BORR Team

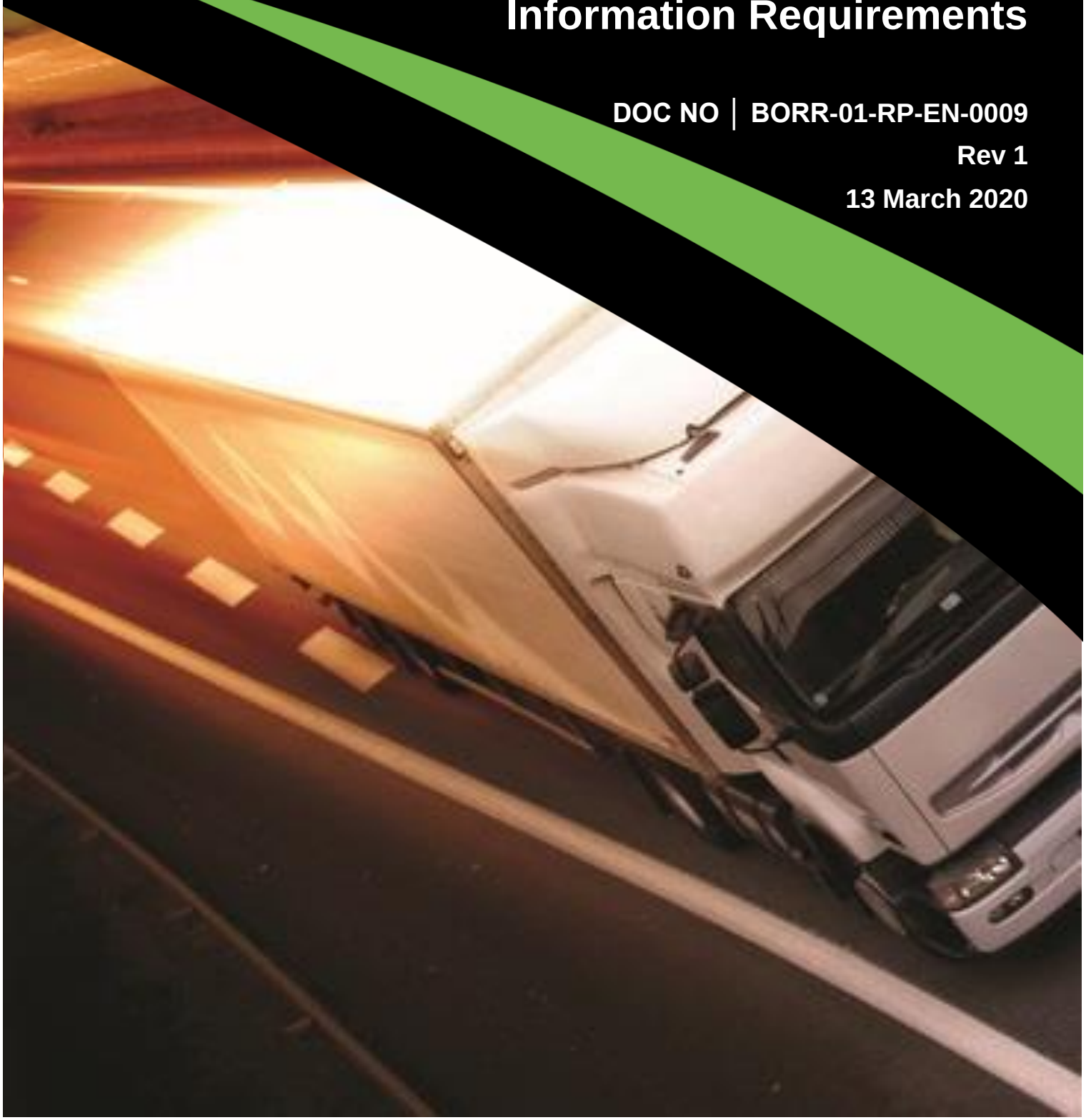
Bunbury Outer Ring Road
Northern and Central Sections

Response to EPA Notice of Decision to Assess: Additional Information Requirements

DOC NO | BORR-01-RP-EN-0009

Rev 1

13 March 2020



EXECUTIVE SUMMARY

The Commissioner of Main Roads Western Australia (Main Roads) is proposing to construct and operate the Northern and Central sections of the Bunbury Outer Ring Road (BORR) project. BORR is a planned Controlled Access Highway linking the Forrest Highway and Bussell Highway. The completed project will provide a high standard route for access to the Bunbury Port, improve road user safety and facilitate proposed development to the east of the City of Bunbury. BORR provides an effective bypass of Bunbury for inter-regional traffic. 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 four km section which was completed in May 2013, along with a three km extension of Willinge Drive southwards to South Western Highway)
- 'BORR Southern Section' – South Western Highway (near Bunbury Airport) to Bussell Highway.

The proposed BORR occurs within the City of Bunbury and Shires of Capel, Dardanup and Harvey. This document refers to BORR Northern and Central Sections only (the Proposal).

The Proposal includes the construction and operation of 19 km of new freeway standard dual carriageway and associated bridges, interchanges and other road infrastructure including, but not limited to, culverts, lighting, noise barriers, fencing, landscaping, road safety barriers and signs. The Proposal is located approximately 200 km south of Perth and, at its closest point, approximately six km south-east of Bunbury. The 625 ha Proposal Area occurs within the City of Bunbury and the Shires of Dardanup and Harvey. Approximately 87 % of land within the Proposal Area is cleared for agriculture. Pockets of native vegetation occur within the Proposal Area in road reserves, along sections of the Collie, Ferguson and Preston Rivers, or as isolated patches on properties. The Proposal Area excludes areas within BORR Central Section which was constructed in 2013.

In June 2019, Main Roads referred the Proposal to the Environmental Protection Authority (EPA) for assessment under Section 38 of the *Environmental Protection Act 1986* (EP Act). The referral included an Environmental Referral Supporting Document (BORR IPT, 2019) which describes the receiving environments, potential impacts and mitigation strategies to address the identified impacts. The Proposal was advertised for a seven day public comment period on 14 June 2019. The EPA determined that the Proposal would be assessed on Referral Information with additional information required under Section 40(2)(a) of the EP Act on 3 July 2019. On 13 February 2020, the EPA consented under Section 43A of the EP Act to a change in the Proposal that will result in an overall reduction of 26 ha from the Proposal Area from 651 ha to 625 ha. The change to the Proposal also resulted in an overall reduction of remnant native vegetation being cleared from 91 ha to 73 ha.

The Proposal was formally referred to the Commonwealth Department of the Environment and Energy (DoEE) on 25 June 2019 as a potential Controlled Action under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) due to impacts on Matters of Nation Environmental Significance (MNES). The DoEE provided advice in October 2019 that the Proposal is considered a Controlled Action and that it would be assessed by preliminary documentation. Details of the further information required to assess the Proposal have been provided and a separate document will be prepared and submitted to the DoEE to support the assessment.

Purpose of this document

This document provides additional information requested by the EPA section 40(2)(a) of the Environmental Protection Act 1986 and along with information provided in the s38 referral will be used by the EPA in their

assessment of the project. This document covers additional information requested by EPA and does not include information the information unchanged since referral of the Proposal.

Information related to the assessment of the Proposal that Main Roads provided to the EPA at the time of Referral can be reviewed at http://www.epa.wa.gov.au/proposals/bunbury-outer-ring-road-northern-and-central-sections under the Stage 1. Referral Section of the page.

Flora and Vegetation

Additional studies have been completed to confirm the occurrence of and impact to '*Herb rich shrublands in clay pans*' TEC, '*Banksia dominated woodlands of the Swan Coastal Plain'* PEC and the *'Banksia Woodlands of the Swan Coastal Plain*' TEC and '*Corymbia calophylla - Xanthorrhoea preissii woodlands and shrublands of the Swan Coastal Plain*' TEC. These surveys were conducted in spring 2019 and were used to confirm the occurrence of and inform design changes to the Proposal to reduce impacts on and TECs and the PEC. Discussion is provided on the potential direct and indirect impacts of the Proposal on the TECs and the PEC.

Terrestrial Fauna

Additional surveys have been undertaken to confirm the occurrence of Black-stripe Minnow and the distribution of suitable habitat within and adjacent to the Proposal Area for Black-stripe Minnow. The document also provides updated information on the potential impacts from the Proposal on Carter's Freshwater Mussel. Further discussion and description of potential impacts of the Proposal on threatened fauna species, including Western Ringtail Possum, Brush-tailed Phascogale and Black Cockatoos is provided.

Social Surroundings

Additional modelling to clarify the potential noise impacts (day-time noise and night-time noise) has been undertaken and details are provided.

Environmental Management Plan

This document addresses additional information for assessment requested by the EPA for an Environmental Management Plan (EMP) to manage, monitor and mitigate direct and indirect impacts to conservation significant fauna species; Western Ringtail Possum, Carter's Freshwater Mussel, Black-stripe Minnow and Brush-tailed Phascogale.

Design changes have specifically targeted reduction in the impact on TEC and PEC vegetation where the total expected impact on these is now estimated to be 5.7 ha as compared to the previously referred total of 8.2 ha. All the occurrences of Banksia Woodland TEC and PEC remaining after Proposal implementation will still meet the criteria for the TEC and PEC. Impacts from fragmentation have been reduced to a single 0.34 ha patch of *Corymbia calophylla - Xanthorrhoea preissii* woodlands and shrublands of the Swan Coastal Plain TEC. This occurrence is unlikely to be left viable as a result of Proposal implementation as it is already small, isolated and has a high edge-to-area ratio. As such its long term viability is already at risk, and this viability is unlikely to change as a result of the Proposal.

As discussed with DWER, Main Roads does not consider that a standalone EMP for TECs and PECs is warranted, and consequently has not been included in this document. Main Roads has included management, monitoring and mitigation measures for TECs and the PEC in this additional information document (see Section 4.1.6 and 4.1.7).

An Offset Strategy

An Offset Strategy detailing the residual impacts of the Proposal, the significance of the residual impacts and proposed offsets to counterbalance the residual impacts is provided.

Provision of survey data

Data from additional surveys undertaken to support the preparation of this document and assessment of the Proposal will be submitted as an Index of Biodiversity Surveys for Assessment (IBSA) data package in accordance with EPA instructions (EPA, 2018a).

Conclusions

Main Roads has refined the design of the Proposal significantly since the referral in June 2019. The primary aim of these refinements was to reduce the potential impacts of the Proposal on the environment. These changes and additional mitigation measures that have been developed for the Proposal are detailed in this document. Main Roads anticipates that the social and environmental impacts of the Proposal can be appropriately managed through the measures detailed within this document and considers the EPA's objectives for each key factor will be met.

ACRONYMS

AHD	Australian Height Datum
AEP	Annual Exceedance Probability
AH Act	*Aboriginal Heritage Act 1972*
ANZECC	Australian and New Zealand Environment and Conservation Council
ARI	Assessment on Referral Information
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ARR	Australian Rainfall and Runoff
AASS	Actual Acid Sulfate Soils
ASS	Acid Sulfate Soils
AQMS	Air Quality Monitoring Station
BC Act	*Biodiversity Conservation Act 2016*
BORR	Bunbury Outer Ring Road
BoM	Bureau of Meteorology
CCW	Conservation Category Wetlands
CEMP	Construction Environmental Management Plan
CO	Carbon monoxide
CRG	Community Reference Group
DAWE	Department of Agriculture, Water and Environment
DBCA	Department of Biodiversity, Conservation and Attractions
DBH	Diameter Breast Height
DMA	Decision making authority
DoEE	Department of Environment and Energy
DoW	Department of Water
DPaW	Department of Parks and Wildlife
DPLH	Department of Planning, Lands and Heritage
DPIRD	Department of Primary Industries and Regional Development
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
DWER	Department of Water and Environmental Regulation
EMP	Environmental Management Plan
EP Act	*Environmental Protection Act 1986*
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
GBRS	Greater Bunbury Region Scheme

GDE	Groundwater Dependent Ecosystem
GHG	Greenhouse Gas
GKB	Gnaala Karla Booja People
GKB NTC	Gnaala Karla Booja Native Title Claim group
GoWA	Government of Western Australia
HGV	Heavy Goods Vehicle
IBRA	Interim Biogeographic Regionalisation of Australia
IFD	Intensity Frequency Duration
ILUA	Indigenous Land Use Agreement
ILM	Investment Logic Mapping
IPT	Integrated Project Team
KSIA	Kemerton Strategic Industrial Area
MCA	Multi-Criteria Assessment
MNES	Matters of National Environmental Significance
MSE	Mechanically Stabilised Earth
NO_2	Nitrogen dioxide
NO_X	Nitrogen oxides
PASS	Potential Acid Sulfate Soils
PEC	Priority Ecological Community
PSP	Principal Shared Path
$PM_{2.5}$	Particulate matter less than or equal to 2.5 microns in diameter
PM_{10}	Particulate matter less than or equal to 10 microns in diameter
RDASW	Regional Development Australia South West
RIWI Act	*Rights in Water and Irrigation Act 1914*
SCP	Swan Coastal Plain
SPP 5.4	*State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning*
SWDC	South West Development Commission
TEC	Threatened Ecological Community
TSSC	Threatened Species Scientific Committee
VOC	Volatile organic compound
WA	Western Australia
WAHERB	Western Australian Herbarium
WAPC	Western Australian Planning Commission
WoNS	Weeds of National Significance

DEFINED TERMS

TERM	DEFINITIONS
BORR Sections	BORR includes three sections (North, Central and South), which are referred to as: The 'BORR Northern Section' – section between Forrest Highway (north) and Boyanup-Picton Road (south). The 'BORR Central Section' – section that has already been constructed, between Boyanup-Picton Road (north) and South Western Highway (south). The 'BORR Southern Section' – section between South Western Highway (north) and Bussell Highway (south).
Conservation Wetland	Wetlands which support a high level of attributes and functions.
Main Roads	Main Roads Western Australia
Multiple Use Wetland	Wetland with few important ecological attributes and functions remaining.
Proposal	Main Roads proposes to construct the Bunbury Outer Ring Road (BORR) Northern and Central Sections from Forrest Highway (north) to South West Highway (south), at its closest point approximately six kilometres (km) from East Bunbury, in the South West Region of Western Australia (WA) (referred to as the Proposal).
Proposal Area	The Proposal Area is located within the City of Bunbury and the Shires of Dardanup and Harvey, at its closest point approximately six km from East Bunbury and 200 km south of Perth. The Proposal Area extends 19 km between Forrest Highway and South Western Highway. The Proposal Area covers 625 hectares (ha) and includes existing road reserves, agricultural land and native vegetation.
Resource Enhancement Wetland	Wetlands which may have been partially modified but still support substantial ecological attributes and functions.
Site	As per the Proposal Area.
Survey area	The Survey area includes all sites of significance that occur both within the Proposal Area and wherever relevant, outside the Proposal Area, in order to determine both direct and indirect impacts.
Swan Coastal Plain	Low-lying coastal plain in the south west of Australia mainly covered with woodlands, with rare landscape features such as Holocene dunes and wetlands.

CONTENTS

1	**INTRODUCTION**		**1**
	1.1	Purpose of this document	2
	1.2	Proposal description	3
	1.3	The Proponent	4
	1.4	Environmental Impact Assessment Process	4
	1.5	Other Approvals and Regulation	5
2	**THE PROPOSAL**		**6**
	2.1	Proposal justification	6
	2.2	Key Proposal characteristics	6
	2.3	Design and refinement	8
3	**STAKEHOLDER CONSULTATION**		**11**
4	**ENVIRONMENTAL PRINCIPLES, THEMES AND FACTORS**		**23**
	4.1	Key Environmental Factor – Flora and Vegetation	23
	4.2	Key Environmental Factor – Terrestrial Fauna	44
	4.3	Key Environmental Factor – Social Surrounds	76
5	**OFFSETS**		**79**
	5.1	Background	79
	5.2	EPBC Act Environmental Offsets Policy (DSEWPaC, 2012)	79
	5.3	WA Environmental Offset Policy (GoWA, 2011)	79
	5.4	Significant residual impact	80
	5.5	Offset strategy	80
6	**CONCLUSION**		**81**
	6.1	Flora and vegetation	81
	6.2	Terrestrial fauna	81
	6.3	Social surrounds	82
	6.4	Impact Summary	82
7	**REFERENCES**		**83**

TABLE INDEX

Table 1-1 Summary of other regulatory approvals required 5
Table 2-1 Key Proposal characteristics 7
Table 2-2 Summary of Proposal design changes and benefits 9
Table 3-1 BORR Stakeholder consultation (since June 2019) summary 12

Table 3-2 Summary of key concerns raised during consultation 21
Table 4-1 Studies and surveys relevant to the Proposal 24
Table 4-2 Banksia Woodlands direct impacts relevant to the Proposal 27
Table 4-3 Banksia Woodlands TEC / PEC direct impact sites 27
Table 4-4 Banksia Woodlands TEC / PEC potential indirect impact sites 28
Table 4-5 Extent of Banksia Woodlands TEC and PEC within Proposal Area / local extent 29
Table 4-6 Extent of the Banksia Woodlands ecological community estimated to be protected in reserves (TSSC, 2016) 29
Table 4-7 Banksia Woodland TEC/PEC occurrences status before and after Proposal implementation ... 30
Table 4-8 Detailed design changes to avoid impacts to Banksia Woodlands TEC / PEC vegetation 30
Table 4-9 Claypan TEC direct impacts relevant to the Proposal 33
Table 4-10 ClaypanTEC direct impact sites 33
Table 4-11 Claypan TEC potential indirect impact sites 34
Table 4-12 Extent of Claypan TEC within Proposal Area / local extent 35
Table 4-13 Detailed design changes to avoid impacts to Claypan TEC vegetation 36
Table 4-14 Corymbia Woodland TEC values and impacts relevant to the Proposal 39
Table 4-15 Corymbia Woodland TEC direct impact sites 39
Table 4-16 Corymbia Woodland TEC potential indirect impact sites 40
Table 4-17 Extent of Corymbia Woodland TEC within Proposal Area / total extent 41
Table 4-18 Detailed design changes to avoid impacts to TEC / PEC vegetation 41
Table 4-19 Fauna investigations undertaken for the purpose of this Proposal 44
Table 4-20 WRP observations within Proposal Area 48
Table 4-21 Summary of potential direct impacts to WRP 50
Table 4-22 Proposal Area WRP habitat extent by quality class 51
Table 4-23 Detailed design changes to avoid impacts to WRP 55
Table 4-24 Detailed design changes to avoid impacts to BTP 62
Table 4-25 Black Cockatoo habitat avoided through design 72
Table 4-26 Black Cockatoo Management Actions 72
Table 4-27 Predicted residual impacts to fauna 74

FIGURES INDEX

Figure 1 Proposal Area
Figure 2 Proposed Design
Figure 3 Flora and vegetation studies undertaken for the Proposal
Figure 4 TEC and PEC extent within the Proposal Area
Figure 5 TEC and PEC extent adjacent to the Proposal Area
Figure 6 Extent of WRP habitat types and WRP observations within the Proposal Area
Figure 7 WRP key habitat areas
Figure 8 WRP connectivity map showing fauna bridges and underpasses
Figure 9 Carter's Freshwater Mussel observations and habitat extent within the Proposal Area
Figure 10 Black-stripe Minnow observations and habitat extent within the Proposal Area
Figure 11 Phascogale habitat extent within the Proposal Area
Figure 12 Black Cockatoo foraging habitat and trees with hollowswithin the Proposal Area
Figure 13 Sensitive receptors noise identified through noise modelling
Figure 14 Day time forecast traffic noise $L_{Aeq,\ day}$ Existing 2018 noise levels at the most affected façade
Figure 15 Night time forecast traffic noise $L_{Aeq,\ night}$ Existing 2018 noise levels at the most affected façade
Figure 16 Forecast traffic noise $LA_{eq,\ day}$ Build 2041 noise levels at the most affected façade - No treatment
Figure 17 Forecast traffic noise $LA_{eq,\ night}$ Build 2041 noise levels at the most affected façade - No treatment

Figure 18 Forecast $LA_{eq,day}$ Build 2041 noise levels at the most affected façade - With treatment

APPENDICES

Appendix A – Figures

Appendix B – Bunbury Outer Ring Road Northern and Central Sections Environmental Management Plan – Conservation Significant Fauna (BORR IPT, 2020a)

Appendix C – Bunbury Outer Ring Road Northern and Central Sections Vegetation and Flora Study (BORR IPT, 2020c)

Appendix D – A Review of the Regional Conservation Status of Clay-pan based Wetland Community (Claypans) (Ecoedge, 2019b)

Appendix E – TEC/PEC Vegetation Monitoring Program

Appendix F – Drainage Monitoring Program for TEC/PEC Vegetation

Appendix G – Triggers, Thresholds and Contingency Actions for Management of TEC/PEC Vegetation

Appendix H – Bunbury Outer Ring Road Northern and Central Section Targeted Fauna Assessment (Biota, 2020)

Appendix I – Bunbury Outer Ring Road Northern and Central Investigation Area: Targeted Conservation Significant Aquatic Fauna Survey (WRM, 2020)

Appendix J – Bunbury Outer Ring Road Northern and Central Sections Traffic Noise Assessment (BORR IPT, 2020b)

Appendix K – BORR Northern and Central Sections Offset Strategy (Main Roads, 2020)

Document *Control*

Revision	Date	Description	Prepared	Reviewed	Approved
A	20/12/19	Draft for Main Roads Review	BORR Team	FH	FH
0	31/01/20	Final issued to Main Roads for submission to EPA	BORR Team	FH	FH
1	10/03/2020	Final issued to Main Roads for Public Review	BORR Team	FH	FH

Invitation to make a submission

The Environmental Protection Authority (EPA) invites people to make a submission on the additional information for this proposal.

The Commissioner of Main Roads Western Australia (Main Roads) proposes to construct and operate the Northern and Central sections of the Bunbury Outer Ring Road (BORR) project. The additional information has been prepared in accordance with the EPA's ***Procedures Manual (Part IV Divisions 1 and 2)***. The additional information from the proponent is supplemental to the referral documentation which describes this proposal and its likely effects on the environment.

The additional information is available for a public review period of **4** weeks from **13 March 2020**, closing on **9 April 2020**.

Information on the proposal from the public may assist the EPA to prepare an assessment report in which it will make recommendations on the proposal to the Minister for Environment.

Why write a submission?

The EPA seeks information that will inform the EPA's consideration of the likely effect of the proposal, if implemented, on the environment. This may include relevant new information that is not in the additional information or referral, such as alternative courses of action or approaches.

In preparing its assessment report for the Minister for Environment, the EPA will consider the information in submissions, the proponent's responses and other relevant information.

Submissions will be treated as public documents unless provided and received in confidence, subject to the requirements of the *Freedom of Information Act 1992*.

Why not join a group?

It may be worthwhile joining a group or other groups interested in making a submission on similar issues. Joint submissions may help to reduce the workload for an individual or group. If you form a small group (up to 10 people) please indicate all the names of the participants. If your group is larger, please indicate how many people your submission represents.

Developing a submission

You may agree or disagree with, or comment on information in the additional information.

When making comments on specific elements in the additional information:

- Clearly state your point of view and give reasons for your conclusions.
- Reference the source of your information, where applicable.
- Suggest alternatives to improve the outcomes on the environment.

What to include in your submission

Include the following in your submission to make it easier for the EPA to consider your submission:

- Your contact details – name and address.
- Date of your submission
- Whether you want your contact details to be confidential.
- Summary of your submission, if your submission is long.
- List points so that issues raised are clear, preferably by environmental factor.
- Refer each point to the page, section and if possible, paragraph of the additional information.

- Attach any reference material, if applicable. Make sure your information is accurate.

The closing date for public submissions is: **9 April 2020**

The EPA prefers submissions to be made electronically via the EPA's Consultation Hub at https://consultation.epa.wa.gov.au.

Alternatively submissions can be:

- posted to: Chairman, Environmental Protection Authority, Locked Bag 10, Joondalup DC WA 6919, or
- delivered to: the Environmental Protection Authority, Prime House, 8 Davidson Terrace, Joondalup WA 6027.

If you have any questions on how to make a submission, please contact the EPA Services at the Department of Water and Environmental Regulation on 6364 7000.

1 INTRODUCTION

The Commissioner of Main Roads Western Australia (Main Roads) is proposing to construct and operate the Northern and Central sections of the Bunbury Outer Ring Road (BORR) project (Figure 1, Appendix A). BORR is a planned Controlled Access Highway linking the Forrest Highway and Bussell Highway. The completed project will provide a high standard route for access to the Bunbury Port, improve road user safety 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 was identified in the draft 2003 Greater Bunbury Region Scheme (GBRS), with the route advertised to the broader community as part of the GBRS assessment.

In late 2016, Main Roads commenced a planning review for a future South West Freeway (Forrest Highway, BORR and Bussell Highway between Mandurah to Busselton) spanning the Forrest and Bussell Highways. This network forms the primary connection of Perth with Bunbury, Busselton and the broader South West Region including the Ports of Fremantle, Bunbury and the proposed Outer Harbour at Kwinana. This planning review resulted in a revised alignment for the northern section of BORR that joins Forrest Highway near Australind, which is now located further east than previously proposed. The revised alignment is therefore not identified in the 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
- 'BORR Southern Section' – South Western Highway (near Bunbury Airport) to Bussell Highway.

The majority of the BORR Central Section (four kilometres) was completed in May 2013, along with a 3 km extension of Willinge Drive southwards to South Western Highway.

This document refers to BORR Northern and Central (unbuilt) Sections only. A description of the Proposal is provided in Section 1.2.

Although the majority of the Central Section has been built, improved connection to the Central Section is still required.

In June 2019, Main Roads referred the Proposal to the Environmental Protection Authority (EPA) for assessment under Section 38 of the *Environmental Protection Act 1986* (EP Act). The referral included an Environmental Referral Supporting Document (BORR IPT, 2019) which describes in detail the receiving environments, potential impacts and mitigation strategies to address the identified impacts. The Proposal was advertised for a seven day public comment period on 14 June 2019. The EPA determined that the Proposal would be assessed on Referral Information with additional information required under Section 40(2)(a) of the EP Act on 3 July 2019.

The request for additional information specified the inclusion of an:

- Updated assessment of impacts to Threatened and Priority Ecological Communities (TECs and PECs) and threatened fauna informed by the results of additional targeted surveys
- Environmental Management Plan for 'viable fragmented or otherwise indirectly impacted Threatened and Priority Ecological Communities'
- Environmental Management Plan (EMP) for conservation significant fauna, specifically:

  - Western Ringtail Possum (listed as critically endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and Schedule 1 under the Western Australian *Biodiversity Conservation Act 2016* (BC Act)
  - Brush-tailed Phascogale
  - Carter's Freshwater Mussel
  - Black-stripe Minnow
- Updated clarification for noise impact and mitigation
- Offsets Strategy
- IBSA data package for any additional studies undertaken.

Subsequent to the s38 referral, the BORR North and Central Proposal Area has been modified as a result of refinement of the alignment. This refinement was in part the result of modifications to the road design, and in part the outcome of targeted efforts to avoid, wherever possible, the direct loss of TECs and PECs and fauna habitats. Discussions with EPA regarding the reduced potential and management of impacts on TECs and the PEC led to a review of the requirement for a standalone EMP on TECs and PECs. As discussed with DWER, Main Roads has determined that an EMP for TECs and PECs is no longer required as a result of the reduced impacts, with management, mitigation and monitoring of the following TECs and PEC to be included in this document:

- Banksia Woodlands of the Swan Coastal Plain (SCP) TEC (listed as Endangered under the EPBC Act)
- Claypans of the SCP TEC (comprised of occurrences of Floristic Community Type (FCT) 08, 'Herb rich shrublands on Claypans') (BC and EPBC Act listed)
- '*Corymbia calophylla* over *Xanthorrhoea preissii* woodlands and shrublands of the SCP' (FCT3c) (BC and EPBC Act listed)
- Banksia Woodlands of the SCP IBRA Region PEC.

On 13 February 2020, the EPA consented under Section 43A of the EP Act to a change in the Proposal that will result in an overall reduction of 26 ha from the Proposal Area from 651 ha to 625 ha. The change to the Proposal also resulted in an overall reduction of remnant native vegetation being cleared from 91 ha to 73 ha.

1.1 Purpose of this document

This document provides additional information requested by the EPA section 40(2)(a) of the Environmental Protection Act 1986 and along with information provided in the s38 referral will be used by the EPA in their assessment of the project. This document covers additional information requested by EPA and does not include information the information unchanged since referral of the Proposal.

Information related to the assessment of the Proposal that Main Roads provided to the EPA at the time of Referral can be reviewed at http://www.epa.wa.gov.au/proposals/bunbury-outer-ring-road-northern-and-central-sections under the Stage 1. Referral Section of the page.

This document has been prepared to address the EPA's request for additional information on the following factors.

1.1.1 Flora and Vegetation

Additional studies have been completed to confirm the occurrence of and impact on three TECs and one PEC that will potentially be impacted by the Proposal. These communities are:

- Banksia Woodlands of the SCP TEC – EPBC Act listed ('Banksia Woodlands TEC')
- 'Herb rich shrublands in clay pans (FCT08)' TEC – BC Act listed, and also a component of the EPBC Act listed Clay Pans of the Swan Coastal Plan TEC ('FCT08') ('Claypan TEC')
- '*Corymbia calophylla* - *Xanthorrhoea preissii* woodlands and shrublands of the SCP (FCT03c)' TEC – BC and EPBC Act listed ('FCT3c') ('Corymbia Woodland TEC')
- Banksia dominated woodlands of the SCP IBRA region Priority Ecological Community (PEC) ('Banksia Woodlands PEC').

Discussion is provided on the potential direct and indirect impacts of the Proposal on the TECs and the PEC, including amendments to the Proposal Area to reduce the area of impact on TECs and the PEC.

1.1.2 Terrestrial Fauna

Additional surveys have been undertaken to confirm the occurrence of Black-stripe Minnow (*Galaxiella nigrostriata*) (BSM) and distribution of its suitable habitat within and adjacent to the Proposal Area. This document also provides updated information on the potential impacts from the Proposal on Carter's Freshwater Mussel (*Westralunio carteri*) (CFM). Further discussion and description of potential impacts of the Proposal on threatened fauna species including Western Ringtail Possum (*Pseudocheirus occidentalis*) (WRP), Brush-tailed Phascogale (*Phascogale tapoatafa wambenger*) (BTP) and Black Cockatoos is also provided.

1.1.3 Social Surroundings

Additional modelling to clarify the potential noise impacts (day-time noise and night-time noise) has been undertaken to provide the information requested by the EPA.

1.1.4 Environmental Management Plan

This document contains the Conservation Significant Fauna EMP as Appendix B. This EMP has been prepared to manage, monitor and mitigate direct and indirect impacts to the WRP, CFM, BSM and BTP.

Given the Proposal's reduced impact on the TECs and PEC, an EMP to manage, monitor and mitigate direct and indirect impacts on these communities was deemed unnecessary and will be instead addressed with this document.

1.1.5 An Offset Strategy

An Offsets Strategy detailing the residual impacts of the Proposal, the significance of the residual impacts and proposed offsets to counterbalance these residual impacts is provided as Appendix K.

1.2 Proposal description

The Proposal is located approximately 200 km south of Perth and at its closest point, approximately six kilometres south-east of Bunbury. It occurs within the City of Bunbury and the Shires of Dardanup and Harvey.

The Proposal includes construction and operation of BORR Northern and Central sections. These sections comprise 19 km of new freeway standard dual carriageway and associated bridges, interchanges and other

road infrastructure including, but not limited to, culverts, lighting, noise barriers, fencing, landscaping, road safety barriers and signs.

The development envelope for the Proposal referred by Main Roads is up to 625 hectares (ha) and referred to as the Proposal Area (Figure 1, Appendix A). There have been modifications to the Proposal Area since it was referred to the EPA in June 2019. This has resulted in a reduction in the overall area (from 651 ha to 625 ha) and potential impact of the Proposal on the environment, in particular on habitat for threatened species, TECs and the PEC (further details of the changes are provide in Sections 4.1 and 4.2).

1.3 The Proponent

The Proponent for the Proposal is the Commissioner of Main Roads and formal contact details are:

PROPONENT	Commissioner of Main Roads Western Australia PO Box 6202 East Perth WA 6002 ABN/ACN 50 860 676 021
PROJECT KEY CONTACT	Martine Scheltema Manager Environment Main Roads Western Australia Don Aitken Centre East Perth WA 6004

1.4 Environmental Impact Assessment Process

1.4.1 *Environmental Protection Act 1986,* Part IV Environmental Impact Assessment

Following referral of the Proposal in June 2019, the EPA determined that the Proposal would be Assessed on Referral Information (ARI) with additional information required. Advice on the additional information required was provided by a Notice Requiring Information for Assessment under Section 40(2) of the EP Act to the Commissioner for Main Roads Western Australia. This document provides the additional information requested to complete the assessment of the Proposal.

1.4.2 Environmental Protection and Biodiversity Conservation Act 1999

The Proposal was formally referred to the Commonwealth Department of the Environment and Energy (DoEE) on 25 June 2019 as a potential Controlled Action under the EPBC Act due to impacts on Matters of National Environmental Significance (MNES). In October 2019, DoEE advised that the referral had been considered and determined to be a Controlled Action and would be assessed by preliminary documentation.

Subsequent to the referral of the Proposal on 26 June 2019, the Department of Environment and Energy (DoEE) was consolidated with the Department of Agriculture. Effective 1 February 2020, the Department of Agriculture, Water and the Environment (DAWE) is the Commonwealth Department with primary EPBC regulatory authority. Reference documents published prior to 1 February 2020 will be appropriately attributed to DoEE or the relevant predecessor agency. All discussion and context relative to EPBC responsibilities and compliance will refer to DAWE.

1.5 Other Approvals and Regulation

Following primary environmental approval of the Proposal under Part IV of the EP Act, additional regulatory approvals will be required to develop and operate the Proposal. These have been summarised in (Table 1-1).

Table 1-1 Summary of other regulatory approvals required

PROPOSED ACTIVITIES	TYPE OF APPROVAL	REGULATORY AGENCY	LEGALISATION REGULATING THE ACTIVITY
Impact to Matters of National Environmental Significance	Referral of a Proposal – Approval type to be determined if the Proposal is deemed a Controlled Action	Commonwealth Department of Agriculture, Water, and Environment (DAWE)	EPBC Act 1999
Interference with bed and banks of a watercourse or wetland (clearing of vegetation and construction works)	Application for a permit to authorise interference or obstruction of the bed and banks of a watercourse or wetland	Department of Water and Environmental Regulation (DWER)	*Rights in Water and Irrigation Act 1914* (RIWI Act)
Sourcing of construction water	Licence to take	DWER	RIWI Act
Disturbance of a registered Aboriginal heritage site	Section 18 consent	Department of Planning, Lands and Heritage (DPLH)	*Aboriginal Heritage Act 1972* (AH Act)
Land acquisition process	Administration of State Land Transfer of private land	DPLH	*Land Administration Act 1997*
Authorisation to take (flora and fauna) and modify (TEC)	Licence to take and modify	Department of Biodiversity, Conservation and Attractions (DBCA)	*Biodiversity Conservation Act 2016* (BC Act)

2 THE PROPOSAL

2.1 Proposal justification

The existing north-south route of Forrest Highway, Robertson Drive and Bussell Highway runs through a highly populated area of the Greater Bunbury Region resulting in congestion, inefficient freight operations, significant road safety issues and reduced social amenity. The future planning for the Greater Bunbury Region projects a population growth from approximately 86,400 persons in 2011 to approximately 122,400 persons by 2026 (WAPC, 2018). This, in conjunction with increased freight and tourist movements to the South West, will lead to unsustainable traffic growth within the existing north-south route resulting in further congestion and reduced amenity.

The Proposal forms a major component of the planned regional road network for the Greater Bunbury Region and will improve port access and road user safety and accommodate the predicted increased traffic levels in this area, associated with anticipated population growth.

The main economic drivers of the South West are mining and mineral processing (predominantly alumina, coal and mineral sands), tourism, construction, timber industry and agriculture/viticulture. Each of these industries is reliant on road transport (South West Development Commission, 2018).

The key benefits of the Proposal include:

- Providing an effective bypass of Bunbury for inter-regional traffic and heavy vehicle transport, such as trucks travelling to and from the Kemerton Strategic Industrial Area (KSIA), thereby reducing congestion and air and noise emissions in developed urban areas on the existing network
- Providing a direct connection to the Bunbury Port via Willinge Drive, which will promote economic activity, improve utilisation and development of the Bunbury Port and growth of industry in the South West Region
- Accommodating future development associated with the Draft Wanju District Structure Plan (WAPC, 2016) and Draft Waterloo Industrial Park District Structure Plan (WAPC, 2017)
- Supporting local industries, heavy vehicle transport operators and commuters with improved freight efficiency and reduced travel time and costs
- Increasing direct and indirect employment opportunities for the local population during the construction phase
- Improving road user safety on Forrest Highway, Bussell Highway and Robertson Drive
- Providing for the planned Perth to Bunbury rail within the median.

2.2 Key Proposal characteristics

Main Roads propose to construct the Proposal (BORR Northern and Central Sections) from Forrest Highway to South Western Highway (South) (Figure 1, Appendix A). The Proposal Area covers up to 625 ha, the majority (approximately 87 %) of which is cleared agricultural land (Table 2-1). Pockets of native vegetation within the Proposal Area typically occur within road reserves, along sections of the Collie, Ferguson and Preston Rivers, or as isolated patches.

The Proposal Area has been refined since the original referral of the Proposal in June 2019 and is discussed below. It should be noted that the previously constructed portion of BORR Central Section is not included in the Proposal Area, however the connection roads to the BORR Central Section are considered here. Pre-

construction activities such as geotechnical investigations, groundwater allocation, fencing and landowner accommodation works are also not included in the Proposal.

Key Proposal characteristics that quantify the limits or context of the physical and operation elements are presented in Table 2-1.

Table 2-1 Key Proposal characteristics

ELEMENT	PROPOSED EXTENT
Physical elements	
Overall Proposal footprint (including all physical elements below)	Clearing or disturbance of up to 625 ha comprising approximately: • 73 ha of native vegetation and approximately 19 ha of revegetation (~15 % combined) • 532 ha (~82 %) of cleared and highly modified areas (agricultural land and existing built infrastructure).
Road construction and associated infrastructure	The road construction and associated infrastructure for the Proposal includes the following components: • 19 km of new rural freeway standard, dual carriageway • A grade separated interchange at the intersection of Forrest Highway, Paris Road and Clifton Road • A grade separated interchange at Raymond Road • A grade separated interchange at South West Highway • A grade separated interchange at Waterloo (Wireless Road) • A grade separated interchange at Willinge Drive • Extension of Willinge Drive south (3 km) to intersect with South West Highway • New local roads and existing local road modifications • Utility modifications.
Bridges and drainage infrastructure	The bridge construction and associated infrastructure for the Proposal includes the following components: • New bridge [14 m and 19 m width / 4 x 35 m spans] BORR over the Collie River • New bridge [35 m width / 2 x 40 m spans] BORR over the South Western Highway (north) • New bridge [35 m width/ 40 m and 20 m spans] BORR over the Perth Bunbury Rail line and Railway Road • New bridge [27 m width/ 3 x 32 m spans] BORR over Golding Crescent/Ferguson River • New bridge [16.5 m width / 3 x 32 m spans] Martin Pelusey over Golding Crescent/Ferguson River • New bridge [27 m width / 40 m span] BORR over Boyanup-Picton Rail • New bridge [16.5 m width / 40 m span] Martin Pelusey over Boyanup-Picton Rail

ELEMENT	PROPOSED EXTENT
	• New bridge [27 m width / 32 m span] BORR over Boyanup-Picton Road • New bridge [16.5 m width / 32 m span] Martin Pelusey over Boyanup-Picton Road • New bridge [30.5 m width/ 40 m span] over South West Highway near Davenport • Drainage basins, drains and other associated infrastructure.
Principal Shared Path (PSP)	A PSP [4.6 m width] will be constructed for the full length of the Proposal, situated on the western side and generally elevated 1 – 1.5 m above the existing ground level.
Other road infrastructure and furniture	Other road infrastructure and furniture, including but not limited to culverts, lighting, noise barriers, fencing, landscaping, road safety barriers and signs.
Operational elements	
Constructed BORR	Main Roads will operate the Proposal including standard management and maintenance practices.

2.3 Design and refinement

The Concept Design has been developed to accommodate traffic generated by a future population of 200,000 in the Greater Bunbury Region and an increased volume of traffic between Perth and the south west. A key constraint on the design is mitigation of impacts on private land as the BORR alignment traverses or is in close proximity to a range of land uses, public infrastructure and environmental constraints, including:

- Residential development (Meadow Landing) on the western boundary near the proposed Raymond Road crossing
- Rail line running parallel with South Western Highway
- Large farm lots with dairy and stock operations
- Environmental constraints.

The Concept Design was developed to minimise these impacts as far as practicable. Since the referral of the Proposal in June, Main Roads has undertaken a comprehensive review of the design and amended it to further reduce the potential impacts on key environmental features including:

- Habitat for WRP, BTP and Black Cockatoos
- Banksia Woodland TEC and PEC, Claypan TEC and Corymbia Woodland TEC.

The changes to the design of the Proposal (detailed in Table 2-2) include:

- Reduction in median widths where the alignment is on high fill embankments
- Changes to interchanges to reduce impacts such as fragmentation
- Increased batter slope (gradients) and use of retaining walls to reduce the area of clearing required

- Bridge designs to avoid the need for piers or abutments within watercourses
- Amendment of the alignment to reduce the area of native vegetation cleared
- Moving the principal shared path (PSP) in closer to the highway to reduce the project footprint
- Inclusion of fauna crossings
- Design of drainage to maintain hydrological regimes.

Table 2-2 Summary of Proposal design changes and benefits

DESIGN CHANGE	FAUNA SPECIES AND COMMUNITIES REDUCED IMPACT					
	BC	WRP	BTP	CFM	BSM	TEC
Whole of alignment						
A combination of permanent and temporary fauna fences will be installed adjacent to known habitat areas to limit WRP access to the Proposal Area. The fence will be 1.5 m high and be constructed to prevent WRP being able to climb it or dig under it.	X	X	X			X
The median widths have been reduced where the BORR alignment is on high fill embankments to mitigate the environmental impacts	X	X	X			X
All bridge designs have been modified to avoid the need for piers or abutments within the watercourse, mitigating environmental and heritage impacts				X		
Install more than 40 fauna crossings to maintain and enhance existing movement pathways		X	X			
BORR/Forrest interchange at Paris and Clifton Roads						
BORR main alignment amended to further minimise impacts on vegetation	X	X	X			X
Interchange amended to reduce impacts to habitat and vegetation.	X	X	X			X
Reduced median width on BORR to minimise impacts on vegetation	X	X	X			X
Relocate noise wall to existing cleared track	X	X	X			X
Installing noise walls instead of bunds to minimise the clearing footprint	X	X	X			X
Road profile and design to maintain existing hydrological flows, including installing more drainage culverts				X	X	
Batter slopes steepened to minimise width of clearing	X	X	X			X

DESIGN CHANGE	FAUNA SPECIES AND COMMUNITIES REDUCED IMPACT					
	BC	WRP	BTP	CFM	BSM	TEC
Excise well vegetated areas in south west quadrant of interchange from Proposal Area. Although this will restrict the construction staging options and require additional costly traffic staging, environmental benefits will be achieved	X	X	X			X
Amend design to avoid established vegetation on the north west quadrant of the interchange	X	X	X			X
A combination of permanent and temporary fauna fences will be installed adjacent to known habitat areas to limit WRP access to the Proposal Area. The fence will be 1.5 m high and be constructed to prevent possums being able to climb it or dig under it.	X	X	X			X
BORR / South West Highway (North)						
Design of works along South West Highway has been modified to mitigate the impact to the TEC west of Waterloo Road						X
BORR / Boyanup Picton Road interchange						
Shift Principle Shared Path closer to the BORR alignment to reduce footprint width and potential vegetation and habitat fragmentation impacts	X	X	X			X
Excised vegetation within loop ramp from the Proposal Area	X	X	X			X
Establish fauna crossings to provide connectivity across the Ferguson River		X	X			
BORR / Moore Road interchange						
Design amended to reduce amount of clearing required for project by shifting footprint further into clearing areas	X	X	X			X
BORR / South West Highway (South) interchange						
Alignment modified to avoid existing vegetation on the northern boundary of the existing alignment. Modification will require additional construction staging efforts to accommodate existing traffic patterns while the new highway is constructed.	X	X	X			X

BC: Black Cockatoo, WRP: Western Ringtail Possum, BTP: Brush-tailed Phascogale, CFM: Carter's Freshwater Mussel, BSM: Black-stripe Minnow, TEC: Threatened Ecological Community.

3 STAKEHOLDER CONSULTATION

Main Roads has undertaken consultation for the BORR Northern and Central sections since the mid-1990s (NB. Previous consultation included earlier versions of the current BORR alignment). Details of this extensive consultation were included in BORR IPT (2019).

As part of the consideration of the Proposal, the EPA advertised the referral and invited public submissions over a seven day period. A total of 98 submissions were received. The EPA determination to assess the Proposal based on Referral Information includes requirement for provision of a four week public review.

In addition to and in preparation for the formal public review period, Main Roads has continued to consult with key stakeholders. Targeted consultation with technical experts and decision making authorities has also been undertaken to inform the preparation of this document and associated EMPs.

A summary of consultation undertaken since referral of the Proposal (post June 2019) is provided in Table 3-1. Information on the previous consultation activities and issues raised is provided in BORR IPT (2019).

Table 3-1 BORR Stakeholder consultation (since June 2019) summary

STAKEHOLDER	DATE	TYPE OF CONSULTATION	REPRESENTATIVES INVOLVED	SUMMARY OF DISCUSSIONS	KEY OUTCOMES OF CONSULTATIONS
State Government					
DWER (Office of the EPA)	13 November 2019	Meeting	• EPA Services Unit • Main Roads • BORR IPT	Pre-referral meeting. Overview of the Proposal and discussion on the EP Act Part IV assessment path for the Proposal.	• Understanding of Proposal scope, timing, setting and impacts. • Confirmation of the referral and assessment process.
Local Government					
City of Bunbury	30 July 2019	Project briefing meeting	• City of Bunbury • Main Roads • BORR IPT	• Environmental approvals • Ministerial announcement • Urban and Landscape Design • Northern interchange built form	Project briefing – no additional matters raised.
Shire of Capel	26 June 2019	Project briefing meeting	• Shire of Capel • BORR IPT	• Southern alignment selection • WRP regional surveys • Avoidance of tuart tree • Southern section local access arrangements • Environmental referrals • Raymond Road North Facing Ramps • BORR northern interchange configuration	Project briefing – no additional matters raised.
	27 November 2019	Project briefing meeting		• Briefing content • Southern section proposed interchange designs	Project briefing – no additional matters raised.

STAKEHOLDER	DATE	TYPE OF CONSULTATION	REPRESENTATIVES INVOLVED	SUMMARY OF DISCUSSIONS	KEY OUTCOMES OF CONSULTATIONS
				• Proposed local access arrangements • Landscape design • Environment & heritage update • Land acquisition • Community engagement update • Delivery procurement update	

Shire of Harvey	27 August 2019	Project briefing	• Shire of Harvey
			• Main Roads
			• BORR IPT
				• Project update
				• Northern and central sections
				  ○ Raymond Road north facing ramps
				  ○ Northern interchange configuration
				  ○ Signing strategy elements
				  ○ Interchange configurations
				  ○ Environmental approvals
				• Southern section
				  ○ Alignment announcement
				  ○ Tuart tree
				• Delivery planning
				• Community and stakeholder engagement update
					Project briefing – no additional matters raised.

Shire of Dardanup	14 August 2019	Project briefing meeting	• Elected members of Shire of Dardanup
			• Main Roads
			• BORR IPT
				• Project update
				• Northern and central sections
				  ○ Raymond Road north facing ramps
				  ○ Northern interchange configuration
					Project briefing – no additional matters raised

STAKEHOLDER	DATE	TYPE OF CONSULTATION	REPRESENTATIVES INVOLVED	SUMMARY OF DISCUSSIONS	KEY OUTCOMES OF CONSULTATIONS
				○ Signing strategy elements ○ Interchange configurations ○ Environmental approvals ○ Timber hub access • Southern section ○ Alignment announcement ○ Tuart tree • Delivery planning	
Community					
Northern/ Central CRG **(Monthly)**	12 August 2019	Meeting # 8	• CRG members • BORR IPT.	• Meeting purpose and process • Previous meeting summary and actions arising • Project update • Northern interchange • Raymond Road – northern ramps • Environmental approval update • Project case considerations • CRG member round table • Next steps	The CRG was formed to facilitate and enhance communication and collaboration with the various communities of interest and: • Provide a conduit for two-way communication and stakeholder input. • Communicate matters to, and from, their respective organisations, groups and committees • Collaboratively inform the planning and development process for the project • Assist in identifying and responding to project issues and opportunities identified by
	14 October 2019	Meeting # 9		• Meeting purpose and process • Previous meeting summary and actions arising • Project update • Raymond Road configuration • Environmental update • Heritage update	

STAKEHOLDER	DATE	TYPE OF CONSULTATION	REPRESENTATIVES INVOLVED	SUMMARY OF DISCUSSIONS	KEY OUTCOMES OF CONSULTATIONS
				• CRG member round table • Next steps	project stakeholders to ensure an optimal solution • Provide issue-specific liaison in selecting / assessing options • The remit of the CRG is bounded by and focussed on the project's area of influence. Refer to Table 3-2 for a summary of key concerns from these consultations.
	Planned for February 2020	Meeting # 10		TBA	TBA
Land owners	November 2019	Kingston noise wall letters	• Potentially impacted landowners • Main Roads	• Braidwood Drive and Carlingford Court properties that back onto Forrest Highway were notified about proposed noise wall mitigation measures • Provided information on proposed treatment at their property including plan, sketch and example images	Concern about noise wall placement and potential unsocial behaviours. Location of wall provides best environmental outcome and meets noise level targets.

STAKEHOLDER	DATE	TYPE OF CONSULTATION	REPRESENTATIVES INVOLVED	SUMMARY OF DISCUSSIONS	KEY OUTCOMES OF CONSULTATIONS
Committees and Reference Groups					
Project Steering Committee **(Bi-monthly)**	5 July 2019	Meeting #6	• Chaired by MD Main Roads • Main Roads' Executive Directors • Department of Treasury • Department of Transport • Department of Infrastructure, Regional Development and Cities • Others by invitation.	• Project update • WRP regional surveys • Landscape urban design and aesthetic strategy / early planting • Delivery – procurement planning • Community & stakeholder engagement update	• Direction setting • Strategic leadership / guidance • Promote collaboration between agencies • Strategic partnerships • Decision making for key / critical issues • Ministerial liaison • Project advocacy.
	19 September 2019	Meeting #7		• Project update • Southern section preferred interchange concepts & local access arrangements • Socio-economic assessment • Community & stakeholder engagement update • Delivery procurement update	
	6 December 2019	Meeting #8		• Project Update • Project Definition • Community & Stakeholder Engagement Update • Delivery procurement	
Project Enabling Group **(Bi-monthly)**	6 August 2019	Meeting # 6		• Project Update • Southern Environmental Referral Boundary and Impacts • Southern Interchange Selection	• Liaison between agencies • Operational decision making • Inform recommendations to the Steering Committee

STAKEHOLDER	DATE	TYPE OF CONSULTATION	REPRESENTATIVES INVOLVED	SUMMARY OF DISCUSSIONS	KEY OUTCOMES OF CONSULTATIONS
				• Bussell Hwy Interchange • Gelorup Local Access • Timber Hub Access • Delivery Planning • Community and Stakeholder Engagement Update	• Enable and facilitate progress • Technical and operational input • Promote efficient interface management • Ensure that project planning is consistent with and supports Government policy.

BORR RLGAG
(Quarterly or at Key Milestones)
	14 June 2019	Meeting # 3	• Chaired by Main Roads' Executive Director Planning and Technical Services
			• City of Bunbury
			• Shire of Capel
			• Shire of Harvey
			• Shire of Dardanup
			• BORR IPT
				• Project update
				  ○ Southern alignment decision
				  ○ Tuart tree
				  ○ Centenary Road interchange
				  ○ Raymond Road north facing ramps
				  ○ Northern interchange configuration
				• Environmental approvals update
				  ○ BORR northern and central
				  ○ BORR southern
					Project briefing – no additional matters raised

STAKEHOLDER	DATE	TYPE OF CONSULTATION	REPRESENTATIVES INVOLVED	SUMMARY OF DISCUSSIONS	KEY OUTCOMES OF CONSULTATIONS
Economic Advisory Group **(At Key Milestones)**	6 August 2019	Meeting # 4	• 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 • Bunbury Wellington Economic Alliance • Shires of Harvey, Capel and Dardanup • Bunbury Port Authority • Bunbury Geographe Tourism Partnership • Main Roads • BORR IPT	• Signage strategy • Local employment • Socio-economic Impact Assessment key findings • Landscaping design	Local organisations to further consider promotion of Bunbury as a tourism destination – including signage and broader marketing
	18 November 2019	Meeting #5		• Project update – delivery arrangements, local business briefing, local and Aboriginal Participation • Project communications activities and transition arrangements • Signage strategy	Options for local business capability register being considered

STAKEHOLDER	DATE	TYPE OF CONSULTATION	REPRESENTATIVES INVOLVED	SUMMARY OF DISCUSSIONS	KEY OUTCOMES OF CONSULTATIONS
Freight and Road Users Group **(At Key Milestones)**	14 October 2019	Meeting #3	• Department of Fire and Emergency Services • Livestock & Rural Transport Association • Southern Ports – Bunbury • WALGA • Greater Bunbury Bicycle Users Group Inc. • RAC • City of Bunbury • Main Roads WA	• Project update • Road user priority map • Discussion- road user priority map • RAV networks and OSOM Provisions • Discussion - RAV networks and OSOM Provisions • Principal shared path network (PSP) • Discussion – principal shared path network (PSP) • Rest areas	• No subsequent FRUG meetings were scheduled; • Project Case information will be provided at a future date in a single briefing of all Reference Groups to present the intended first stage of construction work. This is anticipated during the first quarter of 2020; Members were thanked for feedback and contribution.
Transafe WA Road Transport Industry Safety Forum	14 August 2019	Meeting	• Transafe WA forum • BORR IPT	• Project overview • Ministerial announcement: Raymond Road • Interchange forms • Local road network • Environmental approvals • Ministerial announcement: Southern alignment, tuart tree • Delivery planning	Project briefing – no additional matters raised
Meadow Landing Visual Amenity Workshop	18 November 2019	Meeting	• Meadow Landing Community Members • CRG members	• Workshop objectives and agenda • Project overview • BORR North road design	• Feedback forms to be received from attendees after the meeting

STAKEHOLDER	DATE	TYPE OF CONSULTATION	REPRESENTATIVES INVOLVED	SUMMARY OF DISCUSSIONS	KEY OUTCOMES OF CONSULTATIONS
			• BORR IPT	• Present options to mitigate the visual impact of BORR on the residents of Meadow Landing • Seek feedback on the landscaping concept including stakeholder preferences • Noise impacts • Light impacts	• The planting concept will be updated based on the community feedback. • Opportunities to implement early planting works prior to construction will be investigated.
Wanju/ Waterloo Steering Group	9 July 2019	Meeting	• DPLH • DWER • Shire of Dardanup • South West Development Commission. • LandCorp • BORR Project Team	• Update on Main Roads' work associated with the BORR and network modelling of Greater Bunbury • Post-development Water Modelling and District Water Management Strategy • Water Servicing of Wanju and Waterloo • Summary of submissions to Revised Draft Wanju and Waterloo DSPs • Finalising Wanju and Waterloo District Structure Plans • Development Contributions Plan	Group has been dissolved as the project now progresses to the next phase

Table 3-2 Summary of key concerns raised during consultation

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
Community members, CRG members	Main Roads & BORR IPT Enquiries, CRG Meetings, Community Drop In Sessions	Concerns have been raised by residents living near the alignment, particularly those of the communities of Kingston and Meadow Landing regarding the visual that could not have anticipated the level of impacts of BORR to their property following the change in the alignment of BORR North.	In response to concerns raised by local residents at Meadow Landing regarding visual impacts, a visual amenity workshop was held in November 2019. The purpose of the workshop was to: • Present options to mitigate the visual impact of BORR on the residents of Meadow Landing • Seek feedback on the landscaping concept including stakeholder preferences • Inform the subsequent landscaping concept.
Shire of Harvey, Meadow Landing residents, local road users	Shire briefings, Northern CRG Group Meetings	Concern about ultimate Raymond Road alignment being closer to houses at western end of Raymond Road.	Project case concept design for Raymond Road between the Meadow Landing entrance roundabout and The Grand Entrance has been realigned to the north to increase separation between road and properties.
Community members, CRG members	BORR Team Enquiries, CRG Meetings	Concerns regarding traffic noise impacts to Meadow Landings residents from continued impact of heavy vehicles using Raymond Road west of BORR.	The addition of northbound on ramps and southbound off ramps at the Raymond Road / BORR interchange will allow traffic travelling west on Raymond Road to access BORR northbound and will allow southbound traffic on BORR to head east onto Raymond Road. The northbound ramp at Raymond Road will provide: • Further access options in and out of Bunbury • Improved outcomes for local residents (including at Meadow Landing and Kingston) through diverted freight / regional traffic • Improved regional connectivity from Collie and surrounding catchments to BORR (Forrest Highway) • Emergency vehicles with direct access to the northbound carriageway of BORR in the case of an incident between Raymond Road and Paris Road

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
CRG members, Community members	Northern & Central and Southern CRG meetings	Clarification was sought regarding the level of assessment for the EPA referral for BORR Northern and Central	Main Roads advised that the EPA has specified that there will be a 4 week public review of the additional information required to be submitted.
CRG members, Community members	Northern & Central and Southern CRG meetings	Clarification was sought regarding the difference between a Public Environmental Review (PER) and an ARI	Main Roads advised that it considered the main difference to be that during the public comment period, the public will only be commenting upon the additional referral information submitted.

4 ENVIRONMENTAL PRINCIPLES, THEMES AND FACTORS

4.1 Key Environmental Factor – Flora and Vegetation

4.1.1 EPA objective

The EPA's objective for flora and vegetation is *'To protect flora and vegetation so that biological diversity and ecological integrity are maintained'* (EPA, 2018b).

4.1.2 Policy and guidance

- Environmental Factor Guideline Flora and Vegetation (EPA, 2016a)
- Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016b)
- Protection of Naturally Vegetated Areas Through Planning and Development, Environmental Protection Bulletin No. 20 (EPA, 2013)
- *Environmental Protection (Clearing of Native Vegetation) Regulations 2004 (Clearing Regulations).*

4.1.3 Notice Requiring Information for Assessment – Flora and Vegetation

The EPA required the following information for its assessment of the Proposal:

Clarify occurrence and impacts to threatened ecological communities (TECs) / priority ecological communities (PECs) as follows:

- Undertake additional surveys to confirm occurrence and impacts to '*Herb rich shrublands in clay pans*' TEC
- Undertake additional surveys to confirm occurrence and impacts to '*Banksia dominated woodlands of the Swan Coastal Plain*' PEC and '*Banksia Woodlands of the Swan Coastal Plain'* TEC
- Update mapping to illustrate occurrence of TECs / PECs impacted by the proposal
- Given an accredited assessment with the Commonwealth will not be pursued, please ensure that the '*Banksia dominated woodlands of the Swan Coastal Plain*' PEC is clearly distinguished from the '*Banksia Woodlands of the Swan Coastal Plain'* TEC in all documentation, mapping and GIS.
- Provide an assessment of the composition and condition of directly impacted TECs/PECs as well as any indirectly impacted TECs / PECs and the viability of remaining occurrences following the implementation of the proposal
- In light of any updated impacts to TECs / PECs, revise the mitigation measures accordingly
- Identify requirements for an environmental management plan (EMP) for any remaining viable TECs / PECs that will be impacted as a result of the proposal to ensure the EPA's objective for flora and vegetation will be met.

4.1.4 Previous and additional surveys

The following studies and surveys have been undertaken within, or are relevant to, the Proposal (Table 4-1; Figure 3, Appendix A). Of note, additional survey work undertaken to provide additional information requested in Section 40(2)(a) Notice are documented in an updated revision Vegetation and Flora Study (BORR IPT, 2020c) (Appendix C) for the Proposal.

Table 4-1 Studies and surveys relevant to the Proposal

SURVEY / REPORT NAME	LOCATION / EXTENT IN SURVEY AREA	METHODOLOGY
Surveys undertaken for the Proposal prior to referral		
Bunbury Port Access Road Project Stage 2 – Flora and Vegetation Survey (GHD, 2010)	Near Boyanup Picton Road to South Western Highway. Two survey areas overlap the current Proposal Area.	Survey completed on the 13, 14 and 17 October and the 4 – 5 November 2009. The survey included vegetation type and condition mapping.
Lot 1 Ducane Road, Environmental Values Assessment (GHD, 2014)	Survey of Lot 1 Ducane Road (40.5 ha) – which is located approximately 2.5 km south-west of the current Survey Area.	Survey on the 13 June 2013. This survey included vegetation mapping and quadrat based sampling.
Dardanup Structure Plan (GHD, 2015a)	Approximately 2,700 ha between Collie River and approximately Boyanup Picton Road. The study boundaries overlap the current Survey Area.	Two season flora survey in accordance with EPA guidelines at the time of survey (EPA, 2004b)). Late winter (13 – 14 August 2014) and mid-spring (30 – 31 October 2014). Vegetation type and condition mapping based on quadrats and opportunistic records. Searches for conservation significant flora.
BORR South Flora Survey (GHD, 2015b)	Survey for BORR South Proposal Area. This occurs immediately south of the current Survey Area and is used to provide context. Two quadrats are within the current Survey Area.	Survey completed on 21 – 23 September 2011 and 16 – 18 June 2014. Level 2 flora and vegetation survey including quadrat sampling, targeted searches and vegetation type / condition mapping.
Reassessment of Floristic Communities (Biota, 2016)	Target areas within BORR South alignment. Two quadrats are within the current Survey Area.	Additional quadrats and re-analysis of the FCTs presented in GHD (2015b). Surveys carried out in September 2016.
Banksia TEC Assessment for BORR South (Biota, 2018)	24 target areas within BORR South area and surrounds. This report also provides context for the Banksia TEC assessment. Three target sites are located south-west of the current Survey Area. The closest target site is approximately 3 km south-west of the current Survey Area.	Walking transects and quadrats within the target sites. Surveys carried out in November 2017.
A Flora and Vegetation survey on Lot 104 Willinge Drive Davenport (Ecoedge, 2018)	Survey of the 83.3 ha within Lot 104 (North east of the Preston River). The study boundary intersects the Proposal Area.	Survey carried out on 30 October and 2 and 3 November 2017. Vegetation type and condition mapping and species lists presented.

SURVEY / REPORT NAME	LOCATION / EXTENT IN SURVEY AREA	METHODOLOGY
Bunbury Outer Ring Road North – Phytophthora Dieback Occurrence Survey (Great Southern Bio Logic, 2018)	BORR Northern and Central Sections alignment.	Visual diagnosis of disease supported by laboratory assessment of soil and tissue samples within areas of assessable remnant vegetation.
BORR Northern and Central Sections Drainage Strategy 2018) (BORR IPT, 2018)	BORR Northern and Central Sections alignment.	Outlines broad strategies for management of surface water throughout the Proposal Area, including flood mitigation and maintaining surface water flows to wetlands and agricultural land.
BORR Northern and Central Sections Vegetation and Flora Study (BORR IPT, 2020c) (Appendix C)	Detailed flora and vegetation assessment of 1,128 ha, including the Proposal Area.	Detailed vegetation and flora survey was undertaken from 20 August 2018 to 19 December 2018. Targeted surveys were undertaken from 19 to 30 August 2019. The survey included late winter, early spring, mid-spring, late spring and summer survey periods.
Additional surveys undertaken for Proposal following referral, including information requested in Section 40(2)(a) Notice		
Bunbury Outer Ring Road Central and Northern Sections Claypan TEC Assessment Survey Report 2019 (Ecoedge, 2019a) – included in (BORR IPT, 2020c)	Within the locality of Waterloo, in the BORR Northern and Central Sections alignment.	Survey carried out on 26 July to 1 August 2019. Condition, hydrology and species diversity were assessed to confirm whether the vegetation met the floristic and condition thresholds of the Claypan TEC. Results are documented in an updated revision of the Flora and Vegetation Study for the Proposal to informed the avoidance, management, mitigation and monitoring actions to provide additional information requested in Section 40(2)(a) Notice.
A Review of the Regional Conservation Status of a Clay-based Wetland Community (Claypans) (Ecoedge, 2019b) (Appendix D)	Region defined as on the SCP within Harvey, Bunbury, Capel, Dardanup and Busselton local government areas	Desktop review and targeted field assessments for Claypan TECs conducted in 26 July – 1 August 2019 to provide additional information requested in Section 40(2)(a) Notice.

The assessment of the broader flora and vegetation values of the area are provided in BORR IPT (2019a) and have not been repeated here.

The results of additional targeted surveys requested in the Section 40(2)(a) Notice and, where relevant, previous studies have been incorporated into the following sections. The assessment of impacts, mitigation measures and proposed monitoring methodologies for the TECs and PEC are set out below and in Appendices E to G.

The assessment addresses the request by the EPA to provide:

- Additional information on the composition and condition of directly and indirectly impacted TEC / PEC vegetation, including mapping of TEC and PEC vegetation within and adjacent to the Proposal Area.

TEC / PEC vegetation and drainage monitoring plans are included in Appendix E and Appendix F, respectively, while the management targets, thresholds and contingency actions for the TEC/PEC vegetation are provided in Appendix G.

4.1.5 Threatened and Priority ecological communities

The implementation of the Proposal will result in clearing of up to 73 ha of vegetation and 19 ha of revegetation (~15 % combined) within the 625 ha Proposal Area. An estimated 5.7 ha of this vegetation comprises vegetation representative of TECs and / or PEC, of which 0.9 ha is situated on private land, 0.7 ha is vested in the state and approximately 4.1 ha is within road or railway reserves.

Three TECs and one PEC will potentially be impacted by the Proposal:

- Banksia Woodlands TEC
- Claypan TEC
- Corymbia Woodlands TEC
- Banksia Woodlands PEC.

The impacts include direct impacts through clearing (and loss of TEC/PEC vegetation) and indirect impacts such as fragmentation. The impacts and their management and mitigation are addressed for each TEC/PEC in Sections 4.1.6 to 4.1.8.

4.1.6 Banksia Woodland TEC and PEC

4.1.6.1 Receiving environment

Community description and conservation status

The Banksia Woodlands of the SCP was listed in September 2016 as an Endangered TEC under the EPBC Act. The Threatened Species Scientific Committee (TSSC) (2016) describes the key structural features of the community as:

- A prominent tree layer of Banksia, with scattered eucalypts and other tree species often present among, or emerging above, the canopy
- The understorey is a species rich mix of sclerophyllous shrubs, graminoides and forbs
- High endemism and considerable localised variation in species composition across its range.

The TSSC (2016) provides guidance for determining whether the TEC is present and criteria that encompass community structure and composition and vegetation condition and minimum patch size (TSSC, 2016). These criteria were used to assess vegetation communities representative of the Banksia Woodland TEC during the flora and vegetation assessments undertaken to support the Proposal (BORR IPT, 2020c).

The 'Banksia dominated woodlands of the SCP IBRA region' PEC is listed as Priority 3 by DBCA. The PEC differs from the TEC in that it has no minimum condition and patch size thresholds.

Critical habitat

The areas considered critical to the survival of the Banksia Woodlands cover all patches that meet the key diagnostic characteristics and condition thresholds for the ecological community, plus the buffer zones, particularly where this comprises surrounding native vegetation. This is because this ecological community occurs in a landscape that has often been very heavily cleared and modified, and now exists as mostly very small and highly fragmented patches (TSSC, 2016).

Threats

Key threats to the TEC identified in the conservation advice (TSSC, 2016) include clearing and fragmentation, dieback, invasive species, changes to fire regime, hydrological degradation, climate change, grazing, decline in pollination and seed dispersing fauna and loss of keystone Banksia species.

Community extent within and adjacent to the Proposal Area

Occurrences of both Banksia Woodland TEC and Banksia Woodland PEC were identified within and adjacent to the Proposal Area. Occurrences within the Proposal Area are shown in Figure 4 (Appendix A) and those directly adjacent to the Proposal Area are shown in Figure 5 (Appendix A).

4.1.6.2 Potential impacts

Direct impacts

3.7 ha of Banksia PEC and TEC vegetation within the Proposal Area will be lost as a result of Proposal implementation, all of which are located near Paris Road / Clifton Road interchange (Table 4-2; Figure 4, Appendix A). The Banksia Woodland TEC and PEC vegetation within the Proposal Area is split across three occurrences. The composition and condition of these occurrences are detailed in Table 4-3.

Table 4-2 Banksia Woodlands direct impacts relevant to the Proposal

IMPACT ACTIVITIES	DIRECT IMPACTS
Clearing of native vegetation and earthworks	Clearing of up to 3.7 ha of vegetation representative of the Banksia Woodland TEC and PEC

Table 4-3 Banksia Woodlands TEC / PEC direct impact sites

SITE / OCCURRENCE CODE	LOCATION	TEC / PEC TYPE	VEGETATION COMPOSITION AND CONDITION
BW-N-D-1	Forrest Highway road reserve northbound, north of Paris Road adjacent to Kingston Estate	Banksia Woodland TEC and PEC	Vegetation type: Woodland of *Eucalyptus marginata*, Banksia spp., *Kunzea glabrescens* Condition: 4-6 (Good to Degraded)
BW- N-D-2	Forrest Highway road reserve northbound, south of Paris Road adjacent to the Spud Shed	Banksia Woodland TEC and PEC	Woodland of *Eucalyptus marginata* over *Agonis flexuosa, Banksia attenuata* and *B. ilicifolia* Condition: 2-3 (Excellent to Very Good)
BW- N-D-3	Forrest Highway road reserve southbound, south of Clifton Road and opposite Paris Road and Private property east of Forrest Highway, south of Site 3	Banksia Woodland TEC and PEC	Woodland of *Eucalyptus marginata* over *Agonis flexuosa, Banksia attenuata* and *B. ilicifolia* Condition: 4, 6 (Good and Degraded)

Indirect impacts

No occurrences of Banksia Woodland TEC will be fragmented by the Proposal to the extent that they no longer represent occurrences of the TEC under the criteria specified by the TSSC (2016). No occurrences of

Banksia Woodland TEC or PEC vegetation are expected to be indirectly impacted to the extent that these no longer represent their respective TEC or PEC community.

Potential indirect impacts that may occur in Banksia Woodland TEC and PEC vegetation directly adjacent to the Proposal Area include:

- Possible introduction and/or spread of dieback and weeds to adjacent vegetation
- Damage to surrounding vegetation as the result of a bushfire.

Occurrences of Banksia Woodland TEC and PEC communities directly adjacent to the Proposal Area have been identified as part of the proposed monitoring program, and are detailed in Table 4-4 (Figure 5, Appendix A).

Table 4-4 Banksia Woodlands TEC / PEC potential indirect impact sites

SITE / OCCURRENCE CODE AND TENURE	TEC / PEC TYPE	LOCATION AND LOT NUMBER
BW-N-I-1 **Private property**	Banksia Woodlands TEC and PEC	Forrest Highway interchange, Australind Lot 131 on Plan 27972 and Lot 104 on Plan 31579, on the eastern side of the Highway
BW-N-I-2 **Road reserve**	Banksia Woodlands TEC and PEC	Forrest Highway west, Australind, within the western road reserve of Forrest Highway northbound.
BW-N-I-3 **Private property**	Banksia Woodlands TEC and PEC	Moore Road east the BORR interchange. Lot 504 on Plan 71846
BW-N-I-4 **Private property**	Banksia Woodlands TEC and PEC	Wallrodt Road, Davenport, near Willinge Drive. Lot 111 on Plan 403618
BW-N-I-5 **Private property**	Banksia Woodlands TEC and PEC	South Western Highway at the BORR interchange. Lot 80 on Plan 404278
BW-N-I-6 **Private property**	Banksia Woodlands TEC and PEC	Wallrodt Road, Davenport. Lot 2 on Plan 401654

4.1.6.3 Assessment of impacts

Direct impacts

A total of 3.7 ha of vegetation representing Banksia Woodland TEC and PEC will be directly lost as a result of Proposal implementation (Figure 4, Appendix A).

An assessment of the loss of Banksia Woodland TEC and PEC within local and regional scales was made by comparing the extent within the Proposal Area to that published for the community (regional) and extent within the broader BORR IPT (2020c) Survey Area (Table 4-5). The extent of Banksia Woodlands TEC estimated to be protected in reserves as stated by the Threatened Species Scientific Committee (TSSC) (2016) can be found in Table 4-6.

The TSSC (2016) provides information on the estimated extent of Banksia Woodland TEC within the SCP Bioregion. This advises that approximately 81,800 ha of the TEC are estimated to occur within reserves, most of which are in the Perth subregion of the SCP Bioregion. This represents about 24.3 % of the estimated extent of the TEC (Table 4-6). This document also states that there is approximately 336,489 ha of Banksia Woodland TEC remaining within the SCP.

Based on these assessments, the clearing of up to 3.7 ha associated with the Proposal would result in a reduction of up to 0.0010 % in the reported extent of the Banksia TEC. At the Perth subregion scale, this would represent a reduction of up to 0.0045 %. Of this, 2.1 ha was rated as in Good or better condition[1]. This area represents the maximum possible direct impact associated with the Proposal.

Table 4-5 Extent of Banksia Woodlands TEC and PEC within Proposal Area / local extent

TEC / PEC	EXTENT IN PROPOSAL AREA (HA)	EXTENT IN BORR IPT (2019) SURVEY AREA (HA)	TOTAL % LOSS OF KNOWN TEC EXTENT
Banksia Woodland TEC and PEC	3.7	25	0.0010

Table 4-6 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

Indirect impacts

Potential indirect impacts will be mitigated where possible, with any remaining impacts addressed through the implementation of management actions in accordance with Main Roads standards, as detailed in

[1] 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.

Section 4.1.6.4. The viability of occurrences of Banksia Woodlands TEC or PEC remaining after Proposal implementation will not change as a result of the Proposal, Table 4-7.

Table 4-7 Banksia Woodland TEC/PEC occurrences status before and after Proposal implementation

OCCURRENCE	ORIGINAL AREA (HA) AND CONDITION	HA TO BE CLEARED AND CONDITION	HA TO BE RETAINED AND CONDITION	MET CRITERIA PRIOR TO CLEARING (Yes/No)	MEETS CRITERIA AFTER CLEARING (Yes/No)
BW-N-D-1 / BW-N-I-7	2.49 1.2 ha Good, 1.29 ha Good-Degraded	0.47 0.34 ha Good, 0.13 ha Good-Degraded	2.03 0.87 ha Good, 1.16 ha Good-Degraded	Yes	Yes
BW-N-D-2 / BW-N-I-2	1.02 All Very good-Excellent	0.15 ha All Very Good-Excellent	0.87 ha All Very Good-Excellent	Yes	Yes
BW-N-D-3 / BW-N-I-3	10.88 5.54 ha Good, 0.37 ha Good-Degraded, 4.97 ha Degraded	3.12 ha 1.6 ha Good, 1.51 ha Degraded	7.76 ha 3.93 ha Good, 0.37 ha Good-Degraded, 3.46 ha Degraded	Yes	Yes

4.1.6.4 Mitigation

Avoid

Substantial changes to the Proposal design have been made since referral in June 2019 to reduce impacts to Banksia Woodland TEC and PEC vegetation. As discussed in Section 2.3, the changes to the design have included a range of refinements to minimise the impacts to the environment such as reducing median widths and changing the design of interchanges to reduce clearing requirements.

A summary of the original impact, design changes and resulting impact is presented in Table 4-8. Through the design changes, the area of Banksia Woodlands TEC and PEC that will be lost as a result of Proposal implementation has been reduced by more than 50 per cent.

Table 4-8 Detailed design changes to avoid impacts to Banksia Woodlands TEC / PEC vegetation

TEC / PEC TYPE	JUNE 2019 S.38 REFERRAL	FEBRUARY 2020 S.43	REDUCTION IN TEC / PEC CLEARING AREA
Banksia Woodlands of the SCP TEC and Banksia dominated woodlands of the SCP IBRA region PEC	Up to 7.6 ha combined	Up to 3.7 ha of TEC and PEC	3.9 ha

Mitigation

Additional surveys, as requested by the EPA in the additional information request, were undertaken for 'Herb rich shrublands in clay pans' TEC. These surveys were conducted in spring 2019 and were used to

confirm the occurrence of and inform design changes to the Proposal to reduce impacts on TECs and the PEC. As discussed with DWER, Main Roads does not consider that a standalone EMP for TECs and PECs is warranted, and consequently has not been included in this document.

The following actions will be implemented to manage indirect impacts to remaining Banksia Woodland TEC and PEC vegetation immediately adjacent to the Proposal Area. These actions are all included in the Main Roads Standard Scope of Work and Technical Criteria. As such, it is expected that they will sufficiently manage any indirect impacts. As is detailed in Section 4.1.6.3, Proposal implementation is not expected to reduce the viability of any remaining TEC or PEC occurrences.

Prior to construction

- As part of the contractor's Construction Environmental Management Plan (CEMP), development of a Hygiene Management Plan to prevent the spread of dieback and weeds to adjacent vegetation. The management plan will include procedures such as machinery/vehicle clean down, weed treatments and restrictions on vehicle/machinery movements
- As part of the contractor's CEMP, development of a Fire Management Plan
- Declared Plants and Weeds of National Significance (WoNS) within the Proposal Area and in adjacent Banksia Woodland TEC and PEC vegetation (in reserve or on land owned by Main Roads) will be removed or treated with herbicide.

During construction

- Contractor induction will include familiarisation with and discussion of Banksia Woodland TEC and PEC vegetation, Phytophthora dieback management and hygiene management
- Low impact temporary fencing will be installed on the active construction front of TEC / PEC vegetation areas prior to clearing and maintained during construction phase
- Movement of machines and other vehicles to be restricted to the limits of the areas cleared within the Proposal Area or on designated tracks outside the area
- Infestations of Declared Plants and WoNS in retained Banksia Woodland TEC and PEC vegetation and revegetation and landscaping within the Proposal Area, will be removed or treated with herbicide
- No re-fuelling of equipment will be conducted within 100 m of Banksia Woodland TEC / PEC vegetation
- As far as practical, clearing activities will occur during the dry months to reduce the risk of spreading Dieback.
- All Department of Fire and Emergency Services (DFES) and Local Government Authority (LGA) restrictions on fire and machinery movement will be strictly adhered to.

Post construction

- For three years post construction, control of Declared Plants and WoNS will be undertaken in retained Banksia Woodland TEC and PEC vegetation, as well as in revegetation and landscaping, within the Proposal Area.

Monitoring

A monitoring program has been designed to assess the effectiveness of management actions on potentially indirectly impacted occurrences of Banksia Woodland TEC and PEC vegetation (as detailed in Table 4-4 and shown in Figure 5, Appendix A) and enable the detection of a decline in vegetation condition. This includes a combination of transects (incorporating 2 x 2 m plots) and photopoints and uses species composition and vegetation health attributes as measurement parameters. Consultation with DBCA (Mr. Andrew Webb) regarding the monitoring program design was undertaken, with advice incorporated into the design. The proposed monitoring plan is detailed in Appendix E.

Three reference sites on Crown land or road reserve known to support Banksia Woodland TEC and PEC vegetation located in close proximity to the potential impact monitoring sites have been established (Figure 5, Appendix A). The purpose of these sites is to enable comparison of potential impact site data with data from sites located away from the Proposal Area to assist in determining whether any indirect impacts have resulted from Proposal implementation as well as to assess the impact of factors may have on the viability of the TEC and PEC vegetation, for example lower than average rainfall.

It is proposed that the vegetation monitoring program will be implemented for two years post construction, with the option to extend for a third year if required. The monitoring program consists of activities undertaken in two different frequencies – photo point monitoring will be conducted quarterly and transect monitoring annually in spring.

Opportunistic visual inspection for inundation of Banksia Woodland TEC and PEC vegetation from the Proposal will be conducted during construction. A drainage monitoring plan is included in Appendix E.

Triggers, thresholds and contingency actions that will be implemented should monitoring indicate a decline in monitored parameters are detailed in Appendix G.

4.1.6.5 Predicted Outcomes

A high level of mitigation and management has been applied to the Proposal, with Main Roads making substantial and costly changes to the Proposal design in order to reduce potential impacts on flora and vegetation, including Banksia Woodland TEC and PEC vegetation. The changes have reduced the area of Banksia Woodland TEC and PEC impacted by more than 50 per cent to 3.7 ha.

The EPA objective for Flora and Vegetation will be met for the Proposal through the implementation of the management and mitigation actions detailed in this document.

Based on these assessments, it is unlikely that the Proposal will have a significant impact on the Banksia TEC and PEC.

Main Roads intends to further counterbalance the residual impacts of the Proposal through implementation of an environmental offset strategy (see Section 5).

4.1.7 Herb Rich Shrubland in Clay Pans TEC (FCT08)

4.1.7.1 Receiving environment

Community description and conservation status

The Claypan TEC and other clay pan communities occur where clay substrate is low in the landscape and forms an impermeable layer close to the surface. These wetlands rely on rainfall and local surface drainage to fill and are unlikely to be connected to groundwater. The clay pans then dry out to form a relatively impervious substrate in summer. A suite of perennial plants that propagate by underground bulbs, tubers or corms (geophytes), and annual herbs flower sequentially as the clay pans dry out. The clay pans are the most diverse of the SCP wetlands and contain a number of local endemic flora (DBCA, 2019).

Critical habitat

The recovery plan describes habitat critical to survival as the area of occupancy of known occurrences; similar habitat adjacent to important occurrences (i.e. within approximately 200 m), i.e. poorly drained flats, depressions or winter wet flats with shallow sands and loams; remnant vegetation that surrounds or links several occurrences (to provide habitat for pollinators or to allow them to move between occurrences); and the local catchment for the surface, and potentially groundwater, that maintains the winter-wet habitat of the community. The plant assemblages are dependent on maintenance of the local hydrological conditions (DBCA, 2019).

Threats

The recovery plan lists key threats to the Claypan TECs as including land use (historical clearing), altered hydrology, rising groundwater, weeds and pathogens, inappropriate fire regimes, inappropriate land use and recreation, the viability of the small sized remnants that remain and climate change ((DBCA, 2019).

Community extent within and adjacent to the Proposal Area

Up to 0.63 ha of vegetation representing Claypan TEC was identified within the Proposal Area. A further 9.1 ha is located in Manea Park at the southern end of the Proposal Area. Only a small portion of this area is directly adjacent to the Proposal Area boundary. Occurrences within the Proposal Area are shown in Figure 4 (Appendix A) and those directly adjacent to the Proposal Area are shown in Figure 5 (Appendix A).

4.1.7.2 Potential impacts

Direct impacts

The extent of Claypan TEC within the Proposal Area that will be directly impacted is identified in Table 4-9 and shown in Figure 2 (Appendix A). The composition and condition of these occurrences is also shown in Table 4-10.

Table 4-9 Claypan TEC direct impacts relevant to the Proposal

IMPACT ACTIVITIES	DIRECT IMPACTS
Clearing of native vegetation and earthworks	Clearing of up to 0.63 ha of vegetation representative Claypan TEC

Table 4-10 ClaypanTEC direct impact sites

SITE NO.	LOCATION	AREA (HA)	VEGETATION COMPOSITION AND CONDITION
CP-N-D-1	Railway Road	0.414	Woodland to open forest of *Corymbia calophylla* and *Eucalyptus rudis* and sometimes *Melaleuca rhaphiophylla* over tall shrubland of *Acacia saligna*, *Viminaria juncea* and *Xanthorrhoea preissii* over shrubland of *Astroloma ciliatum*, *Daviesia physodes*, *Grevillea bipinnatifida*, *Hakea varia*, *Hemigenia incana*, *Hypocalymma angustifolium* and *Viminaria juncea* over sedgeland of *Cyathochaeta avenacea*, *Mesomelaena tetragona* and *Tetraria octandra* and open herbland of **Babiana angustifolia*, *Haemodorum simplex*, **Oxalis pes-caprae* and **Watsonia meriana* (in more disturbed areas) and very open grassland of **Briza maxima* on red-brown or yellow-brown clay loam. Condition: 3 (Very Good) - 0.206 ha 4 (Good) - 0.133 ha 6 (Degraded) - 0.075 ha
CP-N-D-2	Wireless Road	0.125 ha	Shrubland of *Acacia incurva, A. saligna*, *Hakea varia*, *Hypocalymma angustifolium*, *Melaleuca lateritia*, *M. pauciflora*, *Olearia elaeophila* and *Xanthorrhoea preissii* with emergent tall shrubs of *Viminaria juncea* over sedgeland of *Leptocarpus roycei* and *Schoenus* sp. and open herbland of *Agrostocrinum scabrum* subsp. *scabrum*, *Borya sphaerocephala*, *Cycnogeton lineare*, *Drosera erythrorhiza*, *Haemodorum simplex* and *Opercularia vaginata* on yellow-brown clay and

SITE NO.	LOCATION	AREA (HA)	VEGETATION COMPOSITION AND CONDITION
			Scattered tall shrubs of *Acacia saligna*, *Viminaria juncea* and *Xanthorrhoea preissii*, with occasional *Melaleuca rhaphiophylla* trees over grassland of **Briza maxima*, **Cenchrus clandestina* and **Ehrharta calycina* on yellow-brown clay loam Condition: 3 (Very Good) - 0.054 ha 4 (Good) - 0.038 ha 6 (Degraded) - 0.033 ha
CP-N-D-3	Bell Road	0.087	Shrubland of *Acacia incurva, A. saligna*, *Hakea varia*, *Hypocalymma angustifolium*, *Melaleuca lateritia*, *M. pauciflora*, *Olearia elaeophila* and *Xanthorrhoea preissii* with emergent tall shrubs of *Viminaria juncea* over sedgeland of *Leptocarpus roycei* and *Schoenus* sp. and open herbland of *Agrostocrinum scabrum* subsp. *scabrum*, *Borya sphaerocephala*, *Cycnogeton lineare*, *Drosera erythrorhiza*, *Haemodorum simplex* and *Opercularia vaginata* on yellow-brown clay Condition: 3 (Very Good) - 0.072 ha 6 (Degraded) - 0.015 ha

Indirect impacts

No Claypan TEC occurrences will be fragmented as a result of the Proposal as all occurrences that require clearing will be cleared in their entirety. No occurrences of FCT08 Claypan TEC are expected to be indirectly impacted to the extent that these no longer meet the description of the TEC community, as defined by the TSSC (2012) and DBCA (2019).

Potential indirect impacts that to Claypan TEC vegetation occurrences directly adjacent to the Proposal Area include:

- Possible introduction and/or spread of Dieback and weeds to adjacent vegetation
- Changes to vegetation structure and floristic composition in surrounding areas through altered surface water drainage
- Damage to surrounding vegetation through accidental generation of a fire.

The extent of Claypan TEC directly adjacent to the Proposal Area is described in Table 4-11 and shown in Figure 3 (Appendix A). The composition and condition of these occurrences is also shown.

Table 4-11 Claypan TEC potential indirect impact sites

SITE NAME AND TENURE	LOCATION	VEGETATION COMPOSITION AND CONDITION
CP-N-I-1 **Road reserve**	Bell Road, Dardanup. Within the road reserve west of the Proposal Area. Located 500 m from the Proposal Area.	*Casuarina obesa*, *Eucalyptus rudis* and *Melaleuca rhaphiophylla* over shrub species such as *Astartea scoparia*, *M. incana*, *M. lateritia* and *Leptocarpus roycei* Condition: 4, 5 and 6 (Good)

SITE NAME AND TENURE	LOCATION	VEGETATION COMPOSITION AND CONDITION
CP-N-I-2 **Reserve**	Manea Park	A Low Woodland of *Melaleuca raphiophylla, Melaleuca preissiana* and *Acacia saligna* over a Tall Shrubland of *Melaleuca viminea, Melaleuca incana* and *Astartea scoparia* over a *Leptocarpus roycei* and *Juncus articulata* Very Open Sedgeland a *Briza minor, Cynodon dactylon* and *Anthoxathum odoratum* Open Grassland and an *Angianthus drummondii* Very Open Herbland. Condition: 6 (Degraded)

4.1.7.3 Assessment of impacts

A total of 0.63 ha of Claypan TEC will be directly lost as a result of Proposal implementation (Figure 4, Appendix A).

An assessment of the loss of Claypan TEC within local and regional scales was undertaken by comparing the extent within the Proposal Area to that published for the community (regional) extent (Table 4-5).

According to the National Recovery Plan, within the state, there are 114 known occurrences of the clay pan communities in 50 separate locations that occupy a total of about 909 ha (DBCA, 2019). The communities are highly fragmented, with about 60% of occurrences under 10 ha in size. Of this, 298.1 ha represents the Claypan TEC (DBCA, 2019). An analysis was undertaken of the data presented in DBCA (2019), and additional field surveys of potential Claypan TEC sites not recorded by DBCA were conducted (Ecoedge, 2019b).

Ecoedge's survey for Claypan TEC occurrences within and near to the Proposal Area (Ecoedge, 2019a) identified three new occurrences, and the addition of 1.7 ha to the known extent of the Claypan TEC. The extent remaining in the greater Bunbury region is 132 ha (Ecoedge, 2019b), an increase of almost 30 ha from the 103.3 ha reported in DBCA (2019). This represents about 44 % of the estimated Statewide extent of the TEC.

An assessment of the extent of Claypan TEC to be cleared as a result of Proposal implementation against the extent remaining can be found in Table 4-12.

Based on this assessment, the clearing of up to 0.63 ha associated with the Proposal would result in a reduction of up to 0.21 % in the reported extent of the TEC. At the greater Bunbury region scale, this represents a reduction of up to 0.5%. Of this, 0.58 ha was rated as in Good or Better condition.

Table 4-12 Extent of Claypan TEC within Proposal Area / local extent

TEC	EXTENT IN PROPOSAL AREA (HA)	% OF EXTENT IN GREATER BUNBURY REGION (HA)[2]	TOTAL % LOSS OF KNOWN TEC EXTENT
Claypan TEC	0.63	0.45%	0.21%

Potential indirect impacts will be mitigated where possible, with any remaining impacts addressed through the implementation of management actions in accordance with Main Roads standards, as detailed in Section 4.1.7.4.

[2] Using the revised total estimated areas as provided by Ecoedge (2019b).

4.1.7.4 Mitigation

Avoid

Substantial changes to the Proposal design were made to avoid impacts to Claypan TEC vegetation. A summary of the original impact, design changes and resulting impact is presented in Table 4-13.

Table 4-13 Detailed design changes to avoid impacts to Claypan TEC vegetation

TEC	JUNE 2019 S. 38 REFERRAL	JANUARY 2020 S. 43	REDUCTION IN TEC / PEC CLEARING AREA
Herb rich shrublands in clay pans TEC	Up to 1.6 ha (including 1 ha unconfirmed)	Up to 0.63	0.21 ha (surveys subsequently showed that 0.79 ha was not Claypan TEC).

Mitigation

Additional surveys, as requested by the EPA in the additional information request, were undertaken for 'Herb rich shrublands in clay pans' TEC. These surveys were conducted in spring 2019 and were used to confirm the occurrence of and inform design changes to the Proposal to reduce impacts on TECs and the PEC. As discussed with DWER, Main Roads does not consider that a standalone EMP for TECs and PECs is warranted, and consequently has not been included in this document.

The following actions will be implemented to manage indirect impacts to remaining Claypan TEC vegetation directly adjacent to the Proposal Area. The majority of these actions are included in the Main Roads Standard Scope of Work and Technical Criteria and have been formulated in consideration of the specific TEC occurrences that will remain after Proposal implementation. Those that are 'above and beyond' standard practice are also detailed below. It is expected that these commitments will sufficiently manage any indirect impacts. As is detailed in Section 4.1.7.3, Proposal implementation is not expected to reduce the viability of any remaining Claypan TEC occurrences.

Prior to construction

- As part of the contractor's CEMP, development of a Hygiene Management Plan to prevent the spread of dieback and weeds to adjacent vegetation. The management plan will include procedures such as machinery/vehicle clean down, weed treatments and restrictions on vehicle/machinery movements
- As part of the contractor's CEMP, development of a Fire Management Plan
- Declared Plants and WoNS within the Proposal Area and in adjacent Claypan TEC vegetation within the Proposal Area will be removed or treated with herbicide.

During construction

- Contractor induction will include familiarisation with and discussion of Claypan TEC vegetation, Phytophthora dieback management and hygiene management
- Low impact temporary fencing will be installed on the active construction front of Claypan TEC vegetation areas prior to clearing and maintained during construction phase
- Movement of machines and other vehicles to be restricted to the limits of the areas cleared within the Proposal Area or on designated tracks outside the area
- Infestations of Declared Plants and WONS in retained Claypan TEC vegetation, as well as in revegetation and landscaping within the Proposal Area, will be removed or treated with herbicide
- No re-fuelling of equipment will be conducted within 100 m of Claypan TEC vegetation

- As far as practical, clearing activities will occur during the dry months to reduce the risk of spreading Dieback. Should this not be possible, access will be restricted to limestone tracks in accordance with the Dieback Management Plan
- All DFES and Local Government Authority (LGA restrictions on fire and machinery movement will be strictly adhered to.

Post construction

- For three years post construction, control of Declared Plants and WoNS will be undertaken in retained Claypan TEC vegetation, as well as in revegetation and landscaping within the Proposal Area.

'Above and beyond' management measures

Hydrologically, Claypan TEC vegetation is reliant on rainfall and infiltrating overland flows. It is not groundwater dependent. As such, as the primary consideration in regards to potential indirect impacts is the maintenance of existing hydrology for adjacent sites that could potentially be indirectly impacted. Road drainage to TEC / PEC vegetation will comply with and be adequately managed by both the Drainage Strategy and Main Roads drainage design criteria.

The Bell Road site (monitoring site CP-N-I-1) is located approximately 500 m from the Proposal Area at the nearest point. Although it is highly unlikely to be affected by changes in hydrology as a result of the Proposal, it has been included in the monitoring program.

The Manea Park potential impact site (monitoring site CP-N-I-2) is located directly adjacent to the Proposal Area, at the tie-in with the existing Centenary Road. In this location it is in degraded condition. This section of Centenary Road will not be impacted by construction works and the existing hydrology of the area to the south of Centenary Road (that would flow towards Centenary Road) will be maintained. Accordingly, it is considered unlikely that the Proposal will indirectly impact this degraded community.

Monitoring

A monitoring program has been designed to assess the effectiveness of management actions on potentially indirectly impacted occurrences of Claypan TEC vegetation (as detailed in Table 4-11 and shown in Figure 5, Appendix A) and enable the detection of a decline in vegetation condition. This includes a combination of transects (incorporating 2 x 2 m plots) and photopoints and uses species composition and vegetation health attributes as measurement parameters. Consultation with DBCA (Mr. Andrew Webb) regarding the monitoring program design was undertaken, with provided advice incorporated into the design. The proposed monitoring plan is detailed in Appendix F.

Potential reference sites on Crown land or road reserve known to support Claypan TEC vegetation located in close proximity to the potential impact monitoring sites have been identified. The purpose of these sites is to enable comparison of potential impact site data with data from sites located away from the Proposal Area to assist in determining whether any indirect impacts have resulted from Proposal implementation. To facilitate comprehensive data analysis, and to minimise risk of loss of reference sites through fire or other unanticipated events, two Claypan TEC reference sites have been identified (Figure 5, Appendix A).

It is proposed that the vegetation monitoring program will be implemented for two years post construction, with the option to extend for a third year if required. The vegetation monitoring program will be implemented in two frequencies – photopoint monitoring will be conducted quarterly and transect monitoring annually in winter-spring (in consultation with DBCA).

Opportunistic visual inspection for drying effects of Claypan TEC vegetation from the Proposal will be conducted during construction. A drainage monitoring plan is included in Appendix E.

Triggers, thresholds and contingency actions that will be implemented should monitoring indicate a decline in monitored parameters are detailed in Appendix G.

4.1.7.5 Predicted Outcomes

A high level of mitigation and management has been applied to the Proposal, with Main Roads making substantial and costly changes to the Proposal design in order to mitigate potential impacts on flora and vegetation, including Claypan TEC vegetation. The changes made have resulted in a 25% reduction in the area of this TEC to be impacted, to 0.63 ha.

The EPA objective for Flora and Vegetation will be met for the Proposal through implementation of appropriate management and mitigation detailed in this document.

Main Roads intends to further counterbalance the residual impacts of the Proposal through implementation of an environmental offset strategy (see Section 5).

4.1.8 *Corymbia calophylla - Xanthorrhoea preissii* woodlands and shrublands of the Swan Coastal Plain (FCT3c) TEC description

4.1.8.1 Receiving environment

Community description and conservation status

The Corymbia Woodland TEC (FCT3c) was listed as an EPBC Act TEC in 2000. It is also listed as Critically Endangered under the BC Act. The DoEE (2017a) describes the TEC as a Marri (*Corymbia calophylla*) dominated plant community located on heavy soils of the eastern side of the SCP between Bullsbrook, and Capel. It is noted that weed levels are generally quite low in most occurrences of the TEC.

Critical habitat

The conservation advice identifies critical habitat for the TEC as the heavy soils on which it occurs, the fresh superficial groundwater, and/or surface water that may help sustain flora species in this community, and the catchment for this groundwater and surface water.

Because of its very restricted distribution, no condition thresholds have been applied to the nationally-listed ecological community and hence all areas meeting the description of the ecological community are habitat areas critical to its survival (DoEE, 2017a).

Threats

Key threats to the TEC identified in the conservation advice include clearing, altered fire regimes, weed invasion, hydrological changes, salinisation, grazing, introduction of disease and erosion by wind or water.

Community extent within and adjacent to the Proposal Area

The Corymbia Woodland TEC was not identified in initial vegetation surveys undertaken to support the referral of the Proposal. In supplementary surveys undertaken in 2019. Up to 1.3 ha of Corymbia Woodland TEC was identified within the Proposal Area, and approximately 0.9 ha directly adjacent. Occurrences within the Proposal Area are shown in Figure 4 (Appendix A) and those directly adjacent to the Proposal Area are shown in Figure 5 (Appendix A).

4.1.8.2 Potential impacts

Direct impacts

The extent of Corymbia Woodland TEC within the Proposal Area that will be lost is specified is Table 4-14 and shown in Figure 4 (Appendix A). The composition and condition of these occurrences is shown in Table 4-15.

Table 4-14 Corymbia Woodland TEC values and impacts relevant to the Proposal

IMPACT ACTIVITIES	DIRECT IMPACTS
Clearing of native vegetation and earthworks	Clearing of up to 1.3 ha of vegetation representative of Corymbia Woodland TEC

Table 4-15 Corymbia Woodland TEC direct impact sites

SITE NO.	LOCATION	AREA (HA)	VEGETATION COMPOSITION AND CONDITION
CW-N-D-1	Raymond Road	0.29	Open woodland to scattered trees of *Corymbia calophylla* over an open shrubland of *Xanthorrhoea preissii, Hypocalymma angustifolium* and *Hakea varia* Condition: 6-7 (Degraded to Completely degraded)
CW-N-D-2	Treendale Road	0.33	Open woodland to scattered trees of *Corymbia calophylla* over an open shrubland of *Xanthorrhoea preissii, Hypocalymma angustifolium* and *Hakea varia* Condition: 6-7 (Degraded to Completely degraded)
CW-N-D-3	Railway Road	0.14	*Corymbia calophylla-Eucalyptus rudis-Melaleuca rhaphiophylla* woodland/open forest. Woodland to open forest of *Corymbia calophylla* and *Eucalyptus rudis* and sometimes *Melaleuca rhaphiophylla* over tall shrubland of *Acacia saligna*, *Viminaria juncea* and *Xanthorrhoea preissii* over shrubland of *Astroloma ciliatum*, *Daviesia physodes*, *Grevillea bipinnatifida*, *Hakea varia*, *Hemigenia incana*, *Hypocalymma angustifolium* and *Viminaria juncea* over sedgeland of *Cyathochaeta avenacea*, *Mesomelaena tetragona* and *Tetraria octandra* and open herbland of **Babiana angustifolia*, *Haemodorum simplex*, **Oxalis pes-caprae* and **Watsonia meriana* (in more disturbed areas) and very open grassland of **Briza maxima* on red-brown or yellow-brown clay loam. Condition: 3 (Very good) - 0.022 ha 4 (Good) - 0.028 ha 6 (Degraded) - 0.057 ha 7 (Completely degraded) 0.032 ha
CW-N-D-4	Harris Road	0.52	Open woodland to scattered trees of *Corymbia calophylla* over an open shrubland of *Xanthorrhoea preissii, Hypocalymma angustifolium* and *Hakea varia* Condition: 6 (Degraded)

Indirect impacts

One occurrence of Corymbia Woodland TEC at Railway Road will be fragmented as a result of the Proposal. This occurrence is unlikely to be left viable as a result of Proposal implementation as it is already small, isolated and has a high edge-to-area ratio. As such its long term viability is already at risk, and this viability is unlikely to change as a result of the Proposal. The majority of the site is in Good or Very Good condition.

No occurrences of Corymbia Woodland TEC are expected to be indirectly impacted to the extent that these no longer represent the TEC community.

Potential indirect impacts that may occur in Corymbia Woodland TEC vegetation occurrences directly adjacent to the Proposal Area include:

- Possible introduction and/or spread of Dieback and weeds to adjacent vegetation
- Changes to vegetation structure and floristic composition in surrounding areas through altered surface water drainage
- Damage to surrounding vegetation through accidental generation of a bushfire.

The extent of Corymbia Woodland TEC directly adjacent to the Proposal Area is specified in Table 4-16 and shown in Figure 5 (Appendix A).

Table 4-16 Corymbia Woodland TEC potential indirect impact sites

SITE NAME AND TENURE	LOCATION AND LOT NUMBER	VEGETATION COMPOSITION AND CONDITION
CW-N-I-1 **Road reserve**	South Western Highway road reserve, Waterloo	*Corymbia calophylla-Eucalyptus rudis-Melaleuca rhaphiophylla* woodland/open forest. Woodland to open forest of *Corymbia calophylla* and *Eucalyptus rudis* and sometimes *Melaleuca rhaphiophylla* over tall shrubland of *Acacia saligna*, *Viminaria juncea* and *Xanthorrhoea preissii* over shrubland of *Astroloma ciliatum*, *Daviesia physodes*, *Grevillea bipinnatifida*, *Hakea varia*, *Hemigenia incana*, *Hypocalymma angustifolium* and *Viminaria juncea* over sedgeland of *Cyathochaeta avenacea*, *Mesomelaena tetragona* and *Tetraria octandra* and open herbland of **Babiana angustifolia*, *Haemodorum simplex*, **Oxalis pes-caprae* and **Watsonia meriana* (in more disturbed areas) and very open grassland of **Briza maxima* on red-brown or yellow-brown clay loam. Condition: 2 (Excellent) - 0.009 ha 3 (Very Good) – 0.405 ha 4 (Good) – 0.233 ha 6 (Degraded) – 0.141 ha
CW-N-I-2 **Road reserve**	Railway Road reserve northern side, west of the Proposal Area boundary east of Waterloo-Dardanup Road	Woodland of *Casuarina obesa, Eucalyptus rudis* and *Melaleuca rhaphiophylla* over open shrubland of *Astartea scoparia, Melaleuca incana, M. lateritia* over open herbland Condition: 6 (Degraded)

4.1.8.3 Assessment of impacts

Up to 1.3 ha of vegetation representative of Corymbia Woodland TEC will be directly lost as a result of Proposal implementation (Figure 4, Appendix A).

According to the Approved Conservation Advice (DoEE, 2017a), as at April 2017, 29 occurrences of this community totalling about 115 ha had been located between Bullsbrook and Capel.

An assessment of the extent of Corymbia Woodland TEC to be cleared as a result of Proposal implementation against the extent remaining can be found in Table 4-17. Based on this assessment, the clearing of up to 1.3 ha associated with the Proposal would result in a reduction of up to 1.1 % in the reported extent of the TEC. Of this, 0.05 ha was rated as in Good or Better condition.

Table 4-17 Extent of Corymbia Woodland TEC within Proposal Area / total extent

TEC	EXTENT IN PROPOSAL AREA (HA)	TOTAL % LOSS OF KNOWN TEC EXTENT
Corymbia Woodland TEC	1.3	1.1%

Potential indirect impacts will be mitigated where possible, with any remaining impacts addressed through the implementation of management actions in accordance with Main Roads standards, as detailed in Section 4.1.8.4.

4.1.8.4 Mitigation

Avoid

Substantial changes to the Proposal design have been made to avoid impacts to Corymbia Woodland TEC vegetation. A summary of the original impact, design changes and resulting impact is presented in Table 4-18.

Table 4-18 Detailed design changes to avoid impacts to TEC / PEC vegetation

TEC / PEC TYPE	JUNE 2019 S. 38 REFERRAL	JANUARY 2020 S. 43	REDUCTION IN TEC / PEC CLEARING AREA
Corymbia Woodland TEC	2.0 ha[3]	Up to 1.3 ha	0.7 ha

Discussions with EPA regarding the reduced potential and management of impacts on TECs and the PEC led to a review of the requirement for a standalone EMP on TECs and PECs. As discussed with DWER, Main Roads does not consider that a standalone EMP for TECs and PECs is warranted, and consequently has not been included in this document.

The following actions will be implemented to manage indirect impacts to remaining Corymbia Woodland TEC vegetation directly adjacent to the Proposal Area. The majority of these actions are included in the Main Roads Standard Scope of Work and Technical Criteria and have been formulated in consideration of the specific TEC occurrences that will remain after Proposal implementation. Those that are 'above and beyond' standard practice are also detailed below. It is expected that they will sufficiently manage any indirect impacts. As is detailed in Section 4.1.7.3, Proposal implementation is not expected to reduce the viability of any remaining Corymbia Woodland TEC occurrences.

Prior to construction

- As part of the contractor's CEMP, development of a Hygiene Management Plan to prevent the spread of dieback and weeds to adjacent vegetation. The management plan will include procedures such as machinery/vehicle clean down, weed treatments and restrictions on vehicle/machinery movements
- As part of the contractor's CEMP, development of a Fire Management Plan
- Declared Plants and WoNS within the Proposal Area and in adjacent Corymbia Woodland TEC vegetation within the Proposal Area will be removed or treated with herbicide.

[3] FCT 3c was identified in a supplementary flora and vegetation survey conducted after the submission of the s.38. The Proposal Area boundary was then modified to reduce impacts to FCT 3c.

During construction

- Contractor induction will include familiarisation with and discussion of Corymbia Woodland TEC vegetation, Phytophthora dieback management and hygiene management
- Low impact temporary fencing will be installed on the active construction front of Corymbia Woodland TEC vegetation areas prior to clearing and maintained during construction phase
- Movement of machines and other vehicles to be restricted to the limits of the areas cleared within the Proposal Area or on designated tracks outside the area
- Infestations of Declared Plants and WoNS in retained Corymbia Woodland TEC vegetation, as well as in revegetation and landscaping within the Proposal Area, will be removed or treated with herbicide
- No re-fuelling of equipment will be conducted within 100 m of Corymbia Woodland TEC vegetation
- As far as practical, clearing activities will occur during the dry months to reduce the risk of spreading Dieback. Should this not be possible, access will be restricted to limestone tracks in accordance with the Dieback Management Plan
- All DFES and LGA restrictions on fire and machinery movement will be strictly adhered to.

Post construction

- For three years post construction, control of Declared Plants and WoNS will be undertaken in retained Corymbia Woodland TEC vegetation, as well as in revegetation and landscaping within the Proposal Area

'Above and beyond' management measures

The Corymbia Woodland TEC vegetation is predominantly reliant on rainfall and infiltration of overland flows. The drainage design for the Proposal has been developed with the aim of maintaining the existing hydrological regime to mitigate potential indirect impacts on environmentally significant areas outside of the Proposal area.

Drainage at CW-N-I-2 flows from the south to the north, concentrating along the south side of Railway Road. A culvert under Railway Road approximately 25 m east of the site conveys this runoff into the Water Corporation Victory Branch Drain H. Railway Road is unsealed through this section and runoff sheets into table drains on each side of the road that then flows into the Water Corporation Victory Main Drain and Branch Drain H. Runoff from this portion of the Proposal Area will be directed to a water quality basin which will outflow to the existing paddock area and into the Victory Branch Drain H via the existing culvert.

The existing South Western Highway drains into roadside drains on both the north and south side, from a crest approximately two kilometres east of Millars Creek back towards Millars Creek. The north side drain discharges to the south side via a culvert approximately 50 m east of the existing Waterloo Road intersection with South Western Highway. The drainage works for the South West Highway interchange will maintain these existing flow paths and tie into the existing drain on the south side of South Western Highway at the existing Waterloo Road intersection, upstream of CW-N-I-1. There will be no drainage works within the existing drain through CW-N-I-1. Accordingly, no impact to vegetation will occur as a result of the drainage works.

Monitoring

In order to assess the effectiveness of management actions on potentially indirectly impacted occurrences of Corymbia Woodland TEC vegetation (as detailed in Table 4-16 and shown in Figure 5, Appendix A), a monitoring program has been designed. This includes a combination of transects (incorporating 2 x 2 m plots) and photo points. Consultation with DBCA (Mr. Andrew Webb) regarding the monitoring program design was undertaken, with provided advice incorporated into the design. The proposed monitoring plan is detailed in Appendix F.

Two reference sites on Crown land or road reserve known to support Corymbia Woodland TEC vegetation located in close proximity to the potential impact monitoring sites have been identified (Figure 5, Appendix A). The purpose of these is to enable comparison of potential impact site data with data from sites located away from the Proposal Area to assist in determining whether any occurring impacts have resulted from Proposal implementation.

It is proposed that the vegetation monitoring program will be implemented for two years post construction, with the option to extend for a third year if required. The vegetation monitoring program will be implemented in two frequencies – photo point monitoring will be conducted quarterly and transect monitoring annually in winter-spring (in consultation with DBCA).

Opportunistic visual inspection for drying effects of Corymbia Woodland TEC vegetation from the Proposal will be conducted during construction. A drainage monitoring plan is included in Appendix E.

Triggers, thresholds and contingency actions that will be implemented should monitoring indicate a decline in monitored parameters are detailed in Appendix G.

4.1.8.5 Predicted Outcomes

A high level of mitigation and management has been applied to the Proposal, with Main Roads making substantial and costly changes to the Proposal design in order to mitigate potential impacts on flora and vegetation, including Corymbia Woodland TEC vegetation. The changes made have resulted in a 35% reduction in the area of this TEC to be impacted, to 1.3 ha.

The EPA objective for Flora and Vegetation will be met for the Proposal through implementation of appropriate management and mitigation detailed in this ARI.

4.1.9 Reporting

Results of monitoring and compliance with proposed management actions will be reported to DWER as part of the Proposal's annual compliance report. The format of this report will be consistent with requirements stipulated by individual regulatory authorities.

An annual report will be submitted to the Environmental Protection Authority Services unit of DWER at an agreed date. The report will document compliance with conditions of approval.

Where applicable, environmental incidents will be reported to the relevant government agency.

Triggers, thresholds and contingency actions are based on the environmental monitoring described in Appendices E and F, and are included in Appendix G. If environmental monitoring identifies a non-conformance with EMP targets / relevant legislation or guidelines, the incident will be reviewed and corrective actions implemented. The corrective actions, which are aimed at preventing recurrences of the incident taking place, are also detailed in Appendix G.

The contingency actions will include changes to equipment / processes / management measures if required. These changes will be communicated through site inductions / toolbox meetings.

Environmental incidents are defined as events that cause or potentially cause harm to the environment.

Environmental incidents are to be reported to the Environmental Manager by the person responsible for the incident or the first person to observe the incident. The Environmental Manager will assess the type and severity of the incident in accordance with Main Roads' standard incident procedures. Relevant personnel will be notified, including reporting to regulatory authorities.

The number and type of contingency actions to be implemented in the case of trigger exceedance will depend upon various factors, including the state of the natural surrounding environment, the location of the trigger and the works undertaken at the time of the exceedance.

4.2 Key Environmental Factor – Terrestrial Fauna

4.2.1 EPA objective

The EPA's objective for terrestrial fauna is '*To protect terrestrial fauna so that biological diversity and ecological integrity are maintained* (EPA, 2018b).

4.2.2 Policy and guidance

- Environmental Factor Guideline Terrestrial Fauna (EPA, 2016c)
- Technical Guidance Sampling methods for terrestrial vertebrate fauna (EPA, 2016d)
- Technical Guidance Terrestrial Fauna Surveys (EPA, 2016e)
- Instructions on how to prepare an Environmental Review Document (EPA, 2018c).

4.2.3 Notice Requiring Information for Assessment – Terrestrial Fauna

The EPA required the following information for its assessment of the Proposal:

- Undertake additional surveys to:
    - confirm occurrence of Black-stripe Minnow and/or suitable habitat for Black-stripe Minnow within the Proposal Area and adjacent areas that may be affected by the proposal
    - confirm and quantify any direct impacts to Black-stripe Minnow such as clearing of habitat
    - confirm and quantify any indirect impacts such as changes to hydrological regimes, changes in water quality, habitat degradation, habitat fragmentation etc.
- Update mapping to include additional survey work and any impacts to suitable habitat for black-striped minnow.
- Update the referral information to confirm and quantify impacts to Carter's Freshwater Mussel.
- Provide updated mapping to better illustrate impacts to Carter's Freshwater Mussel.
- Provide an assessment of any updated impacts to threatened fauna, revise the mitigation measures accordingly and provide a Conservation Significant Fauna EMP to ensure the EPA's objective for terrestrial fauna will be met.

4.2.4 Previous and additional surveys

Field investigations undertaken relevant to this Proposal are provided in Table 4-19.

Table 4-19 Fauna investigations undertaken for the purpose of this Proposal

YEAR SURVEY COMPLETED	CONSULTANT	SURVEY NAME
Surveys undertaken for the Proposal prior to referral		
2018	Biota Environmental Sciences (Biota)	Bunbury Outer Ring Road Northern and Central Section Targeted Fauna Assessment (Biota, 2020)
2019	Biota Environmental Sciences (Biota)	Western Ringtail Possum: *Pseudocheirus occidentalis* Regional Surveys DRAFT (Biota, 2019) (in prep)

YEAR SURVEY COMPLETED	CONSULTANT	SURVEY NAME
2018	Wetland Research & Management (WRM)	Bunbury Outer Ring Road Northern and Central Investigation Area: Targeted Conservation Significant Aquatic Fauna Survey (WRM, 2020)
Additional surveys undertaken for Proposal following referral, including information requested in Section 40(2)(a) Notice		
2019	Biota Environmental Sciences (Biota)	Bunbury Outer Ring Road Northern and Central Section – Targeted Fauna Assessment (Biota, 2020)
2019	Wetland Research & Management (WRM)	Bunbury Outer Ring Road Northern and Central Investigation Area: Targeted Conservation Significant Aquatic Fauna Survey (WRM, 2020)

Following referral of the Proposal in June 2019, additional surveys targeting threatened fauna species identified as occurring within the Proposal Area were undertaken to address the requirements of the July 2019 Section 40(2)(a) Notice. The results of these additional studies are summarised below. The assessment of the broader fauna values of the area is provided in BORR IPT (2019a) and has not been repeated here.

The results of additional targeted surveys and, where relevant, results from previous studies have been incorporated into the following sections. The assessment of impacts and mitigation measures are set out for each threatened fauna species (see below) and includes additional information on:

- The sizes and densities of local WRP populations
- The quality of WRP habitat
- The studies undertaken to inform habitat clearing regimes and the design of engineered fauna movement (connectivity) structures.
- Distribution and habitat of BSM, including mapping of habitat within and adjacent to the Proposal Area
- Impacts to CFM and mapping of habitat within the Proposal Area.

4.2.5 Threatened fauna

Seven conservation significant species were identified in the referral document as occurring or likely to occur within the Proposal Area. These species are the focus of the current assessment and include:

- WRP (Critically Endangered, Schedule 1)
- BTP (Schedule 6)
- BSM (Endangered, Schedule 2)
- CFM (Vulnerable, Schedule 3)
- Baudin's Cockatoo (*Calyptohynchus baudinii*) (Endangered, Schedule 2)
- Carnaby's Cockatoo (*Calyptohynchus latirostris*) (Endangered, Schedule 2)
- Forest Red-tailed Black Cockatoo (*Calyptohynchus banksia naso*) (Vulnerable, Schedule 3).

Updated information on potential impacts to threatened fauna species and mitigation measures are provided below and in the Conservation Significant Fauna EMP.

Terrestrial conservation significant fauna

4.2.6 Western Ringtail Possum

4.2.6.1 Receiving environment

Species description and conservation status

The Western ringtail possum (WRP) is a medium sized arboreal marsupial, endemic to the south-west of Western Australia. WRP were once widely distributed across the south and south-west of the state (from north of Perth to east of Albany) but are now restricted to the southern Swan Coastal Plain, the Jarrah forests near Manjimup and the south coast between Walpole and Albany. The WRP was first listed as threatened under the Western Australian *Wildlife Conservation Act 1950* in 1983, and under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) in 2000. Its listing was reassessed to critically endangered under the *Biodiversity Conservation Act 2016* (BC Act) in 2016 and EPBC Act in 2018.

Breeding parameters

Most young are born during winter (April–June) with a second peak in spring (October–November) but some populations breed all year around. Young possums spend about three months in the pouch. WRP detection rates (for surveys) are greatest during spring (October–April) with peaks coinciding with weaning and maturation of young (April–June) (Shedley & Williams, 2014). WRP populations fluctuate locally on a seasonal basis, peaking with the maturation of young in spring and early summer and falling with the dispersal of young males and death of older individuals through natural attrition. These fluctuations can often be considerable and strongly related to climatic variations (Shedley & Williams, 2014).

Species extent and distribution

The WRP is known from three key management zones: the Swan Coastal Plain, the Southern Forests and the South Coast. In their 2019 regional survey, Biota (Biota, 2019) found that of these zones, the surveyed footprint of the Swan Coastal Plain management zone yielded the greatest estimated abundance of Western Ringtail Possum at 9,270 individuals, with the majority (around 6,500) occurring in the Swan Coastal Plain IBRA region. The estimated abundance within the Southern Forests zone was 7,500 and within the South Coast zone was 3,340, taking the total estimated abundance to approximately 20,000 individuals.

Habitat requirements

The species feeds on leaves of myrtaceous species, predominantly Peppermint (*Agonis flexuosa*), but also Marri (*Corymbia calophylla*) and Jarrah (*Eucalyptus marginata*). Home range sizes and possum density vary with the quality and productivity of the habitat. Home ranges are generally less than 5.0 ha, and those within peppermint dominated habitat are generally less than two hectares and average 0.4 ha and 0.3 ha for females and males respectively (DPaW, 2017). Densities of up to 20 individuals per hectare have been recorded in Peppermint woodland in Busselton on the southern Swan Coastal Plain (DPaW, 2017). In more recent data collected by Biota (Biota, 2019)

Western ringtail possums are known to be susceptible to heat stress and can overheat at ambient temperatures of 35ºC and above (DPaW, 2017; Yin, 2006).

Habitat critical for the survival of the species is understood to vary between population areas (or management zones) but is generally associated with areas that provide high nutrient foliage for food, suitable structures for protection/nesting (including suitable hollows), and canopy continuity. Linkages between areas of suitable habitat area also considered critical to the survival of the species. On the Swan Coastal Plain, critical habitat includes areas of mature unburnt peppermint woodlands with high canopy continuity, high nutrient foliage and connectivity with other patches (DPaW, 2017).

Population size and density can vary significantly with seasonal conditions. Unless they are isolated or constrained, populations usually consist of a combination of resident and transient individuals. It is not possible during discrete surveys to distinguish resident from transient animals however variations in populations as a result of repeated seasonal observations provide an indication of the distinction. The proportion of transient individuals increases during the breeding season as males move through patches in search of a mate, and again when young are dispersing.

Movement pathways are often established between areas of quality habitat and water sources, and along continuous corridor such as vegetated riparian zones. WRP will move to new areas in search of high quality foraging habitat, in search of a mate or if competition for resources is high.

Threats to WRP

The major threats to the species include habitat loss and fragmentation. Other threats include predation by introduced carnivores, climate change, logging, fire, competition for nest hollows and habitat tree decline (DPaW, 2017). In addition to these threats, the Commonwealth Conservation Advice also lists groundwater depletion and altered hydrology, increasing temperature, tree decline and insect outbreaks, domestic dogs, ravens, and (potentially in future) Myrtle rust (TSSC, 2018a).

Species and habitat extent within and adjacent to the Proposal Area

All trees and areas of potential WRP habitat within and adjacent to the Proposal Area were included in field surveys. During these surveys, WRP were recorded in woodland fragments, particularly mixed woodland (Biota, 2020) (Figure 6, Appendix A). Four habitat types, mapped by Biota (2020), were identified as suitable breeding and foraging habitat for WRP, 'Marri/ Eucalyptus Woodland', 'Marri/ Eucalyptus in paddocks and road reserves', 'Peppermint Woodland' and 'Riparian Woodland' (Figure 6, Appendix A). The Proposal Area contains 43.9 ha of WRP habitat.

WRP occur in three main habitat areas within the Proposal Area (Figure 7, Appendix A). From north to south they are:

- At and around the Clifton Road / Paris Road interchange and north to the Brunswick River
- Around the Boyanup Picton Road interchange
- Around Manea Park.

These areas support patches of suitable WRP habitat and are generally separated by large expanses of cleared agricultural land. WRP habitat is present adjacent to the Proposal Area along the length of the Proposal Area, with further larger expanses also in the vicinity of these adjacent areas. None of the Proposal Area habitat areas are isolated from adjoining habitat.

To build an understanding of the local WRP populations and inform the development of suitable mitigation strategies, additional surveys have been completed since the June 2019 referral of the Proposal, as detailed in Table 4-19. These included assessment of suitable habitat within and adjacent to the Proposal Area as well as habitat value and WRP movement pathways (Biota, 2020). In addition to this, Main Roads engaged Biota to conduct a regional survey of WRP to determine the species' distribution and density throughout the entire range of the species (Biota, 2019), as detailed in Section 4.2.6.2. Information from the regional survey has also informed the Proposal planning.

In addition to the original data presented in BORR IPT (2019a), data are now available for August, November and December 2019, as presented in Table 4-20. The survey data shows similar numbers for August and October surveys and significant seasonal variation of the local population between October and December. This information has been integral in the development of mitigation strategies and enhance connectivity between habitat areas along the alignment.

Using a combination of mapping provided by Shedley and Williams (2014) and survey data collected for the Proposal, 'key' habitat areas have been mapped where the highest densities of WRPs have consistently

been recorded (Figure 7, Appendix A). This information has informed the areas to be avoided, as well as the staged clearing approach.

Table 4-20 WRP observations within Proposal Area

SURVEY DATE	NUMBER OF WRP
August 2019	22
October 2019	20
December 2019	15

Biota's (2019) survey data indicates that there may be a seasonal component to habitat use, for example, a single WRP was recorded from the road reserve habitat either side of the Forrest Highway north of Clifton Road during August 2019, yet in October of both 2018 and 2019 at least six detections were made in the same area.

The additional and regional surveys also identified WRP movement pathways in the vicinity of the Proposal Area. The physical location of individual possum sightings recorded during each survey period from each monitoring phase and the change in the position of those points can be used to infer movement. The intensity of the observations combined with the inferred movement highlight locations suitable for installing overpasses / underpasses to maintain habitat connectivity after construction. This data has been utilised by Main Roads to refine the locations of proposed overpasses / underpasses for the Proposal, see Appendix H.

Western Ringtail Possum Movement

Barbara Jones has been studying the WRP population for more than 30 years and is recognized by the Commonwealth as one of the preeminent experts regarding WRP populations and ecology (TSSC, 2018a). Barbara Jones professional observations of the southern Swan Coastal Plain WRP populations have been summarized as follows:

> WRP display a range of behavioural adaptations to using man made features. Examples of this include using reticulation, drippers, bird-baths and pet bowls during extreme summer conditions. In areas with high densities of WRP, sheds and roof spaces (near suitable trees) often provide ideal possum shelter nooks, while appropriate fence tops, old phone cabling, and even live power-lines help individual WRPs to get around in their patch more efficiently, safely or directly.
>
> WRP's movement within their known habitat patches is predominantly achieved by using preferred well-known runways. In the manmade environment, these runways often accumulate a WRP residue of urine and scent.
>
> WRPs have been observed using construction site scaffolding to move between trees within a week of the scaffolding being erected. Most WRPs will explore and investigate manmade structures, but show caution exploring new structures constructed in proximity to preferred habitat.
>
> The amount of time WRP's spend on the ground depends on the habitat and density of feeding trees i.e. sparser vegetation means more time on the ground. Males typically travel more widely and spend more time on the ground.
>
> Where dense cover is available below good foraging trees, WRPs will often shelter in thick vegetation at ground level. WRPs have been observed seeking shelter in known rabbit warrens. In habitat where good foraging canopy connects numerous trees, dominant females may be almost

exclusively arboreal. However, if conditions get too hot or too dry, WRPs often leave the trees seeking a damp cool shelter site at ground level.

Most behavioural observations have been conducted in higher density WRP populations, particularly from the Busselton area, where densities of 5-15 WRPs per hectare have been common.

The BORR WRP habitat surveyed by Biota 2017-19 had an overall average density of approximately one individual per hectare. Repeated counts within the BORR footprint during August, October and December 2019 indicated that some patches were used by WRPs during one count period, but were virtually empty in another count period. This implies that Bunbury WRPs in remnant woodlands move substantially between different habitats. The bimonthly count sequence will run through 2020. This sequence should clarify seasonal (or other) trends in WRP abundance in the BORR habitat remnants.

Western Ringtail Possum Use of Structures

Within WRP populations of the southern Swan Coastal Plain, attempts to mitigate habitat disjunctions associated with linear structures have relied primarily on rope bridges or cables over existing roads. The success of these structures has been mixed. On Caves Road near Vasse a 26.5 meter long bridge built in 2013 was used by WRPs within 36 days of construction and recorded 1,300 crossing in 270 days (9 months) of monitoring (Yokochi & Bencini, 2015). The tallest and longest rope bridge is an 88 meter span of BORR's existing central segment constructed in 2014, which only had two confirmed crossings in 13 months of monitoring (Chambers & Bencini, 2016).

Barbara Jones professional observations regarding WRPs and use of fauna movement structures is summarized as follows:

In addition to rope bridges, there have also been attempts to encourage WRPs to use kangaroo underpasses (e.g. Busselton Bypass), however, none that were monitored have shown repeated use by WRPs (monitoring periods for underpasses have been relatively short).

In all south west WRP crossover examples to date, there has been no field evidence to test whether the frequency of WRP road-crossing events at ground level near used rope bridges or underpasses had truly been reduced by the provision of either treatment. It is considered that WRP will continue to cross at ground level if it is the easier option for the animal. In studies undertaken to date, monitoring of WRP use typically involves a single crossover structure.

The BORR project will provide the first opportunity to monitor WRP use of multiple underpasses and allow assessment of the performance of different crossing treatments. The inclusion of road protection fencing in the BORR design has been designed to prevent WRPs accessing the road at ground level. In BORR's main WRP areas, possum exclusion fencing will also function to turn native mammals away from the road, and to help funnel ground-moving WRPs into an underpass forecourt area. Where feasible, these forecourt areas can be generously landscaped with features to make the underpass forecourt areas increasingly useful, desirable or comfortable for WRPs, especially for WRPs moving at ground level.

Rope cabling has been recently used under Treendale Bridge (Eaton Drive) on the Collie River. The new bridge required a narrow riparian strip on one bank to be severed from a pre-existing connection used by resident WRPs. In autumn 2018, the resultant gap was treated with simple cabling that extended out to suitable nearby trees on either side of the bridge, and was continuous just below the underside of the bridge. When inspected in August 2019, WRP scat (differing ages) was found directly below the rope bridge, but it was most common where the rope bridge was sheltered by the road bridge, suggesting that on the sheltered part of the cable,

WRPs were comfortable enough to pause and rest. But on the exposed cabling adjacent to the bridge, they did not linger in a comparable way. This cabling approach has been incorporated into the BORR Northern and Central bridges.

Fauna bridges in the South west to date have not featured WRP perching and lay-by areas. These allow for the structure to provide a more user-friendly environment, especially suited for WRPs doing staged explorations of a new set of cabling.

With respect to the existing 88 meter BORR Central rope bridge, minor structural treatments should be applied to extend some peripheral cabling, mostly between existing trees (WRP habitat) to develop a desirable crossover forecourt area where dry-season watering points and cameras can be added. Retro fitting the existing long crossover (BORR Central) with features attractive to WRPs should create a better understanding of how to successfully span wider WRP disjunctions in the developing west-coastal habitat strip.

4.2.6.2 Potential impacts

Direct impacts

The Proposal will result in the loss of up to 43.9 ha of WRP habitat within the 625 ha Proposal Area. The habitat to be cleared is currently fragmented, dissected by existing roads, easements and cleared agricultural land.

To reflect the seasonal and transient fluctuations in population size noted in section 4.2.6.1, the potential impact of the Proposal on individual WRP home ranges is presented as a range rather than a discrete figure. Based on these data, it is estimated that between 15 and 25 WRPs within the Proposal Area will potentially have their home ranges disturbed by the Proposal. This indicates that up to 0.11 % to 0.26 % of the 2019 estimated WRP population within the Southern SCP Management Zone as identified by Biota (2019) (of up to 9,270 individuals) could potentially be impacted. No WRP mortalities are likely to result directly from the Proposal. A summary of the potential impact is presented in Table 4-21.

Table 4-21 Summary of potential direct impacts to WRP

FACTOR IMPACTED	LOSS (HA OR NUMBER)	LOSS (%)
WRP Habitat	43.9 ha	Up to 0.70 % of habitat in the Bunbury management zone of Shedley and Williams (2014)[4]
WRP home ranges disturbed	15 to 25	0.11 % to 0.26 % of the estimated 2019 Southern SCP Management Zone population

Context of Proposal Area habitat

The 43.9 ha of WRP habitat constitutes approximately 7 % of the 625 ha Proposal Area.

The targeted fauna assessment was undertaken within a study area of 1128.01 ha that included the current Proposal Area and adjoining remnant vegetation (Biota 2019a). Approximately 147 ha of WRP habitat was mapped in this study area.

Shedley and Williams (2014) calculated that the Bunbury WRP 'management zone' (which encompasses an area from the Preston River in the north to the Capel River in the south) includes 6,264 ha of WRP habitat[5], the majority of the mapped habitat coinciding with the Proposal (58 %) has been classified as 'Medium'

[4] The majority of Proposal Area WRP habitat was included in the mapping of Shedley and Williams (2014)
[5] Shedley and Williams (2014) noted that 'the potential area of class C is likely to be overestimated, especially in the Bunbury and Binningup zones, as there have been very few surveys in these soil landforms'.

quality, with the remaining areas mapped as a combination of 'High' (6 %) and Low (15 %) quality (with no areas were mapped as 'Very High' or 'Very Low' quality). The area of habitat in each habitat quality class within the Proposal Area as mapped by Shedley and Williams (2014) is shown in Table 4-22. No 'A' class (Very High Quality) habitat was present.

The 43.9 ha of habitat that would be lost under the Proposal equates to 0.70 % of the estimated habitat in the Bunbury management zone.

Table 4-22 Proposal Area WRP habitat extent by quality class

HABITAT QUALITY CLASS	EXTENT WITHIN PROPOSAL AREA in HA (Per cent of total)
A ('Very High' quality)	0
B ('High' quality)	2.85 (6%)
C ('Medium' quality)	25.44 (58%)
D ('Low' quality)	6.58 (15%)
Not Assessed	9.03 (21%)

Context of Proposal Area population

Historically, there has been an absence of robust abundance estimates of WRPs, and was recognised as a key knowledge gap (Shedley & Williams, 2014). In 2015, the adult population of WRPs in all of Western Australia was estimated to be 3,400, including 2,000 within the Southern SCP Management Zone. This estimate informed the 2016 (State) and 2018 (Commonwealth) reclassification of the species' conservation status from vulnerable to critically endangered.

Biota (2019) completed additional surveys using distance sampling of regional context sites to provide a regional context for potential impacts from the Proposal on the WRP. This survey was conducted over three key management zones: Southern SCP, Southern Forest (around Manjimup) and South Coast (around Albany). The survey included sites on the southern section of the SCP, between Binningup and Dunsborough, and extending into the northern section of the Whicher Scarp near Dardanup (Biota, 2019b).

Of the three key management zones, the surveyed footprint of the Southern SCP Management Zone yielded the greatest estimated abundance of WRP.

Based on preliminary analysis of these results, the study estimated a WRP population for the Southern SCP Management Zone in 2019 of 9,270 individuals with the majority (around 6,500) occurring in the SCP IBRA region. The estimate does not include smaller remnants of native vegetation or 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 (Biota, 2019).

The well-documented stronghold for the species, the Tuart forests between Busselton and Bunbury yielded some of the highest estimated densities (3.40 – 3.98 individuals/ha (at the study site level)) and the relatively large remnants sampled support some of the largest populations of the species. These densities are substantially lower than the estimated maximum densities previously recorded for the species by DPaW (2017).

The 2019 population estimate was based on intensive surveys that covered 4,211.7 ha within all three management zones. The preliminary results indicate that the Southern SCP Management Zone supports a population larger than the entire previously estimated (2015) Western Australian adult population (Biota,

2019). Any potential impacts to local populations are unlikely to impact overall populations, given the species' presence and distribution in the wider area.

Indirect impacts

The Proposal may potentially result in the following indirect impacts to WRP including:

- Incremental loss of WRP habitat resulting from reduced connectivity, barrier effects and edge effects
- Displacement of WRP due to traffic noise exposure
- Displacement of WRP due to light spill from street lighting and traffic.

Historical clearing combined with incremental reduction in habitat has restricted the distribution of WRP within the Proposal Area. As habitat is cleared, patch sizes decrease and the impact of 'edge effect' increases with likely introduction of weeds and dieback, ultimately changing the species composition of the vegetation community and reducing suitability of habitat for local fauna species, including WRP.

The Proposal Area has been largely cleared for agriculture, urban and industrial developments. Clearing for these landuses has resulted in fragmentation of both terrestrial and riparian / wetland vegetation and ecological linkages, thereby reducing connectivity of WRP habitat. Connectivity of habitat areas is important to enable dispersal of WRP to find habitat and mates, and maintain the exchange of genetic material between populations. Good connectivity is also important to enable WRPs resident in small patches to access additional food resources and water as required.

Although WRP may relocate to other habitat areas in order to move away very noisy and brightly lit areas (pers comm. Barbara Jones), WRP have adapted to urban and semi-urban area and are often found in high densities in these areas (Shedley & Williams, 2014). This indicates that they are able to adjust to and even thrive in developed areas with light and noise levels higher than would be found in undeveloped areas.

4.2.6.3 Assessment of impacts

Direct impacts

Loss of WRP

No WRP mortalities are expected as a direct result of the Proposal. A pre-clearing targeted fauna survey will be undertaken to identify the presence and the locations of *P. occidentalis* individuals to assist with the planning of the clearing activities. *Pseudocheirus occidentalis* are mobile fauna taxa and will be encouraged and enabled (shepherded) to move of their own accord into adjacent areas of retained habitat during the clearing activities[6].

The linear clearing corridor for the Proposal provides for good dispersal options for *P. occidentalis* into adjacent habitat, and it is likely that dispersing individuals are already familiar with these adjacent habitat areas (as part of their home range). It is anticipated that *P. occidentalis* individuals will readily relocate into other areas of their home ranges.

Using the data obtained from the environmental surveys and from Shedley and Williams (2014), the key *P. occidentalis* habitat areas have been identified, and where a significant number of *P. occidentalis* are recorded during the pre-clearing survey, the clearing of such areas will be scheduled not to occur within the *P. occidentalis* breeding season and pouch young season (spring and summer).

Home ranges

[6] The approach of allowing *P. occidentalis* to self-relocate to adjacent habitat has been chosen over translocation of *P. occidentalis* to other areas as it provides the best outcome in terms of animal welfare. The success rates of documented translocation projects is poor, and as yet no successful methodology has been developed or implemented (Clarke, 2011), (de Tores, 2005). Allowing *P. occidentalis* to relocate to adjacent habitat of their own accord eliminates the requirement for handling, substantially reducing the likelihood of *P. occidentalis* being put under undue stress.

Home ranges are generally less than 5 ha, and those within peppermint dominated habitat are generally less than two hectares and average 0.4 ha and 0.3 ha for females and males respectively (DPaW, 2017). The Proposal Area is a relatively long and narrow road corridor, 200 m wide at its maximum width and 19 kilometres long. As such, although a number of WRP home ranges may be reduced, it is unlikely that entire WRP home ranges are contained within the Proposal Area. Although it is expected that between 20 and 25 home ranges may be disturbed to some degree by the Proposal, it is considered that these home ranges extend beyond the Proposal Area. As such, the impact of the Proposal on WRP home ranges is expected to be minor.

Connectivity

The Proposal Area already contains a number of connectivity barriers in the form of the existing Forrest Highway and arterial roads, easements and large expanses of cleared agricultural land. Although connectivity between some habitat areas will be temporarily disrupted during Proposal construction (Figure 1, Appendix A), the majority of habitat within the Proposal Area is already disconnected and will not be further impacted in this way by the Proposal. Conversely, connectivity across the alignment between existing habitat areas will be improved as a result of Proposal implementation through the installation of more than 40 possum over/underpasses and or rope bridges, as described in section 4.2.6.4 and shown in Figure 8 (Appendix A). The maintenance of existing movement pathways and connectivity along either side of the alignment has been a priority during Proposal planning. Connectivity and suitability of cleared areas remaining within the Proposal Area will be further enhanced with targeted revegetation post construction. As is also shown on Figure 8 (Appendix A), the detailed design ensures this connectivity will remain, and potentially improve, after the implementation of the Proposal.

Viability of habitat areas

All WRP habitat areas within the Proposal Area are contiguous with or adjacent to other habitat areas that will be retained. The Proposal Area configuration means that no habitat areas will be cleared in their entirety. There are four main clearing areas with all other clearing comprising small slivers of vegetation removed from patch boundaries in varying degrees (Figure 6, Appendix A).

Habitat patch size is not a reliable indicator of either WRP presence or density. In fact, small habitat remnants have been shown to be well utilised by WRP, especially when peppermint (*Agonis flexuosa*) is present (Shedley & Williams, 2014), as is the case with the Proposal Area and adjacent habitat. In the vicinity of the Proposal Area, WRP have been recorded in very small areas of habitat and even in isolated paddock trees (Biota, 2020). In their assessment of WRP habitat, Shedley and Williams (2014) concluded that all small patches of high quality habitat are important as they contribute significantly to the overall WRP carrying capacity of the region.

None of the habitat areas that are currently known to support WRP (from the surveys undertaken by Biota) are anticipated to become unviable as habitat as a result of Proposal implementation.

Carrying capacity of habitat areas

The density of WRP density within different habitat patches is not predictable and does not follow a set pattern (Shedley & Williams, 2014). As such, the carrying capacity of a given habitat patch is difficult to determine. Some factors which intuitively would be considered important, such as canopy cover and vegetation condition, have been found not to influence WRP densities. Shedley and Williams (2014) further noted that nearly half of the patches assessed in their study with high and very high WRP densities were degraded to completely degraded *"where the basic vegetation structure had been severely impacted by disturbance, and where intensive management was required for regeneration".* Despite stated limitations of their assessment, Shedley and Williams (2014) identified the presence and dominance of peppermint as an important factor in predicting the carrying capacity of a habitat patch. Within the Proposal Area and adjacent vegetation, peppermint occurs as a mid-storey species in mixed woodland habitats, which form the majority of the Proposal Area and adjacent WRP habitat (Biota, 2020).

WRP populations within a given area of habitat fluctuate seasonally. The maximum seasonal WRP population provides an indication of the year round WRP population an area of habitat is capable of sustaining (pers comm., Barbara Jones). Based on this advice and all information obtained through studies and consultation conducted for the Proposal, shepherding WRP into adjacent habitat areas during clearing is considered the optimal approach in regard to WRP welfare i.e. favoured over translocation. In addition, management provisions including timing clearing operations to occur outside of the population peak wherever possible if densities are high at the time of clearing, will ensure that adjacent habitat is capable of sustaining any existing resident individuals as well as dispersing individuals.

Indirect impacts

WRP are present in habitat directly adjacent to the existing Forrest and Bussell Highways (Biota, 2020), indicating that traffic noise exposure is not an impediment to WRP utilising such habitat. WRP do not exhibit a particular sensitivity to light exposure from street lighting or traffic, as evidenced by the high densities of WRP in urban areas (Shedley & Williams, 2014).

Impacts from noise and light exposure resulting from the Proposal are not expected to be at a scale likely to result in WRP abandoning adjacent habitat.

4.2.6.4 Mitigation

Avoid

Substantial changes to the Proposal design have been made to avoid impacts to WRP. These mitigation measures are summarised below, while detailed management measures are presented in the Conservation Significant Fauna EMP in Appendix B (BORR IPT, 2020a).

Following the referral of the original Proposal in June 2019, Main Roads worked hard to avoid and mitigate impacts to WRP habitat and home ranges. Consultation was undertaken with technical experts Barbara Jones and Mr Roy Teale (Biota zoologist) to determine what additional information was required to inform Main Roads' mitigation and management options. Further investigations were then conducted, as described in section 4.2.6.1.

These investigations have provided reliable data regarding the size and distribution of the localised WRP populations and their movement pathways on which to base mitigation and management decisions. Information obtained through these investigations and advice obtained through consultation has guided the refinement of the detailed design and development of management actions as detailed in the EMP. Main Roads has made significant effort to design and include engineering solutions that avoid clearing of WRP habitat wherever possible and provide connectivity where clearing could not be avoided. Many of these options come at a significant additional cost to traditional approaches. The result of this effort is a revised Proposal Area that has a substantially lower impact on WRP than was originally proposed.

The key outcomes of these investigations were:

- That the regional WRP population is substantially greater than previously understood
- Confirmation of WRP presence, population trends and movement pathways within and around the Proposal Area
- Confirmation that habitat areas adjacent to the Proposal Area consistently support populations of WRP
- Confirmation of the importance of maintaining connectivity between habitat areas
- The Proposal Area (and adjacent areas) support low WRP densities compared to those along the 'Holy Mile' in Busselton where possum rope bridges have been successful.

A summary of the original impact, design changes made to avoid impacts, and the resulting impact is presented below.

Original impact

The impact to WRP resulting from the BORR North and Central Proposal Area as referred to the EPA (June 2019) was expected to result in a loss of up to 70.3 ha of habitat, and disturbance of up to 49 individual home ranges. This equated to approximately 0.5 % of the Southern SCP Management Zone population, which in December 2019 was estimated to be approximately 9,720 individuals.

Design modifications to minimise impacts

To minimise the impacts outlined above, BORR Northern and Central Section Proposal Area was further refined during the design process. These changes are summarised in Table 4-23 and shown in Figure 2 (Appendix A).

Table 4-23 Detailed design changes to avoid impacts to WRP

WRP	JUNE 2019 S. 38 REFERRAL	JANUARY 2020 S. 43
Habitat extent (ha)	Approximately 70.3 ha WRP habitat	Approximately 43.9 ha WRP habitat in revised Proposal Area – with up to 26.4 ha of WRP habitat or approximately 37.5 % of expected habitat loss saved through detailed design phase
Observations (number of individuals)	Disturbance of home ranges of up to 49 individual WRPs (44 individuals observed by Biota within the Proposal Area in early 2019)	Field data indicates disturbance of home ranges of 15 to 25 individual WRPs (0.11 to 0.26 % of the 2019 estimated Southern SCP Management Zone population)
Bridges and underpasses	No quantity specified	Installation of more than 40 underpasses/rope bridges now included within the design to reduce fragmentation and to maintain movement corridors

Resulting impact

The changes outlined in Table 4-23 have resulted in more than 25 ha of WRP habitat being removed for the Proposal. The areas that have been retained through these changes comprise intact habitat and known WRP movement pathways. Based on field survey data, in regards to the number of displaced WRP, this equates to between 15 and 25 individuals no longer likely to have their home ranges disturbed/reduced as a result of this Proposal.

Mitigate

Timing of clearing activities

- Staging of construction

In addition to WRP, the timing of clearing activities will need to take into consideration the breeding cycles for Black Cockatoos and Phascogales, and consideration for Dieback management. The WRP breeding and pouch young seasons occurs in spring and summer which is also the optimum time for construction and minimisation of risks associated with the spread of Dieback. As such, optimum timing for WRP may not be possible in all areas. Using data obtained from all surveys undertaken to date and from Shedley and Williams (2014), Main Roads has identified key WRP habitat areas within the Proposal Area (Figure 7, Appendix A). Where significant WRP numbers are recorded during the pre-clearing survey, key habitat areas will be scheduled to be outside of the WRP breeding season and pouch young seasons.

Staging of construction and clearing methodology hierarchy

WRP numbers are known to fluctuate seasonally and in response to climatic conditions, and this is also the case with populations in the Proposal Area (Biota, 2020). Prior to clearing, a pre-clearing survey will be conducted to inform contractors of the likely locations of individual WRPs and the sizes of local populations. Several clearing methodology options have been identified to enable adaption of the approach in response to WRP presence and density at the time of clearing. The methodologies to be implemented will be determined by the results of the pre-clearing survey, and may vary between habitat areas. This will ensure that the most appropriate methodology to minimise impacts is implemented. Staging of construction will also be undertaken to allow for the reduced clearing footprint.

Shepherding

Through the implementation of sensitive clearing protocols as detailed in the Conservation Significant Fauna EMP, WRP will be encouraged and enabled to move of their own accord into adjacent areas of retained habitat. Surveys conducted by Biota indicate that habitat areas adjacent to the Proposal Area support populations of WRP, indicating that these areas provide the necessary habitat requirements. Any given area of habitat is capable of sustaining a year-round WRP population equivalent to but not exceeding the maximum seasonal WRP population recorded for that habitat area (Barbara Jones, pers comm.) i.e. maximum seasonal population provides an indication of the maximum carrying capacity of a given area of habitat. Clearing will be timed (to avoid seasonal population peaks) and staged to encourage WRP to move into adjacent areas of habitat and where possible, to the largest and best-connected habitat.

The approach of allowing WRP to self-relocate to adjacent habitat has been chosen over translocation of WRP to other areas because it provides the best outcome in terms of animal welfare. The success rates of documented translocation projects is poor, and as yet no successful methodology has been developed or implemented (Clarke, 2011; de Tores, 2005). Allowing WRP to relocate to adjacent habitat of their own accord eliminates the requirement for handling, substantially reducing the likelihood of WRP being put under undue stress. The linear clearing corridor provides good dispersal options for WRPs, and it is highly probable that dispersing WRP are already familiar with adjacent habitat areas as these likely form part of their home range. It is anticipated that WRPs will readily relocate into other areas of their home ranges during construction.

If WRP numbers in adjacent habitat are 30% higher or more than the maximum number recorded during monitoring, i.e. the seasonal peak Main Roads will consult with relevant agencies (DBCA) to determine appropriate action including consideration of translocation. As clearing operations will be timed to ensure WRP numbers are below this level at the time of clearing, the potential for translocation to be required as a management measure is only likely to occur post Proposal implementation. This would occur if WRP numbers in adjacent areas increase post clearing-induced dispersal, and WRP do not or cannot move to other habitat areas.

Connectivity

Fragmentation of habitat can lead to isolation of populations, reduced population size and genetic decline. Maintenance of effective meta-population size through retention of adequate habitat area and connectivity is important for maintaining WRP genetic diversity and population viability (Shedley & Williams, 2014).

Recognising the critical importance of maintaining connectivity between habitat areas and across the local landscape, Main Roads has prioritised this aspect of impact mitigation. Known movement pathways have been retained through the detailed design process where possible, and suitably designed underpasses/rope bridges (engineered movement structures) will be installed to reconnect disrupted movement pathways between habitat areas. Forty three (43) such connections are now proposed, see Figure 8 (Appendix A). Through implementation of this project, as the Proposal Area is already highly disturbed and fragmented, the connectivity of habitat areas within the Proposal Area and surrounding areas will be improved over baseline conditions, providing a positive outcome for WRP.

Two areas within the Proposal Area have been identified as 'WRP Treatment Areas'[7] as they require engineering treatments to provide connectivity, even though no resident WRP have been observed. The two WRP Treatment Areas are associated with the crossing points for the Collie River and Ferguson River.

Due to the high number of locations where engineered movement structures can be installed along the Proposal Area, Main Roads has taken the initiative to trial a number of different structures in order to build knowledge around WRP requirements and preferences. Designs for fauna over and underpasses and rope bridges used locally and nationwide have been researched and considered. Main Roads has also considered expert advice to ensure best practice in the designs proposed for the Proposal, as well as investigate how existing structures can be improved, such as installing ledges in the tops of underpasses so that WRP do not have to go to ground, and, via ropes, linking these ledges straight up into the adjacent canopy, assisting WRP to avoid predators (Figure 8, Appendix A). The Proposal includes several design options based on these improved designs and on successful designs used at Treendale (where an underpass connects the riparian zone across the Collie River in Australind) and Busselton (where substantial areas of peppermint woodland habitat on either side of Bussell Highway are connected via rope bridges).

Main Roads acknowledges that an existing rope bridge in BORR Central has not been effective. The lack of usage of this overpass appears to be due to a number of contributing factors such as span length, exposure to predators and less-than-ideal entry and exit points. These learnings have informed the designs proposed for BORR Northern and Central, such that rope bridge spans in the proposed structures are shorter where possible, and other structures are used in places where long exposed rope bridges would otherwise be required.

Although primarily arboreal, WRPs do move on ground as evidenced in urban populations. Usage of underpasses by WRP is not expected to be limited by requiring access to the underpass through overhead connections.

The proposed overpass, underpass and rope bridge design options are shown in Figure 8.

It is noted that the success of the Busselton rope bridges has been due to the presence of historic telegraph pole and line infrastructure, the resident WRP population was already familiar with using these kinds of structures to move between areas. Further, the density of WRP in these areas was very high, increasing the requirement to move between habitat areas in search of food, other resources and mates. None of the Proposal Area populations are as high density as those at Busselton and also it is not known whether these WRP are familiar with using rope bridge type structures. As such, should the structures installed by Main Roads not initially be successful, this may not be because of design failure or incorrect structure placement but because the levels of familiarity or motivation for the WRP to use these structures is not great (low density = low competition) and / or because the resident populations are not yet familiar with that kind of structure. Main Roads will conduct ongoing monitoring to determine the efficacy of the various structures installed, to inform general knowledge about the species and determine any adaptive management actions that may need to be implemented.

Watering

WRPs can suffer serious dehydration, principally during record dry or hot conditions. Such WRP-adverse weather periods have become a common feature of the south west's last two decades of climate drift (Barbara Jones, pers comm). If hot or dehydrated, WRPs tend to go to ground, and in urban circumstances they often find water in pet bowls, shade-houses, bird- baths or reticulation systems. They do not sweat, but like kangaroos, they lick body water onto their forearms where it can evaporate to cool the blood.

In the forecourt areas associated with the BORR Project's main WRP underpasses, WRP accessible watering points will be made available for the first two dry seasons after the forecourt landscaping is completed.

[7] WRP Treatment Areas identified as areas that whilst not supporting WRP populations are important movement corridors for WRP.

Making these areas very attractive for dehydrated WRPs offers the best way for local animals to learn about the new (dark, cool and useful) cavities left in their habitat by the Proposal.

Fencing and noise wall design

A combination of permanent and temporary fauna fences will be installed adjacent to known habitat areas to limit WRP access to the Proposal Area and reduce the chance of vehicle strike of WRP and other fauna, and to protect WRP habitat from unauthorised access.

The fence will be 1.5 m high and be constructed to prevent possums being able to climb it or dig under it (Appendix B).

Where applicable, noise walls will be designed to minimise the risk of WRP climbing on or over the wall and gaining access to the Proposal Area.

Monitoring

Biannual monitoring of WRP and BTP in potential impact sites (retained habitat at the Paris / Clifton interchange Boyanup Picton Rd interchange) and current reference sites (Lot 2 Boyanup Picton Road and Reserve 23 000 Bussell Highway) will be conducted during construction and biannually for three years post construction.to collect data around the size of and variations in local populations in comparison to baseline information being collected currently to support assessment of the Proposal.

This monitoring program also includes reference sites located near to the Proposal Area (Figure 6, Appendix A). These reference sites have been selected because of their size and connectivity. They are large and generally unconnected to other habitat areas, which means that observed variations in WRP density are likely to be the result of natural cycles (breeding and attrition) and / or climatic conditions.

Through a comparison with trends in WRP reference site populations, variations in populations adjacent to the Proposal Area can be measured and investigated further if significant differences are detected.

4.2.6.5 Predicted outcome

A high level of mitigation and management has been applied to the Proposal, with Main Roads making substantial, more expensive changes to the Proposal design in order to mitigate potential impacts on WRP. As a result of the changes, a maximum of 43.9 ha of WRP habitat will be cleared, and between 20 and 25 home ranges potentially disturbed. No areas of habitat will be lost in their entirety and it is also unlikely that any entire home ranges will be impacted. Connectivity along and across the Proposal Area will be maintained and potentially improved through retaining key habitat areas and installing fauna underpasses and / or rope bridges. Impacts of the Proposal on WRP are not considered significant.

The EPA objective for Fauna will be met for the Proposal through implementation of appropriate management and mitigation.

Main Roads intends to further counterbalance the residual impacts of the Proposal through implementation of an environmental offset strategy (see Section 5).

4.2.7 South-western Brush-tailed Phascogale, Wambenger

4.2.7.1 Receiving environment

Species description and conservation status

The South-western Brush-tailed Phascogale (BTP) (*Phascogale tapoatafa wambenger*) is a small (100 – 300 g), strongly arboreal marsupial species. They are carnivorous, short-lived and nocturnal. BTP are grizzled grey in colour above and cream to white below with large naked ears and a conspicuous black ‘bottle -brush’ tail (CALM, 2002). They are listed as Conservation Dependent (Schedule 6) under the BC Act. The south-west population was described as a distinct subspecies in 2015 (Aplin, et al., 2015; Biota, 2020).

Breeding parameters

The mating period varies with locality, but generally occurs over a three-week period from mid-May to early July. During the breeding season, males have large home ranges. The gestation period is approximately 30 days, and a litter size of up to eight may be born, although it may be as low as three. At seven weeks, the young are deposited into a maternal nest. Juveniles disperse in mid-summer, with males moving larger distances than females. There is a male die-off following the mating season. Weakened by stress-induced illnesses, they usually fall prey to owls, foxes and cats (CALM, 2002).

Habitat requirements

Phascogales BTPs are found in dry sclerophyll forests and open woodlands between Perth and Albany. They maintain relatively large territories (>20 ha) and female territories are exclusive; as a result, densities tend to be low (Biota, 2020).

They feed predominantly on arthropods and other invertebrates and forage in tree canopies. Tree hollows are a preferred nesting site for females raising young, and large trees, particularly Jarrah and Marri with a DBH >95 cm provide important habitat (Biota, 2020; Rhind, 1996).

Threats to BTP

CALM (2002) lists threats to the BTP as habitat clearing and fragmentation, and habitat alteration by logging and mining, with the greatest being reduced availability of trees with hollows, and predation by cats. Predation by foxes is also listed, as is the fragmentation of residual habitat which can isolate populations and impede genetic exchange.

Species and habitat extent within and adjacent to the Proposal Area

The Proposal Area provides a total of 17.7 ha of suitable habitat for the BTP comprising the 'Riparian Woodland' and 'Marri/ Eucalyptus Woodland' habitat types. The 'Riparian Woodland' habitat, of which there is 4.9 ha within the Proposal Area, was described as woodlands of the upper banks and floodplains of the significant drainages (Preston River, Collie River and Brunswick River). The 'Marri/ Eucalyptus Woodland' habitat refers to larger more intact remnants of this type of woodland as opposed to small, isolated, weedy remnants (Figure 11, Appendix A). There is 12.8 ha of 'Marri/ Eucalyptus Woodland' recorded within the Proposal Area.

A targeted survey for BTP was not conducted however the species was observed during field surveys (Biota, 2020). The spotlighting methods applied to the sampling of WRP were considered equally applicable to the BTP (Biota, 2020). All trees and areas of potential BTP habitat within the Proposal Area were included in field surveys. One BTP was observed within the Proposal Area during nocturnal searches by Biota (2019a) in 'Riparian Woodland' associated with the Preston River in the southern end of the Proposal Area (Figure 11, Appendix A).

4.2.7.2 Potential impacts

Direct impacts

The Proposal will result in the loss of up to 17.7 ha of BTP habitat within the 625 ha Proposal Area. The majority of the 'Riparian Woodland' habitat type that will be lost is associated with the Collie River, Preston River and Gavins Gully. The 'Marri/ Eucalypt Woodland' habitat is present in three main areas – at the Clifton Road/Paris Road interchange, at Railway Road and at the Boyanup Picton Road interchange.

No BTP are expected to be lost as a result of Proposal implementation.

Context of Proposal Area habitat

Within Biota's recorded 47.92 ha of 'Marri/ Eucalypt Woodland' and 30.14 ha of 'Riparian Woodland' within their 1,128 ha fauna survey study area within and around the Proposal Area (Biota, 2020). Of this 78.06 total, 17.7 ha or 23 % will be lost.

BTP habitat is closely correlated with both WRP habitat and Black Cockatoo habitat. As stated in section 4.2.10.3, Biota estimated approximately 7,618 ha of suitable potential Black Cockatoo habitat with a 12 km radius of the Proposal Area. A large proportion of this habitat is also likely to comprise habitat for BTP.

In their assessment of WRP habitat on the Swan Coastal Plain, Shedley and Williams (2014) estimated that 6,264 ha of WRP habitat[8] remained within the Bunbury WRP 'management zone' (which encompasses an area from the Preston River in the north to the Capel River in the south).

Both these assessments indicate that substantial BTP habitat is present within the area surrounding the Proposal Area, and the area that will be lost as a result of Proposal implementation comprises a very small proportion of this habitat.

Indirect impacts

The Proposal may potentially result in the following indirect impacts to BTP including:

- Incremental loss of BTP habitat resulting from reduced connectivity, barrier effects and edge effects
- Displacement of BTP due to traffic noise exposure
- Displacement of BTP due to light spill from street lighting and traffic.

Historical clearing combined with incremental reduction in habitat has restricted the distribution of BTP within the Proposal Area. As habitat is cleared, patch sizes decrease and the impact of 'edge effect' increases with likely introduction of weeds and dieback, ultimately changing the species composition of the vegetation community and reducing suitability of habitat for local fauna species, including BTP.

The Proposal Area has been largely cleared in the past for agriculture, urban and industrial developments and BORR Central Section. This has resulted in fragmentation of both terrestrial and riparian / wetland vegetation and ecological linkages, thereby reducing connectivity of BTP habitat. Connectivity of habitat areas is important to enable dispersal of the arboreal BTP to find habitat and mates, and to maintain the exchange of genetic material between populations. Good connectivity is also important to enable BTP to access additional food resources and water as required.

BTP have large home ranges of up to 20 ha (Biota, 2020). If severe enough, traffic noise and light exposure may potentially result in BTP relocating to other habitat areas in order to move away from the noise and / or light sources.

4.2.7.3 Assessment of impacts

Loss of BTP

No BTP individuals are likely to be lost as a result of the Proposal.

Home ranges

The Proposal Area is a long and narrow road corridor, 200 m wide at its maximum width and 19 kilometres long. As such, it is highly unlikely that any entire BTP home ranges – which are generally more than 20 ha in area - are contained within the Proposal Area. BTP utilising habitat within the alignment are very likely to be familiar with adjacent habitat areas, which is likely to also be part of their home range, and with navigating between these areas. As such, the impact of the Proposal on BTP home ranges is expected to be minor.

Connectivity

Connectivity between habitat patches in the Proposal Area is already compromised by the existing Forrest Highway and arterial roads, easements and large expanses of cleared agricultural land. Connectivity between some habitat areas will be temporarily disrupted during Proposal construction. However the

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

majority of habitat within the Proposal Area is already disconnected and will not be further impacted in this way by the Proposal. Conversely, connectivity across the alignment between existing habitat areas will be improved as a result of Proposal implementation through the installation of more than 40 fauna over/underpasses and or rope bridges, as described in Section 4.2.6.4 and shown in Figure 8 (Appendix A). The maintenance of existing movement pathways and connectivity along either side of the alignment has been a priority during Proposal planning. As is also shown on Figure 8 (Appendix A), the detailed design ensures this connectivity will remain after Proposal implementation.

Viability of habitat areas

All BTP habitat areas within the Proposal Area are contiguous with or adjacent to other habitat that will be retained. The Proposal Area configuration means that no habitat areas will be cleared in their entirety. There are four main clearing areas (of 1 ha, 1.3 ha, 1.45 ha and 7.0 ha in size) with all other clearing comprising small portions of vegetation removed from a larger area in varying degrees (Figure 11, Appendix A).

None of the areas of potentially suitable BTP habitat are anticipated to become unviable as habitat as a result of Proposal being implemented.

Indirect impacts

BTP have large home ranges of up to 20 ha (Biota, 2020). As such, given the largest block area is 7.0 ha, it is highly likely that BTP would move to other areas within their home range situated away from the road alignment if traffic noise and light exposure resulting from Proposal implementation was sufficiently severe. Further, the majority of the Proposal Area that intersects with BTP habitat does so at existing road junctions or along existing road corridors, therefore traffic noise and light exposure are already present in these areas. Impacts from noise and light exposure resulting from the Proposal are likely to be comparable with the levels experienced on other roads where BTPs have been recorded and are not expected to be at a scale likely to result in BTP abandoning adjacent habitat.

4.2.7.4 Mitigation

In consideration of the predicted impact of the original proposal as submitted in June 2019, Main Roads has gone to significant lengths to avoid and mitigate impacts to conservation significant fauna, including BTP. The majority of the detailed design changes implemented to avoid impacts to WRP habitat will also result in the avoidance of impacts to BTP habitat. The result of this effort is a revised Proposal Area that has substantially lower impact on BTP than originally proposed.

Substantial changes to the Proposal design have been made to avoid impacts to WRP/ BTP habitat. Mitigation measures are summarised below. Management measures are presented in the Conservation Significant Fauna Environmental Management Plan (BORR IPT, 2020a).

Avoid

A summary of the original impact, design changes made to avoid impacts, and the resulting impact is presented below.

Original impact

The impact to BTP habitat resulting from the BORR North and Central Proposal Area as referred to the EPA (June 2019) was expected to result in a loss of up to 28.2 ha of habitat.

Design modifications to minimise impacts

To minimise the impacts outlined above, the BORR North and Central Proposal Area was further refined during the design process. These changes are summarised in Table 4-24 and shown in Figure 2 (Appendix A).

Table 4-24 Detailed design changes to avoid impacts to BTP

BTP	JUNE 2019 S. 38 REFERRAL	JANUARY 2020 S. 43
Habitat extent (ha)	Approximately 28.2 ha BTP habitat	Approximately 17.7 ha BTP habitat in revised Proposal Area – with up to 10.5 ha or approximately 37 % of expected habitat loss saved through detailed design phase
Bridges and underpasses	No quantity specified	Installation of more than 40 underpasses/rope bridges now included within the design to reduce fragmentation and to maintain movement corridors

Resulting impact

The changes outlined in Table 4-24 have resulted in a reduction of up to 10.5 ha of BTP habitat requiring removal for the Proposal.

Mitigate

Mitigation measures to minimise impacts to BTP overlap with those detailed for WRP and Black Cockatoos, and are centred on minimisation of the clearing area, and protecting and connecting of remaining habitat.

Timing of clearing activities

In addition to WRP and Black Cockatoos, the timing of clearing activities will need to take into consideration BTP breeding cycles and Dieback management. The BTP breeding season is short, usually running for three weeks in winter, from mid-May to early July. Where possible, clearing of BTP habitat will be conducted outside of the species' breeding season

Shepherding

As is proposed for WRP, BTP will be encouraged and enabled to move of their own accord into adjacent areas of retained habitat. Surveys conducted by Biota (Biota, 2020) indicate that habitat areas adjacent to the Proposal Area support populations of BTP, indicating that these areas provide the necessary habitat requirements. Based on this understanding, clearing will be staged and directed to encourage BTP to move into adjacent areas of habitat and where possible, to the largest and best-connected habitat.

Measures proposed in section 4.2.6.4 under the headings of Connectivity and Fencing and noise wall design apply equally to BTP in regards to the mitigation of impacts. Resulting benefits of these measures expected for WRP will also result for BTP.

4.2.7.5 Predicted outcome

A high level of mitigation and management has been applied to the Proposal, with Main Roads making substantial, more expensive changes to the Proposal design in order to mitigate potential impacts on conservation significant fauna including the BTP. As a result of the changes made to the Proposal, a maximum of 17.7 ha of BTP habitat will be cleared. No entire areas of BTP habitat will be lost completely, with only a proportion of home ranges expected to be impacted.

Connectivity along and across the Proposal Area will be maintained and potentially improved through retaining key habitat areas and installing fauna underpasses and / or rope bridges. Impacts of the Proposal on BTP are not considered significant.

The EPA objective for Fauna will be met for the Proposal through implementation of appropriate management and mitigation.

Main Roads intends to further counterbalance the residual impacts of the Proposal through implementation of an Offset Strategy (see Section 5).

4.2.8 Carter's Freshwater Mussel

4.2.8.1 Receiving environment

Species description and conservation status

CFM is the only freshwater mussel occurring in the south west of Western Australia. CFM was listed as vulnerable under the EPBC Act and the BC Act in 2018. The listing was in recognition of the estimated contraction of the range of the species by almost 50 % in the last 50 years, primarily as a result of the impacts of secondary salinisation on waterways within its former range. The species is now restricted to freshwater waterways (streams, rivers, reservoirs and lakes) within 50-100 km of the coast from Moore River, north of Perth, to west of Esperance (WRM, 2020).

Species distribution and habitat requirements

The species is patchily distributed in sandy/muddy sediments of freshwater lakes, rivers and streams. The greatest densities are associated with exposed submerged tree roots, woody debris, and overhanging riparian vegetation near stream banks (particularly slower flowing sections) and edges of lakes/dams (IUCN, 2019; WRM, 2020). The species lifecycle includes a parasitic glochidia stage which attach to the gills of fish as part of their development (Klunzinger, M W; Beatty, S J; Morgan, D L; Lymbery, A J; Pinder, A M; Cale, D J, 2012a).

Species and habitat extent within and adjacent to the Proposal Area

Surveying for CFM was undertaken in drainage areas during targeted fauna surveys in 2018 and 2019. Within the Proposal Area, CFM is restricted to major creeklines with shallow sandy banks (Biota, 2020).

During surveys undertaken in 2018 and 2019 by WRM (2019), CFM were recorded from the following sites:

- A tributary of the Collie River (North Creek 3) downstream of the Proposal Area
- Ferguson River (North Creek 5 and Mussels 2) within and just upstream of the Proposal Area
- Preston River (North Creek 2) (Mussels 1 shells only and North Creek 2) within and upstream of the Proposal Area (Figure 9, Appendix A).

Potential habitat for CFM includes the Collie (tributary), Ferguson and Preston Rivers and has been mapped as maximum of 1.4 ha within the Proposal Area. Refer to the Targeted Conservation Significant Aquatic Fauna Survey report (WRM, 2020) in Appendix I for further details.

Mussels were recorded at reference sites outside of the Proposal Area. They are likely to be common within each of the rivers crossing the Proposal Area where suitable habitat occurs. The exception is the lower Collie River, where the species was not recorded within or adjacent to the Proposal Area. Elevated salinity is considered to be the reason for the absence of the species in the lower Collie River (WRM, 2020).

Threats to Carter's Freshwater Mussel

The species is acutely sensitive to salinity, >1.6 g/L, and its distribution has been reduced as a result of secondary salinisation of waterways in the south western of Western Australia (Klunzinger, M W; Beatty, S J; Morgan, D L; Lymbery, A J; Pinder, A M; Cale, D J, 2012a). Reduced rainfall, resulting from a drying climate and dewatering of reservoirs and reduced flows in regulated rivers are also key threats. Secondary threats include habitat destruction, associated sedimentation and erosion, trampling by stock, predation by feral pigs, and loss of suitable host fishes for parasitic stages. Sedimentation to the point of burying mussels has been reported to cause mortality in CFM (IUCN, 2019).

4.2.8.2 Potential impacts

Direct impacts

Changes to the Proposal design have removed the requirement for bridge piers or abutments within any water courses. No direct loss of habitat for or of individual CFM is expected as a consequence of construction or operation of the Proposal.

Indirect impacts

Potential impacts to CFM are restricted to indirect impacts associated with construction and operation and include:

- Erosion and sedimentation resulting from earthworks adjacent to watercourses during construction
- Contamination and/or water quality impacts during construction or operation
- Alteration of hydrological regimes resulting from bridge and/or road construction
- Indirect impacts to host fish populations.

4.2.8.3 Assessment of impacts

Direct impacts

It is unlikely that the Proposal will have a significant impact on CFM as there will not be direct impact to CFM, nor its habitat. In fact, it is possible that the bridge construction may potentially provide positive outcomes for the species. Previous studies and assessments of habitat requirements for CFM have suggested bridges may be a preferred habitat for the species (Hastie, et al., 2000; Klunzinger, M W; Beatty, S J; Morgan, D L; Pinder, A M; Lymbery, A J;, 2015). Shading created by bridges may provide cooler conditions that are beneficial to the species.

Indirect impacts

Erosion and sedimentation

Clearing of vegetation, construction earthworks, bridges construction and altered surface water regimes have the potential to destabilise soils and, if unmanaged, result in erosion of the Proposal Area and sedimentation of CFM habitat within and downstream of the Proposal Area.

Construction of bridges will require clearing of riparian vegetation and excavations in proximity of the riverbanks, which could potentially destabilise soils. These activities have the potential to cause erosion or collapse of the riverbanks, resulting in an increase in turbidity and sedimentation in CFM habitat within and downstream of the Proposal Area. These potential impacts will be effectively managed through the mitigation measures detailed in the Conservation Significant Fauna EMP (BORR IPT, 2020a).

Contamination of surface water

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

Surface water 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 CFM by the precipitation of iron, and metal bioaccumulation. As filter feeders, CFM are susceptible to impact from bioaccumulation, as are species that feed on CFM. Managing the potential for ASS exposure is discussed in BORR IPT (2019a) and will be managed through the implementation of the CEMP.

Contaminated surface water has the potential to impact watercourses and CFM habitat including areas downstream of the Proposal Area. These potential contamination impacts will be effectively managed through the mitigation measures detailed in BORR IPT (2019a) and are considered unlikely to be significant.

Alteration of hydrological regimes

Detailed drainage and bridge design has been undertaken with the intention of maintaining the hydrologic function of the rivers within the Proposal Area. With the refinement of the bridge designs removing the requirement for piers or abutments within water courses, the risk of changes to instream flow velocities (and subsequent erosion or deposition) has been further minimised.

Indirect impacts to host fish species

The larval (glochidia) stage of the mussel requires the presence of freshwater fish (Klunzinger, M W; Beatty, S J; Morgan, D L; Thomson, G J; Lymbery, A J;, 2012b). Any potential impacts on freshwater fish species also has the potential to indirectly impact on CFM. Potential impacts from the Proposal construction and operation on freshwater fish are similar to those for CFM and include:

- Impacts to habitat from erosion and sedimentation
- Contamination and water quality impacts
- Alteration of hydrological regimes
- Barriers to instream movement.

The potential for impact from the first three points have been discussed for CFM and are also considered to be of low risk for freshwater fish. The potential for impacts as a result of barriers to instream movement of fish through the implementation of the Proposal is also considered low. Drainage design has taken into consideration the need to maintain existing hydrology and not obstruct the movement of aquatic fauna. Bridge design has been modified to remove the need for any instream structures and will not result in any obstructions to fish movement.

4.2.8.4 Mitigation

BORR IPT (2019a) identified that there was potential to impact 1.4 ha of habitat for CFM. Since the referral, Main Roads has invested considerable effort in additional targeted surveys to confirm the distribution of CFM and modify the design of the Proposal in order to reduce the potential impact of the Proposal on threatened fauna, including CFM. The surveys conducted for CFM confirmed the occurrence of the species within and adjacent to the Proposal Area. Through refinement of the detailed design of the Proposal the potential direct impacts on CFM have been removed and indirect impacts will be minimised as discussed below. Expert advice has been sought from WRM to inform the development of mitigation measures suitable for CFM.

Avoid

To minimise the potential impacts on watercourses and CFM habitat, bridges over the Collie, Ferguson and Preston Rivers have been redesigned to remove the requirement for any in stream piers or abutments. This action has resulted in the removal of any direct impacts to habitat for the CFM.

These changes to the design will also avoid any impacts to hydrology i.e. effects on flow velocities and erosion or deposition of sediment caused by instream structures.

Mitigate

Indirect impacts to CFM through construction activities are relatively low risk and will be managed through the implementation of clearing controls, appropriate procedures for the monitoring of erosion and sedimentation, handling of fuels and other hazardous substances and monitoring and management of ASS. Management of the risks from spills and contaminated runoff during operation will be minimised through the drainage design and are detailed further in BORR IPT (2019a). Construction risks will be managed through the implementation of the CEMP.

Monitoring

Monitoring for impacts to CFM will be conducted at both reference sites and potential impact site (Collie River) within the Proposal Area. A reference site will be established at the Preston River for the purposes of providing comparative species and population trend data. Monitoring will comprise sampling and visual assessments, and will include photo monitoring. Monitoring will be conducted by a suitably experienced zoologist / environmental scientist. The monitoring program is detailed in Appendix B.

Baseline data collection at monitoring sites will commence early 2020. Any changes in conditions at potential impact sites will be compared with those in the reference site. Note: if relocation should be required, monitoring of CFM during construction will focus on relocation and reference site and include the impact site following replacement of CFM following completion of construction (during operational phase). This will enable determination of the likelihood of impacts having resulted from Proposal.

4.2.8.5 Predicted outcome

Impacts to CFM from the Proposal are considered to be minor. There will be no direct loss of habitat and other potential impacts will be mitigated through implementation of appropriate drainage and management during construction. No residual impact is anticipated.

4.2.9 Black-stripe Minnow

4.2.9.1 Receiving environment

Species description and conservation status

The BSM is a small (maximum 48 mm TL) freshwater fish species endemic to south-western Australia. It most commonly occurs in shallow ephemeral waterbodies of peat flats (WRM, 2020). The species is listed as Endangered under the EPBC Act and the BC Act. The BSM is a short lived (one year) fish that is able to survive dry summer conditions by aestivating (burrowing) into moist soils. Dispersal is understood to be linked to climatic conditions with the species emerging from aestivation following rainfall (WRM, 2020).

Species distribution and habitat requirements

BSM occurs predominantly in shallow, low pH, tannin stained ephemeral wetlands with peat rich soils including isolated populations on the SCP and on the south coast between Augusta and Albany. The populations on the SCP are thought to be remnants of a much wider distribution which has been impacted by widespread urban and rural development.

Threats to BSM

Habitat destruction through continued urban development and other clearing is a key threatening process for the species (TSSC, 2018b; WRM, 2020). Other threats include climate change resulting in reduced rainfall and loss of habitat (drying of wetlands and lowering of groundwater levels), and predation and competition by invasive fish species (including *Gambusia holbrooki*).

Species and habitat extent within and adjacent to the Proposal Area

During additional surveys conducted in August 2019, BSM were recorded from one sampling site within the Proposal Area and four sites outside of the Proposal Area (Figure 10, Appendix A).

Sites where the minnow was recorded were relatively unaltered wetlands, with intact fringing vegetation. All sites were clustered toward the southern end of the Proposal Area and were within or just outside Manea Park bushland reserve. There was little or no suitable habitat for the species identified within the remainder of the Proposal Area, as the majority of wetlands in these areas have been cleared for agriculture or otherwise highly modified (WRM, 2020).

Wetland mapping along the Proposal Area indicates that site North 5, within the Proposal Area, is part of a large palusplain wetland. Review of aerial photography and site observations by WRM (2019) indicate that within the palusplain there is a small channel wetland where sites North 5 and Northern 9 are located

(Figure 10). Within the Proposal Area, the area of habitat provided by this channel wetland likely to be suitable for BSM is approximately 0.55 ha.

Due to the high mobility of the species and connectivity between wetlands in wetter years, it is possible that BSM migrate between wetlands within the local area. Maintaining connectivity between wetlands that provide suitable habitat is an important consideration in drainage design for the Proposal.

Refer to the Targeted Conservation Significant Aquatic Fauna Survey report (WRM, 2020) in Appendix I for further details.

4.2.9.2 Potential impacts

Direct impacts

Direct impacts to BSM resulting from the Proposal include clearing/loss of habitat totalling 0.55 ha. The area of habitat is based on the area of channel wetland mapped by WRM (2019). Some direct loss of aestivating BSM is possible through disturbance of sediments during construction.

Indirect impacts

Potential indirect impacts to BSM associated with construction and operation of the Proposal are in part similar to those identified for CFM and include:

- Erosion and sedimentation resulting from earthworks adjacent to watercourses during construction
- Contamination and/or water quality impacts during construction or operation
- Alteration of hydrological regimes resulting from bridge and/or road construction
- Restriction of fish movement
- Fragmentation of suitable habitat.

4.2.9.3 Assessment of impacts

Direct impacts

Within the Proposal Area, BSM were restricted to a small area of relatively undisturbed wetland in the southern end of the alignment. It was not recorded from additional areas (7 sites surveyed) of wetland habitat in the Proposal Area. The BSM was recorded from four additional sites adjacent to the Proposal Area. All sites outside of the Proposal Area were relatively undisturbed or intact wetlands within or adjacent to Manea Park bushland reserve.

The species has also recently been recorded from nearby wetlands in Gelorup, surveyed as part of investigations for the BORR South Alternate alignment. BSM are considered to be a transient and mobile species and abundance and distribution is likely to vary from year to year in response to seasonal rainfall (WRM, 2020).

Given the distribution of the species in wetlands adjacent to the Proposal Area and to the south, loss of 0.55 ha as a result of construction of the Proposal is unlikely to have a significant impact on the species. Potential loss of connectivity will be minimised and mitigated (see below).

Some direct loss of aestivating BSM is possible during construction through disturbance of sediments. Previous attempts to find and record aestivating BSM in sediments have not been successful (Galeotti, 2013) and the length of time the species can remain aestivating is unknown. Translocation is not considered to be a viable mitigation strategy for this species (WRM, 2020).

Indirect impacts

Erosion and sedimentation

Clearing of vegetation, construction earthworks, drainage construction and altered surface water regimes have the potential to destabilise soils and, if unmanaged, result in erosion of the Proposal Area and sedimentation of BSM habitat within and downstream of the Proposal Area.

Construction will require clearing of vegetation and excavations adjacent to the wetlands, which could potentially destabilise soils. These activities have potential to cause erosion, resulting in an increase in turbidity and sedimentation in BSM habitat within and downstream of the Proposal Area. These potential impacts will be effectively managed through the mitigation measures detailed in BORR IPT (2019a) and are unlikely to be significant.

Contamination of surface water

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

Surface water may also become contaminated through the exposure of acid sulphate soils (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 BSM habitat by the precipitation of iron, and metal bioaccumulation. Managing the potential for ASS exposure is discussed in BORR (2019a) and will be addressed through implementation of a CEMP.

Contaminated surface water has the potential to impact watercourses and BSM habitat including areas downstream of the Proposal Area. These potential contamination impacts will be effectively managed through the mitigation measures detailed in BORR ITP (2019a) and are considered unlikely to be significant.

Alteration of hydrological regimes

Detailed drainage design has been undertaken with the objective of maintaining the hydrology of the Proposal Area and adjacent areas (BORR IPT, 2018). The sizing and design of drainage structures within the BSM habitat area will be sufficient to maintain existing flows through the wetland areas providing habitat.

Fish movement and fragmentation

Maintaining connectivity between wetland areas either side of the Proposal (in the southern end of the alignment) where BSM have been recorded will be achieved by incorporating drainage design that is conducive to movement of aquatic species. In the BSM habitat area drainage design will:

- Set the elevation of the base of the culvert consistent with or below the base of the current drainage line
- Use of suitably sized and shaped (flat based[9]) culverts to avoid increased velocities to water movement through culverts.

4.2.9.4 Mitigation

Avoid

Direct impacts of loss of 0.55 ha of BSM will result from the construction of the Proposal.

Clearing and disturbance of habitat will be carefully managed throughout construction through mechanisms outlined in (BORR IPT, 2019) and through the implementation of a CEMP.

[9] Water flow through round culverts is more likely to have higher velocity than flows through flat-bottomed culverts as the flat bottom allows water to spread out and flow slower. Flat-bottomed culverts are the standard to allow for movement of aquatic species.

Mitigate

Impacts to hydrology will be mitigated through the implementation of the drainage strategy which aims to maintain hydrological conditions as far as possible. Fragmentation of habitat and connectivity between habitats will be mitigated through detailed design, so as to maintain hydrologic connections between BSM habitat areas to enable fish movement.

Indirect impacts to BSM through construction activities are relatively low risk and will be managed through the implementation of clearing controls, appropriate procedures for the monitoring of erosion and sedimentation, handling of fuels and other hazardous substances and monitoring and management of ASS. Management of the risks from spills and contaminated runoff during operation will be minimised through the drainage design and are detailed further in BORR IPT (2019a). During construction the risk of impacts will be managed through the implementation of a CEMP.

Monitoring

Monitoring for impacts to BSM will be conducted at a reference site (Manea Park) and potential impact site (drainage line at southern extent of the Proposal Area). The reference site will be established for the purposes of providing comparative species and population trend data. Monitoring will comprise sampling and visual assessment, and will include photo monitoring. Monitoring will be conducted by a suitably experienced zoologist / environmental scientist.

Reference sites for BSM will be identified prior to commencement of clearing activity. Baseline data collection at reference sites will commence early 2020. Any changes in conditions at potential impact sites will be compared with those in reference sites. This will enable determination of the likelihood of impacts having resulted from Proposal implementation to ensure surface water flows are maintained through the implementation of the Proposal. The monitoring program is detailed in Appendix B.

4.2.9.5 Predicted outcomes

Impacts to BSM from the Proposal are considered relatively minor. Direct loss of habitat will be limited to 0.55 ha and other potential impacts will be mitigated through implementation of appropriate drainage and management. No residual impact is anticipated.

4.2.10 Black Cockatoos

Supplemental information on the occurrence of Black Cockatoos and potential direct and indirect impacts to their foraging and breeding habitats as a result of the construction of the BORR Northern and Central alignment was not specifically requested by the EPA. Consultation with the EPA in November 2019 confirmed that any updates on the potential impacts to BC should be provided.

4.2.10.1 Receiving environment

Species description and conservation status

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

- Baudin's Cockatoo (*Calyptorhynchus baudinii*)
- Carnaby's Cockatoo (*Calyptorhynchus latirostris*)
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*).

The distribution and habitat requirements for each of the three species differs slightly. Baudin's Cockatoo occur predominantly within the Jarrah Forest and SCP zones, approximately from Northam and Muchea near Perth south to Albany. Carnaby's Cockatoo distribution extends into the Wheatbelt north to Kalbarri and east to Esperance. Forest Red-tailed Black Cockatoo occurs within forested areas from Perth south east to Albany.

Habitat loss has affected each of the species. Perhaps most significantly for Carnaby's Cockatoo, which used to only visit the SCP for foraging but over the past 10-30 years has shifted in distribution of breeding area south and west and now breeds in Jarrah Forest and on the SCP (Department of Parks and Wildlife, 2013).

Habitat requirements

Black Cockatoos are known to utilise a range of habitats and plant species for foraging (including introduced species such as pines, **Pinus* spp.). Marri and Jarrah woodlands are particularly important to Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo and proteaceous heaths (i.e. shrublands dominated by *Banksia, Hakea* and *Grevillea* species) are also utilised by Carnaby's Cockatoo (DSEWPaC 2012).

Studies of the breeding behaviours of the three threatened Black Cockatoo species have identified variation between the tree species and characteristics of hollows chosen for nesting. For example, hollows formed in Jarrah are typically smaller than those in Marri, and Forest Red-tailed Black Cockatoos breed predominantly in Marri in the Jarrah-Marri forest of the south-west. Breeding records of Carnaby's Cockatoo on the SCP indicate that the majority of their nests are in Tuart (Biota, 2019; Johnstone & Kirkby, 2011).

Threats to Black Cockatoos

Primary threats to Black Cockatoos as listed in DSEWPaC (2012) are:

- Habitat loss and degradation
- Interactions with humans
- Invasive species.

Species and habitat extent within the Proposal Area

The Proposal Area is located in what is generally considered to be the typical breeding distribution of the Forest Red-tailed Black Cockatoo, however, all three cockatoo species have breeding areas overlapping the Proposal Area (Biota, 2020).

All trees and areas of potential Black Cockatoo habitat within the Proposal Area were included in field surveys. Evidence of foraging by all three species was recorded within and adjacent to the Proposal Area, and either Baudin's or Carnaby's Cockatoos were observed flying overhead during field surveys (Biota, 2020). All three species were identified as occurring within the Proposal Area with suitable habitat for foraging and potentially breeding also identified in targeted surveys (Biota, 2020).

Within the Proposal Area, Black Cockatoo foraging habitat was comprised of three mapped habitat types: 'Marri/Eucalyptus woodland', 'Riparian woodland' and 'Marri/Eucalyptus in paddocks and road reserves'.

The Proposal Area provides 37.8 ha of suitable foraging and potential breeding habitat for Black Cockatoos (Carnaby's Cockatoo, Forest Red-tailed Black Cockatoo and Baudin's Cockatoo) (Figure 12, Appendix A).

No Known Trees with Suitable Nest Hollows will be impacted by the Proposal, however three trees with potentially suitable hollows will be lost. Up to 711 Suitable DBH Trees occur within the Proposal Area (Figure 12, Appendix A).

4.2.10.2 Potential Impacts

Direct impacts

The Proposal will result in loss of up to 37.8 Ha of Black Cockatoo habitat.

711 Suitable DBH trees occur within the Proposal Area and will potentially be cleared during construction.

Three trees with potentially suitable nesting hollows will be impacted by the Proposal.

Indirect impacts

The Proposal may potentially result in the following indirect impacts to Black Cockatoo species:

- Incremental loss of Black Cockatoo habitat from edge effects
- Displacement of Black Cockatoos due to traffic noise and exposure
- Potential vehicle strike during construction activities
- Potential vehicle strike during operation.

The Proposal Area sits within a landscape that has been subject to clearing for agricultural, urban and industrial developments. This has resulted in reduction in patch sizes and increasing edge effects including the introduction of weeds and dieback. This has potential to effect the composition and structure of vegetation communities and impact the suitability of habitat for Black Cockatoos.

If severe enough, traffic noise exposure may result in Black Cockatoos relocating to other habitat areas in order to move away from the noise sources.

Vehicle strike during construction and operation of the Proposal has the potential to impact Black Cockatoos.

4.2.10.3 Assessment of impacts

Direct Impacts

Biota (2019a) reviewed the potential Black Cockatoo foraging habitat within a 12 km radius of the Study Area to provide a wider context to the potential habitat loss associated with the Proposal. Based on this analysis of vegetation complexes, the Bassendean Complex Central and South within the Proposal Area is continuous with much larger extents within the wider area. This is also generally true for the Southern River Complex, although there are isolated sections of this vegetation complex in the Proposal Area (northern extent of the Proposal Area). The Swan Complex within the Study Area is represented by riparian vegetation associated with the Preston River and is more limited in occurrence. However, this complex is generally lower quality foraging habitat for Black Cockatoos with fewer of the preferred foraging plant species (e.g. Marri, Jarrah and Banksia generally absent from this complex).

Within 12 km of the Proposal Area, the Guildford Complex has 1,022 ha of remnant vegetation remaining, the Southern River Complex has 2,046 ha and Bassendean Complex – Central and South has 3,834 ha. The clearing of 37.8 ha of potential habitat represents a 0.5 % reduction in potential foraging and breeding habitat for the Black Cockatoo species within the local area.

No Trees with Known or Suitable Nest Hollows will be cleared for the Proposal. Three trees with potentially suitable nest hollows will be cleared. In surveyed areas adjacent to the Proposal Area, Biota (2020) located one Known Nesting Tree and 18 trees with 19 Suitable Nest Hollows.

Indirect Impacts

Operation of BORR will result in an increase in traffic/vehicle movements and therefore result in a greater risk of fauna strike from vehicle movements. Impacts or disturbance of Black Cockatoos from operational (traffic) noise from the Proposal is likely to be minor and, based on observations of Black Cockatoo foraging recorded in habitat adjacent to existing Forrest and Bussell Highways, not likely to cause an impediment to habitat utilisation.

Given a 10 m foraging habitat buffer will be applied to the rehabilitation of the Proposal Area, Black Cockatoo – vehicle interactions are not expected to be higher than other highways in the region.

4.2.10.4 Mitigation

Avoid

Substantial changes to the Proposal design have been made to avoid impacts to Black Cockatoos. These are summarised in Table 2-2. Changes relating to the extent of Black Cockatoo habitat to be impacted are detailed in Table 4-25.

Table 4-25 Black Cockatoo habitat avoided through design

HABITAT TYPE	JUNE 2019 S. 38 REFERRAL	JANUARY 2020 S. 43
Habitat area (Ha)	59.7	37.8
Suitable DBH trees	1116	711
Trees with a Suitable Nest Hollow	5	3 (potentially suitable nest hollows)
Known nesting trees	0	0

Changes to the Proposal Area have resulted in the retention of 21.9 ha of habitat and 405 Suitable DBH Trees that would have been lost if the Proposal had been implemented as referred. The detailed design changes have also resulted in two trees with potentially suitable nest hollows being avoided.

Mitigation

The following mitigation and management measures will be implemented to minimise the potential impacts on Black Cockatoos:

- Revegetation with suitable native species to provide connectivity of habitat areas and additional foraging for Black Cockatoos (excluding 10 m buffer from nearest traffic lane)
- Clearing to be timed to minimise impacts on native fauna, particularly Black Cockatoos (i.e. clearing ideally not undertaken during the Black Cockatoo nesting period, July - December)
- Any native fauna injured as a result of the Proposal construction or operation will be taken to a designated veterinary clinic or a DBCA nominated wildlife carer

Management

Table 4-26 identifies the key management actions that Main Roads will implement to manage the potential effects of the Proposal to Black Cockatoo individuals and habitat.

Table 4-26 Black Cockatoo Management Actions

TIMING	MANAGEMENT ACTIONS
Prior to Construction	• Identified suitable nest hollows for Black Cockatoos located within the Proposal Area will be 'blocked' prior to the commencement of the breeding season to prevent Black Cockatoo nesting in the hollows of trees to be removed. • Where blocking of the nest hollows cannot be undertaken (e.g. timing, access), a pre-clearing fauna assessment will be undertaken by a suitably qualified person to determine if the identified suitable nest hollows are being used by Black Cockatoos.

TIMING	MANAGEMENT ACTIONS
	• Habitat that is to be retained within the development envelope will be marked accordingly or delineated with temporary fencing to ensure it is avoided.
During Construction	• A qualified zoologist / environmental scientist / fauna-spotter will be on-site at all times during clearing of habitat for Black Cockatoos and must maintain radio communication with machinery operators. • Where a tree with a suitable nest hollow has been blocked prior to the Black Cockatoo breeding season, the tree may be felled as part of the standard vegetation clearing process. • Where a tree with a suitable nest hollow has not been blocked and the pre-clearing fauna assessment has not identified any Black Cockatoo occupation of the nest hollow, prior to clearing the tree will be 'bumped gently" with a machine with the machine operator and zoologist to wait and observe the tree for a short time after. If no Black Cockatoo appears to be present following being bumped gently then the tree shall be pushed over slowly to minimise risk of injury to any undetected animal (if present). • Where a tree with a suitable nest hollow has not been blocked and the pre-clearing fauna assessment identifies any Black Cockatoo occupation of the nest hollow (which may include chicks (young)), the tree with the nest hollow will not be cleared until after the completion of the breeding season. No vegetation within 50 m of the tree will be cleared until after the completion of the breeding season. • Felled trees with hollows that have not been blocked will be checked immediately after felling, and where any undetected fauna are identified the tree will be left on the ground overnight to allow time for the fauna to vacate. • Any Black Cockatoos showing signs of injury or illness will be promptly referred to an experienced wildlife veterinarian or approved wildlife rehabilitation facility. • A post-clearing survey shall be undertaken to ensure no injured Black Cockatoo individuals are present.
Post-Construction	• Revegetation with suitable native species to provide connectivity of habitat areas and additional foraging for Black Cockatoos (excluding 10 m buffer from nearest traffic lane).

4.2.10.5 Predicted outcome

A high level of mitigation and management has been applied to the Proposal, with Main Roads making substantial, more expensive changes to the Proposal design in order to mitigate potential impacts on terrestrial fauna including Black Cockatoos. The changes made have resulted in the reduction in the area of Black Cockatoo habitat impacted to just under 22 ha, and three Trees with potentially suitable nest hollows to be impacted. Connectivity of habitat will be maintained and enhanced through revegetation of additional areas within the Proposal Area.

The EPA objective for Fauna will be met for the Proposal on Black Cockatoos through the implementation of appropriate management and mitigation detailed in this ARI.

Main Roads intends to further counterbalance the residual impacts of the Proposal through implementation of an environmental offset strategy (see Section 5).

4.2.10.6 Reporting

Results of monitoring and compliance with the conservation significant fauna EMP will be reported to DWER as part of the Proposal's annual compliance report. The format of this report will be consistent with requirements stipulated by individual regulatory authorities.

An annual report will be submitted to the Environmental Protection Authority Services unit of DWER at an agreed date. The report will document compliance with conditions of approval including assessment of compliance with management EMP requirements where management EMPs form part of approval conditions.

Triggers, thresholds and contingency actions are based on the environmental monitoring described in the EMP, and are included in the EMP. If environmental monitoring identifies a non-conformance/non-compliance with environmental conditions / EMP targets / relevant legislation or guidelines, the incident will be reviewed and corrective actions implemented. The corrective actions, which are aimed at preventing recurrences of the incident taking place, are detailed in Table 10 of the EMP.

The contingency actions will include changes to equipment / processes / management measures if required. Any changes to processes / management will be updated in the conservation significant fauna EMP. These changes will be communicated through site inductions / toolbox meetings.

Environmental incidents are defined as events that cause or potentially cause harm to the environment.

Environmental incidents are to be reported to the Environmental Manager by the person responsible for the incident or the first person to observe the incident. The Environmental Manager will assess the type and severity of the incident in accordance with Main Roads' standard incident procedures. Relevant personnel will be notified, including reporting to regulatory authorities.

The number and type of contingency actions to be implemented in the case of trigger exceedance will depend upon various factors, including the state of the natural surrounding environment, the location of the trigger and the works undertaken at the time of the exceedance.

4.2.11 Predicted Outcomes

The alignment selected for the Proposal minimises impacts to fauna and, with implementation of the mitigation measures proposed to address the potential impacts of the Proposal, the EPA objective for fauna, will be met. Table 4-27 provides a summary of the key residual impacts to fauna. Impacts set out in the table represent the maximum possible impacts associated with the Proposal.

Main Roads intends to further counterbalance the residual impacts of the Proposal through implementation of an environmental offset strategy (see Section 5).

Table 4-27 Predicted residual impacts to fauna

ISSUE	SUMMARY DISCUSSION OF RESIDUAL / CUMULATIVE IMPACTS	IMPACT AVOIDANCE COMPARED TO PREVIOUS PROPOSAL AREA	OUTCOME
Western Ringtail Possums	Up to 43.9 ha of suitable WRP habitat will potentially be cleared, with between 20 and 25 individual home ranges potentially disturbed. Based on the results of regional surveys, this is estimated to	Reduction in clearing of suitable WRP habitat by up to 37 %, from 70.3 ha to 43.9 ha. 49-59% reduction in number of WRP home	The clearing of WRP habitat, including the disturbance of 0.28 % to 0.34 % of the estimated 2019 Southern SCP Management Zone population is considered to have a minor residual

ISSUE	SUMMARY DISCUSSION OF RESIDUAL / CUMULATIVE IMPACTS	IMPACT AVOIDANCE COMPARED TO PREVIOUS PROPOSAL AREA	OUTCOME
	represent 0.28 % to 0.34 % of the 2019 regional population.	ranges potentially disturbed.	impact on the local WRP population.
South-western Brush-tailed Phascogale	Up to 17.7 ha of suitable BTP habitat will potentially be cleared as a result for the Proposal. BTP maintain relatively large ranges (>20 ha), with low densities (Biota, 2019a).	Reduce clearing of suitable BTP habitat by up to 37 %, from 28.2 ha to 17.7 ha	The impact to the South-western BTP are unlikely to be significant.
Carter's Freshwater Mussel	No impact on CFM habitat during construction of bridges. It is anticipated that disturbance to waterways will be temporary and minor.	Potential impact of up to 1.4 ha reduced to 0 ha (100 % impact reduction)	No impact on CFM.
Black-stripe Minnow	Loss of up to 0.55 ha of BSM habitat.	No change	The impact to the BSM is unlikely to be significant.
Black Cockatoos	The Proposal may potentially result in loss of up to 37.8 ha of suitable Black Cockatoo habitat. Three trees with potentially suitable nest hollows impacted. The clearing of 37.8 ha of potential habitat represents a <1 % reduction in potential foraging and breeding habitat for the Black Cockatoo species within the local area (suitable remnant vegetation within a 12 km radius).	The design has been amended to reduce clearing of suitable Black Cockatoo habitat by up to 36 %, from 59.7 ha to 37.8 ha. Up to 40 % reduction in the number of trees with potentially suitable nest hollows impacted, from five trees to three.	No known impact on Trees with Known Nest Hollows. The reduction in foraging and potential breeding habitat for Black Cockatoo species will result in a minor residual impact associated with the Proposal.

4.3 Key Environmental Factor – Social Surrounds

4.3.1 EPA objective

To protect social surroundings from significant harm (EPA, 2018b).

4.3.2 Policy and guidance

- Environmental Factor Guideline Social Surroundings (EPA, 2016f)
- Guidance for the Assessment of Environmental Factors, Assessment of Aboriginal Heritage No. 41 (EPA, 2004a)
- State Planning Policy 5.4 (SPP 5.4) Road and Rail Noise (WAPC, 2019a)
- Road and Rail Noise Guidelines (WAPC, 2019b).

4.3.3 Receiving environment

4.3.3.1 Noise

The existing noise environment within the vicinity of the Proposal Area is anticipated to be dominated by the following local noise sources:

- Rural activities
- Traffic noise associated with Forrest Highway and other existing roads
- Natural (leaves rustling, wind in trees and bird and insect calls).

In response to the request for additional information provided by the EPA, additional noise modelling and assessment was undertaken including consideration of day-time and night-time noise. The assessment has been provided in Appendix J.

The existing road traffic noise assessment was undertaken by BORR IPT for a 2018 scenario (BORR IPT, 2020b), to assess current road traffic noise impacts at existing roads in proximity to sensitive receptors and the current BORR alignment.

Noise monitoring was used to measure existing noise levels experienced by receptors located within the Proposal Area. Unattended noise monitoring was undertaken at five sites within the vicinity of the Proposal for the purpose of validating noise predictions made using the model. Monitoring locations were chosen so as to be located on existing road sections which are forecast to contribute to combined noise levels at the properties most affected by the Proposal.

One hundred and thirty eight (138) sensitive receptors within Rural and Residential zoned areas were identified as potentially being impacted by the Proposal. The locations of the sensitive receptors and 2018 existing noise levels are illustrated in Figure 13 (Appendix A)

The updated modelling incorporates consideration of the revised road design and includes modelling of noise resulting from the updated interchange design for South West Highway and proposed upgrades for the alignment of Raymond Road.

4.3.4 Potential impacts

Direct Impacts

Direct impacts include potential exceedance of the SPP 5.4 noise target for upgraded roads for rural and residential dwellings adjacent to the Proposal Area. The closest receptors are located in the Kingston Estate area adjacent to the existing Forrest Highway, at the northern end of the Proposal Area.

Indirect Impacts

Indirect impacts from the Proposal on social surroundings are anticipated to be limited or negligible.

4.3.5 Assessment of impacts

Direct Impacts

Noise impact on sensitive receptors

The Noise Assessment modelled road traffic noise for two scenarios based on existing (2018) traffic noise and predicted 2041 traffic noise for the constructed BORR. The existing (2018) forecast road traffic noise maps for night and day (Figure 14 and Figure 15, Appendix A) were compared to the future noise maps (2041) within the constructed BORR present and with no noise mitigation treatment (Figure 16 and Figure 17, Appendix A).

Most sensitive receptors were found to have predicted L_{Aeq} noise level more than 5 dB above the night L_{Aeq} noise level. Therefore, where compliance with the SPP 5.4 noise criteria are predicted to be achieved during the day, they are also predicted to be achieved at night. For the assessment of impacts, the SPP 5.4 $L_{Aeq,day}$ outdoor noise target is used as the governing factor.

Residences within proximity to upgraded roads

Without noise mitigation treatment, 49 properties are predicted to experience noise levels above the SPP 5.4 noise target of $L_{Aeq,day}$ 60 dBA in 2041. The majority of these properties (40) are located adjacent to the existing Forrest Highway, north of BORR/Forrest Interchange (BORR IPT, 2020b). This figure is slightly higher than the previous modelling results. This is due to changes in the road layout (form of interchanges), traffic volume figures, percentage of Heavy Goods Vehicles (HGVs) and SPP 5.4 amendments.

Without treatment, the properties closest to the Proposal Area are forecast to receive levels up to $L_{Aeq,day}$ 68 dBA.

In recognising the challenges in achieving noise level reduction where existing road infrastructure is surrounded by existing noise sensitive development, such as in areas adjacent to the Forrest Highway, north of the proposed BORR/Forrest Highway interchange, the Proposal aims to mitigate noise levels as low as possible and at a minimum to meet the outdoor noise target of L_{Aeq} 60 dBA.

Residences within proximity to new roads

In the absence of mitigation measures, the modelling undertaken predicts 38 properties will experience noise levels over the SPP 5.4 noise target for new roads of $L_{Aeq,day}$ 55 dBA in 2041. The majority of residences in this category are rural one off developments (single dwellings) located adjacent to the Proposal.

4.3.6 Mitigation

Noise walls are proposed to be constructed to mitigate operational day and night traffic noise predicted for areas to the west of Forrest Highway (Figure 18, Appendix A). Noise walls are the most suitable form of mitigation of traffic noise emission for densely populated areas. The noise walls proposed for this section of the Proposal Area will be constructed of concrete panels, steel posts and painted, and meet the

requirements of SPP 5.4. Where appropriate, generally where the height of walls is proposed to be above 2.5 – 3.8 m, high density acrylic / perspex may be used in the top section of the wall to ensure good light transfer to garden areas of adjacent residences.

Architectural treatment packages consisting of, for example, upgraded glazing (such as double glazing) and mechanical ventilation (to allow windows to be kept closed) will provide the most practical mitigation approach for sparsely located residences. Specific architectural treatment packages will be determined for each individual sensitive receptor following completion of an architectural treatment inspection (BORR IPT, 2020b).

Due to the isolated nature of the existing sensitive receptors along the route and cognisant of the current and future land use planning (e.g. rural farmland to future industrial park), mitigation treatment will be discussed on a one-to-one basis with impacted landowners. The development of appropriate noise mitigation measures will be determined through the detailed design phase of the Proposal.

4.3.7 Predicted outcome

Installation of noise walls will mitigate predicted (2041) traffic noise emissions adjacent to the Proposal Area (to the west of Forrest Highway), to below the SPP 5.4 noise target for upgraded roads of $L_{Aeq,day}$ 60 dBA and $L_{Aeq,night}$ 55 dBA.

Suitable mitigation measures for residential properties in sparsely populated areas will be discussed a one-to-one basis with impacted landowners. It is expected that through the application of architectural treatments, traffic noise emissions resulting from the operation of the Proposal can be suitably mitigated.

The EPA objective for Social Environment will be met for the Proposal through implementation of appropriate management and mitigation detailed in this section.

5 OFFSETS

5.1 Background

Environmental offsets are conservation actions that provide environmental benefits intended to counterbalance the significant residual environmental impacts associated with a proposal (GoWA, 2014). Main Roads intend to counterbalance the residual impact of the Proposal through implementation of an environmental offset strategy. The strategy will be prepared in accordance with the WA Government's Environmental Offset Policy (GoWA, 2011), WA Offset Guideline (GoWA, 2014) and the Australian Government's EPBC Act Environmental Offset Policy (DSEWPaC, 2012). The offset will be proportionate to the level of impact and significance of the environmental impact.

Main Roads operates on a hierarchy of avoid, minimise, reduce, rehabilitate and offset environmental impacts. This hierarchy is achieved primarily through changes in scope and design, development and implementation of the EMP and finally, an offset proposal. Application of the management hierarchy has been documented throughout this document.

5.2 EPBC Act Environmental Offsets Policy (DSEWPaC, 2012)

The EPBC Environmental Offsets Policy (DSEWPaC, 2012) requires the following Principles are met by an offset:

- Suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the protected matter
- Suitable offsets must be built around direct offsets but may include other compensatory measures
- Suitable offsets must be in proportion to the level of statutory protection that applies to the protected matter
- Suitable offsets must be of a size and scale proportionate to the residual impacts on the protected matter
- Suitable offsets must effectively account for and manage the risks of the offset not succeeding
- Suitable offsets must be additional to what is already required, determined by law or planning regulations, or agreed to under other schemes or programs
- Suitable offsets must be efficient, effective, timely, transparent, scientifically robust and reasonable
- Suitable offsets must have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.

5.3 WA Environmental Offset Policy (GoWA, 2011)

The WA Environmental Offsets Policy (GoWA, 2011) requires the following Principles are considered when developing an offset proposal:

- Environmental offsets will only be considered after avoidance and mitigation options have been pursued
- Environmental offsets are not appropriate for all projects

- Environmental offsets will be cost-effective, as well as relevant and proportionate to the significance of the environmental value being impacted
- Environmental offsets will be based on sound environmental information and knowledge
- Environmental offsets will be applied within a framework of adaptive management
- Environmental offsets will be focussed on longer term strategic outcomes.

5.4 Significant residual impact

Residual impacts associated with the Proposal have be determined through application of the residual impact significance model detailed in the WA Environmental Offsets Guidelines (GoWA, 2014). Main Roads proposes to counterbalance the significant residual impacts to:

- 3.7 ha of vegetation representative of Banksia Woodland TEC and PEC.
- 0.7 ha of vegetation representative of Herb rich shrublands in clay pans (FCT08).
- 43.9 ha of Western Ringtail Possum habitat comprising impacts to the home range of 20-25 individuals
- 17.7 ha of Southern Brush-tailed Phascogale habitat
- 37.8 ha of potential habitat for Black Cockatoo species (Baudin's Black-Cockatoo (*Calyptorhynchus baudinii*), Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) and Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksia naso*).

5.5 Offset strategy

An Offsets Strategy detailing the residual impacts of the Proposal, the significance of the residual impacts and proposed offsets to counterbalance these residual impacts is provided as Appendix K.

6 CONCLUSION

On 17 July 2019, the EPA's Section 40(2)(a) Notice requested further information on the impacts the Proposal will have on TECs, PECs and Threatened Fauna, the details of an Offset Strategy and noise impacts and mitigation. Significant effort was undertaken during the alignment selection process to locate the corridor for BORR where it would have the least environmental and social impacts. The Northern and Central Sections of BORR had, wherever possible, avoided native vegetation by locating the corridor within areas that are predominately cleared for agriculture. Further refinements during the detailed design phase, subsequent to referral of the project, have significantly reduced the potential impacts of the Proposal to TECs and habitats for threatened fauna. Considerable efforts have been made to reduce the footprint of the Proposal and further efforts have been made in the development of mitigation strategies to ensure quality of habitat and connectivity between habitats is maintained.

As a consequence of these efforts, the impacts to flora and vegetation are not considered to be significant.

Due to the occurrence of fauna of conservation significance, in particular the WRP and Black Cockatoos, some minor residual impacts to fauna are expected. Detailed specific management measures have been developed for mitigation of impacts to threatened fauna. Monitoring and response mechanisms are a key component of this mitigation approach.

Installation of noise walls will mitigate predicted (2041) traffic noise emissions adjacent to the Proposal Area (to the west of Forrest Highway), to below the SPP 5.4 noise target for upgraded roads of $L_{Aeq,day}$ 60 dBA and $L_{Aeq,night}$ 55 dBA. It is expected that through the application of architectural treatments for residential properties in sparsely populated areas, traffic noise emissions resulting from the operation of the Proposal can be suitably mitigated.

6.1 Flora and vegetation

Modification to the Proposal Area since referral to the EPA in June 2019 has reduced the overall loss of native vegetation by more than 18 ha (from 91.2 to 73 ha). The changes have specifically targeted reduction in the impact on TEC and PEC vegetation where the total expected impact on these is now estimated to be 5.7 ha as compared to the previously referred total of 8.2 ha.

Mitigation measures including drainage design, dieback and weed management as well as monitoring of TECs during and following construction will be implemented to avoid and minimise indirect impacts.

Given the relatively small area of TEC and PEC vegetation to be directly impacted through clearing and the comprehensive mitigation measures to be implemented to minimise indirect impacts, the clearing for the Proposal is not considered to have a significant impact on this Environmental Factor, with the EPA's objective for Flora and Vegetation being met.

6.2 Terrestrial fauna

The refinements to the Proposal have resulted in the reduction in the area of mapped fauna habitat impacted by clearing as a result of this Proposal from 104.70 ha to approximately 76 ha. The area of habitat (potentially impacted) remaining includes an estimated:

- 43.9 ha of WRP habitat
- 17.7 ha of BTP habitat
- 0.55 ha of BSM habitat
- 37.8 ha of Black Cockatoo habitat.

Considerable effort has been applied to the development of mitigation measures for threatened fauna. These include reducing the amount of habitat to be cleared and also implementation of a raft of measures to ensure remaining habitat is enhanced through revegetation and improved connectivity. The mitigation measures and monitoring framework for threatened fauna are detailed in the Conservation Significant Fauna EMP which will assist in ensuring impacts are minimised. As a result of the reduction in the area of habitats to be cleared and mitigation measures to be implemented it is considered that the EPA objective for this factor will be met.

6.3 Social surrounds

Noise emissions will managed in accordance with the guidelines provided in State Planning Policy 5.4. The CEMP will be developed to include strategies to ensure the Proposal complies with the requirements of the Environmental Protection (Noise) Regulations 1997.

Installation of noise walls will mitigate predicted (2041) traffic noise emissions adjacent to the Proposal Area and satisfy the SPP 5.4 noise thresholds for day-time and night-time noise. The construction and implementation of the Proposal will meet the EPA's objective to *"protect social surroundings from significant harm".*

6.4 Impact Summary

The Proposal to construct the Northern and Central Sections of BORR will improve road safety and provide substantial efficiency benefits by separating high speed regional and freight traffic from local movements. The Proposal will also provide more efficient access to the Bunbury Port, enable expansion of existing and proposed industrial centres, support economic growth and create more jobs in the region.

The potential impacts from the Northern and Central Sections of the BORR have been significantly reduced as a result of the efforts applied during the detailed design phase. This reduction has been largely achieved through the additional avoidance and mitigation measures that have been developed for the Proposal. Main Roads anticipates that the social and environmental impacts of the Proposal can be appropriately managed through the measures detailed within this document and considers the EPA's objectives for each key factor will be met.

7 REFERENCES

Aplin, K. P., Rhind, S. G., Ten Have, J. & Chesser, R. T., 2015. Taxonomic revision of Phascogale tapoatafa (Meyer, 1793) (Dasyuridae; Marsupialia), including descriptions of two new subspecies and confirmation of P.pirata Thomas, 1904 as a 'Top End' endemic. *Zootaxa,* Volume 4055.

Biota, 2016. *Bunbury Outer Ring Road Southern Section - Reassessment of Floristic Communities,* s.l.: Unpublished report prepared for Main Roads Western Australia.

Biota, 2018. *Bunbury Outer Ring Road Southern Section - Banksia Woodlands TEC Assessment,* s.l.: Unpublished report prepared for Main Roads Western Australia.

Biota, 2019. *Western Ringtail Possum: Pseudocheirus occidentalis Regional Surveys DRAFT,* s.l.: Draft report for Main Roads Western Australia..

Biota, 2020. *Bunbury Outer Ring Road Northern and Central Section Targeted Fauna Assessment,* s.l.: Unpublished report for Main Roads Western Australia..

BORR IPT, 2018. *Drainage Strategy - Northern and Central Sections,* s.l.: Unpublished report for Main Roads Western Australia.

BORR IPT, 2019. *Bunbury Outer Ring Road Northern and Central Sections EPA Environmental Referral Supporting Document,* s.l.: Unpublished report for Main Roads Western Australia.

BORR IPT, 2020a. *Bunbury Outer Ring Road Northern and Central Sections Environmental Management Plan - Conservation Significant Fauna,* s.l.: Unpublished report for Main Roads Western Australia.

BORR IPT, 2020b. *Bunbury Outer Ring Road Northern and Central Sections Traffic Noise Assessment,* s.l.: Unpublished report for Main Roads Western Australia.

BORR IPT, 2020c. *Bunbury Outer Ring Road Northern and Central Sections Vegetation and Flora Study,* s.l.: Unpublished report for Main Roads Western Australia.

CALM, 2002. *Brush-tailed Phascogale Phascogale tapoatafa,* s.l.: Department of Conservation and Land Management (CALM).

Chambers, B. & Bencini, R., 2016. *Bunbury Outer Ring Road: fauna monitoring, rope bridge and fauna underpass use. Final Report to Main Roads Western Australia,* Perth, WA: The University of Western Australia.

Clarke, J. R., 2011. *Translocation outcomes for the western ringtail possum (Pseudocheirus occidentalis) in the presence of the common brushtail possum (Trichosurus vulpecula): health, survivorship and habitat use,* s.l.: (Doctoral dissertation) Murdoch University, Western Australia.

DBCA, 2019. *National Recovery Plan for the Clay Pans of the Swan Coastal Plain Ecological Community ,* Perth: Department of Biodiversity, Conservation and Attractions .

de Tores, P. J., 2005. *A proposal for translocation of the Western Ringtail Possum, Pseudocheirus occidentalis, an arboreal marsupial endemic to the south-west of Western Australia,* s.l.: Department of Conservation and Land Management, Perth.

Department of Parks and Wildlife, 2013. *Carnaby's Cockatoo (Calyptorhynchus latirostris) Recovery Plan,* Perth: Department of Parks and Wildlife.

DoEE, 2017a. *Approved Conservation Advice for Corymbia calophylla - Xanthorrhoea preissii woodlands and shrublands of the Swan Coastal Plain,* Canberra: Department of the Environment and Energy.

DoEE, 2017b. *Revised draft referral guideline for three threatened black cockatoo species: Carnaby's Cockatoo (Endangered) Calyptorhynchus latirostris Baudin's Cockatoo (Vulnerable) Calyptorhynchus baudinii Forest Red-tailed Black Cockatoo (Vulnerable) Calyptorhynchus,* s.l.: Commonwealth of Australia.

DPaW, 2017. *Western Ringtail Possum Recovery Plan,* Perth, Western Australia: Department of Parks and Wildlife.

DSEWPaC, 2012. *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy.* [Online] Available at: http://www.environment.gov.au/system/files/resources/12630bb4-2c10-4c8e-815f-2d7862bf87e7/files/offsets-policy_2.pdf

Ecoedge, 2018. *A Flora and Vegetation Survey on Lot 104 Willinge Drive, Davenport,* s.l.: Unpublished report prepared for Main Roads Western Australia.

Ecoedge, 2019a. *Bunbury Outer Ring Road Central and Northern Sections Claypan Threatened Ecological Community Assessment Survey Report 2019,* s.l.: Unpublished report prepared for Main Roads Western Australia.

Ecoedge, 2019b. *A Review of the Regional Conservation Status of a Clay-based Wetland Community (Clay pans),* s.l.: Unpublished report prepared for Main Roads Western Australia.

EPA, 2004a. *Guidance for the Assessment of Environmental Factors, Assessment of Aboriginal Heritage No. 41,* Perth, Western Australia: EPA.

EPA, 2004b. *Guidance Statement No 51, Guidance for the Assessment of Environmental Factors: Vegetation and Flora Surveys for Environmental Impact Assessment in Western Australia,* Perth: Environmental Protection Authority.

EPA, 2013. *Protection of Naturally Vegetated Areas Through Planning and Development, Environmental Protection Bulletin No. 20,* Perth: Environmental Protection Authority.

EPA, 2016a. *Environmental Factor Guideline: Flora and Vegetation,* s.l.: Prepared for the Government of Western Australia.

EPA, 2016b. *Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment.* [Online] Available at: http://www.epa.wa.gov.au/policies-guidance/technical-guidance-flora-and-vegetation-surveys-environmental-impact-assessment
[Accessed August 2018].

EPA, 2016c. *Environmental Factor Guideline: Terrestrial Fauna.* [Online] Available at: http://www.epa.wa.gov.au/policies-guidance/environmental-factor-guideline-terrestrial-fauna
[Accessed August 2018].

EPA, 2016d. *Technical Guidance Sampling Methods for Terrestrial Vertebrate Fauna.* [Online] Available at: http://www.epa.wa.gov.au/policies-guidance/technical-guidance-sampling-methods-terrestrial-vertebrate-fauna
[Accessed August 2018].

EPA, 2016e. *Technical Guidance Terrestrial Fauna Surveys.* [Online] Available at: http://www.epa.wa.gov.au/policies-guidance/technical-guidance-terrestrial-fauna-surveys
[Accessed August 2018].

EPA, 2016f. *Environmental Factor Guideline: Social Surroundings,* s.l.: Prepared for the Government of Western Australia.

EPA, 2018a. *Instructions for the preparation of data packages for the Index of Biodiversity Surveys for Assessments (IBSA),* s.l.: Government of Western Australia.

EPA, 2018b. *Statement of Environmental Principles, Factors and Objectives,* s.l.: Prepared for the Government of Western Australia.

EPA, 2018c. *Instructions on how to prepare an Environmental Review Document,* s.l.: Government of Western Australia.

Galeotti, D., 2013. *Metapopulation theory explains balck-stripe minnow (Pisces: Galaxidae, Galaxiella nigrostriata) distribution in seasonal wetlands in south-western Western Australia..* s.l.:Retrieved from https://ro.ecu.edu/thesis/708.

GHD, 2010. *Bunbury Outer Ring Road (Stage 1) and Port Access Road (Stage 2),* s.l.: Unpublished report for Main Roads Western Australia.

GHD, 2014. *Lot 1 Ducane Road, Environmental Values Assessment,* s.l.: Unpublished report for Main Roads Western Australia.

GHD, 2015a. *Waterloo Urban and Industrial Expansion,* s.l.: Unpublished report for Shire of Dardanup.

GHD, 2015b. *Bunbury Outer Ring Road, South Western Highway to Bussell Highway, Flora and Vegetation Assessment, Phase 1 and Phase 2,* s.l.: Unpublished report for Main Roads Western Australia.

GoWA, 2011. *WA Environmental Offsets Policy.* [Online] Available at: http://www.epa.wa.gov.au/sites/default/files/Policies_and_Guidance/WAEnvOffsetsPolicy-270911.pdf

GoWA, 2014. *WA Environmental Offsets Guidelines.* [Online] Available at: http://www.epa.wa.gov.au/sites/default/files/Policies_and_Guidance/WA%20Environmental%20Offsets%20Guideline%20August%202014.pdf

Great Southern Bio Logic, 2018. *Phytophthora Dieback Occurrence Survey Bunbury Outer Ring Road North,* s.l.: Unpublished report for BORR IPT.

Hastie, L. C., Boon, P. J. & Young, M. R., 2000. Physical microhabitat requirements of freshwater pearl mussels, Margaritifera margaritifera(L.). *Hydrobiologia,* Volume 429, pp. 59-71.

IUCN, 2019. *IUCN Red List of Threatened Species. Version 2019-3,* s.l.: International Union for Conservation of Nature.

Johnstone, R. E. & Kirkby, T., 2011. *Black Cockatoos on the Swan Coastal Plain,* s.l.: Department of Planning, Western Australia.

Klunzinger, M W; Beatty, S J; Morgan, D L; Lymbery, A J; Pinder, A M; Cale, D J, 2012a. Distribution of Westralunio carteri Iredale 1934 (Bivalvia: Unionoida: Hyriidae) on the south coast of southwestern Australia, including new records of the species. *Journal of the Royal Society of Western Australia,* Volume 95, pp. 77-81.

Klunzinger, M W; Beatty, S J; Morgan, D L; Pinder, A M; Lymbery, A J;, 2015. Range decline and conservation status of Westralunio carteri Iredale, 1934 (Bivalvia : Hyriidae) from south-western Australia. *Australian Journal of Zoology,* Volume 63, p. 127-135.

Klunzinger, M W; Beatty, S J; Morgan, D L; Thomson, G J; Lymbery, A J;, 2012b. Glochidia ecology in wild fish populations and laboratory determination of competent host fishes for an endemic freshwater mussel of south-western Australia. *Australian Journal of Zoology,* Volume 60, pp. 26-36.

Main Roads, 2020. *BORR Northern and Central Sections Offset Strategy Plan,* s.l.: s.n.

Rhind, S. G., 1996. Habitat tree requirements and the effects of removal during logging on the marsupial Brush-tailed Phascogale (Phascogale tapoatafa) in Western Australia. *The Western Australian Naturalist,* Volume 21, pp. 1-22.

Shedley, E. & Williams, K., 2014. *An assessment of habitat for Western Ringtail Possum on the southern Swan Coastal Plain (Binningup to Dunsborough),* s.l.: Department of Parks and Wildlife.

South West Development Commission, 2018. *Impressive Economic Growth.* [Online] Available at: http://www.swdc.wa.gov.au/economy/impressive-economic-growth.aspx

Threatened Species Scientific Committee (TSSC), 2012. *Commonwealth Listing Advice on Claypans of the Swan Coastal Plain.* [Online] Available at: http://www.environment.gov.au/biodiversity/threatened/communities/pubs/121-

TSSC, 2016. *Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community,* s.l.: Threatened Species Scientific Community via DotEE.

TSSC, 2018a. *Conservation Advice Pseudocheirus occidentalis Western ringtail possum,* s.l.: Department of the Environment and Energy.

TSSC, 2018b. *Conservation Advice Galaxiella nigrostriata black-stripe minnow,* Canberra: Department of the Environment and Energy.

WAPC, 2016. *Draft Wanju District Structure Plan.* Perth, Western Australia: WAPC.

WAPC, 2017. *Draft Waterloo Industrial Park District Structure Plan,* Perth, Western Australia: WAPC.

WAPC, 2018. *City of Bunbury Local Planning Strategy.* [Online] Available at: https://www.dplh.wa.gov.au/bunbury [Accessed 26 March 2019].

WAPC, 2019a. *State Planning Policy No. 5.4 Road and Rail Noise (SPP 5.4),* Perth, Western Australia: WAPC.

WAPC, 2019b. *Road and Rail Noise Guidelines,* Perth, Western Australia: WAPC.

WRM, 2020. *Bunbury Outer Ring Road Northern and Central Investigation Area: Targeted Conservation Significant Aquatic Fauna Survey,* s.l.: Unpublished report prepared for Main Roads Western Australia.

Yin, H. K., 2006. *The metabolic and hygric physiology of Western Ringtail Possum (Pseudocheirus occidentalis). (Honours thesis),* s.l.: Curtin University of Technology, Western Australia.

Yokochi, K. & Bencini, R., 2015. A remarkably quick habituation and high use of a rope bridge by an endangered marsupial, the western ringtail possum. *Nature Conservation,* p. 16.

BORR Team

Appendix A

Figures

Figure 1 Proposal Area

Figure 2 Proposed Design

Figure 3 Flora and vegetation studies undertaken for the Proposal

Figure 4 TEC and PEC extent within the Proposal Area

Figure 5 TEC and PEC extent adjacent to the Proposal Area

Figure 6 Extent of WRP habitat types and WRP observations within the Proposal Area

Figure 7 WRP key habitat areas

Figure 8 WRP connectivity map showing fauna bridges and underpasses

Figure 9 Carter's Freshwater Mussel observations and habitat extent within the Proposal Area

Figure 10 Black-stripe Minnow observations and habitat extent within the Proposal Area

Figure 11 Phascogale habitat extent within the Proposal Area

Figure 12 Black Cockatoo foraging habitat and trees with hollowswithin the Proposal Area

Figure 13 Sensitive receptors noise identified through noise modelling

Figure 14 Day time forecast traffic noise $L_{Aeq,\ day}$ Existing 2018 noise levels at the most affected façade

Figure 15 Night time forecast traffic noise $L_{Aeq,\ night}$ Existing 2018 noise levels at the most affected façade

Figure 16 Forecast traffic noise $LA_{eq,\ day}$ Build 2041 noise levels at the most affected façade - No treatment

Figure 17 Forecast traffic noise $LA_{eq,\ night}$ Build 2041 noise levels at the most affected façade - No treatment

Figure 18 Forecast $LA_{eq,day}$ Build 2041 noise levels at the most affected façade - With treatment

Appendix B

Bunbury Outer Ring Road Northern and Central Sections Environmental Management Plan – Conservation Significant Fauna (BORR IPT 2019e)

Appendix C

Bunbury Outer Ring Road Northern and Central Sections Vegetation and Flora Study (BORR IPT 2019b)

Appendix D

A Review of the Regional Conservation Status of Clay-pan based Wetland Community (Claypans) (Ecoedge 2019b)

BORR Team

Appendix E

TEC / PEC Vegetation Monitoring Program

BORR Team

Appendix F

Drainage Monitoring Program for TEC / PEC Vegetation

BORR Team

Appendix G

Triggers, Thresholds and Contingency Actions for Management of TEC / PEC Vegetation

Appendix H

Bunbury Outer Ring Road Northern and Central Section Targeted Fauna Assessment (Biota 2019d)

Appendix I

Bunbury Outer Ring Road Northern and Central Investigation Area: Targeted Conservation Significant Aquatic Fauna Survey (WRM 2019)

Appendix J

Bunbury Outer Ring Road Northern and Central Sections Traffic Noise Assessment (BORR IPT 2019)

Appendix K

BORR Northern and Central Sections Offset Strategy (Main Roads 2020)

BORR
Team

Australian Government

BUILDING OUR FUTURE

mainroads
WESTERN AUSTRALIA

BUNBURY OUTER RING ROAD | PLANNING AND DEVELOPMENT