FAUNA CONNECTIVITY REPORT (TABLE 6.2)

Oxley Highway to Kundabung

DECEMBER 2014

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1 Introduction

1.1 Introduction

The proposed upgrade of the Pacific Highway between the Oxley Highway and Kempsey (the Project) is part of the Pacific Highway Upgrade Program. This program is a joint commitment by the New South Wales (NSW) and Federal Governments to provide a continuous dual carriageway on the Pacific Highway between Hexham (near Newcastle) and the Queensland border. The Project is approximately 37 kilometres in length, from its southern extent, approximately 700 metres north of the Oxley Highway interchange, to its northern connection to the Kempsey Bypass, just south of Kempsey.

The Minister's Conditions of Approval (MCoA) for the Project contain a number of conditions relating to fauna connectivity. This report addresses MCoA B3, which requires Roads and Maritime to prepare a report on the final design of fauna and or waterway crossings identified in Table 6-2 of Appendix B of the document listed under condition A1(d) (hereafter referred to as Table 6.2), where the locations of the crossing has changed and/ or the crossing does not meet the minimum design principles identified in Table 6-2.

1.2 Project staging

As described in the *Oxley Highway to Kempsey Pacific Highway Upgrade Project Staging Report, Revision 1* (Roads and Maritime 2013), the Project is being delivered in stages. Due to the Project's length and funding models available, the Project will be essentially delivered in two main sections – from the Oxley Highway to Kundabung (approximately 24 kilometres) and from Kundabung to Kempsey (approximately 14 kilometres).

Lend Lease Engineering is designing and constructing the Oxley Highway to Kundabung stage of the Project.

This report details the revised concept design development, tender design development and detailed design of the fauna and waterway crossings in the Oxley Highway to Kundabung stage, to fulfil the requirements as stipulated in the MCoA and Statement of Commitments.

Fauna connectivity measures for the Kundabung to Kempsey stage of the Project were approved by Planning & Infrastructure on 25 September 2013. Similarly, fauna underpasses for Stage 4, the Class M upgrade, have not been included within this report.

2 Changes to Table 6.2

Table 6-2 in Appendix B of the *Ecological Review of Fauna Crossings in the Ballengarra State Forest* (RMS 2011) (hereafter referred to as Table 6-2 (RMS 2011)) provides an initial assessment of where 'combined' and 'dedicated' fauna crossing structures should be installed within the Project alignment. It also identifies areas where 'incidental' fauna crossing movements may occur. A number of design iterations of Table 6.2 have occurred since this report, including:

1. Review of the concept design

As part of the review of the OH2Ku concept design, a number of fauna crossing structures required modification due to changes in the horizontal and vertical alignment and hydraulic performance requirements. In addition, changes to underpass structures were made in response to consultation with Office of Environment and Heritage (OEH) and the Department of Primary Industries (Fishing and Aquaculture) (DPI (Fisheries)) in order to maximise their effectiveness for use by fauna and provide adequate provision for fish passage.

2. Preparation of the tender documents by Roads and Maritime

Subsequent to these changes, a number of criteria were developed to allow sufficient flexibility for the OH2Ku tenderers, whilst maintaining acceptable biodiversity outcomes. These criteria were developed in consultation with OEH and DPI (Fisheries) (see memo Appendix C). The criteria were used for the purposes of tender design development only, and were not ongoing allowances during detailed design.

During the development of these criteria it was also agreed to remove incidental fauna crossing structures to allow the hydrology to guide the design of these structures and allow hydraulic modelling to continue throughout detailed design, without impacting review and approvals of combined and dedicated fauna underpasses.

The criteria developed for tendering were as follows:

Changes to the location and/or size of dedicated fauna crossing structures or combined drainage and fauna crossing structures must be undertaken in consultation with a suitably qualified ecologist and taking into consideration:

- *A. the contribution of any other fauna crossing structures proposed in the immediate area of the fauna crossing structures to the overall fauna connectivity (crossing context);*
- *B. the location and extent of known fauna movement (vegetation) corridors;*
- *C. the micro landscape in the immediate vicinity of the inlet and outlet of the fauna crossing structures; and*
- *D. the influence on fauna movement of any local change in vegetation community types due to the construction works.*

Combined drainage and fauna crossing structures or incidental fauna crossing structures located at Class 2 or Class 3 waterways must be retained as detailed in Table 6-2 and must be box culverts, arches, or bridges.

The lengths of fauna crossing structures identified in Table 6-2 may be changed subject to:

- *A. the total length of dedicated fauna crossing structures for the Project Works not increasing;*
- *B. the length of culverts C2.60, C3.59, C7.26 and C17.70, as identified in Table 6-2, not increasing by greater than 5%;*
- *C. the total length of combined drainage and fauna crossing structures for the Project Works not increasing by greater than 5%;*
- *D. the length of any fauna crossing structures where koalas are identified as a target species not increasing by greater than 10%;*
- *E. the length of any fauna crossing structure over 40m in length not increasing by greater than 15%, except where koalas are identified as a target species,; and*
- *F. the length of any fauna crossing structure under 40m not increasing by greater than 10%.*

Incidental fauna crossing structures required by Table 6-2 may be deleted as identified in Table B below. Flood relief structures identified in Table 6-2 that are located in areas that have no linking vegetation are defined as incidental fauna crossing structures.

Other requirements for dedicated, combined and incidental culverts identified in Table 6-2 may be amended as detailed in Table A.

***Table A** Amended Requirements for Dedicated, Combined and Incidental Culverts*

Structure type	***Criteria***
Dedicated fauna crossing structures	• *The number of dedicated fauna crossings identified in Table 6-2 is a minimum.* • *The dimensions (width and height) of dedicated fauna crossings can either remain as detailed in Table 6-2 or be 'improved', where improved means wider and/or higher than the crossing dimensions in Table 6-2.* • *Dedicated fauna crossings may be relocated a maximum of 50 metres north or a maximum of 50 metres south of its location identified in Table 6-2.* • *Dedicated fauna crossings located within a wildlife movement corridor can only be relocated to remain within, and at least 10 metres from the edge of, the wildlife movement corridor.*
Combined drainage and fauna crossing structure	• *Unless constrained by other environmental and / or performance requirements, combined drainage and fauna crossing structures may be relocated a maximum of 50 metres north or 50 metres south of its location as identified in Table 6-2.* • *Combined drainage and fauna crossing structures located within a wildlife movement corridor can only be relocated to remain within the applicable wildlife movement corridor.* • *A minimum clear space envelope must be provided in each combined drainage and fauna crossing structure, where the dimensions (width and height) of the culvert, or the largest cell of a group of culverts as identified in Table 6-2 defines the minimum clear space envelope.* • *Pipe culverts must not be used as combined drainage and fauna crossing structures.* • *Notwithstanding the number of combined drainage and fauna crossing structures identified in Table 6-2 , the number may be reduced by combining adjacent structures subject to;* ➢ *the total length of each combined structure being no less than the total lengths of the separate structures; and* ➢ *the structure lengths being measured parallel to the Main Carriageways.*
Bridge structures	• *Bridge structures identified in Table 6.2 must not be replaced by culverts.* • *The number of bridge structures identified in Table 6-2 is not a minimum.* • *Bridge lengths may be changed, subject to the bridge structure maintaining the biodiversity outcomes provided by the bridge lengths identified in Table 6-2.* • *Changes to bridge lengths must not reduce the availability of dry fauna passage provided by the bridge lengths identified in Table 6-2 (ie fauna movement must not be 'pushed' to wetter areas adjacent to the bridge abutments).*

Other requirements identified in Table 6-2 may be amended as detailed in Table B.

***Table B** Changes to Table 6-2*

Culvert ID	***Station***	***Type***	***Amended Requirements***
4 / C1.01	*1020*	*Incidental*	*Delete from Table 6-2.*
6 / C1.60	*1600*	*Incidental*	*Delete from Table 6-2.*
9 / C2.60	*2600*	*Combined*	*Relocation north or south not permitted*
10 / C3.59	*3590*	*Combined*	*This location is a key fauna crossing structure.*
12 / C4.22	*4220*	*Incidental*	*Delete from Table 6-2.*
13 / C4.46	*4460*	*Combined*	*Relocation north or south not permitted*
- / C4.50	*4500*	*Flood relief structure*	• *Must be provided as a combined fauna crossing structure* • *Relocation north or south not permitted*
15	*4600 - 4900*	*Twin bridges over Fernbank Creek*	• *Movement of the southern abutments for the twin bridges to the north is not permitted.* • *Fish passage requirements for a Class 2 waterway must be accommodated.*
16 / C5.20	*5200*	*Combined*	*Delete from Table 6-2.*
19 / -	*5500 - 6100*	*Twin Bridges Hastings River*	*Fish passage requirements for a Class 1 waterway must be accommodated.*
20 / C6.30	*6300*	*Combined (flood relief structure)*	*This general location (chainage 6km100 to 6km600) is a key fauna movement corridor.*
21 / C6.72	*6720*	*Combined*	*This area is a key Koala movement corridor*
32 / C10.60	*10600*	*Incidental*	*Delete from Table 6-2.*
- / C11.08	*11080*	*Combined*	*Notwithstanding the requirements of Table A, culverts C11.08 and C11.14 must not be further apart than identified in Table 6-2.*
32A / C11.14	*11400*	*Combined*	*Notwithstanding the requirements of Table A, culverts C11.08 and C11.14 must not be further apart than identified in Table 6-2.*
32B / C11.68	*11680*	*Incidental*	*Delete from Table 6-2.*
- / C13.18	*13180*	*Flood relief structure*	*Delete from Table 6-2.*
- / C14.30	*14300*	*Flood relief structure*	*Delete from Table 6-2.*

Culvert ID	*Station*	*Type*	*Amended Requirements*
- / C16.10	*16100*	*Flood relief structure*	*Delete from Table 6-2.*
44 / -	*17200 - 17300*	*Twin Bridges North Coast Rail Line*	*A minimum of 13.5 metres from the toe of the southern abutment to the toe of the northern abutment of the twin bridges over the North Coast Railway Line must be provided.*
50 / C17.60	*17160*	*Incidental*	*Delete from Table 6-2.*
52 / C18.26	*18260*	*Incidental*	*Delete from Table 6-2.*
53x / C18.72	*18720*	*Incidental*	*Delete from Table 6-2.*
53 / C18.74	*18740*	*Incidental*	*Delete from Table 6-2.*
58s / C20.06	*20060*	*Incidental*	*Delete from Table 6-2.*
- / C20.30	*20300*	*Incidental*	*Delete from Table 6-2.*
- / C21.26	*21260*	*Incidental*	*Delete from Table 6-2.*
- / C21.52	*21520*	*Combined*	*Fauna crossings C21.52 and C21.54 must not be further than 20 metres apart.*
- / C21.54	*21540*	*Combined*	*Fauna crossings C21.52 and C21.54 must not be further than 20 metres apart.*
- / C21.78	*21780*	*Combined*	*Fauna crossings C21.78 and C21.80 must not be further than 20 metres apart.*
65 / C21.80	*21800*	*Combined*	*Fauna crossings C21.78 and C21.80 must not be further than 20 metres apart.*
-	*22100*	*Yarrabee Road under bridge*	*Delete from Table 6-2..*
66 / C22.18	*22180*	*Incidental*	• *Fish passage requirements for a Class 3 waterway must be accommodated.* • *A box culvert must be provided at this location.*
71 / C23.06	*23060*	*Incidental*	*Delete from Table 6-2.*

3. Lend Lease Engineering tender design

A number of changes to Table 6.2 were identified by Lend Lease during tender design in order to improve other environmental outcomes, construction efficiencies and/ or to ensure the provision of acceptable biodiversity outcomes within a revised Project layout. All of these

tender design refinements complied with the above criteria. These changes have also been provided to OEH and DPI (Fisheries) for their review and comment.

4. Lend Lease Engineering detailed design
A number of changes to Table 6.2 have been identified by Lend Lease during detailed design in order to improve other environmental outcomes, construction efficiencies and/ or to ensure the provision of acceptable biodiversity outcomes within the final detailed design. These changes have been developed in consultation with OEH and DPI (Fisheries).

Changes made to Table 6.2 during each of the stages listed above, are outlined in the following appendices:

- Appendix A – detailed design
- Appendix B – tender design
- Appendix C – concept design.

Appendix A also contains a report developed by Lend Lease Engineering to address the requirements of Minister's Condition of Approval B3 for the final design of the fauna and waterway crossings, including complementary fauna exclusion fencing measures, input of a suitably qualified and experienced ecologist, etc.

3 Consultation

Consultation occurred with the Office of Environment and Heritage (OEH) and the Department of Primary Industries (Fishing and Aquaculture) (DPI (Fisheries)) during each of the stages of design development outlined in Section 3. This consultation is summarised in Table 7.

Table 7 Consultation undertaken to date on the OH2Ku fauna crossings

Date	Agency consulted	Consultation
7 September 2012	OEH DPI (Fisheries)	Fauna crossing structures, including proposed dedicated and combined culvert locations and bridges. Inspected Pipers, Smiths and Barrys Creek. Conducted site visit for whole OH2K Project. Discussion and inspection of proposed widened median area in Cairncross State Forest.
26 October 2012	DPI (Fisheries)	Fish passage requirements for those culverts not inspected on 7 September site visit. Particular focus on identifying whether any incidental culverts required fish passage.
3 July 2013	OEH	Email from OEH acknowledging that Roads and Maritime responses to comments were appropriate and confirming that it could be sent to P&I for approval (note: it was subsequently decided and agreed to wait for the

Date	Agency consulted	Consultation
		finalisation of the tender design to seek P&I approval).
10 July 2013	OEH	Meeting to discuss Table 6-2 design criteria to allow flexibility during tender design.
11 July 2013	DPI (Fisheries)	Meeting to discuss Table 6-2 design criteria to allow flexibility during tender design.
11 February 2014 & subsequent email correspondence	OEH	Meeting with OEH to discuss tender design changes within agreed criteria.
21 February 2014	DPI (Fisheries)	Consultation with DPI (Fisheries) to discuss tender design changes within agreed criteria.
5 May 2014, 3 June 2014, 5 August 2014,	OEH and DPI (Fisheries)	General discussions regarding Table 6.2 at the Environmental Review Group (ERG) meetings.
11 September 2014	OEH and DPI (Fisheries)	Site visit to discuss and inspect proposed fauna underpass locations.
13 November 2014	OEH and DPI (Fisheries)	Provision of the final version of Table 6.2 for review.
13 November 2014	DPI (Fisheries)	Confirmation of concurrence with changes to Table 6.2.
17 November 2014	OEH	Confirmation of concurrence with changes to Table 6.2.

Evidence of this consultation is provided in Appendices A – C, where they relate to the changes outlined in that Appendix.

4 Revised Table 6.2

The revised version of Table 6.2, for submission to, and agreement with, the Director-General under MCoA B1 & B3 is detailed below.

Appendix A – Revised Table 6.2 – Detailed Design Report

Transport Roads & Maritime Services

REPORT

Environmental Design - Fauna Crossing Refinements

Oxley Highway to Kundabung Pacific Highway Upgrade

NOVEMBER 2014

Document control

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A	11/11/14	Issued to Roads and Maritime Services and ERG for further review	MT
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Attachment 1 – Locations of Fauna Crossings

Attachment 2 – Fauna Fencing Locations and General Arrangement drawings.

Attachment 3 – Consultation Records with the EPA and DPI

1. Introduction

1.1. Background

Lend Lease Engineering (The "Contractor") has been commissioned by the Roads and Maritime Services (RMS) to undertake the Detailed Design and Construction of the Pacific Highway Upgrade between the Oxley Highway Interchange and Kundabung.

The project comprises the construction of approximately 23km of new dual carriageway highway including four interchanges at Sancrox Road, Blackmans Point Road, Haydons Wharf Road and Yarrabee Road, major waterway crossings at Hastings River and Wilson River, and a crossing of the Main North Coast Rail Line.

The project was approved as part of the Oxley Highway to Kempsey project by the Department of Planning and Infrastructure (now Department of Planning and Environment) in 2012. The Minister Conditions of Approval (MCoA) for the Oxley Highway to Kemspey project (OH2K) stipulate the incorporation of fauna crossings into the design to minimise the barrier effects and habitat fragmentation caused by the new road on local and threatened fauna within the locality. Table 6-10 and 6-11 in Chapter 6 of the Environmental Assessment (EA) document provided an initial assessment of where the fauna crossings should be instated within the alignment. However, the EA also recognised that fauna crossing facilities would be further refined during the detailed design phase of the project in consultation with OEH.

Further refinements of the proposed fauna underpass structures were documented in a report to the Department of Planning and Environment (DP&E) from the Roads and Maritime Services titled Oxley Highway to Kempsey- Pacific Highway Upgrade Ecological Review of Fauna Crossings in the Ballengarra State Forest, October 2011. This report then formed part of the MCoA and is referenced in Condition A1(d). Roads and Maritime Services then invited contractors to tender for the construction of the project, resulting in the development of a tender design. This stage of project development included consultation with relevant agencies. As a result of this process, fauna crossing structures were incorporated into the Scope of Works and Technical Criteria (SWTC) to specify the required fauna passages. The table where this information was provided, is known as Table 6-2 and is contained within Appendix 4 of the SWTC. This table details three types of structures:

- Dedicated fauna crossing culvert structures;
- Combined hydrology and fauna crossing structures; and
- Bridge structures.

This document sets out the detailed design refinements to the fauna crossings which have been identified by the Roads and Maritime Services and the Roads and Maritime Contractor- Lend Lease Engineering in consultation with the project ecologist and the nominated representatives from the Office of Environment and Heritage (OEH) and the Department of Primary Industries (DPI).

1.2. Purpose of this report

This report has been written with the primary intent of fulfilling the requirements of Ministers Condition of Approval B1, B2 and B3 of the MCoA, which are reproduced below:

B1: The Proponent shall design (an implement) the fauna and water way crossings identified in Table 6-2 of Appendix B of the document listed under condition A1(d), at the locations and in accordance with the minimum design principles identified in Table 6-2, unless otherwise agreed by the Director-General.

B2: Investigations into the design of fauna and waterway crossings identified in Table 6-2 of Appendix B of the document listed under condition A1 (d) during detailed design shall be undertaken with the input of a suitably qualified and experienced ecologist and in consultation with the OEH and DPI (Fishing and aquaculture).

B3: The Proponent shall prepare a report on the final design of fauna and /or waterway crossings identified in Table 6-2 of Appendix B of the document listed under condition A1 (d), where the location of the crossing has changed and /or the crossing does not meet the minimum design principles identified in Table 6-2. The report shall be submitted to the Director-General prior to the commencement of construction of the relevant crossing, and shall demonstrate how the new location and/or design would result in acceptable biodiversity outcomes. The report shall clearly identify how the fauna and/or waterway crossing will work in conjunction with complementary fauna exclusion fencing measures to be implemented for the project. The report shall be accompanied by evidence of consultation with the OEH and DPI (Fishing and aquaculture) in relation to the suitability of any changes to the location and/or crossing design.

However, as discussed in section 1.1 above, as Table 6-2 has moved on from the table identified in the document A1(d) listed in the MCoAs, the detailed design refinements will be assessed in this report against the Table 6-2 as included in the SWTC. This is reflected by SWTC requirement 4.4.1(a).

1.3. Consultation

Throughout detailed design, ongoing consultation has been undertaken with government agencies through project wide Environmental Review Group (ERG) meetings. These meetings occur once a month, however, where required, additional meetings or field inspections were undertaken. This included field investigations of the proposed fauna crossing locations on 11 September 2014 with representatives from Lend Lease, RMS, OEH and DPI, Correspondence demonstrating the consultation undertaken with the OEH and DPI regarding the fauna crossing design development is included in Attachment 3. Ongoing consultation with the EPA and DPI will continue throughout the construction of the fauna crossings.

Consultation on the location and design of the fauna exclusion fence has been undertaken with the ERG, however, further detailed consultation is planned to be undertaken as detailed design progresses.

The project ecologist (Dr David Rohweder, Sandpiper Ecological Surveys) has also been consulted on the design of the fauna crossings and fauna fencing. The project ecologist's view on the proposed design refinements is provided in Table 2.1 below. Ongoing consultation with the project ecologist will continue as detailed design progresses.

Prior to submission of this document to Department of Planning and Environment, the Project Ecologist and ERG were issued this report to confirm previous findings and capture minor revisions between site inspection and issue of the report. Commentary, where received has also been supplied within Appendix B.

2. Summary of Fauna Crossing Refinements

Table 2.1 below compares the fauna underpass structures, as currently proposed by the Roads and Maritime Services and the Roads and Maritime Contractor, Lend Lease Engineering, against the minimum dimensions specified in 6-2 of the Scope of Works and Technical Criteria (SWTC). The locations of the fauna crossings are shown in Attachment A.

Culvert C6.30 was originally specified to be a box culvert. However, at this location, due to flooding behaviour, a bridge structure was required. In addition, the inclusion of a bridge instead of a culvert would provide a more beneficial outcome in terms of fauna passage.

In accordance with note 2 of Table 6-2, fauna passage under each new bridge is to include a minimum 3m wide unhindered fauna passage, between the toe of the scour protection and the mean high water mark for tidal waterways and between the toe of the scour protection and the top of a bank for non-tidal waterways, on both sides of the crossing where reasonable and feasible. The clearance for the unhindered fauna passage under the highway, service road and access road bridges is to be a minimum of 2.5m in height where reasonable and feasible. The only exception being the northern bank of Cooperabung Creek where the clearance for the bridge on the western access road has a minimum height of 1m.

Whilst detail design has seen bridge lengths alter in some instances, the minimum fauna passage requirements and heights have remained where required under this approval.

As demonstrated by Table 2.1 below, the proposed design refinements to the fauna crossings will provide overall positive environmental outcomes as agreed by the project ecologist, EPA and DPI. The design refinements also provide positive overall outcomes for the Roads and Maritime Services and Lend Lease Engineering.

Table 2.1 Summary of Proposed Design Refinements to Fauna Crossings

Culvert ID	Approved Table 6-2 Fauna Crossing Type	Approved Table 6-2 Chainage	Approved Table 6-2 structure form and dimensions	Approved Table 6-2 length	Proposed Table 6-2 fauna crossing type	Proposed Table 6-2 Chainage	Proposed Table 6-2 structure form and dimensions	Proposed Table 6-2 length	Regrade required	Fauna Furniture (based on preliminary assessment by Ecologist 14/11)	Connectivity Value	Lend Lease Impact	Project Ecologist Impact (Comments)
F01.04	Dedicated	1040	1 cell 3.0 x 3.0 RCBC	Overall length 54.0m	Dedicated	1040	no change proposed	Overall length 50.2m	Regrade upstream 1 in 7 for 6m, downstream extend fill to suit land form	Install rail & refuge poles every 15m within culvert (koalas); Install refuge poles at entry and exit to Culvert; Install 1.8m-high posts adjacent & opposite each other either side of boundary fence (~300mm gap) at 50m intervals for 100m either side of entry/exit to facilitate movement over fence by arboreal fauna;	-	Positive	Positive
C01.60	Incidental	1600	4 cells 1.8 x 1.2 RCBC	Overall length 69.0m	Incidental	1600	2 cells 2.4 x 1.2 1 culvert low flow channel for fish passage	Overall length 68.6m	upstream: 2% 38m (need to direct low point to culvert inlet) regrade downstream: 0.2% 67m (Very shallow regrade just need to tie into ground level to make culvert drain freely)	Install concrete (or equivalent) ledge (900mm(W) x 300mm(H)) along one wall to provide dry access.	Links native vegetation east and west, located in a mapped subregional corridor	Positive	Neutral (Regraded culvert: Install concrete (or equivalent) ledge (900mm(W) x 300mm(H)) along one wall to provide dry access]
F01.62	Dedicated	1640	1 cell 3.0 x 3.0 RCBC	Overall length 52.0m	Dedicated	1660	no change proposed	Overall length 47.8m	Nominal earthworks required subject to exact land form	Install rail & refuge poles every 15m within culvert (koala); Install refuge poles at entrance & exit; Install 1.8m-high posts adjacent & opposite each other either side of boundary fence (~300mm gap) at 50m intervals for 100m either side of entry/exit to facilitate movement over fence for arboreal fauna;	-	Positive	Neutral
C02.60 B	Combined	2600	1 cell 3.0 x 1.8 RCBC	Overall length 88.0m	Combined	2600	2 cells 3.0 x 2.1	Overall length 88.2m	No	Install refuge poles at entrance and exit; and Install rail throughout culvert.	mapped key habitat to the west and habitat to the east	neutral	Neutral
C03.59 A	Incidental	3590	3 cell 1.5 x 1.2 RCBC	Overall length 42.0m	Fish passage	3590	1 cell 1.8 x 1.2	Overall length 41.0m	upstream 6% 6m (Regrades at these inlets are connected so the culverts both take flow in high flow events but in lower ARI events flow will pass through the fish passage culvert only) downstream: none	No	Links native vegetation east and west	neutral	Neutral
C03.59 B	Incidental	3590	3 cell 1.5 x 1.2 RCBC	Overall length 26.0m	Fish passage	3590	1 cell 1.8 x 1.2	Overall length 19.6m		No	Links native vegetation east and west	neutral	Neutral
C03.59 C	Combined	3590	1 cell 3.0 x 1.8 RCBC	Overall length 43.0m	Combined	3590	no change	Overall length 40.4m	upstream: 2% with a 3:1 batter at boundary, 10m (Regrades at these inlets are connected so the culverts both take flow in high flow events but in lower ARI events flow will pass through the fish passage culvert only) downstream: 0.2% 90m (regrade required to allow combined fauna crossing to drain freely)	Install concrete (or equivalent) ledge (900mm(W) x 300mm(H)) along one wall to provide dry access;	mapped key habitat to the west and habitat to the east	Positive	Positive
C03.59 D	Combined	3590	1 cell 3.0 x 1.8 RCBC	Overall length 23.0m	Combined	3590	no change	Overall length 19.6m		Install concrete (or equivalent) ledge (900mm(W) x 300mm(H)) along one wall to provide dry access;	-	Positive	Positive
C04.46	Combined	4460	3 cell 3.0 x 2.1 RCBC	Overall length 47.0m	Combined	4450	no change proposed	Overall length 41.8m	No	Rails and refuge poles (koalas); Install refuge poles at entry and exit to culvert; Install concrete (or equivalent) ledge (900mm(W) x 300mm(H)) along one wall to provide continuous dry access.	Links native vegetation east and west	neutral	Neutral
C04.50	Combined	4500	1 cell 3.6 x 1.8 RCBC	Overall length 59.0m	Combined	4540	no change proposed	Overall length 50.2m	No	Install refuge poles at entrance and exit; Install rail throughout culvert;	-	Positive	Neutral

Culvert ID	Approved Table 6-2 Fauna Crossing Type	Approved Table 6-2 Chainage	Approved Table 6-2 structure form and dimensions	Approved Table 6-2 length	Proposed Table 6-2 fauna crossing type	Proposed Table 6-2 Chainage	Proposed Table 6-2 structure form and dimensions	Proposed Table 6-2 length	Regrade required	Fauna Furniture (based on preliminary assessment by Ecologist 14/11)	Connectivity Value	Lend Lease Impact	Project Ecologist Impact (Comments)
SB02	Twin bridges-Fernbank Creek	4600-4900	-	Overall length: 275 m (NB Carriageway) 250 m (SB Carriageway)	Twin bridges-Fernbank Creek	4600- 4900	-	Overall length: 261m (NB Carriageway) 260.5 m (SB Carriageway)	N/A	N/A	patchy vegetation connectivity within riparian corridor to the east and west of proposed crossing	neutral	Neutral
SB04	Twin Bridges-Hastings River	5500-6100	-		Twin Bridges-Hastings River	5500- 6100	-	no change proposed	N/A	N/A	patchy vegetation connectivity within riparian corridor to the east and west of proposed crossing	neutral	Neutral
SB05 (C6.30)	Combined/ Flood relief	6330	1 cell 3.0 x 3.0 RCBC	Overall length 34.0m	Hastings River Floodplain Bridge No.2	6320-6460	-	Overall fauna passage under bridge: 36.0m (length of bridges 140m)	N/A	N/A	-	Positive	Neutral
C06.72	Combined	6720	1 cell 3.0 x 2.4 RCBC	Overall length 48.0m	Combined	6720	no change proposed	Overall length 36.0m	1 in 5 upstream for 16m, nominal downstream for scour protection	Rails and refuge poles (koalas); install refuge poles at entry and exit to culvert; Install concrete (or equivalent) ledge (900mm(W) x 300mm(H)) along one wall to provide dry access;	Links vegetation east and west.	Neutral	Neutral. Regrade of 1:5 upstream required to meet passage requirements. Fauna path 3m wide with finer rock 40-50mm diameter required. Refuge poles at 3m spacing.
C07.26	Combined	7260	1 cell 3.0 x 2.4 RCBC	Overall length 48.0m	Combined	7270	no change proposed	Overall length 41.6m	1 in 7 upstream for 16m, nominal downstream for scour protection	Rails and refuge poles (koalas); install refuge poles at entry and exit to culvert; Install concrete (or equivalent) ledge (900mm(W) x 300mm(H)) along one wall to provide dry access;	Links vegetation to the east and west contiguous with State forest	Positive	Positive
C09.21	Combined	9210	1 cell 3.0 x 3.0 RCBC	Overall length 43.0m	Combined	9210	no change proposed	Overall length 38.0m	upstream: 25% 5m regrade downstream: 0.2% 21m (Very shallow regrade just need to tie into ground level to make culvert drain freely)	Install refuge poles at entrance and exit; Install rail throughout culvert; Install concrete (or equivalent) ledge (900mm(W) x 300mm(H)) along one wall to provide dry access	Mapped regional corridor associated with key habitat in Rawdon Creek Nature Reserve to the west and key habitat in Cairncross State Forest to the east	Positive	Neutral (1.West entrance visibility probably ok from service rd/highway which is 1-1.5m higher .Consider regrade slope vs area of clearing extra clearing is an option to improve effectiveness. 2. Regraded culvert: Install concrete (or equivalent) ledge (900mm(W) x 300mm(H)) along one wall to provide dry access]
F09.70	Dedicated	9700	1 cell 3.0 x 3.0 RCBC	Overall length 41.0m	Dedicated	9700	no change proposed	Overall length 38.0m	1 in 4 upstream for 7m; none downstream	Install concrete (or equivalent) ledge (900mm(W) x 300mm(H)) along one wall to provide dry access; Install rail and refuge poles (every ~15m) within culvert (koalas) ; rocks & logs(frogs/reptiles/small mammals); Install hollow logs outside near entry/exit (quolls).	Links native vegetation east and west within Cairncross State Forest, vegetation contiguous with mapped regional corridors located to the north and south	Neutral	Neutral. Review of culvert 11/11/14. 1:4 regrade upstream still required. Need to retain strip of vegetation between existing highway and new crossing
C11.08	New combined culvert	11080	1 cell 3.0 x 2.4 RCBC	Overall length 24.0m	Combined	11090	no change proposed	Overall length 17.1 m	No	Rails and refuge poles (koalas); Install refuge poles at entry and exit to culvert; Install concrete (or equivalent) ledge (900mm(W) x 300mm(H)) along one wall to provide dry access.	Links native vegetation east and west within Cairncross State Forest, vegetation contiguous with mapped regional corridors located to the north and south	Positive	Positive

Culvert ID	Approved Table 6-2 Fauna Crossing Type	Approved Table 6-2 Chainage	Approved Table 6-2 structure form and dimensions	Approved Table 6-2 length	Proposed Table 6-2 fauna crossing type	Proposed Table 6-2 Chainage	Proposed Table 6-2 structure form and dimensions	Proposed Table 6-2 length	Regrade required	Fauna Furniture (based on preliminary assessment by Ecologist 14/11)	Connectivity Value	Lend Lease Impact	Project Ecologist Impact (Comments)
C11.14	Combined	11140	1 cell 3.0 x 2.4 RCBC	Overall length 26.0m	Combined	11140	no change proposed	Overall length 19.6m	1 in 6 upstream for 5m, nominal downstream for scour protection	Rails and refuge poles (koalas); install refuge poles at entry and exit to culvert; Install concrete (or equivalent) ledge (900mm(W) x 300mm(H)) along one wall to provide dry access.	Links native vegetation east and west within Cairncross State Forest, vegetation contiguous with mapped regional corridors located to the north and south	Positive	Positive
F11.67	Dedicated	11670	1 cell 3.0 x 2.4 RCBC	Overall length 41.0m	Dedicated	11660	no change proposed	Overall length 38.0m	No	Install rail and refuge poles (every ~15m) (koalas); install refuge poles at entry and exit to culvert rocks & logs (frogs/reptiles/sm. mammals) within culvert; hollow logs outside near entry/exit (quolls)	Located within mapped regional corridor, links vegetation in Cairncross State Forest to the east and west	Positive	Positive
SB09	Twin bridges-Wilsons River	16400-17000	-	Overall length: 523	Twin bridges-Wilsons River	16400-17000	-	no change proposed	N/A	N/A	-	N/A	N/A
SB10	Twin bridges-North Coast Railway Line	17200-17300	-	Overall Length: 25	Twin bridges-North Coast Railway Line	17200-17300	-	no change proposed	N/A	N/A	-	N/A	N/A
C17.70	Combined	17700	1 cell 3.0 x 3.0 RCBC	Overall length 56.0m	Combined	17690	no change proposed	Overall length 40.4m	upstream 10% 6m downstream 1% 10m (shallow regarde just need to tie into ground level to make culvert drain freely)	Install refuge poles at entrance and exit; Install rail throughout culvert; Install concrete (or equivalent) ledge (900mm(W) x 300mm(H)) along one wall to provide dry access.	Fragmented vegetation to the east and west	Positive	Neutral (Regraded culvert: Install concrete (or equivalent) ledge (900mm(W) x 300mm(H)) along one wall to provide dry access
SB11	Twin Bridges-Cooperabung Creek	19700	-	Overall length: 36	Twin Bridges-Cooperabung Creek	19700	-	no change proposed	N/A	N/A	continuous within riparian corridor to the east and west of proposed crossing	N/A	N/A
C20.26	Combined	20260	1 cell 3.0 x 2.4 RCBC	Overall length 47.0m	Combined	20250	no change proposed	Overall length 42.9m	Upstream 25% 6m downstream: none.	Install refuge poles at entrance and exit; Install rail throughout culvert; Install concrete (or equivalent) ledge (900mm(W) x 300mm(H)) along one wall to provide dry access.	Links native vegetation east and west adjacent to Cooperabung Nature Reserve	Positive	Neutral (Regraded culvert: Install concrete (or equivalent) ledge (900mm(W) x 300mm(H)) along one wall to provide dry access
F20.54	Dedicated	20540	1 cell 3.0 x 3.0 RCBC	Overall length 66.0m	Dedicated	20560	no change proposed	Overall length 51.5m	No	Install rail and refuge poles (every ~15m) within culvert (koalas); Install refuge poles at entry and exit to culvert; Rocks & logs (frogs/reptiles/sm. mammals). Install hollow logs outside near entry/exit (quolls).	Links vegetation to the east and west that is contiguous with a mapped regional corridor in Cooperabung Nature Reserve and Ballengarra State Forest	Positive	Positive
F21.24	Dedicated	21240	1 cell 3.0 x 3.0 RCBC	Overall length 62.0m	Dedicated	21240	no change proposed	Overall length 57.8m	No	Install refuge poles at entrance and exit; Install rail throughout culvert; Rocks, hollow logs (quolls).	Located in a mapped regional corridor linking mapped key habitat in Cooperabung Nature Reserve and Ballengarra State Forest	Positive	Positive
C21.54	Combined	21540	1 cell 3.0 x 3.0 RCBC	Overall length 68.0m	Combined	21540	no change proposed	Overall length 53.9m	No	Rails and refuge poles (koalas); install refuge poles at entry and exit to culvert.	Located in a mapped regional corridor linking areas of key habitat to the east and west	Positive	Positive

Culvert ID	Approved Table 6-2 Fauna Crossing Type	Approved Table 6-2 Chainage	Approved Table 6-2 structure form and dimensions	Approved Table 6-2 length	Proposed Table 6-2 fauna crossing type	Proposed Table 6-2 Chainage	Proposed Table 6-2 structure form and dimensions	Proposed Table 6-2 length	Regrade required	Fauna Furniture (based on preliminary assessment by Ecologist 14/11)	Connectivity Value	Lend Lease Impact	Project Ecologist Impact (Comments)
C21.80	Combined	21780	1 cell 3.0 x 3.0 RCBC	Overall length 70.0m	Combined	21780	no change proposed	Overall length 56.3m	No	Rails and refuge poles (koalas); install refuge poles at entry and exit to culvert. Install concrete (or equivalent) ledge (900mm(W) x 300mm(H)) along one wall to provide dry access.	Located in a mapped regional corridor linking areas of key habitat to the east and west	Positive	Positive
SB12	Yarabee Road underbridge	22100	-	Overall Length: 28	Yarabee Road underbridge	22100	-	Overall Length: 28.8	N/A	N/A	Located in a mapped regional corridor linking areas of key habitat to the east and west	neutral	Neutral
C22.18	Incidental (box culvert)	22180	1 cell 1.5 x 1.5 RCBC	Overall length 72.0m	Incidental, fish passage	22160	cell 2100mm dia RCP	Overall length 69.8m	No	No	Located in a mapped regional corridor linking areas of key habitat to the east and west	neutral	Neutral
C22.19			1 cell 1.5 x 1.5 RCBC	Overall length 28.0m	Incidental, fish passage	22170	2 cell 1800dia dia RCP	Overall length 25.7m	No	No	Located in a mapped regional corridor linking areas of key habitat to the east and west	neutral	Neutral
F22.32	Dedicated	22300	1 cell 3.6 x 3.6 RCBC	Overall length 60.0m	Dedicated	22320	no change proposed	Overall length 59.4m	Upstream 1:4; None required downstream.	Install rail and refuge poles (every ~15m)(koalas); install refuge poles at entry and exit to culvert; rocks & logs (frogs/reptiles/small mammals); Install hollow logs outside near entry/exit (quolls).	Located in a mapped regional corridor linking areas of key habitat to the east and west	Neutral	Regrade should be extended to 1 in 4 on the upstream. Agreed commitments to drainage must still apply to F22.32.
C23.05	Combined	23050	1 cell 3.0 x 3.0 RCBC	Overall length 54.0m	Combined	23060	no change proposed	Overall length 40.4m	No	Install rail and refuge poles (every ~15m) within culvert (koalas); install refuge poles at entry and exit to culvert.	Located in a mapped regional corridor linking areas of key habitat to the east and west; vegetation contiguous with mapped climate change corridor to the east	Positive	Positive
SB13	Barrys Creek twin bridges	23940	-	Overall length: 32	Barrys Creek twin bridges	23940	-	no change proposed	N/A	Rails and refuge poles (koalas); install refuge poles at entry and exit to culvert; Rocks, hollow logs (quolls)	Located in a mapped regional corridor linking areas of key habitat to the east and west; vegetation contiguous with mapped climate change corridor to the east	N/A	N/A

3. Fauna Fencing

As part of the federal approval for the project, locations of fauna fences were identified. Detailed design elements have been further reviewed by the Project Ecologist to maintain compliance with federal and state requirements. Further, the fauna fence design has been discussed at the ERG and provided to OEH for review as part of the design process. Key features of the fauna exclusion fencing for Oxley Highway to Kundabung are as follows:

- Fauna fencing has been routed around the top of all culvert headwalls to allow access to the culverts while preventing fauna from entering the Mainline. In some instances the top of the fauna fencing is located above safety barriers due to culvert headwalls and clearing restrictions.

- Fauna fencing generally does not contain corners with internal angles less than 135 degrees on the fauna habitat side to prevent predators from cornering prey.

- Fauna fencing directly connects to bridge abutments and has been installed between twin carriageway bridges.

- Fauna fencing extends a minimum 25m past the defined ends of the fencing and is curved away from the road carriageway with the maximum angle of these curve returns 135 degrees. Where the boundary is constrained or channel crossings have been avoided the fauna fencing has been curved away from the road at wide angle.

- Fauna fencing at permanent water quality basins is installed around the outside of basins to prevent fauna accessing the basin.

- Where fauna underpasses are provided between the mainline carriageway formation and the widened median or Local Roads a fauna fence has been provided between headwalls to prevent fauna accessing the median strip.

- Frog fences have been located between the road and associated drainage including permanent water quality basins, catch drains, table drains and the inlet and outlet of transverse and longitudinal drainage structures;

In addition, drop down structures have been integrated to within the design to provide fauna with an escape path should they enter the road corridor. Drop down structures have been designed at all points where animals could reasonably be expected to enter the road corridor. All practical measures have been undertaken in the design to avoid fauna fences from crossing catch drains and table drains. Fauna and frog exclusion fences have been positioned around the back of all inlets and outlet headwalls of transverse and longitudinal drainage structures.

Locations for fauna fencing, required under the approval are depicted in Attachment 2 with plans and design details also provided for:

- Standard Fauna Exclusion Fence;
- Combined Phascogale and Standard Fauna Fence;
- Combined Giant Barred Frog and Standard Fauna Fence;
- Combined Green Thighed Frog and Standard Fauna Fence;
- Combined Green Thighed Frog, Phascogale and Standard Fauna Fence;
- Giant Barred Frog Fence; and
- Green Thighed Frog Fence.

4. Detailed Description of Fauna Crossing Refinements

The following section describes the detailed design refinement of each structure from that approved in the SWTC Table 6-2, the proposed change in design and fauna habitat considerations for each of the proposed fauna crossings specified within the amended Table 6-2. Of importance, a comment is made detailing and justifying any changes to the location and meeting the minor design requirements detailed in Table 6-2 of the SWTC.

4.1 Incidental Culvert at Chainage 1600

Location:	**C1.60**
Crossing type:	Incidental
SWTC Table 6.2 location	CH 1600
SWTC Table 6.2 Structure form	Box culvert – One structure for incidental use.
SWTC Table 6.2 dimensions	4 Cells, 1.8m wide x 1.2m high
Original location vegetation	Moist Gully Forest (NB) Moist Gully Forest (SB)
Watercourse	Class 3
Connectivity value	Very High – Subregional corridor
Proposed location	Unchanged
Proposed structure	Unchanged
Proposed dimensions	2 cells, 2.4m wide x 1.2m high
New location vegetation	Unchanged
Reason for design change	The culvert has been reduced from four cells to two cells due to detail design identifying that hydraulic flows would not be as significant as detailed in the concept design. However, the sizing of the cells has increased to 2.4m x 1.2m. The new culverts meet the hydraulic requirements required under the deed while minimum open envelope required for fauna passage as specified in SWTC is maintained. Fish passage has been achieved through the use of a low flow channel and use of rip rap and associated regrade of both inlet and outlets to tie the drainage line into surrounding watercourses and vegetation.
Engineering considerations:	No fauna connectivity is anticipated at this structure (hence incidental). Changes allow for it to be used as an incidental crossing through installation of a ledge along one wall for dry passage. The proposed size increases (although reduced number of cells) would not disadvantage the identified incidental species.
Ecological outcome:	Neutral biodiversity outcome.
Fauna exclusion fencing provisions	A Fauna fence runs alongside the highway at the base of the formation along both carriageways. Fencing will be located over the top of the headwall of the crossing allowing this culvert to be used by fauna. Drop down structures will be provided in locations in close proximity to the underpass, as agreed with the project ecologist and confirmed onsite with OEH.
Comment	The culverts have been resized at this location in direct response to hydrological modelling which has seen smaller structures replaced with larger items increased in size. Where multi-celled culverts are required, only one structure is required to provide the nominated passage rather than all. This is achieved in the optimised design. Further, dedicated structures are less than 20m from this location.

4.2 Dedicated crossing at Chainage 1640

Location:	F1.62
Crossing type:	Dedicated
SWTC Table 6.2 location	CH 1640
SWTC Table 6.2 Structure form	Box culvert
SWTC Table 6.2 dimensions	1 Cell, 3m wide x 3m high
Original location vegetation	Moist Gully Forest
Watercourse	N/A
Connectivity value	N/A
Proposed location	Ch 1660
Proposed structure	Unchanged
Proposed dimensions	Unchanged
New location vegetation	Moist Gully Forest (NB) Moist Gully Forest (SB)
Reason for design change	The culvert has been relocated to provide dry passage above the 100 ARI flood level to meet both EPBC condition 3 requirements.
Engineering considerations:	Length of the culvert has reduced to approximately 48m from 52m and has been designed to reduce skew (which reduces overall length) and facilitate dry passage. The reduction in length and skew also translates to a net reduction in complexity and construction footprint thus reducing clearing.
Ecological outcome:	Neutral biodiversity outcome.
Fauna exclusion fencing provisions	A Fauna fence runs alongside the highway at the base of the formation along both carriageways. Fencing will be located over the top of the headwall of the crossing allowing this culvert to be used by fauna. Rails and refuge poles as originally identified will still be provided Drop down structures will be provided in locations in close proximity to the underpass, as agreed with the project ecologist and confirmed onsite with OEH.
Comment	The investigation and active consultation with OEH and DPI in relation to this fauna crossing provision fulfils the requirement of Condition B2 of the MCoA.

4.3 Combined crossing at Chainage 2600

Location:	C2.60A /C2.60B
Crossing type:	Combined
SWTC Table 6.2 location(s)	CH 2600
SWTC Table 6.2 Structure form(s)	C2.60A Box culvert- One structure for incidental use. C2.60B Box culvert
SWTC Table 6.2 dimensions(s)	C2.60A: 3 Cells, 1.8m wide x 1.8m high C2.60B: 1 Cell, 3m wide x 3m high
Original location	Moist Gully Forest (NB)

vegetation	Moist Slopes Forest (SB)
Watercourse	N/A
Connectivity value	High-mapped key habitat to the west
Proposed location	C2.60A and C2.60B: CH2600
Proposed structure	C2.60A and C2.60B combined into one culvert
Proposed dimensions	C2.60: 2 cell 3.0m wide x 2.1m high
New location vegetation	Moist Gully Forest (NB) Moist Slopes Forest (SB)
Reason for design change	C2.60A and C2.60B culverts have been combined due to detail design identifying those hydraulic flows would not be as significant as detailed in the concept design. The new culvert meets the required hydraulic requirements while the open envelope required for fauna passage as specified in Table 6-2 has actually been increased. The increase in size from C2.60A improving opportunity for fauna passage. Regrade of both inlet and outlets are required to tie the drainage line into surrounding watercourses and vegetation.
Engineering considerations:	Length of the culvert has had a slight increase in length, as the culvert needs to tie into the existing creek line. Boundary constraints mean that this creek line cannot be realigned in the corridor to provide a shorter culvert.
Ecological outcome:	Neutral biodiversity outcome.
Fauna exclusion fencing provisions	There is no fauna exclusion fencing at this location. The purpose of the structure is to provide connectivity for small animal species that live in and around the creek line. Fauna furniture and drop down structures will be provided in locations in close proximity to the underpass, as agreed with the project ecologist and confirmed onsite with OEH.
Comment	The investigation and active consultation with OEH and DPI in relation to this fauna crossing provision fulfils the requirement of Condition B2 of the MCoA.

4.4 Combined crossing at Chainage 4460

Location:	**C04.46**
Crossing type:	Combined
SWTC Table 6.2 location(s)	CH 4460
SWTC Table 6.2 Structure form(s)	Box culvert
SWTC Table 6.2 dimensions(s)	3 Cells, 3m wide x 2.1m high
Original location vegetation	Paperbark Swamp Forest
Watercourse	N/A
Connectivity value	Medium- connects native vegetation
Proposed location	CH 4450
Proposed structure	Unchanged
Proposed dimensions	Unchanged

New location vegetation	Paperbark Swamp Forest
Reason for design change	Culvert relocated so that it is out of the main drainage line to improve dry passage through the structure.
Engineering considerations:	Length has been reduced significantly due to the relocation.
Ecological outcome:	Neutral biodiversity outcome.
Fauna exclusion fencing provisions	A Fauna fence runs alongside the highway at the base of the formation along the northern carriageway. A second fauna fence runs offset to the southern lane of service road A (existing highway) with fencing directing fauna to the culvert or toward the Fernbank Creek bridge. Areas between the new carriageway and service road will also feature fauna fencing to avoid fauna from being trapped in this area and/or being struck by service road traffic. Fencing will be located over the top of the headwall of the crossing allowing this culvert to be used by fauna. Rails and refuge poles as originally identified will still be provided Drop down structures will be provided in locations in close proximity to the underpass, as agreed with the project ecologist and confirmed onsite with OEH.
Comment	The investigation and active consultation with OEH and DPI in relation to this fauna crossing provision fulfils the requirement of Condition B2 of the MCoA.

4.5 Combined crossing at Chainage 4540

Location:	**C04.50**
Crossing type:	Combined
SWTC Table 6.2 location(s)	CH 4500
SWTC Table 6.2 Structure form(s)	Box culvert
SWTC Table 6.2 dimensions(s)	1 Cell, 3.6m wide x 1.8m high
Original location vegetation	Paperbark Swamp Forest (SB) Cleared land (NB)
Watercourse	N/A
Connectivity value	N/A
Proposed location	CH 4540
Proposed structure	Unchanged
Proposed dimensions	Unchanged
New location vegetation	Paperbark Swamp Forest
Reason for design change	This culvert was relocated to better align with the existing watercourse and avoid a diversion of the waterway.
Engineering considerations:	The culvert has been skewed to align with low points in water course, low flow channel set >200mm below bed level downstream. This structure still provides dry passage in 1 yr ARI 72hr storm Relocation of the structure has resulted in a substantial reduction in length.
Ecological outcome:	Neutral biodiversity outcome.
Fauna exclusion fencing provisions	A Fauna fence runs alongside the highway at the base of the formation along the northern carriageway. A second fauna fence runs

	offset to the southern lane of the existing highway with fencing directing fauna to the culvert or toward the Fernbank Creek bridge. Fencing between the existing highway and southern carriageway to direct fauna to an area between the permanent water quality basin and existing bridge will also be provided to avoid conflicts with traffic along the existing highway which will be retained as a service road. Fencing will be located over the top of the headwall of the crossing allowing this culvert to be used by fauna. Rails and refuge poles as originally identified will still be provided Drop down structures will be provided in locations in close proximity to the underpass, as agreed with the project ecologist and confirmed onsite with OEH.
Comment	The investigation and active consultation with OEH and DPI in relation to this fauna crossing provision fulfils the requirement of Condition B2 of the MCoA.

4.6 Combined crossing at Chainage 6330

Location:	**C6.30**
Crossing type:	Combined/ flood relief
SWTC Table 6.2 location(s)	CH 6330
SWTC Table 6.2 Structure form(s)	Box culvert
SWTC Table 6.2 dimensions(s)	1 Cell, 3m wide x 3m high
Original location vegetation	Cleared land
Watercourse	N/A
Connectivity value	N/A
Proposed location	CH 6320-6460
Proposed structure	Floodplain bridge structure
Proposed dimensions	30.6m (fauna passage under structure)
New location vegetation	Cleared land
Reason for design change	Culvert was changed to a bridge structure to provide improved hydraulic and flooding performance.
Engineering considerations:	
Ecological outcome:	Neutral biodiversity outcome.
Fauna exclusion fencing provisions	There is no fauna exclusion fencing at this location. The purpose of the structure is to provide connectivity for small animal species that live in and around the creek line.
Comment	The investigation and active consultation with OEH and DPI in relation to this fauna crossing provision fulfils the requirement of Condition B2 of the MCoA.

4.7 Combined crossing at Chainage 7260

Location:	C07.26
Crossing type:	Combined
SWTC Table 6.2 location(s)	CH 7260
SWTC Table 6.2 Structure form(s)	Box culvert
SWTC Table 6.2 dimensions(s)	1 Cell, 3m wide x 2.4m high
Original location vegetation	Moist Slopes Forest (NB) Moist Gully Forest (SB)
Watercourse	N/A
Connectivity value	Medium- links vegetation with State Forest
Proposed location	CH 7270
Proposed structure	Unchanged
Proposed dimensions	C2.60B: 2 cell 3.0m wide x 2.1m high
New location vegetation	Moist Slopes Forest
Reason for design change	Shift north has resulted in a substantial reduction in length of the culvert.
Engineering considerations:	Relocation requires a regrade on the western side (about 1 in 7 metres for 16m).
Ecological outcome:	Positive biodiversity outcome.
Fauna exclusion fencing provisions	A Fauna fence runs alongside the highway at the base of the formation along both carriageways. Fencing will be located over the top of the headwall of the crossing allowing this culvert to be used by fauna. Rails and refuge poles as originally identified will still be provided Drop down structures will be provided in locations in close proximity to the underpass, as agreed with the project ecologist and confirmed onsite with OEH.
Comment	The investigation and active consultation with OEH and DPI in relation to this fauna crossing provision fulfils the requirement of Condition B2.

4.8 Combined crossing at Chainage 11090

Location:	C11.08
Crossing type:	Combined
SWTC Table 6.2 location(s)	CH 11080 (southbound carriageway only)
SWTC Table 6.2 Structure form(s)	Box culvert
SWTC Table 6.2 dimensions(s)	1 Cell, 3m wide x 2.4m high
Original location vegetation	Swamp Mahogany Red Gum Swamp Forest Moist Gully Forest
Watercourse	N/A
Connectivity value	Very high- connects native vegetation and the Cairncross State Forest, vegetation contiguous with mapped regional corridors

Proposed location	CH11090
Proposed structure	Unchanged
Proposed dimensions	Unchanged
New location vegetation	Swamp Mahogany Red Gum Swamp Forest Moist Gully Forest
Reason for design change	The culvert has been relocated to reduce vegetation clearing impacts within the widened median and provide the shortest practical fauna crossing route (through to C11.14).
Engineering considerations:	Culvert needs to provide a hydraulic function as well as be located near culvert C11.14 (goes across the northbound carriageway) for continuous fauna passage. This length of the culvert has also reduced from 21m to about 17m.
Ecological outcome:	Positive biodiversity outcome.
Fauna exclusion fencing provisions	Fauna exclusion fencing is located both within and outside of the highway carriageways. Fauna exclusion fencing is also used in the median to direct fauna from C11.08 to C11.14 and avoids fauna becoming trapped within the widened median. Fencing will be located over the top of the headwall of the crossing allowing this culvert to be used by fauna. Rails and refuge poles as originally identified will still be provided Drop down structures will be provided in locations in close proximity to the underpass, as agreed with the project ecologist and confirmed onsite with OEH.
Comment	The investigation and active consultation with OEH and DPI in relation to this fauna crossing provision fulfils the requirement of Condition B2 of the MCoA.

4.9 Dedicated crossing at Chainage 11660

Location:	**F11.67**
Crossing type:	Dedicated
SWTC Table 6.2 location(s)	CH 11670
SWTC Table 6.2 Structure form(s)	Box culvert
SWTC Table 6.2 dimensions(s)	1 Cell, 3m wide x 2.4m high
Original location vegetation	Swamp Mahogany Red Gum Swamp Forest
Watercourse	N/A
Connectivity value	Very high- in regional corridor
Proposed location	CH11660
Proposed structure	Unchanged
Proposed dimensions	Unchanged
New location vegetation	Swamp Mahogany Red Gum Swamp Forest
Reason for design change	The culvert has been relocated to provide dry passage above the 100 ARI flood level to meet both EPBC condition 3 requirements.
Engineering considerations:	Length of the culvert has been reduced through the relocation, now being 38m in length.
Ecological outcome:	Positive biodiversity outcome.

Fauna exclusion fencing provisions	Combined phascogale, frog and standard fauna fencing is located either side of the highway formation. Fencing will be located over the top of the headwall of the crossing allowing this culvert to be used by fauna. Rails and refuge poles as originally identified will still be provided Drop down structures will be provided in locations in close proximity to the underpass, as agreed with the project ecologist and confirmed onsite with OEH.
Comment	The investigation and active consultation with OEH and DPI in relation to this fauna crossing provision fulfils the requirement of Condition B2 of the MCoA.

4.10 Combined crossing at Chainage 17690

Location:	**C17.70**
Crossing type:	Combined
SWTC Table 6.2 location(s)	CH 17700
SWTC Table 6.2 Structure form(s)	Box culvert
SWTC Table 6.2 dimensions(s)	1 Cell, 3m wide x 3m high
Original location vegetation	Paperbark Swamp Forest
Watercourse	N/A
Connectivity value	N/A
Proposed location	CH11690
Proposed structure	Unchanged
Proposed dimensions	Unchanged
New location vegetation	Paperbark Swamp Forest
Reason for design change	Culvert has been straightened to reduce the length of the structure.
Engineering considerations:	The relocation of the culvert has resulted in a regrade required either side of the highway.
Ecological outcome:	Neutral biodiversity outcome.
Fauna exclusion fencing provisions	Standard fauna fencing is located around the highway formation at this location. Fencing will be located over the top of the headwall of the crossing allowing this culvert to be used by fauna. Drop down structures will be provided in locations in close proximity to the underpass, as agreed with the project ecologist and confirmed onsite with OEH.
Comment	The investigation and active consultation with OEH and DPI in relation to this fauna crossing provision fulfils the requirement of Condition B2 of the MCoA.

4.11 Dedicated crossing at Chainage 20560

Location:	F20.54
Crossing type:	Dedicated
SWTC Table 6.2 location(s)	CH 20540
SWTC Table 6.2 Structure form(s)	Box culvert
SWTC Table 6.2 dimensions(s)	1 Cell, 3m wide x 3m high
Original location vegetation	Moist Gully Forest
Watercourse	N/A
Connectivity value	Very High- links vegetation that is contiguous with mapped regional corridor in Cooperabung Nature Reserve and Ballengarra State Forest.
Proposed location	CH20560
Proposed structure	Unchanged
Proposed dimensions	Unchanged
New location vegetation	Moist Gully Forest (NB)
Reason for design change	The culvert was shifted as the original location placed the culvert in a drainage line. By moving it 20m north, it removed the culvert from the low topography and enabled it to provide dry passage above the 100 ARI flood level to meet both EPBC condition 3 requirements.
Engineering considerations:	IN addition to the relocation, the culvert was placed higher in the fill embankment. Both of these changes have resulted in the substantial reduction in length to 53m.
Ecological outcome:	Positive biodiversity outcome.
Fauna exclusion fencing provisions	Fauna fencing is located around the highway formation at this location. Fencing will be located over the top of the headwall of the crossing allowing this culvert to be used by fauna. Rails and refuge poles as originally identified will still be provided Drop down structures will be provided in locations in close proximity to the underpass, as agreed with the project ecologist and confirmed onsite with OEH.
Comment	The investigation and active consultation with OEH and DPI in relation to this fauna crossing provision fulfils the requirement of Condition B2 of the MCoA.

4.12 Combined crossing at Chainage 21800

Location:	C21.80
Crossing type:	Combined
SWTC Table 6.2 location(s)	CH 21780
SWTC Table 6.2 Structure form(s)	Box culvert
SWTC Table 6.2 dimensions(s)	1 Cell, 3m wide x 3m high
Original location vegetation	Moist Gully Forest (NB) Moist Slopes Forest (SB)

Watercourse	N/A
Connectivity value	Very high- in an area of mapped regional corridor
Proposed location	CH 21785 (same as tender design)
Proposed structure	Unchanged
Proposed dimensions	Unchanged
New location vegetation	Moist Gully Forest (NB) Moist Slopes Forest (SB)
Reason for design change	This culvert has been shifted about 5 metres to offset the culvert from an existing culvert to improve the constructability of the structure.
Engineering considerations:	Length of the culvert has had a substantial decrease in length, increasing the potential that fauna will utilise the structure.
Ecological outcome:	Positive biodiversity outcome.
Fauna exclusion fencing provisions	Fauna fencing is located around the highway formation at this location. Fencing will be located over the top of the headwall of the crossing allowing this culvert to be used by fauna. Rails and refuge poles as originally identified will still be provided Drop down structures will be provided in locations in close proximity to the underpass, as agreed with the project ecologist and confirmed onsite with OEH.
Comment	The investigation and active consultation with OEH and DPI in relation to this fauna crossing provision fulfils the requirement of Condition B2 of the MCoA.

4.13 Incidental crossing at Chainage 22160

Location:	**C22.18**
Crossing type:	Incidental
SWTC Table 6.2 location(s)	CH 22180
SWTC Table 6.2 Structure form(s)	Box culvert
SWTC Table 6.2 dimensions(s)	1 Cell, 1.5m wide x 1.5m high
Original location vegetation	Moist Floodplain Closed Forest with rainforest elements (NB) Moist Gully Forest (SB)
Watercourse	Class 3
Connectivity value	Very high- in an area of mapped regional corridor linking key habitat.
Proposed location	CH 22170 (same as tender)
Proposed structure	Concrete pipe culvert.
Proposed dimensions	2100mm diameter
New location vegetation	Moist Floodplain Closed Forest with rainforest elements (NB) Moist Gully Forest (SB)
Reason for design change	The culvert has increased in size due to detail design identifying that hydraulic flows would be more significant than identified in the concept design. The highway at this location is to be built on the existing highway. The change from the box culvert to the pipe culvert is to improve constructability, with the pipe culverts to be installed inside the existing culverts.
Engineering	While the culvert is incidental for terrestrial fauna, it is to provide fish passage. To facilitate fish passage, the pipe culverts will be laid at

considerations:	<1% grade and the entry and outlet regrade (or at least the low flow channel) needs to be at <5%. Low flow channel to match existing channel (2m (W) & 0.5m (D)).
Ecological outcome:	Neutral biodiversity outcome.
Fauna exclusion fencing provisions	Fauna fencing is located around the highway formation at this location. Fencing will be located over the top of the headwall of the crossing allowing this culvert to be used by fauna. Drop down structures will be provided in locations in close proximity to the underpass, as agreed with the project ecologist and confirmed onsite with OEH.
Comment	The arrangement for this culvert was discussed onsite with the Project Ecologist and OEH and DPI. The investigation and active consultation with OEH and DPI in relation to this fauna crossing provision fulfils the requirement of Condition B2 of the MCoA.

4.14 Incidental crossing at Chainage 22170

Location:	**C22.19 (former C22.18B)**
Crossing type:	Incidental
SWTC Table 6.2 location(s)	CH 22180
SWTC Table 6.2 Structure form(s)	Box culvert
SWTC Table 6.2 dimensions(s)	1 Cell, 1.5m wide x 1.5m high
Original location vegetation	Moist Floodplain Closed Forest with rainforest elements (NB) Moist Gully Forest (SB)
Watercourse	Class 3
Connectivity value	Very high- in an area of mapped regional corridor linking key habitat.
Proposed location	CH 22170 (same as tender)
Proposed structure	Concrete pipe culvert.
Proposed dimensions	2100mm diameter
New location vegetation	Moist Floodplain Closed Forest with rainforest elements (NB) Moist Gully Forest (SB)
Reason for design change	The culvert has increased in size due to detail design identifying that hydraulic flows would be more significant than identified in the concept design. The highway at this location is to be built on the existing highway. The change from the box culvert to the pipe culvert is to improve constructability, with the pipe culverts to be installed inside the existing culverts.
Engineering considerations:	While the culvert is incidental for terrestrial fauna, it is to provide fish passage. To facilitate fish passage, the pipe culverts will be laid at <1% grade and the entry and outlet regrade (or at least the low flow channel) needs to be at <5%. Low flow channel to match existing channel (2m (W) & 0.5m (D)).
Ecological outcome:	Neutral biodiversity outcome.
Fauna exclusion fencing provisions	Fauna fencing is located around the highway formation at this location. Fencing will be located over the top of the headwall of the crossing allowing this culvert to be used by fauna. Drop down structures will be provided in locations in close proximity to the underpass, as agreed with the project ecologist and confirmed onsite with OEH.

Comment	The arrangement for this culvert was discussed onsite with the Project Ecologist and OEH and DPI. The investigation and active consultation with OEH and DPI in relation to this fauna crossing provision fulfils the requirement of Condition B2 of the MCoA.

4.15 Dedicated crossing at Chainage 22320

Location:	**F22.32**
Crossing type:	Dedicated
SWTC Table 6.2 location(s)	CH 22300
SWTC Table 6.2 Structure form(s)	Box culvert
SWTC Table 6.2 dimensions(s)	1 Cell, 3.6m wide x 3.6m high
Original location vegetation	Moist Gully Forest (NB) Moist Slopes Forest (SB)
Watercourse	N/A
Connectivity value	Very high- in an area of mapped regional corridor
Proposed location	CH 22320
Proposed structure	Unchanged
Proposed dimensions	Unchanged
New location vegetation	Moist Gully Forest (NB) Moist Slopes Forest (SB)
Reason for design change	The move of 20m was to combine two culverts (F22.32A and F22.32B) and reduce the overall length of the fauna passage by around 20 metres.
Engineering considerations:	N/A
Ecological outcome:	Neutral biodiversity outcome.
Fauna exclusion fencing provisions	Fauna fencing is located around the highway formation at this location. Fencing will be located over the top of the headwall of the crossing allowing this culvert to be used by fauna. Rails and refuge poles as originally identified will still be provided Drop down structures will be provided in locations in close proximity to the underpass, as agreed with the project ecologist and confirmed onsite with OEH.
Comment	The investigation and active consultation with OEH and DPI in relation to this fauna crossing provision fulfils the requirement of Condition B2 of the MCoA.

4.16 Combined crossing at Chainage 23060

Location:	**C23.05**
Crossing type:	Combined
SWTC Table 6.2 location(s)	CH 23050
SWTC Table 6.2 Structure form(s)	Box culvert

SWTC Table 6.2 dimensions(s)	1 Cell, 3m wide x 3m high
Original location vegetation	Moist Gully Forest
Watercourse	N/A
Connectivity value	Very high- in an area of mapped regional corridor linking areas of key habitat and mapped climate change corridors.
Proposed location	CH 23060
Proposed structure	Unchanged
Proposed dimensions	Unchanged
New location vegetation	Moist Gully Forest
Reason for design change	Change in location will result in a substantial reduction in length. The movement 10 m north will provide greater dry passage, with a smaller culvert being placed at the original location to provide the main hydraulic function.
Engineering considerations:	The culvert has been relocated to provide dry passage above the 100 ARI flood level to meet both EPBC condition 3 requirements. Culvert length has reduced to about 40m. This has resulted in a substantial reduction in length.
Ecological outcome:	Positive biodiversity outcome.
Fauna exclusion fencing provisions	Fauna fencing is located around the highway formation at this location. Fencing will be located over the top of the headwall of the crossing allowing this culvert to be used by fauna. Rails and refuge poles as originally identified will still be provided Drop down structures will be provided in locations in close proximity to the underpass, as agreed with the project ecologist and confirmed onsite with OEH.
Comment	The arrangement for this culvert was discussed onsite with the Project Ecologist and OEH and DPI. The investigation and active consultation with OEH and DPI in relation to this fauna crossing provision fulfils the requirement of Condition B2 of the MCoA.

5. Conclusion

In accordance with Ministers Condition of Approval B3, the Roads and Maritime Services and the Roads and Maritime Contractor, Lend Lease have undertaken investigations into the fauna crossings design (with respect to the crossing design and locations identified in conditions B1 and B2) in consultation with the EPA, the DPI (Fisheries) and the project ecologist.

Through these investigations and design development, the Roads and Maritime Services and the Roads and Maritime Contractor, Lend Lease have identified opportunities for design refinements to the fauna crossings identified in the documents listed under Ministers Condition of Approval A1(d). As demonstrated by the information provided above, the proposed design refinements to the fauna crossings will provide overall positive environmental outcomes as agreed by the project ecologist, EPA and DPI (Fisheries). The design refinements also provide overall positive outcomes for Roads and Maritime Services and Lend Lease.

In accordance with Ministers Condition of Approval B1, the Roads and Maritime Services and Lend Lease will now seek approval from the Department of Planning and Infrastructure to implement the proposed fauna crossing design refinements.

6. Attachments

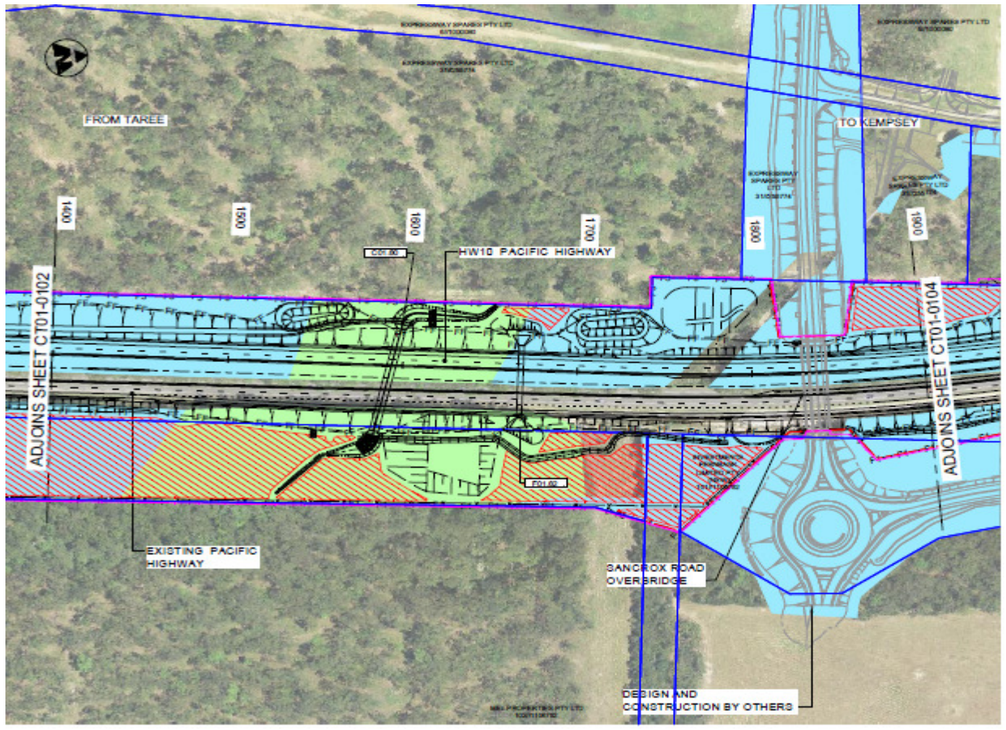
Attachment 1 – Locations of Fauna Crossings

Attachment 2 – Fauna Fencing Locations and General Arrangement drawings.

Attachment 3 - Consultation Records with the EPA and DPI

Attachment 1 – Locations of Fauna Crossings

Culvert CH 1600 and CH 1640



NOTES

1. REFER TO SHEET NUMBER CT01-0005 FOR GENERAL NOTES AND LEGEND.

LEGEND

- PROPOSED PROJECT BOUNDARY
- EXISTING CADASTRE BOUNDARY
- DETAILED DESIGN CLEARING BOUNDARY FOR TOTAL AREA OF NATIVE VEGETATION FOR THE PROJECT WORKS, TEMPORARY WORKS AND CONTRACTORS WORKS 'APP 4 CLAUSE 4.23.1(b)'
- DETAILED DESIGN RETAINED AREA OF NATIVE VEGETATION FOR THE PROJECT WORKS, TEMPORARY WORKS AND CONTRACTOR WORKS, 'APPENDIX 4 CLAUSE 4.23.1(b)'

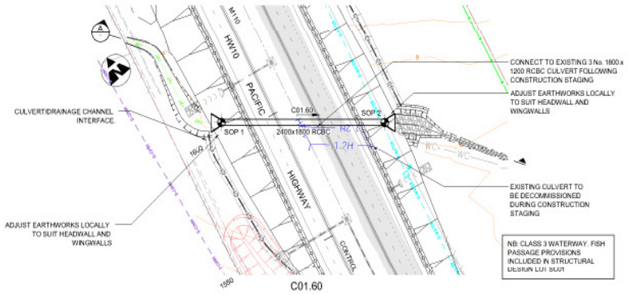
ENVIRONMENTAL FEATURES AND DESIGN

ENDANGERED ECOLOGICAL COMMUNITY
- MOIST FLOODPLAIN CLOSED FOREST WITH RAINFOREST ELEMENTS
- RIPARIAN FOREST
- PAPERBARK SWAMP FOREST
- SWAMP MAHOGANY FOREST RED GUM SWAMP FOREST
- SWAMP OAK FOREST
- WETLAND

ECOLOGICAL COMMUNITY
- MOIST FLOODPLAIN FOREST
- MOIST GULLY FOREST
- MOIST SLOPES FOREST
- DRY RIDGETOP FOREST
- UNIDENTIFIED NATIVE VEGETATION

THREATENED FLORA AND FAUNA
- MAUNDIA POPULATION
- POTENTIAL MAUNDIA POPULATION
- GIANT BARRED FROG HABITAT
- GREEN THIGHED FROG HABITAT
- PROPOSED FROG POND

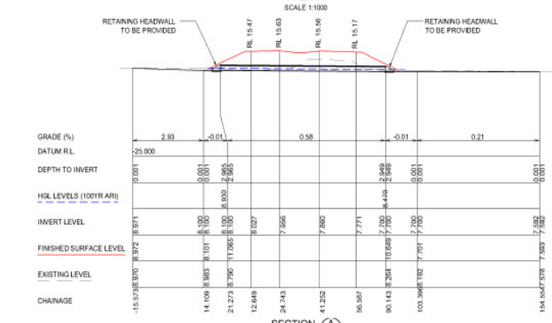
ENVIRONMENTAL INFRASTRUCTURE
- GLIDER POLE
- ROPE BRIDGE AND STAYS



C01.60
PLAN
SCALE 1:1000

NOTES

1. FOR GENERAL NOTES AND LEGEND REFER TO DRAWINGS OH2Ku-SD01-DG-0005 AND OH2Ku-SD01-DG-0010 IN DESIGN LOT SD01.
2. FOR DRAINAGE STANDARD DETAILS REFER TO DRAWINGS OH2Ku-SD01-DG-0011 TO OH2Ku-SD01-DG-0051 IN DESIGN LOT SD01.
3. ALL CROSS DRAINAGE DRAWINGS TO BE READ IN CONJUNCTION WITH THE DRAINAGE GENERAL ARRANGEMENT PLAN DRAWINGS IN DESIGN LOT DL01.
4. FOR CULVERT SCHEDULE REFER TO DRAWING OH2Ku-DC01-DG-0010.
5. FOR CATCH DRAIN DETAILS REFER TO THE DRAINAGE GENERAL ARRANGEMENT PLAN DRAWINGS IN DESIGN LOT DL01.
6. ALL CROSS DRAINAGE DRAWINGS TO BE READ IN CONJUNCTION WITH THE UTILITIES DRAWINGS IN DESIGN LOT UT01.
7. FOR RIP RAP SCOUR PROTECTION TYPICAL DETAILS REFER TO DRAWINGS OH2Ku-SD01-DG-0018 TO OH2Ku-SD01-DG-0022 IN DESIGN LOT SD01.
8. FOR RIP RAP SCOUR PROTECTION DIMENSIONS REFER TO RIP RAP BASINS AND APRONS SCHEDULE IN DRAWING OH2Ku-DC01-DG-0011.
9. FOR INLET EARTHWORKS TYPICAL DETAILS REFER TO DRAWING OH2Ku-SD01-DG-0016.
10. FOR CULVERT AND HEADWALL MATERIAL GRADE (CLASS 'B1' OR 'B2 / MARINE') REFER TO CULVERT SCHEDULE ON DRAWING OH2Ku-DC01-DG-0010.
11. THE DIGITAL DESIGN DRAINAGE MODEL VERSION SHOWN ON THE PLANS IS TO BE USED FOR THE SETOUT OF CULVERT INLET AND OUTLET EARTHWORKS.



CULVERT SETOUT DETAILS

SETOUT POINT	EASTING	NORTHING	LEVEL (RL)
SOP1	483196.75	6520682.88	8.100
SOP2	483250.59	6520639.94	7.700

CULVERT END STRUCTURE DETAILS

SETOUT POINT	STRUCTURE TYPE	REFERENCE
SOP1	3600W x 1200H RCBC HEADWALL	DRAWING NO. OH2Ku-DC01-DG-0061
SOP2	3600W x 1200H RCBC HEADWALL	DRAWING NO. OH2Ku-DC01-DG-0061

NOT FOR CONSTRUCTION

ROADS AND MARITIME SERVICES

HW10 - PACIFIC HIGHWAY
OXLEY HIGHWAY TO KUNDABUNG UPGRADE
DC01 - COMBINED AND DRAINAGE CULVERTS - ZONE 1
C01.60

DRAWING	STAGE	VOL	ISSUE
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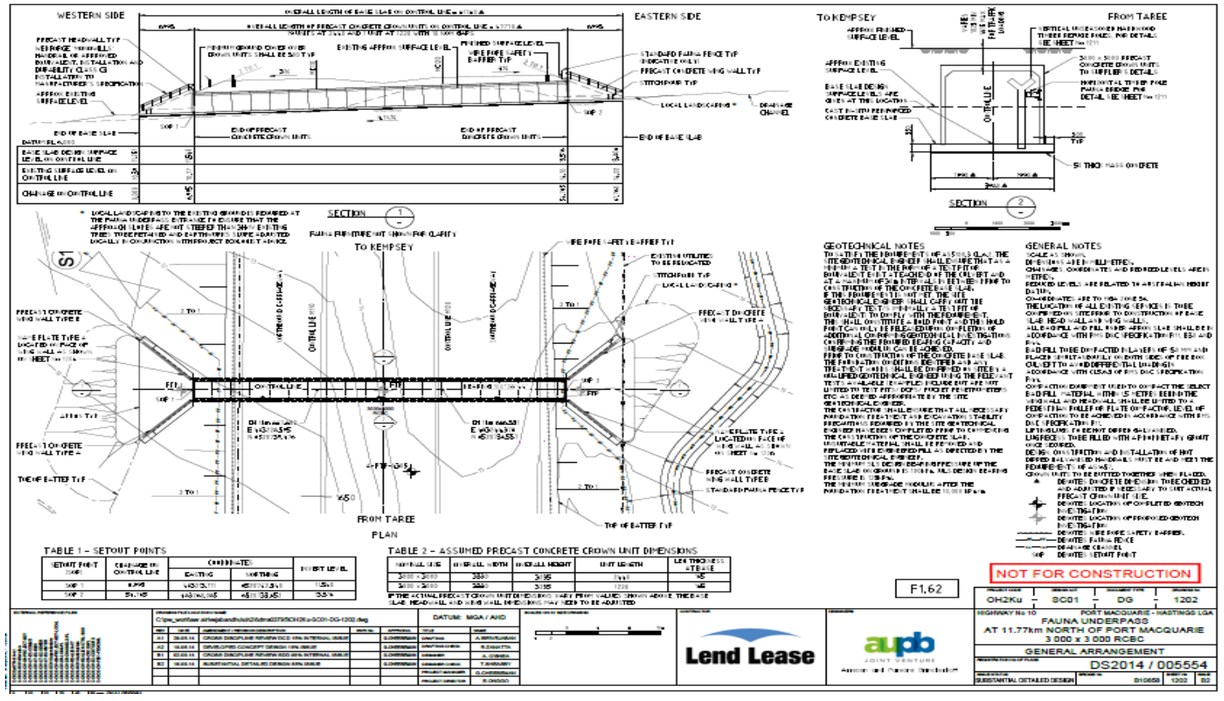
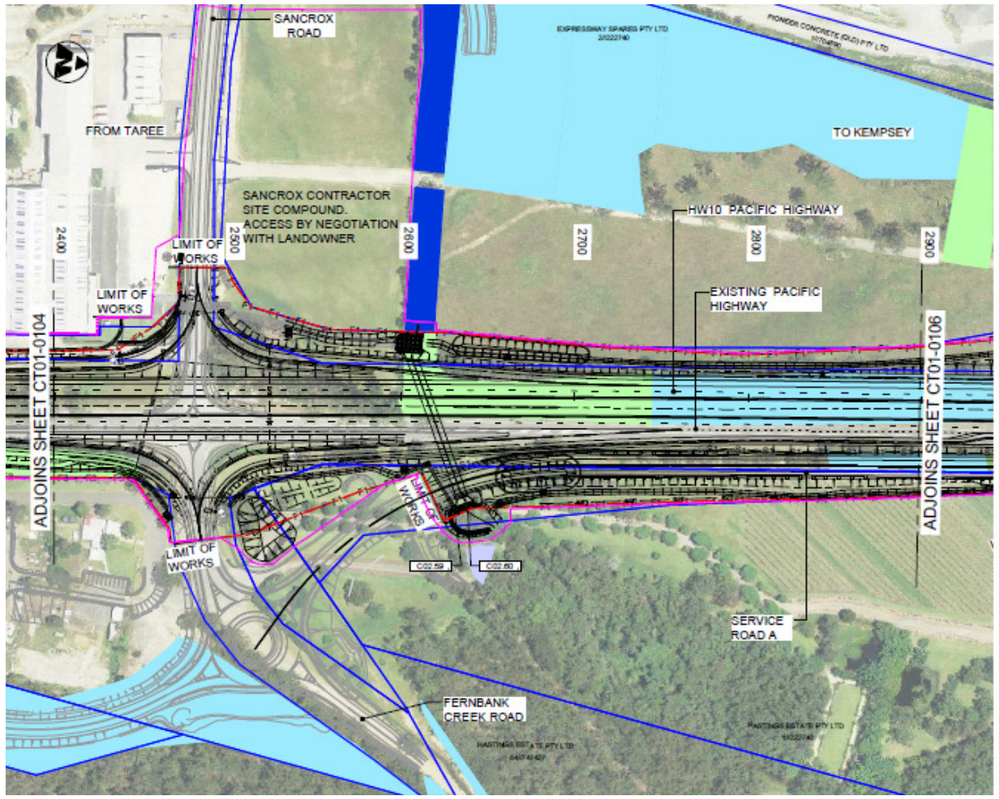
REGISTRATION NUMBER: DS2014/000456
SHEET No.: DC01-0110



Culvert CH 2600



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ENVIRONMENTAL FEATURES AND DESIGN

ENDANGERED ECOLOGICAL COMMUNITY

- MOIST FLOODPLAIN CLOSED FOREST WITH RAINFOREST ELEMENTS
- RIPARIAN FOREST
- PAPERBARK SWAMP FOREST
- SWAMP MAHOGANY FOREST RED GUM SWAMP FOREST
- SWAMP OAK FOREST
- WETLAND

ECOLOGICAL COMMUNITY

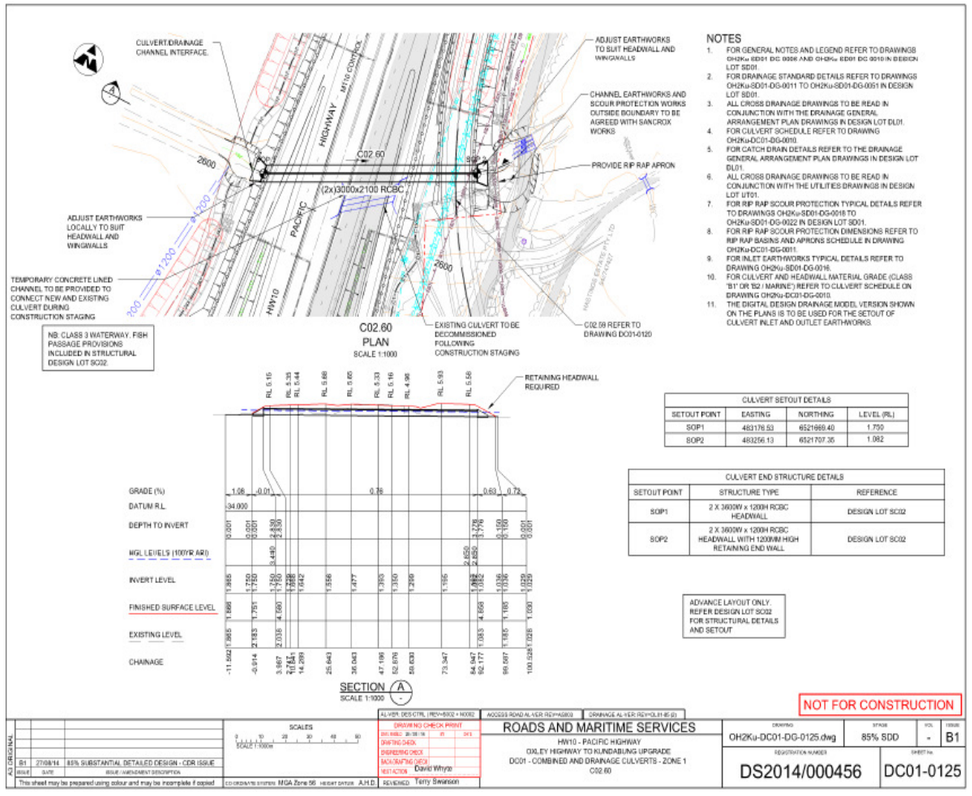
- MOIST FLOODPLAIN FOREST
- MOIST GULLY FOREST
- MOIST SLOPES FOREST
- DRY RIDGETOP FOREST
- UNIDENTIFIED NATIVE VEGETATION

THREATENED FLORA AND FAUNA

- MAUNDIA POPULATION
- POTENTIAL MAUNDIA POPULATION
- GIANT BARRED FROG HABITAT
- GREEN THIGHED FROG HABITAT
- PROPOSED FROG POND

ENVIRONMENTAL INFRASTRUCTURE

- GLIDER POLE
- ROPE BRIDGE AND STAYS



NOTES

1. FOR GENERAL NOTES AND LEGEND REFER TO DRAWINGS OH2Ku-SD01 DIC 0006 AND OH2Ku-SD01 DIC 0010 IN DESIGN LOT SD01
2. FOR DRAINAGE STANDARD DETAILS REFER TO DRAWINGS OH2Ku-SD01-DG-0011 TO OH2Ku-SD01-DG-0051 IN DESIGN LOT SD01
3. ALL CROSS DRAINAGE DRAWINGS TO BE READ IN CONJUNCTION WITH THE DRAINAGE GENERAL ARRANGEMENT PLAN DRAWINGS IN DESIGN LOT DL01.
4. FOR CULVERT SCHEDULE REFER TO DRAWING OH2Ku-DC01-DG-0010.
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6. ALL CROSS DRAINAGE DRAWINGS TO BE READ IN CONJUNCTION WITH THE UTILITIES DRAWINGS IN DESIGN LOT UT01.
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9. FOR INLET EARTHWORKS TYPICAL DETAILS REFER TO DRAWING OH2Ku-SD01-DG-0016.
10. FOR CULVERT AND HEADWALL MATERIAL GRADE (CLASS 'B1' OR 'B2 / MARINE') REFER TO CULVERT SCHEDULE ON DRAWING OH2Ku-DC01-DG-0010.
11. THE DIGITAL DESIGN DRAINAGE MODEL VERSION SHOWN ON THE PLANS IS TO BE USED FOR THE SETOUT OF CULVERT INLET AND OUTLET EARTHWORKS.

CULVERT SETOUT DETAILS

SETOUT POINT	EASTING	NORTHING	LEVEL (RL)
SOP1	483176.53	6521669.40	1.750
SOP2	483256.13	6521707.35	1.082

CULVERT END STRUCTURE DETAILS

SETOUT POINT	STRUCTURE TYPE	REFERENCE
SOP1	2 X 3600W x 1200H RCBC HEADWALL	DESIGN LOT SC02
SOP2	2 X 3600W x 1200H RCBC HEADWALL WITH 1200MM HIGH RETAINING END WALL	DESIGN LOT SC02

ADVANCE LAYOUT ONLY. REFER DESIGN LOT SC02 FOR STRUCTURAL DETAILS AND SETOUT

NOT FOR CONSTRUCTION

B1	27/08/14	85% SUBSTANTIAL DETAILED DESIGN - CDR ISSUE	
ISSUE	DATE	ISSUE / AMENDMENT DESCRIPTION	

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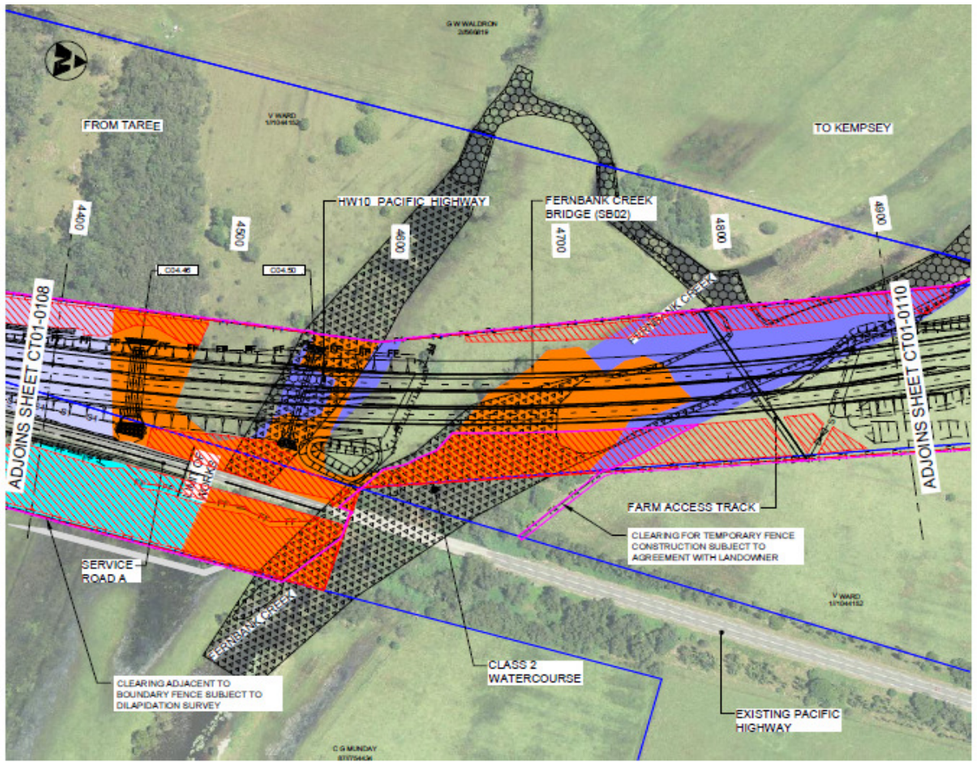
SCALES: SCALE 1:1000m

ROADS AND MARITIME SERVICES

HW10 - PACIFIC HIGHWAY
OXLEY HIGHWAY TO KUNDABUNG UPGRADE
DC01 - COMBINED AND DRAINAGE CULVERTS - ZONE 1
C02.60

DRAWING: OH2Ku-DC01-DG-0125.dwg | STAGE: 85% SDD | VOL: - | ISSUE: B1
REGISTRATION NUMBER: DS2014/000456 | SHEET No: DC01-0125

Culvert CH 4460 and 4540



NOTES

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LEGEND

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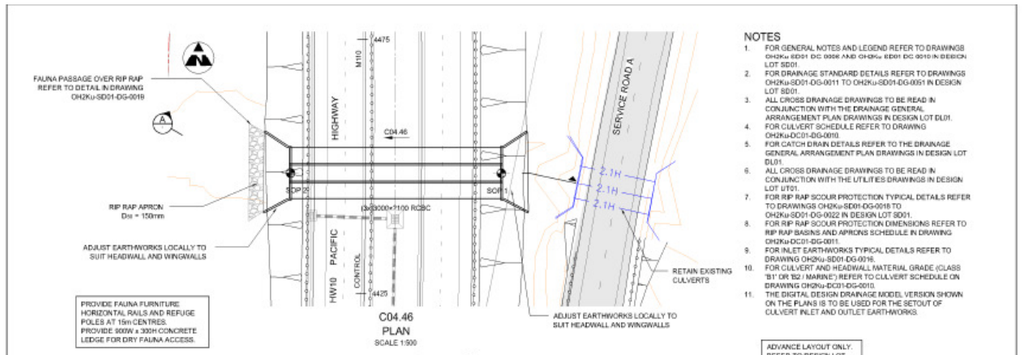
ENVIRONMENTAL FEATURES AND DESIGN

ENDANGERED ECOLOGICAL COMMUNITY
- MOIST FLOODPLAIN CLOSED FOREST WITH RAINFOREST ELEMENTS
- RIPARIAN FOREST
- PAPERBARK SWAMP FOREST
- SWAMP MAHOGANY FOREST RED GUM SWAMP FOREST
- SWAMP OAK FOREST
- WETLAND

ECOLOGICAL COMMUNITY
- MOIST FLOODPLAIN FOREST
- MOIST GULLY FOREST
- MOIST SLOPES FOREST
- DRY RIDGETOP FOREST
- UNIDENTIFIED NATIVE VEGETATION

THREATENED FLORA AND FAUNA
- MAUNDIA POPULATION
- POTENTIAL MAUNDIA POPULATION
- GIANT BARRED FROG HABITAT
- GREEN THIGHED FROG HABITAT
- PROPOSED FROG POND

ENVIRONMENTAL INFRASTRUCTURE
- GLIDER POLE
- ROPE BRIDGE AND STAYS



NOTES

1. FOR GENERAL NOTES AND LEGEND REFER TO DRAWINGS OH2Ku SD01 DC 0006 AND OH2Ku SD01 DC 0010 IN DESIGN LOT SD01.
2. FOR DRAINAGE STANDARD DETAILS REFER TO DRAWINGS OH2Ku-SD01-DG-0011 TO OH2Ku-SD01-DG-0051 IN DESIGN LOT SD01.
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8. FOR RIP RAP SCOUR PROTECTION DIMENSIONS REFER TO RIP RAP BASINS AND APRONS SCHEDULE IN DRAWING OH2Ku-DC01-DG-0011.
9. FOR INLET EARTHWORKS TYPICAL DETAILS REFER TO DRAWING OH2Ku-SD01-DG-0016.
10. FOR CULVERT AND HEADWALL MATERIAL GRADE (CLASS 'B1' OR 'B2 / MARINE') REFER TO CULVERT SCHEDULE ON DRAWING OH2Ku-DC01-DG-0010.
11. THE DIGITAL DESIGN DRAINAGE MODEL VERSION SHOWN ON THE PLANS IS TO BE USED FOR THE SETOUT OF CULVERT INLET AND OUTLET EARTHWORKS.

ADVANCE LAYOUT ONLY. REFER TO DESIGN LOT SC02 FOR STRUCTURAL DETAILS AND SETOUT

CULVERT SETOUT DETAILS

SETOUT POINT	EASTING	NORTHING	LEVEL (RL)
SOP1	483257.55	6523902.45	0.950
SOP2	483215.91	6523902.55	0.890

CULVERT END STRUCTURE DETAILS

SETOUT POINT	STRUCTURE TYPE	REFERENCE
SOP1	3 X 3000W X 2100H RCBC HEADWALL	DESIGN LOT SC02
SOP2	3 X 3000W X 2100H RCBC HEADWALL	DESIGN LOT SC02

NOT FOR CONSTRUCTION

ROADS AND MARITIME SERVICES

HW10 - PACIFIC HIGHWAY
OXLEY HIGHWAY TO KUNDABUNG UPGRADE
DC01 - COMBINED AND DRAINAGE CULVERTS - ZONE 1
C04.46

DRAWING	STAGE	VOL	ISSUE
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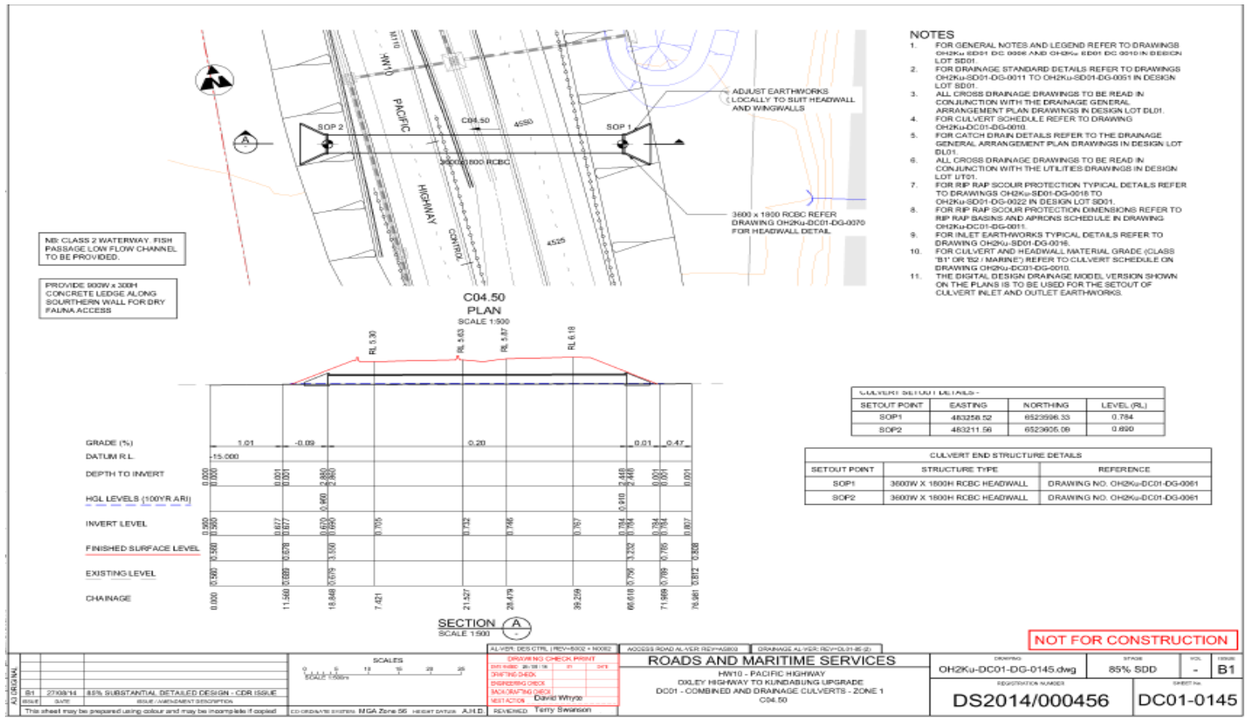
REGISTRATION NUMBER: DS2014/000456 | SHEET No: DC01-0140



NOTES

1. FOR GENERAL NOTES AND LEGEND REFER TO DRAWINGS OH2Ku SD01 DC 0006 AND OH2Ku SD01 DC 0010 IN DESIGN LOT SD01.
2. FOR DRAINAGE STANDARD DETAILS REFER TO DRAWINGS OH2Ku-SD01-DG-0011 TO OH2Ku-SD01-DG-0051 IN DESIGN LOT SD01.
3. ALL CROSS DRAINAGE DRAWINGS TO BE READ IN CONJUNCTION WITH THE DRAINAGE GENERAL ARRANGEMENT PLAN DRAWINGS IN DESIGN LOT DL01.
4. FOR CULVERT SCHEDULE REFER TO DRAWING OH2Ku-DC01-DG-0010.
5. FOR CATCH DRAIN DETAILS REFER TO THE DRAINAGE GENERAL ARRANGEMENT PLAN DRAWINGS IN DESIGN LOT DL01.
6. ALL CROSS DRAINAGE DRAWINGS TO BE READ IN CONJUNCTION WITH THE UTILITIES DRAWINGS IN DESIGN LOT UT01.
7. FOR RIP RAP SCOUR PROTECTION TYPICAL DETAILS REFER TO DRAWINGS OH2Ku-SD01-DG-0016 TO OH2Ku-SD01-DG-0022 IN DESIGN LOT SD01.
8. FOR RIP RAP SCOUR PROTECTION DIMENSIONS REFER TO RIP RAP BASINS AND APRONS SCHEDULE IN DRAWING OH2Ku-DC01-DG-0011.
9. FOR INLET EARTHWORKS TYPICAL DETAILS REFER TO DRAWING OH2Ku-SD01-DG-0016.
10. FOR CULVERT AND HEADWALL MATERIAL GRADE (CLASS 'B1' OR 'B2 / MARINE') REFER TO CULVERT SCHEDULE ON DRAWING OH2Ku-DC01-DG-0010.
11. THE DIGITAL DESIGN DRAINAGE MODEL VERSION SHOWN ON THE PLANS IS TO BE USED FOR THE SETOUT OF CULVERT INLET AND OUTLET EARTHWORKS.

CULVERT SETOUT DETAILS -

SETOUT POINT	EASTING	NORTHING	LEVEL (RL)
SOP1	483258.52	6523996.33	0.784
SOP2	483211.56	6523905.09	0.690

CULVERT END STRUCTURE DETAILS

SETOUT POINT	STRUCTURE TYPE	REFERENCE
SOP1	3600W X 1800H RCBC HEADWALL	DRAWING NO. OH2Ku-DC01-DG-0061
SOP2	3600W X 1800H RCBC HEADWALL	DRAWING NO. OH2Ku-DC01-DG-0061

NOT FOR CONSTRUCTION

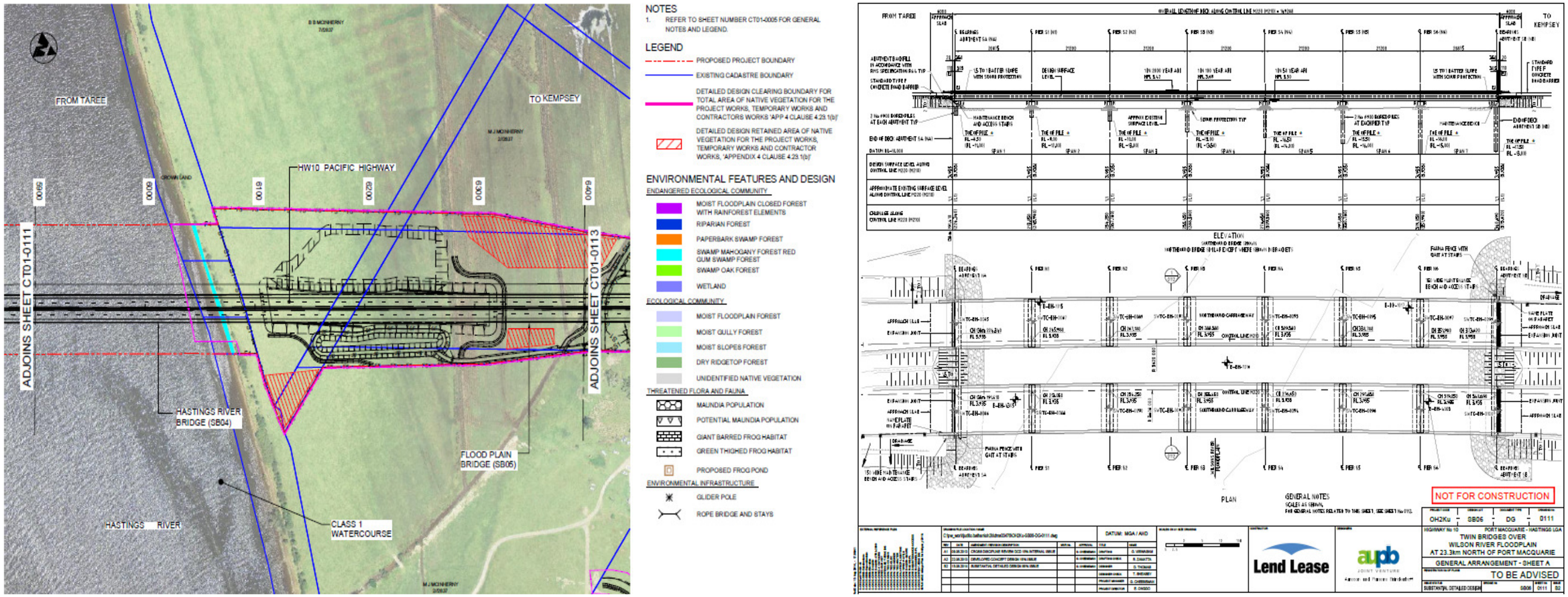
ROADS AND MARITIME SERVICES

HW10 - PACIFIC HIGHWAY
OXLEY HIGHWAY TO KUNDABUNG UPGRADE
DC01 - COMBINED AND DRAINAGE CULVERTS - ZONE 1
C04.50

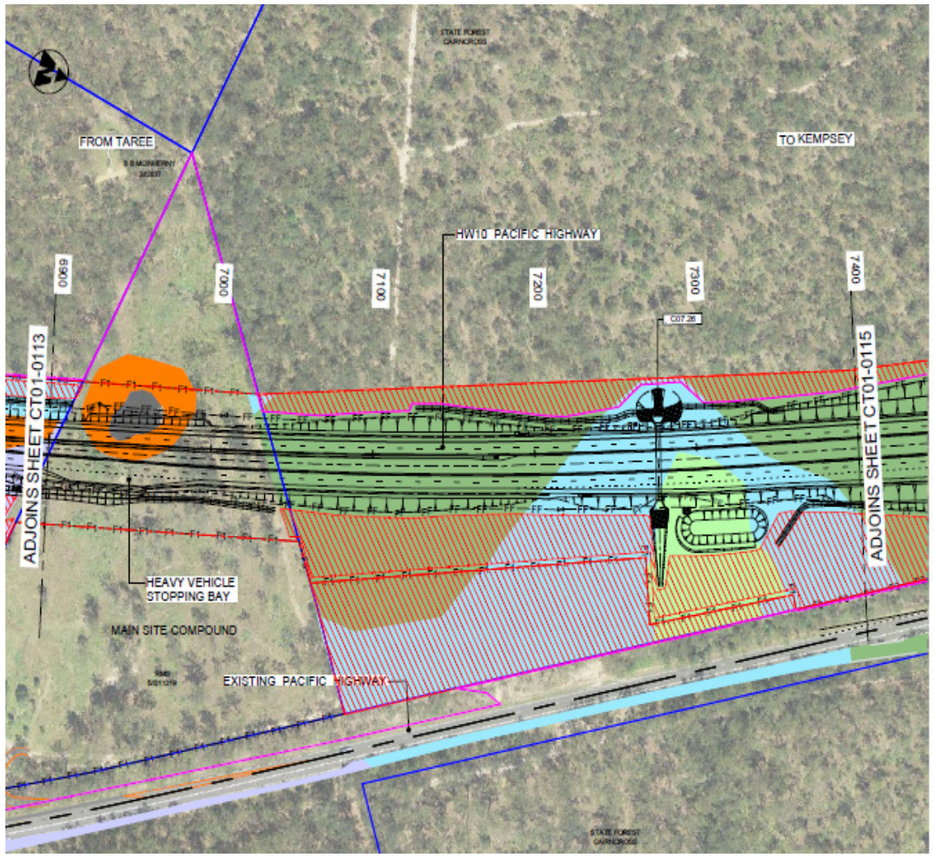
DRAWING	STAGE	VOL	ISSUE
OH2Ku-DC01-DG-0145.dwg	85% SDD	-	B1

REGISTRATION NUMBER: DS2014/000456 | SHEET No: DC01-0145

Culvert CH 6330



Culvert CH 7260



NOTES

1. REFER TO SHEET NUMBER CT01-0005 FOR GENERAL NOTES AND LEGEND.

LEGEND

- PROPOSED PROJECT BOUNDARY
- EXISTING CADASTRE BOUNDARY
- DETAILED DESIGN CLEARING BOUNDARY FOR TOTAL AREA OF NATIVE VEGETATION FOR THE PROJECT WORKS, TEMPORARY WORKS AND CONTRACTORS WORKS 'APP 4 CLAUSE 4.23.1(b)'
- DETAILED DESIGN RETAINED AREA OF NATIVE VEGETATION FOR THE PROJECT WORKS, TEMPORARY WORKS AND CONTRACTOR WORKS, 'APPENDIX 4 CLAUSE 4.23.1(b)'

ENVIRONMENTAL FEATURES AND DESIGN

ENDANGERED ECOLOGICAL COMMUNITY

- MOIST FLOODPLAIN CLOSED FOREST WITH RAINFOREST ELEMENTS
- RIPARIAN FOREST
- PAPERBARK SWAMP FOREST
- SWAMP MAHOGANY FOREST RED GUM SWAMP FOREST
- SWAMP OAK FOREST
- WETLAND

ECOLOGICAL COMMUNITY

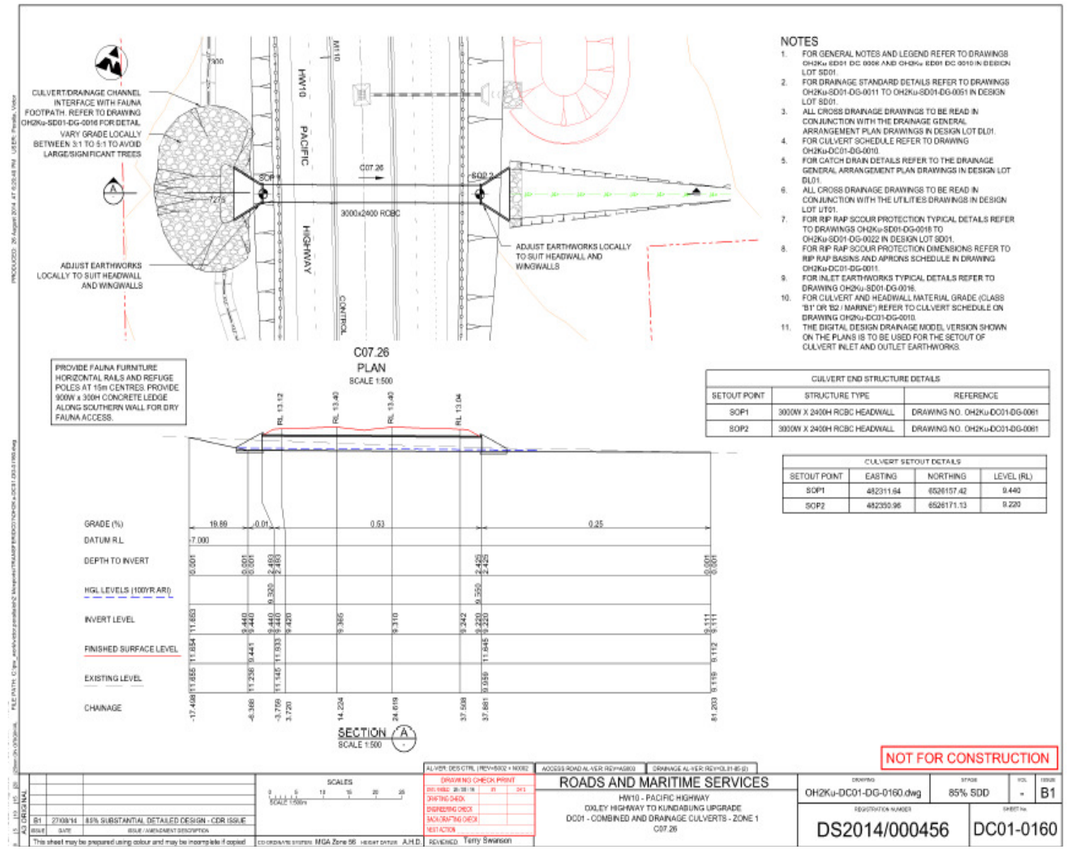
- MOIST FLOODPLAIN FOREST
- MOIST GULLY FOREST
- MOIST SLOPES FOREST
- DRY RIDGETOP FOREST
- UNIDENTIFIED NATIVE VEGETATION

THREATENED FLORA AND FAUNA

- MALINDIA POPULATION
- POTENTIAL MALINDIA POPULATION
- GIANT BARRED FROG HABITAT
- GREEN THIGHED FROG HABITAT
- PROPOSED FROG POND

ENVIRONMENTAL INFRASTRUCTURE

- GLIDER POLE
- ROPE BRIDGE AND STAYS



NOTES

1. FOR GENERAL NOTES AND LEGEND REFER TO DRAWINGS OH2Ku-SD01-DG-0006 AND OH2Ku-SD01-DG-0010 IN DESIGN LOT SD01.
2. FOR DRAINAGE STANDARD DETAILS REFER TO DRAWINGS OH2Ku-SD01-DG-0011 TO OH2Ku-SD01-DG-0051 IN DESIGN LOT SD01.
3. ALL CROSS DRAINAGE DRAWINGS TO BE READ IN CONJUNCTION WITH THE DRAINAGE GENERAL ARRANGEMENT PLAN DRAWINGS IN DESIGN LOT DL01.
4. FOR CULVERT SCHEDULE REFER TO DRAWING OH2Ku-DC01-DG-0010.
5. FOR CATCH DRAIN DETAILS REFER TO THE DRAINAGE GENERAL ARRANGEMENT PLAN DRAWINGS IN DESIGN LOT DL01.
6. ALL CROSS DRAINAGE DRAWINGS TO BE READ IN CONJUNCTION WITH THE UTILITIES DRAWINGS IN DESIGN LOT UT01.
7. FOR RIP RAP SCOUR PROTECTION TYPICAL DETAILS REFER TO DRAWINGS OH2Ku-SD01-DG-0016 TO OH2Ku-SD01-DG-0022 IN DESIGN LOT SD01.
8. FOR RIP RAP SCOUR PROTECTION DIMENSIONS REFER TO RIP RAP BASINS AND APRONS SCHEDULE IN DRAWING OH2Ku-DC01-DG-0011.
9. FOR INLET EARTHWORKS TYPICAL DETAILS REFER TO DRAWING OH2Ku-SD01-DG-0016.
10. FOR CULVERT AND HEADWALL MATERIAL GRADE (CLASS 'B1' OR 'B2 / MARINE') REFER TO CULVERT SCHEDULE ON DRAWING OH2Ku-DC01-DG-0010.
11. THE DIGITAL DESIGN DRAINAGE MODEL VERSION SHOWN ON THE PLANS IS TO BE USED FOR THE SETOUT OF CULVERT INLET AND OUTLET EARTHWORKS.

CULVERT END STRUCTURE DETAILS

SETOUT POINT	STRUCTURE TYPE	REFERENCE
SOP1	3000W X 2400H RCBC HEADWALL	DRAWING NO. OH2Ku-DC01-DG-0061
SOP2	3000W X 2400H RCBC HEADWALL	DRAWING NO. OH2Ku-DC01-DG-0061

CULVERT SETOUT DETAILS

SETOUT POINT	EASTING	NORTHING	LEVEL (RL)
SOP1	482311.64	6526157.42	9.440
SOP2	482350.96	6526171.13	9.220

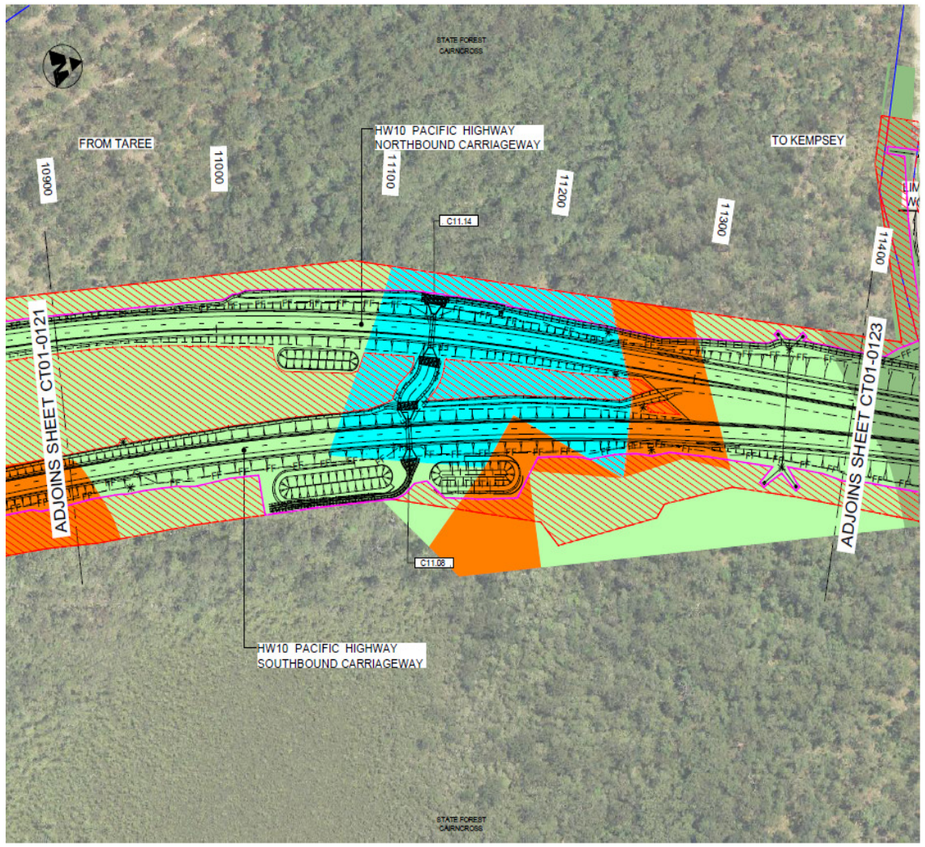
NOT FOR CONSTRUCTION

ROADS AND MARITIME SERVICES

HW10 - PACIFIC HIGHWAY
OXLEY HIGHWAY TO KUNDABUNG UPGRADE
DC01 - COMBINED AND DRAINAGE CULVERTS - ZONE 1
C07.26

DRAWING: OH2Ku-DC01-DG-0160.dwg | STAGE: 85% SDD | VOL: - | ISSUE: B1
REGISTRATION NUMBER: DS2014/000456 | SHEET No: DC01-0160

Culvert CH 11090



NOTES
1. REFER TO SHEET NUMBER CT01-0005 FOR GENERAL NOTES AND LEGEND.

LEGEND
- PROPOSED PROJECT BOUNDARY
- EXISTING CADASTRE BOUNDARY
- DETAILED DESIGN CLEARING BOUNDARY FOR TOTAL AREA OF NATIVE VEGETATION FOR THE PROJECT WORKS, TEMPORARY WORKS AND CONTRACTORS WORKS `APP 4 CLAUSE 4.23.1(b)'
- DETAILED DESIGN RETAINED AREA OF NATIVE VEGETATION FOR THE PROJECT WORKS, TEMPORARY WORKS AND CONTRACTOR WORKS, `APPENDIX 4 CLAUSE 4.23.1(b)'

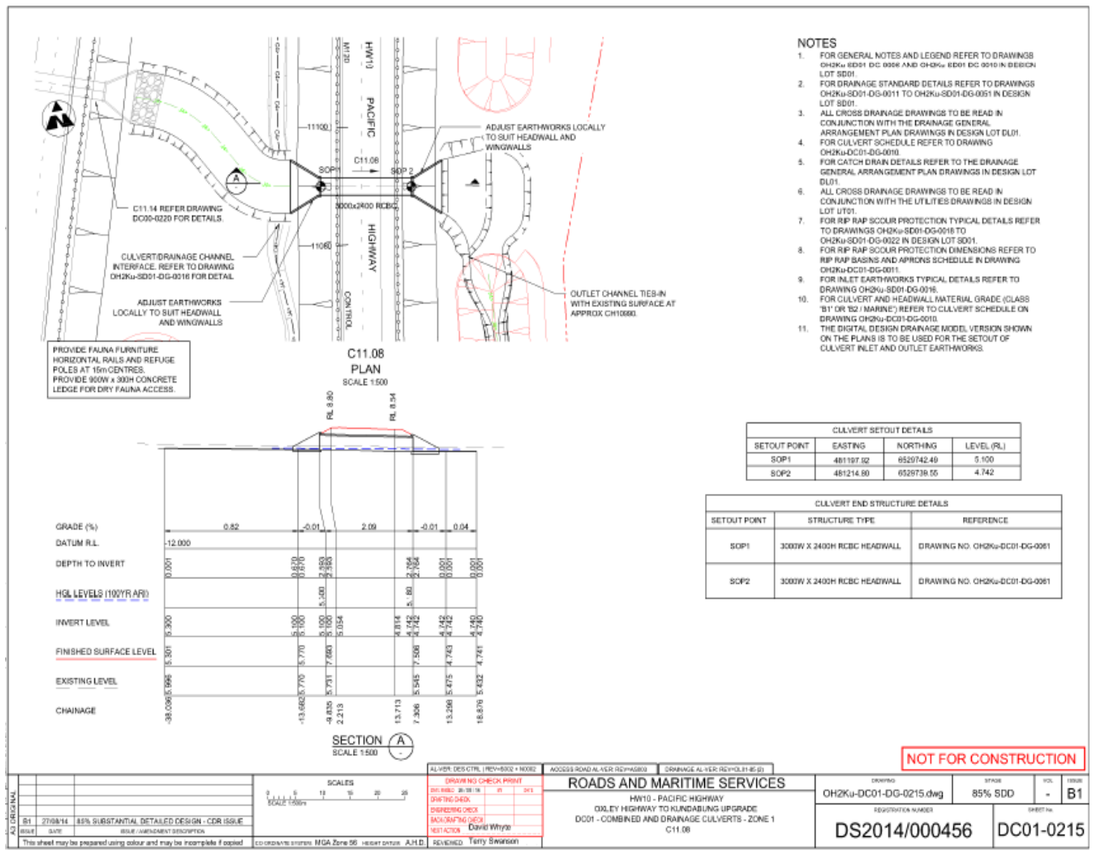
ENVIRONMENTAL FEATURES AND DESIGN

ENDANGERED ECOLOGICAL COMMUNITY
- MOIST FLOODPLAIN CLOSED FOREST WITH RAINFOREST ELEMENTS
- RIPARIAN FOREST
- PAPERBARK SWAMP FOREST
- SWAMP MAHOGANY FOREST RED GUM SWAMP FOREST
- SWAMP OAK FOREST
- WETLAND

ECOLOGICAL COMMUNITY
- MOIST FLOODPLAIN FOREST
- MOIST GULLY FOREST
- MOIST SLOPES FOREST
- DRY RIDGETOP FOREST
- UNIDENTIFIED NATIVE VEGETATION

THREATENED FLORA AND FAUNA
- MAUNDIA POPULATION
- POTENTIAL MAUNDIA POPULATION
- GIANT BARRED FROG HABITAT
- GREEN THIGHED FROG HABITAT
- PROPOSED FROG POND

ENVIRONMENTAL INFRASTRUCTURE
- GLIDER POLE
- ROPE BRIDGE AND STAYS



NOTES
1. FOR GENERAL NOTES AND LEGEND REFER TO DRAWINGS OH2Ku SD01 DC 0006 AND OH2Ku SD01 DC 0010 IN DESIGN LOT SD01.
2. FOR DRAINAGE STANDARD DETAILS REFER TO DRAWINGS OH2Ku-SD01-DG-0011 TO OH2Ku-SD01-DG-0051 IN DESIGN LOT SD01.
3. ALL CROSS DRAINAGE DRAWINGS TO BE READ IN CONJUNCTION WITH THE DRAINAGE GENERAL ARRANGEMENT PLAN DRAWINGS IN DESIGN LOT DL01.
4. FOR CULVERT SCHEDULE REFER TO DRAWING OH2Ku-DC01-DG-0010.
5. FOR CATCH DRAIN DETAILS REFER TO THE DRAINAGE GENERAL ARRANGEMENT PLAN DRAWINGS IN DESIGN LOT DL01.
6. ALL CROSS DRAINAGE DRAWINGS TO BE READ IN CONJUNCTION WITH THE UTILITIES DRAWINGS IN DESIGN LOT UT01.
7. FOR RIP RAP SCOUR PROTECTION TYPICAL DETAILS REFER TO DRAWINGS OH2Ku-SD01-DG-0018 TO OH2Ku-SD01-DG-0022 IN DESIGN LOT SD01.
8. FOR RIP RAP SCOUR PROTECTION DIMENSIONS REFER TO RIP RAP BASINS AND APRONS SCHEDULE IN DRAWING OH2Ku-DC01-DG-0011.
9. FOR INLET EARTHWORKS TYPICAL DETAILS REFER TO DRAWING OH2Ku-SD01-DG-0016.
10. FOR CULVERT AND HEADWALL MATERIAL GRADE (CLASS 'B1' OR 'B2 / MARINE') REFER TO CULVERT SCHEDULE ON DRAWING OH2Ku-DC01-DG-0010.
11. THE DIGITAL DESIGN DRAINAGE MODEL VERSION SHOWN ON THE PLANS IS TO BE USED FOR THE SETOUT OF CULVERT INLET AND OUTLET EARTHWORKS.

CULVERT SETOUT DETAILS

SETOUT POINT	EASTING	NORTHING	LEVEL (RL)
SOP1	481197.92	6529742.49	5.100
SOP2	481214.80	6529739.55	4.742

CULVERT END STRUCTURE DETAILS

SETOUT POINT	STRUCTURE TYPE	REFERENCE
SOP1	3000W X 2400H RCBC HEADWALL	DRAWING NO. OH2Ku-DC01-DG-0061
SOP2	3000W X 2400H RCBC HEADWALL	DRAWING NO. OH2Ku-DC01-DG-0061

NOT FOR CONSTRUCTION

B1	27/08/14	85% SUBSTANTIAL DETAILED DESIGN - CDR ISSUE	
ISSUE	DATE	ISSUE / AMENDMENT DESCRIPTION	

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SCALES

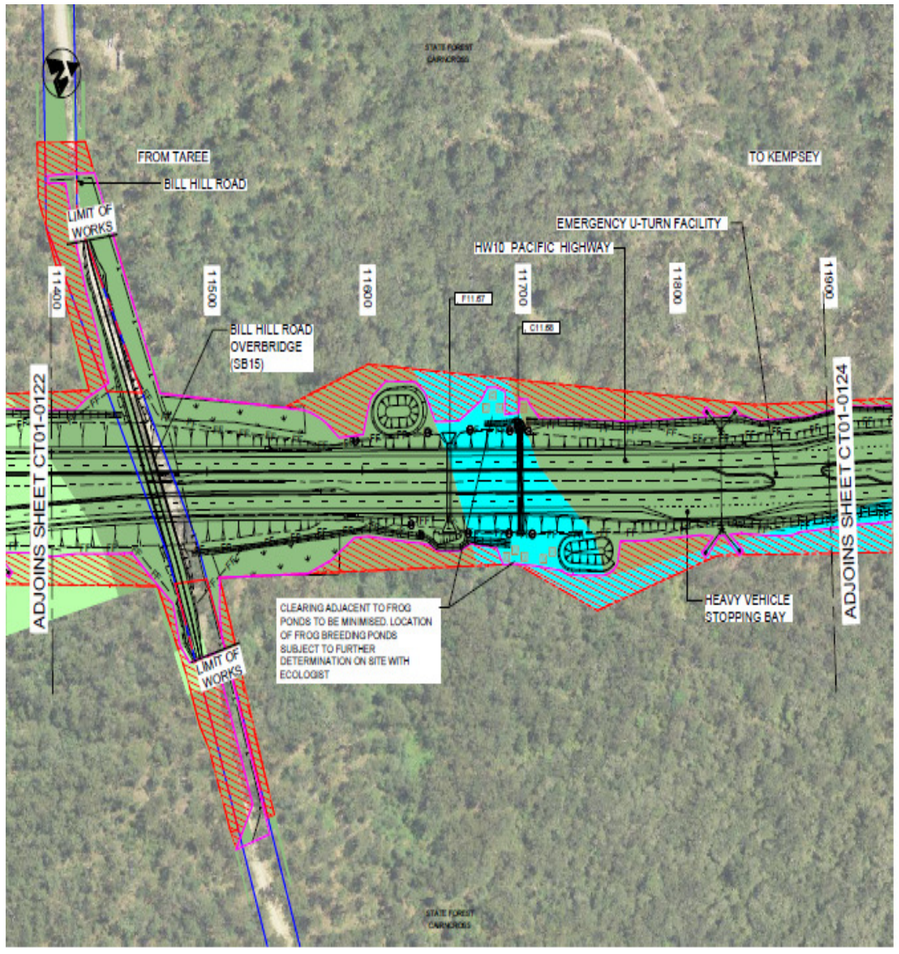
DRAWN NO CHECK PRINT
DRAWING CHECK
ENGINEERING CHECK
BACKSHEETING CHECK
VERIFICATION David Whyte
REVIEWED Terry Swanson

ROADS AND MARITIME SERVICES

HW10 - PACIFIC HIGHWAY
OXLEY HIGHWAY TO KUNDABUNG UPGRADE
DC01 - COMBINED AND DRAINAGE CULVERTS - ZONE 1
C11.08

DRAWING	STAGE	VOL	ISSUE
OH2Ku-DC01-DG-0215.dwg	85% SDD	-	B1
REGISTRATION NUMBER	SHEET No		
DS2014/000456	DC01-0215		

Culvert CH 11660



NOTES

1. REFER TO SHEET NUMBER CT01-0005 FOR GENERAL NOTES AND LEGEND.

LEGEND

- PROPOSED PROJECT BOUNDARY
- EXISTING CADASTRE BOUNDARY
- DETAILED DESIGN CLEARING BOUNDARY FOR TOTAL AREA OF NATIVE VEGETATION FOR THE PROJECT WORKS, TEMPORARY WORKS AND CONTRACTORS WORKS 'APP 4 CLAUSE 4.23.1(b)'
- DETAILED DESIGN RETAINED AREA OF NATIVE VEGETATION FOR THE PROJECT WORKS, TEMPORARY WORKS AND CONTRACTOR WORKS, 'APPENDIX 4 CLAUSE 4.23.1(b)'

ENVIRONMENTAL FEATURES AND DESIGN

ENDANGERED ECOLOGICAL COMMUNITY

- MOIST FLOODPLAIN CLOSED FOREST WITH RAINFOREST ELEMENTS
- RIPARIAN FOREST
- PAPERBARK SWAMP FOREST
- SWAMP MAHOGANY FOREST RED GUM SWAMP FOREST
- SWAMP OAK FOREST
- WETLAND

ECOLOGICAL COMMUNITY

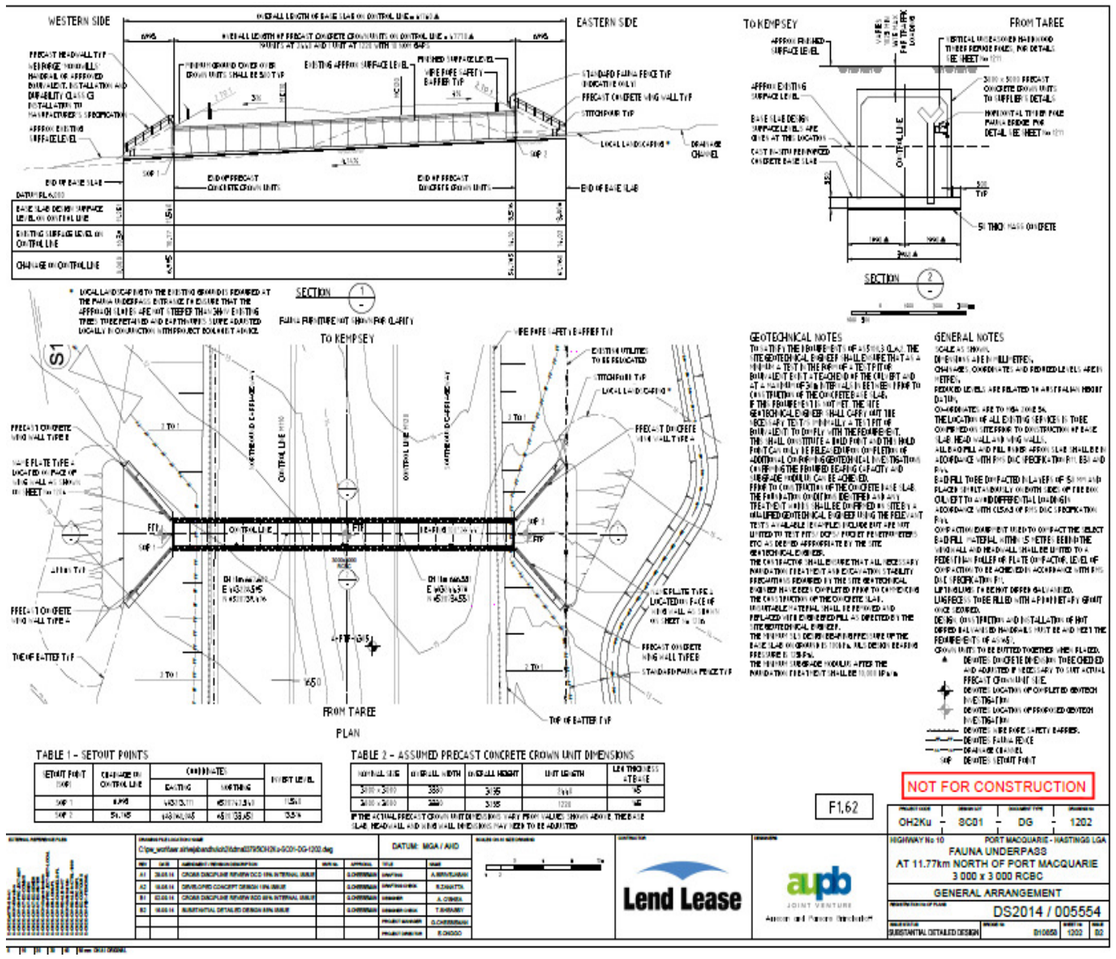
- MOIST FLOODPLAIN FOREST
- MOIST GULLY FOREST
- MOIST SLOPES FOREST
- DRY RIDGETOP FOREST
- UNIDENTIFIED NATIVE VEGETATION

THREATENED FLORA AND FAUNA

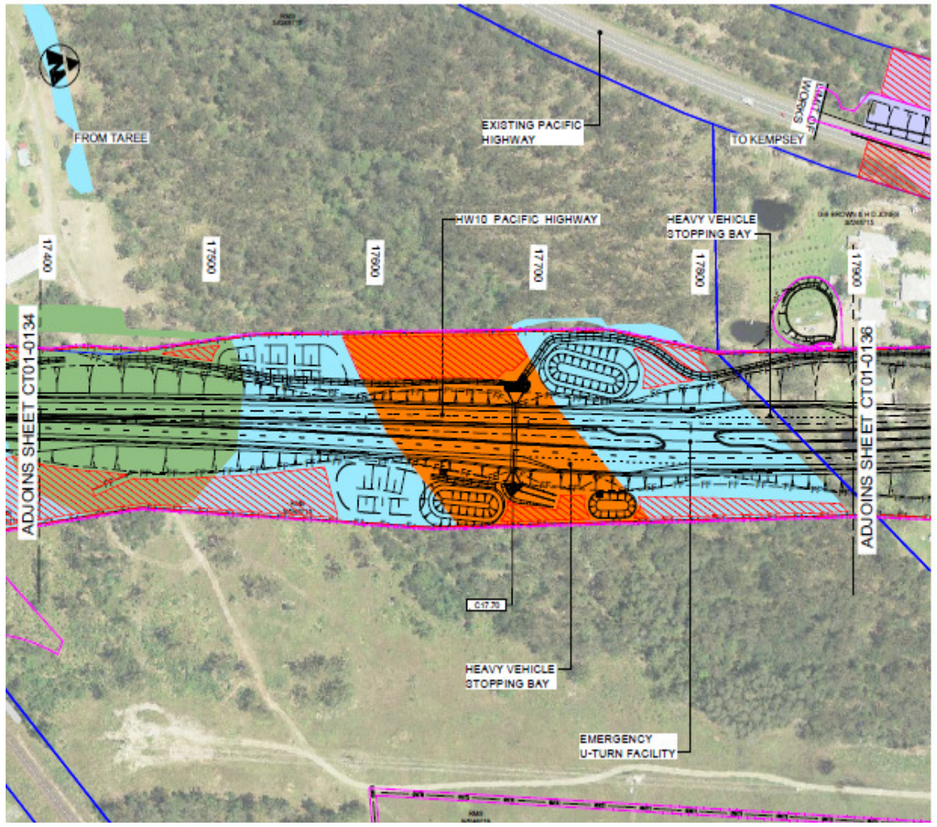
- MAUNDIA POPULATION
- POTENTIAL MAUNDIA POPULATION
- GIANT BARRED FROG HABITAT
- GREEN THIGHED FROG HABITAT
- PROPOSED FROG POND

ENVIRONMENTAL INFRASTRUCTURE

- GLIDER POLE
- ROPE BRIDGE AND STAYS



Culvert CH 17690



NOTES

1. REFER TO SHEET NUMBER CT01-0005 FOR GENERAL NOTES AND LEGEND.

LEGEND

- PROPOSED PROJECT BOUNDARY
- EXISTING CADASTRE BOUNDARY
- DETAILED DESIGN CLEARING BOUNDARY FOR TOTAL AREA OF NATIVE VEGETATION FOR THE PROJECT WORKS, TEMPORARY WORKS AND CONTRACTORS WORKS 'APP 4 CLAUSE 4.23.1(b)'
- DETAILED DESIGN RETAINED AREA OF NATIVE VEGETATION FOR THE PROJECT WORKS, TEMPORARY WORKS AND CONTRACTOR WORKS, 'APPENDIX 4 CLAUSE 4.23.1(b)'

ENVIRONMENTAL FEATURES AND DESIGN

ENDANGERED ECOLOGICAL COMMUNITY

- MOIST FLOODPLAIN CLOSED FOREST WITH RAINFOREST ELEMENTS
- RIPARIAN FOREST
- PAPERBARK SWAMP FOREST
- SWAMP MAHOGANY FOREST RED GUM SWAMP FOREST
- SWAMP OAK FOREST
- WETLAND

ECOLOGICAL COMMUNITY

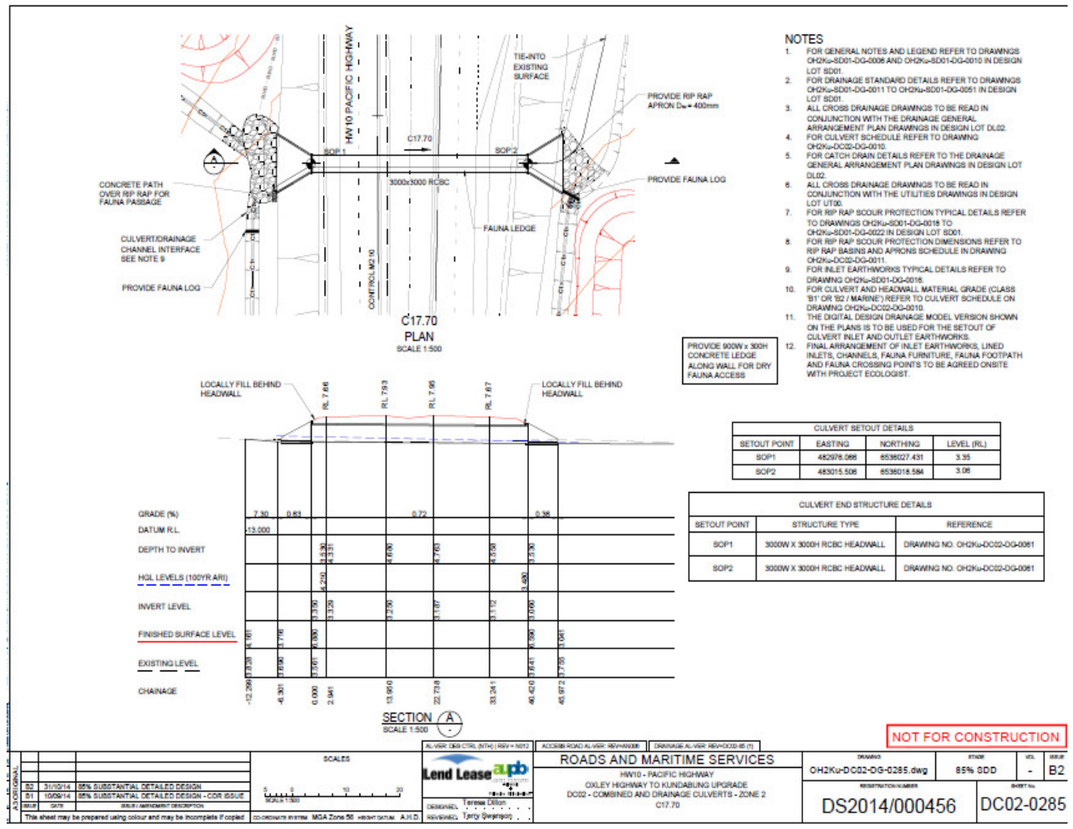
- MOIST FLOODPLAIN FOREST
- MOIST GULLY FOREST
- MOIST SLOPES FOREST
- DRY RIDGETOP FOREST
- UNIDENTIFIED NATIVE VEGETATION

THREATENED FLORA AND FAUNA

- MAUNDIA POPULATION
- POTENTIAL MAUNDIA POPULATION
- GIANT BARRED FROG HABITAT
- GREEN THIGHED FROG HABITAT
- PROPOSED FROG POND

ENVIRONMENTAL INFRASTRUCTURE

- GLIDER POLE
- ROPE BRIDGE AND STAYS



NOTES

1. FOR GENERAL NOTES AND LEGEND REFER TO DRAWINGS OH2Ku-SD01-DG-0006 AND OH2Ku-SD01-DG-0010 IN DESIGN LOT SD01.
2. FOR DRAINAGE STANDARD DETAILS REFER TO DRAWINGS OH2Ku-SD01-DG-0011 TO OH2Ku-SD01-DG-0051 IN DESIGN LOT SD01.
3. ALL CROSS DRAINAGE DRAWINGS TO BE READ IN CONJUNCTION WITH THE DRAINAGE GENERAL ARRANGEMENT PLAN DRAWINGS IN DESIGN LOT DL02.
4. FOR CULVERT SCHEDULE REFER TO DRAWING OH2Ku-DC02-DG-0010.
5. FOR CATCH DRAIN DETAILS REFER TO THE DRAINAGE GENERAL ARRANGEMENT PLAN DRAWINGS IN DESIGN LOT DL02.
6. ALL CROSS DRAINAGE DRAWINGS TO BE READ IN CONJUNCTION WITH THE UTILITIES DRAWINGS IN DESIGN LOT UT00.
7. FOR RIP RAP SCOUR PROTECTION TYPICAL DETAILS REFER TO DRAWINGS OH2Ku-SD01-DG-0018 TO OH2Ku-SD01-DG-0022 IN DESIGN LOT SD01.
8. FOR RIP RAP SCOUR PROTECTION DIMENSIONS REFER TO RIP RAP BASINS AND APRONS SCHEDULE IN DRAWING OH2Ku-DC02-DG-0011.
9. FOR INLET EARTHWORKS TYPICAL DETAILS REFER TO DRAWING OH2Ku-SD01-DG-0016.
10. FOR CULVERT AND HEADWALL MATERIAL GRADE (CLASS 'B1' OR 'B2 / MARINE') REFER TO CULVERT SCHEDULE ON DRAWING OH2Ku-DC02-DG-0010.
11. THE DIGITAL DESIGN DRAINAGE MODEL VERSION SHOWN ON THE PLANS IS TO BE USED FOR THE SETOUT OF CULVERT INLET AND OUTLET EARTHWORKS.
12. FINAL ARRANGEMENT OF INLET EARTHWORKS, LINED INLETS, CHANNELS, FAUNA FURNITURE, FAUNA FOOTPATH AND FAUNA CROSSING POINTS TO BE AGREED ONSITE WITH PROJECT ECOLOGIST.

CULVERT SETOUT DETAILS

SETOUT POINT	EASTING	NORTHING	LEVEL (RL)
SOP1	482976.066	6536027.431	3.35
SOP2	483015.506	6536018.584	3.06

CULVERT END STRUCTURE DETAILS

SETOUT POINT	STRUCTURE TYPE	REFERENCE
SOP1	3000W X 3000H RCBC HEADWALL	DRAWING NO. OH2Ku-DC02-DG-0061
SOP2	3000W X 3000H RCBC HEADWALL	DRAWING NO. OH2Ku-DC02-DG-0061

NOT FOR CONSTRUCTION

REV	DATE	AMENDMENT DESCRIPTION
B2	31/10/14	85% SUBSTANTIAL DETAILED DESIGN
B1	10/09/14	85% SUBSTANTIAL DETAILED DESIGN - COR ISSUE

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SCALES: 0 5 10 20 — SCALE 1:500

Lend Lease apb

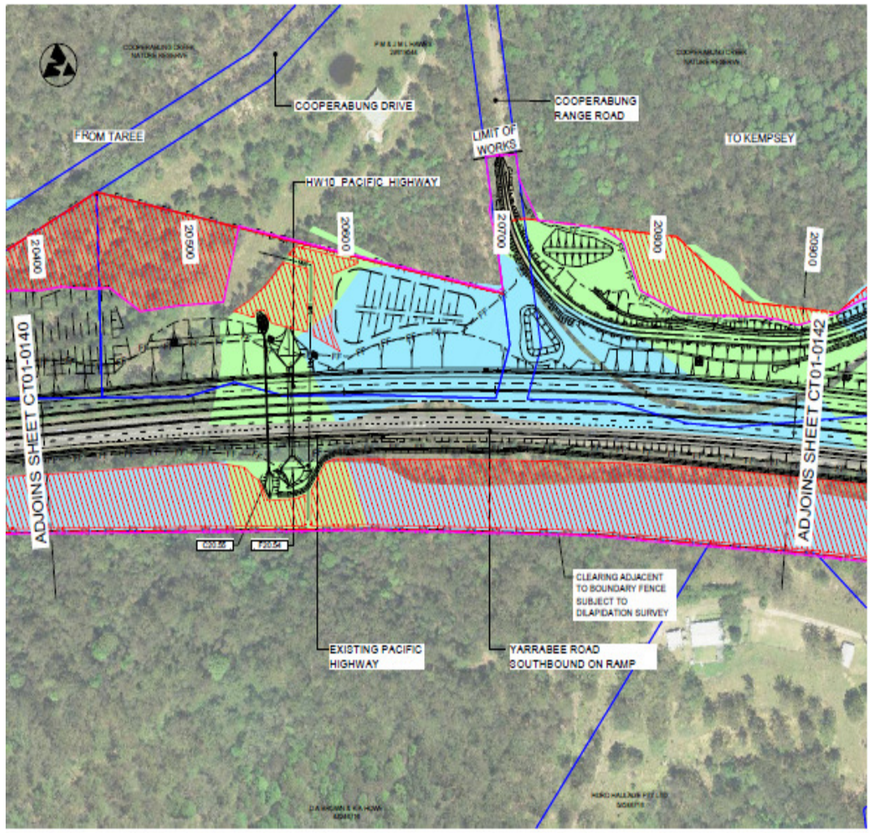
DESIGNED: Teresa Dillon
REVIEWED: Terry Sivyanyon

ROADS AND MARITIME SERVICES

HW10 - PACIFIC HIGHWAY
OXLEY HIGHWAY TO KUNDABUNG UPGRADE
DC02 - COMBINED AND DRAINAGE CULVERTS - ZONE 2
C17.70

DRAWING: OH2Ku-DC02-DG-0285.dwg
STAGE: 85% SDD
VOL: -
ISSUE: B2
REGISTRATION NUMBER: DS2014/000456
SHEET No: DC02-0285

Culvert CH 20560



NOTES

1. REFER TO SHEET NUMBER CT01-0005 FOR GENERAL NOTES AND LEGEND.

LEGEND

- PROPOSED PROJECT BOUNDARY
- EXISTING CADASTRE BOUNDARY
- DETAILED DESIGN CLEARING BOUNDARY FOR TOTAL AREA OF NATIVE VEGETATION FOR THE PROJECT WORKS, TEMPORARY WORKS AND CONTRACTORS WORKS 'APP 4 CLAUSE 4.23.1(b)'
- DETAILED DESIGN RETAINED AREA OF NATIVE VEGETATION FOR THE PROJECT WORKS, TEMPORARY WORKS AND CONTRACTOR WORKS, 'APPENDIX 4 CLAUSE 4.23.1(b)'

ENVIRONMENTAL FEATURES AND DESIGN

ENDANGERED ECOLOGICAL COMMUNITY

- MOIST FLOODPLAIN CLOSED FOREST WITH RAINFOREST ELEMENTS
- RIPARIAN FOREST
- PAPERBARK SWAMP FOREST
- SWAMP MAHOGANY FOREST RED GUM SWAMP FOREST
- SWAMP OAK FOREST
- WETLAND

ECOLOGICAL COMMUNITY

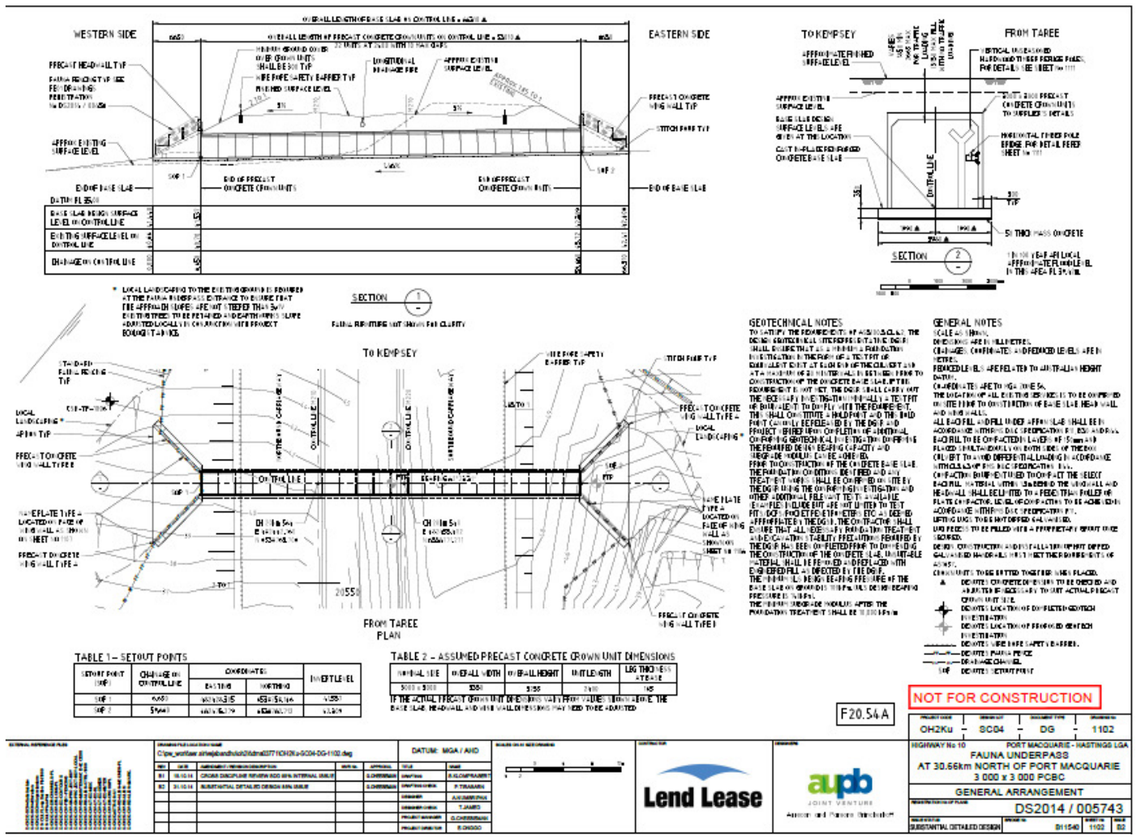
- MOIST FLOODPLAIN FOREST
- MOIST GULLY FOREST
- MOIST SLOPES FOREST
- DRY RIDGETOP FOREST
- UNIDENTIFIED NATIVE VEGETATION

THREATENED FLORA AND FAUNA

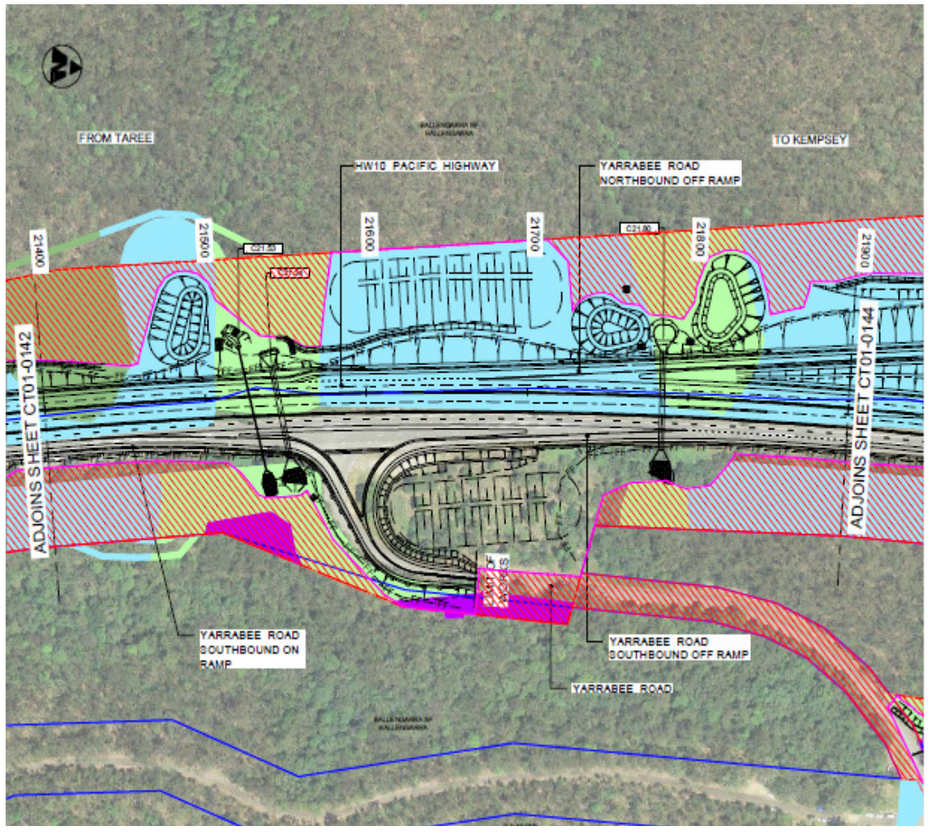
- MAUNDIA POPULATION
- POTENTIAL MAUNDIA POPULATION
- GIANT BARRED FROG HABITAT
- GREEN THIGHED FROG HABITAT
- PROPOSED FROG POND

ENVIRONMENTAL INFRASTRUCTURE

- GLIDER POLE
- ROPE BRIDGE AND STAYS



Culvert CH 21800



NOTES

1. REFER TO SHEET NUMBER CT01-0005 FOR GENERAL NOTES AND LEGEND.

LEGEND

- PROPOSED PROJECT BOUNDARY
- EXISTING CADASTRE BOUNDARY
- DETAILED DESIGN CLEARING BOUNDARY FOR TOTAL AREA OF NATIVE VEGETATION FOR THE PROJECT WORKS, TEMPORARY WORKS AND CONTRACTORS WORKS 'APP 4 CLAUSE 4.23.1(b)'
- DETAILED DESIGN RETAINED AREA OF NATIVE VEGETATION FOR THE PROJECT WORKS, TEMPORARY WORKS AND CONTRACTOR WORKS, 'APPENDIX 4 CLAUSE 4.23.1(b)'

ENVIRONMENTAL FEATURES AND DESIGN

ENDANGERED ECOLOGICAL COMMUNITY

- MOIST FLOODPLAIN CLOSED FOREST WITH RAINFOREST ELEMENTS
- RIPARIAN FOREST
- PAPERBARK SWAMP FOREST
- SWAMP MAHOGANY FOREST RED GUM SWAMP FOREST
- SWAMP OAK FOREST
- WETLAND

ECOLOGICAL COMMUNITY

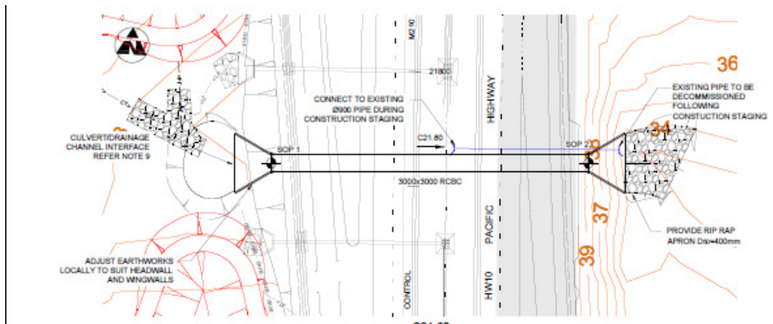
- MOIST FLOODPLAIN FOREST
- MOIST GULLY FOREST
- MOIST SLOPES FOREST
- DRY RIDGETOP FOREST
- UNIDENTIFIED NATIVE VEGETATION

THREATENED FLORA AND FAUNA

- MAUNDIA POPULATION
- POTENTIAL MAUNDIA POPULATION
- GIANT BARRED FROG HABITAT
- GREEN THIGHED FROG HABITAT
- PROPOSED FROG POND

ENVIRONMENTAL INFRASTRUCTURE

- GLIDER POLE
- ROPE BRIDGE AND STAYS



C21.80
PLAN
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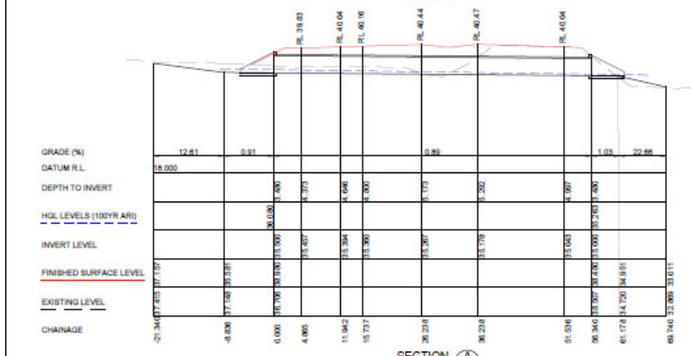


SECTION A
SCALE 1:500

NOTES

1. FOR GENERAL NOTES AND LEGEND REFER TO DRAWINGS OH2Ku-SD01-DG-0006 AND OH2Ku-SD01-DG-0010 IN DESIGN LOT SD01.
2. FOR DRAINAGE STANDARD DETAILS REFER TO DRAWINGS OH2Ku-SD01-DG-0011 TO OH2Ku-SD01-DG-0051 IN DESIGN LOT SD01.
3. ALL CROSS DRAINAGE DRAWINGS TO BE READ IN CONJUNCTION WITH THE DRAINAGE GENERAL ARRANGEMENT PLAN DRAWINGS IN DESIGN LOT DL02.
4. FOR CULVERT SCHEDULE REFER TO DRAWING OH2Ku-DC02-DG-0010.
5. FOR CATCH DRAIN DETAILS REFER TO THE DRAINAGE GENERAL ARRANGEMENT PLAN DRAWINGS IN DESIGN LOT DL02.
6. ALL CROSS DRAINAGE DRAWINGS TO BE READ IN CONJUNCTION WITH THE UTILITIES DRAWINGS IN DESIGN LOT UT00.
7. FOR RIP RAP SCOUR PROTECTION TYPICAL DETAILS REFER TO DRAWINGS OH2Ku-SD01-DG-0015 TO OH2Ku-SD01-DG-0022 IN DESIGN LOT SD01.
8. FOR RIP RAP SCOUR PROTECTION DIMENSIONS REFER TO RIP RAP BASINS AND APRONS SCHEDULE IN DRAWING OH2Ku-DC02-DG-0011.
9. FOR INLET EARTHWORKS TYPICAL DETAILS REFER TO DRAWING OH2Ku-SD01-DG-0016.
10. FOR CULVERT AND HEADWALL MATERIAL GRADE (CLASS 'B1' OR 'B2 / MARINE') REFER TO CULVERT SCHEDULE ON DRAWING OH2Ku-DC02-DG-0010.
11. THE DIGITAL DESIGN DRAINAGE MODEL VERSION SHOWN ON THE PLANS IS TO BE USED FOR THE SETOUT OF CULVERT INLET AND OUTLET EARTHWORKS.
12. FINAL ARRANGEMENT OF INLET EARTHWORKS, LINED INLETS, CHANNELS, FAUNA FURNITURE, FAUNA FOOTPATH AND FAUNA CROSSING POINTS TO BE AGREED ONSITE WITH PROJECT ECOLOGIST.

CULVERT SETOUT DETAILS

SETOUT POINT	EASTING	NORTHING	LEVEL (RL)
SOP1	482102.821	6539932.453	35.5
SOP2	482159.019	6539936.45	35.0

CULVERT END STRUCTURE DETAILS

SETOUT POINT	STRUCTURE TYPE	REFERENCE
SOP1	3000W X 3000H RCBC HEADWALL	DRAWING NO. OH2Ku-DC02-DG-0061
SOP2	3000W X 3000H RCBC HEADWALL	DRAWING NO. OH2Ku-DC02-DG-0061

NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION
B2	31/10/14	85% SUBSTANTIAL DETAILED DESIGN
B1	10/09/14	85% SUBSTANTIAL DETAILED DESIGN - COR ISSUE

This sheet may be prepared using colour and may be incomplete if copied

SCALES

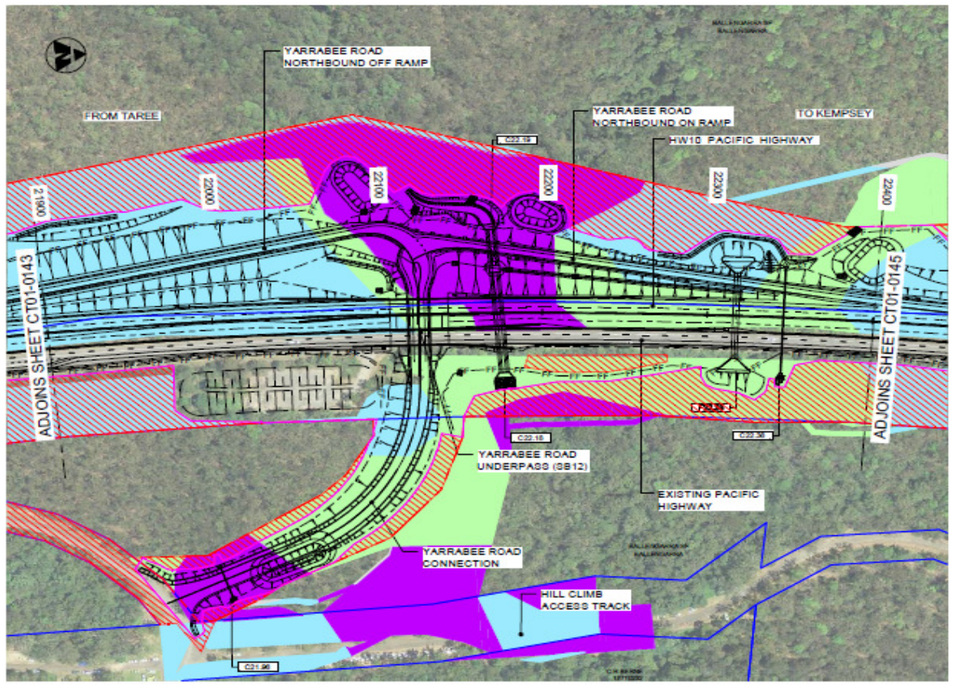
Lend Lease apb

DESIGNED: Teresa Dillon
REVIEWED: Tony Georgiou

ROADS AND MARITIME SERVICES
HW10 - PACIFIC HIGHWAY
OXLEY HIGHWAY TO KUNDABUNG UPGRADE
DC02 - COMBINED AND DRAINAGE CULVERTS - ZONE 2
C21.80

DRAWING: OH2Ku-DC02-DG-0393.dwg
STAGE: 85% SDD
VOL: -
ISSUE: B2
REGISTRATION NUMBER: DS2014/000456
SHEET No: DC02-0393

Culvert CH 22160, CH 22170 and CH 22320



NOTES
1. REFER TO SHEET NUMBER CT01-0005 FOR GENERAL NOTES AND LEGEND.

LEGEND
- PROPOSED PROJECT BOUNDARY
- EXISTING CADASTRE BOUNDARY
- DETAILED DESIGN CLEARING BOUNDARY FOR TOTAL AREA OF NATIVE VEGETATION FOR THE PROJECT WORKS, TEMPORARY WORKS AND CONTRACTORS WORKS 'APP 4 CLAUSE 4.23.1(b)'
- DETAILED DESIGN RETAINED AREA OF NATIVE VEGETATION FOR THE PROJECT WORKS, TEMPORARY WORKS AND CONTRACTOR WORKS, 'APPENDIX 4 CLAUSE 4.23.1(b)'

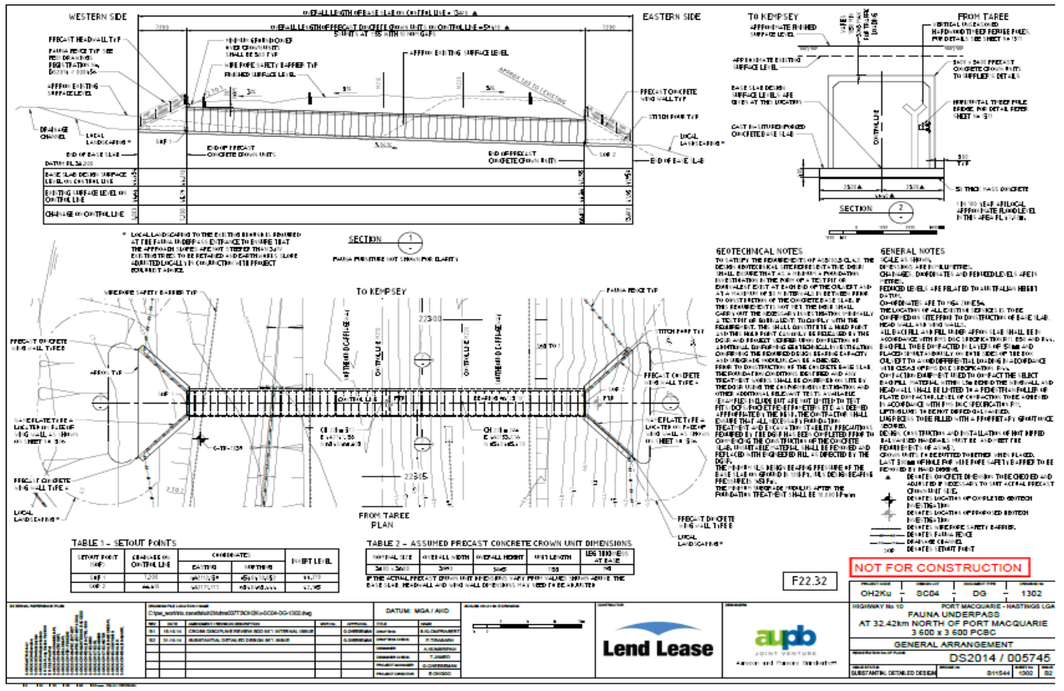
ENVIRONMENTAL FEATURES AND DESIGN

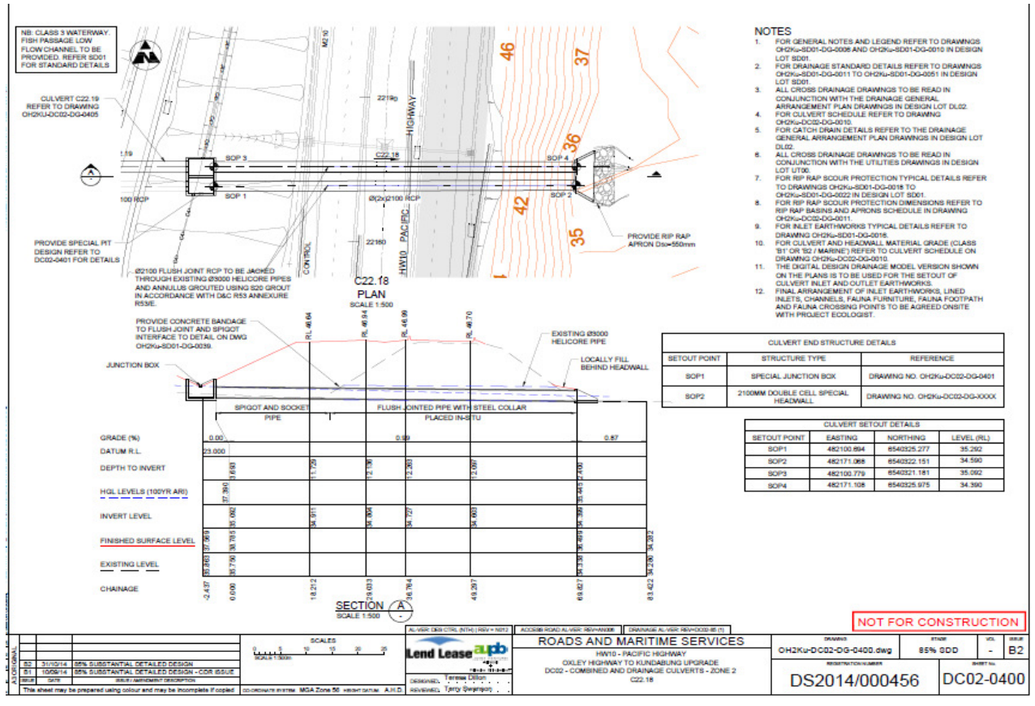
ENDANGERED ECOLOGICAL COMMUNITY
- MOIST FLOODPLAIN CLOSED FOREST WITH RAINFOREST ELEMENTS
- RIPARIAN FOREST
- PAPERBARK SWAMP FOREST
- SWAMP MAHOGANY FOREST RED GUM SWAMP FOREST
- SWAMP OAK FOREST
- WETLAND

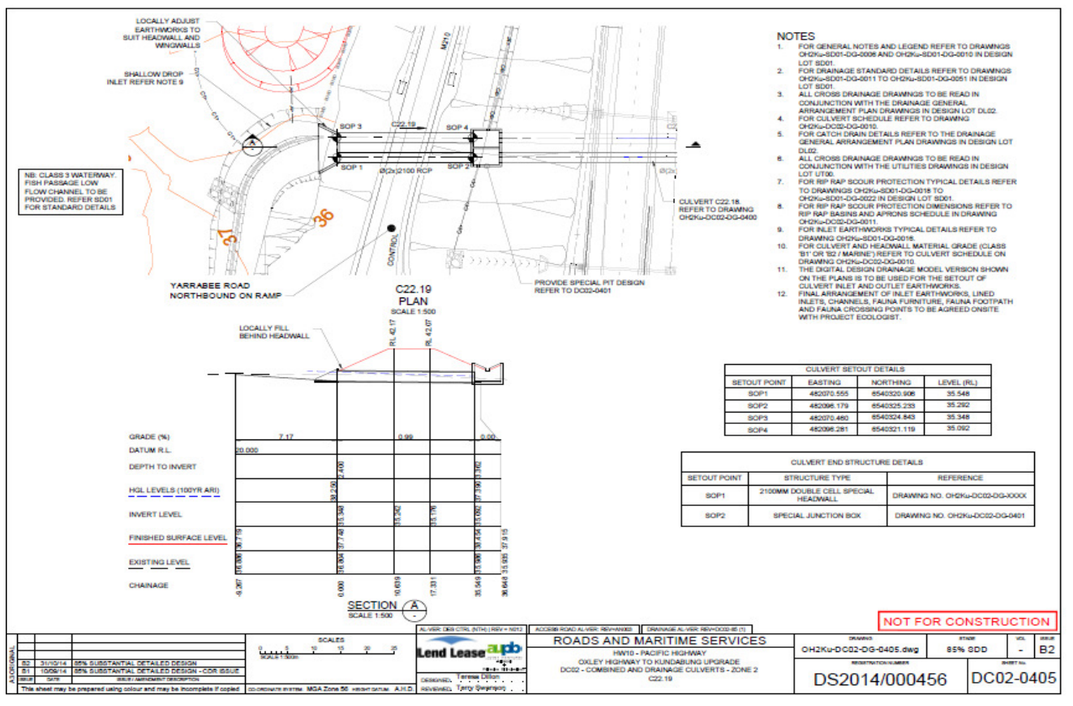
ECOLOGICAL COMMUNITY
- MOIST FLOODPLAIN FOREST
- MOIST GULLY FOREST
- MOIST SLOPES FOREST
- DRY RIDGETOP FOREST
- UNIDENTIFIED NATIVE VEGETATION

THREATENED FLORA AND FAUNA
- MAUNDIA POPULATION
- POTENTIAL MAUNDIA POPULATION
- GIANT BARRED FROG HABITAT
- GREEN THIGHED FROG HABITAT
- PROPOSED FROG POND

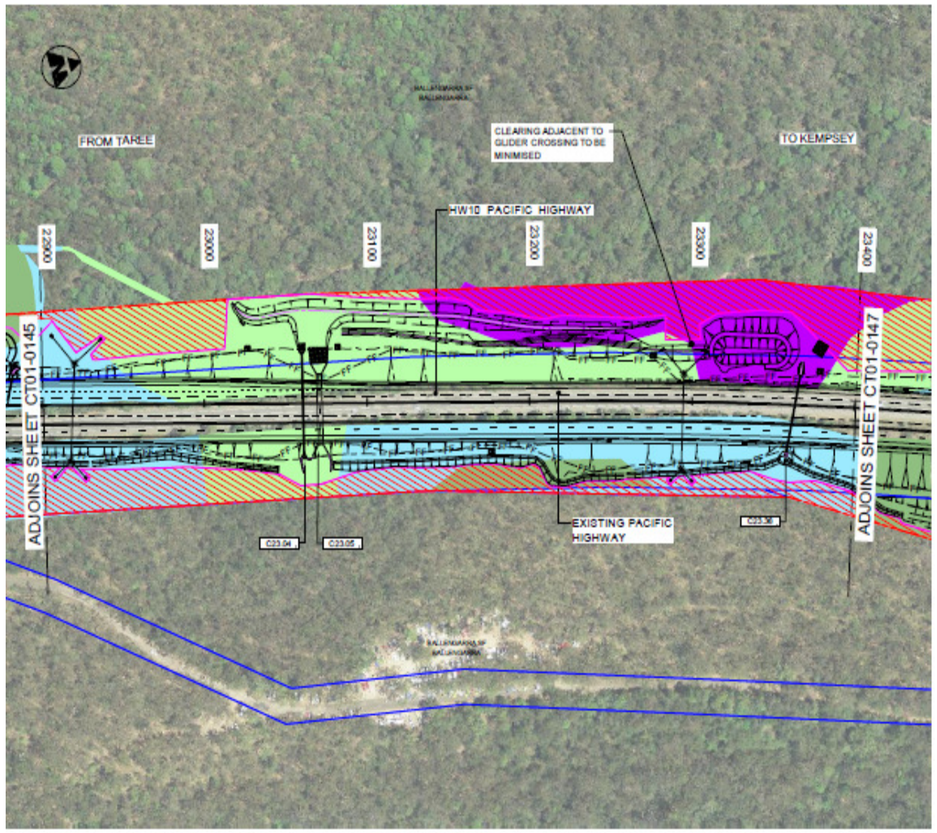
ENVIRONMENTAL INFRASTRUCTURE
- GLIDER POLE
- ROPE BRIDGE AND STAYS







Culvert CH 23050



NOTES
1. REFER TO SHEET NUMBER CT01-0005 FOR GENERAL NOTES AND LEGEND.

LEGEND
- PROPOSED PROJECT BOUNDARY
- EXISTING CADASTRE BOUNDARY
- DETAILED DESIGN CLEARING BOUNDARY FOR TOTAL AREA OF NATIVE VEGETATION FOR THE PROJECT WORKS, TEMPORARY WORKS AND CONTRACTORS WORKS 'APP 4 CLAUSE 4.23.1(b)'
- DETAILED DESIGN RETAINED AREA OF NATIVE VEGETATION FOR THE PROJECT WORKS, TEMPORARY WORKS AND CONTRACTOR WORKS, 'APPENDIX 4 CLAUSE 4.23.1(b)'

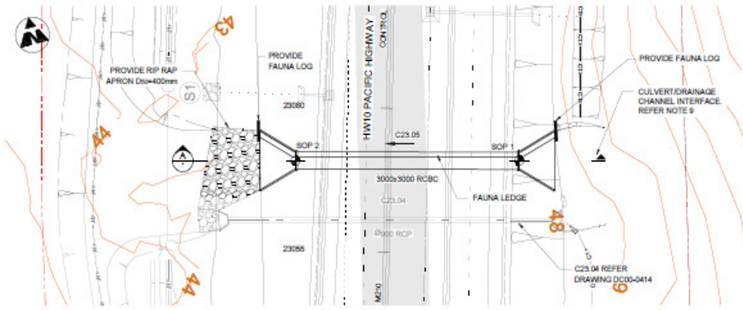
ENVIRONMENTAL FEATURES AND DESIGN

ENDANGERED ECOLOGICAL COMMUNITY
- MOIST FLOODPLAIN CLOSED FOREST WITH RAINFOREST ELEMENTS
- RIPARIAN FOREST
- PAPERBARK SWAMP FOREST
- SWAMP MAHOGANY FOREST RED GUM SWAMP FOREST
- SWAMP OAK FOREST
- WETLAND

ECOLOGICAL COMMUNITY
- MOIST FLOODPLAIN FOREST
- MOIST GULLY FOREST
- MOIST SLOPES FOREST
- DRY RIDGETOP FOREST
- UNIDENTIFIED NATIVE VEGETATION

THREATENED FLORA AND FAUNA
- MAUNDIA POPULATION
- POTENTIAL MAUNDIA POPULATION
- GIANT BARRED FROG HABITAT
- GREEN THIGHED FROG HABITAT
- PROPOSED FROG POND

ENVIRONMENTAL INFRASTRUCTURE
- GLIDER POLE
- ROPE BRIDGE AND STAYS



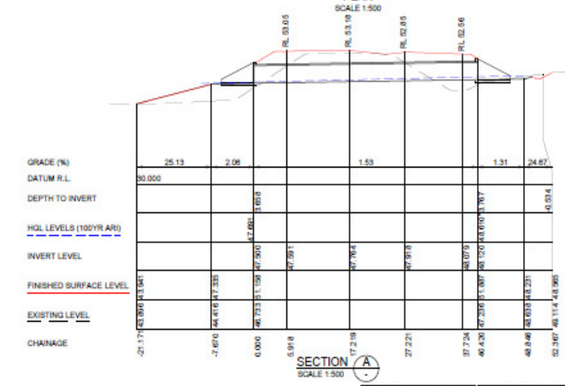
C23.05
PLAN
SCALE 1:500

PROVIDE 900W x 300H CONCRETE LEDGE ALONG WALL FOR DRY FAUNA ACCESS

NOTES
1. FOR GENERAL NOTES AND LEGEND REFER TO DRAWINGS OH2Ku-SD01-DG-0006 AND OH2Ku-SD01-DG-0010 IN DESIGN LOT SD01.
2. FOR DRAINAGE STANDARD DETAILS REFER TO DRAWINGS OH2Ku-SD01-DG-0011 TO OH2Ku-SD01-DG-0051 IN DESIGN LOT SD01.
3. ALL CROSS DRAINAGE DRAWINGS TO BE READ IN CONJUNCTION WITH THE DRAINAGE GENERAL ARRANGEMENT PLAN DRAWINGS IN DESIGN LOT DL02.
4. FOR CULVERT SCHEDULE REFER TO DRAWING OH2Ku-DC02-DG-0010.
5. FOR CATCH DRAIN DETAILS REFER TO THE DRAINAGE GENERAL ARRANGEMENT PLAN DRAWINGS IN DESIGN LOT DL02.
6. ALL CROSS DRAINAGE DRAWINGS TO BE READ IN CONJUNCTION WITH THE UTILITIES DRAWINGS IN DESIGN LOT UT00.
7. FOR RIP RAP SCOUR PROTECTION TYPICAL DETAILS REFER TO DRAWINGS OH2Ku-SD01-DG-0018 TO OH2Ku-SD01-DG-0022 IN DESIGN LOT SD01.
8. FOR RIP RAP SCOUR PROTECTION DIMENSIONS REFER TO RIP RAP BASINS AND APRONS SCHEDULE IN DRAWING OH2Ku-DC02-DG-0011.
9. FOR INLET EARTHWORKS TYPICAL DETAILS REFER TO DRAWING OH2Ku-SD01-DG-0015.
10. FOR CULVERT AND HEADWALL MATERIAL GRADE (CLASS 'S1' OR 'S2 / MARINE') REFER TO CULVERT SCHEDULE ON DRAWING OH2Ku-DC02-DG-0010.
11. THE DIGITAL DESIGN DRAINAGE MODEL VERSION SHOWN ON THE PLANS IS TO BE USED FOR THE SETOUT OF CULVERT INLET AND OUTLET EARTHWORKS.
12. FINAL ARRANGEMENT OF INLET EARTHWORKS, LINED INLETS, CHANNELS, FAUNA FURNITURE, FAUNA FOOTPATH AND FAUNA CROSSING POINTS TO BE AGREED ONSITE WITH PROJECT ECOLOGIST.

CULVERT SETOUT DETAILS			
SETOUT POINT	EASTING	NORTHING	LEVEL (RL)
SOP1	482922.011	6541196.982	48.120
SOP2	482262.782	6541208.641	47.500

CULVERT END STRUCTURE DETAILS		
SETOUT POINT	STRUCTURE TYPE	REFERENCE
SOP1	3000W X 3000H RCBC HEADWALL	DRAWING NO. OH2Ku-DC02-DG-0061
SOP2	3000W X 3000H RCBC HEADWALL	DRAWING NO. OH2Ku-DC02-DG-0061



SECTION A
SCALE 1:500

*THIS CULVERT IS HYDRAULICALLY LINKED TO C23.04 AND WILL HAVE A COMMON HEADWATER

NOT FOR CONSTRUCTION

AS BUILT			
B2	31/03/14	95% SUBSTANTIAL DETAILED DESIGN	
B1	10/06/14	95% SUBSTANTIAL DETAILED DESIGN - CDR ISSUE	
ISSUE	DATE	ISSUE / AMENDMENT DESCRIPTION	

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SCALES
0 5 10 15 20 25
SCALE 1:500m

CO-ORDINATE SYSTEM: MGA Zone 56 HEIGHT DATUM: A.H.D.

Lend Lease apb

DESIGNED: Teresa Dillon
REVIEWED: Terry Dwyer

ROADS AND MARITIME SERVICES
HW10 - PACIFIC HIGHWAY
OXLEY HIGHWAY TO KUNDABUNG UPGRADE
DC02 - COMBINED AND DRAINAGE CULVERTS - ZONE 2
C23.05

DRAWING	STAGE	VOL	ISSUE
OH2Ku-DC02-DG-0415.dwg	85% DDD	-	B2
REGISTRATION NUMBER		SHEET No.	
DS2014/000456		DC02-0415	

Attachment 2 – Fauna Fencing Locations and General Arrangement drawings.

LEGEND

- STANDARD FAUNA FENCE
- COMBINED PHASCOGALE & STANDARD FAUNA FENCE
- COMBINED GIANT BARRED FROG & STANDARD FAUNA FENCE
- COMBINED GREEN-THIGHED FROG & STANDARD FAUNA FENCE
- COMBINED PHASCOGALE, GREEN-THIGHED FROG & STANDARD FAUNA FENCE

No.	Amendment Description	Initials	Date
A3 original	SCALE 1:5000m	PRINTED	19/02/2014

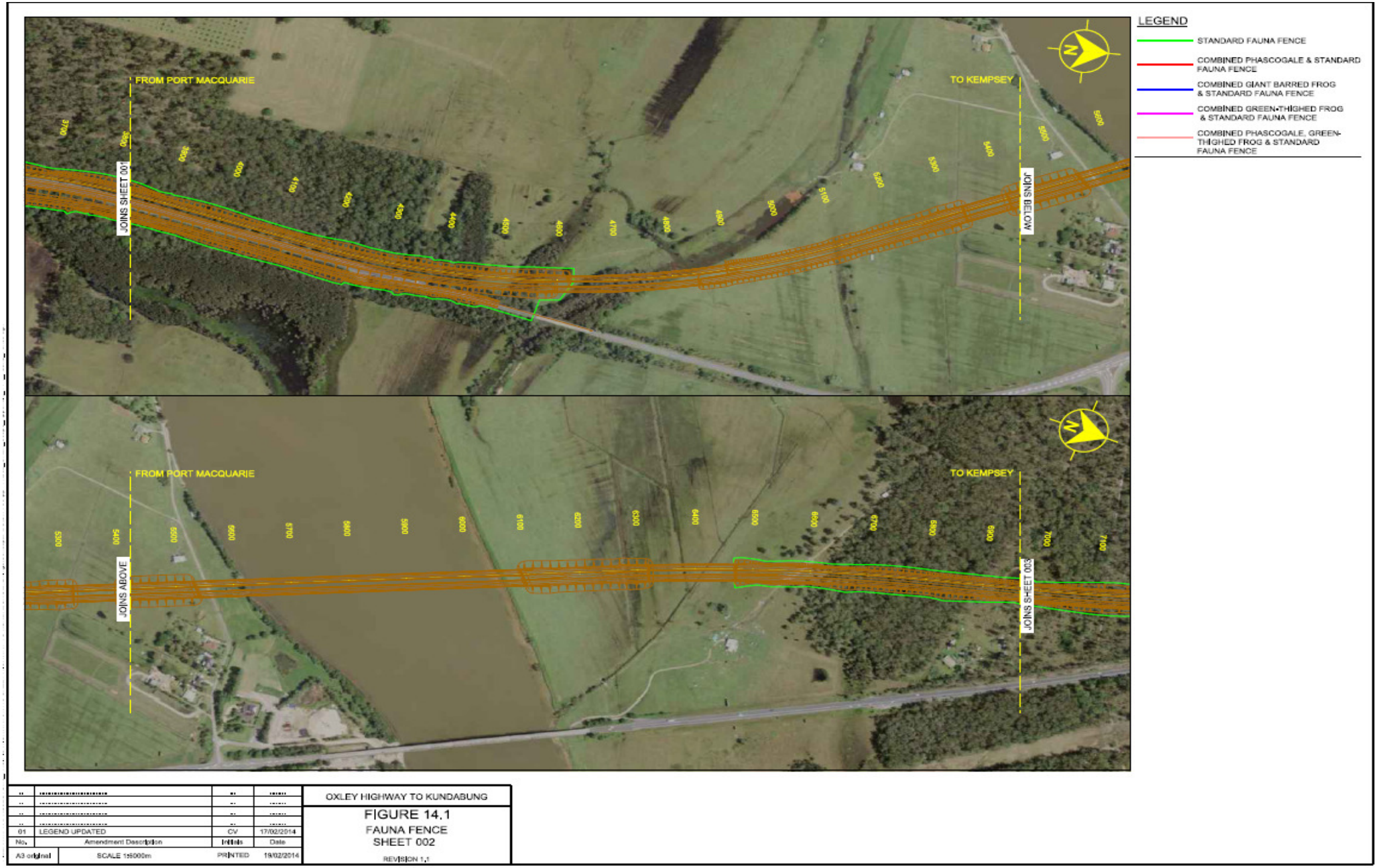
OXLEY HIGHWAY TO KUNDABUNG

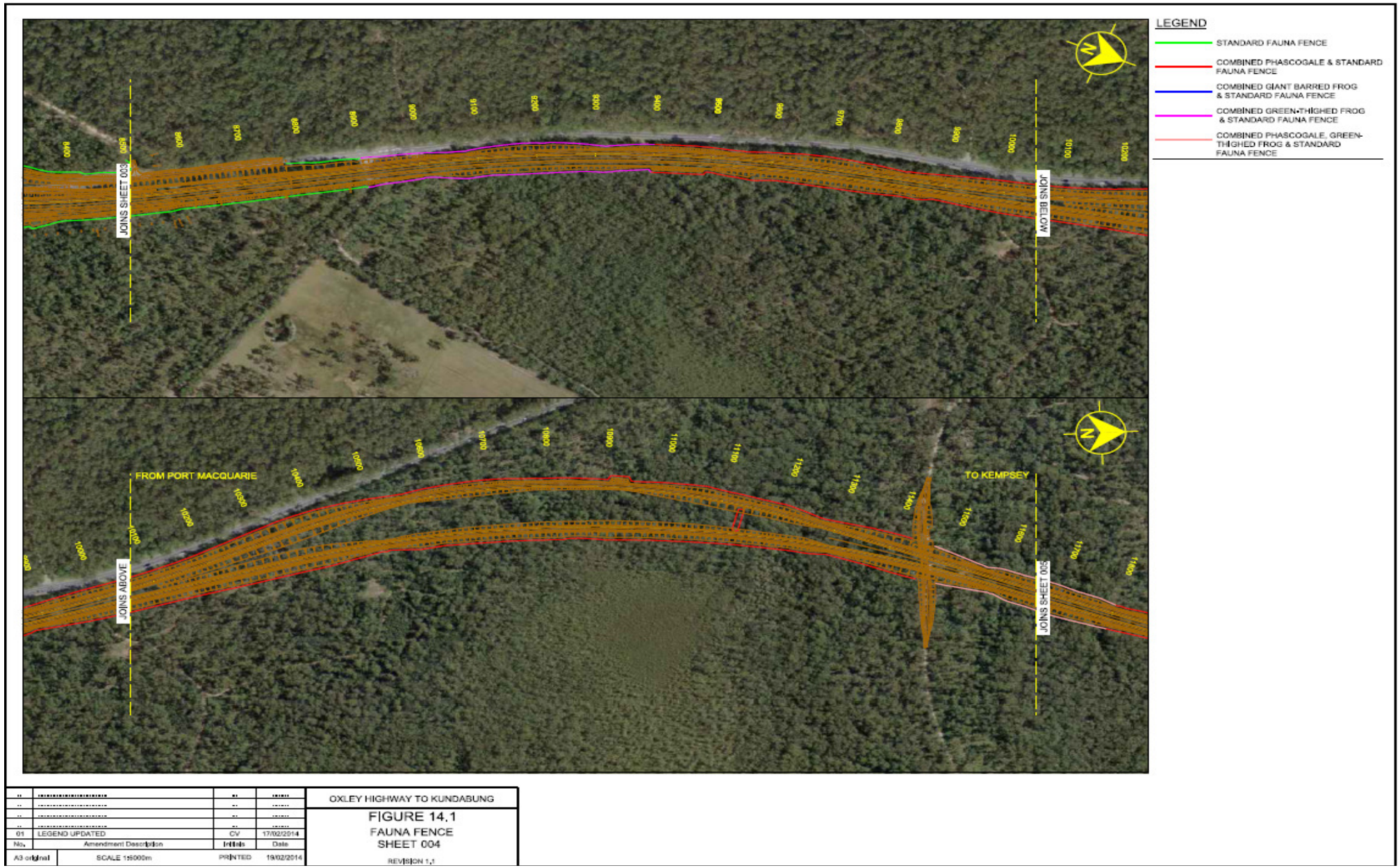
FIGURE 14.1

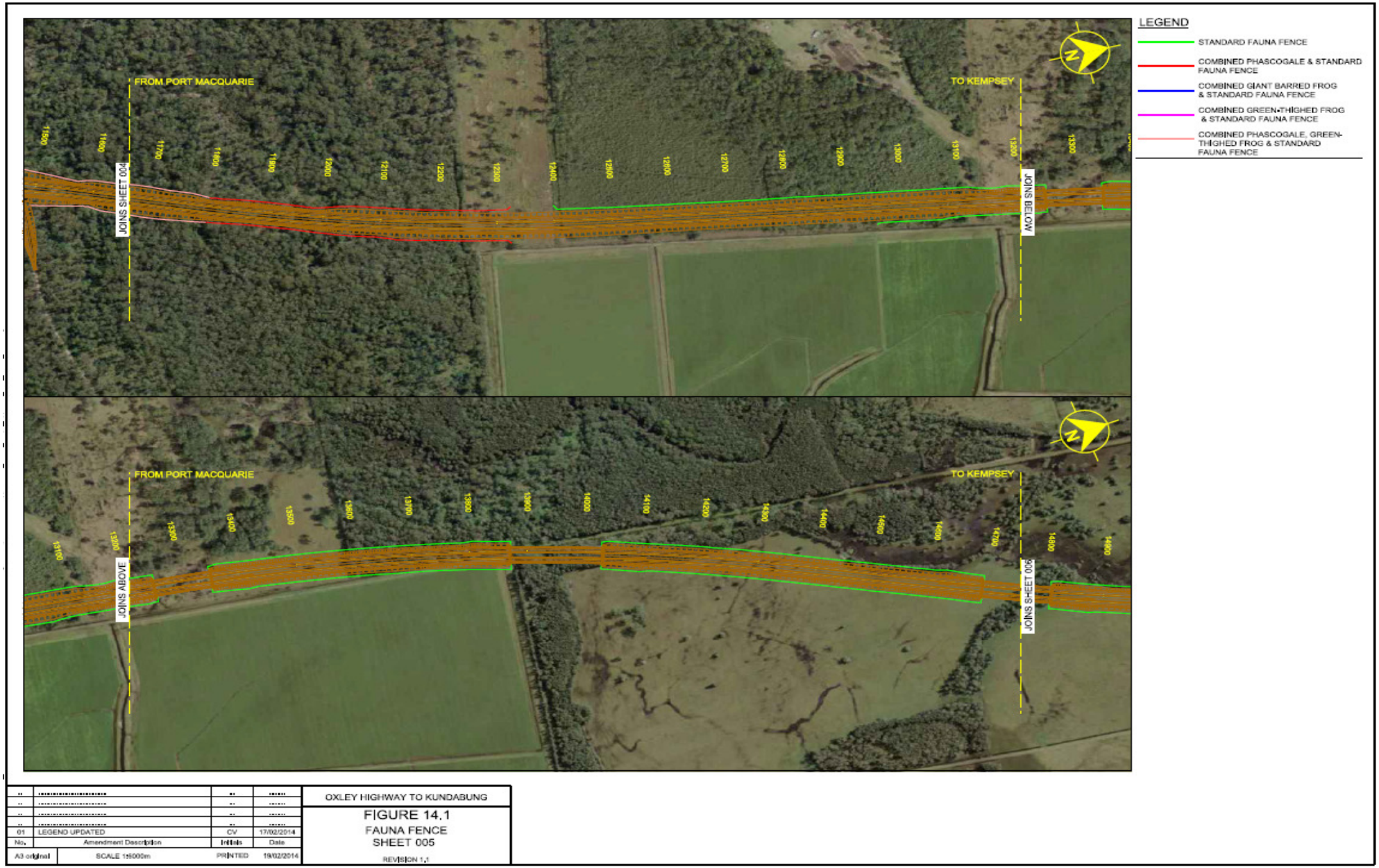
FAUNA FENCE

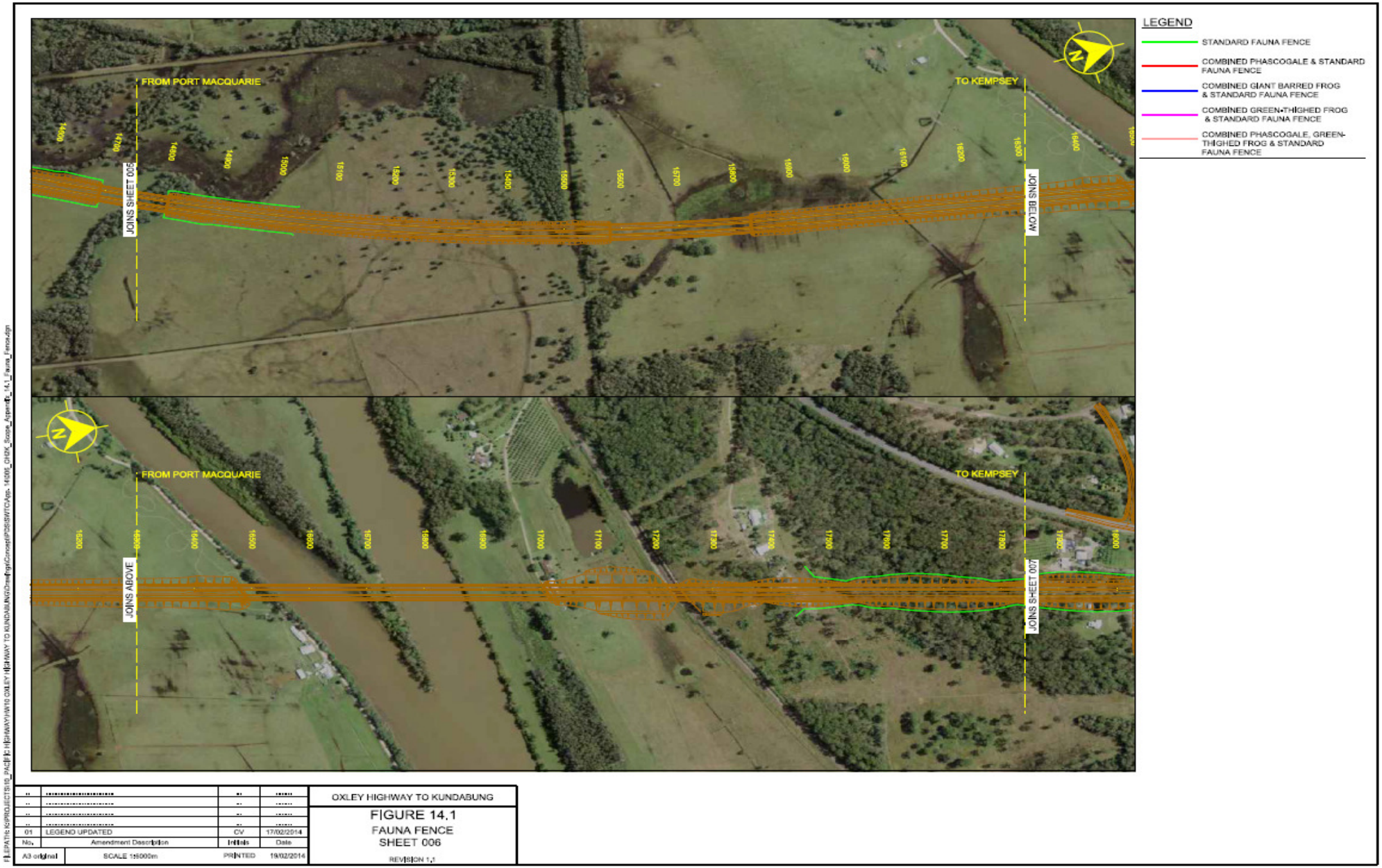
SHEET 001

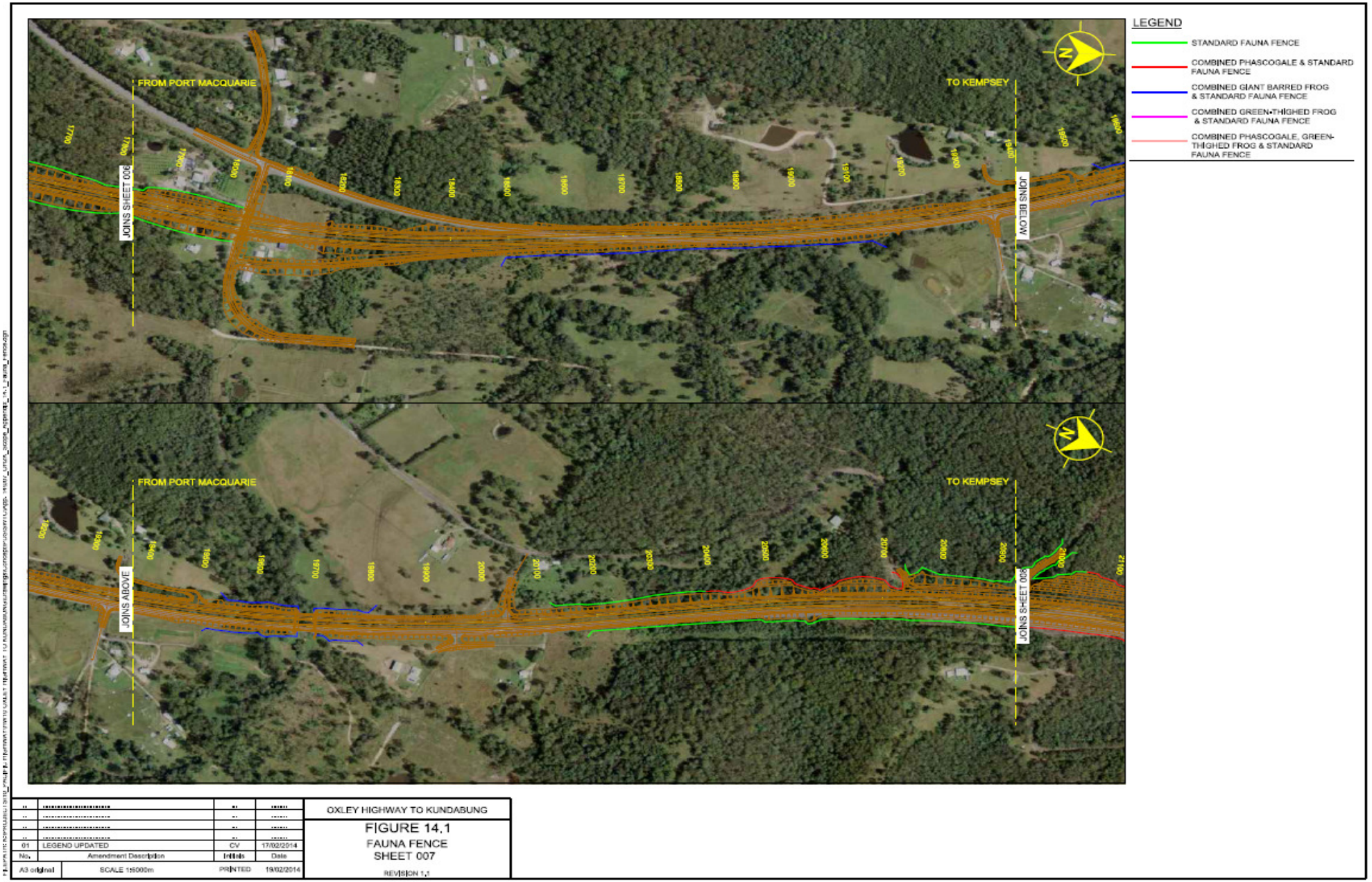
REVISION 1.1

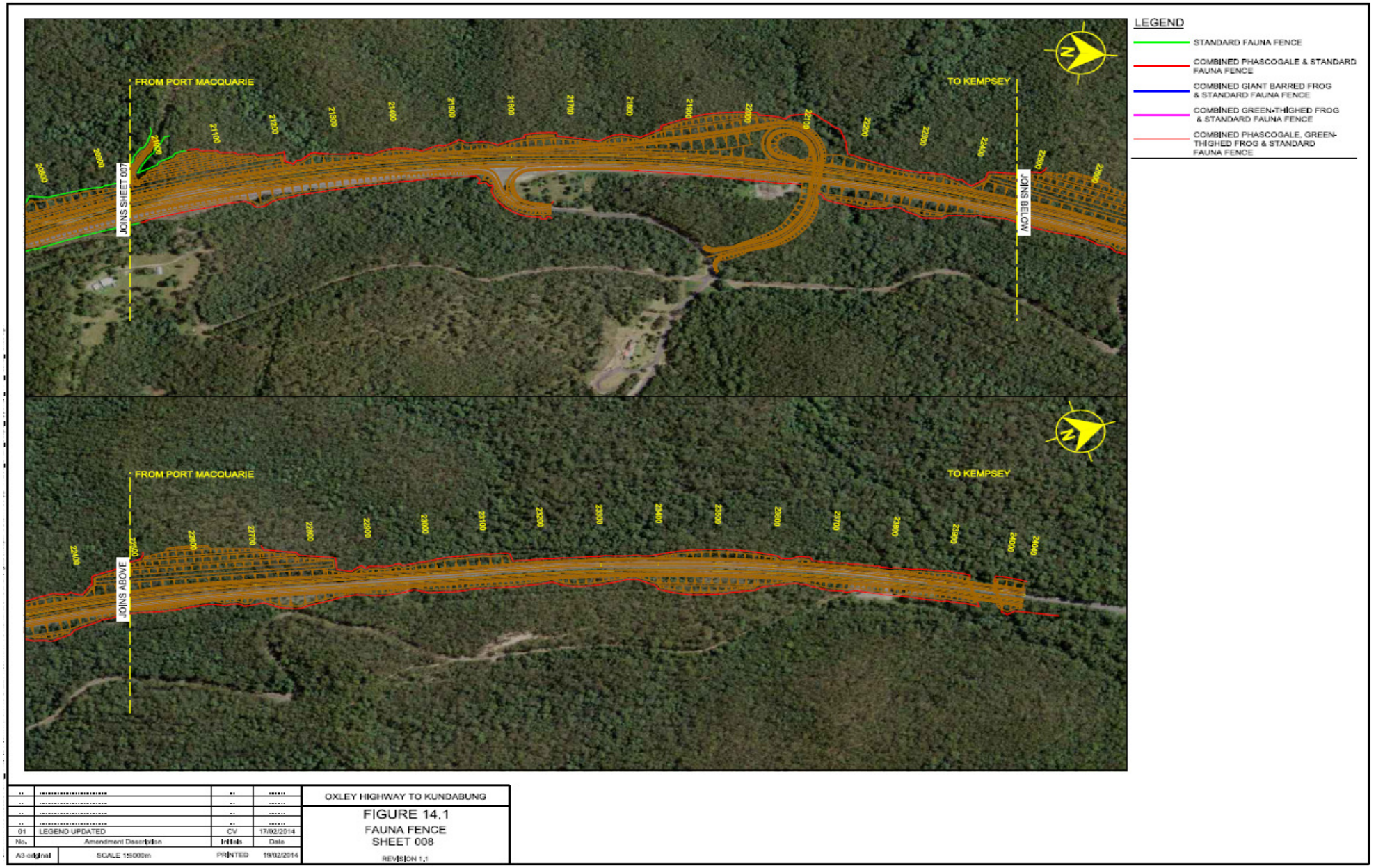

FROM PORT MACQUARIE
TO KEMPSEY
JOINS SHEET 001
JOINS BELOW
FROM PORT MACQUARIE
TO KEMPSEY
JOINS ABOVE
JOINS SHEET 003
LEGEND
STANDARD FAUNA FENCE
COMBINED PHASCOGALE & STANDARD FAUNA FENCE
COMBINED GIANT BARRED FROG & STANDARD FAUNA FENCE
COMBINED GREEN-THIGHED FROG & STANDARD FAUNA FENCE
COMBINED PHASCOGALE, GREEN-THIGHED FROG & STANDARD FAUNA FENCE
OXLEY HIGHWAY TO KUNDABUNG
FIGURE 14.1
FAUNA FENCE
SHEET 002
REVISION 1.1
01 LEGEND UPDATED CV 17/02/2014
No. Amendment Description Initials Date
A3 original SCALE 1:5000m PRINTED 19/02/2014

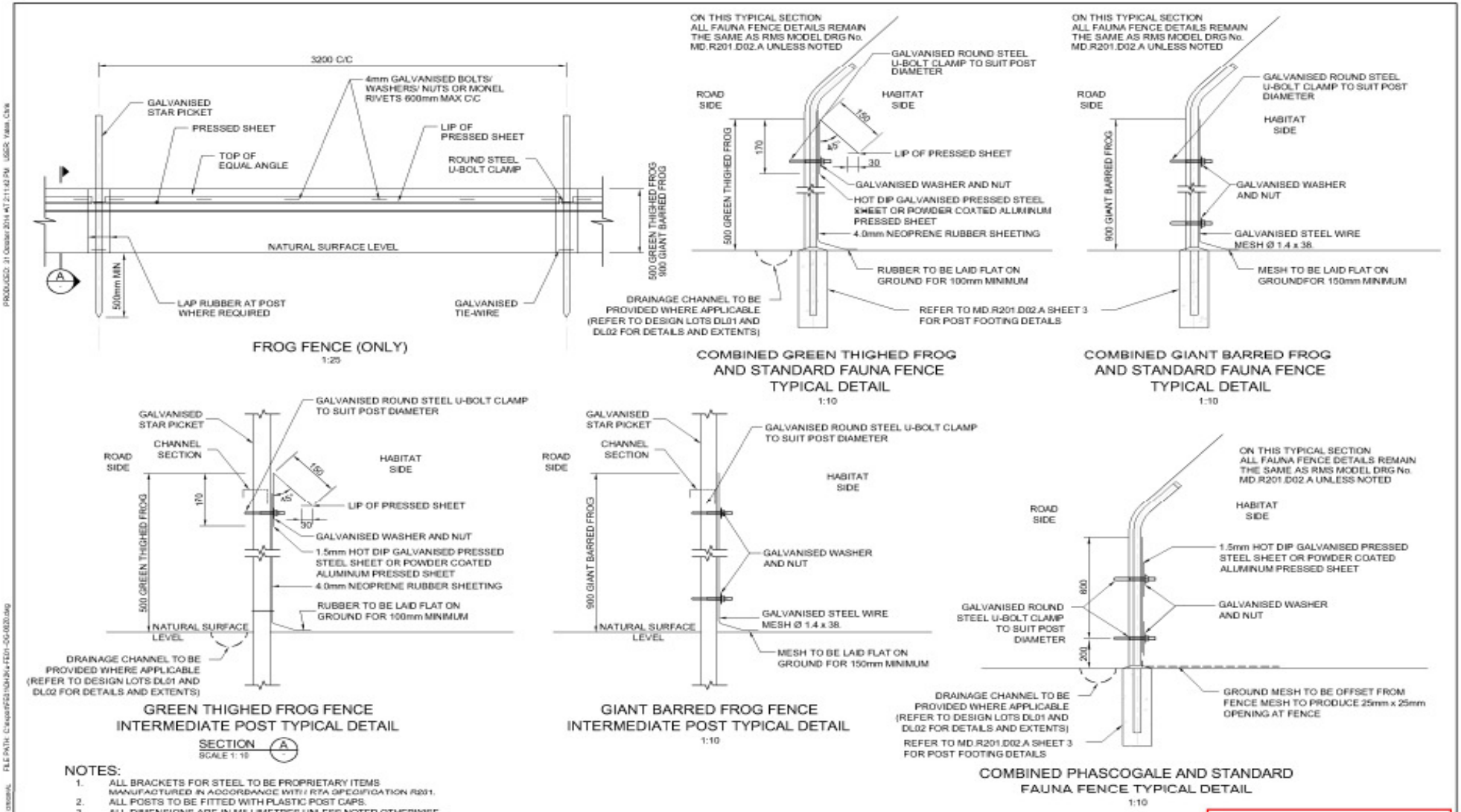

LEGEND
STANDARD FAUNA FENCE
COMBINED PHASCOGALE & STANDARD FAUNA FENCE
COMBINED GIANT BARRED FROG & STANDARD FAUNA FENCE
COMBINED GREEN-THIGHED FROG & STANDARD FAUNA FENCE
COMBINED PHASCOGALE, GREEN-THIGHED FROG & STANDARD FAUNA FENCE
JOINS SHEET 003
JOINS BELOW
FROM PORT MACQUARIE
TO KEMPSEY
JOINS ABOVE
JOINS SHEET 005
OXLEY HIGHWAY TO KUNDABUNG
FIGURE 14.1
FAUNA FENCE
SHEET 004
REVISION 1.1
01 LEGEND UPDATED CV 17/02/2014
No. Amendment Description Initials Date
A3 original SCALE 1:5000m PRINTED 19/02/2014

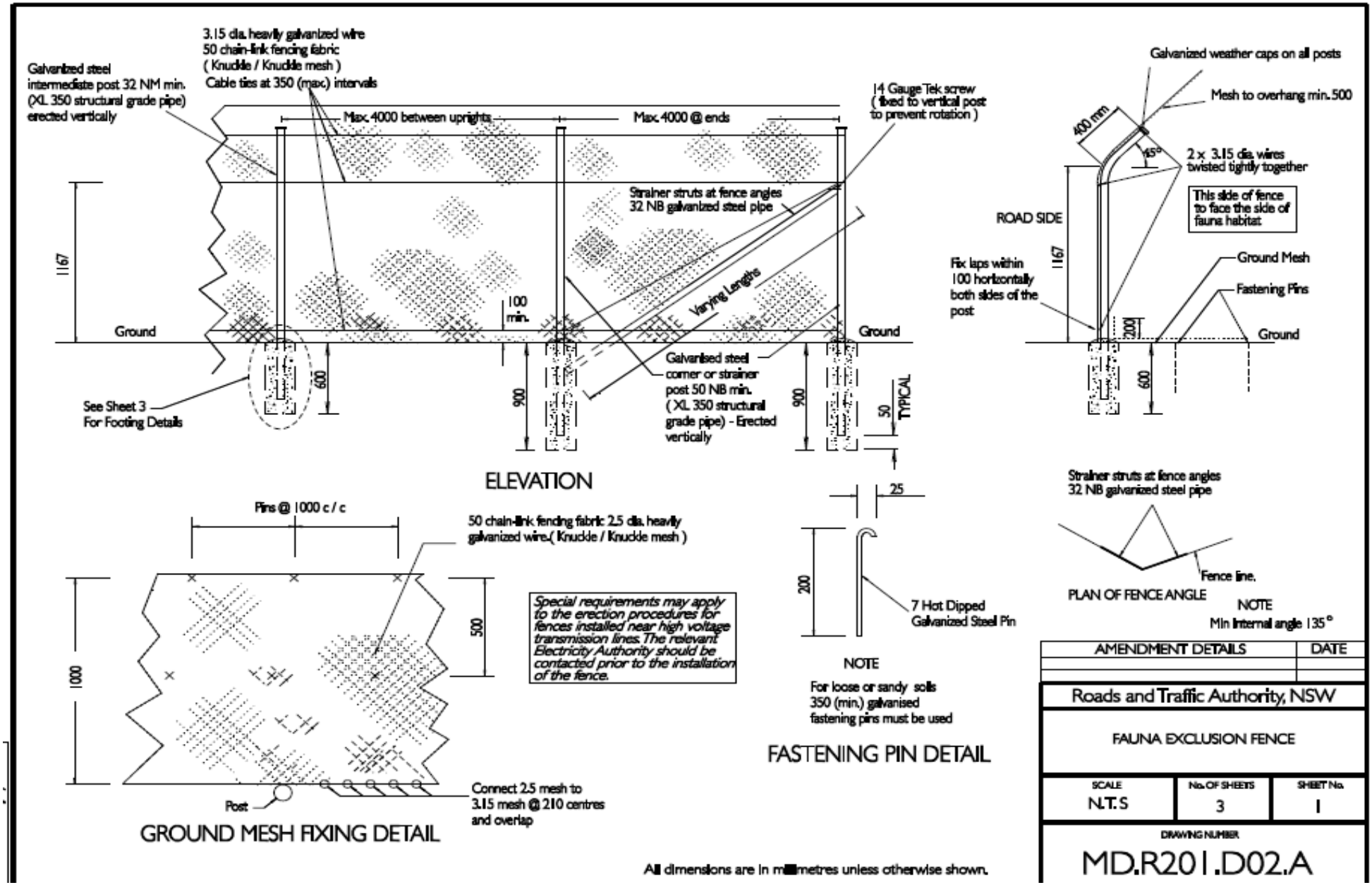

FROM PORT MACQUARIE
TO KEMPSEY
JOINS SHEET 004
JOINS BELOW
FROM PORT MACQUARIE
TO KEMPSEY
JOINS ABOVE
JOINS SHEET 006
LEGEND
STANDARD FAUNA FENCE
COMBINED PHASCOGALE & STANDARD FAUNA FENCE
COMBINED GIANT BARRED FROG & STANDARD FAUNA FENCE
COMBINED GREEN-THIGHED FROG & STANDARD FAUNA FENCE
COMBINED PHASCOGALE, GREEN-THIGHED FROG & STANDARD FAUNA FENCE
01 LEGEND UPDATED CV 17/02/2014
No. Amendment Description Initials Date
A3 original SCALE 1:5000m PRINTED 19/02/2014
OXLEY HIGHWAY TO KUNDABUNG
FIGURE 14.1
FAUNA FENCE
SHEET 005
REVISION 1.1

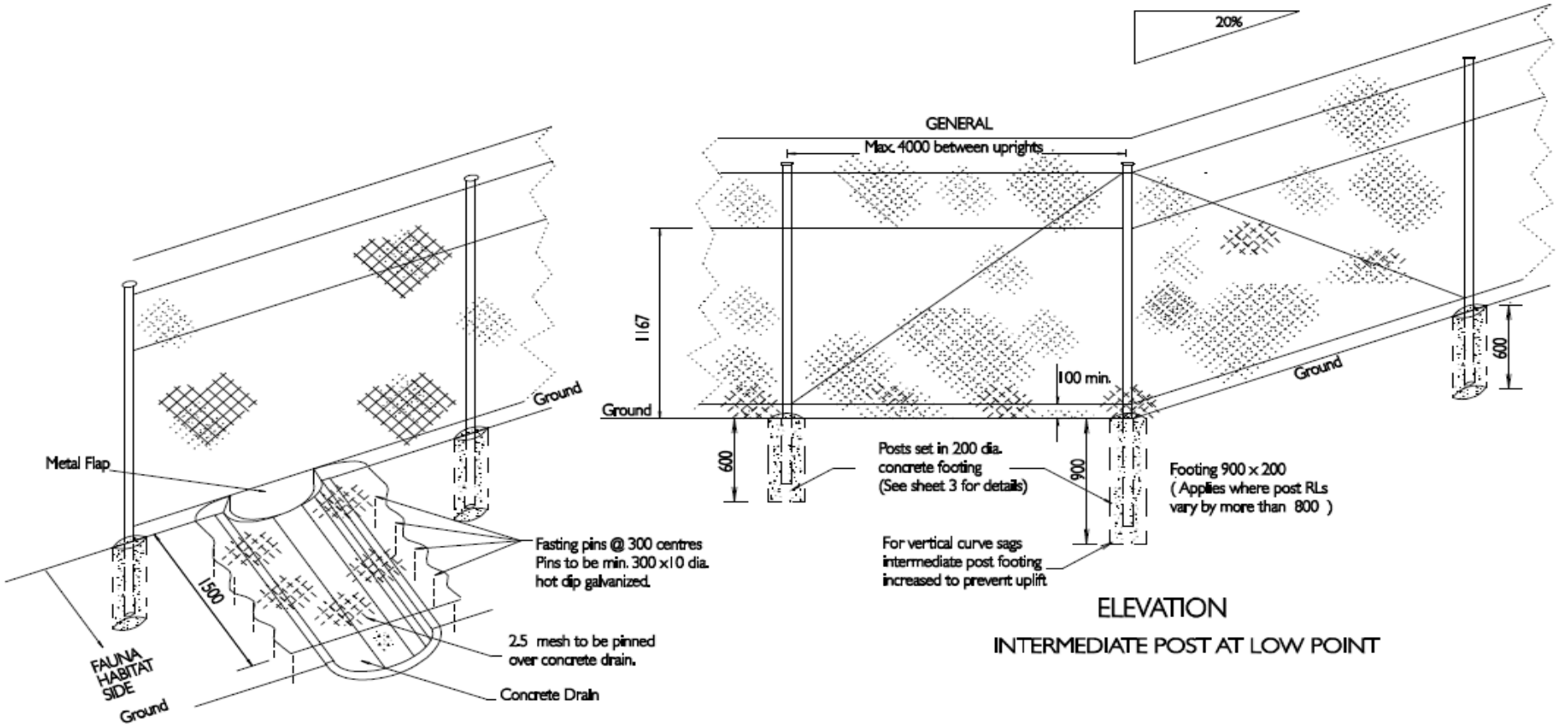

FROM PORT MACQUARIE
TO KEMPSEY
JOINS SHEET 005
JOINS BELOW
FROM PORT MACQUARIE
TO KEMPSEY
JOINS ABOVE
JOINS SHEET 007
LEGEND
STANDARD FAUNA FENCE
COMBINED PHASCOGALE & STANDARD FAUNA FENCE
COMBINED GIANT BARRED FROG & STANDARD FAUNA FENCE
COMBINED GREEN-THIGHED FROG & STANDARD FAUNA FENCE
COMBINED PHASCOGALE, GREEN-THIGHED FROG & STANDARD FAUNA FENCE
OXLEY HIGHWAY TO KUNDABUNG
FIGURE 14.1
FAUNA FENCE
SHEET 006
REVISION 1.1
01 LEGEND UPDATED CV 17/02/2014
SCALE 1:5000m
PRINTED 19/02/2014


FROM PORT MACQUARIE
TO KEMPSEY
JOINS SHEET 008
JOINS BELOW
FROM PORT MACQUARIE
TO KEMPSEY
JOINS ABOVE
JOINS SHEET 009
LEGEND
STANDARD FAUNA FENCE
COMBINED PHASCOGALE & STANDARD FAUNA FENCE
COMBINED GIANT BARRED FROG & STANDARD FAUNA FENCE
COMBINED GREEN-THIGHED FROG & STANDARD FAUNA FENCE
COMBINED PHASCOGALE, GREEN-THIGHED FROG & STANDARD FAUNA FENCE
OXLEY HIGHWAY TO KUNDABUNG
FIGURE 14.1
FAUNA FENCE
SHEET 007
REVISION 1.1
01 LEGEND UPDATED CV 17/02/2014
No. Amendment Description Initials Date
A3 original SCALE 1:5000m PRINTED 19/02/2014


FROM PORT MACQUARIE
TO KEMPSEY
JOINS SHEET 007
JOINS BELOW
FROM PORT MACQUARIE
TO KEMPSEY
JOINS ABOVE
LEGEND
STANDARD FAUNA FENCE
COMBINED PHASCOGALE & STANDARD FAUNA FENCE
COMBINED GIANT BARRED FROG & STANDARD FAUNA FENCE
COMBINED GREEN-THIGHED FROG & STANDARD FAUNA FENCE
COMBINED PHASCOGALE, GREEN-THIGHED FROG & STANDARD FAUNA FENCE
OXLEY HIGHWAY TO KUNDABUNG
FIGURE 14.1
FAUNA FENCE
SHEET 008
REVISION 1.1
01 LEGEND UPDATED CV 17/02/2014
No. Amendment Description Initials Date
A3 original SCALE 1:5000m PRINTED 19/02/2014


3200 C/C
GALVANISED STAR PICKET
4mm GALVANISED BOLTS/ WASHERS/ NUTS OR MONEL RIVETS 600mm MAX C/C
PRESSED SHEET
TOP OF EQUAL ANGLE
LIP OF PRESSED SHEET
ROUND STEEL U-BOLT CLAMP
NATURAL SURFACE LEVEL
500mm MIN
LAP RUBBER AT POST WHERE REQUIRED
GALVANISED TIE-WIRE
500 GREEN THIGHED FROG
900 GIANT BARRED FROG
FROG FENCE (ONLY)
1:25
ON THIS TYPICAL SECTION ALL FAUNA FENCE DETAILS REMAIN THE SAME AS RMS MODEL DRG No. MD.R201.D02.A UNLESS NOTED
GALVANISED ROUND STEEL U-BOLT CLAMP TO SUIT POST DIAMETER
ROAD SIDE
HABITAT SIDE
150
170
45°
30
LIP OF PRESSED SHEET
GALVANISED WASHER AND NUT
HOT DIP GALVANISED PRESSED STEEL SHEET OR POWDER COATED ALUMINUM PRESSED SHEET
4.0mm NEOPRENE RUBBER SHEETING
500 GREEN THIGHED FROG
RUBBER TO BE LAID FLAT ON GROUND FOR 100mm MINIMUM
DRAINAGE CHANNEL TO BE PROVIDED WHERE APPLICABLE (REFER TO DESIGN LOTS DL01 AND DL02 FOR DETAILS AND EXTENTS)
REFER TO MD.R201.D02.A SHEET 3 FOR POST FOOTING DETAILS
COMBINED GREEN THIGHED FROG AND STANDARD FAUNA FENCE TYPICAL DETAIL
1:10
ON THIS TYPICAL SECTION ALL FAUNA FENCE DETAILS REMAIN THE SAME AS RMS MODEL DRG No. MD.R201.D02.A UNLESS NOTED
GALVANISED ROUND STEEL U-BOLT CLAMP TO SUIT POST DIAMETER
ROAD SIDE
HABITAT SIDE
900 GIANT BARRED FROG
GALVANISED WASHER AND NUT
GALVANISED STEEL WIRE MESH Ø 1.4 x 38
MESH TO BE LAID FLAT ON GROUNDFOR 150mm MINIMUM
COMBINED GIANT BARRED FROG AND STANDARD FAUNA FENCE TYPICAL DETAIL
1:10
GALVANISED STAR PICKET
GALVANISED ROUND STEEL U-BOLT CLAMP TO SUIT POST DIAMETER
CHANNEL SECTION
ROAD SIDE
HABITAT SIDE
150
170
45°
30
LIP OF PRESSED SHEET
GALVANISED WASHER AND NUT
1.5mm HOT DIP GALVANISED PRESSED STEEL SHEET OR POWDER COATED ALUMINUM PRESSED SHEET
4.0mm NEOPRENE RUBBER SHEETING
500 GREEN THIGHED FROG
RUBBER TO BE LAID FLAT ON GROUND FOR 100mm MINIMUM
NATURAL SURFACE LEVEL
DRAINAGE CHANNEL TO BE PROVIDED WHERE APPLICABLE (REFER TO DESIGN LOTS DL01 AND DL02 FOR DETAILS AND EXTENTS)
GREEN THIGHED FROG FENCE INTERMEDIATE POST TYPICAL DETAIL
SECTION A
SCALE 1: 10
GALVANISED STAR PICKET
GALVANISED ROUND STEEL U-BOLT CLAMP TO SUIT POST DIAMETER
CHANNEL SECTION
ROAD SIDE
HABITAT SIDE
900 GIANT BARRED FROG
GALVANISED WASHER AND NUT
GALVANISED STEEL WIRE MESH Ø 1.4 x 38.
NATURAL SURFACE LEVEL
MESH TO BE LAID FLAT ON GROUND FOR 150mm MINIMUM
GIANT BARRED FROG FENCE INTERMEDIATE POST TYPICAL DETAIL
1:10
ON THIS TYPICAL SECTION ALL FAUNA FENCE DETAILS REMAIN THE SAME AS RMS MODEL DRG No. MD.R201.D02.A UNLESS NOTED
ROAD SIDE
HABITAT SIDE
1.5mm HOT DIP GALVANISED PRESSED STEEL SHEET OR POWDER COATED ALUMINUM PRESSED SHEET
800
GALVANISED WASHER AND NUT
GALVANISED ROUND STEEL U-BOLT CLAMP TO SUIT POST DIAMETER
200
GROUND MESH TO BE OFFSET FROM FENCE MESH TO PRODUCE 25mm x 25mm OPENING AT FENCE
DRAINAGE CHANNEL TO BE PROVIDED WHERE APPLICABLE (REFER TO DESIGN LOTS DL01 AND DL02 FOR DETAILS AND EXTENTS)
REFER TO MD.R201.D02.A SHEET 3 FOR POST FOOTING DETAILS
COMBINED PHASCOGALE AND STANDARD FAUNA FENCE TYPICAL DETAIL
1:10
NOTES:
1. ALL BRACKETS FOR STEEL TO BE PROPRIETARY ITEMS MANUFACTURED IN ACCORDANCE WITH RTA SPECIFICATION R201.
2. ALL POSTS TO BE FITTED WITH PLASTIC POST CAPS.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
4. RUBBER SHALL HAVE A SMOOTH FINISH.
NOT FOR CONSTRUCTION
C2 31/10/14 FINAL DESIGN DOCUMENTATION
C1 14/10/14 FINAL DESIGN DOCUMENTATION - CDR ISSUE
B2 26/08/14 85% SUBSTANTIAL DETAILED DESIGN
B1 05/08/14 85% SUBSTANTIAL DETAILED DESIGN - CDR ISSUE
A1 18/06/14 15% DEVELOPED CONCEPT DESIGN - CDR ISSUE
ISSUE DATE ISSUE / AMENDMENT DESCRIPTION
This sheet may be prepared using colour and may be incomplete if copied
A3 ORIGINAL
SCALES
SCALE 1:10
SCALE 1:25
Lend Lease apdb
DESIGNED Johnny Rooney
REVIEWED Gareth Chesseman
ROADS AND MARITIME SERVICES
HW10 - PACIFIC HIGHWAY
OXLEY HIGHWAY TO KUNDABUNG UPGRADE
FE01 - FENCING - ZONES 1 AND 2 INCL LOCAL ROADS
FROG, PHASCOGALE AND COMBINED FENCING
TYPICAL DETAILS
DRAWING OH2Ku-FE01-DG-0020.dwg
STAGE FDD
VOL -
ISSUE C2
REGISTRATION NUMBER DS2014/000456
SHEET No. FE01-0020


3.15 dia. heavily galvanized wire
50 chain-link fencing fabric
(Knuckle / Knuckle mesh)
Cable ties at 350 (max.) intervals
Galvanized steel intermediate post 32 NM min. (XL 350 structural grade pipe) erected vertically
Max. 4000 between uprights
Max. 4000 @ ends
14 Gauge Tek screw (fixed to vertical post to prevent rotation)
Strainer struts at fence angles 32 NB galvanized steel pipe
Varying Lengths
1167
Ground
100 min.
600
900
See Sheet 3 For Footing Details
Galvanised steel corner or strainer post 50 NB min. (XL 350 structural grade pipe) - Erected vertically
50 TYPICAL
ELEVATION
Galvanized weather caps on all posts
Mesh to overhang min. 500
400 mm
45°
2 x 3.15 dia. wires twisted tightly together
This side of fence to face the side of fauna habitat
ROAD SIDE
Fix laps within 100 horizontally both sides of the post
Ground Mesh
Fastening Pins
200
Pins @ 1000 c / c
50 chain-link fencing fabric 2.5 dia. heavily galvanized wire.(Knuckle / Knuckle mesh)
500
1000
Special requirements may apply to the erection procedures for fences installed near high voltage transmission lines. The relevant Electricity Authority should be contacted prior to the installation of the fence.
Post
Connect 2.5 mesh to 3.15 mesh @ 210 centres and overlap
GROUND MESH FIXING DETAIL
25
200
7 Hot Dipped Galvanized Steel Pin
NOTE
For loose or sandy soils 350 (min.) galvanised fastening pins must be used
FASTENING PIN DETAIL
Strainer struts at fence angles 32 NB galvanized steel pipe
Fence line.
PLAN OF FENCE ANGLE
NOTE
Min Internal angle 135°
All dimensions are in millimetres unless otherwise shown.
AMENDMENT DETAILS
DATE
Roads and Traffic Authority, NSW
FAUNA EXCLUSION FENCE
SCALE
N.T.S
No. OF SHEETS
3
SHEET No.
1
DRAWING NUMBER
MD.R201.D02.A



ELEVATION

INTERMEDIATE POST AT LOW POINT

FAUNA PROTECTION DRAINAGE DETAILS

NOTE

At drainage lines and gates light corrosion - resistant metal flap to be installed with less than 50 gap.
Flap to be designed to suit hydraulic flows and drain shape in stormwater flow paths.
Metal flap to be connected to fence on downstream side of fence.

Special requirements may apply to the erection procedures for fences installed near high voltage transmission lines. The relevant Electricity Authority should be contacted prior to the installation of the fence.

All dimensions are in millimetres unless otherwise stated.

AMENDMENT DETAILS	DATE

Roads and Traffic Authority, NSW

FAUNA EXCLUSION FENCE

SCALE	No. OF SHEETS	SHEET No.
N.T.S	3	2

DRAWING NUMBER

MD.R201.D02.A

Attachment 3 – Consultation Records with the EPA and DPI

Mark J Turner

From:	Brian Tolhurst <Brian.Tolhurst@epa.nsw.gov.au>
Sent:	Monday, 17 November 2014 11:18 AM
To:	Mark J Turner; Grant Fletcher; Aleesha.Darlington@rms.nsw.gov.au; 'james.sakker@industry.nsw.gov.au' (james.sakker@industry.nsw.gov.au); Stuart Murphy; sandpipereco@optusnet.com.au
Cc:	'LEDLIN David G' (David.LEDLIN@rms.nsw.gov.au); Marosszeky, Akos (Baulderstone); Hari Corliss; Russell, Nathan (Baulderstone); Metcalfe, Kieran (Baulderstone); Ben Luffman (Ben.Luffman@ghd.com)
Subject:	RE: Table 6.2 final review

Hi Mark, thanks for the latest update which addresses the current EPA concerns.

It is noted that the details now included in the dated 'Furniture - preliminary assessment' column will capture the proposed additional site specific measures for each structure. This will help with future review and consultation of these features as the project moves forward.

Regards
Brian.

Brian Tolhurst | Senior Threatened Species Officer | NSW Environment Protection Authority | ☎: (02) 6659 8277| Mobile ☎: 0429 215 388 | 🖷: (02) 6651 6187

From: Mark J Turner [mailto:Mark.J.Turner@lendlease.com]
Sent: Monday, 17 November 2014 8:47 AM
To: Tolhurst Brian; Grant Fletcher; Aleesha.Darlington@rms.nsw.gov.au; 'james.sakker@industry.nsw.gov.au' (james.sakker@industry.nsw.gov.au); Murphy Stuart; sandpipereco@optusnet.com.au
Cc: 'LEDLIN David G' (David.LEDLIN@rms.nsw.gov.au); Marosszeky, Akos (Baulderstone); Hari Corliss; Russell, Nathan (Baulderstone); Metcalfe, Kieran (Baulderstone); Ben Luffman (Ben.Luffman@ghd.com)
Subject: RE: Table 6.2 final review

Morning Brian,

Thanks for your response in relation to Table 6.2. Whilst agency agreement on the structure had been captured, it was not clear in Table 6.2 where fauna furniture would be required. The table has been updated to reflect this and has been double checked by the Project Ecologist Friday.

Could you let me know if the response addresses your concerns, otherwise let me know if there are any issues.

Thanks

Mark

Mark Turner | Environmental Approvals Manager | Oxley Highway to Kundabung Upgrade | Engineering | Lend Lease
Construction & Infrastructure
Unit 2/4 Birraba Avenue, Beresfield NSW 2322
PO Box 245, Beresfield NSW 2322
T +61 2 9499 0973 | M +61 407 370 765
Mark.J.Turner@lendlease.com | www.lendlease.com

From: Brian Tolhurst [mailto:Brian.Tolhurst@epa.nsw.gov.au]
Sent: Friday, 14 November 2014 9:42 AM
To: Mark J Turner; Grant Fletcher; Aleesha.Darlington@rms.nsw.gov.au; 'james.sakker@industry.nsw.gov.au' (james.sakker@industry.nsw.gov.au); Stuart Murphy; sandpipereco@optusnet.com.au

Cc: 'LEDLIN David G' (David.LEDLIN@rms.nsw.gov.au); Marosszeky, Akos (Baulderstone); Hari Corliss; Russell, Nathan (Baulderstone); Metcalfe, Kieran (Baulderstone); Ben Luffman (Ben.Luffman@ghd.com)
Subject: RE: Table 6.2 final review

Hi Mark, thanks for the opportunity to review and comment on these designs and the current changes. The EPA acknowledges the attention to the detail incorporated into the designs to improve the effectiveness and functionality of the these fauna passage structures and encourages the continued engagement of the Project Ecologist and the relevant Agencies to get the best outcomes on site. Overall, the EPA is satisfied with the majority of the design changes that will either improve the functioning of the structures or have negligible effect on their intended purpose.

The only identified issue with the information on the current designs that needs some attention is the specific details for fauna passage at the structure at C2.60. It is noted that the proposed combined structure is to be 2 cell, 3.0 m wide by 2.1 m high and approximately 88 m long. The original intent of the structures and the target species at this site appear to have been confused as they have been modified and combined. Whilst the current dimensions are not ideal for larger fauna passage, given the important location of this structure in regard to the mapped key habitat and the local Koala population, the effectiveness of the structure for fauna passage purposes still needs to be maximised through the use of such measures as a low flow channel, fauna furniture (including rails and refuge poles) and appropriately placed fauna fencing. At the site visit to this structure during the ERG on 5/8/14 some of the details were discussed and included on the that version of table 6.2 but are now omitted and/or confused in the details on page 10 of the report. If you require any further clarification on specifics please don't hesitate to give me a ring.

The EPA also notes the commitment to further consultation as detailed designs progress.

Regards
Brian

Brian Tolhurst | Senior Threatened Species Officer | NSW Environment Protection Authority | ☎: (02) 6659 8277| Mobile ☎: 0429 215 388 | 🖷 (02) 6651 6187

From: Mark J Turner [mailto:Mark.J.Turner@lendlease.com]
Sent: Thursday, 13 November 2014 9:41 AM
To: Grant Fletcher; Aleesha.Darlington@rms.nsw.gov.au; 'james.sakker@industry.nsw.gov.au' (james.sakker@industry.nsw.gov.au); Tolhurst Brian; Murphy Stuart; sandpipereco@optusnet.com.au
Cc: 'LEDLIN David G' (David.LEDLIN@rms.nsw.gov.au); Marosszeky, Akos (Baulderstone); Hari Corliss; Russell, Nathan (Baulderstone); Metcalfe, Kieran (Baulderstone); Ben Luffman (Ben.Luffman@ghd.com)
Subject: RE: Table 6.2 final review

All,

Following Grant's email on Monday, please find attached the updated Table 6.2 and accompanying report.

For ease, Table 6-2 has changes (to that previously agreed in September by the ERG) highlighted in yellow. These changes have been reviewed by Sandpiper Ecological and some locations involved site verification. Ecologist comments are found in the furthest right-hand side column from desktop review and this, and impact columns are highlighted in green as foreshadowed in the advice to the Ecologist which is attached also. The columns remain highlighted so the wider group can match the content in the email.

Your earliest confirmation of the findings and design would be appreciated.

If there are any additional questions, do not hesitate to contact Grant or myself.

Mark

Mark Turner | Environmental Approvals Manager | Oxley Highway to Kundabung Upgrade | Engineering | Lend Lease
Construction & Infrastructure
Unit 2/4 Birraba Avenue, Beresfield NSW 2322

Mark J Turner

From: Grant Fletcher
Sent: Saturday, 13 September 2014 8:05 AM
To: Mark J Turner; Gareth Cheeseman; Matt Boyd; Mark Vella
Subject: Fwd: OH2Ku Fauna Infrastructure Site Inspection 11/09/2014

FYI

Regards Grant

Begin forwarded message:

> **From:** Brian Tolhurst <Brian.Tolhurst@epa.nsw.gov.au>
> **Date:** 12 September 2014 3:51:28 pm AEST
> **To:** Hari Corliss <Hari.Corliss@lendlease.com>, "James Sakker (james.sakker@dpi.nsw.gov.au)" <james.sakker@dpi.nsw.gov.au>
> **Cc:** Grant Fletcher <Grant.Fletcher@lendlease.com>, LEDLIN David G <David.LEDLIN@rms.nsw.gov.au>, "Aleesha.DARLINGTON@rms.nsw.gov.au" <Aleesha.DARLINGTON@rms.nsw.gov.au>, Ben Luffman <Ben.Luffman@ghd.com>, "Cummings, Ben" <bcummings@davislangdon.com.au>, Stuart Murphy <Stuart.Murphy@epa.nsw.gov.au>, Craig Dunk <Craig.Dunk@epa.nsw.gov.au>
> **Subject: RE: OH2Ku Fauna Infrastructure Site Inspection 11/09/2014**
>
> Hari, thanks for the summary of yesterday's field visit. I concur with the record of the general outcomes of the discussions held.
>
> In regard to table 6.2, I would however like to reinforce EPA's position at this time is for further consultation in regards to the site specific fauna furniture and site treatment details that are in the table supplied *Table 6-2 2014-09-11 Ecologist comments and review by EPA and DPI.pdf,* in that the details in the column titled **Project ecologist recommendations (email dated 7/7/14)** may be currently incomplete or require modification and additions. For example: the omission in the notes of internal refuge poles for several combined culverts, the number and position of refuge poles, scour softening treatment at intended fauna passage areas, etc, will need further discussions and agreement for each structure. Also the addition of any identified target species for each structure in the table would also be helpful to guide future discussions are addressing the original intent and the effectiveness of the mitigation measures proposed.
>
> In regard to site specific location and design of the frog ponds, the EPA also requests the opportunity to be consulted at a time suitable for review before work begins at these sites.
>
> Regards
> Brian
>
> **Brian Tolhurst | Senior Threatened Species Officer | NSW Environment Protection Authority |** ☎: (02) 6659 8277| Mobile ☎: 0429 215 388 | 🖷: (02) 6651 6187

Mark J Turner

From: Grant Fletcher
Sent: Thursday, 13 November 2014 4:04 PM
To: James Sakker; Mark J Turner; Aleesha.DARLINGTON@rms.nsw.gov.au; LEDLIN David G
Subject: RE: Table 6.2 final review

James,

Thankyou for the quick turnaround, your comments are noted and as designs are formalised we will pass them.

In addition we will review them as agreed in field at the ERG on regular inspections.

Grant Fletcher | Environmental Manager | Oxley Highway to Kundabung | Lend Lease Engineering Pty Limited
Construction & Infrastructure
PO Box 245,Beresfield NSW 2322 Australia
T +61 2 4033 6600 | M +61 416 120 963
Grant.Fletcher@lendlease.com | www.lendlease.com
P Please consider the environment before printing this email

From: James Sakker [mailto:james.sakker@dpi.nsw.gov.au]
Sent: Thursday, 13 November 2014 12:50 PM
To: Mark J Turner; Aleesha.DARLINGTON@rms.nsw.gov.au; Grant Fletcher; LEDLIN David G
Subject: Re: Table 6.2 final review

Thanks Mark
I'm happy with the table. I would still like to see detailed design and make comments on treatments that may be required for grade issues on inlets and outlets of culverts.
regards James

James Sakker Regional Assessment Officer (Pacific Highway Upgrade)
NSW Department of Primary Industries
1243 Bruxner Hwy Wollongbar NSW 2477
Mobile 0419 185378
Conserve, Share, Provide

On 13 November 2014 10:58, Mark J Turner <Mark.J.Turner@lendlease.com> wrote:

Mark Turner | Environmental Approvals Manager | Oxley Highway to Kundabung Upgrade | Engineering | Lend Lease

Construction & Infrastructure

Unit 2/4 Birraba Avenue, Beresfield NSW 2322

PO Box 245, Beresfield NSW 2322

T +61 2 9499 0973 | M +61 407 370 765

Mark.J.Turner@lendlease.com | www.lendlease.com

From: James Sakker [mailto:james.sakker@dpi.nsw.gov.au]
Sent: Thursday, 13 November 2014 10:54 AM
To: Mark J Turner
Subject: Re: Table 6.2 final review

Hi Mark

can you resend it either as a pdf or in the old xl format. I can't read this version of table 6.2

thanks James

James Sakker Regional Assessment Officer (Pacific Highway Upgrade)

NSW Department of Primary Industries

1243 Bruxner Hwy Wollongbar NSW 2477

Mobile 0419 185378

Conserve, Share, Provide

On 13 November 2014 09:40, Mark J Turner <Mark.J.Turner@lendlease.com> wrote:

All,

Following Grant's email on Monday, please find attached the updated Table 6.2 and accompanying report.

For ease, Table 6-2 has changes (to that previously agreed in September by the ERG) highlighted in yellow. These changes have been reviewed by Sandpiper Ecological and some locations involved site verification. Ecologist comments are found in the furthest right-hand side column from desktop review and this, and impact columns are highlighted in green as foreshadowed in the advice to the Ecologist which is attached also. The columns remain highlighted so the wider group can match the content in the email.

Your earliest confirmation of the findings and design would be appreciated.

If there are any additional questions, do not hesitate to contact Grant or myself.

Mark

Mark Turner | Environmental Approvals Manager | Oxley Highway to Kundabung Upgrade | Engineering | Lend Lease

Construction & Infrastructure

Unit 2/4 Birraba Avenue, Beresfield NSW 2322

PO Box 245, Beresfield NSW 2322

T +61 2 9499 0973 | M +61 407 370 765

Mark.J.Turner@lendlease.com | www.lendlease.com

From: Grant Fletcher
Sent: Monday, 10 November 2014 9:39 AM
To: Aleesha.Darlington@rms.nsw.gov.au; 'james.sakker@industry.nsw.gov.au' (james.sakker@industry.nsw.gov.au); Brian.Tolhurst@epa.nsw.gov.au; stuart.murphy@epa.nsw.gov.au; sandpipereco@optusnet.com.au
Cc: 'LEDLIN David G' (David.LEDLIN@rms.nsw.gov.au); Mark J Turner; Marosszeky, Akos (Baulderstone); Hari Corliss; Russell, Nathan (Baulderstone); Metcalfe, Kieran (Baulderstone); Ben Luffman (Ben.Luffman@ghd.com)
Subject: Table 6.2 final review

Hi,

As per our discussion via telephone, please wait in reviewing table 6.2.

A updated revision should be available mid-week, sorry for the inconvenience.

Regards,

Grant Fletcher | Environmental Manager | Oxley Highway to Kundabung | Lend Lease Engineering Pty Limited

Construction & Infrastructure

PO Box 245, Beresfield NSW 2322 Australia

Mark J Turner

From: Grant Fletcher
Sent: Saturday, 13 September 2014 8:06 AM
To: Mark J Turner; Gareth Cheeseman; Matt Boyd; Mark Vella
Subject: Fwd: OH2Ku Fauna Infrastructure Site Inspection 11/09/2014

FYI

Regards Grant

Begin forwarded message:

> **From:** James Sakker <james.sakker@dpi.nsw.gov.au>
> **Date:** 12 September 2014 4:07:11 pm AEST
> **To:** Hari Corliss <Hari.Corliss@lendlease.com>
> **Cc:** "Brian Tolhurst (Brian.Tolhurst@epa.nsw.gov.au)" <Brian.Tolhurst@epa.nsw.gov.au>, Grant Fletcher <Grant.Fletcher@lendlease.com>, LEDLIN David G <David.LEDLIN@rms.nsw.gov.au>, "Aleesha.DARLINGTON@rms.nsw.gov.au" <Aleesha.DARLINGTON@rms.nsw.gov.au>, Ben Luffman <Ben.Luffman@ghd.com>, "Cummings, Ben" <bcummings@davislangdon.com.au>, "stuart.murphy@epa.nsw.gov.au" <stuart.murphy@epa.nsw.gov.au>
> **Subject: Re: OH2Ku Fauna Infrastructure Site Inspection 11/09/2014**
>
> Hi Hari
> I'm satisfied with the outcomes of the changes to fauna underpasses and approve the changes listed in the document attached '*Table 6-2 2014-09-11 Ecologist comments and review by EPA and DPI.pdf*'
> I agree that the assessments and recommendations provided by the Project Ecologist are considered adequate and satisfy the requirements of DPI. I note that further consultation with DPI will be undertaken in regards to the design and extent of fauna furniture (including tie in to existing vegetation etc.) and provisions for fish passage within fauna underpasses.
> regards James
>
> James Sakker Regional Assessment Officer (Pacific Highway Upgrade)
> NSW Department of Primary Industries
> 1243 Bruxner Hwy Wollongbar NSW 2477
> Mobile 0419 185378
> *Conserve, Share, Provide*

On 12 September 2014 11:40, Hari Corliss <Hari.Corliss@lendlease.com> wrote:

Brian/James,

Thanks for your time yesterday.

To close out discussions held during the site inspection with yourselves and the wider OH2Ku environmental management team Lend Lease would like to confirm the following in regards to items discussed.

Discussions around the revision of changes to Table 6-2:

- EPA and DPI are satisfied with the outcomes of the changes to fauna underpasses and approve the changes listed in the document attached '*Table 6-2 2014-09-11 Ecologist comments and review by EPA and DPI.pdf*';

- The assessments and recommendations provided by the Project Ecologist are considered adequate and satisfy the requirements of EPA and DPI;

- Further consultation with EPA and DPI is to be undertaken in regards to the design and extent of fauna furniture (including tie in to existing vegetation etc.) and provisions for fish passage within fauna underpasses; and

- Lend Lease will maintain a living document throughout construction to capture agreements made on ERG inspections and document construction milestones. This document is to be used to demonstrate compliance at construction completion.

In regards to rope bridge and glide pole locations, the following agreements were made today yesterday:

- EPA has previously had input in the current proposed locations;

- Lend Lease will show an area of 50m either side of the nominated chainage in table attached in the agreed general location on design drawings, with a note stating that the exact location of the pole (or existing tree in the case of glide poles) shall be determined following clearing via an in-field review with the Project Ecologist, EPA and RMS; and

- The Project Ecologist will undertake a preliminary assessment of suitable locations and pole heights prior to clearing. This information shall be fed into the design of the respective fauna crossing locations.

The locations of frog ponds in Green-thighed frog habitat were also inspected and the following points were made:

- The general locations as marked on the design drawings were ok, Lend Lease to revise design to show a hatched area in the location with the exact location of frog ponds to be determined following mainline clearing with the Project Ecologist to minimise impacts on surrounding suitable breeding habitat; and

- Lend Lease and the Project Ecologist are to investigate opportunities to retain existing suitable breeding habitat in preference to clearing to construct artificial frog ponds.

Please confirm your position on the above as soon as possible.

Thanks again for your time.

Cheers

Hari Corliss | **Environmental Coordinator, Oxley Highway to Kundabung Upgrade | Engineering** | Lend Lease

Unit 2/4 Birraba Avenue, Beresfield NSW 2322

PO Box 245, Beresfield NSW 2322

m +61 419 124 227

hari.corliss@lendlease.com | www.lendlease.com

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Lend Lease Reconciliation Action Plan – www.reconciliation.org.au

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Appendix B - Revised Table 6.2 – Tender Design & Consultation

Culvert I.D. (Table 6-2, Appendix B, Doc. A1(d)	New Culvert I.D.	Stn. Appendix B of A1(d) Revised concept Tender	Crossing type	Cells Concept Tender	Diameter (m) Concept Tender	Height (m) Concept Tender	Length (m) (Table 6-2, Appendix B, Doc. A1(d)	Revised length (m), EPA approved May 2013	Revised length (m) EPA approved February 2014	Target species (other species that may use crossing)	Habitat	Fauna furniture	Potential monitoring location?	Fish Passage (J. Sakker pers. comm)
4F	F 1.04	1030 1040 1040	Dedicated	1	3	3	42	49	54	Koala (macropods, small mammals, reptiles, amphibians)	Modified environment, mapped as Cleared Scattered Trees adjoining intact Moist Slopes Forest and Moist Gully Forest	Rails and refuge poles (koalas)	Yes. Dedicated fauna crossing.	No
6	C1.60	1590 1600	Incidental	4	1.8	1.2	60	67	69	(Frogs, reptiles, mammals if dry)	Links native vegetation to east and west, located in a mapped sub-regional corridor	No	No	Yes Class 3
6F	F1.62	1620 1620 1640	Dedicated	1	3	3	45.6	49	52	Koala (macropods, possums, small mammals, reptiles, amphibians)	In a mapped sub-regional corridor	Rails and refuge poles (koalas)	Yes. Dedicated fauna crossing	No
9	C2.60 C2.60A C2.60B	2605 2600 2600	Combined	3+1 3 1	1.8 + 3 1.8 3.0	1.8 1.8 1.8	81.6	91	88 (99) (88)	(Frogs, reptiles, small mammals if dry)	Modified environment, mapped as Cleared Scattered Trees and Totally Cleared Open Pasture/Weed Fallow	No	No. Culvert located in modified environment. Dedicated culvert 6F is located approximately 1km to south	Yes Class 3
10	C3.59 C3.59 C3.59A C3.59B C3.59C C3.59D	3585 3590 3590	Combined	3+1 3+1 3 3 1 1	1.5+3 1.5+3 1.5 1.5 3.0 3.0	1.2+1.8 1.2+1.8 1.2 1.2 1.8 1.8	46.8	76	 42 26 43 23	(frogs, reptiles, small mammals if dry)	Links native vegetation east and west	No	No. Propose to monitor Culvert C4.46.	Yes Class 3

Culvert I.D. (Table 6-2, Appendix B, Doc. A1(d)	New Culvert I.D.	Stn. Appendix B of A1(d) Revised concept Tender	Crossing type	Cells Concept Tender	Diameter (m) Concept Tender	Height (m) Concept Tender	Length (m) (Table 6-2, Appendix B, Doc. A1(d)	Revised length (m), EPA approved May 2013	Revised length (m) EPA approved February 2014	Target species (other species that may use crossing)	Habitat	Fauna furniture	Potential monitoring location?	Fish Passage (J. Sakker pers. comm)
13	C4.46	4456 4460 4460	Combined	4 3 3	3	2.1	69.6	70	47	Koala (Small macropods, possums, small mammals, frogs, reptiles)	Links native vegetation east and west	Rails and refuge poles (koalas)	Yes. Located in fragmented habitat in a drainage line. Culvert may be utilised by koalas. Use to measure successful crossing rates in this long culvert (70m)	No
-	C4.50	4500	Combined	6 1	3.6	1.8		98	59	(Frogs, reptiles, small mammals if dry)	Links small fragmented patches native vegetation to east, in proximity to cleared areas	No	No	Yes Class 2
15		4600-4900	Twin bridges-Fernbank Creek	-	-	-	Overall length: 250 (nb) 275 (sb)	Overall length: 250 (nb) 275 (sb)	Overall length: 275 (nb) 250 (sb)	(Koalas, possums, macropods , wetland and open country birds, reptiles, amphibians)	Patchy vegetation connectivity within riparian corridor to east and west	No	No Located on edge of cleared floodplain. Limited vegetative connectivity to nearby native vegetation	Yes Class 2
19	-	5500-6100	Twin Bridges-Hastings River	-	-	-	570	570	570	(Koalas, possums, macropods, wetland and open country birds, reptiles, amphibians)	Patchy vegetation connectivity within riparian corridor to east and west	No	No. Limited and degraded native vegetation along river banks. Extensive clearing in this locality may affect fauna movement	Yes Class 1
20	C6.30	6283 6300 6300	Combined	1	3	3	50.4	51	34	(Macropods, frogs, reptiles)	Floodplain	No	No. Culvert located in modified environment.	No

Culvert I.D. (Table 6-2, Appendix B, Doc. A1(d)	New Culvert I.D.	Stn. Appendix B of A1(d) Revised concept Tender	Crossing type	Cells Concept Tender	Diameter (m) Concept Tender	Height (m) Concept Tender	Length (m) (Table 6-2, Appendix B, Doc. A1(d)	Revised length (m), EPA approved May 2013	Revised length (m) EPA approved February 2014	Target species (other species that may use crossing)	Habitat	Fauna furniture	Potential monitoring location?	Fish Passage (J. Sakker pers. comm)
21	C6.72	6727 6720 6720	Combined	1	3	2.4	40.8	45	48	(Koala, spotted-tailed quoll, possums, smaller macropods, small mammals, reptiles, amphibians)	Links native vegetation east and west	Rails and refuge poles (koalas)	No. Propose to monitor Culvert 22, located 550m to north.	No
22	C7.26	7272 7260 7260	Combined	1	3	2.4	43.2	53	48	Koala (spotted-tailed quoll, possums, smaller macropods, small mammals, reptiles, amphibians)	Links native vegetation east and west, contiguous with state forest	Rails and refuge poles (koalas)	Yes. Located in vegetation contiguous with Cairncross state forest and Rawdon Creek nature reserve Culvert may be utilised by koalas and quolls.	No
29	C9.21	9210	Combined	1	3	3	52.8	44	43	Koala (Possums, spotted-tailed quoll, macropods, small mammals, reptiles, amphibians- possibly Green-thighed frog)	Regional corridor associated with key habitat in Rawdon Creek nature reserve to west and Cairncross state forest to east	Rails and refuge poles (koalas)	No. Dedicated culvert 30F is located 500m to the north	No
30F	F9.70	9700	Dedicated	1	3	3	43.2	45	41	Koala (Spotted-tailed quoll, macropods, small mammals, reptiles, amphibians	On the margin of a regional corridor in Moist Floodplain Forest in Cairncross state forest	Rails and refuge poles (koalas) Rocks, logs, hollow logs (frogs) Rocks, hollow logs (quolls)	Yes. Dedicated fauna crossing.	No

Culvert I.D. (Table 6-2, Appendix B, Doc. A1(d)	New Culvert I.D.	Stn. Appendix B of A1(d) Revised concept Tender	Crossing type	Cells Concept Tender	Diameter (m) Concept Tender	Height (m) Concept Tender	Length (m) (Table 6-2, Appendix B, Doc. A1(d)	Revised length (m), EPA approved May 2013	Revised length (m) EPA approved February 2014	Target species (other species that may use crossing)	Habitat	Fauna furniture	Potential monitoring location?	Fish Passage (J. Sakker pers. comm)
-	- C11.08 C11.08	- 11080 11080	- Combined Combined	- 1 1	- 3 3	 2.4 2.4	-	22	24	(Frogs, possibly Green-thighed frogs, reptiles, koala, spotted-tailed quoll, small mammals if dry)	Links native vegetation to east and west, continuous with regional corridor associated with key habitat in Rawdon Creek nature reserve to west and Cairncross state forest to east	Rails and refuge poles (koalas)	No. Dedicated fauna culvert 32F is 600m to north.	No
32A	C11.14	11151 11140 11140	Combined	1	3	2.4	43.2	34	26	(Frogs, possibly Green-thighed frogs, reptiles, koala, spotted-tailed quoll, small mammals if dry)	Swamp Mahogany/ Forest Red Gum Swamp Forest in Cairncross State Forest.	Rails and refuge poles (koalas)	No. Dedicated culvert 32F is located 500m to the north	No
32F	F11.67	11670	Dedicated	1	3	2.4	48	42	41	Koala (Spotted-tailed quoll, macropods, small mammals, reptiles, amphibians)	Dry Ridgetop Forest in Cairncross State Forest	Rails and refuge poles (koalas) Rocks, logs, hollow logs (frogs) Rocks, hollow logs (quolls)	Yes. Dedicated fauna crossing	No
40	-	16400-17000	Twin bridges-Wilsons River	-	-	-	Overall length: 522	Overall length: 522	Overall length: 522	(Koala, small – dasyurids, rodents, medium-possums, and larger mammals-macropods, birds, reptiles, amphibians)	Narrow band of generally continuous vegetation to the east and west of proposed crossing	No	No. Limited and degraded native vegetation along river banks. Extensive clearing in this locality may affect fauna movement	Yes Class 1
44	-	17200-17300	Twin bridges-North Coast Railway Line	-	-	-	Length: 68	Length: 68	Length: 68	(Koala, small to large mammals including macropods, birds, reptiles, amphibians)	Moist Slopes Forest within fragmented vegetation	No	No. Rail line is fence restricting fauna access	No

Culvert I.D. (Table 6-2, Appendix B, Doc. A1(d)	New Culvert I.D.	Stn. Appendix B of A1(d) Revised concept Tender	Crossing type	Cells Concept Tender	Diameter (m) Concept Tender	Height (m) Concept Tender	Length (m) (Table 6-2, Appendix B, Doc. A1(d)	Revised length (m), EPA approved May 2013	Revised length (m) EPA approved February 2014	Target species (other species that may use crossing)	Habitat	Fauna furniture	Potential monitoring location?	Fish Passage (J. Sakker pers. comm)
51	C17.70	17700	Combined	1	3.6 3 3	3.6 3 3	57.6	74	56	(Koalas, macropods, small mammals, birds, reptiles, amphibians)	Fragmented vegetation to east and west	No	No. Fragmented connectivity due to rail line, roads and agriculture may limit fauna movement	No
57	-	19700	Twin Bridges-Cooperabung Creek	-	-	-	Overall length: 36	Overall length: 36	Overall length: 36	(Koalas, small medium and larger mammals-macropods, birds, reptiles, amphibians)	Riparian vegetation is continuous within riparian corridor to east and west	No	No. Fragmented landscape, not in corridor or in national park/state forest. Fragmented connectivity of riparian zone with large patches of vegetation to east and west.	Yes Class 2
59	C20.26	20260	Combined	1	3	2.4	43.2	44	47	(Frogs, reptiles, small mammals if dry)	Links native vegetation to east and west, adjacent to Copperabung Nature reserve	No	No. Dedicated culvert 60F is located 300m to the north	No
60F	F20.54A	20528 20540 20540	Dedicated	1	3	3	55.2	60	66	Koala (Spotted-tailed quoll, macropods, small mammals, reptiles, amphibians)	Links native vegetation to east and west, continuous with regional corridor linking key habitat in Copperabung Nature reserve and Ballengarra State Forest	Rails and refuge poles (koalas) Rocks, hollow logs (quolls)	Yes. Dedicated fauna crossing.	No
63F	F21.24	21255 21240 21240	Dedicated	1	3	3	84	78	62	Koala (macropods, spotted-tailed quoll, small mammals, reptiles, amphibians)	Regional corridor linking key habitat in Copperabung Nature reserve and Ballengarra State Forest	Rails and refuge poles (koalas) Rocks, hollow logs (quolls)	Yes. Dedicated fauna crossing.	No

Current as at 14/02/2013

Culvert I.D. (Table 6-2, Appendix B, Doc. A1(d)	New Culvert I.D.	Stn. Appendix B of A1(d) Revised concept Tender	Crossing type	Cells Concept Tender	Diameter (m) Concept Tender	Height (m) Concept Tender	Length (m) (Table 6-2, Appendix B, Doc. A1(d)	Revised length (m), EPA approved May 2013	Revised length (m) EPA approved February 2014	Target species (other species that may use crossing)	Habitat	Fauna furniture	Potential monitoring location?	Fish Passage (J. Sakker pers. comm)
64	C21.54	21531 21540 21540	Combined	1	3	3	64.8	62	68	Koala (possums, spotted-tail quoll, macropods, small mammals, reptiles, amphibians)	Regional corridor linking key habitat to east and west	Rails and refuge poles (koalas)	No. Dedicated culvert 64F is located 300m to the south	No
65	C21.80	21791 21780 21780	Combined	1	3	3	60	64	70	Koala (possums, spotted-tailed quoll, macropods, small mammals, reptiles, amphibians)	Regional corridor linking key habitat to east and west	Rails and refuge poles (koalas)	No. Dedicated culvert 64F is located 550m to the south and 67F is located 600m to the north.	No
-	-	22100	Yarrabee Road under bridge	-	-	-	19	19	19	(koalas, possums, spotted-tail quoll, macropods, small mammals, reptiles, amphibians)	Moist Floodplain Closed Forest with Rainforest Elements in proximity to unnamed drainage line	No	No. Incidental fauna crossing. Dedicated culvert 67F is located 130m to the north	No
66	C22.18 C22.18A C22.18B	22180	Combined Incidental Incidental (box culvert)	2	3.6 1.5 1.5 1.5	3.6 - 1.5 1.5	76.8	83	72 28	Koala (possums, spotted-tailed quoll, macropods, small mammals, reptiles, amphibians)	Moist Floodplain Closed Forest with Rainforest Elements in proximity to unnamed drainage line	No. Insufficient dimensions to accommodation furniture. Fauna passage is provided by 67F, 100m to north.	No. Incidental fauna crossing. Dedicated culvert 67F is located 100m to the north	Yes Class 3

Culvert I.D. (Table 6-2, Appendix B, Doc. A1(d)	New Culvert I.D.	Stn. Appendix B of A1(d) Revised concept Tender	Crossing type	Cells Concept Tender	Diameter (m) Concept Tender	Height (m) Concept Tender	Length (m) (Table 6-2, Appendix B, Doc. A1(d)	Revised length (m), EPA approved May 2013	Revised length (m) EPA approved February 2014	Target species (other species that may use crossing)	Habitat	Fauna furniture	Potential monitoring location?	Fish Passage (J. Sakker pers. comm)
67F	F22.32 F22.32 F22.32A F22.32B	22325 22300 22300	Dedicated	1	3.0 3.6 3.6 3.6	3.0 3.6 3.6 3.6	48	55	 60 19	Koala (possums, spotted-tailed quoll, macropods, small mammals, reptiles, amphibians)	Regional corridor linking key habitat to east and west, vegetation continuous with mapped climate change corridor to east	Rails and refuge poles (koalas) Rocks, hollow logs (quolls)	Yes. Dedicated fauna crossing.	No
-	C23.05	23050	Combined	1	3	3	-	51	54	(Frogs, reptiles, small mammals if dry)	Mosaic of native vegetation communities in Ballengarra State Forest	Rails and refuge poles (koalas)	No. Dedicated fauna culvert 67F is located 1km to south in similar habitat	No
73		23967 23940 23940	Combined Barrys Creek Bridges Barrys Creek Bridges	5	3.0	3.0	93.24	Overall length 32	Overall length 32	Koala (possums, spotted-tailed quoll, macropods, small mammals, reptiles, amphibians.		Rails and refuge poles (koala) Rocks, hollow logs (quolls)	No	Class 2

From: james.sakker@dpi.nsw.gov.au
Sent: Friday, 21 February 2014 7:03 AM
To: DARLINGTON Aleesha K
Cc: WOOD Peter G
Subject: Re: OH2Ku Table 6.2

Hi Aleesha
As discussed yesterday I'm happy with the proposed minor changes to the culverts and the more substantial changes to bridge designs
regards james

James Sakker Conservation Manager (Pacific Highway Upgrade) Department of Primary Industries NSW (NSW DPI) 1243 Bruxner Highway Wollongbar NSW 2477
M 0419 185378 F 02 66283264
james.sakker@industry.nsw.gov.au

-----DARLINGTON Aleesha K <Aleesha.DARLINGTON@rms.nsw.gov.au> wrote: -----
To: "james.sakker@dpi.nsw.gov.au" <james.sakker@dpi.nsw.gov.au>
From: DARLINGTON Aleesha K <Aleesha.DARLINGTON@rms.nsw.gov.au>
Date: 02/19/2014 04:43PM
Cc: WOOD Peter G <Peter.WOOD@rms.nsw.gov.au>
Subject: OH2Ku Table 6.2

Hi James,

As per my voicemail I was just ringing to chat about the OH2Ku tender design Table 6.2 (attached).

All Class 1 and 2 waterway crossings remain relatively unchanged. The exception to this is the change from twin bridges to single bridges over both the Hastings and Wilson Rivers, as discussed with you as part of the Tender Design Environmental Assessment.

All Class 3 waterway crossings have been retained as box culverts. There are some minor proposed changes to the length / width of some of these, two of the longer culverts have been split into two (with one culvert proposed under the main carriageways and one under the service road or interchange exit/ entry ramp) at 3590 and 22180, and two culverts where fish passage has been identified have been split into separate drainage / fauna culverts at 2600 and 3590.

As you are aware, the finer details of all crossings within class 1, 2 or 3 waterways will be determined in consultation with yourself and EPA during detailed design. In addition, Lend Lease are all required to meet the fish passage principles outlined in the conditions of approval.

I'll try and call you again tomorrow, otherwise feel free to contact me when it suits you to have a chat about these changes.

Thanks,

Aleesha

Aleesha Darlington
Environmental Officer
Pacific Highway Environmental | Environment Branch
T 02 4924 0649 **F** 02 4924 0351
www.rms.nsw.gov.au

Roads and Maritime Services
47 Darby Street Newcastle NSW 2300

From: Craig Harre [Craig.HARRE@epa.nsw.gov.au]
Sent: Tuesday, 25 February 2014 2:54 PM
To: DARLINGTON Aleesha K; Robert Donohoe
Cc: WOOD Peter G; WOODS Mark; SUMMERELL Steve J; LAWRENCE Scott B
Subject: RE: OH2Ku tender design environmental assessment and Table 6.2
Follow Up Flag: Follow up
Flag Status: Red

Aleesha

Thanks for providing the EPA with your summary of potential design change commitments. The EPA agrees with the summary however the second dot point is initially confusing as we were primarily seeking a corresponding *increase in culvert* aperture to match the increase in length (hence to maintain functionality). However the point is clarified in brackets at the end of the sentence.

I also mention that the EPA discussed the ongoing issue of 'culvert creep' with Bob Higgins at a meeting in Grafton, Friday 21/2/14. Bob undertook to discuss this issue with the OH2K project. The EPA is concerned that final culvert design is often significantly longer than described in the Environmental Assessment. Hence the EPA has recommended to the Department of Planning and Infrastructure that culverts on the Woolgoolga to Ballina project are only increased to a maximum of 5% above the concept length. Where the increase in length is above 5% in important fauna movement corridors the EPA will be seeking a proportional increase in culvert aperture to maintain functionality.

Regards

Craig Harré | Senior Threatened Species Officer | NSW Environment Protection Authority | ☎ 02 6659 8223

From: DARLINGTON Aleesha K [mailto:Aleesha.DARLINGTON@rms.nsw.gov.au]
Sent: Tuesday, 25 February 2014 12:37 PM
To: Harre Craig; Donohoe Robert
Cc: WOOD Peter G; WOODS Mark; SUMMERELL Steve J; LAWRENCE Scott B
Subject: RE: OH2Ku tender design environmental assessment and Table 6.2

Hi Craig and Rob,

As discussed, and further to my email below, Roads and Maritime is committed to constructing the culverts outlined in the current version of Table 6.2 as a minimum. These meet both the allowable changes developed with you at the time of tender, as well as the Department of the Environment conditions of approval. Despite this, the following would be investigated during detailed design:

- C3.59C & C3.59D - The possibility of aligning these two culverts. If during detailed design the ability to align these two culverts was found not to be feasible or reasonable, the measures outlined below would be implemented. These include 1) plantings between the two culverts, 2) ensuring the run between the two culverts is flat, 3) changing the fence layout between the two culverts to create a 'race' and to prevent access to the drainage culverts.
- F20.54 - Potential reduction in the dimensions of this culvert (either increasing height or reducing length).

Happy to discuss further if you have any questions.

Thanks,

Aleesha

From: Craig Harre [mailto:Craig.HARRE@epa.nsw.gov.au]
Sent: Friday, 14 February 2014 11:35 AM
To: DARLINGTON Aleesha K; Robert Donohoe
Cc: WOOD Peter G; WOODS Mark
Subject: RE: OH2Ku tender design environmental assessment and Table 6.2

Aleesha

Thanks for the comprehensive and accurate meeting notes and update on the tender design.

Regards

Craig Harré

Senior Threatened Species Officer | **NSW Environment Protection Authority** |

☎: (02) 6659 8223 | | : craig.harre@environment.nsw.gov.au

From: DARLINGTON Aleesha K [mailto:Aleesha.DARLINGTON@rms.nsw.gov.au]
Sent: Wednesday, 12 February 2014 7:37 AM
To: Harre Craig; Donohoe Robert
Cc: WOOD Peter G; WOODS Mark
Subject: OH2Ku tender design environmental assessment and Table 6.2

Hi Craig and Rob,

Thanks for taking the time yesterday to sit down and go through the tender design and table 6.2.

Here's a brief summary of the main outcomes of what we discussed:

Tender design Environmental Assessment

No major comments as such, just a couple of items to note:

- Rob is required to keep OEH Waters, Floodplains and Catchments informed of our works in the Wilson and Hastings River. No action for RMS at this stage, Rob will inform me if there are any outcomes from this consultation.
- Further to comments on the Water Quality Monitoring Program, we need to check that the groundwater monitoring bores we have installed for pre-construction monitoring will not be impacted by construction works and that we don't have any 'extra bores' that aren't monitoring any impacts.

As a post-note, I can confirm that all monitoring bores have been placed in areas where they would not be impacted by construction. A number of additional piezometres were installed for the preparation of the groundwater modelling, however these would be removed pre / during construction. I can also confirm that all monitoring bores are located near an area that requires monitoring (eg cuts, floodplains or significant embankments, GDEs, private bores, etc). Therefore, we have no 'additional' monitoring bores that aren't being used for monitoring purposes.

Rob will have a read through of the document itself, and advise if there are any other comments.

Table 6.2

Comments made on particular culverts include:

- C3.59C / C3.59D - request to investigate the feasibility of aligning these two culverts. If this is not feasible, the following measures will be implemented: 1) plantings between the two culverts, 2) ensuring the run between the two culverts is flat, 3) changing the fence layout between the two culverts to create a 'race' and to prevent access to the drainage culverts.
- C11.14 - I can confirm that the version of the table I had printed out yesterday had the incorrect location for this culvert. This culvert is located at Ch. 11140, as per our concept design.
- F20.54 - request to investigate the feasibility of proportionally increasing the width / height of this culvert due to the increase in length. As we discussed, this will depend on fill heights at this location. However, I will have a look at this with our designers when I'm back in the office tomorrow and get back to you.
- F22.32 - fauna fencing will be reviewed by EPA at this location during detailed design to try and optimise it.

Let me know if I've missed anything, otherwise I'll get back to you about C3.59 & F20.54 as soon as possible.

Thanks,

Aleesha

Aleesha Darlington
Environmental Officer
Pacific Highway Environmental | Environment Branch
T 02 4924 0649 **F** 02 4924 0351
www.rms.nsw.gov.au

Roads and Maritime Services
47 Darby Street Newcastle NSW 2300

Transport Roads & Maritime Services

Before printing, please consider the environment

Appendix C – Revised Table 6.2 – Concept Design & Consultation

Culvert ID	Stn	Type	Change[1]	Comment(s)
4F/F1.04	1040	Dedicated	Moved from Stn 1030 to 1040. Length increased from 42m to 54m. Dimensions retained at 3000 x 3000 mm.	Length listed in the Table 6.2 was assumed based on the EA concept design. Increase in length occurred when culvert was fully designed to fit with revised concept design. The road alignment was lifted slightly in this vicinity, causing the culvert length to increase. The culvert skew has been altered to reduce length as much as possible. Fill embankment height lifted slightly during tender design.
6F/ F1.62	1640	Dedicated	Increased length from 45.6m to 52m. Dimensions retained at 3000 x 3000 mm. Culvert has been relocated 20m to the north.	Increased culvert length due to an increase in vertical alignment at this location. The culvert was relocated 20m to the north as batter slopes are shorter and the culvert skew revised (perpendicular to road), allowing the culvert length to be reduced as much as possible. The culvert remains within a regional fauna corridor with links to native vegetation at the revised location. Fill embankment height lifted slightly during tender design.
9/ C.2.60	2600	Combined	Increased length from 81m to 88m.	Increase in length due to need to extend the culverts under the local road arrangement, which has been moved away from the main alignment.
10/C3.59	3590	Combined	Change from one 46m culvert to one culvert 43m under the main alignment, one 23m under the service road.	Additional crossing due to need to provide culvert under service road. The culvert inlet and outlet have been placed at ground level to ensure line of sight for fauna through the culvert.

Culvert ID	Stn	Type	Change[1]	Comment(s)
13/C4.46	4460	Combined	Decreased length from 70m to 47m.	Length of the crossing has been reduced.
20/C6.30	6300	Combined	Decreased length from 50m to 34m.	Flood relief structure converted from culverts to a bridge, resulting in reduced length.
21/C6.72	6720	Combined	Increase in length from 40.8m to 48m.	Changes in road design have resulted in slight increase in length due to increase in batter slopes. The culvert length remains less than 50m to maximise use by fauna.
22/C7.26	7260	Combined	Slight increase in length from 43.2m to 48m.	Increased length due to raised vertical alignment that results in longer batter slopes. The increased culvert length is also necessary to ensure the culvert inlet and outlet is at ground level, providing access and line of sight for fauna. The increased length remains less than 50m to maximise use by fauna.
29/C9.21	9210	Combined	Decrease in length from 52.8m to 43m.	The road level at this location has been lowered, with the culvert also lowered. This has allowed the culvert length to be reduced. Reduced length will allow greater visibility through the culvert for fauna, improving opportunity for fauna movement. Culvert length further reduced during tender design due to decrease in fill width at this location.
30F/C9.70	9700	Dedicated	Decrease in length from 43.2m to 41m.	Decrease in length due to reduced project footprint at this location.
C11.08	11080	Combined	Additional combined culvert, 3000 x 2400 mm, 24 metres length.	Combined culvert added under the southbound carriageway in the widened median section through

Culvert ID	Stn	Type	Change[1]	Comment(s)
				Cairncross State Forest. The culvert aligns with C11.14 to provide continued fauna passage under the road alignment.
32A/C11.14	11400	Combined	Decrease in length from 43.2m to 26m. Culvert moved 9m to the south.	In widened median section through Cairncross State Forest. Due to the provision of a widened median, the culvert now only passes under the northbound carriageway, not both. This has resulted in a reduction in culvert length. Reduced length will allow greater visibility through the culvert for fauna.
32F/F11.67	11670	Dedicated	Decrease in length from 48m to 41m.	Length listed in the Table 6.2 was assumed based on the EA concept design. Decrease in length occurred when culvert was fully designed to fit with revised concept design. The road alignment was lowered slightly in this vicinity, resulting in a reduced culvert length. Culvert length further reduced during tender design due to a slight decrease in the project footprint at this location. Reduced length will allow greater visibility through the culvert for fauna.
51/C17.70	17700	Combined	Changed from multi-use structure to combined structure. Decrease in length from 57.6 metres to 56 metres. Size decreased from 3.6 x 3.6m to 3 x 3m.	Larger size in Table 6-2 (RMS 2011) as was a multi-use crossing predominantly for property, livestock and vehicle access. Propose to change to combined crossing as vehicle/livestock passage no longer required. Size changed to 3m x 3m in line with other fauna culverts. Slight decrease in length due to reduced project

Culvert ID	Stn	Type	Change[1]	Comment(s)
				footprint at this location.
59/C20.26	20260	Combined	Slight increase in length from 43.2 metres to 47 metres.	Slight increase due to the increase in cutting depth at this location.
60F/F20.54A	20540	Dedicated	Increase in length from 55.2m to 66m. Moved 12m to the north.	Increased length due to increase in cutting depth at this location. Culvert relocated 12m north to reduce culvert length as much as possible. Culvert is still located within the native vegetation corridor. Outlet level lifted and extended in order to meet ground level to provide line of sight for fauna movement.
63F/F21.24	21240	Dedicated	Decreased length from 84m to 62m. Moved 15m south.	The EA concept design showed the culvert extending under the existing road. The revised concept design has assumed that the existing road embankment can be excavated as it is not required, resulting in a reduced culvert length. Culvert relocated 15m south to the cut to fill transition, to reduce culvert length further. The culvert is still located within the key regional corridor. Reduced length will allow greater visibility through the culvert for fauna.
64/C21.54	21540	Combined	Slight increase in length from 64.8m to 68m.	Increase due to slight changes in cutting depths at this location.
65/C21.80	21780	Combined	Increase in length from 60m to 70m. Moved 11m south.	Increased length due to raised vertical alignment resulting in longer batter slopes. Culvert location and length changes also a result of the need to locate culvert outlet within existing topography at southbound outlet. Culvert is still located within key regional corridor.

Culvert ID	Stn	Type	Change[1]	Comment(s)
66/C22.18	22180	Incidental	Downsized from combined to incidental. Culvert split from one 76.8m culvert to two culverts, one 72m under the main carriageways, and one 28m under the northbound on ramp.	Downgraded to drainage only (incidental culvert) due to proximity of dedicated fauna culvert. Dedicated crossing structure located 120m to the north at 22300 and Yarrabee Rd under bridge (80m south) widened to provide greater fauna movement and dry passage opportunities. Changed layout of the Yarrabee Interchange, to address safety issues, resulted in the need to split the culvert to maintain adequate fauna passage provisions. Increased length due to increased cutting depth at this location.
67F/F22.32	22300	Dedicated	Relocated from 22325 to 22300 (21m south). Culvert split from one 48m culvert to two culverts, one 60m and one 19m under the northbound on ramp. Size increased from 3 x 3 metres to 3.6 x 3.6 metres.	Size increased as culvert at 22180 downsized and length has increased. Relocated to improve sight lines through culvert and ensure dry passage. Culvert remains within key regional corridor.
C23.05	23050	Combined	Incidental culvert at 23050 changed to combined to accommodate fauna passage. Increased from 1.05 x 1.05 metres to 3.0 x 3.0 metres. Decrease in length from 55.2m to 54m.	Changed to combined culvert, increase in height and reduced length to provide greater opportunities for fauna passage.
71F/F23.14	23140	Dedicated	Culvert deleted	Dedicated culvert has been deleted because it would exit below ground surface level, so would not function

Culvert ID	Stn	Type	Change[1]	Comment(s)
				for fauna passage.
73	23940	Barrys Creek Bridge	Changed from a five cell 3.0 x 3.0 metre culvert, with a total length of 93 metres to a bridge with an overall length of 32 metres.	Changed from a culvert to twin bridges to provide greater opportunity for fauna passage.

To:	Robert Donohoe (EPA) Craig Harre (EPA), James Sakker (DPI – Fisheries)	**Fax:**	
CC:			
From:	Jesse Death	**Date:**	24 July 2013
Ref:	MP 07_0090	**Pages:**	24
File no:	SF2013/005066		
Subject:	Refinements to structures in Table 6-2 for the Oxley Highway to Kundabung section of OH2K		

NSW GOVERNMENT | Transport Roads & Maritime Services

Issue

The Minister's Conditions of Approval (CoA) for the Oxley Highway to Kempsey Pacific Highway Upgrade Project (the Project) contain a number of conditions relating to fauna connectivity. This letter provides further information regarding RMS' proposed approach to fauna connectivity and follows from discussions held with EPA at EPA's Coffs Harbour offices on Wednesday 10 July 2013 and with Fisheries on 11 July 2013 in Port Macquarie.

A number of criteria have been developed to support Table 6-2 and to assist tenderers prepare their design for fauna crossing structures. The criteria have been developed to provide some level of flexibility in the design of fauna crossing structures whilst maintaining or improving biodiversity outcomes. RMS will require that tenderers comply with these criteria when developing their design with respect to fauna crossing structures.

Background

Due to the Project's length and funding models available, the Project will be essentially delivered in two main sections – from the Oxley Highway to Kundabung (OH2Ku) (approximately 24 kilometres) and from Kundabung to Kempsey (K2K) (approximately 14 kilometres). A staging report reflecting this approach to delivery has been approved by Department of Planning and Infrastructure in accordance with Condition A7.

A review of the concept design for the OH2Ku section has occurred. Development of the detailed design for this section of the Project will be undertaken as part of a design and construct (D&C) delivery contract that is currently in the tender phase.

The successful tenderer will be required to consult further with EPA and DPI (Fisheries) on any refinements to Table 6-2 during detailed design in accordance with Condition B2.

Purpose

The purpose of this letter is to:

- Detail criteria to be complied with by tenderers when undertaking design development of the fauna crossing structures detailed in Table 6-2 during the tender phase of OH2Ku (refer Table 1 below).
- Detail refinements to Table 6-2 based on application of the criteria and 'structure specific' considerations as discussed at the meetings held on 10 and 11 July 2013 (refer Table 2 below).

The application of criteria promotes innovation and efficiencies in design of the OH2Ku project, provides government with the opportunity to receive better value for money solutions from tenderers whilst maintaining sound biodiversity outcomes.

Comment

Criteria for detailed design of fauna crossing structures

RMS has developed detailed requirements for the design and construction of the OH2Ku project that are outlined in RMS' Request for Tender documentation (which includes detailed information in the Scope of Works and Technical Criteria (SWTC)). There are numerous sections of the SWTC that focus on delivering environmental outcomes, including Appendix 4, Appendix 5 and Appendix 14 (some of which have been provided to EPA and DPI (Fisheries) for their information as part of the tender phase positive guidance sessions).

In addition to the requirements identified in RMS' D&C contract documentation, the following criteria are identified for the purposes of introducing flexibility into the tender design of fauna crossing structures whilst maintaining biodiversity outcomes:

- Changes to the location and/or size of dedicated fauna crossing structures or combined drainage and fauna crossing structures as part of the detailed design process shall be undertaken in consultation with a suitably qualified ecologist (as required by Condition B2) and must also consider:
    - the contribution of any other fauna crossing structures proposed in the immediate area to overall fauna connectivity (crossing context).
    - the location and extent of known fauna movement (vegetation) corridors.
    - the micro landscape in the immediate vicinity of the inlet and outlet of the crossing structure.
    - the influence on fauna movement of any local change in vegetation community types.
- Combined drainage and fauna crossing structures or incidental fauna crossing structures located at Class 2 or Class 3 waterways, as identified in the current agreed version of OH2Ku Table 6-2 (as provided to the EPA on 24 June 2013) must be retained in Table 6-2 and as a minimum must be box culverts.
- The lengths of fauna crossing structures identified in Table 6-2 may be changed subject to the criteria outlined in Table 1:
- Flood relief structures identified in Table 6-2 that are located in areas that have no linking vegetation are defined as incidental fauna crossing structures.
- Further specific criteria for dedicated, combined and incidental culverts are identified in Table 1 and must be met by contractors in the detailed design.

Table 1 Criteria to be applied in detailed design of fauna movement structures

Structure type	Criteria
Dedicated fauna crossing structures	• The total length of dedicated fauna crossing structures for the Project Works must not increase. • The length of any fauna crossing structure where koalas are identified as a target species in Table 6-2 must not increase by greater than 10%. • The length of any fauna crossing structure over 40m in length must not increase by greater than 15%, except where koalas are identified as a target species (and therefore any increase in length is limited to 10%). • The length of any fauna crossing structure under 40m must not increase by greater than 10%. • The number of dedicated crossings is a minimum (ie there can be no fewer dedicated culverts than identified in the current agreed version of OH2Ku Table 6-2[1]). • The dimensions (width and height) of dedicated crossings as detailed in the current agreed version of OH2Ku Table 6-2 can only be 'improved' (ie wider and higher). • All other environmental and/or performance requirements of the SWTC must be met (eg. 'dry passage' requirements). • Tenderers can relocate a dedicated crossing a maximum of 50 metres north or a maximum of 50 metres south (relative to the current agreed version of OH2Ku Table 6-2[1]) to allow for design optimisation. • Where a dedicated crossing is within wildlife movement (vegetation) corridor, any relocation of that dedicated crossing must remain within, and at least 10 metres from the edge of, the applicable wildlife movement (vegetation) corridor.
Combined drainage and fauna crossing structures	• The total length of combined drainage and fauna crossing structures for the Project Works not increasing by greater than 5%. • The length of culverts C2.60, C3.59, C7.26 and C17.70, as identified in Table 6-2, must not increase by greater than 5%. • The length of any fauna crossing structure where koalas are identified as a target species in Table 6-2 must not increase by greater than 10%. • The length of any fauna crossing structure over 40m in length must not increase by greater than 15%, except where koalas are identified as a target species (and therefore any increase in length is limited to 10%). • The length of any fauna crossing structure under 40m must not increase by greater than 10%. • Unless constrained by other environmental and / or performance

Structure type	Criteria
	requirements in the SWTC, tenderers can relocate combined drainage and fauna crossing structures a maximum of 50 metres north or a maximum of 50 metres south to allow for design optimisation. • Where a combined drainage and fauna crossing structure is within wildlife movement (vegetation) corridor, any relocation of that combined crossing must remain within the applicable wildlife movement (vegetation) corridor. • A minimum clear space envelope applies to any refinements to any combined drainage and fauna crossing structure. The dimensions (width and height) of the structure (as identified in the current agreed version of OH2Ku Table 6-2) defines the minimum clear space envelope. In the case of multiple-cell combined drainage and fauna crossing structures, the minimum clear space envelope to be applied is based on the dimensions (width and height) of the largest cell in the multiple cell structure. • Tenderers cannot propose the use of pipe culverts as combined drainage and fauna crossing structures. • All other environmental and/or performance requirements of the SWTC must be met (eg. 'dry passage' requirements). • The number of combined drainage and fauna crossing structures identified in the current agreed version of OH2Ku Table 6-2 is not a minimum. However, the total clear space envelope of the largest cell of the crossing structures to be combined must be maintained.
Incidental fauna crossing structures	• Design requirements for incidental fauna crossing structures will be removed from OH2Ku Table 6-2. Detailed design for these structures will be based on hydraulic needs. • The preferred tenderer is to include the details of all incidental fauna crossing structures included in the detailed design in the report required by Condition B3 and note any changes in their design.
Bridge structures	• Bridge structures (as identified in the current agreed version of OH2Ku Table 6-2) must not be replaced by culverts. • The number of bridge structures identified in the current agreed version of OH2Ku Table 6-2 is not a minimum. • Bridge 'lengths' are to be removed from the current agreed version of OH2Ku Table 6-2 to provide tenderers with increased flexibility in design whilst maintaining biodiversity outcomes. • Refinement of bridge lengths should seek to limit any further reduction in the availability of dry fauna passage compared with that provided by the design in the current agreed version of Table 6-2 (ie not wanting to

Structure type	Criteria
	'push' fauna movement to wetter areas adjacent to abutments).

[1] The current agreed version of Table 6-2 is as provided to the EPA on 24 June 2013.

Proposed refinements to Table 6-2

Proposed refinements to Table 6-2 based on application of the criteria and 'structure specific' considerations as discussed at the meetings on 10 and 11 July 2013 are identified in Table 2 below.

A revised Table 6-2 will be provided to EPA and DPI (Fisheries) based on the detail included in Table 2 below.

Table 2 – Proposed changes to the current agreed version of OH2Ku Table 6-2 based on discussions with EPA and DPI (Fisheries) on 10 and 11 July 2013

Culvert ID	Station	Type	Detail as included in current agreed Table 6-2[1]	Comment(s)	Consultation
4 / C1.01	1020	Incidental	1 cell 0.9 metre pipe culvert, 61 metres in length	• Remove from Table 6-2. • Apply 'incidental fauna crossing structure criteria' in Table 1 above to detailed design of this structure.	Discussed at meeting with EPA on 10 July 2013. Discussed at meeting with DPI Fisheries on 11 July 2013.
4F / F1.04	1040	Dedicated	1 cell 3 x 3 metre box culvert, 49 metres in length	• Apply 'dedicated fauna crossing structure criteria' in Table 1 above to detailed design of this structure.	Dimensions discussed at site visit with EPA/DPI (Fisheries) on 7 Sept 2012. Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
6 / C1.60	1600	Incidental	4 cell 1.8 x 1.2 metre box culverts, 67 metres in length	• Remove from Table 6-2. • Apply 'incidental fauna crossing structure criteria' in Table 1 above to detailed design of this structure.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
6F / F1.62	1620	Dedicated	1 cell 3 x 3 metre box culvert, 49 metres in length	• Apply 'dedicated fauna crossing structure criteria' in Table 1 above to detailed design of this structure.	Dimensions discussed at site visit with EPA/DPI on 7 September 2012. Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.

Culvert ID	Station	Type	Detail as included in current agreed Table 6-2[1]	Comment(s)	Consultation
9 / C2.60	2600	Combined	4 cell box culvert (3 cells 1.8 x 1.8 metre and 1 cell 3 x 1.8 metre), 91 metres in length.	• Apply 'combined drainage and fauna crossing structure criteria' in Table 1 above to detailed design of this structure. • Notwithstanding the 'combined fauna crossing structure criteria' in Table 1, no 'north / south' optimisation would be accepted at this location based on koala movement corridor. • Minimum clear space envelope for detailed design is 1 cell 3 x 1.8 metres. • Fish passage requirements for a Class 3 waterway must be accommodated.	Discussed at site visit with EPA/DPI on 7 September 2012. Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
10 / C3.59	3590	Combined	4 cell box culvert (3 cells 1.5 x 1.2 metre and 1 cell 3 x 1.8 metre), 76 metres in length.	• Apply 'combined drainage and fauna crossing structure criteria' in Table 1 above to detailed design of this structure. • Minimum clear space envelope for detailed design is 1 cell 3 x 1.8 metres. • Fish passage requirements for a Class 3 waterway must be accommodated. • EPA has identified this location as a key fauna crossing structure.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.

Culvert ID	Station	Type	Detail as included in current agreed Table 6-2[1]	Comment(s)	Consultation
12 / C4.22	4220	Incidental	1 cell 1.2 metre pipe culvert, 71 metres in length	• Remove from Table 6-2. • Apply 'incidental fauna crossing structure criteria' in Table 1 above to detailed design of this structure.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
13 / C4.46	4460	Combined	3 cell 3 x 2.1 metre box culverts, 70 metres in length.	• Apply 'combined drainage and fauna crossing structure criteria' in Table 1 above to detailed design of this structure. • Notwithstanding the 'combined fauna crossing structure criteria' in Table 1, only limited 'north / south' optimisation would be accepted by EPA at this location based on koala movement corridor. • Minimum clear space envelope for detailed design is 1 cell 3 x 2.1 metres.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
- / C4.50	4500	Flood relief structure	6 cell 3.6 x 1.8 metre box culverts, 98 metres in length.	• Retain in refined Table 6-2. • Apply 'combined drainage and fauna crossing structure criteria' in Table 1 above to detailed design of this structure. • Notwithstanding the 'combined fauna crossing structure criteria' in Table 1, only limited 'north / south' optimisation would be accepted at this location based on koala movement corridor. • Minimum clear space envelope for detailed design is 1 cell 3.6 x 1.8 metres. • Fish passage requirements for a Class 2 waterway must be accommodated.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.

Culvert ID	Station	Type	Detail as included in current agreed Table 6-2[1]	Comment(s)	Consultation
15	4600 - 4900	Twin bridges over Fernbank Creek	Overall length 250 metres (northbound) and 275 metres (southbound)	• Apply 'bridge structures criteria' in Table 1 above to detailed design of this structure. • Movement of the southern bridge abutments (NB and SB bridges) further to the north would not be accepted at this location based on the fauna movement corridor present. • Fish passage requirements for a Class 2 waterway must be accommodated.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
16 / C5.20	5200	Combined	4 cell 3 x 2.1 metre box culverts, 48 metres in length.	• Remove from Table 6-2. • Apply 'incidental fauna crossing structure criteria' in Table 1 above to detailed design of this structure.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
19 / -	5500 - 6100	Twin Bridges Hastings River	Overall length 570 metres (NB and SB). 3 x 3 metre unhindered fauna passage on northern and southern banks	• Apply 'bridge structures criteria' in Table 1 above to detailed design of this structure. • Retain 3 x 3 metre unhindered fauna passage on northern and southern banks as per currently agreed Table 6-2. • Fish passage requirements for a Class 1 waterway must be accommodated.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
20 / C6.30	6300	Combined (flood relief structure)	1 cell 3 x 3 metre box culvert, 51 metres in length	• Apply 'combined drainage and fauna crossing structure criteria' in Table 1 above to detailed design of this structure. • Minimum clear space envelope for detailed design is 3 x 3 metres. • This general location (station 6,100 to station 6,600) is a key fauna movement corridor.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.

Culvert ID	Station	Type	Detail as included in current agreed Table 6-2[1]	Comment(s)	Consultation
21 / C6.72	6720	Combined	1 cell 3 x 2.4 metre box culvert, 45 metres in length	• Apply 'combined drainage and fauna crossing structure criteria' in Table 1 above to detailed design of this structure. • Minimum clear space envelope for detailed design is 1 cell 3 x 2.4 metres. • This is considered a key Koala movement corridor.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
22 / C7.26	7260	Combined	1 cell 3 x 2.4 metre box culvert, 54 metres in length	• Apply 'combined drainage and fauna crossing structure criteria' in Table 1 above to detailed design of this structure. • Minimum clear space envelope for detailed design is 1 cell 3 x 2.4 metres.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
29 / C9.21	9210	Combined	1 cell 3 x 3 metre box culvert, 44 metres in length	• Apply 'combined drainage and fauna crossing structure criteria' in Table 1 above to detailed design of this structure. • Minimum clear space envelope for detailed design is 1 cell 3 x 3 metres.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
30F / F9.70	9700	Dedicated	1 cell 3 x 3 metre box culvert, 45 metres in length	• Apply 'combined drainage and fauna crossing structure criteria' in Table 1 above to detailed design of this structure.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
32 / C10.60	10600	Incidental	2 cell 1.05 metre pipe culverts, 34 metres in length	• Remove from Table 6-2. • Apply 'incidental fauna crossing structure criteria' in Table 1 above to detailed design of this structure.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.

Culvert ID	Station	Type	Detail as included in current agreed Table 6-2[1]	Comment(s)	Consultation
- / C11.08	11080	Combined	1 cell 3 x 2.4 metre box culvert, 22 metres in length.	• Apply 'combined drainage and fauna crossing structure criteria' in Table 1 above to detailed design of this structure. • Notwithstanding the 'combined fauna crossing structure criteria' in Table 1, optimisation of this culvert would only be accepted if it brought culverts C11.08 and C11.14 closer together. • Minimum clear space envelope for detailed design is 1 cell 3 x 2.4 metres.	Discussed at site visit with EPA/DPI on 7 September 2012. Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
32A / C11.14	11400	Combined	1 cell 3 x 2.4 metre box culvert, 34 metres in length.	• Apply 'combined drainage and fauna crossing structure criteria' in Table 1 above to detailed design of this structure. • Notwithstanding the 'combined fauna crossing structure criteria' in Table 1, optimisation of this culvert would only be accepted if it brought culverts C11.08 and C11.14 closer together. • Minimum clear space envelope for detailed design is 1 cell 3 x 2.4 metres.	Discussed at site visit with EPA/DPI on 7 September 2012. Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
32F / F11.67	11670	Dedicated	1 cell 3 x 2.4 metre box culvert, 42 metres in length	• Apply 'dedicated fauna crossing structure criteria' in Table 1 above to detailed design of this structure.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
32B / C11.68	11680	Incidental	2 cell 1.05 metre pipe culverts, 48 metres in length	• Remove from Table 6-2. • Apply 'incidental fauna crossing structure criteria' in Table 1 above to detailed design of this structure.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.

Culvert ID	Station	Type	Detail as included in current agreed Table 6-2[1]	Comment(s)	Consultation
- / C13.18	13180	Flood relief structure	5 cell 2.1 x 1.2 metre box culverts, 44 metres in length	• Remove from Table 6-2. • Apply 'incidental fauna crossing structure criteria' in Table 1 above to detailed design of this structure.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
- / C14.30	14300	Flood relief structure	5 cell 3 x 1.2 metre box culverts, 40 metres in length	• Remove from Table 6-2. • Apply 'incidental fauna crossing structure criteria' in Table 1 above to detailed design of this structure.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
- / C16.10	16100	Flood relief structure	3 cell 3 x 1.2 metre box culverts, 44 metres in length	• Remove from Table 6-2. • Apply 'incidental fauna crossing structure criteria' in Table 1 above to detailed design of this structure.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
40 / -	16400 - 17000	Twin Bridges Wilsons River	Overall length 522 metres (NB and SB). 3 x 3 metre unhindered fauna passage on northern and southern banks	• Apply 'bridge structures criteria' in Table 1 above to detailed design of this structure. • Retain 3 x 3 metre unhindered fauna passage on northern and southern banks as per currently agreed Table 6-2. • Fish passage requirements for a Class 1 waterway must be accommodated.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
44 / -	17200 - 17300	Twin Bridges North Coast Rail Line	Overall length 21 metres (NB and SB). 3 x 3 metre unhindered fauna passage on northern and southern banks	• Minimum requirement is for 13.5 metres from toe of southern abutment to toe of northern abutment of the twin bridges over the north coast rail line (inclusive of fauna crossing and rail infrastructure requirements).	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
50 / C17.60	17160	Incidental	2 cell 1.2 metre pipe culverts, 117 metres in length	• Remove from Table 6-2. • Apply 'incidental fauna crossing structure criteria' in Table 1 above to detailed design of this structure.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.

Culvert ID	Station	Type	Detail as included in current agreed Table 6-2[1]	Comment(s)	Consultation
51 / C17.70	17700	Combined	1 cell 3 x 3 metre box culvert, 74 metres in length.	• Apply 'combined drainage and fauna crossing structure criteria' in Table 1 above to detailed design of this structure. • Minimum clear space envelope for detailed design is 1 cell 3 x 3 metres.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
52 / C18.26	18260	Incidental	2 cell 3 x 1.2 metre box culverts, 58 metres in length	• Remove from Table 6-2. • Apply 'incidental fauna crossing structure criteria' in Table 1 above to detailed design of this structure. • Requirements for Giant Barred Frog must be considered in any refinements to the design of this structure.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
53x / C18.72	18720	Incidental	2 cell 1.8 x 0.9 metre box culverts, 26 metres in length	• Remove from Table 6-2. • Apply 'incidental fauna crossing structure criteria' in Table 1 above to detailed design of this structure.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
53 / C18.74	18740	Incidental	1 cell 3 x 2.1 metre box culvert, 56 metres in length	• Remove from Table 6-2. • Apply 'incidental fauna crossing structure criteria' in Table 1 above to detailed design of this structure.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
57 / -	19700	Twin Bridges Cooperabung Creek	Overall length 36 metres (NB and SB). 3 x 3 metre unhindered fauna passage on northern and southern banks.	• Apply 'bridge structures criteria' in Table 1 above to detailed design of this structure. • As a minimum, retain fauna passage requirements as per currently agreed Table 6-2. • Fish passage requirements for a Class 2 waterway must be accommodated.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.

Culvert ID	Station	Type	Detail as included in current agreed Table 6-2[1]	Comment(s)	Consultation
57 (west) / -	19700	Twin Bridges Cooperabung Creek (western access road)	Overall length 35 metres (NB and SB). 3 x 3 metre unhindered fauna passage on southern bank and 3 x 1 metre (1 m = height) on northern bank.	• Apply 'bridge structures criteria' in Table 1 above to detailed design of this structure. • As a minimum, retain fauna passage requirements as per currently agreed Table 6-2. • Fish passage requirements for a Class 2 waterway must be accommodated.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
57 (east) / -	19700	Twin Bridges Cooperabung Creek (eastern access road)	Overall length 35 metres (NB and SB). 3 x 3 metre unhindered fauna passage on northern and southern banks.	• Apply 'bridge structures criteria' in Table 1 above to detailed design of this structure. • As a minimum, retain fauna passage requirements as per currently agreed Table 6-2. • Fish passage requirements for a Class 2 waterway must be accommodated.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
58s / C20.06	20060	Incidental	4 cell 1.5 metre diameter pipe culverts, 56 metres in length	• Remove from Table 6-2. • Apply 'incidental fauna crossing structure criteria' in Table 1 above to detailed design of this structure.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
59 / C20.26	20260	Combined	1 cell 3 x 2.4 metre box culvert, 44 metres in length.	• Apply 'combined drainage and fauna crossing structure criteria' in Table 1 above to detailed design of this structure. • Minimum clear space envelope for detailed design is 1 cell 3 x 2.4 metres.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
- / C20.30	20300	Incidental	2 cell 1.5 metre diameter pipe culverts, 26 metres in length	• Remove from Table 6-2. • Apply 'incidental fauna crossing structure criteria' in Table 1 above to detailed design of this structure.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.

Culvert ID	Station	Type	Detail as included in current agreed Table 6-2[1]	Comment(s)	Consultation
60F / F20.54A	20540	Dedicated	1 cell 3 x 3 metre box culvert, 60 metres in length.	• Apply 'dedicated fauna crossing structure criteria' in Table 1 above to detailed design of this structure.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
- / F20.54B	20540	Dedicated	1 cell 3 x 3 metre box culvert, 31 metres in length.	• Apply 'dedicated fauna crossing structure criteria' in Table 1 above to detailed design of this structure. • Review this structure in consultation with EPA to identify potentially better fauna connectivity outcomes (eg removal of culvert to allow fauna to pass over local access road rather than have a cumulative culvert length of +90 metres).	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
63F / F21.24	21240	Dedicated	1 cell 3 x 3 metre box culvert, 78 metres in length.	• Apply 'dedicated fauna crossing structure criteria' in Table 1 above to detailed design of this structure.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
- / C21.26	21260	Incidental	1 cell 1.05 metre diameter pipe culvert, 102 metres in length.	• Remove from Table 6-2. • Apply 'incidental fauna crossing structure criteria' in Table 1 above to detailed design of this structure.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
- / C21.52	21520	Combined	1 cell 3 x 3 metre box culvert, 32 metres in length.	• Apply 'combined drainage and fauna crossing structure criteria' in Table 1 above to detailed design of this structure. • Any optimisation of this culvert should be considered relative to C21.54. The distance between C21.52 and C21.54 (ie 20 metres) must be retained as a minimum. • Minimum clear space envelope for detailed design is 1 cell 3 x 3 metres.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.

Culvert ID	Station	Type	Detail as included in current agreed Table 6-2[1]	Comment(s)	Consultation
64 / C21.54	21540	Combined	1 cell 3 x 3 metre box culvert, 62 metres in length.	• Apply 'combined drainage and fauna crossing structure criteria' in Table 1 above to detailed design of this structure. • Any optimisation of this culvert should be considered relative to C21.52. The distance between C21.52 and C21.54 (ie 20 metres) must be retained as a minimum. • Minimum clear space envelope for detailed design is 1 cell 3 x 3 metres.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
- / C21.78	21780	Combined	1 cell 3 x 3 metre box culvert, 39 metres in length.	• Apply 'combined drainage and fauna crossing structure criteria' in Table 1 above to detailed design of this structure. • Any optimisation of this culvert should be considered relative to C21.80. The distance between C21.78 and C21.80 (ie 20 metres) must be retained as a minimum. • Minimum clear space envelope for detailed design is 1 cell 3 x 3 metres.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
65 / C21.80	21800	Combined	1 cell 3 x 3 metre box culvert, 64 metres in length.	• Apply 'combined drainage and fauna crossing structure criteria' in Table 1 above to detailed design of this structure. • Any optimisation of this culvert should be considered relative to C21.78. The distance between C21.78 and C21.80 (ie 20 metres) must be retained as a minimum. • Minimum clear space envelope for detailed design is 1 cell 3 x 3 metres.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.

Culvert ID	Station	Type	Detail as included in current agreed Table 6-2[1]	Comment(s)	Consultation
-	22100	Yarrabee Road under bridge	Bridge under the main alignment at Yarrabee Road. Overall length 19 metres (NB and SB).	• Remove from Table 6-2. • Apply 'bridge structures criteria' in Table 1 above to detailed design of this structure. • Fauna movement facilitated by dedicated fauna crossing structure at 22300.	Discussed at site visit with EPA/DPI on 7 September 2012. Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
66 / C22.18	22180	Incidental	2 cell 1.5 metre diameter pipe culvert, 83 metres in length.	• Retain in Table 6-2. • Apply 'incidental fauna crossing structure criteria' in Table 1 above to detailed design of this structure. • Fish passage requirements for a Class 3 waterway must be accommodated. • Minimum clear space envelope for detailed design is 1 cell x 1.05 metre diameter. • Detailed design must incorporate box culvert structures at this location to better facilitate fish passage requirements.	Discussed at site visit with EPA/DPI on 7 September 2012. Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
67F / F22.32	22300	Dedicated	1 cell 3.6 x 3.6 metre box culvert, 55 metres in length.	• Apply 'dedicated fauna crossing structure criteria' in Table 1 above to detailed design of this structure.	Discussed at site visit with EPA/DPI on 7 September 2012. Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
71F / C23.05	23050	Combined	1 cell 3 x 3 metre box culvert, 51 metres in length.	• Apply 'combined drainage and fauna crossing structure criteria' in Table 1 above to detailed design of this structure. • Minimum clear space envelope for detailed design is 1 cell 3 x 3 metres.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.

Culvert ID	Station	Type	Detail as included in current agreed Table 6-2[1]	Comment(s)	Consultation
71 / C23.06	23060	Incidental	1 cell 1.05 metre diameter pipe culvert, 27 metres in length.	• Remove from Table 6-2. • Apply 'incidental fauna crossing structure criteria' in Table 1 above to detailed design of this structure.	Discussed at meeting with EPA on 10 July and DPI (Fisheries) on 11 July 2013.
73 / -	23940	Twin Bridges Barrys Creek	Overall length 40 metres (NB and SB).	• Apply 'bridge structures criteria' in Table 1 above to detailed design of this structure. • Retain 3 x 3 metre unhindered fauna passage on northern and southern banks as per currently agreed Table 6-2. • Fish passage requirements for a Class 2 waterway must be accommodated.	

1. The current agreed version of Table 6-2 is as provided to the EPA on 24 June 2013. Box culvert dimensions are displayed as 'width' x 'height' in metres.

DARLINGTON Aleesha K
From: james.sakker@dpi.nsw.gov.au
Sent: Monday, 22 April 2013 9:13 AM
To: Jesse Death
Cc: DARLINGTON Aleesha K; Craig Harre; Kate Wiggins; DALLEY Steve
Subject: Re: OH2Ku fauna crossing strategy

Hi Jesse
Thanks for refering the interim stage of design for NSW DPI comment and review. NSW DPI is satisfied with the identified fish passage locations and solutions proposed at this stage.
NSW DPI looks forward to further engagement as the detailed design proceeds when issues such as grade and length of culvert structures are better known.
Aleesha can you please circulate this response to any other relevant RMS officers for this project.
regards James

James Sakker Conservation Manager (Pacific Highway Upgrade) Department of Primary Industries NSW (NSW DPI) 1243 Bruxner Highway Wollongbar NSW 2477
M 0419 185378 F 02 66283264
james.sakker@industry.nsw.gov.au

-----Jesse Death <jdeath@manidisroberts.com.au> wrote: -----
To: Craig Harre <Craig.Harre@epa.nsw.gov.au>, "james.sakker@dpi.nsw.gov.au" <james.sakker@dpi.nsw.gov.au>
From: Jesse Death <jdeath@manidisroberts.com.au>
Date: 04/16/2013 04:17PM
Cc: Aleesha Darlington <Aleesha.Darlington@rms.nsw.gov.au>, Kate Wiggins <Kate.Wiggins@shjv.com.au>, Steve Dalley <Steve.Dalley@rms.nsw.gov.au>
Subject: OH2Ku fauna crossing strategy

Hi Craig and James,

The Minister's Conditions of Approval (CoA) for the Oxley Highway to Kempsey Pacific Highway Upgrade Project (the Project) contain a number of conditions (CoA B1, B2, B3 and B6) relating to fauna connectivity.

As has previously been discussed with you, it is proposed that the Project be delivered in stages. A staging report has been approved by DP&I for the Project. The attached memo reflects the current (proposed) concept design relating to fauna movement for the Oxley Highway to Kundabung (OH2Ku) section of the Project.

The proposed approach and intent of this memo is to consult with EPA and DPI on proposed changes to Table 6-2 as a result of the concept design review process. RMS' proposed approach to consultation includes further involvement by EPA and DPI during detailed design and this phase of consultation reflects an interim stage of design for this section of the project.

In line with the above-referenced conditions of approval this report is provided for your comment. It would be appreciated if comments could be provided to RMS by Friday 3 May 2013. After receipt of your comments this report will be updated and provided to DP&I for their review and approval.

Please do not hesitate to contact me if you would like to discuss any aspect of the attached memo.

Regards

Jesse Death
Senior Executive – Environment
Manidis Roberts

T 02 9248 9800
M 0404 853 677
F 02 9248 9810

jdeath@manidisroberts.com.au

Level 9, 17 York Street, Sydney NSW 2000
GPO Box 91, Sydney NSW 2001

From: Robert Donohoe [Robert.Donohoe@epa.nsw.gov.au]
Sent: Wednesday, 3 July 2013 10:05 PM
To: DARLINGTON Aleesha K
Cc: Craig Harre; LAWRENCE Scott B
Subject: RE: Oxley Highway to Kempsey documents
Follow Up Flag: Follow up
Flag Status: Completed
Attachments: GTF Managment OH2K EPAComment July 2013.doc

Hi Aleesha,

I've reviewed the RMS responses to the OH2Ku Connectivity Report EPA comments and consider the RMS responses to be appropriate
to satisfy EPA concerns, we feel its appropriate for you to send this on to Planning for review/approval.

EPA comments on the Green – Thighed Frog Management Strategy are attached.

The EPA review of the OH2K Nest Box Plan of Management has confirmed that the plan is satisfactory and we have no comments on the document.

If there are any concerns in relation to the above issues please don't hesitate to contact me to discuss.

Regards

Rob

From: DARLINGTON Aleesha K [mailto:Aleesha.DARLINGTON@rms.nsw.gov.au]
Sent: Wednesday, 3 July 2013 10:02 AM
To: Donohoe Robert
Cc: Harre Craig; LAWRENCE Scott B
Subject: Oxley Highway to Kempsey documents

Hi Rob,

Just following up on my voicemail message. I tried to call Craig but was advised he is on leave. I was hoping to touch base with one or both of you on a couple of Oxley Highway to Kempsey items we have with you at the moment:

- K2K Connectivity Report (sent 10/04/13) - Scott mentioned that there had been a bit of confusion with this one (ie the assumption that the OH2Ku document included this information as well). My apologies it seems this confused a few people. Despite this, has someone had a chance to have a look at it? As I mentioned to Scott, it should be fairly straightforward as we discussed the detail in this document at length on site with Craig and James. So there shouldn't be anything new in there.
- Green Thighed Frog Management Strategy (send 07/06/13)
- Nest Box Plan (02/07/13)
- OH2Ku Connectivity Report responses to EPA comments (sent 24/06/13) - I noticed Craig mentioned in an email he'd have time to look at this that week after downloading the fauna fencing figures. Did he provide any feedback to you about whether he was satisfied with our responses? Are you ok with me sending this one on to Planning for their review/ approval?

I appreciated the workload you are all facing at the moment, however a number of these documents have Department of Planning timeframes that I am rapidly approaching so even just an indication of when I might hear back from yourself or Craig would be much appreciated.

Thanks,

Aleesha

Aleesha Darlington
Environmental Officer
Pacific Highway Environmental | Environment Branch
T 02 4924 0649 **F** 02 4924 0351
www.rms.nsw.gov.au

Roads and Maritime Services
47 Darby Street Newcastle NSW 2300

From: DARLINGTON Aleesha K
Sent: Monday, 24 June 2013 2:39 PM
To: Craig Harre
Cc: Robert Donohoe; Jesse Death; james.sakker@dpi.nsw.gov.au; LAWRENCE Scott B; WOOD Peter G
Subject: RE: OH2Ku fauna crossing strategy
Attachments: OH2K_connectivtyreport_EPAComment_May2013_RMS responses.doc

Hi Craig,

Thanks for your comments. Responses to these have been included in the attached. The fauna fencing drawings have also been revised, these will follow shortly via large file transfer.

Please call me if you have any questions or concerns.

Thanks,

Aleesha

From: Craig Harre [mailto:Craig.HARRE@epa.nsw.gov.au]
Sent: Friday, 24 May 2013 2:56 PM
To: Jesse Death; james.sakker@dpi.nsw.gov.au
Cc: DARLINGTON Aleesha K; Kate Wiggins; DALLEY Steve; Robert Donohoe
Subject: RE: OH2Ku fauna crossing strategy
Jesse

Thankyou for the opportunity to review and provide comment on the OH2Ku fauna crossing strategy. EPA comments are attached.

Regards

Craig Harré
Senior Threatened Species Officer | **NSW Environment Protection Authority** |
(: (02) 6659 8223 ||8: craig.harre@environment.nsw.gov.au

From: Jesse Death [mailto:jdeath@manidisroberts.com.au]
Sent: Tuesday, 16 April 2013 4:12 PM
To: Harre Craig; james.sakker@dpi.nsw.gov.au
Cc: Aleesha Darlington; Kate Wiggins; Steve Dalley
Subject: OH2Ku fauna crossing strategy

Hi Craig and James,

The Minister's Conditions of Approval (CoA) for the Oxley Highway to Kempsey Pacific Highway Upgrade Project (the Project) contain a number of conditions (CoA B1, B2, B3 and B6) relating to fauna connectivity.

As has previously been discussed with you, it is proposed that the Project be delivered in stages. A staging report has been approved by DP&I for the Project. The attached memo reflects the current (proposed) concept design relating to fauna movement for the Oxley Highway to Kundabung (OH2Ku) section of the Project.

The proposed approach and intent of this memo is to consult with EPA and DPI on proposed changes to Table 6-2 as a result of the concept design review process. RMS' proposed approach to consultation includes further involvement by EPA and DPI during detailed design and this phase of consultation reflects an interim stage of design for this section of the project.

In line with the above-referenced conditions of approval this report is provided for your comment. It would be appreciated if comments could be provided to RMS by Friday 3 May 2013. After receipt of your comments this report will be updated and provided to DP&I for their review and approval.

Please do not hesitate to contact me if you would like to discuss any aspect of the attached memo.

Regards

Jesse Death
Senior Executive – Environment
Manidis Roberts

T 02 9248 9800
M 0404 853 677
F 02 9248 9810

jdeath@manidisroberts.com.au

Level 9, 17 York Street, Sydney NSW 2000
GPO Box 91, Sydney NSW 2001

www.manidisroberts.com.au

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ENVIRONMENT PROTECTION AUTHORITY - COMMENT SHEET

Project:	Pacific Hwy Upgrade – Oxley Highway to Kempsey		
Document title:	OH2Ku fauna connectivity strategy		
Revision No.:	April 2013		
Reviewer name:	Craig Harré	Review date:	24/05/13
Responses by:	Aleesha Darlington	Response date:	17/06/13

Thankyou for the opportunity to comment on the Project's OH2Ku fauna connectivity strategy**.** The EPA has reviewed the document and has outlined key areas of concern and recommendations in the table below.

Reference	EPA comment	RMS Response
C6.72	A 10m increase in culvert length (25% longer) does not qualify as a 'slight' increase. A culvert of length 53m needs to remain at the minimum 2.4m height to provide sufficient clearance for Koalas. The EPA does not generally recommend culverts <3.0m height for Koala connectivity structures. The EPA notes that structures on this project <50m in length are typically nominated at either 3.0m, 2.4m and 2.1m height, although there is no monitoring data to support Koala use of the smaller types of structures. However Koala passage has been recorded in *3.0m x 3.0m* structures for lengths up to and above 50m, therefore this is the EPA preferred *minimum* dimension for Koala culverts up to and beyond 50m in length. Where structures are proposed at <50m it is feasible that smaller sized structures will provide functional Koala connectivity such as was recorded on the Brunswick Heads Bypass where Koala passage was recorded in a 1.8m high structure *20m in length*.	The revised length of C6.72 is 45m. Whilst the length of C6.72 was identified as 40m in the EA, this has since been found to be incorrect. This should have read 46m. Despite this, a review of the fill height in this area has found no major constraints to increasing the height of this culvert from 2.1m to 2.4m. This would result in an increase to the length of this culvert, however this would still be expected to be less than 50m. Exact details on the revised length of this culvert resulting from the height increase would be determined during detailed design.

	Where culverts are exceedingly long there is a high probability that Koalas may investigate the opening but not proceed with complete passage to the other side. The fate of such Koalas could potentially involve continued movement along the fauna fence or another linear feature. This behaviour was recorded by AMBS in their recent monitoring of a 3.0m x3.0m x 80m long culvert on the Bonville Upgrade where it was discussed that Koalas repelled by the excessively long culvert followed the fauna fence to its end point and onto the highway where they were killed.	
C17.70	The proposed changes to this culvert are undesirable as they increase the length and decrease the opening dimensions. As mentioned above a culvert of such an extreme length is unlikely to provide functional connectivity for the Koala. In their monitoring of the 3 x3 x 80m long culvert at Bonville the AMBS concluded that the culvert was too long to provide functional connectivity. Logically, if the culvert can't be decreased in length it would then follow that a larger aperture should be provided to offset the extreme length. Therefore the EPA does not support the downsizing of the culvert to 3.0m x 3.0m. The opportunity to monitor this culvert is recommended as the Australian Koala Foundation also recommends that culverts should be built with a minimum opening dimension of 3.6m x 3.6m.	This culvert was initially sized at 3.6m x 3.6m for a cattle and vehicle underpass. The landowner has since indicated that this is not required. On reviewing the fauna habitat in this area the ecologist has determined that this culvert falls within an area of fragmented habitat, due to the rail line, roads and agriculture and does not form part of a key regional corridor. Additionally, due to this fragmented connectivity the ecologist has indicated that fauna movement would be limited and there would be no target fauna for a crossing at this location. Instead the crossing would be incidental for a range of species. As such, due to the limited fauna movement anticipated and the revised usage requirements of this culvert, RMS considers a 3.0m x 3.0m culvert to be appropriate at this location. Additionally, it is not considered beneficial to monitor this culvert. Instead, dedicated fauna underpasses to the north (F20.54A) and south (F11.67) will be monitored.
F20.54A	The EPA recommends that batter slopes are increased to avoid an increase in culvert length. The previously proposed culvert length of 55.2m is already beyond the maximum proven functional length of 50m.	An increase in batter slopes at this location to reduce culvert length is feasible, however the detailed discussions and studies on how this would be achieved would need to be conducted during the detailed design phase of the project. The D&C Contractor will be encouraged to explore these options during tender assessment and detailed design.
Attachment B	There is not sufficient detail provided to enable EPA review of fauna fencing. The	Revised plans are attached which show the location

	diagrams need to include: • Chainage • Underpasses • Corridors • Greater landscape context (need larger view)	and landscape context of the fauna fencing and associated fauna underpasses.

To:	Craig Harre (EPA), James Sakker (DPI – Fisheries)	**Fax:**	
CC:			
From:	Jesse Death	**Date:**	16 April 2013
Ref:	D/00202	**Pages:**	13
File no:			
Subject:	Refinements to structures in Table 6-2 for the Oxley Highway to Kundabung section of OH2K		

Transport Roads & Maritime Services

MEMO

Dear Craig / James

The Minister's Conditions of Approval (CoA) for the Oxley Highway to Kempsey Pacific Highway Upgrade Project (the Project) contain a number of conditions relating to fauna connectivity. This memo provides information on RMS' approach to delivery of the Project and associated approach to managing CoA relevant to fauna connectivity.

This memo also seeks initial comment from you on refinements to Table 6-2 for the Oxley Highway to Kundabung (OH2Ku) section of the Project.

Project staging

Due to the Project's length and funding models available, the Project will be essentially delivered in two main sections – from the Oxley Highway to Kundabung (approximately 24 kilometres) and from Kundabung to Kempsey (approximately 14 kilometres). A staging report reflecting this approach to delivery has been prepared and submitted to the Department of Planning and Infrastructure in accordance with CoA A7.

A review of the concept design for the OH2Ku section has occurred and development of the detailed design for this section of the Project will occur as part of a design and construct (D&C) delivery contract that has yet to be released for tender. Detailed design is currently being finalised for the Kundabung to Kempsey (K2K) section of the Project, which will be subject to a 'construct only' delivery contract.

Approach to consultation

Given differing levels of design detail for the two main sections of the Project, and with regard to CoA B1, B2, B3 and B6 (refer Table 1 below), RMS intends to consult with EPA and DPI (Fisheries) separately for the K2K and OH2Ku sections of the Project.

This memo focuses on the OH2Ku section only. A staged approach to consultation for the OH2Ku section of the Project has been discussed with DP&I and would include:

- RMS to seek feedback from EPA and DPI (Fisheries) on fauna crossing structure details (via submission of a revised Table 6-2 for OH2Ku). The revised Table 6-2 has been developed based on the outcomes of a concept design review and would be accompanied by information demonstrating compliance with the requirements of relevant CoA (this memo and Attachment A).
- RMS to consider feedback from EPA and DPI (Fisheries) and prepare a final draft of Table 6-2 for OH2Ku for inclusion in D&C tender documentation.

- Further consultation with EPA and DPI (Fisheries) regarding final detail for Table 6-2 for OH2Ku will occur as part of the D&C process.
- An OH2Ku Fauna Crossing Report, including a finalised Table 6-2 will be submitted to DP&I for approval in accordance with CoA B3.

Approach to design refinements

Table 6-2 in Appendix B of the *Ecological Review of Fauna Crossings in the Ballengarra State Forest* (RMS 2011) (hereafter referred to as Table 6-2 (RMS 2011)) provides an initial assessment of where 'combined' and 'dedicated' fauna crossing structures should be installed within the Project alignment. It also identifies areas where 'incidental' fauna crossing movements may occur.

As part of the review of the OH2Ku concept design, a number of fauna crossing structures have required modification due to changes in the horizontal and vertical alignment and hydraulic performance requirements. Further changes to underpass structures have been made in response to consultation with EPA and DPI (Fishing and Aquaculture) in order to maximise their effectiveness for use by fauna and provide adequate provision for fish passage.

Table 1 below identifies the CoA relevant to fauna connectivity and how they have been addressed to date for the purposes of updating Table 6-2 for OH2Ku.

Table 1 Minister's Conditions of Approval

CoA	Condition	Comment
B1	The Proponent shall design (and implement) the fauna and waterway crossings identified in Table 6-2 of Appendix B of the document listed under condition A1 (d), at the locations and in accordance with the minimum design principles identified in Table 6-2 unless otherwise agreed by the Director-General.	The waterway crossing requirements identified in Table 6-2 (RMS 2011) have been applied where feasible during the review of the concept design. Table 2 below provides detail on the fauna crossing structures as proposed, including any changes in dimensions from those stated in Table 6-2 (RMS 2011).
B2	Investigations into the design of fauna and waterway crossings identified in Table 6-2 of Appendix B of the document listed under condition A1 (d) during detailed design shall be undertaken with the input of a suitably qualified and experienced ecologist and in consultation with the EPA and DPI (Fishing and Aquaculture).	An ecologist has been consulted throughout the concept design development process. Site investigations were undertaken by SMEC Hyder JV ecologists during August and October 2012. Input has been sought from sub-consultant ecologist Ben Lewis (Lewis Ecological Surveys) and Kylie Soanes (PhD candidate, University of Melbourne). EPA and DPI (Fishing and Aquaculture) have also been consulted through the design process. A site visit with representatives from EPA and DPI (Fishing and Aquaculture) was held on 7 September 2012 to discuss fauna underpasses and the proposed widened median (CoA B4). RMS also conducted a separate site visit with DPI (Fishing and Aquaculture) on 26 October 2012 to discuss additional fish passage requirements. This memo will also act to facilitate further consultation with EPA and DPI (Fishing and Aquaculture) on changes to fauna crossing structures that have occurred since Project

CoA	Condition	Comment
		Approval.
B3	The proponent shall prepare a report on the final design of fauna and / or waterway crossings identified in Table 6-2 of Appendix B of the document listed under condition A1 (d), where the location of the crossing has changed and/or the crossing does not meet the minimum design principles identified in Table 6-2. The report shall be submitted to the Director General prior to the commencement of construction of the relevant crossing, and shall demonstrate how the new location and/or design would result in acceptable biodiversity outcomes. The report shall clearly identify how the fauna and/or waterway crossing will work in conjunction with complementary fauna exclusion fencing measures to be implemented for the project. The report shall be accompanied by evidence of consultation with the EPA and DPI (Fishing and Aquaculture) in relation to the suitability of any changes to the location and/or crossing design.	This memo provides information on changes to Table 6-2 for OH2Ku as at the revised concept design stage. The detail provided in this memo with regard to the length of fauna crossing structures (including in Table 2 and Attachment A) is based on the concept design review process and is indicative only as the length of the structures is most influenced by other design features such as grades of batter slopes and the highway's vertical alignment, which will be determined during detailed design phase. As outlined above, further consultation will occur during the OH2Ku detailed design phase. After further consultation during the detailed design phase, a detailed OH2Ku fauna connectivity report will be prepared and submitted to DP&I for approval. Conceptual discussion regarding how fauna crossing structures work in conjunction with fauna exclusion fencing is discussed below in the Fauna Fencing section of this memo. Indicative fauna fencing drawings are provided as Attachment A to this memo to reflect approximate locations for fauna fencing in relation to fauna crossing structures. Fauna fencing drawings will be further revised at detailed design. Evidence of consultation with regard to changes to design of fauna crossing structures identified in Table 6-2 (RMS 2011) is shown in Table 2 below.
B6	The Proponent shall, in consultation with the EPA and DPI (Fishing and Aquaculture), ensure that all waterway crossings are designed and constructed consistent with the principles of the *Guidelines for Controlled Activities Watercourse Crossings* (Department of Water and Energy, February 2008), *Policy and Guidelines for Fish Friendly Waterway Crossings* (NSW Fisheries, February 2004) and *Policy and Guidelines for the Design and Construction of Bridges, Roads, Causeways, Culverts and Similar Structures* (NSW Fisheries 1999). Where multiple cell culverts are proposed for creek crossings, at least one cell shall be provided for fish passage, with an inlet or bed level that mimics creek flows.	All culvert waterway crossings have been designed in accordance with guidelines identified in CoA B6. These guidelines will continue to be applied to the design of fauna crossing structures through the detailed design phase. Bridge design was not revised during concept design review and all relevant guidelines will be considered during development of the OH2Ku detailed design. Details on which fauna crossing structures provide for fish passage are included in Table 2 below.

Changes to Table 6-2 (RMS 2011)

Table 2 below details the proposed changes to dedicated and combined fauna crossing structures required as a result of refinements to other aspects of the OH2Ku concept design. There are no changes proposed to fauna crossing structures identified in Table 6-2 (RMS 2011) that are not included in Table 2 below.

A revised OH2Ku Table 6-2 (inclusive of proposed changes identified in Table 2) is included as Attachment A.

The detail provided in this memo with regard to the length of fauna crossing structures (including in Table 2 and Attachment A) is based on the concept design review process and is indicative only as the length of the structures is most influenced by other design features such as grades of batter slopes and the highway's vertical alignment, which will be determined during detailed design phase.

Detailed design will also consider the outcomes of flood modelling currently being undertaken. Results of flood modelling may require further changes to flood relief structures on the Wilson and Hastings River floodplains. The revised Table 6-2 (Attachment A) provides the current design approach for these structures.

Comments from EPA and DPI (Fishing & Aquaculture) on the revised OH2Ku Table 6-2 are welcomed.

Table 2 – Proposed changes to Table 6-2 (RMS 2011) – fauna crossing structures

Culvert ID	Stn	Type	Change	Comment(s)	Consultation
4/C1.01	1020	Incidental	Changed from Combined 3000 x 3000 mm box culvert to 900mm pipe.	Changed as per Table 6.2 (RMS, 2011). Had not yet been incorporated into the design.	
4F/F1.04	1040	Dedicated	Length increased from 42m to 49m. Dimensions retained at 3000 x 3000 mm.	Additional dedicated culvert as per Table 6.2 (RMS, 2011). Had not yet been incorporated into the design. Length listed in the Table 6.2 was assumed based on the EA concept design. Increase in length occurred when culvert was fully designed to fit with revised concept design. The road alignment was lifted slightly in this vicinity, causing the culvert length to increase. The culvert skew has been altered to reduce length as much as possible to ensure dedicated fauna culvert is less than 50m in length to maximise use by fauna. The culvert inlet and outlet have been placed at ground level to ensure line of sight for fauna through the culvert.	Discussed at site visit with EPA/DPI on 7 September 2012.
6F/ F1.62	1620	Dedicated	Increased length from 45.6m to 49m. Dimensions retained at 3000 x 3000 mm. Culvert has been relocated 10m to north.	Increased culvert length due to an increase in vertical alignment at this location. The culvert was relocated 10m to the north as batter slopes are shorter, allowing the culvert length to be kept	Discussed at site visit with EPA/DPI on 7 September 2012.

Culvert ID	Stn	Type	Change	Comment(s)	Consultation
				below 50m. The culvert skew was also revised (perpendicular to road) to reduce culvert length as far as possible. The culvert remains within a regional fauna corridor with links to native vegetation at the revised location. The culvert inlet and outlet have been placed at ground level to ensure line of sight for fauna through the culvert.	
9/ C.2.60	2600	Combined	Once cell increased in width to 3000mm. Changed from four cells 1800 x 1800 mm to three-cells 1800 x 1800 mm and fourth cell 3000 x 1800 mm. Increased length from 81m to 91m.	Change as per Table 6.2 (RMS, 2011). Had not yet been incorporated into the design. Increase in length due to need to extend the culverts under the local road arrangement, which has been moved away from the main alignment. Culvert has been realigned (perpendicular to road) to reduce length as far as possible. One of the 1800 x 1800 cells has been lowered to bed level to allow for low flow fish passage.	Discussed at site visit with EPA/DPI on 7 September 2012.
10/C3.59	3590	Combined	Increased length from 46.8m to 76m. Changed from incidental four-cell 1500 x 1200mm box culverts to three-cell 1500 x 1200 mm incidental	Change as per Table 6.2 (RMS, 2011). Had not yet been incorporated into the design. Increased length due to need to extend culvert under service road. Culvert has been relocated 10m to	No consultation to date regarding this change.

Culvert ID	Stn	Type	Change	Comment(s)	Consultation
			culverts and one-3000 x 1800 mm combined box culvert.	north to where batter slopes are shorter, allowing length to be reduced as far as possible. The culvert skew has been realigned (perpendicular to road) to reduce length. The culvert inlet and outlet have been placed at ground level to ensure line of sight for fauna through the culvert.	
21/C6.72	6720	Combined	Slight increase in length from 40.8m to 45m. Reduction in dimension from 3000x2400 mm to 3000x2100 mm.	Changes in road design have resulted in slight increase in length due to increase in batter slopes. The culvert length remains less than 50m to maximise use by fauna. The culvert inlet and outlet have been placed at ground level to ensure line of sight for fauna through the culvert. The proposed height of 2400 mm could not be accommodated at this location due to cover requirement to the culvert. Option of lifting the road was investigated and it was identified lifting the road will have impact on flood plain bridge No 2. To meet the cover requirements a reduction in culvert height was required from 2400mm to 2100mm.	No consultation to date regarding this change.
22/C7.26	7260	Combined	Slight increase in length from 43.2m to 53m.	Increased length due to raised vertical alignment that results in longer batter	No consultation to date regarding this change.

Culvert ID	Stn	Type	Change	Comment(s)	Consultation
				slopes. The increased culvert length is also necessary to ensure the culvert inlet and outlet is at ground level, providing access and line of sight for fauna. The increased length is only slightly longer than 50m, which is considered an acceptable length for fauna culverts. Combined culverts to the north and south are both approximately 45m in length, providing alternative opportunities for fauna passage.	
29/C9.21	9210	Combined	Decrease in length from 52.8m to 44m.	The road level at this location has been lowered, with the culvert also lowered. This has allowed the culvert length to be reduced. Reduced length will allow greater visibility through the culvert for fauna, improving opportunity for fauna movement.	No consultation to date regarding this change.
30F/C9.70	9700	Dedicated	Slight increase in length from 43.2m to 45m.	A two-metre excavation is required at inlet to ensure it is at ground level. This has also resulted in slight increase in length. There remains an opportunity to reduce the length by three metres at detailed design. The culvert length remains less than 50m to maximise use by fauna. The culvert inlet and outlet have been	No consultation to date regarding this change.

Culvert ID	Stn	Type	Change	Comment(s)	Consultation
				placed at ground level to ensure line of sight for fauna through the culvert.	
C11.08	11080	Combined	Additional combined culvert, 3000 x 2400 mm, 21.20 metres length.	Combined culvert added under the southbound carriageway in the widened median section through Cairncross State Forest. The culvert aligns with C11.14 to provide continued fauna passage under the road alignment.	Discussed at site visit with EPA/DPI on 7 September 2012.
32A/C11.14	11400	Combined	Decrease in length from 43.2m to 34m.	In widened median section through Cairncross State Forest. Due to the provision of a widened median, the culvert now only passes under the northbound carriageway, not both. This has resulted in a reduction in culvert length. Reduced length will allow greater visibility through the culvert for fauna.	Discussed at site visit with EPA/DPI on 7 September 2012.
32F/F11.67	11670	Dedicated	Decrease in length from 48m to 42m.	Added as per Table 6.2 (RMS, 2011). Had not yet been incorporated into the design. Length listed in the Table 6.2 was assumed based on the EA concept design. Decrease in length occurred when culvert was fully designed to fit with revised concept design. The road alignment was lowered slightly in this vicinity, resulting in a reduced culvert length.	Discussed at site visit with EPA/DPI on 7 September 2012.

Culvert ID	Stn	Type	Change	Comment(s)	Consultation
				Reduced length will allow greater visibility through the culvert for fauna.	
51/C17.70	17700	Combined	Changed from multi-use structure to combined structure. Slight increase in length from 68.64 metres to 73.5 metres. Size decreased from 3.6 x 3.6m to 3 x 3m.	Larger size in Table 6-2 (RMS 2011) as was a multi-use crossing predominantly for property, livestock and vehicle access. Propose to change to combined crossing as vehicle/livestock passage no longer required. The EA design showed the culvert outlet sitting under the embankment. The design was amended to extend to the edge of the embankment, resulting in an increased length. Size changed to 3m x 3m in line with other fauna culverts.	No consultation to date regarding this change.
60F/F20.54A	20540	Dedicated	Increase in length from 55.2m to 60m.	Increased length due to raised vertical alignment resulting in longer batter slopes. Outlet level lifted and extended in order to meet ground level to provide line of sight for fauna movement.	No consultation to date regarding this change.
F20.54B	20540	Dedicated	Additional dedicated culvert under local road. 31m in length.	Additional dedicated culvert added under service road that allows fauna to pass under the service road rather than come out of the culvert under the main alignment straight onto the service road.	Discussed at site visit with EPA/DPI on 7 September 2012.
63F/F21.24	21240	Dedicated	Decreased length from 84m	The EA concept design showed the	No consultation to date regarding this

Culvert ID	Stn	Type	Change	Comment(s)	Consultation
			to 78m.	culvert extending under the existing road. The revised concept design has assumed that the existing road embankment can be excavated as it is not required, resulting in a reduced culvert length. Reduced length will allow greater visibility through the culvert for fauna. Opportunities to reduce the length further or provide alternative measures will be sought at detailed design.	change.
64/C21.54	21540	Combined	Decrease in length from 64.8m to 61.25m.	The road alignment has shifted east at this location to utilise the existing road embankment. This has allowed a reduction in culvert length. Reduced length will allow slightly better visibility through the culvert for fauna movement.	No consultation to date regarding this change.
65/C21.80	21780	Combined	Slight increase in length from 60m to 64m.	Increased length due to raised vertical alignment resulting in longer batter slopes.	No consultation to date regarding this change.
-	22100	Yarrabee Rd under bridge	Bridge under the main alignment at Yarrabee Road has been widened (final dimensions to be confirmed at detailed design).	Under bridge widened to accommodate greater width for fauna passage. This change will also allow for higher ground, dry passage during rain events.	Discussed at site visit with EPA/DPI on 7 September 2012.

Culvert ID	Stn	Type	Change	Comment(s)	Consultation
66/C22.18	22180	Incidental	Downsized from combined to incidental. Length increased from 76.8m to 83m.	Dedicated crossing structure located 120m to the north at 22300 and Yarrabee Rd under bridge (80m south) widened to provide greater fauna movement and dry passage opportunities. Culvert has been lowered to bed level for low flow to provide fish passage. Increased length due to raised vertical alignment resulting in longer batter slopes.	Discussed at site visit with EPA/DPI on 7 September 2012.
67F/F22.32	22300	Dedicated	Relocated from 22323 to 22300 (23m south). Size increased from 3 x 3 metres to 3.6 x 3.6 metres.	Size increased as culvert at 22180 downsized. Relocated to improve sight lines through culvert and ensure dry passage.	Discussed at site visit with EPA/DPI on 7 September 2012.
C23.05	23050	Combined	Drainage only culvert at 23050 changed to combined to accommodate fauna passage.	Changed to combined culvert to provide fauna passage due to the removal of dedicated fauna culvert at 23140.	No consultation to date regarding this change.
F23.14	23140	Dedicated	Culvert deleted	Dedicated culvert has been deleted because it would exit below ground surface level, so would not function for fauna passage.	No consultation to date regarding this change.

Fauna Fencing

As part of the review of the concept design, indicative locations for fauna fencing have been identified. These locations have been developed in accordance with environmental design requirements for similar Pacific Highway projects, and in consultation with Hyder / SMEC JV ecologists and consultant ecologist Ben Lewis (Lewis Ecological Surveys). The approach is also in line with the recommendations in the OH2K Giant Barred Frog Management Strategy (RMS 2013) prepared by Lewis Ecological Survey).

Three types of fauna fencing will be used to support fauna crossing structures for OH2Ku:

- Standard floppy-top fencing will be installed along the road corridor where the Project traverses state forests and regional habitat corridors, and for a minimum of 200m either side of dedicated fauna underpasses (culverts). This aims to exclude terrestrial fauna, including but not limited to Spotted-tail Quoll, (*Dasyurus maculatus*), Koala (*Phascolarctos cinereus*), macropods, bandicoots and large reptiles from the road corridor and guide fauna towards fauna crossings.
- Frog fencing will be installed at areas of known or high potential Giant Barred Frog (*Mixophyes iterates*) and Green-thighed Frog (*Litoria brevipalmata*) habitat, to direct frogs away from the highway and towards underpasses. Frog habitat has been identified in the vicinity of Cooperabung Creek and Barrys Creek.
- Phascogale fencing will be installed at areas of known or high potential habitat, to direct phascogales away from the highway and towards underpasses. Potential habitat has been identified in Cairncross State Forest in the vicinity of culvert F11.68; areas associated with fauna crossing F21.24 in the Ballengarra State Forest; and at Barrys Creek.

Maps showing indicative locations for each of these types of fencing are provided as Attachment B.

If you have any queries regarding the above and attached, please do not hesitate to contact me.

Regards

Jesse Death
Environment Officer
02 9248 9800
0404 853 677

ATTACHMENT A

Culvert I.D. (RMS, 2011)	Culvert I.D. (new)	Stn.	Crossing type	Cells	Diameter (m)	Height (m)	Length (m) (Table 6.2 approved)	Revised length (m)	Target species (other species that may use crossing)	Habitat	Issue	Resolution/Comment	Fauna furniture	Potential monitoring location?	Fish Passage (J. Sakker pers. comm)	Stage
4	C1.01	1020	Incidental	1	0.9	-	-	61	(Frogs, reptiles, small mammals if dry)	Links native vegetation to east, in proximity to cleared and disturbed areas	No issue	Has now been incorporated into the design.	No	No	No	Concept Design
4F	F 1.04	1040	Dedicated	1	3.0	3.0	42	49	Koala (macropods, small mammals, reptiles, amphibians)	Modified environment, mapped as Cleared Scattered Trees adjoining intact Moist Slopes Forest and Moist Gully Forest	Increased length	Has now been incorporated into the design. Length listed in the Table 6.2 was assumed based on the EA concept design. The road alignment was lifted slightly in this vicinity, causing the culvert length to increase. The culvert skew has been altered to reduce length as much as possible to ensure dedicated fauna culvert is less than 50m in length to maximise use by fauna. The culvert inlet and outlet have been placed at ground level to ensure line of sight for fauna through the culvert.	Rails and refuge poles (koalas)	Yes. Dedicated fauna crossing.	No	Concept Design
6	C1.60	1600	Incidental	4	1.8	1.2	60	67	(Frogs, reptiles, mammals if dry)	Links native vegetation to east and west, located in a mapped sub-regional corridor	No issue	N/A	No	No	Yes Class 3	Concept Design

Culvert I.D. (RMS, 2011)	Culvert I.D. (new)	Stn.	Crossing type	Cells	Diameter (m)	Height (m)	Length (m) (Table 6.2 approved)	Revised length (m)	Target species (other species that may use crossing)	Habitat	Issue	Resolution/Comment	Fauna furniture	Potential monitoring location?	Fish Passage (J. Sakker pers. comm)	Stage
6F	F1.62	1620	Dedicated	1	3.0	3.0	45.6	49	Koala (macropods, possums, small mammals, reptiles, amphibians)	In a mapped sub-regional corridor	Increased length	Increased culvert length due to an increase in vertical alignment at this location. The culvert was relocated 10m to the north as batter slopes are shorter, allowing the culvert length to be kept below 50m. The culvert skew was also revised (perpendicular to road) to reduce culvert length as far as possible. The culvert inlet and outlet have been placed at ground level to ensure line of sight for fauna through the culvert.	Rails and refuge poles (koalas)	Yes. Dedicated fauna crossing	No	Concept Design
9	C.2.60	2600	Combined	3+1	1.8+3.0	1.8	81.6	91	(Frogs, reptiles, small mammals if dry)	Modified environment, mapped as Cleared Scattered Trees and Totally Cleared Open Pasture/Weed Fallow	Increased length 1 wet cell required for fish passage.	Has now been incorporated into the design. Increase in length due to need to extend the culverts under the local road arrangement, which has been moved away from the main alignment. Culvert has been realigned (perpendicular to road) to reduce length as far as possible. One of the 1800 x 1800 cells has been lowered to bed level to allow for low flow fish passage.	No	No. Culvert located in modified environment. Dedicated culvert 6F is located approximately 1km to south	Yes Class 3	Concept Design

Culvert I.D. (RMS, 2011)	Culvert I.D. (new)	Stn.	Crossing type	Cells	Diameter (m)	Height (m)	Length (m) (Table 6.2 approved)	Revised length (m)	Target species (other species that may use crossing)	Habitat	Issue	Resolution/Comment	Fauna furniture	Potential monitoring location?	Fish Passage (J. Sakker pers. comm)	Stage
10	C3.59	3590	Combined	3+1	1.5+3.0	1.2+1.8	46.8	76	(frogs, reptiles, small mammals if dry)	Links native vegetation east and west	Increased length.	Has now been incorporated into the design. Increased length due to need to extend culvert under service road. Culvert has been relocated 10m to north to where batter slopes are shorter, allowing length to be reduced as far as possible. The culvert skew has been realigned (perpendicular to road) to reduce length. The culvert inlet and outlet have been placed at ground level to ensure line of sight for fauna through the culvert.	No	No. Propose to monitor Culvert 13.	Yes Class 3	Concept Design
12	C4.22	4220	Incidental	1	1.2	-	69.9	71	(Frogs, reptiles, small mammals if dry)	Links fragmented native vegetation to east, in proximity to cleared areas	No issue	N/A	No	No	No	Concept Design
13	C4.46	4460	Combined	3.0	3.0	2.1	69.6	70	Koala (Small macropods, possums, small mammals, frogs, reptiles)	Links native vegetation east and west	No issue.	Extension of flood relief structures.	Rails and refuge poles (koalas)	Yes. Located in fragmented habitat in a drainage line. Culvert may be utilised by koalas. Use to measure successful crossing rates in this long culvert (70m)	No	Concept Design

Current as at 3/04/2013

Culvert I.D. (RMS, 2011)	Culvert I.D. (new)	Stn.	Crossing type	Cells	Diameter (m)	Height (m)	Length (m) (Table 6.2 approved)	Revised length (m)	Target species (other species that may use crossing)	Habitat	Issue	Resolution/Comment	Fauna furniture	Potential monitoring location?	Fish Passage (J. Sakker pers. comm)	Stage
-	C4.50	4500	New flood relief structure	6	3.6	1.8		98	(Frogs, reptiles, small mammals if dry)	Links small fragmented patches native vegetation to east, in proximity to cleared areas	No issue	New flood relief and potential incidental fauna culvert.	No	No	Yes Class 2	Concept Design
15		4600-4900	Twin bridges-Fernbank Creek	-	-	-	Overall length: 250 (nb) 275 (sb)	Overall length: 250 (nb) 275 (sb)	(Koalas, possums, macropods, wetland and open country birds, reptiles, amphibians)	Patchy vegetation connectivity within riparian corridor to east and west	No issue	Flood relief structure-predominantly dry. Unhindered fauna passage of at least 3m width on both banks. Existing bridge to be retained on service road	No	No Located on edge of cleared floodplain. Limited vegetative connectivity to nearby native vegetation	Yes Class 2	Concept Design
16	C5.20	5200	Combined	4	3	2.1	55	48	(Macropods, frogs, reptiles)	Floodplain	Potential use by fauna	Flood relief structure that offers incidental fauna passage.	No	No. Located in cleared floodplain. No vegetative connectivity to nearby native vegetation	No	Concept Design
19	-	5500-6100	Twin Bridges-Hastings River	-	-	-	570	570	(Koalas, possums, macropods, wetland and open country birds, reptiles, amphibians)	Patchy vegetation connectivity within riparian corridor to east and west	No issue	Unhindered fauna passage of at least 3m width on southern bank (excluding Glen Ewan Rd). Unhindered fauna passage of at least 3m width on northern bank	No	No. Limited and degraded native vegetation along river banks. Extensive clearing in this locality may affect fauna movement	Yes Class 1	Concept Design
20	C6.30	6300	Combined	1	3	3	50.4	51	(Macropods, frogs, reptiles)	Floodplain	Slight increase in length	Flood relief structure. Changes in road design have resulted in slight increase in length due to increase in batter slopes.	No	No. Culvert located in modified environment.	No	Concept Design

Culvert I.D. (RMS, 2011)	Culvert I.D. (new)	Stn.	Crossing type	Cells	Diameter (m)	Height (m)	Length (m) (Table 6.2 approved)	Revised length (m)	Target species (other species that may use crossing)	Habitat	Issue	Resolution/Comment	Fauna furniture	Potential monitoring location?	Fish Passage (J. Sakker pers. comm)	Stage
21	C6.72	6720	Combined	1	3	2.4	40.8	45	(Koala, spotted-tailed quoll, possums, smaller macropods, small mammals, reptiles, amphibians)	Links native vegetation east and west	Appears to be a slight increase in length, however the length in the EA was incorrect and should have read 46m.	Changes in road design have resulted in slight increase in length due to increase in batter slopes. The culvert length remains less than 50m to maximise use by fauna. The culvert inlet and outlet have been placed at ground level to ensure line of sight for fauna through the culvert. The proposed height of 2400 mm could not be accommodated at this location due to cover requirement to the culvert. Option of lifting the road was investigated and it was identified lifting the road will have impact on flood plain bridge No 2. To meet the cover requirements a reduction in culvert height was required from 2400mm to 2100mm.	Rails and refuge poles (koalas)	No. Propose to monitor Culvert 22, located 550m to north.	No	Concept Design

Culvert I.D. (RMS, 2011)	Culvert I.D. (new)	Stn.	Crossing type	Cells	Diameter (m)	Height (m)	Length (m) (Table 6.2 approved)	Revised length (m)	Target species (other species that may use crossing)	Habitat	Issue	Resolution/Comment	Fauna furniture	Potential monitoring location?	Fish Passage (J. Sakker pers. comm)	Stage
22	C7.26	7260	Combined	1	3	2.4	43.2	54	Koala (spotted-tailed quoll, possums, smaller macropods, small mammals, reptiles, amphibians)	Links native vegetation east and west, contiguous with state forest	Increased length	Increased length due to raised vertical alignment that results in longer batter slopes. The increased culvert length is also necessary to ensure the culvert inlet and outlet is at ground level, providing access and line of sight for fauna. The increased length is only slightly longer than 50m, which is considered an acceptable length for fauna culverts.	Rails and refuge poles (koalas)	Yes. Located in vegetation contiguous with Cairncross state forest and Rawdon Creek nature reserve Culvert may be utilised by koalas and quolls.	No	Concept Design
29	C9.21	9210	Combined	1	3	3	52.8	44	Koala (Possums, spotted-tailed quoll, macropods, small mammals, reptiles, amphibians-possibly Green-thighed frog)	Regional corridor associated with key habitat in Rawdon Creek nature reserve to west and Cairncross state forest to east	No issue Decreased length	The road level at this location has been lowered, with the culvert also lowered. This has allowed the culvert length to be reduced. Reduced length will allow greater visibility through the culvert for fauna, improving opportunity for fauna movement.	Rails and refuge poles (koalas)	No. Dedicated culvert 30F is located 500m to the north	No	Concept Design

Culvert I.D. (RMS, 2011)	Culvert I.D. (new)	Stn.	Crossing type	Cells	Diameter (m)	Height (m)	Length (m) (Table 6.2 approved)	Revised length (m)	Target species (other species that may use crossing)	Habitat	Issue	Resolution/Comment	Fauna furniture	Potential monitoring location?	Fish Passage (J. Sakker pers. comm)	Stage
30F	F9.70	9700	Dedicated	1	3	3	43.2	45	Koala (Spotted-tailed quoll, macropods, small mammals, reptiles, amphibians	On the margin of a regional corridor in Moist Floodplain Forest in Cairncross state forest	2m excavation at inlet with slight increase in length.	A two-metre excavation is required at inlet to ensure it is at ground level. This has also resulted in slight increase in length. There remains an opportunity to reduce the length by three metres at detailed design. The culvert length remains less than 50m to maximise use by fauna. The culvert inlet and outlet have been placed at ground level to ensure line of sight for fauna through the culvert.	Rails and refuge poles (koalas) Rocks, logs, hollow logs (frogs) Rocks, hollow logs (quolls)	Yes. Dedicated fauna crossing.	No	Concept Design
32	C10.60	10600	Incidental	2	1.05	-	43.2	34	(Frogs, some reptiles, small mammals if dry)	Links native vegetation to east and west, continuous with regional corridor associated with key habitat in Rawdon Creek nature reserve to west and Cairncross state forest to east	No issue	N/A	No	No	No	Concept Design

Culvert I.D. (RMS, 2011)	Culvert I.D. (new)	Stn.	Crossing type	Cells	Diameter (m)	Height (m)	Length (m) (Table 6.2 approved)	Revised length (m)	Target species (other species that may use crossing)	Habitat	Issue	Resolution/Comment	Fauna furniture	Potential monitoring location?	Fish Passage (J. Sakker pers. comm)	Stage
-	C11.08	11080	New combined culvert	1	3	2.4	-	22	(Frogs, possibly Green-thighed frogs, reptiles, koala, spotted-tailed quoll, small mammals if dry)	Links native vegetation to east and west, continuous with regional corridor associated with key habitat in Rawdon Creek nature reserve to west and Cairncross state forest to east	New culvert	Combined culvert added under the southbound carriageway in the widened median section through Cairncross State Forest. The culvert aligns with C11.14 to provide continued fauna passage under the road alignment.	Rails and refuge poles (koalas)	No. Dedicated fauna culvert 32F is 600m to north.	No	Concept Design
32A	C11.14	11400	Combined	1	3	2.4	43.2	34	(Frogs, possibly Green-thighed frogs, reptiles, koala, spotted-tailed quoll, small mammals if dry)	Swamp Mahogany/ Forest Red Gum Swamp Forest in Cairncross State Forest.	Decreased length	In widened median section through Cairncross State Forest. Due to the provision of a widened median, the culvert now only passes under the northbound carriageway, not both. This has resulted in a reduction in culvert length. Reduced length will allow greater visibility through the culvert for fauna.	Rails and refuge poles (koalas)	No. Dedicated culvert 32F is located 500m to the north	No	Concept Design

Culvert I.D. (RMS, 2011)	Culvert I.D. (new)	Stn.	Crossing type	Cells	Diameter (m)	Height (m)	Length (m) (Table 6.2 approved)	Revised length (m)	Target species (other species that may use crossing)	Habitat	Issue	Resolution/Comment	Fauna furniture	Potential monitoring location?	Fish Passage (J. Sakker pers. comm)	Stage
32F	F11.67	11670	Dedicated	1	3	2.4	48	42	Koala (Spotted-tailed quoll, macropods, small mammals, reptiles, amphibians)	Dry Ridgetop Forest in Cairncross State Forest	Decreased length	Had not yet been incorporated into the design. Length listed in the Table 6.2 was assumed based on the EA concept design. Decrease in length occurred when culvert was fully designed to fit with revised concept design. The road alignment was lowered slightly in this vicinity, resulting in a reduced culvert length.	Rails and refuge poles (koalas) Rocks, logs, hollow logs (frogs) Rocks, hollow logs (quolls)	Yes. Dedicated fauna crossing	No	Concept Design
32B	C11.68	11680	Incidental	2	1.05	-	48	48	(Frogs, possible Green-thighed frog, reptiles, other small to medium sized mammals)	Links native vegetation to east and west, Cairncross State Forest, mapped as regional corridor	No issue	N/A	No	No	No	Concept Design
-	C13.18	13180	New flood relief structure	5	2.1	1.2	-	44	(Koala, small – dasyurids, rodents, medium-possums, and larger mammals-macropods, birds, reptiles, amphibians)	Fragmented native vegetative, cleared areas	No issue	Potential use as incidental fauna passage.	No	No. Incidental fauna crossing	No	Concept Design

Culvert I.D. (RMS, 2011)	Culvert I.D. (new)	Stn.	Crossing type	Cells	Diameter (m)	Height (m)	Length (m) (Table 6.2 approved)	Revised length (m)	Target species (other species that may use crossing)	Habitat	Issue	Resolution/Comment	Fauna furniture	Potential monitoring location?	Fish Passage (J. Sakker pers. comm)	Stage
-	C14.30	14300	New flood relief structure	5	3	1.2	-	40	(Koala, small dasyurids, rodents, medium-possums, and larger mammals-macropods, birds, reptiles, amphibians)	Fragmented native vegetative, cleared areas	No issue	Potential use as incidental fauna passage.	No	Incidental fauna crossing	No	Concept Design
-	C16.10	16100	New flood relief structure	3	3	2.1	-	44	(Koala, small – dasyurids, rodents, medium-possums, and larger mammals-macropods, birds, reptiles, amphibians)	Fragmented native vegetative, cleared areas	No issue	Potential use as incidental fauna passage.	No	No. Incidental fauna crossing	No	Concept Design
40	-	16400-1700	Twin bridges-Wilsons River	-	-	-	Overall length: 522	Overall length: 522	(Koala, small – dasyurids, rodents, medium-possums, and larger mammals-macropods, birds, reptiles, amphibians)	Narrow band of generally continuous vegetation to the east and west of proposed crossing	No issue	Unhindered fauna passage of at least 3m width on southern bank (excluding Hacks Ferry Rd). Unhindered fauna passage of at least 3m width on northern bank	No	No. Limited and degraded native vegetation along river banks. Extensive clearing in this locality may affect fauna movement	Yes Class 1	Concept Design

Culvert I.D. (RMS, 2011)	Culvert I.D. (new)	Stn.	Crossing type	Cells	Diameter (m)	Height (m)	Length (m) (Table 6.2 approved)	Revised length (m)	Target species (other species that may use crossing)	Habitat	Issue	Resolution/Comment	Fauna furniture	Potential monitoring location?	Fish Passage (J. Sakker pers. comm)	Stage
44	-	17200-17300	Twin bridges-North Coast Railway Line	-	-	-	Length: 68	Length: 68	(Koala, small to large mammals including macropods, birds, reptiles, amphibians)	Moist Slopes Forest within fragmented vegetation	No issue	Flood relief structure-predominantly dry. Unhindered fauna passage of at least 3m width on both southern and northern side of railway fence.	No	No. Rail line is fence restricting fauna access	No	Concept Design
50	C17.16	17160	Incidental	2	1.2	-	105.6	117	(Koalas, macropods, small mammals, birds, reptiles, amphibians)	Fragmented vegetation to east and west	Changed from multi-use structure to incidental	Structure was not required as a multi-use culvert for vehicle access. Sized for drainage only.	No	No	No	Concept Design
51	C17.70	17700	Combined	1	3	3	57.6	74	(Koalas, macropods, small mammals, birds, reptiles, amphibians)	Fragmented vegetation to east and west	Increased length	Previously a multi-use crossing. Propose to change to combined crossing; vehicle passage not required. The EA design showed the culvert outlet sitting under the embankment. The design was amended to extend to the edge of the embankment, resulting in an increased length. Size changed to 3m x 3m in line with other fauna culverts.	No	No. Fragmented connectivity due to rail line, roads and agriculture may limit fauna movement	No	Concept Design
52	C18.26	18260	Incidental	2	3	1.2	48	58	(Frogs, reptiles, small mammals if dry)	Fragmented vegetation to east and west	No issue	N/A	No	No	No	Concept Design

Culvert I.D. (RMS, 2011)	Culvert I.D. (new)	Stn.	Crossing type	Cells	Diameter (m)	Height (m)	Length (m) (Table 6.2 approved)	Revised length (m)	Target species (other species that may use crossing)	Habitat	Issue	Resolution/Comment	Fauna furniture	Potential monitoring location?	Fish Passage (J. Sakker pers. comm)	Stage
53X	C18.72	18720	New incidental	2	1.8	0.9	-	26	(Frogs, reptiles, small mammals if dry)	Fragmented vegetation to east and west	No issue	Potential use as incidental culvert	No	No	No	Concept Design
53	C18.74	18740	Incidental	1	3	2.1	50.4	56	(Frogs, reptiles, small mammals if dry)	Not part of a mapped regional corridor	Increased length	Increased length due to raised vertical alignment resulting in longer batter slopes	No	No. Incidental fauna crossing.	No	Concept Design
57	-	19700	Twin Bridges-Cooperabung Creek	-	-	-	Overall length: 36	Overall length: 36	(Koalas, small medium and larger mammals-macropods, birds, reptiles, amphibians)	Riparian vegetation is continuous within riparian corridor to east and west	No issue	At least 3m unhindered fauna passage on both banks.	No	No. Fragmented landscape, not in corridor or in national park/state forest. Fragmented connectivity of riparian zone with large patches of vegetation to east and west.	Yes Class 2	Concept Design
57 (west)	-	19700	Bridge-Cooperabung Creek (western access road)	-	-	-	Overall length: 35	Overall length: 35	(Koalas, small medium and larger mammals-macropods, birds, reptiles, amphibians)	Modified environment-patches of Riparian Forest and Moist Floodplain Forest, also Cleared Scattered Trees and Totally Cleared Open Pasture/Weed Fallow	No issue	At least 3m unhindered fauna passage on both banks. Height restricted to minimum of 1m on northern bank.		No. Successful fauna passage under bridges has been demonstrated on other projects.	Yes Class 2	Concept Design

Culvert I.D. (RMS, 2011)	Culvert I.D. (new)	Stn.	Crossing type	Cells	Diameter (m)	Height (m)	Length (m) (Table 6.2 approved)	Revised length (m)	Target species (other species that may use crossing)	Habitat	Issue	Resolution/Comment	Fauna furniture	Potential monitoring location?	Fish Passage (J. Sakker pers. comm)	Stage
57 (east)	-	19700	Bridge-Cooperabung Creek (eastern access road)	-	-	-	Overall length: 35	Overall length: 35	(Koalas, small medium and larger mammals-macropods, birds, reptiles, amphibians)	Modified environment-patches of Riparian Forest and Moist Floodplain Forest, also Cleared Scattered Trees and Totally Cleared Open Pasture/Weed Fallow	No issue	At least 3m unhindered fauna passage on both banks.		No. Successful fauna passage under bridges has been demonstrated on other projects.	Yes Class 2	Concept Design
58S	C20.06	20060	Incidental	4	1.5	-	28.8	56	(Frogs, reptiles)	Fragmented vegetation to east and west	No issue	N/A	No	No	No	Concept Design
59	C20.26	20260	Combined	1	3	2.4	43.2	44	(Frogs, reptiles, small mammals if dry)	Links native vegetation to east and west, adjacent to Cooperabung Nature reserve	Slight increase in length	Increased length due to raised vertical alignment resulting in longer batter slopes.	No	No. Dedicated culvert 60F is located 300m to the north	No	Concept Design
-	C20.30	20300	New incidental	2	1.5	-	-	26	(Frogs, reptiles, small mammals if dry)	Links native vegetation to east and west, adjacent to Cooperabung Nature reserve	No issue	Potential use as incidental culvert	No	No	No	Concept Design
60F	F20.54A	20540	Dedicated	1	3	3	55.2	60	Koala (Spotted-tailed quoll, macropods, small mammals, reptiles, amphibians)	Links native vegetation to east and west, continuous with regional corridor linking key habitat in Cooperabung Nature reserve and Ballengarra State Forest	Increased length – potential to increase slope of batters to reduce culvert length to be investigated during detailed design.	Increased length due to raised vertical alignment resulting in longer batter slopes. Outlet level lifted and extended in order to meet ground level to provide line of sight for fauna movement.	Rails and refuge poles (koalas) Rocks, hollow logs (quolls)	Yes. Dedicated fauna crossing.	No	Concept Design

Culvert I.D. (RMS, 2011)	Culvert I.D. (new)	Stn.	Crossing type	Cells	Diameter (m)	Height (m)	Length (m) (Table 6.2 approved)	Revised length (m)	Target species (other species that may use crossing)	Habitat	Issue	Resolution/Comment	Fauna furniture	Potential monitoring location?	Fish Passage (J. Sakker pers. comm)	Stage
-	F20.54B	20540	New dedicated	1	3	3	-	31	Koala (Spotted-tailed quoll, macropods, small mammals, reptiles, amphibians)	Links native vegetation to east and west, continuous with regional corridor linking key habitat in Cooperabung Nature reserve and Ballengarra State Forest	Additional fauna crossing under local road	Additional dedicated culvert added under service road that allows fauna to pass under the service road rather than come out of the culvert under the main alignment straight onto the service road.	Rails and refuge poles (koalas) Rocks, hollow logs (quolls)	Yes. Dedicated fauna crossing.	No	Concept Design
63F	F21.24	21240	Dedicated	1	3	3	84	78	Koala (macropods, spotted-tailed quoll, small mammals, reptiles, amphibians)	Regional corridor linking key habitat in Cooperabung Nature reserve and Ballengarra State Forest	Decreased length	The EA concept design showed the culvert extending under the existing road. The revised concept design has assumed that the existing road embankment can be excavated as it is not required, resulting in a reduced culvert length. Reduced length will allow greater visibility through the culvert for fauna. Opportunities to reduce the length further or provide alternative measures will be sought at detailed design.	Rails and refuge poles (koalas) Rocks, hollow logs (quolls)	Yes. Dedicated fauna crossing.	No	Concept Design
-	C21.26	21260	New incidental	1	1.05	-	-	102	(Frogs, reptiles, small mammals if dry)	Regional corridor linking key habitat in Copperabung Nature reserve and Ballengarra State Forest	No issue	Potential use as incidental culvert	No	No	No	Concept Design

Culvert I.D. (RMS, 2011)	Culvert I.D. (new)	Stn.	Crossing type	Cells	Diameter (m)	Height (m)	Length (m) (Table 6.2 approved)	Revised length (m)	Target species (other species that may use crossing)	Habitat	Issue	Resolution/Comment	Fauna furniture	Potential monitoring location?	Fish Passage (J. Sakker pers. comm)	Stage
-	C21.52	21520	New combined	1	3	3	-	32	(Frogs, reptiles, small mammals if dry)	Regional corridor linking key habitat to east and west	Smaller culvert dimensions under adjacent service road	Under service road to align with C21.54. Culvert size designed to match the combined fauna culvert C21.54	Rails and refuge poles (koalas)	No Dedicated fauna culvert 63F is located 300m to south	No	Concept Design
64	C21.54	21540	Combined	1	3	3	64.8	62	Koala (possums, spotted-tail quoll, macropods, small mammals, reptiles, amphibians)	Regional corridor linking key habitat to east and west	Decreased length	The road alignment has shifted east at this location to utilise the existing road embankment. This has allowed a reduction in culvert length. Reduced length will allow slightly better visibility through the culvert for fauna movement.	Rails and refuge poles (koalas)	No. Dedicated culvert 64F is located 300m to the south	No	Concept Design
-	C21.78	21780	New combined	1	3	3	-	39	(Frogs, reptiles, small mammals if dry)	Regional corridor linking key habitat to east and west	No issue.	Under service road to align with C21.80. Culvert size designed to match the combined fauna culvert dimension C21.80.	Rails and refuge poles (koalas)	No. Dedicated culvert 64F is located 300m to the south	No	Concept Design
65	C21.80	21780	Combined	1	3	3	60	64	Koala (possums, spotted-tailed quoll, macropods, small mammals, reptiles, amphibians)	Regional corridor linking key habitat to east and west	Increased length.	Increased length due to raised vertical alignment resulting in longer batter slopes.	Rails and refuge poles (koalas)	No. Dedicated culvert 64F is located 550m to the south and 67F is located 600m to the north.	No	Concept Design

Culvert I.D. (RMS, 2011)	Culvert I.D. (new)	Stn.	Crossing type	Cells	Diameter (m)	Height (m)	Length (m) (Table 6.2 approved)	Revised length (m)	Target species (other species that may use crossing)	Habitat	Issue	Resolution/Comment	Fauna furniture	Potential monitoring location?	Fish Passage (J. Sakker pers. comm)	Stage
-	-	22100	Yarabee Road underbridge	-	-	-	19	19	(koalas, possums, spotted-tail quoll, macropods, small mammals, reptiles, amphibians)	Moist Floodplain Closed Forest with Rainforest Elements in proximity to unnamed drainage line	Bridge under the main alignment at Yarrabee Road has been widened (final dimensions to be confirmed at detailed design).	Under bridge widened to accommodate greater width for fauna passage. This change will also allow for higher ground, dry passage during rain events.	No	No. Incidental fauna crossing. Dedicated culvert 67F is located 130m to the north	No	Concept Design
66	C22.18	22180	Incidental	2	1.5	-	76.8	83	Koala (possums, spotted-tailed quoll, macropods, small mammals, reptiles, amphibians)	Moist Floodplain Closed Forest with Rainforest Elements in proximity to unnamed drainage line	Increased length. Cell required for fish passage. Lower to bed level for low flow. Downgraded to drainage only (incidental culvert) due to proximity of dedicated fauna culvert and Yarrabee Rd underbridge.	Increased length due to raised vertical alignment resulting in longer batter slopes. Culvert has been lowered to bed level for low flow. Dedicated crossing structure located 120m to the north at 22300 and Yarrabee Rd under bridge (80m south) widened to provide greater fauna movement and dry passage opportunities.	No. Insufficient dimensions to accommodation furniture. Fauna passage is provided by 67F, 100m to north.	No. Incidental fauna crossing. Dedicated culvert 67F is located 100m to the north	Yes Class 3	Concept Design
67F	F22.32	22300	Dedicated	1	3.6	3.6	48	55	Koala (possums, spotted-tailed quoll, macropods, small mammals, reptiles, amphibians)	Regional corridor linking key habitat to east and west, vegetation continuous with mapped climate change corridor to east	Decreased length. Relocated from 22323 to 22300. Dimensions changed from 3x3 to 3.6x3.6m	Size increased as culvert at 22180 downsized. Relocated to reduce length and improve sight lines through culvert and ensure dry passage.	Rails and refuge poles (koalas) Rocks, hollow logs (quolls)	Yes. Dedicated fauna crossing.	No	Concept Design

Culvert I.D. (RMS, 2011)	Culvert I.D. (new)	Stn.	Crossing type	Cells	Diameter (m)	Height (m)	Length (m) (Table 6.2 approved)	Revised length (m)	Target species (other species that may use crossing)	Habitat	Issue	Resolution/Comment	Fauna furniture	Potential monitoring location?	Fish Passage (J. Sakker pers. comm)	Stage
71F	C23.05	23050	Combined	1	3	3	55.2	51	(Frogs, reptiles, small mammals if dry)	Mosaic of native vegetation communities in Ballengarra State Forest	Decreased length	Dedicated culvert previously located at 23140; however a culvert at this location would exit below the surface level, so the culvert was removed. This culvert has been changed to combined culvert to provide fauna passage due to the removal of dedicated fauna culvert at 23140.	Rails and refuge poles (koalas)	No. Dedicated fauna culvert 67F is located 1km to south in similar habitat	No	Concept Design
71	C23.06	23050	Incidental	1	1.05	-	55.2	27	(Frogs, reptiles, small mammals if dry)	Regional corridor linking key habitat in Ballengarra State Forest	No issue	N/A.	No	No	No	Concept Design
73	-	23940	Barrys Creek twin bridges	-	-	-	93.24 (culvert)	Overall length: 40	Koala (possums, spotted-tailed quoll, macropods, small mammals, reptiles, amphibians)	Regional corridor linking key habitat to east and west, continuous with climate change corridor to east Existing culverts support microbat roosting habitat (Miniopterus sp.)	Previously a 5-cell box culvert.	Twin bridges are now proposed for this location.	Rails and refuge poles (koalas) Rocks, hollow logs (quolls)	No. Successful fauna passage under bridges has been demonstrated on other projects.	Yes Class 2	Concept Design

ATTACHMENT B