



Public Transport Authority
Yanchep Rail Extension Part 1
Biological Factors - Context and Impact Assessment

March 2019

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1. Introduction

1.1 Background

The Public Transport Authority (PTA) is in the planning stage for the extension of the northern suburbs passenger railway, the Yanchep Rail Extension (YRE) (the project). The proposed alignment will ultimately extend from Butler Railway Station to the proposed Yanchep Railway Station.

The YRE project has been referred to the Environmental Protection Authority (EPA) under Section 38 of the *Environmental Protection Act 1986* (EP Act) in two parts, Part 1: Butler Station to Eglinton Station and Part 2: Eglinton Station to Yanchep Station. The PTA referred Part 1 of the project to the EPA in February 2018. This report is focussed on Part 1 of the YRE project.

Part 1 of the project includes a proposal to construct and operate the rail extension and includes two new intermodal transit stations at Alkimos and Eglinton. The EPA determined the referred proposal would be assessed on referral information with additional information requested.

Post submission the PTA has refined the Development Envelope (DE) to reduce impacts to the environment. This report has been revised to reflect this change.

Having regard to the significance considerations in the EPA's Statement of Environmental Principles, Factors and Objectives, the key environmental issues are considered to include clearing of native vegetation (including up to 0.53 hectares (ha) of Threatened Ecological Community 26a), loss of threatened fauna habitat; and fragmentation of a small reserve that provides an east-west linkage.

The EPA did note the proposal is located in an area primarily designated for urban development under the Metropolitan Region Scheme (MRS), with the railway and stations located within commercial and residential areas once surrounding land is fully developed.

1.2 Purpose of report

The purpose of this report is to:

- Provide contextual information of the environmental aspects present within Part 1, as well as at local and regional scales
- Describe and quantify the potential impacts (direct and cumulative) associated with Part 1 of the project on the identified environmental aspects at local and regional scales to support the EPA assessment.

2. Methods

2.1 Approach

This report quantifies potential Part 1 project impacts at a local and regional scale to vegetation, fauna habitat and parabolic dunes. The significance of these impacts are presented, taking into consideration foreseeable future development at the local and regional scale (i.e. potential cumulative impacts).

GHD has used the following approach to quantify the impacts in a systematic manner for vegetation, fauna habitat and parabolic dunes:

1. Describe and quantify the environmental aspects present within the development envelope
2. Describe and quantify the environmental aspects present within the development envelope at a local, regional and bioregional scale
3. Quantify the potential impacts associated with Part 1 of the project, with consideration given to the cumulative impacts associated with foreseeable future development at a local and regional scale.

2.2 Development envelope

PTA has defined a DE for this project, which was refined after referral to the EPA to reduce impacts to the environment. The Part 1 DE covers 63.33 ha and is a combination of vegetation, re-vegetation and cleared areas.

The DE was used for the basis of this assessment, and has been referred to within this report as development area and/or Part 1 project.

2.3 Scales

To provide context to the potential Part 1 project impacts, this assessment has considered the extent of vegetation, fauna habitat and parabolic dunes at a local and regional scale. For the purpose of this assessment, the local and regional scales are defined as:

- The local scale included a 1 km buffer of the DE
- The North West (NW) subregion, as defined in Perth and Peel@3.5million was used as a regional scale. This subregion comprises the City of Joondalup and the City of Wanneroo local government areas (LGAs).

The local and regional scale are shown in Figure 1, Appendix A.

Where spatial data was available, a larger regional scale was also considered for vegetation and fauna habitat, which encompassed the Perth Interim Biogeographical Regionalisation for Australia (IBRA) subregion.

2.4 Data sources

This assessment has used a combination of project specific and publically available GIS spatial files largely sourced from Government of Western Australia (GoWA) (2018a). The data sources utilised are presented in Table 1.

Table 1 Data sources

Aspect	Description and source
Boundaries	YRE Development Envelope (PTA) NW subregion (as shown in Perth and Peel@3.5) Perth IBRA subregions
Vegetation	YRE vegetation type mapping (GHD 2018) Pre-European Vegetation (DPIRD-006) Native Vegetation Extent (DPIRD-005) Vegetation Complexes – Swan Coastal Plain (DBCA-046)
Threatened and Priority Ecological Communities	Threatened Ecological Community (TEC) and Priority Ecological Community (PEC) spatial dataset (Department of Biodiversity, Conservation and Attractions (DBCA) 2018) (not sighted)
Black Cockatoos	Carnaby's Cockatoo requiring investigation as feeding habitat in the Swan Coastal Plain (SCP) IBRA Region (DBCA-057) Carnabys Cockatoo Breeding Areas Confirmed (DBCA-054) Carnabys Cockatoo Roost Areas Confirmed (DBCA-050) Carnabys Cockatoo Roost Areas Unconfirmed (DBCA-051) Glossop et al. (2011)
Conservation estate and reserves	Bush Forever Areas 2000 (DOP-071) DBCA – Legislated Lands and Waters (DBCA-011) DBCA – Lands of Interest (DBCA-012) Regional Parks (DBCA-026)
Ecological linkages	City of Wanneroo Local Biodiversity Strategy 2018/19 – 2023/24 Regional Ecological Linkages for the Perth Metropolitan Region (Western Australian Local Government Association (WALGA) (Perth Biodiversity Project) 2003)
Landforms	Soil Landscape Mapping (DPIRD-027)
Planning	Perth and Peel Urban Land Development Outlook (ULDO) 2016/17 - staging (DOP-096) Perth and Peel ULDO 2016/17 - Industrial (DOP-097) Local Planning Scheme – City of Wanneroo Local Planning Scheme – City of Joondalup MRS Region Scheme – Zones and Reserves (DOP-072)

2.5 Flora and vegetation considerations

2.5.1 Vegetation condition

Vegetation rated as Completely Degraded has been excluded from the analysis as it is considered to no longer represent intact native vegetation. This approach is consistent with the referral documentation this report is supplementing and other recent transport infrastructure environmental assessments assessed by the EPA, such as the Perth Darwin National Highway (Swan Valley Section) project.

One vegetation type (VT13) comprised a mix of degraded native remnant vegetation and native regrowth (>10 years). This vegetation type is mapped as Completely Degraded and not included in the analysis.

2.5.2 Estimating native vegetation extents

To allow a consistent assessment at a local, regional and bioregional scale the decision was made (based on feedback from the PTA and EPA) to utilise the Native Vegetation Extent (DPIRD-005) remaining dataset as the basis to assess direct and cumulative impacts within this document. To calculate the current extent remaining, intersects between the Native Vegetation Extent, and the Pre-European Vegetation (DPIRD-006) and Vegetation Complexes – Swan Coastal Plain (DBCA-046) datasets were completed. As the Native Vegetation Extent dataset was last updated on 23 May 2018, the numbers obtained from the intersect are slightly different

(slightly less) to those published in the Statewide Vegetation Statistics and South West Vegetation Complex Statistics by DBCA on Data WA which are current as of December 2017 and October 2017 respectively. The differences in numbers are a direct result of using the more current Native Vegetation Extent dataset.

GHD has completed a number of detailed surveys throughout the DE and adjacent areas for the YRE project. When using this detailed vegetation mapping, specifically, native vegetation in degraded or better condition, there is a greater amount of native vegetation present when compared with the Native Vegetation Extent dataset for the same area (i.e. the DE). The differences in values is a result of utilising mapping at difference scales (e.g. broad-scale mapping of Beard (1979), Heddle et al. (1980) and Webb et al. (2016) versus fine-scale mapping of a localised area. Vegetation in degraded or better condition mapped within the DE by GHD (2018) that does not intersect the Native Vegetation Extent dataset is considered cleared for the purposes of the native vegetation cumulative impact assessment.

2.5.3 Vegetation associations and complexes

Broad scale (1:250,000) pre-European vegetation mapping completed by Beard (1979) indicates that two vegetation associations intersect the Part 1 DE (Table 2). Regional vegetation on the SCP has also been mapped by Heddle et al. (1980), with updates from Webb et al. (2016); which shows two vegetation complexes intersect the Part 1 DE (Table 3).

Table 2 Vegetation association descriptions (Beard 1979)

Association	Description	Structure	Flora
949	Low woodland; banksia	Low woodland or open low woodland	Other <i>Acacia</i> , <i>Banksia</i> , <i>Agonis flexuosa</i> , <i>Callitris</i> , <i>Allocasuarina</i> , <i>Eucalyptus loxophleba</i>
1007	Mosaic: Shrublands; <i>Acacia lasiocarpa</i> & <i>Melaleuca acerosa</i> [now <i>M. systema</i>] heath / Shrublands; <i>Acacia rostellifera</i> & <i>Acacia cyclops</i> thicket	Scrub-heath / Thicket	<i>Acacia lasiocarpa</i> , <i>Melaleuca acerosa</i> , <i>A. rostellifera</i> , <i>A. cyclops</i>

Table 3 Vegetation complex descriptions (Webb et al. 2016)

Complex	Description
Quindalup complex	Restricted to the coastal dunes and can be subdivided mainly into two alliances. The strand and fore dune alliance contain <i>Angianthus cunninghamii</i> , <i>Trachyandra divaricatum</i> , <i>Arctotheca populifolia</i> , <i>Atriplex isatidea</i> , <i>Cakile maritima</i> , <i>Leucophyta brownii</i> , <i>Carpobrotus virescens</i> , <i>Pelargonium capitatum</i> , <i>Senecio lautus</i> , <i>Actites megalocarpus</i> , <i>Spinifex longifolius</i> , <i>Tetragonia implexicoma</i> , <i>T. decumbens</i> . The mobile and stable dune alliance contains <i>Acacia cyclops</i> , <i>Anthocercis littorea</i> , <i>Lepidosperma gladiatum</i> , <i>Myoporum insulare</i> , <i>Nitraria billardierei</i> , <i>Olearia axillaris</i> , <i>Scaevola crassifolia</i> , <i>S. nitida</i> , <i>Spyridium globulosum</i> , <i>Westringia rigida</i> and <i>Wilsonia backhousei</i> . The vegetation differs in its physiognomy and species composition from one place to another because of the variations in the dune environment caused by edaphic and topographical factors and the degree of shelter from salt-laden winds (McArthur 1957; Smith 1957). The low closed-forest of <i>Melaleuca lanceolata</i> , <i>Callitris preissii</i> is restricted to small localised pockets. This formation was once more widespread along the coast (Baird 1958, Seddon 1972). Other local variations include remnant occurrences of <i>E. foecunda</i> , <i>Pittosporum ligustrifolium</i> , <i>Santalum acuminatum</i> , <i>Exocarpos sparteus</i> and <i>Acacia rostellifera</i> (Seddon 1972).

Complex	Description
Cottesloe complex – central and south	Mosaic of woodland of <i>Eucalyptus gomphocephala</i> and open forest of <i>E. gomphocephala</i> – <i>E. marginata</i> – <i>Corymbia calophylla</i> ; closed heath on the limestone outcrops

2.5.4 Estimating the local and regional extents of Threatened and Priority Ecological Communities

The local and regional extents of Threatened and Priority Ecological Communities (TECs and PECs) recorded within the Part 1 project were provided by the PTA, calculated using spatial data provided by DBCA. This spatial data was not sighted by GHD.

2.6 Terrestrial fauna considerations

2.6.1 Estimating fauna habitat extents

Fauna habitat extents are based on native vegetation extents and were calculated using the same approach as described in section 2.5.2. Similarly, when using detailed fauna habitat mapping of the DE, there is a greater amount of fauna habitat available when compared with that inferred from the Native Vegetation Extent dataset for the same area (i.e. the DE). As noted in section 2.5.2, this difference in values is a result of utilising mapping at difference scales. Fauna habitat mapped within the DE by GHD (2018) that does not intersect the Native Vegetation Extent dataset is considered cleared for the purposes of the fauna habitat cumulative impact assessment.

2.6.2 Estimating the local and regional extent of Carnaby's Cockatoo habitat

Potential breeding habitat

Trees of suitable diameter breast height (DBH) for potential Carnaby's Cockatoos breeding (DSEWPac 2012) were recorded from the DE, however as there is no reliable local or regional publicly available data this aspect has not been considered further as part of this assessment. Carnaby's Cockatoo breeding area datasets were sourced from DBCA to review breeding locations in relation to the DE to provide context. These datasets provided buffered locations of confirmed and possible breeding locations based on observations relating to Carnaby's Cockatoo breeding (as defined by Glossop et al. (2011)), not the presence of suitable DBH trees for potential Carnaby's Cockatoos breeding.

Foraging habitat

The extent of Carnaby's Cockatoo foraging habitat was estimated using Carnaby's Cockatoo data sourced from DBCA. The current extent of potential Carnaby's Cockatoo foraging habitat was determined by intersecting available layers (e.g. Carnaby's Cockatoo Feed Areas Investigation required SCP) with available Native Vegetation Extent. It is noted this dataset excludes pine plantations, which are not native vegetation, but important Carnaby's Cockatoo feeding areas. Further information on the Carnaby's Cockatoo dataset is provided by Glossop et al. (2011).

Carnaby's Cockatoo foraging habitat value within the DE has been determined by reviewing the described/mapped fauna habitat types present within the Part 1 project (GHD 2018), and based on vegetation structure, species (and food items) present and vegetation condition, assigned a value of either high, moderate or low (Table 4). Carnaby's Cockatoo habitat types, definitions and species suitability were sourced from DSEWPac (2012) and the foraging habitat scoring

tool (DEE 2017) used to guide this determination. All fauna habitat types contained species known to support foraging (noting in some habitat types these are scattered, isolated species), however, those types considered to have a low foraging value have been excluded from foraging calculations.

Table 4 Carnaby’s Cockatoo foraging habitat value

Fauna habitat type	Foraging habitat	Foraging habitat value
<i>Acacia</i> shrubland		Low
<i>Banksia sessilis</i> over low mixed shrubland	Yes	High
<i>Eucalyptus</i> woodland	Yes	Moderate
Limestone ridgeland		Low
<i>Lomandra</i> herbland on secondary dunes		Low
Mixed <i>Banksia</i> woodland	Yes	High
Mixed tall shrubland	Yes	Moderate
Planted <i>Eucalyptus</i> woodland	Yes	Moderate
Highly Disturbed		Low

Roosting habitat

Carnaby’s Cockatoo roost areas datasets were sourced from DBCA to review roost locations in relation to the DE to provide context. These datasets provided locations of confirmed, unconfirmed and buffered roost areas based on observations (as outlined by Glossop et al. (2011)). Whilst suitable roosting habitat was identified within the development areas, the extent of this has been captured within breeding and foraging extents and therefore will not be further assessed in this report.

2.7 Landform considerations

2.7.1 Estimating the extent of parabolic dune formations

The parabolic dune formation extent has been estimated by extracting the units Quindalup South oldest dune Phase (211Qu_Q1), Quindalup South second dune Phase (211Qu_Q2), Quindalup South third dune Phase (211Qu_Q3) and Quindalup South youngest dune Phase (211Qu_Q4) from Soil Landscape Mapping (DPIRD-027) spatial data. The current extent of the parabolic dune formation has been determined by estimating cleared areas (using Local Planning Scheme – City of Wanneroo and Perth and Peel ULDO 2016/17 - staging (DOP-096) layers) and overlaying the relevant mapping units listed above. Whilst aerial imagery (from Landgate) was also viewed to validate this approach visually, the imagery was not used to further refine the ‘current’ extent as the approach was deemed fit for purpose.

2.8 Assumption and Limitations

This report has been prepared by GHD for PTA and may only be used and relied on by PTA for the purpose agreed between GHD and the PTA as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than PTA arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by PTA and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked. Observations and conclusions drawn from this information may reflect survey effort and not be a true reflection of distribution and species numbers. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

GHD has relied on spatial data available from Data WA and other government entities to quantify vegetation, fauna habitat and parabolic dune extents and foreseeable future development. It is noted in some instances there is very minor discrepancies between the spatially calculated results and those published by the provisioning organisations. These discrepancies do not adversely impact the analysis or validity of the conclusions drawn from the analysis.

3. Project context

3.1 Local and regional context

The project is situated in the South West Botanical Province of WA within the Swan Coastal Plain bioregion and the Perth subregion as described by IBRA. The project is located approximately 3 km east of the WA coastline extending from the suburbs of Butler to Eglinton.

Conservation areas and ecological linkages discussed in the following section are presented in Figure 2, Appendix A.

3.1.1 Conservation areas

No DBCA-managed conservation areas are located within the development envelope. The closest DBCA managed areas are Yanchep National Park (R 9868, Class A) located approximately 500 m east and north east of the Part 1 project and Neerabup National Park (R 27575, Class A) located approximately 900 m east and south east of the Part 1 project.

Much of the development areas reside within an Environmentally Sensitive Area (ESA). This ESA likely aligns with the presence of TECs and their buffer zones within the local area. The presence of TECs (and PECs) within the development areas is discussed further in Section 4.2.

The development areas are surrounded by Bush Forever sites, although none are intersected by the Part 1 project (Table 5).

The Alkimos Parks and Recreation Reservation (PRR) (also referred to as the Alkimos Parklands) is located within Lot 200 Alkimos Drive and is intersected by the Part 1 project. The Alkimos PRR is currently zoned 'Parks and Recreation' (89.77 ha) and intersected by a small section currently zoned 'Railways' (1.81 ha) under the MRS. The Alkimos PRR is bounded by Marmion Avenue on its western side and Romeo Road (unsealed track) on its eastern side, and ranges from 380 m to 1.7 km in width (north-south).

Table 5 Bush Forever sites in the vicinity of the Part 1 project

BF Site No.	Name	Size (ha)	Location relative to the Part 1 project
288	Yanchep National Park and Adjacent Bushland	2,899.51	500 m east and north east
383	Neerabup National Park, Lake Gnowergup Nature Reserve and adjacent bushland	1,836.14	900 m east and south east
289	Ningana Bushland, Yanchep/ Eglinton	640.83	780 m north
130	Link between Yanchep and Neerabup National Parks	91.95	850 m east
397	Coastal strip from Wilbinga to Mindarie	552.50	1 km west
129	Bernard Road Bushland	102.75	1.1 km east
322	Burns Beach Bushland	368.41	6.6 km south
323	Link from Burns Beach Bushland to Neerabup National Park	119.70	7.7 km south

3.1.2 Ecological Linkages

Two regional ecological linkages mapped in the Regional Ecological Linkages for the Perth Metropolitan Region (PMR) dataset occur in the vicinity of the Part 1 project; Links No. 1 and 6 (Figure 2). Link No. 1 occurs west of the development envelope and links Bush Forever Sites 406 through to 315 (including Bush Forever sites 322 and 397), maintaining connectivity along the Coast for the Quindalup Complex. Link No. 6 occurs east of the project and links Bush Forever Sites 284, 288, 129, 130, 383, 299, 202. A 500 metre (m) wide buffer (250 m each side)

is considered to be the minimum required to promote the inclusion of more viable natural areas within the ecological linkage (Del Marco et al. 2004). Both Link No. 1 and 6 have been impacted by previous vegetation clearing and urban development.

Two local ecological linkages, Link ID: 23 and Link ID: 0 occur in the vicinity of the Part 1 project (Figure 2). Link ID: 23 is an east-west linkage that has been identified in the City of Wanneroo Local Biodiversity Strategy 2018/19 – 2023/24 (City of Wanneroo 2018). This local linkage connects the coastal reserves to the Neerabup and Yanchep National Parks and includes Bush Forever Site No. 397, native vegetation that forms a buffer around a water treatment plant, the Alkimos PRR, Bush Forever Sites No. 129 and 130, and Yanchep and Neerabup National Parks. The linkage is intersected by the existing Marmion Avenue and Wanneroo Road as well as a small section zoned 'Railways' under the MRS (approximately 950 m east of Marmion Avenue, where the Part 1 project is proposed). Link ID: 0 is a smaller linkage that extends south of Link ID: 23, connecting it to regional ecological linkage Link No. 6.

For the purpose of this assessment the extent of the local ecological linkage to be impacted by the Part 1 project includes the Alkimos PRR and Rail reserve within the local ecological linkage (Link ID: 23), which covers 91.58 ha.

3.2 Cumulative considerations

There are a number of existing, approved or proposed developments within the vicinity of the Part 1 project, which have the potential to contribute to cumulative impacts at a local and regional scale. Whilst the impacts of each development may be limited in isolation, they have the potential to become more substantial due to additional impacts from other developments. The reported and/or potential impacts from these local and regional developments (where information is available) have been used to determine potential cumulative impacts.

The spatial distribution of the cumulative considerations quantified as part of this assessment are shown in Figure 3, Appendix A.

Future residential, commercial and industrial development

The Urban Land Development Outlook (ULDO) 2016/17 is based on an assessment of future land supply at all stages of the planning, zoning, approval, development and redevelopment pipeline. The ULDO output covers Perth to Peel and includes scheme amendments, developer intentions, structure planning in progress, subdivision applications/approvals (Western Australian Planning Commission) and local government development applications/approvals. There have been a number of local and regional scheme amendments in the vicinity of the project, with these largely associated with rezoning and subsequent urban development. The ULDO 2016/2017 spatial data has been used to capture future residential, commercial and industrial development at a local and regional scale.

The ULDO 2016/17 data indicates that within the NW Subregion approximately 1,350 ha will support likely future residential/commercial development within the next 5 years. Of this, approximately 848 ha (62.8%) has current conditional approval. Similarly, the data indicates that within 1 km of the Part 1 project approximately 410 ha will support likely future residential/commercial development within the next 5 years with approximately 109 ha (26.56 %) having current conditional approval (Table 6). The total future development within the NW Subregion and 1 km buffer is considerably more than this when the longer term development is also considered.

The Part 1 DE intersects ULDO foreseeable future development areas. To avoid double counting of potential impacts, this overlap in areas has been accounted for by extracting these common areas from the ULDO extents as part of the cumulative assessment.

Table 6 Future residential and industrial development at local and regional scales

Development type	Staging	Extent (ha)	
		NW Subregion	1 km buffer
Residential/commercial	Short term (0-5 years) with current conditional approval	847.47	108.83
	Short term (0-5 years)	501.99	300.82
	Medium term (6-10 years)	789.73	190.26
	Long term (10+ years)	4,370.36	547.49
Industrial	Short term (0-5 years)	39.94	-
	Medium term (6-10 years)	27.23	-
	Long term (10+ years)	680.77	-
TOTAL		7,257.49	1,147.40

Data sources: Perth and Peel Urban Land Development Outlook 2016/17 - staging (DOP-096), Perth and Peel Urban Land Development Outlook 2016/17 - Industrial (DOP-097). Note: the areas presented in this table do not consider the overlap with the Part 1 and Part 2 project areas.

Other potential projects

Other proposed projects in the vicinity of the Part 1 project include the YRE Part 2 project. The Part 2 project extends approximately 8.7 km from Eglinton to Yanchep. The Part 2 DE covers 72.86 ha.

The Part 2 DE also intersects ULDO foreseeable future development areas. Similar to the Part 1 project, to avoid double counting of potential impacts, this overlap in areas has been accounted for by extracting these common areas from the ULDO extents as part of the cumulative assessment.

4. Assessment of impacts – Flora and vegetation

4.1 Native vegetation

4.1.1 Receiving environment

Ten vegetation types as well as re-vegetation in the rail corridor and cleared areas were recorded by GHD (2018) in the DE (Table 7). Eight of the vegetation types comprised remnant native vegetation, one vegetation type (VT12) was dominated by planted taxa and one vegetation type (VT13) comprised a mix of degraded native remnant vegetation and native regrowth (>10 years). The vegetation condition within the DE was rated from Pristine to Completely Degraded. There is 37.72 ha of native vegetation in Degraded or better condition within the DE (Table 7).

Two vegetation associations (Beard 1979) and two vegetation complexes (Hedde et al. 1980, Webb et al. 2016) intersect the Part 1 DE.

4.1.2 Direct impacts

The Part 1 project will result in the direct loss of up to 37.72 ha of native vegetation. The remaining extent of the vegetation associations and complexes at a local, regional and bioregional scale are above 32% of the mapped pre-European extents (Table 8 and Table 10), with much of the remaining extents occurring in conservation areas at one or more scales (Table 9 and Table 11).

The largest % impact to a remaining vegetation association extent by clearing the DE is linked to vegetation association 1007, which will account for a reduction of 3.88% at a local scale. However, at a regional and bioregional scale this impact is significantly less at 0.51% and 0.12%, respectively (Table 8). The current extents remaining of vegetation association 1007 remains greater than 46% at a regional scale and 64% at a local scale after development of the Part 1 project.

Clearing the entire DE will remove up to 3.98% of the remaining extent of the Quindalup complex at a local level; however at a regional and bioregional level this impact is 0.46% and 0.08%, respectively (Table 10). The current extents remaining of the Cottesloe complex – central and south remains greater than 32% at a regional scale and 45% at a local scale after development of the Part 1 project.

Of the vegetation associations, the remaining extent within conservation areas ranges from 5.69% to 83.55% at a local scale and from 21.59% to 87.41% at a regional scale (Table 9). Similarly of the vegetation complexes, the remaining extent within conservation areas ranges from 7.51% to 86.39% at a local scale and from 29.08% to 84.17% at a regional scale (Table 11). These percentages do not account for vegetation occurring within areas zoned as 'Parks and Recreation', such as the Alkimos PRR.

Table 7 Vegetation types recorded in the Part 1 DE

ID	Vegetation type	Conservation significance	Extent in DE (ha)	Extent in DE in Degraded+ condition (ha)
VT02	<i>Banksia sessilis</i> and <i>Melaleuca systema</i> mid-shrubland	Northern Spearwood shrublands and woodlands (PEC) (SCP24)	3.25	3.25 (100%)
VT03	<i>Banksia sessilis</i> and <i>Spyridium globulosum</i> tall shrubland	Northern Spearwood shrublands and woodlands (PEC) (SCP24)	12.80	12.80 (100%)
VT04	<i>Banksia attenuata</i> , <i>B. menziesii</i> low woodland	<i>Banksia</i> woodlands (TEC) / <i>Banksia</i> dominated woodlands (PEC)	14.34	14.17 (98.8%)
VT05	<i>Lomandra</i> sp. herbland		5.95	5.95 (100%)
VT08	<i>Melaleuca huegelii</i> and <i>M. systema</i> shrubland	<i>Melaleuca huegelii</i> – <i>M. acerosa</i> (<i>M. systema</i>) shrublands on limestone ridges (TEC) (SCP26a)	0.53	0.53 (100%)
VT10	<i>Xanthorrhoea preissii</i> shrubland		0.47	0.47 (100%)
VT11	<i>Eucalyptus decipiens</i> woodland		0.26	0.26 (100%)
VT12	Planted		0.11	-
VT13	Scattered Natives		16.27	-
VT14	<i>Acacia rostellifera</i> tall shrubland		0.28	0.28 (100%)
	SUB-TOTAL		54.26	37.72 (69.5%)
NA	Re-vegetation rail corridor		1.82	-
CL	Cleared		7.25	-
	TOTAL		63.33	37.72

Table 8 Extents of vegetation associations mapped within the Part 1 DE at local, regional and bioregional scales

Vegetation association	Scale	Pre-European extent ¹ (ha)	Current extent ¹ (ha)	Remaining (%)	Extent in DE ² (ha)	% of current extent within DE	Current extent after DE developed (ha) (%)
949	Perth subregion	184,475.82	103,972.25	56.36	11.27 (9.07)	0.01	103,963.18 (56.36%)
	NW subregion	38,330.32	17,173.49	44.80		0.05	17,164.42 (44.78%)
	1 km buffer	1,208.69	514.88	42.60		1.76	505.81 (41.85%)
1007	Perth subregion	30,109.89	20,681.70	68.69	26.44 (25.58)	0.12	20,656.12 (68.60%)
	NW subregion	10,801.16	5,048.24	46.74		0.51	5,022.66 (46.50%)
	1 km buffer	987.34	659.97	66.84		3.88	634.39 (64.25%)

¹ Pre-European and Current extents: calculated using Native Vegetation Extent (DPIRD-005), Pre-European Vegetation (DPIRD-006). ² Vegetation in Degraded or better condition mapped by GHD (2018), (vegetation that intersects the Native Vegetation Extent dataset).

Table 9 Current extent of vegetation associations mapped with the Part 1 DE in conservation areas

Vegetation association	Scale	Current extent ¹ (ha)	Remaining (%)	Current extent in conservation areas ² (ha)			
				DBCA	BF	Total (ha)	% of current extent
949	Perth subregion	103,972.25	56.36	21,353.50	5,997.14	27,350.64	26.31
	NW subregion	17,173.49	44.80	12,047.74	2,963.67	15,011.41	87.41
	1 km buffer	514.88	42.60	23.95	19.18	43.13	8.38
1007	Perth subregion	20,681.70	68.69	3,049.76	1,954.09	5,003.85	24.19
	NW subregion	5,048.24	46.74	93.63	996.31	1,089.93	21.59
	1 km buffer	659.97	66.84	5.32	32.20	37.53	5.69

¹ Current extents: Taken from Table 8 ² DBCA extent: calculated using DBCA – Legislated Lands and Waters (DBCA-011) and DBCA – Lands of Interest (DBCA-012); BF extent; calculated using Bush Forever Areas 2000 (DOP-071) that lies outside of calculated DBCA extent.

Table 10 Extents of vegetation complexes mapped within the Part 1 DE at local, regional and bioregional scales

Vegetation complex	Scale	Pre-European extent ¹ (ha)	Current extent ¹ (ha)	Remaining (%)	Extent in DE ² (ha)	% of current extent within DE	Current extent after DE developed (ha)
Cottesloe complex – central and south	Perth subregion	45,030.93	14,571.13	32.36	10.91 (8.74)	0.06	14,562.39 (32.34%)
	NW subregion	17,272.13	5,841.12	33.82		0.15	5,832.38 (33.77%)
	1 km buffer	1,292.49	595.61	46.08		1.47	586.87 (45.41%)
Quindalup complex	Perth subregion	53,007.07	32,954.86	62.17	26.81 (25.90)	0.08	32,928.96 (62.12%)
	NW subregion	11,184.24	5,634.59	50.38		0.46	5,608.69 (50.15%)
	1 km buffer	1,031.55	650.84	63.09		3.98	624.94 (60.258)

¹ Pre-European and Current extents: calculated using Native Vegetation Extent (DPIRD-005), Vegetation Complexes – Swan Coastal Plain. ² Vegetation in Degraded or better condition mapped by GHD (2018), (vegetation that intersects the Native Vegetation Extent dataset).

Table 11 Current extent of vegetation complexes mapped with the Part 1 DE in conservation areas

Vegetation association	Scale	Current extent ¹ (ha)	Remaining (%)	Current extent in conservation areas ² (ha)			
				DBCA	BF	Total (ha)	% of current extent
Cottesloe complex – central and south	Perth subregion	14,571.13	32.36	6,936.51	2,357.75	9,294.26	63.79
	NW subregion	5,841.12	33.82	2,382.93	1,218.78	3,601.72	61.66
	1 km buffer	595.61	46.08	75.75	15.18	90.93	15.27
Quindalup complex	Perth subregion	32,954.86	62.17	6,785.53	3,948.51	10,734.03	32.57
	NW subregion	5,634.59	50.38	109.69	1,528.79	1,638.47	29.08
	1 km buffer	650.84	63.09	10.17	38.70	48.87	7.51

¹ Current extents: taken from table 10. ² DBCA extent: calculated using DBCA – Legislated Lands and Waters (DBCA-011) and DBCA – Lands of Interest (DBCA-012); BF extent: calculated using Bush Forever Areas 2000 (DOP-071) that lies outside of calculated DBCA extent.

4.1.3 Cumulative considerations

Future residential and industrial development

The current extents of vegetation associations and complexes mapped within the Part 1 project that will support future development in the NW Subregion and within 1 km of Part 1 (as reported by ULDO 2016/17 data) are shown in Table 12 and Table 13.

Table 12 Extents of vegetation associations mapped within the Part 1 project at local and regional taking into consideration ULDO

Vegetation association	Scale	Pre-European extent (ha)	Current extent (ha)	Current extent within ULDO areas (ha)	Current extent within ULDO areas (%)
949	NW Subregion	38,330.32	17,173.49	795.91	4.63
	1 km buffer	1,208.69	514.88	305.90	59.41
1007	NW Subregion	10,801.16	5,048.24	3,432.70	68.00
	1 km buffer	987.34	659.97	491.42	74.46

Table 13 Extents of vegetation complexes mapped within the Part 1 project at local and regional taking into consideration ULDO

Vegetation complex	Scale	Pre-European extent (ha)	Current extent (ha)	Current extent within ULDO areas (ha)	Current extent within ULDO areas (%)
Cottesloe complex – central and south	NW Subregion	17,272.13	5,841.12	841.39	14.40
	1 km buffer	1,292.49	595.61	266.06	44.67
Quindalup complex	NW Subregion	11,184.24	5,634.59	3607.40	64.02
	1 km buffer	1,031.55	650.84	531.27	81.63

Part 1 project

Of the 37.72 ha of native vegetation in the Part 1 DE, 31.55 ha intersects areas likely to support future development, with the remaining 6.17 ha not currently intersecting areas considered for future land development.

Part 2 project

The Part 2 DE comprises 49.17 ha of native vegetation. Of this 20.72 ha intersects areas likely to support future development, with the remaining 28.45 ha not currently intersecting areas considered for future land development. Of the 49.17 ha, 5.11 ha is within the Part 1 DE 1 km buffer.

Cumulative impacts

Table 14 and Table 15 show the cumulative impacts on the vegetation associations and complexes mapped within the Part 1 DE at local and regional scales. The assessment shows there will be substantial pressure on the remaining vegetation at a local and regional scale primarily due to future residential, commercial and industrial development.

The largest predicted cumulative impact is associated with vegetation association 1007 and Quindalup complex, where the current extents are predicted to be reduced by more than 64.41% at all scales. By comparison, the impact of Part 1 and Part 2 only is predicted to reduce the current extents of the vegetation associations and complexes by less than 4.74% at all scales.

Table 14 Extents of vegetation associations mapped within the Part 1 project at local and regional taking into consideration YRE Parts 1 and 2 and ULDO

Vegetation association	Scale	Current extent (ha)	Current extent within Part 1 DE (ha) (%) ¹	Current extent within Part 2 DE (ha) (%) ¹	Current extent within ULDO areas ² (ha)	Cumulative extent (ha) (%)
949	NW Subregion	17,173.49	11.27 (0.05%)	0.79 (<0.01%)	788.38 (4.59%)	797.52 (4.64%)
	1 km buffer	514.88	11.27 (1.76%)	0 (0%)	298.37 (57.95%)	307.44 (59.71%)
1007	NW Subregion	5,048.24	26.44 (0.51%)	48.38 (0.83%)	3,387.97 (67.11%)	3,455.41 (68.45%)
	1 km buffer	659.97	26.44 (3.88%)	5.11 (0.75%)	463.79 (70.27%)	494.30 (74.90%)

¹ Percentages based on intersect with Native Vegetation Extent dataset. ² ULDO areas include all levels of staging for residential, commercial and industrial development where applicable.

Table 15 Extents of vegetation complexes mapped within the Part 1 project at local and regional taking into consideration YRE Parts 1 and 2 and ULDO

Vegetation complex	Scale	Current extent (ha)	Current extent within Part 1 DE (ha) (%) ¹	Current extent within Part 2 DE (ha) (%) ¹	Current extent within ULDO areas ² (ha)	Cumulative extent (ha) (%)
Cottesloe complex – central and south	NW Subregion	5,841.12	10.91 (0.15%)	0 (0%)	834.75 (14.29%)	843.49 (14.44%)
	1 km buffer	595.61	10.91 (1.47%)	0 (0%)	259.41 (43.55%)	268.15 (45.02%)
Quindalup complex	NW Subregion	5,634.59	26.81 (0.46%)	48.13 (0.74%)	3,561.78 (63.21%)	3,629.24 (64.41%)
	1 km buffer	650.84	26.81 (3.98%)	5.11 (0.76%)	502.75 (77.25%)	533.58 (81.98%)

¹ Percentages based on intersect with Native Vegetation Extent dataset. ² ULDO areas include all levels of staging for residential, commercial and industrial development where applicable.

4.2 Threatened and Priority Ecological Communities

4.2.1 Receiving environment

Four conservation significant ecological communities were recorded in the DE, these included:

- *Melaleuca huegelii* – *M. acerosa* (*M. systema*) shrublands on limestone ridges (TEC) (SCP26a)
- *Banksia* woodlands of the SCP (TEC)
- *Banksia* dominated woodlands of the SCP IBRA region (PEC)
- Northern Spearwood shrublands and woodlands (PEC) (SCP24).

A breakdown of community type by vegetation condition rating is provided in Table 16.

Table 16 Conservation significant ecological communities recorded in the Part 1 DE

Community ID	Condition rating	Extent in DE (ha)
<i>Melaleuca huegelii</i> – <i>M. acerosa</i> (<i>M. systema</i>) shrublands (TEC) (SCP26a)	Excellent	0.50
	Very Good	0.03
	Subtotal	0.53
<i>Banksia</i> dominated woodlands of the SCP IBRA region (PEC) (<i>Banksia</i> woodlands of the SCP (TEC)) ¹	Excellent	3.38 (3.38)
	Very Good	5.04 (5.04)
	Good	2.55 (2.55)
	Degraded	3.20
	Subtotal	14.17 (10.97)
Northern Spearwood shrublands and woodlands (PEC) (SCP24)	Pristine	1.25
	Excellent	11.76
	Very Good	2.36
	Good	0.68
	Subtotal	16.05

¹ *Banksia* woodlands (TEC) extent is a subset of the PEC. To be representative of the *Banksia* Woodlands TEC, vegetation must meet key diagnostic characteristics which include minimum patch size and condition thresholds. Only vegetation in Good or better in condition was considered representative of the *Banksia* Woodlands TEC.

4.2.1 Direct impact

Melaleuca huegelii – *M. acerosa* (*M. systema*) shrublands (TEC) (SCP26a)

The *Melaleuca huegelii*-*Melaleuca systema* shrublands of limestone ridges TEC occurs on skeletal soils on ridge slopes and ridge tops with limestone outcropping. The community is highly restricted and known from massive limestone ridges around Yanchep north of Perth, and south of Perth near Lake Clifton.

The development of the Part 1 project will remove 0.53 ha of the *Melaleuca huegelii*-*Melaleuca systema* shrublands of limestone ridges TEC. Based on the current extent (provided by DBCA), the project is predicted to reduce the extent of this TEC by up to 100% at a local scale and 0.53% at a regional scale (Table 17). The perceived impact to the *Melaleuca huegelii*-*Melaleuca systema* shrublands TEC at the local scale is likely a reflection of its restricted and isolated occurrences and the limited extent of this TEC within a 1 km buffer of the DE.

Of the estimated extent of the *Melaleuca huegelii*-*Melaleuca systema* shrublands of limestone ridges TEC, a large portion (80.5%) is located within National Park and State Forest (Table 18).

Banksia woodlands of the SCP (TEC) and Banksia dominated woodlands of the SCP IBRA region (PEC)

The Part 1 DE will result in the loss of 14.17 ha of the *Banksia* dominated woodlands PEC, with 10.97 ha of this vegetation also representing the *Banksia* woodlands of the SCP (TEC). The clearing loss associated with the DE is estimated to contribute a 100% reduction in the PEC at a local scale (due to no mapped occurrences of this PEC within a 1 km buffer of the DE) and a 0.08% reduction in the PEC at a regional scale (Table 17).

Of the estimated current extent remaining, there is 92.25% within conservation areas at a regional scale (Table 18).

Northern Spearwood shrublands and woodlands (PEC) (SCP24)

The Part 1 DE will result in the loss of 16.05 ha of the Northern Spearwood shrublands and woodlands (SCP24) PEC. The clearing loss associated with the DE is estimated to contribute a 100% reduction in the PEC at a local scale (due to no mapped occurrences of this PEC within a 1 km buffer of the DE) and a 4.83% reduction in the PEC at the regional scale (Table 17).

Of the estimated current extent remaining, there is 98.98% within conservation areas at a regional scale (Table 18).

4.2.2 Cumulative considerations

Table 19 shows the cumulative impacts on the TECs and PECs mapped within the Part 1 DE at local and regional scales. The assessment shows no predicted impacts on the extents of the TECs and PECs from future residential and commercial development at a local scale. However, at a regional scale there will be pressure on the *Banksia* dominated woodlands of the SCP PEC from future residential and commercial development.

The calculated impact of the Part 1 project indicates 100% removal of the *Melaleuca huegelii* – *M. acerosa* (*M. systema*) shrublands TEC, *Banksia* dominated woodlands of the SCP PEC and Northern Spearwood shrublands and woodlands PEC at the local scale. This calculated impact is a result of the limited extent of this TEC and PEC within a 1 km buffer of the DE.

Table 17 Estimated extents of TECs and PECs at local and regional scales

Scale	Current extent ¹ (ha)	Extent in DE (ha)	% of current extent within DE	Current extent after DE developed (ha)
<i>Melaleuca huegelii</i> – <i>M. acerosa</i> (<i>M. systema</i>) shrublands (TEC) (SCP26a)				
Perth subregion	199.07	0.53	0.27	198.54 (99.73%)
NW subregion	100.84	0.53	0.53	100.31 (99.47%)
1 km buffer	0	0.53	100	-
<i>Banksia</i> dominated woodlands of the SCP IBRA region (PEC) ²				
Perth subregion	259,544.62	14.17	<0.01	259,530.45 (99.99%)
NW subregion	16,836.81	14.17	0.08	16,822.64 (99.92%)
1 km buffer	0	14.17	100	-
Northern Spearwood shrublands and woodlands (PEC) (SCP24)				
Perth subregion	1,008.96	16.05	1.59	992.91 (98.41%)
NW subregion	332.59	16.05	4.83	316.54 (95.17%)
1 km buffer	0	16.05	100	-

¹ Current extents: provided by DBCA. ² *Banksia* woodlands (TEC) extent is a subset of the PEC.

Table 18 Estimated extents of TECs and PECs in conservation areas

Scale	Current extent ¹ (ha)	Current extent in conservation areas (ha)			
		DBCA	BF ²	Total (ha)	% of current extent
<i>Melaleuca huegelii</i> – <i>M. acerosa</i> (<i>M. systema</i>) shrublands (TEC) (SCP26a)					
Perth subregion	199.07	165.20	4.98	170.18	85.49
NW subregion	100.84	76.23	4.98	81.21	80.54
1 km buffer	0	0	0	0	-
<i>Banksia</i> dominated woodlands of the SCP IBRA region (PEC) ³					
Perth subregion	259,544.62	79,007.28	12,463.76	91,471.05	35.24
NW subregion	16,836.81	12,409.19	3,123.14	15,532.33	92.25
1 km buffer	0	0	0	0	-
Northern Spearwood shrublands and woodlands (PEC) (SCP24)					
Perth subregion	1,008.96	387.27	530.37	917.64	90.95
NW subregion	332.59	60.99	268.22	329.22	98.98
1 km buffer	0	0	0	0	-

¹ Current extents: provided by DBCA. ² Bush Forever extent: areas that lies outside of calculated DBCA extent. ³ *Banksia* woodlands (TEC) extent is a subset of the PEC

Table 19 Extents of TECs and PECs mapped within the Part 1 project at local and regional scales taking into consideration YRE Parts 1 and 2 and ULDO

TEC/PEC	Scale	Current extent ¹ (ha)	Current extent within Part 1 DE (ha) (%)	Current extent within Part 2 DE (ha) (%)	Current extent within ULDO areas (ha)	Cumulative extent (ha) (%)
<i>Melaleuca huegelii</i> – <i>M. acerosa</i> (<i>M. systema</i>) shrublands (TEC) (SCP26a)	NW Subregion	100.84	0.53 (0.53%)	0.05 (0.05%)	0 (0%)	0.58 (0.58%)
	1 km buffer	0	0.53 (100%)	0 (0%)	0 (0%)	0.53 (100%)
<i>Banksia</i> dominated woodlands of the SCP IBRA region (PEC) ²	NW Subregion	16,836.43	14.17 (0.08%)	8.76 (0.05%)	203.01 (1.21%)	225.94 (1.34%)
	1 km buffer	0	14.17 (100%)	0 (0%)	0 (0%)	14.17 (100%)
Northern Spearwood shrublands and woodlands (PEC) (SCP24)	NW Subregion	332.59	16.05 (4.83%)	13.68 (4.11%)	0 (0%)	29.73 (8.94%)
	1 km buffer	0.00	16.05 (100%)	2.46 (100%)	0 (0%)	18.51 (100%)

¹ Current extents: provided by DBCA. ² *Banksia* woodlands (TEC) extent is a subset of the PEC.

5. Assessment of impacts – Terrestrial fauna

5.1 Fauna habitat

5.1.1 Receiving environment

Seven fauna habitat types as well as highly disturbed areas were recorded in the Part 1 DE (Table 20). Of the fauna habitat mapped within the DE, approximately 76% was considered high value, with approximately 11% considered medium value and the remaining 13% considered low value (i.e. highly disturbed areas).

Table 20 Fauna habitat types recorded in the Part 1 DE

Fauna habitat type	Habitat value	Extent in DE (ha)
<i>Acacia</i> shrubland	Medium	0.28
<i>Banksia sessilis</i> over low mixed shrubland	High	16.05
Limestone ridgeland	Medium	0.53
<i>Lomandra</i> herbland on secondary dunes	Medium	5.95
Mixed <i>Banksia</i> woodland	High	14.34
Mixed tall shrubland	High	17.71
Planted <i>Eucalyptus</i> woodland	Medium	0.11
Subtotal		54.97
Highly Disturbed	Low	8.36
Total		63.33

5.1.2 Direct impacts

The Part 1 project will result in the direct loss of up to 54.97 ha of fauna habitat. The clearing loss associated with the DE is estimated to contribute a 2.78% reduction in fauna habitat at a local scale; and as little as 0.08% and <0.01% at a region and subregional scale (Table 21).

Of the current extent remaining, there is 12.63% within conservation areas at a local scale and 53.94% and 44.81% within conservation areas at regional and bioregional scales (Table 22).

5.1.3 Cumulative considerations

Future residential, commercial and industrial development

The estimated extent of native vegetation (fauna habitat) that will be impacted by foreseeable future development in the NW Subregion and within 1 km of Part 1 is shown in Table 23.

Part 1 project

Of the 54.97 ha of fauna habitat in the Part 1 DE, 32.19 ha intersect areas likely to support future development, with the remaining 22.78 ha not currently intersecting areas considered for future land development.

Part 2 project

The Part 2 DE comprises 61.68 ha of fauna habitat. Of this 22.36 ha intersect areas likely to support future development, with the remaining 39.32 ha not currently intersecting areas considered for future land development. Of the 61.68 ha, 5.49 ha is within the Part 1 DE 1 km buffer.

Cumulative impacts

Table 23 shows the cumulative impacts on the fauna habitat at local and regional scales. The assessment shows there may be substantial pressure on the remaining fauna habitat at a local and regional scale primarily due to future residential, commercial and industrial development. The predicted cumulative impact will result in a 10.70% reduction to fauna habitat at a regional scale and 63.13% reduction to fauna habitat at a local scale. The combined impact of the Part 1 and Part 2, by comparison is predicted to reduce the current extents of fauna habitat by 3.21% at the local scale and 0.19% at the regional scale.

Table 21 Extent of native vegetation (fauna habitat) at local, regional and bioregional scales

Scale	Pre-European extent ¹ (ha)	Current extent ¹ (ha)	Remaining (%)	Extent in DE ² (ha)	% of current extent within DE	Current extent after DE developed (ha)
Perth subregion	1,117,336.01	465,369.28	41.65	54.97 (35.27)	<0.01	465,334.01 (41.65%)
NW subregion	77,112.88	42,581.90	55.22		0.08	42,546.63 (55.17%)
1 km buffer	2,395.81	1,270.37	53.02		2.78	1,235.11 (51.55%)

¹ Pre-European and Current extents: calculated using Native Vegetation Extent (DPIRD-005), Pre-European Vegetation (DPIRD-006). ² Fauna habitat mapped by GHD (2018), (fauna habitat that intersects the Native Vegetation Extent dataset).

Table 22 Current extent of native vegetation (fauna habitat) in conservation areas

Scale	Current extent ¹ (ha)	Remaining (%)	Current extent in conservation areas ² (ha)			
			DBCA	BF	Total (ha)	% of current extent
Perth subregion	465,369.28	41.65	186,970.02	21,553.29	208,523.32	44.81
NW subregion	42,581.90	55.22	16,363.90	6,606.02	22,969.92	53.94
1 km buffer	1,270.37	53.02	105.51	54.96	160.46	12.63

¹ Current extents: taken from table 21. ² DBCA extent: calculated using DBCA – Legislated Lands and Waters (DBCA-011) and DBCA – Lands of Interest (DBCA-012); BF extent: calculated using Bush Forever Areas 2000 (DOP-071) that lies outside of calculated DBCA extent.

Table 23 Extent of native vegetation (fauna habitat) at local and regional scales taking into consideration YRE Parts 1 and 2 and ULDO

Scale	Current extent (ha)	Current extent within Part 1 DE (ha) (%) ¹	Current extent within Part 2 DE (ha) (%) ¹	Current extent within ULDO areas (ha) ²	Cumulative extent (ha) (%)
NW Subregion	42,581.90	54.97 (0.08%)	61.68 (0.11%)	4,477.76 (10.52%)	4,558.03 (10.70%)
1 km buffer	1,270.37	54.97 (2.78%)	5.49 (0.43%)	761.21 (59.92%)	801.97 (63.13%)

¹ Percentages based on intersect with Native Vegetation Extent dataset. ² ULDO areas include all levels of staging for residential, commercial and industrial development where applicable.

5.2 Ecological linkages

5.2.1 Receiving environment

Two regional ecological linkages (Link No. 1 and 6) run parallel to the Part 1 DE. The Part 1 DE does not intersect either of these linkages (Figure 2).

The Part 1 DE intersects a local ecological linkage that runs east-west in the Alkimos-Eglinton Precinct, Link ID: 23 (Figure 2). The Part 1 DE intersects the Alkimos PRR, and whilst the Part 1 DE is largely contained within the section zoned 'Railways' under the MRS, several small areas extend into the Alkimos PRR. This local ecological linkage is also intersected by the existing Marmion Avenue and Wanneroo Road.

5.2.2 Direct impacts

The Part 1 DE will impact 2.50 ha of the local ecological linkage. Of the 2.50 ha, 1.81 ha is contained within the railway reserve with 0.69 ha extending into the Alkimos PRR. Of the 2.50 ha, 2.06 ha comprises native vegetation in Degraded or better condition with the remaining 0.43 ha comprising scattered natives in Completely Degraded condition. Whilst the Part 1 DE is largely contained within the section zoned 'Railways' under the MRS, it will create an additional barrier within the local ecological linkage.

5.2.3 Cumulative considerations

Future residential and industrial development

There are no foreseeable impacts to the local ecological linkage by future development within a 1 km buffer of the Part 1 project.

Part 1 project

The Part 1 DE will result in the loss of 2.06 ha of the local ecological linkage. The Part 1 DE will also create an additional barrier within the local ecological linkage.

Part 2 project

The Part 2 DE does not intersect any regional ecological linkages as shown in the Regional Ecological Linkages for the PMR. However, the Part 2 DE intersects a regional ecological linkage shown in the City of Wanneroo Local Biodiversity Strategy 2018/19 – 2023/24, Link ID: 0. This linkage runs east-west and connects coastal reserves to Yanchep National Park, including Bush Forever Sites No. 289 and 397.

Cumulative impacts

The Part 1 project will reduce the local ecological linkage (Link ID: 23), by removing approximately 2.25% of this linkage, with no other foreseeable future development contributing additional impacts. The remaining extent of the Alkimos PRR post-Part 1 development is 89.08 ha.

5.3 Carnaby's Cockatoo

5.3.1 Receiving environment

The Part 1 project is located within the modelled feeding and breeding distribution for Carnaby's Cockatoo (DSEWPac 2012). Suitable foraging habitat for Carnaby's Cockatoo was recorded in the DE. Table 24 provides a breakdown of Carnaby's Cockatoo foraging habitat recorded in the DE by value.

Approximately 75% of the DE provides medium or high value foraging habitat for Carnaby's Black Cockatoo. The remaining areas in the DE are highly disturbed or comprise fauna habitat types not considered suitable for Carnaby's Cockatoo foraging.

Table 24 Black Cockatoo habitat types and value recorded in the Part 1 DE

Habitat type	Habitat value	Extent in DE(ha)
Foraging	High	30.39
	Medium	17.82
Total		48.21

The DE is located within a buffer of a confirmed breeding area. It would appear the known breeding record is approximately 4 km north east of the DE (based on the Carnabys Cockatoo Breeding Areas Confirmed dataset). There are two confirmed roosting areas approximately 2.2 km and 3.5 north east of the DE; there is also one unconfirmed roosting area approximately 2.7 km north east of the DE. With the exception of the unconfirmed roosting area, all of these records are from Yanchep National Park.

5.3.2 Direct impacts

The Part 1 DE will result in the direct loss of up to 48.21 ha of foraging habitat. The clearing loss associated with the DE is estimated to contribute a 2.76% reduction in foraging habitat at a local scale and 0.10% reduction in foraging habitat at a regional scale (Table 25).

Of the current extent remaining, there is 12.57% of foraging habitat within conservation areas at a local scale and 80.13% of foraging habitat within conservation areas at regional scale (Table 26).

5.3.3 Cumulative considerations

Future residential, commercial and industrial development

The estimated extent of Carnaby's Cockatoo foraging habitat that will support future development in the NW Subregion and within 1 km of Part 1 is shown in Table 27.

Part 1 project

The Part 1 DE comprises 48.21 ha of Carnaby's Cockatoo foraging habitat. Of this 24.03 ha intersects areas likely to support future development, with the remaining 24.18 ha not currently intersecting areas considered for future land development.

Part 2 project

The Part 2 DE comprises 56.13 ha of Carnaby's Cockatoo breeding and/or foraging habitat. Of this 15.49 ha intersects areas likely to support future development, with the remaining 40.82 ha not currently intersecting areas considered for future land development. Of the 56.13 ha 5.49 ha is within the Part 1 DE 1 km buffer.

Cumulative impacts

Table 27 shows the cumulative impacts on Canaby's Cockatoo foraging habitat at a local and regional scale. The project will reduce the available habitat for Carnaby's Cockatoo foraging by 3.32% or less, however, it is considered future development will have a much larger impact on the available habitat for Carnaby's Cockatoo, particularly at a local scale (59.88%).

Table 25 Extents of Carnaby's Cockatoo foraging habitat at local and regional scales

Scale	Current extent (ha)	Extent in DE (ha) ¹	% of current extent within DE	Current extent after DE developed (ha)
NW subregion	25,808.75	48.21 (27.10)	0.10	25,781.65
1 km buffer	982.44		2.76	955.34

¹ Carnaby's Cockatoo foraging habitat mapped by GHD (2018), (Carnaby's Cockatoo foraging habitat that intersects the Native Vegetation Extent dataset).

Table 26 Current extents of Carnaby's Cockatoo foraging habitat in conservation areas

Scale	Current extent (ha) ¹	Current extent in conservation areas ² (ha)			
		DBCA	BF	Total (ha)	% of current extent
NW subregion	25,808.75	15,088.44	5,593.07	20,681.51	80.13
1 km buffer	982.44	79.17	44.37	123.54	12.57

¹ Current extents: taken from table 25. ² DBCA extent: calculated using DBCA – Legislated Lands and Waters (DBCA-011) and DBCA – Lands of Interest (DBCA-012); BF extent: calculated using Bush Forever Areas 2000 (DOP-071) that lies outside of calculated DBCA extent.

Table 27 Extents of Carnaby's Cockatoo foraging habitat at local and regional taking into consideration YRE Parts 1 and 2 and ULDO

Scale	Current extent (ha)	Current extent within Part 1 DE (ha) (%) ¹	Current extent within Part 2 DE (ha) (%) ¹	Current extent within ULDO areas (ha) ²	Cumulative extent (ha) (%)
NW Subregion	25,808.75	48.21 (0.10%)	56.31 (0.15%)	2,426.39 (9.40%)	2,493.41 (9.66%)
1 km buffer	982.44	48.21 (2.76%)	5.49 (0.56%)	555.71 (56.56%)	588.29 (59.88%)

¹ Percentages based on intersect with Native Vegetation Extent dataset. ² ULDO areas include all levels of staging for residential, commercial and industrial development where applicable.

6. Assessment of impacts – Landforms

6.1 Parabolic dune formation

6.1.1 Receiving environment

The Alkimos dune system represents parabolic dunes belonging to the Quindalup dune system. The project intersects parabolic dune formations along its length.

There is 21.48 ha of parabolic dune formations present within the Alkimos PRR and rail reserve associated with the local ecological linkage.

6.1.2 Direct impacts

The remaining extent of parabolic dune formations at a local and regional scale is greater than 65.26% of the mapped pre-European extent (Table 28). However, less than 30% of the remaining extent occurs in conservation areas (DBCA Legislated Lands and Bush Forever) at both scales (29.82% at a regional scale and 4.28% at a local scale) (Table 29).

Clearing the Part 1 DE will reduce the current parabolic dune formation extent by less than 6.98 ha, which equates to 3.23% at a local scale and 0.20% at a regional scale (Table 28). Of the 6.98 ha, 0.66 ha is within the rail reserve (associated with the local ecological linkage) and 0.10 ha is within the Alkimos PRR, reducing the current parabolic dune formation extent within the Alkimos PRR by 3.55%.

6.1.3 Cumulative considerations

Future residential, commercial and industrial development

The estimated extent of parabolic dune formations that will be impacted by future development in the NW Subregion and within 1 km of the project is shown in Table 30.

Part 1 project

The Part 1 DE intersects 6.98 ha which currently support parabolic dune formations. Of this, 5.87 ha intersect areas likely to support future development, with the remaining 1.11 ha (supporting current parabolic dune formations) not currently intersecting areas considered for future land development.

Part 2 project

The Part 2 DE intersects 17.54 ha which currently support parabolic dune formations. Of this, 8.53 ha intersects area likely to support future development, with the remaining 9.04 ha (supporting current parabolic dune formations) not currently intersecting areas considered for future land development. Of this 17.54 ha, 0.35 ha is within the Part 1 DE 1 km buffer.

Cumulative impacts

Table 30 shows the cumulative impacts on parabolic dune formations at a local and regional scales. The Part 1 DE will impact parabolic dune formations, however, it is considered future development will have a much larger impact on the areas supporting current parabolic dune formations at both local and regional scales (72.19% at a local scale and 63.76% at a regional scale).

Table 28 Extent of parabolic dune formation at local and regional scales

Scale	Pre-European extent (ha)	Current extent (ha)	Remaining (%)	Extent in DE (ha)	% of current extent within DE	Current extent after DE developed (ha) (%)
NW subregion	5,433.49	3,545.82	65.26	6.98	0.20	3,538.83 (65.13%)
1 km buffer	246.87	216.04	87.51		3.23	209.06 (84.68%)

Table 29 Current extent of parabolic dune formation in conservation areas

Scale	Current extent ¹ (ha)	Remaining (%)	Current extent in conservation areas ² (ha)			
			DBCA	BF	Total (ha)	% of current extent
NW subregion	3,545.82	65.26	59.76	997.75	1,057.50	29.82
1 km buffer	216.04	87.51	9.24	-	9.24	4.28

¹ Current extents: taken from table 28. ² DBCA extent: calculated using DBCA – Legislated Lands and Waters (DBCA-011) and DBCA – Lands of Interest (DBCA-012); BF extent: calculated using Bush Forever Areas 2000 (DOP-071) that lies outside of calculated DBCA extent.

Table 30 Extents of parabolic dune formation at local and regional taking into consideration YRE Parts 1 and 2 and ULDO

Scale	Current extent (ha)	Current extent within Part 1 DE (ha) (%)	Current extent within Part 2 DE (ha) (%)	Current extent within ULDO areas (ha)	Cumulative extent (ha) (%)
NW Subregion	3,545.82	6.98 (0.20%)	17.54 (0.49%)	2,236.30 (63.07%)	2,260.82 (63.76%)
1 km buffer	216.04	6.98 (3.23%)	0.35 (0.16%)	148.62 (68.80%)	155.96 (72.19%)

7. Conclusions

7.1 Significance of direct impacts from the Part 1 project

At a local level, the Part 1 project has a more significant impact than when compared to a regional scale. This outcome is not unexpected given the existing development in the immediate area and a lack of conservation areas within a 1 km buffer of the Part 1 project. Whereas when the regional context is considered, the significance of these impacts are reduced.

The development of the Part 1 project is not expected to reduce any of the vegetation associations and complexes (and associated fauna habitat) mapped with the Part 1 DE below 30% of their pre-European extents. Furthermore, all of these vegetation associations and complexes occur within conservation areas at all scales and therefore are afforded some level of protection.

The Part 1 project will remove State and Federally listed TECs and PECs. At a bioregional and regional scale the Part 1 project will reduce TECs and PECs recorded in the DE by less than 4.83%. However, at a local scale the Part 1 project will reduce the Northern Spearwood shrublands and woodlands (PEC) (SCP24), the *Banksia* dominated woodlands of the SCP IBRA region (PEC) and *Melaleuca huegelii* – *M. acerosa* (*M. systema*) shrublands (TEC) (SCP26a) by 100%. This impact is a reflection of the limited extent of these communities within a 1 km buffer of the DE. It is noted at the regional and bioregional scales these communities have greater than 35% of their current extents within conservation areas. However, given the level of protection afforded to these communities the regulator may still consider any impact significant.

The Part 1 project will impact on a local ecological linkages. The associated loss of vegetation with respect to the local ecological linkage is relatively small, but the introduction of an additional barrier within the local ecological linkage is likely to reduce its function. However, will not create a barrier of greater than 500 m between viable natural areas. Furthermore, there are existing barriers within the linkage therefore the cumulative impact of the Part 1 project is likely to be reduced.

The development of the Part 1 project will impact on parabolic dune formations. The associated loss of the dune formations is relatively small (less than 0.20% at a regional scale) and is not anticipated to adversely affect the function at this scale.

7.2 Cumulative considerations with respect to significance of the Part 1 project impacts

The Draft Perth and Peel@3.5million identified the NW subregion as one of the fastest growing areas in the Perth and Peel regions. It is anticipated that this will be the case over the long-term (to 2050) as the subregion has a significant supply of undeveloped Urban and Urban Deferred zoned land available, predominately within the coastal urban growth corridor. The Draft Perth and Peel@3.5million also notes that to provide the capacity to accommodate projected population growth, transit corridors should be identified as a priority for increased density.

The proposed urban growth in the NW subregion, (acknowledging not all is approved at a State level under environmental assessment) will have significant environmental impacts. However, it is reasonable to assume strategic growth will continue, with increasing need/demand for transport networks. The contribution of the YRE project to the various environmental impacts considered in this report are minimal by comparison to the proposed urban growth.

8. References

Beard, JS 1979, Vegetation Survey of WA: the Vegetation of the Perth Area WA, map and explanatory memoir 1:250,000 series, Applecross, Vegmap Publications.

City of Wanneroo 2018, Local Biodiversity Strategy 2018/19 – 2023/24, retrieved January 2019, from

https://www.wanneroo.wa.gov.au/downloads/file/1193/local_biodiversity_plan_201819_%E2%80%93_202324.

Commonwealth of Australia 2017, Revised draft referral guideline for three threatened black cockatoo species: Carnaby's Cockatoo, Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo, Department of the Environment and Energy.

Del Marco A, Taylor R, Clarke K, Savage K, Cullity J and Miles C 2004, Local Government Biodiversity Planning Guidelines for the Perth Metropolitan Region, Perth, Western Australian Local Government Association.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2012, *EPBC Act referral guidelines for three threatened black cockatoo species*, Canberra, Australia, Department of Sustainability, Environment, Water, Population and Communities.

GHD 2018, Yanchep Rail Extension, Biological Assessment, unpublished report prepared for the PTA, January 2018.

Glossop B, Clarke K, Mitchell D and Barrett, G 2011, Methods for mapping Carnaby's cockatoo habitat, Department of Environment and Conservation, Perth.

Government of Western Australia (GoWA) 2000, Bush Forever Volume 2, Directory of Bush Forever Sites Perth, Perth, Department of Environmental Protection.

Government of Western Australia (GoWA) 2018a, Data WA, retrieved April and December 2018, from <http://www.data.wa.gov.au/>.

Government of Western Australia (GoWA) 2018b, *2017 South West Vegetation Complex Statistics*, Current as of October 2017, Perth, Australia, Department of Biodiversity, Conservation and Attractions, retrieved April 2018, from <https://catalogue.data.wa.gov.au/dataset/dbca>.

Government of Western Australia (GoWA) 2018c, *2017 Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full Report)*, current as of December 2017, WA Department of Biodiversity, Conservation and Attractions, retrieved April 2018, from <https://catalogue.data.wa.gov.au/dataset/dbca-statewide-vegetation-statistics>.

Hedde, EM, Loneragan. OW and Havel JJ 1980, Vegetation Complexes of the Darling System, WA, in Atlas of Natural Resources, Darling System WA, Department of Conservation and Environment.

Webb, A, Kinloch J, Keighery, G and Pitt, G 2016, The extension of vegetation complex mapping to landform boundaries within the Swan Coastal Plain landform and forested region of south-west Western Australia, Department of Biodiversity, Conservation and Attractions, Perth.

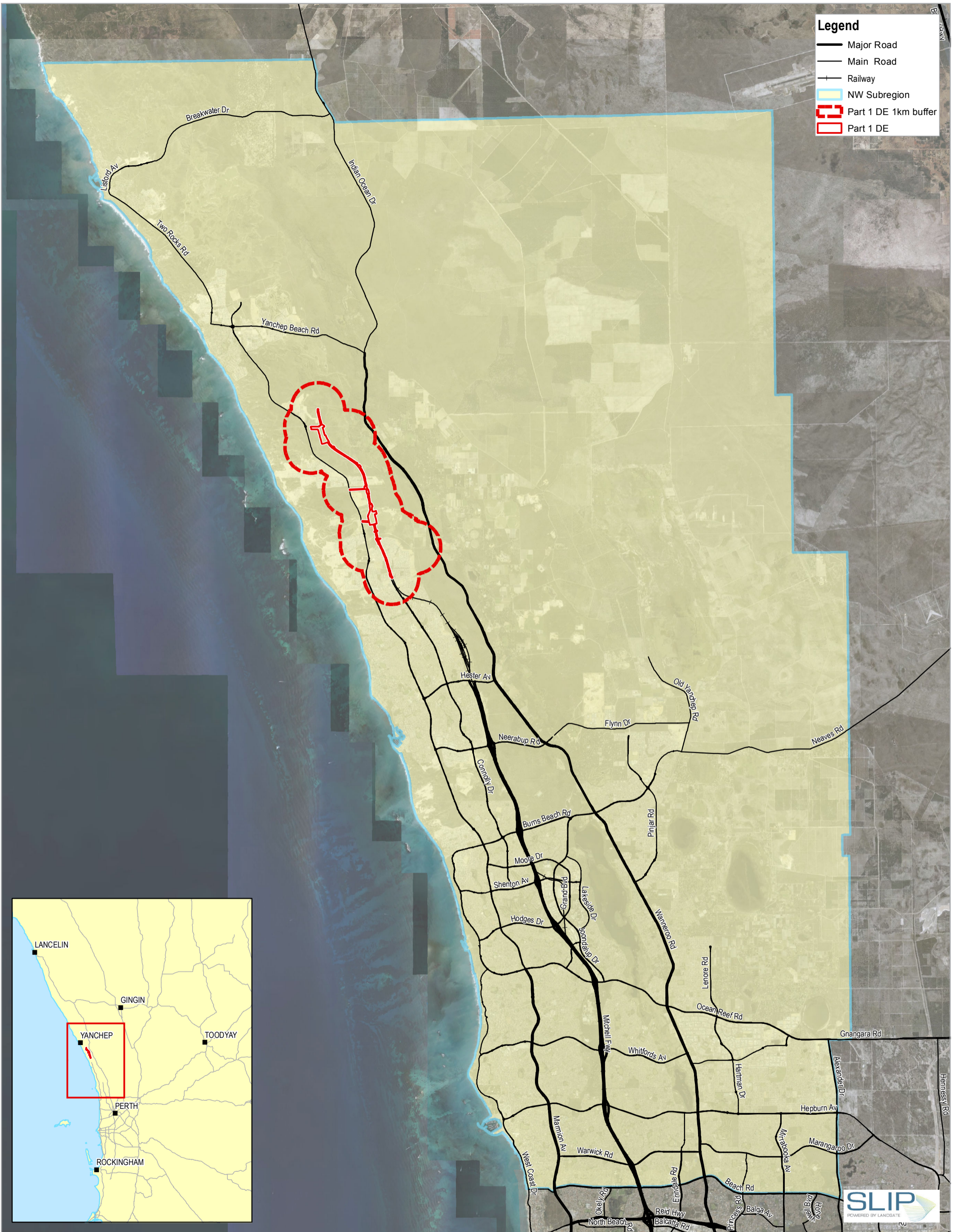
Appendices

Appendix A – Figures







Figure 1 Project locality and scales

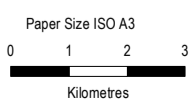
Figure 2 Local and regional context

Figure 3 Cumulative considerations

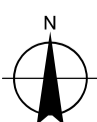


Legend

-  Major Road
-  Main Road
-  Railway
-  NW Subregion
-  Part 1 DE 1km buffer
-  Part 1 DE



Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 50

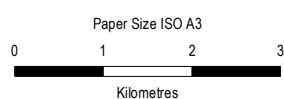
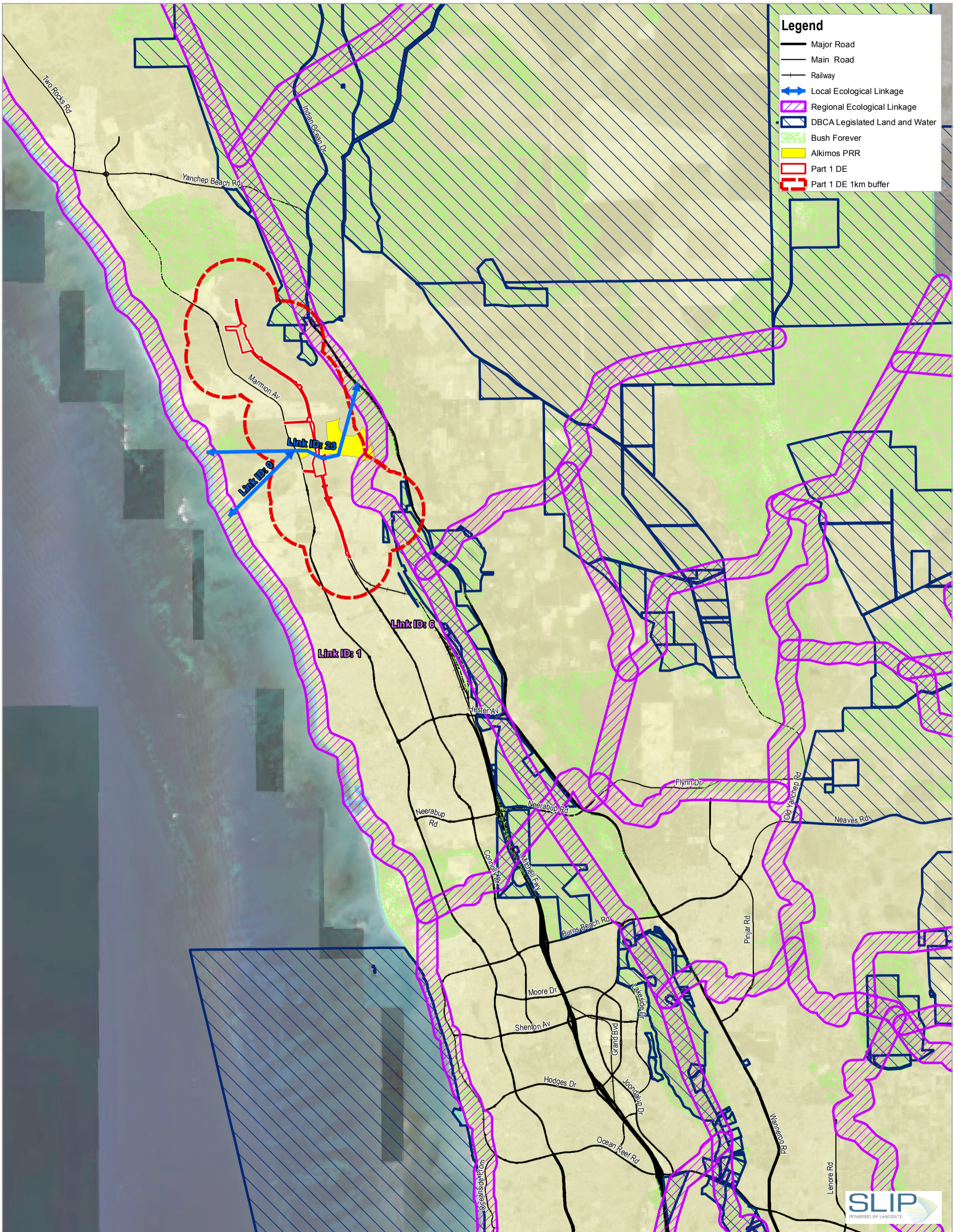


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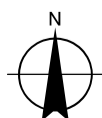
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Project locality and scales

FIGURE 1



Map Projection: Transverse Mercator
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 Grid: GDA 1994 MGA Zone 50

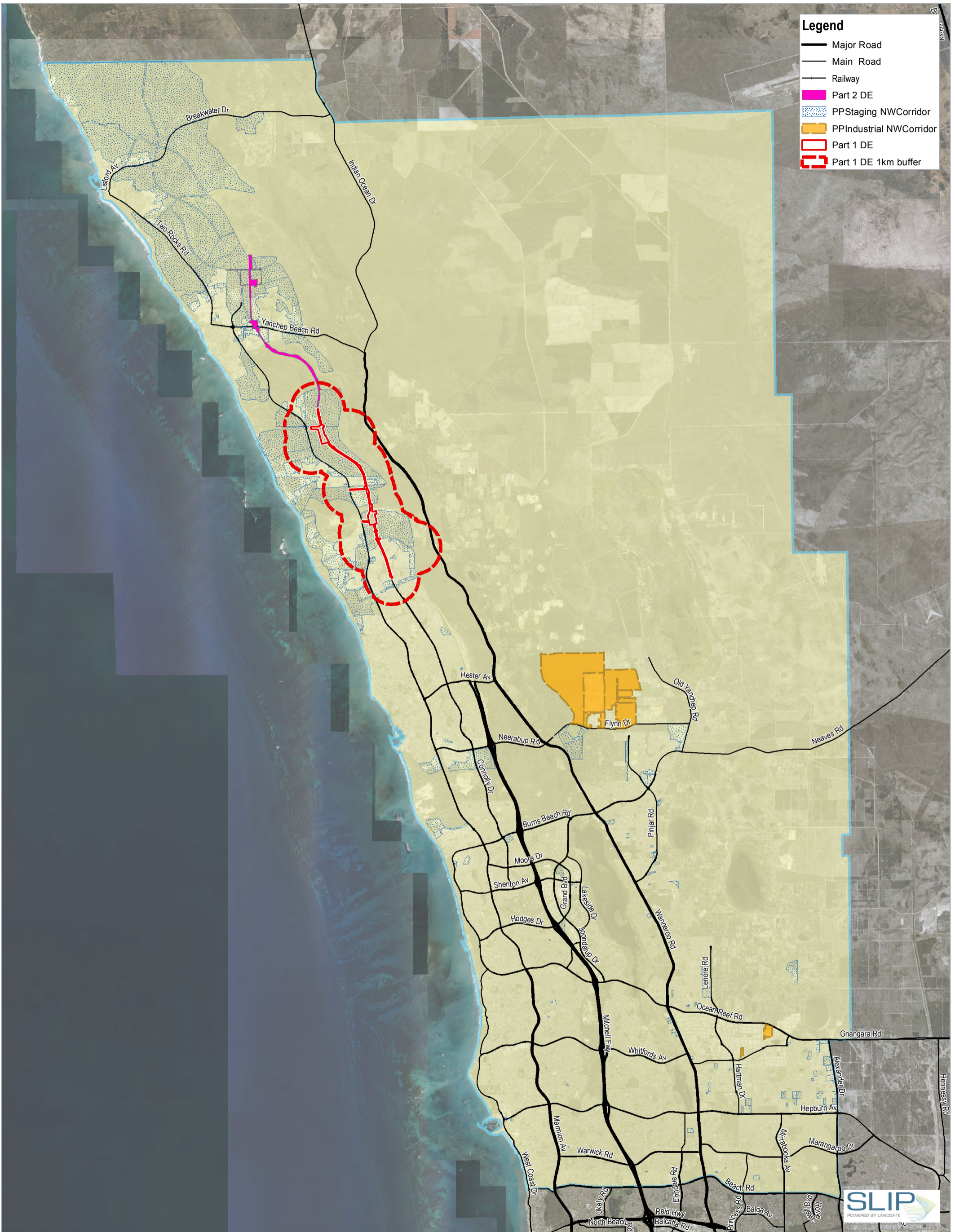


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Local and regional context

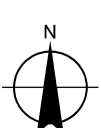
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FIGURE 2



Legend

- Major Road
- Main Road
- Railway
- Part 2 DE
- PP Staging NW Corridor
- PP Industrial NW Corridor
- Part 1 DE
- Part 1 DE 1km buffer



Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 50

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Cumulative considerations

FIGURE 3

GHD

Level 10

999 Hay Street

T: 61 8 6222 8222 F: 61 8 6222 8555 E: permail@ghd.com


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Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	J Tindiglia	D Farrar		D Farrar		1/06/2018
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2	J Tindiglia	D Farrar		D Farrar		8/06/2018
3	J Tindiglia	D Farrar		D Farrar		14/06/2018
4	J Tindiglia	D Farrar		D Farrar		08/02/2019
5	J Tindiglia	D Farrar		D Farrar		1/03/2019
6	J Tindiglia	D Farrar		D Farrar		8/03/2019

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