and amenity.

Air quality in the Kwinana area is regulated by the *Environmental Protection (Kwinana) (Atmospheric Wastes) Policy 1999* and *Environmental Protection (Kwinana) (Atmospheric Wastes) Regulations 1992*.

The Proposal Area is located within Area C of the *Environmental Protection (Kwinana) (Atmospheric Wastes) Regulations 1992* (The Regulations). Area C consists of an area outside the predominantly rural and residentially zoned land located beyond Areas A and B (within the City of Rockingham, Town of Kwinana and City of Cockburn) of the Policy Area but still within the area covered by the Regulations. The Regulations set air quality standards for Area C as described in Section 4.6.3.

4.6.3 Receiving environment

Social Surroundings include aesthetic, cultural, economic and social surroundings of humans that could affect or be affected by physical or biological surroundings.

As presented in Section 2.4 and Figure 1, the Proposal Area is located in the City of Kwinana and is surrounded by predominantly rural land uses. The following 'social' and 'economic' values occur in the local area:

- existing residential areas approximately 50 m north-east of the Proposal Area
- proposed residential development immediately to the east of the Proposal Area.

The residential area immediately to the east, is being cooperatively developed by Qube Property Group and the owners of the mine. Mining will be staged so that the first stage of mining occurs on the eastern boundary of the Proposal Area, prior to residential development, to minimise impacts on future residents to the west.

The Regulations include air quality standards and limits for sulfur dioxide and total suspended particles (TSP). Because of the potential for dust emissions, the TSP guidance is relevant for this proposal. The Regulations define TSP as inert particles having an equivalent aerodynamic diameter of less than 50 micrometres (50 µm), referred to as PM_{50}. Ambient air quality standards under the Regulations relevant to the Proposal Area are presented in Table 12.

Table 12: Ambient air quality standards and limits for PM_{50} in Area C

Area	Standard (µg/m^3)	Limit (µg/m^3)	Averaging period
Policy Area	-	1000	15 minutes
Area C	90	150	24 hours

4.6.4 Potential impacts

Potential impacts to air quality include:

- particulate dust from quarrying and associated activities which may impact upon human health, amenity and the environment.

Dust may impact upon the environment where surface deposition affects vegetation growth.

Impacts to amenity from dust are difficult to define but may include:

- regular dust events over several weeks leading to gradual build-up of dust on surfaces
- short period dust events of very high concentrations which cause rapid build-up of dust on surfaces, or soiling, if dust deposition rates are high.

Key potential sources of dust from the Proposal will be:

- the pit floor machinery
- dumping of sand onto trucks
- wind erosion from the pit floor.

The risk of dust emissions impacting upon residents will be greatest in hot, dry conditions when winds are from the south and west. This will move dust towards residences to the north and northeast and proposed residences to the east.

There is a potential cumulative impact from dust emissions from the broader Mandogalup area and the Proposal on existing and proposed residential areas. This impact will be quantified through further work including:

- detailed review of existing dust monitoring
- assessment of potential dust production from the Proposal and, if required, dust modelling
- quantification of potential impacts of dust from the Proposal in the context of existing dust impacts in the Mandogalup area.

4.6.5 Mitigation

Impacts to air quality from dust emissions will be managed through the EMP, which will include the following management measures for dust:

- a complaints register is maintained on site record any complaints received; this register will include the date, nature and resolution action of any complaints
- following complaints, the source of any excessive dust generation is identified and work practices modified or rescheduled to reduce or eliminate the risk of future events
- staged clearing and reseeding to minimise areas at risk of erosion
- undertaking sand mining adjacent to proposed residential development prior to development occurring
- use of water carts on roads
- minimising the working pit face and potential use of sprinklers in hot, windy conditions
- use of dust monitoring to ensure dust management occurs in a timely and effective manner.

4.6.6 Predicted outcome

The Proposal will be managed through an Extractive Industries Licence, and implement an EMP to minimise impacts to air quality from dust emissions. Furthermore, quantification of potential cumulative impacts from dust emissions from the broader Mandogalup area and the Proposal on existing and proposed residential areas will inform the EMP and assist with developing appropriate site-specific dust control measures.

Accordingly, it is expected that the EPA's objective for air quality will be met.

4.7 Key Environmental Factor 5 – Social surroundings

4.7.1 EPA objective

The EPA's Statement of Environmental Principles, Factors and Objectives (EPA 2018b) identifies the following objective for social surroundings:

- To protect social surroundings from significant harm.

The issue of dust and the relevant policy requirements, potential impacts and mitigation has been addressed under the air quality factor (section 4.6) and therefore, the primary focus of the following section is noise emissions and its potential impact to social surroundings.

4.7.2 EPA policy and guidelines

The social surroundings investigations that have informed the planning of the Proposal have been conducted in accordance with the *Environmental Factor Guideline: Social Surroundings* (EPA 2016h).

The *Environmental Protection (Noise) Regulations 1997* operate as a prescribed standard under the EP Act and set limits on noise emissions to protect the amenity of nearby residents and other land users from noise impacts, which may arise from activities associated with the proposal.

4.7.3 Receiving environment

Social Surroundings include aesthetic, cultural, economic and social surroundings of humans that could affect or be affected by physical or biological surroundings.

As presented in Section 2.4 and Figure 1, the Proposal Area is located in the City of Kwinana and is surrounded by predominantly rural land uses. The following 'social' and 'economic' values occur in the local area:

- existing residential areas approximately 50 m north-east of the Proposal Area
- proposed residential development immediately to the east of the Proposal Area.

The residential area immediately to the east, is being cooperatively developed by Qube Property Group. Mining will be staged so that the first stage of mining occurs on the eastern boundary of the Proposal Area, prior to residential development, to minimise impacts on future residents to the west.

4.7.4 Potential impacts

Potential impacts to social surroundings include:

- particulate dust from quarrying and associated activities (see section 4.6.4)
- noise emissions from quarrying and associated activities.

Dust

For further detail on potential impacts from particulate dust, please refer to Section 4.6.4.

Noise

Key potential sources of noise emissions from the Proposal will be from the following:

- noise generating structures
- operation of heavy equipment
- movement of vehicles and reversing beepers.

4.7.5 Mitigation

Dust

For further detail on proposed management measures for dust, please refer to Section 4.6.5.

Noise

Impacts to social surroundings from noise emissions will be managed through the EMP, which will include the following management measures for noise:

- a complaints register is maintained on site record any complaints received; this register will include the date, nature and resolution action of any complaints,
- following complaints, the source of any excessive noise is identified and work practices modified or rescheduled to reduce or eliminate the risk of future events
- road traffic movements will be scheduled to avoid noise sensitive periods i.e. after work hours
- all mobile plant used on site is regularly maintained including exhaust mufflers
- speed limits are enforced on all site access road
- proposed working hours during operating days (i.e. 7am to 5pm, Monday to Saturday)
- use of noise monitoring to ensure compliance with *the Environmental Protection (Noise Regulations) 1997* requirements.

4.7.6 Predicted outcome

The Proposal will be managed through an Extractive Industries Licence, and implement an EMP to minimise impacts to social surroundings from dust and noise emissions.

Accordingly, it is expected that the EPA's objective for social surroundings will be met.

5. Matters of National Environmental Significance

The Proposal was referred to the Commonwealth Department of Environmental and Energy (DEE) on 6 April 2018. DEE advised on 19 June 2018 that the Proposal was determined to be a Controlled Action under the EPBC Act (EPBC 2018/8182) because of potential impacts of clearing on:

- Banksia Woodlands of the Swan Coastal Plain Threatened Ecological Community (BWSCP TEC) – Endangered
- Carnaby's black cockatoo (*Calyptorhynchus latirostris*) – Endangered
- Forest red-tailed black cockatoo (*Calyptorhynchus banksii naso*) – Vulnerable.

Potential impacts on black cockatoo species are addressed in Section 4.4.4.

Potential impacts on the BWSCP TEC are described in Section 4.3.

Should the EPA decide to assess the proposal, then the proponent will request that the assessment is undertaken under the Bilateral Agreement.

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Appendix 1
Existing extraction licence

City of Kwinana

SECOND SCHEDULE
LOCAL GOVERNMENT ACT
MUNICIPALITY OF THE CITY OF KWINANA
BY-LAW RELATING TO
EXTRACTIVE INDUSTRIES LICENCE

1. **FULL NAME AND ADDRESS OF LICENSEE:**
Frankland Enterprises Pty Ltd T/A Frankland Sand Supplies
37 Burlington Street
Naval Base WA 6165

2. **DATE OF ISSUE OF THIS LICENCE/RECEIPT:**

1 July 2018

3. **DATE OF EXPIRATION OF THIS LICENCE:**

30 June 2019

4. **LICENCE NUMBER:** 14

5. **THE SITE TO WHICH THE LICENCE RELATES:**

Lot 1 Rowley Road Mandogalup 6167

6. **THE LICENCE FEE:** $4,431.00

7. **SECURITY FOR RESTORATION AND REINSTATEMENT:** $40,000

8. **FURTHER TERMS AND CONDITIONS APPLICABLE TO THIS LICENCE:**

(i) The operational times are to be between the hours of 6am – 6pm Monday to Saturday

(ii) Trucks must not leave the quarry site before 6.30am on any day.

(iii) Operations may ONLY be undertaken on a Sunday, or outside of the above specified times in special circumstances with the **prior** permission of the City's Manager Engineering Services, and subject to all adjoining landowners being notified prior to the permission being granted.

(iv) Heavy haulage vehicles associated with the extractive industry MUST utilise Rowley Road, in order to gain access to/from the subject land and to/from wider heavy haulage regional road network, to the satisfaction of the City of Kwinana.

(v) The cross over to the extractive operations site to be maintained to the satisfaction of the City of Kwinana. Any damage to the intersection of

City of Kwinana

Rowley Road and / or the access road to the extractive operations site caused or contributed to by the extractive industry operations shall be repaired by the Licensee at the expense of the Licensee to the satisfaction of the City of Kwinana.

(vi) No blasting is permitted to occur.

(vii) Any spillage from vehicles entering or exiting the subject land is the responsibility of the Licensee and or its operators and must be cleared and removed immediately by Licensee and or it's the operators at the expense of the Licensee.

(viii) Warning sign to be erected and maintained to the satisfaction of the City of Kwinana.

(ix) All heavy haulage vehicles leaving the subject land to be fully covered to the satisfaction of the City of Kwinana.

(x) Boundary fencing is to be installed and maintained (in accordance with the City's specifications) to the satisfaction of the City of Kwinana.

(xi) The licensee will be charged an Accelerated Pavement Depreciation fee for using roads owned by the City of Kwinana for transporting extracted material, to assist with the repair, maintenance and upgrade of such roads.

The current Accelerated Pavement Depreciation fee is 1.17 cents / tonne / km

(xii) Certificate of Currency for Public Liability Insurance to a value of no less than $10,000,000 must be supplied at time of renewal. Should the Public Liability Insurance expire during the licence period a copy of the insurance renewal must be supplied to the City within 14 days of expiry.

(xiii) Development Approval – A current DA is required and must be renewed if it expires during the term of Licence.

Reza Najafzadeh
Manager – Engineering Services

Appendix 2
Flora, vegetation and black cockatoo habitat survey

Lot 2 and 10 Rowley Road, Mandogalup

Flora, vegetation and black cockatoo habitat survey

DRAFT

Prepared for
Frankland Sand Supplies
by Strategen

December 2017

strategen
ENVIRONMENTAL

Lot 2 and 10 Rowley Road, Mandogalup

Flora, vegetation and black cockatoo habitat survey

DRAFT

Strategen is a trading name of
Strategen Environmental Consultants Pty Ltd
Level 1, 50 Subiaco Square Road Subiaco WA 6008
ACN: 056 190 419

December 2017

Limitations

Scope of services

This report ("the report") has been prepared by Strategen Environmental Consultants Pty Ltd (Strategen) in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and Strategen. In some circumstances, a range of factors such as time, budget, access and/or site disturbance constraints may have limited the scope of services. This report is strictly limited to the matters stated in it and is not to be read as extending, by implication, to any other matter in connection with the matters addressed in it.

Reliance on data

In preparing the report, Strategen has relied upon data and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ("the data"). Except as otherwise expressly stated in the report, Strategen has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Strategen has also not attempted to determine whether any material matter has been omitted from the data. Strategen will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to Strategen. The making of any assumption does not imply that Strategen has made any enquiry to verify the correctness of that assumption.

The report is based on conditions encountered and information received at the time of preparation of this report or the time that site investigations were carried out. Strategen disclaims responsibility for any changes that may have occurred after this time. This report and any legal issues arising from it are governed by and construed in accordance with the law of Western Australia as at the date of this report.

Environmental conclusions

Within the limitations imposed by the scope of services, the preparation of this report has been undertaken and performed in a professional manner, in accordance with generally accepted environmental consulting practices. No other warranty, whether express or implied, is made.

Client: **Frankland Sand Supplies**

Report Version	Revision No.	Purpose	Strategen author/reviewer	Submitted to Client	
				Form	Date
Draft Report	A	Client review	R. Chesney / T. Sleigh / K. Cooper	Electronic	19 Dec 2017

Filename: QPG17054_01 R001 Rev A - 19 December 2017

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1. Introduction

1.1 Background

Frankland Sand Supplies (FSS) commissioned Strategen to undertake a flora, vegetation and black cockatoo habitat assessment of land at Lots 2 and 10 Rowley Road, Mandogalup (the Survey Area), to identify the values present.

The Survey Area is located approximately 35 km south of the Perth CBD in the City of Kwinana. The Survey Area is displayed in Figure 1 and encompasses approximately 43.7 ha.

1.2 Scope

The scope of this flora and vegetation survey was to undertake a desktop assessment and field assessment within the Survey Area consistent with the requirements of a detailed flora and vegetation survey as specified in *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016).

The objectives were to:

- conduct a desktop survey for Threatened and Priority flora which have been identified as being present in or around the Survey Area
- collect and identify the vascular plant species present within the Survey Area
- search areas of suitable habitat for Threatened and/or Priority flora
- define and map the native vegetation communities present within the Survey Area
- determine whether vegetation communities within the Survey Area are suitable as black cockatoo habitat, and describe and map quality of each area of habitat
- search for any potential nesting habitat trees for any of the threatened black cockatoo species (eucalypts with diameter at breast height [DBH] >500 mm)
- record and map locations of potential nesting habitat trees
- map vegetation condition within the Survey Area
- provide recommendations on the local and regional significance of the vegetation communities
- prepare a report summarising the findings.

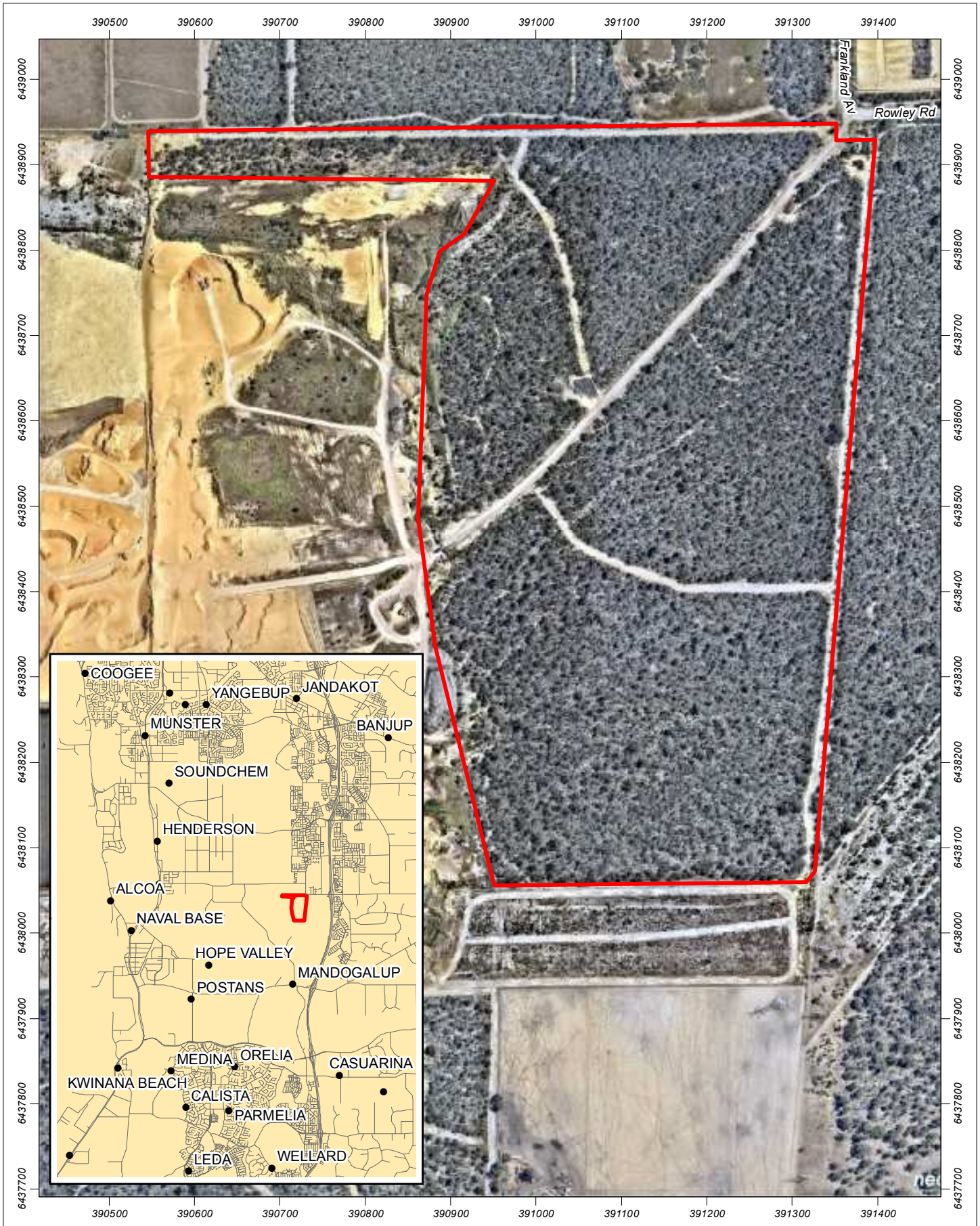

Figure 1: Survey Area

Scale 1:6,000 at A4

0 50 100 150 m

N

Legend

Survey area

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 20/11/2017
Author: JCrute
Source: Aerial image: Nearmap, flown 10/2017.

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2. Context

2.1 Legislative context

This biological survey has been conducted with reference to the following Australian and Western Australian legislation:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) – Australian Government
- *Wildlife Conservation Act 1950* (WC Act) – State
- *Environmental Protection Act 1986* (EP Act) – State
- *Biosecurity and Agriculture Management Act 2007* (BAM Act) – State.

2.1.1 Conservation significant flora and ecological communities

Conservation significant flora and ecological communities are determined at a state and federal legislative level. Threatened species are listed under the EPBC Act at the Australian Government level and under the WC Act at the State level (Appendix 1). Priority species are listed by the Department of Biodiversity, Conservation and Attractions (DBCA, formerly the Department of Parks and Wildlife) and include species of 'significant conservation value' (Appendix 1).

Threatened Ecological Communities (TECs) are listed under both the EPBC Act and EP Act (Appendix 1). Priority Ecological Communities (PECs) are listed by DBCA and include species of significant conservation value (Appendix 1).

2.1.2 Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are protected under the EP Act, and include the following:

- World Heritage areas
- areas included on the National Estate Register
- defined wetlands and associated buffers
- vegetation within 50 m of a listed Threatened species
- TECs.

2.1.3 Protection of native vegetation

Native vegetation is defined under the EP Act as "indigenous aquatic or terrestrial vegetation, and includes dead vegetation unless that dead vegetation is of a class declared by regulation to be excluded from this definition but does not include vegetation in a plantation".

This definition of native vegetation does not include vegetation that was intentionally sown, planted or propagated unless either of the following applies:

(a) the vegetation was sown, planted or propagated as required under the EP Act or another written law

(b) the vegetation is declared to be native under Regulation 4 of the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*.

Regulation 4 prescribes the kinds of intentionally planted indigenous vegetation that are "native vegetation" and which therefore require a clearing permit or exemption to clear and includes:

(c) planting that was funded (fully or partly)
   i. by a person who was not the owner of the land
   ii. for the purpose of biodiversity conservation or land conservation

(d) intentionally planted vegetation that has one of the following:
   i. a conservation covenant or agreement to reserve under section 30B of the *Soil and Land Conservation Act 1945*
   ii. a covenant to conserve under section 21A of the *National Trust of Australia (WA) Act 1964*
   iii. restrictive covenant to conserve under section 129B of the *Transfer of Land Act 1983*
   iv. some other form of binding or undertaking to establish and maintain, or maintain, the vegetation.

Native vegetation can only be cleared with a clearing permit, unless for some circumstances where exemptions apply pursuant to the EP Act and the Environmental Protection (Clearing of Native Vegetation) Regulations 2004 (the Regulations). Clearing permits issued pursuant to the Regulations may be issued as area permits or purpose permits. Exemptions for clearing under Regulation 5 of the Regulations do not apply within ESAs.

2.1.4 Introduced species

The BAM Act provides for management and control of listed organisms, including introduced flora species (weeds). Species listed as declared pests under the BAM Act are classified under three categories:

- C1 Exclusion: Pests assigned under this category are not established in Western Australia, and control measures are to be taken to prevent them entering and establishing in the State
- C2 Eradication: Pests assigned under this category are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility
- C3 Management: Pests assigned under this category are established in Western Australia, but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area that is currently free of that pest.

Under the BAM Act, land managers are required to manage populations of declared pests as outlined under the relevant category.

2.2 Environmental setting

2.2.1 Soils and topography

The Survey Area is located within the Swan Coastal Plain 2 (SWA2 – Swan Coastal Plain subregion) of Western Australia (Mitchell et al. 2002). The Swan Coastal Plain comprises five major geomorphologic systems that lie parallel to the coast, namely (from west to east) the Quindalup Dunes, Spearwood Dunes, Bassendean Dunes, Pinjarra Plain and Ridge Hill Shelf (Churchward & McArthur 1980; Gibson *et al.* 1994). The Survey Area is located within the Bassendean Dune system (Churchward & McArthur 1980).

2.2.2 Climate

The Mandogalup locality experiences a Mediterranean climate characterised by mild, wet winters and warm to hot, dry summers. The nearest Bureau of Meteorology (BoM) weather station at Medina Research Centre (Station No. 009194) provides average monthly climate statistics for the Mandogalup locality (Figure 2). Average annual rainfall recorded at Medina Research Centre since 1983 is 745.5 mm (BoM 2017). Rainfall may occur at any time of year; however, most occurs in winter in association with cold fronts from the southwest. Highest temperatures occur between January and February, with average monthly maximums ranging from 18°C in July to 31.5°C in February (BoM 2017). Lowest temperatures occur in July and August, with average monthly minimums ranging from 8.2°C in July and August to 17.6°C in February (BoM 2017).

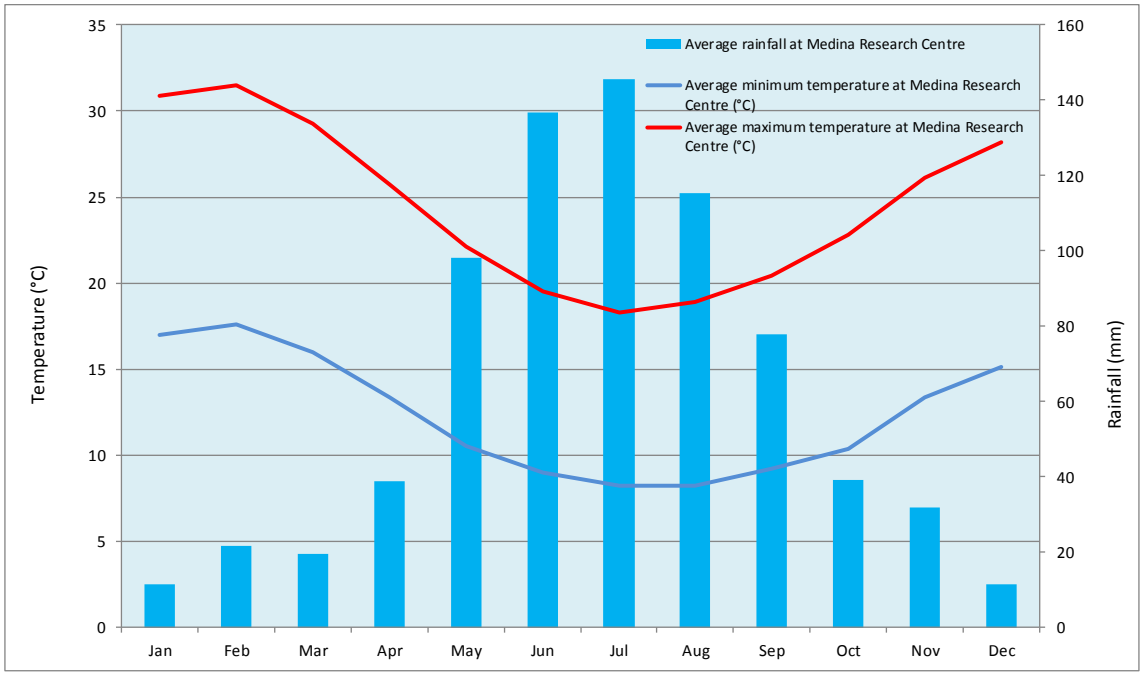

Figure 2: Mean monthly climatic data (temperature and rainfall) for Medina Research Centre

2.2.3 Regional vegetation

Vegetation occurring within the region was initially mapped at a broad scale (1:1 000 000) by Beard during the 1970s. This dataset has formed the basis of several regional mapping systems, including physiographic regions defined by Beard (1981) which led to the delineation of botanical districts as described in Beard (1990); the biogeographical region dataset (Interim Biogeographic Regionalisation for Australia, IBRA) for Western Australia (DEE 2017a) and System 6 Vegetation Complex mapping undertaken by Heddle et al. (1980).

Beard (1990) Botanical Subdistrict

The Survey Area occurs within the Drummond Botanical Subdistrict which is characterised by low *Banksia* woodlands on leached sands; *Melaleuca* swamps on poorly-drained depressions; and *Eucalyptus gomphocephala* (Tuart), *Eucalyptus marginata* (Jarrah) and *Corymbia calophylla* (Marri) woodlands on less leached soils (Beard 1990).

IBRA subregion

IBRA describes a system of 85 'biogeographic regions' (bioregions) and 403 subregions covering the entirety of the Australian continent (Thackway & Cresswell 1995). Bioregions are defined on the basis of climate, geology, landforms, vegetation and fauna.

The Survey Area occurs within the Swan Coastal Plain 2 IBRA subregion which is dominated by *Banksia* or Tuart on sandy soils, *Casuarina obesa* on outwash plains and paperbark (*Melaleuca*) in swampy areas (Mitchell et al. 2002).

System 6 and vegetation system association mapping

System 6 mapping refers to vegetation mapping undertaken at a Vegetation Complex scale by Heddle et al. (1980). This is the primary source of information used to calculate potential impacts of proposals to clear native vegetation on the Swan Coastal Plain. The Survey Area occurs within the Bassendean Central and South vegetation complex, illustrated in Figure 3.

The Survey Area falls within one vegetation system association (Beard 1990), as defined by the Government of Western Australia (2017) (Table 1).

Table 1: Vegetation associations within Survey Area

Identifier	Description	Percent of pre-European extent remaining (as at 2016)
1001	Medium very sparse woodland; jarrah, with low woodland; banksia & casuarina	22.28

2.2.1 Black cockatoo habitat

Carnaby's Black-Cockatoos, listed as Endangered under the EPBC Act, feed on the seeds, nuts and flowers, of a variety of native and introduced plant species and insect larvae (DEE 2017b). Food plants generally occur within proteaceous genera such as *Banksia, Hakea* and *Grevillea*, though are known to forage on eucalypt species in woodland areas. Carnaby's black cockatoos have also adapted to feeding on exotic species such as pines and cape lilac and weeds such as wild radish and wild geranium (DEE 2017b). Carnaby's black cockatoos usually breed between July and December in the hollows of live or dead eucalypts; primarily in Salmon Gum and Wandoo, but also within Jarrah, Marri and other eucalypt species (Johnstone 2010a). Hollows are usually at least 2 m above ground, sometimes over 10 m and the depth of the hollow varies from 0.25 m to 6 m (DEE 2017b). Mapping of Carnaby's Black Cockatoo distribution (Johnstone and Kirkby undated) identifies the Survey Area as occurring within the range of the species.

Forest Red-tailed Black-Cockatoos, listed as Vulnerable under the EPBC Act, depend primarily on Marri and Jarrah trees for both foraging and nesting. The seeds of both eucalypts are the favoured food source of the birds and hollows within live or dead individual trees are utilised for nesting purposes (Johnstone 2010b). Breeding varies between years and occurs at times of Jarrah and Marri fruiting. These black cockatoos breed in woodland, forest or artificial nest boxes, but may also breed in former woodland or forest that has been reduced to isolated trees (DEE 2017b). Mapping of the Forest Red-tailed Black Cockatoo distribution (Johnstone and Kirkby undated) identifies the species as likely to occur in the Survey Area.

Baudin's Black-Cockatoos primarily occur in eucalypt forests and forage at all strata levels within the forests with a tendency to favour areas containing Marri (Johnstone and Kirkby 2008, DEE 2017b). Breeding generally occurs in the Jarrah, Marri and Karri forests of the southwest of Western Australia in areas averaging more than 750 mm of rainfall annually (DEE 2017b). As with the other two species of Threatened black cockatoos in Western Australia, breeding habitat also occurs in former woodland or forest that has been reduced to isolated trees (DEE 2017b). Mapping of the Baudin's Black-Cockatoos distribution (Johnstone and Kirkby undated) identifies the species as unlikely to occur in the Survey Area.

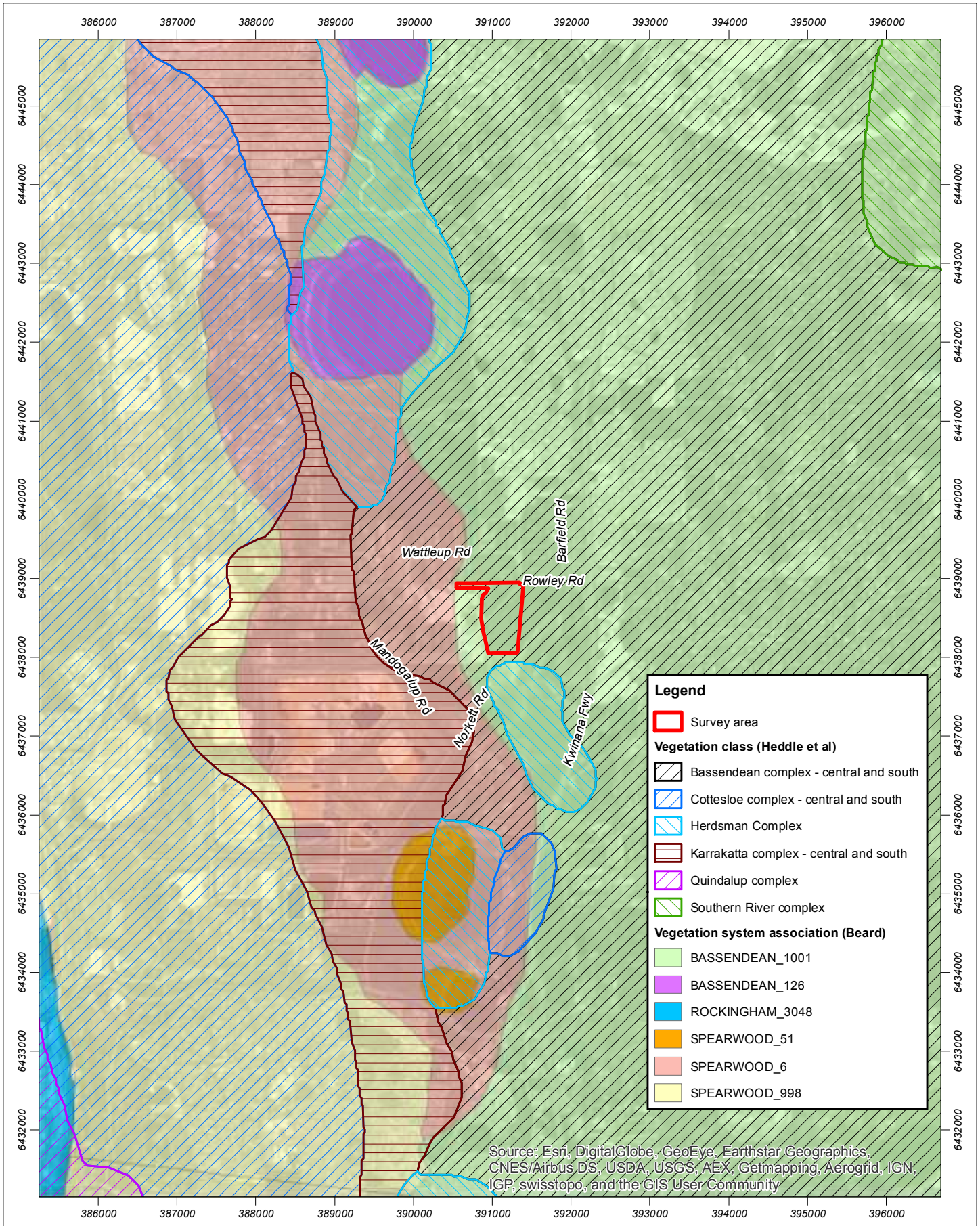

Figure 3: Regional vegetation mapping

Scale 1:65,000 at A4

0 500 1,000 1,500 2,000 m

N

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 20/11/2017
Author: JCrute
Source: Aerial image: ESRI, approx. 2016. Vegetation Beard: DAFWA, 2017. Vegetation Heddle: DPAW, 2017.

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3. Methods

3.1 Desktop assessment

A desktop assessment was conducted using FloraBase, DBCA, and Department of the Environment and Energy (DEE) databases to identify the possible occurrence of TECs, PECs and Threatened and Priority flora potentially occurring within the Survey Area. Reports that document regional flora, vegetation and fauna within the surrounds of the Survey Area were also reviewed prior to the field assessment.

A database search request was also submitted to the Threatened Communities Branch of DBCA to identify any potential TECs or PECs within 5 km of the Survey Area.

Desktop surveys were undertaken prior to the field survey which involved querying NatureMap (Parks and Wildlife 2007-) and the Commonwealth Protected Matters Search Tool (DEE 2017) as well as requesting data from the Threatened Species and Communities branches of Parks and Wildlife.

3.2 Field assessment

The field survey was conducted according to standards set out in *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016). The assessment of flora and vegetation within the Survey Area was undertaken by four ecologists from Strategen on 18 July 2017, and 10 – 11 October 2017. Table 2 identifies staff involved in the field surveys, their role and qualifications. The Survey Area was traversed on foot to record changes in vegetation structure and type. Eight vegetation quadrats were surveyed to identify vegetation types.

Table 2: Personnel

Name	Role	Flora collection permit	Dates
Robyn Chesney Strategen (Senior Ecologist)	Fieldwork, plant identification, data interpretation and report preparation	SL012076	18 July 2017 10 October 2017 11 October 2017
Clare Courtauld Strategen (Ecologist)	Fieldwork, plant identification	SL011638	18 July 2017
Megan Stone Strategen (Senior Ecologist)	Fieldwork, plant identification	SL012164	10 October 2017
Lina Ramlee (Ecologist)	Fieldwork	SL012151	11 October 2017

Site selection for vegetation mapping was based on differences in structure and species composition of the communities present within the Survey Area. Vegetation mapping sites were determined from aerial photographs and confirmed on site. The Survey Area was traversed on foot, allowing for opportunistic sites to be placed where a change in vegetation structure or composition was observed.

Flora and vegetation was described and sampled systematically at each quadrat and additional opportunistic collecting was undertaken wherever previously unrecorded plants were observed. At each site the following floristic and environmental parameters were noted:

- GPS location
- topography
- soil type and colour
- outcropping rocks and their type
- percentage cover and average height of each vegetation stratum
- vegetation condition.

For each vascular plant species, the average height and percent cover were recorded. Vegetation condition was rated according to the scale of Keighery (1994) (Table 3).

Table 3: Vegetation condition scale (Keighery 1994)

Condition rating	Description
Pristine (1)	Pristine or nearly so, no obvious sign of disturbance.
Excellent (2)	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good (3)	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 (4)	Vegetation structure significantly altered by obvious signs of multiple disturbances. 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, grazing.
Degraded (5)	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 (6)	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

All plant specimens collected during the field surveys were identified using appropriate reference material or through comparisons with pressed specimens housed at the Western Australian Herbarium where necessary. Nomenclature of the species recorded is in accordance with Western Australian Herbarium (1998-).

3.2.1 Data analysis and vegetation mapping

Remnant vegetation of the southern Swan Coastal Plain was surveyed and mapped by Gibson *et al.* (1994) to provide an understanding of the major floristic types and transitions across the region. The major FCTs were defined by classifying the data collected according to the similarities in species composition between plots. When determining the FCT of a new record, a floristic analysis of species composition provides the most robust method that is consistent with the original classification.

Obvious limitations are associated with determining and mapping the presence of FCTs within the Survey Area, particularly in places where vegetation has been modified due to widespread and sustained weed invasion resulting in the understorey being almost completely replaced by exotic species in some areas. As a result, species richness (per quadrat) in the current survey was lower than that recorded by Gibson *et al.* (1994). In addition, vegetation mapping requires the extrapolation of quadrat data to generalise vegetation communities and map 'like' vegetation over relatively small spatial scales. Significant groupings of quadrats and resultant delineation of vegetation communities are primarily determined *a-priori*. Comparing this type of data with that of Gibson *et al*. (1994), which contains accumulated species data over successive seasons within known vegetation communities across the Swan Coastal Plain, is problematic.

Vegetation types were delineated using a combination of results from the cluster analysis (see below), combined with site observations. Aerial photography interpretation and field notes taken during the survey. were then used to develop VT mapping polygon boundaries over the Survey Area. These polygon boundaries were then digitised using Geographic Information System (GIS) software.

VT descriptions (though floristic in origin) have been adapted from the National Vegetation Information System (NVIS) Australian Vegetation Attribute Manual Version 6.0 (ESCAVI 2003), a system of describing structural vegetation units (based on dominant taxa). This model follows nationally-agreed guidelines to describe and represent vegetation types, so that comparable and consistent data is produced nation-wide. For the purposes of this report, a VT is considered equivalent to a NVIS sub-association as described in ESCAVI (2003).

Vegetation condition was recorded at all quadrats, and also opportunistically within the Survey Area during the field assessment where required. Vegetation condition was described using the vegetation condition scale for the South West Botanical Province (Keighery 1994). Vegetation condition polygon boundaries were developed using this information in conjunction with aerial photography interpretation, and were digitised as for vegetation type mapping polygon boundaries.

To identify possible TECs and PECs in the Survey Area, vegetation quadrats were compared to Floristic Community Types (FCTs) defined by Gibson et al. (1994). An association matrix was prepared using the Bray-Curtis coefficient, resulting in pairwise coefficients of similarities between quadrats (both recorded during the survey and from the SCP dataset). Agglomerative hierarchical clustering, using flexible UPGMA (ß=-0.1) was used to generate quadrat classification dendrograms for each quadrat within the Survey Area.

The broad nature of FCTs lead many vegetation types to comprise admixtures and transition zones between FCTs. In addition, the Survey Area was mapped based on extrapolated quadrat data from a single flora assessment, rather than accumulated species data over successive seasons within known vegetation community types as per Gibson et al. (1994). Consequently, assigned FCTs within the Survey Area are inferred and not absolute; i.e. a vegetation code assigned to an FCT is inferred to resemble floristic aspects of that FCT as defined by Gibson et al. (1994).

3.3 Black cockatoo habitat assessment

The Survey Area was inspected on 10 and 11 October 2017 by Strategen personnel with relevant experience as specified by the *EPBC Act Referral guidelines for three threatened black cockatoo species* (DSEWPaC 2012). The inspection included:

- a vegetation assessment to identify vegetation communities and potential black cockatoo foraging species
- a significant tree assessment to identify any trees with the potential to be utilised by black cockatoos for breeding.

3.3.1 Vegetation and foraging assessment

The Survey Area was traversed on foot to record any flora species with the potential to provide a food source for black cockatoos. Following the assessment, vegetation units defined as part of the flora and vegetation survey were assigned a foraging value based on the presence and quantity of potential food species and any evidence of foraging by black cockatoos.

3.3.2 Significant tree assessment

Significant trees are defined as trees of suitable species with a diameter at breast height (DBH) greater than 500 mm (> 300 mm for salmon gum and wandoo) (DSEWPaC 2012). Tree species which are considered to be potential breeding or roosting trees are outlined in Table 4. Trees with a DBH greater than 500 mm (or >300 mm for salmon gum and wandoo) are large enough to potentially contain hollows suitable for nesting black cockatoos, or have the potential to develop suitable hollows over the next 50 years. Trees of this size may also be large enough to provide roosting habitat (i.e. trees which provide a roost or rest area for the birds). The locations of such trees within the Survey Area were recorded using a Global Positioning System (GPS) device. In addition to the location and DBH, the species of each tree was also recorded.

Table 4: Black cockatoo potential breeding and roosting tree species (Groom 2011, DSEWPaC 2012)

Scientific name	Common name	Breeding	Roosting
Corymbia calophylla	Marri	Yes	Yes
Corymbia maculata	Spotted Gum		Yes
Eucalyptus accedens	Powderbark	Yes	
Eucalyptus camaldulensis	River Red Gum		Yes
Eucalyptus citriodora	Lemon Scented Gum		Yes
Eucalyptus diversicolor	Karri	Yes	
Eucalyptus globulus	Tasmania Blue Gum		Yes
Eucalyptus gomphocephala	Tuart	Yes	Yes
Eucalyptus grandis	Flooded Gum, Rose Gum		Yes
Eucalyptus longicornis	Red Morrell	Yes	
Eucalyptus loxophleba	York Gum	Yes	
Eucalyptus marginata	Jarrah	Yes	Yes
Eucalyptus megacarpa	Bullich	Yes	Yes
Eucalyptus occidentalis	Swamp Yate	Yes	
Eucalyptus patens	Blackbutt	Yes	Yes
Eucalyptus robusta	Swamp Mahogany		Yes
Eucalyptus rudis	Flooded Gum	Yes	Yes
Eucalyptus salmonophloia	Salmon Gum	Yes	
Eucalyptus salubris	Gimlet	Yes	
Eucalyptus wandoo	Wandoo	Yes	Yes
Pinus pinaster	Pinaster, Maritime Pine		Yes
Pinus radiata	Monterey, Radiata Pine		Yes

3.4 Survey limitations and constraints

Table 5 displays the evaluation of the flora and vegetation assessment against a range of potential limitations that may have an effect on that assessment. Based on this evaluation, the assessment has not been subject to constraints that would affect the thoroughness of the assessment and the conclusions reached.

Table 5: Flora and vegetation survey potential limitations and constraints

Potential limitation	Impact on assessment	Comment
Sources of information and availability of contextual information (i.e. pre-existing background versus new material).	**Not a constraint.**	The survey has been undertaken in the Drummond Botanical Subdistrict on the Swan Coastal Plain which has been well studied and documented with ample literature available (Beard 1990).
Scope (i.e. what life forms, etc., were sampled).	**Not a constraint.**	Number of species recorded, number of quadrats sampled and timing of the survey (i.e. spring) were adequate for this level of survey.
Proportion of flora/fauna collected and identified (based on sampling, timing and intensity).	**Not a constraint.**	The proportion of flora surveyed was adequate. The entire Survey Area was traversed and flora species were recorded systematically.
Completeness and further work which might be needed (i.e. was the relevant Survey Area fully surveyed).	**Not a constraint.**	The information collected during the survey was sufficient to assess the vegetation that was present during the time of the survey.
Mapping reliability.	**Not a constraint.**	Aerial photography of a suitable scale was used to map the Survey Area. Sites were chosen from these aerials to reflect changes in community structure. Opportunistic sites were also used if differences were observed during on ground reconnaissance. Vegetation types were assigned to each site based on topography, soil type and presence/absence and percent foliage cover of vegetation.
Timing, weather, season, cycle.	**Not a constraint.**	Flora and vegetation surveys are normally conducted following winter rainfall in the South-West Province, ideally during spring (EPA 2016). The field assessments were conducted in October (i.e. spring) in fine weather conditions and therefore these factors are not deemed to be constraints. Surveys for *D. elastica* were conducted in July upon current advice from DBCA.
Disturbances (fire flood, accidental human intervention, etc.).	**Not a constraint.**	The Survey Area and regional surrounds have been subject to disturbance over a significant period of time. Given the wide range of this disturbance, this is not considered to be a limitation within the Survey Area.
Intensity (in retrospect, was the intensity adequate).	**Not a constraint.**	The Survey Area was traversed on foot and all differences in vegetation structure were recorded appropriately.
Resources (i.e. were there adequate resources to complete the survey to the required standard).	**Not a constraint.**	The available resources were adequate to complete the survey.
Access problems (i.e. ability to access Survey Area).	**Not a constraint.**	Existing tracks enabled adequate access to survey the vegetation within the Survey Area. Where access was not available by car, the area was easily traversed by foot.
Experience levels (e.g. degree of expertise in species identification to taxon level).	**Not a constraint.**	All survey personnel have the appropriate training in sampling and identifying the flora of the region.

4. Results

4.1 Desktop assessment results

4.1.1 Threatened and Priority flora

A desktop survey for Threatened and Priority flora that may potentially occur within the Survey Area was undertaken using NatureMap (Parks and Wildlife 2007-), the Western Australian Herbarium (Western Australian Herbarium 1998-), and the DEE Protected Matters Search Tool (DEE 2017c) (Appendix 1).

Flora within Western Australia that is considered to be under threat may be classed as either Threatened flora or Priority flora. Where flora has been gazetted as Threatened flora under the WC Act, the taking of such flora without the written consent of the Minister is an offence. The WC Act defines "to take" flora as to gather, pluck, cut, pull up, destroy, dig up, remove or injure the flora or to cause or permit the same to be done by any means. DBCA (2017a) contains the current list of Threatened flora in Western Australia.

Priority flora are considered to be species which are potentially under threat, but for which there is insufficient information available concerning their distribution and/or populations to make a proper evaluation of their conservation status. Parks and Wildlife categorises Priority flora according to their conservation priority using five categories, P1 (highest conservation significance) to P5 (lowest conservation significance), to denote the conservation priority status of such species. Priority flora species are regularly reviewed and may have their priority status changed when more information on the species becomes available. Appendix 1 defines levels of Threatened and Priority flora (Western Australian Herbarium 1998-).

At the national level, the EPBC Act lists Threatened species as extinct, extinct in the wild, critically endangered, endangered, vulnerable, or conservation dependent. Appendix 1 defines each of these categories of Threatened species. The EPBC Act prohibits an action that has or will have a significant impact on a listed Threatened species without approval from the Australian Government Minister for the Environment. The current EPBC Act list of Threatened flora may be found on the DEE (2017b) website.

Table 6 shows the Threatened and Priority flora potentially occurring within the Survey Area. The desktop assessment identified four Threatened flora and four Priority flora species that have been recorded in the local area. Of these, based on general habitat requirements (Table 6), three Threatened and one Priority flora species were considered to have the potential to occur within the Survey Area; as follows:

- *Caladenia huegelii* (T)
- *Dodonaea hackettiana* (P4)
- *Drakaea elastica* (T)
- *Drakaea micrantha* (T).

Table 6: Threatened and Priority flora potentially occurring within the Survey Area

Species	Conservation status		Description	Potential to occur
	EPBC Act	WC Act		
Caladenia huegelii	Threatened – Endangered	Threatened	A slender orchid from 30 to 50 cm tall. One or two striking flowers characterised by a greenish-cream lower petal with a maroon tip. Other petals are cream with red or pink suffusions. Habitat for this species occurs within well-drained, deep sandy soils in low mixed *Banksia*, *Allocasuarina* and Jarrah woodlands (Western Australian Herbarium 1998-, DEE 2017b).	**Possible** due to presence of preferred habitat.
Diuris micrantha	Threatened – Vulnerable	Threatened	A slender orchid to 60 cm tall. Yellow flowers with reddish-brown markings measuring 1.3 cm across. Habitat for this species occurs within clay-loam substrates in winter-wet depressions or swamps.	**Unlikely** due to absence of preferred habitat.
Diuris purdiei	Threatened – Endangered	Threatened	A slender orchid to 0.35 m tall. Flowers are yellow and visible from September to October. Habitat for this species is grey-black sand substrates in winter-wet swamps which have high moisture (Western Australian Herbarium 1998-). Diuris purdiei occurs from Perth south to near the Whicher Range, within the Swan (Western Australia) Natural Resource Management Region. It grows on sand to sandy clay soils, in areas subject to winter inundation, and amongst native sedges and dense heath with scattered emergent *Melaleuca preissiana*, *Corymbia calophylla*, *E. marginata* and *Nuytsia floribunda* (DEE 2017b).	**Unlikely** due to absence of preferred habitat.
Dodonaea hackettiana	-	P4	An erect shrub or tree, 100 to 500 cm tall. Flowers are yellow to green/red and occur mainly from July to October. Habitat for this species occurs in sand and outcropping limestone (Western Australian Herbarium 1998-).	**Possible** due to presence of preferred habitat.
Drakaea elastica	Threatened – Endangered	Threatened	A slender orchid to 30 cm tall with a prostrate, round to heart shaped leaf. Singular, bright green, glossy flower. The species grows on bare patches of sand within otherwise dense vegetation in low-lying areas alongside winter-wet swamps, typically in banksia (*Banksia menziesii*, *B. attenuata* and *B. ilicifolia*) woodland or spearwood (*Kunzea glabrescens*) thicket vegetation. *D. elastica* often occurs with other orchid species (DEE 2017b).	**Possible** due to presence of marginal habitat (Banksia woodland).
Drakaea micrantha	Threatened – Vulnerable	Threatened	A tuberous, terrestrial herb which has a diminutive red and yellow flower, 1.2–2.5 cm long, on a stem that grows to 30 cm. Flowering occurs form September to October. Its heart-shaped leaf, about 1.5 cm long, is silvery grey with prominent green veins. Habitat for this species occurs within cleared firebreaks or open sandy patches that have been disturbed, where competition from other plants has been removed (Western Australian Herbarium 1998-, DEE 2017b).	**Possible** due to presence of preferred habitat.

Species	Conservation status		Description	Potential to occur
	EPBC Act	WC Act		
Eleocharis keigheryi	Threatened – Vulnerable	Threatened	A rhizomatous, tufted/clumped perennial herb, reaching a maximum diameter of 40 cm. It has erect, smooth, green stems that are 20–40 cm tall and hollow, supporting cross bars that are 2 mm in diameter. This species grows in small clumps in a substrate of clay or sandy loam. This species is emergent in freshwater creeks, and transient waterbodies such as drainage lines and claypans in water to approximately 15 cm deep. Fringing woodland species and associated species include Swamp Sheoak (*Casuarina obesa*), Flooded Gum (*Eucalyptus rudis*), Red Robin Bush (*Melaleuca lateritia*), Swamp Paperbark (*M. rhaphiophylla*), Common Spike-sedge (*Eleocharis acuta*), *Aponogeton hexatepalus*, Veined Swamp Wallaby Grass (*Amphibromus nervosus*) and herbs such as *Wurmbea*, *Tribonanthes* and *Leptocarpus* spp. (Western Australian Herbarium 1998-, DEE 2017b).	**Unlikely** due to absence of preferred habitat and associated species.
Lepidosperma rostratum	Threatened – Endangered	-	A rhizomatous sedge to 30 cm in diameter. Stems are circular in cross section and flowers are spike-like and up to 4 cm long. Habitat for this species occurs in sandy soils among low heath comprised of *Banksia telmatiaea* and *Calothamnus hirsutus* in winter-wet swamps (Western Australian Herbarium 1998-, DEE 2017b).	**Unlikely** due to absence of preferred habitat and associated species.
Pimelea calcicola	-	P3	An erect to spreading shrub to 1 m tall. Flowers are pink and visible between September to November. Habitat for this species occurs in sand on coastal limestone ridges (Western Australian Herbarium 1998-).	**Unlikely** due to absence of preferred habitat.
Stylidium paludicola	-	P3	Reed-like perennial, herb, 35 to 100 cm tall. Leaves are tufted, linear or subulate or narrowly oblanceolate. Flowers are pink and occur in October to December. Habitat for this species occurs in peaty sand over clay and winter wet areas, often in Marri and Melaleuca woodland or Melaleuca shrubland (Western Australian Herbarium 1998-).	**Unlikely** due to absence of preferred habitat and associated species.

4.1.2 Threatened and Priority Ecological Communities

A TEC is defined under the EP Act as an ecological community listed, designated or declared under a written law or a law of the Australian Government as Threatened, Endangered or Vulnerable. There are four State categories of TECs (DEC 2010)[1]:

- presumed totally destroyed (PD)
- critically endangered (CR)
- endangered (EN)
- vulnerable (VU).

A description of each of these TEC categories is presented in Appendix 1. TECs are gazetted as such (Parks and Wildlife 2016) and some Western Australian TECs listed by Parks and Wildlife (2016) are also listed as Threatened under the EPBC Act.

Under the EPBC Act, a person must not undertake an action that has or will have a significant impact on a listed TEC without approval from the Australian Government Minister for the Environment, unless those actions are not prohibited under the EPBC Act. A description of each of these categories of TECs is presented in Appendix 1. The current EPBC Act list of TECs can be located on the DEE (2017e) website.

Ecological communities identified as Threatened, but not listed as TECs, are classified as Priority Ecological Communities (PECs). These communities are under threat, but there is insufficient information available concerning their distribution to make a proper evaluation of their conservation status. Parks and Wildlife categorises PECs according to their conservation priority, using five categories, P1 (highest conservation significance) to P5 (lowest conservation significance), to denote the conservation priority status of such ecological communities. Appendix 1 defines PECs (DEC 2010). DBCA (2017b) contains a list of current PECs.

One TEC listed under the WC Act, three PECs listed by DBCA and one TEC listed under the EPBC Act were identified within 5 km of the Survey Area (Figure 4); however, it is worth noting that these mapped boundaries do not necessarily represent the actual extent of their respective communities and are rather a broad scale indication of where the communities have been previously mapped plus an additional buffer.

Table 7: Mapped TECs identified within Survey Area

Community identifier	Community name	Listing under WC Act	Listing under EPBC Act
Banksia woodlands of the Swan Coastal Plain		Various listings; encompasses multiple state-listed TECs and PECs	Endangered
Limestone ridges (SCP 26a)	*Melaleuca huegelii - Melaleuca systena* shrublands on limestone ridges	Endangered	NA
SCP21c	Low lying *Banksia attenuata* woodlands or shrublands	Priority 3	Endangered
SCP22	*Banksia ilicifolia* woodlands	Priority 3	Endangered
SCP24	Northern Spearwood shrublands and woodlands	Priority 3	Endangered

[1] The Department of Environment and Conservation is still listed as the author of all TEC and PEC databases and have been referred to as such in this document instead of the Department of Biodiversity, Conservation and Attractions [DBCA]).

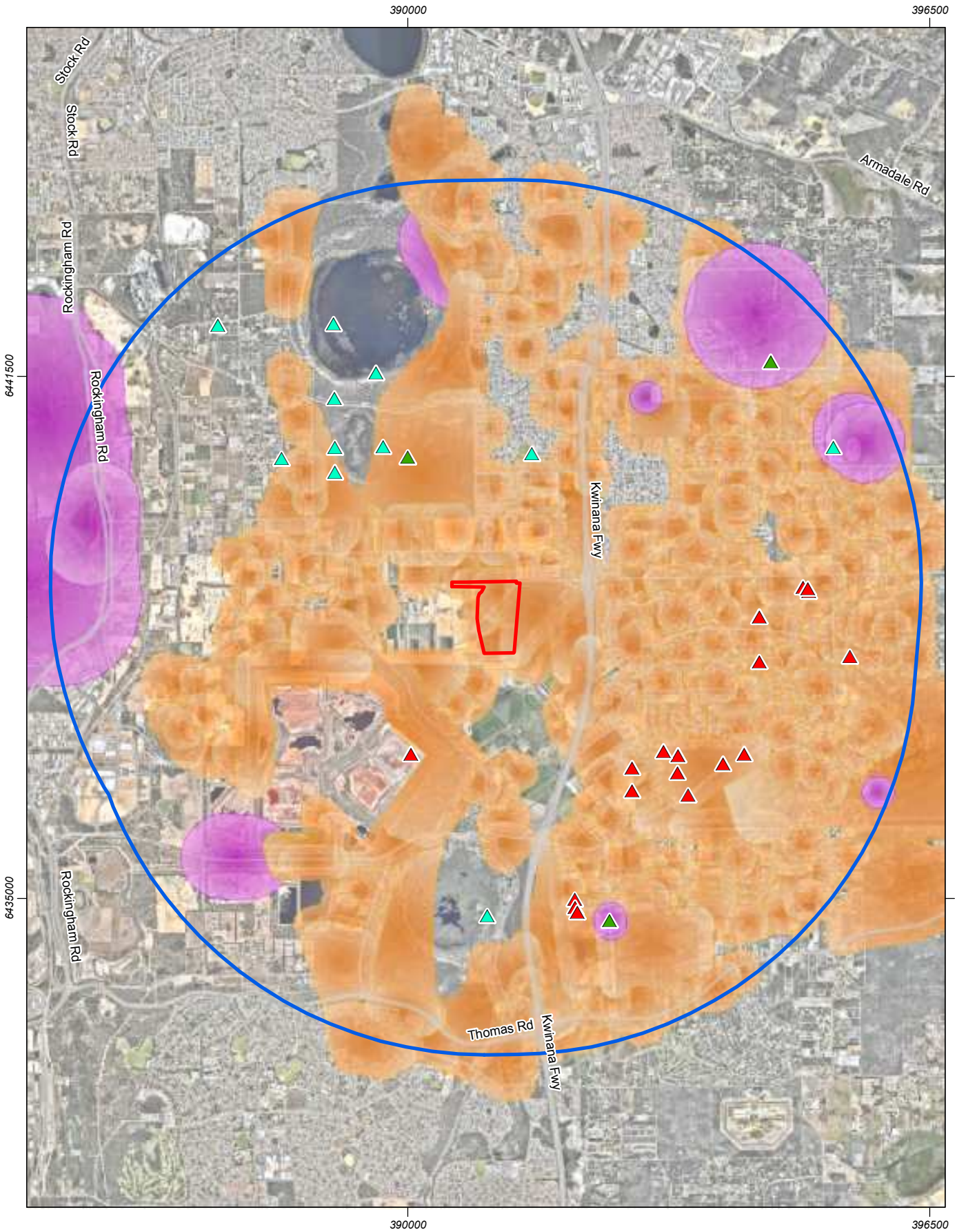

Figure 4: Location of Threatened & Priority Flora and Ecological Communities within 5 km of the survey area

Scale 1:65,000 at A4

0 650 1,300 1,950 m

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 7/12/2017
Author: vdinh
Source: Nearmap: Aerial imagery - 2017.

Legend

Threatened & Priority Flora

- (T) Threatened Rare Flora - Extant Taxa; T
- Priority 1 - Poorly Known Taxa
- Priority 2 - Poorly Known Taxa
- Priority 3 - Poorly Known Taxa
- Priority 4 - Rare, Near Threatened and other species in need of monitoring
- Priority 5 - Conservation Dependent Taxa

Survey area

5km buffer

Threatened & priority ecological communities

- Priority Ecological Community
- Endangered

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4.1.3 Wetlands

There are no geomorphic wetlands within or adjacent to the Survey Area (Figure 5). The nearest mapped wetlands are approximately 2 km from the Survey Area.

4.1.4 Bush Forever

There are no Bush Forever sites located within the Survey Area. The closest Bush Forever sites are as follows:

- site no. 392 – Harry Waring Marsupial Reserve, Wattleup, located approximately 800 m to the north of the Survey Area and separated by residential blocks
- site no. 268 – Mandogalup Road Bushland, to the southwest of the Survey Area, separated by firebreaks at the southern boundary of the Survey Area.

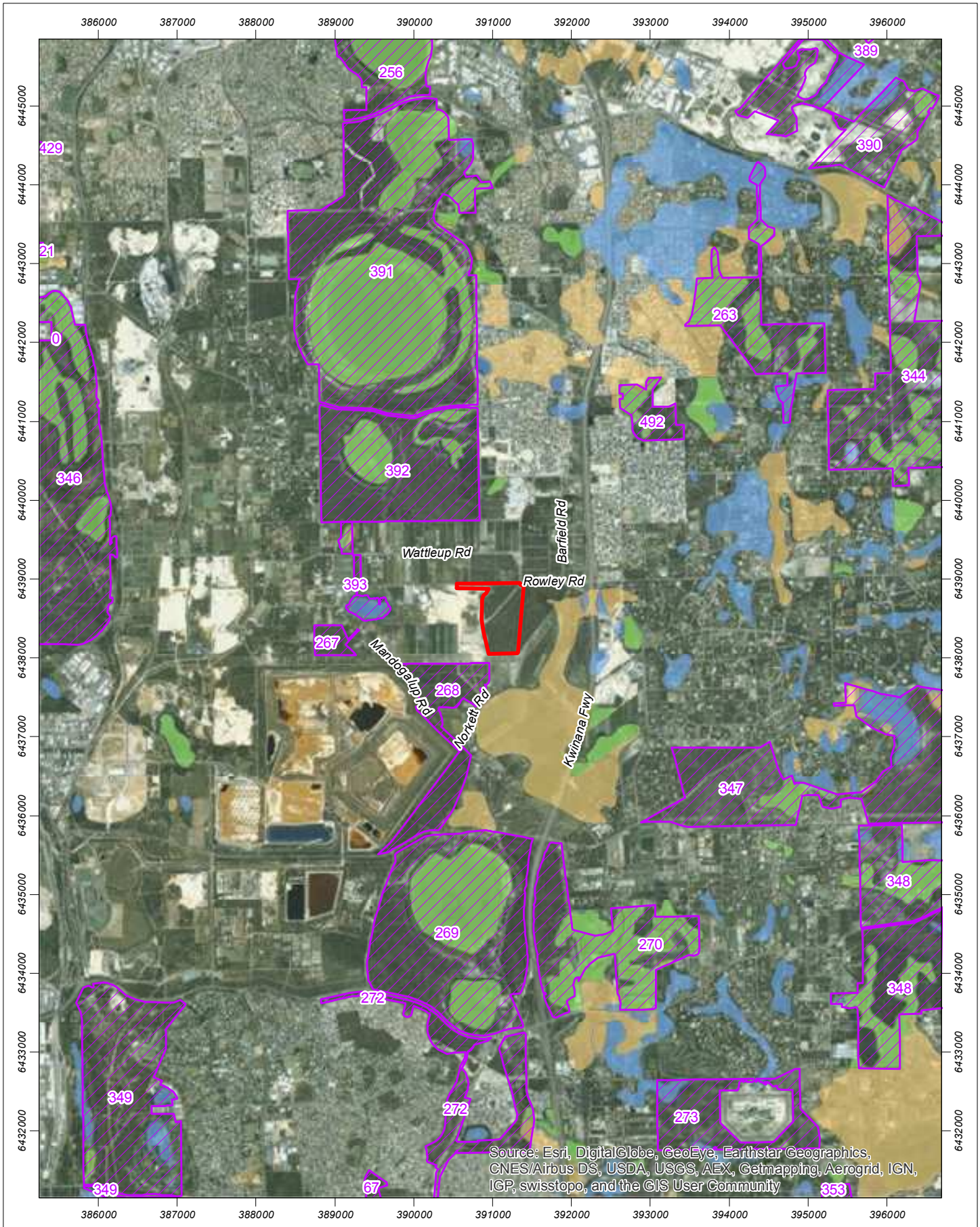

Figure 5: Wetlands and Bush Forever sites within 5 km of survey area

Scale 1:65,000 at A4

0 500 1,000 1,500 2,000 m

N

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 20/11/2017
Author: JCrute
Source: Aerial image: ESRI, approx. 2016. Wetlands: DPAW, 2017. Bush Forever: DoP, 2017.

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Legend

- Bush Forever sites
- Survey area

Wetlands

- Conservation
- Multiple Use
- Resource Enhancement

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4.2 Field survey results

4.2.1 Native flora

A total of 74 native vascular plant taxa from 25 plant families were recorded within the Survey Area (Appendix 4).

4.2.2 Threatened and Priority flora

No Threatened flora species as listed under section 178 of the EPBC Act were recorded within the Survey Area. No Threatened flora species pursuant to Schedule 1 of the WC Act and as listed by Parks and Wildlife (2015) and no Priority flora species as listed by Western Australian Herbarium (1998-) were recorded within the Survey Area. Potential habitat for three Threatened and one Priority flora species was identified within the Survey Area (Table 8).

Table 8: Priority flora species potentially occurring within Survey Area

Species	Habitat	Flowering time	Potential habitat location within Survey Area
Caladenia huegelii	Sandy soils in Banksia, Jarrah and Allocasuarina woodland	September – October	Throughout
Dodonaea hackettiana	Sand and outcropping limestone	July – October	Throughout
Drakaea elastica	Banksia woodland alongside low-lying winter-wet swamps	October – November	Throughout*
Drakaea micrantha	Open sandy patches in Banksia, Jarrah and Allocasuarina woodland, often under Kunzea thickets	September - October	Throughout including firebreaks and tracks

Source: Western Australian Herbarium (1998-)
*While no wetland areas were expected to be present within the Survey Area, advice received from DBCA indicated areas of Banksia woodland should be considered as potential habitat for this species

The survey was conducted during the main flowering season for flora of the southwest botanical region (i.e. spring), including the Threatened and Priority species with potential to occur in the Survey Area; as such, this is the optimal time to detect the majority of species present.

4.2.3 Introduced (exotic) taxa

A total of 15 introduced (exotic) taxa were recorded within the Survey Area, as follows:

- *Aira caryophyllea*
- *Brassica tournefortii*
- *Briza maxima*
- *Carpobrotus edulis*
- *Chamelaucium uncinatum*
- *Ehrharta calycina*
- *Fumaria capreolata*
- *Gladiolus caryophyllaceus*
- *Grevillea leucopteris*
- *Hypochaeris glabra*
- *Lysimachia arvensis*
- *Pelargonium capitatum*
- *Ursinia anthemoides*
- *Watsonia meriana*
- *Zantedeschia aethiopica.*

Zantedeschia aethiopica is a Declared Plant species in Western Australia pursuant to section 22 of the *Biosecurity and Agriculture Management Act 2007* (BAM Act) according to the Western Australian Department of Agriculture and Food (DAFWA 2017).

4.2.4 Accumulated species – sites surveyed (species-area curve)

The species-area curve (Figure 6), based on a species accumulation analysis was used to evaluate the adequacy of sampling (Colwell 2013). The asymptotic value was determined using Michaelis-Menten modelling. Using this analysis, the incidence based coverage estimator of species richness (ICE) was calculated to be 114.7 (Chao 2005). Based on this value, and the total of 80 species recorded within quadrats during the survey (including introduced species), approximately 70% of the flora species potentially present within the Survey Area were recorded.

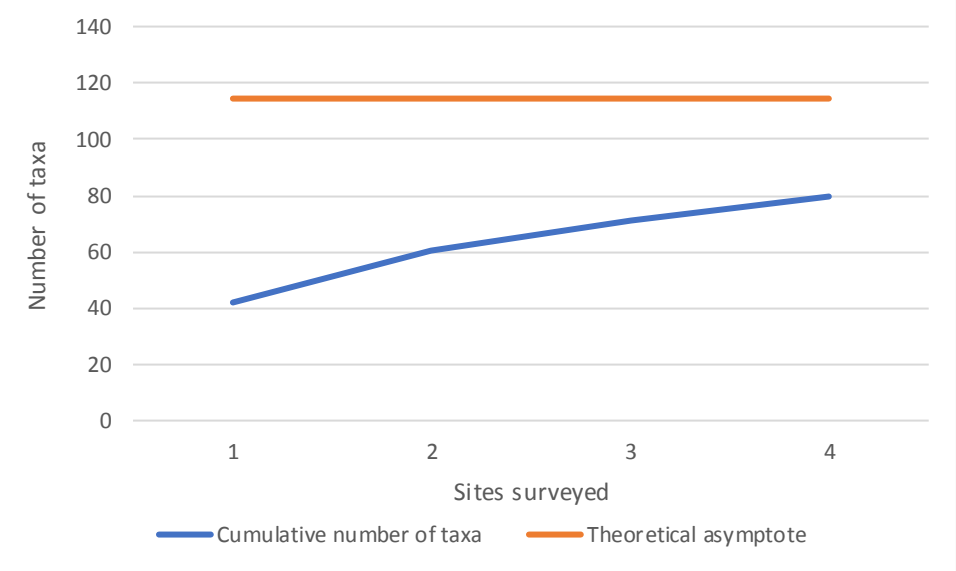

Figure 6: Averaged randomised Species Accumulation Curve

4.2.5 Vegetation types

Three vegetation types (VTs) were defined and mapped within the Survey Area (Figure 7).

Areas containing vegetation in parkland cleared or highly degraded state have not been counted as unique native VTs but have been included in Table 9 for area calculation purposes. Total areas occupied within the Survey Area by each of the identified VTs are set out in Table 12.

The total area mapped within the Survey Area was 43.67 ha which includes cleared areas.

Table 9: Vegetation types

Vegetation Type	Description	Area (ha)	Percentage of the Survey Area
1	Low woodland of *Banksia menziesii* and *B. attenuata* over open heath of *Xanthorrhoea preissii*, *Hibbertia hypericoides* and *Mesomelaena pseudostygia* with emergent *Eucalyptus marginata*.	37.48	85.82
2	Closed scrub of *Acacia saligna* over mixed introduced species.	1.28	2.92
3	Closed herbland of mixed introduced species with emergent *Eucalyptus marginata*, *Allocasuarina fraseriana* and *Acacia saligna*.	0.62	1.41
C	Cleared areas with exotic grasses and herbs.	4.30	9.84
Total		**43.67**	**100**

Figure 7: Vegetation Types (VTs) mapped within the survey area

Scale 1:6,000 at A4

0 50 100 150 m

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 23/11/2017
Author: vdinh
Source: Nearmap: Aerial imagery - 2017.

Survey area

Vegetation type

- VT1: Low woodland of Banksia menziesii and B. attenuata over open heath of Xanthorrhoea preissii, Hibbertia hypericoides and Mesomelaena pseudostygia with emergent Eucalyptus marginata.
- VT2: Closed scrub of *Acacia saligna* over mixed introduced species
- VT3: Closed herbland of mixed introduced species with emergent *Eucalyptus maginata*,*Allocasuarina fraseriana* and *Acacia saligna*
- Cleared

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4.2.6 FCT analysis

The results of the hierarchical clustering show strong linkage for all four quadrats to FCT 28, as shown in Table 10 and the partial dendrograms in Appendix 4. As such, vegetation within VT1 can unequivocally be assigned to FCT 28, which is described as Spearwood *Banksia attenuata* or *Banksia attenuata* - *Eucalyptus* woodlands.

Table 10: Results of hierarchical analysis for plots from the Survey Area

Site	FCT First fusion	FCT of nearest main group fusion	Possible FCT
RR01	28	28	28
RR02	28	28	28
RR03	28	28	28
RR04	28	28	28

FCT 28 is variously made up of *Banksia attenuata* woodlands, *Corymbia calophylla* - *B. attenuata* woodlands or *Eucalyptus marginata* - *B. attenuata* woodlands, recorded from Thompson's Lake as far north as Seabird. Species richness averages 55.2 species per plot and average weed frequency is high at 8 species per plot.

FCT 28 is not listed as a TEC under the WC Act or as a PEC by DBCA, but forms part of the Banksia woodlands of the Swan Coastal Plain, listed as Endangered under the EPBC Act.

4.2.7 Threatened and Priority Ecological Communities

One TEC (Banksia woodlands of the Swan Coastal Plain) was recorded in the Survey Area (Figure 8).

All vegetation mapped as VT1 within the Survey Area met diagnostic criteria provided in the approved conservation advice for the *Banksia woodlands of the Swan Coastal Plain* TEC (Table 11).

Table 11: Characteristics of the Banksia woodland within the Subject Site compared to the key diagnostic criteria as per TSSC (2016)

Key diagnostic criteria (TSSC 2016)	Banksia woodlands within the Survey Area
Location: Occurs in the Swan Coastal Plain or Jarrah Forest IBRA bioregions.	Yes. Banksia woodlands within the Survey Area occur on the Swan Coastal Plain.
Soils and landform: Occurs on: • well drained, low nutrient soils on sandplain landforms, particularly deep Bassendean and Spearwood sands and occasionally on Quindalup sands • sandy colluviums and aeolian sands of the Ridge Hill Shelf, Whicher Scarp and Dandaragan Plateau • transitional substrates and sandflats.	Yes. Banksia woodlands within the Survey Area occur on Bassendean sands.
Structure: Low woodland to forest with: • a distinctive upper sclerophyllous layer of low trees (occasionally large shrubs more than 2 m tall), typically dominated or co-dominated by one or more of the banksia species identified below • emergent trees of medium or tall (>10 m) height. *Eucalyptus* or *Allocasuarina* species may sometimes be present above the banksia canopy • an often highly species-rich understorey.	Yes. Banksia woodlands within the Survey Area display the structure characteristics described.

Key diagnostic criteria (TSSC 2016)	Banksia woodlands within the Survey Area
Composition: Contains at least one of the following species: • *Banksia attenuata* • *Banksia menziesii* • *Banksia prionotes* • *Banksia ilicifolia.*	Yes. Banksia woodlands within the Survey Area contain *Banksia attenuata* and *B. menziesii*.
Condition (Keighery 1994): 'Pristine': no minimum patch size 'Excellent': 0.5 ha 'Very Good': 1 ha 'Good': 2 ha.	Yes. Banksia woodlands within the Survey Area are predominantly in Very Good - Excellent condition and comprise 37.5 ha.

4.2.8 Vegetation condition

The Survey Area contains a mixture of relatively undisturbed land, as well as areas which show signs of having been degraded through clearing for firebreaks, roads and other activities, as well as weed invasion, particularly along the western boundary adjacent to an area cleared for sand mining. As such, vegetation condition within the Survey Area ranged from Completely Degraded to Excellent (Keighery 1994; Figure 9). Table 12 gives a numerical breakdown of the area occupied by each vegetation condition rating within the Survey Area.

Table 12: Area (ha) covered by each vegetation condition category within the Survey Area

Vegetation Condition	Area (ha)	Percentage of the Survey area
Very Good – Excellent	34.61	79.25
Good – Very Good	1.83	4.18
Degraded – Good	1.04	2.38
Completely Degraded	1.84	4.21
Cleared	4.35	9.95
Total	**43.67**	**100**

4.2.9 Black cockatoo habitat

A total of 64 potential nesting habitat trees were recorded within the project area (*Eucalyptus marginata*). Of these, 23 trees contained visible hollows of at least 10 cm diameter (Figure 10).

Habitat foraging quality of each vegetation type is shown in Table 14 and was determined using the scale described in Table 13.

Table 13: Definitions of black cockatoo foraging habitat quality

Foraging quality	Justification
Excellent	High density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species >60%) and presence of food sources at several strata (i.e. canopy, midstorey and understorey).
Good	High density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species >60%) but food sources only present at one or two strata (i.e. canopy and midstorey).
Moderate	Moderate foraging value density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species 20-40%) and food sources only present at one or two strata (i.e. canopy and midstorey).
Poor	Low density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species 10-20%) and presence of food sources at only one stratum (i.e. canopy).
Very poor	Very low density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species <10%) and presence of food sources at only one stratum (i.e. canopy).
Nil	Cleared areas - no suitable vegetation present.

Baudin's black cockatoo was considered unlikely to be present as the Survey Area is beyond the range of its known distribution (Section 2.2.1, Johnstone and Kirkby undated); as such, foraging habitat quality has been assessed for only Carnaby's and Forest Red-tailed Black Cockatoo.

Table 14: Vegetation types and black cockatoo foraging species within the Survey Area

Vegetation type	Black cockatoo foraging species	Foraging quality	Area (ha)
VT1	CBC – *Acacia saligna, Allocasuarina fraseriana, Banksia attenuata, B. dallanneyi, B. menziesii, Eucalyptus marginata, Hakea lissocarpha, Mesomelaena pseudostygia, Xanthorrhoea preissii* FRTBC - *Allocasuarina fraseriana, Eucalyptus marginata*	• Moderate - Good (CBC) • Very poor (FRTBC)	37.48
VT2	CBC – *Acacia saligna* FRTBC – Nil	• Good (CBC) • Nil (FRTBC)	1.28
VT3	CBC – *Allocasuarina fraseriana, Eucalyptus marginata, Acacia saligna* FRTBC – *Allocasuarina fraseriana, Eucalyptus marginata.*	• Very poor (CBC) • Very poor (FRTBC)	0.62
C	CBC – Nil FRTBC – Nil	Nil	4.30
TOTAL			**43.67**

Figure 8: FCTs, PECs and TECs mapped within the survey area

Scale 1:6,000 at A4

0 50 100 150 m

N

Legend

- Survey area
- Banksia woodlands of the Swan Coastal Plain

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 23/11/2017
Author: JCrute
Source: Aerial image: Nearmap, flown 10/2017.

Path: Q:\Consult\2017\QPG\QPG17054\ArcMap_documents\QPG17054_G007_RevB.mxd

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Figure 9: Vegetation condition within the survey area

Scale 1:6,000 at A4

0 50 100 150 m

N

Legend

Survey area

Vegetation condition

- Very good - Excellent
- Good - very good
- Degraded - good
- Completely degraded
- Cleared

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 23/11/2017
Author: vdinh
Source: Aerial image: Nearmap, flown 10/2017.

Path: Q:\Consult\2017\QPG\QPG17054\ArcMap_documents\QPG17054_G008_RevB.mxd

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Figure 10: Black cockatoo habitat

Scale 1:6,000 at A4

0 50 100 150 m

N

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 21/11/2017
Author: JCrute
Source: Aerial image: Nearmap, flown 10/2017.

Legend

- Significant trees
- Survey area
- Good quality black cockatoo foraging habitat

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5. Discussion

The flora and vegetation assessment of the Survey Area was conducted during October 2017, which was prime flowering time for majority of species within the region. An additional survey was conducted in July 2017 to search for habitat and individuals of the orchid species Drakaea elastica, listed as Threatened under the WC Act and EPBC Act.

The field survey focussed on traversing the entire Survey Area to delineate vegetation types and is consistent with the requirements of a detailed flora and vegetation survey as specified in *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016).

The Survey Area falls within one broad-scale vegetation association, Bassendean 1001 (Table 1), of which approximately 22% of the pre-European extent remains, as at the most recent assessment in 2015 (Government of Western Australia 2017). Three VTs were mapped within the Survey Area, as well as cleared areas. The Survey Area was dominated by low woodland of *Banksia menziesii* and *B. attenuata* over open heath of *Xanthorrhoea preissii*, *Hibbertia hypericoides* and *Mesomelaena pseudostygia* with emergent *Eucalyptus marginata*.

Seventy-four native vascular plant taxa from 55 plant genera and 25 plant families as well as 33 exotic taxa were recorded within the Survey Area. One Declared Plant species pursuant to section 22 of the BAM Act (*Zantedeschia aethiopica*) was recorded within the Survey Area.

The following Threatened and Priority Flora species were considered to have the potential to occur within the Survey Area (Table 6 and Table 8) based on habitat requirements:

- *Caladenia huegelii* (T)
- *Dodonaea hackettiana* (P4)
- *Drakaea elastica* (T)
- *Drakaea micrantha* (T).

Two separate targeted surveys were undertaken to search for the above listed Threatened and Priority flora species with the potential to occur. One survey was undertaken during July in order to search for areas of optimal habitat for *Drakaea elastica* (i.e. vegetation alongside winter-wet swamps) and / or individuals of the species, which are most easily observed in July and early August due to a distinctive leaf which emerges at this time of year. No areas of optimal habitat were located, nor were any individuals observed.

A further targeted survey was conducted in October to search for *Caladenia huegelii*. The survey was conducted during peak flowering time for the species (10 and 11 October 2017). Peak flowering time was advised by an expert Orchidaceae taxonomist at DBCA (Brown A [DBCA], 2017, pers. comm., 4 October). Any plants of the spider orchid group (of which C. huegelii is part) that were observed were photographed and locations were recorded using a handheld GPS. Photographs of each population were submitted to DBCA for expert identification. The spider orchid species observed within the Survey Area were identified as *C. arenicola* and *C. longicauda*.

Drakaea micrantha and *Dodonaea hackettiana* were also searched for concurrently during the October 2017 survey.

Targeted surveys were conducted in accordance with *Survey Guidelines for Australia's Threatened Orchids: Guidelines for Detecting Orchids Listed as 'Threatened' under the Environment Protection and Biodiversity Conservation Act 1999* (DEE 2013).

No Threatened flora species as listed under section 178 of the EPBC Act or pursuant to Schedule 1 of the WC Act and as listed by Parks and Wildlife (2015) were recorded within the Survey Area. Additionally, no Priority flora species as listed by Western Australian Herbarium (1998-), including those listed above, were recorded.

Statistical analyses of vegetation data from the Survey Area determined one FCT (FCT 28) was present. FCT 28 is included as one of the FCTs constituting the *Banksia woodlands of the Swan Coastal Plain* TEC, which is listed as Endangered under the EPBC Act.

Vegetation condition within the Survey Area ranged from Completely Degraded to Excellent (Keighery 1994), with the majority of vegetation (>79%) rated as Very Good - Excellent. Generally, the areas rated as Completely Degraded had been at least partially cleared, and had a small amount of native vegetation either remaining or regenerating.

A total of 64 potential nesting trees for black cockatoo species (largely *Eucalyptus marginata*) were recorded within the Survey Area, of which 23 contained hollows of at least 10 cm diameter.

VT1 contained 37.48 ha of moderate – good quality foraging habitat for Carnaby's Black Cockatoo, largely due to the presence of *Banksia* species, *Allocasuarina fraseriana* and *Eucalyptus marginata*, as well as smaller understorey species. Despite being heavily degraded and comprising one native species over weed species, vegetation in VT2 was rated as good quality foraging habitat (1.28 ha) for Carnaby's black cockatoo due to its high foliage cover of Acacia saligna. VT3, in which occasional large native species were present (*Allocasuarina fraseriana*, *Eucalyptus marginata* and *Acacia saligna*) contained 0.62 ha of very poor quality foraging habitat for both Carnaby's and Forest Red-tailed Black Cockatoos.

6. Summary and conclusion

The majority of the Survey Area comprised vegetation listed as a TEC under the EPBC Act.

One Priority and three Threatened flora species were considered to have the potential to be present within the Survey Area; however, none of these species were observed during any of the targeted surveys, which were conducted during the optimal time for observing each of the species.

Sixty-four potential nesting habitat trees for black cockatoo species were recorded within the Survey Area, of which 23 contained hollows, along with a total of 39.37 ha of varying quality foraging habitat for Carnaby's and Forest Red-tailed Black Cockatoos.

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Appendix 1
Conservation significant flora and ecological community definitions

Conservation Codes for Western Australia (Western Australian Herbarium 1998-)

Under the *Wildlife Conservation Act* (1950), the Minister for the Environment may declare species of flora to be protected if they are considered to be in danger of extinction, rare or otherwise in need of special protection. Schedules 1 and 2 deal with those that are threatened and those that are presumed extinct, respectively.

T: Threatened Flora (Declared Rare Flora – Extant)

Species which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such (Schedule 1 under the *Wildlife Conservation Act 1950*).

Threatened Flora (Schedule 1) are further ranked by the Department according to their level of threat using IUCN Red List Criteria:

- CR: Critically Endangered – considered to be facing an extremely high risk of extinction in the wild
- EN: Endangered – considered to be facing a very high risk of extinction in the wild
- VU: Vulnerable – considered to be facing a high risk of extinction in the wild
- X: Presumed Extinct Flora (Declared Rare Flora – Extinct).

Species that have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such (Schedule 2 under the *Wildlife Conservation Act 1950*).

Priority Flora

Species that have not yet been adequately surveyed to be listed under Schedule 1 or 2 are added to the Priority Flora List under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna. Species that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Conservation Dependent species are placed in Priority 5.

Priority One: Poorly-known Species

Species that are known from one or a few collections or sight records (generally less than 5), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.

Priority Two: Poorly-known Species

Species that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.

Priority Three: Poorly-known Species

Species that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.

Priority Four: Rare, Near Threatened and other species in need of monitoring

1. Rare: Species that are considered to be have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands.
2. Near Threatened: Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.
3. Species that have been removed from the list of threatened species during the past 5 years for reasons other than taxonomy.

Definition of Threatened Ecological Communities (DEC 2010)

Presumed Totally Destroyed (PD)

An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies:

- records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats or
- all occurrences recorded within the last 50 years have since been destroyed.

Critically Endangered (CR)

An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria:

1. The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply:
   (a) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years)
   (b) modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated.
2. Current distribution is limited, and one or more of the following apply:
   (a) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years)
   (b) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes
   (c) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes.
3. The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).

Endangered (EN)

An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria:

1. The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement and either or both of the following apply:
   (a) the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years)
   (b) modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated.

2. Current distribution is limited, and one or more of the following apply"
    (a) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years)
    (b) there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes
    (c) there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes.
3. The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).

Vulnerable (VU)

An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria:

1. The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated.
2. The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations.
3. The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.

Definition of Priority Ecological Communities (DEC 2010)

Priority One: Poorly-known ecological communities

Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.

Priority Two: Poorly-known ecological communities

Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.

Priority Three: Poorly known ecological communities

- communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation
- communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat
- communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes.

Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.

Priority Four

Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring. These include:

1. Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands.
2. Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.
3. Ecological communities that have been removed from the list of threatened communities during the past five years.

Appendix 2
Desktop assessment results (Parks and Wildlife 2007-, DEE 2017c)

NatureMap Species Report

Created By Guest user on 28/06/2017

Kingdom Plantae
Conservation Status Conservation Taxon (T, X, IA, S, P1-P5)
Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 115° 50' 36" E,32° 11' 05" S
Buffer 3km

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1.	1596	*Caladenia huegelii (Grand Spider Orchid)*		T	
2.	12938	*Diuris micrantha*		T	
3.	4763	*Dodonaea hackettiana (Hackett's Hopbush)*		P4	
4.	1639	*Drakaea elastica (Glossy-leaved Hammer Orchid)*		T	
5.	5237	*Pimelea calcicola*		P3	
6.	25800	*Stylidium paludicola*		P3	

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

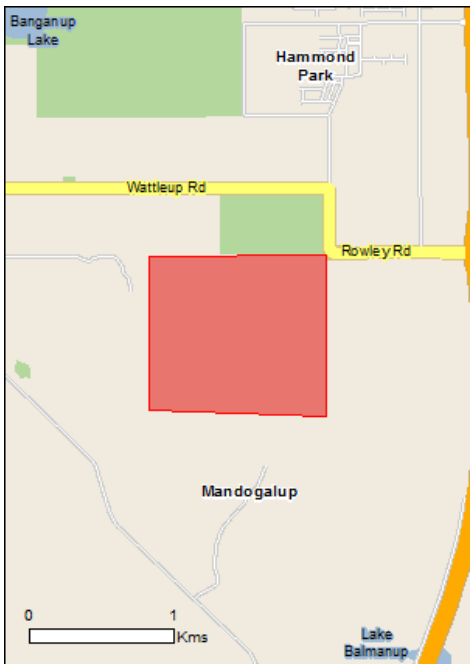
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

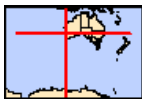
Report created: 28/06/17 14:47:36

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements



Coordinates
Buffer: 2.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	2
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	17
Listed Migratory Species:	10

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	16
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	2
Regional Forest Agreements:	None
Invasive Species:	36
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Forrestdale and thomsons lakes	Within 10km of Ramsar
Peel-yalgorup system	30 - 40km upstream

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat likely to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat known to occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Mammals		
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat known to occur within area
Pseudocheirus occidentalis Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Vulnerable	Species or species habitat likely to occur within area
Plants		

Name	Status	Type of Presence
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat may occur within area
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat known to occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat known to occur within area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat likely to occur within area
Drakaea elastica Glossy-leafed Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat likely to occur within area
Drakaea micrantha Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat likely to occur within area
Eleocharis keigheryi Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat may occur within area
Lepidosperma rostratum Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat likely to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat likely to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat likely to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Harry Waring Marsupial Reserve	WA
Unnamed WA48291	WA

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area

Nationally Important Wetlands

[Resource Information]

Name	State
Gibbs Road Swamp System	WA

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-32.189335 115.847365,-32.189335 115.847324,-32.189335 115.847324,-32.188955 115.83637,-32.180826 115.836289,-32.180722 115.847406,-32.189335 115.847365

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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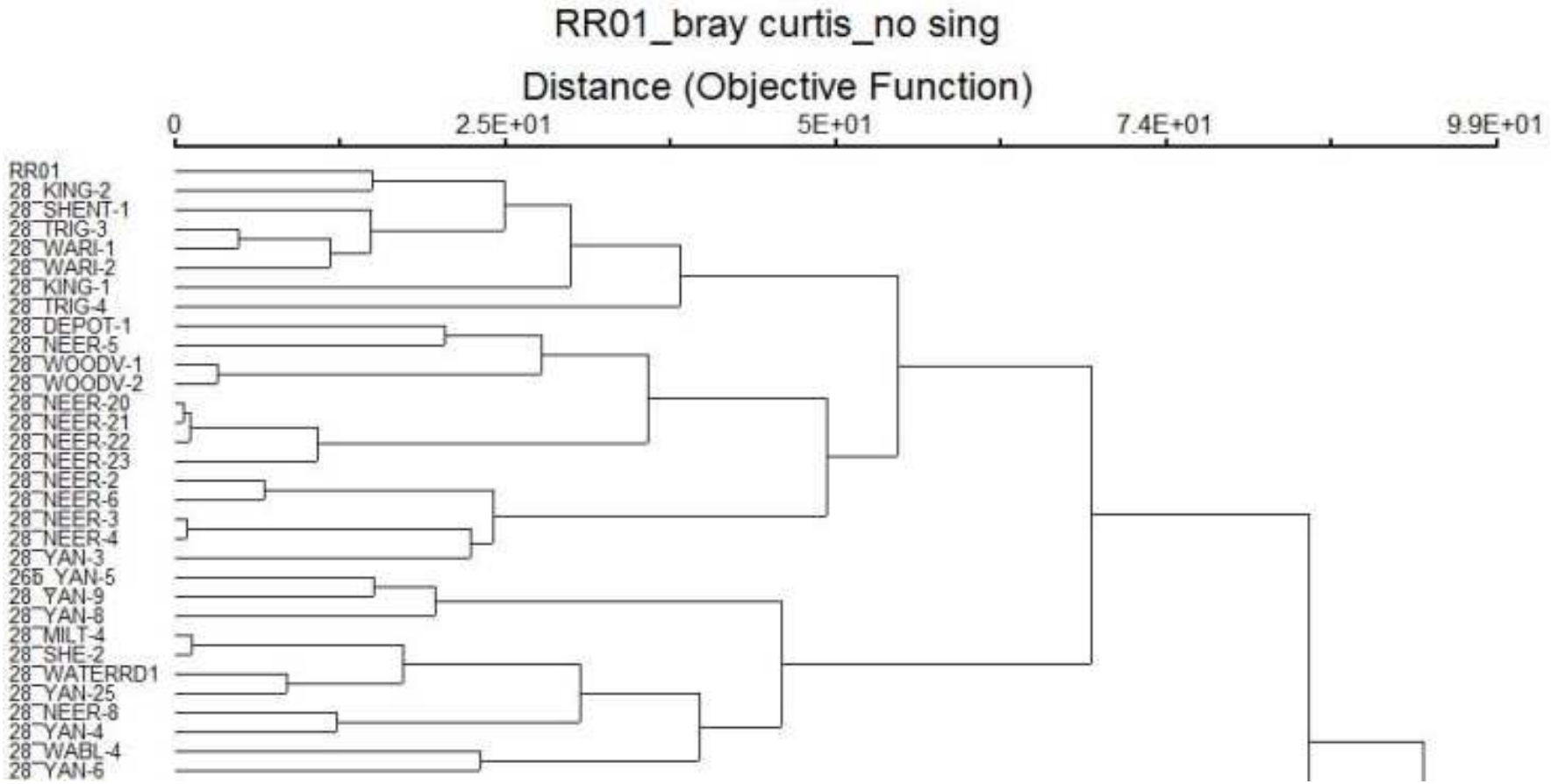
Appendix 3
Native plant taxa recorded within the Survey Area

Family	Species
Apiaceae	*Xanthosia huegelii*
Araliaceae	*Trachymene pilosa*
Asparagaceae	*Lomandra hermaphrodita*
	Lomandra preissii
	Sowerbaea laxiflora
	Thysanotus manglesianus
Asteraceae	*Lagenophora huegelii*
	Podolepis gracilis
	Rhodanthe citrina
	Siloxerus humifusus
Casuarinaceae	*Allocasuarina fraseriana*
	Allocasuarina humilis
Colchicaceae	*Burchardia congesta*
Cyperaceae	*Lepidosperma leptostachyum*
	Lepidosperma sp.
	Mesomelaena pseudostygia
	Schoenus curvifolius
	Tetraria octandra
Dasypogonaceae	*Dasypogon bromeliifolius*
Dilleniaceae	*Hibbertia hypericoides*
Droseraceae	*Drosera ?erythrorhiza*
	Drosera ?menziesii
Ericaceae	*Conostephium pendulum*
	Leucopogon sp.
Fabaceae	*?Daviesia triflora*
	Acacia pulchella
	Acacia stenoptera
	Bossiaea eriocarpa
	Daviesia nudiflora
	Gastrolobium bilobum
	Gompholobium confertum
	Gompholobium tomentosum
	Hardenbergia comptoniana
	Hovea trisperma
Goodeniaceae	*Dampiera linearis*
	Scaevola canescens
Haemodoraceae	*Anigozanthos manglesii*
	Anigozanthos sp.
	Conostylis aculeata
	Conostylis setigera
	Phlebocarya ciliata
Hemerocallidaceae	*Tricoryne* sp.
Iridaceae	*Patersonia occidentalis*
Myrtaceae	*Calytrix fraseri*
	Eremaea pauciflora
	Eucalyptus marginata
	Hypocalymma robustum
	Myrtaceae sp.
Orchidaceae	*Caladenia arenicola*
	Caladenia discoidea
	Caladenia longicauda
	Caladenia sp.
	Leporella fimbriata
	Thelymitra crinita

Family	Species
	Thelymitra sp.
Poaceae	*Neurachne alopecuroidea*
	Rytidosperma ?setaceum
Proteaceae	*Banksia attenuata*
	Banksia dallanneyi
	Banksia menziesii
	Hakea lissocarpha
	Petrophile linearis
	Stirlingia latifolia
Restionaceae	*Desmocladus flexuosus*
Restionaceae	*Lyginia barbata*
Stylidiaceae	*Stylidium brunonianum*
	Stylidium piliferum
	Stylidium repens
	Stylidium schoenoides
Violaceae	*Hybanthus calycinus*
Xanthorrhoeaceae	*Chamaescilla corymbosa*
	Xanthorrhoea gracilis
	Xanthorrhoea preissii
Zamiaceae	*Macrozamia riedlei*

Appendix 4
FCT analysis results


RR01_bray curtis_no sing
Distance (Objective Function)
0
2.5E+01
5E+01
7.4E+01
9.9E+01
RR01
28_KING-2
28¯SHENT-1
28¯TRIG-3
28¯WARI-1
28¯WARI-2
28¯KING-1
28¯TRIG-4
28¯DEPOT-1
28¯NEER-5
28¯WOODV-1
28¯WOODV-2
28¯NEER-20
28¯NEER-21
28¯NEER-22
28¯NEER-23
28¯NEER-2
28¯NEER-6
28¯NEER-3
28¯NEER-4
28¯YAN-3
265_YAN-5
28_YAN-9
28¯YAN-8
28¯MILT-4
28¯SHE-2
28¯WATERRD1
28¯YAN-25
28¯NEER-8
28¯YAN-4
28¯WABL-4
28¯YAN-6

Appendix 5
Photographic record of vegetation types and condition

Plate 1: VT1 - Very Good – Excellent condition

Plate 2: VT2 – Completely Degraded condition

Plate 3: VT1 – Degraded – Good condition

Plate 4: VT3 – Completely Degraded condition

Appendix 6
Vascular plant taxa recorded by quadrat

Species	Quadrat number / location				
	RR01	RR02	RR03	RR04	Opportunistic
Acacia pulchella	x				
Acacia saligna					x
Acacia stenoptera		x	x	x	
**Aira caryophyllea*			x		
Allocasuarina fraseriana			x	x	
Allocasuarina humilis			x		
Anigozanthos manglesii		x	x		
Anigozanthos sp.				x	
Banksia attenuata	x	x		x	
Banksia dallanneyi			x		
Banksia menziesii		x	x	x	
Bossiaea eriocarpa		x	x		
**Brassica tournefortii*					x
**Briza maxima*	x	x	x	x	
Burchardia congesta	x	x		x	
Caladenia arenicola		x			
Caladenia discoidea					x
Caladenia longicauda					x
Caladenia sp.				x	
Calytrix fraseri		x			
**Carpobrotus edulis*	x		x	x	
Chamaescilla corymbosa		x	x	x	
**Chamelaucium uncinatum*					x
Conostephium pendulum	x	x	x	x	
Conostylis aculeata	x	x	x		
Conostylis setigera		x	x	x	
Dampiera linearis	x	x		x	
Dasypogon bromeliifolius		x			
Daviesia nudiflora	x	x			
?Daviesia triflora		x			
Desmocladus flexuosus	x	x	x	x	
Drosera ?erythrorhiza	x	x			
Drosera ?menziesii		x	x		
**Ehrharta calycina*	x		x		
Eremaea pauciflora				x	
Eucalyptus marginata	x				
**Fumaria capreolata*					x

Species	Quadrat number / location				
	RR01	RR02	RR03	RR04	Opportunistic
Gastrolobium bilobum		x		x	
**Gladiolus caryophyllaceus*	x	x	x	x	
Gompholobium tomentosum	x		x	x	
^Grevillea leucopteris					x
Hakea lissocarpha			x		
Hardenbergia comptoniana	x				
Hibbertia hypericoides	x	x	x	x	
Hovea trisperma	x	x	x		
Hybanthus calycinus			x		
Hypocalymma robustum	x	x	x	x	
**Hypochaeris glabra*	x	x	x	x	
Lagenophora huegelii	x	x	x	x	
Lepidosperma leptostachyum	x				
Lepidosperma sp.			x		
Leporella fimbriata	x	x		x	
Leucopogon sp.		x			
Lomandra hermaphrodita		x			
Lomandra preissii	x				
Lyginia barbata	x	x			
**Lysimachia arvensis*			x		
Macrozamia riedlei	x		x		
Mesomelaena pseudostygia	x		x	x	
Myrtaceae sp.	x	x			
Neurachne alopecuroidea	x	x	x	x	
Patersonia occidentalis	x		x		
**Pelargonium capitatum*					x
Petrophile linearis		x	x	x	
Phlebocarya ciliata			x		
Podolepis gracilis			x	x	
Rhodanthe citrina			x		
Rytidosperma ?setaceum		x			
Scaevola canescens	x		x		
Schoenus curvifolius		x			
Siloxerus humifusus		x	x	x	
Sowerbaea laxiflora	x	x	x		
Stirlingia latifolia	x	x		x	
Stylidium brunonianum		x	x	x	
Stylidium piliferum			x	x	
Stylidium repens	x				
Stylidium schoenoides	x				

Species	Quadrat number / location				
	RR01	RR02	RR03	RR04	Opportunistic
Tetraria octandra	x		x	x	
Thelymitra crinita				x	
Thelymitra sp.			x		
Thysanotus manglesianus			x		
Trachymene pilosa	x	x	x	x	
Tricoryne sp.	x				
**Ursinia anthemoides*	x	x			
**Watsonia meriana*					x
Xanthorrhoea gracilis		x			
Xanthorrhoea preissii	x	x	x	x	
Xanthosia huegelii	x				
**Zantedeschia aethiopica*	x				

Appendix 3
Targeted Spring Flora Survey

Level 1, 50 Subiaco Square Road Subiaco WA 6008 PO Box 243 Subiaco WA 6904
Phone (08) 9380 3100 Fax (08) 9380 4606
177 Spencer Street Bunbury WA 6230 PO Box 287 Bunbury WA 6231
Phone (08) 9792 4797 Fax (08) 9792 4708

To: Jackie De Meyrick

Company: Frankland Sand Supplies

Date: 19 December 2018

Project No: QPG17054.02

Inquiries: Darren Walsh

Lot 2 and 10 Rowley Road Mandogalup
Targeted Flora Survey

Background

Frankland Sand Supplies (FSS) commissioned Strategen to undertake a targeted flora survey for two Threatened orchid species, *Drakaea elastica* and *Caladenia huegelii* at Lots 2 and 10 Rowley Road, Mandogalup (survey area) in spring 2018. *D. elastica and C. huegelii* are currently listed as Threatened under the *Wildlife Conservation Act 1950* and *Environmental Protection and Biodiversity Conservation Act 1999*.

A targeted survey was previously undertaken by Strategen for *both species* in spring 2017, however no individuals were observed. Three botanists from Strategen undertook an additional targeted survey for *D. elastica* on the 12 and 13 August 2018, and an additional target survey for C. huegelii on the 15, 16, 18 and 19 October 2018.

The National Recovery Plan for *D. elastica* (DEE 2018) was reviewed prior to the survey, with the optimal survey timing for *D. elastica* being in June, July and early August. The species is most detectable during this period due to the presence of its distinctive glossy leaf. The survey was therefore not carried out in spring as the species is more difficult to detect due to its sporadic flowering habit (DEE 2018; WAH 1998).

Caladenia huegelii is detectable in September to early November during the flowering period (DEC 2009). Known populations were inspected prior to the targeted surveys being undertaken to ensure the species was in flower, assisting with detection.

Methods

Drakaea elastica

A total of 88 parallel transects were traversed in an east-west direction. Transects were walked approximately 10 m apart throughout the entire survey area, depending on vegetation density and presence of preferred habitat for the species.

Additional searching was conducted within the following areas of preferred habitat, as described by Department of Environment and Energy (DEE) (2018):

- microhabitats containing known associated species, particularly *Leporella fimbriata* which was present within the survey area
- microhabitats containing other orchid species, or species with similar growth habit to *D. elastica* (e.g. *Drosera* spp.)
- areas containing *Kunzea glabrescens* thicket, or where *K. glabrescens* was a more dominant species
- cleared areas including firebreaks.

Caladenia huegelii

A total of 88 parallel transects were traversed in an east-west direction. Transects were walked approximately 10 m apart throughout the entire survey area, depending on vegetation density and presence of preferred habitat for the species. The survey was conducted during October, during which known local populations of *C. huegelii* were in flower.

Results

Neither *D. elastica nor C. huegelii* were recorded during the targeted survey, however the following Orchidaceae species were recorded:

- *Caladenia arenicola*
- *Caladenia* flava
- *Caladenia georgei*
- *Caladenia* sp.
- *Leporella fimbriata*
- *Pterostylis ?sanguinea*
- *Pyrorchis nigricans*
- *Thelymitra crinita*
- *Thelymitra* sp.

Conclusions

The following conclusions can be drawn from the results of the targeted flora survey:

- targeted searches were carried out by three botanists throughout the entire survey area, with additional searching conducted in areas of preferred habitat for the species
- six Orchidaceae species were recorded during the targeted searches, however none of these species are considered to be of conservation significance
- *D. elastica* was not recorded in the survey area
- *C. huegelii* was not recorded in the survey area.

References

Department of Environment and Conservation (DEC) 2009, *Grand Spider Orchid (Caladenia huegelii) Recovery Plan*, Commonwealth Department of the Environment, Water, Heritage and the Arts, Canberra, available from: *http://www.environment.gov.au/resource/grand-spider-orchid-caladenia-huegelii-recovery-plan* [September 2018].

Department of the Environment and Energy (DEE) 2018, *Species Profiles and Threats Database*, *Drakaea elastic – Glossy-leafed Hammer Orchid, Glossy – leaved Hammer Orchid, Wart Hammer Orchid* [Online], Australian Government, available from: *http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=16753* [August 2018].

Western Australian Herbarium (WAH) 1998-, *FloraBase – the Western Australian Flora*, [Online], Government of Western Australia, Available from: *http://florabase.dpaw.wa.gov.au/* [August 2018].