
2 DESCRIPTION OF THE ENVIRONMENT AND MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

2.1 Description of Protected Matters within the Proposed Action Area

Matters of National Environmental Significance (MNES), listed under the EPBC Act that are, or have the potential to be, in the Proposal Area and surrounds include the following:

- Banksia Woodlands of the Swan Coastal Plain ecological community (Endangered) (Banksia Woodlands TEC)
- Clay Pans of the Swan Coastal Plain (Critically Endangered) (Clay Pans TEC)
- *Corymbia calophylla* - *Xanthorrhoea preissii* woodlands and shrublands of the Swan Coastal Plain (Endangered) (Corymbia Woodlands TEC)
- Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain ecological community (Critically Endangered)
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) (Vulnerable)
- Baudin's Cockatoo (*Calyptorhynchus baudinii*) (Endangered)
- Carnaby's Cockatoo (*Calyptorhynchus latirostris*) (Endangered)
- Western Ringtail Possum (*Pseudocheirus occidentalis*) (Critically endangered)
- Balston's Pygmy Perch (*Nannatherina balstoni*) (Vulnerable)
- Black-stripe Minnow (*Galaxiella nigrostriata*) (Endangered)
- Carter's Freshwater Mussel (*Westralunio carteri*) (Vulnerable)
- King Spider-orchid (*Caladenia huegelii*) (Endangered)
- Tall Donkey Orchid (*Diuris drummondii*) (Vulnerable)
- Dwarf Bee-orchid (*Diuris micrantha*) (Vulnerable)
- Glossy-leafed Hammer Orchid (*Drakaea elastica*) (Endangered)
- Dwarf Hammer-orchid (*Drakaea micrantha*) (Vulnerable)
- Keighery's Eleocharis (*Eleocharis keigheryi*) (Vulnerable).

2.2 Existing environment

2.2.1 Existing land use

The Proposal Area intersects 132 Crown, Freehold and Reserve land titles and 46 easements, plus a combination of Easement, Primary Road and Other (e.g. railway, water and vacant Crown land) lot types (Figure 3).

The Greater Bunbury Region Scheme (GBRS), legislated under the *Planning and Development Act 2005*, applies to land use in the Greater Bunbury Area. This Scheme comprises the City of Bunbury and Shires of Harvey, Dardanup and Capel.

The majority of land, 66.82 %, within the Proposal Area is zoned as Rural, within the GBRS. The Proposal Area also intersects land reserved as primary regional road (e.g. Forrest Highway, South Western Highway and Boyanup-Picton Road and the current BORR alignment as identified in the GBRS), railways (e.g. along South Western Highway and Boyanup-Picton Road), urban, urban deferred, regional open space and industrial.

2.2.2 Topography

Topography ranges from 5 – 25 m Australian Height Datum (AHD) with the more elevated areas associated with undulating dunes of Bassendean sands (20 – 25 m AHD) and the least elevated areas associated with drainage lines (5 – 10 m AHD).

2.2.3 Geology

The published surface geology (Geological Survey of WA, 2009) indicates that the predominant surface geological unit within the Proposal Area is the Guildford Formation, which comprises sandy clay and coffee rock.

The following surface geological units are shown to be present within isolated sections of the Proposal Area:

- Bassendean Sand: Described as low rounded dunes, this unit is underlain by the Guildford Formation throughout the Proposal Area
- Alluvium: Described as older river terraces, this unit is associated with the rivers and tributaries that occur within the Proposal Area
- Swamp deposits: Described as mainly consisting of peaty sand, this unit is underlain by the Guildford Formation throughout the Proposal Area.

They are also anticipated to be underlain by variably weathered rock at variable depths.

2.2.4 Soils

The Proposal Area occurs within the Swan Province and primarily intersects the Pinjarra Plain, with a lesser proportion intersecting the Bassendean dune and sandplain system. The Pinjarra Plain is described as a broad low relief plain west of the foothills, comprising predominantly Pleistocene fluvial sediments and some Holocene alluvium associated with major current drainage systems. Major soils are naturally poorly drained with many swamps.

The Bassendean dune and sandplain system is described as Pleistocene sand dunes with very low relief, leached grey siliceous sand, intervening sandy and clayey swamps and gently undulating plains. These occur west of, and partly overlie, the Pinjarra Plain (Barnesby, B. King, P. Proulx-Nixon, M., 1994).

The Proposal Area comprises primarily cleared agricultural land, with some remnant vegetation predominantly associated with road reserves and creek lines. The use of land for agriculture has impacted the terrestrial environment of the Proposal Area.

Twenty-nine (29) soil landscapes occur within the Proposal Area. The two best represented soil landscapes are Pinjarra P1b and P3 phases, which represent 22 % and 17 % of the Proposal Area respectively.

Acid sulfate soils

A review of the Acid Sulfate Soils (ASS) risk mapping for the Proposal Area (GoWA, 2019a) found the alignment is predominantly within areas mapped as Class 2, which indicate *'Moderate to low risk of ASS occurring within 3 m of natural soil surface, but high to moderate risk of ASS beyond 3 m of natural soil surface'* (BORR IPT, 2019c). In remaining areas, soils associated with the Brunswick, Collie and Ferguson rivers and floodplains were mapped as Class 1 areas indicating a *'High to moderate risk of ASS occurring within 3 m of natural soil surface'*.

A preliminary ASS investigation was undertaken by BORR IPT throughout the Proposal Area (BORR IPT, 2019c). Soil profiles, soil samples and groundwater samples were collected at each of the 21 test locations. Soil samples were collected at 0.5 m intervals or where significant changes within the soil profile were encountered. The water and soil samples were sent to a laboratory and screened for analytes that are indicative of ASS, including pH, chromium reducible sulphur and net acidity values.

The preliminary ASS investigation identified the presence of ASS within all soil units throughout the Proposal Area at depths ranging between 1.0 m and 5.5 m (investigation depth). The severity of ASS varied, with highest concentrations of sulfur located below the seasonal groundwater table.

The ASS encountered was consistent with the Guildford Formation and soil units formed by alluvial and fluvial deposition. Typically, exceedances were identified within sandy zones and potentially lenses within the ground conditions. Ferricrete gravels formed from sediments and cemented iron oxides were present in the southern portion of the Proposal Area. Due to the highly cemented nature of ferricrete, it is unlikely that significant acid release would occur from these materials.

The groundwater samples from each of the 21 test locations further confirmed the presence of ASS where laboratory results exceeded the ASS criteria (DER, 2015b). The analytes which exceeded the criteria were:

- Field pH, which was below the ASS criteria (5.0) at three locations spread over the length of the alignment (BORR MW18, BORR MW24 and BORR MW27)
- Total acidity concentrations, which were below the ASS criteria (40 mg/L) at 15 out of 21 test locations
- Total alkalinity concentrations, which were below the ASS criteria minimum (30 mg/L) at eight out of 21 test locations.

Contaminated sites

A review of the Contaminated Sites Database indicates that no publically available registered contaminated sites currently classified under the *Contaminated Sites Act 2003*, occur within 500 m of the Proposal Area (DWER, 2018a).

One land parcel, Lot 521 Boyanup-Picton Road, was historically used for the purposes of animal feed lotting (understood to be a piggery) and general livestock grazing. This land parcel intersects the Proposal Area at the intersection of Boyanup-Picton Road and the existing BORR Central section and is currently used for low intensity agriculture. A Basic Summary of Records (dated 1 August 2018) confirmed that the site has not been reported to DWER as a known or suspected contaminated site.

A high-level qualitative contaminated sites assessment was undertaken to further investigate this site in July 2018 (GHD, 2018). The qualitative contaminated sites assessment found that the location of the former piggery is considered the most likely contamination risk due to the likelihood of chemical usage, wastewater/effluent generation, landfilling and the potential for asbestos containing buildings materials in the main structures. It was recommended that further investigation of the site be undertaken prior to construction.

2.2.5 Groundwater

The Proposal Area is within the Bunbury Groundwater Area which is proclaimed under the *Rights in Water Irrigation Act 1914* (RIWI Act). The Proposal Area occurs across the Bunbury-Yarragadee, Kemerton South, Australind and Dardanup groundwater sub-areas. There are three main groundwater units underlying the Proposal Area:

- **Superficial aquifer:** the superficial layer is thin (5 – 40 m below ground level [bgl]) to absent and predominantly unconfined. The superficial formations consist of Bassendean sands, Guildford formation and Alluvium (west near Bunbury) and overlies the Leederville aquifer. This aquifer is recharged by direct infiltration of rainfall. Wetlands are often hydraulically connected to the superficial aquifer
- **Leederville aquifer:** the formation is confined and made up of interbedded sand and shale, with depth ranging from 15 – 300 m bgl. The aquifer is recharged by downward leakage from the overlying Superficial Aquifer and direct infiltration in areas where the aquifer outcrops

- **Yarragadee aquifer:** consists of weakly consolidated sandstone, siltstone and shale. The Yarragadee aquifer underlies the Leederville aquifer and is confined in the Proposal Area. The thickness of the aquifer ranges from 600 m to 1200 m. It is recharged by direct infiltration of rainfall on the Blackwood Plateau to the south, and through limited leakage from the overlying Leederville aquifer. The Bunbury Water Reserve draws its drinking supply from this aquifer (Department of Water, 2009; Department of Water, 2008).
- The Cattamarra Coal Measures is a fourth aquifer unit that has a minor occurrence in the north of the Proposal Area underlying the Leederville aquifer in the Kemerton South groundwater subarea.

Twenty-one (21) groundwater wells were installed throughout the Proposal Area in September/October 2018. Groundwater levels ranged from 5.48 – 17.1 m AHD (7.2 – 0.6 m bgl), and confirmed that the regional groundwater flow is in a westerly direction towards the Indian Ocean.

Groundwater within the Proposal Area and adjacent groundwater subareas is used predominantly for agriculture and public water supply. In the Dardanup sub area (the main sub area the Proposal Area coincides with) the water allocation for the superficial aquifer is fully allocated (use is stock, domestic and garden purposes). Groundwater from the Leederville aquifer is abstracted primarily for irrigated pasture (33 %), mining and industry (19 %), services including drinking water (18 %) and domestic, stock and garden purposes (15 %) (Department of Water, 2009).

2.2.6 Surface water

The Proposal Area is characterised by very low relief areas with poor drainage. Topography is generally 5 – 10 m AHD for the majority of the area, which is agricultural land that is subject to waterlogging through the winter months. The southern section of the Proposal Area consists of some elevated areas (20 – 25 m AHD) which are well drained (draining towards the Preston and Ferguson Rivers and tributaries).

The Proposal Area is intercepted by four rivers as well as numerous tributaries and minor drainage lines, including:

- Brunswick River – located adjacent to the Proposal Area at its northern extent and flows to the Collie River
- Collie River – flows to the Leschenault Estuary which is located 3.25 km west of the Proposal Area at the closet point
- Ferguson River – flows to the Preston River
- Preston River – flows to the Leschenault Estuary.

These four rivers all have amenity, recreation and cultural value. The Preston and Ferguson Rivers and tributaries are proclaimed under the RIWI Act and, the part of the Proposal Area that lies within the Leschenault Inlet Management Area is proclaimed under the *Waterways Conservation Act 1976*.

The Proposal Area is within the Collie River Irrigation District, with a network of open channels supplying irrigation water to the rural properties during summer. The rural properties within the Proposal Area are predominantly flood irrigated.

There are numerous drains through agricultural parts of the Proposal Area, which have been constructed to mitigate seasonal waterlogging and flooding. The Water Corporation owns and manages the larger drains and minor drains, which occur on private property.

Drainage systems from the existing road infrastructure within the Proposal Area includes local infiltration and water quality basins, and drains that ultimately discharge into the Collie River (runoff from Forrest Highway) and Millars Creek (runoff from South Western Highway) (BORR IPT, 2018).

Approximately 89 % of the Proposal Area is mapped as geomorphic wetlands, totalling 578.2 ha, and including 35 geomorphic wetlands that intersect the Proposal Area. The wetlands include:

- Six Conservation Category – Totalling 2.93 ha and 0.5 % of the Proposal Area

- Two Resource Enhancement –Totalling 0.77 ha and 0.1 % of the Proposal Area
- 26 Multiple Use –Totalling 573.78 ha and 88.2 % of the Proposal Area
- One Artificial Lake (management category not assessed) – Totalling 0.69 ha and 0.1 % of the Proposal Area.

A Drainage Strategy has been developed for the Proposal Area, in consultation with the Project Drainage Reference Group (DRG) (BORR IPT, 2018). The DRG is comprised of relevant stakeholders and was formed to investigate the opportunities, issues and options related to drainage and water management across the Proposal Area.

The objectives of the Drainage Strategy include:

- Minimisation of road user risk, including risk of injury or loss of life, by effective removal and disposal of surface runoff water from the pavement
- Protection of the existing and future built environment from flooding and water logging conditions. Prevention of adverse impacts where the existing built environment is already impacted by flooding. In areas where the existing ground is already water logged (i.e. in areas of palusplain), ponding adjacent the road formation should be minimised
- Maintenance of existing water cycle balance within the Proposal Area whilst also improving the surface and groundwater quality.

DWER has provided the following in principle support for the Drainage Strategy (Pers comm. Krish Seewraj, Planning Advice Program Manager South West Region, DWER, 4 February 2019):

- The DWER supports in principle the drainage strategy for the Northern and Central sections of the Bunbury Outer Ring Road project. No fatal flaws or areas of concern were identified with what was both discussed prior to and presented at the Drainage Reference Group on the 4th December 2018
- The detail will be assessed as the design is progressed, with a focus on: ensuring minimum impact to the flood regime of the Wanju and Waterloo District Structure plans; limiting impacts to the flood regime in other developed areas or areas zoned to be developed; protection of foreshores of major rivers which are being crossed, ensuring that discharge pathways have been designed to mitigate erosion risks; and ensuring that buffer distances to receiving water resources have been appropriately assessed (as per discussions at the Drainage Reference Group on the 1st August 2018).

There is a risk of direct impacts to wetlands and waterways as a result of the Proposal. However, it is expected that the surface water hydrology can be maintained in its current regime with appropriate drainage design.

2.2.7 Vegetation and flora

2.2.7.1 Broad vegetation

The Proposal Area is located in the Swan Coastal Plain (SCP) Bioregion and Perth Subregion (SWA02) as described by the Interim Biogeographic Regionalisation for Australia (IBRA). The Perth Subregion is dominated by *Banksia* or Tuart on sandy soils, *Casuarina obesa* on outwash plains and paperbark in swampy areas. In the east, the plain rises to duricrusted Mesozoic sediments dominated by Jarrah woodland. The outwash plains, once dominated by *C. obesa* – Marri woodlands and *Melaleuca* shrublands, are extensive only in the south (Mitchell, Williams, & Desmond, 2002).

Broad scale (1:250,000) pre-European vegetation mapping of the area has been completed by Beard (1979) at an association level. This indicates that the Proposal Area intersects three vegetation associations:

- Mosaic: Medium forest; Jarrah-Marri / Low woodland; *Banksia* / Low forest; Teatree (*Melaleuca* spp.) (association 1000) – occurs in the northern and southern extent of the Survey Area

- Medium woodland; *Eucalyptus rudis* and *Melaleuca raphiophylla* (association 1182) – occurs near the Collie River in the northern section of the Survey Area
- Medium Woodland; Jarrah, Marri and Wandoo (association 968) – occurs throughout the central section of the Survey Area.

Regional vegetation has been mapped by Heddle *et al.* (1980) and Webb *et al.* (2016) based on major geomorphic units on the SCP and identifies four vegetation complexes within the Proposal Area:

- Bassendean Complex – Central and South: Vegetation ranges from woodland of *Eucalyptus marginata* (Jarrah) – *Allocasuarina fraseriana* (Sheoak) – Banksia species to low woodland of *Melaleuca* species, and sedgelands on the moister sites. Occurs in the northern extent of the Proposal Area to Raymond Road
- Southern River Complex – Open woodland of *Corymbia calophylla* (Marri) – *Eucalyptus marginata* (Jarrah) – Banksia species on elevated areas and a fringing woodland of *Eucalyptus rudis* (Flooded Gum) – *Melaleuca raphiophylla* (Swamp Paperbark) along streams. South of the Murray River *Agonis flexuosa* (Peppermint) occurs in association with the Flooded Gum and Swamp Paperbark. Occurs in the northern and southern extent of the Proposal Area along the eastern margin
- Swan Complex – Fringing woodland of *Eucalyptus rudis* (Flooded Gum) – *Melaleuca raphiophylla* (Swamp Paperbark) with localised occurrence of low open forest of *Casuarina obesa* (Swamp Sheoak) and *Melaleuca cuticularis* (Saltwater Paperbark). Occurs in a band near the Collie River and Preston River
- Guilford Complex – A mixture of open forest to tall open forest of *Corymbia calophylla* (Marri) - *Eucalyptus wandoo* (Wandoo) – *Eucalyptus marginata* (Jarrah) and woodland of *Eucalyptus wandoo* (Wandoo) (with rare occurrences of *Eucalyptus lane-poolei* (Salmon White Gum)). Minor components include *Eucalyptus rudis* (Flooded Gum) – *Melaleuca raphiophylla* (Swamp Paperbark). Occurs through the central section of the Survey Area.

2.2.7.2 Flora

The flora and vegetation values are primarily derived from the flora and vegetation report (BORR IPT, 2020c). The flora and vegetation report presents the findings of a detailed flora and vegetation assessment of a broader Survey Area (1,128 ha) that encompasses the entirety of the Proposal Area (625 ha) (Appendix D) BORR IPT (2020c).

The flora and vegetation report included a desktop assessment and review of previous flora and vegetation assessments undertaken within the Survey Area or in close proximity to the Proposal. A detailed vegetation and flora assessment of the Survey Area was conducted in August, September (spring) and November 2018. The field survey was undertaken to verify the results of the desktop assessment, identify and describe the dominant vegetation units, assess vegetation condition, and identify and record vascular flora species present at the time of survey. Searches for conservation significant or other significant ecological communities and flora species were also undertaken during the field survey. A targeted Tall Donkey Orchid survey was completed in December 2018

A *Phytophthora* dieback survey for the Survey Area was completed (Great Southern Bio Logic, 2018) to inform the assessment of the condition of vegetation units identified.

Subsequent to the referral of the Proposal to the WA EPA and DAWE, additional floristic and vegetation surveys were undertaken. A targeted *Drakaea* survey of selected sites was completed in August 2019. In response to additional information requested by the DAWE and WA EPA, a targeted survey for Banksia Woodland TEC and confirmation of vegetation types in previously unsurveyed gaps in the survey area was completed in August 2019. Ecoedge (2019a) also undertook a Clay Pans TEC assessment in July-August 2019 (Table 2-1) specific to the EPA request for additional information.

BORR IPT (2020c) recorded 414 flora taxa (including subspecies and varieties and unidentified species), representing 70 families and 210 genera during the field survey. This total comprised 299 native taxa and 115 introduced / planted flora taxa.

Dominant families recorded from the Survey Area included:

- Fabaceae (48 taxa including 16 introduced taxa)
- Myrtaceae (40 taxa including 10 planted species)
- Orchidaceae (32 taxa including one introduced species)
- Cyperaceae (32 taxa including three introduced)
- Poaceae (29 taxa including 20 introduced species).

Desktop searches of the EPBC Act Protected Matters Search Tool (PMST), NatureMap, Department of Biodiversity, Conservation and Attractions (DBCA) Threatened and Priority Flora List (TPFL) and Western Australian Herbarium (WAHERB) databases identified the presence/potential presence of 50 conservation significant flora taxa within BORR IPT (2020c) Survey Area (including a 5 km buffer). This included 18 taxa listed under the EPBC Act and/or as Threatened under the *Biodiversity Conservation Act 2016* (BC Act) and 32 listed as Priority species by the DBCA.

The field survey did not record any EPBC Act or BC Act listed flora. Five DBCA Priority-listed flora species were recorded within the Survey Area during the field survey (*Shoenus* aff. *Loliaceus* – Priority 2, *Chamaescilla gibsonii* – Priority 3, *Acacia semitrullata* – Priority 4, *Caladenia speciosa* – Priority 4 and *Eucalyptus rudis* subsp. *cratyantha* – Priority 4).

The likelihood of occurrence assessment, post-field survey, concluded that five species are known to occur (including one species not identified in the desktop assessment) within the broader Survey Area and 16 species possibly occur within the Survey Area.

2.2.7.3 Introduced and invasive species

One hundred and fifteen introduced flora taxa were recorded in the Survey Area (BORR IPT, 2020c). Of the introduced taxa, five are listed as Declared Pests under the *Biosecurity and Management Act 2007* and/or as a Weeds of National Significance (WONS):

- * *Asparagus asparagoides* (Bridal Creeper) – Declared Pest and WONS
- * *Gomphocarpus fruticosus* (Narrowleaf Cottonbush) – Declared Pest
- * *Moraea flaccida* (One-leaf Cape Tulip) – Declared Pest
- * *Solanum linnaeanum* (Apple of Sodom) – Declared Pest
- * *Zantedeschia aethiopica* (Arum lily) – Declared Pest.

The remaining introduced taxa are considered environmental weeds and all have been previously recorded on the SCP. The locations of the declared weeds are included in Appendix D.

2.2.7.4 Vegetation types

The Vegetation and Flora Study undertaken for the BORR Northern and Central Sections describes the Proposal Area as being extensively cleared for agriculture with native vegetation occurring within road reserves, along rivers and creeklines, in patches on private land and as scattered trees (BORR IPT, 2020c). This study has been included in Appendix D.

The Proposal Area includes 25 vegetation types as well as highly disturbed areas, non-native vegetation and revegetation / regrowth, of which 23 occur within the Proposal Area. These vegetation types are outlined in Table 2-1 and Figure 5 within Appendix A. The vegetation condition within the Survey Area was rated from Excellent to Completely Degraded. The great majority of the Survey Area was rated as Degraded to Completely Degraded (95.9%). These areas typically included small, disjunct patches within paddocks that had scattered trees but lacked structure (BORR IPT, 2020c).

Table 2-1 Vegetation types and extent within the Proposal Area

ID	VEGETATION TYPE	VEGETATION TYPE DESCRIPTION	EXTENT WITHIN THE PROPOSAL AREA (HA)	CONDITION
HM-VT1	Highly modified vegetation	This includes areas such as existing roads, firebreaks and tracks, buildings, yards and agricultural paddocks. These areas are either devoid of vegetation or are dominated by introduced grasses and herbs.	508	Completely Degraded
NN-VT2	Non-native vegetation	Non-native planted vegetation, including planted <i>Eucalyptus</i> species along internal fence lines and driveways, Blue gum plantations and landscaping.	24	Completely Degraded
R/P-VT3	Revegetation / Regrowth / Planted	This includes revegetation as well as areas planted with a mixture of native and non-native vegetation. There are scattered remnant trees occasionally present (including <i>Corymbia calophylla</i> , <i>Eucalyptus marginata</i> , <i>E. rudis</i> , <i>E. gomphocephala</i> (uncommon), <i>Agonis flexuosa</i> , <i>Casuarina obesa</i> and <i>Melaleuca</i> species) with revegetation undertaken in the understorey. Common shrubs include <i>Melaleuca nesophila</i> , <i>M. lanceolata</i> , <i>Kunzea glabrescens</i> and <i>Acacia saligna</i> . Non-endemic species present include: <i>*Corymbia citriodora</i> , <i>*Eucalyptus cladocalyx</i> , <i>*E. botryoides</i> and <i>E. lane-polei</i> (native to South West but not naturally occurring in study area). The understorey was mostly dominated by introduced grasses and herbs.	19	Good to Degraded
ErMr-VT4	Low woodland of <i>Eucalyptus rudis</i> and <i>Melaleuca raphiophylla</i>	Woodland to very open woodland of <i>Eucalyptus rudis</i> and <i>Melaleuca raphiophylla</i> (occasionally <i>Melaleuca preissiana</i>) over mixed sedgeland over introduced grasses and herbs.	13	Degraded to Completely Degraded

ID	VEGETATION TYPE	VEGETATION TYPE DESCRIPTION	EXTENT WITHIN THE PROPOSAL AREA (HA)	CONDITION
MpKgS-VT5	Woodland of <i>Melaleuca preissiana</i> / <i>Kunzea glabrescens</i> over mixed sedgeland	Woodland of <i>Melaleuca preissiana</i> with scattered <i>Corymbia calophylla</i> in higher elevation areas. The shrubland to open shrubland is dominated by <i>Kunzea glabrescens</i> , <i>Xanthorrhoea brunonis</i> and <i>Acacia pulchella</i> var. <i>glaberrima</i> over sedgeland of <i>Lepidosperma longitudinale</i> , <i>L. pubisquameum</i> and <i>Schoenus efoliatus</i> .	0.3	Very Good to Degraded
Mr-VT6	Very open woodland of <i>Melaleuca raphiophylla</i> over introduced grasses and herbs in paddocks and road reserves	Woodland to very open woodland of <i>Melaleuca raphiophylla</i> (occasionally <i>M. preissiana</i>) over introduced grasses and herbs.	19	Good to Completely Degraded
MpKg-VT7	Woodland of <i>Melaleuca preissiana</i> and <i>Kunzea glabrescens</i> in damplands	Woodland to closed woodland of <i>Melaleuca preissiana</i> and <i>Kunzea glabrescens</i> over an open grassland / sedgeland / open herbland.	2	Good to Degraded
MrCcEr-VT8	Mosaic of <i>Melaleuca raphiophylla</i> , <i>Corymbia calophylla</i> and <i>Eucalyptus rudis</i> woodland	Mosaic of vegetation types VT4 and VT17. This vegetation type occurs in road reserves where a mosaic of scattered trees of <i>Melaleuca raphiophylla</i> , <i>Corymbia calophylla</i> and <i>Eucalyptus rudis</i> occur over a ground-layer dominated by introduced grasses.	4	Degraded to Completely Degraded
MrAsVjXp-VT21	Low closed forest of <i>Melaleuca raphiophylla</i> (sometimes with emergent <i>Eucalyptus rudis</i>)	Low closed forest of <i>Melaleuca raphiophylla</i> (sometimes with emergent <i>Eucalyptus rudis</i>) over tall shrubland of <i>Acacia saligna</i> , <i>Viminaria juncea</i> and <i>Xanthorrhoea preissii</i> over herbland, sedgeland and grassland.	0.2	Good to Degraded
ErCcMr-VT9	Woodland of <i>Eucalyptus rudis</i> and <i>Corymbia calophylla</i> over <i>Melaleuca raphiophylla</i>	Woodland of <i>Eucalyptus rudis</i> and <i>Corymbia calophylla</i> over <i>Melaleuca raphiophylla</i> over grassland / herbland.	1	Degraded to Completely Degraded

ID	VEGETATION TYPE	VEGETATION TYPE DESCRIPTION	EXTENT WITHIN THE PROPOSAL AREA (HA)	CONDITION
ErMrCo-VT10	Woodland of <i>Melaleuca raphiophylla</i> , <i>Eucalyptus rudis</i> and <i>Casuarina obesa</i> ; fringing vegetation along Collie River	Woodland of <i>Melaleuca raphiophylla</i> , <i>Eucalyptus rudis</i> and <i>Casuarina obesa</i> over sedgeland of <i>Juncus</i> species over grassland of introduced species.	2	Good to Degraded
CcErAf-VT11	Open Forest of <i>Corymbia calophylla</i> and <i>Eucalyptus rudis</i> over <i>Agonis flexuosa</i> along the Preston River	Open forest of <i>Corymbia calophylla</i> and <i>Eucalyptus rudis</i> over <i>Agonis flexuosa</i> over scattered shrubs of <i>Acacia pulchella</i> , <i>Hardenbergia comptoniana</i> and <i>Macrozamia riedlei</i> over hermland and open grassland.	2	Good to Completely Degraded
HvMIMpVjXp-V13c	Shrubland of <i>Acacia incurva</i> , <i>A. saligna</i> , <i>Hakea varia</i> , <i>Hypocalymma angustifolium</i> , <i>Melaleuca lateritia</i> , <i>M. pauciflora</i> , <i>Olearia elaeophila</i> and <i>Xanthorrhoea preissii</i>	Shrubland of <i>Acacia incurva</i> , <i>A. saligna</i> , <i>Hakea varia</i> , <i>Hypocalymma angustifolium</i> , <i>Melaleuca lateritia</i> , <i>M. pauciflora</i> , <i>Olearia elaeophila</i> and <i>Xanthorrhoea preissii</i> with emergent tall shrubs of <i>Viminaria juncea</i> over sedgeland of <i>Leptocarpus roycei</i> and <i>Schoenus</i> sp. and open hermland of <i>Agrostocrinum scabrum</i> subsp. <i>scabrum</i> , <i>Borya sphaerocephala</i> , <i>Cycnogeton lineare</i> , <i>Drosera erythrorhiza</i> , <i>Haemodorum simplex</i> and <i>Opercularia vaginata</i> on yellow-brown clay.	0.4	Excellent, Very Good, Good to Degraded
AsVjXp-VT13d	Scattered tall shrubs of <i>Acacia saligna</i> , <i>Viminaria juncea</i> and <i>Xanthorrhoea preissii</i>	Scattered tall shrubs of <i>Acacia saligna</i> , <i>Viminaria juncea</i> and <i>Xanthorrhoea preissii</i> , with occasional <i>Melaleuca raphiophylla</i> trees over grassland on yellow-brown clay loam.	0.4	Degraded to Completely Degraded
CcAf-V14	Woodland of <i>Corymbia calophylla</i> and <i>Agonis flexuosa</i> over weedy grass and hermland	Woodland of <i>Corymbia calophylla</i> and <i>Agonis flexuosa</i> with occasional <i>Eucalyptus marginata</i> typically over introduced grasses and herbs.	1	Good to Completely Degraded
CcEm-VT15	Open woodland of <i>Corymbia calophylla</i> and <i>Eucalyptus marginata</i> over introduced	Woodland of <i>Corymbia calophylla</i> and <i>Eucalyptus marginata</i> with occasionally a lower tree layer of <i>Agonis flexuosa</i> over a shrubland of <i>Kunzea glabrescens</i> , <i>Xylomelum occidentale</i> and <i>Xanthorrhoea brunonis</i> over a grassland of introduced grasses.	12	Good to Completely Degraded

ID	VEGETATION TYPE	VEGETATION TYPE DESCRIPTION	EXTENT WITHIN THE PROPOSAL AREA (HA)	CONDITION
	grasses in road reserves and paddocks			
CcXp-VT15b	Open woodland to scattered trees of <i>Corymbia calophylla</i> over an open shrubland of <i>Xanthorrhoea preissii</i> , <i>Hypocalymma angustifolium</i> and <i>Hakea varia</i>	Open woodland to scattered trees of <i>Corymbia calophylla</i> over an open shrubland of <i>Xanthorrhoea preissii</i> , <i>Hypocalymma angustifolium</i> and <i>Hakea varia</i> over <i>Cyathochaeta avenacea</i> , <i>Lepidosperma apricola</i> and <i>Mesomelaena tetragona</i> open sedges and open grassland in road reserves.	1	Good to Completely Degraded
CcErMr – VT15c	Woodland of <i>Casuarina obesa</i> , <i>Eucalyptus rudis</i> and <i>Melaleuca raphiophylla</i>	Woodland of <i>Casuarina obesa</i> , <i>Eucalyptus rudis</i> and <i>Melaleuca raphiophylla</i> over open shrubland of <i>Astartea scoparia</i> , <i>Melaleuca incana</i> , <i>M. lateritia</i> over open herbland of <i>*Watsonia meriana</i> (with <i>Cassytha racemosa</i> , a climber), open grassland and scattered sedges of <i>Ficinia nodosa</i> and <i>Leptocarpus roycei</i> on redbrown clay.	0.2	Excellent, Very Good, Good to Completely Degraded
Af-VT16	<i>Agonis flexuosa</i> closed woodland over pasture grasses	<i>Agonis flexuosa</i> woodland to closed woodland over introduced grasses.	6	Good to Completely Degraded
Er-VT17	Scattered <i>Eucalyptus rudis</i>	Scattered trees of <i>Eucalyptus rudis</i> over grassland of introduced grasses.	1	Degraded to Completely Degraded
EspAfMsp–VT18	Isolated trees of <i>Eucalyptus</i> species / <i>Agonis flexuosa</i> and <i>Melaleuca</i> species in paddocks	Isolated trees of <i>Eucalyptus</i> (<i>E. marginata</i> / <i>E. rudis</i> and <i>Corymbia calophylla</i>), <i>Agonis flexuosa</i> or <i>Melaleuca raphiophylla</i> in paddocks or road reserves.	5	Degraded to Completely Degraded

ID	VEGETATION TYPE	VEGETATION TYPE DESCRIPTION	EXTENT WITHIN THE PROPOSAL AREA (HA)	CONDITION
EmAfBaBi–VT19	Woodland of <i>Eucalyptus marginata</i> over <i>Agonis flexuosa</i> , <i>Banksia attenuata</i> and <i>B. ilicifolia</i>	Woodland of <i>Eucalyptus marginata</i> and <i>Corymbia calophylla</i> with lower tree layer of <i>Agonis flexuosa</i> , <i>Banksia attenuata</i> and <i>B. ilicifolia</i> . The diverse shrubland (when present) was dominated by <i>Hibbertia racemosa</i> , <i>Macrozamia riedlei</i> and <i>Xanthorrhoea brunonis</i> over herbland / sedgeland including <i>Desmocladius fasciculatus</i> , <i>Lomandra</i> species and <i>Dasyopogon bromeliifolius</i> . Introduced grass species were common.	3	Very good to Completely Degraded
EmBKg – VT20	Woodland of <i>Eucalyptus marginata</i> , <i>Banksia</i> spp., <i>Kunzea glabrescens</i>	<i>Eucalyptus marginata</i> woodland with <i>Banksia ilicifolia</i> and <i>Banksia attenuata</i> low woodland over <i>Kunzea glabrescens</i> , <i>Xanthorrhoea brunonis</i> and <i>Acacia pulchella</i> var. <i>glaberrima</i> over sedgeland / herbland of <i>Lomandra caespitosa</i> , <i>Hypolaena exsulca</i> and <i>Lyginia barbata</i> . Introduced grass species including <i>*Ehrharta</i> species and <i>*Briza maxima</i> . This community was noted by Great Southern Biologic (Great Southern Bio Logic, 2018) as being dieback infested.	0.5	Good to Degraded
Total			625	

2.2.8 Fauna

Six broad habitat types were identified by Biota (2020) within the Proposal Area (Appendix D):

- Marri/ Eucalyptus woodland
- Marri/Eucalyptus in paddocks and road reserves
- Dampland with Melaleuca woodland and shrubland
- Riparian woodland
- Peppermint woodland
- Artificial wetland.

In addition, three low value habitat types considered to be largely devoid of fauna habitat were described as: highly modified/ cleared, cleared with early revegetation, and non-native vegetation (including large blue gum plantation) (Biota, 2020).

Biota (2020) completed a desktop review of relevant databases and four previous fauna studies within 10 km of the Survey Area. The database search indicated a combined species inventory of 230 vertebrate fauna species, comprising 28 mammals (14 native non-volant, five bat and nine non-native), 159 birds (72 of which are largely reliant on freshwater or marine habitats), 33 reptiles and 10 amphibians (Appendix D).

More than 920 individual fish were caught during the 2018 aquatic study (WRM, 2020) (Appendix E). Native aquatic fauna recorded included:

- Six native fish species (including the BSM)
- Two southwest endemic freshwater crustacean species (gilgie, *Cherax quinquecarinatus*, and smooth marron, *Cherax cainii*)
- South-western snake-necked turtles, *Chelodina colliei* (listed on the IUCN Redlist of Threatened Species as Near Threatened).
- 21 introduced fauna species, including birds, mammals, fish and crustaceans were recorded within 10 km of the wider Survey Area.

Additional targeted aquatic fauna surveys were undertaken in 2019 to further survey habitat and presence for CFM and BSM.

Searches of the EPBC Act Protected Matters database, DBCA NatureMap database and four previous studies identified the presence/ potential presence of 19 conservation significant fauna species within 10 km of the wider Survey Area. The desktop searches undertaken by Biota (2020) recorded:

- 34 species listed under the EPBC Act
- 46 migratory birds protected under international agreement (Schedule 5)
- Six species listed under the EPBC Act were directly and indirectly observed within the broader Survey Area by Biota (2020) and WRM (2020), including:
 - Baudin’s Cockatoo
 - Carnaby’s Cockatoo
 - Forest Red-tailed Black Cockatoo
 - Western Ringtail Possum
 - Black-stripe Minnow
 - Carter’s Freshwater Mussel.

Threatened fauna observations within the Proposal Area and contextual sites are shown in Figure 8 through Figure 12 (Appendix A).

2.3 Technical reports

Following referral of the Proposal in June 2019, additional surveys targeting threatened fauna species identified as occurring within the Proposal Area were undertaken to address the request for additional information (October 2019). The previous and additional studies are summarised in Table 2-2.

Table 2-2 Studies and surveys relevant to the Proposal

SURVEY / REPORT NAME	LOCATION / EXTENT IN SURVEY AREA	METHODOLOGY
Surveys undertaken for the Proposal prior to referral		
Vegetation and Flora		
Bunbury Port Access Road Project Stage 2 – Flora and Vegetation Survey (GHD, 2010)	Near Boyanup Picton Road to South Western Highway. Two survey areas overlap the current Proposal Area.	Survey completed on the 13, 14 and 17 October and the 4 – 5 November 2009. The survey included vegetation type and condition mapping.
Lot 1 Ducane Road, Environmental Values Assessment (GHD, 2014)	Survey of Lot 1 Ducane Road (40.5 ha) – which is located approximately 2.5 km south-west of the current Survey Area.	Survey on the 13 June 2013. This survey included vegetation mapping and quadrat based sampling.
Dardanup Structure Plan (GHD, 2015a)	Approximately 2,700 ha between Collie River and approximately Boyanup Picton Road. The Structure Plan Study Area boundaries overlap the current Survey Area.	Two season flora survey in accordance with EPA guidelines at the time of survey (EPA, 2004b). Late winter (13 – 14 August 2014) and mid-spring (30 – 31 October 2014). Vegetation type and condition mapping based on quadrats and opportunistic records. Searches for conservation significant flora.
BORR South Flora Survey (GHD, 2015b)	Survey for BORR South Project Area. This occurs immediately south of the current Survey Area and is used to provide context. Two quadrats are within the current Survey Area.	Survey completed on 21 – 23 September 2011 and 16 – 18 June 2014. Level 2 flora and vegetation survey including quadrat sampling, targeted searches and vegetation type / condition mapping.
Reassessment of Floristic Communities (Biota, 2016)	Target areas within BORR South alignment. Two quadrats are within the current Survey Area.	Additional quadrats and re-analysis of the Floristic Community Types (FCTs) presented in GHD (2015b). Surveys carried out in September 2016.
Banksia TEC Assessment for BORR South (Biota, 2018)	24 target areas within BORR South area and surrounds. This report also provides context for the Banksia TEC assessment. Three target sites are located south-west of the current	Walking transects and quadrats within the target sites. Surveys carried out in November 2017.

SURVEY / REPORT NAME	LOCATION / EXTENT IN SURVEY AREA	METHODOLOGY
	Survey Area. The closest target site is approximately 3 km south-west of the current Survey Area.	
A Flora and Vegetation survey on Lot 104 Willinge Drive Davenport (Ecoedge, 2018)	Survey of the 83.3 ha within Lot 104 (North east of the Preston River). The Study Area boundary intersects the Proposal Area.	Survey carried out on 30 October and 2 and 3 November 2017. Vegetation type and condition mapping and species lists presented.
Bunbury Outer Ring Road North – Phytophthora Dieback Occurrence Survey (Great Southern Bio Logic, 2018)	BORR Northern and Central Sections alignment.	Visual diagnosis of disease supported by laboratory assessment of soil and tissue samples within areas of assessable remnant vegetation.
BORR Northern and Central Sections Drainage Strategy 2018 (BORR IPT, 2018)	BORR Northern and Central Sections alignment.	Outlines broad strategies for management of surface water throughout the Proposal Area, including flood mitigation and maintaining surface water flows to wetlands and agricultural land.
Fauna		
Western Ringtail Possum: <i>Pseudocheirus occidentalis</i> Regional Surveys (Biota, 2019) (in prep)	Local vicinity of Northern, Central, and Southern Section alignments and buffering context area.	Focussed Regional surveys from December of 2019 through December 2020. Surveys including radio tagging for home range assessments, trapping and survey of potential offset areas and other local context sites to better define local movement of populations.
Further surveys undertaken for Proposal following referral to provide supplementary information		
Vegetation and Flora		
BORR Northern and Central Sections Vegetation and Flora Study (BORR IPT, 2020c)	Detailed flora and vegetation assessment of 1,128 ha, including the Proposal Area.	Detailed vegetation and flora survey was undertaken from 20 August 2018 to 19 December 2018. Targeted surveys were undertaken from 19 to 30 August 2019. The survey included late winter, early spring, mid-spring, late spring and summer survey periods.
Bunbury Outer Ring Road Central and Northern Sections Claypan TEC Assessment Survey Report 2019 (Ecoedge, 2019b) –	Within the locality of Waterloo, in the BORR Northern and Central Sections alignment.	Survey carried out on 26 July to 1 August 2019. Condition, hydrology and species diversity were assessed to confirm whether the vegetation met the floristic and condition thresholds of the Clay Pans TEC. Results informed the avoidance,

SURVEY / REPORT NAME	LOCATION / EXTENT IN SURVEY AREA	METHODOLOGY
included in (BORR IPT, 2020c)		management, mitigation and monitoring actions.
A Review of the Regional Conservation Status of a Clay-based Wetland Community (Claypans) (Ecoedge, 2019a) in (BORR IPT, 2020c)	Region defined as on the SCP within Harvey, Bunbury, Capel, Dardanup and Busselton local government areas	Desktop and field assessments conducted in August 2019.
Fauna		
Bunbury Outer Ring Road Northern and Central Section Targeted Fauna Assessment (Biota, 2020)	Targeted habitat survey encompassing the 624.24 ha Proposal Area and 444.21 ha buffering context area.	Targeted field surveys carried out between August and December of 2019 for conservation significant Black Cockatoo species, WRP, and CFM Survey.
Bunbury Outer Ring Road Northern and Central Investigation Area: Targeted Conservation Significant Aquatic Fauna Survey (WRM, 2020)	Targeted aquatic fauna survey within seasonal wetlands and creeks within the Proposal Area.	Winter (19 - 23 August 2019) targeted conservation significant aquatic fauna survey.

2.4 Threatened ecological communities

Implementation of the Proposal will result in the clearing of up to 73 ha of vegetation and 19 ha of revegetation (~15% of the Proposal Area combined) within the 625 ha Proposal Area. An estimated 3.7 ha of this vegetation comprises vegetation representative of TECs, of which 3.1 ha is situated on private land and 0.62 ha is within road reserve.

Occurrences of three TECs have been identified within the Proposal Area, as detailed below. The corresponding Floristic Community Type (FCT) as identified by (Gibson, N., Keighery, B.J., Keighery, G.J., Burbridge, A.H. and Lyons, M.N., 1994), is also noted.

- Banksia Woodlands TEC (FCT21a)
- Clay Pans TEC (FCT 08)
- Corymbia Woodlands TEC (FCT3c)

Potential impacts from Proposal implementation include direct impacts through clearing (including the loss of TEC vegetation) and indirect impacts such as the introduction or spread of weeds and / or *Phytophthora* dieback.

The extent of TECs that are likely to be directly impacted by the Proposal are shown in Figure 6 (Appendix A). TEC occurrences that may potentially be indirectly impacted are shown in Figure 7 (Appendix A).

2.4.1 Banksia Woodlands TEC – Endangered

A description of this ecological community, along with likely direct and potential indirect impacts from the Proposal, is outlined in Table 2-3.

Table 2-3 Banksia Woodlands TEC – Endangered

ASPECT	DESCRIPTION
<p>Ecology, abundance, distribution and habitat preferences</p>	<p><u>Ecology</u></p> <p>Banksia Woodlands TEC was listed as an Endangered TEC under the EPBC Act in September 2016. The Threatened Species Scientific Committee (TSSC) (2016) describes the key structural features of the community as:</p> <ul style="list-style-type: none"> • A prominent tree layer of Banksia, with scattered eucalypts and other tree species often present among, or emerging above, the canopy • The understorey is a species rich mix of sclerophyllous shrubs, graminoides and forbs • High endemism and considerable localised variation in species composition across its range. <p>The community is a low woodland to forest, but may also include shrubland, open woodland or forest under some classification systems. The percentage canopy cover is more than 2% and typically less than 50%. The structure and appearance may also vary due to disturbance history (TSSC, 2016).</p> <p>The canopy is commonly dominated by <i>Banksia attenuata</i> and or <i>B. menziesii</i>. Other <i>Banksia</i> species that dominate include <i>B. prionotes</i> or <i>B. ilicifolia</i>. The patch must include at least one of these diagnostic species (TSSC, 2016).</p> <p><u>Abundance</u></p> <p>The current statewide extent of Banksia Woodlands TEC as of 2015 is estimated to be 336,489.9 ha (TSSC, 2016).</p> <p><u>Distribution</u></p> <p>The Banksia Woodlands TEC occurs within the SCP IBRA Bioregion within the subregions of Dandaragan, Perth and Jarrah Forests. It typically occurs on well drained, low nutrient soils on sandplains landforms, particularly in deep Bassendean and Spearwood sands and occasionally on Quindalup sands (TSSC, 2016).</p> <p><u>Critical Habitat</u></p> <p>Areas considered critical to the survival of the Banksia Woodlands TEC cover all patches that meet the key diagnostic characteristics and condition thresholds for the ecological community, plus the buffer zones, particularly where this comprises surrounding native vegetation. This is because this ecological community occurs in a landscape that has often been very heavily cleared and modified, and now exists as mostly very small and highly fragmented patches (TSSC, 2016).</p> <p><u>Threats</u></p> <p>Key threats to the TEC identified in the Approved Conservation Advice (TSSC, 2016) include clearing and fragmentation, dieback, invasive species, changes</p>

ASPECT	DESCRIPTION
	<p>to fire regime, hydrological degradation, climate change, grazing, decline in pollination and seed dispersing fauna, and loss of keystone Banksia species.</p> <p><u>Description of this TEC vegetation within the Proposal Area</u></p> <p>Vegetation types VT19 and VT20 (EmAfBaBi–VT19 and EmBKg–VT20) mapped by BORR IPT (2020c) were considered to be potentially representative of the Banksia Woodland TEC, however, not all occurrences of these vegetation types are considered to be TEC as they do not meet the patch size/condition thresholds for the TEC as defined in TSSC (2016). These vegetation types were inferred to be FCT21a.</p> <p><u>Extent within and adjacent to the Proposal Area</u></p> <p>Up to 3.7 ha of vegetation representing Banksia Woodland TEC was identified within the Proposal Area, all of which was inferred to be FCT21a. A further 2.67 ha is located within 20 m of the Proposal Area boundary, as detailed below (indirect impact) (BORR IPT, 2020c).</p> <p>Occurrences within the Proposal Area are listed below and shown in Figure 6, (Appendix A), and those directly adjacent to the Proposal Area are shown in Figure 7 (Appendix A).</p>
Direct impact (ha)	<p>Up to 3.7 ha of Banksia Woodlands TEC vegetation within the Proposal Area would be cleared as a result of Proposal implementation, all of which is located near Paris Road / Clifton Road interchange (Figure 6, Appendix A).</p> <p>The Banksia Woodlands TEC vegetation within the Proposal Area is split across three sites:</p> <ul style="list-style-type: none"> • Site BW-N-D-1: Forrest Highway road reserve northbound, north of Paris Road adjacent to Kingston Estate <ul style="list-style-type: none"> – 0.47 ha of Woodland of <i>Eucalyptus marginata</i>, <i>Banksia</i> spp., <i>Kunzea glabrescens</i> (0.34 h in Good and 0.13 ha in Good to Degraded condition) • Site BW-N-D-2: Forrest Highway road reserve northbound, south of Paris Road adjacent to the Spud Shed <ul style="list-style-type: none"> – 0.15 ha of Woodland of <i>Eucalyptus marginata</i> over <i>Agonis flexuosa</i>, <i>Banksia attenuata</i> and <i>B. ilicifolia</i> (Excellent to Very good condition) • Site BW-N-D-3: Forrest Highway road reserve southbound (eastern), south of Clifton Road and opposite Paris Road <ul style="list-style-type: none"> – 3.12 ha of Woodland of <i>Eucalyptus marginata</i> over <i>Agonis flexuosa</i>, <i>Banksia attenuata</i> and <i>B. ilicifolia</i> (1.6 ha of Good and 1.51 ha Degraded condition)
Indirect impact (ha)	<p>Potential indirect impacts resulting from Proposal implementation that may occur in Banksia Woodlands TEC vegetation directly adjacent to the Proposal Area include:</p> <ul style="list-style-type: none"> • Possible introduction and/or spread of <i>Phytophthora</i> dieback and weeds

ASPECT	DESCRIPTION
	<ul style="list-style-type: none"> • Damage through accidental generation of a bushfire during construction. <p>Of these, the risk of fire and <i>Phytophthora</i> dieback are potentially the most far-reaching, extending up to 100 m or more beyond the Proposal Area boundary. Main Roads' standard construction practices combined with the management actions detailed in Section 4.1.2 will specifically and effectively manage the potential for these indirect impacts to occur. As such, the potential for fire and <i>Phytophthora</i> dieback impacts up to 100 m from the Proposal are not anticipated to result from Proposal implementation.</p> <p>The introduction and spread of weeds is a more localised potential impact within 20 m of the Proposal with a greater risk of occurrence that will be managed through implementation of the proposed active management in accordance with Main Roads standards, as detailed in Section 4.1.1.4.</p> <p>The extent of Banksia Woodland TEC within 20 m of the Proposal Area has been calculated and is presented below (Figure 7, Appendix A) to identify areas of higher risk and greater potential for indirect impacts proximate to the Proposal Area. Considering the nature of the project (road construction) and that construction will be limited to the Proposal Area, the likelihood of indirect impacts from the introduction or spread of weeds on Banksia Woodland TEC vegetation further than 20 m from the Proposal Area boundary resulting from the Proposal is negligible.</p> <ul style="list-style-type: none"> • Site BW-N-I-1: Forrest Highway interchange, private property on the eastern side of the Highway Australind (Lot 131 on Plan 27972 and Lot 104 on Plan 31579). <ul style="list-style-type: none"> - 0.15 ha within 20 m of the Proposal Area - Vegetation type: <i>Corymbia calophylla</i>, <i>Eucalyptus marginata</i> Low woodland over <i>Agonis flexuosa</i>, <i>Banksia ilicifolia</i> Low Open Woodland to Low Woodland over <i>Kunzea glabrescens</i> Tall Shrubland over <i>Xanthorrhoea brunonis</i>, <i>Hibbertia hypericoides</i>, <i>Dasyopogon bromeliifolius</i> Very Open Shrubland over introduced Very Open Herbland and Grassland - Condition: Degraded • Site BW-N-I-2: Forrest Highway west, Australind, within the western road reserve of Forrest Highway northbound <ul style="list-style-type: none"> - 0.39 ha within 20 m of the Proposal Area - Vegetation type: <i>Eucalyptus marginata</i>, <i>Corymbia calophylla</i> Open Low Woodland over <i>Agonis flexuosa</i>, <i>Banksia attenuata</i>, <i>Banksia ilicifolia</i>, <i>Banksia grandis</i> with occasional <i>Xylomelum occidentale</i> over <i>Kunzea glabrescens</i> Tall Shrubland over <i>Daviesia divaricata</i>, <i>Melaleuca thymoides</i> and <i>Acacia pulchella</i> Open Shrubland over <i>Xanthorrhoea brunonis</i>, <i>Hibbertia hypericoides</i>, <i>Leucopogon propinquus</i>, <i>Stirlingia latifolia</i> and <i>Bossiaea eriocarpa</i> Low Shrubland over <i>Dasyopogon bromeliifolius</i>, <i>Phlebocarya ciliata</i> Very Open Herbland over <i>*Briza maxima</i> Very Open Grassland over

ASPECT	DESCRIPTION
	<p><i>Lyginia imberbis</i>, <i>Hypolaena exsulca</i>, <i>Lepidosperma pubisquameum</i> Very Open Sedgeland.</p> <ul style="list-style-type: none"> - Condition: Good and Very Good <ul style="list-style-type: none"> • Site BW-N-I-3: Moore Road east the BORR interchange (Lot 504 on Plan 71846) <ul style="list-style-type: none"> - 0.02 ha within 20 m of the Proposal Area - Vegetation type: <i>Corymbia calophylla</i>, <i>Eucalyptus marginata</i> Open Low Woodland over <i>Kunzea glabrescens</i> Tall Open Shrubland over <i>Xanthorrhoea brunonis</i> Very open shrubland over <i>Briza maxima</i> very open grass land over <i>Hypolaena exsulca</i>, <i>Desmocladius flexuosa</i> Very Open Sedgeland - Condition: Good • Site BW-N-I-4: Wallrodt Road, Davenport, near Willinge Drive (Lot 111 on Plan 403618) <ul style="list-style-type: none"> - 0.19 ha within 20 m of the Proposal Area - Vegetation type: <i>Corymbia calophylla</i>, <i>Eucalyptus marginata</i> Open Low Woodland over <i>Banksia ilicifolia</i>, <i>Xylomelum occidentale</i> Low Open Woodland over <i>Kunzea glabrescens</i> Tall Open Shrubland over <i>Xanthorrhoea brunonis</i>, <i>Dasypogon bromeliifolius</i> Very Open Shrubland over Very Open introduced grassland. - Condition: Degraded to Good • Site BW-N-I-5: South Western Highway at the BORR interchange (Lot 80 on Plan 404278) <ul style="list-style-type: none"> - 0.0 ha¹ within 20 m of the Proposal Area - Vegetation type: <i>Eucalyptus marginata</i>, <i>Corymbia calophylla</i> Open Low Woodland over <i>Agonis flexuosa</i>, <i>Banksia attenuata</i> Low Woodland over <i>Kunzea glabrescens</i> Tall Open Shrubland over <i>Leucopogon propinquus</i> Very Open Shrubland over <i>Conostylis aculeata var preissii</i> Very Open Herbland - Condition: Good • Site BW-N-I-6: Wallrodt Road, Davenport (Lot 2 on Plan 401654) <ul style="list-style-type: none"> - 0.55 ha within 20 m of the Proposal Area - Vegetation type: <i>Corymbia calophylla</i> and <i>Eucalyptus marginata</i> Open Low Woodland over <i>Agonis flexuosa</i>, <i>Banksia attenuata</i>, <i>Xylomelum occidentale</i>, <i>Banksia ilicifolia</i> Low Open Forest over <i>Kunzea glabrescens</i> Tall Open Scrubland over <i>Xanthorrhoea brunonis</i> Very Open Shrubland - Condition: Good • Site BW-N-I-7: Forrest Highway west, Australind, within the western road reserve of Forrest Highway northbound, north of Paris Road. <ul style="list-style-type: none"> - 1.37 ha within 20 m of the Proposal Area - Vegetation type: <i>Eucalyptus marginata</i> Low Woodland over <i>Eucalyptus marginata</i>, <i>Nuytsia floribundas</i>, <i>Banksia</i>

¹ No TEC is present within 20 m of the Proposal Area boundary at Site BW-N-I-5.

ASPECT	DESCRIPTION
	<p><i>attenuata</i>, <i>Banksia ilicifolia</i> Low Open Woodland over <i>Kunzea glabrescens</i> Tall Open Shrubland over <i>Allocasuarina humilis</i>, <i>Acacia pulchella</i> and <i>Melaleuca thymoides</i> Open Shrubland over <i>Xanthorrhoea brunonis</i>, <i>Stirlingia latifolia</i>, <i>Hibbertia hypericoides</i> Low Shrubland over a Very Open Herbland</p> <p>- Condition: Good to Very Good</p>
<p>Areas of larger contiguous patches that will be fragmented</p>	<p>Based on the findings of BORR IPT (2020c) vegetation and flora study, no occurrences of Banksia Woodlands TEC will be fragmented by the Proposal to the extent that they no longer represent occurrences of the TEC under the criteria specified by the TSSC (2016).</p> <p>Further, no occurrences of Banksia Woodlands TEC vegetation are expected to be indirectly impacted to the extent that these no longer represent this TEC.</p>
<p>Quality and importance of known or potential habitat within the proposed action area and surrounds</p>	<p>Areas considered critical to the survival of the Banksia Woodlands TEC cover all patches that meet the key diagnostic characteristics and condition thresholds for the ecological community, plus the buffer zones, particularly where this comprises surrounding native vegetation. This is because this ecological community occurs in a landscape that has often been very heavily cleared and modified, and now exists as mostly very small and highly fragmented patches (TSSC, 2016).</p> <p>The condition of the Banksia Woodlands TEC within the Proposal Area is as follows:</p> <ul style="list-style-type: none"> • Site BW-N-D-1: Forrest Highway road reserve northbound, north of Paris Road adjacent to Kingston Estate (Good to Degraded condition as detailed above) • Site BW-N-D-2: Forrest Highway road reserve northbound, south of Paris Road adjacent to the Spud Shed (Excellent to Very good condition as detailed above) • Site BW-N-D-3: Forrest Highway road reserve southbound, south of Clifton Road and opposite Paris Road (Good and Degraded condition as detailed above)
<p>Known extent within a 5 km buffer</p>	<p>An assessment of DBCA database extracts (DBCA, 2020) indicates that 30,852.5 ha of Banksia Woodlands TEC remains within 5 km of the Proposal Area.</p> <p>Occurrences of Banksia Woodlands TEC communities directly adjacent to the Proposal Area have been identified as part of the proposed monitoring program. These are detailed above and shown in Figure 7, Appendix A.</p>
<p>Adequacy of any surveys undertaken</p>	<p>Areas of potential TEC were identified through the desktop review (including soil mapping), previous surveys in the area (Biota, 2018; Ecoedge, 2018; GHD, 2015a), initial site reconnaissance visit, detailed vegetation assessment and aerial photography. Potential TEC areas were assessed using quadrats and traverses during the BORR IPT survey (BORR IPT, 2020c) (Appendix C).</p> <p>Field surveys were undertaken in accordance with the EPA's Technical Guidance and the Commonwealth Government's Survey Guidelines for</p>

ASPECT	DESCRIPTION
	<p>Australia’s Threatened Orchids (EPA, 2016; Commonwealth of Australia, 2013).</p> <p>The detailed vegetation and flora survey was undertaken from August to November 2018. Targeted flora surveys for TECs were undertaken in December 2018 and August 2019. The surveys included early spring, mid-spring, late spring and summer survey periods.</p> <p>The 20.7 ha of vegetation that was unsurveyed in the original referral was surveyed in spring of 2019. This information gap has now been filled and no uncertainties in relation to the Proposal Area vegetation remain.</p> <p>A total of 650 person hours was spent on flora and vegetation surveys for the Proposal. Survey effort was sufficient to determine conservation significant values and enable assessment of potential impacts resulting from Proposal implementation.</p>
Methods, data analysis and scientific literature used to identify and assess the environmental values	The significance of Banksia Woodlands TEC occurrences within and adjacent to the Proposal Area was assessed based on data collected during field surveys and analysed using multivariate analysis, NatureMap and Protected Matters Search results, and consideration of the Approved Conservation Advice (TSSC, 2016).

2.4.2 Clay Pans TEC – Critically Endangered

A description of this ecological community, along with likely direct and potential indirect impacts from the Proposal, is outlined in Table 2-4.

Table 2-4 Clay Pans TEC – Critically Endangered

ASPECT	DESCRIPTION
Ecology, abundance, distribution and habitat preferences	<p><u>Ecology</u></p> <p>The Herb rich shrublands in Clay Pans TEC (FCT08) and other Clay Pan communities occur where clay substrate is low in the landscape and forms an impermeable layer close to the surface. These wetlands rely on rainfall and local surface drainage to fill and are unlikely to be connected to groundwater. The Clay Pans dry out to form a relatively impervious substrate in summer. A suite of perennial plants that propagate by underground bulbs, tubers or corms (geophytes), and annual herbs flower sequentially as the Clay Pans dry out. The Clay Pans are the most diverse of the SCP wetlands and contain a number of local endemic flora (DBCA, 2019).</p> <p>This vegetation community type is dominated by one or more of the shrubs: <i>Viminaria juncea</i>, <i>Melaleuca viminea</i>, <i>M. lateritia</i>, <i>Kunzea micrantha</i> or <i>K. recurva</i> with occasional emergent of <i>Eucalyptus wandoo</i>. Species such as <i>Hypocalymma angustifolium</i>, <i>Acacia lasiocarpa</i> var. <i>bracteolata</i> long peduncle variant (G. J. Keighery 5026) (P1) and <i>Verticordia huegelii</i> occur at moderate frequencies (TSSC, 2012a).</p>

ASPECT	DESCRIPTION
	<p><u>Abundance</u></p> <p>The Clay Pans TEC Conservation Advice noted that in 2010, the ecological community occupied 600 ha, however it was highly fragmented with most remnants being less than 10 ha in size (TSSC, 2012a).</p> <p><u>Distribution</u></p> <p>The ecological community occurs within the IBRA regions of the SCP and Jarrah Forest and the South West Botanical Province (SWBP) of Western Australia (TSSC, 2012a). The TEC extends from Jurien in the north to Dunsborough in the south and over most of the length of the plain it is less than 30 km wide, bounded on the east by the faulted Yilgarn block and on the west by the Indian Ocean.</p> <p><u>Critical Habitat</u></p> <p>The recovery plan describes habitat critical to survival as including the area of occupancy of known occurrences; similar habitat adjacent to important occurrences (i.e. within approximately 200 m), i.e. poorly drained flats, depressions or winter wet flats with shallow sands and loams; remnant vegetation that surrounds or links several occurrences (this is to provide habitat for pollinators or to allow them to move between occurrences); and the local catchment for the surface, and potentially groundwater, that maintains the winter-wet habitat of the community. The plant assemblages are dependent on maintenance of the local hydrological conditions (DBCA, 2019).</p> <p><u>Threats</u></p> <p>The recovery plan lists key threats to the Clay Pans TECs as including land use (historical clearing), altered hydrology, rising groundwater, weeds and pathogens, inappropriate fire regimes, inappropriate land use and recreation, the viability of the small sized remnants that remain and climate change (DBCA, 2019).</p> <p><u>Description of this TEC vegetation within the Proposal Area</u></p> <p>Vegetation types VT13c (HvMIMpVjXp) mapped by Ecoedge (2019b) and VT15 (CcEm) as mapped by BORR IPT (2020c) were considered to be potentially representative of the Clay Pans TEC.</p> <p><u>Extent within and adjacent to the Proposal Area</u></p> <p>Up to 0.63 ha of vegetation representing Clay Pans TEC was identified within the Proposal Area. This vegetation was inferred to be FCT08. A further 0.12 ha of Clay Pans TEC is located within 20 m of the Proposal Area boundary, as detailed below (indirect impact).</p> <p>Occurrences within the Proposal Area are detailed below and shown in Figure 6 (Appendix A), and those directly adjacent to the Proposal Area are shown in Figure 7 (Appendix A).</p>
Direct impact (ha)	Up to 0.63 ha of vegetation representing Clay Pans TEC was identified within the Proposal Area and will likely be cleared as a result of implementing the Proposal (Figure 6, Appendix A).

ASPECT	DESCRIPTION
	<p>The Clay Pans TEC vegetation within the Proposal Area is split across three sites:</p> <ul style="list-style-type: none"> • Site CP-N-D-1: Railway Road <ul style="list-style-type: none"> – 0.41 ha of Shrubland of <i>Acacia incurva</i>, <i>A. saligna</i>, <i>Hakea varia</i>, <i>Hypocalymma angustifolium</i>, <i>Melaleuca lateritia</i>, <i>M. pauciflora</i>, <i>Olearia elaeophila</i> and <i>Xanthorrhoea preissii</i> with emergent tall shrubs of <i>Viminaria juncea</i> over sedgeland of <i>Leptocarpus roycei</i> and <i>Schoenus sp.</i> and open herbland of <i>Agrostocrinum scabrum</i> subsp. <i>scabrum</i>, <i>Borya sphaerocephala</i>, <i>Cycnogeton lineare</i>, <i>Drosera erythrorhiza</i>, <i>Haemodorum simplex</i> and <i>Opercularia vaginata</i> on yellow-brown clay. – Condition: <ul style="list-style-type: none"> 3 (Very good) - 0.21 ha 4 (Good) - 0.12 ha 6 (Degraded) - 0.08 ha • Site CP-N-D-2: Wireless Road. <ul style="list-style-type: none"> - 0.13 ha of Shrubland of <i>Acacia incurva</i>, <i>A. saligna</i>, <i>Hakea varia</i>, <i>Hypocalymma angustifolium</i>, <i>Melaleuca lateritia</i>, <i>M. pauciflora</i>, <i>Olearia elaeophila</i> and <i>Xanthorrhoea preissii</i> with emergent tall shrubs of <i>Viminaria juncea</i> over sedgeland of <i>Leptocarpus roycei</i> and <i>Schoenus sp.</i> and open herbland of <i>Agrostocrinum scabrum</i> subsp. <i>scabrum</i>, <i>Borya sphaerocephala</i>, <i>Cycnogeton lineare</i>, <i>Drosera erythrorhiza</i>, <i>Haemodorum simplex</i> and <i>Opercularia vaginata</i> on yellow-brown clay and scattered tall shrubs of <i>Acacia saligna</i>, <i>Viminaria juncea</i> and <i>Xanthorrhoea preissii</i>, with occasional <i>Melaleuca raphiophylla</i> trees over grassland of <i>*Briza maxima</i>, <i>*Cenchrus clandestina</i> and <i>*Ehrharta calycina</i> on yellow-brown clay loam – Condition: <ul style="list-style-type: none"> 3 (Very good) - 0.05 ha 4 (Good) - 0.04 ha 6 (Degraded) - 0.04 ha • Site CP-N-D-3: Bell Road <ul style="list-style-type: none"> - 0.09 ha of Shrubland of <i>Acacia incurva</i>, <i>A. saligna</i>, <i>Hakea varia</i>, <i>Hypocalymma angustifolium</i>, <i>Melaleuca lateritia</i>, <i>M. pauciflora</i>, <i>Olearia elaeophila</i> and <i>Xanthorrhoea preissii</i> with emergent tall shrubs of <i>Viminaria juncea</i> over sedgeland of <i>Leptocarpus roycei</i> and <i>Schoenus sp.</i> and open herbland of <i>Agrostocrinum scabrum</i> subsp. <i>scabrum</i>, <i>Borya sphaerocephala</i>, <i>Cycnogeton lineare</i>, <i>Drosera erythrorhiza</i>, <i>Haemodorum simplex</i> and <i>Opercularia vaginata</i> on yellow-brown clay. – Condition: <ul style="list-style-type: none"> 3 (Very good) - 0.07 ha 6 (Degraded) - 0.02 ha

ASPECT	DESCRIPTION
	<p>The clearing of up to 0.63 ha of Clay Pans TEC within the Proposal Area would result in a reduction of up to 0.21% in the reported extent of the TEC. At the greater Bunbury region scale, this represents a reduction of up to 0.5%. Of the 0.63 ha, 0.50 ha was rated as in Good or Better condition. This represents the maximum possible direct impact associated with the Proposal.</p>
<p>Indirect impact (ha)</p>	<p>One Clay Pans TEC occurrence, at Railway Road, will be fragmented as a result of the Proposal. All remaining occurrences that require clearing will be cleared in their entirety. Indirect impacts are not expected at the Railway Road site as it occurs upstream of the Proposal Area. No occurrences of Clay Pans TEC are expected to be indirectly impacted to the extent that these no longer meet the description of the TEC community, as defined by the TSSC (2012a) and DBCA (2019).</p> <p>Potential indirect impacts that may occur in Clay Pans TEC vegetation occurrences directly adjacent to the Proposal Area include:</p> <ul style="list-style-type: none"> • Possible introduction and/or spread of <i>Phytophthora</i> dieback and weeds • Changes to vegetation structure and floristic composition through hydrological changes • Damage through accidental generation of a bushfire during construction. <p>Of these, the risk of fire, hydrological changes and <i>Phytophthora</i> dieback are potentially the most far-reaching, extending up to 100 m or more beyond the Proposal Area boundary. Main Roads' standard construction practices combined with the management actions detailed in Section 4.1.2 will specifically and effectively manage the potential for these indirect impacts to occur. As such, the potential for fire, hydrological changes and <i>Phytophthora</i> dieback impacts up to 100 m from the Proposal are not anticipated to result from Proposal implementation.</p> <p>The introduction and spread of weeds is a more localised potential impact within 20 m of the Proposal with a greater risk of occurrence that will be managed through implementation of the proposed active management in accordance with Main Roads standards, as detailed in Section 4.1.1.4.</p> <p>The extent of Clay Pans TEC within 20 m of the Proposal Area, as confirmed by Ecoedge (2019b), has been calculated and is presented below (Figure 7, Appendix A) to identify areas of higher risk and greater potential for indirect impacts proximate to the Proposal Area. Considering the nature of the project (road construction) and that construction will be limited to the Proposal Area, the likelihood of indirect impacts from the introduction or spread of weeds on Clay Pans TEC vegetation further than 20 m from the Proposal Area boundary resulting from the Proposal is negligible.</p> <ul style="list-style-type: none"> • Site CP-N-I-2: Manea Park <ul style="list-style-type: none"> - 0.12 ha within 20 m of the Proposal Area boundary of A Low Woodland of <i>Melaleuca raphiophylla</i>, <i>Melaleuca preissiana</i> and <i>Acacia saligna</i> over a Tall Shrubland of <i>Melaleuca viminea</i>, <i>Melaleuca incana</i> and <i>Astartea scoparia</i> over a <i>Leptocarpus roycei</i> and <i>Juncus articulata</i> Very Open Sedgeland over a *<i>Briza</i>

ASPECT	DESCRIPTION
	<p><i>minor</i>, <i>Cynodon dactylon</i> and <i>Anthoxanthum odoratum</i> Open Grassland and an <i>Angianthus drummondii</i> Very Open Herbland</p> <ul style="list-style-type: none"> - Condition: Degraded • Site CP-N-I-3: Railway Road <ul style="list-style-type: none"> - >0.01 ha within 20 m of the Proposal Area boundary of Shrubland of <i>Acacia incurva</i>, <i>A. saligna</i>, <i>Hakea varia</i>, <i>Hypocalymma angustifolium</i>, <i>Melaleuca lateritia</i>, <i>M. pauciflora</i>, <i>Olearia elaeophila</i> and <i>Xanthorrhoea preissii</i> with emergent tall shrubs of <i>Viminaria juncea</i> over sedgeland of <i>Leptocarpus roycei</i> and <i>Schoenus</i> sp. and open herbland of <i>Agrostocrinum scabrum</i> subsp. <i>scabrum</i>, <i>Borya sphaerocephala</i>, <i>Cycnogeton lineare</i>, <i>Drosera erythrorhiza</i>, <i>Haemodorum simplex</i> and <i>Opercularia vaginata</i> on yellow-brown clay. - Condition: Good
Areas of larger contiguous patches that will be fragmented	<p>One Clay Pans TEC occurrence, at Railway Road, will be fragmented as a result of the Proposal. All remaining occurrences that require clearing will be cleared in their entirety. Indirect impacts are not expected at the Railway Road site as it occurs upstream of the Proposal Area. No occurrences of Clay Pans TEC are expected to be indirectly impacted to the extent that these no longer meet the description of the TEC community, as defined by the TSSC (2012a) and DBCA (2019).</p>
Quality and importance of known or potential habitat within the proposed action area and surrounds	<p>The recovery plan describes habitat critical to survival as including the area of occupancy of known occurrences; similar habitat adjacent to important occurrences (i.e. within approximately 200 m), i.e. poorly drained flats, depressions or winter wet flats with shallow sands and loams; remnant vegetation that surrounds or links several occurrences (this is to provide habitat for pollinators or to allow them to move between occurrences); and the local catchment for the surface, and potentially groundwater, that maintains the winter-wet habitat of the community. The plant assemblages are dependent on maintenance of the local hydrological conditions (DBCA, 2019).</p> <p>The condition of the habitat within the Proposal Area is as follows:</p> <ul style="list-style-type: none"> • Site CP-N-D-1: Railway Road (0.41 ha) <ul style="list-style-type: none"> - Condition: <ul style="list-style-type: none"> 3 (Very good) - 0.21 ha 4 (Good) - 0.12 ha 6 (Degraded) - 0.08 ha • Site CP-N-D-2: Wireless Road (0.13 ha) <ul style="list-style-type: none"> - Condition: <ul style="list-style-type: none"> 3 (Very good) - 0.05 ha 4 (Good) - 0.04 ha 6 (Degraded) - 0.04 ha • Site CP-N-D-3: Bell Road (0.09 ha)

ASPECT	DESCRIPTION
	<ul style="list-style-type: none"> - Condition: <ul style="list-style-type: none"> 3 (Very good) - 0.07 ha 6 (Degraded) - 0.02 ha
Known extent within at least a 2 km buffer	<p>An assessment of DBCA database extracts (DBCA, 2020) indicates that 708 ha of Clay Pans TEC remains within 5 km of the Proposal Area.</p> <p>Occurrences of Clay Pans TEC communities directly adjacent to the Proposal Area have been identified as part of the proposed monitoring program. These are detailed above and shown in Figure 7 (Appendix A).</p>
Adequacy of any surveys undertaken	<p>The detailed vegetation and flora survey was undertaken from August to November 2018. Targeted flora surveys were undertaken in December 2018 and August 2019. The survey included early spring, mid-spring, late spring and summer survey periods (BORR IPT, 2020c)(Appendix C).</p> <p>A targeted survey for new occurrences of Clay Pans TEC was undertaken by Ecoedge (2019) between 26 July and 1 August 2019. The survey was conducted over 3.65 ha of vegetation potentially containing Clay Pan TEC vegetation within and outside the Proposal Area.</p> <p>Field surveys were undertaken in accordance with the EPA’s Technical Guidance and the Commonwealth Government’s Survey Guidelines for Australia’s Threatened Orchids (Commonwealth of Australia, 2013; EPA, 2016).</p> <p>The 20.7 ha of vegetation that was unsurveyed in the June 2019 referral (EPBC Act referral 2019/8471) was surveyed in spring of 2019. This information gap has now been filled and no uncertainties in relation to the Proposal Area vegetation remain.</p> <p>A total of 650 person hours was spent on flora and vegetation surveys for the Proposal. Survey effort was sufficient to determine conservation significant values and enable assessment of potential impacts resulting from Proposal implementation.</p>
Methods, data analysis and scientific literature used to identify and assess the environmental values	<p>The significance of Clay Pans TEC occurrences within and adjacent to the Proposal Area was assessed based on data collected during field surveys and analysed using multivariate analysis, NatureMap and Protected Matters Search results, and consideration of the interim and National Recovery plans (DBCA, 2015; DBCA, 2019), the Commonwealth Listing Advice (TSSC, 2012a) and consultation with DBCA staff.</p>

2.4.3 Corymbia Woodlands TEC – Endangered

A description of this ecological community, along with likely direct and potential indirect impacts from the Proposal, is outlined in Table 2-5.

Table 2-5 Corymbia Woodlands TEC (FCT3c) – Endangered

ASPECT	DESCRIPTION
<p>Ecology, abundance, distribution and habitat preferences</p>	<p><u>Ecology</u></p> <p>DoEE (2017a) describes FCT3c as a Marri (<i>Corymbia calophylla</i>) dominated plant community located on heavy soils of the eastern side of the SCP between Bullsbrook, and Capel. It is noted that weed levels in most occurrences are generally quite low in this community type.</p> <p>Dominant species within this community include <i>Corymbia calophylla</i> (marri), and occasionally <i>Eucalyptus wandoo</i> (wandoo); the shrubs <i>Xanthorrhoea preissii</i>, <i>Acacia pulchella</i>, <i>Banksia dallanneyi</i>, <i>Gompholobium marginatum</i>, and <i>Hypocalymma angustifolium</i> and the herbs <i>Burchardia congesta</i>, <i>Cyathochaeta avenacea</i> and <i>Neurachne alopecuroidea</i> (DoEE, 2017a).</p> <p><u>Abundance</u></p> <p>As at April 2017, 29 occurrences of this community totalling about 115 ha have been located between Bullsbrook and Capel. The sites were located through an extensive survey of the southern SCP that involved compilation and analysis of data from over 1,500 plots (Keighery & Trudgen, 1992; Gibson, N., Keighery, B.J., Keighery, G.J., Burbridge, A.H. and Lyons, M.N., 1994; Government of Western Australia, 2000).</p> <p>Marri dominated woodlands on heavy soils are now very rare and likely to be at least 90% cleared. Most occurrences are surrounded by cleared land (DoEE, 2017a).</p> <p>Because of its very restricted distribution, no condition thresholds have been applied to the nationally-listed ecological community and hence all areas meeting the description of the ecological community are habitat areas critical to its survival (DoEE, 2017a).</p> <p><u>Distribution</u></p> <p>FCT3c is located on heavy soils on the eastern side of the SCP, between Bullsbrook and Capel.</p> <p><u>Critical Habitat</u></p> <p>The conservation advice identifies critical habitat for the TEC as the heavy soils on which it occurs, the fresh superficial groundwater, and/or surface water that may help sustain flora species in this community, and the catchment for this groundwater and surface water.</p> <p><u>Threats</u></p> <p>Key threats to the Corymbia Woodlands TEC identified in the conservation advice include clearing, altered fire regimes, weed invasion, hydrological changes, salinisation, grazing, introduction of disease and erosion by wind or water.</p> <p><u>Description of this TEC vegetation within the Proposal Area</u></p> <p>The <i>Corymbia calophylla</i> dominated vegetation types (VT15) on the heavier soils through the central section of the Survey Area (that overlaps with the Guildford Complex) may align with this community. However, a review of the key species recorded in the three quadrats within the VT15 indicates that very few of the</p>

ASPECT	DESCRIPTION
	<p>common species recorded in this community were present within quadrats and it is considered that in these areas the structure of the vegetation has been highly modified and no longer represents FCT3c. Many of these areas are on highly modified road reserves.</p> <p>Patches of <i>Corymbia calophylla</i> over <i>Xanthorrhoea preissii</i> on clay soils located on the Guildford Complex are considered to represent the TEC. Vegetation type VT15b (CcXp) open woodland to scattered trees of <i>Corymbia calophylla</i> over an open shrubland of <i>Xanthorrhoea preissii</i>, <i>Hypocalymma angustifolium</i> and <i>Hakea varia</i> on clay soils is considered to represent the Corymbia Woodlands TEC. VT15b ranged from Good to Degraded condition and is subject to edge effects from existing adjacent roads. Occurrences of this TEC were determined from a combination of statistical analysis results and interpretation of FCT descriptions. Three patches representing FCT3c (VT15b) were recorded within the Proposal Area, all occurring on road reserves.</p> <p><u>Extent within and adjacent to the Proposal Area</u></p> <p>Up to 1.3 ha of vegetation inferred to be FCT3c and thus representing Corymbia Woodlands TEC was identified within the Proposal Area. A further 0.45 ha is located within 20 m of the Proposal Area boundary, as detailed below (indirect impact).</p> <p>Occurrences within the Proposal Area are listed below and shown in Figure 6 (Appendix A), and those directly adjacent to the Proposal Area are shown in Figure 7 (Appendix A).</p>
<p>Direct impact (ha)</p>	<p>Up to 1.3 ha of Corymbia Woodlands TEC was identified within the Proposal Area. The FCT3c TEC vegetation within the Proposal Area is split across five sites:</p> <ul style="list-style-type: none"> • Site CW-N-D-1: Raymond Road <ul style="list-style-type: none"> - 0.29 ha of Open woodland to scattered trees of <i>Corymbia calophylla</i> over an open shrubland of <i>Xanthorrhoea preissii</i>, <i>Hypocalymma angustifolium</i> and <i>Hakea varia</i> - Condition: Degraded to Completely degraded • Site CW-N-D-2: Treendale Road <ul style="list-style-type: none"> - 0.33 ha of Open woodland to scattered trees of <i>Corymbia calophylla</i> over an open shrubland of <i>Xanthorrhoea preissii</i>, <i>Hypocalymma angustifolium</i> and <i>Hakea varia</i> - Condition: Degraded to Completed degraded • Site CW-N-D-3: Railway Road <ul style="list-style-type: none"> - 0.14 ha of <i>Corymbia calophylla</i>-<i>Eucalyptus rudis</i>-<i>Melaleuca raphiophylla</i> woodland/open forest. Woodland to open forest of <i>Corymbia calophylla</i> and <i>Eucalyptus rudis</i> and sometimes <i>Melaleuca raphiophylla</i> over tall shrubland of <i>Acacia saligna</i>, <i>Viminaria juncea</i> and <i>Xanthorrhoea preissii</i> over shrubland of <i>Astroloma ciliatum</i>, <i>Daviesia physodes</i>, <i>Grevillea bipinnatifida</i>, <i>Hakea varia</i>, <i>Hemigenia incana</i>, <i>Hypocalymma angustifolium</i> and <i>Viminaria juncea</i> over sedgeland of <i>Cyathochaeta avenacea</i>,

ASPECT	DESCRIPTION
	<p><i>Mesomelaena tetragona</i> and <i>Tetraria octandra</i> and open herbland of <i>*Babiana angustifolia</i>, <i>Haemodorum simplex</i>, <i>*Oxalis pes-caprae</i> and <i>*Watsonia meriana</i> (in more disturbed areas) and very open grassland of <i>*Briza maxima</i> on red-brown or yellow-brown clay loam.</p> <ul style="list-style-type: none"> - Condition: <ul style="list-style-type: none"> Very good - 0.02 ha Good - 0.03 ha Degraded - 0.06 ha Completely degraded - 0.03 ha • Site CW-N-D-4: Harris Road <ul style="list-style-type: none"> - 0.52 ha of Open woodland to scattered trees of <i>Corymbia calophylla</i> over an open shrubland of <i>Xanthorrhoea preissii</i>, <i>Hypocalymma angustifolium</i> and <i>Hakea varia</i>. - Condition: Degraded
<p>Indirect impact (ha)</p>	<p>Approximately 0.45 ha of <i>Corymbia</i> Woodlands TEC vegetation is located directly adjacent to the Proposal Area and may be indirectly impacted.</p> <p>Potential indirect impacts that may occur in <i>Corymbia</i> Woodlands TEC vegetation occurrences directly adjacent to the Proposal Area include:</p> <ul style="list-style-type: none"> • Possible introduction and/or spread of <i>Phytophthora</i> dieback and weeds • Changes to vegetation structure and floristic composition through altered surface water drainage • Damage through accidental generation of a bushfire. <p>Of these, the risk of fire, altered surface water drainage and <i>Phytophthora</i> dieback are potentially the most far-reaching, extending up to 100 m or more beyond the Proposal Area boundary. Main Roads' standard construction practices combined with the management actions detailed in Section 4.1.2 will specifically and effectively manage the potential for these indirect impacts to occur. As such, the potential for fire, altered surface water drainage and <i>Phytophthora</i> dieback impacts up to 100 m from the Proposal are not anticipated to result from Proposal implementation.</p> <p>The introduction and spread of weeds is a more localised potential impact within 20 m of the Proposal with a greater risk of occurrence that will be managed through implementation of the proposed active management in accordance with Main Roads standards, as detailed in Section 4.1.1.4.</p> <p>The extent of <i>Corymbia</i> Woodlands TEC within 20 m of the Proposal Area has been calculated and is presented below (Figure 7, Appendix A) to identify areas of higher risk and greater potential for indirect impacts proximate to the Proposal Area. Considering the nature of the project (road construction) and that construction will be limited to the Proposal Area, the likelihood of indirect impacts from the introduction or spread of weeds on <i>Corymbia</i> Woodlands TEC vegetation further than 20 m from the Proposal Area boundary resulting from the Proposal is negligible.</p>

ASPECT	DESCRIPTION
	<ul style="list-style-type: none"> • Site CW-N-I-1: South Western Highway road reserve, Waterloo <ul style="list-style-type: none"> - 0.42 ha of a Woodland to open forest of <i>Corymbia calophylla</i> and <i>Eucalyptus rudis</i> and sometimes <i>Melaleuca raphiophylla</i> over tall shrubland of <i>Acacia saligna</i>, <i>Viminaria juncea</i> and <i>Xanthorrhoea preissii</i> over shrubland of <i>Astroloma ciliatum</i>, <i>Daviesia physodes</i>, <i>Grevillea bipinnatifida</i>, <i>Hakea varia</i>, <i>Hemigenia incana</i>, <i>Hypocalymma angustifolium</i> and <i>Viminaria juncea</i> over sedgeland of <i>Cyathochaeta avenacea</i>, <i>Mesomelaena tetragona</i> and <i>Tetraria octandra</i> and open herbland of <i>*Babiana angustifolia</i>, <i>Haemodorum simplex</i>, <i>*Oxalis pes-caprae</i> and <i>*Watsonia meriana</i> (in more disturbed areas) and very open grassland of <i>*Briza maxima</i> on red-brown or yellow-brown clay loam. - Condition: Good • Site CW-N-I-2: Railway Road reserve northern side, west of the Proposal Area boundary east of Waterloo-Dardanup Road <ul style="list-style-type: none"> - 0.03 ha of Woodland of <i>Casuarina obesa</i>, <i>Eucalyptus rudis</i> and <i>Melaleuca raphiophylla</i> over open shrubland of <i>Astartea scoparia</i>, <i>Melaleuca incana</i>, <i>M. lateritia</i> over open herbland - Condition: Not assessed due to access restriction
<p>Areas of larger contiguous patches that will be fragmented</p>	<p>One occurrence of <i>Corymbia</i> Woodlands TEC at Railway Road will be fragmented as a result of the Proposal. This occurrence is unlikely to be left viable as a result of Proposal implementation as it is already small, isolated and has a high edge-to-area ratio. As such its long term viability is already at risk, and this is unlikely to change as a result of the Proposal. The majority of the site is in Good or Very good condition. No occurrences of <i>Corymbia</i> Woodlands TEC are expected to be indirectly impacted to the extent that these no longer represent the TEC community.</p>
<p>Quality and importance of known or potential habitat within the proposed action area and surrounds</p>	<p>The conservation advice identifies critical habitat for the TEC as the heavy soils on which it occurs, the fresh superficial groundwater, and/ or surface water that may help sustain flora species in this community, and the catchment for this groundwater and surface water.</p> <p>Because of its very restricted distribution, no condition thresholds have been applied to the nationally-listed ecological community and hence all areas meeting the description of the ecological community are habitat areas critical to its survival (Department of Conservation and Land Management, 2000)</p> <p>The condition of the habitat within the Proposal Area is as follows:</p> <ul style="list-style-type: none"> • Site CW-N-D-1: Raymond Road <ul style="list-style-type: none"> – Condition: Degraded to Completely degraded • Site CW-N-D-2: Treendale Road <ul style="list-style-type: none"> – Condition: Degraded to Completely degraded • Site CW-N-D-3: Railway Road <ul style="list-style-type: none"> – Condition:

ASPECT	DESCRIPTION
	<p>Very good - 0.02 ha Good - 0.03 ha Degraded - 0.06 ha Completely degraded - 0.03 ha</p> <ul style="list-style-type: none"> • Site CW-N-D-4: Harris Road <ul style="list-style-type: none"> – Condition: Completely degraded <p>The condition of habitat adjacent to the Proposal Area is as follows:</p> <ul style="list-style-type: none"> • Site CW-N-I-1: South Western Highway road reserve, Waterloo <ul style="list-style-type: none"> – Condition: <ul style="list-style-type: none"> Excellent - 0.01 ha Very good – 0.41 ha Good – 0.23 ha Degraded – 0.14 ha • Site CW-N-I-2: Railway Road reserve northern side, west of the Proposal Area boundary east of Waterloo-Dardanup Road <ul style="list-style-type: none"> – Condition: Not assessed due to access restriction
<p>Known extent within a 5 km buffer</p>	<p>An assessment of DBCA database extracts (DBCA, 2020) indicates that 312 ha of Corymbia Woodlands TEC remains within 5 km of the Proposal Area.</p> <p>Occurrences of Corymbia Woodlands TEC directly adjacent to the Proposal Area have been identified as part of the proposed monitoring program. These are detailed above and shown in Figure 7, Appendix A.</p>
<p>Adequacy of any surveys undertaken</p>	<p>Areas of potential TEC were identified through the desktop review (including soil mapping), previous surveys in the area (Biota, 2018; Ecoedge, 2018; GHD, 2015a) initial site reconnaissance visit, targeted survey (Ecoedge, 2019b) and aerial photography (Appendix C).</p> <p>Field surveys were undertaken in accordance with the EPA’s Technical Guidance (EPA, 2016) and the Commonwealth Government’s Survey Guidelines for Australia’s Threatened Orchids (Commonwealth of Australia, 2013).</p> <p>The detailed vegetation and flora survey was undertaken from August to November 2018. Targeted flora surveys for TECs were undertaken in December 2018 and August 2019. The survey included early spring, mid-spring, late spring and summer survey periods.</p> <p>The 20.7 ha of vegetation that was unsurveyed in the original referral was surveyed in spring of 2019. This information gap has now been filled and no uncertainties in relation to the Proposal Area vegetation remain.</p> <p>A total of 650 person hours was spent on flora and vegetation surveys for the Proposal. Survey effort was sufficient to determine conservation significant values and enable assessment of potential impacts resulting from Proposal implementation.</p>
<p>Methods, data analysis and</p>	<p>The significance of Corymbia Woodlands TEC occurrences within and adjacent to the Proposal Area was assessed based on data collected during field surveys and</p>

ASPECT	DESCRIPTION
scientific literature used to identify and assess the environmental values	analysed using multivariate analysis, NatureMap and Protected Matters Search results, and in consideration of the Interim Recovery Plan (Department of Conservation and Land Management, 2000), the Approved Conservation Advice (DoEE, 2017a), and consultation with DBCA staff.

2.4.4 Tuart Woodlands TEC - Critically Endangered

The Tuart Woodlands TEC was listed as Critically Endangered under the EPBC Act in July 2019.

The primary defining feature of this ecological community is the presence of at least two living established Tuart trees in the uppermost canopy layer and a gap of no more than 60 m between the outer edges of the canopies of adjacent Tuart trees (DoEE, 2019).

The vegetation and flora surveys undertaken for the Proposal did not identify this ecological community within or adjacent to the Proposal Area (BORR IPT, 2020c). In the Survey Area, Tuart occurred in scattered locations but did not form continuous canopy cover and was not the dominant overstorey in any of the vegetation types described. The FCT analysis identified several vegetation types that had affinities to FCT25 (Southern SCP *E. gomphocephala* – *A. flexuosa* woodlands), which constitutes the TEC, however Tuart was not present and the vegetation units were mostly in Degraded or worse condition. They were therefore not considered to be representative of Tuart Woodlands TEC, and it was concluded that the Tuart Woodlands TEC does not occur within the Proposal Area (BORR IPT, 2020c).

2.5 Threatened fauna

2.5.1 Black Cockatoos (Forest Red-tailed Black Cockatoo - Vulnerable; Baudin's Cockatoo - Endangered; Carnaby's Cockatoo – Endangered)

The following three species of threatened Black Cockatoo identified as occurring (foraging evidence) within the Proposal Area during detailed fauna assessments:

- Baudin's Black-Cockatoo (Vulnerable under the EPBC Act)
- Carnaby's Black-Cockatoo (Endangered under the EPBC Act)
- Forest Red-tailed Black Cockatoo (Vulnerable under the EPBC Act).

The distribution and habitat requirements for each of the above taxa are similar, and accordingly, the impact of the Proposal to these three taxa has been considered together, grouped as 'Black Cockatoos'. For Black Cockatoos, the significance of environmental impact is considered in terms of the impact on habitat and individuals, rather than a resident population, given the mobility of the taxa.

A description of these species, along with likely direct and potential indirect impacts from the Proposal, has been outlined in Table 2-6. The extent of Black Cockatoo foraging habitat within the Proposal Area and the modelled local extent of Black Cockatoo foraging habitat within a 12 km radius is identified in Table 2-7.

Table 2-6 Forest Red-tailed Black Cockatoo - Vulnerable; Baudin's Cockatoo - Endangered; Carnaby's Cockatoo - Endangered

ASPECT	DESCRIPTION
Ecology, abundance, distribution and habitat preferences	<p><u>Ecology</u></p> <p>The Forest Red-tailed Black Cockatoo is 55 – 60 cm in length and are mostly glossy black with a pair of black central tail feathers, a crest, robust beak and bright red,</p>

ASPECT	DESCRIPTION
	<p>orange and yellow barring in the tail. The male is distinguished by broad red tail panels that are only visible when alighting. The female is distinguished by yellow or whitish spots on the feathers of the head and upper wing (DEWHA, 2009b).</p> <p>The Baudin’s Cockatoo is 50 – 57 cm in length and is mostly dull black in colour, with pale whitish margins on the feathers, ear coverts and tail. The male has a large black bill whilst females are whitish-grey with a black tip (TSSC, 2018c).</p> <p>The Carnaby’s Cockatoo is 53-58 cm in length and is mostly black, with white cheek patches, large white panels on the tail and a curved beak (TSSC, 2006).</p> <p><u>Abundance</u></p> <p>The Forest Red-tailed Black Cockatoo occurs in one population of approximately 15,000 individuals (DEWHA, 2009b). The total population of the Baudin’s Cockatoo is estimated at 12,500 individuals. The species occurs mainly in flocks (up to 300 individuals), and occasionally larger aggregations (up to 1,200 individuals) at roosts (TSSC, 2006). The Carnaby’s Cockatoo total population has been estimated between 11,000 and 60,000 individuals and is considered to exist as one large interconnected population (TSSC, 2006).</p> <p><u>Distribution</u></p> <p>The distribution for each of the three species differs slightly. Baudin’s Cockatoo occur predominantly within the Jarrah Forest and SCP zones, approximately from Northam and Muchea near Perth and south to Albany. Carnaby’s Cockatoo distribution extends into the Wheatbelt north to Kalbarri and east to Esperance. Forest Red-tailed Black Cockatoo occurs within forested areas from Perth south east to Albany.</p> <p><u>Habitat preferences</u></p> <p>Black Cockatoos are known to utilise a range of habitats and plant species for foraging (including introduced species such as pines, <i>*Pinus</i> spp.), although Marri and Jarrah woodlands are particularly important to Baudin’s Black-Cockatoo and the Forest Red-tailed Black-Cockatoo. Proteaceous heaths (i.e. shrublands dominated by <i>Banksia</i>, <i>Hakea</i> and <i>Grevillea</i> species) are also utilised by Carnaby’s Black-Cockatoo (DSEWPaC 2012).</p> <p>Black Cockatoo breeding habitat, as defined in the Commonwealth referral guidelines (DoEE, 2017b), includes:</p> <ul style="list-style-type: none"> • Relevant tree species with a suitable Diameter at Breast Height (DBH) to develop a nest hollow, where DBH is greater than or equal to 500 mm (herein referred to as ‘Suitable DBH Trees’) • Trees with a hollow that meets the DoEE (2017b) depth, width and angle criteria for nesting by Black Cockatoos, herein referred to as ‘Trees with a Suitable Nest Hollow’ • Known Nesting Trees are those trees that have secondary evidence of nesting i.e. feathers, eggs/ shells etc. <p><u>Breeding parameters</u></p>

ASPECT	DESCRIPTION
	<p>Studies of the breeding behaviours of the three threatened black-cockatoo species have identified variation between the tree species and characteristics of hollows chosen for nesting.</p> <p>Baudin’s Black-Cockatoo nest in hollows in live or dead trees of Karri, Marri, Wandoo and Tuart, with hollow depth ranging from 0.1 to 2.5 m (Johnstone, 2011). Carnaby’s Black-Cockatoo nest in hollows in live or dead trees of Salmon Gum, Wandoo, Tuart, Jarrah, Flooded Gum, York Gum, Powderbark, Karri and Marrim with a hollow depth ranging from 0.5 to over 2.0 m, with an average of just over 1 m (Saunders, 2014). Forest Red-Tailed Black-Cockatoos nest in hollows in live or dead trees of Karri, Marri, Bullich, Swan River Blackbutt, Tuart and Jarrah with a hollow depth ranging from 1 – 5 m (Johnstone, 2011).</p> <p>The breeding timing of the three species is as follows (DSEWPaC, 2012c):</p> <ul style="list-style-type: none"> • Baudin’s Black-Cockatoo breeds from August/September through to February/March • Carnaby’s Black-Cockatoo breeds from July/August through to January/February • Forest Red-tailed Black-Cockatoo breeds in October/November, however, in years with good autumn rainfall, may breed in March/April <p><u>Species presence and habitat extent within the Proposal Area</u></p> <p>The Proposal Area is located in what is generally considered to be the typical breeding distribution of the Forest Red-tailed Black Cockatoo, however, all three cockatoo species have breeding areas overlapping the Proposal Area (Biota, 2020) as shown in Figure 8, Appendix A.</p> <p>All trees and areas of potential Black Cockatoo habitat within the Proposal Area were included in field surveys (Figure 8, Appendix A). Evidence of foraging by all three species was recorded within and adjacent to the Proposal Area, and either Baudin’s or Carnaby’s cockatoo were observed flying overhead during field surveys (Biota, 2020). All three species were identified as occurring within the Proposal Area with 37.8 ha of suitable habitat for foraging and potentially breeding identified in targeted surveys (Biota, 2020).</p> <p>Within the Proposal Area, Black Cockatoo foraging habitat was comprised of three mapped habitat types: ‘Marri/Eucalyptus woodland’, ‘Riparian woodland’ and ‘Marri/Eucalyptus in paddocks and road reserves’ shown in Figure 8, Appendix A.</p> <p><u>Threats</u></p> <p>Primary threats to Black Cockatoos as listed in (DSEWPaC, 2012c) are:</p> <ul style="list-style-type: none"> • Habitat Loss and habitat degradation (loss of foraging habitat, breeding hollows, habitat connectivity habitat quality) • Interactions with humans (vehicle strikes, agriculture protection measures, disturbance from noise/light, unauthorised taking (poaching)) • Invasive Species (competition for nest hollows with European honey bees and bird invading taxa, injury/death from European honey bees). <p>Habitat loss has affected each of the species. Perhaps most significantly for Carnaby’s Cockatoo, which used to only visit the SCP for foraging. Over the past 10-</p>

ASPECT	DESCRIPTION
	<p>30 years Carnaby's Cockatoo has shifted in breeding distribution to areas south and west, now breeding in Jarrah Forest and on the SCP (DPaW, 2013).</p>
<p>Direct impact</p>	<p>The modelled extent of foraging habitat for Black Cockatoo within a 12 km radius of the Proposal was calculated (Biota, 2020) to provide context to the potential loss of foraging habitat associated with the Proposal. This modelling identified > 7,600 ha of foraging habitat within this radius.</p> <p>There is 5.9 ha of known roosting habitat within 12 km of the Proposal Area. This area is located at the very edge of the 12 km buffer, in Gwindinup in the Shire of Capel (Figure 8, Appendix A) (GoWA, 2019b).</p> <p>There are no known nesting sites within 12 km of the Proposal Area (GoWA, 2019b).</p> <p>The Proposal will require the clearing of up to 37.8 ha of Black Cockatoo foraging habitat, representing approximately < 0.5% of the recorded > 7,600 ha of the locally available foraging habitat (suitable remnant vegetation within a 12 km radius).</p> <p>Black Cockatoos require hollows with specific attributes for breeding (i.e. a particular size, depth and orientation), with such hollows only typically occurring in large mature trees of > 200 year age (DSEWPac, 2012c) cited in (Biota, 2020). No known Black Cockatoo nesting hollows were recorded within the Proposal Area, however three trees with potentially suitable hollows were recorded. The clearing of native vegetation for the Proposal will remove three large trees each containing a suitable nest hollow for Black Cockatoos.</p> <p>The environmental surveys recorded a total of 2,942 large trees which do not contain a suitable nesting hollow, with the Proposal coinciding with 711 of these large trees. These large trees cannot be used for nesting by Black Cockatoos due to the absence of a suitable hollow, however, they were identified as trees that, in the future, may (or may not) form hollows which may (or may not) be suitable for nesting by Black Cockatoos. The objective of recording large trees which do not contain hollows is to identify a potential for 'future' nesting hollows which may form as the large trees mature and senesce (deteriorate with age). These trees with the potential to form hollows compensates for the future loss of the current nesting hollows as those trees are lost through natural attrition (fall over, decay). Based upon the proportion of large trees in the Survey Area with suitable nest hollows (< 1%), it may be expected of the total 711 large trees (without suitable hollows) to be removed by the Proposal that approximately seven of these trees could in the future form a suitable hollow.</p>
<p>Indirect impact</p>	<p>The Proposal may potentially result in the following indirect impacts to Black Cockatoo species:</p> <ul style="list-style-type: none"> • Incremental loss of Black Cockatoo habitat from edge effects • Displacement of Black Cockatoos due to traffic noise and exposure • Potential vehicle strike during construction activities • Potential vehicle strike during operation. <p>The Proposal Area sits within a landscape that has been subject to historical clearing for agricultural, urban and industrial developments. These developments have resulted in reduction in patch sizes and increasing edge effects including the introduction of weeds and dieback. This has potential to impact the composition and</p>

ASPECT	DESCRIPTION
	<p>structure of vegetation communities and impact the suitability of habitat for Black Cockatoos.</p> <p>If severe enough, exposure to traffic noise may result in Black Cockatoos relocating to other habitat areas in order to move away from the noise sources.</p> <p>Vehicle strike during construction and operation of the Proposal has the potential to impact Black Cockatoos.</p>
<p>Quality and importance of known or potential habitat within the proposed action area and surrounds</p>	<p>Classification and quality of habitat has been calculated consistent with current Commonwealth guidance (DSEWPaC, 2012c) (Figure 8, Appendix A):</p> <ul style="list-style-type: none"> • Areas of Marri, Jarrah woodland will be classified as “quality foraging habitat” • Areas of scattered Marri/Eucalyptus in paddocks and road reserves would be classified as “foraging habitat” and • Vegetation units that don’t contain any foraging plants or are cleared will constitute “not foraging habitat” <p>95.0% of the area assessed during the fauna survey is cleared, highly disturbed, consisting of non-native vegetation or consisting of native vegetation that does not contain foraging plants, and is therefore devoid of Black Cockatoo foraging habitat (Biota, 2020).</p> <p>Although much of the Proposal Area has been cleared for land development purposes, 17.7 ha of vegetation remaining within the Proposal Area represents quality foraging habitat, and a further 20.1 ha represents foraging habitat (Biota, 2020).</p>
<p>Quantification of impact</p>	<p>The Proposal will require clearing of up to 37.8 ha of Black Cockatoo foraging habitat, representing approximately < 0.5% of the recorded > 7,600 ha of the locally available foraging habitat (suitable remnant vegetation within a 12 km radius). Of the 37.8 ha of foraging habitat impacted, 17.7 ha of the impacted habitat is classified as quality foraging habitat.</p>
<p>Known populations within at least a 2 km buffer</p>	<p>Biota (Biota, 2020) reviewed the potential Black Cockatoo foraging habitat within a 12 km radius of the Study Area to provide a wider context to the potential habitat loss associated with the Proposal, as is detailed in Table 2-7.</p> <p>This analysis of vegetation complexes found that the Bassendean Complex Central and South within the Proposal Area is continuous with much larger extents within the wider area (3,384 ha within 12 km). This is also generally true for the Southern River Complex (2,046 ha within 12 km), with the exception of a portion of this vegetation complex in the northern extent of the Proposal Area which is isolated from other vegetation in this complex. The Swan Complex within the Study Area is represented by riparian vegetation associated with the Preston River and is more limited in occurrence. However, this complex is generally lower quality foraging habitat for Black Cockatoos with fewer of the preferred foraging plant species (e.g. Marri, Jarrah and Banksia are generally absent from this complex).</p>
<p>Adequacy of any surveys undertaken</p>	<p>Areas of potential Black Cockatoo habitat were identified through desktop review, aerial imagery and surveys in the area (Biota, 2020) (Figure 8, Appendix A). The surveys were completed in accordance with relevant State and Commonwealth</p>

ASPECT	DESCRIPTION
	<p>policy, and to a standard that would provide adequate information to assess the Proposal against principles and environmental aims relating to the Black Cockatoo. This included the <i>EPBC Act referral guidelines for three threatened Black Cockatoo species: Carnaby's Cockatoo (Calyptorhynchus latirostris), Baudin's Cockatoo (Calyptorhynchus baudinii) and the Forest Red-tailed Black Cockatoo (Calyptorhynchus banksii naso)</i> (DSEWPaC, 2012c).</p> <p>The field surveys were conducted in several phases in September, October and November 2018 with follow up surveys to eliminate gaps in survey coverage in August, September and October 2019 (Appendix D).</p> <p>The aim of the surveys was to assess, as far as practicable, all potential breeding trees within the Proposal Area. Two approaches were taken:</p> <ol style="list-style-type: none"> 1. Larger areas of continuous vegetation were identified from aerial imagery and overlain with 25 m spaced transects in GIS. Using a GPS, a biologist walked up the middle of each 25 m wide transect, assessing all trees within it. 2. In smaller treed areas (e.g. roadside verges and paddocks containing singular trees), a biologist would maintain a GPS track file while using aerial imagery to visit as many trees as possible <p>All individual trees of species with the potential to form hollows (primarily Jarrah, Marri and Tuart) and with sufficient diameter to be considered breeding habitat trees (DBH >50 cm) were recorded using a standard GPS (accurate to within 3 m). Furthermore, the positions of trees observed to contain hollows that were potentially suitable for black-cockatoo nesting were recorded using a differential GPS (accurate to within 1.5 m).</p> <p>For trees with hollows that appeared potentially suitable for breeding during the ground assessment, a follow-up survey was conducted using a remotely-piloted aircraft (RPA; DJI Mavic Pro) to more fully assess the suitability of the hollows for black-cockatoo breeding. Within the Proposal Area, all potentially suitable hollows were subject to drone assessment twice; once in spring (at this time, survey work took place over the entire North Environmental Survey Area), with a follow-up re-survey of potentially suitable hollows within the Proposal Area in September 2019 to determine if any nesting activity could be detected.</p> <p>While conducting assessments of breeding habitat, notes on foraging habitat and foraging evidence were also opportunistically recorded. Not all locations of foraging evidence were recorded, as these were too numerous for this to be practicable. However, generally any first encounter with foraging evidence within a vegetation fragment was recorded, and subsequent encounters were also recorded if they were indicative of an additional species utilising the area.</p>
<p>Methods, data analysis and scientific literature used to identify and assess the environmental values</p>	<p>The significance of foraging / breeding habitat and suitable trees with hollows for breeding was assessed based on data collected from within and surrounding the Proposal Area during field surveys conducted in both 2018 and 2019, consideration of EPBC Act referral guidelines (DSEWPaC, 2012c) and the Carnaby's Cockatoo Recovery Plan (DPaW, 2013), analysis of NatureMap and Protected Matters Search results (Biota, 2020).</p>

Table 2-7 Black Cockatoo foraging habitat extent within 12 km of the Proposal Area (GoWA, 2019a) in (Biota, 2020)

COMPLEX NAME	COMPLEX DESCRIPTION	HABITAT WITHIN 12 KM (HA)
Guildford Complex	A mixture of open forest to tall open forest of <i>Corymbia calophylla</i> (Marri) – <i>Eucalyptus wandoo</i> (Wandoo) – <i>Eucalyptus marginata</i> (Jarrah), and woodland of <i>E. wandoo</i> (with rare occurrences of <i>Eucalyptus lane-poolei</i> (Salmon White Gum)). Minor components include <i>Eucalyptus rudis</i> (Flooded Gum) – <i>Melaleuca raphiophylla</i> (Swamp Paperbark).	1,021.8
Swan Complex	Fringing woodland of <i>E. rudis</i> – <i>M. raphiophylla</i> with localised occurrence of low open forest of <i>Casuarina obesa</i> (Swamp Sheoak) and <i>Melaleuca cuticularis</i> (Saltwater Paperbark).	716.3
Southern River Complex	Open woodland of <i>C. calophylla</i> – <i>E. marginata</i> – Banksia species with fringing woodland of <i>E. rudis</i> – <i>M. raphiophylla</i> along creek beds.	2,045.7
Bassendean Complex-Central and South	Vegetation ranges from woodland of <i>Eucalyptus marginata</i> – <i>Allocasuarina fraseriana</i> (Sheoak) – Banksia species to low woodland of <i>Melaleuca</i> species, and sedgelands on the moister sites. This area includes the transition of <i>Eucalyptus arginata</i> (Jarrah) to <i>Eucalyptus todtiana</i> (Pricklybark) in the vicinity of Perth.	3,834.2
Total		7,618.0

2.5.2 Western Ringtail Possum – Critically Endangered

The WRP was first listed as threatened under the Western Australian *Wildlife Conservation Act 1950* in 1983, and under the EPBC Act in 2000. Its listing was reassessed to Critically Endangered under the BC Act in 2016 and EPBC Act in 2018.

A description of this species, direct and potential indirect impacts from the Proposal has been outlined in Table 2-8.

Table 2-8 Western Ringtail Possum – Critically Endangered

ASPECT	DESCRIPTION
<p>Ecology, abundance, distribution and habitat preferences</p>	<p><u>Ecology</u></p> <p>The WRP is a medium sized arboreal marsupial, endemic to the south-west of Western Australia.</p> <p>The WRP population size and density can vary significantly with seasonal conditions. Unless they are isolated or constrained, populations usually consist of a combination of resident and transient individuals. It is not possible during discrete surveys to distinguish resident from transient animals however variations in populations as a result of repeated seasonal observations provide an indication of the distinction. The proportion of transient individuals increases during the breeding season as males move through patches in search of a mate, and again when young are dispersing.</p> <p>The peak season for WRP births in western coastal areas (Bunbury, Busselton) is typically in winter to early spring (June-September), with most young mature enough to leave the pouch during spring (September-November) when climate and food resources are at their optimum. Consistent with the Busselton WRP population, it is unlikely that there is any substantial WRP breeding peak in autumn within the Bunbury area.</p> <p>WRP populations fluctuate locally on a seasonal basis, with the population peaking in spring and early summer with the maturation of young, and then falling over summer into early autumn due to increased temperatures, lower forage quality and less moisture availability. These fluctuations can often be considerable and strongly related to climatic variations (Shedley & Williams, 2014).</p> <p><u>Habitat preferences</u></p> <p>The species feed on leaves of myrtaceous species, predominantly Peppermint (<i>Agonis flexuosa</i>), but also Marri (<i>Corymbia calophylla</i>) and Jarrah (<i>Eucalyptus marginata</i>) and also non-natives. Home range sizes and possum density vary with the quality and productivity of the habitat. Home ranges are generally less than 5.0 ha, and those within peppermint dominated habitat are generally less than 2.0 ha and average 0.4 ha and 0.3 ha for females and males respectively (DPaW, 2017). Densities of up to 20 individuals per hectare have been recorded in Peppermint woodland in Busselton on the southern SCP (DPaW, 2017).</p> <p>WRP are known to be susceptible to heat stress and can overheat at ambient temperatures of 35°C and above (Yin, 2006) in (DPaW, 2017).</p> <p>Habitat critical for the survival of the species is understood to vary between population areas (or management zones) but is generally associated with areas that provide high nutrient foliage for food, suitable structures for</p>

ASPECT	DESCRIPTION
	<p>protection/nesting (including suitable hollows), and canopy continuity. Linkages between areas of suitable habitat area also considered critical to the survival of the species. On the SCP, critical habitat includes areas of mature unburnt peppermint woodlands with high canopy continuity, high nutrient foliage and connectivity with other patches (DPaW, 2017).</p> <p>Movement pathways are often established between areas of quality habitat and water sources, and along continuous corridors such as vegetated riparian zones. WRP will move to new areas in search of high quality foraging habitat, in search of a mate or if competition for resources is high.</p> <p><u>Abundance</u></p> <p>In their 2019 regional survey, Biota (2019) found that of the three management zones, the surveyed footprint of the SCP management zone (in which the Proposal Area is located) yielded the greatest estimated abundance of WRP at 9,270 individuals, with the majority (around 6,500) occurring in the SCP IBRA region. The estimated abundance within the Southern Forests management zone was 7,500 and within the South Coast management zone was 3,340, taking the total estimated abundance to more than 20,000 individuals.</p> <p><u>Distribution</u></p> <p>WRP were once widely distributed across the south and south-west of the state (from north of Perth to east of Albany) but are now restricted to three key management zones: the SCP, the Southern Forests and the South Coast.</p> <p><u>Species presence and habitat extent within the Proposal Area</u></p> <p>The Proposal Area provides areas of suitable breeding and foraging habitat for WRP including Marri/ Eucalyptus Woodland, Marri/ Eucalyptus in paddocks and road reserves, Peppermint Woodland and Riparian Woodland (43.9 ha). WRP were recorded in woodland fragments (particularly mixed woodland) within the Proposal Area (Biota, 2020). WRP occur in three main habitat areas within the Proposal Area. From north to south they are:</p> <ul style="list-style-type: none"> • At and around the Clifton Road / Paris Road interchange and north to the Brunswick River • Around the Boyanup Picton Road interchange • In the south near Manea Park. <p>WRP habitat is present adjacent to the Proposal Area along the length of the Proposal Area, with further larger expanses also in the vicinity of these adjacent areas. None of the Proposal Area habitat areas are isolated from adjoining habitat.</p> <p><u>Western Ringtail Possum Movement</u></p> <p>Barbara Jones has been studying the WRP population for more than 30 years and is recognized by the Commonwealth as one of the preeminent experts regarding WRP populations and ecology (Threatened Species Scientific Committee, 2017). Barbara Jones professional observations of the southern Swan Coastal Plain WRP populations have been summarised as follows:</p> <p style="padding-left: 40px;">WRP display a range of behavioural adaptations to using man made features. Examples of this include using reticulation, drippers, bird-baths</p>

ASPECT	DESCRIPTION
	<p>and pet bowls during extreme summer conditions. In areas with high densities of WRP, sheds and roof spaces (near suitable trees) often provide ideal possum shelter nooks, while appropriate fence tops, old phone cabling, and even live power-lines help individual WRPs to get around in their patch more efficiently, safely or directly.</p> <p>WRP's movement within their known habitat patches is predominantly achieved by using preferred well-known runways. In the manmade environment, these runways often accumulate a WRP residue of urine and scent.</p> <p>WRPs have been observed using construction site scaffolding to move between trees within a week of the scaffolding being erected. Most WRPs will explore and investigate manmade structures, but show caution exploring new structures constructed in proximity to preferred habitat.</p> <p>The amount of time WRP's spend on the ground depends on the habitat and density of feeding trees i.e. sparser vegetation means more time on the ground. Males typically travel more widely and spend more time on the ground.</p> <p>Where dense cover is available below good foraging trees, WRPs will often shelter in thick vegetation at ground level. WRPs have been observed seeking shelter in known rabbit warrens. In habitat where good foraging canopy connects numerous trees, dominant females may be almost exclusively arboreal. However, if conditions get too hot or too dry, WRPs often leave the trees seeking a damp cool shelter site at ground level.</p> <p>Most behavioural observations have been conducted in higher density WRP populations, particularly from the Busselton area, where densities of 5-15 WRPs per hectare have been common.</p> <p>The BORR WRP habitat surveyed by Biota 2017-19 had an overall average density of approximately one individual per hectare. Repeated counts within the BORR footprint during August, October and December 2019 indicated that some patches were used by WRPs during one count period, but were virtually empty in another count period. This implies that Bunbury WRPs in remnant woodlands move substantially between different habitats. The bimonthly count sequence will run through 2020. This sequence should clarify seasonal (or other) trends in WRP abundance in the BORR habitat remnants.</p> <p>Western Ringtail Possum Use of Structures</p> <p>Within WRP populations of the southern Swan Coastal Plain, attempts to mitigate habitat disjunctions associated with linear structures have relied primarily on rope bridges or cables over existing roads. The success of these structures has been mixed. On Caves Road near Vasse a 26.5 metre long bridge built in 2013 was used by WRPs within 36 days of construction and recorded 1,300 crossing in 270 days (9 months) of monitoring (Yokochi & Bencini, 2015). The tallest and longest rope bridge is an 88 metre span of BORR's existing central segment constructed in 2014, which only had two confirmed crossings in 13 months of monitoring (Chambers & Bencini, 2016).</p>

ASPECT	DESCRIPTION
	<p>Barbara Jones’ professional observations regarding WRPs and use of fauna movement structures is summarised as follows:</p> <p>In addition to rope bridges, there have also been attempts to encourage WRPs to use kangaroo underpasses (e.g. Busselton Bypass), however, none that were monitored have shown repeated use by WRPs (monitoring periods for underpasses have been relatively short).</p> <p>In all south west WRP crossover examples to date, there has been no field evidence to test whether the frequency of WRP road-crossing events at ground level near used rope bridges or underpasses had truly been reduced by the provision of either treatment. It is considered that WRP will continue to cross at ground level if it is the easier option for the animal. In studies undertaken to date, monitoring of WRP use typically involves a single crossover structure.</p> <p>The BORR project will provide the first opportunity to monitor WRP use of multiple underpasses and allow assessment of the performance of different crossing treatments. The inclusion of road protection fencing in the BORR design has been designed to prevent WRPs accessing the road at ground level. In BORR’s main WRP areas, possum exclusion fencing will also function to turn native mammals away from the road, and to help funnel ground-moving WRPs into an underpass forecourt area. Where feasible, these forecourt areas can be generously landscaped with features to make the underpass forecourt areas increasingly useful, desirable or comfortable for WRPs, especially for WRPs moving at ground level.</p> <p>Rope cabling has been recently used under Treendale Bridge (Eaton Drive) on the Collie River. The new bridge required a narrow riparian strip on one bank to be severed from a pre-existing connection used by resident WRPs. In autumn 2018, the resultant gap was treated with simple cabling that extended out to suitable nearby trees on either side of the bridge, and was continuous just below the underside of the bridge. When inspected in August 2019, WRP scat (differing ages) was found directly below the rope bridge, but it was most common where the rope bridge was sheltered by the road bridge, suggesting that on the sheltered part of the cable, WRPs were comfortable enough to pause and rest. But on the exposed cabling adjacent to the bridge, they did not linger in a comparable way. This cabling approach has been incorporated into the BORR Northern and Central bridges.</p> <p>Fauna bridges in the South west to date have not featured WRP perching and lay-by areas. These allow for the structure to provide a more user-friendly environment, especially suited for WRPs doing staged explorations of a new set of cabling.</p> <p>With respect to the existing 88 metre BORR Central rope bridge, minor structural treatments should be applied to extend some peripheral cabling, mostly between existing trees (WRP habitat) to develop a desirable crossover forecourt area where dry-season watering points and cameras can be added. Retro fitting the existing long crossover (BORR Central) with features attractive to WRPs should create a better understanding of how</p>

ASPECT	DESCRIPTION
	<p>to successfully span wider WRP disjunctions in the developing west-coastal habitat strip.</p>
<p>Direct impact</p>	<p>The Proposal will result in the loss of up to 43.9 ha of WRP habitat within the 625 ha Proposal Area (approximately 7 % of the 625 ha Proposal Area). The habitat to be cleared is fragmented, dissected by existing roads, easements and cleared agricultural land.</p> <p>Noting the WRP population peak in spring and early summer, as outlined in Ecology (above), clearing for the Proposal within key WRP habitats will be restricted to the period of February to August (late summer to late winter) to avoid this period.</p> <p>To reflect the seasonal and transient fluctuations in population size, the potential impact of the Proposal on individual WRP home ranges is presented as a range rather than a discrete number. Based on these data, it is estimated that between 15 and 25 WRPs within the Proposal Area will potentially have their home ranges disturbed by the Proposal. This indicates that up to 0.11 % to 0.26 % of the 2019 estimated WRP population within the Southern SCP Management Zone as identified by Biota (2019) (of up to 9,270 individuals) could potentially be impacted.</p>
<p>Indirect impact</p>	<p>The Proposal may potentially result in the following indirect impacts to WRP including:</p> <ul style="list-style-type: none"> • Incremental loss of WRP habitat resulting from reduced connectivity, barrier effects and edge effects • Displacement of WRP due to traffic noise exposure • Displacement of WRP due to light spill from street lighting and traffic. <p>Historical clearing combined with incremental reduction in habitat has restricted the distribution of WRP within the Proposal Area. As habitat is cleared, patch sizes decrease and the impact of ‘edge effect’ increases with likely introduction of weeds and dieback, ultimately changing the species composition of the vegetation community and reducing suitability of habitat for local fauna species, including WRP.</p> <p>The Proposal Area has been largely cleared for agriculture, urban and industrial developments and BORR Central Section. Clearing for the land uses has resulted in fragmentation of both terrestrial and riparian / wetland vegetation and ecological linkages, thereby reducing connectivity of WRP habitat. Connectivity of habitat areas is important to enable dispersal of WRP to find habitat and mates, and maintain the exchange of genetic material between populations. Good connectivity is also important to enable WRPs resident in small patches to access additional food resources and water as required.</p> <p>If severe enough, traffic noise and light exposure may result in WRP relocating to other habitat areas in order to move away from the noise and / or light sources (pers comm. Ms Barbara Jones). WRP have adapted to urban and semi-urban area and are often found in high densities in these areas (Shedley & Williams, 2014). This indicates that they are able to adjust to and even thrive in developed areas with light and noise levels higher than would be found in undeveloped areas.</p>

ASPECT	DESCRIPTION
<p>Areas of larger contiguous patches that will be fragmented</p>	<p>Connectivity between habitat patches in the Proposal Area is already compromised by the existing Forrest Highway and arterial roads, easements and large expanses of cleared agricultural land. Connectivity between some habitat areas, such as at the Paris Road/Clifton Road interchange (Figure 10, Appendix A), will be temporarily disrupted during Proposal construction, however, the majority of habitat within the Proposal Area is already disconnected and will not be further impacted in this way by the Proposal.</p> <p>Conversely, connectivity across the alignment between existing habitat areas will maintain and may improve connectivity as a result of Proposal implementation through the installation of more than 22 possum over/underpasses and or rope bridges at key locations identified along the alignment. The maintenance of existing movement pathways and connectivity along either side of the alignment has been a priority during Proposal planning. Connectivity and suitability of cleared areas remaining within the Proposal Area will be further enhanced with targeted revegetation post construction and design features to ensure access to water in maintained. As is also shown on Figure 15 (Appendix A), the detailed design ensures this connectivity will remain after Proposal implementation.</p>
<p>Quality and importance of known or potential habitat within the proposed action area and surrounds</p>	<p>Shedley and Williams (2014) calculated that the Bunbury WRP ‘management zone’ (which encompasses an area from the Preston River in the north to the Capel River in the south and is a component of the Swan Coastal Plan management zone) includes 6,264 ha of WRP habitat², most of which was rated as having a ‘C’ (medium) suitability score (which was the lowest score in this zone). The area of habitat in each habitat quality class within the Proposal Area as mapped by Shedley and Williams (2014) is shown in Figure 10. No ‘A’ class (premium) habitat was present.</p> <p>WRP habitat quality mapped by Shedley and Williams (2014) within the Proposal Area includes 34.9 ha of WRP Habitat classified accordingly:</p> <ul style="list-style-type: none"> • 0 ha of Habitat Quality Class A (Very High) • 2.85 ha of Habitat Quality Class B (High) • 25.44 ha of Habitat Quality Class C (Medium) • 6.58 ha of Habitat Quality Class D (Low) • 0 ha of Habitat Quality Class E (Very Low) <p>Due to the regional scale at which the Shedley and Williams (2014) mapping was conducted there are differences between this study and the field Survey of the Proposal Area, with surveys for the Proposal identifying an additional 9 ha of smaller suitable habitat patches than were identified by Shedley and Williams (2014) which focussed on larger patches of habitat. However, Shedley and Williams (2014) provides a valuable rigorous approximation of general quality of WRP habitat within the Proposal Area and the context of habitat quality in the greater region.</p> <p>The 43.9 ha of habitat that would be cleared under the Proposal is generally considered to be of ‘Medium’ quality, with roughly equal smaller percentages of</p>

² Shedley and Williams (2014) noted that ‘the potential area of class C is likely to be overestimated, especially in the Bunbury and Binningup zones, as there have been very few surveys in these soil landforms’.

ASPECT	DESCRIPTION
	<p>'High' and 'Low' quality habitat. The 43.9 ha of habitat that would be cleared under the Proposal equates to 0.70 % of the estimated habitat in the Bunbury management zone.</p>
<p>Known populations within at least a 2 km buffer</p>	<p>Biota (2019) completed additional surveys (using distance sampling) to provide a regional context for potential impacts from the Proposal on the WRP. The survey included sites on the southern section of the SCP, between Binningup and Dunsborough, and extending into the northern section of the Whicher Scarp near Dardanup.</p> <p>The distance sampling within the BORR Proposal Area and regional context sites surveyed a combined distance of 256 km and recorded a combined total of 1,521 individual WRP. Based on preliminary analysis of these results, the Biota (2019) study estimated a population for the Southern SCP Management Zone of 5,373 WRP. This estimate includes 3,582 mature adults and 1,791 juveniles. The estimate does not include suitable habitats in the semi-urban and urban environment that are known to be inhabited by WRP, and is therefore considered to be a conservative estimate (Biota, 2020).</p>
<p>Environmental management</p>	<p>No translocation of WRP is proposed.</p> <p>Clearing procedures are defined in Section 4.2.2, and include:</p> <ul style="list-style-type: none"> • Clearing within key WRP habitat areas to be conducted during the period of February to August • Habitat clearing to be staged, commencing from existing edge lines / roads and progressing towards habitat that will be retained to direct WRP towards retained habitat • Potential WRP habitat trees would be cleared appropriately, by either directional onto vegetation within the clearing area that is yet to be cleared or by ensuring trees don't fall on hollows whenever possible (trees with multiple hollows will be assessed on a case by case basis). The 'soft felling' of habitat trees will provide a 'cushion' for the vegetation being felled, allowing any WRP in a hollow more opportunity to safely vacate the hollow • If WRP are detected during clearing operations, the tree containing the animal shall be left for up to 48 hours to allow for the animal to vacate the tree, while clearing continues adjacent to the inhabited tree. If the tree continues to be occupied after 48 hours, the animal will be coerced/moved to a safe area outside of the clearing footprint by the appointed zoologist / environmental scientist / fauna spotter • A post-clearing survey shall be undertaken to ensure no injured individuals are present • Felled trees with hollows will be left on the ground overnight to allow time for any undetected fauna to vacate. All hollows will be checked immediately after felling and prior to further processing of the tree. <p>The proposed measures are anticipated to preclude the need for active translocation by the construction contractor.</p>

ASPECT	DESCRIPTION
<p>Adequacy of any surveys undertaken</p>	<p>Areas of potential WRP habitat were identified through desktop review, aerial imagery and surveys in the area during Biota (Biota, 2020) survey. The surveys were completed in accordance with relevant State and Commonwealth policy, and to a standard that would provide adequate information to assess the Proposal against principles and environmental aims relating to the WRP. This included the <i>Significant impact guidelines for the vulnerable western ringtail possum (Pseudocheirus occidentalis) in the southern Swan Coastal Plain, Western Australia</i> (DEWHA, 2009a).</p> <p>The aim of the surveys were to assess evidence of WRP and suitable habitat. A strip-sampling approach was applied to the entirety of the Proposal Area. Many adjacent areas of habitat, often continuous with the Proposal Area, were also surveyed to assess areas of potential movement in and out of the Proposal Area. This strip-sampling exercise was undertaken on three occasions (mid-August, mid-October and early-December 2019) to examine temporal variation in abundance throughout the Proposal Area (Appendix D). The sampling will be conducted over a 12 month period to provide baseline data for the monitoring program.</p> <p>In addition to the WRP, observations of the Common Brushtail Possum and Brush-tailed Phascogale were also recorded. Approximately 37.9 km of transect was walked inside the Proposal Area and 17.4 km of transect was walked in adjacent areas.</p>
<p>Methods, data analysis and scientific literature used to identify and assess the environmental values</p>	<p>The significance of potential impacts to WRP habitat and individuals was assessed based on data collected from within and surrounding the Proposal Area during field surveys conducted in spring/summer of 2019, consideration of survey guidelines (DSEWPaC, 2011), impact significance guidance (DEWHA, 2009a), Recovery Plan (DPaW, 2017), and analysis of NatureMap and Protected Matters Search results (Biota, 2020).</p>

2.5.3 Balston's Pygmy Perch - Vulnerable

BPP is currently listed as Vulnerable nationally (EPBC Act) and at a state level in Western Australia (Schedule 3 of the Wildlife Conservation Specially Protected Fauna Notice 2018).

A description of this species, direct and potential indirect impacts from the Proposal has been outlined in Table 2-9.

Table 2-9 Balston's Pygmy Perch – Vulnerable

ASPECT	DESCRIPTION
<p>Ecology, abundance, distribution and habitat preferences</p>	<p><u>Ecology</u></p> <p>BPP is a small freshwater fish that grows to a maximum length of around 90 mm. The species is brownish dorsally and silver below, usually with a prominent brown mid-lateral stripe and a series of vertical brown bars on sides (Allen, Midgley, & Allen, 2002).</p> <p><u>Abundance</u></p> <p>The species is estimated to contain less than 12,000 mature fish, with less than 1,000 estimated to occur in each river system (TSSC, 2006).</p> <p><u>Distribution</u></p> <p>BPP is known to occur in coastal peat flats in south western Western Australia that extends from Margaret River to Two Peoples Bay (DEWHA, 2008a).</p> <p><u>Habitat preferences</u></p> <p>The species is confined to smaller streams within major river systems of south-west Western Australia (Allen, Potter, & Lenanton, 1994). BPP are historically known to occur from the Moore River (north of Perth) to the Goodga River near Albany in the south, and the Collie River to the east. Habitat is primarily acidic, tannin-stained freshwater pools, streams and lakes (Morgan, Gill, & Potter, 1998). It is likely the species has been lost from the northern half of its range including the SCP (Morgan & Gill, 2000) and is therefore not anticipated to occur within the Northern and Central Sections investigation area.</p> <p><u>Breeding parameters</u></p> <p>Species breed during the winter months, spawning occurring from June through to September with a peak in mid-July to early August when water levels are at their maximum (DoEE, 2008).</p> <p><u>Species presence and habitat extent within the Proposal Area</u></p> <p>No BPP were recorded during the 2019 WRM Aquatic Fauna Survey, and no BPP habitat is present within the Proposal Area. BPP is unlikely to occur within the Proposal Area (WRM, 2020).</p>
<p>Direct impact</p>	<p>Changes to the Proposal design have removed the requirement for bridge piers or abutments within any water courses. No direct loss of habitat for or of individual BPP is expected as a consequence of construction or operation of the Proposal.</p>
<p>Indirect impact</p>	<p>Potential impacts to BPP are restricted to indirect impacts associated with construction and operation and include:</p>

ASPECT	DESCRIPTION
	<ul style="list-style-type: none"> • Erosion and sedimentation resulting from earthworks adjacent to watercourses during construction • Contamination and/or water quality impacts during construction or operation • Alteration of hydrological regimes resulting from bridge and/or road construction • Indirect impacts to host fish populations.
Areas of larger contiguous patches that will be fragmented	<p>Changes to the Proposal design have removed the requirement for bridge piers or abutments within any water courses. No riverine habitat is expected to be fragmented as a consequence of construction or operation of the Proposal.</p>
Quality and importance of known or potential habitat within the proposed action area and surrounds	<p>BPP is confined to smaller streams within major river systems of south-west Western Australia and typically inhabit acidic, tannin-stained freshwater pools, streams and lakes. While historically known for the Collie River and surrounding tributaries, no known extent habitat exists within the Proposal Area</p> <p>It is likely the species has been lost from the northern half of its range including the SCP (Morgan <i>et al.</i> 2000) and is therefore not anticipated to occur within the Northern and Central Sections investigation areas. No BPP were recorded during the 2018 or 2019 surveys.</p>
Known populations within at least a 2 km buffer	<p>No BPP were recorded during the 2018 or 2019 surveys (WRM, 2020). No known extant populations of BPP have been identified within a 2km buffer of the project footprint.</p>
Adequacy of any surveys undertaken	<p>A number of methods were used to effectively collect as many species/individuals as possible and increase the likelihood of recording the conservation significant BSM and BPP. Fish sampling methods included beach seine netting, dip netting and fyke netting. Surveys included the Collie River and a tributary downstream of the Proposal Area, in addition to eight sites on three other waterbodies in the Proposal Area and sites immediately downstream and upstream of proposed bridge crossings (Appendix E).</p>
Methods, data analysis and scientific literature used to identify and assess the environmental values	<p>The potential significance of habitat for BPP was assessed based on data collected from waterbodies within and upstream/downstream of the Proposal Area during field surveys, consideration of the conservation advice (DEWHA, 2008a), listing advice (TSSC, 2006), analysis of NatureMap and Protected Matters Search results (WRM, 2020).</p>

2.5.4 Black-stripe Minnow - Endangered

BSM is listed as Endangered under the EPBC Act and the BC Act. A description of this species, direct and potential indirect impacts from the Proposal has been outlined in Table 2-10.

Table 2-10 Black-stripe Minnow - Endangered

ASPECT	DESCRIPTION
<p>Ecology, abundance, distribution and habitat preferences</p>	<p><u>Ecology</u></p> <p>BSM is a small (maximum 48 mm TL) freshwater fish species endemic to south-western Australia. It most commonly occurs in shallow ephemeral waterbodies of peat flats (WRM, 2020).</p> <p>It is short lived (one year) and able to survive dry summer conditions by aestivating (burrowing) into moist soils. Dispersal is understood to be linked to climatic conditions with the species emerging from aestivation following rainfall (WRM, 2020).</p> <p><u>Abundance</u></p> <p>Surveys for the Proposal (WRM, 2020) recorded the presence of BSM at four locations in which a total of >160 individuals were recorded in habitats at the southern end of the Survey Area, both within, and adjacent to, the Proposal.</p> <p><u>Distribution</u></p> <p>The majority of BSM populations are confined to peat flat wetlands of the Warren sub-region between Augusta and Albany in the extreme south-west corner of Western Australia (TSSC, 2018a), though three isolated populations exist between Bunbury and Gingin on the SCP (Lake Chandala ca. 55 km north-east of Perth, Melaleuca Park ca. 30 km north-east of Perth, and Kemerton Nature Reserve ca. 130 km south of Perth), intimating its historically-wider distribution. The identification of BSM during 2018 and 2019 surveys of the BORR northern central investigation area, as well as nearby wetlands in Gelorup within the BORR southern investigation area and the BORR southern alternate alignment investigation area, extends the distribution of the species on the SCP approximately 30 km further south (WRM, 2020).</p> <p><u>Habitat preferences</u></p> <p>BSM occurs predominantly in shallow, low pH, tannin stained ephemeral wetlands with peat rich soils including isolated populations on the SCP and on the south coast between Augusta and Albany. The populations on the SCP are thought to be remnants of a much wider distribution which has been impacted by widespread urban and rural development.</p> <p><u>Species presence and habitat extent within the Proposal Area</u></p> <p>During additional surveys conducted in August 2019, BSM were recorded from one sampling site within the Proposal Area and four sites outside of the Proposal Area (Figure 11).</p> <p>Sites where the minnow was recorded were relatively unaltered wetlands, with intact fringing vegetation. All sites were clustered toward the southern end of the Proposal Area and were within or just outside the Manea Park bushland reserve. There was little or no suitable habitat for the species identified within the</p>

ASPECT	DESCRIPTION
	<p>remainder of the Proposal Area, as wetlands in these areas have been largely cleared for agriculture or otherwise highly modified (WRM 2019).</p> <p>Wetland mapping along the Proposal Area indicates that site North 5, within the Proposal Area, is part of a large palusplain wetland. Review of aerial photography and site observations by WRM (2019) indicate that within the palusplain there is a small channel wetland where sites North 5 and Northern 9³ are located (Figure 11). Within the Proposal Area, the area of habitat provided by this channel wetland likely to be suitable for BSM is approximately 0.55 ha.</p> <p>Due to the high mobility of the species and connectivity between wetlands in wetter years, it is possible that BSM migrate between wetlands within the local area. Maintaining connectivity between wetlands that provide suitable habitat is an important consideration in drainage design for the Proposal.</p>
<p>Direct impact</p>	<p>During additional surveys conducted in August 2019, a total of 164 BSM were recorded, with the species present at all four sampling sites including 30 individuals recorded at the North 5 site within the Proposal Area (WRM, 2020). This site is shown in Figure 11 (Appendix A).</p> <p>Wetland mapping along the Proposal Area indicates that site North 5, within the Proposal Area, is part of a large palusplain wetland. Review of aerial photography and site observations by WRM (2020) indicate that within the palusplain there is a small channel wetland where the WRM sample site North 5 is located (Figure 11). Within the Proposal Area, the area of habitat provided by this channel wetland likely to be suitable for BSM is approximately 0.55 ha.</p> <p>Within the Proposal Area, BSM were restricted to a small area of relatively undisturbed wetland in the southern end of the alignment. It was not recorded from additional areas (seven sites surveyed) of wetland habitat in the Proposal Area (Figure 11).</p> <p>Some direct loss of aestivating BSM is possible during construction through disturbance of sediments. Previous attempts to find and record aestivating BSM in sediments have not been successful (Galeotti, 2013) and the length of time the species can remain aestivating is unknown. Translocation is not considered a viable mitigation strategy for this species (WRM, 2020).</p> <p>Given the distribution of the species in wetlands adjacent to the Proposal Area and to the south, loss of 0.55 ha as a result of construction of the Proposal is unlikely to have a significant impact on the species. Potential loss of connectivity will be mitigated as per strategies outlined in Section 4.2.4.</p>
<p>Indirect impact</p>	<p>In 2018, one BSM individual was recorded by WRM at site Northern 9, located outside the Proposal Area. A further survey undertaken in August 2019, recorded 134 individuals at three additional sites outside of the Proposal Area (WRM, 2020). These sites are shown in Figure 11 (Appendix A).</p> <p>All sites outside of the Proposal Area were relatively undisturbed or intact wetlands within or adjacent to the Manea Park bushland reserve. The area of</p>

³ These sites names differ because Northern 9 (site North 4 2019) was not sampled in the 2019 survey due to site access restrictions at the time of sampling (WRM, 2020).

ASPECT	DESCRIPTION
	<p>habitat outside of the Proposal Area associated with the Manea Park sites surveyed by WRM is approximately 8.9 ha.</p> <p>The species has recently been recorded to occur in nearby wetlands (>2 km away) in Gelorup, surveyed as part of investigations for the BORR South Alternate alignment. In part, due to their short lived lifecycle, BSM are considered to be a transient and mobile species and abundance and distribution is likely to vary from year to year in response to seasonal rainfall (WRM, 2020).</p> <p>Potential indirect impacts to BSM associated with construction and operation of the Proposal are, in part, similar to those identified for CFM and include:</p> <ul style="list-style-type: none"> • Erosion and sedimentation resulting from earthworks adjacent to watercourses during construction • Contamination and/or water quality impacts during construction or operation • Alteration of hydrological regimes resulting from bridge and/or road construction • Restriction of fish movement • Fragmentation of suitable habitat.
<p>Quality and importance of known or potential habitat within the proposed action area and surrounds</p>	<p>The identification of BSM during 2018 and 2019 surveys of the BORR northern central investigation area, as well as nearby wetlands in Gelorup within the BORR southern investigation area, extends the distribution of the species on the SCP approximately 30 km further south (WRM, 2020). Habitat identified for both proposals identifies habitat and species abundance outside of the proposals to be greater than what has identified within the Proposal Area.</p>
<p>Known populations within at least a 2 km buffer</p>	<p>Known populations within at least a 2 km buffer include four locations in wetlands within Manea Park to the north of Centenary Road (Figure 11, Appendix A).</p> <p>As previously noted, surveys undertaken in August 2019 recorded 134 individuals at three additional sites outside of the Proposal Area (WRM, 2020).</p>
<p>Adequacy of any surveys undertaken</p>	<p>Targeted aquatic fauna sampling for BSM was first undertaken in November 2018 at nine sites. The majority of wetlands were deemed unsuitable for BSM based on observations made during the November 2018 survey. Additional targeted surveys were undertaken in August 2019 at six sites where BSM were likely to occur, based on desktop assessment of previous records and habitat preferences. Due to site restrictions around private property access, only four of the six identified BSM sites were sampled during the August 2019 survey (Appendix E).</p> <p>Aquatic fauna surveys were conducted by WRM under Department of Primary Industries and Regional Development (DPIRD) Fisheries Licence EXEM 2483 (Instruments of Exemption to the <i>Fish Resources Management Act 1994</i> for Scientific Research Purposes). As a condition of this licence, taxa lists and reports are required to be submitted to DPIRD. The study was also conducted under DBCA Fauna Taking (Biological Assessment) Licence BA27000105. As a condition of this licence, a fauna return including taxa lists and locations, is required upon project completion.</p> <p>Aquatic fauna sampling by WRM is consistent with methodology used by others in similar surveys across Australia (i.e. (Cheal, Davis, Grown, Bradley, & Whittles,</p>

ASPECT	DESCRIPTION
	1993), Storey <i>et al.</i> 1993, Edward <i>et al.</i> 1994), including the sampling of wetlands of the SCP by Murdoch University (Davis, et al., 1993) and the National Monitoring River Health Initiative (Department of Environment Sport and Territories, 1994).
Methods, data analysis and scientific literature used to identify and assess the environmental values	The potential significance of habitat for BSM was assessed based on data collected from ponds and wetlands within and adjacent to the Proposal Area during field surveys, consideration of the conservation advice (TSSC, 2018a), analysis of NatureMap and Protected Matters Search results (WRM, 2020).

2.5.5 Carter's Freshwater Mussel – Vulnerable

Carter's Freshwater Mussel (*Westralunio carteri*) (CFM) is the only freshwater mussel occurring in the south west of Western Australia. CFM was listed as vulnerable under the EPBC Act and BC Act in 2018. The listing was in recognition of the estimated contraction of the range of the species by almost 50% in the last 50 years, primarily as a result of the impacts of secondary salinisation on waterways within its former range.

A description of this species, as well as direct and potential indirect impacts from the Proposal is outlined in Table 2-11.

Table 2-11 Carter's Freshwater Mussel – Vulnerable

ASPECT	DESCRIPTION
Ecology, abundance, distribution and habitat preferences	<p><u>Ecology</u></p> <p>CFM has brown to red and sometimes black shells. The species is mostly sessile but can move through sediments with a muscular foot (TSSC, 2018b).</p> <p><u>Abundance</u></p> <p>The exact population of the species is unknown (TSSC, 2018b).</p> <p><u>Distribution</u></p> <p>The species is restricted to freshwater waterways (streams, rivers, reservoirs and lakes) within 50-100 km of the coast from Moore River, north of Perth, to west of Esperance (WRM, 2020).</p> <p><u>Habitat preferences</u></p> <p>The species is patchily distributed in sandy/muddy sediments of freshwater lakes, rivers and streams. The greatest densities are associated with exposed submerged tree roots, woody debris, and overhanging riparian vegetation near stream banks (particularly slower flowing sections) and edges of lakes/dams (IUCN, 2019; WRM, 2020).</p> <p><u>Breeding parameters</u></p> <p>The species is known to spawn in winter (June – August). CFM is a spermcaster, with males spawning in July/August. Larvae (glochidia) are retained by the female until October/November, when they are released as larva. The lifecycle of CFM involves an obligate parasitic 'larval' stage, known as glochidia, which attach to the</p>

ASPECT	DESCRIPTION
	<p>gills of host fish for several weeks to complete their development (Beatty <i>et al.</i> 2010). The glochidia aids with the distribution of this species, with individuals being dispersed by migrating fish.</p> <p><u>Species presence and habitat extent within the Proposal Area</u></p> <p>Surveying for CFM was undertaken in drainage areas during targeted fauna surveys in 2018 and 2019. Within the Proposal Area, CFM is restricted to major creeklines with shallow sandy banks (Biota, 2020). During surveys undertaken in 2018 and 2019 by WRM (2019), CFM were recorded from:</p> <ul style="list-style-type: none"> • A tributary of the Collie River (North Creek 3) downstream of the Proposal Area • The Ferguson River (North Creek 5 and Mussels 2) within and just upstream of the Proposal Area • The Preston River (North Creek 2) (Mussels 1 shells only and North Creek 2) within and upstream of the Proposal Area (Figure 12, Appendix A). <p>Potential habitat for CFM includes the Collie (tributary), Ferguson and Preston Rivers and has been mapped as a maximum of 1.4 ha within the Proposal Area.</p> <p>CFMs were recorded at reference sites outside of the Proposal Area, including the Preston River. They are likely to be common within each of the rivers crossing the Proposal Area where suitable habitat occurs. The exception is the lower Collie River, where the species was not recorded within or adjacent to the Proposal Area. Elevated salinity is considered to be the primary reason for the absence of the species in the lower Collie River (WRM, 2020).</p> <p>Due to a lack of field surveys for the species and resulting paucity of data it is not possible to provide an estimate of the size of the population within the Proposal Area, or of the local or regional populations.</p>
Direct impact	Changes to the Proposal design have removed the requirement for bridge piers or abutments within any water courses. No direct loss of habitat for or of individual CFM is expected as a consequence of construction or operation of the Proposal.
Indirect impact	<p>Potential impacts to CFM are restricted to indirect impacts associated with construction and operation and include:</p> <ul style="list-style-type: none"> • Erosion related turbidity and reduced dissolved oxygen resulting from earthworks adjacent to watercourses during construction • Contamination and/or water quality impacts during construction or operation • Alteration of hydrological regimes resulting from bridge and/or road construction • Indirect impacts during the breeding season • Indirect impacts to host fish populations.
Quality and importance of known or potential habitat within the	CFM were recorded on the Ferguson and Preston rivers at locations within, upstream and downstream of the northern and central investigation area. CFM have also been recorded on other creeks which the Proposal intersects (WRM, 2020). CFM were not recorded from the Collie River where the Proposal intersects

ASPECT	DESCRIPTION
proposed action area and surrounds	<p>the river, likely due to the high salinity in the lower reaches of the Collie River watershed due to estuarine intrusion.</p> <p>Management of the Collie River watershed and saline intrusion has resulted in pre-existing degradation of habitat within the Proposal Area. Conservation advice notes some level of tolerance in CFM to changing water quality and the presence of CFM in less impacted smaller tributaries and the Preston/Ferguson rivers is supported by this evidence (TSSC, 2018a).</p>
Known populations within at least a 2 km buffer	CFM is endemic to the South West Coast Drainage Division, where it is the only freshwater mussel to be found. The distribution of this species is from the Moore River in the north, to the south coast, west of Esperance (Klunzinger MW, 2012a; WRM, 2020).
Adequacy of any surveys undertaken	The presence of CFM was confirmed from the Ferguson and Preston rivers during targeted surveys in November 2018. In 2019, two additional sites on the Preston River, and three additional sites on the Ferguson River were surveyed for CFM, in an attempt to understand their wider distribution in the area, particularly upstream and downstream of the Proposal Area (Appendix E).
Methods, data analysis and scientific literature used to identify and assess the environmental values	The potential significance of habitat and abundance for CFM was assessed based on data collected from ponds and wetlands within and adjacent to the Proposal Area during field surveys, consideration of the conservation advice (TSSC, 2018a), analysis of NatureMap and Protected Matters Search results (WRM, 2020).

2.6 Threatened flora

2.6.1 King Spider-orchid – Endangered

A description of this species, along with likely direct and potential indirect impacts from the Proposal, is outlined in Table 2-12.

Table 2-12 King Spider-orchid – Endangered

ASPECT	DESCRIPTION
Ecology, habitat preferences, abundance, distribution and disturbance history	<p><u>Ecology</u></p> <p>King Spider-orchid <i>Caladenia huegelii</i> is a tuberous, perennial, herb, growing 0.25-0.6 m high. The flowering period is from September to October and grows in grey or brown sand and clay loam (Western Australian Herbarium, 1998-).</p> <p><u>Habitat preferences</u></p> <p>Habitat preference for this species generally includes areas of mixed woodland of Jarrah, Banksia with scattered Sheoak and Marri, usually in deep grey-white sand within 20 km of the coast (DEC, 2009b).</p> <p><u>Abundance and historical records</u></p> <p>The Recovery Plan indicates that 1,614 mature plants were known from 33 extant populations, these occurrences were recorded during surveys in the decade prior</p>

ASPECT	DESCRIPTION
	<p>to its release (DEC, 2009b). There are 41 records (approximately 635 plants) of this species in the WA Herbarium database* (Western Australian Herbarium, 1998-). More current abundance and distribution data for this species is not available.</p> <p><u>Distribution</u></p> <p>This species has been recorded from the Jarrah Forest and SCP IBRA regions in Jarrah-Banksia woodland, within 20 km of the coast from north of Perth to the Busselton area (DEC, 2009b).</p> <p><u>Disturbance history</u></p> <p>Clearing of native vegetation for agriculture, housing and industry has resulted in clearing of much of the historical areas of habitat of <i>C. huegelii</i> (Brown, Dundas, Dixon, & Hopper, 2008).</p>
<p>Surveys undertaken</p>	<p>A detailed vegetation and flora survey was undertaken from 20 August 2018 to December 2018. The survey included early spring (August), mid-spring (September), late spring (November) and summer (December) survey periods (BORR IPT, 2020c). The field survey was undertaken in reference to the Commonwealth of Australia - Draft Orchid Survey Guidelines (2013) and was conducted at the appropriate time for the species.</p> <p>Targeted surveys for conservation listed <i>Caladenia</i> sp. were undertaken by BORR IPT during the targeted searches for <i>Drakaea</i> sp. between 19 and 30 August 2019. The targeted survey was undertaken in Banksia woodland habitat, including vegetation types VT19 and 20 (BORR IPT, 2020c). Mapping showing the location of the search sites is shown in Figure 13 (Appendix A</p>
<p>Extent of habitat and number of individuals directly impacted by the Proposal</p>	<p>Approximately 2.3 ha of suitable habitat for <i>C. huegelii</i> was identified within the Proposal Area. This area has been determined based on the area of VT19 and VT20, excluding vegetation that was of Degraded and Completely Degraded condition, present within the Proposal Area (BORR IPT, 2020c).</p> <p>Vegetation of Degraded and Completely Degraded condition has been excluded as suitable habitat as the species is considered to be very susceptible to disturbances such as high weed cover, grazing, overly frequent fire and reduced native species diversity, with these factors causing the decline of populations (DEC, 2009b).</p> <p>Despite significant survey effort, during the optimum flowering period, the species was not observed within the survey area (BORR IPT, 2020c). It is therefore considered unlikely that <i>C. huegelii</i> occurs in the Proposal Area or wider survey area.</p>
<p>Extent of habitat and number of individuals indirectly impacted by the Proposal</p>	<p>Potentially suitable habitat that may be indirectly impacted by the Proposal has been identified adjacent in the northern end of the Proposal Area (BORR IPT, 2020c). This habitat generally correlates with the Banksia Woodlands TEC as per Table 2-3.</p>
<p>Quality and importance of known or potential habitat</p>	<p>Approximately 2.3 ha of suitable habitat for <i>C. huegelii</i> was identified within the Proposal Area. This area has been determined based on the quality of the following vegetation types (BORR IPT, 2020c):</p>

ASPECT	DESCRIPTION
within the Proposal Area	<ul style="list-style-type: none"> • VT19 <ul style="list-style-type: none"> - 0.2 ha in Excellent to Very Good condition - 1.6 ha in Good condition • VT20 <ul style="list-style-type: none"> - 0.1 ha in Very Good condition - 0.3 ha in Good condition - 0.1 ha in Good to Degraded condition
Known populations within at least a 2 km buffer	<p>Based on an extract from DBCA and WA herbarium databases (DBCA, 2020), two known populations of the species have been previously recorded within 5 km of the Proposal Area. However no known populations have been previously recorded within 2 km of the Proposal Area (Figure 14, Appendix A).</p>
Adequacy of survey	<p>The field survey was undertaken in reference to the Commonwealth of Australia - Draft Orchid Survey Guidelines (2013). The methodology employed involved (BORR IPT, 2020c):</p> <ul style="list-style-type: none"> • Identification of potential habitat – this was based on the vegetation mapping and field observations during the spring surveys • Areas that had been completely cleared and heavily grazed paddocks that did not contain remnant vegetation were excluded from the survey • Surveys involved two senior botanists and a field ecologist, sites were traversed on foot. Higher quality habitat (sites that retained structure (had an upper / mid or ground layer that comprised native species) were traversed on a parallel grid (at a 5-10 m intervals). Lower quality sites (sites that were almost completely cleared / or contained scattered native sedge (such as <i>Juncus pallidus</i>) but were grazed and had high visibility through the ground layer were traversed via meander surveys. <p>In total, 80 person hours were spent surveying for <i>C. huegelii</i> (BORR IPT, 2020c).</p> <p>The 20.7 ha of vegetation that was unsurveyed in the original referral was surveyed in spring of 2019. This information gap has now been filled and no uncertainties in relation to the Proposal Area vegetation remain.</p>
Methods, data analysis and scientific literature used to identify and assess the environmental values	<p>The significance of <i>C. huegelii</i> habitat was assessed based on data collected from within and surrounding the Proposal Area during field surveys, consideration of information presented in the species' Recovery Plan (DEC, 2009b) and analysis of desktop assessments (NatureMap and Protected Matters Search results) undertaken in the Vegetation and Flora Study (BORR IPT, 2020c).</p>

* Current records taken from Florabase (Western Australian Herbarium, 1998-). Estimate of individuals based on the count (frequency) data where available. Where no count data were available, the record has been counted as one individual.

2.6.2 Tall Donkey Orchid – Vulnerable

A description of this species, along with likely direct and potential indirect impacts from the Proposal, is outlined in Table 2-13.

Table 2-13 Tall Donkey Orchid – Vulnerable

ASPECT	DESCRIPTION
<p>Ecology, habitat preferences, abundance, distribution and disturbance history</p>	<p><u>Ecology</u></p> <p>Tall Donkey Orchid <i>Diuris drummondii</i> is a tuberous, perennial, herb, growing 0.5-1.05 m high. It is found in low-lying depressions in peaty and sandy clay swamps. The flowering period is November to December or January. The species' conservation advice (DEWHA, 2008c) notes that certain fire regimes, in particular fire between July and early January, will damage the above ground parts of this plant. As the species is often found with its base in water, significant changes to watertables over time could also have a detrimental impact (DEWHA, 2008c).</p> <p><u>Habitat preferences</u></p> <p>Habitat preference includes low lying depressions and swamps that are inundated well into the summer months (Brown, Dundas, Dixon, & Hopper, 2008; Western Australian Herbarium, 1998-).</p> <p><u>Abundance and historical records</u></p> <p>Approximately 7080 plants have been recorded from 51 records of this species in the WA Herbarium database* (Western Australian Herbarium, 1998-).</p> <p><u>Distribution</u></p> <p>This species has been located within the Avon Wheatbelt, Jarrah Forest, SCP and Warren IBRA regions, in scattered populations between Northampton to Albany (Brown, Dundas, Dixon, & Hopper, 2008; Western Australian Herbarium, 1998-).</p> <p><u>Disturbance history</u></p> <p>Within the 20 patches of suitable habitat that were searched, all were disturbed to some degree and 17 were highly disturbed. Disturbance sources observed were historic clearing, grazing by stock and very high weed density. It is considered that fire history did not have an impact on the likely detectability of the species as recent occurrences of fires were not recorded within the targeted search areas (BORR IPT, 2020c).</p>
<p>Surveys undertaken</p>	<p>A detailed vegetation and flora survey was undertaken by BORR IPT from 20 August 2018 to December 2018. The survey included early spring, mid-spring, late spring and summer survey periods (BORR IPT, 2020c).</p> <p>A targeted survey for the species was undertaken in conjunction with a targeted survey for <i>Diuris micrantha</i> and <i>Eleocharis keigheryi</i>. This survey was carried out over twenty sites within the Proposal Area by BORR IPT in December 2018 i.e. during the optimum flowering period.</p> <p>The targeted survey was undertaken in VT6, VT7, VT9 and VT21 (BORR IPT, 2020c).</p> <p>Grid and meander searches of the twenty sites were carried out over three days by two senior botanists and a support ecologist (BORR IPT, 2020c). Search site locations are shown in Figure 13 (Appendix A). A description of each search site is provided in Appendix D of the Vegetation and Flora Study (BORR IPT, 2020c).</p>
<p>Extent of habitat and number of individuals directly</p>	<p>Approximately 3.1 ha of suitable habitat for <i>D. drummondii</i> was identified within the Proposal Area. This area has been determined based on the area of VT6, VT7,</p>

ASPECT	DESCRIPTION
<p>impacted by the Proposal</p>	<p>VT9 and VT21, excluding vegetation that was of Degraded and Completely Degraded condition, present within the Proposal Area (BORR IPT, 2020c).</p> <p>Vegetation of Degraded and Completely Degraded condition has been excluded as suitable habitat. This species is considered to be very susceptible to disturbances such as high weed cover, grazing, inappropriate fire regimes and reduced native species diversity, with these factors causing the decline of populations (DEWHA, 2008c).</p> <p>Despite significant survey effort, during the optimum flowering period, no individuals were observed within the Survey Area (BORR IPT, 2020c). While it is acknowledged that the species may not flower each year, the targeted survey was undertaken during the optimum flowering period however the species was not detected either from flowering or vegetative growth (long stem and leaf) (BORR IPT, 2020c). It is therefore considered unlikely that the species occurs in the Proposal Area or wider Survey Area.</p>
<p>Extent of habitat and number of individuals indirectly impacted by the Proposal</p>	<p>Potential habitat adjacent to the Proposal Area may include areas in the following locations (BORR IPT, 2020c):</p> <ul style="list-style-type: none"> • VT6 adjacent to the Artificial wetland (Geomorphic Wetland 1729) to the east of the Proposal Area • VT7 present on the western side of Forest Highway road reserve adjacent to Geomorphic Wetland UFI 1525 within Lot 104 on Plan 31579 • VT7 within road reserve on the eastern side of Forest Highway, south of Clifton Road, extending into Lot 131 on Plan 27972 • VT21 to the east of the Proposal Area within Railway Road road reserve in Waterloo.
<p>Quality and importance of known or potential habitat within the Proposal Area</p>	<p>Approximately 3.1 ha of suitable habitat was identified within the Proposal Area. This area has been determined based on the quality of the following vegetation types (BORR IPT, 2020c):</p> <ul style="list-style-type: none"> • VT6 - 2.8 ha in Good to Degraded condition • VT7 - 0.2 ha in Good to Degraded condition • VT9 - 0 ha – this vegetation type was in Degraded to Completely Degraded condition • VT21 - 0.1 ha in Good condition <p>Many of the sites surveyed during the targeted survey were found to be highly disturbed with limited native species remaining, high weed invasion and evidence of grazing by cattle (BORR IPT, 2020c).</p>
<p>Known populations within at least a 2 km buffer</p>	<p>Based on an extract from DBCA and WA herbarium databases (DBCA, 2020), four known populations of <i>D. drummondii</i> have been previously recorded within 5 km, and two known populations have been previously recorded within 2 km, of the Proposal Area (Figure 14, Appendix A).</p>
<p>Adequacy of survey</p>	<p>The field survey was undertaken in reference to the Commonwealth of Australia - Draft Orchid Survey Guidelines (2013) and the methodology was discussed with Mr Andrew Webb (DBCA Parks and Wildlife Service – South West Region Flora Officer)</p>

ASPECT	DESCRIPTION
	<p>prior to commencing the field work. The methodology employed involved (BORR IPT, 2020c):</p> <ul style="list-style-type: none"> • Identification of potential habitat – this was based on the vegetation mapping and field observations during the spring surveys • Selecting sites that were within swamps / dampland areas within the Proposal Area (Figure 13, Appendix A) • Areas that had been completely cleared, heavily grazed paddocks that did not contain remnant vegetation, were excluded from the survey • Prior to the field survey, Mr Andrew Webb confirmed that <i>D. drummondii</i> was flowering in the Bunbury region and one of the known sites (outside of the survey area) was visited to confirm that the species was in flower. <p>Surveys involved two senior botanists and a field ecologist, sites were traversed on foot with:</p> <ul style="list-style-type: none"> • Higher quality habitat (sites that retained structure (had a upper / mid or ground layer that comprised native species) traversed on a parallel grid (at a 5-10 m intervals) • Lower quality sites (sites that were almost completely cleared / or contained scattered native sedge (such as <i>Juncus pallidus</i>) but were grazed and had high visibility through the ground layer were traversed via meander surveys <p>In total, 72 person hours were spent surveying for <i>D. drummondii</i> (BORR IPT, 2020c).</p> <p>Fire history is not considered to have had an impact on the detectability of the species as recent occurrences of fires were not recorded within the targeted search areas (BORR IPT, 2020c).</p> <p>The 20.7 ha of vegetation that was unsurveyed in the original referral was surveyed in spring of 2019. This information gaps have now been filled and no uncertainties in relation to the Proposal Area vegetation remain.</p>
<p>Methods, data analysis and scientific literature used to identify and assess the environmental values</p>	<p>The significance of <i>D. drummondii</i> habitat was assessed based on data collected from within and surrounding the Proposal Area during field surveys, consideration of the Approved Conservation Advice (DEWHA, 2008c), analysis of desktop assessments (NatureMap and Protected Matters Search results) undertaken in the Vegetation and Flora Study (BORR IPT, 2020c) and, where required, consultation with DBCA staff.</p>

* Current records taken from Florabase (Western Australian Herbarium, 1998-). Estimate of individuals based on the count (frequency) data where available. Where no count data were available, the record has been counted as one individual.

2.6.3 Dwarf Bee-orchid – Vulnerable

A description of this species, along with likely direct and potential indirect impacts from the Proposal, is outlined in Table 2-14.

Table 2-14 Dwarf Bee-orchid – Vulnerable

ASPECT	DESCRIPTION
<p>Ecology, habitat preferences, abundance, distribution and disturbance history</p>	<p><u>Ecology</u></p> <p>Dwarf Bee-orchid <i>Diuris micrantha</i> is a tuberous, perennial, herb, growing 0.3-0.6 m high. The flowering period is from September to October.</p> <p><u>Habitat preferences</u></p> <p>Habitat preference includes winter-wet swamps in shallow water (Western Australian Herbarium, 1998-).</p> <p><u>Abundance and historical records</u></p> <p>Approximately 62 plants have been recorded from seven records of this species in the WA Herbarium database* (Western Australian Herbarium, 1998-).</p> <p><u>Distribution</u></p> <p>This species has been recorded from the Jarrah Forest and SCP IBRA regions, with seven scattered populations from east of Kwinana and south to Boyup Brook (Brown, Dundas, Dixon, & Hopper, 2008; Western Australian Herbarium, 1998-).</p> <p><u>Disturbance history</u></p> <p>Main disturbance to the species has resulted from fire and weed invasion, with potential threats including grazing, clearing, feral animals and changes in hydrology (DEWHA, 2008d).</p>
<p>Surveys undertaken</p>	<p>A detailed vegetation and flora survey was undertaken from 20 August 2018 to December 2018. The survey included early spring, mid-spring, late spring and summer survey periods (BORR IPT, 2020c).</p> <p>A targeted survey for <i>D. micrantha</i> was undertaken in conjunction with a targeted survey for <i>D. drummondii</i> and <i>Eleocharis keigheryi</i>. This survey was carried out by BORR IPT in December 2018 over twenty sites within the Proposal Area.</p> <p>The targeted survey was undertaken in VT6, VT7, VT9 and VT21 (BORR IPT, 2020c).</p> <p>Grid and meander searches of the twenty sites were carried out over of three days by two senior botanists and a support ecologist (BORR IPT, 2020c). Search site locations are shown in Figure 13 (Appendix A). A description of each search site is provided in Appendix D of the Vegetation and Flora Study (BORR IPT, 2020c).</p>
<p>Extent of habitat and number of individuals directly impacted by the Proposal</p>	<p>Approximately 3.1 ha of suitable habitat was identified within the Proposal Area. This area has been determined based on the area of VT6, VT7, VT9 and VT21, excluding vegetation that was of Degraded and Completely Degraded condition, present within the Proposal Area (BORR IPT, 2020c).</p> <p>Vegetation of Degraded and Completely Degraded condition has been excluded as suitable habitat. This species is considered to be very susceptible to disturbances such as high weed cover, grazing, inappropriate fire regimes, changes in hydrology and reduced native species diversity, with these factors causing the decline of populations (DEWHA, 2008d).</p> <p>Despite significant survey effort, during the optimum flowering period, no <i>D. micrantha</i> were observed within the survey area (BORR IPT, 2020c). It is therefore</p>

ASPECT	DESCRIPTION
	considered unlikely that the species occurs in the Proposal Area or wider survey area.
Extent of habitat and number of individuals indirectly impacted by the Proposal	<p>Potential <i>D. micrantha</i> habitat adjacent to the Proposal Area may include areas in the following locations (BORR IPT, 2020c):</p> <ul style="list-style-type: none"> • VT6 adjacent to the Artificial Wetland (Geomorphic Wetland 1729) to the east of the Proposal Area • VT7 present on the western side of Forest Highway road reserve adjacent to Geomorphic Wetland UFI 1525 within Lot 104 on Plan 31579 • VT7 within road reserve on the eastern side of Forest Highway, south of Clifton Road, extending into Lot 131 on Plan 27972 • VT21 to the east of the Proposal Area within Railway Road road reserve in Waterloo <p>No individuals are expected to be indirectly impacted.</p>
Quality and importance of known or potential habitat within the Proposal Area	<p>Approximately 3.1 ha of suitable habitat was identified within the Proposal Area. This area has been determined based on the quality of the following vegetation types (BORR IPT, 2020c):</p> <ul style="list-style-type: none"> • VT6 - 2.8 ha in Good to Degraded condition • VT7 - 0.2 ha in Good to Degraded condition • VT9 - 0 ha – this vegetation type was in Degraded to Completely Degraded condition • VT21 - 0.1 ha in Good condition
Known populations within at least a 2 km buffer	<p>Based on an extract from DBCA and WA herbarium databases, no known populations of <i>D. micrantha</i> have been previously recorded within 5 km of the Proposal Area (DBCA, 2020).</p>
Adequacy of survey	<p>The field survey was undertaken in reference to the Commonwealth of Australia - Draft Orchid Survey Guidelines (2013). The methodology employed involved (BORR IPT, 2020c):</p> <ul style="list-style-type: none"> • Identification of potential habitat – this was based on the vegetation mapping and field observations during the spring surveys • Areas that had been completely cleared, heavily grazed paddocks that did not contain remnant vegetation, were excluded from the survey <p>Surveys involved two senior botanists and a field ecologist, sites were traversed on foot with:</p> <ul style="list-style-type: none"> • Higher quality habitat (sites that retained structure (had a upper / mid or ground layer that comprised native species) traversed on a parallel grid (at a 5-10 m intervals) • Lower quality sites (sites that were almost completely cleared / or contained scattered native sedge (such as <i>Juncus pallidus</i>) but were grazed and had high visibility through the ground layer were traversed via meander surveys <p>In total, 72 person hours were spent surveying for <i>D. micrantha</i> (BORR IPT, 2020c).</p>

ASPECT	DESCRIPTION
	The 20.7 ha of vegetation that was unsurveyed in the original referral was surveyed in spring of 2019. This information gaps have now been filled and no uncertainties in relation to the Proposal Area vegetation remain.
Methods, data analysis and scientific literature used to identify and assess the environmental values	The significance of <i>D. micrantha</i> habitat was assessed based on data collected from within and surrounding the Proposal Area during field surveys, consideration of the Approved Conservation Advice (DEWHA, 2008d) and analysis of desktop assessments (NatureMap and Protected Matters Search results) undertaken in the Vegetation and Flora Study (BORR IPT, 2020c).

* Current records taken from Florabase (Western Australian Herbarium, 1998-). Estimate of individuals based on the count (frequency) data where available. Where no count data were available, the record has been counted as one individual.

2.6.4 Glossy-leafed Hammer Orchid – Endangered

A description of this species, along with likely direct and potential indirect impacts from the Proposal, is outlined in Table 2-15.

Table 2-15 Glossy-leafed Hammer Orchid – Endangered

ASPECT	DESCRIPTION
<p>Ecology, habitat preferences, abundance, distribution and disturbance history</p>	<p><u>Ecology</u></p> <p>Glossy-leafed Hammer Orchid <i>Drakaea elastica</i> is a tuberous, perennial, herb, growing 12 – 30 cm high. The flowering period is from October to November. The plant dies back to an underground tuber over summer.</p> <p><u>Habitat preferences</u></p> <p>Habitat preference includes white or grey sand in low-lying areas adjoining winter-wet swamps (Western Australian Herbarium, 1998-). The species typically occurs in banksia woodland or Spearwood thicket vegetation and often with other orchid species such as <i>Drakaea glyptodon</i> (King-in-his-Carriage), <i>D. livida</i> (Warty Hammer Orchid) and <i>Paracaleana nigrita</i> (Flying Duck Orchid) (DEC, 2009a).</p> <p><u>Abundance and historical records</u></p> <p>Approximately 1228 plants have been recorded from 19 records of this species in the WA Herbarium database* (Western Australian Herbarium, 1998-).</p> <p><u>Distribution</u></p> <p>This species has been recorded from the SCP IBRA region, with populations identified between Cataby in the north to Busselton in the south (Brown, Dundas, Dixon, & Hopper, 2008; DEC, 2009a).</p> <p><u>Disturbance history</u></p> <p>The main threats to the species includes land clearing, degradation and fragmentation of habitat, edge effects, density of ground level vegetation, grazing, construction and maintenance work, rubbish dumping, weed invasion, disease, inappropriate fire regimes, poor recruitment and salinity (DEC, 2009a).</p>
<p>Surveys undertaken</p>	<p>A detailed vegetation and flora survey was undertaken from 20 August 2018 to December 2018. The survey included early spring, mid-spring, late spring and summer survey periods (BORR IPT, 2020c).</p> <p>Targeted surveys for conservation listed <i>Drakaea</i> sp. were undertaken by BORR IPT between 19 and 30 August 2019, during the species’ optimum flowering period. The targeted survey was undertaken in Banksia woodland habitat, including vegetation types VT19 and 20 (BORR IPT, 2020c). Mapping showing the location of the <i>Drakaea</i> search sites is shown in Figure 13 (Appendix A).</p>
<p>Extent of habitat and number of individuals directly impacted by the Proposal</p>	<p>Approximately 2.3 ha of suitable habitat was identified within the Proposal Area. This area has been determined based on the area of VT19 and VT20, excluding vegetation that was of Degraded and Completely Degraded condition, present within the Proposal Area (BORR IPT, 2020c).</p> <p>Vegetation of Degraded and Completely Degraded condition has been excluded as suitable habitat. This species is considered to be very susceptible to disturbances such as high weed cover, grazing, inappropriate fire regimes and reduced native</p>

ASPECT	DESCRIPTION
	<p>species diversity, with these factors causing the decline of populations (DEC, 2009a).</p> <p>Despite significant survey effort, during the optimum flowering period, the species was not observed within the survey area (BORR IPT, 2020c). It is therefore considered unlikely that <i>D. elastica</i> occurs in the Proposal Area or wider survey area.</p>
<p>Extent of habitat and number of individuals indirectly impacted by the Proposal</p>	<p>Potentially suitable habitat that may be indirectly impacted by the Proposal has been identified adjacent in the northern end of the Proposal Area (BORR IPT, 2020c). This habitat generally correlates with the Banksia Woodlands TEC as per Table 2-3.</p> <p>No individuals are expected to be indirectly impacted.</p>
<p>Quality and importance of known or potential habitat within the Proposal Area</p>	<p>Approximately 2.3 ha of suitable habitat was identified within the Proposal Area. This area has been determined based on the following vegetation types (BORR IPT, 2020c):</p> <ul style="list-style-type: none"> • VT19 <ul style="list-style-type: none"> - 0.2 ha in Excellent to Very Good condition - 1.6 ha in Good condition • VT20 <ul style="list-style-type: none"> - 0.1 ha in Very Good condition - 0.3 ha in Good condition - 0.1 ha in Good to Degraded condition
<p>Known populations within at least a 2 km buffer</p>	<p>Based on an extract from DBCA and WA herbarium databases (DBCA, 2020), two known populations of <i>D. elastica</i> have been previously recorded within five km, and one known population has been previously recorded within two km, of the Proposal Area (Figure 14, Appendix A).</p>
<p>Adequacy of survey</p>	<p>The field survey was undertaken in reference to the Commonwealth of Australia - Draft Orchid Survey Guidelines (2013) and the methodology was discussed with Mr Andrew Webb (DBCA Flora Officer) prior to commencing the field work. The methodology employed involved (BORR IPT, 2020c):</p> <ul style="list-style-type: none"> • Identification of potential habitat – this was based on the vegetation mapping and field observations during the spring surveys. Sites selected were nearby swamps / dampland areas and contained <i>Kunzea</i> thickets with <i>Banksia</i> woodlands within the Proposal Area (Figure 13, Appendix A). Areas that had been completely cleared, heavily grazed paddocks that did not contain remnant vegetation, were excluded from the survey • Surveys were undertaken in mid to late August to coincide with the presence of <i>D. elastica</i> leaf being conspicuous and detectable in the field. <p>Surveys involved one senior botanist and botanist, sites were traversed on foot with:</p>

ASPECT	DESCRIPTION
	<ul style="list-style-type: none"> • Higher quality habitat (sites that retained structure (had a upper / mid or ground layer that comprised native species) traversed on a parallel grid (at 10 m intervals) • Lower quality sites (sites that were almost completed cleared / or contained scattered native species but were grazed and had high visibility through the ground layer were traversed via meander surveys. <p>In total, 80 person hours were spent surveying for <i>D. elastica</i> (BORR IPT, 2020c).</p> <p>The 20.7 ha of vegetation that was unsurveyed in the original referral was surveyed in spring of 2019. This information gaps has now been filled and no uncertainties in relation to the Proposal Area vegetation remain.</p>
<p>Methods, data analysis and scientific literature used to identify and assess the environmental values</p>	<p>The significance of <i>D. elastica</i> habitat was assessed based on data collected from within and surrounding the Proposal Area during field surveys, consideration of the species' Recovery Plan (DEC, 2009a), analysis of desktop assessments (NatureMap and Protected Matters Search results) undertaken in the Vegetation and Flora Study (BORR IPT, 2020c) and, where required, consultation with DBCA staff.</p>

* Current records taken from Florabase (Western Australian Herbarium, 1998-). Estimate of individuals based on the count (frequency) data where available. Where no count data were available, the record has been counted as one individual.

2.6.5 Dwarf Hammer Orchid - Vulnerable

A description of this species, along with likely direct and potential indirect impacts from the Proposal, is outlined in Table 2-16.

Table 2-16 Dwarf Hammer Orchid - Vulnerable

ASPECT	DESCRIPTION
<p>Ecology, habitat preferences, abundance, distribution and disturbance history</p>	<p><u>Ecology</u></p> <p>Dwarf Hammer Orchid <i>Drakaea micrantha</i> is a tuberous, perennial, herb, growing 15 – 30 cm high. The flowering period is from September to October. The main threat to the species is fires between June and October, when the species above ground parts and replacement tubers are actively growing (DEWHA, 2008e).</p> <p><u>Habitat preferences</u></p> <p>The preferred habitat for the species consists of thickets of <i>Kunzea glabrescens</i> with open patches of white sand, often shaded, near damplands (BORR IPT, 2020c).</p> <p><u>Abundance and historical records</u></p> <p>Approximately 687 plants have been recorded from 49 records of this species in the WA Herbarium database* (Western Australian Herbarium, 1998-).</p> <p><u>Distribution</u></p> <p>This species has been recorded from the Jarrah Forest, SCP and Warren IBRA regions, with populations identified between Perth and Albany (Brown, Dundas, Dixon, & Hopper, 2008; Western Australian Herbarium, 1998-).</p> <p><u>Disturbance history</u></p> <p>Information about the species' general disturbance history is not available, however, plants usually occur on old firebreaks and open disturbed areas where competition has been removed (CALM, 2006). This indicates that the species is positively responsive to some forms of disturbance.</p>
<p>Surveys undertaken</p>	<p>A detailed vegetation and flora survey was undertaken from 20 August 2018 to December 2018. The survey included early spring, mid-spring, late spring and summer survey periods (BORR IPT, 2020c).</p> <p>Targeted surveys for conservation listed <i>Drakaea</i> sp. were undertaken by BORR IPT between 19 and 30 August 2019. The targeted survey was undertaken in Banksia woodland habitat, including vegetation types VT19 and 20 (BORR IPT, 2020c). Mapping showing the location of the <i>Drakaea</i> search sites is shown in Figure 13 (Appendix A).</p>
<p>Extent of habitat and number of individuals directly impacted by the Proposal</p>	<p>Approximately 2.3 ha of suitable habitat was identified within the Proposal Area. This area has been determined based on the area of VT19 and VT20, excluding vegetation that was of Degraded and Completely Degraded condition, present within the Proposal Area (BORR IPT, 2020c).</p> <p>Vegetation of Degraded and Completely Degraded condition has been excluded as suitable habitat. This species is considered to be very susceptible to disturbances such as high weed cover, grazing, inappropriate fire regimes and reduced native</p>

ASPECT	DESCRIPTION
	<p>species diversity, with these factors causing the decline of populations (DEC, 2009a).</p> <p>Despite significant survey effort, during the optimum flowering period, the species was not observed within the survey area (BORR IPT, 2020c). It is therefore considered unlikely that <i>D. elastica</i> occurs in the Proposal Area or wider survey area.</p>
<p>Extent of habitat and number of individuals indirectly impacted by the Proposal</p>	<p>Potentially suitable habitat that may be indirectly impacted by the Proposal has been identified adjacent in the northern end of the Proposal Area (BORR IPT, 2020c). This habitat generally correlates with the Banksia Woodlands TEC as per Table 2-3.</p> <p>No individuals are expected to be indirectly impacted.</p>
<p>Quality and importance of known or potential habitat within the Proposal Area</p>	<p>Approximately 2.3 ha of suitable habitat for <i>D. micrantha</i> was identified within the Proposal Area. This area has been determined based on the following vegetation types (BORR IPT, 2020c):</p> <ul style="list-style-type: none"> • VT19 <ul style="list-style-type: none"> - 0.2 ha in Excellent to Very Good condition - 1.6 ha in Good condition • VT20 <ul style="list-style-type: none"> - 0.1 ha in Very Good condition - 0.3 ha in Good condition - 0.1 ha in Good to Degraded condition
<p>Known populations within at least a 2 km buffer</p>	<p>Based on an extract from DBCA and WA herbarium databases (DBCA, 2020), three known populations of <i>D. micrantha</i> have been previously recorded within 5 km of the Proposal Area. However no known populations have been previously recorded within 2 km of the Proposal Area (Figure 14, Appendix A).</p> <p>Known locations of the species outside of the wider survey area are typically in situated larger continuous patches containing suitable habitat that is in Very Good to Excellent condition (BORR IPT, 2020c).</p>
<p>Adequacy of survey</p>	<p>The field survey was undertaken in reference to the Commonwealth of Australia - Draft Orchid Survey Guidelines (2013) and the methodology was discussed with Mr Andrew Webb (DBCA Flora Officer) prior to commencing the field work. The methodology employed involved (BORR IPT, 2020c):</p> <ul style="list-style-type: none"> • Identification of potential habitat – this was based on the vegetation mapping and field observations during the spring surveys. Sites selected were nearby swamps / dampland areas and contained <i>Kunzea</i> thickets with <i>Banksia</i> woodlands within the Proposal Area (Figure 14, Appendix A). Areas that had been completely cleared, heavily grazed paddocks that did not contain remnant vegetation, were excluded from the survey • Surveys were undertaken in mid to late August to coincide with the presence of and <i>D. micrantha</i> leaf being conspicuous and detectable in the field

ASPECT	DESCRIPTION
	<ul style="list-style-type: none"> • While the species may not flower each year, targeted surveys for the presence of the <i>Drakaea</i> leaf were undertaken early in the season to ensure that if <i>Drakaea</i> species were present it would have been detected through adequate survey effort. <p>Surveys involved one senior botanist and a one botanist, sites were traversed on foot with:</p> <ul style="list-style-type: none"> • Higher quality habitat (sites that retained structure (had a upper / mid or ground layer that comprised native species) traversed on a parallel grid (at 10 m intervals) • Lower quality sites (sites that were almost completely cleared / or contained scattered native species but were grazed and had high visibility through the ground layer were traversed via meander surveys <p>In total, 80 person hours were spent surveying for <i>D. micrantha</i> (BORR IPT, 2020c).</p> <p>The 20.7 ha of vegetation that was unsurveyed in the original referral was surveyed in spring of 2019. This information gap has now been filled and no uncertainties in relation to the Proposal Area vegetation remain.</p>
<p>Methods, data analysis and scientific literature used to identify and assess the environmental values</p>	<p>The significance of <i>D. micrantha</i> habitat was assessed based on data collected from within and surrounding the Proposal Area during field surveys, consideration of Approved Conservation Advice (DEWHA, 2008a), analysis of desktop assessments (NatureMap and Protected Matters Search results) undertaken in the Vegetation and Flora Study (BORR IPT, 2020c) and, where required, consultation with DBCA staff.</p>

* Current records taken from Florabase (Western Australian Herbarium, 1998-). Estimate of individuals based on the count (frequency) data where available. Where no count data were available, the record has been counted as one individual.

2.6.6 Keighery's Eleocharis - Vulnerable

A description of this species, along with likely direct and potential indirect impacts from the Proposal, is outlined in Table 2-17.

Table 2-17 Keighery's Eleocharis - Vulnerable

ASPECT	DESCRIPTION
<p>Ecology, habitat preferences, abundance, distribution and disturbance history</p>	<p><u>Ecology</u></p> <p>Keighery's Eleocharis <i>Eleocharis keigheryi</i> is a rhizomatous, clumped perennial, grass-like or herb (sedge) to 0.4 m high. The flowering period is from August to November. Main threats include invasive weed species, firebreak, road and rail maintenance, livestock damage and grazing (DEWHA, 2008b).</p> <p><u>Habitat preferences</u></p> <p>Habitat preference includes clay, sandy loam and this is an emergent species in freshwater creeks and claypan vegetation (Western Australian Herbarium, 1998-).</p> <p><u>Abundance and historical records</u></p> <p>Approximately 10,707 plants have been recorded from 56 records of this species in the WA Herbarium database* (Western Australian Herbarium, 1998-).</p> <p><u>Distribution</u></p> <p>This species has been is recorded from the Avon Wheatbelt, Geraldton Sandplains, Jarrah Forest and SCP IBRA regions, with populations identified between Perth and Albany (Western Australian Herbarium, 1998-).</p> <p><u>Disturbance history</u></p> <p>Known populations are fragmented with considerable distances between them. Invasive weed species have impacted most populations through competition for space, water and nutrients (DEWHA, 2008b).</p>
<p>Surveys undertaken</p>	<p>A detailed vegetation and flora survey was undertaken by BORR IPT, from 20 August 2018 to December 2018. The survey included early spring, mid-spring, late spring and summer survey periods (BORR IPT, 2020c).</p> <p>A targeted survey for the species was undertaken in conjunction with a targeted survey for <i>D. drummondii</i> and <i>D. micrantha</i>. This survey was carried out by BORR IPT in December 2018 over twenty sites within the Proposal Area within vegetation types VT6, VT7, VT9 and VT21 (BORR IPT, 2020c).</p> <p>Grid and meander searches of the twenty sites were carried out over of three days by two senior botanists and a support ecologist (BORR IPT, 2020c). Search site locations are shown in Figure 13 (Appendix A). A description of each search site is provided in Appendix D of the Vegetation and Flora Study (BORR IPT, 2020c).</p> <p>A Clay Pans TEC assessment, undertaken over three days between 26 July and 1 August 2019, also included targeted searches for conservation listed species in and near wetlands, however, did not identify this species (Ecoedge, 2019a).</p>
<p>Extent of habitat and number of individuals directly</p>	<p>Approximately 3.1 ha of suitable habitat was identified within the Proposal Area. This area has been determined based on the area of VT6, VT7, VT9 and VT21,</p>

ASPECT	DESCRIPTION
<p>impacted by the Proposal</p>	<p>excluding vegetation that was of Degraded and Completely Degraded condition, present within the Proposal Area (BORR IPT, 2020c).</p> <p>Vegetation of Degraded and Completely Degraded condition has been excluded as suitable habitat. This species is considered to be very susceptible to disturbances such as high weed cover, grazing, altered hydrology and reduced native species diversity, with these factors causing the decline of populations (DEWHA, 2008b).</p> <p>Despite significant survey effort during the optimum flowering period, the species was not observed within the survey area (BORR IPT, 2020c). It is therefore considered unlikely that <i>E. keigheryi</i> occurs in the Proposal Area or wider survey area and no individuals are expected to be impacted by the Proposal.</p>
<p>Extent of habitat and number of individuals indirectly impacted by the Proposal</p>	<p>Potential habitat adjacent to the Proposal Area may include areas in the following locations (BORR IPT, 2020c):</p> <ul style="list-style-type: none"> • VT6 adjacent to the Artificial wetland (Geomorphic Wetland 1729) to the east of the Proposal Area • VT7 present on the western side of Forest Highway road reserve adjacent to Geomorphic Wetland UFI 1525 within Lot 104 on Plan 31579 • VT7 within road reserve on the eastern side of Forest Highway, south of Clifton Road, extending into Lot 131 on Plan 27972 • VT21 to the east of the Proposal Area within Railway Road reserve in Waterloo. <p>No individuals are expected to be indirectly impacted.</p>
<p>Quality and importance of known or potential habitat within the Proposal Area</p>	<p>Approximately 3.1 ha of suitable habitat was identified within the Proposal Area. This area has been determined based on the following vegetation types (BORR IPT, 2020c):</p> <ul style="list-style-type: none"> • VT6 - 2.8 ha in Good to Degraded condition • VT7 - 0.2 ha in Good to Degraded condition • VT9 - 0 ha – this vegetation type was in Degraded to Completely Degraded condition • VT21 - 0.1 ha in Good condition
<p>Known populations within at least a 2 km buffer</p>	<p>Based on an extract from DBCA and WA herbarium databases (DBCA, 2020), one known population of <i>E. keigheryi</i> has been previously recorded within five km of the Proposal Area (Figure 14, Appendix A).</p> <p>This record is located near St Helena Road, east of the central area of the Proposal Area and approximately 600 m north east from the easternmost extent of the Harris Road development area (DBCA, 2020). This location is considered unreliable as the point is located in a cleared paddock. Suitable survey effort in potential habitat within the vicinity of this area during field surveys did not record the species and it is considered unlikely to occur in the Proposal Area or wider survey area (BORR IPT, 2020c) (Figure 14, Appendix A).</p>
<p>Adequacy of survey including extent to which surveys were</p>	<p>A detailed vegetation and flora survey was undertaken by BORR IPT, from 20 August 2018 to December 2018. The survey included early spring, mid-spring, late spring and summer survey periods (BORR IPT, 2020c).</p>

ASPECT	DESCRIPTION
relevant to the species in question and undertaken in accordance with the relevant guidelines	<p>In total, 72 person hours were spent surveying for <i>E. keigheryi</i> (BORR IPT, 2020c).</p> <p>A Clay Pans TEC assessment, undertaken over three days between 26 July and 1 August 2019, also included targeted searches for conservation listed species in and near wetlands, however, did not identify this species (Ecoedge, 2019a).</p> <p>The 20.7 ha of vegetation that was unsurveyed in the original referral was surveyed in spring of 2019. This information gaps have now been filled and no uncertainties in relation to the Proposal Area vegetation remain.</p>
Methods, data analysis and scientific literature used to identify and assess the environmental values	<p>The significance of <i>E. keigheryi</i> habitat was assessed based on data collected from within and surrounding the Proposal Area during field surveys, consideration of the Approved Conservation Advice (DEWHA, 2008b) and analysis of desktop assessments (NatureMap and Protected Matters Search results) undertaken in the Vegetation and Flora Study (BORR IPT, 2020c).</p>

* Current records taken from Florabase (Western Australian Herbarium, 1998-). Estimate of individuals based on the count (frequency) data where available. Where no count data were available, the record has been counted as one individual.