



Additional Information Report Rev B

Additional Information Request

Lots 4 and 5 Ludlow Rd, Myalup: Proposed Limestone Extraction

EPBC 2019/8388

March 2020



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Prepared for B&J Catalano Pty Ltd by Lundstrom Environmental Consultants Pty Ltd

B&J Catalano Pty Ltd

Telephone: 08 9726 8100

Email: peterbennett@catalano.com.au

Web: <https://www.catalano.com.au/>

Lundstrom Environmental Consultants Pty Ltd

Telephone: 08 9310 3297

Email: mike@lundstrom-environmental.com.au

Web: <https://www.lundstrom-environmental.com.au>

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Front cover image: *Eucalyptus decipiens* Woodland

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GLOSSARY

BAM Act	<i>Biosecurity and Agriculture Management Act 2007</i> (Western Australian Government)
BC Act	<i>Biodiversity Conservation Act 2016</i> (Western Australian Government)
DAFWA	Department of Agriculture and Food Western Australia – superseded, now DPIRD (Western Australian Government)
DBCA	Department of Biodiversity, Conservation and Attractions (Western Australian Government)
DAWE	Department of Agriculture, Water and the Environment (formally DoEE)
DEC	Department of Environment and Conservation – superseded, now DBCA (Western Australian Government)
DoEE	Department of the Environment and Energy (Australian Government), now DAWE
DMIRS	Department of Mines, Industry Regulation and Safety (Western Australian Government)
DoW	Department of Water - superseded, now DWER (Western Australian Government)
DPIRD	Department of Primary Industries and Regional Development (Western Australian Government)
DRF	Declared Rare Flora
DWER	Department of Water and Environmental Regulation (Western Australian Government)
EPA	Environmental Protection Authority (Western Australian Government)
EP Act	<i>Environmental Protection Act 1986</i> (Western Australian Government)
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Australian Government)
ESA	Environmentally Sensitive Area
LEC	Lundstrom Environmental Consultants
MNES	Matters of National Environmental Significance
PEC	Priority Ecological Community
TEC	Threatened Ecological Community
TPF	Threatened and Priority Flora
WALGA	Western Australian Local Government Association
WC Act	<i>Wildlife Conservation Act 1950</i> (Western Australian Government) superseded, now BC Act (Western Australian Government)
WONS	Weeds of National Significance

1 INTRODUCTION

1.1 PROPONENT

1.1.1 Company details

Entity	B&J Catalano Pty Ltd
ABN	89 619 75
Registered Address	South West Highway, Brunswick WA, 6224
Contact person	Mr Peter Bennett, Manager Optimisation and Rates
Contact details	08 9726 8100 peterbennett@catalano.com.au
Web	https://www.catalano.com.au/

1.1.2 Environmental record

B&J Catalano Pty Ltd (Catalano) operates as a Basic Raw Materials (BRM) extractor in the south west of Western Australia (WA).

Catalano is committed to the protection of the environment in the course of providing comprehensive earthmoving, transport, bulk earthworks and civil contracting solutions. The business objective is to plan and perform workplace activities in ways that minimise the impact on the environment.

To meet environmental objectives, Catalano are committed to the following actions and practices:

- Maintaining an Environmental Management System, certified to ISO 14001:2015, managing operations in accordance with compliance obligations and demonstrating due diligence
- All staff and contractors will be made aware of the environmental policy and procedures with an appropriate level of training provided
- Act within the business towards reducing greenhouse gas emissions and environmental impact
- Reduce and where possible, prevent pollution
- Facilitate recycling of materials and resources wherever possible
- Pursue an active rehabilitation program by returning disturbed areas where possible to pre-existing conditions
- Working to identify, assess and control environmental risks associated with each project
- Encourage open dialogue with employees, Regulators and the public on environmental issues and be responsive to their concerns
- Monitoring and review for continual improvement of the Company's environmental performance

Catalano operates a cohesive Environmental Management System certified to the requirements of ISO 14001:2015. The comprehensive system underpins the Company's "sustainable development" approach to all areas of the business and operations.

Catalano strive to minimise the impact on the environment at all sites, as well as having an ongoing commitment to exploring initiatives in waste management and renewable energy.

Specific environmental initiatives include:

- Comprehensive Fuel Management Systems: Use of bio-diesel in all vehicles, to ensure there are no detrimental effects to the environment
- Developed and implemented a Black-Cockatoo Management Plan (Runnymede Rd Sand Mine)

The Company demonstrates a proactive approach to continually finding opportunities and technologies that will ensure the business remains sustainable into the future.

1.2 ADDITIONAL REQUIREMENTS

On April 29, 2019, the proposed action was determined to be a controlled action under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act), based on the following factors:

- listed threatened species and communities (s. 18 and 18A),
- listed migratory species (s. 20 and 20A) and
- the ecological character of a declared Ramsar wetland (s. 16 and 17B).

It determined that the proposed action will be assessed by Preliminary Documentation. The information required for the Preliminary Documentation, as requested by the Department of Agriculture, Water and the Environment (DAWE) (formally Department of the Environment and Energy, DoEE) (EPBC Ref 2019/8388, 24 June 2019) is provided in Appendix A1.

Following the submission of preliminary documents in August 2019, further information was requested (on September 26, 2019) and is provided in Appendix A2. This further information requested has been added to this document.

A further request for more information was made by DAWE on February 7, 2020 (Appendix A3), to which a response was provided March 4, 2020.

Table 1 provides a summary of the requirements requested by DAWE (formally DoEE) in September 2019 and February 2020 and provides a reference in this document for the information requested.

Table 1. Additional information requested by DAWE September 2019 and February 2020.

Information Requested	Preliminary and Supporting Documentation	Comments
INFORMATION REQUESTED SEPTEMBER 26, 2019		
2. DESCRIPTION OF THE ENVIRONMENT AND MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE		
The draft preliminary documents submitted relied heavily on data provided by Naturemap records, which failed to address the following points:	A comprehensive list of all literature and databases reviewed, including but not limited to NatureMap, is provided in Section 2.1.2.1; as well as 2.2.2.	*NatureMap is a combined dataset of records submitted directly to DBCA (by their officers, by the public and by consultants), WA Museum records, ALA records and Birdlife Australia. It is the most comprehensive dataset publicly available. The author is unaware of other more reliable consolidated database sources (besides the individual ones listed above (ALA, WAM, Birdlife Australia) which would be a subset of the NatureMap results anyway).
• For listed threatened species and communities and listed migratory	For vegetation identified from desktop and field assessments, refer to Section 2.1.4.	

Information Requested	Preliminary and Supporting Documentation	Comments
<p>species that are, or have the potential to be, present within the proposed action area and surrounds, a minimum of:</p>	<p>For terrestrial fauna from desktop and field assessments, refer to Section 2.2.4.</p>	
<ul style="list-style-type: none"> ○ Information detailing known populations or records of individuals within at least 1km of the proposed action area and the size of these populations, if available. 	<p>Available information on fauna surveys, assessments and reviews undertaken in nearby areas were referenced. The most significant of those available have been used as the primary reference material for compiling a list of fauna species of conservation significance most likely to occur in the general area.</p> <p>A complete and comprehensive list of local studies referenced, and databases utilised is summarised in Section 2.2.2.2.</p> <p>A comprehensive list of technical publications was also cited and is summarised in Section 2.2.2.3.</p> <p>Conservation significant fauna has been assessed using information from a comprehensive list of legislative, policy and guidance documents, as provided in Section 2.2.2.4.</p> <p>Likelihood of occurrence tables, based on literature and database searches, are found at Section 2.2.4.1.</p> <p>The approach used to determine the likelihood of occurrence is described in Section 2.2.2.6.</p>	<p>*This information was provided using NatureMap records – The author is unaware of other information sources / consolidated databases that are better than NatureMap. Also please note that Carnaby’s black cockatoo are a post breeding nomad so for the most part would not have sedentary populations in one area. During eth nonbreeding season they forage over large areas. Trying to define population numbers within 1km of the project area would eb impossible as most of the time there wouldn’t be any there. When they are foraging in this area it would only be for a short period. Habitat assessment is the main way of assessing impact son black cockatoos.</p>
<ul style="list-style-type: none"> ○ An assessment of the adequacy of any surveys undertaken (including survey effort and timing). In particular, the extent to which these surveys were appropriate for the listed species or community and undertaken in accordance with relevant Departmental survey guidelines. 	<p>A description of the vegetation surveys undertaken are provided in Section 2.1.2.</p> <p>A description of the terrestrial fauna surveys undertaken are provided in Section 2.2.2 and 2.2.3.</p> <p>Methods employed to undertaken black cockatoo habitat assessment are based on guidelines published by the DoEE (Commonwealth of Australia 2012), as detailed in Section 2.2.3.2.</p>	<p>*A habitat assessment of the project area has been undertaken over a period of 3 days in two different seasons/years (once in May/June 2018 and one in November 2019). The project area is relatively small and easily surveyed. The assessment has included documenting all habitat trees (DBH >50cm), foraging habitat and roosting habitat. Based on the information obtained to date no additional surveys are considered warranted as no useful information is likely to be obtained.</p>
<ul style="list-style-type: none"> ● Information about the methods, data and scientific literature used to identify 	<p>Section 2.2.2.2 provides a list of the previous fauna surveys of the area and was used as the primary reference material for compiling a</p>	

Information Requested	Preliminary and Supporting Documentation	Comments
<p>and assess the environmental values within the proposed action area and surrounds, including survey data and historical records. Survey data relating to the proposed action area must be provided for the relevant listed species and/or communities, be as recent as possible and must not have been collected more than two years before the date the draft preliminary documentation is submitted to the Department.</p>	<p>list of fauna species of conservation significance most likely to occur in the general area. A description of each of the relevant matters of national environmental significance are provided in Section 3.</p>	
<p><u>Habitat quality</u> The draft preliminary documents did not use the methodology suitable for each individual listed species or community (i.e. approved by the Department or supported by literature) used to assess habitat or vegetation quality, noting that the same scoring system must be used at both impact and offset sites, where relevant (see Section 4). The quality score for an area of habitat must relate directly to the habitat requirements of the species (e.g. number of suitable nesting hollows). There are three components that must be considered when calculating habitat quality: site condition, site context and species stocking rates.</p>	<p>Methods used for fauna habitat assessment are detailed in the following Sections:</p> <ul style="list-style-type: none"> • Section 2.2.3.1 General fauna habitat assessment; • Section 2.2.3.2 Black cockatoo habitat assessment (Commonwealth of Australia 2012), which includes further information on: <ul style="list-style-type: none"> o breeding habitat; o foraging habitat; o roosting habitat; • Section 2.2.3.3 Western ringtail possum assessment. <p>Black cockatoo habitat assessment is based on assessment guidelines published by the DotEE (Commonwealth of Australia 2012).</p>	<p>*The quality of habitat within the project area has been rated as low. There are only a small number of habitat trees (DBH >50cm) in or near the project area and none contain hollows suitable for black cockatoos to use for nesting. The extent of foraging habitat is very small and dominated by plant species foraged upon only rarely if at all (i.e. small fruited eucalypts). There were no roosting sites identified within or near the project area. Based on available vegetation mapping it is estimated that there is approximately 9,500 ha of native vegetation within 10 km the project area, much of which is very likely to represent potential black cockatoo breeding, foraging and roosting habitat of some type. Remnant native vegetation present within the project area (total ~8.3 ha) makes up ~0.087% of this total. There is also over 3,000ha of pine plantation within 10km of the project area which has the potential to represent high value foraging habitat Given the low quality of the habitat black cockatoos would only visit the project area very occasionally and only for short periods of time – so “stocking rates” are not particularly relevant and impossible to determine.</p>

3. ASSESSMENT OF IMPACTS

Information Requested	Preliminary and Supporting Documentation	Comments
<p>The draft preliminary documentation only addressed parts of this section and it did not include an assessment of the potential direct and indirect impacts on protected matters that are likely to be present within the proposed action area and surrounds. The impacts of the proposed action should be considered at the broadest scope and all components of the proposed action should be considered, including any associated supporting infrastructure.</p> <p>In particular, the draft preliminary documentation did not address the following types of impacts relevant to your proposed action:</p>	<p>A description of potential direct and indirect impacts on matters of national environmental significance is provided in Section 4.1.</p>	
<ul style="list-style-type: none"> Although the draft preliminary documentation mentioned that the proposed project will increase noise, dust, emissions and/or vibrations associated with the proposed action, including disruption of key behaviours. The document claimed these will not cause disturbance to listed threatened and/or migratory species with no evidence provided to back up the claim. 	<p>An assessment for each potential impact identified (including direct removal of habitat, as well as noise and dust emissions), are provided in Section 4.3. An assessment has also been made against the significant impact criteria for each matter of national environmental significance, which is provided in Section 4.4.</p>	<p>*Regarding Black cockatoos, impacts on black cockatoos from vegetation clearing and then the operation of the proposed pit will be non-existent/negligible. This conclusion is justified by the fact that the area is small, it contains no existing/potential nest hollows, foraging habitat is limited in extent and very poor quality and there was no roosting activity detected. There are large expanses of better-quality habitat in surrounding areas much of it in national park.</p>
<ul style="list-style-type: none"> The draft preliminary documentation claimed the proposed project will have minimal to no impact on important habitat for listed threatened and/or migratory shorebirds and/or the ecological character of the Peel-Yalgorup System Ramsar Site (PYSRS) as a result of the proposed action. However, it did not provide source of information to back up this claim. 	<p>An assessment for each potential impact identified (including direct removal of habitat, as well as noise and dust emissions), are provided in Section 4.3. An assessment has also been made against the significant impact criteria for the Peel-Yalgorup System Ramsar Site (PYSRS), which is provided in Section 4.4.9. Additional information has been provided potential hydrological impacts to Migratory shorebirds (Section 4.1.2), the Peel-Yalgorup System Ramsar Site (Section 4.1.3), and other social/amenity impacts in Section 4.1.4. Further assessment of the potential impacts to the PYSRS is provided in the following sections:</p> <ul style="list-style-type: none"> 4.3.3 Dust 4.3.4 Noise 4.3.6 Weeds of significance 4.3.9 Altered surface water flow 4.3.10 Altered groundwater levels 4.3.11 Water contamination 	
<ul style="list-style-type: none"> The draft preliminary documentation stated there will be no direct impact to groundwater and/or surface water. However, it failed to address indirect 	<p>Further information has been provided in the following Sections (within Impact Assessment):</p>	

Information Requested	Preliminary and Supporting Documentation	Comments
<p>impact from the proposed project on groundwater and surface water in particular contamination, groundwater extraction, stormwater management and the lowering of groundwater levels as a result of vegetation removal.</p>	<ul style="list-style-type: none"> • Section 4.3.9 Altered surface water flow (sedimentation and turbidity) • Section 4.3.10 Altered groundwater levels <p>Section 4.3.11 Water contamination</p>	
<ul style="list-style-type: none"> • The draft preliminary documentation stated there will be no impact on any listed threatened species but did not provide source of information to back up this statement. 	<p>Impacts to threatened species are identified in Section 4.1.1 and 4.1.2 and summarised in Section 4.2.</p> <p>Impact assessment of all relevant matters of national environmental significance is provided in Section 4.3.</p> <p>An assessment against the significant impact criteria is provided in Section 4.4.</p>	
<ul style="list-style-type: none"> • The draft preliminary documentation stated there will be no to minimal impacts on the ecological character of the PYSRS, but it failed to provide evidence to the statement. 	<p>Impacts to PRSRS are identified in Section 4.1.3 and summaries in Section 4.2.</p> <p>Impact assessment of the PYSRS is provided in Section 4.3 with relevance to PYSRS discussed in Sections 4.3.9 to 4.3.12.</p> <p>An assessment against the significant impact criteria is provided in Section 4.4.9</p>	
<p>In addition, the draft preliminary documentation submitted failed to include results specifically requested by the assessment officer which are:</p>	<p>The survey approach is provided in Section 2.2.3, with detailed methodology for Carnaby’s black cockatoo habitat assessment provided in Section 2.2.3.2.</p>	<p>*The 2019 survey was carried out within the breeding season. It should however be noted that the project area contains no actual or potential nest hollows, so this requirement is somewhat irrelevant in this case.</p>
<ul style="list-style-type: none"> • Include the results of a targeted Carnaby’s Black Cockatoo nest hollow assessment, which must: <ul style="list-style-type: none"> ○ be conducted within the Carnaby’s Black Cockatoo breeding season, as defined in the Carnaby’s Black Cockatoo (<i>Calyptorhynchus latirostris</i>) Recovery Plan (2013); 		
<ul style="list-style-type: none"> ○ be conducted using a telescopic pole-mounted camera or camera drone technology; 		<p>*This equipment was available and used to double check some trees. In most cases it was not needed</p>
<ul style="list-style-type: none"> ○ include close visual inspection of all potential nesting hollows within the proposed action area (and immediate vicinity) from above ground-level and provide photographic evidence of all potential nesting hollows inspected; 		<p>*No actual or potential black cockatoo nest hollows were detected.</p>
<ul style="list-style-type: none"> ○ detail any evidence of use by Carnaby’s Black Cockatoo i.e. chew marks, feather, debris, etc.; 		<p>*No actual or potential black cockatoo nest hollows were detected.</p>
<ul style="list-style-type: none"> ○ include mapping of all potential breeding trees, suitable nesting hollows and known nesting hollows within the proposed action area (and immediate vicinity); and 		<p>*This information was provided.</p>
<ul style="list-style-type: none"> ○ take care not to disturb any Carnaby’s Black Cockatoo nesting activity. 		<p>*No actual or potential black cockatoo nest hollows were detected.</p>

Information Requested	Preliminary and Supporting Documentation	Comments
4. AVOIDANCE AND MITIGATION MEASURES		
<p>The Department considers further details are required for avoidance and mitigation measures.</p>	<p>Information on the management of weeds of significance is provided in the Weed Management Plan (Appendix H).</p>	<p>Weeds of significance are described in Section 4.3.6.3.</p>
<ul style="list-style-type: none"> • The draft preliminary document failed to provide details of pre-clearance and clearance procedures to ensure that protected matters are adequately detected and managed to minimise impacts (i.e. the introduction or spread of disease or pathogens to habitats and vegetation). 	<p>Management measures, as described in the Weed Management Plan (Appendix H) are also provided in Section 5.4.5.</p> <p>Pre-clearing actions are provided in Section 5.1.1.</p>	
<ul style="list-style-type: none"> • The draft preliminary document failed to provide details of any rehabilitation measures to be implemented, including objectives, target species, timing of relevant stages, methodology, maintenance and monitoring. 	<p>A Revegetation Report, including rehabilitation management procedures is provided in Appendix C. This plan includes objectives/goals, target species, timing of relevant stages, methodology, maintenance and monitoring.</p>	
<ul style="list-style-type: none"> • For each mitigation measures the draft preliminary document failed to provide: <ul style="list-style-type: none"> ○ performance and completion criteria; 	<p>Completion and performance criteria are provided in Section 5.5. These criteria are based on criteria and management objectives set out in the following management plans and procedures:</p> <ul style="list-style-type: none"> • Environmental Management Plan (Appendix B) • Revegetation Report Plan (Appendix C) • Water Management Plan (Appendix D) 	
<ul style="list-style-type: none"> ○ monitoring and reporting arrangements; and 	<p>Monitoring and reporting arrangements are provided in Section 5.6. Monitoring requirements are based on information provided in the following management plans and procedures:</p>	
<ul style="list-style-type: none"> ○ potential risks/threats, including residual risks, and any measures that would be implemented to mitigate against these risks, and any proposed monitoring to confirm the effectiveness of these measures. 	<p>A detailed risk assessment has been developed for the project and is provided in Section 5.7.</p>	
<ul style="list-style-type: none"> • The draft preliminary document failed to provide evidence of the effectiveness of avoidance and mitigation measures discussed above, noting that the effectiveness of a particular measure is a reflection of the confidence in the ability of the measure to reduce the risk or threat. The assessment of effectiveness should be evidence-based and include examples of demonstrated success of the measure to achieve the desired avoidance or mitigation outcome. 	<p>Avoidance and mitigation measures for all potential impacts are provided in Section 5.</p> <p>An assessment of the risk of the project to MNES is provided in Section Risk assessment on the project is provided in Section 5.7.</p>	<p>Measures identified as avoidance and mitigation in this document are largely standard best practice as identified by state and local government agencies. Through this process the entire project has evolved in accordance with environmental planning principles, with all the relevant approvals being sought and received.</p>
<ul style="list-style-type: none"> • The draft preliminary document did not discuss proposed avoidance and 	<p>As part of the approval process for this project, the disturbance footprint has been almost halved (since the original application),</p>	

Information Requested	Preliminary and Supporting Documentation	Comments
mitigation measures in terms of their expected effectiveness and cost.	which has resulting in a net benefit to the local environment at financial cost to the proponent. A cost schedule is provided in the Revegetation Report (Appendix C)	
<ul style="list-style-type: none"> The draft preliminary document did not provide management commitments by the person proposing to take the action must be clearly distinguished from recommendations or statements of best practice made by the document author or other technical expert. It is preferable to provide a consolidated table of management commitments, including details on funding, roles and responsibilities and measurable performance criteria. 	Management commitments are provided in a table form in Section 7.	
5. OFFSETS		
The proposed offsets did not sufficiently address information requirements for EPBC Act offset proposal (Attachment B).	Information on offsets is provided in Section 8. This section includes information of the potential impacts to the MNES as well as an offsets strategy, which will meet 100% of the direct offset requirements for loss to foraging habitat. Compliance against the offset principles is provided in Section 8.3.	*The proposed action will have no significant direct impact on Carnaby’s cockatoo individuals or their breeding habitat. The site does not provide suitable nesting/breeding or roosting habitat, with only low value foraging habitat recorded. Dominant plant species present in the project area are not considered preferred foraging plants. Regardless, the project has committed to revegetating an adjacent 10.6ha area to compensate for the 8.3ha of low value foraging habitat. This offset area has been determined based on the offset calculator.
6. ECONOMIC AND SOCIAL MATTERS		
<p>The draft preliminary document did not provide information about the expected economic and social impacts of the proposed action (both positive and negative). This should include, but not necessarily be limited to, the following:</p> <ul style="list-style-type: none"> Consideration of both costs (e.g. disruption to existing community infrastructure or environmental features) and benefits (e.g. increased housing or employment) of the proposed action, including the basis of any estimations of costs and/or benefits. 	<p>Economic benefits of the project are provided in Section 1.3.5.</p> <p>Potential social impacts, which specifically relate to amenity issues (such as visual impacts, noise and dust emissions for residents) are identified in Section 4.1.4.</p> <p>Impact assessment of potential amenity related impacts is provided in the following sections:</p> <ul style="list-style-type: none"> 4.3.3 Dust impact assessment 4.3.4 Noise impact assessment 4.3.13 Visual amenity 	
<ul style="list-style-type: none"> Details of any public and/or Indigenous stakeholder consultation activities, 	Indigenous heritage considerations are provided in	During the initial application for planning consent, the register of

Information Requested	Preliminary and Supporting Documentation	Comments
including the outcomes of those consultations.	Section 9.2 (within Section 9, Economic and Social Matters) Economic benefits and considerations are provided in Section 1.3.5 and Section 9.1	Aboriginal Heritage Sites was examined, and no sites were identified.
<ul style="list-style-type: none"> Consideration of different scales of economic and/or social impacts where relevant (e.g. local versus national). 	Indigenous heritage considerations are provided in Section 9.2 (within Section 9, Economic and Social Matters) Economic benefits and considerations are provided in Section 1.3.5 and Section 9.1	Not completely sure what this means in the context of the project.

8. ECOLOGICALLY SUSTAINABLE DEVELOPMENT

The draft preliminary document did not include a discussion of how the proposed action meets the principles of ecologically sustainable development, as defined in s.3A of the EPBC Act.

The draft preliminary document simply states that the proponent will incorporate a range of processes to achieve and promote these five Ecologically Sustainable Development principles within their proposed limestone extraction operation.

Section 10 provides information on ecologically sustainable development. Each ecologically sustainable development principle (as defined in section 3A of the EPBC Act) is addressed in the following Sections:

- Section 10.1 The integration principle
- Section 10.2 The precautionary principle
- Section 10.3 The intergenerational principle
- Section 10.4 The biodiversity principle
- Section 10.5 The valuation principle

INFORMATION REQUESTED FEBRUARY 7, 2020

Regarding section 2.1 of the Additional Information Report (the Report), the targeted flora survey conducted by Plantecology Consulting on 19 November 2018 and the NatureMap desktop analysis, do not adequately address threatened vascular plant species. The Department notes that the NatureMap desktop analysis states that Dwarf Bee Orchid (*Diuris micrantha*) is unlikely to occur within 5km of the proposed action area. However, the Department's Environmental Reporting Tool (ERT) shows that *D. micrantha* is known to occur within that area, and that the Dwarf Hammer Orchid (*Drakaea micrantha*) is likely to also occur. Furthermore, according to the Department's orchid survey guidelines, the targeted flora survey was conducted outside peak flowering period for these species and is insufficient for a cryptic species that requires survey replication. The Department therefore requests the Report be updated to include a discussion of threatened orchid species within the development envelope.

Information provided by Plantecology (Dr Shane Chalwell).

Following a reconnaissance survey (Flora and Vegetation Environmental Values Survey, LEC 2018), which accompanied the initial application to clear native vegetation under the EP Act, a review identified a number of potential impacts, as outlined below:

- The application area comprises limestone heath geology, which corresponds with the recorded occurrence of Vegetation Type 2 (as identified in the Flora and Vegetation Environmental Values Survey, 2018 (the Survey)). This vegetation type may be representative of Floristic Community Type 26a, known as '*Melaleuca huegelii* - *Melaleuca systema* shrublands on limestone ridges (Gibson et al. 1994 type 26a)' (*Melaleuca* TEC), which is a State listed threatened ecological community.
- The application area, and specifically Vegetation Type 2, is considered to provide suitable habitat for three priority flora species, being, *Alyogyne* sp. Rockingham (G.J. Keighery 14463) (Priority 2), *Pterostylis frenchii* (Priority 2) and *Hibbertia spicata* subsp. *leptotheca* (Priority 3). The Survey noted that *Alyogyne* sp. Rockingham (G.J. Keighery 14463) and *Hibbertia spicata* subsp. *leptotheca* were unlikely to occur within the application area, however both species have been recorded within habitat types that share similarities with the application area.
- Based on the distribution and number of records of these species, the proposed clearing may impact on their conservation status if present. While the Survey did not identify these species, noting that it was a reconnaissance survey rather than a targeted survey, and that it was not undertaken at the ideal time to detect these

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		<p>species (April rather than during spring), it is considered that these species may occur within the application area.</p> <p>A second survey was then undertaken, in which the survey timing was agreed with DWER prior to the survey (see attached email correspondence Appendix 1). This second Survey (Plantecology 2018) was then commissioned with a specific scope to identify and confirm the presence of conservation significant flora and vegetation, as identified above. Apart from the FCT 26a issue (the major focus of the survey), the main priority species likely to occur given the habitat was <i>Pterostylis frenchii</i>, which occurs in tuart woodland on limestone. The threatened flora were not flagged as being a concern by DWER. We therefore planned the survey to address the specific DWER concerns, which is why we timed the survey for November and why a letter report was considered appropriate following discussion with DWER regarding this. At no time in discussions with DWER was <i>Diuris micrantha</i> (which does come up on the NatureMap search but occurs in winter-wet swamps and so is not an issue for that site), or <i>Drakaea micrantha</i> (which does not come up in the NatureMap searches and occurs in sandy soils in jarrah forest further inland and is not a limestone species, so also wasn't an issue) raised as a concern and potentially occurring in the area (given that its limestone habitat) and neither sandy. This information was not an issue for the State agencies at the time, and the issues that did concern the State have been specifically addressed.</p>
<p>Regarding section 5.2 of the Report, noise from activity on the proposed action area is "expected to be localised and create minimal nuisance" to the migratory species that utilise the Ramsar listed Lake Preston. The Department notes that section 5.6 of the Environmental Management Plan recommends a buffer of 300-500 m between the limestone pit and "Sensitive Land Uses", "depending on the extent of the processing". Given that the proposed 300 m buffer is the minimum distance required and that neither Sensitive Land Uses nor the extent of the processing is defined, the Department requires the Environmental Management Plan be updated with further detail and justification for the expectation of minimal noise impacts to migratory species within the Ramsar wetland.</p>		<p>An environmental noise model has been constructed using Sound Plan 4. This model illustrates that the 45 dB contour has a maximum extent of the eastern lakeshore and that the 40 dB contour crosses into the Lake. These contours have been simulated with 5 pieces of crushing and ancillary equipment operating in the pit simultaneously. These values are very low when viewed in the context of the noise produced by wind on water in the coastal zone. The noise model has been printed to Figure 2 and included as Appendix 2. In addition, results of research conducted by Institute of Estuarine & Coastal Studies, University of Hull (Cutts et al 2013), suggest that construction noise of less than 50dB have a Low impact on estuarine waterbirds.</p>
<p>Regarding section 3.1.1 of the Report, the Department notes that the Baudin's Black Cockatoo (<i>Calyptorhynchus baudinii</i>) and Forest Red-tailed Black Cockatoo (<i>Calyptorhynchus banksii naso</i>) utilise Jarrah (<i>Eucalyptus marginata</i>) and Tuart (<i>Eucalyptus gomphocephala</i>) as habitat. The Department also notes that these are the dominant tree species within the proposed project area. Please provide a discussion on the likely occurrence of these two</p>		<p>Information provided by Greg Harewood, consulting Zoologist. A black cockatoo habitat assessment has been carried out over the site and the results presented in a stand-alone report this being - Harewood, G. (2019) Fauna Assessment CPS 8057/1 Lot 4 & 5 Ludlow Road, Myalup. Unpublished report for B & J Catalano. Version 3. November 2019.</p> <p>The Department state above that the dominant tree species within the proposed project area are tuart and jarrah. This is incorrect, the dominant tree species (i.e. greatest number of individual specimens) is Limestone marlock (<i>Eucalyptus decipiens</i>). Limestone marlock is not documented in available literature as being used by any of the</p>

Information Requested	Preliminary and Supporting Documentation	Comments
<p>threatened black cockatoo species within the proposed project area and the impacts to their habitat.</p>	<p>black cockatoo species a breeding habitat, foraging habitat or roosting habitat.</p> <p>A breeding habitat survey identified a total of 27 trees with a DBH of >50cms within the proposed pit area (15 of which were limestone marlock which is not a tree known to be used for breeding in any event). Twenty-two of the trees (~81.5%) were not observed to contain hollows of any size. Five trees (~18.5%) contained one or more possible hollows considered by the Author not to be suitable for black cockatoos to use for nesting purposes.</p> <p>No trees appeared to contain hollows with larger entrances (greater than ~10cm) that appeared big enough to possibly allow the entry of a black cockatoo into a suitably sized and orientated branch/trunk.</p> <p>Based on available vegetation mapping it is estimated that there is approximately 9,514 ha of native vegetation within 10 km the subject site. Remnant native vegetation present within the subject site (total ~8.3 ha) makes up ~0.087% of this total. It can be reasonably expected that these areas contain numerous “habitat trees” many of which are likely to provide breeding opportunities for black cockatoos.</p> <p>Following is a list of the main flora species recorded within the subject site during the fauna assessment that are known to be used as a direct food source (i.e. seeds or flowers) or indirect food source (grubs) by one or more species of black cockatoo:</p> <ul style="list-style-type: none"> • Tuart (<i>Eucalyptus gomphocephala</i>) - seeds, • Jarrah (<i>Eucalyptus marginata</i>) - seeds; • Peppermint (<i>Agonis flexuosa</i>) – bark, grubs; and • Candlestick Banksia (<i>Banksia attenuata</i>) - seeds. <p>Overall, the subject site cannot be regarded as representing quality black cockatoo foraging habitat. Tuarts and peppermint are only foraged upon rarely and the number of jarrah and banksia trees present is very small and would amount to far less than 1 ha in total. No foraging debris left by black cockatoos was observed within the subject site during the site surveys, though a small amount of evidence (chewed tuart fruits) was recorded just outside of the proposed pit area. This foraging evidence was attributed to the forest red-tailed black cockatoo two individuals of which were observed feeding within the tree.</p> <p>Based on available vegetation mapping it is estimated that there is approximately 9,514 ha of native vegetation within 10 km the subject site. Remnant native vegetation present within the subject site (total ~8.3 ha) makes up ~0.087% of this total. There area is also over 3,000 ha of pine plantations with 10km of the site. Pinecones provide an important food source for Carnaby’s black cockatoo and to a lesser extent Baudin’s black cockatoo.</p> <p>No evidence of black cockatoo roosting within trees located within the subject site was observed during the field reconnaissance survey. A review of the 2017 Great Cocky Count database shows no documented roost sites within or near the subject site. The closest recorded roost is about 6 km south east of the subject site, but no birds have been recorded at this location (during the Great Cocky Count) since 2011.</p> <p>Based on available vegetation mapping it is estimated that there is approximately 9,514 ha of native vegetation within 10 km the subject</p>	

Information Requested	Preliminary and Supporting Documentation	Comments
	<p>site. Remnant native vegetation present within the subject site (total ~8.3 ha) makes up ~0.087% of this total. There are also over 3,000 ha of pine plantations with 10km of the site. It can be reasonably expected that these areas contain many roosting options for black cockatoos.</p> <p>The overall habitat quality for black cockatoos within the subject site can therefore be regarded as being low. There are only a small number of habitat trees (DBH >50cm) in or near the subject site and none contain hollows suitable for black cockatoos to use for nesting. The extent of foraging habitat is very small and dominated by plant species foraged upon only rarely, if at all (i.e. small fruited eucalypts). There were no roosting sites identified within or near the subject site. Based on available vegetation mapping it is estimated that there is approximately 9,500 ha of native vegetation within 10 km the subject site, much of which is very likely to represent potential black cockatoo breeding, foraging and roosting habitat of some type. Remnant native vegetation present within the subject site (total ~8.3 ha) makes up ~0.087% of this total.</p> <p>Based on these observations impacts on black cockatoos that will result as a consequence of development at the subject site is likely to be negligible.</p>	
<p>According to section 5.3 of the Report, a minimum depth to the underlying water table of 4.5m from the pit floor will be maintained, and if groundwater is exposed, the exposed area will be backfilled to a depth of 2m. The Department requires that the Report be updated with details on how monitoring of the distance between the pit floor and the water table will be carried out.</p>	<p>It is proposed that the separation of 4.5m between the pit floor and the water table will be monitored by the construction of a monitoring bore in the pit to measure groundwater levels and by an annual pit survey to monitor the pit floor level.</p>	
<p>Substances, quantities, and area of application of fertilisers and herbicides post closure to be included.</p>	<p>The Water Management Plan will be updated as follows:</p>	<p>A total of 18,000 native plants and 28 ha of pastures will be planted on completion of the extraction activities. Where native vegetation is to be planted, weed management will be undertaken by a licensed contractor using the appropriate quantities of glyphosate required. This can only be calculated just before planting since weed cover cannot be predicted. Each native plant stem will be fertilised using a 10gm native plant fertiliser tablet with NPK composition of 20:1:10%. For the 28ha of pasture planting, best practice guidelines for planting near sensitive water resources indicate that a soil test should be done just prior to planting with the appropriate soil treatments being determined from the soil tests. It is still at least 5 years before any planting will be undertaken and soil conditions will change during this period.</p>

*Notes provided by Greg Harewood, experienced Zoologist, responsible for fauna surveys within the project area.

1.3 THE PROPOSED ACTION

1.3.1 Location, Land Use and Tenure

1.3.1.1 Property description

Address	Lot 4 and Lot 5 on Deposited Plan 15419, Ludlow Road, Myalup,
Local Government Authority boundary	Shire of Harvey
Volume	1884
Folio	210
Area	Lot 4 – 81.115ha; Lot 5 - 62.030ha
Disturbance footprint	13.5ha total footprint, of which 8.5ha is vegetated

1.3.1.2 Location

The property is situated west of Forrest Highway, approximately 50km north of Bunbury (Figure 1). Lots 4 and 5 are bounded by Lake Preston to the west, Lot 2 to the north, Lot 17 to the east and Lot 18 to the south (Figure 2).

1.3.1.3 Ownership

Geoffrey Thomas Pearson T/A Pearson Nominees Pty Ltd.

1.3.1.4 Zoning

The area is zoned as 'General Farming' in terms of the Shire of Harvey Town Planning Scheme No. 1 (Shire of Harvey 1996) and 'Rural' in terms of the Greater Bunbury Region Scheme (WA Planning Commission 2017).

1.3.1.5 Land Use

Catalano has been undertaking limestone extraction on the property (Lots 4 and 5 on Deposited Plan 15419 Ludlow Road, Myalup, Shire of Harvey, Western Australia) since 2009. The south-eastern section of Lot 5 is also currently used for cattle grazing.

Adjacent land to the property is used primarily for livestock pastures interspersed with remnant vegetation. To the west of the property is Lake Preston, a RAMSAR designated wetland.

The closest residence to the outer boundaries of the extraction area is located 250m to the west of the proposed extraction area (Figure 2). This residence is used as a holiday accommodation by the landowner. The landowner has no objections to the proposed operations; hence this residence is not considered a sensitive premise. No other residences or structures are located within 1000m of the Proposed Action.

1.3.1.6 Size of proposed action

A total 13.5ha extraction area (reduced from 25ha), of which 8.3ha contains native vegetation and 5.2ha is already cleared.

1.3.2 Proposal Description

1.3.2.1 Project industry type

Mining

1.3.2.2 Existing operations

Limestone extraction operations are currently being undertaken within the southern section of Lot 4 and northern section of Lot 5. These existing operations cover an area of 21 ha with an annual extraction volume of 55,000m³. The sequence of operational activities is as follows:

- Vegetation is removed and the area stripped of topsoil.
- Topsoil is placed in stockpiles.
- Within the active cell, a bulldozer rips and blades limestone material to a stockpile.
- A mobile crushing and screening plant (used for approximately six weeks per annum) processes the stockpiled material.
- Trucks enter pit via Ludlow Road and are loaded from the processed stockpile using a front-end loader.
- Excavation of limestone material proceeds until a bottom pit level of 6 meters Australian Height Datum (mAHD) is reached with pit batters maintained at a 1:6 throughout the operation where possible.
- The pit area is then re-landscaped (contoured) and topsoil from stockpiles is spread over the resurfaced landscape.
- Seedlings and seed will be used to revegetate the site to pasture or native vegetation, as per the rehabilitation requirements within the Environmental Management Plan (Appendix B).

On average 14 truck movements per working day are associated with the operation, but actual truck movements will depend on demand. Operating times are Monday to Saturday 6am to 6pm.

1.3.2.3 Proposed action

It is proposed to expand the limestone extraction operations in a westerly direction. The new pit area will be developed over a 13.5ha area (reduced from 25ha). The expansion will result in the removal of 8.3ha of degraded to completed degraded Eucalyptus woodland and Melaleuca shrubland with a predominantly pasture grass understorey. Operational activities in the new pit area will be the same as those described above for existing operations (Section 3.2.2).

An annual extraction volume of 95,000 tonnes is planned over a 5-year period. The day to day operations will be conducted using one bulldozer and up to two front-end loaders, which will load trucks (off-site equipment anticipated to generate an average of 14 truck movements per working day).

The final land surface will be at 6 mAHD with pit batters of 1:6, which is not dissimilar to slopes occurring naturally within the surrounding landscape. The area will be rehabilitated upon cessation of extraction activity and will be required to meet defined completion criteria as detailed in the rehabilitation section of the Environmental Management Plan (Appendix B) and in the Revegetation Report (Appendix C).

A recommended buffer of approximately 300m from Lake Preston will be maintained throughout the operational life of the extraction activities. Proposed activities will not directly impact this conservation area.

No major servicing, which could lead to fuel and oil spills, will take place on the site. In accordance with the currently approved Reconsideration Decision – not a controlled action if undertaken in a particular manner

for EPBC 2008/3956 dated 24th April 2017, ‘Servicing of any vehicle must take place at least 100 metres from the shore of Lake Preston’. All vehicles must be serviced and refuelled in a contained and bunded area. Prior to servicing, a suitably sized spill mat or drip tray will be placed under the vehicle to capture any leaks or spills. Servicing of vehicles will consist of the direct vacuuming of waste fluids from the engine of the vehicle being serviced to a waste oil tank on the service truck. A drum will be placed under the oil filter of the vehicle being serviced prior to its removal. Any material captured in the drip tray or drum during servicing will be disposed of into the waste facility of the service truck, removed off site and disposed of at an appropriately licensed waste facility. Spill kits will be kept on all service truck(s) when servicing vehicles on site. Any spills will be contained on site, mitigated and recorded. The Western Australian Water Quality Protection Guidelines No’s 6,7,10 and 11 will be adhered to, to prevent hydrocarbons or other contaminants from being spilled into the Peel-Yalgorup System Ramsar Wetland.

There will be no chemicals or other hazardous materials stored on-site.

Proposed activities

Catalano have been operating a limestone extraction pit on this property since 2009 (under Extractive Industries Licence Ref:15/06142). The extent of the extraction undertaken to date is shown in Figure 2 and Figure 3.

The proposed limestone extraction area is approximately 13.5ha total, as illustrated in Figure 3.

The approximate annual removal of limestone over the 5-year licence period will be 95,000 tonnes but actual extraction volumes will depend on demand.

Key characteristics of the proposed activities are as follows:

- Extraction of limestone from a total area of approximately 13.5ha.
- Removal of existing trees from the 8.3ha vegetated portion of the extraction area (12.9ha under Clearing Permit) by mechanical means. Cleared vegetation will be windrowed and redistributed as part of the rehabilitation process. Of the 13.5ha extraction area, 5.2ha (38.4%) is already cleared and 8.3ha (61.6%) is vegetated.
- Removal and stockpiling of topsoil and overburden. Topsoil and over-burden will be stockpiled separately along the edges of the extraction area, with stockpiles being no higher than three metres.
- Limestone processing via a mobile crushing and screening plant used for approximately six weeks per annum to prepare the material for haulage offsite. Dust management is discussed in Section 9 and Appendix B.
- The final pit floor after extraction will be 6m AHD.
- Rehabilitation with native vegetation will be done in accordance with the Clearing Permit, with the remaining area sown to pasture grasses.

Rehabilitation is broadly covered in in the proposal’s Environmental Management Plan (Appendix B) and in further detail in the Revegetation Report (Appendix C). Table 2 below summarises the actions that are to take place on the property over the next 5-year licence period commencing from the time of approval.

Table 2. Stages of proposed activities

Action	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
Remove existing trees					
Excavate and crush limestone					
Remove material by truck					
Rehabilitate (in winter)					

Site Access and Egress Roads

Access to the site will be obtained via Ludlow Road which is surfaced with limestone. The access road is pre-existing due to previous excavation and is maintained by Catalano (Figure 3).

Estimated Traffic to be Generated

Estimates of traffic movements

- Total annual limestone removal: 95 000 tonnes approx. (59 300m³)
- Number of working days per month: 24 days
- Vehicle payloads (GAV¹): Road train (56 tonnes) Rigid truck and trailer (42 t) Single Semi-loader (25 t)
- Proportional use: 56 tonners (t) (80%), 42 t (15%), 25 t (5%)

The above estimates suggest an average of 14 truck trips (in and out) per working day, but this will be dependent on demand. Operating times will be Monday to Saturday 6am to 6pm.

1.3.2.4 Decommissioning and rehabilitation

Catalano is committed to revegetating 5ha within the pit perimeter under existing approvals (EIL 15/06142). A further 13ha will be rehabilitated as part of the proposed excavation area giving a total of 18ha of revegetated land and 28ha of pasture grasses. The areas planted with native vegetation will have a similar species composition, structure and density to the pre-cleared vegetation types in the area.

The approval of the current Extractive Industries License 1/06142 that covers the existing operation on Lots 4 and 5 Ludlow Road included the endorsement of a rehabilitation plan and a list of species to be used in rehabilitation. The endorsed species list will be applied to the rehabilitation of the proposed new extraction area.

Proposed Rehabilitation Measures

Rehabilitation will commence once extraction within the area is complete with the following steps being implemented:

- All batters behind the active working face will be contoured to achieve a slope gradient of no more than 1:6. The final rehabilitated pit floor will be at 6 mAHD;
- Stockpiled topsoil/ overburden will be respread over completed areas;
- The pit floor and batters will be ripped to alleviate compaction, improve filtration, attenuate stormwater runoff and facilitate rapid root penetration;
- The base of the pit will be seeded with pasture grasses which will be used for cattle grazing;
- An area of batter slopes of approximately 13ha will be revegetated using endemic species of local provenance using both direct seeding and planted seedlings.
- Rehabilitation work will only be carried out just prior to, or during winter, within 6 months of cessation of extraction activity; and
- Due to the internally draining nature of the pit no offsite sedimentation issues are anticipated. Stormwater within the pit will continue to infiltrate to the underlying water table.

The proposed final land surface is shown in Figure 5.

¹ General Access Vehicle (in terms of Road Traffic Rules and Regulations 2002)

1.3.2.5 Monitoring and maintenance

During the extraction and early rehabilitation phase, the extraction area will be inspected after every significant rainfall event to check erosion damage. If any repairs are required, this will be attended to immediately.

After pit closure the areas sown with pasture grasses will be monitored to ensure that any areas requiring remedial work are identified. Monitoring will be carried out on an annual basis to assess:

- The physical stability of the landform in the rehabilitated areas.
- Evidence of concentrated sheet flow rather than infiltration.
- The emergence of weeds requiring control.

Maintenance procedures will be carried out where necessary and may include:

- Repair of any erosion damage.
- Replanting/seeding areas that may not have regenerated sufficiently.
- Weed control.

Completion Criteria

Completion criteria have been defined to ensure that the overall objectives of the rehabilitation are met. The completion criteria for extractive operations on Lots 4 and 5 are presented in Table 3 and are based on the Rehabilitation component of the Environmental Management Plan (Appendix B) and the Revegetation Report (Appendix C).

Table 3. Completion criteria, objectives and interim targets.

Criteria	Objective	Interim Targets
Safety	The site is safe to humans.	Site is safe to humans during operations.
Sustainability	The site is sustainable in the long term without additional management inputs.	-
Suitability	The site is suitable for use as pasture.	-
Visual amenity and heritage	The rehabilitated extraction area blends into the surrounding environment.	No public complaints about a loss of visual amenity.
Soils and stability	Soil profiles and structures are sufficient to ensure grass establishment. The landform is stable. Stormwater is contained within the site.	Topsoil is respread in all rehabilitation areas. Identification and mitigation of potential erosion scars and scours during operations.
Weeds	No new declared weed pests are present. The level of weed species should not be detrimental to the planted seedlings or horticulture.	Declared weed species removed systematically during operations.

A Permit to Clear Native Vegetation under the *Environmental Protection Act 1986* (EP Act) is required prior to the commencement of clearing operations. The conditions of the Clearing Permit are likely to require that detailed native vegetation rehabilitation, monitoring and maintenance plans are prepared.

1.3.3 Estimated timing of the proposed action.

- Start date 01/2020
- End date 12/2029

1.3.4 Feasible alternatives

No feasible alternatives to the development of this additional area exists.

1.3.5 Economic Benefits

The material extracted from this pit has a high calcium carbonate content and is very suitable for soil conditioning within the agricultural areas of the south west of Western Australia. The agricultural lime supply from this pit is an important resource for farmers within 50km of the site.

1.3.6 Planning Framework and Government requirements

The proposal has been applied for as an Extractive Industry Licence (EIL) and is thus subject to local government laws and is currently being assessed by the Shire of Harvey. A clearing permit (CPS 8057/1) has been applied for and all technical studies undertaken. A letter of Agreement in Principle, noting that a clearing permit would be granted once the EIL has been issued is to be provided by the Department of Water and Environmental Regulation as stated in an email to M Lundstrom on 27th November 2018.

1.3.7 Stakeholder Consultation

The proposal has been publicly advertised via the EIL, Clearing Permit and EPBC Act approval processes.

Engagement of stakeholders is ongoing, including with decision making authorities (DMA's), land owners, local residents (via local government).

1.4 EXISTING ENVIRONMENT

1.4.1 Topography

The broad drainage pattern across the surrounding unaltered land surface is east to west towards Lake Preston. There are no surface drainage lines within the extraction area. Instead, rainfall infiltrates into the permeable substrate.

The proposed excavation area is partially situated over a north-south trending ridge of dune/karstic topography with a maximum elevation of 23 mAHD. The western extent of the proposed excavation has an elevation of approximately 12 mAHD. The property contains some hills near the extraction area that reach an elevation of 35 mAHD. From these hills to the eastern boundary of the property, the elevation decreases to approximately 15 mAHD.

1.4.2 Groundwater Hydrology

The property lies in the Harvey Diversion Catchment within the Harvey River Basin and does not fall within a Public Drinking Water Source Area. The property lies within a *Rights in Water and Irrigation Act 1914* (RIWI Act) Groundwater Proclamation Area (South West Coastal Groundwater Area) but does not fall within a RIWI Act Surface Water Proclamation Area (Landgate 2018).

Lots 4 and 5 adjoin the eastern boundary of Lake Preston, which is listed as a conservation wetland, a Ramsar wetland, an Environment Protection Policy (EPP) Lake, and is included in the Department of Parks and Wildlife (DPaW) managed lands and waters (Figure 2).

Groundwater flows in a westerly direction in the superficial aquifer below the site into Lake Preston where it is discharged by evaporation. This results in Lake water salinities that vary between 42,000 and 90,000 mg/l TDS (Commander 1988) with super-saline groundwater below the Lake. Groundwater flowing into the Lake is reasonably fresh, usually below 1500mg/l. A TDS measurement of 1,000mg/l was taken from a groundwater soak 30m to the east of the lake edge in early November 2005, whilst the Lake water itself was in excess of 30000mg/l. This illustrates that the westward moving groundwater discharges over the top of the hyper-saline plume below the Lake.

The cross-sections (Figure 5 and Figure 6) suggests a hydraulic gradient of approximately 1:1,100. Due to very high transmissivity within the ground materials, this gradient is likely to occur beneath the deeper limestones also.

Further details of the water resources (and management) are included in the Water Management Plan as Appendix D.

1.4.3 Geology and soils

The superficial geology comprises calcarenite, marl and shell beds of the Tamala Formation (Commander 1988). In this area various facies of calcarenite achieve thicknesses of 30 to 35m (Semeniuk 1995). The westernmost third of the property has a covering of calcitic caprock which is up to 1 metre thick, whilst further east the limestone is covered by 0.5 to 1m of sand.

The proposal area lies within the Swan Coastal Plain, which is characterised as a low-lying coastal plain, often swampy, with sand hills consisting mainly sandy, yellow soils (Beard 1990).

The soils are mapped within the Perth Coastal Soil Landscape Zone (211), which is described as coastal sand dunes of calcareous and siliceous sands and calcarenite, of late Pleistocene to Recent age (Purdie *et al.* 2004).

The Perth Coastal soil landscape is further divided into subsystems, of which the proposal area sits within the Spearwood S1a Phase (211Sp__S1a) subsystem. The Spearwood S1a subsystem is described as dune

ridges with shallow to moderately deep siliceous yellow-brown sands, very common limestone outcrop and slopes up to 15% (Purdie *et al.* 2004).

The area is described as having a shallow, sandy topsoil that overlies inter-bedded limestone, calcarenite, marl and shell beds of the Tamala Formation. Previous work by Commander (1988) shows that the limestone is approximately 20m to 25m thick and unconformably overlies sands, shales and siltstones of the Leederville Formation.

The westernmost third of Lots 4 and 5 has a covering of calcitic caprock which is up to one metre thick, whilst further east, the limestone is covered by 0.5 to 1m of sand.

A search of the Acid Sulphate Soil (ASS) risk map for the Swan Coastal Plain identified no risk from ASS within the proposal area. The nearby Lake Preston (and approximately 100m buffer) is considered a high to moderate risk of ASS occurring within 3m of natural soil surface (Acid Sulphate Soil Risk Map, Swan Coastal Plain, DWER-055).

1.4.4 Hydrogeology

The proposal is located within the Harvey Diversion Catchment of the Harvey River Basin (Hydrographic Catchments – Subcatchments, DWER-030).

A search of the Department of Water and Environmental Regulation (DWER) Water Information Reporting database found four bores (these are the Lake Clifton D1, D2, C4 and C5 bores), lying within the same catchment as the property, for which sufficient water level data was available to build and interpret hydrographs. Hydraulic gradients and flows in the area are heavily influenced by groundwater discharge to the eastern shore of Lake Preston.

Due to the uniformity of the groundwater gradient north to south, the conditions observed at these bores are considered to be representative of the groundwater conditions at the property, even though these bores are located approximately 5.5km to the south and 5.5km to the north of the property (Figure 7).

Details on the bores and associated hydrographs have been provided in the Water Management Plan (Appendix D). Using publicly available groundwater level data, it is estimated that the highest water table that occurred at the proposed EIL area was 0.15mAHD at the western boundary, and 0.5mAHD at the eastern boundary. Since the proposed extraction depth is 6mAHD, no groundwater is expected to be intercepted during limestone extraction (Figure 5, Figure 6 and Figure 7).

1.4.5 Wetlands

There are no geomorphic wetlands mapped within the proposal area. Lake Preston (approximately 300m west of proposal area at its closest point) is mapped as a conservation category lake/wetland, and there are numerous multiple use category damplands approximately 2.5-3 km east of the proposal area, running parallel to Lake Preston (Geomorphic Wetlands, Swan Coastal Plain, DBCA-019).

There is no Ramsar Site within the proposal area. Lake Preston, which is approximately 300m west of the survey area, is part of the “Peel – Yalgorup System” (Ref 36) Ramsar wetland (Ramsar Sites, DBCA-010). This wetland covers an area of approximately 26,500ha and comprises a large system of shallow estuary and saline, brackish and freshwater lakes. Many tens of thousands of waterbirds, including large numbers of migrant shorebirds from the northern hemisphere, use the estuary and lakes each year (RIS 2003).

1.4.6 Vegetation

1.4.6.1 General

The property is situated in the Southwest Botanical Province of Western Australia (Beard 1990), and within the Swan Coastal Plain bioregion (Perth subregion) as described by the Interim Biogeographic Region of Western Australia (DoEE 2018c). At a regional level, the property occurs within the Cottesloe-Central and

South vegetation complex which is described as a mosaic of woodland of *Eucalyptus gomphocephala* (Tuart) and open forest of *Eucalyptus gomphocephala* - *Eucalyptus marginata* (Jarrah) - *Corymbia calophylla* (Marri); closed heath on the Limestone outcrops. The Cottesloe Complex-Central and South has 32.2% of the pre-European extent remaining on the Swan Coastal Plain and 41.8% remaining within the Shire of Harvey (DBCA 2017) which meets the EPA's Natural Area Strategy objective of retention of at least 30% of the pre-clearing extent on the Swan Coastal Plain.

An Environmentally Sensitive Area (ESA) is an area where the vegetation has high conservation value and cannot be cleared. ESAs are declared by the Minister in the Environmental Protection (Environmentally Sensitive Areas) Notice 55 (2005) under section 51B of the *Environmental Protection Act 1986* (EP Act). There is no ESA within the proposal area. Lake Preston is listed as an ESA and is located approximately 300m from the proposal area at its closest point.

No Department of Biodiversity Conservation and Attractions (DBCA) listed Threatened Ecological Communities (TECs) have been previously recorded within the proposal area. The closest recorded TEC is approximately 2km north of Lot 4 (Threatened Ecological Communities, DBCA-038). According to a map of potential EPBC Act listed TECs, Banksia Woodlands of the Swan Coastal Plain may occur within the proposal area (DoEE 2018b).

The proposal area is not within the Bush Forever mapping area (DoP 2018). The proposal area lies within a Tuart Woodlands, as mapped by CALM (2003) in the "Tuart Atlas", which maps and assesses data on tuart occurrence, overstorey density and understorey condition on the Swan Coastal Plain. The Atlas has classified the tuart woodland polygon within the proposal area as 10-19% canopy density and classified the visible native understorey condition as highly disturbed.

A reconnaissance vegetation assessment (LEC 2018) and a follow-up detailed flora and vegetation survey (Plant Ecology 2018, Appendix E) have been conducted at the proposal area. Results from these field assessments found that there were three main vegetation types within the proposal area (Figure 8):

- *Eucalyptus decipiens* open woodland on the shallow soils over limestone of the ridge crest and upper slopes;
- *Eucalyptus gomphocephala* woodland on the deeper soils of the lower slopes; and
- *Melaleuca systema* shrubland on shallow soils over limestone on the ridge crest and upper slopes.

These vegetation types were rated as being in a 'Completely Degraded' condition, as the native understorey was largely absent and replaced by weed species and the original structure has been almost entirely lost.

The crest and upper slopes also supported patches of *Melaleuca systema* shrubland, which was rated as being in a 'Degraded' condition. These patches supported more native species (mainly shrubs) than the woodland areas, but aggressive weed species such as *Gomphocarpus fruticosus* were prevalent.

1.4.6.2 Conservation significant

Desktop assessments found that the site may potentially support vegetation of Floristic Community Type (FCT) 26a '*Melaleuca huegelii* – *Melaleuca systema* shrublands of limestone ridges'. FCT 26a is listed as a state-based Threatened Ecological Community (TEC) with the rating of 'Endangered' under Western Australian criteria. FCT 26a occurs on skeletal soils of large limestone ridges to the north of Perth and to the south of Mandurah (Gibson *et al.* 1994).

Following two field assessments (LEC 2018 and Plant Ecology 2018 (Appendix E)), it was found that no Threatened or Priority Ecological Communities or Threatened or conservation significant flora or Priority flora (EPBC Act, WC Act or DBCA listed) were identified within the proposal area.

The vegetation within the site is highly unlikely to be part of FCT 26a. FCT 26a is a very distinct group within the SCP dataset with a high mean species richness (50.2 species per plot), and assignment of plots when present is normally quite clear. This result is supported by the description for FCT 26a as occurring on

massive limestones with skeletal soil. Although all the Ludlow Rd plots included outcropping limestone, these areas mainly supported *Eucalyptus decipiens* Woodland, which does not form part of FCT 26a.

Assessment of the FCT on site found that it was most likely that the shrubland areas on the ridges are part of FCT 29a – ‘Coastal shrublands on shallow sands’. FCT 29a is a State-based Priority 3(i) Ecological Community under Western Australian criteria, which indicates this vegetation type, although poorly known, has several to many occurrences, a significant proportion of which is not under threat. This result is consistent with the description of FCT 29a as being mostly heaths of shallow soils over near coastal limestone from Yalgorup to Seabird on the Quindalup Dune System. This FCT has no consistent dominant species and is often quite weedy (Gibson *et al.* 1994).

The vegetation condition within the site ranged from ‘Degraded’ to ‘Completely Degraded’. This was reflected in the equivocal results of the cluster analysis for FCT assignment and is probably due to past use for stock grazing. A significant proportion of the taxa recorded were weeds, some of which were aggressive species such as *Gomphocarpus fruticosus*, *Euphorbia terracina* and *Ehrharta longiflora*. This condition compromises the botanical values of the site and it could not be returned to a more natural structure without the input of considerable resources.

In summary, the results of this survey and analysis indicate that the vegetation within the proposal area is most likely to belong to FCT 29a, which is a Priority 3(i) community under Western Australian criteria, but the ecological values of the site have been compromised by past land uses and the currently degraded condition.

1.4.6.3 Condition (weeds and dieback)

As mentioned previously, the vegetation quality is generally degraded with no native ground cover and a prevalence of weed species due to a cattle grazing land use across the site. Of the weed species recorded within the proposal area, two species, *Gomphocarpus fruticosus* (narrow leaf cottonbush) and *Solanaum linneanum* (apple of Sodom) are listed as Declared Plant species in Western Australia pursuant to Section 22 of the *Biosecurity and Agriculture Management Act 2007* (BAM Act).

There was no evidence of dieback infestations at the site based on the apparent health of dieback susceptible species (i.e. Banksia species).

1.4.7 Flora

1.4.7.1 General

A total of 16 vascular flora species were recorded within the proposal area, which is a low species diversity for vegetation of the Swan Coastal Plain. The low species richness is due to the poor condition of the vegetation, which is predominantly the result of grazing.

The proposal area centres on a subtle ridge of thin grey sand over irregular outcropping limestone, which accommodates *Eucalyptus decipiens* (limestone marlock), *Eucalyptus gomphocephala* (tuart), *Eucalyptus marginata* (jarrah), *Agonis flexuosa* (peppermint) and small populations of *Banksia attenuata* (candlestick banksia) and *Nuytsia floribunda* (Western Australian Christmas tree). The more vegetated sections are generally associated with the central limestone ridge, with isolated trees scattered in the remaining parts.

A native ground cover is generally absent from the site, with only some small areas represented with a relatively dense shrub cover (in patches along the limestone ridge). *Eucalyptus decipiens* is generally the dominant tree species over much of the area. Tuart, *Eucalyptus gomphocephala*, only occurs as isolated trees in the northern and southern sections of the proposal area where soil cover is thicker and clearing is more extensive.

Eucalyptus marginata is represented by only a few specimens at scattered locations in the southern third of the proposal area. *Agonis flexuosa* also has a limited extent with a few scattered specimens and some small groves in the south eastern corner of the proposal area.

Nuytsia floribunda occurs as scattered individuals and small groves in the northern and central section of the proposal area. Only a few specimens of *Banksia attenuata* were observed on the site.

1.4.7.2 Conservation significant

The site is located on a limestone ridge between the active quarry and Lake Preston. The Department of Water and Environmental Regulation (DWER) advised that three priority taxa could potentially occur within the location of the proposal area:

- *Pterostylis frenchii* (P2). This species occurs in tuart and peppermint coastal woodland over limestone (Brundrett 2014);
- *Alyogyne* sp. Rockingham (P2). This taxon is a perennial shrub of the coastal region south of Perth, mainly occurring on soils with limestone nodules; and
- *Hibbertia spicata* subsp. *leptothea* (P3). This taxon is a perennial shrub and occurs in sand on near coastal limestone ridges and cliffs.

Desktop assessments of the area found no Threatened and/or Priority Flora previously recorded within the proposal area, with Priority flora (P3) recorded approximately 1km north and 2km north east of the proposal area (Threatened and Priority Flora, DBCA-036).

Two follow-up field assessments at the site, including a targeted search for conservation significant flora species, recorded no priority or Threatened flora within the proposal area (LEC 2018; Plant Ecology 2018).

1.4.8 Fauna

1.4.8.1 General

With respect to native vertebrate fauna, 12 mammal (including nine bat species), 82 bird, 15 reptile and two frog species have previously been recorded in the wider area, some of which have the potential to occur in (or utilise sections of) the proposal area at times.

Eight species of introduced animals are also considered to frequent the broader area (Harewood 2018).

A terrestrial fauna survey at the proposal area recorded evidence of six fauna species, both native and introduced (Harewood 2018). The western grey kangaroo (*Macropus fuliginosus*) was the most commonly recorded species, with the common brushtail possum (*Trichosurus vulpecula*), Australian magpie (*Cracticus tibicen*) and Australia raven (*Corvus coronoides*) also being recorded.

1.4.8.2 Conservation significant

No fauna species of conservation significance were confirmed as being present or using the site during site surveys. The habitat assessment and other observations made during field reconnaissance surveys does suggest that some fauna species of conservation significance are likely to persist in the general area. Subject to suitable habitat being present (i.e. quality and extent) it is considered possible that some are also likely to reside or at least frequent the proposal area at times. The total size of the proposal area is however relatively small and therefore any fauna species actually present are only likely to be represented by a small number of individuals at any one time.

Black cockatoo habitat at the proposal area is discussed in more detail in Section 5 and in Harewood's revised (2019) Fauna Assessment Report (Appendix F).

1.4.8.3 Pests

Feral species recorded included the red fox (*Vulpes vulpes*) and the rabbit (*Oryctolagus cuniculus*) at one location.

1.4.9 Fauna habitat

1.4.9.1 General habitat

Descriptions of the broadly defined fauna habitats, based on vegetation units and landforms, are broadly described below:

- *Eucalyptus decipiens* over scattered shrubs and bare limestone over most of the proposal area.
- *Eucalyptus gomphocephala* over pasture grasses, dominant in small areas at the northern and southern ends of the proposal area.
- Small grove of *Agonis flexuosa* and *Eucalyptus marginata* in the south east corner of the proposal area.

The area appears to have been open to livestock grazing for many years and therefore is now in a degraded/highly degraded state. Because of this fact many of the fauna species that would have originally occurred in the area no longer persist. The Yalgorup National Park is located east and north of the proposal area and this area is likely to harbour much more biodiversity and represents much better habitat for fauna species in general.

The proposal area is surrounded by vegetation in a similar condition and does not represent a key “linkage” or “corridor” for wildlife movement and the relatively small amount of clearing likely to be required is not likely to create any significant barriers to fauna movement on a local or regional scale.

1.4.9.2 Black cockatoo habitat trees

Trees considered potentially suitable for black cockatoos to use as nesting habitat (subject to a suitable hollow being present and other factors) which were found within the proposal area are comprised of the following species:

- *Eucalyptus gomphocephala* (tuart);
- *Eucalyptus marginata* (jarrah); and
- *Eucalyptus decipiens* (limestone marlock).

It should be noted that the likelihood of any one particular tree species developing hollows suitable for black cockatoos to use for breeding varies considerably. For example, available data suggests that *Eucalyptus marginata* rarely produces hollows large enough for black cockatoos, with Kirkby (2009) (in Harewood 2018) reporting that from a database of 109 confirmed black cockatoo nest trees throughout the jarrah forest, only six were in jarrah trees.

Most of the *Eucalyptus decipiens* specimens within the proposal area did not have the characteristics required to create hollows suitable for black cockatoos, with most trees being small, stunted and absent of any hollows (despite a DBH of >50cm). *Eucalyptus decipiens* is not documented in the literature as being used by black cockatoos for breeding.

A summary of the potential black cockatoo breeding trees within the proposal area, based on DAWE criteria (Commonwealth of Australia 2012) (i.e. any suitable tree species with a DBH > 50cm) is presented in Figure 7. Refer to Appendix 7 (Harewood 2019) for all the results from the black cockatoo assessment (Harewood 2018).

The assessment identified a total of 76 trees with a DBH of >50cm within the original proposal area (25ha). Of these, 62 trees (~81.6%) were not observed to contain hollows of any size, 12 trees (~15.8%) contained hollows not suitable for black cockatoo nesting, and two trees (~2.6%) with hollows large enough (greater than ~10cm) to possibly allow entry of a black cockatoo. Hollows on both these trees showed signs of use, though it was unclear if the chew marks were caused by black cockatoos or galahs (Harewood 2019, Appendix F).

A further refinement of the proposal area (from 25ha to 13.5ha) found only 25 trees with a DBH of >50cm within this revised proposal footprint, of which 20 trees (80%) did not contain hollows of any size and 5 trees (20%) contained hollows not suitable for black cockatoo nesting. No trees with hollows large enough (greater than ~10cm) to allow entry of a black cockatoo were recorded in the revised proposal footprint (Figure 8).

Harewood (2018) also noted that significant areas of better-quality woodland habitat in the nearby Yalgorup National Park are expected to contain numerous 'habitat trees', many of which are likely to provide breeding opportunities for black cockatoos.

1.4.9.3 Black cockatoo foraging habitat

The main flora species recorded within the proposal area used as a direct food source (i.e. seeds or flowers) by one or more species of black cockatoo include:

- *Eucalyptus gomphocephala* (for seeds);
- *Eucalyptus marginata* (for seeds);
- *Agonis flexuosa* (for bark and grubs); and
- *Banksia attenuata* (for seeds).

Overall the proposal area is not regarded as representing quality black cockatoo foraging habitat. Tuarts and peppermint are only foraged upon rarely and the number of jarrah and banksia trees present is very small and would amount to far less than 1 ha in total.

No foraging debris left by black cockatoos was observed within the area during the fauna surveys (Harewood 2018).

As mentioned previously, there are vast areas of better-quality woodland habitat in the nearby Yalgorup National Park, which can reasonably be expected to contain many hectares of quality foraging habitat for black cockatoos.

1.4.9.4 Black cockatoo roosting habitat

No evidence of black cockatoo roosting within of the proposal area was observed during field surveys.

A review of the 2017 Great Cocky Count database shows no documented roost sites within or near the proposal area. The closest recorded roost is about 6 km south east of the proposal area, but no birds have been recorded at this location since 2011.

The vast areas of similar woodland vegetation bordering the proposal area can be reasonably expected to contain many roosting options for black cockatoos.

1.4.9.5 Shorebird habitat

The proposed action area contains no habitat suitable for any of the listed threatened/migratory shorebird species to utilise and none would ever occur under normal circumstances.

As described in Section 4.2.4 (above), the proposed action area mainly contains a low woodland of *Eucalyptus decipiens*, over scattered shrubs and bare limestone with some areas of scattered *Eucalyptus gomphocephala*, *Agonis flexuosa* and *Eucalyptus marginata* over pasture grasses (Harewood 2018). This

habitat is totally unsuitable for the shorebirds in question and therefore none are considered as likely to occur (Appendix G).

Habitat suitable for shorebirds within 1km of the proposed action area is limited in extent to a 2.7km section of the eastern shoreline and a 300m section of the western shoreline of Lake Preston (Appendix G).

An assessment of NatureMap records for the seven species of shorebirds of interest in this document found that only one shorebird species (the red-necked stint) is shown as being recorded within 1 km of the proposed action area. Except for the red-necked stint, the number of records of each species recorded in the Yalgorup Lakes area appears to be relatively low (Appendix G).

1.4.9.6 Western ringtail possum habitat

There was no evidence of western ringtail possums using the proposal area during both day and night surveys (i.e. no fresh dreys, no scats and no individuals). The lack of evidence of the species along with a general poor quality habitat for the western ringtail possum (e.g. lack of favoured foraging species) suggest that they do not occur in the proposal area.

2 LOCAL INVESTIGATIONS

2.1 VEGETATION AND FLORA

2.1.1 Introduction

The site is located on a limestone ridge between the active quarry and Lake Preston. The Department of Water and Environmental Regulation (DWER) advised that three priority taxa could potentially occur within such a habitat in this location:

- *Pterostylis frenchii* (P2). This species occurs in tuart and peppermint coastal woodland over limestone (Brundrett 2014);
- *Alyogyne* sp. Rockingham (P2). This taxon is a perennial shrub of the coastal region south of Perth, mainly occurring on soils with limestone nodules; and
- *Hibbertia spicata* subsp. *leptotheca* (P3). This taxon is a perennial shrub and occurs in sand on near-coastal limestone ridges and cliffs.

Furthermore, the habitat could potentially support vegetation of floristic community type (FCT) 26a ‘- *Melaleuca huegelii* – *Melaleuca systena* shrublands of limestone ridges’. FCT 26a is listed as a Threatened Ecological Community (TEC) with the rating of ‘Endangered’ under Western Australian criteria. FCT 26a occurs on skeletal soils of large limestone ridges to the north of Perth and to the south of Mandurah (Gibson *et al.* 1994).

2.1.2 Methods

2.1.2.1 Desktop assessment

An evaluation of flora known within the area was undertaken to help develop an understanding of dominant flora species, typical families and potential diversity. The desktop flora assessment output consisted of an inventory of known and/or expected flora species within the Survey Area based on the following database searches:

- EPBC Act listed Threatened Flora (DEE 2018a)
- DBCA’s threatened and priority flora databases (DBCA 2018c)
- NatureMap custom reports of recorded species in the locality (DBCA 2018d)
- FloraBase (Western Australian Herbarium 2018)
- Survey reports or references in the region or locality:
 - Maunsell (2007) Spring Flora and Vegetation Assessment – Lots 2 and 4 Ludlow Road. Rev 1, December 2007. Report prepared for MBS Environmental, on behalf of B & F Catalano.
 - Lundstrom Environmental Consultants (2018) Flora and Vegetation Environmental Values Survey Report. Prepared for B&J Catalano Pty Ltd, Lot 4 Ludlow Road Myalup.

An evaluation of known and likely vegetation within the Survey Area was based on an assessment of regional and local mapping and databases, including:

- Statewide Vegetation Mapping (Beard 1968-1981, Beard 1972-1980 and Beard *et al.* 2005)
- Regional vegetation mapping (Hedde *et al.* 1980)

- EPBC Act List of Threatened Ecological Communities (Protected Matters Search Tool, DEE 2018b)
- DBCA threatened and priority ecological communities' databases (DBCA 2018e)
- Recovery Plans and other reports/documents containing information on the preferred habitats and distributions of TECs of relevance to the Study Area (i.e. DEE 2016 – a guide on Banksia Woodlands of the Swan Coastal Plain)
- Survey reports or references in the region or locality.
- General environmental databases to identify environmental values of the area and further site characteristics:
 - GeoVIEW to identified geology types for the Survey Area (DMIRS 2018)
 - National Map (Commonwealth of Australia 2018)
 - Environmental Planning Tool (WALGA 2018)
 - Locate (via SLIP and Landgate) (Government of Western Australia 2018a)

2.1.2.2 Field assessment

Timing and expertise

The field survey was conducted on the 19th November 2018. This period was selected to coincide with the optimum flowering period for many of the species of the region.

Field assessments were undertaken by two experienced botanists from Plant Ecology Consulting and Bush Consultancy:

- Shane Chalwell (Plant Ecology)
 - Qualification: PhD, Plant Ecology
 - Scientific Licence: SL012223
 - Experience: Shane is a highly qualified and skilled consulting botanist with extensive experience in vegetation surveys and monitoring throughout Western Australia. His expertise in plant community ecology includes the design of broad and fine scale vegetation mapping, vegetation health and rehabilitation monitoring programs, wetland condition assessments, and searches for Threatened and Priority flora.
 - Role: Shane was team leader during the field assessment, coordinated field surveys, and undertook data analysis.
- Frank Obbens (Bushtech Consultancy)
 - Qualification: BSc Honours (1st), (Biology/Plant Science)
 - Scientific Licence: SL012278
 - Experience: Frank, a research associate with the WA Herbarium, has provided botanical services for over 20 years, including botanical identification, taxonomic investigation services and field support. He has been involved with many detailed flora and vegetation surveys, threatened and priority flora searches, vegetation mapping surveys, rehabilitation monitoring as well as flora identifications and specific taxonomic investigations. Frank is also an expert on the genus *Calandrinia* and has published several papers.
 - Role: Frank was a field botanist during surveys and undertook plant identification of the collected plant specimens.

Approach

The survey was conducted in two parts: 1) a transect-based targeted flora survey; and 2) a quadrat-based vegetation survey.

2.1.2.3 Targeted flora survey

A search was undertaken to target significant flora and vegetation with the potential to occur in the Survey Area, based on desktop study.

The targeted search was conducted by walking in parallel transects approximately 10–20 m apart, depending on the density of the understory vegetation. The following data was recorded along the traverse:

- a descriptive location;
- GPS coordinates and datum;
- targeted species or community data per vegetation type boundary/potential quadrat location (dependant on purpose of traverse);
- landform; aspect;
- soils;
- vegetation condition;
- description of any disturbances; and
- any apparent correlation between vegetation and landform features.

2.1.2.4 Quadrat vegetation survey

The survey of the vegetation within the site was undertaken at 3 sampling points, each 100 m² (10 m x 10 m) and located in the best condition vegetation. Within each plot, all observable vascular plant species were recorded. The species data recorded was qualitative (presence/absence) as this was the type of data used in the original Swan Coastal Plain survey (Gibson et al., 1994).

Quadrat sampling is the most appropriate technique for determining and describing vegetation during detailed vegetation surveys. Three 10m x 10m quadrats were installed across representative vegetation units and recorded the following information.

- site code;
- location, with GPS coordinates (estimate of their accuracy) and datum;
- size and shape of quadrat;
- photograph/s from north-west corner;
- landform and soil description;
- dominant growth form, height, cover and species for the three traditional strata (upper, mid and ground) compatible with NVIS Level V (NVIS Technical Working Group, 2017);
- any other location information that might be useful in vegetation classification including slope, aspect, litter, fire history, vegetation/landform/soil correlations;
- a comprehensive species list, including weeds; and
- quadrat marking method.

2.1.2.5 Vegetation condition rating

The condition of vegetation was assessed and mapped using the vegetation condition scales outlined in Keighery (1994). A description of the condition scale is summarised in Table 4.

Table 4. Vegetation Condition Scale (adapted from Keighery 1994)

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

2.1.3 Data analysis

The remnant vegetation of the southern Swan Coastal Plain was surveyed by Gibson et al. (1994) to provide an understanding of the major floristic gradients across the region. The major plant communities (or FCTs) were defined by classifying the data 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.

Presently, a single consistent method for the determination of FCTs for vegetation data in the Swan Coastal Plain is not available. Therefore, it is preferable to use multiple methods and compare the output for the most likely result. All analyses described below were undertaken using R packages Cluster, Vegclust and Vegan.

2.1.3.1 Hierarchical Clustering

Hierarchical agglomerative clustering is the usual first stage in classifying vegetation data into community types. This involves calculating the similarity (or more often, the dissimilarity) between plots within the dataset and then sequentially fusing the plots into groups according to their similarity. This type of method was used in the analysis of the original Swan Coastal Plain dataset (Gibson et al. 1994), but its use as the basis for assigning new plot data to the regional classification has some drawbacks. Firstly, a hierarchical clustering only applies to the relationships between plots, and the relative distances between them, within that particular dataset. The addition of new data often alters the relative distances and disrupts the clustering output. Secondly, as an unsupervised method, hierarchical clustering does not

define rules for the membership of the defined groups, and so the addition of new plots requires the rebuilding of the entire hierarchy (De Cáceres and Wiser 2012).

The data for the Swan Coastal Plain regional survey (Gibson et al. 1994) was downloaded from the NatureMap website. This is largely similar to the original survey except for one site (OATES-1), which has now been excluded. The species nomenclature of the original dataset was updated to be consistent with current usage. Where original names could not be matched clearly to the updated usage, those taxa were removed from the analysis. The data from the three surveyed sites of the Ludlow Rd survey was added to the matrix both together and also one plot a time, which served to remove any effect of spatial correlation between the new plots. Each new dataset was then analysed calculating the Bray-Curtis distance coefficient (or resemblance measure) and the flexible beta linkage method ($\beta = -0.1$). Assignment of the Ludlow Rd plots was to the nearest distinct group by inspection of the resulting dendrogram.

2.1.3.2 Non-hierarchical clustering

Non-hierarchical clustering methods often allow new plot data to be added to previous classifications because they are based on the concept that each group or cluster is represented by a prototype i.e. either a centroid or a medoid (a 'type' plot) (De Cáceres and Wiser 2012). Therefore, new observations can be assigned to an existing classification by calculating the distance to the nearest prototype (which may be considered a membership criterion). This approach is to be preferred to the hierarchical reconstruction approach because it defines numerical rules that can be consistently applied. However, it also means the original classification needs to be re-analysed using a different method, which can be problematic because not all sites from the original classification may be diagnostic for their respective clusters.

For the analysis of the Ludlow Rd data, the same updated Swan Coastal Plain dataset was used as for the hierarchical clustering analysis. After calculating a Bray-Curtis distance matrix, the dataset was then analysed using Fuzzy C-Means clustering in the R package 'Vegclust'. A fuzziness coefficient of 1.1 was chosen to minimise influence from noisy data points. FCTs with too few plots to reliably define determine a prototype (e.g. FCT 14 with two plots) were removed from the analysis. Similarly, some plots that were regularly being misclassified (such as those from clusters with large internal heterogeneity) were also removed. The final dataset consisted of 344 plots with 1316 taxa representing 38 FCTs. Each site of the Ludlow Rd data was then assigned a FCT using function 'vegclass' in the Vegclust package.

It should be noted that this approach for FCT assignment is preliminary and will need to be refined further before it can be used consistently. For example, the assignment of sites to dryland FCTs gives robust and consistent results. Sampling of seasonally-inundated wetlands, however, often gives problematic results as these floristic types show a greater degree of floristic overlap between groups and/or require additional sampling to provide a clearer differentiation between such groups. Also, disturbed sites with a high proportion of introduced taxa often give spurious results.

2.1.4 Results

2.1.4.1 Desktop assessment

Vegetation

At a state level, the assessment area is situated in the Southwest Botanical Province of Western Australia (Beard 1990), and within the Swan Coastal Plain bioregion (Perth subregion) as described by the Interim Biogeographic Region of Western Australia (IBRA; DoEE 2018).

The Perth subregion (SWA2) is composed of colluvial and aeolian sands, alluvial river flats, and coastal limestone. It comprises of Heath and/or Tuart woodlands on limestone, Banksia and Jarrah-Banksia woodlands on Quaternary marine dunes of various ages, and Marri on colluvial and alluvials and also includes a complex series of seasonal wetlands (Mitchell et al. 2002).

At a regional level, the assessment area occurs within the Cottesloe-Central and South vegetation complex which is described as a mosaic of woodland of *Eucalyptus gomphocephala* (Tuart) and open forest of *Eucalyptus gomphocephala* (Tuart) - *Eucalyptus marginata* (Jarrah) - *Corymbia calophylla* (Marri); closed heath on the Limestone outcrops.

The Cottesloe Complex-Central and South has 32.2% of the pre-European extent remaining on the Swan Coastal Plain and 41.8% remaining within the Shire of Harvey (DBCA 2017) (Table 5).

The objective of the EPA-endorsed Natural Area Strategy is to achieve a standard level of native vegetation retention of at least 30% of the pre-clearing extent of the ecological communities on the Swan Coastal Plain (EPA 2003). As there is slightly more than 30% of the Cottesloe Complex-Central and South remaining on the Swan Coastal Plain, this complex is meeting this objective.

Conservation Significant Vegetation

No DBCA listed Threatened Ecological Communities (TECs) have been previously recorded within the assessment area. The closest recorded TEC is approximately 2km north of Lot 4 (Threatened Ecological Communities, DBCA-038).

According to a map of potential EPBC Act listed TECs, *Banksia* Woodlands of the Swan Coastal Plain may occur within the assessment area (DoEE 2018).

The assessment area is not within the Bush Forever mapping area (Bush Forever Areas 2000, DOP-071).

The assessment area lies within a Tuart Woodlands, as mapped by CALM (2003) in the "Tuart Atlas", which maps and assesses data on tuart occurrence, overstorey density and understorey condition on the Swan Coastal Plain. The Atlas has classified the tuart woodland polygon within the assessment area as 10-19% canopy density and classified the visible native understorey condition as highly disturbed.

Table 5. Pre-European and Current Extent of the Cottesloe Vegetation Complex – Central and South, within the Swan Coastal Plan and the Shire of Harvey (Source: DBCA 2017).

Area	Vegetation Complex	Pre-European Extent (ha)	Current Extent (ha)	% Remaining	Current extent in all DBCA managed land* (ha)	Current % remaining within DBCA managed land* (%)	Proportion of the Vegetation Complex within Shire of Harvey (%)
Swan Coastal Plain	Cottesloe Complex-Central and South	45299.6	14571.4	32.2	6591.8	14.6	-
Shire of Harvey	Cottesloe Complex-Central and South	1,332.7	557.6	41.8	-	-	2.9

* Excludes Crown Freehold Department Managed Lands that are managed under Section 8A of the CALM Act.

Flora

Database searches of NatureMap, the DBCA and the WA Herbarium Threatened Flora Databases were undertaken to determine whether any Threatened or Priority flora species are known from within a 5km radius of the assessment area. The literature review and database searches identified 13 conservation significant species with the potential to occur within proximity of the assessment area (1 Threatened Flora and 12 Priority Flora). The likelihood of each conservation significant species occurring within the Survey Area is summarised in Table 6.

No Threatened and/or Priority Flora have been previously recorded within the assessment area. Based on desktop assessment, the closest Priority flora recorded is a Priority 3 (P3) species, recorded approximately 1km north and 2km north east of the assessment area (Threatened and Priority Flora, DBCA-036).

Table 6. Vascular plant species recorded in the vicinity of the project.

Species	WC Act/DBCA listing	Description (Source: Florabase)	Potential to occur (soil type/habitat within area)
<i>Alyogyne</i> sp. Rockingham (G.J. Keighery 14463)	P2	Shrubs (with a sparse to dense indumentum)	unlikely
<i>Blennospora doliiformis</i>	P3	Erect annual, herb, to 0.15 m high. Fl. yellow, Oct to Nov. Grey or red clay soils over ironstone. Seasonally-wet flats.	unlikely
<i>Conostylis pauciflora</i> subsp. <i>pauciflora</i>	P4	Rhizomatous, stoloniferous perennial, grass-like or herb, 0.1-0.35 m high. Fl. yellow, Aug to Oct. Grey sand, limestone. Hillslopes, consolidated dunes.	possible
<i>Diuris micrantha</i>	T	Tuberous, perennial, herb, 0.3-0.6 m high. Fl. yellow & brown, Sep to Oct. Brown loamy clay. Winter-wet swamps, in shallow water.	unlikely
<i>Haloragis aculeolata</i>	P2	Slender, erect perennial, herb, to 0.4 m high. Fl. green, Sep or Dec. Black sand or clay over limestone. Winter-wet areas.	unlikely
<i>Haloragis scoparia</i>	P1	Perennial, herb, 0.3-0.6 m high.	unlikely
<i>Hibbertia spicata</i> subsp. <i>leptotheca</i>	P3	Erect or spreading shrub, 0.2-0.5 m high. Fl. yellow, Jul to Oct. Sand. Near-coastal limestone ridges, outcrops & cliffs.	unlikely
<i>Lasiopetalum membranaceum</i>	P3	Shrub. Stems hairy. Leaves 30-50 mm long, 14-40 mm wide. Calyx pink, blue or purple, 5.5-7 mm long, the lobes fused less than half their length. Flowering time September - December. Distribution Botanical Province South-West, IBRA Bioregion Swan Coastal Plain, Jarrah Forest or Warren.	unlikely
<i>Pimelea calcicola</i>	P3	Erect to spreading shrub, 0.2-1 m high. Fl. pink, Sep to Nov. Sand. Coastal limestone ridges.	unlikely
<i>Pterostylis frenchii</i>	P2	Tuberous, herb, to 0.35 m high, with rosette leaves. Calcareous sand with limestone, laterite. Flatlands and gentle slopes.	possible

Species	WC Act/DBCA listing	Description (Source: Florabase)	Potential to occur (soil type/habitat within area)
<i>Sphaerolobium calcicola</i>	P3	Slender, multi-stemmed, scandent or erect shrub, to 1.5 m high. Fl. orange-red, Jun or Sep to Nov. White-grey-brown sand, sandy clay over limestone, black peaty sandy clay. Tall dunes, winter-wet flats, interdunal swamps, low-lying areas.	unlikely
<i>Stylidium longitubum</i> (Jumping Jacks)	P4	Erect annual (ephemeral), herb, 0.05-0.12 m high. Fl. pink, Oct to Dec. Sandy clay, clay. Seasonal wetlands.	unlikely
<i>Stylidium maritimum</i>	P3	Caespitose perennial, herb, 0.3-0.7 m high, Leaves tufted, linear to narrowly oblanceolate, 10-40 cm long, 1-5.5 mm wide, apex acute to mucronate, margin involute, glabrous. Fl. white/purple, Sep to Nov. Sand over limestone. Dune slopes and flats. Coastal heath and shrubland, open Banksia woodland.	unlikely

2.1.4.2 Field assessment

Vegetation

The main vegetation types within the site were a *Eucalyptus decipiens* open woodland on the shallow soils over limestone of the ridge crest and upper slopes and a *Eucalyptus gomphocephala* woodland on the deeper soils of the lower slopes (Plate 1, Appendix E).

These vegetation types were rated as being in a 'Completely Degraded' condition, as the native understorey was largely absent and replaced by weed species and the original structure has been almost entirely lost. The crest and upper slopes also supported patches of *Melaleuca systema* shrubland, which was rated as being in a 'Degraded' condition. These patches supported more native species (mainly shrubs) than the woodland areas, but aggressive weed species such as *Gomphocarpus fruticosus* were prevalent.

Flora

No priority flora were observed during the survey.

2.1.5 Data analysis

2.1.5.1 Hierarchical analysis

The results of the hierarchical analysis show that plots 1 and 3 were assigned to FCT 29a – Coastal shrublands on shallow sands, while Plot 2 was assigned to FCT 24 - Northern Spearwood shrublands and woodlands (relevant parts of the dendrograms are shown in Appendix E). When all the Ludlow Rd plots were analysed together, they were assigned to FCT 24 (not shown).

2.1.5.2 Non-hierarchical analysis

The results of the FCT assignment by non-hierarchical analysis are shown in Table 7. The results show the highest similarity to either FCT 29a or FCT 6 each plot, although the strengths of membership (similar to a probability) are not strong and not much greater than to other groups. This is likely due to the number of weed species within the site, which is evidenced by the highest strength of membership for Plot 2 being to FCT 6 (weed dominated wetlands). The strength of membership to FCT 6 for Plots 1 and 3 was each approximately 19%.

The strength of membership for FCT 26a is very low and, as FCT 26a is a distinct group within the Swan Coastal Plain dataset, it is highly unlikely that vegetation within the site would be a part of this FCT.

Table 7. Results of non- hierarchical analysis for plots from the Ludlow Rd survey (Strength of membership shown in brackets)

Plot	FCT of nearest group	FCT of 2nd nearest group	FCT of 3rd nearest group	Strength of membership to FCT 26a
Plot 01	29a (26.6%)	6 (19.8 %)	13,15,16,17 (14.4%)	0.38%
Plot 02	6 (25.3%)	29a (23.0%)	13,15,16,17 (16.8%)	0.07%
Plot 03	29a (34.1%)	13,15,16,17 (22.4%)	6 (19.5%)	0.08%

2.2 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

2.2.1 Introduction

The scope of works was to conduct a Level 1 fauna survey as defined by the EPA (EPA 2016). Because the general area is known to be utilised by black cockatoos and western ringtail possums, the scope of the survey work was expanded to include a baseline assessment of the site's significance to these species as well. The fauna assessment has therefore included:

- Level 1 fauna assessment (in accordance with EPA (2016) guidelines);
- Targeted searches for black cockatoo habitat/site use (habitat trees, existing and potential nest hollows, foraging and roosting habitat);
- Targeted day and night searches for western ringtail possum habitat/site use (foraging, refuge and dispersal habitat and individuals);
- An assessment of the likelihood of occurrence of any other significant fauna species and their habitat; and
- Report summarising results, methods and conclusions.

Note: For the purposes of this report the term black cockatoo is in reference to Baudin's black cockatoo *Calyptorhynchus baudinii*, Carnaby's black cockatoo *Calyptorhynchus latirostris* and the forest red-tailed black cockatoo *Calyptorhynchus banksii naso*.

2.2.2 Methods – Desktop assessment

2.2.2.1 Database Searches

Searches of the following databases were undertaken to aid in the compilation of a list of conservation significant fauna potentially occurring within the project area:

- DBCA's NatureMap Database Search (combined data from DBCA, ALA, WAM, BA and consultant's reports) (DBCA 2018b); and
- Protected Matters Search Tool (DotEE 2018).

It should be noted that lists produced during the abovementioned database searches contain observations/inferred distributions from a broader area than the project area and therefore may include species that would never occur/only ever occur as vagrants due to a lack of suitable habitat or the presence of only marginal habitat within the project area itself. The databases also often include or are based on very old records and in some cases the species in question have become locally or regionally extinct.

Information from these sources should therefore be taken as indicative only and local knowledge and information also needs to be taken into consideration when determining what actual species may be present within the specific area being investigated.

2.2.2.2 Previous Fauna Surveys in the Area

Fauna surveys, assessments and reviews have been undertaken in nearby areas in the past, though not all are publicly available and could not be referenced. The most significant of those available have been used as the primary reference material for compiling a list of fauna species of conservation significance most likely to occur in the general area.

Those reports referred to included, but were not limited to:

- 360 Environmental Pty Ltd (2008). Southern Seawater Desalination Project 2007, Terrestrial Flora and Fauna Survey Report. Unpublished report for the Water Corporation.
- Alan Tingay and Associates (ATA) (1998). Vertebrate Fauna. Lake Clifton Land Exchange Proposal. Unpublished report for Bouvard Investment's Pty Ltd.
- ATA Environment (2005). Environmental Assessment, South Binningup V2, June 2005. Unpublished report.
- Bamford Consulting Ecologists (2003). Fauna Values of Cape Bouvard Investment's Pty Ltd Land, Yalgorup. Unpublished report for RPS.
- Bamford Consulting Ecologists (2008). Fauna Assessment of the Proposed South Binningup Development. Unpublished report for RPS Consulting/Mirvac.
- Bamford Consulting Ecologists (2010). Level 2 Fauna Assessment of Remnant Vegetation at the Proposed Point Grey Marina. Unpublished report for ATA Environmental.
- Bullen, R.D. (2009). Binningup Bat Survey 2009. Echolocation Survey of Bat Activity in the Lake Clifton and Lake Preston Localities on the Swan Coastal Plain. Prepared for Department of Environment and Conservation by Bat Call WA, Hillarys, Western Australia.
- Dell, J. and Hyder, B. (2009a). An Assessment of the Avifauna of the area between Dawesville and Binningup, Southern Swan Coastal Plain. Report prepared for Environmental Protection Authority, Perth.
- Dell, J. and Hyder, B. (2009b). Summary of the Fauna Values of the area between Dawesville and Binningup, Southern Swan Coastal Plain. Report prepared for Environmental Protection Authority, Perth.
- ENV Australia (ENV) (2009). Clifton Beach Fauna Assessment. Unpublished report for Cape Bouvard Investments Pty Ltd.
- Harewood, G. (2008). Western Ringtail Possum Assessment Survey – Proposed Limestone Extraction Area within Lot 4 Ludlow Road, Myalup. Unpublished report for MBS Environmental.
- Harewood, G. (2010). Fauna Survey (Level 2). Kemerton Industrial Core. Unpublished report for Cardno (WA) Pty Ltd.
- Harewood, G. (2015). Fauna Survey (Level 2). Dampier to Bunbury Natural Gas Pipeline Corridor Bristol Road (Waroona) to Clifton Road (Brunswick). Unpublished report for Aurora Environmental.

- How, R. A., Maryan, B. and Stevenson, C. A. (2009). An Assessment of Herpetofauna on Near-Coastal Landforms between Dawesville and Binningup, Southern Swan Coastal Plain. Prepared for Department of Environment and Conservation. Welshpool, Western Australia.
- Hyder, B. and Dell, J. (2009). An Assessment of the Non-volant Mammal Fauna of the area between Dawesville and Binningup, Southern Swan Coastal Plain. Report prepared for Environmental Protection Authority, Perth.
- Western Wildlife (2009). Lot 76 Binningup Road Binningup. Fauna Survey 2008. Unpublished report for Niche Consulting.

As with the databases searches, some reports refer to species that would not occur in the project area due to a lack of suitable habitat (extent and/or quality) and this fact was taken into consideration when compiling the potential fauna species list. It should also be noted that the NatureMap database is likely to include some records from previous fauna surveys in the area including some of those listed above.

2.2.2.3 Existing Publications

The following represent the main publications used to identify and refine the potential fauna species list for the project area:

- Anstis, M. (2013). Tadpoles and Frogs of Australia. New Holland Publishers, Sydney.
- Barrett, G., Silcocks, A., Barry, S., Cunningham, R. and Poulter, R. (2003). The New Atlas of Australian Birds. Royal Australasian Ornithologists Union, Victoria.
- Bush, B., Maryan, B., Browne-Cooper, R. & Robinson, D. (2007). Reptiles and Frogs in the Bush: Southwestern Australia. UWA Press, Nedlands.
- Churchill, S. (2008). Australian Bats. Second Edition, Allen & Unwin.
- Cogger, H.G. (2014). Reptiles and Amphibians of Australia. 7th Edition. CSIRO Publishing.
- Johnstone, R.E. and Storr, G.M. (1998). Handbook of Western Australian Birds: Volume 1 – Non-passerines (Emu to Dollarbird). Western Australian Museum, Perth Western Australia.
- Johnstone, R.E. and Storr, G.M. (2004). Handbook of Western Australian Birds: Volume 2 – Passerines (Blue-winged Pitta to Goldfinch). Western Australian Museum, Perth Western Australia.
- Menkhorst, P. and Knight, F. (2011). A Field Guide to the Mammals of Australia. Oxford University Press, Melbourne.
- Morgan, D.L., Beatty, S.J., Klunzinger, M.W, Allen, M.G. and Burnham, Q.E (2011). Field Guide to the Freshwater Fishes, Crayfishes and Mussels of South Western Australia. Published by SERCUL.
- Storr, G.M., Smith, L.A. and Johnstone R.E. (1983). Lizards of Western Australia II: Dragons and Monitors. WA Museum, Perth.
- Storr, G.M., Smith, L.A. and Johnstone R.E. (1990). Lizards of Western Australia III: Geckos and Pygopods. WA Museum, Perth.
- Storr, G.M., Smith, L.A. and Johnstone R.E. (1999). Lizards of Western Australia I: Skinks. Revised Edition, WA Museum, Perth.
- Storr, G.M., Smith, L.A. and Johnstone R.E. (2002). Snakes of Western Australia. Revised Edition, WA Museum, Perth.
- Tyler M.J. & Doughty P. (2009). Field Guide to Frogs of Western Australia, Fourth Edition, WA Museum, Perth.

- Van Dyck, S., Gynther, I. & Baker, A. Eds (2013). Field Companion to The Mammals of Australia. Queensland Museum.
- Wilson, S. and Swan, G. (2013). A Complete Guide to Reptiles of Australia. Reed, New Holland, Sydney.
- Woinarski, J., Burbidge, A. & Harrison, P. (2014). The Action Plan for Australian Mammals 2012. CSIRO Publishing.

2.2.2.4 Fauna of Conservation Significance

The conservation significance of fauna species has been assessed using data from the following sources:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Administered by the Australian Government DotEE;
- *Wildlife Conservation Act 1950* (WC Act). Administered by the Western Australian DBCA (Govt. of WA 2019). Note: The Wildlife Conservation (Specially Protected Fauna) Notice 2018 has been transitioned under regulations 170, 171 and 172 of the Biodiversity Conservation Regulations 2018 to be the lists of Threatened, Extinct and Specially Protected species under Part 2 of the BC Act;
- Red List produced by the SSC of the World Conservation Union (also known as the IUCN Red List - the acronym derived from its former name of the International Union for Conservation of Nature and Natural Resources). The Red List has no legislative power in Australia but is used as a framework for State and Commonwealth categories and criteria; and
- DBCA Priority Fauna list. A non-statutory list maintained by the DBCA for management purposes (DBCA 2018a).

The EPBC Act also requires the compilation of a list of migratory species that are recognised under international treaties including the:

- Japan Australia Migratory Bird Agreement 1981 (JAMBA);
- China Australia Migratory Bird Agreement 1998 (CAMBA);
- Republic of Korea-Australia Migratory Bird Agreement 2007 (ROKAMBA); and
- Bonn Convention 1979 (The Convention on the Conservation of Migratory Species of Wild Animals).

(Note – Some but not all species listed under JAMBA are also protected under Schedule 5 of the BC Act.)

Most migratory bird species listed in the annexes to these bilateral agreements are protected in Australia as matters of national environmental significance (MNES) under the EPBC Act.

The conservation status of all vertebrate fauna species listed as occurring or possibly occurring in the vicinity of the project area has been assessed using the most recent lists published in accordance with the above-mentioned instruments and is indicated as such in the fauna listings of this report. A full listing of conservation codes is provided in Appendix F.

2.2.2.5 Taxonomy and Nomenclature

Taxonomy and nomenclature for vertebrate fauna species used in this report is generally taken from the DBCA's WA Fauna Census Database which is assumed to follow Aplin and Smith (2001) for amphibians and reptiles and Johnstone (2001) for birds. Jackson and Groves (2015) has been used for mammals.

Common names are taken from the Western Australia Museum (WAM) recognised primary common name listings when specified, though where common names are not provided they have been acquired from other publications. Sources include Cogger (2014), Wilson and Swan (2017), Van Dyck & Strahan (2013),

Christidis and Boles (2008), Bush et al. (2010), Bush et al. (2007), Tyler & Doughty (2009), and Glauret (1961). Not all common names are generally accepted.

2.2.2.6 Likelihood of Occurrence – Fauna of Conservation Significance

Fauna of conservation significance identified during the literature review as previously being recorded in the general area were assessed and ranked for their likelihood of occurrence within the project area itself. The rankings and criteria used were:

- **Would Not Occur:** There is no suitable habitat for the species in the project area and/or there is no documented record of the species in the general area since records have been kept and/or the species is generally accepted as being locally/regionally extinct (supported by a lack of recent records).
 - **Locally Extinct:** Populations no longer occur within a small part of the species natural range, in this case within 10 or 20 km of the project area. Populations do however persist outside of this area.
 - **Regionally Extinct:** Populations no longer occur in a large part of the species natural range, in this case within the central/southern swan coastal plain region. Populations do however persist outside of this area.
- **Unlikely to Occur:** The project area is outside of the currently documented distribution for the species in question, or no suitable habitat (type, quality and extent) was identified as being present during the field assessment. Individuals of some species may occur occasionally as vagrants/transients especially if suitable habitat is located nearby but the project area itself would not support individuals or a population the species.
- **Possibly Occurs:** The project area is within the known distribution of the species in question and habitat of at least marginal quality was identified as being present during the field assessment, supported in some cases by recent records being documented in literature from within or near the project area. In some cases, while a species may be classified as possibly being present at times, habitat may be marginal (e.g. poor quality, fragmented, limited in extent) and therefore the frequency of occurrence and/or population levels may be low.
- **Known to Occur:** The species in question was positively identified as being present (for sedentary species) or as using the project area as habitat for some other purpose (for non-sedentary/mobile species) during the field survey. This information may have been obtained by direct observation of individuals or by way of secondary evidence (e.g. foraging debris, tracks and scats). In some cases, while a species may be classified as known to occur, habitat may be marginal (e.g. poor quality, fragmented, limited in extent) and therefore the frequency of occurrence and/or population levels may be low.

2.2.3 Methods – Field surveys

Daytime field survey work at the site was carried out in two phases, the first on the 26 and 28 May and the 2 June 2018 the second on the 11 November 2019. A nocturnal survey of the project area was carried out on the 28 May 2018. All field survey work was carried out by Greg Harewood (B.Sc. - Zoology).

2.2.3.1 Fauna Habitat Assessment

The vegetation communities, landforms and soils observed during the fauna assessment have been used as the basis for a classification of areas into broad fauna habitat types.

As part of the literature review, available information on the habitat requirements of the species of conservation significance listed as possibly occurring in the area was researched. During the daytime reconnaissance survey, the habitats within the project area were assessed and specific elements identified,

if present, to determine the likelihood of listed species of conservation significance occurring and its likely overall value to them on a local and regional scale.

2.2.3.2 Black Cockatoo Habitat Assessment

The following methods were employed during the black cockatoo habitat assessment to comply with the defined scope of works and are based on guidelines published by the DotEE (Commonwealth of Australia 2012) which states that surveys for Carnaby's, Baudin's and forest red-tailed black cockatoo habitat should:

- be done by a suitably qualified person with experience in vegetation or cockatoo surveys, depending on the type of survey being undertaken;
- maximise the chance of detecting the species' habitat and/or signs of use;
- determine the context of the site within the broader landscape—for example, the amount and quality of habitat nearby and in the local region (for example, within 10 km);
- account for uncertainty and error (false presence and absences); and
- include collation of existing data on known locations of breeding and feeding birds and night roost locations.

Habitat used by black cockatoos have been placed into three categories by the DotEE (Commonwealth of Australia 2012) these being:

- Breeding Habitat;
- Foraging Habitat; and
- Night Roosting Habitat.

To comply with the requested scope of works and published guidelines, assessments of black cockatoo breeding habitat, foraging habitat and roosting habitat were carried out, as described below.

Black Cockatoo Breeding Habitat

The black cockatoo breeding habitat assessment involved the identification of all suitable breeding trees species (native, endemic species only) within the project area (plus a 50m buffer) that had a DBH of equal to or over 50cm. The DBH of each tree was estimated using a pre-made 50 cm "caliper".

The 2019 survey was carried within the black cockatoo breeding season (Harewood 2018 and 2019).

Target tree species included marri and jarrah or any other *Corymbia*/*Eucalyptus* species of a suitable size that may have been present. Peppermints, banksia, sheoak and melaleuca tree species (for example) were not assessed as they typically do not develop hollows that are used by black cockatoos.

The location of each tree identified as being over the threshold DBH was recorded with a GPS and details on tree species, number and size of hollows (if any) noted. Trees observed to contain hollows (of any size/type) were marked with "H" using spray paint for easy future reference.

Potential hollows were placed into one of four categories, based on the size of the apparent hollow entrance, these being:

- Small = ~<5cm diameter (i.e. entrance too small for a black cockatoo);
- Medium = ~5cm-10cm diameter (i.e. entrance too small for a black cockatoo);
- Large = ~>10cm diameter (entrance large enough for a black cockatoo but possible hollow appears to be unsuitable for nesting i.e. wrong orientation, too small, too low or too shallow); or
- Large (cockatoo) = ~>10cm diameter (entrance appears big enough to provide access to a possible hollow that may be suitable for a black cockatoo to use for nesting).

Based on this assessment, trees present within the project area have been placed into one of four categories:

- Tree < 50cm DBH or an unsuitable species (not recorded);
- Tree >50cm DBH, no hollows seen;
- Tree >50cm DBH, one or more possible hollows seen, none of which were considered suitable for black cockatoos to use for nesting; or
- Tree >50cm DBH, one or more possible hollows seen, with at least one considered potentially suitable for black cockatoos to use for nesting.

For the purposes of this assessment, a tree containing a potential cockatoo nest hollow was defined as:

Generally, any tree which is alive or dead that contains one or more visible hollows (cavities within the trunk or branches) or possible hollows considered potentially suitable for occupation by a black cockatoo for the purpose of nesting/breeding. Hollows that had an entrance greater than about 10cm in diameter and would allow the entry of a black cockatoo into a suitably orientated and sized branch/trunk were recorded as a “potential black cockatoo nest hollow”.

Identified hollows were examined using binoculars for evidence of actual use by black cockatoos (e.g. chewing around hollow entrance, scarring and scratch marks on trunks and branches). Trees with possible nest hollows were also scratched and raked with a large stick/pole in an attempt to flush any sitting birds from hollows and calls of chicks were also listened for.

Where considered necessary and if possible, hollows were examined using a pole mounted camera and/or a drone.

Black Cockatoo Foraging Habitat

The location and nature of black cockatoo foraging evidence (e.g. chewed fruits around base of trees) observed during the reconnaissance survey was recorded. The nature and extent of potential foraging habitat present was also documented irrespective of the presence of any actual foraging evidence.

Black Cockatoo Roosting Habitat

Direct and indirect evidence of black cockatoos roosting in trees within the project area was noted if observed (e.g. branch clippings, droppings or moulted feathers).

2.2.3.3 Western Ringtail Possum Assessment

To determine if western ringtail possums were utilising the project area, the following was carried out:

- Concurrent with the daytime black cockatoo habitat assessment, dreys (and other potential daytime refuge habitat), scats and individual WRPs were searched for and recorded if observed; and
- One night time survey was carried out to locate and record the distribution and abundance of WRPs within the project area. The nocturnal count involved the systematic searching of potential WRP habitats on foot using a head torch.

2.2.3.4 Camera Traps

Eight camera traps (infrared motion sensing cameras – Model: LTL Acorn 5210A) were set up within the project area and left in place for seven nights. The camera trap locations are presented in Appendix F.

2.2.3.5 Other Fauna Species of Conservation Significance

Evidence of the presence or likely presence of other fauna species of conservation significance (or suitable habitat) was searched for and recorded concurrent with other site surveys. The aim was to obtain sufficient

information to make a definitive comment on the likely significance of the project area to other fauna species of conservation significance.

Methods involved searching microhabitats such as logs, rocks, leaf litter and observations with binoculars. Secondary evidence of a species presence such as tracks, scats, skeletal remains, foraging evidence or calls were also noted, if observed/heard.

2.2.3.6 Opportunistic Fauna Observations

Opportunistic observations of fauna species were made during all field survey work and recorded where positive species identifications were made.

2.2.4 Results

2.2.4.1 Potential Fauna Inventory – Literature Review

A list of fauna species considered most likely to occur in the project area has been compiled from information obtained during the literature review and is presented Table 8. This list was refined after information gathered during the site reconnaissance survey was assessed. The results of some previous fauna surveys carried out in the general area are summarised in this list as are the DBCA NatureMap database search results (with species considered unlikely to occur being omitted). The raw database search results from NatureMap (DBCA 2018b) and the Protected Matters Search Tool (DotEE 2018) are appended to Harewood (2019) Fauna Assessment Report (Appendix F).

The list of potential fauna takes into consideration that firstly, the species in question is not known to be locally extinct and secondly, that suitable habitat for each species, as identified during the habitat assessment, is present within the project area, though compiling an accurate list has limitations (see Section 4 above) and therefore as discussed, the list is very likely to be an overestimation of the fauna species actually present onsite at any one time.

With respect to native vertebrate fauna, 12 mammal (including nine bat species), 82 bird, 15 reptile and two frog species have previously been recorded in the wider area, some of which have the potential to occur in or utilise sections of the project area at times. Eight species of introduced animals could also frequent the area.

Of the 111 native animals that are listed as potentially occurring, five are considered to be endangered/vulnerable or in need of special protection under State and/or Federal law. In addition, one DBCA priority species is also listed as potential species. These particular species are discussed in further detail in the following sections of the report.

Table 8. Likelihood of Occurrence and Possible Impacts - Fauna Species of Conservation Significance

Species	Conservation Status		Habitat Preferences	Habitat Present	Likelihood of Occurrence	Possible Impacts
	WC Act/ DBCA Priority	EPBC Act				
Graceful Sunmoth <i>Synemon gratiosa</i>	P4	-	Areas of herbland, heathland and shrubland containing <i>Lomandra maritima</i> or Banksia woodland/woolly bush <i>Lomandra hermaphrodita</i> .	No/Very Marginal	Unlikely to Occur.	No impact anticipated.
Carter 's Freshwater Mussel <i>Westralunio carteri</i>	S3	-	Occurs in greatest abundance in slower flowing streams with stable sediments that are soft enough for burrowing amongst woody debris and exposed tree roots.	No	Would Not Occur.	No impact.
Black-stripe Minnow <i>Galaxiella nigrostriata</i>	S2	-	Permanent or ephemeral pools, roadside ditches and small creeks in sandy, thickly vegetated wetland areas. Water is usually darkly tannin stained and acidic (pH 4.6 - 6.5)	No	Would Not Occur.	No impact.
Pouched Lamprey <i>Geotria australis</i>	P1	-	This species lives in mud burrows in the upper reaches of coastal streams for the first four years of life until migrating to the sea. Adults migrate up to 60km upstream during spawning.	No	Would Not Occur.	No impact.
Perth Lined Lerista <i>Lerista lineata</i>	P3	-	This small species of skink inhabits white sands under areas of shrubs and heath where it inhabits loose soil and leaf litter particularly in association with banksias.	No/Very Marginal	Unlikely to Occur.	No impact anticipated.
Coastal Plains Skink <i>Ctenotus ora</i>	P3	-	Sandy substrates with low vegetation (including heath) in open <i>Eucalyptus/Corymbia</i> woodland over <i>Banksia</i> .	No/Very Marginal	Unlikely to Occur.	No impact anticipated.

Species	Conservation Status		Habitat Preferences	Habitat Present	Likelihood of Occurrence	Possible Impacts
	WC Act/ DBCA Priority	EPBC Act				
Malleefowl <i>Leipoa ocellata</i>	S3	VU	Mainly scrubs and thickets of mallee <i>Eucalyptus</i> spp., boree <i>Melaleuca lanceolata</i> and bowgada <i>Acacia linophylla</i> , also dense litter forming shrublands	No	Would Not Occur	No impact.
Blue-billed Duck <i>Oxyura australis</i>	P4	-	Well vegetated freshwater swamps, large dams and lakes, winters on more open water. Occasionally salt lakes and estuaries freshened by floodwaters.	No	Would Not Occur.	No impact.
Glossy Ibis <i>Plegadis falcinellus</i>	S5	Mig	Well vegetated wetlands, wet pastures, rice fields, floodwaters, floodplains, brackish or occasionally saline wetlands, mangroves, mudflats, occasionally dry grasslands.	No	Would Not Occur.	No impact.
Painted Snipe <i>Rostratula benghalensis</i>	S2	EN, Mig	Well vegetated shallows and margins of wetlands, dams, sewerage ponds, wet pastures, marshy areas, irrigation systems, lignum, tea tree scrub, open timber. Requires dense low cover.	No	Would Not Occur	No impact.
Hooded Plover <i>Charadrius rubricollis</i>	P4	-	Broad sandy ocean beaches and bays, coastal and inland salt lakes	No	Would Not Occur	No impact.
Migratory Shorebirds/Wetland Species/Marine Species (various reptiles, birds and mammals)	S5, Various	Ma, Mig, Various	Varies between species but includes open ocean, beaches and permanent/temporary wetlands varying from billabongs, swamps, lakes, floodplains, sewerage farms, saltwork ponds, estuaries, lagoons, mudflats sandbars, pastures, airfields, sports fields and lawns.	No	Would Not Occur.	No impact.
Eastern Osprey <i>Pandion haliaetus</i>	S5	Ma, Mig	Coasts, estuaries, bays, inlets, islands, and surrounding waters, coral atolls, reefs, lagoons, rock cliffs and stacks. Ascends larger rivers.	No	Would Not Occur.	No impact.

Species	Conservation Status		Habitat Preferences	Habitat Present	Likelihood of Occurrence	Possible Impacts
	WC Act/ DBCA Priority	EPBC Act				
Peregrine Falcon <i>Falco peregrinus</i>	S7	-	Diverse from rainforest to arid shrublands, from coastal heath to alpine. Mainly about cliffs along coasts, rivers and ranges and about wooded watercourses and lakes.	Yes	Possibly Occurs but only rarely.	Loss/modification of a small area of habitat.
Australasian Bittern <i>Botaurus poiciloptilus</i>	Si	EN	Freshwater wetlands, occasionally estuarine; prefers heavy vegetation such as beds of tall dense <i>Typha</i> , <i>Baumea</i> and sedges in freshwater swamps.	No	Would Not Occur.	No impact.
Painted Snipe <i>Rostratula benghalensis</i>	S2/S5	Mig	Well vegetated shallows and margins of wetlands, dams, sewerage ponds, wet pastures, marshy areas, irrigation systems, lignum, tea tree scrub, open timber. Requires dense low cover.	No	Would Not Occur.	No impact.
Carnaby's Black Cockatoo <i>Calyptorhynchus latirostris</i>	S2	EN	Forests, woodlands, heathlands, farms; feeds on <i>Banksia</i> , <i>Hakea</i> and Marri.	Yes	Possibly Occurs.	Loss/modification of a small area of marginal habitat.
Baudin's Black Cockatoo <i>Calyptorhynchus baudinii</i>	S2	EN	Mainly eucalypt forests where it feeds primarily on the marri seeds.	Yes	Possibly Occurs.	Loss/modification of a small area of marginal habitat
Forest Red-tailed Black Cockatoo <i>Calyptorhynchus banksii naso</i>	S3	VU	Eucalypt forests, feeds on marri, jarrah, blackbutt, karri, sheoak and snottygobble.	Yes	.nown to Occur	Loss/modification of a small area of marginal habitat
Fork-tailed Swift <i>Apus pacificus</i>	S5	Ma, Mig	Low to very high airspace over varied habitat from rainforest to semi desert.	Yes	Unlikely to Occur, Flyover only on very rare occasions.	No impact.

Species	Conservation Status		Habitat Preferences	Habitat Present	Likelihood of Occurrence	Possible Impacts
	WC Act/ DBCA Priority	EPBC Act				
Grey Wagtail <i>Motacilla cinerea</i>	S5	Mig, Ma	In Australia, near running water in disused quarries, sandy, rocky streams in escarpments and rainforest, sewerage ponds, ploughed fields and airfields.	No	Would Not Occur.	No impact.
Chuditch <i>Dasyurus geoffroii</i>	S3	VU	Forest, mallee shrublands, woodland and desert. The densest populations have been found in riparian jarrah forest.	No	Unlikely to Occur - Locally extinct.	No impact anticipated.
South-western Brush tailed Phascogale <i>Phascogale tapoatafa wambenger</i>	S6	-	sclerophyll forests and open woodlands that contain hollow-bearing trees but a sparse ground cover.	Yes/Marginal	Possibly Occurs.	Loss/modification of a small area of habitat. Death/injury of individuals during clearing.
Quenda <i>Isoodon fusciventer</i>	P4	-	Dense scrubby, often swampy, vegetation with dense cover.	No	Would Not Occur.	No impact.
Western Ringtail Possum <i>Pseudocheirus occidentalis</i>	Si	CR	Coastal peppermint, coastal peppermint-tuart, jarrah-marri associations, sheoak woodland, and eucalypt woodland and mallee.	Yes/Very Marginal	Unlikely to Occur.	No impact anticipated.
Quokka <i>Setonix brachyurus</i>	S3	VU	Currently restricted to densely vegetated coastal heaths, swamps, riverine habitats including tea-tree thickets on sandy soils along creek systems.	No	Would Not Occur.	No impact.
Western Brush Wallaby <i>Macropus irma</i>	P4	-	Open forest or woodland, particularly favouring open, seasonally wet flats with low grasses and open scrubby thickets.	Yes	Unlikely to Occur.	No impact anticipated.

Species	Conservation Status		Habitat Preferences	Habitat Present	Likelihood of Occurrence	Possible Impacts
	WC Act/ DBCA Priority	EPBC Act				
Western False Pipistrelle <i>Falsistrellus mackenziei</i>	P4	-	Wet sclerophyll forest dominated by karri and in high rainfall zones of the jarrah and marri forest.	Yes	Possibly Occurs.	Loss/modification of a small area of habitat. Death/injury of



2.2.4.2 Fauna Habitat Assessment


Descriptions of the broadly defined fauna habitats, based primarily on vegetation units and landforms identified during the field reconnaissance survey are provided in Table 9.

The project area is centred on a subtle ridge with thin grey sand over irregular outcropping limestone. Vegetated sections of the project area are comprised of various combinations of limestone marlock (*Eucalyptus decipiens*), tuart (*Eucalyptus gomphocephala*), jarrah (*Eucalyptus marginata*) peppermint (*Agonis flexuosa*) with a very small number of candlestick banksia (*Banksia attenuata*) and WA Christmas tree (*Nuytsia floribunda*).

Native ground cover is generally absent though some small areas contain a relatively dense shrub cover. Limestone marlock (*Eucalyptus decipiens*) is the dominant tree species over much of the area. Tuart generally only occurs in the northern and southern sections of the project area where soil cover is thicker and clearing has been more intensive. Jarrah is represented by only a few specimens at scattered locations in the southern third of the project area. Peppermint also has a limited extent with only a few scattered specimens and some small groves in the south eastern corner of the project area. *Nuytsia floribunda* occurs as scattered individuals and small groves in the northern and central section of the project area. Only a few specimens of *Banksia attenuata* were observed with several dead or dying.

Table 9. Main Fauna Habitats within the project area

Unit	Fauna Habitat Description	Example Images
1	Limestone marlock (<i>Eucalyptus decipiens</i>) over scattered shrubs and bare limestone covering the majority of the project area.	
2	Scattered tuart (<i>E. gomphocephala</i>) over pasture grasses, dominant in small areas at the northern and southern ends of the project area.	

Unit	Fauna Habitat Description	Example Images
3	Small grove of peppermint (<i>Agonis flexuosa</i>) and jarrah (<i>E. marginata</i>) in the south east corner of the project area.	

The area appears to have been open to livestock grazing for many years and therefore is now in a degraded/highly degraded state. Because of this fact many of the fauna species that would have originally occurred in the area no longer persist. The Yalgorup National Park is located to the west (Lake Preston), east and north of the project area and these areas are likely to harbour much more biodiversity and represents much better habitat for fauna species in general.

The project area is surrounded by vegetation in a similar condition and does not represent a key “linkage” or “corridor” for wildlife movement and the relatively small amount of clearing likely to be required is not likely to create any significant barriers to fauna movement on a local or regional scale.

2.2.4.3 Black Cockatoo Habitat Assessment

Black Cockatoo Habitat Tree Assessment

Trees considered potentially suitable for black cockatoos to use as nesting habitat (subject to a suitable hollow being present and other factors) which were found within the project area are comprised of the following species:

- Tuart (*Eucalyptus gomphocephala*),
- Jarrah (*Eucalyptus marginata*); and
- Limestone Marlock (*Eucalyptus decipiens*).

It should be noted that the likelihood of any one particular tree species developing hollows suitable for black cockatoos to use for breeding varies considerably. For example, available data suggests that jarrah (*Eucalyptus marginata*) rarely produces hollows large enough for black cockatoos. Kirkby (2009) reports that from a database of 109 confirmed black cockatoo nest trees throughout the jarrah forest only six were located in jarrah trees.

The vast majority of limestone marlock (*Eucalyptus decipiens*), specimens within the project area also did not appear to have the characteristics suitable for the creation of hollows suitable for black cockatoos with most specimens being small and stunted (despite having a DBH of >50cm) with no hollows whatsoever. This tree species is not documented in the literature as being used by black cockatoos for breeding.

A summary of the potential black cockatoo breeding trees (using DotEE criteria i.e. any suitable tree species with a DBH > 50cm (Commonwealth of Australia 2012)) observed within the project area is provided in Table 10 and their location shown in Figure 8.

Table 10. Summary of potential cockatoo breeding habitat trees (DBH \geq 50cm)

Area	Total Number of Habitat Trees	Number of Trees with <u>No Hollows Observed</u>	Number of Trees with Hollows Considered <u>Unsuitable</u> for Nesting Black Cockatoos	Number of Trees with Hollows Considered <u>Possibly Suitable</u> for Nesting Black Cockatoos	Tree Species		
					Tuart	Limestone Marlock	Jarrah
Pit Area	27	22	5	0	8	15	4
50m Buffer	35	26	9	0	25	8	2
Total	62	48	14	0	33	23	6

The assessment identified a total of 27 trees with a DBH of >50cms within the proposed pit area. Twenty two of the trees (~81.5%) were not observed to contain hollows of any size. Five trees (~18.5%) contained one or more possible hollows considered by the Author not to be suitable for black cockatoos to use for nesting purposes.

No trees appeared to contain hollows with larger entrances (greater than ~10cm) that appeared big enough to possibly allow the entry of a black cockatoo into a suitably sized and orientated branch/trunk.

Thirty five habitat trees are present with 50m of the proposed bit area. None of these trees contain hollows considered suitable for black cockatoos to use for nesting purposes.

Additional details on each habitat tree observed can be found in Appendix F.

Based on available vegetation mapping it is estimated that there is approximately 9,514 ha of native vegetation within 10 km the project area. Remnant native vegetation present within the project area (total ~8.3 ha) makes up ~0.087% of this total. It can be reasonably expected that these areas contain numerous "habitat trees" many of which are likely to provide breeding opportunities for black cockatoos.

Black Cockatoo Foraging Habitat Assessment

Following is a list of the main flora species recorded within the project area during the fauna assessment that are known to be used as a direct food source (i.e. seeds or flowers) by one or more species of black cockatoo:

- Tuart (*Eucalyptus gomphocephala*) - seeds,
- Jarrah (*Eucalyptus marginata*) - seeds;
- Peppermint (*Agonis flexuosa*) – bark, grubs; and
- Candlestick Banksia (*Banksia attenuata*) - seeds.

Overall the project area cannot be regarded as representing quality black cockatoo foraging habitat. Tuarts and peppermint are only foraged upon rarely and the number of jarrah and banksia trees present is very small and would amount to far less than 1 ha in total.

No foraging debris left by black cockatoos was observed within the project area during the site surveys, though a small amount of evidence (chewed tuart fruits) was recorded just outside of the proposed pit area. This foraging evidence was attributed to the forest red-tailed black cockatoo two individuals of which were observed feeding within the tree.

Based on available vegetation mapping it is estimated that there is approximately 9,514 ha of native vegetation within 10 km the project area. Remnant native vegetation present within the project area (total ~8.3 ha) makes up ~0.087% of this total. There are is also over 3,000 ha of pine plantations with 10km of

the site. Pinecones provide an important food source for Carnaby's black cockatoo and to a lesser extent Baudin's black cockatoo.

Black Cockatoo Roosting Habitat Assessment

No evidence of black cockatoo roosting within trees located within the project area was observed during the field reconnaissance survey.

A review of the 2017 Great Cocky Count database shows no documented roost sites within or near the project area. The closest recorded roost is about 6 km south east of the project area, but no birds have been recorded at this location (during the great cocky count) since 2011.

Based on available vegetation mapping it is estimated that there is approximately 9,514 ha of native vegetation within 10 km the project area. Remnant native vegetation present within the project area (total ~8.3 ha) makes up ~0.087% of this total. There are also over 3,000 ha of pine plantations with 10km of the site. It can be reasonably expected that these areas contain many roosting options for black cockatoos.

2.2.4.4 Western Ringtail Possum Assessment

No evidence of western ringtail possums using the project area was found during the day or night surveys i.e. no fresh dreys, no scats and no individuals. The generally poor quality of the habitat present (e.g. lack of favoured foraging species) and the results of the survey work suggest that they do not occur in the project area.

2.2.4.5 Camera Traps

The complete results of the camera trapping carried out are provided within Appendix F. In total, six fauna species (native and introduced) were recorded. The western grey kangaroo (*Macropus fuliginosus*) was the most commonly recorded species, with the common brushtail possum (*Trichosurus vulpecula*), Australian magpie (*Cracticus tibicen*) and Australia raven (*Corvus coronoides*) also being photographed.

Feral species recorded included the red fox (*Vulpes vulpes*) and the rabbit (*Oryctolagus cuniculus*) at one location.

2.2.4.6 Other Fauna Species of Conservation Significance

No fauna species of conservation significance were confirmed as being present or using the site during the various site surveys. The habitat assessment and other observations made during the field reconnaissance survey does however suggest that some fauna species of conservation significance are likely to persist in the general area. Subject to suitable habitat being present (i.e. quality and extent) it is considered possible that some are also likely to reside or at least frequent the project area at times. The total size of the project area is however relatively small and therefore any fauna species present are only likely to be represented by a small number of individuals at any one time. A summary of those species considered likely to be present is provided in Table 8.

2.2.4.7 Opportunistic Fauna Observations

Opportunistic fauna observations are itemised in Appendix F and Table 11. Including those species recorded on camera traps and during the nocturnal survey, a total of 21 native fauna species were observed (or positively identified from foraging evidence, scats, tracks, skeletons or calls) within or very near the project area during the survey period. Three introduced species (laughing kookaburra, red fox, and rabbit) were also recorded.

Most of the fauna species recorded were common, widespread bird species.

2.2.4.8 Fauna Inventory – summary

Table 11 summarises the number of fauna species potentially occurring within or utilising at times, the project area, based on results from the literature review and observations made during the field assessment. A complete list of fauna possibly inhabiting or frequenting the project area is in Appendix F.

As previously indicated, not all species listed as potentially occurring within the wider area in existing databases and publications (i.e. EPBC Act threatened fauna and migratory species lists, DBCA's NatureMap database, various reports and publications) are shown in the expected listing in Appendix F. Some species have been excluded from this list based largely on the lack of suitable habitat at the project area and in the general area or known local extinction even if suitable habitat is present.

Despite the omission of some species it should be noted that the list provided is still very likely an over estimation of the fauna species utilising the site (either on a regular or infrequent basis) as a result of the precautionary approach adopted for the assessment. At any one time, only a subset of the listed potential species is likely to be present within the bounds of the project area.

Table 11. Summary of Potential Fauna Species (as listed in Appendix F)

Group	Total number of <u>Potential</u> species	Potential number of <u>Specially Protected</u> species	Potential number of <u>Migratory</u> species	Potential number of <u>Priority</u> species	Number of species <u>Observed:</u> Field Survey 2018/2019
Amphibians	2	0	0	0	0
Reptiles	15	0	0	0	0
Birds	83 ¹	4	0	0	20 ¹
Non-Volant Mammals	10 ⁷	1	0	0	4 ²
Volant Mammals (Bats)	9	0	0	1	0
Total	119⁸	5	0	1	24³

Superscript = number of introduced species included in total.

A number of other species of conservation significance, while possibly present in the general area, are not listed as potential species due to known localised extinction (and no subsequent recruitment from adjoining areas) and/or lack of suitable habitat and/or the presence of feral predators.

3 ENVIRONMENT MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

Information below is based on literature reviews of technical reports, books and scientific papers, as listed in Section 2.2.2. For more information, refer to Appendix F and Appendix G.

3.1 THREATENED SPECIES

3.1.1 Carnaby's black cockatoo (*Calyptorhynchus latirostris*)

3.1.1.1 Conservation status

EPBC Act – Endangered

BC Act – Schedule 2

3.1.1.2 Abundance and distribution

Abundance: 40,000 (DPAW 2013)

Carnaby's Cockatoo is endemic to the south-west of Western Australia, north to the lower Murchison River and east to Nabawa, Wilroy, Waddi Forest, Nugadong, Manmanning, Durokoppin, Noogar (Moorine Rock), Lake Cronin, Ravensthorpe Range, head of Oldfield River, 20 km ESE of Coondingup and Cape Arid; also casual on Rottnest Island (Johnstone and Storr 1998).

3.1.1.3 Ecology

Carnaby's cockatoos nest in the hollows of live or dead eucalypts, primarily the smooth-barked Salmon Gum and Wandoo (Saunders 1979b 1982), though breeding has been reported in other wheatbelt tree species and some tree species on the Coastal Plain and jarrah forest (Saunders 1979b 1982; Storr 1991; Johnstone and Storr 1998; Johnstone *et al.* 2011) (see Groom 2010a for tree species used for breeding by Carnaby's cockatoo).

Carnaby's cockatoos have been recorded nesting in trees on private property, road and railway reserves, conservation estate and other crown land. There are significant breeding areas located outside the conservation estate, particularly along rail and road reserves and on agricultural land (Saunders 1982; Saunders and Ingram 1998). Success in breeding is dependent on the quality and proximity of feeding habitat within 12 km of nesting sites (Saunders 1977 and 1986; Saunders and Ingram 1987). Along with the trees that provide nest hollows, the protection, management and increase of this feeding habitat that supports the breeding of Carnaby's cockatoo is a critical requirement for the conservation of the species.

During the non-breeding season (January to July) the majority of the birds migrate to the higher rainfall coastal regions of their range in the midwest coast, Swan Coastal Plain and south coast (Saunders 1980 and 1990; Berry 2008; Saunders *et al.* 2011b; Johnstone *et al.* 2011), though some non-breeding birds remain in non-breeding areas all year round. These areas have better natural water sources over the summer period and historically had extensive areas of proteaceous woodlands and shrublands to provide feed for young birds, and good resources for adult birds to stock up for the following breeding season (DPAW 2013).

3.1.1.4 Habitat

Breeding Habitat

Any patch of woodland or forest that contains live or dead trees of salmon gum, wandoo, tuart, jarrah, flooded gum, york gum, karri or marri, with presence of suitable nest hollow (Commonwealth of Australia 2017). On the Swan Coastal Plain most nests are in tuart (Johnstone and Kirkby 2010).

Foraging Habitat

Native shrubland, kwongan heathland and woodland dominated by proteaceous plant species such as *Banksia* spp. (including *Dryandra* spp.), *Hakea* spp. and *Grevillea* spp. Foraging also occurs in pine plantations (*Pinus* spp.), Eucalypt woodland and forest that contains foraging species (either as individual trees and small stands of these species).

Roosting Habitat

Generally, in or near riparian environments or natural and artificial permanent water sources. Flat-topped yate, salmon gum, wandoo, marri, karri, blackbutt, tuart, introduced eucalypts (for example blue gum) and introduced pines (Commonwealth of Australia 2017).

The Swan Coastal Plain is used by black cockatoos primarily for foraging resources, with some small patches of breeding habitat. The area is dominated by *Banksia* spp. and tuart woodlands on sandy soils, as well as marri, with jarrah occurring in the east. A key focus for this region is the ongoing viability of foraging resources for black cockatoos, particularly Carnaby's Cockatoo.

Breeding occurs mainly from early July to mid-December in the semiarid and subhumid interior from the Three Springs district south to the Stirling Range, west to Cockleshell Gully, Cataby, Regans Ford, Gingin, near mouth of Moore River, Yanchep, Serpentine, Mandurah, Lake Clifton, Bunbury, Nannup and Tone River and east to Manmanning, Kellerberrin, Woolundra, Lake Cronin, Hatters Hill and near Ravensthorpe (Johnstone and Kirkby 2010).

There has been an apparent shift in its breeding range further west and south since the middle of last century with a more rapid increase in the past 10–30 years into the Jarrah-Marri forests of the Darling Scarp and the Tuart forests of the Swan Coastal Plain. There are now numerous breeding records for the northern Darling Scarp, including Bindoon, Bullsbrook, Mundaring, Lower Darkin River, near Canning Dam, near Wungong Dam, Serpentine and near Collie, and on the Swan Coastal Plain at Gingin, Boonanarring, Mooliabeenee, near mouth of Moore River, Yanchep, Baldivis, near Mandurah, Lake Clifton and near Bunbury.

Apart from recent roost surveys and counts (Peck *et al.* 2018) very little of the Swan Coastal Plain and adjacent Darling Scarp has been surveyed for feeding, breeding and roosting sites. The only studies carried out so far with detailed information on foraging and breeding are in the Gngangara Sustainability study area, the East Wanneroo area, near Bindoon, the corridor of the Forrest Highway, Wungong Dam Catchment, the Serpentine area and parts of the Whicher Range and in the Bunbury-Busselton road verges. In most cases these too have also only been short term studies of only a few months making it difficult to determine the importance of certain habitats and sites (Johnstone and Kirkby 2010).

3.1.1.5 Suitable habitat at the proposal area

The proposal area is surrounded by vegetation in a similar condition and does not represent a key “linkage” or “corridor” for wildlife movement and the relatively small amount of clearing likely to be required is not likely to create any significant barriers to fauna movement on a local or regional scale (Harewood 2019, Appendix F).

As detailed in Section 4.2.4 of this document, the proposal footprint does not represent quality black cockatoo foraging habitat. Tuarts and peppermint are only foraged upon rarely and the number of jarrah

and banksia trees present is very small and would amount to far less than 1ha in total. No existing roosting trees (trees used at night by black cockatoos to rest) were positively identified during the survey.

No trees within the proposal footprint contain hollows with large entrances (greater than ~10cm), big enough to allow the entry of a black cockatoo. Two trees with these characteristics are located approximately 170m south west of the proposal area.

The Yalgorup National Park is located to the west (Lake Preston), east and north of the project area and these areas are likely to harbour much more biodiversity and represents much better habitat for fauna species in general (Figure 9).

3.1.2 Bar-tailed Godwit (Baueri) (*Limosa lapponica baueri*)

3.1.2.1 Conservation status

EPBC Act – Vulnerable, Migratory

BC Act - Vulnerable

3.1.2.2 Abundance, distribution and habitat preference

Abundance (East Asian-Australasian Flyway): 133,000 (*L. l. baueri* only – year 2007 -2009 - Wetlands International 2019), 325,000 (all subspecies - Hansen *et al.* 2016).

The bar-tailed godwit (western Alaskan) is a large migratory shorebird, recorded in the coastal areas of all Australian states. It is a non-breeding migrant to Australia and has been recorded in the coastal areas of all Australian states though they are generally more numerous in northern Australia.

In Western Australia it is widespread around the coast, from Eyre to Derby, with a few scattered records elsewhere in the Kimberley Division. (Marchant and Higgins 1993). West Australian sites of international importance and highest recorded number of birds are (Bamford *et al.* 2008):

- Eighty Mile Beach, Western Australia (110 290)
- Roebuck Bay, Western Australia (65 000).

The bar-tailed godwit (western Alaskan) occurs mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It has also been recorded in coastal sewage farms and saltworks, saltlakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms, and coral reef-flats (Higgins and Davies 1996, in DoEE Conservation Advice 2016, 5 May 2016).

3.1.2.3 Ecology

Breeding take place each year in Scandinavia, northern Asia and Alaska in the northern hemisphere summer after which they migrate to Australia arriving each year around August. The birds start the return migration northwards generally from early February to mid-April (Marchant and Higgins 1993) however many Bar-tailed Godwits remain in the non-breeding range all year (Alcorn 1988).

The bar-tailed godwit is mainly carnivorous with a diet consisting of worms, molluscs, crustaceans, insects and some plant material. It has also been recorded eating fruits, fish and tadpoles. While it is in breeding grounds it eats mainly ground dwelling insects (Marchant and Higgins 1993).

3.1.2.4 Suitable habitat at the proposal area

There is no suitable habitat within the proposal area. The project area is approximately 300m from the closest known suitable habitat for wader bird species, and on a limestone ridge that is approximately 18m higher in elevation than the lake shore.

The bar-tailed godwit is listed as a species “present” within Yalgorup National Park (Hale and Butcher 2007) but no records appear in the NatureMap database (NatureMap 2019). There are however records from the Harvey Estuary, which is approximately 20km north east of the project area (Figure 10, source: Appendix G).

3.1.3 Curlew Sandpiper (*Calidris ferruginea*)

3.1.3.1 Conservation status

EPBC Act – Critically Endangered, Migratory

BC Act - Critically Endangered

3.1.3.2 Abundance, distribution and habitat preference

Abundance (East Asian-Australasian Flyway): 90,000 (Hansen *et al.* 2016).

In Australia, curlew sandpipers occur around the coasts and are also quite widespread inland, though in smaller numbers. Records occur in all states during the non-breeding period, and also during the breeding season when many non-breeding one year old birds remain in Australia rather than migrating north. In Western Australia, they are widespread around coastal and subcoastal plains from Cape Arid to south-west Kimberley Division, but are more sparsely distributed between Carnarvon and Dampier Archipelago. They occur in large numbers, in thousands to tens of thousands, at Port Hedland Saltworks, 80 Mile Beach, Roebuck Bay and Lake Macleod. They are rarely recorded in the north-west Kimberley, around Wyndham and Lake Argyle (Higgins and Davies 1996).

Curlew sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms (DoEE Conservation Advice, 14 May 2015, Higgins and Davies 1996).

3.1.3.3 Ecology

The curlew sandpiper breeds in north-eastern Siberia and Alaska where nesting occurs during June and July (Hayman *et al.* 1986). Males depart breeding grounds during early July, followed by females in July and early August, then juveniles in August (Higgins and Davies 1996). After a stopover in northern Australia, migration continues on a direct route to south-east Australia, the first birds arriving in late August, but the majority not until September. They return north in March (Higgins and Davies 1996).

This species forages mainly on invertebrates, including worms, molluscs, crustaceans, and insects, as well as seeds. Outside Australia, they also forage on shrimp, crabs and small fish (Dann 1999b).

3.1.3.4 Suitable habitat at the proposal area

There is no suitable habitat within the proposal area. The project area is approximately 300m from the closest known suitable habitat for wader bird species, and is separated by a limestone ridge that is approximately 18m higher in elevation than the lake shore.

The curlew sandpiper is listed as a species “present” within Yalgorup National Park (Hale and Butcher 2007) and there are numerous records of it being observed in this area in the NatureMap database (NatureMap 2019) (Appendix F). The species does not however appear to have been recorded on Lake Preston near the proposed action area.

3.1.4 Great Knot (*Calidris tenuirostris*)

3.1.4.1 Conservation status

EPBC Act – Critically Endangered, Migratory

BC Act - Critically Endangered

3.1.4.2 Abundance, distribution and habitat preference

Abundance (East Asian-Australasian Flyway): 425,000 (Hansen *et al.* 2016).

The great knot is the largest of the calidrid shorebirds.

The great knot has been recorded around the entirety of the Australian coast, with a few scattered records inland. It is no longer regular at some sites along the south coast of Australia which used to support small numbers (Garnett *et al.* 2011 in DoEE Conservation Advice, 5 May 2016). The greatest numbers are found in northern Western Australia and the Northern Territory.

West Australian sites of international importance and the highest recorded number of birds are (Bamford *et al.* 2008):

- Eighty Mile Beach, Western Australia (169 044)
- Roebuck Bay, Western Australia (22 600).

In Australia, great knots prefer sheltered coastal habitats with large intertidal mudflats or sandflats. This includes inlets, bays, harbours, estuaries and lagoons.

3.1.4.3 Ecology

The great knot breeds in north-east Siberia but the breeding distribution is poorly known. During the non-breeding season, most of the Great Knot population occurs in Australia. Post-breeding migration starts in late June and seems to occur in three waves up to early September. In Australia, large numbers arrive in the north-west in late August-early September (Lane 1987), though juveniles and many males may not arrive till October-November (Barter 1986).

The great knot feeds on invertebrates by pecking at or just below the surface of moist mud or sand. They feed on bivalves, gastropods, crustaceans and other invertebrates (Higgins and Davies 1996).

3.1.4.4 Suitable habitat at the proposal area

There is no suitable habitat within the proposal area. The project area is approximately 300m from the closest known suitable habitat for wader bird species, and on a limestone ridge that is approximately 18m higher in elevation than the lake shore.

The great knot is listed as a species “present” within Yalgorup National Park (Hale and Butcher 2007) and there a several records of it being observed in this area in the NatureMap database (NatureMap 2019) (Figure 11, source: Appendix G). The species does not however appear to have been recorded on Lake Preston near the proposed action area.

3.1.5 Greater Sand Plover (*Charadrius leschenaultia*)

3.1.5.1 Conservation status

EPBC Act – Vulnerable, Migratory

BC Act - Vulnerable

3.1.5.2 Abundance, distribution and habitat preference

Abundance (East Asian-Australasian Flyway): 200,000-300,000 (Hansen *et al.* 2016).

The greater sand plover is a small-to-medium sized shorebird. In Western Australia the bird is especially widespread between North West Cape and Roebuck Bay and occasionally recorded along the coast of southern Western Australia (DoEE Conservation Advice, 5 May 2016).

It also occasionally occurs along the coast of southern Western Australia (Barrett *et al.* 2003; Blakers *et al.* 1984; Emison *et al.* 1987; Jaensch *et al.* 1988; Lane 1987; Storr 1987).

Internationally important sites in Western Australia and maximum counts include (Bamford *et al.* 2008):

- Eighty Mile Beach, Western Australia (64 584);
- Roebuck Bay, Western Australia (26 900); and
- Ashmore Reef, Western Australia (1 196).

In the non-breeding grounds in Australasia, the species is almost entirely coastal, inhabiting littoral and estuarine habitats. They mainly occur on sheltered sandy, shelly or muddy beaches, large intertidal mudflats, sandbanks, salt-marshes, estuaries, coral reefs, rocky islands rock platforms, tidal lagoons and dunes near the coast (Marchant and Higgins 1993; del Hoyo *et al.* 1996; BirdLife International 2015 in DoEE Conservation Advice, 5 May 2016).

3.1.5.3 Ecology

The greater sand plover is a migratory species, breeding in the Northern Hemisphere and flying south for the boreal winter (Lane 1987; Marchant and Higgins 1993). The Greater Sand Plover is one of the first migratory waders to return to north-western Australia, usually arriving in late July (Minton *et al.* 2005). In the East Asian-Australasian Flyway, Greater Sand Plovers have been recorded moving through Indonesia between February and June (White and Bruce 1986). The species begins to vacate southern coasts by March, with most Plovers having left the north-west by mid to late April (Lane 1987; Marchant and Higgins 1993).

During the non-breeding season, greater sand plovers mostly eat molluscs, worms, crustaceans (especially small crabs and sometimes shrimps) and insects (including adults and larvae of termites, beetles, weevils, earwigs and ants) (Barker and Vestjens 1989). They are said to have been recorded eating lizards and plant material (Marchant and Higgins 1993).

3.1.5.4 Suitable habitat at the proposal area

The greater sand plover is listed as a species “present” within Yalgorup National Park (Hale and Butcher 2007) and there are numerous records of it being observed in this area in the NatureMap database (NatureMap 2019) (Figure 12, source: Appendix G). The species does not however appear to have been recorded at Lake Preston.

There is no suitable habitat within the proposal area. The project area is approximately 300m from the closest known suitable habitat for wader bird species, and on a limestone ridge that is approximately 18m higher in elevation than the lake shore.

3.1.6 Lesser Sand Plover (*Charadrius mongolus*)

3.1.6.1 Conservation status

EPBC Act – Endangered, Migratory

BC Act - Endangered

3.1.6.2 Abundance, distribution and habitat preference

Abundance (East Asian-Australasian Flyway): 180,000-275,000 (Hansen *et al.* 2016).

The lesser sand plover is a small to medium-sized grey-brown and white shorebird. Within Australia, the lesser sand plover is widespread in coastal regions and has been recorded in all states (DoEE Conservation Advice, 5 May 2016).

It mainly occurs in northern and eastern Australia, in south-eastern parts of the Gulf of Carpentaria, western Cape York Peninsula and islands in Torres Strait, and along the entire east coast, though it occasionally also occurs inland. It is most numerous in Queensland and NSW (Blakers *et al.* 1984; Marchant and Higgins 1993; Minton *et al.* 2006).

Internationally important sites in Western Australia and maximum counts include (Bamford *et al.* 2008):

- Eighty Mile Beach, Western Australia (1 575)
- Roebuck Bay, Western Australia (1 057)
- Broome, Western Australia (745)
- Port Hedland Saltworks (668)

During the non-breeding season, the species is almost strictly coastal, preferring sandy beaches, mudflats of coastal bays and estuaries, sand-flats and dunes near the coast (del Hoyo *et al.* 1996) and occasionally frequenting mangrove mudflats in Australia (BirdLife International 2015). The lesser sand plover is gregarious and usually occurs in small to large flocks often with more than 100 individuals at favoured sites in northern Australia (Department of the Environment *Charadrius mongolus* (lesser sand plover) Conservation Advice Page 4 of 15 2015a, b in DoEE Conservation Advice, 5 May 2016).

3.1.6.3 Ecology

The lesser sand plover is a migratory species, breeding in the Northern Hemisphere and flying south for the boreal winter. The species is present at non-breeding grounds in Australasia mostly between September and April or May, with greatest numbers in northern Australia (Lane 1987; Marchant and Higgins 1993).

During the non-breeding season lesser sand plovers eat invertebrates, such as molluscs (especially bivalves), worms, crustaceans (especially crabs) and insects (Lane 1987).

3.1.6.4 Suitable habitat at the proposal area

The lesser sand plover is listed as a species “present” within Yalgorup National Park (Hale and Butcher 2007) but no records from this area appear in the NatureMap database (NatureMap 2019). There are however several records from Lake McClarty and Peel inlet, which are approximately 30km further north of the project area.

There is no suitable habitat within the proposal area. The project area is approximately 300m from the closest potentially suitable habitat for shorebirds and is separated from the project by a limestone ridge that is approximately 18m higher in elevation than the lake shore.

3.1.7 Eastern Curlew (*Numenius madagascariensis*)

3.1.7.1 Conservation status

EPBC Act – Critically Endangered, Migratory

BC Act - Critically Endangered

3.1.7.2 Abundance, distribution and habitat preference

Abundance (East Asian-Australasian Flyway): 35,000 (Hansen *et al.* 2016).

The eastern curlew is the largest migratory shorebird in the world, with a long neck, long legs, and a very long downcurved bill.

Within Australia, the eastern curlew has a primarily coastal distribution. The species is found in all states, particularly the north, east, and south-east regions including Tasmania. Eastern curlews are rarely recorded inland. They have a continuous distribution from Barrow Island and Dampier Archipelago, Western Australia, through the Kimberley and along the Northern Territory, Queensland, and NSW coasts and the islands of Torres Strait.

In southern Western Australia, eastern curlews are recorded from Eyre, and there are scattered records from Stokes Inlet to Peel Inlet. The species is a scarce visitor to Houtman Abrolhos and the adjacent mainland and is also recorded around Shark Bay (Marchant and Higgins 1993); DoEE Conservation Advice, 26 May 2015).

The eastern curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass (*Zosteraceae*).

3.1.7.3 Ecology

The eastern curlew is migratory and after breeding, they move south for the Northern Hemisphere winter. The birds arrive in north-west and eastern Australia as early as July (Lane 1987). In Australia, most eastern curlews leave between late February and March-April (Marchant and Higgins 1993).

The eastern curlew is carnivorous during the non-breeding season, mainly eating crustaceans (including crabs, shrimps and prawns), small molluscs, as well as some insects (Marchant and Higgins 1993).

3.1.7.4 Suitable habitat at the proposal area

The eastern curlew is listed as a species “present” within Yalgorup National Park (Hale and Butcher 2007) and there are several records of it being observed in this area in the NatureMap database (NatureMap 2019) (Figure 13, source: Appendix G). The species does not however appear to have been recorded near the proposed action area.

There is no suitable habitat within the proposal area. The project area is approximately 300m from the closest known suitable habitat for wader bird species, and on a limestone ridge that is approximately 18m higher in elevation than the lake shore.

3.2 MIGRATORY SPECIES

3.2.1 Red-necked Stint (*Calidris ruficolis*)

3.2.1.1 Conservation status

EPBC Act – Migratory, Marine

3.2.1.2 Abundance, distribution and habitat preference

Abundance (East Asian-Australasian Flyway): 475,000 (Hansen *et al.* 2016).

The Red-necked Stint is the smallest shorebird in Australia. It is distributed along most of the Australian coastline with large densities on the Victorian and Tasmanian coasts.

The Red-necked Stint has been recorded in all coastal regions and found inland in all states when conditions are suitable. The Red-necked Stint probably travels in flocks and has been observed to feed in dense flocks.

Western Australian sites of international importance and maximum or average counts (Watkins 1993) in Australia include:

- Eighty Mile Beach, Western Australia (60,000)
- Port Hedland Saltworks, Western Australia (23,000)
- Roebuck Bay, Western Australia (19,800)
- Wilson Inlet, Western Australia (15,252)
- Alfred Cove Nature Reserve, Western Australia (10,000)
- Lake Macleod, Western Australia (8,312)
- Peel Inlet, Western Australia (8,063)

In Australasia, the Red-necked Stint is mostly found in coastal areas, including in sheltered inlets, bays, lagoons and estuaries with intertidal mudflats, often near spits, islets and banks and, sometimes, on protected sandy or coralline shores.

3.2.1.3 Ecology

The Red-necked Stint is migratory and breeds in Siberia and west Alaska and then moves to non-breeding areas in south-east Asia and Australasia. The Red-necked Stint arrives in Australia from August (and possibly July), with most from early September. The Red-necked Stint leaves Australia from late February or March through to April. A few, however, may remain until May (Higgins and Davies 1996).

The Red-necked Stint is omnivorous. In Australia it is known to forage on intertidal and near-coastal wetlands. It jabs and probes with its bill into the soft mud for small invertebrates. It also gleans from plants in saltmarsh and water. The Red-necked Stint also forages on plant seeds and on a range of marine worms, molluscs, snails and slugs, shrimps, spiders, beetles, flies and ants. The Red-necked Stint also eats grit (Higgins and Davies 1996).

3.2.1.4 Suitable habitat at the proposal area

The red-necked stint is listed as a species “present” within Yalgorup National Park (Hale and Butcher 2007) and there are numerous records of it being observed in this area in the NatureMap database (NatureMap 2019) (Figure 14, source: Appendix G). The species appears to have been recorded near the proposed action area on several occasions in the past.

Historically up to 15,000 red-necked stints have been recorded within the Yalgorup Lakes during a single count which at the time represented 3% of the estimated total population (Hale and Butcher 2007).

There is no suitable habitat within the proposal area

3.3 DECLARED RAMSAR WETLAND

3.3.1 Peel-Yalgorup System Ramsar site (PYSRS)

The following information has been sourced from the DAWE (<http://www.environment.gov.au/cgi-bin/wetlands/ramsardetails.pl?refcode=36>).

3.3.1.1 Key facts

Date of listing: 7 June 1990

Ramsar site Number: 36

Area: 26,530ha

3.3.1.2 Justification of the listing criteria

The Peel-Yalgorup wetland Ramsar site meets four of the nine criteria:

- Criterion 1: The Peel-Yalgorup wetland Ramsar site includes the largest and most diverse estuarine complex in south-western Australia. It also includes particularly good examples of coastal saline lakes and freshwater marshes.
- Criterion 3: Lake Clifton, which is part of the Peel-Yalgorup wetland Ramsar site, is one of the few locations in the world where living thrombolites occur in inland, hyposaline waters.
- Criterion 5: The Peel-Yalgorup wetland Ramsar site is the most important area for waterbirds in south-western Australia, supporting in excess of 20,000 waterbirds annually. At one time (February 1977) greater than 150,000 individual waterbirds were recorded.
- Criterion 6: Over 1% of the world population of several waterbird species including the Red-necked Avocet, Red-necked Stint, Red-capped Plover, Banded Stilt and Fairy Tern, regularly use the Peel-Yalgorup for the services the wetland provides such as food, shelter, nesting and moulting sites.

3.3.1.3 Wetland type

- F - Estuarine waters; permanent water of estuaries and estuarine systems of deltas
- G - Intertidal mud, sand or salt flats
- H - Intertidal marshes; includes salt marshes, salt meadows, raised salt marshes; includes tidal brackish and freshwater marshes
- O - Permanent freshwater lakes (over 8 ha); includes large oxbow lakes
- Q - Permanent saline/brackish/alkaline lakes
- Tp - Permanent freshwater marshes/pools; ponds (below 8ha), marshes and swamps on inorganic soils; with emergent vegetation water-logged for at least most of the growing season
- Ts - Seasonal/intermittent freshwater marshes/pools on inorganic soils; includes sloughs, potholes, seasonally flooded meadows, sedge marshes
- W - Shrub-dominated wetlands; shrub swamps, shrub-dominated freshwater marshes, shrub carr, alder thicket on inorganic soils

- Xf - Freshwater, tree-dominated wetlands; includes freshwater swamp forests, seasonally flooded forests, wooded swamps on inorganic soils

3.3.1.4 Description of system

The Peel-Yalgorup System, located adjacent to the City of Mandurah in Western Australia, is a large and diverse system of shallow estuaries, coastal saline lakes and freshwater marshes. The site includes the Peel Inlet, Harvey Estuary, Lake McLarty, Lake Mealup and ten Yalgorup National Park wetlands.

The Peel Inlet and Harvey Estuary are large shallow estuarine waters fed from the Serpentine, Murray and Harvey Rivers, and are connected to the Indian Ocean through various channels. Lake McLarty and Lake Mealup are seasonal freshwater to brackish wetlands. The Yalgorup National Park wetlands are brackish to hypersaline. The wetlands are shallow and fed mainly from groundwater and rainfall. The site is fringed mainly by samphire, rushes and sedges and paperbark communities.

The Peel-Yalgorup System Ramsar site is the most important area for waterbirds in south-western Australia. It supports many waterbirds and a wide variety of waterbird species. It also supports a wide variety of invertebrates, and estuarine and marine fish.

The Yalgorup Lakes wetlands include Lake Clifton, which is one of the few places in the world where living thrombolites occur in inland water. Thrombolites are underwater rock-like structures that are formed by the activities of microbial communities. They are actively growing and rely on an inflow of fresh groundwater rich in calcium and bicarbonate. In Lake Clifton the thrombolites are over 2000 years old.

The Peel Inlet and Harvey Estuary are mainly used for recreational and commercial fishing, and other aquatic activities. The estuary system supports the largest professional and amateur estuarine fishery in Western Australia, with a high catch of Blue Swimmer Crabs and Western King Prawns.

The Peel-Yalgorup Ramsar site lies within Pinjarup country, a dialect group of the Nyoongar. There are hundreds of sites of significance to the indigenous community including sites of artefact scatter, camp sites, ceremonial sites, fish traps, skeletal remains and other sites of significance.

3.3.1.5 Relevance to proposal area

Lake Preston is the largest of the 10 wetlands collectively referred to as Yalgorup Lakes, all of which are contained within the Yalgorup National Park. The lakes are all shallow (< 3 m deep) and have no defined inlet or outlet channels. Lake Preston is a long, narrow, largely hypersaline water body approximately 30 km long and 0.5–1.5 km wide, running parallel to the coastline. An artificial causeway separates the northern section of Lake Preston from the remainder of the waterbody (Hale and Butcher 2007).

Lake Preston also forms part of the Peel-Yalgorup System Ramsar Site. The site as a whole is documented as regularly supporting over 20,000 water birds and at least 1% of individuals of some species these being: Red necked Avocet (*Recurvirostra novaehollandiae*), Red necked Stint (*Calidris ruficollis*), Red-capped Plover (*Charadrius ruficapillus*), Banded Stilt (*Cladorhynchus leucocephalus*), Caspian Tern (*Sterna caspia*) and Fairy Tern (*Sterna nereis*) (Ramsar information Sheet - Peel – Yalgorup System, Western Australia).

The Yalgorup lakes are important habitat for a number of waterbird species and are considered a summer sanctuary for waterfowl (CALM 1995), with Lake Clifton and Lake Preston in particular supporting large numbers of waterbirds in the period up to Ramsar listing (Hale and Butcher 2007).

More than 15 000 red-necked stints were observed at Lake Preston in December 1999, which is more than 3% of the population of this species (Rose and Scott 1997; Russell 2000). The very large numbers of Stint and other waders at this time may have been due in part to very high-water levels at Lake McLarty and Harvey Estuary restricting the availability of suitable habitat (Russell 2000).

Habitat suitable for shorebirds present within 1km of the proposed action area is also limited in extent being represented by a 2.7km section of the eastern shoreline and a 300m section of the western shoreline of Lake Preston. The narrow band of shallow water and open shoreline along these sections represents

the habitat most likely to be utilised for both roosting and feeding by shorebirds though the value of this section of the Lake relative to other areas is not documented.

An extract of NatureMap records for the seven species of shorebirds referenced in the document shows that only one species (the red-necked stint) has been recorded within 1 km of the proposed action area. Other than the red-necked stint, the number of records of each species recorded in the Yalgorup Lakes area appears to be relatively low.

The project area is approximately 300m from the Ramsar site and is separated from the project area by a limestone ridge that is approximately 18m higher in elevation than the lake shore.

As mentioned previously, the proposed action area contains no habitat suitable for any of the listed threatened/migratory shorebird species to utilise and therefore none are considered likely to occur.

4 ASSESSMENT OF IMPACTS

4.1 POTENTIAL DIRECT AND INDIRECT IMPACTS

A list of the key potential impacts that may occur as a result of the project.

4.1.1 Carnaby's Black Cockatoo

Potential impacts to Carnaby's Black Cockatoo from the project may include the following potential direct and indirect impacts:

4.1.1.1 Direct impact

- Direct **loss of habitat**, which may include habitat used for foraging, breeding, roosting, or dispersal (includes loss of hollow bearing trees). Loss of habitat has the potential to reduce the extent, connectivity and the quality of habitat for black cockatoos in the local area.

4.1.1.2 Indirect impacts

- **Habitat fragmentation** as a result of clearing, which has the potential to disrupt known ecological and habitat linkages and restrict movement within the area.
- Decline in the condition and value of adjacent habitat from **dust deposition** on habitat trees and **noise emissions**, which all may contribute to the potential degradation of any adjacent black cockatoo habitat.
- Spread of **plant pathogens** (e.g. dieback) and **weeds**, which may contribute to the potential degradation of any adjacent black cockatoo habitat.
- Increase in the number of **predatory introduced species** (e.g. cats, foxes), due to increase in human activity.
- Death or injury of individuals from **vehicle strike** during clearing and operations as a result of increased traffic in the area.

4.1.2 Listed Threatened and Migratory Shorebirds

Listed Threatened and Migratory shorebird include the Bar-tailed Godwit, Curlew Sandpiper, Great Knot, Greater Sand Plover, Lesser Sand Plover, Eastern Curlew, Red-necked Stint. Potential impacts to these species from the project may include the following potential indirect impacts.

4.1.2.1 Indirect impacts

- Decline in adjacent habitat quality as a result of **dust deposition** and **noise emissions**, which all may potentially contribute to the degradation of shorebird habitat.
- Spread of **plant pathogens** (e.g. dieback) and **weeds**, which may potentially contribute to the degradation of shorebird habitat.
- Increase in the number of **predatory introduced species** (e.g. cats, foxes), due to increase in human activity.
- Death or injury of individuals from **vehicle strike** during clearing and operations as a result of increased traffic in the area.

4.1.3 Lake Preston (Peel-Yalgorup System Ramsar site)

Potential impacts from the project to the environmental values of Lake Preston and the broader Peel-Yalgorup System Ramsar site may include the following potential indirect impacts.

4.1.3.1 Indirect impacts

- Change in surface water flows, which may result in **sedimentation** and increased **turbidity** at Lake Preston
- **Contamination** of surface water and/or groundwater from hydrocarbon spills at the project area
- **Alteration of ground water levels**, which may result in waterlogged or dryer conditions at Lake Preston.
- Decline in the conservation value of the wetland system as a result of the spread of **plant pathogens** (e.g. dieback) and **weeds, dust deposition** and **uncontrolled access**.
- Generation of **acid sulphate soils**

4.1.4 Social and Economic Impacts

4.1.4.1 Indirect impacts

- Changes to the amenity in the local area as a result of temporary and short term increases in **dust and noise** emissions.
- Changes to the amenity in the local area, which may result in a negative **visual impact** to the surrounding landscape of the area.

4.2 IMPACT SUMMARY

A summary of the key potential impacts identified for each of the matters of NES at the project area are presented in Table 12. An impact assessment of each of these potential impacts is provided in Section 4.3.

Table 12. Summary of the potential impacts at the project area

Potential impact	Matters of NES		
	Carnaby’s Black Cockatoo	Listed Threatened and Migratory Shorebirds	Lake Preston (Peel-Yalgorup System Ramsar site)
Direct potential impacts			
Loss of habitat	x		
Indirect potential impacts			
Habitat fragmentation	x		
Dust deposition	x	x	x
Noise emissions	x	x	
Plant pathogens (e.g. dieback)	x	x	x
Weeds	x	x	x
Predatory introduced species (e.g. cats, foxes),	x	x	
Vehicle strike	x	x	

Potential impact	Matters of NES		
	Carnaby's Black Cockatoo	Listed Threatened and Migratory Shorebirds	Lake Preston (Peel-Yalgorup System Ramsar site)
Uncontrolled access.			x
Surface water flows change (sedimentation and turbidity)			x
Water contamination			x
Alteration of groundwater levels			x
Acid sulphate soils			x
Amenity/social values (visual, dust and noise impacts)			

4.3 IMPACT ASSESSMENT

Each of the potential impacts to MNES, identified in Section 4.1 and summarised in the Section 4.2 have been assessed below.

4.3.1 Loss of habitat

4.3.1.1 Black cockatoos

Nesting habitat

Of the 62 potential habitat trees recorded across the broad project area (including the proposed pit area and buffer), none contain hollows with large entrances (greater than ~10cm), big enough to allow the entry of a black cockatoo.

Overall, within the proposed footprint, it is proposed to remove the following number of black cockatoo potential habitat trees (with a DBH >50cm):

- 4 potential habitat trees with small hollows (<10cm), considered unsuitable for nesting black cockatoos
- 18 trees with no hollows), considered unsuitable for nesting black cockatoos

Foraging habitat

The project area does not represent quality black cockatoo foraging habitat.

Of the four flora species recorded in the project area that are used as a food source by the black cockatoo (tuart, jarrah, peppermint, banksia), only the tuart trees are represented by a vegetation type, with the jarrah, peppermint and banksia only found to be distributed sparsely across project area. Of these foraging species, tuarts and peppermint are only foraged rarely by black cockatoos.

The tuart woodland mapped in the footprint (*Eucalyptus gomphocephala* woodland on deeper soils of the lower slopes) represents 0.8ha of the total proposed disturbance (6.2% of the disturbance footprint).

The largest portion of the project area is covered by *Eucalyptus decipiens* open woodland on the shallow soils over limestone of the ridge crest and upper slopes (6.3ha, 47% of project area). *Eucalyptus decipiens* is not a preferred food source for black cockatoos, and the tree has a multistem form making it unable to form large hollows or DBHs.

Overall, the project area represents low value foraging habitat for black cockatoos.

Roosting habitat

During multiple field visits to the project area to undertake fauna surveys, no records were made of black cockatoos roosting within the trees. Furthermore, a the 'Great Cocky Count' database shows no documented roost sites within or near the project. The closest recorded roost is about 6km south east of the project area.

Overall, the project area does not seem to represent regular roosting opportunities for black cockatoos.

4.3.2 Habitat fragmentation

4.3.2.1 Black cockatoos

The South West Regional Ecological Linkages Project, delivered by the South West Biodiversity Project in 2009, identified and mapped Regional Ecological Linkages across the South West Region. These data indicate that the project area has a density value of 5.4, which categorises the area as 'least fragmented', within a broader 13,836ha polygon (WALGA EPT 2019, <http://lbp.asn.au/module/enviro#map>) (Molley et al 2009).

The same database also identifies the project area's regional connectivity as part of a 'large, regionally well-connected patch', and its connectivity reach score is rated as 'part of a large network (Molley et al 2009).

Based on available vegetation mapping it is estimated that there is approximately 9,514 ha of native vegetation within 10 km of the project area. Remnant native vegetation present within the project area (total ~8.3 ha) makes up ~0.087% of this total. It can be reasonably expected that these areas contain numerous "habitat trees", many of which are likely to provide breeding opportunities for black cockatoos.

The Yalgorup National Park is located to the west (Lake Preston), east and north of the project area and these areas are likely to harbour much more biodiversity and represents much better habitat for fauna species in general.

Overall, the project area is surrounded by vegetation and does not represent a key "linkage" or "corridor" for wildlife movement and the relatively small amount of clearing likely to be required is not likely to create any significant barriers to fauna movement on a local or regional scale (Harewood 2019, Appendix F).

4.3.3 Dust deposition

Operational and transport activities have the potential to cause increased atmospheric dust levels and impact potential black cockatoo habitat. The proposed extraction may emit dust from the following activities:

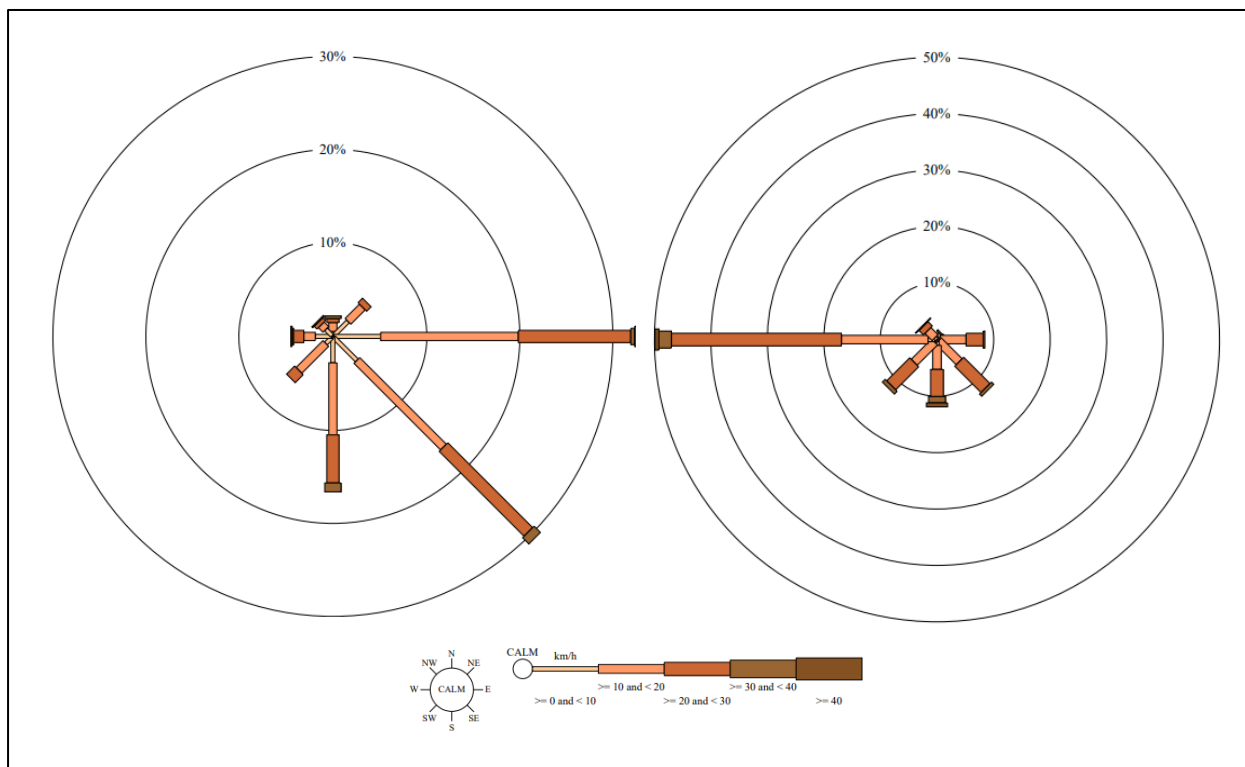
- Removing topsoil.
- Excavation of limestone.
- Crushing and screening.
- Loading of haulage trucks.
- Equipment movement on unsealed surfaces.

Since 2015, particulate matter has been regularly monitored across four locations at Lot 4 Ludlow Rd, north, south east and west of the project area.

These monitoring stations were installed and monitored under condition 3 of Licence L8831/2014/1 (Part V, EP Act) (File Number: DER2014/001608), as per AS/NZS 3580.10.1:2003, Australian/New Zealand Standard (Methods for sampling and analysis of ambient air. Method 10.1: Determination of particulate matter—Deposited matter—Gravimetric method).

In summer, when the risk of dust impacts is highest, the prevailing wind direction is east and south east in the morning and westerly in the afternoon (Wind Rose data below).

Results to date from the dust monitoring on sites have shown that the monitoring station to the east of the project area is consistently higher than the dust levels in other directions.



Rose of Wind direction versus Wind speed in km/h (22 Nov 1995 to 11 Aug 2019) Bunbury Site No: 009965. (Latitude: -33.3567, Longitude: 115.6447, Elevation 5.m). January, average reading at 9am (left) and 3pm (right).

Table 13. 2018 dust monitoring results

2018 Month	Sample Location	Total Solids (g/m ² /month)	Total Insoluble Matter (g/m ² /month)
17/01/18 – 20/02/18	North AQ1	4.1	2.7
	South AQ2	5.1	3.2
	East AQ3	18.0	7.5
	West AQ4	4	3.1
19/02/18-19/03/18	North	4.1	3.5
	South	8.7	6.2
	East	12	10.0
	West	10	8.1
19/3/18-04/12/18	North	1.3	1.2
	South	1.6	1.6
	East	2.1	2.0
	West	0.8	0.8
04/12/18-09/01/19	North	2.6	1.5
	South	7.0	4.9
	East	9.1	8.3
	West	4.3	0.7

4.3.3.1 Black cockatoos

The location of the two identified potential nesting trees recorded during local area surveys (off-footprint) are south west of the project area. Given the direction of prevailing wind is east and south east in the morning and westerly in the afternoon, the dust during summer will not be in the direction of the potential breeding trees and will therefore reduce the potential for dust impacts on these sites.

The two recorded potential breeding trees are also over 150m from the proposed mine at its closest point (160m and 190m south west of the project).

The dust and wind rose results suggest that dust emissions are not impacting sensitive environments south west (cockatoo breeding trees) of the project area.

4.3.3.2 Shorebird habitat and Ramsar Wetland

The Lake Preston shoreline, which accommodates potential shorebird habitat is west of the project area and ranges between 350-440m from the disturbance footprint. Given the direction of prevailing wind is east and south east in the morning and westerly in the afternoon, the dust during summer will not be in the direction of the potential shorebird habitat at Lake Preston and will therefore reduce the potential for dust impacts at this area.

The dust and wind rose results suggest that dust emissions are not impacting sensitive environments west of the project area at Lake Preston and shore bird habitat.

4.3.3.3 Local amenity

The EPA guidance "Separation Distances between Industrial and Sensitive Land Uses" lists the generic buffers for sand and limestone pits as 300-500m depending on the extent of the processing (EPA 2015). There are no dust sensitive premises located within 1km of the proposed operations, except for the landowner's premises. The landowner's residence is screened from the extraction area by a belt of native vegetation and the landowner has no objections to the proposed operations.

4.3.4 Noise emissions

4.3.4.1 Black cockatoos

The proposed extraction activities will create some operational noise, the majority of which will be generated by bulldozers, screening, loaders and haulage trucks. This noise is expected to be localised and create minimal nuisance beyond the boundary of the extraction area.

The EPA environmental assessment guideline "Separation Distances between Industrial and Sensitive Land Uses" lists the generic buffers for sand and limestone pits as 300-500m depending on the extent of the processing (EPA 2015).

The nearby potential cockatoo breeding trees are over 150m from the proposed extraction site. A review of the management plans and studies on distribution do not highlight noise impacts on black cockatoos or provide a minimum distance from operations (Carnaby's Cockatoo (*Calyptorhynchus latirostris*) Recovery Plan (DPaW 2013) Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Baudin's Cockatoo (*Calyptorhynchus baudinii*) and the Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) on the Swan Coastal Plain (Johnstone and Kirby, date unknown).

A vegetation buffer exists between the potential breeding trees and the extraction area. It must be noted that there was no evidence of active nesting in these potential breeding trees and that approximately 9,514 ha of native vegetation is within 10 km of the project area. It can be reasonably expected that these areas contain numerous breeding trees and foraging habitat, many of which are likely to provide breeding opportunities for black cockatoos.

4.3.4.2 Shorebirds

Roosting and foraging birds are most sensitive to discrete, unpredictable disturbances such as sudden loud noises and from objects that approach them from the water (for example boats). High and sustained levels of disturbance can prevent shorebirds from using all or parts of the habitat (EPBC Act Policy Statement 3.21 Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species).

The proposed activity is located at a minimum of 300m from the shorebirds habitat. A natural limestone ridge will buffer the shoreline and the mining activities, with mining occurring at the site for over 20 years. No blasting will occur on site and the limestone is considered relatively 'soft', which ensures that extraction requires less force than other locations. All activities will be conducted east of the ridge and noise is not expected to impact shorebirds at Lake Preston.

4.3.4.3 Local amenity

The proposed extraction activities will create some operational noise, the majority of which will be generated by bulldozers, screening, loaders and haulage trucks. This noise is expected to be localised and create minimal nuisance beyond the boundary of the extraction area.

The EPA environmental assessment guideline "Separation Distances between Industrial and Sensitive Land Uses" lists the generic buffers for sand and limestone pits as 300-500m depending on the extent of the processing (EPA 2015). The nearest noise sensitive premise is a residence owned by the landowner, located approximately 240m to the west of the proposed extraction operations. No other residences are located within 1km of the proposed activity.

A vegetation buffer exists between the landowner's residence and the extraction area. During previous quarrying on the property no noise issues were recorded.

No offsite noise impacts are anticipated due to the surrounding vegetation and distance to residential areas.

4.3.5 Plant pathogens

4.3.5.1 Black cockatoo breeding trees

During a recent field survey, no *Phytophthora* sensitive species were observed to exhibit signs of dieback infestation. The following preventative measures have been already implemented and will continue to be adhered to:

- The property will always be fenced.
- Access to the property will be via a single entrance gate.
- All machinery, trucks and other vehicles will arrive clean and free of soil and organic matter.
- Any soil and plant material brought to the site (i.e. for rehabilitation) should be dieback free.
- Employees and contractors working on the site will be informed of the purpose of the above measures and their responsibilities in relation to dieback prevention.

The project is not expected to exacerbate this threat to Black cockatoo breeding trees. Hygiene Management procedures are described in the Environmental Management Plan (Appendix B), the Revegetation Plan (Appendix C) and the Weed Management Plan (Appendix H) will be implemented for construction of the project to minimise risk of the impact of disease.

4.3.5.2 Shorebird habitat and Lake Preston

The project is not expected to exacerbate the threat of dieback on shorebird habitat.

The shorebird habitat is at least 300m from the project, all surface water flow at the project area will be contained on site, with no surface water from the project area to be directed to lake Preston. Furthermore, no vehicles or staff from the project area will access Lake Preston from the project area. Hygiene

Management procedures are described in the Environmental Management Plan (Appendix B), the Revegetation Plan (Appendix C) and the Weed Management Plan (Appendix H) and will be implemented for construction of the project to minimise risk of the impact of disease.

4.3.6 Weeds

4.3.6.1 Black cockatoos

Three habitat types were identified during field Surveys (Harewood 2019, Appendix G), all of which contained weeds are in a degraded condition following decades of cattle grazing.

Two weed species present on the property, *Gomphocarpus fruiticosus* (Cotton Bush) and *Solanaum linneanum* (Apple of Sodom) are declared under the Biosecurity and Agriculture Management Act 2007 and require control methods associated with them (DAF 2014), as outlined in the Weed Management Plan (Appendix H).

Existing approvals stipulate that Catalano comply with the endorsed Weed Management Plan as described in Appendix H.

A Weed Management Plan has been developed for the project (Appendix H), which will ensure that weeds are not introduced and/or spread to adjacent vegetation. The management plan includes procedures such as machinery/vehicle clean down, weed treatments and restrictions on vehicle/machinery movements.

Development of topsoil management procedures in the Revegetation Report (Appendix C) will also ensure topsoil health for re-use and to mitigate the risk of introducing weeds into the Proposal Area and surrounds. The management plan will include the development and implementation of a system to allow for traceability of disposed weed infested topsoil, predetermined stockpile locations and instructions on topsoil management procedures

4.3.6.2 Shorebird habitat and Lake Preston

The project is not expected to exacerbate the threat of weeds on shorebird habitat.

The shorebird habitat is at least 300m from the project and no vehicles or staff from the project area will access Lake Preston from the project area. Hygiene management procedures, described in the Environmental Management Plan (Appendix B), the Revegetation Plan (Appendix C) and the Weed Management Plan (Appendix H), will be implemented for construction and operation of the project to minimise risk of the impact of spread of weeds.

4.3.6.3 Weeds of significance

Two weed species present on land surrounding the site, **Gomphocarpus fruiticosus* (Cotton Bush) and **Solanaum linneanum* (Apple of Sodom), are declared under the Biosecurity and Agriculture Management Act 2007, and therefore have required control methods associated with them (DAF 2014) as described in Weed Management Plan (Appendix H).

4.3.7 Vehicle strike

The project will result in an increase in traffic/vehicle movements and may result in a greater risk of fauna strike from vehicle movements.

4.3.7.1 Black cockatoos

The project may exacerbate this threat as it is predominantly located in rural landscape which is largely undeveloped.

4.3.7.2 Shorebirds

Lake Preston is at least 300m from the project area. The project area does not contain any evidence or records of shorebirds or shorebird habitat and no vehicles or staff from the project area will access the lake.

4.3.8 Uncontrolled access

4.3.8.1 Ramsar Wetland

The only infrastructure associated with this project is a haul road, which is located 750m from Lake Preston at its closest point. Vehicles and staff from the project area will not be authorised to access Lake Preston.

4.3.9 Altered surface water flow (sedimentation and turbidity)

4.3.9.1 Ramsar Wetland

There are no direct impacts on Lake Preston from this operation. The limestone pit itself is further than 300m away from the edge of the Lake and it will be completely internally draining. The only infrastructure associated with this project is a haul road and the closest that this road gets to the Lake is 750m away. It is therefore not possible for stormwater erosion or sedimentation to occur in areas outside of the pit void due to this.

4.3.10 Altered groundwater levels

4.3.10.1 Ramsar Wetland

No additional water requirement for dust suppression will be required. The existing Licence on the site GWL162560 has an existing allocation identified for dust suppression of 22,000kl and this will not be exceeded.

Regarding impacts on groundwater level change, considering the larger scale environmental fluxes such as Lake evapo-transpiration, climate change, decreasing Lake and groundwater levels and the large amount of abstraction for horticulture in the surrounding area, there is no evidence that the removal of 8ha of vegetation will have any negative effects on groundwater levels.

This project needs to be viewed against the background of the entire Lake and its surrounds, but it is necessary to preface the comments below with a statement that: although there is a reasonable amount of information available for the lakes to the north of Lake Preston, the amount of data that could be accessed for Lake Preston itself is fairly limited. This means that much of the information provided in this document is based either on first principles, or information from other areas.

In order to estimate the impacts, various baseline data and information resources have been reviewed regarding the Yalgorup Lakes generally and in some cases for Lake Preston specifically, and includes:

- Basic hydrogeology work undertaken by D. P. Commander (1988) and A.C Deeny (1989) was reviewed together with the more recent groundwater review by Rockwater (2009).
- Irrigation allocations were obtained from the Department of Water (2009).
- Water quality protection notes were reviewed regarding extractive industries (Dept of Water).
- Basic groundwater chemistry for Lake Clifton has been described by Noble, C. (2010) and due to the lack of such data for Lake Preston, the Lake Clifton data have been used as generally indicative of Lake Preston.
- Unpublished paper written by Mike Whitehead (Chairman of the Leschenault Catchment Council) on the food chain dynamics of Lake Preston has been reviewed. In addition, in order to provide appropriate context, various sections, maps and monitoring bore hydrographs have been provided.

The following points have been evaluated in order to provide an assessment of groundwater impact associated with vegetation clearing:

- There are approximately 160 trees within the clearing area, of which 25 have a girth of 50cm or greater (Harewood, G. 2019). It is estimated that a mature Eucalypt (eg tuart) tree transpires at an average of 0.05ML per year (Dept Primary Industries Victoria, 1999). This means that 160 tuarts transpire a total of $160 \times 0.05 = 8\text{ML}$ per year (broad estimate). The closest rainfall station (Bunbury) has a mean annual rainfall of 870mm. It has been estimated by the Department of Water (Kearn. A, 1998) that the annual groundwater recharge from rainfall is 30%. Since the trees occupy an area of 13ha, the amount of recharge to the aquifer from rainfall is therefore $30\% \times 870\text{mm} \times 13\text{ha} = 27\text{ML}$.
- The groundwater throughflow calculated for the Lake Preston flow system is 10,500ML per annum calculated over the 22km length of the 2m groundwater contour (Commander D. P. 1988). Since the width of the property over which the trees are situated is 629m, this means that the extrapolated throughflow at this point is $629/22000 \times 10,500\text{ML} = 320\text{ML}$ (assuming the same general aquifer parameters apply). Thus, the transpiration from the trees represents 2.5% of the throughflow across the width of the property. Taking the direct recharge from rainfall into account as well, the likely impact of clearing 8ha on the water table is very low.
- The owner of the property has a licence to pump 420ML per year for irrigation (although he does not use the full allocation). This represents 130% of the throughflow estimated in 2 above.
- A cross section through the property is illustrated in Figure 5 and Figure 6 and the elevation of the water table has been taken from the closest Department of Water monitoring bores as explained in the Water Management Plan in Appendix D.
- There is a general pattern of declining water table and a downward trend in Lake water levels. These declining water levels are illustrated in the hydrographs for monitoring bores E1B and E2B (contained in Appendix D). This has been ascribed to declining rainfall over the past 30 years as well as increased groundwater abstraction (Rockwater 2009). Modelling indicates that a declining trend will continue in the South West of Western Australia into the foreseeable future (Australian Government, Dept of Climate Change and Energy Efficiency, 2012). This is likely to further impact the salinity increases within the Lake very significantly.
- Lake Preston is a groundwater sink and, other than direct rainfall, receives all its freshwater from shallow aquifers to the west and east of its shores. It has been estimated the water inputs to Lake Preston are 64% from direct rainfall, 29% from the eastern shoreline inflows and 7% from western shoreline inflows (Whitehead, M. 2012).
- The geological evolution of the Lake, being cut off from the ocean by a barrier dune, has given rise to hyper salinity with a steep salinity gradient between the surface and the underlying hyper saline water. Baseline calculations of the Lake water budget illustrate that the Lake's salinity is increasing due to evapo-concentration (Commander, 1988). Subsequent reviews of this water budget indicate that recent climate change will further increase the rate at which this evapo-concentration is occurring (Noble, C. 2010) (Whitehead, M. 2012).
- The environmental values of the Ramsar site are associated largely with the quality of the water that occurs on the surface of the Lake, since it is in this zone that the food organisms live that the migrating birds feed on. Significant changes to the water quality at the surface can alter the productivity of these food organisms and thus impact the numbers of birds that visit the area (Whitehead, M. 2012).
- In order to place the cumulative impacts associated with limestone extraction in context, the following geographical dimensions are pertinent: Lake Preston is 28km long and has an area of approximately 30km². The groundwater flow system that feeds Lake Preston from the east has an area of 230km². The area of the groundwater flow system that is to the west of the Old Coast Road is approximately 57km². The area of Lake Preston that is exposed during seasonal groundwater lows is 3km². The existing and old limestone pits that occur between Lake Preston and Old Coast Rd measure approximately 130ha in total. This represents

0.00043% of the Lake area, 0.00006% of the Lake Preston groundwater flow system, 0.00023% of the area between the Lake and Old Coast Road and 0.0043% of the area within Lake Preston that is seasonally exposed.

4.3.11 Water contamination

4.3.11.1 Ramsar Wetland

The limestone quarrying operations are small scale and most of the time the only plant that is on site is a front-end loader. A bulldozer and crusher are only on the site for approximately 12 weeks of the year. Once the stockpiles of lime have been created, trucks will access the site to be loaded and then leave again.

There will be no storage of fuels, lubricants or other toxic or hazardous chemicals on site. Refuelling will take place using a mobile refuelling vehicle which is equipped with a "Snap-On snap-off, fast-fill and auto shut-off" facility. Plant will be refuelled each morning, leaving the vehicles almost empty overnight.

No major servicing, which could lead to fuel and oil spills, will take place on the site. In accordance with the currently approved Reconsideration Decision – not a controlled action if undertaken in a particular manner for EPBC 2008/3956 dated 24th April 2017, 'Servicing of any vehicle must take place at least 100 metres from the shore of Lake Preston'. Prior to servicing, a suitably sized spill mat or drip tray will be placed under the vehicle to capture any leaks or spills. Servicing of vehicles will consist of the direct vacuuming of and waste fluids from the engine of the vehicle being serviced to a waste oil tank on the service truck. A drum will be placed under the oil filter of the vehicle being serviced prior to its removal. Any material captured in the drip tray or drum during servicing will be disposed of into the waste facility of the service truck, removed off site and disposed of at an appropriately licensed waste facility. Spill kits will always be kept on all service truck(s) when servicing vehicles on site. Any spills will be contained on site, mitigated and recorded.

The Western Australian Water Quality Protection Guidelines No's 6,7,10 and 11 will be adhered to, to prevent hydrocarbons or other contaminants from being spilled into the Peel-Yalgorup System Ramsar Wetland.

Although the potential for large scale spillage is low, it is nevertheless proposed to ensure that no groundwater will be exposed on the site by extraction and that operations will always be at least 4m above the water table as illustrated in the cross-section contained in Figure 5 and Figure 6. The highest-ever seasonal groundwater high has been calculated to be 0.015m AHD and 0.5m AHD below the pit floor, from west to east respectively.

4.3.12 Acid sulphate soils

4.3.12.1 Ramsar Wetland

A search of the CSIRO's Australian Soil Resource Information System (ASRIS) database identified the area as having an extremely low probability of occurrence for acid sulphate soils (ASRIS 2019). This is further supported by the main soil type in the area being identified as deep sandy soils with limestone outcrops.

4.3.13 Visual amenity

The proposed extraction is unlikely to create a visual impact due to remnant topography on either side of the proposed extraction area, and the natural undulation of the landscape.

The nearest residence is owned by the landowner who has no objections to the proposed extraction operations.

The nearest main road, Forrest Highway, is located approximately 2.5km east of the proposed extraction area. There is an existing 40m buffer zone of native vegetation between Ludlow Road and extraction activities on the property. Since the extraction area is well screened by existing vegetation on the property and on neighbouring properties, no visual impact will occur. Previous extraction activities at the site have not resulted in any significant visual impact. No visual impacts are therefore anticipated.

4.4 ASSESSMENT AGAINST SIGNIFICANT IMPACT CRITERIA

The 'significant impact criteria', as set out in *Matters of National Environmental Significance Significant impact guidelines 1.1* (Commonwealth of Australia 2013), have been developed for each matter of national environmental significance to assist in determining the likelihood of a significant impact. The criteria provide general guidance on the types of actions that will require approval and the types of actions that will not require approval (Commonwealth of Australia 2013).

4.4.1 Carnaby's black cockatoo (*Calyptorhynchus latirostris*)

The Proposal will not remove any nesting/breeding or known roosting trees and habitat. No potential breeding trees within the project footprint contain hollows large enough (greater than ~10cm) to allow the entry of a black cockatoo into a suitably sized and orientated branch/trunk.

The proposal will result in the loss and modification of some low-quality foraging habitat.

Overall, the proposal is unlikely to meet any of the significant impact criteria for Carnaby's Black cockatoo (Table 14).

Table 14. Assessment against significant impact criteria, Carnaby's black cockatoo

Significant impact criteria	Likelihood of significant impact	Response to criteria
Lead to a long-term decrease in the size of a population	unlikely	All potential breeding habitat trees have been avoided
Reduce the area of occupancy of the species	unlikely	Low habitat value
Fragment an existing population into two or more populations	unlikely	Very small disturbance footprint
Adversely affect habitat critical to the survival of a species	unlikely	No breeding trees will be removed
Disrupt the breeding cycle of a population	unlikely	No breeding trees will be removed
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	unlikely	No breeding trees will be removed
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	unlikely	Current environment is already highly disturbed from weeds
Introduce disease that may cause the species to decline	unlikely	Unlikely that dieback is present on site. Hygiene management on site will prevent the introduction or spread of dieback
Interfere with the recovery of the species	unlikely	Small scale temporary impact to low value habitat

4.4.2 Bar-tailed Godwit (Baueri) (*Limosa lapponica baueri*)

Migratory shorebirds, such as the bar-tailed godwit (western Alaskan), are sensitive to certain development activities due to their: high site fidelity, tendency to aggregate, very high energy demands, and need for habitat networks containing both roosting and foraging sites (DoEE Conservation Advice, 5 May 2016). It is a non-breeding migrant to Australia and has been recorded in the coastal areas of all Australian states though they are generally more numerous in northern Australia. Western Australian sites of international

importance and highest recorded number of these birds is much further north of the project area in the Kimberly at Eighty Mile Beach and Roebuck Bay (Bamford *et al.* 2008).

No Bar-tailed Godwit habitat will be removed or disturbed. The nearest possible shoreline habitat is located more than 300m west of the project area and shielded by a limestone ridge.

The proposed development will have no impact on the bar-tailed godwit and does not meet any of the significant impact criteria for this Vulnerable species (Table 15).

Table 15. Assessment against significant impact criteria, Bar-tailed godwit

Significant impact criteria	Likelihood of significant impact	Response to criteria
Lead to a long-term decrease in the size of an important population of a species	unlikely	No bar-tailed godwit individuals or their suitable habitat have been recorded within the proposal area.
Reduce the area of occupancy of an important population	unlikely	No populations of the bar-tailed godwit are within the proposal area
Fragment an existing important population into two or more populations	unlikely	No populations of the bar-tailed godwit are within the proposal area
Adversely affect habitat critical to the survival of a species	unlikely	No suitable habitat is found with the proposal area
Disrupt the breeding cycle of an important population	highly unlikely	No breeding occurs in the region. The bar-tailed godwit is a non-breeding migrant to Australia.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	unlikely	No habitat suitable for the bar-tailed godwit is found within the proposal area.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	unlikely	There will be no disturbance to bar-tailed godwit habitat or vegetation immediately adjacent this habitat.
Introduce disease that may cause the species to decline	unlikely	There will be no disturbance to bar-tailed godwit habitat or vegetation immediately adjacent this habitat. No Phytophthora sensitive species have been observed to exhibit signs of dieback infestation at the proposal area (approximately 300m from Lake Preston). Strict hygiene management of the site will be implemented.
Interfere substantially with the recovery of the species	unlikely	No bar-tailed godwit individuals or suitable habitat have been recorded within the proposal area and will therefore not be disturbed as part of this proposal.
Migratory component		
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	unlikely	No modification will be made to bar-tailed godwit habitat

Significant impact criteria	Likelihood of significant impact	Response to criteria
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	unlikely	There will be no disturbance to bar-tailed godwit habitat or vegetation immediately adjacent this habitat.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species	unlikely	The bar-tailed godwit is a non-breeding migrant to Australia.

4.4.3 Curlew Sandpiper (*Calidris ferruginea*)

Threats in Australia, especially eastern and southern Australia, include ongoing human disturbance, habitat loss and degradation from pollution, changes to the water regime and invasive plants (Rogers *et al.* 2006; Australian Government 2009; Garnett *et al.* 2011 in DoEE Conservation Advice 14 May 2015).

The proposed development will have no impact on the curlew sandpiper habitat. There is no suitable habitat within the proposal area. The project area is approximately 300m from the closest known suitable habitat for wader bird species and is separated by a limestone ridge that is approximately 18m higher in elevation than the lake shore.

The curlew sandpiper is listed as a species “present” within Yalgorup National Park (Hale and Butcher 2007) and there are numerous records in this area in the NatureMap database (NatureMap 2019) (Appendix G). The species does not however appear to have been recorded on Lake Preston near the proposed action area.

As the proposed development will not impact curlew sandpiper habitat and does not meet any of the significant impact criteria for this Critically Endangered species (Table 16).

Table 16. Assessment against significant impact criteria, Curlew sandpiper

Significant impact criteria	Likelihood of significant impact	Response to criteria
Critically Endangered component		
Lead to a long-term decrease in the size of a population	unlikely	No curlew sandpiper individuals or their suitable habitat have been recorded within the proposal area.
Reduce the area of occupancy of the species	unlikely	No populations of the curlew sandpiper are within the proposal area
Fragment an existing population into two or more populations	unlikely	No populations of the curlew sandpiper are within the proposal area
Adversely affect habitat critical to the survival of a species	unlikely	No suitable habitat is found with the proposal area
Disrupt the breeding cycle of a population	highly unlikely	No breeding occurs in the region/hemisphere. The curlew sandpiper is a non-breeding migrant to Australia.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	unlikely	No habitat suitable for the curlew sandpiper is found within the proposal area.

Significant impact criteria	Likelihood of significant impact	Response to criteria
Result in invasive species that are harmful to a Critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	unlikely	There will be no disturbance to curlew sandpiper habitat or vegetation immediately adjacent this habitat.
Introduce disease that may cause the species to decline	unlikely	There will be no disturbance to curlew sandpiper habitat or vegetation immediately adjacent this habitat. No Phytophthora sensitive species have been observed to exhibit signs of dieback infestation at the proposal area (approximately 300m from Lake Preston). Strict hygiene management of the site will be implemented.
Interfere with the recovery of the species	unlikely	No curlew sandpiper individuals or suitable habitat have been recorded within the proposal area and will therefore not be disturbed as part of this proposal.
Migratory component		
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	unlikely	No modification will be made to curlew sandpiper habitat
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	unlikely	There will be no disturbance to curlew sandpiper habitat or vegetation immediately adjacent this habitat.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species	unlikely	The curlew sandpiper is a non-breeding migrant to Australia.

4.4.4 Great Knot (*Calidris tenuirostris*)

Migratory shorebirds, such as the great knot, are sensitive to certain development activities due to their high site fidelity, tendency to aggregate, very high energy demands, and need for habitat networks containing both roosting and foraging sites (DoEE Conservation Advice, 5 May 2016).

The great knots greatest numbers are found in northern Western Australia and the Northern Territory. In Western Australia, sites of international importance and the highest recorded number of birds are in the Kimberly at Eighty Mile Beach and Roebuck Bay (Bamford *et al.* 2008).

The proposed development will not remove or disturb great knot individuals or habitat as there is no suitable habitat within the project area. The project area is approximately 300m from the closest potentially suitable habitat for shorebirds, which is further separated by a limestone ridge that is approximately 18m higher in elevation than the lake shore.

It is unlikely that the project will meet any of the significant impact criteria for this Critically Endangered species (Table 17).

Table 17. Assessment against significant impact criteria, Great Knot

Significant impact criteria	Likelihood of significant impact	Response to criteria
Critically Endangered component		
Lead to a long-term decrease in the size of a population	unlikely	No great knot individuals or their suitable habitat have been recorded within the proposal area.
Reduce the area of occupancy of the species	unlikely	No populations of the great knot are within the proposal area
Fragment an existing population into two or more populations	unlikely	No populations of the great knot are within the proposal area
Adversely affect habitat critical to the survival of a species	unlikely	No suitable habitat is found with the proposal area
Disrupt the breeding cycle of a population	highly unlikely	No breeding occurs in the region. The great knot is a non-breeding migrant to Australia.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	unlikely	No habitat suitable for the great knot is found within the proposal area.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	unlikely	There will be no disturbance to great knot habitat or vegetation immediately adjacent this habitat.
Introduce disease that may cause the species to decline	unlikely	There will be no disturbance to great knot habitat or vegetation immediately adjacent this habitat. No Phytophthora sensitive species have been observed to exhibit signs of dieback infestation at the proposal area (approximately 300m from Lake Preston). Strict hygiene management of the site will be implemented.
Interfere with the recovery of the species	unlikely	No great knot individuals or suitable habitat have been recorded within the proposal area and will therefore not be disturbed as part of this proposal.
Migratory component		
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	unlikely	No modification will be made to great knot habitat
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	unlikely	There will be no disturbance to great knot habitat or vegetation immediately adjacent this habitat.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species	unlikely	The great knot is a non-breeding migrant to Australia.

4.4.5 Greater Sand Plover (*Charadrius leschenaultia*)

Migratory shorebirds, such as the greater sand plover, are sensitive to certain development activities due to their: high site fidelity, tendency to aggregate, very high energy demands required for migration; and need for habitat networks containing both roosting and foraging sites (Department of the Environment 2015a,b in DoEE Conservation Advice, 5 May 2016).

In Western Australia, the greater sand-plover is especially widespread between North West Cape and Roebuck Bay and occasionally recorded along the coast of southern Western Australia (DoEE Conservation Advice, 5 May 2016).

The greater sand plover is listed as a species “present” within Yalgorup National Park (Hale and Butcher 2007) and there are numerous records of it being observed in this area in the NatureMap database (NatureMap 2019) (Figure 12, source: Appendix G), but it has not been recorded at Lake Preston.

The proposed development will not impact on the greater sand plover as there is no suitable habitat within the proposal area. The project area is approximately 300m from the closest potentially suitable habitat for shorebird species and is separated from the project by a limestone ridge that is approximately 18m higher in elevation than the lake shore. The project does not meet any of the significant impact criteria for this Vulnerable species (Table 18).

Table 18. Assessment against significant impact criteria, Greater Sand Plover

Significant impact criteria	Likelihood of significant impact	Response to criteria
Vulnerable component		
Lead to a long-term decrease in the size of an important population of a species	unlikely	No greater sand plover individuals or their suitable habitat have been recorded within the proposal area.
Reduce the area of occupancy of an important population	unlikely	No populations of the greater sand plover are within the proposal area
Fragment an existing important population into two or more populations	unlikely	No populations of the greater sand plover are within the proposal area
Adversely affect habitat critical to the survival of a species	unlikely	No suitable habitat is found with the proposal area
Disrupt the breeding cycle of an important population	highly unlikely	No breeding occurs in the region. The greater sand plover is a non-breeding migrant to Australia.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	unlikely	No habitat suitable for the greater sand plover is found within the proposal area.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	unlikely	There will be no disturbance to greater sand plover habitat or vegetation immediately adjacent this habitat.
Introduce disease that may cause the species to decline	unlikely	There will be no disturbance to greater sand plover habitat or vegetation immediately adjacent this habitat. No Phytophthora sensitive species have been observed to exhibit signs of dieback infestation at the proposal area (approximately 300m from Lake Preston).

Significant impact criteria	Likelihood of significant impact	Response to criteria
		Strict hygiene management of the site will be implemented.
Interfere substantially with the recovery of the species	unlikely	No greater sand plover individuals or suitable habitat have been recorded within the proposal area and will therefore not be disturbed as part of this proposal.
Migratory component		
Substantially modify (including by Fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	unlikely	No modification will be made to greater sand plover habitat
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	unlikely	There will be no disturbance to greater sand plover habitat or vegetation immediately adjacent this habitat.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species	unlikely	The greater sand plover is a non-breeding migrant to Australia.

4.4.6 Lesser Sand Plover (*Charadrius mongolus*)

Migratory shorebirds, such as the lesser sand plover, are sensitive to certain development activities due to their: high site fidelity, tendency to aggregate, very high energy demands required for migration; and need for habitat networks containing both roosting and foraging sites (Department of the Environment 2015a,b in DoEE Conservation Advice, 5 May 2016).

The lesser sand plover mainly occurs in northern and eastern Australia, in south-eastern parts of the Gulf of Carpentaria, western Cape York Peninsula and islands in Torres Strait, and along the entire east coast, though it occasionally also occurs inland. It is most numerous in Queensland and NSW (Blakers *et al.* 1984; Marchant and Higgins 1993; Minton *et al.* 2006).

The lesser sand plover is listed as a species “present” within Yalgorup National Park (Hale and Butcher 2007) but no records from this area appear in the NatureMap database (NatureMap 2019). There are however several records from Lake McClarty and Peel inlet, which are approximately 30km further north of the project area.

There is no suitable habitat within the proposal area. The project area is approximately 300m from the closest potentially suitable habitat for shorebird species, and is separated from the project by a limestone ridge that is approximately 18m higher in elevation than the lake shore.

The proposed development will not impact or disturb lesser sand plover habitat or individuals and does not meet any of the significant impact criteria for this Endangered species (Table 19).

Table 19. Assessment against significant impact criteria, Lesser Sand Plover

Significant impact criteria	Likelihood of significant impact	Response to criteria
Endangered component		
Lead to a long-term decrease in the size of a population	unlikely	No lesser sand plover individuals or their suitable habitat have been recorded within the proposal area.
Reduce the area of occupancy of the species	unlikely	No populations of the lesser sand plover are within the proposal area
Fragment an existing population into two or more populations	unlikely	No populations of the lesser sand plover are within the proposal area
Adversely affect habitat critical to the survival of a species	unlikely	No suitable habitat is found with the proposal area
Disrupt the breeding cycle of a population	highly unlikely	No breeding occurs in the region. The lesser sand plover is a non-breeding migrant to Australia.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	unlikely	No habitat suitable for the lesser sand plover is found within the proposal area.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	unlikely	There will be no disturbance to lesser sand plover habitat or vegetation immediately adjacent this habitat.
Introduce disease that may cause the species to decline	unlikely	There will be no disturbance to lesser sand plover habitat or vegetation immediately adjacent this habitat. No Phytophthora sensitive species have been observed to exhibit signs of dieback infestation at the proposal area (approximately 300m from Lake Preston). Strict hygiene management of the site will be implemented.
Interfere with the recovery of the species	unlikely	No lesser sand plover individuals or suitable habitat have been recorded within the proposal area and will therefore not be disturbed as part of this proposal.
Migratory component		
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	unlikely	No modification will be made to lesser sand plover habitat
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	unlikely	There will be no disturbance to lesser sand plover habitat or vegetation immediately adjacent this habitat.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an	unlikely	The lesser sand plover is a non-breeding migrant to Australia.

Significant impact criteria	Likelihood of significant impact	Response to criteria
ecologically significant proportion of the population of a migratory species		

4.4.7 Eastern Curlew (*Numenius madagascariensis*)

Threats in Australia, especially eastern and southern Australia, include ongoing human disturbance, habitat loss and degradation from pollution, changes to the water regime and invasive plants (Rogers *et al.* 2006; Australian Government 2009; Garnett *et al.* 2011 in DoEE Conservation Advice, 26 May 2015).

Within Australia, the eastern curlew has a primarily coastal distribution. The species is found in all states, particularly the north, east, and south-east regions. In Western Australia they have a continuous distribution from Barrow Island and Dampier Archipelago, through the Kimberley and along the Northern Territory coasts.

The eastern curlew is associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass (Zosteraceae).

The eastern curlew is listed as a species “present” within Yalgorup National Park (Hale and Butcher 2007) and there are several records of it being observed in this area in the NatureMap database (NatureMap 2019) (Figure 13, source: Appendix G), however the species has not been recorded near the proposed action area.

There is no suitable habitat within the proposal area. The project area is approximately 300m from the closest potentially suitable habitat for shorebird species, and is separated from the project area by a limestone ridge that is approximately 18m higher in elevation than the lake shore.

The proposed development will have no impact on the eastern curlew and does not meet any of the significant impact criteria for this Critically Endangered species (Table 20).

Table 20. Assessment against significant impact criteria, Eastern Curlew

Significant impact criteria	Likelihood of significant impact	Response to criteria
Critically Endangered component		
Lead to a long-term decrease in the size of a population	unlikely	No eastern curlew individuals or their suitable habitat have been recorded within the proposal area.
Reduce the area of occupancy of the species	unlikely	No populations of the eastern curlew are within the proposal area
Fragment an existing population into two or more populations	unlikely	No populations of the eastern curlew are within the proposal area
Adversely affect habitat critical to the survival of a species	unlikely	No suitable habitat is found within the proposal area
Disrupt the breeding cycle of a population	highly unlikely	No breeding occurs in the region. The eastern curlew is a non-breeding migrant to Australia.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	unlikely	No habitat suitable for the eastern curlew is found within the proposal area.

Significant impact criteria	Likelihood of significant impact	Response to criteria
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	unlikely	There will be no disturbance to eastern curlew habitat or vegetation immediately adjacent this habitat.
Introduce disease that may cause the species to decline	unlikely	There will be no disturbance to eastern curlew habitat or vegetation immediately adjacent this habitat. No Phytophthora sensitive species have been observed to exhibit signs of dieback infestation at the proposal area (approximately 300m from Lake Preston). Strict hygiene management of the site will be implemented.
Interfere with the recovery of the species	unlikely	No eastern curlew individuals or suitable habitat have been recorded within the proposal area and will therefore not be disturbed as part of this proposal.
Migratory component		
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	unlikely	No modification will be made to eastern curlew habitat
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	unlikely	There will be no disturbance to eastern curlew habitat or vegetation immediately adjacent this habitat.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species	unlikely	The eastern curlew is a non-breeding migrant to Australia.

4.4.8 Red-necked Stint (*Calidris ruficollis*)

The greatest threat is indirect and direct habitat loss. As most migratory shorebirds have specialized feeding techniques, they are particularly susceptible to slight changes in prey sources and foraging environments. Activities that cause habitat degradation (DEWHA 2009aj) include:

- loss of marine or estuarine vegetation, which alters the dynamic of sediment banks and mudflats
- invasion of intertidal mudflats by weeds such as cord grass
- water pollution and changes to the water regime
- changes to the hydrological regime
- exposure of acid sulphate soils, hence changing the chemical balance at the site.

In Australasia, the Red-necked Stint is mostly found in coastal areas, including in sheltered inlets, bays, lagoons and estuaries with intertidal mudflats, often near spits, islets and banks and, sometimes, on protected sandy or coralline shores.

The red-necked stint is listed as a species “present” within Yalgorup National Park (Hale and Butcher 2007) and there are numerous records of it being observed in this area in the NatureMap database (NatureMap 2019) (Figure 14, source: Appendix G). The species appears to have been recorded near the proposed action area on several occasions in the past.

Historically up to 15,000 red-necked stints have been recorded within the Yalgorup Lakes during a single count which at the time represented 3% of the estimated total population (Hale and Butcher 2007).

There is no suitable red-necked stint habitat within the proposal area. The project area is approximately 300m from the closest potentially suitable habitat for shorebird species and is separated from the project area by a limestone ridge that is approximately 18m higher in elevation than the lake shore.

The proposed development will have no impact on the red-neck stint habitat or individuals and does not meet any of the significant impact criteria for this Migratory species (Table 21).

Table 21. Assessment against significant impact criteria, Red-necked Stint

Significant impact criteria	Likelihood of significant impact	Response to criteria
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	unlikely	No modification will be made to red-necked stint habitat
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	unlikely	There will be no disturbance to red-necked stint habitat or vegetation immediately adjacent this habitat.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species	unlikely	The red-necked stint is a non-breeding migrant to Australia.

4.4.9 Peel-Yalgorup System Ramsar site (PYSRS)

Commander, D.P. (1988). Geology and Hydrogeology of the Superficial Formations and Coastal Lakes Between Harvey and Leschenault Inlets (Lake Clifton Project). Western Australia Geological Survey, Report 23, pp. 37-50.

The project area is approximately 300m from the Ramsar site and is separated from the project area by a limestone ridge that is approximately 18m higher in elevation than the lake shore.

The proposed development will have no impact on the Peel-Yalgorup System and does not meet any of the significant impact criteria for this Ramsar site (Table 22).

Table 22. Assessment against significant impact criteria, Peel-Yalgorup System Ramsar site

Significant impact criteria	Likelihood of significant impact	Response to criteria
areas of the wetland being destroyed or substantially modified	unlikely	There will be no disturbance to shorebird habitat or vegetation immediately adjacent this habitat.
a substantial and measurable change in the hydrological regime of the wetland, for example, a substantial change to the volume, timing,	unlikely	There will be no disturbance or impact to the hydrological regime of the wetland.

Significant impact criteria	Likelihood of significant impact	Response to criteria
duration and frequency of ground and surface water flows to and within the wetland		<p>The total inflow of groundwater to Lake Preston is 19×10^6 m³ per annum over a front of approximately 24 km (Deeney 1989).</p> <p>Since the width of the proposed pit is approximately 0.7km and no groundwater will be intersected, the impact to Lake Preston hydrological regime is negligible.</p>
the habitat or lifecycle of native species, including invertebrate fauna and fish species, dependent upon the wetland being seriously affected	unlikely	There will be no disturbance to shorebird habitat or vegetation immediately adjacent this habitat.
a substantial and measurable change in the water quality of the wetland – for example, a substantial change in the level of salinity, pollutants, or nutrients in the wetland, or water temperature which may adversely impact on biodiversity, ecological integrity, social amenity or human health	unlikely	<p>There will be no disturbance or significant impact to the water quality of the Peel-Yalgorup System Ramsar site.</p> <p>Since the depth to groundwater below the pit floor is 6m, and the permeability of the limestone is very high, there is no possibility of evaporative concentration of salts.</p> <p>CSIRO's ASRIS database also identified the area as having an extremely low probability of occurrence for acid sulphate soils (ASRIS 2019), thus negating the risk of increased acidity within the Lake.</p> <p>There will be no storage of fuels, lubricants or other toxic or hazardous chemicals on site.</p> <p>No major servicing, which could lead to fuel and oil spills, will take place on the site. For further information on water quality management refer to Section 8.4.</p>
an invasive species that is harmful to the ecological character of the wetland being established (or an existing invasive species being spread) in the wetland	unlikely	There will be no disturbance to wetland habitat or vegetation immediately adjacent this habitat.

5 AVOIDANCE AND MITIGATION MEASURES

The management measures proposed for the relevant EPBC Act-listed species are presented as per the four steps of the mitigation hierarchy (avoid, minimise, rehabilitate and offset) in the following sections. For further information on management and mitigation measures, refer to Appendix B (Environmental Management Plan), Appendix D (Water Management Plan) and Appendix H (Weed Management Plan) of this document.

5.1 CARNABY'S BLACK COCKATOO

The black cockatoo habitat tree assessment identified two trees which appeared to contain hollows with entrances large enough (greater than ~10cm) to allow the entry of a black cockatoo into a suitably sized and orientated branch/trunk.

5.1.1 Avoid

The two trees identified as potential cockatoo nest hollows within the original proposed clearing area will be avoided and removed from the proposed pit area.

Clearly demarcate Black Cockatoo habitat to be retained in the project area (i.e. with star pickets, coloured tape and/or bunting).

5.1.2 Minimise

Reduce indirect dust impacts on habitat trees through the implementation of the Environmental Management Plan (Appendix B), including dust management measures outlined in Section 8.6.

5.1.3 Rehabilitate

The species composition of revegetation will include a suite of preferred habitat plant species for Black cockatoos, including potential foraging, roosting and nesting plants (i.e. Eucalyptus, Banksia and Hakea species).

5.1.4 Offset

Installation of artificial nesting boxes in adjacent undisturbed vegetation

Revegetation (infill planting) of foraging plant species in adjacent undisturbed vegetation

5.2 SHOREBIRDS

Shorebirds include the threatened species listed in the DAWE (formally DoEE) response letter (Bar-tailed Godwit, Curlew Sandpiper, Great Knot, Greater Sand Plover, Lesser Sand Plover, Eastern Curlew, Red-necked Stint).

Habitat for these species varies, but can include open ocean, beaches and permanent/temporary wetlands varying from billabongs, swamps, lakes, floodplains, sewerage farms, salt-work ponds, estuaries, lagoons, mudflats, sandbars, pastures, airfields, sports fields and lawns.

No preferred habitat of shorebirds occurs within the proposal area and the proposed development will not have a direct impact on shorebirds and their preferred habitat.

The proposed extraction activities will create some operational noise, the majority of which will be generated by bulldozers, screening, loaders and haulage trucks. This noise is expected to be localised and create minimal nuisance beyond the boundary of the extraction area.

5.2.1 Avoid

- A buffer of approximately 300m from the nearest shorebird habitat at Lake Preston will be maintained throughout the operational life of the extraction activities.
- No dewatering activities will be undertaken.

5.2.2 Minimise

- Reduce potential (although unlikely) indirect impacts to hydrology at Lake Preston through the implementation of a Water Management Plan (Appendix D).
- Reduce potential (although unlikely) indirect impacts to the quality of shorebird habitat through the implementation of the Weed Management Plan (Appendix H).

5.3 PEEL-YALGORUP SYSTEMS RAMSAR SITE

Stormwater management issues are not anticipated for this property due to the high permeability of the land surface and the limit of disturbance, which will remain on the eastern side of the limestone ridge and outside the local wetland catchment.

Due to the very permeable nature of the sand within the operational area, and the revegetation techniques to be employed, it is unlikely that any long-lived expression of surface water will exist within the proposed extraction area. Proposed activities will therefore not directly impact this conservation area.

Risk of groundwater contamination is also negligible due to the small volumes of contaminants used, careful operating procedures and the maintenance of a minimum depth to the underlying water table of approximately 4.5m from the pit floor.

5.3.1 Avoid

- A buffer of approximately 300m from Lake Preston will be maintained throughout the operational life of the extraction activities.
- No dewatering activities will be undertaken.
- No surface water runoff from the working areas will be discharged to the surrounding unaltered landscape, with all stormwater runoff contained in the base of the extraction area.
- No fuels, lubricants or other toxic or hazardous chemicals will be stored on site.
- The Western Australian Water Quality Protection Guidelines No's 6, 7, 10 and 11 will be adhered to, to prevent hydrocarbons or other contaminants from being spilled into the Peel-Yalgorup System Ramsar Wetland.

5.3.2 Minimise

- Continue to adhere to Groundwater Licence conditions for the existing Licence on the site (GWL162560), which has an existing allocation identified for dust suppression of 22,000kl.
- A Water Management Plan has been prepared for this project, which identifies all the management issues to be implemented, including key management actions listed below (but not limited to):

- Minimise the risk of unintentional groundwater exposure during excavation through the development and promotion of contingency measures (i.e. if groundwater is exposed operations will cease until pit is refilled to achieve a 2m buffer distance above the water table).
- Reduce the risk of hydrocarbon spills by refuelling using a mobile refuelling vehicle that is equipped with a “snap-on snap-off, fast-fill and auto shut-off” facility.
- Reduce the risk of leaks and spills by leaving vehicles almost empty overnight and refuelling each morning
- Reduce the risk of hydrocarbon spills by servicing vehicle at least 300m from the shore of Lake Preston. This is in accordance with EPBC 2008/3956 conditions: deemed not a controlled action if undertaken in a particular manner for (24th April 2017) - ‘Servicing of any vehicle must take place at least 100 metres from the shore of Lake Preston’. Other vehicle servicing related actions include: using a spill mat or drip tray; direct vacuuming of waste fluids to a waste oil tank on the service truck; any waste material captured during servicing will be disposed of at an appropriately licensed waste facility; and spill kits on all service truck(s).
- Spill kits contained on site will be mitigated and recorded.
- Adhere to conditions required in relevant groundwater abstraction licences.
- Adhere to the dust management procedures as prescribed in the Environmental Management Plan (Appendix B).
- Adhere to all other the actions as prescribed in the Water Management Plan (Appendix D).
- Adhere to the actions prescribed in the Weed Management Plan (Appendix H).

5.3.3 Rehabilitate

- The final rehabilitated land surface will be 5m above the maximum winter high groundwater level.

5.4 OTHER MEASURES

5.4.1 Dust management measures

- Visual inspection of site and access road for dust generation that is moving off site
- All loads covered before leaving the property
- Speed limits on all vehicles entering the site
- Induct all employees and contractors working on site about dust management
- Provide a contact number for dust complaints
- Undertake rehabilitation on completed areas immediately to manage dust.

A summary of dust control measures to be implemented are summarised in Table 23. Visual monitoring will be undertaken to confirm dust management measures are effectively maintaining dust emissions at acceptable levels.

Table 23. Summary of dust control actions

Activity	Action	Control Measure	Outcome
Daily			
Limestone extraction and product loading	Visual inspection of site and access road for dust generation that is moving off site.	Water cart application over dust prone areas. Crushing and stockpiling activities located in topographic low points with stockpiles arranged as windbreaks to further shield sensitive receptors. Reduce speed limits on site to reduce dust generation from vehicles.	Reduced dust generation. No dust leaving the property.
Product transport	All loads covered before leaving the property.	Cover loads. Reduce speed limit on site to reduce overall dust generation from vehicles	Reduced dust generation from product transport.
As Required			
Training	Induct all employees and contractors working on site.	Site induction includes awareness of dust generation and management measures to be utilised by all personnel on site.	Reduced dust generation on site.
Dust complaints	Provide a contact number for dust complaints.	Undertake review of potential complaints and implement appropriate action to reduce dust generation from site.	Reduced dust generation
Rehabilitation /stabilisation	Undertake rehabilitation on completed areas.	As per Appendix B and Appendix C	Reduced dust generation

5.4.2 Dieback management measures

- The property will always be fenced.
- Access to the property will be via a single entrance gate.
- All machinery, trucks and other vehicles will arrive in a clean condition free of soil and organic matter that may contain dieback fungus.
- Any soil and plant material brought to the site for rehabilitation purposes should be from dieback free sources.
- Employees and contractors working on the site will be informed of the purpose of the above measures and their responsibilities in relation to dieback prevention.

5.4.3 Heritage management measures

- If during activities on this property an Aboriginal cultural heritage site is discovered, Catalano will immediately advise the Department of Planning, Lands and Heritage.

5.4.4 Rehabilitation management measures

- Adhere to management and mitigation measures as prescribed in the Revegetation Report (Appendix C)
- All batters behind the active working face will be contoured to achieve a slope gradient of no more than 1:6. The final rehabilitated pit floor will be at 6 mAHD;
- Stockpiled topsoil/ overburden will be respread over completed areas;
- The pit floor and batters will be ripped to alleviate compaction, improve filtration, attenuate stormwater runoff and facilitate rapid root penetration;
- The base of the pit will be seeded with pasture grasses which will be used for cattle grazing;
- An area of batter slopes of approximately 13ha will be revegetated using endemic species of local provenance using both direct seeding and planted seedlings.
- Rehabilitation work will only be carried out just prior to, or during winter, within 6 months of cessation of extraction activity; and
- Due to the internally draining nature of the pit, no offsite sedimentation issues are anticipated. Stormwater within the pit will continue to infiltrate to the underlying water table.

5.4.4.1 Maintenance and contingency measures

Revegetation areas will need to be inspected and managed after initial planting/seeding as initial success is often compromised by weeds, feral animals, human activities, fire and drought.

Maintenance procedures will be carried out where necessary and may include:

- Repair of any erosion damage
- Replanting/seeding areas in subsequent years that may not have established
- Weed control – weed inspections should be undertaken in autumn, spring and summer by a suitably qualified contractor and appropriate treatment undertaken when required.

5.4.5 Weed management measures

Adhere to management actions prescribed in the Weed Management Plan (Appendix H), including key actions provided in the following subheadings.

5.4.5.1 Weed Management Zones

- Zone A: This is all the land within the active extraction area and includes the base of the excavation, roadways and stockpiles of topsoil, overburden and all product stockpiles.
- Zone B: This is all land that is at natural level and which extends 100 meters beyond the perimeter of the active extraction areas and includes any stockpiles of soil or overburden created by the excavation.

5.4.5.2 Weed Emergence Monitoring

- Monitoring of the emergence of weeds in Zones A and B will be undertaken by an experienced and licensed weed management contractor on a six-monthly basis (i.e. after the first seasonal rains and at the end of spring).
- B&J Catalano Pty Ltd personnel on-site will be instructed to report any weed infestations that may occur on other occasions.

- Based on the type of weed that emerges, a control plan will be formulated by the licensed weed management contractor.

5.4.5.3 Import and Export of Weeds

- All plant and equipment either entering or leaving the site will be clean and free of any soil. Any quarry products imported to the site will be free of weeds.

5.4.5.4 Weed Control Program

- If a weed infestation occurs within Zones A and B the licensed weed management contractor will apply the appropriate method of control, in accordance with the guidelines published by the DAF, whether chemical or mechanical, at the appropriate time.

5.5 COMPLETION CRITERIA

Completion criteria must be sufficiently stringent to ensure that the overall objectives have been met. These criteria must also be designed to allow effective reporting and auditing to define an endpoint for the rehabilitation activities. Completion criteria is provided in Table 24, and is based on criteria and management objectives set out in the following management plans and procedures for the project:

- Environmental Management Plan (Appendix B)
- Revegetation Report (Appendix C)
- Water Management Plan (Appendix D)

Table 24. Completion criteria, objectives and interim targets

Complementation criteria category	Objective	Interim target
Erosion/soil stability	Site hydrology does not prevent the establishment of desired vegetation. No erosion scars by end Year 5	Stormwater is retained within the site Identification and mitigation of potential erosion scars during rehabilitation Direct autumn return of topsoil in areas to be revegetated
Fauna	Native fauna are using rehabilitation areas by end Year 5	Some fauna using rehabilitation areas. It is likely that ants and then reptiles will be the first to recolonise the site. Evidence through observation of individuals, scats and tracks
Pest animals	Grazing by herbivores, including macropods, affects no more than 10% of rehabilitation by end Year 5	Herbivore grazing affects no more than 10% of rehabilitation at any time throughout the rehabilitation process
Revegetation	Survival rates 60% or higher by end Year 5	75% survival of planted tubestock/germinants at the end of Year 1
	Species diversity 75% or higher by end Year 5	85% of planted/seeded species diversity remaining at the end of Year 1
	Rehabilitated areas blend into the surrounding area by end Year 5	Achievement of the above ‘revegetation’ objectives will ensure that this objective is met.

Complementation criteria category	Objective	Interim target
Safety	The site is safe to humans.	Site is safe to humans during operations.
Soils and stability	Soil profiles and structures are sufficient to ensure grass establishment. The landform is stable. Stormwater is contained within the site.	Topsoil is respread in all rehabilitation areas. Identification and mitigation of potential erosion scars and scours during operations.
Suitability	The site is suitable for use as pasture.	-
Sustainability	The site is sustainable in the long term without additional management inputs.	-
Visual amenity and heritage	The rehabilitated extraction area blends into the surrounding environment.	No public complaints about a loss of visual amenity.
Weeds	Weed cover 20% or less by end of Year 5 No new declared weed pests are present. The level of weed species should not be detrimental to the planted seedlings or horticulture.	No more than 20% weeds at any time throughout rehabilitation process. Declared weed species removed systematically during operations.

5.6 MONITORING AND REPORTING

Monitoring is important as it provides a measure of the effectiveness of mitigation actions and identifies if maintenance and contingency actions are required. Reporting will be based on requirements of licence conditions and occurrences of noncompliance.

Monitoring information provided below is based on requirements prescribed in the following documents:

- Environmental Management Plan (Appendix B)
- Revegetation Report (Appendix C)
- Water Management Plan (Appendix D)
- Weed Management Plan (Appendix H)

5.6.1 Erosion/stability monitoring

During the extraction and early rehabilitation phase, the extraction area will be inspected after every significant rainfall event to check erosion damage. If any repairs are required, this will be attended to immediately.

5.6.2 Pit closure monitoring

After pit closure the areas will be monitored to ensure that any areas requiring remedial work are identified. Monitoring will be carried out on an annual basis to assess:

- The physical stability of the landform in the rehabilitated areas.
- Evidence of concentrated sheet flow rather than infiltration.
- The emergence of weeds requiring control.

5.6.3 Weed monitoring

Monitoring of the emergence of weeds in Zones A and B will be undertaken by an experienced and licensed weed management contractor on a six monthly basis i.e. after the first seasonal rains and at the end of spring.

B & J Catalano Pty Ltd personnel on site will be instructed to report any weed infestations that may occur on other occasions. Based on the type of weed that emerges, a control plan will be formulated by the licensed weed management contractor.

5.6.4 Revegetation monitoring

5.6.4.1 Photo point monitoring

Five photo points will be established across the two revegetated areas to provide a record of vegetation growth and success over the years. The locations of these photo points are presented in Appendix C.

The photo points will be marked and recorded using the following procedure:

- 900mm white-tipped jarrah stakes flagged with pink tape and labelled with the respective monitoring point name and number on the side from which the photograph is taken will be hammered into the ground at each photo point.
- GPS coordinates and compass bearings will be recorded for each photo point.
- Photos will be taken from behind the photo point, from as far back as necessary to include the peg in the bottom centre of the photo.
- In order to assess the structure of replanted vegetation, for this project, photos will also be taken directly in front of the photo point marker from 50cm above the ground.

5.6.4.2 Relevè monitoring

In order to further assess vegetation structure within the revegetation areas, a relevè (5m x 5m) will be set up within an area captured in each photo point. The relevès will be marked using the following procedure:

- The centre of the relevè point will be marked with a 900mm white-tipped jarrah stake flagged with yellow tape and labelled with the respective monitoring point name and number.
- Vegetation structure of each relevè will be measured using the structural classification of Keighery (1994).

The following records will be obtained for each relevè:

- Native species composition (stems per hectare per structure level)
- Species diversity (species per hectare)
- Weed density or cover and weed species present
- Record success of additional control actions (e.g. rabbit control, fences)

5.6.4.3 Frequency

Monitoring of vegetation establishment and structure will be undertaken on an annual basis in spring for a period of five years as a minimum, to ensure success and to account for differences in annual rainfall. Thereafter, providing revegetation has been successful by the end of Year 5, monitoring will be undertaken every second year until ten years after planting to ensure targets set in the completion criteria have been met.

5.6.5 Maintenance

Maintenance procedures will be carried out where necessary and may include:

- Repair of any erosion damage.
- Replanting/seeding areas that may not have regenerated sufficiently.
- Weed control.

5.6.6 Reporting

A summary of the rehabilitation activities undertaken each year and the monitoring results will be presented in the Annual Clearing Permit Audit Report

5.7 RISK ASSESSMENT

A risk assessment of the proposal has been undertaken to assess the risk of increased environmental impacts on environmental values at the site and to determine the requirement for additional mitigation.

The risk assessment approach is based on guidance developed by the Department of Mines, Industry Regulation and Safety (DMP 2013), which uses a consequence and likelihood ranking system to determine the most appropriate risk rating for each impact. Details of the risk assessment approach are discussed below.

5.7.1 Consequence

Consequence refers to an environmental outcome or impact arising from a risk event occurring. An assessment of consequence will indicate the seriousness of a risk event, which may be expressed in terms of environment and corporate/economic implications (Table 25).

Table 25. Consequence rankings

Consequence levels	Types of risk events	Potential consequences/impacts
Very low	Events that cause insignificant, slight, negligible and very low impacts.	Minimal environmental impacts.
Low	Events that cause temporary, limited or minor impacts.	Confined / localized environmental impacts.
Moderate	Events that cause moderate or localized impacts.	Minor, but manageable, environmental impacts. Disruption to business activity.
High	Events that cause major, significant, or serious impacts	Significant environmental impacts. Negatively impacts company.
Very high	Events that cause catastrophic, very significant, critical, or extensive impacts.	Irreversible significant impacts to environment. Significant negative impacts for company.

Source: DMP (2013)

5.7.2 Likelihood

Likelihood refers to the probability of an environmental risk event occurring. Risks that have a high likelihood (i.e. frequent occurrences) have a greater chance of an environmental impact occurring (Table 26).

Table 26. Likelihood rankings

Likelihood levels	Frequency of risk events	Examples of estimated probability of occurrence
Highly Unlikely	rare, remote, unheard of, exceptional.	< 0.1% chance of occurring. 1 year in 1000 years
Unlikely	infrequent, uncommon.	~ 1% chance of occurring. 1 year in 100 years
Possible	occasionally, periodically.	~ 10% chance of occurring. 1 year in 10 years
Likely	frequent, regular, common.	~ 50% chance of occurring. 1 in every 2 years
Highly likely	almost certain, expected, repeating.	>90% chance of occurring. Almost annually

Source: DMP (2013)

5.7.3 Risk rating

The risk rating is determined for a particular risk by combining the consequence level with the likelihood level (Table 27). The results of the risk evaluation process are summarised in a risk matrix table (Table 28), noting that the main feature is to divide the table into thirds for relative priorities in risk treatment.

The three risk rating classifications are:

- Major risks: Levels of risk are regarded as unacceptable or intolerable and risk mitigation and treatment measures are essential irrespective of the costs;
- Medium risks: Levels of risks are regarded as unacceptable, but may be tolerable, and risk treatment and mitigation should apply where possible; and
- Minor risks: Levels of risks are regarded as acceptable and risk treatment may not be necessary.

Table 27. Likelihood rankings

		Likelihood level				
		Highly unlikely	Unlikely	Possible	Likely	Highly likely
Consequence level	Very high	Medium	Major	Major	Major	Major
	High	Medium	Medium	Major	Major	Major
	Moderate	Minor	Medium	Medium	Medium	Major
	Low	Minor	Minor	Medium	Medium	Medium
	Very Low	Minor	Minor	Minor	Minor	Medium

Source: DMP (2013)

As no significant habitat for any of the EPBC Act listed species is found at the site, including Black cockatoos (only low value foraging habitat – with no nesting or roosting habitat found), the risk assessment revealed that the proposal poses only a minor environmental risk to the key environmental factors of the area (Table 28).

Table 28. Risk matrix table

Ref	Activity	Factor	Potential Impact	Management / Mitigation / Comments*	Consequence	Likelihood	Risk Level
1	Clearing	Black cockatoos	Removal of potential nesting, foraging or roosting habitat trees	Proposal area has been modified to exclude the only two recorded potential black cockatoo habitat trees within the proposed footprint. Proposal area does not represent quality black cockatoo foraging habitat.	Low	Unlikely	Minor
2	Clearing	Black cockatoos	Habitat degradation through the introduction of dieback	Hygiene management practices to be introduced to site prior to clearing	Low	Unlikely	Minor
3	Clearing	Black cockatoos	Habitat degradation through the introduction of weeds	Hygiene management practices to be introduced to site prior to clearing	Very Low	Unlikely	Minor
4	Clearing	Black cockatoos	Disruption to behaviour through noise and vibrations emissions	Small scale, short-term clearing operation consisting of a bulldozer for no more than 1 week each year (generally a few days). Black cockatoos are found frequenting built-up areas exhibiting a wide range of noise levels within the Swan Coastal Plain and the south west forests. Site is not considered to provide roosting habitat for black-cockatoos.	Low	Possible	Minor
5	Clearing	Black cockatoos	Habitat degradation through dust emissions	The site does not provide roosting or nesting habitat for black-cockatoos (local potential roosting and nesting trees will be avoided). Small scale, short-term clearing operation consisting of a bulldozer for no more than 1 week each year. Dust suppression practices to be implemented	Low	Unlikely	Minor
6	Clearing	Shore birds	Reduction of groundwater levels from clearing	The proposal area will be located approximately 300m from the eastern boundary of Lake Preston. No clearing will occur west of the limestone ridge, which is the catchment boundary of Lake Preston. Staged implementation and progressive rehabilitation	Low	Unlikely	Minor

Ref	Activity	Factor	Potential Impact	Management / Mitigation / Comments*	Consequence	Likelihood	Risk Level
7	Clearing	Shore birds	Disruption to behaviour through noise and vibrations emissions	<p>Small scale, short-term clearing operation consisting of a bulldozer for no more than 1 week each year.</p> <p>It is unlikely that noise emissions will be significant for shorebirds, whose habitat can sometimes be associated with semi-industrial environments (sewage/stormwater ponds, saltworks etc).</p> <p>The proposal plan has been altered so that no development occurs over the limestone ridge and is kept at a maximum distance from the shore. Noise emissions will occur at least 300m from the Lake and will be obstructed by a limestone ridge, which will act as a natural noise bund between the operation and the Lake.</p>	Low	Unlikely	Minor
8	Clearing	PYSRS	Reduction of groundwater levels from clearing	Clearing will not occur within the Lake Preston sub-catchment, instead clearing will be confined to the eastern side of the dividing limestone ridge that separates the operations from the Lake.	Low	Unlikely	Minor
9	Clearing	PYSRS	Sedimentation runoff from clearing and operations	Clearing will not occur within the Lake Preston sub catchment. There will be no roads or development on the western side of the limestone divide between the operations and the Lake and therefore runoff in to the Lake from the development is not expected.	Low	Unlikely	Minor
10	Extraction operations	Black cockatoos	Disruption to behaviour through noise and vibrations emissions	<p>Small scale, short-term operation consisting of a front-end loader and haulage trucks (with a bulldozer and crusher required for six only weeks each year for 5 years).</p> <p>Two trees (previously inside disturbance footprint) are immediately adjacent to the pit. It is unknown if noise from operations will influence black cockatoo behaviour.</p> <p>The site does not provide roosting or nesting habitat for black-cockatoos (local potential roosting and nesting trees will be avoided).</p>	Low	Unlikely	Minor

Ref	Activity	Factor	Potential Impact	Management / Mitigation / Comments*	Consequence	Likelihood	Risk Level
				Black cockatoos are found frequenting built-up areas exhibiting a wide range of noise levels within the Swan Coastal Plain and the south west forests.			
11	Extraction operations	Shore birds	Disruption to behaviour through noise and vibrations emissions	<p>It is unlikely that noise emissions will be significant for shorebirds.</p> <p>The proposal plan has been altered so that no development occurs over the limestone ridge and is kept at a maximum distance from the shore. Noise emissions will occur at least 300m from the Lake and will be obstructed by a limestone ridge, which will act as a natural noise bund between the operation and the Lake.</p>	Low	Unlikely	Minor
12	Extraction operations	Black cockatoos	Habitat degradation through dust emissions	<p>Dust suppression practices to be implemented as per the proposal's Environmental Management Plan (Appendix B).</p> <p>The site does not provide roosting or nesting habitat for black-cockatoos (local potential roosting and nesting trees will be avoided).</p>	Low	Unlikely	Minor
13	Extraction operations	Shore birds	Habitat degradation through dust emissions	<p>Small scale, short-term operation consisting of a front-end loader and haulage trucks (with a bulldozer and crusher required for six only weeks each year).</p> <p>Dust suppression practices to be implemented, however it is not expected that shorebirds will be impacted by dust emissions due to the distance (at least 300m), topography (limestone ridge) between the operations and the Lake.</p> <p>Furthermore, the operations are directly east of the Lake, and as the stronger prevailing wind direction is from the west, this factor will further reduce the impacts from dust emissions.</p>	Low	Unlikely	Minor

Ref	Activity	Factor	Potential Impact	Management / Mitigation / Comments*	Consequence	Likelihood	Risk Level
14	Extraction operations	PYSRS	Contamination of groundwater during maintenance and refuelling	<p>Small scale, short-term operations (majority of time only a front-end loader on site, with a bulldozer and crusher required for 12 weeks of the year).</p> <p>Strict hydrocarbon management procedures will be established including a Spill Management Plan (as documented in the Environmental Management Plan, Appendix B), and will include but not be limited to the following:</p> <p>No fuel or lubricant storage will occur on the site. Refuelling will take place using a mobile refuelling vehicle which is equipped with a “snap-on snap-off, fast-fill and auto shut-off” facility.</p> <p>No major servicing, which could lead to fuel and oil spills, will take place on the site.</p> <p>Water monitoring bores will be installed which will allow for easy water table monitoring.</p>	Moderate	Highly Unlikely	Minor
15	Transport / haulage	PYSRS	sedimentation from roads into wetland	Due to the high permeability of the substrate and the 200-metre buffer zone (through which no surface flow features exist), there is no potential for sedimentation to the Lake to be caused by the proposal.	Low	Unlikely	Minor
16	Water abstraction	Black cockatoos	Reduction of groundwater levels resulting in a decline in health of habitat trees	Water will be abstracted under strict conditions of the Licence.	Low	Unlikely	Minor
17	Water abstraction	Shore birds	Reduction of groundwater levels disturbing habitat	Water will be abstracted under strict conditions of the Licence	Low	Unlikely	Minor
18	Water abstraction	PYSRS	Reduction of groundwater levels from clearing	Water will be abstracted under strict conditions of the Licence	Low	Unlikely	Minor

*For more detail on management and mitigation measures, refer to Appendix B (Environmental Management Plan), Appendix D (Water Management Plan) and Appendix H (Weed Management Plan).

6 REHABILITATION AND REVEGETATION

6.1 REVEGETATION AREAS

An area of 8.3ha within the total 13.5ha extraction area will be revegetated with native species on completion of extraction (Figure 4). This native species revegetation will occur on the embankments of the completed extraction pit, with the remainder of the area being returned to pastures.

The area to be revegetated with native vegetation to offset the impacts of clearing 8.3 ha within Lot 4 is also shown on Figure 4 (and Figure 2 in Appendix C). This area is in the adjacent Lot 17 and is 10.6 ha in size and has previously been cleared for grazing and is considered to be 'completely degraded' (Keighery 1994) in terms of vegetation condition.

6.2 REVEGETATION GOALS

The revegetation goals proposed for this area include:

- restoring native vegetation within the identified degraded area, to a condition considered to be good according to Keighery (1994).
- creating a landform that is stable, erosion resistant, aesthetically pleasing and safe for humans and animals, both on and surrounding the site
- encouraging rapid re-colonisation of the mined area by native fauna and to provide an ecological linkage between the remnant vegetation to the north and south of the revegetated area

6.2.1 Completion criteria

- Revegetation of the area will be deemed successful according to the following criteria:
- A planted seedling (tubestock) or germinant (direct seeding) survival rate in year 5 of 60% or more representing at least 75% of the intended species diversity (as per the species lists included in Annexure 1) will constitute success for this project. If mortality rates are higher than this, supplementary planting will be required in the subsequent year(s) until such time as the target rate is achieved.
- Weed cover within the revegetated areas is less than 20%
- No erosion scars are present within the rehabilitation areas
- Native fauna are utilising vegetation within the rehabilitation areas

6.3 BEST PRACTICE METHODS

B & J Catalano intends to use best practice methods to achieve revegetation on this site. The specific strategies that will be implemented to achieve the restoration goals are discussed below.

6.3.1 Collection of seed and use of cleared vegetative material

Remnant vegetation to be cleared within the extraction area is a valuable source of seed and vegetative material to assist in future rehabilitation of the site. Prior to clearing, the vegetation should be assessed by revegetation personnel and any viable seed of appropriate species collected, if

required. Cleared vegetation will be retained for windrow/mulching, seed harvesting (if required), erosion management and habitat replacement. Large logs should be strategically placed throughout the sit, during rehabilitation, to create habitat for reptiles, small mammals and invertebrates.

6.3.2 Landform reshaping and alleviation of compaction

After extraction is complete, the land will be reshaped into a stable landform with gradients no greater than 1 in 6. During this stage and prior to topsoil respreading, the pit floor will be ripped at six metre centres, to a depth of approximately one metre, using a tyne to alleviate compaction.

6.3.3 Topsoil management

Once the area has been shaped and ripped, stockpiled topsoil will be spread onto the prepared surface of the previously mined area at an average depth of 50 mm.

6.3.4 Weed management

As the proposed offset revegetation area is under pasture grasses, it will be essential to eliminate the pasture species and any other weed species, prior to revegetating with native species, to reduce the competition for moisture and nutrients.

Effective ongoing weed management in this area will be necessary to maintain a low weed burden. The most appropriate form of weed management will be applied in response to the level of infestation that actually occurs on the revegetation site. This is most likely to be a combination of mechanical, manual and chemical measures.

The success of any revegetation program is dependent on weed control. The two main aims of the weed control program are:

- To prevent weed seed set
- To reduce competition for water and nutrients between weeds and the emerging/planted seedlings.

Weed control during the operational, extraction phase will be undertaken to minimise weed seed set within and around the proposed revegetation area and any associated topsoil stockpiles. It is important that sufficient attention is directed to the management of weeds during all stages of the project to minimise disruptions to revegetation timeframes.

A suitably qualified weed management contractor will be engaged to undertake this weed management.

6.3.5 Revegetation Methodology

Direct seeding and tubestock planting will be undertaken both the offset and extraction revegetation areas to ensure successful revegetation within a reasonable timeframe. The seedmix and tubestock for these areas will consist of species which provide the best results for soil stabilisation and out-competing of weed species (Annexure 1).

The target structure of the revegetated area as proposed in the species list is as follows:

- Trees – 70%
- Mid-storey – 20%
- Understorey – 10%

6.3.5.1 Tubestock (seedling) plantings

Tubestock grown from local provenance seed or plant material will be sourced from local nurseries. Seedling orders will need to be submitted by November 30 in the year preceding the proposed plantings to enable sufficient time for nursery staff to collect and propagate the necessary seeds to ensure tubestock is of reasonable size for planting.

Seedlings will be planted at a density of 500 plants/ha throughout the revegetation areas. A recommended species list and required quantities is included in Annexure 1.

6.3.5.2 Direct seeding

Seed of local provenance will be purchased from, or collected by, a local seed supplier and seeded by hand at a rate of approximately 2 kg/ha. The species to be used in the seed mix have been identified as those occurring within and adjacent to the proposed extraction site and are summarised in Annexure 1. These species are typical of those found on the limestone soils of the Swan Coastal Plain. Seeding should occur after the first rain of the season.

6.3.5.3 Erosion control

The following erosion control measures will be implemented at the commencement of mining and continue through to the end of the monitoring period:

- Prior to planting of tubestock and seeds, the re-topsoiled surface will be ripped at 1.5m centres to create mounds.
- A polymer may be applied to the soil surface in areas where wind erosion may be a problem. Spreading of cleared vegetation material in windrows or the use of wind fences are additional options if erosion in the vegetated areas is a problem.

6.3.5.4 Herbivore control

Kangaroo activity onsite should be monitored during the extraction phase. If kangaroo numbers are high, the area to be revegetated will need to be fenced to limit damage by predation.

If rabbits are present on site, the use of '1080' oat baits and ripping of the rabbit warrens have proven to be effective control methods.

6.3.6 Revegetation Schedule

The proposed revegetation of the 10.6 ha degraded offset area in Lot 17, will commence as soon as approval for extraction in the new area has been granted.

Revegetation within the 13.5ha extraction area will commence as soon as extraction within the area is complete.

6.3.6.1 Extraction Area

Activities to be undertaken to prepare the extraction area for revegetation include:

- Engage seed contractor at least 12 – 24 months in advance of the proposed revegetation works
- Once extraction has been completed, grade and contour the site and rip the area to a depth of approximately one metre using a tyne to relieve compaction
- Return stockpiled topsoil to the area to be revegetated (usually in autumn)
- Establish photo monitoring points
- Undertake necessary weed control

- Broadcast of native seed mix following winter rains in the year of planting
- Plant out seedlings once the winter has commenced proper (ie. following good rains after the break of season), usually around June. Providing there is good winter rainfall, planting can be undertaken until the end of August.
- Fence off area to prevent cattle entering

6.3.6.2 Offset Area

For the offset area which has previously been sown with pasture species, the ground will need to be ripped to alleviate any compaction and the pasture will need to be sprayed off to reduce competition for nutrients and moisture. Once the pasture species have been killed off the following activities will be undertaken:

- Broadcast of native seed mix following winter rains in the year of planting
- Plant out seedlings once the winter has commenced proper (ie. following good rains after the break of season), usually around June. Providing there is good winter rainfall, planting can be undertaken until the end of August.
- Establish photo monitoring points

A preliminary timetable of actions for the area to be revegetated is summarised in Table 29.

6.3.7 Monitoring and Maintenance

Monitoring is important as it provides a measure of the effectiveness of revegetation actions and identifies if maintenance and contingency actions such as follow-up planting or weed control are required.

6.3.7.1 Photo points and relevè

Five photo points will be established across the two revegetated areas to provide a record of vegetation growth and success over the years. The locations of these photo points are presented in Appendix C.

The photo points will be marked and recorded using the following procedure:

- 900mm white-tipped jarrah stakes flagged with pink tape and labelled with the respective monitoring point name and number on the side from which the photograph is taken will be hammered into the ground at each photo point.
- GPS coordinates and compass bearings will be recorded for each photo point.
- Photos will be taken from behind the photo point, from as far back as necessary to include the peg in the bottom centre of the photo.
- In order to assess the structure of replanted vegetation, for this project, photos will also be taken directly in front of the photo point marker from 50cm above the ground.

In order to further assess vegetation structure within the revegetation areas, a relevè (5m x 5m) will be set up within an area captured in each photo point. The relevès will be marked using the following procedure:

- the centre of the relevè point will be marked with a 900mm white-tipped jarrah stake flagged with yellow tape and labelled with the respective monitoring point name and number.

Vegetation structure of each relevè will be measured using the structural classification of Keighery (1994).

The following records will be obtained for each relevè:

- Native species composition (stems per hectare per structure level)
- Species diversity (species per hectare)
- Weed density or cover and weed species present
- Record success of additional control actions (e.g. rabbit control, fences)

Monitoring of vegetation establishment and structure will be undertaken on an annual basis in spring for a period of five years as a minimum, to ensure success and to account for differences in annual rainfall. Thereafter, providing revegetation has been successful by the end of Year 5, monitoring will be undertaken every second year until ten years after planting to ensure targets set in the completion criteria have been met.

A summary of the rehabilitation activities undertaken each year and the monitoring results will be presented in the Annual Clearing Permit Audit Report.

6.3.8 Measuring success against completion criteria

Completion criteria must be sufficiently stringent to ensure that the overall objectives of the rehabilitation have been met. These criteria must also be designed to allow effective reporting and auditing to define an endpoint for the rehabilitation activities

Regular monitoring against set completion criteria will be undertaken and appropriate actions implemented where necessary. Monitoring will continue until the completion criteria presented in **Error! Reference source not found.** have been fulfilled.

Table 30. Closure criteria, objectives and interim targets

Closure Criteria	Objective	Interim target
Revegetation	Survival rates 60% or higher by end Year 5	75% survival of planted tubestock / germinants at the end of Year 1
	Species diversity 75% or higher by end Year 5	85% of planted/seeded species diversity remaining at the end of Year 1
	Rehabilitated areas blend into the surrounding area by end Year 5	Achievement of the above 'revegetation' objectives will ensure that this objective is met.
Weeds	Weed cover 20% or less by end Year 5	No more than 20% weeds at any time throughout rehabilitation process
Erosion/soil stability	Site hydrology does not prevent the establishment of desired vegetation. No erosion scars by end Year 5	Stormwater is retained within the site Identification and mitigation of potential erosion scars during rehabilitation Direct autumn return of topsoil in areas to be revegetated
Fauna	Native fauna are using rehabilitation areas by end Year 5	Some fauna using rehabilitation areas. It is likely that ants and then reptiles will be the first to recolonise the site. Evidence through observation of individuals, scats and tracks
Pest animals	Grazing by herbivores, including macropods, affects no more than 10% of rehabilitation by end Year 5	Herbivore grazing affects no more than 10% of rehabilitation at any time throughout the rehabilitation process

6.3.9 Maintenance and contingency measures

Revegetation areas will need to be inspected and managed after initial planting/seeding as initial success is often compromised by weeds, feral animals, human activities, fire and drought.

Maintenance procedures will be carried out where necessary and may include:

- Repair of any erosion damage
- Replanting/seeding areas in subsequent years that may not have established
- Weed control – weed inspections should be undertaken in autumn, spring and summer by a suitably qualified contractor and appropriate treatment undertaken when required.

7 MANAGEMENT COMMITMENTS

Table 31 provides a summary of commitments made by the proponent, including details on funding, roles and responsibilities and measurable performance criteria.

Table 31. Management commitments

Management Commitment	Costs/funding	Responsibilities	Performance criteria
<p>Restore native vegetation within the identified degraded area, to a condition considered to be good according to Keighery (1994).</p> <p>Create a landform that is stable, erosion resistant, aesthetically pleasing and safe for humans and animals, both on and surrounding the site</p> <p>Encourage rapid re-colonisation of the mined area by native fauna and to provide an ecological linkage between the remnant vegetation to the north and south of the revegetated area</p>	<p>Revegetation will cost is expected to cost an estimated \$210,750 (approximately \$12,000 per hectare)</p>	<p>B&J Catalano</p>	<p>Revegetation of the area will be deemed successful according to the following criteria:</p> <p>A planted seedling (tubestock) or germinant (direct seeding) survival rate in year 5 of 60% or more representing at least 75% of the intended species diversity (as per the species lists included in Appendix C, the Revegetation Report) will constitute success for this project. If mortality rates are higher than this, supplementary planting will be required in the subsequent year(s) until such time as the target rate is achieved.</p> <p>Weed cover within the revegetated areas is less than 20%</p> <p>No erosion scars are present within the rehabilitation areas</p> <p>Native fauna are utilising vegetation within the rehabilitation areas</p>

8 OFFSETS

8.1 PROPOSAL IMPACTS

8.1.1 Carnaby's Black Cockatoos

8.1.1.1 Nesting/breeding habitat

Habitat assessment of the proposal area (as further refined from Harewood 2019, Appendix F) identified 25 trees with a DBH of >50cm, 20 trees (80%) of which did not contain hollows of any size and 5 trees (20%) contained hollows not suitable for black cockatoo nesting. Trees with hollows large enough (greater than ~10cm) to possibly allow entry of a black cockatoo were not recorded in the revised proposal footprint (Figure 8).

The proposal will have no direct impact on Carnaby's black cockatoo nesting/breeding habitat.

8.1.1.2 Black cockatoo foraging habitat

The proposal area does not represent quality black cockatoo foraging habitat. No foraging debris left by black cockatoos was observed within the area during the fauna surveys (Harewood 2018).

The dominant trees of the local area - limestone marlock, tuart and peppermints are only foraged rarely. There are vast areas of better-quality woodland habitat in the nearby Yalgorup National Park, which can reasonably be expected to contain many hectares of quality foraging habitat for black cockatoos.

The proposal will have no direct impact on Carnaby's black cockatoo quality foraging habitat.

8.1.1.3 Black cockatoo roosting habitat

No evidence of black cockatoo roosting within trees located within the proposal area was observed during field surveys.

A review of the 2017 Great Cocky Count database shows no documented roost sites within or near the proposal area. The closest recorded roost is about 6 km south east of the proposal area, but no birds have been recorded at this location since 2011.

The vast areas of similar woodland vegetation bordering the proposal area can be reasonably expected to contain many roosting options for black cockatoos.

The proposal will have no direct impact on Carnaby's black cockatoo quality roosting habitat.

8.1.2 Shorebirds

No shorebird individuals, populations or their suitable habitat have been recorded within the proposal area.

No shore breeding occurs at Lake Preston as all the shorebirds listed are non-breeding migrants to Australia.

There will be no disturbance to shorebird habitat or the vegetation immediately adjacent this habitat.

8.2 OFFSET STRATEGY

The proposed action will have no significant direct impact on Carnaby's cockatoo individuals or their habitat. The site does not provide suitable nesting/breeding or roosting habitat, with only low value foraging black cockatoos habitat recorded, with the dominant plant species present not considered preferred foraging plants.

8.2.1 Offsets Assessment Guide (OAG)

The delivery of environmental offsets for MNES is required to comply with the EPBC Act Environmental Offsets Policy 2012. The policy provides guidance on the identification and assessment of suitable offsets, helping to ensure that proposals approved under the EPBC Act are consistent, transparent and achieve high quality environmental outcomes. This guidance is in the form of the Offsets Assessment Guide (OAG), which utilises a balance-sheet approach to estimate impacts and offsets for threatened species and ecological communities.

When working through the OAG for this Proposal, the focus of the impact and offset calculations were based on Black-cockatoo 'foraging habitat' as this is the only habitat value that is affected by the proposal.

In summary, the OAG has determined that in order to meet 100% of the direct offset requirement for loss to foraging habitat, the site is required to revegetate 10.6ha of adjacent farmland. This is based on key assumptions summarised below and further detailed in Table 32 and Table 33.

- Matter of NES impacted is Carnaby's Black Cockatoo
- Impact on low quality foraging habitat
- Area of impacted habitat (low quality foraging habitat) is 8.3ha (the vegetated portion of the extraction area), with a current quality ranking of 3 (degraded to good)
- Revegetation area in adjacent area is 10.6ha
- Revegetation must elevate the quality of the site to a quality ranking of 5 (good to very good)
- Revegetation must reach a quality ranking of 5 within 5 years

Table 32. Impact Calculator summary results

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact	Units	Information source	
Area of habitat	Yes	impact to low quality foraging habitat	Area	8.3	Hectares	Harewood 2018 (Fauna and Fauna Habitat Assessment, Lots 4&5 Ludlow Rd); Harewood 2019 (Threatened Species Review, Lots 4&5 Ludlow Rd)
			Quality	3	Scale 0-10	
			Total quantum of impact	2.49	Adjusted hectares	

Table 33. Offset Calculator summary results

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)	Start area and quality	Future area and quality without offset	Future area and quality with offset	Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	
Area of habitat	Yes	2.49	Adjusted hectares	revegetate foraging species in adjacent farm areas.	Time over which loss is averted (max. 20 years)	15	Start area (ha)	10.6	Risk of loss (%) without offset	30	Risk of loss (%) with offset	20	1.06	90%	0.95 0.80
					Time until ecological benefit	5	Start quality (scale of 0-10)	3	Future area without offset (adjusted hectares)	7.4	Future area with offset (adjusted hectares)	8.5			
							Future quality without offset (scale of 0-10)	1	Future quality with offset (scale of 0-10)	5	4.00	75%	3.00 2.83		

8.3 COMPLIANCE WITH OFFSET PRINCIPLES

The delivery of environmental offsets for MNES is required to comply with the EPBC Act Environmental Offsets Policy 2012. The policy outlines offset principles that govern the selection and nature of offsets and government assessment and decision-making. The proposal's compliance with these principles is outlined below.

1. Suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed action

The offset area provides for an improved foraging habitat area for black cockatoos, which are values that will be impacted by the proposal. The offset area provides offsets in excess of minimum requirements and is a 1.3-fold increase in the current habitat area impacted. This increase will result in a net conservation gain and overall improvement in the viability of the values being offset.

Threatening processes within the offset will be mitigated, and native vegetation will be restored to remnant condition. In doing so the proposed offset areas will deliver a conservation outcome that will maintain and improve the viability of the affected MNES.

2. Suitable offsets must be built around direct offsets but may include other compensatory measures

The proposed offsets will provide a direct land-based offset and measurable conservation gain mitigating 100% of the impacts associated with the proposal.

3. Suitable offsets must be in proportion to the level of statutory protection that applies to the protected matter

The proposed offsets, which provide a direct offset and measurable conservation gain, have been developed using the OAG. The OAG incorporates the level of statutory protection of each protected matter being offset.

4. Suitable offsets must be of a size and scale proportionate to the residual impacts on the protected matter

The proposed offsets will provide a direct offset that equates to 100% of the impacts associated with the proposal. The proposed offsets have been developed using the OAG, which uses the area of impact and the quality of habitat to assess the total quantum of impact to protected matters that needs to be offset. As such, the offset areas are of a size and scale that is proportionate to the unavoidable impacts on protected matters.

The revegetation/habitat improvement area is approximately 22% larger than the proposed disturbance area (8.3ha of vegetation to be cleared, with 10.6ha to be restored).

5. Suitable offsets must effectively account for and manage the risks of the offset not succeeding

Additional measures and remedial actions have been developed and will be implemented if any potential risks occur. This includes weed control, irrigation and further infill planting if there is a low seeding success rate.

In addition to this, a monitoring and reporting schedule will be developed which will assess the condition of the offsets at regular intervals and trigger changes to the management strategies, as required.

6. Suitable offsets must be additional to what is already required, determined by law or planning regulations, agreed to under other schemes or programs

The proposed offset areas do not have any existing formal conservation arrangement in place or existing requirements from other approvals that requires the landowner to undertake conservation works.

7. Suitable offsets must be efficient, timely, transparent, scientifically robust and reasonable

Direct, land-based offsets have been selected as the preferred offset methodology for this proposal as it is a robust and widely accepted approach, with a high degree of confidence in outcome. The proposed offsets will be implemented once approval has been granted and prior to the action occurring. Based on the OAG, ecological benefit will be achieved for black cockatoos within 5 years (i.e. planted seedlings will be producing foraging fruit for black cockatoos). This offsets package has been prepared to ensure the efficient and effective delivery of a conservation outcome in a timely manner.

8. Suitable offsets must have transparent governance arrangements, including being able to be readily measured, monitored, audited and enforced.

An Offset Area Management Plan (OAMP) will be prepared that will incorporate the details of offset management that is included in this offsets package. A monitoring program and reporting schedule will be developed and will be included in the OAMP.

9 ECONOMIC AND SOCIAL MATTERS

Long and short-term economic and social considerations have been integrated into decision-making processes for the proposal.

9.1 ECONOMIC BENEFITS

The proposal plays an important role in accessing and utilising Basic Raw Materials within the region.

The material extracted from this pit has a high calcium carbonate content and is very suitable for soil conditioning within the agricultural areas of the south west of Western Australia. The agricultural lime supply from this pit is an important resource for farmers within 50km of the site.

The existing pit, which will be expanded as part of this proposal, is a well-established, long-term, limestone excavation operation that has provided local material and employment for local industries and communities. Failure to capitalise on the proposal's opportunities would leave a substantial volume of the limestone resource unobtainable and shorten the life of the mine considerably.

Expansion of an existing operation also has considerable efficiencies and benefits economically, socially and environmentally.

9.2 ABORIGINAL HERITAGE

A search of the Department of Aboriginal Affairs AHIS (Aboriginal Heritage Inquiry System) system identified three survey areas across the project area:

- Heritage Survey Area 104608 (1): Bunbury-Wellington Regional Planning Study: Aboriginal Heritage & Planning Survey: working paper no. 6
- Heritage Survey Area 104079 (1) Bunbury-Wellington Regional Planning Study: Working Paper no.6, Aboriginal Heritage and Planning Survey. [Open] Released for Public Comment July 1992.
- Heritage Survey Area 102190 (1) Report on Aboriginal Sites of the Lake Peel-Preston Lakelands.

Despite these surveys, no heritage sites or places are registered as conforming to Section 5 of the *Aboriginal Heritage Act 1972* on Lots 4 and 5 Ludlow Road (Department of Planning Lands and Heritage 2018). The search reports have been appended to the Environmental Management Plan (Appendix B).

If during operations an Aboriginal cultural heritage site is discovered, B&J Catalano Pty Ltd will immediately advise the Department of Planning, Lands and Heritage.

10 ECOLOGICAL SUSTAINABLE DEVELOPMENT

The National Strategy for Ecologically Sustainable Development (ESD), endorsed by all Australian jurisdictions in 1992, defines the goal of ESD as: *'development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends.'* (DEWHA: Guidelines for Section 516A reporting – EPBC Act).

The following ESD principles are outlined in Section 3A of the EPBC Act:

- a) Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations (the 'integration principle').
- b) If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation (the 'precautionary principle').
- c) The principle of inter-generational equity – that 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 'intergenerational principle').
- d) The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making (the 'biodiversity principle').
- e) Improved valuation, pricing and incentive mechanisms should be promoted (the 'valuation principle').

Catalano will incorporate a range of processes to achieve and promote these five ESD principles within their proposed limestone extraction operation at Lots and 5 Ludlow Rd, Myalup. Consideration of the proposal against the ESD principles is presented below.

10.1 THE INTEGRATION PRINCIPLE

Long and short-term economic, environmental, social and equitable considerations have been integrated into decision-making processes for the proposal. The proposal plays an important role in accessing and utilising Basic Raw Materials within the region.

The existing pit, which will be expanded as part of this proposal, is a well-established, long-term, limestone excavation operation that has provided local material and employment for local industries and communities. Failure to capitalise on the proposal's opportunities would leave a substantial volume of the limestone resource unobtainable and shorten the life of the mine considerably.

Expansion of an existing operation also has considerable efficiencies and benefits economically, socially and environmentally.

Environmental considerations continue to be an integral part of proposal planning, design and implementation. Modifications to extraction areas to avoid significant habitat and offset planning are examples of environmental considerations integrated into early planning processes.

10.2 THE PRECAUTIONARY PRINCIPLE

The precautionary principle has been considered during early planning. The capitalisation of an existing operation has considerable benefits in terms of footprint reduction, infrastructure, water use and overall land disturbance. Environmental investigations undertaken to understand aspects of the

proposal (including flora and fauna) have shown that the proposal presents a low environmental risk and that any impacts can be avoided, managed and offset to produce an acceptable outcome. Examples include the avoidance of known potential roosting and nesting trees, setting the proposal back from Lake Preston as much as practicable, as well as proposed offsets to improve the current state of foraging habitat for Black cockatoos within the local area.

10.3 THE INTERGENERATIONAL PRINCIPLE

Catalano are committed to providing biodiversity offsets that meet the requirements of the EPBC Act Environmental Offsets Policy.

The offsets, developed through the OAG, will be managed and protected to ensure the health, diversity and productivity of the environment is enhanced for the benefit of future generations. The rehabilitated offset and mined lands are required to be: safe to humans and wildlife; non-polluting; stable and able to sustain a post-mining land use.

10.4 THE BIODIVERSITY PRINCIPLE

Biological diversity has been a consideration in planning many aspects of the proposal including environmental investigations and impact assessment, mine pit design and placement, as well as rehabilitation of mined and offset land. Residual impacts, such as the removal of low value foraging habitat, will be offset in the form of improved foraging habitat in adjacent farmland, which will achieve a net positive conservation outcome.

10.5 THE VALUATION PRINCIPLE

The use of this resource with minimal environmental and social impacts is desirable and maximises the value adding potential of the resource.

11 OUTCOMES AND CONCLUSION

Investigations indicate that the proposal footprint does not intersect regionally significant habitat of any listed species and that habitat types within the proposal area are relatively common across the local region, including within conservation estate.

One conservation significant species protected under the EPBC Act (Carnaby's black cockatoo) is known to, or considered likely to, occur within the proposal area. The proposal is likely to result in the removal of some low value foraging habitat for the EPBC Act listed Carnaby's black cockatoo, however it is unlikely that Carnaby's black cockatoo will be significantly affected by the proposal.

The listed Migratory shorebirds are highly transitory in nature and are known to occur over large areas of Western Australia in habitats not found within the proposal area. As such, any potential for these species or their key habitats to be affected by the proposal is highly unlikely.

Based on targeted environmental investigations, the proposal area is not considered to contain any significant areas of key habitat for EPBC Act listed species of the area. Any local-scale impacts will be mitigated via management plans and offsets.

Overall, the potential impact to EPBC Act listed species as a result of the proposal is unlikely to be significant.

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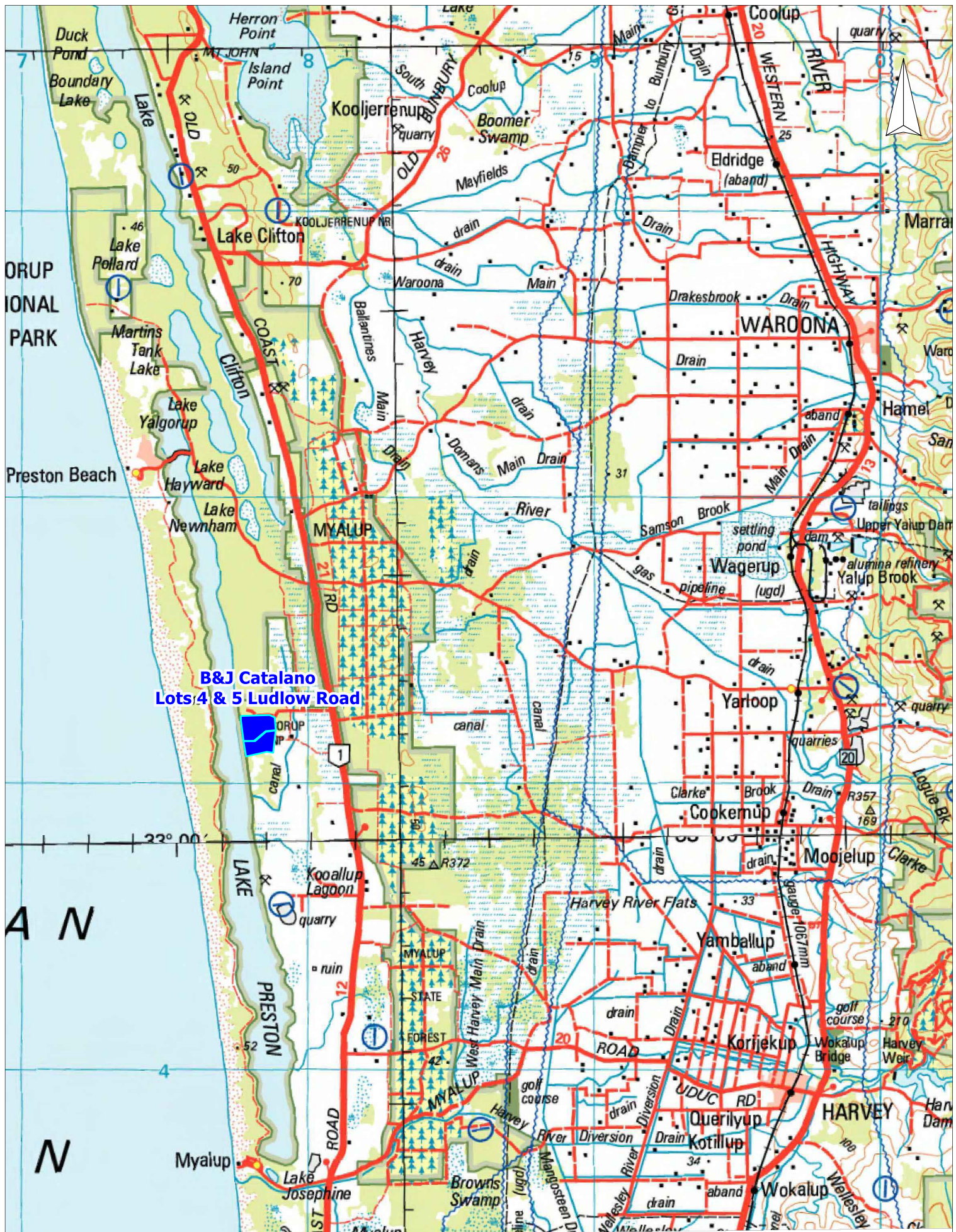
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13 FIGURES

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- Figure 7. Water values (local bores, water bodies, groundwater contours)
- Figure 8. Environmental values (vegetation and Black Cockatoo potential breeding habitat)
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- Figure 13. Local distribution of the Eastern Curlew (*Numenius madagascariensis*)
- Figure 14. Local distribution of the Red-necked Stint (*Calidris ruficolis*)



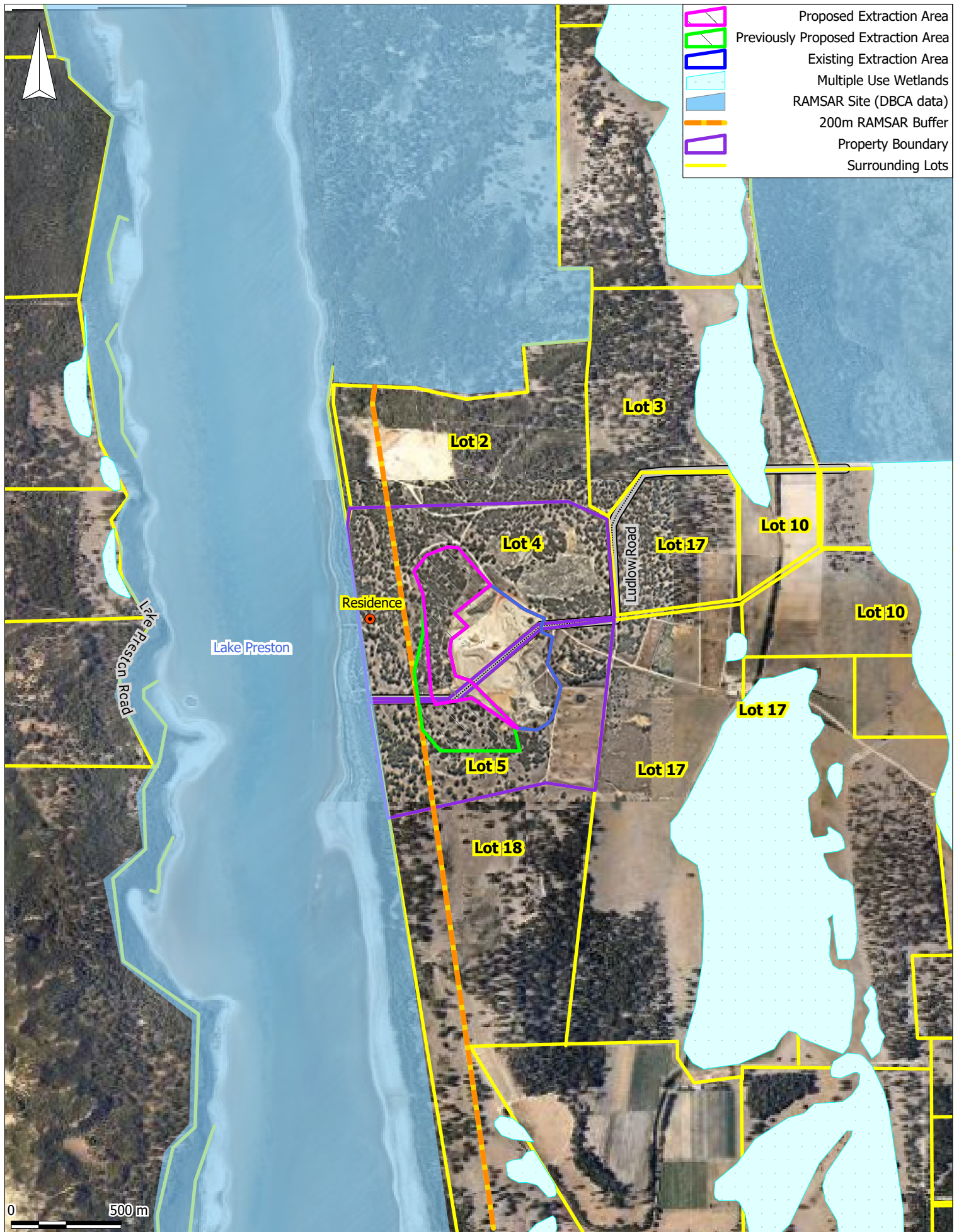
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Leeming WA 6149
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mikelund1@bigpond.com

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Client: B & J Catalano
Project: Limestone Extraction
Location: Lots 4 & 5 Ludlow Road
Myalup

**Figure 1:
Locality Plan**



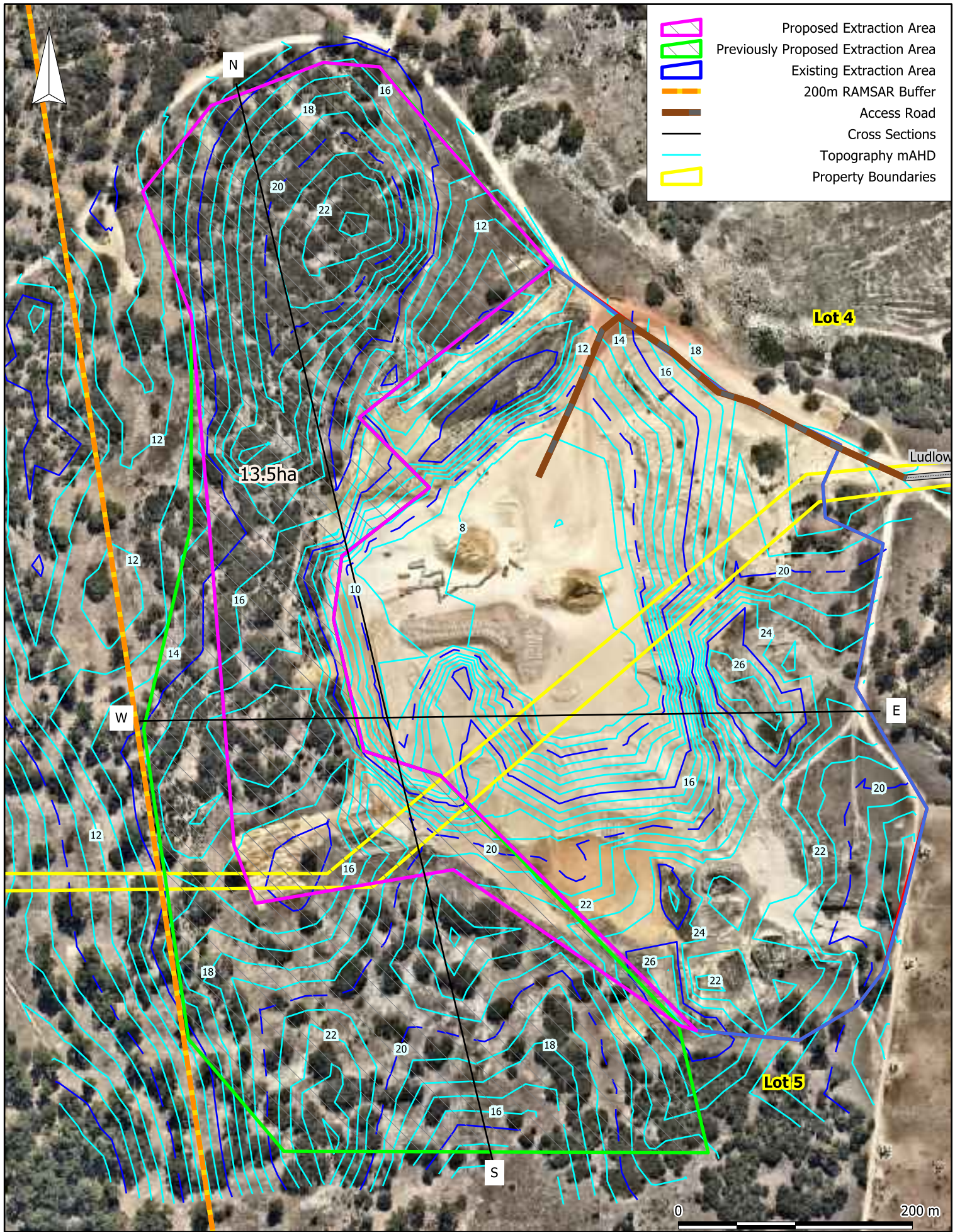
- Proposed Extraction Area
- Previously Proposed Extraction Area
- Existing Extraction Area
- Multiple Use Wetlands
- RAMSAR Site (DBCA data)
- 200m RAMSAR Buffer
- Property Boundary
- Surrounding Lots

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 Leeming WA 6149
 Mob: 0417934863
 mikelund1@bigpond.com

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 Project: Limestone Extraction
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Figure 2:
Site and Surrounds

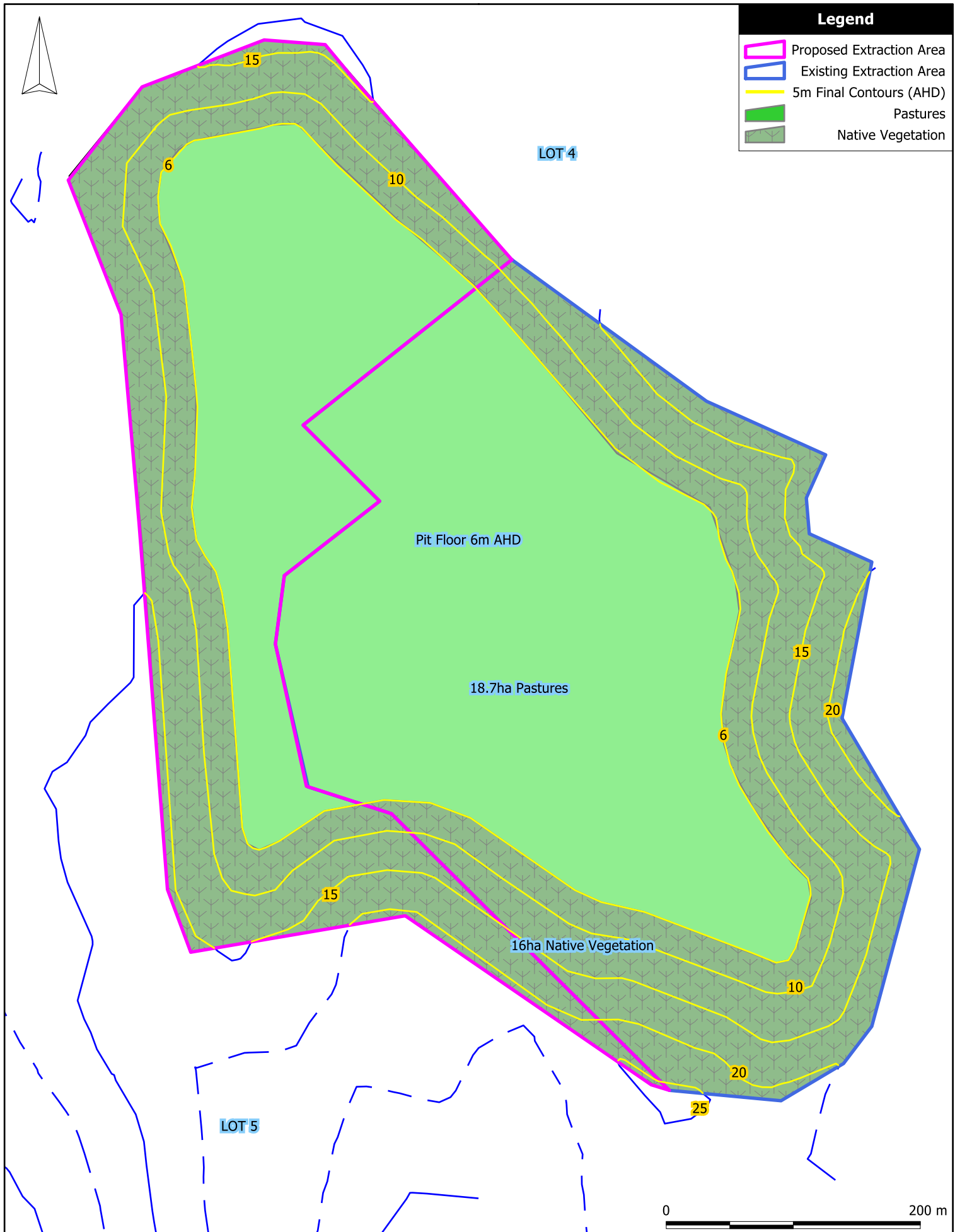


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 mikelund1@bigpond.com

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**Figure 3:
 Proposal Area**

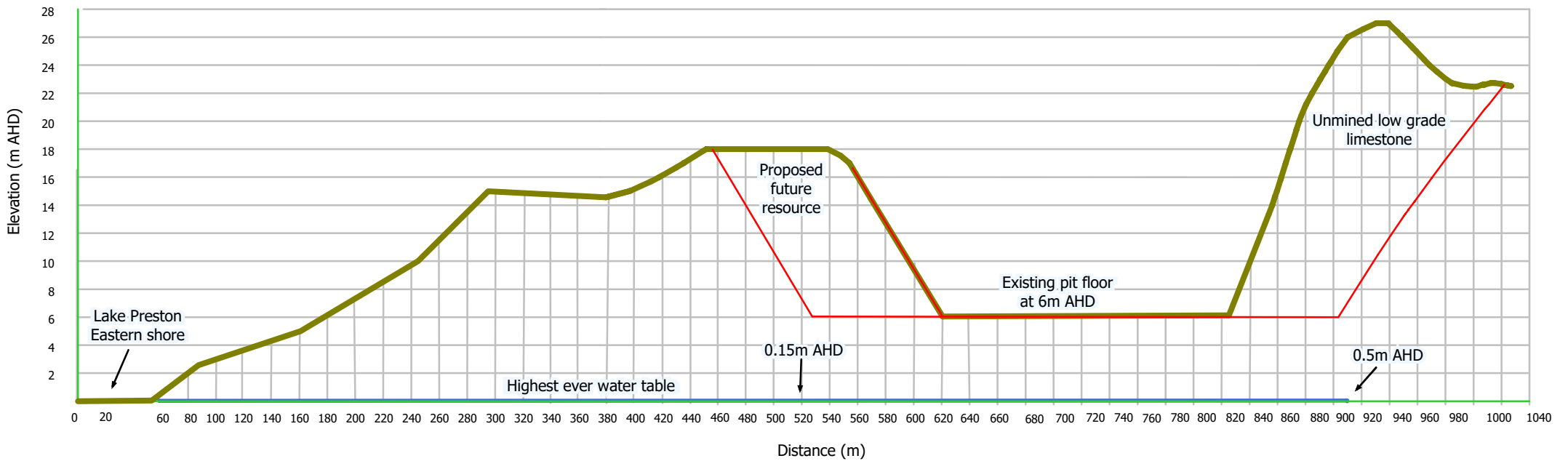





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mikelund1@bigpond.com

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Myalup

**Figure 4:
Final
Landscape**



Legend	
	Natural Landsurface
	Watertable
	Final EIL Landsurface

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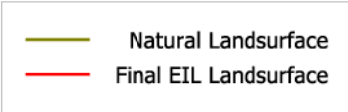
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mikelund1@bigpond.com
0417934863

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Lots 4 & 5 Ludlow Rd
Limestone Extraction**

Cross Section WE

Figure 5

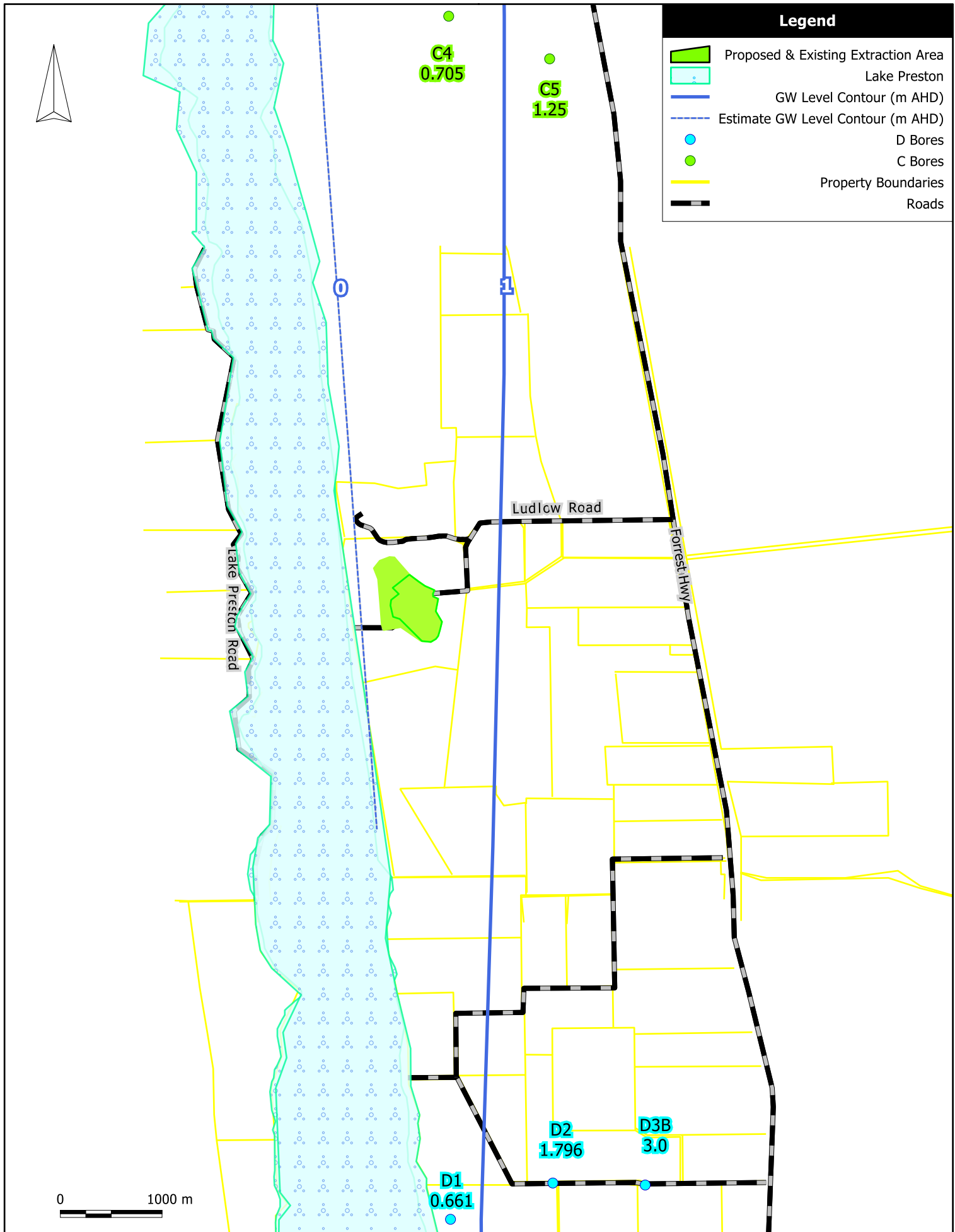


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mikelund1@bigpond.com
0417934863

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Limestone Extraction

Cross Section NS
Figure 6

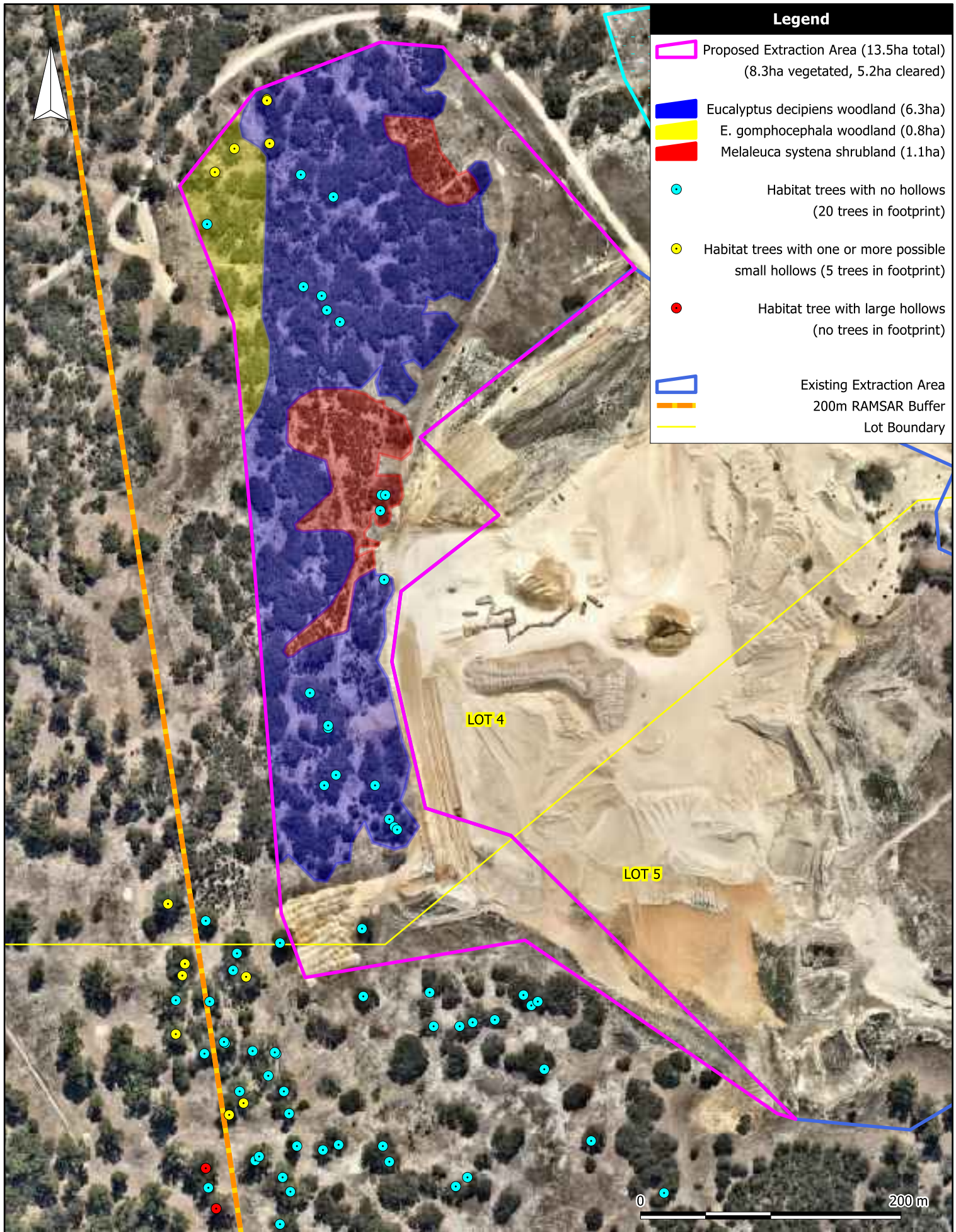


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 Leeming WA 6149
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 mikelund1@bigpond.com

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 Project: Limestone Extraction
 Location: Lots 4 & 5 Ludlow Road Myalup

Figure 7:
Groundwater Level Contours
26th October 1989

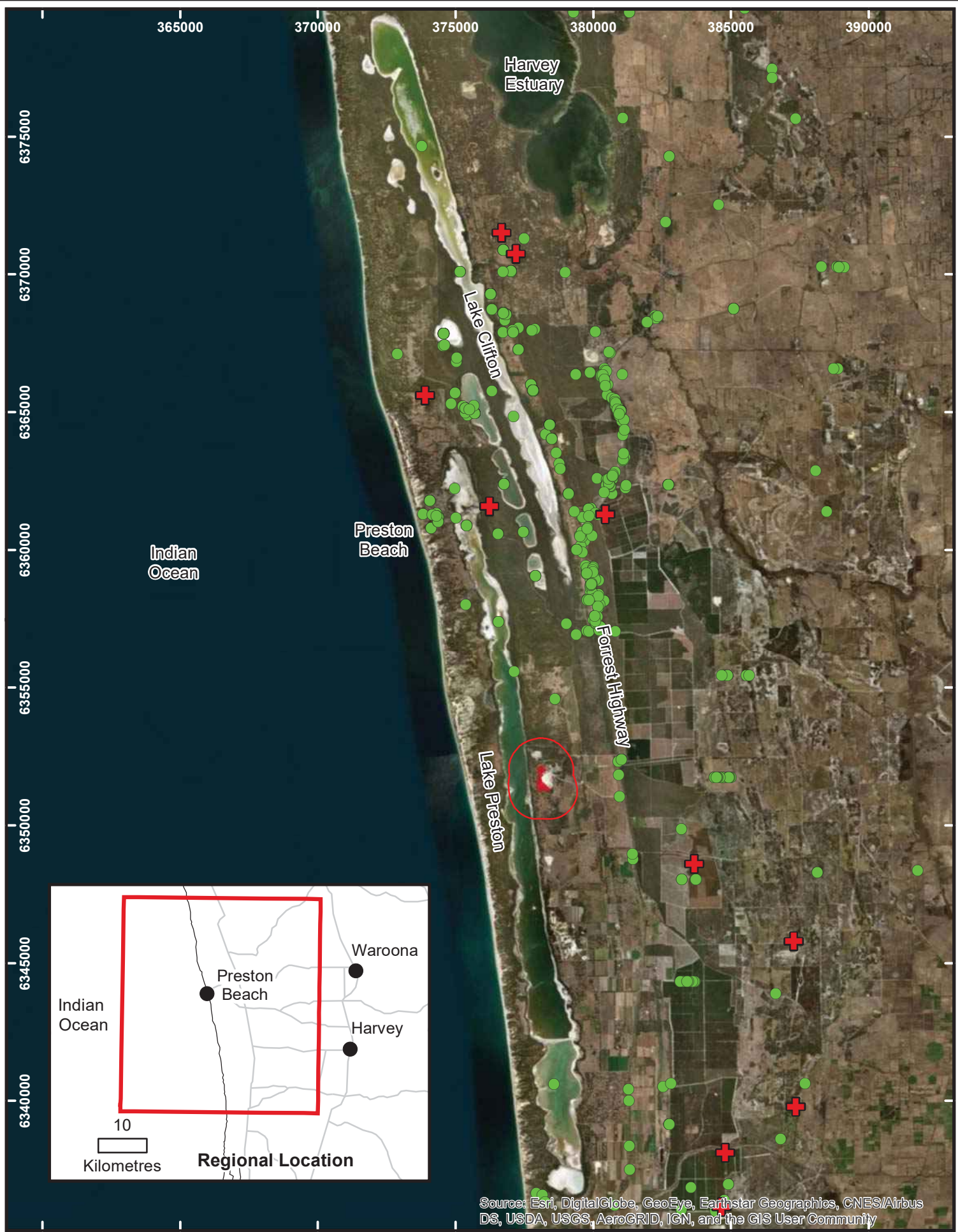


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mikelund1@bigpond.com

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Project: Limestone Extraction
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Myalup

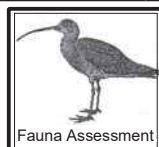
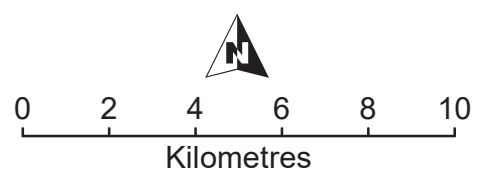
**Figure 8:
Environmental
Values**



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

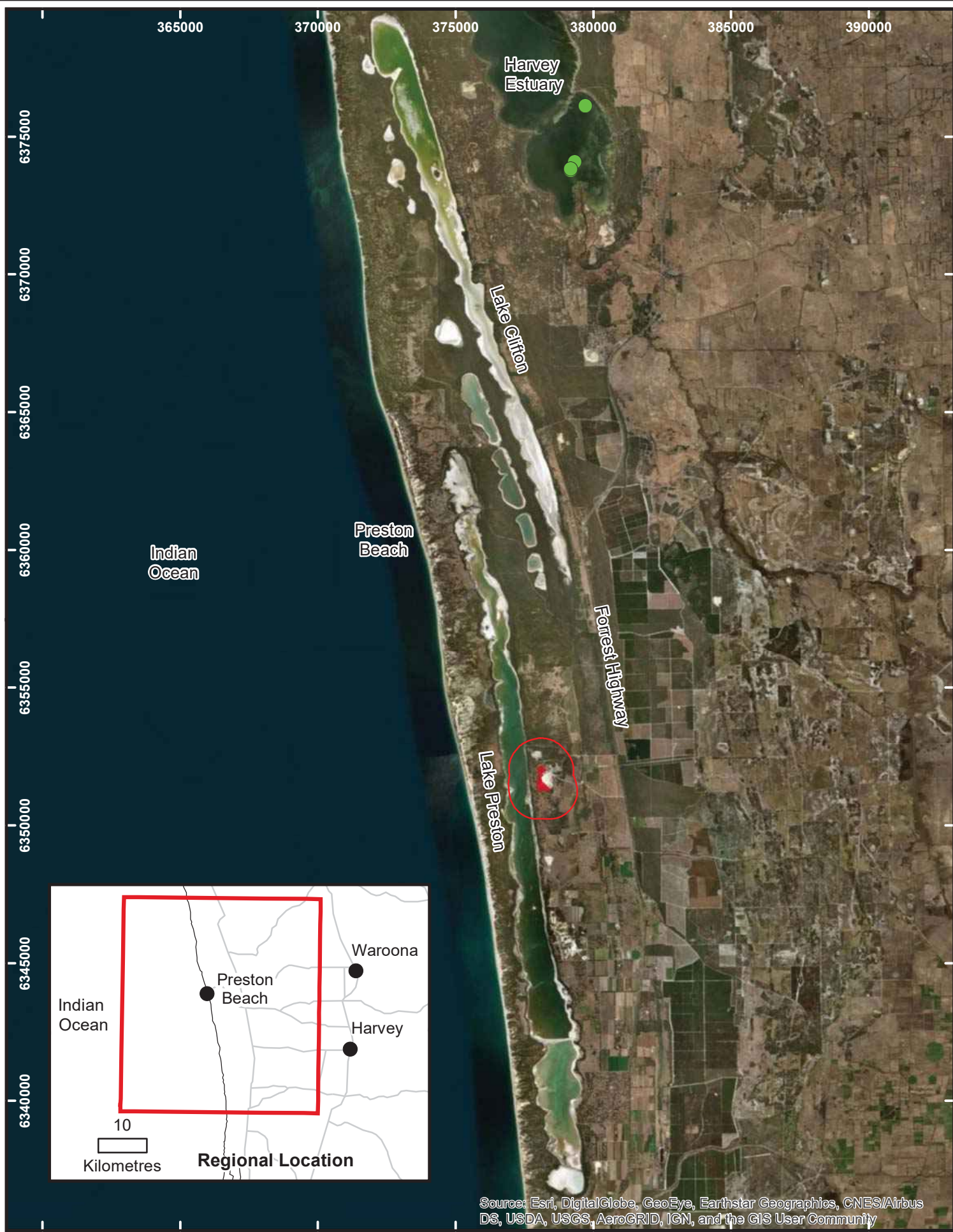
Legend

- Subject Site
- 1km Buffer
- Carnaby's Black Cockatoo Record
- Black Cockatoo Roost Site



Fauna Assessment
 Drawn: G Harewood
 Date: July 2019
 Scale: 1:175,000

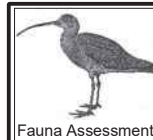
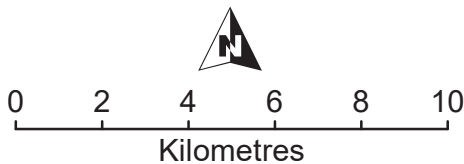
Lot 4 & 5 Ludlow Road Myalup
Carnaby's Black Cockatoo (*Calyptrorhynchus latirostris*) Records (NatureMap 2019)



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

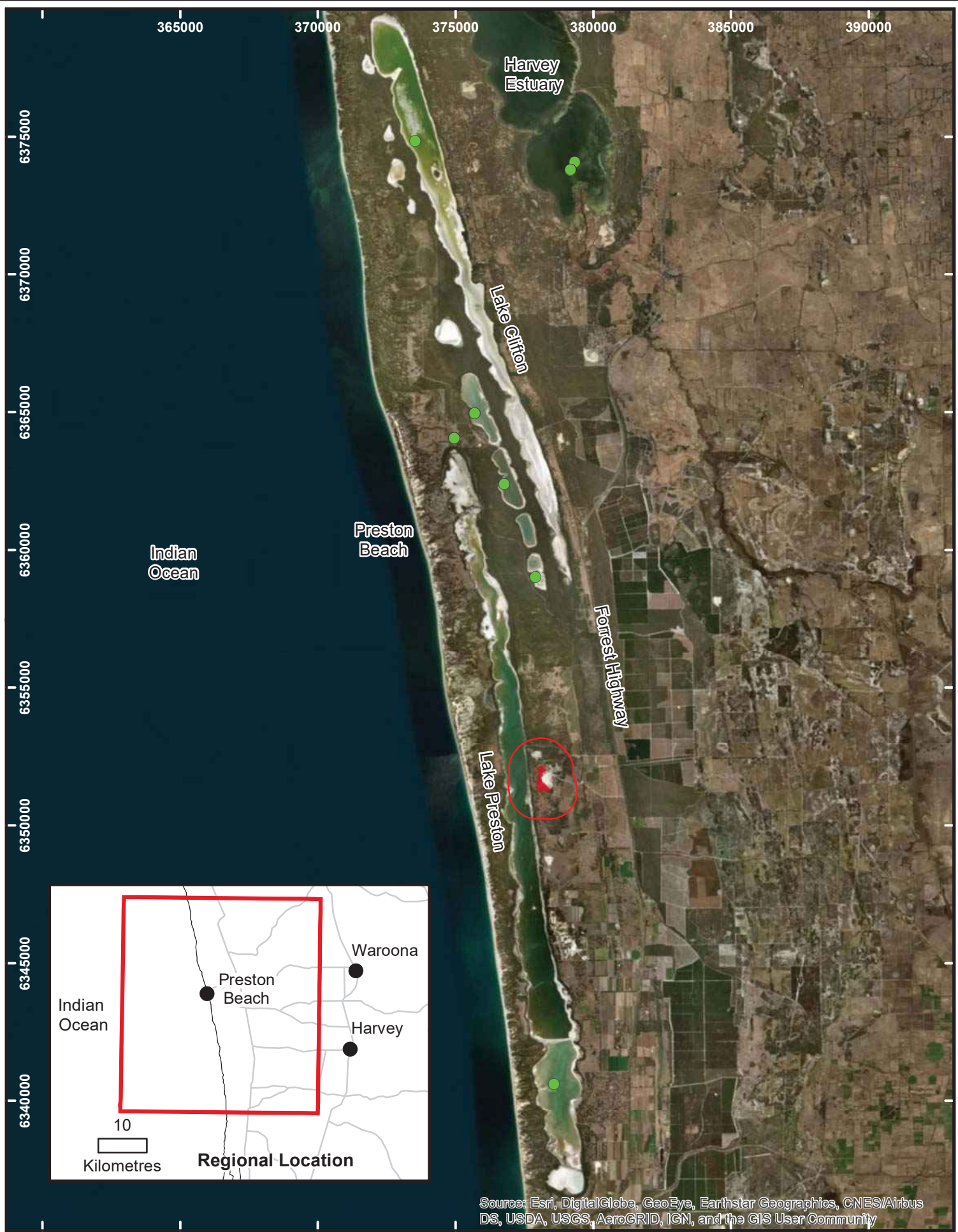
- Subject Site
- 1km Buffer
- Bar-tailed Godwit Record



Fauna Assessment
 Drawn: G Harewood
 Date: July 2019
 Scale: 1:175,000

**Lot 4 & 5 Ludlow Road
 Myalup**

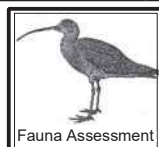
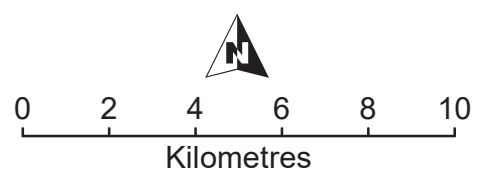
**Bar-tailed Godwit
 (*Limosa lapponica baueri*)
 Records (NatureMap 2019)**



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

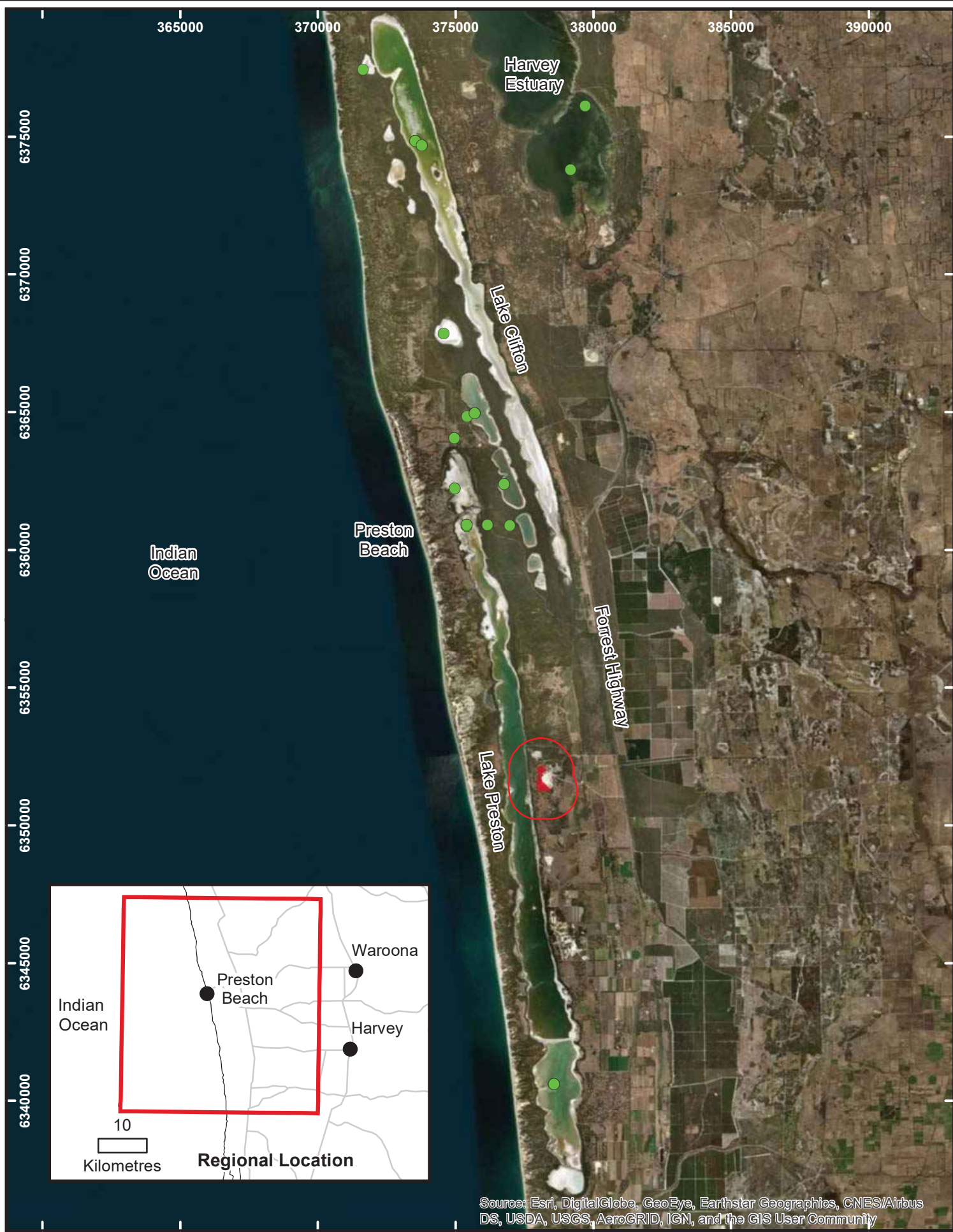
- Subject Site
- 1km Buffer
- Great Knot Record



Fauna Assessment
 Drawn: G Harewood
 Date: July 2019
 Scale: 1:175,000

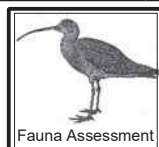
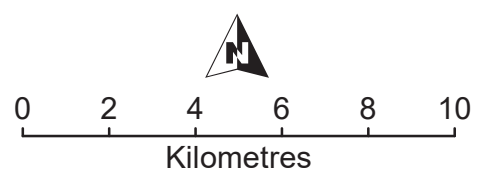
**Lot 4 & 5 Ludlow Road
 Myalup**

**Great Knot
 (*Calidris tenuirostris*)
 Records (NatureMap 2019)**



Legend

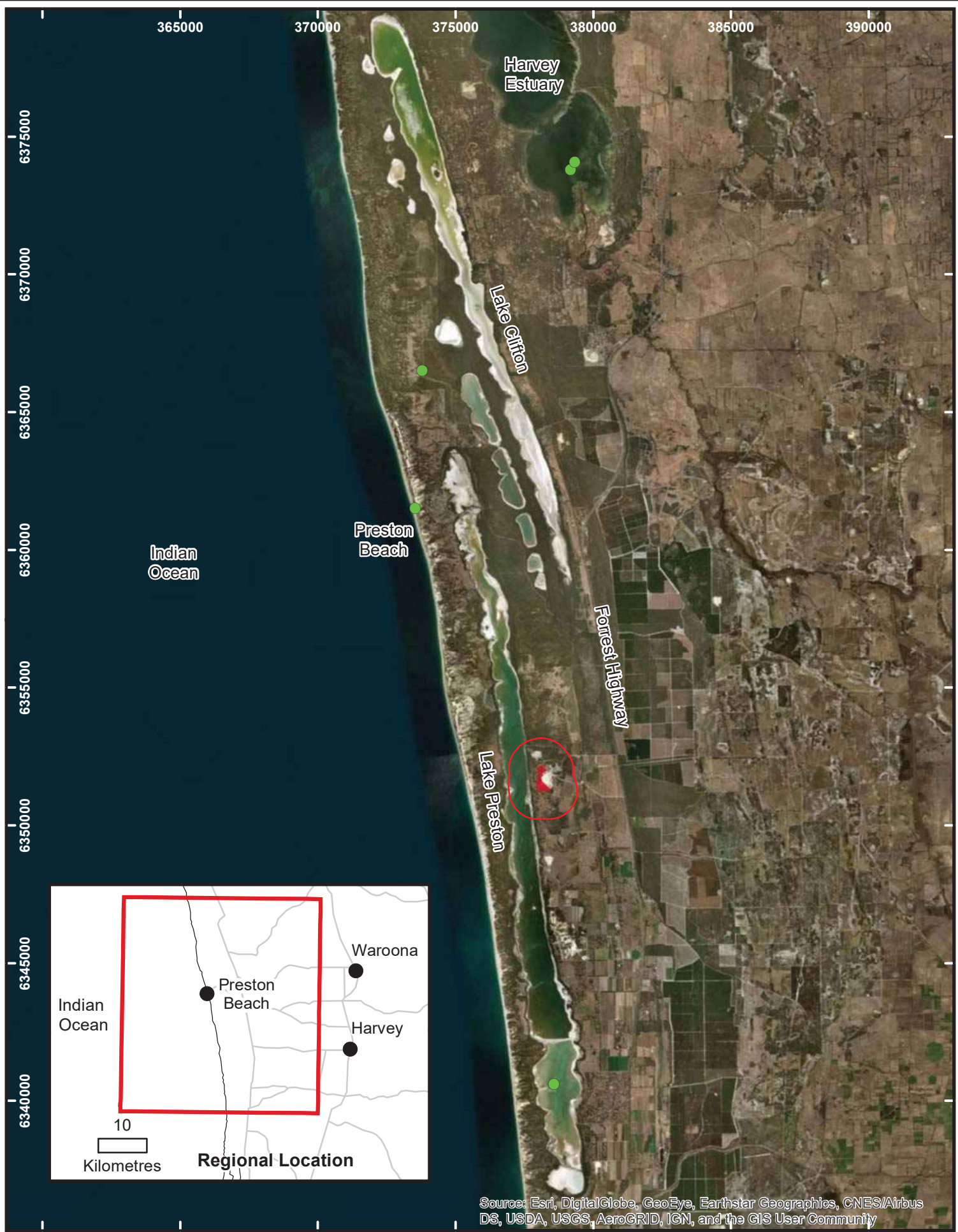
- Subject Site
- 1km Buffer
- Greater Sand Plover Record



Drawn: G Harewood
Date: July 2019
Scale: 1:175,000

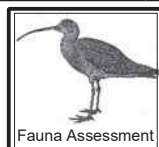
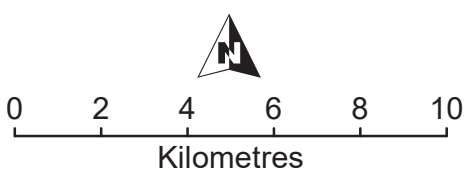
**Lot 4 & 5 Ludlow Road
Myalup**

**Greater Sand Plover
(*Charadrius leschenaultia*)
Records (NatureMap 2019)**



Legend

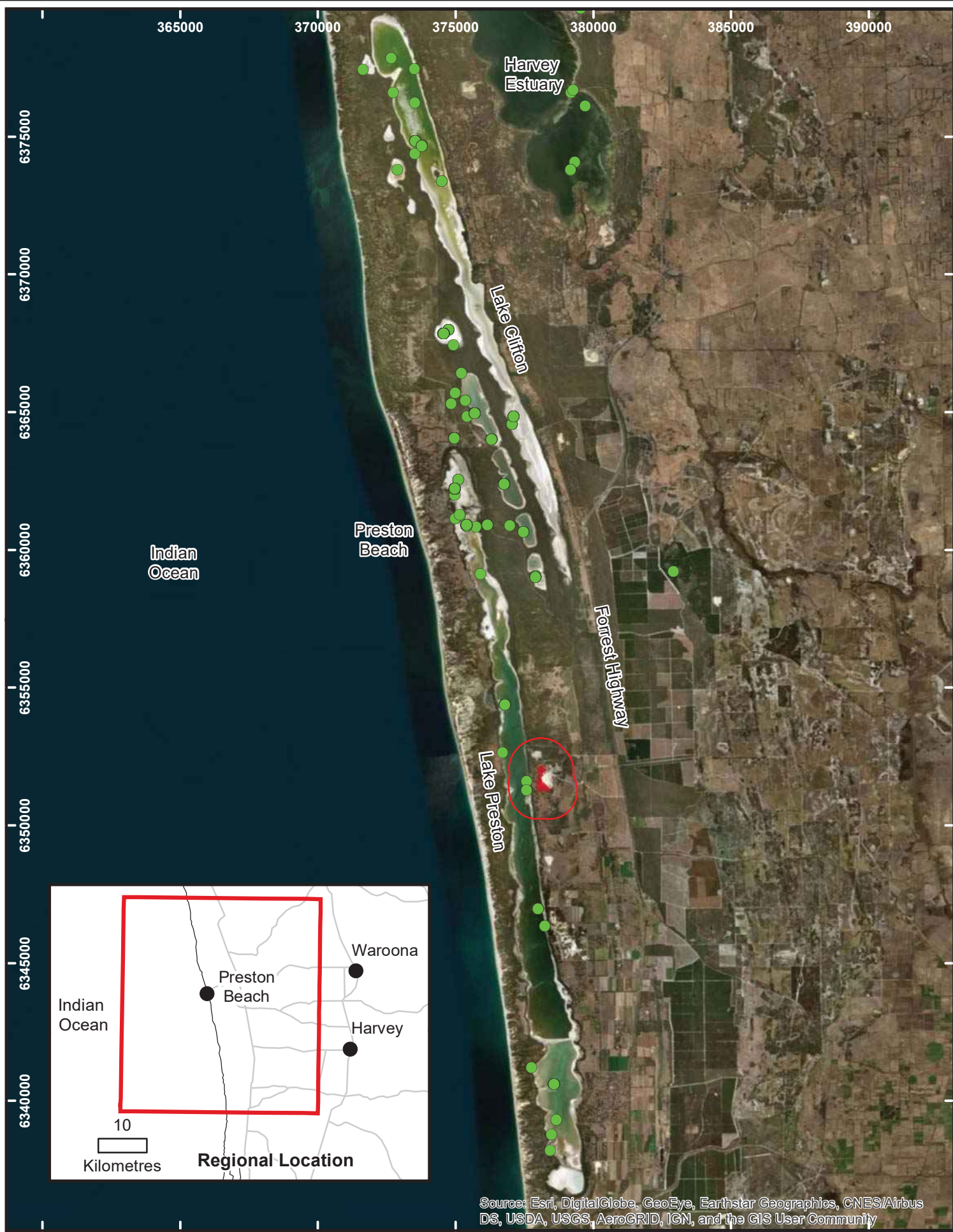
- Subject Site
- 1km Buffer
- Eastern Curlew Record



Drawn: G Harewood
Date: July 2019
Scale: 1:175,000

**Lot 4 & 5 Ludlow Road
Myalup**

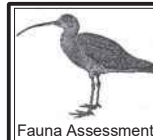
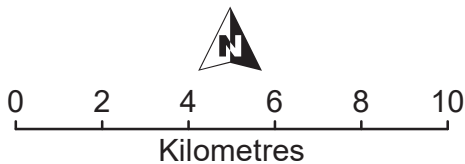
**Eastern Curlew
(*Numenius madagascariensis*)
Records (NatureMap 2019)**



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

- Subject Site
- 1km Buffer
- Red-necked Stint Record



Fauna Assessment

Drawn: G Harewood

Date: July 2019

Scale: 1:175,000

Projection/Coordinate System: UTM/MGA Zone 50

**Lot 4 & 5 Ludlow Road
Myalup**

**Red-necked Stint
(*Calidris ruficolis*)
Records (NatureMap 2019)**

Figure:14

14 APPENDICES

- Appendix A. (1) Department Response to Referral Application
 - (2) Department Response to Preliminary Documentation
 - (3) Department of Response to draft changes to Preliminary Documentation
- Appendix B. Environmental Management Plan
- Appendix C. Revegetation Report Plan
- Appendix D. Water Management Plan
- Appendix E. Vegetation and Flora Assessment (Plant Ecology 2018)
- Appendix F. Fauna Assessment Report (Harewood 2019)
- Appendix G. MNES (Shorebird and Black Cockatoo) Impact Assessment Review (Harewood 2019)
- Appendix H. Weed Management Plan

APPENDIX A.

- (1) Department of Environment and Energy response to referral application EPBC 2019/8388 (24 June 2019)**
- (2) Department of Environment and Energy response to Preliminary Documentation report (26 September 2019)**
- (3) Department of Agriculture, Water and the Environment (formally DoEE) response to changes to draft Preliminary Document report.**

APPENDIX B.

Environmental Management Plan

APPENDIX C.

Revegetation Report Plan

APPENDIX D.

Water Management Plan

APPENDIX E.

Vegetation and Flora Assessment (Plant Ecology 2018)

APPENDIX F.

Fauna and Fauna Habitat Assessment (Harewood 2019a)

APPENDIX G.

MNES (Shorebird and Black Cockatoo) Impact Assessment and Review (Harewood 2019b)

APPENDIX H.

Weed Management Plan