

6. Matters of National Environmental Significance

Main Roads referred the Bindoon Bypass to DAWE under the EPBC Act on 1 September 2017. DAWE determined the Proposal was a Controlled Action on 29 January 2018. A request for additional information, in the form of Preliminary Documentation, was received by Main Roads on 7 May 2018. **Table 6-1** details the requirements of the request for additional information and provides cross references to where this information is provided in this document.

Table 6-1: Additional Information Requirements from DAWE

Requirement No.	Assessment Requirements	Chapter Reference
1.	<p>Description of the Action</p> <p>A summary of all components of the action, a description of the activities associated with the potential development, and plans or maps to delineate the position of all components of the action. Please clearly state any variables in the design of the action and take this into account in the discussion of impacts under section 3.</p> <p>Please ensure the information includes the following:</p>	
a.	The location, boundaries and size (in hectares) of the disturbance footprint and of any adjoining areas which may be indirectly impacted by the proposal, including nearby habitat; and areas for stockpiles, vehicle access and associated activities.	Chapter 2
b.	A description of the operational requirements of the action including any anticipated maintenance works.	Chapter 2
c.	Any feasible alternatives to the action to the extent reasonably practicable, including the alternative of taking no action, a comparative description of the impacts of each alternative on MNES and sufficient detail to make clear why any alternative is preferred to another. The short, medium and long-term advantages and disadvantages of the options should be discussed.	Chapter 2
	<p>For pre-construction, construction and operation phases, include:</p> <p>a. The proposed activities associated with each phase.</p> <p>b. The anticipated timing and duration including start and completion dates of each phase.</p>	Chapter 2

Requirement No.	Assessment Requirements	Chapter Reference
2.	<p>A Description of the Existing Environment and Relevant Matters of National Environmental Significance</p> <p>Provide a general description of the environment affected by and surrounding the proposed action area, in both the short and long term. This section must address the following MNES including but not limited to:</p> <ul style="list-style-type: none"> • Banksia Woodlands TEC – Endangered • Carnaby's Black Cockatoo - (<i>Calvptorhynchus latirostris</i>) – Endangered • Forest Red-tailed Black Cockatoo - (<i>Calvptorhynchus banksii naso</i>) - Vulnerable • Chuditch (<i>Dasyurus geoffroi</i>) – Vulnerable • Bindoon Starbush (<i>Asterolasia nivea</i>) – Vulnerable • Fine-leaved Darwinia (<i>Darwinia acerosa</i>) – Endangered • Muchea Bell (<i>Darwinia foetida</i>) – Critically Endangered • Glossy-leaved Hammer Orchid (<i>Drakaea elastica</i>) – Endangered • Gingin Wax (<i>Chamelaucium</i> sp. Gingin—NG Marchant 6) – Endangered • Grevillea corrugata - Endangered • Spiral Bush (<i>Spirogardnera rubescens</i>) – Endangered • Star Sun-orchid (<i>Thelymitra stellata</i>) – Endangered <p>Please provide further descriptions of the existing environment and relevant matters of national environmental significance, including:</p>	Chapter 6.3
a.	Survey information assessing the population sizes or suitable habitats (for the species listed above) both within and surrounding the project area.	Chapter 6.3
b.	A description of the quality and extent of the Banksia woodlands of the Swan coastal plain ecological community both within and surrounding the project area.	Chapter 6.3.3
c.	Details of the resources used to identify and assess the environmental values of the site, including survey data and historical records. An assessment of the adequacy of any surveys undertaken, in particular the extent to which these surveys were appropriate and undertaken in accordance with the Department's relevant scientific and policy guidance.	Chapter 6.8
d.	Whether consultation/advice was sought from local community groups or experts.	Chapter 3
3.	<p>An Assessment of the Relevant Impacts of the Action</p> <p>Include an assessment of potential impacts (including direct, indirect, consequential and cumulative impacts) that may occur as a result of the proposed action on the MNES addressed at Section 2.</p> <p>Consideration of impacts must not be confined to the immediate area of the proposed action but must also consider the potential of the proposed action to impact on adjacent areas that are likely to contain habitat for MNES.</p> <p>For listed threatened species and communities this must include, but not be limited to:</p>	Chapter 6.4
a.	An assessment of potential impacts (including direct, indirect, consequential and cumulative impacts) that may occur as a result of all elements and project phases of the proposed action, incorporating relevant conservation advices, recovery plans and threat abatement plans, if applicable.	

Requirement No.	Assessment Requirements	Chapter Reference
b.	An assessment of the direct and indirect loss and/or disturbance of habitat for each species and analysis of the impacts to species population resulting from the proposed action including impacts to connectivity of habitat. This must include the quality and type of habitat impacted and a quantification (in hectares) of the total impact area and areas indirectly impacted from the proposed action.	
c.	An assessment of the direct and indirect loss and/or disturbance of the Banksia Woodlands of the Swan Coastal Plain ecological community, including quality impacts, as a result of the proposed action. This response must detail the quantum and quality in hectares and the potential area to be impacted through direct removal and disturbance, along with the likely areas to be impacted surrounding the direct impact area.	
d.	A local, regional and national scale analysis of the likely impacts to the MNES listed in section 2. This should include a discussion of potential cumulative impacts on relevant MNES within the broader region where potential impacts from this proposed action are in addition to existing impacts of other activities (including known potential future expansions or developments by the proponent and other developers in the region and vicinity).	
e.	Any technical data and other information used or needed to make a detailed assessment of the relevant impacts.	Appendix D Appendix E
f.	Details on whether any impacts are likely to be unknown, unpredictable or irreversible.	Chapter 6.4
g.	All discussions and conclusions should include a full justification based on the best available information including relevant conservation advices, recovery plans, threat abatement plans and guidance documents, if applicable.	
Please ensure you have considered and discussed all potential impacts. Impacts will include (but may not be limited to): dust, noise, vibration, run off and water management, hazardous materials management, fire management, equipment and vehicle use (during and post construction).		
4.	<p>Proposed Avoidance and Mitigation Measures</p> <p>Provide information on proposed avoidance and mitigation measures to prevent or minimise impacts to the MNES addressed at Section 2 that are likely to be impacted by the proposed action. A consolidated list of proposed avoidance and mitigation measures must be provided, based on best available practices and must include, but not be limited to, the following elements:</p>	
a.	A detailed description of the measures proposed. This must include relevant protocols, the name of the agency responsible for each measure, locations and the timing for each measure.	Chapter 6.5
b.	A statement addressing the environmental objectives/outcomes the measures are expected to achieve. This must include details of any baseline data, performance criteria, monitoring, reporting and corrective action proposed to demonstrate progress towards achieving these objectives.	
c.	A description (including maps) of the location, boundaries and size (in metres) of any buffer areas for proposed exclusion zones or conservation purposes and details on how these areas will be excluded or protected.	
d.	An assessment of the expected or predicted effectiveness of the measures proposed.	

Requirement No.	Assessment Requirements	Chapter Reference
	<p>e. Any statutory or policy basis for the measures proposed.</p> <p>f. Measures for all project phases of the proposed action</p> <p>g. Details of ongoing management, including research and monitoring programs to support an adaptive management approach and determine the effectiveness of the measures proposed.</p> <p>h. The achievability of the measures proposed, including affordability</p> <p>i. description of any proposed rehabilitation to disturbed habitat areas, including its management, methodology and timing</p>	
	<p>Specific measures can be presented in the form of a management plan, such as a Conservation Management Plan and/or a Construction Environmental Management Plan, which is specific to the proposed action. At a minimum, the plan must include a detailed outline that sets out the framework for management, mitigation and monitoring of relevant impacts of the action, including provision for independent auditing. The plans must include details of the key commitments and measures to ensure that impacts to relevant MNES are avoided and minimised. The plans should refer to relevant conservation advices, recovery plans, threat abatement plans, and other guidance documents published by the Department.</p>	
5.	<p>Offsets</p> <p>Provide details of the likely residual impacts on MNES discussed at Section 3 that are likely to occur after proposed avoidance and/or mitigation measures are taken into account. If applicable, include the reasons why avoidance or mitigation of impacts cannot be reasonably achieved.</p> <p>If relevant, to compensate for residual impacts on MNES, the preliminary documentation should include details of any offset package proposed to be implemented along with an analysis of how the offset package meets the requirements of the EPBC Act Offsets Policy (Offsets Policy) including but not limited to:</p> <p>a. A description of the offset site(s) including location, size, condition and environmental values present</p> <p>b. Information on and justification of how the offset package will deliver a conservation outcome that will maintain or improve the viability of the species consistent with the Offsets Policy</p> <p>c. Consideration of section 7.2.2 of the Offsets Policy including a discussion of how the offset proposal compensates for impacts to existing EPBC offset sites.</p> <p>d.. An assessment (and justification for each input used) of the offset site(s) using the Department's Offset Assessment Guide.</p> <p>e. Details on how the offset will be secured, managed and monitored, including: - management actions, responsibility, timing and performance criteria; and - specific environmental outcomes to be achieved from management measures</p> <p>f. Information on whether the offset package is being developed in accordance with the requirements of a State endorsed offsets policy or fund e.g. OWER offsets fund</p> <p>Include a statement on the cost effectiveness of the measures proposed and how these will be funded</p>	
6.	<p>Economic and Social Matters</p> <p>Provide information on the relevant economic and social impacts of the action and should include:</p> <p>a. Costs (e.g. disruption to existing community infrastructure or environmental features) as well as benefits (e.g. increase housing or employment).</p>	

Requirement No.	Assessment Requirements	Chapter Reference
	<ul style="list-style-type: none"> b. Consideration of different scales where relevant (e.g. local versus national). c. Specific dollar or other numeric values where relevant d. Discussion of how the principles of ecologically sustainable development are addressed in the action. 	
	<ul style="list-style-type: none"> e. Discussion of the environmental history of the company 	Chapter 6.1
7.	<p>Other Approvals and Conditions</p> <p>Include information on any other requirements for approval or conditions that apply, or that you reasonably believe are likely to apply, to the proposed action. This must include:</p> <ul style="list-style-type: none"> a. A description of any approval obtained or required to be obtained from a state or Commonwealth agency or authority (other than an approval under the EPBC Act), including any conditions that apply to the proposed action b. A statement identifying any additional approval that is required c. A description of the monitoring, enforcement and review procedures that apply, or are proposed to apply, to the action. d. A statement identifying any interaction with other approved projects under the EPBC Act, including compliance with conditions on other approved projects. 	Chapter 1
9.	<p>Environmental Record of the Person Proposing to Take the Action</p> <p>The information provided must include details of any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against:</p> <ul style="list-style-type: none"> a. The person proposing to take the action. b. For an action for which a person has applied for a permit, the person making the application. 	Chapter 6.1
	If the person proposing to take the action is a corporation, details of the corporation's environmental policy and planning framework should be described	Chapter 6.1
10.	<p>Conclusion</p> <p>Provide an overall conclusion as to the environmental acceptability of the proposal, including discussion on compliance with the principles of Ecologically Sustainable Development (ESD) and the objects and requirements of the EPBC Act.</p> <p>You may wish to include a statement as to whether or not the controlled action should be approved and may recommend conditions pertaining to an approval. This should include justification for undertaking the proposed action in the manner proposed. The measures proposed or required by way of offset for any unavoidable impacts on MNES and the relative degree of compensation, should be restated here</p>	Chapter 6.7
11.	<p>Information Sources</p> <p>State for the information provided, the following:</p> <ul style="list-style-type: none"> a. The source and currency (date) of the information. b. How the reliability of the information was tested. c. The uncertainties (if any) in the information. d. The guidelines, plans and/or policies considered 	Chapter 6.8

6.1 Main Roads Environmental Policy and Planning Framework

Main Roads has an internal environment management system (EMS) to enhance environmental performance and facilitate the management of environmental risk. This EMS is certified to ISO 14001:2015 and is supported by a number of policies and procedures.

Main Roads Environment Policy, dated May 2018, contains the following four objectives:

- Deliver our services in full compliance with the obligations of environmental legislation and policy as a minimum standard.
- Manage the environmental impacts of our activities through the hierarchy of 'avoid, minimise, rehabilitate and offset'.
- Contribute to a sustainable transport system through the delivery of products and services that minimise environmental impacts, conserve natural resources and also achieve positive social and economic outcomes.
- Implement, maintain and continually improve an effective environmental management system compliance with ISO 14001:2015 Main Roads activities.

The objectives of this policy are implemented through a number of internal Main Roads processes. The following paragraphs described these processes as relevant to the Bindoon Bypass.

Prior to finalising design, Main Roads assess proposals through an internal EIA. This allows unacceptable environmental impacts to be identified early in the design process providing the opportunity to change the design to avoid, mitigate or reduce the potential environmental impacts and to identify impacts that require management through an environmental management plan or offset proposal. The internal environmental impact assessment process also provides Main Roads with a mechanism for determining whether proposals need to be referred to State or Commonwealth regulators.

During the implementation of projects, Main Roads has a series of environmental specifications and agreements with contractors to achieve a high level of environmental performance and meet all objectives of the environmental policy. Construction contractors are required to implement their own CEMP that aligns with the environmental specifications and any environmental and heritage approvals obtained for the project. The expectation is that this construction environmental management plan will facilitate compliance with all relevant regulatory environmental requirements, the Main Roads environment specifications and provide sufficient checks and balances to achieve effective implementation of management measures throughout the construction phase.

Main Roads has successfully implemented many new and upgraded road infrastructure projects in WA, while demonstrating responsible environmental management. Some of these have required referral under the EPBC Act, though not all have been determined to be Controlled Actions. These projects include:

- Completed projects:
 - ▶ South Coast Highway Realignment (EPBC 2016/7777 – not a Controlled Action)
 - ▶ Great Northern Highway Upgrades: New Norcia Bypass (EPBC 2015/7523 - not a Controlled Action), Miling Straight (between Miling and Pithara) (EPBC 2015/7584 - Not a Controlled Action), Batty Bog Road to Walebing (EPBC 2014/7129 - not a Controlled Action) and Bindi Bindi to Lyons East Road (EPBC 2012/6700 – not a Controlled Action)
 - ▶ Tonkin Grade Separations (EPBC 2014/7385)
 - ▶ Mitchell Freeway Extension (EPBC 2013/7091)
 - ▶ Bunbury Port Access Road (EPBC 2010/5768)
 - ▶ Gateway WA - Perth Airport and Freight Access (EPBC 2010/5384)

- ▶ new Perth to Bunbury Highway (Forest Highway and Kwinana Freeway extension) (EPBC 2005/2193).
- Projects under construction:
 - ▶ Northlink WA (Perth-Darwin National Highway – Swan Valley Section: EPBC 2013/7042)
 - ▶ Great Northern Highway Upgrades: Miling Bypass and Pithara sections (EPBC 2016/7761)
 - ▶ Margaret River Perimeter Road (EPBC 2012/6677 – not a Controlled Action).

Main Roads has not been subject to any proceedings under Commonwealth or State law for the protection of the environment or the conservation and sustainable use of natural resources.

6.2 Economic and Social Matters

6.2.1 State Overview

The GNH forms part of the of the national highway and freight network, linking the Perth metropolitan area and the Port of Fremantle with the significant economic activity zones, spread across the mid-west and north west of the State. The GNH is critical in servicing the State's mining, agricultural and northern tourist industries. The Bindoon Bypass will remove the final restriction to travel of triple road trains between Muchea and Wubin (the steep grades at Bindoon Hill), and will therefore deliver significant efficiencies for freight transport to the State's North West. It will also reduce the number of heavy vehicles using GNH between Muchea and Wubin, and provide safety benefits for the residents of Bindoon by removing a significant portion of the heavy vehicles running through the centre of town. This will improve road safety for all road users.

Approximately \$2.7 billion has already been invested or committed to deliver improved access for vehicles entering the Perth metropolitan area from the North. These vehicles typically connect to the industrial and commercial areas in Forreestfield and Kewdale, the southern Perth metropolitan area and the Port of Fremantle. Improved access projects include Perth-Darwin National Highway - Swan Valley Bypass, Gateway WA, and the \$344 million GNH Upgrade (Stage 2). Whilst these projects will deliver improved access for heavy vehicles along the route, constraints still exist to enabling access for triple road trains.

Currently, triple road trains, travelling from the northern regions (e.g. Pilbara) are required to stop at Wubin, 276 km north of Perth. Here, triple road trains travelling south are decoupled and the freight is transported to Perth via smaller vehicle and trailer combinations. This is highly inefficient and results in a higher number of freight vehicles using GNH. Expanding access for triple road trains to travel along the Muchea-Wubin section of GNH, will provide significant efficiencies for the freight industry which will flow onto greater productivity benefits for the mining and agricultural sectors.

The proposal has been derived through a planning study, initiated targeted at increasing freight efficiency by removing the remaining constraints on GNH.

The problems addressed by the Proposal are as follows:

1. Freight transport costs for vehicles using GNH between Muchea and Wubin are unnecessarily high due to the existing road alignment and gradients which restrict the configuration of vehicles on this 218km section of the National Freight Network.
2. Safety issues associated with the passage of GNH through Bindoon (including the Calingiri section) are preventing this route from carrying larger and more efficient freight vehicles.

In order to assess the socio-economic costs and benefits of the Proposal, an economic assessment was undertaken. The parameters for calculating the benefits generated by the Proposal are based upon the National guidelines for transport system management (ATAP 2016), *Guideline to project valuation, part 4: project evaluation data* (Tan, Lloyd & Evans 2012) and *Updating environmental externalities unit values* (Austrroads 2014). The following benefit components have been calculated as part of the economic assessment:

- **Travel time savings** – these are reductions in travel time due to increased speeds and reduced freight vehicle hours travelled.
- **Vehicle operating cost savings** (vehicle maintenance/repair costs & fuel costs) - the reduction in vehicle operating costs for road users and freight operators due to a reduction freight traffic due to the adoption of triple road trains (from the current double road trains) and increased travel speeds.
- **Environmental benefits** – these benefits arise from a reduction in total vehicle kilometres travelled (due to a reduction in freight traffic) and thus less pollution.
- **Safety benefits** – these are based on the reduced number of vehicles on the road, leading to a reduction in the incidence of crashes.

Economic parameters used were escalated to 2018 constant dollars using indices from the Australian Bureau of Statistics indexes. The estimated economic benefits for the above items are provided in **Table 6-2**, assuming a 30-year operation period commencing in the financial year 2023/24 and ending in 2052/53.

Table 6-2: Economic Value of Benefits Resulting from the Bindoon Bypass

Benefit Item	Present Value (\$ million)*
Travel time savings	81.0
Vehicle operating cost savings	514.8
Environmental benefits	8.4
Crash benefits	2.5
Residual value	3.6
Total benefits	610.3

* in real terms, 2017/2018 dollars, discounted using 7 per cent discount rate

6.2.2 Local Region Social and Economic Overview

Local area social and economic impacts associated with the Proposal relate to residents and businesses within the Town of Bindoon itself and property owners along the route. The concept design process considered the social impact of land acquisition on the lifestyle and workability of affected properties along the proposal, attempting to mitigate the potential impacts on properties through avoidance or minimisation of severance impacts to properties where practicable. Additionally, route selection attempted to maximise distances from affected residential buildings where practicable considering other key considerations of road geometry and minimisation of environmental impacts.

It is expected that up to 50 properties across approximately 40 land owners will be directly affected through the land acquisition required for the Proposal. Formal land acquisition processes have commenced on four properties where there is a significant impact on residences or the operability of the property. Land Acquisition processes will follow the requirements set out in *Land Administration Act 1997* (WA). Depending on the complexity of the potential impacts to property, the land acquisition process can take up to two years and is expected to run in parallel to the environmental assessment process.

With regards to the town of Bindoon, potential impacts fall into four categories:

- passing trade
- tourism
- growth
- connectivity.

6.2.2.1 Passing trade

Retail is considered to be the sector most affected by changes in passing trade given that expenditure in town is made up of locals, tourists and those in transit. Reductions in vehicle numbers may impact the approximately 50 Bindoon based jobs in passing trade affected industries (retail trade, accommodation and food services and Arts and Recreation services). A plausible range of reliance on passing trade of 10% to 50% has been estimated and a sensitivity analysis has been conducted. The reduced vehicle numbers through Bindoon as a result of the Bindoon Bypass translates to the potential loss of full time employment, based on the assumption that passing trade expenditure is directly proportional to vehicle numbers (**Table 6-3**).

Table 6-3: Relative Impact of the Difference in Vehicle Numbers from the Bindoon Bypass

	Reliance on Passing Trade				
	10%	20%	30%	40%	50%
Impact in jobs (full-time employee)	1.0	2.0	3.0	4.1	5.1

Management strategies to reduce the effect of reduced passing trade include signage and intersection design to increase the visibility of the facilities and amenities within Bindoon, and allow for easy access to Bindoon from the Bindoon Bypass.

6.2.2.2 Tourism

Tourism is a key consideration for Bindoon and more generally for the Shire of Chittering as evidenced within strategic planning documentation. The *Economic development strategy 2015-2025* (Shire of Chittering 2015) lists tourism as a specific area of economic opportunity and ‘visitor attraction’ as one of five key strategic directions for the Shire, noting that aspects of tourism which can be influenced (by the Shire) are:

- access – roads, public transport, tour operators
- accommodation – range of styles and qualities
- amenities – banks, eateries, parks, public toilets, shops and visitor information
- attractions/activities – cultural, events, heritage and natural
- awareness – marketing and promotion
- attitude – a welcoming community will add to a visitor’s experience.

While the exact turnover and employment levels of specific accommodation businesses are not known, ABS statistics suggest that direct employment in tourism industries is relatively low. Four jobs were recorded in the 2016 ABS census; however, this is likely to be lower than actual full-time employee (FTE) numbers. There is a potential for loss of local expenditure arising from the Proposal from overnight visitors and, more broadly, the ability to attract large tour groups to the town for any extended period e.g. during major event periods. Amenity may be enhanced for tourists due to reduced traffic through the town site and in close proximity to accommodation providers.

With regards to tourism potential, the development of tourist attractions in relative proximity to the town centre would assist in providing a greater concentration and consolidation of tourism offerings. Suitable land with relatively smaller lots exists both directly to the north (to Mooliabeenee and along Crest Hill Road, Bindoon-Moora Road and Wells Glover Road) and east of the town centre. However, the eastern extent is severely limited by the Mount Byroomanning Nature Reserve and Julimar State Forest. Land directly to the north of the town centre is therefore considered to be most appropriate for future tourism related businesses, this land is not intersected by the Proposal.

Wildflowers are one of the major natural attractions of Bindoon, with the existing Wildflower Way trail using GNH as a central spine. While portions of the trail (to the north-west) form quiet off-highway sections and may be affected by the Bindoon Bypass.

6.2.2.3 Connectivity

Bindoon currently relies on a network of local connector roads, regional connector roads and GNH to provide access to the town centre, Gingin to the west, and Perth to the southwest. For those accessing Bindoon from the west and north on a regular basis (e.g. residents of Gingin, Mooliabeenee and Wannamal), Mooliabeenee Road, Bindoon-Moora Road and Crest Hill Road provide reasonable access, with relatively less interaction with heavy vehicles. The introduction of the Bindoon Bypass to the west will introduce the need for residents in these areas to cross a major freight route (or turn on to the route). This must be considered against the fact that both of these regional connector roads currently require residents to enter GNH in order to access the town centre. Rather than quantifying specific safety aspects or changes in traffic flows, this measure considers the perceived disruption to regular trips (e.g. shopping and running children to school) and the perception that a portion of residents will now be physically divided from the town.

A secondary issue was the degree of interaction and travel between Bindoon and Gingin. Residents of these two centres share facilities and services to make up for the lack of facilities in each centre considered alone. For example, Gingin has a high school, golf club, aquatic/recreation centre, aged care facility, and competes regularly with Bindoon in a range of sports. Gingin is accessed by Mooliabeenee Road, via Teatree Road, Crest Hill Road or Bindoon-Moora Road, and this access route is intersected by the Proposal (though a grade-separated interchange is proposed for Mooliabeenee Road).

The existing GNH will be retained as a local access road through the town of Bindoon. This will maintain access to the town from the Chittering/Muchea area to the south, New Norcia in the north and towns and properties to the east of Bindoon.

6.2.2.4 Growth

Future subdivision in Bindoon appears to be largely dictated by the existing water treatment plant and the Water Corporation 'water supply boundary'. Development outside of this area, such as in locations adjacent to the Proposal, would likely require additional trunk infrastructure that would significantly influence the cost of development, to the point that it is may be prohibitive.

It has also been considered that, given the rural residential setting, land in relatively close proximity to the Proposal, or that lies on the far side of the Proposal (from the Bindoon town centre), will be less attractive to land purchasers, which in turn affects the ability to profitably sub-divide land given the development costs involved.

6.2.3 Construction Employment

A standard baseline of 1 FTE per \$1.5 million in construction cost has been used in estimating the number of construction jobs that may be generated by the Proposal. This amounts to 44 jobs over 2 years. In 2011 there were 50 Bindoon residents employed in the construction industry. Assuming a 5% to 10% local quotient, this could translate to between 2.2 to 4.4 local jobs over the construction period. The direct impact on employment over the two-year construction period can therefore be considered to be relatively minor. More considerable impacts will be experienced as a result of increased retail spending during this period (particularly food and beverage), associated with an influx of temporary workers, assuming these workers are based in or near to Bindoon.

6.3 Existing Environment

The following paragraphs describe the environment in which the Proposal is located. This description pays particular attention to MNES that have the potential to exist, or have been confirmed to exist, in or near the Development Envelope. This includes the following species and ecological communities directly referenced in the request for additional information:

- Bindoon Starbush (*Asterolasia nivea*) – Vulnerable
- Fine-leaved Darwinia (*Darwinia acerosa*) – Endangered

- Muchea Bell (*Darwinia foetida*) – Critically Endangered
- Glossy-leaved Hammer Orchid (*Drakaea elastica*) – Endangered
- Gingin Wax (*Chamelaucium* sp. Gingin—NG Marchant 6) – Endangered
- *Grevillea corrugata* - Endangered
- Spiral Bush (*Spirogardnera rubescens*) – Endangered
- Star Sun-orchid (*Thelymitra stellata*) – Endangered
- Carnaby's Black Cockatoo - (*Calvptorhynchus latirostris*) – Endangered
- Forest Red-tailed Black Cockatoo - (*Calvptorhynchus banksii naso*) - Vulnerable
- Chuditch (*Dasyurus geoffroii*) – Vulnerable
- Banksia Woodlands TEC – Endangered.

6.3.1 Surveys Undertaken

Ecological field surveys have been conducted during 2016, 2017, 2018 and 2019. These surveys were undertaken in order to characterise the flora, vegetation, fauna and fauna habitats of the Development Envelope and included targeted surveys for EPBC-listed species and ecological communities.

Flora and vegetation surveys were undertaken by Focused Vision Consulting (FVC) in October 2016, November 2016, April-November 2017 and April, July and November 2018. Targeted searches for *Thelymitra stellata* (Star Sun-orchid) were conducted in November 2016, November 2017 and November 2018. Targeted surveys for *Drakaea elastica* were conducted in July 2017 and July to August 2018. Both of these targeted surveys were in accordance with the *Guidelines for detecting orchids listed as 'Threatened'* (Department of the Environment 2013).

The flora and vegetation surveys included targeted searches for all EPBC Act-listed species that could occur in the Development Envelope or surrounds, including the Bindoon Starbush (*Asterolasia nivea*), Fine-leaved Darwinia (*Darwinia acerosa*), Muchea Bell (*Darwinia foetida*), Gingin Wax (*Chamelaucium* sp. Gingin—NG Marchant 6), *Grevillea corrugata* and Spiral Bush (*Spirogardnera rubescens*). None of these species were recorded, despite extensive searches of suitable habitat.

Fauna surveys were undertaken by Bamford Consulting Ecologists (BCE) between October 2016 and December 2016, with additional targeted surveys undertaken throughout 2017, 2018 and 2019. These surveys included targeted searches for Black Cockatoos and Chuditch. Motion sensitive cameras were deployed at two wetland locations (Mooliabeenee Road and Teatree Road) between 7 October and 15 November 2016. Additional Black Cockatoo surveys were undertaken in February, September and November 2018, and March and May 2019.

Further information on the scope of these surveys and the methods employed are provided in **Chapter 4.3. Appendix D** and **Appendix E** contain full copies of the flora, vegetation and fauna reports, and include detailed descriptions of the surveys that have been undertaken to support this ERD.

6.3.2 Threatened Flora

A total of 572 flora taxa from 218 genera and 63 families were recorded during the 2016, 2017 and 2018 surveys (FVC 2019). Of these, 30 taxa (7%) were identified as weed species. Over 30% of the taxa recorded were from three families: Fabaceae (12.2%), Proteaceae (10.3%) and Myrtaceae (9.9%) (FVC 2018a). The number of flora taxa recorded is considered relatively high in terms of species diversity, and reflects the diversity of landform types, soils and the location of the Proposal on the boundary of two IBRA regions (FVC 2018a).

Desktop studies identified a total of 33 flora species listed under the EPBC Act that have potential to occur in the Bindoon region. Three species currently under assessment for EPBC Act listing were also identified. Of the 36 species identified by the desktop study, 27 are considered unlikely to occur, for the following reasons:

- known records are a significant distance from the Development Envelope
- the species is not known to occur in the Swan Coastal Plain or Jarrah Forest IBRA regions
- there is a lack of habitat in the Development Envelope for the species.

The remaining nine species listed under the EPBC Act are classified as ‘may occur’ within the Development Envelope (**Figure 6-1**):

- *Darwinia foetida* (Endangered)
- *Drakaea elastica* (Endangered)
- *Grevillea althoferorum* subsp. *fragilis* (Endangered)
- *Thelymitra stellata* (Endangered)
- *Chamelaucium* sp. Gingin—NG Marchant 6 (Endangered)
- *Grevillea corrugata* (Endangered)
- *Spirogardnera rubescens* (Endangered)
- *Eremophila glabra* subsp. *chlorella* (nominated for listing as Endangered)
- *Asterolasia nivea* (Vulnerable).

Darwinia acerosa (Endangered) is considered unlikely to occur in the Development Envelope, as its preferred habitat includes granite rocks, outcrops and orange-brown gravelly soils, which are not present in the Development Envelope.

The targeted surveys for *Thelymitra stellata* and *Drakaea elastica* focused on areas with suitable habitats for these species, as well as the location where a historic population was thought to be located. However, despite these efforts, no evidence of either species was identified. Furthermore, the area where the historic population of *Drakaea elastica* was located was found to be significantly degraded. The historic record of *Drakaea elastica* is approximately 240 m from the Development Envelope and 450 m from the clearing footprint.

In relation to *D. elastica*, no specific surveys for the mycorrhizal fungus have been undertaken for the proposed action. Research undertaken by Dixon et. al. (2012) found that *D. elastica* relies on a single particular species of mycorrhizal fungus. However all species of *Drakaea*, including common species, can use this fungus and that the fungus occurs at sites not occupied by *D. elastica*. Note that other species of *Drakaea* can use multiple species of mycorrhizal fungus. Whilst the specific species of mycorrhizal fungus is a limiting factor in the distribution of *D. elastica*, the presence of the fungus does not necessarily correlate to the presence or potential presence of *D. elastica*.

Currently the only way to determine whether this specific mycorrhizal fungus is present is to conduct “seed baiting”. This is where seed from *D. elastica* is left in a location under experimental conditions that allow it to contact the soil. The seed is then examined to determine if it has germinated, indicating the mycorrhizal fungus is present. This technique requires a large amount of seed and considering the rarity of *D. elastica* this is considered not to be in the best interests of the species.

No specific surveys for the pollinating wasp species (*Zaspilothynnus gilesii*) were undertaken. Research conducted by Dixon et. al. (2012) on the pollination of *D. elastica* found that the pollinating wasp species, while abundant in the Capel area, is very scarce at the northern extent of *D. elastica*’s range. Dixon et. al. (2012) Given this scarcity, it is possible that surveys for the wasp would not detect its presence. Furthermore, Dixon et. al. (2012) states that the wasp has a maximum movement distance of 556 m. This puts the footprint for the proposed action at the edge of the range of the wasp in relation to the historic record location.

The Endangered species *Chamelaucium* sp. Gingin is known from six populations approximately 7 km west of the Chittering Roadhouse, where the Bindoon Bypass joins the existing GNH. A review of the known locations of the species against soils landscape mapping indicates that the species is associated with the Coonambidgee

Land System. This Land System does not occur within the Development Envelope. Additionally, within its known distribution, the species occurs on “white/yellow sand supporting open low woodland over open scrub, with *Eucalyptus todtiana*, *Banksia attenuata* and *Hibbertia* sp.” (Stack and English, 2003). The EtBeAn vegetation association mapped by Focused Vision (2017; 2018) fits this description, however most of the occurrences mapped by FVC (2017; 2018) are on grey sands, and therefore not likely to provide habitat for *Chamelaucium* sp. Gingin. The exception is the occurrence north of Mooliabeenee Road (**Figure 4-4**), which occurs on white sands.

Asterolasia nivea has been determined to be a synonym of *A. grandiflora*. Wege (2017) examined collections of both species and found that morphology in both was more highly variable than previously thought. The two species were also found to grade into each other. Wege (2017) concluded that “*Asterolasia nivea* is therefore best synonymised under *A. grandiflora*, forming a single, geographically restricted species with a petal hair morphology that is highly distinctive in the genus”.

All former records of *A. nivea* now known as *A. grandiflora*, which is listed as Priority 4 by DBCA and not listed under the EPBC Act.

All other EPBC Act-listed species were targeted as part of the general flora surveys in 2016, 2017 and 2018. No EPBC Act-listed species were recorded during these surveys.

6.3.3 Banksia Woodland of the Swan Coastal Plain TEC

Desktop and field surveys between 2016 and 2018 characterised vegetation within the study area, including the EPBC-listed Banksia Woodlands of the Swan Coastal Plain TEC (Banksia Woodlands TEC). Confirming the presence of the Banksia Woodlands TEC within the study area was a focus of field surveys. Desktop results also showed that there are twenty-one floristic community Types (FCTs) that best correspond to the Banksia Woodlands TEC. These FCTs have been used to identify where field survey results have defined the Banksia Woodlands TEC.

Field surveys were conducted in 2016, 2017 and 2018 whereby vegetation associations and vegetation quality were defined and mapped. The Banksia Woodlands TEC assessment method required sampling of quadrats, and analysis to determine the FCT (Gibson et al., in FVC 2018a). FCTs were diagnosed using criteria listed in the conservation advice (Threatened Species Scientific Committee 2016). This process identified the following five of the mapped vegetation associations that are representative of the Banksia Woodlands TEC:

- BaXpAn – *Banksia* spp. sparse woodland
- BaXpUa – *B. attenuata* sparse woodland
- EmXpAn – *Eucalyptus marginata* (and *B. attenuata*) sparse woodland
- EtBeAn – *E. todtiana*, *B. attenuata* and *B. menziesii* low sparse woodland
- EtEpAn – *E. todtiana* and *Banksia* spp. low sparse woodland.

Analysis of the quadrats within the Banksia woodlands vegetation associations was undertaken with the aim to determine the Floristic Community Types (FVCs) represented by the vegetation associations. An analysis against the presence-absence species data of Gibson *et al.* (1994) and Keighery (2008) datasets (**Table 6-4**) suggests the Banksia woodland vegetation associations are mostly representative of FCT 28 or FCT 23a (FVC 2019).

Table 6-4: Banksia Woodland Vegetation Associations and Inferred FCT (FVC 2019)

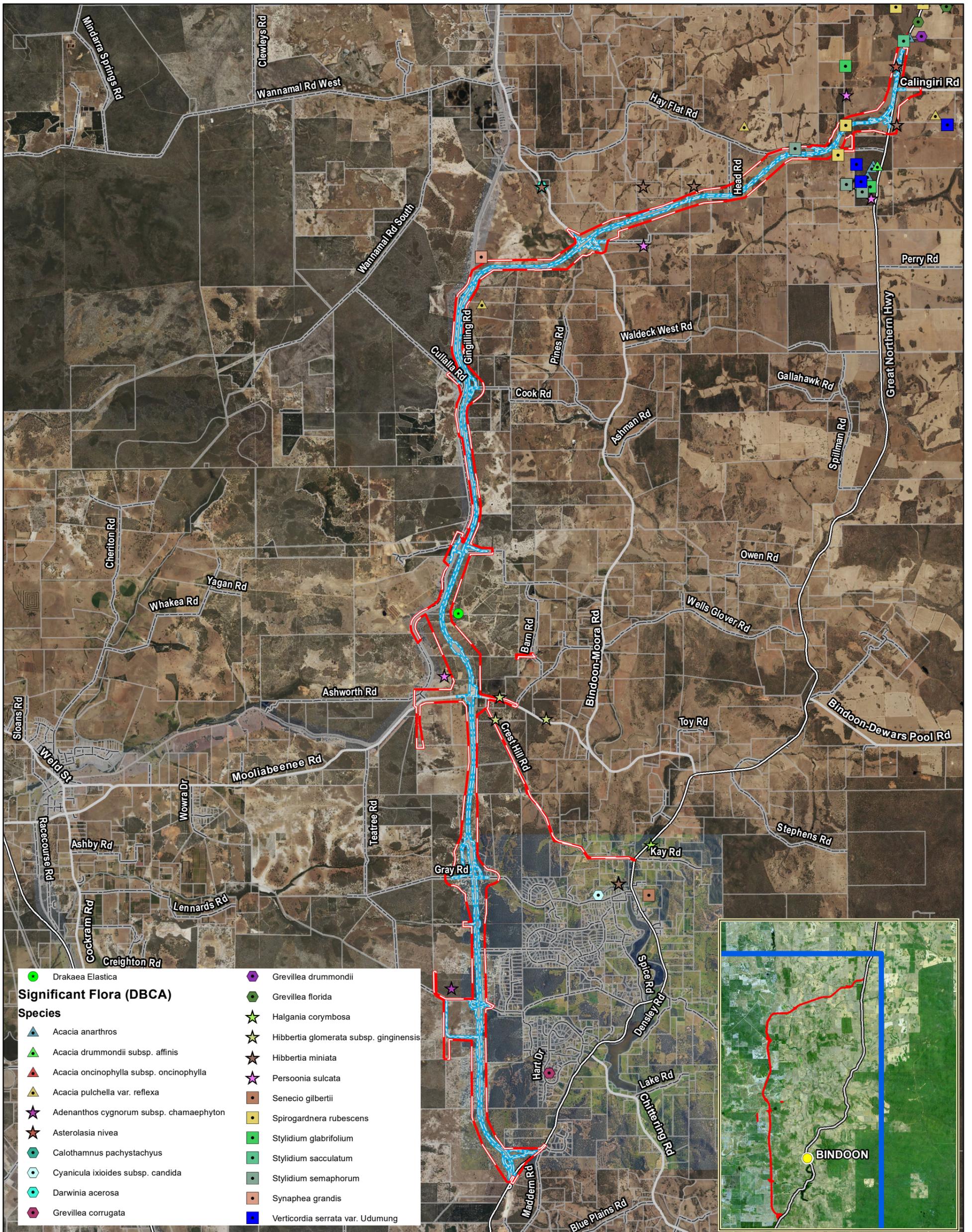
FVC Vegetation Unit and Description	Inferred FCT
<p>BaXpAn <i>Banksia</i> spp. sparse woodland <i>Banksia attenuata</i>, <i>Banksia menziesii</i> and <i>Eucalyptus todtiana</i> low sparse woodland over <i>Xanthorrhoea preissii</i> mid isolated to sparse shrubs over <i>Bossiaea eriocarpa</i>, <i>Gompholobium tomentosum</i> and <i>Petrophile linearis</i> low isolated shrubs over <i>Alexgeorgea nitens</i> and <i>Lyginia imberbis</i> sparse sedgeland</p>	<p>28 – Spearwood <i>Banksia attenuata</i> or <i>Banksia attenuata</i> – <i>Eucalyptus</i> woodlands</p>
<p>BaXpUa <i>Banksia attenuata</i> sparse woodland <i>Banksia attenuata</i> low sparse woodland (with occasional <i>Banksia menziesii</i>) over <i>Xanthorrhoea preissii</i> mid isolated shrubs over <i>Bossiaea eriocarpa</i>, <i>Hibbertia hypericoides</i> and <i>Petrophile linearis</i> low isolated shrubs over <i>Ursinia anthemoides</i>, <i>Conostylis aculeata</i> and <i>Hypochoeris glabra</i> isolated herbs</p>	<p>28 – Spearwood <i>Banksia attenuata</i> or <i>Banksia attenuata</i> – <i>Eucalyptus</i> woodlands</p>
<p>EmXpAn <i>Eucalyptus marginata</i> sparse woodland <i>Eucalyptus marginata</i> (and <i>Banksia attenuata</i>) low sparse woodland over <i>Xanthorrhoea preissii</i> mid sparse shrubland over <i>Bossiaea eriocarpa</i>, <i>Hibbertia hypericoides</i> and <i>Petrophile linearis</i> low isolated to sparse shrubland over <i>Alexgeorgea nitens</i> and <i>Lomandra</i> spp. isolated sedges</p>	<p>28 – Spearwood <i>Banksia attenuata</i> or <i>Banksia attenuata</i> – <i>Eucalyptus</i> woodlands</p>
<p>EtBeAn <i>Eucalyptus todtiana</i> sparse woodland <i>Eucalyptus todtiana</i>, <i>Banksia attenuata</i> and <i>Banksia menziesii</i> low sparse woodland over <i>Bossiaea eriocarpa</i>, <i>Hibbertia hypericoides</i> and <i>Petrophile linearis</i> low isolated shrubs over <i>Alexgeorgea nitens</i>, <i>Lyginia imberbis</i> and <i>Mesomelaena pseudostygia</i> sparse sedgeland</p>	<p>23a – Central <i>Banksia attenuata</i> – <i>Banksia menziesii</i> woodlands and 28 – Spearwood <i>Banksia attenuata</i> or <i>Banksia attenuata</i> – <i>Eucalyptus</i> woodlands</p>
<p>EtEpAn <i>Eucalyptus todtiana</i> sparse woodland <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</p>	<p>23a – Central <i>Banksia attenuata</i> – <i>Banksia menziesii</i> woodlands</p>

The total area of the Banksia Woodlands TEC has been mapped within the study area, based on data from 55 quadrats. In accordance with conservation advice (Threatened Species Scientific Committee 2016), each area of mapped Banksia woodland has been grouped with other relevant areas of Banksia woodland connected to those areas within the study area to form patches. A total of six patches have been identified within or adjacent to the Development Envelope. The condition of each patch has also been assessed against condition thresholds in the conservation advice (Threatened Species Scientific Committee 2016), to determine whether the patch as a whole retains sufficient conservation values to be considered an MNES, as defined under the EPBC Act. Patches that do not meet the minimum condition thresholds are excluded from full national protection. On this basis, patches that are in Degraded or worse condition are not considered to be MNES, unless they are connected to or in close proximity to other areas of applicable Banksia woodland. The resulting areas of Banksia Woodlands TEC within the study area totals 467.1 ha (Table 6-6, Figure 4-8).

FVC (2018a) undertook a desktop assessment of the native vegetation complexes adjacent to the Development Envelope, to determine if these are likely to be representative of the Banksia Woodlands TEC. This assessment found there to be approximately 18,142 ha of vegetation likely to be the Banksia Woodlands TEC that are contiguous with the areas of TEC present within the Development Envelope (**Figure 6-2**).

Table 6-5: Banksia Woodlands TEC by Vegetation Association and Condition within the Development Envelope

Vegetation Association	Vegetation Condition (ha)							Total (ha)
	Degraded	Degraded – Good	Good	Good – Very Good	Very Good	Very Good – Excellent	Excellent	
BaXpAn	3.0	0.0	0.1	2.5	16.1	2.8	36.5	61.0
BaXpUa	0.0	14.1	0.0	18.7	3.4	5.6	0.0	41.7
EmXpAn	0.0	0.0	0.0	0.6	0.0	12.8	0.0	13.4
EtBeAn	0.0	0.5	0.0	60.2	13.4	52.5	25.7	152.2
EtEpAn	0.0	0.0	0.0	0.0	25.6	13.6	0.0	39.2
Total (ha)	3.0	14.5	0.1	81.9	58.5	87.3	62.2	307.5



- Significant Flora (DBCA)**
- Species**
- *Drakaea Elastica*
 - *Grevillea drummondii*
 - *Grevillea florida*
 - ▲ *Acacia anarthros*
 - ▲ *Acacia drummondii* subsp. *affinis*
 - ▲ *Acacia ocnophylla* subsp. *ocnophylla*
 - ▲ *Acacia pulchella* var. *reflexa*
 - ★ *Adenanthos cygnorum* subsp. *chamaephyton*
 - ★ *Asterolasia nivea*
 - *Calothamnus pachystachyus*
 - *Cyanicula ixioides* subsp. *candida*
 - *Darwinia acerosa*
 - *Grevillea corrugata*
 - *Grevillea florida*
 - ★ *Halgania corymbosa*
 - ★ *Hibbertia glomerata* subsp. *ginginensis*
 - ★ *Hibbertia miniata*
 - ★ *Persoonia sulcata*
 - *Senecio gilbertii*
 - *Spirogardnera rubescens*
 - *Stylidium glabrifolium*
 - *Stylidium sacculatum*
 - *Stylidium semaphorum*
 - *Synaphea grandis*
 - *Verticordia serrata* var. *Udumung*

Legend

- Development Envelope
- Development Footprint
- Cadastral Boundary
- Highway
- Major Road
- Minor Road

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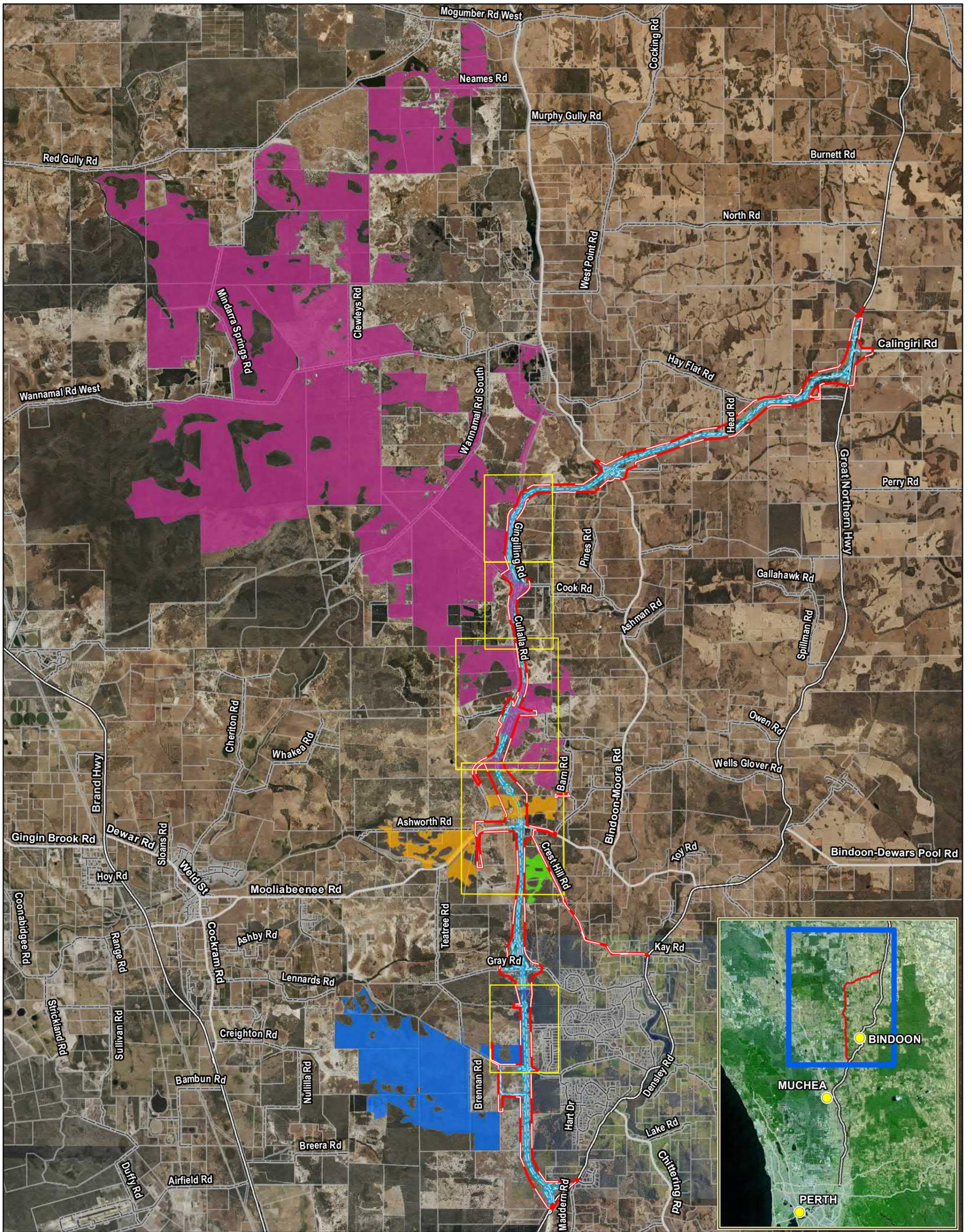
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EPBC Act Listed flora species that May Occur in the Region

Figure: 6-1

Drawing No GNH-CN12-EA-PER-00001 - F6-1	Issue 1		
Task No ERD	Drawing Status / Other Draft		
Date 13/03/2020	By BG	Chkd LB	Appd TJ

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Legend

- Development Envelope
- Development Footprint
- Cadastral Boundary
- Highway
- Major Road
- Minor Road

- Banksia Woodlands TEC Patch**
- 1
 - 2
 - 3
 - 4
 - 5
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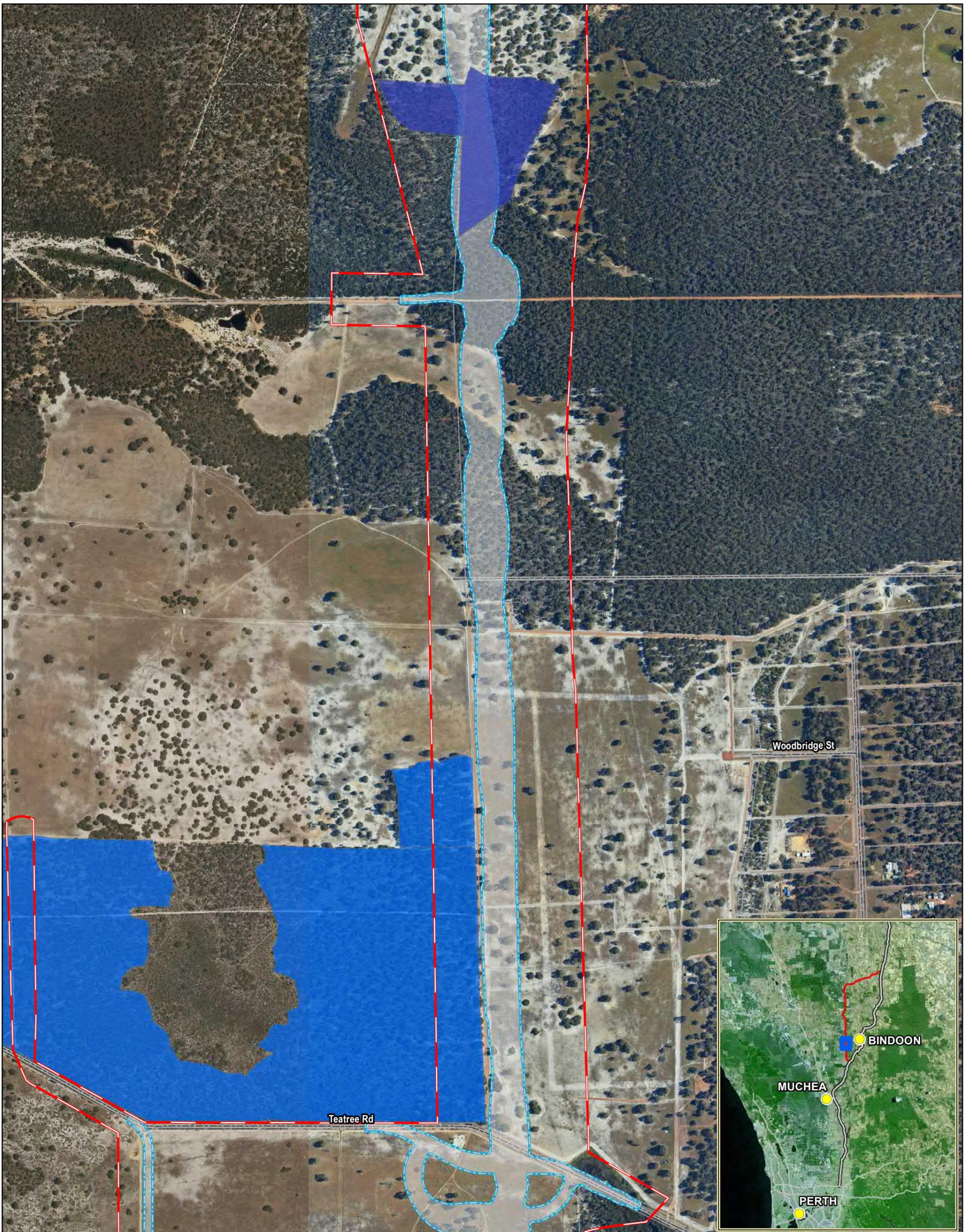
Extent of Contiguous Areas of the Banksia Woodlands TEC Index

Figure: 6-2

Drawing No: GNH-CN12-EA-PER-00001 Issue: 1
 - F6-2

Task No: ERD Drawing Status / Other: Draft

Date	By	Chkd	Appd
9/12/2020	BG	LB	TJ



Legend

- Development Envelope
 - Development Footprint
 - Cadastral Boundary
 - Minor Road
- Banksia Woodlands TEC Patch**
- 1
 - 3

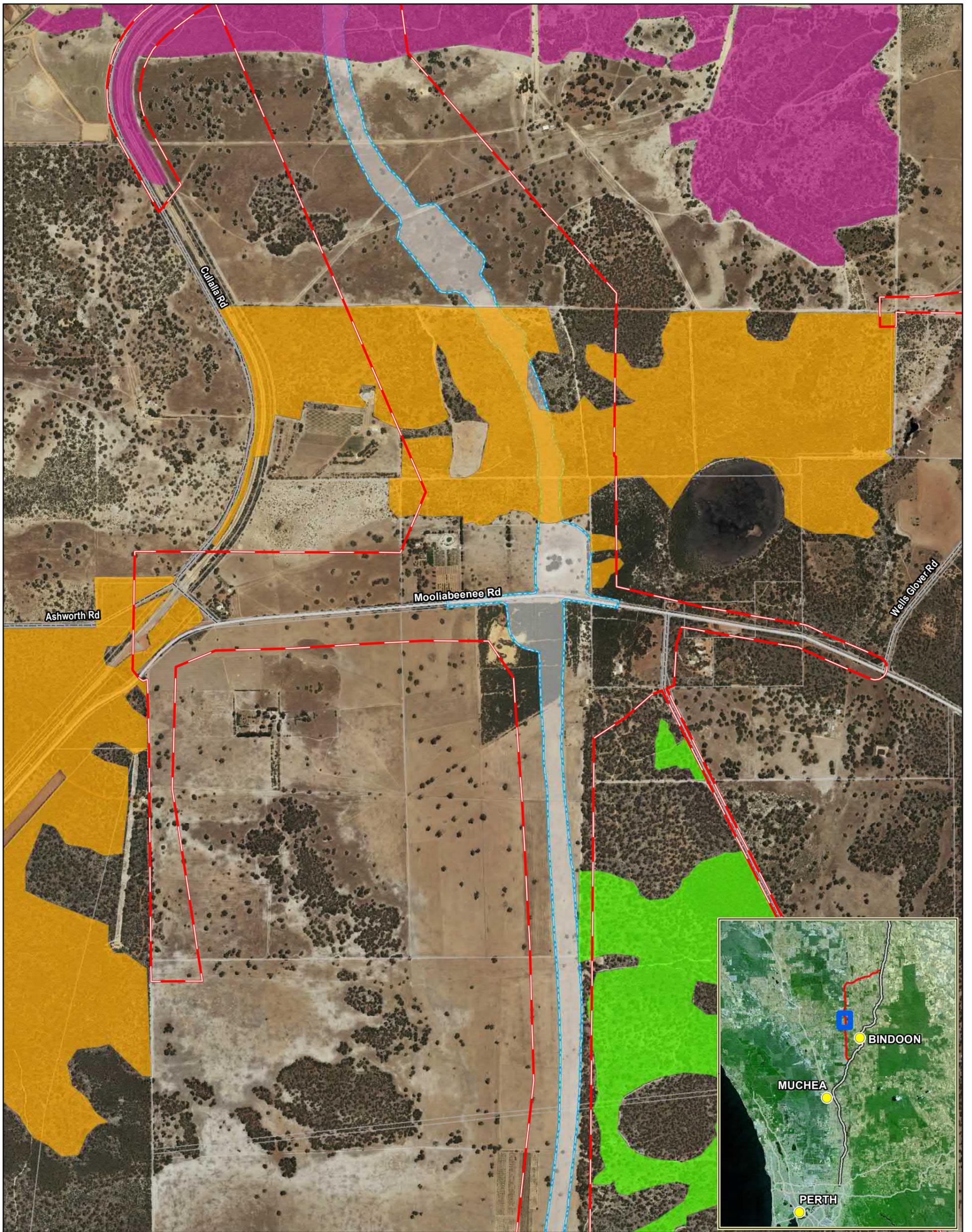
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**Extent of Contiguous Areas of the
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Figure: 6-2
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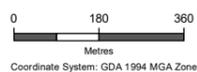
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|  | Cadastral Boundary |  5 |
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|  | Minor Road | |



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Extent of Contiguous Areas of the
 Banksia Woodlands TEC Page 2 of 5

Figure: 6-2

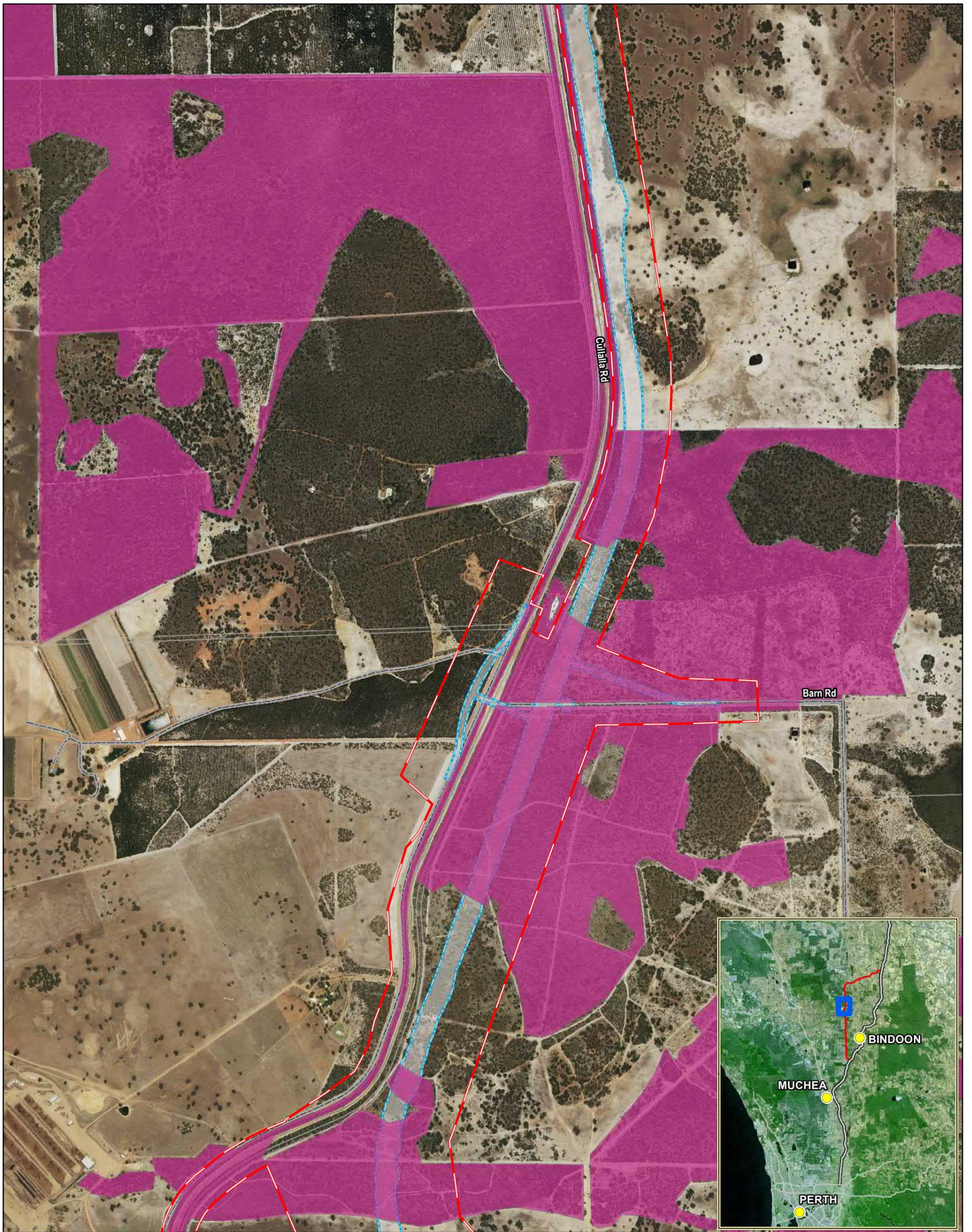
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Date	By	Chkd	Appd
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Legend

- Development Envelope
- Development Footprint
- Cadastral Boundary
- Minor Road
- Banksia Woodlands TEC Patch
- 6



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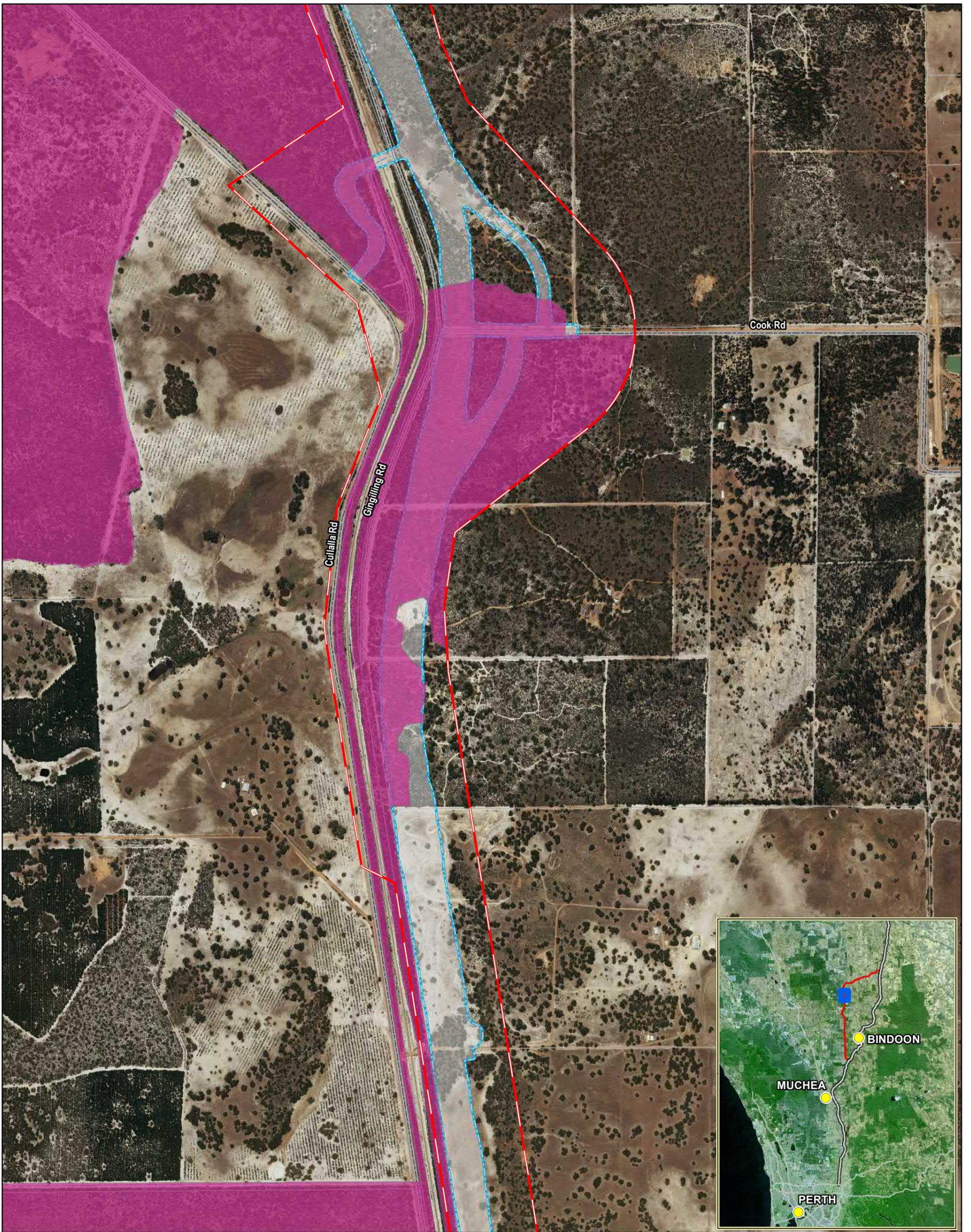
Extent of Contiguous Areas of the
 Banksia Woodlands TEC Page 3 of 5

Figure: 6-2

Drawing No: **GNH-CN12-EA-PER-00001** Issue: **1**

Task No: **ERD** Drawing Status / Other: **Draft**

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Legend

- Development Envelope
- Development Footprint
- Cadastral Boundary
- Minor Road
- Banksia Woodlands TEC Patch 6

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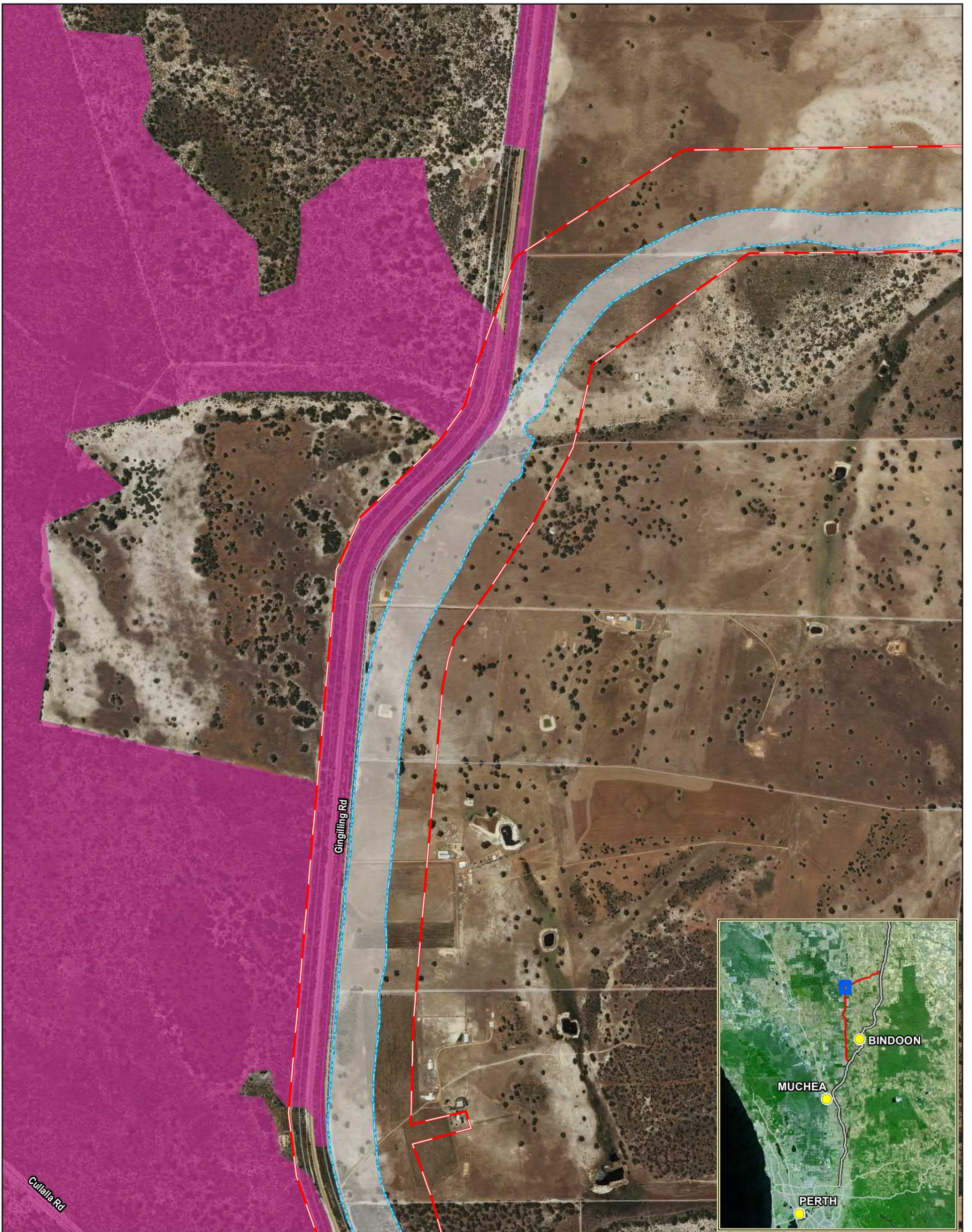
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Extent of Contiguous Areas of the
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- Development Envelope
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Extent of Contiguous Areas of the
 Banksia Woodlands TEC Page 5 of 5
Figure: 6-2

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6.3.4 Threatened Fauna

The desktop study undertaken for the Proposal identified 15 fauna species listed under the EPBC Act that may occur within the Development Envelope (**Table 6-6**). Of these, two are Critically Endangered, three are Endangered and four are Vulnerable. Six species of migratory birds are also expected to occur.

Of those EPBC Act-listed fauna that may occur, two (the Endangered Carnaby’s Black Cockatoo and the Vulnerable Forest Red-tailed Black Cockatoo) were recorded from the Development Envelope. *Merops ornatus* (Rainbow Bee-eater) and *Ardea modesta* (Eastern Great Egret) were also recorded; however, these species were removed from the EPBC Act list of migratory species in 2016.

Table 6-6: Species Listed under the EPBC Act Expected to Occur

Species	EPBC Act Status	Expected Occurrence	Recorded
<i>Pseudemydura umbrina</i> (Western Swamp Tortoise)	Critically Endangered	Unlikely	
<i>Calidris ferruginea</i> (Curlew Sandpiper)	Critically Endangered and Migratory	Migrant	
<i>Botaurus poiciloptilus</i> (Australasian Bittern)	Endangered	Irregular Visitor	
<i>Rostratula australis</i> (Australian Painted Snipe)	Endangered	Vagrant	
<i>Calyptorhynchus latirostris</i> (Carnaby’s Black-Cockatoo)	Endangered	Resident	+
<i>Calyptorhynchus baudinii</i> (Baudin’s Black-Cockatoo)	Vulnerable	Irregular Visitor	
<i>Calyptorhynchus banksia naso</i> (Forest Red-tailed Black-Cockatoo)	Vulnerable	Resident	+
<i>Dasyurus geoffroii</i> (Chuditch)	Vulnerable	Resident	
<i>Idiosoma nigrum</i> (Shield-backed Trapdoor Spider)	Vulnerable	Resident	
<i>Apus pacificus</i> (Fork-tailed Swift)	Migratory	Migrant	
<i>Plegadis falcinellus</i> (Glossy Ibis)	Migratory	Migrant	
<i>Actitis Hypoleucos</i> (Common Sandpiper)	Migratory	Migrant	
<i>Tringa nebularia</i> (Common Greenshank)	Migratory	Migrant	
<i>Tringa glareola</i> (Wood Sandpiper)	Migratory	Migrant	
<i>Calidris ruficollis</i> (Red-neck Stint)	Migratory	Migrant	

6.3.5 Chuditch

Motion-sensitive camera traps were deployed in areas of habitat suitable for the Chuditch between October and November 2016. While this survey did not detect the presence of Chuditch within the Development Envelope, BCE (2018) concluded that this did not mean the species is absent from the area; rather, they are likely to be present in very low levels. There is also anecdotal evidence of Chuditch in the Bindoon area and a recent report from a landowner on Hay Flat Road of a Chuditch caught (and released) in a feral cat trap (*pers. comm.* James Nelson, June 2019).

Suitable habitat for the species within the Development Envelope consists of the Jarrah/Marri woodlands. A total of 54.4 ha of this habitat is within the Development Footprint. Habitat for Chuditch within and adjacent to the Development Envelope is highly fragmented and, in many cases, poorly linked to other patches as shown on **Figure 6-4**. An estimated 7,302 ha of the native vegetation within 5 km of the Development Envelope is expected to provide additional habitat for this species, based on vegetation complex mapping for the south west of Western Australia (Government of Western Australia 2018).

6.3.6 Black Cockatoos

The surveys undertaken by BCE (2017, 2018, 2019) identified a total of 11,554 potential Black Cockatoo breeding trees. Of these, approximately 90% did not have hollows suitable for Black Cockatoos. A total of 1,352 tree hollows were recorded that are suitable for use by Black Cockatoos (BCE 2018), with a further 83 identified with evidence of chew marks around hollow entrances, indicating these are likely to be used for breeding. During the 2017 survey, one active nest was recorded within the Development Envelope along Crest Hill Road (BCE 2018). An additional two active nests were recorded outside of the Development Envelope. Those trees with hollows suitable for, or showing evidence of use by, Black Cockatoos are shown on **Figure 4-13**. Feral honey bees were confirmed to have colonised 30 hollows that would otherwise have been suitable for use by Black Cockatoos (BCE 2018).

Foraging habitat for both Carnaby’s Black Cockatoo and the Forest Red-tailed Black Cockatoo was recorded across the study area during the surveys by BCE (2017, 2018, 2019). The criteria and method used to define habitat value is provided in Appendix 5 of BCE (2018—**Table 6-7; Appendix E**). The value of the foraging habitat ranged from Negligible to High for both species (**Table 6-8, Figure 4-14 and Figure 4-15**). For the Forest Red-tailed Black Cockatoo, 68.5% of the survey area was determined to consist of habitat with Low or Negligible foraging value while for Carnaby’s Black Cockatoo 60% of the survey area was recorded as Low or Negligible (BCE 2018). Only 2.7% and 6.2% of the foraging habitat was recorded as High value for the Forest Red-tailed Black Cockatoo and Carnaby’s Black Cockatoo respectively. In general, the Development Envelope provides Moderate value foraging habitat for both species of Black Cockatoo (BCE 2019).

Table 6-7: Relationship between Foraging Habitat Value of BCE (2018) and DoEE (2017)

Habitat Value as per BCE (2018)	Context Score		Species Density Score		Habitat Value as per DoEE (2017)
	CBC	FRTBC	CBC	FRTBC	
6: High	2	2	1	1	9. Very High Quality
5: Moderate to High	2	2	1	1	8. Very High Quality
4: Moderate	2	2	1	1	7. High Quality
3: Low to Moderate	2	2	1	1	6. Quality
2: Low	0	0	0	0	N/A (veg. score <3)
1: Negligible	0	0	0	0	N/A (veg. score <3)
0: Nil	2	2	1	1	N/A (veg. score <3)

CBC = Carnaby’s Black Cockatoo; FRTBC = Forest Red-tailed Black Cockatoo

Table 6-8: Black Cockatoo Foraging Habitat Value within the Study Area

Habitat Value	Forest Red-tailed Black Cockatoo		Carnaby's Black Cockatoo	
	Area (ha)	%	Area (ha)	%
6: High	106.5	2.7	243.3	6.2
5: Moderate to High	202.1	5.2	383.7	9.8
4: Moderate	365.1	9.4	664.4	17.0
3: Low to Moderate	555.2	14.2	313.3	8.0
2: Low	1,362.0	34.9	1,452.0	37.1
1: Negligible	1,308.5	33.6	855.4	21.9
0: Nil	0.0	0.0	0.0	0.0

Within 15 km of the Development Envelope, there are an estimated 93,004 ha of remnant native vegetation likely to provide foraging habitat for Black Cockatoos. Of this, 775 ha of foraging habitat is within the Development Envelope, constituting 0.8% of the habitat available in the local area.

Foraging habitat for Black Cockatoos was mapped as part of the Perth-Peel strategic assessment (Department of the Premier and Cabinet 2015). According to this mapping, 225,338.45 ha of foraging habitat for Carnaby's Black Cockatoo and 3,138,214.33 ha of foraging habitat for the Forest Red-tailed Black Cockatoo remains within the Swan Coastal Plain and Jarrah Forest bioregions. It should be noted that the Proposal is located outside of the core habitat for the Forest Red-tailed Black Cockatoo.

Three roost sites for the Forest Red-tailed Black Cockatoo were identified by BCE (2018). None of these roosts are within the Development Envelope. No roost sites for Carnaby's Black Cockatoo were recorded (BCE 2018—**Table 6-9**).

Table 6-9: Forest Red-tailed Black Cockatoo Roost Sites within the Study Area

Roost ID	Location	Distance from Development Envelope (m)
FRTBC Roost 01	In paddock trees and remnant woodland north-east of the cemetery on Gray Road. 10-15 birds observed in April 2017.	130
FRTBC Roost 02	In remnant woodland between Cockatoo Road and Warbler Court, Bindoon. 10-15 birds observed in May 2017.	980
FRTBC Roost 03	In paddock trees and remnant woodland south of the Mooliabeenee Road/Glover-Wells Road intersection. 20-30 birds observed.	220

6.4 Impacts of the Action

The implementation, construction, operation and ongoing maintenance of the Proposal will have both direct and indirect impacts to terrestrial fauna. Potential impacts may arise as a result of the following aspects of the Proposal:

- clearing and earthmoving
- vehicle movements (both during construction and operational use)
- watercourse and wetland crossings
- road reserve fencing

- physical presence of cut and fill areas.

The following general impacts are anticipated or may occur as a result of the Proposal:

- loss of native vegetation
- degradation and changes to biodiversity of native vegetation as a result of:
 - ▶ introduction and/or spread of weeds
 - ▶ edge effects from fragmentation of vegetation
 - ▶ spread of *Phytophthora cinnamomi* dieback
 - ▶ changed fire regimes
 - ▶ changes to groundwater levels
- loss of foraging and breeding habitat for Black Cockatoos
- loss of habitat for fauna
- fragmentation of habitat and loss of connectivity
- habitat degradation due to altered ground and surface water hydrology
- habitat degradation due to introduction or spread of weeds or dieback
- fauna mortality from vehicle strikes.

Impacts to Threatened flora, the Banksia Woodlands TEC, Black Cockatoos and other Threatened fauna are discussed in more detail below.

6.4.1 Threatened Flora

No flora listed under the EPBC Act were identified within the Development Envelope or the surrounding area covered by the flora and vegetation surveys (FVC 2017, 2018a, 2019). Therefore, the Proposal is not expected to have any impacts on Threatened flora species.

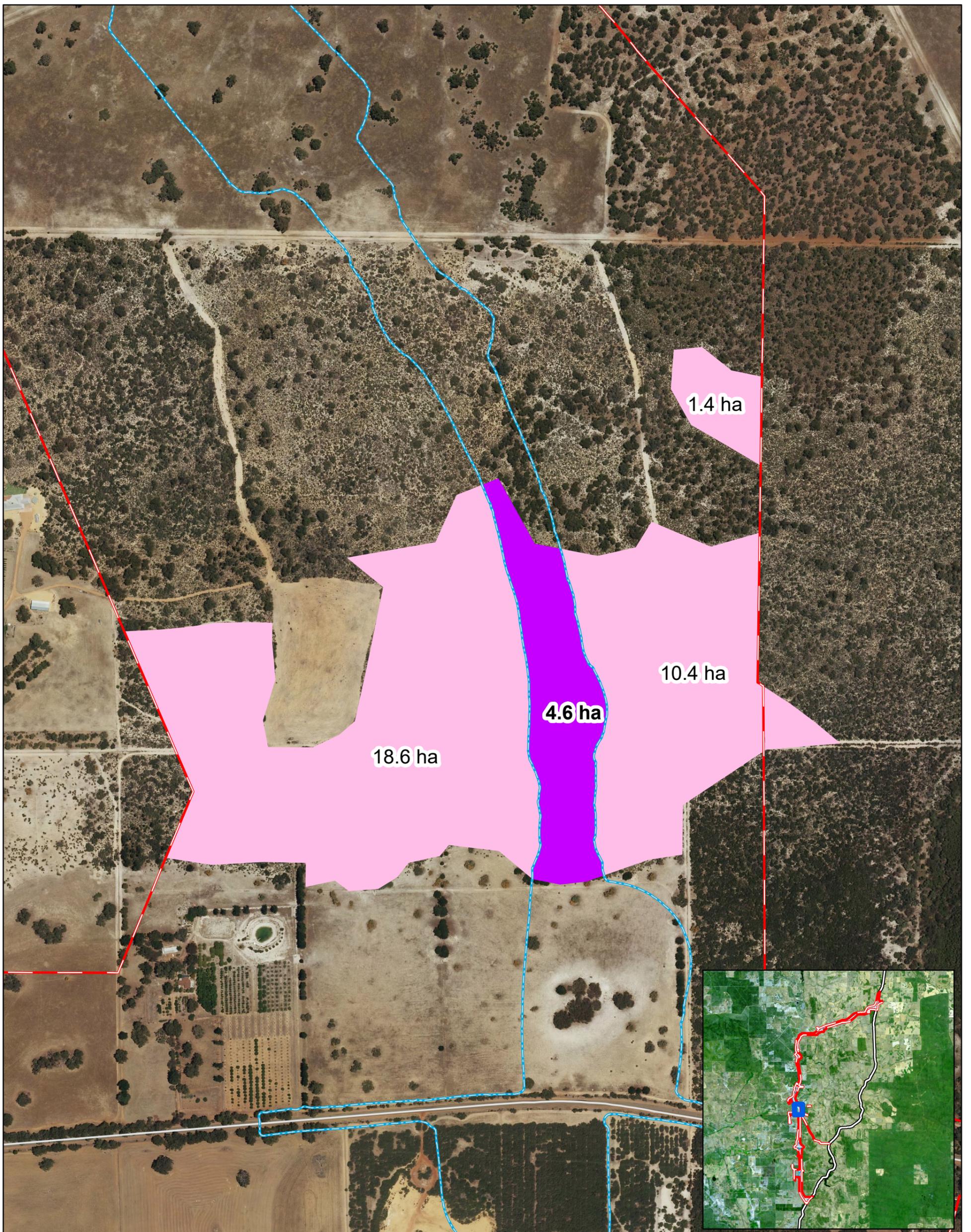
While the Endangered species *Chamelaucium* sp. Gingin was not recorded during targeted searches for the species, the patch of EtBeAn vegetation association mapped by FVC (2017; 2018) to the north of Mooliabeenee Road matches the habitat description for the species. Approximately 27 ha of EtBeAn has been mapped within the survey area at this location with 4.6 ha of this is within the disturbance footprint (**Figure 6-3**). This vegetation association has also been identified as a component of the Banksia woodlands TEC.

6.4.2 Banksia Woodlands of the Swan Coastal Plain TEC

Potential impacts from the Proposal on vegetation include the direct loss of portions of the Banksia Woodlands TEC, due to clearing for road construction activities and indirect impacts from the following:

- changes to Banksia Woodlands TEC health as a result of changes to groundwater levels
- reduced biodiversity due to introduction and/or spread of weeds, and edge effects from fragmentation of Banksia Woodlands TEC
- loss of Banksia Woodlands TEC from the spread of *Phytophthora* dieback
- loss of Banksia Woodlands TEC due to changed fire regimes.

Approximately 60 ha of Banksia Woodlands TEC will be cleared in order to implement the Proposal. **Table 6-10** shows the areas that are planned to be cleared, and the extent remaining within the Development Envelope, by vegetation association while **Table 6-11** details the clearing required by vegetation condition. Of the six patches of Banksia Woodlands identified, three patches overlap the footprint for the Proposal (**Table 6-12; Figure 6-2**).



Legend

- Development Envelope
- Disturbance Footprint
- Gingin-Wax Suitable Habitat: Extent of Clearing
- Gingin-Wax Suitable Habitat

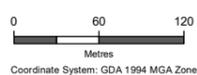
Data Source: Main Roads WA, Landgate



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Potential Habitat for Gingin Wax
 Figure 6-3

Drawing No: **GNH-CN12-EA-GD-0114** Issue: **A**

Task No: **GNH-XXXX** Drawing Status / Other: **Draft / Other Info**

Date	By	Chkd	Appd
7/12/2020	SP	XX	XX

Table 6-10: Clearing Required by Vegetation Associations Representative of Banksia Woodland TEC in Good or Better Condition

Vegetation Association	Extent mapped by FVC (2018a) (ha)	Extent Cleared (ha)	% Extent Cleared	% Extent Remaining
BaXpAn	95.2	8.5	8.9	91.1
BaXpUa	49.1	7.5	15.3	84.7
EmXpAn	22.8	2.0	8.8	91.2
EtBeAn	257.5	34.0	13.2	86.8
EtEpAn	59.1	8.0	13.5	86.5
Total	483.7	60.0	12.4	87.6

Table 6-11: Condition of the Banksia Woodland TEC to be Cleared

Vegetation Association	Vegetation Condition (ha)								Total (ha)
	Degraded	Degraded - Good	Good	Good - Very Good	Very Good	Very Good - Excellent	Excellent	Pristine	
BaXpAn	0.0	0.0	0.0	0.0	4.3	0.0	4.2	0.0	8.5
BaXpUa	0.0	4.0	0.0	1.7	1.3	0.5	0.0	0.0	7.5
EmXpAn	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	2.0
EtBeAn	0.0	0.0	0.0	19.5	1.5	8.0	5.0	0.0	34.0
EtEpAn	0.0	0.0	0.0	0.0	4.5	3.5	0.0	0.0	8.0
Total	0.0	4.0	0.0	21.2	11.6	14.0	9.2	0.0	60.0

Table 6-12: Clearing by Banksia Woodlands TEC Patch

Patch #	Total Area of Patch (ha)	Area within Disturbance Footprint (ha)
3	11.0	4.4
5	575.7	7.8
6	15,528.6	47.8

The main ongoing threats to the Banksia Woodlands TEC as listed in the conservation advice (Threatened Species Scientific Committee 2016) and are relevant to this Proposal, include the following:

- clearing and fragmentation
- dieback diseases (especially those caused by *Phytophthora* species)
- invasive species
- fire regime change (particularly increased fire frequency; prescribed burning during late autumn to late spring when plants are in active growth, flowering and seed development and animals are active)
- hydrological degradation (groundwater abstraction, eutrophication, soil acidification)
- loss of keystone Banksia species and fragmenting of nectar/pollen nutritional networks e.g. loss of *Banksia ilicifolia* in water drawdown areas.

The majority of native vegetation areas within the Development Envelope has been mapped as dieback free. Spread of dieback as a result of implementation of the Proposal has the potential to cause significant degradation to the Banksia Woodlands TEC, as this ecological community contains a high proportion of susceptible species. Drainage for the road will be designed to avoid movement of water from areas identified as dieback-infested to dieback-free areas. Additionally, dieback management during construction is a standard practice in the southwest of WA. Appropriate management and mitigation controls, including segregation of topsoil and excavated material according to its dieback status, will be in place. It is unlikely that implementation of the Proposal will result in the spread or introduction of dieback.

A review of the potential edge effects due to the construction of new roads identified weeds to have the greatest potential for impact (van Etten 2014). This review determined that the effects could be minimised, provided appropriate management controls were in place. These would include the ongoing control of invasive weeds, and appropriate drainage design such that run-off is captured and not allowed to flow unmanaged into adjacent native vegetation. Main Roads requires that the road drainage network is capable of capturing surface water flows from rain events and discharging this run-off in a managed way; for example, through infiltration in locations with sandy soils, or discharge to adjacent waterways. Annual monitoring of revegetation areas is undertaken until the vegetation has become established. This includes an assessment of weed presence and cover. Follow-up weed control is undertaken should the monitoring indicate it is required.

Fragmentation of occurrences of the Banksia Woodlands TEC may also disrupt nectar/pollen nutritional networks. Banksia species are known to be pollinated by a range of bird and small mammal species. In relation to bird pollinators, the proposed action is unlikely to create a separation between Banksia Woodlands TEC patches that would inhibit movement between the patches. The largest gap that will be created in areas of the TEC, prior to revegetation, is 150 m with the average being about 60 m. This distance does not form a barrier to larger bird species, such as Black Cockatoos. Revegetation planting of the median between the carriageways will provide opportunities for smaller understorey bird species to cross the highway in a series of movements.

Of the seven proposed fauna underpass locations (**Figure 4-19**) four are located where the proposed alignment will bisect occurrences of the TEC. This will allow for continued movement of small mammal pollinators across four of the five occurrences fragmented by the proposed action. The fifth occurrence is connected to other occurrences through contiguous buffer (non-Banksia woodland) vegetation, which will also allow for continued movement of pollinators.

The Proposal may increase the risk of accidental and deliberately lit fires (in particular during the operational phase), due to increased human access into areas of native vegetation; however, this is unlikely due to increased surveillance of these areas from the road. Fires already occur in the region, and local landowners and land managers manage this risk through hazard reduction burns during the cooler months. The Proposal will not significantly increase or alter the fire regimes already present.

Groundwater abstraction will be required in order to provide water for construction activities. Usual practice is for a number of sources to be used in order to reduce the haulage distance between the source and location where the water is required. The duration of use for each source will depend on the number of available sources. Review of the water use during construction of the Miling Bypass and Miling Straight section of the Great Northern Highway Upgrade, and groundwater licence allocations for the Northlink project indicate that daily water requirements are likely to be between 100 and 700kL, depending on the stage of construction and climatic conditions at the time.

As described in **Chapter 4.2**, many Banksia species are (at least partially) groundwater-dependent. Groundwater abstraction adjacent to areas of Banksia woodland has the potential to lower the water table, to an extent that impacts the health of the ecological community. Groom et al (2000) notes that high levels of groundwater drawdown during hot, dry conditions can result in the death of individual Banksia plants. The event studied by Groom et al (2000) was related to abstraction by the Water Corporation for drink water. These bores abstract water at much higher daily volumes than is typically required for road construction activities. For example, the licenced allocation of the Water Corporation bores supplying Bindoon and Chittering equates to an average abstraction of 1,682 kL per day, more than double that typically required for road construction.

In order to minimise these potential impacts, abstraction will be managed such that the drawdown below adjacent areas of Banksia woodland is no more than 0.5 m below the existing groundwater levels, taking into consideration seasonal variability. This magnitude of change is consistent with the ecological water requirements of GDEs identified by DoW (2006b). In addition, the portion of the Development Envelope which overlaps the mapped occurrences of the Banksia woodlands TEC is within the boundaries of the Gingin groundwater allocation plan. This plan "establishes the total volume of water that can be reliably taken every year from each of the 35 water resources in the Gingin plan area while managing risks to groundwater dependent values" (DoW, 2015). One of the stated outcomes of the plan is that "groundwater-dependent ecosystems and watercourses are protected from over-abstraction" (DoW, 2015). Any groundwater abstraction within the plan area will need to be either from already licenced bores or will require an application for a new licence. In either scenario, the Water Licencing group within DWER will assess/has assessed the licence application against the allocation plan requirements to make sure the abstraction supports the outcomes of the plan.

There are 18 groundwater licences either intersected by or adjacent to the Development Envelope within the boundaries of the Gingin groundwater allocation plan. One of these, held by the Water Corporation for drinking water supply to Bindoon and Chittering, is within the Leederville Parmelia Aquifer, two are within the Mirrabooka aquifer and the remaining 15 are within the Surficial Aquifer. Within the area of the proposed action, the Leederville Parmelia Aquifer and Mirrabooka aquifer are confined aquifers. They do not interact with the Surficial Aquifer and are not available to the roots of plants. Groundwater dependent Banksia species will therefore be accessing water from the Surficial Aquifer only within the area of the proposed action.

A total annual abstraction of 1,852.31 ML has been allocated under three licences with 841.91 ML allocated from the Surficial Aquifer. A review of the condition of the Banksia woodlands TEC occurrences close to these licences shows that the TEC is in Very Good to Excellent condition, indicating that the current levels of abstraction are not adversely affecting the TEC. DoW 2015 states that "at the current level of use, the environmental values within the Bindoon subarea have not been adversely affected and risks from use can be managed through licensing". Implementation of the Proposal will result in the clearing of 60 ha of vegetation associations that are representative of the Banksia Woodlands TEC. This represents 0.3% of the extent estimated by FVC (2018a) that is contiguous with the TEC occurrences within the Development Envelope. Additionally, the conservation advice estimates that 336,489.9 ha of Banksia Woodlands TEC exists across the bioregion (Threatened Species Scientific Committee 2016). The clearing required for the Proposal therefore equates to 0.015% of the expected extent of this TEC.

Clearing 60 ha of the Banksia Woodlands TEC is considered significant, but acceptable in the context of the region. Main Roads will offset the residual impact in order to mitigate impacts further.

6.4.3 Black Cockatoos

The entirety of the Development Footprint has been mapped as having at least some value as foraging habitat for Black Cockatoos (**Table 6-13** and **Table 6-14**). A total of 204.8 ha of foraging habitat identified as having Moderate or higher value for Carnaby's Black Cockatoo will be cleared, while 168 ha of foraging habitat with a Moderate or higher value for the Forest Red-tailed Black Cockatoo will be cleared. This includes 79.3 ha of potential breeding habitat for Carnaby's Black Cockatoo and 69.2 ha of potential breeding habitat for the Forest Red-tailed Black Cockatoo.

A total of 10 trees containing hollows showing evidence of previous use by Black Cockatoos, and 117 trees with suitable (but not used) hollows, are located within the Development Footprint and are intended to be cleared. This represents 12% and 9.2% of the total number of hollows used by or suitable for Black Cockatoos recorded by BCE (2017, 2018—**Table 6-15**). No hollows recorded as 'active' (BCE 2018) will be cleared by the Proposal.

Table 6-13: Clearing of Carnaby's Black Cockatoo Foraging Habitat

Habitat Value	Extent within the Study Area (ha)	Area to be Cleared (ha)	% of Mapped Extent Cleared
6: High	243.3	18.8	7.7
5: Moderate to High	383.7	40.2	10.5
4: Moderate	664.4	83.6	12.6
3: Low to Moderate	313.3	62.2	19.9
Subtotal	1,604.7	204.8	12.8
2: Low	1,452.0	174.1	12.0
1: Negligible	855.4	117.3	13.7
Total	3,912.1	496.2	12.7

Table 6-14: Clearing of Forest Red-tailed Black Cockatoo Foraging Habitat

Habitat Value	Extent within the Study Area (ha)	Area to be Cleared (ha)	% of Mapped Extent Cleared
6: High	106.5	17.4	16.3
5: Moderate to High	202.1	24.7	12.2
4: Moderate	365.1	28.5	7.8
3: Low to Moderate	555.2	97.4	17.5
Subtotal	1,228.9	168.0	13.7
2: Low	1,362.0	176.6	13.0
1: Negligible	1,308.5	151.5	11.6
Total	3,899.4	496.1	12.7

Table 6-15: Impacts to Black Cockatoo Hollows

Hollow Type	Recorded by BCE (2018)	Within Development Footprint	% Cleared
Evidence of previous use	83	10	12.0
Suitable (no evidence of use)	1,269	117	9.2
Total	1,352	127	9.4

Impacts to hollows showing evidence of use by Black Cockatoos have been avoided and minimised, through alignment changes and engineering solutions (such as steepening of batters), resulting in 15 trees with hollows used by Black Cockatoos being avoided. A total of 10 trees with hollows used by Black Cockatoos are within the Development Footprint and are expected to be cleared (**Figure 4-18**). This equates to 12% of the hollows used by Black Cockatoos recorded by BCE (2017, 2018, 2019). These trees have been examined to determine if they can be avoided and the results presented in **Table 6-16**.

Although the clearing of trees with hollows used by Black Cockatoos has been minimised to as low as reasonably practicable, the clearing of up to 10 trees is considered a significant impact. In addition, 117 trees with hollows suitable for Black Cockatoos, but with no evidence they have been used, are within the Development Footprint and will be cleared. A further 83 hollows previously used by Black Cockatoos have been recorded within the study area of the Black Cockatoo surveys (BCE 2018). To further mitigate impacts, Main Roads will offset the clearing of hollows previously used by or suitable for Black Cockatoos through the

acquisition of land containing at least an equivalent number of suitable hollows, or a combination of land acquisition and installation of artificial hollows. Details of the offsets proposed are provided in **Chapter 7**.

A total of 204.8 ha of foraging habitat, which includes 79.3 ha of potential breeding habitat for Carnaby's Black Cockatoo, will be cleared as a result of the Proposal. For the Forest Red-tailed Black Cockatoo, 168 ha of foraging habitat, which includes 69.2 ha of potential breeding habitat, will be cleared for the Proposal. This equates to 0.2% of the potential habitat (approximately 34,600 ha) within 15 km of the Development Envelope for both species. In a bioregional context, the required clearing represents 0.09%, for Carnaby's Black Cockatoo, and 0.005%, for the Forest Red-tailed Black Cockatoo, of the habitat mapped within the Swan Coastal Plain and Jarrah Forest bioregions.

Although there is substantial foraging habitat within 15 km of the Development Envelope, the Proposal is located within habitat that meets the definition of critical habitat for each species, as outlined in their respective recovery plans (DPaW 2013; Chapman 2008). As such, the required clearing is considered significant. Additionally, land clearance and loss of habitat is a key threatening process for Black Cockatoos. Main Roads will further mitigate the impacts through land acquisition offsets as detailed in **Chapter 7**.

No roost sites or roosting habitat has been recorded in the Development Envelope.

Table 6-16: Review of Impacted Trees with Hollows Used by Black Cockatoos

Tree ID	Location	Reason for Impact
1232	Lot 18 (No. 5077), GNH, Chittering	Tree is located at the very start of the alignment, where the existing road ties into the southern interchange. Due to the geometry requirements and the need to tie in with the Muchea North upgrade it is not possible to avoid this tree.
4317	Lot 20 Gray Road, Bindoon	Localised steep ground to the east of the alignment in this vicinity leads to a significant cutting, which results in unavoidable impact to the tree. The vertical profile to the north and south of this location, as well as the requirement to connect the adjacent Watercorp access road to the west means that the highway cannot be raised through here to reduce the depth of the cut and avoid impact to the tree.
5806	Lot 21 Gray Road, Bindoon	The alignment veers slightly to the west so as to avoid a thick array of trees and an existing farm dam, and to minimise severance of the property. While this causes one tree to be impacted it allows a further six to be avoided to the north. It may be possible to retain this tree within the median.
4142 and 4135	Lot M2059 Cullalla Road, Mooliabeenee	Two trees are impacted at this location. The alignment runs parallel to the Midland to Geraldton railway to minimise severance of the adjacent properties. There is a high density of hollows in this area and moving the alignment to avoid these will result in others being impacts. It may be possible to retain the tree that falls within the median.
1746	Lot M2082 (No. 176) Gingilling Road, Mooliabeenee	The alignment follows the railway closely in this location so as to avoid impact to additional farm dwellings and minimise severance of the property. Movement of the alignment in this location will have unacceptable social impacts.
2949 and 1650	Lot 1 (No. 428) & Lot 2 (No. 434) Gingilling Road, Mooliabeenee	The alignment follows the railway closely to minimise severance of the property. Horizontal geometry requirements mean it is very difficult to avoid impacting the two trees. Were the alignment moved east these particular trees could be avoided, but four more would be impacted.

Tree ID	Location	Reason for Impact
2999	Lot 2 (No. 434) Gingilling Road, Mooliabeenee	The alignment follows the railway closely to minimise severance of the property. Horizontal geometry requirements mean it is very difficult to avoid impacting this tree. Were the alignment moved west slightly this particular tree could be avoided, but four more would be impacted.
9081	Lot 3252 (No. 1080) Hay Flat Road, Wannamal	At this location, the alignment is constrained by three existing farm dams to the south and the tie-in location of Hay Flat Road to the north. The concept level design was not able to avoid this tree.

6.4.4 Chuditch

While BCE (2017, 2018, 2019) did not record Chuditch within the Development Envelope, it is expected that they do occur, albeit in low numbers across the study area. Suitable habitat for the species within the Development Envelope is the Jarrah/Marri woodlands. A total of 54.4 ha of this habitat is within the Development Footprint and will be cleared (**Table 6-17**).

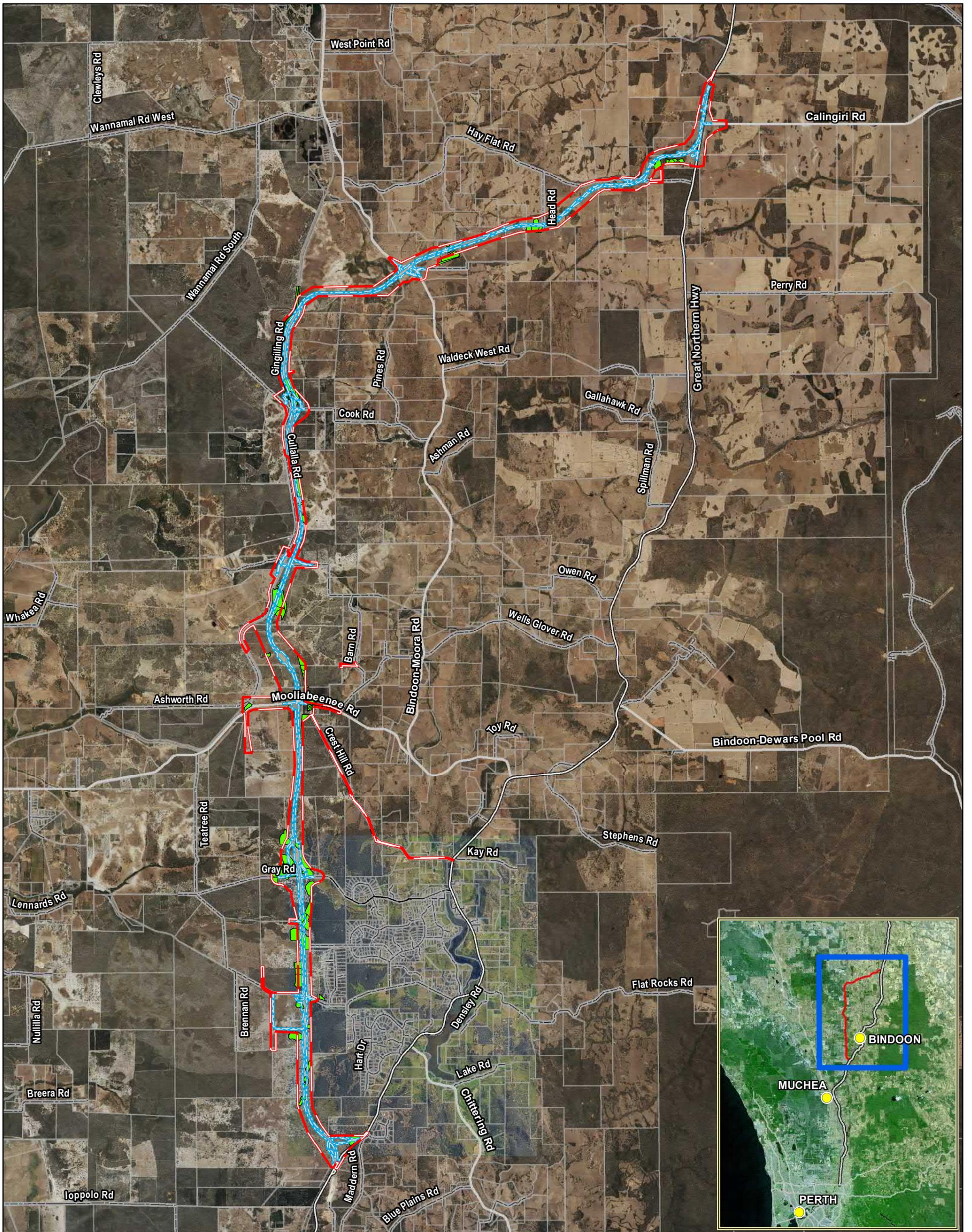
Table 6-17: Condition of Potential Chuditch Habitat to Cleared

Condition	Area (ha)
Completely Degraded – Degraded	15.3
Degraded	2.0
Good	10.5
Good – Very Good	6.2
Very Good	14.0
Very Good – Excellent	6.4

An estimated 7,302 ha of the native vegetation within 5 km of the Development Envelope is expected to provide additional habitat for this species. The area to be cleared is 0.6% of the habitat available within 5 km of the Development Envelope. As such, provided appropriate management and mitigation measures are in place in relation to habitat connectivity and fauna movement, impacts to the Chuditch are not expected to be significant.

The Proposal is located in a highly fragmented agricultural landscape with a number of towns and settlements within a 50 km radius. Introduced predators, both feral and domestic, are present within the landscape. The implementation of the Proposal will not change the risk or frequency of predation in relation to Chuditch and other terrestrial fauna.

DBCA is the lead agency in WA managing introduced predators through the Western Shield program, which includes fox and cat baiting in areas such as Julimar State Forest, Lake Wannamal Nature Reserve and Moore River National Park.



Legend

- Development Envelope
- Development Footprint
- Suitable Chuditch Habitat
- Cadastral Boundary
- Highway
- Major Road
- Minor Road



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 0 1,300 2,600
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 Coordinate System: GDA 1994 MGA Zone 50

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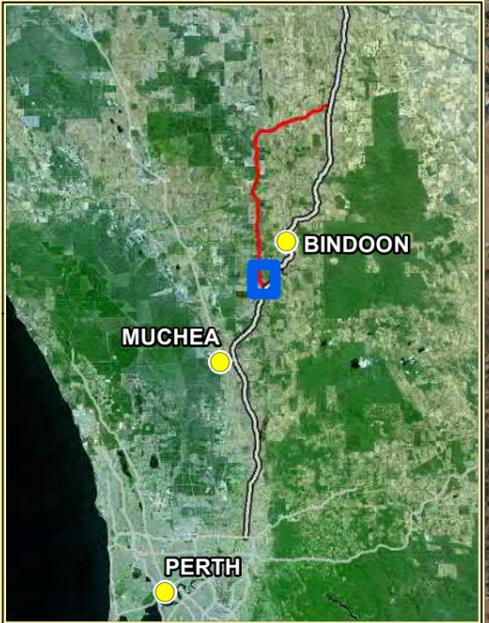
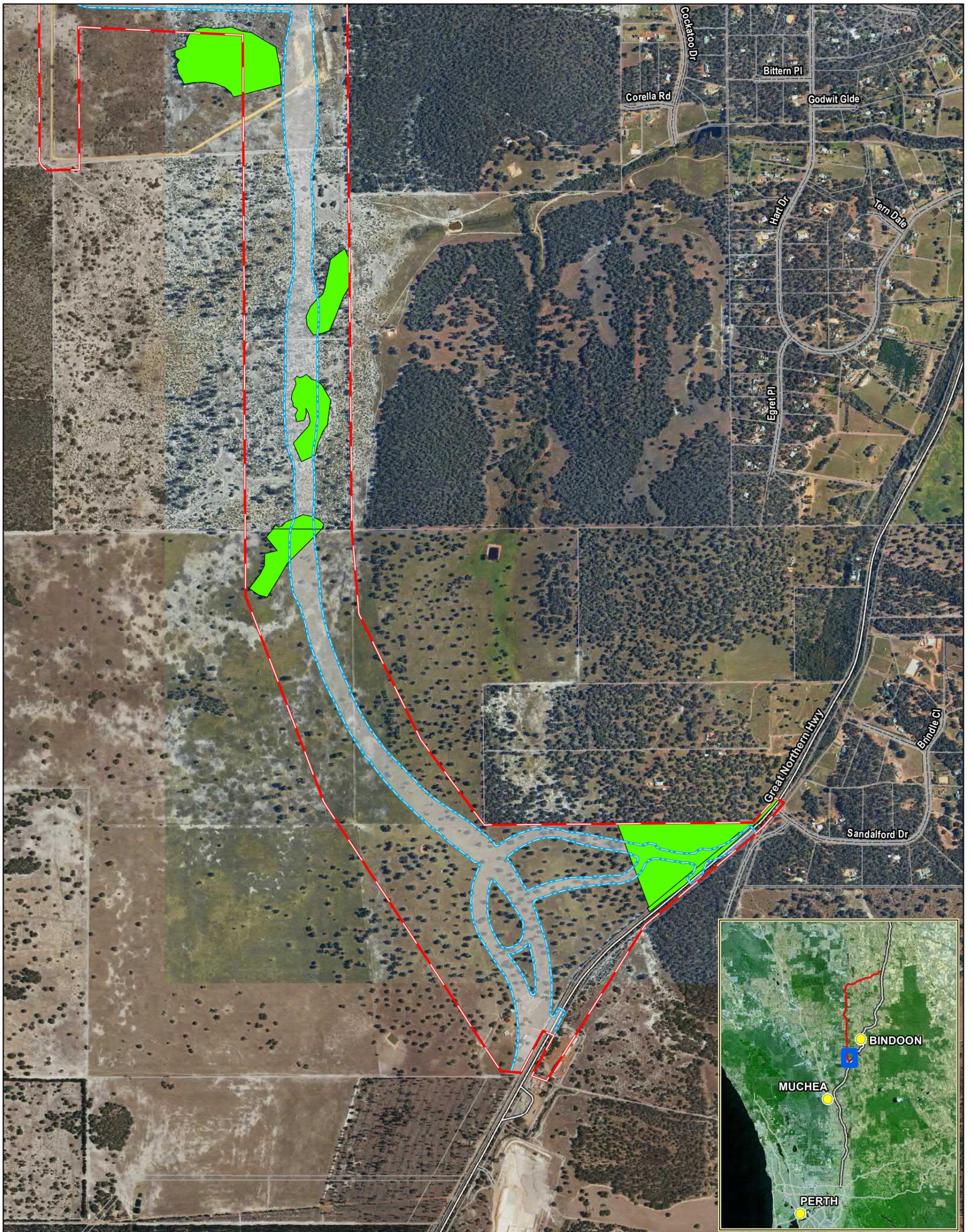
Suitable Habitat for Chuditch

Figure 6-4 Page 1 of 9

Drawing No: GNH-CN12-E-EA-GD-0115 Issue: A

Task No: XXXX Drawing Status / Other: Draft

Date	By	Chkd	Appd
9/12/2020	SP	LB	XX



Legend

- Development Envelope
- Development Footprint
- Suitable Chuditch Habitat
- Cadastral Boundary
- Highway
- Minor Road

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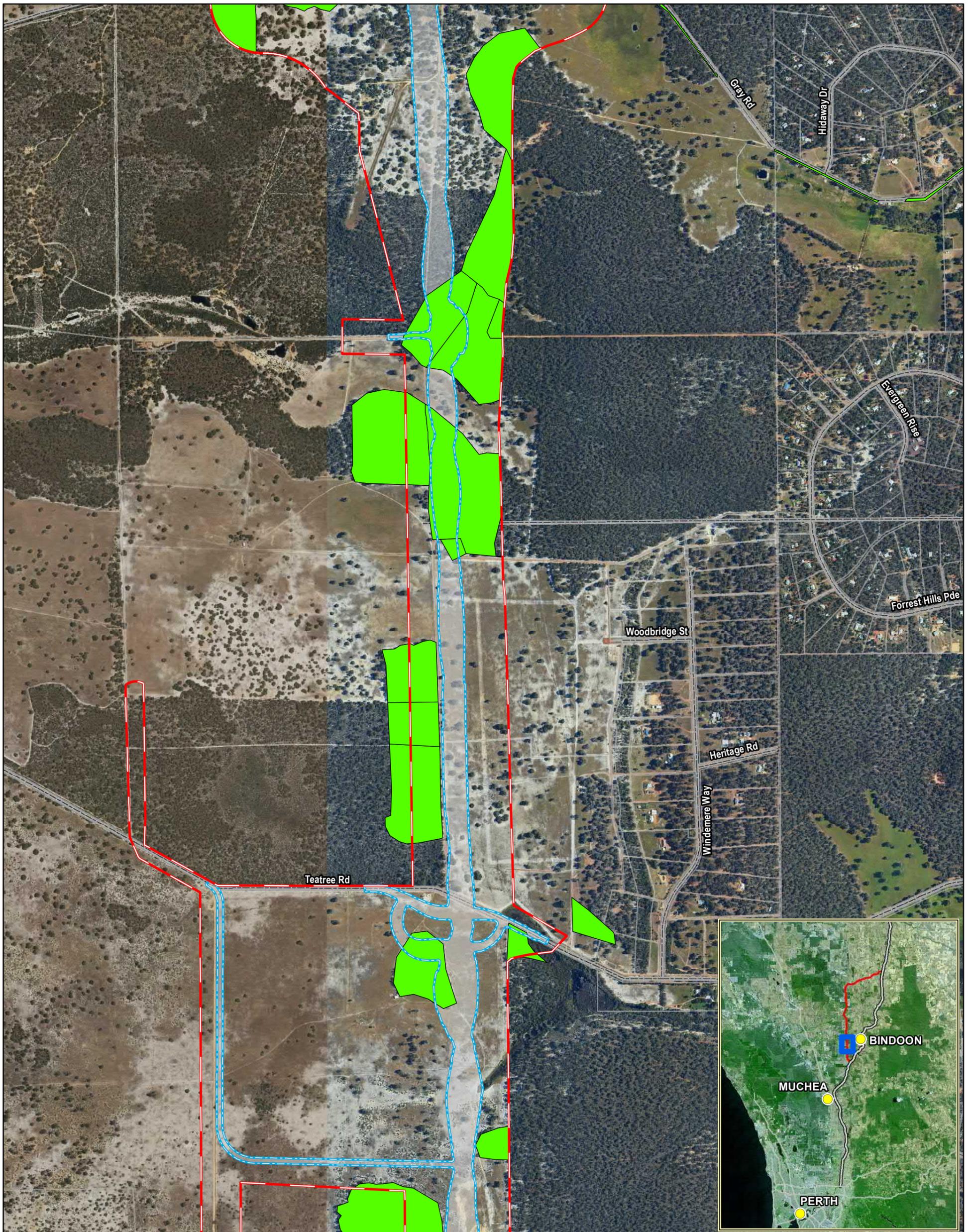
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Drawing No GNH-CN12-E-EA-GD-0115		Issue A	
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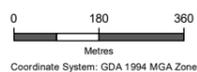
- Legend**
- Development Envelope
 - Development Footprint
 - Suitable Chuditch Habitat
 - Cadastral Boundary
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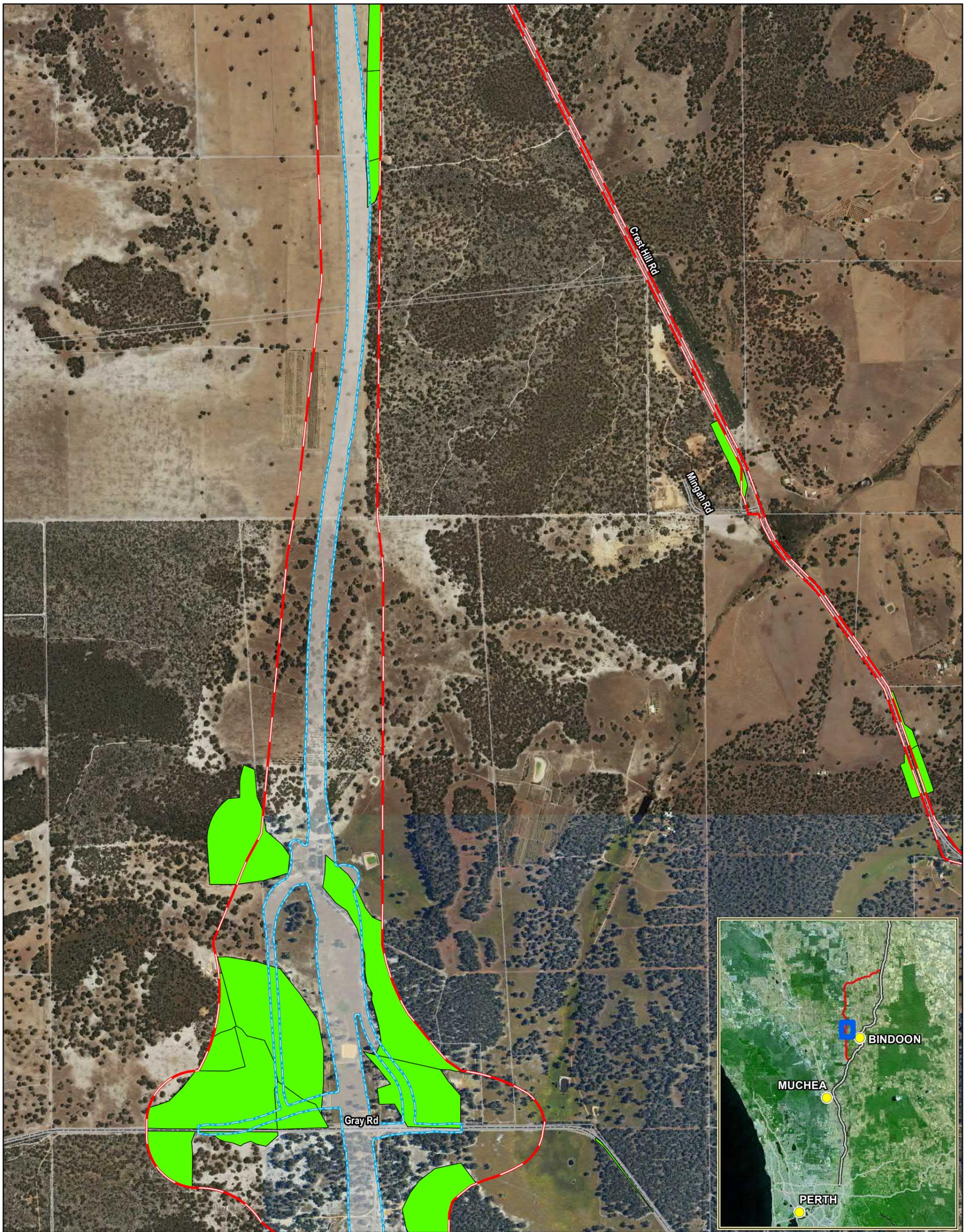
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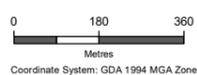
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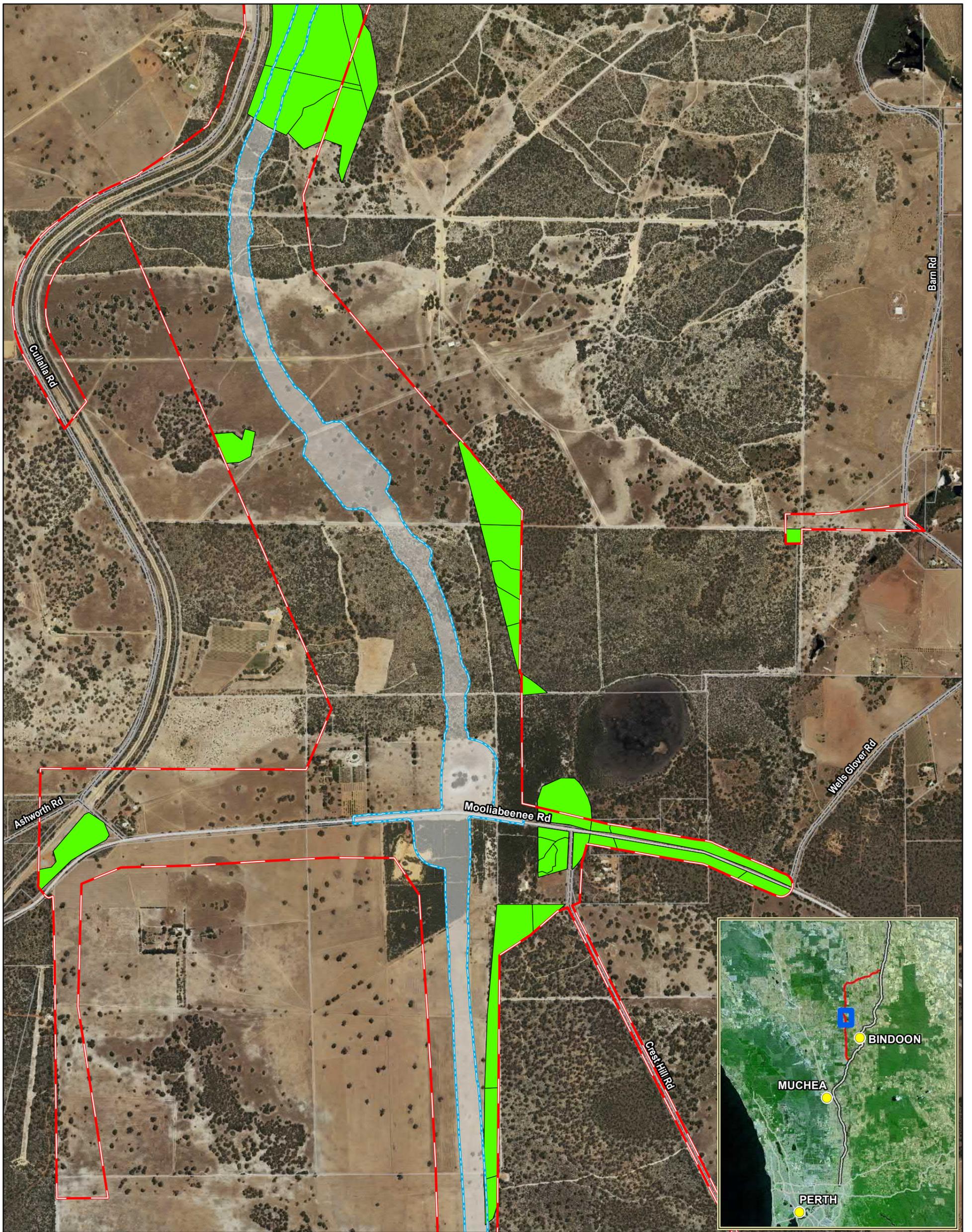
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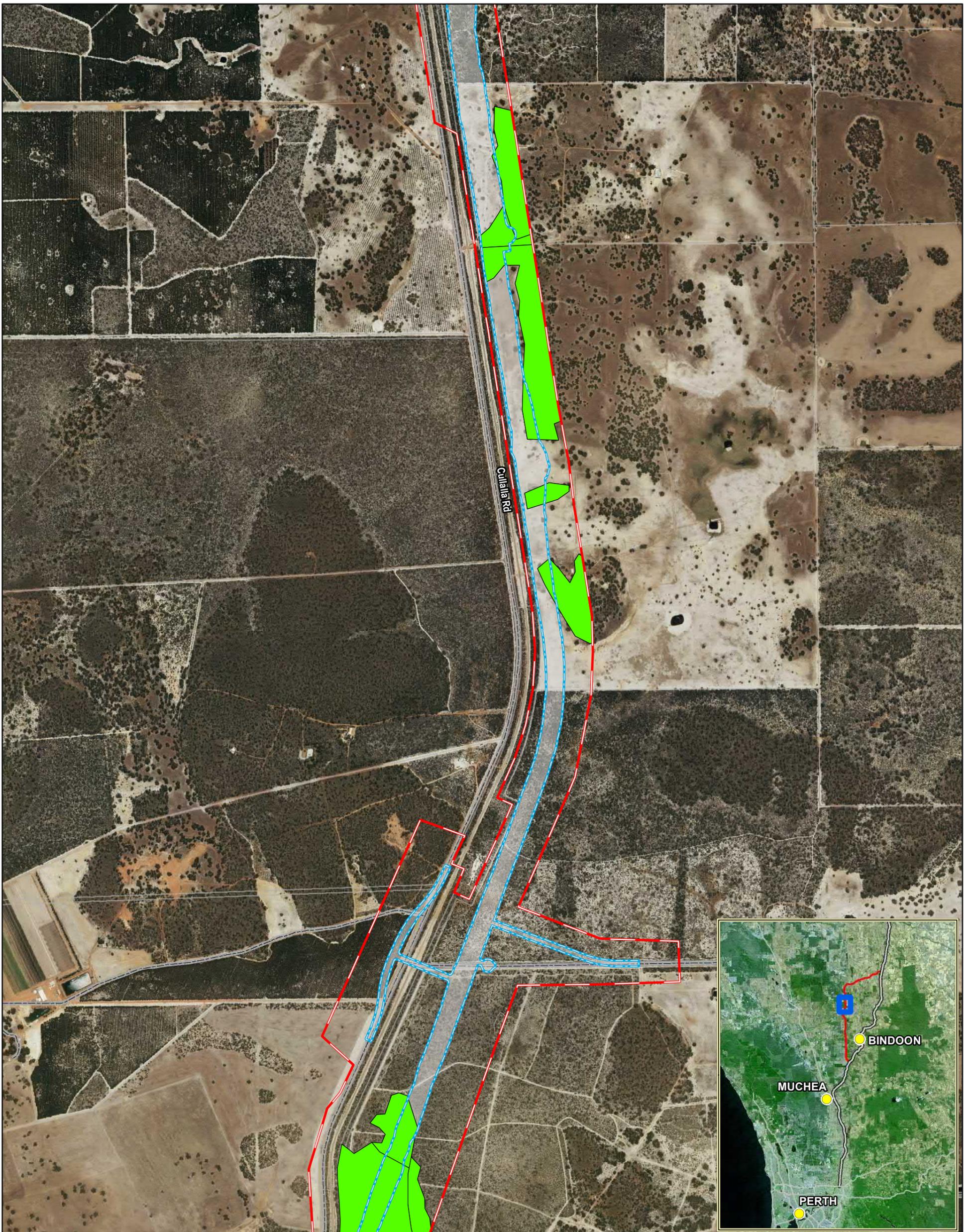
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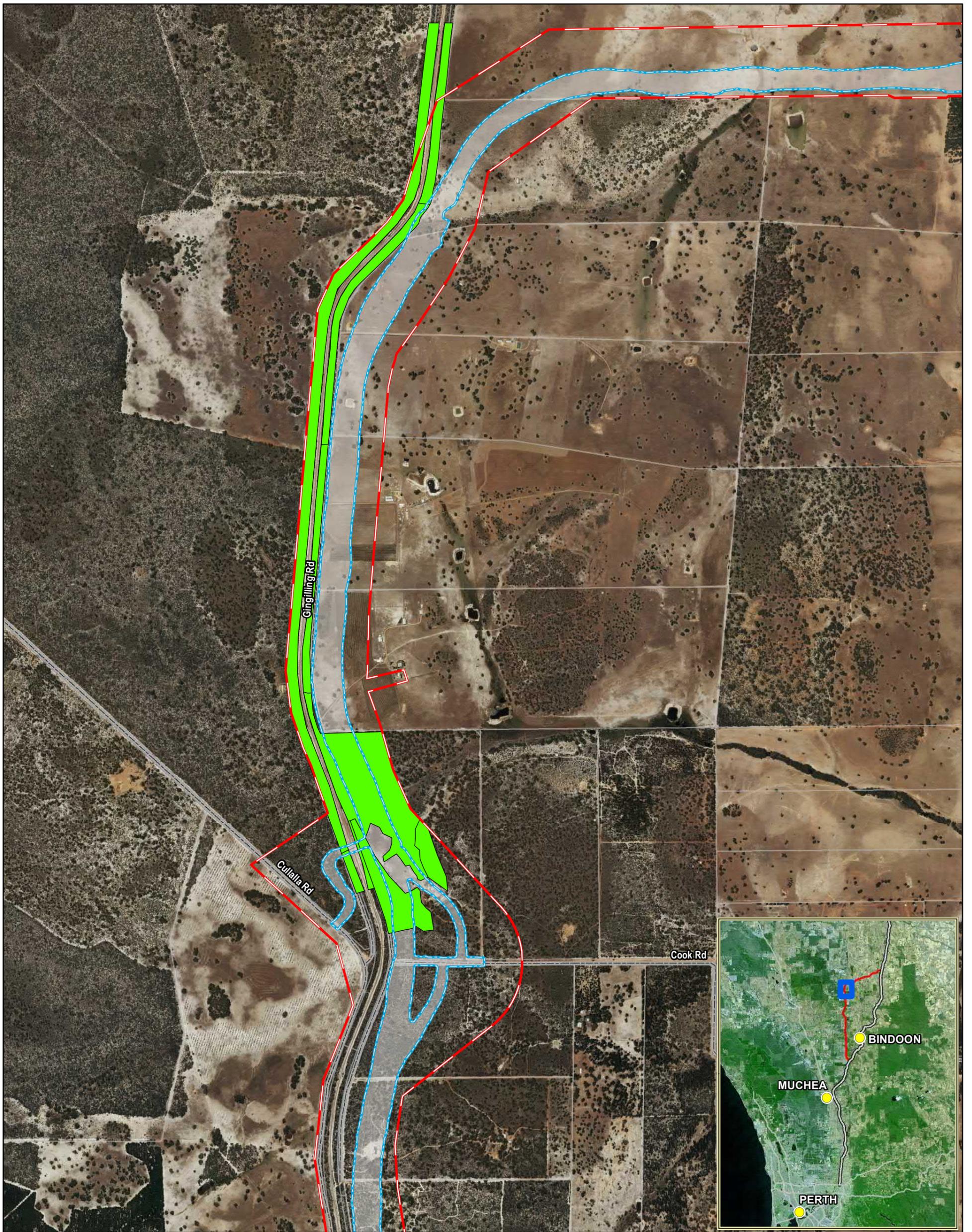
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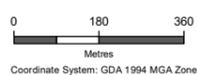
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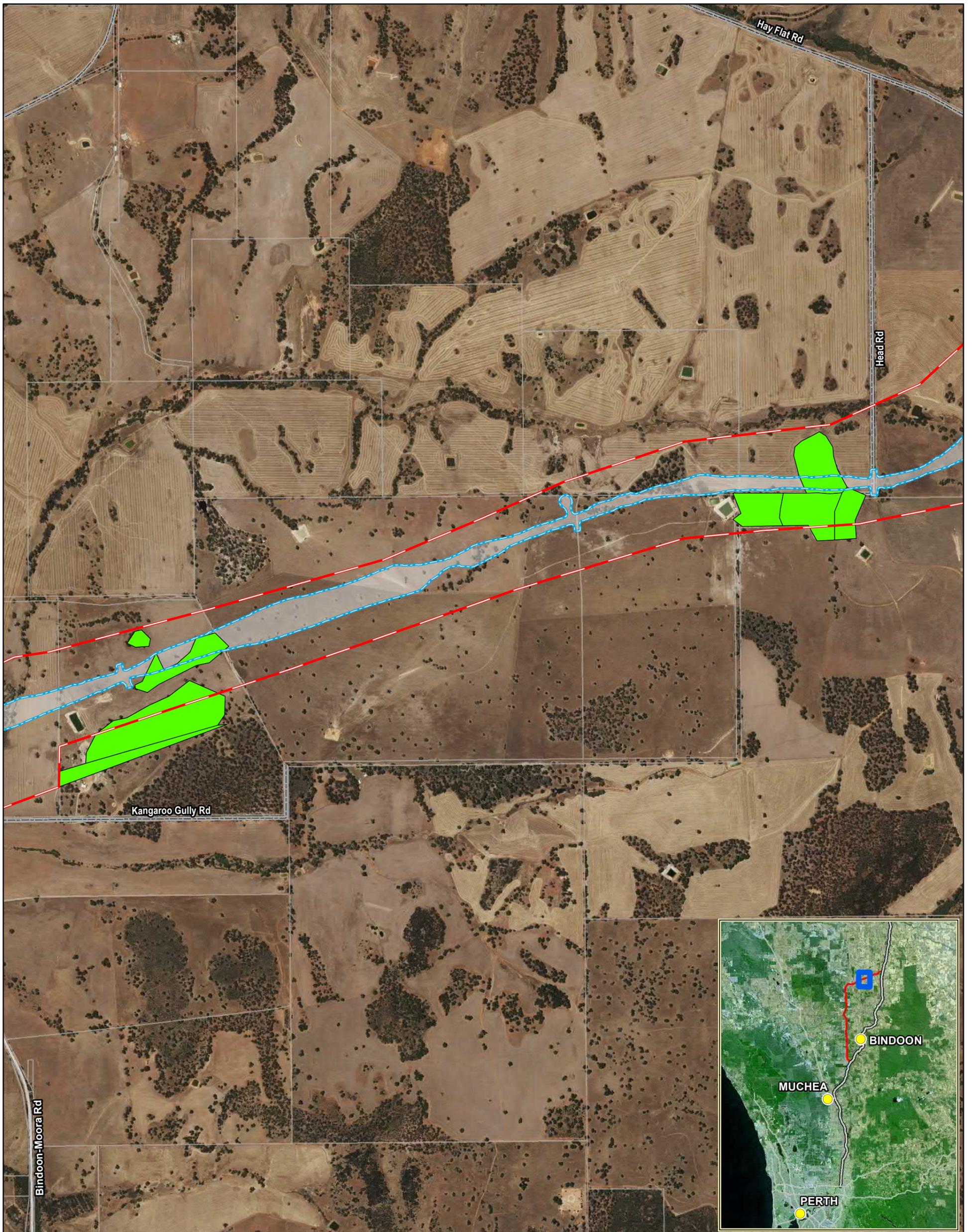
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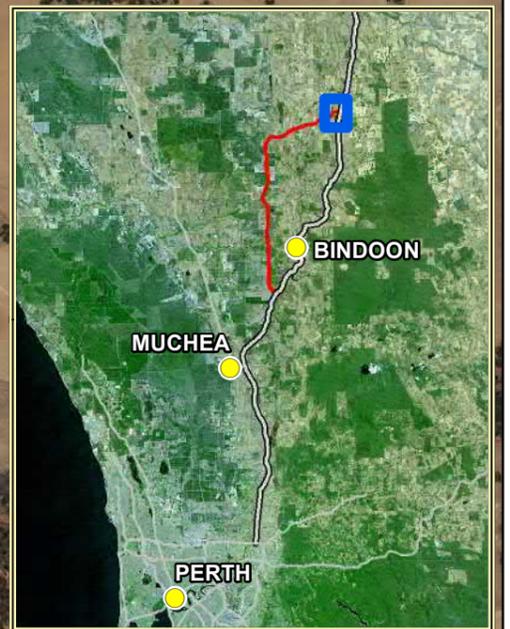
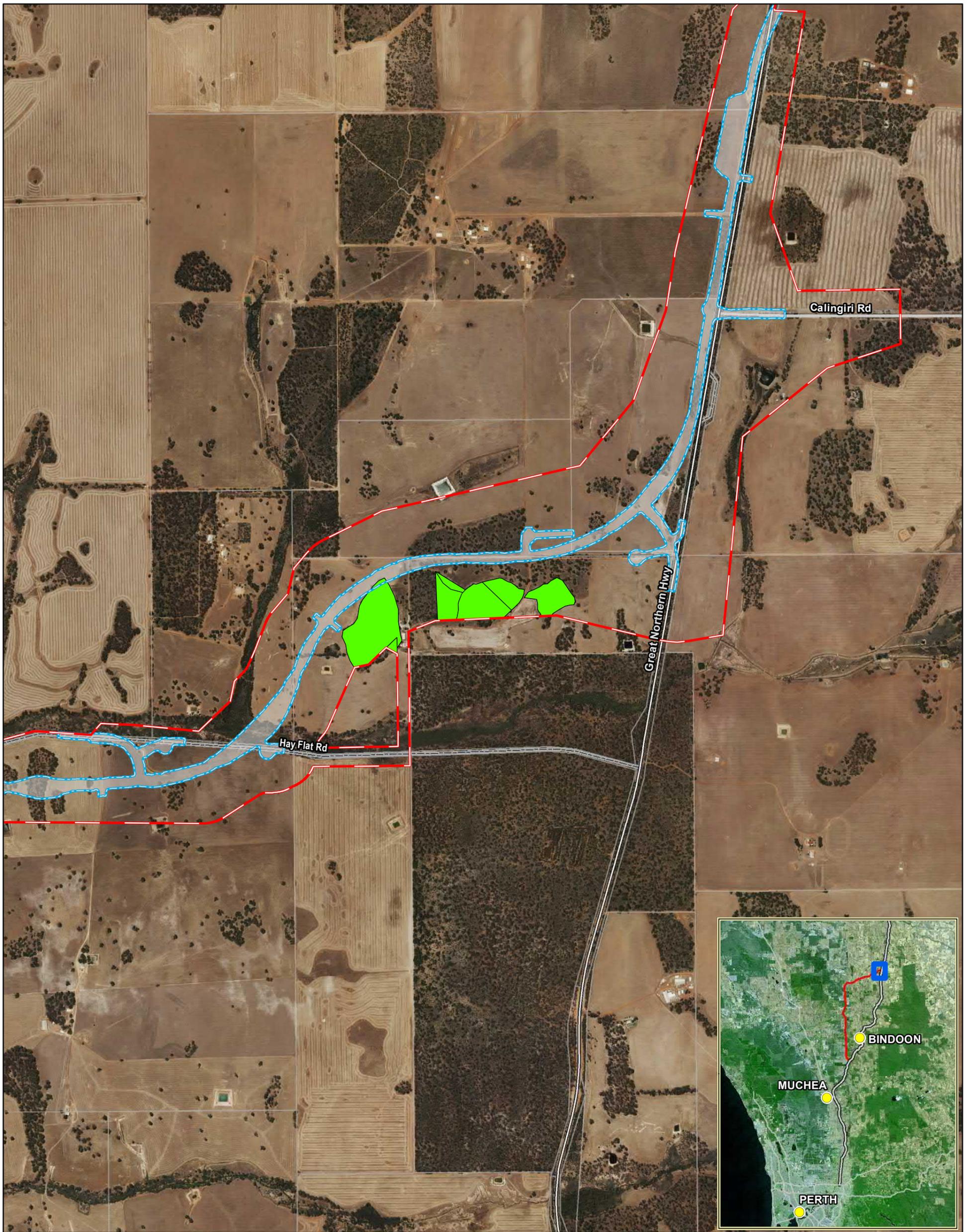
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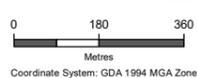
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6.5 Avoidance and Mitigation Measures

The mitigation hierarchy (**Chapter 4.2.6**) has been implemented throughout the concept design phase of the Proposal and will continue to be implemented during detailed design and construction. Impacts to MNES have been avoided and minimised during the concept design phase by preferentially locating Development Footprint within previously cleared paddock. Additionally, the concept alignment has sought to avoid known locations of conservation significant flora species. In particular, the Development Envelope was modified to avoid a historic record of *Drakaea elastica*. The concept alignment has also sought to avoid hollow-bearing trees, particularly those identified as previously used by Black Cockatoos. Where impacts to MNES were unavoidable, the extent of clearing has been minimised by steepening batters of cut and fill areas and adjusting road levels to minimise the depth/height of cut and fill areas.

As detailed in **Section 2.4**, a number of alternatives have been considered prior to the selection of the current alignment presented in this document. In relation to the most recent corridor selection process, the assessment of the three proposed corridors (Western Bypass Corridor A, Western Bypass Corridor B and Eastern Bypass Corridor C) included preliminary ecological studies of the three corridors to identify the environmental values present. These studies determined the density of potential breeding trees within each corridor. Based on these results, the follow numbers of trees with suitable hollows have been estimated within each of the corridor study areas:

- Western Bypass Corridor A: 1,513 trees within a 2,500 ha study area.
- Western Bypass Corridor B: 1,055 trees within a 1,750 ha study area
- Eastern Bypass Corridor C: 341 trees within a 1,123 ha study area.

While Eastern Bypass Corridor C was expected to contain the least number of trees with suitable hollows, other considerations, such as impacts to the Chittering-Needonga Lakes (a Wetland of National Importance), meant that this corridor was not preferred.

As detailed in the request to vary the proposed action under section 156 of the EPBC Act (, changes to the alignment at the southern end of the proposed action (near Lot 9010 owned by Odelon Pty Ltd) and the location of the Brockman River crossing resulted in the avoidance of two hollows that showed evidence of use by Black Cockatoos and four hollows suitable for, but not previously used by, Black Cockatoos.

So that impacts to MNES within the Development Envelope are minimised, Main Roads commits to the following outcomes:

- A maximum of 60 ha of Banksia Woodlands TEC will be cleared.
- A maximum of 204.8 ha of Carnaby's Black Cockatoo foraging habitat will be cleared.
- A maximum of 168 ha of Forest Red-tailed Black Cockatoo foraging habitat will be cleared.
- No more than 10 trees with hollows previously used by Black Cockatoos, as identified in BCE (2017, 2018, 2019), will be cleared.
- Ecological connectivity will be maintained across the Proposal through the provision of fauna underpasses.

To achieve the outcomes, the management measures in **Table 6-18** are proposed. **Table 6-18** also provides information on the outcomes achieved by each management measure, the effectiveness of the measure, monitoring required to confirm the measure is achieving the objective, and the achievability of the measure. Management measures specifically related to construction form part of the CEMP developed for the Proposal (**Appendix L**).

To further mitigate the potential impacts of the proposal, Main Roads will offset residual impacts to the Banksia Woodlands TEC, Black Cockatoo habitat and previously used hollows.

Table 6-18: Management Measures for Matters of National Environmental Significance

Management Measure	Timing	Location	Environmental Objective Achieved	Effectiveness of Measure	Monitoring Required	Achievability
<p>During the detailed design phase:</p> <ul style="list-style-type: none"> Clearing of native vegetation will be further reduced during detailed design through the use of engineering solutions including but not limited to: <ul style="list-style-type: none"> additional steepening of batters; installation of barriers in areas of high conservation value (e.g. through Banksia Woodland TEC or where Black Cockatoo hollows are close to the road) to reduce clear zone requirements; reduction of median widths or design of medians to reduce the clearing required between carriageways; and Drainage will be designed to: <ul style="list-style-type: none"> avoid the movement of soils and/or water potentially carrying <i>Phytophthora</i> Dieback into areas mapped as dieback free. capture stormwater run-off, such that is not allowed to flow unmanaged into adjacent native vegetation or waterbodies. promote infiltration of runoff as close to the source as possible. the method of infiltration will be determined based on the location and proximity to sensitive values. Fauna underpasses will be included in the detailed design within the broad areas indicated on Figure 4-19. Underpasses may be co-located with culverts where appropriate and will be designed to allow movement of fauna Chuditch. 	Detailed Design	N/A	<ul style="list-style-type: none"> A maximum of 60 ha of Banksia Woodlands TEC will be cleared. A maximum of 204.8 ha of Carnaby's Black Cockatoo foraging habitat will be cleared. A maximum of 168 ha of Forest Red-tailed Black Cockatoo foraging habitat will be cleared. No more than 10 trees with hollows previously used by Black Cockatoos as identified in BCE (2017, 2018, 2019) will be cleared. Ecological (fauna) connectivity will be maintained across the Proposal. 	<p>Reductions in the Development Footprint can be realised in the detailed design phase as significant design optimisation occurs during this phase. Batter slopes and cut and fill heights can also be refined based on detailed geotechnical information gathered prior to detailed design but after concept design.</p> <p>Movement of dieback by road drainage is a significant risk. Appropriate drainage design is a major contributor in minimising this risk.</p> <p>Appropriate drainage design will reduce the potential for spread of weeds in surface water run-off.</p> <p>Well designed and appropriately located fauna underpasses will maintain habitat connectivity across the Proposal.</p>	N/A	<p>Main Roads considers there is a high likelihood this measure will result in reductions in the Development Footprint and the resultant impacts.</p> <p>Dieback mapping has been undertaken for the Proposal and locations of infested areas are known. This will be fed into the drainage design during the detailed design phase.</p> <p>Fauna underpasses are a standard requirement for major roads. Main Roads is experienced in designing and locating these elements of projects.</p>
<p>The Development Footprint will be progressively cleared ahead of construction in order to minimise the amount of time bare ground is exposed.</p>	Construction	Development Footprint.	Ecological connectivity will be maintained across the Proposal.	Progressive clearing of the footprint will provide escape routes for ground dwelling fauna ahead of clearing and maintain ecological connection across areas where construction is not planned to commence immediately.	Weekly site inspections of the construction site.	Scheduling of clearing activities is a standard construction action.

Management Measure		Timing	Location	Environmental Objective Achieved	Effectiveness of Measure	Monitoring Required	Achievability
3	Trees with hollows previously used by or suitable for Black Cockatoos within the Development Envelope but not within the Development Footprint will be clearly marked as no-go zones and access to these areas restricted. No-go zones will include a 10 m buffer from the trunk of the tree unless this is not achievable due to the proximity of the Development Footprint. Where a 10 m buffer is not achievable, the maximum buffer achievable between the tree and the Development Footprint will be implemented.	Prior to clearing	Black Cockatoo Trees marked on issued-for-construction drawings as no-go zones.	No more than 10 trees with hollows previously used by Black Cockatoos as identified in BCE (2017, 2018, 2019) will be cleared.	While clearing outside of the Development Footprint is not envisaged, the establishment of no-go zones will assist in avoiding accidental clearing of trees with hollows.	Initial site inspection prior to clearing to confirm no-go zones are in place. Weekly site inspections to confirm no-go zones remain in place and have not been entered.	The use of no-go zones is a standard construction practice and is proven to be effective in avoiding accidental clearing or disturbance to these areas.
4	If clearing of Black Cockatoo habitat is to occur between 1 July and 28 February, all potential nesting trees identified by BCE (2017, 2018, 2019) within the area to be cleared will be inspected by a suitably qualified person to determine if any hollows are being used by Black Cockatoos	1 July - 28 February and no more than 7 days prior to clearing	Areas of Black Cockatoo habitat within the Development Footprint	The risk of mortality for individual Black Cockatoos or other Threatened fauna will be minimised.	The measure will avoid unintentional impacts to Black Cockatoos through disturbance/mortality of nesting individuals and chicks. This measure will also assist in minimising impacts to breeding success during the construction period.	Survey of areas of Black Cockatoo habitat within the seven days preceding clearing. An 'area of habitat' is defined as native vegetation, mapped by BCE (2017, 2018, 2019) as Black Cockatoo habitat, with no more than a 50 m break in vegetative cover. Where isolated trees occur in otherwise cleared paddocks, the extent of the paddock shall be the 'area of habitat' applicable to this measure.	Main Roads have successfully implemented this management measure on other projects including the Perth-Darwin Highway - Swan Valley Section and the Great Northern Highway: Muchea to Wubin Stage 2 Upgrade Project.
5	If any hollows within the Development Footprint are identified as being in use by Black Cockatoos, the hollow bearing tree and a 10 m buffer will be marked as a No-Go area. Clearing of the tree will not be undertaken until a suitably qualified person has verified that the hollow is no longer being used	Construction	Trees identified in Management Measure 4.	<ul style="list-style-type: none"> A maximum of 60 ha of Banksia Woodlands TEC will be cleared. A maximum of 204.8 ha of Carnaby's Black Cockatoo foraging habitat will be cleared. A maximum of 168 ha of Forest Red-tailed Black Cockatoo foraging habitat will be cleared. No more than 10 trees with hollows previously used by Black Cockatoos as identified in BCE (2017, 2018, 2019) will be cleared. 	This measure will assist in minimising impacts to breeding success during the construction period.	Monthly monitoring of identified tree until a suitably qualified specialist has determined the hollow is no longer being used. Weekly site inspections to confirm no-go zones remain in place and have not been entered, other than for the required monthly survey.	Main Roads have successfully implemented this management measure on other projects including the Perth-Darwin Highway - Swan Valley Section and the Great Northern Highway: Muchea to Wubin Stage 2 Upgrade Project.
6	Water abstraction for construction purposes will be operated so as not to reduce groundwater levels below groundwater dependent banksia communities more than 0.5 m below existing groundwater levels.	Construction	Construction water source bores	Avoidance of indirect impacts to the Banksia Woodlands TEC and Carnaby's Black Cockatoo foraging habitat.	The measure will reduce the risk of short term changes to groundwater levels impacting the health of groundwater dependent Banksia species and other flora species that make up the ecological community.	Modelling of groundwater drawdown prior to commencing water abstraction. Monitoring in accordance with the groundwater operating strategy required under RIWI Act approval for the abstraction.	Abstraction of groundwater is required to be licenced through the RIWI Act. A groundwater operating strategy and requirement to manage drawdown to certain levels is a standard requirement.

Management Measure		Timing	Location	Environmental Objective Achieved	Effectiveness of Measure	Monitoring Required	Achievability
7	Revegetation will commence in the autumn following completion of construction works within designated revegetation areas and corridors to maintain ecological linkages	May-June	Completed construction areas	Ecological connectivity will be maintained across the Proposal.	Progressive revegetation, particularly around locations of fauna underpasses, will assist with maintenance of connectivity as clearing progressively continues along the Development Footprint.	Weekly site inspections of the construction site	This is a standard requirement for construction of Main Roads projects.
8	The area to be cleared will be accurately marked in the field	Prior to clearing	Area to be cleared	<ul style="list-style-type: none"> A maximum of 60 ha of Banksia Woodlands TEC will be cleared. A maximum of 204.8 ha of Carnaby's Black Cockatoo foraging habitat will be cleared. A maximum of 168 ha of Forest Red-tailed Black Cockatoo foraging habitat will be cleared. No more than 10 trees with hollows previously used by Black Cockatoos as identified in BCE (2017, 2018, 2019) will be cleared. 	This measure will assist in avoiding accidental clearing or over clearing of the Development Envelope.	Initial site inspection prior to clearing. Weekly site inspections of the construction site	This is a standard requirement for construction of Main Roads projects.
9	<p>Species mixes used in revegetation will aim to provide the following ecological services:</p> <ul style="list-style-type: none"> provide foraging and potential breeding habitat for Black Cockatoos in locations more than 10 m from the edge of the seal; and support fauna movement within the road reserve and between patches of existing native vegetation outside of the Development Envelope. 	N/A	Revegetation areas	Ecological connectivity will be maintained across the Proposal.	<p>The measure will provide foraging resources to replace those cleared as a result of the proposal, assisting in maintaining the density of foraging resources and presence of foraging resources near potential breeding habitat. The measure will maintain and potentially increase connectivity within the broader region. Roadside vegetation can provide valuable corridors for fauna, allowing movement between larger patches of vegetation.</p>	N/A	<p>Areas available for planting with Black Cockatoo will be limited as they are required to be more than 10 m from the edge of seal. Main Roads is looking to acquire a wide road reserve that will allow for the retention of native vegetation along the boundary between the road reserve and private land. This combined with revegetation within the road reserve presents a high likelihood that wildlife corridors between patches of vegetation can be achieved.</p>
10	Revegetation will include placement of hollow logs and brush to provide fauna habitat and protection from feral predators while vegetation establishes	May-June	Revegetation areas	<ul style="list-style-type: none"> Ecological connectivity will be maintained across the Proposal. The risk of mortality for individual Black Cockatoos or other Threatened fauna will be minimised. 	Placement of logs and other materials increases the structural complexity of revegetation areas and provides refuge and/or cover for smaller terrestrial fauna from predators. Inclusion of hollows logs and brush in revegetation activities around fauna underpasses will provide protective cover and encourage movement of fauna through the underpasses while vegetation establishes.	Site inspections following revegetation activities in an area.	This is a standard revegetation practice.

Management Measure		Timing	Location	Environmental Objective Achieved	Effectiveness of Measure	Monitoring Required	Achievability
11	No plant species which provides habitat for Black Cockatoos will be planted within 10 m of the edge of the seal	Revegetation	Revegetation areas	The risk of mortality for individual Black Cockatoos or other Threatened fauna will be minimised.	This will reduce the risk of fauna being struck by vehicle on the highway.	Site inspections following revegetation activities in an area.	This is a standard requirement for construction of Main Roads projects.
12	During construction, speed limits will be reduced (e.g. 40 km/h). This will reduce the risk of fauna strikes	Construction	Entire site	The risk of mortality for individual Black Cockatoos or other Threatened fauna will be minimised.	This will reduce the risk of fauna being struck by construction vehicles.	Weekly site inspections	This is a standard activity undertaken on construction projects.
13	All fauna injured during the construction period will be taken to an authorised veterinarian or wildlife carer	Construction	Entire site	The risk of mortality for individual Black Cockatoos or other Threatened fauna will be minimised.	This will maximise the potential for injured Black Cockatoos to be healed, rehabilitated and released back into the wild.	N/A	This is a standard activity undertaken on construction projects.
14	Fauna warning signs will be installed in areas where native vegetation occurs next to the roadside on either side of the road.	Construction	As per issued-for-construction drawings.	The risk of mortality for individual Black Cockatoos or other Threatened fauna will be minimised.	Fauna warning signs will alter the general public to the potential for increase fauna activity. The actual effect this has will depend upon individual driver attitudes.	Site inspection following completion of construction	Fauna warning signs will be included on IFC drawings.
15	<p>A dieback and weed hygiene management plan will be developed for construction of the Proposal. The plan will include:</p> <ul style="list-style-type: none"> A risk assessment of potential sources and activities. The identification of 'protectable' areas adjacent to the Proposal footprint. All machinery, plant and vehicles arriving on site, and moving from a weed and dieback risk area within the Development Envelope, shall be certified to be free of vegetative matter and soil in order to avoid introducing weed species and dieback to the Development Envelope or within it. <ul style="list-style-type: none"> Requirements for hygiene wash-down locations that consider risk in the surrounding landscape. A program to monitor and report on compliance and corrective actions where non-compliance has occurred. Quarterly auditing of wash-down sites to identify weed incursions. Regular walk-overs at strategic locations along the Development Footprint (i.e. in association with native vegetation) to identify and ameliorate weed incursions. An auditable hygiene inspection form will be prepared to detail inspection results at the hygiene locations. 	Construction	Weed and dieback risk areas	<ul style="list-style-type: none"> A maximum of 60 ha of Banksia Woodlands TEC will be cleared. A maximum of 204.8 ha of Carnaby's Black Cockatoo foraging habitat will be cleared. A maximum of 168 ha of Forest Red-tailed Black Cockatoo foraging habitat will be cleared. No more than 10 trees with hollows previously used by Black Cockatoos as identified in BCE (2017, 2018, 2019) will be cleared. Ecological connectivity will be maintained across the Proposal. 	A dieback and weed hygiene management plan will provide confidence that dieback and invasive weeds are not spread to new areas during construction	<p>As required inspections of vehicles and machinery arriving on site and moving from a weed and dieback risk area.</p> <p>Quarterly auditing of wash-down sites</p> <p>Weekly site inspections.</p>	This is a standard requirement for construction of Main Roads projects.

Management Measure		Timing	Location	Environmental Objective Achieved	Effectiveness of Measure	Monitoring Required	Achievability
16	Topsoil and excavated material will be segregated and managed according to its weed and dieback status. Material from dieback infested areas will not be used in areas mapped as uninfected, or uninterpretable.	Construction	Entire site	Avoidance of indirect impacts to the Banksia Woodlands TEC and Black Cockatoo foraging habitat	Dieback and invasive weeds are not spread to new areas during construction through movement of materials within the site.	Weekly site inspections to confirm materials handling, stockpiling and management.	This is a standard requirement for construction of Main Roads projects.
17	Educational and induction material will be provided about the significant fauna and ecological communities to contractors working on the construction to reduce the risk of accidental clearing and other potential impacts.	Construction – as new people arrive on site	N/A	<ul style="list-style-type: none"> A maximum of 60 ha of Banksia Woodlands TEC will be cleared. A maximum of 204.8 ha of Carnaby's Black Cockatoo foraging habitat will be cleared. A maximum of 168 ha of Forest Red-tailed Black Cockatoo foraging habitat will be cleared. No more than 10 trees with hollows previously used by Black Cockatoos as identified in BCE (2017, 2018, 2019) will be cleared. Ecological connectivity will be maintained across the Proposal. Dieback and invasive weeds are not spread during construction. 	Education of staff, contractors and visitors will provide them with and understanding the value of the environmental assets related to the Proposal. This in turn will assist in developing their understanding as to why certain management measures are in place and their responsibilities in relation to environmental protection.	Monthly review of records to confirm all people on site have been inducted.	This is a standard activity undertaken on construction projects.

6.6 Offsets

An environmental offsets proposal is presented in **Chapter 7** of this ERD. The offset proposal includes details of how the offset will be secured, managed and monitored, how the offset meets the requirements of both the EPBC Act offsets policy (DSWEPaC 2012b) and WA environmental offsets policy (Government of WA 2011), quantification of the offsets required using the offset guide (Government of WA 2014a) and justification for the inputs used in the offset guide.

6.7 Conclusion

6.7.1 Principles of Ecologically Sustainable Development and Objects of the EPBC Act

The EPBC Act sets out five principles of ecologically sustainable development. These are:

- Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations.
- If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
- The principle of inter-generational equity—that 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 conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making.
- Improved valuation, pricing and incentive mechanisms should be promoted.

These principles are supported through the EPBC Act via the Objects of the Act, which are:

- to provide for the protection of the environment, especially those aspects of the environment that are MNES;
- to promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources
- to promote the conservation of biodiversity
- to provide for the protection and conservation of heritage
- to promote a co-operative approach to the protection and management of the environment involving governments, the community, land-holders and indigenous peoples
- to assist in the co-operative implementation of Australia's international environmental responsibilities
- to recognise the role of indigenous people in the conservation and ecologically sustainable use of Australia's biodiversity
- to promote the use of indigenous peoples' knowledge of biodiversity with the involvement of, and in co-operation with, the owners of the knowledge.

The principles of ecologically sustainable development, and the objects of the EPBC Act, have been considered throughout the development of the Proposal, and shall be considered as the Proposal progresses into detailed design, construction and ultimately operation. Details on how these principles have been considered to date for this Proposal are presented below.

A detailed corridor selection process, as described in **Chapter 2**, was undertaken in order to identify a preferred corridor for the Bindoon Bypass. This process took into account previously identified corridors along with corridors defined specifically in relation to the current needs and requirements of the Bindoon Bypass. Initially, an assessment of alternative alignments for a possible deviation of the GNH around or through Bindoon Hill was

undertaken. Five corridors were considered in the concept stage and presented to the community in October 2015. Community opposition resulted in a review of the previously-endorsed PDNH alignment and other options, that would make greater use of the Brand Highway or the GNH. A wide range of corridors were investigated, then refined from sixteen down to three using environmental, heritage, social, freight efficiency and cost criteria. The three remaining corridors were named the Western Bypass Corridor A, Western Bypass Corridor B and Eastern Bypass Corridor C.

The three corridors were presented to the Minister for Transport on 21 March 2016. After further analysis and a period of public consultation, a detailed framework was developed to assess the three corridors. Criteria for assessment included safety, freight efficiency, network reliability, travel well-being, sustainability, community impacts and environment. Western Bypass Corridor A was the best-performing option, resulting in its endorsement as the preferred corridor on 12 January 2017 (by the Minister for Transport, and following approval by the WAPC). Western Bypass Corridor A thereafter became known as the Bindoon Bypass, as represented in this Proposal.

The corridor assessment processes sought to find a route which, among other aspects, reduced the environmental and social impacts of the Proposal (precautionary principle, and the principle of the conservation of biological diversity and ecological integrity). The assessments against constructability and cost considered items such as the likely cut/fill balance of each route (principle of waste minimisation).

Concept design for the alignment within the ultimately selected corridor (as endorsed by the Minister for Transport) sought to avoid areas of high environmental value where practicable. To this end, the alignment has been located in areas of cleared (or largely cleared) paddock. Where locating the alignment within paddocks was not feasible, the concept design was reviewed as the results of studies undertaken for the environmental assessment process became available. This has resulted in changes to the alignment and engineering solutions such as steepening of batter slopes to avoid, for example, Black Cockatoo hollows. The cut and fill balance across the concept alignment has also been reviewed to determine the ratio of cut to fill, with the objective being for this to be as close to 1:1 as reasonably practicable. Additional work will be undertaken in the detailed design phase to further reduce the impacts to the environment.

Main Roads has undertaken an extensive programme of stakeholder consultation in relation to this proposal, which commenced during the corridor selection phase (**Chapter 3**). Stakeholder groups that have been consulted include the local community of Bindoon, affected landowners, regulators and other decision making authorities, industry and business groups such as the Heavy Vehicles Liaison Group and Chittering Tourist Association, natural resource management groups such as the Chittering Landcare Centre, non-governmental organisations such as the Wildflower Society of WA, and the SWALSC and Yued Working Group. Issues and concerns raised during these consultations have been taken into consideration during the route selection process, concept design phase and this environmental impact assessment. Some of the feedback received has resulted in changes to the alignment which, in turn, have resulted in better outcomes for landowners and the environment.

Main Roads plans to seek a rating under the ISCA framework for this Proposal. This process will further assist Main Roads in securing sustainable outcomes which benefit all Western Australians, now and in the future.

In order to accurately budget for major infrastructure projects such as the Bindoon Bypass, Main Roads undertaken a cost estimation exercise. This cost estimation includes items such as environmental offset requirements and environmental management and mitigations actions required during construction. Tenders issued by Main Roads for detailed design and/or construction of the Proposal will require tenderers to include costs for all environmental management and mitigation activities and controls, as well as ISCA-related activities.

6.7.2 Summary of Environmental Outcomes and Acceptability of Impacts

Potential impacts to MNES as a result of this Proposal have been assessed through an EIA and presented in this ERD. A summary of the outcomes of this assessment is presented below.

No EPBC Act-listed threatened flora species have been recorded from the Development Envelope and surrounds.

Implementation of the Proposal will require clearing of native vegetation that supports EPBC Act-listed fauna species, and an EPBC Act-listed ecological community. The Proposal will be managed so that the outcomes proposed will be met. The following residual impacts are anticipated:

- permanent loss of 60 ha of the Banksia Woodlands of the Swan Coastal Plain TEC
- permanent loss of foraging habitat, identified as Moderate value or better, for Carnaby's Black Cockatoo (204.8 ha) and the Forest Red-tailed Black Cockatoo (168 ha)
- permanent loss of up to 10 hollows previously used by Black Cockatoos.

Impacts to Black Cockatoo foraging habitat are considered acceptable, as:

- the clearing required represents 0.2% of the potential habitat within 15 km of the Development Envelope for both species
- the Proposal is located outside of the core habitat for the Forest Red-tailed Black Cockatoo
- detailed design will seek to reduce the amount of clearing required
- clearing of Black Cockatoo habitat will be offset.

The clearing of up to 10 hollows previously used by Black Cockatoo is considered significant. To further mitigate impacts to hollows previously used by Black Cockatoos, the offset site selected by Main Roads will include at least 30 hollows showing evidence of use by Black Cockatoos. Artificial hollows may also be installed if the identified offset site does not provide sufficient hollows.

The Proposal will result in clearing of 60 ha of the Banksia Woodlands TEC. Impacts to the TEC are considered acceptable as:

- the clearing required represents 0.3% of the extent of the TEC in the local area, and 0.015% of the extent expected to occur within the bioregion (as per Threatened Species Scientific Committee 2016)
- detailed design will seek to reduce the amount of clearing required
- clearing of the Banksia Woodlands TEC will be offset, thereby increasing the amount of the TEC present within secure tenure and protected in perpetuity.

6.8 Information Sources

Sources of information which have informed the impact assessment process are detailed in **Table 6-19**. An appraisal of the reliability of this information and any uncertainties that exist is also provided. The following guidelines and policies have been considered by this Proposal:

- Guidance for terrestrial flora and vegetation surveys for environmental impact assessment in WA⁶ (EPA 2004a)
- Technical guide for flora and vegetation surveys for environmental impact assessment⁷ (EPA & DPaW 2015)
- Survey guidelines for Australia's threatened orchids: guidelines for detecting orchids listed as 'Threatened' under the EPBC Act (Department of the Environment 2013)
- Approved conservation advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain Ecological Community (Threatened Species Scientific Community 2016)
- Terrestrial fauna surveys for environmental impact assessment in WA (EPA 2004b)
- Technical guidance: terrestrial fauna surveys (EPA 2016g)
- Technical guidance: sampling methods for terrestrial vertebrate fauna (EPA 2016e)
- Technical guidance: sampling of short range endemic invertebrate fauna (EPA 2016f)
- Survey guidelines for Australia's threatened mammals: guidelines for detecting mammals listed as threatened under the EPBC Act (DSEWPaC 2011a)
- EPBC Act referral guidelines for three threatened black cockatoo species: Carnaby's Cockatoo (endangered) *Calyptorhynchus latirostris*, Baudin's Cockatoo (vulnerable) *Calyptorhynchus baudinii*, Forest Red-tailed Black Cockatoo (vulnerable) *Calyptorhynchus banksii naso* (DSEWPaC 2012a)
- Survey guidelines for Australia's threatened bats: guidelines for detecting bats listed as threatened under the EPBC Act (DEWHA 2010)
- Survey guidelines for Australia's threatened reptiles: guidelines for detecting reptiles listed as threatened under the EPBC Act (DSEWPaC 2011b)
- Standards for reporting bat detector surveys (Australian Bat Society 2006)
- National guidelines for transport system management (ATAP 2016)
- Guideline to project valuation, part 4: project evaluation data (Tan, Lloyd & Evans 2012)
- Updating environmental externalities unit values (Austroads 2014)
- Shire of Chittering economic development strategy 2015-2025 (Shire of Chittering 2015).

⁶ This was superseded by EPA (2016b) after the 2016 Spring Survey, which was conducted in accordance with this guidance

⁷ This was superseded by EPA (2016c) after the 2016 Spring Survey, which was conducted in accordance with this guidance

Table 6-19: Information Sources

Information Source	Author(s) and Date	Reliability	Uncertainties
Level 2 Flora and Vegetation Assessment and Targeted <i>Thelymitra Stellata</i> Survey Great Northern Highway, Muchea to Wubin Upgrades Stage 2 – Bindoon Options	FVC (2017)	The surveys were undertaken by appropriately qualified personnel and conducted in line with the relevant policies and guidance (as listed above).	
Detailed Flora and Vegetation Assessment Bindoon Bypass, Great Northern Highway	FVC (2018a)	The surveys were undertaken by appropriately qualified personnel and conducted in line with the relevant policies and guidance (as listed above).	Lower than expected rainfall during winter 2017 may have resulted in limited flowering of <i>Thelymitra stellata</i> . Additional surveys were undertaken in 2018. Rainfall in 2018 was much more favourable and unlikely to negatively impact flowering.
Flora and Vegetation Assessments, Bindoon Bypass, Great Northern Highway	FVC (2019)	The surveys were undertaken by appropriately qualified personnel and conducted in line with the relevant policies and guidance (as listed above).	
Great Northern Highway: Bindoon Bypass Fauna Assessment	BCE (2017)	The surveys were undertaken by appropriately qualified personnel and conducted in line with the relevant policies and guidance (as listed above).	
Great Northern Highway: Bindoon Bypass Targeted Fauna Surveys	BCE (2018)	The surveys were undertaken by appropriately qualified personnel and conducted in line with the relevant policies and guidance (as listed above).	
Great Northern Highway Bindoon Bypass Project: Revised Fauna Assessment	BCE (2019)	The surveys were undertaken by appropriately qualified personnel and conducted in line with the relevant policies and guidance (as listed above).	

Information Source	Author(s) and Date	Reliability	Uncertainties
Conservation Advice for the Banksia Woodlands of the Swan Coastal Plain TEC	Threatened Species Scientific Committee (2016)	The information has been prepared based on currently available scientific information regarding the ecological community.	The conservation advice relies on mapping undertaken for/by DBCA in relation to the extent of vegetation complexes in the south west of WA. This data has been digitised at a relatively coarse level and may result in over estimation of the extent of the TEC.
2017 South West Vegetation Complex Statistics	Government of Western Australia (2018)	The information is updated on an annual basis by DBCA and is based on vegetation complex mapping prepared by Heddlie et al. (1980) and Matiske and Havel (1998).	Data has been digitised at a relatively coarse level and may not accurately reflect the vegetation associations identified during the flora and vegetation surveys, which are conducted at a much finer scale.
Black Cockatoo Habitat Mapping undertaken for the Strategic Assessment of the Perth – Peel Region	DBCA (2015)	Mapping was undertaken using the current scientific understanding of habitat preferences for each species of Black Cockatoo and current extent of vegetation complexes in the Swan Coastal Plain and Jarrah Forest IBRA regions.	Mapping was undertaken as a desktop exercise. The exact boundaries of Black Cockatoo habitat may vary when mapped via field surveys.
Economic Development Strategy 2015-2025	Shire of Chittering (2015)	Prepared in-house by the Shire and links to relevant regional plans and strategies. Local community and businesses were consulted to input to the strategy. Considered to provide a realistic approach to development of the Shire as well as accurate information relating to the current socio-economic environment of Bindoon.	

7. Offsets

As described in the *WA environmental offsets guidelines*, offsets are 'actions that provide environmental benefits which counterbalance the significant residual environmental impacts of a project or activity' (Government of WA 2014a, p. 3). Offsets relevant for significant residual impacts to biodiversity may include land acquisition, on-ground management such as revegetation and rehabilitation, or research projects. An assessment of the potential impacts from the Proposal has been undertaken using the Residual Impact Significance Model outlined in the *WA environmental offsets guidelines* in order to determine where significant impacts remain after mitigation (residual impact) and therefore where offsets are likely to be required (**Table 7-1**). In relation to this Proposal, Main Roads is proposing to offset the potential significant residual impacts to:

- hollows previously used by Black Cockatoos (Carnaby's Black Cockatoo and the Forest Red-tailed Black Cockatoo)
- Carnaby's Black Cockatoo foraging and potential breeding habitat (including trees with hollows suitable for Black Cockatoos)
- Forest Red-tailed Black Cockatoo foraging and potential breeding habitat (including trees with hollows suitable for Black Cockatoos)
- EPBC Act listed Banksia Woodlands TEC
- vegetation associated with CC wetlands
- vegetation corresponding to the Nooning vegetation complex (which is below 30% of the pre-European extent).

Offsets for all aspects will primarily take the form of land acquisition, along with some resoration/revegetation and potentially indirect offsets through research. Main Roads is currently in discussion with DBCA to identify an appropriate parcel or parcels of land which contain the required environmental values, and are in a location (and of a size) suitable to DBCA, such that they are willing to take on the management responsibility for these lands. Main Roads may also investigate partnering opportunities with a conservation focussed non-government organisation (such as Bush Heritage Australia). The offsets proposed, the process for securing these offsets including timeframes, how the offsets will be managed, an indication of the anticipated effectiveness of the offset, and how the State and Commonwealth offset policies have been applied is detailed hereafter.

The *WA environmental offsets template* has been used to provide a summary of the predicted impacts, avoidance and mitigation measures applied, the residual impacts following mitigation, and the offsets proposed for the residual impacts (Government of WA 2014b; **Table 7-2**). Quantification of the area (hectares) of land required to offset the residual impacts has been determined using the EPBC Act offset guide, a spreadsheet-based tool that allows proponents to input the predicted residual impacts, and determine the amount of land required to offset these impacts, based on the characteristics of both the impact and offset sites.

Table 7-1: Assessment of Impacts against the Residual Impact Significance Model

Residual Impact Classification	Vegetation and Flora	Terrestrial Fauna	Inland Waters
Residual impacts that is environmentally unacceptable and cannot be offset	None	None	None
Significant residual impacts that will require an offset	<ul style="list-style-type: none"> Clearing of 204.8 ha of foraging habitat which includes 79.3 ha of potential breeding habitat for Carnaby's Black Cockatoo Clearing of 168 ha of foraging habitat which includes 69.2 ha of potential breeding habitat for the Forest Red-tailed Black Cockatoo Clearing of 60 ha of the EPBC Act listed Banksia Woodlands TEC Clearing of 0.4 ha of Good or Very Good to Excellent condition vegetation within the mapped boundaries of CC wetlands Clearing of 2.5 ha of vegetation corresponding to the Nooning complex 	<ul style="list-style-type: none"> Clearing of 204.8 ha of foraging habitat which includes 79.3 ha of potential breeding habitat for Carnaby's Black Cockatoo Clearing of 168 ha of foraging habitat which includes 69.2 ha of potential breeding habitat for the Forest Red-tailed Black Cockatoo Clearing of 10 hollows previously used by either Carnaby's Black Cockatoo or the Forest Red-tailed Black Cockatoo¹ 	<ul style="list-style-type: none"> Clearing of 0.4 ha of Good or Very Good to Excellent condition vegetation within the mapped boundaries of CC wetlands
Potentially significant residual impact that may require an offset	<ul style="list-style-type: none"> Clearing of 13.5 ha of riparian vegetation in Good or better condition Clearing of 2.3 ha of land in Degraded or Completely Degraded condition within the mapped boundaries of CC wetlands Clearing of four occurrences (42 individuals) of the P2 species <i>Drosera sewelliae</i> Clearing of four occurrences (four individuals) of the P2 species <i>Leucopogon squarrosus</i> subsp. <i>trigynus</i> 		<ul style="list-style-type: none"> Clearing of 13.5 ha of riparian vegetation in Good or better condition Clearing of 2.3 ha of land in Degraded or Completely Degraded condition within the mapped boundaries of CC wetlands
Residual impacts that are not significant and do not require an offset	<ul style="list-style-type: none"> Clearing of two occurrences (two individuals) of the P3 species <i>Verticordia rutilastra</i> Clearing of one individual of the P4 species <i>Anigozanthos humilis</i> subsp. <i>chrysanthus</i> Clearing of 57 occurrences (108 individuals) of the P4 species <i>Verticordia paludosa</i> Clearing of 459.5 ha of vegetation corresponding to the South West Vegetation Complexes with more than 30% of their pre-European extent remaining (Coolakin, Cullalla, Mogumber – south, Moondah and Yalanbee (Y6) complexes) Clearing of 15.5 ha of riparian vegetation in Degraded or Completely Degraded condition 	<ul style="list-style-type: none"> Clearing of 130.3 ha of Brush Wallaby habitat Clearing of 54.4 ha of Chuditch habitat Clearing of 69.2 ha of Brush-tailed Phascogale habitat Clearing of 6.8 ha of Water-rat habitat 	<ul style="list-style-type: none"> Clearing of 15.5 ha of riparian vegetation in Degraded or Completely Degraded condition

¹ The exact species which has used the hollow cannot be determined from the secondary evidence

Table 7-2: Summary of Residual Impact and Offset Requirements

Existing Environment / Impact	Mitigation			Significant Residual Impact	Offset Calculation Method				
	Avoid & Minimise	Rehabilitation	Likely Rehab Success		Type	Risk	Likely Offset Success	Time Lag	Offset Quantification
<p>Carnaby's Black Cockatoo Habitat</p> <p>204.8 ha of foraging habitat which includes 79.3 ha of potential breeding habitat</p> <p>10 hollows showing evidence of previous use by Black Cockatoos (exact species using each hollow cannot be accurately determined)</p>	<p>The Development Footprint is predominantly (76%) located in cleared paddocks (secondary habitats) which reduces impacts to natural fauna habitats.</p>	<p>Onsite rehabilitation opportunities will be limited.</p> <p>No Banksia or flora species that provide Black Cockatoo foraging resources will be included in revegetation mixes used within 10 m of the road, as this increases the risk of bird strike.</p> <p>As Main Roads will work to minimise its Development Footprint, temporary areas of disturbance greater than 10 m from the road are anticipated to be limited.</p>	N/A	<p>Extent: The residual impacts remains the same as potential area of suitable rehabilitation unknown at this stage.</p> <p>Quality: Average foraging value of Moderate.</p> <p>Conservation Significance: Endangered species.</p> <p>Land Tenure: Freehold (private) land</p> <p>Timescale: Permanent</p> <p>The residual impact is considered significant as land clearance is a recognised threatening process for Black Cockatoos.</p>	Land acquisition	Low – land to be acquired and placed in secure tenure.	High – land transferred to secure tenure and managed by DBCA	No time lag. The proposed offset is to acquire land and transfer this to secure tenure managed by DBCA	<p>860 ha of foraging habitat including at least 300 ha of potential breeding habitat, including land that can be revegetated to provide foraging and breeding habitat.</p> <p>DAWE's EPBC Offsets Guide has been used to calculate the required offset.</p> <p>30 trees with hollows previously used by Black Cockatoos.</p> <p>A ratio of 3:1 has been applied. This ratio is the consistent with other recent Main Roads proposals.</p>

Existing Environment / Impact	Mitigation			Significant Residual Impact	Offset Calculation Method				
	Avoid & Minimise	Rehabilitation	Likely Rehab Success		Type	Risk	Likely Offset Success	Time Lag	Offset Quantification
<p>Forest Red-tailed Black Cockatoo Habitat</p> <p>168 ha of foraging habitat which includes 69.2 ha of potential breeding habitat</p> <p>10 hollows showing evidence of previous use by Black Cockatoos (exact species using each hollow cannot be accurately determined)</p>	<p>The Development Footprint is predominantly (63%) located in cleared paddocks (secondary habitats) which reduces impacts to natural fauna habitats.</p>	<p>Onsite rehabilitation opportunities will be limited.</p> <p>No Banksia or flora species that provide Black Cockatoo foraging resources will be included in revegetation mixes used within 10 m of the road, as this increases the risk of bird strike.</p> <p>As Main Roads will work to minimise its Development Footprint, temporary areas of disturbance greater than 10 m from the road are anticipated to be limited.</p>	N/A	<p>Extent: The residual impacts remains the same as potential area of suitable rehabilitation unknown at this stage.</p> <p>Quality: Average foraging value of Moderate.</p> <p>Conservation Significance: Vulnerable species.</p> <p>Land Tenure: Freehold (private) land</p> <p>Timescale: Permanent</p> <p>The residual impact is considered significant as land clearance is a recognised threatening process for Black Cockatoos.</p>	Land acquisition	Low – land to be acquired and placed in secure tenure.	High – land transferred to secure tenure and managed by DBCA	No time lag. The proposed offset is to acquire land and transfer this to secure tenure managed by DBCA	<p>841 ha of foraging habitat including 226 ha of potential breeding habitat, including land that can be revegetated to provide foraging and breeding habitat.</p> <p>DAWE's EPBC Offsets Guide has been used to calculate the required offset.</p> <p>30 trees with hollows previously used by Black Cockatoos.</p> <p>A ratio of 3:1 has been applied. This ratio is the consistent with other recent Main Roads proposals.</p>
<p>Black Cockatoo Hollows</p> <p>10 hollows previously used by Black Cockatoos</p>	<p>The Development Footprint is predominantly (63 %) located in cleared paddocks (secondary habitats) which reduces impacts to natural fauna habitats.</p> <p>During the concept design phase, the locations of trees with hollows previously used by Black Cockatoos were reviewed and avoided where practicable. This has resulted in 12 trees with previously used hollows avoided.</p>	<p>Onsite rehabilitation opportunities will be limited.</p> <p>No tree species that provide breeding habitat for Black cockatoos will be planted within 10 m of the road as this increases the risk of bird strike.</p> <p>As Main Roads will work to minimise its Development Footprint, temporary areas of disturbance greater than 10 m from the road are anticipated to be limited.</p>	N/A	<p>Extent: The residual impacts remains the same as potential area of suitable rehabilitation unknown at this stage.</p> <p>Quality: Average foraging value of Moderate.</p> <p>Conservation Significance: Endangered and Vulnerable species.</p> <p>Land Tenure: Freehold (private) land</p> <p>Timescale: Permanent</p> <p>The residual impact is considered significant as the loss of known nesting hollows (either through clearing of trees or invasion by feral bees or other species) is a recognised threatening process for Black Cockatoos.</p>	Artificial hollows	Low – research shows that Black cockatoos will readily use artificial hollows (Groom 2010). Recent surveys south of Bindoon recorded Carnaby's Black Cockatoo breeding in artificial hollows (Johnstone, Johnstone & Kirkby 2010; Phoenix Environmental Sciences 2018).	High – The offset proposed includes adaptive management and completion criteria to measure the success of the offset.	No time lag. Artificial hollows will be installed prior to the breeding season following clearing	<p>30 artificial hollows.</p> <p>A ratio of 3:1 has been applied. This ratio is the consistent with other recent Main Roads proposals.</p>

Existing Environment / Impact	Mitigation			Significant Residual Impact	Offset Calculation Method				
	Avoid & Minimise	Rehabilitation	Likely Rehab Success		Type	Risk	Likely Offset Success	Time Lag	Offset Quantification
<p>EPBC Act listed Banksia Woodlands of the Swan Coastal Plain TEC</p> <p>60 ha of the Banksia Woodlands TEC</p>	<p>The Development Footprint is predominantly located in cleared or largely cleared paddocks which reduces impacts to native vegetation.</p> <p>Further reductions are expected during the detailed design phase.</p>	<p>Onsite rehabilitation opportunities will be limited.</p> <p>No Banksia species that provide Black Cockatoo foraging resources will be included in revegetation mixes used within 10 m of the road, as this increases the risk of bird strike.</p> <p>As Main Roads will work to minimise its Development Footprint, temporary areas of disturbance greater than 10 m from the road are anticipated to be limited.</p>	N/A	<p>Extent: The residual impacts remain the same as potential area of suitable rehabilitation unknown at this stage.</p> <p>Quality: Average quality of Very Good but ranges from Degraded to Excellent.</p> <p>Conservation Significance: EPBC Act listed Endangered TEC</p> <p>Land Tenure: Freehold (private) land</p> <p>Timescale: Permanent</p> <p>The residual impact is considered significant as land clearance is a threatening process for this TEC.</p>	Land acquisition	Low – land to be acquired and placed into secure tenure.	High – land transferred to secure tenure and managed by DBCA	No time lag. The proposed offset is to acquire land transfer this to secure tenure with DBCA management	<p>304.7 ha of the EPBC Act listed Banksia Woodlands TEC and/or land that can be rehabilitated to meet the criteria outlined in the Conservation Advice for this TEC.</p> <p>DAWE's EPBC Offsets Guide has been used to calculate the required offset.</p>
<p>Vegetation associated with conservation category (CC) wetlands</p> <p>0.4 ha of Good or Very Good to Excellent condition vegetation within the mapped boundaries of CC wetlands</p>	<p>The Development Footprint is predominantly located in cleared or largely cleared paddocks which reduces impacts to native vegetation.</p> <p>The Development Footprint has avoided CC wetland where practicable, however upgrades to adjoining local roads and crossing of the Brockman River means some impacts are unavoidable.</p>	As Main Roads will work to minimise its Development Footprint, onsite rehabilitation opportunities will be limited.	N/A	<p>Extent: The residual impacts remains the same as potential area of suitable rehabilitation unknown at this stage.</p> <p>Quality: Good to Excellent.</p> <p>Conservation Significance: CC wetlands.</p> <p>Land Tenure: Freehold (private) land</p> <p>Timescale: Permanent</p> <p>The residual impact is considered significant as land clearance is a threatening process for CC wetlands.</p>	Land acquisition	Low – land to be acquired and placed in secure tenure.	High – land transferred to secure tenure and managed by DBCA	No time lag. The proposed offset is to acquire land and transfer this to secure tenure managed by DBCA	<p>1.7 ha of vegetation associated with CC wetlands in at least Very Good condition, and/or land that can be rehabilitated to at least Very Good condition.</p> <p>DAWE's EPBC offsets guide has been used to calculate the required offset.</p>

Existing Environment / Impact	Mitigation			Significant Residual Impact	Offset Calculation Method				
	Avoid & Minimise	Rehabilitation	Likely Rehab Success		Type	Risk	Likely Offset Success	Time Lag	Offset Quantification
<p>Vegetation associations corresponding to the Nooning vegetation complexes</p> <p>2.5 ha of vegetation corresponding to the Nooning complex</p>	<p>The Development Footprint is predominantly located in cleared or largely cleared paddocks which reduces impacts to native vegetation.</p> <p>Further reductions are expected during the detailed design phase.</p>	<p>As Main Roads will work to minimise its Development Footprint, onsite rehabilitation opportunities will be limited.</p>	N/A	<p>Extent: The residual impacts remains the same as potential area of suitable rehabilitation unknown at this stage.</p> <p>Quality: Good to Excellent.</p> <p>Conservation Significance: Under-represented Vegetation complexes below 30% of the pre-European extent.</p> <p>Land Tenure: Freehold (private) land</p> <p>Timescale: Permanent</p> <p>The residual impact is considered significant as these vegetation complexes are below 30% of their pre-European extent.</p>	Land acquisition	Low – land to be acquired and placed in secure tenure.	High – land transferred to secure tenure and managed by DBCA	No time lag. The proposed offset is to acquire land and transfer this to secure tenure managed by DBCA	<p>2.8 ha within the Nooning complex. Vegetation should be in at least Very Good condition or that can be rehabilitated to at least Very Good condition.</p> <p>DAWE's EPBC Offsets Guide has been used to calculate the required offset.</p>

7.1 Land Acquisition Offsets

As detailed in **Table 7-2**, the following offsets have been estimated in order to mitigate the residual impacts of the proposal:

- at least 860 ha of Carnaby's Black Cockatoo foraging habitat, including at least 300 ha of potential breeding habitat, 351 trees with hollows suitable for use and 30 hollows previously used by Black Cockatoos
- at least 841 ha of Forest Red-tailed Black Cockatoo foraging habitat, including at least 226 ha of potential breeding habitat, 351 trees with hollows suitable for use and 30 hollows previously used by Black Cockatoos
- at least 172 ha of habitat suitable for Chuditch
- at least 304.7 ha of the EPBC Act listed Banksia Woodlands TEC
- 2.5 ha of vegetation associated with CC wetlands
- 2.8 ha of vegetation of the Nooning complex.

It should be noted that the offsets detailed above may include a combination of vegetated (uncleared) land and degraded or cleared land that will be revegetated to provide the required environmental values or ecosystem services. Artificial hollows may also be installed if the identified offset site does not provide sufficient hollows showing evidence of previous use by Black Cockatoos.

The above-estimated offset requirements are not intended to be cumulative. Often, more than one offset requirement can be met by the same parcel of land. For example, Banksia woodlands are foraging habitat for Carnaby's Black Cockatoo and, as such, can contribute towards offsetting both Carnaby's Black Cockatoo foraging habitat and the EPBC Act listed Banksia Woodlands TEC.

The inputs used in the EPBC Act offset guide to estimate these requirements, and the justifications for these, are provided in **Chapter 7.3**.

Main Roads proposes to identify and acquire an appropriate parcel of land to offset the residual impacts of this Proposal, prior to the start of clearing. To this end, the timeline detailed in **Table 7-3** is proposed, to provide certainty that an appropriate offset will be in place prior to the commencement of the Proposal.

Once an appropriate offset property or properties have been acquired, DBCA will acquire the land and Main Roads will reimburse the cost to DBCA. To support this, a memorandum of understanding (MoU) will be agreed between Main Roads and DBCA, for the conservation and ongoing management of acquired land for seven years. The MoU will set out the obligations of each party in respect to:

- funding for the works associated with the establishment of land to be managed for conservation, and the timing of payment(s)
- additional funding, and the term and payment schedule of that funding, for ongoing management of the land
- the works and activities to be undertaken to:
 - ▶ establish the conservation reserve
 - ▶ manage the conservation reserve, meet the offset requirements and any relevant conditions of approval for this Proposal
- reporting requirements.

Table 7-3: Land Acquisition Activities

Indicative Duration	Activity
20 months	Consultation with DBCA to identify properties that may be suitable for acquisition (in progress).
Three months	Initial environmental investigations to confirm identified property(ies) contain the required environmental values.
One month	Main Roads consults with EPA and DAWE on acceptability of offset property.
Three months	Main Roads/DBCA begins acquisition process (assuming offset requirements are met and are acceptable to regulators).
Six months	Main Roads and DBCA agree an MoU for the management of the acquired property(ies), funding for establishment as a conservation reserve, term of funding for ongoing management of the property, and the conservation and management activities to be undertaken.
Autumn and Spring following identification of target property	Detailed investigations to further delineate the environmental values present within the property(ies) and confirm they meet the offset requirements. For example, confirmation that the correct FCTs are present within any areas identified as the EPBC Act listed Banksia Woodlands TEC.
Six months following surveys of property	Acquisition process complete. Note, this date depends on the results of the surveys confirming the required values are present.

7.2 Hollows Previously used by Black Cockatoos

Main Roads proposes to offset the clearing of ten trees with hollows previously used by Black Cockatoos through the installation of artificial hollows. A ratio of three artificial hollows for each natural hollow cleared has been applied, thus a total of 30 artificial hollows are planned to be installed. Artificial hollows will be installed prior to breeding season which follows the clearing of the ten trees, in order to maximise the number of hollows available at the commencement of the breeding season. As no active nests will be cleared, this timing is considered appropriate to avoid any additional impacts on the species.

Main Roads is intending to procure and install artificial hollows known as Cockatubes® (**Figure 7-1**). These are constructed by Landcare Serpentine-Jarrahdale Inc. (Landcare SJ), and the current design has been developed over a period of 10 years with the assistance of DBCA and the WA Museum. Cockatubes® have an expected lifespan of 50 years or more, provided they are regularly maintained (maintenance includes, for example, replacing the sacrificial wood chewing post as required). They are used extensively throughout the south west of WA, including a number of Cockatubes® that have been installed by Main Roads along the GNH in the Bindoon area. Recent monitoring of the artificial hollows show they have been used for breeding (Johnstone, Johnstone & Kirkby 2010; Phoenix Environmental Sciences 2018).

Main Roads will engage a suitably qualified person with experience in Black Cockatoos to assist with the identification of trees suitable for artificial hollow installation. Appropriate trees will be identified by taking into consideration the following parameters:

- trees should be within the road reserve, but not adjacent to the road, or within other Crown lands (e.g. DBCA-managed lands) to facilitate ease of access for monitoring and maintenance
- located in proximity to impacted nesting hollow, or existing nesting hollow which will not be impacted
- located within or adjacent to foraging habitat
- located in proximity to water
- trees should be mature and well shaded

- trees should be accessible with a cherry picker, without requiring additional disturbance, to allow installation of the artificial hollows.

Main Roads has developed an Artificial Hollow Management Plan (**Appendix M**). This plan sets out the monitoring required to demonstrate the artificial hollows are effective as an offset (i.e. they are used by Black Cockatoos), maintenance schedule and an adaptive management approach should monitoring identify that the offset is at risk of not succeeding.



Figure 7-1: Example Cockatube® (photo credit: Landcare SJ Inc.)

7.3 Indirect Offsets

Main Roads is currently negotiating a funding arrange with Murdoch University to fund research into Carnaby's Black Cockatoo. The proposed total funding of \$400,000 will be shared between the Mitchell Freeway Extension (Hester Road to Romeo Road), Roe Highway and Kalamunda Road Interchange, and the Bindoon Bypass. The Bindoon Bypass will contribute \$150,000 to this funding.

7.4 Offset Guide Inputs and Justification

The EPBC offset guide (Government of WA 2014a) was used to quantify the area of land required to offset 100% of the significant residual impacts resulting from the Proposal. The inputs used, and justifications for these, are provided in **Table 7-5**. The full EPBC offset guide worksheets are provided in **Appendix N**.

Table 7-4: Offsets Guide Inputs and Justifications

Offset Guide Item	Input Value																								Justification																										
	Carnaby's Black Cockatoo				Forest Red-Tailed Black Cockatoo				EPBC Act listed Banksia Woodlands TEC					Chuditch					CC Wetland Vegetation		Nooning Complex																														
EPBC Act Status	Endangered				Vulnerable				Endangered					Vulnerable					N/A (Other)		N/A (Other)				Current EPBC Act listing.																										
Impact area (ha)	62.2	83.6	40.2	18.8	97.4	28.5	24.7	17.4	4	21.2	11.6	14	9.2	15.3	2.0	10.5	6.2	14.0	6.4	0.2	0.2	15.5	6.3	21.3	6.9	1.0	Total amount of clearing required for the Proposal. This has been separated according to Quality																								
Quality of impact area	6	7	8	9	6	7	8	9	3	5	6	7	8	1	2	4	5	6	7	4	7	4	5	6	7	8	The quality of the impact area for Black Cockatoos has been determined based on the value of the habitat as recorded by BCE (2018). Vegetation condition was translated to Quality as follows: <table border="1" data-bbox="2220 779 2763 1392"> <thead> <tr> <th>Vegetation Condition</th> <th>EPBC Act Offset Guide Quality</th> </tr> </thead> <tbody> <tr><td>Pristine</td><td>10</td></tr> <tr><td>Excellent to Pristine</td><td>9</td></tr> <tr><td>Excellent</td><td>8</td></tr> <tr><td>Very Good to Excellent</td><td>7</td></tr> <tr><td>Very Good</td><td>6</td></tr> <tr><td>Good to Very Good</td><td>5</td></tr> <tr><td>Good</td><td>4</td></tr> <tr><td>Degraded to Good</td><td>3</td></tr> <tr><td>Degraded</td><td>2</td></tr> <tr><td>Completely Degraded to Degraded</td><td>1</td></tr> <tr><td>Completely Degraded</td><td>0</td></tr> </tbody> </table>	Vegetation Condition	EPBC Act Offset Guide Quality	Pristine	10	Excellent to Pristine	9	Excellent	8	Very Good to Excellent	7	Very Good	6	Good to Very Good	5	Good	4	Degraded to Good	3	Degraded	2	Completely Degraded to Degraded	1	Completely Degraded	0
Vegetation Condition	EPBC Act Offset Guide Quality																																																		
Pristine	10																																																		
Excellent to Pristine	9																																																		
Excellent	8																																																		
Very Good to Excellent	7																																																		
Very Good	6																																																		
Good to Very Good	5																																																		
Good	4																																																		
Degraded to Good	3																																																		
Degraded	2																																																		
Completely Degraded to Degraded	1																																																		
Completely Degraded	0																																																		
Time over which Loss is averted	20 years				20 years				20 years					20 years					20 years		20 years				The transfer of the offset site to secure tenure managed by DBCA will provide protection and management in perpetuity.																										
Time until ecological benefit	1 year				1 year				1 year					1 year					1 year		1 year				Vegetated land will be acquired and transferred to secure tenure prior to commencement of the Proposal. An agreement for the ongoing management of the land will be established between Main Roads and either DBCA. The ecological benefit will be realised within 1 year.																										
Start area (ha)	860 (foraging)				832 (foraging)				304.7					172					2.5		2.8				This area achieves 100% direct offset (for each aspect), based on the other inputs used. Refer to the individual calculation worksheets in Appendix N for the breakdown by start quality																										
	300 (potential breeding)				226 (potential breeding)																																														

Offset Guide Item	Input Value						Justification
	Carnaby's Black Cockatoo	Forest Red-Tailed Black Cockatoo	EPBC Act listed Banksia Woodlands TEC	Chuditch	CC Wetland Vegetation	Nooning Complex	
Start quality	7	7	6	6	6	6	Properties targeted for acquisition will be required to provide: <ul style="list-style-type: none"> Black Cockatoo foraging habitat that is at least Moderate in value vegetation that is at least Very Good in Condition.
Future quality without offset	6	6	5	5	5	5	It is assumed that acquired land will be freehold (private). If the offset site was to remain private freehold land, there is a risk of degradation to the site. This may be through illegal dumping of rubbish, grazing of the site by stock or clearing of vegetation for economic purposes such as farming or housing.
Future quality with offset	7	7	6	6	6	6	The quality of the vegetation will, at a minimum, be maintained through management of the offset site by DBCA. Where revegetation is undertaken, this will improve the quality of the offset.
Risk of loss (%) without offset	15	15	15	15	15	15	If the offset sites were to remain private freehold land, there is a risk of degradation to the sites. This may be through grazing of the site by stock or clearing of vegetation for economic purposes such as farming or housing. The risk is further increased due to the pressure on Black Cockatoo habitat in the Swan Coastal Plain and Jarrah Forest bioregions due to the expanding population of the Perth and Peel areas, and resultant need to provide land for housing, and mining activities on the Darling Range.
Risk of loss (%) with offset	5	5	5	5	5	5	As the offset sites will be managed by DBCA and protected in perpetuity, there is a low 5% risk that the values will be lost.
Confidence (%) in result (averted risk)	90	90	90	90	90	90	As the offset sites will be managed by DBCA and protected in perpetuity, there is a high level of confidence that the averted risk will be realised.
Confidence (%) in result (change in habitat quality)	90	90	90	90	90	90	A conservative approach has been applied by assuming acquisition of vegetated land and no increase in habitat quality due to the offset.

7.5 Consistency with WA Government and EPBC Act Offset Policies

In determining the offset previously described, consideration has been given to the requirements of the WA government’s environmental offsets policy (Government of WA 2011) and the EPBC Act environmental offsets policy (DSWEPaC 2012b). **Table 7-5** and **Table 7-6** provide discussion on how the policies have been considered. It should be noted that minor residual impacts have not been offset. Refer to **Table 7-2** for a full breakdown of residual impacts.

Table 7-5: Consistency with WA Government Environmental Offsets Policy

Offsets Policy Requirement	Consideration in Offset proposal
<p>Environmental offsets will only be considered after avoidance and mitigation options have been pursued.</p>	<p>The following avoidance and mitigation measures have been applied during the concept design phase:</p> <ul style="list-style-type: none"> Review of environmental, social and heritage constraints during the corridor selection study to identify the corridor which presented the least impact, while still providing other benefits such as reduced travel time and lower construction costs. These impact reduction endeavours were undertaken in accordance with the mitigation hierarchy described in Chapter 4.2.6. The Proposal is predominantly located in cleared paddock (63%). Cut and fill batters have been steepened to reduce the amount of clearing required. Locations of trees with hollows previously used by Black Cockatoos have been avoided where practicable. Where avoidance is not practicable, justification has been given for this.
<p>Environmental offsets are not appropriate for all projects.</p>	<p>Offsets are considered appropriate for this Proposal due to the significant residual impacts identified.</p>
<p>Environmental offsets will be cost-effective, as well as relevant and proportionate to the significance of the environmental value being impacted.</p>	<p>The EPBC offset calculator has been used to determine the area of land required to offset impacts to Black Cockatoo habitat and the EPBC Act listed Banksia Woodlands TEC.</p>
<p>Environmental offsets will be based on sound environmental information and knowledge.</p>	<p>Where vegetated land is acquired, ecological surveys will be carried out prior to acquisition to confirm that the environmental values to be offset are present. Land acquisition targets will be identified based on the known area of occurrence and habitat preferences (e.g. soil conditions, geology, vegetation types, climate, etc) of the environmental values to be offset. This may necessitate multiple offset site to achieve the outcomes.</p>

Offsets Policy Requirement	Consideration in Offset proposal
Environmental offsets will be applied within a framework of adaptive management.	Where land will be revegetated to achieve the offset required, monitoring of the revegetation is undertaken to confirm that the required environmental values and/or ecosystem services are provided by the revegetated area. Should artificial hollows be installed, these hollows are monitored to confirm they are used by the target species and identify future maintenance requirements.
Environmental offsets will be focussed on longer term strategic outcomes.	Land acquisition increases the amount of Black Cockatoo habitat and the EPBC Act listed Banksia Woodlands TEC present within secure, protected tenure, providing protection for a greater proportion of these values in perpetuity. Should revegetation be undertaken, the area of Black Cockatoo habitat and Banksia Woodlands TEC, along with other environmental values and ecosystem services will be increased.

Table 7-6: Consistency with EPBC Environmental Offsets Policy

Offsets Policy Requirement	Consideration in Offset proposal
Suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the protected matter	The offset proposed will increase the representation of foraging and breeding habitat for Black Cockatoo and the EPBC Act listed Banksia Woodlands TEC, within secure tenure. This protection will, at a minimum, assist in maintaining the viability of the protected matter. Should revegetation be undertaken, the area of Black Cockatoo habitat and Banksia Woodlands TEC, along with other environmental values and ecosystem services will be increased.
Suitable offsets must be built around direct offsets but may include other compensatory measures	The offset strategies proposed are built around direct offsets.
Tenure for direct offsets	Acquired land will transferred to secure tenure to be managed by DBCA or a conservation focussed non-government organisation (such as Bush Heritage Australia), providing in perpetuity protection and management. An MoU between Main Roads and DBCA will be agreed to set out the management and funding arrangements of the acquired land.
Impacting on existing EPBC Act offsets	There are no impacts on existing EPBC Act offsets
Suitable offsets must be in proportion to the level of statutory protection that applies to the protected matter	The EPBC offset guide has been used to calculate the area required for direct offset. The guide takes into consideration the level of statutory protection for the protected matter.

Offsets Policy Requirement	Consideration in Offset proposal
Suitable offsets must be of a size and scale proportionate to the residual impacts on the protected matter	Offsets have been calculated based on the residual impact to the protected matter. As discussed previously, there is little opportunity for revegetation to reduce the residual impact given the nature of the Proposal and the efforts made to avoid unnecessary clearing.
Suitable offsets must effectively account for and manage the risks of the offset not succeeding	Vegetated land will be acquired to be managed by DBCA. Given this, there is a low risk of the offset not succeeding. This has been reflected in the inputs used in the EPBC offset guide to calculate the offset required. An adaptive management approach will be implemented to evaluate the effectiveness of artificial nesting hollows should these form part of the offset package. This approach includes monitoring of the offset to determine whether the offset requirements have been achieved.
Suitable offsets must be additional to what is already required, determined by law or planning regulations, or agreed to under other schemes or programs	The proposed offset strategies are additional to any other requirements.
Links with state and territory approval processes	Offsets will also be required under Part IV of the EP Act.
Suitable offsets must be efficient, effective, timely, transparent, scientifically robust and reasonable	The proposed offset is considered to be effective and efficient as the offset site will be managed DBCA and transferred to secure tenure. The offset is considered to meet the timeliness requirement as the site will be acquired by Main Roads prior to commencement of the Proposal, and will provide foraging and potential breeding habitat for Carnaby's Black Cockatoos and the Forest Red-tailed Black Cockatoo, and vegetation representative of the EPBC Act listed Banksia Woodlands TEC. Black Cockatoo habitat and Banksia Woodlands vegetation has been defined by a number of field surveys. The offset has been calculated using the EPBC offset guide and is therefore considered reasonable.
Suitable offsets must have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced	An MoU between Main Roads and DBCA will be established for the management of acquired land. This MoU will set of the responsibilities and requirements of each party.

7.6 Consideration of Recovery Plans and Conservation Advice

Recovery plans have been prepared for Carnaby's Black Cockatoo and the Forest Red-tailed Black Cockatoo (DPaW 2013; Chapman 2008). These plans outline a number of actions to be implemented in order to aid recovery of the species. The recovery action items outlined in Section 14 of the recovery plan for Carnaby's Black Cockatoo (DPaW 2013) are primarily targeted for regulators and conservation groups. Similarly, the actions outline in Section 14 of the Forest Red-tailed Black Cockatoo recovery plan (Chapman 2008) are primarily the responsibility of DBCA, Water Corporation, DPIRD and the WA Museum. The recovery actions have been formulated to address a broad range of threats, some of which are not relevant to Main Roads activities and responsibilities. **Table 7-7** and **Table 7-8** detail how the recovery actions have been considered by Main Roads for this Proposal.

The conservation advice for the EPBC Act listed Banksia Woodlands TEC (Threatened Species Scientific Committee 2016) outlines a number of priority research and conservation actions for the ecological community. While many of these are aimed at research organisations and government agencies responsible for conservation management (i.e. DBCA), there are opportunities for Main Roads to contribute to these actions. **Table 7-9** details how Main Roads has taken these actions into consideration for this Proposal.

Table 7-7: Main Roads Consideration of the Carnaby's Black Cockatoo Recovery Plan Actions

Recovery Plan Action	Main Roads Consideration
Action 1. Protect and manage important habitat	Breeding sites are considered to be critical habitat for the species. The offset strategy for the Proposal will result in additional Carnaby's Black Cockatoo habitat being added to secure tenure that is managed for conservation.
Action 2: Undertake regular monitoring	The Proposal is not inconsistent with this recovery plan action. The results of surveys for Black Cockatoos have been shared with the WA Museum.
Action 3: Conduct research to inform management	The Proposal is not inconsistent with this recovery plan action. Data from surveys will be provided to DBCA and, upon request, other interested research organisations
Action 4. Manage other impacts	Any injured birds found during construction activities (within the construction area) will be taken to the nearest local wildlife carer as appropriate.
Action 5: Engage with the broader community	The community has been kept informed of developments regarding the Proposal. A number of meetings have been held with the Ellen Brockman Integrated Catchment Group.
Action 6: Undertake information and communication activities	The Proposal is not inconsistent with this recovery plan action. Information presented during construction inductions and toolbox meetings will assist in educating the general public about Black Cockatoos.

Table 7-8: Main Roads Consideration of the Forest Red-tailed Black Cockatoo Recovery Plan Actions

Recovery Plan Action	Main Roads Consideration
1. Seek the funding required to implement future recovery actions.	Main Roads has included funding for research into Carnaby's Black Cockatoo as part of the proposed offset.
2. Determine and promote non-lethal means of mitigating fruit damage by Baudin's Cockatoo in orchards.	Not relevant to this Proposal as Baudin's Black Cockatoo does not occur within the Development Envelope.
3. Eliminate illegal shooting	This action item is outside of Main Roads ability to influence or control. The Proposal is not inconsistent with this recovery plan action.
4. Develop and implement strategies to allow for the use of noise emitting devices in orchards.	This action item is outside of Main Roads ability to influence or control. The Proposal is not inconsistent with this recovery plan action.

Recovery Plan Action	Main Roads Consideration
5. Determine and implement ways to remove feral Honeybees from nesting hollows	This action item is outside of Main Roads ability to influence or control. The Proposal is not inconsistent with this recovery plan action.
6. Identify factors affecting the number of breeding attempts and breeding success and manage nest hollows to increase recruitment.	Main Roads will provide the results of any surveys to DBCA and the recovery team upon request, to add to the knowledge base in this area.
7. Determine and implement ways to minimise the effects of mining and urban development on habitat loss.	While not a mining or urban development, Main Roads has, and will continue to, minimise clearing of Black Cockatoo habitat during the design and implementation of the Proposal. This has been achieved through locating the Development Footprint in cleared land where practicable and employing design and engineering solutions such as steepening of batter slopes, use of barriers to protect significant vegetation.
8. Determine and implement ways to manage forests for the conservation of Forest Black Cockatoos	The offset strategy for the Proposal will result in additional Forest Red-tailed Black Cockatoo habitat being added to secure tenure that is managed for conservation.
9. Identify and manage important sites and protect from threatening processes	No important sites have been identified in relation to the Proposal. The surveys undertaken for this Proposal will also add to the DBCA knowledge base for the Bindoon area. Main Roads will provide the results of surveys to DBCA upon request. This will assist in determining the usage of the area by Forest Red-tailed Black Cockatoos and if it is an important site now, or in the future.
10. Map feeding and breeding habitat critical to survival and important populations, and prepare management guidelines for these habitats	The surveys undertaken for this Proposal have mapped feeding and breeding habitat and will add to the knowledge base for the species.
11. Monitor population numbers and distribution	Main Roads will provide the results of surveys to DBCA and the recovery team upon request. This will assist in the monitoring of population numbers and distribution, particularly during the breeding season.
12. Determine the patterns and significance of movement	The Proposal is not inconsistent with this recovery plan action.
13: Maintain the Cockatoo Care program and use other opportunities to promote the recovery of Forest Black Cockatoos.	The Proposal is not inconsistent with this recovery plan action.

Table 7-9: Main Roads Consideration of the EPBC Act listed Banksia Woodlands TEC Conservation Advice

Conservation Advice Priority Research and Conservation Actions	Main Roads Consideration
Preventing vegetation clearance and direct habitat damage.	The Proposal has avoided clearing native vegetation and the ecological community, where practicable, by locating the alignment in cleared, or largely cleared, paddocks. Additional design elements such as steepening of batters, use of barriers and reductions in cut and fill height/depth have also been employed during the concept design phase. Further refinement of the design and reduction in the Disturbance Footprint will be undertaken in the detailed design phase.
Preventing weeds, feral animals, dieback and other diseases.	Weed and disease management will form part of the CEMP for the Proposal. Monitoring of revegetation will include an assessment of weed presence and cover, and signs of possible dieback infestation
Manage groundwater extraction by monitoring changes to levels of groundwater over the long-term.	The Proposal is not inconsistent with this action. Groundwater abstraction for the Proposal will be temporary and managed such that drawdown for construction water does not exceed 0.5 m and is within the natural variability of the water table. No long term changes to groundwater levels are expected as a result of construction of the Proposal.
<p>Fire:</p> <ul style="list-style-type: none"> • Use a landscape-scale approach and available knowledge on fire histories and age of stands, to identify appropriate fire regimes. • Given the cycle of fires promoting grassy weed establishment and higher fuel loads, manage the fire-weed cycle by controlling invasive weed species before and after any fire events. • In some areas of Banksia woodlands 8-16 years is currently recommended as an appropriate fire interval for the ecological community: however, a mosaic pattern of burning and fire ages is recommended, with retention of some long-unburnt areas. • Implement appropriate fire management regimes for the ecological community. 	The Proposal is not inconsistent with this action. Monitoring of revegetation and implementation of weed control as required will assist in reducing the potential fuel load along the roadside.
Preventing grazing damage.	The road reserve will be fenced, preventing access by stock from adjacent private land.

Conservation Advice Priority Research and Conservation Actions	Main Roads Consideration
<p>Re-vegetation:</p> <ul style="list-style-type: none"> • Implement optimal regeneration, revegetation and restoration strategies for the ecological community, across the landscape. • Site specific restoration, including consideration of the appropriate FCT, is important to the success of restoration efforts. • Restore wildlife corridors and linkages between remnants of the ecological community and other areas of native vegetation. • Consider particularly the needs of species of conservation concern or known to be of functional importance for the ecological community, for example feed trees for Carnaby's Black Cockatoo. 	<p>Cleared areas more than 10 m from the edge of the road will be revegetated using native species found in adjacent areas. This will include species which make up the ecological community</p> <p>Fauna underpasses will be installed to maintain ecological linkages.</p>
<p>Control invasive species and diseases.</p>	<p>Weed and disease management will form part of the CEMP for the Proposal. Monitoring of revegetation will include an assessment of weed presence and cover, and signs of possible dieback infestation.</p>
<p>Education, information and local regulation. Promote awareness and protection of the ecological community.</p>	<p>The Proposal is not inconsistent with this action. Information presented during construction inductions and toolbox meetings will assist in educating the general public about the ecological community.</p>
<p>Incentives and support:</p> <ul style="list-style-type: none"> • Support opportunities for traditional owners or other members of the indigenous community to manage the ecological community. • Implement formal conservation agreements (for example, covenants) for sites on private tenure that contain the ecological community. • Develop coordinated incentive projects to encourage conservation and stewardship on private land, and link with other programs and activities, especially those managed by regional catchment councils 	<p>The Proposal is not inconsistent with this action. The offset strategy for the Proposal will result in additional Banksia woodlands within secure tenure that is managed for conservation.</p>

8. Holistic Impact Assessment

This ERD has assessed the potential impacts to the Key Environmental Factors defined by the ESD, and presents environmental management and mitigation measures, to reduce the potential for significant environmental impacts resulting from the Proposal. Significant residual impacts have been identified in relation to Carnaby's Black Cockatoo, the Forest Red-tailed Black Cockatoo, the EPBC Act listed Banksia Woodlands TEC, , vegetation associated with CC wetlands, and vegetation of the Nooning complexes. An offset proposal has been prepared to further mitigate significant residual impacts.

Throughout the concept design and environmental assessment phases of the Proposal, the principles of environmental protection defined in the EP Act have been considered. These are:

- the precautionary principle
- the principle of intergenerational equity
- the principle of the conservation of biological diversity and ecological integrity
- principles relating to improved valuation, pricing and incentive mechanisms
- the principle of waste minimisation.

A detailed corridor selection process, as described in **Chapter 2**, was undertaken in order to identify a preferred corridor for the Bindoon Bypass. This process took into account previously identified corridors along with corridors defined specifically in relation to the current needs and requirements of the Bindoon Bypass. Initially, an assessment of alternative alignments for a possible deviation of the GNH around or through Bindoon Hill was undertaken. Five corridors were considered in the concept stage and presented to the community in October 2015. Community opposition resulted in a review of the previously-endorsed PDNH alignment and other options, that would make greater use of the Brand Highway or the GNH. A wide range of corridors were investigated, then refined from sixteen down to three using environmental, heritage, social, freight efficiency and cost criteria. The three remaining corridors were named the Western Bypass Corridor A, Western Bypass Corridor B and Eastern Bypass Corridor C.

The three corridors were presented to the Minister for Transport on 21 March 2016. After further analysis and a period of public consultation, a detailed framework was developed to assess the three corridors. Criteria for assessment included safety, freight efficiency, network reliability, travel well-being, sustainability, community impacts and environment. Western Bypass Corridor A was the best-performing option, resulting in its endorsement as the preferred corridor on 12 January 2017 (by the Minister for Transport, and following approval by the WAPC). Western Bypass Corridor A thereafter became known as the Bindoon Bypass, as represented in this Proposal.

The corridor assessment processes sought to find a route which, among other aspects, reduced the environmental and social impacts of the Proposal (precautionary principle, and the principle of the conservation of biological diversity and ecological integrity). The assessments against constructability and cost considered items such as the likely cut/fill balance of each route (principle of waste minimisation).

Concept design for the alignment within the ultimately selected corridor sought to avoid areas of high environmental value where practicable. To this end, the alignment has been located in areas of cleared (or largely cleared) paddock where practicable (precautionary principle and principle of the conservation of biological diversity and ecological integrity). Where locating the alignment within paddocks was not feasible, the concept design was reviewed as the results of studies undertaken for the environmental assessment process became available. This resulted in changes to the proposed alignment, and engineering solutions such as steepening of batter slopes to avoid, for example, Black Cockatoo hollows (principle of intergenerational equity). Additional work will be undertaken in the detailed design phase to further reduce the impacts to the environment.

Main Roads will develop and implement a sustainability strategy for the Bindoon Bypass. This will include seeking a rating under the ISCA framework for the Proposal. This process will further assist Main Roads in

securing sustainable outcomes that benefit all Western Australians, now and in the future (principle of intergenerational equity, principles relating to improved valuation, pricing and incentive mechanisms and the principle of waste minimisation).

A detailed assessment of the Proposal against the Key Environmental Factors is presented in this ERD. Main Roads believes the EPA objectives for the Key Environmental Factors can be met through a combination of impact avoidance and minimisation, engineering solutions to mitigate impacts, environmental management controls implemented during construction and maintenance works, and provision of offsets for significant residual impacts. **Table 8-1** presents the EPA objectives for each Key Environmental Factor, together with the outcome expected from this Proposal, to demonstrate that the objective can be met. A visual representation of how the EPA's significance framework has been applied for each Key Environmental Factor is presented in **Figure 8-1**.

There are a number of connections and interactions between the Key Environmental Factors considered in this ERD. The interactions relevant to this Proposal are:

- Surface Water – Vegetation interactions:
 - ▶ Vegetation clearing can lead to increased sediment loads in surface runoff and ultimately in waterways.
 - ▶ Vegetation clearing can lead to changes in overland (surface water runoff) flow paths and quantities of runoff entering waterways.
 - ▶ Changes to surface water flow paths, quantity and quality can adversely impact the health of wetland and riparian vegetation.
- Groundwater – Vegetation interactions:
 - ▶ Changes to groundwater levels can impact the health of groundwater dependent species.
 - ▶ Changes to groundwater levels can result in changes to species composition of vegetation associated that contain groundwater dependent species.
 - ▶ It should be noted that any changes to groundwater levels as a result of the Proposal will be temporary.
- Surface Water – Terrestrial Fauna interactions:
 - ▶ Changes to surface water flow paths, velocity, quantity and quality can change/degrade the aquatic habitats present and may change the distribution of aquatic species.
 - ▶ Changes to surface water quantity and quality can change the water sources available to fauna.
- Vegetation – Terrestrial Fauna interactions:
 - ▶ Clearing of native vegetation reduces the area of fauna habitat and specific components such as habitat trees available for use by terrestrial fauna.
- Vegetation – Social Surrounds interactions:
 - ▶ Clearing of vegetation may reduce the amenity of the area through reduces 'naturalness'.
 - ▶ Clearing of vegetation associated with waterways may impact the Aboriginal ethnographic values of these areas.
- Surface Water – Social Surrounds interactions
 - ▶ Impacts to waterways may have flow on impacts to the Aboriginal ethnographic values of these areas.

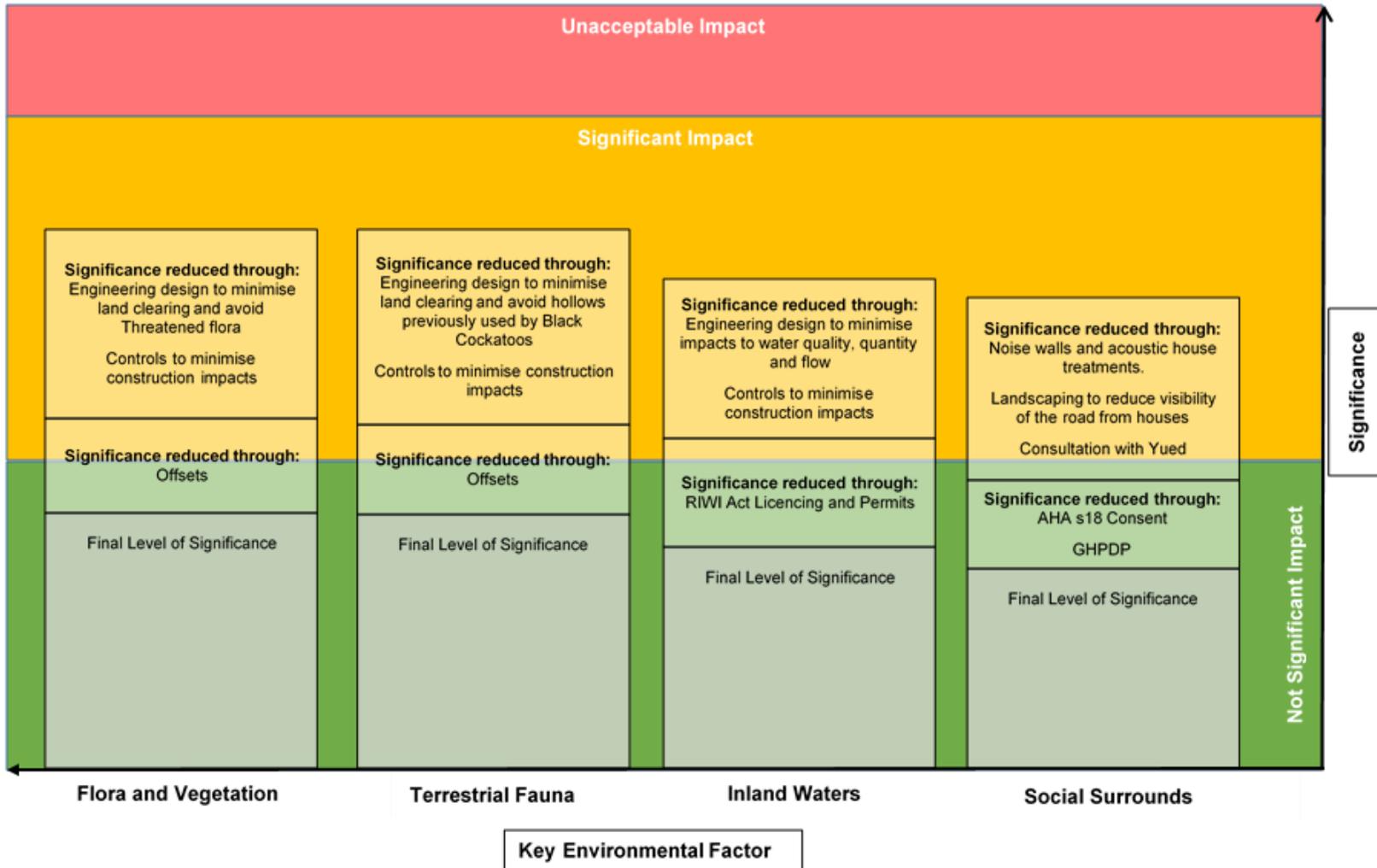
The management measures and controls proposed for each of the Key Environmental Factors will minimise the impacts resulting from these interactions. For example, engineering design of culverts and bridge structures will maintain surface water flow paths, quantity and velocity, which in turn will minimise or avoid impacts to vegetation and aquatic habitats. Main Roads believes these interactions will not reduce the ability of the

Proposal to meet the EPA’s objectives in relation to the Key Environmental Factors, or protection of the environment as a whole.

Table 8-1: Environmental Factors, Objectives and Outcomes

Key Environmental Factor	EPA Objective	Outcome
Flora and Vegetation	To protect flora and vegetation so that biological diversity and ecological integrity are maintained.	<p>Objective can be met.</p> <p>The majority of impacts are not significant after implementation of management controls and further avoidance during detailed design.</p> <p>No Threatened flora occur within the Development Envelope.</p> <p>Vegetation clearing does not significantly reduce the current extent of the South West Vegetation Complexes present.</p> <p>Significant residual impact to the EPBC Act listed Banksia Woodlands TEC will be offset through the acquisition of land.</p>
Terrestrial Fauna	To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.	<p>Objective can be met.</p> <p>The majority of impacts are considered not significant after implementation of management controls and further avoidance during detailed design.</p> <p>Connectivity will be maintained across the Proposal.</p> <p>Significant residual impacts to foraging and breeding habitat for Carnaby’s Black Cockatoo and the Forest Red-tailed Black Cockatoo remain. These impacts will be offset through acquisition of land, installation of artificial hollows and funding for research.</p>
Inland Waters	To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.	<p>Objective can be met.</p> <p>The potential impacts to surface waters are considered not significant as flow paths and quantity will be maintained, the Proposal is at least 3 km from significant wetlands (i.e. Nationally Important Wetlands) and much of the catchment is already degraded. Impacts from construction can be readily managed using standard controls.</p> <p>Groundwater impacts due to the physical presence of the road are not considered significant, as they will be confined to the superficial aquifer, are unlikely to result in permanent changes to groundwater levels, particularly near wetland areas, and will not interact with drinking water sources.</p> <p>Water abstraction for construction purposes, will be operated so as not to reduce groundwater levels below groundwater-dependent banksia communities more than 0.5 m below existing groundwater levels.</p> <p>RIWI Act licencing and permits will provide further assessment and management of impacts.</p>

Key Environmental Factor	EPA Objective	Outcome
Social Surrounds – Heritage		<p>Objective can be met.</p> <p>No registered Aboriginal heritage sites, or sites listed on State or Commonwealth heritage lists, will be impacted.</p> <p>One newly discovered (potential) aboriginal heritage site is likely to be impacted.</p> <p>The non-indigenous heritage sites impacted are considered unlikely to have historical significance (Archae-aus 2018).</p> <p>AH Act s18 consent and the GHPD process will provide further assessment and management of impacts.</p>
Social Surrounds – Amenity	To protect social surroundings from significant harm.	<p>Objective can be met.</p> <p>A single house was identified to exceed SPP 5.4 noise limits. A noise management plan will be prepared for the Proposal to manage the impacts. The mitigation measures proposed will reduce impacts such that they are not considered significant.</p> <p>Visual impact due to the presence of the highway may be significant at four locations, due to the close proximity of the new road. The landscaping and revegetation measures proposed (e.g. obstruction of direct views of the road and use of vegetation to blend road embankments into the surrounding landscape) are considered sufficient to reduce these impacts, such that they are no longer considered significant.</p>



Note: this figure is for illustrational purposes only and is intended to convey how the EPA's significance framework has been applied to this Proposal. The size of the box for each component is not necessarily reflective of the specific contribution to either the start or final level of significance

Figure 8-1: Application of the EPA's Significance Framework to the Proposal

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Note: All appendices are contained on the electronic media that accompanies this hardcopy document.

Appendix A. Environmental Scoping Document Endorsed by the Environmental Protection Authority

Appendix B. Request for Additional Information—Preliminary Documentation

Appendix C. EP Act Section 43A Request to Change Proposal and EPBC Act Section 156 Request to Vary Proposed Action

C.1 EP Act Section 43A Request to Change Proposal

C.2 EPBC Act Section 156 Request to Vary Proposed Action

Appendix D. Flora and Vegetation Assessment Reports

D.1 Level 2 Flora and Vegetation Assessment and Targeted *Thelymitra Stellata* Survey (FVC, 2017)

D.2 Detailed Flora and Vegetation Assessment (FVC, 2018a)

D.3 Wetland Assessment (FVC, 2018b)

D.4 Flora and Vegetation Assessment (FVC, 2019)

Appendix E. Fauna Assessment Reports

E.1 Bindoon Bypass Fauna Assessment (BCE, 2017)

E.2 Bindoon Bypass Targeted Fauna Surveys (BCE, 2018)

E.3 Revised Fauna Assessment (BCE, 2019)

Appendix F. Surface Water Assessment Report

Appendix G. Groundwater Assessment Report

Appendix H. Heritage Assessment Reports

H.1 Aboriginal Heritage Assessment

H.2 Historical Heritage Assessment

Appendix I. Noise Assessment Report

Appendix J. Landscape Character and Visual Amenity Assessment Report

Appendix K. Technical Note: Lighting Concept Design

Appendix L. Construction Environmental Management Plan

Appendix M. Artificial Hollow Management Plan

Appendix N. EPBC Offset Guide Worksheets