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Reconnaissance Flora, Vegetation and Fauna Survey

Busselton Strategic Network Corridors

17 November 2017

Prepared for:
City of Busselton
C/- Strategen Environmental

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Document Control

City of Busselton

Busselton Strategic Network Corridors

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1 Introduction

Ecosystem Solutions were contracted by Strategen Environmental on behalf of the City of Busselton to undertake a Reconnaissance Flora, Vegetation and Fauna Survey for the proposed Strategic Network Corridors project in Busselton.

The Busselton Strategic Network Corridors program has been developed based on extensive work over recent years to identify the strategic direction for ongoing development, management and improvement of the road network in and around Busselton. This strategic direction is critical to managing current and future traffic flows and supporting the town's growth as a key tourism hub in the South West region.

The program involves a number of upgraded or newly constructed roads and bridge crossings within the town of Busselton, as presented in Table 1 and Map 1.

Table 1: Strategic Network Corridor projects and footprints

Initiative	Part	Item	Name	Proposed works
2	(iii)	A	Eastern Link	New two lane crossing linking Causeway Road to Cammilleri Street or Stanley Street including new bridge over Vasse River and widening of existing railway line embankment south of the river.
2	(ii)	B	Causeway Bridge Duplication	Widening of existing bridge over Vasse River to four lanes and upgrade of Causeway Road.
3	(ii)	C	Strelly-Barlee-West Street Route	Three intersection treatments along West Street and Barlee Street, at intersections with Bussell Highway, Frederick Street and Strelly Street.
4	(ii)	D	Strelly-Barlee-West Street Duplication	Upgrade West Street to four lanes and widening of existing embankment/culverts over New River. Development of two lanes along Roe Terrace and Frederick Street.
4	(iii)	E	Fairway Drive Duplication	Upgrade Fairway Drive to four lanes and widening of existing embankment/culverts over New River.
5	(i), (ii)	F	Ford Road 'Transport Corridor' Option Ford Road 'Existing Reserve, Low Level' Option Molloy Street Option	New two lane road between Peel Terrace / Layman Road intersection and Bussell Highway. New bridge over Vasse Estuary. Two route options between new bridge and Bussell Highway: Option 1: southern route to Korden Place. Option 2: eastern route to Vasse Highway intersection. Additional Option 3: Ford Rd connection to Molloy St

This report provides the methodology and results of our surveys on the sites.

2 Site Details

The project was split up into five discrete survey areas, as shown in Map 1.

Item A -Initiative 2 (iii) Eastern Link

New two lane crossing linking Causeway Road to Cammilleri Street or Stanley Street including new bridge over Vasse River and widening of existing railway line embankment south of the river (Map 2).

Item B – Initiative 2 (ii) Causeway Bridge Duplication

Widening of existing bridge over Vasse River to four lanes and upgrade of Causeway Road (Map 3).

Item C – Initiative 3 (ii) Strelly-Barlee-West Street Route

Three intersection treatments along West Street and Barlee Street, at intersections with Bussell Highway, Frederick Street and Strelly Street (Map 4).

Item D – Initiative 4 (ii) Strelly-Barlee-West Street Duplication

Upgrade West Street to four lanes and widening of existing embankment/culverts over New River.

Development of two lanes along Roe Terrace and Frederick Street (Map 4).

Item E – Initiative 4 (iii) Fairway Drive Duplication

Upgrade Fairway Drive to four lanes and widening of existing embankment/culverts over New River (Map 5).

Item F -Initiative 5 (i), (ii) Ford Rd "Transport Corridor" Option, Ford Rd "Existing Reserve, Low Level" Option & Molloy St Option.

New two lane road between Peel Terrace / Layman Road intersection and Bussell Highway. New bridge over Vasse Estuary (Map 6).

Two route options between new bridge and Bussell Highway:

- Option 1: southern route to Korden Place.
- Option 2: eastern route to Vasse Highway intersection.
- Additional Option 3: Ford Rd connection to Molloy St

3 Flora, Vegetation & Communities

3.1 Objectives

To assess the flora and vegetation of the site with regard to its conservation value and report on these.

3.2 Legislation & Guidance Statements

Flora and vegetation are protected by various legislative and non-legislative instruments. These include

- Environmental Protection and Biodiversity Conservation Act 1999 (Cwth) (EPBC Act);
- Wildlife Conservation Act 1950 (WA) (WC Act)
- Environmental Protection Act 1986 (WA) (EP Act)
- Department of Biodiversity, Conservation and Attractions (DBCA) Priority lists for flora and vegetation.

A reconnaissance level flora and vegetation survey was conducted to be compliant with the Environment Protection Authority's (EPA's) requirements for the environmental survey and reporting for flora and vegetation in Western Australia.

These requirements are set out in the following documents:

- Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, December 2016);
- Environmental Factor Guideline – Flora and Vegetation (EPA December 2016);
- Environmental Protection of Native Vegetation in Western Australia: Clearing of Native Vegetation with particular reference to Agricultural Areas: Position Statement No. 2 (EPA, 2000).

The EPA categorises a number of levels of flora study/survey as detailed in Technical Guidance Statement Flora and Vegetation Surveys for EIA (2016):

- Desktop Study – used to gather contextual information on the site based on existing surveys, literature, database searches and spatial information. At the completion of the desktop study, there should be sufficient information to identify the potential range of flora and vegetation that may be impacted by a proposal. Note this is not a survey but a study of the available information used to determine a survey effort.
- Reconnaissance Survey: used to provide contexts and gather broad information about an area. It is generally used to verify the information obtained from a desktop study, to characterise the flora and delineate the vegetation units present. It involved low intensity sampling of the flora and vegetation

to describe the general vegetation characteristics and condition. The reconnaissance survey should clarify whether any significant flora may be present and may recommend a higher level of survey.

- Targeted Survey: used to gather comprehensive information on significant flora and/or vegetation. It aims to determine the size and extent of all significant flora populations or vegetation in a survey area and place any impacts in contexts.
- Detailed Survey: provides adequate local and regional context relative to the flora and vegetation with the survey area. This survey required detailed comprehensive survey design, ensuring optimal survey timing for the botanical province, disturbance events that may affect sampling result and supplementary survey requirements.

The methodology adopted in this survey complies with those of a reconnaissance survey, providing contextual information obtained from a desktop survey, ground-truthed via a field survey. The methodology is presented in Section 3.3.

3.3 Methodology

3.3.1 Desktop Review

The desktop review gathered background information on the survey area and the flora species and vegetation communities that may be present. This involved a search of the literature, public data, aerial imagery and maps of the physical and biological characteristics of the study area (topography, soil types, Soil-Landscapes and previous vegetation mapping).

For this analysis the following resources were used:

- DBCA Threatened Flora Database (extract obtained from Strategen Environmental)
- DBCA Threatened Ecological Community Database (extract obtained from Strategen Environmental)
- NatureMap (DBCA);
- Florabase (Western Australian Herbarium);
- EPBC Act List of Threated Flora;
- EPBC Act List of Threatened Ecological Communities;
- Australian Government's EPBC Act Protected Matters Search Tool (Dept. of Environment and Energy) extract obtained August 2017; and
- Landgate's Shared Land Information Platform (SLIP) Database (accessed August 2017).

3.3.2 Field Survey

A field survey was conducted in August 2017. The field survey involved walking all of the five survey areas on foot inspecting all of the vegetation on both sides of the road.

Along with survey, the vegetation was assessed using the releve method whereby the following information was collected at unmarked survey sites;

- GPS coordinates;
- Dominant or important plant species and the differing strata layers, within approximately 10 m radius of the observer;
- Notes on vegetation structure using the method of Muir (1977);
- Vegetation condition score (Keighery, 1994);
- Surface soil texture and colour;
- Species other than the dominant were also recorded.

This method is more compatible to long narrow strips of vegetation like the road reserves in the study area. A releve point was taken in where the native vegetation composition or structure changed.

A standardised field data sheet was used to collect field data. Vegetation condition was assessed using the scale developed by Keighery (1994) which is the standard for the South West region.

Note that a spring flora survey was not conducted as part of this survey and as such, a number of potential species would not be flowering or able to be identified.

3.4 Declared Rare & Priority Flora

Species of flora and fauna are defined as Declared Rare or Priority conservation status where their populations are restricted geographically or threatened by local processes. DBCA recognises these threats of extinction and consequently applies regulations towards population and species protection. Declared rare flora species are gazetted under subsection 2 of section 23F of the WC Act (1950) and therefore it is an offence to "take" or damage rare flora without Ministerial approval. Section 23F of the WC Act (1950) defines "to take" as "… to gather, pick, cut, pull up, destroy, dig up, remove or injure the flora or to cause or permit the same to be done by any means" (Government of Western Australia, 2010).

Priority List Flora are under consideration for declaration as "rare flora", but are in urgent need of further survey (Priority One to Three) or require monitoring every 5-10 years (Priority Four). Table 1 presents the definitions of Declared Rare and the four Priority ratings under the WC Act (1950) (Department of Environment and Conservation, 2010a).

Table 2: Rare & Priority Flora Categories

CONSERVATION CODE	CATEGORY
T	"Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection and have been gazetted as such.'
P1	"Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey."
P2	Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey."
P3	"Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora', but are in need of further survey."
P4	"Taxa which are considered to have been adequately surveyed and which, while being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years."

3.5 Threatened & Priority Ecological Communities

An ecological community is a naturally occurring biological assemblage that occurring in a particular type of habitat. A threatened ecological community (TEC) is one which found to fit into one of the following categories: Presumed Totally Destroyed; Critically Endangered; Endangered, or Vulnerable.

Possible TECs that do not meet survey criteria are added to the DBCA's Priority Ecological Community Lists, under Priority 1, 2 and 3. These are ranked in order of priority for survey and/or the definition of the community and evaluation of its conservation status.

3.6 Field Survey limitations

Limitations with the survey are listed in Table

Table 3: Field Survey Limitations.

Issue	Limitation	Comment
Sources of Information	No constraint	The area of survey has been reasonably well surveyed and adequate data are available.
Intensity of survey	No constraint	For a reconnaissance survey, the level of investigation and data collection was sufficient for this project.
Seasonality of survey	Moderate constraint	One species, *Caladenia procera*, is known within the study area. This species would not be detectable during the timeframe of this study. A detailed spring flora survey was not conducted as part of this reconnaissance survey.
Expertise	No constraints	Gary McMahon has 20 years of survey experience for flora within the Swan Coastal Plain. Additional flora identification was provided by Nathan McQuoid, who has extensive botanical experience in the south west.
Completeness	No constraints	The survey sites were linear road verge areas, where easy access and the ability to walk though most areas. 27 hours were spent in all of the sites.

3.7 Desktop Study Findings

3.7.1 Flora

A desktop study of the flora values within the study area reveal a total of 46 flora species of significance occurring within 5 kms of the sites (Table 2).

Table 4: Threatened and Priority Flora within a 5 km radius of the sites.

SPECIES	STATUS	LIFE FORM	HABITAT	Eastern Link	Causeway Bridge	West-Strelly St	Fairway Drive	Ford St-Molloy St
Andersonia gracilis	Endangered	Shrub	Seasonally damp, black sandy clay flats near the margins of swamps.	Possible	Unlikely	Possible	Possible	Unlikely
Banksia nivea subsp uliginosa	Threatened	Shrub	Sandy clay, gravel	Unlikely	Possible	Possible	Possible	Unlikely
Banksia squarrosa subs argillacea	Vulnerable	Shrub	Winter wet clay over ironstone	Unlikely	Unlikely	Unlikely	Unlikely	Unlikely
Brachyscias verecundus	Critically Endangered	Herb	Winter wet clays over ironstone	Unlikely	Unlikely	Unlikely	Unlikely	Unlikely
Caladenia huegelii	Threatened	Herb	Grey or brown sand, clay loam	Unlikely	Possible	Possible	Possible	Possible
Caladenia procera	Threatened	Herb	Alluvial loamy flats	Unlikely	Unlikely	Unlikely	Known	Unlikely
Chamelaucium sp SCP	Threatened	Shrub	Swamp margins, winter wet sandy clays.	Possible	Unlikely	Possible	Possible	Possible
Darwinia whicherensis	Endangered	Shrub	Winter wet areas over shallow red clay over ironstone	Unlikely	Unlikely	Unlikely	Unlikely	Unlikely

SPECIES	STATUS	LIFE FORM	HABITAT	Eastern Link	Causeway Bridge	West-Strelly St	Fairway Drive	Ford St-Molloy St
Diuris micrantha	Vulnerable	Herb	Dark, grey to blackish, sandy clay loams in winter wet depressions or swamps.	Unlikely	Unlikely	Unlikely	Unlikely	Unlikely
Drakaea elastica	Threatened	Herb	White or grey sand, low lying situations adjoining winter wet swamps.	Unlikely	Unlikely	Unlikely	Unlikely	Unlikely
Drakaea micrantha	Vulnerable	Herb	White Grey Sand	Unlikely	Unlikely	Unlikely	Unlikely	Unlikely
Gastrolobium papilio	Endangered	Shrub	Peaty Grey brown sandy clay over ironstones or winter wet flats	Unlikely	Unlikely	Unlikely	Unlikely	Unlikely
Grevillea elongata	Vulnerable	Shrub	Gravelly Clay, sandy clay and sand on road verges, swamps and creek banks.	Unlikely	Possible	Possible	Possible	Possible
Kennedia lateritia	Threatened	G/cover		Unlikely	Possible	Possible	Possible	Unlikely
Lambertia echinata subsp occidentalis	Endangered	Shrub	Shallow soils over sheet ironstone and white sandy soils over laterite. Winter wet rich heathlands.	Unlikely	Unlikely	Unlikely	Unlikely	Unlikely
Lambertia orbifolia subs Scot River Plain	Threatened	Shrub	Grey brown white gravelly sandy loam over ironstone	Unlikely	Unlikely	Unlikely	Unlikely	Unlikely
Petrophile latericola	Endangered	Shrub	Winter wet flats of red sandy clay over ironstone	Unlikely	Unlikely	Unlikely	Unlikely	Unlikely
Verticordia densiflora var pedunculata	Threatened	Shrub	Light yellow or grey sands in low lying winter wet areas.	Unlikely	Unlikely	Unlikely	Unlikely	Unlikely

SPECIES	STATUS	LIFE FORM	HABITAT	Eastern Link	Causeway Bridge	West-Strelly St	Fairway Drive	Ford St-Molloy St
Verticordia plumose var vassensis	Threatened	Shrub	Variety of sands and swampy clay soils in mostly winter wet flats and depressions.	Unlikely	Unlikely	Unlikely	Unlikely	Unlikely
Gastrolobium sp Yoongarillup	P1	Shrub	Sandy soils, lateritic gravelly soils	Unlikely	Unlikely	Unlikely	Unlikely	Unlikely
Puccinellia vassica	P1	Grass like herb	Saline soils. On the outer margins of coastal saltmarshes	Unlikely	Unlikely	Unlikely	Unlikely	Unlikely
Stachystemon sp Keysbrook	P1	Shrub	To 0.2 m	Unlikely	Unlikely	Unlikely	Unlikely	Unlikely
Amperea micrantha	P2	Herb	Sandy Soils	Unlikely	Unlikely	Unlikely	Unlikely	Unlikely
Calystegia sepium subs roseate	P2	Twining herb	Damp places	Possible	Unlikely	Possible	Known	Possible
Leucopogon sp Busselton	P2	Shrub	Variety of habitats	Possible	Likely	Likely	Possible	Likely
Chorizema carinatum	P3	Shrub	Sand or sandy clays.	Unlikely	Possible	Possible	Possible	Possible
Conospermum paniculatum	P3	Open shrub	Sandy or clayey soils, Swampy areas plains and slopes	Unlikely	Unlikely	Possible	Possible	Unlikely
Grevillea brachystylis subsp brachystylis	P3	Shrub	Flowers: red, Aug to Nov.	Possible	Unlikely	Possible	Possible	Unlikely

SPECIES	STATUS	LIFE FORM	HABITAT	Eastern Link	Causeway Bridge	West-Strelly St	Fairway Drive	Ford St-Molloy St
Grevillea bronwenae	P3	Shrub	Grey sand over laterite, lateritic loams, Hillslopes.	Unlikely	Unlikely	Unlikely	Unlikely	Unlikely
Hakea oldfieldii	P3	Open shrub	Red clay or sand over laterite, seasonally wet flats.	Unlikely	Possible	Possible	Possible	Unlikely
Isopogon formosum subsp dasylepis	P3	Shrub	Sand, sand clay, gravelly sandy soils over laterite. Often swampy areas	Unlikely	Unlikely	Unlikely	Unlikely	Unlikely
Jacksonia gracillima	P3	Shrub	Sandy soils, Sandplains rises swampy depressions.	Unlikely	Unlikely	Possible	Possible	Unlikely
Johnsonia inconspicua	P3	Grass like herb	White-grey or black sand. Low dunes, winter-wet flats	Unlikely	Unlikely	Possible	Possible	Unlikely
Lasiopetalum laxiflorum	P3	Shrub	Heavy soils in tuart woodlands	Unlikely	Unlikely	Possible	Possible	Unlikely
Loxocarya magna	P3	Sedge like herb	Sand, loam, clay, ironstone, seasonally inundated or damp habitats.	Unlikely	Possible	Possible	Possible	Possible
Pimelea ciliata subsp. longituba	P3	Shrub	Grey sand over clay, loam	Unlikely	Possible	Possible	Possible	Possible
Pultenaea pinifolia	P3	Shrub	Loam or clay, floodplains, swampy areas.	Unlikely	Possible	Possible	Possible	Possible
Synaphea hians	P3	Shrub	Sandy soils and rises.	Unlikely	Possible	Possible	Possible	Unlikely

SPECIES	STATUS	LIFE FORM	HABITAT	Eastern Link	Causeway Bridge	West-Strelly St	Fairway Drive	Ford St-Molloy St
Synaphea petiolaris subsp. simplex	P3	Shrub	Sandy Soils, Flats, Winter Wet Areas	Unlikely	Possible	Possible	Possible	Unlikely
Acacia flagelliformis	P4	Rush like erect or sprawling shrub.	Sandy Soils and winter wet areas.	Unlikely	Possible	Possible	Possible	Unlikely
Acacia semitrullata	P4	Shrub	White /Grey sands, Sandplains and swampy areas.	Unlikely	Unlikely	Possible	Possible	Unlikely
Chamelaucium sp. Yoongarillup	P4	Evergreen shrub	Variety of soil types.	Unlikely	Possible	Possible	Possible	Unlikely
Franklandia triaristata	P4	Shrub	White or grey sand	Unlikely	Unlikely	Possible	Possible	Unlikely
Laxmannia jamesii	P4	Herb	Grey Sand, winter wet areas	Unlikely	Possible	Possible	Possible	Unlikely
Ornduffia submersa	P4	Herb	Freshwater lakes swamps and Claypans.	Unlikely	Possible	Possible	Possible	Possible
Thysanotus glaucus	P4	Herb	White, grey or yellow sand, sandy gravel.	Unlikely	Possible	Possible	Possible	Unlikely

Within the five survey areas, the extracts from DBCA, highlighted three flora species known within of the survey areas:

- *Synaphea hians* – within Item F (Ford Road) survey area, although not directly within the site boundary;
- *Caladenia procera* – in Item E (Fairway Drive). The author is aware of this population from previous studies;

- *Calystegia sepium* subsp *roseata* – in Item E (Fairway Drive) within the northern part of the site.

3.7.2 Vegetation & Ecological Communities

Heddle, et.al (1980) mapping, classifies remnant vegetation into a number of vegetation complexes and systems.

Within the five study areas, the following complexes were determined (Map 8):

- Ludlow Complex (Lw) – Open woodland of Melaleuca rhaphiophylla and sedgelands of Cyperaceae-Restionaceae spp. on broad depressions in the subhumid zone
- Quindalup Complex (Qw, Qwy, QD) - Tall shrubland of Acacia saligna-Agonis flexuosa and open heath on depressions amongst recent dunes in the subhumid zone.

Table 2 summarises the vegetation complexes within each of the five areas.

Table 5 Vegetation Complexes (Heddle et al, 1980)

Complex	% Present Extent	% in Formal Reserves	Item A - Eastern Link	Item B - Causeway Bridge Duplication	Item C & D - Strelly-Barlee, West St Route & Duplication	Item E - Fairway Dve Duplication	Item F - Ford Rd & Molly St Options
Ludlow	25	11				✓	
Quindalup	44	16	✓		✓	✓	✓

The amount of the Ludlow Vegetation Complex remaining places it in a category requiring further consideration from any potential clearing.

The desktop study revealed three known Threatened or Priority Ecological Communities within the five survey areas.

Banksia Woodlands of the Swan Coastal Plain - Endangered

The ecological community can be identified by these general features:

- It typically occurs on well drained, low nutrient soils in sands of dune landforms, in particular deep Bassendean and Spearwood sands, or occasionally on Quindalup sands. It is also common on sandy colluvium and aeolian (wind-blown) sands of the Ridge Hill Shelf, Whicher Scarp and Dandaragan Plateau.
- Banksia Woodlands vary in their structure (height, cover, density) and species composition across the region where they occur. These variations can occur over small distances, but the woodlands are united by having a generally dominant Banksia component, which includes at least one of four key species— Banksia attenuata (candlestick banksia), B. menziesii (firewood banksia), B. prionotes (acorn banksia) and/or B. ilicifolia (holly-leaved banksia) Banksia littoralis (swamp banksia) and B. burdettii (Burdett's banksia) may be co-dominant in some areas, but where they become dominant, they typically form other communities and are not considered the Banksia Woodlands of the Swan Coastal Plain ecological community.
- Other trees of a medium height that may be present, and may be co-dominant with the Banksia species across a patch, include Eucalyptus todtiana (blackbutt, pricklybark), Nuytsia floribunda (Western Australian Christmas tree), Allocasuarina fraseriana (western sheoak), Callitris arenaria (sandplain cypress), Callitris pyramidalis (swamp cypress) and Xylomelum occidentale (woody pear).
- Emergent taller trees that can occur above the Banksia canopy may include Corymbia calophylla (marri), Eucalyptus gomphocephala (tuart) and E. marginata (jarrah).
- Key species in the sclerophyllous shrub layer include members of the families Asteraceae, Dilleniaceae, Ericaceae, Fabaceae, Myrtaceae and Proteaceae. Widespread species include Adenanthos cygnorum (woolly bush), Allocasuarina humilis (dwarf sheoak), Bossiaea eriocarpa (common brown pea), Conostephium pendulum (pearl flower), Daviesia spp., Eremaea pauciflora, Gompholobium tomentosum (hairy yellow pea), Hibbertia hypericoides (yellow buttercups), Hypolaena exsulca, Jacksonia spp., Kunzea glabrescens, Petrophile linearis (pixie mops), Phlebocarya ciliata, Philotheca spicata (pepper and salt), Stirlingia latifolia (blueboy) and Xanthorrhoea preissii (balga, grass tree).
- Key species in the herbaceous ground layer include members of the families Cyperaceae, Droseraceae, Haemodoraceae, Orchidaceae, Restionaceae and "lilies" from various families. Widespread species include Amphipogon turbinatus (tufted beard grass), Burchardia congesta (milkmaids), Caladenia spp. (spider orchids), Dasypogon bromeliifolius (pineapple bush), Desmocladus flexuosus, Drosera erythrorhiza (red ink sun dew), Lepidosperma squamatum (a tufted sedge), Lomandra hermaphrodita, Lyginia barbata (southern rush), Lyginia imberbis, Mesomelaena pseudostygia (semaphore sedge), Patersonia occidentalis (purple flag), Podolepis spp., Stylidium brunonianum (pink fountain trigger plant), Stylidium piliferum (common butterfly trigger plant), Trachymene pilosa (dwarf parsnip), and

Xanthosia huegelii (heath Xanthosia). The development of a ground layer may vary depending on the density of the shrub layer and disturbance history

Subtropical and Temperate Coastal Saltmarsh – Vulnerable (Cwth), P3 WA

This is wide ranging community associates with saltmarsh in coastal regions of sub-tropical and temperate Australia (south of 23^0 S latitude). The habitat is defined as coastal areas under tidal influence. It is typically restricted to the upper intertidal environment, generally between elevation of the mean high tide, and the mean spring tide. The community consists mainly of salt-tolerant vegetation (halophytes) including: grasses, herbs, reeds, sedges and shrubs. Succulent herbs and grasses generally dominate and vegetation is generally <0.5m tall with the exception of some reeds and sedges. Many species of non-vascular plants are also found in saltmarsh, including epiphytic algae, diatoms and cyanobacterial mats. Saltmarsh consists of many vascular plant species but is dominated by relatively few families. There is also typically a high degree of endemism at the species level. The two most widely represented coastal saltmarsh plant families are the Chenopodiaceae and Poaceae. Four structural saltmarsh forms are currently recognised based on dominance of a particular vegetation type:

- dominance by succulent shrubs (e.g. Tecticornia)
- dominance by grasses (e.g. Sporobolus virginicus)
- dominance by sedges and grasses (e.g. Juncus kraussii, Gahnia trifida)
- dominance by herbs (e.g. low-growing creeping plants such as Wilsonia backhousei, Samolus repens, Schoenus nitens).

The Coastal Saltmarsh ecological community also include areas that have groundwater connectivity to tidal water bodies. Thus it occurs at places with at least some tidal connection, including rarely-inundated supratidal areas and intermittently opened or closed lagoons, but not areas receiving only aerosol spray (i.e. such as cliff tops). Western Australian coastal areas support an entire series of saline coastal wetlands that abut typical coastal saltmarshes. These include: saline lakes on the coast and offshore islands, coastal lagoons (open and closed) and the birridas (gypsum claypans) of Shark Bay. These wetlands are all connected to the sea in various ways, and contain typical saltmarsh vegetation (Keighery and Keighery, 2013a). As such they would be included within the ecological community. Many similar wetlands along the Western Australian coastline have lost their connection to the sea, for example the lagoon saline lakes of the Swan Coastal Plain (Keighery and Keighery 2013b), and it is likely that eventually others will also (G. Keighery, pers. comm.). These would not be considered as part of the ecological community if the disconnection were permanent.

Eucalyptus rudis, Corymbia calophylla, Agonis flexuosa Closed Low Forest – P1 (WA)

Eucalyptus rudis, Corymbia calophylla, Agonis flexuosa Closed Low Forest (near Busselton) Priority 1 A low lying Spearwood Dune plant community associated with shallow sandy soils over Tamala limestone that in places is exposed at the surface. The plant community on these soils supports a unique mixture of wetland and upland flora. Typically low forest dominated by Eucalyptus rudis, Eucalyptus calophylla, Agonis flexuosa over a diverse understorey including Hibbertia hypericoides, Logania vaginalis, Conospermum caeruleum, Agrostocrinum hirsutum and Lomandra micrantha. Other associated species include Eucalyptus decipiens, Melaleuca rhaphiophylla, Banksia littoralis, Hakea varia and the sedge species Baumea juncea and Gahnia trifida.

3.8 Results & Discussion

The field surveys were conducted over 4 days in August 2017 by Gary McMahon with assistance and taxonomic advice from Nathan McQuoid. The flora survey was conducted under Scientific and Other Prescribed Purposes Licence SL 011148 and SL 011557 and Permit to Take DRF No. 57-1516.

The vegetation was classified and mapped as "Vegetation Groups" each of which comprises a combination of vegetation type and condition.

3.8.1.1 Item A - Eastern Link

Four releve points were taken in this area. Areas of maintained, introduced grassland are noted but were not used as survey points. The vegetation groups are shown in Map 2.

Table 4 summarises the results based on the structural and species classification by Muir (1977) and Aplin (1979)(Appendix A). The condition ratings are based on the scale devised by Keighery (1994)(Appendix B).

Table 6:Descriptions of Vegetation Points in Eastern Link Survey Area

Vegetation Group	Description	Condition
Eastern Link 1	Low Woodland of Agonis flexuosa and Eucalyptus rudis over grasses (managed *Cynodon dactylon) (Figures 1 & 2)	Degraded on river edge to Completely degraded in parkland cleared area
Eastern Link 2	Low Woodland of Agonis flexuosa, E. rudis, E. cornuta, Melaleuca rhaphiophylla (& planted eucalypts), over open shrubland of Acacia littoralis, over closed grassland of Bolboschoenus caldwellii and assorted pasture grasses (*Cenchrus clandestinum) (Figures 3 & 4)	Degraded to Good

Vegetation Group	Description	Condition
Eastern Link 3	Low Open Forest of M. rhaphiophylla, M. preissii, over Open Scrub of M. viminea, over pasture grasses (dominated by *Cenchrus clandestinum & *Cynodon dactylon) (Figure 5)	Degraded
Eastern Link 4	Closed sedge land of samphire species (predominantly Sarcocornia quinqueflora, though includes Suaeda australis and Halosarcia indica) and Juncus kraussii and J pallidus. incursions of introduced grasses (Figures 5 & 6)	Good – Very Good.

Figure 1 Eastern Link Vegetation Group 1

Figure 2 Eastern Link Vegetation Group 1

Figure 3 Eastern Link Vegetation Group 2

Figure 4 Eastern Link Vegetation Group 2

Figure 5 Eastern Link Vegetation Group 3 (area to the left)

Figure 6 Eastern Link Vegetation Group 4

Appendix C itemises the species found in the reconnaissance survey within this area.

No threatened or priority flora species listed under Commonwealth or WA legislation were observed in the survey area.

No Weeds of National Significance were observed and only one species, Arum Lily (*Zantedeschia aethiopica*) which is declared under the Biosecurity and Agriculture Management Act (2007) (BAM Act) was found in the survey area.

Vegetation Group 4 was dominated by samphire and is potentially subject to tidal influences of the Vasse Estuary (seen in Figure 6). Discussions with the Department of Biodiversity, Conservation and Attractions (DBCA) has confirmed that the species within of this association are consistent with the definition of the EPBC listed TEC (WA listed PEC) – Subtropical and Temperate Coastal Saltmarsh community (A. Webb, Regional Botanist SW DBCA, *pers comm* Sept 2017). Further investigations would be required to determine the specific extent of salt water inundation in this area to determine if the TEC is present.

3.8.1.2 Item B – Causeway Bridge Duplication

Three vegetation groups were found in this area. Areas of maintained, introduced grassland are noted but were not assessed. The vegetation groups are shown in Map 3.

Table 5 summarises the results based on the structural and species classification and condition

Table 7: Vegetation Groups in Causeway Bridge Survey Area

Vegetation Point	Description	Condition
Causeway 1	Low Woodland of Agonis flexuosa over managed grasses.	Completely Degraded - parkland cleared area
Causeway 2	Low Woodland of Agonis flexuosa, over sedgeland of Juncus spp on river with . managed grasses (Figures 7 & 8)	Degraded to Good on river edge
Causeway 3	Low Woodland of E. rudis, M. rhaphiophylla, M. preissii and A. flexuosa, Open sedgeland of Lepidosperma gladiatum, J. pallidus and J kraussii, with incursions of managed grasses. (Figure 9)	Degraded to Good on river edge.

Figure 7 Causeway Vegetation Group 2

Figure 8 Causeway Vegetation Group2 – note good quality of vegetation along edge of river

Figure 9 Causeway Vegetation Group 3

Appendix A itemises the species found in the reconnaissance survey within this area.

No threatened or priority flora species listed under Commonwealth or WA legislation were observed in the survey area.

No Weeds of National Significance were observed and only one species, Arum Lily (*Zantedeschia aethiopica*) which is declared under the Biosecurity and Agriculture Management Act (2007) (BAM Act) was found in the survey area.

None of the areas within this site were consistent with any of the known TEC/PECs.

3.8.1.3 Item C & D – Strelly- Barlee-West St Route and Duplication

Six vegetation groups were identified within this area as described in Table 6 and shown in Map 4. There were other areas of vegetation, such as planted street trees, garden escapees and grassed areas that couldn't be categorised as a functional vegetation group. While these are noted in map 4 they were not categorised as a distinct vegetation group.

Vegetation Group 1 was predominantly inundated (refer Figure 11) and complete descriptions were not available as any ground cover species were not observable.

Table 8: Vegetation Groups in Strelly West St Survey Area

Vegetation Group	Description	Condition
Strelly-West 1	Tall Open Scrub of Melaleuca viminea, over low open Heath of M. viminea and Acacia saligna, over Sedgeland of Gahnia trifida, Juncus pallidus, Ficinia nodosa, over herbland of *Zantedeschia aethiopica, Edges affected by *Cenchrus clandestinum and other grasses)(Figures 10 & 11)	Very Good, with edges Degraded due to weeds
Strelly-West 2	Tall Open Scrub of M. viminea, A. flexuosa and Acacia littoralis, over Low open heath of M. viminea, over sedgeland of Lepidosperma gladiatum, Juncus pallidus and Gahnia trifida, over open herbland of *Zantedeschia aethiopica, Edges affected by *Cenchrus clandestinum and other introduced grasses and Clover spp., very wet areas covered by *Typha orientalis (Figures 12 & 13)..	Good to Degraded on edges
Strelly-West 3	Tall open Scrub of Acacia saligna, Agonis flexuosa, over Low shrubland of A. saligna over Closed sedgeland of Gahnia trifida. Edges affected by clovers and introduced annual grasses very wet areas covered by *Typha orientalis (Figures 14 & 15)	Good to Degraded on edges
Strelly-West 4	Sedge land of samphire species (predominantly Sarcocornia quinqueflora, though includes Suaeda australis and Halosarcia indica) and Juncus kraussii and J pallidus. incursions of introduced grasses (Figures 16 & 17)	Good.
Strelly-West 5	Open Scrub of Melaleuca raphiophylla and M. viminea, with scatted *Pittosporum undulatum, * Cortaderia selloana, over introduced grasses	Degraded
Strelly-West 6	Scattered Low Trees of E. rudis, M. raphiophylla, over Scattered shrubs of Spyridium globulosum and Callistemon spp.	Degraded

No threatened or priority flora species listed under Commonwealth or WA legislation were observed in the survey area.

No Weeds of National Significance were observed and only one species, Arum Lily (Zantedeschia aethiopica) which is declared under the Biosecurity and Agriculture Management Act (2007) (BAM Act) was found in the survey area.

The samphire areas (Group 4) is potentially subject to tidal inundation and while it would not be considered to be in a very good condition, it would be prudent to consider its potential to be the EPBC listed TEC (WA Listed PEC) Coastal Saltmarsh complex, unless further detailed investigation can precisely describe the dynamics of this site.

Figure 10 Strelly-West Vegetation Group 1

Figure 11 Strelly-West Vegetation Group 1

Figure 12 Strelly-West Vegetation Group 2

Figure 13 Strelly-West Vegetation Group 2, looking west

Figure 14 Strelly-West Vegetation Group 3

Figure 15 Strelly-West Vegetation Group 3

Figure 16 Strelly-West Vegetation Group 4

Figure 17 Strelly-West Vegetation Group 4, Northern Samphire

3.8.1.4 Item E- Fairway Drive Duplication

Seven vegetation groups were assessed in this survey area, as described in Table 7 and shown in Map 5.

Table 9: Vegetation Groups within Fairway Drive Survey Area

Vegetation Group	Description	Condition
Fairway 1	Open forest of Agonis flexuosa, Corymbia calophylla with scatted Eucalyptus rudis, over Tall Shrubland of A. flexuosa and Melaleuca rhaphiophylla and M. viminea, over Open shrubland of Agonis and Melaleuca, over scattered Lepidosperma squamatum, and open herbland of Lomandra spp, Phyllanthus calycinus and grassland of introduced pasture grasses. (Figure 18)	Good
Fairway 2	Low Open Forest of C. calophylla, A. flexuosa, M. raphiophylla, over open shrubland of Acacia saligna, M. raphiophylla, over herbland of Lomandra spp and Patersonia umbrosa, Hibbertia furfuracea, and grassland of *Avena fatua with scattered *Zantedeschia aethiopica (Figure 19)	Degraded – Good Due to weed and lack of structure
Fairway 3	Low Open Forest of A. flexuosa and M. raphiophylla, over Tall open Scrub of M. viminea, A flexuosa, A saligna and M. preissiana over tall shrubland of A. saligna and M viminea, over herbland of Sparaxis spp over grassland (some managed)	Degraded
Fairway 4	Low Open Woodland of planted A. flexuosa, Acacia spp, Melaleuca spp, over closed managed grassland.	Completely degraded
Fairway 5	Low Woodland of Corymbia calophylla, and A. flexuosa, over open shrubland of A. flexuosa, over open grassland of *Avena fatua, Hypochaeris spp and annual grasses	Degraded
Fairway 6	Low Open Woodland of C. calophylla, Callitris preissii, E. rudis, M. raphiophylla, M. viminea, M preissii, over open shrubland of M. viminea, over scattered Adenanthos and a closed grassland of perennial grasses..	Very good
Fairway 7	Low Open Forest of A. flexuosa, over Tall open scrub of A. flexuosa, Spyridium globulosum, M. viminea, M, raphiophylla and M. preissiana over scattered low shrubs of A. saligna, over closed grassland of *Cenchrus clandestinum and *Cynodon dactylon	Degraded

Figure 18 Fairway Vegetation Group 1

Figure 19 Fairway Vegetation Group 2

Figure 20 Fairway Vegetation Group 3

Figure 21 Fairway Vegetation Group 4

Figure 22 Fairway Vegetation Group 5

Figure 23 Fairway Vegetation Group 6

Figure 24 Fairway Vegetation Group 7

No threatened or priority flora species listed under Commonwealth or WA legislation were observed in the survey area.

No Weeds of National Significance were observed and only one species, Arum Lily (Zantedeschia aethiopica) which is declared under the Biosecurity and Agriculture Management Act (2007) (BAM Act) was found in the survey area.

While no species of significance was observed, Fairway 1 vegetation group is known to support a population of *Caladenia procera* (Critically Endangered taxa). This species can only be identified during flowering

season, however it is known to populate this area as evidenced from previous studies Ecosystem Solutions have competed in previous projects.

Vegetation Groups 1, 2 and 6 have species consistent with the Priority 1 PEC, *Eucalyptus rudis*, *Corymbia calophylla* and *Agonis flexuosa* Forest. While these areas vary in condition from Degraded to Very Good, they should be considered as the PEC unless proven otherwise.

3.8.1.5 Item F- Ford Road Options 1 and 2 & Molloy St Option

This survey area consists of the length of Ford Road from Bussell Highway to Peel Terrace and Ford Road connecting south to Molloy St and crossing the Vasse River Delta Wetlands. There was an additional area to the east of Ford Road, as indicated on Map 6.

Ford Road is an unmade road reserve for the full length and this is dominated by annual grass weeds (Figures 25, 27 & 28).

Areas were noted where change occurred, but only native vegetation association were assessed. Other area are noted and shown in Map 6.

In total, 4 sites were assessed in the Ford Road area (Map 6) and 3 within the Molloy St survey area (Map 7), as shown in Table 8

Table 10: Vegetation Groups within Ford Road Options and Molloy St Survey Areas

Vegetation Group	Description	Condition
Ford Rd 1	Closed Grassland of introduced pasture grasses, *Trifolium spp, *Cenchrus clandestinum and *Cynodon dactylon with scattered *Zantedeschia aethiopica (Figure 25)	Completely Degraded
Ford Rd 2	Scattered Tall Trees of Eucalyptus gomphocephala over pasture grasses (Figure 26)	Completely Degraded
Ford Rd 3	Closed sedge land of samphire species (predominantly Sarcocornia quinqueflora, though includes Suaeda australis and Halosarcia indica) and Juncus kraussii and J pallidus. incursions of introduced grasses (Figure 27)	Good .
Ford Rd 4	Closed grassland of Typha orientalis with Scattered Melaleuca raphiophylla (Figure 28) .	Degraded to Completely Degraded
Molloy St - 1	Closed sedge land of samphire species (predominantly Sarcocornia quinqueflora, though includes Suaeda australis and Halosarcia	Good – Very Good.

Vegetation Group	Description	Condition
	indica) and Juncus kraussii and J pallidus. incursions of introduced grasses and scattered *Zantedeschia aethiopica (Figure 29)	
Molloy St 2	Closed Grassland of Bolboschoenus caldwellii and assorted pasture grasses (*Cenchrus clandestinum, *Cynodon dactylon with scattered *Zantedeschia aethiopica (Figure 30).	Completely Degraded
Molloy St 3	Closed grassland of Typha orientalis with Scattered Melaleuca raphiophylla (Figure 31).	Degraded to Completely Degraded
Molloy St 4	Open Shrubland of Melaleuca raphiophylla and Acacia spp, over introduced grasses	Degraded

Figure 25 Ford Rd Vegetation Group 1

Figure 26 Ford Rd Vegetation Group 2

Figure 27 Ford Rd Vegetation Group 3

Figure 28 Ford Rd Vegetation Group 4

Figure 29 Molloy Vegetation Group 1

Figure 30 Molloy Vegetation Group 2

Figure 31 Molloy Vegetation Group 1 in foreground and Vegetation Group 3 in background

No threatened or priority flora species listed under Commonwealth or WA legislation were observed in the survey area.

No Weeds of National Significance were observed and only one species, Arum Lily (*Zantedeschia aethiopica*) which is declared under the Biosecurity and Agriculture Management Act (2007) (BAM Act) was found in the survey area.

Most of the vegetation groups within Ford Rd are degraded to completely degraded. However Vegetation Group 3 within Ford Road and Lot 80 contain the species consistent with the EPBC listed TEC(WA listed PEC) Coastal Saltmarsh. They are appear to be influenced by coastal/tidal movements and therefore should be considered to be the TEC unless they can be proven otherwise from further investigations.

4 Fauna

4.1 Objectives

The objective of the reconnaissance fauna survey was to identify fauna of conservation significance, including threatened and priority species or migratory species listed and protected under Commonwealth or Western Australian legislation.

Key conservation significant fauna expected with the five survey areas include Western Ringtail Possum (WRP), endangered Black Cockatoo species, and migratory waterbirds.

4.2 Methodology

This survey was conducted to be compliant with the EPA's requirement for the environmental survey and reporting for flora and vegetation in Western Australia.

These requirements are set out in the following documents:

- Technical Guidance – Sampling Methods for Terrestrial Vertebrate Fauna (EPA, December 2016);
- Technical Guidance – Terrestrial Fauna Surveys (EPA, December 2016);
- Environmental Factor Guideline – Terrestrial Fauna (EPA December 2016);
- Development Planning Guidelines for Western Ringtail Possums (CALM, 2003 (now DBCA); and
- Guidelines for the three Black Cockatoo species (Department of Sustainability, Environment, Water, Populations and Communities, 2011, now Department of Environment and Energy) .

A desktop study and analysis of the records of the DBCA's (Nature Map) and the Australian Government's Department of the Environment and Energy's EPBC Act Protected Matters Search Tool (Appendix A & B) were made to determine the presence or likely presence of fauna or faunal assemblages within the Site. The analysis primarily targeted terrestrial threatened vertebrate species listed under the Environmental Protection and Biodiversity Conservation Act 1999 (Cwth), (EPBC Act) and the Western Australian WC Act (WA) 1950.

Based on the finding of the desktop study and considering the vegetation groups present, a field survey of each of the five sites was conducted. The approach adopted for this survey was:

- A Satellite Image of the study area, incorporating all five survey areas was acquired;
- A day time visual inspection of each survey area and adjoining vegetation for any signs of fauna (e.g. scats, diggings, dreys, nests, burrows, feeding signs) was conducted;
- Hollow bearing trees or trees suitable for Black Cockatoos were recorded;

- Direct observations of terrestrial vertebrate fauna and signs of that fauna were recorded using a Trimble Global Positioning System (GPS) and ArcPad© (Version 8- ESRI);
- A 20 minute bird survey, including observation and recording of any waterbirds within the Vasse River, New River and Vasse Estuary within each survey area;
- Two, non-consecutive, night time spotlight surveys were conducted to determine nocturnal fauna activity. A 40 w LightForce hand-held spotlight was used with white light. Observations were recorded using GPS and ArcPad©;
- Two pre-dawn and two dusk surveys were conducted to determine Black Cockatoo activity. A spotting scope was used in these surveys to identify any other birds within the site; and
- Field observations were analysed and mapped with ArcGis (ArcMap V10.3©).

Each of the five survey areas were inspected via a walked transect and the trees were inspected via a visual inspection for hollows or signs of fauna usage.

All trees with large hollows were inspected for any signs of use by cockatoos. These include wear around the hollow, chewing, scarring and scratch marks on the trunks or branches which may be evidence for use by threatened Black Cockatoo species. Old or recent evidence of cockatoo's feeding or roosting sites (feathers, droppings etc.) were also searched for.

The field survey methodology has minimal impact on the fauna within the property and provides sufficient data on the presence and relative abundance and distribution of taxa. During the field surveys, the habitat at the site was assessed to determine its potential suitability to host any of the anticipated threatened, priority or migratory species listed under Commonwealth and State legislation. This approach is consistent with a Level 1 survey under the EPA's Technical Guide: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (2016) which specifies a minimum requirement of a background research or desktop study to gather information on the five survey areas and a reconnaissance survey to verify the accuracy of the background study and delineate fauna and faunal assemblages for a given survey area.

4.3 Conservation Significant Fauna

The conservation status of fauna within Western Australia is determined by criteria outlined within two acts of legislation: the Environmental Protection and Biodiversity Conservation Act 1999 (Cwth), (EPBC Act) and the State-based Western Australian WC Act (WA) 1950.

Under Section 179 of the EPBC Act, fauna may be listed in one of the following categories (in decreasing degree of threat of extinction):

- Extinct;

- Extinct in the wild;
- Critically Endangered;
- Endangered;
- Vulnerable; and
- Conservation Dependant.

These categories are consistent with the International Union for Conservation of Nature (IUCN) classifications and therefore link into a global ranking system for taxa at risk of extinction.

The WC Act also uses these categories, but uses a set of schedules to define extinction risk (Table 9).

Table 11: Conservation Categories in the Wildlife Conservation Act (WA) 1950.

Category	Code	Description
Schedule 1	S1	Fauna which is rare or likely to become extinct.
Schedule 2	S2	Fauna which is presumed extinct.
Schedule 3	S3	Birds which are subject to an agreement between the governments of Australia and Japan (JAMBA) relating to the protection of migratory birds and birds in danger of extinction.
Schedule 4	S4	Fauna that is otherwise in need of special protection.

The DBCA also produce a supplementary list of possible threatened species that do not meet the criteria for listing in the above categories. These species are not considered threatened under the WC Act, but due to a lack of knowledge or where species are poorly represented in conservation reserves, some concern for their long term survival exists. Table 10 shows the priority classifications.

Table 12: Priority Classifications used in WA.

Category	Code	Description
Priority 1	P1	Taxa with a few, poorly known populations on lands not managed for conservation (e.g. agricultural lands, urban areas etc.).
Priority 2	P2	Taxa with few, poorly known populations on conservation lands (e.g. national parks, nature reserves etc.).
Priority 3	P3	Taxa with several, poorly known populations, some on conservation lands, but where known threats could affect them.
Priority 4	P4	Rare, near threatened and other species in need of monitoring.

The EPBC Act also requires the compilation of a list of migratory species that are recognised under international treaties including the Japan Australia Migratory Bird Agreement (JAMBA), the China Australia Migratory Bird Agreement (CAMBA), and the Bonn Convention (The Convention on the conservation of Migratory Species of Wild Animals). Species listed under JAMBA are also protected under Schedule 3 of the WC Act.

The conservation status of all terrestrial vertebrate species listed as occurring within, near or likely to occur within each of the five survey areas, were assessed using the most recent lists of the relevant legislation and DBCA priority lists. The reconnaissance fauna survey did not include aquatic species, such as Carter's Freshwater Mussel (*Westralunio carteri*). Aquatic survey has separately been undertaken for the Eastern Link and Causeway Bridge areas (Murdoch University, 2017).

4.4 Limitations

Field surveys were confined to four day surveys and two nocturnal spotlight surveys conducted over non-consecutive night at each site. Two pre-dawn and two pre-dusk surveys for Black Cockatoo activity were also conducted. The night surveys were conducted using experienced ecologists utilising individual head torches and a single hand-held spotlight.

Each of the five survey areas was traversed by foot walking the entire length of each site. In the road ways, both sides of the road was inspected. The linear nature of the survey areas allowed ready access and reasonable visibility for any potential fauna within each site.

All large trees of suitable size were examined from the ground for the presence of hollows. Guidelines for the survey techniques for Black Cockatoo species (Dept. of Sustainability, Environment, Water Populations and Communities, 2011) state that all trees with a Diameter at Breast Height (DBH) of over 500m should be inspected. All of these trees were inspected, however only those with observable hollows or potential for hollows, or those with suitable foraging habitat or evidence of feeding activities, were recorded. It should be noted however, that all of the prerequisites that determine the suitability of a hollow for use by cockatoos is difficult to assess. In addition to entrance size, the depth, floor and orientation of the hollow are important factors. The presence of suitable hollows, even in breeding areas, does not make them available for breeding as hollows must be spatially, structurally and temporally correct (Johnstone and Johnston, 2004). The listing of potential nesting hollows is therefore likely to be an over estimation of those actually suitable.

4.5 Expected Fauna

A list of fauna expected to occur within a five kilometre radius of the five survey areas was compiled from conservation significant searches conducted on the WA Museum database and DBCA fauna

database (Nature Maps), Commonwealth's EPBC Act Protected Matters Search Tool and the Birds Australia Atlas project database.

The results of the native fauna database search for rare, threatened or endangered species likely to still be within or utilise the study area (comprising the five survey areas) are shown in Table 13[1]:

Table 13: Rare, Threatened or Endangered Species likely within the five survey areas.

Species	Common Name	Cwth Listing	WA Listing	Habitat	Eastern Link	Causeway Bridge	West-Strelly St	Fairway Dve	Ford Rd- Molloy St
Botaurus poiciloptilus	Australasian Bittern	Endangered	Endangered	Wetlands with tall dense vegetation, favours permanent and seasonal freshwater habitats, dominated by sedges rushes and reeds, growing over a muddy or peaty substrate	Unlikely	Unlikely	Possible	Unlikely	Known
Calyptorhynchus banksii subsp naso	Forest Red Tailed Black Cockatoo	Vulnerable	Vulnerable	Dense Jarrah, Karri and Marri Forests. Species nests in large hollows in these species	Unlikely	known	Unlikely	Unlikely	Unlikely
Calyptorhynchus baudinii	Baudin's White Tailed Black Cockatoo	Vulnerable	Endangered	Dense Jarrah, Karri and Marri Forests. Species nests in large hollows in these species	Possible	Unlikely	Possible	Possible	Possible
Calyptorhynchus latirostris	Carnaby's White Tailed Black Cockatoo	Endangered	Endangered	Dense Jarrah, Karri and Marri Forests. Species nests in large hollows in these species	Known	Unlikely	Possible	Possible	Possible
Dasyurus geoffroii	Chuditch	Vulnerable	Vulnerable	Variety, most dense in riparian jarrah forests. Require large unfragmented habitats	Unlikely	Unlikely	Unlikely	Unlikely	Unlikely
Pseudocheirus occidentalis	Western Ringtail Possum	Vulnerable	Critically Endangered	Coastal Areas of Peppermint woodland and peppermint /tuart associations	Known	Known	Known	Known	Known
Phascogale tapoatafa subsp. wambenger	Southern Brush-Tailed Phascogale	Vulnerable	Conservation Dependant	Highly arboreal, prefers open forest with sparse groundcover.	Unlikely	Unlikely	Possible	Known	Unlikely

[1] Note marine and water based species were excluded due to the terrestrial/inland location of the study area.

Species	Common Name	Cwth Listing	WA Listing	Habitat	Eastern Link	Causeway Bridge	West-Strelly St	Fairway Dve	Ford Rd- Molloy St
Botaurus poiciloptilus	Australasian Bittern	Endangered	Endangered	Wetlands with tall dense vegetation, favours permanent and seasonal freshwater habitats, dominated by sedges rushes and reeds, growing over a muddy or peaty substrate	Unlikely	Unlikely	Possible	Unlikely	Known
Tyto novaehollandiae subsp. *novaehollandiae*	Masked Owl - southern subspecies	N/A	P3	Tall open eucapyt forest and woodlands. Preferred roosts large hollows in standing trees.	Unlikely	Unlikely	Possible	Possible	Unlikely
Isoodon obesulus subsp. *fusciventer*	Southern Brown Bandicoot	N/A	P4	Forest, woodland, shrub and heath, usually in sandy soils with dense healthy vegetation in lower stratum	Known	Possible	Possible	Possible	Possible
Oxyura australis	Blue Billed Duck	N/A	P4	Deep freshwater areas with dense vegetation.	Known	Known	Possible	Possible	Knownr
Hydromys chrysogaster	Water Rat	N/A	P4	Found near permanent fresh or brackish waters.	Possible	Possible	Possible	Possible	Unlikely

The following species are protected under international agreement or are specially protected bird fauna and have been noted within 5 km of the five survey areas. Table 14 shows their status and likelihood of inhabiting or utilising the five survey areas. Note that given the nature of the five survey areas, marine fauna have been excluded.

Table 14 Specially Protected, Migratory or other significant

Species	Common Name	Habitat	Eastern Link	Causeway Bridge	West-Strelly St	Fairway Dve	Ford rd- Molloy St
Falco peregrinus	Peregrine Falcon	Wide variety	Known	Known	Possible	Possible	Possible
Actitis hypoleucos	Common Sandpiper	Coastal wetlands and some inland wetland. Utilises muddy margins. Often associated with mangroves.	Possible	Unlikely	Possible	Possible	Possible
Anous stolidus subsp. pileatus	Common Noddy	Can nest in bushes, saltbush and other low vegetation, on grass or bare rock	Unlikely	Possible	Possible	Possible	Possible
Ardea ibis	Cattle Egret	Moist, low lying poorly drained pastures. Avoids low grass pastures. Roosts in trees or in ground vegetation near lakes.	Unlikely	Possible	Possible	Possible	Possible
Ardea modesta	Eastern Great Egret	Wide range of wetland habitats	Known	Known	Possible	Possible	Known
Calidris acuminata	Sharp-tailed Sandpiper	Prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergency sedges or other low vegetation.	Unlikely	Possible	Possible	Possible	Known
Calidris ruficollis	Red-necked Stint	Coastal Area, including sheltered inlets, bays and estuaries with intertidal mudflats.	Unlikely	Possible	Possible	Possible	Known
Calidris subminuta	Long-toed Stint	Variety of terrestrial wetlands. Preference is for shallow freshwater or brackish wetlands. Also prefers muddy shorelines.	known	known	Possible	Possible	Possible
Charadrius leschenaultii	Greater Sand Plover	Littoral and estuarine habitats, sheltered sandy, shelly or muddy beaches with intertidal mudflats and sandy estuarine lagoons.	Unlikely	Possible	Possible	Possible	Possible
Macronectes giganteus	Southern Giant Petrel	Marine bird occurs in subtropical waters	Unlikely	Unlikely	Unlikely	Unlikely	Unlikely

Species	Common Name	Habitat	Eastern Link	Causeway Bridge	West-Strelly St	Fairway Dve	Ford rd- Molloy St
Merops ornatus	Rainbow Bee-eater	Open forest, woodland and shrublands, and in various cleared or semi cleared areas	known	known	Possible	Possible	Known
Plegadis falcinellus	Glossy Ibis	Freshwater marshes at the edges of wetland areas. occasionally found in coastal locations such as estuaries	Known	Possible	Possible	Possible	Known
Pluvialis fulva	Pacific Golden Plover	Inhabits coastal habitats and forages on sandy or muddy shores of estuaries and lagoons,.	Possible	Possible	Possible	Possible	Possible
Sterna anaethetus subsp. anaethetus	Bridled Tern	Breeds on islands included vegetated coral cays, and rocks, rarely found inshore. Forager over offshore mid and continental shelf waters.	Possible	Possible	Possible	Possible	Possible
Tringa glareola	Wood Sandpiper	Well vegetated, shallow freshwater wetlands. Typically associated with emergent aquatic plants or grass, dominated by taller fringing vegetation.	Unlikely	Possible	Possible	Possible	Possible
Tringa nebularia	Common Greenshank	Sheltered coastal habitats, typically with large mudflats, and saltmarshes. Forages at the edges of wetlands in soft mud and in shallows around the edges of water along emergent or fringing vegetation	Known	Known	Possible	Possible	Possible
Tringa stagnatilis	Marsh Sandpiper	Permanent or ephemeral wetlands of varying salinity. Forages in shallow water at the edges and probe wet mud or feed among marshy vegetation.	Unlikely	Possible	Possible	Possible	Possible

4.6 Fauna Results and Discussion

4.6.1 Item A – Eastern Link & Item B – Causeway Bridge Duplication

The results of the day and night fauna survey at the Eastern Link and Causeway Bridge survey areas is presented in Map 9.

During the day survey, 6 areas of WRP scats were found, with one drey being observed. The trees in this area are old and have potential gaps or hollows in their lees which would provide WRP habitat.

During the nocturnal surveys , 4 WRP were found in Night 1 and 3 were found in Night 2. Their location is shown in Map 9.

All of these were found in the more dense vegetation around the Eastern Link area, although some scats near the Causeway Bridge site would indicate that the entire area is utilised by population of WRP.

Within both Item A – Eastern Link and Item B – Causeway bridge survey areas, trees known to provide food and roosting sites for black cockatoo species (for example Marri and Flooded Gums) were present, however there were no signs of foraging or feeding within the areas. There were no trees suitable for Black Cockatoo nesting habitat (i.e. there were no hollows) within either of the two sites, nor were any Black Cockatoos seen or heard during either of the dawn or dusk surveys.

Apart from the WRP observations, the field surveys at the Eastern Link and Causeway Bridge survey areas did not record any threatened, priority or migratory terrestrial vertebrate fauna species listed under Commonwealth or State legislation. No listed migratory birds were observed on either the Vasse River or the Vasse River Delta Wetlands within or adjacent to the two survey areas. Note however that the listed migratory bird species would not be expected to be present during August. Surveys between December to March would be more likely to confirm presence.

Historical data from DBCA show some migratory bird observations in this vicinity (e.g. *Ardea modesta*) however the better suited habitat areas are within the Vasse River Delta Wetlands and the Vasse Estuary further to the east, where summer water is present. Historical satellite imagery shows that the wetland area within this site, has the potential to dry out during summer/early autumn, which are key seasons for waterbird activity. This is likely to reduce these wetland areas suitability for habitat for waterbirds.

4.6.2 Items C & D: Strelly-Barlee-West Street Route & Duplication

The results of the day and night fauna surveys at the West-Strelly St survey areas are presented in Map 10.

Only a single drey was observed during the day survey in this site, which was found in a E. rudis in a street tree in Roe St, outside the Community Garden.

3 WRP were observed in Night 1, all in the vegetation off Fredrick St, Two animals were found in Night 2, one near the corner of West and Fredrick St, and one in a clump of Melaleuca behind the industrial area in the Roe St extension area. These data are shown in Map 10.

Trees known to provide food and roosting sites for black cockatoo species (for example Marri and Flooded Gums) were present, however there were no signs of foraging or feeding within the areas. There were no trees suitable for Black Cockatoo nesting habitat (i.e. there were no hollows) within the study area. Black cockatoos were heard at dusk passing over the site on both nights but none were found to roost or shelter within the site.

Apart from the WRP observations and Black Cockatoo calls, the field surveys at the West-Strelly St survey area did not record any threatened, priority or migratory terrestrial vertebrate fauna species listed under Commonwealth or State legislation. No listed migratory birds were observed on the New River within or adjacent to the survey area. Note however that the listed migratory bird species would not be expected to be present during August. Surveys between December to March would be more likely to confirm presence.

4.6.3 Item E – Fairway Drive Duplication

The results of the day and night fauna survey at the Fairway Drive survey area are presented in Map 10.

Within this survey area, 7 trees were found with a potential to have hollows suitable for Black Cockatoos and comply with the Guidelines for Black Cockatoos (Department of Sustainability, Environment, Water, Populations and Communities, 2011). These are shown in Map 11 and summarised in Table 15.

Table 15 Possible Black Cockatoo Habitat Tree Fairway Dve site

No	Easting	Northing	Species	DBH (mm)	Height	Heath	Notes
1	343880	6273404	Marri	690	11	Healthy	No obvious hollows
2	343883	6273375	Marri	760	11	Dead	Chimney Hollow
3	343907	6273406	Marri	760	17	Healthy	No obvious hollows
4	343907	6273438	Marri	1060	16	Healthy	No obvious hollows
5	343904	6273455	Marri	780	12	Healthy	No obvious hollows
6	343908	6273506	Marri	860	12	Healthy	Possible Hollows
7	343928	6273580	Marri	580	14	Healthy	Possible Hollows

Dawn and dusk survey revealed no Black cockatoos were utilising these trees during the survey period.

During the day survey, 7 dreys were observed and a single WRP was found. During Night 1, 7 WRP were seen throughout the site, and 6 were seen during Night 2.This is shown in Map 11.

This indicates there is a healthy population of Western Ringtail possums utilising the entire length of the site.

Apart from the WRP observations, the field surveys at the Fairway Dr survey area did not record any threatened, priority or migratory terrestrial vertebrate fauna species listed under Commonwealth or State legislation. No listed migratory birds were observed on the New River within or adjacent to the survey area.

4.6.4 Item F – Ford Rd Options 1 & 2: Molloy St Option

The field surveys at the Ford Rd-Molloy St survey area did not record any threatened, priority or migratory terrestrial vertebrate fauna species listed under Commonwealth or State legislation. No listed migratory birds were observed on the Vasse Estuary or Vasse River Delta Wetlands within or adjacent to the survey area. Accordingly there is no mapping presented of fauna records for the survey area.

Significant water bird species have been recorded at this survey area as evidenced by the DBCA database records, however during this survey, only common species (Pacific Black Duck (*Anas superciliosa*), Black Swans (*Cygus atratus*), Buff Banded Rail(*Gallirallus philippensis*), Purple Swamp Hen (*Porphyrio porphyrio*) and Australian Shelduck (*Tadorna tadornoides*)) were observed. Note however that the listed migratory bird species would not be expected to be present during August. Surveys between December to March would be more likely to confirm presence.

Black Cockatoos were heard to the south of the study area at dusk of both nights. These calls were from vegetation more than 500 m away (adjoining the Busselton Hockey Stadium) and not connected to the study area.

5 Significance

Under the EPBC Act, an action that has, will have, or is likely to have, a significant impact on a matter of national environmental significance, requires approval from the Minister. A significant impact is defined as an impact which is important or of consequence, having regard for its context or intensity (Commonwealth of Australia, 2009).

Matters of environmental significance are:

- Listed threatened species and ecological communities
- Migratory species protected under international agreements
- Ramsar wetlands of international importance
- The Commonwealth marine environment

- World Heritage properties
- National Heritage places
- Great Barrier Reef Marine Park, and
- Nuclear actions.

Three areas are potentially impacted within the five survey areas:

- Listed threatened species and ecological communities;
- Migratory Species protected under international agreements; and
- Ramsar Wetlands of International Importance.

Significant Impact Guidelines 1.1 (Commonwealth of Australia, 2013) lists significant impact criteria for the assessment for activities which may impact on threatened and migratory species and Ramsar Wetlands.

Table 16 describes these criteria as it relates to the five survey areas and the significant species that may potentially be impacted within their respective survey area.

Table 17 describes these criteria as it relates to the five survey areas and the ecological communities that may potentially be impacted within their respective survey area

Table 18 describes the criteria to define significant impact on listed migratory species as they related to the five survey areas and the species potentially impacted.

Table 19 describes the criteria to define significant impact on wetland of international importance as they relate to the survey areas.

Note that the specific details of what is proposed at each site is not known, and as such the full potential impact of the development cannot be determined. A 40 m clearing for the width of each road expansion is used to base the significant criteria upon.

Table 16: Significant Impact Criteria for Key Listed Species.

Significant Impact Criterion	Black Cockatoo Species	Western Ringtail Possum	*Caladenia procera*	Meets Criterion
Lead to a long term decrease in the size of an important population[2] of a species.	There was no evidence that any of the trees within the study areas are used as breeding or foraging habitat. Trees may be used opportunistically but higher quality nesting sites would be available within their large range, away from urban development.	WRP populations were found in all four of the five survey areas. DBCA records show a WRP in Molloy St within the Ford Road survey area. This was not found during this survey. Given the definition of "important population" the Fairway Drive site is likely to be considered an important populations and management will be required to ensure no decline in population occurs. All of the survey areas have suitable habitat adjoin the road areas and relocation of any animals into this habitat should not lead to a long term decline with appropriate management of the species during any vegetation modification. The population that exists in the Eastern Link and Causeway Bridge has connectivity along the Vasse River would not be considered important, given the quality of the habitat. However, any modification to these survey areas will need to consider maintaining this connectivity, via alternative techniques, if these were the chosen locations.	This species exists in the Fairway Drive survey area. The species is Critically Endangered. The exact location of the individuals within this survey area need to be determined in a spring flora survey, however it likely the widening of the road would lead to a decrease in the size of the population.	The Fairway Drive survey area contains a population of WRP that may be considered important. There are also populations of *Caladenia procera* within the survey area. The use of this survey area could be considered likely to lead to a decrease in these species and as such a referral should be made, if this site is the preferred option. The other sites have WRP present, however will appropriate management the proposal is unlikely to lead to a decrease in the population size.
Reduce the area of occupancy of an important population.	Will not impact on the area of occupancy of the current population.	Given width of each road expansion (40m), clearing in each survey area is unlikely to reduce the area of occupancy of an important population. However management will be required.	The exact location of the individuals of this population within the Fairway Drive survey area need to be determined to know if the occupancy of this population will be impacted by the development	More detail is needed for the location of Caladenia procera individuals for the Fairway Drive location, however for all the other survey areas, the area of occupancy of an important population is not likely.
Fragment an existing important population into two or more populations.	The species does not appear to utilise any of the sites. There were no evidence of feeding, roosting or nesting therefore the local population will not be fragmented.	The linear nature of most of the sites and the proximity of adjacent suitable habitat would mean that fragmentation will not occur. For the Causeway and Eastern Link populations, the vegetation/habitat along the Vasse River is the best within the population range and it is likely that they will use that vegetation to move through the landscape. The development of these two sites may fragment this population and alternative methods of maintaining connectivity will need to be employed (for example, rope bridges, fauna underpasses).	Unlikely to fragment the existing population.	The Causeway and Eastern Link

[2] *An 'important population' is a population that is necessary for a species' long-term survival and recovery.*

Significant Impact Criterion	Black Cockatoo Species	Western Ringtail Possum	*Caladenia procera*	Meets Criterion
Adversely affect habitat critical to the survival of a species.	None of the trees or vegetation appear to be presently being utilised by Black Cockatoos. Will not affect critical habitat.	While any of the proposals will impact upon habitat, it is unlikely that it will impact to the degree that will affect the survival of the species.	The exact location of the individuals within the Fairway Drive area need to be determined to quantify the potential impact on the species	
Disrupt the breeding cycle of an important population.	No breeding sites identified on site.	Unlikely to impact on the breeding cycle given small area within sites.	Will not disrupt the breeding cycle.	No
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	It is unlikely that the species is present on the site No impact is anticipated.	No impact is anticipated provided management of animals is conducted during any clearing.	The exact location of the individuals within the Fairway Drive area need to be determined to quantify the potential impact on the species.	Depending upon the results of a spring survey along Fairway Drive, there is a potential that this proposal may impact on Caladenia procera to the extent that the species may decline. For the other survey areas, the proposals would not impact the species to the point that the species would decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.	Any introductions highly unlikely to have any impact on species.	Any introductions highly unlikely to have any impact on species.	Any introductions highly unlikely to have any impact on species.	No
Introduce disease that may cause the species to decline.	Highly unlikely to occur.	Highly unlikely to occur.	Highly unlikely to occur.	No
Interfere substantially with the recovery of the species.	Development will not impact on the recovery of the species.	Development will not impact on the recovery of the species.	The exact location of the individuals within the Fairway Drive area need to be determined to quantify the potential impact on the species.	Apart from Fairway Drive area, the development is unlikely to substantially interfere with the recovery of any species. The exact location of individuals with the Fairway drive survey area need to be determined and correlated to the specific extent of disturbance proposed to determine if there will be a substantial impact.

Using these criteria, any proposed development in the Fairway Drive, Causeway Bridge and Eastern Link survey areas would require a referral under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as the potential actions may be determined significant upon two endangered species, Western Ringtail Possums and *Caladenia procera*.

Table 17: Significant Impact Criteria for Commonwealth listed Ecological Communities.

Significant Impact Criterion	Banksia Woodlands of the SCP	Subtropical & Temperate Coastal Saltmarsh	Meets Criterion
Reduce the extent of an ecological community.	No evidence that the community exists in any of the five study areas.	Three of the five study areas are likely to contain this TEC: Eastern Link, Strelly-West St and Ford Rd/Molloy St. Any development in these areas will likely reduce the current extent of those communities.	The following study areas meet this criterion for Subtropical and Temperate Coastal Saltmarsh Communities; • Item A – Eastern Link; • Items C & D – Strelly-West St; and • Item F – Ford Rd/Molloy St options
Fragment or increase fragmentation of an ecological community	No evidence that the community exists in any of the five study areas.	The Eastern Link and Strelly- West St study areas will impact on the edges of the community and are unlikely to fragment them in these locations. The Ford Rd/Molloy St study area proposal is likely to fragment this community.	Item F – Ford Rd/Molloy St meet this criterion for Subtropical and Temperate Coastal Saltmarsh Communities.
Adversely affect habitat critical to the survival of an ecological community.	No evidence that the community exists in any of the five study areas.	Little is known of the biology and ecology of this community. If the proposed development occurs within the thee study areas that contain this community, it is difficult to determine if the small areas of impact will critically affect the survival of this community.	Uncertain, however using the Precautionary Principle, it would be prudent to assume this criterion is met in the three known study areas.
Modify or destroy abiotic factors (such as water, nutrients or soil) necessary for an ecological communities survival, including reduction of groundwater levels or substantial alteration of surface water drainage patterns.	No evidence that the community exists in any of the five study areas.	Little is known on the full suite of requirements necessary for this community's survival. There is a potential for works in the three likely location may impact on groundwater/surface water or other abiotic factors.	Likely to impact but the degree to which this element meets this criteria is unclear. Using the Precautionary Principle, it would be prudent to assume this criterion is met in the three known study areas.
Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species.	No evidence that the community exists in any of the five study areas.	Within those study areas where the community exists, the proposal will require the reduction of extent of the community not necessarily a change in the composition of the community.	Unlikely to meet this criterion.
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including: • Assisting invasive species to become established; or • Causing regular mobilisation of fertilisers, herbicide or other chemicals or pollutants into the community.	No evidence that the community exists in any of the five study areas.	Proposal will require the reduction of extent of the community. The addition of roads thought these areas may increase the potential for invasion by grass weed or other introduced plant species. Consequently, herbicide use that would result may potential impact on the community.	Uncertain, however using the Precautionary Principle, it would be prudent to assume this criterion is met in the three known study areas.
Interfere with the recovery of an ecological community.	No evidence that the community exists in any of the five study areas.	Little detail is known on the ecology/biology and interactions within this community. Only a small area (up to 40 m wide) is proposed and the degree to which this would impact on the recovery of the community is unclear	Uncertain, however using the Precautionary Principle, it would be prudent to assume this criterion is met in the three known study areas.

Using these criteria, any proposed development in the Fairway Drive, Causeway Bridge and Eastern Link survey areas would require a referral under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) as the potential actions may be determined significant upon the TEC : Subtropical & Temperate Coastal Saltmarsh

Table 18: Significant Impact Criteria for Migratory or other Protected Species.

Significant Impact Criterion	Discussion	Meets Criterion
Substantially modify (including fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species.	The New River, the Vasse River Delta wetlands and the Vasse Estuary are known areas for migratory waterbird. None of these were observed during the surveys conducted for this project, however it should be assumed that a number of the species still utilises these wetland systems. Items A and B are within the highly modified and degraded riverine habitat areas, it is unlikely that any activities in these two survey areas would significantly impact upon any migratory species. Items E would cross the New River system and there is a potentially for activities to impact on these species, although none were observed during this survey. Item F is directly adjoining the Vasse Wonnerup Estuary and wetland system which is known to provide habitat for these species. The proposed activities int Items E and F, while able to be managed to minimise or mitigate impacts have the potential to modify habitat for these species.	Yes for the following study areas: • Item E – Fairway Drive; and • Item F -Ford Rd/Molloy St sites
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	Non-native plants and issues such as Phytophthora dieback have the potential to be spread during construction activities, however many of the areas are already degraded through grass and other introduced weeds, which do not seem to have a significant impact on the known species Management and Hygiene procedures can be implemented to minimise any impacts.	Unlikely
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	Many of the species do not utilise the study areas consistently throughout the year. Works could be planned and times to minimise impact on targeted species to the point where it could not seriously disrupt the lifecycle for a significant proportion of the population of a migratory species	Unlikely, however would depend upon timing and targeted location.

Using these criteria, any proposed development in the Fairway Drive and Ford Road/Molloy St survey areas would require a referral under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) as the potential actions may be determined significant upon the known populations of Migratory or other protected species present in those study areas.

Table 19: Significant Impact Criteria for Wetlands of International Importance.

Significant Impact Criterion	Discussion	Meets Criterion
Areas of the wetland being destroyed or substantially modified.	The Ford Rd/Molly St study area on on the western most edge of the Vasse Wonnerup Estuary system. While the area is degraded with introduced plant species The construction of a road way has the potential to modify the western edge of the wetland	The study area is on the western boundary of the Ramsar site. The establishment of a road will likely have the potential to modify or impact on the wetland, albeit with management and mitigation measures in place. It would be prudent to assume that this criterion will be met.
A substantial and measurable change in the hydrological regime of the wetland.	The construction of any road through the Ford Rd would cause temporary changes in the hydrological regime, however it would not be considered to be substantial or significantly measurable over time	No
The habitat or lifecycle of native species, including vertebrate fauna and fish species, dependent upon the wetland being seriously affected.	The Ecological Character Description for the Vasse- Wonnerup Wetland (Wetland Research & Management, 2007) describes the native species within the wetland. The area is known as an important site for migratory species as well and breeding ground for local bird species. The degree of potential impact on these from any construction in this study area is beyond the scope of this initial report however there is the potential to impact both avifauna and other wetland fauna species, albeit this could be minimised with appropriate management and timing.	Likely to impact but the degree to which this would seriously affect species is unclear. Using the Precautionary Principle, it would be prudent to assume this criterion is met in the Ford Rd/Molly St study area..
A substantial and measurable change in the water quality of the wetland (e.g. salinity , pollutant, nutrients, water temperature) which may adversely impact on biodiversity, ecological integrity, social amenity or human health.	The degree to which any works in the Ford Rd/Molly St study area will impact on the water quality is beyond the scope of this level 1 flora, fauna and vegetation report. Further information and input will be required.	More data is required on water quality and flow on effects before determination on this criterion can be made.
An invasive species that is harmful to the ecological character of the wetland being established (or an existing species being spread).	Non-native plants and issues such as Phytophthora dieback have the potential to be spread during construction activities, however many of the areas are already degraded through grass and other introduced weeds, which do not seem to have a significant impact on the known species Management and Hygiene procedures can be implemented to minimise any impacts.	Unlikely

Using these criteria, any proposed development in the Ford Road/Molloy St survey areas would require a referral under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) as the potential actions may be determined significant upon the Internationally Important Wetland in the Vasse Wonnerup Wetland System, which abuts the Ford Rd study area. Note further speciality information on water quality and hydrological impacts from any development in this study area will be required as part of the referral to ensure all criterion are addressed.

Referral guidelines for three threatened Black Cockatoo species (Dept. of Sustainability, Environment, Water Populations and Communities, 2011) uses a decision tree and a set of criteria to determine whether actions significantly impact on Black Cockatoos. These are set out below based on the details of the development and the data obtained from the surveys. Notes on the flow chart follow.

Question	Answer	High Risk of Significance – Referral Recommended
1. Could the impacts of your action occur within the modelled distribution of the Black Cockatoos?	Yes – Action occurs within the distribution area of all three species.	• Clearing of any known nesting tree • Clearing of any part or degradation of breeding habitat • Clearing more than 1ha of quality foraging habitat • Creating a gap of greater than 4 km between patches of habitat • Clearing or degradation of known roosting site.
2. Could the impacts of your action affect any Black Cockatoo habitat or individuals?	Unlikely. No signs of animal utilisation in the survey areas, or activity in or around the site were found. Trees that met criteria were observed and no activity found.	**Uncertainty – Referral Recommended or contact Department**
3. Have you surveyed for Black Cockatoos using the recommended methods?	Yes	• Degradation of more than 1 ha of foraging habitat. • Clearing or disturbance in areas surrounding habitat that has the potential to degrade through introduction of threats. • Actions that do not directly affect species but have potential to introduce indirect impacts. • Actions with potential to introduce known plant diseases.
4. Could your actions have an impact on Black Cockatoos or their habitats?	No. No signs of animal activity was found within the five survey areas.	**Low risk of significant impacts – referral may not be required.**
5. Is your impact mitigation best practice so that it may reduce the significance of your impacts on Black Cockatoos?	No significant impact is anticipated due to lack of evidence of activity on any of the five survey areas.	• Actions that do not affect Black Cockatoo habitat or individuals • Actions whose impact occurs outside modelled distribution.
6. Could your action require a referral to the federal environmental Minister for significant impact on Black Cockatoos?	No. As there are no signs of any of the three species present within or adjoining the five survey areas, It is unlikely that the species is dependent on any of the five survey areas.	

The summary of these responses are:

1- The development is within the area of modelled distribution of Black Cockatoo species.
2- The type of proposed actions within the Busselton Strategic Network Corridor study area could impact Black Cockatoo individuals or habitat. However, all five survey sites contain less than 1 ha of low quality foraging habitat and no known or observable nesting trees. The narrow width of any proposed development of roads/bridges are unlikely to significantly degrade surrounding habitat values. The animals may utilise survey areas opportunistically rather than habitually.
3- The proposed areas have been surveyed using the recommended methods from the guideline.
4- It is unlikely that any actions for the proposed road or bridge upgrades will impact on any animals or habitat as no evidence of use or visitation by the species were found on any of the five survey sites. Trees with hollows that met the criteria were noted and were observed with no activity. There was no sign of feeding or roosting within any of the site.
5- No evidence within any of the five survey areas of utilisation and the unlikely presence of any of the three species of Black Cockatoos, except opportunistically as part of their range, would mean that no mitigation measures are required.
6- Using the flow chart and criteria it is determined that there is a low risk of actions resulting in an impact upon Black Cockatoos within the five survey areas.

8- Summary and Recommendations

This project is designed to provide a broad overview of the significance values of a number of sites. These are summarised in Table 13

Table 20 Summary of Significance Values

Site	Flora/Vegetation	Fauna
Item A- Eastern Link	Potential to contain Coastal Saltmarsh EPBC listed TEC (WA Listed PEC)	Contains populations of WRP Does not comprise significant Black Cockatoo habit. Potential to impact migratory species habitat.
Item B – Causeway Bridge Duplication	No significant values observed	Area is utilised by WRP, however none observed during survey. Does not comprise significant Black Cockatoo habitat. Potential to impact migratory species habitat
Items C & D – Strelly/West	Potential to contain Coastal Saltmarsh EPBC listed TEC(WA Listed PEC)	Contains populations of WRP Does not comprise significant Black Cockatoo habit. Unlikely to compromise significant migratory species habitat
Item E – Fairway Drive	Contains E. rudis TEC and DRF Caladenia procera (though not found during survey)	Contains significant populations of WRP Does not comprise significant Black Cockatoo habit. Potential to impact migratory species habitat
Item F - Ford Rd Options	Likely to contain Coastal Saltmarsh EPBC listed TEC(WA Listed PEC)	Potential to impact significant migratory species habitat .

Based on the results of the analysis of the five survey areas, the following conclusions and recommendations are made.

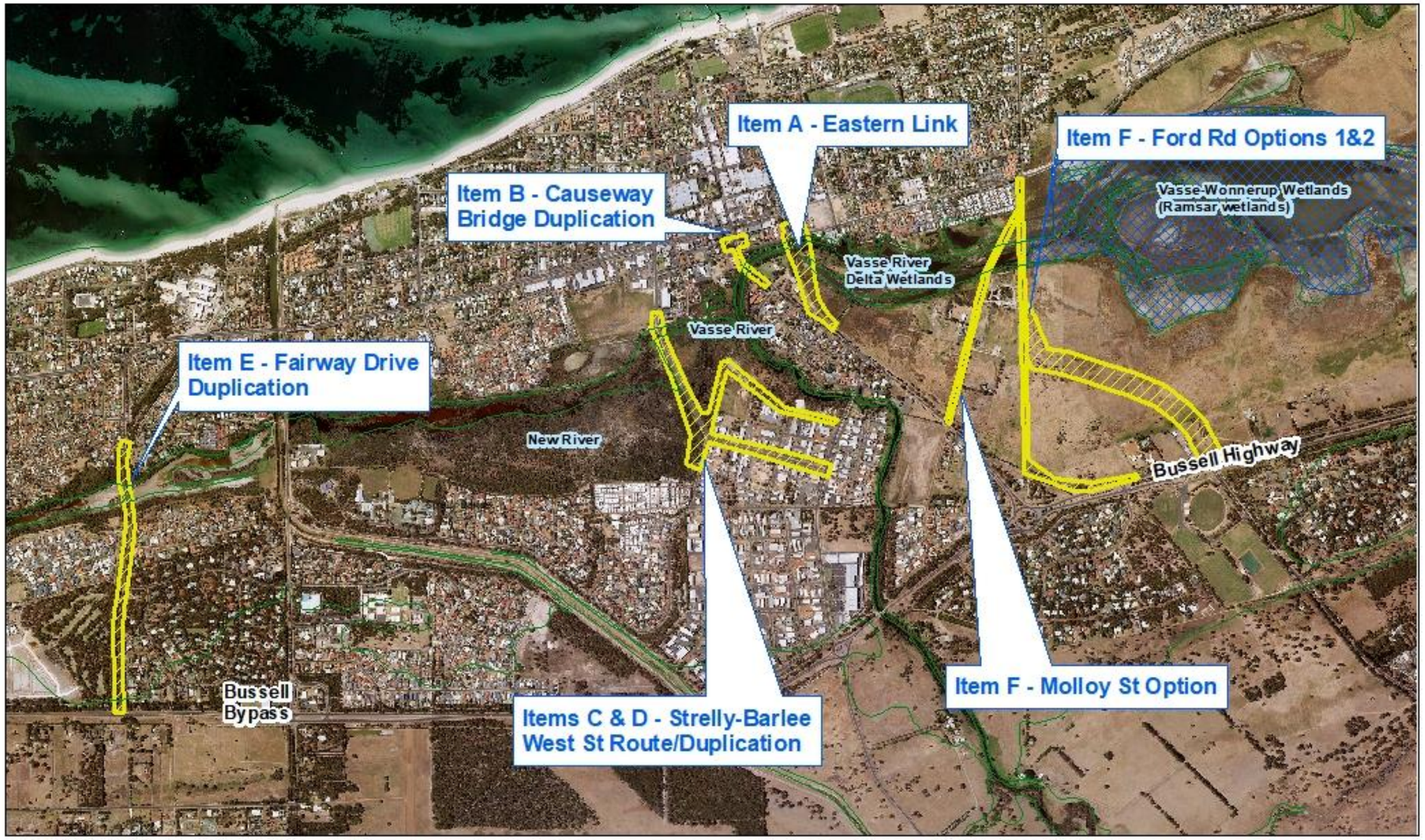
- The vegetation and habitat of the five survey areas vary in condition, however many do contain significant values.
- No threatened or priority flora species listed under Commonwealth or State legislation were observed in any of the five survey areas, however *Caladenia procera* is known from Item E Fairway Drive survey area although it was not in its flowering period and observable during this survey. DBCA records show *Calystegia sepium*, a priority species in the north. This is outside of the footprint of this study area, however the area was searched and this species was not found during the survey.
- All five survey areas contain vegetation classified as Quindalup or Ludlow vegetation, Fairway Drive has Ludlow vegetation which is highly cleared.
- Four of the six areas have populations of WRP, with one other having signs that the species utilises this site. The vegetation within Item A – Eastern Link and Item B – Causeway Bridge Duplication supports connectivity for a population and Item E – Fairway Drive contains a significant population of WRP. Any impacts on these areas should be referred to the Commonwealth under the EPCA Act.
- No Black Cockatoo species were observed in any of the five study areas.
- There are no signs of feeding, nesting or roosting by Black Cockatoos species within any of the five study areas..
- Black cockatoo species are highly mobile and it is highly unlikely they would utilise any of the five survey areas as a feeding, roosting or nesting site.

Given the above information, a referral to under the EPBC Act should occur for any disturbance to the following sites:

- Item A: Eastern Link – Coastal Saltmarsh EPBC listed TEC(WA Listed PEC), Potential impact on migratory species habitat.
- Item B: Causeway Bridge Duplication - Potential impact on migratory species habitat.
- Items C & D West-Strelly St - Coastal Saltmarsh EPBC listed TEC(WA Listed PEC) and WRP impacts
- Item E -Fairway Drive – E rudis WA listed PEC, DRF Caladenia procera and significant population of WRP, Potential impact on migratory species habitat
- Item F - Ford Rd/Molloy Rd sites -Coastal Saltmarsh EPBC listed TEC(WA Listed PEC), Potential impact on migratory species habitat, potential impact on Vasse Wonnerup Ramsar listed wetland system

.

6 Maps



Map 1: Project Sites Project Address: City of Busselton

Projection - MGA50
Datum - GDA94
June 2017
Prepared by G McMahon
Our Ref: 17365

N

Scale: 1:23,000

Meters
0 110 220 440 660 880

Legend

- Study Areas
- Vasse-Wonnerup Ramsar Site

ecosystem solutions
www.ecosystemsolutions.com.au
(08) 9759 1960

Map 2: Item A: Eastern Link Vegetation Groups **Project Address: City of Busselton**

Projection - MGA50
Datum - GDA94
June 2017
Prepared by G McMahon
Our Ref: 17365

N

Scale: 1:3,500

0 15 30 60 90 120 Meters

Eastern Link Boundary
Elevation (m)

Vegetation Groups
Vegetation 1
Vegetation 2
Vegetation 3
Vegetation 4

Flora Database
Threatened
Priority 1
Priority 2
Priority 3
Priority 4

TEC/PEC Results
Erudis, Marri & Peppermint Forest (P1)
Subtropical and Temperate Coastal Saltmarsh

ecosystem solutions
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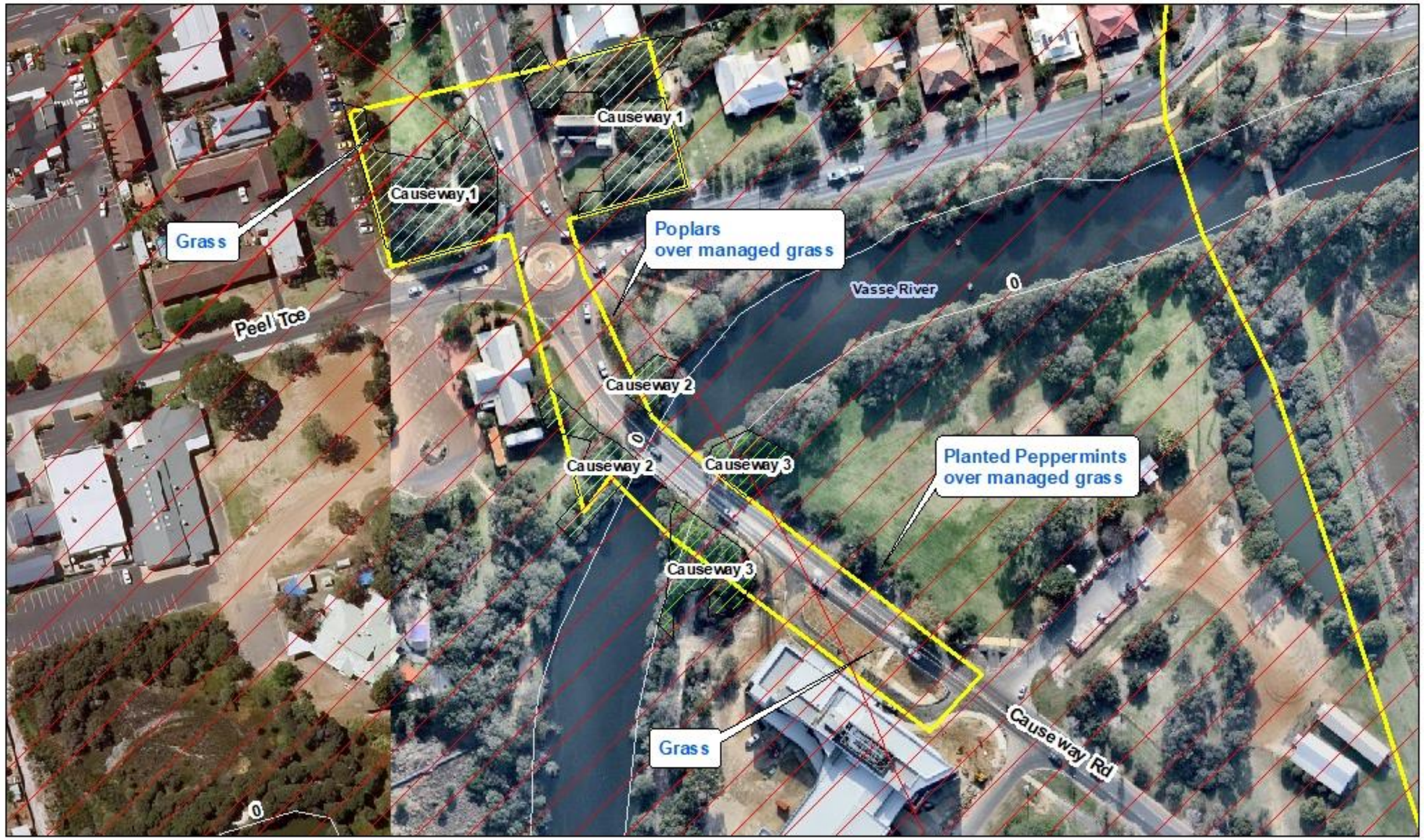

Map 3:Item B: Causeway Duplication Vegetation Groups **Project Address: City of Busselton**

Projection - MGA50
Datum - GDA94
June 2017
Prepared by G McMahon
Our Ref: 17365

N

Scale: 1:3,500

0 5 10 20 30 40 Meters

Study Area
Elevation (m)
Vegetation
Causeway 1
Causeway 2
Causeway 3

Flora Database
Threatened
Priority 1
Priority 2
Priority 3
Priority 4

TEC/PEC Results
E rudis, Marri, Peppermint P1
Subtropical and Temperate Coastal Saltmarsh

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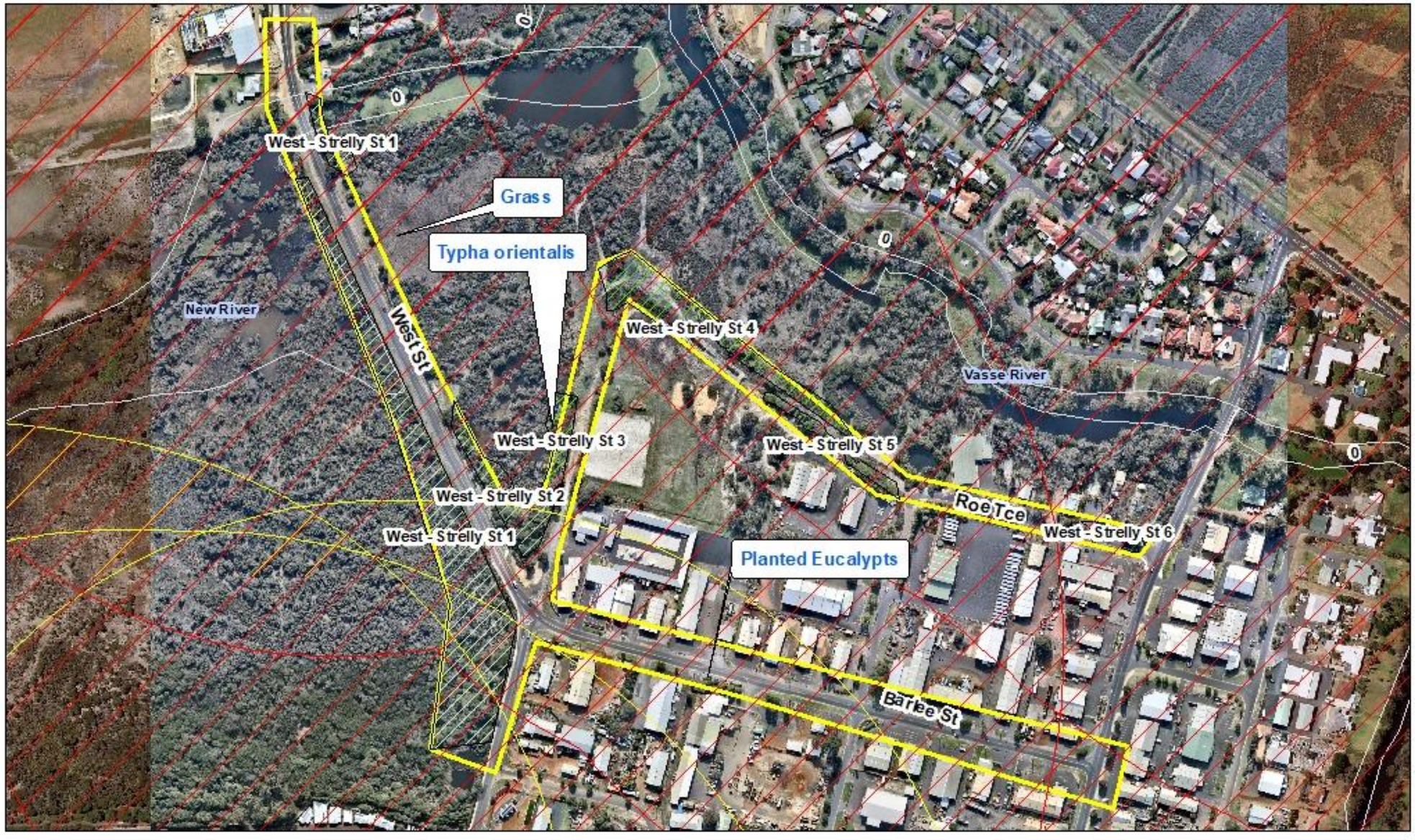

Map 4: Items C & D West-Strelly St Vegetation Groups **Project Address: City of Busselton**

Projection - MGA50
Datum - GDA94
June 2017
Prepared by G McMahon
Our Ref: 17365

N

Scale: 1:4,500

0 20 40 80 120 160 Meters

Vegetation Groups

Fredrick St West St Boundary
Elevation (m)
West - Strelly St 1
West - Strelly St 2
West - Strelly St 3
West - Strelly St 4
West - Strelly St 5
West - Strelly St 6

Flora Database TEC/PEC Results

Threatened
Priority 1
Priority 2
Priority 3
Priority 4
Eruda, Warri, Peppermint Pl
Subtropical and Temperate Coastal Saltmarsh

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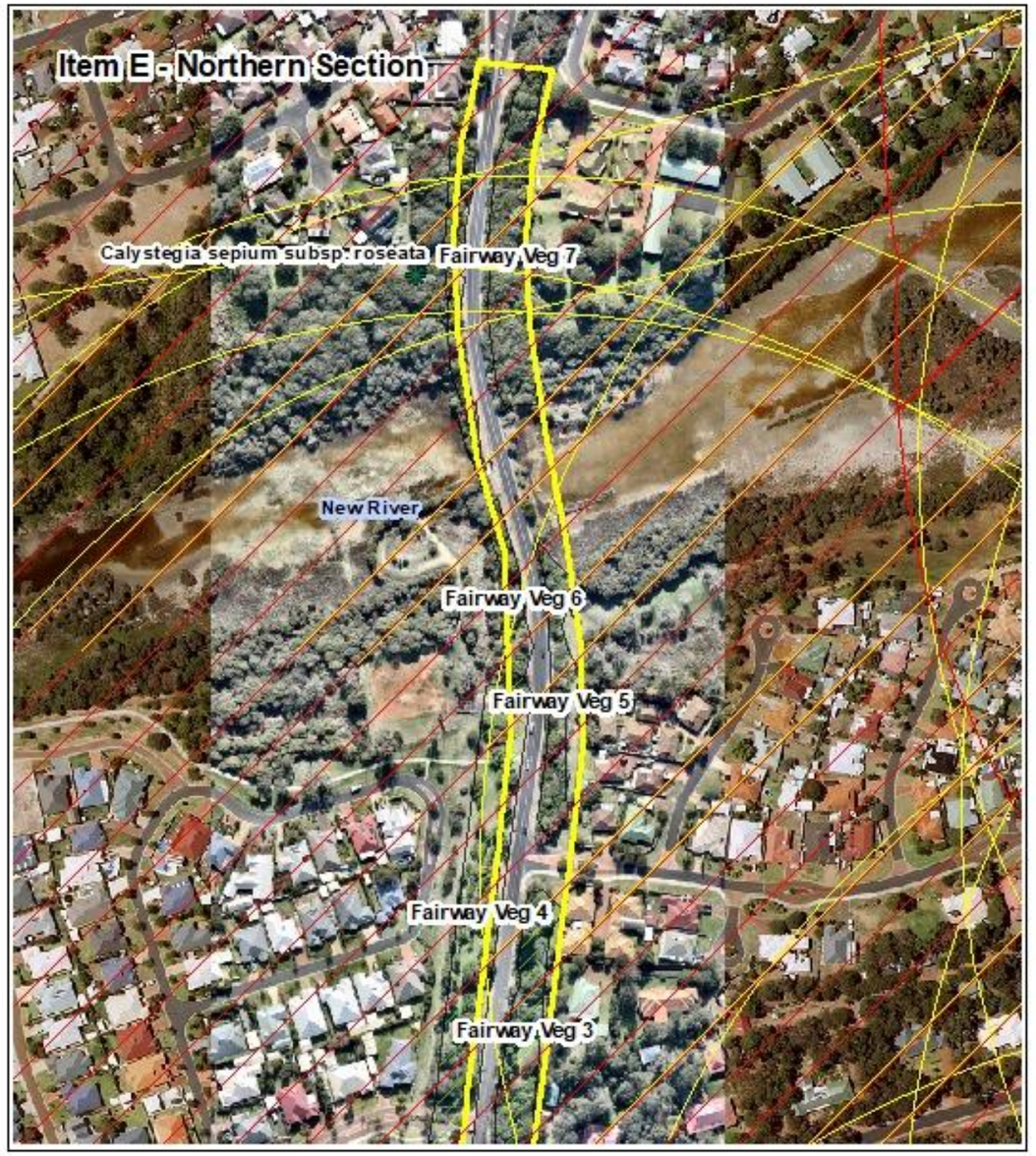

Map 5: Item E Fairway Drive Vegetation Groups **Project Address: City of Busselton**

Projection - MGA50
Datum - GDA94
June 2017
Prepared by G McMahon
Our Ref: 17365

N

Scale: 1:4,000

0 20 40 80 120 160 Meters

Survey Area
Elevation (m)
Fairway Veg 1
Fairway Veg 2
Fairway Veg 3
Fairway Veg 4
Fairway Veg 5
Fairway Veg 6
Fairway Veg 7

Flora Database TEC/PEC Results
Threatened
Priority 1
Priority 2
Priority 3
Priority 4
E rudis, Marri, Peppermint P1
Subtropical and Temperate Coastal Saltmarsh

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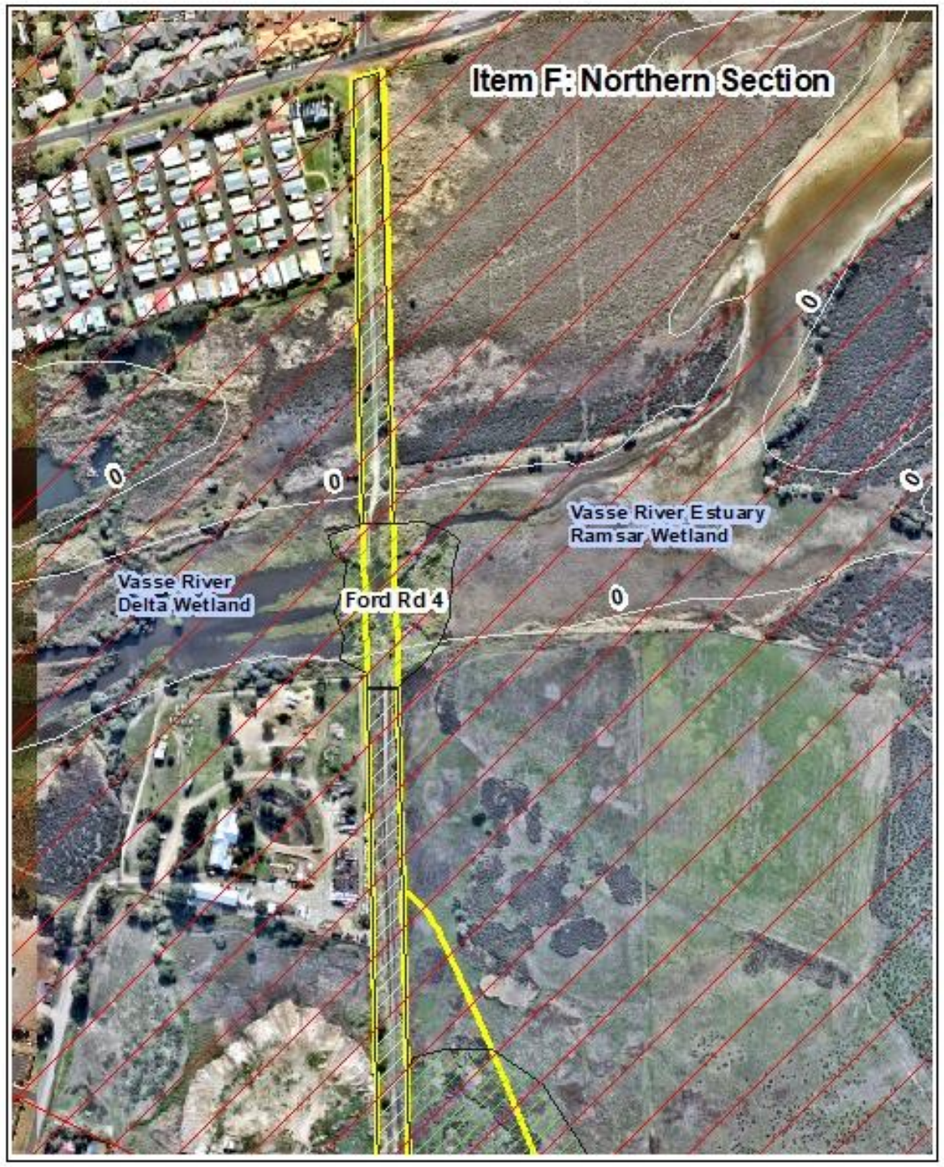

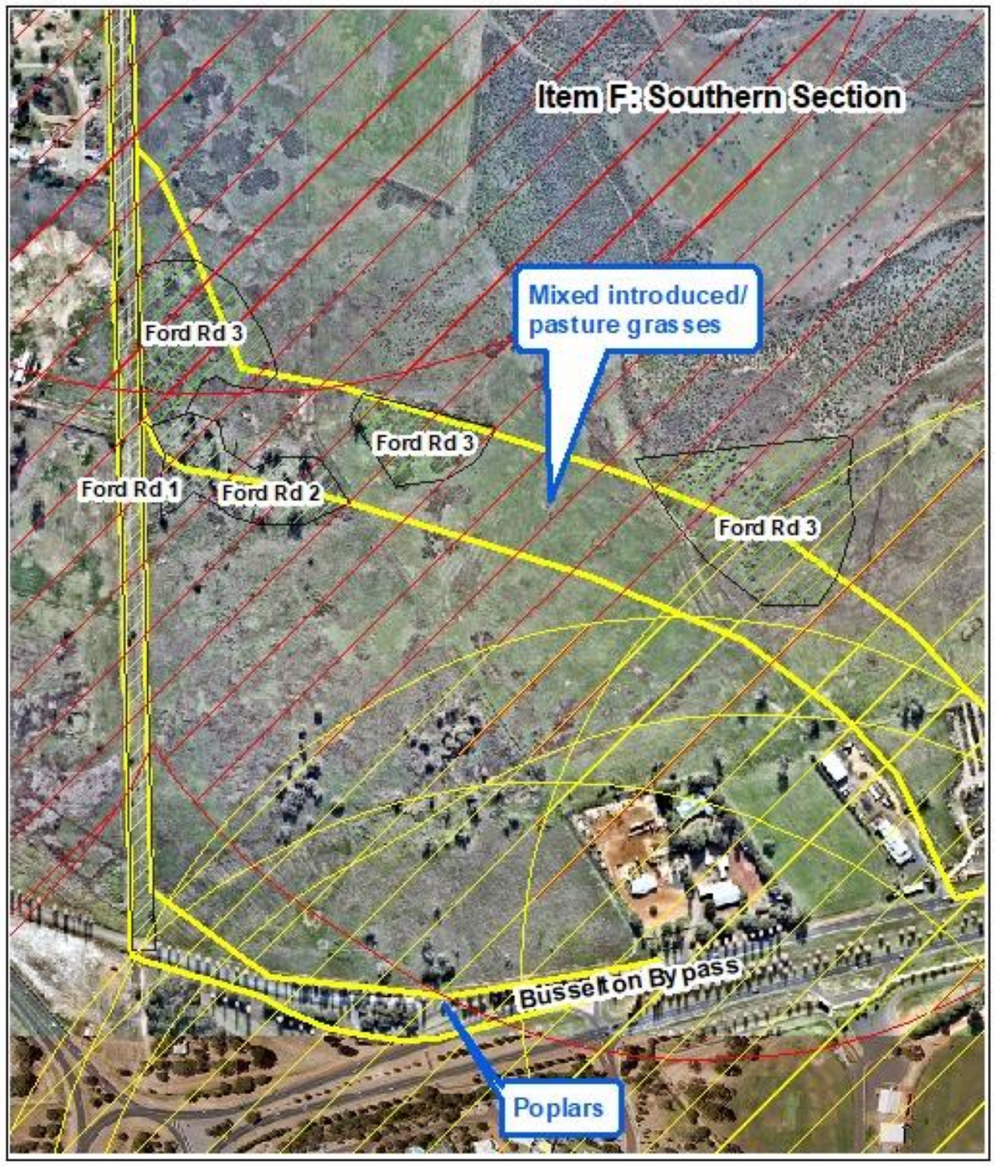

Map 6: Item F - Ford Road Options 1 & 2 Vegetation Groups

Project Address: City of Busselton

Projection - MGA50
Datum - GDA94
June 2017
Prepared by G McMahon
Our Ref: 17365

N

Scale: 1:6,500

0 20 40 80 120 160 Meters

Survey Area
Elevation (m)

Vegetation Groups
- Ford Rd 1
- Ford Rd 2
- Ford Rd 3
- Ford Rd 4

Flora Database
- Threatened
- Priority 1
- Priority 2
- Priority 3
- Priority 4

TEC/PEC Results
- Eruclis, Marri, Peppermint P1
- Subtropical and Temperate Coastal Saltmarsh

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Map 7: Item F- Ford Rd/Molloy St Option **Project Address: City of Busselton**

Projection - MGA50
Datum - GDA94
June 2017
Prepared by G McMahon
Our Ref: 17365

N

Scale: 1:3,500

0 15 30 60 90 120 Meters

Survey Area
Elevation (m)
Ramsar Boundary

Vegetation Groups Flora Database TEC/PEC Results
Molloy St 1
Molloy St 2
Molloy St 3
Molloy St 4
Threatened
Priority 1
Priority 2
Priority 3
Priority 4
E rudis, Marri, Peppermint P1
Subtropical and Temperate Coastal Saltmarsh

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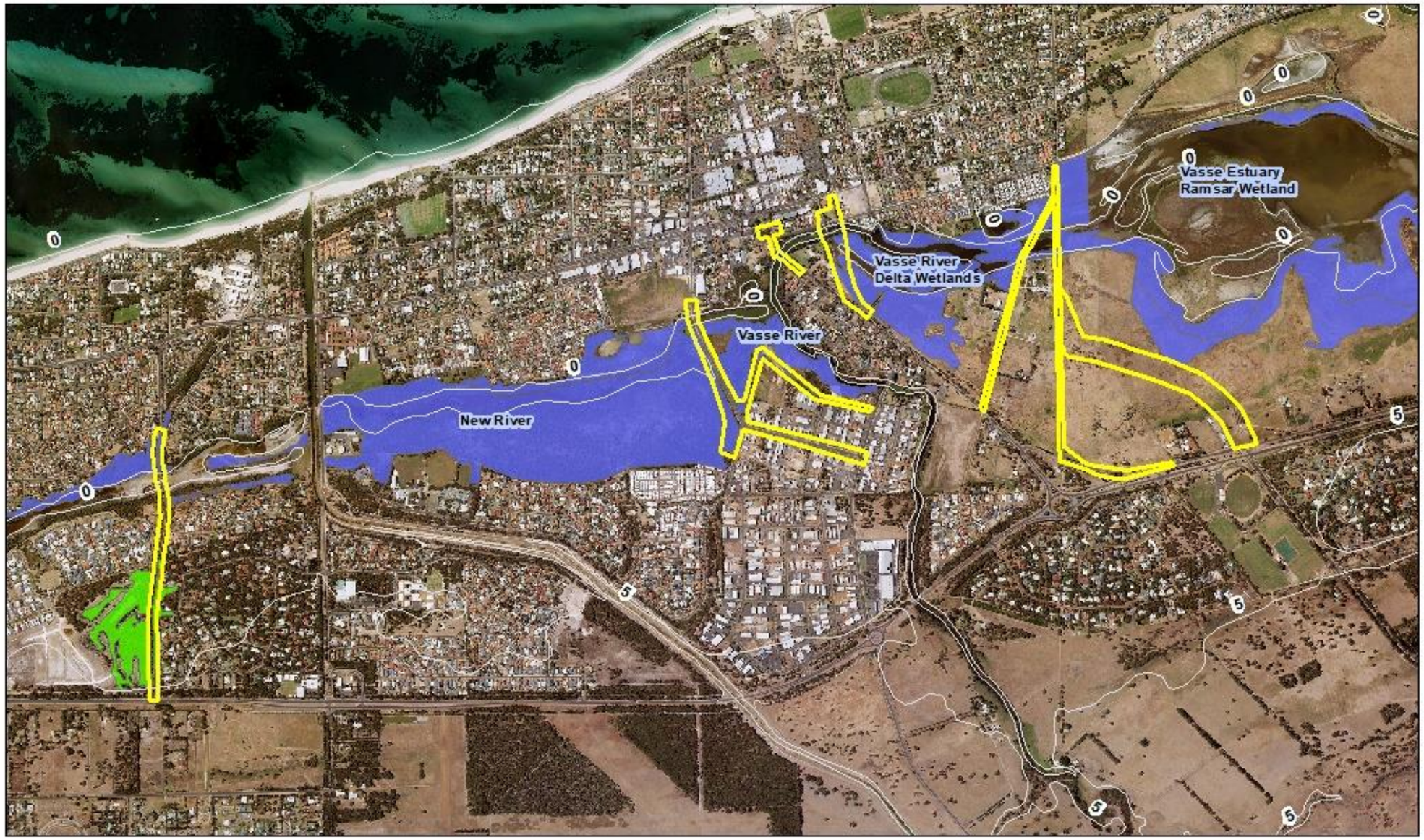

Map 8:Vegetation Complexes (Heddle et al, 1980) **Project Address: City of Busselton**

Projection - MGA50
Datum - GDA94
June 2017
Prepared by G McMahon
Our Ref: 17365

N

Scale: 1:23,000

0 110 220 440 660 880 Meters

Study Areas

Vegetation Association

- Ludlow
- Quindalup

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Map 9: Item A Eastern Link & Item B Causeway Bridge Fauna Survey **Project Address: City of Busselton**

Projection - MGA50
Datum - GDA94
June 2017
Prepared by G McMahon
Our Ref: 17365

N

Scale: 1:3,500

0 15 30 60 90 120 Meters

DBCA Database Records

Survey Areas
Elevation (m)
Fauna Observed
Drey
Soak
WRP Night 1
WRP Night 2
WRP
Critically Endangered
Endangered
Vulnerable
Priority 3
Priority 4
Conservation Dependant
Other Specially Protected
Endangered Migratory Birds
Vulnerable Migratory Birds
Migratory Birds P4
Migratory Birds

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Map 10: Item C & D West- Strelley St Fauna Survey Project Address: City of Busselton

Map 11: Item F Fairway Drive Fauna Survey **Project Address: City of Busselton**

Projection - MGA50
Datum - GDA94
June 2017
Prepared by G McMahon
Our Ref: 17365

N

Scale: 1:4,000

0 37.5 75 150 225 300 Meters

Study Area
Elevation (m)
Hollow Bearing Tree
Drey
WRP Day Survey
WRP Night 1
WRP Night 2

DBCA Database Records

WRP
Critically Endangered
Endangered
Vulnerable
Priority 3
Priority 4
Conservation Dependant
Other Specially Protected
Endangered Migratory Birds
Vulnerable Migratory Birds
Migratory Birds P4
Migratory Birds

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Appendix A Species found in surveys

Family	Species	Item A - Eastern Link	Item B - Causeway Bridge Duplication	Item C&D - Strelly, Barlee, West St	Item E - Fairway Drive Duplication	Item F - Ford Rd Options 1 & 2 & Molloy St.
Anthericaceae	Sowerbaea laxiflora				✓	
Araceae	*Zantedeschia aethiopica	✓	✓	✓	✓	✓
Asparagaceae	Lomandra spp				✓	
Asteraceae	*Arctotheca calendula	✓	✓	✓	✓	✓
Asteraceae	*Hypochaeris radicata	✓	✓		✓	✓
Casuarinaceae	Allocasuarina fraseriana			✓		
Chenopodiaceae	Sarcocornia quinqueflora	✓				✓
Chenopodiaceae	Suaeda australis	✓				✓
Chenopodiaceae	Tecticornia indica	✓				✓
Cupressaceae	Callitris preissii				✓	
Cupressaceae	Callitris spp				✓	
Cyperaceae	*Carex divisa	✓				✓
Cyperaceae	Bolboschoenus caldwellii	✓				✓
Cyperaceae	Ficinia nodosa			✓	✓	
Cyperaceae	Gahnia trifida			✓		
Cyperaceae	Lepidosperma gladiatum		✓		✓	✓
Cyperaceae	Lepidosperma squamatum				✓	
Dilleniaceae	Hibbertia furfuracea				✓	
Fabaceae	*Acacia iteaphylla				✓	
Fabaceae	Acacia cochlearis			✓		
Fabaceae	Acacia divergens	✓		✓	✓	✓
Fabaceae	Acacia littoralis			✓	✓	✓
Fabaceae	Acacia saligna			✓	✓	✓
Haemodoraceae	Conostylis candicans				✓	

Family	Species	Item A - Eastern Link	Item B - Causeway Bridge Duplication	Item C&D - Strelly, Barlee, West St	Item E - Fairway Drive Duplication	Item F - Ford Rd Options 1 & 2 & Molloy St.
Hemerocallidaceae	Dianella revoluta			✓		
Iridaceae	Patersonia umbrosa				✓	
Iridaceae	Sparaxis spp				✓	✓
Juncaceae	Juncus kraussii	✓	✓			✓
Juncaceae	Juncus preissii	✓	✓			✓
Lauraceae	Cassytha racemosa			✓	✓	
Myrtaceae	Agonis flexuosa	✓	✓			✓
Myrtaceae	Callistemon spp.			✓		
Myrtaceae	Corymbia calophylla	✓	✓	✓	✓	
Myrtaceae	Eucalyptus cornuta	✓			✓	
Myrtaceae	Eucalyptus rudis	✓	✓		✓	
Myrtaceae	Hypocalymma angustifolium				✓	
Myrtaceae	Melaleuca cuticularis	✓				
Myrtaceae	Melaleuca preissii	✓				
Myrtaceae	Melaleuca rhaphiophylla	✓	✓		✓	✓
Myrtaceae	Melaleuca viminea	✓			✓	
Orchidaceae	Caladenia latifolia				✓	
Papilionaceae	Hardenbergia comptoniana				✓	
Phyllanthaceae	Phyllanthus calycinus				✓	
Pittosporaceae	*Pittosporum undulatum			✓		✓
Poaceae	*Avena fatua	✓	✓	✓		
Poaceae	*Avena fatua	✓			✓	✓
Poaceae	*Cynodon dactylon	✓	✓			✓
Poaceae	*Lolium multiflorum			✓		✓

Family	Species	Item A - Eastern Link	Item B - Causeway Bridge Duplication	Item C&D - Strelly, Barlee, West St	Item E - Fairway Drive Duplication	Item F - Ford Rd Options 1 & 2 & Molloy St.
Poaceae	*Paspalum vaginatum	✓				✓
Poaceae	*Cenchrus clandestinum	✓				✓
Poaceae	Briza minima	✓	✓	✓	✓	✓
Proteaceae	Banksia littoralis				✓	
Typhaceae	*Typha orientalis			✓		✓
Xanthorrhoeaceae	Xanthorrhoea gracilis				✓	
Xanthorrhoeaceae	Xanthorrhoea preissii				✓	

Appendix B Vegetation Classification Under Muir (1977) & Aplin (1979)

Stratum	Canopy Cover				
	70%-100%	30%-70%	10%-30%	2%-10%	<2%
Trees > 30m	Tall Closed Forest	Tall Open Forest	Tall Woodland	Tall Open Woodland	Scattered Tall Trees
Trees 10-30m	Closed Forest	Open Forest	Woodland	Open Woodland	Scattered Trees
Trees < 10m	Low Closed Forest	Low Open Forest	Low Woodland	Low Open Woodland	Scattered Low Trees
Shrubs >2m	Tall Closed Scrub	Tall Open Scrub	Tall Shrubland	Tall Open Shrubland	Scattered Tall Shrubs
Shrubs 1-2m	Closed Heath	Open Heath	Shrubland	Open Shrubland	Scattered Shrubs
Shrubs <1m	Low Closed Heath	Low Open Heath	Low Shrubland	Low Open Shrubland	Scattered Low Shrubs
Hummock Grasses	Closed Hummock Grassland	Mid-Dense Hummock Grasslands	Hummock Grassland	Open Hummock Grassland	Scattered Hummock Grassland
Grasses, Sedges & Herbs	Closed Tussock Grassland/ Sedgeland/ Herbland	Tussock Grassland/ Sedgeland/ Herbland	Open Tussock Grassland/ Sedgeland/ Herbland	Very Open Tussock Grassland/ Sedgeland/ Herbland	Scattered Tussock Grassland/ Sedgeland/ Herbland

Appendix C Keighery Vegetation Condition Classification

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