GOVERNMENT OF WESTERN AUSTRALIA

Environmental Protection Authority

EPA Referral Form

Form for the referral of a proposal to the Environmental Protection Authority under Section 38 of the *Environmental Protection Act 1986*

Referrer information

Who is referring this proposal?		✓ Proponent ☐ Decision-making authority ☐ Community member/third party	
Name (print) Neil Parry		**Signature**	
Position	Manager Land Management	Organisation	DBNGP (WA) Nominees Pty Limited NOTE: Referred to as DBP
Email	neil.parry@agig.com.au		
Address	L6, 12-14	The Esplanade	
	Perth	WA	6000
Date	11 January 2019		

Does the referrer request that the EPA treat any part of the proposal information in the referral as confidential? *Provide confidential information in a separate attachment.*	☐ Yes ✓ No

Referral declaration for organisations, proponents and decision-making authorities:

I, Neil Parry, *(full name)* declare that I am authorised to refer this proposal on behalf of DBNGP (WA) Nominees Pty Limited and further declare that the information contained in this form is true and not misleading.

Part A: Proponent and proposal description

Proponent information

Name of the proponent/s (including Trading Name if relevant)		**DBNGP (WA) Nominees Pty Limited**
Australian Company Number(s) **OR** Australian Business Number(s)	☐ ✓	78 081 609 289

Contact for the proposal (if different from the referrer) *Please include: name, physical address, phone, and email.*	☐ Yes ✓ No
Does the proponent have the legal access required for the implementation of all aspects of the proposal? ***If yes**, provide details of legal access authorisations / agreements / tenure.* ***If no**, what authorisations / agreements / tenure is required and from whom?*	✓ Yes ☐ No
Proposal type	
What type of proposal is being referred? For a change to an approved proposal please state the Ministerial Statement number/s (MS No./s) of the approved proposal For a derived proposal please state the Ministerial Statement number (MS No.) of the associated strategic proposal	✓ significant – new proposal ☐ significant – change to approved proposal (MS No./s: _____) ☐ proposal under an assessed planning scheme ☐ strategic ☐ derived (Strategic MS No.: _____)
For a significant proposal: • Why do you consider the proposal may have a significant effect on the environment and warrant referral to the EPA?	DBP does not view the proposal as having the potential to have a significant impact on the environment given its small footprint and the nature of environmental values present. DBP is referring the proposal to the EPA to confirm the insignificance of environmental impacts, given the attention the EPA has previously given to projects in the Kemerton Strategic Industrial Area.
For a proposal under an assessed planning scheme, provide the following details: • Scheme name and number For the Responsible Authority: • What new environmental issues are raised by the proposal that were not assessed during the assessment of the planning scheme? • How does the proposal not comply with the assessed scheme and/or the environmental conditions in the assessed planning scheme?	N/A
Proposal description	
Title of the proposal	DBNGP to Albemarle Lithium Plant Gas Pipeline Proposal
Name of the Local Government Authority in which the proposal is located.	Shire of Harvey
Location: a) street address, lot number, suburb, and nearest road intersection; or b) if remote the nearest town and distance and direction from that town to the proposal site.	Lot 253 on Deposited Plan 411027 & Lot 92 on Deposited Plan 021622, Marriot Road, Wellesley, Western Australia.

Proposal description – including the key characteristics of the proposal *Provide as an attachment to the form*	A buried 670 m long natural gas pipeline within a 30 m construction Right of Way (ROW) to connect the existing Dampier to Bunbury Natural Gas Pipeline (DBNGP) infrastructure westwards to the Albemarle Kemerton Plant, a lithium hydroxide manufacturing plant located in Kemerton, Western Australia (**Figure 1**). Refer to Attachment A for key characteristics table.
Have you provided electronic spatial data, maps and figure in the appropriate format? *Refer to instructions at the front of the form*	✓ Yes ☐ No
What is the current land use on the property, and the extent (area in hectares) of the property?	The Proposal Area is 2.1 hectares in size and is zoned for industrial use. It has historically been used for rural and plantation purposes.
Have you had pre-referral discussions with the EPA at DWER Services? If so, quote the reference number and/or the DWER contact.	No

Part B: Environmental impacts

Environmental factors

What are the likely significant environmental factors for this proposal?	☐ Benthic Communities and Habitat ☐ Coastal Processes ☐ Marine Environmental Quality ☐ Marine Fauna ✓ Flora and Vegetation ☐ Landforms ☐ Subterranean Fauna ✓ Terrestrial Environmental Quality ✓ Terrestrial Fauna ✓ Inland Waters ☐ Air Quality ☐ Social Surroundings ☐ Human Health

*For **each** of the environmental factors identified above, complete the following table, or provide the information in a supplementary report*

Potential environmental impacts

1	***EPA Factor***	**Flora and vegetation**
2	***EPA policy and guidance*** - What have you considered and how have you applied them in relation to this factor?	<u>EPA Objective</u> • To protect flora and vegetation so that biological diversity and ecological integrity are maintained. <u>Policy and Guidance</u> Environmental Factor Guideline: Flora and Vegetation (EPA 2016a) has formed the basis for the assessment of potential environmental impacts on flora and vegetation.

		The vegetation and flora survey of the Proposal Area conducted in November 2018 was in accordance with Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016b) -. The survey consisted of a broad vegetation assessment to delineate and characterise vegetation associations and potential resemblance to conservation significant ecological communities, including a vegetation condition assessment, and a targeted survey for conservation significant flora.
3	***Consultation*** – Outline the outcomes of consultation in relation to the potential environmental impacts	DBP has consulted with LandCorp (the landowner), Albemarle (the operator of the proposed Lithium Plant), and the Commonwealth Department of Environment and Energy (DOEE) regarding management of potential environmental impacts. In doing so, the need to minimise impacts to features of higher environmental value were identified. As a result, DBP have modified the proposed pipeline alignment to: • Minimise the length of the pipeline and therefore reduced the area of native vegetation to be cleared • Reduced impacts and clearance to vegetation associated with the Banksia Woodland TEC Consultation with the DOEE also resulted in DBP determining to replant all areas with native vegetation including land currently cleared or plantation. As such, all but 5 m of the 30 m wide corridor will be replanted with native flora species, mostly Banksia spp., providing 1.6 ha revegetation containing species associated with the Banksia Woodlands TEC in the long term.
4	***Receiving environment*** – Describe the current condition of the receiving environment in relation to this factor.	The following is a summary of the flora and vegetation information in the 'Survey for conservation significant flora species and ecological communities, Marriott Rd, Kemerton' (ELA 2018) as per Attachment C. The survey site included the Proposal area as well as a sufficient land surrounding the Proposal area to provide information on environmental values adjacent that could be subject to indirect impacts as well as areas beyond this for local context of occurrence of environmental values. <u>Regional vegetation description</u> The Survey Site, in which the Proposal area occurs, is within the Bassendean Complex-Central and South vegetation complex, as per Vegetation Complex scale by Heddle et al. (1980), which is described as 'Vegetation ranging from woodland of Jarrah-Sheoak-Banksia on the sand dunes to low woodland of Melaleuca spp. and sedgelands on the low-lying depressions and swamps.' At a finer scale, the Survey Site falls within the Bassendean 1000 vegetation system association as defined in Government of Western Australia (2018) being' Bassendean 1000 – Mosaic: Medium forest; jarrah-marri / Low woodland; banksia / Low forest; Tea tree (Melaleuca spp.)'. <u>Local vegetation description</u> One vegetation community (W1) was delineated and mapped within the Survey Site. The W1 vegetation community contains *Eucalyptus marginata*, *Banksia ilicifolia*, *Banksia attenuata* mid open woodland over *Xanthorrhoea preissii*, *Kunzea glabrescens* tall sparse shrubland over mixed weeds. In addition to the W1 community, the boundaries of plantation (P1) and cleared land (CL) were also mapped (**Figure 2**).

		The survey found that W1 shared structural and floristic aspects of the Banksia Woodlands of the Swan Coastal Plain Threatened Ecological Community (Banksia Woodlands TEC), namely *Banksia attenuata* and *Banksia ilicifolia*, listed as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The W1 vegetation community does not support a species-rich native understorey. Rather, weed species dominate and form a contiguous understorey layer, with native species being scattered throughout the community. No other Threatened Ecological Communities (TECs) listed under the EPBC Act or Priority Ecological Communities (PECs) listed by DBCA occur or were inferred to occur with the Survey Site. The Survey Site is highly modified with vegetation condition ranging from Completely Degraded to Good (**Figure 3**). Significant disturbance was noted throughout the survey site and cleared tracks and fields, plantation areas and weed infested understorey vegetation dominated. The W1 vegetation community was conservatively rated as being in Good condition. This rating was solely based on the intact native overstorey structure, with understorey values comprising little conservation value. <u>Flora</u> A total of 28 taxa from 27 genera and 19 families were recorded from within the Proposal area. A complete flora species list is provided in Appendix A of ELA (2018) in Attachment C. The highest number of taxa were found from the Poaceae family with four species recorded. Site data is presented in Appendix B. <u>Conservation significant flora</u> No Threatened flora species as listed under section 178 of the EPBC Act or pursuant to Schedule 1 of the WC Act and as listed by DBCA (2018) or Priority flora species as listed by Western Australian Herbarium (1998-) were recorded within the survey site. Twenty-six conservation significant flora species were initially considered to have the potential to occur within the survey site, however factors such as clearing and grazing make the area unlikely to support any of these species (ELA 2018).
5	***Proposal activities*** – Describe the proposal activities that have the potential to impact the environment	The following activities to be undertaken for the proposal have the potential to impact flora and vegetation: • Clearing of vegetation in the pipeline corridor, or Right of Way (ROW), for pipeline trenching and construction laydown areas and vehicle movement; • Movement of vehicles and machinery along the ROW during construction; • Presence of construction workforce; • Revegetation of the clearing footprint; • Maintenance of running strip over pipeline during operation.

6	***Mitigation*** – Describe the measures proposed to manage and mitigate the potential environmental impacts.	A Construction Environmental Management Plan (CEMP) will be implemented to manage impacts to flora and vegetation including the following measures: • Delineation of clearing boundaries and ongoing monitoring to ensure clearing does no go outside approved footprint is not exceeded • Installation of wind fencing around the perimeter of the proposed clearing area to prevent dust deposition of adjacent vegetation; • Erosion monitoring of the construction ROW; • Dust suppression; and • Groundwater and surface water quality management. An Operational Environmental Management Plan (OEMP) will be implemented to manage ongoing environmental aspects associated with construction that could affect vegetation and flora including: • Maintenance of the grassed running strip over the pipeline • Weed monitoring and control • Unauthorised access management.

7	***Impacts*** – Assess the impacts of the proposal and review the residual impacts against the EPA objective.	<u>Direct impacts to vegetation from clearing</u> The clearing of 2.1 ha for a 30 m wide ROW is anticipated to have the following impacts on vegetation: • loss of 0.87 ha of W1 vegetation community (**Figure 2**). The remainder of the 2.1 ha being cleared consists of 1.23 ha of cleared land and exotic (plantation) vegetation. The vegetation community is also considered to be widespread throughout the surrounding area and ranges from Completely Degraded to Good (**Figure 3**). There will be some fragmentation of the vegetation community as a result of the Proposed Action as the pipeline infrastructure will separate the northern and southern portions. However, it should be noted that this vegetation community is already existing in a highly fragmented environment due to the level of plantation and clearance areas already existing. No Schedule 1 of the WC Act and as listed by DBCA (2018) or Priority flora species as listed by Western Australian Herbarium (1998-) were recorded within or surrounding the Proposal Area. Due to previously cleared areas and grazing, it is unlikely to support any significant flora species. <u>Indirect impacts to vegetation during construction</u> Indirect impacts from weeds, dieback, fire and uncontrolled access will be minimised through application of the relevant measures of the CEMP. DBP has a track record of managing construction impacts effectively on multiple pipeline construction projects. <u>Revegetation</u> Revegetation of all but 5 m width of the 30 m disturbed corridor will result in an area of 1.6 ha of replanted vegetation consisting of Banksia and other Banksia woodland associated species. This vegetation will be sympathetic to the adjacent remnant areas of vegetation. The outcome is a net increase (0.7 ha) native vegetation cover compared to prior to the Proposal. <u>Management of impacts during operation</u> Indirect impacts from weeds and uncontrolled access will be minimised through application of the relevant measures of the OEMP. DBP has a track record of managing operational aspects of its pipeline maintenance including on the adjacent DBNGP. DBP will maintain the 5 m wide running strip such that it is not a vector for weed infestation in adjacent revegetation. The clearing of this small area of vegetation and management of indirect impacts from construction and operation will ensure the EPA's objective for this factor is met.
8	***Assumptions*** - Describe any assumptions critical to your assessment e.g. particular mitigation measures or regulatory conditions .	DBP will achieve successful revegetation within the proposed corridor. This assumption is based on DBP's previous revegetation experience within construction corridors.

1	***EPA Factor***	**Terrestrial fauna**
2	***EPA policy and guidance*** - What have you considered and how have you applied them in relation to this factor?	<u>EPA Objective</u> To protect terrestrial fauna so that biological diversity and ecological integrity are maintained. <u>Policy and Guidance</u> Environmental Factor Guideline: Terrestrial Fauna (EPA 2016c) has formed the basis of the following assessment of potential environmental impacts. A targeted black cockatoo habitat assessment was undertaken according to the Department of Sustainability, Environment, Water, Population and Communities (DSEWPAC 2012) Environment Protection and Biodiversity Conservation Act 1999 referral guidelines for three threatened black cockatoo species: Carnaby's cockatoo (endangered) *Calyptorhynchus latirostris*; Baudin's cockatoo (vulnerable) *Calyptorhynchus baudinii*; Forest red-tailed black cockatoo (vulnerable) *Calyptorhynchus banksii naso*. Australian Government. The assessment incorporated: • A vegetation assessment to identify potential black cockatoo foraging species; and • A significant tree assessment to identify any trees with the potential to be utilised by black cockatoos for breeding. Historical fauna studies supporting the Kemerton Strategic Industrial Area (KSIA) Over-arching Environmental Management Plan (EMP) (ELA 2015) have considered EPA guidance requirements for fauna surveys.
3	***Consultation*** – Outline the outcomes of consultation in relation to the potential environmental impacts	DBP has consulted with LandCorp (the landowner), Albemarle (the operator of the proposed Lithium Plant), and the Commonwealth Department of Environment and Energy (DOEE) regarding management of potential environmental impacts. In doing so, the need to minimise impacts to features of higher environmental value were identified. As a result, DBP have modified the proposed pipeline alignment to: • Minimise the length of the pipeline and therefore reduced the area of habitat to be cleared • Reduced impacts and clearance to foraging habitat for threatened cockatoo species • Avoid mature potential habitat trees. Consultation with the DOEE also resulted in DBP determining to replant all areas with native vegetation including land currently cleared or plantation. As such, all but 5 m of the 30 m wide corridor will be replanted with native flora species, mostly Banksia spp., providing 1.6 ha revegetation containing foraging species for threatened cockatoo species in the long term.

4	***Receiving environment*** – Describe the current condition of the receiving environment in relation to this factor.	The following is a summary of the fauna and fauna habitat information in the 'Survey for conservation significant flora species and ecological communities, Marriott Rd, Kemerton' (ELA 2018) and the KSIA Over-arching EMP (ELA 2015). <u>Fauna</u> A total of 103 species of vertebrate fauna including 56 birds, 10 mammals, 21 reptiles, five frogs and six introduced species have been recorded at the KSIA. This includes a total of 11 Conservation Significant and six Priority fauna species listed under the EPBC Act and/or the WC Act. Of these, three were identified to potentially occur, being Forest Red-tailed Black-Cockatoos [FRTBC], Baudin's Black- Cockatoos [BBC] and Carnaby's Black-Cockatoos [CBC]). No other conservation significant fauna species were considered likely to occur within the survey site (ELA 2018). <u>Fauna habitat types</u> Vegetation community W1, represents a woodland fauna habitat that would be utilised by a number of species. P1 represents Plantations and there is also Pasture with remnant trees (**Figure 4**). The desktop assessment found that no other conservation species would have utilised the proposal area, however there will still be a range of terrestrial fauna species. <u>Black Cockatoo Habitat</u> Foraging habitat for Black Cockatoos is generally defined as the availability of plant food sources within an area (Finn 2012). The quality of foraging habitat for black cockatoo species within the survey site has been assessed based on the availability and density of plant food sources as observed on site. Vegetation associations W1 is suitable for all three species of Black Cockatoo (**Figure 5, Figure 6** and **Figure 7**). P1 is suitable foraging habitat for CBC and BBC (**Figure 5** and **Figure 6**). No signs of foraging were observed during the survey. Black Cockatoo Foraging habitat quality varies within the Survey Site and for each species: • Carnaby's Black-Cockatoo o High: 5.87 ha o Low: 0.24 ha • Baudin's Black-Cockatoo o High: 1.97 ha o Low: 3.26 ha • Forest Red-tailed Black-Cockatoo o Low: 3.06 ha 'Breeding habitat' for black cockatoos is defined in DSEWPaC (2012) as trees of species known to support breeding within the range of the species which either have a suitable nest hollow or are of a suitable DBH to develop a nest hollow (> 300 mm for salmon gum and wandoo, and >500 mm for other species). Trees of this size may also be large enough to provide roosting habitat (i.e. trees which provide a roost or rest area for the birds). 20 potentially significant trees were identified within the survey site, four of which are pines that are only suitable as potential roosting habitat (**Figure 5, Figure 6** and **Figure 7**). No trees within the survey site contained a hollow of sufficient size to be utilised by black cockatoos for breeding purposes.

5	***Proposal activities*** – Describe the proposal activities that have the potential to impact the environment	The following activities to be undertaken for the proposal have the potential to impact flora and vegetation: • Clearing of habitat prior for pipeline trench and construction space; • Excavation and opening of a pipeline trench to a nominal depth of 1.2 m (depending on the requirements of the pipe); • Movement of vehicles and machinery along ROW during construction; • Presence of construction workforce; • Revegetation of the clearing footprint; and • Maintenance of running strip over pipeline during operation
6	***Mitigation*** – Describe the measures proposed to manage and mitigate the potential environmental impacts.	A CEMP will be implemented to manage impacts to fauna including the following measures: • Trench management procedures; • Habitat tree avoidance measures; • Fauna spotting before clearing; • Removal of fauna and checking cleared vegetation; • Erosion management of the site; and • Dust suppression. Trench management involves the following: • Construction activities involving excavations shall be timed to occur in dry conditions as much as possible; • The maximum length of the open trench will not exceed the length capable of being practically inspected and cleared by teams of fauna spotters/catchers; • Fauna shelters and ramps shall be installed to allow egress by fauna; and • Trenches shall be inspected by construction crews half an hour prior to backfilling and if trapped fauna are present, a fauna handler will be notified and engaged to assist, prior to backfilling. The length of trench open at any one time will not exceed 670 m for 10 days. Operational Environmental Management Plan (OEMP) will be implemented to manage ongoing environmental aspects associated with operations that could affect fauna including: • Maintenance of the grassed running strip over the pipeline. • Unauthorised access management. • Erosion management and control. • Fire prevention and control.

7	***Impacts*** – Assess the impacts of the proposal and review the residual impacts against the EPA objective.	<u>Impact of clearing on terrestrial fauna</u> The clearing of vegetation is anticipated to result in the loss of 2.1 ha native habitat. The clearing of native vegetation will result in the progressive movement of fauna into areas outside of the Proposal Area. There is potential for some loss of fauna during construction, so fauna spotters will be on hand to aide in the removal of fauna when possible, to limit the potential loss. <u>Impact of clearing on threatened cockatoo species</u> The estimated impacts to cockatoo foraging habitat are the removal of: • 1.28 ha of high quality and 0.04 ha of low-quality foraging habitat of CBC. • 0.41 ha of high quality and 0.86 ha of low-quality foraging habitat of BBC. • 0.83 ha of low-quality foraging habitat of FRTBC. The loss of this extent of foraging habitat is not considered to be significant given the availability of food source for the Black Cockatoos within 2,550 ha of DBCA managed land within 5 km of the Proposal Area. The long-term impact of this removal will be further mitigated by the revegetation of 1.6 ha of low to moderate quality habitat in excess of the area of habitat cleared. There are two trees within the Proposal Area with the potential to provide breeding habitat for all three species of black cockatoos (1 *Corymbla calophylla* and 1 *Eucalyptus,* **Figure 5, Figure 6** and **Figure 7**). These trees lack active breeding evidence and the presence of conservation reserves and managed areas regionally reduces the significance of potential indirect impacts from construction. Nevertheless, they are to be avoided during construction. No known nesting sites are affected by this Proposal There are no known roosting trees location within the Proposal Area (**Figure 5, Figure 6** and **Figure 7**).. <u>Management of impacts from trench excavation</u> As the native vegetation is progressively cleared, a trench will be dug for the installation of the pipeline in accordance with pre-defined depths of burial, approximately 1.2 m deep, however these may vary where necessary to protect the pipe. Trenching can result in fauna becoming trapped as a result of falling in open trench excavations. To limit the impact of the trench, the CEMP fauna handling measures shall be implemented and followed. <u>Indirect impacts to fauna during construction</u> Indirect impacts from fire and uncontrolled access will be minimised through application of the relevant fauna management measures of the CEMP. DBP has a good track record of managing potential construction impacts on fauna effectively on multiple pipeline construction projects. <u>Revegetation</u> Revegetation of all but 5 m width of the 30 m disturbed corridor will result in an area of 1.6 ha of replanted vegetation consisting of Banksia and other Banksia woodland associated species. This vegetation will be sympathetic to the adjacent remnant areas of habitat. The outcome is a net increase (0.7 ha) habitat compared to prior to the Proposal, able to be utilised by fauna including threatened cockatoo species for foraging. <u>Management of impacts during operation</u> Indirect impacts from uncontrolled access will be minimised through application of the relevant measures of the OEMP. DBP has a track record of managing operational aspects of its pipeline maintenance including on the

		adjacent DBNGP. DBP will maintain the 5 m wide running strip such that it is not a vector for weed infestation or fire in adjacent revegetation. The 5 m wide running strip will have a local effect on habitat fragmentation through the small remnant area of Banksia woodland. This is considered to be mitigated by the net increase (0.7 ha) in woodland habitat from revegetation of areas currently cleared. The clearing of this small area of habitat, combined with net increase in vegetation from revegetation activities, and management of indirect impacts from construction and operation will ensure the EPA's objective for this factor is met.
8	***Assumptions*** - Describe any assumptions critical to your assessment e.g. particular mitigation measures or regulatory conditions.	DBP will achieve successful revegetation within the proposed corridor. This assumption is based on DBP's previous revegetation experience within construction corridors.
1	***EPA Factor***	**Terrestrial Environmental Quality**
2	***EPA policy and guidance*** - What have you considered and how have you applied them in relation to this factor?	<u>EPA Objective</u> To maintain the quality of land and soils so that environmental values are protected <u>Policy and Guidance</u> Environmental Factor Guideline: Terrestrial Environmental Quality (EPA 2016d) has been used as the basis for the environmental impact assessment. The following guidance has been referred to in considering management of impacts from acid sulfate soils: • Western Australia Planning Commission (WAPC) *Acid Sulfate Soils Planning Bulletin No. 64* (WAPC 2009a); and • WAPC Acid Sulfate Soils Planning Guidelines (WAPC 2009b).
3	***Consultation*** – Outline the outcomes of consultation in relation to the potential environmental impacts	DBP has consulted with LandCorp (the landowner), Albemarle (the operator of the proposed Lithium Plant), and the Commonwealth Department of Environment and Energy (DOEE) regarding management of potential environmental impacts.

4	***Receiving environment*** – Describe the current condition of the receiving environment in relation to this factor.	The Proposal Area is in portion of the KSIA that is heavily disturbed land comprised of remnant native vegetation and land historically for activities such as pine plantations and grazing. The land has historically been used for agriculture, plantation and now zoned for industrial use. Significant disturbance was noted throughout the survey site and cleared tracks, fields and plantation areas. The Proposal Area comprises low hilly, to gently undulating terrain situated on the Bassendean Dune System (Gozzard 1982). The Bassendean Dune System is generally composed of well-drained and weathered white-grey quartz sand, which form coarse-textured soils that are poor in nutrients (Gozzard 1982). Acid sulfate soils (ASS) occur naturally in Western Australia and are not considered an issue when left in a waterlogged, undisturbed environment. Preliminary desktop assessment shows that Potential Acid Sulfate Soils (PASS) range from moderate to low with small pickets of high. • KP 0 to KP 0.016 - High to moderate risk • KP 0.016 to KP 0.600 - Moderate to low risk • KP 0.600 to KP 0.660 - High to moderate risk. The nearest population centres are Bunbury (17 km away) and Harvey (21 km away).
5	***Proposal activities*** – Describe the proposal activities that have the potential to impact the environment	PASS can be disturbed through construction and clearing causing oxidisation of the iron sulfides in the soil resulting in iron compounds and sulfuric acid spreading through the surrounding environment and waterways. The following activities to be undertaken for the proposal have the potential to impact ASS: • Construction of the pipeline trench to a depth of 1.2 m depending on the requirements of the pipe.; No dewatering is proposed for this Proposal. If dewatering is required then this shall be incorporated into the Acid Sulfate Soil Management Plan.
6	***Mitigation*** – Describe the measures proposed to manage and mitigate the potential environmental impacts.	An Acid Sulfate Soil Management Plan (ASSMP) and CEMP will be implemented to manage ASS related issues including the following measures: • Minimisation of soil excavation period; • Segregation of excavated soils; • Stockpiling erosion controls; • Trench spoil stockpiling; • Field screening of soil material for pH and titratable acidity (TTA); • Laboratory analysis of soil samples; • Treatment of soils prior to placement back in trench.

7	***Impacts*** – Assess the impacts of the proposal and review the residual impacts against the EPA objective.	Oxidation of PASS material can result in generation of ASS. The generation of ASS can result in the release of sulphuric acid and iron into the soil and groundwater. If acid sulfates are mobilised the acid can release aluminium, nitrates and other heavy metals. This can in turn cause degradation to vegetation, flora, fauna and can also degrade built form such as concrete or steel pipes. The long-term changes in soil chemistry will reduce the biodiversity and cause potential land sterilisation. The excavation of the nominally 1.2 m deep trench (depending on the requirements of the pipe) to install the pipeline has the potential to expose PASS/ASS and for ongoing associated issues following replacement of exposed material back into the trench following pipeline placement. Preliminary sampling will be undertaken prior to any excavation to confirm high to moderate risk areas within the Proposal Area. Soil segregation of the excavated soil will allow on site inspections to be undertaken and for samples to be provided for laboratory analysis if required. If any ASS is found through the sampling and Laboratory analysis, the soil will be treated accordingly prior to filling in of the pipeline trench. This will be set out in the ASSMP. With mitigation there is unlikely to be acid generation from exposed soils throughout the Proposal Area. The EPA's objective for Terrestrial Environmental Quality will therefore be met.
8	***Assumptions*** - Describe any assumptions critical to your assessment e.g. particular mitigation measures or regulatory conditions.	DBP will achieve successful PASS/ASS management of the Proposal Area based on DBP's previous experience of managing PASS/ASS issue in pipeline construction. The implementation of previous ASSMP has shown that DBP have a working knowledge of construction in similar environments.
1	***EPA Factor***	Inland Waters
2	***EPA policy and guidance - What have you considered and how have you applied them in relation to this factor?***	<u>EPA Objective</u> To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected <u>Policy and Guidance</u> Environmental Factor Guideline: Inland Waters (EPA 2016e) has been used as the basis for the environmental impact assessment.
3	***Consultation – Outline the outcomes of consultation in relation to the potential environmental impacts***	DBP has consulted with LandCorp (the landowner), Albemarle (the operator of the proposed Lithium Plant), and the Commonwealth Department of Environment and Energy (DOEE) regarding management of potential environmental impacts. In doing so, the need to minimise impacts to features of higher environmental value including wetlands were identified. As a result, DBP have ensure the proposed pipeline alignment does not affect the nearby Resource Enhancement wetland.

4	***Receiving environment –*** *Describe the current condition of the receiving environment in relation to this factor.*	The Proposal Area is in the (KSIA), in a portion of the KSIA which is heavily disturbed land comprised of remnant native vegetation and land historically for activities such as pine plantations and grazing. All three management categories of wetlands occur within the KSIA more broadly, including Conservation Category Wetlands (CCW), Resource Enhancement Category Wetlands (REW) and Multiple Use Wetland (MUW). The suite of wetlands within the KSIA is regarded as one of the largest remaining aggregations of relatively undisturbed wetlands within the Swan Coastal Plain (ELA 2015). The Proposal Area is also adjacent to a Kemerton REW, approximately 5 m to the east, and unnamed REWs 35 m to the south and 300 m north (**Figure 8**). The proposed alignment has been designed to avoid the REWs. The Proposal Area intersects an area classified as a MUW sumpland (**Figure 8**). A sumpland is defined as an area that is seasonally inundated. The MUW is classified as Completely Degraded to Degraded and having previously been used for pasture and grazing, is not considered a good representation of a wetland within the surrounding area. Management objectives of MUW's relate to ecologically sustainable development and the application of best management practices in catchment planning in the use, development and management of these wetlands (DPaW 2013). Wetlands designated as Multiple Use do not have requirements such as implementation of buffers which may be associated with other management categories such as Conservation and Rehabilitation potential.
5	***Proposal activities –*** *Describe the proposal activities that have the potential to impact the environment*	The following activities to be undertaken for the proposal have the potential to impact wetlands: • Clearing of wetland associated vegetation for pipeline trench and construction laydown space; • Disturbance of wetland associated soils during earthworks and excavation of pipeline trench to a depth of 1.2 m depending on the requirements of the pipe. • Exposure of PASS/ASS Potential Acid Sulfate soils during excavation; • Changes to wetland hydrology from permanent placement of pipeline within sumpland. • Spills of hazardous materials during construction • Revegetation of the clearing footprint; and • Maintenance of running strip over pipeline during operation. No Dewatering is proposed within the Proposal Area.
6	***Mitigation –*** *Describe the measures proposed to manage and mitigate the potential environmental impacts.*	A CEMP and an ASSMP will be implemented to manage impacts to wetlands including the following measures: • Delineation of all clearing boundaries in the field and restricting clearing to that which is necessary; • ASS/PASS management measures ; and • Spill prevention and response measures. The proposed alignment has been designed to avoid any REWs and there are no foreseeable direct impacts to these wetlands.

7	***Impacts –*** *Assess the impacts of the proposal and review the residual impacts against the EPA objective.*	<u>Clearing of wetland vegetation</u> The placement of the Proposal in this area of the KSIA has potential to cause direct and indirect impacts to wetlands. In considering location, DBP have designed the proposed alignment of the pipeline to avoid direct disturbance to the surrounding REWs. The Proposal Area does sit within a degraded sumpland MUW and impacts to the W1 vegetation community within the MUW sumpland is addressed under 'Flora and Vegetation' factor. <u>Disturbance of soils from excavation</u> Construction will cause physical disturbance of the MUW, through excavation of the trench. This is not considered to be a significant impact as the depth of excavation is nominally low and such works are not inconsistent with the MUW management category. If acid sulfates are mobilised, the acid can release aluminium, nitrates and other heavy metals. This can in turn cause degradation to the wetlands. PASS/ASS management and impact evaluation is addressed in detail under Terrestrial Environmental Quality. Application of such management measures should ensure nearby REWs are not affected. <u>Changes to wetland hydrology</u> The avoidance of the REWs outside of the alignment should ensure their hydrology is not affected. The placement of a buried pipeline has the potential to alter the hydrology to the MUW sumpland in the short term, construction phase only, through its interference with sub-surface groundwater flow across its length within the wetland. However, this is unlikely to be a significant impact as replaced material into the pipeline trench will not compacted and should ensure ongoing through-flow of water. <u>Management of hazardous materials</u> Construction has the potential to release liquid waste, spills and leaks of hydrocarbons and the release of hazardous materials, resulting in contamination of any potential wetlands and therefore other surface water systems and groundwater. The CEMP will include spill prevention and response measures and hazardous materials control. As such impacts to the nearby REWs will be avoided. <u>Revegetation</u> Revegetation of all but 5 m width (running strip) of the 30 m disturbed corridor will result in an area of 1.6 ha of replanted vegetation consisting of Banksia and other Banksia woodland associated species. This vegetation will be sympathetic to nearby wetland environments. Through the implementation of the CEMP and ASSMP and the correct proposed alignment of the pipeline, there are no likely significant impacts to the wetlands. The EPA's objective for Inland Waters will therefore be met.
8	***Assumptions -*** *Describe any assumptions critical to your assessment e.g. particular mitigation measures or regulatory conditions.*	DBP will achieve successful construction of the pipeline within the proposed corridor, while avoiding impacts to the wetlands. This assumption is based on DBP's previous experience with construction within and adjacent to wetland areas.

Part C: Other approvals and regulation

State and Local Government approvals

Is rezoning of any land required before the proposal can be implemented? If yes, please provide details.	☐ Yes ✓ No
If this proposal has been referred by a decision-making authority, what approval(s) are required from you?	

Please identify other approvals required for the proposal:

Proposal activities e.g. clearing, dewatering, mining, processing, dredging	**Land tenure/access** e.g. Crown land, Mining lease, specify legislation for access if relevant	**Type of approval** e.g. Native Vegetation Clearing Permit, licence, mining proposal,	**Legislation regulating the activity** e.g. *EP Act 1986* – Part V, *RiWI Act 1914*, *Mining Act 1979*
Pipeline construction	Pipeline Licence - easement	Pipeline Licence Environmental Approval (DMIRS) Safety Case Approval Technical Approvals – consent to construct and consent to operate	*Petroleum Pipelines Act 1969* (and associated regulations)
Clearing	Pipeline license area	Native Vegetation Clearing Permit	*Environmental Protection (Clearing of Native Vegetation) Regulations 2004*

Commonwealth Government approvals

Does the proposal involve an action that may be or is a controlled action under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)?	✓ Yes ☐ No
Has the proposed action been referred? If yes, when was it referred and what is the reference number (EPBC No.)?	☐ Yes ✓ No Date: _____ EPBC No.: *To be confirmed*_____
If referred, has a decision been made on whether the proposed action is a controlled action? If 'yes', check the appropriate box and provide the decision in an attachment.	☐ Yes ✓ No ☐ Decision – controlled action ☐ Decision – not a controlled action
If the proposal is determined to be a controlled action, do you request that this proposal be assessed under the bilateral agreement or as an accredited assessment?	☐ Yes - Bilateral ☐ No ☐ Yes - Accredited
Is approval required from other Commonwealth Government/s for any part of the proposal? *If yes, describe.*	☐ Yes ✓ No Approval:

References:

Department of Biodiversity Conservation and Attractions (DBCA). 2018. *Wildlife Conservation (Threatened Flora) Notice 2017*. Available from: https://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-species/Listings/fauna_notice.pdf. Accessed September 2018

Department of Parks and Wildlife (DPaW). 2013. *A Methodology for the Evaluation of Specific Wetland Types on the Swan Coastal Plain, Western Australia*. Draft document published by Department of Parks and Wildlife August 2013.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC). 2012. *Environment Protection and Biodiversity Conservation Act 1999 referral guidelines for three threatened black cockatoo species: Carnaby's cockatoo (endangered) Calyptorhynchus latirostris; Baudin's cockatoo (vulnerable) Calyptorhynchus baudinii; Forest red-tailed black cockatoo (vulnerable) Calyptorhynchus banksii naso*. Australian Government.

Eco Logical Australia 2015. *Kemerton Strategic Industrial Area: Overarching Environmental Management Plan*. Prepared for LandCorp

Eco Logical Australia 2018. *Survey for conservation significant flora species and ecological communities Marriot Rd, Kemerton.* Prepared for DBH

Environmental Protection Authority (EPA). 2016a. *Environmental Factor Guideline – Flora and Vegetation.* Perth, Western Australia.

Environmental Protection Authority (EPA). 2016b. *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment*. Perth, Western Australia

Environmental Protection Authority (EPA). 2016c. *Environmental Factor Guideline – Terrestrial Fauna.* Perth, Western Australia.

Environmental Protection Authority (EPA). 2016d. *Environmental Factor Guideline – Terrestrial Environmental Quality.* Perth, Western Australia.

Environmental Protection Authority (EPA). 2016d. *Environmental Factor Guideline – Inland Waters.* Perth, Western Australia

Finn, H. 2012. *Assessment of habitat values for black-cockatoos within selected sites at Newmont Boddington Gold Mine*. Report prepared for Newmont Boddington Gold Pty Ltd.

Government of Western Australia. 2018. SLIP Enabler. Available from: https://www2.landgate.wa.gov.au/web/guest/downloader

Gozzard, J.R. 1982. *Perth Metropolitan Region Environmental Geology Series*. Geological Survey of Western Australia, Perth.

Heddle, E.M., Loneragan D.W., & Havel J.J. 1980. 'Vegetation complexes of the Darling System, Western Australia', in: *Atlas of natural resources of the Darling System, Western Australia*. Perth, Western Australia

Salama et al 2005

Western Australian Herbarium. 1998-. *FloraBase – the Western Australian Flora.* Available from: https://florabase.dpaw.wa.gov.au/. Accessed August 2018

Western Australian Planning Commission (WAPC). January 2009. Planning Bulletin 64/2009 Acid Sulfate Soils. (WAPC 2009a).

Western Australian Planning Commission (WAPC). January 2009. Acid Sulfate Soils Planning Guidelines. (WAPC 2009b).

ATTACHMENT A – Key characteristics of proposal

Table 1: Summary of the proposal

Proposal title	DBNGP to Albemarle Lithium Plant Gas Pipeline Proposal
Proponent name	DBNGP (WA) Nominees Pty Limited
Short description	A 670 m long pipeline to connect the existing Dampier to Bunbury Natural Gas Pipeline (DBNGP) infrastructure westwards to the Albemarle Kemerton Plant, a lithium hydroxide manufacturing plant located in Kemerton, Western Australia, approximately 17 km north-east of Bunbury. The pipeline will facilitate the connection of natural gas to the lithium hydroxide manufacturing plant. The proposed pipeline alignment will be approximately 30 m wide, with nominally 15 m cleared of vegetation either side of the pipeline centreline. A trench will be excavated, with topsoil and vegetative material placed aside, where appropriate for reuse, and a pipeline laid and then covered. A 5 m wide permanent 'running strip' will be left along the corridor over the pipeline with the remainder of the 25 m width revegetated, utilising available recovered topsoil and vegetative materials, with native flora species.

Table 2: Location and proposed extent of physical and operational elements

Element	Location	Proposed extent
Physical		
Construction Right of Way (ROW)	West of existing DBNGP	670 m x 30 m (2.1 ha)
Excavated trench	Within ROW	670 m long at nominal 1.2 m depth
Buried gas pipeline	Within ROW	670 m with diameter of 8" pipeline

ATTACHMENT B – Figures

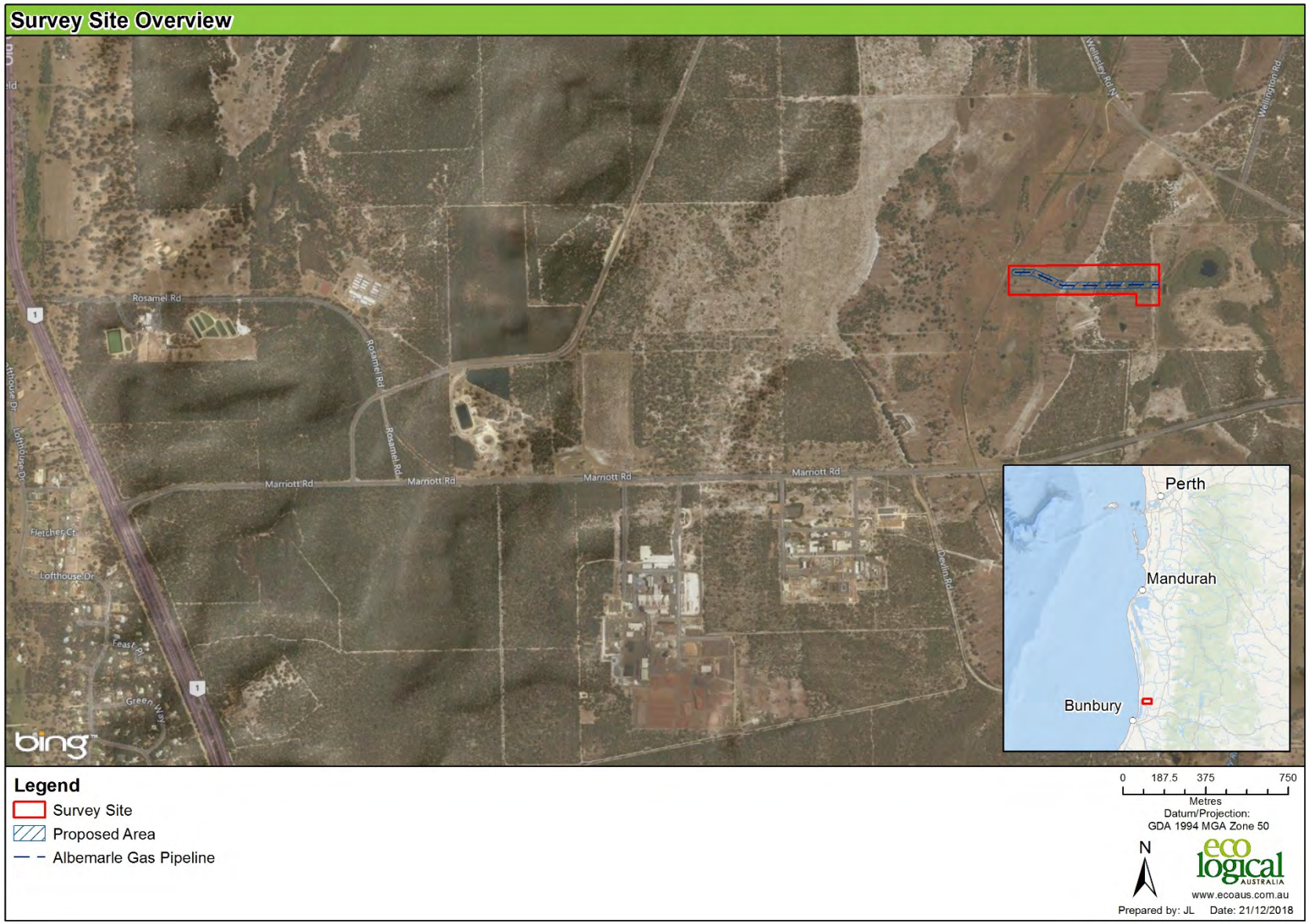


Figure 1: Site Overview

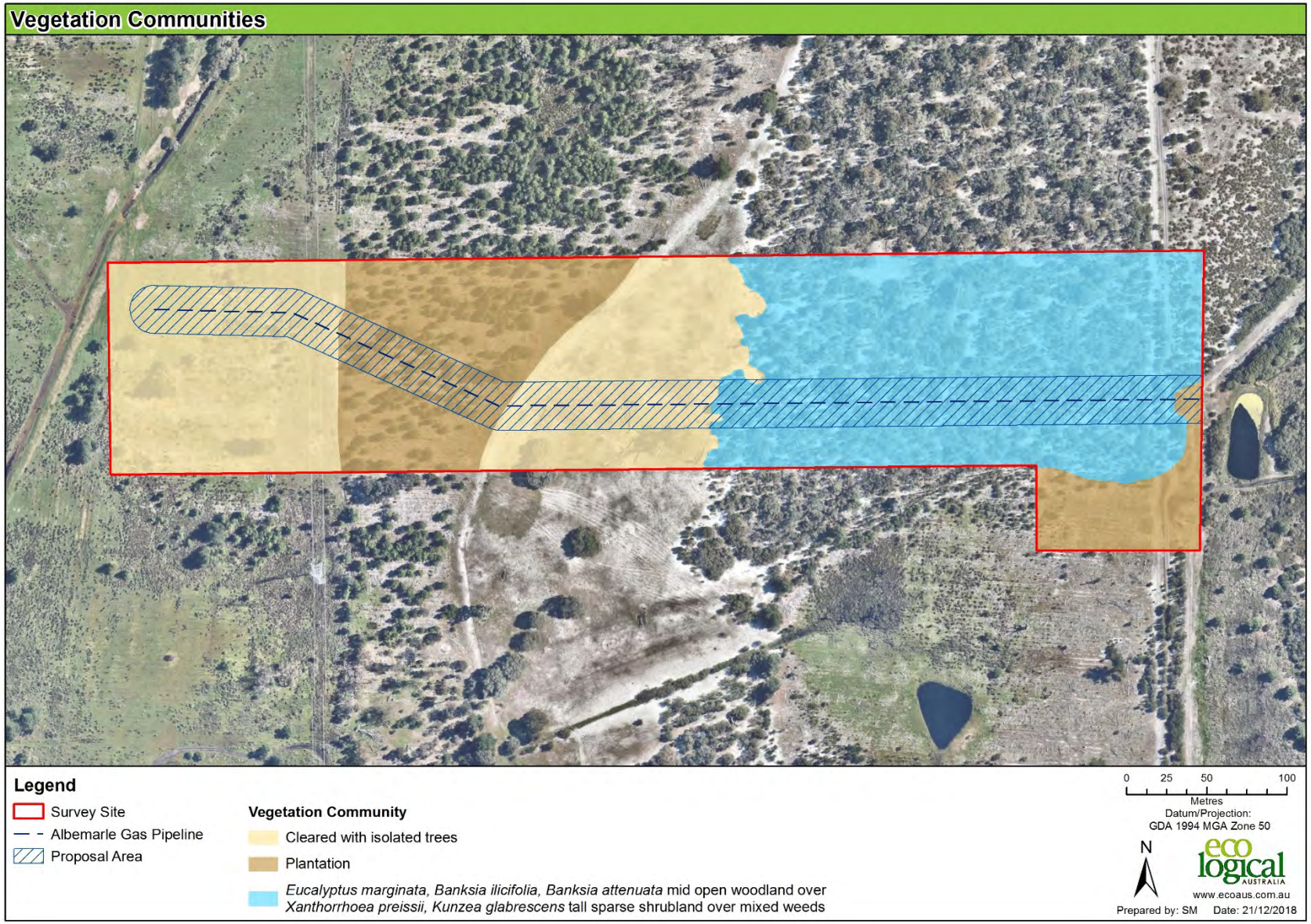


Figure 2: Vegetation communities within the Proposal Area

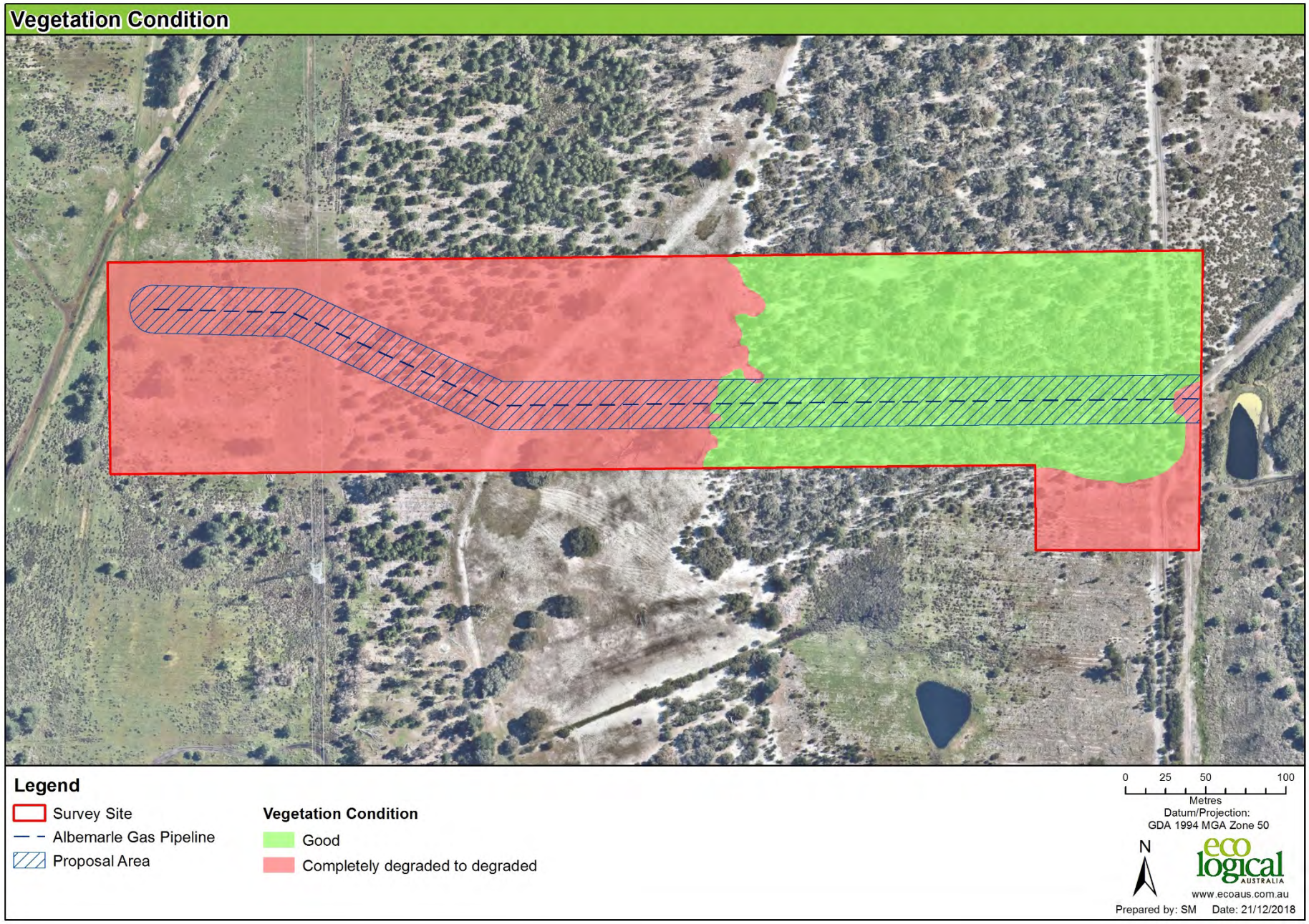


Figure 3: Vegetation condition of the Proposal Area

Figure 4: Fauna habitat of the Proposal Area

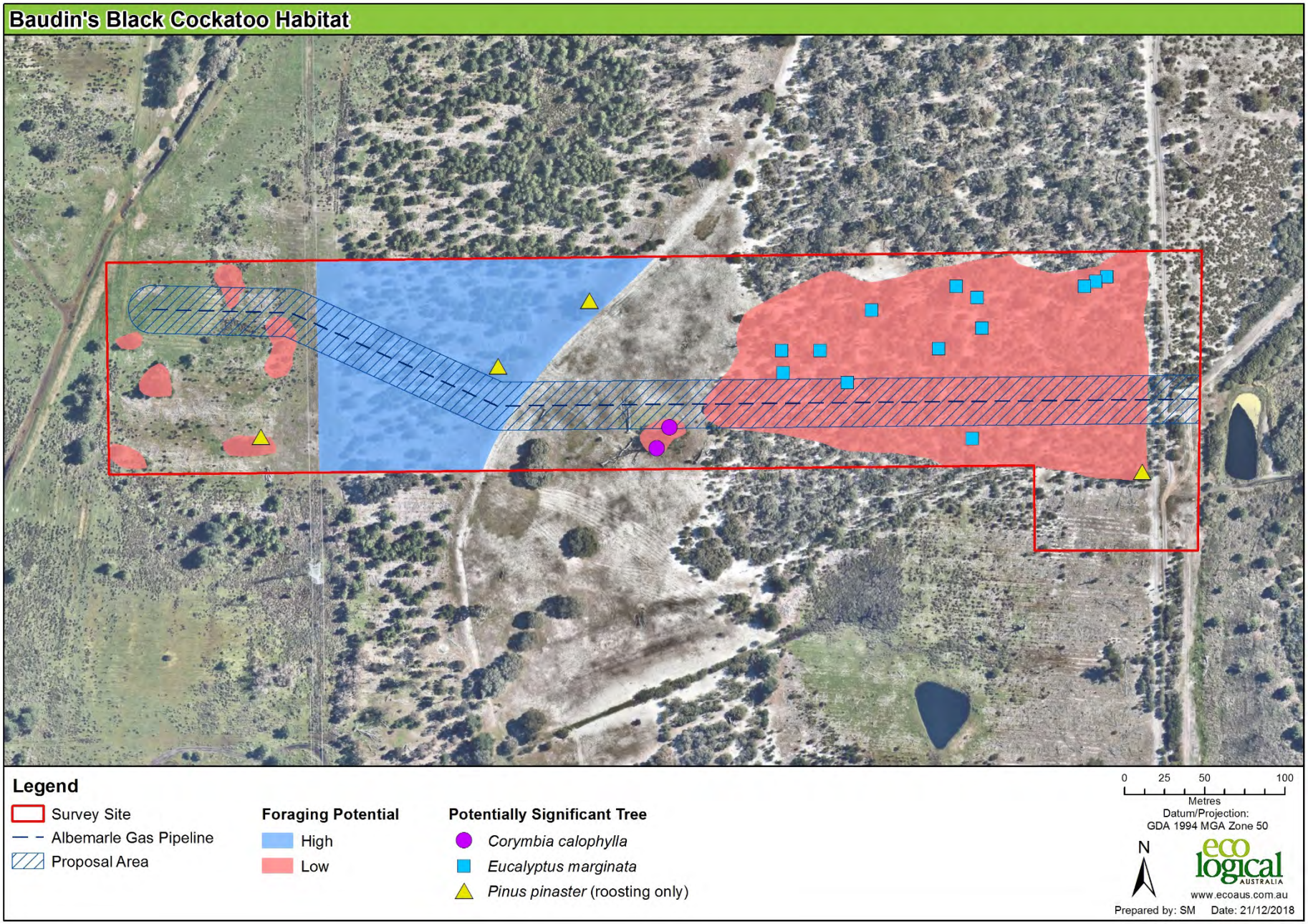


Figure 5: Baudin's Black Cockatoo Habitat

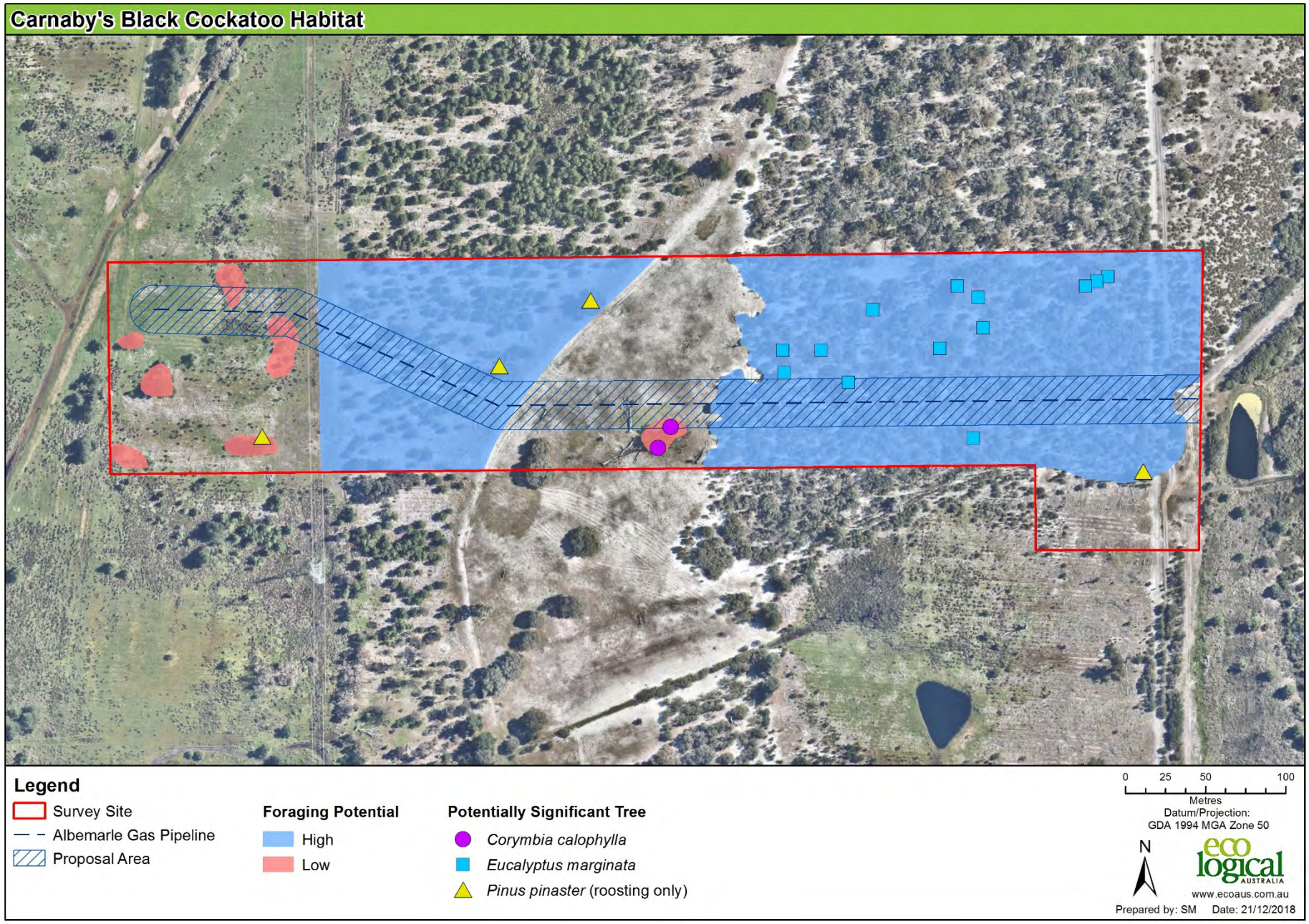


Figure 6: Carnaby's Black Cockatoo Habitat

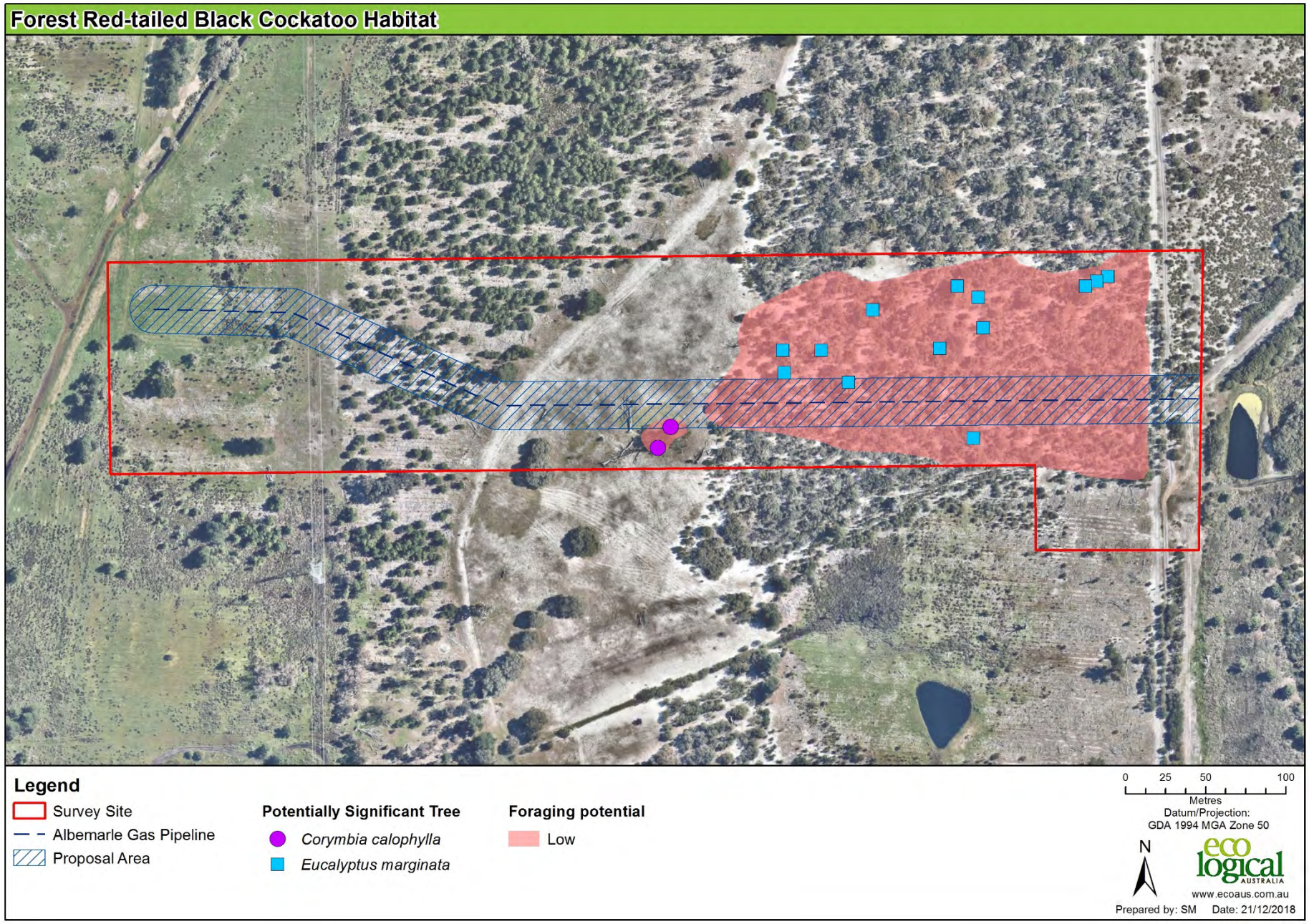


Figure 7: Forest Red-tailed Black Cockatoo Habitat

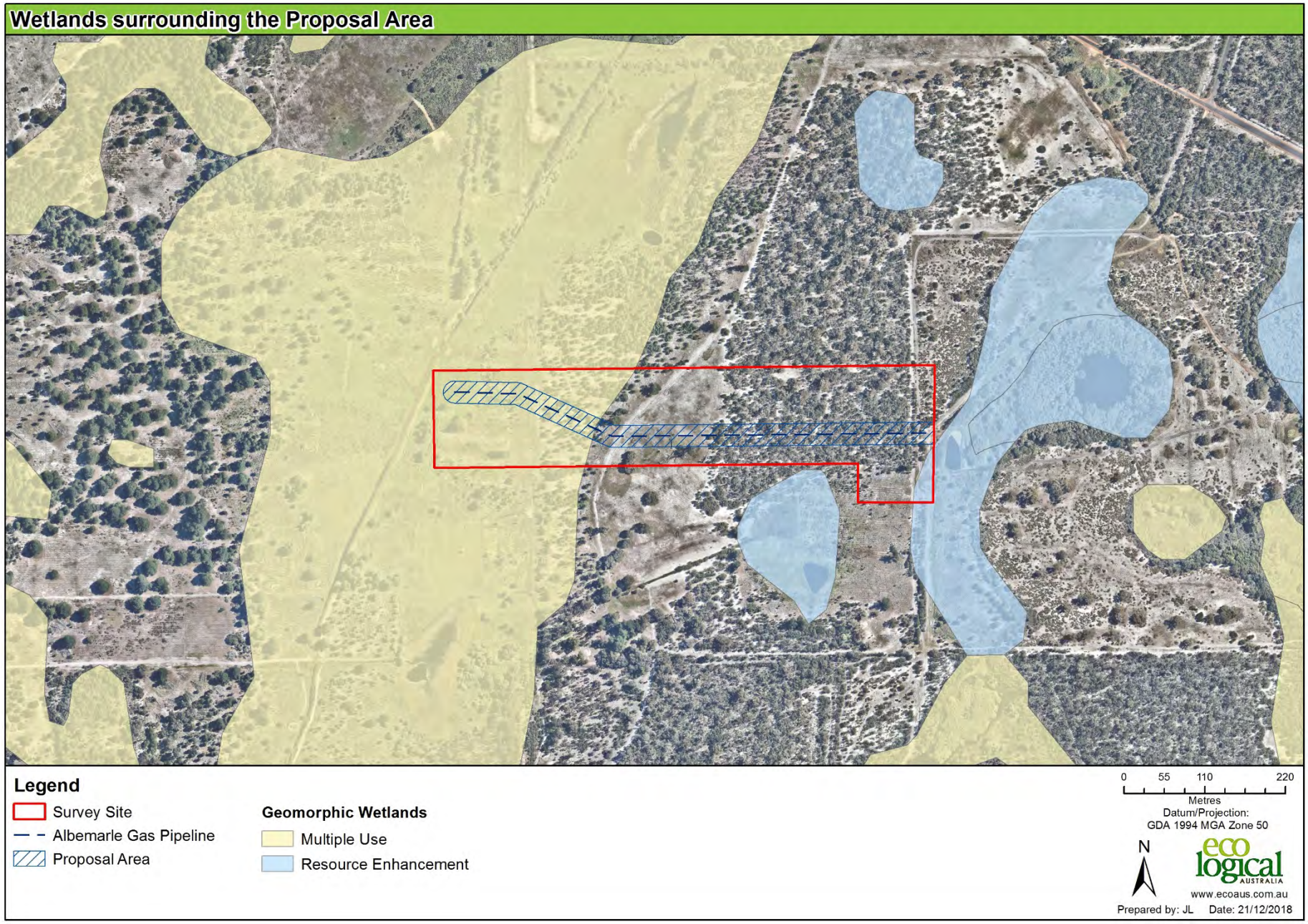


Figure 8: Wetlands surrounding the Proposal Area

ATTACHMENT C - Survey for conservation significant flora species and ecological communities, Marriott Rd, Kemerton

Published July 2018

ECO LOGICAL AUSTRALIA PTY LTD
ABN 87 096 512 088
www.ecoaus.com.au

MEMORANDUM

TO	Neil Parry – Manager, Land Management – Dampier Bunbury Pipeline
FROM	Jeff Cargill, Daniel Panickar and Warren McGrath
DATE	7 November 2018
SUBJECT	**Survey for conservation significant flora species and ecological communities, Marriott Rd, Kemerton**

Eco Logical Australia (ELA) undertook a survey for species and communities that are Matters of National Environmental Significance (MNES) or conservation significant (Threatened/Priority) at a State level within a proposed pipeline corridor (the survey site) located in the Kemerton Industrial Area in Wellesley, Western Australia (**Figure 1**).

The objectives of the survey were to:

- Undertake targeted surveys for Threatened flora species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), State *Wildlife Conservation Act 1950* (WC Act) and Priority flora species as listed by Western Australian Herbarium (1998-);
- Undertake an assessment for the presence of the Banksia Woodlands of the Swan Coastal Plain Threatened Ecological Community (TEC), listed under the EPBC Act; and
- Undertake a Black Cockatoo habitat assessment in accordance with the Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) EPBC Act Referral Guidelines for three threatened Black Cockatoo species (2012).

Methodology

Desktop review and likelihood of occurrence

Prior to the survey, ELA conducted a desktop assessment to gather information on potentially occurring conservation listed flora, vegetation and fauna within the survey site. The following databases were searched:

- Commonwealth EPBC Act Protected Matters Search Tool (PMST) for Threatened species and communities listed under the EPBC Act (DotEE 2018a); and
- DBCA and WA Museum's NatureMap (DBCA 2007 – 2018).

A 10 km buffer around the survey site was used for each of the above database searches. This buffer is considered suitable based on flora and fauna assemblages expected to occur within the survey site. An initial twenty-six conservation listed flora taxa were identified as possibly occurring within the survey site based on database searches.

Survey Site Overview

Legend

- Survey Site
- Albemarle Gas Pipeline

0 250 500 1,000

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

N

eco logical AUSTRALIA

www.ecoaus.com.au

Prepared by: SM Date: 2/11/2018

Survey team and timing

The survey was conducted on 19 October 2018 by Dr. Jeff Cargill (Senior Ecologist). The flora survey was conducted in accordance with the Environmental Protection Authority (EPA) *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016a). The Black cockatoo habitat assessment was undertaken in accordance with the Department of the Environment and Energy's (DotEE) *EPBC Act Referral Guidelines for Three Threatened Black Cockatoo Species* (DSEWPaC 2012).

Based on climate data from the nearby Bureau of Meteorology (BoM) Brunswick Junction Weather Station (Station number 9513, rainfall data 1909 – current, approximately 8.3 km south-east of the survey site), a total of 660 millimetres (mm) of rainfall was received between May and September 2018, which is below the annual average rainfall of 771.2 mm for the same period (BoM 2018). Notwithstanding the below average rainfall, the weather conditions were considered suitable for survey as the amount and timing of rainfall resulted in sufficient material present (flowering herbs) at the time of the survey.

Flora, vegetation and black cockatoo survey

The desktop review, including review of aerial imagery and database searches, informed the approximate number of sites required to describe vegetation communities within the survey site. In addition, a foot-traverse of the site aided in further refining site locations. Three quadrats were established across the survey site to delineate and characterise vegetation communities.

The following tasks were undertaken within the survey site as part of the flora and vegetation survey:

- Broad vegetation assessment to delineate and characterise vegetation associations and potential resemblance to conservation significant ecological communities, including a vegetation condition assessment; and
- Targeted survey for conservation significant flora and habitat supporting these species.

Desktop assessments identified the potential occurrence of all three species of Threatened black cockatoos occurring in Western Australia (Forest Red-tailed Black-Cockatoos [FRTBC], Baudin's Black- Cockatoos [BBC] and Carnaby's Black-Cockatoos [CBC]) within the survey site. No other conservation significant fauna species were considered likely to occur within the survey site.

A targeted black cockatoo habitat assessment was undertaken that incorporated the following:

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

The survey site was traversed on foot to record any flora species with the potential to provide a food source for Black Cockatoos. Following the assessment, vegetation units were defined and mapped based on dominant flora species contained within. These units were then assigned a foraging value based on the presence and quantity of potential food species and any evidence of foraging by black cockatoos.

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

Environmental setting

Climate

The survey site is situated within the Swan Coastal Plain 2 (Perth) sub-region of the Swan Coastal Plain bioregion under the Interim Biogeographic Regionalisation for Australia (IBRA). This subregion experiences a warm, Mediterranean climate with hot dry summers and mild wet winters (Mitchell et al. 2002).

Landform, topography and soils

The Swan Coastal Plain is described by Beard (1990) as a low-lying coastal plain, often swampy, with sand hills also containing dissected country rising to the duricrust Dandaragan plateau on Mesozoic, mainly sandy, yellow soils. The geology of the site comprises Tamala Limestone and Sand Derived from Tamala Limestone (Gozzard 1982) and is situated on the Spearwood Dune System. The following phases of the Spearwood and Bassendean soil systems occur within the study site (Department of Agriculture and Food WA (DAFWA) 2007):

- Bassendean B1a Phase: Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands with an intensely coloured yellow B horizon within 1m of the surface – marri and jarrah dominant;
- Bassendean B6 Phase: Sandplain and broad extremely low rises with imperfectly drained deep or very deep grey siliceous sands.
- Spearwood S1b Phase – Dune ridges with deep siliceous yellow brown sands or pale sands with yellow-brown subsoil and slopes up to 15%; and
- Spearwood S1c Phase: Dune ridges with deep bleached grey sands with yellow-brown subsoils and slopes up to 15%.

Regional vegetation

Vegetation occurring within the region was initially mapped at a broad scale (1:1 000 000) by Beard during the 1970s. This dataset has formed the basis of several regional mapping systems, including physiographic regions defined by Beard (1981); System 6 Vegetation Complex mapping undertaken by Heddle et al. (1980); the biogeographical region dataset (Interim Biogeographic Regionalisation for Australia) for Western Australia (DotEE 2018b).

Beard (1990) Botanical Subdistrict

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

IBRA subregion

IBRA divides Western Australia into 26 biogeographic regions and 53 subregions based on dominant landscape characteristics of climate, lithology, geology, landform and vegetation (McKenzie et al. 2003). The site is located within the Swan Coastal Plain bioregion, which is dominated by woodlands of Banksia and Tuart on sandy soils, Sheoaks on outwash plains and Paperbarks in swampy areas (McKenzie et al. 2003).

System 6 mapping

System 6 mapping refers to vegetation mapping undertaken at a Vegetation Complex scale by Heddle et al. (1980). This is the primary source of information used to calculate potential impacts of proposals to clear native vegetation on the Swan Coastal Plain. The survey site occurs within the Bassendean Complex-Central and South vegetation complex which is described as:

- Vegetation ranging from woodland of Jarrah-Sheoak-Banksia on the sand dunes to low woodland of Melaleuca spp. and sedgelands on the low-lying depressions and swamps.

At a finer scale, the survey site falls within the Bassendean 1000 vegetation system association as defined in Government of Western Australia (2018):

- Bassendean 1000 – Mosaic: Medium forest; jarrah-marri / Low woodland; banksia / Low forest; Tea tree (*Melaleuca* spp.).

Results

Flora and vegetation

A total of 28 taxa from 27 genera and 19 families were recorded from within the survey site. A complete flora species list is provided in **Appendix A**. The highest number of taxa were found from the Poaceae family with four species recorded. Site data is presented in **Appendix B**.

No Threatened flora species as listed under section 178 of the EPBC Act or pursuant to Schedule 1 of the WC Act and as listed by DBCA (2018) or Priority flora species as listed by Western Australian Herbarium (1998-) were recorded within the survey site. Twenty-six conservation significant flora species were initially considered to have the potential to occur within the survey site (**Appendix C**), however factors such as clearing and grazing make the area unlikely to support any of these species.

One native vegetation community was delineated and mapped within the survey site (W1). In addition to the W1 community, the boundaries of plantation (P1) and cleared (CL) areas were also mapped. The mapped extent of the W1 community covers an approximated area of 3.9 ha (40.5% of the survey site), while P1 and CL cover an area of 2.3 ha (23.5% of the survey site) and 3.45 ha (35.9% of the survey site), respectively. The W1 community has been described in full, including associated species, in **Table 1.** Mapping boundaries are presented in **Figure 2**.

The W1 vegetation community contained Banksia species that are known to form part of the *Banksia Woodlands of the Swan Coastal Plain Threatened Ecological Community* (Banksia Woodlands TEC), namely *Banksia attenuata* and *Banksia ilicifolia*. As such, an assessment was undertaken to determine if this community occurs within the survey site (**Appendix D**). Based on results of the assessment, it can be inferred that structural and floristic aspects of the Banksia Woodlands TEC occur. It is recognised however, that the W1 vegetation community does not support a species-rich native understorey. Rather, weed species dominate and form a contiguous understorey layer, with native species being scattered throughout the community. No other Threatened Ecological Communities (TECs) listed under the EPBC Act or Priority Ecological Communities (PECs) listed by DBCA occur or were inferred to occur with the study site.

Vegetation condition within the survey site ranged from Completely Degraded to Good based on the EPA *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016a; **Figure 3**). Significant disturbance was noted throughout the survey site and cleared tracks and fields, plantation areas and weed infested understorey vegetation dominated. The W1 vegetation community was conservatively rated as being in Good condition. This rating was solely based on the intact native overstorey structure, with understorey values comprising little conservation value.

A total of eleven weed species were recorded within the survey site. Of these, none is listed as a Declared Plant species in Western Australia pursuant to Section 22 of the *Biosecurity and Agriculture Management Act 2007* (BAM Act; DPRID 2018).

Table 1: Native vegetation communities within the survey site

Vegetation description	Area occupied (ha)	Quadrat	Condition
W1 - *Eucalyptus marginata*, *Banksia ilicifolia*, *Banksia attenuata* mid open woodland over *Xanthorrhoea preissii*, *Kunzea glabrescens* tall sparse shrubland over mixed weeds.	3.90	ELA01; ELA02; ELA03	Good



Black cockatoo habitat assessment

No black cockatoos were observed within the survey site at the time of assessment.

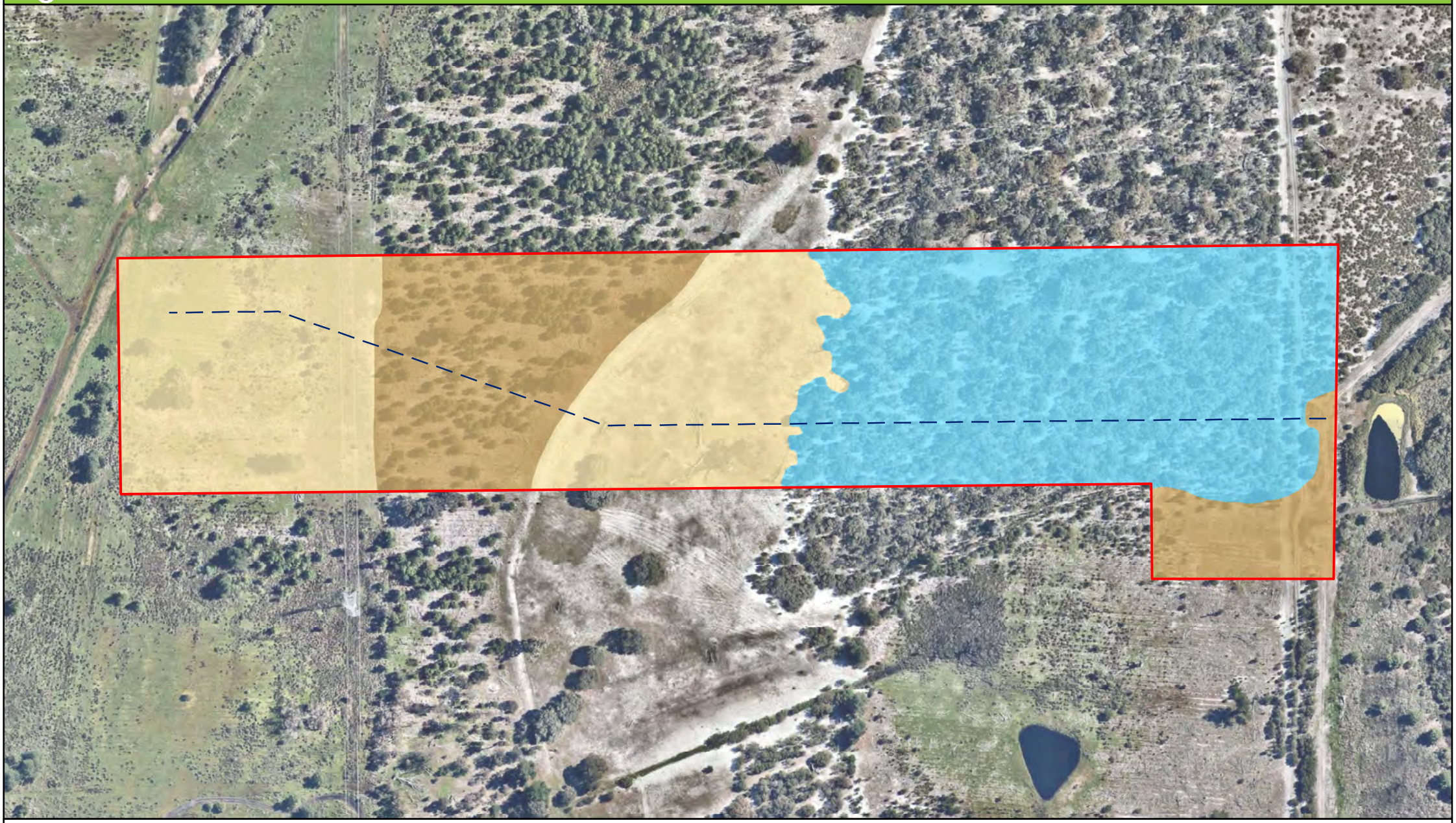
Foraging habitat for black cockatoos is generally defined as the availability of plant food sources within an area (Finn 2012). Food availability for black-cockatoos is a function of the diversity, abundance, distribution, energetic and nutritional qualities, and seasonality (phenology) of the food sources within a particular area.

Black cockatoo foraging habitat has been determined using vegetation associations defined in the vegetation assessment. The quality of foraging habitat for black cockatoo species within the survey site (as defined in **Table 2** below) has been assessed based on the availability and density of plant food sources as observed on site. As with vegetation condition, foraging quality is not uniform throughout an entire vegetation association and these variations have been accounted for within the assessment. Where habitat quality falls between two scores, a conservative approach has been taken and the higher of the two scores has been used.

Table 2: Definition of black cockatoo foraging habitat quality

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

Vegetation Communities



Legend

- Survey Site
- Albemarle Gas Pipeline

Vegetation Community

- Cleared with isolated trees
- Plantation
- *Eucalyptus marginata, Banksia ilicifolia, Banksia attenuata* mid open woodland over *Xanthorrhoea preissii, Kunzea glabrescens* tall sparse shrubland over mixed weeds

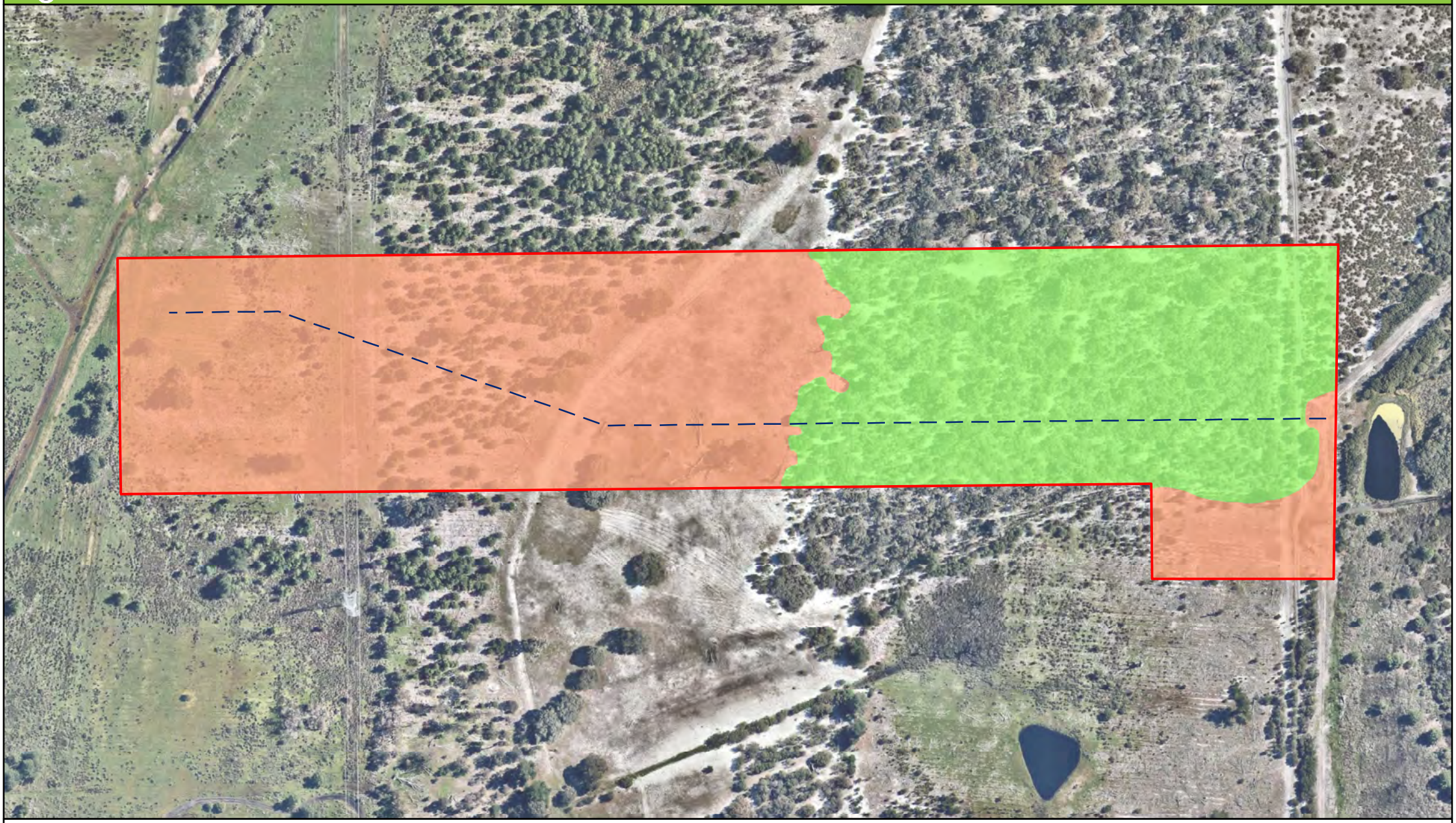
0 25 50 100
Metres
Datum/Projection:
GDA 1994 MGA Zone 50

N

eco logical AUSTRALIA
www.ecoaus.com.au

Prepared by: SM Date: 2/11/2018

Vegetation Condition



Legend

- Survey Site
- Albemarle Gas Pipeline

Vegetation Condition

- Good
- Completely degraded to degraded

0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

N

eco logical AUSTRALIA

www.ecoaus.com.au

Prepared by: SM Date: 2/11/2018

Table 3 contains a summary of each vegetation association occurring within the survey site and its respective foraging quality score and the total area of foraging habitat for each species of black cockatoo is summarised in **Table 4**. Vegetation within the survey site provides foraging habitat for all three species of black cockatoo, however the quality of habitat is highly variable, and no signs of active foraging were observed. These results are depicted in **Figures 4-6**.

Table 3: Vegetation types and black cockatoo foraging habitat quality within the survey site

Vegetation community	Assessed foraging quality	Justification
W1	Carnaby's Black-Cockatoo: High; Baudin's Black-Cockatoo: Low; Forest Red-tailed Black-Cockatoo: Low	Presence of *Banksia* and *Xanthorrhoea* species considered primary foraging species for Carnaby's Black-Cockatoo. Scattered *Eucalyptus marginata* trees used by all three black cockatoo species for foraging.
P1	Carnaby's Black-Cockatoo: High; Baudin's Black-Cockatoo: High; Forest Red-tailed Black-Cockatoo: Nil	*Pinus pinaster* trees considered suitable foraging habitat for Carnaby's Black-Cockatoo and Baudin's Black-Cockatoo. No suitable habitat for Forest Red-tailed Black-Cockatoo.
Cleared	Carnaby's Black-Cockatoo: Low; Baudin's Black-Cockatoo: Low; Forest Red-tailed Black-Cockatoo: Nil.	Isolated *Pinus pinaster* trees considered suitable foraging habitat for Carnaby's Black-Cockatoo and Baudin's Black-Cockatoo. No suitable habitat for Forest Red-tailed Black-Cockatoo.

Table 4: Summary of black cockatoo foraging habitat quality within the survey site

Black cockatoo species	Area of foraging habitat (ha)
Carnaby's Black-Cockatoo	High: 5.87 Low: 0.24
Baudin's Black-Cockatoo	High: 1.97 Low: 3.26
Forest Red-tailed Black-Cockatoo	Low: 3.06

'Breeding habitat' for black cockatoos is defined in DSEWPaC (2012) as trees of species known to support breeding within the range of the species which either have a suitable nest hollow or are of a suitable DBH to develop a nest hollow (> 300 mm for salmon gum and wandoo, and >500 mm for other species). These trees are known as significant trees. Trees of this size may also be large enough to provide roosting habitat (i.e. trees which provide a roost or rest area for the birds). Significant trees which contain hollows that have an entrance diameter of more than 100 mm are suitable for use by black cockatoos (Whitford & Williams 2002). In general, hollows of sufficient size to support black-cockatoos do not form until trees are at least 230 years old, and the majority of nests are found in 300-500 year old trees (Johnstone 2006).

The black cockatoo breeding habitat assessment identified 20 potentially significant trees within the survey site, four of which are pines that are only suitable as potential roosting habitat (**Table 5**; **Figures 4-6**). None of these trees contained a hollow of sufficient size to be utilised by black cockatoos for breeding purposes.

Table 5: Potentially significant black cockatoo habitat trees within the survey site

Tree number	Species	Hollows noted	Diameter at Breast Height (DBH; mm)
1	*Pinus pinaster*	No hollows	650
2	*Eucalyptus marginata*	No hollows	530.5
3	*Eucalyptus marginata*	No hollows	690.1
4	*Eucalyptus marginata*	No hollows	520
5	*Eucalyptus marginata*	No hollows	650
6	*Eucalyptus marginata*	Small branch hollows	990.4
7	*Eucalyptus marginata*	No hollows	650
8	*Eucalyptus marginata*	No hollows	900
9	*Eucalyptus marginata*	No hollows	590
10	*Eucalyptus marginata*	No hollows	600
11	*Eucalyptus marginata*	No hollows	550
12	*Eucalyptus marginata*	No hollows	550
13	*Eucalyptus marginata*	No hollows	600
14	*Eucalyptus marginata*	No hollows	700
15	*Eucalyptus marginata*	Small branch	1000
16	*Corymbia calophylla*	Small spout & branch hollows	1260.5
17	*Corymbia calophylla*	Small spout & branch hollows	1490
18	*Pinus pinaster*	No hollows	800
19	*Pinus pinaster*	No hollows	1000
20	*Pinus pinaster*	No hollows	990.4

Baudin's Black Cockatoo Habitat

Legend

- Survey Site
- Albemarle Gas Pipeline

Foraging Potential

- High
- Low

Potentially Significant Tree

- *Corymbia calophylla*
- *Eucalyptus marginata*
- *Pinus pinaster* (roosting only)

0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

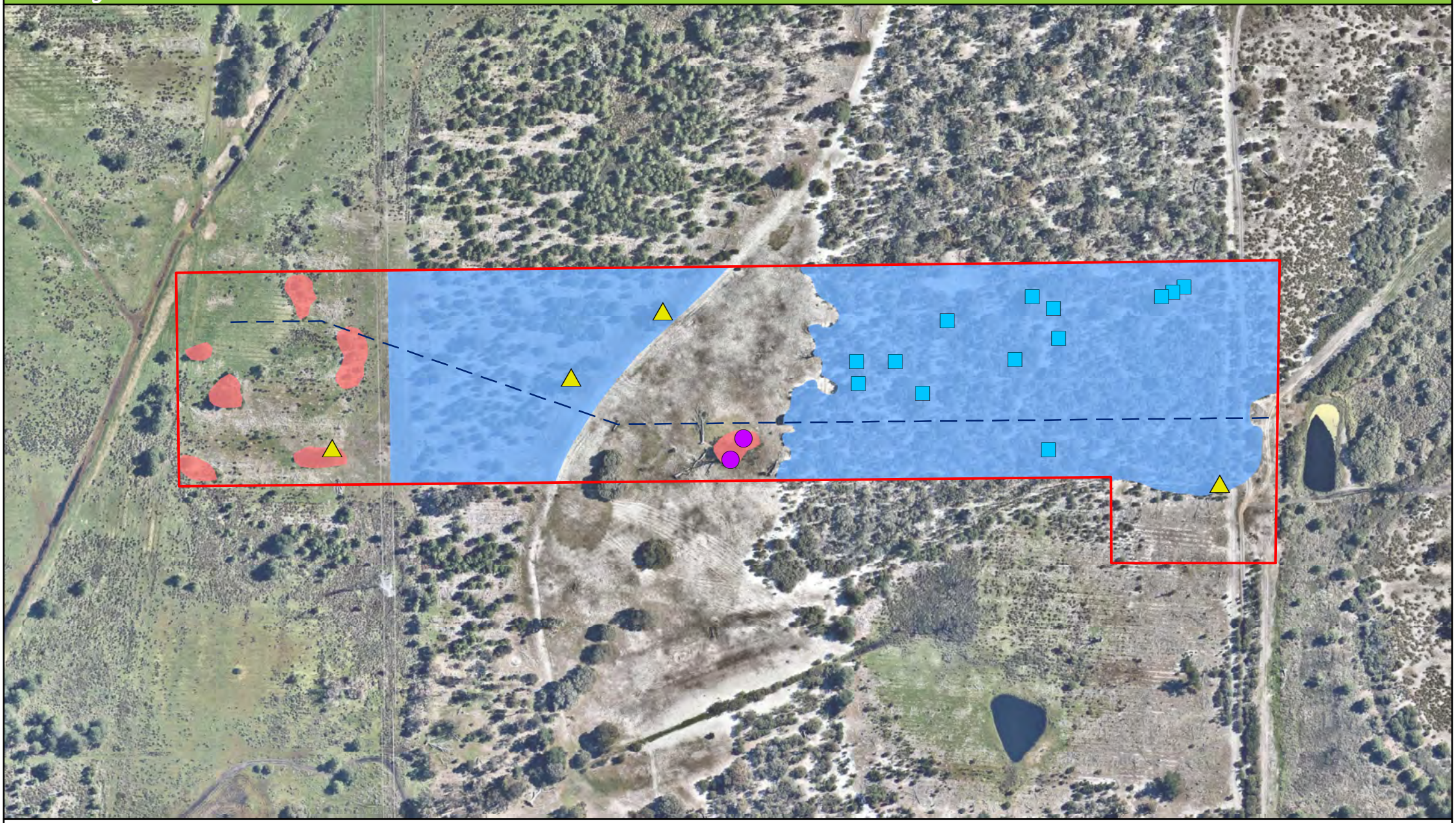
N

eco logical AUSTRALIA

www.ecoaus.com.au

Prepared by: SM Date: 5/11/2018

Carnaby's Black Cockatoo Habitat



Legend

- Survey Site
- Albemarle Gas Pipeline

Foraging Potential

- High
- Low

Potentially Significant Tree

- *Corymbia calophylla*
- *Eucalyptus marginata*
- *Pinus pinaster* (roosting only)

0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

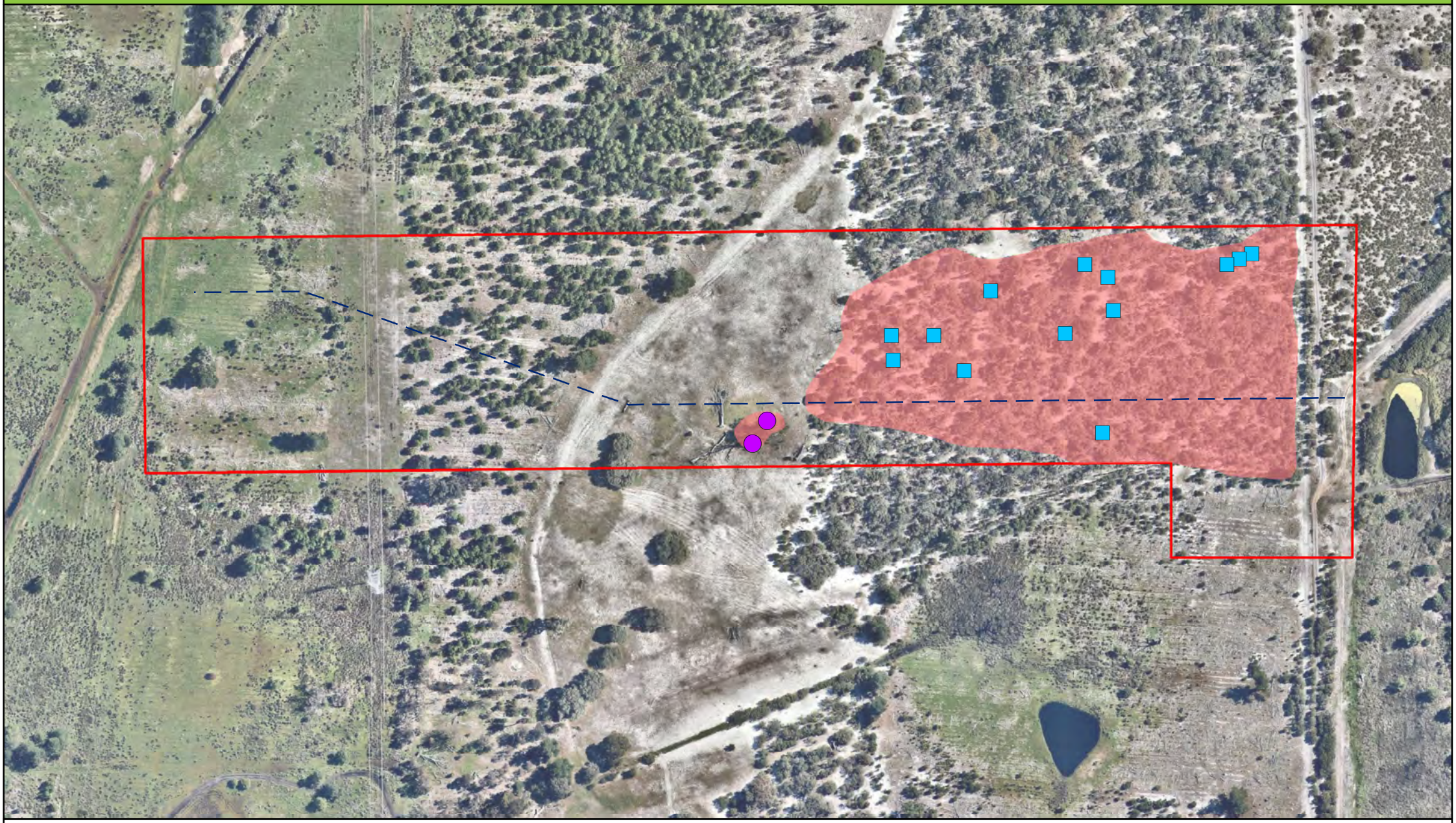
N

eco logical AUSTRALIA

www.ecoaus.com.au

Prepared by: SM Date: 5/11/2018

Forest Red-tailed Black Cockatoo Habitat



Legend

- Survey Site
- Albemarle Gas Pipeline

Potentially Significant Tree

- *Corymbia calophylla*
- *Eucalyptus marginata*

Foraging potential

- Low

0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

N

eco logical AUSTRALIA

www.ecoaus.com.au

Prepared by: SM Date: 5/11/2018

Summary

Vegetation within the survey site comprises low quality Banksia woodland (3.9 ha), plantations (2.3 ha) and cleared areas with isolated trees (3.5 ha). The area been subject to prolonged degradation from sources including clearing, sustained weed invasion and grazing. As a result, the survey site is a poor representation of vegetation of the Swan Coastal Plain.

No Threatened flora species as listed under section 178 of the EPBC Act or pursuant to Schedule 1 of the WC Act and as listed by DBCA (2018) or Priority flora species as listed by Western Australian Herbarium (1998-) were recorded. Given the degraded nature of understorey vegetation, it is considered unlikely that the site would support any of these species.

One native vegetation community was delineated and mapped within the survey area, namely W1. The W1 vegetation community contained Banksia species that are known to form part of the *Banksia Woodlands of the Swan Coastal Plain Threatened Ecological Community* (Banksia Woodlands TEC), namely *Banksia attenuata* and *Banksia ilicifolia*. This inference was based on the presence of key indicator species, intact overstorey structure and good condition of overstorey vegetation. It is duly recognised that the W1 vegetation community does not support a species-rich native understorey and as a result of sustained weed invasion comprises little conservation value.

Vegetation within the survey site provides foraging habitat for all three species of black cockatoo, however the quality of habitat is highly variable, and no signs of foraging were observed. A total of 20 potentially significant trees were recorded within the survey site, four of which are pines that are only suitable as potential roosting habitat. None of these trees contained a hollow of sufficient size to be utilised by black cockatoos for breeding purposes.

References

Beard, J. 1981. *Vegetation of the Perth area, Western Australia: map and explanatory memoir, 1:250 000 series*, Vegmap Publications, Perth.

Beard, J. 1990. *Plant Life of Western Australia*. Kangaroo Press, Perth.

Bureau of Meteorology (BoM). 2018. *Climate Data Online: Monthly Rainfall: Hopelands.* Available from: http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=139&p_display_type=dataFile&p_startYear=&p_c=&p_stn_num=009253. Accessed September 2018.

Department of Agriculture and Food Western Australia (DAFWA). 2007. *Soil – Landscape Mapping of the South West of Western Australia.* Department of Agriculture and Food Western Australia, Perth.

Department of Biodiversity, Conservation and Attractions (DBCA). 2007 - 2018. *NatureMap*. Department of Parks and Wildlife and WA Museum. Available from: http://naturemap.dpaw.wa.gov.au/default.aspx. Accessed August 2018.

Department of Biodiversity Conservation and Attractions (DBCA). 2018. *Wildlife Conservation (Threatened Flora) Notice 2017*. Available from: https://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-species/Listings/fauna_notice.pdf. Accessed September 2018.

Department of Primary Industries and Regional Development (DPRID). 2018. *Western Australian Organism List: Declared Pests*. Available from: https://www.agric.wa.gov.au/organisms?search_string=%2A&ref_code_name=PER-DP. Accessed September 2018

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC). 2012. *Environment Protection and Biodiversity Conservation Act 1999 referral guidelines for three threatened black cockatoo species: Carnaby's cockatoo (endangered) Calyptorhynchus latirostris; Baudin's cockatoo (vulnerable) Calyptorhynchus baudinii; Forest red-tailed black cockatoo (vulnerable) Calyptorhynchus banksii naso*. Australian Government.

Department of the Environment and Energy (DotEE). 2018a. *EPBC Act Protected Matters Search Tool*. Available from: http://www.environment.gov.au/epbc/pmst/index.html. Accessed August 2018.

Department of the Environment and Energy (DotEE). 2018b. *Interim Biogeographic Regionalisation for Australia, Version 7*. Available from: http://www.environment.gov.au/land/nrs/science/ibra. Accessed September 2018.

Department of the Environment and Energy (DotEE). 2018c. *Species Profiles and Threats Database*. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl. Accessed September 2018.

Department of Water and Environmental Regulation (DWER). 2018. *Perth Groundwater Map.* Available from: http://www.water.wa.gov.au/maps-and-data/maps/perth-groundwater-atlas. Accessed September 2018.

Environmental Protection Authority (EPA). 2016a. *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment*. Perth, Western Australia.

Environmental Protection Authority (EPA). 2016b. *Technical Guidance: Terrestrial Fauna Surveys*. Perth, Western Australia.

Finn, H. 2012. *Assessment of habitat values for black-cockatoos within selected sites at Newmont Boddington Gold Mine*. Report prepared for Newmont Boddington Gold Pty Ltd.

Geological Survey of Western Australia. (GSWA). 1978. *Geological Series, Perth WA 1:250,000 Environmental Geology Series*. Geological Survey of Western Australia.

Gibson, N., Keighery, B., Keighery., G., Burbidge, A., and Lyons, M. (1994). *A Floristic survey of the southern Swan Coastal Plain.* Unpublished Report for the Australian Heritage Commission, prepared by Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.).

Gozzard, J.R. 1982. *Perth Metropolitan Region Environmental Geology Series*. Geological Survey of Western Australia, Perth.

Heddle, E.M., Loneragan D.W., & Havel J.J. 1980. 'Vegetation complexes of the Darling System, Western Australia', in: *Atlas of natural resources of the Darling System, Western Australia*. Perth, Western Australia.

International Union for Conservation of Nature (IUCN). 2018. *The IUCN Red List of Threatened Species.* Available from: http://www.iucnredlist.org/. Accessed September 2018.

Johnstone, R. 2006. *Going, going, gone! Veteran and stag trees: a valuable resource.* Western Australian Museum, Perth.

Marchant, S. & Higgins, P.J. 1990. *Handbook of Australian, New Zealand & Antarctic birds.* Oxford University Press, Melbourne.

McKenzie, N.L., May, J.E. & McKenna, S. 2003. *Bioregional Summary of the 2002 Biodiversity Audit of Western Australia.* Department of Conservation and Land Management, Perth, Western Australia.

Mitchell D., Williams K. & Desmond A. 2002. 'Swan Coastal Plain 2 (SWA2 – Swan Coastal Plain subregion)', in *A biodiversity audit of Western Australia's 53 Biogeographical Subregions in 2002*, eds Department of Conservation and Land Management, Perth, pp. 606-623.

New South Wales Office of Environment & Heritage (NSW OEH). 2018. *Blue-billed Duck – Profile.* Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10580. Accessed September 2018.

Western Australian Herbarium. 1998-. *FloraBase – the Western Australian Flora*. Available from: https://florabase.dpaw.wa.gov.au/. Accessed August 2018.

Whitford, K.R. & Williams, M.R. 2002. 'Hollows in jarrah (Eucalyptus marginata) and marri (Corymbia calophylla) trees II: Selecting trees to retain for hollow dependent fauna'. *Forest Ecology and Management.* vol. 160: pp. 215-232.

Appendix A: Flora species list

Family	Species
Anarthriaceae	*Lyginia barbata*
Araliaceae	*Trachymene pilosa*
Asteraceae	**Hypochaeris glabra*
	**Ursinia anthemoides*
Colchicaceae	*Burchardia congesta*
Dasypogonaceae	*Dasypogon bromeliifolius*
Dilleniaceae	*Hibbertia subvaginata*
Droseraceae	*Drosera stolonifera*
Fabaceae	**Trifolium subterraneum*
	Jacksonia horrida
Haemodoraceae	*Conostylis aculeata*
Iridaceae	**Romulea rosea*
Myrtaceae	*Eucalyptus marginata*
	Kunzea glabrescens
Orchidaceae	**Disa bracteata*
	Caladenia flava
Orobanchaceae	**Bartsia trixago*
Pinaceae	**Pinus pinaster*
Poaceae	**Briza maxima*
	**Ehrharta calycina*
	**Holcus* sp.
	**Vulpia myros*
Proteaceae	*Banksia attenuata*
	Banksia ilicifolia
Restionaceae	*Desmocladus flexuosus*
	Hypoleana exsulca
Stylidiaceae	*Stylidium juneceum*
Xanthorrhoeaceae	*Xanthorrhoea preissii*

Appendix B: Relevé site data

Site number	Date	Site type	Observer
ELA01	19/10/2018	Relevé	JC
Landscape type	Soils	Easting	Northing
Flat	Light grey sand	385417	635212
Soil condition	Fire	Condition	Disturbance
Deep sand	>10 years	Degraded-Good	Heavy grazing, high weed density, rabbit burrows, tracks

Species	Cover (%)	Stratum (U=Upper, M=Middle, L=Low)	Height (m)
Kunzea glabrescens	10	M	2.5
Eucalyptus marginata	5	U	15
Banksia ilicifolia	15	U	10
Banksia attenuata	10	U	8
Xanthorrhoea preissii	0.5	M	1.6
**Hypochaeris glabra*	0.1	L	0.05
**Ursinia anthemoides*	2.5	L	0.2
**Ehrharta calycina*	1.4	L	0.3
**Romulea rosea*	0.05	L	0.1
**Briza maxima*	3	L	0.25
Drosera stolonifera	0.01	L	0.1

**Bartsia trixago*	0.05	L	0.2
**Vulpia myros*	2	L	0.3
Caladenia flava	0.01	L	0.15
Burchardia congesta	0.01	L	0.25
**Trifolium subterraneum*	0.5	L	0.1
Lyginia barbata	0.08	L	0.5

Site number	Date	Site type	Observer
ELA02	19/10/2018	Relevé	JC
Landscape type	Soils	Easting	Northing
Flat	Light grey sand	385510	6325199
Soil condition	Fire	Condition	Disturbance
Deep sand	>10 years	Degraded-Good	Heavy grazing, high weed density, rabbit burrows, tracks

Species	Cover (%)	Stratum (U=Upper, M=Middle, L=Low)	Height (m)
Trachymene pilosa	0.1	L	0.1
Banksia ilicifolia	20	U	9
Banksia attenuata	15	U	8.5
Eucalyptus marginata	8	U	15
Kunzea glabrescens	25	M	1.6
**Ehrharta calycina*	2	L	0.4
**Ursinia anthemoides*	2.5	L	0.3
**Hypochaeris glabra*	0.3	L	0.05
Drosera stolonifera	0.05	L	0.15
Hibbertia subvaginata	0.1	L	0.3
Stylidium juneceum	0.02	L	0.15
Hypoleana exsulca	0.2	L	0.4
Xanthorrhoea preissii	0.3	M	1.5

**Trifolium subterraneum*	0.35	L	0.1
Dasypogon bromeliifolius	0.4	L	0.3
Jacksonia horrida	0.5	M	1.2
Lyginia barbata	0.1	L	0.4

Site number	Date	Site type	Observer
ELA03	19/10/2018	Relevé	JC
Landscape type	Soils	Easting	Northing
Flat	Light grey sand	385586	6325230
Soil condition	Fire	Condition	Disturbance
Deep sand	>10 years	Degraded-Good	Heavy grazing, high weed density, rabbit burrows, tracks

Species	Cover (%)	Stratum (U=Upper, M=Middle, L=Low)	Height (m)
**Pinus pinaster*	0.3	M	3
Banksia ilicifolia	25	U	12
Banksia attenuata	20	U	9
Eucalyptus marginata	10	U	15
Xanthorrhoea preissii	2	M	1.2
Dasypogon bromeliifolius	0.2	L	0.3
Kunzea glabrescens	18	M	2.5
Desmocladus flexuosus	0.1	L	0.15
**Hypochaeris glabra*	0.3	L	0.05
**Ursinia anthemoides*	0.6	L	0.3
**Briza maxima*	1.4	L	0.3
**Vulpia myros*	0.5	L	0.2
Trachymene pilosa	0.15	L	0.1

**Disa bracteata*	0.02	L	0.15
Conostylis aculeata	0.15	L	0.2
**Holcus* sp.	0.05	L	0.2
**Ehrharta calycina*	1.2	L	0.4
**Trifolium subterraneum*	0.5	L	0.1

Appendix C: Flora likelihood of occurrence assessment

Species	Conservation code		Source[3]	Preferred habitat	Likelihood of occurrence	Justification for likelihood rating
	EPBC Ranking[1]	WA Ranking[2]				
Brachyscias verecundus	CR	S1	PMST	An annual (or ephemeral), entirely glabrous herb, growing to 12-22 mm high. The inner bases of compound inflorescence bracts are white and the flowers are white during early flowering. The species is endemic to ironstone soils in the Busselton region. It grows in winter-wet clay over ironstone in open to tall shrubland (DotEE 2018b).	Does not occur	Preferred habitat does not occur
Caladenia procera	CR	S1	PMST	A tall orchid reaching 70 cm tall. One to three spider-like flowers that are predominately greenish-yellow, characterised with dark maroon/pink lines and spots. Habitat for this species occurs within sandy-clay loam flats, generally occurring within Jarrah, Marri or Peppermint woodlands amongst dense heath and sedges, or shrubs (DotEE 2018b).	Does not occur	Adequate survey effort did not record this species
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	CR	S1	PMST	A sub-shrub ranging from 0.25-0.65 tall. Flowers are yellow in colour, narrow, hairy and are openly spaced. Flowering occurs from September through to November. It can be found on areas with clayey-sand with lateritic pebbles and prefers low woodland areas that are situated near winter flats (DotEE 2018b).	Does not occur	Adequate survey effort did not record this species
Synaphea sp. Serpentine (G.R. Brand 103)	CR	S1	PMST	This species is a clumped subshrub reaching a height of up to 0.6 m. Flowers are yellow in colour, narrow, hairy and are openly spaced. Flowering occurs from late August through to November. Habitat for this species is grey-brown sandy loams to clay soil occurring on predominately flat, seasonally wet terrain (DotEE 2018b).	Does not occur	Adequate survey effort did not record this species

Species	Conservation code		Source[3]	Preferred habitat	Likelihood of occurrence	Justification for likelihood rating
	EPBC Ranking[1]	WA Ranking[2]				
Andersonia gracilis	EN	S3	PMST	Slender erect or open straggly shrub grows to 0.1-0.5(-1) m high. Grows in white/grey sand, sandy clay, gravelly loam in winter-wet areas and near swamps (WAH 1998 - 2018).	Does not occur	Adequate survey effort did not record this species
Austrostipa bronwenae	EN	S2	PMST NatureMap	A perennial grass reaching up to 60 cm tall with green flowers that flower from October through to November. Habitat for this species occurs within wetlands consisting of muddy sand that are seasonally waterlogged (DotEE 2018b).	Does not occur	Adequate survey effort did not record this species
Banksia nivea subsp. *uliginosa*	EN	S2	PMST	A mounded shrub up to 1.5 m tall and 1.5 m across with yellow-brown flowers, well hidden within the bush. Habitat for this species is confined to orange clay loam over laterite and sandy areas within winter-wet southern ironstones that are highly restricted in distribution. Associated vegetation includes dense shrubland of *Viminaria juncea*, *Kunzea recurva*, *Xanthorrhoea* sp. and *Banksia squarrosa* subsp. *argillacea* over sedges (DotEE 2018b).	Does not occur	Adequate survey effort did not record this species
Caladenia huegelii	EN	S1	PMST; NatureMap	A slender orchid 30 to 50 cm tall. One or two striking flowers characterised by a greenish-cream lower petal with a maroon tip. Other petals are cream with red or pink suffusions. Habitat for this species occurs within well-drained, deep sandy soils of the Bassendean and Spearwood systems in low mixed Banksia, *Allocasuarina* and Jarrah woodlands (Western Australian Herbarium 1998, DotEE 2018b).	Does not occur	Adequate survey effort did not record this species

Species	Conservation code		Source[3]	Preferred habitat	Likelihood of occurrence	Justification for likelihood rating
	EPBC Ranking[1]	WA Ranking[2]				
Diuris purdiei	EN	S2	PMST	A slender orchid to 0.35 m tall. Flowers are yellow and visible from September to October. Habitat for this species is grey-black sand substrates in winter-wet swamps which have high moisture (Western Australian Herbarium 1998-). It grows on sand to sandy clay soils, in areas subject to winter inundation, and amongst native sedges and dense heath with scattered emergent *Melaleuca preissiana*, *Corymbia calophylla*, *E*. marginata and *Nuytsia floribunda* (DotEE 2018b).	Does not occur	Adequate survey effort did not record this species
Drakaea elastica	EN	S1	PMST	A slender flower stem up to 30 cm high with a single glossy green, heart shaped leaf. The single flower is 3 to 4 cm long. It can be found on bare patches of sand within dense vegetation in low lying winter-wet swamps. *D. elastica* often occurs with other orchid species (DotEE 2018b).	Does not occur	Adequate survey effort did not record this species
Lambertia echinata subsp. *occidentalis*	EN	S1	PMST	A prickly, non-lignotuberous shrub that grows up to three metres high with many branches at the base and a few long, erect floral branches. It has yellow flowers which are crowded at the ends of branchlets, visible from October to December. Habitat for this species occurs on shallow soils over sheet ironstone and white sandy soils over laterite. It occurs on flats to foothills and grows in winter-wet rich scrub heath/shrubland with sedges and scattered Banksia and Marri (DotEE 2018b).	Does not occur	Adequate survey effort did not record this species
Synaphea stenoloba	EN	S1		This species is a compact shrub that can grow up to 0.5 m tall. Flowers are hairless and yellow in colour and can be seen from late August through to November. This species prefers low lying areas with loamy soils that are sporadically flooded. This species is described as a mild disturbance opportunist due to its ability to resprout from long tap root rather than regenerating from seed (DotEE 2018b).	Does not occur	Adequate survey effort did not record this species

Species	Conservation code		Source[3]	Preferred habitat	Likelihood of occurrence	Justification for likelihood rating
	EPBC Ranking[1]	WA Ranking[2]				
Banksia squarrosa subsp. *argillacea*	VU	S3	PMST	An erect, open, non-lignotuberous shrub, which grows 1.2–4 m tall. It has 3–6 teeth on each side of the leaves, which are 5–9 mm wide. It has yellow flowers in June–November and grows on winter-wet clay over ironstone in open to tall shrubland (DotEE 2018b).	Does not occur	Adequate survey effort did not record this species
Chamelaucium sp. S coastal plain	VU	S3	PMST	An intricately branched spreading shrub up to 120 cm tall and 60 cm across. It has inconspicuous greenish-white flowers and young branches are coloured fawn to reddish. Habitat is confined to swamp margins in open Dryandra shrubland in winter-wet sandy clay sites on a coastal plain. It occurs in low woodlands of *Eucalyptus rudis*, *Melaleuca rhaphiophylla*, *Astartea fascicularis*, or Proteaceous heaths (DotEE 2018b).	Does not occur	Adequate survey effort did not record this species
Diuris micrantha	VU	S3	PMST	A slender orchid to 60 cm tall. Flowers are yellow with reddish-brown markings and visible from September to October. Habitat for this species occurs within clay-loam substrates in winter-wet depressions or swamps (DotEE 2018b).	Does not occur	Adequate survey effort did not record this species
Drakaea micrantha	VU	S2	PMST NatureMap	A tuberous, terrestrial herb which has a diminutive red and yellow flower, 1.2–2.5 cm long, on a stem that grows to 30 cm. Flowering occurs form September to October. Its heart-shaped leaf, about 1.5 cm long, is silvery grey with prominent green veins. Habitat for this species occurs within cleared firebreaks or open sandy patches that have been disturbed, where competition from other plants has been removed in lower lying areas near wetlands under Spearwood (*Kunzea glabrescens*) thickets (Western Australian Herbarium 1998-, DotEE 2018b).	Does not occur	Adequate survey effort did not record this species

Species	Conservation code		Source[3]	Preferred habitat	Likelihood of occurrence	Justification for likelihood rating
	EPBC Ranking[1]	WA Ranking[2]				
Eleocharis keigheryi	VU	S3	PMST	A rhizomatous, tufted/clumped perennial herb, reaching a maximum diameter of 40 cm. When this species grows in water, there are numerous hair-like sterile stems at the base of the main stems. Flowering occurs from August to November, but will extend to December if conditions are favourable. This species grows in small clumps in a substrate of clay or sandy loam. This species is emergent in freshwater creeks and claypans (DotEE 2018b).	Does not occur	Adequate survey effort did not record this species
Boronia juncea subsp. *juncea*	-	P1	NatureMap	A slender or straggly shrub with pink flowers visible in April. Habitat for this species occurs on sand in low scrub areas (WAH 1998 – 2018).	Does not occur	Adequate survey effort did not record this species
Puccinellia vassica	-	P1	NatureMap	A caespitose, annual or perennial grass-like herb, 0.41-0.55 m high. Habitat for this species occurs on saline soils on the outer margins of coastal saltmarshes (WAH 1998 – 2018).	Does not occur	Preferred habitat does not occur
Pterostylis frenchii	-	P2	NatureMap	A tuberous herb 0.35 m tall with rosette leaves. Habitat for this species occurs on calcareous sand with limestone or laterite within flatlands and gentle slopes (WAH 1998 – 2018).	Does not occur	Preferred habitat does not occur
Carex tereticaulis	-	P3	NatureMap	A monoecious, rhizomatous, tufted perennial sedge, grass-like or herb, to 70 cm tall. Flowers are brown and visible September through to October. Habitat for this species is on substrate of black peaty sand (WAH 1998 – 2018).	Does not occur	Preferred habitat does not occur
Chamaescilla gibsonii	-	P3	NatureMap	Herb (clumped and tuberous). Flowers are blue and visible in September. Habitat for this species is clay or sandy-clay substrate in winter-wet flats and shallow water-filled claypans (WAH 1998 – 2018).	Does not occur	Adequate survey effort did not record this species

Species	Conservation code		Source[3]	Preferred habitat	Likelihood of occurrence	Justification for likelihood rating
	EPBC Ranking[1]	WA Ranking[2]				
Cyathochaeta teretifolia	-	P3	NatureMap	A perennial grass-like sedge that can grow up to 2 m high and 1 m wide. Has a brown flower and can be found within swamps and along creek edges on grey sand/sandy clay (WAH 1998 – 2018).	Does not occur	Preferred habitat does not occur
Dillwynia dillwynioides	-	P3	NatureMap	A decumbent or erect, slender shrub between 30‑120 cm tall. Flowers are red & yellow/orange and visible from August to December. Habitat for this species occurs on sandy soils in winter-wet depressions (WAH 1998 – 2018).	Does not occur	Adequate survey effort did not record this species
Lasiopetalum membranaceum	-	P3	NatureMap	Multi-stemmed shrub to 1 m tall. Flowers are pink-blue-purple and visible September to December. Habitat for this species is sandy substrate over limestone (WAH 1998 – 2018).	Does not occur	Preferred habitat does not occur
Verticordia attenuata	-	P3	NatureMap	A shrub 0.4-1 m tall. Flowers are pink, occurring in December or January to May. Habitat for this species includes white or grey sand in winter-wet depressions (WAH 1998 – 2018).	Does not occur	Adequate survey effort did not record this species
Acacia flagelliformis	-	P4	NatureMap	A rush-like, erect or sprawling shrub between 0.3-0.75 m tall with yellow flowers visible from May to September. Habitat for this species occurs on sandy soils in winter-wet areas (WAH 1998 – 2018).	Does not occur	Adequate survey effort did not record this species
Acacia semitrullata	-	P4	NatureMap	A slender, erect, pungent shrub, (0.1-) 0.2 m to 0.7(-1.5) m tall. Flowers are cream-white, occurring from May to October. Habitat for this species occurs on white/grey sand, sometimes over laterite and clay, within sandplains and swampy areas (WAH 1998 – 2018).	Does not occur	Adequate survey effort did not record this species

Species	Conservation code		Source[3]	Preferred habitat	Likelihood of occurrence	Justification for likelihood rating
	EPBC Ranking[1]	WA Ranking[2]				
Caladenia speciosa	-	P4	NatureMap	A tuberous herb (perennial) to 60 cm tall. Flowers are white-pink and visible from September to October. This species is known to occupy a habitat with white, grey or black sandy substrate (WAH 1998 – 2018).	Does not occur	Adequate survey effort did not record this species
Eucalyptus rudis subsp. *cratyantha*	-	P4	NatureMap	A tree 5-20 m tall. Bark is rough and boxy. Flowers are white and visible form July to September. Habitat for this species occurs on loam on flats and hillsides (WAH 1998 – 2018).	Does not occur	Adequate survey effort did not record this species
Pultenaea skinneri	-	P4	NatureMap	A slender shrub 1-2 m tall. Flowers are yellow/orange and red, occurring from July to September. Habitat for this species includes sandy or clayey soils within winter-wet depressions (WAH 1998 – 2018).	Does not occur	Adequate survey effort did not record this species
Tripterococcus sp. Brachylobus (A.S. George 14234)	-	P4	Nature Map	Annual herb up to 0.6 m grows in grey sand and clay soils in moist environments such as winter wet flats (WAH 1998 - 2018).	Does not occur	Adequate survey effort did not record this species

Appendix D: Diagnostic assessment: Banksia Woodlands of the Swan Coastal Plain

Step	Key diagnostic characteristics (DotEE 2016)	Outcome
1	**Location and physical environment** The Banksia Woodlands ecological community primarily occurs in the Swan Coastal Plain IBRA bioregion	Yes. The survey site is located on the Swan Coastal Plain
	Soil and landform The Banksia Woodlands typically occurs on well drained, low nutrient soils on sandplain landforms, particularly deep Bassendean and Spearwood sands and occasionally on Quindalup sands	Yes. The survey site is located on the Bassendean Dune System
	Structure The structure of the Banksia Woodlands is a low woodland to forest with these features: A distinctive upper sclerophyllous layer of low trees* (occasionally large shrubs more than 2 m tall), typically dominated or co-dominated by one or more of the Banksia species identified under composition Emergent trees of medium or tall (>10 m) height *Eucalyptus* or *Allocasuarina* species may sometimes be present above the Banksia canopy An often highly species-rich understorey that consists of: a layer of sclerophyllous shrubs of various heights; and, a herbaceous ground layer of cord rushes, sedges and perennial and ephemeral forbs, that sometimes includes grasses. The development of a ground layer may vary depending on the density of the shrub layer and disturbance history.	Yes. The eastern section of the survey site contains a structurally intact native overstorey. This vegetation community (W1), comprises *Eucalyptus marginata*, *Banksia ilicifolia*, *Banksia attenuata* mid open woodland over *Xanthorrhoea preissii*, *Kunzea glabrescens* tall sparse shrubland over mixed weeds. Due to the high degree of disturbance and weed cover, native understorey species were scattered (isolated) throughout this community, but did not form a contiguous/definable layer.

Step	Key diagnostic characteristics (DotEE 2016)	Outcome
	Composition The canopy is most commonly dominated or co-dominated by *Banksia attenuata* (candlestick banksia, slender banksia) and/or *B. menziesii* (firewood banksia). Other Banksia species that dominate in some examples of the ecological community are *B. prionotes* (acorn banksia) or *B. ilicifolia* (holly-leaved banksia); and The patch must include at least one of the following diagnostic species: *Banksia attenuata* (candlestick banksia) *Banksia menziesii* (firewood banksia) *Banksia prionotes* (acorn banksia) *Banksia ilicifolia* (holly-leaved banksia). If present, the emergent tree layer often includes *Corymbia calophylla* (marri), *E. marginata* (jarrah), or less commonly *Eucalyptus gomphocephala* (tuart); and Other trees of a medium height that may be present, and may be codominant with the Banksia species across a patch, include *Eucalyptus todtiana* (blackbutt, pricklybark), *Nuytsia floribunda* (Western Australian Christmas tree), *Allocasuarina fraseriana* (western sheoak), *Callitris arenaria* (sandplain cypress), *Callitris pyramidalis* (swamp cypress) and *Xylomelum occidentale* (woody pear); and The understorey typically contains a high to very high diversity of shrub and herb species that often vary from patch to patch*** Contra-indicators: Patches clearly dominated by *Banksia littoralis* are not part of the Banksia Woodlands ecological community but indicates a different, dampland community is present. Patches clearly dominated by *Banksia burdettii* are not part of the Banksia Woodlands ecological community but indicates a tall shrubland and not the Banksia Woodlands ecological community. FCT 20c – Eastern shrublands and woodlands, corresponds with a separate EPBC ecological community listing, Shrublands and Woodlands of the eastern Swan Coastal Plain. Occurrences of this FCT should be considered under that separate listing.	Yes. The canopy comprises *Eucalyptus marginata*, with key diagnostic species *Banksia attenuata* and *Banksia ilicifolia* occurring throughout. A species poor native understorey was present in Community W1, with species including *Dasypogon bromeliifolius*, *Lyginia barbata* and *Trachymene pilosa* being scattered (isolated) across the site. Bare areas (unvegetated) were prevalent throughout Community W1. Weed species including **Briza maxima*, **Vulpia myros*, **Ursinia anthemoides* and **Ehrharta* spp. were compositionally dominant components of the understorey. This community does not represent FCT 20c – Eastern shrublands and woodlands.

Step	Key diagnostic characteristics (DotEE 2016)	Outcome
2	**Condition thresholds** Assessments of a patch should initially be centered on the area of highest native floristic diversity and/or cover, i.e. the best condition area of the patch. Consideration must be given to the timing of surveys and recent disturbance. Ideally surveys should be undertaken in spring with two sampling periods to capture early and late flowering species. The surrounding context of a patch must also be taken into account when considering factors that add to the importance of a patch that meets the condition thresholds. Certain vegetation components of the Banksia Woodlands ecological community merit consideration as critical elements to protect. Three components are recognised as threatened in their own right in WA and, as such, are priorities for protection; refer to Table 1 in the Approved Conservation Advice (DotEE 2016). A relevant expert (e.g. ecological consultant, local NRM or environment agency) may be useful to help identify the ecological community and its condition.	Yes. The W1 community was assessed and sampled in the highest condition represented and available in the study area. Structure and condition of the W1 community was similar throughout the broader patch (i.e. adjacent areas outside of the survey boundary). The survey was undertaken at an appropriate time to best capture the floristic composition of the survey area; including annual and cryptic flora species.
3	**Minimum patch size** Minimum patch sizes apply for consideration of a patch as part of the listed ecological community for EPBC Act referral, assessment and compliance purposes. Where patches meet different levels of condition, different minimum patch sizes apply: 'Pristine' – no minimum patch size applies 'Excellent' – 0.5 ha or 5,000 m2 (e.g. 50 m x 100 m) 'Very Good' – 1 ha or 10,000 m2 (e.g. 100 m x 100 m) 'Good' – 2 ha or 20,000 m2 (e.g. 200 m x 100 m). Note: To be considered as part of the EPBC Act ecological community, a patch should meet at least the Good Condition category.	Yes. Description and mapping of vegetation community W1 have been presented in Table 1 and Figure 2 respectively. The W1 community has been conservatively mapped as being in 'Good' condition. This score was based on an intact overstorey structure comprising the key diagnostic species *Banksia attenuata* and *Banksia ilicifolia*. It is duly recognised, however, that understorey values reflect a degraded state with weed species providing dominant cover. The W1 community has a total mapped extent of approx. 3.9 ha, with the broader associated patch being approximately 15 ha in size. Based on the aforementioned results, the W1 community satisfies the condition requirements of at

Step	Key diagnostic characteristics (DotEE 2016)	Outcome
		least a minimum of 2 ha of Good condition when considered in isolation from surrounding vegetation.
4	**Further information to assist in determining the presence of the ecological community and significant impacts.** The landscape position of the patch, including its position relative to surrounding vegetation also influences how important it is in the broader landscape. For example, if it enables movement of native fauna or plant material or supports other ecological processes A patch is a discrete and mostly continuous area of the ecological community. A patch may include small-scale (<30 m) variations, gaps and disturbances, such as tracks, paths or breaks. Where there is a break in native vegetation cover, from the edge of the tree canopy of 30 m or more (e.g. due to permanent artificial structures, wide roads or other barriers; or due to water bodies typically more than 30m wide) then the gap typically indicates that separate patches are present. Variation in canopy cover, quality or condition of vegetation across a patch should not initially be considered to be evidence of multiple patches. Patches can be spatially variable and are often characterised by one or more areas within a patch that meet the key diagnostic characteristics and condition threshold criteria amongst areas of lower condition. Average canopy cover and quality across the broadest area that meets the general description of the ecological community should be used initially in determining overall canopy cover and vegetation condition. Also note any areas that are either significantly higher or lower in quality, gaps in canopy cover and the condition categories that would apply across different parts of the site respectively. Where the average canopy cover or quality falls below the minimum thresholds, the next largest area or areas that meet key diagnostics (including minimum canopy cover requirements) and minimum condition thresholds should be specified and protected. This may result in multiple patches being identified within the overall area first considered. A buffer zone is a contiguous area immediately adjacent to a patch of the ecological community that is important for protecting its integrity. The purpose of the buffer zone is to help protect and manage the national threatened ecological community. The edges of a patch are considered particularly susceptible to disturbance and the presence of a buffer zone is intended to act as a barrier to further direct disturbance.	The degraded nature of the understorey and high proportion of weeds precluded more detailed FCT analysis being undertaken (e.g. comparisons with Gibson et al. 1994 dataset).

Step	Key diagnostic characteristics (DotEE 2016)	Outcome
	The recommended minimum buffer zone for the ecological community is 20–50 metres from the outer edge of a patch, and the appropriate size depends on the nature of the buffer and local context (e.g. slope). A larger buffer zone should be applied, where practical, to protect patches that are of particularly high conservation value, or if patches are down slope of drainage lines or a source of nutrient enrichment, or groundwater drawdown.	