



Great Northern Highway Muchea to Wubin Upgrade - Stage 2

MAIN ROADS WESTERN AUSTRALIA

Bindoon Bypass - SLK 51.4 - 93.0 | Environment | S38 EP Act Referral - Supporting Information Document

Document Number :	GNH-CN12-EN01-RPT-0002
Revision :	3
Phase :	Stage 2
Date :	4 / 09 / 2017
Contract Number :	CN12-EN01
Client Contract Number :	10/13



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Document Control

Document description	
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Current Issue

Revision	Date
3	4 September 2017

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Issue summary

Revision	Date	Issue description	Distribution
1	22-06-2017	Draft	Cross Discipline Review / Technical Review / PAG Review
2	28-08-2017	Final Draft	PAG for Approval
3	04-09-2017	Final	Submission to EPA

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Glossary

Abbreviation	Description
AHA	<i>Aboriginal Heritage Act 1972</i>
AHD	Australian Height Datum
AHIS	Aboriginal Heritage Inquiry System
ARI	Average Recurrence Interval
ASJV	Arup Jacobs Joint Venture
ASRIS	Australian Soil Resource Information System
ASS	Acid Sulfate Soils
BAM Act	<i>Biosecurity and Agriculture Management Act 2007</i>
BC Act	<i>Biodiversity Conservation Act 2016</i>
BoM	Bureau of Meteorology
CEMP	Construction Environmental Management Plan
CN	Contract Number
CNOX	Contract XX – [Contract Name]
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DBCA	Department of Biodiversity Conservation and Attractions
DWER	Department of Water and Environmental and Regulation
DoEE	Department of the Environment and Energy
Parks and Wildlife	Parks and Wildlife Service
DSEWPaC	Department of Sustainability Environment Water Planning and Community
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPA	Environmental Protection Authority
EP Act	<i>Environmental Protection Act 1986</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
ESA	Environmentally Sensitive Area
GDA94	Geocentric Datum of Australia 1994
GDE	Groundwater Dependent Ecosystems
GIS	Geographic Information System
GNH	Great Northern Highway
GPS	Global Positioning System
ha	Hectare
IBA	Important Bird Area
IBRA	Interim Biogeographic Regionalisation of Australia
IUCN	International Union for Conservation of Nature
km	Kilometre

Abbreviation	Description
LGA	Local Government Authority
m	Metre
Main Roads WA	Main Roads Western Australia
MGA94	Map Grid of Australia 1994
MI	Municipal Inventory
MNES	Matters of National Environmental Significance
mm	Millimetre
M2W	Muchea to Wubin
M2W team	Muchea to Wubin Integrated Project Team, comprising Main Roads WA and industry partners Jacobs and Arup
PDNH	Perth to Darwin National Highway
PEC	Priority Ecological Communities
PEIA	Preliminary Environmental Impact Assessment
RIWI Act	<i>Rights in Water and Irrigation Act 1914</i>
SLK	Straight Line Kilometre
SWALSC	South West Aboriginal Land and Sea Council
t	Metric tonne
TEC	Threatened Ecological Communities
WA	Western Australia
WAOL	Western Australian Organism List
WAPC	Western Australian Planning Commission
WC Act	<i>Wildlife Conservation Act 1950</i>
WoNS	Weeds of National Significance

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1. Introduction

1.1 Project Background

The Great Northern Highway (GNH) is a critical freight link between the Perth metropolitan area and the towns and mining centres of the Midwest and Pilbara regions of Western Australia. In 2014, Main Roads Western Australia (Main Roads WA) established the Muchea to Wubin Integrated Project Team (M2W Team), comprising Main Roads WA and industry partners Arup and Jacobs (combining to form Arup Jacobs Joint Venture, ASJV) to conduct a comprehensive planning review of the full Muchea to Wubin link along the GNH. The focus of the planning review was to improve freight efficiency and safety for both road users and local communities.

The review identified Bindoon Hill as a critical area requiring improvement before 53.5 m road trains could safely travel between Muchea and Wubin. The key design constraint was poor geometry, in particular steep grades on Bindoon Hill, which may be impassable for 53.5 m road trains travelling uphill and/or result in unsafe conditions for descending road trains. Due to different requirements at the time, the previously endorsed (eastern) bypass of the town of Bindoon did not take into account the steep grades on Bindoon Hill and retained the current alignment through this area. As a result, a separate planning review and options assessment was undertaken for the Bindoon area which resulted in the decision to develop a bypass of the Bindoon township with Western Bypass Corridor A as the preferred alignment.

1.2 Scope and Purpose of this Document

The scope of this document covers the Bindoon Bypass section of the GNH (the 'Proposal').

In accordance with Main Roads WA environmental assessment process an environmental impact assessment (EIA) of the Proposal has been undertaken to provide an initial assessment of the potential environmental and heritage values of the area, assess the significance of these potential impacts and define the approvals strategy. The preliminary assessment involved a desktop analysis of environmental aspects and impacts, a site investigation and an assessment of native vegetation clearing.

The results of the PEIA and initial consultation of the Office of the Environmental Protection Agency (OEPA) indicate that there is potential for the Proposal to have a significant environmental effect and, as such, it should be referred to the Environmental Protection Agency (EPA) for assessment under Section 38 (S38) of the *Environmental Protection Act 1986* (EP Act). This Supporting Information Document has been prepared as part of the referral submission and should be read in conjunction with the EPA S38 referral form.

This Supporting Information Document details the key characteristics of the Proposal and provides a preliminary assessment of the potential impacts that may occur to each of the EPA environmental factors. This assessment details:

- the EPA environmental factors that may be impacted;
- the EPA Policy and Guidance that has been considered;
- outcomes of consultation that has been undertaken;
- the condition of the receiving environment;
- the proposal activities that may impact the environment;
- proposed management and mitigation;
- an assessment of the potential impacts against the EPA objective; and
- any assumptions that have been made in the assessment.

The terms below are used to describe various parts of the project throughout the document:

- **Bindoon Bypass:** The proposed road alignment from the Chittering Roadhouse, bypassing the town of Bindoon and re-joining GNH between Hay Flat Road and Calingiri Road.
- **Concept Alignment:** The current early stage design alignment.
- **Indicative Disturbance Footprint:** The current proposed area of disturbance based on the concept alignment. The Indicative Disturbance Footprint is based on the required road reserve width plus a 5 m buffer each side for fencing and other works. Clearing within the full extent of the Disturbance Boundary will be required.
- **Development Envelope:** The area in which the final Disturbance Boundary will lie.

2. Proposal Description

The current GNH runs through the increasingly populated regions of the Swan Valley, Bullsbrook and Bindoon, resulting in increased congestion, reduced social amenity and service quality in this area and negatively impacting freight efficiency. Heavy vehicles currently struggle with the steep grades on the existing GNH at Bindoon Hill. With the proposed approval of 53.5 m road trains to travel between Muchea and Wubin, it has been identified that the current grade was likely to present a barrier to the movement of 53.5 m road trains and a more efficient route through or around Bindoon is required.

Identified impediments to 53.5 m road trains travelling along this section of GNH include:

- Bindoon Townsite: Major safety concerns regarding conflicts between local traffic, pedestrian, Over Size Over Mass vehicles (OSOMs) and heavy freight through the Bindoon town centre; and
- Bindoon Hill:
 - ▶ the steep grades of up to 6.2% over a 2 km length currently result in heavy vehicles travelling slowly at speeds of approximately 20 km/h. This would be exacerbated by 53.5 m road trains travelling as slow as 12 km/h or slower. The speed differential between slow moving heavy vehicles and light vehicles would cause operational safety issues;
 - ▶ there are a number of substandard horizontal curves and no passing lanes on the downhill sections; and
 - ▶ high temperatures in the summer months can adversely impact the bitumen surface and heavy vehicle performance on the steep sections of the hill.

As such, Main Roads WA proposes to construct a bypass of the town of Bindoon located within the Shire of Chittering approximately 70 km north east of Perth and approximately 13 km north of Muchea, Western Australia (**Figure 1**). The Bindoon Bypass will divert from the existing GNH at the Chittering Roadhouse running west of Bindoon and re-joining the GNH between Hay Flat Road and Calingiri West Road. This will involve the construction of 48 km of new highway. The Bindoon Bypass will be constructed in stages based on the expected traffic volumes. The initial stage is proposed to consist of single carriageway (two lane) with a number of overtaking lanes for both north-bound and south-bound traffic as well as stopping facilities. It is proposed that the new highway will ultimately be dual carriageway (four lanes) between Chittering Roadhouse and Bindoon-Moora Road and single carriageway (two lanes) between Bindoon-Moora Road the tie in to the existing GNH between Hay Flat Road and Calingiri West Road. Upgrades to local roads, rail crossings and intersections may also be required.

In order to provide an indication of the potential environmental impacts of the Proposal a concept alignment has been developed as shown in **Figure 1**. An Indicative Disturbance Boundary has been applied to this concept alignment which indicates the area that would likely be disturbed facilitate the construction of the carriageway, earthworks and fencing. Further route alignment optimisation based on engineering, environmental, social and cost factors will be undertaken as the design progresses, further stakeholder engagement is undertaken, and further information with regards to engineering and environmental constraints becomes available.

To maintain flexibility with respect to the ongoing route optimisation and potential changes to the Indicative Disturbance Boundary, a Development Envelope has been proposed as shown in **Figure 1**. This Development Envelope represents the area in which the final Disturbance Boundary will lie. The Development Envelope does not represent that total area of disturbance. This approach has been adopted to facilitate the referral of the Proposal to the EPA under S38 of the EP Act and subsequent scoping and execution of the various studies and surveys that will be required to build on the current information available.

Table 2-1 provides a general description of the proposal while **Table 2-2** summaries the key characteristics of the Proposal.

Table 2-1 : Summary of Proposal

Proposal Title	Great Northern Highway – Bindoon Bypass.
Proponent Name	Main Roads Western Australia.
Short Description	The proposal is to construct and operate a new 48 km section of the Great Northern Highway within the Shire of Chittering. The proposal would bypass the town of Bindoon located approximately 70 km north east of Perth, Western Australia. The Proposal would consist of a combination of four lane dual carriageway, four lane single carriageway and two lane single carriageway and would divert from the existing GNH at the Chittering Roadhouse running west of Bindoon and re-joining the GNH between Hay Flat Road and Calingiri West Road.

Table 2-2 : Key Characteristic of Proposal

Element	Location	Proposed Extent
Road construction and associated infrastructure	Figure 1	<p>Clearing and disturbance of no more than 650 ha consisting of up to 144 ha of native vegetation and 392 ha of scattered trees over pasture. This includes up to:</p> <ul style="list-style-type: none"> • 55 ha of Priority 2 PEC Banksia woodland of the Gingin area restricted to soils dominated by yellow to orange sands. • 2.5 ha of Conservation Category Wetlands. • 144 ha of habitat for Black Cockatoos. <p>within a 3,422 ha Development Envelope.</p>

3. Alternatives Considered

A wide range of corridors were investigated including the previously endorsed Perth Darwin National Highway (PDNH), Brand Highway alternatives and hybrid GNH/PDNH corridors. Two Multi Criteria Analysis (MCA) processes were undertaken to refine the number of preliminary corridors for the Bindoon Bypass from sixteen down to three; Western Bypass Corridor A (the proposed action); Western Bypass Corridor B; and Eastern Bypass Corridor C.

The three corridors were presented to the Minister for Transport on 21 March 2016 (**Figure 2**). Approval was received to undertake further analysis and a public consultation process. Following the public consultation, the GNH M2W team developed a detailed MCA framework to assess the three corridors. In addition to the detailed MCA, the three corridors were assessed and compared in terms of cost, economics (Benefit Cost Ratio (BCR)), project delivery risks and other engineering considerations.

Western Bypass Corridor A was the best performing option in the detailed MCA. This strong performance in the MCA, combined with a comparable cost to the cheapest option, a good BCR, the least risks to delivery of the project, and better travel characteristics, resulted in the Western Bypass Corridor A being endorsed as the preferred corridor on 12 January 2017, following approval by the Western Australian Planning Commission.

Not taking the action is not considered a viable alternative for the following reasons:

- Steep grades on the existing GNH at Bindoon Hill present a hazard to heavy vehicles and other road users. Heavy vehicles slow down to extremely slow speeds travelling uphill, while on the downhill side, there is a risk of heavy vehicles being unable to control the increase in speed, presenting a higher risk of collisions or vehicle rollovers. The Bindoon Bypass eliminates the need for heavy vehicles to travel this section of road.
- Heavy vehicles currently travel through the town of Bindoon, creating a community safety hazard. Bindoon Primary School is located approximately 180 m east of the existing GNH at the northern end of Bindoon. The Bindoon Bypass will remove heavy vehicles from the town (except those servicing Bindoon), providing an increase in community safety and amenity.
- The steep grades at Bindoon Hill represent an obstacle for 53.3 m road trains. An alternative route around Bindoon Hill is required to allow passage of 53.3 m road trains and improve the efficiency of freight transport along the highway.

4. Consultation

From the commencement of planning studies associated with the proposed action, consultation has been undertaken with various parties including:

- Shire of Chittering;
- Shire of Gingin;
- OEPA;
- DoEE;
- Department of Water and Environmental Regulation (DWER);
- Department of Biodiversity Conservation and Attractions, specifically the Parks and Wildlife Service;
- Department of Planning, Lands and Heritage
- Department of Transport;
- Local community;
- Landowners, tenants and lease holders;
- Heavy Vehicle Liaison Group;
- Local Businesses,
- Chittering Tourist Association;
- Wheatbelt Development Commission;
- Bindoon Bypass Reference Group;
- Agricultural Lime Cartage Association; and
- Traditional Owners (TOs) of the Yued Noongar dialect group.

A number of methods have been used to communicate with stakeholders including:

- community consultation sessions;
- Heavy Vehicle Liaison Group sessions;
- project overview brochures and newsletters;
- newspaper advertising;
- media briefings/ releases;
- direct mail/ email;
- Collabmaps (online spatial comments tool);
- direct contact with key stakeholders (face-to-face meetings);
- public displays (static displays of enlarged maps – accompanied by newsletters);
- Ministerial Briefing Notes; and
- website information.

A number of issues and concerns have been raised to date. The major issues raised were:

- Bindoon town viability (reduced number of visitors to town);
- Property devaluation;
- Severance of properties and impact on economic viability;

- Noise and visual impacts;
- Environmental impacts including pollution of waterways; and
- Loss of access to water bores, dams and soaks.

Further consultation will take place as the Proposal progresses.

5. Potential Environmental Impacts

5.1 Preliminary Key Environmental Factors

Main Roads WA has reviewed the factors and objectives defined in the EPA's Statement of Environmental Principles, Factors and Objectives (EPA, 2016) and identified the following preliminary key environmental factors as relevant to the Proposal:

- Flora and Vegetation;
- Terrestrial Fauna;
- Hydrological Process;
- Inland Waters Environmental Quality; and
- Social Surroundings.

The above factors are discussed in **Table 5-1** to **Table 5-5**. Main Roads WA considers that the remaining environmental factors are either not relevant to this Proposal or potential impacts will not be significant (see **Section 5.2**).

Table 5-1 : Potential Impacts – Flora and Vegetation

No.	Item	Response
1	EPA Factor	Flora and Vegetation Objective: To maintain representation, diversity, viability and ecological function at the species, population and assemblage level
2	EPA policy and guidance - What have you considered and how have you applied them in relation to this factor?	<p>The following EPA policies and guidelines have been considered for the proposal in order to meet the EPA’s objective in relation to this factor:</p> <ul style="list-style-type: none"> • Statement of Environmental Principles, Factors and Objectives (EPA, 2016); • Environmental Factor Guideline: Flora and Vegetation (EPA, 2016); and • Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016). <p>Flora and vegetation surveys have been and will continue to be planned and executed in accordance with the EPA’s technical guidance for this factor. Any survey limitations relative to the technical guidance will be noted in the flora and vegetation survey report.</p> <p>The Development Envelope and Indicative Development Footprint have been designed such that known locations of conservation significant flora and ecological communities have been avoided or potential impacts minimised where practicable using the mitigation hierarchy.</p> <p>The Environmental Factor Guideline has been considered during the identification of flora and vegetation values within the Development Envelope and the issues identified in the guideline considered in relation to potential impacts from the Proposal.</p>
4	Receiving environment - Describe the current condition of the receiving environment in relation to this factor.	<p>The Proposal is situated in the Dandaragan Plateau subregion of the Swan Coastal Plain Bioregion and the Northern Jarrah Forest subregion of the Jarrah Forest Bioregion, as defined by the Interim Biogeographic Regionalisation for Australia (IBRA) (DoEE; 2016h).</p> <p>Flora and vegetation surveys have been undertaken across the Disturbance Envelope in Spring 2016 (Appendix A). Additional Surveys are planned for Autumn/Winter 2017 and Spring 2017.</p> <p>Vegetation</p> <p>The Spring 2016 survey (Focused Vision, 2017) identified 13 vegetation communities within the Development Envelope (Figure 3). These vegetation communities together with their corresponding Shepherd <i>et. al.</i> (2002) association are detailed below. When correlated back to the Shepherd <i>et. al.</i> (2002) vegetation associations used to assess current extent against pre-European extent, three vegetation communities were considered to be Vulnerable with less than 30% of their pre-European extent remaining. The communities were Vegetation Association 4, Vegetation Association 999 and Vegetation Association 1018. Refer to Appendix B for full details of the current extent of these vegetation communities. The Focused Vision (2017) vegetation community BmKgHg could not be correlated to a Shepherd <i>et. al.</i> (2002) vegetation community. The community was</p>

No.	Item	Response																					
		associated with a wetland area at Mooliabeenee Road and may be considered locally and regionally significant.																					
		<table border="1"> <thead> <tr> <th>Focused Vision Vegetation Code</th> <th>Vegetation Association Description</th> <th>Shepherd <i>et. al.</i> (2002) vegetation code</th> </tr> </thead> <tbody> <tr> <td>BaXpAn</td> <td><i>Banksia attenuata</i> and <i>Banksia menziesii</i> low sparse woodland over <i>Xanthorrhoea preissii</i> mid isolated to sparse shrubs over <i>Bossiaea eriocarpa</i> and <i>Petrophile linearis</i> low isolated shrubs over <i>Alexgeorgea nitens</i> and <i>Lyginia imberbis</i> sparse sedges.</td> <td>1027</td> </tr> <tr> <td>EtBeAn</td> <td><i>Eucalyptus todtiana</i> and <i>Banksia attenuata</i> low sparse woodland over <i>Bossiaea eriocarpa</i> and <i>Hibbertia hypericoides</i> low isolated shrubs over <i>Trachymene pilosa</i> and <i>Gladiolus caryophyllaceus</i> isolated herbs and <i>Alexgeorgea nitens</i> and <i>Mesomelaena pseudostygia</i> sedges.</td> <td>949</td> </tr> <tr> <td>BmKgHg</td> <td><i>Banksia menziesii</i> and <i>Banksia</i> spp low sparse to open woodland over <i>Kunzea glabrescens</i> and <i>Xanthorrhoea preissii</i> mid shrubland over <i>Hypochaeris glabra</i> and <i>Drosera erythrorhiza</i> isolated herbs</td> <td>Could not be mapped to a corresponding code</td> </tr> <tr> <td>EtEpAn</td> <td><i>Eucalyptus todtiana</i> and <i>Banksia</i> spp. low sparse woodland over <i>Adenanthos cygnorum</i> tall sparse shrubland over <i>Eremaea pauciflora</i> and <i>Stirlingia latifolia</i> mid sparse to isolated shrubland over <i>Bossiaea eriocarpa</i> and <i>Conostephium pendulum</i> low isolated shrubs over <i>Austrostipa hemipogon</i> and <i>Briza maxima</i> grasses and <i>Alexgeorgea nitens</i> sedges</td> <td>949</td> </tr> <tr> <td>EmXpHh</td> <td><i>Eucalyptus marginata</i> low sparse woodland over <i>Xanthorrhoea preissii</i> mid sparse shrubland over <i>Hibbertia hypericoides</i>, <i>Bossiaea eriocarpa</i> and <i>Banksia dallanneyi</i> low isolated shrubs over <i>Conostylis setosa</i>, <i>Xanthosia huegelii</i> and <i>Philothea spicata</i> isolated herbs</td> <td>1019</td> </tr> <tr> <td>EmBsHh</td> <td><i>Eucalyptus marginata</i> low sparse woodland over <i>Banksia sessilis</i> and <i>Xanthorrhoea preissii</i> tall to mid-sparse shrubland over <i>Hibbertia hypericoides</i> and <i>Bossiaea eriocarpa</i> low isolated to sparse shrubland over <i>Hypochaeris glabra</i> and <i>Ursinia anthemoides</i> isolated herbs</td> <td>1019</td> </tr> </tbody> </table>	Focused Vision Vegetation Code	Vegetation Association Description	Shepherd <i>et. al.</i> (2002) vegetation code	BaXpAn	<i>Banksia attenuata</i> and <i>Banksia menziesii</i> low sparse woodland over <i>Xanthorrhoea preissii</i> mid isolated to sparse shrubs over <i>Bossiaea eriocarpa</i> and <i>Petrophile linearis</i> low isolated shrubs over <i>Alexgeorgea nitens</i> and <i>Lyginia imberbis</i> sparse sedges.	1027	EtBeAn	<i>Eucalyptus todtiana</i> and <i>Banksia attenuata</i> low sparse woodland over <i>Bossiaea eriocarpa</i> and <i>Hibbertia hypericoides</i> low isolated shrubs over <i>Trachymene pilosa</i> and <i>Gladiolus caryophyllaceus</i> isolated herbs and <i>Alexgeorgea nitens</i> and <i>Mesomelaena pseudostygia</i> sedges.	949	BmKgHg	<i>Banksia menziesii</i> and <i>Banksia</i> spp low sparse to open woodland over <i>Kunzea glabrescens</i> and <i>Xanthorrhoea preissii</i> mid shrubland over <i>Hypochaeris glabra</i> and <i>Drosera erythrorhiza</i> isolated herbs	Could not be mapped to a corresponding code	EtEpAn	<i>Eucalyptus todtiana</i> and <i>Banksia</i> spp. low sparse woodland over <i>Adenanthos cygnorum</i> tall sparse shrubland over <i>Eremaea pauciflora</i> and <i>Stirlingia latifolia</i> mid sparse to isolated shrubland over <i>Bossiaea eriocarpa</i> and <i>Conostephium pendulum</i> low isolated shrubs over <i>Austrostipa hemipogon</i> and <i>Briza maxima</i> grasses and <i>Alexgeorgea nitens</i> sedges	949	EmXpHh	<i>Eucalyptus marginata</i> low sparse woodland over <i>Xanthorrhoea preissii</i> mid sparse shrubland over <i>Hibbertia hypericoides</i> , <i>Bossiaea eriocarpa</i> and <i>Banksia dallanneyi</i> low isolated shrubs over <i>Conostylis setosa</i> , <i>Xanthosia huegelii</i> and <i>Philothea spicata</i> isolated herbs	1019	EmBsHh	<i>Eucalyptus marginata</i> low sparse woodland over <i>Banksia sessilis</i> and <i>Xanthorrhoea preissii</i> tall to mid-sparse shrubland over <i>Hibbertia hypericoides</i> and <i>Bossiaea eriocarpa</i> low isolated to sparse shrubland over <i>Hypochaeris glabra</i> and <i>Ursinia anthemoides</i> isolated herbs	1019
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EmBsHh	<i>Eucalyptus marginata</i> low sparse woodland over <i>Banksia sessilis</i> and <i>Xanthorrhoea preissii</i> tall to mid-sparse shrubland over <i>Hibbertia hypericoides</i> and <i>Bossiaea eriocarpa</i> low isolated to sparse shrubland over <i>Hypochaeris glabra</i> and <i>Ursinia anthemoides</i> isolated herbs	1019																					

No.	Item	Response	
		EwXpHh <i>Eucalyptus wandoo</i> mid sparse woodland over <i>Xanthorrhoea preissii</i> mid isolated shrubs over <i>Hibbertia hypericoides</i> , <i>Bossiaea eriocarpa</i> and <i>Banksia dallanneyi</i> low isolated shrubs over <i>Conostylis setosa</i> , <i>Hypochaeris glabra</i> and <i>Drosera menziesii</i> isolated herbs	4
		EwBeNa <i>Eucalyptus wandoo</i> and <i>Casuarina obesa</i> mid to low sparse woodland over <i>Bossiaea eriocarpa</i> and <i>Gastrolobium calycinum</i> and <i>Hakea lissocarpa</i> low isolated shrubs over <i>Neurachne alopecuroidea</i> and <i>Lepidosperma tenue</i> isolated grasses and sedges	1018
		MpRcLf <i>Melaleuca preissiana</i> and <i>Banksia attenuata</i> low sparse woodland over <i>Regelia ciliata</i> and <i>Jacksonia furcellata</i> mid shrubland over <i>Lechenaultia floribunda</i> low isolated shrubs over <i>Hypochaeris glabra</i> and <i>Ursinia anthemoides</i> isolated herbs and <i>Austrostipa hemipogon</i> , <i>Ehrharta calycina</i> and <i>Pentameris airoides</i> isolated grasses	37
		ErHaBr <i>Eucalyptus rudis</i> and <i>Melaleuca preissiana</i> low sparse woodland over <i>Aotus gracillima</i> and <i>Xanthorrhoea preissii</i> mid isolated shrubs over <i>Hypocalymma angustifolium</i> low shrubland over <i>Baumea rubiginosa</i> and <i>Cyperus polystachyos</i> sedgeland	973
		ErXpLt <i>Eucalyptus rudis</i> and <i>Corymbia calophylla</i> low to mid sparse woodland over <i>Xanthorrhoea preissii</i> and <i>Hakea varia</i> mid isolated shrubs over <i>Lepidosperma tenue</i> and <i>Lepidosperma ?squamatum</i> sparse sedgeland over <i>Hypochaeris glabra</i> and <i>Ursinia anthemoides</i> isolated herbs and <i>Briza maxima</i> isolated grass	1009
		CcXpBe <i>Corymbia calophylla</i> mid to low sparse woodland over <i>Xanthorrhoea preissii</i> and <i>Grevillea bipinnatifida</i> subsp. <i>bipinnatifida</i> mid sparse shrubland over <i>Bossiaea eriocarpa</i> , <i>Phyllanthus calycinus</i> and <i>Hypocalymma angustifolium</i> low open shrubland over <i>Hypochaeris glabra</i> , <i>Lysimachia arvensis</i> and <i>Haemodorum laxum</i> isolated herbs and <i>Briza maxima</i> and <i>Neurachne alopecuroidea</i> isolated grasses	999
		MvJspLs <i>Melaleuca viminea</i> tall shrubland over <i>Juncus</i> spp. and <i>Isolepis</i> spp. sparse sedgeland and <i>Cotula coronopifolia</i> , <i>Lotus</i> spp. and <i>Utricularia multifida</i> isolated herbs	37

No.	Item	Response
		<p>The Shire of Chittering has identified a number of regional and local ecological linkages as part of their Biodiversity Strategy (Shire of Chittering, 2010). The Proposal passes through a number of these linkages (Figure 4).</p> <p>Significant Vegetation</p> <p>The following Threatened or Priority Ecological Communities occur within the Development Envelope (Figure 5):</p> <ul style="list-style-type: none"> • Banksia woodlands of the Gingin area restricted to soils dominated by yellow to orange sands (WA - Priority 2 PEC); • Banksia Woodlands of the Swan Coastal Plain TEC (Commonwealth - Endangered TEC). The three ecological communities listed above are also considered part of this TEC at the Commonwealth level. <p>Vegetation Condition</p> <p>Vegetation within the Development Envelope ranges from Completely Degraded to Excellent (Figure 6) with over 75% represented by cleared pasture with occasional trees or stands of trees, usually native Eucalypts (Focused Vision, 2017). Approximately 19% of the area was recorded as Good Condition or better with 1.76% in Excellent Condition.</p> <p>Groundwater Dependent Ecosystems</p> <p>A search of the Australian Government’s National Atlas of Groundwater Dependent Ecosystems (GDEs) identified four GDEs which are reliant on the surface expression of groundwater in the vicinity of the Proposal (Figure 7):</p> <ul style="list-style-type: none"> • Wetland on Teatree Road – palusplain and floodplain intersected by the Development Envelope and the Indicative Disturbance Boundary – noting that within this area, the Proposal involves the potential upgrade to an existing road (not the construction of new road); • Palusplain approximately 1 km north of Gray Road – Palusplain with low potential for groundwater interaction located within the Development Envelope; • Lake Nangar on Mooliabeenee Road including: <ul style="list-style-type: none"> ▶ Sumpland with high potential for interaction with groundwater intersected by the Development Envelope; and ▶ Sumpland with moderate potential for interaction with groundwater intersected by Disturbance Boundary – noting that within this area, the Proposal involves the potential upgrade to an existing road (not the construction of new road). • Brookman River – dampland, floodplain and palusplain with high potential for groundwater interaction intersected by Development Envelope and Indicative Disturbance Boundary – noting that the Proposal includes a bridge over the Brookman River.

No.	Item	Response
		<p>Flora</p> <p>A total of 103 conservation significant flora species may be present within or in proximity to the Disturbance Envelope. The surveys undertaken by Focused Vision (2017) have recorded the following flora species (Figure 8):</p> <ul style="list-style-type: none"> • <i>Gastrolobium ?crispatum</i> (P1); • <i>Synaphea panhesya</i> (P1); • <i>Drosera sewelliae</i> (P2); • <i>Acacia drummondii</i> subsp. <i>affinis</i> (P2); • <i>Adenanthos cygnorum</i> subsp. <i>chamaephyton</i> (P3); • <i>Anigozanthos humilis</i> subsp. <i>chrysanthus</i> (P3); and • <i>Hibbertia miniata</i> (P4). <p>In addition, the WA herbarium has records of the following threatened flora species within or in close proximity to the Development Envelope:</p> <ul style="list-style-type: none"> • <i>Drakaea elastica</i>; • <i>Spirogardnera rubescens</i>; and • <i>Grevillea corrugata</i>. <p>A desktop assessment identified 24 weed species which may occur within the Development envelope. Of these, four (<i>Asparagus asparagoides</i>, <i>Chrysanthemoides monilifera</i>, <i>Echium plantagineum</i> and <i>Tamarix aphylla</i>) are Declared Plants under the <i>Biosecurity and Agriculture Management Act 2007</i> (BAM Act) and four (<i>Asparagus asparagoides</i>, <i>Chrysanthemoides monilifera</i>, <i>Genista</i> sp. x <i>genista monspessulana</i> and <i>Tamarix aphylla</i>) are Weeds of National Significance (WoNS).</p> <p>Phytophthora Dieback</p> <p>A review of the Project Dieback public dieback map identified small areas mapped as uninterpretable in the south and north of the Development Envelope, along with areas ranging from low confidence un-infested to high confidence un-infested throughout the project area. No infestations were mapped within the project area.</p> <p>During field surveys, Focused Vision (2017) noted that occurrences of dieback infestations were apparent within some areas of the Development Envelope. Given that the majority of the remnant native vegetation within the project area comprises of eucalypt and banksia woodlands, these parts of the project area are considered to be at a medium risk of infestation.</p>

No.	Item	Response
		<p>Conservation Areas</p> <p>There are two nature reserves and three properties with conservation covenants within or adjacent to the Development Envelope (Figure 4).</p> <p>Udamung Nature Reserve (vested in the Conservation Commission of WA for the purpose of conservation of flora and fauna) is located adjacent to the northern end of the Development Envelope where Hay Flat Road joins the existing GNH while Reserve 42560 (under management order with the Conservation Commission of WA for the purposes of foreshore Management) is partially within the Development Envelope at the intersection of Gray Road and the existing GNH.</p> <p>Lot 3281 Great Northern Highway, Lot 2138 Hay Flat Road and Lot 2917 Kangaroo Gully Road, all within the locality of Wannamal, have conservation covenants registered on their respective certificates of title. The Development Envelope intersects the area to be protected on Lot 3281 Great Northern Highway, Lot 2138 Hay Flat Road. The area to be protected on Lot 2917 Kangaroo Gully Road is outside of the Development Envelope.</p>
5	<p>Proposal activities – Describe the proposal activities that have the potential to impact the environment</p>	<p>The following proposal activities have the potential to affect flora and vegetation values within the Development Envelope:</p> <ul style="list-style-type: none"> • Clearing of vegetation for construction, including TECs and Priority flora species; • Vehicle movements and earthmoving activities may result in the introduction or spread of weeds and disease (particularly dieback); • Dewatering for bridge construction may impact GDEs; • Installation of culverts and bridges may result in changes to surface water flows.
6	<p>Mitigation - Describe the measures proposed to manage and mitigate the potential environmental impacts.</p>	<p>The following measures have been proposed to manage and mitigate the potential environmental impacts:</p> <ul style="list-style-type: none"> • The final road alignment will be designed to minimise the removal of native vegetation, conservation significant flora, PECs, TECs and high quality or underrepresented vegetation. • The final alignment will be designed to maximise the use of degraded habitat (e.g. paddocks). • Construction will be managed under a Construction Environmental Management Plan (CEMP). Management measures will include: <ul style="list-style-type: none"> ▶ marking out the boundaries of areas to be cleared. ▶ marking out no-go zones. ▶ weed and disease hygiene measures.

No.	Item	Response
		<ul style="list-style-type: none"> ▶ topsoil management. ▶ ASS management. • road drainage will be managed through engineering design; • creek crossings will be designed to minimise potential changes to surface water flows; • if dewatering is required for bridge construction, dewatering rates will be managed to minimise drawdown and potential impacts to GDEs; and • Residual impacts to TECs, PECs and conservation significant flora will be managed via offsetting as appropriate.
7	<p>Impacts - Assess the impacts of the proposal and review the residual impacts against the EPA objective.</p>	<p>Clearing of native vegetation will be required. Based on the concept design a total of approximately 144 ha of native vegetation will need to be cleared. Cleared vegetation is likely to comprise the following vegetation associations (Shepherd <i>et. al.</i> (2002)):</p> <ul style="list-style-type: none"> • 4 – Medium woodland; marri & wandoo • 37 – Shrublands; teatree thicket • 949 – Low woodland; <i>banksia</i> • 1009 – Medium woodland; marri & river gum • 1018 – Mosaic: Medium forest; jarrah-marri/Low woodland; <i>banksia</i>/Low forest; teatree/Low woodland; <i>Casuarina obesa</i> • 1019 – Medium sparse woodland; jarrah & marri • 1027 – Mosaic: Medium open woodland; jarrah & marri, with low woodland; <i>banksia</i>/Medium sparse woodland; jarrah & marri <p>Other potential impacts to Flora and Vegetation include:</p> <ul style="list-style-type: none"> • potential for clearing of conservation significant flora within the Development Envelope. Further surveys are required to confirm the presence of conservation significant flora species; • clearing of the Banksia Woodlands of the Swan Coastal Plain TEC is likely to be required. Additional surveys will be undertaken in spring to accurately map the boundaries of any occurrences of this TEC within the Development Envelope; • clearing may also be required in known occurrences of the State listed PEC <i>Banksia</i> woodlands of the Gingin area restricted to soils dominated by yellow to orange sands.

No.	Item	Response
		<ul style="list-style-type: none"> • fragmentation of vegetation patches or reduction in patch size resulting in increased pressures from edge effects; • reduced vegetation health of GDE's and vegetation associated with wetlands and watercourses due to changes in hydrological processes. This impact is expected to be minor and not result in long term changes to vegetation or flora; • introduction or spread of weeds or dieback resulting in increased land degradation, reduced vegetation condition and loss of flora species; • increased dust deposition on vegetation during earthmoving activities. This impact is expected to be minor and temporary in nature; <p>While a direct impact to conservation significant species may occur as a result of clearing, this impact has, and will continue to be minimised via ecological surveys, route options assessments and the finalisation of the proposed alignment. The concept alignment aims to avoid conservation significant flora, TECs, PECs and vegetation types identified as 'Vulnerable'. However, further surveys will be conducted to confirm the presence/absence of vegetation and flora of conservation significance.</p> <p>Given the expected clearing amounts and the representative habitat in close proximity to the Proposal, it is not expected that significant impacts will occur to the representation, diversity or ecological function at the species, population or assemblage level. Impacts to flora and vegetation as a result of construction activities are expected to be minor and can be managed via the CEMP.</p> <p>It is considered that the EPA's objective for this factor can be met.</p>
8	<p>Assumptions - Describe any assumptions critical to your assessment.</p>	<p>Some properties within the development Envelope could not be accessed in Spring 2016. Vegetation associations and likely presence of conservation significant flora in these areas has been extrapolated from nearby surveyed areas using in field observations and aerial photography interrogation/interpretation. Further surveys are planned to verify this extrapolation.</p>

Table 5-2 : Potential Impacts – Terrestrial Fauna

No.	Item	Response
1	EPA Factor	<p>Terrestrial Fauna Objective: To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.</p>
2	EPA policy and guidance - What have you considered and how have you applied them in relation to this factor?	<p>The following EPA policies and guidelines have been considered for the proposal in order to meet the EPA’s objective in relation to this factor:</p> <ul style="list-style-type: none"> • Statement of Environmental Principles, Factors and Objectives (EPA, 2016); • Environmental Factor Guideline: Terrestrial Fauna (EPA, 2016); • Technical Guidance – Terrestrial Fauna Surveys (EPA, 2016); and • Technical Guidance – Sampling Methods for Terrestrial Vertebrate Fauna (EPA, 2016). <p>The Development Envelope and Indicative Development Footprint have been designed using the mitigation hierarchy, such that clearing of fauna habitat and potential impacts to fauna are minimised where practicable.</p> <p>The Environmental Factor Guideline has been considered during the identification of fauna values within the Development Envelope and the issues identified in the guideline considered in relation to potential impacts from the Proposal.</p>
4	Receiving environment - Describe the current condition of the receiving environment in relation to this factor.	<p>Fauna and habitat surveys have been undertaken across part of the Development Envelope in Spring 2016 (Bamford, 2017) (Appendix C). Additional surveys are planned during the second half of 2017.</p> <p>Fauna Habitat (Vegetation and Substrate Associations [VSAs]) Nine VSAs have been identified within the Development Envelope, consisting of:</p> <ul style="list-style-type: none"> • <i>Banksia</i> woodland; • <i>Banksia</i> woodland with scattered Marri and/or Jarrah; • Marri-Jarrah woodland; • Marri-Jarrah woodland with little to no understorey; • Wandoo woodland; • heath; • waterways or wetlands; • paddocks with large remnant trees; and

		<ul style="list-style-type: none"> • paddocks. <p>Areas of Marri and Wandoo, including trees in paddocks, are likely to be important for nesting Black Cockatoos while the <i>Banksia</i> woodlands supported a higher richness of reptiles and small mammals. Weed invasion was noted to be high in cleared and partly cleared areas (Bamford, 2017). Bamford (2017) noted that native vegetation habitats were more extensive in the south of the Proposal with important linkages along narrow reserves, drainage lines and along roads.</p> <p>Vertebrate Fauna Assemblage</p> <p>The desktop study undertaken by Bamford (2017) identified 306 vertebrate fauna species as potentially occurring. This included eight freshwater fish, 17 frogs, 69 reptiles, 177 birds and 35 mammals. The 2016 survey recorded 66 of these (one fish, five frogs, three reptiles, 52 birds and five mammals).</p> <p>Conservation Significant Fauna</p> <p>Of those species identified in the desktop study, 46 are considered to be of conservation significance. These consist of 22 listed under the <i>Wildlife Conservation Act 1950</i>, nine which are also listed as threatened under the EPBC Act, eight listed as migratory under the EPBC Act, eight species are listed on the DBCA Priority Fauna List (one Priority 2, two Priority 3 and five Priority 4), with remaining 16 considered locally significant. Of particular significance for the Proposal is Carnaby’s Black Cockatoo (<i>Calyptorhynchus latirostris</i>), the Forest Red-tailed Black Cockatoo (<i>C. banksii naso</i>), Carter’s Freshwater Mussel (<i>Westralunio carteri</i>) and Chuditch (<i>Dasyurus geoffroii</i>). Habitat for these species is present within the Development Envelope and both Black Cockatoo species were recorded during the 2016 surveys (Bamford, 2017).</p> <p>Habitat for Black Cockatoos has previously been mapped as part of the Perth and Peel Green Growth Plan (Figure 9). Initial surveys of the Development Envelope undertaken by Bamford (2017) indicate that all vegetated areas within the Development Envelope are likely to provide habitat for Black Cockatoos. A total of 846 potential breeding trees were mapped during the survey (Bamford, 2017), however this was not an exhaustive search of the Development Envelope. Additional surveys are planned to capture areas not previously surveyed and accurately quantify and map habitat for Black Cockatoos, including potential or actual breeding trees.</p> <p>The South Western Brush-tailed Phascogale (<i>Phascogale tapoatafa wambenger</i>) is listed as Conservation Dependant and may occur, though the Proposal is at the northern extent of the expected range for the species. The Quenda (<i>Isodon obesulus fusciventer</i>) and Water Rat (<i>Hydromys chrysogaster</i>), both Priority 4 listed species, may also occur within the Development Envelope in wetland habitats.</p> <p>Introduced Fauna Species</p> <p>Feral and pest animals are known from the area with the feral pigeon, laughing dove, spotted dove, Long-billed Corella, Rainbow Lorikeet, house mouse, brown rat, black rat, rabbit, dog, fox, feral cat, and feral pig all likely to occur.</p>
5	<p>Proposal activities – Describe the proposal activities that have the potential to impact the environment</p>	<p>The following proposal activities have the potential to affect fauna values within the Development Envelope:</p> <ul style="list-style-type: none"> • clearing of fauna habitats;

		<ul style="list-style-type: none"> • vehicle movements (including operational road traffic) and earthmoving activities may result in injury or death of fauna species; • installation of culverts and bridges may result in changes to surface water flows which may impact freshwater fauna; • noise during construction; and • roadside (intersection) lighting.
6	<p>Mitigation - Describe the measures proposed to manage and mitigate the potential environmental impacts.</p>	<p>The following measures have been proposed to manage and mitigate the potential environmental impacts:</p> <ul style="list-style-type: none"> • the final road alignment will be designed to minimise the removal of quality habitat and Moderate or better foraging and breeding habitat for Carnaby’s Black Cockatoo and Forest Red-Tailed Black Cockatoo where practicable; • fauna underpasses incorporated into the road design to maximise fauna connectivity; • the final alignment will be designed to maximise the use of degraded habitat (e.g. paddocks) to minimise population fragmentation; • impacts to wetland systems will be minimised via the alignment selection and the road design; • construction will be managed under the CEMP. Management measures will include: <ul style="list-style-type: none"> ▶ potential breeding trees for Carnaby’s Black Cockatoo will be flagged and avoided where practicable; ▶ marking out the boundaries of areas to be cleared; ▶ speed limits will be implemented and enforced; and ▶ injured fauna management procedures. • residual impacts to conservation significant fauna will be managed via offsetting as appropriate.
7	<p>Impacts - Assess the impacts of the proposal and review the residual impacts against the EPA objective.</p>	<p>Clearing of fauna habitat will be required. Based on the concept design approximately 144 ha of habitat for both Carnaby’s Black Cockatoo and the Forest Red-tailed Black Cockatoo will be cleared.</p> <p>Other potential impacts to fauna values within the Development Envelope include:</p> <ul style="list-style-type: none"> • fragmentation of fauna habitat and fauna populations; • fauna injury or mortality as a result of machinery and vehicles around site during construction; • fauna mortality as a result of operational traffic movement; • potential impacts to wetland systems and subsequent impacts to associated fauna; and

		<ul style="list-style-type: none"> introduction and/or spread of weeds and pests. <p>While a direct impact to conservation significant species will occur as a result of clearing, this impact has, and will continue to be minimised via ecological surveys, route options assessments and the finalisation of the proposed alignment.</p> <p>As the Proposal will result in the clearing of a significant amount of Black Cockatoo breeding and foraging habitat; and there is potential for habitat fragmentation and the creation of a barrier to movement for ground dwelling fauna, it is considered that there is the potential for significant impacts to occur to terrestrial fauna including conservation significant species.</p> <p>As such, it is considered that the EPA's may be at risk for this factor.</p>
8	Assumptions - Describe any assumptions critical to your assessment.	Some properties within the development Envelope could not be accessed in Spring 2016. Fauna habitat and likely presence of conservation significant fauna in these areas has been extrapolated from nearby surveyed areas using in field observations and aerial photography interrogation/interpretation. Further surveys are planned to verify this extrapolation and confirm the presence or absence of conservation significant fauna species.

Table 5-3 : Potential Impacts – Hydrological Processes

No.	Item	Response
1	EPA Factor	<p>Hydrological Processes</p> <p>Objective: To maintain the hydrological regimes of groundwater and surface water so that environmental values are protected.</p>
2	EPA policy and guidance - What have you considered and how have you applied them in relation to this factor?	<p>The following EPA policies and guidelines have been considered for the proposal in order to meet the EPA's objective in relation to this factor:</p> <ul style="list-style-type: none"> Statement of Environmental Principles, Factors and Objectives (EPA, 2016); and Environmental Factor Guideline: Hydrological Processes (EPA, 2016). <p>The Development Envelope and Indicative Development Footprint have been designed such that direct impacts to hydrological process have been minimized using the mitigation hierarchy as appropriate.</p> <p>The Environmental Factor Guideline has been considered during the identification of the hydrological processes within the Development Envelope and the issues identified in the guideline considered in relation to potential impacts from the Proposal.</p>
4	Receiving environment - Describe the current condition of the receiving environment in relation to this factor.	<p>Surface Waters</p> <p>The majority of the Development Envelope lies within the Ellen Brook and Brockman River sub-catchments of the Swan Avon (Main Avon) Catchment area (DoW, 2016a) (Figure 10). A small portion of the Development Envelope crosses over the Lennard Brook and the Moondah Brook sub-catchments, which are within the Gingin Brook catchment (DoW, 2016b).</p> <p>The main surface water features within the development envelope are the Brockman River, Udumung Brook, Longbridge Gully</p>

		<p>and Lennard Brook. A number of unnamed surface water features are also located within the project area. The surface water features within the Development Envelope are shown in Figure 10.</p> <p>Much of the Brockman River Floodplain is identified as a Conservation Category wetland while Chittering - Needonga Lakes is a Wetland of National Importance and is located downstream of the majority of the Development Envelope, near Bindoon townsite. The Wannamal Lake System (also a Wetland of National Importance) is located approximately 7 km north and upstream of the Development Envelope.</p> <p>Groundwater</p> <p>The Development Envelope is located within the Gingin Groundwater Area (proclaimed under the RIWI Act) which covers approximately 6,000 km² of the Northern Perth Basin, extending between Guilderton and Bindoon in the south, to Grey and Moora in the north (DoW, 2016b). The groundwater area has been subdivided into 23 sub areas, and the Development Envelope is located within the Eclipse Hill and the Bindoon groundwater sub areas (unconfined/semi-confined aquifer category) and the Karri groundwater sub area (Figure 11). The surficial aquifer of the Gingin groundwater area, which is described as being unconfined, thin and often unsaturated, generally consisting of fresh groundwater (DoW, 2016b, Water and Rivers Commissions, 2002).</p> <p>There are no public drinking water source areas (PDWSA) in close proximity to the Proposal. The closest PDWSA associated with a groundwater area is the Bindoon/Chittering Water Reserve which is located approximately 2.5 km to the west of the development envelope in the Gingin Groundwater Area.</p> <p>Groundwater in the Brockman River catchment is needed for domestic supplies, irrigation and livestock. Fresh groundwater is not readily found in the catchment but brackish groundwater can be used for livestock and for some irrigation (Australian Water Resources Council, 1988).</p>
5	<p>Proposal activities – Describe the proposal activities that have the potential to impact the environment</p>	<p>The following proposal activities have the potential to affect hydrological processes within the Development Envelope:</p> <ul style="list-style-type: none"> • construction/installation of bridges, culverts and creek crossings; • compaction of sandy soils for road construction; and • presence of the final road acting as a barrier to infiltration or overland flow.
6	<p>Mitigation - Describe the measures proposed to manage and mitigate the potential environmental impacts.</p>	<p>The following measures have been proposed to manage and mitigate the potential environmental impacts:</p> <ul style="list-style-type: none"> • where possible, utilise existing natural drainage features. Where this is not practicable then artificial ones should be created, such as pipes, culverts and engineered swales; • the avoidance / minimisation of dewatering activities where practicable; • the use of vegetation to promote filtering and slow run-off; • reinstatement or protection of creek banks to reduce the risk of erosion; and

		<ul style="list-style-type: none"> • construction will be managed under the CEMP. Management measures will include: <ul style="list-style-type: none"> ▶ management of dewatering during construction; ▶ no refuelling within/adjacent to wetlands and watercourses; and ▶ construction in accordance with the approved Bed and Banks permit for the Proposal.
7	<p>Impacts - Assess the impacts of the proposal and review the residual impacts against the EPA objective.</p>	<p>Potential impacts to hydrological processes within the Development Envelope include:</p> <ul style="list-style-type: none"> • interruption of and changes to surface water flows; • changes to infiltration and recharge of groundwater aquifers; and • temporary drawdown of groundwater during dewatering for bridge construction. <p>The engineering design, route options assessments and the finalisation of the proposed alignment will mean minimal disruption to groundwater and surface water regimes, meaning negligible impact to environmental values are expected to occur. As such, it is expected that the EPA objective for this factor will be met.</p>
8	<p>Assumptions - Describe any assumptions critical to your assessment.</p>	<p>Wetland identification has been undertaken using online databases. Further surveys will be undertaken to accurately map and define wetland values.</p>

Table 5-4 : Potential Impacts – Inland Waters Environmental Quality

No.	Item	Response
1	EPA Factor	Inland Waters Environmental Quality Objective: To maintain the quality of groundwater and surface water so that environmental values are protected.
2	EPA policy and guidance - What have you considered and how have you applied them in relation to this factor?	<p>The following EPA policies and guidelines have been considered for the proposal in order to meet the EPA’s objective in relation to this factor:</p> <ul style="list-style-type: none"> • Statement of Environmental Principles, Factors and Objectives (EPA, 2016); and • Environmental Factor Guideline: Inland Waters Environmental Quality (EPA, 2016). <p>The Development Envelope and Indicative Development Footprint have been designed such that potential impacts to water quality have been minimised where practicable using the mitigation hierarchy.</p> <p>The Environmental Factor Guideline has been considered during the identification of water quality values within the Development Envelope and the issues identified in the guideline considered in relation to potential impacts from the Proposal.</p>
4	Receiving environment - Describe the current condition of the receiving environment in relation to this factor.	<p>Surface water and groundwater are discussed in Table 5-3. Surface water features within the Development Envelope are detailed in Figure 10.</p> <p>Water quality in the Ellen Brook and Brockman River sub-catchments is currently impacted on by nutrient runoff from farming and horticulture in the region. This has resulted in high Nitrogen and Phosphorus levels that are exceed the Healthy River Action Plan Interim Long Term Targets. Levels for non-nutrients meet ANZECC & ARMCANZ 2000 guidelines (Parks and Wildlife, 2009). No data on water quality within the Development Envelope is available.</p> <p>Groundwater in the Brockman River catchment is needed for domestic supplies, irrigation and livestock. Fresh groundwater is not readily found in the catchment but brackish groundwater can be used for livestock and for some irrigation (Australian Water Resources Council, 1988).</p> <p>The CSIRO Atlas of Australian Acid Sulfate Soil (ASS) mapping indicates that the ASS occurrence probability within the majority of the Development Envelope is <i>Class C: Extremely low; 1-5% chance</i> (CSIRO, 2013), with some patches adjacent to the alignment that are classified as <i>Class B: Low, 6-70% chance</i>. These patches are presented in Figure 12. The entire length of the proposed alignment is Class C: Extremely low; 1-5% chance with the exception of:</p> <ul style="list-style-type: none"> • There is a patch of Class A: High, >70% chance mapped ASS occurring approximately 400 m to the east of the Development Envelope and north of Mooliabeenee Road, associated with Lake Nangarl; and • There is a large area mapped as Class B: Low, 6-70% chance approximately 300 m away south from the proposed alignment. This ASS mapped area is conducive with the north eastern section of the Brockman River and associated

		floodplain channel.
5	Proposal activities – Describe the proposal activities that have the potential to impact the environment	<p>The following proposal activities have the potential to affect water environmental quality within the Development Envelope:</p> <ul style="list-style-type: none"> • construction/installation of bridges, culverts and creek crossings; • earthworks, clearing and stockpiling of topsoil; • leaks and spills from construction machinery and light vehicles; and • runoff from road surface during operational use.
6	Mitigation - Describe the measures proposed to manage and mitigate the potential environmental impacts.	<p>The following measures have been proposed to manage and mitigate the potential environmental impacts:</p> <ul style="list-style-type: none"> • prevent sediment from construction activities entering watercourses through the use of sediment fences and hay bales; • install silt curtains into watercourses when working over or in water to limit sedimentation impacts; • storage of chemicals and fuel is not to occur within 100m of a watercourse or within the 100 year ARI flood high water mark; • spill kits are to be employed for all works; • all road runoff is to be treated or detained prior to entering a natural watercourse or wetland; • where possible, utilise existing natural drainage features. Where this is not practicable then artificial ones should be created, such as pipes, culverts and engineered swales; • the avoidance / minimisation of dewatering activities where practicable; • the use of vegetation to promote filtering and slow run-off; • reinstatement or protection of creek banks to reduce the risk of erosion; and • identification and management of ASS in accordance with DWER guidelines.
7	Impacts - Assess the impacts of the proposal and review the residual impacts against the EPA objective.	<p>Potential impacts to water environmental quality within the Development Envelope include:</p> <ul style="list-style-type: none"> • clearing and earthworks during construction may result in temporary increased sediment loads entering watercourses; • contamination of surface water and groundwater as a result of construction activities may occur (for example, as a result of diesel spills); • clearing and earthworks may expose ASS leading to mobilisation of contaminants potentially impacting on water quality; • temporary change to surface water quality as a result of discharge of groundwater during dewatering activities (if required);

		<p>and</p> <ul style="list-style-type: none"> • pollution of local water ways from road runoff. <p>Management of potential impacts during construction including the exposure of ASS can readily be managed via the CEMP. The impact of run-off which may potentially contain contaminants is expected to be minimal. Based on this assessment, it is expected that minimal impact will occur to the quality of groundwater, surface water, sediment and biota in the Area and the ecological and social environmental values will be protected. In view of this, the EPA objective for this factor will be met.</p>
8	Assumptions - Describe any assumptions critical to your assessment	None

Table 5-5 : Potential Impacts – Social Surroundings

No.	Item	Response
1	EPA Factor	Social Surroundings Objective: To protect social surroundings from significant harm.
2	EPA policy and guidance - What have you considered and how have you applied them in relation to this factor?	<p>The following policies and guidelines have been considered for the proposal in order to meet the EPA’s objective in relation to this factor:</p> <ul style="list-style-type: none"> • Statement of Environmental Principles, Factors and Objectives (EPA, 2016); • Environmental Factor Guideline: Social Surroundings (EPA, 2016); • Environmental Protection (Noise) Regulations 1997; and • State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning (WAPC, 2009). <p>The Development Envelope and Indicative Development Footprint have been designed such that known locations of heritage sites have been avoided or potential impacts minimised where practicable using the mitigation hierarchy.</p> <p>The Environmental Factor Guideline has been considered during the definition of the social surroundings relevant to the Proposal and the issues identified in the guideline considered in relation to potential impacts from the Proposal.</p>
4	Receiving environment - Describe the current condition of the	Aboriginal Heritage and Culture The Proposal is located within the Yued Indigenous Land Use Agreement Area. The majority of the land is privately owned

<p>receiving environment in relation to this factor.</p>	<p>freehold land and therefore Native Title has been extinguished over these areas.</p> <p>A search of the Department of Planning, Lands and Heritage Aboriginal Heritage Inquiry System (AHIS) database identified the following Aboriginal Heritage sites within or in close proximity to the Development Envelope (Figure 13):</p> <ul style="list-style-type: none"> • Wetlands & Watercourses Moore River to Bullsbrook, known as Complex #42: (DAA Site ID: 19138). It is a complex of multiple sites (sites 19183, 3525, 20008, 20749 and 21614-21620) that are all registered as mythological/sacred sites associated with the Waugal. The sites specifically impacted by the proposed alignment within this complex include Boonanarring Brook (Site ID: 21616); Moore River Waugal (Site ID: 20749); Wallering Brook (Site ID: 21617); Chandala Brook (Site ID: 21620); • Udumung Brook Artefact 1 (Site ID: 22027); and • Burroloo Well site (Site ID: 3528). <p>It is also important to note that wetlands and watercourses are of special importance and significance to Aboriginal people. Wetlands are places that served as areas for resource procurement and are often associated with camps and sometimes with strong positive memories of earlier times (Big Island, 2015). The Traditional Yued Owners stated that watercourses are often considered to have been created by mythological beings, usually a serpent of some form which in this area is known as the <i>Waugal</i> (Big Island, 2015).</p> <p>Previous ethnographic and archaeological surveys that have occurred in the area have been undertaken by Quartermaine (2004), who conducted an archaeological survey of a previous Main Roads WA GNH Upgrade. Part of this survey covers the Development Envelope. These surveys concluded that most of the area is of moderate archaeological site potential. Potential archaeological site locations within the corridor are low areas where water would be available, such as the margins of the lakes, swamps, and watercourses; as well as caves and rockshelters, rock outcrops, sand hills and hills (Quartermaine, 2004).</p> <p>Natural and Historical Heritage</p> <p>Heritage places are found on various different registers, lists, surveys and inventories including the State Register, National Heritage List, Town Planning Schemes (TPS) and Municipal Inventories (MI). A desktop search of these inventories determined that no registered places occur within the Development Envelope. Burroloo Well (Place number 14178) lies just outside of the Development Envelope near the Chattering Road House (Figure 13).</p> <p>Noise</p> <p>There are no existing noise sources within the Development Envelope, with the exception of traffic on local roads. There are no mines or industrial sites/quarries within, or within close proximity to, the Development Envelope. A desktop assessment of possible sensitive receptors within 500 m of the concept alignment identified 34 houses and 100 other buildings (sheds, commercial and unknown).</p> <p>Amenity</p> <p>The majority of the Proposal lies within open farmland with native vegetation areas, and the only existing disturbance to the</p>
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		visual amenity of the area is the presence local roads and power lines. There are no key viewpoints/ tourist spots within the Development Envelope.
5	Proposal activities – Describe the proposal activities that have the potential to impact the environment	<p>The following proposal activities have the potential to affect the social surroundings of the Development Envelope:</p> <ul style="list-style-type: none"> • earthworks and excavations; • bridge construction and creek crossings; • operational road traffic; • noise from construction activities; • locations of cut and fill; and • physical presence of the new road.
6	Mitigation - Describe the measures proposed to manage and mitigate the potential environmental impacts.	<p>The following measures have been proposed to manage and mitigate the potential impacts to social surroundings:</p> <ul style="list-style-type: none"> • traffic noise assessment to be conducted in accordance with State Planning Policy 5.4; • construction noise will be managed in accordance with the Environmental Protection (Noise) Regulations 1997; • additional aboriginal heritage surveys (Archaeological and Ethnographic) to identify sites within the Development Envelope; • consultation with heritage experts and Traditional Owners as required; • heritage sites identified during surveys will be protected from disturbance during construction; • where disturbance to aboriginal heritage sites is unavoidable, approval under the <i>Aboriginal Heritage Act 1972</i> will be sought to disturb these sites; and • landscaping strategy to encourage native vegetation and use of vegetation as visual screening.
7	Impacts - Assess the impacts of the proposal and review the residual impacts against the EPA objective.	<p>Potential impacts to the social surrounds of the Development Envelope include:</p> <ul style="list-style-type: none"> • physical damage to aboriginal heritage sites; • impacts to mythological values of heritage sites; • loss of access for Traditional Owners to heritage sites; • increase in noise levels at sensitive receptors; • short term increase in dust emissions from the site during construction; and

		<ul style="list-style-type: none"> reduced local amenity due to increase in road traffic, glare from headlights and proximity of national highway. <p>While some impact may occur to Aboriginal heritage sites, the proposal has been designed, will continue to be designed and will be managed to avoid and minimise impacts on the sites. Ongoing refinement of the route alignment will take into consideration the location of Aboriginal heritage sites. It is considered that impacts can be managed under the <i>Aboriginal Heritage Act 1972</i>. Limited impact to amenity is expected and the proposal has been designed to minimise impacts in order to provide the ability for people to live and recreate within their surrounds.</p> <p>It is considered that the EPA's objective can be met for this factor.</p>
8	<p>Assumptions - Describe any assumptions critical to your assessment</p>	<p>The assessment of Aboriginal and other heritage has been based on a desktop review of available data. Heritage studies are planned to verify the accuracy and completeness of this information.</p>

5.2 Other EPA Factors

5.2.1 Landforms

Minor modification to landforms is likely to result from construction activities, in particular where cut and fill is required. Any impacts are expected to be low and insignificant as the landscape is already disturbed and landforms in the Development Envelope are not considered significant.

5.2.2 Terrestrial Environmental Quality

Potential impacts that may occur to the terrestrial environmental quality include compaction of soils and release of hazardous substances from construction activities, erosion of soils from earthworks and excavation and the exposure of ASS. The CEMP will incorporate specific ASS management measures to mitigate any potential impact and will include appropriate waste disposal mechanisms and hazardous materials management measures.

A search on the DWER Contaminated Sites Database was conducted to identify the presence or absence of contaminated sites within the Development Envelope. The search identified no contaminated sites on, or in, close proximity to the Development Envelope. It is considered unlikely that contaminating activities have occurred within the development envelope given the rural agricultural context.

5.2.3 Air Quality

Dust may be generated from vegetation clearing, materials handling and soil stockpiling impacting on air quality. Impacts are expected to be temporary (during construction). Appropriate application of the CEMP will ensure that potential dust sources are managed appropriately.

The Proposal will move the current source of air pollution (traffic) away from the Bindoon townsite, which should have a positive impact on the quality of air at the townsite.

5.2.4 Factors Considered Not Relevant

The following factors are considered not relevant to this Proposal:

- Benthic Communities and Habitat – the proposal is not within or near the marine environment;
- Coastal Processes - the proposal is not on or near the coast;
- Marine Environmental Quality – the proposal is not within or near the marine environment;
- Marine Fauna – the proposal is not within or near the marine environment;
- Subterranean Fauna – the proposal does not require significant abstraction of groundwater or excavation below the water level; and
- Human Health – the proposal does not involve radioactive activities or emissions of radiation.

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Figures

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Appendix A. 2016 Spring Flora Survey Report

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Appendix B. Pre-European and Current Extents of Vegetation Communities within the Development Envelope

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Code	Vegetation Description as per Shepherd et al. 2002	Corresponding Vegetation Community/ies (Focused Vision 2017)	Pre-European extent (ha)	Current extent (ha)	% remaining	Extent within Development Envelope (ha)	Extent within Indicative Disturbance Boundary (ha)	Vegetation status	Local Significance
4	Medium woodland; marri & wandoo	EwXpHh	1,054,279.89	293,916.91	27.88	39.48	14.14	Vulnerable	Priority Flora recorded in EmXpHh High species diversity recorded in EwXpHh
37	Shrublands; teatree thicket	MpRcLf, MvJspLs	38,930.32	24,519.41	62.98	31.39	7.87	Least Concern	
949	Low woodland; banksia	EtBeAn, EtEpAn	218,193.94	123,096.71	56.42	168.19	62.68	Least Concern	Priority Flora recorded in EtBeAn High species diversity recorded in EtBeAn
973	Low forest; paperbark (Melaleuca raphiophylla)	ErHaBr	4,987.82	1903.70	38.17	2.17	0.81	Depleted	
1018	Mosaic: Medium forest; jarrah-marri/Low woodland; banksia/Low forest; teatree/Low woodland; Casuarina obesa	EwBeNa	14,059.36	2,414.91	17.19	2.58	0.59	Vulnerable	Priority Flora recorded in EwBeNa
1019	Medium sparse woodland; jarrah and marri	EmXpHh, EmBsHh	804.43	384.64	47.81	226.22	49.04	Depleted	Priority Flora recorded in EmXpHh, EmBsHh. High species diversity recorded in EmXpHh
1027	Mosaic: Medium open woodland; jarrah & marri, with low woodland; banksia / medium sparse woodland; jarrah & marri	BaXpAn	39,809.21	23,329.60	58.9	48.88	9.09	Least Concern	High species diversity recorded in BaXpAn

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Appendix C. 2016 Spring Fauna Survey Report

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