

Newell Highway Heavy Duty Pavements, Narrabri to Moree

Submission report

Roads and Maritime Services | September 2018



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Prepared by Jacobs and Roads and Maritime Services

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Approval and authorisation

Title	Newell Highway Heavy Duty Pavements, Narrabri to Moree
Accepted on behalf of NSW Roads and Maritime Services by:	Edward Paas Project Development Manager Freight and Regional Program Office
Signed:	
Dated:	13/09/2018

Executive summary

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

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 five sections of the existing highway 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
- Provision of 1.5 kilometre long overtaking lanes at five locations (three northbound and two southbound)
- Upgrading numerous intersections along the Newell Highway to dedicated right hand turn intersections, with additional left hand turn intersection treatments
- Provision of a central two way right turning lane (TWRTL) at Bellata
- Provision of three metre wide shoulders for 30 metres on either side of property accesses
- Improving the Newell Highway flood immunity to a target of 20 year average recurrence interval (ARI) where feasible and reasonable
- Property acquisitions as required
- Utility relocations as required
- Establishing temporary facilities, including construction compounds, stockpile sites and erosion and sedimentation measures as required.

The main features of the proposal are as outlined in the Review of Environmental Factors (REF).

The REF was publically displayed between Friday 22 June to Monday 23 July 2018 at the Narrabri and 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 via email on Friday 22 June 2018.

Roads and Maritime received four submissions in response to the REF during the public display period. This included submissions from Moree Plains Shire Council, Narrabri Shire Council and two submissions from the community (one from an individual and another from a sporting group). Of the submissions, three of the respondents generally supported the proposal. All submissions received have been considered in the preparation of this report.

Two of the four submissions sought clarification from adjacent landowners regarding the inclusion of certain intersection treatments, private driveways and access points. Roads and Maritime has confirmed the proposal includes the measures the landowners have sought clarification on.

The main issues raised in the submissions related to:

- Co-ordinating 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
- Compatibility of the proposal with the Inland Rail, Moree Gateway Project and future development activities within the area
- General concerns regarding road safety, speed limits and signage.

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 five proposal sections (N2MS2) as opposed to three of the five proposal sections (N2MS2, N2MS4 and N2MS5) originally assessed in the REF. The supplementary biodiversity assessment concluded that the proposal would still have a would have a significant impact on the Natural Grasslands CEEC within N2MS5.

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 five sections of the Newell Highway between Narrabri and Moree (the highway) in north west NSW within the existing road corridor (the proposal). The proposal is located in the Narrabri Shire and Moree Plains Shire Local Government Areas (LGAs).

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 five sections of the existing highway to a heavy duty (HD) pavement
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- Property acquisitions as required
- Utility relocations as required
- Establishing temporary facilities, including construction compounds, stockpile sites and erosion and sedimentation measures as required.

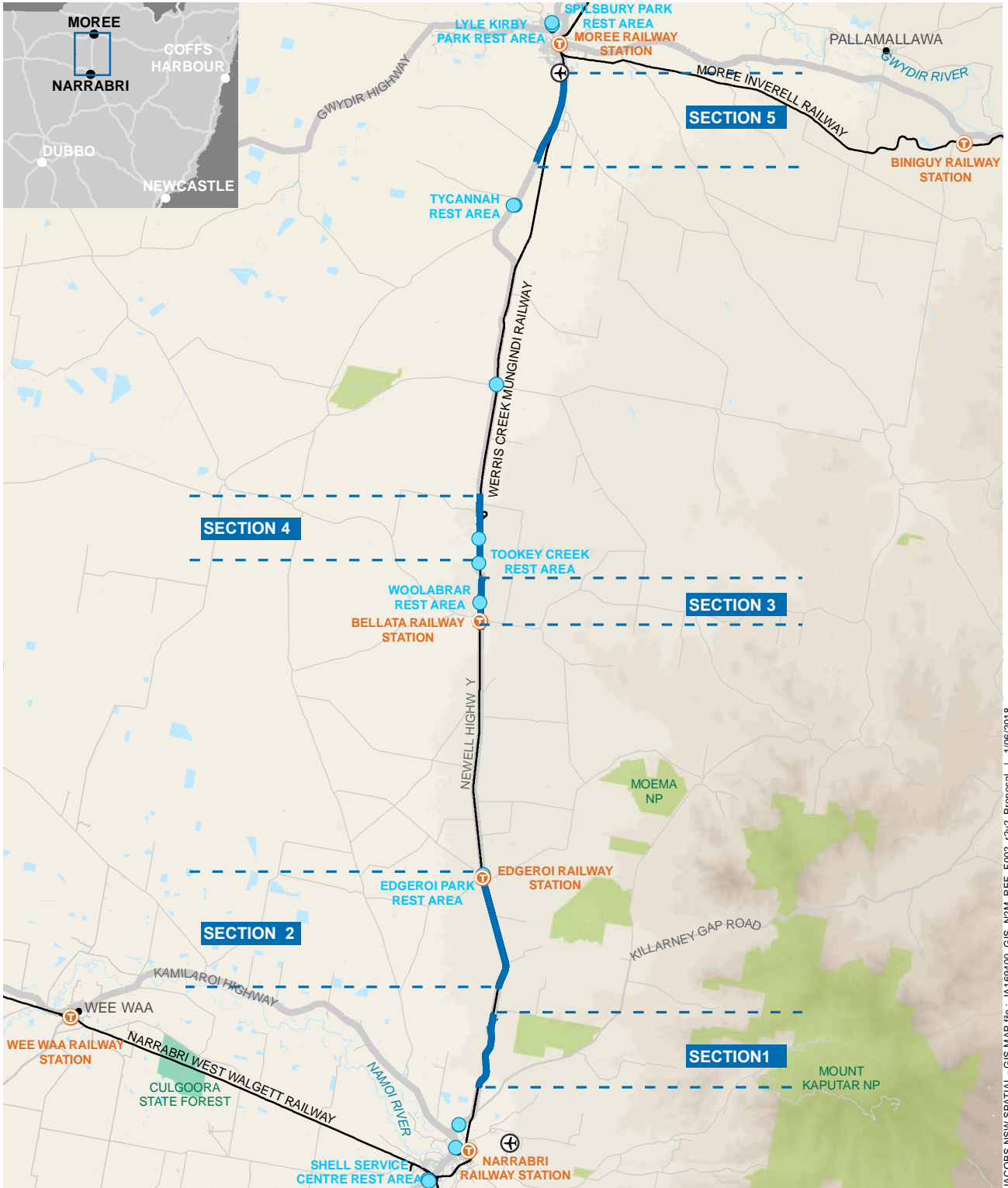
The proposal would be delivered in five sections with a combined length of about 33.8 kilometres of upgrades along the highway. The five sections and indicative work locations are described in **Table 1-1**. Each section would be staged to enable work to be completed safely while maintaining traffic 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

Section	Location	Proposed works
N2MS1	6.4 kilometres to 12.9 kilometres north of Narrabri	<ul style="list-style-type: none">• Upgrading 6.5 kilometres of the Newell Highway.
N2MS2	15.6 kilometres to 25.9 kilometres north of Narrabri at Edgeroi	<ul style="list-style-type: none">• Upgrading 10.3 kilometres of the Newell Highway• Two overtaking lanes – northbound and southbound.
N2MS3	46.8 kilometres to 51.3 kilometres north of Narrabri at Bellata	<ul style="list-style-type: none">• Upgrading 4.5 kilometres of the Newell Highway• One northbound overtaking lane.
N2MS4	52.4 kilometres to 58.3 kilometres north of Narrabri, north of Bellata	<ul style="list-style-type: none">• Upgrading 5.9 kilometres of Newell Highway.
N2MS5	88.4 kilometres to 96.3 kilometres north of Narrabri, south of Moree	<ul style="list-style-type: none">• Upgrading 7.9 kilometres of the Newell Highway• Two overtaking lanes – northbound and southbound.

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.



JACOBS NSW SPATIAL - GIS MAP file : I:\169400_GIS_N2M_REF_F002_r2\2_Proposal | 1/06/2018

Legend

- The proposal
- Roadside rest area
- ⊕ Airport
- Ⓣ Train station
- Railway

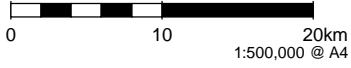


Figure 1-1 | Locality



JACOBS NSW SPATIAL - GIS MAP file - IA169400_GIS_N2M_REF_F007_r2v1_Design_Segment1 | 31/05/2018

— The proposal ●●●● Railway line
 — Waterway

0 100 200m

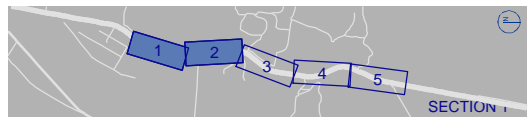
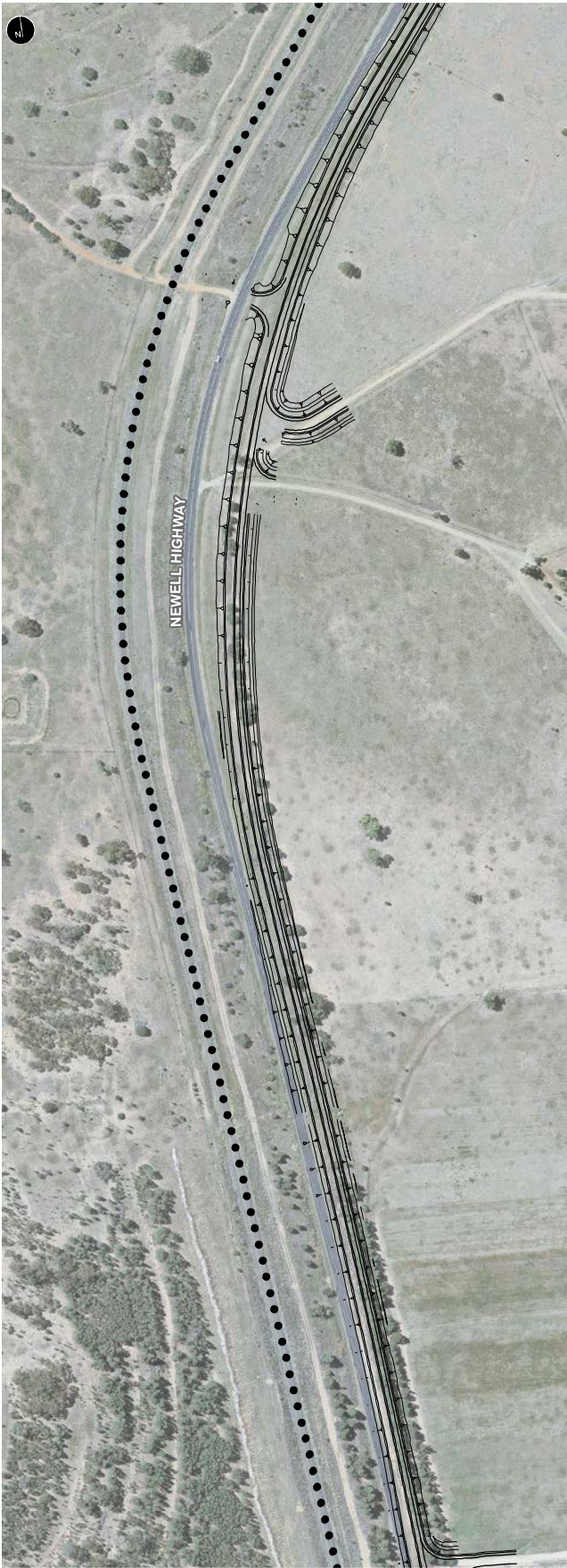


Figure 1-2 | The proposal N2M S1



JACOBS NSW SPATIAL - GIS MAP file - IA189400_GIS_N2M_REF_F007_r2v1_Design_Segment1 | 31/05/2018

— The proposal ●●●● Railway line
 — Waterway

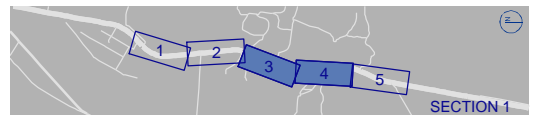
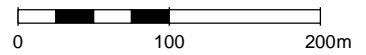


Figure 1-2 | The proposal N2M S1



JACOBS NSW SPATIAL - GIS MAP file - IA169400_GIS_N2M_REF_F007_r2v1_Design_Segment1 | 31/05/2018

— The proposal ●●●● Railway line
 — Waterway

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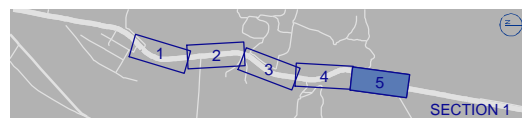


Figure 1-2 | The proposal N2M S1



JACOBS NSW SPATIAL - GIS MAP file - IA169400_GIS_N2M_REF_F007_r2v1_Design_Segment2 | 31/05/2018

— The proposal ●●●● Railway line
 — Waterway

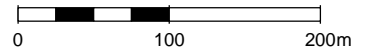
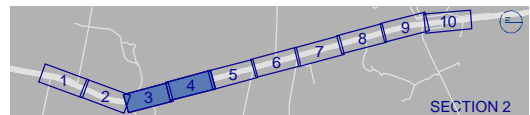
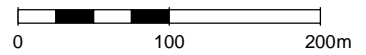


Figure 1-2 | The proposal N2M S2



— The proposal ●●●● Railway line
 — Waterway



JACOBS NSW SPATIAL - GIS MAP file - IA169400_GIS_N2M_REF_F007_r2v1_Design_Segment2 | 31/05/2018

Figure 1-2 | The proposal N2M S2



JACOBS NSW SPATIAL - GIS MAP file - IA169400_GIS_N2M_REF_F007_r2v1_Design_Segment2 | 31/05/2018

— The proposal ●●●● Railway line
 — Waterway

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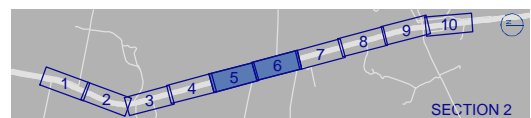


Figure 1-2 | The proposal N2M S2



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— The proposal ●●●● Railway line
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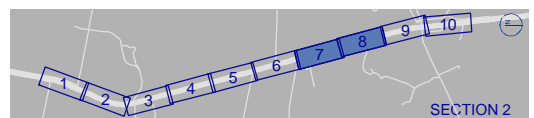


Figure 1-2 | The proposal N2M S2



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— The proposal ●●●● Railway line
 — Waterway

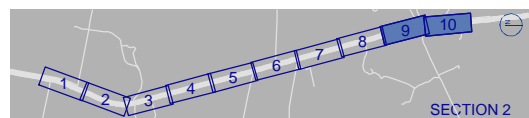
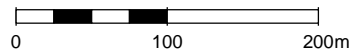
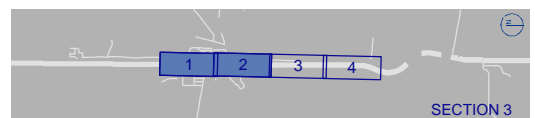


Figure 1-2 | The proposal N2M S2



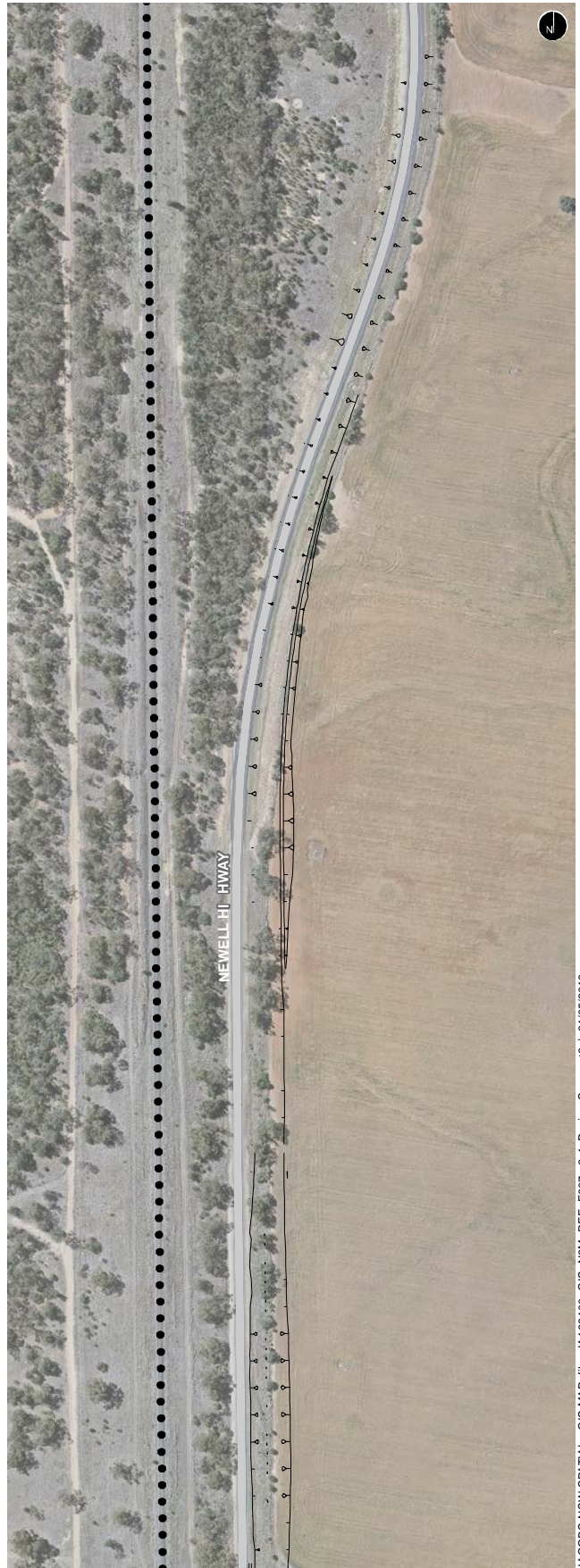
— The proposal ●●●● Railway line
 — Waterway

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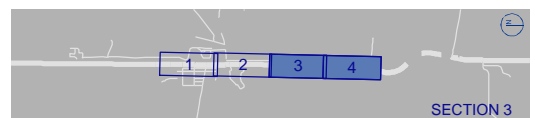
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Figure 1-2 | The proposal N2M S3



— The proposal ●●●● Railway line
 — Waterway

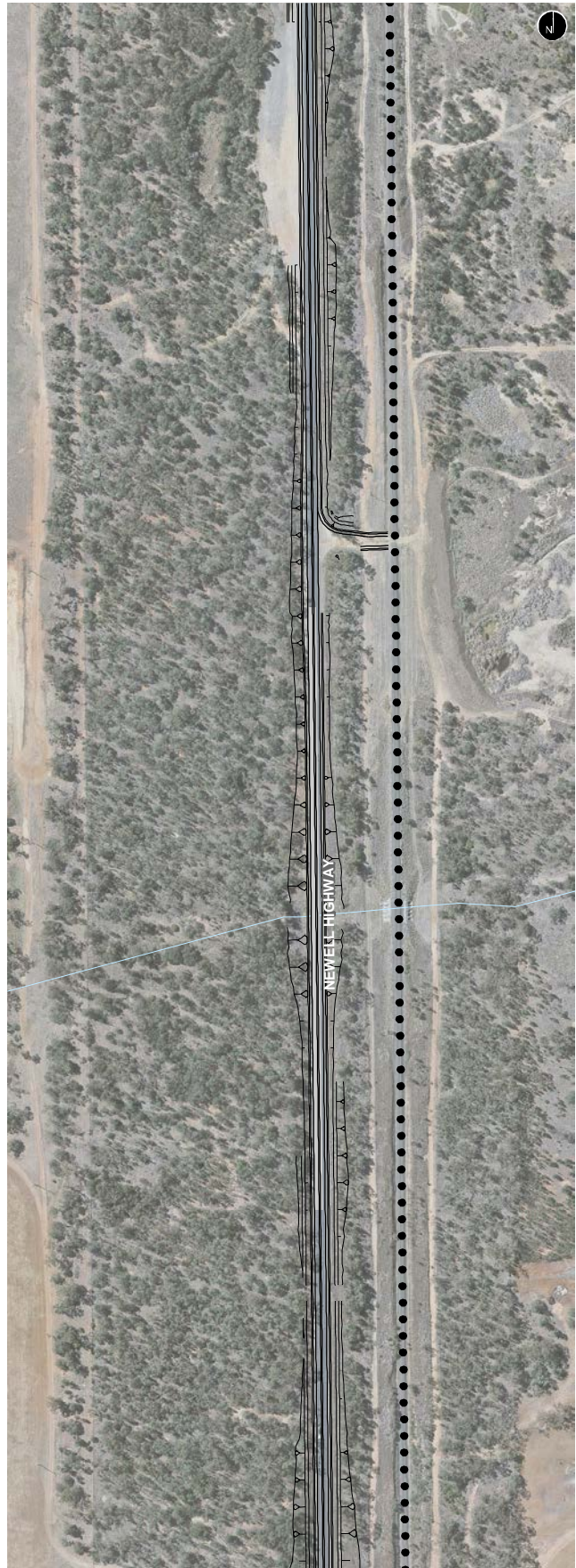
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SECTION 3

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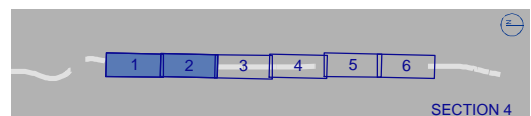
Figure 1-2 | The proposal N2M S3



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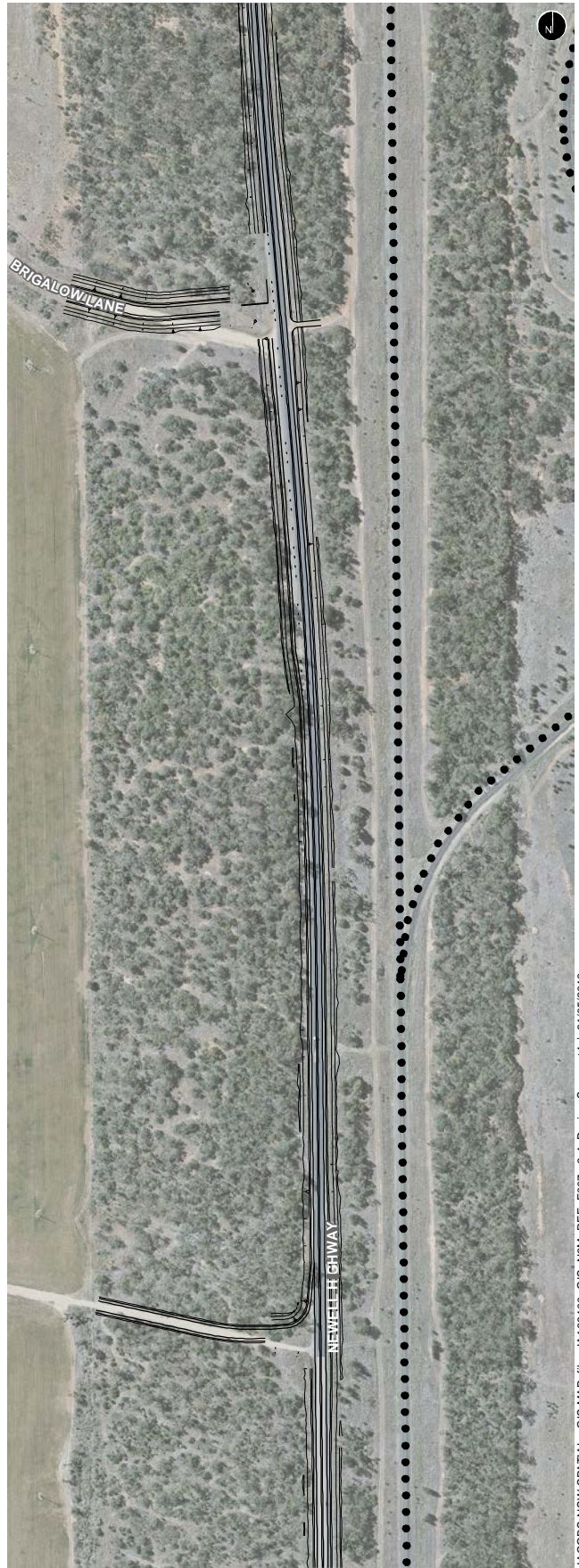
— The proposal ●●●● Railway line
 — Waterway

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SECTION 4

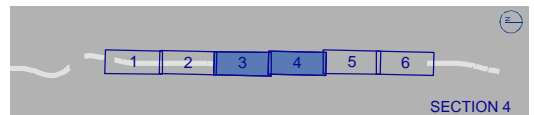
Figure 1-2 | The proposal N2M S4



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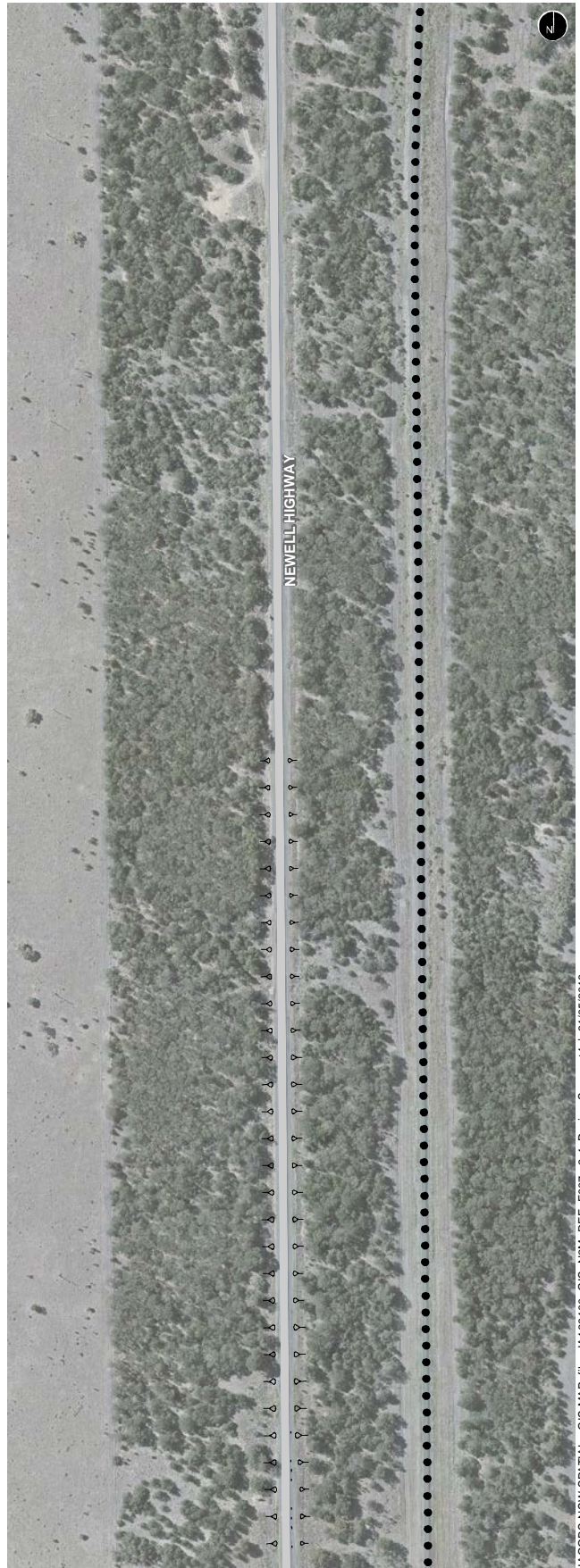
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 — Waterway

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SECTION 4

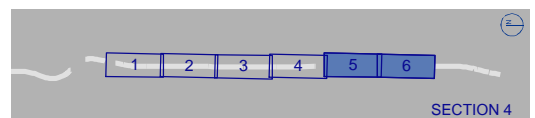
Figure 1-2 | The proposal N2M S4



JACOBS NSW SPATIAL - GIS MAP file - IA169400_GIS_N2M_REF_F007_r2v1_Design_Segment4 | 31/05/2018

— The proposal ●●●● Railway line
 — Waterway

0 100 200m



SECTION 4

Figure 1-2 | The proposal N2M S4



JACOBS NSW SPATIAL - GIS MAP file - IA189400_GIS_N2M_REF_F007_r2v1_Design_Segment5 | 31/05/2018

— The proposal ●●●● Railway line
 — Waterway

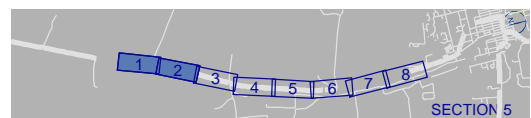
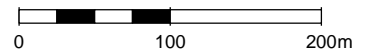
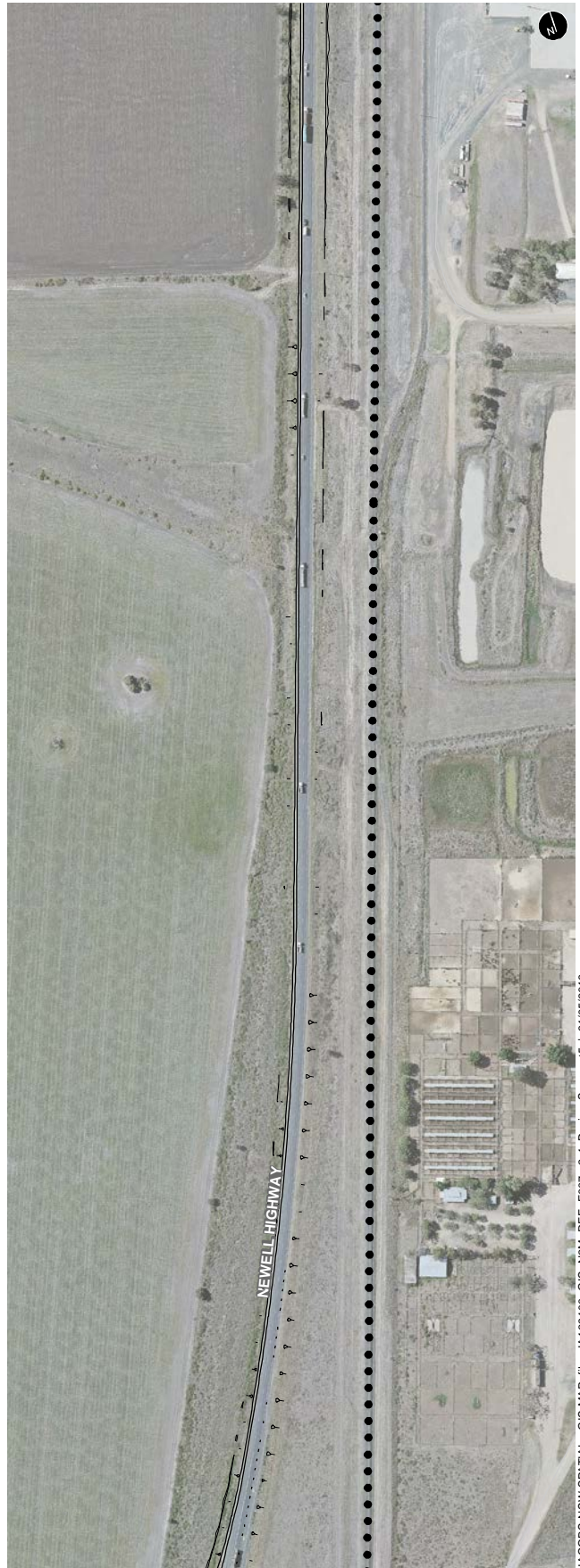


Figure 1-2 | The proposal N2M S5



JACOBS NSW SPATIAL - GIS MAP file - IA189400_GIS_N2M_REF_F007_r2v1_Design_Segment5 | 31/05/2018

— The proposal ●●●● Railway line
 — Waterway

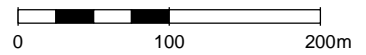


Figure 1-2 | The proposal N2M S5



JACOBS NSW SPATIAL - GIS MAP file - IA169400_GIS_N2M_REF_F007_r2v1_Design_Segment5 | 31/05/2018

— The proposal ●●●● Railway line
 — Waterway

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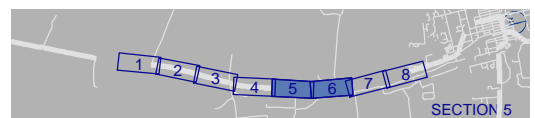
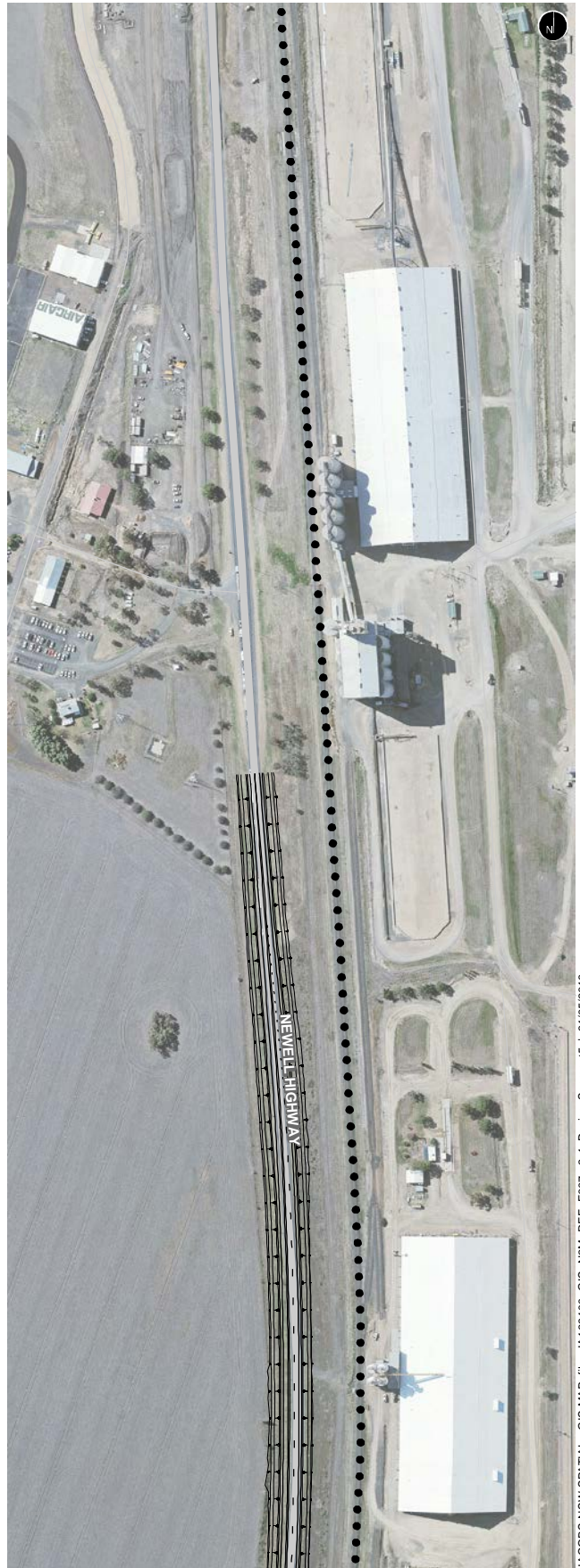


Figure 1-2 | The proposal N2M S5



JACOBS NSW SPATIAL - GIS MAP file - IA189400_GIS_N2M_REF_F007_r2v1_Design_Segment5 | 31/05/2018

— The proposal ●●●● Railway line
 — Waterway

0 100 200m



Figure 1-2 | The proposal N2M S5

1.2 REF display

Roads and Maritime prepared a REF to assess the environmental impacts of the proposal. The review of environmental factors was publically displayed for 32 days between 22 June 2018 and 23 July 2018 at two locations, as detailed in **Table 1-2 Display locations**. 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 via email on Friday 22 June 2018.

Table 1-2 Display locations

Location	Address
Narrabri Shire Council	46-48 Maitland Street Narrabri
Moree Plains Shire Council	MAX Centre, Corner Balo and Herber Streets Moree

1.3 Purpose of the report

This submissions report relates to the REF prepared for the Newell Highway Heavy Duty Pavements, Narrabri to 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 four submissions, accepted up until the 20 July 2018. **Table 2-1** lists the respondents and each respondent's allocated submission number.

Table 2-1: Respondents

Respondent	Submission No.	Section number where issues are addressed
Local sporting club	1	Section 2.1, Section 2.4.4
Individual	2	Section 2.3.3
Narrabri Shire Council	3	Section 2.1
Moree Plains Shire Council	4	Section 2.1, Section 2.2.1, Section 2.2.2, Section 2.3.1, Section 2.3.2, Section 2.4.1, Section 2.4.2, Section 2.4.3, Section 2.4.4, Section 2.4.5, Section 2.4.6, Section 2.5, Section 2.6.1, Section 2.6.2, Section 2.7

2.1 Overview of issues raised

A total of four submissions were received in response to the display of the REF. This included submissions from two government agencies and two submissions from the community. Of the submissions, three of the respondents generally supported the proposal.

Each submission has been examined individually to understand the issues being raised. The issues raised in each 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 in the submissions 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
- Compatibility of the proposal with the Inland Rail, Moree Gateway Project and future development activities within the area
- General concerns regarding road safety, speed limits and signage.

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, 3, 4

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)

4 (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 Council's 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 will continue to have regular meetings with Council under the Road Maintenance Council Contract (RMCC). 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 of workshops for each of the Newell Highway Projects where program updates are provided. This would continue to be the case. Further 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)

4 (13 and 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)

4(16)

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.

Response

Council concerns have been noted and all 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.

2.3.2 Local road intersection treatments with the Newell highway

Submission number(s)

4(15)

Issue description

Moree Plains Shire Council responded with the following comments on local road intersections with the Newell Highway:

- The design of the Burrington Road intersection with Newell Highway currently has adequate axillary left hand turn (AUL) and channelised right hand turn (CHR) as large trucks are not permitted to access Burrington Road however there is potential for future local road changes. Council requests further consultation with Roads and Maritime regarding these potential upgrades
- For the Tapscott Road intersection with Newell Highway, AUL and CHR designs needs to consider the Inland Rail and future developments. Due to the proximity of this intersection to the east-west bypass and Intermodal Park, traffic flows in the area would likely increase.

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 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

Roads and Maritime acknowledges Moree Plains Shire Council's concern about potential future changes to local roads and the associated impacts to Burrington Road. Roads and Maritime would continue to consult with Council throughout the detailed design stage to ensure the intersection with Burrington Road has adequate AUL and CHR.

The AUL and CHR intersection treatment proposed for the intersection of Tapscott Road and Newell Highway is considered adequate to meet the Austroads guidelines. Roads and Maritime are currently in ongoing discussion with Inland Rail and would also continue to consult with Council throughout the detailed design stage.

While Council's 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.

2.3.3 Brigalow Lane access (N2MS4)

Submission number(s)

2

Issue description

The respondent raised concerns regarding the safety of accessing the driveway to the Shire Gravel Pit and a private residence particularly due to a crest in the road to the north of the driveway. The respondent requested additional signage to warn vehicles at the concealed driveway and a dedicated turning lane.

Response

As outlined in the REF, the road level at this location would be modified to increase sight distances and improve safety for vehicles exiting or entering the Newell Highway. Treatment to the driveway at this location would include sealing the driveway for 15 metres from the edge line of the Newell Highway.

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. This would include opportunities to improve traffic safety through the provision of signage to advise of upcoming overtaking lanes and potential concealed traffic movements.

2.4 Traffic and transport

2.4.1 Bellata (N2MS3)

Submission number(s)

4(27)

Issue description

The delineation of access to the truck stop and railway station is required to ensure public safety. This location is used as a set down and pick up location for railway commuters south of Moree and North of Narrabri. Council requests that support be given to improve access to the railway station and the truck stop to support the use of public transport and encourage drivers to take a break.

Response

Moree Plains Shire Council's concerns have been noted and Roads and Maritime would consider opportunities to support the improvement and delineation of the access road to the truck stop and railway station as part of the detailed design stage.

2.4.2 Penneys Road Intersection (N2MS4)

Submission number(s)

4(28)

Issue description

Moree Plains Shire Council's requests consideration of longer AUL and CHR at Penneys Road Intersection due to the frequency of use by trucks during harvest and the proximity to the railway line. Moree Plains Shire Council also requests additional advanced warning signage to ensure the safety of turning trucks. This could include the provision of a permanent Variable Message Sign that can be activated during the harvest period and also provide other road safety messages at other times of the year. Moree Plains Shire Council also noted that Inland Rail are proposing to install a boom gate and signal lights at this intersection.

Response

Moree Plains Shire Council's concerns have been noted and all 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. 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.

Roads and Maritime currently carry out a safety campaign during the harvest period and use temporary Variable Message Signs to provide advanced warning to trucks of upcoming intersections. Roads and Maritime would continue this campaign during, and following completion of construction.

2.4.3 Brigalow Lane access (N2MS4)

Submission number(s)

4(29)

Issue description

A responded contacted Moree Plains Shire Council to prompt Roads and Maritime to consider assisting with the construction of an internal road from a private driveway to connect with Brigalow Lane and so eliminate the Newell Highway access. This road is the primary access for the homestead however it has poor sight distance and is considered unsafe. The saving of the Newell Highway access construction could be diverted to the internal road.

Response

Roads and Maritime would contact the private owner and consider opportunities to improve road safety by changing the location of the access road from Newell Highway to Brigalow Lane.

2.4.4 Adequate signage / advance warning of overtaking lanes

Submission number(s)

1, 4(25), 4(26)

Issue description

Many trucks are limited to 100 kilometres per hour, which results in numerous cars looking for safe overtaking areas. Adequate signage is required to give advance warning of upcoming overtaking lanes.

There were other requests for advance information signage in regards to the approach of other local road intersections with the Newell Highway (such as Murrumbilla Lane) and amenities available at villages such as Edgeroi.

Response

The concerns of Moree Plains Shire Council and the private resident have been noted. All 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. 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. This would include opportunities to improve traffic safety through the provision of signage to advise of upcoming overtaking lanes and potential concealed traffic movements.

2.4.5 Impacts to the stopping area north of the proposal

Submission number(s)

4(7)

Issue description

Moree Plains Shire Council notified Roads and Maritime of an informal roadside stopping area north of the proposal. This area has multiple uses including:

- Use as a pick up and drop off location for the Millie Bus route
- Safety checks on wide loads and regrouping with their escorts
- U-turn area for caravans
- Site for temporary Variable Message Signs advising road users of upcoming wide loads.

Moree Plains Shire Council has indicated their concern that the proposal would impact on the use of this area.

Response

Roads and Maritime acknowledge Moree Plains Shire Council's concern regarding impacts to the informal stopping area to the north of the proposal. At this point, there are no planned impacts to this area. Roads and Maritime would continue to consult with Moree Plains Shire Council throughout the detailed construction stage, once more details are known to ensure that impacts to this rest area are mitigated.

Roads and Maritime would also pass on this information to the Area Maintenance Manager and Network and Safety for separate consideration.

2.4.6 Overtaking lanes

Submission number(s)

4(6)

Issue description

Moree Plains Shire Council is in support of the addition of two over taking lanes. However due to increasing development in the area, Moree Plains Shire Council recommended that Roads and Maritime consider swapping the location of the north and south overtaking lanes such that the north bound overtaking lane is located immediately south of the airport. This would ensure that traffic associated with any future development activities would not compromise the performance and safety of the Newell Highway.

Response

Roads and Maritime acknowledge Moree Plains Shire Council's suggestion of relocating the north and south overtaking lanes and the potential associated benefits. Roads and Maritime would further consider opportunities to relocate overtaking lanes and the potential benefits of doing so as part of the detailed design stage.

2.5 Future developments around N2MS5

Submission number(s)

4 (1-3).

Issue description

Moree Plains Shire Council commented that the entire section of the Newell Highway from the Moree Regional Airport to Wallanool Road is part of a larger freight network study which is concurrently being prepared. This study is funded with support from the NSW State, and the Australia Federal Governments. Moree Plains Shire Council has stated that it has obtained the preliminary results of this study.

Moree Plains Shire Council are concerned that the proposed works to section N2MS5 would greatly impact on a number of critically significant future developments for the Moree Plains Shire and the greater region. Moree Plains Shire Council requested an opportunity to meet with the Roads and Maritime design team following the finalisation of the freight network study to consider the findings of the study.

As part of the submission, Moree Plains Shire Council provided the preliminary schematic of the preferred option for the East-West bypass, following Halls Creek, and meeting the Newell Highway with both an overpass for the east west traffic, and clover leaf intersections for access from the Newell Highway to the east west link road. Moree Plains Shire Council also commented that the proposal may interact with the Inland Rail and the Moree Intermodal Park.

Response

The Roads and Maritime design team have met with and would continue to consult with Moree Plains Shire Council, particularly in relation to the outcomes of the freight network study, as the detailed design is developed.

Roads and Maritime acknowledges the receipt of the preliminary schematic drawings. Any future realignment of the Gwydir Highway and overpass of the Newell Highway for a development project such as the Moree Intermodal Park would require a detailed review as part of any future Work Authorisation Deed (WAD) process.

2.6 Moree Gateway South

2.6.1 New intersection to support the Moree Gateway Project

Submission number(s)

4(4)

Issue description

Moree Plains Shire Council raised the need for an additional public road intersection with the Newell Highway north of Halls Creek to provide access to the southern section of the Moree Gateway Project.

Response

Roads and Maritime acknowledges the future request for an additional public road at this location. Any intersection works at this location would require consideration under a WAD process when plans are more mature. Roads and Maritime would continue to consult with Moree Plains Shire Council during the detailed design stage.

2.6.2 Changes to speed limits on Newell Highway

Submission number(s)

4(5)

Issue description

Moree Plains Shire Council requests that Roads and Maritime extend the 80 kilometre speed limit zone south of Moree by an additional 800 metres. This would support:

- Safe movement of heavy vehicles into and out of the proposed access road to the southern section of the Moree Gateway Project
- Safe bus movements and vehicles access a stopping area near the former airport entrance
- Safe movement into the future viewing area of a proposed silo art project anticipated to be the largest of its kind in Australia.
- Future development activities.

Response

The changes proposed by Moree Plains Shire Council to extend the 80 kilometre speed limit zone by another 800 metres would not support the objectives of the proposal as it would increase travel time and decrease freight efficiency. Previous discussions carried out between Roads and Maritime and Moree Plains Shire Council regarding potential connections to Newell Highway were such that any additional access would need to be designed to accommodate a posted of 110 kilometres per hour.

Roads and Maritime would continue to consult with Moree Plains Shire Council regarding these safety concerns and would include the outcomes of such discussions in the detailed design stage.

2.7 Existing culverts at capacity

Submission number(s)

4(10 and 11)

Issue description

Moree Plains Shire Council is concerned with the capacity of existing culverts, specifically:

- The culverts located between Wallanol Road and Clarks Gully (RMS ID Bridge 2897) regularly overflows due to the additional stormwater being diverted to this location. Overland flows should be modelled at this location and water quality analysis should be undertaken upstream and downstream and provided to Office of Environment and Heritage for future development benchmarking
- The culvert located between Tapscott Road and Burrington Road (RMS ID Bridge 2898) experience capacity issues and is regularly close to overflowing. Moree Plains Shire Council recommend that hydraulic modelling be carried out. Moree Plains Shire Council also notes the table drains on the eastern side regularly has water in proximity to the road level and during minor flood events water can spill over.

Response

Roads and Maritime acknowledge Moree Plains Shire Council's concern regarding the two culverts in question. Roads and Maritime would carry out flood modelling of RMS ID Bridge 2897 and review the results in conjunction with the proposed drainage designs for Inland Rail to the east.

Roads and Maritime has recently carried out hydraulic modelling of RMS ID Bridge 2898 as part of the flood study. The results of this modelling deemed the culvert adequate to meet the design criteria. Roads and Maritime would further review the capacity of the table drain as part of the detailed design stage.

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 the 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**.

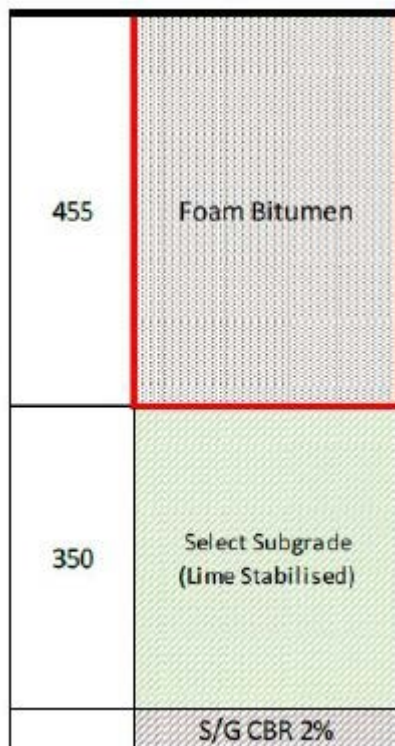


Figure 3-1 Indicative pavement profile (GHD, 2018)

3.1.2 Background and need for the change

Since the exhibition of the REF, further detailed geotechnical investigations were undertaken 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 select a recommended pavement options 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 determined 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 recommend 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 (**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.

Asphalt surfacing is preferred within town limits, such as within Bellata and Edgeroi. The asphalt surfacing would be placed over the bound pavement solution, 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**.

The proposed changes to the pavement design as a result of the pavement workshop for each section of the proposal are outlined in **Table 3-1**.

Table 3-1 Proposed changes to the pavement design

Section	Proposed pavement design	Details
N2MS1	Heavy duty granular pavement with a spray seal	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).

Section	Proposed pavement design	Details
N2MS2	Heavy duty granular pavement with a spray seal Thick asphalt over heavily bound subbase	Sprayed bitumen seal wearing course over 200 millimetre heavy duty DGB20 on a 140 millimetre DGS20. Except through village of Edgeroi which would have 50 millimetre Asphaltic concrete 14 (AC14) heavy duty wearing course with Foamed bitumen base (FBB) rather than a spray seal.
N2MS3	Heavy duty granular pavement with a spray seal Thick asphalt over heavily bound subbase	Sprayed bitumen seal wearing course over 200 millimetre heavy duty DGB20 base on a 140 millimetre DGS20 sub base. Except through village of Bellata which will have 50 millimetre AC14 heavy duty wearing course with FBB rather than a spray seal.
N2MS4	Heavy duty granular pavement with a spray seal	Sprayed bitumen seal wearing course over 200 millimetre heavy duty DGB20 base on a 140 millimetre DGS20 sub base.
N2MS5	Heavy duty granular pavement with a spray seal	Sprayed bitumen seal wearing course over 200 millimetre heavy duty DGB20 base on a 140 millimetre DGS20 sub base.

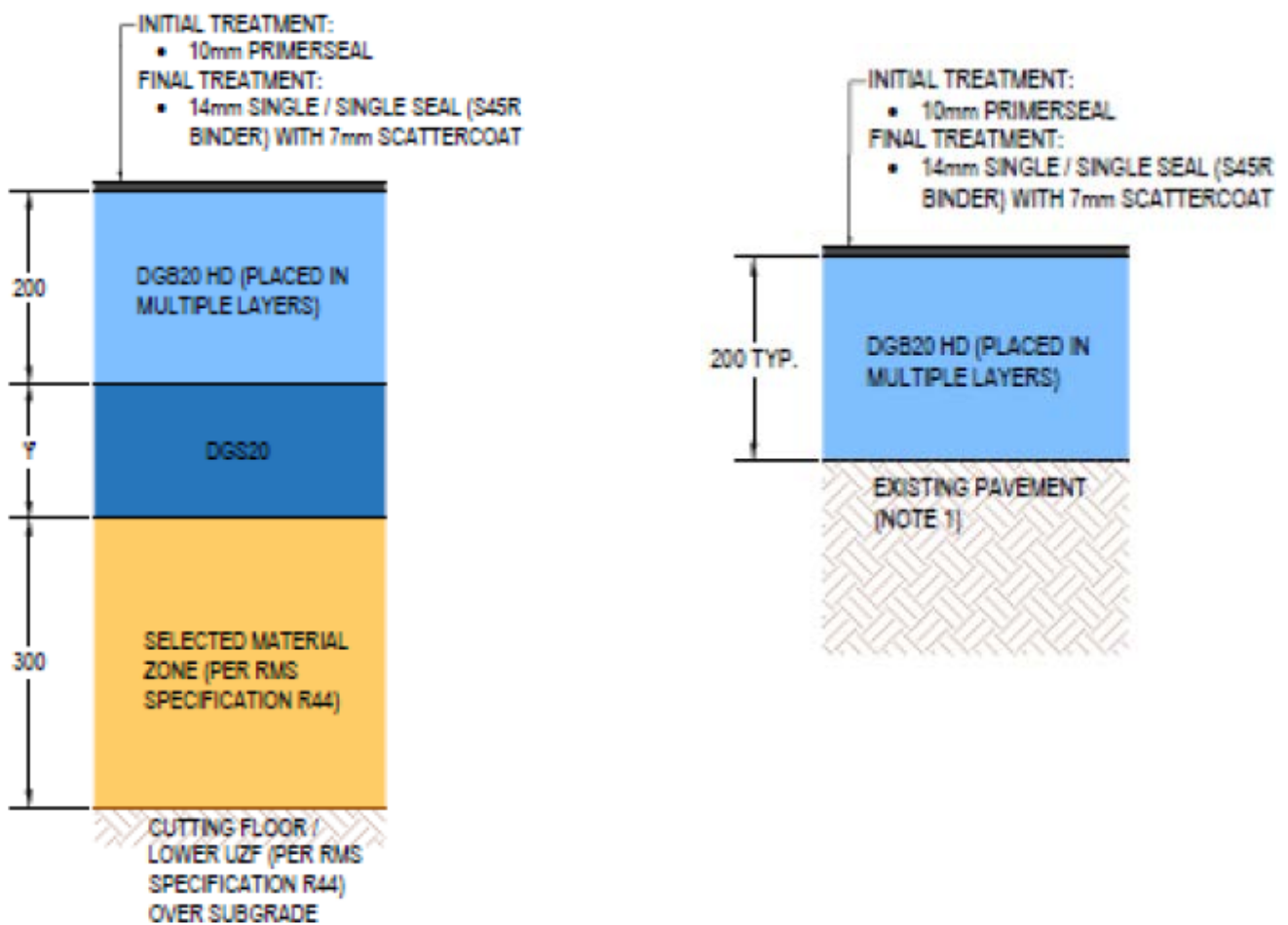


Figure 3-2 Heavy duty granular pavement profile (left) and heavy duty granular pavement re-use profile (right) (Aurecon, 2018)

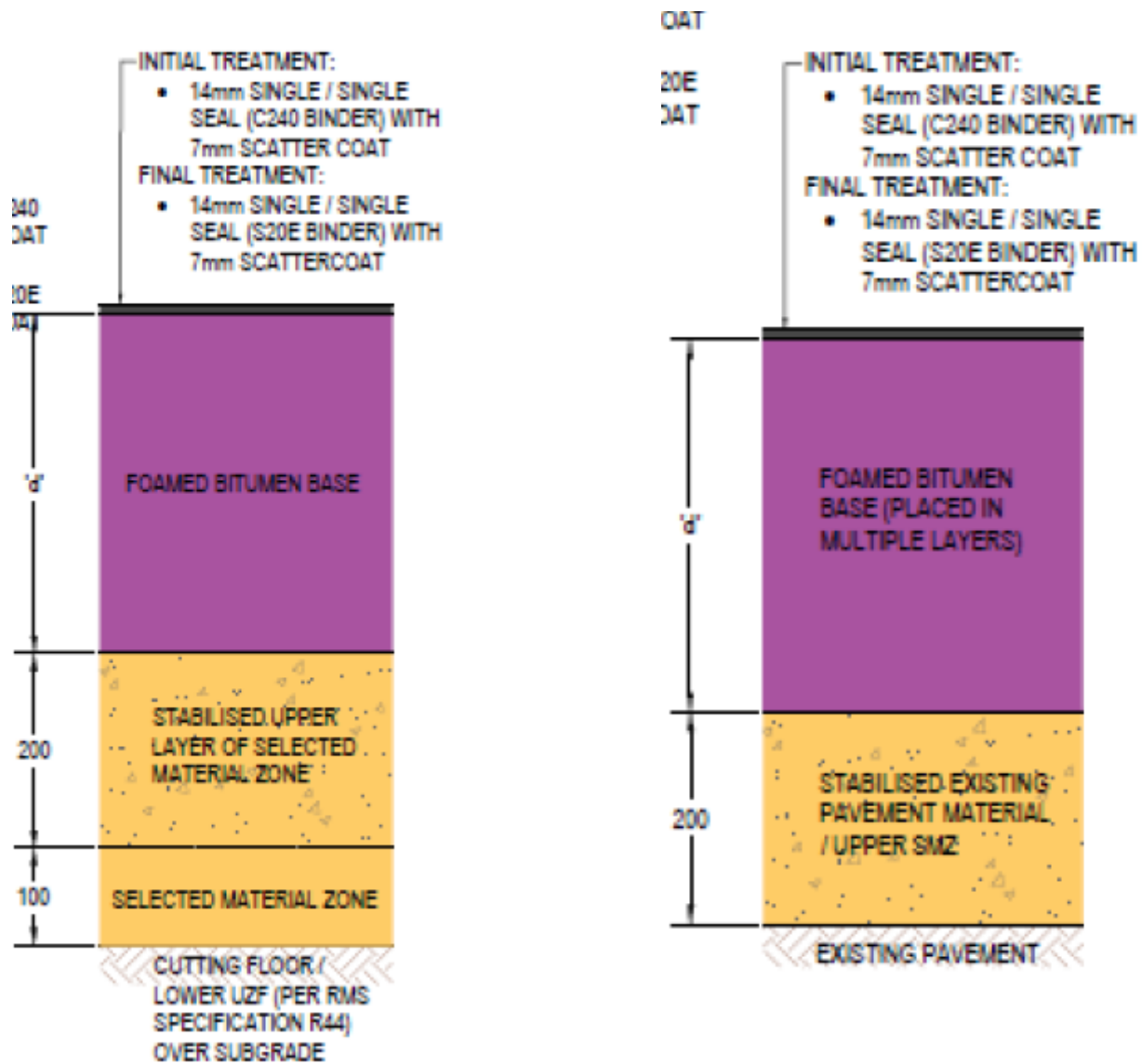


Figure 3-3 Foam bitumen base over bound subbase plus spray seal profile (left) and Foam bitumen base over bound subbase plus spray seal profile re-use profile (right) (Aurecon, 2018)

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 included about eight hectares of *Biodiversity Conservation Act 2016* (BC Act) listed threatened ecological communities (TEC) and 16 hectares of *Environment 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, Belson's Panic (*Homopholis belsonii*) 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 to carry out a supplementary 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, *Homopholis belsonii* and the Natural Grasslands CEEC, to better inform the EPBC Act assessment of significance. For the Five-clawed worm-skink, 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.

The findings of the additional assessment carried out by AREA has been 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 supplementary assessment provided in **Appendix A**. The following provides a summary of the methodology used.

The methodology for the supplementary biodiversity assessment for Belson's Panic and the Natural Grasslands CEEC involved:

- Review of the N2M BAR (Jacobs, 2018) to consider:
 - Where known or potential habitat of *Homopholis belsonii* occurred
 - Where impact to these populations was determined significant.
- Targeted terrestrial flora surveys for *Homopholis belsonii* and the Natural Grasslands CEEC were carried out from 2 to 5 July 2018
- Assessments in Natural Grasslands CEEC habitat were carried out 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* were carried out at and nearby the known populations identified by Jacobs. The searches were carried out 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 in-tact population. 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* 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*. The alternative impact footprint, with an additional 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* and the Natural Grasslands CEEC determined by the BAR (Jacobs, 2018)
- Update the EBPC Act assessment of significance for *Homopholis belsonii* and the Natural Grasslands CEEC.

While the methodology for the supplement biodiversity assessment for the Five-clawed Worm-skink involved:

- A search was made of Australian Museum records, the Atlas of Living Australia (ALA) and BioNet databases
- Collection of additional data on the location, size and extent of the populations of Five-clawed worm-skink 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 about every two kilometres (dependant on traffic and parking constraints) in each of the five sections. 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 metre buffer for about 100 metres. A similar process was carried out on the western side of the highway. The purpose of the transects was to assess the suitability of habitat in the study area for the Five-clawed Worm-skink. 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 determined by the BAR (Jacobs, 2018)
- Update the EBPC Act assessment of significance for the Five-clawed Worm-skink.

4.1.3 Description of existing environment

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

AREA's search for *Homopholis belsonii* were carried out at and nearby the known populations identified by Jacobs. In addition, all areas of suitable habitat (ie EPBC Act woodland) identified by Jacobs within N2MS2 were searched by AREA for additional populations of *Homopholis belsonii*, however, no other populations were recorded within N2MS2.

In total about 2.9 hectares of known/potential habitat (one population) of *Homopholis belsonii* was identified in Weeping Myall open woodland within N2MS2.

AREA concluded that after ground truthing the *Homopholis belsonii* population and community, the field surveys carried out by Jacobs were accurate and thorough.

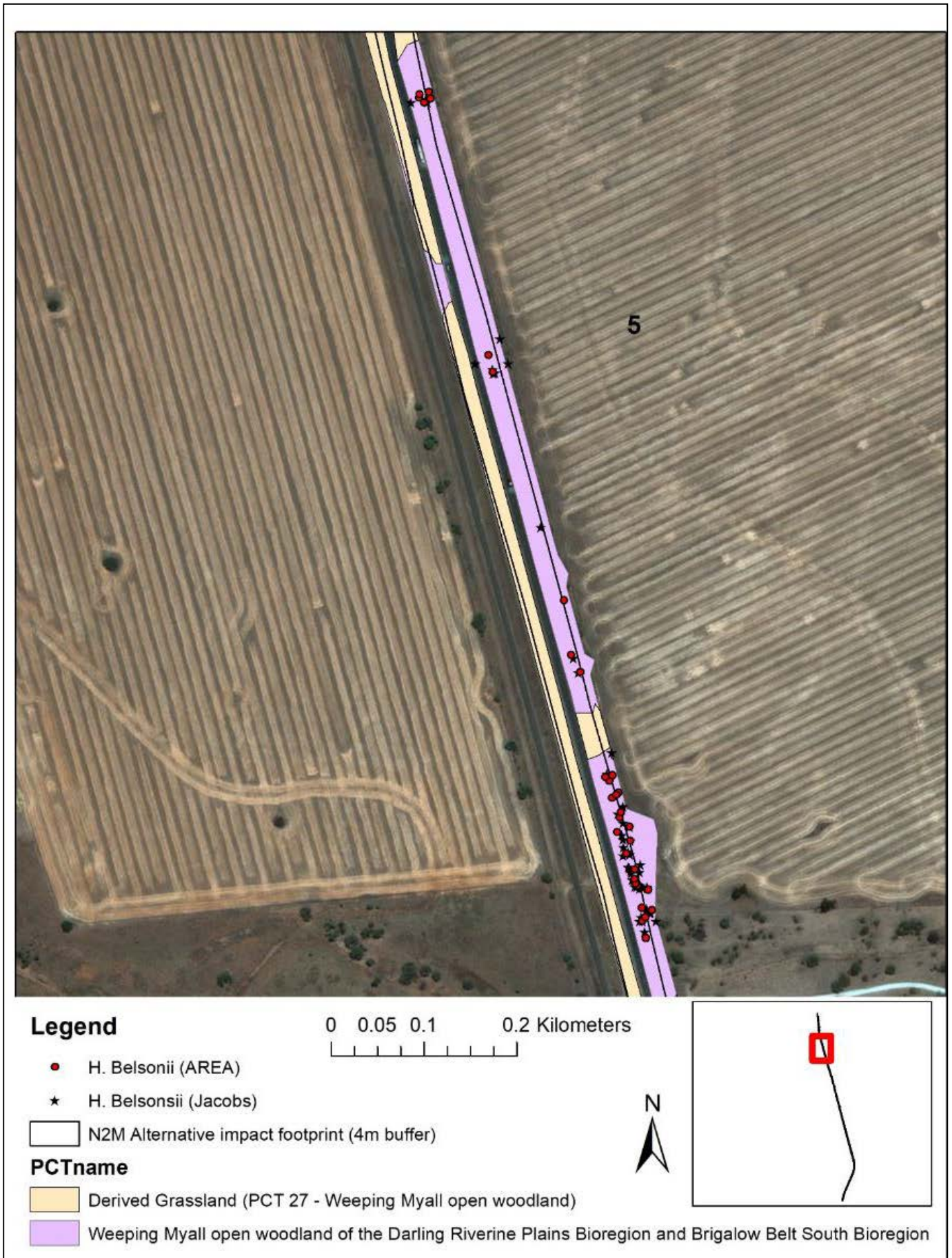


Figure 4-1 Location of *Homopholis belsonii* in N2MS2 (AREA, 2018)

Five-clawed Worm-skink (Anomalopus mackayi)

Five-clawed Worm-skink is known to be associated with five of the PCTs in the study area, including many areas of grassland. Additionally, N2MS3 is in the middle of the 'likely-to-occur' distribution, with the floodplain area around Bellata also being in the 'known' distribution of the species. The BAR (Jacobs, 2018) stated that one local population of the Five-clawed Worm-skink is currently inhabiting N2MS3 study area near Bellata (based on the presence of several records).

Twenty-two transects over the five sections and a further 19 intervening transects were completed by AREA in July 2018. Completing transects allowed AREA to carry out an assessment of potential suitable habitat for the Five-clawed Worm Skink (ie whether it was continuous, the condition, and any other factors).

In their report, AREA discussed the suitability of habitat within the Newell Highway corridor. It is noted that the section of Newell highway subject to this assessment was constructed in the 1960s experiences a high volume of traffic with a large proportion of heavy vehicles and that any potential suitable 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 next 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 the road corridor is unlikely to provide suitable habitat for the Five-clawed worm-skink.

Several locations examined by AREA along the 30 metre 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. The author also draws on personal experience with the species, stating that the impact of Mimosa bush on the Five-clawed Worm-skink is likely detrimental.

Despite this assessment, AREA also noted the presence of suitable habitat for Five-clawed worm-skink, including areas containing deep soil cracks and a good cover of grass litter. 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 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 N2MS3 proposal area does not contain suitable habitat for the Five-clawed Worm-skink. Where suitable habitat is present it is too marginal to sustain a viable population. Therefore, the N2MS3 proposal area would be unlikely to contain an important population of this species.

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

The Natural Grasslands CEEC mapping created for the BAR (Jacobs, 2018) was found to be accurate. By AREA

4.1.4 Potential impacts

Homopholis belsonii (Belson's Panic)

The BAR (Jacobs 2018) identified the proposal would result in the removal of about 19.04 hectares of habitat for three separate local populations of *Homopholis belsonii*, located within N2MS2 (Edgeroi South), N2MS4 (Brigalow Lane) and N2MS5 (Tybannah North). However, AREA identified that the proposal would

only be likely to have a significant impact on the Edgeroi South population of *Homopholis belsonii* (within N2MS2).

The additional assessment by AREA, has refined the location of *Homopholis belsonii* 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*, the additional assessment of impacts could be undertaken with to a higher degree of accuracy.

AREA concluded that only the population in N2MS2, totaling about 2.9 hectares of actual habitat (including about 1.9 hectares of moderate to good condition habitat), would be significantly reduced in size by the proposal and significantly affected as per the EPBC criterion. It is expected that over 60 per cent of this habitat would be removed by the proposal, with the remaining area likely to be affected by edge effects, as the width of the remaining community is reduced to less than 10 metres. Refer to **Table 4-1**.

Table 4-1 Area of known or potential habitat of *Homopholis belsonii* (Belson’s Panic) within N2MS2, and impacts from the Proposal in N2MS2

N2MS2	Total area
Potential habitat (hectares)	2.9
Habitat in proposal area (hectares)	1.9
Per cent potential habitat with the proposal area	52.7

The total area of habitat identified by Jacobs in the BAR differed to those reported by AREA. This likely reflects differences in methodologies, and not errors by Jacobs or AREA.

As stated above, AREA concluded that the proposal would result in a significant impact to populations of *Homopholis belsonii* only within sections N2MS2. The updated assessments of significance under the EPBC Act are provided in **Appendix B**.

If the proposal avoided the population within N2MS2, a significant impact on the Edgeroi South population of *Homopholis belsonii* would be avoided. While is noted that the proposal footprint is constrained by the location of the railway line to the west of the highway, and cultivated land to the east. The proposal could still potentially avoid the N2MS2 population by shifting the overtaking location to the south and using narrow batters near areas occupys by *Homopholis belsonii*.

Five-clawed Worm-skink (Anomalopus mackayi)

The proposal would require the removal of about 34.50 hectares of habitat listed as being associated with the Five-clawed Worm-skink. 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 would 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 a conservative approach finds that the proposal is not at risk of causing a significant impact (as defined under the EPBC Act) on a viable local population of the Five-clawed Worm-skink. 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 through the removal of about 11.31 hectares within N2MS5.

AREA concluded that challenging Jacobs determination 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 determination can be interpreted 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 will '*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 TEC
- 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 also be substantially mitigated with the management of weeds.

Therefore, the proposal would still have a would have a significant impact on the Natural Grasslands CEEC within N2MS5.

Summary

The additional assessment carried out by AREA for the Five-clawed worm-skink, *Homopholis belsonii* and the Natural Grasslands CEEC under the EPBC Act significance criteria identified that the proposal would still have significant impact on *Homopholis belsonii* within N2MS2 and the Natural Grasslands CEEC within N2MS5.

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 4-2**.

Table 4-2 Additional and/ or revised safeguards and management measures

Impact	Environmental safeguard	Responsibility	Timing	Reference
Impact to <i>Homopholis belsonii</i> (Belson's Panic) within N2MS2	To further reduce the impact on <i>Homopholis belsonii</i> (Belson's Panic) within N2MS2, the following will be considered during detailed design:	Roads and Maritime	Detailed design	Additional safeguard

Impact	Environmental safeguard	Responsibility	Timing	Reference
	<ul style="list-style-type: none"> Investigate moving the overtaking lanes further north or south of the known population Consider using narrow batters near the known population. 			

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**.

The general offsetting requirements for the proposal are summarised below in **Table 4-3**.

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 4-3** can be used to calculate the offset.

Table 4-3 Offsetting ratios for REF projects

Impact	Offset ration
Loss of threatened ecological community	<ul style="list-style-type: none"> 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 4-3**, the offset requirements for proposals are summarised in **Table 4-4**.

Table 4-4 Offsetting ratios for the proposal

EPBC significantly affected CEEC or threatened species	Offset requirement
Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland	About 45.24 ha where offset sites are in moderate to good condition or About 90.48 ha where offset sites are in poor condition including rehabilitation sites
<i>Homopholis belsonii</i> (Belson's Panic)	About 8.7 ha
Five-clawed worm skink (<i>Anomalopus mackayi</i>)	No offset requirement as impact of Proposal not deemed significant

5. Environmental management

The REF for the Newell Highway Heavy Duty Pavements, Narrabri to 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
- QA Specification G10 – Traffic Management.

5.2 Summary of safeguards and management measures

The REF for the Newell Highway Heavy Duty Pavement, Narrabri to 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 have underlined. While deleted measures, or parts of measures, have been struck out.

Table 5-1: Summary of environmental safeguards and management measures

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
GEN1	General - minimise environmental impacts during construction	<p>A CEMP will be prepared for each segment section and submitted for review and endorsement of the Roads and Maritime Environment Manager prior to commencement of the activity.</p> <p>As a minimum, the CEMP will address the following:</p> <ul style="list-style-type: none"> • 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. <p>The endorsed CEMP will be implemented during the undertaking of the activity.</p>	Contractor / Roads and Maritime project manager	Pre-construction / detailed design	Core standard safeguard
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
GEN3	General – environmental awareness	<p>All personnel working on site will receive training to ensure awareness of environment protection requirements to be implemented during the project. This will include up-front site induction and regular "toolbox" style briefings.</p> <p>Site-specific training will be provided to personnel engaged in activities or areas of higher risk. These include:</p> <ul style="list-style-type: none"> • Areas of Aboriginal heritage sensitivity 	Contractor / Roads and Maritime project manager	Pre-construction / detailed design	Core standard safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		<ul style="list-style-type: none"> Threatened species habitat Aboriginal heritage management including unexpected finds procedures Threatened species habitat and EEC. 			
GEN4	Utilities	<p>Prior to the commencement of works:</p> <ul style="list-style-type: none"> 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. 	Contractor	Detailed design / pre-construction	Core standard safeguard
GEN5	Hazards and risk management	<p>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:</p> <ul style="list-style-type: none"> 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 Contingency measures to be implemented in the event of unexpected hazards or risks arising, including emergency situations. <p>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.</p>	Contractor	Detailed design / pre-construction	Core standard safeguard
GEN6	General – environmental awareness	<p>The RMS Project Manager will notify the RMS 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).</p>	Contractor	Pre-construction / detailed design	Additional safeguard
GEN7	General – environmental awareness	<p>Standard construction hours:</p> <ul style="list-style-type: none"> 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. 	Contractor	Construction	Core standard safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		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.			
Biodiversity					
B1	Biodiversity	<p>A Flora and Fauna Management Plan will be prepared in accordance with Roads and Maritime's <i>Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects</i> (RTA, 2011) and implemented as part of the CEMP. It will include, but not be limited to:</p> <ul style="list-style-type: none"> Plans showing areas to be cleared and areas to be protected, including exclusion zones, protected habitat features and revegetation areas Requirements set out in the <i>Landscape Guideline</i> (RTA, 2008) Pre-clearing survey requirements in accordance with Guide 1: Pre-clearing process of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA 2011) Procedures for unexpected threatened species finds and fauna handling Procedures addressing relevant matters specified in the <i>Policy and guidelines for fish habitat conservation and management</i> (DPI Fisheries, 2013) Protocols to manage weeds and pathogens. 	Contractor	Detailed design / pre-construction	Section 4.8 of QA G36 <i>Environment Protection</i>
B2	Biodiversity	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.	Contractor	Detailed design / pre-construction	Core standard safeguard
B3	Removal of native vegetation	<ul style="list-style-type: none"> Vegetation removal would be carried out in accordance with <i>Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011) Native vegetation would be re-established in accordance with <i>Guide 3: Re-establishment of native vegetation of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011) Exclusion zones would be set up at the limit of clearing (i.e. the edge of the impact area) in accordance with <i>Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011). 	Contractor	Detailed design / pre-construction	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
B4	Removal of threatened species habitat and habitat features	<ul style="list-style-type: none"> Habitat would be replaced or re-instated in accordance with <i>Guide 5: Re-use of woody debris and bushrock</i> and <i>Guide 8: Nest boxes</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011) The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011) if threatened fauna, not assessed in the biodiversity assessment, are identified in the proposal area. 	Contractor	Detailed design / pre-construction	Additional safeguard
B5	Aquatic impacts	Aquatic habitat would be protected in accordance with <i>Guide 10: Aquatic habitats and riparian zones</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011) and Section 3.3.2 <i>Standard precautions and mitigation measures of the Policy and guidelines for fish habitat conservation and management Update 2013</i> (DPI (Fisheries NSW) 2013).	Contractor	Construction	Additional safeguard
B6	Injury and mortality of fauna	<ul style="list-style-type: none"> Fauna would be managed in accordance with <i>Guide 9: Fauna handling</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011) Investigate the potential benefits and drawbacks of installing fauna fencing in N2MS4. 	Contractor	Construction and operation	Additional safeguard
B7	Invasion and spread of weeds	<ul style="list-style-type: none"> Weed species would be managed in accordance with <i>Guide 6: Weed management</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011) Pest species would be managed within the proposal area. 	Contractor	Construction	Additional safeguard
B8	Invasion and spread of pathogens and disease	Pathogens would be managed in accordance with <i>Guide 2: Exclusion zones</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	Contractor	Construction	Additional safeguard
B9	Noise, light and vibration	Shading and artificial light impacts would be considered and minimised where possible through detailed design.	Contractor	Detailed design	Additional safeguard
B10	Biodiversity offsets	The final design impact area will be ground-truthed and offsets will be calculated and implemented as per <i>Guideline for Biodiversity Offsets</i> (November 2016)	Roads and Maritime	Detailed design	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
B12	<u>Impact to <i>Homopholis belsonii</i> (Belson's Panic) within N2MS2</u>	<p><u>To further reduce the impact on <i>Homopholis belsonii</i> (Belson's Panic) within N2MS2, the following will be considered during detailed design:</u></p> <ul style="list-style-type: none"> <u>Investigate moving the overtaking lanes further north or south of the known population</u> <u>Consider using narrow batters near the known population.</u> 	<u>Roads and Maritime</u>	<u>Detailed design</u>	<u>Additional safeguard</u>
Hydrology and flooding					
HF1	Soil and water	A Soil and Water Management Plan (SWMP) will be prepared for each segment <u>section</u> 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 <i>Soil and Water Management</i>
HF2	Soil and water	<ul style="list-style-type: none"> A site specific Erosion and Sediment Control Plan/s (ESCP) will be prepared for each segment <u>section</u> 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 <i>Soil and Water Management</i>
HF3	Contaminants entering receiving environments during construction	<p>Control measures to minimise the risk of water pollution will be implemented including:</p> <ul style="list-style-type: none"> 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 would be undertaken within a designated bunded area of an impervious surface or carried out off-site. 	Construction contractor	Construction	Additional safeguard
HF4	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

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
HF5	Hydrology and flood management	<p>A Flood Management Plan will be prepared prior to the work starting. This plan would include:</p> <ul style="list-style-type: none"> 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
HF6	Flooding	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.	Contractor	Construction	Additional safeguard
Soils and contamination					
SC1	Contaminated land	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.	Contractor	Detailed design/Pre-construction	Section 4.2 of QA G36 <i>Environment Protection</i>
SC2	Accidental spill	A site specific emergency spill plan will be developed, and include spill management measures in accordance with the Roads and Maritime <i>Code of Practice for Water Management</i> (RTA, 1999) and relevant EPA guidelines. 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).	Contractor	Detailed design/Pre-construction	Section 4.3 of QA G36 <i>Environment Protection</i>
SC3	Stockpile management	Stockpiles will be designed, established, operated and decommissioned in accordance with the Roads and Maritimes' <i>Stockpile Site Management Guideline 2015</i> .	Construction contractor	Construction	Additional safeguard
SC4	Soil stabilisation	<p>The rehabilitation of disturbed areas will be carried out progressively as construction stages are completed, and in accordance with:</p> <ul style="list-style-type: none"> Landcom's Managing Urban Stormwater: Soils and Construction series 	Construction contractor	Construction	Additional standard safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
	and restoration	<ul style="list-style-type: none"> RTA Landscape Guideline Roads and Maritimes' Guideline for Batter Stabilisation Using Vegetation (2015). 			
SC5	Pollution from run-off	<p>The ancillary facilities will be managed within the ESCP. The following measures will be included to limit sediment and other contaminations entering receiving waterways:</p> <ul style="list-style-type: none"> 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	<p>A Traffic Management Plan (TMP) will be prepared and implemented as part of the CEMP. The TMP will be prepared in accordance with the <i>Roads and Maritime Traffic Control at Work Sites Manual</i> (RTA, 2010) and <i>QA Specification G10 Control of Traffic</i> (Roads and Maritime, 2008). The TMP will include:</p> <ul style="list-style-type: none"> 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 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. 	Contractor	Detailed design/Pre-construction	Section 4.8 of QA G36 <i>Environment Protection</i>

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
TT2	Property access - pre-construction	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	Pre-construction/detailed design	Additional standard safeguard
TT3	Notifications to landowners	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
TT4	Property access - during construction	Access to properties will be maintained during construction. Where that is not feasible or necessary, temporary alternative access arrangements will be provided following consultation with affected landowners and the relevant local road authority.	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
TT7	Impacts of the regional road network	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.	Roads and Maritime and Construction Contractor	Construction	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
Noise and vibration					
NV1	Noise and vibration	<p>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 <i>Interim Construction Noise Guideline</i> (ICNG) (DECC, 2009) and identify:</p> <ul style="list-style-type: none"> • All potential significant noise and vibration generating activities associated with the activity • Feasible and reasonable mitigation measures to be implemented, taking into account <i>Beyond the Pavement: urban design policy, process and principles</i> (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 <i>Environment Protection</i>
NV2	Noise and vibration	<p>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:</p> <ul style="list-style-type: none"> • The project • The construction period and construction hours • Contact information for project management staff • Complaint and incident reporting • How to obtain further information. 	Contractor	Detailed design / pre-construction	Core standard safeguard N
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

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
NV4	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	Additional safeguard
NV6	Reducing Vibration impacts	<ul style="list-style-type: none"> • 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 • Wherever practical, static compaction techniques should be utilised for compaction required within the applicable setback distances recommended to avoid human comfort impacts. 	Construction contractor	Construction	Additional safeguard
NV7	Vibration impacts on buildings and heritage items	<ul style="list-style-type: none"> • 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
NV8	Vibration impacts to Heritage items	The use of high intensity vibratory compaction equipment near underground services will be limited. If vibration-intensive plant and equipment change from that which has been in the Noise and Vibration Assessment (Jacobs, 2018a), a review will be carried out prior to commencing work.	Construction contractor	Construction	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
Aboriginal heritage					
AH1	Aboriginal heritage	An Aboriginal Heritage Management Plan (AHMP) will be prepared in accordance with the <i>Procedure for Aboriginal cultural heritage consultation and investigation</i> (Roads and Maritime, 2012) and <i>Standard Management Procedure - Unexpected Heritage Items</i> (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.	Contractor	Detailed design/pre-construction	Section 4.9 of QA G36 <i>Environment Protection</i>
AH2	Aboriginal heritage	<ul style="list-style-type: none"> The <i>Standard Management Procedure - Unexpected Heritage Items</i> (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. 	Contractor	Detailed design/pre-construction	Section 4.9 of QA G36 <i>Environment Protection</i>
AH3	Impacts to Aboriginal heritage	If impact to Aboriginal heritage items are unavoidable then the Aboriginal cultural heritage investigation must proceed to PACHCI Stage 3 (RMS 2011).	Road and Maritime	Detailed design/pre-construction	Additional safeguard
AH4	Aboriginal heritage	Any further changes to the proposal area outside the survey area will be assessed by a suitably qualified heritage professional.	Road and Maritime	Detailed design/pre-construction	Additional safeguard
AH5	Minimise risks to Aboriginal cultural heritage during construction	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.	Contractor	Detailed design/pre-construction	Additional standard
AH7	Aboriginal heritage items <u>BC-HW17-ST1</u>	<ul style="list-style-type: none"> During construction, BR-HW17-ST1 and BR-HW17-ST2 and BC-HW17-ST1 will be demarcated using high visibility ground markers to delineate the site perimeter (ie 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 	Contractor	Detailed design /pre-construction	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		<ul style="list-style-type: none"> BR-HW17-ST1, BR-HW17-ST2 and BC-HW17-ST1 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, BR-HW17-ST2 and BC-HW17-ST1 site extent. <p>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.</p>			
AH8	Aboriginal heritage item BL-HW17-ST1	<ul style="list-style-type: none"> If the bitumen currently surrounding BL-HW17-ST1 is to be removed as part of the proposal, this will be done without harming the tree's absorption roots The area surrounding the tree will not subsequently be built upon, providing an area large enough to allow adequate moisture to reach the tree's absorption roots. Minimally, this area will fully encompass the tree canopy extent and this area must be excluded from bitumen cover and compaction Sufficient distances will be provided to allow vehicles to access the rest area where the tree is located, without colliding with or damaging the tree If a significant residual risk of collision remains, steps will be taken to minimise that risk (eg installation of bollards and/or permanent high visibility barriers). 	Contractor	Construction	Additional safeguard
Non-Aboriginal heritage					
NH1	Non-Aboriginal heritage	A Non-Aboriginal Heritage Management Plan (NAHMP) will be prepared and implemented as part of the CEMP. It will provide specific guidance on measures and controls to be implemented to avoid and mitigate impacts on non-Aboriginal heritage.	Contractor	Detailed design/pre-construction	Section 4.10 of QA G36 <i>Environment Protection</i>
NH2	Non-Aboriginal heritage	<ul style="list-style-type: none"> The Standard Management <i>Procedure – Unexpected Heritage Items</i> (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	Section 4.10 of QA G36 <i>Environment Protection</i>
NH3	Non-Aboriginal heritage	Non-Aboriginal heritage awareness training must 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	Contractor	Pre-construction	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		the discovery of non-Aboriginal heritage materials, features or deposits (that is, unexpected finds), or the discovery of human remains.			
NH4	AB Meppem & Co, Bellata Post Office, Oldhams Smallgoods, Bellata Police Station and LS Rowe Stock and Station Agents	<ul style="list-style-type: none"> All heritage items will be demarcated during the construction of proposal using high visibility ground markers to delineate historic site extent along the western boundary next to the Newell Highway The demarcation method will be developed in consultation with property owners and/or tenants to ensure that the method is practical and fit for purpose The ground markers used must be visible to any person in the vicinity of the site, whether on foot or in a vehicle A 'no-go' and 'no-harm' area must be mapped on the CEMP and detailed design plans encompassing the historic site extent as shown in section 9 of the <i>Aboriginal and Historical Archaeological Survey Report: Newell Highway HD Pavements – Narrabri to Moree</i> (OzArk, 2018) provide in Appendix D of the REF All ground-disturbing work will be confined to areas, outside of the identified historic site extends and 'no-go' and 'no-harm' areas Once the nature and extent of the proposal in the vicinity of the heritage buildings has been finalised, a condition assessment may be required to determine how structurally sound the building is and whether or not and a vibration assessment may be required. 	Contractor	Pre-construction	Additional safeguard
Landscape character and visual impacts					
LC1	Landscape character and visual impact	<p>An Urban Design Plan will be prepared to support the final detailed project design and implemented as part of the CEMP.</p> <p>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:</p> <ul style="list-style-type: none"> 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 Details of the staging of landscape works taking account of related environmental controls such as erosion and sedimentation controls and drainage Procedures for monitoring and maintaining landscaped or rehabilitated areas. 	Contractor	Detailed design/pre-construction	Core standard safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		<p>The Urban Design Plan will be prepared in accordance with relevant guidelines, including:</p> <ul style="list-style-type: none"> • <i>Beyond the Pavement urban design policy, process and principles</i> (Roads and Maritime, 2014) • <i>Landscape Guideline</i> (RTA, 2008) • <i>Bridge Aesthetics</i> (Roads and Maritime 2012). 			
LC2	Landscape character and visual impact	Limit vegetation loss - either through revisions to alignment or scale of proposed cross section.	Contactora	Detailed design / pre-construction	Additional safeguard
LC3	Landscape character and visual impact	Provide screening to properties which have been impacted by the proposal through the opening up of views to the proposed alignment.	Contactora	Detailed design / pre-construction	Additional safeguard
LC4	Landscape character and visual impact	Provide definition to the changing land uses associated with the townships through which the highway passes.	Contactora	Detailed design / pre-construction	Additional safeguard
LC5	Landscape character and visual impact	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.	Contactora	Detailed design / pre-construction	Additional safeguard
Property, land use and socio-economic					
SE1	Consultation	A Project Communications Plan (CP) will be prepared and implemented as part of the CEMP.	Contractora	Detailed design/pre-construction	Section 3.7 of QA G36 <i>Environment Protection</i>
SE2	Consultation	<p>Individual project CPP will be prepared and implemented to help provide timely and accurate information to the community during construction. The CPs will include (as a minimum):</p> <ul style="list-style-type: none"> • Mechanisms to provide details and timing of proposed activities to affected residents and businesses, including changed traffic and access conditions 	Roads and Maritime	Pre-construction and construction	Core standard safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		<ul style="list-style-type: none"> Contact name and number of complaints The CPs will be prepared in accordance with the <i>Community Involvement and Communications Resource Manual</i> (RTA, 2008). 			
SE3	Consultation	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.	Roads and Maritime	Pre-construction and construction	Additional safeguard
SE4	Emergency vehicle access	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.	Roads and Maritime	Pre-construction and construction	Additional safeguard
Waste and resource management					
WR1	Generation of construction waste	<p>A Waste Management Plan will be prepared and implemented as part of the CEMP. The WMP will include but not be limited to:</p> <ul style="list-style-type: none"> Measures to avoid and minimise waste associated with the project Classification of wastes generated by the project and management options (re-use, recycle, stockpile, disposal) Classification of wastes received from off-site for use in the project and management options 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. <p>The Plan will be prepared taking into account the Roads and Maritime <i>Environmental Procedure - Management of Wastes on Roads and Maritime Services Land</i> and relevant <i>Roads and Maritime Waste Fact Sheets</i>, as well as the adopting the Resources Management Hierarchy principles of the WARR Act.</p>	Contractor	Pre-construction/detailed design	Section 4.2 of QA G36 <i>Environment Protection</i>
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.	Contractor	Pre-construction/	Core standard safeguard W

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
				detailed design	
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: <ul style="list-style-type: none"> • 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 • Methods to manage work during strong winds or other adverse weather conditions • A progressive rehabilitation strategy for disturbed areas. 	Contractor	Detailed design/pre-construction	Core standard safeguard Section 4.4 of QA G36 <i>Environment Protection</i>
AQ2	Impacts on climate change during construction	During construction, the following measures will be considered and implemented where possible: <ul style="list-style-type: none"> • 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

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
Cumulative impacts					
CU1	Cumulative impacts from construction of multiple projects	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 and Construction	Additional safeguard
CU2	Cumulative impacts to biodiversity	Biodiversity offsets will be secured as per the Roads and Maritime's <i>Guideline for Biodiversity Offsets</i> (November 2016).	Roads and Maritime	Detailed design	Additional safeguard

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

Instrument	Requirement	Timing
<i>Protection of the Environment Operations Act 1997</i>	Environment protection licence (EPL) for scheduled activities (road construction / extractive activities / crushing, grinding or separating waste processing or storage) >30,000t/pa from the EPA.	Prior to start of the activity.
<i>Roads Act 1993</i>	Road Occupancy Permit would need to be obtained as necessary prior to construction commencing.	Prior to start of the activity.
<i>Crown Lands Act 1989 (s6)</i>	Licence to occupy areas of Crown land.	Prior to start of the activity
<i>Permission to enter from private landowners and residents</i>	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.	Before accessing any private property.

6. References

AREA Environmental consultants and communication 2017. Roads and Maritime Services 2018, *Newell Highway Heavy Duty Pavements Supplementary Assessment: Anomalopus mackayi*

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, Narrabri to Moree Review of Environmental Factors*. Dubbo, NSW

Roads and Maritime Services 2018, *Newell Highway Heavy Duty Pavements, Narrabri to 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



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Document history and status

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

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

Name	Role	Qualifications
Dr Sarah McDonald	Ecologist – Survey design, field survey, mapping, reporting	Bachelor of Natural Resources (Honours) Doctor of Philosophy (PhD)
Phillip Cameron	Project Management, survey design, review and certification	BSc, Ass Dip App Sci

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. AREAs 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 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

N2MS2	Total (ha)
Potential habitat (ha)	2.9
Habitat in impact footprint (ha)	1.5
% potential habitat in IF	52.7

(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 *Homopholis belsonii* within NMS1, and area to the impacted from the Proposal in NMS1

NMS1	Total (ha)
Potential habitat (ha)	11.5
Habit in impact footprint (ha)	2.63
% potential habitat in IF	22.6

(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

NMS2	Clusters 1 & 2	Cluster 3	Cluster 4	Cluster 5	Total (ha)
Potential habitat (ha)	51.4	8.3	7.4	15.4	82.5
Habit in impact footprint (ha)	4.7	0.8	1.1	2.8	9.4
% potential habitat in IF	10.7	16.8	31.4	21.2	11.4

(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

NMS3	Clusters 1 & 2	Cluster 3	Cluster 4	Cluster 5	Total (ha)
Potential habitat (ha)	139.1	22.7	50.0	17.7	229.5
Habit in impact footprint (ha)	7.1	1.2	0.0	0.5	8.8
% potential habitat in IF	5.1	5.3	0.0	2.8	3.8

(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 of 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 (ha)
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)

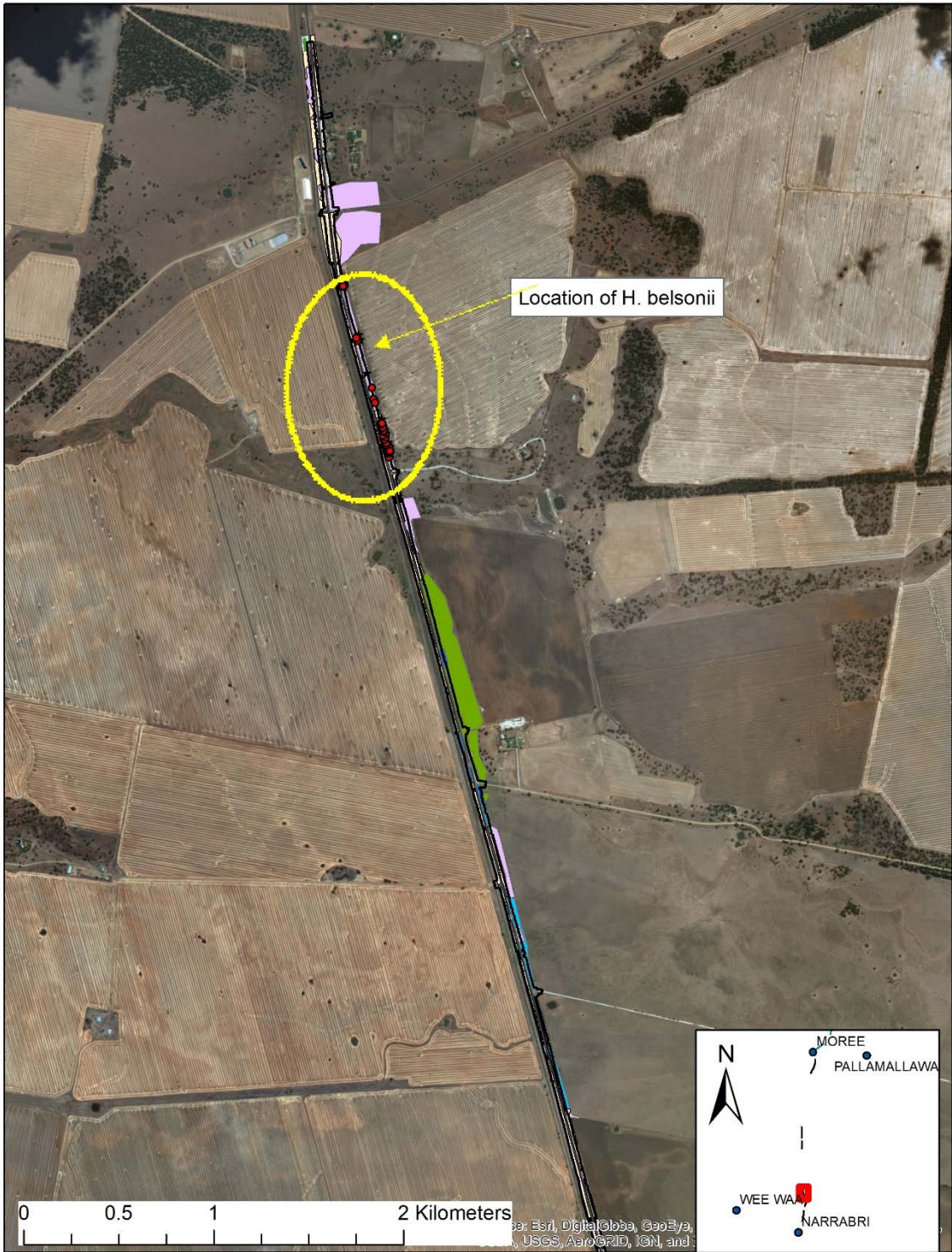


Figure 1. Location of *Homopholis belsonii* in N2MS2

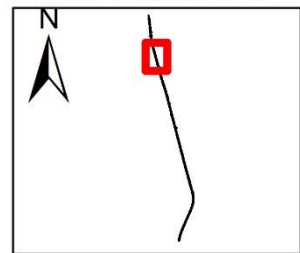
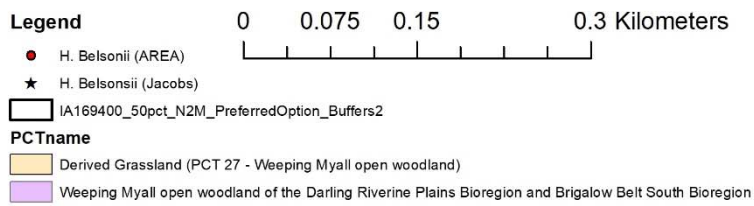
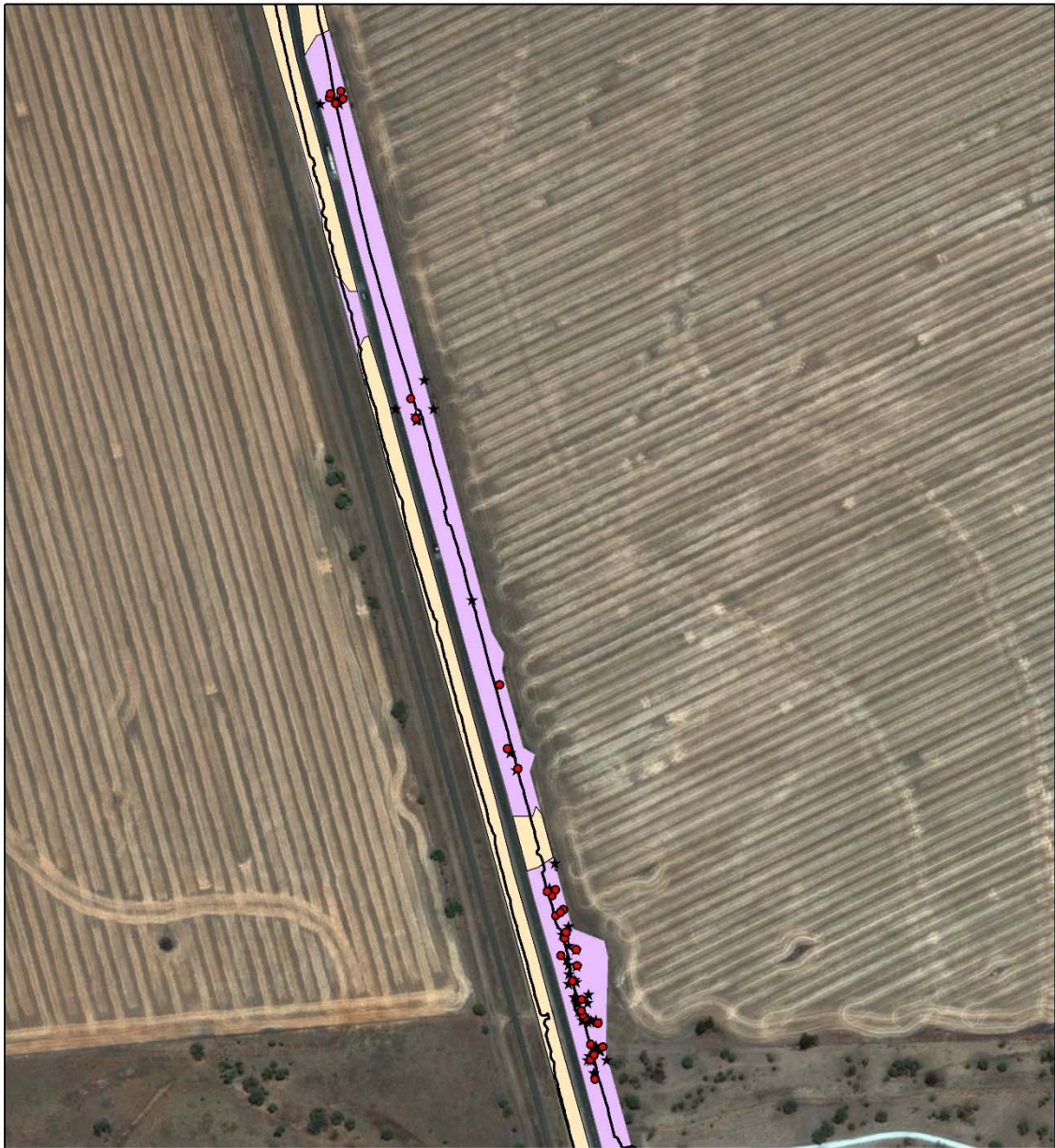


Figure 2. Location of *Homopholis belsonii* in N2MS2

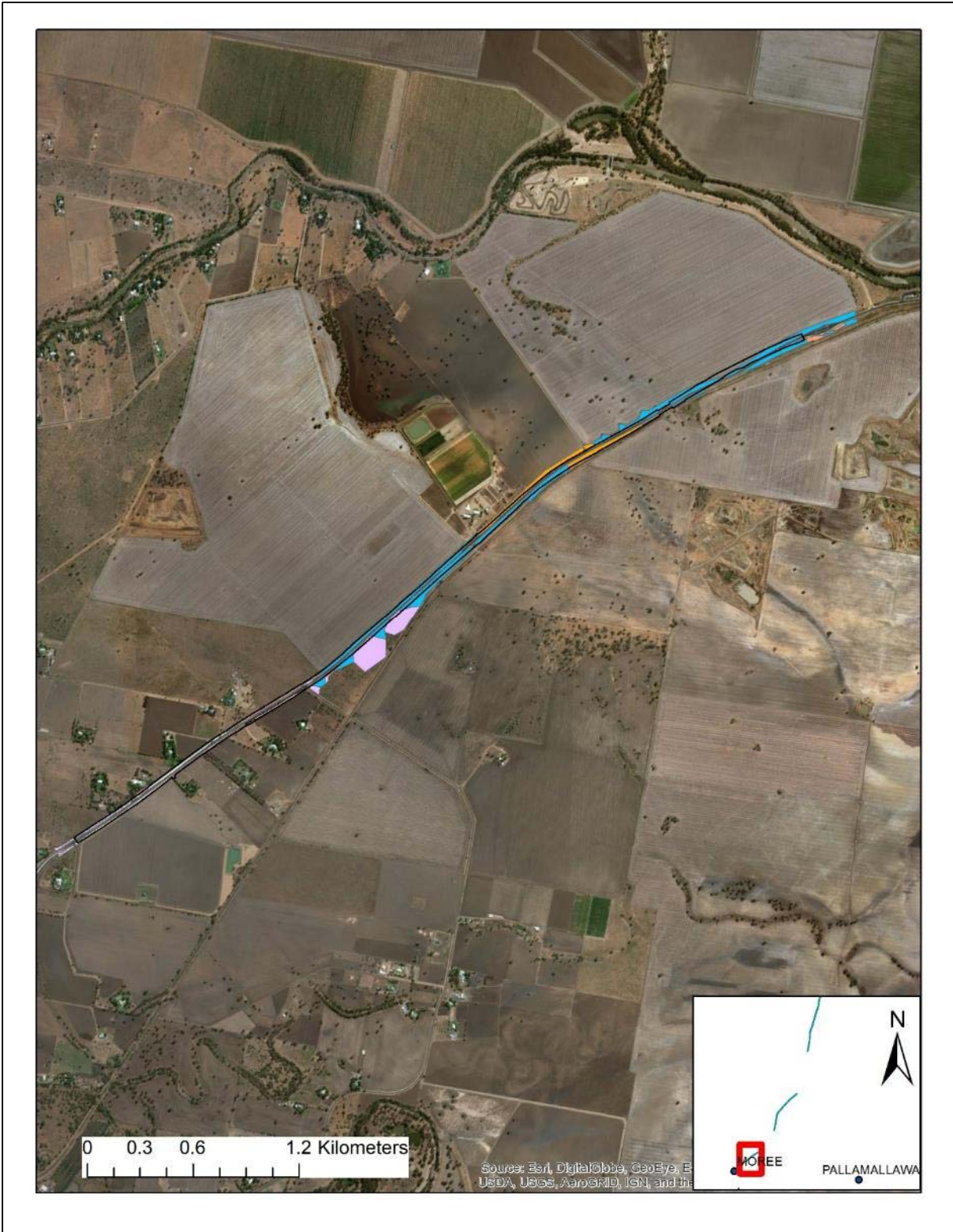


Figure 3. Vegetation communities within NMS1

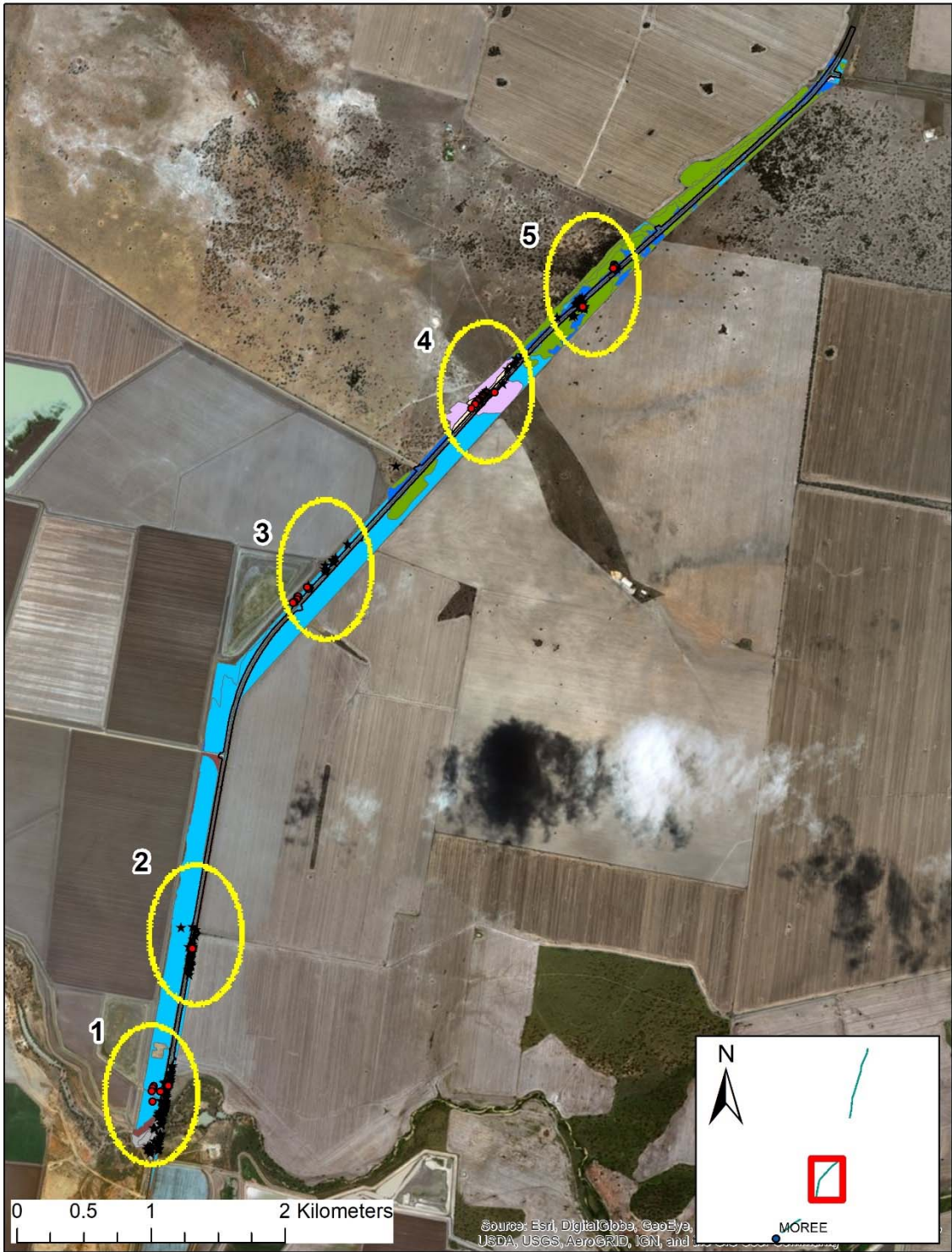
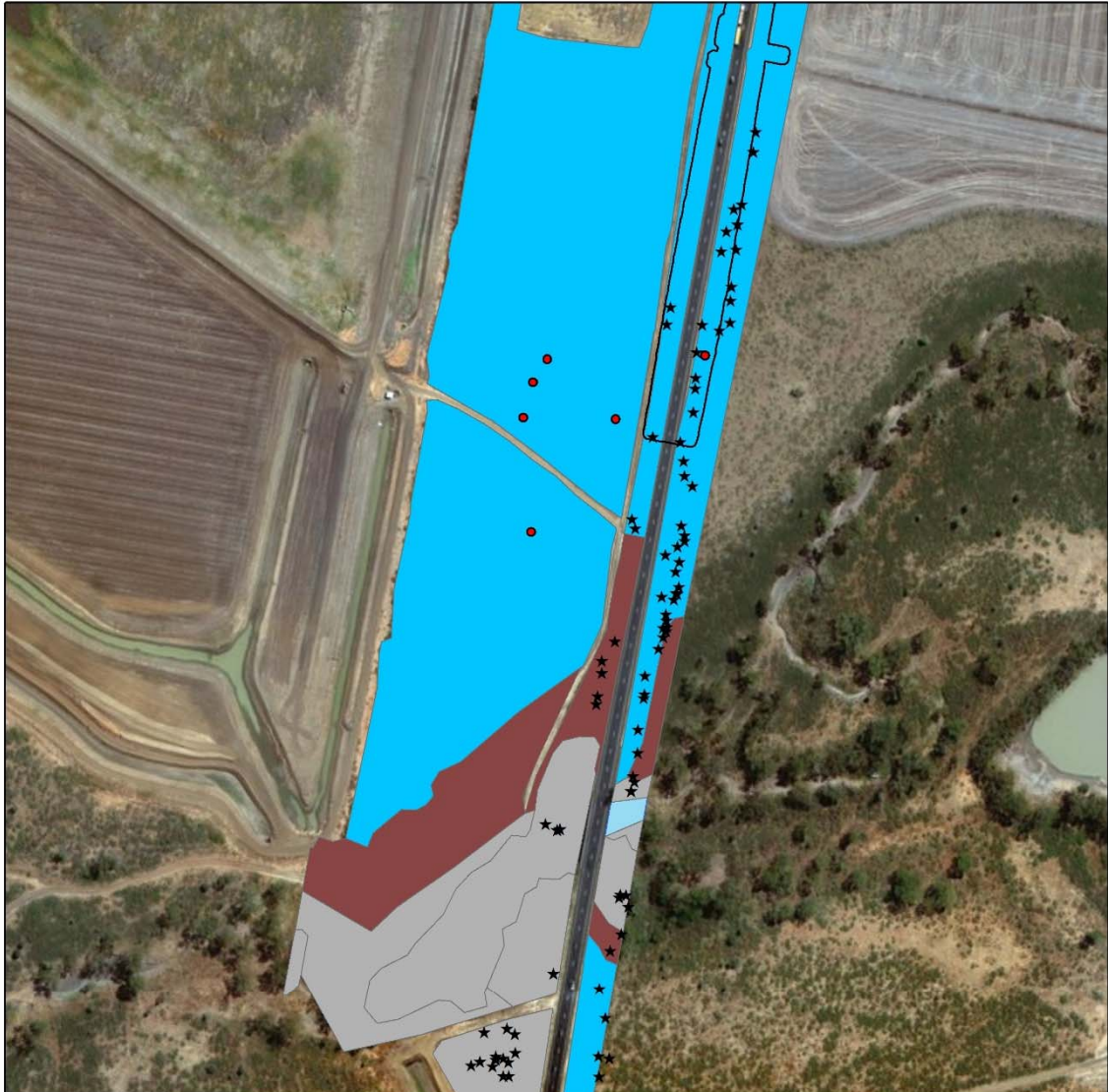


Figure 4. Location of clusters (numbered and circled) of *Homopholis belsonii* in NMS2



Legend

- H. belsonii (AREA)
- ★ H. belsonii (Jacobs)
- IA169400_50pct_NM_ALT_4mBuffer

PCType

- Billabong
- Coolibah - River Coobah - Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion
- Derived Grassland (PCT 39 - Coolabah - River Coobah - Lignum woodland wetland)
- Derived Grassland (PCT 52 - Coolibah - River Coobah - Lignum woodland wetland)
- Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion

0 0.05 0.1 0.2 Kilometers

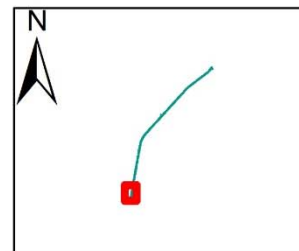
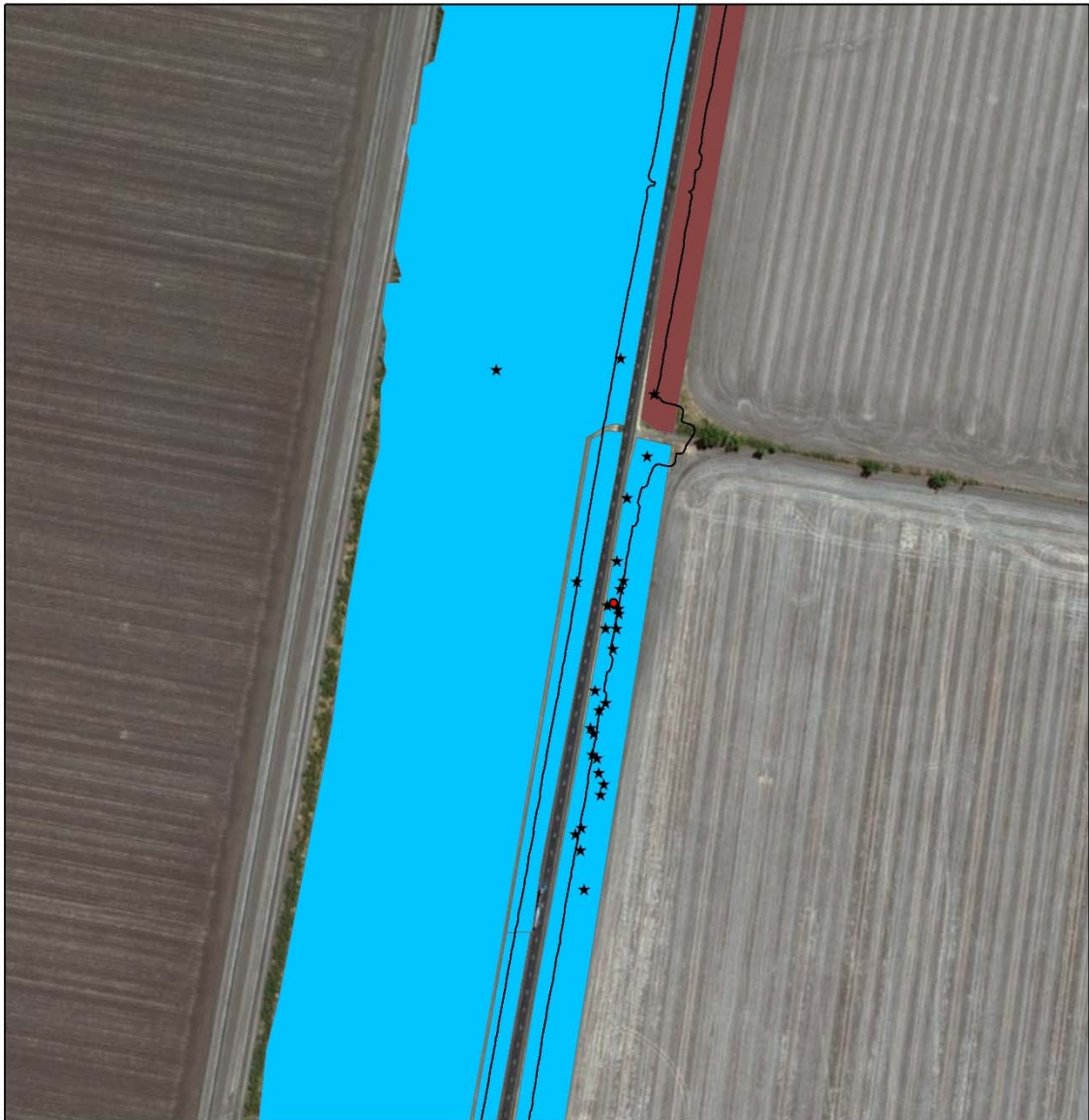


Figure 5. Location of *Homopholis belsonii* in cluster 1 of NMS2



0 0.05 0.1 0.2 Kilometers

Legend

● H. belsonii (AREA)

★ H. belsonii (Jacobs)

□ IA169400_50pct_NM_ALT_4mBuffer

PCTname

■ Derived Grassland (PCT 52 - Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains)

■ Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion

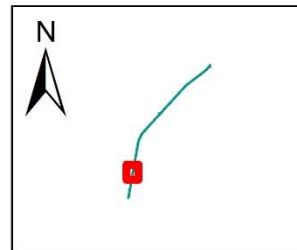


Figure 6. Location of *Homopholis belsonii* in cluster 2 of NMS2



0 0.04 0.08 0.16 Kilometers

Legend

- H. Belsonii (AREA)
- ★ H. Belsonii (Jacobs)
- IA169400_50pct_NM_ALT_4mBuffer

PCName

Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion

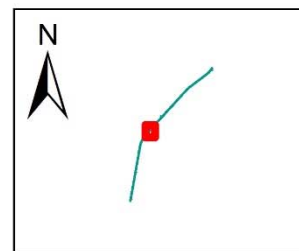


Figure 7. Location of *Homopholis belsonii* in cluster 3 of NMS2



Legend

- H. belsonii (AREA)
- ★ H. belsonii (Jacobs)
- IA169400_50pct_NM_ALT_4mBuffer

PC Tname

- Derived Grassland (PCT 27 - Weeping Myall open woodland)
- Derived Grassland (PCT 56 - Poplar Box - Belah woodland on clay-loam soils on alluvial plains)
- Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
- Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion
- Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion

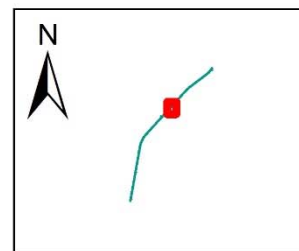


Figure 8. Location of *Homopholis belsonii* in cluster 4 of NMS2

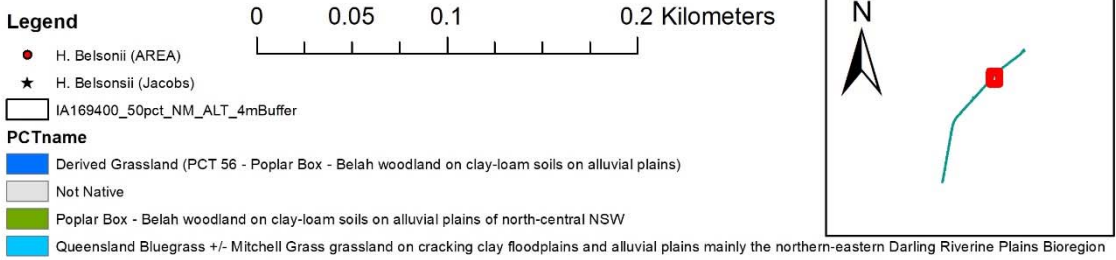
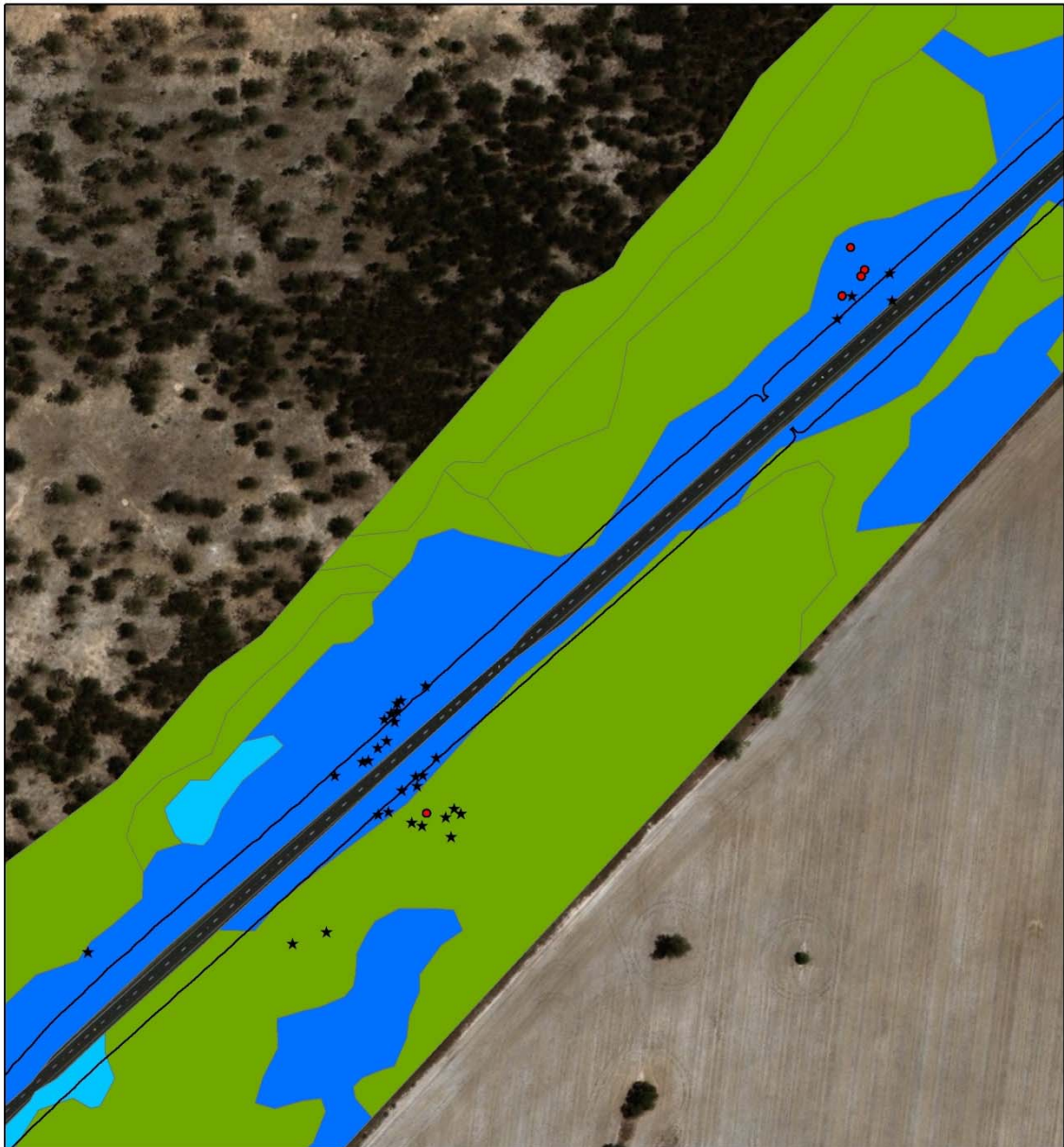


Figure 9. Location of *Homopholis belsonii* in cluster 5 of NMS2

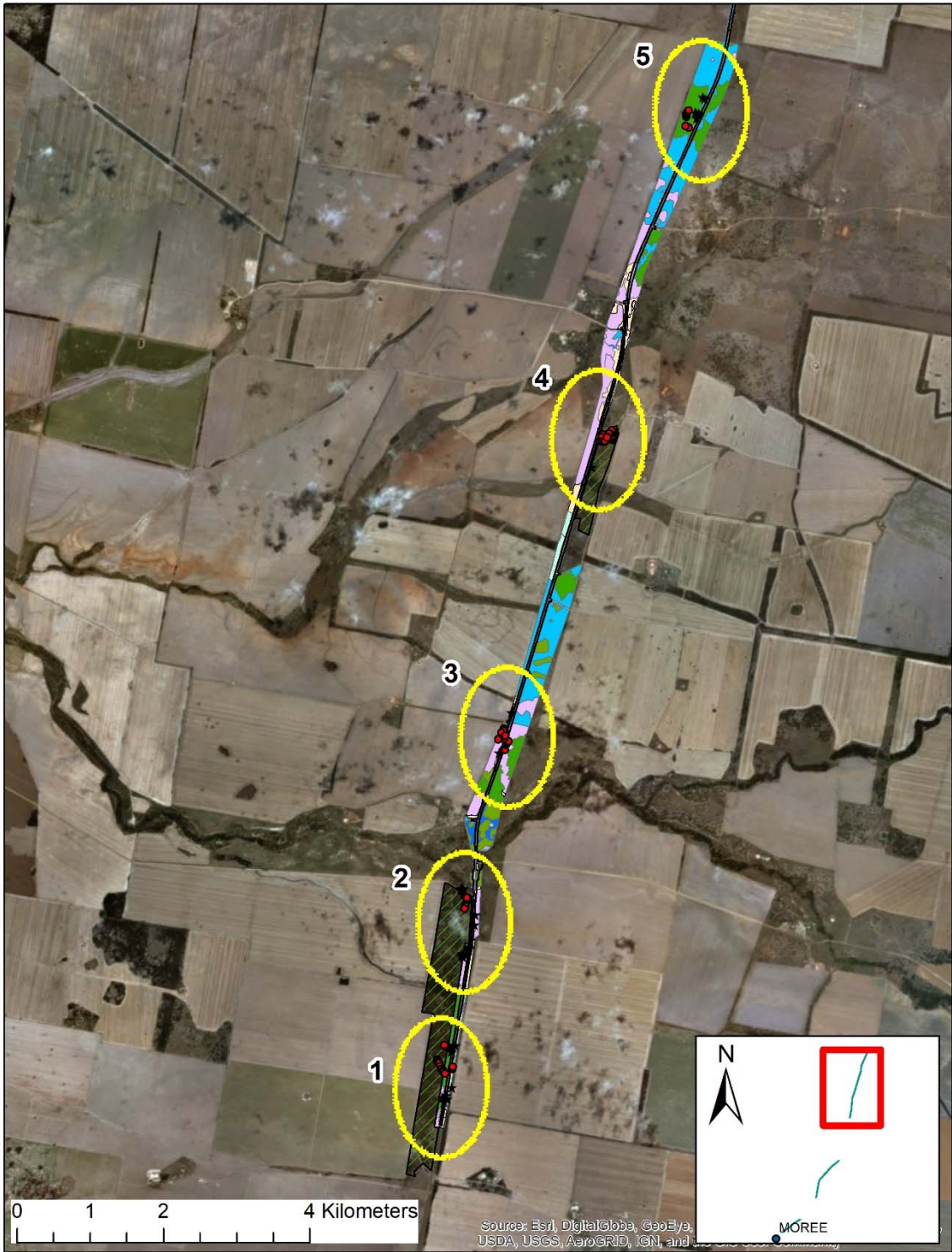


Figure 10. Location of clusters (numbered and circled) of *Homopholis belsonii* in NMS3

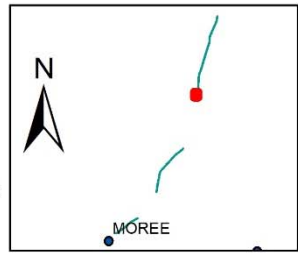
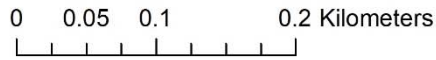
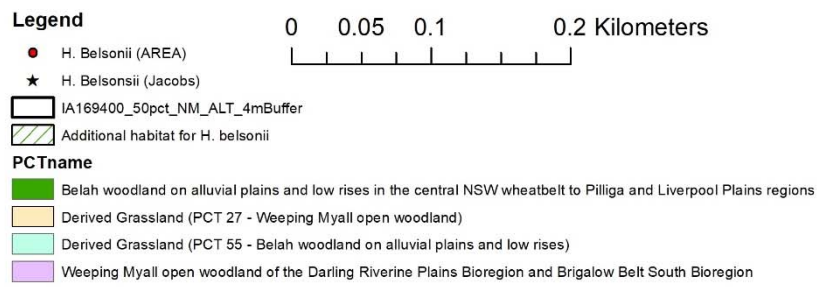
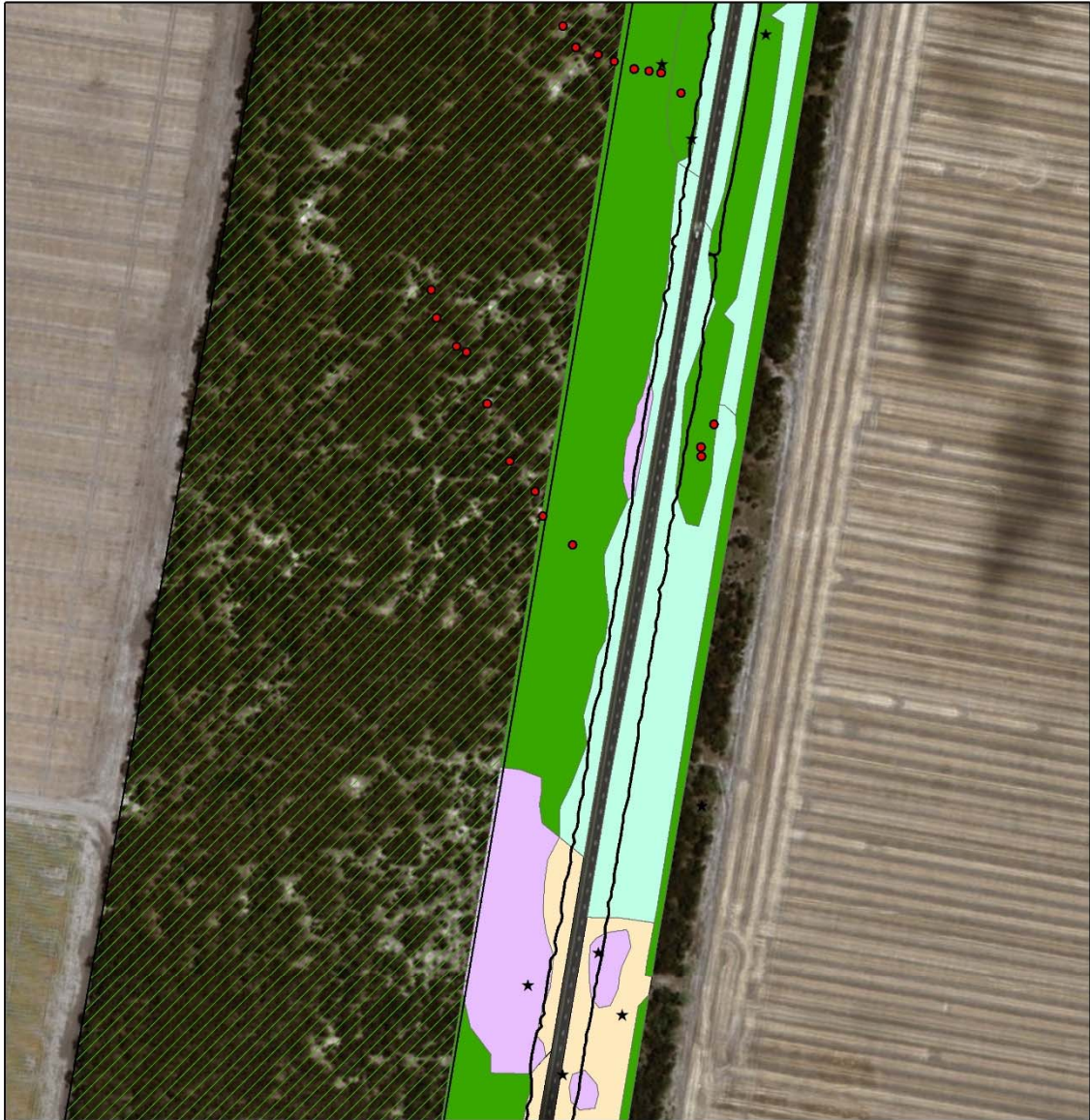


Figure 11. Location of *Homopholis belsonii* in cluster 1 of NMS3

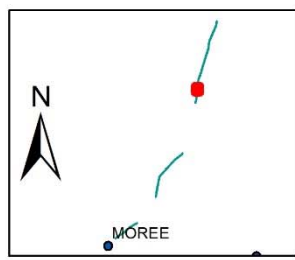
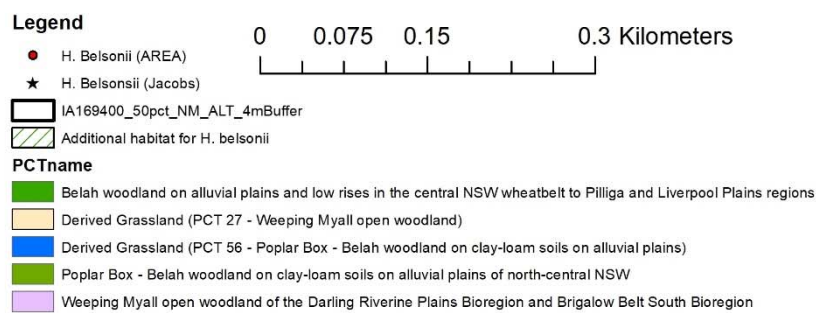


Figure 12. Location of *Homopholis belsonii* in cluster 2 of NMS3

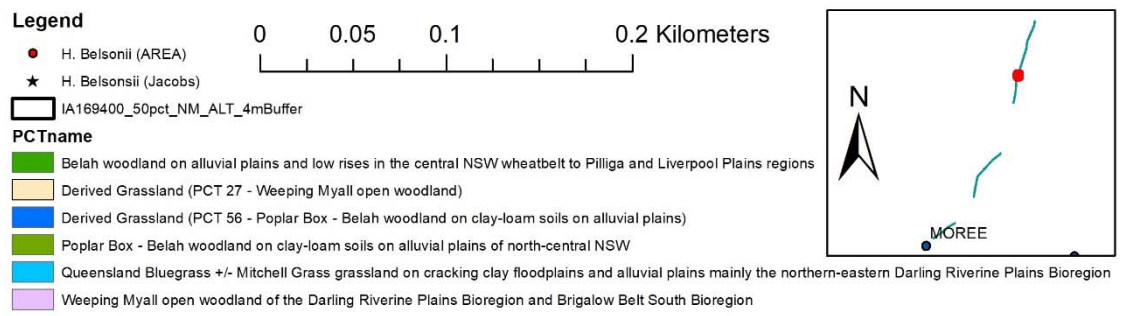


Figure 13. Location of *Homopholis belsonii* in cluster 3 of NMS3

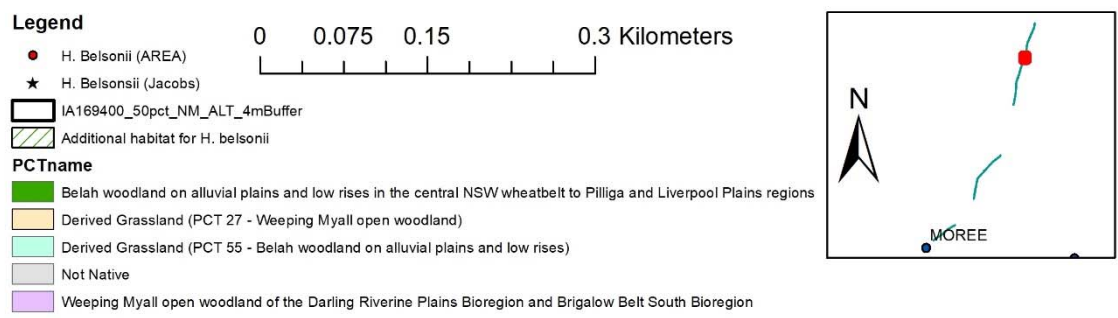


Figure 14. Location of *Homopholis belsonii* in cluster 4 of NMS3

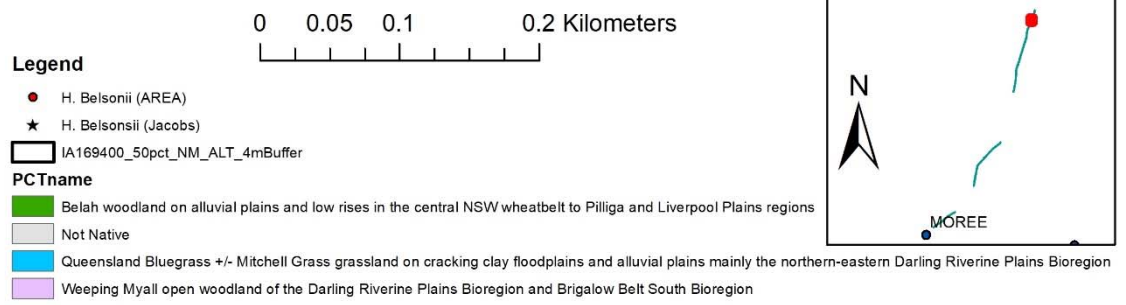


Figure 15. Location of *Homopholis belsonii* in cluster 5 of NMS3

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 through development would have been substantially gained with management of weeds.

Roads and Maritime Services

Newell Highway Heavy Duty Pavements, Narrabri to Moree (N2M) and North Moree (NM)

July 2018

Anomalopus mackayi



Prepared by: **Gerry Swan** **Cygnets Surveys & Consultancy** on behalf of
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Document history and status

Revision	Date	Description	By	Review	Approved
Rev 01	13/07/2018	Draft	Gerry Swan With contributions by Phil Cameron	Phillip Cameron (AREA Env) Paul Rossington (Jacobs) Jon Blizzard (Roads and Maritime) Ben Orford (Roads and Maritime)	With minor revisions
Rev 02	28/07/2017	FINAL	Phil Cameron	Jon Blizzard (Roads and Maritime) Ben Orford (Roads and Maritime)	Finalised

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.

N2M1	6.6km	5 transects
N2M2	12.0km	6 transects
N2M3	5.0km	3 transects
N2M4	7.0km	4 transects
N2M5	9.2km	4 transects
Intervening areas 54km		19 transects
NMS1	5km	4 transects
NMS2	10km	5 transects
NMS3	16km	8 transects
Intervening areas 18km		6 transects

4 Discussion

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 negetative.

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 Approach¹ 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.

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.

Segment N2M (North of Narrabri)

- N2M1 8-9km eastern side (1.5-2.5km from beginning of segment)
- N2M2 18-20km eastern side (2.5-4.5km from beginning of segment)
- N2M2 23.5-25.5km eastern side (8-10km from beginning of segment)
- N2M3 48-49km western side (1.5-2.0km from beginning of segment)
- N2M3 50-51km eastern side (3-4km from beginning of segment)
- N2M4 56.5-57.5km east & west side (4-5km from beginning of segment)
- N2M5 94.5-95.5km east & west side (6-7km from beginning of segment)

Segment NM (North of Moree)

- NMS1 5.5-6.5km east & west side (1.5-2.5km from beginning of segment)
- NMS2 17.6-20km east & west side (0-2.5km from beginning of segment)
- NMS3 40km east & west side (3km from beginning of segment)
- NMS3 49.5-50km eastern side (12.5-13km from beginning of segment)

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.

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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

Current field work involves establishing the population size of the skink *Liopholis modesta* at

Gerry is also currently updating *A Field Guide to Reptiles of New South Wales* for the 3rd edition, working on the 5th edition of *A Complete Guide to Reptiles of Australia*, and writing a concise guide of the snakes of Australia for the tourist market.

Publications

Books

- Swan, G. 1990. *A Field Guide to the Snakes and Lizards of New South Wales*. Three Sisters

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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.”

Scientific certainty is accepted as 95 per cent confidence level (Jeffery, M. I. (1986), *The appropriateness of Dealing with Scientific Evidence in the Adversarial Arena* Environmental and Planning Law Journal, 3(4), 313-319).

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:

http://www.environment.gov.au/system/files/resources/42f84df4-720b-4dcf-b262-48679a3aba58/files/nes-guidelines_1.pdf:

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 surveys.

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 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* which have a vital 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 per cent 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 ten per cent 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:

Reduce the extent of an ecological community

The listing advice for the community concluded that the ecological community has undergone a very severe decline in extent, likely to be at least 95 per cent, from about 683 000 hectares to about 29 000 hectares.

The proposal would remove approximately 11.31 hectares of the TEC from two patches, one the east and one on the west of the highway. Each of these patches is estimated to have an extent of around 300 hectares and the impact of the proposal would affect each to a similar extent. The proposal is likely to result in a reduction in the extent of each of these populations by around two per cent.

The reduction in the extent of the community is not considered to be substantial at a local context.

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 reduction in the connectivity of patches due to the increase in the width of cleared land associated with the road widening. The slight increase in isolation of patches because of road widening is unlikely to significantly impact their long-term viability.

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; most 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 1.

Table C.1 - Condition thresholds for the Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland ecological community.

Condition thresholds	Best quality	Good quality
Patch size	Minimum patch size at least 0.5 ha, AND	Minimum patch size at least 2 ha AND
Grasses	At least 4 native perennial grass species from the indicator species list AND	At least 3 native perennial grass species from the indicator species list AND
Tussock cover	At least 200 native perennial grass tussocks AND	At least 200 native perennial grass tussocks AND
Woody shrub cover	Total projected canopy cover of shrubs is less than 30% AND	Total projected canopy cover of shrubs is less than 50% AND
Introduced species	Perennial non-woody introduced weed species are less than 5% of the total projected crown cover	Perennial non-woody introduced weed species are less than 30% of the total projected crown cover
Notes:		
<ul style="list-style-type: none"> • 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 five metres of the edges of the community) would only meet the good quality thresholds. Both patches affected are large (~300 hectares) and are considered to be of high importance to the survival of the community.

The removal of approximately 11.31 hectares of habitat for the community, from patches considered to be critical to the survival of the ecological community, is considered 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 a small proportion of the immediately adjacent retained area of the TEC due to edge effects such as increased wind, altered hydrology and weed invasion.

These changes in environmental conditions may result in a change in the species composition 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. This impact would be restricted to areas immediately adjacent to the proposal and would not substantially affect the broader patch of the community.

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. This impact would be restricted to areas immediately adjacent to the proposal and would not substantially affect the broader patch 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 11.31 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 11.31 ha. This represents a loss of about two per cent when considered in the context of the contiguous extent of the TEC in the surrounding environment. The proposal is also considered likely to adversely modify the composition of some immediately 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 large 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 impact on the extent of the *Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland*.

Homopholis belsonii (Belson's Panic)

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

A 'population of a species' is defined under the EPBC Act as an occurrence of the species in a particular area. In relation to critically endangered, endangered or vulnerable threatened species, occurrences include but are not limited to:

- A geographically distinct regional population, or collection of local populations, or
- A population, or collection of local populations, that occurs within a particular bioregion.

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 local populations of the species in the study area are considered to form an important population 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 population of the species in the study area can be considered an important population. Therefore, by this assessment process, the study area is likely to contain an important population of this species within suitable habitat.

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 19.04 hectares of habitat for an important population of the species, consisting of a collection of three local populations. The clearing will result in direct mortality to individuals and loss of habitat. As this species is stoloniferous, forming small patches to extensive mats of intertwined stems, and the accuracy of GPS data collection is typically limited to plus or minus approximately five metres, it is difficult to determine an accurate number of individuals affected. This assessment is therefore based on the amount of habitat affected of locations where the species was recorded and similar areas of contiguous habitat. As the entire study area was searched for the species the assessment could determine with a high degree of accuracy what was potential habitat and what is actual habitat. The proposal will lead to a long-term decrease in the size of an important population by about 19.04 hectares due to the loss of potential habitat. However, only the population/s in segment 2 (N2MS2, between 149.799956 -30.120516 and 149.803101 -30.129579; **Figure C.1**), totalling 2.9 hectares of actual habitat, will be significantly reduced in size by the Proposal and significantly affected per the EPBC criterion. If the Proposal avoided this area a significant impact on the population of *Homopholis belsonii* would be avoided.

Reduce the area of occupancy of an important population

Area of occupancy is defined as the area within a species' 'extent of occurrence' (shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a species) which is occupied by the species. To avoid inconsistencies and bias in assessments caused by estimating area of occupancy at different scales, IUCN (2016) recommends standardization of estimates by applying a 2 x 2 km grid to occurrence data and this is the approach adopted by the Threatened Species Scientific Committee in its assessment of the conservation status of native species (Threatened Species Scientific Committee, 2017). By this definition of area of occupancy, the proposal will not reduce the area of occupancy of an important population as it would not cause the species to be lost from an entire 2 x 2 km grid cell.

At a fine scale, however, the proposal will result in the removal of 19.04 hectares of potential habitat for an important population of the species, reducing the fine scale area of occupancy by that amount. However, only the population/s in segment 2 (N2MS2, between 149.799956 -30.120516 and 149.803101 -30.129579), totalling 2.9 hectares of actual habitat, will be significantly reduced in size by the Proposal. If the Proposal avoided this area, there would not be significant impact on the area of occupancy of the population of *Homopholis belsonii*.

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 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 19.04 hectares of potential habitat critical to the survival of the species. However, only the population/s in segment 2 (N2MS2, between 149.799956 -30.120516 and 149.803101 -30.129579), totalling 2.9 hectares of actual habitat, will be significantly reduced in size by the Proposal. If the Proposal avoided this area, there would not be significant impact on the important habitat for the population of *Homopholis belsonii*. 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 but is unlikely to disrupt the breeding cycle as it would not substantially affect the wind pollination or wind dispersal mechanisms used by this 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 19.04 hectares of important potential habitat for the species. However, only the population/s in segment 2 (N2MS2, between 149.799956 -30.120516 and 149.803101 -30.129579), totalling 2.9 hectares of actual habitat, will be significantly reduced in size by the Proposal. If the Proposal avoided this area, there would not be significant impact on the habitat of *Homopholis belsonii*. 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 one-off reduction in the population of the species in the study area but not an ongoing decline in the population beyond the construction phase of the proposal.

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 and associated habitat degradation. 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*), Coolatai 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 19.04 hectares of the habitat for the species. However, only the population/s in segment 2 (N2MS2, between 149.799956 - 30.120516 and 149.803101 -30.129579), totalling 2.9 hectares of actual habitat, will be significantly reduced in size by the Proposal. If the Proposal avoided this area, there would not be significant impact on the population of *Homopholis belsonii*.

The surveys conducted for the proposal will contribute to a better understanding of the abundance and distribution of the species in the locality and the conservation priority of populations.

- 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, as defined under the EPBC Act, on *Homopholis belsonii* in segment N2MS2, totalling 2.9 ha of actual habitat, and at a low risk of causing significant impact to *H. belsonii* in segments N2MS4 and N2MS5. However, if the Proposal avoided the populations in N2MS2, the risk would be reduced to low across the entire Proposal and would not be significant.

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 grassland. Additionally, the proposal is in the middle of the 'likely-to-occur' distribution, with the floodplain area around Bellata also being in the 'known' distribution of the species. Based on supplementary assessment of habitat within the study area by a subject matter expert, it was concluded much of the road corridor in the study area does not contain suitable habitat for the Five-clawed Worm-skink, or where suitable habitat is present it is too marginal to sustain a viable population. Therefore, the study area is unlikely to contain an important population of this species.

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 34.50 hectares of important habitat for a local population/s of the Five-clawed Worm-skink. Any earthworks 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. Due to the lack of suitable habitat or viable populations within the study area, the Proposal will not lead to a long term decrease in the size of an important population.

Reduce the area of occupancy of an important population

The proposal will remove 34.50 hectares of habitat listed as being associated with this species however a subject matter expert 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. Due to the lack of suitable habitat or viable populations within the study area, the Proposal will not 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 the proposal is in the middle of the 'likely-to-occur' distribution, with the floodplain area around Bellata also being in the 'known' distribution of the species. However, after a field-assessment of the habitat within the road corridor by a subject matter expert, it was concluded habitat within the proposal is too marginal to sustain a viable population and that no local populations of the Five-clawed worm skink would be significantly affected by the proposal. Based on this assessment process, 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 34.50 hectares of habitat for the Five-clawed Worm-skink. Additionally, there will be a further removal of exotic-dominated grassland habitat listed as being associated with this 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. Table 1 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.2 Referral guidelines

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

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 34.50 hectares of important habitat as defined by the *Draft Referral guidelines for the nationally listed Brigalow Belt reptiles*. Approximately 34.50 hectares of habitat listed as being associated with this species is will be impacted by the proposal. However, a field assessment by a subject matter expert revealed much of the habitat within the study area was degraded and/or unsuitable 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 habitat suitability for this species. This clearing will lead to an insignificant 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 impact to this species with any potential increase in invasive grass 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 and associated degradation of habitat. 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 34.50 hectares of important habitat.

Conclusion

Based on the information available, a conservative approach finds this proposal is not at risk of causing a significant impact, as defined under the EPBC Act, on a viable local population of the Five-clawed Worm-skink.

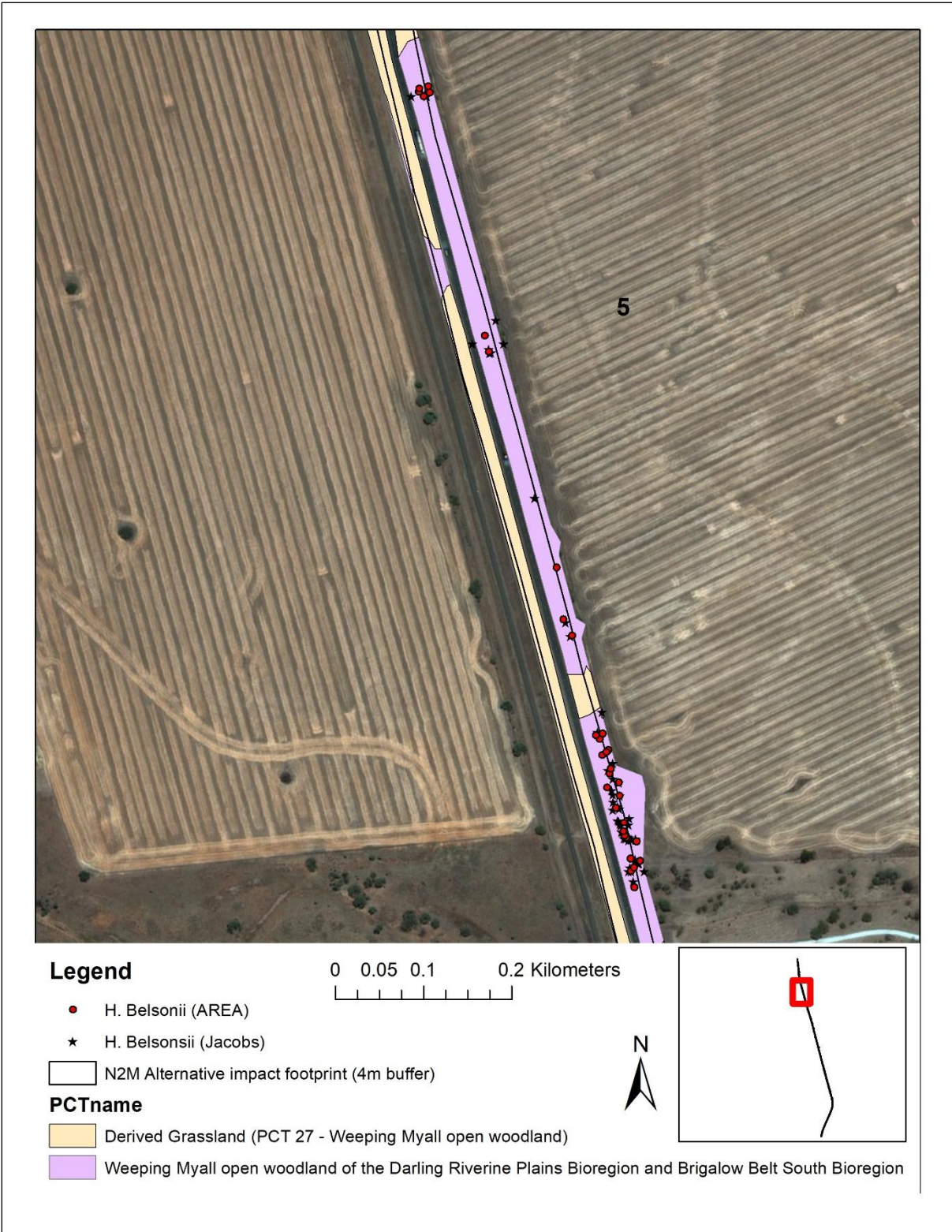


Figure C.1 Location of cluster of *Homopholis belsonii* within segment N2MS2 of the Proposal

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

Description of activity or impact	Consider offsets or supplementary measures
Activities in accordance with Roads and Maritime Services Environmental assessment procedure: Routine and Minor Works (RTA 2011)	No
Works on cleared land, plantations, exotic vegetation where there are no threatened species or habitat present	No
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)	No
Works involving clearing of national or NSW listed critically endangered ecological communities (CEEC)	Where there is any clearing of an CEEC in moderate to good condition
Works involving clearing of nationally listed threatened ecological community (TEC) or nationally listed threatened species habitat	Where clearing >1 ha of a TEC or habitat in moderate to good condition
Works involving clearing of NSW endangered or vulnerable ecological community	Where clearing > 5 ha or where the ecological community is subject to an SIS
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)	Where clearing > 1ha or where the species is the subject of an SIS
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)	Where clearing > 5ha or where the species is the subject of an SIS
Type 1 or Type 2 key fish habitats (as defined by NSW Fisheries)	Where there is any net loss of habitat

Calculation method

To ensure consistency and predictability in offset requirements for REF projects, the Major Projects linear infrastructure module of the BioBanking Credit Calculator (BCC) (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

Loss	Offset ratios
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

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

N2M EPBC significantly affected CEEC or threatened species	Offset requirement
<i>Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland</i>	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
Belson's Panic	8.7 ha
Five-clawed worm skink	No offset requirement as impact of Proposal not deemed significant

Table 4: Offsetting ratios for NM Proposal

N2M EPBC significantly affected CEEC or threatened species	Offset requirement
<i>Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland</i>	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
Belson's Panic	8.7 ha
Five-clawed worm skink	No offset requirement as impact of Proposal not deemed significant



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