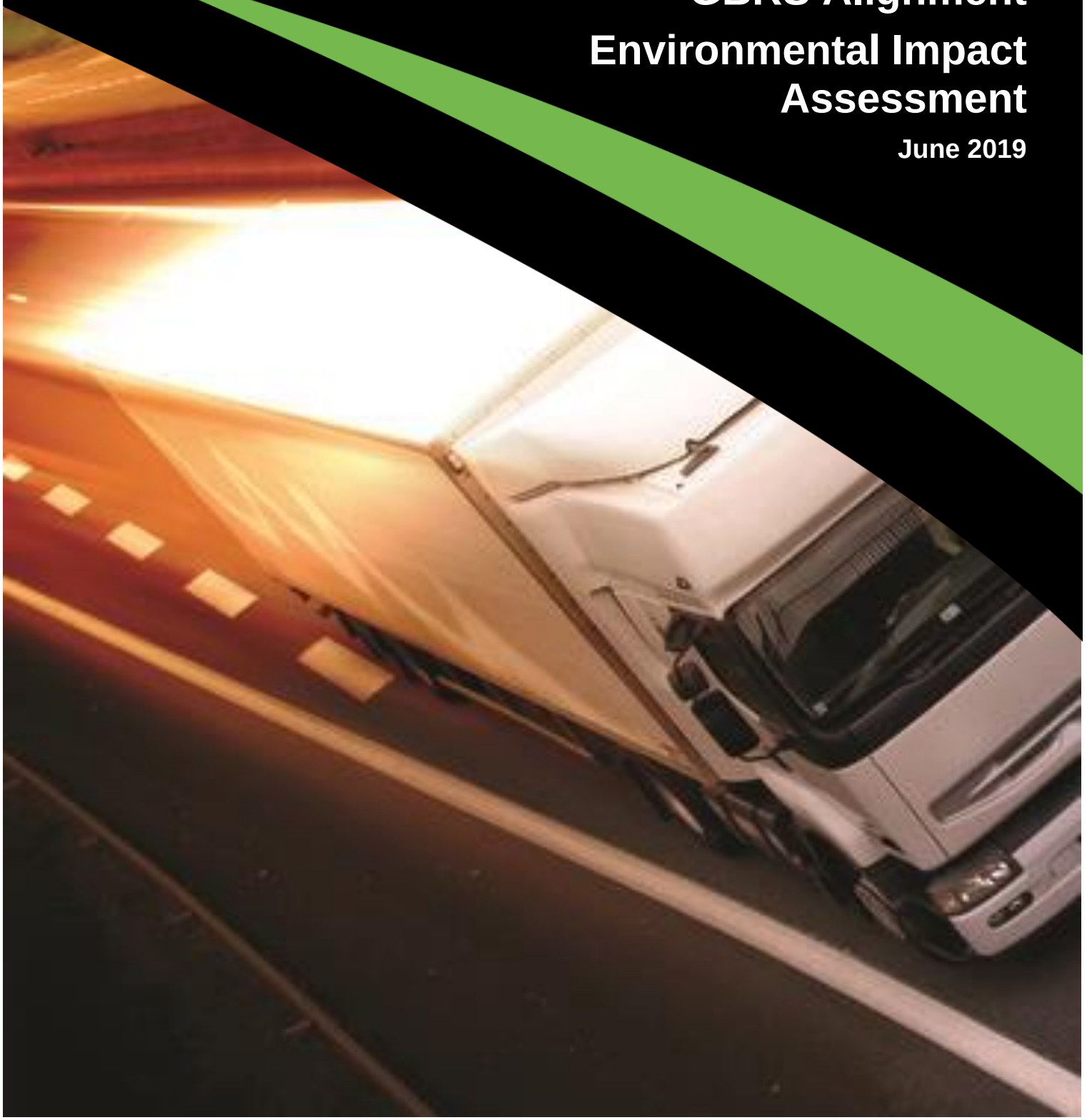
BORR Team

Bunbury Outer Ring Road Southern Section

GBRS Alignment

Environmental Impact Assessment

June 2019



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Revision	Date	Description	Prepared	Reviewed	Approved
A	15/2/2019	Draft for Main Roads Review	BORR Team	FH	PM
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1 INTRODUCTION

1.1 Background

The Commissioner of Main Roads Western Australia (Main Roads) is planning for the construction of the Bunbury Outer Ring Road (BORR) Project. BORR is a planned Controlled Access Highway linking the Forrest Highway and Bussell Highway. The completed BORR will provide a high standard route for access to the Bunbury Port and facilitate proposed development to the east of the City of Bunbury. BORR will also provide an effective bypass of Bunbury for inter-regional traffic.

BORR forms a major component of the planned regional road network for the Greater Bunbury area. The land requirement for BORR is identified in the Greater Bunbury Region Scheme (GBRS).

The proposed BORR comprises three sections:

- 'BORR Northern Section' – Forrest Highway to Boyanup-Picton Road
- 'BORR Central Section' – Boyanup-Picton Road to South Western Highway, an existing 4 km section which was completed in May 2013, along with a 3 km extension of Willinge Drive southwards to South Western Highway
- 'BORR Southern Section' – South Western Highway (near Bunbury Airport) to Bussell Highway.

The alignment of BORR Northern and Central Sections is planned from Forrest Highway to South Western Highway and was referred as a single project to the Environmental Protection Authority (EPA) on 6 June 2019. BORR Southern Section will provide a highway link between South Western Highway and Bussell Highway and will link with BORR Northern and Central sections to the Port Access Road (PAR).

Main Roads referred BORR Southern Section to the EPA for assessment under Section 38 of the *Environmental Protection Act 1986* (EP Act) in November 2012. In February 2013, the EPA determined that BORR Southern Section did not require formal environmental assessment under Part IV of the EP Act and that BORR Southern Section could progress under Part V of the EP Act and other relevant legislation. Clearing of native vegetation for the Southern Section would be approved under a Purpose Clearing Permit. An application for the clearing permit was submitted in December 2015 and withdrawn prior to a decision being made in June 2017.

Main Roads also referred BORR Southern Section to the Commonwealth Minister for the Environment through the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC, now Department of the Environment and Energy (DotEE)) for a decision on the requirement for formal assessment under the provisions of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). In March 2013, the Department of the Environment (DotE now DotEE) advised that BORR Southern Section was considered a Controlled Action and would be assessed through preliminary documentation. Main Roads has since withdrawn the referral from DotEE assessment.

In response to changes to the EPBC Act's protection status of the Western Ringtail Possum in May 2018, from 'Vulnerable' to 'Critically Endangered', Main Roads identified that the approval to construct BORR Southern Section with the GBRS Alignment may need to be reconsidered. To address this concern, Main Roads commissioned an Environmental Options Assessment of five options for an alternative route for the BORR Southern Section (BORR IPT, 2018).

The Environmental Options Assessment confirmed that significant environmental factors for BORR Southern Section alignments included the clearing of native vegetation and the consequent removal of fauna habitat (BORR IPT, 2018).

Based on outcomes of the options assessment two alignments were selected for further investigation. These were:

- BORR Southern Section GBRS Alignment
- BORR Southern Section Alternative Alignment.

A suite of field investigations was undertaken on both alignments in Q3 and Q4 of 2018.

For the purposes of comparing the environmental impact of these two alignment options, this assessment considers a dual carriageway highway from Hasties Road in Gelorup to Yeardy Road in Stratham. It should be noted that the alignments are preliminary in design and further refinement will be undertaken during the detailed design phase.

1.2 Purpose of this document

To inform the decision of the preferred Project footprint, Main Roads WA commissioned an Environmental Impact Assessment (EIA) for each of the two alignment options.

This EIA presents the environmental values and potential impact of the construction and operation of a preliminary BORR Southern Section GBRS Alignment (referred to as 'the Project' in this report). It should be noted that the alignment for the BORR Southern Section GBRS Alignment that is subject of this assessment, differs to the alignment subject of the 2012 referral. Due to the changes in the footprint and changes in status of threatened species and communities potentially impacted by the Project, this EIA supersedes the referral document and impact assessment associated with the 2012 alignment.

Main Roads used the findings in this EIA to assist in their determination of the preferred BORR Southern Section alignment. The selected alignment will be subject to environmental assessment and reporting for approvals processes under the EP and EPBC Acts. Revision of the environmental impacts (to support the referral and assessment) will be undertaken as necessary to incorporate any change in the Project footprint following the detailed design phase.

This EIA addresses the Principles and Factors of Section 4A of the EP Act and is structured around the EPA's "*Instructions on how to prepare an Environmental Review Document*" (EPA, 2018a).

1.3 Project description

The Project is located 10 km south of Bunbury in the Shire of Capel and City of Bunbury. The Project is shown in Figure 1 and comprises the following elements:

- Construction of a 14.2 km dual carriageway highway between Hasties Road and Yeardy Road
- Construction of interchanges at:
  - Bussell Highway (in the form of a Y-interchange)
  - Boyanup Road West/Fishermans Road (in the form a dumbbell interchange)
- Construction of a road overpass and associated road works at Yalinda Drive
- Upgrade of 26.5 km of service/local roads including:
  - Realignment of Calinup Road
  - Connection of Jilley Road to Ducane Road
- Construction of drainage structures including basins and culverts
- Construction of 5.8 km of Principal Shared Path including a pedestrian bridge over Bussell Highway at Lakes Road
- Installation of fencing and noise walls/treatments
- Service relocation and protection

- Construction of access roads to severed properties
- Pre-construction activities including geotechnical investigations and service utilities relocations
- Landscaping and rehabilitation works.

1.3.1 Project Area

The Project Area covers approximately 190 ha and is the boundary for this EIA (Figure 1). The majority of the Project Area is cleared land comprising of previously constructed roads and includes an approximately 80-100 m wide corridor for the dual carriageway and associated infrastructure. Pockets of native vegetation are present within the Project Area in road reserves or as isolated patches on agricultural land.

1.3.2 Surveyed and Unsurveyed areas

Access to the entire Project Area was not available when the environmental field surveys were undertaken in 2018 and the study areas differed slightly for each environmental field survey. As a result, approximately 53 % of the Project Area was not surveyed during field investigations (Figure 2).

Unsurveyed areas (identified in Sections 3.3 and 3.4) have undergone desktop investigations to inform this EIA. Additional field investigations will be completed in unsurveyed areas if this alignment is chosen for development as part of the formal environmental assessment.

The Southern section (Alternative Alignment) Study Area overlaps the Project Area by approximately 17 ha, therefore the total area surveyed within the Project Area was just under 90 ha.

Table 1-1 outlines the areas surveyed and gaps within the Project Area during the 2018 field surveys. Interpretation of aerial imagery identifies that the majority of the unsurveyed area is likely to be in Degraded or Worse condition. Two unsurveyed areas (Bourne Loop to Bussell Highway (approximately 4 ha) and Ramsey Road (<1 ha)) are likely to be in Good or Better condition.

Table 1-1 Project Area, Surveyed and Unsurveyed areas in the 2018 field surveys

	AREA
Project Area – Southern section (GBRS Alignment)	189.6 ha
Study Area – Southern section (GBRS Alignment) flora and fauna (excluding contextual sites) field surveys	Approx. 297 ha
Surveyed Area (Southern section – GBRS Alignment) intersecting the Project Area	73.0 ha
Surveyed Area (Southern section – Alternative Alignment) intersecting the Project Area	16.5 ha
Unsurveyed Area – Gap in survey effort within the Project Area)	100.1 ha

1.4 Legislative framework

A summary of the anticipated regulatory approvals required for the establishment of the Project is provided in Table 1-2.

Table 1-2 Summary of regulatory approval requirements for BORR Southern Section

PROJECT ACTIVITIES	TYPE OF APPROVAL	REGULATORY AGENCY	LEGISLATION REGULATING THE ACTIVITY
Potentially significant impacts to the environment	Division 1 of Part IV of the EP Act - referral and assessment of significant and strategic proposals Approval type to be determined if the Project is Assessed, Assessed on Referral Information or Not Assessed	Environmental Protection Authority (EPA)	EP Act
Impacts to matters of National Environmental Significance (MNES)	Referral of a Project – Approval type to be determined if the Project is deemed a Controlled Action	Department of the Environment and Energy (DotEE)	EPBC Act
Clearing of Native Vegetation	Native Vegetation Clearing Permit	Department of Water and Environment Regulation (DWER)	EP Act, Part V Div 2, EP (Clearing) Regulations 2004
Impacts to flora and fauna	Approval to take flora and fauna (if required)	Department of Biodiversity Conservation and Attractions	*Biodiversity Conservation Act 2016* (BC Act), Biodiversity Conservation Regulations 2018
Impacts to waterways	Bed and Banks Permit	DWER	*Rights in Water and Irrigation Act 1914* (RIWI Act)
Sourcing of construction water	Licence to take	DWER	RIWI Act
Impacts to Registered/Lodged Aboriginal Heritage sites	Section 18 consent	Department of Planning, Lands and Heritage	*Aboriginal Heritage Act 1972*
Impacts to Municipal heritage site	Consent from Shire	Shire of Capel	-

1.5 Limitations and assumptions

This report has been prepared by Bunbury Outer Ring Road Integrated Project Team (BORR IPT) for Main Roads and may only be used and relied on by Main Roads for the purpose agreed between BORR IPT and Main Roads, as set out in Section 1.2 of this Report.

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

The services undertaken by BORR IPT 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. BORR IPT 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 BORR IPT described in this report. BORR IPT disclaims liability arising from any of the assumptions being incorrect.

BORR IPT has prepared this report on the basis of information provided by Main Roads and others who provided information to BORR IPT (including Government authorities), which BORR IPT has not independently verified or checked beyond the agreed scope of work. BORR IPT 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.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of infrastructure, services and vegetation, and access. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions may change after the date of this Report. BORR IPT does not accept responsibility arising from, or in connection with, any change to the site conditions. BORR IPT is also not responsible for updating this report if the site conditions change.

This report has assessed the environmental impact within the Project Area, as shown in Figure 1.

Approximately 53 % of the Project Area (100ha) was inaccessible during the 2018 environmental field investigations and not surveyed. Desktop assessments were undertaken to identify potential impacts of the Project in the following unsurveyed areas:

- Lakes road
- Minninup Road / Maidment Parade
- Jilley Road
- Additional sections in agricultural land near Ducane Road and Jilley Road
- Additional section north of Calinup Road between Brockway Drive and Bussell Highway
- Jaymon Road
- Eucalypt Drive
- Brockway Drive
- Ramsay Road
- Child Place
- 120 m north of the Project Area on Bussell Highway
- The southern end of the Project on Bussell Highway from Capel Golf Course to Yeardy Road, approximately 6.8 km, including intersection with Boyanup Road West and Fishermans Road
- New access road linking to Bourne Loop from Bussell Highway.

If this alignment is chosen for development, additional field surveys will be conducted for these areas as part of the formal environmental assessment process.

2 STAKEHOLDER CONSULTATION

Main Roads has been engaged in consultation with key stakeholders since the mid-1990s for the entire 'BORR Project'. Previous consultation has been undertaken by Main Roads with key stakeholders including:

- Technical Working Group: with engineering and planning representatives from Main Roads, the City of Bunbury, the Department of Planning, the Department of Environment and Conservation, the Shire of Capel and the Shire of Dardanup
- BORR Stakeholder Group: State and local government agencies that met as required and included: City of Bunbury (CEO, Mayor), Shire of Capel (CEO, Shire President), Shire of Dardanup (CEO, Shire President), Bunbury Port Authority, South West Development Commission (SWDC), Bunbury Chamber of Commerce and John Castrilli (Member for Bunbury)
- Consultation with: Department of Planning, Lands and Heritage (DPLH) (formerly Department of Planning), Public Transport Authority, Local Government, Service Authorities
- Consultation with environmental stakeholders including:
  - Commonwealth DotEE (formerly Department of Sustainability Environment, Water, Population and Communities)
  - DBCA (formerly Department of Environment and Conservation)
  - DWER (formerly Department of Water and Office of the EPA).

Stakeholder and community engagement is continuing with landowners and local residents, communities of interest, local government authorities and State Government agencies. During 2018, Main Roads consulted with key stakeholders to discuss 'BORR Project' issues and potential impacts, including environmental, heritage (Aboriginal and European), social and economic impacts.

A summary of consultation completed to date is provided in Table 2-1. Regulatory agencies consulted to date are shown in Table 2-2. A summary of the key concerns raised during stakeholder consultation is provided in Table 2-3, along with Main Roads responses.

Table 2-1 Consultation summary to date

STAKEHOLDER CONSULTATION	DATE	PARTICIPANT AGENCIES
Investment Logic Mapping (ILM) Workshop	4 December 2017	• Main Roads • South West Development Commission • Great Southern Ports • Qube (bulk minerals sand transporter).
Project Steering Committee	June 2018 – ongoing (bi-monthly)	• Chaired by MD Main Roads • Main Roads' Project Director • Department of Treasury • DPLH • Department of Infrastructure, Regional Development and Cities • Others by invitation.
Project Enabling Group	June 2018 – ongoing (bi-monthly)	• Chaired by Main Roads' Executive Director Planning and Technical Services • City of Bunbury • Shire of Capel • Shire of Harvey • Shire of Dardanup • DPLH • BORR IPT.
BORR Regional Local Government Advisory Group (RLGAG)	August 2018 – ongoing (quarterly or at Key Milestones)	• Chaired by Main Roads' Executive Director Planning and Technical Services • City of Bunbury • Shire of Capel • Shire of Harvey • Shire of Dardanup • BORR IPT.
Economic Advisory Group	October 2018 – ongoing (at Key Milestones)	• City of Bunbury • Bunbury Geographe Economic Alliance (BGEA) • South West Development Commission (SWDC) • Regional Development Australia South West (RDASW) • Chamber of Minerals and Energy • Wespine • Bunbury Geographe Chamber of Commerce and Industry • Main Roads • BORR IPT.
Drainage Reference Group	August 2018 – ongoing (at Key Milestones)	• DBCA – Parks and Wildlife Service • DWER • Water Corporation • City of Bunbury • Shire of Capel • Shire of Dardanup • Shire of Harvey • Department of Primary Industries and Regional Development (DPIRD) • Harvey Water

STAKEHOLDER CONSULTATION	DATE	PARTICIPANT AGENCIES
		• Leschenault Catchment Council • South West Catchments Council • BORR Team • Main Roads.
Freight and Road Users Group	August 2018 – ongoing (at Key Milestones)	• City of Bunbury • Shire of Capel • Shire of Dardanup • DFES • DPLH • Department of Transport • Freight and Logistics Council WA • Livestock & Rural Transport Association • Public Transport Authority • RAC WA • WA Pilot Drivers Association.
Local Members meetings	Ongoing	• Member for Bunbury, Don Punch • Member for Collie - Preston, Mick Murray • Member for Murray - Wellington, Robyn Clarke • Nola Marino - Federal Member • Adele Farina, MLC.
BORR – Bunbury Freight Access Enhancement – Options workshop	25 January 2018	• Department of Transport.
Presentation to Chamber of Commerce	14 November 2018	• Main Roads • Chamber of Commerce • BORR IPT.
Shire Project Briefing Meetings	May 2018 – ongoing (at Key Milestones)	• City of Bunbury • Shire of Capel • Shire of Dardanup • Shire of Harvey • Main Roads • BORR IPT.
Gnaala Karla Boodja WC1998/058 Native Title Claim group (GKB NTC) meeting	7 May 2018, 29 October 2018	• Brad Goode & Associates • Nine representatives from the GKB NTC group • DPLH • Main Roads • BORR IPT.
General public and local residents drop in sessions	24, 25, 30 and 31 October 2018	• Community members.

STAKEHOLDER CONSULTATION	DATE	PARTICIPANT AGENCIES
Project newsletter	2018	• Local community (distribution) • General public (via website) • Local Government Areas (distribution) • MLAs (distribution).
Community Reference Group (CRG) Southern Alignment	July 2018 – ongoing (monthly)	• Community members.
Local landowners and residents	23 Oct 2019	• Landowners within BORR Southern Section GBRS Alignment • Residents (if renting within BORR Southern Section GBRS Alignment).
Local Community Group	July 2018	• Friends of Gelorup Corridor.

Table 2-2 Agency consultation

AGENCY	DATE	PURPOSE
DWER – EPA	13/03/18	Project update
	05/09/18	Project update
	13/02/19	Project update
DotEE	25/5/18	Project briefing
	26/5/18	BORR site walk through – BORR Southern Section Gelorup
	17/07/18	Meeting at Main Roads head office, Don Aitken Centre (DAC) Perth- Project update
	08/10/18	Meeting at DAC - Project update
	14/2/19	Meeting at DAC - Project update
DWER – Environmental Regulation	25/5/18	Briefing South West Regional Office
	26/5/18	BORR site walk through – BORR Southern Section Gelorup
DBCA	25/5/17	BORR Project update
	13/11/17	Site visit BORR south wetlands
	30/7/18	BORR Project Update
	24/5/18	BORR and Western Ringtail Possum issues
	14/9/18	Western Ringtail Possum issues
	28/11/18	BORR Project update

Table 2-3 Summary of key concerns raised during consultation

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
CRG Members, Community members	CRG Meetings, Community Drop in Sessions,	**Need for BORR and Strategic Traffic Modelling Basis** There have been numerous enquiries by CRG members into the basis of population statistics used to inform the traffic model. More broadly there have been questions relating to the need for BORR.	There is already significant pressure on the road network around Bunbury, and this is Projected to increase due to a number of factors including: • Population growth in Greater Bunbury • Proposed development in Wanju, Waterloo and surrounding areas • Increased freight movements, due to mining activity and associated growth in Bunbury Port activities. The existing road network in and around Bunbury supports a range of vehicle movements, including freight and light vehicles, regional and local traffic. These combinations of vehicles on local road networks impact on road safety and amenity. As a Port City, Bunbury plays an important role in the WA economy. Twelve per cent of the world exports of alumina leave from the Port of Bunbury. The current access to Bunbury Port is problematic and impacts on freight efficiency. Currently, vehicles travelling between the Bussell Highway and Forrest Highway have to navigate 13 sets of traffic lights and one rail level crossing. When complete, between 10,000 and 15,000 vehicles per day on average are expected to use the new road. These regional / port movements would otherwise mix with local traffic on local roads. Population forecasts used in strategic traffic modelling come from the land use planning by the Department of Planning, Land and Heritage and it considers the City of Bunbury, Shire of Dardanup and Shire of Harvey and is based on planned land use changes forecast for the Ultimate design life of BORR.

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
Community members, CRG members, impacted businesses	CRG Meetings, Community Drop in Sessions, Public Enquiries, Landowner Briefings	**Southern Alignment Investigations** Questions have been raised around why an alternative alignment has been investigated, what were the triggers and what investigations have been undertaken to assist in making a decision. Community members within the green alternative southern alignment voiced anxiety and mental health concerns in regards to the alignment uncertainty and potential for direct impact to their properties. Confusion between the EIA process for the southern alignment and the environmental referral process for the northern and central alignment.	Land for the southern alignment of Bunbury Outer Ring Road has been reserved within the Greater Bunbury Region Scheme for many years. It contains habitat for the Western Ringtail Possum, Black Cockatoo and Banksia Woodland Threatened Ecological Community which are Federally listed. In May 2018, the Commonwealth changed the status of the Western Ringtail Possum under the Environment Protection and Biodiversity Conservation Act from Vulnerable to Critically Endangered. This is the highest classification level possible before a species is declared extinct. When referring a Project for environmental assessment it is necessary to demonstrate that there are not feasible alternatives with lesser environmental impact. As a result of the reclassification of the Western Ringtail Possum and the presence of other Matters of National Environmental Significance (MNES) such as the Black Cockatoo, investigations into an alternative alignment located further to the east (green corridor) have been undertaken to support the environmental referral process. These investigations, including detailed site surveys, have been undertaken in addition to those in the existing GBRS alignment to support preparation of EIAs. The Project team has consulted with landowners potentially affected by this alternative alignment. Following completion of consultation and the environmental surveys, the findings will be presented to the landowners, the Community Reference Groups established for BORR Project and the wider community. Once an alignment is selected based on the results of the selection study and design progresses, then the southern alignment will be referred to the EPA and DoTEE for environmental assessment and approval.

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
CRG members, Community members	Norther & Central and Southern CRG meetings	**Western Ringtail Possum** Management of impacts to Western Ringtail Possums.	The Western Ringtail Possum (WRP) is critically endangered, which means the Commonwealth Minister for the Environment is responsible for ensuring that any approved actions by The Minister will not put the species at further risk.
		What studies were undertaken and by whom?	Regional surveys of the WRP were commissioned to more accurately estimate the population size and determine the potential impact of BORR Project on the WRP population. The methodology for these surveys was agreed with the Department of Biodiversity, Conservation and Attractions and the WRP Recovery Team. WRP studies were completed by specialist zoological consultants Biota Environmental Sciences. Investigations have been undertaken in the Southern Swan Coastal Plain, Cape to Capes, Southern Forrest and Albany Areas to get a total estimate for the species.
		Will possums be relocated/translocated?	There have been examples of successful relocations in the region. If we could do it successfully that would be wonderful but we and the federal regulator must be confident that any relocation would be successful. That confidence does not exist currently. This is something we need to better understand to ensure it is successful if adopted with no perfect solution available.
		Offset areas – have they been selected, what offset ratios will be applied and is there a maintenance budget for offsets?	Offsets have not been identified yet. This comes later in the process when the nature and extent of the impacts are known. Main Roads has a bank of offsets available with further acquisitions likely to be required depending upon values impacted. There is a calculator used for determining offsets, which are generally greater in area than the impact. Budgets would depend on the offsets selected. There are previous examples where there are contributions to maintenance.

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
		If relocation fails what else is there? Are animals euthanised?	One of the challenges with the WRP is that there is no approved translocation program currently in operation. Other measures are available for birds, such as cockatoos. The first steps are to avoid or minimise impacts wherever possible. Native fauna are not euthanised.
		Fragmentation of possum/ fauna habitats.	Any alignment resulting in fragmentation will consider mitigation measures including bridges or underpasses.
Community members, CRG Members	Enquiries, Northern & Central and Southern CRG meetings, Drop in Sessions	**Longevity of GBRS Alignment** Queries about investigating an even more eastern alignment have been raised by numerous newly concerned communities including concerns about the redundancy of the GBRS Alignment between Hasties Road and Bussell Highway. This has been raised specifically in the context of a future north south freeway grade road.	Currently there is no planning or consideration for a further outer ring road (more eastern alignment). The capacity provided by the BORR and existing roads will service the region well into the future. BORR is being designed to cater for the long term planning needs which includes catering for the transport movements of a future population of 200,000 people living in the Greater Bunbury area. The transport movement basis is built upon the Greater Bunbury Strategy (2013) report and includes consideration of the planned expansion of residential and industrial areas at Wanju, Waterloo Industrial Park and Picton Industrial Park as well as other investigation areas for potential urban development rezoning.
CRG members, Community members	Northern & Central and Southern CRG meetings, Drop in Sessions	**Environmental Approvals Process and Studies** The community has been highly interested in the types of environmental studies being completed to support the Project.	An EIA study including multiple investigations has been undertaken for the two alternative southern alignments. We are committed to ensuring that all environmental aspects of the Project are completed with great sensitivity and in accordance with all State and Commonwealth legislative requirements. Detailed reports were completed for a portion of the Project Area including (refer to section 1.3.2 regarding Surveyed and Unsurveyed Areas): • Noise management plan • Targeted fauna (including Matters of National Environmental Significance MNES) assessment • Aquatic Fauna • Flora and Vegetation assessment

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
			• Air quality impact assessment. There are three opportunities in the environmental approvals process for the public to provide feedback, they are: • At the start of the process when the level of assessment is set; • In review of the information submitted by BORR Team to the regulator/s; and • In response to the Draft Ministerial Conditions that result if approval is granted.
		The process of submitting comments on the environmental referral. Concerns around the public comment period.	This is a formal process, managed by the responsible regulatory entity (Environmental Protection Authority) and is not a process managed by Main Roads. Detailed information can be found at www.epa.wa.gov.au .
CRG members, Community members	Northern & Central and Southern CRG meetings	**Flora and Fauna** How will impacts to flora and fauna be managed?	The BORR alignment includes habitat for critically endangered species, as determined under the Commonwealth Government's *Environment Protection and Biodiversity Conservation Act 1999*. Avoidance is the first option for impacts, but where avoidance of impacts is not practicable, minimisation of impacts is sought. In BORR Northern Alignment Selection report, the environmental criteria, alongside other criteria used in the multi criteria analysis, to assess options included: • Rare flora and native vegetation • Rare fauna, fauna habitat and TECs • Waterways or wetlands. When considering BORR interchange options and local connectivity options, assessment of the environmental criteria included: Wetlands

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
			(Conservation Category Wetland (CCW) and Resource Enhancement), remnant native vegetation, rare Fauna (WRP), TECs, European Heritage and Aboriginal Heritage.
CRG members (local residents, road users and property owners/ farmers)	Northern & Central Community CRG Meetings (10/18, 11/18, 12/18)	**Social and Economic Bypass Impacts** Primacy of Bunbury and economic impacts of 'bypass'. Consideration of social and economic impacts on community business, particularly of severance on farmers. Formation of an economic advisory group was first discussed in the October North and Central CRG.	An Economic Advisory Group (EAG) was subsequently developed and is chaired by the SWDC. KPMG has been commissioned by Main Roads to undertake a Social and Economic Study for the wider BORR Project. Impacts for the local farming community will be included in this assessment. The study will be in line with NSW Road Maritime Services Environmental Impact Assessment Practice Note – Socio-economic Assessment (EIA-N05).
		Economic impacts of BORR and impacts on businesses.	Bunbury is the gateway to the South West Region. The Region has a strong economy based on mining, manufacturing, building and construction, agriculture, viticulture, aquaculture, forestry, tourism and emerging smart and creative industries, generating $13 billion in the 2016-2017 financial year (SWDC, 2018). In addition, the Port of Bunbury is a large deep sea port which allows the berthing of commercial cargo vessels and is supporting the development of tourism by welcoming large tourist cruising passengers to our shores. The construction phase of the Project will create jobs and provide economic benefits to the region. Once constructed BORR will provide more efficient access for freight to the Bunbury Port, and enable the expansion of industrial centres, leading to more manufacturing, agricultural processing and local employment.

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
Community members, CRG Members	Main Roads enquiries, CRG meetings and Community Drop In Sessions.	**Noise Impacts** Community members along the alignment have raised concerns in regards to noise from vehicle traffic (particularly trucks), braking vehicles at interchanges and roundabouts and vehicles travelling over bridge joints.	The BORR Team is committed to managing the impacts of noise in line with the State Planning Policy 5.4 "Road and Rail Transport Noise and Freight Considerations in Land Use Planning" with the aim to protect communities from unreasonable levels of transport noise. BORR Team has committed to undertake a noise study for the Ultimate Planning Design Concept of the Southern Section of BORR. This noise study will be informed by the development of a noise model that will help to identify locations where noise mitigation may be required to comply with State Planning Policy 5.4. The noise model will consider topography, distances between properties and the road, road design levels, gradients and surface type and consideration of future projected traffic volumes and types. Existing noise in the study area will be recorded to be used in the model development.
Community members, CRG Members	Main Roads enquiries, CRG meetings and Community Drop In Sessions.	**Future Development Noise Mitigation** Impacts and management of noise to any future developments.	Where houses pre-date the road it is Main Roads responsibility to mitigate. Where the road pre-dates the development, it is the developer's responsibility to comply with the policy.
CRG Members	Main Roads enquiries, CRG meetings and Community Drop In Sessions.	**Noise Modelling Assumptions** Assumptions used in developing the noise model in regards to exclusion of mitigation measures and choice of road surface treatments.	The noise modelling process is conservative and assumes a worse-case noise scenario to ensure likely noise exceedances are identified and appropriate management implemented.

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
Community members, CRG members	Main Roads Enquiries line, CRG Meetings, Community Drop In Sessions	**Light pollution and Visual Amenity** Impact of light pollution from street lights and vehicle headlights, as well as impacts to visual amenity as the result of construction of roads, associated interchanges, bridges and overpasses.	The EIA process considers impacts to visual amenity, including lighting. This includes reporting potential visual impacts and identifying likely locations where design measures may be required to mitigate the impacts. Mitigation may include providing screening, which can take a variety of forms, including the construction of walls, earth mounds and planting of vegetation. Strategies will be developed to comply with the Australian Standard for lighting of public roads (AS/NZS 1158). This will include consideration of light backspill and treatments such as backshades and reducing light pole height where possible to minimise impact on adjacent properties. Visual amenity is also a key consideration of the Urban and Landscape Design Framework that has been prepared for BORR Project.
Property owners	Main Roads Enquiries, Southern CRG (07/18, 12/18)	**Air and Water Quality.** Residents of some farming and residential properties, are not connected to scheme water and rely upon rainwater tanks as their primary source of potable water. Impact of traffic pollution particulate matter on water tank water quality is a concern to the community.	There is no comparative air quality policy or legislative requirement for pollutants from traffic in comparison to SPP 5.4 that deals with noise from traffic. Air quality modelling to the relevant standards will be completed to establish baseline conditions. National standards for air and water quality apply for land and water managed under the EP Act, but not necessarily water in rainwater tanks. It is recognised that pollutants are emitted from diesel and petrol powered vehicles. The concentration levels of those chemicals have decreased with improved engine and fuel technology. Fuel used to have lead and sulphur additives but these have been removed or reduced in current vehicle fuels. Vehicle age is another factor with the average vehicle age around 10 or 11 years in Perth. As a result, the pollutants coming out of an exhaust pipe are steadily reducing over time. Pollutants in water tanks is a separate issue that is up to the land owner with various potential pollutant sources to consider.

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
Directly impacted property owners	Southern CRG meetings, Main Roads Enquiries	**Land Acquisition and Compensation Process** Property owners, particularly famers, are concerned about the impact of severance on their properties and businesses. Concerns include land compensation process and valuation, impacts to current and future business operations as well as social & mental health impacts that this will have on their families.	Main Roads appoints up to three independent land valuers and pays for the land owner to appoint a valuer of their choice. The valuation process includes business compensation. Main Roads can only compulsorily acquire land needed for the Project but can acquire small remnant land parcels through negotiations. We provide access to small parcels and if unviable it would be part of the compensation calculation.
		Timeline of land acquisition and ability for impact on broader Project implementation timeline.	Main Roads is planning to deliver the Project and will progress the enabling tasks including talking to the owners of property required for the Project to try and agree an early settlement as part of a voluntary acquisition process.
Local community and road users CRG Members	Southern CRG meetings	**Local Access Changes on Journey Times** Is compensation payable as a result of impacts of local road severance on journey times?	Compensation is only payable where land is required for the Project. Main Roads will endeavour to ensure connectivity remains but it will change.
Directly impacted property owners	Southern CRG meetings, Main Roads Enquiries	**Property Severance** Property owners who are likely to have access to their properties altered or their land parcels split are concerned about how they will access their properties/land and how business as usual will take place.	Main Roads will provide access to the portions of land that are severed. Any associated economic loss is included as part of the compensation payable and depends on individual circumstances. Under the Act we can't resume land that isn't required for road purposes. Main Roads often finds that if a convoluted route to provide access results, compensation will be payable. In some cases, other measures are considered to walk or even truck cattle.
Directly impacted property owners	Southern CRG meetings, Main Roads Enquiries	**Property Access** Property owners who are likely to have access to their properties altered are concerned about what form new access will take.	Any existing accesses affected by the ultimate design of the highway will require consideration of alternative routes. The planning, construction and funding of alternative routes will be undertaken by Main Roads WA as part of the Project scope. These works can include the provision of new service roads and upgrades, or realignment of existing driveways.

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
			Main Roads does not generally provide slip lanes for individual properties as they are usually only provided for local roads. However, in some instances where there is a need due to higher traffic volumes or presence of trucks or a road safety risk, a slip lane can be provided. This will be assessed on a case by case basis. If access is required via adjacent privately owned land – we will undertake discussions with the landowners around access routes, acquisition and compensation.
Gelorup residents, local road users	Southern CRG Meeting (07/18, 9/18, 10/18, 11/18, 12/18, 2/19)	**Traffic and Safety** BORR connection to Gelorup via Hasties Rd due to increased traffic through community and past community infrastructure, interaction with school traffic and narrow road reserve. Concern was raised at numerous CRG meetings.	Centenary Road connection concept options were subsequently developed and assessed as part of the Gelorup connectivity assessment. The Centenary Road connection is the preferred connection recommended by the BORR Team.
CRG Members, Fire Emergency Service, Shire of Capel	Southern CRG meetings	**Emergency Service Access and Emergency Egress** The effects of road severance on emergency access eg to allow firefighting and provide emergency egress to the community either side of the alignment.	BORR Team has undertaken consultation with the Shire of Capel and the Bush Fire Service to determine issues which will arise from severance to local roads and determined the requirements for the provision of additional water tanks and stand pipes. Local and access road connections are being planned where existing local and access roads will be disrupted.
CRG members	Southern CRG meetings	**Impacts to Cultural Heritage** Potential for loss of cultural heritage.	There are no European heritage sites expected to be impacted within the Project Area.
CRG members	Southern CRG Meetings (03/19)	**Impacts to Aboriginal Heritage** What was the source of data used to show aboriginal sites used to inform field investigations.	The source of mapped Aboriginal Heritage sites used to inform field investigations was publicly available data from the DPLH and a previous Aboriginal Heritage Survey which covered a portion of the Project Area (Brad Goode & Associates, 2012).

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
		Concerns around the Aboriginal Heritage values and history of the assessment process and what additional studies are being completed.	Main Roads will re-consult with members of the Aboriginal community on the preferred southern alignment to update the 2012 Aboriginal Heritage Survey.
CRG members	Southern CRG meetings	**Construction Impacts** Construction impacts on access to and from properties – particularly if there is an emergency such as a fire.	Bushfire and other emergency responses will be a prime consideration to manage during and after construction. Main Roads includes requirements to maintain emergency routes during construction in contracts. The same would apply to standpipes and other fire response assets.
		Construction noise/vibration and hours of works.	Point source noises (eg horns) and noises during construction are not subject to SPP5.4. Details on the management of construction noises and vibrations will form part of the construction contract.
Drainage Reference Group (DRG)	DRG meetings	**Wetlands and Waterways** Concern in relation to two TEC (wetlands) located within the green alternative alignment. DBCA encouraged BORR Team to liaise with DBCA Wetlands unit.	BORR Team has undertaken a wetland study within a portion of the Project Area as part of a survey located predominantly to the north. BORR Team have liaised with DBCA officers where appropriate regarding TECs within the Project Area.
		Request for spill management for wetlands, outside of wetland buffers – and be based on risk based approach.	Main Roads has requirements around what is to be provided where spill control is required, but not around where spill control is required. Recommendations from DRG members were discussed.
Land owners	Landowner meetings	**Irrigation and Drainage** Concerns have been raised by landowners in relation to localised flooding impacting on access and egress to and from their properties under BORR.	BORR Team will undertake discussions with landowners to determine suitable alternate access where access will be directly impacted by BORR once a decision on the southern alignment has been made.
		Landowners have also raised concerns where investigations have been required in relation to use of heavy machinery impacting on contours/ damaging drainage of their land.	Prior to all investigations, landowners were contacted by BORR Team for approval to access their land and landowners were consulted on the proposed machinery details, size, weight etc to be used on their property. Investigations with machinery on land vulnerable to becoming waterlogged

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
			during wet months was timed to occur where possible prior to the onset of the wet season.
Drainage Reference Group (DRG) Members, Water Corporation	DRG (08/2018)	**Water Quality** Need for spill management (eg oil and chemical spills). Oil spill traps were initially only considered for water draining to sensitive environmental receptors (eg wetlands). Water Corporation indicated that spill protection was required upstream of their drains.	BORR drainage strategy now includes the use of oil spill traps to Water Corporation drains.
DRG Members, Leschenault Catchment Council Inc.	DRG (08/2018)	**Water Quality** Nutrient stripping (via soil amendments using Iron Man Gypsum) in the buffer strip along the alignment.	Options were investigated, but it was identified that the major source of nutrients was farm land. Water, particularly in irrigated plots, is carefully managed on farms by paddock grading and is collected by drains and therefore is unlikely to reach the road alignment. There is limited benefit and a very high cost for undertaking soil improvement measurements within the alignment.

3 ENVIRONMENTAL PRINCIPLES AND FACTORS

3.1 Principles

Section 4A of the EP Act establishes the object and principles of the Act. In accordance with the EPA's Statement of Environmental Principles, Factors and Objectives (EPA, 2018b), this section describes how each of the five principles of the EP Act has been applied to the Project (Table 3-1).

Table 3-1 *Environmental Protection Act 1986* Principles

PRINCIPLE	CONSIDERATION OF PRINCIPLE IN THE PROJECT
The precautionary principle Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, decision should be guided by: • Careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and • An assessment of the risk-weighted consequences of various options.	A wide range of comprehensive desktop and field studies were undertaken to assess the impact of the Project (including studies undertaken to support the previous referral of the alignment). Studies included: • Flora and vegetation • Terrestrial fauna • Inland Waters • Amenity (noise and vibration) • Heritage (Aboriginal) • Air quality. Information gathered during these studies was used to inform the EIA and has reduced the uncertainty surrounding the prediction of impacts for the assessment. Main Roads has committed that the Project's design (where possible) avoids serious or irreversible damage to the environment. Various studies have been undertaken within and adjacent to the alignment for the last two decades. Impacts have been identified and described under each key environmental factor and mitigation and management measures have been proposed to ensure they are environmentally acceptable.
The principle of intergenerational equity The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.	The Project will commit to maintain the health, diversity and productivity of the environment through retaining as much habitat as possible, establishing noise walls to reduce noise related impacts and maintaining access for property owners.
The principle of the conservation of biological diversity and ecological integrity Conservation of biological diversity and ecological integrity should be a fundamental consideration.	The Project has been subject to a number of studies to identify and reduce impacts to biological diversity and ecological integrity, including the following which cover various portions of the Project Area: • Bunbury Outer Ring Road Fauna Assessment (Biota, 2019a) • Bunbury Outer Ring Road Flora and Vegetation Assessment (BORR IPT, 2019a; BORR IPT, 2019b)

PRINCIPLE	CONSIDERATION OF PRINCIPLE IN THE PROJECT
	• Bunbury Outer Ring Road (Southern Section GBRS Corridor) Black Cockatoo Tree Survey (Biota, 2018a) • Western Ringtail Possum Assessment (Biota, 2018b) • Bunbury Outer Ring Road Aquatic Fauna Survey (WRM, 2018a) • Bunbury Outer Ring Road Southern Section GBRS Corridor – *Banksia* Woodlands TEC Assessment (Biota, 2018c) • Report of a Targeted Rare Flora Survey for *Diuris drummondii* along four sections of the Bunbury Outer Ring Road proposed alignment (Ecoedge, 2017) • Bunbury Outer Ring Road Southern Section GBRS Corridor – Reassessment of Floristic Communities (Biota, 2016) • Bunbury Outer Ring Road - Southern Section GBRS Corridor - Fauna Study (GHD, 2015a) • Bunbury Outer Ring Road, South Western Highway to Bussell Highway Flora and Vegetation Assessment, Phase 1 and Phase 2 (GHD, 2015b) • Bunbury Outer Ring Road Southern Section GBRS Corridor Clearing Permit Supporting Document (GHD, 2015c) • Bunbury Outer Ring Road, Western Ringtail Possum Assessment (GHD, 2013) • Bunbury Outer Ring Road - Southern Section GBRS Corridor, South Western to Bussell Highways, Fauna Assessment (GHD, 2012a) • Report for the Bunbury Outer Ring Road – Southern Section GBRS Corridor (South Western Highway to Bussell Highway) Environmental Impact Assessment (GHD, 2012b). The Project will be subject to environmental assessment and approvals including referral to the EPA and DotEE.
Principles relating to the improved valuation, pricing and incentive mechanisms Environmental factors should be included in the valuation of assets and services. The polluter pays principle – those who generate pollution and waste should bear the cost of containment, avoidance or abatement. The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any wastes. Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, which enable those best placed to maximise benefits and/or	Main Roads acknowledges the need for improved valuation, pricing and incentive mechanisms and endeavours to pursue these principles when appropriate. For example, environmental factors will greatly determine the location of road corridors, with the Project having a strong focus on reducing its direct and indirect clearing footprint. Impacts on flora, vegetation and terrestrial fauna have been assessed and mitigation and management measures proposed. Main Roads accepts that the cost of the Project must include environmental impact mitigation, management and maintenance activities. These requirements will be incorporated into the overall Project costs. The Project will be subject to a sustainability rating, which will assess the environmental, social and economic impacts, including its waste stream and the resources utilised for construction. The Infrastructure Sustainability Council of Australia (ISCA) rating scheme is designed such that goals are established for a Project, then the Project is assessed against the achievement of those goals.

PRINCIPLE	CONSIDERATION OF PRINCIPLE IN THE PROJECT
minimise costs to develop their own solutions and responses to environmental problems.	
The principle of waste minimisation All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.	The Project will be subject to an ISCA sustainability rating, which will assess the environmental, social and economic impacts of the Project, including waste minimisation and discharges resulting from the Project. Cut and fill principles will be utilised to minimise external fill requirements. Consideration of otherwise waste materials such as crushed concrete in road construction. The design for the Project includes drainage design to minimise the discharge of contaminated water into the environment. Management strategies will be implemented to ensure that the generation of waste during the construction phase is minimised. All activities shall be carried out with the principles of cleaner production and waste minimisation.

3.2 Identification of Key Environmental Factors

Environmental factors are those parts of the environment that may be impacted by an aspect of a Project. The EPA has 14 environmental factors, arranged under five themes: Sea, Land, Water, Air and People.

The environmental factors and EPA objectives are provided in Table 3-2. The relevance of each factor to the Project is summarised and the Key Environmental Factors that require further consideration are identified.

Table 3-2 Identification of Key Environmental Factors

FACTOR	OBJECTIVE	RELEVANCE TO PROJECT	KEY ENVIRONMENTAL FACTOR (YES/NO)
Sea			
Benthic communities and Habitat	To protect benthic communities and habitat so that biological diversity and ecological integrity are maintained.	No benthic communities or habitats will be impacted by this Project.	No
Coastal Processes	To maintain the geophysical processes that shape coastal morphology so that the environmental values of the coast are protected.	No coastal processes are expected to be impacted by this Project.	No
Marine Environmental Quality	To maintain the quality of water, sediment and biota so that environmental values are protected.	No impacts to marine environmental quality are expected to be impacted by this Project.	No
Marine Fauna	To protect marine fauna so that biological diversity and ecological integrity are maintained.	No impacts to marine fauna are expected.	No
Land			
Flora and Vegetation	To protect flora and vegetation so that biological diversity and ecological integrity are maintained.	Construction will result in clearing of native vegetation.	Yes
Landforms	To maintain the variety and integrity of distinctive physical landforms so that environmental values are protected.	No significant changes to landforms are expected as much of the Project will be constructed in an existing disturbed area. Some fill of palusplain will be required to ensure the road is dry and allow for water passage under the road. The Project will require cut into one hill, however this is not considered to be a significant landform.	No

FACTOR	OBJECTIVE	RELEVANCE TO PROJECT	KEY ENVIRONMENTAL FACTOR (YES/NO)
Subterranean Fauna	To protect subterranean fauna so that biological diversity and ecological integrity are maintained.	No impacts to subterranean fauna are expected from the road construction.	No
Terrestrial Fauna	To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.	Construction will result in clearing of fauna habitat.	Yes
Terrestrial Environmental Quality	To maintain the quality of land and soils so that environmental values are protected.	Construction is not expected to impact contaminated sites or result in increased risk of salinity. Some Acid Sulfate Soils (ASS) are expected within the Project Area.	Yes
Water			
Inland Waters	To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.	The Project area contains CCW, Resource Enhancement (RE) and Multiple Use (MU) Geomorphic Wetlands and Five Mile Brook. The southern half of the Project Area is also a proclaimed Surface Water Area (the Capel River System) under the RIWI Act.	Yes
Air			
Air Quality	To maintain air quality and minimise emissions so that environmental values are protected.	Dust will be generated during construction of the Project.	Yes
People			
Social Surroundings	To protect social surroundings from significant harm.	Aboriginal heritage aspects may be impacted during construction of the Project. Noise will be generated during construction and operation of the Project. Dust will be generated during construction of the Project. Light spill will be generated during the construction and operation of the Project. Visual amenity will be altered due to construction and operation of the Project.	Yes

FACTOR	OBJECTIVE	RELEVANCE TO PROJECT	KEY ENVIRONMENTAL FACTOR (YES/NO)
Human Health	To protect human health from significant harm.	No impacts to human health are expected.	No

3.3 Key Environmental Factor – Flora and Vegetation

3.3.1 Studies undertaken

The following field investigations have been undertaken for this Factor:

- BORR Southern Section Vegetation and Flora Study (BORR IPT, 2019b), which surveyed 73 ha (~39 %) of the Project Area
- BORR Southern Section Alternative Alignment Vegetation and Flora Study (BORR IPT, 2019a), which surveyed approximately 17 ha (~8 %) of the Project Area
- BORR Southern Section GBRS Alignment– Banksia Woodlands TEC Assessment (Biota, 2018c)
- Report of a Targeted Rare Flora Survey for *Diuris drummondii* along four sections of the Bunbury Outer Ring Road proposed alignment (Ecoedge, 2017)
- BORR Southern Section GBRS Alignment – Reassessment of Floristic Communities (Biota, 2016)
- BORR, South Western Highway to Bussell Highway Flora and Vegetation Assessment, Phase 1 and Phase 2 (GHD, 2015b).

The following locations were not surveyed and have undergone desktop assessment:

- Lakes Road
- Minninup Road / Maidment Parade
- Jilley Road
- Additional sections in agricultural land near Ducane Road and Jilley Road
- Additional section north of Calinup Road between Brockway Drive and Bussell Highway
- Jaymon Road
- Eucalypt Drive
- Brockway Drive
- Ramsay Road
- Child Place
- 120 m north of the Project Area on Bussell Highway
- The southern end of the Project on Bussell Highway from Capel Golf Course to Yeardy Road, approximately 6.8 km, including intersection with Boyanup Road West and Fishermans Road
- New access road linking to Bourne Loop from Bussell Highway.

Approximately 100ha (53 %) of the Project Area has not been surveyed (Figure 2). Flora and vegetation surveys will be undertaken at these locations if BORR Southern Section GBRS Alignment is selected for development. For the purposes of this EIA, vegetation types and condition have been extrapolated for the gaps, based on:

- DPIRD Native Vegetation Extent dataset (GoWA, 2019a) – used as the initial identification of vegetated / cleared area
- The areas that were not mapped by the DPIRD Native Vegetation Extent dataset (GoWA, 2019a) were digitised based on aerial photography
- Assigning likely vegetation types / condition types based on nearby vegetation types assigned by BORR IPT (2019a and 2019b), aerial photograph and desktop information (soil type / broad vegetation mapping).

3.3.2 Receiving environment

Regional biogeography

The Project Area is located in the South West Botanical Province of WA (Beard J. , 1990) and experiences a Mediterranean climate with distinctly hot, dry summers and cool, wet winters. The Project Area is located in the Swan

Coastal Plain bioregion and Perth (SWA2) subregion as described by the Interim Biogeographic Region of Australia (IBRA) (DotEE, 2016).

The Perth subregion is composed of colluvial and aeolian sands, alluvial river flats and coastal limestone. Heath and/or Tuart woodlands occur on limestone, Banksia and Jarrah-Banksia woodlands on Quaternary marine dunes of various ages and Marri on colluvial and alluvial soils. The subregion also includes a complex series of seasonal wetlands (Mitchell, Williams, & Desmond, 2002).

Broad scale (1:250,000) pre-European vegetation mapping (Beard J. S., 1979) of the area has been completed at an association level. The mapping indicates that the Project Area intersects four vegetation associations:

- Medium woodland; Tuart and Jarrah (association 6) – occurs in the northern, central and southern extents of the Study Area
- Shrublands; Teatree Thicket (association 37) – occurs in the northern extent of the Study Area
- Medium woodland; Jarrah, Marri and Wandoo (association 968) – occurs in the southern extent of the Study Area
- Mosaic: Medium forest; Jarrah-Marri / Low woodland; Banksia / Low forest; Teatree (*Melaleuca spp*.) (association 1000) – occurs in the northern extent of the Study Area (Figure 3).

Regional vegetation complex mapping, completed as an extension and consolidation of earlier mapping (Heddle, Loneragan, & Havel, 1980; Mattiske & Havel, 1998) indicates that four vegetation complexes are present within the Project Area (Webb *et al*., 2016):

- Bassendean Complex – Central and South: Vegetation ranges from woodland of *Eucalyptus marginata* (Jarrah) - *Allocasuarina fraseriana* (Sheoak) - *Banksia* species to low woodland of *Melaleuca* species, and sedgelands on the moister sites. This area includes the transition of *Eucalyptus marginata* (Jarrah) to *Eucalyptus todtiana* (Pricklybark) in the vicinity of Perth
- Karrakatta Complex – Central and South: Predominantly open forest of *Eucalyptus gomphocephala* (Tuart) - *Eucalyptus marginata* (Jarrah) - *Corymbia calophylla* (Marri) and woodland of *Eucalyptus marginata* (Jarrah) - *Banksia* species. *Agonis flexuosa* (Peppermint) is co-dominant south of the Capel River
- Guilford Complex – A mixture of open forest to tall open forest of *Corymbia calophylla* (Marri) - *Eucalyptus wandoo* (Wandoo) - *Eucalyptus marginata* (Jarrah) and woodland of *Eucalyptus wandoo* (Wandoo) (with rare occurrences of *Eucalyptus lane-poolei* (Salmon White Gum)). Minor components include *Eucalyptus rudis* (Flooded Gum) - *Melaleuca rhaphiophylla* (Swamp Paperbark)
- Vasse Complex – A mixture of the closed scrub of *Melaleuca* species fringing woodland of *Eucalyptus rudis* (Flooded Gum) - *Melaleuca* species and open forest of *Eucalyptus gomphocephala* (Tuart) - *Eucalyptus marginata* (Jarrah) - *Corymbia calophylla* (Marri). Will include areas dominated by *Tecticornia* and *Sarcocornia* species (Samphire) near Mandurah and south of the Capel River.

Vegetation communities

BORR IPT (2019a and 2019b) completed vegetation mapping over approximately 90 ha (47 %) within the Project Area. The sandy low dunes and plains were dominated by *Eucalyptus / Banksia* forests in particular *Eucalyptus / Agonis* and *Banksia* woodlands / forests. The creeklines, swamps and low relief / seasonally inundated areas were dominated by *Eucalyptus rudis / Melaleuca preissiana / Melaleuca rhaphiophylla* woodlands. These were generally disturbed and dominated by introduced grasses and herbs in the ground-layer. In the agricultural areas and some road reserves, native vegetation occurred as scattered remnant trees or stands over introduced grasses.

A summary of the vegetation types recorded within the Project Area during BORR IPT (2019a and 2019b) assessments is presented in Table 3-3 and mapping is provided in Figure 3. A summary of the desktop data for the unsurveyed areas and their vegetation descriptions is presented in Table 3-4. Based on DPIRD native vegetation extent mapping (GoWA, 2019a) and aerial photography, it is estimated that just under 33 ha of the 100 ha of unsurveyed area is native vegetation (approximately 33 %).

Table 3-3 Vegetation communities within the Project Area

VEGETATION DESCRIPTION	EXTENT WITHIN PROJECT AREA AND CONDITION (KEIGHERY 1994)	POTENTIAL CORRESPONDING GIBSON *ET AL.* (1994A) SWAN COASTAL PLAIN FLORISTIC COMMUNITY TYPES (FCT) AND INDICATIVE PHOTO
***Eucalyptus / Banksia* forests on sand dunes and plains**		
Open forest of *Eucalyptus marginata*, *Corymbia calophylla* and *Banksia attenuata* on Karrakatta deep sands (BORR IPT (2019a) - VT01) Open forest of *Eucalyptus marginata* and *Corymbia calophylla* +/- *Agonis flexuosa* with isolated occurrences of *Eucalyptus gomphocephala* over low open forest of *Banksia attenuata* over shrubland of *Hibbertia hypericoides*, *Macrozamia riedlei* and *Xanthorrhoea brunonis* over grassland of **Ehrharta* spp., *Briza maxima* over herbland of *Dasypogon bromeliifolius*, *Lomandra* spp. and *Phlebocarya ciliata* over open sedgeland of *Lepidosperma pubisquameum*.	**19.8 ha** 3.8 ha Excellent to Very Good 2.2 ha Very Good 0.6 ha Very Good to Good 1.5 ha Good 11.0 ha Good to Degraded 0.3 ha Degraded 0.4 ha Degraded to Completely Degraded	Southern *Eucalyptus gomphocephala-Agonis flexuosa* woodlands (FCT 25). 
Open forest of *Eucalyptus marginata*, *Corymbia calophylla, Banksia attenuata* and *Agonis flexuosa* on Bassendean dunes (BORR IPT (2019a) - VT02 and BORR IPT (2019b VT06) Open forest of *Eucalyptus marginata, Corymbia calophylla* and *Agonis flexuosa* over low forest of *Banksia attenuata* and *Banksia ilicifolia* over tall shrubland of *Kunzea glabrescens, Jacksonia furcellata* and *Xylomelum occidentale* over shrubland of *Hibbertia hypericoides*, *Acacia* spp. and *Xanthorrhoea brunonis* over grassland / sedgeland of *Tetraria octandra*, *Desmocladus fascicularis* and introduced grasses.	**3.7 ha** 0.1 ha Excellent 0.2 ha Good to Degraded 3.2 ha Degraded 0.1 ha Degraded to Completely Degraded 0.1 ha Completely Degraded	Central *Banksia attenuata – Eucalyptus marginata* woodland (FCT 21a). 

VEGETATION DESCRIPTION	EXTENT WITHIN PROJECT AREA AND CONDITION (KEIGHERY 1994)	POTENTIAL CORRESPONDING GIBSON *ET AL.* (1994A) SWAN COASTAL PLAIN FLORISTIC COMMUNITY TYPES (FCT) AND INDICATIVE PHOTO
***Corymbia calophylla* and *Eucalyptus marginata* +/- *Banksia* spp. (BORR IPT (2019a) VT03 & BORR IPT (2019b) VT07)** Scattered *Eucalyptus marginata, Corymbia calophylla* and +/- *Agonis flexuosa* over a tall open shrubland of *Banksia attenuata, Banksia ilicifolia, Xylomelum occidentale* and *Kunzea glabrescens* over grassland of introduced grasses. Occurs in paddocks and road reserves. In the road reserve along South West Highway the shrubland is largely absent and *Agonis flexuosa* is present in the tree layer.	**1.2 ha** All Degraded to Completely Degraded	Likely to be a degraded form of Central *Banksia attenuata – Eucalyptus marginata* woodland (FCT 21a) but as it only occurs in Degraded or worse condition alignment with an FCT has not been confirmed. 
Open forest of *Banksia attenuata* and *Agonis flexuosa* (BORR IPT (2019a) VT04) Open forest of *Banksia attenuata* and *Agonis flexuosa* over shrubland of *Hibbertia hypericoides*, *Macrozamia riedlei* and *Leucopogon propinquus* over open grassland of **Ehrharta* spp. and **Briza maxima* over herbland of *Dichopogon capillipes, Phlebocarya ciliata* and *Conostylis aculeata.* Scattered *Eucalyptus marginata* as an emergent. Occurs in one location on grey sands on a rounded hill slope.	**3.5 ha** 0.7 ha Very Good 2.8 ha Very Good - Good	Southern *Eucalyptus gomphocephala-Agonis flexuosa* woodlands (FCT 25).

VEGETATION DESCRIPTION	EXTENT WITHIN PROJECT AREA AND CONDITION (KEIGHERY 1994)	POTENTIAL CORRESPONDING GIBSON *ET AL.* (1994A) SWAN COASTAL PLAIN FLORISTIC COMMUNITY TYPES (FCT) AND INDICATIVE PHOTO
		
Low open forest of *Eucalyptus rudis* and *Melaleuca preissiana* over sedgeland (BORR IPT (2019a) VT08 & BORR IPT (2019b) VT02) Low open forest of *Eucalyptus rudis* and *Melaleuca preissiana* over grassland of **Ehrharta longiflora* and **Avena* spp. over sedgeland of *Lepidosperma longitudinale* over herbland of **Rumex* spp. In Lot 1 Ducane Road an open tall shrubland of *Kunzea glabrescens* and *Melaleuca teretifolia* over open heath of *Astartea scoparia* over a sedgeland of *Hypolaena exsulca* and *Lepidosperma longitudinale* was present. This was the only occurrence of the vegetation in Very Good condition. Occurs along drainage lines and seasonally inundated areas.	**2.2 ha** 0.9 ha Good 1.3 ha Degraded / Completely Degraded	FCT: Wet forests and woodlands (FCT 11). 

VEGETATION DESCRIPTION	EXTENT WITHIN PROJECT AREA AND CONDITION (KEIGHERY 1994)	POTENTIAL CORRESPONDING GIBSON *ET AL.* (1994A) SWAN COASTAL PLAIN FLORISTIC COMMUNITY TYPES (FCT) AND INDICATIVE PHOTO
Woodland of *Melaleuca preissiana* and *M. rhaphiophylla* (BORR IPT (2019a) VT07 and BORR IPT (2019b) VT03) Low woodland of *Melaleuca preissiana* and *M. rhaphiophylla* over tall sparse shrubland of *Astartea scoparia* +/- *M. lateritia* over sedgeland of *Juncus pallidus, Lepidosperma longitudinale* over herbland of **Cotula coronopifolia, *Lotus subbiflorus* and *Isolepis cernua* var. *setiformis* with **Callitriche stagnalis* in open water.	**1.6 ha** All Degraded to Completely Degraded	
Scattered remnant vegetation / Highly modified vegetation types		
Scattered remnant vegetation present in agricultural areas and along road reserves: **BORR IPT (2019a)** • **VT09a** - *Corymbia calophylla* and *Eucalyptus marginata* +/- *Agonis flexuosa* with very occasional *E. gomphocephala* • **VT09c** – *Agonis flexuosa* stands • **VT09d** – *Eucalyptus rudis* and *Corymbia calophylla* +/- *M. rhaphiophylla.* **BORR IPT (2019b)** • **VT01a** - *Corymbia calophylla* and *Eucalyptus marginata* +/- *Agonis flexuosa* over closed grassland of **Bromus diandrus*, **Ehrharta calycina* and **Lolium rigidum*	**5.8 ha** 9a – 1.7 ha 9c – 2.0 ha 9d – 0.5 ha 1a – 0.9 ha 1b – 0.7 ha All Degraded to Completely Degraded	N/A 

VEGETATION DESCRIPTION	EXTENT WITHIN PROJECT AREA AND CONDITION (KEIGHERY 1994)	POTENTIAL CORRESPONDING GIBSON *ET AL.* (1994A) SWAN COASTAL PLAIN FLORISTIC COMMUNITY TYPES (FCT) AND INDICATIVE PHOTO
• **VT01b –** Isolated trees of *Eucalyptus rudis* and *Corymbia calophylla* closed grassland of **Bromus diandrus*, **Ehrharta calycina* and **Lolium rigidum.*		
Parkland cleared with native / non-native trees (BORR IPT (2019a) VT10) Parkland cleared with occasional *Corymbia calophylla, Eucalyptus marginata* and *Agonis flexuosa* trees with planted tree species over an understorey of weedy herbs and grasses.	**2.0 ha** Completely Degraded	N/A 
Revegetation / Regrowth (BORR IPT (2019a) VT10b) This includes revegetation as well as areas planted with a mixture of native and non-native vegetation. There are scattered remnant trees occasionally present (including *Corymbia calophylla, Eucalyptus marginata, E. rudis*, *Agonis flexuosa* and *Casuarina obesa).* Common shrubs include *Melaleuca nesophila, M. lanceolata*, *Kunzea glabrescens* and *Acacia saligna*. The understorey was mostly dominated by introduced grasses and herbs.	**0.4 ha** All Degraded to Completely Degraded	N/A

VEGETATION DESCRIPTION	EXTENT WITHIN PROJECT AREA AND CONDITION (KEIGHERY 1994)	POTENTIAL CORRESPONDING GIBSON *ET AL.* (1994A) SWAN COASTAL PLAIN FLORISTIC COMMUNITY TYPES (FCT) AND INDICATIVE PHOTO
Cleared / Highly Disturbed Areas where clearing or other activities have fundamentally altered the composition of native vegetation and are not in a condition of self-sustaining. These areas are completely or almost completely without native species.	**49.3 ha** All Completely Degraded.	N/A 
Total Surveyed		**89.5 ha** **Native Vegetation (40.2 ha)** **Cleared (49.3 ha)**

Table 3-4 Survey gaps – Description of potential vegetation communities within the Project Area

SURVEY GAP	EXTENT WITHIN PROJECT AREA (ha)	EXTENT OF NATIVE VEGETATION (ha)	POTENTIAL DESCRIPTION OF VEGETATION COMMUNITY	POTENTIAL VEGETATION CONDITION (KEIGHERY 1994)
Lakes Road	1.0	0.2	Cleared and scattered native trees – *Corymbia calophylla* and *Eucalyptus marginata* +/- *Agonis flexuosa* with very occasional *E. gomphocephala* (VT9a).	Degraded (6) to Completely Degraded (7)
Minninup Road / Maidment Parade	3.1	0.8	Cleared and scattered native trees – *Corymbia calophylla* and *Eucalyptus marginata* +/- *Agonis flexuosa* with very occasional *E. gomphocephala* (VT9a).	Degraded (6) to Completely Degraded (7)
Jilley Road	3.8	1.4	Cleared and scattered native trees – *Corymbia calophylla* and *Eucalyptus marginata* +/- *Agonis flexuosa* with very occasional *E. gomphocephala* (VT9a). South of Manea Drive there is a dampland which is likely to be VT 7 (Low open forest of *Melaleuca preissiana* and *Melaleuca rhaphiophylla* over sedgeland).	Degraded (6) to Completely Degraded (7)
Additional sections in agricultural land near Ducane Road and Jilley Road	0.4	0.1	Cleared.	Completely Degraded (7)
Additional section north of Caliinup Road and between Brockway Drive and Bussell Hwy	0.4	0.4	Open forest of *Eucalyptus marginata*, *Corymbia calophylla* and *Banksia attenuata* on Karrakatta deep sands (VT 1).	Good (4) to Degraded (6)
Jaymon Road	0.8	0.3	Cleared.	Completely Degraded (7)
Eucalypt Drive	0.1	0.1	Cleared and scattered native trees – *Corymbia calophylla* and *Eucalyptus marginata* +/- *Agonis flexuosa* with very occasional *E. gomphocephala* (VT9a).	Degraded (6) to Completely Degraded (7)

SURVEY GAP	EXTENT WITHIN PROJECT AREA (ha)	EXTENT OF NATIVE VEGETATION (ha)	POTENTIAL DESCRIPTION OF VEGETATION COMMUNITY	POTENTIAL VEGETATION CONDITION (KEIGHERY 1994)
Brockway Drive	0.3	0.1	Cleared.	Completely Degraded (7)
Ramsay Road	0.8	0.8	Open forest of *Eucalyptus marginata*, *Corymbia calophylla* and *Banksia attenuata* on Karrakatta deep sands (VT 1).	Good (4) or better. Aerial photography shows intact canopy cover. Condition will be dependent on the structure / weediness in the understorey.
Child Place	0.6	0.4	Cleared and scattered native trees – *Corymbia calophylla* and *Eucalyptus marginata* +/- *Agonis flexuosa* with very occasional *E. gomphocephala* (VT9a).	Degraded (6) to Completely Degraded (7)
120 m north of the Project Area on Bussell Highway	1.2	0.7	Western and median strip - Open forest of *Eucalyptus marginata*, *Corymbia calophylla* and *Banksia attenuata* on Karrakatta deep sands (VT1). Likely to be Banksia Woodland TEC. Eastern side – Cleared.	Western side – Excellent (2) to Very Good (3), median strip – Good (4) Completely Degraded (7)
Bussell Highway from Capel Golf Course to Yeardy Road (6.8 km)	83.5	25.0	Appears to be mostly scattered trees with some landscape planting. Expected to be VT 9a / VT 3 and VT 10 / VT 10 b: Cleared and scattered native trees – *Corymbia calophylla* and *Eucalyptus marginata* +/- *Agonis flexuosa* with very occasional *E. gomphocephala* (VT9a) / *Corymbia calophylla* and *Eucalyptus marginata* +/- *Banksia* spp. (VT03). Planted trees (VT10) / Revegetation/Regrowth (VT10b).	Degraded (6) to Completely Degraded (7) Aerial photograph shows that this section of Bussel Hwy look similar to the section south of Lakes Road to Capel Golf Course that was surveyed as part of BORR IPT (2019a). This area was assiged condition ratings of Degraded to Completley Degraded and it is expected that the 6.8 km section would be similar.
New access road linking Bourne Loop from Bussell Highway	4.1	2.3	Cleared through paddocks. Remnant stand of vegetatio - VT 1 (Open forest of *Eucalyptus marginata*, *Corymbia calophylla* and *Banksia attenuata* on Karrakatta deep sands).	Completley Degraded Good (4) or better – depending on weediness and structure in the understorey

SURVEY GAP	EXTENT WITHIN PROJECT AREA (ha)	EXTENT OF NATIVE VEGETATION (ha)	POTENTIAL DESCRIPTION OF VEGETATION COMMUNITY	POTENTIAL VEGETATION CONDITION (KEIGHERY 1994)
			Appears to be dampland / creekline which is likely to be VT 7 or VT 8 (Low open forest of *Melaleuca preissiana* and *Melaleuca rhaphiophylla* over sedgeland [VT07], Low open forest of *Eucalyptus rudis* and *Melaleuca preissiana* over sedgeland [VT08]).	Degraded (6) to Completley Degraded (7)
Total Unsurveyed within the Project Area			**100.1 ha** **(Approx. 32.6 ha of vegetation and 67.5 ha cleared)**	

Vegetation condition

The vegetation condition of the Surveyed Area within the Project Area ranged from Excellent (2) to Completely Degraded (7) (BORR IPT 2019a and 2019b). The majority of this vegetation was in Degraded or worse condition (~66 ha / 74 %). Historical clearing and aggressive weed species have influenced the structure and composition of the native vegetation. There was approximately 12 ha of vegetation in Good or better condition, which is 14 % of the surveyed vegetation. The remaining vegetation was in Good – Degraded condition (~11 ha, 12 %).

From interpretation of aerial imagery, the majority of the unsurveyed area is likely to be in Degraded or worse condition. Two unsurveyed areas (Bourne Loop to Bussell Highway [~4 ha] and Ramsey Road [<1 ha]), are likely to be in Good or better condition.

A summary of the vegetation condition within the Project Area is provided in Table 3-5 and vegetation condition mapping is shown in Figure 4.

Table 3-5 Extent of vegetation condition ratings mapped within the Project Area

VEGETATION CONDITION	EXTENT IN SURVEYED AREA (ha)	POTENTIAL EXTENT IN UNSURVEYED AREA (ha)	ESTIMATED EXTENT IN PROJECT AREA (ha)
Excellent	0.1	-	0.1
Excellent - Very Good	3.8	-	3.8
Very Good	2.9	-	2.9
Very Good - Good	3.3	-	3.3
Good	2.4	5.0*	7.4
Good – Degraded	11.1	-	11.1
Degraded	8.7	95.1	103.8
Degraded - Completely Degraded	2.9	-	2.9
Completely Degraded	54.3	-	54.3
Total	**89.5**	**100.1**	**189.6**

* Good or better condition.

Dieback

The Project Area is considered to be susceptible to dieback as it has water gaining areas and lies within the 600 – 800 mm rainfall zone (CALM, 2003a), receiving a mean annual rainfall of 726.1 mm (BoM, 2019).

A dieback field assessment was conducted by Glevan Consulting in October 2011 over part of the Project Area. The survey (Glevan Conuslting, 2011) noted the following:

- The section of the Project east of Jilley Road was considered to be unmappable for dieback due to the lack of indicator species and past disturbance
- The sections west of Jilley Road were considered to be not infested with dieback
- Lot 1 Ducane Road located at the northern end of the Project Area was not infested with dieback, and hygiene measures should be implemented to access the Project Area through this property
- A Dieback Management Plan should be prepared and implemented for the construction of the Project.

The dieback mapping requires updating to confirm if there are areas that can be protected from dieback within the Project Area.

Threatened and Priority Ecological Communities

One Threatened Ecological Community (TEC) and two Priority Ecological Communities (PECs) were recorded within the Study Area (BORR IPT 2019a and 2019b):

- Banksia Woodlands of the Swan Coastal Plain (SCP) TEC
- Banksia dominated woodlands of the SCP IBRA region PEC (Floristic Community Type (FCT) 21a)
- The Tuart (*Eucalyptus gomphocephala*) woodlands of the SCP PEC (FCT25).

The extent and condition of each of these communities within the surveyed portion of the Project Area is summarised in Table 3-6 and presented in Figure 5. The State PEC FCT21a forms part of the Federal Banksia Woodland TEC, when condition and size thresholds are met (see BORR IPT (2019b) for further information). State PEC FCT25 can also form part of the Federal Banksia Woodland TEC when the composition aligns with the TEC and condition and size thresholds are met.

Just over 16 ha of native vegetation within the surveyed portion of the Project Area was identified as the 'Banksia Woodlands of the SCP' TEC. Of this, approximately 99 % is also representative of 'the Tuart (*Eucalyptus gomphocephala*) woodlands of the SCP' PEC and just under 1 % is representative of the 'Banksia dominated woodlands of the SCP IBRA region' PEC.

An additional 6.5 ha of 'the Tuart (*Eucalyptus gomphocephala*) woodlands of the SCP' PEC and 3.5 ha of the 'Banksia dominated woodlands of the SCP IBRA region' PEC occur that are not representative of the 'Banksia Woodlands of the SCP' TEC.

The vegetation types 'Open forest of *Eucalyptus marginata*, *Corymbia calophylla*, *Banksia attenuata* and *Agonis flexuosa* on Karrakatta deep sands' (VT1) and 'Open forest of *Banksia attenuata* and *Agonis flexuosa*' (VT4) were inferred to be equivalent to FCT 25 based on geographic location, landforms and the species recorded within these vegetation types. These vegetation types contained isolated occurrences of *Eucalyptus gomphocephala*; however this is likely to be related to disturbance factors and the species is likely to have been more abundant within this area.

Mapping of the Tuart Woodlands by DBCA (CALM, 2003b) shows that *Eucalyptus gomphocephala* woodlands with 0 to 9 % canopy cover and highly disturbed visible native understorey condition have been mapped within this section of the Study Area, inferred to be equivalent to the PEC FCT 25. Mr. Andrew Webb from DBCA (pers. comm. 2011 and 2015) stated that the vegetation types with the Study Area represent FCT 25.

Based on aerial photography, Banksia TEC / Tuart PEC potentially occur within the 'Bourne Loop to Bussell Highway' and 'Ramsey Road' Unsurveyed Areas (5 ha).

Table 3-6 Threatened and Priority Ecological Communities identified within the Project Area

COMMUNITY TYPE	EPBC ACT	DBCA	EXTENT IN SURVEYED AREA (HA) AND CONDITION	POTENTIAL EXTENT IN UNSURVEYED AREA (ha)	POTENTIAL EXTENT WITHIN THE PROJECT AREA (ha)
Banksia woodlands of the SCP(TEC)	Endangered	Priority 3	**16.4** Excellent: 0.1 Excellent to Very Good: 3.8 Very Good: 2.9 Good: 1.3 Very Good to Good: 3.1 Good to Degraded: 5.2	5.0	21.4
Banksia dominated woodlands of the SCP IBRA region (PEC)	-	Priority 3	**3.5** VT2 Excellent: 0.1 Good to Degraded: 0.2 Degraded to Completely Degraded: 3.2	-	3.5
The Tuart (*Eucalyptus gomphocephala*) woodlands of the SCP (PEC)	-	Priority 3	**22.8 ha** (VT1 and VT4) Excellent to Very Good: 3.8 Very Good: 2.9 Very Good to Good: 3.3 Good: 1.5 Good to Degraded: 11.0 Degraded: 0.3	5.0	27.8

Other significant vegetation

The Project Area traverses a number of waterways including Five Mile Brook, small drainage lines and man-made drains, as well as seasonally inundated areas (wetlands). Vegetation associated with the watercourses and wetland areas includes remnant trees and shrubs (e.g. *E. rudis, Melaleuca preissiana* and *Melaleuca rhaphiophylla*) over introduced grasses and herbs, with mixed native sedges present.

There is approximately 4 ha of vegetation within the Project Area that occurs in association with a watercourse and/or wetland. This vegetation has a restricted distribution and has been impacted by extensive clearing throughout the area. Vegetation types that represent riparian/wetland vegetation included:

- Low open forest of *Eucalyptus rudis* and *Melaleuca preissiana* over sedgeland (BORR IPT (2019a) VT08 & BORR IPT (2019b) VT02) – just over 2 ha (0.9 ha in Good and 1.3 ha in Degraded to Completely Degraded condition)
- Woodland of *Melaleuca preissiana* and *M. rhaphiophylla* (BORR IPT (2019a) VT7 and BORR IPT (2019b) VT03) – 1.6 ha in Degraded to Completely Degraded condition.

In addition, there is a remnant, mature Tuart tree located within the Project Area between Five Mile Brook and Woods Road, Gelorup. This tree is listed as an Australian Champion Tree (National Register of Big Trees, 2019) and was assessed by an arborist on 5 March 2019 to be:

- Large for its genus and likely well in excess of 100 years old
- Over-mature, displaying evidence of multiple large branch fractures
- Providing numerous hollows within the trunk and branch structure which could potentially be used by fauna (not Black Cockatoos as determined by the fauna assessment, see Section 3.4.2)
- Potentially going to continue to live for another 100 years, if left undisturbed.

Conservation reserves and areas

There are three conservation reserves within 5 km of the Project Area (GoWA, 2019a) (Figure 6). Two reserves are Crown Land vested to the Conservation Commission of WA and managed by DBCA. These reserves are:

- 'Roselands Nature Reserve', located adjacent to the Project Area on Boyanup West Road
- 'Un-named Nature Reserve', located adjacent to the Project Area, south of Bourne Loop and west of Bussell Highway.

The third reserve is the Tuart Forest National Park, which is located directly west of the 'Un-named Nature Reserve', approximately 350 m west of the Project Area.

Environmentally Sensitive Areas

There are numerous Environmentally Sensitive Areas (ESAs) within 5 km of the Project Area and four ESAs which intersect the Project Area (GoWA, 2019a). The Project Area intersects:

- The buffered extent of one ESA associated with Conservation Category and Resource Enhancement wetlands (UFI 1025, 1004, 1023, 1024 and 15821)
- Two ESAs that abut Bussell Highway and are associated with Conservation Category Wetlands (UFI 14478 and UFI 1019)
- The buffered extent of one ESA associated with Roselands Nature Reserve on Boyanup West Road.

The Project Area is also located adjacent to an ESA that is associated with Five Mile Brook.

Flora diversity

BORR IPT (2019b) undertook a NatureMap database search on the vegetation and flora Study Area (297 ha). The search identified 568 plant taxa, representing 92 families, and comprising 469 native and 99 introduced flora taxa (DBCA, 2007).

During the field assessment, BORR IPT (2019a) recorded 267 plant taxa (including subspecies and varieties) representing 182 genera and 62 plant families. This was recorded over 297 ha, of which 73 ha intersects the Project Area. The total flora taxa was comprised of 178 native species and 89 introduced (exotic) and planted species. Table 3-7 provides a summary of previous flora surveys and the current survey. As shown, the species diversity between the two BORR IPT surveys (2019a and b) were similar.

Whilst BORR IPT (2019b) Study Area did not cover the entire Project Area, it is considered it can be used as an indicator of flora diversity within the Project Area.

Table 3-7 Floristic diversity of the Study Area

SURVEY	TOTAL TAXA	TOTAL NATIVE : WEED	COMMENTS
BORR Southern Section Vegetation and Flora Study **(BORR IPT, 2019b)**	267	178 : 89	Survey over multiple sites and vegetation communities of 267 ha.
BORR Southern Section Alternative Alignment Vegetation and Flora Study **(BORR IPT, 2019a)**	247	171 : 76	One season survey over 1,409 ha, multiple sites assessed and differing vegetation communities.
Lot 1 Ducane Road **(GHD, 2014)**	104	81 : 23	Smaller Study Area with few vegetation types, winter survey only.
BORR, South Western Highway to Bussell Highway Flora and Vegetation Assessment, Phase 1 and Phase 2 **(GHD, 2015b)**	198	145 : 53	Similar Study Area as the current survey, September and June survey period.
BORR Southern Section GBRS Alignment – Reassessment of Floristic Communities **(Biota, 2016)**	96	62 : 34	Restricted to small Study Area with only few vegetation types.
BORR Southern Section GBRS Alignment– Banksia Woodlands TEC Assessment **(Biota, 2018c)**	112	92 : 20	Survey of potential Banksia woodland TEC only.

Conservation significant flora

No EPBC Act or BC Act listed flora were recorded within the Project Area during the surveys conducted in October and November 2018 (BORR IPT, 2019a; BORR IPT, 2019b). This supports data from flora and vegetation surveys undertaken in November 2007 (Bennett Environmental Consulting, 2008), October 2008 (GHD, 2009), November 2011 and June 2014 (GHD, 2015b), June 2013 (GHD, 2014), October 2016 (Biota, 2016), February 2017 (targeted *Diuris drummondii)* (Ecoedge, 2017) and November 2017 (Biota, 2018c).

GHD (2015b) confirmed the presence of one DBCA Priority flora species, *Caladenia speciosa* (Sandplain White Spider Orchid – Priority 4) mostly in small populations between Yalinda Drive and Bussell Highway, within the Project Area. A total of 71 individual *Caladenia speciosa* plants were recorded within the Project Area (Figure 5).

BORR IPT (2019b) completed a likelihood of occurrence assessment post-field survey for all conservation significant flora taxa identified in the desktop assessment. This assessment took into account previous records, habitat requirements, efficacy of the survey, intensity of the survey, flowering times and the cryptic nature of species. The likelihood of occurrence assessment confirmed that two taxa are known to occur, one taxa is likely to occur, 27 taxa possibly occur and the remaining 15 taxa are unlikely to occur within the Study Area.

The taxa that are known and likely to occur in the Study Area are listed in Table 3-8. Species that occur more than 5 km from the Study Area and had habitat present that was heavily grazed, were considered unlikely to occur (BORR IPT, 2019b). For a conservative approach, it is considered that this likelihood of occurrence assessment also applies to the Project Area.

Table 3-8 Known and likely to occur conservation significant flora within the Study Area

TAXA	STATUS	LIKELIHOOD ASSESSMENT
Acacia semitrullata	P4	Known – recorded during the GHD (2015b) and GHD (2014) survey however has not been identified within the Project Area. This species has been recorded within 5 km of the Study Area.
Aponogeton hexatepalus	P4	Likely - species occurs within 5 km of Study Area and habitat occurs within Study Area.
Caladenia speciosa	P4	Known within the Project Area – this species was recorded during the GHD (2015b) survey. Database records show this species as recorded within the Study Area and in a 5 km buffer of the Study Area.

Introduced and invasive species

Two of the introduced taxa recorded by BORR IPT (2019a and b) within the Project Area, are listed as Declared Pests under the *Biosecurity and Agriculture Management Act 2007* and one is also listed as a Weed of National Significance (WONS):

- **Asparagus asparagoides* (Bridal Creeper) – Declared Pest and WONS
- **Zantedeschia aethiopica* (Arum lily) – Declared Pest.

Two additional Declared Pests (one of which is also a WONS) have been previously recorded within and to the north of the Project Area however were not identified in the Project Area during the 2018 field survey. These species are also considered likely to be at risk of spread within the Project Area:

- * *Lantana camara* – Declared Pest and WONS
- * *Moraea flaccida*– Declared Pest.

**Moraea flaccida* was recorded during the survey undertaken in 2016 (Biota, 2016) however it was not recorded in the current survey (BORR IPT 2019a and b). Locations of the Declared Pests are shown in Figure 3. The remaining introduced taxa are considered environmental weeds and all have been previously recorded on the Swan Coastal Plain.

Comparison with other mapped vegetation

The vegetation within the Study Area broadly aligns with the mapped Beard (1979) vegetation associations and the Webb *et al*. (2016) vegetation complexes. Based on a review of species present, where possible, vegetation types were assigned a Floristic Community Type (FCT). The FCT comparisons are provided in Table 3-3.

3.3.3 Potential impacts

The Project will potentially result in the direct loss of vegetation and flora through clearing of:

- Approximately 40 ha of mapped native vegetation (within the Surveyed Area of the Project Area), and a further 33 ha of native vegetation identified via aerial imagery (within the unsurveyed area of the Project Area). The remainder of the Project Area (~117 ha) is considered to be cleared or highly modified.
  - Within the Surveyed Area, 74 % is in Degraded or worse condition and 14 % is in Good or better condition. The remaining 12 % ranges from Good – Degraded (Figure 4)
  - Within the Unsurveyed Area, the majority of vegetation appears to be scattered trees which is likely to be assigned a Degraded condition. One remnant stand of vegetation may be in Good or better condition
- Just over 21 ha of native vegetation associated with the 'Banksia Woodlands of the Swan Coastal Plain' TEC, including approximately 16 ha of mapped native vegetation within the surveyed area and 5 ha of unsurveyed vegetation (that requires confirmation with a field survey). The majority of the surveyed

native vegetation is in Good to Degraded condition (30 %), followed by vegetation in Excellent to Very Good condition (21 %)

  - Of the approximate 16 ha mapped 'Banksia Woodlands of the Swan Coastal Plain' TEC, approximately 99 % is also representative of 'the Tuart (*Eucalyptus gomphocephala*) woodlands of the SCP' PEC and approximately 1 % is representative of 'Banksia dominated woodlands of the SCP IBRA region' PEC

- Approximately 4 ha of native vegetation associated with the 'Low lying *Banksia attenuata* woodlands or shrublands' PEC, the majority of which is in Degraded condition (93 %)
- A total of approximately 28 ha of native vegetation associated with 'the Tuart (*Eucalyptus gomphocephala*) woodlands of the SCP' PEC, approximately 50 % of this is in Good or better condition
- A total of 4 ha riparian vegetation (associated with watercourses or wetlands)
- One Priority listed species *Caladenia speciosa* (P4), of which 71 individuals are estimated to occur within the Project Area (Figure 5)
  - A conservative estimate of the known populations identified 3,906 individual plants (59 records on FloraBase)
- Potential loss of *Acacia semitrullata* (P4) and *Aponogeton hexatepalus* (P4), which are considered likely to occur but were not recorded within the Project Area
- Native vegetation associations and complexes (Beard, 1979; Webb *et al*., 2016) that have less than 30 % remaining at the local scale (Shire of Capel).

The Project also has the potential (if appropriate management and mitigation measures are not implemented) to result in the following indirect impacts to vegetation and flora:

- Fragmentation of native vegetation remnants within the local area
- Possible introduction and/or spread of Dieback and weeds (WONS and Declared Pests) to adjacent native vegetation
- Changes to vegetation structure and floristic composition in surrounding areas through altered surface water drainage patterns and flows
- Damage to surrounding vegetation through accidental generation of a bushfire.

3.3.4 Assessment of impacts

The assessment of impacts is presented (where possible) at a regional (Bioregion) and Local Government Area (LGA) scale. Information is also provided on the extent of vegetation within the broader BORR IPT (2019b) Study Area to supplement the local scale assessment.

For the purposes of this EIA, cumulative impacts have been assessed by comparing the known regional / local extents of vegetation associations / complexes and types against published information on their extent, to estimate the overall percent impact of the Project. Consideration of other future Projects have not been included at this stage.

Regional and local Significance

The pre-European vegetation mapping has been adapted and digitised (Shepherd, Beeston, & Hopkins, 2002). The extent of the vegetation associations (remaining uncleared) have been determined from the state-wide vegetation area calculations maintained by the DBCA (latest update March 2019) (GoWA, 2019b).

The DPIRD Native Vegetation Extent database (GoWA, 2019a) was used as the basis to assess direct and cumulative impacts at a local, regional and bioregional scale for this EIA. To calculate the current extent remaining, intersects between the Native Vegetation Extent, and the Pre-European Vegetation and Vegetation Complexes – SCP datasets were completed (GoWA, 2019a).

As shown in Table 3-9, the current extent of vegetation association 6 is less than 30 % of its pre-European extent at IBRA bioregion and IBRA subregion levels. Vegetation association 37 has less than 30 % remaining at the Local Government Authority (LGA) level in the Shire of Capel.

Vegetation association 968 and 1000 have less than 30 % of their pre-European extent at all levels, with the exception of association 968 at the state level. Vegetation association 968 has less than 10 % remaining at the IBRA bioregion, IBRA subregion and LGA (Shire of Capel) levels.

GoWA (2019c) has assessed the vegetation complexes mapped by Webb *et al*. (2016) against presumed pre-European extents within the SWA IBRA bioregion (Table 3-10) and LGA levels (Table 3-11). Current extents of all complexes within the Project Area are less than 30 % of their pre-European extents within the SWA IBRA bioregion and within the City of Bunbury and Shire of Capel LGAs, with the exception of the Vasse Complex at the SCP level and the Karrakatta Complex at the LGA level (GoWA, 2019c).

Table 3-9 Extent of vegetation associations mapped within the Project Area (GoWA, 2019b)

VEGETATION ASSOCIATION	SCALE	PRE-EUROPEAN EXTENT (ha)	CURRENT EXTENT (ha)	REMAINING (%)	CURRENT EXTENT IN ALL DBCA MANAGED LAND (%)	AMOUNT WITHIN THE PROJECT AREA (ha)	% OF CURRENT EXTENT WITHIN THE PROJECT AREA	% REMAINING AFTER PROJECT IMPACTS
Swan Coastal Plain IBRA Bioregion		1,501,221.9	579,813.5	38.6	38.5	47.6	<0.1	38.6
6	State: WA	56,343.0	13,362.3	23.7	39.8	39.8	<0.1	23.7
	IBRA Bioregion: Swan Coastal Plain	56,343.0	13,362.3	23.7	39.8	39.8	<0.1	23.7
	Sub-region: Perth	56,343.0	13,362.3	23.7	39.8	39.8	<0.1	23.7
	Shire of Capel (LGA)	5,245.3	2,301.1	43.9	16.5	39.8	1.73	43.1
37	State: WA	39,296.5	24,727.2	62.9	20.9	<0.1	<0.1	62.9
	IBRA Bioregion: Swan Coastal Plain	15,617.9	5,404.7	34.6	41.0	<0.1	<0.1	34.6
	Sub-region: Perth	14,018.5	4,784.2	34.1	44.9	<0.1	<0.1	34.1
	Shire of Capel (LGA)	1,737.0	484.6	27.9	9.9	<0.1	<0.1	27.9
968	State: WA	296,877.8	95,048.8	32.0	57.6	0.9	<0.1	32.0
	IBRA Bioregion: Swan Coastal Plain	136,188.2	9,017.3	6.6	21.6	0.9	<0.1	6.6
	Sub-region: Perth	136,188.2	9,017.3	6.6	21.6	0.9	<0.1	6.6
	Shire of Capel (LGA)	6,657.3	660.4	9.9	3.5	0.9	0.1	9.9
1000	State: WA	99,835.9	27,768.8	27.8	18.6	6.8	<0.1	27.8
	IBRA Bioregion: Swan Coastal Plain	94,175.3	24,869.2	26.4	19.2	6.8	<0.1	26.4
	Sub-region: Perth	94,175.3	24,869.2	26.4	19.2	6.8	<0.1	26.4
	Shire of Capel (LGA)	15,173.8	3,189.9	21.0	7.3	6.8	0.2	21.0

Table 3-10 Extent of vegetation complex on the Swan Coastal Plain within the Project Area (GoWA, 2019c)

VEGETATION COMPLEX	PRE-EUROPEAN EXTENT (ha)	CURRENT EXTENT (ha)	REMAINING EXTENT (%)	CURRENT EXTENT REMAINING WITHIN ALL DBCA MANAGED LAND (%)	AMOUNT WITHIN THE PROJECT AREA (ha)	% OF CURRENT EXTENT WITHIN THE PROJECT AREA	% REMAINING AFTER PROJECT IMPACTS
Bassendean Complex – Central and South	87,476.3	23,508.7	26.9	5.0	6.8	<0.1	26.9
Karrakatta Complex - Central and South	53,081.0	12,467.2	23.5	8.1	35.4	0.3	23.4
Guildford Complex	90,513.1	4,607.9	5.1	0.3	5.4	0.1	5.1
Vasse Complex	15,691.6	4,927.0	31.4	14.6	<0.1	<0.1	31.4

Table 3-11 Extent of vegetation complex within Shire of Capel within the Project Area (GoWA, 2019c)

VEGETATION COMPLEX	PRE-EUROPEAN EXTENT (ha)	CURRENT EXTENT (ha)	REMAINING EXTENT (%)	PROPORTION OF THE VEGETATION COMPLEX WITHIN THE LGA (%)	AMOUNT WITHIN THE PROJECT AREA (ha)	% OF CURRENT EXTENT WITHIN THE PROJECT AREA	% REMAINING AFTER PROJECT IMPACTS
Bassendean Complex – Central and South	4,946.6	1,162.2	23.5	5.7	6.8	0.6	23.4
Karrakatta Complex - Central and South	6,902.3	3,400.6	49.3	13.0	35.4	1.0	48.8
Guildford Complex	6,508.4	540.5	8.3	7.2	5.4	1.0	8.2
Vasse Complex	2,104.4	526.2	25.0	13.4	<0.1	<0.1	25.0

Note: red and orange indicate that less than 10 % and 30 %, respectively, of the pre-European extent remains before and after Project impacts.

Threatened and Priority Ecological Communities

Banksia Woodland TEC/ PEC

The Threatened Species Scientific Committee (TSSC) provides information on the estimated extent of Banksia Woodland TEC within the SCP Bioregion. The TSSC advises that approximately 81,800 ha (~24 %) of the TEC occurs within reserves, most of which are in the Perth subregion of the SCP Bioregion (TSSC, 2016) (Table 3-12). This document also states that there is approximately 336,490 ha of Banksia TEC remaining within the SCP (TSSC, 2016).

Table 3-12 Extent of the Banksia Woodlands ecological community estimated to be protected in reserves (TSSC, 2016)

SUBREGION	CURRENT EXTENT (ha)	EXTENT IN RESERVES (ha)	% PROTECTED
Dandaragan (SWA01)	81,067.8	24,671.2	30.4
Perth (SWA02)	253,540.6	57,054.9	23.0
Jarrah Forests (JAF01/02)	1,881.4	105.9	5.6
Total	336,489.9	81,832.2	24.3

Clearing would result in loss of just over 21 ha of Banksia TEC (Table 3-6); equivalent to a 0.006 % reduction in the Banksia Woodland TEC (Table 3-12). At the Perth subregion scale, this would represent a 0.008 % reduction. Of this, approximately 11 ha was rated as in Good or better condition. NB: Assessment of patches takes into account overall vegetation condition and therefore areas of Banksia Woodland can be included as part of a TEC patch if the condition is less than Good but the overall condition of the patch is rated Good or better.

This represents the maximum likely impact associated with the Project and includes 5 ha of potential Banksia Woodland that requires additional survey to confirm if it meets the criteria for TEC condition and patch size.

Tuart Woodland PEC

The pre-European extent of 'the Tuart (*Eucalyptus gomphocephala*) woodlands of the SCP' PEC is estimated to be 125,400 ha with approximately 17,060 ha (2015 indicative extent) or 14 % of the pre-European extent remaining. Of this, 5,535 ha is reserved in 20 reserves (IUCN management categories I-IV) and comprise 22 % of the remaining extent of the ecological community (DotEE, 2017a).

Approximately 28 ha of native vegetation associated with this PEC is located within the Project Area. Approximately 50 % of this is in Good or better condition. Clearing of this amount for the Project would represent a 0.2 % reduction in the remaining extent of the PEC.

This total includes 5 ha that requires additional survey to confirm if it meets the criteria for TEC condition and patch size.

Threatened Flora

No EPBC Act or BC Act listed flora were recorded within the Project Area during the surveys conducted in October and November 2018 (BORR IPT, 2019a; BORR IPT, 2019b) or previous surveys listed in Table 3.1.

The Project is not expected to result in negative impacts on any EPBC Act or BC Act listed flora.

Priority Flora

Spatial data (with sufficient information) were not available to inform a cumulative assessment for conservation significant flora at a local or regional scale. The impacts have been estimated by interrogating records on FloraBase (Western Australian Herbarium, 1998-). It is noted these records often provide the count (frequency) in descriptors such as common, abundant, frequent, occasional and scattered without providing an actual number of individuals. For the purposes of this assessment, these records have been counted as one

individual, and therefore the population estimates are underrepresented with the actual number of individuals expected to be much higher.

There were 71 individuals of *Caladenia speciosa* (P4) recorded within the Project Area (BORR IPT, 2019b). *Caladenia speciosa* is a relatively widespread species and occurs from Mundijong to Boyanup, with additional populations south towards Donnybrook and further east at Lake Muir (Brown, Dundas, Dixon, & Hopper, 2008). The potential loss of up to 71 individuals represents a <2 % reduction in the recorded occurrence of this species (compared with approximately 3906 plants from 59 records on the Western Australian Herbarium database), (Western Australian Herbarium, 1998-). It should be noted that it is likely that the population for the species is greater than the approximate 4000 plants as FloraBase and NatureMap (DBCA 2007) do not always provide details on the number of plants present.

Both priority 4 species *Acacia semitrullata* and *Aponogeton hexatepalus* considered likely to occur but not recorded within the Project Area, have relatively wide distributions. *Acacia semitrullata* has been recorded from Waroona to Manjimup and *Aponogeton hexatepalus* from Nannup to Gosnells (Western Australian Herbarium, 1998-).

Given the population estimates used are likely to be underestimates, and the species are relatively widespread, the potential impacts associated with the Project are not considered to be significant to the Priority species recorded.

3.3.5 Mitigation

The mitigation of impacts will be refined during the formal environmental assessment process and developed in consultation with Main Roads and key stakeholders if the alignment is selected as the preferred option. The following management and mitigation measures will be developed for this Project.

Impacts to flora and vegetation will be minimised through the following mitigation and management measures:

- Developing a Project design to minimise environmental impacts as far as practicable
- The selection of engineering and drainage solutions to avoid and minimise environmental impacts
- Compliance with State and Commonwealth environmental legal requirements
- Preparation and implementation of a Project specific Construction Environmental Management Plan (CEMP) that addresses issues specific to flora and vegetation including:
  - Complaints response site management
  - Vegetation management, and clearing procedures and processes
  - Topsoil management
  - ASS management
  - Dieback and weed management
  - Wetlands, drainage and groundwater management
  - Construction management (noise, vibration and dust)
  - Fire risk management
  - Environmental incident reporting and management
- The CEMP will include targets and key performance indicators, management actions, monitoring requirements and contingency measures.

3.3.6 Predicted outcome

Based on the information available to support the EIA, the Project has the potential to result in residual impacts including:

- Clearing of approximately 73 ha of native vegetation, including:
  - Approximately 40 ha of mapped native vegetation, including 14 % Good or better condition and 61 % is in Completely Degraded condition
  - Approximately 33 ha within unsurveyed areas that appears to include native vegetation (identified from aerial imagery) the majority of which is likely to be in Degraded or worse condition

- Clearing of vegetation associations (Beard, 1979) and complexes (Webb *et al*., 2016) that are under-represented
- Permanent loss of TECS and PECs:
  - Banksia Woodlands of the Swan Coastal Plain (TEC) – an estimated 21 ha
  - Banksia dominated woodlands of the Swan Coastal Plain IBRA region (PEC) – approximately 4 ha
  - The Tuart (*Eucalyptus gomphocephala*) woodlands of the Swan Coastal Plain (PEC) – approximately 28 ha
- Loss of up to 4 ha riparian vegetation associated with wetlands and minor waterways / drainage lines
- Permanent loss of approximately 71 known individuals of *Caledenia speciosa* (P4). This represents an estimated 2 % of the known population.

Given the extent of impacts to conservation significant communities (TECs / PECs), loss of under-represented vegetation, riparian vegetation and priority flora species, offsetting of residual impacts may need to be investigated. Additional surveys will be required to address information gaps in unsurveyed area and confirm the likely outcome for flora and vegetation if this alignment is selected as the preferred option.

3.4 Key Environmental Factor – Terrestrial Fauna

3.4.1 Studies undertaken

The following field investigations have been undertaken for this aspect:

- BORR GBRS Alignment Targeted Fauna Assessment and BORR Southern Alternative Alignment Targeted Fauna Assessment (Biota 2019a and 2019b respectively), which covered approximately 90 ha (47 %) of the Project Area
- Bunbury Outer Ring Road Alternate Alignment: Targeted Conservation Significant Aquatic Fauna Survey (WRM, 2018b)
- BORR Southern Investigation Area: Targeted Conservation Significant Aquatic Fauna Survey (WRM, 2018a)
- BORR (Southern Section GBRS Corridor) Black Cockatoo Tree Survey (Biota, 2018a)
- Western Ringtail Possum Assessment (Biota, 2018b)
- Western Ringtail Possum Survey (GHD 2018)
- BORR Southern Section GBRS Alignment- Fauna Study (GHD, 2015a)
- BORR Southern Section GBRS Alignment Clearing Permit Supporting Document (GHD, 2015c)
- Lot 1 Ducane Road, Environmental Values Assessment (GHD, 2014)
- BORR Western Ringtail Possum Assessment (GHD, 2013)
- Report for the Bunbury Outer Ring Road – Southern Section GBRS Corridor (South Western Highway to Bussell Highway) Environmental Impact Assessment (GHD, 2012b)
- BORR Southern Section GBRS Alignment, South Western to Bussell Highways, Fauna Assessment (GHD, 2012a).

The following locations were not surveyed and have undergone desktop assessment:

- Lakes road
- Jilley Road
- Jaymon Road
- Minninup Road / Maidment Parade (surveyed for Western Ringtail Possums only)
- Ramsay Road
- Child Place
- 120 m north of the Project Area on Bussell Highway
- The southern end of the Project on Bussell Highway from Capel Golf Course to Yeardy Road, approximately 6.8 km, including intersection with Boyanup Road West and Fishermans Road
- New access road linking to Bourne Loop from Bussell Highway.

Gaps in the field surveys total approximately 100 ha and are shown in Figure 2. Additional fauna field surveys will be undertaken at these locations if BORR Southern Section GBRS Alignment is selected for development. For the purposes of the EIA, Biota 2019a and 2019b have been used as the primary reference to identify fauna species occurring or likely to occur within the Project Area and fauna habitats occurring within the Project Area. The Biota field surveys included reference sites outside of the Project Area and all areas surveyed are referred to as the Biota Study Area. Parts of the Biota Study Area intersect the Project Area. These are referred to as Surveyed Areas. Sections of the Project Area were not covered by the Biota Study Area and are referred to as unsurveyed areas.

3.4.2 Receiving environment

Fauna habitat

Fauna habitat within the Surveyed Areas Biota (2019a and b) were classified into three dominant fauna habitat types covering approximately 40 ha combined (Figure 7):

- Jarrah/Marri woodland: Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*) dominated over storey, varying understorey of Banksia (*Banksia attenuata* and *B. grandis*) or Peppermint (*Agonis flexuosa*) dominance
- Scattered trees over introduced grasses: Overstorey consisting of a scattering of mature Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*) in upland areas, and Flooded Gum (*Eucalyptus rudis*) and Tuart (*Eucalyptus gomphocephala*) in low lying areas over introduced grasses
- Damplands and Wetlands: dominated by *Melaleuca* spp. and sedges often in grazed paddocks. Vegetation comprised *Melaleuca raphiophylla* with scattered Flooded Gum (*Eucalyptus rudis*) over mixed sedge species. In some wetland areas Peppermint (*Agonis flexuosa*) often co-dominant with *Melaleuca* spp.

The remainder of the Surveyed Area (~49 ha) was classified as Cleared. The fauna habitat types are based on vegetation composition or features in the environment that fauna can utilise and includes scattered remnant paddock trees, as these are often suitable forging and / or potential breeding (e.g. hollow-bearing trees) resources.

The description and area of each habitat type within the Surveyed Area is summarised in Table 3-13. Approximately 33 ha of potential fauna habitat has been estimated in the unsurveyed area, based on interpretation of aerial imagery (Table 3-14). Therefore, the Project Area contains up to 73 ha of fauna habitat.

Table 3-13 Fauna habitat types identified within the surveyed component of the Project Area

HABITAT TYPE AND DESCRIPTION	EXTENT WITHIN THE PROJECT AREA (ha)
Damplands with Melaleuca shrubland and/or woodland 	2.3
Marri/Eucalyptus Woodland 	30.3
Marri/Eucalyptus in paddocks and road reserves 	7.6
Cleared	49.3
Total	89.5

Table 3-14 Survey gaps – description of potential fauna habitat within the Project Area

SURVEY GAP	EXTENT WITHIN PROJECT AREA (ha)	EXTENT OF NATIVE VEGETATION (ha)	POTENTIAL DESCRIPTION OF FAUNA HABITAT
Lakes Road	1.0	0.2	Marri/Eucalyptus in paddocks and road reserves.
Minninup Road / Maidment Parade	3.1	0.8	Marri/Eucalyptus in paddocks and road reserves.
Jilley Road	3.8	1.4	Marri/Eucalyptus in paddocks and road reserves. Dampland with Melaleuca shrubland and/or woodland (patch south of Manea Drive).
Additional sections in agricultural land near Ducane Road and Jilley Road	0.4	0.1	Cleared.
Additional section north of Calinup Road and between Brockway Drive and Bussell Hwy	0.4	0.4	Marri/Eucalyptus woodland.
Jaymon Road	0.8	0.3	Cleared.
Eucalypt Drive	0.1	0.1	Marri/Eucalyptus in paddocks and road reserves.
Brockway Drive	0.3	0.1	Cleared.
Ramsay Road	0.8	0.7	Marri/Eucalyptus woodland.
Child Place	0.6	0.4	Marri/Eucalyptus in paddocks and road reserves.
120 m north of the Project Area on Bussell Highway	1.2	0.7	Western and median strip - Marri/Eucalyptus woodland. Eastern side – Cleared.
Bussell Highway from Capel Golf Course to Yeardy Road (6.8 km)	83.4	25.1	Marri/Eucalyptus in paddocks and road reserves.

SURVEY GAP	EXTENT WITHIN PROJECT AREA (ha)	EXTENT OF NATIVE VEGETATION (ha)	POTENTIAL DESCRIPTION OF FAUNA HABITAT
New access road linking Bourne Loop from Bussell Highway	4.1	2.3	Cleared through paddocks. Remnant stand of vegetation – Marri/ Eucalyptus woodland. Creekline – Dampland with Melaleuca shrubland and/or woodland.
Total Unsurveyed Gaps			**100.1 ha** (including an estimated 32.6 ha of fauna habitat and 67.5 ha Cleared/ Highly Modified land)

Fauna habitat value

The fauna habitat types recorded within the Project Area have both suitable foraging and potential breeding habitat for conservation significant species such as Black Cockatoos (Carnaby's Cockatoo, Forest Red-tailed Black Cockatoo and Baudin's Cockatoo) and Western Ringtail Possum (Biota 2019a and b).

The majority of fauna habitats mapped within the Project Area were assessed as potentially Very High Quality for Black Cockatoo species (Biota, 2019a). Only those areas comprising uniform stands of *Melaleuca* shrubs and Peppermint woodland were considered unlikely to contain foraging or breeding habitat.

WRPs were observed utilising habitats ranging from relatively isolated trees through to remnant strips (along road reserves and riparian belts) surrounding by cleared land, to larger remnants of native vegetation.

The fauna habitat within the unsurveyed area is estimated to comprise approximately 33 ha of native vegetation which may provide additional habitat for conservation significant fauna species. The fauna habitat types within the Biota Study Area and how they are used by conservation significant fauna species (possibly, likely or known to occur) are presented in Table 3-15.

Ecological linkages

The Project Area intersects one South West Regional Ecological Linkage (SWREL) axis line which connects large vegetation remnants west of Bussell Highway to large vegetation remnants in South Boyanup (approximately 7 km to the east) (Molloy, Wood, Wallrodt, & Whisson, 2009). The location where the SWREL is intersected is along the existing Bussell Highway, which already fragments the SWREL.

On a local scale, vegetation along road reserves, Five Mile Brook and Gynudup Brook provide local ecological linkages that are intersected by the Project Area. These linkages are likely to be used by conservation significant fauna (e.g. WRP) as well as a number of more common mammals, birds, reptiles and amphibians.

Fauna diversity

Biota (2019a) completed a desktop NatureMap database search on their Study Area and this has been used as an indicator of potential faunal diversity within the Project Area. The database search indicated a species inventory of 223 vertebrate fauna species, comprising 25 mammals (14 native non-volant, 1 bat and 10 non-native), 159 birds (63 of which are largely reliant on freshwater or marine habitats), 29 reptiles and 10 amphibians.

Conservation significant terrestrial fauna

The desktop review identified 20 conservation significant terrestrial fauna species within 10 km of the Biota (2019a) Study Area. Five conservation significant fauna are known to occur within the Biota Study Area, including:

- Western Ringtail Possum (Critically Endangered)
- Carnaby's Cockatoo (Endangered)
- Baudin's Cockatoo (Endangered)
- Forest Red-tailed Black Cockatoo (Vulnerable)
- Evidence of Quenda, Southern Brown Bandicoot (Priority 4), in the form of diggings.

A likelihood of occurrence assessment was undertaken for 12 conservation significant terrestrial fauna (Biota, 2019a). Conservation significant species considered likely or possibly occurring, and their habitat preferences, are summarised in Table 3-15. This likelihood of occurrence assessment on the Biota Study Area is assumed to apply within the wider Project Area.

Table 3-15 Likelihood of occurrence for terrestrial conservation significant fauna species and their habitat availability within the Project Area

SPECIES	COMMON NAME	LISTING UNDER BC ACT 2018 OR DPAW PRIORITY LIST	LISTING UNDER EPBC ACT	LIKELIHOOD OF OCCURRENCE ASSESSMENT	FAUNA HABITAT TYPE		
					MARRI/EUCALYPTUS WOODLAND	MARRI/EUCALYPTUS IN PADDOCKS AND RESERVES	DAMPLAND WITH MELALEUCA SHRUBLAND AND/OR WOODLAND
Mammals							
Pseudocheirus occidentalis	Western Ringtail Possum	S1	CR	Recorded	Breeding, Foraging	Breeding, Foraging	-
Isoodon fusciventer	Quenda, Southern Brown Bandicoot	P4		Recorded	Breeding, Foraging	Breeding, Foraging	Breeding, Foraging
Phascogale tapoatafa wambenger	South-western Brush-tailed Phascogale, Wambenger	S6		Likely to occur	Breeding, Foraging	-	-
Dasyurus geoffroii	Chuditch, Western Quoll	S3	VU	Possible	Foraging	Foraging	-
Falsistrellus mackenziei	Western False Pipistrelle, Western Falsistrelle	P4		Possible	Breeding, Foraging	Foraging	-
Notamacropus irma	Western Brush Wallaby	P4		Possible	Foraging	Foraging	-
Reptiles							
Ctenotus ora	Coastal Plains Skink	P3		Possible	Breeding, Foraging	Breeding, Foraging	-

SPECIES	COMMON NAME	LISTING UNDER BC ACT 2018 OR DPAW PRIORITY LIST	LISTING UNDER EPBC ACT	LIKELIHOOD OF OCCURRENCE ASSESSMENT	FAUNA HABITAT TYPE		
					MARRI/EUCALYPTUS WOODLAND	MARRI/EUCALYPTUS IN PADDOCKS AND RESERVES	DAMPLAND WITH MELALEUCA SHRUBLAND AND/OR WOODLAND
Birds							
Calyptorhynchus banksia naso	Forest Red-tailed Black-Cockatoo	S3	VU	Recorded	Breeding, Foraging	Breeding, Foraging	-
Calyptorhynchus baudinii	Baudin's Cockatoo	S2	EN	Recorded	Breeding, Foraging	Breeding, Foraging	-
Calyptorhynchus latirostris	Carnaby's Cockatoo	S2	EN	Recorded	Breeding, Foraging	Breeding, Foraging	-
Falco peregrinus	Peregrine Falcon	S7		Likely to Occur	Foraging	Foraging	-
Oxyura australia	Blue-billed Duck	P4		Possible	-	-	Foraging

Black Cockatoos

The Surveyed Area provides up to 38 ha of suitable foraging and potential breeding habitat for Black Cockatoos (Carnaby's Cockatoo, Baudin's Cockatoo and Forest Red-tailed Black Cockatoo). Suitable foraging and potential breeding habitat for Black Cockatoos within the Study Area includes Jarrah/Marri Woodland and Scattered trees over introduced grasses.

During the field survey, Black Cockatoo individuals were recorded within the Biota Study Area, as described below:

- Four Forest Red-tailed Black Cockatoo individuals recorded from four observations
- Eight white-tailed Black Cockatoo individuals recorded from one observation (likely Carnaby's Cockatoo)
- Evidence of Baudin's Cockatoo (Marri nuts with chew marks).

Black Cockatoo breeding habitat, as defined in the Commonwealth referral guidelines (DotEE, 2017b), includes:

- Relevant tree species with a suitable Diameter at Breast Height (DBH) to develop a nest hollow, where DBH is greater than or equal to 500 mm (herein referred to as 'Suitable DBH Trees')
- Trees with a hollow that meets the DotEE (2017b) depth, width and angle criteria for nesting by Black Cockatoos, herein referred to a 'Trees with a Suitable Nest Hollow'
- 'Known Nesting Trees' are those trees that have secondary evidence of nesting i.e. feathers, eggs/ shells etc.

A total of 443 Suitable DBH Trees were identified within the Surveyed Area. Of these, the drone survey identified eight Trees with a Suitable Nest Hollow and four Known Nesting Trees. Three additional trees with hollows could not be assessed by drone. Survey observations and future potential breeding tree locations are shown in Figure 8.

Due to their breeding distribution, Forest Red-tailed Black Cockatoos are considered the most likely of the three cockatoo species to breed within the Project Area. However, all three species may potentially breed within the Project Area.

The unsurveyed area (~100 ha) is estimated to have an additional 33 ha of vegetation which is potential Black Cockatoo breeding and/or foraging habitat.

Western Ringtail Possum

Biota (2019a) identified approximately 38 ha of breeding and foraging habitat for WRPs within the Surveyed Area including Jarrah/Marri Woodland and scattered trees over introduced grasses. WRPs were recorded wherever woodland fragments (particularly mixed woodland) occurred (Biota 2019a).

Using possum density, Biota (2019a) assessed the importance of WRP habitat, within the targeted fauna Biota Study Area, by direct comparison with habitat in four contextual sites (within an 18 km radius of Bunbury town centre). Possum density was calculated based on the results of strip and distance sampling (Biota, 2019a).

The estimated density and abundance of WRPs within the Biota Study Area is shown in Table 3-16. Based on the occurrence density, approximately 56 individuals are estimated to occur within the Surveyed Area (~38 ha). The unsurveyed area (~100 ha) is estimated to have up to 33 ha of potential WRP habitat. Based on a total potential habitat area of approximately 71 ha (8 ha within Surveyed Area and 33 ha within unsurveyed area) and the occurrence density, a conservative estimate of the abundance of WRPs within the Project Area is around 100 individuals.

Biota (2019c) completed additional surveys to provide a regional context for the potential impacts from the Project on WRPs. Preliminary results from the additional surveys estimate the WRP population for the southern Swan Coastal Plain at 5,373 individuals. This estimate does not include suitable habitats in the semi-urban and urban environment that are known to be inhabited by WRPs and is therefore considered to be a conservative estimate (i.e. lower than in reality). Based on the conservative estimate of WRPs within the

Project Area (approximately 100 individuals), the Project Area represents up to 2.0 % of the regional population.

A summary of WRP observations within the Biota Study Area and within the contextual sites are shown in Figure 9.

Table 3-16 Western Ringtail Possum densities estimated within the Study Area

Study Area	WRP Density Recorded
Strip sampling (per hectare)	1.78
Lot 1 (Distance sampling) – contextual site	0.31 ± 0.18
Jilley Road to Bussell Highway	2.22 ± 0.54
Average density (WRP per ha)	1.4
Predicted abundance (across 37.9 ha of Surveyed Area)	56

Quenda, Southern Brown Bandicoot

Evidence of Quenda was recorded within the Study Area, in the form of diggings. The Surveyed Area identifies suitable habitat for Quenda, which includes all three dominant fauna habitat types (Marri/Eucalyptus Woodland, Marri/Eucalyptus in paddocks and road reserves and Damplands with Melaleuca shrubland and/or woodland) (40.2 ha).

The unsurveyed area is estimated to have approximately 33 ha of potential Quenda habitat. From a review of aerial imagery, the remainder of the unsurveyed area appears to be cleared land, which is not likely to be significant habitat for Quenda (~68 ha).

Likely to occur

South-western Brush-tailed Phascogale, Wambenger

No South-western Brush-tailed Phascogales were observed within the Surveyed Area. However, six individuals were recorded in close proximity (Reserve 23,000). The Biota Study Area identifies suitable habitat for the South-western Brush-tailed Phascogale, namely; Marri/Eucalyptus Woodland (~30 ha).

Approximately 33 ha of the unsurveyed area is considered likely to provide habitat for South-western Brush-tailed Phascogale. From a review of aerial imagery, the remainder of the unsurveyed area appears to be cleared land and is not likely to represent suitable habitat for South-western Brush-tailed Phascogales (68 ha).

Conservation significant aquatic fauna

An aquatic fauna survey was undertaken by WRM in November 2018 (WRM, 2018a). The survey focused on species of conservation significance within specific wetlands and waterbodies that were identified from aerial imagery to provide potential aquatic fauna habitat. One survey site occurred within the Project Area (Southern 7), which was dry at the time of the survey. In addition, the WRM (2018b) survey of the Alternative Alignment surveyed wetlands adjacent to the Project Area.

Black -stripe Minnow and Western Mud Minnow

A total of 29 Black-stripe Minnow (listed as Endangered under the EPBC Act) were recorded at two wetlands sampled by WRM (2018b). These wetlands (site reference Wetland 2 and Wetland 3a) are hydrologically connected to up to 0.3 ha of potential habitat within the Project Area (Figure 10).

Black-stripe Minnows are known to disperse in years of high rainfall and have been historically recorded intermittently in some wetlands (MBS Environmental, 2009). Due to their high mobility and the high connectivity between wetlands in wetter years, it is likely that Black-stripe Minnow would migrate between wetlands, opportunistically utilising habitat within the Project Area.

Further field investigations will be undertaken if the alignment is chosen for development to further identify suitable habitat for Black-stripe Minnow and determine the likelihood of occurrence within the Project Area.

No Western Mud Minnows were recorded within the survey sites and are considered unlikely to occur within the Project Area.

Carter's Freshwater Mussel

Despite extensive survey effort, no Carter's Freshwater Mussel were recorded within the wider investigation area. This is likely due to the ephemeral nature of the sites sampled, and lack of suitable habitat (creek lines) within the investigation area.

Australian Water Rat

Despite extensive survey effort (motion sensor cameras and visual observations), no Australian Water Rats were identified at any of the sites within the wider investigation area.

South-Western Snake-Necked Turtle

The South-Western Snake-Necked Turtle (*Chelodina colliei*[1]) is endemic to the south-west of Western Australia and is listed on the IUCN Redlist of Threatened Species as Near Threatened (IUCN, 2018).

A total of 11 South-Western Snake-Necked Turtles were recorded within the WRM (2018a) Study Area.

This species is known to occur in both permanent and seasonal habitats, including rivers, lakes, farm dams, swamps, damplands and natural and constructed wetlands (Balla, 1994; Guyot & Kuchling, 1998). They can migrate relatively long distances overland if local conditions deteriorate (Dr Gerald Kuchling, UWA, pers. comm. (WRM, 2018a)) and can aestivate to avoid drought in seasonal waterbodies for up to five to six months (Kuchling, 1998; Kuchling, 1989).

Since their diet includes tadpoles, fish, and aquatic invertebrates, South-Western Snake-Necked Turtles only eat when open water is present. In permanent waters, this species has two nesting periods (September-October and December-January), but in seasonal systems, nesting will only occur in spring. The main threats to these turtles are road deaths during movement in the nesting season and predation by feral animals (Bencini & Turnball, 2012).

It is possible that South-Western Snake-Necked Turtles occur within the Project Area.

3.4.3 Potential impacts

The Project Area is predominantly cleared, with approximately 117 ha of the total 190 ha, cleared or highly modified. The Project has the potential to directly and indirectly impact on fauna and fauna habitat in remnant native vegetation areas during the construction and operational phases.

Potential direct impacts to species known to occur within the Project Area include:

- Clearing of an estimated 73 ha of potential fauna habitat types across the Project Area (190 ha), which includes approximately 40 ha of mapped fauna habitat (within the Surveyed Area), and a further 33 ha of potential fauna habitat (within the unsurveyed area)
- Clearing of approximately 71 ha of Black Cockatoo (Carnaby's Cockatoo (Endangered), Baudin's Cockatoo (Endangered) and Forest Red-tailed Black Cockatoos (Vulnerable)) breeding and foraging habitat (including 38 ha surveyed and 33 ha unsurveyed)
- A total of 443 Suitable DBH Trees, including eight Trees with a Suitable Nest Hollow, four Known Nesting Trees and three that could not be assessed by drone
- Clearing of approximately 71 ha of WRP habitat (including 38 ha surveyed and 33 ha unsurveyed) and displacement of an estimated 100 individual WRPs, representing less than 2 % of the regional population

[1] This species was referred to as *Chelodina oblonga* in the past. However, there was some debate over species names and distributions. In 2013, the ICZN handed down its decision on nomenclature, with *C. colliei* given to the south-western snake-necked turtle, and *C. oblonga* given to the northern snake-necked turtle (previously *C. rugosa*).

- Clearing of up to 73 ha of Southern Brown Bandicoot, Quenda (Priority 4) habitat (including 40 ha surveyed and 33 ha unsurveyed).

Potential direct impacts to species that have potential to occur within the Project Area include:

- Clearing of an estimated 63 ha of South-western Brush-tailed Phascogale habitat (including 30 ha surveyed and 33 ha unsurveyed)
- Potential loss of habitat for Black-stripe Minnow including up to 0.3 ha of Geomorphic Wetland intersected by the Project Area (where the species was recorded adjacent to the Project Area)
- Habitat for a further six conservation significant species that possibly occur within the Project Area.

Other potential direct impacts to fauna during construction and operations (to be mitigated through implementation of a CEMP and other mitigation measures detailed in the following sections) include:

- Temporary, localised impacts on aquatic fauna due to disturbance of wetlands and waterways
- Death or displacement of native fauna species from vehicle movements.

The Project may also result in the following indirect impacts to fauna including:

- Incremental loss of fauna habitat (fragmentation, barrier effects and edge effects)
- Displacement of native fauna species due to traffic noise exposure
- Displacement of native fauna species due to light spill from street lighting and traffic.

3.4.4 Assessment of impacts

Approximately 61 % the Project Area is predominantly cleared, with approximately 117 ha of the total 190 ha already cleared or highly modified. Reduction of potential impacts on the environment was a key consideration in the selection of the GBRS alignment. Further reduction in the potential impacts will occur through the detailed design phase should this alignment be selected for development.

Clearing and loss of habitat

The Project will result in the potential clearing of up to 73 ha of potential fauna habitat across the 190 ha Project Area. Further reduction to the clearing area associated with the Project will be achieved through consideration of impacts during the detailed design process.

Further discussion on potential impacts to conservation significant fauna is provided below.

Impact to conservation significant fauna

Clearing and operation of the Project has the potential to impact conservation significant fauna including:

- Black Cockatoos (approximately 71 ha of potential habitat), including Carnaby's Cockatoo (Endangered), Baudin's Cockatoo (Endangered) and Forest Red-tailed Black Cockatoos (Vulnerable)
- WRP (approximately 71 ha of potential habitat) (Critically Endangered)
- Black-stripe Minnow (less than 0.3 ha of potential habitat) (Endangered).

Black Cockatoos

The Project Area is located in what is generally considered to be the typical breeding distribution of the Forest Red-tailed Black Cockatoo, however all three Black Cockatoo species have breeding areas overlapping the Project Area (Biota, 2019a).

A total of 443 Suitable DBH Trees, including eight Trees with a Suitable Nest Hollow, four Known Nesting Trees and three that could not be assessed by drone.

Western Ringtail Possum

Approximately 100 WRPs may potentially be displaced from the Project Area. Based on assessment of local and regional context sites covering 4,212 ha, the potentially displaced WRPs represent less than 2 % of the estimated regional population (Biota, 2019c).

Furthermore, the 2019 southern SCP estimate does not include suitable habitat in the semi-urban and urban environment, which are known to be utilised by WRPs. As such, the 2019 estimate is considered to be conservative (i.e. lower than in reality).

Black-stripe Minnow

The Project Area intersects up to 0.3 ha of Geomorphic Wetlands, where the Black-stripe Minnow was recorded adjacent to the Project Area. However, the area of wetland potentially impacted by the Project is likely to be less than 0.3 ha, as part of the area mapped as wetland (section of wetland UFI1149) is an existing unsealed road.

The transverse drainage design will include culverts (or similar) to maintain fish passage movement (including Black-stripe Minnow) through the drainage network (i.e. the drainage design will be sympathetic to fish movement requirements).

Other potential impacts

There will be a temporary increase in secondary impacts on fauna through noise, vibration, light and dust during construction. Increased noise, vibration and dust may result in native fauna avoiding the area. However, this is unlikely to have a permanent impact on fauna species in the area.

Vehicle strike

Operation of the Project will result in an increase in traffic/vehicle movements and resulting in a greater risk of fauna strike from vehicle movements.

Habitat fragmentation

Incremental reduction in fauna habitat has restricted the distribution of a number of conservation significant species known to occur within the Project Area, including WRP and Black-stripe Minnow. As habitat is cleared, patch sizes decrease and the impact of 'edge effect' increases with likely introduction of weeds and dieback, ultimately changing the species composition of the vegetation community and reducing suitability of habitat for local fauna species.

The Project Area has been largely cleared in the past for agriculture purposes. This has resulted in fragmentation of both terrestrial and riparian/ wetland vegetation and ecological linkages, thereby reducing connectivity of fauna habitat.

3.4.5 Mitigation

As detailed in section 3.3.5, the mitigation and management measures for the Project will be developed and refined in consultation with key stakeholders if this alignment is selected as the preferred option. Impacts to fauna will be minimised through the following mitigation and management measures:

- Developing a Project design to minimise environmental impacts as far as practicable
- The selection of engineering and drainage solutions to avoid and minimise environmental impacts
- Installation of fauna exclusion fencing
- Compliance with State and Commonwealth environmental legal requirements
- Preparation and implementation of a CEMP that addresses issues specific to fauna including:
    - Complaints response and management
    - Vegetation management, and clearing procedures and processes
    - Fauna management
    - Wetlands, drainage and groundwater management

- Construction management (noise, vibration and dust)
- Fire risk management
- Environmental incident reporting and management

- The CEMP will include targets and key performance indicators, management actions, monitoring requirements and contingency measures.

3.4.6 Predicted outcome

The Project Area is predominantly cleared, with approximately 117 ha of the total 190 ha, cleared or highly modified. The Project has the potential to directly impact species known to occur within the Project Area. Based on the information available to support this assessment these potential direct impacts include:

- Clearing of an estimated 73 ha of potential fauna habitat types across the Project Area (190 ha), which includes approximately 40 ha of mapped fauna habitat (within the Study Area), and a further 33 ha of potential fauna habitat (within the unsurveyed area)
- Clearing of approximately 71 ha of Black Cockatoo (Carnaby's Cockatoo (Endangered), Baudin's Cockatoo (Endangered) and Forest Red-tailed Black Cockatoos (Vulnerable)) breeding and foraging habitat (including 38 ha surveyed and 33 ha unsurveyed)
- A total of 443 Suitable DBH Trees, including eight Trees with a Suitable Nest Hollow, four Known Nesting Trees and three that could not be assessed by drone
- Clearing of approximately 71 ha of WRP habitat (including 38 ha surveyed and 33 ha unsurveyed) and displacement of an estimated 100 individual WRPs, representing less than 2 % of the regional population
- Clearing of approximately 73 ha of Southern Brown Bandicoot, Quenda (Priority 4) habitat (including 40 ha surveyed and 33 ha unsurveyed).

Impacts to species that have potential to occur within the Project Area:

- Clearing of an estimated 63 ha of South-western Brush-tailed Phascogale habitat (including 30 ha surveyed and 33 ha unsurveyed)
- Potential loss of habitat for Black-stripe Minnow including less than 0.3 ha of Geomorphic Wetland intersected by the Project Area where the species was recorded adjacent to the Project Area (NB area of habitat potentially impacted by the Project is likely to be less than 0.3 ha, as part of the area mapped as wetland is an existing unsealed road)
- Habitat for a further six conservation significant species that possibly occur within the Project Area.

Given the potential for impacts to conservation significant fauna (particularly Black Cockatoo species and WRPs) and loss of under-represented fauna habitat, environmental offsets to counter-balance the residual impacts of the Project are likely to be required, should this alignment be selected for development. Additional surveys will be required to address information gaps in unsurveyed area and confirm the likely outcome for fauna if this alignment is selected as the preferred option.

3.5 Key Environmental Factor – Terrestrial Environmental Quality

3.5.1 Studies undertaken

Desktop assessments including DWER Contaminated Sites Database (DWER, 2018) and ASS Risk Mapping for the Swan Coastal Plain (GoWA, 2019a).

No additional studies are considered likely to be required for this aspect.

3.5.2 Receiving environment

Geology

The Swan Coastal Plain is comprised of five major geomorphological units, which lie more or less parallel to the coast, being the Quindalup, Spearwood and Bassendean Dunes, the Pinjarra Plain and the Ridge Hill Shelf (Churchward & McArthur, 1980; McArthur & Bettenay, 1960). The Project Area lies within the Spearwood and Bassendean Dunes and Pinjarra Plain elements, which are broadly described as:

- Bassendean dune and sandplain system: Pleistocene sand dunes with very low relief, leached grey siliceous sand intervening sandy and clayey swamps and gently undulating plains. These occur immediately west of, and partly overlie, the Pinjarra Plain
- Spearwood dune system: Pleistocene and aeolian sands overlying Tamala limestone. Low dunes and swales of shallow pale grey sands over yellow sands are characteristic of the Spearwood system. Wetlands are associated with peats and carbonate sands, occasionally with clay overlaying sands
- Pinjarra Plain: Broad low relief plain west of the foothills, comprising predominantly Pleistocene fluvial sediments and some Holocene alluvium associated with major current drainage systems. Major soils are naturally poorly drained with many swamps.

Desktop assessment of broad geological formations indicates that the Project Area occurs within three broad formations in addition to rivers and wetland areas (GSWA, 2009), which are outlined in Table 3-17.

Table 3-17 Geology, landform and soils information for the Project Area

Formation	Geological Type	Geological Description/ Landform
Tamala Limestone	Qts	Sand associated with Tamala Limestone, high dunes
Guildford Formation	Qpa	Mainly alluvial sandy clay
Bassendean Sand	Qpb	Low rounded dunes

Acid Sulfate Soils

Acid Sulfate Soils (ASS) are naturally occurring soils and sediments containing sulphide minerals, predominantly pyrite (an iron sulphide). In an undisturbed state below the water table, these soils are benign. However, if the soils are drained, excavated or exposed by lowering of the water table, the sulphides will react with oxygen to form sulphuric acid. Disturbance of these soils can flush acidic leachate to groundwater and surface waters and cause off site environmental impacts.

ASS Risk Mapping for the Project Area indicated low to moderate risk of ASS, with minor areas of high risk associated with wetlands and watercourses and the Capel Golf Course (GoWA, 2019a). ASS Risk Mapping is shown in Figure 11.

Contaminated Sites

The DWER *Contaminated Sites Database* presents information on known contaminated sites that have been classified by the DWER as one of the following:

- Contaminated – remediation required
- Contaminated – restricted use

- Remediated for restricted use.

The DWER *Contaminated Sites Database* does not provide details of the Sites that are listed as 'Possibly contaminated – investigation required' (PC-IR).

A further limitation to the DWER *Contaminated Sites Database* is unreported contaminated sites.

A search of the DWER *Contaminated Sites Database* indicates that there are no listed contaminated sites within the Project Area (GoWA, 2018).

The Project Area traverses agricultural land that may contain sources of contamination such as dumped building materials, kill pits, landfill sites, and chemical storage sites. Additional investigations will be required to identify and remediate these sites prior to construction.

3.5.3 Potential impacts

Project activities that have the potential to impact the terrestrial environmental quality during construction include earthworks, and storage and handling of environmentally hazardous materials.

Potential construction impacts as a consequence of developing the Project are:

- Disturbance of ASS resulting in acid leachate into the receiving environment causing contamination of land and/or waters
- Disturbance of unknown contaminated sites resulting in spread of contamination
- Accidental release or spread of litter, hydrocarbons or chemicals resulting in contamination of land and water bodies.

Operational impacts to Terrestrial Environmental Quality resulting from the Project are mainly limited to road use, including pollution and waste. Road drainage will be designed to prevent direct discharge of road surface run-off to the adjacent environment.

Potential indirect impacts that could arise from the construction of the Project also include salinization and soil erosion. The risk of salinization on the Swan Coastal Plain is considered to be low and clearing associated with the Project in the context of local and regional water tables is unlikely to result in increased risk of salinization of soils. Soil erosion has the potential to occur during construction, associated with vegetation clearing and earthworks, and during operation as a consequence of stormwater runoff.

3.5.4 Assessment of impacts

Direct impacts

Acid Sulfate Soils

ASS can be disturbed either by excavation or lowering of the water table below natural seasonal levels (i.e. dewatering). Excavations occurring for the Project will be limited and associated with construction of bridge footings. It is likely that ASS will be encountered within excavations greater than 1.0 m depth, particularly within riparian zones. Dewatering may also be required during construction of bridge footings, which may expose Potential Acid Sulfate Soils (PASS).

When PASS are disturbed, sulfides present are exposed to air, allowing oxidisation and consequently, the formation of sulfuric acid (H_2SO_4). ASS are also capable of generating acidity in-situ in their natural state; disturbance is not required for acidic discharges to develop.

As a result of the presence of ASS, or the oxidation of PASS, surrounding land (soil) and nearby waterways may become acidic (pH<6.5). Under acidic conditions, metals such as aluminium (generally at pH<4.5) and iron, as well as trace heavy metals (including arsenic), become more mobile in the environment and can readily be transported offsite by infiltrating waters. As a result, concentrations of metals within surface and / or groundwater may reach concentrations, which have the potential to cause acute or chronic toxicity to sensitive terrestrial and aquatic plants and animals.

Hazardous material and waste disposal

Direct contamination of soils and land could occur as a result of release of hazardous materials (such as hydrocarbons, chemicals and reagents) from storage or handling areas. Storage of hazardous materials during the construction period will be limited to temporary storage areas holding minor quantities of oils and grease for maintenance, and fuel supply for small construction equipment.

Hazardous waste will be temporarily stored onsite prior to disposal to an appropriately licensed facility. All such materials will be stored within a sealed, covered and bunded area. Refuelling of larger equipment and generators will occur within the Project Area, but preference will be given to off-site refuelling for general vehicles, where practical, to limit storage and handling volumes within the Project Area. Due to the limited scale of hazardous material storage, any accidental releases are expected to be small. Further, any potential contamination will be localised and restricted to the surface of the soil profile. The depth of localised contamination could increase beyond the soil surface if releases are not rectified in a timely manner.

There will be no soil or land impacts within the Project Area relating to the disposal of waste products. Waste from all waste streams, including used oils/greases and municipal waste, will be disposed or recycled to an appropriate off-site waste management facility.

Contamination and erosion during operation

Stormwater is road run-off that occurs during and following rainfall. Stormwater runoff from the operational road is likely to include pollutants deposited on the tarmac by vehicles. Exhaust gases and lubricants release lead, hydrocarbons, nickel and bromine. Iron and chromium detach from corroded bodywork, while sulphur, chlorine and cyanide are dispersed via cooling liquids. In addition, tyres deposit rubber particles containing lead, cadmium and zinc on the tarmac (ENI School, n.d.).

Stormwater run-off can result in bank erosion and transport of contaminants to soils and water bodies if not managed appropriately. Drainage infrastructure will be in place to manage and control stormwater, therefore direct release to soils or land is unlikely. Volumes of hydrocarbons on the road are not likely to be significant, however if a large-scale discharge does occur it could be released beyond the road infrastructure if not adequately managed.

Loss of soil function

The constructed Project will be a permanent bituminised road surface which will result in impairment of soil function below the road surface. Soil function may be retained if topsoil is separated, stockpiled and re-used for landscaping.

Indirect impacts

Salinisation and erosion of soils

Clearing of deep-rooted native vegetation has the potential to increase salinisation and erosion of soils, particularly in agricultural areas, which are prone to salinity and erosion. Vegetation helps to stabilize soil and restrict upward movement of water tables which bring salts up the soil profile.

Salinisation is a potential impact within the Project Area, particularly in the poorly drained areas on Pinjarra Plain soils. However, the risk of dryland salinity on the Swan Coastal Plain as a result of clearing native vegetation is known to be low (Simons, George, & Raper, 2013).

Vegetation clearing and soil excavation can increase the potential for soil erosion because of altered surface water drainage patterns and the effect of wind on exposed dry soils. Erosion impacts can potentially lead to poor soil structure, reduced water infiltration and general loss of soil health.

3.5.5 Mitigation

Risks associated with potential impacts to Terrestrial Ecosystem Quality, particularly ASS and contaminated sites, are considered relatively minor and manageable. Main Roads has extensive experience with the

management of these risks in similar Projects throughout the south west of WA. Impacts will be avoided and minimised through the following mitigation and management measures:

- Developing a Project design to minimise environmental impacts as far as practicable
- The selection of engineering and drainage solutions to avoid and minimise environmental impacts
- Compliance with State and Commonwealth environmental legal requirements
- Preparation and implementation of a Project specific CEMP that addresses issues specifically related to terrestrial ecosystem quality including:
  - Complaints response and management
  - Vegetation management, and clearing procedures and processes
  - Topsoil management
  - ASS management
  - Dieback and weed management
  - Wetlands, drainage and groundwater management
  - Construction management (noise, vibration and dust)
  - Hazardous materials management
  - Fire risk management
  - Environmental incident reporting and management
- The CEMP will include targets and key performance indicators, management actions, monitoring requirements and contingency measures.

3.5.6 Predicted outcome

Based on the information available to support the EIA the potential risks to the terrestrial ecosystem quality associated with construction and operation of the Project are likely to be able to be effectively managed through implementation of mitigation and management measures.

Additional surveys would be required if this alignment is selected as the preferred option, however it is considered that the Project would meet the EPA objective to maintain the quality of land and soils so that environmental values are protected.

3.6 Key Environmental Factor – Inland Waters

3.6.1 Studies undertaken

The following studies have been undertaken for this aspect:

- Water quality sampling was undertaken as part of BORR Alternate Alignment: Targeted Conservation Significant Aquatic Fauna Survey (WRM, 2018b)
- Desktop information has been assessed for this aspect including the DWER datasets (GoWA, 2019a).

3.6.2 Receiving environment

Desktop searches of the DWER datasets (GoWA, 2019a) were undertaken and are summarised in Table 3-18.

Table 3-18 Hydrology queries within the Project Area

ASPECT	DETAILS	RESULT
Groundwater Areas	Groundwater areas proclaimed under the RIWI Act.	Bunbury Groundwater Area Busselton-Capel Groundwater Area
Surface Water Areas	Surface water areas proclaimed under the RIWI Act.	Capel River System
Rivers	Rivers proclaimed under the RIWI Act.	None
Public Drinking Water Source Areas (PDWSAs)	PDWSA is a collective term used for the description of Water Reserves, Catchment Areas and Underground Pollution Control Areas declared (gazetted) under the provisions of the *Metropolitan Water Supply, Sewage and Drainage Act 1909* or the *Country Area Water Supply Act 1947.*	None
Waterways Conservation Areas	Areas proclaimed under the *Waterway Conservation Act 1976*.	None

Surface water

The southern half of the Project is in a Proclaimed Surface Water area, Capel River System. No rivers protected under the WC Act will be impacted by the Project (GoWA, 2019a). A number of minor drainage lines will be impacted, including Five Mile Brook, however these are not proclaimed under the RIWI Act (Figure 10).

Surface water quality

Four wetlands were sampled as part of BORR Alternative Alignment Aquatic Fauna Survey which intersects the Project Area (WRM, 2018b). In situ water quality was generally good and characterised by slightly acidic pH (6.23 to 6.68), variable dissolved oxygen (DO) (28.7 % to 170.8 %), and warm temperatures (18.5 ºC to 25 ºC). All wetlands were fresh with electrical conductivity (EC) ranging from 183 µs/cm to 1422 µs/cm.

The pH at all wetlands was slightly below the guidelines (ANZECC & ARMCANZ, 2000) for the protection of slightly/moderately disturbed wetland ecosystems in the southwest of WA (pH 7 – 8.5) (Table 3-19).

Table 3-19 *In situ* water quality results from all wetlands sampled

WETLAND	WETLAND CODE	TEMP (°C)	CONDUCTIVITY (µS/cm)	PH	OXYGEN %	OXYGEN (mg/L)	CONSERVATION CATEGORY/ UFI
1	1a	22.0	1422	6.51	28.7	2.09	MU UFI 1189
	1b	25.0	983	6.67	95.5	8.55	RE UFI 1170
2	2	21.1	855	6.68	170.8	15.01	RE UFI 1180
3	3a	22.7	596	6.62	57.7	5.03	Unmapped however assumed to be a combination of CCW UFI 16075, 16076, 16077 and 16088) (previously RE UFI 1149)
	3b	21.0	365	6.57	103.9	7.77	CCW UFI 16079 and UFI 16080 (previously MU UFI 1150)
	3c	19.0	380	6.61	100.0	7.80	MU UFI 1150
4	4a	18.8	278	6.42	49.5	4.43	MU UFI 1014
	4b	18.5	183	6.23	102.0	8.18	MU UFI 1014

Note: CCW – Conservation Category Wetland, RE – Resource Enhancement, MU – Multiple Use

Wetlands of international significance

There are no Ramsar wetlands located within 10 km of the Project Area. The nearest Ramsar wetland (Vasse-Wonnerup System) is located approximately 19 km to the south west of the Project Area (GoWA, 2019a).

Geomorphic Wetlands

Wetlands on the Swan Coastal Plain have been classified (Hill, Semeniuk, Semeniuk, & del Marco, 1996) using a geomorphic-hydrologic approach to wetland classification (Semeniuk & Semeniuk, 1995). Wetlands have also been evaluated and assigned an appropriate management category which provides guidance on the nature of wetland management and protection that the wetland should be afforded.

There are 15 Geomorphic Wetlands (approximately 33 ha) within the Project Area. The Project Area intersects six Conservation Category Wetlands (CCW), two Resource Enhancement and seven Multiple Use Geomorphic Wetlands (GoWA, 2019a). The mapped Geomorphic Wetlands include:

- Approximately 1 ha of CCW (0.5 % of the Project Area)
- < 1 ha of Resource Enhancement wetlands (0.2 % of the Project Area)
- Approximately 31 ha of Multiple Use wetlands (16.6 % of the Project Area).

The wetlands within the Project Area are described in Table 3-20 and mapped in Figure 10.

Table 3-20 Geomorphic wetlands and their vegetation condition within the Project Area

GEOMORPHIC WETLAND IDENTIFICATION (UFI)	WETLAND TYPE	CLASSIFICATION	TOTAL AREA WETLAND (ha)	MAPPED WETLAND VEGETATION TYPE/ DESCRIPTION (BORR IPT 2019A AND B)	VEGETATION CONDITION (BORR IPT 2019A AND B)	EXTENT WITHIN PROJECT AREA (ha)
1019	Palusplain	Conservation	35.7	Unsurveyed – aerial photography shows this area is partially Cleared and located in the Bussell Highway road reserve, however vegetation is also located on the boundary of the wetland.	Unknown to Completely Degraded	0.3
14478	Sumpland	Conservation	59.5	VT08 Low open forest of *Eucalyptus rudis* and *Melaleuca preissiana* over sedgeland. Cleared.	Degraded to Completely Degraded	0.6
16075	Sumpland	Conservation	<0.1	VT01b Isolated trees *Eucalyptus rudis* and *Corymbia calophylla* closed grassland. VT07 Woodland *Melaleuca preissiana* and *M. rhaphiophylla* wetland.	Degraded	<0.1
16076	Sumpland	Conservation	0.2	VT07 Woodland *Melaleuca preissiana* and *M. rhaphiophylla* wetland. Cleared.	Degraded to Completely Degraded	<0.1
16077	Sumpland	Conservation	2.4	VT01b Isolated trees *Eucalyptus rudis* and *Corymbia calophylla* closed grassland. VT07 Woodland *Melaleuca preissiana* and *M. rhaphiophylla* wetland. Cleared.	Degraded to Completely Degraded	<0.1
16078	Sumpland	Conservation	0.4	VT07 Woodland *Melaleuca preissiana* and *M. rhaphiophylla* wetland. Cleared.	Degraded to Completely Degraded	<0.1
1149	Sumpland	Resource Enhancement	0.2	VT01b Isolated trees *Eucalyptus rudis* and *Corymbia calophylla* closed grassland. VT07 Woodland *Melaleuca preissiana* and *M. rhaphiophylla* wetland. Cleared.	Degraded to Completely Degraded	0.2

GEOMORPHIC WETLAND IDENTIFICATION (UFI)	WETLAND TYPE	CLASSIFICATION	TOTAL AREA WETLAND (ha)	MAPPED WETLAND VEGETATION TYPE/ DESCRIPTION (BORR IPT 2019A AND B)	VEGETATION CONDITION (BORR IPT 2019A AND B)	EXTENT WITHIN PROJECT AREA (ha)
1180	Sumpland	Resource Enhancement	3.4	VT08 Low open forest of *Eucalyptus rudis* and *Melaleuca preissiana* over sedgeland. VT07 Woodland *Melaleuca preissiana* and *M. rhaphiophylla* wetland.	Good to Completely Degraded	0.1
953	Sumpland	Multiple Use	15.4	VT01b Isolated trees *Eucalyptus rudis* and *Corymbia calophylla* closed grassland. VT07 Woodland *Melaleuca preissiana* and *M. rhaphiophylla* wetland. Cleared.	Degraded to Completely Degraded	0.2
1015	Sumpland	Multiple Use	23.9	VT08 Low open forest of *Eucalyptus rudis* and *Melaleuca preissiana* over sedgeland. VT09a Scattered remnant vegetation present in agricultural areas and along road reserves. Cleared.	Degraded to Completely Degraded	0.5
1016	Palusplain	Multiple Use	15.5	VT09a Scattered remnant vegetation present in agricultural areas and along road reserves. Cleared.	Degraded to Completely Degraded	1.1
1163	Sumpland	Multiple Use	21.1	VT08 Low open forest of *Eucalyptus rudis* and *Melaleuca preissiana* over sedgeland. VT10 Parkland cleared with occasional Marri (*Corymbia calophylla*), Jarrah (*Eucalyptus marginata*) and Peppermint (*Agonis flexuosa*) trees or planted tree species over an understorey of weedy herbs and grasses. Cleared.	Degraded to Completely Degraded	1.0
1177	Sumpland	Multiple Use	2.4	VT08 Low open forest of *Eucalyptus rudis* and *Melaleuca preissiana* over sedgeland. Cleared.	Good to Completely Degraded	0.4

GEOMORPHIC WETLAND IDENTIFICATION (UFI)	WETLAND TYPE	CLASSIFICATION	TOTAL AREA WETLAND (ha)	MAPPED WETLAND VEGETATION TYPE/ DESCRIPTION (BORR IPT 2019A AND B)	VEGETATION CONDITION (BORR IPT 2019A AND B)	EXTENT WITHIN PROJECT AREA (ha)
1179	Sumpland	Multiple Use	20.1	VT08 Low open forest of *Eucalyptus rudis* and *Melaleuca preissiana* over sedgeland. VT07 Woodland *Melaleuca preissiana* and *M. rhaphiophylla* wetland. Cleared.	Good to Completely Degraded	0.4
13229	Palusplain	Multiple Use	114.8	Only a portion of this area was surveyed and identified as VT01b Isolated trees *Eucalyptus rudis* and *Corymbia calophylla* closed grassland. Aerial photography shows cleared paddock, roads and scattered trees.	Likely to be Degraded to Completely Degraded	27.9
Total						**32.6**

* Wetland observations are based on field surveys carried out for flora and vegetation (BORR IPT 2019 a and b), fauna surveys (WRM, 2018a; Biota, 2019b) and aerial photographs (for wetlands not assessed during field surveys).

Groundwater

The Project is within the Bunbury Groundwater Area and the Busselton-Capel Groundwater Area, as proclaimed under the RIWI Act (GoWA, 2019a).

3.6.3 Potential impacts

Project activities that have the potential to impact on Inland Waters during construction include vegetation clearing, earthworks and construction of drainage structures.

In the absence of suitable mitigation and management, the potential impacts that may occur to Inland Waters as a consequence of developing the Project include:

- Loss of approximately 33 ha of mapped Geomorphic Wetlands, including
  - Approximately 1 ha of CCW (0.5 % of the Project Area)
  - less than 1 ha of RE wetlands (0.2 % of the Project Area)
  - Approximately 31 ha of MU wetlands (16.6 % of the Project Area)
- Direct impacts to the bed and banks of waterways (erosion, sedimentation and scouring) at Five Mile Brook, minor drainage lines, CCW and RE wetlands
- Impacts to surface water flows causing changes to wetland water quality, including the DBCA managed Roselands Nature Reserve which lies directly adjacent to the Project Area
- Indirect impacts from construction including dust and pollution
- Contamination of ground and/or surface water from exposure to PASS or contaminants.

3.6.4 Assessment of impacts

Direct Impacts

Dewatering for construction activities

Once detailed design has been completed, an analysis will be undertaken to determine final construction methods and dewatering requirements for construction of the Project. Dewatering activities will be temporary and impacts are likely to be restricted in spatial extent.

Changes to groundwater levels in the shallow aquifer associated with clearing

Vegetation clearing within the Project Area has the potential to allow the groundwater level to rise and flood the surrounding area. However, given that the majority of the Project Area has been cleared for farmland, proposed clearing requirements are linear and areas of contiguous vegetation outside of the Project Area will be retained. Groundwater level rise as a result of the Project activities is considered unlikely to occur.

Erosion and sedimentation

Clearing of vegetation, construction earthworks and altered surface water regimes have the potential to destabilise soils and, if unmanaged, result in erosion of the Project Area and sedimentation of surrounding drainage infrastructure, vegetation, wetlands and waterways.

Contamination of surface water and groundwater

Contamination of surface water and groundwater may result during the construction phase as a result of the accidental release of hazardous materials during onsite works (construction materials and hazardous materials stored onsite), runoff during stormwater events and contaminated sediment or settled dust.

Surface and/or groundwater may also become contaminated through the exposure of ASS during construction (excavation). ASS disturbance may have a range of impacts including enhanced phosphorus leaching, death of vegetation irrigated with affected water, the smothering of benthic aquatic animals by the precipitation of iron, and metal bioaccumulation in aquatic plants and animals.

Contaminated surface water and groundwater has the potential to impact sensitive receptors, including neighbouring properties, vegetation, fauna, wetlands and waterways. Impacts can also manifest downstream as loss of benthic habitat, fish deaths and damage to vegetation health. Further assessment of ASS/PASS risks will be undertaken if this alignment is selected for construction.

Alteration of hydrological flow to Geomorphic Wetlands and minor waterways

Construction of the Project will involve the loss of wetlands within the Project Area. Filling the wetlands and clearing the vegetation has the potential to directly alter the existing surface water flow regime within the Project Area and adjacent wetlands. This has the potential to adversely affect the function of surrounding wetland and river systems, including changes in the vegetation structure and surrounding agricultural properties.

Once constructed, the bituminised road will prevent infiltration from occurring. Road runoff and stormwater will be managed with the objective of maintaining local hydrological regimes. Stormwater management will aim to allow infiltration at the point of collection. It is not considered that the Project will significantly restrict rainfall recharge to the superficial aquifer such as to significantly lower groundwater levels and / or change the volume of water available to surrounding wetlands.

Climate change

The drying climate in the South West region could result in reduced groundwater and surface water availability, increased seawater intrusion and a greater risk of impacts of abstraction on groundwater dependent ecosystems (GDEs) (Department of Water, 2015). Sea level rise is also a major consideration of infrastructure Projects on the coastal zone.

In accordance with the Main Roads Guideline on Climate Change (MRWA Doc No. D10#97260), the impacts of climate change have been considered during planning for the Project. The Main Roads Guideline specifies that impacts of a 300 mm sea level rise is considered as part of planning, design and construction for all Projects near coastal areas.

The Main Roads Guideline specifically addresses the potential impacts on rainfall patterns as a result of climate change. The guideline recommends that Intensity Frequency Duration (IFD) rainfall data are adjusted for future climate change. This recommendation will be incorporated in a review of the effects of rainfall intensification for transverse drainage at the detailed design stage.

3.6.5 Mitigation

Impacts to inland waters will be minimised through the following mitigation and management measures:

- Developing a Project design to minimise environmental impacts as far as practicable
- The selection of engineering and drainage solutions to avoid and minimise environmental impacts
- Compliance with State and Commonwealth environmental legal requirements
- Preparation and implementation of a Project specific CEMP that addresses issues specific to inland waters including:
  - Complaints response and management
  - Vegetation management, and clearing procedures and processes
  - Topsoil management
  - ASS management
  - Wetlands, drainage and groundwater management
  - Construction management (noise, vibration and dust)
  - Hazardous materials management
  - Environmental incident reporting and management
- The CEMP will include targets and key performance indicators, management actions, monitoring requirements and contingency measures.

3.6.6 Predicted outcome

The existing hydrological processes are in a largely modified state due to historical clearing and draining of land within the Project Area for development including rural-residential development, road construction and agricultural purposes. Based the information available to support the EIA it is anticipated that the potential impacts to inland waters associated with the Project are manageable with the implementation of the mitigation measures proposed and no residual impacts are anticipated. This will be confirmed as part of the studies undertaken once the alignment is finalised.

3.7 Key Environmental Factor – Air Quality

3.7.1 Studies undertaken

The requirements to conduct an Air Quality Impact Assessment for new road Projects are detailed in Main Roads Environmental Guideline 6707/007 (Main Roads, 2004). An air quality assessment for the Project was completed as a consequence of private residences being located within 200 m of the Project centreline. Consequently, Main Roads engaged GHD to undertake an Air Quality Impact Assessment for the Project (GHD, 2012c). The 2012 Air Quality Impact Assessment modelled emissions using an AUSROADS Gaussian plume dispersion model predicting the concentration of pollutants at identified receptors, with the receptors used in the noise modelling used as a basis for assessing air quality. Automatic receptors were also used, which involved estimating concentrations at 50 and 100 m from the Project alignment.

Three scenarios were modelled, based on existing 2012 traffic counts, Projected 2021 and 2031 traffic counts.

3.7.2 Receiving environment

Climate

Bunbury is located on the south-western corner of Western Australia and the climate of the Project Area is broadly described as Mediterranean, with hot dry summers and cool wet winters. The nearest Bureau of Meteorology (BoM) official recording station is Bunbury (Station No. 9965), located approximately 8 km north of the Project Area (BoM, 2019).

The area has a mean annual rainfall of 726.1 mm and experiences a wide range of temperatures, with mean maximum temperatures of approximately 30°C in summer and 17°C in winter (Table 3-21).

Table 3-21 Climate data – Bureau of Meteorology Bunbury Station No 9965

CLIMATIC VARIABLE	RANGE
Mean Annual Maximum Temperature Range	17.3°C in July to 30°C in February
Mean Annual Minimum Temperature Range	7.1°C in July to 15.9°C in February
Mean Annual Rainfall	726.1 mm
Mean Annual Rain days per year	84.5

Sensitive receptors

Sensitive receptors are any place where people are likely to reside in a non-occupational setting. This may include dwellings, schools, hospitals or public recreational areas (NSW Department of Environment and Conservation, 2005). Residential areas are located within 20 m of the Project Area.

Bunbury Regional Airshed

The Project is within the Bunbury Regional Airshed, which encompasses an area approximately 38,610 km^2 and includes 22 Shires, including the entire City of Bunbury and Shire of Capel.

The major economic activities in the Bunbury Regional Airshed are very diverse and include mining, agriculture, tourism, forestry and manufacturing. Motor vehicles dominate the emissions of carbon monoxide (CO), volatile organic carbon (VOC) and nitrous oxides (NO_x) (SKM, 2003).

3.7.3 Potential impacts

Potential direct construction impacts that may occur to Air Quality as a consequence of developing the Project are:

- Increased construction vehicle emissions
- Dust generated from construction activities
- Smoke from bushfires proximate to the Project
- Increased greenhouse gas (GHG) emissions.

The construction of the Project has the potential to reduce air quality via increased road vehicle traffic and GHG emissions.

The operation of the Project may reduce vehicle emissions in the local and regional airshed as a consequence of improved traffic flows and improved vehicle efficiency.

Major vehicle pollutants include products of combustion, such as CO, particulate matter with an aerodynamic diameter of 10 microns or less (PM10), NOx, and VOCs. The human health effects of these air pollutants range from mild airway irritations to major organ damage. Many of the emissions from motor vehicles react together and with pollutants from other sources to form secondary pollutants, such as photochemical oxidants (ozone; O3), which can also have significant effects.

Potential indirect impacts from dust generated during construction may include impacts to vegetation and changes to vegetation communities directly adjacent to construction works.

Indirect impacts may also include GHG emissions associated with operation of Main Roads buildings, depots and light vehicle fleet (emission from power generation and vehicles).

3.7.4 Assessment of impacts

Increased construction vehicle emissions

Construction works for the Project will involve the operation of heavy machinery and vehicles. Some minor increase in emissions associated with the construction activities is anticipated but will be temporary – expected to occur for the duration of construction. The impacts associated with these emissions is not considered likely to be significant.

Dust impacts during construction

Construction works for the Project will involve the operation of loaders, dozers, graders, excavators and trucks to clear vegetation from the Project Area, and to excavate and remove material from areas of the site for use as fill within other areas of the site. There will also be miscellaneous vehicle movements around the Project Area as part of the construction works.

These activities can result in dust emissions due to:

- Movement of vehicles and heavy equipment on unsealed surfaces
- Excavating, spreading and compacting soils
- Wind erosion from exposed and disturbed soil surfaces.

Dust may be a nuisance to nearby sensitive receptors if unmitigated during construction activities, however it is not considered to have an adverse impact on local air quality.

Reduced air quality due to bushfire

Construction activities have the potential to ignite bushfires through hot work and vehicle movements, which could cause a temporary reduction in local air quality. Potential risks associated with bushfires are considered low and will be managed through appropriate mitigation as part of the CEMP. No significant impacts resulting from accidental bushfires are expected.

Impacts from car emissions

The 2012 model predicted that all emission concentrations, aside from Benzo(a)pyrene (BaP) were below the National Environmental Protection Measure (NEPM)/World Health Organisation criterion (Table 3-22). With conservatism built into the model, it was considered unlikely that BaP concentrations would exceed the relevant criteria (GHD, 2012c).

No significant impacts resulting from vehicle traffic are expected.

Greenhouse gas emission impacts

The operation of site offices, light diesel powered vehicles and heavy equipment for construction of the Proposal will result in generation of GHG emissions.

The GHG emissions associated with construction activities are expected to occur for the duration of construction.

An assessment of GHG emissions for the construction phase of the Proposal will be undertaken to quantify direct emissions and therefore, determine the requirement for management measures.

Table 3-22 Predicted maximum car emission concentrations 2031

POLLUTANT	BACKGROUND CONC. (µg/m3)	PREDICTED MAXIMUM CONCENTRATION (µg/m3)		AIR NEPM/ WHO CRITERION (µg/m3)	AVG. PERIOD	MAX % OF CRITERION
		DISCRETE RECEPTOR	AUTO RECEPTOR			
CO	375	471	592	11,254	8-Hours	5
NO_2[2]	51	19	27	247	1-Hour	11
PM_{10}	20.8	21	22	50	24-Hours	44
$PM_{2.5}$[3]	12.5	13	13.2	25	24-Hours	53
Volatile Organic Compounds						
Benzene	0	0.06	0.24	11	Annual	2.3
Toluene	0	0.33	0.83	4114	24-Hours	0.02
Xylene	0	0.22	2.1	1183	24-Hours	0.18
Formaldehyde	0	0.09	0.18	54	24-Hours	0.34
Acetaldehyde	0	0.45	0.79	2300	1-Hour	0.03
Benzo(A) Pyrene[4]	0	0.03 Ng/M^3	0.07 Ng/M^3	0.3 Ng/M^3	Annual	22

3.7.5 Mitigation

Main Roads has a carbon reduction target of 5 % of 2010 carbon emission by 2020, with a stretch target reduction of 15 % through improving energy efficiency. Opportunities to reduce ongoing energy include, but are not limited to the following, where practicable:

- Use of energy efficient electrical assets such as LED street lights
- Incorporating design treatments such as roundabouts or modified intersections to minimise the number of traffic lights required to manage congestion
- Use of renewable energy sources
- Use of materials with lower embodied energy.

Impacts to air quality will be minimised through the following mitigation and management measures:

- Developing a Project design to minimise environmental impacts as far as practicable
- The selection of engineering and drainage solutions to avoid and minimise environmental impacts
- Compliance with State and Commonwealth environmental legal requirements
- Preparation and implementation of a Project specific CEMP that addresses issues specific to air quality including:
  - Complaints response and management
  - Construction management (noise, vibration and dust)
  - Hazardous materials management
  - Fire risk management

[2] Assessed as 15 % NOx as NO_2
[3] Assessed as 60 % PM_{10} as $PM_{2.5}$
[4] Predicted total PAH concentrations multiplied by 0.009

- Environmental incident reporting and management

- The CEMP will include targets and key performance indicators, management actions, monitoring requirements and contingency measures.

3.7.6 Predicted outcome

Dust is anticipated to be generated during construction. This impact will be controlled using standard mitigation measures, such as watering trucks. Appropriate measures will be implemented to ensure the short term construction related air quality impacts are effectively managed.

It is considered unlikely that ongoing street lighting, traffic signals and road maintenance activities would produce significant GHG emissions for the Project. However, construction and operation of the Project will be subject to an assessment for direct GHG emissions.

Given these proposed measures, no residual impacts are expected for this aspect.

3.8 Key Environmental Factor – Social Surroundings

3.8.1 Studies undertaken

The following studies have been undertaken for this aspect:

- Noise Management Plan Bunbury Outer Ring Road Southern Section GBRS Corridor (Lloyd George Acoustics, 2014)
- Aboriginal Heritage Survey Report of the Proposed Bunbury Outer Ring Road Stage 2, Western Australia (Brad Goode & Associates, 2012).

3.8.2 Receiving environment

European heritage

The EPBC Protected Matters Search Tool did not identify any Commonwealth listed heritage sites within the Project Area, or within 10 km of the Project Area (DotEE, 2018). The State Heritage Office dataset indicated that there are no state heritage sites within the Project Area (GoWA, 2018) (Figure 12).

No European heritage sites will be directly impacted by the construction of the Project. As a result, no impacts were identified or recommendations warranted for this factor.

Aboriginal heritage

A search of the Aboriginal Heritage Inquiry System identified one Registered Aboriginal site; Capel Bussell Highway (Site 5813) (DPLH, 2019). This site will be directly impacted by the Project. Site 5813 is recorded as a Registered site, comprised of Artefacts / Scatter, Arch Deposit and Camp.

Two 'Other Heritage Places' were identified within the Project Area (DPLH, 2019), including:

- Place ID 37869 Paperbark Wetlands – Modified Tree, Birth Place, Hunting Place, Water Source
- Place ID 37870 The Gelorup Corridor – Artefacts/ Scatter, Ceremonial, Skeletal Material, Burial.

Aboriginal heritage surveys of BORR were conducted in 1995 (McDonald Hales and Associates, 1995) and updated in 2002. These earlier surveys were again updated in 2009 (Brad Goode & Associates, 2009) and again in 2012 (Brad Goode & Associates, 2012). The 2012 survey included both archaeological and ethnographic components, however did not assess Site 5813.

Additional Aboriginal and Archaeological surveys will be conducted if the GBRS alignment is selected as the preferred alignment.

Land use

The GBRS indicates the Project Area is zoned as "Primary Regional Road", with the eastern part also zoned as "Rural" (DPLH, 2018).

Demography and economy

The Project Area is 7.4 km south-east of the Bunbury CBD, 1.1 km from the suburb of Gelorup and 3.6 km from the town of Capel, in the Shire of Capel.

The Shire of Capel had an estimated resident population of 17,894 for June 2017 (ABS, n.d.). Health care and social assistance is the main industry accounting for 13 % of employment, followed by construction accounting for 12 %.

The Greater Bunbury Region which includes the Shire of Harvey, Dardanup and Capel, as well as the City of Bunbury, had a population of 89,628 in 2016 and the South West region had a total population of 172,179 (Shire of Capel, 2018). Construction is the main industry accounting for 12.8 % of employment, with manufacturing accounting for approximately 11.8 %.

Visual amenity

The Swan Coastal Plain is characterised as a low lying coastal plain mainly covered with woodlands, with rare landscape features such as Holocene dunes and wetlands. Bushland is often retained as a visual or spatial buffer between land uses (Mitchell, Williams, & Desmond, 2002). Changes to amenity are greatest in areas with a high perceived scenic amenity value which are visible from public locations, such as roads, walk trails and lookouts.

The existing amenity of the Project Area includes urban and semi-rural properties, pockets of native vegetation, rural / agricultural areas, existing roads (including Bussell Highway) and previously cleared areas.

Noise

Noise sensitive receptors include residences in the rural and semi-rural developments abutting the Project. The Project will result in a major highway and highway upgrade being located within 50 m of some existing residences.

3.8.3 Potential impacts

Project activities that have the potential to impact social surroundings during construction include vegetation clearing, earthworks and off-site transport.

The potential construction impacts include:

- Heritage site disturbance during clearing and/or excavation works
- Changes to visual amenity
- Noise impacts to sensitive receptors, from noise emissions generated by construction
- Vibration generated by construction
- Increased traffic on local road network.

The potential operational impacts on social surroundings as a consequence of developing the Project are:

- Changes in visual amenity
- Noise impacts to sensitive receptors through noise emissions from the road.

3.8.4 Assessment of impacts

Direct Impacts

Heritage site disturbance during clearing and/or excavation works

The Aboriginal Heritage Identification System (AHIS) identified one Registered Aboriginal heritage archaeological site intersected by the Project Area (ID 5813 Capel Bussell Highway) and two Other Heritage Places (ID 37869 Paperbark Wetlands and ID 37870 The Gelorup Corridor) which will be directly impacted by this Project (DPLH, 2019).

Additional Aboriginal and Archaeological surveys will be conducted if the GBRS alignment is selected as the preferred alignment.

Noise and vibration impacts from construction and operation

Noise and vibration impacts are expected to result from the construction phase, however these impacts are expected to be short in duration and are not considered significant. Noise and vibration impacts during construction will be managed under a Project specific CEMP.

The Project will result in the exposure of noise sensitive residences to traffic noise from the highway. The extent of impact will be determined through a Traffic Noise Assessment for the Project, should it be selected as the preferred alignment. Noise management will be implemented to comply with SPP 5.4 (WAPC, 2009). Management measures may include the installation of noise walls and / or treatments to individual properties

to comply with SPP 5.4 (WAPC, 2009). Noise mitigation measures will be developed during the detailed design phase for operation of the Project to be compliant with the requirements of SPP 5.4 (WAPC, 2009).

Reduced visual amenity

Direct and permanent impacts to visual amenity of the existing rural area are expected to result from this Project. The impacts to visual amenity are expected to be greatest between South West Highway and Bussell Highway.

An assessment of the impacts to visual amenity will be completed if this alignment is selected as the preferred option. The results of the assessment and potential mitigation measures will be included in relevant documentation to support the formal referral and assessment of the Project through the EP Act as necessary.

Glare or light spill on sensitive receptors

There will be changes in the local light environment as a result of the Project. It is anticipated that only intersections and interchanges will be lit for safety reasons.

Indirect Impacts

Indirect impacts from the Project on social surrounds are anticipated. Construction of the Project will potentially affect the amenity of residents through changes to the landscape. These impacts will be further investigated during visual impact assessment and mitigation measures will be identified during design phase if this alignment is selected as the preferred option.

3.8.5 Mitigation

Impacts to social surroundings will be minimised through the following mitigation and management measures:

- Developing a Project design to minimise environmental impacts as far as practicable
- The selection of engineering solutions to avoid and minimise environmental impacts
- Compliance with State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning
- Compliance with State and Commonwealth environmental legal requirements
- Preparation and implementation of a Project specific CEMP that addresses issues specific to social surroundings including:
  - Complaints response and management
  - Heritage site management
  - Construction management (noise, vibration and dust)
  - Hazardous materials management
  - Environmental incident reporting and management
- The CEMP will include targets and key performance indicators, management actions, monitoring requirements and contingency measures.

3.8.6 Predicted outcome

Potential impacts on Aboriginal heritage sites associated with the Project will be managed through consultation with all relevant groups and undertaken in accordance with State and Commonwealth legislation. Potential impacts to Aboriginal heritage will be managed through AH Act.

Construction and operation of the Project is likely to result in impacts to visual amenity and localised change in the landscape. If selected as the preferred alignment option, the potential impact of these changes will be mitigated through consideration during the detailed design phase and implementation of the landscaping, and other mitigation measures during construction via the CEMP.

Mitigation measures identified in the Traffic Noise Assessment will be developed during the detailed design phase of the Project if the alignment is selected as the preferred option.

4 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

A search of the Protected Matters Search Tool (PMST) identified Banksia Woodlands of the Swan Coastal Plain TEC, threatened Black Cockatoo species and Western Ringtail Possums as the key matters of national environmental significance that may be impacted by the Project. An assessment of these has been undertaken in Table 4-1.

Table 4-1 Assessment against Matters of National Environmental Significance

MATTER OF MNES	IMPACT ASSESSMENT
Threatened Species and ecological communities	Impacts to one Threatened Ecological Community (TEC) was confirmed within the Project Area during field investigations: • Banksia Woodlands of the Swan Coastal Plain (SCP) TEC (approximately 21 ha). No Threatened flora species 'known' or 'likely to occur' in the Project Area. Impacts to Carnaby's Cockatoo (Endangered), Baudin's Cockatoo (Endangered) and the Forest Red-Tailed Black Cockatoo (Vulnerable), including: • Removal of approximately 71 ha potential habitat (38 ha surveyed and 33 ha unsurveyed) • Removal of 443 Suitable DBH Trees, including eight Trees with a Suitable Nest Hollow, four Known Nesting Trees and three that could not be assessed by drone Impacts to Western Ringtail Possums (Critically Endangered), including: • Removal of approximately 71 ha potential habitat (38 ha surveyed and 33 ha unsurveyed), providing habitat for an estimated 100 individuals, which represent less than 2 % of the regional population. Loss of less than 0.3 ha wetland habitat hydrologically connected to wetlands where Black-stripe Minnow were recorded.
Migratory Species	The PMST identified 42 migratory species including: • 26 bird species (Inc. 9 wetland species) • 15 marine species • 1 terrestrial species.
Commonwealth Marine Areas	The Project will not impact any Commonwealth Marine Area. The closest is Geographe Commonwealth Marine Reserve, approximately 14 km west of Project Area.
World Heritage Properties	The Project will not impact any World Heritage Properties.
National Heritage Properties	The Project will not impact any National Heritage Properties.

MATTER OF MNES	IMPACT ASSESSMENT
Wetlands of International Importance	The Project will not impact any wetlands of international importance. The closest is the Vasse-Wonnerup System, approximately 20 km south of the Project Area.

5 SUMMARY

BORR Project has been divided into three sections (Northern, Central and Southern Sections). Two alignments for BORR Southern Section are currently being assessed by Main Roads (BORR Southern Section GBRS Alignment and BORR Southern Section Alternative Alignment) to determine the preferred alignment.

The findings in this EIA were used to identify and assess the environmental impacts associated with BORR Southern Section GBRS Alignment ('the Project'). Main Roads used the findings of this EIA to support the determination of the preferred southern alignment for BORR. The impacts of the Project have been summarised in Table 5-1 for the purposes of comparison. This document is not intended to be used for regulatory environmental approval processes.

Table 5-1 Summary of Environmental Impacts

ASPECT	BORR SOUTHERN SECTION GBRS ALIGNMENT
Total Area	190 ha
VEGETATION AND FLORA	
Total Native Vegetation	Approximately 73 ha (40 ha surveyed, 33 ha unsurveyed)
Total non-native / cleared area	Approximately 120 ha
Total native Good or better condition	Approximately 18 ha (~9 % of the Project Area)
Total areas in Good – Degraded or worse condition	An estimated 172 ha (~91 % of the Project Area) (includes Cleared/parkland areas, which are classified as Completely Degraded)
Threatened and Priority Communities	Present: 1. Banksia woodlands of the SCP TEC – approximately 21 ha 2. Banksia woodlands PEC – up to 3.5 ha 3. Tuart woodlands PEC – approximately 28 ha.
Other significant	Approximately 4 ha of riparian vegetation
Conservation significant flora	One Priority Flora recorded – *Caladenia speciosa* (Priority 4), of which 71 individuals occur within the Project Area. No Threatened flora recorded during the filed investigations.
FAUNA	
EPBC / BC Fauna - confirmed - Black Cockatoos	Approximately 71 ha of potential Black Cockatoo habitat (38 ha surveyed and 33 ha unsurveyed). Up to 443 Suitable DBH Trees, including eight Trees with a Suitable Nest Hollow, four Known Nesting Trees and three that could not be assessed by drone.

ASPECT	BORR SOUTHERN SECTION GBRS ALIGNMENT
- Western Ringtail Possum (Critically Endangered)	Approximately 71 ha of WRP habitat (including 37.9 ha surveyed and 32.6 ha unsurveyed) and displacement of an estimated 100 individual WRPs, representing less than 2 % of the regional population.
Priority Fauna – confirmed - Southern Brown Bandicoot / Quenda (Priority 4)	Approximately 73 ha of potential Southern Brown Bandicoot, Quenda (Priority 4) habitat (including 40 ha surveyed and 33 ha unsurveyed).
Threatened species likely to occur - Black-stripe Minnow (Endangered)	Loss of less than 0.3 ha wetland habitat hydrologically connected to wetlands where Black-stripe Minnow were recorded.
South-western Brush-tailed Phascogale (Schedule 6)	Clearing of an estimated 63 ha of South-western Brush-tailed Phascogale habitat (including 30 ha surveyed and 33 ha unsurveyed).
Migratory birds	A small number (< 50) of migratory bird species were considered to be potentially transient visitors to the Project Area at times when wetlands are inundated and are not expected to be significantly impacted by the Project.
TERRESTRIAL ENVIRONMENT QUALITY	
Acid Sulphate Soils	The Project has low to moderate risk of ASS, with minor areas of high risk associated with watercourses and the Capel Golf Course. Although the Project will widen an existing road adjacent to the Golf Course no impacts to ASS at that location are considered likely.
Contaminated Sites	No impact anticipated.
RIVERS AND WETLANDS	
Rivers	No rivers protected under the RIWI Act will be impacted by the Project, however a number of minor waterways will be impacted, including Five Mile Brook.
Geomorphic wetlands	Loss of up to 33 ha of mapped Geomorphic Wetlands including approximately: Conservation: 1 ha Resource Enhancement: <1 ha Multiple use: 31 ha
AIR QUALITY	
Air quality	No significant impacts anticipated.
SOCIAL	
State and Municipal heritage	No significant impacts anticipated.
Aboriginal Heritage	Capel Bussell Highway (ID 5813). Site 5813 is recorded as a Registered site, comprised of Artefacts / Scatter, Archaeological Deposit and Camp.

ASPECT	BORR SOUTHERN SECTION GBRS ALIGNMENT
	Paperbark Wetlands (ID 37869) is recorded as a Lodged Other Heritage Place, comprised of Modified Tree, Birth Place, Hunting Place, Water Source. The Gelorup Corridor (ID 37870) is recorded as a Lodged Other Heritage Place, comprised of Artefacts/ Scatter, Ceremonial, Skeletal Material, Burial.
Noise	Noise and vibration impacts are expected to result from the construction phase. These impacts are not considered likely to be significant. If required noise mitigation measures will be developed during the detailed design phase to be compliant with the requirements of SPP 5.4 (WAPC, 2009).
Visual	Direct and permanent impacts to visual amenity of the existing rural area are expected to result from this Project. An assessment of the impacts to visual amenity will be completed if this alignment is selected as the preferred option.
Amenity	Construction of the Project will potentially affect the amenity of residents through changes to the landscape. These impacts will be further investigated during visual impact assessment and mitigation measures will be identified during design phase if this alignment is selected as the preferred option.

It is considered likely that the Project will require the following environmental approvals:

- Referral to the EPA under Section 38 of the EP Act
- Referral to DotEE under the EPBC Act for assessment as a Controlled Action
- Native Vegetation Clearing Permit (DWER)
- Works approval and licence to operate an asphalt plant (DWER)
- Bed and Banks Permit (DWER)
- Licence to take water for construction purposes (DWER)
- Section 18 consent to disturb Aboriginal heritage sites (Minister for Aboriginal Heritage)
- Permission from the Shire of Capel to disturb the European heritage site.

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- Clearing Regulations – Environmentally Sensitive Areas (DWER-046)
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- EPA Redbook Recommended Conservation Reserves 1976-1991 (DBCA-029)
- Geomorphic Wetlands, Swan Coastal Plain (DBCA-019)
- Groundwater Salinity Statewide (DWER-026)
- Heritage Council WA – State Register (SHO-003)
- Hydrographic Catchments – Catchments (DWER-028)

- Legislated Lands and Waters (DBCA-011)
- Pre-European Vegetation (DPIRD-006)
- Public Drinking Water Source Areas (DWER-033)
- Ramsar Sites (DBCA-010)
- RIWI Act, Groundwater Areas (DWER-019)
- RIWI Act, Rivers (DWER-036)
- RIWI Act, Surface Water Areas and Irrigation Districts (DWER-037)
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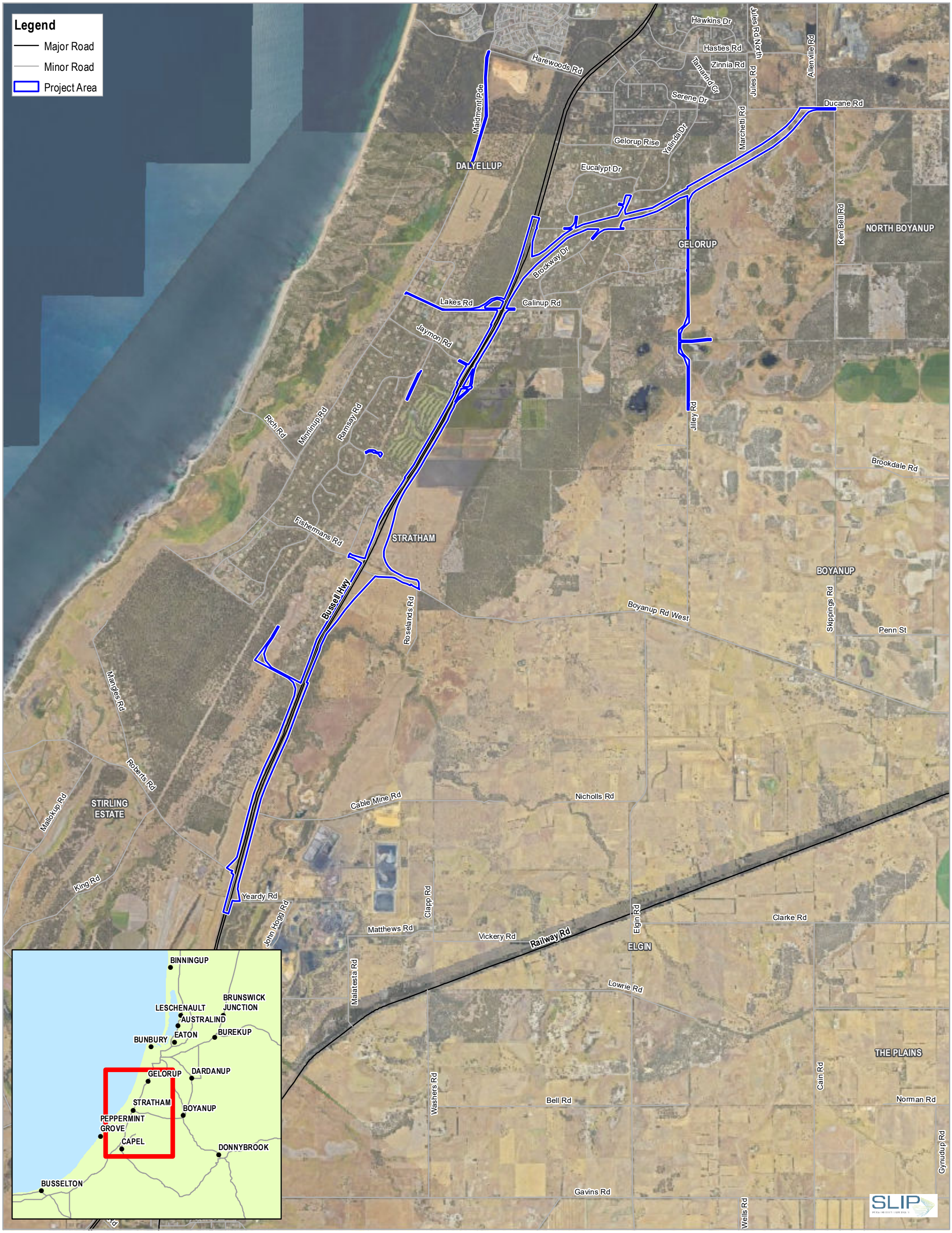

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Grid: GDA 1994 Perth Coastal Grid 1994

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Main Roads Western Australia
Bunbury Outer Ring Road
Southern Section GBRS Alignment
Environmental Impact Assessment

BORR Southern Section GBRS Alignment

Project No. **61-37041**
Revision No. **1**
Date **24/06/2019**

FIGURE 1

Data source: BORR: South EIA Boundary - 20181212; MRWA: Road Network - 20180519; Landgate: Imagery accessed on 20190522, Locality names - 2018; Geoscience Australia: Geodata Topo 250k..
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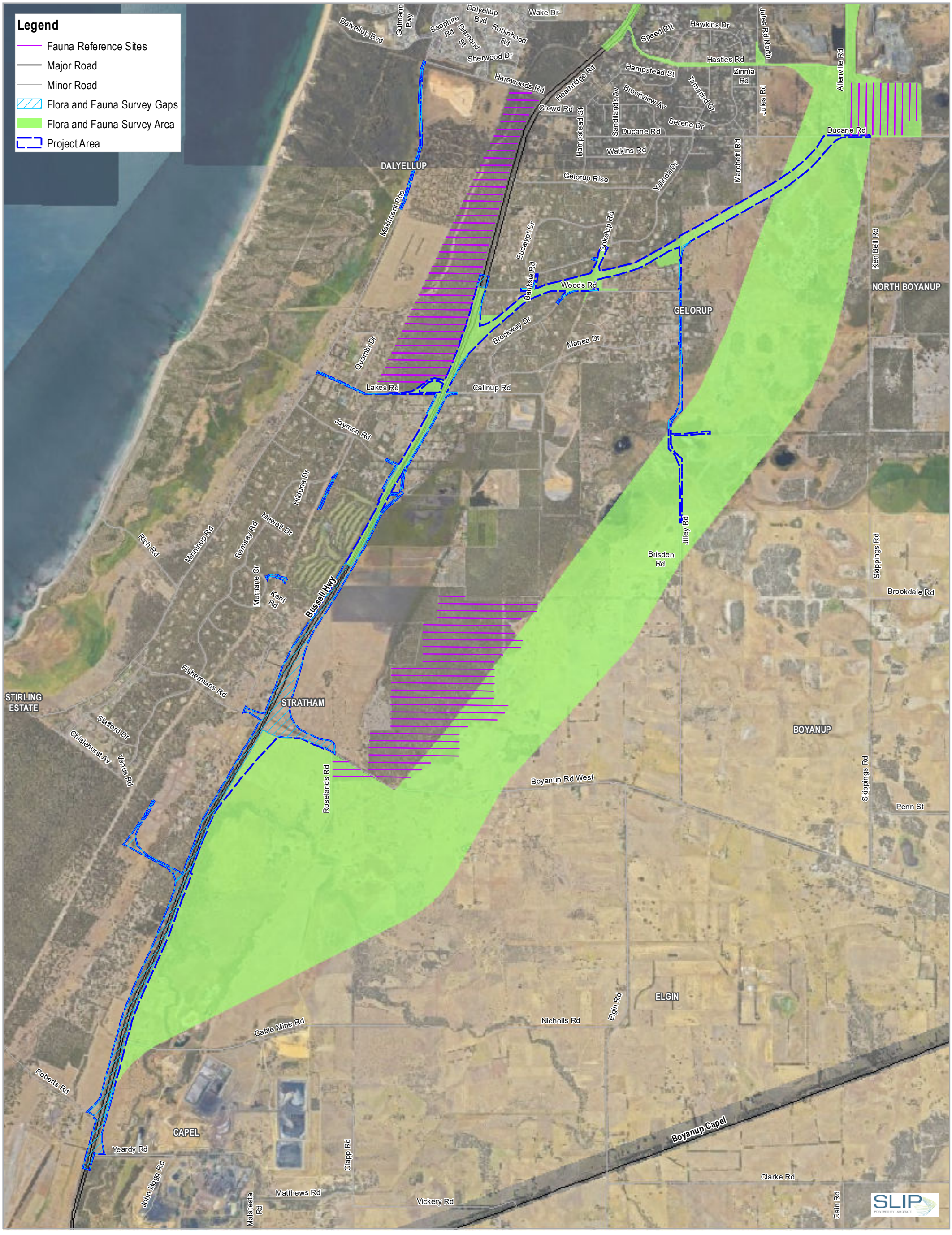

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Southern Section GBRS Alignment
Environmental Impact Assessment

Project No.	**61-37041**
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Date	**24/06/2019**

Surveyed and Unsurveyed Areas

FIGURE 2

Data source: BORR: South Alternate Boundary - 20181212, Survey areas and gaps - 20190213, Fauna Reference Sites - 20190122; MRWA: Road Network - 20180519; Landgate: Imagery accessed on 20190415, Locality names - 2018; Geoscience Australia: Geodata Topo 250k.. Created by: slei

Legend
Major Road
Minor Road
Project Area
Map sheet

DALYELLUP
GELORUP
NORTH BOYANUP
Map 1
Map 2
Map 3
Map 4
Bussell Hwy
STRATHAM
BOYANUP
STIRLING ESTATE
CAPEL
ELGIN
Railway Rd
THE PLAINS

Paper Size ISO A3
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Kilometres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
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OVERVIEW

FIGURE 3

Data source: BORR: South EIA Boundary - 20181212; MRWA: Road Network - 20180519; Landgate: Imagery accessed on 20190522, Locality names - 2018; Geoscience Australia: Geodata Topo 250k..
Created by: slei

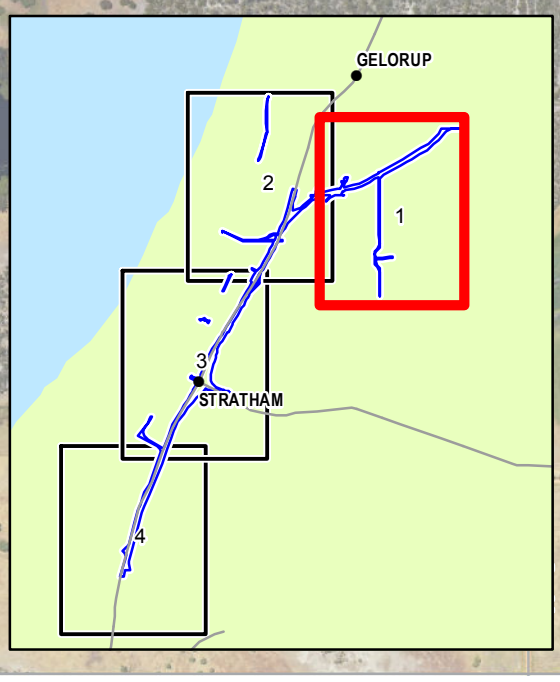
Crowd Rd
Mossdale Pl
Sandilands Av
Brookview Av
Serene Dr
Coachwood Wy
Jules Rd
Allenville Rd
Ducane Rd
Hampstead St
Watkins Rd
Ridge Pl
Tarrock Ct
Zanadu Ct
Marchetti Rd
Gelorup Rise
Yalinda Dr
Eucalypt Dr
Cokelup Rd
Cleared
9d
1
9a
9c
10
4
Woods Rd
Brockway Dr
St Clair Ct
Marri Pl
Stable Cl
Manea Dr
Rd No 308
Jilley Rd
8
*Zantedeschia aethiopica (DP/WONS)
1b
3
1a
7
2

Legend

- Significant weed
- Major Road
- Minor Road
- Project Area
- Unsurveyed gaps (white)
- Vegetation cover in unsurveyed gaps

Vegetation Type

- 1 - Open forest of Jarrah, Marri and Banksia
- 1a - Marri and Jarrah +/- Peppermint over closed grassland
- 1b - Isolated Flooded Gum and Marri closed grassland
- 2 - Open forest of Jarrah, Marri, Banksia and Peppermint
- 3 - Scattered Jarrah, Marri +/- Peppermint over tall open shrubland Banksia, Xylomelum, *Kunzea* sp.
- 4 - Open forest of Banksia and Peppermint
- 7 - Woodland of Paperbark over tall sparse shrubland
- 8 - Woodland of Flooded Gum and Paperbark over sparse Melaleuca shrubland
- 9a - Marri and Jarrah +/- Peppermint with very occasional Tuart
- 9c - Peppermint stands
- 9d - Flooded Gum and Marri +/- Paperbark
- 10 - Parkland cleared with occasional Marri, Jarrah and Peppermint
- Cleared



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Southern Section GBRS Alignment
Environmental Impact Assessment

Vegetation Type

Project No. **61-37041**
Revision No. **0**
Date **24/06/2019**

FIGURE 3

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Print date: 24 Jun 2019 - 15:13

Data source: BORR: South Boundary - 20181212, Vegetation type, Additional non-surveyed vegetation extent - 20190220, Significant Weeds - 2019; Landgate: Roads - 2018, Aerial imagery - WA Now accessed 20190522; DPIRD: Native vegetation extent - 20171026. Landgate / SLIP. Created by: mmikkonen

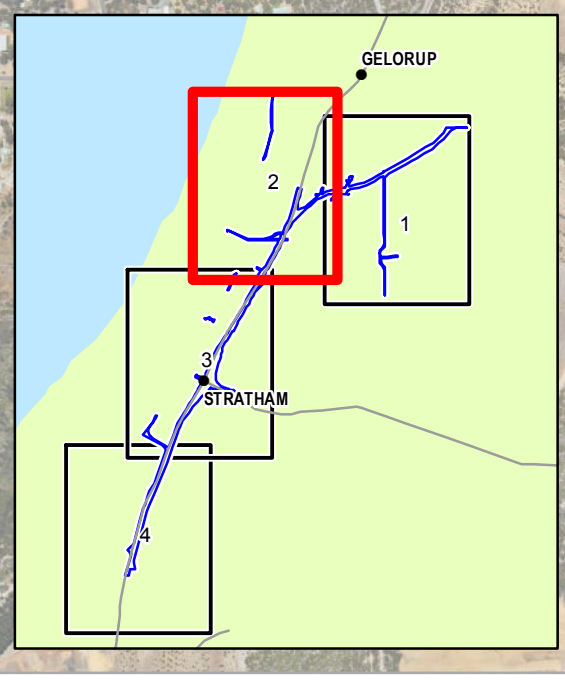
Legend

- Major Road
- Minor Road
- Project Area
- Unsurveyed gaps (white)
- Vegetation cover in unsurveyed gaps

Vegetation Type

- 1 - Open forest of Jarrah, Marri and Banksia
- 3 - Scattered Jarrah, Marri +/- Peppermint over tall open shrubland Banksia, Xylomelum, *Kunzea* sp.
- 4 - Open forest of Banksia and Peppermint
- 9a - Marri and Jarrah +/- Peppermint with very occasional Tuart
- 9c - Peppermint stands
- 10 - Parkland cleared with occasional Marri, Jarrah and Peppermint
- 10b - Revegetation/regrowth
- Cleared

Citrine St
Sherwood Dr
Jade Cr
Edwinstone Cl
Robinhood Rd
Trent Wy
Harewoods Rd
Heathridge Rd
Crowd Rd
Maidment Pde
Gelorup Rise
Bussell Hwy
Eucalypt Dr
Banksia Rd
Woods Rd
Brockway Dr
St Clair Ct
Manea Dr
Quambi Dr
Lakes Rd
Tamra Cl
Minninup Rd
Jaymon Rd
Rosemore Wy
Ramsay Rd
Hilduna Dr



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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
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Vegetation Type

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FIGURE 3

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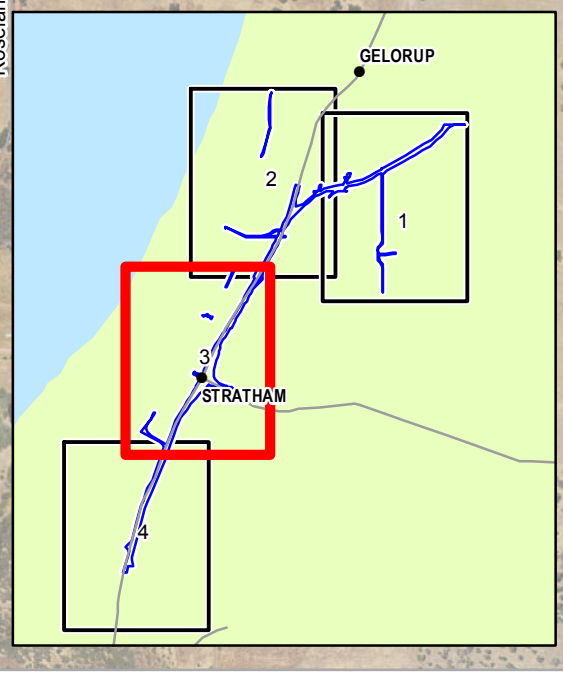
Hilduna Dr
Mewett Dr
Rich Rd
Ramsay Rd
Minninup Rd
Child Pl
Murnane Cr
Kent Rd
Cheriton Ct
Fishermans Rd
Stratham Cl
Chislehurst Av
Stafford Dr
Venus Rd
Bussell Hwy
Boyanup Rd West
Rosellands Rd
10
8
3
10b
9a
1b
1a
Cleared
*Zantedeschia aethiopica (DP/WONS)

Legend

- Significant weed
- Major Road
- Minor Road
- Project Area
- Unsurveyed gaps (white)
- Vegetation cover in unsurveyed gaps

Vegetation Type

- 1a - Marri and Jarrah +/- Peppermint over closed grassland
- 1b - Isolated Flooded Gum and Marri closed grassland
- 3 - Scattered Jarrah, Marri +/- Peppermint over tall open shrubland Banksia, Xylomelum, *Kunzea* sp.
- 8 - Woodland of Flooded Gum and Paperbark over sparse Melaleuca shrubland
- 9a - Marri and Jarrah +/- Peppermint with very occasional Tuart
- 10 - Parkland cleared with occasional Marri, Jarrah and Peppermint
- 10b - Revegetation/regrowth
- Cleared



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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
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Bunbury Outer Ring Road
Southern Section GBRS Alignment
Environmental Impact Assessment

Vegetation Type

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FIGURE 3

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*Zantedeschia aethiopica (DP/WONS)

*Zantedeschia aethiopica (DP/WONS)

*Asparagus asparagoides (DP/WONS)

8

1a

1b

Cleared

Mangles Rd

Roberts Rd

King Rd

Bussell Hwy

Cable Mine Rd

Yeardy Rd

John Hogg Rd

Matthews Rd

Hansen Rd

Urquhart Rd

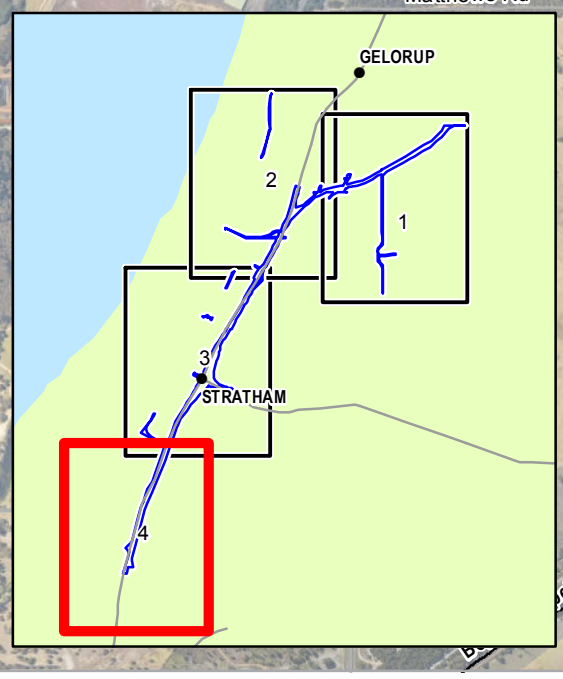
Bentley Dr

Legend

- Significant weed
- Major Road
- Minor Road
- Project Area
- Unsurveyed gaps (white)
- Vegetation cover in unsurveyed gaps

Vegetation Type

- 1a - Marri and Jarrah +/- Peppermint over closed grassland
- 1b - Isolated Flooded Gum and Marri closed grassland
- 8 - Woodland of Flooded Gum and Paperbark over sparse Melaleuca shrubland
- Cleared



Paper Size ISO A3

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

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BUILDING OUR FUTURE

mainroads WESTERN AUSTRALIA
BUNBURY OUTER RING ROAD | PLANNING AND DEVELOPMENT

Main Roads Western Australia
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Southern Section GBRS Alignment
Environmental Impact Assessment

Vegetation Type

Project No. **61-37041**
Revision No. **0**
Date **24/06/2019**

FIGURE 3

G:\61\37041\19_0_GIS\Maps\Working\EIASouth\61137041_003_SouthVegetationTypeMapbook_Rev0.mxd
Print date: 24 Jun 2019 - 15:15

Data source: BORR: South Boundary - 20181212, Vegetation type, Additional non-surveyed vegetation extent - 20190220, Significant Weeds - 2019; Landgate: Roads - 2018, Aerial imagery - WA Now accessed 20190522; DPIRD: Native vegetation extent - 20171026, Landgate / SLIP. Created by: mmikkonen

Legend
Major Road
Minor Road
Project Area
Map sheet

DALYELLUP
Map 2
GELORUP
NORTH BOYANUP
Map 1
Bussell Hwy
Map 3
STRATHAM
BOYANUP
STIRLING ESTATE
Map 4
ELGIN
Railway Rd
CAPEL
THE PLAINS

Paper Size ISO A3
0 0.5 1 1.5
Kilometres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

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Vegetation Condition

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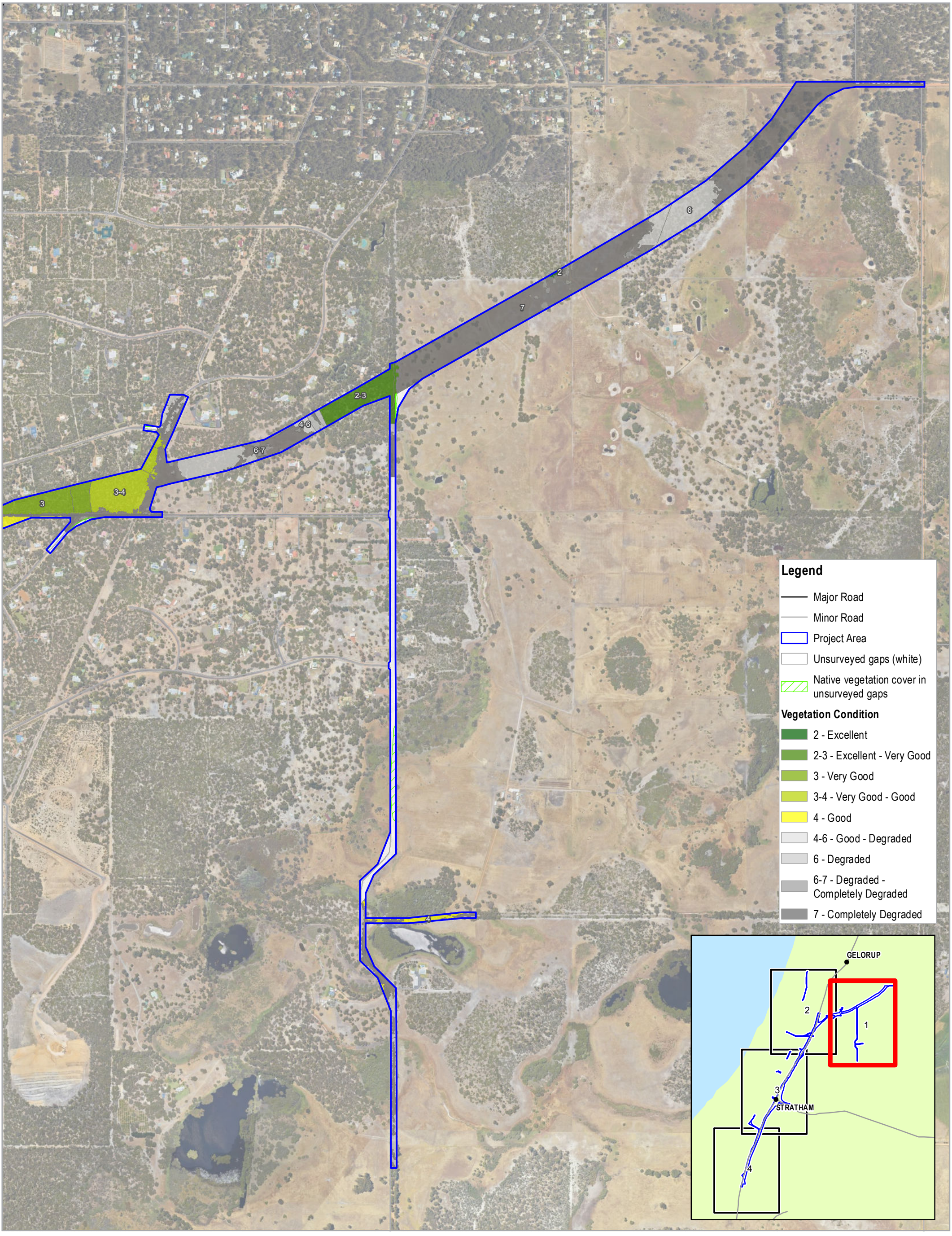
Revision No. 1
Date 24/06/2019

OVERVIEW

FIGURE 4

Data source: BORR: South EIA Boundary - 20181212; MRWA: Road Network - 20180519; Landgate: Imagery accessed on 20190522, Locality names - 2018; Geoscience Australia: Geodata Topo 250k..
Created by: slei



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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

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Vegetation Condition

Project No. **61-37041**
Revision No. **2**
Date **24/06/2019**

FIGURE 4

Data source: BORR: South Boundary - 20181212, Vegetation Condition- 20190221; Landgate: Imagery accessed on 20190415, Roads - 20180519; Geoscience Australia: Topo 250k - 2006. Landgate / SLIP.
Created by: mmikkonen

Legend

- Major Road
- Minor Road
- Project Area
- Unsurveyed gaps (white)
- Native vegetation cover in unsurveyed gaps

Vegetation Condition

- 2-3 - Excellent - Very Good
- 3 - Very Good
- 3-4 - Very Good - Good
- 4 - Good
- 4-6 - Good - Degraded
- 6 - Degraded
- 6-7 - Degraded - Completely Degraded
- 7 - Completely Degraded

Bussell Hwy

2-3

6

3

3-4

4

4-6

6-7

7

GELORUP

STRATHAM

1

2

3

4

Paper Size ISO A3

0 90 180 270 360

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

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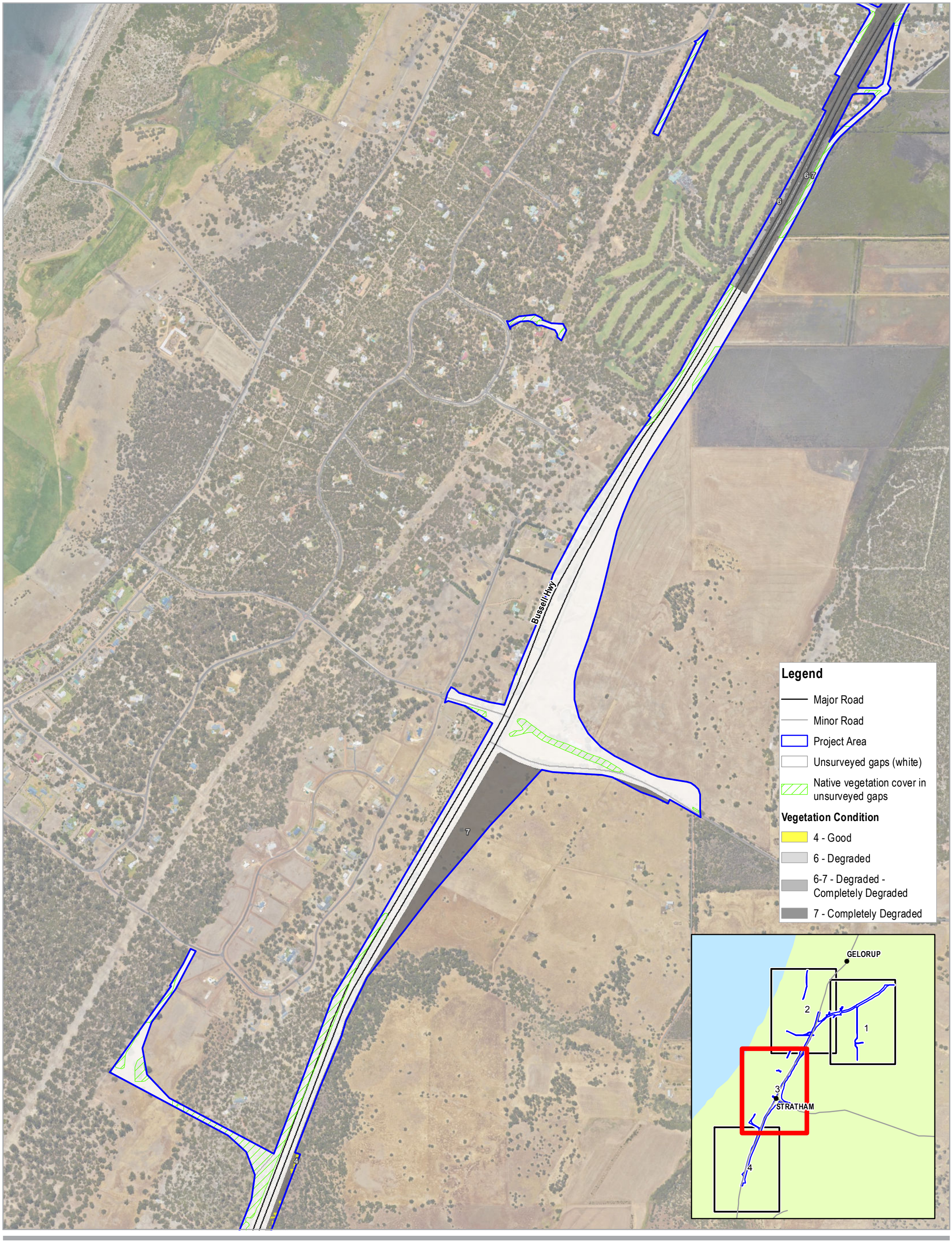
Environmental Impact Assessment

Vegetation Condition

Project No. **61-37041**
Revision No. **2**
Date **24/06/2019**

FIGURE 4

Data source: BORR: South Boundary - 20181212, Vegetation Condition- 20190221; Landgate: Imagery accessed on 20190415, Roads - 20180519; Geoscience Australia: Topo 250k - 2006. Landgate / SLIP.
Created by: mmikkonen



Paper Size ISO A3

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

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Vegetation Condition

Project No. **61-37041**
Revision No. **2**
Date **24/06/2019**

FIGURE 4

Data source: BORR: South Boundary - 20181212, Vegetation Condition- 20190221; Landgate: Imagery accessed on 20190415, Roads - 20180519; Geoscience Australia: Topo 250k - 2006. Landgate / SLIP.
Created by: mmikkonen

Bussell Hwy

4

6

7

Legend

- Major Road
- Minor Road
- Project Area
- Unsurveyed gaps (white)
- Native vegetation cover in unsurveyed gaps

Vegetation Condition

- 4 - Good
- 6 - Degraded
- 7 - Completely Degraded

Paper Size ISO A3

0 90 180 270 360

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

N

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Bunbury Outer Ring Road
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Vegetation Condition

Project No. **61-37041**
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Date **24/06/2019**

FIGURE 4

Data source: BORR: South Boundary - 20181212, Vegetation Condition- 20190221; Landgate: Imagery accessed on 20190415, Roads - 20180519; Geoscience Australia: Topo 250k - 2006. Landgate / SLIP.
Created by: mmikkonen

Legend
Major Road
Minor Road
Project Area
Map sheet

DALYELLUP
GELORUP
NORTH BOYANUP
Map 2
Map 1
Bussell Hwy
Map 3
STRATHAM
BOYANUP
STIRLING ESTATE
Map 4
ELGIN
Railway Rd
CAPEL
THE PLAINS

Paper Size ISO A3
0 0.5 1 1.5
Kilometres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

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BUNBURY OUTER RING ROAD | PLANNING AND DEVELOPMENT

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Conservation Significant Ecological Communities and Flora

Project No. 61-37041
Revision No. 1
Date 24/06/2019

OVERVIEW

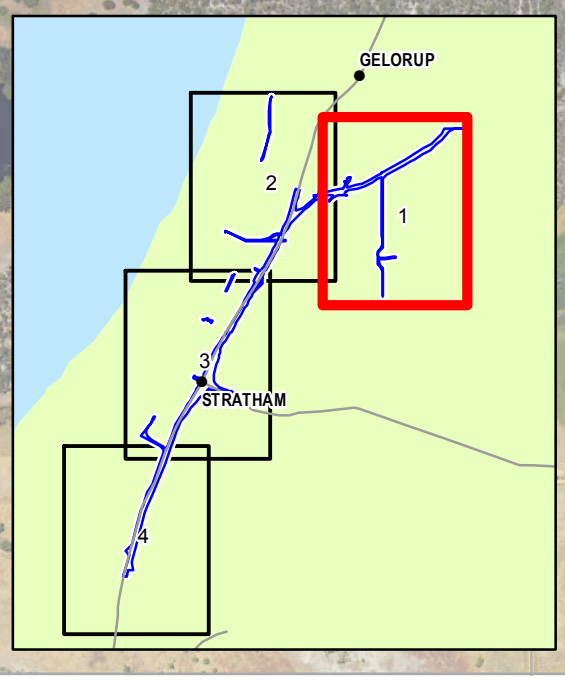
FIGURE 5

Data source: BORR: South EIA Boundary - 20181212; MRWA: Road Network - 20180519; Landgate: Imagery accessed on 20190522, Locality names - 2018; Geoscience Australia: Geodata Topo 250k..
Created by: slei

Legend

Conservation Significant Flora

- *Acacia semitrullata* (P4)
- Major Road
- Minor Road
- Project Area
- Banksia Woodlands TEC
- Banksia Woodlands PEC
- Tuart Woodlands PEC
- Unsurveyed gaps (white)
- Vegetation cover in unsurveyed gaps (not considered likely to represent TEC/PEC)



Paper Size ISO A3

0 90 180 270 360

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

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BUILDING OUR FUTURE

BUNBURY OUTER RING ROAD | PLANNING AND DEVELOPMENT

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Conservation Significant Ecological Communities and Flora

Project No. **61-37041**
Revision No. **1**
Date **24/06/2019**

FIGURE 5

G:\61\37041\19_0_GIS\Maps\Working\EIASouth\6137041_005_TECPEC_Consigs_Mapbook_Rev1.mxd
Print date: 24 Jun 2019 - 15:40

Data source: BORR: South Boundary - 20181212, TEC/PEC - 201902; Landgate: Imagery accessed on 20190523; MRWA: Road Network - 20180519; Geoscience Australia: Topo 250k - 2006. Landgate / SLIP.
Created by: mmikkonen

Legend

- Major Road
- Minor Road
- Project Area
- Banksia Woodlands TEC
- Banksia Woodlands PEC
- Tuart Woodlands PEC
- Unsurveyed gaps
- Vegetation cover in unsurveyed gaps (considered likely to represent Banksia Woodlands TEC and PEC)
- Vegetation cover in unsurveyed gaps (not considered likely to represent TEC/PEC)

Bussell Hwy

GELORUP

STRATHAM

1

2

3

4

Paper Size ISO A3

0 90 180 270 360

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

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Date **24/06/2019**

FIGURE 5

G:\61\37041\19_0_GIS\Maps\Working\EIASouth\6137041_005_TECPEC_Consigs_Mapbook_Rev1.mxd
Print date: 24 Jun 2019 - 15:44

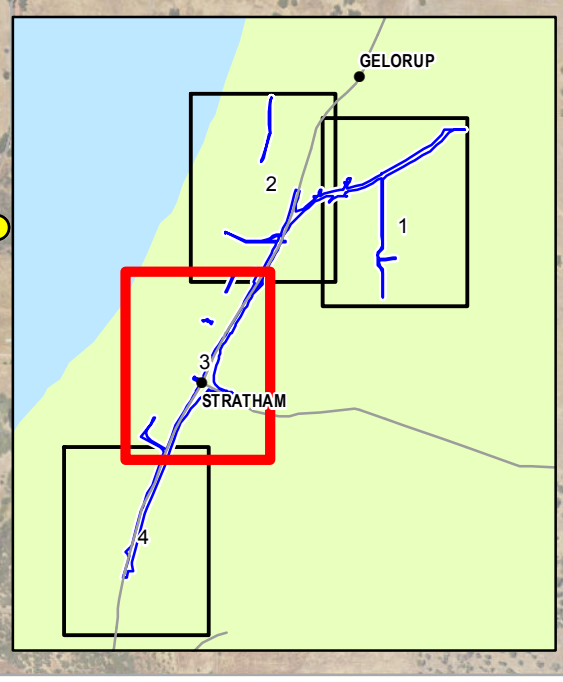
Data source: BORR: South Boundary - 20181212, TEC/PEC - 201902; Landgate: Imagery accessed on 20190523; MRWA: Road Network - 20180519; Geoscience Australia: Topo 250k - 2006. Landgate / SLIP.
Created by: mmikkonen

Bussell Hwy

Legend

Conservation Significant Flora

- *Acacia semitrullata* (P4)
- *Chamaescilla gibsonii* (P3)
- Major Road
- Minor Road
- Project Area
- Banksia Woodlands TEC
- Banksia Woodlands PEC
- Tuart Woodlands PEC
- Unsurveyed gaps (white)
- Vegetation cover in unsurveyed gaps (considered likely to represent Banksia Woodlands TEC and PEC)
- Vegetation cover in unsurveyed gaps (not considered likely to represent TEC/PEC)



Paper Size ISO A3

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

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Conservation Significant Ecological Communities and Flora

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Revision No. **1**
Date **24/06/2019**

FIGURE 5

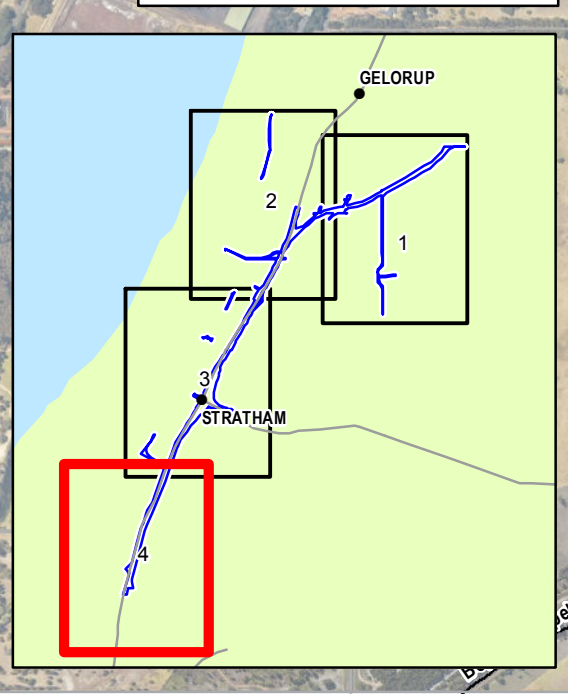
G:\61\37041\19_0_GIS\Maps\Working\EIASouth\6137041_005_TECPEC_Consigs_Mapbook_Rev1.mxd
Print date: 24 Jun 2019 - 15:41

Data source: BORR: South Boundary - 20181212, TEC/PEC - 201902; Landgate: Imagery accessed on 20190523; MRWA: Road Network - 20180519; Geoscience Australia: Topo 250k - 2006. Landgate / SLIP.
Created by: mmikkonen

Bussell Hwy

Legend

- Major Road
- Minor Road
- Project Area
- Banksia Woodlands TEC
- Banksia Woodlands PEC
- Tuart Woodlands PEC
- Unsurveyed gaps (white)
- Vegetation cover in unsurveyed gaps (considered likely to represent Banksia Woodlands TEC and PEC)
- Vegetation cover in unsurveyed gaps (not considered likely to represent TEC/PEC)



Paper Size ISO A3

0 90 180 270 360

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

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BUILDING OUR FUTURE

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Conservation Significant Ecological Communities and Flora

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Revision No. **1**
Date **24/06/2019**

FIGURE 5

G:\61\37041\19_0_GIS\Maps\Working\EIASouth\6137041_005_TECPEC_Consigs_Mapbook_Rev1.mxd
Print date: 24 Jun 2019 - 15:42

Data source: BORR: South Boundary - 20181212, TEC/PEC - 201902; Landgate: Imagery accessed on 20190523; MRWA: Road Network - 20180519; Geoscience Australia: Topo 250k - 2006. Landgate / SLIP.
Created by: mmikkonen

Legend

Conservation Significant Flora

- *Acacia semitrullata* (P4)
- *Chamaescilla gibsonii* (P3)
- Black-stripe Minnow observation
- Suitable DBH Trees (Black Cockatoo)
- Major Road
- Minor Road
- Project Area
- DBCA Nature Reserve
- Environmentally Sensitive Areas
- Threatened Ecological Community
- Priority Ecological Community

Geomorphic Wetlands category

- Conservation
- Resource Enhancement
- Multiple Use

DALYELLUP
NORTH BOYANUP
GELORUP
Bussell Hwy
STRATHAM
Roselands Nature Reserve
BOYANUP
Tuart Forest National Park
STIRLING ESTATE
CAPEL
ELGIN
Boyanup Capel
THE PLAINS
SLIP

Paper Size ISO A3

0 0.3 0.6 0.9 1.2

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

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Environmental Constraints

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Date **24/06/2019**

FIGURE 6

G:\61\37041\19_0_GIS\Maps\Working\EIASouth\6137041_012_EnvConstraints_Rev1.mxd
Print date: 24 Jun 2019 - 16:32

Data source: BORR Team: Conservation significant flora - 20190212, Project Area - 201812; Biota: Cockatoo trees - 20190208; DBCA: TEC/PEC boundaries - 20180605, Geomorphic wetlands - 20190604, Nature Reserves - 20170730; DWER: ESAs - 20151012; Landgate: Roads, Localities - 2018, Imagery: WA Now accessed 20190620. . Created by: mmikkonen

Legend
Major Road
Minor Road
Project Area
Map sheet

DALYELLUP
Map 2
GELORUP
NORTH BOYANUP
Map 1
Bussell Hwy
Map 3
STRATHAM
BOYANUP
STIRLING ESTATE
Map 4
ELGIN
Railway Rd
CAPEL
THE PLAINS

Paper Size ISO A3
0 0.5 1 1.5
Kilometres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

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Fauna Habitat

Project No. 61-37041
Revision No. 1
Date 24/06/2019

OVERVIEW

FIGURE 7

Data source: BORR: South EIA Boundary - 20181212; MRWA: Road Network - 20180519; Landgate: Imagery accessed on 20190522, Locality names - 2018; Geoscience Australia: Geodata Topo 250k..
Created by: slei

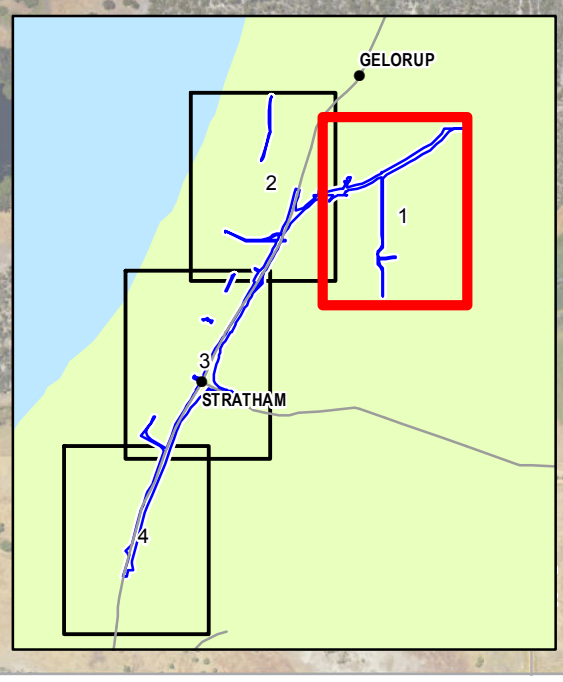
Crowd Rd
Mossdale Pl
Sandlands Av
Brookview Av
Serene Dr
Coachwood Wy
Jules Rd
Allenville Rd
Ducane Rd
Hampstead St
Watkins Rd
Ridge Pl
Tarrock Ct
Zanadu Ct
Marchetti Rd
Gelorup Rise
Yalinda Dr
Eucalypt Dr
Cokelup Rd
Woods Rd
Brockway Dr
St Clair Ct
Marri Pl
Stable Ct
Manea Dr
Rd No 308
Jilley Rd
Ken Bell Rd
Hair Pl

Legend

- Major Road
- Minor Road
- Project Area

Fauna Habitat

- Damplands and wetlands
- Jarrah/Marri woodland
- Scattered trees over introduced grasses
- Cleared
- Unsurveyed gaps (white)
- Vegetation cover in unsurveyed gaps



Paper Size ISO A3

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

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Date **24/06/2019**

FIGURE 7

G:\61\37041\19_0_GIS\Maps\Working\EIASouth\6137041_006_SouthFaunaHabitatMapbook_Rev1.mxd
Print date: 24 Jun 2019 - 15:48

Data source: BORR: South Boundary - 20181212; Landgate: Roads - 2018, Imagery accessed on 20190415; Biota: Fauna habitat - 20190220; Geoscience Australia: Geodata Topo 250k - 2006. Landgate / SLIP.
Created by: mmikkonen

Legend

- Major Road
- Minor Road
- Project Area

Fauna Habitat

- Jarrah/Marri woodland
- Scattered trees over introduced grasses
- Cleared
- Unsurveyed gaps (white)
- Vegetation cover in unsurveyed gaps

Citrine St
Garnet Wy
Sherwood Dr
Hornibrook Rd
Edwinstone Cl
Robinhood Rd
Jade Cr
Harewoods Rd
Trent Wy
Heathridge Rd
Crowd Rd
Maidment Pde
Gelorup Rise
Bussell Hwy
Eucalypt Dr
Banksia Rd
Woods Rd
Brockway Dr
St Clair Ct
Quambi Dr
Manea Dr
Lakes Rd
Tamra Cl
Minninup Rd
Jaymon Rd
Rosemore Wy
Ramsay Rd
Hiduna Dr

GELORUP
STRATHAM
1
2
3
4

Paper Size ISO A3

0 90 180 270 360

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

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Southern Section GBRS Alignment
Environmental Impact Assessment

Fauna Habitat

Project No. **61-37041**
Revision No. **1**
Date **24/06/2019**

FIGURE 7

G:\61\37041\19_0_GIS\Maps\Working\EIASouth\61137041_006_SouthFaunaHabitatMapbook_Rev1.mxd
Print date: 24 Jun 2019 - 15:51

Data source: BORR: South Boundary - 20181212; Landgate: Roads - 2018, Imagery accessed on 20190415; Biota: Fauna habitat - 20190220; Geoscience Australia: Geodata Topo 250k - 2006. Landgate / SLIP.
Created by: mmikkonen

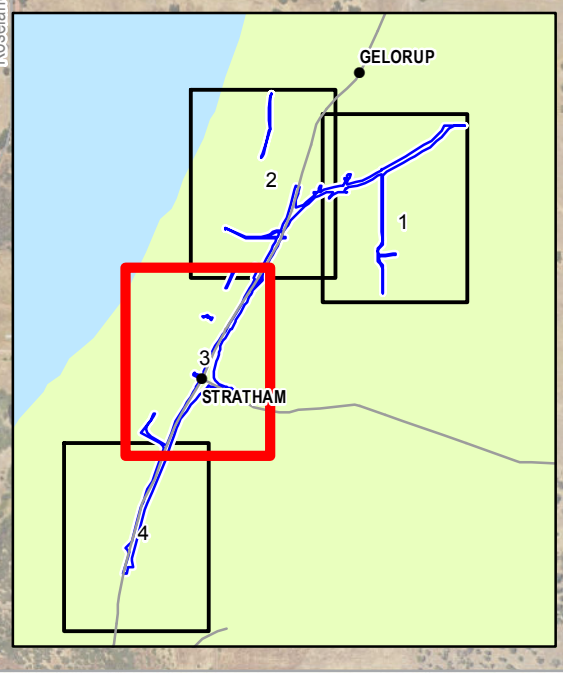
Hilcuma Dr
Mewett Dr
Rich Rd
Ramsay Rd
Child Pl
Mimmup Rd
Mumane Cr
Kent Rd
Cherion Ct
Fishermans Rd
Stratham Cl
Bussell Hwy
Chislehurst Av
Stafford Dr
Chislehurst Av
Venus Rd
Boyanup Rd West
Roselands Rd

Legend

- Major Road
- Minor Road
- Project Area

Fauna Habitat

- Damplands and wetlands
- Jarrah/Marri woodland
- Scattered trees over introduced grasses
- Cleared
- Unsurveyed gaps (white)
- Vegetation cover in unsurveyed gaps



Paper Size ISO A3

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

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Revision No. **1**
Date **24/06/2019**

FIGURE 7

G:\61\37041\19_0_GIS\Maps\Working\EIASouth\6137041_006_SouthFaunaHabitatMapbook_Rev1.mxd
Print date: 24 Jun 2019 - 15:49

Data source: BORR: South Boundary - 20181212; Landgate: Roads - 2018, Imagery accessed on 20190415; Biota: Fauna habitat - 20190220; Geoscience Australia: Geodata Topo 250k - 2006. Landgate / SLIP.
Created by: mmikkonen

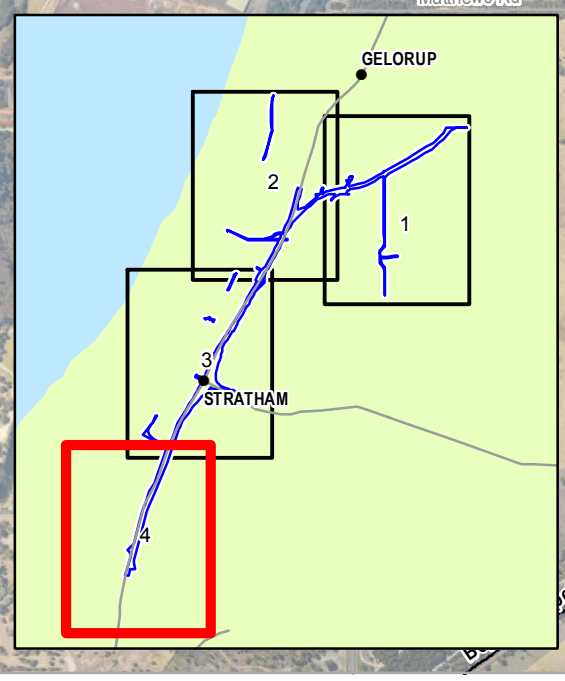
Mangles Rd
Roberts Rd
King Rd
Bussell Hwy
Cable Mine Rd
Yeardy Rd
John Hogg Rd
Matthews Rd
Hansen Rd
Urquhart Rd
Bentley Dr

Legend

- Major Road
- Minor Road
- Project Area

Fauna Habitat

- Damplands and wetlands
- Jarrah/Marri woodland
- Scattered trees over introduced grasses
- Cleared
- Unsurveyed gaps (white)
- Vegetation cover in unsurveyed gaps



Paper Size ISO A3

0 90 180 270 360

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

N

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BUILDING OUR FUTURE

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Main Roads Western Australia
Bunbury Outer Ring Road
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Fauna Habitat

Project No. **61-37041**
Revision No. **1**
Date **24/06/2019**

FIGURE 7

G:\61\37041\19_0_GIS\Maps\Working\EIASouth\6137041_006_SouthFaunaHabitatMapbook_Rev1.mxd
Print date: 24 Jun 2019 - 15:50

Data source: BORR: South Boundary - 20181212; Landgate: Roads - 2018, Imagery accessed on 20190415; Biota: Fauna habitat - 20190220; Geoscience Australia: Geodata Topo 250k - 2006. Landgate / SLIP.
Created by: mmikkonen

Legend
Major Road
Minor Road
Project Area
Map sheet

DALYELLUP
GELORUP
NORTH BOYANUP
Map 1
Map 2
Map 3
Map 4
Bussell Hwy
STRATHAM
BOYANUP
STIRLING ESTATE
CAPEL
ELGIN
Railway Rd
THE PLAINS

Paper Size ISO A3
0 0.5 1 1.5
Kilometres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

N

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Australian Government
BUILDING OUR FUTURE
mainroads WESTERN AUSTRALIA
BUNBURY OUTER RING ROAD | PLANNING AND DEVELOPMENT

Main Roads Western Australia
Bunbury Outer Ring Road
Southern Section GBRS Alignment
Environmental Impact Assessment

Black Cockatoos

Project No. **61-37041**
Revision No. **2**
Date **24/06/2019**

OVERVIEW

FIGURE 8

Data source: BORR: South EIA Boundary - 20181212; MRWA: Road Network - 20180519; Landgate: Imagery accessed on 20190522, Locality names - 2018; Geoscience Australia: Geodata Topo 250k..
Created by: slei

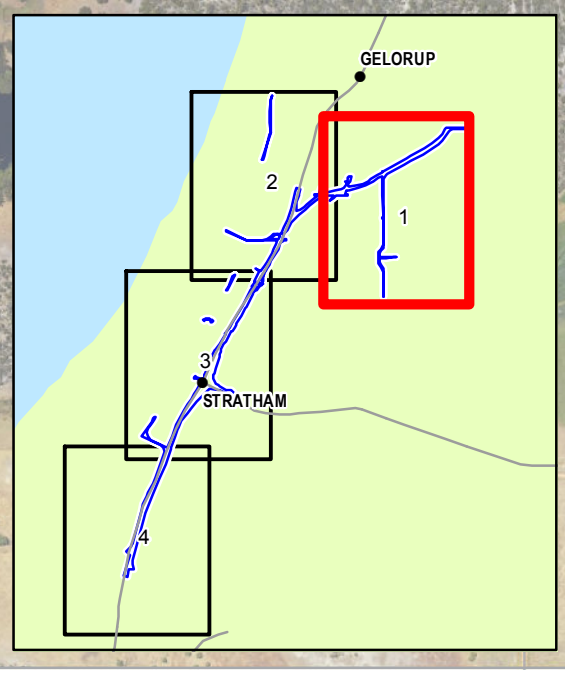
Crowd Rd
Mossdale Pl
Sandilands Av
Brookview Av
Serene Dr
Coachwood Wy
Jules Rd
Allenville Rd
Ducane Rd
Hampstead St
Ridge Pl
Zanadu Ct
Tarrock Ct
Watkins Rd
Marchetti Rd
Gelorup Rise
Yalinda Dr
Eucalypt Dr
Cokelup Rd
Woods Rd
Brockway Dr
St Clair Ct
Marri Pl
Stable Cl
Manea Dr
Rd No 308
Jilley Rd
Ken Bell Rd

Legend

- Black Cockatoo observation (Nov. 2017)

Trees with Hollows Potentially Suitable - Black Cockatoo

- Known nesting tree
- Suitable with no evidence of use
- Not suitable
- Ground assessed – suitability not confirmed
- Major Road
- Minor Road
- Project Area
- Survey Area
- Unsurveyed gaps
- Vegetation cover in unsurveyed gaps
- Black Cockatoo breeding and foraging habitat



Paper Size ISO A3

0 90 180 270 360

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

N

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Southern Section GBRS Alignment
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Black Cockatoos

Project No. **61-37041**
Revision No. **3**
Date **24/06/2019**

FIGURE 8

G:\61\37041\19_0_GIS\Maps\Working\EIASouth\6137041_007_BCsMapbook_Rev3.mxd
Print date: 24 Jun 2019 - 16:16

Data source: BORR: South Boundary - 20181212; MRWA: Road Network - 20180519; Landgate: Imagery accessed on 20190507; Biota: Fauna habitat, BC trees - 20190220, BC observations - 201711; Geoscience Australia: Geodata Topo 250k - 2006. Landgate / SLIP. Created by: mmikkonen

Legend

- Black Cockatoo observation (Nov. 2017)

Trees with Hollows Potentially Suitable - Black Cockatoo

- Known nesting tree
- Suitable with no evidence of use
- Not suitable
- Ground assessed – suitability not confirmed
- Major Road
- Minor Road
- Project Area
- Survey Area
- Unsurveyed gaps
- Vegetation cover in unsurveyed gaps
- Black Cockatoo breeding and foraging habitat

Citrine St
Sherwood Dr
Jade Cr
Edwinstone Cl
Robinhood Rd
Trent Wy
Harewoods Rd
Heathridge Rd
Crowd Rd
Maidment Pde
Gelorup Rise
Bussell Hwy
Eucalypt Dr
Banksia Rd
Woods Rd
Brockway Dr
St Clair Ct
Quambi Dr
Manea Dr
Lakes Rd
Tamra Cl
Minninup Rd
Jaymon Rd
Rosemore Wy
Ramsay Rd
Hilduna Dr

GELORUP
STRATHAM
1
2
3
4

Paper Size ISO A3

0 90 180 270 360

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

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Black Cockatoos

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Date **24/06/2019**

FIGURE 8

G:\61\37041\19_0_GIS\Maps\Working\EIASouth\6137041_007_BCsMapbook_Rev3.mxd
Print date: 24 Jun 2019 - 16:19

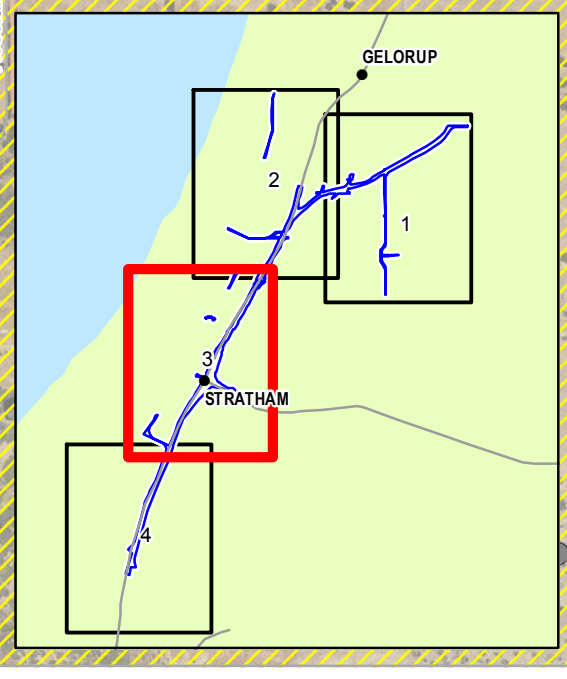
Data source: BORR: South Boundary - 20181212; MRWA: Road Network - 20180519; Landgate: Imagery accessed on 20190507; Biota: Fauna habitat, BC trees - 20190220, BC observations - 201711; Geoscience Australia: Geodata Topo 250k - 2006. Landgate / SLIP. Created by: mmikkonen

Hilduna Dr
Mewett Dr
Rich Rd
Ramsay Rd
Minninup Rd
Child Pl
Murnane Cr
Kent Rd
Cheriton Ct
Stratham Cl
Fishermans Rd
Chislehurst Av
Stafford Dr
Chislehurst Av
Venus Rd
Bussell Hwy
Boyanup Rd West
Rosellands Rd

Legend

Trees with Hollows Potentially Suitable - Black Cockatoo

- Known nesting tree
- Suitable with no evidence of use
- Not suitable
- Ground assessed – suitability not confirmed
- Major Road
- Minor Road
- Project Area
- Survey Area
- Unsurveyed gaps
- Vegetation cover in unsurveyed gaps
- Black Cockatoo breeding and foraging habitat



Paper Size ISO A3

0 90 180 270 360

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

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BUILDING OUR FUTURE

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Environmental Impact Assessment

Project No. **61-37041**
Revision No. **3**
Date **24/06/2019**

Black Cockatoos

FIGURE 8

G:\61\37041\19_0_GIS\Maps\Working\EIASouth\6137041_007_BCsMapbook_Rev3.mxd
Print date: 24 Jun 2019 - 16:16

Data source: BORR: South Boundary - 20181212; MRWA: Road Network - 20180519; Landgate: Imagery accessed on 20190507; Biota: Fauna habitat, BC trees - 20190220, BC observations - 201711; Geoscience Australia: Geodata Topo 250k - 2006. Landgate / SLIP. Created by: mmikkonen

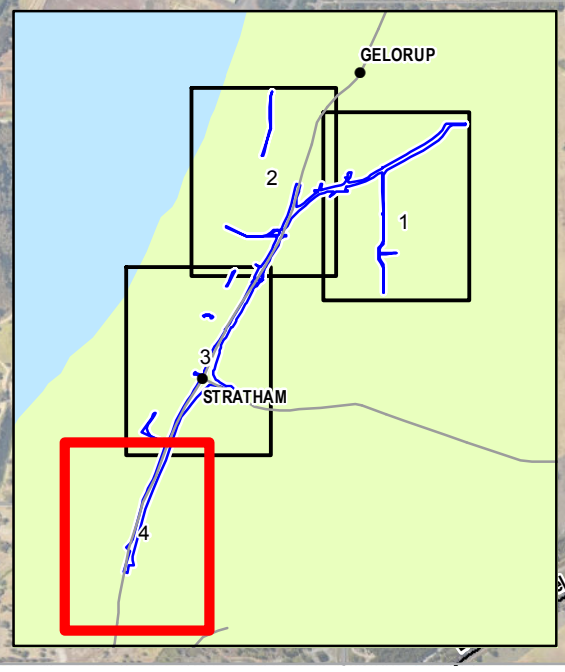
Mangles Rd
Roberts Rd
King Rd
Bussell Hwy
Cable Mine Rd
Yeardy Rd
John Hogg Rd
Hansen Rd
Urquhart Rd
Bentley Dr

Legend

Trees with Hollows Potentially Suitable - Black Cockatoo

- Known nesting tree
- Suitable with no evidence of use
- Not suitable
- Ground assessed – suitability not confirmed

- Major Road
- Minor Road
- Project Area
- Survey Area
- Unsurveyed gaps
- Vegetation cover in unsurveyed gaps
- Black Cockatoo breeding and foraging habitat



Paper Size ISO A3

0 90 180 270 360

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

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BUILDING OUR FUTURE

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Black Cockatoos

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Revision No. **3**
Date **24/06/2019**

FIGURE 8

G:\61\37041\19_0_GIS\Maps\Working\EIASouth\6137041_007_BCsMapbook_Rev3.mxd
Print date: 24 Jun 2019 - 16:17

Data source: BORR: South Boundary - 20181212; MRWA: Road Network - 20180519; Landgate: Imagery accessed on 20190507; Biota: Fauna habitat, BC trees - 20190220, BC observations - 201711; Geoscience Australia: Geodata Topo 250k - 2006. Landgate / SLIP. Created by: mmikkonen

Legend
Major Road
Minor Road
Project Area
Map sheet

DALYELLUP
Map 2
GELORUP
NORTH BOYANUP
Map 1
Bussell Hwy
Map 3
STRATHAM
BOYANUP
STIRLING ESTATE
Map 4
CAPEL
ELGIN
Railway Rd
THE PLAINS

Paper Size ISO A3
0 0.5 1 1.5
Kilometres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

N

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BUILDING OUR FUTURE
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Environmental Impact Assessment

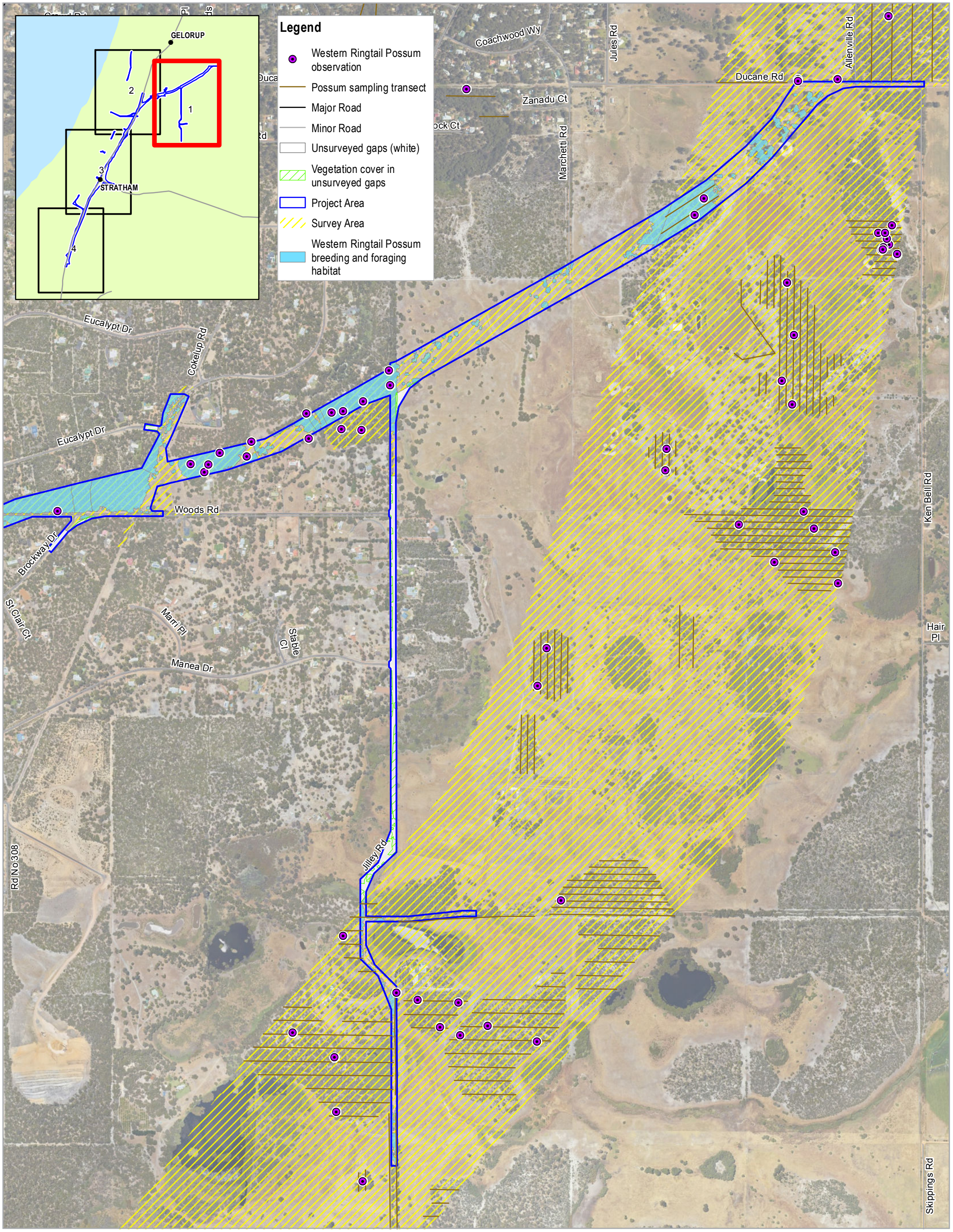
Western Ringtail Possums

Project No. 61-37041
Revision No. 1
Date 24/06/2019

OVERVIEW

FIGURE 9

Data source: BORR: South EIA Boundary - 20181212; MRWA: Road Network - 20180519; Landgate: Imagery accessed on 20190522, Locality names - 2018; Geoscience Australia: Geodata Topo 250k..
Created by: slei



Paper Size ISO A3

0 90 180 270 360

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

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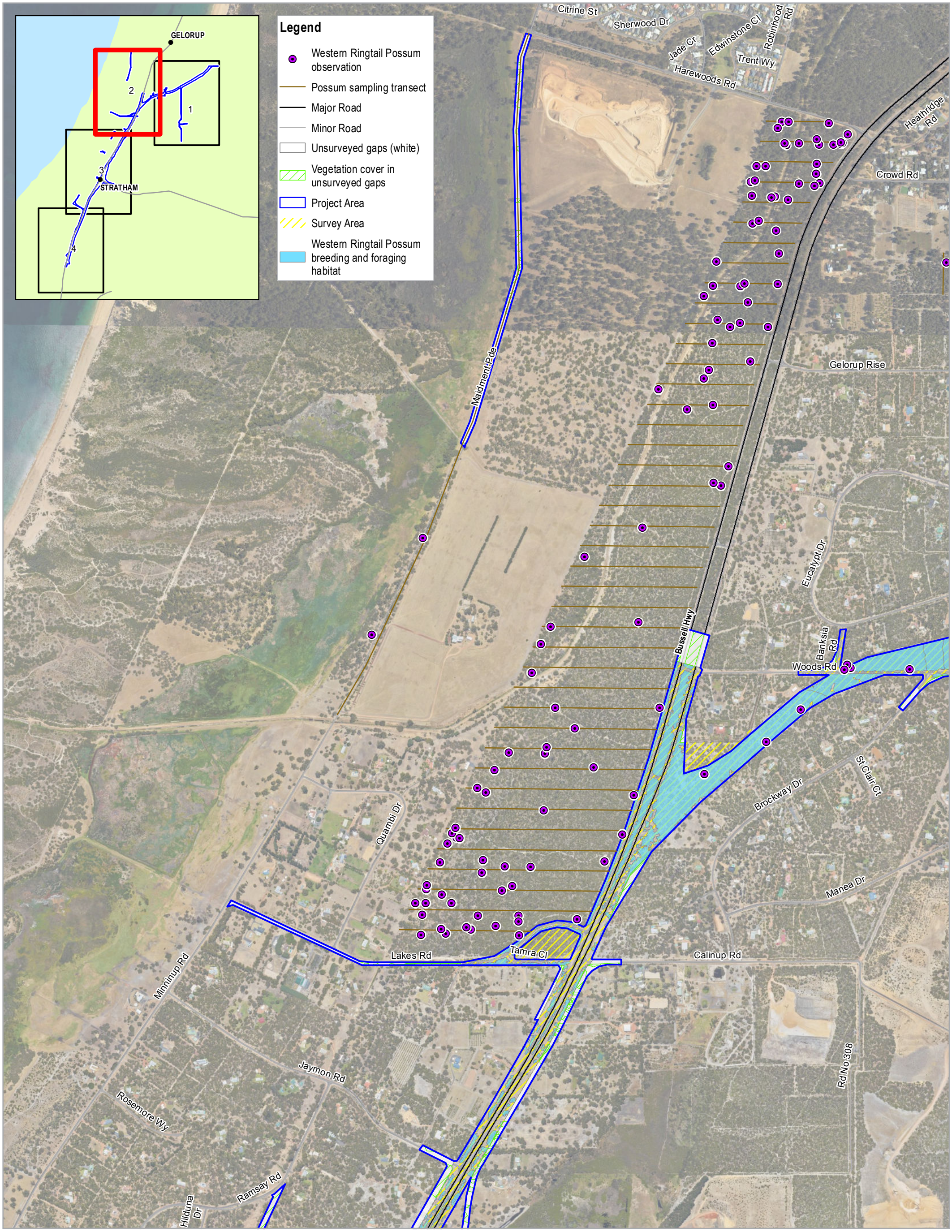
Western Ringtail Possums

Project No. **61-37041**
Revision No. **1**
Date **24/06/2019**

FIGURE 9

G:\61\37041\19_0_GIS\Maps\Working\EIASouth\61370 41_008_WRPsMapbook_Rev1.mxd
Print date: 24 Jun 2019 - 16:14

Data source: BORR: South Boundary - 20181212; MRWA: Road Network - 20180519; Landgate: Imagery accessed on 20190416; Biota: Fauna habitat, Possum observations - 20190220; Geoscience Australia: Geodata Topo 250k - 2006. Landgate / SLIP. Created by: mmikkonen



Paper Size ISO A3

0 90 180 270 360

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

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Western Ringtail Possums

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Revision No. **1**
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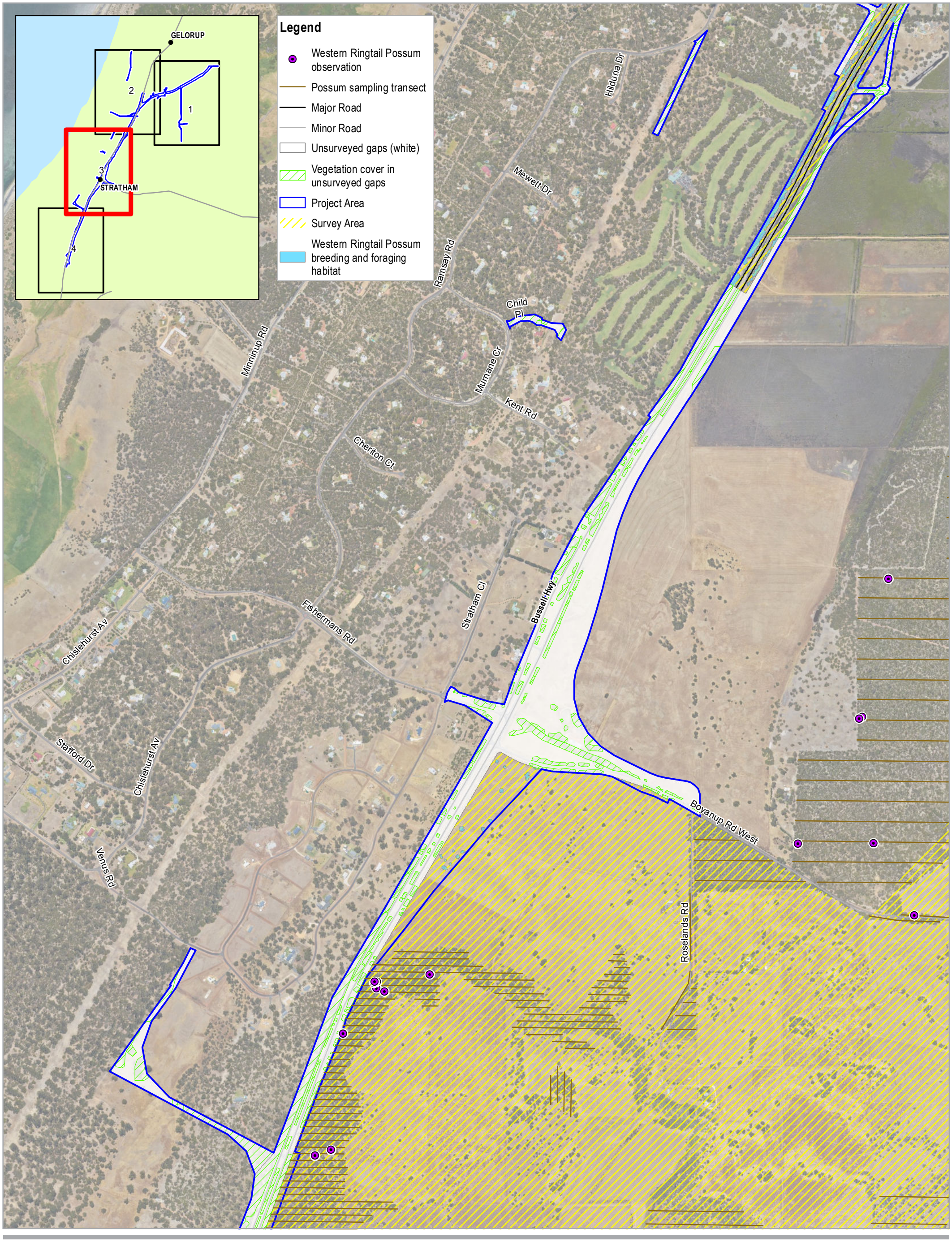
FIGURE 9

G:\61\37041\19_0_GIS\Maps\Working\EIASouth\6137041_008_WRPsMapbook_Rev1.mxd
Print date: 24 Jun 2019 - 16:14

Data source: BORR: South Boundary - 20181212; MRWA: Road Network - 20180519; Landgate: Imagery accessed on 20190416; Biota: Fauna habitat, Possum observations - 20190220; Geoscience Australia: Geodata Topo 250k - 2006. Landgate / SLIP: Created by: mmikkonen



Paper Size ISO A3

0 90 180 270 360

Metres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

BORR Team

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BUILDING OUR FUTURE

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BUNBURY OUTER RING ROAD | PLANNING AND DEVELOPMENT

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Southern Section GBRS Alignment
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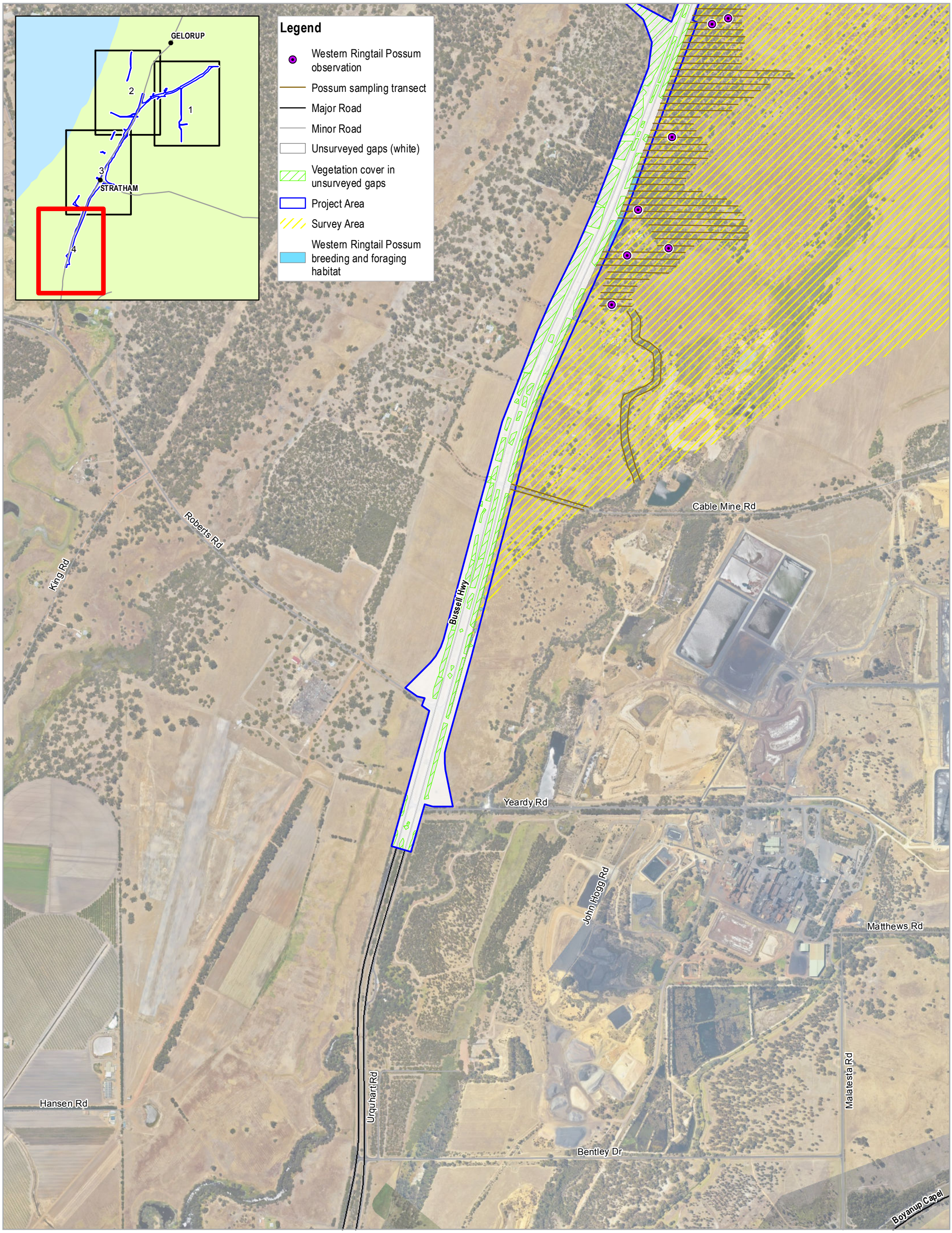
Western Ringtail Possums

FIGURE 9

G:\61\37041\19_0_GIS\Maps\Working\EIASouth\6137041_008_WRPsMapbook_Rev1.mxd
Print date: 24 Jun 2019 - 16:14

Data source: BORR: South Boundary - 20181212; MRWA: Road Network - 20180519; Landgate: Imagery accessed on 20190416; Biota: Fauna habitat, Possum observations - 20190220; Geoscience Australia: Geodata Topo 250k - 2006. Landgate / SLIP. Created by: mmikkonen



Paper Size ISO A3

0 90 180 270 360

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

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Western Ringtail Possums

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FIGURE 9

G:\61\37041\19_0_GIS\Maps\Working\EIASouth\6137041_008_WRPsMapbook_Rev1.mxd
Print date: 24 Jun 2019 - 16:14

Data source: BORR: South Boundary - 20181212; MRWA: Road Network - 20180519; Landgate: Imagery accessed on 20190416; Biota: Fauna habitat, Possum observations - 20190220; Geoscience Australia: Geodata Topo 250k - 2006. Landgate / SLIP. Created by: mmikkonen

Legend
Major Road
Minor Road
Project Area
Map sheet

DALYELLUP
Map 2
GELORUP
NORTH BOYANUP
Map 1
Bussell Hwy
Map 3
STRATHAM
BOYANUP
STIRLING ESTATE
Map 4
ELGIN
Railway Rd
CAPEL
THE PLAINS

Paper Size ISO A3
0 0.5 1 1.5
Kilometres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

N

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Inland Waters

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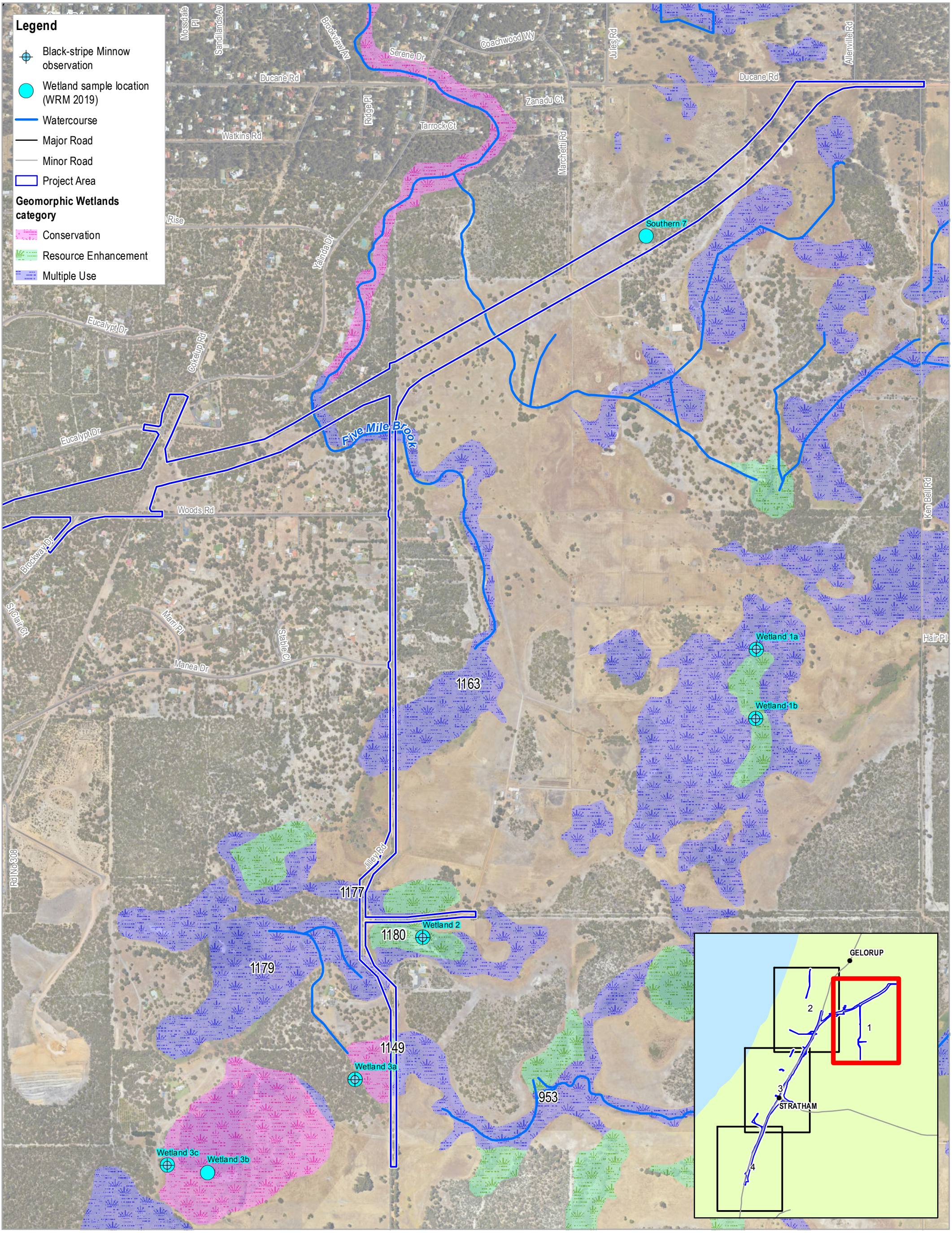
OVERVIEW

FIGURE 10

Data source: BORR: South EIA Boundary - 20181212; MRWA: Road Network - 20180519; Landgate: Imagery accessed on 20190522, Locality names - 2018; Geoscience Australia: Geodata Topo 250k..
Created by: slei



Paper Size ISO A3

0 90 180 270 360

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

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FIGURE 10

G:\61\37041\19_0_GIS\Maps\Working\EIASouth\6137041_010_InlandWaters_Rev1.mxd
Print date: 24 Jun 2019 - 16:28

Data source: BORR: South Boundary - 20181212; MRWA: Road Network - 20180519; Landgate: Imagery accessed on 20190620; DBCA: Geomorphic wetlands - 20190604; LGATE: Rivers - 2018; Geoscience Australia: Geodata Topo 250k - 2006; WRM: Minnow observations - 2019. Landgate / SLIP. Created by: mmikkonen

Legend

- Watercourse
- Major Road
- Minor Road
- Project Area

Geomorphic Wetlands category

- Conservation
- Resource Enhancement
- Multiple Use

Citrine St
Gamet Wy
Sherwood Dr
Jade Cr
Hornibrook Rd
Edwinstone Cl
Robinhood Rd
Trent Wy
Harewoods Rd
Heathridge Rd
Crowd Rd
Maidment Pde
Gelorup Rise
Bussell Hwy
Eucalypt Dr
Banksia Rd
Woods Rd
St Clair Ct
Brockway Dr
Quambi Dr
Manea Dr
Lakes Rd
Tamra Cl
Minninup Rd
Jaymon Rd
Rosemore Wy
Ramsay Rd
Hildina Dr
14478

GELORUP
STRATHAM
1
2
3
4

Paper Size ISO A3

0 90 180 270 360

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

N

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Inland Waters

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Revision No. **1**
Date **24/06/2019**

FIGURE 10

G:\61\37041\19_0_GIS\Maps\Working\EIASouth\6137041_010_InlandWaters_Rev1.mxd
Print date: 24 Jun 2019 - 16:28

Data source: BORR: South Boundary - 20181212; MRWA: Road Network - 20180519; Landgate: Imagery accessed on 20190620; DBCA: Geomorphic wetlands - 20190604; LGATE: Rivers - 2018; Geoscience Australia: Geodata Topo 250k - 2006; WRM: Minnow observations - 2019. Landgate / SLIP. Created by: mmikkonen

Legend

- Watercourse
- Major Road
- Minor Road
- Project Area

Geomorphic Wetlands category

- Conservation
- Resource Enhancement
- Multiple Use

Hilcuma Dr
Mewett Dr
Rich Rd
Ramsay Rd
Child Pl
Minninup Rd
Mumane Cr
Kent Rd
Cherlton Ct
Stratham Cl
Fishermans Rd
Chisiehurst Av
Stafford Dr
Venus Rd
Bussell Hwy
Boyanup Rd West
Roselands Rd

14478
1015
1016
1019
13229

GELORUP
STRATHAM
1
2
3
4

Paper Size ISO A3

0 90 180 270 360

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

N

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Inland Waters

FIGURE 10

G:\61\37041\19_0_GIS\Maps\Working\EIASouth\6137041_010_InlandWaters_Rev1.mxd
Print date: 24 Jun 2019 - 16:28

Data source: BORR: South Boundary - 20181212; MRWA: Road Network - 20180519; Landgate: Imagery accessed on 20190620; DBCA: Geomorphic wetlands - 20190604; LGATE: Rivers - 2018; Geoscience Australia: Geodata Topo 250k - 2006; WRM: Minnow observations - 2019. Landgate / SLIP. Created by: mmikkonen

Legend

Watercourse

Major Road

Minor Road

Project Area

Geomorphic Wetlands category

Multiple Use

Mangles Rd

Roberts Rd

King Rd

Bussell Hwy

Cable Mine Rd

Yeardy Rd

John Higgs Rd

Matthews Rd

Urquhart Rd

Hansen Rd

Bentley Dr

GELORUP

STRATHAM

1

2

3

4

Paper Size ISO A3

0 90 180 270 360

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

N

BORR Team

Australian Government

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Inland Waters

FIGURE 10

G:\61\37041\19_0_GIS\Maps\Working\EIASouth\6137041_010_InlandWaters_Rev1.mxd
Print date: 24 Jun 2019 - 16:28

Data source: BORR: South Boundary - 20181212; MRWA: Road Network - 20180519; Landgate: Imagery accessed on 20190620; DBCA: Geomorphic wetlands - 20190604; LGATE: Rivers - 2018; Geoscience Australia: Geodata Topo 250k - 2006; WRM: Minnow observations - 2019. Landgate / SLIP. Created by: mmikkonen

Legend

- Major Road
- Minor Road
- Project Area

Acid Sulfate Soil Risk

- Moderate to low risk
- High to moderate risk

DALYELLUP
NORTH BOYANUP
GELORUP
Bussell Hwy
STIRLING ESTATE
STRATHAM
BOYANUP
ELGIN
Boyanup Capel
CAPEL
THE PLAINS

SLIP POWERED BY LANDGATE

Paper Size ISO A3

0 0.25 0.5 0.75 1

Kilometres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

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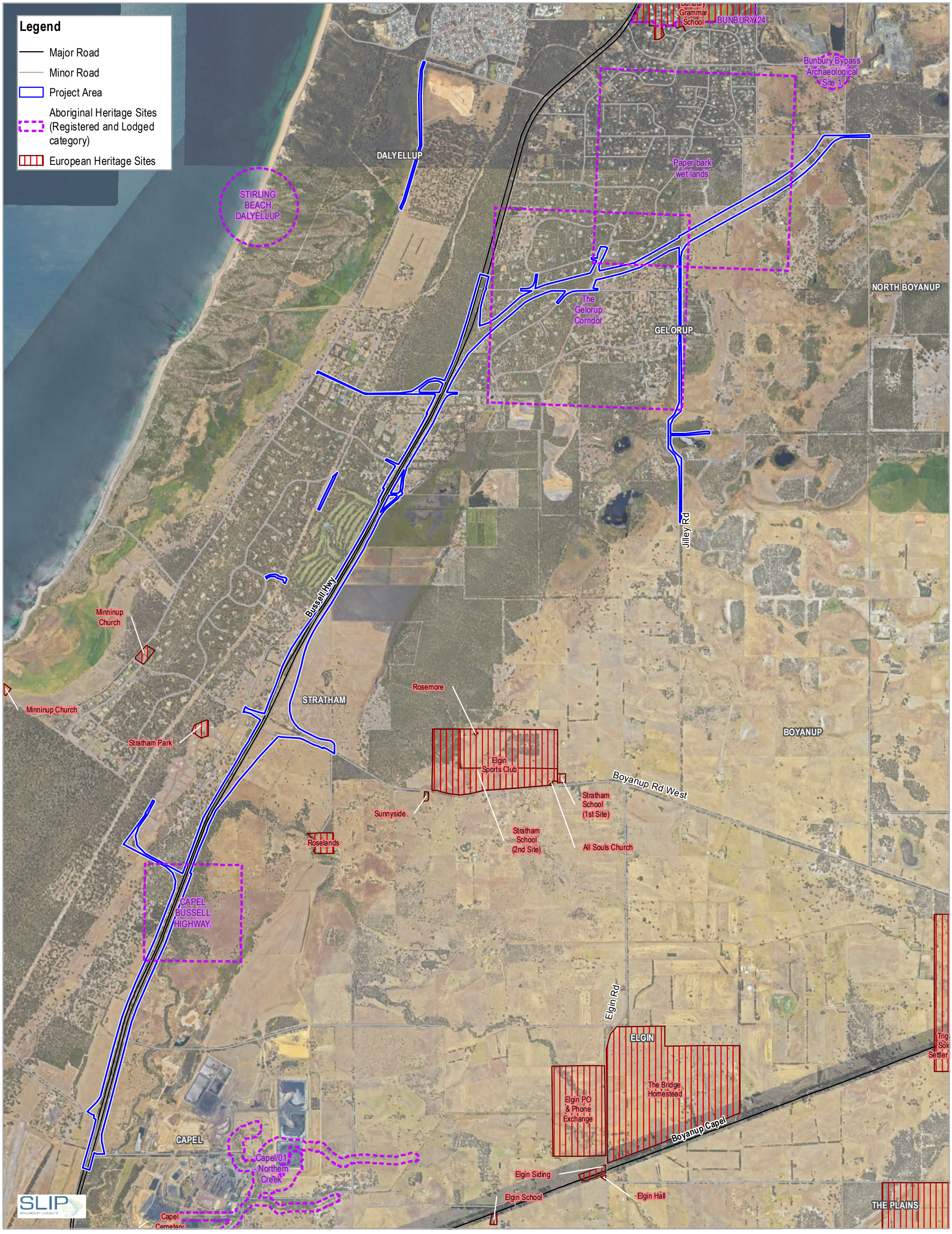
Acid Sulfate Soils

Project No. **61-37041**
Revision No. **1**
Date **24/06/2019**

FIGURE 11

\\ghdnet.internal\ghd\AU\Perth\Projects\61\37041\19_0_GIS\Maps\Working\EIASouth\6137041_009_AcidSulfateSoils_Rev1.mxd
Print date: 24 Jun 2019 - 15:21

Data source: BORR: South Boundary - 20181212; Landgate: Imagery accessed on 20190416; MRWA: Road Network - 20180519; DWER: Acid sulphate soils - 201409, Contaminated Land - 20180615; Geoscience Australia: Geodata Topo 250k - 2006. . Created by: slei



Paper Size ISO A3

0 0.5 1 1.5 Kilometres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 Perth Coastal Grid 1994

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Heritage Constraints

Project No. **61-37041**
Revision No. **1**
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FIGURE 12

G:\61\37041\19_0_GIS\Maps\Working\EIASouth\6137041_011_Heritage_Rev1.mxd
Print date: 27 Jun 2019 - 09:39

Data source: BORR Team: South Boundary - 201812; State Heritage Office: European heritage sites - 20190115; DAA: Aboriginal Heritage Sites - 20190627; Landgate: Aerial photography - Virtual Mosaic accessed 20190627, Roads - 2018. . Created by: mmikkonen

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