

4 AVOIDANCE AND MITIGATION MEASURES

DAWE offsets policy (DSEWPaC, 2012a) identifies that mitigation and management actions should prioritise the avoidance of environmental impacts over reduction measures. Substantial changes to the Proposal design have been made since referral in June 2019 to reduce impacts on TECs, conservation significant fauna and conservation significant flora, as appropriate and necessary to avoid and minimise impacts on the environment.

No further practicable avoidance measures can be implemented that will not have other environmental or social consequences elsewhere, or remove necessary minor flexibility for the Proposal given that the design of the Proposal is still preliminary.

Given the extent and timing of the survey effort, measures in Section 4 are proposed only for species known to occur within the Proposal footprint or where presence of suitable habitat and/or past presence of species indicates measures are warranted under the precautionary principle.

4.1 Threatened ecological communities

Avoidance and mitigation measures for TECs that were confirmed or are considered likely to be present within the Proposal Area only are included in this document.

4.1.1 Avoidance

4.1.1.1 Banksia Woodlands TEC - Endangered

Avoidance

Changes to the Proposal design have been made since referral in June 2019 to reduce impacts to Banksia Woodlands TEC vegetation. As discussed in Section 1.3.6, changes to the design have included a range of refinements to minimise the impacts to the environment such as reducing median widths and changing the design of interchanges to reduce clearing requirements. The resulting Proposal reflects the minimum land area required for the road corridor. Impacts to MNES and other environmental values have been reduced to the maximum extent possible and the remaining impact cannot be avoided if the Proposal is to proceed.

A summary of the original impact, and resulting impact post design changes and the net reduction in clearing area is presented in Table 4-1. Through the design changes, the area of Banksia Woodlands TEC that would be cleared as a result of Proposal implementation has been reduced by more than 50 per cent.

Table 4-1 Detailed design changes to avoid impacts to Banksia Woodlands TEC vegetation

TEC TYPE	ORIGINAL PROPOSAL (JUNE 2019 REFERRAL)	REVISED PROPOSAL (JANUARY 2020)	REDUCTION IN TEC CLEARING AREA
Banksia Woodlands TEC	Up to 7.6 ha	Up to 3.7 ha	3.9 ha

Mitigation

Actions to be implemented to manage indirect impacts to remaining Banksia Woodlands TEC vegetation directly adjacent to the Proposal Area are detailed in Table 4-4. The majority of these actions are included in the Main Roads Standard Scope of Work and Technical Criteria and have been formulated in consideration of the specific TEC occurrences that will remain after Proposal implementation. It is expected that they will sufficiently manage any indirect impacts. As is detailed in Section 3.1.1, Proposal implementation is not expected to reduce the viability of any remaining Banksia Woodlands TEC occurrences.

Predicted outcome

A high level of mitigation and management has been applied to the Proposal, with Main Roads making substantial and costly changes to the Proposal design in order to reduce potential impacts on flora and vegetation, including Banksia Woodlands TEC vegetation. The changes have reduced the area of Banksia Woodlands TEC impacted by more than 50 per cent to 3.7 ha. This constitutes 0.6 % of the 625 ha Proposal Area, which has been intentionally located within cleared land wherever possible.

The Conservation advice (TSSC, 2016) lists the protection of existing TEC vegetation to prevent loss of extent and condition as the priority conservation action. The second objective includes the abatement of threats, such as dieback and weeds. Refinements to the Proposal design have substantially reduced the extent of Banksia Woodlands TEC that will be impacted, and the implementation of the proposed management measures will maintain the existing condition of TEC occurrences adjoining the Proposal Area. The Proposal is aligned with the objectives of the conservation advice.

Based on an assessment of results of studies conducted for the Proposal and the assessment against the Significant Impact Guidelines included in Section 3.1.1, it is considered unlikely that the Proposal will have a significant impact on the Banksia Woodlands TEC.

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

4.1.1.2 Clay Pans TEC – Critically Endangered

Avoidance

Substantial changes to the Proposal design were made to avoid impacts to Clay Pans TEC vegetation. As discussed in Section 1.3.6, changes to the design have included a range of refinements to minimise the impacts to the environment such as reducing median widths and changing the design of interchanges to reduce clearing requirements. The resulting Proposal reflects the minimum land area required for the road corridor. Impacts to MNES and other environmental values have been reduced to the maximum extent possible and the remaining impact cannot be avoided if the Proposal is to proceed.

A summary of the original impact, design changes and resulting impact is presented in Table 4-2.

Table 4-2 Detailed design changes to avoid impacts to Clay Pans TEC vegetation

TEC	ORIGINAL PROPOSAL (JUNE 2019 REFERRAL)	REVISED PROPOSAL (JANUARY 2020)	REDUCTION IN TEC CLEARING AREA
Clay Pans TEC	Up to 1.6 ha (including 1 ha unconfirmed)	Up to 0.63	0.21 ha (surveys subsequently showed that 0.79 ha was not Clay Pans TEC).

Mitigation

Actions to be implemented to manage indirect impacts to remaining Clay Pans TEC vegetation directly adjacent to the Proposal Area are detailed in Table 4-4. The majority of these actions are included in the Main Roads Standard Scope of Work and Technical Criteria and have been formulated in consideration of the specific TEC occurrences that will remain after Proposal implementation. Those that are ‘above and beyond’ standard practice are also detailed below. It is expected that they will sufficiently manage any indirect impacts. As is detailed in Section 3.1.2, Proposal implementation is not expected to reduce the viability of any remaining Clay Pans TEC occurrences.

Additional management measures

Hydrologically, Clay Pans TEC vegetation is reliant on rainfall and infiltrating overland flows to fill (TSSC, 2012a). The limited studies of groundwater and surface water in the Clay pan communities indicate a lack of connection between the two systems (DBCA, 2015). As such, as the primary consideration in regards to potential indirect impacts is the maintenance of existing hydrology for adjacent sites that could potentially be indirectly impacted. Road drainage to TEC vegetation will comply with and be adequately managed by both the Drainage Strategy and Main Roads drainage design criteria.

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

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

The Railway Road potential impact site (monitoring site CP-N-I-3) is located directly adjacent to the Proposal Area. In this location, it is in Good condition. Indirect impacts are not expected at this site as it occurs upstream of the Proposal Area. Although it is considered unlikely that the Proposal will indirectly impact this occurrence, it has been included in the monitoring program to enable adaptive management as required. **Predicted outcome**

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

Based on an assessment of results of studies conducted for the Proposal and the assessment against the Significant Impact Guidelines included in Section 3.1.2, it is considered unlikely that the Proposal will have a significant impact on the Clay Pans TEC.

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

4.1.1.3 Corymbia Woodlands TEC – Endangered

Avoidance

Substantial changes to the Proposal design have been made to avoid impacts to Corymbia Woodlands TEC vegetation. As discussed in Section 1.3.6, changes to the design have included a range of refinements to minimise the impacts to the environment such as reducing median widths and changing the design of interchanges to reduce clearing requirements. The resulting Proposal reflects the minimum land area required for the road corridor. Impacts to MNES and other environmental values have been reduced to the maximum extent possible and the remaining impact cannot be avoided if the Proposal is to proceed.

A summary of the original impact, design changes and resulting impact is presented in Table 4-3.

Table 4-3 Detailed design changes to avoid impacts to Corymbia Woodlands TEC vegetation

TEC TYPE	ORIGINAL PROPOSAL (JUNE 2019 REFERRAL)	REVISED PROPOSAL (JANUARY 2020)	REDUCTION IN TEC CLEARING AREA
Corymbia Woodlands TEC	2.0 ha ¹²	Up to 1.3 ha	0.7 ha (35%)

Mitigation

Actions to be implemented to manage indirect impacts to remaining Corymbia Woodlands TEC vegetation directly adjacent to the Proposal Area are detailed in Table 4-4. The majority of these actions are included in the Main Roads Standard Scope of Work and Technical Criteria and have been formulated in consideration of the specific TEC occurrences that will remain after Proposal implementation. Those that are ‘above and beyond’ standard practice are also detailed below. It is expected that they will sufficiently manage any indirect impacts. As is detailed in Section 3.1.3, Proposal implementation is not expected to reduce the viability of any remaining Corymbia Woodlands TEC occurrences.

Additional management measures

The Corymbia Woodlands TEC vegetation is predominantly reliant on rainfall and infiltration of overland flows (CALM, 2000). The drainage design for the Proposal has been developed with the aim of maintaining the existing hydrological regime to mitigate potential indirect impacts on environmentally significant areas outside of the Proposal Area.

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

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

Predicted outcome

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

Based on an assessment of results of studies conducted for the Proposal and the assessment against the Significant Impact Guidelines included in Section 3.1.3, it is considered unlikely that the Proposal will have a significant impact on the Banksia Woodlands TEC.

¹² FCT 3c was identified in a supplementary flora and vegetation survey conducted after the submission of the referral. The Proposal Area boundary was then modified to reduce impacts to FCT 3c.

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

4.1.1.4 Tuart Woodlands TEC - Critically Endangered

No vegetation communities within the Proposal Area have been determined to be representative of Tuart Woodlands TEC, and the Tuart Woodlands TEC does not occur within the Proposal Area (BORR IPT, 2020c).

Consequently the Proposal completely avoids potential impacts on the Tuart Woodlands TEC and no additional avoidance and/or management measures are proposed.

4.1.2 Management actions and completion criteria

Actions that will be implemented to manage indirect impacts to remaining all TEC vegetation immediately adjacent to the Proposal Area, and associated completion criteria, are detailed in Table 4-4. These actions are all included in the Main Roads Standard Scope of Work and Technical Criteria and are expected to sufficiently manage any indirect impacts.

As is detailed in Sections 3.1.1, 3.1.2 and 3.1.3, Proposal implementation is not expected to reduce the viability of any remaining TEC occurrences.

No rehabilitation of TEC vegetation is included as part of the Proposal.

Revegetation along the development envelope would comply with MRWA Vegetation Placement within the Road Reserve Doc. No. 6707/022 (MRWA, 2013). This guide defines the recommended setbacks and clearance requirements that apply to all revegetation or landscaping associated with new road construction.

Revegetation would utilise locally native species that will be resilient within three years after the rehabilitation works are completed. Revegetation would not include species of foraging habitat for black cockatoos, including but not limited to, *Banksia* spp., *Hakea* spp., *Grevillea* spp. and *Eucalyptus* spp. within 10 m of the constructed road carriageway.

Placement of vegetation near road infrastructure is restricted to maintain road safety. These requirements minimise ongoing maintenance and maintain a standard amenity level for road users. Revegetation will incorporate these restrictions when undertaking planting, in particular, the need for roadside maintenance and clear zones. Rehabilitation would not include areas required for ongoing operations such as drainage basins, road embankments and median strips. Specific rehabilitation activities are included in the Offset Strategy, which is attached in Appendix I.

Table 4-4 TEC vegetation management actions and targets

MANAGEMENT ACTION	MEASURABLE PERFORMANCE CRITERIA	COMPLETION CRITERIA	ROLES AND RESPONSIBILITIES	MONITORING / REPORTING
Prior to construction				
<ul style="list-style-type: none"> As part of the contractor's CEMP, development of a Hygiene Management Plan to prevent the spread of dieback and weeds to adjacent vegetation. The CEMP will include procedures such as machinery/vehicle clean down, weed treatments and restrictions on vehicle/machinery movements As part of the contractor's CEMP, development of a Fire Management Plan Declared Plants and WoNS within the Proposal Area and in adjacent Banksia Woodlands TEC vegetation (in reserve or on land owned by Main Roads) will be removed or treated with herbicide. 	<p>CEMP and associated plans prepared.</p> <p>Declared Plants and WoNS within the Proposal Area and in adjacent Banksia Woodlands TEC vegetation (in reserve or on land owned by Main Roads) is removed or treated with herbicide</p>	<p>Baseline condition of TEC vegetation adjacent to the Proposal Area is maintained</p>	<p>Construction contractor to develop and implement required plans, and implement all other listed actions</p> <p>Environmental Officer to conduct monitoring and compliance assessment</p> <p>Environmental Manager to assess and respond to any incident reports or trigger exceedances</p>	<p>Monitoring in accordance with the Vegetation Monitoring Plan included in Appendix G</p> <p>Annual Compliance Report</p>
During construction				
<ul style="list-style-type: none"> Contractor induction will include familiarisation with and discussion of TEC vegetation, <i>Phytophthora</i> dieback management and hygiene management The Proposal Area boundary will be fenced to restrict access. The fence will be installed inside the approved Proposal Area. Low impact temporary fencing will be installed on the active construction front of TEC vegetation areas prior to clearing and maintained during construction phase Movement of machines and other vehicles to be restricted to the limits of the areas cleared within the Proposal Area or on designated tracks outside the area Infestations of Declared Plants and WoNS in retained TEC vegetation and revegetation and landscaping within the Proposal Area, will be removed or treated with herbicide No re-fuelling of equipment will be conducted within 100 m of TEC vegetation As far as practical, clearing activities will occur during the dry months to reduce the risk of spreading Dieback All Department of Fire and Emergency Services (DFES) and Local Government Authority (LGA) restrictions on fire and machinery movement will be strictly adhered to. 	<p>No decline in condition of TEC vegetation adjacent to the Proposal Area attributable to Proposal implementation.</p> <p>No disturbance of TEC vegetation during construction as a result of unrestricted access.</p> <p>No new Dieback infestations identified in TEC vegetation as a result of Proposal implementation</p> <p>No new WoNS or Declared Plants identified in TEC vegetation as a result of Proposal implementation</p>	<p>Baseline condition of TEC vegetation adjacent to the Proposal Area is maintained. Refer to Appendix G for more information</p>	<p>Construction contractor to develop and implement required plans, and implement all other listed actions</p> <p>Environmental Officer to conduct monitoring and compliance assessment</p> <p>Environmental Manager to assess and respond to any incident reports or trigger exceedances</p>	<p>Monitoring in accordance with the Vegetation Monitoring Plan included in Appendix G</p> <p>Annual Compliance Report</p>
Post construction				
<ul style="list-style-type: none"> For three years post construction, undertake control of Declared Plants and WoNS in monitored TEC vegetation in reserve or under Main Roads jurisdiction, as well as in revegetation and landscaping within the Proposal Area. 	<p>No new WONS or Declared Plants identified in monitored TEC vegetation in reserve or under Main Roads jurisdiction as a result of Proposal implementation</p>	<p>Baseline condition of TEC vegetation adjacent to the Proposal Area is maintained. Refer to Appendix G for more information</p>	<p>Main Roads to implement listed actions</p> <p>Environmental Officer to conduct monitoring and compliance assessment</p> <p>Environmental Manager to assess and respond to any incident reports or trigger exceedances</p>	<p>Monitoring in accordance with the Vegetation Monitoring Plan included in Appendix G</p> <p>Annual Compliance Report</p>

4.1.3 Monitoring

A monitoring program has been designed to assess the effectiveness of management actions on potentially indirectly impacted occurrences of TEC vegetation adjacent to the Proposal Area (as detailed in Table 2-3 and shown in Figure 7, Appendix A), and enable the detection of a decline in vegetation condition. This includes a combination of transects (incorporating 2 x 2 m plots) and photopoints and uses species composition and vegetation health attributes as measurement parameters. Consultation with DBCA (Mr. Andrew Webb) regarding the monitoring program design was undertaken, with advice incorporated into the design. The proposed monitoring plan is detailed in Appendix G.

Three reference sites known to support Banksia Woodlands TEC vegetation, two known to support Clay Pans TEC vegetation and two known to support Corymbia Woodlands TEC vegetation have been identified. All reference sites are located on Crown land or road reserve in close proximity to the potential impact monitoring sites. They are shown on Figure 7 (Appendix A).

The purpose of these sites is to enable comparison of potential impact site data with data from sites located away from the Proposal Area to assist in determining whether any indirect impacts have resulted from Proposal implementation.

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

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

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

4.1.4 Reporting

Results of monitoring and compliance with proposed management actions will be reported to DAWE as part of the Proposal's annual report. The format of this report will be consistent with requirements stipulated by DAWE. The report will document compliance with conditions of approval.

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

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

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

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

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

4.2 Threatened fauna

4.2.1 Forest Red-tailed Black Cockatoo - Vulnerable; Baudin's Cockatoo - Endangered; Carnaby's Cockatoo - Endangered

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

Avoidance

Substantial changes to the Proposal design have been made to avoid impacts to Black Cockatoos. These design changes are summarised in. Changes relating to the extent of Black Cockatoo habitat to be impacted are detailed in Table 4-5.

Table 4-5 Black Cockatoo habitat and nesting trees avoided through design

ASPECT	ORIGINAL PROPOSAL (JUNE 2019 REFERRAL)	REVISED PROPOSAL (JANUARY 2020)	REDUCTION IN IMPACT
Black Cockatoo Habitat area (Ha)	59.7 ha	37.8 ha	21.9 ha
Black Cockatoo Trees with a Suitable Nest Hollow	5	3 (potentially suitable nest hollows)	2
Black Cockatoo known nesting trees	0	0	n/a

Changes to the Proposal Area have resulted in the retention of 21.9 ha of habitat and two potentially suitable nest hollow trees that would have been cleared if the Proposal had been implemented as referred.

Mitigation / Management

Table 4-6 identifies the key management actions that Main Roads will implement to manage the potential impacts of the Proposal to Black Cockatoo individuals and habitat. A complete list of management actions is outlined within the Black Cockatoo AMP BORR IPT (2020e)(Appendix I).

Table 4-6 Black Cockatoo management actions

TIMING	KEY IMPACTS/RISKS	MANAGEMENT ACTIONS
Prior to construction	<p>Avoid abandonment of breeding hollows and breeding failure</p> <p>Clearing of Black Cockatoo habitat in excess of approved limits</p>	<ul style="list-style-type: none"> Habitat to be cleared within the area of the Proposal Area will be demarcated in the field to ensure clearing only occurs within the approved clearing area The final design will avoid trees with suitable nest hollows where possible Where any of the three trees with suitable nest hollows for Black Cockatoo will require clearing for the Proposal, the hollow will be visually inspected where safe and practicable. Where not in use the hollow will be 'blocked' to prevent breeding

TIMING	KEY IMPACTS/RISKS	MANAGEMENT ACTIONS
		<ul style="list-style-type: none"> Where blocking of the nest hollows cannot be undertaken (e.g. timing, access), a pre-clearing fauna assessment will be undertaken by a suitably experienced person to determine if the hollows are being used by Black Cockatoos
<p>During construction</p>	<p>Injury or death of Black Cockatoos</p> <p>Avoid abandonment of breeding hollows and breeding failure</p> <p>Clearing of Black Cockatoo habitat in excess of approved limits</p>	<ul style="list-style-type: none"> A suitably experienced zoologist / environmental scientist will be on-site at all times during clearing of breeding habitat for Black Cockatoos and must maintain radio communication with machinery operators Where a suitable nest hollow has been blocked prior to the Black Cockatoo breeding season, the tree may be felled as part of the standard vegetation clearing process. Where a suitable nest hollow has not been blocked and the pre-clearing fauna assessment has not identified any Black Cockatoo occupation of the nest hollow, prior to clearing the tree will be ‘bumped gently’ with a machine with the machine operator and zoologist to wait and observe the tree for a short time after. If no Black Cockatoo appears to be present following being bumped gently then the tree shall be pushed over slowly to minimise risk of injury to any undetected animal (if present). Where a suitable nest hollow has not been blocked and the pre-clearing fauna assessment identifies any Black Cockatoo occupation of the nest hollow (which may include chicks (young)), the tree with the nest hollow will not be cleared until after the completion of the breeding season. No vegetation within 50 m of the tree would be cleared until after the completion of the breeding season. Felled trees with hollows that have not been blocked will be checked immediately after felling, and where any undetected fauna are identified the tree will be left on the ground overnight to allow time for the fauna to vacate. Any Black Cockatoos showing signs of injury or illness will be promptly referred to an experienced wildlife veterinarian or approved wildlife rehabilitation facility. A post-clearing survey shall be undertaken to ensure no injured Black Cockatoo individuals are present.
<p>Post construction</p>	<p>Failure of rehabilitation and revegetation areas</p>	<ul style="list-style-type: none"> Where space and access allows, revegetation and landscaping of cleared areas within the Proposal Area with suitable endemic native species will be undertaken to provide foraging habitat for Black Cockatoos (excluding 10 m buffer from nearest traffic lane).

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

Monitoring

Table 4-7 identifies the key monitoring actions that Main Roads will implement to monitor the potential impacts of the Proposal to Black Cockatoo individuals and habitat.

Table 4-7 Black Cockatoo monitoring and reporting

KEY IMPACT/RISK	MONITORING	REPORTING
Direct impacts to Black Cockatoos	<p>Injury or death of Black Cockatoos</p> <p>Pre-clearing</p> <p>Visual inspection during construction: Post each clearing event and opportunistically</p> <p>Post construction:</p> <p>Not applicable</p>	<p>Injury or death of Black Cockatoos recorded by construction contractor and reported to Manager Environment within 24 hours of incident occurring</p> <p>Report annually to DAWE as part of annual compliance reporting</p>
<p>Clearing of Black Cockatoo habitat to the extent practicable in final design</p> <p>Avoid clearing outside the approved footprint</p>	<p>Clearing area (ha) of Black Cockatoo foraging habitat</p> <p>Field survey of cleared areas with comparison to approved clearing area and mapped Black Cockatoo habitat areas monthly during construction.</p> <p>Post construction:</p> <p>Not applicable</p>	<p>Area of Black Cockatoo habitat cleared recorded by construction contractor and reported to Manager Environment monthly</p> <p>Report annually to DAWE as part of annual compliance reporting</p>
	<p>Number of suitable DBH trees (DBH \geq 500 mm) containing a potentially suitable nesting hollow(s) cleared</p> <p>Field survey of cleared areas with comparison to approved clearing area and known Black Cockatoo nest hollow locations During construction: Monthly</p> <p>Post construction: Not applicable</p>	<p>Number of suitable DBH trees cleared recorded by construction contractor and reported to Manager Environment monthly</p> <p>Report annually to DAWE as part of annual compliance reporting</p>
Nesting within Proposal Area	<p>Black Cockatoo access to potentially suitable nesting hollow(s)</p> <p>Visual inspection prior to Black Cockatoo breeding season(s)</p>	<p>Number of potentially suitable nesting hollow(s) blocked prior to construction recorded by construction contractor and reported to Manager Environment monthly</p>
Abandonment of breeding hollows within the Proposal Area	<p>Presence of nesting Black Cockatoos</p> <p>Distance of construction activities from any nesting Black Cockatoos</p> <p>Visual inspection during construction: Monthly</p> <p>Post construction: Not applicable</p>	<p>Presence/absence of nesting Black Cockatoos and if present, distance of construction activities from them recorded by construction contractor and reported to Manager Environment monthly</p>

KEY IMPACT/RISK	MONITORING	REPORTING
Rehabilitation does not provide suitable foraging habitat within 10 years of completion	Presence/absence and quality of foraging habitat available in rehabilitated areas Field survey by suitably experienced personnel During construction: Monthly during rehabilitation activities Post construction: Bi-annually	Presence/absence and quality of Black Cockatoo foraging habitat in rehabilitated areas recorded by construction contractor and reported to Manager Environment: During construction: monthly during rehabilitation activities Post construction: bi-annually once rehabilitation works are completed

4.2.2 Western Ringtail Possum – Critically Endangered

Avoidance

Changes to the Proposal design have been made subsequent to referral of the Proposal to reduce the environmental impacts to WRP habitat, including consultation with technical experts Ms. Barbara Jones (Independent Consultant) and Dr Roy Teale (of Biota Environmental Sciences Pty Ltd).

A summary of the impact of the referred Proposal (September 2019), the impact of the revised Proposal (current Proposal), and the net reduction in the environmental impact to WRP habitat is presented in Table 4-8. Through the design changes, the area of WRP habitat that will be removed as a result of Proposal implementation has been reduced by 26.4 ha (38 %), and with a corresponding reduction in the number of WRP home ranges affected.

Table 4-8 Design changes to avoid Western Ringtail Possum habitat

FAUNA TAXON	ORIGINAL PROPOSAL (JUNE 2019 REFERRAL)	REVISED PROPOSAL (JANUARY 2020)	REDUCTION IN ENVIRONMENTAL IMPACT
Western Ringtail Possum (EPBC-CE, BC-CE)	70.3 ha	43.9 ha	26.4 ha

Mitigation and management

Table 4-9 identifies the key management actions that Main Roads will implement to manage the potential impacts of the Proposal to WRP individuals and habitat. A complete list of management actions is outlined within the Conservation Significant Fauna EMP (BORR IPT, 2020d) (Appendix H).

Table 4-9 Western Ringtail Possum management actions

TIMING	KEY IMPACTS/RISKS	MANAGEMENT ACTIONS
Prior to construction	Injury or death of WRP	<ul style="list-style-type: none"> Pre-clearing fauna assessment and spotlighting will be undertaken by a suitably qualified person for two nights within the five nights prior to clearing. Assessments are to include hollows, dreys, ground debris, dense ground-level vegetation, timber and logs

TIMING	KEY IMPACTS/RISKS	MANAGEMENT ACTIONS
	Habitat clearing	<ul style="list-style-type: none"> Habitat that is to be retained within the development envelope will be marked accordingly or delineated with temporary fencing to ensure it is avoided.
During construction	Injury or death of WRP Habitat clearing Loss of ecological connectivity	<ul style="list-style-type: none"> A qualified zoologist / environmental scientist / fauna-spotter will be on-site at all times during clearing of habitat for WRP and must maintain radio communication with machinery operators. Trees that have been identified as supporting WRP will be ‘bumped gently’ with a machine prior to felling. The operator and zoologist will wait and observe the tree for a short time. If no possum appears to be present then the tree shall be pushed over slowly to minimise risk of injury to any undetected animal (if present). If WRP are detected during clearing operations, the tree containing the animal shall be left for up to 48 hours to allow for the animal to vacate the tree, while clearing continues adjacent to the inhabited tree. If the tree continues to be occupied after 48 hours, the animal will be coerced/moved to a safe area outside of the clearing footprint by the appointed zoologist / environmental scientist / fauna spotter. Potential habitat trees would be cleared appropriately, by either directional onto vegetation within the clearing area that is yet to be cleared or by ensuring trees don’t fall on hollows whenever possible (trees with multiple hollows will be assessed on a case by case basis). The ‘soft felling’ of habitat trees will provide a ‘cushion’ for the vegetation being felled, allowing any WRP in a hollow more opportunity to safely vacate the hollow. Felled trees will be checked immediately after felling, and where any undetected fauna are identified the tree will be left on the ground overnight to allow time for the fauna to vacate. Vacant dreys within felled trees will be destroyed immediately to prevent animals re-entering it. Where clearing operations abut existing roads, visual message boards will be installed to warn drivers of the potential for fauna to cross the road during clearing operations Habitat clearing to be staged, commencing from existing edge lines / roads and progressing towards habitat that will be retained to direct WRP towards these areas Any WRP showing signs of injury or illness will be promptly referred to an experienced wildlife veterinarian or approved wildlife rehabilitation facility A post-clearing survey shall be undertaken to ensure no injured individuals are present

TIMING	KEY IMPACTS/RISKS	MANAGEMENT ACTIONS
		<ul style="list-style-type: none"> Install permanent bridge(s) / underpasses at key location(s) to enable WRP to move between key habitat areas, as per designs Install fauna fence adjacent to known habitat areas to limit WRP access to the Proposal Area.
Post construction		No post construction management actions are proposed

Monitoring

Table 4-10 identifies the key monitoring actions that Main Roads will implement to monitor the potential impacts of the Proposal to WRP individuals and habitat. Bi-monthly monitoring of WRP within and adjacent to the Proposal is currently being conducted (commenced in August 2019) to collect baseline data around the number of WRP in each area and will continue through December 2020.

This monitoring also includes Reference Sites located near to the Proposal, selected because of their large size and being generally unconnected to other habitat areas to detect any variations in WRP density which may be likely the result of natural cycles (breeding and attrition) and/or climatic conditions. Through a comparison with trends in WRP reference sites, variations in the number of individuals adjacent to the Proposal can be measured and investigated further if significant differences are detected.

Table 4-10 Western Ringtail Possum monitoring and reporting

KEY IMPACT/RISK	MONITORING	REPORTING
Habitat clearing	<p>Prior to clearing, the final road design will be assessed against the proposed clearing area to ensure the required clearing area is less than the approved amount</p> <p>Daily construction area assessments to visually check / review clearing boundaries and assess vegetation clearing</p>	Annual reporting of the amount of conservation significant fauna habitat cleared, and monitoring undertaken
Injury or death or WRP	<p>Pre and post clearing fauna assessments conducted</p> <p>Post-clearing assessments of fallen trees</p> <p>Pre-demolition fauna assessments</p> <p>Pre-removal checks of vegetation stockpile areas</p>	Prepare report annually and or in response to exceedance of an agreed trigger or threshold
Loss of ecological connectivity	<p>Review of design reports and drawings at 50% design and IFC (issued for construction) to ensure WRP and BTP bridges / underpasses are designed and incorporated into the Proposal</p> <p>Bi-annual monitoring during construction to ensure WRP and BTP bridges / underpasses are installed as per the detailed design</p> <p>Quarterly monitoring for scats beneath rope bridges and in underpasses for five years post-construction</p>	Prepare report annually and or in response to exceedance of an agreed trigger or threshold

KEY IMPACT/RISK	MONITORING	REPORTING
Impacts to WRP in adjacent habitat	<p>Biannual monitoring of WRP and BTP in potential impact sites (retained habitat at the Paris / Clifton interchange Boyanup Picton Rd interchange) and current reference sites (Lot 2 Boyanup Picton Road and Reserve 23 000 Bussell Highway) during construction and biannually for three years post construction.</p> <p>Monitor possum fence installation and maintenance during construction and biannually for five years post-construction</p>	Prepare report annually and or in response to exceedance of an agreed trigger or threshold

4.2.3 Balston's Pygmy Perch – Vulnerable

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

Avoidance

To minimise the potential impacts on watercourses and habitat for BPP, bridges over the Collie, Ferguson and Preston Rivers have been redesigned to remove the requirement for any in stream piers or abutments. This action has resulted in the removal of any direct impacts to potential habitat for the BPP. The extents to which design changes result in impact reductions for conservation significant species and communities is summarised in Table 4-11.

Table 4-11 Extent of design changes resulting in avoidance of impacts to Balston's Pygmy Perch

ASPECT	ORIGINAL PROPOSAL (JUNE 2019 REFERRAL)	REVISED PROPOSAL (JANUARY 2020)	REDUCTION IN IMPACT
Balston's Pygmy Perch	Not assessed	No bridge piers or abutments within water courses	No direct impacts

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

Mitigate

Indirect impacts to BPP through construction activities are relatively low risk and will be managed through the implementation of clearing controls, appropriate procedures for the monitoring of erosion and sedimentation, handling of fuels and other hazardous substances and monitoring and management of ASS. The management measures developed for CFM overlap with potential habitat for BPP. While BPP have not been observed within the Proposal Area, potential habitat does exist that would be effectively managed through the management measures proposed for CFM habitat in Table 4-15.

Management

Management of the risks from spills and contaminated runoff during operation will be minimised through the drainage design and are further detailed in (BORR IPT, 2019e). Construction risks will be managed through the implementation of the CEMP.

Monitoring

Monitoring for impacts to BPP will be conducted at both reference sites and potential impact sites for CFM in potential habitat for BPP. Reference sites will be established for the purposes of providing comparative species and population trend data. Monitoring will comprise sampling and visual assessments, and will include photo monitoring. Monitoring will be conducted by a suitably qualified environmental scientist.

Reference sites and potential impact sites

Monitoring sites indicative for BPP potential habitat will be identified as part of CFM monitoring prior to commencement of clearing activity. Baseline data collection at monitoring sites will commence early 2020. Any changes in conditions at potential impact sites will be compared with those in reference sites. Note: if translocation is undertaken, monitoring of BPP during construction will focus on translocation site and reference sites and include impact site following replacement of BPP following completion of construction (during operational phase). This will enable determination of the likelihood of impacts having resulted from Proposal implementation. The monitoring program is detailed in Table 4-16.

4.2.4 Black-stripe Minnow - Endangered

Avoidance

Direct impacts of loss of 0.55 ha of BSM will result from the construction of the Proposal and remain unchanged from the initial referral of the project in June 2019. While design changes to avoid BSM were evaluated, aligning with the existing BORR Central corridor, avoiding residential homes, and the meandering intersection of BSM habitat perpendicular with the Proposal precluded changes that would result in avoidance of impacts. Clearing and disturbance of habitat will be carefully managed throughout construction through mechanisms outlined in BOOR IPT (2019b) and through the implementation of a CEMP.

Mitigate

Impacts to hydrology will be mitigated through the implementation of the drainage strategy which aims to maintain hydrological conditions as far as possible. Fragmentation of habitat and connectivity between habitats will be mitigated through installation of culverts to maintain hydrologic linkage. Current design for culverts is two concrete box culverts (1200 mm wide x 900 mm tall) built on a concrete base. Culverts will be set at or slightly below the existing channel invert to ensure the existing drainage is maintained either side of the culvert. Management actions listed in Table 4-12 were specifically developed to ensure that impacts to BSM are minimised as far as practicable during the final design and construction of the Proposal.

Table 4-12 Management actions for Black-stripe Minnow

KEY IMPACTS/RISKS	TIMING	MANAGEMENT ACTION
Nil	Prior to construction	No management actions proposed
Loss of ecological connectivity	During construction	Install suitable culvert to maintain habitat connectivity for BSM (small section of channel wetland in southern end of the alignment) during construction.
Impacts to BSM in adjacent habitat		Install silt curtains and or fences on the banks at bridge crossing points that have adjacent aquatic habitat.

KEY IMPACTS/RISKS	TIMING	MANAGEMENT ACTION
Hydrology and drainage changes		<ul style="list-style-type: none"> • Long term hydrocarbon storage (i.e. hydrocarbons which shall not be used that day or not stored within equipment waiting to be used) or re-fuelling of equipment (with the exception of stationary plant) will not be permitted within 50 m of aquatic habitat • Prepare a Spill Response Procedure for oil, chemical or hazardous material spill events to ensure any spill is contained effectively and cleaned up appropriately and efficiently with approved materials • Through detailed design, maintain hydrologic connections between BSM habitat areas to enable fish movement • Design and construction of drainage to maintain surface water flows and groundwater regimes consistent with the pre-disturbance condition (baseline) as far as practicable • Prior to any interruption of current surface water flows or fish pathways, culverts will be installed.
Nil	Post construction	No management actions proposed

Indirect impacts to BSM through construction activities are relatively low risk and will be managed through the implementation of clearing controls, appropriate procedures for the monitoring of erosion and sedimentation, handling of fuels and other hazardous substances and monitoring and management of ASS.

Management

Management of the risks from spills and contaminated runoff during operation will be minimised through the drainage design and are detailed further in BORR IPT (2019a). During construction, the risk of impacts will be managed through the implementation of a CEMP.

Monitoring

Monitoring for impacts to BSM will be conducted at both reference sites and potential impact sites. Reference sites will be established for the purposes of providing comparative species and population trend data. Monitoring will comprise sampling and visual assessments, and include photo monitoring. Monitoring will be conducted by a suitably qualified environmental scientist.

Reference sites and potential impact sites

Reference sites for BSM will be identified prior to commencement of clearing activity. Baseline data collection at reference sites will commence mid to late 2020. Any changes in conditions at potential impact sites will be compared with those in reference sites. This will enable determination of the likelihood of impacts having resulted from Proposal implementation to ensure surface water flows are maintained through the implementation of the Proposal. The monitoring program is detailed in Table 4-13.

Table 4-13 Black-stripe Minnow monitoring and reporting

KEY IMPACTS/RISKS	MONITORING	REPORTING
<p>Loss of ecological connectivity</p> <p>Impacts to BSM in adjacent habitat</p>	<p>During construction and for three years post construction, annual winter monitoring and maintenance program implemented to check for damage to BSM habitat and / or blockages to fish pathways</p> <p>Monitor water quality parameters critical to BSM survival (including turbidity, pH, temperature, salinity, BOD) during construction (quarterly) of each section of BORR and for three years post construction (biannually)</p> <p>Monitor annually for presence of BSM in known habitat areas and in at least one reference area for three years post construction</p>	<p>Report to DAWE annually and or in response to exceedance of an agreed trigger or threshold</p>
<p>Hydrology and drainage changes</p>	<p>Quarterly monitoring of surface and groundwater to detect any changes in hydrology impacting BSM habitat during construction</p> <p>Opportunistic and weekly visual inspection during construction for evidence of erosion or sedimentation of BSM habitat attributable to the Proposal. Biannual inspections post construction</p>	<p>Report to DAWE annually and or in response to exceedance of an agreed trigger or threshold</p>

Photopoint design

Photopoints will be used in assessing sedimentation and function of culverts and will be established prior to construction commencing. Where possible, photopoints will be marked permanently with a stake and their locations will be and geo-referenced (recorded using a handheld GPS). All photographs will be taken from the top of the stake. Photopoint monitoring will form part of each monitoring event.

Data analysis

Data analysis will consist of the following:

- Water quality - Assessment of change against baseline conditions and comparison with Australian and New Zealand Environment and Conservation Council (ANZECC) guideline values
- Water levels - Assessment of change in water levels against baseline conditions and comparison with trends in reference monitoring sites (groundwater wells)
- Habitat condition - Assessment of change against baseline and or reference site condition between monitoring periods and seasonally, and trend analysis
- Presence / absence - Assessment of presence/absence data and trends between monitoring periods and between potential impact sites and reference sites.

4.2.5 Carter's Freshwater Mussel – Vulnerable

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

Avoidance

The extents to which design changes result in impact reductions for conservation significant species and communities is summarised in Table 4-14.

Table 4-14 Extent of design changes resulting in avoidance of impacts to Carter's Freshwater Mussel

ASPECT	ORIGINAL PROPOSAL (JUNE 2019 REFERRAL)	REVISED PROPOSAL (JANUARY 2020)	REDUCTION IN IMPACT
Carter's Freshwater Mussel	Potential for bridge piers or abutments within water courses	No bridge piers or abutments within water courses	No direct impacts

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

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

Mitigate

Indirect impacts to CFM through construction activities are relatively low risk and will be managed through the implementation of clearing controls, appropriate procedures for the monitoring of erosion and sedimentation, handling of fuels and other hazardous substances and monitoring and management of ASS. Management actions listed in Table 4-15 were specifically developed to ensure that impacts to CFM are minimised as far as practicable during the final design and construction of the Proposal.

Table 4-15 Management actions for Carter's Freshwater Mussel

KEY IMPACTS/RISKS	TIMING	MANAGEMENT ACTION
Mortality of CFM	Prior to and during construction	<ul style="list-style-type: none"> Changes to the Proposal design mean that no direct impact to CFM habitat is anticipated as no bridge abutment piers located in the water course. Translocation of CFM is therefore unlikely to be required and would only be triggered in response to sedimentation of water ways resulting from construction activities. If required, translocation procedures will be developed in consultation with DBCA.
Impacts to CFM habitat	During construction	<ul style="list-style-type: none"> Install silt curtains and or fences on the banks at bridge crossing points that have adjacent CFM habitat
Hydrology and drainage changes		<ul style="list-style-type: none"> Long term hydrocarbon storage (i.e. hydrocarbons which shall not be used that day or not stored within equipment waiting to be used) or re-fuelling of equipment (with the exception of stationary plant) will not be permitted within 50 m of CFM habitat Prepare a Spill Response Procedure for oil, chemical or hazardous material spill events to ensure any spill is contained effectively and cleaned up appropriately and efficiently with approved materials

KEY IMPACTS/RISKS	TIMING	MANAGEMENT ACTION
		<ul style="list-style-type: none"> Design and construction of drainage to maintain surface water flows and groundwater regimes consistent with the pre-disturbance condition (baseline) as far as practicable. Prior to any interruption of current surface water flows, culverts will be installed.

Management

Management of the risks from spills and contaminated runoff during operation will be minimised through the drainage design and are further detailed in (BORR IPT, 2019e). Construction risks will be managed through the implementation of the CEMP.

Monitoring

Reference sites and potential impact sites

Monitoring for impacts to CFM will be conducted at both reference sites and potential impact sites where the Proposal would cross the Collie, Preston and Ferguson Rivers. Five reference sites (Appendix F) have already been defined for the Proposal and monitoring sites will be identified for CFM prior to commencement of clearing activity. Baseline data collection at monitoring sites will commence in mid to late 2020.

Reference sites will be established for the purposes of providing comparative species and population trend data. Monitoring will comprise sampling and visual assessments, and will include photo monitoring. Monitoring will be conducted by a suitably qualified environmental scientist.

Any changes in conditions at potential impact sites will be compared with those in reference sites. Note: if translocation is undertaken, monitoring of CFM during construction will focus on translocation site and reference sites and include impact site following replacement of CFM following completion of construction (during operational phase). This will enable determination of the likelihood of impacts having resulted from Proposal implementation.

The monitoring program is detailed in Table 4-16.

Table 4-16 Carter's Freshwater Mussel monitoring and reporting

KEY IMPACTS/RISKS	MONITORING	REPORTING
Mortality of CFM	Pre and post clearing fauna assessments conducted. Post-clearing assessments of fallen trees. Pre-demolition fauna assessments. Pre-removal checks of vegetation stockpile areas.	Report to DAWE annually and or in response to exceedance of an agreed trigger or threshold
Impacts to CFM in adjacent habitat	Monitor water quality parameters critical to CFM survival (including turbidity, pH, temperature, salinity, BOD) upstream of the Collie River bridge site during construction (quarterly) and for three years post construction (biannually).	Report to DAWE annually and or in response to exceedance of an agreed trigger or threshold

KEY IMPACTS/RISKS	MONITORING	REPORTING
	Monitor annually during construction and for three years post construction for presence of CFM in known habitat areas within the Proposal Area (Collie River) and in one reference site (Preston River).	
Hydrology and drainage changes	<p>Opportunistic and weekly visual inspection of offsite discharges from the Proposal Area into CFM habitat.</p> <p>Quarterly monitoring of surface and groundwater to detect any changes in hydrology impacting CFM habitat during construction.</p> <p>Opportunistic and weekly visual inspection during construction for evidence of erosion or sedimentation of CFM habitat attributable to the Proposal. Biannual inspections post-construction.</p>	Report to DAWE annually and or in response to exceedance of an agreed trigger or threshold

Data analysis

Data analysis will consist of the following:

- Water quality
- Assessment of change against baseline conditions and comparison with ANZECC guideline values.
- Presence / absence
- Assessment of presence/absence data and trends between monitoring periods and between potential impact sites and reference sites.
- Habitat condition
- Assessment of change against baseline and or reference site condition between monitoring periods and seasonally, and trend analysis.

4.3 Threatened flora

Impacts on Threatened flora species assessed in Section 3.3 resulting from construction of the Proposal are considered to be minor. It is unlikely that individuals will be impacted and other potential indirect impacts will be mitigated through implementation of the contractor’s CEMP during construction. No residual impact is anticipated.

Avoidance

Changes to the Proposal design have been made since referral in June 2019 to reduce impacts to native vegetation. As discussed in Section 1.3.6, these changes have included a range of refinements to minimise impacts to the environment such as reducing median widths and changing the design of interchanges to reduce clearing requirements. The resulting Proposal reflects the minimum land area required for the road corridor. Impacts to MNES and other environmental values have been reduced to the maximum extent possible and the remaining impact cannot be avoided if the Proposal is to proceed.

This has resulted in a reduction in the overall Proposal Area from 651 ha to 625 ha.

Mitigate

Indirect impacts to Threatened flora species assessed in Section 3.3 resulting from construction activities are considered low risk and will be managed through the implementation of clearing controls, appropriate procedures for the monitoring of erosion and sedimentation, handling of fuels and other hazardous

substances, and monitoring and management of ASS. The management measures developed for TECs overlap with potential habitat for Threatened flora. While the Threatened flora taxa assessed in Section 3.3 were not recorded within the Proposal Area, potential habitat does exist. Potential indirect impacts to this habitat will be effectively managed through the management measures proposed for TEC habitat in Table 4-4. These actions are all included in the Main Roads Standard Scope of Work and Technical Criteria and are expected to sufficiently manage any indirect impacts.

Management

Construction risks to Threatened flora will be managed through the implementation of the contractor's CEMP.

Monitoring

As no Threatened flora species populations were identified within or adjacent the Proposal Area, monitoring of populations is not required.

4.4 Effectiveness and cost of proposed measures

Main Roads has a strong track record of both developing and implementing best practice in environmental management and implementation of management measures. The measures proposed herein have been successfully implemented on past projects subject to EPBC conditions and management measures including the following projects for which Compliance Reports have been issued in the past year:

- Great Northern Highway Upgrade Stage 2 (EPBC 2016/7761)
- Bowelling Curves Realignment (EPBC 2016/7757)
- Northam Pithara Road Widening (EPBC 2015/7454)
- Mitchell Freeway Extension - Burns Beach to Hester Avenue (EPBC 2013/7091)
- Broome - Cape Leveque Road Upgrade (EPBC 2013/6984)
- Dampier Highway Duplication project (EPBC 2010/5419)
- Gateway WA – Perth Airport and Freight Access Project (EPBC 2010/5384)

Main Roads is a State agency with an assured record of responsible environmental management and environmental management systems. Main Roads is not subject to any past or present proceedings under Commonwealth or State law for protection of the environment or conservation and sustainable use of natural resources. Main Roads track record indicates a history of effective implementation and monitoring of management measures to ensure effectiveness and implementation of corrective actions when effectiveness does not meet completion criteria.

4.4.1 Effectiveness and cost of proposed connectivity structures

Recognising the critical importance of maintaining connectivity between fauna habitats, the design for the Proposal incorporates a number of fauna underpasses, fauna rope bridges and drainage culverts (all as engineered movement structures) to maintain the connectivity of fauna habitats and enable individuals to move between the habitat areas. The conceptual locations and design specifications for the underpasses, rope bridges and drainage culverts are identified in [Figure 11](#) (Appendix A).

The underpasses will be installed to maintain the habitat connectivity for WRP, BTP and Quenda, with the rope bridges to provide additional habitat connectivity for both WRP and BTP. The drainage culverts will seek to maintain habitat connectivity for BSM. Whilst acknowledging the Proposal will present a new obstacle to habitat connectivity, these underpasses, rope bridges and drainage culverts will seek to maintain connectivity as far as practicable.

As identified by Independent Consultant Ms. Barbara Jones (Section 2.5.2), underpasses have been demonstrated as successful for maintaining WRP connectivity along the riparian zone across the Collie River in Australind (Treendale), and rope bridges have been demonstrated as successful for maintaining WRP

connectivity between Peppermint woodland on either side of the Bussell Highway in Busselton. The design of the underpasses include potential improvements upon standard designs to include the installation of ledges in the tops of underpasses so that WRP do not have to go to ground, and ropes linking these ledges straight up into the adjacent canopy; both which may assist WRP to avoid predators¹³. The designs for the rope bridges have also had regard to the existing rope bridge in BORR Central Section which has not been successful, with a view towards a reduced span length, reduced exposure to predators and improved entry/exit points.

Monitoring of the use of underpasses by [Harris *et al.* \(2010\)](#) confirmed that Quenda will readily use fauna underpasses below roads to move between habitat areas. The use of underpasses and rope bridges by BTP does not appear to have been previously documented, but the high mobility and arboreal nature of BTP suggests that BTP may use either or both rope bridges and underpasses (similar to WRP).

The use of drainage culverts by BSM also appear to have not been previously documented. Noting BSM is a transient and mobile taxon with abundance and distribution likely to vary from year to year in response to seasonal rainfall ([Biota, 2020](#)), it is expected that BSM will readily use drainage culverts to move between habitat areas.

The installation of the underpasses and rope bridges will be followed by monitoring of their use through a combination of scats (faecal) monitoring in underpasses and below rope bridges, and the use of motion sensor cameras (where they can be secured and readily accessed). The monitoring will be used to determine the efficacy of the installed structures, and determine any adaptive management actions that may need to be implemented to maintain/improve their use by the target fauna.

The costs associated with these environmental measures have been incorporated into the total cost for the Proposal. The cost for each individual underpass or rope bridge or drainage culvert has not been separately calculated. The financial cost of the environmental measures identified above are in addition to the financial costs associated with the proposed Environmental Offsets for the Proposal (Appendix J).

¹³ Although primarily arboreal, WRP commonly move on-ground as observed within urban environments. Use of underpasses by WRP is therefore not expected to be limited by requiring access through overhead connections, but rather, may provide an additional access pathway.