Newell Highway Heavy Duty Pavements, North Moree
Submission report
Roads and Maritime Services | September 2018

Prepared by Jacobs and Roads and Maritime Services
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Approval and authorisation

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<th>Title</th>
<th>Newell Highway Heavy Duty Pavements, North Moree</th>
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<tr>
<td>Accepted on behalf of NSW Roads and Maritime Services by:</td>
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<td>Dated:</td>
<td>13/09/2018</td>
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Executive summary

Roads and Maritime Services (Roads and Maritime) proposes to carry out major pavement upgrades to three sections of the Newell Highway north of Moree (the highway) in north west NSW within the existing road corridor (the proposal). The proposal is located in the Moree Plains Shire Local Government Area (LGA).

The proposal forms part of the Newell Highway Corridor Strategy (Transport for NSW, 2015) to provide an efficient and sustainable corridor that caters for increasing growth and improves safety along the Newell Highway.

The Newell Highway carries substantial freight volumes, large volumes of inter-regional and local freight traffic, and is increasingly catering for substantial volumes of tourist traffic. The strategy identified that a large portion of the northern section of the Newell Highway is nearing its end of life, with regular failures occurring with structural pavement, as well as large sections not meeting desired cross section dimensions.

Key features of the proposal include:

- Upgrading and resurfacing three sections of the existing highway north of Moree to a heavy duty (HD) pavement
- Road widening to provide 3.5 metre wide lanes and two metre shoulders
- Provision of one metre wide painted medians
- Upgrading numerous intersections along the Newell Highway to dedicated right hand turn intersections, with additional left hand turn intersection treatments
- Provision of three metre wide shoulders for 30 metres on either side of property accesses
- Improving the Newell Highway flood immunity to a target 20 year average recurrence interval (ARI) where feasible and reasonable
- Utility relocations as required
- Property acquisitions as required
- Establishing temporary facilities, including construction compounds, stockpile sites and erosion and sedimentation measures as required.

The proposal would be delivered in three sections with a combined length of about 30 kilometres of upgrades along the Newell Highway, north of Moree.

The REF was publically displayed between Friday 22 June to Monday 23 July 2018 at the Moree Plains Shire Council Administration Building. The REF was placed on the Roads and Maritime project website and made available for download The display locations and website link were advertised in the Moree Champion and Narrabri North West Courier as well as 40 radio spots on 2MaxFM and 2VM over the four week display period.

Notification of the REF, contact methods, closing date for submissions, location of the hard copy documents, and project website were distributed to residences and businesses in the vicinity of the proposal and the freight industry in via email on Friday 22 June 2018.

Roads and Maritime received one submission from Moree Shire Plains Council with a number of comments and concerns during the public display period. The submission received has been considered in the preparation of this report.

The main issues raised by this submission related to:

- Coordinating with Moree Plains Shire Council regarding pavement materials and water supply, haulage routes and road closures to ensure neither Moree Plains Shire Council or Roads and Maritime projects are not compromised
- Intersections, private driveways and access points
- Change of road heights from Gwydirfield Road to Boolooroo Rest Area
• Compatibility of the proposal with the Inland Rail
• General concerns regarding road safety, speed limits and signage.

It was also noted that Moree Plains Shire Council supported a number of the local road intersection upgrades with the Newell Highway.

Responses to issues raised by Moree Plains Shire Council have been included in the Submissions Report. Roads and Maritime will meet further with Moree Plains Shire Council to inform and consult with the Council on these issues as the project progresses.

The only change to the proposal design since public display of the REF is modification of the proposal pavement design.

During the display of the REF additional biodiversity assessments were completed. The biodiversity assessment prepared for the REF identified the potential for significant impact to the following entities listed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act):

- Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland which is a critically endangered ecological community ecological community (CEEC)
- Homopholis belsonii (Belson’s Panic)
- Five-clawed Worm-skink (Anomalopus mackayi).

The supplementary biodiversity assessment carried out sought to confirm the presence and extent of CEEC’s and species habitat within the study area. The supplementary biodiversity assessment confirmed the presence of the EPBC Act listed Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland EEC (Natural Grasslands CEEC) and Homopholis belsonii (Belson’s Panic) in the study area, although the location and extent for each entity differed from that identified in the REF.

As a result of the additional assessment the significant impact findings to Homopholis belsonii (Belson’s Panic) populations would only occur in one of the three proposal sections (NMS2) as opposed to the two the proposal sections (NMS2 and NMS3) originally assessed in the REF. The area of impact to the Natural Grasslands CEEC has decreased. However, the proposal would still have a significant impact on this Natural Grasslands CEEC.

The proposal would require the removal of habitat listed as being associated with the Five-clawed Worm-skink (Anomalopus mackayi). This is consistent with the finding of the BAR (Jacobs, 2018). However, Gerry Swan (a subject matter expert commissioned by AREA) determined much of this in the road corridor is unsuitable. Remaining areas of suitable habitat in the road corridor are also likely to be modified by edge effects that may change the soil surface and microhabitat conditions, altering its suitability for this species.

Based on the information available, AREA concluded that the proposal is unlikely to cause a significant impact (as defined under the EPBC Act) on a viable local population of the Five-clawed Worm-skink (Anomalopus mackayi).

The impacts on threatened biodiversity would be avoided or further minimised through the design process and implementation of management and mitigation measures identified in the REF. Biodiversity offsets would still be required for the residual impacts to threatened biodiversity in accordance with the EPBC Act strategic assessment approval and the Roads and Maritime Guideline for Biodiversity Offsets (2016).

As the additional biodiversity assessment indicates that there is generally less of an impact that that identified in the REF, Roads and Maritime is not proposing further changes to the proposal other than the pavement design.

The issues raised during the public display of the REF have been adequately summarised and responded to. All potential environmental impacts have been assessed adequately with appropriate safeguards and management measures identified to avoid, minimise and mitigate impacts. The implementation of the
safeguards and management measures identified in the submissions report would appropriately manage and mitigate the potential impacts.
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1. Introduction and background

1.1 The proposal

Roads and Maritime Services (Roads and Maritime) proposes to carry out major pavement upgrades to three sections of the Newell Highway (the highway) north of Moree in the north west of NSW (the proposal). The proposal is located in the Moree Plains Shire Local Government Area (LGA).

The proposal forms part of the Newell Highway Corridor Strategy (Transport for NSW, 2015) to provide an efficient and sustainable corridor that caters for increasing growth and improves safety along the Newell Highway.

The Newell Highway carries substantial freight volumes, large volumes of inter-regional and local freight traffic, and is increasingly catering for substantial volumes of tourist traffic. The strategy identified that a large portion of the northern section of the Newell Highway is nearing its end of life, with regular failures occurring with structural pavement, as well as large sections not meeting desired cross section dimensions.

Key features of the proposal include:

- Upgrading and resurfacing three sections of the existing highway north of Moree to a heavy duty (HD) pavement
- Road widening to provide 3.5 metre wide lanes and two metre shoulders
- Provision of one metre wide painted medians
- Upgrading of the existing intersections along the Newell Highway to dedicated right hand turn intersections, with additional left hand turn intersection treatments
- Provision of three metre wide shoulders for 30 metres on either side of property accesses
- Improving the Newell Highway flood immunity to a target 20 year average recurrence interval (ARI) where feasible and reasonable
- Utility relocations as required
- Property acquisitions as required
- Establishing temporary facilities, including construction compounds, stockpile sites and erosion and sedimentation measures within the road corridor as required.

The proposal would be delivered in three sections with a combined length of about 30 kilometres of upgrades along the Newell Highway, north of Moree. The three sections and indicative work locations are described in Table 1-1. Each section would be staged to enable work to be completed safely while maintaining traffic flows at all times. Construction would generally involve building one carriageway at a time, and switching traffic between the carriageways to preserve traffic flows for the duration of work.

Table 1-1 Section and proposed works

<table>
<thead>
<tr>
<th>Section</th>
<th>Location</th>
<th>Proposed works</th>
</tr>
</thead>
<tbody>
<tr>
<td>NMS1</td>
<td>4.2 kilometres to 9.2 kilometres north of Moree</td>
<td>Upgrading 5 kilometres of the Newell Highway (heavy duty pavement)</td>
</tr>
<tr>
<td>NMS2</td>
<td>17.6 kilometres to 27.4 kilometres north of Moree</td>
<td>Upgrading of 9.8 kilometres of the Newell Highway (heavy duty pavement)</td>
</tr>
<tr>
<td>NMS3</td>
<td>36.9 kilometres to 53.0 kilometres north of Moree</td>
<td>Upgrading 16.1 kilometres of the Newell Highway (heavy duty pavement)</td>
</tr>
</tbody>
</table>
A more detailed description of the proposal can be found in Section 3 of the REF prepared by Roads and Maritime in June 2018. Figure 1-1 shows the locality of the proposal. Figure 1-2 identifies the key features of the proposal.
Legend
- The proposal
- Train station
- Roadside rest area
- Railway

Figure 1-1 | Location of the proposal
Figure 1-2 | The proposal NMS1
Figure 1-2 | The proposal NMS1
Figure 1-2 | The proposal NM S1
Figure 1-2 | The proposal NM S2
Figure 1-2 | The proposal NM S2
Figure 1-2 | The proposal NM S2
Figure 1-2 | The proposal NM S2
Figure 1-2 | The proposal NM S2
Figure 1-2 | The proposal NM S3
Figure 1-2 | The proposal NM S3
Figure 1-2 | The proposal NM S3
Figure 1-2 | The proposal NM S3
Figure 1-2 | The proposal NM S3
Figure 1-2 | The proposal NM S3
Figure 1-2 | The proposal NM S3
Figure 1-2 | The proposal NM S3
1.2 REF display

Roads and Maritime prepared a REF to assess the environmental impacts of the proposal. The REF was publically displayed for 32 days between 22 June 2018 and 23 July 2018 at one location, as detailed in Table 1-2. The REF was placed on the Roads and Maritime project website and made available for download. The display locations and website link were advertised in the Moree Champion and Narrabri North West Courier as well as 40 radio spots on 2MaxFM and 2VM over the four week display period.

A newsletter notifying the commencement of the REF display period, contact methods, closing date for submissions, location of the hard copy documents, and the project website were distributed to residences and businesses in the vicinity of the proposal and the freight industry in via email on Friday 22 June 2018.

Table 1-2 Display locations

<table>
<thead>
<tr>
<th>Location</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moree Plains Shire Council</td>
<td>MAX Centre, Corner Balo and Herber Streets Moree</td>
</tr>
</tbody>
</table>

1.3 Purpose of the report

This submissions report relates to the REF prepared for the Newell Highway Heavy Duty Pavements, North Moree, and should be read in conjunction with that document.

The REF was placed on public display and submissions relating to the proposal and the REF were received by Roads and Maritime. This submissions report summarises the issues raised and provides responses to each issue (Chapter 2).

It details the changes to the proposal since finalisation of the REF (Chapter 3), describes and assesses the environmental impact of changes to the proposal (Chapter 4) and identifies new or revised environmental management measures (Chapter 5).

No project changes are proposed that would require the preparation of a preferred infrastructure report. No revisions have been made to the assessment or environmental management measures as described in the environmental impact statement.
2. Response to issues

Roads and Maritime received one submission, accepted up until the 23 July 2018. Table 2-1 lists the respondent and the respondents allocated submission number. The table also indicates where the issues from each submission have been addressed in Chapter 3 of this report.

Table 2-1: Respondents

<table>
<thead>
<tr>
<th>Respondent</th>
<th>Submission No.</th>
<th>Section number where issues are addressed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moree Plains Shire Council</td>
<td>1</td>
<td>Sections 2.2 to Section 2.5</td>
</tr>
</tbody>
</table>

2.1 Overview of issues raised

One submission was received in response to the display of the REF. This was a submission from Moree Plains Shire Council which include a number of comments and suggestions for both this proposal and the Newell Highway Narrabri to Moree heavy duty pavement project to the south.

The submission has been examined to understand the issues being raised. The relevant issues raised by the submission have been extracted and collated, and corresponding responses to the issues have been provided. Where similar issues have been raised in different submissions, only one response has been provided. The issues raised and Roads and Maritime response to these issues forms the basis of this chapter.

The main issues raised relate to:

- Coordinating with Moree Plains Shire Council regarding pavement materials and water supply, haulage routes and road closures to ensure neither Moree Plains Shire Council or Roads and Maritime projects are not compromised
- Intersections, private driveways and access points
- Change of road heights from Gwydirfield Road to Boolooroo Rest Area
- Compatibility of the proposal with the Inland Rail
- General concerns regarding road safety, speed limits and signage.

It was also noted that Moree Plains Shire Council also supported a number of the local road intersection upgrades with the Newell Highway.

Responses to issues raised by Moree Plains Shire Council have been included in the Submissions Report. Roads and Maritime will meet further with Moree Plains Shire Council to inform and consult with the Council on these issues as the project progresses.

2.1 General support for the proposal

Submission number(s)

1

Issue description

Respondent expresses general support for the proposal.
Response
Roads and Maritime acknowledge the general support for the proposal.

2.2 Coordination with Moree Plains Shire Council

2.2.1 Supply of pavement materials and water supply

Submission number(s)
1 (12)

Issue description
Moree Plains Shire Council formally requested that Roads and Maritime works closely with their Engineering Works Department to ensure that supply of pavement materials and water is coordinated with their operational staff. This would ensure that neither Moree Plains Shire Councils or Roads and Maritime’s projects are not compromised.

Response
The formal request from Moree Plains Shire Council to work closely with their Engineering Works Department has been noted. Road and Maritime has had and would continue to have regular meetings with Council under the Roads Maintenance Council Contract. These meetings would be a possible forum to provide updates on the various Newell Highway Projects. Further Moree Plains Shire Council has been invited to a number or workshops for each of the Newell projects where program updates are provided. This would continue to be the case. Roads and Maritime would continue to invite Moree Plains Shire Council to the various workshops as the project progresses to the construction stage.

2.2.2 Haulage routes and road closures

Submission number(s)
1(13), 1(14)

Issue description
Moree Plains Shire Council responded that they would work with Road and Maritime to initiate temporary closures of the local road network, where practical, providing the closures do not interfere with the peak season for truck transport. Moree Plains Shire Council raised concerns that the construction works and access to local roads or restriction of access must be not be programmed to not interfere with peak harvest periods for both cotton and wheat.

Moree Plains Shire Council also responded that primary haulage routes must be identified well in advance of construction and Roads and Maritime need to work with Council to establish an agreed scope of works for reinstatement to 'as was condition' of local roads and other related assets used for material haulage.

Response
As part of continued consultation with Moree Plains Shire Council during the proposal development and delivery. Programming of works for outside of the various harvest periods would not always be feasible.
However, maintaining traffic flows and appropriate access in the immediate vicinity of grain and cotton receival sites would form part of the delivery readiness and construction staging phases.

It is usual practice to carry out a pre and post dilapidation inspection of any roads potentially affected by haulage of the works. The pre and post dilapidation inspection would be done jointly with Moree Plains Shire Council and a video recording and report provided before and after the construction period. Any required remediation measures would then be agreed with Moree Plains Shire Council.

### 2.3 Local road intersections and private driveways and access points with the Newell Highway

#### 2.3.1 Private driveways and access points

**Submission number(s)**
1 (16) and 1(17)

**Issue description**

Moree Plains Shire Council have encouraged Roads and Maritime to square up as many of the private driveways, as practical as this would be a great safety initiative for all users. Safe intersection sight distance (SISD) and appropriate line of sight should be the aim in all design upgrades in conjunction with line marking, and signage, to remind users that they must give way to all oncoming traffic.

Moree Plains Shire Council also responded that within NMS1, the numerous property driveways should warrant the need for a speed zone review of this area and that consideration should be given to moving the 80 kilometres per hour zone out to Gwydirfield road an extension of less than two kilometres.

**Response**

Moree Plains Shire Council concerns have been noted. All the intersections for the proposal are currently being designed to meet or exceed the current Austroad guideline. Where this cannot be achieved road safety mitigation measures would be put in place.

The current design for the private accesses for the proposal are a Basic right turn and Basic left turn (BAR/BAL) which exceeds the Austroads requirement for a rural intersection. However, during the final concept and detail design stages road safety audits would be carried out on the design to further assess and mitigate any risks. Changing the posted speed limit to 80 kilometres per hour is not being considered at this stage.

#### 2.3.2 Local road intersection treatments with the Newell highway

**Submission number(s)**
1(15), 1(200, 1(21), 1(22), 1(23), 1(24)

**Issue description**

Moree Plains Shire Council responded with the following comments on local road intersections with the Newell Highway:
• The Gwydirfield Road intersection with the Newell Highway (within NMS1) requires axillary left hand turn (AUL) upgrade. The improved channelised right hand turn (CHR) which is proposal at this intersection is a valuable safety initiate for this busy intersection. Council's preliminary assessment of this intersection has identified that private land acquisition is required to accommodate the AUL. Council is willing to assist where required.

• The Newport and Milo Road (within NMS2) AUL and CHR intersection treatments are a good addition to these two roads that have significant truck movements during the peak harvest/planting seasons.

• The Croppa Moree Road (within NMS2) upgrade of the AUL and CHR treatment is very important at this location as it is major arterial road on our road network.

• The Murrays Road's AUL and CHR intersection treatments are a good addition to this road as it a through road from central west of the Moree Plains Shire to the Newell Highway. The slight realignment of the intersection would assist with the safe movement of all vehicles but particular the trucks.

• The elimination of the AUL truck rest access and combining it with the Bogamildi Road intersection is a positive safety initiative as it reduces the number of intersections in this vicinity.

• Extra signage should be considered to ensure that traffic does not considered the merging of the Bogamildi’s AUL and the Murrays Road CHR to be an overtaking lane.

Finally, Moree Plains Shire Council also responded that consideration of an appropriate safety initiative to seal about 20 metres back from the intersections of the Newell Highway on all unsealed roads intersections. Council suggested that this length of seal would reduce dragging of large stones on to the Newell Highway, ensure dust is not an issue at the intersections, and would allow Moree Plains Shire Council to maintain the line marking to direct traffic to stay on the correct side of the local road as they approach the intersection.

**Response**

Current design for Gwydirfield Road intersection with the Newell Highway is a CHR/AUL which is adequate for the intersection. Moree Plains Shire Council’s comments on assistance with land acquisition are noted.

The current design is to upgrade the Croppa Moree Road intersection with the Newell Highway to a CHR/AUL.

Roads and Maritime has also noted the support of the intersection upgrades with the Newell Highway at Newport Road, Milo Road and Murrays Road.

The safety risk of the intersections would be further considered during the concept and detail design stage Roads Safety Audits.

While Councils suggestion regarding seal distances lengths on unsealed roads intersections has been noted. The 15 metres is the standard seal extension width on the Newell Highway (from the edge line) that would be applied to this proposal.

2.4 Flood waters

*Submission number(s)*

1(18)
**Issue description**

Moree Plains Shire Council raised concerns that any potential road height changes from Gwydirfield Road to Boolooroo Rest Area, that may act as a levee funnelling floodwaters. Currently water breaks out of the Gwydir River upstream of Boolooroo Bridge and crosses the Newell Highway. If the hydraulic conditions are not fully understood, there is concerned that the water could divert straight down into Moree township.

Moree Plains Shire Council have advised that they have recently completed a 2D model of the Moree township which could be provide to Roads and Maritime to use as the base of their modelling. Moree Plains Shire Council have also have noted that the existing Newell Highway is quite flat which allows water to flood across it. If the Newell Highway is raised it would need to have enough culverts to take the floodwaters.

**Response**

Any changes to the road height would fully consider the flooding impacts through hydraulic analysis. Roads and Maritime will request the 2D flood model from Moree Plains Shire Council to be included as part of the overall flood study for the proposal.

The current pavement design could accommodate removal and replacement of the existing pavement with foamed bitumen pavement and have minimal impact on existing road levels.

### 2.5 Inland Rail

**Submission number(s)**

1(19)

**Issue description**

Moree Plains Shire Council have expressed that they would like to ensure that the road design in the vicinity of NMS1 is cognisant of the Inland Rail designs.

**Response**

Roads and Maritime are in regular discussions and consultation with Inland Rail regarding the proposal.
3. Changes to the proposal

3.1 Modification of the proposed pavement design

3.1.1 Pavement design assessed in the REF

As outlined in Section 3.2.3 of the REF, the proposal requires the existing pavement on Newell Highway be replaced by new pavement capable of withstanding loads from large heavy vehicles including AB and B-triples and double road trains. The proposed pavement design outlined in REF specifies the new pavement would include a 455 millimetre foamed bitumen pavement. The REF acknowledged that the proposed pavement cross section would be revised and refined during detailed design to meet geotechnical conditions along the proposed alignment.

The indicative profile of the proposed pavement as outlined in the REF is presented in Figure 3-1.

![Figure 3-1 Indicative pavement profile (GHD, 2018)](image)

3.1.2 Background and need for the change

Since the exhibition of the REF, further detailed geotechnical investigations were carried and the Pavement Design Options Report (Aurecon, 2018) prepared.

The aim of the geotechnical investigations and pavement design option assessment were to:

- Characterise and assess the current ground conditions along the proposal alignment
- Determine pavement design requirements, and provide a range of options
- Review construction methodologies for each pavement option.
Several pavement types were nominated by Roads and Maritime which have since been developed further along with alternative pavement options for consideration. The Pavement Design Options Report (Aurecon, 2018) did not recommend a preferred option but concluded that the developed pavement options would be workshopped with Roads and Maritime and industry participants. Where the aim of the workshop would be to select a recommended pavement option to be taken forward to the detailed design phase of the proposal.

Following on from the assessment, a pavement workshop was held in July 2018 with Roads and Maritime and the pavement design specialists and industry participants to review the outcomes of the options assessment and determine the most suitable pavement design.

During the workshop each pavement option includes consideration of the following proposal pavement design requirements:

- Upgrade to main carriageways
- Widening of existing pavement
- Rehabilitation of existing pavement
  - Overlay
  - Patching
  - Stabilisation
- Carriageway cross overs (where applicable)
- Local roads
- Intersection and access upgrades
- Tie-ins and temporary connections
- Temporary pavements (online).

The recommended pavement options selected during the workshop are summarized in the sections below.

3.1.3 Proposed changes to the pavement design

The pavement workshop selected that the heavy duty granular pavement with a spray seal pavement option (refer to Figure 3-2) would be adopted as the default pavement type in locations where there is no flood impact, or where flood impacted carriageway is less than 500 metres in length. In such situations, localised repair is likely to be required after flood events, but is considered a preferred solution to the bound pavement options given project budget constraints.

In locations where any part of the main carriageway is submerged during the 20-year flood event, a bound pavement solution is proposed. The preferred pavement type is a foamed bitumen over stabilised subbase/Selected Material Zone (SMZ) (refer to Figure 3-3).

The proposed changes to the pavement design as a result of the pavement workshop for each section of the project are outlined in Table 3-1, and the indicative profile of the new proposed pavement types are shown in Figure 3-2 and Figure 3-3.

Table 3-1 Proposed changes to the pavement design

<table>
<thead>
<tr>
<th>Section</th>
<th>Proposed pavement design</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>NMS1</td>
<td>Foam bitumen base over bound subbase plus spray seal</td>
<td>Top wearing course comprising a single seal with a scatter course on a base course comprising a 290 millimetre thick foam base bitumen placed in multiple layers.</td>
</tr>
<tr>
<td>Section</td>
<td>Proposed pavement design</td>
<td>Details</td>
</tr>
<tr>
<td>---------</td>
<td>--------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>NMS2</td>
<td>Heavy duty granular pavement with a spray seal</td>
<td>Sprayed bitumen seal wearing course over 200 millimetre heavy duty 20 mm nominal size densely graded base (DGB20) on a 140 millimetre 20 mm nominal size densely graded subbase (DGS20).</td>
</tr>
<tr>
<td>NMS3</td>
<td>Heavy duty granular pavement with a spray seal</td>
<td>Sprayed bitumen seel wearing course over 200 millimetre heavy duty DGB20 base on a 140 millimetre DGS20 sub base</td>
</tr>
</tbody>
</table>

Figure 3-2 Heavy duty granular pavement profile (left) and heavy duty granular pavement re-use profile (right) (Aurecon, 2018)
Figure 3-3 Foam bitumen base over bound subbase plus spray seal profile (left) and Foam bitumen base over bound subbase plus spray seal profile re-use profile (right) (Aurecon, 2018)
4. Environmental assessment

Following the public display of the REF, Roads and Maritime has carried out additional environmental impact assessment to minimise the environmental impacts of the proposal.

4.1 Biodiversity

4.1.1 Summary of additional study

The Biodiversity assessment report (BAR) was completed by Jacobs in May 2018 as part of the REF. The BAR concluded that the proposal would removal of about 47 hectares of native vegetation. This includes about eight hectares of Biodiversity Conservation Act 2016 (BC Act) listed threatened ecological communities (TEC) and 16 hectares of Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act) listed TECs. In many instances, the same patches of vegetation are part of both a BC Act and EPBC Act listed TEC. An assessment of significance was carried out for each of the threatened species and ecological communities that are known or likely to occur in the proposal area. The assessments concluded that the proposal would not have a significant impact on any species, population or TEC listed under the BC Act or Fisheries Management Act 1994 (FM Act).

However, it was determined that the proposal may have a significant impact on two threatened species (Homopholis belsonii (Belson's Panic) and Five-clawed Worm-skink (Anomalopus mackayi)) and the EPBC Act listed Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland EEC (Natural Grasslands CEEC). The REF stated that further assessment to confirm the presence of this community and species within the study area, and therefore the significance of the impact, would be carried out in consultation with the Department of the Environment and Energy if required. The outcomes of this assessment would be provided in the submissions report prepared for the proposal.

As such, AREA Environmental Consultants (AREA) were commissioned by Roads and Maritime carry out a supplement assessment as part of the submission process. This further assessment involved collecting additional data on the location, size and extent of the populations of Five-clawed worm-skink (Anomalopus mackayi), Homopholis belsonii (Belson’s Panic) and the Natural Grasslands CEEC, to better inform the EPBC Act assessment of significance. For the Five-clawed worm-skink (Anomalopus mackayi), Mr Gerry Swan (an expert on the subject matter) was contracted by AREA to complete this task and apply the Precautionary Approach to either validate or challenge the significant impact assessment findings from the BAR on Five-clawed Worm-skink (Anomalopus mackayi).

The findings of the additional assessment carried out AREA are summarised below and documented in more detail in the Newell Highway Heavy Duty Pavements, Narrabri to Moree and North Moree Supplementary Assessment; Homopholis belsonii (Belson’s Panic) and the Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland (AREA, 2018) and the Newell Highway Heavy Duty Pavements, Narrabri to Moree and North Moree Supplementary Assessment; Five-clawed worm-skink (Anomalopus mackayi) (AREA, 2018) (refer to Appendix A).

4.1.2 Methodology

The detailed methodology for the additional biodiversity assessment carried out by AREA is provided in the supplement assessment provided in Appendix A. The following provides a summary of the methodology used.

The methodology for the supplementary biodiversity assessment for Homopholis belsonii (Belson’s Panic) and the Natural Grasslands CEEC involved:
• Review of the BAR (Jacobs, 2018) to consider:
  – Where known or potential habitat of *Homopholis belsonii* (Belson’s Panic) occurred
  – Where impact to these populations was determined significant.

• Targeted terrestrial flora surveys for *Homopholis belsonii* (Belson’s Panic) and the Natural Grasslands CEEC were carried out from 2 to 5 July 2018

• Assessments in Natural Grasslands CEEC habitat were undertaken to confirm Plant Community Type (PCT) and extent of the community.

• Ground truthing the Natural Grasslands CEEC mapping carried out by Jacobs during the preparation of the BAR (Jacobs, 2018) to refine what is classified as native grasslands next to the Newell Highway (ie native grassland must have less than 51 per cent cover of exotic species as defined by NSW OEH).

• Targeted searches for *Homopholis belsonii* (Belson’s Panic) were carried out at and nearby the known populations identified by Jacobs. The searches were undertaken both inside and outside of the proposal area (which is as per the REF, ie the 50 per cent concept design including a four metre buffer), to estimate the size/extent of the population that would be both affected by the proposal and remain intact. The survey effort was concentrated beneath the canopy of trees and shrubs (Belah, Myall, Poplar Box, Wilga and the exotic Mimosa bush) as this is the predominant habitat known for the species.

• Estimation of relative population size was determined using either percent cover, frequency of occurrence, and/or the proportion of habitat affected. A population of *Homopholis belsonii* (Belson’s Panic) was considered as the area of contiguous PCT’s in which the species was recorded. The area of known or potential habitat was calculated using the sum of area of contiguous PCT’s with known occurrence of *Homopholis belsonii* (Belson’s Panic). The proposal area (50 per cent concept design including a four metre buffer) was used to determine the area of habitat affected by the proposal.

• Validate or challenge the significant impact assessment findings on *Homopholis belsonii* (Belson’s Panic) and the Natural Grasslands CEEC determined by the BAR (Jacobs, 2018)

• Update the EBPC Act assessment of significance for *Homopholis belsonii* (Belson’s Panic) and the Natural Grasslands CEEC.

While the methodology for the supplement biodiversity assessment for the Five-clawed Worm-skink (*Anomalopus mackayi*), involved:

• A search was made of Australian Museum records, the Atlas of Living Australian (ALA) and BioNet databases.

• Collection of additional data on the location, size and extent of the populations of Five-clawed worm-skink (*Anomalopus mackayi*) to better inform the EPBC Act assessment of significance criteria. This was done by
  – Commissioning an expert (Gerry Swan) to assess the proposal area.
  – Completing a transect every two kilometres (dependant on traffic and parking constraints) in each of the five sections. Each transect involved striding out 30 metres from the Newell Highway centre line to the eastern side (unless a railway line or fence blocked further access). An assessment was made of the habitat and soil along the transect together with land use in the adjoining properties. Transects were also walked along the outer edge of the 30 metre buffer for about 100 metres. A similar process was carried out on the western side of the Newell Highway. The purpose of the transects was to assess the suitability of habitat in the study area for the Five-clawed Worm-skink (*Anomalopus mackayi*). No active searches for this species were carried out except for opportunistic inspections of habitat features along the transect (eg rolling over logs).
  – Random transects at intervals along the areas between the sections were also completed as per the method above.

• Validate or challenge the significant impact assessment findings on Five-clawed worm-skink (*Anomalopus mackayi*) determined by the BAR (Jacobs, 2018)

• Update the EBPC Act assessment of significance for the Five-clawed Worm-skink (*Anomalopus mackayi*).
4.1.3 Description of existing environment

**Homopholis belsonii (Belson’s Panic)**

AREA’s targeted search for *Homopholis belsonii* (Belson’s Panic) were carried out and nearby the known populations identified by Jacobs. The results of the additional assessment are summarised as follows:

- No populations of *Homopholis belsonii* (Belson’s Panic) were been located within NMS1. However, NMS1 contains 18.4 ha of potential habitat (Queensland Bluegrass +/- Mitchell Grass and Weeping Myall open woodland. A substantial proportion of the proposal footprint was classed as ‘not native’ and is unlikely to provide suitable habitat for *Homopholis belsonii* (Belson’s Panic).

- Five population clusters of *Homopholis belsonii* (Belson’s Panic) were identified within NMS2, as detailed below (refer to **Figure 4-1**):
  - Clusters 1 and 2 were recorded in Coolabah / River Cooba woodland, Queensland bluegrass +/- Mitchell Grass grassland and derived grassland. Most of the individuals are located east of the highway where the species reached over 80 per cent cover, forming a mat beneath Mimosa shrubs.
  - Cluster 3 was recorded in Queensland bluegrass +/- Mitchell Grass grassland beneath Mimosa shrubs. Most of the population occurred outside the proposal area along the fence line, with only two individuals recorded within the proposal area.
  - Cluster 4 was recorded within derived grassland, adjacent to Myall woodland. Most *Homopholis belsonii* (Belson’s Panic) are beneath Mimosa, outside of the proposal area. Although a substantial proportion of habitat occurs in the proposal area, this is not considered to contain a significant proportion of the population of *Homopholis belsonii* (Belson’s Panic).
  - Cluster 5 was recorded within Poplar Box – Belah woodland and derived grassland. A greater proportion of the *Homopholis belsonii* was within the derived grassland near the Newell Highway, than in the adjacent woodland. About 21 per cent of total *Homopholis belsonii* (Belson’s Panic) habitat is located within the proposal area.

Five population clusters of *Homopholis belsonii* (Belson’s Panic) were also identified within NMS3 as detailed below (refer to **Figure 4-2**):

- Clusters 1 and 2 were within Belah woodland, Weeping Myall woodland and Derived Grassland. A large area of Belah woodland to the west of the study area was searched and *Homopholis belsonii* (Belson’s Panic) was frequently recorded throughout. This increased the total area of contiguous *Homopholis belsonii* (Belson’s Panic) habitat in this cluster to 137 hectares.
- Cluster 3 was within the Weeping Myall woodland. Only two records of *Homopholis belsonii* (Belson’s Panic) were located within the proposal area and over 90 per cent of the population was located outside the proposal area.
- Cluster 4 was within the Belah woodland outside of the study area to the east of the Newell Highway. *Homopholis belsonii* (Belson’s Panic) was frequently located beneath the canopy of large, old Belah trees. No *Homopholis belsonii* (Belson’s Panic) were located within the proposal area.
- Cluster 5 was in Belah woodland. Less than five per cent of the potential habitat is located within the proposal area. None of the *Homopholis belsonii* (Belson’s Panic) in this cluster were recorded within the proposal area.

AREA concluded that after ground truthing the *Homopholis belsonii* (Belson’s Panic) population and community, the field surveys undertaken by Jacobs were accurate and thorough.
Figure 4-1 Location of clusters (numbered and circled) of *Homophilis belsonii* (Belson’s Panic) in NMS2
Figure 4-2 Location of clusters (numbered and circled) of *Homopholis belsonii* (Belson’s Panic) in NMS3
**Five-clawed Worm-skink (Anomalopus mackayi)**

Five-clawed worm-skink (*Anomalopus mackayi*). is known to be associated with five of the PCTs in the study area, including many areas of grassland. Additionally, the proposal is in the middle of the ‘Species May Occur’ distribution. The BAR (Jacobs, 2018) stated that the study area is likely to contain an important population of this species within suitable habitat.

Seventeen transects over the three sections and a further six intervening transects were completed by AREA in July 2018. Completing transects allowed AREA to undertake an assessment of potential suitable habitat for the Five-clawed Worm Skink (*Anomalopus mackayi*) (ie whether it was continuous, the condition, and any other factors).

In their report, AREA discuss the suitability of habitat within the Newell Highway corridor. It is noted that the section of the Newell Highway subject to this assessment was constructed in the 1960s, experiences high volumes of traffic with a large proportion of heavy vehicles and that any potential suitable habitat for Five-clawed Worm-skink (*Anomalopus mackayi*) within the road corridor is quite degraded. Apart from the accumulated rubbish of 50+ years of motor traffic, it is bisected by numerous side roads and property access tracks. There are maintenance tracks for the railway line and for the power lines running parallel to the highway. The grass areas adjacent to the railway line, under the power poles and along the edge of the highway are often weedy and / or slashed. There are also numerous tracks presumably made to move heavy farming equipment from one property to another without coming out onto the highway. Cattle regularly are grazed along the side of the Newell Highway, contributing to the degradation. Coupled with the current drought conditions this the road corridor is unlikely to provide suitable habitat for the Five-clawed worm-skink (*Anomalopus mackayi*).

Several locations examined by AREA along the 30 meter transects contained gravelly soil or conglomerate pebbles (presumably imported fill), although the soil outside these zones was cracking clay. The report states that the gravel / fill areas are not suitable habitat for the Five-clawed Worm Skink (*Anomalopus mackayi*). The skink expert also draws on personal experience with the species, stating that the impact of Mimosa bush on the Five-clawed Worm-skink (*Anomalopus mackayi*) is likely detrimental.

Despite this assessment, AREA also noted the presence of suitable habitat for Five-clawed worm-skink (*Anomalopus mackayi*), including areas containing deep soil cracks and a good cover of grass litter (refer below for further discussion). These areas of suitable habitat were considered as unlikely to be occupied by the Five-clawed worm-skink because they are not continuous through the landscape. If present, Five-clawed worm-skink (*Anomalopus mackayi*) populations are likely to be small and isolated. The adjoining land is predominantly cropped or grazed with discrete native woodland present.

In conclusion, based on further assessment of habitat within the study area by skink expert Gerry Swan, it was concluded that much of the vegetation within the proposal area is degraded or unsuitable for this species., While the proposal does contain areas of suitable habitat for the Five-clawed Worm–skink (*Anomalopus mackayi*), it is too marginal to sustain a viable population.

**Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland CEEC**

AREA ground truthed (Jacobs, 2018) mapping of this community carried out for the BAR to refine what is classified as native grasslands next to the Newell Highway (ie native grassland must have less than 51 per cent cover of exotic species as defined by NSW OEH).

Within NMS1, AREA found the condition of the majority of grassland within the proposal area to be of poor quality, with the ‘not-native’ zone often extending between five to 20 metres from the edge of the Newell Highway. Small adjustments were also made to the extent of the ‘not-native’ zone in sections NMS2 and NMS3. Revised figures on extent of Natural s CEEC are provided in Table 4-2.
4.1.4 Potential impacts

**Homopholis belsonii (Belson’s Panic)**

The BAR (Jacobs, 2018) identified the proposal would have a significant impact on populations of *Homopholis belsonii* (Belson’s Panic) in NMS2 and NMS3.

The additional assessment by AREA, refined the location of *Homopholis belsonii* (Belson’s Panic) and provided further information regarding the size and extent of these populations and the potential impact of the proposal. As AREA surveyed the entire study area for *Homopholis belsonii* (Belson’s Panic), the additional assessment of impacts could be undertaken to a higher degree of accuracy.

The proposal (with a four metre buffer) would result in the removal of 20.8 hectares of *Homopholis belsonii* (Belson’s Panic) habitat which would include (refer to Table 4-1):

- 2.3 hectares in NMS1 (Low condition).
- 9.4 hectares in NMS2 (Moderate to Good condition)
- 8.8 hectares in NMS3 (Moderate to Good condition).

It should be noted, that the total area of habitat determined by Jacobs in the BAR differed to those reported by AREA. This likely reflects differences in methodologies, and not errors by Jacobs or AREA.

**Table 4-1 Area of known or potential habitat of *Homopholis belsonii* (Belson’s Panic), and impact from the proposal**

<table>
<thead>
<tr>
<th>Section / cluster</th>
<th>NMS1</th>
<th>NMS2</th>
<th>NMS3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 &amp; 2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Potential habitat (hectares)</td>
<td>11.5</td>
<td>51.4</td>
<td>8.3</td>
</tr>
<tr>
<td>Habit within proposal area (hectares)</td>
<td>2.63</td>
<td>4.7</td>
<td>0.8</td>
</tr>
<tr>
<td>Per cent potential habitat within the proposal area</td>
<td>22.6</td>
<td>10.7</td>
<td>16.8</td>
</tr>
</tbody>
</table>

A summary of the EPBC Act assessment of significance undertaken by AREA of impacts to *Homopholis belsonii* (Belson’s Panic) as a result of the proposal is provided below:

- **NMS1**: A substantial proportion of the proposal impact area is unlikely to provide suitable habitat for *Homopholis belsonii* (Belson’s Panic). Therefore, the NMS1 proposal area is unlikely contain an important population of *Homopholis belsonii* (Belson’s Panic) and the impact of the proposal on this species is unlikely to be significant.
- **NMS2** for:
  - Clusters 1 and 2, about 10.7 per cent of habitat is in the proposal area and would be impacted. Therefore, AREA agrees with the BAR (Jacobs, 2018), that the **impact would be significant** to the local population.
  - Cluster 3, most of the population occurred outside the proposal area along the fence line, with only two records located within the proposal area. Therefore, the impact to the population in Cluster 3 was not considered to be significant.
– Cluster 4, most plants are beneath Mimosa shrubs, outside of the proposal area. Although a substantial proportion of habitat occurs in the proposal area, this was not considered to contain a significant proportion of the population of *Homopholis belsonii* (Belson’s Panic) and the proposal would not have a significant impact on this population.

– Cluster 5, about 21 per cent of total habitat is located within the proposal area. Although this represents a sizable proportion of the population, given the prevalence of the species in previously disturbed habitat, it was considered likely that the species would recover in disturbed areas after the completion of the proposal. Therefore, impact of the proposal was not considered to be significant to this cluster.

• NMS3 for:
  – Clusters 1 and 2, only a small proportion (less than about five per cent) of the population was located within the proposal area. Therefore, the impact of the proposal on the Homopholis belsonii (Belson’s Panic) population would not be significant in these clusters.
  – Cluster 3, only two Homopholis belsonii (Belson’s Panic) were located inside the proposal area, with over 90 per cent of the population located outside the proposal area. Therefore, the impact on the Homopholis belsonii (Belson’s Panic) population would not be significant in this cluster.
  – Cluster 4, no plants were located within the proposal area. AREA concluded the impact of the proposal on the Homopholis belsonii (Belson’s Panic) population would not be significant in this cluster.
  – Cluster 5, less than about five per cent of the potential habitat is located within the proposal area and no Homopholis belsonii (Belson’s Panic) were located within the proposal area. The impact of the proposal on the Homopholis belsonii (Belson’s Panic) population would not be significant in this cluster.

In summary, AREA concluded that the proposal would result in a significant impact to populations of *Homopholis belsonii* (Belson’s Panic) only within NMS2. This is in contrast to BAR (Jacobs, 2018) which considered that the proposal would also have a significant impact on populations of *Homopholis belsonii* (Belson’s Panic) within NMS1 and NMS3. Jacobs agree with the findings from the additional assessment carried out by AREA, and concur with the findings that the proposal would only have a significant to the local population of *Homopholis belsonii* (Belson’s Panic) within NMS2.

The updated assessments of significance under the EPBC Act (completed by AREA) are provided in Appendix B.

Moving the proposal to the west of the occurrence of Queensland Bluegrass +/- Mitchell grassland (PCT52) in NMS2, would avoid disturbance east of the existing Newell Highway and would likely reduce the significance of the impact. Additionally, this has the potential to avoid clusters 1 and 2 of *Homopholis belsonii* (Belson’s Panic), which would also likely reduce the significance of the impact to this species.

**Five-clawed Worm-skink (*Anomalopus mackayi*)**

AREA identified that the proposal would require the removal of about 68.55 hectares of habitat listed as being associated with the Five-clawed Worm-skink (*Anomalopus mackayi*). However, Gerry Swan (a subject matter expert commissioned by AREA), concluded that much of this in the road corridor would be unsuitable. Remaining areas of suitable habitat in the road corridor were also likely to be modified by edge effects that may change the soil surface and microhabitat conditions, altering its suitability for this species. In the opinion of Gerry Swan, there would be no local populations of Five-clawed worm-skink (*Anomalopus mackayi*) (if there are any along the highway route) that would be significantly impacted by the proposal.

Based on the information available and updated assessment of significance, AREA concluded that a conservative approach finds that the proposal would not be at risk of causing a significant impact (as defined under the EPBC Act) on a viable local population of the Five-clawed Worm-skink (*Anomalopus mackayi*). The updated assessments of significance under the EPBC Act are provided in Appendix B.
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland CEEC

The BAR (Jacobs 2018) concluded the proposal would have a significant impact on the Natural Grasslands CEEC within due to the removal of about 6.25 hectares within NMS2, which would constitute about a 2.6 per cent permanent reduction of the extent of the community. AREA agrees with this conclusion, however provides the following additional information:

- In NMS1, AREA found the condition of majority of Natural Grasslands CEEC within the proposal area to be of poor quality, with the ‘not-native’ zone often extending from five to 20 metres from the edge line of the Newell Highway. Small adjustments were also made to the extent of the ‘not-native’ zone in sections NMS2 and NMS3. Revised figures on extent of Natural Grasslands CEEC are provided in Table 4-2.
- The EPBC Critical Habitat Register (search date 11 July 2018) does not list habitat for this CEEC as critical.
- Jacobs review and explanation of MNES SIG 1.1 EPBC Act (DoE 2013) ‘Habitat critical to the survival of an ecological community’ provides evidence:
  - NMS1 contains affected patches meeting the definition of good quality (less than two hectares in size). AREA’s assessment concluded this section was poor quality (thus not triggering a need for offsetting under Roads and Maritime Guidelines for Biodiversity Offsets (November 2016).
  - NMS2 and NMS3 contain large patches less than 30 hectares in size meeting the definition of good quality. AREA concluded these patches may be considered to be of importance to the survival of the community.
- Post construction it would be likely, based on observed edge effects in the study area, NMS1, NMS2 and NMS3 would retain attributes to be considered “good quality remnants”, however the permanent area of occupancy would be reduced (see Table 4-2).

Table 4-2 Area of known or potential habitat of Natural Grasslands CEEC within NM sections, and area to be impacted by the Proposal in NM sections

<table>
<thead>
<tr>
<th>Habitat</th>
<th>NMS1</th>
<th>NMS2</th>
<th>NMS3</th>
<th>Total (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential habitat (hectares)</td>
<td>0</td>
<td>107.0</td>
<td>0</td>
<td>107</td>
</tr>
<tr>
<td>Habit in proposal area (hectares)</td>
<td>0</td>
<td>6.25</td>
<td>0</td>
<td>6.25</td>
</tr>
<tr>
<td>Per cent potential habitat with the proposal area</td>
<td>0%</td>
<td>5.8%</td>
<td>0%</td>
<td>5.8%</td>
</tr>
</tbody>
</table>

AREA concluded that challenging Jacobs conclusion of a significant impact to the Natural grasslands CEEC listed under the EBPC Act, would rely on at-best subjective opinion because the evidence provided in the BAR (Jacobs, 2018) is technically sound even after applying in depth critique.

The conclusion can be understood based on the legal interpretation of key words used in the EPBC guidance documents. To make the call, AREA refers to the assessment of significance for the Natural Grasslands CEEC provided in the BAR that questions if the proposal would ‘Interfere with the recovery of an ecological community’. Considering the existing occurrence of the Natural Grasslands CEEC within the study area as a benchmark (ie with regard to current road and rail activities), AREA has concluded that the proposal:

- Would adversely impact on known local populations
• Would change water flows and hydrology which may result in changes to the water table levels, increased salinity and increased run off or sediment
• Does not employ a management plan for the control of weeds such as Lippia (*Phyla canescens*), Coolatai Grass (*Hyparrhenia hirta*), African Love Grass (*Eragrostis curvula*) and Buffel Grass (*Cenchrus ciliaris*) in the region
• Does not employ a management plan to prevent introduction of invasive weeds, which could become a threat to the ecological community
• Does not employ hygiene measures for mowing and grading equipment and observe appropriate state protocols for moving stock.

It is possible that the implementation of an effective and resourced management plan that meets the requirements of the EPBC Act conservation advice for the Natural Grasslands CEEC may reduce the degree of impact. Areas of this TEC that would be directly impacted by the proposal may be substantially mitigated with the management of weeds.

Therefore, the proposal would still have a significant impact on the Natural Grasslands CEEC within NMS2.

**Summary**

The additional assessment carried out by AREA for Five-clawed worm-skink (*Anomalopus mackayi*), *Homopholis belsonii* (Belson’s Panic) and the Natural Grasslands CEEC under the EPBC Act significance criteria identified that the proposal would still have significant impact on *Homopholis belsonii* (Belson’s Panic) within NMS2 and the Natural Grasslands CEEC within NMS2.

Ecologists from Jacobs have reviewed the additional assessment and offsetting requirements prepared by AREA as provided in Appendix A to Appendix C and concur with the findings.

### 4.1.5 Revised safeguards and management measures

To respond to the additional assessment discussed above, the following changes to the mitigation measures are proposed as outlined in Table 4-3.

**Table 4-3 Additional and/ or revised safeguards and management measures**

<table>
<thead>
<tr>
<th>Impact</th>
<th>Environmental safeguard</th>
<th>Responsibility</th>
<th>Timing</th>
<th>Reference</th>
</tr>
</thead>
</table>
| Impact to *Homopholis belsonii* (Belson’s Panic) within NMS2 | To further reduce the impact on *Homopholis belsonii* (Belson’s Panic) within NMS2, the detailed design would consider avoiding the *Homopholis belsonii* (Belson’s Panic) clusters 1 and 2. This could be achieved by:  
- Investigate moving proposal further to the west of the known population  
- Consider using narrow batters near the known population. | Roads and Maritime | Detailed design | Additional safeguard |

### 4.1.6 Offsetting requirements

Biodiversity offsets would still be required for residual impacts to threatened biodiversity in accordance with the EPBC Act strategic assessment approval and the Roads and Maritime Guideline for Biodiversity Offsets (2016).
AREA found the BAR (Jacobs, 2018) offset requirements consistent with the Roads and Maritime thresholds. Refer to Table 6-16 of the REF and Appendix C.

To ensure consistency and predictability in offset requirements for projects, the Major Projects linear infrastructure module of the BioBanking Credit Calculator (or as updated) should be used to calculate the amount of credits required. Calculations are only required for those values where a threshold (Table 6-16 of the REF and Table 1 in Appendix C) has been reached. However, for smaller projects and where the cost of this assessment is considered excessive, the ratios in Table 4-4 can be used to calculate the offset.

### Table 4-4 Offsetting ratios for REF projects

<table>
<thead>
<tr>
<th>Impact</th>
<th>Offset ration</th>
</tr>
</thead>
</table>
| Loss of threatened ecological community | • Offset at a ratio of 4:1 where the offset sites are in moderate to good condition  
• Offset at a ratio of 8:1 where the offset sites are in poor condition including rehabilitation sites |
| Loss of threatened fauna species | Offset area of habitat lost at a ratio of 3:1                                |
| Loss of threatened flora species | Offset individuals lost at a ratio of 3:1                                    |

Using the ratios in Table 4-4, the offset requirements for proposals are summarised in Table 4-5.

### Table 4-5 Offsetting ratios for the proposal

<table>
<thead>
<tr>
<th>EPBC significantly affected CEEC or threatened species</th>
<th>Offset requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland</td>
<td>70.4 ha where offset sites are in moderate to good condition or 140.8 ha where offset sites are in poor condition including rehabilitation sites</td>
</tr>
<tr>
<td>Homopholis belsonii (Belson’s Panic)</td>
<td>8.7 ha</td>
</tr>
<tr>
<td>Five-clawed worm skink (<em>Anomalopus mackayi</em>)</td>
<td>No offset requirement as impact of the proposal was not deemed significant</td>
</tr>
</tbody>
</table>
5. Environmental management

The REF for the Newell Highway Heavy Duty Pavements, North Moree identified the framework for environmental management, including safeguards and management measures that would be adopted to avoid or reduce environmental impacts (Section 7 of the REF).

After consideration of the issues raised in the public submissions and changes to the proposal, the safeguard and management measures have been revised. One additional safeguard to reduce the impact on *Homopholis belsonii* (Belson’s Panic) has been added as an additional mitigation measure, refer to Section 5.2.

Should the proposal proceed, environmental management will be guided by the framework and measures outlined below.

### 5.1 Environmental management plans (or system)

A number of safeguards and management measures have been identified in order to minimise adverse environmental impacts, including social impacts, which could potentially arise as a result of the proposal. Should the proposal proceed, these management measures would be incorporated into the detailed design and applied during the construction and operation of the proposal.

A Construction Environmental Management Plan (CEMP) will be prepared to describe safeguards and management measures identified. The CEMP will provide a framework for establishing how these measures will be implemented and who would be responsible for their implementation.

The CEMP will be prepared prior to construction of the proposal and must be reviewed and certified by environment staff, Western Region, prior to the commencement of any on-site works. The CEMP will be a working document, subject to ongoing change and updated as necessary to respond to specific requirements. The CEMP would be developed in accordance with the specifications set out in the:

- QA Specification G36 – Environmental Protection (Management System)
- QA Specification G38 – Soil and Water Management (Soil and Water Plan)
- QA Specification G40 – Clearing and Grubbing

### 5.2 Summary of safeguards and management measures

The REF for the Newell Highway Heavy Duty Pavement, North Moree identified a range of environmental outcomes and management measures that would be required to avoid or reduce the environmental impacts.

After consideration of the issues raised in the public submissions, the environmental management measures for the proposal (refer to Chapter 7 of the REF) have been revised. Should the proposal proceed, the environmental management measures in Table 5-1 will guide the subsequent phases of the proposal. Additional and/or modified environmental safeguards and management measures to those presented in the REF have are in **bold** and been underlined. While deleted measures, or parts of measures, have been struck out.
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| GEN1 | General - minimise environmental impacts during construction | A CEMP will be prepared for each section and submitted for review and endorsement of the Roads and Maritime Environment Manager prior to commencement of the activity. As a minimum, the CEMP will address the following:  
- Any requirements associated with statutory approvals  
- Details of how the project will implement the identified safeguards outlined in the REF  
- Issue-specific environmental management plans  
- Roles and responsibilities  
- Communication requirements  
- Induction and training requirements  
- Procedures for monitoring and evaluating environmental performance, and for corrective action  
- Reporting requirements and record-keeping  
- Procedures for emergency and incident management  
- Procedures for audit and review.  
The endorsed CEMP will be implemented during the undertaking of the activity. | Contractor / Roads and Maritime project manager | Pre-construction / detailed design | Core standard safeguard GEN1 |
<p>| GEN2 | General - notification | All businesses, residential properties and other key stakeholders (eg schools, local councils) affected by the activity will be notified at least five days prior to commencement of the activity. | Contractor / Roads and Maritime project manager | Pre-construction | Core standard safeguard GEN2 |
| GEN3 | General – environmental awareness | All personnel working on site will receive training to ensure awareness of environment protection requirements to be | Contractor / Roads and Maritime project manager | Pre-construction / detailed design | Core standard safeguard |</p>
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<td>implemented during the project. This will include up-front site induction and regular &quot;toolbox&quot; style briefings. Site-specific training will be provided to personnel engaged in activities or areas of higher risk. These include • Areas of Aboriginal heritage sensitivity • Threatened species habitat • Aboriginal heritage management including unexpected finds procedures • Threatened species habitat and EEC.</td>
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<tr>
<td>GEN4</td>
<td>Utilities</td>
<td>Prior to the commencement of works: • The location of existing utilities and relocation details will be confirmed following consultation with the affected utility owners • If the scope or location of proposed utility relocation works falls outside of the assessed proposal scope and footprint, further assessment will be carried out.</td>
<td>Contractor</td>
<td>Detailed design / pre-construction</td>
<td>Core standard safeguard</td>
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<tr>
<td>GEN5</td>
<td>Hazards and risk management</td>
<td>A Hazard and Risk Management Plan (HRMP) will be prepared and implemented as part of the CEMP. The HRMP will include, but not be limited to: • Details of hazards and risks associated with the activity • Measures to be implemented during construction to minimise these risks • Record keeping arrangements, including information on the materials present on the site, material safety data sheets, and personnel trained and authorised to use such materials • A monitoring program to assess performance in managing the identified risks</td>
<td>Contractor</td>
<td>Detailed design / pre-construction</td>
<td>Core standard safeguard</td>
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<td>• Contingency measures to be implemented in the event of unexpected hazards or risks arising, including emergency situations. The HRMP will be prepared in accordance with relevant guidelines and standards, including relevant Safe Work Australia Codes of Practice, and EPA or Office of Environment and Heritage publications.</td>
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<tr>
<td>GEN6</td>
<td>General – environmental</td>
<td>Standard construction hours:</td>
<td>Contractor</td>
<td>Construction</td>
<td>Core standard safeguard</td>
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|     | awareness               | • Monday to Friday 7.00 am to 6.00 pm  
• Saturdays 8.00 am to 1.00 pm  
• No construction on Sundays or Public Holidays.                                                                                                                                                                                                                                                                                                                                                                 |                |                      |                                  |
<p>|     |                         | Works outside standard construction hours (including those detailed within this REF) will be undertaken in accordance with the management and mitigation measures detailed within the Noise and Vibration Management Plan.                                                                                                                                                                                                                                        |                |                      |                                  |
| GEN7| General – environmental | The Roads and Maritime Project Manager will notify the Roads and Maritime Environment Manager at least five days prior to the commencement of the activity. The notification will include a copy of any local community notification undertaken (GEN2).                                                                                                                  | Contractor     | Pre-construction /   | Additional safeguard            |
|     | awareness               | detailed design                                                                                              |                |                      |                                  |
| B1  | Biodiversity            | A Flora and Fauna Management Plan will be prepared in accordance with Roads and Maritime’s <em>Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects</em> (RTA, 2011) and implemented as part of the CEMP. It will include, but not be limited to:                                                                                                              | Contractor     | Detailed design /    | Section 4.8 of QA G36            |
|     |                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                | pre-construction      | Environment Protection          |</p>
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<td>• Plans showing areas to be cleared and areas to be protected, including exclusion zones, protected habitat features and revegetation areas&lt;br&gt;• Requirements set out in the <em>Landscape Guideline</em> (RTA, 2008)&lt;br&gt;• Pre-clearing survey <em>requirements</em> in accordance with Guide 1: Pre-clearing process of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011)&lt;br&gt;• Procedures for unexpected threatened species finds and fauna handling&lt;br&gt;• Procedures addressing relevant matters specified in the <em>Policy and guidelines for fish habitat conservation and management</em> (DPI Fisheries, 2013)&lt;br&gt;• Protocols to manage weeds and pathogens.</td>
<td>Contactor</td>
<td>Detailed design / pre-construction</td>
<td>Core standard safeguard</td>
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<tr>
<td>B2</td>
<td>Biodiversity</td>
<td>Measures to further avoid and minimise the construction footprint and native vegetation or habitat removal will be investigated during detailed design and implemented where practicable and feasible.</td>
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<tr>
<td>B3</td>
<td>Removal of native vegetation</td>
<td>• Vegetation and habitat removal would be undertaken in accordance with Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011)&lt;br&gt;• Native vegetation would be re-established in accordance with Guide 3: Re-establishment of native vegetation of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011)&lt;br&gt;• Exclusion zones would be set up at the limit of clearing (ie the edge of the impact area) in accordance with Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011).</td>
<td>Contactor</td>
<td>Construction</td>
<td>Additional safeguard</td>
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| B4  | Removal of threatened species habitat and habitat features             | • Habitat would be replaced or re-instated in accordance with Guide 5: Re-use of woody debris and bushrock and Guide 8: Nest boxes of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011)  
• The unexpected species find procedure is to be followed under Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011) if threatened fauna, not assessed in the biodiversity assessment, are identified in the proposal site | Contractor       | Detailed design / pre-construction | Additional safeguard |
<p>| B5  | Aquatic impacts                                                        | Aquatic habitat would be protected in accordance with Guide 10: Aquatic habitats and riparian zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011) and Section 3.3.2 Standard precautions and mitigation measures of the Policy and guidelines for fish habitat conservation and management Update 2013 (DPI (Fisheries NSW) 2013). | Contractor       | Construction                  | Additional safeguard |
| B7  | Invasion and spread of weeds                                           | Weed species would be managed in accordance with Guide 6: Weed management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011).                                                                                                                | Contractor       | Construction                  | Additional safeguard |
| B8  | Invasion and spread of pests                                          | Pest species would be managed within the proposal site.                                                                                                                                                                                                                                                                                                | Contractor       | Construction                  | Additional safeguard |
| B9  | Invasion and spread of pathogens and disease                           | Pathogens would be managed in accordance with Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011).                                                                                                                             | Contractor       | Construction                  | Additional safeguard |</p>
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<tr>
<td>B10</td>
<td>Noise, light and vibration</td>
<td>Shading and artificial light impacts would be minimised through detailed design.</td>
<td>Contractor</td>
<td>Detailed design</td>
<td>Additional safeguard</td>
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<tr>
<td>B11</td>
<td>Biodiversity offsets</td>
<td>The final design impact area will be ground-truthed and offsets will be calculated and implemented as per <em>Guideline for Biodiversity Offsets</em> (November 2016).</td>
<td>Roads and Maritime</td>
<td>Detailed design</td>
<td>Additional safeguard</td>
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| B12 | Impact to *Homopholis belsonii* (Belson’s Panic) within NMS2 | To further reduce the impact on *Homopholis belsonii* within NMS2, the detailed design would consider avoiding the *Homopholis belsonii* (Belson’s Panic) clusters 1 and 2. This could be achieved by:  
  - Investigate moving proposal further to the west of the known population  
  - Consider using narrow batters near the known population. | Roads and Maritime | Detailed design | Additional safeguard |

**Hydrology and flooding**

| HF1 | Soil and water[a] | A Soil and Water Management Plan (SWMP) will be prepared for each segment section and implemented as part of the CEMP. The SWMP will identify all reasonably foreseeable risks relating to soil erosion and water pollution and describe how these risks will be addressed during construction. | Contractor | Detailed design/pre-construction | Section 2.1 of QA G38 *Soil and Water Management* |
| HF2 | Soil and water[a] |  
- A site specific Erosion and Sediment Control Plan/s (ESCP) will be prepared for each segment section and implemented as part of the Soil and Water Management Plan  
- The plan will include arrangements for managing wet weather events, including monitoring of potential high risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather. | Contractor | Detailed design/Pre-construction | Section 2.2 of QA G38 *Soil and Water Management* |
<p>| HF3 | Contaminants entering receiving environments | Control measures to minimise the risk of water pollution will be implemented including: | Construction contractor | Construction | Additional safeguard |</p>
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|     | during construction | • All fuels, chemicals, and liquids will be stored at least 40 metres away from the existing stormwater drainage system and stored in an impervious bunded area within the compound site  
• Plant and maintenance machinery will be refuelled in impervious bunded areas in the designated compound area  
• Vehicle wash downs and/or concrete truck washouts will be carried out within a designated bunded area of an impervious surface or carried out off-site. |                                    |        |           |
| HF4 | Construction water source Extraction of water | Non-potable water sources (including water from landowners, potential for waterway, borehole extraction) will be investigated during detailed design to minimise reliance on potable water where feasible | Roads and Maritime/Construction contractor | Construction | Additional safeguard |
| HF5 | Extraction of water | Non-potable water sources (including the potential for waterway, borehole extraction and sourcing from private landowners) would be investigated during detailed design to minimise reliance on potable water where feasible. | Roads and Maritime/Construction contractor | Construction | Additional safeguard |
| HF6 | Hydrology and flood management | • A Flood Management Plan will be prepared prior to the work starting. This plan will include:  
  • Review and coordination with existing local flood plans and evacuation procedures  
  • Flood emergency preparation, response, and recovery measures which will be implemented during construction  
  • Procedure for daily review of The Bureau of Meteorology website  
  • Site protection measures to be implemented prior to and in the event of flooding  
  • Procedure for monitoring and maintenance of protection measures during heavy rainfall events. | Construction contractor | Construction | Additional safeguard |
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<td>HF7</td>
<td>Flooding</td>
<td>The CEMP will consider the potential impacts of temporary construction works including trenching, solid traffic barriers and stockpiles on overland flows and incorporate appropriate management measures to address these issues.</td>
<td>Contractor</td>
<td>Construction</td>
<td>Additional safeguard</td>
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<td>SC1</td>
<td>Contaminated land</td>
<td>If contaminated areas are encountered during construction, appropriate control measures will be implemented to manage the immediate risks of contamination. All other works that may impact on the contaminated area will cease until the nature and extent of the contamination has been confirmed and any necessary site-specific controls or further actions identified in consultation with the Roads and Maritime Environment Manager and/or EPA If required</td>
<td>Contractor</td>
<td>Detailed design/Pre-construction</td>
<td>Section 4.2 of QA G36 Environment Protection</td>
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<tr>
<td>SC2</td>
<td>Accidental spill</td>
<td>A site specific emergency spill plan will be developed, and include spill management measures in accordance with the Roads and Maritime Code of Practice for Water Management (RTA, 1999) and relevant EPA guidelines. SC3 The plan will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities (including Roads and Maritime and EPA officers).</td>
<td>Contractor</td>
<td>Detailed design/Pre-construction</td>
<td>Section 4.3 of QA G36 Environment Protection</td>
</tr>
<tr>
<td>SC3</td>
<td>Stockpile management</td>
<td>Stockpiles will be designed, established, operated and decommissioned in accordance with Roads and Maritimes’ Stockpile Site Management Guideline 2015.</td>
<td>Construction contractor</td>
<td>Construction</td>
<td>Additional standard safeguard SW9</td>
</tr>
<tr>
<td>SC4</td>
<td>Soil stabilisation and restoration</td>
<td>The rehabilitation of disturbed areas will be carried out progressively as construction stages are completed, and in accordance with:</td>
<td>Construction contractor</td>
<td>Construction</td>
<td>Additional standard safeguard</td>
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| SC5 | Pollution from run-off | The ancillary facilities will be managed within the ESCP. The following measures will be included to limit sediment and other contaminations entering receiving waterways:  
- Chemicals will be stored within a sealed or bunded area  
- Appropriate controls will be in place where plant is stored  
- Run-off from ancillary sites will be controlled and treated before discharging into downstream waterways  
- Vehicle movements will be restricted to designated pathways where feasible  
- Areas that will be exposed for extended periods, such as car parks and main access roads, will be stabilised where feasible. | Construction contractor | Construction | Additional safeguard |

**Traffic and transport**

| TT1 | Traffic and transport | A Traffic Management Plan (TMP) will be prepared and implemented as part of the CEMP. The TMP will be prepared in accordance with the Roads and Maritime *Traffic Control at Work Sites Manual* (RTA, 2010) and QA Specification G10 Control of Traffic (Roads and Maritime, 2008). The TMP will include:  
- Confirmation of haulage routes  
- Measures to maintain access to local roads and properties  
- Site specific traffic control measures (including signage) to manage and regulate traffic movement  
- Measures to maintain pedestrian and cyclist access  
- Requirements and methods to consult and inform the local community of impacts on the local road network | Contractor | Detailed design/Pre-construction | Section 4.8 of QA G36 Environment Protection |
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| TT2 | Property access - pre-construction         | • Access to construction sites including entry and exit locations and measures to prevent construction vehicles queuing on public roads.  
• A response plan for any construction traffic incident  
• Consideration of other developments that may be under construction to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic  
• Monitoring, review and amendment mechanisms.                                                                                                               | Roads and Maritime                 | Pre-construction/detailed design          | Additional standard safeguard          |
<p>| TT3 | Notifications to landowners                | Requirements for any changes to local access arrangements will be confirmed during detailed design in consultation with the local road authority and any affected landowners.                                                                 | Roads and Maritime and Construction Contractor | Construction | Additional standard safeguard          |
| TT4 | Property access - during construction      | Disruptions to property access and traffic will be notified to landowners at least five in accordance with the relevant community consultation processes outlined in the TMP.                                                                 | Roads and Maritime and Construction Contractor | Construction | Additional standard safeguard          |
| TT5 | Reduce speeds, traffic delays and disruptions during construction | Road users, local communities and the freight industry will be provided with timely, accurate, relevant and accessible information about changed traffic arrangements and delays owing to construction activities.                                                                 | Roads and Maritime and Construction Contractor | Construction | Additional standard safeguard          |
| TT6 | Disruption to public transport, including school bus services | Access for public transport services, including school bus services, will be maintained. The requirements for any temporary changes will be confirmed following consultation with local bus operators and the community.                                                                 | Roads and Maritime and Construction Contractor | Construction | Additional standard safeguard          |</p>
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<td>TT7</td>
<td>Impacts of the regional road network</td>
<td>Where possible, the most disruption work (such as work that requires lane closures) will be carried out at night to minimise potential impacts on the regional road network. This, combined with temporary effective traffic management, will assist in minimising impacts to traffic and transport using the Newell Highway.</td>
<td>Roads and Maritime and Construction Contractor</td>
<td>Construction</td>
<td>Additional safeguard</td>
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### Noise and vibration

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| NV1 | Noise and vibration                         | A Noise and Vibration Management Plan (NVMP) will be prepared and implemented as part of the CEMP. The NVMP will generally follow the approach in the *Interim Construction Noise Guideline* (ICNG) (DECC, 2009) and identify:  
  - All potential significant noise and vibration generating activities associated with the activity  
  - Feasible and reasonable mitigation measures to be implemented, taking into account *Beyond the Pavement: urban design policy, process and principles* (Roads and Maritime, 2014)  
  - A monitoring program to assess performance against relevant noise and vibration criteria  
  - Arrangements for consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures  
  - Contingency measures to be implemented in the event of non-compliance with noise and vibration criteria. | Contractor      | Detailed design / pre-construction | Section 4.6 of QA G36 Environment Protection |
| NV2 | Noise and vibration                         | All sensitive receivers (eg schools, local residents) likely to be affected will be notified at least [insert no. of days] prior to commencement of any works associated with the activity that may have an adverse noise or vibration impact. The notification will provide details of:  
  - The project  
  - The construction period and construction hours | Contractor      | Detailed design / pre-construction | Core standard safeguard NV2 |

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|     |                               | • Contact information for project management staff  
• Complaint and incident reporting  
• How to obtain further information.                                                                                                                                                                                      |                         |                               |                                  |
| NV3 | Site induction                | All personnel working on site will receive training to ensure awareness of requirements of the NVMP. Site-specific training will be given to personnel when working in the vicinity of sensitive receivers.                           | Contractor              | Pre-construction / construction | Additional safeguard              |
| NV4 | Noise and vibration           | Where possible, works outside of standard construction hours will be planned so that noisier works are carried out in the earlier part of the evening or night time.                                                   | Contractor              | Pre-construction / construction | Additional safeguard              |
| NV5 | Noise and vibration           | Where there are complaints about noise from an identified work activity, the work activity will be reviewed, and where feasible and reasonable, action additional control measures. This may include monitoring to confirm that predicted impacts are in line with levels predicted in this assessment. | Contractor              | Construction                  | Addition safeguard               |
| NV6 | Reducing Vibration impacts    | • Choosing alternative, lower-impact equipment or methods wherever possible  
• Scheduling the use of vibration-causing equipment at the least sensitive times of the day (wherever possible)  
• Locating high vibration sources as far away from sensitive receiver areas as possible  
• Sequencing operations so that vibration-causing activities do not occur simultaneously  
• Keeping equipment well maintained  
• Do not conduct vibration intensive works within the building damage distances outlined in Table 6-40 of the REF. Where possible, avoid the use of vibration intensive plant within the nominated human comfort distances. Where this isn’t possible, an attendee should be present during the works to suspend activities in the instance of any issues or complaints | Construction contractor | Construction                  | Additional safeguard              |
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<td>• Wherever practical, static compaction techniques should be utilised for compaction required within the applicable setback distances recommended to avoid human comfort impacts.</td>
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| NV7 | Vibration impacts on buildings | • Building condition inspection reports must be completed in accordance with QA Specification G36 for all heritage structures in the proposal area and any other nearby structures or buildings at risk from vibration impacts  
• A follow up building condition inspection of all heritage structures in the work area will be carried out when all the construction work is complete. | Construction contractor | Pre-construction and during construction as required | Additional safeguard               |

**Aboriginal heritage**

| AH1 | Aboriginal heritage            | An Aboriginal Heritage Management Plan (AHMP) will be prepared in accordance with the Procedure for Aboriginal cultural heritage consultation and investigation (Roads and Maritime, 2012) and Standard Management Procedure - Unexpected Heritage Items (Roads and Maritime, 2015) and implemented as part of the CEMP. It will provide specific guidance on measures and controls to be implemented for managing impacts on Aboriginal heritage. The AHMP will be prepared in consultation with all relevant Aboriginal groups. | Contactor            | Detailed design/pre-construction | Section 4.9 of QA G36 Environment Protection |
| AH2 | Aboriginal heritage            | • The *Standard Management Procedure - Unexpected Heritage Items* (Roads and Maritime, 2015) will be followed in the event that an unknown or potential Aboriginal object/s, including skeletal remains, is found during construction  
• Work will only re-commence once the requirements of that Procedure have been satisfied. | Contactor            | Detailed design/pre-construction | Section 4.9 of QA G36 Environment Protection |
| AH3 | Impacts to Aboriginal heritage | • Where possible, the design will avoid impacts to modified trees (BR-HW17-ST1 and BR-HW17-ST2)  
• If this is possible then exclusion zones will be established around the items to ensure their protection | Road and Maritime    | Detailed design/pre-construction | Additional safeguard               |
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<td>• If impact to these items is unavoidable then the Aboriginal cultural heritage investigation must proceed to PACHCI Stage 3 (Roads and Maritime, 2011).</td>
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<td>AH4</td>
<td>Aboriginal heritage</td>
<td>• Any further changes to the proposal area outside the survey area will be assessed by a suitably qualified heritage professional.</td>
<td>Road and Maritime</td>
<td>Detailed design/pre-const</td>
<td>Additional safeguard</td>
</tr>
<tr>
<td>AH5</td>
<td>Minimise risks to Aboriginal cultural heritage during construction</td>
<td>• All personnel working on site will receive training to ensure awareness of requirements of the Aboriginal Heritage Management Plan and relevant statutory responsibilities. Site-specific training will be given to personnel when working in the vicinity of identified Aboriginal heritage items.</td>
<td>Contactor</td>
<td>Detailed design/pre-const</td>
<td>Additional standard safeguard</td>
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</tbody>
</table>
| AH6 | Aboriginal heritage items BR-HW17-ST1 and BR-HW17-ST2 | • During construction, BR-HW17-ST1 and BR-HW17-ST2 (if not impacted) will be demarcated using high visibility ground markers to delineate the site perimeter (such as staking and flagging) encompassing the tree canopy  
• The ground markers will be visible to any person in the vicinity of the site, whether on foot or in a vehicle  
• BR-HW17-ST1 and BR-HW17-ST2 will be mapped on the CEMP and detailed design plans and the canopy extent demarcated as a ‘no-go’ and ‘no-harm’ area  
• Vehicles will not be driven on, or in the immediate vicinity of, the BR-HW17-ST1 and BR-HW17-ST2 site extent  
• If required, appropriate sediment control measures will be installed, operated and maintained to prevent sediment moving onto the site extent during the construction of the proposal. | Contractor          | Construction                   | Additional safeguard                           |

**Non-Aboriginal heritage**

| NAH1 | Non-Aboriginal heritage                      | Non-Aboriginal Heritage management measure will be included and implemented as part of the CEMP. The measures will provide specific guidance on measures and controls to be                                                                                                                                                                      | Contractor          | Detailed design/pre-const        | Section 4.10 of QA G36                         |

Newell Highway Heavy Duty Pavements, North Moree
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<table>
<thead>
<tr>
<th>No.</th>
<th>Impact</th>
<th>Environmental safeguards</th>
<th>Responsibility</th>
<th>Timing</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>implemented to avoid and mitigate impacts on non-Aboriginal heritage.</td>
<td></td>
<td></td>
<td>Environment Protection</td>
</tr>
</tbody>
</table>
| NAH2 | Non-Aboriginal heritage | • The *Standard Management Procedure – Unexpected Heritage Items* (Roads and Maritime, 2015) will be followed in the event that any unexpected heritage items, archaeological remains or potential relics of non-Aboriginal origin are encountered  
• Work will only re-commence once the requirements of that Procedure have been satisfied. | Contractor | Detailed design/pre-construction | Core standard safeguard  
Section 4.10 of QA G36 Environment Protection |
| NAH3 | Non-Aboriginal heritage | Non-Aboriginal heritage awareness training will be provided for all contractors and personnel prior to commencement of construction to outline the identification of potential heritage items and associated procedures to be implemented in the event of the discovery of non-Aboriginal heritage materials, features or deposits (that is, unexpected finds), or the discovery of human remains. | Contractor | Pre-construction | Additional safeguard |

**Landscape character and visual impacts**

| LC1 | Landscape character and visual impact | An Urban Design Plan will be prepared to support the final detailed project design and implemented as part of the CEMP. The Urban Design Plan will present an integrated urban design for the project, providing practical detail on the application of design principles and objectives identified in the environmental assessment. The Plan will include design treatments for:  
• Location and identification of existing vegetation and proposed landscaped areas, including species to be used  
• Built elements including retaining walls and bridges  
• Fixtures such as seating, lighting, fencing and signs | Contractor | Detailed design / pre-construction | Core standard safeguard |
<table>
<thead>
<tr>
<th>No.</th>
<th>Impact</th>
<th>Environmental safeguards</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>• Details of the staging of landscape works taking account of related environmental controls such as erosion and sedimentation controls and drainage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Procedures for monitoring and maintaining landscaped or rehabilitated areas.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The Urban Design Plan will be prepared in accordance with relevant guidelines, including:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• <em>Beyond the Pavement urban design policy, process and principles</em> (Roads and Maritime, 2014)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• <em>Landscape Guideline</em> (RTA, 2008)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• <em>Bridge Aesthetics</em> (Roads and Maritime 2012).</td>
</tr>
<tr>
<td>LC2</td>
<td>Landscape character and visual impact</td>
<td>Limit vegetation loss - either through revisions to alignment or scale of proposed cross section.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Contactor</td>
</tr>
<tr>
<td>LC3</td>
<td>Landscape character and visual impact</td>
<td>Provide screening to properties which have been impacted by the proposal through the opening up of views to the proposed alignment.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Contactor</td>
</tr>
<tr>
<td>LC4</td>
<td>Landscape character and visual impact</td>
<td>Provide definition to the changing land uses associated with the townships through which the highway passes.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Contactor</td>
</tr>
<tr>
<td>LC5</td>
<td>Landscape character and visual impact</td>
<td>Providing interest to the motorist along their journey in an effort to breakdown the sense of distance and provide a sense of progression and connection to context.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Contactor</td>
</tr>
</tbody>
</table>

**Property, land use and socio-economic**

<p>| SE1 | Consultation | A Project Communications Plan (CP) will be prepared and implemented as part of the CEMP |
|     |             | Contractor | Detailed design/pre-construction | Section 3.7 of QA G36 Environment Protection |</p>
<table>
<thead>
<tr>
<th>No.</th>
<th>Impact</th>
<th>Environmental safeguards</th>
<th>Responsibility</th>
<th>Timing</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE2</td>
<td>Consultation</td>
<td>Individual project CPI will be prepared and implemented to help provide timely and accurate information to the community during construction. The CPs will include (as a minimum): • Mechanisms to provide details and timing of proposed activities to affected residents and businesses, including changed traffic and access conditions • Contact name and number of complaints • The CPs will be prepared in accordance with the Community Involvement and Communications Resource Manual (RTA, 2008). Early and ongoing consultation and communication should be carried with local accommodation providers and tourism industry representatives to ensure that demands on short-term accommodation are appropriately managed, particularly during peak tourist times.</td>
<td>Roads and Maritime</td>
<td>Pre-construction and construction</td>
<td>Core standard safeguard</td>
</tr>
<tr>
<td>SE3</td>
<td>Emergency vehicle access</td>
<td>Access for emergency vehicles will be maintained at all times during construction. Any site-specific requirements will be determined in consultation with the relevant emergency services agency.</td>
<td>Roads and Maritime</td>
<td>Pre-construction and construction</td>
<td>Additional safeguard</td>
</tr>
</tbody>
</table>

**Waste and resource management**

<p>| WR1 | Generation of construction waste | A Waste Management Plan will be prepared and implemented as part of the CEMP. The WMP will include but not be limited to: • Measures to avoid and minimise waste associated with the proposal • Classification of wastes generated by the proposal and management options (re-use, recycle, stockpile, disposal) • Classification of wastes received from off-site for use in the proposal and management options | Contactor               | Pre- construction /detailed design         | Section 4.2 of QA G36 Environment Protection  |</p>
<table>
<thead>
<tr>
<th>No.</th>
<th>Impact</th>
<th>Environmental safeguards</th>
<th>Responsibility</th>
<th>Timing</th>
<th>Reference</th>
</tr>
</thead>
</table>
|     |        | • Identifying any statutory approvals required for managing both on and off-site waste, or application of any relevant resource recovery exemptions  
• Procedures for storage, transport and disposal  
• Monitoring, record keeping and reporting, including any documentation management obligations arising from resource recovery exemptions  
• The Plan will be prepared taking into account the Roads and Maritime Environmental Procedure - Management of Wastes on Roads and Maritime Services Land and relevant Roads and Maritime Waste Fact Sheets, as well as the adopting the Resources Management Hierarchy principles of the WARR Act. | | | |
| WR2 | Existing condition of ancillary sites | Prior to land being used for ancillary construction purposes (compounds, storage, parking, etc) a pre-construction land assessment will be carried out to identify the presence of any pre-existing wastes. | Contactor | Pre-construction/detailed design | Core standard safeguard |
| WR3 | Final condition of ancillary sites | A post-construction land assessment will be carried out of land that was used for ancillary construction purposes (compounds, storage, parking, etc.) to determine the suitability for hand-back to the landowner. | Contractor | Post construction/operation | Additional standard |

**Air quality, climate change and greenhouse gas**

| AQ1 | Impacts on air quality during construction | An Air Quality Management Plan (AQMP) will be prepared and implemented as part of the CEMP. The AQMP will include, but not be limited to:  
• Potential sources of air pollution  
• Air quality management objectives consistent with any relevant published EPA and/or OEH guidelines  
• Mitigation and suppression measures to be implemented | Contactor | Detailed design/pre-construction | Section 4.4 of QA G36 Environment Protection |
<table>
<thead>
<tr>
<th>No.</th>
<th>Impact</th>
<th>Environmental safeguards</th>
<th>Responsibility</th>
<th>Timing</th>
<th>Reference</th>
</tr>
</thead>
</table>
|     |                                            | • Methods to manage work during strong winds or other adverse weather conditions  
• A progressive rehabilitation strategy for disturbed areas.                                                                                                                                                    |                      |                         |                                 |
| AQ2 | Impacts on climate change during construction | During construction, the following measures will be considered and implemented where possible:  
• Plant and equipment will be switched off when not in use  
• Vehicles, plant and construction equipment will be appropriately sized for the task and properly maintained so as to achieve optimum fuel efficiency  
• Materials will be delivered with full loads and will come from local suppliers, where possible  
• Energy efficiency and related carbon emissions will be considered when selecting vehicles and equipment  
• Vegetation clearing will be reduced as much as feasible, and re-established in suitable areas when construction is completed  
• Waste will be reduced and recycled as a preference before disposing to landfill. | Construction contractor | Construction | Additional safeguard |
| AQ3 | Climate change risks to construction       | Environmental safeguards and management measures in the CEMP will be designed to accommodate and respond to the increased frequency and severity of rainfall events.                                                   | Construction contractor | Pre-construction | Additional safeguard |
|     |                                            |                                                                                                                                                                                                                      |                      |                         |                                 |
|     | Cumulative impacts                         | The CEMP will be updated as required to address cumulative impacts as other projects/activities begin. This will include a process to review and update mitigation measures as new work begins or if complaints are received. | Contractor           | Pre-construction/Construction | Additional safeguard |
| CU2 | Cumulative impacts to biodiversity         | Biodiversity offsets will be secured as per the Roads and Maritime *Guideline for Biodiversity Offsets* (November 2016).                                                                                             | Roads and Maritime   | Detailed design         | Additional safeguard |

*Newell Highway Heavy Duty Pavements, North Moree Submission report*
5.3 Licensing and approvals

Licences and approvals required for the proposal are listed in Table 5-2.

Table 5-2: Summary of licensing and approval required

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Requirement</th>
<th>Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protection of the Environment Operations Act 1997</td>
<td>Environment protection licence (EPL) for scheduled activities (road construction / extractive activities / crushing, grinding or separating waste processing or storage) &gt;30,000t/pa from the EPA.</td>
<td>Prior to start of the activity.</td>
</tr>
<tr>
<td>Roads Act 1993</td>
<td>Road Occupancy Permit would need to be obtained as necessary prior to construction commencing.</td>
<td>Prior to start of the activity.</td>
</tr>
<tr>
<td>Crown Lands Act 1989 (s6)</td>
<td>Licence to occupy areas of Crown land</td>
<td>Prior to start of the activity</td>
</tr>
<tr>
<td>Permission to enter from private landowners and residents</td>
<td>Permission to enter from private landowners and residents must be obtained to access proposal work sites. This would likely be obtained through temporary lease arrangements or land acquisition.</td>
<td>Before accessing any private property.</td>
</tr>
</tbody>
</table>
6. References

Aurecon, 2018 Pavement Design Options Report


AREA Environmental consultants and communication 2017. Newell Highway Heavy Duty Pavements, Narrabri to Moree and North Moree Supplementary Assessment; Homopholis belsonii (Belson’s Panic) and the Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland


Roads and Maritime Services 2018, Newell Highway Heavy Duty Pavements, North Moree Biodiversity Assessment. Dubbo, NSW
Appendix A
Additional Biodiversity assessments
Roads and Maritime Services

Newell Highway Heavy Duty Pavements, Narrabri to Moree and North Moree Supplementary Assessment

July 2018

Prepared by: AREA Environmental Consultants & Communication Pty Ltd
M 0409 852 098
E phil@areaenvironmental.com.au
ABN:29 616 529 867
### Document history and status

<table>
<thead>
<tr>
<th>Revision</th>
<th>Date</th>
<th>Description</th>
<th>By</th>
<th>Review</th>
<th>Approved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rev 01</td>
<td>10/07/2018</td>
<td>Draft</td>
<td>Dr S. McDonald</td>
<td>Phillip Cameron (AREA Env)</td>
<td>With minor revisions</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Paul Rossington (Jacobs)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Jon Blizzard (Roads and Maritime)</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Ben Orford (Roads and Maritime)</td>
<td></td>
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<tr>
<td>Rev 02</td>
<td>28/07/2018</td>
<td>FINAL</td>
<td>Phillip Cameron</td>
<td>Jon Blizzard (Roads and Maritime)</td>
<td>Finalised</td>
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<td></td>
<td>Ben Orford (Roads and Maritime)</td>
<td></td>
</tr>
</tbody>
</table>

### Important note about your report

In preparing this submission, AREA has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and/or from other sources. Except as otherwise stated in the report, AREA has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then our observations and conclusions as expressed in this report may change.

AREA derived the data in this report from information sourced from the Client (if any) and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the Proposal and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report. AREA has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by AREA for use of any part of this report in any other context.

This report has been prepared on behalf of, and for the exclusive use of, AREA’s Client, and is subject to, and issued in accordance with, the provisions of the contract between Jacobs and the Client. AREA accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.
1 Introduction

Roads and Maritime Services (Roads and Maritime) proposes to carry out major pavement upgrades to five segments of the Newell Highway (the highway) between Narrabri and Moree (N2M), and three segments of the Newell Highway north of Moree (NM) in northern NSW (the Proposal). The Proposal forms part of the Newell Highway Corridor Strategy (Transport for NSW, 2015) to provide an efficient and sustainable corridor catering for increasing growth and improves safety along the Newell Highway.

Biodiversity assessment reports were completed by Jacobs in May 2018 which identified significant impacts under the Commonwealth Environmental Protection Biodiversity Conservation Act 1999 (EPBC Act) to populations of Homopholis belsonii (Belson’s Panic) and the Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland (Natural Grasslands [Critically Endangered, EPBC]).

AREA was commissioned by Roads and Maritime Services to collect additional data on the location, size and extent of the populations of Belson’s Panic (Homopholis belsonii) and the Natural Grasslands community to better inform the EPBC Act assessment of significance criteria for both matters.
2 Methodology

In developing the methodology for this assessment, AREA reviewed the N2M and NM biodiversity assessments undertaken by Jacobs to consider:

- where known or potential habitat of Belson’s Panic occurred
- where impact to these populations was determined significant.

Jacobs identified the Proposal will have a significant impact on populations of Belson’s Panic in segments N2MS2, NMS2 and NMS3 (N2MS4 and N2NS5 are not significantly impacted). AREA after ground truthing considered the population and community field surveys undertaken by Jacobs to be accurate and thorough.

*Homopholis belsonii* (Endangered BC Act) occurs as three populations within the Proposal. The population within N2MS2 (clusters 1 and 2) will be significantly impacted. Impacts on the other populations in the study area are considered unlikely to be significantly impacted, as surveys have demonstrated that these populations are large and extend well beyond the proposal area.

AREAs search for Belson’s Panic were undertaken at and nearby the known populations identified by Jacobs. Searches were undertaken both inside and outside of the ‘Alternative’ impact footprint, to estimate the size/extent of population affected by the Proposal and estimate the size/extent remaining in-tact. Search effort was concentrated beneath the canopy of trees and shrubs (Belah, Myall, Poplar Box, Wilga and the exotic Mimosa bush) as this is the predominant habitat known for the species. Jacobs Biodiversity Assessment Report (BAR) did not have the survey effort information AREA needed, especially transect data, to work out where exactly assessors looked. Therefore, we cannot be certain that additional populations of Belson’s Panic do not exist outside of the areas searched by Jacobs and for the same reason by AREA (although AREA can supply transect data upon request). Assessments in Natural Grasslands habitat were undertaken to confirm Plant Community Type (PCT) and extent of the community.

Jacobs BAR states “*it was not possible to determine the population size of Belson’s Panic due to the rhizomatous nature of the species*”. AREAs additional assessment estimates of relative population size have been determined using either percent cover, frequency of occurrence, and/or the proportion of habitat affected. A population of Belson’s Panic was considered as the area of contiguous PCT’s in which the species was recorded. The area of known or potential habitat was calculated using the sum of area of contiguous PCT’s with known occurrence of Belson’s Panic. AREA used the Alternative impact footprint, with an additional 4.0 m buffer to determine the area of habitat affected by the Proposal.

Searches by AREA were undertaken between 2 to 5 July 2018. Weather was fine, with light winds and maximum temperatures between 20 to 23 degrees Celsius. Rain had fallen in the week prior to undertaking surveys. Belson’s Panic remains readily detectable during winter in the field.

This submission was undertaken and prepared by a team of appropriately qualified and experienced ecologists (refer to Table 1)
Table 1: Personnel, role and qualifications

<table>
<thead>
<tr>
<th>Name</th>
<th>Role</th>
<th>Qualifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr Sarah McDonald</td>
<td>Ecologist – Survey design, field survey, mapping, reporting</td>
<td>Bachelor of Natural Resources (Honours)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Doctor of Philosophy (PhD)</td>
</tr>
<tr>
<td>Phillip Cameron</td>
<td>Project Management, survey design, review and certification</td>
<td>BSc, Ass Dip App Sci</td>
</tr>
</tbody>
</table>
3 Results

Total area of habitat determined by Jacobs in the BAR and in the segments assessed in this submission differed. This likely reflects differences in methodologies, and not errors by Jacobs or AREA. AREA’s uncertainty of Jacobs work was associated with how Jacobs determined area of habitat affected, as inconsistent areas for segments and PCT’s were stated throughout the BAR. Therefore, this report does not directly compare the areas of both studies, but rather the final outcomes which as noted earlier were ground truthed as accurate.

3.1 Homopholis belsonii

Re assessment of N2MS4 and N2MS5 were was not part of this additional assessment as the BAR (pp 154) states impact to these areas would not be significant.

3.1.1 Segment N2MS2

In total 2.9 ha of known/potential habitat (one population) of Homopholis belsonii was identified in Weeping Myall open woodland (PCT27, Figure 1 & 2, Table 2). Over 60 per cent of this habitat would be removed under the ‘alternative’ impact footprint scenario, with the remaining area likely to be affected by edge effects, as the width of the remaining community is reduced to less than 10m (effectively a road corridor bottleneck where there is no difference between the recommended and alternate alignment options).

All areas of EPBC quality woodland identified by Jacobs within segment N2MS2 were searched for additional populations of Belson’s Panic, however, no other populations were recorded within the segment. AREA agrees with the conclusions of Jacobs, a significant impact to this population of Belson’s Panic will occur because of the Proposal.

Table 2. Area of known or potential habitat of Homopholis belsonii within N2MS2, and impacts from the Proposal in N2MS2

<table>
<thead>
<tr>
<th>N2MS2</th>
<th>Total (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential habitat (ha)</td>
<td>2.9</td>
</tr>
<tr>
<td>Habitat in impact footprint (ha)</td>
<td>1.5</td>
</tr>
<tr>
<td>% potential habitat in IF</td>
<td>52.7</td>
</tr>
</tbody>
</table>

(IF = Alternative impact footprint + 4 m buffer)

3.1.2 Segment NMS1

No populations of Belson’s Panic have been located within NMS1, however, NMS1 contains 18.4 ha of potential habitat (Queensland Bluegrass +/- Mitchell Grass and Weeping Myall open woodland, identified as associated habitat by Jacobs, Figure 3). Approximately 23 per cent of this community would be affected by the Proposal (Table 3).

A substantial proportion of the impact footprint under the alternative scenario was classed as ‘not native’ after AREA assessed the community (see results for Natural Grasslands) and is unlikely to provide desirable habitat for Belson’s Panic. Therefore, the impact footprint within this segment is unlikely contain an important population of Belson’s Panic, and the impact to this species in NMS1 is unlikely to be significant according to the EPBC Act assessment of significance criteria.
Table 3. Area of known or potential habitat of *Homopolis belsonii* within NMS1, and area to the impacted from the Proposal in NMS1

<table>
<thead>
<tr>
<th>NMS1</th>
<th>Total (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential habitat (ha)</td>
<td>11.5</td>
</tr>
<tr>
<td>Habit in impact footprint (ha)</td>
<td>2.63</td>
</tr>
<tr>
<td>% potential habitat in IF</td>
<td>22.6</td>
</tr>
</tbody>
</table>

(IF = Alternative impact footprint + 4 m buffer)

3.1.3 Segment NMS2

Five clusters of populations of Belson’s Panic were identified within NMS2 (Figure 4).

- Clusters 1 & 2 were in Coolabah / River Cooba woodland, Queensland bluegrass +/- Mitchell Grass grassland and derived grassland (Figures 5 & 6). Most individuals are located east of the highway where the species reached over 80 per cent cover, forming a mat beneath Mimosa shrubs.
  - Mimosa bush/briar bush/yellow mimosa – *Vachellia farnesiana* (previously *Acacia farnesiana*) is a problem weed but is not listed as a Priority Weed in NSW.
  - Scattered Belson’s Panic individuals are located to the west of the highway and are considerably less prevalent.
  - AREA agrees with Jacobs, the impact would be significant to the local population (Table 4). 10.7 per cent of habitat in clusters 1&2 will be affected.

- Cluster 3 of Belson’s Panic was in Queensland bluegrass +/- Mitchell Grass grassland beneath Mimosa (Figure 7). Most of the population occurred outside the alternative impact footprint along the fence line, with only two known occurrence of the species located within the impact footprint. Therefore, the impact to the population in Cluster 3 was not considered to be significant by AREA.

- Cluster 4 was in derived grassland, adjacent to Myall woodland (Figure 8). Most records are beneath Mimosa, outside of the impact footprint. Although a substantial proportion of habitat occurs in the impact footprint, this is not considered to contain a significant proportion of the population of Belson’s Panic, and the Proposal will not have a significant impact on this population.

- Cluster 5 was in Poplar Box – Belah woodland and derived grassland. A greater proportion of Belson’s Panic is in derived grassland near the highway, than in the adjacent woodland (Figure 9). Approximately 21 per cent of total habitat is located within the impact footprint. Although this represents a sizable proportion of the population, given the prevalence of the species in previously disturbed habitat, it is likely that the species will recover in the newly disturbed areas created because of the Proposal as it clearly has done in the past. Therefore, the impact on this Proposal is not considered to be significant.
Table 4. Area of known or potential habitat of Homopholis belsonii within NMS2, and area to the impacted from the Proposal in NMS2

<table>
<thead>
<tr>
<th>NMS2 Clusters</th>
<th>Clusters 1 &amp; 2</th>
<th>Cluster 3</th>
<th>Cluster 4</th>
<th>Cluster 5</th>
<th>Total (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential habitat (ha)</td>
<td>51.4</td>
<td>8.3</td>
<td>7.4</td>
<td>15.4</td>
<td>82.5</td>
</tr>
<tr>
<td>Habit in impact footprint (ha)</td>
<td>4.7</td>
<td>0.8</td>
<td>1.1</td>
<td>2.8</td>
<td>9.4</td>
</tr>
<tr>
<td>% potential habitat in IF</td>
<td>10.7</td>
<td>16.8</td>
<td>31.4</td>
<td>21.2</td>
<td>11.4</td>
</tr>
</tbody>
</table>

(IF = Alternative impact footprint + 4 m buffer)

3.1.4 Segment NMS3

Five clusters of populations of Belson’s Panic were identified within NMS3 (Figure 10).

- Clusters 1 & 2 were in Belah woodland, Weeping Myall woodland and Derived Grassland (Figures 11 & 12). A large area of Belah woodland to the west of the study area was searched and Belson’s Panic was frequently recorded throughout. This increased the total area of contiguous Belson’s Panic habitat in this cluster to 137 ha (Table 5). Only a small proportion (five per cent) of the population and study area was located within the alternative impact footprint. Therefore, AREA concludes the impact of the Proposal on the Belson’s Panic population as **not significant** in these clusters.

- Cluster 3 was in Weeping Myall woodland (Figure 13). Only two records of Belson’s Panic were located inside the Alternative impact footprint, with over 90 per cent of the population located outside the impact footprint. Therefore, AREA concludes the impact of the Proposal on the Belson’s Panic population as **not significant** in this cluster.

- Cluster 4 was in Belah woodland outside of the study area to the east of the highway (Figure 14). Belson’s Panic was frequently located beneath the canopy of large, old Belah trees. No records were located within the Alternative impact footprint. AREA concludes the impact of the Proposal on the Belson’s Panic population as **not significant** in this cluster.

- Cluster 5 was in Belah woodland (Figure 15). Less than five per cent of the potential habitat is located within the Alternative impact footprint and no records of Belson’s Panic were located within the impact footprint. AREA concludes the impact of the Proposal on the Belson’s Panic population as **not significant** in this cluster.

Table 5. Area of known or potential habitat of Homopholis belsonii within NMS3, and area to the impacted from the Proposal in NMS3

<table>
<thead>
<tr>
<th>NMS3 Clusters</th>
<th>Clusters 1 &amp; 2</th>
<th>Cluster 3</th>
<th>Cluster 4</th>
<th>Cluster 5</th>
<th>Total (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential habitat (ha)</td>
<td>139.1</td>
<td>22.7</td>
<td>50.0</td>
<td>17.7</td>
<td>229.5</td>
</tr>
<tr>
<td>Habit in impact footprint (ha)</td>
<td>7.1</td>
<td>1.2</td>
<td>0.0</td>
<td>0.5</td>
<td>8.8</td>
</tr>
<tr>
<td>% potential habitat in IF</td>
<td>5.1</td>
<td>5.3</td>
<td>0.0</td>
<td>2.8</td>
<td>3.8</td>
</tr>
</tbody>
</table>

(IF = Alternative impact footprint + 4 m buffer)
3.2 Natural Grasslands

Jacobs concluded the Proposal would have a significant impact on the Natural Grasslands in segments NMS2. The proposal would remove 6.25 hectares of this community.

As part of this consideration AREA ground truthed Jacobs PCT mapping for this community across the Proposal to refine what was, and what was not native grasslands (not native grassland means >51 per cent cover by exotic species as defined by NSW OEH) adjacent to the highway.

AREA found the mapping of N2MS5 to be accurate.

AREA found the mapping by Jacobs of N2MS5 be accurate, however in contrast to Jacobs conclusion, does not consider the 11.31 ha in N2MS5, constituting a two per cent permanent reduction of the extent of the community in the impact footprint, to result in a substantial adverse impact on habitat critical to survival of the community. Jacobs assessment of significance in their BAR provides reasoning why the impact to this CEEC was determined as significant, and AREA agrees the Proposal would have a significant impact.

In segment NMS1, AREA found the condition of majority of grassland within the Alternative impact footprint to be of poor quality, with the ‘not-native- zone often extending between 5-20m from the roads edge line (while line on the outside pf the lane) line of the highway. Small adjustments were also made to the extent of the ‘not-native zone in segments NMS2 and NMS3. Revised figures on extent of Natural Grassland are provided in Table 6.

AREA provides the following additional information:

- Adversely affect habitat critical for survival (AoS for the CEEC pp162 of the BAR)

  - The EPBC Critical Habitat Register (search date 11 July 2018) does not list habitat for this CEEC as critical.
  - Jacobs review and explanation of MNES SIG 1.1 EPBC Act (DoE 2013)
    - ‘Habitat critical to the survival of an ecological community’ provides evidence:
      - NMS1 contains affected patches meeting the definition of good quality (>2 ha in size). AREAs assessment concluded this section was poor quality (thus not triggering a need for offsetting under Roads and Maritime Guidelines for Biodiversity Offsets November 2016).
      - NMS2 and NMS3 contain large patches >30 hectares in size meeting the definition of good quality.
      - Concludes these patches may be considered to be of importance to the survival of the community.
  - Post construction it is likely, based on observed edge effects in the study area, NMS1, NMS2 and NMS3 will retain attributes to be ‘good quality remnants’ however the permanent area of occupancy will be reduced.

| Table 6. Area of known or potential habitat of Natural Grasslands within NM segments, and area to the impacted from the Proposal in NM segments |
|-----------------|---------|---------|---------|---------|
|                  | NMS1    | NMS2    | NMS3    | Total   |
| Total habitat (ha) | 0       | 107.0   | 0       | 107.0   |
| Habitat in impact footprint (ha) | 0       | 6.25    | 0       | 6.25    |
| % potential habitat in IF | 0%      | 5.8%    | 0%      | 5.8%    |

(IF = Alternative impact footprint + 4 m buffer)
Figure 1. Location of *Homopholis belsonii* in N2MS2
Figure 2. Location of *Homopholis belsonii* in N2MS2
Figure 3. Vegetation communities within NMS1
Figure 4. Location of clusters (numbered and circled) of *Homopholis belsonii* in NMS2
Figure 5. Location of *Homopholis belsonii* in cluster 1 of NMS2
Figure 6. Location of *Homopholis belsonii* in cluster 2 of NMS2
Figure 7. Location of *Homopholis belsonii* in cluster 3 of NMS2
Figure 8. Location of *Homopholis belsonii* in cluster 4 of NMS2
Figure 9. Location of *Homopholis belsonii* in cluster 5 of NMS2
Figure 10. Location of clusters (numbered and circled) of *Homopholis belsonii* in NMS3
Figure 11. Location of *Homopolis belsonii* in cluster 1 of NMS3
Figure 12. Location of Homopholis belsonii in cluster 2 of NMS3
Figure 13. Location of *Homopholis belsonii* in cluster 3 of NMS3
Figure 14. Location of *Homopholis belsonii* in cluster 4 of NMS3
Figure 15. Location of *Homopholis belsonii* in cluster 5 of NMS3
4 Discussion and conclusions

4.1 Homopholis belsonii

This study has further refined the location of Belson’s Panic and provided additional information regarding the size and extent and the impact of the Proposal on these populations.

The total known or potential Belson’s Panic habitat that will be affected by the Proposal under the Alternative impact footprint with a four-metre (m) buffer is:

- 1.9 ha in segment N2MS2 (Moderate to Good condition) – Offsetting triggered
- 2.3 ha in NMS1 (Low condition)
- 9.4 ha in NMS2 (Moderate to Good condition)
- 8.8 ha in NMS3 (Moderate to Good condition)

Results of this study indicate significant impacts to populations within segments N2MS2 and NMS2 would occur totalling 12.2 ha of habitat.

AREA does not consider the Proposal to have a significant effect on populations of Belson’s Panic in segments NMS1 or NMS3 totalling 12.5 ha of habitat.

If the impact footprint within Belson’s Panic clusters 1 and 2 of NMS2 was moved to the west in the Queensland Bluegrass +/- Mitchell grassland (PCT52), to avoid disturbance east of the existing highway, this reduced the significance of the impact.

In N2MS2, the potential location of the footprint is constrained by the location of the railway line to the west of the highway, and cultivated land to the east. The significance of the impact to Belson’s Panic in this segment represents an unavoidable bottleneck.

4.2 Natural Grasslands

The Proposal will have a significant impact to NMS2 and N2NS5.

Challenging Jacobs determination of a significant impact to this CEEC would rely on, at best, subjective opinion, because the evidence provided in the BAR is technically sound even after applying in depth critique. The determination would be won or lost based on the legal interpretation of key words used in the EPBC guidance documents. To make the call, AREA refers to ‘Interfere with the recovery of an ecological community’ in the BAR AoS and have considered this based on existing attributes in the study area of road (and rail) activities in areas where the Natural Grassland ecological community occurs as the benchmark and concluded the Proposal:

- Would adversely impact on known local populations.
- Will change water flows and hydrology which may result in changes to the water table levels, increased salinity and increased run off or sediment.
- does not employ a management plan for the control of weeds such as Lippia (Phyla canescens), Coolatai Grass (Hyparrhenia hirta), African Love Grass (Eragrostis curvula) and Buffel Grass (Cenchrus ciliaris) in the region.
- does not employ a management plan to prevent introduction of invasive weeds, which could become a threat to the ecological community.
- does not employ hygiene measures for mowing and grading equipment and observe appropriate state protocols for moving stock.
If areas mapped as the CEEC had an effective and resourced management plan to meet requirement of the EPBC conservation advice, the significance of the impact to this CEEC is likely to have been not significant because the area of occupancy lost though development would have been substantially gained with management of weeds.
Newell Highway Heavy Duty Pavements, Narrabri to Moree (N2M) and North Moree (NM)
July 2018

Anomalopus mackayi

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ABN:29 616 529 867
Important note about your report

In preparing this submission, AREA has relied upon, and presumed information (or confirmation of the absence thereof) provided by the Client and/or from other sources is accurate. Except as otherwise stated in the report, AREA has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be inaccurate or incomplete then our observations and conclusions as expressed in this report may change.

AREA derived the data in this report from information sourced from the Client (if any) and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the Proposal and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report. AREA has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by AREA for use of any part of this report in any other context.

This report has been prepared on behalf of, and for the exclusive use of, AREA’s Client, and is subject to, and issued in accordance with, the provisions of the contract between Jacobs and the Client. AREA accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.
1 Introduction

Roads and Maritime Services (Roads and Maritime) proposes to carry out major pavement upgrades to five segments of the Newell Highway (the highway) between Narrabri and Moree (N2M), and three segments of the Newell Highway north of Moree (NM) in northern NSW (the Proposal). The Proposal forms part of the Newell Highway Corridor Strategy (Transport for NSW, 2015) to provide an efficient and sustainable corridor catering for increasing growth and improves safety along the Newell Highway.

Biodiversity assessment reports were completed by Jacobs in May 2018 which identified significant impacts under the Commonwealth Environmental Protection Biodiversity Conservation Act 1999 (EPBC Act) to *Anomalopus mackayi* (Five-clawed worm-skink).

Jacobs BAR stated ‘one local population of the Five-clawed Worm-skink is currently inhabiting the N2MS3 study area near Bellata. Based on the findings of this assessment, the proposal is considered likely to have a significant adverse effect on the extent and condition of habitat important to the Five-clawed Worm-skink. Due to a lack of survey data and general ecological understanding of the species, and in keeping with the precautionary principle, the proposal is considered likely to place a local population of the Five-clawed Worm-skink at risk of extinction’.

AREA was commissioned by Roads and Maritime Services to collect additional data on the location, size and extent of the populations of Five-clawed worm-skink (*Anomalopus mackayi*) to better inform the EPBC Act assessment of significance criteria for both matters. Mr Gerry Swan a subject matter expert (See Appendix 1) was contracted by AREA to complete this task and apply the Precautionary Approach which addresses both areas listed below in the assessment requiring strengthening:

- Lack of survey data
- General ecological understanding
- Both study areas, N2M and NM were assessed by Gerry Swan. The aim of the assessment was to either validate or challenge the significant impact assessment findings on Five-clawed worm-skink.
2 Background

Gerry Swan (CV in Appendix 1) was commissioned to examine the N2M and NM proposal area of the Narrabri-Moree heavy duty pavement works on the Newell Highway to:

1. Provide an opinion as to whether or not it contains habitat that could be suitable to support a population of the Five-clawed Worm-skink (Five-clawed worm-skink).

2. Provide an opinion as to whether or not any local population of the *Anomalopus mackayi* (Five-clawed worm-skink) would be significantly impacted by the Proposal.

Until the mid-1980s this Five-clawed worm-skink was undescribed and was identified in the literature as *Anomalopus* sp(2) (Cogger 1986). In 1985 it was formally described in a paper under the name *Anomalopus mackayi* (Greer & Cogger 1985). At that time there were only eight specimens in the Australian Museum with locality information. No details on habitat had been recorded with these specimens and indeed the locality information for some was inaccurate (Shea 1987).

Five-clawed worm-skink is a fossorial lizard (Hutchinson 1993) that can reach a maximum total length of around 250mm of which just over 50 per cent is tail. All four limbs are poorly developed with three fingers and two toes. These digits are very short and difficult to distinguish without a magnifying glass. It is an egg layer but nothing else is known of its life history. Phil Spark (Spark 2010) has carried out field work relating to habitat. In the eastern area of its range it lives in and under rotting logs on rich basalt soil, while in the west it is found on cracking clay soils and lives down these cracks. It occurs on the North Western Slopes, North Western Plains and North Far Western Plains, and extends into inland south-eastern Queensland (Spark, 2013).
3 Methodology

A search was made of Australian Museum records, the Australian Living Atlas (ALA) and BioNet databases.

There are 22 NSW Five-clawed worm-skink specimens in the Australian Museum all of which are on ALA (13 of them twice), but only 13 of these 22 records are on BioNet. ALA has an additional three records which are also on BioNet and BioNet has independently a further two. Phil Spark (Spark 2010) records another 11, and there is one from Wee Waa held in the Field Museum of Natural History in the USA. In total Gerry Sawn has located 39 records of this species in NSW and is a subject matter Expert.

A transect approximately every two kilometres in each of the eight Proposal segments were completed. The approximation reflects heavy continual traffic and difficulty in parking. Each transect involved striding out 30 metres from the highway centre line to the eastern side (unless a railway line or fence blocked further access). An assessment was made of the habitat and soil along the transect together with land use in the adjoining properties. Transects were also walked along the outer edge of the 30 metres buffer for about 100 metres. A similar process was carried out on the western side of the highway.

Completing transects allowed the assessor to provide an informed opinion relating to possible suitable habitat, whether it was continuous, the condition, and any other factors. At no stage active searches for this species was undertaken except for assessing under the only log in the study area by rolling it over and looking for or movement of debris, to ascertain soil moisture levels and see if there were large cracks in the soil underneath.

Random transects at intervals along the areas between the segments were also completed. These involved same methodology described above.

Number of transects carried out 5 to 10 July 2018 in each segment.

<table>
<thead>
<tr>
<th>Segment</th>
<th>Length (km)</th>
<th>Transects</th>
</tr>
</thead>
<tbody>
<tr>
<td>N2M1</td>
<td>6.6</td>
<td>5</td>
</tr>
<tr>
<td>N2M2</td>
<td>12.0</td>
<td>6</td>
</tr>
<tr>
<td>N2M3</td>
<td>5.0</td>
<td>3</td>
</tr>
<tr>
<td>N2M4</td>
<td>7.0</td>
<td>4</td>
</tr>
<tr>
<td>N2M5</td>
<td>9.2</td>
<td>4</td>
</tr>
<tr>
<td>Intervening areas 54km</td>
<td>19 transects</td>
<td></td>
</tr>
<tr>
<td>NMS1</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>NMS2</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>NMS3</td>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>Intervening areas 18km</td>
<td>6 transects</td>
<td></td>
</tr>
</tbody>
</table>
This section considers whether or not there is habitat suitable for the Five-clawed Worm-skink \((Anomalopus mackayi)\) in the footprint of the N2M and NM Proposals. This submission assessed areas within 30 metres of the current road centre line. In some instances, there were fence lines inside the 30-metre boundary and these fences were not crossed.

The Newell highway constructed in the 1960s in the region, is an extremely busy road with a high proportion of heavy vehicles. Habitat for Five-clawed worm-skink within the road corridor is quite degraded. Apart from the accumulated rubbish of 50+ years of motor traffic, it is bisected by numerous side roads and property access tracks. There are maintenance tracks for the railway line and for the power lines running parallel to the highway. The grass areas adjacent to the railway line, under the power poles and along the edge of the highway are often weedy and / or slashed. There are also numerous tracks presumably made to move heavy farming equipment from one property to another without coming out onto the highway. Cattle regularly are grazed along the side of the highway, contributing to the degradation. Coupled with the current drought conditions this the road corridor is unlikely habitat for the Five-clawed worm-skink.

Several areas examined in the road corridor had a gravelly soil or conglomerate pebbles in the 30m area (presumably imported fill) although the soil outside this zone was cracking clay. The gravels / fill areas are not suitable habitat for the species. Gerry Swans experience with the species indicates the impact of Mimosa bush on Five-clawed Worm-skink is likely negative.

Notwithstanding, suitable habitat for Five-clawed worm-skink, containing deep soil cracks and a good cover of grass litter was observed, these areas are described below. These areas of suitable habitat were considered as unlikely to be occupied by the Five-clawed worm-skink because they are not continuous. If present, Five-clawed worm-skink populations would be in small and isolated. The adjoining land is predominantly cropped or grazed with discrete native woodland present.

A notable limitation to this habitat-based assessment is that others may have differing opinions. The only way to resolve the matter is if considerable trapping effort is carried out over several years. To this end a subject matter specialists opinion allows for a Precautionary Approach\(^1\) to be applied to meet the EPBC assessment criterion. This supplementary assessment provides further, detailed information regarding impact to Five-clawed worm-skink based on extensive experience with the species and knowledge of the local population near Bellata.

In laymans terms, application of the Precautionary Approach (confused by the Commonwealths wording of the EPBCs significant impact criteria) ensures a range of factors has been considered by experts and professionals with diverse backgrounds resulting in a consensus of the Assessment of Significance for Five-clawed worm-skink.

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\(^1\) Please review the difference between ‘Precautionary Principle’ and ‘Precautionary Approach’ in Appendix 2 and how it is used globally and relates to the EPBC Act. For this assessment the Precautionary Approach is used where subject matter specialist provides an informed opinion to assist the Regulator when considering the significance of the potential impact to the species.
# Newell Highway Heavy Duty Pavements, Narrabri to Moree and North Moree Supplementary Report July 2018

## Anomalopus mackayi

### Segment  N2M (North of Narrabri)

<table>
<thead>
<tr>
<th>Segment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>N2M1</td>
<td>8-9km eastern side (1.5-2.5km from beginning of segment)</td>
</tr>
<tr>
<td>N2M2</td>
<td>18-20km eastern side (2.5-4.5km from beginning of segment)</td>
</tr>
<tr>
<td>N2M2</td>
<td>23.5-25.5km eastern side (8-10km from beginning of segment)</td>
</tr>
<tr>
<td>N2M3</td>
<td>48-49km western side (1.5-2.0km from beginning of segment)</td>
</tr>
<tr>
<td>N2M3</td>
<td>50-51km eastern side (3-4km from beginning of segment)</td>
</tr>
<tr>
<td>N2M4</td>
<td>56.5-57.5km east &amp; west side (4-5km from beginning of segment)</td>
</tr>
<tr>
<td>N2M5</td>
<td>94.5-95.5km east &amp; west side (6-7km from beginning of segment)</td>
</tr>
</tbody>
</table>

### Segment  NM (North of Moree)

<table>
<thead>
<tr>
<th>Segment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NMS1</td>
<td>5.5-6.5km east &amp; west side (1.5-2.5km from beginning of segment)</td>
</tr>
<tr>
<td>NMS2</td>
<td>17.6-20km east &amp; west side (0-2.5km from beginning of segment)</td>
</tr>
<tr>
<td>NMS3</td>
<td>40km east &amp; west side (3km from beginning of segment)</td>
</tr>
<tr>
<td>NMS3</td>
<td>49.5-50km eastern side (12.5-13km from beginning of segment)</td>
</tr>
</tbody>
</table>
5 Conclusion

While the Proposal does contain suitable habitat for Five-clawed worm-skink identified in Section 4, it is too marginal to sustain a viable population.

I do not believe any local population would be significantly impacted as there is a remarkable lack of records from this area. The first of the two records were in 1961-62 (Dr Judd) and other in 2009 (Sass, Swan & Coulson 2009) from the Bellata area is the one I recorded. The 2009 record was at Myall Hollow which is about 6km east of Bellata and the Proposal. By comparison the Namoi catchment from Narrabri to Walgett have nine records, four of them since 2010.

To consider the context of the Bellata local viable population referred to in the BAR and to determine if it is at risk from the Proposal, the Myall Hollow site was revisited. In 2008 it showed no evidence of cropping or grazing activity but upon assessment (July 2018) there are now extensive areas of cultivated land around the site. This limits dispersal of the species toward the highway.

My experience has demonstrated where there are good populations of Five-clawed worm-skink then specimens are consistently found when searched for. This was not the case in the BAR. In the Wallangra area there have been 14 recorded since 1986, at the Combardello Bridge six recorded since 1998. In 1984 Dr Allen Greer and Ross Sadlier, who were herpetologists from the Australian Museum, did a lot of fieldwork in the Narrabri-Bellata region specifically to locate further specimens (Shea 1987; Sadlier pers. comm.) but with no success. What is puzzling is that no specimens were recorded during the construction of the highway in the 1960s. Perhaps the specimens sent in by Dr Judd in 1961-62 from Bellata came from that source.

The Proposal footprint is for the most part centred on the existing highway with expansion into the road reserve or other land. A lot of this land is not suitable habitat and that which is suitable is mainly marginal for a sustainable population.

In conclusion, my opinion is no local populations of Five-clawed worm-skink (if there are any along the highway route) would be significantly impacted by the Proposal.
6 References


Spark, P. (2013) Frogs, Reptiles and mammals of the North Western Floodplain of NSW. Namoi CMA & Border Rivers-Gwydir CMA.
APPENDIX 1: GERRY SWAN CV

Gerry Swan is a Research Associate in Herpetology at the Australian Museum.

Gerry Swan is an ecological consultant whose primary interests are the reptiles of the arid and semi-arid areas of NSW. However, over the past 10 years he has worked with gas pipeline construction companies helping develop best practice for the removal of native animals that become trapped in pipeline trenches.

Current field work involves establishing the population size of the skink *Liopholis modesta* at Yathong Nature Reserve, and assisting in the SOS program with the Office of Environment and Heritage for the dragon *Ctenophorus mirrityana* at Mutawintji National Park and Purnamoota Station.


**Publications**

**Books**


Articles

APPENDIX 2: PRINCIPLE VS APPROACH

The Principle

The precautionary principle states that:

“Where 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 trigger for the application of the precautionary principle is the threat of “serious or irreversible environmental damage”. Whether such a threat is real will depend on scientific evaluation. Opinions will not only differ on the nature and magnitude of possible damage, but also whether such damage is a threat; and if it is, whether it could be described as serious or irreversible. In *Telstra Corporation Ltd v Hornsby Shire Council* (2006) NSWLEC 133, Preston CJ said [132]:

“… the assessment of whether the threats are serious or irreversible will be enhanced by broadening the range of professional expertise consulted and seeking and taking into account the views of relevant stakeholders and rightsholders. The former is important because of the interdisciplinary nature of the questions involved. The latter is important because different judgements, values and cultural perceptions of risk, threat and required action play a role in the assessment process.”


Principle vs Approach

No introduction to the precautionary principle would be complete without brief reference to the difference between the precautionary principle and the precautionary approach.

Principle 15 of the Rio Declaration 1992 states that: “in order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall be not used as a reason for postponing cost-effective measures to prevent environmental degradation.” As Garcia (1995) pointed out, “the wording, largely similar to that of the principle, is subtly different in that: (1) it recognizes that there may be differences in local capabilities to apply the approach, and (2) it calls for cost-effectiveness in applying the approach, e.g., taking economic and social costs into account.” The ‘approach’ is generally considered a softening of the ‘principle’.

“As Recuerda has noted, the distinction between the ‘precautionary principle’ and a ‘precautionary approach’ is diffuse and, in some contexts, controversial. In the negotiations of international declarations, the United States has opposed the use of the term ‘principle’ because this term has special connotations in legal language, due to the fact that a ‘principle of law’ is a source of law. This means that it is compulsory, so a court can quash or confirm a decision through the application of the precautionary principle. In this sense, the precautionary principle is not a simple idea or a desideratum but a source of law. This is the legal status of the precautionary principle in the European Union. On the other hand, an ‘approach’ usually does not have the same meaning, although in some particular cases an approach could be binding. A precautionary approach is a particular ‘lens’ used to identify risk that every prudent person possesses (Recuerda, 2008)”\[18\]
Commonwealth Legislation

Found in s 391(2) of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Importantly, this section is not linked to section 18 of that Act.

However, regarding *Five-clawed worm-skink* the Australian Government Department of the Environment *Significant Impact Guidelines 1.1* provides:


Vulnerable species

Significant impact criteria

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- lead to a long-term decrease in the size of an important population of a species
- reduce the area of occupancy of an important population
- fragment an existing important population into two or more populations
- adversely affect habitat critical to the survival of a species
- disrupt the breeding cycle of an important population
- modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
- result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species’ habitat
- introduce disease that may cause the species to decline, or
- interfere substantially with the recovery of the species.

What is an important population of a species?

An ‘important population’ is a population that is necessary for a species’ long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

When is a significant impact likely?

To be ‘likely’, it is not necessary for a significant impact to have a greater than 50% chance of happening; it is sufficient if a significant impact on the environment is a real or not remote chance or possibility.

If there is scientific uncertainty about the impacts of your action and potential impacts are serious or irreversible, the precautionary principle is applicable. Accordingly, a lack of scientific certainty about the potential impacts of an action will not itself justify a decision that the action is not likely to have a significant impact on the environment.

In short, there are a range of factors that need to be considered. The greater the consensus by a broad range of competent and informed experts, the better. I would think that the precautionary approach can apply to any one or a combination of the ‘Significant impact criteria’ outlined above.
Appendix B

Updated assessments of significance under the EPBC Act
Assessments of Significance – EPBC Act

Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland

*Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland* occurs on the Darling Downs, Liverpool Plains and Moree Plains, mostly in the Brigalow Belt South and Darling Riverine Plains bioregions of Queensland and New South Wales (NSW). The following descriptions and information used in the assessment is sourced from the Commonwealth advice for listing this ecological community under the EPBC Act, and the results of the targeted survey.

The distribution of the ecological community is strongly reliant on soil type as it is associated with fine textured, often cracking clays derived from either basalt or quaternary alluvium. The development of deep cracks as the soils dry, and the tearing of tap roots during the soil contraction and expansion cycle are possible reasons why trees and large woody shrubs are typically lacking in these grasslands.

The ecological community generally occurs on flat to low slopes, of no more than 5 percent inclination. As slope increases, grassy woodlands dominated by trees such as *Acacia pendula* (Weeping Myall), *Eucalyptus coolabah* (Coolabah), *E. populnea* (Poplar Box) or *E. melliodora* (Yellow Box) occur. The ground layer component of these woodlands may be similar to the grassland but the soils will not be the same cracking clays as on the plains.

It is important to note that native grasslands comprise not only the more obvious grass species, but also a great diversity of other herbaceous plants such as native daisies, orchids, lilies and other wildflowers. Many of these plants are only easily seen in the spring. The native grassland flora also includes herbaceous legumes such as *Desmodium*, *Glycine*, *Lotus* and *Rhynchosia* that have an important role in soil nitrogen fixation. The native legumes of grasslands on the Liverpool Plains are now mainly restricted to sites that have not been heavily degraded by past land management practices.

The shrub cover is typically a very minor component of the grassland however in some areas such as Kirramingly (south of Moree) the cover of shrubs, such as *Acacia farnesiana* (Mimosa), can be quite thick. At sites like this, the thick shrub cover does not affect the abundance of grass species. The total projective canopy cover of woody shrubs over 0.5 m tall can be up to 50% in this ecological community but is typically much less. A tree canopy is typically absent. Where trees are present, they are of variable species composition and comprise less than 10% of projective crown cover.

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

---

The proposal would remove approximately 6.25 hectares of the TEC. The available regional mapping (Border River Gwydir) does not discriminate between natural grasslands and derived grasslands and assigned most areas of natural grasslands as ‘candidate native grassland’ instead of a PCT. This means that obtaining an accurate indication of the local occurrence of the TEC is problematic. The area of contiguous mapped ‘candidate native grassland’ is quite extensive with about 260 hectares for NMS1, >11,000 hectares for NMS2, and >1,100 hectares for NMS3. However, much of this mapped ‘candidate native grassland’ is likely to be derived grassland from eucalypt and acacia woodlands. In the absence of further work at this time to determine the extent of the local occurrence, the extent within the study area has been used to represent the local occurrence. Although this will provide an underestimation of the true extent of the local occurrence, the available regional mapping cannot be used for this purpose. There is about 107 hectares of the TEC mapped in the study area and the proposal would remove about 16.25 hectares (5.8 %) (see Table C.1). This reduction in extent is substantial both in absolute terms and in proportion to the local occurrence.
Table C.1 Breakdown of impacts to the Natural Grasslands TEC by proposal segment

<table>
<thead>
<tr>
<th>Threatened Ecological Community (BC Act)</th>
<th>NMS1 (ha)</th>
<th>NMS2 (ha)</th>
<th>NMS3 (ha)</th>
<th>Total (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland</td>
<td>0</td>
<td>6.25</td>
<td>0</td>
<td>6.25</td>
</tr>
<tr>
<td>Local occurrence (ha)</td>
<td>0</td>
<td>107.0</td>
<td>0</td>
<td>107.0</td>
</tr>
<tr>
<td>% of local occurrence impacted</td>
<td>0%</td>
<td>5.8%</td>
<td>0%</td>
<td>5.8%</td>
</tr>
</tbody>
</table>

Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines

The proposal will result in a minor increase in fragmentation (dividing a moderate-sized patch), and reduce the connectivity of patches due to the increase in the width of cleared land associated with the road widening.

Adversely affect habitat critical to the survival of an ecological community

According to the MNES SIG 1.1 EPBC Act (DoE 2013) Habitat critical to the survival of an ecological community refers to areas that are necessary:

- For the long-term maintenance of the ecological community (including the maintenance of species essential to the survival of the ecological community, such as pollinators)
- To maintain genetic diversity and long term evolutionary development, or
- For the reintroduction of populations or recovery of the ecological community.

Such habitat may be, but is not limited to: habitat identified in a recovery plan for the ecological community as habitat critical for that species or ecological community; and/or habitat listed on the Register of Critical Habitat maintained by the minister under the EPBC Act.

There are very few undisturbed patches of the community remaining in existence; most remaining patches have some degree of disturbance and degradation. While habitat critical to the survival of the community has not been formally identified, important habitat for the community is assumed to consist of large patches in ‘best’ and/or ‘good’ condition as defined in the condition thresholds for the community and shown in Table C.2.

**Table C.2 - Condition thresholds for the Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland ecological community.**

<table>
<thead>
<tr>
<th>Condition thresholds and quality</th>
<th>Best quality</th>
<th>Good quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patch size</td>
<td>Minimum patch size at least 0.5 ha, <strong>AND</strong></td>
<td>Minimum patch size at least 2 ha <strong>AND</strong></td>
</tr>
<tr>
<td>Grasses</td>
<td>At least 4 native perennial grass species from the indicator species list <strong>AND</strong></td>
<td>At least 3 native perennial grass species from the indicator species list <strong>AND</strong></td>
</tr>
<tr>
<td>Tussock cover</td>
<td>At least 200 native perennial grass tussocks <strong>AND</strong></td>
<td>At least 200 native perennial grass tussocks <strong>AND</strong></td>
</tr>
<tr>
<td>Woody shrub cover</td>
<td>Total projected canopy cover of shrubs is less than 30% <strong>AND</strong></td>
<td>Total projected canopy cover of shrubs is less than 50% <strong>AND</strong></td>
</tr>
<tr>
<td>Introduced species</td>
<td>Perennial non-woody introduced weed species are</td>
<td>Perennial non-woody introduced weed species are less than 30% of the total projected crown cover</td>
</tr>
</tbody>
</table>
### Condition thresholds and quality

<table>
<thead>
<tr>
<th>Best quality</th>
<th>Good quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>less than 5% of the total projected crown cover</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
- Shrubs are typically absent. When present, they are defined as woody plants more than 0.5 m tall that occupy the mid vegetation layer. The upper, tree canopy layer also is typically absent but may comprise scattered trees to less than 10% projective crown cover.
- Sampling should be based upon a quadrat size of 0.1 ha (e.g. 50 m x 20 m) selected in an area with the most apparent native perennial grass species. Unless exceptional circumstances apply, to maximise the assessment of condition, a site must be assessed during a good season, two months after cessation of disturbance (fire, grazing, mowing or slashing) and within two months of effective rain.

Most of the occurrence of the community in the impacted areas and broader study area meets the thresholds for inclusion in the best quality category while edge areas that have been subject to a moderate level of disturbance (typically within 5 metres of the edges of the community) would only meet the good quality thresholds. Field assessment in NMS1 revealed the majority of grassland habitat within the impact footprint in this segment was in poor quality, extending 5-20m from the fog-line of the highway y (~2 ha in size). NMS2 and NMS3 contain large patches >30 hectares in size that are considered good quality. These patches may be considered to be of importance to the survival of the community and the removal of approximately 6.25 hectares of the community, from patches considered to be moderately to highly important, is considered likely to have a substantial adverse impact on habitat critical to the survival of the community.

**Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community’s survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns**

The proposal is likely to reduce the quality of some of the adjacent retained area of the TEC due to edge effects such as increased light, increased wind, altered hydrology and weed invasion.

**Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting**

The proposal is likely to reduce the quality of some of the adjacent retained area of the TEC due to edge effects such as increased light, increased wind, altered hydrology and weed invasion. These changes in environmental conditions may result in a change in the species constitution and vegetation structure. This would likely involve a proliferation of tolerant species (typically grasses), a reduction in floristic diversity (particularly of small herbs) and reduced structural complexity due to the development of a continuous grass cover with little or no inter-tussock space.

**Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:**

- **assisting invasive species, that are harmful to the listed ecological community, to become established, or**
- **causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or**

Unless the proposal includes very careful soil management, weed monitoring and management and intensive vegetation restoration, weed proliferation is likely to occur on the newly created fill batters. Weeds on the fill batters are likely to invade the adjacent edges of the community.

**Interfere with the recovery of an ecological community.**
There is no adopted or made Recovery Plan for this ecological community. The conservation advice for the community includes the following priority actions of relevance to the proposal:

- Ensure road widening and maintenance activities (or other infrastructure or development activities as appropriate) in areas where the ecological community occurs do not adversely impact on known sites.
- Manage disruptions to water flows and any changes to hydrology which may result in changes to the water table levels, increased salinity and increased run off or sediment.
- Develop and implement a management plan for the control of weeds such as Lippia (*Phyla canescens*), Coolatai Grass (*Hyparrhenia hirta*), African Love Grass (*Eragrostis curvula*) and Buffel Grass (*Cenchrus ciliaris*) in the region.
- Manage sites to prevent introduction of invasive weeds, which could become a threat to the ecological community, using appropriate methods.
- Implement good hygiene measures for mowing and grading equipment and observe appropriate state protocols for moving stock.

The proposal is not consistent with the first priority action through removal of 6.25 hectares of this critically endangered ecological community. Mitigation measures for the proposal would be designed to ensure it does not interfere with the remaining actions.

**Conclusion**

The extent of the critically endangered ecological community that would be lost is 6.25 hectares. This represents a loss of 2.6% when considered in the context of the contiguous extent of the TEC in the study area. There may be more of this TEC contiguous with the study area but at the current time this extent is not known. The proposal is also considered likely to adversely modify the composition of adjacent areas of the TEC that would not be cleared, due to increased edge effects. The TEC within the study area is likely to be important to the long-term survival of the TEC as the patches are of moderate to large size and in moderate to good condition. There is likely to be minor increase in fragmentation and isolation of patches due to the increase in the width of cleared land associated with the road.

In summary, the proposal is considered likely to have a significant adverse effect on the extent and condition of the *Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland*. 
**Homopholis belsonii** (Belson’s Panic)

*Homopholis belsonii* was found in the study area in NMS2 and NMS3 during field surveys in a variety of PCTs. Associated habitat on site includes:

- Belah woodland (PCT 55)
- Poplar Box - Belah woodland (PCT 56)
- Queensland Bluegrass +/- Mitchell Grass (PCT 52)
- Weeping Myall open woodland (PCT 27).

The following information regarding ‘important populations’ is taken from the EPBC Act Significant Impact Guidelines 1.1. An ‘important population’ is a population that is necessary for a species’ long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

There are no specific populations listed in the SPRAT profile or conservation advice for the species.

The populations of the species in the study area are considered to be important as they are:

- Large and hence may constitute key source populations for dispersal
- Distributed across a variety of plant community types and hence are likely to have relatively high genetic diversity, reflecting environmental differences between habitats
- At or near the south-west limit of the species’ known range.

Based on this assessment process, the habitat for the species in the study area can be considered important habitat. Therefore, by this assessment process, the study area is likely to contain an important population of this species within suitable habitat. Considering the length of the proposal boundary, the study area contains multiple populations (Table C.3).

**Table C.3 Belson’s panic habitat and population clusters within the three segments in the NM proposal**

<table>
<thead>
<tr>
<th>Segment/cluster</th>
<th>NMS1</th>
<th>NMS2</th>
<th>NMS3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 &amp; 2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Potential habitat (ha)</td>
<td>11.5</td>
<td>51.4</td>
<td>8.3</td>
</tr>
<tr>
<td>Habit in impact footprint (ha)</td>
<td>2.6</td>
<td>4.7</td>
<td>0.8</td>
</tr>
<tr>
<td>% potential habitat in IF</td>
<td>22.6</td>
<td>10.7</td>
<td>16.8</td>
</tr>
</tbody>
</table>

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

**Lead to a long-term decrease in the size of an important population**

The proposal will result in the removal of 20.8 hectares of important habitat for a local population/s of *Homopholis belsonii* in NMS1 = 2.6 ha NMS2 = 9.4 ha; and NMS3 = 8.8 ha.

Associated habitat to be impacted includes:

- Belah woodland
- Poplar Box - Belah woodland
• River Red Gum woodland
• Weeping Myall open woodland
• Queensland Bluegrass +/- Mitchell Grass

The clearing will result in direct mortality to individuals and loss of habitat. It must be assumed that these impacts associated with the proposal may lead to a long-term decrease in the size of an important population. After an in-depth field assessment, it was determined that only populations within clusters 1 and 2 of segment NMS2 (Figure C.1 and Figure C.2) will be significantly reduced in size, with only minor reductions to other populations. The population in Cluster 5 of NMS2 will also be significantly reduced, however is expected to recover based on location predominantly in previously disturbed areas adjacent to highway. However, if the alignment of highway was shifted to the west in the grassland in clusters 1 and 2 of segment NMS2 the impact would not be significant.

Reduction the area of occupancy of an important population

The proposal will result in the removal of 20.8 hectares of important habitat for the species. Remaining areas of habitat are also likely to be modified by edge effects that may change the soil surface and microhabitat conditions, altering its suitability for this species. After an in-depth field assessment of location of populations, it was determined that only clusters 1 and 2 in segment NMS2 will be significantly reduced by 4.7 ha. However, if the alignment of highway was shifted to the west in the grassland in clusters 1 and 2 of segment NMS2 the impact would not be significant.

Fragment an existing important population into two or more populations

There is likely to be an increase in distance between patches within the population due to the increase in the width of cleared land associated with the road. Vegetation and potential habitat within the landscape is already highly fragmented due to a history of clearing for agricultural purposes and road construction. However, considering the wind pollination and wind seed dispersal mechanisms in this species, the increase in distance between patches of habitat is unlikely to affect the species to such an extent that an existing important population would be split into two or more populations.

Adversely affect habitat critical to the survival of the species

Habitat critical to the survival of a species refers to areas that are necessary for activities such as:

• Foraging, breeding, roosting, or dispersal
• For the long-term maintenance of the species including the maintenance of other species essential to the survival of the species, such as pollinators
• To maintain genetic diversity and long-term evolutionary development
• For the reintroduction of populations or recovery of the species.

The habitat of the species in the study area is considered to be part of an area of critical habitat as it:

• Contains a large population and hence may be necessary for dispersal and may be of value for the reintroduction and recovery of the species
• Contains a variety of plant community types, is at or near the south-west limit of the species’ known range and is hence likely to be of value in the maintenance of genetic diversity and facilitation of long-term evolutionary development of the species.

The proposal will result in the removal of 20.8 hectares of habitat critical to the survival of the species. Remaining areas of habitat are also likely to be modified by edge effects that may change the soil surface and microhabitat conditions, altering its suitability for this species.

Disrupt the breeding cycle of an important population

The reduction in population size and degradation of habitat that would be caused by the proposal is likely to have an adverse effect on the life cycle of the species such that the local population in clusters 1 and 2 of segment NMS2 is likely to be placed at significantly increased risk of extinction. However, if the alignment of highway was shifted to the west in the grassland in clusters 1 and 2 of segment NMS2 the impact would not be significant.
Modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

Clearing of vegetation associated with the proposal would remove 20.81.51 hectares of important habitat for the species. Remaining areas of habitat are also likely to be modified by edge effects that may change the soil surface and microhabitat conditions, altering habitat suitability for this species. This clearing is likely to lead to a decline in the population of the species in clusters 1 and 2 of segment NMS2. However, if the alignment of highway was shifted to the west in the grassland in clusters 1 and 2 of segment NMS2 the impact would not be significant.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat

The clearing of habitat is recognised as a major factor contributing to the threatened status of the species. The associated indirect impacts of this key threatening process are well documented and include increased potential for the proliferation of invasive species. Measures to minimise invasion of weeds during construction and operation would be included in the CEMP. With these measures in place, this proposal is not considered likely to result in a significant increase in the impact of invasive species on the species or its habitat.

Introduce disease that may cause the species to decline

Infection of native plants by Phytophthora cinnamomi has been identified as being spread by construction machinery. This water-borne fungus infects the roots of plants and has the potential to cause dieback. Machinery associated with vegetation clearance and subsequent construction for the proposal has the potential to transmit the fungus to remaining native vegetation remnants of the species. This is a potential indirect impact to the species as it may lead to a reduction in the quality of the soil surface microhabitat. This can be suitably mitigated through the development and implementation of suitable control measures for vehicle and plant hygiene such as the current best practice hygiene protocols as detailed in RTA (2011).

Interfere substantially with the recovery of the species

There is currently no specific recovery plan for Belson’s Panic but the following regional priority recovery and threat abatement actions of relevance to the proposal are recommended in the conservation advice for the species:

- Ensure road widening and maintenance and mining activities (or other infrastructure or development activities) involving substrate or vegetation disturbance in areas where H. belsonii occurs do not adversely impact on known populations.
- Protect populations of the listed species through the development of conservation agreements and/or covenants.
- Identify populations of high conservation priority
- Undertake survey work in suitable habitat and potential habitat to locate any additional populations/occurrences/remnants
- Ensure fertilisers used in agriculture, and chemicals or other mechanisms used to eradicate weeds, do not have a significant adverse impact on Homopholis belsonii.
- Develop and implement a management plan for the control of invasive weeds such as Green Panic Grass (Panicum maximum var. trichoglume), Cooalai Grass (Hyparrhenia hirta) and Tiger Pear (Opuntia aurantiaca) in the local region.
- Manage sites to prevent introduction of invasive weeds, which could become a threat to the H. belsonii, using appropriate methods.
- Investigate options for linking, enhancing or establishing additional populations.

The proposal may interfere with the first two of these actions as it would adversely impact remnants of the community that may otherwise be suitable for conservation, through loss of 23.8 hectares of habitat for the species.

There may be opportunities to contribute to the identification of additional populations of the species and refinement of the current understanding of the conservation priority of populations if additional surveys for the species are undertaken for the proposal. Environmental management during construction and landscaping associated with the proposal will include weed control and hygiene
protocols to minimise weed dispersal, will be designed to minimise risks associated with herbicide use and will not include the use of fertilisers. The offset package for the proposal may provide opportunities for linking, enhancing or establishing additional populations. While the proposal will interfere with the recovery of the species through removal of individuals and habitat, it may also provide opportunities for increasing the information available about the distribution of the species and its restoration.

Conclusion

Based on the information available, this proposal is at high risk of causing a significant impact on the populations of *Homopholis belsonii* in clusters 1 and 2 of segment NMS2, at low risk of causing a significant impact to other populations within the Proposal. If the alignment of highway was shifted to the west in the grassland in clusters 1 and 2 of segment NMS2, the Proposal would not have a significant impact on populations of *H. belsonii*. 
Five-clawed Worm-skink (*Anomalopus mackayi*)

The following information regarding ‘important populations’ is taken from the EPBC Act Significant Impact Guidelines 1.1.

An ‘important population’ is a population that is necessary for a species’ long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

Given the difficulty in detecting this species, the Commonwealth environment department considers that an occurrence of important habitat for the Five-clawed Worm-skink is a surrogate for an ‘important population’ of the species (DoEE, 2018). Known important habitat for the Five-clawed Worm-skink is listed in the Draft Referral guidelines for the nationally listed Brigalow Belt reptiles (Commonwealth of Australia 2011) and includes:

- All suitable habitat within floodplains and riparian zones, uncultivated grassy headlands and strips between cropped areas, road reserves, travelling stock routes and remnant vegetation on vacant lands.
- Suitable habitat within the Known / Likely-to occur distribution of the species (see Map 3 in Appendix 1 of the report).

This species is known to be associated with five of the PCTs in the study area, including many areas of shrub and grassland. Additionally, all of the proposal is in the middle of the ‘Species May Occur’ distribution. Based on the conclusions of the field assessment however, much of the vegetation in the study area is degraded or unsuitable, and while the Proposal does contain suitable habitat for the Five-clawed Worm–skink, it is too marginal to sustain a viable population.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

**Lead to a long-term decrease in the size of an important population**

The proposal will result in the removal of 68.55 hectares of important habitat for a local population/s of the Five-clawed Worm-skink. Any machine works within areas of suitable habitat could result in direct mortality to individuals. A reduction of available habitat could directly affect the ability of this species to survive (i.e. foraging and breeding life cycle activities) within its local distribution. Without a detailed understanding of the local occurrence of this species, it must be assumed that these impacts associated with the proposal may lead to a long-term decrease in the size of the important population.

**Reduce the area of occupancy of an important population**

The proposal will result in the removal of 68.55 hectares of important habitat for the Five-clawed Worm-skink. Remaining areas of habitat are also likely to be modified by edge effects that may change the soil surface and microhabitat conditions, altering its suitability for this species. However, an in-depth field assessment determined that much of the habitat within the road corridor is degraded or unsuitable, and while the Proposal does contain suitable habitat for the Five-clawed Worm–skink, it is too marginal to sustain a viable population. Therefore, it is unlikely that the proposal would reduce the area of occupancy of an important population.

**Fragment an existing important population into two or more populations**

There is likely to be an increase in distance between patches within the local occurrence due to the increase in the width of cleared land associated with the road. Vegetation and potential habitat within the landscape is already highly fragmented due to a history of clearing for agricultural purposes and road construction. This species may cross the road surface at night. As the proposal will involve widening of the current road surface, it will reduce east-west habitat connectivity, therefore increasing fragmentation. This may also increase the risk of mortality by vehicle strike. However, considering the, at least partial, barrier created by the existing road surface, the increase in distance between patches of habitat is unlikely to affect the species to such an extent that an existing important population would be split into two or more populations.
Adversely affect habitat critical to the survival of the species

Habitat critical to the survival of a species refers to areas that are necessary for activities such as:

- Foraging, breeding, roosting, or dispersal
- For the long-term maintenance of the species including the maintenance of other species essential to the survival of the species, such as pollinators
- To maintain genetic diversity and long-term evolutionary development
- For the reintroduction of populations or recovery of the species.

On the floodplains within its range in north-eastern New South Wales, the Five-clawed Worm-skink occurs in grasslands and grassy, open woodlands on heavy black and grey, alluvial cracking clay soils from 135–200 m above sea level. Known important habitat for the Five-clawed Worm-skink is listed in the Draft Referral guidelines for the nationally listed Brigalow Belt reptiles (Commonwealth of Australia 2011) and includes:

- All suitable habitat within floodplains and riparian zones, uncultivated grassy headlands and strips between cropped areas, road reserves, travelling stock routes and remnant vegetation on vacant lands.
- Suitable habitat within the Known / Likely-to occur distribution of the species (see Map 3 in Appendix 1 of the report).

This species is known to be associated with five of the PCTs in the study area, including many areas of shrub and grassland. Additionally, all of the proposal is in the middle of the ‘Species May Occur’ distribution. However, an in-depth field assessment determined that much of the habitat within the road corridor is degraded or unsuitable, and while the Proposal does contain suitable habitat for the Five-clawed Worm-skink, it is too marginal to sustain a viable population. Therefore, much of the vegetation in the study area is not considered habitat critical to the survival of the Five-clawed Worm-skink.

The proposal will result in the removal of 68.55 hectares of potential (albeit marginal) habitat for the Five-clawed Worm-skink. Remaining areas of habitat are also likely to be modified by edge effects that may change the soil surface and microhabitat conditions, altering its suitability for this species. Table C.4 details impact risk thresholds listed specifically for the Five-clawed Worm-skink taken from the Draft Referral guidelines for the nationally listed Brigalow Belt reptiles (Commonwealth of Australia 2011). Based on these guidelines, a referral is recommended for impacts to the Five-clawed Worm-skink associated with the proposal.

Table C.4 Referral guidelines

<table>
<thead>
<tr>
<th>Risk of significant impact</th>
<th>Impact threshold listed for Five-clawed Worm-skink</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example of low-risk significant impact</td>
<td>Clearing two or less hectares of important habitat (providing that important habitat connectivity is not compromised)</td>
</tr>
<tr>
<td>Example where uncertainty may arise as to the risk of significant impact</td>
<td>Clearing between two and four hectares of important habitat</td>
</tr>
<tr>
<td>Example of high-risk significant impact: referral recommended</td>
<td>Clearing four or more hectares of important habitat</td>
</tr>
</tbody>
</table>

Disrupt the breeding cycle of an important population

Very little is known about the biology of the Five-clawed Worm-skink. Average clutch size or mortality rates for newborns is unknown. One specimen was observed laying three eggs in spring (DoEE, 2018).

The process of habitat removal will reduce areas available for mating, breeding and foraging. Earthworks associated with the proposal may also alter behavioural patterns of this species such that the breeding cycle is disrupted. As the habitat is too marginal to sustain a viable population of the
Five-clawed Worm-skink, it is not expected that these impacts will disrupt the breeding cycle of a local population of the species.

**Modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline**

Clearing of vegetation associated with the proposal would remove 68.55 hectares of important habitat as defined by the *Draft Referral guidelines for the nationally listed Brigalow Belt reptiles*. Remaining areas of habitat are also likely to be modified by edge effects that may change the soil surface and microhabitat conditions, altering habitat suitability for this species. This clearing will lead to a reduction in habitat.

**Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat**

The clearing of habitat is recognised as a major factor contributing to the threatened status of the Five-clawed Worm-skink. The associated indirect impacts of this key threatening process are well documented and include increased potential for the proliferation of invasive species. Measures to minimise invasion of weeds during construction and operation would be included in the CEMP. With these measures in place, this proposal is not considered likely to result in a significant increase in the impact of invasive species on the Five-clawed Worm-skink or its habitat.

**Introduce disease that may cause the species to decline**

Infection of native plants by *Phytophthora cinnamomi* has been identified as being spread by construction machinery. This water-borne fungus infects the roots of plants and has the potential to cause dieback. Machinery associated with vegetation clearance and subsequent construction for the proposal has the potential to transmit the fungus to remaining native vegetation remnants of the species. This is a potential indirect impact to the species as it may lead to a reduction in the quality of the soil surface microhabitat. This can be suitably mitigated through the development and implementation of suitable control measures for vehicle and plant hygiene such as the current best practice hygiene protocols as detailed in RTA (2011).

**Interferes substantially with the recovery of the species**

There is currently no specific recovery plan for the Five-clawed Worm-skink. This species was included in *The Action Plan for Australian Reptiles* (Cogger *et al.* 1993). The recovery plan objectives for this species include:

- 14.1: To obtain sufficient information on the species biology, ecology and distribution to determine its current conservation status and formulate appropriate management strategies,
- 14.2: To ensure that secure, viable populations of the species are maintained within a reserve system
- 14.3: To implement land management practices which promote the maintenance of secure viable populations of the species outside reserves.

The Action Plan for Australian Reptiles (Cogger *et al.* 1993) is now becoming a relatively old document, although not much has changed regarding the level of understanding of this species’ biology. The proposal could be considered as interfering substantially with objective 14.3, through the removal of 69.01 hectares of important habitat. However, an in-depth field assessment revealed that the habitat is too marginal to sustain a viable population of the Five-clawed Worm-skink, and therefore, objective 14.3 will not be affected by the Proposal.

**Conclusion**

Based on the information available, a conservative approach finds this proposal is at low risk of causing a significant impact on a viable local population of the Five-clawed Worm-skink.
Figure C.1. Location of cluster 1 of *Homopholis belsonii* populations within segment NMS2
Figure C.2. Location of cluster 2 of *Homopholis belsonii* populations within segment NMS2
Appendix C
Offsetting requirements
Project offsetting requirements

The biodiversity assessment and REF for a project details offset requirements, consistent with the thresholds in Table 1.

Table 1: Offsetting thresholds for REFs

<table>
<thead>
<tr>
<th>Description of activity or impact</th>
<th>Consider offsets or supplementary measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activities in accordance with Roads and Maritime Services Environmental assessment procedure: Routine and Minor Works (RTA 2011)</td>
<td>No</td>
</tr>
<tr>
<td>Works on cleared land, plantations, exotic vegetation where there are no threatened species or habitat present</td>
<td>No</td>
</tr>
<tr>
<td>Works involving clearing of vegetation planted as part of a road corridor landscaping program (this includes where threatened species or species comprising listed ecological communities have been used for landscaping purposes)</td>
<td>No</td>
</tr>
<tr>
<td>Works involving clearing of national or NSW listed critically endangered ecological communities (CEEC)</td>
<td>Where there is any clearing of an CEEC in moderate to good condition</td>
</tr>
<tr>
<td>Works involving clearing of nationally listed threatened ecological community (TEC) or nationally listed threatened species habitat</td>
<td>Where clearing &gt;1 ha of a TEC or habitat in moderate to good condition</td>
</tr>
<tr>
<td>Works involving clearing of NSW endangered or vulnerable ecological community</td>
<td>Where clearing &gt; 5 ha or where the ecological community is subject to an SIS</td>
</tr>
<tr>
<td>Works involving clearing of NSW listed threatened species habitat where the species is a species credit species as defined in the OEH Threatened Species Profile Database (TSPD)</td>
<td>Where clearing &gt; 1ha or where the species is the subject of an SIS</td>
</tr>
<tr>
<td>Works involving clearing of NSW listed threatened species habitat and the species is an ecosystem credit species as defined in OEH’s Threatened Species Profile Database (TSPD)</td>
<td>Where clearing &gt; 5ha or where the species is the subject of an SIS</td>
</tr>
<tr>
<td>Type 1 or Type 2 key fish habitats (as defined by NSW Fisheries)</td>
<td>Where there is any net loss of habitat</td>
</tr>
</tbody>
</table>

Calculation method

To ensure consistency and predictability in offset requirements for REF projects, the Major Projects linear infrastructure module of the BioBanking Credit Calculator (BBCC) (or as updated) should be used to calculate the amount of credits. Calculations are only required for those values where a threshold from Table 1 has been reached. For smaller projects and where the cost of this assessment is considered excessive, the ratios in Table 2 can be used to calculate the offset.

Table 2: Offsetting ratios for REF projects

<table>
<thead>
<tr>
<th>Loss</th>
<th>Offset ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss of threatened ecological community</td>
<td>Offset at a ratio of 4:1 where the offset sites are in moderate to good condition</td>
</tr>
<tr>
<td></td>
<td>Offset at a ratio of 8:1 where the offset sites are in poor condition including rehabilitation sites</td>
</tr>
<tr>
<td>Loss of threatened fauna species</td>
<td>Offset area of habitat lost at a ratio of 3:1</td>
</tr>
<tr>
<td>Loss of threatened flora species</td>
<td>Offset individuals lost at a ratio of 3:1</td>
</tr>
</tbody>
</table>
Offsetting requirements for N2M and NM Proposals

Offset requirements for Proposals N2M and NM have been addressed separately in Tables 3 and 4 below.

**Table 3: Offsetting ratios for N2M Proposal**

<table>
<thead>
<tr>
<th>N2M EPBC significantly affected CEEC or threatened species</th>
<th>Offset requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland</strong></td>
<td>45.24 ha where offset sites are in moderate to good condition or 90.48ha where offset sites are in poor condition including rehabilitation sites</td>
</tr>
<tr>
<td>Belson’s Panic</td>
<td>8.7 ha</td>
</tr>
<tr>
<td>Five-clawed worm skink</td>
<td>No offset requirement as impact of Proposal not deemed significant</td>
</tr>
</tbody>
</table>

**Table 4: Offsetting ratios for NM Proposal**

<table>
<thead>
<tr>
<th>N2M EPBC significantly affected CEEC or threatened species</th>
<th>Offset requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland</strong></td>
<td>70.4 ha where offset sites are in moderate to good condition or 140.8 ha where offset sites are in poor condition including rehabilitation sites</td>
</tr>
<tr>
<td>Belson’s Panic</td>
<td>8.7 ha</td>
</tr>
<tr>
<td>Five-clawed worm skink</td>
<td>No offset requirement as impact of Proposal not deemed significant</td>
</tr>
</tbody>
</table>