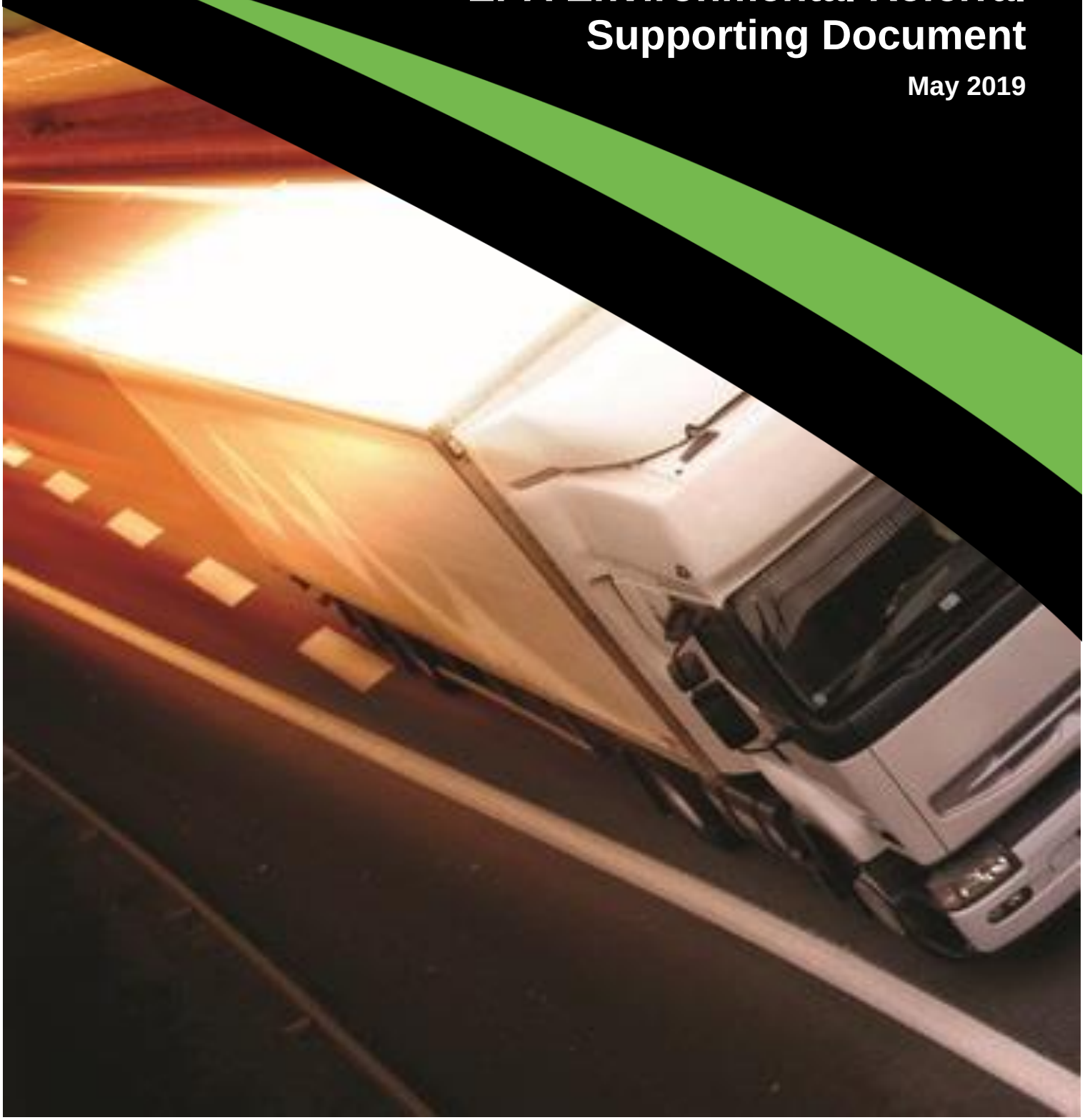
BORR Team

Bunbury Outer Ring Road
Northern and Central Sections

EPA Environmental Referral Supporting Document

May 2019



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 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.

Main Roads proposes to refer BORR Northern and Central Sections (the **Proposal**) to the Environmental Protection Authority (EPA) for assessment under Section 38 of the *Environmental Protection Act 1986* (EP Act). This document refers to BORR Northern and Central Sections only.

The Proposal is located approximately 200 km south of Perth and, at its closest point, approximately six km south-east of Bunbury. It occurs within the City of Bunbury and Shires of Capel, Dardanup and Harvey. 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 area being referred by Main Roads is up to 651 hectares (ha) and is referred to as the **Proposal Area**. The majority (80 %) of the land within the Proposal Area is cleared agricultural land. Pockets of native vegetation are established 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.

A summary of the potential impacts, proposed mitigation and outcomes for the identified environmental factors of the Proposal are provided in the following table.

KEY ENVIRONMENTAL FACTOR – FLORA AND VEGETATION	
EPA objective	*'To protect flora and vegetation so that biological diversity and ecological integrity are maintained.'*
Policy and guidance	Flora and vegetation surveys that have informed planning for the Proposal were conducted in accordance with the Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016a) and the Environmental Factor Guideline (EPA, 2016b).
Potential impacts	Loss of up to 91.2 ha of native remnant vegetation and up to 28.1 ha of revegetation/regrowth vegetation, including: • 7.6 ha of '*Banksia* Woodlands of the Swan Coastal Plain (SCP)' Threatened Ecological Community (TEC) and '*Banksia* dominated woodlands of the SCP Interim Biogeographic Regionalisation of Australia (IBRA) region' Priority Ecological Community (PEC) (including 3.0 ha requiring confirmation) • 0.6 ha likely to be occurrence of 'Herb rich shrublands in clay pans (FCT08)' TEC (requiring confirmation and an additional 1.0 ha in the unsurveyed portion of the Proposal Area which requires surveying)

	• 1.6 ha vegetation associated with the Preston River • 5.4 ha of other significant riparian vegetation (not associated with the Preston River) • 1.1 ha of as yet unsurveyed native vegetation (1.0 ha of which has been previously identified as Herb rich shrublands in clay pans TEC). Loss of individual flora, including *Caladenia speciosa* (Priority 4), *Acacia semitrullata* (Priority 4) and *Chamaescilla gibsonii* (Priority 3). Indirect impacts such as fragmentation of native vegetation, possible introduction/spread of Dieback (*Phytophthora cinnamomi*) or weeds, changes to vegetation structure in surrounding areas and damage to surrounding vegetation through bushfire.
Mitigation	**Avoid** • Clearing of remnant native vegetation was minimised through selection of the Proposal Area where the majority of land has been previously disturbed or cleared. **Minimise** • Implementation of a Construction Environmental Management Plan (CEMP), Hygiene Management Plan and Topsoil Management Plan. **Rehabilitate** • Implementation of a Topsoil Management Plan and Environmental Offsets Strategy.
Outcomes	Permanent loss of native remnant vegetation, including vegetation representative of TECs/PECs, which will require offsets to be determined through an Environmental Offset Strategy. Indirect impacts can be mitigated through implementation of relevant management plans during construction.
KEY ENVIRONMENTAL FACTOR – TERRESTRIAL FAUNA	
EPA objective	*'To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.'*
Policy and guidance	The fauna survey that has informed the planning of the Proposal was conducted in accordance with the Technical Guidance – Terrestrial Fauna Surveys (EPA, 2016c) and the Environmental Factor Guideline – Terrestrial Fauna (EPA, 2016d).
Potential impacts	Loss of up to 104.7 ha of fauna habitat, including breeding and foraging habitat for conservation significant fauna species known to occur within the Proposal Area: • 59.7 ha habitat for Black Cockatoos (Carnaby's Cockatoo [Endangered], Baudin's Cockatoo [Endangered] and Forest Red-tailed Black Cockatoo [Vulnerable]) including: – Loss of up to five trees considered to be Trees with a Suitable Nest Hollow (for Black Cockatoos), and a further 1111 Suitable DBH Trees • 70.3 ha habitat for Western Ringtail Possums (WRP) (Critically Endangered) and displacement of up to 49 individual WRPs • 28.2 ha habitat for South-western Brush-tailed Phascogale (Schedule 6) • 104.7 ha habitat for Southern Brown Bandicoot (Priority 4). Disturbance of up to 1.4 ha of Carter's Freshwater Mussel (Vulnerable) habitat during construction of bridges.

	No black-stripe Minnow (Endangered) were found within the Proposal Area. One Black-stripe Minnow was found within the Survey Area in a wetland adjoining the Proposal Area. Further field investigations will be undertaken during winter 2019 to identify suitable habitat for Black-stripe Minnow and determine the likelihood of occurrence within the Proposal Area. Loss of fauna habitat for a further eight conservation significant fauna species that are likely to occur or possibly occur within the Proposal Area. Potential for death or displacement of fauna species through vehicle movements, traffic noise exposure, light spill or disturbance of the bed and banks of watercourses.
Mitigation	**Avoid** • Design to include infrastructure to facilitate fauna movement. **Minimise** • Implementation of a CEMP and Fauna Management Plan • Timing of construction to avoid Black Cockatoo nesting period. **Rehabilitate** • Implementation an Environmental Offsets Strategy.
Outcomes	Permanent loss of fauna habitat that provides for conservation significant fauna species. This impact will require offsets which will be determined through an Environmental Offsets Strategy. Other potential impacts can be mitigated through implementation of relevant management plans during construction. Clearing of native vegetation for the construction and operation of the Proposal will result in reduction of habitat supporting conservation significant fauna. It is therefore considered likely that the Proposal will have minor residual impacts on Black Cockatoos and WRP.
KEY ENVIRONMENTAL FACTOR – TERRESTRIAL ENVIRONMENTAL QUALITY	
EPA objective	*'To maintain the quality of land and soils so that environmental values are protected.'*
Policy and guidance	Investigations that informed the planning of the Proposal were were conducted in accordance of the requirments of the Environmental Factor Guideline – Terrestrial Environmental Quality (EPA, 2016e), Department of Water and Environmental Regulation (DWER) Acid Sulfate Soil (ASS) Guideline Series (DER, 2015a) and Assessment and the Management of Contaminated Sites (DER, 2014).
Potential impacts	**Construction** • Excavation and exposure of ASS into the receiving environment causing contamination of land and/or waters • Erosion of surrounding soils • Accidental release of environmentally hazardous material from storage or handling areas, causing contamination of land • Indirect impacts such as loss of soil health from erosion and vegetation clearing, including soil salinisation. **Operations** • Contamination of land and erosion from stormwater runoff

	• Loss of soil function due to establishment of a permanent bitumenised (road base) surface.
Mitigation	**Avoid** • Hydrocarbon and chemical handling will be managed through the implementation of a CEMP • Avoidance of soil salinisation through minimising clearing of native vegetation (where practicable) and revegetation • Drainage design to contain hazardous spills. **Minimise** • Implementation of an ASS Management Plan (ASSMP), CEMP and Topsoil Management Plan • Undertake an additional investigation of a former piggery site (Lot 521 Boyanup Picton Road) to minimise the risk of exposing contamination • Undertake a contamination risk assessment of the entire alignment (when available) and remediate as required. **Rehabilitate** • Soil rehabilitation through implementation of a Topsoil Management Plan.
Outcomes	The construction of the Proposal will result in a loss of soil function for the bituminised area (road base). The remainder of the Proposal Area can be rehabilitated to restore soil function. The risk of ASS during construction of the Proposal can be managed under a detailed ASS Management Plan.
KEY ENVIRONMENTAL FACTOR – INLAND WATERS	
EPA objective	*'To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.'*
Policy and guidance	The Inland Waters studies that have informed the planning of the Proposal were conducted in accordance with the Environmental Factor Guideline – Inland Waters (EPA, 2018a) and Contaminated Sites Guidelines (DER, 2014).
Potential impacts	Without effective management measures in place direct impacts on Inland Waters that may result during the construction of the Proposal include: • Temporary abstraction of groundwater for construction activities (dust suppression, dewatering bridge footings) and resultant short term changes to groundwater levels in the superficial aquifer • Potential changes to hydrological regimes of Geomorphic Wetlands and waterways • Erosion and sedimentation in surrounding areas • Impact on river beds and banks • Increase in upstream water levels (proposed) at proposed bridge sites • Contamination of surface water and/or groundwater. Potential indirect impacts during construction and operation of the Proposal include changes to hydrological regimes of Geomorphic Wetlands.

Mitigation	**Avoid** • Drainage design to maintain hydrological flow regimes and control stormwater run. **Minimise** • Implementation of a CEMP and ASSMP • Monitoring in accordance with the Environmental Management Plan (EMP) and CEMP. **Rehabilitate** Not applicable.
Outcomes	Impacts to hydrological flows will be mitigated through the drainage design process. Temporary impacts on groundwater and surface water during construction will be managed in accordance with the Proposal specific CEMP. Permanent change in groundwater regimes is considered unlikely to occur as a consequence of the Proposal. Operation of the Proposal is considered unlikely to significantly impact on surface water and groundwater quality. Based on the mitigation measures proposed, no significant residual impacts on inland waters are expected and it is considered the Proposal meets the EPA objective to maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.
KEY ENVIRONMENTAL FACTOR – AIR QUALITY	
EPA objective	*'To maintain air quality and minimise emissions so that environmental values are protected.'*
Policy and guidance	The Air Quality studies that have informed the Proposal planning and design were conducted in accordance with the Environmental Factor Guideline – Air Quality (EPA, 2016f) and the National Environment Protection (Ambient Air Quality) Measure (AIR NEPM) (National Environment Protection Council (NEPC), 2016).
Potential impacts	• Reduced air quality due to increased vehicle emissions • Dust generated from construction activities • Increased greenhouse gas (GHG) emissions • Indirect impacts such as dust deposition on adjacent vegetation communities.
Mitigation	**Avoid** • Selection of energy efficient assets, renewable energy sources and materials with lower embodied energy • Reducing congestion through alternative design treatments such as roundabouts or modified intersections. **Minimise** • Implementation of a CEMP • Management measures of GHG emissions to be determined through an assessment of direct emissions during construction. **Rehabilitate** Not applicable.
Outcomes	Visible dust emissions will likely occur during construction. An Air Quality Assessment for future road traffic emissions indicates that the Proposal is unlikely to adversely impact local air quality.

	Street lighting, traffic signals and road maintenance activities are unlikely to produce significant GHG emissions throughout the Proposal. Construction and operation phases of the Proposal will be subject to a direct GHG emissions assessment. Given the proposed mitigation measures outlined above, no residual impacts are expected for this aspect and the Proposal meets the EPA objective to maintain air quality and minimise emissions so that environmental values are protected.
KEY ENVIRONMENTAL FACTOR – SOCIAL SURROUNDS	
EPA objective	*'To protect social surroundings from significant harm.'*
Policy and guidance	The social surroundings investigations that have informed the planning and design of the Proposal were conducted in accordance with Environmental Factor Guideline – Social Surroundings (EPA, 2016g), *Environmental Protection (Noise) Regulations 1997* (Noise Regulations) and the *Aboriginal Heritage Act 1972* (AH Act).
Potential impacts	**Construction** • Aboriginal Heritage Site disturbance during clearing and/ or excavation works • Reduced visual amenity due to vegetation clearing, dust and where construction occurs in areas visible to surrounding residential and rural properties • Noise impacts to sensitive receptors (from equipment and vehicle operation, increased traffic on local road network). **Operations** • Reduced visual amenity where the new road is visible to residents surrounding the Proposal Area • Increased noise impacts to sensitive receptors from a change in rural land use to a roadway • Increased glare or light spill on sensitive receptors from lighting at interchanges and vehicle headlights • Change in land use from predominantly rural to regional roads. Indirect impacts to Social Surrounding as a result of developing the Proposal are expected to be limited or negligible.
Mitigation	**Avoid** • Minimise noise emissions through site selection and design (e.g. noise walls). **Minimise** • Implementation of a CEMP and EMP • Development and implementation of an Aboriginal Heritage Management Plan • Development and implementation of a Landscape Management Plan. **Rehabilitate** • Implementation of a Landscape Management Plan to improve visual amenity.

Outcomes	The construction and operation of the Proposal will change land use from 'rural' to 'regional roads'. Social aspects will be reduced to direct impact on Aboriginal Heritage sites, direct impact to local visual amenity, and an increase in noise emissions. The EPA objective for Social Environment will be met for the Proposal through implementation of appropriate management and mitigation detailed in the environmental management plans and SPP5.4 Guidelines (Noise).

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	Average Recurrence Interval
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
DBCA	Department of Biodiversity, Conservation and Attractions
DBH	Diameter Breast Height
DMA	Decision making authority
DoEE	Department of Environment and Energy
DPLH	Department of Planning, Lands and Heritage
DPIRD	Department of Primary Industries and Regional Development
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
IBRA	Interim Biogeographic Regionalisation of Australia
IFD	Intensity Frequency Duration
ILUA	Indigenous Land Use Agreement
ILM	Investment Logic Mapping
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
$PM_{2.5}$	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
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 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 Shires of Capel, Dardanup and Harvey, at its closest point approximately 6 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 650.65 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.
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

TABLE INDEX

FIGURES INDEX

PLATES INDEX

APPENDICES

Document Control

Revision	Date	Description	Prepared	Reviewed	Approved
A	13/02/19	Draft for Main Roads Review	BORR Team	FH	FH
B	15/05/19	Draft for Main Roads Review	BORR Team	FH	FH
C	20/05/19	Final Draft for Main Roads Review	BORR Team	FH	FH
0	31/05/19	Final Document	BORR Team	FH	FH

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 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 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, and is 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, an existing four km section which was completed in May 2013, along with a 3 km extension of Willinge Drive southwards to South Western Highway
- 'BORR Southern Section' – South Western Highway (near Bunbury Airport) to Bussell Highway.

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

1.1 Purpose of this document

Main Roads propose to refer BORR Northern and Central Sections (the **Proposal**) to the Environmental Protection Authority (EPA) for assessment under Section 38 of the *Environmental Protection Act 1986* (EP Act). The purpose of this document is to support the formal referral of the Proposal. The document provides information on the Proposal activities, potential environmental impacts and proposed mitigation measures associated with the construction and operation of BORR Northern and Central Sections.

A separate referral will be prepared for BORR Southern Section following completion of an alignment selection process. The separate referral process has been undertaken as BORR will be designed and constructed as separate work packages. Separation of the referrals also enables thorough and respectful engagement and consultation with the communities and stakeholders for all sections.

This document has been prepared in accordance with *Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2016* (EPA, 2016h) and *Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual* (EPA, 2018b).

1.2 Proposal description

The Proposal is located approximately 200 km south of Perth and at its closest point, approximately six km south-east of Bunbury. It occurs within the City of Bunbury and Shires of Capel, 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 components of the Proposal are described in Section 2.

The area being referred by Main Roads is up to 651 hectares (ha) and referred to as the **Proposal Area**. The majority of the land within the Proposal Area is cleared agricultural land. Pockets of native vegetation are present 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. The Proposal Area is illustrated in Figure 1 (Appendix A).

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	Dominic Boyle Project Director 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

The Proposal will be assessed under Part IV of the EP Act which is the primary legislation governing environmental protection and impact assessment in Western Australia (WA). Division 1 of Part IV of the EP Act provides for the referral and assessment of significant and strategic proposals.

The Proposal Area partially overlaps with the GBRS which was formally assessed under Part IV of the EP Act (referred in 1996 and Ministerial Statement 697 issued in 2005). This Proposal is not being referred as a proposal under the GBRS. Conditions set out in Ministerial Statement 697 (Western Australian Minister for the Environment, 2005) therefore, do not formally apply to the Proposal, but have been taken into account where relevant.

1.4.2 *Environmental Protection and Biodiversity Conservation Act 1999*

A proposed action that may have a significant impact on a Matter of National Environmental Significance (MNES) requires approval from the Commonwealth under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The Proposal will be referred to the Department of Environment and Energy (DoEE) under the EPBC Act due to the potential impacts to protected fauna species and

communities. Further details on potential MNES within the Proposal Area are provided in Sections 4.3, 4.4 and 6.

1.4.3 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 the Environment and Energy (DEE)	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)

1.4.4 Planning Approvals

The alignment of the Proposal will not be fully located within land currently reserved under the GBRS for Primary Regional Roads or Other Regional Roads (Refer Section 2). This will require an amendment to the GBRS to reserve the alignment for the purposes of Primary Regional Roads.

No development approval is required for road construction works on land reserved by the GBRS for the purpose of Primary Regional Roads or Other Regional Roads. Approval of the WAPC may be required, through a development approval, for any works that occur before the land is appropriately reserved by the GBRS. This includes land reserved by the GBRS for any other purpose, and on land zoned by the GBRS. Clause 27 of the GBRS identifies that the WAPC, by way of resolution, can require development on zoned land to have the approval of the WAPC. The relevant instrument of delegation includes a number of circumstances expected to apply to the Proposal; where construction occurs before gazettal of an amendment to the GBRS, elements of the Proposal will require development approval.

Land within the proposed alignment will be acquired by Main Roads and dedicated as a road pursuant to section 28 (1) of the *Land Administration Act 1997*.

1.4.5 Decision Making Authorities

The authorities listed in Table 1-2 have been identified as decision making authorities (DMAs) for the Proposal.

Table 1-2 Decision making authorities for the Proposal

DECISION MAKING AUTHORITY	RELEVANT LEGISLATION
Minister for Lands	*Land Administration Act 1997*
Minister for Planning	*Planning and Development Act 2005*
Western Australian Planning Commission	*Planning and Development Act 2005*
Chief Executive Officer of the Department of Water and Environmental Regulation	*Rights in Water and Irrigation Act 1914* (RIWI Act)
Minister for Aboriginal Affairs	*Aboriginal Heritage Act 1972*

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 increased congestion, inefficient freight operations, significant road safety issues, reduced social amenity and community separation. 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 accommodate 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 are 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, air and noise pollution in developed urban areas on the existing network
- Providing a direct connection to the Bunbury Port via Willinge Drive, thereby promoting economic activity, improve utilisation and development of the Bunbury Port and growth of industry in the South West Region
- Accommodating future planning for 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 651 ha, the majority (approximately 80 %) of which is cleared agricultural land (Table 2-1). Pockets of native vegetation are present 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 has been developed to provide an upper limit to disturbance. This extent includes the carriageway, earthworks, drainage and fencing.

Further route alignment optimisation will be undertaken as the design progresses further reducing impacts to the environment. The Proposal Area provides a development envelope where the infrastructure will be established. The Proposal Area does not represent the total disturbance area.

The previously constructed section of BORR Central Section is not included in the Proposal Area. Pre-construction activities such as geotechnical investigations, fencing and landowner accommodation works are 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	LOCATION	PROPOSED EXTENT
Physical elements		
Overall Proposal footprint (including all physical elements below)	Figure 1 Proposal Area (Appendix A)	Clearing and disturbance of no more than 651 ha consisting of up to 91 ha of native vegetation and 28 ha of revegetation (~18 % combined), up to 532 ha (~82 %) of highly modified area (agricultural land and existing built infrastructure) and non-native vegetation within the Proposal Area. The clearing required for the proposal is expected to clear up to 7.7 ha of vegetation in Good or better condition.
Road construction and associated infrastructure	Section 2.3	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 (partial connection) • A grade separated interchange at South West Highway (partial connection) • New grade separated interchange at Waterloo (Wireless Road) • New grade separated interchange at Willinge Drive • Extension of Willinge Drive south (2.8 km) to intersect with South West Highway • Local road modifications • Utility modifications.

ELEMENT	LOCATION	PROPOSED EXTENT
Bridges and drainage infrastructure	Section 2.3	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 • 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)	Section 2.3	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	Section 2.3	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	Section 2.3	Main Roads will operate the Proposal including standard management and maintenance practices.

2.3 Proposal stages

2.3.1 Design

The Concept Design has been developed to accommodate traffic generated by a future population of 200,000 in the Greater Bunbury Region and increased demand between Perth and the south west. A key constraint on the design is mitigation of impacts on private land as 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.

The Proposal is planned as a future freeway and accordingly has been designed as a high-speed dual carriageway freeway. The adopted cross sections and geometry are consistent with Austroads, Main Roads and local government standards. The vertical alignment has been designed as low as possible to minimise the impacts on the landscape and quantities of imported fill.

The locations of all proposed structures in the Concept Design are included in Table 2-2 and illustrated in Figure 2 (Appendix A).

Table 2-2 Locations of proposed structures in the Concept Design

PROPOSED BRIDGE STRUCTURE	VERTICAL CLEARANCE (m)	SPAN LENGTH (m)	NO OF SPANS
Paris Road/Clifton Road over BORR/Forrest Highway (including PSP)	7.0	25	2
Raymond Road over BORR	7.0	25	2
BORR over Collie River (including PSP)	Based on 100 year flood level	35	4
BORR over South Western Highway	7.0	40	2
BORR over ARC rail	7.3	40	1
BORR over Railway Road	4.6	20	1
BORR over Wireless Road (2 bridges)	7.0	20	1
BORR over Golding Crescent/Ferguson River	5.8 m / 100 year flood level	27	3
BORR over Boyanup-Picton rail	7.3	40	1
BORR over Boyanup-Picton Road	7.0	22	1
Martin Pelusey Road over Golding Crescent/Ferguson River	5.8 m / 100 year flood level	27	3
Martin Pelusey Road over Boyanup-Picton rail	7.3	40	1
Martin Pelusey Road over Boyanup-Picton Road	7.0	22	1
Willinge Drive over BORR (2 bridges)	5.8	2 × 23 m	1
Willinge Drive westbound entry ramp over Preston River	Based on 100 year flood level	25	3
Willinge Drive Extension over Preston River	Based on 100 year flood level	25	3
2w=	5.8	40	1

The majority of the Proposal has been designed in 'fill' as it will be constructed on existing palusplain wetlands, established overland flow patterns and in some areas, established flood irrigated agricultural land.

The earthworks volumes calculated for the Proposal are:

- Cut: 120,000 cubic metres
- Fill: 4,700,000 cubic metres.

Key areas of earthworks are:

- Raised earthworks are necessary at interchange locations to facilitate the grade separation between the highway and connecting roads

- Between Raymond Road and the Collie River the vertical alignment has been lowered below ground level to mitigate the visual impacts of the proposed Raymond Road interchange to the adjacent Meadow Landing community. A clearance of 1.5 m from the groundwater level to the design reference line has been achieved through this section
- Significant fill is required over South West Highway (North), the ARC railway and Railway Road to achieve the required vertical clearances
- Significant fill required for BORR to span over Golding Crescent, Ferguson River, the Boyanup Picton rail and Boyanup Picton Road.

The design of the Proposal is at the concept stage (Concept Design). Detailed design during delivery will address key constraints such as groundwater level, bridge and culvert clearances, sight distance, vertical curve lengths and surfacing which may result in amendments to the Concept Design.

2.3.2 Construction

Construction of the Proposal is planned to commence in Quarter 1 (Q1) 2021 for a period of two to three years. The construction methodology for structures depends on their final form.

Construction of the road will be undertaken using traditional earth-moving, equipment and construction techniques. The road formation will be built using both imported fill and cut-to-fill materials from the Proposal Area. The majority of the road alignment is in fill, with some cut material to be sourced from the approaches to the Collie River Crossing. The depth of excavation at cut locations will be determined by groundwater and design levels. Geohydrology investigations and modelling are currently determining the levels that will inform site excavations.

Bridges are likely to consist of pre-cast concrete or steel, supported on piled foundations or spread footings with mechanically stabilised earth (MSE) walls at the abutments. Piers (upright support columns for the structure) will consist of concrete columns at bridges, over roads or rail lines. High-level construction methodology for bridges would typically comprise:

- Piling works for foundation construction
- Construction of concrete pier columns
- Construction and installation of MSE walls at abutments
- Construction of concrete topping slab
- Completion of ancillary works, such as landscaping.

Underpasses will be installed. These underpasses will either be a pre-cast concrete arch or trapezoid structure, supported on concrete strip footings.

Materials for the construction of the road and associated structures will be sourced according to the Materials Sourcing Strategy (MSS), which is currently in preparation. The MSS considers projects, nearby developments, potential areas of acquisition, commercial quarries as well as alternative recyclable material sources. The key basic raw materials required for construction of the road include sand, limestone, clay, lateritic gravel, and crushed rock aggregate. Impacts associated with sourcing materials are not included in this Proposal.

Lay down areas for material will be established by the Contractor in consultation with Main Roads and the Local Government Authorities. All laydown areas are expected to be within the Proposal Area.

Construction water will be sourced from temporary boreholes, and other water suppliers.

2.3.3 Operation

BORR will operate as a controlled access highway (freeway standard), with access restricted to the grade-separated interchange locations. Traffic will generally be free flowing on the four lane dual carriageway (two lanes each direction). Daily volumes along the alignment are likely to ultimately range from 30,000 to 45,000 vehicles, with the busiest sections between South Western Highway (North) and Willinge Drive.

BORR will be subject to normal routine, recurrent and periodic maintenance during operation of the highway. The maintenance operations are confined to the road corridor and the road itself, typically including vegetation, drainage, lighting, road markings, signs and the road pavement.

2.4 Alternative options considered

2.4.1 Planning history

BORR concept was originally developed by Main Roads in the early 1970s in consultation with other State Government departments and Local Authorities. The original concept linked the Australind Bypass (now known as Forrest Highway) to the north of Bunbury with Bussell Highway to the south of Bunbury, over a distance of approximately 19 km. It was planned as a controlled access four-lane divided rural highway. This body of work formed part of the Bunbury Region Plan (State Planning Commission 1987), now replaced by the Bunbury Wellington Region Plan (Department of Planning and Urban Development, 1993). BORR Northern Section Alignment was identified to the west of the existing Hynes Road and was included as regional roads in the GBRS, prepared by the Western Australian Planning Commission (WAPC), along with an alignment for BORR Southern and Central Sections, as detailed in Figure 3 (Appendix A).

Further planning and development work followed over many years, resulting in the *construction* of BORR Central Section in 2013 as part of the Bunbury Port Access Road, Stage 2 project, as shown in Figure 1 (Appendix A).

In 2010, the Department of Planning (now DPLH), approached Main Roads seeking to modify BORR Northern Section alignment detailed in the GBRS to accommodate a future expansion of the Greater Bunbury urban and industrial footprint, including the newly identified Wanju Urban and Waterloo Industrial areas. This planning review was prompted by a number of factors including the need to accommodate a future population of Greater Bunbury and Main Roads understanding of the initially planned population of the proposed Wanju development (located to the east of BORR GBRS northern alignment) of around 16,500.

This resulted in Main Roads reviewing the road corridor for BORR Northern Section, including its intersection with Forrest Highway and future requirements for passenger rail infrastructure. In 2012, Main Roads finalised a concept for a corridor located slightly east of that shown in the GBRS as shown at Figure 4 (Appendix A), and referred to below as BORR Northern Section Western Alignment Corridor.

Draft District Structure Plans for the proposed Wanju (urban) and Waterloo (industrial) areas were advertised between 2016 and 2017 based on BORR Northern Section Western Alignment Corridor.

In late 2016, Main Roads WA commenced a planning review for a future South West Freeway (from Mandurah to Busselton) spanning the Forrest and Bussell Highways, and including BORR. It was recognised that updated land use planning surrounding Greater Bunbury and BORR Northern Section Western Alignment Corridor provided an opportunity for an alternative alignment to be considered. Government agency and stakeholder engagement confirmed broad support for investigations into a revised BORR Northern Section corridor to the east of BORR Northern Section Western Alignment Corridor, referred to as BORR Northern Section Eastern Alignment Corridor. The subsequent planning review of BORR Northern Section is detailed in Section 2.4.2.

2.4.2 2017 Alignment Review

Main Roads consulted DPLH in 2017 regarding the South West Freeway planning, including BORR, in response to the advertising of the Draft District Structure Plans for Wanju and Waterloo. MRWA sought advice regarding future land use planning where it was confirmed that Greater Bunbury's ultimate population is planned to be in the order of 200,000, including in excess of 50,000 people within the proposed Wanju urban development.

Main Roads completed a constraints mapping and option analysis of BORR Northern Section based on:

- The proposed increase in land use intensity surrounding BORR Northern Section Western Alignment Corridor
- Planned increase in the ultimate population of Greater Bunbury
- Complexities in catering for additional traffic pressures
- The review of BORR as part of the South West Freeway Planning Study.

The process and outcomes of this assessment is detailed in the Bunbury Outer Ring Road Northern Section - Alignment Selection Report (Main Roads WA, 2018) (Appendix B), and discussed below.

The constraints mapping and options analysis identified that the alternative BORR Northern Section Eastern Alignment Corridor located to the east of BORR Northern Section Western Alignment Corridor warranted consideration as it provided a number of potential benefits. The two options considered are shown in Plate 1 with the existing BORR Northern Section Western Alignment Corridor (light green) and an alternative BORR Northern Section Eastern Alignment Corridor (pink).

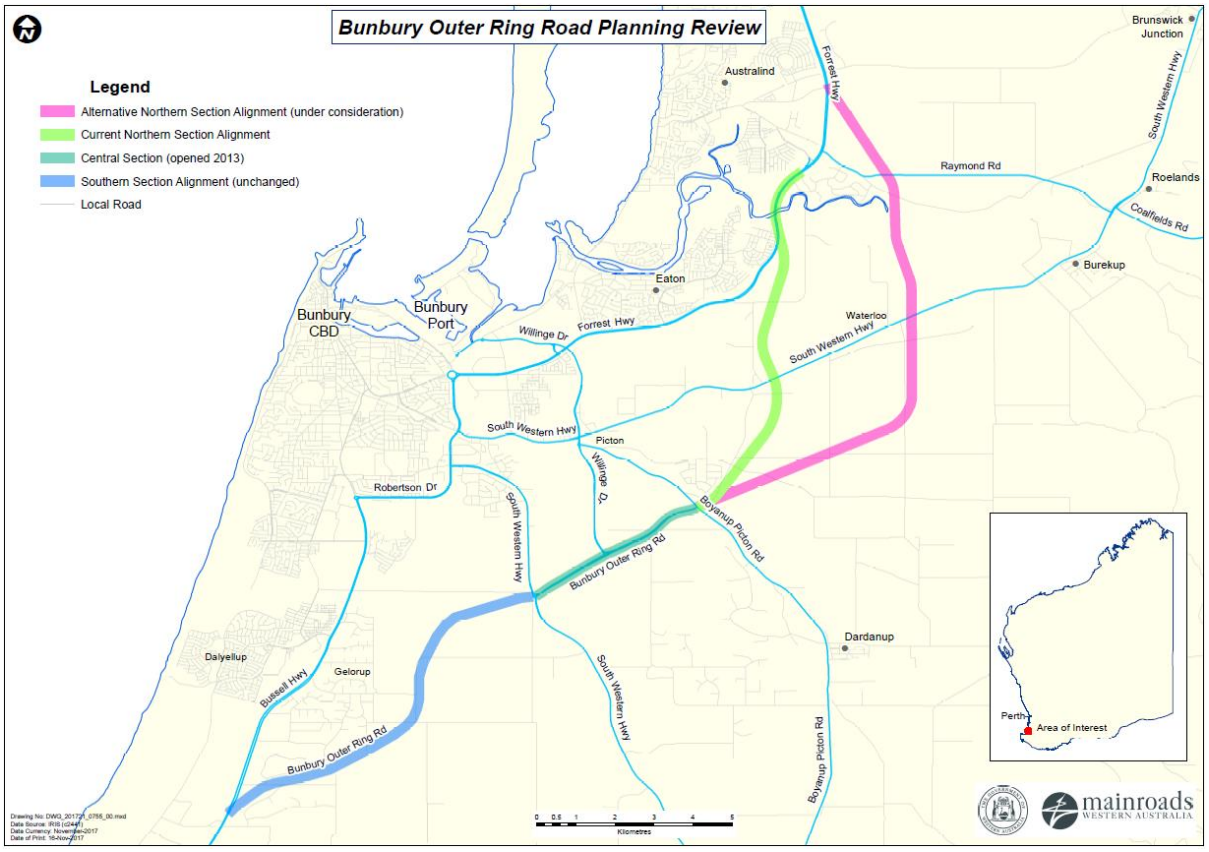


Plate 1 BORR Northern Section Western Alignment Corridor and alternative Eastern Alignment Corridor

As part of the alignment selection process, a Multi-Criteria Assessment (MCA) was prepared to assess the two BORR Northern Section Alignment options under consideration. The MCA is included in Appendix 1 of *BORR North Section Alignment Selection Report* (Main Roads WA, 2018) (Appendix B). The MCA included a desktop assessment of critical aspects relevant to major infrastructure projects including environment, social, economic and engineering considerations, using a consistent number of criteria for each aspect so as not to skew the results (i.e. three sub-headings for each aspect).

The desktop assessments, including the MCA, confirmed the alternative BORR Northern Section Eastern Alignment Corridor provided a number of advantages over BORR Northern Section Western Alignment Corridor. Based on the desktop assessment, the difference between BORR Northern Section Western Alignment Corridor and the alternative BORR Northern Section Eastern Alignment Corridor on environmental grounds was marginal.

A two phase consultation process was adopted as part of the planning study, comprising:

- Engagement with Government Agencies and key stakeholders through 2017 and 2018 to determine whether options were consistent with State and Federal frameworks, priorities and objectives and whether the options were robust enough to warrant targeted landholder consultation; and
- Targeted landholder consultation with those potentially directly impacted by either the existing BORR Northern Section Western Alignment Corridor or alternative BORR Northern Section Eastern Alignment Corridor. This initial consultation was undertaken between November 2017 and May 2018.

This consultation provided valuable information that has informed the assessment process.

The desktop assessment in the Alignment Selection Report found there was very little difference in terms of potential environmental impact of the two options (Main Roads WA, 2018) (Appendix B). However, the alternative BORR Northern Section Eastern Alignment Corridor provided additional planning, traffic, safety and efficiency benefits.

These benefits are:

- Provision of an integrated planning solution that provides a defined outer perimeter rather than dividing Wanju and the Greater Bunbury urban footprint
- Separation of regional/freight traffic from local traffic
- Separation of local, high speed regional and freight traffic improves road safety, efficiency and provides a more effective bypass and improved access to Bunbury Port
- Caters for a forecast population for Greater Bunbury in excess of 200,000 people
- Traffic demand can be accommodated with four lanes for the entire extent of BORR and efficiently caters for long weekend traffic peaks
- Provides improved connectivity between Wanju and Greater Bunbury through additional access points to Forrest Highway (strong east-west movements are suggested in the traffic model)
- Ties in further north of the existing green alternative considered, bypassing an additional major intersection on Forrest Highway, improving safety and efficiency
- Strongly aligns with State, Federal and Infrastructure Australia frameworks, drivers and objectives
- Is a cost effective solution consistent with broader overall ultimate South West Freeway strategy between Perth and the South West Region
- Does not preclude future rail options, including a future fast rail station within Wanju, a station in Bunbury's CBD and a number of other possible rail scenarios yet to be identified/ planned.

In May 2018, Main Roads presented to the WAPC the alignment selection process for BORR Northern Section. A formal submission was made to the Commission for consideration at the 30 May 2018 session, seeking their support for the alternative BORR Northern Section Eastern Alignment Corridor. In June 2018, the WAPC confirmed their support for selection of the alternative BORR Northern Section Eastern Alignment Corridor to allow further detailed planning activities to progress (Appendix C).

BORR Northern Section Alignment being assessed as part of this Proposal, is the alternative BORR Northern Section Eastern Alignment Corridor.

2.4.3 Refinement of BORR Northern Section

BORR Northern Section Alignment has undergone further refinement by BORR Integrated Project Team (IPT) during development of the current concept design, to minimise environmental impacts where possible. An MCA was undertaken for several of the interchange options to determine a preferred option. The MCA evaluated six equally weighted criteria:

- Road safety
- Community amenity
- Freight efficiency
- Urban congestion
- Environment
- Project cost.

Desktop information was used to inform the MCA as the field survey results were not yet available. The environmental considerations and outcomes of the MCA informed the locations and form of the interchanges within the final Proposal Area, and are provided in Appendix 1 of *BORR North Section*

Alignment Selection Report (Main Roads WA, 2018) (Appendix B). Interchange concepts may change in detailed design but will remain within the Proposal Area and consistent with approvals.

An additional access road was under consideration to link the South Western Highway to Willinge Drive (the 'Davenport Link'). This option was discarded as part of the scope for the current Proposal and was not considered further.

3 STAKEHOLDER CONSULTATION

Stakeholder consultation has been an integral consideration in the development of the Proposal. The overarching objectives of the stakeholder engagement program are:

- To inform stakeholders about the Proposal and its impacts to the environment and describe the outcomes of consultation in Project design
- To establish relationships with key stakeholders that enable ongoing dialogue through implementation and regulatory phases of the Proposal.

Main Roads has been engaged in consultation with key stakeholders for BORR Northern and Central sections since the mid-1990s.

Consultation undertaken by Main Roads with key stakeholders has included:

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

Stakeholder and community engagement is continuing, with landowners, communities of interest, local government authorities and State Government agencies. Key stakeholders have been provided in Table 3-1.

Stakeholder engagement was undertaken by Main Roads as part of the Alignment Selection process in 2017 and early 2018. Stakeholders consulted included potential affected landowners and nearby communities of interest, in order to obtain their input prior to the alignment selection decision. Details of these meetings are provided in Table 3-2.

During 2018, Main Roads consulted with key stakeholders to discuss project issues and potential impacts, including environmental, heritage (Aboriginal and European), social and economic impacts. This consultation will continue until construction of the Proposal is completed.

A summary of consultation undertaken to date regarding the options development and assessment process has been provided in Table 3-2. A summary of the key concerns raised during the stakeholder consultation to date is provided in Table 3-3, along with Main Roads responses.

Table 3-1 Key stakeholders

STAKEHOLDER TYPE	STAKEHOLDER
Commonwealth Government	DoEE Regional Development Australia
State Government	DPLH Local Members DWER (Office of the EPA) Department of Transport Chamber of Commerce South West Development Commission Bunbury Port Authority
Local Government	City of Bunbury Shire of Capel Shire of Harvey Shire of Dardanup
Community	Gnaala Karla Booja WC1998/058 Native Title Claim group (GKB NTC) Northern/ Central Community Reference Group (CRG) Land owners General public and local residents
Committees and Reference Groups	Bunbury Wellington Economic Alliance Investment Logic Mapping (ILM) Workshop Project Steering Committee Project Enabling Group BORR Regional Local Government Advisory Group (RLGAG) Economic Advisory Group Drainage Reference Group Freight and Road Users Group Meadow Landing Working Group Wanju/ Waterloo Steering Group

Table 3-2 Stakeholder consultation summary

STAKEHOLDER	DATE	TYPE OF CONSULTATION	PEOPLE INVOLVED	SUMMARY OF DISCUSSIONS	KEY OUTCOMES OF CONSULTATIONS
Commonwealth Government					
DoEE	25 May 2018 17 July 2018 8 October 2018 14 February 2019	Meeting	• EPA Services • Main Roads • BORR IPT.	• Pre-referral meeting to inform of intention to submit an EPBC Act referral for the Proposal. Discussion of potentially significant matters and spatial scope of the submission • Project update meetings throughout 2018 and in February 2019.	• Understanding of Proposal scope, timing, setting and impacts.
Regional Development Australia	Early 2017 onwards	Meeting	• Main Roads • Charles Jenkinson.	• Planning awareness / overview • Seek regional context and input into BORR North Alignment Selection process • Input into the IA process.	• Share information and obtain regional context for BORR. • Obtain input into the Alignment Selection process. • Obtain input into the IA process.
State Government					
DPLH	Early 2017 onwards	Meeting	• Main Roads • DPLH officers and SW Director.	• Planning awareness / overview • Obtain input into BORR North Alignment Selection process given the interactions with land use planning • Explore risks and opportunities • Coordination of BORR planning with planning for the future Wanju/Waterloo developments.	• Coordinate transport and land use planning for the Greater Bunbury area.

STAKEHOLDER	DATE	TYPE OF CONSULTATION	PEOPLE INVOLVED	SUMMARY OF DISCUSSIONS	KEY OUTCOMES OF CONSULTATIONS
Local Members **(Ongoing)**	2018 – 2019 (as required)	Meeting	• Member for Bunbury, Don Punch • Member for Collie-Preston, Mick Murray • Member for Murray-Wellington, Robyn Clarke.	• Project awareness / overview • Share feedback received from community • Outline engagement opportunities • Opportunity to raise stakeholder / community concerns • Inform design development.	• Briefing of project status and any contentious issues and/or constituent concerns.
DWER (Office of the EPA)	13 March 2018 5 September 2018 13 February 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.
Department of Transport	25 January 2018	BORR – Bunbury Freight Access Enhancement – Options workshop	Key stakeholder representatives from Main Roads WA and the Department of Transport	In preparation for the workshop participants were provided with a draft paper outlining the long list of options as well as the decision criteria.	At the workshop the decision criteria and long list of options were confirmed. A consensus scoring process was used to score each option against the decision criteria. Where participants were unable to reach unanimity to assign a score, the majority score was taken with any dissenting comments noted.

STAKEHOLDER	DATE	TYPE OF CONSULTATION	PEOPLE INVOLVED	SUMMARY OF DISCUSSIONS	KEY OUTCOMES OF CONSULTATIONS
Chamber of Commerce	14 November 2018	Presentation	• Main Roads • BORR IPT.	• Project overview and background • BORR ultimate planning concept • IA submissions • Project development and funding • Economic risks and opportunities • Planning and design • Ultimate planning criteria for BORR • Interchange options • Community and stakeholder engagement.	• Presentation only.
Bunbury Port Authority	Early 2017 onwards	Meeting	• Main Roads • Southern Ports officers and Managing Director.	• Planning awareness / overview • Obtain an understanding of current and future Port operations and plans/objectives • Seek input into BORR North Alignment Selection process • Coordinate transport planning requirements for the port and broader network.	• Coordinate transport planning and future port requirements.
Local Government					
City of Bunbury	July 2017	Project briefing meeting	• City of Bunbury • Main Roads.	• Planning review.	• Presentation.
	October/ November 2017	Project briefing meeting	• Elected members of City of Bunbury • Main Roads.	• Planning Study • Consultation process.	• Presentation.

STAKEHOLDER	DATE	TYPE OF CONSULTATION	PEOPLE INVOLVED	SUMMARY OF DISCUSSIONS	KEY OUTCOMES OF CONSULTATIONS
	3 July 2018	Project briefing meeting	• City of Bunbury • Main Roads • BORR IPT.	• Funding commitments • Infrastructure Australia submissions • Establishment of IPT including Main Roads, GHD and BG&E • Northern section planning review • Alignment selection to alignment definition – investigation areas • Existing environment including crash history, traffic flow • Network operation objectives • Forward planning for connectivity, rail • Community and stakeholder engagement strategy and activities.	• Presentation.
	13 November 2018	Project briefing meeting		• Project overview • Key dates • Stage 1 – shortlist criteria • Stage 2 – Multi criteria assessment • Paris-Clifton, Raymond Road, Waterloo, Willinge Drive options • Project update • Community engagement.	• Presentation • Request for further information regarding the impact on the economy of Bunbury and the support for the socio-economic assessment work.
Shire of Capel	July 2017	Project briefing	• Shire of Capel • Main Roads.	• Planning review.	• Presentation.
	October/ November 2017	Project briefing meeting	• Elected members of Shire of Capel • Main Roads.	• Planning Study • Consultation process.	• Presentation.

STAKEHOLDER	DATE	TYPE OF CONSULTATION	PEOPLE INVOLVED	SUMMARY OF DISCUSSIONS	KEY OUTCOMES OF CONSULTATIONS
	23 May 2018	Project briefing meeting	• Shire of Capel • Main Roads • BORR IPT.	• Progress update – Northern Section alignment selection • Funding commitments • Establishment of IPT including Main Roads, GHD and BG&E • BORR project objectives and benefits • Environmental approvals.	• Presentation.
	25 July 2018	Project briefing meeting		• Northern Section planning study • Project update • Network operation objectives • Forward planning for connectivity, rail • Key risks and opportunities • Community and stakeholder engagement strategy and activities.	• Presentation.
Shire of Harvey	July 2017	Project briefing	• Shire of Harvey • Main Roads.	• Planning review.	• Presentation.
	31 August 2017	Project briefing consultation	• Shire of Harvey • Main Roads.	• Main Roads requested comment on draft letter to landowners prior to distribution.	• The Shire of Harvey objected to the proposed alignment revision as it impacted upon an urban investigation area in local planning scheme. • The Shire requested that landowner consultation not be undertaken for this reason.
	October/ November 2017	Project briefing meeting	• Elected members of Shire of Harvey • Main Roads.	• Planning Study • Consultation process.	• Presentation.

STAKEHOLDER	DATE	TYPE OF CONSULTATION	PEOPLE INVOLVED	SUMMARY OF DISCUSSIONS	KEY OUTCOMES OF CONSULTATIONS
	9 October 2018	Project briefing	• Shire of Harvey • Main Roads • BORR IPT.	• Planning and project development update focussing on the Northern Section and interchange options • Community and stakeholder engagement update • Noise management process. •	• Presentation only.
	18 December 2018	Project briefing		• Project update • Future traffic volumes • Proposed BORR Northern Section Alignment and connectivity • Local road modifications • Urban design and landscaping • Environmental referral process • Noise management • Business case update/ socio-economic study • Community and stakeholder engagement update • Next steps. •	• Presentation only.
Shire of Dardanup	July 2017	Project briefing	• Shire of Dardanup • Main Roads.	• Planning review.	• Presentation.
	October/ November 2017	Project briefing meeting	• Elected members of Shire of Dardanup • Main Roads.	• Planning Study • Consultation process.	• Presentation.

STAKEHOLDER	DATE	TYPE OF CONSULTATION	PEOPLE INVOLVED	SUMMARY OF DISCUSSIONS	KEY OUTCOMES OF CONSULTATIONS
Community					
GKB NTC	29 October 2018	Ethnographic consultation including field inspections	• Brad Goode & Associates • Nine representatives from the GKB NTC group • DPLH • Main Roads • BORR IPT.	• The purpose of the ethnographic survey was to discuss any Aboriginal heritage sites, sacred places, such as water courses, wetlands and river crossings or places of historical significance that maybe a constraint to planning for the Northern and Central section of BORR • Where consent under the AH Act is required if avoidance is not possible, such as where bridges are required • The focus of the field inspections was to determine impacts from bridge construction.	Approval under Section 18 of the AHA be granted on the provision that Main Roads gives consideration to the GKB NTC group representatives requests (Brad Goode & Associates, 2018): • *Pylons for the proposed bridges not be situated within the actual water channels of the Preston, Collie, Ferguson and Brunswick Rivers and their tributaries* • *Cultural monitors be present for any ground disturbing works occurring within the 30 m buffer zone on either side of the waterways* • *Main Roads re-consults with the GKB NTC group representatives once the actual plans for the bridges over the Preston and Collie Rivers have been finalised* • *The results from geotechnical investigations be provided to the GKB NTC representatives* • *Nyungar access to the Collie, Preston, Ferguson and Brunswick Rivers and their tributaries be retained*

STAKEHOLDER	DATE	TYPE OF CONSULTATION	PEOPLE INVOLVED	SUMMARY OF DISCUSSIONS	KEY OUTCOMES OF CONSULTATIONS
					• *Any archaeological material uncovered during the works be salvaged and relocated as directed by the GKB NTC group representatives* • *Workshops with the landscape design team and the GKB NTC group representatives be held to incorporate Nyungar cultural values into the project* • *Clearing of native vegetation be minimised wherever possible and native plant species from the local provenance be used in the rehabilitation works* • *The new bridges be given Nyungar names* • *Employment opportunities and skill development training be provided to the Nyungar community as part of the project.* Refer to Section 4.8.3.1.

STAKEHOLDER	DATE	TYPE OF CONSULTATION	PEOPLE INVOLVED	SUMMARY OF DISCUSSIONS	KEY OUTCOMES OF CONSULTATIONS
Northern/ Central CRG **(Monthly)**	9 July 2018	Meeting # 1	• CRG members • BORR IPT.	• Meeting purpose and process • Project overview and context • Planning and project development • Planning and design criteria • Terms of reference • Community issues and priorities • 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 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 3-3 for a summary of key concerns from these consultations.

STAKEHOLDER	DATE	TYPE OF CONSULTATION	PEOPLE INVOLVED	SUMMARY OF DISCUSSIONS	KEY OUTCOMES OF CONSULTATIONS
	3 September 2018	Meeting # 2		• Meeting purpose and process • Previous workshop summary and actions arising • Project update • Meadow Landing Working Group update • Northern Section project development – options • Consultation and engagement update • CRG member comment • Next steps.	
	1 October 2018	Meeting # 3		• Workshop purpose and process • Project update – CRG governance • Previous meeting summary and actions arising • Traffic data • Alignment selection information • Alignment definition • Noise management process and environmental management • Consultation and engagement update • CRG comment • Next steps.	

STAKEHOLDER	DATE	TYPE OF CONSULTATION	PEOPLE INVOLVED	SUMMARY OF DISCUSSIONS	KEY OUTCOMES OF CONSULTATIONS
	5 November 2018	Meeting # 4		• Meeting purpose and process • Previous meeting summary and actions arising • Urban landscape design strategy • Preferred BORR Northern and Central Section interchange options • Environmental assessment process • Noise management process • Consultation and engagement update • CRG member comment • Next steps.	
	3 December 2018	Meeting # 5		• Previous meeting summary and actions arising • Environment update • Local road access strategy • Overview of Economic Advisory Group • Project milestones • CRG member round table • Next steps • Resources.	
	March 2019 - planned	Meeting # 6		• TBA.	• TBA.
	Further meetings TBA	Meeting # 7		• TBA.	• TBA.

STAKEHOLDER	DATE	TYPE OF CONSULTATION	PEOPLE INVOLVED	SUMMARY OF DISCUSSIONS	KEY OUTCOMES OF CONSULTATIONS
Land owners	November 2017 – May 2018	Meetings	Lot owners and BORR Team members	• Met with majority of land owners individually to discuss impacts on their properties, potential access arrangements and the process for an acquisition to proceed • During the flora and fauna surveys land owners provided consent for the surveys to be completed and where the land owner required a meeting on site occurred prior to the survey • Geotechnical investigations have been occurring in parallel to the environmental investigations and this entry onto private land has been managed in consultation with the landowner.	• Additional noise loggers were deployed at residences who had concerns about noise as part of the noise assessment • The geotechnical investigation program was amended to take into account landowner concerns regarding impacts on farming operations.
	November 2017	Letters	• Potentially impacted landowners • Main Roads.	• Letters sent to all potentially impacted landowners • Individual landholder meetings offered to all those intersected by potential BORR North corridors. • Input into the Alignment Selection process sought prior to a decision as well as potential impacts on the property holders.	• Input into the Alignment Selection process prior to a decision. • Obtain an understanding of potential impacts to businesses/ lifestyle.

STAKEHOLDER	DATE	TYPE OF CONSULTATION	PEOPLE INVOLVED	SUMMARY OF DISCUSSIONS	KEY OUTCOMES OF CONSULTATIONS
	April 2018	Letters	• Potentially impacted landowners • Main Roads.	• Letters sent to an additional five landowners located east of the proposed Shire of Harvey Investigation Area, offering a meeting to discuss an extension to BORR Northern Eastern Alignment Corridor. • Individual landholder meetings offered to all those intersected by potential BORR North corridors. • Input into the Alignment Selection process sought prior to a decision as well as potential impacts on the property holders.	• Input into the Alignment Selection process prior to a decision. • Obtain an understanding of potential impacts to businesses/ lifestyle.
	20 November 2018	BORR Northern and Central Section landowner briefing	• Main Roads • BORR IPT • Landowners.	• Project overview • Project timelines • Main alignment – Northern section • Northern interchanges • Local Access Strategy • Environmental process and preliminary findings • Noise management process • Landscaping • Land acquisition process.	• Q & A session.

STAKEHOLDER	DATE	TYPE OF CONSULTATION	PEOPLE INVOLVED	SUMMARY OF DISCUSSIONS	KEY OUTCOMES OF CONSULTATIONS
General public and local residents	February 2018	Letters	• Residents in Roelands (Meadow Landing) • Main Roads.	• Letters sent to residents in Roelands (Meadow Landing) seeking their comment on the Alignment Selection Study prior to a decision.	A meeting of approximately 30 residents (from 170 homes) was held to seek feedback and discuss concerns regarding the alignment. Subsequent meetings were held with approx. 5 individuals to obtain input into the Alignment Selection process.
	24, 25, 30 and 31 October 2018	Community information 'Drop In' Sessions (4:30-7:30 pm – three hours each) – please note these sessions addressed both BORR Northern and Central Sections, and BORR Southern Section Community information 'Drop-In' Sessions were held at four locations:	• Main Roads • BORR IPT • Community members	The Community Drop In Sessions were designed to: • Raise awareness of the project including the planning concept, features, impacts and benefits • Disseminate factual and consistent information to key stakeholders and the community; and dispel myths being circulated by project opponents • Encourage greater community and stakeholder involvement and deliberation of key issues	Key themes raised by the community: • Alignment selection • Environmental impacts • Land acquisition/ compensation • Local access/ connections • Impact on amenity/ lifestyle • Certainty of future development • Traffic volumes/ movement • Impact on agricultural land/ businesses • Impact on the local economy "the bypass effect".

STAKEHOLDER	DATE	TYPE OF CONSULTATION	PEOPLE INVOLVED	SUMMARY OF DISCUSSIONS	KEY OUTCOMES OF CONSULTATIONS
		• Eaton Sports Club • Leschenault Leisure Centre • Bunbury RSL • Gelorup Community Hall.	.	• Provide a conduit for active engagement - forum for residents and landowners to interact with members of the project team to raise questions, comments, concerns and/or preferences • Assist in identifying project issues and/or opportunities that can inform key project decisions and help to develop an optimal project solution • Achieve a sustainable outcome that is generally accepted by stakeholders and the community and meets the relevant local, regional and State infrastructure requirements • Monitor perceptions and sentiment through direct liaison and surveys.	
	July 2018	Project newsletter # 1 (Distribution by unaddressed mail and Connect Click Dimensions)	Local community (distribution) General public (via website)	• Project awareness / overview • Promote public display • Promote opportunity for email registration (project updates).	• Copies are provided to all relevant LGAs and local Members of Parliament; distribution to households/ businesses involved approx. 38,000 copies.

STAKEHOLDER	DATE	TYPE OF CONSULTATION	PEOPLE INVOLVED	SUMMARY OF DISCUSSIONS	KEY OUTCOMES OF CONSULTATIONS
	Monthly (indicative only)	Website update	Main Roads	• Project awareness / progress update / latest news.	• This has been timed with key announcements/ progress.
	25 and 26 February 2019	Community Information Sessions (4pm to 7pm) BREC Leischenault Leisure Centre.	• Members of Parliament • LGA • Main Roads • BORR IPT • Community members.	• BORR alignment and connectivity (local access and modifications) • Location and configuration of interchanges, with most interest in the northern interchange (BORR/Forrest Highway), Raymond Road and South Western Highway • Traffic volumes and key movements • Environmental impacts and proposed mitigations • Noise/ visual amenity and proposed mitigations. Information regarding landscaping and urban design, and sustainability was also on display.	• Suggestion by numerous attendees/stakeholders was the need to modify the Ultimate Planning Concept Design to include a full interchange at Raymond Road (the design presented did not include north-facing ramps). As a result of stakeholder and community feedback, the interchange has been amended and full access provided at this location Feedback from the sessions was positive with many attendees indicating their support for BORR Project.
Committees and Reference Groups					
Bunbury Wellington Economic Alliance	Early 2017 onwards	Meeting	• Main Roads • BWEA CEO.	• Planning awareness / overview • Seek regional context and input into BORR North Alignment Selection process.	• Share information and obtain regional context for BORR. • Obtain input into the Alignment Selection process.

STAKEHOLDER	DATE	TYPE OF CONSULTATION	PEOPLE INVOLVED	SUMMARY OF DISCUSSIONS	KEY OUTCOMES OF CONSULTATIONS
ILM Workshop	4 December 2017	Workshop	• Main Roads • South West Development Commission • Great Southern Ports • Qube (bulk minerals sand transporter).	• Two 'problem statements' were formulated based on an understanding of the current context and environment facing the movement of freight and people around and within the Greater Bunbury Area • A series of 'problem / opportunity elements' were identified for each problem / opportunity statement to demonstrate the magnitude of each problem / opportunity, together with underlying root causes.	• The outcomes of the ILM were used as the basis to progress the options development and assessment process.
Project Steering Committee **(Bi-monthly)**	28 June 2018	Meeting	• 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 • Planning and project development • Program • Budget • Other business.	• Direction setting • Strategic leadership / guidance • Promote collaboration between agencies • Strategic partnerships • Decision making for key / critical issues • Ministerial liaison • Project advocacy.
	23 August 2018	Meeting		• Project update • Planning and project development update • BORR Northern Section interchange options • Community and stakeholder engagement update.	

STAKEHOLDER	DATE	TYPE OF CONSULTATION	PEOPLE INVOLVED	SUMMARY OF DISCUSSIONS	KEY OUTCOMES OF CONSULTATIONS
	17 October 2018	Meeting		• Project update • Planning and project development program update • Community and stakeholder engagement update.	
	13 December 2018	Meeting		• Project update • Planning and project development program update • Community and stakeholder engagement update.	
Project Enabling Group **(Bi-monthly)**	12 June 2018 (formation and Meeting # 1)	Meeting # 1 (meets bi-monthly chaired by Main Roads)	• Chaired by Main Roads' Executive Director Planning and Technical Services • City of Bunbury • Shire of Capel • Shire of Harvey • Shire of Dardanup • DPLH • BORR IPT.	• Project overview • Funding • IA submissions • Key risks and opportunities • Project governance and PEG Terms of Reference • Project objectives and key result areas • Performance framework • BORR Team objectives and program • Community and Stakeholder Engagement • Ultimate planning criteria and objectives • Issues • Round table – PEG member input.	• Liaison between agencies • Operational decision making • Inform recommendations to the Steering Committee • Enable and facilitate progress • Technical and operational input • Promote efficient interface management • Ensure that project planning is consistent with and supports Government policy.

STAKEHOLDER	DATE	TYPE OF CONSULTATION	PEOPLE INVOLVED	SUMMARY OF DISCUSSIONS	KEY OUTCOMES OF CONSULTATIONS
	16 August 2018	Meeting # 2		• Project update • Community and stakeholder engagement update • Site investigations update • Sustainability and performance framework • Planning update • Interchange options selection process • Other work • BORR Northern Section Alignment and interchange options • BORR South options and BORR South Alternative investigation corridor • Typical cross sections • Round Table – PEG member input.	
	4 October 2018	Meeting # 3		• Consultation to date • Site investigations • Recommended BORR Northern Section interchanges • Network operations and other connectivity • Waterways and drainage • Utilities • BORR South status • Roundtable discussion • Next steps.	

STAKEHOLDER	DATE	TYPE OF CONSULTATION	PEOPLE INVOLVED	SUMMARY OF DISCUSSIONS	KEY OUTCOMES OF CONSULTATIONS
	29 November 2018	Meeting # 4		• Urban design and landscaping • Consultation to date • BORR Northern Section environmental referral area • BORR Northern Section local road access strategy • BORR Northern Section environmental findings and BORR South status • Social and economic impact assessment update.	
BORR RLGAG **(Quarterly or at Key Milestones)**	16 August 2018	Meeting # 1	• 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 and IPT overview • Funding and IA process • Performance framework • Key risks and opportunities • Project governance and RLGAG Terms of Reference • Ultimate planning criteria and objectives • Existing environment • Issues • Community and stakeholder engagement • Environmental approval process • 90 look ahead • Questions and discussion.	

STAKEHOLDER	DATE	TYPE OF CONSULTATION	PEOPLE INVOLVED	SUMMARY OF DISCUSSIONS	KEY OUTCOMES OF CONSULTATIONS
	21 November 2018	Meeting # 2	• 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 • Consultation update • Site investigations • Recommended BORR Northern Section interchanges and connectivity • BORR South status • Environmental approval process • Key program milestones • Roundtable discussion • Next steps.	
Economic Advisory Group **(At Key Milestones)**	30 October 2018	Meeting # 1	• City of Bunbury • Bunbury Geographe Economic Alliance (BGEA) • South West Development Commission (SWDC) • Regional Development Australia South West (RDASW) • Chamber of Minerals and Energy • Wespine • Bunbury Geographe Chamber of Commerce and Industry • Main Roads • BORR IPT.	• Project overview and background • Project objectives and benefits • Planning and project development • Ultimate planning criteria for BORR • Terms of Reference • Bypass effect concerns • Discussion • Next steps.	
	28 November 2018	Meeting # 2		• BORR Northern and Central Section preferred interchange designs and connectivity • Comments and discussion on socio-economic assessment • Next steps – project milestones and future meetings.	• Endorsement of the scope for the socio-economic assessment.

STAKEHOLDER	DATE	TYPE OF CONSULTATION	PEOPLE INVOLVED	SUMMARY OF DISCUSSIONS	KEY OUTCOMES OF CONSULTATIONS
	2018 – 2019 (as required)	Project briefing meeting	• Main Roads • SWDC.	• Project overview and background • Industry participation • Funding commitments • Procurement models.	• Agreement to form the Economic Advisory Group and work collaboratively to create opportunities for local supplier participation.
Drainage Reference Group **(At Key Milestones)**	1 August 2018	Meeting **#** 1	• DBCA – Parks and Wildlife Service • DWER • Water Corporation • City of Bunbury • Shire of Capel • Shire of Dardanup • Shire of Harvey • Department of Primary Industries and Regional Development (DPIRD) • Harvey Water • Leschenault Catchment Council	• Project overview and context • Planning and project development • Terms of reference • Existing conditions and constraints • Transverse drainage • Drainage options • Next steps.	• Collaboratively inform the Drainage Strategy for BORR • Assist in coordinating the concerns, suggestions and advice of the various agencies and stakeholders to ensure an optimal solution results • Adopt innovative outcomes extending beyond compliance to the maximum extent possible in keeping with BORR objectives • Provide issue-specific liaison in developing the drainage solution • Communicate project matters to, and from, relevant drainage and stakeholder groups.

STAKEHOLDER	DATE	TYPE OF CONSULTATION	PEOPLE INVOLVED	SUMMARY OF DISCUSSIONS	KEY OUTCOMES OF CONSULTATIONS
	4 December 2018	Meeting # 2	• South West Catchments Council • BORR Team • Main Roads.	• Project update • Highway runoff quality • Soil amendments • Drainage strategy • General comments • Next steps.	• Agreement to the principles set out in the drainage strategy for BORR Northern and Central Section, including the treatment of the water quality and quantity processes • The DWER supports in principle the drainage strategy for the Northern and Central sections of BORR project. No fatal flaws or areas of concern were identified with what was both discussed prior to and presented at the Drainage Reference Group (4 December 2018).
Freight and Road Users Group **(At Key Milestones)**	22 August 2018	Meeting # 1	• City of Bunbury • Shire of Capel • Shire of Dardanup • DFES • DPLH • Department of Transport • Freight and Logistics Council WA • Livestock & Rural Transport Association • Public Transport Authority	• Workshop purpose and process • Project overview and context • Terms of Reference • Road network operations – overview of existing conditions • Bunbury Port exports • Other road users • Freight rail network • Existing network issues • Proposed network conditions • Discussion – proposed network, RAV/ OSOM and pedestrian and cycling.	• Provide input on road user objectives, issues and opportunities • Promote integration and understanding between the various road users • Advise on operational requirements • Provide input into possible network management options • Provide input and feedback on the development of the Network Operations Plan

STAKEHOLDER	DATE	TYPE OF CONSULTATION	PEOPLE INVOLVED	SUMMARY OF DISCUSSIONS	KEY OUTCOMES OF CONSULTATIONS
	28 November 2018	Meeting # 2	• RAC • WA Pilot Drivers Association • Southern Ports – Port of Bunbury • Westport Taskforce • Trans Bunbury (PTA) • TransWA (PTA) • QUBE • K&S Freighters (Dardanup) • Greater Bunbury Bicyclers Users Group Inc. • Main Roads • BORR IPT.	• Project update • Network operation goals and objectives • Discussion – network operations goals and objectives • Road network connections and interchange forms (BORR Northern Section) • Discussion – road network connections and interchange forms (BORR Northern Section) • Principal shared path network (PSP) • Discussion – principal shared path network (PSP) • Amenities • Discussion – amenities • Priorities project case planning • Discussion – priorities project case planning.	• Provide issue-specific liaison in developing the project.
Meadow Landing Working Group	13 August 2018	Meeting	• CRG members • BORR IPT.	• Workshop purpose and process • Corridor selection process • Road planning background and CRG meeting recap • Road planning response to CRG concerns • Workshop sessions • Next steps.	The purpose of the workshop was to: • Meet with CRG members from Meadow Landing area to discuss concerns raised at the CRG meeting of 9 July 2019 • Discuss subsequent follow up project development actions • Seek a collaborative approach to ongoing project development.

STAKEHOLDER	DATE	TYPE OF CONSULTATION	PEOPLE INVOLVED	SUMMARY OF DISCUSSIONS	KEY OUTCOMES OF CONSULTATIONS
Wanju/ Waterloo Steering Group	Mid 2017 onwards	Meeting	• DPLH • DWER • Shire of Dardanup • South West Development Commission.	• External meeting • Input into BORR North Alignment Selection process • Coordinate transport and land use planning • Coordination of Main Roads and proposed urban development road networks.	• Provide progress updates • Ensure the concurrent refinement of the Wanju, Waterloo and Picton structure plans progress in a consistent manner with planning for BORR • Information exchange • Mutual understanding of priorities, constraints or key risks • Promote integration • Coordination of BORR transport planning and the interface with the planning work being undertaken by DPLH and the Shire of Dardanup.

Table 3-3 Summary of key concerns raised during consultation

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

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
Community members, CRG members, landowners	CRG Meetings, Community Drop in Sessions, Public Enquiries, Landowner Briefings	**Northern Alignment Changes since GBRS** Community members, particularly those who did not expect to have a BORR near or directly impacting their properties, have expressed concerns and made queries around why the alignment of the northern section of BORR has changed from the previously proposed alignment of Forrest Hwy – Hynes Road - Martin Pelusey Road. Subsequent questions on basis for traffic modelling have also resulted.	In early 2017, Main Roads commenced an alignment selection planning study for the northern section of BORR. This involved the investigation of two alignments. The planning study has now been completed and a preferred corridor that aligns with the proposed future development of Greater Bunbury has been selected. The decision was supported by the WAPC on 31 May 2018. This corridor, which is further east of the previously considered route, is now the subject of further detailed planning and project development. The preferred corridor: • Provides an integrated planning solution and defines an outer perimeter for development rather than dividing the future Greater Bunbury footprint • More effectively separates high speed regional and freight traffic from local Bunbury traffic improving safety, efficiency and improved port access • Starts further north and in doing so will improve safety for a number of intersections along the existing Forrest Highway (including Raymond Road, Grand Entrance, and Hynes Road) • Has the capacity to cater for a future population of up to 200,000 people with 4 traffic lanes whereas previously considered corridors that joined Forrest Highway further south would require more lanes and larger interchanges.
		Queries about investigating an even more eastern alignment have been raised by numerous newly concerned communities.	Moving the corridor even further to the east would increase project cost, increase journey distance and travel times, reduce efficiency and sever land that is proposed to remain rural.

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
CRG members (local residents, road users and property owners/ farmers)	Northern & Central Community CRG Meetings (10/18, 11/18, 12/18)	**Social and Economic Bypass Impacts** Primacy of Bunbury and economic impacts of 'bypass'. Consideration of social and economic impacts on community business, particularly of severance on farmers. Formation of an economic advisory group was first discussed in the October North and Central CRG.	An Economic Advisory Group (EAG) has been formed and is chaired by the South West Development Commission (SWDC). KPMG has been commissioned by the EAG to undertake a Social and Economic Study for the project as a whole. Impacts for the local farming community will be part of the assessment. The study will be in line with NSW Roads and Maritime Services Practice Note – Socio-economic Assessment (EIA-N05)
		Economic impacts of BORR and impacts on businesses.	Bunbury is the gateway to the South West Region that has a strong economy built on mining, manufacturing, building and construction, agriculture, viticulture, aquaculture, forestry, tourism and emerging smart and creative industries, generating $13 billion in the 2016-2017 financial year. (SWDC) In addition, the Port of Bunbury is a large deep sea port which allows the berthing of commercial cargo vessels and is supporting the development of tourism by welcoming large tourist cruising passengers to our shores. The construction phase of the project will create jobs and provide economic benefits to the region. Once constructed BORR will provide more efficient access for freight to the Bunbury Port, and enable the expansion of industrial centres, leading to more manufacturing, agricultural processing and local employment.
Community members, identified sensitive receptors, neighbours to sensitive receptors	Main Roads enquiries, CRG meetings and Community Drop In Sessions.	**Noise Impacts** Community members along the alignment, in both the northern and southern corridors have raised concerns in regards to noise from vehicle traffic, vehicles (particularly trucks) braking at interchanges and roundabouts and vehicles travelling over bridge joints. Whilst some communities could have expected to be impacted by noise from future upgrades to Forrest Highway (Kingston) and BORR (southern red corridor), from the alignments depicted in shown in the GBRS, the new ultimate planning alignment of the northern	Main Roads is committed to managing the impacts of noise in line with the State Planning Policy 5.4 (SPP 5.4) "Road and Rail Transport Noise and Freight Considerations in Land Use Planning" with the aim to protect communities from unreasonable levels of transport noise. Main Roads has completed a noise study for the Ultimate Planning Design Concept of the northern and central sections of BORR. This informed the development of a noise model and has helped to identify locations where mitigation may be required to comply with SPP 5.4. The noise model considers topography, distances between properties and the road, road design levels, gradients and surface type and consideration

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
		corridor may now impact some properties in Meadow Landing.	of future projected traffic volumes and types. Noise logs from the study are were used in the model development.
		Members of the CRG have requested to have noise loggers on their property to inform the noise modelling process.	Supplementary to the CRG meeting request, a noise logger was deployed at a CRG member's property near the proposed alignment.
Community members, identified sensitive receptors, neighbours to sensitive receptors	Main Roads enquiries, CRG meetings and Community Drop In Sessions.	**Noise Mitigation Measures** Concerns have been raised by some neighbours of identified sensitive receptors where their own properties have not been identified, particularly in relation to noise mitigation measures. Others have requested for noise walls and bunds, speed changes and similar modifications to their properties now that they are aware that interchanges and BORR will exist.	Main Roads will comply with SPP 5.4 in regards to identification of sensitive noise receptors and the provision of mitigation treatments to properties above the identified threshold. Landowners predicted to be impacted by noise levels above 55 decibels in the northern and central corridors have been sent an initial letter. Noise mitigation treatments may include using a quieter road surface, constructing noise walls or installing architectural treatment at individual properties in order to comply with SPP 5.4. Where mitigation is required, Main Roads will liaise with landowners to help identify the best overall solution for the location.
		Future Development Noise Mitigation Impacts and management of noise to the proposed Wanju development.	Where houses pre-date the road it is Main Roads' responsibility to mitigate. Where the development occurs after the road, it is the developer's responsibility to comply with the policy.
CRG Members	CRG Meetings	**Noise Modelling Assumptions** Assumptions used in developing the noise model in regards to exclusion of mitigation measures and choice of road surface treatments.	The noise modelling process is conservative and assumes a worse-case noise scenario to ensure likely noise exceedances are identified and acted upon.
Community members, CRG members	Main Roads Enquiries line, CRG Meetings, Community Drop In Sessions	**Light pollution and Visual Amenity** Impact of light pollution from street lights and vehicle headlights, as well as impacts to visual amenity as the result of construction of roads, associated interchanges, bridges and overpasses. Concerns have been raised by residents living near the alignment, particularly those of the communities of Kingston and Meadow Landing.	The EIA process considers impacts to visual amenity including lighting. This includes reporting potential visual impacts and identifying likely locations where design measures may be required to mitigate the impacts. Mitigation may include providing screening, which can take a variety of forms, including the construction of walls, earth mounds and planting of vegetation.

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
			Strategies will be developed to comply with the Australian Standard for lighting of public roads (AS/NZS 1158). This will include consideration of light backspill and treatments such as backshades and reducing light pole height where possible to minimise impact on adjacent properties. Visual amenity is also a key consideration of the Urban and Landscape Design Framework that has been prepared for BORR Project.
CRG members	Northern CRG (11/18)	**Urban Design** Community requested review of the 'node' hierarchy in the 'Reflecting Place' within the Urban and Landscape Design.	Willinge Drive is now a node priority has been increased and this will be reflected in the urban and landscape design strategies and treatments. Note: the original request was for Boyanup-Picton Road to be a higher priority node but it does not have connectivity from BORR so Willinge Drive was selected instead.
CRG members	Northern CRG (11/18)	**Wayfinding** Request to highlight routes to key tourist attractions around BORR.	An information and wayfinding strategy for both vehicles and cyclists will be included in the urban and landscape design strategy. This will consider feedback from the community and user groups on the major routes used to access these attractions. Note: Signage and information will be probably be delivered by others but provision will be made on BORR for this.
CRG members	Northern CRG (11/18) and October 2018 Community Drop In Sessions	**Urban Design and Art** Request was made for community involvement with project artwork such as at interchanges.	At the October community drop in sessions suggestions were sought on the initial urban design and public art themes. The key theme identified was celebrating community values of the area.
Property owners	Main Roads Enquiries, Southern CRG (07/18, 12/18)	**Air and Water Quality.** Residents of some farming and residential properties are not connected to scheme water and rely upon rainwater tanks as their primary source of potable water. Impact of traffic pollution particulate matter on water tank water quality is a concern to the community.	There is no comparative air quality policy or legislative requirement for pollutants from traffic in comparison to SPP 5.4 that deals with noise from traffic. Elective air quality modelling to the relevant standards is undertaken to establish baseline conditions. National standards for air and water quality apply for land and water managed under the EP Act but not necessarily water in rainwater tanks. There are a couple of pollutants coming from diesel and petrol powered vehicles. The concentration levels of those elements has decreased with improved engine and fuel technology. Fuel used to have lead and sulphur in

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
			it but it is different now. Vehicle age is another factor with the average vehicle age around 10 or 11 years in Perth. As a result, the pollutants coming out of a tail pipe are steadily improving over time. Pollutants in water tanks is a separate issue that is up to the land owner with various potential pollutant sources to consider.
Directly impacted property owners	Northern and Central CRG meetings, Main Roads Enquiries	**Land Acquisition and Compensation Process** Property owners, particularly famers, are concerned about the impact of severance on their properties and businesses. Concerns include land compensation process and valuation, impacts to current and future business operations as well as social & mental health impacts that this will have on their families.	Main Roads appoints up to three independent valuations and pays for the land owner to appoint a suitably qualified cost consultant of their choice. That process includes business compensation. MR can only compulsorily acquire land needed for the project but can acquire small remnant land parcels through negotiations. Access is provided to small parcels and if unviable it would be part of the compensation calculation.
		Queries raised if compensation values, particularly for value of land around Waterloo and Wanju developments, will reflect current or future land use.	Compensation based on independent valuation. See above.
		Timeline of land acquisition and ability for impact on broader project implementation timeline.	Planning to deliver the project and will progress the enabling tasks including talking to the owners of property required for the project to try and agree an early settlement as part of a voluntary acquisition process.
Local community and road users CRG Members	Northern and Central CRG meetings	**Local Access Changes on Journey Times** Is compensation payable as a result of impacts of local road severance on journey times?	Compensation is only payable where land is required for the project. Access will be maintained but may change.
Directly impacted property owners	Northern and Central CRG meetings, Main Roads Enquiries	**Property Severance** Property owners who are likely to have access to their properties altered or their land parcels split are concerned about how they will access their properties/land and how business as usual will take place.	Will provide access to the portions of land that are severed. Any associated economic loss is included as part of the compensation payable and depends on individual circumstances. Main Roads cannot resume land unless required for road purposes. If a convoluted route is required to maintain access, this may be reflected in compensation.
Directly impacted property owners	Northern and Central CRG	**Property Access**	Any existing accesses affected by the ultimate design of the highway will require consideration of alternative routes. The planning, construction and

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
	meetings, Main Roads Enquiries	Property owners who are likely to have access to their properties altered are concerned about what form new access will take.	funding of alternative routes will be undertaken by Main Roads as part of the project scope. These works can include the provision of new service roads and upgrades or realignment of existing driveways. Main Roads do not generally provide slip lanes for individual properties as they are usually only provided for local roads. However, in some instances where there is a need due to higher traffic volumes or presence of trucks or a road safety risk, a slip lane can be provided. This will be assessed on a case by case basis.
CRG Members, Fire Emergency Service	Southern CRG meetings	**Emergency Service Access and Emergency Egress** The effects of road severance on emergency access eg to allow firefighting and provide emergency egress to the community either side of the alignment.	Main Roads has undertaken consultation with the City of Bunbury, Shire of Harvey and Shire of Dardanup in regards to fire emergency service access. In the northern and central sections of BORR all major roads (Raymond Road, South West Highway, Waterloo Road, Wireless Road, Willinge Drive etc) will not experience disconnection and no severance of community is expected. Therefore existing major routes of access are expected to be maintained. Local and access roads connections have been planned for where local and access roads will be disrupted.
CRG members	Southern CRG meetings	**Impacts to Cultural Heritage** Potential for loss of cultural heritage.	There are no Heritage WA sites expected to be impacted and there is 1 Australian Heritage site expected to be impacted, 9509 South West Irrigation Area.
CRG members	Southern CRG Meetings (03/19)	**Impacts to Aboriginal Heritage** What was the source of data used to show aboriginal sites used to inform field investigations.	The source of mapped Aboriginal Heritage sites used to inform field investigations was publicly available data from the Department of Aboriginal Affairs.
		Concerns around the Aboriginal Heritage values and history of the assessment process and what additional studies are being completed.	Consultation with representatives of the GKB NTC group were undertaken in May 2018 to discuss the northern alignment options in October 2018 to undertake archaeological surveys. Results of the studies identified that four river sites will be directly affected by bridge crossings. Two previously recorded archaeological sites and six heritage places were located, may be potentially be impacted
CRG members,		**Construction Impacts**	Bushfire and other emergency responses will be a prime consideration to manage during and after construction. Main Roads includes requirements

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
	Southern CRG meetings,	Construction impacts on access to and from properties – particularly if there is an emergency such as a fire.	to maintain emergency routes during construction in contracts. The same would apply to pipe stands and other fire response assets.
		Construction noise/vibration and hours of works.	Point source noises (eg horns) and noises during construction are not subject to SPP5.4. Details on the management of construction noises and vibrations will form part of the Contract.
Meadow Landing residents, local road users	Northern and CRG Group Meetings (07/18, 09/18, 10/18, 11/18, 12/18, 2/19, 3/19)	**Traffic, Safety and Noise of Residential Development** Lack of connectivity between Raymond Road and BORR resulting in large volumes of traffic, including freight passing Meadow Landings and travelling north on Forrest Hwy. Also concerned about noise being generated from vehicles going through the multiple roundabouts in the vicinity of Meadow Landing community. Speed limiting west of BORR was suggested as one way to reduce noise volume. Concern was raised at numerous CRG meetings.	Following community and stakeholder feedback, north facing ramps have been added to reduce freight traffic on Raymond Road west of BORR. The connection now caters for all movements. 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. The speed limit on Raymond Road past Meadow Landing will be considered in the project definition stage.
CRG members, Community members	Norther & Central and Southern CRG meetings	**Environmental Approvals Process and Studies** The community has been highly interested in the types of environmental studies being completed to support the Proposal.	An extensive environmental approvals process has been undertaken for the Northern and Central sections and is being undertaken for the southern section. Main Roads is committed to ensuring that all environmental aspects of the project are completed with great sensitivity and in accordance with all State and Commonwealth legislative requirements. Detailed reports were completed for: • Wetlands Assessment • Noise modelling • Archaeological surveys • Acid Sulphate soil sampling • Lighting and visual amenity • Matters of National Environmental Significance (Threatened and Endangered) • Native Vegetation.

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
		The process of submitting comments on the environmental referral. Concerns around the public comment period.	There are three opportunities in the environmental approvals process for the public to provide feedback, they are: • At the start of the process when the level of assessment is set • In review of the information submitted by the Proponent to the regulator/s • In response to the Draft Ministerial Conditions that result if approval is granted. This is a formal process, managed by the responsible regulatory entity (EPA) and is not a process managed by Main Roads. Detailed information can be found at www.epa.wa.gov.au
CRG members, Community members	Norther & Central and Southern CRG meetings	**Flora and Fauna** How will impacts to flora and fauna be managed.	The corridor of BORR includes habitat for Critically Endangered and Endangered species, as determined under the Commonwealth Government EPBC Act. • Matters of National Environmental Significance – Western Ringtail Possum – Critically Endangered – Carnaby's Cockatoo – Endangered – Banksia Woodland TEC – Tuart Woodland TEC. Avoidance is the first option for impacts, but where avoidance of impacts is not possible, minimisation of impacts is sought. In BORR Northern Section Alignment selection report, the environmental criteria, alongside other criteria used in the multi criteria analysis, to assess options included: • Rare flora and native vegetation • Rare fauna, fauna habitat and TECs • Waterways or wetlands. When considering BORR interchange options and local connectivity options, assessment of the environmental criteria included: Wetlands (CCW

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
			and Resource Enhancement), remnant native vegetation, rare Fauna (WRP), TEC's, European Heritage and Aboriginal Heritage.
CRG members, Community members	Norther & Central and Southern CRG meetings	**Western Ringtail Possum** Management of impacts to Western Ringtail Possums.	Western Ringtail Possum. Carnaby's Cockatoos and the Banksia woodland are all protected under the Federal Act. Other factors are assessed under State Act. The Western Ringtail Possum is critically endangered which means the Commonwealth Minister for the Environment is responsible for ensuring any approved actions will not put the species at further risk.
		What studies are being undertaken and by whom?	Possum studies have been completed by specialist ecologist consultants Biota Environmental Sciences and GHD in 2018.
		Were possum communities identified in the northern and central corridor?	Western Ringtail Possums were found near Paris/Clifton Road in some vegetated areas along with some areas where cockatoos were found.
		Will possums be relocated/translocated?	Few previous relocation programs have been successful, however this may be considered as part of the assessment.
		Offset areas – have they been selected, what offset ratios will be applied and is there a maintenance budget for offsets?	Offsets have not been identified yet. This comes later in the process when the nature and extent of the impacts are known. A calculator is used for determining offsets, which are generally greater in area than the area impacted. Budgets would depend on the offsets selected.
		If relocation fails what else is there? Are animals euthanised?	One of the challenges with the Western Ringtail Possum is that there is no approved translocation program currently in operation. Other measures are available for birds, such as cockatubes. The first steps are to avoid or minimise impacts wherever possible. Fauna are not euthanised.
		Fragmentation of possum/fauna habitats.	Any alignment resulting in fragmentation will consider mitigation measures including bridges or underpasses.
Drainage Reference Group (DRG)	DRG meetings	**Wetlands and Waterways** Concern about alignment and interchange location in relation to TEC (wetland) at central BORR South West Highway interchange.	Explained that the alignment had been shifted east at this location to avoid the TEC and associated wetland and also to minimise land impacts (reduce fragmentation/maintain existing buildings).

AGENCY	FORUM	CONCERN RAISED	MAIN ROADS RESPONSE
		Impact of BORR South West Highway interchange on the Resource Enhancement Wetland and TEC, as TEC is within the southern road reserve and future expansion of South West Highway to the south would impact on it.	Confirmed that the ultimate design for the interchange was being prepared allowing for widening of the existing South Western Highway to the north.
		DBCA highlighted that the TEC in Central BORR at South West Highway is sensitive to changes in water conditions.	Appreciative of the local insight provided by DBCA.
		Request for spill management for wetlands, outside of wetland buffers – and be based on risk based approach.	Main Roads have requirements around what is to be provided where spill control is required, but not around where spill control is required. Recommendations from DRG members were discussed.
CRG members	Norther & Central CRG meetings (7/18)	**Irrigation and Drainage** Road corridor location in prime and scarce irrigation country. Concerns around impacts to Myalup and Harvey water channels and pipes through the corridor.	Harvey Water has been involved in stakeholder discussions and the project will reinstate existing irrigation systems impacted by the project and Harvey Water is comfortable with that.
Water Corporation	Drainage Reference Group (DRG) (08/2018)	**Water Quality** Need for spill management (eg oil and chemical spills). Oil spill traps were initially only considered for water draining to sensitive environmental receptors (eg wetlands). Water Corporation indicated that spill protection was required upstream of their drains.	BORR drainage strategy includes the use of oil spill traps to Water Corporation drains.
Leschenault Catchment Council Inc.	DRG (08/2018)	**Water Quality** Nutrient stripping (via soil amendments using Iron Man Gypsum) in the buffer strip along the alignment.	Options were investigated, but it was identified that the major source of nutrients was farm land. Water, particularly in irrigated plots, is carefully managed in farms by paddock grading and is collected by drains and therefore is unlikely to reach the road alignment. There is limited benefit and a very high cost for undertaking soil improvement measurements within the alignment.

4 ENVIRONMENTAL PRINCIPLES, THEMES AND FACTORS

4.1 Principles

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

Table 4-1 *Environmental Protection Act 1986* Principles

NO.	PRINCIPLE	CONSIDERATION OF PRINCIPLE IN THE PROPOSAL
1	**The precautionary principle** *Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.* *In the application of the precautionary principle, decision should be guided by:* *a. careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and* *b. an assessment of the risk-weighted consequences of various options.*	A Natural Hazards and Climate Change Risk Assessment workshop was held to identify risks to the project from natural hazards and aspects of climate change. These risks were then rated and adaption controls were identified which will be integrated into the detailed design for the Proposal. A wide range of comprehensive desktop and field studies were undertaken to assess the impact of the Proposal. Studies included: • Brad Goode & Associates. (2018) Report of an Aboriginal Heritage Survey of the Bunbury Outer Ring Road (BORR) North and Central Project: Brunswick to North Boyanup, WA • Biota (2019a) BORR Northern and Central Section Targeted Fauna Assessment • BORR IPT (2019a) BORR Northern and Central Sections Preliminary Acid Sulfate Soil Investigation Report • BORR IPT (2019b) BORR Northern and Central Sections Air Quality Assessment • BORR IPT (2019c) BORR Northern and Central Sections Vegetation and Flora Study • BORR IPT (2019d) BORR Northern and Central Sections Noise Assessment • BORR IPT (2019e) BORR Northern and Central Sections Wetland Study • BORR IPT (2018a) Drainage Strategy – Northern and Central Sections • Great Southern Biologic (2018) Phytophthora Dieback Occurrence Survey Bunbury Outer Ring Road North, 8 October 2018 • WRM (2019) Bunbury Outer Ring Road Northern and Central Investigation Area: Targeted Conservation Significant Aquatic Fauna Survey. Information gathered during these studies was used to inform this Proposal and has reduced the uncertainty surrounding the prediction of impacts for the assessment.

NO.	PRINCIPLE	CONSIDERATION OF PRINCIPLE IN THE PROPOSAL
		Main Roads has ensured that the proposal's design (where possible) avoids serious or irreversible damage to the environment. Impacts have been identified and described under each key environmental factor. Mitigation and management measures have been proposed to ensure they are environmentally acceptable.
2	**The principle of intergenerational equity** *The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.*	The Proposal will ensure the health, diversity and productivity of the environment is maintained through retaining as much habitat as possible, establishing noise walls to reduce noise related impacts and maintaining access for property owners.
3	**The principle of the conservation of biological diversity and ecological integrity** *Conservation of biological diversity and ecological integrity should be a fundamental consideration.*	There are patches of limited biological diversity and ecological integrity within and adjacent to the Proposal. Main Roads has sought to preserve as much of the remnant biodiversity as possible by avoiding areas of native vegetation where practicable.
4	**Principles relating to improved valuation, pricing and incentive mechanisms** *a. Environmental factors should be included in the valuation of assets and services* *b. The polluter pays principle – those who generate pollution and waste should bear the cost of containment, avoidance or abatement* *c. The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any wastes* *d. Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solutions and responses to environmental problems.*	Main Roads acknowledges the need for improved valuation, pricing and incentive mechanisms and endeavours to pursue these principles when appropriate. For example, environmental factors will greatly determine the location of road corridors, with the project having a strong focus on reducing its direct and indirect clearing footprint. Impacts on flora, vegetation and terrestrial fauna have been assessed and mitigation and management measures proposed. Main Roads accepts that the cost of the Proposal must include environmental impact mitigation, management and maintenance activities. These requirements will be incorporated into the overall Proposal costs. The Proposal will be subject to a sustainability rating, which will assess the environmental, social and economic impacts of the Proposal, including its waste stream and the resources utilised for construction. The Infrastructure Sustainability Council of Australian (ISCA) rating scheme is designed such that goals are established for a Proposal, then the Proposal is assessed against the achievement of those goals.

NO.	PRINCIPLE	CONSIDERATION OF PRINCIPLE IN THE PROPOSAL
5	**The principle of waste minimisation** *All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.*	The Proposal will be subject to an ISCA sustainability rating, which will assess the environmental, social and economic impacts of the Proposal, including waste minimisation and discharges resulting from the Proposal. Cut and fill principles will be utilised to minimise external fill requirements. Consideration of otherwise waste materials such as crushed concrete in road construction. The design for the Proposal includes drainage design to minimise the discharge of contaminated water into the environment. Management strategies will be implemented to ensure that the generation of waste during the construction phase is minimised. All activities shall be carried out with the principles of cleaner production and waste minimisation.

4.2 Identification of Environmental Factors

Environmental factors are those parts of the environment that may be impacted by an aspect of a Proposal. The EPA has 13 environmental factors, organised into five themes: Sea, Land, Water, Air and People.

The environmental factors and EPA objectives are provided in Table 4-2. The relevance of each factor to the Proposal is summarised and the significant environmental factors that require further consideration are identified.

Table 4-2 Environmental factors relevant to the Proposal

THEME	FACTOR	OBJECTIVE	RELEVANCE TO PROPOSAL	SIGNIFICANT ENVIRONMENTAL FACTOR
Sea	Benthic Communities and Habitats	To protect benthic communities and habitats so that biological diversity and ecological integrity are maintained.	No impacts to benthic habitats.	No
	Coastal Processes	To maintain the geophysical processes that shape coastal morphology so that the environmental values of the coast are protected.	No impacts to coastal processes.	No
	Marine Environmental Quality	To maintain the quality of water, sediment and biota so that environmental values are protected.	No impacts to marine environmental quality.	No
	Marine Fauna	To protect marine fauna so that biological diversity and ecological integrity are maintained.	No impacts to marine fauna.	No

THEME	FACTOR	OBJECTIVE	RELEVANCE TO PROPOSAL	SIGNIFICANT ENVIRONMENTAL FACTOR
Land	Flora and Vegetation	To protect flora and vegetation so that biological diversity and ecological integrity are maintained.	Construction requires vegetation clearing.	Yes
	Landforms	To maintain the variety and integrity of significant physical landforms so that environmental values are protected.	Distinctive landforms are not present.	No
	Subterranean Fauna	To protect subterranean fauna so that biological diversity and ecological integrity are maintained.	No conservation significant subterranean fauna given the location of the Proposal Area (South West Australia).	No
	Terrestrial Environmental Quality	To maintain the quality of land and soils so that environmental values are protected.	Acid Sulfate Soils (ASS) are present within the Proposal Area.	Yes
	Terrestrial Fauna	To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.	Construction will result in habitat clearing.	Yes
Water	Inland Waters	To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.	Wetlands and rivers present within the Proposal Area.	Yes
Air	Air Quality	To maintain air quality and minimise emissions so that environmental values are protected.	Air emissions will be generated during construction of the Proposal	Yes
People	Social Surroundings	To protect social surroundings from significant harm.	Proposal Area is within a populated area with potential Aboriginal heritage disturbance and noise and amenity issues.	Yes
	Human Health	To protect human health from significant harm.	No human health impacts expected. No radiation emissions.	No

4.3 Key Environmental Factor – Flora and Vegetation

4.3.1 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, 2018c).

4.3.2 Policy and guidance

- Environmental Factor Guideline Flora and Vegetation (EPA, 2016b)
- Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016a)
- 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).*

4.3.3 Receiving environment

Flora and vegetation studies

The flora and vegetation values have been primarily derived from the flora and vegetation report (BORR IPT, 2019c) (Appendix D). The flora and vegetation report presents the findings of a detailed flora and vegetation assessment of a broader Survey Area (1,128 ha) that encompasses the Proposal Area (650.7 ha) (Figure 5, Appendix A). BORR IPT (2019c) assessment included:

- A desktop assessment (5 km buffer of the Survey Area) and review of previous flora and vegetation assessments undertaken within the Survey Area or in close proximity. The previous surveys are summarised in Table 4-3
- A detailed vegetation and flora assessment of the Survey Area with field components undertaken in August (reconnaissance), September (spring) and November 2018. Field survey methods included a combination of sampling quadrats and photographic reference points as well as traversing the Survey Area by foot / vehicle. In total, 38 non-permanent quadrats and 159 photographic reference points (PPs) were described throughout the Survey Area (Figure 5, Appendix A). The field survey was undertaken to verify the results of the desktop assessment, identify and describe the dominant vegetation units, assess vegetation condition, and identify and record vascular flora taxa present at the time of survey. Searches for conservation significant or other significant ecological communities and flora taxa were also undertaken during the field survey
- A targeted survey was completed for *Diuris drummondii* (an orchid species listed as Vulnerable under the EPBC Act and BC Act). The field survey was undertaken in reference to the Draft Orchid Survey Guidelines (Commonwealth of Australia, 2013) and the methodology was discussed with Mr Andrew Webb (DBCA Flora Officer) prior to commencing the field work. In total, 72 person hours were spent surveying for *D. drummondii* over three days between the 17 and 19 December 2018 during the ideal flowering period
- A Phytophthora Dieback assessment (Great Southern Bio Logic, 2018) was undertaken using the methodologies referred to as linear and comprehensive transect surveys that are consistent with the DBCA guidelines (Department of Parks and Wildlife (DBCA), 2015).

Table 4-3 Summary of Previous Flora and Vegetation Surveys

STUDY NAME	LOCATION / EXTENT IN SURVEY AREA	METHODOLOGY
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 Survey 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, 2004a). Late winter (13 – 14 August 2014) and mid-spring (30 – 31 October 2014). Vegetation type and condition mapping based on quadrats and opportunistic records. Searches for conservation significant flora.
BORR South Flora Survey (GHD, 2015b)	Survey for BORR South Project Area. This occurs immediately south of the current Survey Area and is used to provide context. Two quadrats are within the current Survey Area.	Survey completed on 21 – 23 September 2011 and 16 – 18 June 2014. Level 2 flora and vegetation survey including quadrat sampling, targeted searches and vegetation type / condition mapping.
Reassessment of Floristic Communities (Biota, 2016)	Target areas within BORR South alignment. Two quadrats are within the current Survey Area.	Additional quadrats and re-analysis of the FCTs presented in GHD (2015b). Surveys carried out in September 2016.
Biota 2018 – 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 overlaps the current Survey Area.	Survey carried out on 30 October and 2 and 3 November 2017. Vegetation type and condition mapping and species lists presented.

Regional biogeography

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

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

- Mosaic: Medium forest; Jarrah-Marri / Low woodland; *Banksia* / Low forest; Teatree (*Melaleuca* spp.) (association 1000) – occurs in the northern and southern extent of the Proposal Area
- Medium woodland; *Eucalyptus rudis* and *Melaleuca rhaphiophylla* (association 1182) – occurs near the Collie River in the northern section of the Proposal Area
- Medium Woodland; Jarrah, Marri and Wandoo (association 968) – occurs throughout the central section of the Proposal Area.

Regional vegetation has been mapped based on major geomorphic units on the SCP and identifies four vegetation complexes within the Proposal Area (Heddle, Loneragan, & Havel, 1980) and (Webb, Kinloch, Keighery, & Pitt, 2016):

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

Vegetation communities and condition

BORR IPT (2019c) survey describes the Proposal Area as being extensively cleared for agriculture with native vegetation occurring within road reserves, along rivers and creeklines, in patches on private land and as scattered trees.

The Proposal Area includes 16 vegetation types as well as highly disturbed areas, non-native vegetation and revegetation / regrowth (Table 4-4) (Figure 6, Appendix A). One of the vegetation types identified within the broader Survey Area did not occur within the Proposal Area.

Due to a change in the Proposal boundary since completion of the survey, vegetation mapping was not completed over approximately 20.7 ha of the Proposal Area. Based on Native Vegetation Extent dataset

(GoWA 2019a), up to 1.1 ha (of the 20.7 ha unsurveyed) contains native vegetation. Combining this with the results of the vegetation survey, the Proposal Area contains up to 531.5 ha (82 %) of highly modified area (cleared paddock, existing infrastructure and non-native vegetation (such as blue gums)), 91.2 ha (14 %) of native vegetation (this includes scattered trees in paddocks) and 28.1 ha of revegetation / regrowth (4 %).

Of the 91.2 ha of native vegetation, 30.3 ha (33 %) was present as scattered trees (represented by areas rated in condition as Degraded – Completely Degraded and Completely Degraded), 59.9 ha (66 %) was native vegetation in patches within road reserves / paddocks (assigned condition ratings from Excellent to Degraded) and 1.1 ha (1 %) is yet to be surveyed (Figure 7, Appendix A) (Table 4-5).

Some larger patches of native vegetation within the agricultural area were present, particularly in the northern and southern extent of the Proposal Area (such as along Preston River and adjacent to Clifton Road). These areas where assigned a condition rating of Degraded where the tree (overstorey) layer was retained but no native mid or ground layers were present, often as a consequence of current or historical grazing. When these patches retained native species in the mid / ground layers, they were assigned condition ratings of Good or better.

Table 4-4 Vegetation types within the Proposal Area

VEGETATION TYPE DESCRIPTION	EXTENT IN PROPOSAL AREA
Highly Modified (VT1 – HM) This includes areas such as existing roads, firebreaks and tracks, buildings, yards and agricultural paddocks. These areas are either devoid of vegetation or are dominated by introduced grasses and herbs with very scattered native species.	487.7 ha (All Completely Degraded)
Non Native Vegetation (NN – VT2) Non-native planted vegetation, including planted *Eucalyptus* species (blue-gums) along internal fence lines and driveways, blue gum plantations and land-scaping.	24.2 ha (All Completely Degraded)
Revegetation / Regrowth/ Planted (R/P – VT3) This includes revegetation / regrowth as well as areas planted with a mixture of native and non-native vegetation. The revegetation near the existing BORR Central is recent (typically less than 1 m in height – and mapped as VT3A).	3 – 14.6 ha and 3A – up to 13.6 ha (2.5 ha Good, up to 18.8 ha Good – Degraded, 3.3 ha Degraded, 3.7 ha Degraded – Completely Degraded*)
Low woodland of *Eucalyptus rudis* and *Melaleuca rhaphiophylla* (ErMr – VT4) Woodland to very open woodland of *Eucalyptus rudis* and *Melaleuca rhaphiophylla* (occasionally *Melaleuca preissiana*) over mixed sedgeland over introduced grasses and herbs.	14.9 ha (up to 7.4 ha Degraded and up to 7.6 ha Degraded - Completely Degraded*)
***Melaleuca preissiana* / *Kunzea glabrescens* Swamp (MpKgS– VT5)** Woodland of *Melaleuca preissiana* with scattered *Corymbia calophylla* in higher elevation areas. The shrubland to open shrubland is dominated by *Kunzea glabrescens, Xanthorrhoea brunonis* and *Acacia pulchella* var. *glaberrima* over Sedgeland of *Lepidosperma longitudinale, L. pubisquameum* and *Schoenus efoliatus*.	0.4 ha (All Degraded)
Very open woodland of *Melaleuca rhaphiophylla* over introduced grasses and herbs in paddocks and road reserves (Mr – VT6) Woodland to very open woodland of *Melaleuca rhaphiophylla* (occasionally *M. preissiana*) over introduced grasses and herbs.	16.4 ha (2.2 ha Good – Degraded, 6.1 ha Degraded, 8.1 ha Degraded to Completely Degraded)
***Melaleuca preissiana* and *Kunzea glabrescens* swamp (MpKg – VT7)** Woodland to closed woodland of *Melaleuca preissiana* and *Kunzea glabrescens* over an open grassland / sedgeland / open herbland.	3.1 ha (0.2 ha Good, 0.4 ha Good – Degraded and 2.5 ha Degraded)

VEGETATION TYPE DESCRIPTION	EXTENT IN PROPOSAL AREA
Mosaic of *Melaleuca rhaphiophylla, Corymbia calophylla* and *Eucalyptus rudis* woodland (MrCcEr – VT8) Mosaic of vegetation types VT4 and VT17. This vegetation type occurs in road reserves where a mosaic of scattered trees of *Melaleuca rhaphiophylla, Corymbia calophylla* and *Eucalyptus rudis* occur over a ground-layer dominated by introduced grasses.	3.3 ha (2.1 Degraded and 1.2 ha Degraded to Completely Degraded)
Woodland of *Eucalyptus rudis* and *Corymbia calophylla* over *Melaleuca rhaphiophylla* (ErCcMr – VT9) Woodland of *Eucalyptus rudis* and *Corymbia calophylla* over *Melaleuca rhaphiophylla* over grassland / herbland.	1.1 ha (1.1 Degraded and <0.1 ha Degraded to Completely Degraded)
Woodland of *Melaleuca rhaphiophylla, Eucalyptus rudis* and *Casuarina obesa*; fringing vegetation along Collie River (ErMrCo – VT10) Woodland of *Melaleuca rhaphiophylla, Eucalyptus rudis* and *Casuarina obesa* over sedgeland of *Juncus* species over grassland of introduced species.	2.4 ha (<0.1 ha Good, 2.4 ha Good – Degraded)
Open Forest of *Corymbia calophylla* and *Eucalyptus rudis* over *Agonis flexuosa* along the Preston River (CcErAf – VT11) Open forest of *Corymbia calophylla* and *Eucalyptus rudis* over *Agonis flexuosa* over scattered shrubs of *Acacia pulchella*, *Hardenbergia comptoniana* and *Macrozamia riedlei* over herbland and open grassland.	1.6 ha (1.6 Good – Degraded and <0.1 ha Degraded to Completely Degraded)
Open Forest of *Eucalyptus rudis* on the floodplain / upper banks of the Brunswick River (VT11a) Open forest of *Eucalyptus rudis* over introduced grasses on the upper banks / floodplain of the Brunswick River	0.3 ha (all Good - Degraded)
***Melaleuca rhaphiophylla* and *Melaleuca lateritia* shrubland (MrMl – VT12)** Open woodland of *Melaleuca rhaphiophylla* over tall shrubland of *Melaleuca lateritia, Viminaria juncea* and *Acacia pulchella* var. *glaberrima* over mixed sedgeland / grassland.	0.6 ha (0.6 ha Good – Degraded and <0.1 ha Degraded)
Woodland of *Corymbia calophylla* and *Agonis flexuosa* over weedy grass and herbland (CcAf – VT 14) Woodland of *Corymbia calophylla* and *Agonis flexuosa* with occasional *Eucalyptus marginata* typically over introduced grasses and herbs.	4.7 ha (0.2 ha Good, 0.5 ha Good – Degraded, 4.0 ha Degraded and <0.1 ha Degraded- Completely Degraded)
Open woodland of *Corymbia calophylla* and *Eucalyptus marginata* over introduced grasses in road reserves and paddocks (CcEm – VT15) Woodland of *Corymbia calophylla and Eucalyptus marginata* with occasionally a lower tree layer of *Agonis flexuosa* over a shrubland of *Kunzea glabrescens, Xylomelum occidentale* and *Xanthorrhoea brunonis* over a grassland of introduced grasses.	19.8 ha (4.5 ha Good – Degraded, 9.9 ha Degraded, 5.4 ha Degraded – Completely Degraded*)
***Agonis flexuosa* closed woodland over pasture grasses (Af – VT16)** This unit occurs as *Agonis flexuosa* woodland to closed woodland over introduced grasses.	8.2 ha (0.6 ha Good, 0.2 ha Good – Degraded, 6.3 ha Degraded and 1.1 ha Degraded – Completely Degraded)
Scattered *Eucalyptus rudis* (Er – VT 17)	1.2 ha (All Degraded – Completely Degraded *)

VEGETATION TYPE DESCRIPTION	EXTENT IN PROPOSAL AREA
Scattered trees of *Eucalyptus rudis* over grassland of introduced grasses.	
Isolated trees of *Eucalyptus* species / *Agonis flexuosa* and *Melaleuca* species in paddocks (EspAfMsp – VT18) Isolated trees of *Eucalyptus* (*E. marginata / E. rudis* and *Corymbia calophylla*), *Agonis flexuosa* or *Melaleuca rhaphiophylla* in paddocks or road reserves.	5.5 ha (All Degraded – Completely Degraded *)
Woodland of *Eucalyptus marginata* over *Agonis flexuosa*, *Banksia attenuata* and *B. ilicifolia* (EmAfBaBi – VT19) Woodland of *Eucalyptus marginata* and *Corymbia calophylla* with lower tree layer of *Agonis flexuosa*, *Banksia attenuata* and *B. ilicifolia*.	4.6 ha (1.0 ha Excellent – Very Good, 1.7 ha Good, 0.1 ha Good – Degraded, 1.8 ha Degraded)
Woodland of *Eucalyptus marginata, Banksia* species., *Kunzea glabrescens* (EmBKg – VT20) *Eucalyptus marginata* woodland with *Banksia ilicifolia* and *Banksia attenuata* low woodland over *Kunzea glabrescens, Xanthorrhoea brunonis and Acacia pulchella* var. *glaberrima* over sedgeland / herbland of *Lomandra caespitosa, Hypolaena exsulca* and *Lyginia barbata*.	3.0 ha (1.7 ha Good, 1.3 ha Good – Degraded)
Unsurveyed Gap Includes 1.1 ha mapped as native vegetation within the Natvie Vegetation Extenet dataset (GoWA 2019a) and 19.7 ha cleared agricultural land.	20.7 ha including 1.1 ha mapped as native vegetation by the Government of Western Australia (GoWA) (2019a)

* Merge or condition Degraded – Completely Degraded and Completely Degraded

Table 4-5 Vegetation condition within the Proposal Area

VEGETATION CONDITION	EXTENT IN PROPOSAL AREA (ha)	% OF PROPOSAL AREA
Excellent (2) to Very Good (3)	1.0	0.2
Good (4)	6.7	1.0
Good – Degraded (4-6)	32.5	5.0
Degraded (6)	44.5	6.8
Degraded – Completely Degraded (6-7)	31.8	4.9
Completely Degraded (7)	513.5	78.9
Unsurveyed gap Includes 1.04 ha of native vegetation (condition unknown) and 19.62 ha cleared (likely completely modified condition).	20.7	3.2
Total	650.7	100

Threatened and Priority Ecological Communities

BORR IPT (2019c) identified Threatened and Priority Ecological Communities (TEC/PEC) within the Proposal Area (Table 4-6). Figure 8 (Appendix A) shows the extent of the TECs and PECs within the Proposal Area and broader Survey Area. A summary of the TECs and PECs within the Proposal Area is provided in Table 4-6.

Table 4-6 TEC/PEC within the Proposal Area

TEC/PEC	STATUS	EXTENT IN PROPOSAL AREA (ha)	VEGETATION CONDITION
***Banksia* Woodlands of the Swan Coastal Plain - TEC** Vegetation types 19 and 20 are considered to be potentially representative of the Banksia woodland TEC (when condition and size thresholds were met).	Endangered TEC – EPBC Act	7.6 ha Including 3.0 ha requiring confirmation**	Excellent – Very Good (1.0 ha) Good (3.4 ha) Good – Degraded (1.4 ha) Degraded (1.8 ha)
***Banksia* dominated woodlands of the Swan Coastal Plain IBRA region – PEC** Vegetation types 19 and 20 are considered to be potentially representative of the Banksia woodland PEC.	Priority 3 PEC* - DBCA listed		
Herb rich shrublands in clay pans (FCT08) - TEC Although not supported by the statistical analysis VT12 – *Melaleuca rhaphiophylla* and *M. lateritia* shrubland shows affinities with FCT08 (Gibson et al., 1994). It is considered that this vegetation type potentially represents a degraded form of this TEC. A follow up winter survey is required to confirm occurrence of this TEC.	Critically Endangered TEC – EPBC Act and Vulnerable – BC Act	0.6 ha*** Up to 1.0 ha of previously mapped TEC (DBCA database) occurs within the unsurveyed area	Good – Degraded (0.53 ha) Degraded (0.02 ha) Unknown (0.94 ha)

* State listed Banksia dominated woodlands of the SCP PEC forms part of the Federally listed TEC. In the Proposal Area all of the banksia woodlands (VT19 and VT20) meet the TEC and PEC criteria.

** Two patches of Banksia woodland in the northern end of the Proposal Area require additional survey to be completed to confirm fine scale condition and composition of vegetation of adjoining area.

*** Confirmation of Claypan TEC occurrence is required, taking in consideration of vegetation composition, condition and hydrological function. 0.53 ha of good-degraded vegetation is considered likely (at least in part) to meet the condition requirements for TEC classification under EPBC Act (no condition requirement under BC Act). 0.02 ha was mapped as degraded as is unlikely to meet EPBC Act listing condition requirements. 0.94 ha has not been surveyed.

Other significant vegetation

Preston River

Vegetation type 11 (Open Forest of *Corymbia calophylla* and *Eucalyptus rudis* over *Agonis flexuosa*) which occurs as a fringe along the Preston River, is an example of a riverine community that has largely disappeared on the southern Swan Coastal Plain and is regionally significant (Ecoedge, 2018). The condition of the vegetation was relatively poor and of the 1.6 ha of this vegetation type within the Proposal Area, 1.5 ha was rated as Good-Degraded and 0.1 ha Degraded-Completely Degraded. The vegetation is identified as part of an ecological linkage (see Section 4.6.3).

Other wetland / riparian vegetation

There is approximately 41 ha (excluding vegetation type 11 associated with the Preston River) of vegetation within the Proposal Area that grows in association with a watercourse and/or wetland (vegetation types 4, 5, 6, 7, 8, 9, 10 and 11A). Approximately 36 ha of this area is in poor condition and was mapped as Degraded or Completely Degraded.

The remaining 5.2 ha was rated as in Good (0.1 ha) or Good to Degraded (5.1 ha) condition and, due to the extensive clearing and restricted distribution of vegetation of this type, is considered to be the significant vegetation (other than that formally listed under legislation and policy).

Flora diversity

BORR IPT (2019c) recorded three hundred and fifty four flora taxa (including subspecies and varieties), representing 69 families and 198 genera during the field survey. This total comprised 241 native taxa and 113 introduced / planted flora taxa.

Dominant families recorded from the Survey Area included:

- Fabaceae (41 taxa including 16 introduced taxa)
- Myrtaceae (35 taxa including ten planted species)
- Orchidaceae (25 taxa including one introduced species)
- Poaceae (24 taxa including 19 introduced species)
- Cyperaceae (23 taxa including three introduced).

Conservation significant flora

Desktop searches of the EPBC Act Protected Matters Search Tool (PMST), NatureMap, DBCA Threatened and Priority Flora List (TPFL) and Western Australian Herbarium (WAHERB) databases identified the presence/potential presence of 48 conservation significant flora taxa within BORR IPT (2019c) Survey Area (including a 5 km buffer). This included 18 taxa listed under the EPBC Act and/or as Threatened under the BC Act and 30 listed as Priority species by the DBCA.

The field survey did not record any EPBC Act or BC Act listed flora. Three DBCA Priority-listed flora species were recorded within the Survey Area during the field survey, which also occur within the Proposal Area:

- ***Chamaescilla* gibsonii – Priority 3:** a clumped tuberous herb with blue flowers. It occurs on clay to sandy clay in winter wet flats and shallow water filled clay pans. Plants of this species were recorded from one locations within the Survey Area (as a less than 2 % component of the vegetation, approximately 4 plants within the quadrat site). It was recorded within the *Melaleuca rhaphiophylla* and *Melaleuca lateritia* Shrubland (VT12)
- ***Acacia semitrullata* – Priority 4:** an erect, pungent shrub to about 0.5 m high with cream-white flowers. *Acacia semitrullata* were recorded from five locations (eight plants) within the Proposal Area. It was recorded from the *Eucalyptus* / *Banksia* woodlands (VT 19 and VT 20) and within the *Melaleuca preissiana* and *Kunzea glabrescens* swamp (VT7). All locations are in the northern extent of the Proposal Area near the Forrest Highway / Clifton Road area. It is likely this plant would be scattered throughout these vegetation types where they are in Good or Better Condition
- ***Caladenia speciosa* – Priority 4:** Sandplain White Spider Orchid is a tuberous, perennial herb, approximately 0.35 to 0.6 m high, with white to pink flowers. *Caladenia speciosa* was recorded at one location within the Survey Area in *Eucalyptus* / *Banksia* woodland along the western side of Forrest Highway. The survey period was towards the end of this species flowering season, and it is likely this species would occur at more locations within the *Eucalyptus* / *Banksia* woodlands (VT 19 and VT 20).

The locations of the recorded DBCA Priority-listed flora recorded within the Survey Area are mapped in Figure 8 (Appendix A).

The likelihood of occurrence assessment, post-field survey, concluded that:

- three taxa are known to occur
- three taxa are likely to occur:

  - *Aponogeton hexatepalus* (Priority 4): aquatic perennial, herb, leaves floating. Known to occur mud, freshwater ponts, rivers and claypans. Suitable habitat present within the Proposal Area associated with wetland (VT4, 5, 6, 7 and 8) / rivers (VT10 and 11), claypans (VT12) and man made drainage areas
  - *Schoenus capillifolius* (Priority 3): Semi-aquatic tufted annual, grass-like or herb (sedge). Known to ocucr in claypans. Suitable habitat within VT12 and wetland vegetation types (VT4, 5, 6, 7 and 8) within the Proposal Area
  - *Stylidium longitubum* (Priority 4): Erect annual (ephemeral), herb. Known to occur in seasonal wetlands. Suitable habitat within the wetland vegetation types (VT4, 5, 6, 7 and 8) within the Proposal Area
- 26 taxa possibly occur
- 16 taxa are unlikely to occur within the Survey Area.

Introduced and invasive species

One hundred and thirteen introduced flora taxa were recorded in the Survey Area. Of the introduced taxa, four are listed as Declared Pests under the *Biosecurity and Management Act 2007* and/or as a Weeds of National Significance (WoNS):

- * *Gomphocarpus fruticosus* (Narrowleaf Cottonbush) – Declared Pest
- * *Asparagus asparagoides* (Bridal Creeper) – Declared Pest and WoNS
- * *Zantedeschia aethiopica* (Arum lily) – Declared Pest
- **Solanum linnaeanum* (Apple of Sodom) – Declared Pest.

The remaining introduced taxa are considered environmental weeds and all have been previously recorded on the SCP. The locations of the declared weeds is shown in Figure 7 (Appendix A).

Dieback

The Phytophthora Dieback survey was undertaken by Great Southern Bio Logic (2018), and identified:

- The presence of the disease throughout most of the low lying wetlands with some limited spread into elevated areas
- Several areas of vegetation have been classified as uninfested and these are typically associated with elevated areas where public access is limited or restricted
- Significant areas of vegetation were also classified as uninterpretable as the vegetation communities did not contain suitable numbers of disease indicator species
- Following the determination of disease hygiene categories, all uninterpretable or uninfested vegetation was assessed for protectability, using the DBCA protectable areas criteria. It was determined that with the application of suitable hygiene during operational activities, six separate parcels of vegetation are protectable from future introduction or spread of the disease.

The extent of areas mapped as uninfested are shown in Figure 7 (Appendix A) and the six protectable areas are shown in Figure 9 (Appendix A).

4.3.4 Potential impacts

The Proposal Area is predominantly cleared, with approximately 531 ha of the total 651 ha, cleared or highly modified. The Proposal has the potential to directly and indirectly impact on flora and vegetation in remaining areas during the construction and operational phases. The potential direct impacts include:

- Loss of up to 120 ha of vegetation, including:
  - 28.1 ha of revegetated/rehabilitated vegetation

  - 91.2 ha of remnant native vegetation of which 1.0 ha Excellent-Very Good (1.1 %), 4.2 ha Good (5 %), 13.7 ha Good-Degraded (~15 %) and 71.2ha (~78 %) was rated as Degraded or worse condition and 1.1 ha are unsurveyed

- Loss of vegetation types of conservation significance including:
  - 7.6 ha of Banksia Woodland TEC (and Banksia Woodland PEC) (including 2.97 ha requiring confirmation)
  - 0.6 ha likely to be occurrence of the Herb rich shrublands in clay pans TEC and 1.0 ha potentially occurring within the unsurveyed portion of the Proposal Area (0.53 ha likely to meet EPBC Act criteria and 0.55 ha when assessed under BC Act requirements)
  - 1.6 ha of riparian vegetation associated with the Preston River that has a restricted distribution
  - 5.2 ha of other (not associated with the Preston River) riparian or wetland vegetation which is considered representative of other significant vegetation
  - 1.1 ha of as yet unsurveyed native vegetation (of which 1.0 ha has been previously identified as Herb rich shrublands in clay pans TEC)
- Loss of known conservation significant flora including:
  - *Caladenia speciosa* (Priority 4) (1 plant), *Acacia semitrullata* (Priority 4) (seven plants) and *Chamaescilla gibsonii* (Priority 3) (approximately 4 plants).

The Proposal could also result in the following indirect impacts to vegetation and flora:

- Fragmentation of native vegetation. The Proposal will fragment existing vegetation resulting in increased edge effect pressures and potentially a decline in condition of existing remnant vegetation. Fragmentation will also result in the additional loss of 2.2 ha of Banksia Woodland TEC (as the fragmented patch will no longer meet the condition / size thresholds to be considered the TEC). Note: that the fragmentation will not result in an additional loss of PEC as there are no condition / size thresholds for the Banksia PEC, thus the fragmented patches would still be considered to be the PEC
- Possible (risk to be managed) 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 patterns and flows (to be managed through Drainage Strategy)
- Damage to surrounding vegetation through accidental generation of a bushfire (to be managed through CEMP).

The potential indirect impacts from dust will be managed in accordance with procedures outlined in section 4.7.6 and are not discussed further here.

4.3.5 Assessment of impacts

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

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

To allow a consistent assessment at a local, regional and bioregional scale the decision was made to utilise the DPIRD Native Vegetation Extent dataset (GoWA, 2019a) as the basis to assess direct and cumulative impacts within this document. To calculate the current extent remaining, intersects between the Native Vegetation Extent, and the Pre-European Vegetation and Vegetation Complexes – SCP datasets were completed (GoWA, 2019a).

BORR IPT (2019c) survey provides more detailed vegetation mapping (finer scale) and captures native vegetation in degraded or worse condition (such as scattered trees) which results in a greater amount of native vegetation present when compared with the Native Vegetation Extent dataset for the Proposal Area. The differences in values is a result of utilising mapping at difference scales (e.g. broad-scale mapping of Beard (1979), Heddle *et al*. (1980) and Webb *et al.* (2016) versus fine-scale mapping of a localised area) as well as mapping scattered vegetation that is not captured in the DPIRD Native Vegetation Extent dataset. As shown, in Table 4-7 this results in almost 50 % greater native vegetation being recorded in BORR IPT (2019c) survey than recorded in the DPIRD Native Vegetation Exent dataset (GoWA, 2019a).

Table 4-7 Comparison of BORR IPT and Native Vegetation Extent dataset

LOCAL GOVERNMENT AREA	EXTENT BASED ON BORR IPT MAPPING	EXTENT BASED ON DPIRD MAPPING (GOWA (2019A))
City of Bunbury	8.3 ha	5.4 ha
Shire of Capel	3.2 ha	0.9 ha
Shire of Dardanup	43.0 ha	22.1 ha
Shire of Harvey	35.7 ha	21.8 ha
Total	90.1 ha	50.2 ha

Regional Significance – Vegetation Associations / Complexes

The pre-European vegetation mapping (Beard, 1979) has been adapted and digitised by Shepherd *et al.* (2002). The extent of the vegetation associations has been determined by the state-wide vegetation remaining extent calculations maintained by the DBCA (latest update March 2019 – GoWA 2019b). As shown in Table 4-8, the current extents of vegetation associations 1000 and 1182 (applicable to the Proposal Area) are less than 30 % of their pre-European extent at the IBRA bioregion, IBRA subregion and within some of the Local Government Authority (LGA) levels. The current extent of vegetation association 968 is less than 10 % of its pre-European extent at the IBRA bioregion, IBRA subregion and within some of the LGA levels.

A portion of the Central corridor occurs within Constrained Area within the Greater Bunbury Region Scheme. Constrained areas have modified objectives to retain at least 10 % of the pre-clearing extent of the ecological community where >10 % of the ecological community remains. Given the relatively small amount of vegetation located within the Constrained Area, the vegetation within this area has not be differentiated with vegetation from outside the Constrained Area. All vegetation has been assessed using the 30 % pre-European extent target.

GoWA (2019c) has assessed the vegetation complexes mapped by Heddle *et al.* (1980) and Webb *et al.* (2016) against presumed pre-European extents within the SCP IBRA bioregion (Table 4-9) and LGA levels (Table 4-10). These tables show that the current extent of all four complexes that occur within the Proposal Area have less than 30 % of their pre-European extents remaining at both levels.

The Proposal will result in the direct loss of up to 50.2 ha of native vegetation mapped by DPIRD (GoWA (2019a)). The loss of this vegetation will result in the following changes to the remaining extents of the vegetation associations and complexes (Table 4-8 to Table 4-10):

Associations

- State scale: the three associations will decline by <0.1 to 0.1 % with 26.2 to 32.0 % of their pre-European extent remaining
- IBRA subregion: the three associations will decline by 0.1 to 0.2 % with 6.6 to 26.4 % of their pre-European extent remaining
- Local Government Area scale: the three associations will decline by <0.1 to 1.6 % with 5.4 to 40.7 % of their pre-European extent remaining.

The potential reductions in area of vegetation assocations are relatively minor, particularly at a State scale where 1 of 3 associations have greater than 30 % of their pre-European extent remaining and two have >25 %. The potential impacts of the Proposal on vegetation assocations are greatest when the potential clearing of association 968 and 1182 are considerd at a local government scale. Association 968 has less than 10 % of pre-European extent remaining in three of the four LGAs and 1182 has less than 10 % remaining in one of the four LGAs. Further clearing of this association through the Proposal will be minimised through the detailed design process to reduce potential impacts and reduce the likelihood of a significant impact.

Complexes

- SCP: the four complexes will decline by between <0.1 to 0.3 % of their current extent. All complexes are currently at and will remain below 30 % of their pre-European extent (between 5.1 and 26.9 %)
- Local Government Area scale: the four complexes will decline by between 0 and 3.2 % of their current extent. The four complexes are currently and will remain below 30 % of their pre-European extent, with the exception of Bassendean Complex – Central and South for the Shire of Harvey**,** with 42.9 % remaining. The Guildford and Southern River complexes are currently and will remain below 10 % of their pre-European extent within some Local Government Areas.

The reduction in pre-European extent of all four vegetation complexes is less than a 1 % reduction when considered in terms of their extent on the SCP. Further reduction to the clearing area associated with the Proposal will be achieved through consideration of imapcts during the detailed design process. Particular attention will be paid to mitigating impacts to the Guildford and Southern River vegetation complexes which have 5.1 % and 18.4 % of their pre-European extent remaining on the SCP.

Table 4-8 Extent of Beard (1979) vegetation association within the Proposal Area (GoWA, 2019b)

VEGETATION ASSOCIATION	SCALE		PRE-EUROPEAN EXTENT (ha)	CURRENT EXTENT (ha)	REMAINING (%)	CURRENT EXTENT IN ALL DBCA MANAGED LAND (%)	AMOUNT WITHIN THE PROPOSAL AREA (ha)	% OF CURRENT EXTENT WITHIN THE PROPOSAL AREA	% REMAINING AFTER PROPOSAL IMPACTS
Swan Coastal Plain IBRA Bioregion			1,501,221.9	579,813.5	38.6	38.5	50.1	<0.1	38.6
968	State: WA		296,877.8	95,048.8	32.0	57.6	14.5	<0.1	32.0
	IBRA Bioregion: Swan Coastal Plain		136,188.2	9,017.3	6.6	21.6	14.5	0.2	6.6
	Sub-region: Perth		136,188.2	9,017.3	6.6	21.6	14.5	0.2	6.6
	LGA:	City of Bunbury	4.5	1.1	24.5	NA		0	24.5
		Shire of Capel	6,657.3	660.4	9.9	3.5		0	9.9
		Shire of Dardanup	9,655.1	641.3	6.6	11.7	14.3	2.2	6.5
		Shire of Harvey	23,465.2	1,260.9	5.4	36.8	0.2	<0.1	5.4
1000	State: WA		99,835.9	27,768.8	27.8	18.6	32.3	0.1	27.8
	IBRA Bioregion: Swan Coastal Plain		94,175.3	24,869.2	26.4	19.2	32.3	0.1	26.4
	Sub-region: Perth		94,175.3	24,869.2	26.4	19.2	32.3	0.1	26.4
	LGA:	City of Bunbury	2,171.7	621.0	28.6	2.1	4.0	0.6	28.4
		Shire of Capel	15,173.8	3,189.9	21.0	7.3	0.9	<0.1	21.0
		Shire of Dardanup	3,375.4	820.9	24.3	NA	7.6	0.9	24.1

VEGETATION ASSOCIATION	SCALE		PRE-EUROPEAN EXTENT (ha)	CURRENT EXTENT (ha)	REMAINING (%)	CURRENT EXTENT IN ALL DBCA MANAGED LAND (%)	AMOUNT WITHIN THE PROPOSAL AREA (ha)	% OF CURRENT EXTENT WITHIN THE PROPOSAL AREA	% REMAINING AFTER PROPOSAL IMPACTS
		Shire of Harvey	20,121.6	8,209.8	40.8	30.4	19.9	0.2	40.7
1182	State: WA		23,437.1	6,133.6	26.2	55.3	3.4	<0.1	26.2
	IBRA Bioregion: Swan Coastal Plain		12,309.3	1,400.6	11.4	6.1	3.4	0.2	11.4
	Sub-region: Perth		12,309.3	1,400.6	11.4	6.1	3.4	0.2	11.4
	LGA:	City of Bunbury	280.1	86.9	31.0	NA	1.4	1.6	30.5
		Shire of Capel	4,028.8	1,132.7	28.1	33.1		0	28.1
		Shire of Dardanup	4,267.3	1,096.7	25.7	57.9	0.2	<0.1	25.7
		Shire of Harvey	7,311.5	598.5	8.2	6.9	1.8	0.3	8.2

Table 4-9 Extent of Heddle *et al*. (1980) vegetation complex on the Swan Coastal Plain within the Proposal Area (GoWA, 2019c)

VEGETATION COMPLEX	PRE-EUROPEAN EXTENT (ha)	CURRENT EXTENT (ha)	REMAINING EXTENT (%)	CURRENT EXTENT REMAINING WITHIN ALL DBCA MANAGED LAND (%)	AMOUNT WITHIN THE PROPOSAL AREA (ha)	% OF CURRENT EXTENT WITHIN THE PROPOSAL AREA	% REMAINING AFTER PROPOSAL IMPACTS
Bassendean Complex – Central and South	87,476.3	23,508.7	26.9	5.0	18.6	<0.1	26.9
Guildford Complex	90,513.1	4,607.9	5.1	0.3	14.5	0.3	5.1
Southern River Complex	58,781.5	10,832.2	18.4	1.6	13.8	0.1	18.4
Swan Complex	15,194.1	2,062.0	13.6	0.9	3.3	0.2	13.6

Table 4-10 Extent of Heddle *et al*. (1980) vegetation complex within Local Government Areas intercepted by the Proposal Area (GoWA, 2019c)

VEGETATION COMPLEX	LGA	PRE-EUROPEAN EXTENT (ha)	CURRENT EXTENT (%)	REMAINING EXTENT (%)	AMOUNT WITHIN THE PROPOSAL AREA (ha)	% OF CURRENT EXTENT WITHIN THE PROPOSAL AREA	% REMAINING AFTER PROPOSAL IMPACTS
Bassendean Complex – Central and South	City of Bunbury	NA	NA	NA	NA		NA
	Shire of Capel	4,946.6	1,162.2	23.5	0	0	23.5
	Shire of Dardanup	2.6	0.4	16.6	0	0	16.6
	Shire of Harvey	19,017.5	8,155.0	42.9	18.6	0.2	42.8
Guildford Complex	City of Bunbury	10.3	1.7	16.4	0	0.0	16.4
	Shire of Capel	6,508.4	540.5	8.3	0	0.0	8.3

VEGETATION COMPLEX	LGA	PRE-EUROPEAN EXTENT (ha)	CURRENT EXTENT (%)	REMAINING EXTENT (%)	AMOUNT WITHIN THE PROPOSAL AREA (ha)	% OF CURRENT EXTENT WITHIN THE PROPOSAL AREA	% REMAINING AFTER PROPOSAL IMPACTS
	Shire of Dardanup	8,582.4	453.8	5.3	14.3	3.2	5.1
	Shire of Harvey	16,378.8	534.9	3.3	0.2	<0.1	3.3
Southern River Complex	City of Bunbury	2,205.2	635.7	28.8	4.0	0.6	28.7
	Shire of Capel	7,876.1	1,794.3	22.8	0.9	<0.1	22.8
	Shire of Dardanup	3,331.0	811.9	24.4	7.6	0.9	24.2
	Shire of Harvey	798.4	75.7	9.5	1.4	1.9	9.3
Swan Complex	City of Bunbury	305.6	88.1	28.8	1.4	1.6	28.4
	Shire of Capel	2,047.1	417.5	20.4	0	0.0	20.4
	Shire of Dardanup	1,267.8	151.2	11.9	0.2	0.1	11.9
	Shire of Harvey	1,512.0	259.4	17.2	1.6	0.6	17.1

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

Local scale assessment

Assessment of the local scale impacts has been determined through use of the DPIRD Native Vegetation Extent data (GoWA 2019a) for a 5 km buffer surrounding the Proposal area. This shows that the 5 km buffer (totalling an area of 33,996.32 ha) contains 6,404.13 ha of native vegetation (18.8 %). The Proposal Area includes up to 50.2 ha of mapped native vegetation. The loss of this 50.2 ha would result in a 0.8 % reduction in the extent of native vegetation within the five km buffer, reducing the native vegetation remaining within five km of the Proposal Area to approximately 18 % of the total area.

Threatened and Priority Ecological Communities

An assessment of the loss of TEC / PEC within the local and regional scale has been made through comparing the extent within the Proposal Area to that published for the community (regional) and extent within the broader BORR IPT (2019c) Survey Area (Table 4-11). The extent of Banksia Woodlands ecological community estimated to be protected in reserves (Threatened Species Scientific Committee (TSSC), 2012) can be found in Table 4-12.

Banksia Woodland TEC / PEC

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 TEC remaining within the SCP.

Based on these assessments, the clearing of up to 7.6 ha (direct impacts) and 2.11 ha (indirect impacts from fragmentation), would result in up to a 9.7 ha (0.003 %) reduction in the reported extent of the Banksia TEC. At the Perth subregion scale, this would represent a 0.004 % reduction. Of this 5.6 ha was rated as in Good or better condition NB. Assessment of patches takes into account overall vegetation condition and therefore areas of Banksia Woodland can be included as part of a TEC patch if the condition is less than Good but the overall condition of the patch is rated Good or better.

This represents a maximum possible impact associated with the proposal and includes 2.97 ha of Banksia Woodland that requires additional survey to confirm if it meets the criteria for TEC condition and patch size. In the Perth sub region alone there will be an estimated 253,531 ha of Banksia Woodland (with almost 60,000 ha in reserves) remaining post construction of the Proposal. With further likely reductions in actual impact through the detailed design process it is unlikely that the Proposal will have a significant impact on the Banksia Woodlands of the SCP TEC.

Table 4-11 Extent of the TECs and PECs 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
Banksia Woodland TEC	7.6	14.9	0.003
Banksia Woodland PEC	7.6	25.7	0.003*
Herb rich shrublands in clay pans TEC	1.5 **	1.3	0.5

* using data for the Banksia TEC as representative of PEC extent.

** including 1.0 ha currently unsurveyed but previously mapped as the TEC.

Table 4-12 Extent of the Banksia Woodlands ecological community estimated to be protected in reserves (TSSC 2016)

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

Herb rich shrublands in clay pans TEC (FCT08) (Critically Endangered – EPBC Act and Vulnerable BC Act)

The recovery plan (DBCA 2019) states that there are 114 occurrences of the clay pan community (consisting of several different floristic community types) that cover approximately 909 ha. Of the total area of clay pan community FCT 08, which broadly aligns with BORR IPT (2019c) VT 12, has a reported extent of 298.1 ha. BORR IPT (2019c) mapped up to 0.6 ha of VT 12 within the Proposal Area. An additional 1.0 ha of previously identified clay pan community FCT 08 occurs within the unsurveyed portion of the Proposal Area. The loss of up to 1.5 ha within the Proposal Area would result in a 0.5 % loss of the herb rich shrublands in clay pans (FCT08) TEC.

Whilst the TEC does not have a minimum patch size criteria, due to its often fragemented and restricted distribution, a minimum condition rating of Good is required for the community to meet criteria as the TEC. Of the 0.6 ha identified within the Proposal Area the condition ranged from Degraded (0.02 ha) to Good-Degraded (0.53 ha). The Degraded-Good area included a fine scale mosaic of Good and Degraded condition areas.

As this community is critically endangered, any reduction in extent is likely to be considered to be significant. Verification of the composition and condition of vegetation as the TEC will be undertaken to confirm the impacts to this community.

Threatened Flora

The surveys (BORR IPT 2019c) did not identify the presence of any EPBC Act or BC Act listed flora within the Survey Area. One species, *Drakaea elastica*, has previously been recorded within the Proposal Area. However, searches for this species at the known site in August 2018 did not confirm its presence. The known location was weedy and it is expected thought that habitat suitability is diminished and the species no longer occurs at this location / or the locality data is not accurate. Targeted searches for *Diuris drummondii* were also completed by BORR IPT (2019c) and did not record any individuals. The Proposal is not expected to result in negative impacts to any EPBC Act or BC Act listed flora.

Priority Flora

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

The predicted impact indicates up to 2 % impact to *Acacia semitrullata*, 0.02 % impact to *Caladenia speciosa* and 9 % for *Chamaescilla gibsonii* regionally (Table 4-13). Furthermore the species have relatively wide distributions. *Caladenia speciosa* occurs from Mundijong to Boyanup, with additional populations south towards Donnybrook and further east at Lake Muir (Brown, Dundas, Dixon, & Hopper, 2008). *Acacia semitrullata* occurs from Waroona to Manjimup (Western Australian Herbarium, 1998-) and *Chamaescilla gibsonii* occurs from Chitterina to Augusta (Western Australian Herbarium, 1998-). Given the population estimates used are likely to be underestimates (as detailed above), and the species are relatively widespread, the potential impacts associated with the Proposal are not considered to be significant to the priority species recorded.

Table 4-13 Extent of Priority flora within the Proposal Area

SPECIES	CURRENT RECORDS* (ESTIMATE OF NUMBER)	AMOUNT IN PROPOSAL AREA	AMOUNT IN SURVEY AREA	% IMPACT FLORABASE RECORDS	% IMPACT SURVEY AREA
Caladenia speciosa (P4)	Approx. 3906 plants from 59 records	1 plant at 1 location	1 plant at 1 location	0.02 %	100
Acacia semitrullata (P4)	Approx. 383 plants from 87 records	7 plants at 4 locations	8 plants at 5 locations	1.8 %	88
Chamaescilla gibsonii (P3)	Approx. 45 plants from 26 records	1 location with 2 % cover (approx. 4 plants).	2 locations with 2 % cover (approx. 8 plants).	8.9 %	50

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

4.3.6 Mitigation

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

- Avoidance through selection of the Proposal Area where the majority of land (approximately 531 ha of 651 ha Proposal Area cleared or highly modified) has been previously disturbed or cleared. More than 86 % of the project area has been located on land that has been cleared highly modified or revegetated
- Minimisation of clearing impacts through the detailed design process
- Rehabilitation and revegetation using suitable native species in any areas disturbed during construction but not required for road and assocatied infrastructure
- Development of a Construction Environmental Management Plan (CEMP) to define techniques to minimise risks to the surrounding environment and provide monitoring during construction. Included will be:
  - Measures to minimise the risk of over-clearing, such as clear demarcation of clearing areas and the implementation of an internal clearing permit system
  - Measures to minimise the risk of impacting adjacent vegetation, such as temporary fencing and adherence to Shire fire restrictions

- Development of a Hygiene Management Plan to ensure that dieback and weeds are not introduced and/or spread to adjacent vegetation. The management plan will include procedures such as machinery/vehicle clean down, weed treatments and restrictions on vehicle/machinery movements
- Development of a Topsoil Management Plan, to ensure topsoil health for re-use and to mitigate the risk of introducing weeds into the Proposal Area and surrounds. The management plan will include the development and implementation of a system to allow for traceability of disposed weed infested topsoil, predetermined stockpile locations and instructions on topsoil management procedures
- Indirect impacts to flora and vegetation are mitigated through drainage design, as discussed in Section 4.6.6
- Development of an Environmental Offsets Strategy to mitigate unavoidable impacts on native vegetation.

For futher detail on the proposed management and mitigation measures, refer to Section 2.1, BORR Northern and Central Sections Environmental Management Plan (EMP) (BORR IPT, 2019f). The CEMP, Hygiene Management Plan and Topsoil Management Plan will comply with the EMP.

4.3.7 Predicted Outcomes

The selection of an alignment for the Proposal that minimises impacts to flora and vegetation and the mitigation measures proposed to address the potential impacts of the Proposal, the EPA objective for flora and vegetation *to protect flora and vegetation so that biological diversity and ecological integrity are matained*, will be met. Table 4-14 provides a summary of the key residual impacts to vegetation and flora. Impacts set out in the table represent the maximum possible impacts associated with the Proposal. As detailed previously, clearing extent will be refined through the detailed design process and the extent of TECs verified through additional surveys.

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

Table 4-14 Predicted residual impacts to flora and vegetation

SCALE	SUMMARY DISCUSSION OF RESIDUAL / CUMULATIVE IMPACTS
Subregion / SCP and Local Government Areas	All vegetation associations and complexes are currently and will remain below 30 % of their pre-European extent, with the exception of Bassendean Complex – Central and South for the Shire of Harvey with 42.9 %. The Proposal will result in between 0.1 and 0.3 % reductions to associations and complexes at the subregion / SCP scale. The Proposal will result in between 0 and 3.2 % reductions to associations and complexes at the LGA scale. The Guildford and Southern River complexes are currently below 10 % of their pre-European extent within some LGAs.
5 km buffer	The Proposal Area includes up to 50.2 ha of DPIRD mapped native vegetation. The loss of this 50.2 ha would result in a 0.8 % reduction in the extent of native vegetation within the 5 km buffer reducing this to approximately 18 % of DPIRD native vegetation remaining within 5 km of the Proposal Area.
Survey Area	Loss of up to 91.1 ha of native remnant vegetation and 28.1 ha of revegetation / regrowth vegetation, including 59.9 ha of native vegetation in fragmented patches within paddocks and road reserves and up to 30.3 ha of scattered / isolated trees.
TECs / PECs	Banksia woodland TEC Loss of 7.6 ha direct and 2.1 ha indirect, which is approximately 0.004 % of the known extent within the Perth Subregion and 65.2 % loss within BORR IPT (2019c) Survey Area. Banksia woodland PEC (included in Banksia TEC) Loss of up to 7.6 ha direct (included in 7.6 ha for Banksia TEC), which is approximately 0.004 % of the predicted extent within the Perth Subregion and 37.7 % loss within BORR IPT (2019c) Survey Area. Herb rich shrublands on clay pans (FCT 08) TEC Loss of up to 1.5 ha, which is approximately 0.5 % of the predicted extent.
Other significant vegetation	Direct loss of up to 1.6 ha of vegetation associated with the Preston River and 5.4 ha of riparian vegetation that is considered representative of other significant vegetation.
Priority Flora	*Chamaescilla gibsonii* (Priority 3) (approx. 4 plants), *Caladenia speciosa* (Priority 4) (1 plant) and *Acacia semitrullata* (Priority 4) (seven plants). This results in an estimated 8.9 %, 0.02 % and 1.8 % respectively, impacts on these species regionally.

4.4 Key Environmental Factor – Terrestrial Fauna

4.4.1 EPA objective

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

4.4.2 Policy and guidance

- Environmental Factor Guideline Terrestrial Fauna (EPA, 2016d)
- Technical Guidance Sampling methods for terrestrial vertebrate fauna (EPA, 2016i)
- Technical Guidance Terrestrial Fauna Surveys (EPA, 2016c).

4.4.3 Receiving environment

Field investigations undertaken relevant to this Proposal are provided in Table 4-15.

Table 4-15 Fauna investigations undertaken for the purpose of this Proposal

YEAR SURVEY COMPLETED	CONSULTANT	SURVEY NAME
2018	Biota Environmental Sciences (Biota)	Bunbury Outer Ring Road Northern and Central Section Targeted Fauna Assessment (Biota, 2019a)
2018	Wetland Research & Management (WRM)	Bunbury Outer Ring Road Northern and Central Investigation Area: Targeted Conservation Significant Aquatic Fauna Survey (WRM, 2019)

4.4.3.1 Terrestrial fauna habitats

Fauna habitat types within the Proposal Area were assessed during investigation of a wider Survey Area by Biota (2019a) and WRM (2019). A total of 630.0 ha was surveyed within the Proposal Area, with 20.8 ha unsurveyed within the Proposal Area.

Six broad habitat types were identified by Biota (2019a) within the Proposal Area. These habitat types approximately align with vegetation communities outlined in section 4.3 however, additional detailed review of areas was undertaken taking into consideration the likely value as fauna habitat (Biota 2019a). In addition, two low value habitat types considered to be largely devoid of fauna habitat, were described as: highly modified/ cleared and non-native vegetation (including large blue gum plantation) (Biota, 2019a).

A description of fauna habitat types, correlating vegetation communities and extent within the Proposal Area is provided in Table 4-16. The extent of the habitat types within the Proposal Area is shown in Figure 10 (Appendix A).

Table 4-16 Fauna habitat types identified within the Proposal Area

HABITAT TYPE AND DESCRIPTION (Biota, 2019a)	EXAMPLE PHOTOGRAPHS FOR EACH HABITAT TYPE (Biota, 2019a)	VEGETATION CODE (BORR IPT, 2019c)	EXTENT WITHIN THE PROPOSAL AREA TOTAL (ha)
Marri/ *Eucalyptus* woodland Jarrah (*Eucalyptus marginata*) +/- Marri (*Corymbia calophylla*) dominated overstorey, varying understorey of Banksia (*Banksia attenuata* and *B. grandis*) or Peppermint (*Agonis flexuosa*).		VT14 VT15 VT19 VT20	23.0
Dampland with *Melaleuca* woodland and shrubland Very open woodland of *Melaleuca rhaphiophylla* over herbs and weeds in road reserves and over introduced grasses in paddocks. When occurring in paddocks, the understorey was heavily grazed.		VT6 VT7 VT12	32.3
Marri/*Eucalyptus* in paddocks and road reserves Typically occurring as widely spaced trees or occasionally as small stands in paddocks; comprising a mosaic of scattered trees of *Melaleuca*, Marri and/or Flooded Gum. The understorey was usually heavily grazed. Roadside species composition was variable including native tree species as above, areas of *Casuarina*, as well as planted introduced *Eucalyptus*.		VT4 VT8 VT17 VT18	31.6

HABITAT TYPE AND DESCRIPTION (Biota, 2019a)	EXAMPLE PHOTOGRAPHS FOR EACH HABITAT TYPE (Biota, 2019a)	VEGETATION CODE (BORR IPT, 2019c)	EXTENT WITHIN THE PROPOSAL AREA TOTAL (ha)
Riparian woodland Woodland of Flooded Gum (*E. rudis*) and Marri (*C. calophylla*) over *Melaleuca rhaphiophylla* on Preston River; Woodland of *Melaleuca rhaphiophylla*, *Eucalyptus rudis* and *Casuarina obesa* fringing Collie River.		VT9 VT10 VT11/11a VT12 VT17	5.2
Peppermint woodland While Peppermint (*Agonis flexuosa*) was more commonly found as a midstorey species within Marri/*Eucalypt* woodland, it did occur in uniform stands in some areas, often over introduced pasture grasses**.**		VT16	10.7
Artificial wetland Artificial drainage channels used to create small wetlands in two locations within the study area, the most notable being south of Clifton Road. Very open woodland of *Melaleuca rhaphiophylla* over introduced grasses and herbs in paddocks and road reserves.		Part VT6	2.2

HABITAT TYPE AND DESCRIPTION (Biota, 2019a)	EXAMPLE PHOTOGRAPHS FOR EACH HABITAT TYPE (Biota, 2019a)	VEGETATION CODE (BORR IPT, 2019c)	EXTENT WITHIN THE PROPOSAL AREA TOTAL (ha)
Highly modified/ cleared Land cleared for agriculture, housing, roads and other infrastructure.		VT1	487.6
Non-native vegetation (included large blue gum plantation) Mature planted vegetation including *Eucalyptus* species along internal fence lines, driveways and landscaping.		VT2	37.7
Total			630.0

4.4.3.2 Fauna habitat value

The Biota (2019a) investigation identified the following key aspects with regard to fauna habitat within the Proposal Area:

- 487.6 ha (~75 %) of the Proposal Area has been cleared for agricultural and road infrastructure (highly modified/ cleared)
- The woodland fauna habitat types recorded provide suitable foraging and potential breeding habitat for Black Cockatoos (Carnaby's Cockatoo, Forest Red-tailed Black Cockatoo and Baudin's Cockatoo see section 4.4.3.5) Foraging habitat and habitat quality for Black Cockatoo species was assessed in more detail, using the vegetation type mapping (BORR IPT 2019c) and the DoEE foraging habitat scoring tool by Biota (2019). This is discussed in more detail in 4.4.3.5
- The woodland fauna habitat types recorded provide suitable habitat for Western Ringtail Possums.

4.4.3.3 Ecological linkages

The Preston, Collie and Brunswick rivers flow into the Leschenault Estuary, which is located 3.3 km west of the Proposal Area at the closest point. The Ferguson River meets with the Preston River 5.7 km upstream of the discharge point into the estuary.

These four rivers and their associated riparian corridors, have been identified as regionally significant Ecological Linkages within the Greater Bunbury Region, as shown in Figure 10 (Appendix A) (Molloy, Wood, Wallrodt, & Whisson, 2009).

On a local scale, vegetation along road reserves, minor waterways and Geomorphic Wetlands (where vegetated) provide local ecological linkages that will be intersected by the Proposal Area. These linkages are likely to be used by conservation significant fauna as well as a number of more common mammals, birds, reptiles and amphibians.

4.4.3.4 Fauna diversity

Biota (2019a) completed a desktop review of relevant databases and four previous fauna studies within 10 km of the Survey Area. The database search indicated a combined species inventory of 230 vertebrate fauna species, comprising 28 mammals (14 native non-volant, 5 bat and 9 non-native), 159 birds (72 of which are largely reliant on freshwater or marine habitats), 33 reptiles and 10 amphibians.

More than 920 individual fish were caught during the 2018 aquatic study (WRM, 2019). Native aquatic fauna recorded included:

- Six native fish species (including the Black Striped Minnow, *Galaxiella nigrostriata*)
- Two south-west endemic freshwater crustacean species (gilgie, *Cherax quinquecarinatus,* and smooth marron, *Cherax cainii*)
- South-western snake-necked turtles, *Chelodina colliei* (listed on the IUCN Redlist of Threatened Species as Near Threatened).

Twenty-one introduced fauna species, including birds, mammals, fish and crustaceans were recorded within 10 km of the wider Survey Area.

4.4.3.5 Conservation significant fauna

Searches of the EPBC Act Protected Matters database, DBCA *NatureMap* database and four previous studies identified the presence/ potential presence of 19 conservation significant fauna species within 10 km of the wider Survey Area. The desktop searches undertaken by Biota (2019a) recorded:

- 34 species listed under the EPBC Act and/or the BC Act
- 46 migratory birds protected under international agreement (Schedule 5)
- Eight DBCA Priority listed species.

Eight conservation significant species were directly and indirectly observed within the broader Survey Area by Biota (2019a) and WRM (2019), including:

- 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)
- Western Ringtail Possum (Pseudocheirus occidentalis) (Critically Endangered, Schedule 1)
- Brush-tailed Phascogale (Phascogale tapoatafa wambenger) (Schedule 6)
- Southern Brown Bandicoot (Isoodon fusciventer) (Priority 4)
- Black-stripe Minnow (Galaxiella nigrostriata) (Endangered, Schedule 2)
- Carter's Freshwater Mussel (Westralunio carteri) (Vulnerable, Schedule 3).

Conservation significant species (terrestrial species only, aquatic species are discussed separately below) considered likely to possibly occurring, their habitat preferences and potential extent of habitat within the Proposal Area are summarised in Table 4-17. The likelihood of occurrence assessment on the wider Survey Area undertaken by Biota (2019a), is assumed to also apply within the Proposal Area.

Threatened Fauna observations within the Proposal Area and contextual sites are shown in Figure 11 (Appendix A).

Table 4-17 Likelihood of occurrence for conservation significant fauna species and their habitat availability within the Proposal Area

SPECIES	COMMON NAME	BC Act	EPBC ACT	LIKELIHOOD OF OCCURRENCE	DOMINANT FAUNA HABITAT TYPE						POTENTIAL FOR DOMINANT HABITAT EXTENT WITHIN THE PROPOSAL AREA (ha)
					MARRI/ EUCALYPTUS WOODLAND	DAMPLAND WITH MELALEUCA WOODLAND AND SHRUBLAND	MARRI/ EUCALYPTUS IN PADDOCKS AND ROAD RESERVES	RIPARIAN WOODLAND	PEPPERMINT WOODLAND	ARTIFICIAL WETLAND	
Birds											
Calyptorhynchus banksia naso	Forest Red-tailed Black-Cockatoo	S3	VU	Occurs	Foraging, Breeding	-	Foraging, Breeding	Foraging, Breeding	-	-	59.7
Calyptorhynchus baudinii	Baudin's Cockatoo	S2	EN	Occurs	Foraging, Breeding	-	Foraging, Breeding	Foraging, Breeding	-	-	59.7
Calyptorhynchus latirostris	Carnaby's Cockatoo	S2	EN	Occurs	Foraging, Breeding	-	Foraging, Breeding	Foraging, Breeding	-	-	59.7
Falco peregrinus	Peregrine Falcon	S7	-	Possible (foraging visitor)	-	-	-	Foraging	-	-	5.2
Oxyura australis	Blue-billed Duck	P4	-	Likely to occur	-	-	-	Foraging		Foraging	7.4
Mammals											
Pseudocheirus occidentalis	Western Ringtail Possum	S1	CR	Occurs	Foraging, Breeding	-	Foraging, Breeding	Foraging, Breeding	Foraging, Breeding	-	70.3
Isoodon fusciventer	Southern Brown Bandicoot Quenda,	P4	-	Likely to occur	Foraging, Breeding	Foraging, Breeding	Foraging, Breeding	Foraging, Breeding	Foraging, Breeding	Foraging, Breeding	104.7

SPECIES	COMMON NAME	BC Act	EPBC ACT	LIKELIHOOD OF OCCURRENCE	DOMINANT FAUNA HABITAT TYPE						POTENTIAL FOR DOMINANT HABITAT EXTENT WITHIN THE PROPOSAL AREA (ha)
					MARRI/ EUCALYPTUS WOODLAND	DAMPLAND WITH MELALEUCA WOODLAND AND SHRUBLAND	MARRI/ EUCALYPTUS IN PADDOCKS AND ROAD RESERVES	RIPARIAN WOODLAND	PEPPERMINT WOODLAND	ARTIFICIAL WETLAND	
Phascogale tapoatafa wambenger	South-western Brush-tailed Phascogale, Wambenger	S6	-	Occurs	Foraging, Breeding	-	-	Foraging, Breeding	-	-	28.2
Dasyurus geoffroii	Chuditch, Western Quoll	S3	VU	Possible (foraging visitor)	Foraging	-	-	Foraging, Breeding	-	-	28.2
Hydromys chrysogaster	Water-rat, Rakali	P4	-	Possible (resident)	-	-	-	Foraging, Breeding	-	Foraging, Breeding	7.4
Notamacropus irma	Western Brush Wallaby	P4	-	Possible (visitor)	Foraging	-	-	-	-	-	23.0
Falsistrellus mackenziei	Western False Pipistrelle	P4	-	Possible (resident)	Foraging, Breeding	-	-	Foraging, Breeding	-	-	28.2
Reptiles											
Ctenotus ora	Coastal Plains Skink	P3	-	Possible (resident)	Foraging, Breeding	-	-	-	-	-	23.0

Terrestrial conservation significant fauna

Black Cockatoos

The Proposal Area provides areas of suitable foraging and potential breeding habitat (59.7 ha) for Black Cockatoos (Carnaby's Cockatoo, Forest Red-tailed Black Cockatoo and Baudin's Cockatoo).

During the field survey two observations of white-tailed Black Cockatoo flying over the wider Survey Area were recorded but could not be distinguished between Carnaby's Cockatoo and Baudin's Cockatoo (Biota, 2019a). Evidence of foraging by all three species was recorded within the wider Survey Area. (Biota 2019a).

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

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

Of the 1116 Suitable DBH Trees assessed within the Proposal Area, no Known Nesting Trees were recorded by Biota (2019a). Five Trees with a Suitable Nest Hollow and two were ground assessed as potentially suitable. The remaining Suitable DBH Trees did not contain suitably sized hollows (Figure 11).

Biota (2019a) reviewed the potential Black Cockatoo foraging habitat within a 12km 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, with the exception of a portion of this vegetation complex in the northern extent of the Proposal Area which is isolated from other vegetation in this complex. The Swan Complex within the study area is represented by riparian vegetation assocated 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 (eg Marri, Jarrah and Banksia generally absent from this complex).

Western Ringtail Possum

The Proposal Area provides areas of suitable breeding and foraging habitat for Western Ringtail Possums including Marri/ Eucalyptus Woodland, Marri/ Eucalyptus in paddocks and road reserves, Peppermint Woodland and Riparian Woodland (70.28 ha). Western Ringtail Possums were recorded in woodland fragments (particularly mixed woodland) within the Proposal Area (Biota, 2019a).

Biota (2019a) observed 44 Western Ringtail Possums within the Proposal area. Based on a combination of the number of animals observed within the Proposal Area and density calculations, it is estimated that between 44 – 49 individual Western Ringtail Possums occur within the Proposal Area (Biota pers comm.).

Biota (2019b) completed additional surveys (using distance sampling) to provide a regional context for potential impacts from the Proposal on the Western Ringtail Possum. 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. The results from the additional Western Ringtail Possum surveys are preliminary as the report is currently in draft.

The distance sampling of BORR context sites and regional context sites surveyed a combined distance of 256.0 km and recorded a combined total of 1,521 individual Western Ringtail Possums. Based on preliminary analysis of these results, the study estimated a population for the southern SCP of 5,373 Western Ringtail Possums. This estimate includes 3,582 mature adults and 1791 juveniles. The estimate

does not include suitable habitats in the semi-urban and urban environment that are known to be inhabited by Western Ringtail Possums, and is therefore considered to be a conservative estimate (Biota, 2019b).

The recorded density and preliminary estimation of abundance of Western Ringtail Possums within the local and regional area is shown in Table 4-18.

The preliminary estimation of abundance within the Proposal Area, based on approximately 70 ha of suitable habitat present, indicates that 0.9 % (up to 49 individuals) of the estimated regional population (up to 5,373 individuals) could be impacted.

Table 4-18 Western Ringtail Possum density and abundance estimates within the Surveyed areas (Biota, 2019b)

SURVEYED AREAS		AREA (ha)	WESTERN RINGTAIL POSSUM DENSITY RECORDED (Individuals per ha)	ABUNDANCE ESTIMATES (INDIVIDUALS)
Northern Lots within the Proposal Area		33.3	0.62 ± 0.26	21 ± 9
Sub-total		**33.3**	-	**21**
BORR contextual sites	Lot 2 Boyanup-Picton Road (August phase)	87.6	1.37 ± 0.19	121 ± 17
	Manea Park (October phase)	155	1.20 ± 0.27	186 ± 41
	Reserve 23000 (August survey)	146.1	0.56 ± 0.11	82 ± 16
	Lot 1 Ducane Road	40.5	0.26 ± 0.16	11 ± 6
	Southern Lots	188	0.39 ± 0.11	73 ± 20
Sub-total		**617.2**	-	**473**
Regional contextual sites	Leschenault Peninsula Conservation Park*	N/A	N/A	N/A
	Dardanup Conservation Park	926	0	0
	Crooked Brook**	N/A	N/A	N/A
	Kemerton	581	0	0
	Tuart Forest North	257	3.89 ± 0.42	998 ± 108
	Tuart Forest Central	1080	1,287 ± 0.13	1390 ± 140
	Tuart Forest South	643	3.36 ± 0.32	2159 ± 206
	Locke Nature Reserve	107.5	3.29 ± 0.67	353 ± 72
Sub-total		**3594.5**	-	**4900**
Grand total		**4245.0**	-	**5394**

Notes:

*The transect layout for Leschenault Peninsula Conservation Park did not adequately sample the extent of suitable habitat for Western Ringtail Possums. The results should be viewed as representative of a reconnaissance only.

**The Crooked Brook Forest study site was incompletely surveyed, having been selected to replace the Dardanup Conservation Park when consecutive sampling failed to detect any Western Ringtail Possums. The limited data for this study site were not able to be analysed.

South-western Brush-tailed Phascogale, Wambenger

One South-western Brush-tailed Phascogale 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.

In addition, a further nine South-western Brush-tailed Phascogale were observed in vegetation adjacent to the Proposal Area. The Proposal Area provides suitable habitat for the South-western Brush-tailed Phascogale, namely; Riparian Woodland and Marri/ Eucalyptus Woodland (28.2 ha).

Southern Brown Bandicoot, Quenda

Southern Brown Bandicoot individuals were not recorded within the Proposal Area during the survey by Biota (2019a). However, this species is considered 'Likely to Occur' within the Proposal Area as there is suitable habitat and diggings were observed in the wider Survey Area. The Proposal Area may provide suitable habitat in all six dominant fauna habitat types (104.7 ha), however the species is known to preferrantially utilise habitats with dense understorey vegetation and is often associated with wetlands (Biota 2019a).

Aquatic conservation significant fauna

Black-stripe Minnow

The Black-stripe Minnow (*Galaxiella nigrostriata*) is listed as Endangered under the EPBC Act. The species is endemic to south-western Australia and most commonly occurs in shallow ephemeral waterbodies of peat flats (WRM, 2019). The Black-Stripe Minnow is able to survive dry summer conditions by aestivating (burrowing) into moist soils until the first rains and is known to disperse in years of high rainfall (WRM, 2019). Observations of Black-Stripe Minnows have been recorded in wetlands to the south of the Proposal Area (WRM, 2019).

Due to the high mobility of the species and connectivity between wetlands in wetter years, it is possible that Black-stripe Minnows migrate between wetlands and are still located within the local area.

No Black-stripe Minnow were found within the Proposal Area, however one individual was found (Northern 9 WRM sample location) in a wetland adjoining the Proposal Area (UFI 15450 – Multiple Use Palusplain Geomorphic Wetland) (Figure 12, Appendix A).

There is potential for Black-stripe Minnow to opportunistically utilise habitat within the Proposal Area. The majority (>99 %) of the 578 ha of Geomorphic Wetlands within the proposal area are classified as 'Multiple Use' (see section 4.6.3). A sub-set of these may provide suitable habitat for Black-stripe Minnow. Further field investigations will be undertaken during winter 2019 to identify suitable habitat for Black-stripe Minnow and determine the likelihood of occurrence within the Proposal Area.

Refer to the Targeted Conservation Significant Aquatic Fauna Survey report (WRM, 2019) in Appendix F for further details.

Carter's Freshwater Mussel

Carter's Freshwater Mussel is an aquatic species restricted, within the Proposal Area, to major creeklines with shallow sandy banks (Biota, 2019a).

This species was recorded at a tributary of the Collie River (North Creek 5), Ferguson River (North Creek 5) and Preston River (North Creek 2) by WRM (2019) and in the Preston River by Biota (2019a), during the 2018 surveys (Figure 12, Appendix A).

Potential habitat for Carter's Freshwater Mussel includes the Collie, 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, 2019) in Appendix F for further details.

Australian Water Rat

Despite extensive survey effort (motion sensor cameras and visual observations), no Australian Water Rats were identified at any of the sites within the wider investigation area by WRM or Biota during the field surveys undertaken in 2018 (Biota, 2019a; WRM, 2019).

Refer to the Targeted Conservation Significant Aquatic Fauna Survey report (WRM, 2019) in Appendix F for further details.

South-Western Snake-necked Turtle

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

A total of 74 South-Western Snake-Necked Turtles were recorded within the wider Survey Area by Biota (2019a). This species is considered likely to have the potential to occur in permanent and seasonal rivers, lakes, farm dams, swamps and damplands, including natural and constructed wetlands within the Proposal Area (WRM, 2019).

Refer to the Targeted Conservation Significant Aquatic Fauna Survey report (WRM, 2019) in Appendix F for further details.

4.4.4 Potential impacts

Direct impacts

The Proposal Area is predominantly cleared, with approximately 531 ha of the total 651 ha, cleared or highly modified. The Proposal has the potential to directly and indirectly impact on fauna and fauna habitat in remaining areas during the construction and operational phases. The potential direct impacts include:

- Clearing of up to 104.70 ha of mapped fauna habitat types across the Proposal Area of 650.65 ha
- Clearing of up to 59.7 ha of Black Cockatoo foraging and breeding habitat including five trees considered to be Trees with a Suitable Nest Hollow (for Black Cockatoos), and a further 1111 Suitable DBH Trees
- Clearing of up to 70.3 ha of Western Ringtail Possum habitat and displacement of up to 49 individual Western Ringtail Possums, representing less than 1 % of the regional population
- Clearing of up to 28.2 ha of South-western Brush-tailed Phascogale habitat
- Potential impact to up to 1.7 ha of habitat of Carter's Freshwater Mussel
- Potential loss of habitat for the Black-stripe Minnow. No Black-stripe Minnow were found within the Proposal Area, however one individual was found within the Survey Area in a wetland adjoining the Proposal Area. Further field investigations will be undertaken during winter 2019 to identify suitable habitat for Black-stripe Minnow and determine the likelihood of occurrence within the Proposal Area

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

- Clearing of habitat for conservation significant species that are likely to occur within the Proposal Area:
  - Up to 104.7 ha of Southern Brown Bandicoot, Quenda (Priority 4) breeding and foraging habitat
  - Up to 7.3 ha of Blue-billed Duck (Priority 4) breeding and foraging habitat.

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

- Temporary, localised impacts on aquatic fauna due to disturbance of bed and banks during construction of bridge structures, such as pylons within, and on the banks of the rivers within the Proposal Area
- Death or displacement of native fauna species from vehicle movements.

Indirect impacts

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

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

4.4.5 Assessment of impacts

Direct impacts

More than 80 % of the Proposal Area is predominantly cleared, with approximately 531 ha of the total 651 ha already cleared or highly modified. Reduction of potential impacts on the environment was a key consideration in the selection of the alignment and identification of the Proposal Area. Further reduction in the potential impacts will occur through the detailed design phase with the Proposal Area representing the maximum possible area of disturbance.

Clearing and Loss of Habitat

The Proposal will result in the potential clearing of up to 104.7 ha of mapped fauna habitat across the 651 ha Proposal Area.

Using vegetation complexes to provide regional context to potential impacts on fauna habitats, as detailed in section 4.3.5, the clearing associated with the Proposal will potentially impact four vegetation complexes but result in less than a 1 % reduction when considered in terms of their extent on the SCP. Further reduction to the clearing area associated with the Proposal will be achieved through consideration of impacts during the detailed design process.

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

Impact to conservation significant fauna

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

- Black Cockatoos (up to 59.7 ha foraging and potential breeding habitat), including Carnaby's Cockatoo (Endangered), Baudin's Cockatoo (Endangered) and Forest Red-tailed Black Cockatoos (Vulnerable)
- Western Ringtail Possum (70.3 ha breeding and foraging) (Critically Endangered).

Black Cockatoos

Assessment of the potential impacts on Black cockatoo habitat using vegetation complexes within a 12 km radius indicated that the vegetation complexes which provided the highest quality foraging habitat (eg Bassendean Central and South and the Southern River vegetation complexes) were in general well represented outside of the Proposal Area (Biota 2019). Within 12km of the Biota (2019) study area, the Guidlford Complex has 1022 ha of remnant vegetation remaining, the Southern River Complex has 2046 ha and Bassendean Complex – Central and South has 3834 ha. The clearing of 59.7 ha of potential habitat represents a 0.9 % reduction in potential foraging and breeding habitat for the Black Cockatoo species within the local 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 Propsal Area (Biota 2019). No trees with known breeding hollows were identified during the fauna surveys associated with the Proposal. Five Trees with a Suitable Nest Hollow (for Black Cockatoos) were identified within the Proposal Area and 1111 Suitable DBH Trees were also located. Within the Survey Area, Biota (2019) found an additional 14 trees supporting 15 hollows suitable for Black Cockatoo nesting, including one tree with potential evidence (two broken eggs of size and colour consistent with Black Cockatoos) of use in the previous breeding season.

Western Ringtail Possums

An assessment of the density and abundance of Western Ringtail Possums within the Proposal Area has enabled an estimate of the individuals to be displaced. Up to 49 Western Ringtail Possums are expected to be displaced from the Proposal Area. Further assessment of local and regional context sites has determined that the displaced Western Ringtail Possums represent < 1 % of the estimated regional population.

Historically, there has been an absence of robust abundance estimates of Western Ringtail Possums, and this has previously been recognised as a knowledge gap. The adult population of Western Ringtail Possums was estimated in 2015 to be 3,400, including a sub-population of 2,000 on the southern SCP. The 2019 population estimate was based on intensive surveys that covered 4,211.7 ha, with preliminary results indicating a population larger than the entire Western Australian adult 2015 population (Biota 2019b). Furthermore, the 2019 southern SCP estimate does not include suitable habitat in the semi-urban and urban environment, which are known to be utilised be Western Ringtail Possums. As such, the 2019 estimate is considered to be conservative (i.e. lower than in reality).

Other potential impacts

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

Vehicle Strike

Operation of BORR will result in an increase in traffic/vehicle movements and therefore result in a greater risk of fauna strike from vehicle movements.

Indirect impacts

Habitat fragmentation

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

The 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 fauna habitat.

4.4.6 Mitigation

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

- Detailed design to include infrastructure to facilitate fauna movement, such as overpasses, underpasses, transverse drainage and strategically placed fencing
- Fauna relocation will be considered for conservation significant terrestrial fauna species, including trapping for Western Ringtail Possums. A Fauna Management Plan will be written for the Proposal
- An appropriately qualified fauna handler will be on site during clearing of Western Ringtail Possum habitat
- Provision of transverse drainage design as discussed in Section 4.6.6, which will include culverts (or similar) to maintain fish passage movement (including Black-stripe Minnow) through the drainage network i.e. drainage design sympathetic to fish movement requirements
- Development of a CEMP to define techniques to minimise risks to native fauna and provide monitoring during construction. Included will be the requirement for checks for known Black Cockatoo hollows
- Wherever practical, clearing will be undertaken on one front only, to provide an opportunity for fauna to move out of the Proposal Area
- Clearing to be timed to minimise impacts on native fauna, particularly Black Cockatoos (i.e. clearing will be avoided during the Black Cockatoo nesting period, July - December)
- If native fauna is disturbed during clearing, it should be allowed to make its own way to adjacent vegetated areas
- Should trenches be constructed, which native fauna are unable to escape from, they will be inspected by a “fauna spotter” on a regular basis (dawn, midday and prior to sunset). If trenches are left open overnight, ramps will be established to permit native fauna to escape
- Any native fauna injured as a result of the Proposal construction or operation should be taken to a designated veterinary clinic or a DBCA nominated wildlife carer
- Dust, noise and vibration management measures as outlined in a project specific CEMP.

4.4.7 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 4-19 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. As detailed previously, clearing extent and impacts to fauna habitats will be refined through the detailed design process.

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

Table 4-19 Predicted residual impacts to fauna

ISSUE	SUMMARY DISCUSSION OF RESIDUAL / CUMULATIVE IMPACTS	OUTCOME
Fauna habitat	Over the total Proposal area of 651 ha up to 104.7 ha of fauna habitat of varying quality and significance to fauna will be cleared. Using vegetation complexes as a proxy for fauna habitat, the loss of vegetation within local (12km radius) context, results in <1 % reduction in current extent of 3 of 4 vegetation complexes within the Proposal Area and a <2 % reduction in the remaining. Results for reduction in area of vegetation within each complex were similar when considered in the context of the LGAs occurring within the Proposal Area. Reduction in the clearing of fauna habitats will occur through the detailed design process.	The overall loss of fauna habitats when considered in a local context is not considered significant.
Black Cockatoos	The Proposal may potentially result in loss of up to 59.65 ha of suitable Black Cockatoo habitat and five trees considered to be Trees with a Suitable Nest Hollow. The clearing of 59.7 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 12km radius).	The reduction in foraging and potential breeding habitat for Black Cockatoo species will result in a minor residual impact associated with the Proposal.
Western Ringtail Possums	Up to 70.3 ha of suitable Western Ringtail Possum habitat will potentially be cleared. This area is estimated to provide habitat for up to 49 individual Western Ringtail Possums. Based on the results of regional surveys, this is estimated to represent 0.9 % of the regional population.	The clearing of Western Ringtail Possum habitat and displacement of 0.9 % of the regional population will result in a minor residual impact associated with the Proposal.
South-western Brush-tailed Phascogale	Up to 28.2 ha of suitable South-western Brush-tailed Phascogale habitat will potentially be cleared as a result fo the Proposal. Brush-tailed Phascogales maintain relatively large ranges (>20 ha) and densities therefore tend to be low (Biota 2019).	The impact to the South-western Brush-tailed Phascogale are unlikely to be significant.
Carter's Freshwater Mussel	Disturbance of up to 1.4 ha of Carter's Freshwater Mussel (Vulnerable) habitat during construction of bridges. Refinement of the estimated potential impact to Carter's Freshwater Mussel will occur once detailed design of bridge and drainage works are available. It is anticipated that disturbance to waterways will be temporary and minor.	The impact to Carter's Freshwater Mussel is unlikely to be significant.
Black-stripe Minnow	No black-stripe Minnow were found within the Proposal Area, however one Black-stripe Minnow was found within the Survey Area in a wetland adjoining the Proposal Area. There is potential for Black-stripe Minnow to opportunistically utilise habitat within the Proposal Area. The majority (>99 %) of the 578 ha of Geomorphic Wetlands within the proposal area are classified as 'Multiple Use' (see section 4.6.3). A sub-set of these may	The impact to the Black-stripe Minnow is unlikely to be significant.

ISSUE	SUMMARY DISCUSSION OF RESIDUAL / CUMULATIVE IMPACTS	OUTCOME
	provide suitable habitat for Black-stripe Minnow. Further investigations will be conducted to confirm whether Black-stripe minnow occur within the Proposal are and to identify potential suitable habitat. Impacts to the hydrologic function of wetlands undisturbed within and adjacent to the Proposal Area will be managed through the implementation of the Drainage Strategy.	
Southern Brown Bandicoot, Quenda	Up to 104.7 ha potentially supporting the Southern Brown Bandicoot may be cleared as a consequence of the Proposal. The Southern Brown Bandicoot is likely to occur within the Proposal area. They are known to preferentially utilise areas of denser vegetation, particularly within wetlands (Biota 2019) and therefore their ulitisation of habitat across the Proposal Area is likely to be much less than the 104.7 ha.	The impact to the Southern Brown Bandicoot is unlikely to be significant.
Blue-billed Duck	The Proposal will potentially result in the loss of up 7.4 ha of riparian woodland and wetland habitat that is considered likely to provide habitat for Blue-billed Duck. Impacts to waterways and riparian vegetation will be minimised through the detailed design process and implementation of the Drainage Strategy.	Impact to Blue-billed duck is unlikely to be significant.

Clearing of native vegetation for the construction and operation of the Proposal will result in a reduction of habitat supporting conservation significant fauna and loss of under-represented fauna habitat. As the Proposal Area does not contain any known nesting hollows, and the project will impact on less than 1 % of local Black Cockatoo habitat and less than 1 % of the regional Western Ringtail Possum population, the Proposal is considered to have a minor residual impacts significant impact on terrestrial fauna, including conservation significant fauna.

4.5 Key Environmental Factor – Terrestrial Environmental Quality

4.5.1 EPA objective

For the purpose of EIA, the EPA defined Terrestrial Environmental Quality as 'the chemical, physical, biological and aesthetic characteristic of soils'.

The EPA objective is '*to maintain the quality of land and soils so that environmental values are protected*' (EPA, 2018c).

4.5.2 Policy and guidance

- Assessment and Management of Contaminated Sites (DER, 2014)
- Environmental Factor Guideline Terrestrial Environmental Quality (EPA, 2016e)
- Water Quality Australia: Australian Government Initiative – *National Acid Sulfate Soils Guidance, national acid sulfate soils sampling and identification methods manual* (Sullivan, Ward, Toppler, & Lancaster, 2018)
- DWER Acid Sulfate Soil Guideline Series - *Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes* (DER, 2015a)
- DWER Acid Sulfate Soil Guideline Series - *Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes* (DER, 2015b)
- Department of Water, *Water Quality Protection Note 13, Dewatering of soils at construction sites* (November 2012)
- WAPC*, Acid Sulfate Soils, Planning Guidelines* (WAPC, 2008).

4.5.3 Receiving environment

4.5.3.1 Geology

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

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

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

The geological units discussed above are shown in Figure 13 (Appendix A). They are also anticipated to be underlain by variably weathered rock at variable depths.

Soil landscape and land use

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

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

Twenty-nine (29) soil landscapes occur within the Proposal Area. The location and extent of the soil landscapes within the Proposal Area are outlined in Table 4-20. The two best represented soil landscapes are Pinjarra P1b and P3 phases, which represent 22 % and 17 % of the Proposal Area respectively.

The Proposal Area is characterised by very low relief areas with poor drainage. Topography ranges from 5 – 25 m Australian Height Datum (AHD) with the more elevated areas associated with undulating dunes of Bassendean sands (20 – 25 m AHD) and the least elevated areas associated with drainage lines (5 – 10 m AHD).

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

Table 4-20 Soil landscape mapping units of the Proposal Area (GoWA, 2019a)

SYSTEM AND SUB-SYSTEM	SOIL LANDSCAPE MAPPING UNIT	DESCRIPTION	LOCATION WITHIN THE PROPOSAL AREA	EXTENT WITHIN THE PROPOSAL AREA (%)
Pinjarra System Pinjarra sub-system	213Pj_P1a	Flat to very gently undulating plain with deep acidic mottled yellow duplex (or effective duplex) soils. Shallow pale sand to sandy loam over clay; imperfect to poorly drained and generally not susceptible to salinity.	Southern and central extents (minor)	2.1
	213Pj_P1b	Flat to very gently undulating plain with deep acidic mottled yellow duplex (or effective duplex) soils. Moderately deep pale sand to loamy sand over clay: imperfectly drains and moderately susceptible to salinity in limited areas.	Northern extent and minor representation in the southern extent.	22.2
	213Pj_P1d	Flat to very gently undulating plain with deep acidic mottled yellow duplex (or effective duplex) soils. Shallow pale sand to sandy loam over clay; imperfect to poorly drained and moderately susceptible to salinity.	Central extent.	15.7
	213Pj_P2	Flat to very gently undulating plain with deep alkaline mottled yellow duplex soils which generally consist of shallow pale sand to sandy loam over clay.	Northern and southern extents (minor)	0.6
	213Pj_P3	Flat to very gently undulating plain with deep, imperfect to poorly drained acidic gradational yellow or grey-brown earths and mottled yellow duplex soils, with loam to clay loam surface horizons.	Central extent and minor representation in the southern extent.	17.6
	213Pj_P3a	Flat to gently undulating plain with deep, moderately to imperfectly drained gradational or duplex soils, with loam to clay loam surface horizons and subsoils going alkaline.	Southern extent (minor)	0.5
	213Pj_P5	Poorly drained flats, commonly with gilgai microrelief and with deep black-grey to olive-brown cracking clays with subsoils becoming alkaline.	Southern extent (minor)	3.8
	213Pj_P7a	Seasonally inundated swamps and depressions with very poorly drained variable acidic mottled yellow and gley duplex soils becoming alkaline with depth.	Central and southern extent (minor)	0.9

SYSTEM AND SUB-SYSTEM	SOIL LANDSCAPE MAPPING UNIT	DESCRIPTION	LOCATION WITHIN THE PROPOSAL AREA	EXTENT WITHIN THE PROPOSAL AREA (%)
	213Pj_P8	Broad poorly drained flats and poorly defined stream channels with moderately deep to deep sands over mottled clays; acidic or less commonly alkaline gley and yellow duplex soils to uniform bleached or pale brown sands over clay.	Southern extent (minor)	2.3
	213Pj_P9	Shallowly incised stream channels of minor creeks and rivers with deep acidic mottled yellow duplex soils.	Associated with tributaries of the Preston River.	0.9
	213Pj_B1	Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than 2 m; banksia dominant.	Southern extent (minor)	0.3
	213Pj_B1a	Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands with an intensely coloured yellow B horizon occurring within 1 m of the surface; marri and jarrah dominant.	Southern extent (minor)	0.1
	213Pj_B1b	Very low relief dunes of undulating sand plain with deep bleached grey sandy A2 horizons and pale yellow B horizons.	Southern extent (minor)	2.3
	213Pj_B2	Flat to very gently undulating sandplain with well to moderately well drained deep bleached grey sands with a pale yellow B horizon or a weak iron-organic hardpan 1-2 m.	Southern extent (minor)	0.9
	213Pj_B6	Sandplain and broad extremely low rises with imperfectly drained deep or very deep grey siliceous sands.	Southern extent (minor)	0.2
Pinjarra System	213PjSWP10	Gently undulating to flat terraces adjacent to major rivers, but below the general level of the plain, with deep well drained uniform brownish sands or loams subject to periodic flooding.	Associated with the Brunswick, Collie, Ferguson and Preston Rivers and tributaries.	2.9

SYSTEM AND SUB-SYSTEM	SOIL LANDSCAPE MAPPING UNIT	DESCRIPTION	LOCATION WITHIN THE PROPOSAL AREA	EXTENT WITHIN THE PROPOSAL AREA (%)
Pinjarra Swan sub-system	213PjSWP6a	Very gently undulating alluvial terraces and low rises contiguous with the plain, with deep moderately well to well drained soils associated with major current river systems and larger streams. Acidic red and yellow duplex soils, less common.	Associated with the tributaries of the Collie and Preston Rivers.	2.3
	213PjSWP6b	Very gently undulating alluvial terraces and low rises contiguous with the plain, with deep moderately well to well drained soils associated with prior stream deposits. Soils are uniform brownish sands.	Associated with the tributaries of the Ferguson and Preston Rivers.	1.4
	213PjSWP6c	Very gently undulating alluvial terraces and fans. Moderate to moderately well-drained uniform friable brown loams, or well-structured gradational brown earths.	Southern extent (minor)	0.2
Pinjarra System Pinjarra wet swamp sub-system	213PjW_SWAMP	Swamp.	Northern and central extent (minor)	0.2
Bassendean System Bassendean sub-system	212Bs_B1	Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than 2 m; banksia dominant.	Southern extent (minor)	0.8
	212Bs_B1a	Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands with an intensely coloured yellow B horizon occurring within 1 m of the surface; marri and jarrah dominant.	Northern extent and minor band in the southern extent.	8.7
	212Bs_B1b	Very low relief dunes of undulating sand plain with deep bleached grey sandy A2 horizons and pale yellow B horizons.	Southern extent (minor)	0.1
	212Bs_B2	Flat to very gently undulating sandplain with well to moderately well drained deep bleached grey sands with a pale yellow B horizon or a weak iron-organic hardpan 1-2 m.	Northern and southern extents (minor)	6.3

SYSTEM AND SUB-SYSTEM	SOIL LANDSCAPE MAPPING UNIT	DESCRIPTION	LOCATION WITHIN THE PROPOSAL AREA	EXTENT WITHIN THE PROPOSAL AREA (%)
	212Bs_B3a	Broad depression and narrow swales between sand ridges with poor to very poorly drained grey and brown sands, with an iron-organic (or siliceous) hardpan at generally less than one metre.	Northern extent (minor)	1.2
	212Bs_B4	Broad poorly drained sandplain with deep grey siliceous sands or bleached sands, underlain at depths generally greater than 1.5 m by clay or less frequently a strong iron-organic hardpan.	Southern extent (minor)	< 0.01
	212Bs_B5	Shallowly incised stream channels of minor creeks and rivers with deep grey siliceous sands or bleached sands, underlain at depths generally greater than 1.5 m by clay or less frequently a strong iron-organic hardpan.	Northern extent (minor)	0.2
	212Bs_B6	Sandplain and broad extremely low rises with imperfectly drained deep or very deep grey siliceous sands.	Northern extent	6.4
Bassendean System Bassendean Wet sub-system	212BsW_SWAMP	Swamp.	Southern extent (minor)	0.1

Acid sulfate soils

A review of the ASS risk mapping for the Proposal Area (GoWA, 2019a) found the alignment is predominantly within areas mapped as Class 2, which indicate *'Moderate to low risk of ASS occurring within 3 m of natural soil surface, but high to moderate risk of ASS beyond 3 m of natural soil* surface' (BORR IPT, 2019a). In remaining areas, soils associated with the Brunswick, Collie and Ferguson rivers and floodplains were mapped as Class 1 areas indicating a '*High to moderate risk of ASS occurring within 3 m of natural soil surface'.* The ASS risk mapping is shown in Figure 14 (Appendix A).

The classification of ASS includes both actual acid sulfate soils (AASS) and potential acid sulfate soils (PASS). AASS are soils that generate acidity in situ, whereas PASS are soils that have the potential to generate acidity if disturbed and/or oxidised. ASS are soils containing naturally-occurring, fine-grained metal sulfides typically pyrite (FeS2), formed under saturated, anoxic/reducing conditions.

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

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

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

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

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

The groundwater monitoring locations are shown in Figure 15 (Appendix A).

Contaminated sites

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

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

A high-level qualitative contaminated sites assessment was undertaken to further investigate this site in July 2018 (GHD, 2018). The contaminated sites assessment included a historical review of information, stakeholder consultation and a site walkover. Visual indications of contamination were recorded such as:

- Current land use
- Discolouration of soils
- Odours
- Vegetation condition
- Presence and condition of surface water bodies (pond structure on site)
- Surrounding land uses.

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

Soil quality

Soils throughout the majority of the Proposal Area (Pinjarra plain soils) have a high susceptibility to waterlogging and have mostly been sown to pasture for the grazing industries (Bolland, 1998). The extent of salinity in soils within the SCP is minor, due to mostly stable trends in groundwater levels. Salinisation is generally limited to poorly drained areas on the Pinjarra Plain and coastal swales (Simons, George, & Raper, 2013).

A review of the DPIRD NRInfo Database identified that soils are likely to be more saline in the central and southern extent of the Proposal Area (GoWA, 2018a). Soil salinity appears to correspond to Pinjarra plain soils (particularly complexes '213Pj_P1d' and '213Pj_P2') which are well represented in the Proposal Area. The salinity hazard for moderate to presently saline soils is 20-25 % and the salinity at the surface (moderate to extreme) is 35 – 50 % for these soil complexes. Salinity hazard and salinity at the surface for the remainder of the Proposal Area is mapped as negligible (0 %).

The soils of a lesser proportion of the Proposal Area (Bassendean sands) are leached and infertile sands. These sand contains little silt or clay, and very low levels of nutrient elements, with any nutrient content being associated with organic matter (Bolland, 1998).

4.5.4 Potential impacts

Direct Impacts

Proposal activities that have the potential to impact terrestrial environmental quality during construction include clearing of native vegetation, dewatering of sediments, storage and handling of environmentally hazardous materials, and earthworks. Earthworks will include excavations around bridge footings and fill to achieve the required road base level. Without suitable management measures, the following potential direct construction impacts may occur to terrestrial environmental quality as a consequence of developing the Proposal are:

- Excavation and exposure of ASS into the receiving environment causing contamination of land and/or waters
- Erosion of surrounding soils
- Accidental release of environmentally hazardous material from storage or handling areas, causing contamination of land.

Potential generation of ASS material through dewatering associated with construction or abstraction of groundwater for construction water supplies also have the potential for impacts if unmitigated. These are addressed in Section 4.6.4.

The operational activity associated with the Proposal is traffic movement associated with the completed road. The potential impacts associated with the construction and operational phases of the Proposal are discussed in the sections below.

The potential operational impacts that may occur to terrestrial environmental quality as a consequence of developing the Proposal are:

- Contamination of land and erosion from stormwater runoff
- Loss of soil function due to establishment of a permanent constructed surface.

Indirect Impacts

Without suitable management measures applied, the following potential indirect impacts may include:

- Erosion impacts potentially leading to poor soil structure, reduced water infiltration and general loss of soil health from vegetation clearing and soil excavation.

4.5.5 Assessment of impacts

Direct Impacts

Acid sulfate soils

The majority of the alignment has been designed in 'fill' (approximately 4.7 million cubic metres required) and as such the potnetial for disturbance of ASS material in these areas is low to negligible. A much smaller amount of 'cut' is required (approximately 120,000 cubic metres).

ASS can be disturbed either by excavation or lowering of the water table below natural seasonal levels (i.e. dewatering). Excavations occurring for the Proposal will be associated with construction of the bridge footings. It is likely that ASS will be encountered within excavations greater than 1.0 m depth, particularly within riparian zones where the bridge footings are located (BORR IPT, 2019a). Dewatering may also be required during construction of the bridge footings, which may expose PASS.

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

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

Hazardous material and waste disposal

Direct contamination of soils and land could occur as a result of releases of hazardous materials (such as hydrocarbons, chemicals and reagents) from storage or handling areas. Storage of hazardous materials during the construction period will be limited to temporary storage areas holding minor quantities of oils and grease for maintenance, and fuel supply for small construction equipment. Hazardous waste will be temporarily stored onsite prior to disposal to an appropriately licensed facility. All such materials will be stored within a sealed, covered and bunded area. Refuelling of larger equipment and generators will occur within the Proposal Area, but preference will be given to off-site refuelling for general vehicles, where practical, to limit storage and handling volumes within the Proposal Area. Due to the limited scale of

hazardous material storage, any accidental releases are expected to be small. Further, any potential contamination will be localised and restricted to the surface of the soil profile. The depth of localised contamination could increase beyond the soil surface if releases are not rectified in a timely manner.

The proposed hazardous chemicals and waste materials for the construction of the Proposal are likely to include:

- Diesel and petrol (in jerry cans and a fuel truck)
- Oil and grease
- Bitumen or other hydrocarbon containing produces for road surfacing (such as emulsion and prime)
- Concentrated dust suppression chemicals (such as Glu-on or Dustex)
- Miscellaneous chemicals in minor volumes for various uses over different stages of the Proposal construction (for example, paint used for noise walls and interchange abutments).

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

Contamination and erosion during operation

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

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

Loss of soil function

The Proposal includes a permanent bituminised road surface (19 km long, 34.2 m wide for the typical mainline), which will result in impairment of soil function below the road surface.

Soil function may be retained if topsoil is separated and stockpiled, then re-used for landscaping.

Indirect impacts

Salinisation and erosion of soils

Clearing of deep-rooted native vegetation has the potential to increase salinisation and erosion of soils, particularly in agricultural areas, which are prone to salinity and erosion. Native vegetation provides soil fertility through nutrients, regulating salt levels of the soil, and preventing erosion by stabilising the soil.

Accumulation of salts at or near the soil surface (‘dryland salinity’) causes reduced plant growth and water quality through a reduction in soil quality. Clearing of native deep-rooted vegetation is a major driver of salinity in the south-west of WA and this can affect the productivity of agricultural crops (GoWA, 2018b). Salinisation is a potential impact within the Proposal Area, particularly in the poorly drained areas on Pinjarra Plain soils. However, the risk of dryland salinity on the SCP as a result of clearing native vegetation is known to be low (Simons, George, & Raper, 2013).

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

4.5.6 Mitigation

The risks associated with potential impacts to Terrestrial Ecosystem Quality, specifically ASS and contaminated sites are considered relatively minor and manageable. Main Roads have extensive experience with the management of these risks in similar projects throughout the south west of WA. Impacts will be avoided and minimised through the following mitigation and management measures:

Avoid

- Hydrocarbon and chemical management through the implementation of a CEMP, which will include details on the handling and storage of hydrocarbons, chemicals and hazardous materials
- Avoidance of soil salinisation through minimising clearing of native vegetation (as far as reasonably practicable) and through revegetation
- Avoidance of contaminated stormwater discharge through drainage design (further described in Section 4.6.6).

Minimise

- Implement an ASS Management Plan (ASSMP) throughout construction of the Project
  - An overarching ASSMP has been included in the EMP (BORR IPT, 2019f). The ASSMP will be updated at the detailed design stage when cut and fill volumes are confirmed. Key management measures include:
  - Spoil management including treatment via chemical neutralisation (use of Agricultural Lime or similar)
  - Dewatering management strategies and requirements for disposal of dewatering effluent (see Section 4.6.6)
  - Groundwater monitoring and management (see Section 4.6.6)
- Minimise soil impacts through the implementation of a CEMP:
  - Drainage treatments to minimise and/or direct runoff from cleared areas in order to minimise downslope erosion and sedimentation
  - Stabilisation techniques applied if erosion or sedimentation is evident
  - Vehicle and machinery traffic will be confined to the disturbance area to prevent damage to retained vegetation/land
  - Minimise the loss of soil structure through re-use in landscaped areas via a Topsoil Management Plan (see Section 4.3.6)
  - Sediment reduction and control methods for the retention areas of dewatering effluent
  - Monitoring during construction
- Minimise the risk of exposing contamination through conducting an additional investigation of the former piggery site at Lot 521 Boyanup Picton Road
- Undertake a contamination risk assessment of the entire alignment (when available) and remediating any contamination as required

- If, during construction works within the Proposal Area, contamination is identified it is recommended that the site is reported to DWER under the Contaminated Sites Act 2003 and further investigation and management is undertaken as per DWER guidelines for Assessment and Management of Contaminated Sites (DER, 2014).

4.5.7 Predicted outcome

The potential risks to terrestrial ecosystem quality associated with the construction of the Proposal, specifically ASS, salinisation, contaminated sites and erosion will be effectively managed through implementation of the mitigiation measures detailed in the previous section and the EPA objective for this factor will be met.

The risk of ASS exposure during construction of the bridge footings associated with the Proposal can be managed under a detailed ASS Management Plan. The detailed ASS Management Plan will be site specific, and will be developed once the alignment and construction methods have been finalised. It is considered that this risk can be adequately managed and that there will be no residual impact to terrestrial environmental quality from ASS.

The risk of dryland salinity on the SCP as a result of clearing native vegetation for this proposal is considered to be low. The majority of the Proposal Area is historically cleared agricultural land, and clearing associated with the Proposal is linear in nature. The majority of vegetation to be cleared is associated with fence lines, wind breaks and riparian vegetation where there is contiguous vegetation that will be retained, minimising the risk of potential impacts to local hydrology and rising water tables. Given the scale, nature and location of the clearing required to implement the proposal, it is considered unlikely that salinisation will occur as a result of this proposal.

The construction of the Proposal will result in a loss of soil function for the bituminised area (road base). The remainder of the Proposal Area can be rehabilitated to restore the soil function.

It is considered that the potential for erosion and soil contamination during construction can be adequately managed under a CEMP. The potential for erosion and contamination from stormwater during the operational phase will be avoided with adequate drainage design.

4.6 Key Environmental Factor – Inland Waters

4.6.1 EPA objective

To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected (EPA, 2018c).

4.6.2 Policy and guidance

- Environmental Factor Guideline Inland Waters (EPA, 2018a)
- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC & ARMCANZ, 2000)
- Contaminated Sites Guidelines: *Assessment and Management of Contaminated Sites* (DER, 2014).

4.6.3 Receiving environment

Desktop searches of relevant DWER datasets were undertaken and are summarised in Table 4-21.

Table 4-21 DWER data queries within the Proposal Area (GoWA, 2019a)

ASPECT	DETAILS	RESULT
Public Drinking Water Source Areas (PDWSA)	PDWSA is a collective term used for the description of Water Reserves, Catchment Areas and Underground Pollution Control Areas declared (gazetted) under the provisions of the *Metropolitan Water Supply, Sewage and Drainage Act 1909* or the *Country Area Water Supply Act 1947*	None present. Bunbury Water Reserve is located approx. 2 km west of the Proposal Area.
Groundwater Areas	Groundwater areas proclaimed under the RIWI Act	The entire Proposal Area lies within the Bunbury Groundwater Area
Surface Water Areas	Surface water areas proclaimed under the RIWI Act	None present. The Brunswick River and Tributaries area is 200 m north-east of the Proposal Area at its closest point.
Irrigation Districts	Irrigation Districts proclaimed under the RIWI Act	The Collie River Irrigation District is intersected by the majority of the Proposal Area (between the Collie and Ferguson Rivers).
Rivers	Rivers proclaimed under the RIWI Act	Preston River and tributaries. Ferguson River and tributaries.
Waterways Conservation Act Management Areas	Areas proclaimed under the *Waterway Conservation Act 1976*	Approx. half of the Proposal Area is located within the Leschenault Inlet Management Area (in vicinity of the Preston River and Collie River).
Clearing Control Catchments	*Country Area Water Supply Act 1947* Part 2A	None present

In addition to the desktop searches, a number of technical studies were undertaken in order to describe the receiving environment for inland waters within the Proposal Area. These studies are provided in Table 4-22, and the technical reports are provided in relevant appendices.

Table 4-22 Baseline studies - Inland Waters

SURVEY NAME	DESCRIPTION	REFERENCE
BORR Northern and Central Sections – Drainage Strategy	The Drainage Strategy outlines consultation undertaken with the Drainage Reference Group and 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 IPT, 2018a)
Acid Sulfate Soil Factual Report – BORR Northern and Central Sections	This report presents factual data associated with the preliminary ASS investigation undertaken within the Proposal Area. A hydrogeological investigation was undertaken concurrently to inform groundwater level and design parameters.	(BORR IPT, 2019a)
BORR Northern and Central Sections: Targeted Conservation Significant Aquatic Fauna Survey	A technical study on targeted conservation significant aquatic fauna, which included in situ surface water quality readings.	(WRM, 2019)
BORR Northern and Central Sections – Wetland Study	A wetland assessment which was carried out in accordance with *A methodology for the evaluation of wetlands on the Swan Coastal Plain* (DBCA, 2017)	(BORR IPT, 2019e)
BORR Major Waterways Assessment	This report presents the waterways assessment carried out for the proposed bridge crossings of the Collie, Ferguson and Preston Rivers.	(BORR IPT, 2019g) – final report pending
BORR Transverse Drainage – Northern and Central Sections	This report presents the waterways assessment carried out for transverse drainage crossings.	(BORR IPT, 2019h) – final report pending

4.6.3.1 Groundwater

Groundwater hydrology and hydrogeology

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

- **Superficial aquifer:** the superficial layer is thin (5 – 40 m below ground level [bgl]) to absent and predominantly unconfined. The superficial formations consist of Bassendean sands, Guildford formation and Alluvium (west near Bunbury) and overlies the Leederville aquifer. This aquifer is recharged by direct infiltration of rainfall. Wetlands are often hydraulically connected to the superficial aquifer
- **Leederville aquifer:** the formation is confined and made up of interbedded sand and shale, with depth ranging from 15 – 300 m bgl. The aquifer is recharged by downward leakage from the overlying Superficial Aquifer and direct infiltration in areas where the aquifer outcrops
- **Yarragadee aquifer**: consists of weakly consolidated sandstone, siltstone and shale. The Yarragadee aquifer underlies the Leederville aquifer and is confined in the Proposal Area. The thickness of the aquifer ranges from 600 m to 1200 m. It is recharged by direct infiltration of rainfall on the Blackwood

Plateau to the south, and through limited leakage from the overlying Leederville aquifer. The Bunbury Water Reserve draws its drinking supply from this aquifer (Department of Water, 2009) (Department of Water, 2008).

The Cattamarra Coal Measures is a fourth aquifer unit that has a minor occurrence in the north of the Proposal Area underlying the Leederville aquifer in the Kemerton South groundwater subarea.

Groundwater contours available from the Perth Groundwater Atlas (DWER, 2018b) indicate that the superficial aquifer generally flows west towards the Indian Ocean, with localised flow towards the river systems. The depth of the groundwater varies throughout the Proposal Area, and is summarised in Table 4-23.

Table 4-23 Summary groundwater information (DWER, 2018b)

PGA DATASET	ELEVATION RANGE (m AHD)	COMMENTS
May 2003	1.0 – 15.0	Coincides towards the end of the dry season, and typically assumed to represent seasonal groundwater lows.
Historical Maximum	1.0 – 17.0	Typically assumed to relate to the highest estimated groundwater level.

Twenty-one (21) groundwater wells were installed throughout the Proposal Area in September/October 2018 (Figure 15, Appendix A). Groundwater levels ranged from 5.48 – 17.1 m AHD (7.2 – 0.6 m bgl), and confirmed that the regional groundwater flow is in a westerly direction towards the Indian Ocean. A summary of groundwater levels is provided in the ASS Factual Report (BORR IPT, 2019a).

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

Groundwater quality

For the purposes of providing interpretation of current ecological state of the groundwater within the Proposal Area, the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* for South West Australia Lowland Rivers have been adopted as assessment criteria for this report due to unavailability of guidelines for groundwater for this purpose (ANZECC & ARMCANZ, 2000).

BORR IPT notes the Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) (2000), now ANZG (2018), which came into effect on 4 September 2018. However, preliminary review of these guidelines by BORR IPT (and others) has identified a number of discrepancies with ANZECC (2000) which have yet to be clarified. As such, ANZECC and ARMCANZ (2000) criteria have been adopted by BORR IPT until the issues (ANZG, 2018) have been resolved.

The groundwater quality within the Proposal Area is variable, ranging from 500 – 3000 mg/L Total Dissolved Solids (TDS). Salinity levels in the northern section of the Proposal Area range from 500 – 1000 mg/L TDS, increasing towards the coastline (west) and indicating a fresh to marginal environment. The southern section of the Proposal Area is located in an area of 1000 – 3000 mg/L TDS, indicating a marginal to brackish environment (GoWA, 2019a). Concentrations of TDS may reach as high as 7000 mg/L in some areas of the Pinjarra Plain, where heavy clay areas and a shallow water table is present (Commander, 1984).

Groundwater quality was measured at each of the 21 groundwater wells installed within the Proposal Area. The quality of the groundwater was found to be:

- Acidic to mildly acidic (pH 4.70 – 6.78)
- Varying from fresh to saline (EC 182.7 – 11,146 µS/cm)
- Varying between reducing and oxidising conditions (-223.6 – 256.5 mV)
- Elevated in nutrients (ammonia as N, total nitrogen and reactive phosphorus)
- Elevated in metals, including aluminium, copper, zinc and iron at the majority of wells.

When compared against the adopted assessment criteria (ANZECC & ARMCANZ, 2000), the following exceedances were noted:

- Field pH was below the fresh water criteria minimum (7.0 – 8.5) for all wells
- Sodium and chloride concentrations exceeded the short term irrigation criteria (460 mg/L and 700 mg/L respectively) at three wells (MW19, MW22 and MW25)
- Nutrients were elevated at all wells, and exceeded the freshwater criteria for TN and TP and six and four of the 21 wells, respectively
- Dissolved aluminium, copper and zinc exceeded the freshwater criteria at the majority of groundwater wells
- Total iron concentrations ranged between <0.05 mg/L and 118 mg/L and exceeded the shore term irrigation criteria at 11 out of 21 groundwater wells
- Exceedances of ASS criteria as discussed in Section 4.5.3.

There were no reportable concentrations of TRH or BTEXN within the groundwater at any location. Groundwater quality laboratory results can be found in the ASS Factual Report (BORR IPT, 2019a).

Groundwater Dependent Ecosystems

The majority of wetlands and associated vegetation within the Proposal Area were identified as having a moderate to high potential to be groundwater dependent ecosystems (GDE) in the Bureau of Meteorology (BoM) Groundwater Dependent Ecosystems Atlas. However, not all GDEs are solely reliant on groundwater. The Proposal Area is also mapped as likely to be an Inflow Dependence Ecosystem (IDE), reliant on water in addition to rainfall (BoM, 2018).

The Bunbury area has experienced a declining trend in annual rainfall levels since records began in 1877 with a more pronounced downward trend in the last 30 years as shown in Plate 2 (BoM, 2019). Declining rainfall has resulted in reduced recharge to groundwater and surface water runoff to overland waterways, particularly in the last 30 years.

Reduced rainfall and groundwater recharge places additional pressure on GDE, which are also often under additional pressure as a result of clearing, fragmentation, weed invasion and dieback disease.

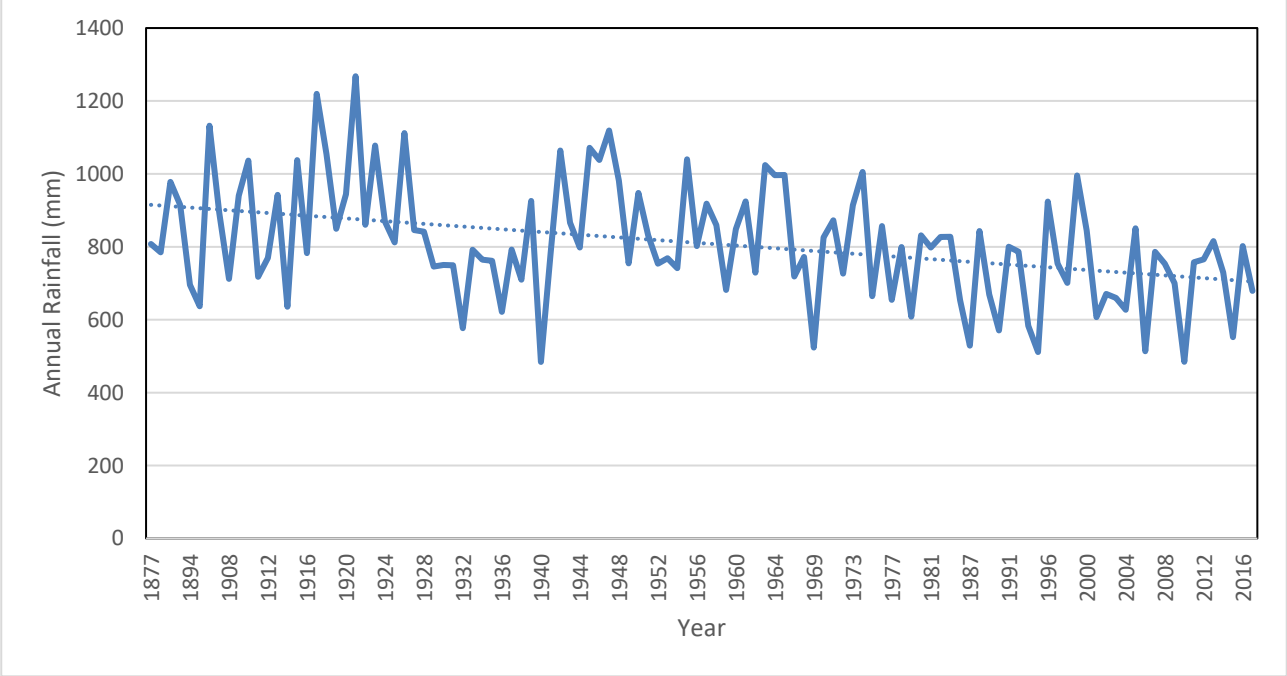


Plate 2 Bunbury annual rainfall recorded at BoM stations 9514 (1877 to 1985), 9885 (1985 to 1995) and 9965 (1995 to current)

4.6.3.2 Surface Water and Drainage

Surface Water Hydrology

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

The Proposal Area is intercepted by four rivers as well as numerous tributaries and minor drainage lines (Figure 12, Appendix A), including:

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

These four rivers all have amenity, recreation and cultural value (as discussed in Section 4.8.3). The Preston and Ferguson Rivers and tributaries are also proclaimed under the RIWI Act and, the part of the Proposal Area lies within the Leschenault Inlet Management Area proclaimed under the *Waterways Conservation Act 1976*.

There are several wetlands within the Proposal Area, including large areas that are seasonally waterlogged. These are discussed further in Section 4.6.3.3.

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

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

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

A Drainage Strategy has been developed, for the Proposal Area, in consultation with the Drainage Reference Group (DRG) (BORR IPT, 2018a). The DRG is comprised of relevant stakeholders and was formed to investigate the opportunities, issues and options related to drainage and water management across the Proposal Area (Section 3).

The objectives of the Drainage Strategy include:

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

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

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

Surface Water Quality

The receiving environments for surface water quality include four major rivers and numerous wetlands, drainage and irrigation channels. The Proposal Area occurs within the lower margin of the four rivers. The Proposal intersects the Collie River at a point where it is still considered estuarine, whereas the crossing points of the Brunswick, Preston and Ferguson Rivers are at points where the water is generally fresh (Department of Water, 2012). The mix of fresh and saline water provide habitat for a range of aquatic species including dolphins, mulloway, blue swimmer crab and black bream (Leschenault Catchment Council, 2018).

The four rivers within the Proposal Area are known to be nutrient rich as a result of catchment landuse including agricultural uses such as cattle for beef or dairy production. The DoW routinely monitored nutrient levels within the four rivers between 2004 and 2012 (Department of Water, 2012). The monitoring undertaken by DoW identified:

- Nutrient and phosphorus loads were highest in the Ferguson River, where cattle accounted for 78 % and 72 % of total nitrogen (TN) and total phosphorus (TP) respectively

- Nutrient and phosphorus loads were lowest in the Preston River, where cattle accounted for 53 % of TN and 66 % of TP
- The Ferguson River also had significant nutrients attributed to horses and lifestyle blocks (18 % of TN and 23 % of TP).

Nutrients in water closer to the Leschenault Estuary were dominated by urban, septic and wastewater treatment plant sources (82 % of TN, 80 % of TP). Nutrient levels are generally above what is considered acceptable under the ANZECC (2000) national water quality standards (Department of Water, 2012).

In situ surface water quality measurements and samples were collected by BORR IPT at the three rivers sites (Collie River, Preston River and a tributary of the Preston River) and two surface water bodies (a man-made lake and a flooded area near the northern-tie in) during 18 – 19 September 2018 (BORR IPT, 2019e). In situ water quality measurements were recorded by WRM at 12 locations (five creek/ river sites and seven wetlands), during 20 – 29 November 2018 (WRM, 2019). The sample locations have been illustrated in Figure 12 (Appendix A).

The key findings of the in situ surface water quality monitoring undertaken in September and November 2018 by BORR ITP and WRM indicate the following:

- Temperature ranged from 12.8 to 27.0 ^{o}C
- pH ranged from 6.0 to 8.7 – the pH at the majority of the sites was within the ANZEEC/ ARMCANZ (2000) guideline values for the protection of slightly/ moderately disturbed wetland ecosystems in WA (pH 6.0 – 8.0). With the exception of pH from Northern 3 (pH 6.0) which was slightly lower than, and SW03, SW04, SW01 and North Creek 4 which exceeded, the adopted assessment criteria range
- EC ranged from 183 µS/cm (SW01) to 3360 µS/cm (Northern 9)
- The Collie River and the tributary of the Preston River were recorded as brackish (EC 1780 and 1300 µS/cm respectively) and also reported higher concentrations of sodium (236 mg/L, 183 mg/L) and chloride (582 mg/L, 401 mg/L) than the other surface water locations
- The main artery of the Preston River (SW04) and the two surface water bodies (SW01 and SW02) were recorded as fresh water (EC 183µS/cm to 579 µS/cm)
- DO (% S) ranged from 6 % to 264 % with seven of the 12 WRM sample locations recording results outside the ANZEEC/ ARMCANZ (2000) guideline of 80-120 %. The DO recorded at Northern 7 was highly anoxic
- Redox ranged from 67 mV to 180.5 mV
- Turbidity ranged from 3.3 NTU to 79.2 NTU
- Surface water quality within the rivers supported historical information from DoW in that nutrient levels were elevated, particularly Total Nitrogen and Total Phosphorus which exceeded the adopted assessment criteria at JT03, SW01 and SW02
- Total Oxidised Nitrogen exceed the adopted assessment criteria at the Collie River and Preston River locations (SW03, SW04 and SW05)
- Concentrations of benzene, toluene, xylene and naphthalene (BTEXN), Total Recoverable Hydrocarbons (TRH) and Polyaromatic Hydrocarbons (PAHs) were negligible at all locations, with the exception of trace levels of toluene in the flooded area near the northern tie-in
- Concentrations of metals were also elevated and exceeded the ANZEEC/ ARMCANZ (2000) water quality guidelines at all BORR IPT locations for aluminium (0.1 – 0.8 mg/L)

- The flooded area near the northern tie-in (SW02) also exceeded the water quality guidelines for zinc (0.016 mg/L)
- There is high to moderate risk of ASS occurrence associated with the rivers, as discussed in Section 4.5.3.

The adopted guidelines are presented with the summarised field and laboratory results for September 2018 water quality results, Chain of Custody documentation and Laboratory Certificate of Analysis in the Wetland Study (BORR IPT, 2019e).

Water quality results recorded by WRM (2019) and BORR IPT (2019e) in November 2018 are included in the report presented in (BORR IPT, 2019e).

Flood Modelling

Waterway assessments were conducted for major waterways within the Proposal Area (BORR IPT, 2019g). Flood modelling was undertaken on each waterway to inform bridge and crossing designs, including the crossing of the Collie, Preston and Ferguson Rivers.

Annual Exceedance Probability (AEP) terminology has been adopted for consistency with the recommended probability terminology in Australian Rainfall and Runoff (ARR) (Ball, et al., 2016). AEP is the probability or likelihood of an event occurring or being exceeded within any given year, usually expressed as a percentage.

The use of Average Recurrence Interval (ARI) is no longer recommended by ARR (2016). Table 4-24 shows the relationship between AEP and ARI.

Table 4-24 Flood modelling probability terminology

TERMINOLOGY	PROBABILITY				
Annual Exceedance Probability (AEP)	5 %		2 %	1 %	0.05 %
Average Recurrence Interval (ARI)	20 year		50 year	100 year	2000 year

The event frequency of AEP range 10 % to 1 % is described as “Rare” and >1 % to 0.05 % is “Very Rare” (Ball, et al., 2016).

The results for hydraulic modelling undertaken (BORR IPT, 2019g) for proposed bridge sites for the Proposal are summarised in Table 4-25.

Table 4-25 Hydraulic modelling for proposed bridge sites at Collie, Ferguson and Preston Rivers

BRIDGE SITE	1 % ANNUAL EXCEEDANCE PROBABILITY (AEP) EVENT	CLIMATE CHANGE
Collie River	The minimum soffit level of the bridge is 8.0 m AHD which provides 2.5 m freeboard to the 1 % AEP water level. 1 % AEP velocities through the bridge are relatively low and would not require rock protection in accordance with Austroads standards. It is expected, however, that 'Facing' class rock protection would be adopted for consistency with other bridges in the region. The hydraulic model shows a 60 mm increase in upstream water level for the 1 % AEP event due to the proposed bridge and road embankment. Backwater is considered acceptable given existing properties along the floodplain are located several metres above the 1 % AEP flood level and the extent of flooding is essentially unchanged. Velocities within the main channel are generally maintained.	It was not possible to quantify the impact to flood behaviour for the Lower Collie River, given that flows are governed by the Wellington Dam overflow (model not available). Further investigation will be carried out in future design stages of the Collie River bridge. A 0.9 m increase in tide level to account for potential sea level rise has been adopted for consistency with the Lower Collie River Flood Study (Department of Water, 2014). This does not influence flood behaviour at the bridge site.
Ferguson River	Significant breakout flows are shown to occur upstream of Ferguson River railway bridge and are conveyed towards Martin Pelusey Road via Vice Regal main drain or shallow overland flow. Flows are shown to overtop Martin Pelusey Road causing flooding to upstream areas. Downstream of Martin Pelusey Road (at the Proposal Area) flows converge with the Ferguson River main channel where the floodplain is more defined.	For the Ferguson River catchment, the ARR 2016 data hub recommends adopting an 8 % and 17 % increase in rainfall intensities for the year 2090 using the RCP 4.5 and RCP 8.5 climate models respectively. Increasing the 1 % AEP rainfall depth in the RORB by 17 % resulted in a 20 % increase in peak flow. Hydraulic modelling for the climate change scenario has not been carried out to date. Climate change is not expected to impact the design given the road and bridges are several metres above 1 % AEP flood levels to maintain vertical clearance to the railway.

BRIDGE SITE	1 % ANNUAL EXCEEDANCE PROBABILITY (AEP) EVENT	CLIMATE CHANGE
Preston River	The current bridge soffit level is approximately 15.3 mAHD which provides 0.5 m freeboard to the 1 % AEP flood level. There are two existing residential dwellings directly upstream of the bridge crossing. Habitable floor levels for these dwellings have been estimated as 15.2 mAHD which is equal to the 1 % AEP flood level at these buildings. Preliminary post-development modelling has been carried out for the bridge crossing which shows the potential for localised backwater in the vicinity of these dwellings.	For the Preston River catchment, the ARR 2016 data hub recommends adopting an 8 % and 17 % increase in rainfall intensities for the year 2090 using the RCP 4.5 and RCP 8.5 climate models respectively. Increasing the 1 % AEP rainfall depth in the RORB by 17 % resulted in a 22 % increase in peak flow. This translated to an increase in peak water levels of 0.2 m in the TUFLOW hydraulic model.

A waterways assessment of the transverse drainage crossings associated with the Proposal was also undertaken. Transverse drainage crossings within the Proposal are listed in Table 4-26. The assessment determined that existing flow regimes and irrigation networks must be maintained as close as practicable to the existing flows, to prevent adverse impacts to existing paddocks and dwellings.

Major transverse drainage crossings (Water Corporation main drains) will be designed to achieve a 1 % AEP flood immunity for the highway. The estimated 1 % AEP peak flows are summarised in Table 4-26. Flood mapping for the 1 % AEP event under the pre-development scenario is illustrated in Figure 16 to Figure 18 (Appendix A).

Table 4-26 1 % AEP design flows at significant crossings (BORR IPT, 2019h)

CROSSING LOCATION	1 % ANNUAL EXCEEDANCE PROBABILITY (AEP) DESIGN FLOW (m^3/s)
Treendale Main Drain	3.4
Treendale Branch Drains A and B	5.3
Raymond Road Diversion Channel	1.9
Victory Main Drain – Railway Road	19.3
Victory Main Drain – Waterloo Road	43.5
Vindictive Branch Drain C	2.5
Vindictive Main Drain	2.5
Gavins Gully Main Drain	25.5

4.6.3.3 Wetlands

International and Nationally Important Wetlands

A search of the EPBC Protected Matters database (DoEE, 2018a) did not identify any Ramsar listed or Nationally Important wetlands within the Proposal Area. The closest Ramsar wetland is the Peel-Yalgorup

System, located approximately 16.8 km north of the Proposal Area (GoWA, 2019a). The closest Nationally Important Wetland is located 10.7 km north-east of the Proposal Area.

Geomorphic Wetlands

Approximately 89 % of the Proposal Area is mapped as geomorphic wetlands, totalling 578.2 ha, and comprising 35 geomorphic wetlands that intersect the Survey Area. These include the following:

- Six Conservation Category – totalling 2.93 ha and 0.5 % of the Survey Area
- Two Resource Enhancement – Totalling 0.77 ha and 0.1 % of the Survey Area
- 25 Multiple Use – Totalling 573.78 ha and 88.2 % of the Survey Area
- One Artificial Lake (management category not assessed) – Totalling 0.69 ha and 0.1 % of the Survey Area.

There are also eight waterbodies that intersect the Proposal Area. Two of the waterbodies (closest to the Brunswick River) are associated with Conservation wetlands, with the remaining six waterbodies being areas of waterlogging in agricultural land.

Relevant information for each geomorphic wetland is provided in the Wetlands Assessment (BORR IPT, 2019e). The locations of the Geomorphic Wetlands are shown in Figure 12 (Appendix A).

Consanguineous Wetlands

Three consanguineous wetland suites intercept the Proposal Area. These include the following:

- Swan River (67.4 ha, 10 % of the Proposal Area)
- Keysbrook (390.8 ha, 60 % of the Proposal Area)
- Bennett Brook (192.6 ha and 30 % of the Proposal Area).

Within the Swan River suite, 0.5 ha of wetlands within the Proposal Area are Conservation Category Wetlands (CCW), representing 0.03 % of CCW for the suite across its entire range (total area of CCW for suite of 1,602 ha). For the Keysbrook suite, CCW within the Proposal Area covered 0.7 ha, representing 0.04 % of CCW within the suite (total area of CCW for the suite of 1,620 ha). And for the Bennett Brook suite 1.7 ha of CCW occurred within the Proposal Area, representing 0.06 % of CCW within the suite across its entire range (total area of CCW for the suite of 2,715 ha) (DBCA 2017).

Relevant information for each consanguineous wetland suite within the Proposal Area and Conservation Category Geomorphic Wetlands intersecting each suite can be found in the Wetland Study (BORR IPT, 2019e).

4.6.4 Potential impacts

Direct Impacts

The potential direct impacts on inland waters during construction of the Proposal include:

- Abstraction of groundwater for construction activities (dust suppression, dewatering bridge footings)
- Changes to groundwater levels in the superficial aquifer associated with vegetation clearing
- Changes to hydrological regimes of Geomorphic Wetlands and waterways – specifically resulting in loss of connectivity and fragmentation of Black-stripe Minnow and other aquatic fauna habitat
- Erosion and sedimentation in surrounding areas, as a result of vegetation clearing, bridge construction, earthworks and alteration of surface water drainage

- Impact on river bed and banks due to construction of bridge structures, such as pylons within, and on the banks of the rivers
- Increase in upstream water levels (backwater) at proposed bridge sites and in the vicinity of the road alignment due to constriction or diversion of the existing flowpaths
- Contamination of surface and/or groundwater as a result of:
  - Contaminated stormwater run-off from storage and handling of environmentally hazardous materials
  - Accidental release of hazardous substances
  - Exposure to PASS and contaminants during excavation.

The potential indirect impacts on inland waters during construction and operation of the Proposal include changes to vegetation structure in surrounding GDEs (geomorphic wetlands), as a result of changes to hydrological regimes.

The operational activity associated with the Proposal is traffic movement associated with the completed road and bridges. The potential impacts associated with the construction and operational phases of the Proposal are discussed in the sections below.

4.6.5 Assessment of impacts

Direct Impacts

Dewatering for construction activities

Based on the information from the groundwater level assessment (BORR IPT, 2019a), temporary, localised groundwater dewatering may be required at the proposed bridge sites for construction of bridge footings.

Once detailed design has been completed, a more detailed investigation will be carried out to determine final construction methods and drawdown requirements for dewatering, and outlined in a Dewatering Management Plan in the CEMP.

The location of abstraction bores will be determined at the detailed design stage prior to construction. A dewatering licence application will be submitted to DWER if dewatering is required for construction activities, including construction water and bridge construction. This impact will be localised and temporary and is not considered likely to be significant.

Changes to groundwater levels in the shallow aquifer associated with clearing

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

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 surrounding drainage infrastructure, vegetation, wetlands and waterways.

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 greatest potential to cause erosion or collapse of the riverbanks, resulting in an increase in turbidity and consequent decrease water quality within the watercourses. Erosion of the riverbanks also has the potential for downstream effects such as sedimentation and discharge of turbid water into the Leschenault Estuary. These potential impacts

will be effectively managed through the mitigation measures detailed in section 4.6.6 and are considered unlikely to be significant.

Contamination of surface water and groundwater

Contamination of surface water and groundwater 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. Environmentally hazardous material releases during construction are discussed in Section 4.5.5 and management of dust in Section 4.7.5.

Surface and/or groundwater may also become contaminated through the exposure of ASS during construction (excavation). ASS disturbance may have a range of impacts including enhanced phosphorus leaching, death of vegetation irrigated with affected water, the smothering of benthic aquatic animals by the precipitation of iron, and metal bioaccumulation in aquatic plants and animals. Managing the potential for ASS exposure is discussed in Section 4.5.5.

Contaminated surface water and groundwater has the potential to impact sensitive receptors including neighbouring properties, vegetation, fauna, wetlands and waterways. Impacts can also manifest downstream as loss of benthic habitat, fish deaths and damage to vegetation health. Downstream sensitive receptors include the Leschenault Estuary and Conservation management category Geomorphic Wetlands.

These potential contamination impacts will be effectively managed through the mitigation measures detailed in section 4.6.6 and are considered unlikely to be significant.

Alteration in surface water hydrology due to bridge construction

The Major Waterways Assessment (BORR IPT, 2019g) identified the following potential impacts with regards to proposed bridge sites at Preston and Ferguson Rivers:

- There are two existing residential dwellings directly upstream of the Preston River bridge crossing. Habitable floor levels for these dwellings have been estimated as 15.2 mAHD which is equal to the 1 % AEP flood level at these buildings. Preliminary post-development modelling has been carried out for the bridge crossing which shows the potential for localised backwater in the vicinity of these dwellings
- The proposed Ferguson River road embankment and bridge crossings are located in close proximity to existing infrastructure including Martin Pelusey Road, Boyanup Picton Road, and the railway. Additionally, there are several existing residential and industrial buildings to the south of Martin Pelusey Road which are shown to be flooded under the pre-development scenario. The approximate depth of flooding at these buildings for the 18 %, 5 %, and 1 % AEP events is 0.2, 0.8, and 1.2 m respectively. The Proposal has the potential to increase flood levels in the vicinity of the works due to:
  - Loss of floodplain storage due to filling associated with the road embankment east of Martin Pelusey Road where ponding is shown to occur
  - Constriction of the floodplain at the river crossing caused by the bridge abutments and piers.

The bridges have been designed to minimise backwater and flooding as follows:

- Collie River bridge site:
  - The bridge has been sized to minimize backwater due to constriction of the floodplain associated with piers and embankments. All piers have been located outside of the main channel to ensure there are no adverse impacts to frequent flood events and river bank vegetation. Consultation with traditional owners is ongoing to ensure heritage requirements are met

- Ferguson River bridge site:
  - The bridge has been sized and located to minimize backwater due to constriction of the floodplain associated with piers and embankments. All piers have been located outside of the main channel to ensure there are no adverse impacts to frequent flood events and river bank vegetation. Consultation with traditional landowners is ongoing to ensure heritage requirements are met
  - Relief culverts have been included in the road embankment east of Martin Pelusey Road to provide connectivity between the areas north and south of the road embankment
- Preston River bridge site:
  - Measures to mitigate backwater caused by constriction of the floodplain are currently being investigated
  - Potential measures include:
    - Relief culverts to the south of the main channel
    - Compensatory cut and a breakout channel to the east of the main Preston River channel to divert flows away from the existing dwellings. This land is owned by Main Roads WA and is currently identified as a potential source of fill material for the project. Earthworks may be required within the drainage reserve to provide connectivity to the main Preston River channel.

Alteration of hydrological flow to Geomorphic Wetlands and minor waterways

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

The road will be predominantly above ground level (fill), linear (34.2 m for the typical mainline), and surrounded by expanses of unsealed ground. The bituminised road will prevent infiltration from occurring, however, due to the localised management of stormwater where it will be collected, it is not considered that the Proposal will significantly restrict rainfall recharge to the superficial aquifer such as to significantly lower groundwater levels and/or change the volume of water available to surrounding wetlands.

Pre-development surface water flows will be maintained and mitigation measures refined at the detailed design stage of the Proposal as per the Drainage Strategy (BORR IPT, 2018a). DWER provided in principle support for the Drainage Strategy (pers comms Krish Seewraj, Planning Advice Program Manager South West Region, DWER, 4 February 2019).

Climate change

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

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

The infrastructure associated with the Proposal is generally above 10 m AHD, with the exception of the Collie River crossing, which falls to approximately 6.5 m AHD. The level of the proposed infrastructure is sufficiently high that it is considered a sea level rise of 300 mm will not impact the Proposal infrastructure (road and associated drainage).

Of the four proposed structures over major waterways, only the bridge over the Collie River is close enough to the coast to have an element of tidal influence. The Collie River hydraulic model incorporates a sea level rise of 0.9 m (as recommended by the WAPC), however, the investigation showed that sea level rise does not propagate up to the Collie River bridge location and therefore does not impact the Proposal.

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

A Natural Hazards and Climate Change Risk Assessment has been undertaken and will be reviewed throughout the planning and design processes of this Proposal in accordance with AS 5334-2013. This assessment identified risks to the functioning of the asset as a result of natural hazards, and how those hazards may change over time due to climate change.

In addition, risks to others stakeholders were reviewed, namely to determine if the placement of this Proposal would exacerbate existing risks to these stakeholders. Risks identified included those already summarised earlier in the section, as well as those in relation to a drying climate. The only 'high' rated risk was in relation to the change in access routes during an emergency, for both those wishing to evacuate and those requiring access to combat the hazard (such as fire).As a result of this, discussions with the LGAs and DFES are occurring to mitigate this risk to an acceptable level. Such efforts include reviewing access routes for fire fighting vehicles and access to water points. This process will continue throughout the planning and design phase to review risks, and continue to include adaptation measures for the risks identified.

4.6.6 Mitigation

Potential impacts on inland waters will be minimised during the detailed design phase and implementation of an EMP and CEMP:

- Transverse drainage design will be provided at the detailed design stage to achieve the objective of maintaining the existing water cycle balance of the Proposal Area (i.e. minimising drainage shadow effects on surrounding wetlands, waterways, vegetation and agricultural properties) and prevention of adverse impacts to the existing built environment
- In particular, detailed drainage design will maintain fish passage (Black-stripe Minnow) under the constructed road (culverts or other) for part UFI 15450 (Multiple Use Geomorphic Wetland) which is considered likely to provide connection between the Conservation management category Geomorphic Wetland (UFI 1101) to the north and the Resource Enhancement Geomorphic Wetland (UFI 1112) to the south of the Proposal Area
- The risk of erosion, sedimentation and spills of hazardous chemicals during operation of the Proposal will be managed through drainage design, as outlined in the Drainage Strategy (BORR IPT, 2018a) and Major Waterways Assessment (BORR IPT, 2019g):
  - Erosion control will be applied at drainage discharge points
  - Detention/infiltration basins where there is potential for discharge of hazardous spills into the major waterways

- The risk of erosion and sedimentation during construction will be managed under a CEMP, and will include (but is not limited to) the following site-specific erosion and sediment controls:
  - Ensure there is no direct run-off to the adjacent watercourses and wetlands
  - Install temporary erosion and sediment control measures and during bridge construction
  - Design watercourse crossings to include erosion control and scour protection measures
  - Prepare the Rehabilitation and Landscape Plan so that roadsides and medians will be vegetated and capable of acting as a biological filter for run-off (see Section 4.3.6)
- The risk of contamination from poor hydrocarbon and chemical management during construction will be managed under a CEMP which includes management measures outlined in Section 4.5.6, as well as the following management measures:
  - Ensure there is a Spill Response Procedure for hazardous material spill events to ensure any spill is contained effectively and cleaned up appropriately
  - Hydrocarbon storage and re-fuelling will not be permitted within 200 m and 50 m, respectively, of a natural watercourse or Conservation / Resource Enhancement wetland
  - Storage of hydrocarbons on site will be within suitably designed containers within a bunded area
- Implement an ASS Management Plan throughout construction of the Proposal. An overarching ASS Management Plan has been prepared, which will be updated when more information about the alignment is available. Compliance with the ASS Management Plan is required in the event of dewatering. Compliance will ensure correct dewatering methods, effluent management, effluent treatment, effluent disposal and monitoring requirements
- Minimise the risk of exposing existing contamination as described in Section 4.5.6
- Monitoring of groundwater and surface water will be required and managed under a CEMP, as detailed in the EMP (BORR IPT, 2019f) and summarised below:
  - Baseline water monitoring event prior to commencing construction, which will be used to ascertain water quality performance criteria
  - Evidence of erosion on embankments to be monitored opportunistically and weekly during construction
  - Run-off from construction areas into wetlands and watercourses to be monitored opportunistically and weekly during construction
  - Daily surface water monitoring during construction over rivers
  - If dewatering is required:
    - Fortnightly groundwater and surface water monitoring by an Environmental Scientist
    - Daily monitoring and reporting of dewater effluent, undertaken by the Contractor, with reference to specific trigger criteria (as outlined in the EMP)
    - Twice per week groundwater monitoring undertaken by the Contractor
  - Monitoring as per individual ground and/or surface water abstraction and dewatering licence conditions (if required)
  - Post-construction monitoring of surface and groundwater required.

4.6.7 Predicted outcomes

The existing hydrological processes are in a largely modified state due to historical clearing and draining of land within the Proposal Area for agricultural purposes.

Surface water and drainage impacts will be mitigated through the design process to allow predevelopment flows to be maintained.

Temporary impacts on groundwater and surface water during construction will be managed via implementation of a Proposal specific CEMP.

Operation of the Proposal, once built, is considered unlikely to significantly impact on surface water and groundwater quality.

Based on the mitigation measures proposed, no significant residual impacts on inland waters are expected and it is considered the Proposal meets the EPA objective to maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.

4.7 Key Environmental Factor – Air Quality

4.7.1 EPA objective

To maintain air quality and minimise emissions so that environmental values are protected (EPA, 2018c).

4.7.2 Policy and guidance

- Environmental Factor Guideline Air Quality (EPA, 2016f)
- Guidance for the Assessment of Environmental Factors – Separation Distances between Industrial and Sensitive Land Uses No. 3 (EPA, 2005)
- National Environment Protection (Ambient Air Quality) Measure (AIR NEPM) (National Environment Protection Council (NEPC), 2016).

4.7.3 Receiving environment

4.7.3.1 Meteorology

The Proposal Area is subject to a Mediterranean climate, with hot dry summers and mild wet winters, with the majority of the rain falling in winter. The closest BoM weather station to the Proposal Area is the Bunbury Automatic Weather Station (AWS) (Station ID 9965). This station records temperature, rainfall, relative humidity, wind speed and direction and has data available dating back to 1995. Plate 3 to Plate 5 illustrate recorded average monthly meteorological data for the Bunbury AWS BoM station for years 1995 to 2018 (BoM, 2019).

Temperatures range from a mean maximum of 30 °C in summer and drop to a mean maximum of 17 °C in winter. Mean minimum temperatures follow a similar trend, reaching 16 °C in summer and 7 °C in winter. Rainfall is low throughout the summer months and peaks in July, with a monthly average of 140 mm. Relative humidity at Bunbury reflects the Mediterranean climate, demonstrating drier summers and a comparatively high relative humidity of 85 % in the morning in winter (BoM, 2019).

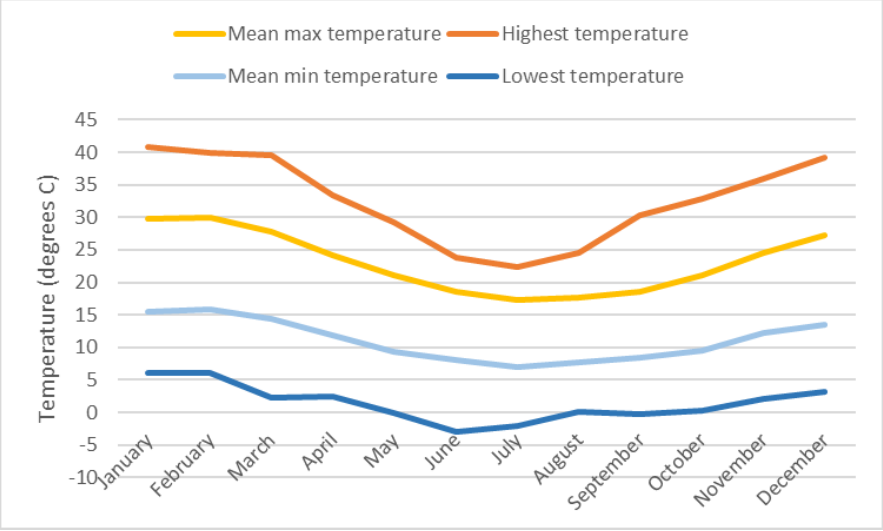


Plate 3 Temperature recorded at Bunbury BoM station for years 1995 to 2018

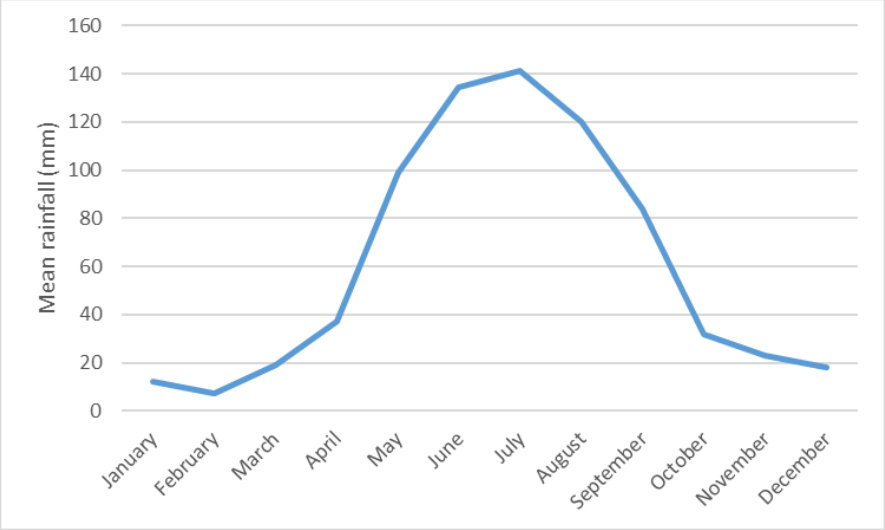


Plate 4 Rainfall recorded at Bunbury BoM station for years 1995 to 2018

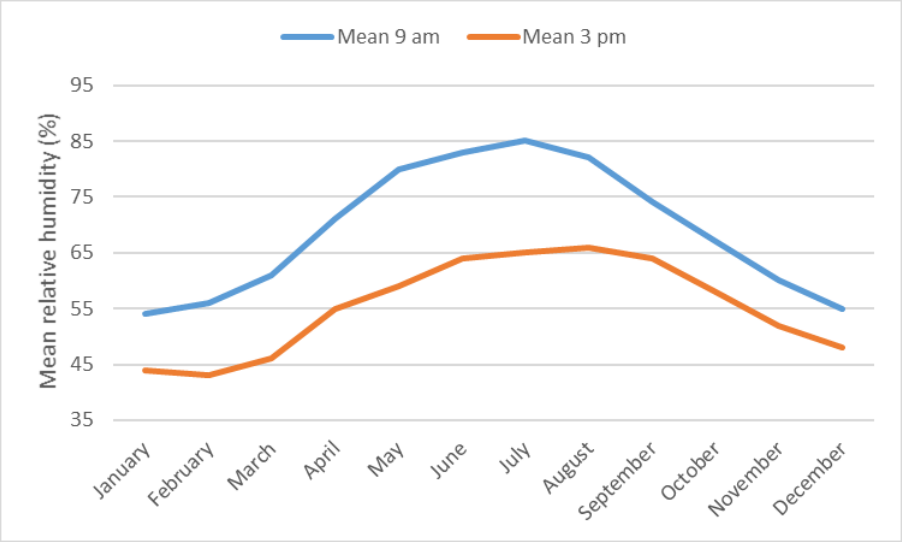


Plate 5 Relative humidity recorded at Bunbury BoM station for years 1995 to 2018

4.7.3.2 Background air quality

The majority of land in the vicinity of the Proposal Area is zoned Rural. The factors affecting existing air quality are primarily limited to road traffic and vehicles/ machinery on rural properties.

Major pollutants from vehicles include products of combustion such as carbon monoxide (CO), particulate matter with an aerodynamic diameter of 10 microns or less (PM_{10}), nitrogen oxides (NOx), and volatile organic compounds (VOCs).

A road traffic Air Quality Assessment was undertaken to develop an air quality model to predict emissions associated with the existing road network (BORR IPT, 2019b). The Proposal Area is surrounded by a network of existing roads, which influence local air quality. Major pollutants from vehicles include products of combustion such as CO, PM_{10}, NO_X, and VOCs.

No background measurements of air quality were available for the Proposal Area, therefore suitable reference sites were identified. DWER maintains an air quality monitoring station (AQMS) in Bunbury, located approximately eight km from the closest point of the Proposal Area. Bunbury AQMS monitors particulates (particulate matter less than or equal to 2.5 microns in diameter ($PM_{2.5}$) and PM_{10}). Data from

this AQMS are considered to be an appropriate reference for background particulate levels within the receiving environment

The closest DWER monitoring stations which record nitrogen dioxide (NO_2) and CO are Rockingham AQMS and South Lake AQMS, respectively. The monitoring stations in Rockingham and South Lake are situated 110 km and 125 km north of the Proposal Area, respectively. The areas surrounding Rockingham and South Lake are heavily urbanised, as opposed to the Proposal Area which is within a rural area. The Rockingham and South Lake AQMS data are therefore considered a conservative estimation for existing air quality, as Rockingham and South Lake are expected to have a higher level of pollution contributions from vehicles.

Air quality monitoring data for the Bunbury, Rockingham and South Lake AQMS's, are shown in Table 4-27. Background concentrations for other averaging periods and VOCs were not available and were therefore assumed to be zero.

Table 4-27 Assumed background air quality from DWER AQMS data summary statistics (BORR IPT, 2019b)

POLLUTANT	AVERAGING PERIOD	BACKGROUND CONCENTRATION (ug/m3)	AQMS STATION
CO	8-hour	625.2	South Lake
NO2	1-hour	34.9	Rockingham
PM10	24-hours	20.1	Bunbury
PM2.5	24-hours	9.8	Bunbury

4.7.3.3 Sensitive receptors

Sensitive receptors are any place where people are likely to reside in a non-occupational setting. This may include dwellings, schools, hospitals or public recreational areas (NSW Department of Environment and Conservation, 2005). As the majority of the Proposal is to be situated on Rural zoned land with a minimal number of dwellings within proximity, receptors were automatically generated along the modelled road networks at intervals of 10 m, 25 m, 50 m, 100 m and 150 m setback from the road (called auto-generated receptors). This was intended to adequately predict concentrations of pollutants within close proximity to the Proposal, demonstrating a worst case scenario (BORR IPT, 2019b).

4.7.4 Potential impacts

Direct impacts

The potential construction impacts that may occur to air quality as a consequence of developing the Proposal are:

- Reduced air quality due to increased construction vehicle emissions
- Dust generated from construction activities
- Increased greenhouse gas (GHG) emissions.

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

Major vehicle pollutants include products of combustion, such as CO, particulate matter with an aerodynamic diameter of 10 microns or less (PM10), NOx, and VOCs. The human health effects of these air pollutants range from mild airway irritations to major organ damage. Many of the emissions from motor vehicles react

together and with pollutants from other sources to form secondary pollutants, such as photochemical oxidants (ozone; O_3), which can also have significant effects.

Indirect impacts

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

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

4.7.5 Assessment of impacts

Direct impacts

Dust impacts during construction

Whilst manageable through the implementation of mitigation measures detailed in section (4.7.6), dust can cause reduced air quality, acute and chronic health effects, as well as amenity impacts due to reduced visibility and settling on surfaces causing soiling and staining. The potential impact of dust is determined by particle size, chemicals composition and concentration (DEC, 2011).

The total suspended solid (TSP) fraction of dust is typically responsible for nuisance or loss of amenity whereas the smaller PM_{10} and $PM_{2.5}$ fractions are more commonly associated with the potential for health impacts due to their ability to penetrate the lungs (DEC, 2011).

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

If unmanaged, these activities can result in dust emissions due to: movement of vehicles and heavy equipment on unsealed surfaces; excavating, spreading and compacting soils and wind erosion from exposed and disturbed soil surfaces.

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

Greenhouse gas emission impacts

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

The GHG emissions associated with construction activities are expected to occur for approximately 2 – 3 years while construction work is ongoing.

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

Operational impacts

Pollutant concentrations emitted from a vehicle depends on the type of vehicle (passenger, light or heavy vehicle), fuel type (petrol, diesel or LPG) and driving conditions (grade of slope, congestion and road conditions). Emissions profiles will also vary over time as new vehicle emission standards become effective. The vehicle emission rates adopted for the model have been based on various data sources, see Section 2.3 of the air quality assessment (BORR IPT, 2019b).

Vehicle emission dispersion was modelled for this air assessment using the AUSROADS dispersion model. This methodology is widely accepted across Australian jurisdictions.

AUSROADS was used for dispersion modelling of the predicted emissions from the Proposal for the following scenarios:

- Scenario 1: Existing road network (no build), year 2020
- Scenario 2: Built road network, projected year 2041.

The predicted maximum concentrations at descrete receptors, for both scenarios, where less than the assessment criterion are highlighted in green in Table 4-28.

Table 4-28 Predicted maximum concentration of air pollutants within the Proposa Area for scenario 1 (Year 2018 No Build) and scenario 2 (Year 2041 Build) (BORR IPT, 2019b)

POLLUTANT	BACK GROUND CONCENTRATION (ug/m3)	PREDICTED MAXIMUM CONCENTRATION (ug/m3)	ASSESSMENT CRITERION (ug/m3)	AVERAGING PERIOD	MAXIMUM % OF DISCRETE CRITERION
Scenario 1: Existing road network 2018					
CO	625.2	1,096.0	11,254	8-hour	10 %
NO_2	34.9	117.2	247	1-hour	47 %
PM_{10}	20.1	23.6	50	24-hours	47 %
$PM_{2.5}$	9.8	13.1	25	24-hours	52 %
Benzene	-	0.22	11	Annual	2 %
Toluene	-	1.15	4,114	24-hours	0.03 %
Xylenes (as a total of ortho-, meta- and para-isomers)	-	0.97	1,183	24-hours	0.08 %
Formaldehyde	-	1.4	54	24-hours	3 %
Acetaldehyde	-	1.8	2,300	1-hour	0.08 %
Benzo(a)pyrene – as a markers for PAHs	-	<0.0003	0.0003	Annual	33 %
Scenario 1: Year 2041 predicted traffic data, built road					
CO	625.2	1,178.0	11,254	8-hour	10 %
NO_2	34.9	142.2	247	1-hour	58 %
PM_{10}	20.1	24.9	50	24-hours	50 %
$PM_{2.5}$	9.8	13.9	25	24-hours	56 %
Benzene	-	0.26	11	Annual	2 %
Toluene	-	1.36	4,114	24-hours	0.03 %
Xylenes (as a total of ortho-, meta- and para-isomers)	-	1.07	1,183	24-hours	0.09 %
Formaldehyde	-	1.6	54	24-hours	3 %
Acetaldehyde	-	2.3	2,300	1-hour	0.10 %

POLLUTANT	BACK GROUND CONCENTRATION (ug/m3)	PREDICTED MAXIMUM CONCENTRATION (ug/m3)	ASSESSMENT CRITERION (ug/m3)	AVERAGING PERIOD	MAXIMUM % OF DISCRETE CRITERION
Benzo(a)pyrene – as a markers for PAHs	-	<0.0003	0.0003	Annual	40 %

The highest predicted concentration at the auto-generated receptors were compared to relevant assessment criteria. This assessment identified the following:

- The modelling results indicated that for both scenarios, maximum predicted concentrations for all pollutants were below the relevant assessment criteria
- For pollutants without background concentrations, predicted concentrations of benzene, toluene, xylene, formaldehyde and acetaldehyde were below 25 % of the relevant assessment criteria, allowing for future sustainable growth in the airshed
- The only exception to this for both scenarios was BaP (PAH), which contributed to 33 % and 40 % of the assessment criteria for Year 2018 (No Build Scenario) and Year 2041 (Build Scenario), respectively. Due to the conservative nature of this assessment in terms of the emission factors used for BaP (PAH) and future vehicle emissions, it is expected that in reality, concentrations from vehicles utilising the Proposal will be lower than presented in this assessment.

The results of this assessment suggest that it is unlikely that the constructed Proposal will have an adverse impact on local air quality.

Once the Proposal is constructed it is considered that, whilst there are vehicles on the road which would produce GHG emissions, the road itself would not.

GHG emissions would also be associated with energy use for ongoing street lighting and traffic signals. Asset management includes depots, light vehicle fleet, plant and equipment and raw materials.

Indirect impacts

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

4.7.6 Mitigation

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

- Use of energy efficient electrical assets such as LED street lights
- Reducing the expansion of traffic signals and Main Roads has adopted a policy of alternative design treatments such as roundabouts or modified intersections to assist with reducing congestion
- Use of renewable energy sources
- Use of materials with lower embodied energy

- The impact on air quality during construction of the Proposal, will be minimised through implementation of a CEMP. The CEMP will include mitigation measures including:
  - Implementation of dust suppression measures, such as surface watering and spreading of hydromulch
  - Daily monitoring of meteorological conditions to identify and prepare or modify operations which increase the risk of windblown dust
  - Restriction of earthmoving if high winds are generating unmanageable dust levels
  - Progressive clearing to minimise the extent of soil exposed
  - Restriction on vehicle speeds to minimise the generation of dust
  - Establishment of a complaints register
  - Maintenance of vehicles in accordance with manufacturer's specifications to minimise exhaust emissions
  - Low emissions producing equipment will be selected (if possible).

It is considered unlikely that the operation of the Proposal will have a significant impact on local air quality. Therefore, mitigation measures have not be proposed.

The requirement for GHG emission management and mitigation will be determined in an assessment of direct emissions for the construction and operation phases of the Proposal.

4.7.7 Predicted outcomes

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

The results of the Air Quality Assessment for future road traffic emissions indicate that the constructed Proposal is unlikely to have an adverse impact on local air quality.

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

The EPA's objective for the factor air quality is to maintain air quality and minimise emissions so that environmental values are protected.

Given the proposed measures outlined above, no residual impacts are expected for this aspect and the Proposal meets the EPA objective to maintain air quality and minimise emissions so that environmental values are protected.

4.8 Key Environmental Factor – Social Surrounds

4.8.1 EPA objective

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

4.8.2 Policy and guidance

- Environmental Factor Guideline Social Surroundings (EPA, 2016g)
- Guidance for the Assessment of Environmental Factors, Assessment of Aboriginal Heritage No. 41 (EPA, 2004b)
- State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning (WAPC, 2009)
- Implementation Guidelines for State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning (WAPC, 2014).

4.8.3 Receiving environment

4.8.3.1 Cultural heritage

European heritage

No World Heritage Properties or Commonwealth Heritage Places occur within 10 km of the Proposal Area (DoEE, 2018a).

A search of the State Heritage Office – inHerit WA database did not identify any Heritage Places within the Proposal Area (GoWA, 2019a).

There are 12 State Register Places and 81 Municipal Inventory Places located within 5 km of the Proposal Area, as illustrated in Figure 19 (Appendix A).

However, there are no State Register Places within 1 km of the Proposal Area and the closest mapped Municipal Inventory Places located within 1 km of the Proposal Area include:

- 'Taunton Vale Homestead' (Place No 3017), located approximately 0.5 km south of the Proposal Area. Listed on the Municipal Inventory by the Shire of Dardanup (adopted September 2002)
- 'Bushbelt – Ocean-Preston Regional Park' (Place No 5670), a 7 km length of Conservation Corridor, Tuart Valley and The Maidens. The Proposal Area is located approximately 0.5 km from the most eastern point. Listed on the Municipal Inventory by the City of Bunbury (adopted July 1996).

Aboriginal heritage

A search of Aboriginal heritage (DPLH, 2019) in May 2019, identified five 'Registered' Sites of Aboriginal heritage significance, and 12 lodged as 'Other Heritage Places' within the Proposal Area (Appendix H). The 'Registered' Aboriginal Sites include:

- Site ID 4875 Bunbury 1
- Site ID 4880 Bunbury 20
- Site ID 16713 Collie River Waugal
- Site ID 17776 Brunswick River
- Site 19795 Preston River.

The 'Other Heritage Places' identified within the Proposal Area include:

- Place ID 4870 Bunbury 19
- Place ID 4876 Bunbury 15
- Place ID 4877 Bunbury 16
- Place ID 5168 NATGAS 262
- Place ID 5169 NATGAS 263
- Place ID 17775 Waterloo Brickworks Camp and Hunting Grounds
- Place ID 18885 Bunbury Bypass Archaeological Site 2
- Place ID 18886 Bunbury Bypass Archaeological Site 3
- Place ID 18889 Bunbury Bypass Individual Find 1
- Place ID 19796 Ferguson River
- Place ID 20057 Howson Drive Lagoon
- Place ID 29334 Picton Isolated Finds.

The Proposal Area occurs within the Gnaala Karla Booja (GKB) People Indigenous Land Use Agreement (ILUA). An Aboriginal Heritage Survey, including ethnographic consultation and archaeological heritage survey, was undertaken in October 2018 (Brad Goode & Associates, 2018).

The adequacy of the Aboriginal Heritage Survey (Brad Goode & Associates, 2018) was confirmed based on a search of the DPLH Aboriginal Heritage Inquiry System (AHIS) for the Proposal Area on 27 November 2018 (DPLH, 2019). This desktop search confirmed that all Registered Aboriginal Sites and Other Heritage Places identified in the Proposal Area were included in the Aboriginal Heritage Survey Area.

Ethnographic consultation was undertaken by Brad Goode & Associates, on 29 October 2018, with nine representatives from the GKB NTC group and it was "*determined that there are no new ethnographic sites, as defined by section 5 of the AHA, located within BORR North Survey Area*" (Brad Goode & Associates, 2018).

4.8.3.2 Land use

Existing land use

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

Greater Bunbury Regional Scheme

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

The majority of land, 66.82 %, within the Proposal Area is zoned as Rural, within the GBRS (Table 4-29). The Proposal Area also intersects land reserved as primary regional road (e.g. Forrest Highway, South Western Highway and Boyanup-Picton Road and the current BORR alignment as identified in the GBRS), railways (e.g. along South Western Highway and Boyanup-Picton Road), urban, urban deferred, regional open space and industrial (Figure 20, Appendix A).

Table 4-29 Proportion of zoning and reserves within the Proposal Area

REGIONAL SCHEME DESCRIPTION	RESERVED LANDS/ ZONES	AREA WITHIN PROPOSAL AREA (ha)	PROPORTION OF PROPOSAL AREA (%)
Industrial	Zone	6.0	0.9
Primary regional roads	Reserve	191.4	29.4
Railways	Reserve	1.1	0.2
Regional open space	Reserve	7.4	1.1
Rural	Zone	434.8	66.8
Urban	Zone	7.9	1.2
Urban deferred	Zone	2.0	0.3
	Total	650.7	100

4.8.3.3 Demography and economy

The Proposal Area is, at its closest point, approximately six km east of East Bunbury. The Greater Bunbury Region which includes the Shire of Harvey, Dardanup and Capel, as well as the City of Bunbury, had a population of 89,628 in 2016 and the South West region had total population of 172,179 (Shire of Capel, 2018). Construction is the main industry accounting for 13 % of employment, with manufacturing approximately 12 %.

4.8.3.4 Visual amenity

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

The existing amenity of the Proposal Area includes pockets of native vegetation, rural/ agricultural areas, existing roads and railways and previously cleared areas. An Urban and Landscape Design Framework (BORR IPT, 2018b) has been developed which outlines the urban and landscape design vision, objectives and principles for the Proposal. A site analysis identified 10 Landscape Character Units which are located in Plate 6 and described in the Urban and Landscape Design Framework (BORR IPT, 2018b).

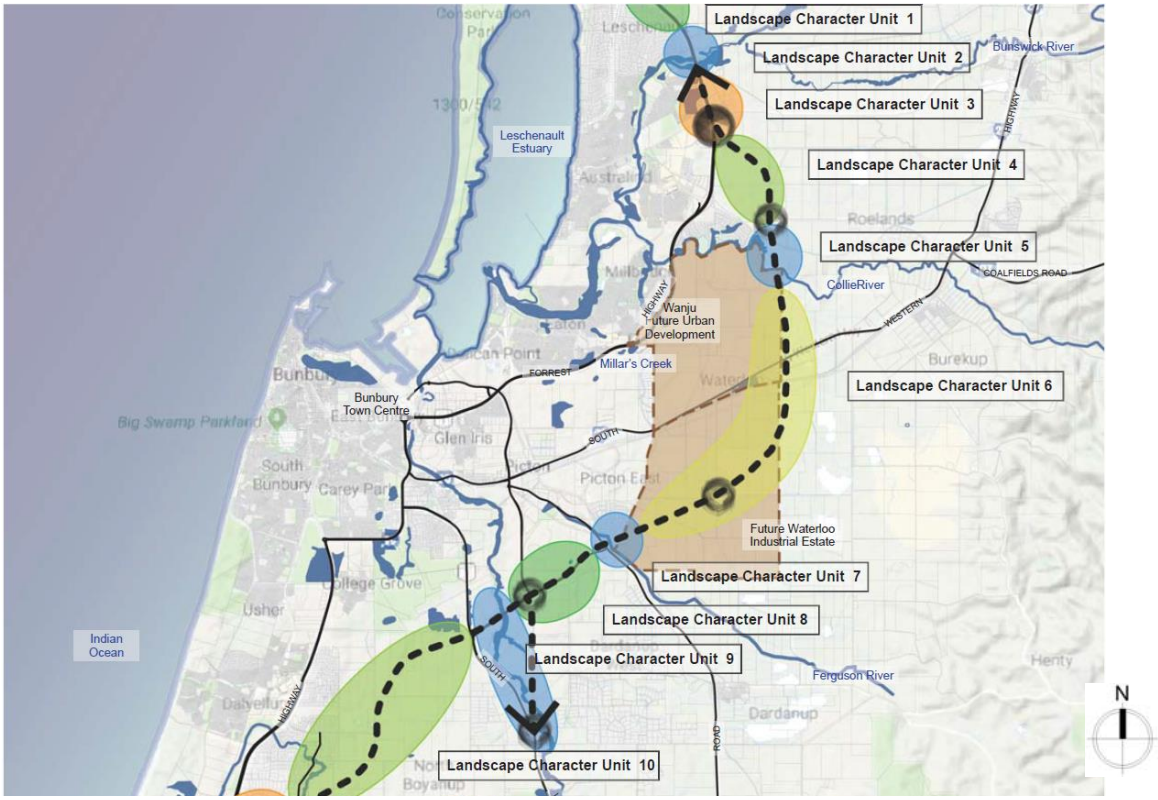


Plate 6 Landscape Charater Unit mapping within the Proposal Area (BORR IPT, 2018b)

4.8.3.5 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 roads
- Natural (leaves rustling, wind in trees and bird and insect calls).

The existing road traffic noise assessment was undertaken by BORR IPT for a 2018 scenario (BORR IPT, 2019d), to assess current road traffic noise impacts at existing roads in proximity to sensitive receptors and the current BORR alignment. This assessment has been provided in Appendix I. The traffic noise assessment was independently peer reviewed. The review found the assessment adequate for this Proposal. A letter of confirmation has been provided in Appendix I.

Noise monitoring was used to measure existing noise levels experienced by receptors located within the Proposal Area. Unattended noise monitoring was undertaken at six 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, with the closest receptors being located immediately adjacent to the Proposal Area in Residential areas. The locations of the sensitive receptors and 2018 existing noise levels are illustrated in Figure 21 (Appendix A).

4.8.3.6 Lighting

The existing lighting environment within the vicinity of the Proposal Area is considered, as this is a largely rural area, to be limited to:

- Lighting on existing roads
- Industrial areas
- Residential dwellings and associated buildings
- Vehicle headlights.

4.8.4 Potential impacts

Direct Impacts

In the absence of suitable mitigation measures, construction of the Proposal could potentially result in the the following impacts to social surrounding:

- Aboriginal Heritage Site disturbance during clearing and/ or excavation works
- Reduced visual amenity due to vegetation clearing, dust and where construction occurs in areas visible to surrounding residential and rural properties
- Noise and vibration impacts to sensitive receptors, from noise emissions generated by construction activity within the Proposal Area (equipment and vehicle operation, increased traffic on local road network).

The potential operational impacts that may occur to social surroundings as a consequence of developing the Proposal are:

- Reduced visual amenity where the new road is visible to residents surrounding the Proposal Area
- Increased noise impacts to sensitive receptors from a change in rural land use to a roadway
- Increased glare or light spill on sensitive receptors from lighting at interchanges and vehicle headlights
- Change in land use from predominantly rural to regional roads.

Indirect Impacts

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

4.8.5 Assessment of impacts

Direct Impacts

Heritage Site disturbance during clearing and/ or excavation works

There are no known European heritage places within the Proposal Area and impacts on European heritage issues are considered unlikely.

The Aboriginal Heritage Survey, which included ethnographic consultation and archaeological heritage surveys, identified two previously recorded archaeological sites, six heritage places and two stored data places which were previously relocated within the boundaries of the Proposal Area (Brad Goode & Associates, 2018). Risks to sites of Aboriginal Heritage significance will be managed through consultation with relevant groups and where necessary additional approvals (including Section 18 clearance) will be obtained via the AH Act.

Noise and vibration impacts resulting from construction and operation

The construction of the Proposal has the potential to produce noise and vibration which may be a nuisance to nearby sensitive receptors if unmitigated. Risks associated with noise and vibration will be managed through the implementation of a CEMP. These risks are considered manageable.

Reduced visual amenity

The existing built form within the Proposal Area is generally low in height with at grade intersections and small in scale with the exception. The Proposal will include a number of elevated structures in an area that is generally flat with very few large structures. This will be a substantial change in the built form character which will reduce visual amenity within the low lying landscape in areas which are predominantly rural. Potential impacts on visual amenity are illustrated in Plate 7.

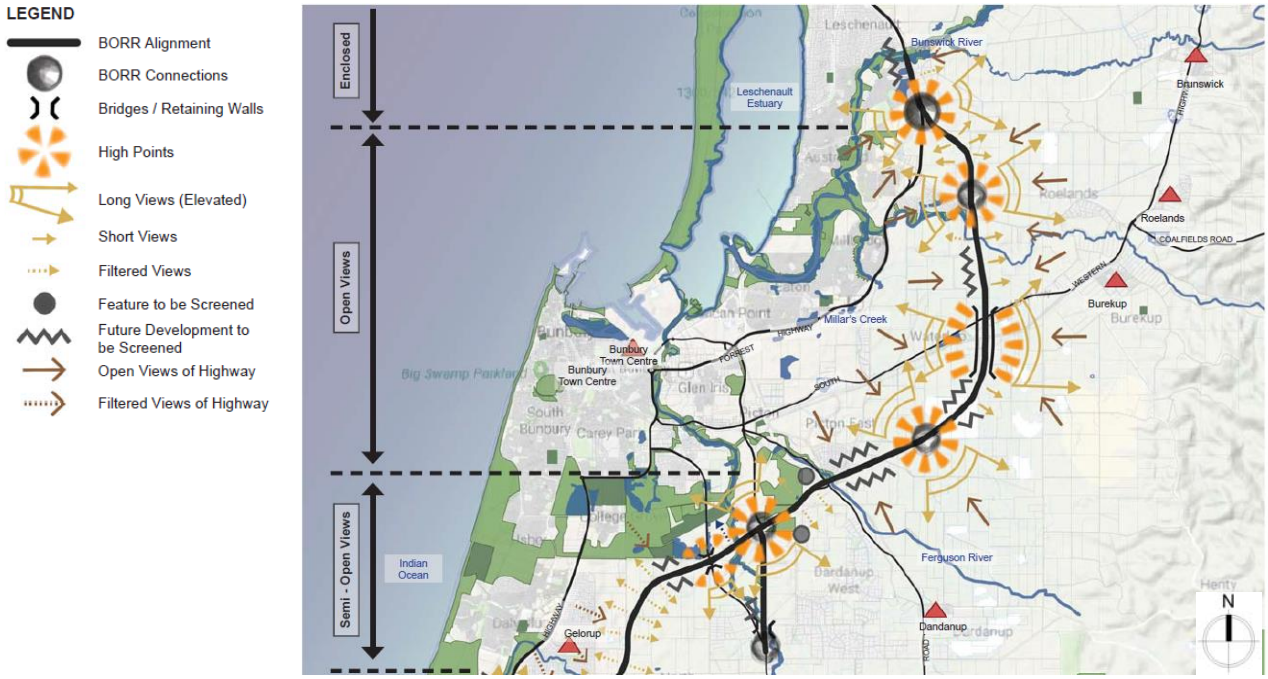


Plate 7 Visual analysis mapping (BORR IPT, 2018b)

Key views of the Proposal Area which will reduce visual amenity are:

- Residents of Meadow Landing and Treendale will have views of the elevated road at Raymond Road. Affected residents are along Treendale Road, Ranson Drive, Britza Avenue, Thomas Stanley Way, Bevan Loop, Warburton Street and Craigie Drive. Residents will have views of the road infrastructure including bridge, retaining walls, noise walls, moving traffic, lighting and signage. These views will be a substantial change given the generally flat topography and open character of the area
- Rural dwellings either side of the alignment where BORR is at grade will have significant views of road. Some views will be dappled by vegetation and others will be completely open view
- Rural dwellings either side of the alignment at elevated intersections and sections will have views of the road. Elevated areas are at Clifton Road, Raymond Road, South Western Highway and rail line, Harris Road, Willinge Drive (at BORR and South Western Highway) and South Western Highway (near Bunbury Airport). Views will include bridges, lighting, vegetation, retaining walls, moving traffic and signage. These views will be substantial given the generally flat topography of the area
- Recreational users at river crossings will have views of the new bridge structures where BORR crosses over. This is a change from the natural river and vegetation views they currently experience. This is

mainly an issue at the Collie River and Preston River, as Ferguson River is not currently used for recreation

- The Waterloo Brickworks Camp and Hunting Grounds (Other Heritage Place 17775 – located outside the Proposal Area) at Waterloo will have filtered views of BORR as the site is heavily vegetated, providing visual screening. The road will be elevated up to 12 m through this segment but the alignment will be positioned away from the site and not lit so the views should be limited.

Key views from the Proposal Area which will reduce visual amenity are:

- Views of existing industrial/commercial use at Picton Industrial Park will be seen from the Proposal to the west of the alignment at Boyanup-Picton Road. The view will be comprised of large warehouses and associated signage
- The Laminex site near Willinge Road is screened by vegetation from the road (where at grade) but the chimney protrudes above the vegetation and is dominant in the landscape emitting steam as a result of plant operations. Elevated sections of BORR will likely have views of the industrial use in this area which is to the east.

Glare or light spill impact on sensitive receptors

There will be minor change in the local light environment as a result of the Proposal. It is anticipated that only intersections and interchanges will be lit.

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) road traffic noise map (Figure 21, Appendix A) was then compared to the future noise map (2041) within the constructed BORR present and with no noise mitigation treatement (Figure 22, Appendix A).

Without noise mitigation treatment, 77 properties are predicted to experience noise levels above the SPP 5.4 noise target of LAeq,day 55 dBA in 2041, of which 44 are also predicted to experience noise levels above the threshold of LAeq,day 60 dBA. The majority of these 44 properties are located adjacent to the existing Forrest Highway, north of BORR/Forrest Interchange (BORR IPT, 2019d).

Properties closest to the new road are forecast to receive levels up to $L_{Aeq,day}$ 67 dBA. With this level of noise exposure, each property above the 55 dBA noise target would need to be considered for acoustic treatment. In recognising the challenges in achieving noise level reduction where existing road infrastructure is surrounded by existing noise sensitive developedment, 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 60 dBA day noise limit or 55 dBA night noise limit (BORR IPT, 2019d) (Figure 23, Appendix A).

Indirect Impacts

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

4.8.6 Mitigation

Impacts to social surroundings will be reduced through consideration of impacts during the detailed design phase and minimised during construction through the following mitigation and management measures included in an EMP and CEMP:

- Impact on Aboriginal heritage sites will be minimised and managed through the implementation of a CEMP and an Aboriginal Heritage Management Plan which addresses the recommendations provided

in (Brad Goode & Associates, 2018). Main Roads will undertake consultation with all relevant groups and will undertake work in accordance with the AH Act

- Impacts to visual amenity addressed through the detailed design of the Proposal and will be minimised and suitably managed through the implementation of a CEMP
- Landscaping will be managed in accordance with a CEMP and a Landscape Management Plan (as discussed in Section 4.3.6).

Construction noise:

- The CEMP prepared for the Proposal will:
  - Ensure compliance with the requirements of the Environmental Protection (Noise) Regulations 1997
  - Limit construction activity to normal business hours and liaise with the local Shire/LGA if construction activities are required outside of these hours
  - Communicate the need to undertake out of hour's project activities to the community, if necessary
  - Install alternative requirements to audible reversing alarms, where practicable
  - Adopt construction techniques that will minimise vibration impacts within nearby sensitive receptors, particularly for compaction operations
  - Undertake compaction operations during normal business hours and maximise separation distances between vibration inducing activities and nearby sensitive receptors
  - A complaints register to be maintained by the Contractor.

Operational noise - Noise mitigation will be required to reduce received noise levels at properties. Noise mitigation treatments typically consist of the following for road projects:

- Earth bunds, located on the road or property boundary. In some areas constrained by the required surface area to obtain sufficient height. Most effective for groups of properties rather than single rural properties
- Noise walls, located on the road or property boundary. Require less area for installation than earth bunds. Like earth bunds, most effective for groups of properties rather than single rural properties
- Architectural treatment package consisting of, for example, upgraded glazing (such as double glazing) and mechanical ventilation (to allow windows to be kept closed). Specific architectural treatment packages are determined for each individual sensitive receptor following completion of an architectural treatment inspection. (BORR IPT, 2019d).

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 need to 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.

4.8.7 Predicted outcome

Construction and operation of the Proposal will result in minor impacts to visual amenity and localised change in the landscape. The impact of these changes will be mitigated through consideration of impacts during the detailed design phase and implementation of landscaping and other mitigation measures during construction via the CEMP. Minor impacts to visual amenity are predicted.

Potential impacts to Aboriginal heritage sites associated with the project will be managed through consultation with all relevant groups and works will be undertaken in accordance with AH Act. Potential impacts to Aboriginal heritage will be managed through the AH Act.

Mitigation measures, including for sensitive receptors identified through the noise modelling will be developed through the detailed design phase of the project. Other noise impacts associated with the proposal (aside from sensitive receptors to the specifically mitigated) are likely to be minor.

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 will be determined through application of the residual impact significance model detailed in the WA Environmental Offsets Guidelines (GoWA, 2014).

5.5 Offset strategy

Main Roads proposes to develop an offset strategy for this Proposal. Identification of suitable direct and indirect offsets will occur in accordance with the state and federal offset policies and guidelines. Development of the strategy will include liaison with relevant agencies and other stakeholders to identify suitable offsets (direct and indirect), assessment of proposed offsets sites to determine their environmental value, acquisition of the offset site and implementation of the strategy.

Main Roads has successfully delivered environmental offsets for Projects throughout the State. This delivery includes working closely with relevant agencies and other stakeholders to identify suitable offsets (direct and indirect), acquire offsets and implement the strategy.

Quantification of offsets

There are two parts to quantification of an appropriate offset:

- quantification of the significant residual impact to be offset
- quantification of the value of environmental benefit provided from the proposed offset (GoWA, 2014).

The DotEE Offset Assessment Guide will be used to assess the quantum of residual impact associated with the Proposal, and quantify offset requirements.

Identify suitable offset sites (direct offsets)

Main Roads intends to offset through land acquisition to provide on-ground improvement, rehabilitation and conservation of habitat. The direct offset will be 'like-for-like', where impacts to an environmental value are offset by a property/properties that benefit the same environmental value.

Identify suitable indirect offsets

The indirect offsets under consideration include actions aimed at improving scientific or community understanding and awareness of environmental values. They are likely to include research on the federally listed Western Ringtail Possum or Black Cockatoo species.

6 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

6.1 Controlled action provisions

Controlled action provisions will be discussed with the DotEE as part of future consultation.

6.2 Policy and guidelines

Matters of National Environmental Significance (MNES) are listed and protected under the following legislation and guidelines:

- EPBC Act
- Environment Protection and Biodiversity Conservation Regulations 2000
- Significant impact guidelines 1.1 – Matters of National Environmental Significance (DoEE, 2013)
- Under the EPBC Act, Proposals which have the potential to significantly impact MNES, trigger the requirement for referral to the Commonwealth DotEE for potential assessment as a 'controlled action'. MNES which trigger the requirement for referral include:
  - World heritage properties
  - National heritage places
  - Wetlands of International Importance (listed under the RAMSAR Convention)
  - Listed threatened species and ecological communities
  - Migratory species protected under international agreements
  - Commonwealth marine areas
  - The Great Barrier Reef Marine Park
  - Nuclear actions (including uranium mines)
  - A water resource, in relation to coal seam gas development and large coal mining development.

6.3 Summary of existing environmental values and potential impacts on MNES

A number of desktop and targeted field surveys have been undertaken for the Proposal in order to assess the presence of MNES which trigger the requirement for referral (section 4) and have been summarised in (Table 6-1).

A referral of the Proposal will be made to the DotEE on the basis that threatened species and ecological communities listed under the EPBC Act will be impacted within the Proposal Area.

Extensive consultation with the DotEE and consideration has been made during the alignment selection process, so to avoid impact on MNES. Amendment to the Proposal Area during the early preliminary design stage has been an iterative process and information from the findings of the desktop and field assessments has been incorporated to further minimise impact where practicable (refer to section 2.4).

Table 6-1 Matters of National Environmental Significance within the Proposal Area

MNES	IMPACT
Listed Threatened Species and Ecological Communities	Direct loss of up to 7.6 ha of Banksia woodlands of the Swan Coastal Plain TEC (Endangered) and Banksia dominated woodlands of the Swan Coastal Plain IBRA region PEC (section 4.3.3). NB Additional survey required to confirm 3.0 ha of the 7.6 ha TEC meets criteria for listing as TEC Direct loss of up to 1.5 ha of Herb rich shrublands in clay pans TEC (Critically Endangered) (section 4.3.3) NB Occurrence of the TEC and condition of potential patches is to be confirmed through additional surveys. The 1.5 ha includes 1.0 ha mapped through previous surveys but not verified through surveys associated with the Proposal Direct loss of habitat for the following EPBC Act listed fauna species known to occur within the Proposal Area (section 4.4.3.5): • 59.7 ha of Carnaby's Cockatoo habitat (Endangered) • 59.7 ha of Baudin's Cockatoo habitat (Endangered) • 59.7 ha of Forest Red-tailed Black Cockatoo habitat (Vulnerable) • Up to 1116 Black Cockatoo Suitable DBH Trees • 70.3 ha Western Ringtail Possum habitat (Critically Endangered) • Disturbance of 1.4 ha Carter's Freshwater Mussel habitat (Vulnerable) • Potential risk of impact to the Black-stripe Minnow (Endangered), which was recorded in a wetland adjacent to the Proposal Area and may opportunistically utilise wetlands within the Proposal Area as habitat • No EPBC Act listed flora species were identified during field surveys within the Proposal Area. Eight species of EPBC Act listed flora were identified through desktop searches as possibly occurring (section 4.3.3) but no listed species were identified during field surveys within the Proposal Area. The following risks have the potential to impact listed threatened species and communities but risks will be managed and mitigated through appropriate actions during the detailed design, construction and operation of the Proposal: • Habitat decline due to: – Possible introduction and/ or spread of invasive pathogens (section 4.3.3) – Possible introduction/ spread and/ or abundance increase of invasive plant species (weeds) (section 4.3.3) – Changes to surface water hydrology (section 4.6.4) – Disturbance of waterways during and post bridge construction works (section 4.6.4) – Smothering of vegetation by dust generated from the operational activities (section 4.7.4) • Impact on fauna species: – Damage to, and loss of habitat or mortality of fauna through accidental generation of a bushfire (section 4.4.4)

MNES	IMPACT
	– Death, injury or displacement of native fauna species due to vehicle interaction or entrapment (section 4.4.4) – Disruption or disturbance to fauna as a result of noise, vibration, light and dust emissions from construction activities (section 4.8.4).

6.4 Mitigation measures

Mitigation measures to address the potential impacts on MNES are outlined in relevant sections for each environmental factor in this document and will also be detailed in the project EMP.

6.5 Summary of assessment of level of significance of impact on MNES

Recovery Plans, Threat Abatement Plans and Conservation Advice relevant to MNES which the Proposal may impact upon have been listed in Table 6-2 and Table 6-3. A discussion of how the Proposal conforms to the Advice or Plan requirements is included.

Table 6-2 Relevant Recovery Plans, Threat Abatement Plans and Conservation Advice for MNES

EPBC ACT LISTED	PLAN/ CONSERVATION ADVICE AND THREATS		RESPONSE
Banksia Woodland TEC	**Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community** (DoEE, 2016a)		
	1	*Land clearing and impacts associated with fragmentation*	The Proposal may exacerbate this threat due to direct impact on the TEC of up to 7.6 ha. Additional survey required to confirm 3.0 ha of the 7.6 ha TEC meets criteria for listing as TEC.
	2	*Groundwater drawdown*	The Proposal may cause temporary (dewatering activities) change to groundwater levels associated with the TEC and may exacerbate this threat in the short term.
	3	*Altered fire regimes*	The Proposal is not expected to exacerbate this threat. There is considered to be a low risk of accidental fire as a result of construction activities. Clearing activities are a potential risk of fire generation. To minimise the risk of fire, clearing activities will not be undertaken when the Fire Danger Rating is severe or higher. The CEMP will include an emergency management plan.
	4	*Plant pathogens (dieback)*	The Proposal is not expected to exacerbate this threat. A dieback occurrence assessment has been completed to identify priority areas within the Proposal Area (Great Southern Bio Logic, 2018). A Hygiene Management Plan will be implemented for construction of the Proposal as per the EMP to minimise risk of the impact of disease.
	5	*Invasive flora and fauna*	The Proposal is not expected exacerbate this threat. A Hygiene Management Plan will be implemented for construction of the Proposal as per the EMP, to minimise risk of the impact of disease and spread of invasive flora.
	6	*Other disturbances to patches (dumped rubbish, access by unauthorised vehicles, paths from trampling through the vegetation, illegal cutting of vegetation, firewood collections, bare patches of ground where vegetation cover has been destroyed, erosion, feral animals and domestic animals)*	The Proposal is not expected to exacerbate this threat. Access to the Proposal Area will be managed through the construction phase and access to remnant vegetation controlled during the operational phase through appropriate fencing and vehicle management.

EPBC ACT LISTED	PLAN/ CONSERVATION ADVICE AND THREATS		RESPONSE
Clay Pans TEC	**National Recovery Plan for the Clay Pans of the Swan Coastal Plain Ecological Community** (DBCA, 2019)		
	1	*Clearing*	The Proposal may exacerbate this threat due to direct impact on the TEC of up to 1.5 ha. NB Occurrence of the TEC and condition of potential patches is to be confirmed through additional surveys. The 1.5ha includes 1.0 ha mapped through previous surveys but not verified through surveys associated with the Proposal.
	2	*Hydrological changes*	The Proposal is not expected to exacerbate this threat. A Drainage Strategy has been developed for the project with principle support from DWER (section 4.6.3.2), of which one of the main objectives of the strategy is "maintenance of existing water cycle balance within the project area whilst also improving the surface and groundwater quality". Drainage design will be undertaken at the detailed design stage to allow for pre-development flows to be maintained within the Proposal Area.
	3	*Weed invasion*	The Proposal is not expected to exacerbate this threat. A Hygiene Management Plan will be implemented for construction of the Proposal as per the EMP, to minimise risk of the impact of disease and spread of invasive flora.
	4	*Altered fire regimes*	The Proposal is not expected to exacerbate this threat. There is considered to be a low risk of accidental fire as a result of construction activities. Clearing activities are a potential risk of fire generation. To minimise the risk of fire, clearing activities will not be undertaken when the Fire Danger Rating is severe or higher. The CEMP will include an emergency management plan.
	5	*Disease*	The Proposal is not expected to exacerbate this threat. A dieback occurrence assessment has been completed to identify priority areas within the Proposal Area (Great Southern Bio Logic, 2018). A Hygiene Management Plan will be implemented for construction of the Proposal as per the EMP to minimise risk of the impact of disease.

EPBC ACT LISTED	PLAN/ CONSERVATION ADVICE AND THREATS		RESPONSE
Black Cockatoos	**Western Australian Department of Parks and Wildlife (2013), Carnaby's Cockatoo (*Calyptorhynchus latirostris*) Recovery Plan.**		
	1	*Loss of breeding habitat*	The Proposal may exacerbate this threat, however the Proposal is designed to maximise use of existing disturbed areas to minimise the loss of breeding habitat. Up to 59.7 ha of native vegetation will be removed for the Proposal which has been assessed as potential Black Cockatoo breeding habitat. A total of up to 1116 Black Cockatoo Suitable DBH Trees will be removed for the Proposal, five of which are considered to be Trees with a Suitable Hollow. No known Black Cockatoo hollows were recorded within the Proposal Area.
	2	*Loss of non-breeding, foraging and night roosting habitat*	The Proposal may exacerbate this threat, however the Proposal is designed to maximise the use of existing disturbed areas to minimise the loss of foraging and night-roosting habitat.
	3	*Tree health*	The Proposal is not expected to exacerbate this threat. A Hygiene Management Plan will be implemented for construction of the Proposal as per the EMP, to minimise risk of the impact of dieback on tree health.
	4	*Illegal shooting*	The Proposal will not exacerbate this threat. No firearms will be permitted on site as per the EMP.
	5	*Illegal taking*	The Proposal will not exacerbate this threat. Only qualified fauna handlers will relocate fauna as per the Fauna Management Plan.
	6	*Collisions with motor vehicles*	The Proposal may exacerbate this threat.
	Department of the Environment, Water, Heritage and the Arts (2009). *Approved Conservation Advice for* Calyptorhynchus banksii naso *(Forest Red-tailed Black Cockatoo).* Canberra: Department of the Environment, Water, Heritage and the Arts.		
	1	*Illegal shooting*	The Proposal will not exacerbate this threat. No firearms will be permitted on site as per the EMP.
	2	*Habitat loss*	The Proposal may exacerbate this threat, however the Proposal is designed to maximise the use of existing disturbed areas to minimise the loss of breeding habitat. Up to 59.7 ha of native vegetation will be removed for the Proposal which has been assessed as potential Black Cockatoo breeding habitat.

EPBC ACT LISTED	PLAN/ CONSERVATION ADVICE AND THREATS		RESPONSE
	3	*Nest hollow shortage*	The Proposal may exacerbate this threat. A total of up to 1116 Black Cockatoo Suitable DBH Trees will be removed for the Proposal, 68 of which have hollows and five of which are considered to be Trees with a Suitable Hollow.
	4	*Competition from other species*	The Proposal is unlikely to exacerbate this threat. There are various other birds known to occur within the Proposal Area (e.g. other Black Cockatoo species, Galahs and Wood Ducks) and other fauna (Western Ringtail Possums and South-western Brush-tailed Phascogales), which may compete for hollows with the Black Cockatoo.
	5	*Injury or death from* Apis mellifera *(European Honeybees)*	The Proposal is unlikely to exacerbate this threat. The Proposal will result in the clearing of five trees with suitable hollows for Black Cockatoo breeding. A general reduction in the amount of tree hollows may increase competition between fauna using the hollows and the European Honeybee. There are no plans to control European Honeybee populations.
	Forest Black Cockatoo (Baudin's Cockatoo *Calyptorhynchus Baudinii* and Forest Red-Tailed Black Cockatoo *Calyptorhynchus Banksii Naso*) Recovery Plan (Department of Environment and Conservation, 2008)		
	1	*Killing by illegal shooting*	The Proposal will not exacerbate this threat. No firearms will be permitted on site as per the EMP.
	2	*Feral honeybees*	The Proposal is unlikely to exacerbate this threat. The Proposal will result in the clearing of five trees with suitable hollows for Black Cockatoo breeding. A general reduction in the amount of tree hollows may increase competition between fauna using the hollows and the European Honeybee. There are no plans to control European Honeybee populations.
	3	*Habitat loss*	The Proposal may exacerbate this threat, however the Proposal is designed to maximise the use of existing disturbed areas to minimise the loss of breeding habitat. Up to 59.7 ha of native vegetation will be removed for the Proposal which has been assessed as potential Black Cockatoo breeding habitat.

EPBC ACT LISTED	PLAN/ CONSERVATION ADVICE AND THREATS		RESPONSE
	4	*Nest hollow shortage*	The Proposal may exacerbate this threat. A total of up to 1116 Black Cockatoo Suitable DBH Trees will be removed for the Proposal, 68 of which have hollows and five of which are considered to be Trees with a Suitable Hollow.
	5	*Nest hollow competition*	The Proposal may exacerbate this threat. There are various other birds known to occur within the Proposal Area (e.g. other Black Cockatoo species, Galahs and Wood Ducks) and other fauna (Western Ringtail Possums and South-western Brush-tailed Phascogales), which may compete for hollows with the Black Cockatoo.
	Threatened Species Scientific Committee (2018). Conservation Advice *Calyptorhynchus baudinii* Baudin's cockatoo. Canberra: Department of the Environment and Energy.		
	1	*Destruction of nesting and foraging trees from fire events*	The Proposal is not expected to exacerbate this threat. The threat of bushfires will be managed as per the EMP.
	2	*Loss of hollows from European honey bees (*Apis mellifera*)*	The Proposal is unlikely to exacerbate this threat. The Proposal will result in the clearing of up to five trees with 'suitable' hollows for Black Cockatoo breeding. A general reduction in the amount of tree hollows may increase competition between fauna using the hollows and the European Honeybee. There are no plans to control European Honeybee populations.
	3	*Nest hollow shortage due to competition with native bird species*	The Proposal may exacerbate this threat. There are various other birds known to occur within the Proposal Area (e.g. other Black Cockatoo species, Galahs and Wood Ducks), which may compete for hollows with Baudin's Cockatoo. Sixty eight hollows not considered suitable or had limited suitability for Black Cockatoo breeding, but suitable for other bird species, will be cleared. A general reduction in the number of available hollows may increase competition between bird species.
	4	*Illegal shooting*	The Proposal will not exacerbate this threat. No firearms will be permitted on site as per the EMP.

EPBC ACT LISTED	PLAN/ CONSERVATION ADVICE AND THREATS		RESPONSE
	5	*Phytopathogens (Dieback)*	The Proposal is not expected to exacerbate this threat. A dieback occurrence assessment has been completed to identify priority areas within the Proposal Area (Great Southern Bio Logic, 2018). A Hygiene Management Plan will be implemented for construction of the Proposal as per the EMP, to minimise risk of the impact of disease.
Western Ringtail Possum	**Department of Parks and Wildlife (2017). Western Ringtail Possum *Pseudocheirus occidentalis*) Recovery Plan. Wildlife Management Program No. 58. Department of Parks and Wildlife, Perth, WA.**		
	1	*Habitat loss and fragmentation*	The Proposal may exacerbate this threat due to clearing of suitable Western Ringtail Possum habitat (up to 70.3 ha).
	2	*Timber harvesting*	The Proposal is not considered to exacerbate this threat as timber harvesting will not be undertaken, other than to recover the timber resource within clearing area.
	3	*Fire*	The Proposal is not expected to exacerbate this threat. There is considered to be a low risk of accidental fire as a result of construction activities. Clearing activities are a potential risk of fire generation. To minimise the risk of fire, clearing activities will not be undertaken when the Fire Danger Rating is severe or higher. The CEMP will include an emergency management plan.
	4	*Competition for tree hollows*	The Proposal may exacerbate this threat due to clearing of suitable Western Ringtail habitat thereby increasing competition for tree hollows within habitat surrounding the Proposal Area.
	5	*Habitat tree decline*	The Proposal is not expected to exacerbate this threat. A dieback occurrence assessment has been completed to identify priority areas within the Proposal Area (Great Southern Bio Logic, 2018). A Hygiene Management Plan will be implemented for construction of the Proposal as per the EMP to minimise risk of the impact of disease.

EPBC ACT LISTED	PLAN/ CONSERVATION ADVICE AND THREATS		RESPONSE
	6	*Unregulated relocation of orphaned, injured and rehabilitated Western Ringtail Possums*	The Proposal will not exacerbate this threat. Fauna relocation will be considered for conservation significant terrestrial fauna species, including trapping for Western Ringtail Possums. A Fauna Management Plan will be written for the Proposal. An appropriately qualified fauna handler will be on site during clearing of Western Ringtail Possum habitat.
	7	*Disease*	The Proposal is not expected to exacerbate this threat. A dieback occurrence assessment has been completed to identify priority areas within the Proposal Area (Great Southern Bio Logic, 2018). A Hygiene Management Plan will be implemented for construction of the Proposal as per the EMP to minimise risk of the impact of disease.
	8	*Gaps in knowledge*	The Proposal will not exacerbate this threat as numerous studies and investigations have been undertaken for the purpose of reducing gaps in knowledge regarding the Proposal.
	Threatened Species Scientific Committee (2018). Conservation Advice *Pseudocheirus* occidentalis Western Ringtail possum. Canberra: Department of the Environment and Energy.		
	1	*Groundwater depletion and altered hydrology*	The Proposal is not expected to exacerbate this threat. A Drainage Strategy has been developed for the project with in principle support from DWER (section 4.6.3.2) Of which one of the main objectives of the strategy is "maintenance of existing water cycle balance within the project area whilst also improving the surface and groundwater quality". Drainage design will be undertaken at the detailed design stage to allow for pre-development flows to be maintained within the Proposal Area.
	2	*Land clearing and habitat fragmentation caused by urbanisation*	The Proposal may exacerbate this threat due to clearing of suitable Western Ringtail Possum habitat (up to 70.3 ha).

EPBC ACT LISTED	PLAN/ CONSERVATION ADVICE AND THREATS		RESPONSE
	3	*Fire*	The Proposal is not expected to exacerbate this threat. There is considered to be a low risk of accidental fire as a result of construction activities. Clearing activities are a potential risk of fire generation. To minimise the risk of fire clearing activities will not be undertaken when the Fire Danger Rating is severe or higher. The CEMP will include an emergency management plan.
	4	*Tree decline and insect outbreaks*	The Proposal is not expected to exacerbate this threat. A dieback occurrence assessment has been completed to identify priority areas within the Proposal Area (Great Southern Bio Logic, 2018). A Hygiene Management Plan will be implemented for construction of the Proposal as per the EMP to minimise risk of the impact of disease.
	5	*Competition for tree hollows*	The Proposal may exacerbate this threat due to clearing of suitable Western Ringtail habitat thereby increasing competition for tree hollows within habitat surrounding the Proposal Area.
	6	*Logging*	The Proposal will not exacerbate this threat as timber harvesting will not be undertaken other than to recover the timber resource within clearing area.
	7	*Myrtle rust*	The Proposal is not expected to exacerbate this threat. A Hygiene Management Plan will be implemented for construction of the Proposal as per the EMP to minimise risk of the impact of disease.
	8	*Injury and mortality due to vehicle strike*	The Proposal may exacerbate this threat as the Proposal is predominantly located in rural landscape which is largely undeveloped.
	9	*Unregulated relocation of orphaned, injured and rehabilitated Western Ringtail Possums*	The Proposal will not exacerbate this threat. Fauna relocation will be considered for conservation significant terrestrial fauna species, including trapping for Western Ringtail Possums. A Fauna Management Plan will be written for the Proposal. An appropriately qualified fauna handler will be on site during clearing of Western Ringtail Possum habitat.

EPBC ACT LISTED	PLAN/ CONSERVATION ADVICE AND THREATS		RESPONSE
Black-stripe Minnow	**Threatened Species Scientific Committee Conservation Advice *Galaxiella nigrostriata* Black-stripe Minnow** (DoEE, 2018b)		
	1	*Introduced invasive fish:* *The introduction of exotic fish, including the mosquitofish* Gambusia holbrooki*, could impact on* Galaxiella nigrostirata *through food competition, aggressive or predatory behaviour (i.e. fin-nipping) leading to displacement, injury and/or death, and introduction of diseases.*	The Proposal is not expected to exacerbate this threat.
	2	*Habitat modification leading to degradation and loss of habitat:* *Filling and draining of wetlands and waterways for various land-use practices, including agriculture, urbanisation, road construction and maintenance, forestry, dams and other related infrastructure, and mineral and quartzite sand mining* *Excessive anthropogenic groundwater extraction* *Altered fire regimes* *Increased salinity due to agricultural practices/historical land clearing.*	The Proposal is not expected to exacerbate this threat. Minor loss of cleared and degraded wetlands within the Proposal area will occur however, hydrological regimes of wetlands adjacent to the Proposal Area will be maintained through the implementation a Drainage Strategy. Where appropriate, drainage design will incorporate designs to facilitate the movement of aquatic fauna.
Carter's Freshwater Mussel	**Threatened Species Scientific Committee Conservation Advice *Westralunio carteri* Carter's Freshwater Mussel** (DoEE, 2018b)		
	1	*Water extraction, dehydration and heat stress*	The Proposal is unlikely to exacerbate this threat. Potential impacts to or disturbance of waterways during and post construction of bridges at the Collie, Ferguson and Preston Rivers will be carefully managed through implementation of the Drainage Strategy and CEMP. A Fauna management plan will be developed and may include a relocation of Carter's Freshwater Mussel if required.
	2	*Nutrient pollution*	The Proposal is unlikely to exacerbate this threat. Runoff during and post construction will be carefully managed during and post construction of bridges at the Collie, Ferguson and Preston Rivers through the implementation of the Drainage Strategy and the CEMP.

Table 6-3 Relevant Commonwealth threat abatement plan/ objectives for potential impacts on MNES within the Proposal Area

IMPACT	PLAN/ CONSERVATION ADVICE AND OBJECTIVES		RESPONSE
Dieback	**Threat abatement plan for disease in natural ecosystems caused by *Phytophthora cinnamomi*** (DoEE, 2018c)		
	1	*Identify and prioritise for protection biodiversity assets that are, or may be, impacted by* Phytophthora cinnamomi.	The Proposal is considered to be consistent within this objective. A dieback occurrence assessment has been completed to identify priority areas within the Proposal Area (Great Southern Bio Logic, 2018). A Hygiene Management Plan will be implemented for construction of the Proposal as per the EMP.
	2	*Reduce the spread and mitigate the impacts of Phytophthora to protect priority biodiversity assets and susceptible landscapes.*	
	3	*Inform and engage the community by promoting information about* Phytophthora*, its impacts on biodiversity and actions to mitigate these impacts.*	The Proposal is considered to be consistent within this objective. Extensive community and stakeholder consultation has been undertaken regarding environmental investigations undertaken for the Proposal and are outlined in section 3.

6.6 Predicted outcome

The predicted outcomes for MNES impacted by the Proposal are:

- Direct loss of up to 7.6 ha of Banksia Woodlands of the Swan Coastal Plain TEC (Endangered) (section 4.3.3)
- Direct loss of up to 1.5 ha of Herb rich shrublands in clay pans TEC (Critically Endangered) (section 4.3.3)
- Direct loss of habitat for the following EPBC Act listed fauna species known to occur within the Proposal Area (section 4.4.3.5):
  - 59.7 ha of Carnaby's Cockatoo habitat (Endangered)
  - 59.7 ha of Baudin's Cockatoo habitat (Endangered)
  - 59.7 ha of Forest Red-tailed Black Cockatoo habitat (Vulnerable)
  - Up to 1116 Black Cockatoo Suitable DBH Trees, five of which are considered to be Trees with a Suitable Hollow
  - 70.3 ha Western Ringtail Possum habitat (Critically Endangered)
  - Disturbance of 1.4 ha Carter's Freshwater Mussel habitat (Vulnerable)
- Potential loss of habitat for the Black-stripe Minnow. No Black-stripe Minnow were found within the Proposal Area, however one individual was found within the Survey Area in a wetland adjoining the Proposal Area. Further field investigations will be undertaken during winter 2019 to identify suitable habitat for Black-stripe Minnow and determine the likelihood of occurrence within the Proposal Area.

7 HOLISTIC IMPACT ASSESSMENT

The EIA process needs to consider the connections and interactions between parts of the environment to inform a holistic view of impacts to the whole environment. This requires consideration of the impacts of the Proposal in a regional context as well as at the local scale.

The primary purpose of the Proposal is to:

- Reduce local congestion through increasing efficiency for freight vehicles and regional traffic
- Improve long term access to the Bunbury Port
- Support socio-economic growth and facilitate integrated development in greater Bunbury and the South West region
- Enhance amenity on local roads by reducing freight and regional traffic
- Create a safer road system for our community.

The environmental and social impact studies undertaken for this Proposal have considered and assessed potential impacts at both at a local and regional scale. The results of these studies have informed the Proposal impact assessment and development of mitigation measures.

Although it is considered that the Proposal will not have a significant adverse impact on the environmental and social factors, it is recognised that there is a high level of public interest in this proposal, particularly among nearby residents and landowners.

The Proposal's predicted outcomes have been considered in relation to the environmental principles (see Section 4.1) and the EPA's environmental objectives for each Key Environmental Factor.

Main Roads considers that the significant measures undertaken to reduce the Proposal's social impacts and by avoiding areas containing high quality environmental values, demonstrated by the Proposal Area almost containing no Good or better condition vegetation, will ensure the EPA's objectives for each key factor will be met.

8 CONCLUSION

Significant effort was undertaken during the alignment selection process to locate the corridor for BORR where it will have the least environmental and social impacts. The selection of the Northern and Central Sections of BORR attempted, wherever possible, to avoid good patches of native vegetation by locating the corridor within areas that have been predominately cleared for agricultural purposes. This has resulted in impacts to vegetation, flora and fauna and their habitats being minimised. Further refinements will be made to reduce the potential impacts during the detailed design process.

As a consequence of the location of the Proposal in a predominantly cleared area, the impacts to flora and vegetation are not considered to be significant.

Due to the occurrence of fauna of conservation significance, in particular the Western Ringtail Possum and three species of threatened black-cockatoo, some minor residual impacts to fauna are expected.

Impacts to soil quality, hydrological process and water quality are not considered to be significant as proposed management measures will avoid and minimise any potential impacts.

There will be air emissions during construction of the road however these are not considered to be significant as these will be effectively managed during construction. Air quality modelling predicted that there will be not be a significant impact on air quality as a result of the construction and operation of the Proposal.

Although noise emissions will increase along the length of the alignment, the mitigation of these emissions will be managed in accordance with the requirements of State Planning Policy 5.4.

The visual amenity will be altered as a result of the construction and operation of the Proposal, however, this is not expected to be significant as the Proposal Area is predominately low lying, cleared agricultural land.

The ongoing review and implementation of the Environmental Management Plan (BORR IPT 2019f) will assist in minimising actual and potential impacts.

8.1 Flora and vegetation

The Proposal's impacts to vegetation includes the loss of 91.2 ha of native vegetation and 28.1 ha of revegetated/rehabilitated land. The loss of native vegetation is approximately 14 % of the total area of the Proposal. The remaining 86 % of the Proposal Area is cleared or highly modified agricultural land or revegetation. The conservation significant vegetation Banksia Woodland of the SCP TEC (up to 7.6 ha including 3.0 ha requiring additional surveys) and Herb rich shrublands in clay pans TEC (up to 1.49 ha all requiring additional survey to confirm occurrence) were recorded in the Proposal Area. Nine plants from two Priority 4 flora species and four Priority 3 plants (single species) were also recorded. No known Threatened flora will be impacted by the Proposal.

The majority of the proposal area has been cleared for agriculture and this remains the dominant landuse. The fragmented native vegetation that occurs within the proposal area is predominately 'Degraded' or 'Completely Degraded' including areas mapped as wetlands. Overall, the Proposal Area is considered to have low ecological and floristic diversity.

Detailed design of BORR is predicted to further reduce the area of native vegetation to be cleared.

Given the highly degraded nature of the Proposal Area, the clearing for the Proposal is not considered to have a significant impact this Environmental Factor, with the EPA's objective for Flora and Vegetation being met.

8.2 Terrestrial fauna

The Proposal will result in the direct loss of 104.70 ha of mapped fauna habitat. This loss includes the following potential impacts to conservation significant fauna:

- Clearing of up to 59.7 ha of Black Cockatoo foraging and breeding habitat, representing less than 1 % of local habitat
- Loss of up to five trees considered to be Trees with a Suitable Black Cockatoo Nest Hollow and a further 1111 Suitable DBH Trees. No known nesting hollows will be impacted
- Clearing of up to 70.3 ha of Western Ringtail Possum habitat and displacement of up to 49 individual Western Ringtail Possums, representing less than 1 % of the regional population
- Clearing of up to 28.2 ha of South-western Brush-tailed Phascogale habitat
- Potential impact to up to 1.4 ha of habitat of Carter's Freshwater Mussel.

Given the Proposal Area does not contain any known nesting hollows and that the project will impact on less than 1 % of local Black Cockatoo habitat and regional Western Ringtail Possum habitat, the Proposal is not considered to have a significant impact on terrestrial fauna, including conservation significant fauna.

8.3 Terrestrial environmental quality

The Proposal will result in the impairment of soil function as a result of establishing a permanent constructed surface. It is anticipated that soil function will be maintained outside of constructed surfaces as a result of the re-use of stockpiled topsoil during the rehabilation and landscaping phase of the project.

The potential for contamination of soils and land environmental quality will be mitigated through standard construction management measures. Spillages that may occur during the operation of BORR will be located and managed by dedicated response teams.

Although manageable, the Proposal's most significant risk to terrestrial environmental quality is the release of PASS to the terrestrial and hydrological environment during construction. The local PASS risk will be quanitifed through investigation and development of site specific management will be undertaken.

8.4 Inland waters

Impacts to existing hydrology within the Proposal Area will be minimised during the detailed design phase and implementation of the Drainage Strategy. Surface water will be managed during construction with adherence to the CEMP and an EMP once the Proposal is operational. The detailed design phase will include transverse drainage to maintain the existing water balance within the Proposal Area, particularly in the wetlands and waterways.

Construction of the Proposal will require limited dewatering which would temporarily impact groundwater levels. These impacts are however expected to be short term, localised and minor.

The risk of water contamination during constrctuion and operation will be mitigated with appropriate management and monitoring.

The Proposal includes bridge structures that have the potential to impact the stability of river banks and impede flow. Design of the structures will reduce the risk of impacting the bed and banks of these waterways.

The construction of the Proposal will meet the EPA's objective to *"maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected".*

8.5 Air quality

Construction of the Proposal will result in the emissions of dust which may have a short term, localised impact air quality. Dust emission will be managed with implementation of the CEMP.

The construction of the Proposal will meet the EPA's objective to "maintain air quality and minimise emissions so that environmental values are protected".

8.6 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.*

The Proposal has the potential to impact known Aboriginal heritage values. Risks to sites of Aboriginal Heritage significance will be managed through consultation with relevant groups and, where necessary, additional approvals (including Section 18 clearance) will be obtained via the AH Act.

The construction of the Proposal will meet the EPA's objective to *"protect social surroundings from significant harm".*

8.7 Impact Summary

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

The Northern and Central Sections of BORR largely occur within areas that have been largely cleared for agricultural purposes. Main Roads anticipates that the social and environmental impacts of the Proposal can be appropriately managed through the measures discussed within this document and considers the EPA's objectives for each key factor will be met.

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– Acid Sulfate Soil Risk Map, Swan Coastal Plain (DWER-055)
– CAWSA Part 2A Clearing Control Catchments (DWER-004)
– Clearing Regulations – Environmentally Sensitive Areas (DWER-046)
– Consanguineous Wetlands Suites (DBCA-020)
– Geomorphic Wetlands, Swan Coastal Plain (DBCA-019)
– Groundwater Salinity Statewide (DWER-026)
– Legislated Lands and Waters (DBCA-011)
– Municipal Inventory (SHO-005)
– Native Vegetation Extent (DPIRD-005)
– Pre-European Vegetation (DPIRD-006)
– Public Drinking Water Source Areas (DWER-033)
– Ramsar Sites (DBCA-010)
– RIWI Act, Groundwater Areas (DWER-019)
– RIWI Act, Rivers (DWER-036)
– RIWI Act, Surface Water Areas and Irrigation Districts (DWER-037)
– Soil Landscape Mapping – Best Available (DPIRD-027)
– Heritage Council WA – State Register (SHO-003)
– Threatened Ecological Communities (DBCA-038)
– Waterways Conservation Act Management Areas (DWER-072)

BORR Team

APPENDIX A

Figures

Figure 23 Forecast $LA_{eq,day}$ Build 2041 noise levesl at the most affected façade - With barriers to meet the 60 dB noise limit at properties adversely affected by the new roads

APPENDIX B

Bunbury Outer Ring Road Northern Section – Alignment Selection Report (Main Roads 2018)

APPENDIX C

WAPC Decision Sheet (2018)

APPENDIX D

BORR Northern and Central Sections Vegetation and Flora Assessment (BORR IPT 2019c)

APPENDIX E

BORR Northern and Central Section Targeted Fauna Assessment (Biota 2019a)

APPENDIX F

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

APPENDIX G

Basic Summary of Records (August 2018)

APPENDIX H

Aboriginal Heritage Desktop Searches

APPENDIX I

BORR Northern and Central Sections Traffic Noise Assessment (BORR IPT 2019d)

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