Document No.: 7699-650-REP-0009

Santos Ltd

GLNG Project Roma West Phase 2a: Stage 2 Environmental Assessments

M4 Sub-branch Ecological Assessment Report

October 2014

Executive summary

This ecological assessment report has been prepared for Santos Pty Ltd by GHD Pty Ltd to identify environmental features and approval requirements relevant to the M4 sub-branch within the Roma West Phase 2a area of the GLNG Project. The scope of works involved undertaking ecological desktop and field assessments across the M4 investigation area to identify environmental features and constraints relevant to the Project's Environmental Authority (EA) and environmental approval conditions.

The M4 investigation area comprises area comprises 14 right of way (RoW) corridors and nine well pads, of which three are existing appraisal wells. The field assessment was undertaken by two GHD ecologists from 15 to 23 July 2014. With regards to the overall M4 sub-branch investigation area, results of the desktop and field assessments identified the following:

- No threatened ecological communites are present
- No regional ecosystems are present
- Two vegetation communities and habitat types are present: (1) regrowth eucalypt woodland and (2) non-remant shrubby regrowth within cleared open pasture
- No environmentally sensitive areas are present
- No essential habitat mapped under the *Vegetation Management Act 1999* is present
- Fauna habitat features that have potential to be breeding places for fauna species are present
- Watercourses defined under the *Water Act 2000* are present
- No wetlands, lakes or springs are present

The presence of environmental features are identified and explained for each RoW or proposed well pad within this report.

The quality of potential habitat for endangered, vulnerable and near threatened species (EVNT) species within the M4 investigation area was also assessed using the Santos Fauna Habitat Mapping Assessment Tool (version A3) (HMAT). Within the M4 investigation area, the HMAT outputs identified the presence of General Habitat for four *Environment Protection and Biodiversity Conservation Act 1999* listed species; koala, south-eastern long-eared bat, brigalow scaly-foot and yakka skink. The *Nature Conservation Act 1992* listed little pied bat was also confirmed present from the field assessments. The area of impact to potential EVNT species habitat from vegetation clearing for construction of the M4 investigation area was also calculated to assist in determining habitat clearing requirements in relation to the thresholds for threatened species outlined in the Project's EA conditions.

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Acronyms

Acronym	Definition
CDZ	Construction Disturbance Zone
DEHP	(Queensland) Department of Environment and Heritage Protection
DoE	(Commonwealth) Department of the Environment
EA	Environmental Authority
EPBC Act	(Commonwealth) *Environment Protection and Biodiversity Conservation Act 1999*
ESA	Environmentally Sensitive Area
EVNT	Endangered, Vulnerable or Near Threatened
HMAT	Santos Fauna Habitat Mapping Assessment Tool
GTP SMP	GLNG Gas Transmission Pipeline Species Management Plan
MNES	Matter of National Environmental Significance
NC Act	(Queensland) *Nature Conservation Act 1992*
RE	Regional Ecosystem
RoW	Right of Way(s)
RRRMP	Remediation, Rehabilitation, Recovery and Monitoring Plan
RWP2a	Roma West Phase 2a project
SMP	Roma, Arcadia and Fairview CSG Species Management Plan
SSMP	GLNG Project CSG Field Significant Species Management Plan
TEC	Threatened Ecological Community
VAST	Vegetation Assets States and Transitions
VM Act	(Queensland) *Vegetation Management Act 1999*
Water Act	(Queensland) *Water Act 2000*

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1. Introduction

1.1 Background

The M4 sub-branch is centrally located within the Roma West Phase 2a (RWP2a) area of the GLNG Project. Power lines, gas and water pipeline right of ways (RoWs) and well pads are proposed for construction within this area.

Stage 2 Environmental Field Assessments were undertaken for selected infrastructure within the M4 sub-branch investigation area. Construction footprints within the sub-branches relevant to the current scope of works comprise 14 RoWs and nine proposed well pads (the 'M4 investigation area') (refer Figure 1).

This report presents the results of an ecological assessment of the selected RoWs and proposed well pads within the M4 investigation area for the purpose of informing permitting and approvals.

1.2 Report layout

Section 2 provides an overview of the methods used for this assessment.

Section 3 of this report provides, for each RoW or proposed well pad (refer to Section 3.1), a summary of the following environmental features:

- Regional Ecosystems (REs)
- Threatened Ecological Communities (TECs)
- Vegetation community and habitat values
- Environmentally Sensitive Areas (ESAs)
- Essential habitat
- Threatened species
- Fauna habitat features
- Watercourses
- Wetlands, lakes and springs

Section 4 provides information on threatened species relevant to the M4 investigation area, including habitat mapping and habitat clearing calculations.

Further details, including species lists and data sheets are provided in the report appendices.

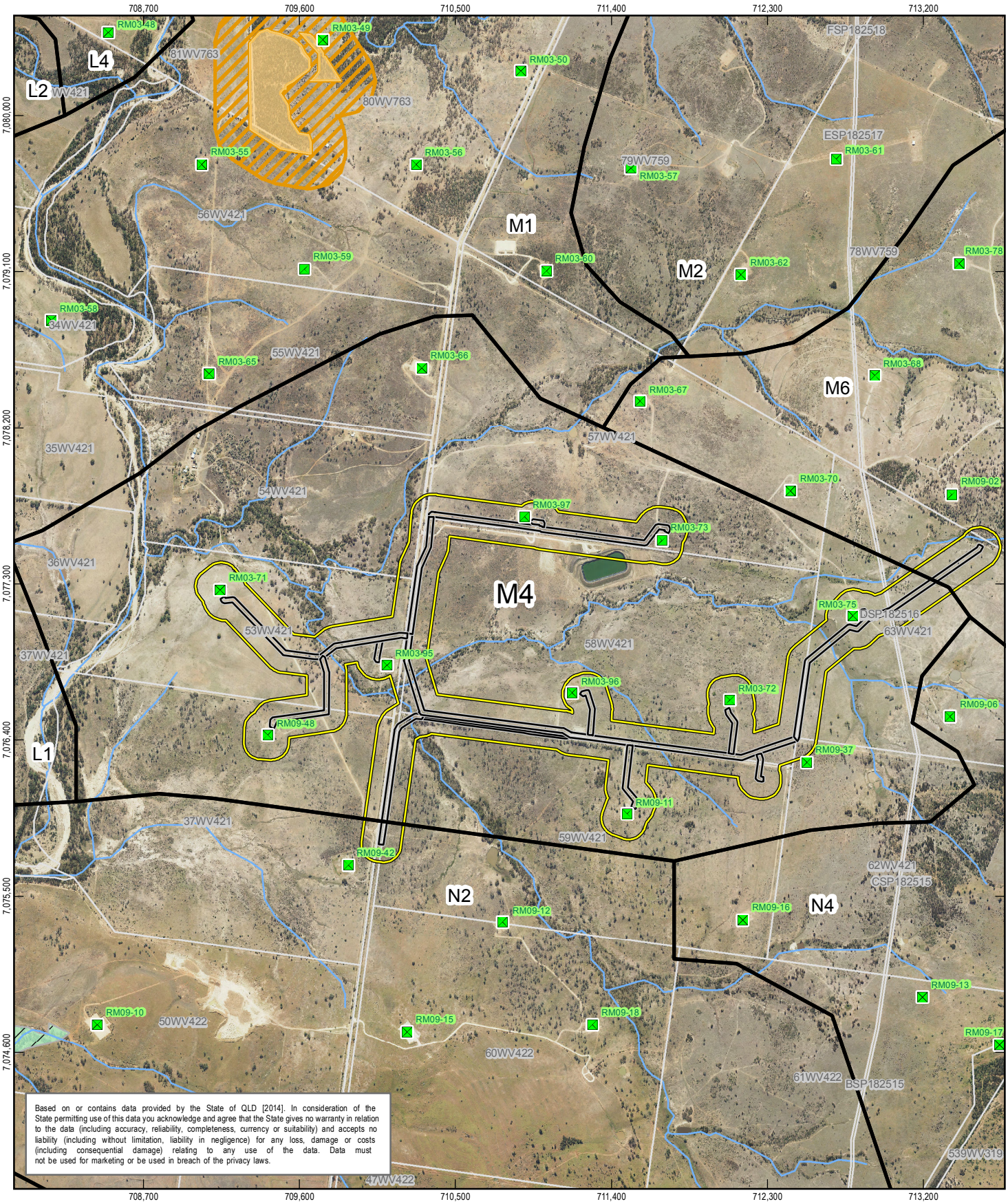
1.3 Limitations

Ecological field assessment and reporting is limited to the M4 investigation area which includes RoWs and proposed well pad footprints, and appropriate assessment buffers. The area for assessment was identified within the scope of works provided by Santos (via email, 28 May 2014) and subsequent correspondence. Of note, well pad RM03-73 and its associated RoW, M4-14, were not part of the scope of works and have not been assessed as a component of this report. However, the locations of RM03-73 and RoW M4-14 do appear on the figues within this report as these depict the overall Project location. The investigation area for conducting desktop and field assessments and subsequent reporting encompassed a 29 m wide construction disturbance zone (CDZ RoW) and additional 100 m to 300 m buffer areas for environmental values as outlined in Section 2. Ecological values that are outside of the M4 investigation area

and associated buffer distances were not required to be assessed as part of this scope of works.

Seasonality is also recognised as a potential influence on findings from the field assessment. Temperatures during the survey period ranged between -3.5 °C and 22.3 °C. Low overnight temperatures may have influenced detectability of some fauna species, particularly reptiles. Additionally, detectability of some groundcover species may have been reduced as the ecological surveys were undertaken in the dry season after considerable die-off of annual flowering/seeding grass and herb species. Identification of flora species was also further limited by the lack of rainfall in the region (42 mm 1 April to 15 July 2014 (Bureau of Meteorology, Roma Airport, station ID 043091)) and heavy grazing by livestock whereby the required floristics for identification were absent or removed.

All ecological data presented in the text of this report refers to the field data collected at the time of survey for the M4 investigation area as stated in Section 2. GIS data collected within the M4 investigation area during field surveys, pertaining to this report, is current as at the date of this report. Ecological feature GIS data represented on the figures within this report may also contain ecological feature data that has been captured during previous field surveys, particularly with reference to Type A restricted plant and fauna habitat features points. Previous relevant ecological feature GIS data has been ground-truthed during the field surveys pertaining to this report. Where features have been ground-truthed, a new spatial data point was recorded. As a result some GIS data point duplication between data collected during M4 investigation field surveys and any previous spatial data may be present. GIS data presented within the figures of this report has undergone quality assurance by Santos spatial analysts.



LEGEND

- Well Pad
- Watercourse
- Gathering Network Sub-branch
- CDZ ROW Area (29m)
- CSG Infrastructure Area (100m Buffer)
- Essential Habitat (BPA)
- Referable Wetlands
- Cadastre
- Regional Ecosystem (BD)
- Not of Concern
- Environmentally Sensitive Area
- Category B - Primary
- Category B Constraints Area

1:30,000 (@ A4)

0 300 600 900

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Santos GLNG Project

Santos GLNG
M4 Ecological Assessments

Job Number	41-27312
Revision	0
Date	03 Oct 2014

M4 Investigation Area Overview

Figure 1

G:\41\27312\GIS\Maps\MXD\41_27312_022_Overview_Rev_0.mxd
145 Ann St Brisbane QLD 4000 Australia **T** 61 7 3316 3000 **F** 61 7 3316 3333 **E** bnemail@ghd.com **W** www.ghd.com

Data source: DNRM: Ordered Drainage/2011; Santos GLNG: Cadastre, Regional Ecosystems, Essential Habitat, Imagery, ESA/Supplied October 2013, Well Pad, Construction Disturbance Zone, Referred Wetlands/Supplied September 2014;
GHD: CSG Infrastructure Area (produced in conjunction with Santos)/2014. Created by: AJ

2. Methodology

2.1 Desktop and field assessments

Desktop and field ecological assessments of RoWs, proposed well pads and associated assessment buffers were undertaken within the RWP2a project area. All desktop and field assessments were undertaken in accordance with the scope of works documents provided by Santos via email (dated 28/05/2014), the Santos GLNG Upstream Methodology for Undertaking Environmental Assessments (Santos document number: 6300-650-SPE-0002, Rev 1 dated 16/08/2013) (Santos Methodology) and email from Monique Harrison dated 20/06/2014 advising of required buffer distances from RoWs to be included in field surveys. The field assessments were undertaken from 15 to 23 July 2014.

Ecological features assessed and types of assessments undertaken within the M4 investigation area included:

- Environmentally sensitive areas – assessed within RoW and well pad footprints by quaternary vegetation assessments (Neldner *et al*. 2012).
- Regional ecosystems – assessed within RoW and well pad footprints and 200 m buffer by quaternary vegetation assessments (Neldner *et al*. 2012) and the Vegetation Assets States and Transitions (VAST) methodology for assessing vegetation condition.
- Threatened Ecological Community assessments - assessed within RoW and well pad footprints and 200 m buffer by quaternary vegetation assessments (Neldner *et al*. 2012).
- Vegetation community assessments and ecosystem functioning – assessed within RoW and well pad footprints for infrastructure groups from criteria defined in the Roma Shallow Gas Project Area Environmental Authority (EA) (EPPG00898213), Schedule D – Land.
- Mapped watercourses – assessed within RoW and well pad footprints and 100 m buffer by the Works Within a Watercourse Assessment Checklist and Fluor/Santos Works Within a Watercourse Assessment and Approvals manual (document number: 6300-110-PRC-10104-FLR02-GENL Rev B).
- Wetlands, lakes, springs and floodplains – assessed within 300 m of RoW and well pad footprints by the Wetland Rapid Assessment Checklist and the Procedure for Conducting Wetlands Assessments (document number: 3301-GLNG-4-1.3-0016) and Guideline for Conducting Wetlands Assessments (document number: 3301-GLNG-4-1.3-0017).
- General fauna habitat assessments – assessed within RoW and well pad footprints by habitat and condition assessments (Eyre *et al*. 2012) and assessments of the presence/absence of general habitat for threatened fauna species within the CDZ RoW using the Santos Habitat Mapping Assessment Tool (versionA3, received from Santos 31/07/2014).
- Essential habitat (mapped under the *Vegetation Management Act 1999* (VM Act)) – assessed within RoW and well pad footprints by targeted species searches.
- Fauna habitat features and potential breeding places – type and location recorded within each RoW and well pad footprint, together with incidental observations within a 200 m buffer.
- Targeted threatened species searches – assessed within RoW and well pad footprints together with incidental observations within a 200 m buffer for flora and fauna species listed as endangered, vulnerable or near threatened (EVNT) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and *Nature Conservation*

Act 1992 (NC Act). Survey methods undertaken were appropriate for each targeted flora and fauna species as identified within relevant species survey guidelines published by the Department of the Environment (DoE) and/or the Department of Environment and Heritage Protection (DEHP). Survey techniques included:

  - Random meander transects (Cropper 1993) for threatened flora species;
  - Diurnal active searches;
  - Anabat deployment;
  - Diurnal bird surveys;
  - Spotlighting – driving and walking transects;
  - Call playback; and
  - Incidental species observations.

- Koala habitat assessments and surveys – presence/absence of koala habitat assessed within RoW and well pad footprints by collecting information on koala population and habitat information outlined in the *Draft EPBC Act referral guidelines for the vulnerable koala (combined populations of Queensland, New South Wales and the Australian Capital Territory)* (DoE 2013), including:
  - Koala habitat assessment: determining habitat critical to the survival of the koala including lists of primary food tree and shelter species; and
  - Koala survey: undertaking koala surveys using the techniques outlined in Policy 4 (page 72) of the *Nature Conservation (Koala) Conservation Plan 2006 and Management Program 2006-2016* and for koala utilisation and frequency (faecal pellet surveys) using the spot assessment technique (Phillips & Callaghan 2011).
- Type A restricted species, weeds and least concern flora and fauna observations – assessed through targeted searches within RoW and well pad footprints together with incidental observations within a 200 m buffer.

2.2 Identification and calculation of RoW footprints and well pad areas

Proposed infrastructure within sub-branch M4 includes well pad areas and co-located linear infrastructure including CSG flowlines, water flowlines, utility lines and fibre optic cables. For the purposes of this report, the CDZ RoW footprints for sub-branch M4 linear infrastructure was determined through the outcomes of a series of meetings held between Santos and GHD on 25 August 2014 and 19 September 2014 and review of applicable Santos GIS linear infrastructure data layers.

RoW footprints were created through applying a nominal 29 m wide area around the pipeline infrastructure GIS data layer, received from Santos on 19 September 2014. This created a standard 29 m RoW footprint width for all proposed co-located CSG flowlines, water flowlines, utility lines and fibre optic cables within the M4 sub-branch area. However, within RoW M4-09, for a distance of approximately 850 m, the proposed CSG and water flowlines are not collocated with the proposed utility line and fibre optic cable. In this location, a 13 m wide RoW for the utility line and fibre optic cable was applied in addition to the 29 m RoW containing the two flowlines as per information provided by email (M. Harrison, 2 October 2014). The RoW footprints appear on all figures contained within this report. The RoW footprint widths was also used to calculate the areas of disturbance in relation to threatened species habitats present within the M4 sub-branch. Areas of disturdance in relation to threatened species habitat are explained further in Section 4.

Well pad footprints and areas, as shown on the figures within this report and referred to within Section 4, were mapped from the well pad vertex coordinates contained within volume reports supplied by Santos (email from Monique Harrison, dated 23 September 2014). Volume reports supplied are as follows:

- RM03-71-1 Rev 2 Volume Report
- RM03-72-1 Rev 1A Volume Report
- RM03-73-1 RevA Volume Report
- RM03-75 Rev 1A Volume Report
- RM09-11-1 Rev2 Volume Report
- RM09-48-1 Rev 1 Volume Report

At the time of report preparation, volume reports were not available for existing appraisal well pads within the M4 sub-branch (RM09-42, RM03-95, RM03-96 and RM03-97). These appraisal well pads have also been excluded from any disturbance calculations regarding threatened species habitats present within the M4 sub-branch (refer to Section 4).

3. Ecological assessment results

3.1 M4 investigation area overview

The result of the ecological assessment of the RoWs and proposed well pads within the M4 investigation area has been presented for infrastructure in the following sections:

- Section 3.2 – Proposed M4-01 RoW identification area
- Section 3.3 – Proposed M4-03 and M4-04 RoW identification areas
- Section 3.4 – Proposed M4-05 and M4-06 RoW identification areas
- Section 3.5 – Proposed M4-07 and M4-08 RoW identification areas
- Section 3.6 – Proposed M4-09 RoW identification area
- Section 3.7 – Proposed M4-10 RoW identification area
- Section 3.8 – Proposed M4-11 RoW identification area
- Section 3.9 – Proposed M4-12 RoW identification area
- Section 3.10 – Proposed M4-13 and M6-02 RoW identification areas
- Section 3.11 – Proposed M4-15 RoW identification area

Each of the above sections is preceded by a figure showing the location of the infrastructure, together with documented environmental features.

LEGEND

- Fauna Assessment Site
- Flora Assessment Site
- Fauna Habitat Site
- Dead hollow log
- Hollow log
- Mature tree
- Well Pad
- Watercourse
- CDZ ROW Area (29m)
- CSG Infrastructure Area (100m Buffer)
- Gathering Network Sub-branch
- Cadastre

1:5,000 (@ A4)

0 40 80 120

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Santos GLNG Project

Santos GLNG
L1 and N1 Ecological Assessments

Job Number	41-27312
Revision	0
Date	03 Oct 2014

Proposed M4-01 Sub-branch Infrastructure Area

Figure 2

G:\41\27312\GIS\Maps\MXD\41_27312_021_M4_Rev_0.mxd 145 Ann St Brisbane QLD 4000 Australia **T** 61 7 3316 3000 **F** 61 7 3316 3333 **E** bnemail@ghd.com **W** www.ghd.com

Data source: DNRM: Ordered Drainage/2011; Santos GLNG: Cadastre, Regional Ecosystems, Essential Habitat, Imagery, Referred Wetlands/Supplied October 2013, Well Pad, Construction Disturbance Zone/Supplied September 2014; GHD: CSG Infrastructure Area (produced in conjunction with Santos), Watercourse Assessment Site, Notable Flora Species, Notable Fauna Species, Fauna Habitat, Fauna Habitat Assessment Site, Flora Habitat Assessment Site/2014. Created by: AJ

3.2 Proposed M4 -01 RoW identification area

3.2.1 Summary of the M4-01 RoW identification area

The M4-01 RoW identification area includes RoW M4-01 from the intersection with M4-05/M4-09 RoWs to the intersection with RoW M4-04.

Item	Present/Absent	Item	Present/Absent
REs	Absent	**Threatened species**	Absent
TECs	Absent	**Fauna habitat features**	Present within 200 m buffer only
Vegetation community/ habitat values	Shrubby regrowth/cleared open pasture	**Watercourses**	Absent
ESAs	Absent	**Wetlands**	Absent
Essential habitat	Absent		

3.2.2 Regional ecosystems

No REs are mapped as present within the M4-01 RoW identification area and none were identified during the ecological assessments. Field validation points for REs are shown in Figure 2 (Q16).

Approval requirement or further action

None

3.2.3 Threatened ecological communities

No TECs are mapped as present within the M4-01 RoW identification area and none were identified during the ecological assessments. Field validation points for REs are shown in Figure 2 (Q16).

Approval requirement or further action

None

3.2.4 Vegetation communities and habitat values

The following vegetation community occurs within the M4-01 RoW identification area:

- Shrubby regrowth/cleared open pasture

Descriptions of this vegetation community and habitat values are summarised in Section 3.2.11. Field validation points for vegetation communities and habitat values are shown in Figure 2 (VC16, HA16).

Approval requirement or further action

None, however, rehabilitation activities are to be undertaken post-operation in accordance with the GLNG Project Remediation, Rehabilitation, Recovery and Monitoring Plan, Coal Seam Gas Fields (Document number: 0020-GLNG-4.1.3-0012) (RRRMP) (RPS 2011).

3.2.5 Environmentally sensitive areas

No ESAs or associated buffers are mapped or were observed to occur within the M4-01 RoW identification area.

Approval requirement or further action

None

3.2.6 Essential habitat

No essential habitat mapped under the VM Act is present within the M4-01 RoW identification area.

Approval requirement or further action

None

3.2.7 Threatened species

No threatened fauna or flora species were recorded within the M4-01 RoW identification area during ecological field assessments. Further information relating to threatened species records is contained within Section 4.

Lists of flora and fauna species recorded from field assessments are contained within Appendix B.

Threatened species habitat mapping

Habitat with the potential to support a population of fauna species listed under the EPBC Act and the NC Act has been mapped for the two habitat types, namely regrowth eucalypt woodland and non-remnant shrubby regrowth/cleared open pasture, that are present within the M4 investigation area (refer to Section 4). Calculations of the extent of species habitat to be cleared within M4 investigation area are presented in Section 4.1.

Habitat mapped as having potential to support a population of threatened fauna species is not present within the M4-01 identification area.

Approval requirement or further action

No further action currently required. Should a threatened species be encountered, management actions listed within the following approved GLNG Project documents are to be followed during pre-construction, construction and operation:

- GLNG Project CSG Fields Significant Species Management Plan (RPS 2012) (document number: 0020-GLNG-4-1.3-0003) (SSMP)
- Roma, Arcadia and Fairview CSG Fields Species Management Plan (Aurecon 2012) (document number: STO-FL-T2GS-L-321) (SMP)
- GLNG Gas Transmission Pipeline Species Management Plan (document number: 3380-GLNG-3-1.3-0036) (GTP SMP)

It is recommended that all management plans are checked for validity prior to implementation on this project.

3.2.8 Fauna habitat features

Fauna habitat features that have potential to be fauna breeding places for least concern or threatened fauna species were recorded incidentally in the 200 m buffer within the M4-01 RoW

identification area (refer to Section 3.2.11). Locations of these features are mapped in Figure 2. Spatial data has been provided to Santos for incorporation into their webGIS system.

Approval requirement or further action

Management actions listed within the SSMP, SMP and GTP SMP documents are to be followed during pre-construction, construction and operation.

3.2.9 Watercourses

No watercourses are mapped or were confirmed present within the M4-01 RoW identification area, or within the 100 m buffer.

Approval requirement or further action

None

3.2.10 Wetlands, lakes and springs

No wetlands are mapped or were confirmed present within the M4-01 RoW identification area, or within the 300 m buffer.

Approval requirement or further action

None

3.2.11 M4-01 RoW identification area: Vegetation community and habitat (non-remnant shrubby regrowth/cleared open pasture) summary

Vegetation community description – Baseline data																				
Site:	Q16/VC16/HA16	**Recorder:**	LM RF	**Date:**	21/07/2014	**Time:**	10:00am													
Project:	M4 ecological field surveys			**Photos:**	N:4388 E:4389 S:4390 W:4391															
Locality:	M4-01 RoW			**Property (lot/plan):**	Mt Hope (58WV421)															
Coordinates:	**Zone:**	5	5		7	1	0	3	6	7		7	0	7	7	5	0	4		
Vegetation community description: low shrubland (non-remnant) with a grassy understorey.																				

Vegetation Structure

Median height of EDL is to be measured and cover density estimated: D, touching-overlap<0; M, touching-slight separation 0-0/25; S, clearly separated 0.25-1, V, well separated 1-20

Stratum	Median height	Height interval	Est. cover density (D,M,S,V)
E	10	8 - 12	V
T1		-	
T2		-	
T3		-	
S1	2	1 – 2.5	S
S2		-	
G	0.5	0 – 0.75	S

Structural formation (including height): low shrubland

Ecologically dominant layer: S1

Landform situation: flat gentle slopes, undulating terrain

Land form element (40 m radius): plain

Land form pattern (300 m radius): undulating plain

Soil and geology: brown, sandy loam. Lateritic ironstone present

Topsoil depth: Skeletal

Slope position, degree and aspect: Mid-slope, 3˚ west

Vast condition assessment: Type III

Plant species

Relative (numerical) dominance for each stratum: d, dominant; c, codominant; s, subdominant; a, associated.

Str.	Rel. dom.	Scientific Name
E	d	*Eucalyptus melanophloia*

Str.	Rel. dom.	Scientific Name
E	s	*Eucalyptus populnea*
S1	d	*Acacia decora*
S1	s	*Eucalyptus melanophloia* (juvenile)
S1	a	*Eucalyptus populnea* (juvenile)
S1	a	*Eremophila mitchellii*
S1	a	*Acacia oswaldii*
S1	a	*Opuntia stricta**
S1	a	*Callitris glaucophylla*
G	d	*Aristida jerichoensis*
G	a	*Chloris ventricosa*
G	a	*Chrysocephalum apiculatum*
G	a	*Aristida latifolia*
G	a	*Bothriochloa pertusa**
G	a	*Bothriochloa ewartiana*
G	a	*Sclerolaena birchii*
G	a	*Alloteropsis semialata*

**Denotes exotic species*

Ground cover and organic litter (%) (average from five 1 m x 1 m quadrats)	
Type	**% cover**
Native grass	5
Native herbs/forbs (non-grass)	0
Native shrubs (<1 m high))	3
Non-native grass	0.4
Non-native herbs and shrubs	0
Litter (woodies <10 cm diameter, dead annuals, etc.)	42.6
Litter (logs >10 cm diameter)	5
Rock	0
Bare ground	43

Fauna habitat features (within 0.5 ha area)	
Characteristic	**Abundance (0-7) ^**
Decorticating bark	0
Coarse leaf litter (>2 cm diameter)	0
Fine leaf litter (<2 cm diameter)	0
Bare ground	5
Grass	5
Soil cracks	0
Stones (20-60 cm)	1
Boulders (61 cm – 2 m)	0
Larger boulders (>2 m)	0
Rock crevices	0
Exfoliating rock	0
^ 0, nil; **1**, rare; **2,** rare to occasional; **3,** occasional; **4**, Occasional to common; **5**, common; **6**, common to abundant; **7**, abundant	

Vegetative cover	
Strata	**Cover (100 m line intercept)**
E	-
T1	-
T2	-
S1	21.5
S2	-
G	-
Species	
S1	
Callitris glaucophylla	3
Acacia decora	11.5
Eremophila mitchellii	2
Eucalyptus melanophloia	3.5
Eucalyptus populnea	1.5

Vegetative density	
Strata	**Stem count (per ha)**
E	2
T1	-
T2	-
S1	1800
S2	-
G	-
Species	
E	
Eucalyptus melanophloia	2
S1	
Eucalyptus melanophloia	60
Acacia decora	1580
Eremophila mitchellii	100
Eucalyptus populnea	20
Callitris glaucophylla	40

Fauna habitat value (within 1 ha area) – Baseline data	
Characteristic	**Value**
Number of trees with hollows: - Hollow size <10 cm diameter - Hollow size >10 cm diameter	 0 0
Number of hollow bearing logs (hollows >10 cm diameter)	2
Total number of hollows in logs	2
Total length of fallen woody material (e.g. logs) >10 cm diameter	570 m

General habitat features and fauna breeding places present
General habitat features and potential fauna breeding places have been recorded in the Santos webGIS system. Refer to Santos webGIS for more information on these features.
Potential habitat for EVNT fauna species (including essential habitat): No potential habitat for EVNT species present

Koala habitat
Identification area not koala habitat due to non-remnant vegetation and absence of suitable koala food trees. Koala habitat assesssments were not undertaken at this location.

Disturbances (e.g. grazing, clearing, ploughing etc.)
Wildfire: 2 – >5 years **Grazing:** 2 – small to moderate amounts from many plants **Weeds:** 2 – moderate infestations **Erosion:** 1 – slight disturbance (e.g. cattle tracks)

Clearing: 3 – large amount, non-remnant, cleared grazing paddock
Ecosystem functioning (e.g. Extent of remnant vegetation in the landscape, connectivity, etc.):
Patch size and characteristics: large patch (>100 ha) of non-remnant vegetation. **Location of patch:** low – not connected to remnant or regrowth vegetation **Degree of edge effects:** 3 - severe **Floodplain characteristics:** nil, as landscape is of undulating topography Large mature trees may provide habitat for woodland birds and arboreal mammals. Large trees may also provide stepping stones to vegetation corridors in broader landscape. Shrub layer provides habitat and cover for woodland birds. Woody debris may provide habitat for smaller reptiles and mammals.

Declared weeds and introduced species
Weeds present:
Rare (<10 plants observed): prickly pear[1] (*Opuntia stricta*)
Uncommon (11-50 plants observed):
Common (>50 plants observed): Indian bluegrass (*Bothriochloa pertusa)*
Total percentage weed cover: prickly pear 1%, Indian bluegrass 8%
[1]Class 2 declared weed under the LP Act

EVNT/Type A flora present
Nil

Incidental fauna observations
Jacky winter
Striated pardalote
Weebill
Yellow-rumped thornbill

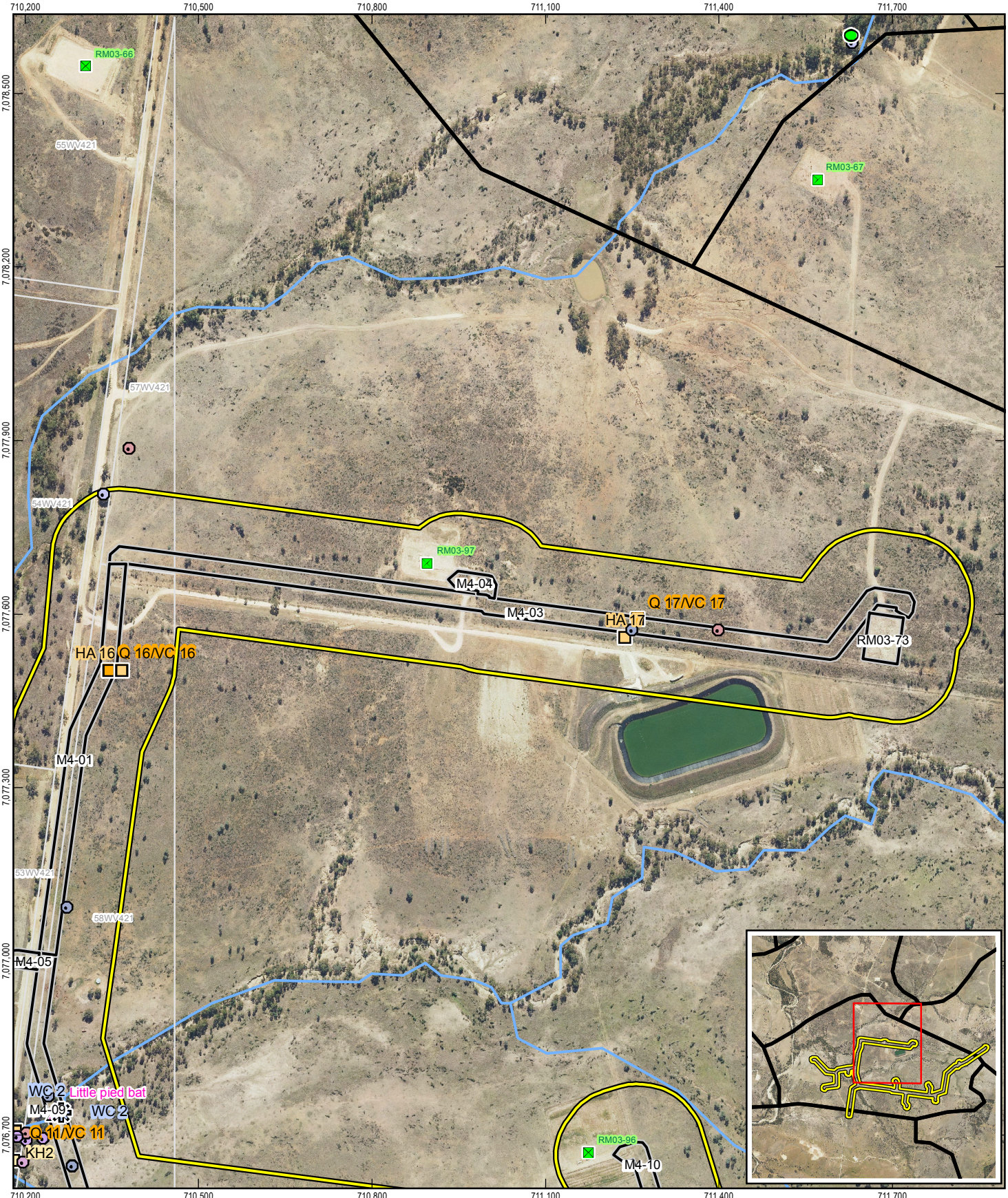
Representative photos for the M4-01 RoW identification area

North

East

South

West



LEGEND

- Koala Assessment Site
- Fauna Assessment Site
- Flora Assessment Site
- Watercourse Assessment Site

Fauna Habitat Site
- Dead hollow log
- Hollow in Tree
- Hollow log
- Mature tree
- Nest in Tree

Type A Restricted Plant Site
- Brachychiton populneus

- Well Pad
- Watercourse
- CDZ ROW Area (29m)
- CSG Infrastructure Area (100m Buffer)
- Gathering Network Sub-branch
- Cadastre

1:9,000 (@ A4)

0 80 160 240

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

GHD

Santos GLNG Project

Santos GLNG
L1 and N1 Ecological Assessments

Job Number 41-27312
Revision 0
Date 03 Oct 2014

Proposed M4-03 and M4-04 Sub-branch Infrastructure Area

Figure 3

G:\41\27312\GIS\Maps\MXD\41_27312_021_M4_Rev_0.mxd 145 Ann St Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: DNRM: Ordered Drainage/2011; Santos GLNG: Cadastre, Regional Ecosystems, Essential Habitat, Imagery, Referred Wetlands/Supplied October 2013, Well Pad, Construction Disturbance Zone/Supplied September 2014; GHD: CSG Infrastructure Area (produced in conjunction with Santos), Watercourse Assessment Site, Notable Flora Species, Notable Fauna Species, Fauna Habitat, Fauna Habitat Assessment Site, Flora Habitat Assessment Site/2014. Created by: AJ

3.3 Proposed M4-03 and M4-04 RoW identification areas

3.3.1 Summary for the M4-03 and M4-04 RoW identification areas

The M4-03 and M4-04 RoW identification areas include RoWs M4-03 and M4-04 and the RM03-97 and RM03-73 wellpad areas.

Item	Present/Absent	Item	Present/Absent
REs	Absent	**Threatened species**	Absent
TECs	Absent	**Fauna habitat features**	Present within CDZ RoW and 200 m buffer
Vegetation community/ habitat values	Shrubby regrowth/cleared open pasture	**Watercourses**	Absent
ESAs	Absent	**Wetlands**	Absent
Essential habitat	Absent		

3.3.2 Regional ecosystems

No REs are mapped as present within the M4-03 and M4-04 RoW identification areas and none were identified during the ecological assessments. Field validation points for REs are shown in Figure 3 (Q17).

Approval requirement or further action

None

3.3.3 Threatened ecological communities

No TECs are mapped as present within the M4-03 and M4-04 RoW identification areas and none were identified during the ecological assessments. Field validation points for REs are shown in Figure 3 (Q17).

Approval requirement or further action

None

3.3.4 Vegetation communities and habitat values

The following vegetation community occurs within the M4-03 and M4-04 RoW identification areas:

- Shrubby regrowth/cleared open pasture

Descriptions of this vegetation community and habitat values are summarised in Section 3.3.11. Field validation points for vegetation communities and habitat values are shown in Figure 3 (VC17, HA17).

Approval requirement or further action

None, however, rehabilitation activities are to be undertaken post-operation in accordance with the GLNG Project RRRMP (RPS 2011).

3.3.5 Environmentally sensitive areas

No ESAs or associated buffers are mapped or were observed to occur within the M4-03 and M4-04 RoW identification areas.

Approval requirement or further action

None

3.3.6 Essential habitat

No essential habitat mapped under the VM Act is present within the M4-03 and M4-04 RoW identification areas.

Approval requirement or further action

None

3.3.7 Threatened species

No threatened fauna or flora species were recorded within the M4-03 and M4-04 RoW identification areas during ecological field assessments. Further information relating to threatened species records is contained within Section 4.

Lists of flora and fauna species recorded from field assessments are contained within Appendix B.

Threatened species habitat mapping

Habitat with the potential to support a population of fauna species listed under the EPBC Act and the NC Act has been mapped for the two habitat types, namely regrowth eucalypt woodland and non-remnant shrubby regrowth/cleared open pasture, that are present within the M4 investigation area (refer to Section 4). Calculations of the extent of species habitat to be cleared within M4 investigation area are presented in Section 4.1.

Habitat mapped as having potential to support a population of threatened fauna species is not present within the M4-03 and M4-04 RoW identification areas.

Approval requirement or further action

No further action currently required. Should a threatened species be encountered, management actions listed within the SSMP, SMP and GTP SMP are to be followed during pre-construction, construction and operation.

It is recommended that all management plans are checked for validity prior to implementation on this project.

3.3.8 Fauna habitat features

Fauna habitat features that have potential to be fauna breeding places for least concern or threatened fauna species were recorded within the CDZ RoW and incidentally in the 200 m buffer of the M4-03 and M4-04 RoW identification areas (refer to Section 3.3.11). Locations of these features are mapped in Figure 3. Spatial data has been provided to Santos for incorporation into their webGIS system.

Approval requirement or further action

Management actions listed within the SSMP, SMP and GTP SMP documents are to be followed during pre-construction, construction and operation.

3.3.9 Watercourses

No watercourses are mapped or were confirmed present within the M4-03 and M4-04 RoW identification areas, or within the 100 m buffer.

Approval requirement or further action

None

3.3.10 Wetlands, lakes and springs

No wetlands are mapped or were confirmed present within the M4-03 and M4-04 RoW identification areas, or within the 300 m buffer. Also of note is a large dam constructed by Santos GLNG that is located adjacent to (and within 300 m) the M4-04 RoW.

Approval requirement or further action

None

3.3.11 M4-03 and M4-04 RoW identification areas: Vegetation community and habitat (non-remnant shrubby regrowth/cleared open pasture) summary

Vegetation community description – Baseline data																				
Site:	Q17/VC17/HA17		**Recorder:**	LM RF			**Date:** 21/07/2014									**Time:**	12:45pm			
Project:	M4 ecological field surveys						**Photos:** N:4391 E:4392 S:4394 W:4395													
Locality:	M4-03 and M4-04 RoW						**Property (lot/plan):**	Mt Hope (57WV421)												
Coordinates:	**Zone:**	5	5		7	1	1	2	3	7		7	0	7	7	5	6	1		
Vegetation community description: Low shrubland (non-remnant) with a grassy understorey																				

Vegetation Structure

Median height of EDL is to be measured and cover density estimated: D, touching-overlap<0; M, touching-slight separation 0-0/25; S, clearly separated 0.25-1, V, well separated 1-20

Stratum	Median height	Height interval	Est. cover density (D,M,S,V)
E	8	6 - 10	V
T1		-	
T2		-	
T3		-	
S1	2	1 – 3	M
S2		-	
G	0.2	0 – 0.4	M

Structural formation (including height): low shrubland

Ecologically dominant layer: S1

Landform situation: flat gentle slopes, undulating terrain

Land form element (40 m radius): Hillcrest

Land form pattern (300 m radius): Gently undulating plain

Soil and geology: brown, sandy clay/loam

Topsoil depth: Skeletal

Slope position, degree and aspect: Hillock, 4˚ south-east

Vast condition assessment: Type III

Plant species

Relative (numerical) dominance for each stratum: d, dominant; c, codominant; s, subdominant; a, associated.

Str.	Rel. dom.	Scientific Name
E	d	*Eucalyptus melanophloia*
S1	d	*Acacia decora*
S1	s	*Callitris glaucophylla*
S1	a	*Eucalyptus populnea* (juvenile)
S1	a	*Eucalyptus melanophloia* (juvenile)
S1	a	*Opuntia tomentosa**
S1	a	*Geijera parviflora*
S1	a	*Eremophila mitchellii*
S1	a	*Psydrax oleifolius*
G	c	*Aristida latifolia*
G	c	*Aristida jerichoensis*
G	a	*Bothriochloa decipiens*
G	a	*Maireana microphylla*
G	a	*Verbena aristigera**
c	a	*Themeda triandra*

*Denotes exotic species

Ground cover and organic litter (%) (average from five 1 m x 1 m quadrats)	
Type	**% cover**
Native grass	18
Native herbs/forbs (non-grass)	0
Native shrubs (<1 m high))	2
Non-native grass	0
Non-native herbs and shrubs	2
Litter (woodies <10 cm diameter, dead annuals, etc.)	44
Litter (logs >10 cm diameter)	5.6
Rock	0
Bare ground	28.4

Fauna habitat features (within 0.5 ha area)	
Characteristic	**Abundance (0-7) ^**
Decorticating bark	0
Coarse leaf litter (>2 cm diameter)	1
Fine leaf litter (<2 cm diameter)	0
Bare ground	3
Grass	5
Soil cracks	0
Stones (20-60 cm)	0
Boulders (61 cm – 2 m)	0
Larger boulders (>2 m)	0
Rock crevices	0
Exfoliating rock	0
^ 0, nil; **1**, rare; **2,** rare to occasional; **3,** occasional; **4**, Occasional to common; **5**, common; **6**, common to abundant; **7**, abundant	

Vegetative cover	
Strata	**Cover (100 m line intercept)**
E	-
T1	-
T2	-
S1	21.5
S2	-
G	-
Species	
S1	
Acacia decora	17
Psydrax oleifolius	2
Callitris glaucophylla	2.5

Vegetative density	
Strata	**Stem count (per ha)**
E	12
T1	-
T2	-
S1	2420
S2	-
G	-
Species	
T1	
Eucalyptus melanophloia	12
S1	
Acacia decora	2100
Callitris glaucophylla	320

Fauna habitat value (within 1 ha area) – Baseline data	
Characteristic	**Value**
Number of trees with hollows: - Hollow size <10 cm diameter - Hollow size >10 cm diameter	 0 0
Number of hollow bearing logs (hollows >10 cm diameter)	38
Total number of hollows in logs	32
Total length of fallen woody material (e.g. logs) >10 cm diameter	1010 m

General habitat features and fauna breeding places present
General habitat features and potential fauna breeding places have been recorded in the Santos webGIS system. Refer to Santos webGIS for more information on these features.
Potential habitat for EVNT fauna species (including essential habitat):
No potential habitat for EVNT species present

Koala habitat
Identification area not koala habitat due to non-remnant vegetation and absence of suitable koala food trees. Koala habitat assesssments were not undertaken at this location.

Disturbances (e.g. grazing, clearing, ploughing etc.)
Wildfire: 2 – >5 years **Grazing:** 3 –moderate to large amounts from many plants **Weeds:** 2 – moderate infestations **Erosion:** 1 – slight disturbance (e.g. cattle tracks) **Clearing:** 3 – large amount, non-remnant status
Ecosystem functioning (e.g. Extent of remnant vegetation in the landscape, connectivity, etc.):
Patch size and characteristics: large patch (>100 ha) of non-remnant vegetation.

Location of patch: low – not connected to remnant or regrowth vegetation
Degree of edge effects: 3 - severe
Floodplain characteristics: nil, as landscape is of undulating topography

Shrub layer provides habitat and cover for woodland birds. Scattered wood debris may provide habitat for small reptiles and mammals. Site is adjacent to dam, which may increase habitat suitability for birds e.g. when water present.

Declared weeds and introduced species
Weeds present:
Rare (<10 plants observed): prickly pear[1] (*Opuntia stricta*)
Uncommon (11-50 plants observed):
Common (>50 plants observed): Mayne's pest (*Verbena aristigera*)
Total percentage weed cover: prickly pear[1] 1%, Mayne's pest 2%
[1]Class 2 declared weed under the LP Act

EVNT/Type A flora present
Nil

Incidental fauna observations
Australian magpie
Striated pardalote
Weebill

Representative photos for the M4-03 and M4-04 RoW identification areas

North

East

South

West

LEGEND

- Koala Assessment Site
- Fauna Assessment Site
- Flora Assessment Site
- Watercourse Assessment Site

Fauna Habitat Site
- Dead hollow log
- Hollow in Tree
- Hollow log
- Mature tree
- Nest in Tree
- Well Pad
- Watercourse
- CDZ ROW Area (29m)
- CSG Infrastructure Area (100m Buffer)
- Gathering Network Sub-branch
- Cadastre

1:4,000 (@ A4)
0 40 80 120
Metres
Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

GHD

Santos GLNG Project

Santos GLNG
L1 and N1 Ecological Assessments

Job Number 41-27312
Revision 0
Date 03 Oct 2014

Proposed M4-05 and M4-06 Sub-branch Infrastructure Area

Figure 4

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145 Ann St Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: DNRM: Ordered Drainage/2011; Santos GLNG: Cadastre, Regional Ecosystems, Essential Habitat, Imagery, Referred Wetlands/Supplied October 2013, Well Pad, Construction Disturbance Zone/Supplied September 2014; GHD: CSG Infrastructure Area (produced in conjunction with Santos), Watercourse Assessment Site, Notable Flora Species, Notable Fauna Species, Fauna Habitat, Fauna Habitat Assessment Site, Flora Habitat Assessment Site/2014. Created by: AJ

3.4 Proposed M4-05 and M4-06 RoW identification areas

3.4.1 Summary for the M4-05 and M4-06 RoW identification areas

The M4-05 and M4-06 RoW identification areas include RoWs M4-05 and M4-06 and the RM03-95 wellpad area.

Item	Present/Absent	Item	Present/Absent
REs	Absent	**Threatened species**	Absent
TECs	Absent	**Fauna habitat features**	Present within 200 m only
Vegetation community/ habitat values	Shrubby regrowth/ cleared open pasture	**Watercourses**	Present within CDZ RoW and 100 m buffer
ESAs	Absent	**Wetlands**	Absent
Essential habitat	Absent		

3.4.2 Regional ecosystems

No REs are mapped as present within the M4-05 and M4-06 RoW identification areas and none were identified during the ecological assessments. Field validation points for REs are shown in Figure 4 (Q10 and Q12).

Approval requirement or further action

None

3.4.3 Threatened ecological communities

No TECs are mapped as present within the M4-05 and M4-06 RoW identification areas and none were identified during the ecological assessments. Field validation points for REs are shown in Figure 4 (Q10 and Q12).

Approval requirement or further action

None

3.4.4 Vegetation communities and habitat values

The following vegetation community occurs within the M4-05 and M4-06 RoW identification areas:

- Shrubby regrowth/cleared open pasture

Descriptions of this vegetation community and habitat values are summarised in Section 3.4.11. Field validation points for vegetation communities and habitat values are shown in Figure 4 (VC10 and VC12; HA10 and HA12).

Approval requirement or further action

None, however, rehabilitation activities are to be undertaken post-operation in accordance with the GLNG Project RRRMP (RPS 2011).

3.4.5 Environmentally sensitive areas

No ESAs or associated buffers are mapped or were observed to occur within the M4-05 and M4-06 RoW identification areas.

Approval requirement or further action

None

3.4.6 Essential habitat

No essential habitat mapped under the VM Act is present within the M4-05 and M4-06 RoW identification areas.

Approval requirement or further action

None

3.4.7 Threatened species

No threatened fauna or flora species were recorded within the M4-05 and M4-06 RoW identification areas during ecological field assessments. Further information relating to threatened species records is contained within Section 4.

Lists of flora and fauna species recorded from field assessments are contained within Appendix B.

Threatened species habitat mapping

Habitat with the potential to support a population of fauna species listed under the EPBC Act and the NC Act has been mapped for the two habitat types, namely regrowth eucalypt woodland and non-remnant shrubby regrowth/cleared open pasture, that are present within the M4 investigation area (refer to Section 4). Calculations of the extent of species habitat to be cleared within M4 investigation area are presented in Section 4.1.

While general habitat mapped as having potential to support a population of threatened fauna species is present within the M4-06 RoW identification area (within the surveyed buffer extents), no mapped habitat is present within the the M4-06 RoW construction footprint. Habitat mapped as having potential to support a population of threatened fauna species is not present within the M4-05 RoW identification area.

Approval requirement or further action

No further action currently required. Should a threatened species be encountered, management actions listed within the SSMP, SMP and GTP SMP are to be followed during pre-construction, construction and operation.

It is recommended that all management plans are checked for validity prior to implementation on this project.

3.4.8 Fauna habitat features

Fauna habitat features that have potential to be fauna breeding places for least concern or threatened fauna species were recorded incidentally in the 200 m buffer of the M4-05 and M4-06 RoW identification areas (refer to Section 3.4.11). Locations of these features are mapped in Figure 4. Spatial data has been provided to Santos for incorporation into their webGIS system.

Approval requirement or further action

Management actions listed within the SSMP, SMP and GTP SMP documents are to be followed during pre-construction, construction and operation.

3.4.9 Watercourses

A mapped second order watercourse intersects M4-05 RoW identification area. This same watercourse is also located within 100 m of the RM03-95 wellpad area.

Field validation of the watercourse determined it as a watercourse under the *Water Act 2000* (Water Act). The watercourse assessment location is shown as site WC06 on Figure 4. A summary of results is presented in Table 1 and the watercourse assessments are presented in Appendix C.

Table 1 Watercourse assessments in the M4-05 and M4-06 RoW identification areas

Watercourse reference	Location (easting, northing)		Assessment outcome	Assessment outcome explanation
WC06	709761	7076913	Watercourse (*Water Act 2000*)	No extended or permanent period of flow – only carries water flow for a short duration after a rainfall event Lacks sufficient flow adequacy to sustain basic ecological processes and support riverine species Features continuous and defined bed and banks and the presence of in-stream islands, benches or bars
			Not a waterway (*Fisheries Act 1994*)	Features continuous and defined bed and banks and the presence of in-stream islands, benches or bars No extended or permanent period of flow – only carries water flow for a short duration after a rainfall event Lacks sufficient flow adequacy to sustain basic ecological processes and support riverine species

Approval requirement or further action

As the feature constitutes a watercourse under the Water Act, construction must comply with relevant assessable codes under the Water Act and the relevant EA requirements relating to watercourses (Schedule B). Pre and post work checklists must be completed and all approvals must be lodged with the relevant agencies a minimum of ten business days prior to works.

3.4.10 Wetlands, lakes and springs

No wetlands are mapped or were confirmed present within the M4-05 and M4-06 RoW identification areas, or within the 300 m buffer.

Approval requirement or further action

None

3.4.11 M4-05 and M4-06 RoW identification areas: Vegetation community and habitat (non-remnant shrubby regrowth/cleared open pasture) summary

Vegetation community description – Baseline data																				
Site:	Q10/VC10/HA10 Q12/VC12/HA12		**Recorder:**	LM RF		**Date:**	19/7/2014 20/7/2014		**Time:**9:30 am 8:30 am											
Project:	M4 ecological field surveys					**Photos:**	N: 4350 E: 4351 S: 4352 W: 4353 N: 4367 E: 4368 S: 4369 W: 4370													
Locality:	M4-05 and M4-06 RoW					**Property (lot/plan):**	Mt Hope (53WV421)													
Coordinates (10): **Coordinates (12)**	**Zone:**	5	5		7	1	0	1	0	6		7	0	7	6	9	0	6		
		5	5		7	0	9	9	3	7		7	0	7	6	9	6	9		
Vegetation community description: Open, non-remnant cleared pasture land. Mature trees absent, sparse to absent sapling and shrub layer, low heavily grazed groundcover, mostly dead																				

Vegetation Structure

Median height of EDL is to be measured and cover density estimated: D, touching-overlap<0; M, touching-slight separation 0-0/25; S, clearly separated 0.25-1, V, well separated 1-20

Stratum	Median height	Height interval	Est. cover density (D,M,S,V)
E		-	
T1		-	
T2		-	
T3		-	
S1	2	0.5 - 3	V
S2		-	
G	0.4	0 - 1	M

Structural formation (including height): grassland

Ecologically dominant layer: G

Landform situation: flat gentle slopes, undulating terrain

Land form element (40 m radius): plain

Land form pattern (300 m radius): plain, creek channels present

Soil and geology: brown, hard clay (Q10), grey/brown sandy loam with small areas of cracking clay (Q12)

Topsoil depth: Skeletal/shallow

Slope position, degree and aspect: Flat, 0°

Vast condition assessment: Type V

Plant species

Relative (numerical) dominance for each stratum: d, dominant; c, codominant; s, subdominant; a, associated.

Str.	Rel. dom.	Scientific Name
S1	d	*Eucalyptus populnea*
S1	a	*Acacia decora*
S1	a	*Acacia excelsa*
S1	a	*Callitris glaucophylla*
S1	a	*Casuarina cristata*
S1	a	*Geijera parviflora*
S1	a	*Opuntia tomentosa**
G	d	*Bothriochloa pertusa**
G	c	*Chloris ventricosa*
G	c	*Themeda triandra*
G	a	*Verbena aristigera**
G	a	*Sclerolaena birchii*
G	a	*Aristida latifolia*
G	a	*Eragrostis lacunaria*
G	a	*Chrysocephalum apiculatum*
G	a	*Panicum effusum*
G	a	*Lomandra longifolia*
G	a	*Cenchrus ciliaris**
G	a	*Xanthium occidentale**
G	a	*Juncus usitatus*
G	a	*Enteropogon ramosus*
G	a	*Aristida jerichoensis*
G	a	*Aristida sp.*
G	a	*Urochloa mosambicensis**
G	a	*Aristida calycina*

S1	a	*Vachellia farnesiana**
G	a	*Dichanthium sericeum*
G	a	*Maireana microphylla*

G	a	*Bothriochloa ewartiana*
**Denotes exotic species*		

Ground cover and organic litter (%) (average from five 1 m x 1 m quadrats)	
Type	**% cover**
Native grass	2
Native herbs/forbs (non-grass)	8
Native shrubs (<1 m high))	0
Non-native grass	16
Non-native herbs and shrubs	6
Litter (woodies <10 cm diameter, dead annuals, etc.)	40
Litter (logs >10 cm diameter)	0
Rock	0
Bare ground	30

Fauna habitat features (within 0.5 ha area)	
Characteristic	**Abundance (0-7) ^**
Decorticating bark	0
Coarse leaf litter (>2 cm diameter)	0
Fine leaf litter (<2 cm diameter)	0
Bare ground	5
Grass	5
Soil cracks	0
Stones (20-60 cm)	0
Boulders (61 cm – 2 m)	0
Larger boulders (>2 m)	0
Rock crevices	0
Exfoliating rock	0
^ 0, nil; **1**, rare; **2,** rare to occasional; **3,** occasional; **4**, Occasional to common; **5**, common; **6**, common to abundant; **7**, abundant	

Vegetative cover	
Strata	**Cover (100 m line intercept)**
E	-
T1	-
T2	-
S1	0
S2	-
G	-
Species	

Vegetative density	
Strata	**Stem count (per ha)**
E	-
T1	-
T2	-
S1	190
S2	-
G	-
Species	
S1	
Eucalyptus populnea	120
*Vachellia farnesiana**	60
Casuarina cristata	10

Fauna habitat value (within 1 ha area) – Baseline data	
Characteristic	**Value**
Number of trees with hollows: - Hollow size <10 cm diameter - Hollow size >10 cm diameter	4 8 0
Number of hollow bearing logs (hollows >10 cm diameter)	4
Total number of hollows in logs	6
Total length of fallen woody material (e.g. logs) >10 cm diameter	480 m

General habitat features and fauna breeding places present
General habitat features and potential fauna breeding places have been recorded in the Santos webGIS system. Refer to Santos webGIS for more information on these features.
Potential habitat for EVNT fauna species (including essential habitat): No potential habitat for EVNT species present

Koala habitat
Identification area not koala habitat due to non-remnant vegetation and minimal suitable koala food trees. Koala habitat assesssments were not undertaken at this location.

Disturbances (e.g. grazing, clearing, ploughing etc.)
Wildfire: 1 – 1-5 years

Grazing: 3 – moderate to large amounts from many plants **Weeds:** 2 – moderate infestations **Erosion:** 1 – slight disturbance (e.g. cattle tracks) **Clearing:** 3 – large amount, non-remnant, cleared grazing paddock
Ecosystem functioning (e.g. Extent of remnant vegetation in the landscape, connectivity, etc.):
Patch size and characteristics: large patch (>100 ha) of non-remnant vegetation. **Location of patch:** medium – connected to regrowth vegetation along >25% of border **Degree of edge effects:** 3 - severe **Floodplain characteristics:** part of M4-05 RoW traverses flat land adjacent to a watercourse. This area contains relict stream channels and depressions that appear to be filled with water during flood events. The flat topography of this area, within 100 m of the northern watercourse bank, is conducive to land that would be inundated when the adjacent watercourse is in flood. Non-remnant vegetation with some mature eucalypts present. Riparian vegetation links to larger patch of regrowth vegetation. Mature trees may provide habitat for arboreal mammals and woodland birds. Shrub layer may provide habitat for woodland birds. Ground layer may provide food resources for macropods. Riparian vegetation may provide higher value habitat in broader landscape.

Declared weeds and introduced species
Weeds present: **Rare (<10 plants observed):** velvety tree pear[1] (*Opuntia tomentosa*) **Uncommon (11-50 plants observed):** buffel grass (*Cenchrus ciliaris*), mimosa bush (*Vachellia farnesiana*) **Common (>50 plants observed):** Indian bluegrass (*Bothriochloa pertusa*), Mayne's pest (*Verbena aristigera*); Noogoora burr (*Xanthium occidentale*)
Total percentage weed cover: velvety tree pear[1] 0.2%; Indian bluegrass 19%; buffel grass 5%; Mayne's pest 16%; mimosa bush 2%; Noogoora burr 8%
[1]Class 2 declared weed under the LP Act

EVNT/Type A flora present
Nil

Incidental fauna observations
Australian magpie
Australasian pipit
Australian raven
Crested pigeon
Galah
Grey-crowned babbler
Jacky winter
Magpie lark
Pale-headed rosella
Pied butcherbird
Red-backed fairy-wren
Striated pardalote
Superb fairy-wren
Torresiana crow
Weebill
White-throated gerygone
Willie wagtail
Yellow-rumped thornbill
Yellow thornbill

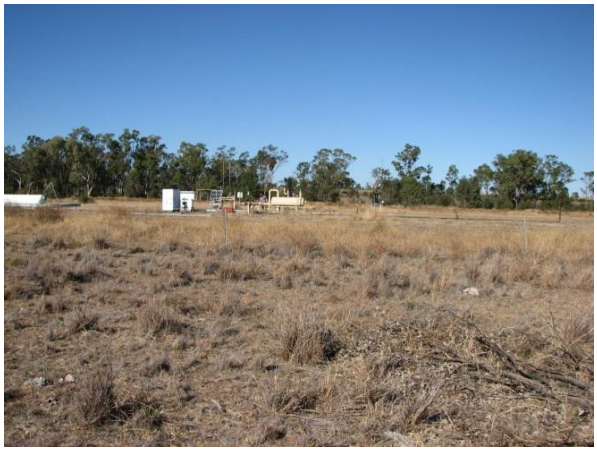
NOTE: The results of the vegetation community and habitat assessments have been averaged from two sites representative of this community. Sites Q10/VC10/HA10 and Q12/VC12/HA12.

Representative photos for the M4-05 and M4-06 RoW identification areas (from Q10/VC10/HA10)

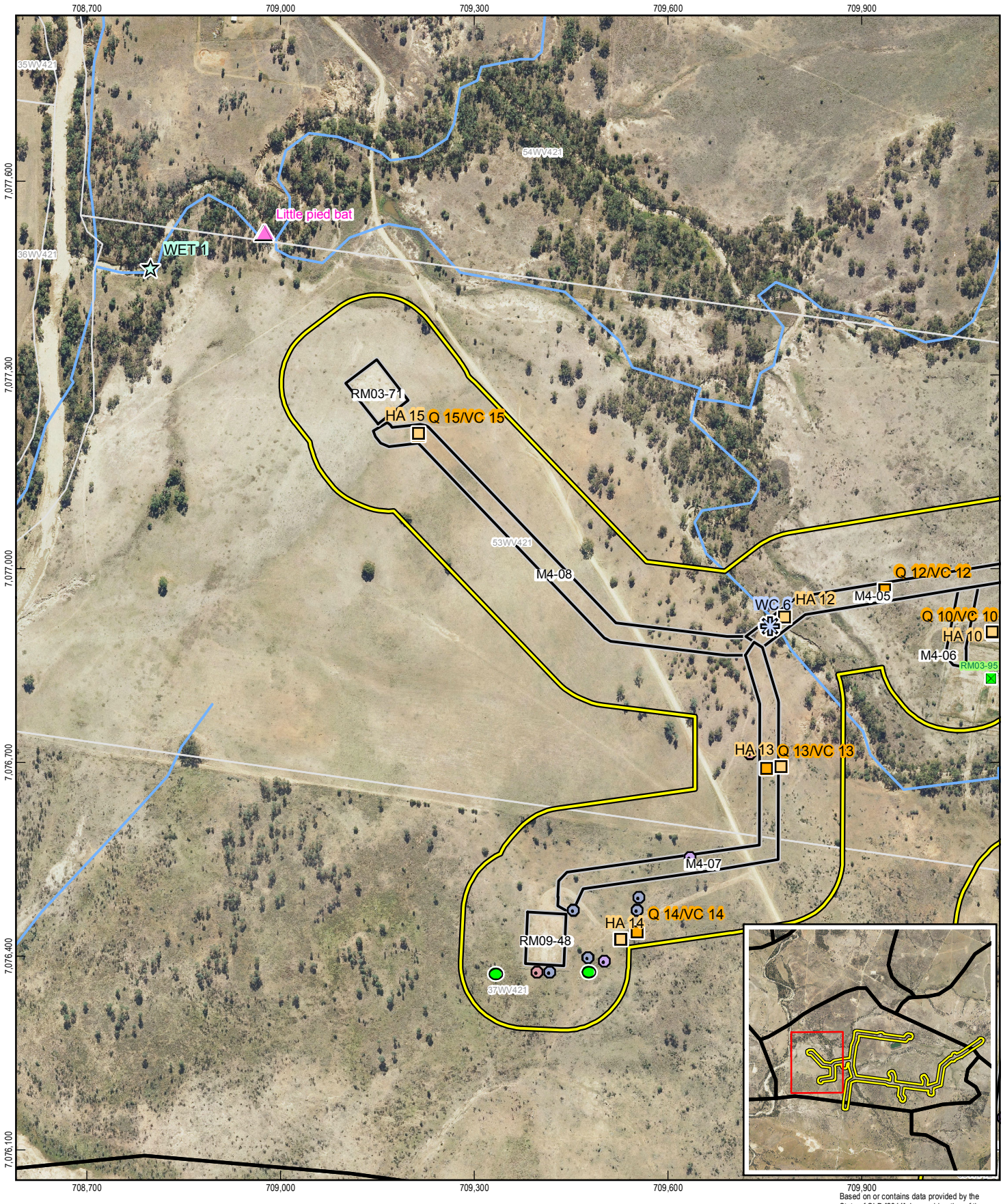
North

East

South



West



LEGEND

- Fauna Assessment Site
- Flora Assessment Site
- Watercourse Assessment Site
- Wetland Assessment Site
- Fauna Habitat Site
  - Dead hollow log
  - Hollow in Tree
- Hollow log
- Type A Restricted Plant Site
- Brachychiton populneus
- Well Pad
- Watercourse
- CDZ ROW Area (29m)
- CSG Infrastructure Area (100m Buffer)
- Gathering Network Sub-branch
- Cadastre

1:8,000 (@ A4)

0 75 150 225

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

GHD

Santos GLNG Project

Santos GLNG
L1 and N1 Ecological Assessments

Job Number 41-27312
Revision 0
Date 03 Oct 2014

Proposed M4-07 and M4-08 Sub-branch Infrastructure Area

Figure 5

G:\41\27312\GIS\Maps\MXD\41_27312_021_M4_Rev_0.mxd 145 Ann St Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: DNRM: Ordered Drainage/2011; Santos GLNG: Cadastre, Regional Ecosystems, Essential Habitat, Imagery, Referred Wetlands/Supplied October 2013, Well Pad, Construction Disturbance Zone/Supplied September 2014; GHD: CSG Infrastructure Area (produced in conjunction with Santos), Watercourse Assessment Site, Notable Flora Species, Notable Fauna Species, Fauna Habitat, Fauna Habitat Assessment Site, Flora Habitat Assessment Site/2014. Created by: AJ

3.5 Proposed M4-07 and M4-08 RoW identification areas

3.5.1 Summary for M4-07 and M4-08 RoW identification areas

The M4-07 and M4-08 RoW identification areas include RoWs M4-07 and M4-08 and the RM09-48 and RM03-71 wellpad areas.

Item	Present/Absent	Item	Present/Absent
REs	Absent	**Threatened species**	Present within 200 m buffer only
TECs	Absent	**Fauna habitat features**	Present within CDZ RoW and 200 m buffer
Vegetation community/ habitat values	• Shrubby regrowth/ cleared open pasture • Regrowth eucalypt woodland	**Watercourses**	Present within 100 m buffer only
ESAs	Absent	**Wetlands**	Present within 300 m buffer only
Essential habitat	Absent		

3.5.2 Regional ecosystems

No REs are mapped as present within the M4-07 and M4-08 RoW identification areas and none were identified during the ecological assessments. Field validation points for REs are shown in Figure 5 (Q13, Q14 and Q15).

Approval requirement or further action

None

3.5.3 Threatened ecological communities

No TECs are mapped as present within the M4-07 and M4-08 RoW identification areas and none were identified during the ecological assessments. Field validation points for REs are shown in Figure 5 (Q13, Q14 and Q15).

Approval requirement or further action

None

3.5.4 Vegetation communities and habitat values

The following vegetation community occurs within the M4-07 and M4-08 RoW identification areas:

- Shrubby regrowth/cleared open pasture
- Regrowth eucalypt woodland

Descriptions of this vegetation community and habitat values are summarised in Section 3.5.11. Field validation points for vegetation communities and habitat values are shown in Figure 5 (VC13, VC14 and VC15; HA13, HA14 and HA15).

Approval requirement or further action

None, however, rehabilitation activities are to be undertaken post-operation in accordance with the GLNG Project RRRMP (RPS 2011).

3.5.5 Environmentally sensitive areas

No ESAs or associated buffers are mapped or were observed to occur within the M4-07 and M4-08 RoW identification areas.

Approval requirement or further action

None

3.5.6 Essential habitat

No essential habitat mapped under the VM Act is present within the M4-07 and M4-08 RoW identification areas.

Approval requirement or further action

None

3.5.7 Threatened species

No threatened fauna or flora species were recorded within the M4-07 and M4-08 RoW identification areas during ecological field assessments. The little pied bat (*Chalinolobus picatus*), listed as near threatened under the NC Act, was identified from echolocation calls recorded on an anabat device placed at a tributary of Blyth Creek approximately 200 m from RoW M4-08 and RM03-71. Further information relating to threatened species records is contained within Section 4.

Lists of flora and fauna species recorded from field assessments are contained within Appendix B.

Threatened species habitat mapping

Habitat with the potential to support a population of fauna species listed under the EPBC Act and the NC Act has been mapped for the two habitat types, namely regrowth eucalypt woodland and non-remnant shrubby regrowth/cleared open pasture, that are present within the M4 investigation area (refer to Section 4). Calculations of the extent of species habitat to be cleared within M4 investigation area are presented in Section 4.1.

Habitat mapped as having potential to support a population of threatened fauna species is not present within the M4-07 and M4-08 RoW identification areas.

Approval requirement or further action

No further action currently required. Should a threatened species be encountered, management actions listed within the SSMP, SMP and GTP SMP are to be followed during pre-construction, construction and operation.

It is recommended that all management plans are checked for validity prior to implementation on this project.

3.5.8 Fauna habitat features

Fauna habitat features that have potential to be fauna breeding places for least concern or threatened fauna species were recorded within the CDZ RoW and incidentally in the 200 m buffer of M4-07 RoW identification area (refer to Section 3.5.11). Locations of these features are

mapped in Figure 5. No potential fauna habitat breeding places were identified within the M4-08 RoW identification area. Spatial data has been provided to Santos for incorporation into their webGIS system.

Approval requirement or further action

Management actions listed within the SSMP, SMP and GTP SMP documents are to be followed during pre-construction, construction and operation.

3.5.9 Watercourses

A mapped second order watercourse is present within the 100 m buffer of the M4-07 and M4-08 RoW identification areas.

Field validation of the watercourse determined it as a watercourse under the Water Act. The watercourse assessment location is shown as site WC06 on Figure 5. A summary of results is presented in Table 2 and the watercourse assessments are presented in Appendix C.

Table 2 Watercourse assessments in the M4-07 and M4-08 RoW identification areas

Watercourse reference	Location (easting, northing)		Assessment outcome	Assessment outcome explanation
WC06 (within 100 m buffer)	709761	7076913	Watercourse (*Water Act 2000*)	No extended or permanent period of flow – only carries water flow for a short duration after a rainfall event Lacks sufficient flow adequacy to sustain basic ecological processes and support riverine species Features continuous and defined bed and banks and the presence of in-stream islands, benches or bars
			Not a waterway (*Fisheries Act 1994*)	Features continuous and defined bed and banks and the presence of in-stream islands, benches or bars No extended or permanent period of flow – only carries water flow for a short duration after a rainfall event Lacks sufficient flow adequacy to sustain basic ecological processes and support riverine species

Approval requirement or further action

As the feature constitutes a watercourse under the Water Act, construction and vegetation clearing within 100 m of a high bank of any watercourse must comply with relevant assessable codes under the Water Act and the relevant EA requirements relating to watercourses (Schedule B). Pre and post work checklists must be completed and all approvals must be lodged with the relevant agencies a minimum of ten business days prior to works.

3.5.10 Wetlands, lakes and springs

A Queensland Wetland Area is mapped within the 300 m buffer of the M4-07 and M4-08 RoW identification areas in association with Blyth Creek. This wetland was field validated as riverine and not a wetland under GLNG EA. The wetland assessment is provided in Appendix C.

Approval requirement or further action

None

3.5.11 M4-07 and M4-08 RoW identification areas: Vegetation community and habitat (non-remnant shrubby regrowth/cleared open pasture) summary

Vegetation community description – Baseline data

Site:	Q14/VC14/HA14 Q15/VC15/HA15	**Recorder:**	LM RF	**Date:** 20/7/2014	**Time:** 11:30am 1:45pm
Project:	M4 ecological field surveys			**Photos:**	N: 4375 E: 4376 S: 4377 W: 4378 N: 4379 E: 4380 S: 4381 W: 4382
Locality:	M4-07 and M4-08 RoW			**Property (lot/plan):**	Mt Hope (53WV421)

Coordinates (14):	**Zone:**	5	5	7	0	9	5	5	4	7	0	7	6	4	3	9		
Coordinates (15):	**Zone:**	5	5	7	0	9	2	1	4	7	0	7	7	2	0	9		

Vegetation community description: Open, cleared pasture land with very sparse mature and regrowth trees. Low shrublayer is very sparse to absent and grassy groundcover is heavily grazed.

Vegetation Structure

Median height of EDL is to be measured and cover density estimated: D, touching-overlap<0; M, touching-slight separation 0-0/25; S, clearly separated 0.25-1, V, well separated 1-20

Stratum	Median height	Height interval	Est. cover density (D,M,S,V)
E	11	6 - 18	V
T1		–	
T2		-	
T3		-	
S1	2	0.5 - 3	V
S2		-	
G	0.1	0 - 0.5	S

Structural formation (including height): low shrubland (regrowth)/cleared pasture

Ecologically dominant layer: S (14), G (15)

Landform situation: flat gentle slopes, undulating terrain

Land form element (40 m radius): hillslope

Land form pattern (300 m radius): undulating plain

Soil and geology: light brown to brown, sandy-loam, sandstone derived, ironstone nodules present

Topsoil depth: Skeletal

Slope position, degree and aspect: Mid-slope, <3°, west

Vast condition assessment: Type V

Plant species

Relative (numerical) dominance for each stratum: d, dominant; c, codominant; s, subdominant; a, associated.

Str.	Rel. dom.	Scientific Name
E	c	*Eucalyptus melanophloia*
E	c	*Eucalyptus populnea*
G	a	*Wahlenbergia gracilis*

Str.	Rel. dom.	Scientific Name
S1	a	*Eucalyptus populnea*
S1	d	*Eremophila mitchellii*
S1	a	*Hakea lorea*
S1	a	*Psydrax oleifolia*
S1	a	*Maireana microphylla*
S1	a	*Acacia decora*
S1	a	*Opuntia stricta**
S1	a	*Geijera parviflora*
S1	a	*Dodonaea viscosa subsp. spatulata*
G	c	*Cenchrus ciliaris**
G	c	*Bothriochloa pertusa**
G	c	*Aristida latifolia*
G	c	*Aristida jerichoensis*
G	a	*Pimelea trichostachya*
G	a	*Sporobolus creber*
G	a	*Paspalidium sp.*
G	a	*Aristida platychaeta*
G	a	*Sida sp.*
G	a	*Sclerolaena birchii*
G	a	*Panicum effusum*
G	a	*Senecio brigalowensis*
G	a	*Dichanthium sericeum*

G	a	*Dichanthium sericeum*
G	a	*Enteropogon ramosus*
G	a	*Digitaria ciliaris**
G	a	*Heteropogon contortus*

G	a	*Enneapogon nigricans*
G	a	*Eragrostis lacunaria*
G	a	*Verbena aristigera**
G	a	*Chloris ventricosa*
**Denotes exotic species*		

Ground cover and organic litter (%) (average from five 1 m x 1 m quadrats)

Type	% cover
Native grass	5.6
Native herbs/forbs (non-grass)	0.1
Native shrubs (<1 m high))	0
Non-native grass	6.3
Non-native herbs and shrubs	2.6
Litter (woodies <10 cm diameter, dead annuals, etc.)	32.7
Litter (logs >10 cm diameter)	0
Rock	0
Bare ground	48.8

Fauna habitat features (within 0.5 ha area)

Characteristic	Abundance (0-7) ^
Decorticating bark	0
Coarse leaf litter (>2 cm diameter)	0
Fine leaf litter (<2 cm diameter)	0
Bare ground	5
Grass	4
Soil cracks	0
Stones (20-60 cm)	1
Boulders (61 cm – 2 m)	0
Larger boulders (>2 m)	0
Rock crevices	0
Exfoliating rock	0

^ 0, nil; **1**, rare; **2,** rare to occasional; **3,** occasional; **4**, Occasional to common; **5**, common; **6**, common to abundant; **7**, abundant

Vegetative cover

Strata	Cover (100 m line intercept)
E	-
T1	-
T2	-
S1	-
S2	-
G	-
Species	
Nil	

Vegetative density

Strata	Stem count (per ha)
E	2
T1	-
T2	-
S1	260
S2	-
G	-
Species	
T1	
Eucalyptus melanophloia	2
S1	
Eucalyptus populnea	40
Eremophila mitchellii	180
Geijera parviflora	20
Maireana microphylla	20

Fauna habitat value (within 1 ha area) – Baseline data

Characteristic	Value
Number of trees with hollows: - Hollow size <10 cm diameter - Hollow size >10 cm diameter	0 0 0
Number of hollow bearing logs (hollows >10 cm diameter)	20
Total number of hollows in logs	20
Total length of fallen woody material (e.g. logs) >10 cm diameter	130 m

General habitat features and fauna breeding places present

General habitat features and potential fauna breeding places have been recorded in the Santos webGIS system. Refer to Santos webGIS for more information on these features.

Potential habitat for EVNT fauna species (including essential habitat):

Little pied bat confirmed present in woodland within 200 m of RoW M4-08 and RM03-71

Koala habitat
Identification area not koala habitat due to non-remnant vegetation and absence of suitable koala food trees. Koala habitat assesssments were not undertaken at this location.

Disturbances (e.g. grazing, clearing, ploughing etc.)
Wildfire: 2 – >5 years **Grazing:** 3 – moderate to large amounts from many plants **Weeds:** 2 – moderate **Erosion:** 1 – slight disturbance (e.g. cattle tracks) **Clearing:** 3 – large amount, non-remnant
Ecosystem functioning (e.g. Extent of remnant vegetation in the landscape, connectivity, etc.):
Patch size and characteristics: large patch (>100 ha), connected to regrowth eucalypt woodland to the north and west at drainage lines. **Location of patch: medium –** connected to regrowth vegetation along >25% of border **Degree of edge effects:** 3 - severe **Floodplain characteristics:** nil, as landscape is of undulating topography Riparian vegetation outside of CDZ RoW may provide habitat for woodland birds and arboreal mammals in the broader landscape. Sparse mature trees within CDZ RoW may provide stepping stone to riparian vegetation in broader landscape. Shrubs may provide marginal habitat for woodland birds and woody debris may provide habitat for small reptiles.

Declared weeds and introduced species
Weeds present: **Rare (<10 plants observed):** prickly pear[1] (*Opuntia stricta*) **Uncommon (11-50 plants observed):** **Common (>50 plants observed):** Indian bluegrass (*Bothriochloa pertusa*), buffel grass (*Cenchrus ciliaris*), Mayne's pest (*Verbena aristigera*)
Total percentage weed cover:
prickly pear[1] 0.75%; Indian bluegrass 24%; buffel grass 10%; Mayne's pest 3%
[1]Class 2 declared weed under the LP Act

EVNT/Type A flora present
Kurrajong (*Brachychiton populneus*). Refer to santos webGIS system for point locations.

Incidental fauna observations
Australasian pipit Striated pardalote Banded lapwing Grey butcherbird Noisy miner Nankeen kestrel

NOTE: The results of the vegetation community and habitat assessments have been averaged from two sites representative of this community. Sites Q14/VC14/HA14 and Q15/VC15/HA15.

Representative photos for M4-07 and M4-08 RoW identification area (from Q14/VC14/HA14)

North

East

South

West

3.5.12 M4-07 and M4-08 RoW identification areas: Vegetation community and habitat (regrowth eucalypt woodland) summary

Vegetation community description – Baseline data					
Site:	Q13/VC13/HA13	**Recorder:**	LM RF	**Date:** 20/7/2014	**Time:** 10:15 am
Project:	M4 ecological field surveys			**Photos:**	N: 4371 E:4372 S:4373 W:4374
Locality:	M4-07 and M4-08 RoWs			**Property (lot/plan):**	Mt Hope (53WV421)
Coordinates (13):	**Zone:** 55	709755		7076692	
Vegetation community description: Open eucalypt woodland (mapped as non-remnant) containing a sparse shrublayer and grassy understorey.					

Vegetation Structure

Median height of EDL is to be measured and cover density estimated: D, touching-overlap<0; M, touching-slight separation 0-0/25; S, clearly separated 0.25-1, V, well separated 1-20

Stratum	Median height	Height interval	Est. cover density (D,M,S,V)
E	18	14 - 20	V
T1	10	10 - 14	V
T2	8	6 - 10	V
T3		-	
S1	2	0.5 - 3	V
S2		-	
G	0.1	0 - 0.5	S

Structural formation (including height): open woodland (regrowth)

Ecologically dominant layer: T1

Landform situation: flat gentle slopes, undulating terrain

Land form element (40 m radius): plain

Land form pattern (300 m radius): gently undulating plain

Soil and geology: light brown, sandy-loam, ironstone nodules present

Topsoil depth: Skeletal

Slope position, degree and aspect: Mid-slope, 1°, north

Vast condition assessment: Type V

Plant species

Relative (numerical) dominance for each stratum: d, dominant; c, codominant; s, subdominant; a, associated.

Str.	Rel. dom.	Scientific Name
E	d	*Eucalyptus fibrosa*
T1	d	*Eucalyptus populnea*
T2	d	*Eucalyptus populnea*
T2	c	*Acacia harpophylla*
T2	a	*Alectryon oleifolius*
S1	d	*Eremophila mitchellii*
S1	a	*Acacia oswaldii*
S1	a	*Opuntia tomentosa**
S1	a	*Geijera parviflora*
S1	a	*Eucalyptus populnea*
G	c	*Aristida jerichoensis*
G	c	*Aristida platychaeta*
G	c	*Cenchrus ciliaris**
G	c	*Bothriochloa pertusa**
G	a	*Enneapogon nigricans*
G	a	*Panicum effusum*
G	a	*Sporobolus actinocladus*
G	a	*Bothriochloa ewartiana*
G	a	*Chrysocephalum apiculatum*
G	a	*Pimelea trichostachya*
G	a	*Verbena aristigera**
G	a	*Dichanthium sericeum*
G	a	*Rhodanthe floribunda*
G	a	*Sporobolus caroli*

**Denotes exotic species*

Ground cover (%) (average from five 1 m x 1 m quadrats)	
Type	**% cover**
Native grass	5.6
Native herbs/forbs (non-grass)	0.6
Native shrubs (<1 m high))	6
Non-native grass	8.8
Non-native herbs and shrubs	0.2
Litter (woodies <10 cm diameter, dead annuals, etc.)	28.8
Litter (logs >10 cm diameter)	0
Rock	0
Bare ground	49

Fauna habitat features (within 1 ha area) – Baseline data	
Characteristic	**Abundance (0-7) ^**
Decorticating bark	0
Coarse leaf litter (>2 cm diameter)	0
Fine leaf litter (<2 cm diameter)	0
Bare ground	6
Grass	3
Soil cracks	0
Stones (20-60 cm)	0
Boulders (61 cm – 2 m)	0
Larger boulders (>2 m)	0
Rock crevices	0
Exfoliating rock	0
^ 0, nil; **1**, rare; **2,** rare to occasional; **3,** occasional; **4**, Occasional to common; **5**, common; **6**, common to abundant; **7**, abundant	

Vegetative cover	
Strata	**% cover (100 m line intercept)**
E	-
T1	-
T2	-
S1	1
S2	-
G	-
Species	
S1	
Eucalyptus populnea	0.5
Eremophila mitchellii	0.5

Vegetative density	
Strata	**Stem count (per ha)**
E	-
T1	-
T2	-
S1	260
S2	-
G	-
Species	
S1	
Eucalyptus populnea	20
Eremophila mitchellii	240

Fauna habitat value (within 1 ha area) – Baseline data	
Characteristic	**Value**
Number of trees with hollows: - Hollow size <10 cm diameter - Hollow size >10 cm diameter	0 0 0
Number of hollow bearing logs (hollows >10 cm diameter)	18
Total number of hollows in logs	20
Total length of fallen woody material (e.g. logs) >10 cm diameter	110 m

General habitat features and fauna breeding places present
General habitat features and potential fauna breeding places have been recorded in the Santos webGIS system. Refer to Santos webGIS for more information on these features.
Potential habitat for EVNT fauna species (including essential habitat): No potential habitat for EVNT species present

Koala habitat
Koala food trees present; however, due to patch size, the lack of water and low soil moisture trees are unlikely to be koala habitat trees. Koala habitat assesssments were not undertaken at this location.

Disturbances (e.g. grazing, clearing, ploughing etc.)
Wildfire: 2 – >5 years **Grazing:** 3 – moderate to large amounts from many plants **Weeds:** 2 – moderate **Erosion:** 1 – slight disturbance (e.g. cattle tracks) **Clearing:** 3 – large amount, non-remnant
Ecosystem functioning (e.g. Extent of remnant vegetation in the landscape, connectivity, etc.):
Patch size and characteristics: large patch (>100 ha), connected to regrowth eucalypt woodland to the north and west at drainage lines.

Location of patch: medium – connected to regrowth vegetation along >25% of border **Degree of edge effects:** 3 - severe **Floodplain characteristics:** nil, as landscape is of undulating topography Scattered trees may provide habitat for woodland birds. Logs and woody debris may provide habitat for small reptiles. Grass may provide food resources for macropods. Trees outside of the CDZ RoW may provide stepping stones for fauna movement in the broader landscape.

Declared weeds and introduced species
Weeds present: **Rare (<10 plants observed):** **Uncommon (11-50 plants observed):** velvety tree pear[1] (*Opuntia tomentosa*), buffel grass (*Cenchrus ciliaris*), Mayne's pest (*Verbena aristigera*) **Common (>50 plants observed):** Indian bluegrass (*Bothriochloa pertusa*)
Total percentage weed cover (ha): velvety tree pear[1] 0.2%; Indian bluegrass 6%; buffel grass 3%; Mayne's pest 0.5%
[1]Class 2 declared weed under the LP Act

EVNT/Type A flora present
Nil

Incidental fauna observations
Yellow-rumped thornbill
Striated pardalote
Weebill
Australian raven
Pied butcherbird
Grey-crowned babbler
Sulfur-crested cockatoo

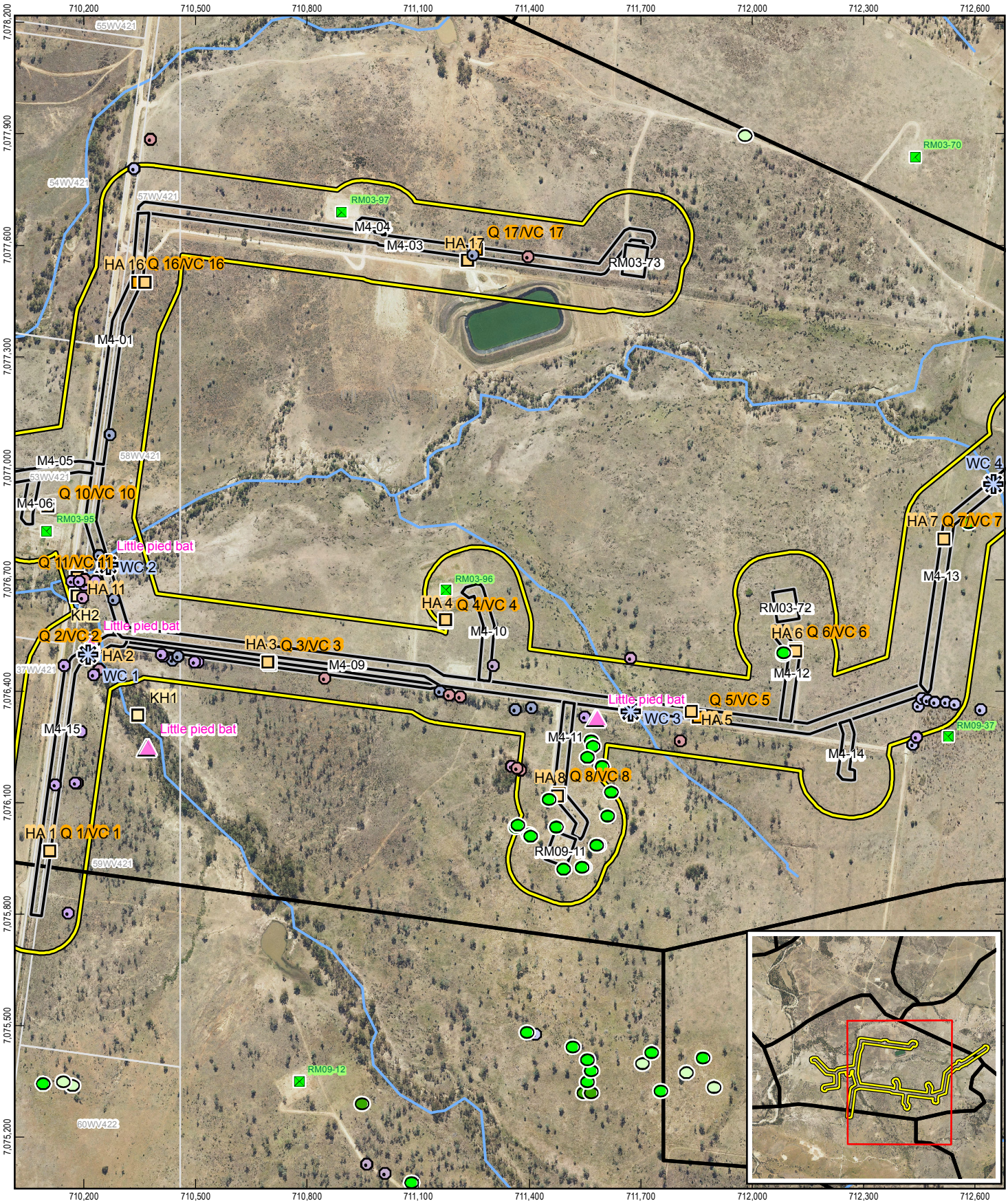
Representative photos for the M4-07 and M4-08 RoWs infrastructure area

North

East

South

West



LEGEND

- Koala Assessment Site
- Fauna Assessment Site
- Flora Assessment Site
- Watercourse Assessment Site

Fauna Habitat Site
- Dead hollow log
- Hollow in Tree

- Hollow log
- Mature tree
- Nest in Tree
- Other
- Pile of logs/timber

Type A Restricted Plant Site
- Brachychiton populneus
- Brachychiton rupestris
- Brachychiton spp.

- Well Pad
- Watercourse
- CDZ ROW Area (29m)
- CSG Infrastructure Area (100m Buffer)

- Gathering Network
- Sub-branch
- Cadastre

1:14,000 (@ A4)

0 130 260 390

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

GHD

Santos GLNG Project

Santos GLNG
L1 and N1 Ecological Assessments

Job Number 41-27312
Revision 0
Date 03 Oct 2014

Proposed M4-09 Sub-branch Infrastructure Area

Figure 6

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Data source: DNRM: Ordered Drainage/2011; Santos GLNG: Cadastre, Regional Ecosystems, Essential Habitat, Imagery, Referred Wetlands/Supplied October 2013, Well Pad, Construction Disturbance Zone/Supplied September 2014; GHD: CSG Infrastructure Area (produced in conjunction with Santos), Watercourse Assessment Site, Notable Flora Species, Notable Fauna Species, Fauna Habitat, Fauna Habitat Assessment Site, Flora Habitat Assessment Site/2014. Created by: AJ

3.6 Proposed M4-09 RoW identification area

3.6.1 Summary for the M4-09 RoW identification area

The M4-09 RoW identification area includes RoW M4-09 from the intersection with M4-05/M4-01 RoWs to the intersection with RoW M4-13.

Item	Present/Absent	Item	Present/Absent
REs	Absent	**Threatened species**	Present within CDZ RoW and 200 m buffer
TECs	Absent	**Fauna habitat features**	Present within CDZ RoW and 200 m buffer
Vegetation community/ habitat values	• Shrubby regrowth/cleared open pasture • Regrowth eucalypt woodland	**Watercourses**	Present within CDZ RoW and 100 m buffer
ESAs	Absent	**Wetlands**	Absent
Essential habitat	Absent		

3.6.2 Regional ecosystems

No REs are mapped as present within the M4-09 RoW identification area and none were identified during the ecological assessments. Field validation points for REs are shown in Figure 6 (Q3, Q5 and Q11).

A quaternary assessment at site Q11 was undertaken to verify the remnant/non-remnant status of the vegetation that is currently mapped as non-remnant regrowth eucalypt woodland at this location. A small linear patch of mature vegetation consistent with the description for remnant RE 11.10.11 (*Eucalyptus populnea, E. melanophloia* +/- *Callitris glaucophylla* woodland on coarse-grained sedimentary rocks) is present in this area fringing a watercourse. The vegetation of this area comprises *E. populnea* woodland (12-20 m tall) with mature *E. tereticornis* present along the watercourse through the site. Low *E. populnea* and *C. glaucophylla* (8-12 m tall) comprise the secondary tree layer. A mixed shrub layer (1-5 m tall) is also present. However, the extent of this mature vegetation was measured on the ground and from aerial imagery to be approximately 1.5 ha in size and approximately 50 m in width. The size of this patch does not meet the criteria for the minimum area (5 ha patch size with a minimum width of 75 m for linear features) required for mapping remnant vegetation at a 1:100,000 scale (consistent with the RE mapping scale for the Brigalow Belt bioregion) (Neldner *et al.* 2012)). Therefore the patch of vegetation at site Q11 is verified as non-remnant vegetation. Further description of this vegetation community is provided in Section 3.6.12

Approval requirement or further action

None

3.6.3 Threatened ecological communities

No TECs are mapped as present within the M4-09 RoW identification area and none were identified during the ecological assessments. Field validation points for REs are shown in Figure 6 (Q3, Q5 and Q11).

Approval requirement or further action

None

3.6.4 Vegetation communities and habitat values

The following vegetation communities occur within the M4-09 RoW identification area:

- Shrubby regrowth/cleared open pasture – VC3 and VC5; HA3 and HA5
- Regrowth eucalypt woodland – VC11; HA11

Descriptions of this vegetation community and habitat values are summarised in Section 3.6.11 and Section 3.6.12. Field validation points for vegetation communities and habitat values are shown in Figure 6.

Approval requirement or further action

None, however, rehabilitation activities are to be undertaken post-operation in accordance with the GLNG Project RRRMP (RPS 2011).

3.6.5 Environmentally sensitive areas

No ESAs or associated buffers are mapped or were observed to occur within the M4-09 RoW identification area.

Approval requirement or further action

None

3.6.6 Essential habitat

No essential habitat mapped under the VM Act is present within the M4-09 RoW identification area.

Approval requirement or further action

None

3.6.7 Threatened species

One threatened fauna species, the little pied bat, listed as near threatened under the NC Act, was recorded within the CDZ RoW and within the 200 m buffer of the M4-09 RoW identification area during ecological field assessments. The little pied bat was identified from echolocation calls recorded on anabat devices placed within regrowth eucalypt woodland within the RoW and within 200 m of the RoW and also at the base of a hollow bearing tree in open woodland (near the intersection with M4-11 RoW). Further information relating to threatened species records is contained within Section 4.

No threatened flora species were recorded within the M4-09 RoW identification area during ecological assessments. Lists of flora and fauna species recorded from field assessments are contained within Appendix B

Threatened species habitat mapping

Habitat with the potential to support a population of fauna species listed under the EPBC Act and the NC Act has been mapped for the two habitat types, namely regrowth eucalypt woodland and non-remnant shrubby regrowth/cleared open pasture, that are present within the M4 investigation area (refer to Section 4). Calculations of the extent of species habitat to be cleared within M4 investigation area are presented in Section 4.1.

General habitat mapped as having potential to support a population of threatened fauna species is present within the M4-09 RoW identification area within both the CDZ RoW and surveyed buffer extents.

Approval requirement or further action

No further action currently required. Should a threatened species be encountered, management actions listed within the SSMP, SMP and GTP SMP are to be followed during pre-construction, construction and operation.

It is recommended that within the regrowth eucalypt woodland vegetation community at the junction with the M4-15 RoW, the width of the construction RoW for M4-09 is reduced to the minimum width necessary for safe construction to minimise the clearing extent to general habitat for threatened fauna species. It is recommended that all management plans are checked for validity prior to implementation on this project.

3.6.8 Fauna habitat features

Fauna habitat features that have potential to be fauna breeding places for least concern or threatened fauna species were recorded within the CDZ RoW and incidentally in the 200 m buffer of the M4-09 RoW identification area (refer to Section 3.6.11). Locations of these features are mapped in Figure 6. Spatial data has been provided to Santos for incorporation into their webGIS system.

Potential fauna breeding places previously recorded on Lot 62WV421 were not ground-truthed due to restricted land access.

Approval requirement or further action

Management actions listed within the SSMP, SMP and GTP SMP documents are to be followed during pre-construction, construction and operation.

3.6.9 Watercourses

Mapped first and second order watercourses intersect the M4-09 RoW and a single second order watercourse is located within the 100 m buffer of M4-09 RoW identification area.

Field validation of the watercourses determined two to be watercourses (WC01 and WC02) and one to be a drainage feature (WC03) under the Water Act. The watercourse assessment locations are shown as sites WC01, WC02 and WC03 on Figure 6. A summary of results is presented in Table 3 and the watercourse assessments are presented in Appendix C.

Table 3 Watercourse assessments in the M4-09 RoW identification area

Watercourse reference	Location (easting, northing)		Assessment outcome	Assessment outcome explanation
WC01 (within 100 m buffer)	710215	7076501	Watercourse (*Water Act 2000*)	No extended or permanent period of flow – only carries water flow for a short duration after a rainfall event Lacks sufficient flow adequacy to sustain basic ecological processes and support riverine species Features continuous and defined bed and banks and the presence of in-stream islands, benches or bars
			Not a waterway (*Fisheries Act 1994*)	Features continuous and defined bed and banks and the presence of in-stream islands, benches or bars No extended or permanent period of flow – only carries water flow for a short duration after a rainfall event Lacks sufficient flow adequacy to sustain basic ecological processes and support riverine species
WC02	710265	7076741	Watercourse (*Water Act 2000*)	No extended or permanent period of flow – only carries water flow for a short duration after a rainfall event Lacks sufficient flow adequacy to sustain basic ecological processes and support riverine species Features a continuous and defined bed and banks and the presence of in-stream islands, benches or bars
			Not a waterway (*Fisheries Act 1994*)	Features continuous and defined bed and banks and the presence of in-stream islands, benches or bars No extended or permanent period of flow – only carries water flow for a short duration after a rainfall event Lacks sufficient flow adequacy to sustain basic ecological processes and support riverine species

Watercourse reference	Location (easting, northing)		Assessment outcome	Assessment outcome explanation
WC03	711673	7076348	Drainage feature (*Water Act 2000*)	No extended or permanent period of flow – only carries water flow for a short duration after a rainfall event Lacks sufficient flow adequacy to sustain basic ecological processes and support riverine species Lacks continuous and defined bed and banks and the presence of in-stream islands, benches or bars
			Not a waterway (*Fisheries Act 1994*)	No continuous and defined bed and banks or the presence of in-stream islands, benches or bars No extended or permanent period of flow – only carries water flow for a short duration after a rainfall event Lacks sufficient flow adequacy to sustain basic ecological processes and support riverine species

Approval requirement or further action

As the feature constitutes a watercourse under the Water Act, construction and vegetation clearing must comply with relevant assessable codes under the Water Act and the relevant EA requirements relating to watercourses (Schedule B). Pre and post work checklists must be completed and all approvals must be lodged with the relevant agencies a minimum of ten business days prior to works.

3.6.10 Wetlands, lakes and springs

No wetlands are mapped or were confirmed present within the M4-09 RoW identification area, or within the 300 m buffer.

Approval requirement or further action

None

3.6.11 M4-09 RoW identification area: Vegetation community and habitat (non-remnant shrubby regrowth/cleared open pasture) summary

Vegetation community description – Baseline data																					
Site:	Q3/ VC3/ HA3 Q5/ VC5/ HA5		**Recorder:**	LM RF		**Date:**	16/07/2014/ 17/07/2014		**Time:**	1:15pm 8:15am											
Project:	M4 ecological field surveys					**Photos:**	N: 4297 E: 4298 S: 4299 W: 4300 N: 4318 E: 4319 S: 4320 W: 4321														
Locality:	M4-09 RoW					**Property (lot/plan):**	Mt Hope (58WV421)														
Coordinates (3)	**Zone:**	5	5		7	1	0	6	9	9		7	0	7	6	4	8	2			
Coordinates (5):		5	5		7	1	1	8	3	5		7	0	7	6	3	5	0			
Vegetation community description: Open, non-remnant cleared pasture land. Very sparse mature trees, occasional low regrowth shrubs and saplings, low heavily grazed groundcover, mostly dead.																					

Vegetation Structure

Median height of EDL is to be measured and cover density estimated: D, touching-overlap<0; M, touching-slight separation 0-0/25; S, clearly separated 0.25-1, V, well separated 1-20

Stratum	Median height	Height interval	Est. cover density (D,M,S,V)
E		-	
T1	15	12 - 18	V
T2		-	
T3		-	
S1	2	0.5 - 5	V
S2		-	
G	0.4	0 - 1	M

Structural formation (including height): grassland

Ecologically dominant layer: S

Landform situation: flat gentle slopes, undulating terrain

Land form element (40 m radius): hillslope/plain

Land form pattern (300 m radius): undulating plain

Soil and geology: light brown/grey, sandy loam, sandstone derived, ironstone nodules present on surface

Topsoil depth: Skeletal/shallow

Slope position, degree and aspect: upper-slope/crest, 2°, west/south-west

Vast condition assessment: Type V

Plant species

Relative (numerical) dominance for each stratum: d, dominant; c, codominant; s, subdominant; a, associated.

Str.	Rel. dom.	Scientific Name
T1	d	*Eucalyptus melanophloia*
T1	a	*Eucalyptus orgadophila*
S1	d	*Acacia decora*
S1	s	*Eucalyptus melanophloia*
S1	a	*Eucalyptus orgadophila*
S1	a	*Eucalyptus populnea*
S1	a	*Acacia oswaldii*
G	s	*Aristida calycina*
G	s	*Cenchrus ciliaris**
G	s	*Enteropogon ramosus*
G	s	*Heteropogon contortus*
G	s	*Urochloa mosambicensis**
G	a	*Sclerolaena birchii*
G	a	*Aristida latifolia*
G	a	*Chrysocephalum apiculatum*
G	a	*Panicum effusum*
G	a	*Bothriochloa pertusa**
G	a	*Aristida caput-medusae*
G	a	*Panicum decompositum var. decompositum*
G	a	*Verbena aristigera**
G	a	*Aristida jerichoensis*
G	a	*Chrysopogon fallax*
G	a	*Alloteropsis semialata*
G	a	*Aristida platychaeta*
G	a	*Aristida sp.*
G	a	*Pimelea trichostachya*

G	a	*Bothriochloa ewartiana*
G	a	*Dichanthium sericeum*
G	a	*Cyperus sp.*

G	a	*Opuntia stricta**
G	a	*Melinis repens**
*Denotes exotic species		

Ground cover and organic litter (%) (average from five 1 m x 1 m quadrats)	
Type	**% cover**
Native grass	6.5
Native herbs/forbs (non-grass)	0.5
Native shrubs (<1 m high)	0.2
Non-native grass	3.6
Non-native herbs and shrubs	0.4
Litter (woodies <10 cm diameter, dead annuals, etc.)	32.3
Litter (logs >10 cm diameter)	0
Rock	1.6
Bare ground	54.9

Fauna habitat features (within 0.5 ha area)	
Characteristic	**Abundance (0-7) ^**
Decorticating bark	0
Coarse leaf litter (>2 cm diameter)	0
Fine leaf litter (<2 cm diameter)	0
Bare ground	3
Grass	5
Soil cracks	0
Stones (20-60 cm)	2
Boulders (61 cm – 2 m)	0
Larger boulders (>2 m)	0
Rock crevices	0
Exfoliating rock	0
^ 0, nil; **1**, rare; **2,** rare to occasional; **3,** occasional; **4**, Occasional to common; **5**, common; **6**, common to abundant; **7**, abundant	

Vegetative cover	
Strata	**Cover (100 m line intercept)**
E	-
T1	0
T2	-
S1	10.5
S2	-
G	-
Species	
S1	
Eucalyptus melanophloia	2.5
Acacia decora	7.5
Acacia oswaldii	0.5

Vegetative density	
Strata	**Stem count (1 ha area)**
E	-
T1	-
T2	-
S1	390
S2	-
G	-
Species	
S1	
Eucalyptus populnea	40
Eucalyptus melanophloia	100
Acacia decora	150
Acacia oswaldii	90
Eremophila mitchellii	10

Fauna habitat value (within 1 ha area) – Baseline data	
Characteristic	**Value**
Number of trees with hollows: - Hollow size <10 cm diameter - Hollow size >10 cm diameter	0 0 0
Number of hollow bearing logs (hollows >10 cm diameter)	6
Total number of hollows in logs	6
Total length of fallen woody material (e.g. logs) >10 cm diameter	410 m

General habitat features and fauna breeding places present
General habitat features and potential fauna breeding places have been recorded in the Santos webGIS system. Refer to Santos webGIS for more information on these features.
Potential habitat for EVNT fauna species (including essential habitat): Little pied bat confirmed present

Koala habitat
Identification area not koala habitat due to non-remnant vegetation and absence of suitable koala food trees. Koala habitat assesssments were not undertaken at this location.

Disturbances (e.g. grazing, clearing, ploughing etc.)
Wildfire: 1 – 1-5 years **Grazing:** 3 – moderate to large amounts from many plants **Weeds:** 2 – moderate infestations **Erosion:** 1-2 – slight to moderate disturbance (e.g. cattle tracks, pedestalling, sheet, rill) **Clearing:** 3 – large amount, non-remnant, cleared grazing paddock
Ecosystem functioning (e.g. Extent of remnant vegetation in the landscape, connectivity, etc.):
Patch size and characteristics: large patch (>100 ha) of non-remnant vegetation. **Location of patch:** low – not connected to remnant or regrowth vegetation **Degree of edge effects:** 3 - severe **Floodplain characteristics:** nil as topography is undulating terrain Few scattered trees provide habitat for woodland birds and may provide stepping stone for fauna in broader landscape. Low shrubs may provide habitat for small woodland birds. Log piles and woody debris may provide shelter for small reptiles.

Declared weeds and introduced species
Weeds present: **Rare (<10 plants observed):** prickly pear[1] (*Opuntia stricta*), mimosa bush (*Vachellia farnesiana*) **Uncommon (11-50 plants observed):** buffel grass (*Cenchrus ciliaris*), sabi grass (*Urochloa mosambicensis*); Indian bluegrass (*Bothriochloa pertusa* **Common (>50 plants observed):** red natal grass (*Melinis repens*)Mayne's pest (*Verbena aristigera*);
Total percentage weed cover: prickly pear[1] 0.5%; Indian bluegrass 1%; buffel grass 15%; Mayne's pest 8%; mimosa bush 1%; sabi grass 10%; red natal grass 10%
[1]Class 2 declared weed under the LP Act

EVNT/Type A flora present
Kurrajong (*Brachychiton populneus*). Refer to santos webGIS system for point locations.

Incidental fauna observations
Australian magpie
Australian raven
Kookaburra
Noisy miner
Galah
Grey-crowned babbler
Magpie lark
Masked lapwing
Pale-headed rosella
Pied butcherbird
Striated pardalote
Torresian crow
Weebill

NOTE: The results of the vegetation community and habitat assessments have been averaged from two sites representative of this community. Sites Q3/VC3/HA3 and Q5/VC5/HA5.

Representative photos for the M4-09 RoW identification area (from Q5/VC5/HA5)

North

East

South

West

3.6.12 M4-09 RoW identification area: Vegetation community and habitat (regrowth eucalypt woodland) summary

Vegetation community description – Baseline data							
Site:	Q11/VC11/HA11	**Recorder:**	LM RF	**Date:**	19/07/2014	**Time:**	11:00am
Project:	M4 ecological field surveys			**Photos:**	N: 4359 E: 4360 S: 4361 W: 4362		
Locality:	M4-09 RoW			**Property (lot/plan):**	Mt Hope (58WV421)		
Coordinates:	**Zone:** 5 5	7 1 0 1 8 3		7 0 7 6 7 0 8			
Vegetation community description: Open woodland, mapped non-remnant regrowth eucalypt woodland containing sparse mature emergent trees and lower regrowth vegetation fringing a watercourse. Regrowth eucalypt woodland vegetation is surrounded by historically cleared grazing lands.							

Vegetation Structure

Median height of EDL is to be measured and cover density estimated: D, touching-overlap<0; M, touching-slight separation 0-0/25; S, clearly separated 0.25-1, V, well separated 1-20

Stratum	Median height	Height interval	Est. cover density (D,M,S,V)
E		-	
T1	18	12 - 20	V
T2	12	8 - 12	V
T3		-	
S1	3.5	1 - 5	V
S2		-	
G	0.3	0 – 1	s

Structural formation (including height): woodland

Ecologically dominant layer: T1

Landform situation: Alluvial plain or flat and drainage line

Land form element (40 m radius): creek channel and high banks

Land form pattern (300 m radius): undulating plain

Soil and geology: light brown sandy alluvium in channel, hard packed brown sandy loam on plain

Topsoil depth: Deep

Slope position, degree and aspect: flat/open depression**,** 1° south

Vast condition assessment: Type III

Plant species

Relative (numerical) dominance for each stratum: d, dominant; c, codominant; s, subdominant; a, associated.

Str.	Rel. dom.	Scientific Name
T1	d	*Eucalyptus populnea*
T1	s	*Eucalyptus tereticornis*
T2	d	*Eucalyptus populnea*
T2	a	*Callitris glaucophylla*
S1	c	*Acacia deanei subsp. deanei*
S1	c	*Geijera parviflora*
S1	c	*Eremophila mitchellii*
S1	a	*Acacia excelsa*
S1	a	*Acacia decora*
S1	a	*Acacia salicina*
S1	a	*Carissa ovata*
S1	a	*Opuntia tomentosa**
G	d	*Themeda triandra*
G	a	*Dichanthium sericeum*
G	a	*Verbena aristigera**
G	a	*Imperata cylindrica*
G	a	*Aristida jerichoensis*
G	a	*Lomandra longifolia*
G	a	*Tagetes minuta**
G	a	*Bothriochloa pertusa**
G	a	*Themeda avenacea*
G	a	*Xanthium occidentale**
G	a	*Cynodon dactylon var. dactylon**
G	a	*Chrysopogon fallax*
G	a	*Chloris ventricosa*

**Denotes exotic species*

Ground cover and organic litter (%) (average from five 1 m x 1 m quadrats)	
Type	**% cover**
Native grass	10
Native herbs/forbs (non-grass)	0
Native shrubs (<1 m high))	0
Non-native grass	12
Non-native herbs and shrubs	10
Litter (woodies <10 cm diameter, dead annuals, etc.)	38
Litter (logs >10 cm diameter)	0
Rock	0
Bare ground	30

Fauna habitat features (within 0.5 ha area)	
Characteristic	**Abundance (0-7) ^**
Decorticating bark	1
Coarse leaf litter (>2 cm diameter)	3
Fine leaf litter (<2 cm diameter)	1
Bare ground	4
Grass	4
Soil cracks	0
Stones (20-60 cm)	0
Boulders (61 cm – 2 m)	0
Larger boulders (>2 m)	0
Rock crevices	0
Exfoliating rock	0
^ 0, nil; **1**, rare; **2,** rare to occasional; **3,** occasional; **4**, Occasional to common; **5**, common; **6**, common to abundant; **7**, abundant	

Vegetative cover	
Strata	**Cover (100 m line intercept)**
E	-
T1	47.5
T2	34
S1	16.5
S2	-
G	-
Species	
T1	
Eucalyptus populnea	20
Eucalyptus tereticornis	27.5
T2	
Eucalyptus populnea	34
S1	
Acacia salicina	6.5
Eremophila mitchellii	1
Acacia decora	1
Geijera parviflora	5
Acacia deanei	3

Vegetative density	
Strata	**Stem count (per ha)**
E	-
T1	22
T2	86
S1	800
S2	-
G	-
Species	
T1	
Eucalyptus populnea	12
Eucalyptus tereticornis	10
T2	
Eucalyptus populnea	76
Callitris glaucophylla	10
S1	
Eremophila mitchellii	300
Acacia excelsa	20
Geijera parviflora	120
Acacia deanei	340
Carissa ovata	20

Fauna habitat value (within 1 ha area) – Baseline data	
Characteristic	**Value**
Number of trees with hollows: - Hollow size <10 cm diameter - Hollow size >10 cm diameter	4 12 2
Number of hollow bearing logs (hollows >10 cm diameter)	8
Total number of hollows in logs	12
Total length of fallen woody material (e.g. logs) >10 cm diameter	360 m

General habitat features and fauna breeding places present
General habitat features and potential fauna breeding places have been recorded in the Santos webGIS system. Refer to Santos webGIS for more information on these features.
Potential habitat for EVNT fauna species (including essential habitat): Little pied bat confirmed present General Habitat for EVNT species is present, refer to Section 4.1

Koala habitat
Koala food trees present; however, due to patch size, the lack of water and low soil moisture trees are unlikely to be koala habitat trees. Refer to Appendix C for koala habitat assessment.

Disturbances (e.g. grazing, clearing, ploughing etc.)
Wildfire: 2 – =>5 years **Grazing:** 3 –small to moderate amounts from many plants **Weeds:** 2 – moderate infestations **Erosion:** 2/3 – moderate to severe disturbance (e.g. sheet, rill erosion, pedestals, scalds, sand blown, exposure) particularly around watercourse **Clearing:** 2 – moderate amount, regrowth or near-remnant status
Ecosystem functioning (e.g. Extent of remnant vegetation in the landscape, connectivity, etc.):
Patch size and characteristics: linear regrowth eucalypt woodland polygon, less than 100 m wide following the watercourse, surrounded by cleared non-remnant vegetation. **Location of patch:** low – not connected to remnant or regrowth vegetation **Degree of edge effects:** 2 – moderate, minor disturbance, some non-native species **Floodplain characteristics: the convergence to two** narrow watercourses occurs in the area, flat topography is present to the east in a triangular shape bounded by the two watercourses extending for a distance of approximately 300 m from the watercourse convergence. This area may be inundated by floodwaters. Large riparian trees provide habitat for arboreal mammals and woodland birds. Mature trees with hollows may provide nesting habitat for may provide nesting habitat for parrots and roosting habitat for bats. Hollow logs, woody debris and leaf litter may provide habitat for small reptiles and mammals. Regrowth vegetation provides habitat corridor in otherwise vastly cleared landscape.

Declared weeds and introduced species
Weeds present: **Rare (<10 plants observed):** nil **Uncommon (11-50 plants observed):** velvety tree pear[1] (*Opuntia tomentosa*), green couch (*Cynodon dactylon var. dactylon*) **Common (>50 plants observed):** Indian bluegrass (*Bothriochloa pertusa*), Mayne's pest (*Verbena aristigera*); Noogoora burr (*Xanthium occidentale*)
Total percentage weed cover: velvety tree pear[1] 4%; Mayne's pest 20%; Indian bluegrass 20%; green couch 8%; Noogoora burr 10%
[1]Class 2 declared weed under the LP Act

EVNT/Type A flora present
Nil

Incidental fauna observations
Noisy miner Pale-headed rosella Weebill

Representative photos for the M4-09 RoW identification area

North

East

South

West

LEGEND

- Fauna Assessment Site
- Flora Assessment Site
- Fauna Habitat Site
- Dead hollow log
- Hollow log
- Pile of logs/timber
- Well Pad
- Watercourse
- CDZ ROW Area (29m)
- CSG Infrastructure Area (100m Buffer)
- Gathering Network Sub-branch
- Cadastre

1:3,000 (@ A4)

0 30 60 90

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

Santos GLNG
L1 and N1 Ecological Assessments

Job Number 41-27312
Revision 0
Date 03 Oct 2014

Proposed M4-10 Sub-branch Infrastructure Area

Figure 7

G:\41\27312\GIS\Maps\MXD\41_27312_021_M4_Rev_0.mxd
145 Ann St Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: DNRM: Ordered Drainage/2011; Santos GLNG: Cadastre, Regional Ecosystems, Essential Habitat, Imagery, Referred Wetlands/Supplied October 2013, Well Pad, Construction Disturbance Zone/Supplied September 2014; GHD: CSG Infrastructure Area (produced in conjunction with Santos), Watercourse Assessment Site, Notable Flora Species, Notable Fauna Species, Fauna Habitat, Fauna Habitat Assessment Site, Flora Habitat Assessment Site/2014. Created by: AJ

3.7 Proposed M4-10 RoW identification area

3.7.1 Summary for the M4-10 RoW identification area

The M4-10 RoW identification area includes RoW M4-10 and the RM03-96 wellpad area.

Item	Present/Absent	Item	Present/Absent
REs	Absent	**Threatened species**	Absent
TECs	Absent	**Fauna habitat features**	Present within CDZ RoW and 200 m buffer
Vegetation community/ habitat values	Shrubby regrowth/cleared open pasture	**Watercourses**	Absent
ESAs	Absent	**Wetlands**	Absent
Essential habitat	Absent		

3.7.2 Regional ecosystems

No REs are mapped as present within the M4-10 RoW identification area and none were identified during the ecological assessments. Field validation points for REs are shown in Figure 7 (Q4).

Approval requirement or further action

None

3.7.3 Threatened ecological communities

No TECs are mapped as present within the M4-10 RoW identification area and none were identified during the ecological assessments. Field validation points for REs are shown in Figure 7 (Q4).

Approval requirement or further action

None

3.7.4 Vegetation communities and habitat values

The following vegetation community occurs within the M4-10 RoW identification area:

- Shrubby regrowth/cleared open pasture

Descriptions of this vegetation community and habitat values are summarised in Section 3.7.11. Field validation points for vegetation communities and habitat values are shown in Figure 7 (VC4, HA4).

Approval requirement or further action

None, however, rehabilitation activities are to be undertaken post-operation in accordance with the GLNG Project RRRMP (RPS 2011).

3.7.5 Environmentally sensitive areas

No ESAs or associated buffers are mapped or were observed to occur within M4-10 RoW identification area.

Approval requirement or further action

None

3.7.6 Essential habitat

No essential habitat mapped under the VM Act is present within the M4-10 RoW identification area.

Approval requirement or further action

None

3.7.7 Threatened species

No threatened fauna or flora species were recorded within the M4-10 RoW identification area during ecological field assessments. Further information relating to threatened species records is contained within Section 4.

Lists of flora and fauna species recorded from field assessments are contained within Appendix B.

Threatened species habitat mapping

Habitat with the potential to support a population of fauna species listed under the EPBC Act and the NC Act has been mapped for the two habitat types, namely regrowth eucalypt woodland and non-remnant shrubby regrowth/cleared open pasture, that are present within the M4 investigation area (refer to Section 4). Calculations of the extent of species habitat to be cleared within M4 investigation area are presented in Section 4.1.

Habitat mapped as having potential to support a population of threatened fauna species is not present within the M4-10 RoW identification area.

Approval requirement or further action

No further action currently required. Should a threatened species be encountered, management actions listed within the SSMP, SMP and GTP SMP are to be followed during pre-construction, construction and operation.

It is recommended that all management plans are checked for validity prior to implementation on this project.

3.7.8 Fauna habitat features

Fauna habitat features that have potential to be fauna breeding places for least concern or threatened fauna species were recorded within the CDZ RoW and incidentally in the 200 m buffer of the M4-10 RoW identification area (refer to Section 3.7.11). Locations of these features are mapped in Figure 7. Spatial data has been provided to Santos for incorporation into their webGIS system.

Approval requirement or further action

Management actions listed within the SSMP, SMP and GTP SMP documents are to be followed during pre-construction, construction and operation.

3.7.9 Watercourses

No watercourses are mapped or were confirmed present within the M4-10 RoW identification area, or within the 100 m buffer.

Approval requirement or further action

None

3.7.10 Wetlands, lakes and springs

No wetlands are mapped or were confirmed present within the M4-10 RoW identification area, or within the 300 m buffer.

Approval requirement or further action

None

3.7.11 M4-10 RoW identification area: Vegetation community and habitat (non-remnant shrubby regrowth/cleared open pasture) summary

Vegetation community description – Baseline data							
Site:	Q4/VC4/HA4	**Recorder:**	LM RF	**Date:** 16/07/2014		**Time:**	2:10 pm
Project:	M4 ecological field surveys			**Photos:** N: 4301 E: 4302 S: 4303 W: 4304			
Locality:	M4-10 RoW			**Property (lot/plan):**	Mt Hope (58WV421)		
Coordinates:	**Zone:** 5 5	7 1 1 1 7 8		7 0 7 6 5 8 9			
Vegetation community description: Open, non-remnant cleared pasture land. Mature trees absent, sparse sapling and shrub layer, low heavily grazed groundcover, mostly dead.							

Vegetation Structure

Median height of EDL is to be measured and cover density estimated: D, touching-overlap<0; M, touching-slight separation 0-0/25; S, clearly separated 0.25-1, V, well separated 1-20

Stratum	Median height	Height interval	Est. cover density (D,M,S,V)
E		-	
T1		-	
T2		-	
T3		-	
S1	2	0.5 - 3	V
S2		-	
G	0.1	0 - 1	M

Structural formation (including height): grassland

Ecologically dominant layer: S1

Landform situation: flat gentle slopes, undulating terrain

Land form element (40 m radius): hillslope

Land form pattern (300 m radius): undulating plain

Soil and geology: grey, loam

Topsoil depth: Skeletal

Slope position, degree and aspect: Mid-slope, 2^{o}, north

Vast condition assessment: Type V

Plant species

Relative (numerical) dominance for each stratum: d, dominant; c, codominant; s, subdominant; a, associated.

Str.	Rel. dom.	Scientific Name
S1	d	*Acacia decora*
S1	s	*Eucalyptus melanophloia*
S1	a	*Eremophila mitchellii*
S1	a	*Psydrax oleifolia*
G	s	*Cenchrus ciliaris**
G	a	*Dichanthium sericeum*
G	a	*Urochloa mosambicensis**
G	a	*Pimelea trichostachya*
G	a	*Aristida calycina*
G	a	*Aristida latifolia*
G	a	*Heteropogon contortus*
G	a	*Bothriochloa pertusa**
G	a	*Bothriochloa ewartiana*
G	a	*Opuntia stricta**
G	a	*Sclerolaena birchii*

**Denotes exotic species*

Ground cover and organic litter (%) (average from five 1 m x 1 m quadrats)	
Type	**% cover**
Native grass	13
Native herbs/forbs (non-grass)	0
Native shrubs (<1 m high))	0
Non-native grass	18
Non-native herbs and shrubs	0.8
Litter (woodies <10 cm diameter, dead annuals, etc.)	15.2
Litter (logs >10 cm diameter)	0
Rock	0
Bare ground	53

Fauna habitat features (within 0.5 ha area)	
Characteristic	**Abundance (0-7) ^**
Decorticating bark	0
Coarse leaf litter (>2 cm diameter)	0
Fine leaf litter (<2 cm diameter)	0
Bare ground	5
Grass	5
Soil cracks	0
Stones (20-60 cm)	0
Boulders (61 cm – 2 m)	0
Larger boulders (>2 m)	0
Rock crevices	0
Exfoliating rock	0
^ 0, nil; **1**, rare; **2,** rare to occasional; **3,** occasional; **4**, Occasional to common; **5**, common; **6**, common to abundant; **7**, abundant	

Vegetative cover	
Strata	**Cover (100 m line intercept)**
E	-
T1	-
T2	-
S1	1.5
S2	-
G	-
Species	
S1	
Eucalyptus melanophloia	1
Acacia decora	0.5

Vegetative density	
Strata	**Stem count (per ha)**
E	-
T1	-
T2	-
S1	160
S2	-
G	-
Species	
S1	
Eucalyptus melanophloia	160

Fauna habitat value (within 1 ha area) – Baseline data	
Characteristic	**Value**
Number of trees with hollows: - Hollow size <10 cm diameter - Hollow size >10 cm diameter	0 0 0
Number of hollow bearing logs (hollows >10 cm diameter)	12
Total number of hollows in logs	12
Total length of fallen woody material (e.g. logs) >10 cm diameter	260 m

General habitat features and fauna breeding places present
General habitat features and potential fauna breeding places have been recorded in the Santos webGIS system. Refer to Santos webGIS for more information on these features.
Potential habitat for EVNT fauna species (including essential habitat): No potential habitat for EVNT species present

Koala habitat
Identification area not koala habitat due to non-remnant vegetation and absence of suitable koala food trees. Koala habitat assesssments were not undertaken at this location.

Disturbances (e.g. grazing, clearing, ploughing etc.)
Wildfire: 1 – 1-5 years **Grazing:** 3 – moderate to large amounts from many plants **Weeds:** 2 – moderate infestations **Erosion:** 1 – slight disturbance (e.g. cattle tracks) **Clearing:** 3 – large amount, non-remnant, cleared grazing paddock
Ecosystem functioning (e.g. Extent of remnant vegetation in the landscape, connectivity, etc.):
Patch size and characteristics: large patch (>100 ha) of non-remnant vegetation. **Location of patch:** low – not connected to remnant or regrowth vegetation

Degree of edge effects: 3 - severe
Floodplain characteristics: nil, as landscape is of undulating topography

Large trees adjacent to CDZ RoW may provide habitat for woodland birds. Logs and woody debris may provide habitat for small reptiles.

Declared weeds and introduced species
Weeds present: **Rare (<10 plants observed):** prickly pear[1] (*Opuntia stricta*) **Uncommon (11-50 plants observed):** buffel grass (*Cenchrus ciliaris*), Indian bluegrass (*Bothriochloa pertusa*), sabi grass (*Urochloa mosambicensis*) **Common (>50 plants observed):** nil
Total percentage weed cover: prickly pear[1] 0.2%; Indian bluegrass 10%; buffel grass 22%; sabi grass 4%
[1]Class 2 declared weed under the LP Act

EVNT/Type A flora present
Nil

Incidental fauna observations
Banded lapwing Magpie lark Noisy miner Torresian crow

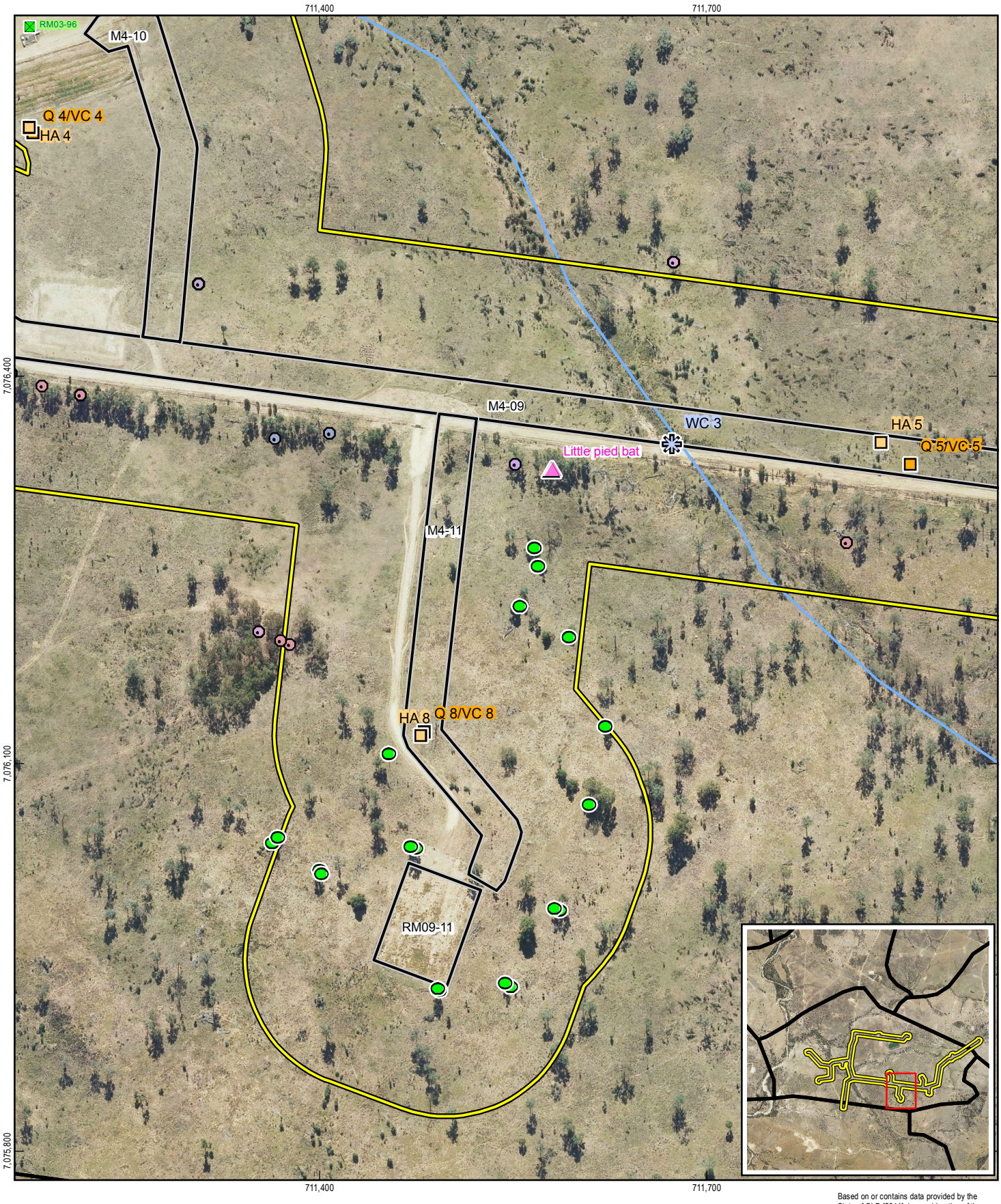
Representative photos for the M4-10 RoW identification area

North

East

South

West



LEGEND

- Fauna Assessment Site
- Flora Assessment Site
- Watercourse Assessment Site

Fauna Habitat Site
- Dead hollow log
- Hollow in Tree
- Hollow log
- Nest in Tree
- Pile of logs/timber

Type A Restricted Plant Site
- Brachychiton populneus

- Well Pad
- Watercourse
- CDZ ROW Area (29m)
- CSG Infrastructure Area (100m Buffer)
- Gathering Network Sub-branch
- Cadastre

1:4,000 (@ A4)

0 40 80 120

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

GHD

Santos GLNG Project

Santos GLNG
L1 and N1 Ecological Assessments

Job Number 41-27312
Revision 0
Date 03 Oct 2014

Proposed M4-11 Sub-branch Infrastructure Area

Figure 8

G:\41\27312\GIS\Maps\MXD\41_27312_021_M4_Rev_0.mxd 145 Ann St Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: DNRM: Ordered Drainage/2011; Santos GLNG: Cadastre, Regional Ecosystems, Essential Habitat, Imagery, Referred Wetlands/Supplied October 2013, Well Pad, Construction Disturbance Zone/Supplied September 2014; GHD: CSG Infrastructure Area (produced in conjunction with Santos), Watercourse Assessment Site, Notable Flora Species, Notable Fauna Species, Fauna Habitat, Fauna Habitat Assessment Site, Flora Habitat Assessment Site/2014. Created by: AJ

3.8 Proposed M4-11 RoW identification area

3.8.1 Summary for the M4-11 RoW identification area

The M4-11 RoW identification area includes RoW M4-11 and the RM09-11 wellpad area.

Item	Present/Absent	Item	Present/Absent
REs	Absent	**Threatened species**	Present within 200 m buffer only
TECs	Absent	**Fauna habitat features**	Present within 200 m buffer only
Vegetation community/ habitat values	Regrowth eucalypt woodland	**Watercourses**	Absent
ESAs	Absent	**Wetlands**	Absent
Essential habitat	Absent		

3.8.2 Regional ecosystems

No REs are mapped as present within the M4-11 RoW identification area and none were identified during the ecological assessments. Field validation points for REs are shown in Figure 8 (Q8 and Q19).

An additional quaternary assessment (Q19) was undertaken at a small patch (approximately 0.7 ha) of vegetation within 200 m of the M4-11 RoW to verify the remnant/non-remnant status of the vegetation. The vegetation is currently mapped as non-remnant vegetation. The vegetation within this patch is a low open woodland comprising a dominant low tree layer (4-8 m tall) of *Eremophila mitchellii,* Callitris *glaucophylla* and *Psydrax oleifolius* with occasional emergent *Eucalyptus populnea* and *Acacia harpophylla* (10-15 m tall). This vegetation patch was determined to be non-remnant vegetation as the size of this patch, as measured from aerial imagery, does not meet the criteria for the minimum area (5 ha patch size) required for mapping remnant vegetation at a 1:100,000 scale (consistent with the RE mapping scale for the Brigalow Belt bioregion) (Neldner *et al.* 2012)).

Approval requirement or further action

None

3.8.3 Threatened ecological communities

No TECs are mapped as present within the M4-11 RoW identification area and none were identified during the ecological assessments. Field validation points for REs are shown in Figure 8 (Q8).

Approval requirement or further action

None

3.8.4 Vegetation communities and habitat values

The following vegetation community occurs within M4-11 RoW identification area:

- Regrowth eucalypt woodland

Descriptions of this vegetation community and habitat values are summarised in Section 3.8.11. Field validation points for vegetation communities and habitat values are shown in Figure 8 (VC8, HA8).

Approval requirement or further action

None, however, rehabilitation activities are to be undertaken post-operation in accordance with the GLNG Project RRRMP (RPS 2011).

3.8.5 Environmentally sensitive areas

No ESAs or associated buffers are mapped or were observed to occur within the M4-11 RoW identification area.

Approval requirement or further action

None

3.8.6 Essential habitat

No essential habitat mapped under the VM Act is present within the M4-11 RoW identification area.

Approval requirement or further action

None

3.8.7 Threatened species

No threatened fauna or flora species were recorded within the M4-11 RoW identification area during ecological field assessments. The little pied bat, listed as near threatened under the NC Act, was identified from echolocation calls recorded on an anabat device placed at the base of a hollow bearing tree in open woodland approximately 200 m from RoW M4-11. Further information relating to threatened species records is contained within Section 4.

Lists of flora and fauna species recorded from field assessments are contained within Appendix B

Threatened species habitat mapping

Habitat with the potential to support a population of fauna species listed under the EPBC Act and the NC Act has been mapped for the two habitat types, namely regrowth eucalypt woodland and non-remnant shrubby regrowth/cleared open pasture, that are present within the M4 investigation area (refer to Section 4). Calculations of the extent of species habitat to be cleared within M4 investigation area are presented in Section 4.1.

Habitat mapped as having potential to support a population of threatened fauna species is not present within the M4-11 RoW identification area.

Approval requirement or further action

No further action currently required. Should a threatened species be encountered, management actions listed within the SSMP, SMP and GTP SMP are to be followed during pre-construction, construction and operation.

It is recommended that all management plans are checked for validity prior to implementation on this project.

3.8.8 Fauna habitat features

Fauna habitat features that have potential to be fauna breeding places for least concern or threatened fauna species were recorded incidentally in the 200 m buffer of the M4-11 RoW identification area (refer to Section 3.8.11). Locations of these features are mapped in Figure 8. Spatial data has been provided to Santos for incorporation into their webGIS system.

Approval requirement or further action

Management actions listed within the SSMP, SMP and GTP SMP documents are to be followed during pre-construction, construction and operation.

3.8.9 Watercourses

No watercourses are mapped or were confirmed present within the M4-11 RoW identification area, or within the 100 m buffer.

Approval requirement or further action

None

3.8.10 Wetlands, lakes and springs

No wetlands are mapped or were confirmed present within the M4-11 RoW identification area, or within the 300 m buffer.

Approval requirement or further action

None

3.8.11 M4-11 RoW identification area: Vegetation community and habitat (regrowth eucalypt woodland) summary

Vegetation community description – Baseline data							
Site:	VC8/Q8/HA8	**Recorder:**	LM RF	**Date:**	17/07/2014	**Time:**	12:00pm
Project:	M4 ecological field surveys			**Photos:**	N: 4340 E: 4341 S: 4342 W: 4343		
Locality:	M4-11 RoW			**Property (lot/plan):**	Oakleigh (59WV421)		
Coordinates:	**Zone:** 55	711479		707612 3			
Vegetation community description: Open woodland (mapped as non-remnant) with a grassy understorey (grazing pastures). Scattered mature trees and small patches of mature vegetation present							

Vegetation Structure

Median height of EDL is to be measured and cover density estimated: D, touching-overlap<0; M, touching-slight separation 0-0/25; S, clearly separated 0.25-1, V, well separated 1-20

Stratum	Median height	Height interval	Est. cover density (D,M,S,V)
E		-	
T1	15	12 - 18	V
T2		-	
T3		-	
S1	2	0.5 - 3	V
S2		-	
G	0.7	0 – 1.5	M

Structural formation (including height): open woodland (non-remnant)

Ecologically dominant layer: T1

Landform situation: flat gentle slopes, undulating terrain

Land form element (40 m radius): Plain

Land form pattern (300 m radius): Gently undulating plain

Soil and geology: brown, clay

Topsoil depth: Skeletal

Slope position, degree and aspect: Gentle slope, 2° north

Vast: Type III

Plant species

Relative (numerical) dominance for each stratum: d, dominant; c, codominant; s, subdominant; a, associated.

Str.	Rel. dom.	Scientific Name
T1	d	*Eucalyptus melanophloia*
T1	a	*Eucalyptus populnea*
T1	a	*Brachychiton populneus*
S1	d	*Callitris glaucophylla*
S1	a	*E. melanophloia* (juvenile)
S1	a	*E. populnea* (juvenile)
S1	a	*Opuntia tomentosa**
G	c	*Heteropogon contortus*
G	c	*Melinis repens**
G	s	*Aristida latifolia*
G	a	*Pimelea trichostachya*
G	a	*Verbena aristigera**
G	c	*Cenchrus ciliaris**
G	a	*Lomandra leucocephala*
G	a	*Chrysocephalum apiculatum*
G	a	*Aristida jerichoensis*
G	a	*Austrostipa ramosissima*

*Denotes exotic species

Ground cover and organic litter (%) (average from five 1 m x 1 m quadrats)	
Type	**% cover**
Native grass	25
Native herbs/forbs (non-grass)	0.8
Native shrubs (<1 m high))	0
Non-native grass	20.4
Non-native herbs and shrubs	0
Litter (woodies <10 cm diameter, dead annuals, etc.)	12.4
Litter (logs >10 cm diameter)	0
Rock	0
Bare ground	41.4

Fauna habitat features (within 0.5 ha area)	
Characteristic	**Abundance (0-7) ^**
Decorticating bark	1
Coarse leaf litter (>2 cm diameter)	0
Fine leaf litter (<2 cm diameter)	0
Bare ground	2
Grass	5
Soil cracks	0
Stones (20-60 cm)	0
Boulders (61 cm – 2 m)	0
Larger boulders (>2 m)	0
Rock crevices	0
Exfoliating rock	0
^ 0, nil; **1**, rare; **2,** rare to occasional; **3,** occasional; **4**, Occasional to common; **5**, common; **6**, common to abundant; **7**, abundant	

Vegetative cover	
Strata	**Cover (100 m line intercept)**
E	-
T1	-
T2	-
S1	1.4
S2	-
G	-
Species	
S1	
*Opuntia tomentosa**	0.4
Eucalyptus populnea	1

Vegetative density	
Strata	**Stem count (per ha)**
E	-
T1	-
T2	-
S1	30
S2	-
G	-
Species	
S1	
Eucalyptus populnea	40
Eucalyptus melanophloia	20

Fauna habitat value (within 1 ha area) – Baseline data	
Characteristic	**Value**
Number of trees with hollows: - Hollow size <10 cm diameter - Hollow size >10 cm diameter	2 4 0
Number of hollow bearing logs (hollows >10 cm diameter)	0
Total number of hollows in logs	0
Total length of fallen woody material (e.g. logs) >10 cm diameter	110 m

General habitat features and fauna breeding places present
General habitat features and potential fauna breeding places have been recorded in the Santos webGIS system. Refer to Santos webGIS for more information on these features.
Potential habitat for EVNT fauna species (including essential habitat): Little pied bat confirmed present in woodland within 200 m of RoW M4-11

Koala habitat
Identification area not koala habitat due to non-remnant vegetation and absence of suitable koala food trees. Koala habitat assesssments were not undertaken at this location.

Disturbances (e.g. grazing, clearing, ploughing etc.)
Wildfire: 1 – 1-5 years **Grazing:** 2 – small to moderate amounts from many plants **Weeds:** 2 – moderate infestations **Erosion:** 1 – slight disturbance (e.g. cattle tracks) **Clearing:** 2 – moderate amount, regrowth or near remnant status
Ecosystem functioning (e.g. Extent of remnant vegetation in the landscape, connectivity, etc.):

Patch size and characteristics: large patch (>100 ha) of non-remnant vegetation.
Location of patch: low – not connected to remnant or regrowth vegetation
Degree of edge effects: 3 - severe
Floodplain characteristics: nil, as landscape is of undulating topography

Scattered trees may provide habitat for woodland birds. Logs and woody debris may provide habitat for small reptiles. Grass may provide food resources for macropods. Trees outside of CDZ RoW may provide stepping stone for fauna movement in broader landscape.

Declared weeds and introduced species
Weeds present: **Rare (<10 plants observed):** prickly pear[1] (*Opuntia stricta*) **Uncommon (11-50 plants observed):** Mayne's pest (*Verbena aristigera*) **Common (>50 plants observed):** buffel grass (*Cenchrus ciliaris*), red natal grass (*Melinis repens*)
Total percentage weed cover: prickly pear[1] 1%; red natal grass 12%; buffel grass 50%; Mayne's pest 5%
[1]Class 2 declared weed under the LP Act

EVNT/Type A flora present
Kurrajong (*Brachychiton populneus*) (Some previously recorded). Refer to santos webGIS system for point locations. Please note the *B. populneus* recorded at 711401; 7076109 (FID 382) was dead at the time of the survey.

Incidental fauna observations
Pied butcherbird Noisy miner Pale-headed rosella

Representative photos for the M4-11 RoW identification area

North

East

South

West

LEGEND

- Fauna Assessment Site
- Flora Assessment Site
- Fauna Habitat Site
- Dead hollow log
- Type A Restricted Plant Site
- Brachychiton populneus
- Watercourse
- CDZ ROW Area (29m)
- CSG Infrastructure Area (100m Buffer)
- Gathering Network Sub-branch
- Cadastre

1:3,000 (@ A4)

0 30 60 90

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

GHD

Santos GLNG Project

Santos GLNG
L1 and N1 Ecological Assessments

Job Number 41-27312
Revision 0
Date 03 Oct 2014

Proposed M4-12 Sub-branch Infrastructure Area

Figure 9

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Data source: DNRM: Ordered Drainage/2011; Santos GLNG: Cadastre, Regional Ecosystems, Essential Habitat, Imagery, Referred Wetlands/Supplied October 2013, Well Pad, Construction Disturbance Zone/Supplied September 2014; GHD: CSG Infrastructure Area (produced in conjunction with Santos), Watercourse Assessment Site, Notable Flora Species, Notable Fauna Species, Fauna Habitat, Fauna Habitat Assessment Site, Flora Habitat Assessment Site/2014. Created by: AJ

3.9 Proposed M4-12 RoW identification area

3.9.1 Summary of the M4-12 RoW identification area

The M4-12 RoW identification area includes RoW M4-12 and the RM03-72 wellpad area.

Item	Present/Absent	Item	Present/Absent
REs	Absent	**Threatened species**	Absent
TECs	Absent	**Fauna habitat features**	Absent
Vegetation community/ habitat values	Shrubby regrowth/cleared open pasture	**Watercourses**	Absent
ESAs	Absent	**Wetlands**	Absent
Essential habitat	Absent		

3.9.2 Regional ecosystems

No REs are mapped as present within the M4-12 RoW identification area and none were identified during the ecological assessments. Field validation points for REs are shown in Figure 9 (Q6).

Approval requirement or further action

None

3.9.3 Threatened ecological communities

No TECs are mapped as present within the M4-12 RoW identification area and none were identified during the ecological assessments. Field validation points for REs are shown in Figure 9 (Q6).

Approval requirement or further action

None

3.9.4 Vegetation communities and habitat values

The following vegetation community occurs within the M4-12 RoW identification area:

- Shrubby regrowth/cleared open pasture

Descriptions of this vegetation community and habitat values are summarised in Section 3.9.11. Field validation points for vegetation communities and habitat values are shown in Figure 9 (VC6; HA6).

Approval requirement or further action

None, however, rehabilitation activities are to be undertaken post-operation in accordance with the GLNG Project RRRMP (RPS 2011).

3.9.5 Environmentally sensitive areas

No ESAs or associated buffers are mapped or were observed to occur within the M4-12 RoW identification area.

Approval requirement or further action

None

3.9.6 Essential habitat

No essential habitat mapped under the VM Act is present within the M4-12 RoW identification area.

Approval requirement or further action

None

3.9.7 Threatened species

No threatened fauna or flora species were recorded within the M4-12 RoW identification area during ecological field assessments. Further information relating to threatened species records is contained within Section 4.

Lists of flora and fauna species recorded from field assessments are contained within Appendix B.

Threatened species habitat mapping

Habitat with the potential to support a population of fauna species listed under the EPBC Act and the NC Act has been mapped for the two habitat types, namely regrowth eucalypt woodland and non-remnant shrubby regrowth/cleared open pasture, that are present within the M4 investigation area (refer to Section 4). Calculations of the extent of species habitat to be cleared within M4 investigation area are presented in Section 4.1.

Habitat mapped as having potential to support a population of threatened fauna species is not present within the M4-12 RoW identification area.

Approval requirement or further action

No further action currently required. Should a threatened species be encountered, management actions listed within the SSMP, SMP and GTP SMP are to be followed during pre-construction, construction and operation.

It is recommended that all management plans are checked for validity prior to implementation on this project.

3.9.8 Fauna habitat features

Fauna habitat features that have potential to be fauna breeding places for least concern or threatened fauna species were not recorded within the M4-12 RoW identification area.

Approval requirement or further action

Management actions listed within the SSMP, SMP and GTP SMP documents are to be followed during pre-construction, construction and operation.

3.9.9 Watercourses

No watercourses are mapped or were confirmed present within the M4-12 RoW identification area, or within the 100 m buffer.

Approval requirement or further action

None

3.9.10 Wetlands, lakes and springs

No wetlands are mapped or were confirmed present within the M4-12 RoW identification area, or within the 300 m buffer.

Approval requirement or further action

None

3.9.11 M4-12 RoW identification area: Vegetation community and habitat (non-remnant shrubby regrowth/cleared open pasture) summary

Vegetation community description – Baseline data							
Site:	Q6/VC6/HA6	**Recorder:**	LM RF	**Date:**	17/7/2014	**Time:**	9:45am
Project:	M4 ecological field surveys			**Photos:**	N: 4322 E: 4324 S: 4325 W: 4326		
Locality:	M4-12 RoW			**Property (lot/plan):**	Mt Hope (58WV421)		
Coordinates:	**Zone:** 5 5	7 1 2 1 1 8		7 0 7 6 5 1 3			
Vegetation community description: Open, non-remnant cleared pasture land. Mature trees absent, sparse sapling and shrub layer, low heavily grazed groundcover, mostly dead.							

Vegetation Structure

Median height of EDL is to be measured and cover density estimated: D, touching-overlap<0; M, touching-slight separation 0-0/25; S, clearly separated 0.25-1, V, well separated 1-20

Stratum	Median height	Height interval	Est. cover density (D,M,S,V)
E		-	
T1		-	
T2		-	
T3		-	
S1	1.5	1 - 3	V
S2		-	
G	0.4	0 - 1	M

Structural formation (including height): grassland

Ecologically dominant layer: G

Landform situation: flat gentle slopes, undulating terrain

Land form element (40 m radius): plain

Land form pattern (300 m radius): undulating plain

Soil and geology: brown, clay-loam

Topsoil depth: Skeletal

Slope position, degree and aspect: Crest, 1^{o}, south

Vast condition assessment: Type V

Plant species

Relative (numerical) dominance for each stratum: d, dominant; c, codominant; s, subdominant; a, associated.

Str.	Rel. dom.	Scientific Name
S1	a	*Eremophila mitchellii*
S1	c	*Eucalyptus populnea*
S1	a	*Acacia decora*
S1	c	*Acacia oswaldii*
S1	c	*Psydrax oleifolia*
S1	a	*Owenia acidula*
G	c	*Cenchrus ciliaris**
G	c	*Aristida calycina*
G	a	*Aristida platychaeta*
G	a	*Enneapogon nigricans*
G	a	*Verbena aristigera**
G	a	*Pimelea trichostachya*
G	a	*Rhodanthe floribunda*
G	a	*Aristida personata*
G	a	*Heteropogon contortus*
G	a	*Sonchus asper**
G	a	*Melinis repens**
G	a	*Eragrostis lacunaria*
G	a	*Bothriochloa ewartiana*
G	a	*Chrysocephalum apiculatum*
G	a	*Cucumis myriocarpus**
G	a	*Lomandra leucocephala subsp. leucocephala*
G	a	*Opuntia tomentosa**
G	a	*Sclerolaena birchii*
G	c	*Aristida jerichoensis*

** Denotes exotic species*

Ground cover and organic litter (%) (average from five 1 m x 1 m quadrats)	
Type	**% cover**
Native grass	1.8
Native herbs/forbs (non-grass)	0.6
Native shrubs (<1 m high))	0
Non-native grass	11.2
Non-native herbs and shrubs	2.2
Litter (woodies <10 cm diameter, dead annuals, etc.)	38
Litter (logs >10 cm diameter)	0
Rock	0
Bare ground	48.2

Fauna habitat features (within 0.5 ha area)	
Characteristic	**Abundance (0-7) ^**
Decorticating bark	0
Coarse leaf litter (>2 cm diameter)	0
Fine leaf litter (<2 cm diameter)	0
Bare ground	4
Grass	4
Soil cracks	0
Stones (20-60 cm)	0
Boulders (61 cm – 2 m)	0
Larger boulders (>2 m)	0
Rock crevices	0
Exfoliating rock	0
^ 0, nil; **1**, rare; **2,** rare to occasional; **3,** occasional; **4**, Occasional to common; **5**, common; **6**, common to abundant; **7**, abundant	

Vegetative cover	
Strata	**Cover (100 m line intercept)**
E	-
T1	-
T2	-
S1	0
S2	-
G	-
Species	
Nil	

Vegetative density	
Strata	**Stem count (per ha)**
E	-
T1	-
T2	-
S1	900
S2	-
G	-
Species	
S1	
Acacia oswaldii	240
Eucalyptus populnea	20
Eremophila mitchellii	40
Psydrax oleifolia	600

Fauna habitat value (within 1 ha area) – Baseline data	
Characteristic	**Value**
Number of trees with hollows: - Hollow size <10 cm diameter - Hollow size >10 cm diameter	0 0 0
Number of hollow bearing logs (hollows >10 cm diameter)	0
Total number of hollows in logs	0
Total length of fallen woody material (e.g. logs) >10 cm diameter	370 m

General habitat features and fauna breeding places present
General habitat features and potential fauna breeding places have been recorded in the Santos webGIS system. Refer to Santos webGIS for more information on these features.
Potential habitat for EVNT fauna species (including essential habitat):
No potential habitat for EVNT species present

Koala habitat
Identification area not koala habitat due to non-remnant vegetation and absence of suitable koala food trees. Koala habitat assesssments were not undertaken at this location.

Disturbances (e.g. grazing, clearing, ploughing etc.)
Wildfire: 1 – 1-5 years **Grazing:** 3 – moderate to large amounts from many plants **Weeds:** 1 – minor infestations **Erosion:** 1 – slight disturbance (e.g. cattle tracks) **Clearing:** 3 – large amount, non-remnant, cleared grazing paddock
Ecosystem functioning (e.g. Extent of remnant vegetation in the landscape, connectivity, etc.):

Patch size and characteristics: large patch (>100 ha) of non-remnant vegetation. **Location of patch:** low – not connected to remnant or regrowth vegetation **Degree of edge effects:** 3 - severe **Floodplain characteristics:** nil, as landscape is of undulating topography Occasional shrubs provide habitat to small woodland birds. Occasional logs and woody debris may provide shelter for small reptiles.

Declared weeds and introduced species
Weeds present: R, rare (<10 plants observed); U, uncommon (11-50 plants observed); C, common (>50 plants observed)
Weeds present: **Rare (<10 plants observed):** velvety tree pear[1] (*Opuntia tomentosa*), prickly sowthistle (*Sonchus asper*), prickly pademelon (*Cucumis myriocarpus*) **Uncommon (11-50 plants observed):** Mayne's pest (*Verbena aristigera*), red natal grass (*Melinis repens*) **Common (>50 plants observed):** buffel grass (*Cenchrus ciliaris*),
Total percentage weed cover:
velvety tree pear[1] 0.2%; red natal grass 6%; buffel grass 50%; Mayne's pest 14%
[1]Class 2 declared weed under the LP Act

EVNT/Type A flora present
Kurrajong (*Brachychiton populneus*) (previously recorded). Refer to santos webGIS system for point locations.

Incidental fauna observations
Australian magpie
Australian raven
Black-faced cuckoo-shrike
Crested pigeon
Magpie lark
Noisy miner
Pied butcherbird
Striated pardalote
Torresian crow
Weebill
Willy wagtail

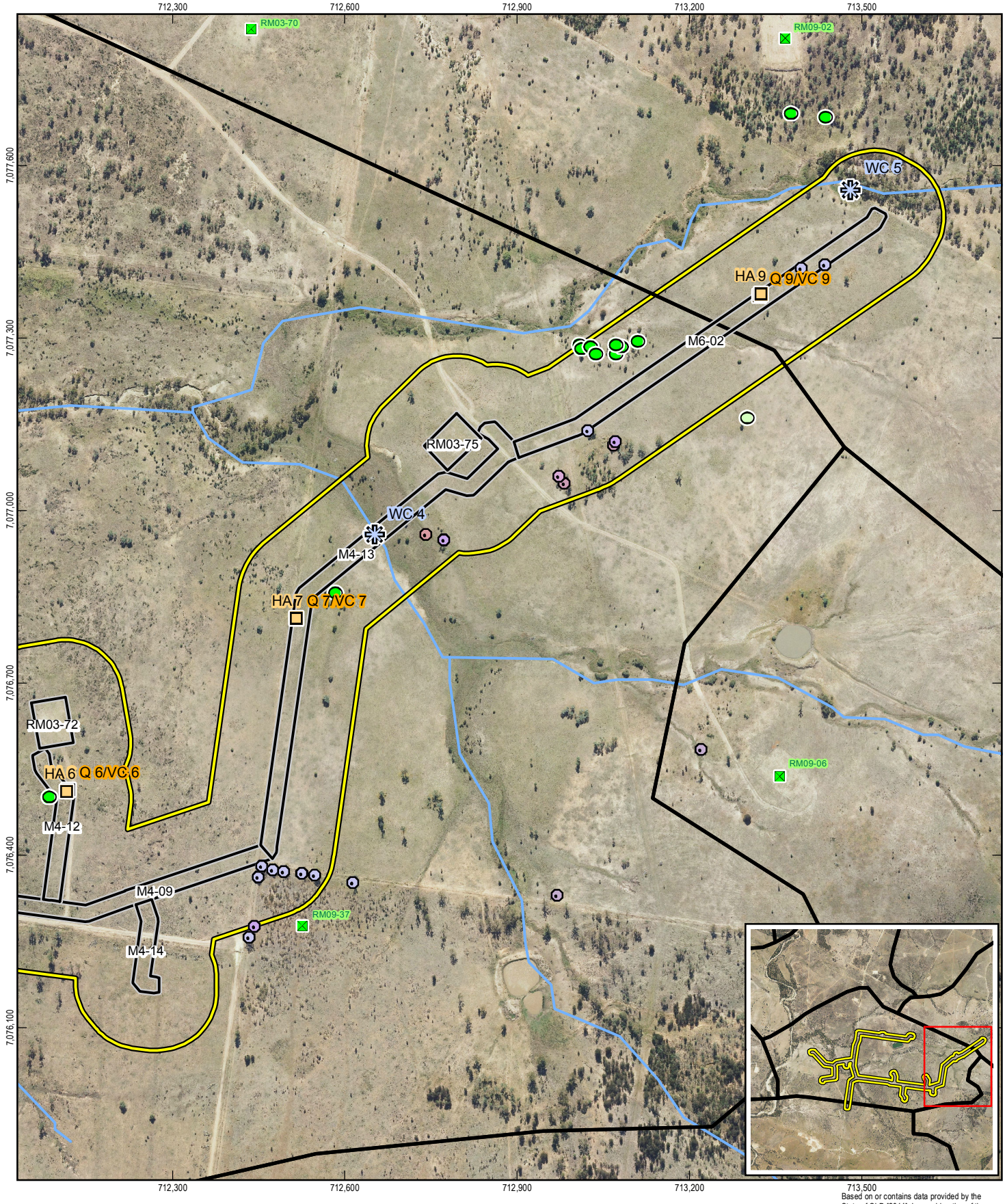
Representative photos for the M4-12 RoW identification area

North

East

South

West



LEGEND

- Fauna Assessment Site
- Flora Assessment Site
- Watercourse Assessment Site

Fauna Habitat Site
- Dead hollow log
- Hollow in Tree
- Mature tree
- Nest in Tree
- Other
- Pile of logs/timber

Type A Restricted Plant Site
- Brachychiton populneus
- Brachychiton rupestris

- Well Pad
- Watercourse
- CDZ ROW Area (29m)
- CSG Infrastructure Area (100m Buffer)
- Gathering Network Sub-branch
- Cadastre

1:9,000 (@ A4)

0 80 160 240

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

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Santos GLNG Project

Santos GLNG
L1 and N1 Ecological Assessments

Job Number 41-27312
Revision 0
Date 03 Oct 2014

Proposed M4-13 and M6-02 Sub-branch Infrastructure Area

Figure 10

G:\41\27312\GIS\Maps\MXD\41_27312_021_M4_Rev_0.mxd 145 Ann St Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: DNRM: Ordered Drainage/2011; Santos GLNG: Cadastre, Regional Ecosystems, Essential Habitat, Imagery, Referred Wetlands/Supplied October 2013, Well Pad, Construction Disturbance Zone/Supplied September 2014; GHD: CSG Infrastructure Area (produced in conjunction with Santos), Watercourse Assessment Site, Notable Flora Species, Notable Fauna Species, Fauna Habitat, Fauna Habitat Assessment Site, Flora Habitat Assessment Site/2014. Created by: AJ

3.10 Proposed M4-13 and M6-02 RoW identification areas

3.10.1 Summary of the M4-13 and M6-02 RoW identification areas

The M4-13 and M6-02 RoW identification area includes RoWs M4-13, M6-02 and the RM03-75 wellpad area.

Item	Present/Absent	Item	Present/Absent
REs	Absent	**Threatened species**	Absent
TECs	Absent	**Fauna habitat features**	Present within CDZ RoW and 200 m buffer
Vegetation community/ habitat values	Shrubby regrowth/cleared open pasture	**Watercourses**	Present within CDZ RoW and 100 m buffer
ESAs	Absent	**Wetlands**	Absent
Essential habitat	Absent		

3.10.2 Regional ecosystems

No REs are mapped as present within the M4-13 and M6-02 RoW identification areas and none were identified during the ecological assessments. Field validation points for REs are shown in Figure 10 (Q7 and Q9).

Approval requirement or further action

None

3.10.3 Threatened ecological communities

No TECs are mapped as present within the M4-13 and M6-02 RoW identification areas and none were identified during the ecological assessments. Field validation points for REs are shown in Figure 10 (Q7 and Q9).

Approval requirement or further action

None

3.10.4 Vegetation communities and habitat values

The following vegetation community occurs within the M4-13 and M6-02 RoW identification areas:

- Shrubby regrowth/cleared open pasture

Descriptions of this vegetation community and habitat values are summarised in Section 3.10.11. Field validation points for vegetation communities and habitat values are shown in Figure 10 (VC7 and VC9; HA7 and HA9).

Approval requirement or further action

None, however, rehabilitation activities are to be undertaken post-operation in accordance with the GLNG Project RRRMP (RPS 2011).

3.10.5 Environmentally sensitive areas

No ESAs or associated buffers are mapped or were observed to occur within the M4-13 and M6-02 RoW identification areas.

Approval requirement or further action

None

3.10.6 Essential habitat

No essential habitat mapped under the VM Act is present within the M4-13 and M6-02 RoW identification areas.

Approval requirement or further action

None

3.10.7 Threatened species

No threatened fauna or flora species were recorded within the M4-13 and M6-02 RoW identification areas during ecological field assessments. Further information relating to threatened species records is contained within Section 4.

Lists of flora and fauna species recorded from field assessments are contained within Appendix B.

Threatened species habitat mapping

Habitat with the potential to support a population of fauna species listed under the EPBC Act and the NC Act has been mapped for the two habitat types, namely regrowth eucalypt woodland and non-remnant shrubby regrowth/cleared open pasture, that are present within the M4 investigation area (refer to Section 4). Calculations of the extent of species habitat to be cleared within M4 investigation area are presented in Section 4.1.

Habitat mapped as having potential to support a population of threatened fauna species is not present within the M4-13 and M6-02 RoW identification areas.

Approval requirement or further action

No further action currently required. Should a threatened species be encountered, management actions listed within the SSMP, SMP and GTP SMP are to be followed during pre-construction, construction and operation.

It is recommended that all management plans are checked for validity prior to implementation on this project.

3.10.8 Fauna habitat features

Fauna habitat features that have potential to be fauna breeding places for least concern or threatened fauna species were recorded within the CDZ RoW and incidentally in the 200 m buffer of the M4-13 and M6-02 RoW identification area (refer to Section 3.10.11). Locations of these features are mapped in Figure 10. Spatial data has been provided to Santos for incorporation into their webGIS system.

Please note potential fauna breeding places previously recorded on Lot 62WV421 were not ground-truthed due to restricted land access.

Approval requirement or further action

Management actions listed within the SSMP, SMP and GTP SMP documents are to be followed during pre-construction, construction and operation.

3.10.9 Watercourses

A mapped second order watercourse intersects the M4-13 RoW identification area and a single first order watercourse is located within the 100 m buffer of M6-02 RoW identification area.

Field validation of the watercourses determined them to be a drainage feature under the Water Act. The watercourse assessment location is shown as site WC04 and WC05 on Figure 10. A summary of results is presented in Table 4 and the watercourse assessments are presented in Appendix C.

Table 4 Watercourse assessments in the M4-13 and M6-02 RoW identification areas

Watercourse reference	Location (easting, northing)		Assessment outcome	Assessment outcome explanation
WC04	712653	7076959	Drainage feature (*Water Act 2000)*	No extended or permanent period of flow – only carries water flow for a short duration after a rainfall event Lacks sufficient flow adequacy to sustain basic ecological processes and support riverine species Lacks continuous and defined bed and banks and the presence of in-stream islands, benches or bars
			Not a waterway (*Fisheries Act 1994*)	No continuous and defined bed and banks or the presence of in-stream islands, benches or bars No extended or permanent period of flow – only carries water flow for a short duration after a rainfall event Lacks sufficient flow adequacy to sustain basic ecological processes and support riverine species
WC05 (within 100 m buffer)	713483	7077561	Drainage feature (*Water Act 2000)*	No extended or permanent period of flow – only carries water flow for a short duration after a rainfall event Lacks sufficient flow adequacy to sustain basic ecological processes and support riverine species Lacks continuous and defined bed and banks and the presence of in-stream islands, benches or bars

Watercourse reference	Location (easting, northing)		Assessment outcome	Assessment outcome explanation
			Not a waterway (*Fisheries Act 1994*)	No continuous and defined bed and banks or the presence of in-stream islands, benches or bars No extended or permanent period of flow – only carries water flow for a short duration after a rainfall event Lacks sufficient flow adequacy to sustain basic ecological processes and support riverine species

Approval requirement or further action

None

3.10.10 Wetlands, lakes and springs

No wetlands are mapped or were confirmed present within the M4-13 and M6-02 RoW identification areas, or within the 300 m buffer.

Approval requirement or further action

None

3.10.11 RoWs M4-13 and M6-02: Vegetation community and habitat (non-remnant shrubby regrowth/cleared open pasture) summary

Vegetation community description – Baseline data							
Site:	Q7/VC7/HA7 Q9/VC9/HA9	**Recorder:**	LM RF	**Date:**	17/7/2014 18/7/2014	**Time:**	11:00am 9:15am
Project:	M4 ecological field surveys			**Photos:**	N: 4328 E: 4329 S: 4330 W: 4331 N: 4346 E: 4347 S: 4348 W: 4349		
Locality:	M4-13 and M6-02 RoWs			**Property (lot/plan):**	Mt Hope (63WV421)		
Coordinates (7):	**Zone:** 5 5	7 1 2 5 1 7	7 0 7 6 8 1 4				
Coordinates (9)	5 5	7 1 3 3 2 3	7 0 7 7 3 7 5				

Vegetation community description: Open, non-remnant cleared pasture land. Scattered, isolated mature trees, sparse sapling and shrub layer, low heavily grazed groundcover, mostly dead.

Vegetation Structure

Median height of EDL is to be measured and cover density estimated: D, touching-overlap<0; M, touching-slight separation 0-0/25; S, clearly separated 0.25-1, V, well separated 1-20

Stratum	Median height	Height interval	Est. cover density (D,M,S,V)
E		-	
T1	6	4 - 8	V
T2		-	
T3		-	
S1	0.5	0.5 - 1	V
S2		-	
G	0.25	0 – 0.5	M

Structural formation (including height): grassland

Ecologically dominant layer: G

Landform situation: flat gentle slopes, undulating terrain

Land form element (40 m radius): plain

Land form pattern (300 m radius): undulating plain

Soil and geology: brown/grey, clay

Topsoil depth: Skeletal

Slope position, degree and aspect: Mid-slope, 2°, north

Vast condition assessment: Type V

Plant species

Relative (numerical) dominance for each stratum: d, dominant; c, codominant; s, subdominant; a, associated.

Str.	Rel. dom.	Scientific Name
T1	d	*Eucalyptus melanophloia*
S1	d	*Psydrax oleifolia*
G	c	*Cenchrus ciliaris**
G	c	*Chloris ventricosa*
G	s	*Verbena aristigera**
G	a	*Aristida latifolia*
G	a	*Pimelea trichostachya*
G	a	*Heteropogon contortus*
G	a	*Bothriochloa pertusa**
G	a	*Rhodanthe floribunda*
G	a	*Sclerolaena birchii*
G	a	*Themeda triandra*
G	a	*Eragrostis lacunaria*
G	a	*Chrysocephalum apiculatum*
G	a	*Cyperus sp.*
G	a	*Lomandra leucocephala subsp. leucocephala*
G	a	*Eragrostis sororia*
G	a	*Xanthium occidentale**
G	a	*Senecio brigalowensis*
G	a	*Sporobolus creber*
G	a	*Enteropogon ramosus*

**Denotes exotic species*

Ground cover and organic litter (%) (average from five 1 m x 1 m quadrats)	
Type	**% cover**
Native grass	0.2
Native herbs/forbs (non-grass)	0.9
Native shrubs (<1 m high))	0
Non-native grass	16
Non-native herbs and shrubs	11.3
Litter (woodies <10 cm diameter, dead annuals, etc.)	16.9
Litter (logs >10 cm diameter)	0
Rock	0
Bare ground	36.7

Fauna habitat features (within 0.5 ha area)	
Characteristic	**Abundance (0-7) ^**
Decorticating bark	0
Coarse leaf litter (>2 cm diameter)	0
Fine leaf litter (<2 cm diameter)	0
Bare ground	5
Grass	5
Soil cracks	0
Stones (20-60 cm)	0
Boulders (61 cm – 2 m)	0
Larger boulders (>2 m)	0
Rock crevices	0
Exfoliating rock	0
^ 0, nil; **1**, rare; **2,** rare to occasional; **3,** occasional; **4**, Occasional to common; **5**, common; **6**, common to abundant; **7**, abundant	

Vegetative cover	
Strata	**Cover (100 m line intercept)**
E	-
T1	0
T2	-
S1	0
S2	-
G	-
Species	
Nil	

Vegetative density	
Strata	**Stem count (per ha)**
E	-
T1	20
T2	-
S1	30
S2	-
G	-
Species	
T1	
Eucalyptus melanophloia	20
S1	
Psydrax oleifolia	30

Fauna habitat value (within 1 ha area) – Baseline data	
Characteristic	**Value**
Number of trees with hollows: - Hollow size <10 cm diameter - Hollow size >10 cm diameter	0 0 0
Number of hollow bearing logs (hollows >10 cm diameter)	0
Total number of hollows in logs	0
Total length of fallen woody material (e.g. logs) >10 cm diameter	0

General habitat features and fauna breeding places present
General habitat features and potential fauna breeding places have been recorded in the Santos webGIS system. Refer to Santos webGIS for more information on these features.
Potential habitat for EVNT fauna species (including essential habitat): No potential habitat for EVNT species present

Koala habitat
Identification area not koala habitat due to non-remnant vegetation and absence of suitable koala food trees. Koala habitat assesssments were not undertaken at this location.

Disturbances (e.g. grazing, clearing, ploughing etc.)
Wildfire: 1 – 1-5 years **Grazing:** 3 – moderate to large amounts from many plants **Weeds:** 2 – moderate infestations **Erosion:** 1-2 – slight disturbance (e.g. cattle tracks) to moderate (pedestalling, sheet, rill) erosion **Clearing:** 3 – large amount, non-remnant, cleared grazing paddock
Ecosystem functioning (e.g. Extent of remnant vegetation in the landscape, connectivity, etc.):

Patch size and characteristics: large patch (>100 ha) of non-remnant vegetation. **Location of patch:** low – not connected to remnant or regrowth vegetation **Degree of edge effects:** 3 - severe **Floodplain characteristics:** nil, as landscape is of undulating topography

Declared weeds and introduced species
Weeds present: R, rare (<10 plants observed); U, uncommon (11-50 plants observed); C, common (>50 plants observed)
Weeds present: **Rare (<10 plants observed):** Noogoora burr (*Xanthium occidentale*) **Uncommon (11-50 plants observed):** **Common (>50 plants observed):** buffel grass (*Cenchrus ciliaris*), Indian bluegrass (*Bothriochloa pertusa*), Mayne's pest (*Verbena aristigera*)
Total percentage weed cover: Indian bluegrass 11%; buffel grass 60%; Mayne's pest 10%; Noogoora burr 0.2%
[1]Class 2 declared weed under the LP Act

EVNT/Type A flora present
Kurrajong (*Brachychiton populneus*). Refer to santos webGIS system for point locations. Please note Type A flora species identified on Lot 78WV759 were not ground-truthed due to restricted land access.

Incidental fauna observations
Australian magpie
Black-faced cuckoo-shrike
Nankeen kestrel
Noisy miner
Pied butcherbird
Weebill

NOTE: The results of the vegetation community and habitat assessments have been averaged from three sites representative of this community. Sites Q7/VC7/HA7 and Q9/VC9/HA9.

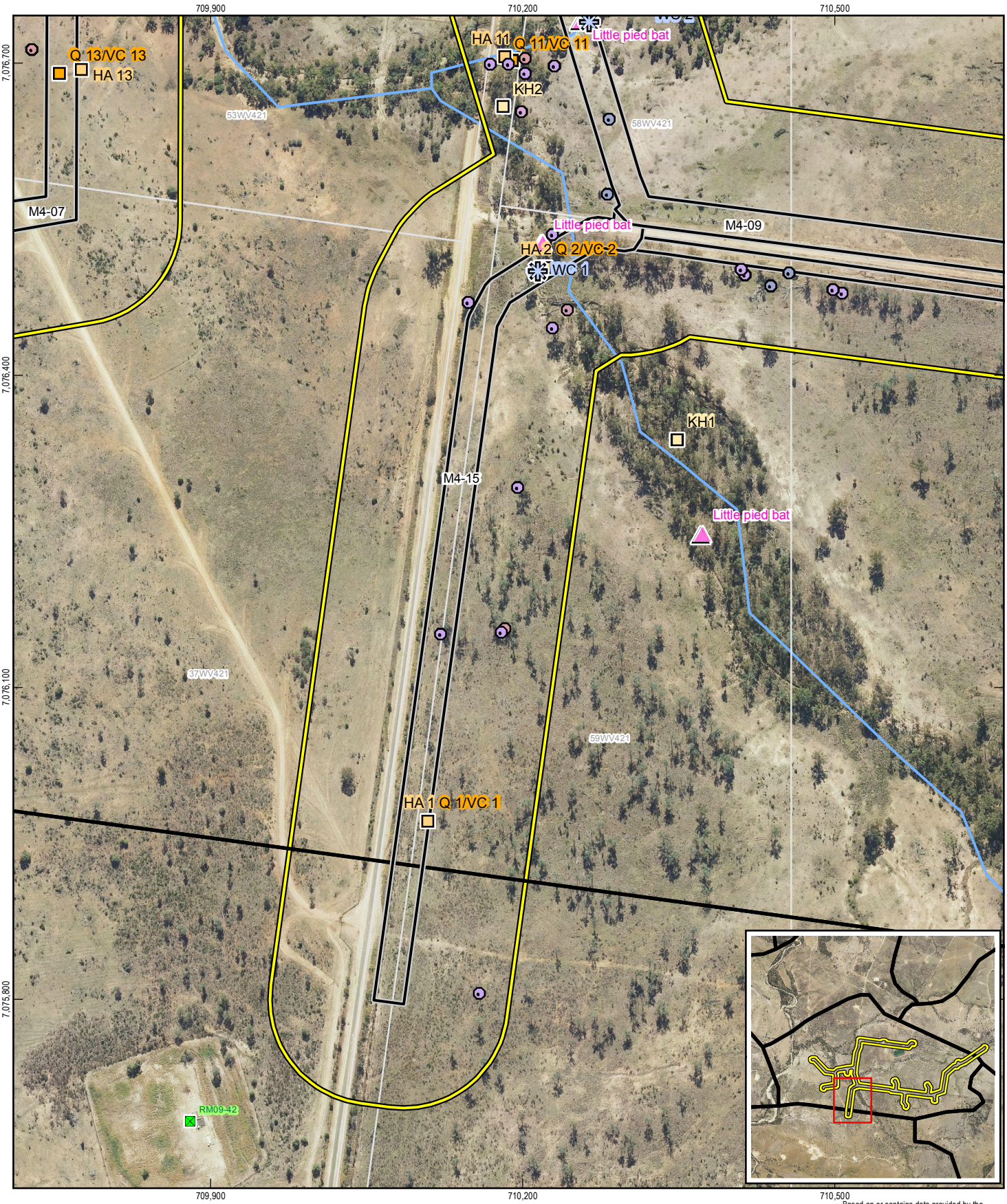
Representative photos for the M4-13 and M6-02 RoW identification areas (from Q9/VC9/HA9)

North

East

South

West



LEGEND

- Koala Assessment Site
- Fauna Assessment Site
- Flora Assessment Site
- Watercourse Assessment Site

Fauna Habitat Site
- Dead hollow log
- Hollow in Tree
- Hollow log
- Mature tree
- Nest in Tree
- Other

- Well Pad
- Watercourse
- CDZ ROW Area (29m)
- CSG Infrastructure Area (100m Buffer)
- Gathering Network
- Sub-branch
- Cadastre

1:5,000 (@ A4)

0 40 80 120

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

GHD

Santos GLNG Project

Santos GLNG
L1 and N1 Ecological Assessments

Job Number 41-27312
Revision 0
Date 03 Oct 2014

Proposed M4-15 Sub-branch Infrastructure Area

Figure 11

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145 Ann St Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: DNRM: Ordered Drainage/2011; Santos GLNG: Cadastre, Regional Ecosystems, Essential Habitat, Imagery, Referred Wetlands/Supplied October 2013, Well Pad, Construction Disturbance Zone/Supplied September 2014; GHD: CSG Infrastructure Area (produced in conjunction with Santos), Watercourse Assessment Site, Notable Flora Species, Notable Fauna Species, Fauna Habitat, Fauna Habitat Assessment Site, Flora Habitat Assessment Site/2014. Created by: AJ

3.11 Proposed M4-15 RoW identification area

3.11.1 Summary of the M4-15 RoW identification area

The M4-15 RoW identification area includes RoW M4-15 from the start of sub-branch M4, adjacent to wellpad RM09-42 to the intersection of RoW M4-15 with M4-09 RoW.

Item	Present/Absent	Item	Present/Absent
REs	Absent	**Threatened species**	Present within CDZ RoW and 200 m buffer
TECs	Absent	**Fauna habitat features**	Present within CDZ RoW and 200 m buffer
Vegetation community/ habitat values	• Shrubby regrowth/cleared open pasture • Regrowth eucalypt woodland	**Watercourses**	Present within CDZ RoW
ESAs	Absent	**Wetlands**	Absent
Essential habitat	Absent		

3.11.2 Regional ecosystems

No REs are mapped as present within the M4-15 RoW identification area and none were identified during the ecological assessments. Field validation points for REs are shown in Figure 11 (Q01, Q02 and Q18).

A quaternary assessment at site Q18, within approximately 200 m of the M4-15 RoW, was undertaken to verify the remnant/non-remnant status of the vegetation that is currently mapped as non-remnant regrowth eucalypt woodland at this location. The vegetation of this area comprises *E. populnea* woodland (8-13 m tall, medial height 12 m) with *E. tereticornis* and *E. coolabah* present in the dominant tree layer. Emergent *Angophora floribunda*, *E. populnea* and *E. melanophloia* (16-24 m tall) and a secondary tree layer *of Acacia salicina, Callitris glaucophylla* and *Eremophila mitchellii* (5-8 m tall) are sparsely present. The vegetation present is consistent with the description for RE 11.10.11, however this patch has not achieved remnant status as the height of the dominant tree layer is less than 70% of the mature remnant height of the canopy species for this RE (mature height of 11.10.11: 13-18 m tall) (Neldner *et al.* 2012). Therefore field verification of this vegetation confirms this patch is non-remnant regrowth eucalypt woodland vegetation.

Approval requirement or further action

None

3.11.3 Threatened ecological communities

No TECs are mapped as present within the M4-15 RoW identification area and none were identified during the ecological assessments. Field validation points for REs are shown in Figure 11 (Q01 and Q02).

Approval requirement or further action

None

3.11.4 Vegetation communities and habitat values

The following vegetation community occurs within the M4-15 RoW identification area:

- Shrubby regrowth/cleared open pasture (VC01, HA01)
- Regrowth eucalypt woodland (VC02, HA02)

Descriptions of this vegetation community and habitat values are summarised in Section 3.11.11. Field validation points for vegetation communities and habitat values are shown in Figure 11.

Approval requirement or further action

None, however, rehabilitation activities are to be undertaken post-operation in accordance with the GLNG Project RRRMP (RPS 2011).

3.11.5 Environmentally sensitive areas

No ESAs or associated buffers are mapped or were observed to occur within the M4-15 RoW identification area.

Approval requirement or further action

None

3.11.6 Essential habitat

No essential habitat mapped under the VM Act is present within the M4-15 RoW identification area

Approval requirement or further action

None

3.11.7 Threatened species

One threatened fauna species, the little pied bat, listed as near threatened under the NC Act, was recorded within the M4-15 RoW identification area and also within 200 m of the M4-15 RoW identification area during ecological field assessments. The little pied bat was identified from echolocation calls recorded on an anabat device placed within regrowth eucalypt woodland in both recorded instances. Further information relating to threatened species records is contained within Section 4.

No threatened flora species were recorded within the M4-15 RoW identification area during ecological assessments. Lists of flora and fauna species recorded from field assessments are contained within Appendix B

Threatened species habitat mapping

Habitat with the potential to support a population of fauna species listed under the EPBC Act and the NC Act has been mapped for the two habitat types, namely regrowth eucalypt woodland and non-remnant shrubby regrowth/cleared open pasture, that are present within the M4 investigation area (refer to Section 4). Calculations of the total extent of species habitat to be cleared within M4 investigation area are presented in Section 4.1.

General habitat, mapped as having potential to support a population of threatened fauna species, was identified for the koala, yakka skink, south-eastern long-eared bat and brigalow scaly-foot within the M4-15 RoW identification area. This habitat was present within both the CDZ RoW and surveyed buffer extents.

Approval requirement or further action

No further action currently required. Should a threatened species be encountered, management actions listed within the SSMP, SMP and GTP SMP are to be followed during pre-construction, construction and operation. Furthermore it is recommended that all management plans are checked for validity prior to implementation on this project.

The identification of general habitat as having the potential to support some threatened fauna species listed under the EPBC Act could be considered as a category B constraint in the Santos Ecological Constraints Mapping dataset, described within the GLNG Project CSG Fields, Environmental Protocol for Constraints Planning and Field Development Report, (document number: 0020-GLNG-3-3.3-0063-DOC) (Santos 2011). No category B constraint regions are mapped within the M4 sub-branch area (refer to Figure 1), therefore the area of general habitat within M4 would be considered an additional category B constraint region.

RoW widths within constraint class B regions are required to be compliant with Condition 5, number 3 e) ii) of the Santos EPBC Act approval document (SEWPAC 2010). The condition states that linear infrastructure within a constraint class B region is unlikely to have an adverse impact on matters of national environmental significance (MNES) if trunk lines and co-located linear infrastructure RoW widths are limited to 30 m in width where there are one or two gas and water trunklines, underground 33kV power lines and fibre optic cables in parallel. The proposed width of RoW M4-15, that intersects the area of general habitat for threatened species, is 29 m. This width is compliant with the maximum width of 30 m as specified in the EPBC Act approval condition.

3.11.8 Fauna habitat features

Fauna habitat features that have potential to be fauna breeding places for least concern or threatened fauna species were recorded within the CDZ RoW and incidentally in the 200 m buffer of the M4-15 RoW identification area (refer to Section 3.11.11). Locations of these features are mapped in Figure 11. Spatial data has been provided to Santos for incorporation into their webGIS system.

Approval requirement or further action

Management actions listed within the SSMP, SMP and GTP SMP documents are to be followed during pre-construction, construction and operation.

3.11.9 Watercourses

One mapped second order watercourse intersects the M4-15 RoW identification area.

Field validation of the watercourse determined this to be a watercourse under the Water Act. The watercourse assessment location is shown as site WC01 on Figure 11. A summary of results is presented in Table 5 and the watercourse assessments are presented in Appendix C.

Table 5 Watercourse assessments in the M4-15 RoW identification area

Watercourse reference	Location (easting, northing)		Assessment outcome	Assessment outcome explanation
WC01	710215	7076501	Watercourse (*Water Act 2000*)	No extended or permanent period of flow – only carries water flow for a short duration after a rainfall event Lacks sufficient flow adequacy to sustain basic ecological processes and support riverine species Features continuous and defined bed and banks and the presence of in-stream islands, benches or bars
			Not a waterway (*Fisheries Act 1994*)	Features continuous and defined bed and banks and the presence of in-stream islands, benches or bars No extended or permanent period of flow – only carries water flow for a short duration after a rainfall event Lacks sufficient flow adequacy to sustain basic ecological processes and support riverine species

Approval requirement or further action

As the feature constitutes a watercourse under the Water Act, construction and vegetation clearing must comply with relevant assessable codes under the Water Act and the relevant EA requirements relating to watercourses (Schedule B). Pre and post work checklists must be completed and all approvals must be lodged with the relevant agencies a minimum of ten business days prior to works.

3.11.10 Wetlands, lakes and springs

No wetlands are mapped or were confirmed present within the M4-15 RoW identification area, or within the 300 m buffer.

Approval requirement or further action

None

3.11.11 M4-15 RoW identification area: Vegetation community and habitat (non-remnant shrubby regrowth/cleared open pasture) summary

Vegetation community description – Baseline data							
Site:	Q1/VC1/HA1	**Recorder:**	LM RF	**Date:**	16/07/2014	**Time:** 9:00am	
Project:	M4 ecological field surveys			**Photos:**	N: 4284 E: 4285 S: 4286 W: 4287		
Locality:	M4-15 RoW			**Property (lot/plan):**	Oakleigh (59WV421)		
Coordinates:	**Zone:** 5 5		7 1 0 1 1 0		7 0 7 5 9 7 3		
Vegetation community description: Non-remnant shrubby regrowth/cleared pasture land. Scattered sparse mature trees absent, dense to mid-dense sapling and shrub layer, mid-dense grassy groundcover with areas of bare ground.							

Vegetation Structure

Median height of EDL is to be measured and cover density estimated: D, touching-overlap<0; M, touching-slight separation 0-0/25; S, clearly separated 0.25-1, V, well separated 1-20

Stratum	Median height	Height interval	Est. cover density (D,M,S,V)
E		-	
T1	11	8 - 12	V
T2		-	
T3		-	
S1	2	0.5 - 3	S
S2		-	
G	0.5	0 - 1	S

Structural formation (including height): shrubby regrowth/cleared pasture

Ecologically dominant layer: S1

Landform situation: flat gentle slopes, undulating terrain

Land form element (40 m radius): plain

Land form pattern (300 m radius): undulating plain

Soil and geology: brown, clay

Topsoil depth: Skeletal

Slope position, degree and aspect: Upper-slope, 3° north

Vast condition assessment: Type III

Plant species

Relative (numerical) dominance for each stratum: d, dominant; c, codominant; s, subdominant; a, associated.

Str.	Rel. dom.	Scientific Name
T1	d	*Eucalyptus melanophloia*
S1	d	*Acacia decora*
S1	a	*Maireana microphylla*
S1	a	*Opuntia tomentosa**
S1	a	*Eucalyptus melanophloia*
S1	a	*Eremophila mitchellii*
S1	a	*Acacia excelsa*
S1	a	*Atalaya hemiglauca*
G	c	*Cenchrus ciliaris**
G	c	*Dichanthium sericeum*
G	c	*Themeda triandra*
G	a	*Cymbopogon refractus*
G	a	*Bothriochloa ewartiana*
G	a	*Verbena aristigera**
G	a	*Aristida jerichoensis*
G	a	*Aristida latifolia*
G	a	*Eragrostis lacunaria*
G	a	*Aristida platychaeta*
G	a	*Panicum effusum*
G	a	*Aristida calycina*
G	a	*Xanthium occidentale**
G	a	*Melinis repens**
G	a	*Urochloa mosambicensis**

**Denotes exotic species*

Ground cover and organic litter (%) (average from five 1 m x 1 m quadrats)	
Type	**% cover**
Native grass	14
Native herbs/forbs (non-grass)	4.8
Native shrubs (<1 m high))	2
Non-native grass	17
Non-native herbs and shrubs	0.6
Litter (woodies <10 cm diameter, dead annuals, etc.)	4.4
Litter (logs >10 cm diameter)	0
Rock	0.2
Bare ground	57.6

Fauna habitat features (within 0.5 ha area)	
Characteristic	**Abundance (0-7) ^**
Decorticating bark	1
Coarse leaf litter (>2 cm diameter)	0
Fine leaf litter (<2 cm diameter)	0
Bare ground	3
Grass	5
Soil cracks	0
Stones (20-60 cm)	2
Boulders (61 cm – 2 m)	0
Larger boulders (>2 m)	0
Rock crevices	0
Exfoliating rock	0
^ 0, nil; **1**, rare; **2,** rare to occasional; **3,** occasional; **4**, Occasional to common; **5**, common; **6**, common to abundant; **7**, abundant	

Vegetative cover	
Strata	**Cover (100 m line intercept)**
E	-
T1	18
T2	-
S1	16
S2	-
G	-
Species	
T1	
Eucalyptus melanophloia	18
S1	
Eucalyptus melanophloia	4.5
Acacia decora	8
Eremophila mitchellii	3.5

Vegetative density	
Strata	**Stem count (per ha)**
E	-
T1	12
T2	-
S1	130
S2	-
G	-
Species	
T1	
Eucalyptus melanophloia	12
S1	
Eucalyptus melanophloia	10
Acacia decora	70
Eremophila mitchellii	18
*Opuntia tomentosa**	8
Acacia excelsa	10
Atalaya hemiglauca	4

Fauna habitat value (within 1 ha area) – Baseline data	
Characteristic	**Value**
Number of trees with hollows: - Hollow size <10 cm diameter - Hollow size >10 cm diameter	0 0 0
Number of hollow bearing logs (hollows >10 cm diameter)	4
Total number of hollows in logs	4
Total length of fallen woody material (e.g. logs) >10 cm diameter	1320 m

General habitat features and fauna breeding places present
General habitat features and potential fauna breeding places have been recorded in the Santos webGIS system. Refer to Santos webGIS for more information on these features.
Potential habitat for EVNT fauna species (including essential habitat): No potential habitat for EVNT species present

Koala habitat
Identification area not koala habitat due to non-remnant vegetation and absence of suitable koala food trees. Koala habitat assesssments were not undertaken at this location.

Disturbances (e.g. grazing, clearing, ploughing etc.)
Wildfire: 1 – 1-5 years **Grazing:** 3 –small to moderate amounts from many plants **Weeds:** 2 – minor infestations

Erosion: 1 – slight disturbance (e.g. cattle tracks) **Clearing:** 3 – large amount, non-remnant, cleared grazing paddock
Ecosystem functioning (e.g. Extent of remnant vegetation in the landscape, connectivity, etc.):
Patch size and characteristics: large patch (>100 ha) of non-remnant vegetation. **Location of patch:** medium – connected to regrowth vegetation along >25% of border **Degree of edge effects:** 3 - severe **Floodplain characteristics:** nil due to undulating topography. Large *Eucalyptus melanophloia* trees provide habitat features for woodland birds. Shrub layer provides habitat for small woodland birds. Log piles and woody debris (created predominately through clearing) may provide habitat value for smaller reptiles. Grasses provide food resources for macropods. Site is situated in predominately non-remnant landscape with isolated and fragmented refuges for wildlife. Riparian vegetation to the north of the site may provide higher value habitat in the broader landscape context.

Declared weeds and introduced species
Weeds present: **Rare (<10 plants observed):** velvety tree pear[1] (*Opuntia tomentosa*), red natal grass (*Melinis repens*), Mayne's pest (*Verbena aristigera*); Noogoora burr (*Xanthium occidentale*) **Uncommon (11-50 plants observed):** nil **Common (>50 plants observed):** buffel grass (*Cenchrus ciliaris*), sabi grass (*Urochloa mosambicensis*)
Total percentage weed cover: velvety tree pear[1] 3%; red natal grass 10%; buffel grass 40%; Mayne's pest 0.5%; sabi grass 30%; Noogoora burr 0.5%
[1]Class 2 declared weed under the LP Act

EVNT/Type A flora present
Nil

Incidental fauna observations
Australian magpie
Australian raven
Black-faced cuckoo-shrike
Crested pigeon
Noisy miner
Magpie lark
Pied butcherbird
Striated pardalote
Sulphur-crested cockatoo
Superb fairy-wren
Torresian crow
Weebill

Representative photos for the M4-15 RoW identification area

North

East

South

West

3.11.12 M4-15 RoW identification area: Vegetation community and habitat (regrowth eucalypt woodland) summary

Vegetation community description – Baseline data							
Site:	Q2/VC2/HA2	**Recorder:**	LM RF	**Date:** 16/7/2014		**Time:** 11:15 am	
Project:	M4 ecological field surveys			**Photos:**	N: 4293 E: 4294 S: 4295 W: 4296		
Locality:	M4-15 RoW			**Property (lot/plan):** Oakleigh (59WV421)			
Coordinates:	**Zone:** 5 5	7 1 0 2 2 2	7 0 7 6 5 0 5				
Vegetation community description: Open woodland, mapped non-remnant regrowth eucalypt woodland containing sparse mature emergent trees and lower regrowth vegetation fringing a watercourse. Vegetation is surrounded by historically cleared grazing lands.							

Vegetation Structure

Median height of EDL is to be measured and cover density estimated: D, touching-overlap<0; M, touching-slight separation 0-0/25; S, clearly separated 0.25-1, V, well separated 1-20

Stratum	Median height	Height interval	Est. cover density (D,M,S,V)
E	20	18 - 24	V
T1	14	12 - 16	S/V
T2	9	7 - 12	V
T3		-	
S1	2	0.5 - 3	V
S2		-	
G	1	0 – 1.5	M

Structural formation (including height): open woodland

Ecologically dominant layer: T1

Landform situation: gully, drainage line

Land form element (40 m radius): stream bank and plain

Land form pattern (300 m radius): undulating plain

Soil and geology: light brown alluvial, loam

Topsoil depth: Shallow

Slope position, degree and aspect: open depression**,** 1° north

Vast condition assessment: Type III

Plant species

Relative (numerical) dominance for each stratum: d, dominant; c, codominant; s, subdominant; a, associated.

Str.	Rel. dom.	Scientific Name
E	d	*Eucalyptus populnea*
T1	d	*Eucalyptus populnea*
T1	a	*Angophora floribunda*
T1	a	*Eucalyptus chloroclada*
T2	d	*Eucalyptus populnea*
S1	c	*Eremophila mitchellii*
S1	c	*Acacia excelsa*
S1	a	*Acacia decora*
S1	a	*Callitris glaucophylla*
S1	a	*Geijera parviflora*
S1	a	*Lycium ferocissimum*
S1	a	*Opuntia tomentosa**
G	d	*Cenchrus ciliaris**
G	a	*Dichanthium sericeum*
G	s	*Themeda triandra*
G	a	*Verbena aristigera**
G	a	*Aristida caput-medusae*
G	s	*Aristida latifolia*
G	a	*Lomandra longifolia*
G	a	*Sclerolaena birchii*
G	a	*Bothriochloa decipiens var. decipiens*
G	a	*Aristida calycina*
G	a	*Bothriochloa ewartiana*
G	a	*Bothriochloa pertusa**
G	a	*Themeda avenacea*
G	a	*Sporobolus creber*
G	a	*Urochloa mosambicensis**
G	a	*Chrysopogon fallax*
G	a	*Melinis repens**

T2	s	*Eremophila mitchellii*
T2	a	*Geijera parviflora*
T2	a	*Eucalyptus coolabah*

G	a	*Enteropogon ramosus*
G	a	*Chloris ventricosa*
G	a	*Opuntia stricta**
**Denotes exotic species*		

Ground cover (%) (average from five 1 m x 1 m quadrats)	
Type	**% cover**
Native grass	4
Native herbs/forbs (non-grass)	0
Native shrubs (<1 m high))	0.6
Non-native grass	15.4
Non-native herbs and shrubs	10
Litter (woodies <10 cm diameter, dead annuals, etc.)	17.6
Litter (logs >10 cm diameter)	0
Rock	0
Bare ground	52.4

Fauna habitat features (within 1 ha area) – Baseline data	
Characteristic	**Abundance (0-7) ^**
Decorticating bark	1
Coarse leaf litter (>2 cm diameter)	1
Fine leaf litter (<2 cm diameter)	0
Bare ground	2
Grass	6
Soil cracks	0
Stones (20-60 cm)	0
Boulders (61 cm – 2 m)	0
Larger boulders (>2 m)	0
Rock crevices	0
Exfoliating rock	0
^ 0, nil; **1**, rare; **2,** rare to occasional; **3,** occasional; **4**, Occasional to common; **5**, common; **6**, common to abundant; **7**, abundant	

Vegetative cover	
Strata	**% cover (100 m line intercept)**
E	-
T1	12
T2	-
S1	1.5
S2	-
G	-
Species	
T1	
Eucalyptus populnea	12
S1	
Eremophila mitchellii	1
Acacia excelsa	0.5

Vegetative density	
Strata	**Stem count (per ha)**
E	2
T1	28
T2	20
S1	22
S2	-
G	-
Species	
E	
Eucalyptus populnea	2
T1	
Eucalyptus populnea	22
Eucalyptus chloroclada	4
Eucalyptus coolabah	2
T2	
Eucalyptus populnea	14
Eucalyptus coolabah	2
Geijera parviflora	2
Eremophila mitchellii	2
S1	
Eremophila mitchellii	14
Acacia excelsa	8

Fauna habitat value (within 1 ha area) – Baseline data	
Characteristic	**Value**
Number of trees with hollows: - Hollow size <10 cm diameter - Hollow size >10 cm diameter	8 14 0
Number of hollow bearing logs (hollows >10 cm	2

diameter)	
Total number of hollows in logs	2
Total length of fallen woody material (e.g. logs) >10 cm diameter	740 m

General habitat features and fauna breeding places present
General habitat features and potential fauna breeding places have been recorded in the Santos webGIS system. Refer to Santos webGIS for more information on these features.
Potential habitat for EVNT fauna species (including essential habitat): Little pied bat confirmed present General Habitat for EVNT species is present, refer to Section 4.1

Koala habitat
Identification area contains potential koala habitat (although non-remnant vegetation) and contains suitable koala food trees. Refer to Appendix C for koala habitat assessment.

Disturbances (e.g. grazing, clearing, ploughing etc.)
Wildfire: 2 – =>5 years **Grazing:** 3 –small to moderate amounts from many plants **Weeds:** 1 – minor infestations **Erosion:** 3 – severe disturbance (e.g. pedestals, scalds, sand blown, exposure) particularly around watercourse **Clearing:** 2 – moderate amount, regrowth or near-remnant status
Ecosystem functioning (e.g. Extent of remnant vegetation in the landscape, connectivity, etc.):
Patch size and characteristics: linear regrowth eucalypt woodland polygon, approx. 200 m wide following the watercourse, surrounded by cleared non-remnant vegetation. **Location of patch:** medium – connected to regrowth vegetation along >25% of border **Degree of edge effects:** 3 - severe **Floodplain characteristics:** narrow watercourse present with flat topography immediately adjacent to the high banks to approx. 100 m from the watercourse which may be inundated by floodwaters. Undulating topography is present beyond the watercourse. Scattered mature eucalypts provide habitat for woodland birds. Dense grass cover provides potential habitat for macropods. Riparian vegetation along adjacent drainage line may provide habitat for arboreal fauna and aquatic fauna (when water present).

Declared weeds and introduced species
Weeds present: **Rare (<10 plants observed):** velvety tree pear[1] (*Opuntia tomentosa*), prickly pear[1] (*Opuntia stricta*), African box thorn[1] (*Lycium ferocissimum*) **Uncommon (11-50 plants observed):** red natal grass (*Melinis repens*), Mayne's pest (*Verbena aristigera*); **Common (>50 plants observed):** buffel grass (*Cenchrus ciliaris*), sabi grass (*Urochloa mosambicensis*); Indian bluegrass (*Bothriochloa pertusa*),
Total percentage weed cover (ha): velvety tree pear[1] 2%; prickly pear[1] 0.5%; African box thorn[1] 3%; red natal grass 10%; buffel grass 40%; Mayne's pest 6%; sabi grass 40%; Indian bluegrass 20%
[1]Class 2 declared weed under the LP Act

EVNT/Type A flora present
Nil

Incidental fauna observations
Weebill Pale-headed rosella Torresian crow Noisy miner Australian raven Pied butcherbird Australian magpie Striated pardalote

Representative photos for the M4-15 RoW identification area

North

East

South

West

4. Threatened species

4.1 Threatened fauna species habitat mapping and clearing extents

The quality of potential habitat for EVNT species within the M4 investigation area were assessed using the Santos Fauna Habitat Mapping Assessment Tool (version A3) (HMAT). Specifically this assessment encompassed the 16 EVNT fauna species conditioned with maximum habitat disturbance limits as part of the broader Santos GLNG Project approvals. Using the HMAT, potential habitat is identified through inputting recorded habitat and microhabitat features for each habitat type present. An output habitat classification is then produced in accordance with habitat hierarchy described in Section 4.2 of the Santos Methodology.

For the M4 investigation area, the outputs of the HMAT identified areas of General Habitat for four of the 16 EVNT fauna species of relevance. The HMAT habitat assessment results are provided in Appendix D and have also been provided with the accompanying spatial data, which include the habitat polygons. Table 6 contains the areas of potential habitat for the 16 EVNT fauna species of relevance to the Santos GLNG Project, which will be cleared for the construction of RoWs within the M4 investigation area. The HMAT allows for flexibility in interpreting the output results for each habitat type present, such that the habitat result for each species can be adjusted by a suitably qualified ecologist if necessary. Table 6 presents the final HMAT habitat output results and denotes species where adjustment to the HMAT result has been made. Justification for the associated adjustment of results is provided within the HMAT result spreadsheets provided in Appendix D. Table 7 identifies the proportion of General Habitat and Unlikely Habitat present within each RoW identification area and well pad footprint.

Table 6 Threatened fauna species habitat clearing extents

Species	EPBC Act / NC Act status^	HMAT (version A3) habitat output	General Habitat within M4 to be cleared for construction (ha)*
Koala *Phascolarctos cinereus*	V / SLC	A: Regrowth eucalypt woodland: General Habitat B: Non-remnant: Unlikely Habitat	0.54
Squatter pigeon *Geophaps scripta scripta*	V / V	A: Regrowth eucalypt woodland: Unlikely Habitat B: Non-remnant: Unlikely Habitat	0.00
Black-breasted button-quail *Turnix melanogaster*	V / V	A: Regrowth eucalypt woodland: Unlikely Habitat B: Non-remnant: Unlikely Habitat	0.00
Red goshawk *Erythrotriorchis radiatus*	V / E	A: Regrowth eucalypt woodland: Unlikely Habitat B: Non-remnant: Unlikely Habitat	0.00
Large-eared pied bat *Chalinolobus dwyeri*	V / V	A: Regrowth eucalypt woodland: Unlikely Habitat B: Non-remnant: Unlikely Habitat	0.00
South-eastern long-eared bat *Nyctophilus corbeni*	V / V	A: Regrowth eucalypt woodland: General Habitat B: Non-remnant: Unlikely Habitat	0.54
Northern quoll	E / -	A: Regrowth eucalypt woodland:	0.00

Species	EPBC Act / NC Act status^	HMAT (version A3) habitat output	General Habitat within M4 to be cleared for construction (ha)*
Dasyurus hallucatus		Unlikely Habitat B: Non-remnant: Unlikely Habitat	
Ornamental snake *Denisonia maculata*	V / V	A: Regrowth eucalypt woodland: Unlikely Habitat B: Non-remnant: Unlikely Habitat	0.00
Dunmall's snake *Furina dunmalli*	V / V	A: Regrowth eucalypt woodland: Unlikely Habitat[#] B: Non-remnant: Unlikely Habitat	0.00
Brigalow scaly-foot *Paradelma orientalis*	- / V	A: Regrowth eucalypt woodland: General Habitat B: Non-remnant: Unlikely Habitat	0.54
Yakka skink *Egernia rugosa*	V / V	A: Regrowth eucalypt woodland: General Habitat B: Non-remnant: Unlikely Habitat[#]	0.54
Collared delma *Delma torquata*	V / V	A: Regrowth eucalypt woodland: Unlikely Habitat[#] B: Non-remnant: Unlikely Habitat	0.00
Australian painted snipe *Rostratula australis*	E, Mi / V	A: Regrowth eucalypt woodland: Unlikely Habitat B: Non-remnant: Unlikely Habitat	0.00
Fitzroy River turtle	V / V	A: Regrowth eucalypt woodland:	0.00

Species	EPBC Act / NC Act status^	HMAT (version A3) habitat output	General Habitat within M4 to be cleared for construction (ha)*
Rheodytes leukops		Unlikely Habitat B: Non-remnant: Unlikely Habitat	
Murray cod *Maccullochella peelii*	V / -	A: Regrowth eucalypt woodland: Unlikely Habitat B: Non-remnant: Unlikely Habitat	0.00
Boggomoss snail *Adclarkia dawsonensis*	CE / -	A: Regrowth eucalypt woodland: Unlikely Habitat B: Non-remnant: Unlikely Habitat	0.00

^ EPBC Act status: CE – critically endangered; E – endangered; V – vulnerable; Mi – migratory; - – not listed. NC Act status: E – endangered; V – vulnerable; NT – near threatened; SLC – special least concern; - – not listed.

*Where habitat calculations are 0 ha, no general habitat for the species has been identified within the M4 investigation area RoWs.

The HMAT output results decision has been adjusted by a suitably qualified ecologist. The amended result has been presented within this table. Justification regarding the rejected decision is presented within the HMAT results table provided in Appendix D and issued in the data accompanying this report.

Table 7 Habitat outputs by RoW and well pad infrastructure

Infrastructure name	Area of General Habitat – Polygon A: Regrowth eucalypt woodland (ha)	Area of Unlikely Habitat – Polygon B: Non-remnant (ha)	Total infrastructure footprint area (ha)
RoW infrastructure area			
M4-01	0	2.00	2.00
M4-03	0	4.20	4.20
M4-04	0	0.23	0.23
M4-05	0	1.48	1.48
M4-06	0	0.35	0.35
M4-07	0	1.96	1.96
M4-08	0	2.06	2.06
M4-09 flowlines	0	7.71	7.71
M4-09 utilities	0	1.11	1.11
M4-10	0	0.83	0.83
M4-11	0	1.12	1.12
M4-12	0	0.79	0.79
M4-13	0	2.82	2.82
M4-14	0	0.50	0.50
M4-15	0.54	1.91	2.45
M6-02	0	2.21	2.21
Well pad area			
RM03-71	0	0.48	0.48
RM03-72	0	0.48	0.48
RM03-73	0	0.48	0.48
RM03-75	0	0.48	0.48
RM09-11	0	0.48	0.48
RM09-48	0	0.48	0.48

In addition to the species presented above, a further three threatened species of importance have been identified from desktop and field assessments of the M4 investigation area. The three species; little pied bat, golden-tail gecko and glossy black cockatoo, are listed as EVNT species under the NC Act. Table 8 provides a likelihood of occurrence assessment and identifies potential habitat within the investigation area for the three additional threatened fauna species using the habitat hierarchy described in Section 4.2 of the Santos Methodology. Threatened fauna species survey effort and results from field assessments within the investigation area are presented in Appendix A.

Potential habitat mapping for threatened flora species is not a requirement of the Santos Methodology; therefore, threatened flora species of relevance to the investigation area are not included further in this section. A brief discussion on threatened flora potential habitat within the investigation area and results of the field survey is contained within Section 4.2 and Appendix A.

Table 8 Threatened fauna species habitat descriptions and likelihood of occurrence for the M4 investigation area

Species	Likelihood of occurrence*	Potential habitat within the M4 investigation area
Little pied bat (*Chalinolobus picatus*) EPBC Act: not listed NC Act: near threatened	Confirmed present	**General habitat:** Within the M4 investigation area, General Habitat for this species has been identified as regrowth eucalypt woodlands, fringing riparian vegetation and non-remnant areas with suitable microhabitat features to shelter including stag trees, mature trees, hollow bearing trees, logs with hollows and peeling bark present in relation to where the species was recorded during field surveys. The total footprint areas for following M4 sub branch RoW infrastructure areas and well pad footprints are considered General Habitat for the species: M4-09 (flowlines and utilities RoWs), M4-11, M4-15 and RM09-11. Therefore, the area of General Habitat for the little pied bat to be impacted by vegetation clearing for the construction of M4 sub-branch infrastructure is 12.87 ha. Although little pied bat echolocations were recorded from five locations during field assessments, there is a general lack of existing records for the species within the M4 investigation area from previous ecological studies or database results. Little pied bat is reported as scarce in highly fragmented landscapes but persists in vegetated corridors and well-connected patches of remnant vegetation (DSITIA, 2012). Vegetated corridors along watercourses and existing roads are representative of the areas where the species was recorded during field surveys. Areas within the M4 investigation area are considered to provide general habitat for this species based on field survey, but were not considered to represent core or essential habitat areas for the species as the available resources were not considered essential for the maintenance of populations within the M4 investigation area and due to the transient nature of the species, even though the species was recorded on site. **Unlikely habitat:** Areas within the M4 investigation area that contained highly modified communities including non-remnant vegetation that contain cleared paddocks that are absent of trees. These areas were generally lacking in habitat features and suitable microhabitat features for little pied bat and are areas where the species was not recorded present during the field assessment.
Glossy black cockatoo *Calyptorhynchus lathami*	Potential to occur	**General habitat:** General habitat for this species is represented by woodlands dominated by *Allocasuarina* or *Casuarina* species also including open eucalypt forests or woodlands containing *Allocasuarina* or *Casuarina* species as food sources. They may also feed in remnant belah (*Casuarina cristata*) and bull oak (*Allocasuarina luehmannii*) forests. Large hollow bearing trees or stags are a

Species	Likelihood of occurrence*	Potential habitat within the M4 investigation area
EPBC Act: not listed NC Act: vulnerable		requirement for breeding (Glossy Black Conservancy 2010). Within the M4 investigation area, General habitat for this species has been identified as the regrowth eucalypt woodland and fringing riparian vegetation. Appropriate food trees, genus *Casuarina*, within this habitat area were recorded with a very sparse distribution. This species has been identified within the M4 investigation area from desktop assessments (Wildlife Online search); however this species or evidence of this species was not recorded during field surveys. Therefore, the area of potential General Habitat for the species impacted by the construction of the M4 sub-branch has not been calculated. **Unlikely habitat:** Areas of non-remnant vegetation within the M4 investigation area that do not contain woodlands dominated by *Allocasuarina* or *Casuarina* species.
Golden-tailed gecko *Strophurus taenicauda* EPBC Act: not listed NC Act: near threatened	Potential to occur	**General habitat:** General habitat for this species includes dry open forests and woodlands containing cypress pine (*Callitris* sp.), ironbarks, eucalypts with flaky or peeling bark, bull oak and brigalow/belah that contain loose bark and hollow limbs microhabitat features (QMDC 2008). Within the M4 investigation area, General habitat for this species has been identified as the regrowth eucalypt woodland and fringing riparian vegetation. Suitable flora species and microhabitat features were identified within this habitat area from field surveys. This species has been identified within the M4 investigation area from desktop assessments (Wildlife Online search); however this species was not recorded during field surveys. Therefore, the area of potential General Habitat for the species impacted by the construction of the M4 sub-branch has not been calculated. **Unlikely habitat:** Areas of non-remnant vegetation within the M4 investigation area representing cleared grazing paddocks with or without low shrubs and regrowth saplings.

*Likelihood of occurrence criteria:
Confirmed present – species was recorded during field surveys of the M4 investigation area undertaken in July 2014.
Potential to occur – suitable habitat requirements are present within the M4 investigation area, even if the species has not been recorded from field surveys.
Unlikely to occur – habitat requirements for the species are not present within M4 investigation area.

4.2 Threatened flora species

No threatened flora species listed under the NC Act or EPBC Act were identified during the field surveys. A likelihood of occurrence assessment has been undertaken for listed flora species identified as having the potential to occur within the M4 investigation area. The results are presented in Table 11, Appendix A.

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Appendices

Appendix A – Threatened species survey results

Targeted threatened species survey effort

During the July 2014 field surveys of the M4 investigation area, threatened species searches were undertaken targeting threatened fauna species listed under the EPBC Act or NC Act with potential to occur. Additionally, four listed threatened flora species identified as having the potential to occur were targeted during surveys of investigation area. Survey methods undertaken were appropriate for each species as identified within relevant species survey guidelines published by DOE and/or DEHP. These methods are listed in Section 2. Table 9 outlines the survey effort undertaken for each targeted method employed during field surveys.

Table 9 Survey effort

Survey method/technique	Survey effort
Active search, bird surveys, targeted fauna surveys	23 person hours
Spotlighting (walking and driving transects)	11.5 person hours
Call playback	1.5 person hours
Unattended anabat survey - overnight	6 nights (approx. 48 hours)

M4 threatened species field survey results

Field surveys undertaken in the investigation area during July 2014 recorded one species, little pied bat (*Chalinolobus picatus*), which are protected under the EPBC Act and/or NC Act. The little pied bat is listed as near threatened under the NC Act and is not listed under the EPBC Act. No species protected under the EPBC Act (including migratory species) were identified from field surveys. Similarly, no NC Act listed special least concern species were recorded during field surveys. Threatened fauna species recorded from field surveys are detailed in Table 10.

Three EPBC Act marine species were recorded from field surveys, these species are presented in Appendix B. No threatened flora species were recorded during field surveys. A likelihood of occurrence assessment for threatened flora species identified during the desktop assessment process is presented in Table 11.

Table 10 Threatened fauna species records

Species name	Location (easting, northing)		Date, Time	Number	Activity	Habitat type
Little pied bat	710219	7076527	16/07/2014, no time data	Multiple	Echolocation calls recorded on anabat device within M4-15 RoW	Regrowth eucalypt woodland fringing a watercourse
Little pied bat	710256	7076741	17/07/2014, no time data	Multiple	Echolocation calls recorded on anabat device within/adjacent to M4-09 RoW	Non-remnant regrowth eucalypt woodland fringing a watercourse
Little pied bat	711580	7076328	18/07/2014, no time data	Multiple	Echolocation calls recorded on anabat device adjacent to M4-09 and M4-11 RoW	Cleared paddock with mature eucalypts and hollow bearing trees within 100 m of a drainage feature
Little pied bat	708975	7077521	20/07/2014, no time data	Multiple	Echolocation calls recorded on anabat device at a tributary of Blyth Creek, within 200 m of M4-08 RoW and well pad RM03-71	Regrowth eucalypt woodland fringing a watercourse
Little pied bat	710372	7076248	21/07/2014, no time data	Multiple	Echolocation calls recorded on anabat device, within 200 m of M4-09 and M4-15 RoW	Regrowth eucalypt woodland fringing a watercourse

Table 11 Threatened flora likelihood of occurrence assessment

Species	EPBC Act/NC Act status	Records*	Habitat requirements	Habitat available in the M4 investigation area
Belson's panic *Homopholis belsonii*	vulnerable/ endangered	PMST	*Homopholis belsonii* occurs within dry woodland habitats on poor soils (often basalt derived), mostly in rocky hills supporting white box (*Eucalyptus albens*) and wilga woodland, or alluvial areas supporting belah and poplar box woodland.	No suitable habitat was observed within and adjacent to the M4 investigation area **Unlikely to occur**
ooline *Cadellia pentastylis*	vulnerable/ vulnerable	PMST	*Cadellia pentastylis* occurs in a range of vegetation types including semi-evergreen vine thicket, brigalow-belah, *Eucalyptus populnea* and *Acacia catenulata* communities. The species often occurs on the edges of sandstone and basalt escarpments where it may be locally dominant or an emergent.	No suitable habitat was observed within and adjacent to the M4 investigation area **Unlikely to occur**
slender darling-pea *Swainsona murrayana*	vulnerable/ vulnerable	PMST	*Swainsona murrayana* grows in heavy grey/brown clay, loam or cracking clays and is found in grassland and open woodland. It is often associated with low chenopod shrubs (*Maireana* spp.) and native grass species (e.g. *Austrodanthonia* and *Austrostipa* spp.) It may be disturbance mediated.	No suitable habitat was observed within and adjacent to the M4 investigation area. However, flora species known to be associated with *S. murrayana* were recorded on site (e.g. *Maireana* sp. and *Austrostipa* spp.) **Unlikely to occur**
Tylophora linearis	endangered/ endangered	PMST	*Tylophora linearis* grows in dry scrub, open forest and woodlands occurring on low sedimentary flats in association with *Melaleuca uncinata*, *Eucalyptus fibrosa*, *E. sideroxylon*, *E. albens*, *C. glaucophylla* and *Allocasuarina luehmannii*.	No suitable habitat was observed within and adjacent to the M4 investigation area **Unlikely to occur**

*Desktop search sources: WO, Wildlife Online; PMST, Protected Matters Search Tool; EH, essential habitat and species location occurs for the species within the search area

[1]Likelihood of occurrence criteria:

Confirmed present – species was recorded during field surveys of the M4 investigation area undertaken in July 2014.

Potential to occur – suitable habitat requirements are present within the M4 investigation area, even if the species has not been recorded from field surveys.

Unlikely to occur – habitat requirements for the species are not present within the M4 investigation area.

Appendix B – Flora and fauna species list

- Fauna species list
- Flora species list

Table 12 Fauna survey species list

Species	Common name	EPBC Act status	NC Act status	Identification Area
Birds				
Acanthiza chrysorrhoa	yellow-rumped thornbill	-	Least concern	M4-05, M4-07, M4-01
Acanthiza nana	yellow thornbilll	-	Least concern	M4-05
Acanthiza uropygialis	chestnut-rumped thornbill	-	Least concern	incidental
Aegotheles cristatus	Australian owlet-nightjar	-	Least concern	spotlighting
Anthus novaeseelandiae	Australasian pipit	Marine	Least concern	M4-05, M4-08
Aprosmictus erythropterus	red-winged parrot	-	Least concern	incidental
Aquila audax	wedge-tailed eagle	-	Least concern	incidental
Cacatua galerita	sulphur crested cockatoo	-	Least concern	M4-15, M4-10, M4-07, incidental
Coracina novaehollandiae	black-faced cuckoo-shrike	Marine	Least concern	M4-15, M4-12, M4-13, incidental
Corvus coronoides	Australian raven	-	Least concern	M4-15, M4-09, M4-12, M4-05, M4-07, incidental
Corvus orru	Torresian crow	-	Least concern	M4-15, M4-09, M4-10, M4-12, M4-11, M6-02, M4-05, incidental, spotlighting
Cracticus nigrogularis	pied butcherbird	-	Least concern	M4-15, M4-09, M4-12, M4-05, M4-07, incidental
Cracticus tibicen	Australian magpie	-	Least concern	M4-15, M4-09, M4-12, M4-13, M4-11, M4-06, M4-05, M4-03, incidental
Cracticus torquatus	grey butcherbird	-	Least concern	M6-02, M4-07, incidental
Dacelo novaeguineae	laughing kookaburra	-	Least concern	M4-09, incidental, spotlighting
Egretta novaehollandiae	white-faced heron	-	Least concern	incidental
Eolophus roseicapilla	galah	-	Least concern	M4-09, M4-05, incidental
Falco cenchroides	nankeen kestrel	Marine	Least concern	M4-13, M6-02, M4-08, incidental

Species	Common name	EPBC Act status	NC Act status	Identification Area
Gerygone albogularis	white-throated gerygone	-	Least concern	M4-05
Grallina cyanoleuca	magpie lark	-	Least concern	M4-15, M4-09, M4-10, M4-12, M4-05, incidental
Malurus cyaneus	superb fairy wren	-	Least concern	M4-15, M6-02, M4-05
Malurus melanocephalus	red-backed fairy-wren	-	Least concern	M4-05
Manorina melanocephala	noisy miner	-	Least concern	M4-15, M4-10, M4-09, M4-12, M4-11, M6-02, M4-07, incidental
Microeca fascinans	Jacky winter	-	Least concern	M4-06, M4-05, M4-01, incidental
Northiella haematogaster	blue bonnet	-	Least concern	M4-11, incidental
Nymphicus hollandicus	cockatiel	-	Least concern	incidental
Ocyphaps lophotes	crested pigeon	-	Least concern	M4-15, M4-12, M4-11, M4-05, incidental
Pardalotus striatus	striated pardalote	-	Least concern	M4-15, M4-09, M4-12, M4-06, M4-05, M4-07, M4-08, M4-01, M4-03, incidental
Platycercus adscitus	pale-headed rosella	-	Least concern	M4-15, M4-09, M4-11, M4-06, M4-05, incidental
Pomatostomus temporalis	grey-crowned babbler	-	Least concern	M4-09, M4-05, M4-07, incidental
Psephotus haematonotus	red-rumped parrot	-	Least concern	incidental
Rhipidura leucophrys	willie wagtail	-	Least concern	M4-12, M6-02, M4-06, M4-05
Smicrornis brevirostris	weebill	-	Least concern	M4-15, M4-09, M4-12, M4-13, M6-02, M4-05, M4-07, M4-01, M4-03
Struthidea cinerea	apostlebird	-	Least concern	spotlighting
Vanellus miles	masked lapwing	-	Least concern	M4-09, M4-11, incidental
Vanellus tricolor	banded lapwing	-	Least concern	M4-10, M6-02, M4-07, incidental
Crustaceans				

Species	Common name	EPBC Act status	NC Act status	Identification Area
Cherax destructor	yabby	-	Least concern	incidental
Mammals				
Aepyprymnus rufescens	rufous bettong	-	Least concern	spotlighting
Austronomus australis	white-striped freetail bat	-	Least concern	M4-15, M4-09, M4-11, near M4-08/RM03-71
Chalinolobus gouldii	Gould's wattled bat	-	Least concern	M4-15 (unconfirmed), M4-09 (unconfirmed), M4-08 (unconfirmed)
Chalinolobus picatus	little pied bat	-	Near threatened	M4-15, M4-09, M4-08
Felis catus	cat	-	Introduced	spotlighting
Macropus agilis	agile wallaby	-	Least concern	incidental, spotlighting
Macropus dorsalis	black-striped wallaby	-	Least concern	spotlighting
Macropus giganteus	eastern grey kangaroo	-	Least concern	M4-15, incidental, spotlighting
Macropus rufogriseus	red-necked wallaby	-	Least concern	incidental
Miniopterus orianae oceanensis	Australasian bent-winged bat	-	Least concern	M4-15, M4-09
Mormopterus petersi	inland free-tailed bat	-	Least concern	M4-15 (unconfirmed), M4-09 (unconfirmed), M4-08 (unconfirmed)
Mus musculus	house mouse	-	Introduced	spotlighting
Oryctolagus cuniculus	European rabbit	-	Introduced	M4-09, M4-11, incidental, spotlighting
Scotorepens balstoni	western broad-nosed bat	-	Least concern	M4-09 (unconfirmed), M4-01 (unconfirmed)
Scotorepens greyii	little broad-nosed bat	-	Least concern	M4-15, M4-09, M4-01 (unconfirmed)
Trichosurus vulpecula	brushtail possum	-	Least concern	spotlighting
Vespadalus sp.		-	Least concern	M4-15 (unconfirmed), M4-09 (unconfirmed)
Vespadelus baverstocki	inland forest bat	-	Least concern	M4-15 (unconfirmed), M4-09 (unconfirmed)
Wallabia bicolor	Swamp wallaby	-	Least concern	incidental

Species	Common name	EPBC Act status	NC Act status	Identification Area
Reptiles				
Gehyra dubia	dubious dtella	-	Least concern	M4-15

Table 13 Flora survey species list

Family	Species	Common name	EPBC Act status	NC Act status	LP Act status	Flora survey site
Apocynaceae	*Carissa ovata*	currant bush	-	Least concern	-	Q11
Asteraceae	*Chrysocephalum apiculatum*	billy-buttons	-	Least concern	-	Q3, Q6, Q8, Q9, Q12, Q13, Q16
Asteraceae	*Rhodanthe floribunda*	white paper-daisy	-	Least concern	-	Q6, Q7, Q9, Q13
Asteraceae	*Senecio brigalowensis*	native senecio	-	Least concern	-	Q7, Q14
Asteraceae	*Sonchus asper*	prickly sowthistle	-	Introduced	-	Q6
Asteraceae	*Xanthium occidentale*	Noogoora burr	-	Introduced	-	Q1, Q7, Q11, Q12
Cactaceae	*Opuntia stricta*	prickly pear	-	Introduced	Class 2	Q3, Q4, Q13, Q14, Q15, Q16
Cactaceae	*Opuntia tomentosa*	velvety tree pear	-	Introduced	Class 2	Q1, Q2, Q8, Q11, Q12, Q17
Campanulaceae	*Wahlenbergia gracilis*	bluebell	-	Least concern	-	Q14
Capparaceae	*Capparis lasiantha*	wait-a-while	-	Least concern	-	Q19
Casuarinaceae	*Casuarina cristata*	belah	-	Least concern	-	Q12
Chenopodiaceae	*Maireana microphylla*	cotton bush	-	Least concern	-	Q1, Q10, Q12, Q14, Q17
Chenopodiaceae	*Sclerolaena birchii*	galvanised burr	-	Least concern	-	Q2, Q3, Q4, Q6, Q9, Q10, Q12, Q14, Q15, Q16, Q17
Cucurbitaceae	*Cucumis myriocarpus*	prickly pademelon	-	Introduced	-	Q6
Cupressaceae	*Callitris glaucophylla*	white cypress pine	-	Least concern	-	Q2, Q8, Q11, Q12, Q16, Q17, Q18, Q19
Cyperaceae	*Cyperus sp.*		-		-	Q5, Q7, Q9
Juncaceae	*Juncus usitatus*		-	Least concern	-	Q12
Laxmanniaceae	*Lomandra leucocephala* subsp. *leucocephala*	woolly-headed matrush	-	Least concern	-	Q6, Q7, Q8

Family	Species	Common name	EPBC Act status	NC Act status	LP Act status	Flora survey site
Laxmanniaceae	*Lomandra longifolia*	long-leaved matrush	-	Least concern	-	Q2, Q11, Q12, Q18
Malvaceae	*Sida sp.*		-		-	Q14
Meliaceae	*Owenia acidula*	emu apple	-	Least concern	-	Q6
Mimosaceae	*Acacia deanei subsp. deanei*	Dean's wattle	-	Least concern	-	Q11, Q14
Mimosaceae	*Acacia decora*	pretty wattle	-	Least concern	-	Q1, Q2, Q3, Q4, Q5, Q6, Q10, Q11, Q13, Q16, Q17
Mimosaceae	*Acacia excelsa* subsp. *excelsa*	ironwood	-	Least concern	-	Q1, Q2, Q10, Q11, Q12
Mimosaceae	*Acacia harpophylla*	brigalow	-	Least concern	-	Q13, Q19
Mimosaceae	*Acacia oswaldii*	miljee	-	Least concern	-	Q5, Q6, Q13, Q19
Mimosaceae	*Acacia salicina*	sally wattle	-	Least concern	-	Q11, Q18
Mimosaceae	*Vachellia farnesiana*	mimosa bush	-	Introduced	-	Q3, Q10, Q12
Myoporaceae	*Eremophila mitchellii*	false sandalwood	-	Least concern	-	Q1, Q2, Q3, Q4, Q6, Q11, Q13, Q14, Q16, Q17, Q18, Q19
Myrtaceae	*Angophora floribunda*	rough barked apple	-	Least concern	-	Q2, Q18
Myrtaceae	*Eucalyptus chloroclada*	Baradine gum	-	Least concern	-	Q2
Myrtaceae	*Eucalyptus coolabah*	coolibah	-	Least concern	-	Q2, Q18
Myrtaceae	*Eucalyptus fibrosa nubila*	dusky-leaved ironbark	-	Least concern	-	Q13
Myrtaceae	*Eucalyptus melanophloia*	silver-leaved ironbark	-	Least concern	-	Q1, Q3, Q4, Q5, Q8, Q9, Q14, Q16, Q17, Q18
Myrtaceae	*Eucalyptus orgadophila*	mountain coolibah	-	Least concern	-	Q5
Myrtaceae	*Eucalyptus populnea*	poplar box	-	Least concern	-	Q2, Q5, Q6, Q8, Q10, Q11, Q12, Q13, Q14, Q15, Q16, Q17, Q18, Q19

Family	Species	Common name	EPBC Act status	NC Act status	LP Act status	Flora survey site
Myrtaceae	*Eucalyptus tereticornis*	forest red gum	-	Least concern	-	Q11, Q18
Poaceae	*Alloteropsis semialata*	cockatoo grass	-	Least concern	-	Q5, Q16
Poaceae	*Ancistrachne uncinulata*	hooky grass	-	Least concern	-	Q19
Poaceae	*Aristida calycina*	dark wiregrass	-	Least concern	-	Q1, Q2, Q3, Q4, Q5, Q6, Q12, Q18
Poaceae	*Aristida caput-medusae*	many-headed wiregrass	-	Least concern	-	Q2, Q5, Q18
Poaceae	*Aristida jerichoensis*	Jericho wiregrass	-	Least concern	-	Q1, Q5, Q6, Q8, Q10, Q11, Q12, Q13, Q14, Q15, Q16, Q17, Q18, Q19
Poaceae	*Aristida latifolia*	feathertop wiregrass	-	Least concern	-	Q1, Q2, Q4, Q5, Q7, Q8, Q12, Q14, Q15, Q16, Q17
Poaceae	*Aristida leptopoda*	white spear grass	-	Least concern	-	Q14, Q15
Poaceae	*Aristida personata*	purple wiregrass	-	Least concern	-	Q6
Poaceae	*Aristida platychaeta*		-	Least concern	-	Q1, Q3, Q6, Q13, Q14
Poaceae	*Aristida sp.*		-	Least concern	-	Q3, Q10
Poaceae	*Arundinella nepalensis*	reed grass	-	Least concern	-	Q2
Poaceae	*Austrostipa ramosissima*	stout bamboo grass	-	Least concern	-	Q8, Q19
Poaceae	*Austrostipa verticillata*	slender bamboo grass	-	Least concern	-	Q18
Poaceae	*Bothriochloa decipiens var. decipiens*	pitted bluegrass	-	Least concern	-	Q2, Q17, Q18
Poaceae	*Bothriochloa ewartiana*	desert bluegrass	-	Least concern	-	Q1, Q2, Q3, Q4, Q6, Q10, Q13, Q15, Q16, Q18
Poaceae	*Bothriochloa pertusa*	Indian bluegrass	-	Introduced	-	Q2, Q4, Q5, Q7, Q9, Q10, Q11, Q12, Q13, Q14, Q15, Q16

Family	Species	Common name	EPBC Act status	NC Act status	LP Act status	Flora survey site
Poaceae	*Cenchrus ciliaris*	buffel grass	-	Introduced	-	Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8, Q9, Q10, Q12, Q13, Q14, Q15, Q19
Poaceae	*Chloris ventricosa*	tall chloris	-	Least concern	-	Q1, Q2, Q7, Q9, Q10, Q11, Q15, Q16, Q18
Poaceae	*Chrysopogon fallax*	golden beard grass	-	Least concern	-	Q2, Q5, Q11, Q18
Poaceae	*Cymbopogon refractus*	barbed wire grass	-	Least concern	-	Q1
Poaceae	*Cynodon dactylon var. dactylon*	green couch	-	Introduced	-	Q11
Poaceae	*Dichanthium sericeum*	Queensland blue grass	-	Least concern	-	Q1, Q2, Q3, Q4, Q10, Q11, Q13, Q14
Poaceae	*Digitaria ciliaris*		-	Introduced	-	Q15
Poaceae	*Enneapogon nigricans*	bottle washers	-	Least concern	-	Q6, Q13, Q14
Poaceae	*Enteropogon ramosus*	twirly windmill grass	-	Least concern	-	Q2, Q3, Q5, Q7, Q12, Q15, Q18, Q19
Poaceae	*Eragrostis lacunaria*	purple lovegrass	-	Least concern	-	Q1, Q6, Q7, Q9, Q10, Q12, Q15
Poaceae	*Eragrostis sororia*	woodland lovegrass	-	Least concern	-	Q6, Q7
Poaceae	*Heteropogon contortus*	black spear grass	-	Least concern	-	Q3, Q4, Q5, Q6, Q7, Q8, Q15
Poaceae	*Imperata cylindrica*	blady grass	-	Least concern	-	Q11
Poaceae	*Leptochloa digitata*	umbrella cane grass	-	Least concern	-	Q18
Poaceae	*Melinis repens*	red natal grass	-	Introduced	-	Q1, Q2, Q5, Q6, Q8
Poaceae	*Panicum decompositum var. decompositum*	native millet	-	Least concern	-	Q5
Poaceae	*Panicum effusum*	hairy panic	-	Least concern	-	Q1, Q3, Q12, Q13
Poaceae	*Paspalidium sp.*		-	Least concern	-	Q14

Family	Species	Common name	EPBC Act status	NC Act status	LP Act status	Flora survey site
Poaceae	*Sporobolus actinocladus*	katoora grass	-	Least concern	-	Q13, Q15
Poaceae	*Sporobolus caroli*	fairy grass	-	Least concern	-	Q13
Poaceae	*Sporobolus creber*	western rat's tail grass	-	Least concern	-	Q1, Q2, Q7, Q14, Q15
Poaceae	*Tagetes minuta*	stinking roger	-	Introduced	-	Q11
Poaceae	*Themeda avenacea*	oat kangaroo grass	-	Least concern	-	Q2, Q11, Q18
Poaceae	*Themeda triandra*	kangaroo grass	-	Least concern	-	Q1, Q2, Q7, Q9, Q10, Q11, Q12, Q17, Q18
Poaceae	*Urochloa mosambicensis*	sabi grass	-	Introduced	-	Q1, Q2, Q3, Q4, Q10
Proteaceae	*Hakea lorea*	bootlace hakea	-	Least concern	-	Q14
Rubiaceae	*Psydrax oleifolia*	myrtle tree	-	Least concern	-	Q3, Q4, Q6, Q7, Q14, Q17, Q19
Rutaceae	*Geijera parviflora*	wilga	-	Least concern	-	Q2, Q11, Q12, Q13, Q14, Q17, Q18, Q19
Sapindaceae	*Alectryon oleifolius*	boonaree	-	Least concern	-	Q13
Sapindaceae	*Atalaya hemiglauca*	cattle bush	-	Least concern	-	Q1
Sapindaceae	*Dodonaea viscosa* subsp. *spatulata*	sticky hopbush	-	Least concern	-	Q14
Solanaceae	*Lycium ferocissimum*	African box thorn	-	Introduced	Class 2	Q2, Q19
Sterculiaceae	*Brachychiton populneus*	kurrajong	-	Special least concern	-	Q8
Thymelaeaceae	*Pimelea trichostachya*		-	Least concern	-	Q4, Q5, Q6, Q7, Q8, Q9, Q13, Q14, Q15
Verbenaceae	*Verbena aristigera*	Mayne's pest	-	Introduced	-	Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8, Q9, Q10, Q11, Q12, Q13, Q15, Q17

Appendix C – Field data sheets

- Koala habitat assessments
- Watercourse assessments
- Wetland assessments
- Microbat call identification report

Koala Habitat Assessment and Faecal Pellet Survey

Project: M4 Ecological Surveys
Site name/number: KHA 1
Date and recorder: 22/07/2014, LM
Photos: North: 368, East: 369, South: 370, West: 371
Easting: 710349
Northing: 7076339

General habitat description: Narrow strip of riparian woodland, mapped as high value regrowth along an ephemeral watercourse.

Canopy tree species composition

Tree species	**% canopy cover of species** What proportion of canopy is represented by this species	**Primary food tree species in LGA –** refer AKF *National Koala Tree Protection List 2012* [a] – trees in bold	**Food tree species in LGA –** refer AKF *National Koala Tree Protection List 2012* [a] – trees not in bold	**Koala habitat tree* as defined in SEQ Koala SPP** [b] **–** *any other Eucalyptus sp., and trees in genera Corymbia, Melaleuca, Lophostemon, Angophora*	**Not a koala habitat tree**
		Tick one for each tree species			
Eucalyptus populnea (poplar box)	52	no	yes	yes	
Eucalyptus tereticornis (forest red gum)	25	yes	no	yes	
Angophera floribunda (rough-barked apple)	10	no	no	yes	
Eucalyptus coolabah (coolibah)	8	no	yes	yes	
Eucalyptus melanophloia (silver-leaved ironbark)	5	no	yes	yes	

***** non-juvenile koala habitat tree > 4 m in height OR trunk circumference > 31.5 cm at height of 1.3 m

Other habitat information [c]	**Comments**
Vegetative ground cover (% of ground area)	85
Leaf litter cover (% of ground area)	10
Area of surface water (% of ground area)	0
Distance to surface water (approximate)	200 m to a farm dam, ephemeral watercourse is present on site
Evidence of dogs in area	Yes, farm dogs present, feral cats present also

Habitat critical to the survival of the koala [c]	**Yes / No**
Primary koala food tree species comprise at least 30% of the overstorey trees	no
Primary koala food tree species comprise less than 30% of the overstorey trees, but together with secondary food tree species comprise at least 50% of the overstorey trees (**secondary food trees in this instance are those identified for LGA that are not primary food trees (AKF, 2012**))	yes
Primary food tree species are absent but secondary food tree species alone comprise at least 50% of the overstorey trees	no
The above qualities are absent in a forest or woodland, but other essential habitat features are present and adjacent to areas exhibiting the above qualities	no
A relatively high density of koalas is supported, regardless of the presence of food tree species	no
Any form of landscape corridor which is essential for the dispersal of koalas between forest of woodland habitats	yes

Other site notes

Site context: vegetation is part of a landscape riparian corridor that connects with riparian vegetation along Blyth Creek to the west. Corridor does contain gaps in vegetation and constructed barriers such as roads and fences.

Condition and disturbance: cattle grazing, some weed infestation

Koala faecal pellet survey - overview

Method based on Spot Assessment Technique (Phillips and Callaghan, 2011 [d])

Note: If a more detailed koala survey is required (i.e. density estimates), refer to Policy 4 of the Queensland Government's Nature Conservation (Koala) Conservation Plan 2006-2016 [e] and Dique *et al.* 2003 [f]. This may be required where preliminary surveys (i.e. faecal pellet searches) reveal the presence of the koala at a site, for the purposes of informing impact assessment and Commonwealth referral.

Faecal pellet survey data

Survey date and time; 22/07/2014, 9am

Survey location details (site name / number): as per koala habitat assessment

Survey location (transect start) Easting and Northing: as per koala habitat assessment

	Search area 1	Search area 2	Search area 3
Pellet visibility (Poor, Medium, Good)*	Poor/Medium	Poor/Medium	-
Number of trees searched	30	30	-
Koala faecal pellets observed (Y/N)	N	N	-
Arboreal mammal scratches observed (Y/N)	N	Y	-
Koala(s) observed (Y/N – if yes, details)	N	N	-

*Poor: Thick layer of leaf litter, grasses, weeds, shed bark / Medium: Limited amount of leaf litter, grasses, weeds, shed bark / Good: little or no leaf litter, grasses, weeds, shed bark

Comments: No evidence (i.e. scats or scratches) were observed during the survey

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Key references:

a Australian Koala Foundation's National Koala Tree Protection List; Recommended Tree Species for Protection and Planting of Koala Habitat (Mitchell, 2012): https://www.savethekoala.com/sites/default/files/Australian%20Koala%20Foundation_National%20Koala%20Tree%20Protection%20List.pdf

b State Planning Policy 2/10 Koala Conservation in South East Queensland (DERM, 2010): http://www.ehp.qld.gov.au/wildlife/koalas/strategy/pdf/koala-spp.pdf also as defined in Nature Conservation (Koala) Conservation Plan 2006

c Required habitat information and definition of 'habitat critical to the survival of the species' sourced from Interim koala referral advice for proponents (DSEWPaC, 2012): http://www.environment.gov.au/epbc/publications/pubs/bio240-0612-interim-koala-referral-advice.pdf

NOTE: this habitat assessment sheet will need to be reviewed and where necessary updated when the finalised koala referral guidelines are released by the Commonwealth

d The Spot Assessment Technique (Phillips and Callaghan, 2011): http://www.biolink.com.au/sites/www.biolink.com.au/files/publications/Phillips%20%26%20Callaghan.pdf

e Nature Conservation (Koala) Conservation Plan 2006-2016: http://www.ehp.qld.gov.au/wildlife/koalas/legislation/pdf/conservation-plan-06-16.pdf

f Dique *et al*. (2003). Evaluation of line transect sampling for estimating koala abundance in the Pine Rivers Shire, south east Queensland. Wildlife Research, 30, 127-133.

Photos

North

East

South

West

Koala Habitat Assessment and Faecal Pellet Survey

Project: M4 Ecological Surveys
Site name/number: KHA 2
Date and recorder: 22/07/2014, LM
Photos: North: 387, East: 388, South: 389, West: 390
Easting: 710182
Northing: 7076659

General habitat description: Fringing riparian woodland, mapped as high value regrowth along an ephemeral watercourse that feeds into Blyth Creek.

Canopy tree species composition

Tree species	**% canopy cover of species** What proportion of canopy is represented by this species	**Primary food tree species in LGA –** refer AKF *National Koala Tree Protection List 2012* [a] – trees in bold	**Food tree species in LGA –** refer AKF *National Koala Tree Protection List 2012* [a] – trees not in bold	**Koala habitat tree* as defined in SEQ Koala SPP** [b] **–** *any other Eucalyptus sp., and trees in genera Corymbia, Melaleuca, Lophostemon, Angophora*	**Not a koala habitat tree**
		Tick one for each tree species			
Eucalyptus populnea (poplar box)	65	no	yes	yes	
Eucalyptus tereticornis (forest red gum)	25	yes	no	yes	
Eucalyptus chloroclada (Baradine red gum)	5	yes	no	yes	

***** non-juvenile koala habitat tree > 4 m in height OR trunk circumference > 31.5 cm at height of 1.3 m

Other habitat information [c]	**Comments**
Vegetative ground cover (% of ground area)	65
Leaf litter cover (% of ground area)	15
Area of surface water (% of ground area)	0
Distance to surface water (approximate)	Approximately 1 km to a farm dam, ephemeral watercourse is present on site
Evidence of dogs in area	Yes, farm dogs present, feral cats present also

Habitat critical to the survival of the koala [c]	**Yes / No**
Primary koala food tree species comprise at least 30% of the overstorey trees	no
Primary koala food tree species comprise less than 30% of the overstorey trees, but together with secondary food tree species comprise at least 50% of the overstorey trees (**secondary food trees in this instance are those identified for LGA that are not primary food trees (AKF, 2012**))	yes
Primary food tree species are absent but secondary food tree species alone comprise at least 50% of the overstorey trees	no
The above qualities are absent in a forest or woodland, but other essential habitat features are present and adjacent to areas exhibiting the above qualities	no
A relatively high density of koalas is supported, regardless of the presence of food tree species	no
Any form of landscape corridor which is essential for the dispersal of koalas between forest of woodland habitats	yes

Other site notes

Site context: vegetation is part of a landscape riparian corridor that connects with riparian vegetation along Blyth Creek to the west. Corridor does contain gaps in vegetation and constructed barriers such as roads and fences, it is also surrounded by large cleared paddocks absent of mature vegetation.

Condition and disturbance: groundcover is heavily grazed by cattle, some weed infestation, erosion in watercourse channel.

Koala faecal pellet survey - overview

Method based on Spot Assessment Technique (Phillips and Callaghan, 2011 [d])

Note: If a more detailed koala survey is required (i.e. density estimates), refer to Policy 4 of the Queensland Government's Nature Conservation (Koala) Conservation Plan 2006-2016 [e] and Dique *et al.* 2003 [f]. This may be required where preliminary surveys (i.e. faecal pellet searches) reveal the presence of the koala at a site, for the purposes of informing impact assessment and Commonwealth referral.

Faecal pellet survey data

Survey date and time; 22/07/2014, 10:30 am

Survey location details (site name / number): as per koala habitat assessment

Survey location (transect start) Easting and Northing: as per koala habitat assessment

	Search area 1	Search area 2	Search area 3
Pellet visibility (Poor, Medium, Good)*	Medium	Medium	-
Number of trees searched	30	30	-
Koala faecal pellets observed (Y/N)	N	N	-
Arboreal mammal scratches observed (Y/N)	Y (infrequent)	N	-
Koala(s) observed (Y/N – if yes, details)	N	N	-

*Poor: Thick layer of leaf litter, grasses, weeds, shed bark / Medium: Limited amount of leaf litter, grasses, weeds, shed bark / Good: little or no leaf litter, grasses, weeds, shed bark

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Key references:

a Australian Koala Foundation's National Koala Tree Protection List; Recommended Tree Species for Protection and Planting of Koala Habitat (Mitchell, 2012): https://www.savethekoala.com/sites/default/files/Australian%20Koala%20Foundation_National%20Koala%20Tree%20Protection%20List.pdf

b State Planning Policy 2/10 Koala Conservation in South East Queensland (DERM, 2010): http://www.ehp.qld.gov.au/wildlife/koalas/strategy/pdf/koala-spp.pdf also as defined in Nature Conservation (Koala) Conservation Plan 2006

c Required habitat information and definition of 'habitat critical to the survival of the species' sourced from Interim koala referral advice for proponents (DSEWPaC, 2012): http://www.environment.gov.au/epbc/publications/pubs/bio240-0612-interim-koala-referral-advice.pdf

NOTE: this habitat assessment sheet will need to be reviewed and where necessary updated when the finalised koala referral guidelines are released by the Commonwealth

d The Spot Assessment Technique (Phillips and Callaghan, 2011): http://www.biolink.com.au/sites/www.biolink.com.au/files/publications/Phillips%20%26%20Callaghan.pdf

e Nature Conservation (Koala) Conservation Plan 2006-2016: http://www.ehp.qld.gov.au/wildlife/koalas/legislation/pdf/conservation-plan-06-16.pdf

f Dique *et al*. (2003). Evaluation of line transect sampling for estimating koala abundance in the Pine Rivers Shire, south east Queensland. Wildlife Research, 30, 127-133.

Photos

North

East

South

West

WORKS WITHIN A WATERCOURSE ASSESSMENT

This watercourse assessment is to be filled out for all watercourse crossings to ensure compliance with environmental requirements and to ensure appropriate approvals are obtained.

FIELD ASSESSMENT

Inspected by:	R.Feeney	GHD	**Inspected Date:**	16/07/2014
Company:			**Time:**	11 am

Crossing Name:	WC01	**CWP Number**	M4
Watercourse ID	WWBC- 01	**Crossing Type (E.g. pipeline/road)**	Pipeline
Lot/Plan:	59WV421	**Location Reference**	Oakleigh
Site	R-HCS-02 ☒ F-HCS-04 ☐ F-HCS-05 ☐ other/area:		
Land Tenure:	Freehold / Leasehold / other :	**Petroleum Tenure**	
Crossing Disturbance Status:	Existing crossing with no upgrade required: ☐ Existing crossing with upgrade required: ☐ New crossing in previously disturbed area: ☒ New crossing in undisturbed area: ☐		
Land Access Approval to undertake assessment:	Yes ☒ No ☐	**Approval No:**	SPR 1887
Cultural Heritage Approval to undertake assessment:	Yes ☒ No ☐	**Approval No:**	
Anticipated commencement date:		**Can the crossing be installed within 10 days?** If No, development approval and other approvals may be required.	Yes ☒ No ☐

HEALTH AND SAFETY		
Have you completed a Safety Task Assessment (STA)?	Yes ☒ No ☐	If No, cease inspection and complete.
Do you have appropriate PPE for the task?	Yes ☒ No ☐	
Do you have adequate amount of water – at least 10 litres?	Yes ☒ No ☐	

GENERAL ENVIRONMENTAL CONDITIONS	
Temp: Cold (<5◦C) ☐ Cool (<15◦C) ☐ Mild (<25◦C) ☒ Warm (<35◦C) ☐ Hot (>35◦C) ☐	Weather now: Clear/Fine ☐ Scattered Clouds ☐ Cloudy ☒
	Past 24 hrs: Clear/Fine ☐ Scattered Clouds ☒ Cloudy ☐
Wind: Still ☐ Slight breeze ☒ Windy ☐ Strong Wind ☐	Air now: Dry ☐ Humid ☐ Rain (Steady)☒ Rain (Heavy) ☐
	Air past 24hrs: Dry ☒ Humid ☐ Rain (Steady)☐ Rain (Heavy) ☐

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CROSSING LOCATION (REFER SECTION 8.2)

GPS Coordinates - Latitude/Longitude (E – 6 Figs, N – 7 Figs) GDA94

Latitude (E)	710215	**Longitude (S)**	7076501
Bankfull Width (m)	9 m	**Bank Width (m):**	Left Bank: 3 m Right Bank: 3 m
Stream Width at Water Surface (m):	0 m	**Baseflow Stream Width (m):**	3 m
Bank Height: Baseflow and water surface height difference:	Downstream left Bank: 1.5 m / 0 m Downstream Right Bank 1.5 m / 0 m	**Photographs of site** Provide photos looking upstream and downstream from crossing location, as well as relevant to watercourse / waterway determination. Label photos.	

Location	Latitude (E)	Longitude (S)
A		
B		
C		
D		
E		

Water Present:	Yes ☐ No ☐
Water Type:	Flowing ☐ Pool(s) present ☐ Dry ☐
Sample Site Length:	Water Surface Depth to Bed:

CHANNEL DETERMINATION (REFER TO SECTION 8.3)

Stream Order: 1☐ 2☒ 3☐ 4☐ 4+☐	Functional Zone Type - Sediment	Supply☒ Transfer☐ Storage☐	
Identify Channel Type:	Irregular		
Channel Modifications:	Natural		
Bed Sediment Character:	Tight ☐ Packed ☐ Moderate ☐ Low 1 ☐ Low 2 ☒		
Bank Sediments Composition:	Bedrock % Boulder % Cobble % Pebble % Gravel % Sand Fines 100 %		
Bed Material Angularity:	Very Angular☐ Angular ☐ Sub-angular ☐ Rounded ☐Well-rounded ☐ Cobble peddle and gravel fractions not present ☒		
Bank Predominant Shape:	Concave ☒ Convex ☐ Stepped ☐ Wide lower bench ☐ Undercut ☐		
Bank Slope Downstream Right:	Vertical 80-90° ☐ Steep 60-80° ☒ Moderate 30-60° ☐ Low 10-30° ☐ Flat<10°☐		
Bank Slope Downstream Left:	Vertical 80-90° ☐ Steep 60-80° ☒ Moderate 30-60° ☐ Low 10-30° ☐ Flat<10°☐		
Channel Shape:	Concave/ Wide lower bench		
Bed Stability:	Severe Erosion ☒ Moderate Erosion ☐ Bed Stable ☐ Moderate Deposition ☐ Severe Deposition ☐		
Potential Fish Habitat Class:	Class1 ☐ Class2 ☐ Class3 ☐ Class4 ☒		
Fish Migratory Passage Potential:	Nil ☒ Very Restricted ☐ Moderately Restricted ☐ Partly Restricted ☐ Good Passage ☐ Unrestricted Passage ☐		

FLORA/FAUNA ASSESSMENT (REFER TO SECTION 8.4)

Does any vegetation need to be removed?	Yes ☒ No ☐	**If Yes, no more than 0.25 Ha can be removed Estimate how much needs to be removed** **< 0.25 ha**
Vegetation community description		
Has an Aquatic and Ecological Assessment been undertaken previously that encompasses the watercourse crossing point (both for flora and fauna characteristics).	Yes ☐ No ☐	If yes, reference Report No:

Has a pre-disturbance assessment been undertaken previously that encompasses the watercourse crossing point (both for flora and fauna characteristics).	Yes ☒ No ☐	If no, a pre-disturbance assessment may be required
Does the riparian zone at the watercourse fall within a mapped extent of a Regional Ecosystem and/ or TEC? (refer to Dekho maps)	Yes ☐ No ☒	If Yes, detail mapped RE code (biodiversity status) and TEC where applicable:
Does the riparian zone at the watercourse fall within any Category A, B or C Environmentally Sensitive Areas (ESAs) and/or their primary or secondary primary protection (buffer) zones (refer to Dekho maps)	Yes ☐ No ☒	If Yes, detail ESA category: non remnant (HVR)
If present, is the mapped RE/TEC community consistent with the vegetation community observed on the ground	Yes ☐ No ☐	If no, Check whether discrepancies have already been recorded in previous reports and GIS layers updated. If not a pre-disturbance assessment or quaternary level assessment may be required
Does the proposed development activity comply with the clearing/significant disturbance restrictions of the applicable EA (refer Table 3)	Yes ☒ No ☐	If, no then flag with FLUOR Environment Team for review.
Are there any Cultural Heritage sites located within the crossing location or nearby area (refer to Dekho maps)	Yes ☐ No ☒	If Yes, detail site:
General Vegetation Community description: (including a list of dominant flora species within each stratum)	**Non-remnant vegetation with scattered mature mixed eucalypts, sparse shrub layer consisting of *Callitris glucophylla*, *Eucalyptus populnea* and mid-dense to dense ground layer of mixed grass species including *Themeda triandra* and *Lomandra longifolia*.**	

Are there any declared weeds within the area of the crossing?	Yes☐ No ☒	If yes, describe flag on the ground and GPS and provide on map. Opuntia spp. in area
Are there any conservation significant species (i.e ENVT or Type A flora) within the area of the crossing?	Yes☐ No ☒	
Riparian vegetation cover: Trees > 10 m: Trees < 10 m: Shrubs: Grasses, herbs and sedges:	1 % 1 % 5 % 90 %	
Riparian vegetation patchiness:	Isolated/ scattered	
Describe the riparian vegetation condition:	3	

Native woody vegetation regeneration:	Abundant ☐	Present ☒	Limited ☐

SAFETY CONSIDERATIONS		
Are there any safety implications at the proposed crossing due to decreased Right of Way from Environmental Sensitive Areas or other constraints like topography?	Yes ☐ No ☒	**If Yes, Note concerns**

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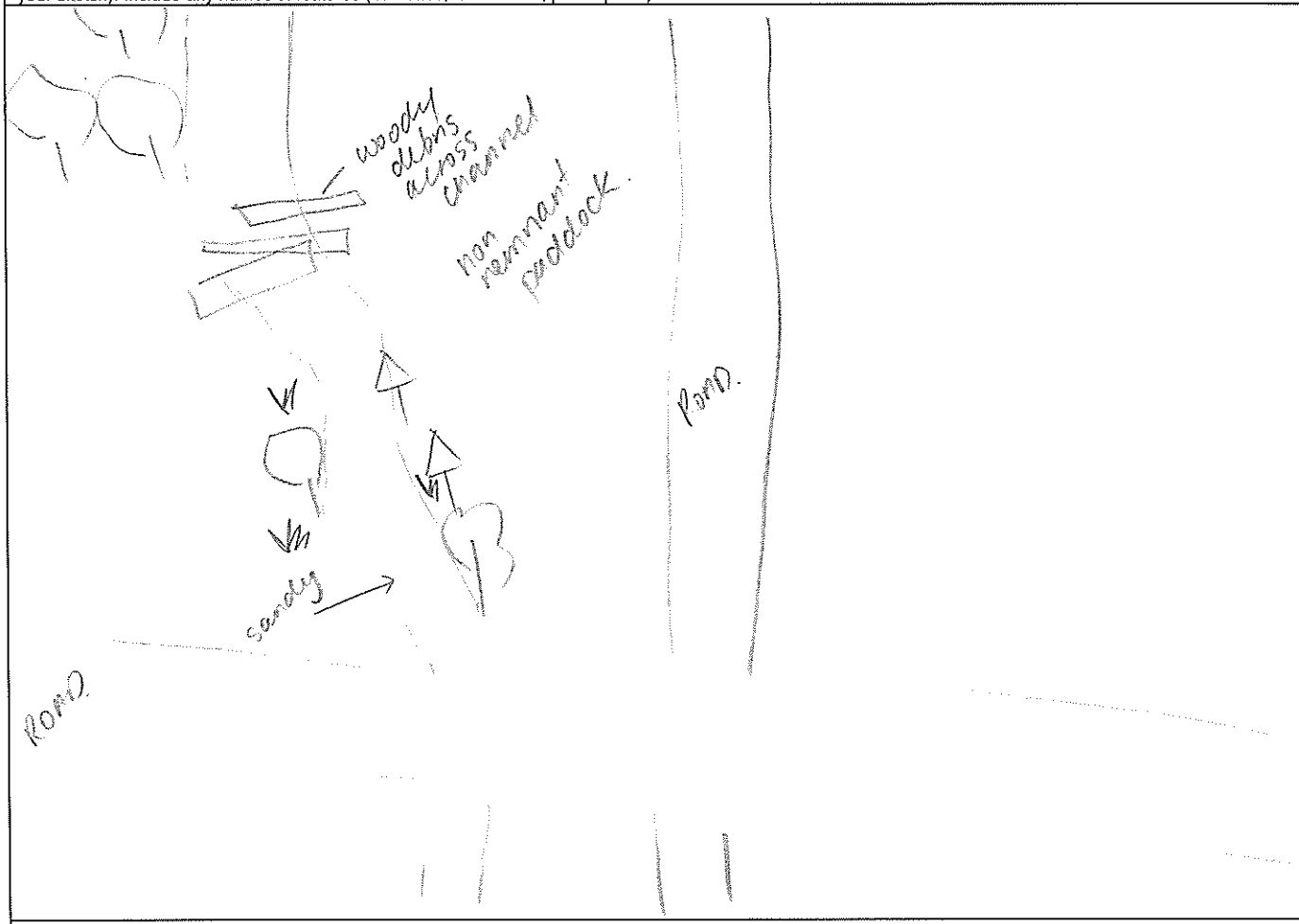
SKETCH OF CROSSING (BIRDS EYE VIEW) (REFER SECTION 8.5)

Sketch birds eye view (i.e. view looking from above), depict how the stream curves, any vegetation, trees, areas of significance (cultural significance if known). Complete approx 10 times the Bankfull Width upstream and downstream of crossing site. Take photographs upstream and downstream (write photo locations on your sketch). Include any names of features (i.e. roads, farm house, power poles).



Notes:

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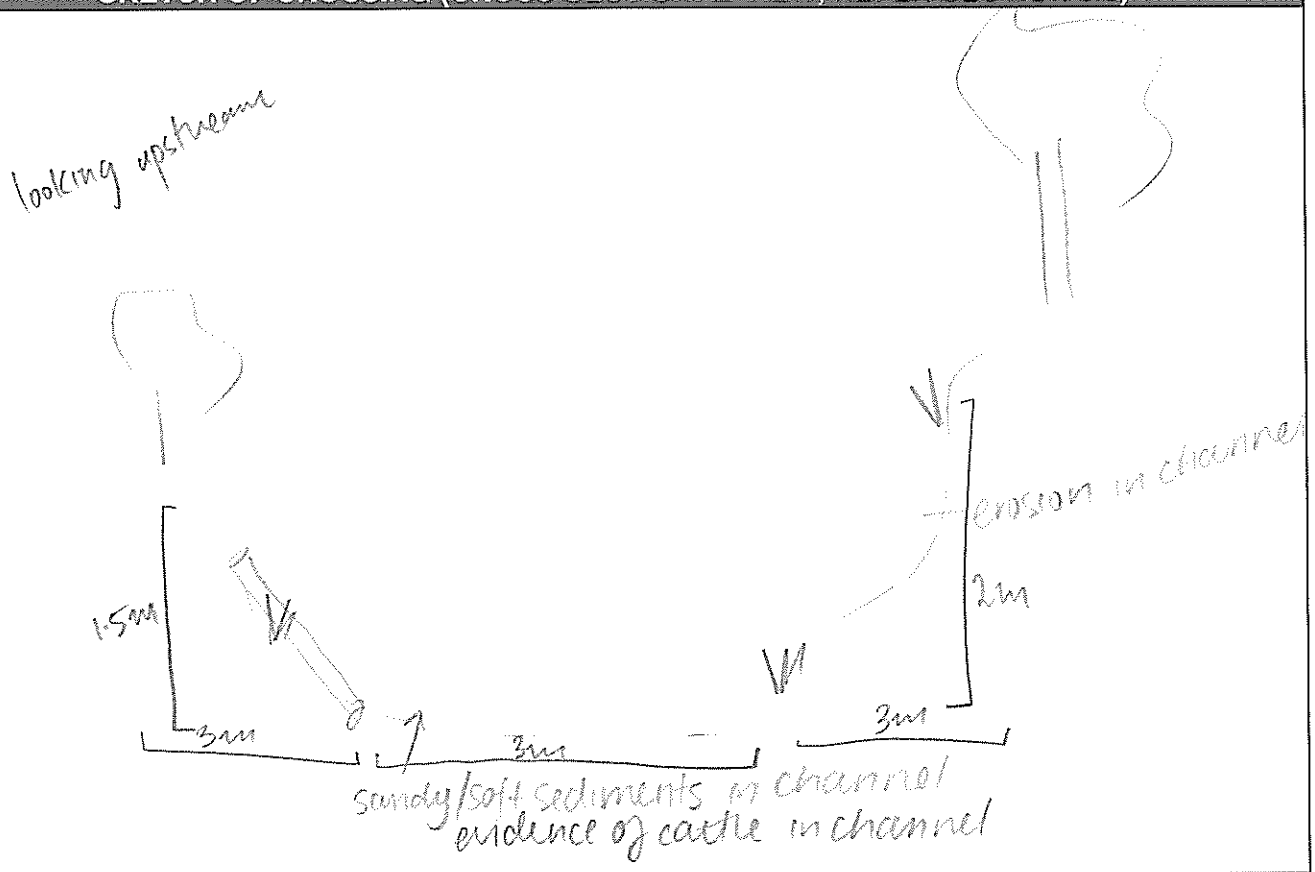
SKETCH OF CROSSING (CROSS-SECTIONAL VIEW, REFER SECTION 8.5)



Notes:

ASSESSMENT OUTCOME

LEGISLATIVE REQUIREMENTS DETERMINATION				
Part 1 - Waterway Definition Assessment (*Fisheries Act 1994*)				
Environmental Value	**Checklist**	**Y / N**	**Justification for Placement**	**Field Comments**
Does the feature satisfy the waterway definition requirements of FHMOP 008 2009 (refer section 7.3.2) under the *Fisheries Act 1994*? Refer to Section 7 of Watercourse Assessment Manual	Does the feature have a defined bed and banks: The bed and banks need to be continuous rather than isolated and broken sections of a depression.	☒yes ☐no	If **Yes to all** , complete Section 2 If **No to any of these, the feature does not constitute a waterway and no further assessment is required for the Fisheries Act.** Implement waterway crossing design and environmental protection measures as required in Environmental Authority and other relevant environmental requirements.	**WATERWAY UNDER *FISHERIES ACT 1994?*** ☐ **YES** **(APPROVAL/ LODGEMENT REQUIRED)**
	Does the feature have an extended, if non-permanent, period of flow: Flow must continue for a reasonable period after rain ceases and have some reliability commensurate with rainfall? Flow for several weeks after rainfall ceases does not constitute extended flow. Consider e.g. water present, catchment size, geomorphological features, and ecological indicators of sustained flow.	☐yes ☒no	If **Yes to all** , complete Section 2 If **No to any of these, the feature does not constitute a waterway and no further assessment is required for the Fisheries Act.** Implement waterway crossing design and environmental protection measures as required in Environmental Authority and other relevant environmental requirements.	☒ **NO** **(NO LODGEMENT REQUIRED**
	Does the feature have sufficient flow adequacy: The flow needs to be sufficient to sustain basic ecological processes and to maintain biodiversity within the feature. Comment on any ecological indicators present e.g. riparian vegetation, presence/evidence of aquatic life etc.	☐yes ☒no		

Section 2 - Waterway Barrier Works Requirements (Only complete if works are to take place within a waterway)				
Environmental Value	**Checklist**	**Y / N**	**Justification for Placement**	**Field Comments**
a. **Do the works constitute waterway barrier works as defined in FHMOP 008 2009 (Appendix 3)?**	As well as dams and weirs the following are examples of developments that are considered to be waterway barrier works: ▪ Temporary dams, barriers to flow ▪ Culverts ▪ Bed level waterway crossings ▪ Causeways (water crossings slightly above stream bed) ▪ Tidal or floodgates (including maintenance and repair) ▪ Partial bunds (where the development will only partially block a waterway) ▪ Levee banks ▪ Silt curtains ▪ Netting and screens ▪ Litter booms or Trash racks ▪ Riffle structure	☐yes ☐no	If **Yes**, complete Section **2b**. If **No**, implement construction works in accordance with environmental protection measures as requires in Environmental Authority and other relevant environmental requirements. Attach/reference all records and place in Z:\653R_Environmental Complete paperwork and forward to FLUOR Environment Team for review.	

b.
 	
Is the waterway crossing self assessable under WWBW01 for Temporary Waterway Barrier Works
	Do the works involve:
	▪ Waterway barriers that will be in place for less than 42 calendar days
	▪ Waterway barriers that are less than 20m in length across the waterway from bank to bank and;
	▪ 10m or less in width (at the widest point).
	▪ Waterway barriers that are at least 500m distance from any existing natural or artificial waterway barrier (upstream or downstream) unless:
	  ○ the barrier is being constructed in order to perform maintenance or repairs on, or removal of, the existing barrier, or
	  ○ the barrier is being constructed in order to facilitate dewatering between the new and existing barriers, or
	  ○ the barrier is a silt curtain for control of sediment.
	▪ Disturbance to the bed and banks of a waterway less than 5m from the toe of the barrier on either side.
	▪ Construction at the time of the year when the flows are lowest or have completely stopped.
	▪ A waterway barrier where there will be no ponding of water upstream.
		☐yes
		☐no
			If **Yes**, comply with all applicable requirements of WWBW01 in addition to waterway crossing design and environmental protection measures as required in CEMP, Environmental Authority, EIS and other relevant environmental requirements.
			Provide evidence that waterway crossing design satisfies DAFF self assessment codes including reference to design drawings.
			Attach/reference all records and place in Z:\653R_Environmental
			Complete paperwork and forward to FLUOR Environment Team for review.
			If **No**, go to Section **2c**.	

Section 2 - Waterway Barrier Works Requirements (Only complete if works are to take place within a waterway)				
Environmental Value	**Checklist**	**Y / N**	**Justification for Placement**	**Field Comments**
c. **Is the waterway crossing self assessable under WWBW02 for Minor Waterway Barrier Works**	Do the works involve: • New waterway barrier works **at least 100m** from any other permanent waterway barrier works on same waterway. • Construction that is **not** on a bend or rapid section of a waterway. • Construction perpendicular to the water flow (within 10°). • Construction of minor barriers must commence and finish within 60 calendar days. • Construction during times of low flow, base flow or no flow conditions. • And either one of either: • <u>*Part 1, Dams and Weirs*</u> • Construction of a new **dam or weir** or maintenance of existing one on a waterway with a stream order of 1 or 2 • Maximum waterway barrier height is **one metre or less** above the lowest point of the waterway bed • Upstream and downstream disturbance area must not be more than **10 m** in total from the upstream and downstream toe of the barrier. • <u>Or, *Part 3, Culverts*</u> • Construction of a new **culvert** crossing or replacement/ modification or maintenance of existing culvert where the bankfull width of the waterway **is not** greater than 20m. • Construction of **culverts** where the **maximum** upstream/downstream length of the culvert cells is 15m plus apron (3m scour protection for culverts) or less. • The maximum disturbance area outside barrier footprint of 10 m (scour protection is included in the barrier footprint (upstream and/or downstream). • <u>Or, *Part 4, Bed Level Crossings*</u> • Construction of a new **bed level** crossing or replacement/ modification or maintenance of existing **bed level** waterway where the bankfull width of the waterway can be less than or greater than 20m. • **Bed level** crossing footprint is no more than **15 m wide** (upstream/downstream), with a maximum disturbance area outside crossing footprint of **10 m** (**25 m in total**). • Installation of **bed level** crossings **no higher** than natural bed level. • Installation of a **bed level** crossing at the same gradient as the waterway bed gradient.	☐yes ☐no	If **Yes**, comply with all applicable requirements of WWBW02 in addition to waterway crossing design and environmental protection measures as required, Environmental Authority and other relevant environmental requirements. Provide evidence that waterway crossing design satisfies DAFF self assessment codes including reference to design drawings. Attach/reference all records and place in Z:\653R_Environmental Complete paperwork and forward to FLUOR Environment Team for review.	

Part 3 - Water Definition Assessment (Water Act 2000) & Relevant Environmental Authority				
Environmental Value	**Checklist**	**Y / N**	**Justification for Placement**	**Overall Outcome**
Does the feature fit the definition of a ***Drainage Feature*** under the Water Act 2000? ***Drainage feature*** means a natural landscape feature, including a gully, drain, drainage depression or other erosion feature that— (a) is formed by the concentration of, or operates to confine or concentrate, overland flow water during and immediately after rainfall events; and (b) flows for only a short duration after a rainfall event, regardless of the frequency of flow events; and (c) commonly, does not have enough continuing flow to create a Riverine environment Refer to Section 7 of Watercourse Assessment Manual	1. Does the feature carrying water flow only for a short duration after a rainfall event? 2. Does the feature lack the presence of a riverine environment? (i.e flow adequacy to support riverine species). 3. Does the feature lack a defined bed and banks and the presence of in-stream islands, benches or bars	☒yes ☐no ☒yes ☐no ☐yes ☒no	If ***Yes to all*** of these questions then the feature does not constitute a watercourse and no further assessment is required for the Water Act. If ***no to any*** one of these questions then this feature constitutes a watercourse under the Water Act 2000	**Drainage Feature UNDER the *WATER ACT 2000?*** ☐ **YES** **(NO APPROVAL REQUIRED)** Implement environmental protection measures as required in Environmental authority and other relevant environmental requirements. **X** **NO** **Determined a Watercourse – see below** **Watercourse under the *WATER ACT 2000*?** **X** **YES** **(APPROVAL/ LODGEMENT REQUIRED – DETERMINED A WATERCOURSE)** Complete Pre and Post works checklists, and ensure appropriate lodgements are undertaken as per Environmental Authority Requirements. ☐ **NO** **Determined a drainage feature– see Above.**

Part 4 - Water Act Requirements (only complete if works are to take place within or adjacent to the watercourse – refer to Section 2 (Water Act) outcomes)				
Environmental Value	**Checklist**	**Y / N**	**Justification for Placement**	**Comments**
Do the works require approval under the Water Act? (Refer to summary flowchart within Section 9 of watercourse manual)	Do the works involve: • Excavation or placing fill in a way that would interfere with the flow of water in a watercourse, lake or spring by impounding or redirecting the flow of water (referring to completed product, following construction works).	☐yes ☒no	If **Yes**, go to Part **5**, works may require a Riverine Protection Permit under the Water Act. Provide evidence that waterway crossing design satisfies DEHP Guidelines (next section) including reference to design drawings. Attach/reference all records and store in relevant Environmental Drive. Complete paperwork and forward to FLUOR Environment Team for review. If No, adhere to EA requirements!	Construct during dry season

Part 5 – DNRM Assessment Requirements (Guideline – activities in a watercourse, lake or spring associated with mining operations) (refer to Section 1 (Water Act) outcomes)			
What type (if any) vegetation will be required to be removed and quantity (area). (no more than 0.25ha), how will the vegetation be removed?	☒yes ☐no	List all species required for removal. Ensure FLUOR/SANTOS vegetation management plan and EA conditions are followed (indicate the requirements for this crossing).	< 0.25 ha Shrubs, grasses
Can the water crossing be located in a previously disturbed area?	☒yes ☐no	If No, why not?	Non remnant
Is the water course from groundwater origin?	☐yes ☒no	Determine upstream water sources	

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Section 6 – Overall Assessment Outcome			
Has the stream order been assessed a watercourse (Water Act)	☒yes ☐no	If Yes, must comply with the "Guideline – activities in a watercourse, lake or spring associated with mining operations" – Ensure all of this checklist is completed and conveyed to all relevant staff, contractors are to ensure compliance with EA conditions – ensure lodgement of PREWORKS TO DEHP 10 Business prior	X **YES** **(APPROVAL REQUIRED)** ☐ **NO** **(NO LODGEMENT REQUIRED, ASSESSED AS DRAINAGE FEATURE)**
Has the stream order been assessed as a waterway (*Fisheries Act*)	☐yes ☒no	If **Yes** complete check boxes below If **No** – no further assessment required	☐ **YES** **(APPROVAL REQUIRED)** X **NO** **(NO LODGEMENT REQUIRED)**
Is a development approval required (i.e. the self assessable code can not be adhered to)?	☐yes ☒no	If **Yes** Contact FLUOR Environment Team.	
Was the crossing assessed as a 'minor waterway barrier'?, either:		If **Yes** complete the relevant 'Minor Waterway Barrier Works Self-Assessment Sheet' lodge to FLUOR Environment Team.	
Part 1 – Dams and Weirs	☐yes ☐no		
Part 3 – Culverts	☐yes ☐no		
Part 4 – Bed Level Crossings	☐yes ☐no		
Was the crossing assessed as a 'temporary waterway barrier'?	☐yes ☐no	If **Yes** complete a Temporary Waterway Barrier Works Self-Assessment Sheet lodge to FLUOR Environmental Team for review.	
Were any EVNT species listed under the EPBC Act and/or NC Act present within the riparian zone of the waterway crossing	☐yes ☒no	If Yes GPS the position of individuals/populations, flag on site and contact FLUOR Environmental Team for review. If No – no further assessment required	
Were any vegetation mapping discrepancies identified within the riparian zone of the waterway crossing	☐yes ☒no	If Yes undertake a quaternary level RE assessment and GPS the extent of the mapped community assemblage where applicable. Contact FLUOR Environment Team for review. If No – no further assessment required	Non-remnant

WORKS WITHIN A WATERCOURSE ASSESSMENT- FIELD ASSESSMENT PHOTOS

WC01 (710215, 7076501)

Looking upstream

Looking downstream

Left bank looking downstream

WORKS WITHIN A WATERCOURSE ASSESSMENT

This watercourse assessment is to be filled out for all watercourse crossings to ensure compliance with environmental requirements and to ensure appropriate approvals are obtained.

FIELD ASSESSMENT

Inspected by:	R. Feeney	GHD	**Inspected Date:**	19/07/2014
Company:			**Time:**	11am

Crossing Name:	WC02	**CWP Number**	M4
Watercourse ID	WWBC- 02	**Crossing Type (E.g. pipeline/road)**	Pipeline
Lot/Plan:	58WV421	**Location Reference**	Mt Hope
Site	R-HCS-02 ☒ F-HCS-04 ☐ F-HCS-05 ☐ other/area:		
Land Tenure:	Freehold / Leasehold / other :	**Petroleum Tenure**	
Crossing Disturbance Status:	Existing crossing with no upgrade required: ☐ Existing crossing with upgrade required: ☐ New crossing in previously disturbed area: ☒ New crossing in undisturbed area: ☐		
Land Access Approval to undertake assessment:	Yes ☒ No ☐	**Approval No:**	SPR 1885
Cultural Heritage Approval to undertake assessment:	Yes ☒ No ☐	**Approval No:**	
Anticipated commencement date:		**Can the crossing be installed within 10 days?** If No, development approval and other approvals may be required.	Yes ☒ No ☐

HEALTH AND SAFETY		
Have you completed a Safety Task Assessment (STA)?	Yes ☒ No ☐	If No, cease inspection and complete.
Do you have appropriate PPE for the task?	Yes ☒ No ☐	
Do you have adequate amount of water – at least 10 litres?	Yes ☒ No ☐	

GENERAL ENVIRONMENTAL CONDITIONS	
Temp: Cold (<5◦C) ☐ Cool (<15◦C) ☐ Mild (<25◦C) ☒ Warm (<35◦C) ☐ Hot (>35◦C) ☐	Weather now: Clear/Fine ☒ Scattered Clouds ☐ Cloudy ☐
	Past 24 hrs: Clear/Fine ☒ Scattered Clouds ☐ Cloudy ☐
Wind: Still ☐ Slight breeze ☐ Windy ☒ Strong Wind ☐	Air now: Dry ☒ Humid ☐ Rain (Steady) ☐ Rain (Heavy) ☐
	Air past 24hrs: Dry ☒ Humid ☐ Rain (Steady) ☐ Rain (Heavy) ☐

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CROSSING LOCATION (REFER SECTION 8.2)

GPS Coordinates - Latitude/Longitude (E – 6 Figs, N – 7 Figs) GDA94

Latitude (E)	0710265	**Longitude (S)**	7076741
Bankfull Width (m)	10 m	**Bank Width (m):**	Left Bank: 3 m Right Bank: 3 m
Stream Width at Water Surface (m):	0 m	**Baseflow Stream Width (m):**	4 m
Bank Height: Baseflow and water surface height difference:	Downstream left Bank: 0 m/ 1.5 m Downstream Right Bank 0 m/ 1.5 m	**Photographs of site** Provide photos looking upstream and downstream from crossing location, as well as relevant to watercourse / waterway determination. Label photos.	

Location	Latitude (E)	Longitude (S)
A		
B		
C		
D		
E		

Water Present:	Yes ☐ No ☒
Water Type:	Flowing ☐ Pool(s) present ☐ Dry ☒
Sample Site Length:	Water Surface Depth to Bed:

CHANNEL DETERMINATION (REFER TO SECTION 8.3)

Stream Order: 1☐ 2☒ 3☐ 4☐ 4+☐		Functional Zone Type - Sediment	Supply☐ Transfer☐ Storage☒
Identify Channel Type:		Irregular	
Channel Modifications:		Natural	
Bed Sediment Character:		Tight ☐ Packed ☐ Moderate ☐ Low 1 ☐ Low 2 ☒	
Bank Sediments Composition:		Bedrock % Boulder % Cobble % Pebble % Gravel % Sand Fines 100 %	
Bed Material Angularity:		Very Angular☐ Angular ☐ Sub-angular ☐ Rounded ☐Well-rounded ☐ Cobble peddle and gravel fractions not present ☒	
Bank Predominant Shape:		Concave ☒ Convex ☐ Stepped ☐ Wide lower bench ☐ Undercut ☐	
Bank Slope Downstream Right:		Vertical 80-90° ☐ Steep 60-80° ☒ Moderate 30-60° ☐ Low 10-30° ☐ Flat<10°☐	
Bank Slope Downstream Left:		Vertical 80-90° ☐ Steep 60-80° ☐ Moderate 30-60° ☒ Low 10-30° ☐ Flat<10°☐	
Channel Shape:		U Shape	
Bed Stability:		Severe Erosion ☐ Moderate Erosion ☐ Bed Stable ☐ Moderate Deposition ☒ Severe Deposition ☐	
Potential Fish Habitat Class:		Class1 ☐ Class2 ☐ Class3 ☐ Class4 ☒	
Fish Migratory Passage Potential:		Nil ☒ Very Restricted ☐ Moderately Restricted ☐ Partly Restricted ☐ Good Passage ☐ Unrestricted Passage ☐	

FLORA/FAUNA ASSESSMENT (REFER TO SECTION 8.4)

Does any vegetation need to be removed?	Yes ☒ No ☐	**If Yes, no more than 0.25 Ha can be removed Estimate how much needs to be removed**
Vegetation community description		
Has an Aquatic and Ecological Assessment been undertaken previously that encompasses the watercourse crossing point (both for flora and fauna characteristics).	Yes ☐ No ☐	If yes, reference Report No:

Has a pre-disturbance assessment been undertaken previously that encompasses the watercourse crossing point (both for flora and fauna characteristics).	Yes ☒ No ☐	If no, a pre-disturbance assessment may be required
Does the riparian zone at the watercourse fall within a mapped extent of a Regional Ecosystem and/ or TEC? (refer to Dekho maps)	Yes ☐ No ☒	If Yes, detail mapped RE code (biodiversity status) and TEC where applicable:
Does the riparian zone at the watercourse fall within any Category A, B or C Environmentally Sensitive Areas (ESAs) and/or their primary or secondary primary protection (buffer) zones (refer to Dekho maps)	Yes ☐ No ☒	If Yes, detail ESA category:
If present, is the mapped RE/TEC community consistent with the vegetation community observed on the ground	Yes ☐ No ☐	If no, Check whether discrepancies have already been recorded in previous reports and GIS layers updated. If not a pre-disturbance assessment or quaternary level assessment may be required
Does the proposed development activity comply with the clearing/significant disturbance restrictions of the applicable EA (refer Table 3)	Yes ☒ No ☐	If, no then flag with FLUOR Environment Team for review.
Are there any Cultural Heritage sites located within the crossing location or nearby area (refer to Dekho maps)	Yes ☐ No ☒	If Yes, detail site:
General Vegetation Community description: (including a list of dominant flora species within each stratum)	**Regrowth riparian vegetation of E. populnea, E. teriticornis and E. chloroclada, shrub layer including C. glucophylla and heavily grazed ground layer**	

Are there any declared weeds within the area of the crossing?	Yes☐ No ☒	If yes, describe flag on the ground and GPS and provide on map. Opuntia spp. in broader area
Are there any conservation significant species (i.e ENVT or Type A flora) within the area of the crossing?	Yes☐ No ☒	
Riparian vegetation cover: Trees > 10 m: Trees < 10 m: Shrubs: Grasses, herbs and sedges:	1 % 20 % 5 % 40 %	
Riparian vegetation patchiness:	Semi-continuous	
Describe the riparian vegetation condition:	2	

Native woody vegetation regeneration:	Abundant ☐	Present ☒	Limited ☐

SAFETY CONSIDERATIONS		
Are there any safety implications at the proposed crossing due to decreased Right of Way from Environmental Sensitive Areas or other constraints like	Yes ☐ No ☒	**If Yes, Note concerns**

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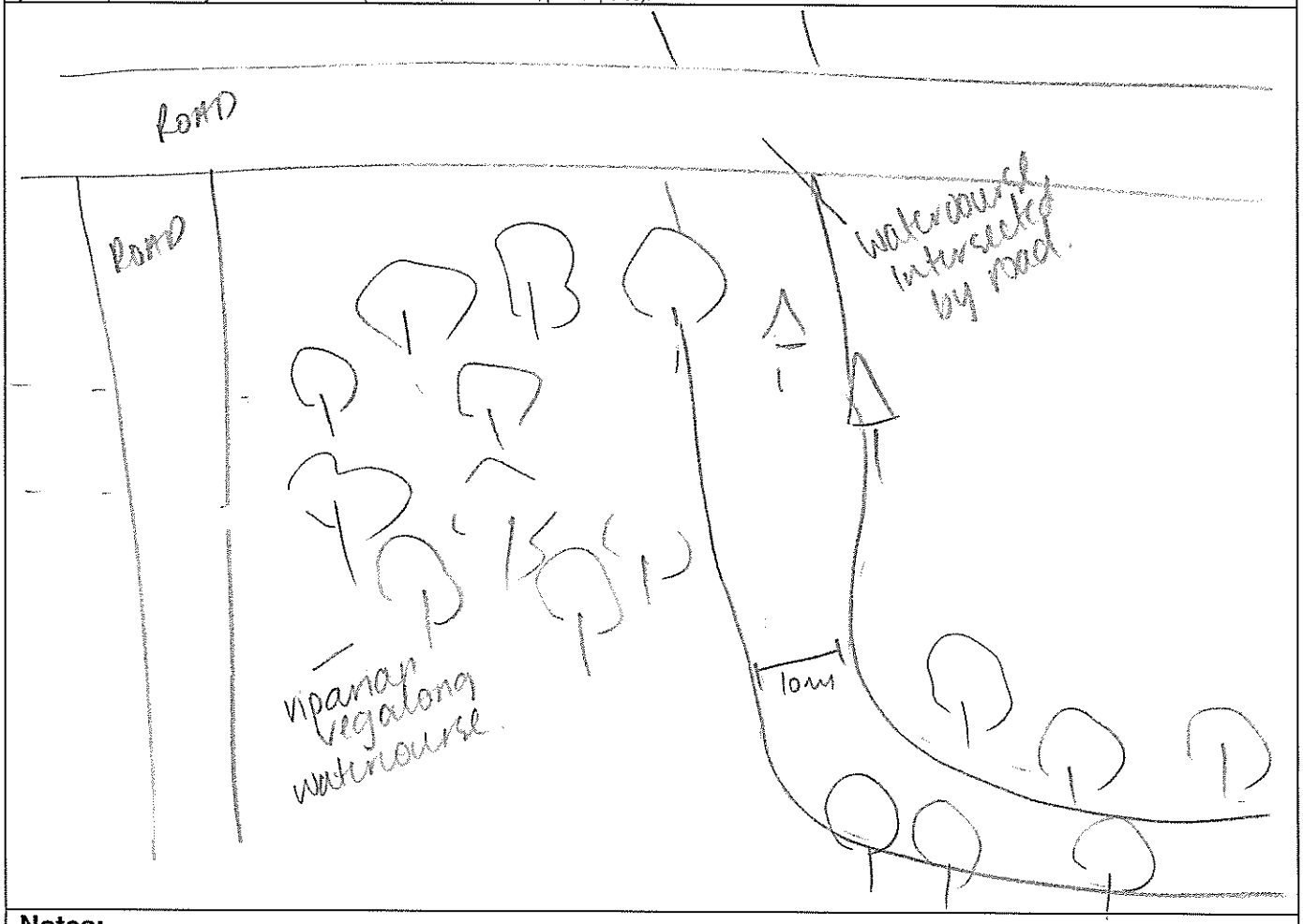
SKETCH OF CROSSING (BIRDS EYE VIEW) (REFER SECTION 8.5)

Sketch birds eye view (i.e. view looking from above), depict how the stream curves, any vegetation, trees, areas of significance (cultural significance if known). Complete approx 10 times the Bankfull Width upstream and downstream of crossing site. Take photographs upstream and downstream (write photo locations on your sketch). Include any names of features (i.e. roads, farm house, power poles).



Notes:

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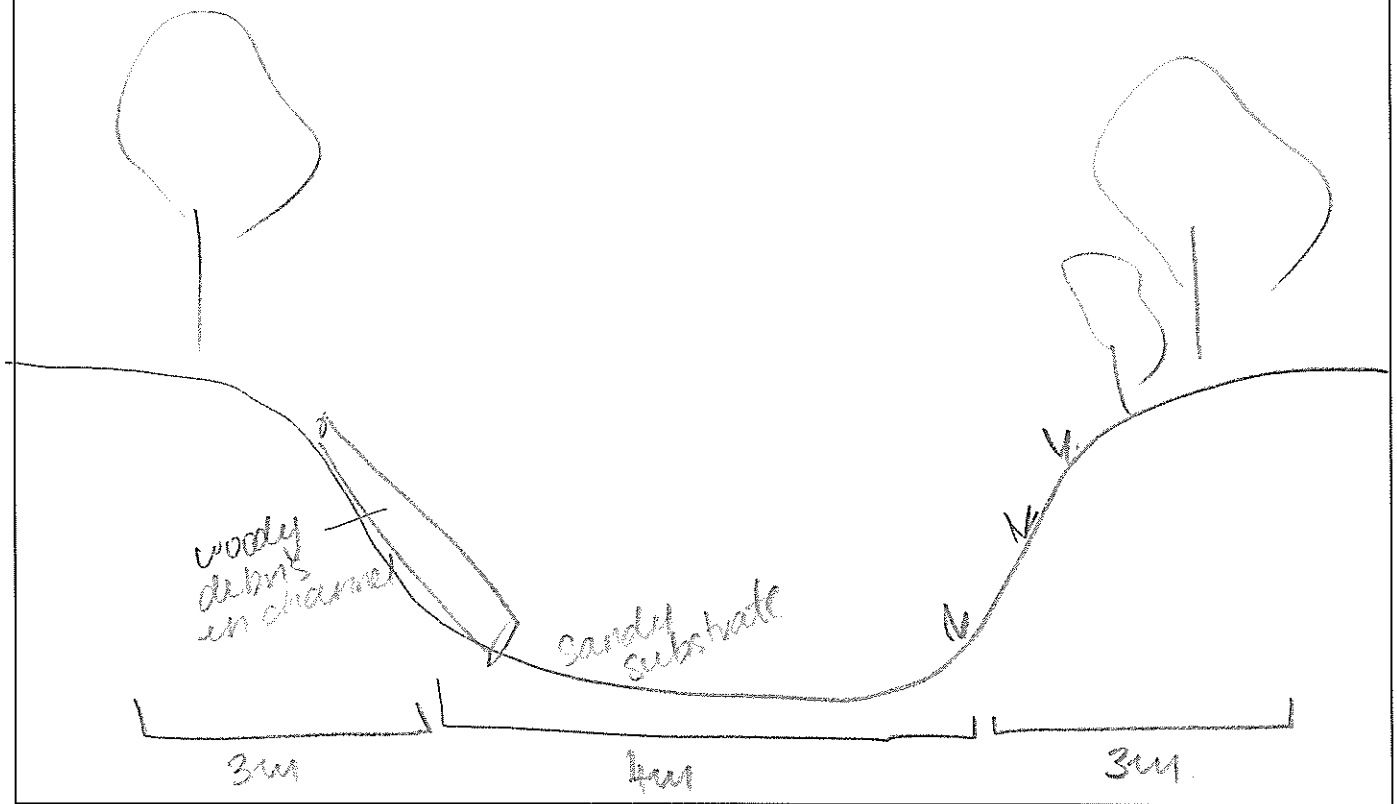
SKETCH OF CROSSING (CROSS-SECTIONAL VIEW, REFER SECTION 8.5)



Notes:

ASSESSMENT OUTCOME

LEGISLATIVE REQUIREMENTS DETERMINATION				
Part 1 - Waterway Definition Assessment (*Fisheries Act 1994*)				
Environmental Value	**Checklist**	**Y / N**	**Justification for Placement**	**Field Comments**
Does the feature satisfy the waterway definition requirements of FHMOP 008 2009 (refer section 7.3.2) under the *Fisheries Act 1994*? Refer to Section 7 of Watercourse Assessment Manual	Does the feature have a defined bed and banks: The bed and banks need to be continuous rather than isolated and broken sections of a depression.	☒yes ☐no	If **Yes to all** , complete Section 2 If **No to any of these, the feature does not constitute a waterway and no further assessment is required for the Fisheries Act.** Implement waterway crossing design and environmental protection measures as required in Environmental Authority and other relevant environmental requirements.	**WATERWAY UNDER *FISHERIES ACT 1994?*** ☐ **YES** **(APPROVAL/ LODGEMENT REQUIRED)**
	Does the feature have an extended, if non-permanent, period of flow: Flow must continue for a reasonable period after rain ceases and have some reliability commensurate with rainfall? Flow for several weeks after rainfall ceases does not constitute extended flow. Consider e.g. water present, catchment size, geomorphological features, and ecological indicators of sustained flow.	☐yes ☒no	If **Yes to all** , complete Section 2 If **No to any of these, the feature does not constitute a waterway and no further assessment is required for the Fisheries Act.** Implement waterway crossing design and environmental protection measures as required in Environmental Authority and other relevant environmental requirements.	☒ **NO** **(NO LODGEMENT REQUIRED**
	Does the feature have sufficient flow adequacy: The flow needs to be sufficient to sustain basic ecological processes and to maintain biodiversity within the feature. Comment on any ecological indicators present e.g. riparian vegetation, presence/evidence of aquatic life etc.	☐yes ☒no		

Section 2 - Waterway Barrier Works Requirements (Only complete if works are to take place within a waterway)				
Environmental Value	**Checklist**	**Y / N**	**Justification for Placement**	**Field Comments**
a. **Do the works constitute waterway barrier works as defined in FHMOP 008 2009 (Appendix 3)?**	As well as dams and weirs the following are examples of developments that are considered to be waterway barrier works: ▪ Temporary dams, barriers to flow ▪ Culverts ▪ Bed level waterway crossings ▪ Causeways (water crossings slightly above stream bed) ▪ Tidal or floodgates (including maintenance and repair) ▪ Partial bunds (where the development will only partially block a waterway) ▪ Levee banks ▪ Silt curtains ▪ Netting and screens ▪ Litter booms or Trash racks ▪ Riffle structure	☐yes ☐no	If **Yes**, complete Section **2b**. If **No**, implement construction works in accordance with environmental protection measures as requires in Environmental Authority and other relevant environmental requirements. Attach/reference all records and place in Z:\653R_Environmental Complete paperwork and forward to FLUOR Environment Team for review.	

b.
 	
Is the waterway crossing self assessable under WWBW01 for Temporary Waterway Barrier Works
	Do the works involve:
	▪ Waterway barriers that will be in place for less than 42 calendar days
	▪ Waterway barriers that are less than 20m in length across the waterway from bank to bank and;
	▪ 10m or less in width (at the widest point).
	▪ Waterway barriers that are at least 500m distance from any existing natural or artificial waterway barrier (upstream or downstream) unless:
	  ○ the barrier is being constructed in order to perform maintenance or repairs on, or removal of, the existing barrier, or
	  ○ the barrier is being constructed in order to facilitate dewatering between the new and existing barriers, or
	  ○ the barrier is a silt curtain for control of sediment.
	▪ Disturbance to the bed and banks of a waterway less than 5m from the toe of the barrier on either side.
	▪ Construction at the time of the year when the flows are lowest or have completely stopped.
	▪ A waterway barrier where there will be no ponding of water upstream.
		☐yes
		☐no
			If **Yes**, comply with all applicable requirements of WWBW01 in addition to waterway crossing design and environmental protection measures as required in CEMP, Environmental Authority, EIS and other relevant environmental requirements.
			Provide evidence that waterway crossing design satisfies DAFF self assessment codes including reference to design drawings.
			Attach/reference all records and place in Z:\653R_Environmental
			Complete paperwork and forward to FLUOR Environment Team for review.
			If **No**, go to Section **2c**.	

Section 2 - Waterway Barrier Works Requirements (Only complete if works are to take place within a waterway)				
Environmental Value	**Checklist**	**Y / N**	**Justification for Placement**	**Field Comments**
c. **Is the waterway crossing self assessable under WWBW02 for Minor Waterway Barrier Works**	Do the works involve: • New waterway barrier works **at least 100m** from any other permanent waterway barrier works on same waterway. • Construction that is **not** on a bend or rapid section of a waterway. • Construction perpendicular to the water flow (within 10°). • Construction of minor barriers must commence and finish within 60 calendar days. • Construction during times of low flow, base flow or no flow conditions. • And either one of either: • <u>*Part 1, Dams and Weirs*</u> • Construction of a new **dam or weir** or maintenance of existing one on a waterway with a stream order of 1 or 2 • Maximum waterway barrier height is **one metre or less** above the lowest point of the waterway bed • Upstream and downstream disturbance area must not be more than **10 m** in total from the upstream and downstream toe of the barrier. • <u>Or, *Part 3, Culverts*</u> • Construction of a new **culvert** crossing or replacement/ modification or maintenance of existing culvert where the bankfull width of the waterway **is not** greater than 20m. • Construction of **culverts** where the **maximum** upstream/downstream length of the culvert cells is 15m plus apron (3m scour protection for culverts) or less. • The maximum disturbance area outside barrier footprint of 10 m (scour protection is included in the barrier footprint (upstream and/or downstream). • <u>Or, *Part 4, Bed Level Crossings*</u> • Construction of a new **bed level** crossing or replacement/ modification or maintenance of existing **bed level** waterway where the bankfull width of the waterway can be less than or greater than 20m. • **Bed level** crossing footprint is no more than **15 m wide** (upstream/downstream), with a maximum disturbance area outside crossing footprint of **10 m** (**25 m in total**). • Installation of **bed level** crossings **no higher** than natural bed level. • Installation of a **bed level** crossing at the same gradient as the waterway bed gradient.	☐yes ☐no	If **Yes**, comply with all applicable requirements of WWBW02 in addition to waterway crossing design and environmental protection measures as required, Environmental Authority and other relevant environmental requirements. Provide evidence that waterway crossing design satisfies DAFF self assessment codes including reference to design drawings. Attach/reference all records and place in Z:\653R_Environmental Complete paperwork and forward to FLUOR Environment Team for review.	

Part 3 - Water Definition Assessment (Water Act 2000) & Relevant Environmental Authority				
Environmental Value	**Checklist**	**Y / N**	**Justification for Placement**	**Overall Outcome**
Does the feature fit the definition of a ***Drainage Feature*** under the Water Act 2000? ***Drainage feature*** means a natural landscape feature, including a gully, drain, drainage depression or other erosion feature that— (a) is formed by the concentration of, or operates to confine or concentrate, overland flow water during and immediately after rainfall events; and (b) flows for only a short duration after a rainfall event, regardless of the frequency of flow events; and (c) commonly, does not have enough continuing flow to create a Riverine environment Refer to Section 7 of Watercourse Assessment Manual	1. Does the feature carrying water flow only for a short duration after a rainfall event? 2. Does the feature lack the presence of a riverine environment? (i.e flow adequacy to support riverine species). 3. Does the feature lack a defined bed and banks and the presence of in-stream islands, benches or bars	☒yes ☐no ☒yes ☐no ☐yes ☒no	If ***Yes to all*** of these questions then the feature does not constitute a watercourse and no further assessment is required for the Water Act. If ***no to any*** one of these questions then this feature constitutes a watercourse under the Water Act 2000	**Drainage Feature UNDER the *WATER ACT 2000?*** ☐ **YES** **(NO APPROVAL REQUIRED)** Implement environmental protection measures as required in Environmental authority and other relevant environmental requirements. ☒ **NO** **Determined a Watercourse – see below** **Watercourse under the *WATER ACT 2000*?** ☒ **YES** **(APPROVAL/ LODGEMENT REQUIRED – DETERMINED A WATERCOURSE)** Complete Pre and Post works checklists, and ensure appropriate lodgements are undertaken as per Environmental Authority Requirements. ☐ **NO** **Determined a drainage feature– see Above.**

Part 4 - Water Act Requirements (only complete if works are to take place within or adjacent to the watercourse – refer to Section 2 (Water Act) outcomes)				
Environmental Value	**Checklist**	**Y / N**	**Justification for Placement**	**Comments**
Do the works require approval under the Water Act? (Refer to summary flowchart within Section 9 of watercourse manual)	Do the works involve: • Excavation or placing fill in a way that would interfere with the flow of water in a watercourse, lake or spring by impounding or redirecting the flow of water (referring to completed product, following construction works).	☐yes ☒no	If **Yes**, go to Part **5**, works may require a Riverine Protection Permit under the Water Act. Provide evidence that waterway crossing design satisfies DEHP Guidelines (next section) including reference to design drawings. Attach/reference all records and store in relevant Environmental Drive. Complete paperwork and forward to FLUOR Environment Team for review. If No, adhere to EA requirements!	Construct during dry season

Part 5 – DNRM Assessment Requirements (Guideline – activities in a watercourse, lake or spring associated with mining operations) (refer to Section 1 (Water Act) outcomes)			
What type (if any) vegetation will be required to be removed and quantity (area). (no more than 0.25ha), how will the vegetation be removed?	☒yes ☐no	List all species required for removal. Ensure FLUOR/SANTOS vegetation management plan and EA conditions are followed (indicate the requirements for this crossing).	Ground cover, shrubs, eucalypts
Can the water crossing be located in a previously disturbed area?	☒yes ☐no	If No, why not?	Non remnant vegetation
Is the water course from groundwater origin?	☐yes ☒no	Determine upstream water sources	

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Section 6 – Overall Assessment Outcome			
Has the stream order been assessed a watercourse (Water Act)	☒yes ☐no	If Yes, must comply with the "Guideline – activities in a watercourse, lake or spring associated with mining operations" – Ensure all of this checklist is completed and conveyed to all relevant staff, contractors are to ensure compliance with EA conditions – ensure lodgement of PREWORKS TO DEHP 10 Business prior	X **YES** **(APPROVAL REQUIRED)** ☐ **NO** **(NO LODGEMENT REQUIRED, ASSESSED AS DRAINAGE FEATURE)**
Has the stream order been assessed as a waterway (*Fisheries Act*)	☐yes ☒no	If **Yes** complete check boxes below If **No** – no further assessment required	☐ **YES** **(APPROVAL REQUIRED)** X **NO** **(NO LODGEMENT REQUIRED)**
Is a development approval required (i.e. the self assessable code can not be adhered to)?	☐yes ☒no	If **Yes** Contact FLUOR Environment Team.	
Was the crossing assessed as a 'minor waterway barrier'?, either:		If **Yes** complete the relevant 'Minor Waterway Barrier Works Self-Assessment Sheet' lodge to FLUOR Environment Team.	
Part 1 – Dams and Weirs	☐yes ☒no		
Part 3 – Culverts	☐yes ☒no		
Part 4 – Bed Level Crossings	☐yes ☒no		
Was the crossing assessed as a 'temporary waterway barrier'?	☐yes ☒no	If **Yes** complete a Temporary Waterway Barrier Works Self-Assessment Sheet lodge to FLUOR Environmental Team for review.	
Were any EVNT species listed under the EPBC Act and/or NC Act present within the riparian zone of the waterway crossing	☐yes ☒no	If Yes GPS the position of individuals/populations, flag on site and contact FLUOR Environmental Team for review. If No – no further assessment required	
Were any vegetation mapping discrepancies identified within the riparian zone of the waterway crossing	☐yes ☒no	If Yes undertake a quaternary level RE assessment and GPS the extent of the mapped community assemblage where applicable. Contact FLUOR Environment Team for review. If No – no further assessment required	

WORKS WITHIN A WATERCOURSE ASSESSMENT- FIELD ASSESSMENT PHOTOS

WC02 (710265, 7076741)

Looking upstream

Looking downstream

Looking across channel

WORKS WITHIN A WATERCOURSE ASSESSMENT

This watercourse assessment is to be filled out for all watercourse crossings to ensure compliance with environmental requirements and to ensure appropriate approvals are obtained.

FIELD ASSESSMENT

Inspected by:	R. Feeney	GHD	**Inspected Date:**	16/07/2014
Company:			**Time:**	3 pm

Crossing Name:	WC03	**CWP Number**	M4
Watercourse ID	WWBC- 03	**Crossing Type (E.g. pipeline/road)**	Pipeline
Lot/Plan:	58WV421	**Location Reference**	Mt Hope
Site	R-HCS-02 ☒ F-HCS-04 ☐ F-HCS-05 ☐ other/area:		
Land Tenure:	Freehold / Leasehold / other :	**Petroleum Tenure**	
Crossing Disturbance Status:	Existing crossing with no upgrade required: ☐ Existing crossing with upgrade required: ☐ New crossing in previously disturbed area: ☒ New crossing in undisturbed area: ☐		
Land Access Approval to undertake assessment:	Yes ☒ No ☐	**Approval No:**	SPR 1885
Cultural Heritage Approval to undertake assessment:	Yes ☒ No ☐	**Approval No:**	
Anticipated commencement date:		**Can the crossing be installed within 10 days?** If No, development approval and other approvals may be required.	Yes ☒ No ☐

HEALTH AND SAFETY		
Have you completed a Safety Task Assessment (STA)?	Yes ☒ No ☐	If No, cease inspection and complete.
Do you have appropriate PPE for the task?	Yes ☒ No ☐	
Do you have adequate amount of water – at least 10 litres?	Yes ☒ No ☐	

GENERAL ENVIRONMENTAL CONDITIONS	
Temp: Cold (<5◦C) ☐ Cool (<15◦C) ☐ Mild (<25◦C) ☒ Warm (<35◦C) ☐ Hot (>35◦C) ☐	Weather now: Clear/Fine ☐ Scattered Clouds ☒ Cloudy ☐
	Past 24 hrs: Clear/Fine ☐ Scattered Clouds ☒ Cloudy ☐
Wind: Still ☐ Slight breeze ☒ Windy ☐ Strong Wind ☐	Air now: Dry ☒ Humid ☐ Rain (Steady)☐ Rain (Heavy) ☐
	Air past 24hrs: Dry ☒ Humid ☐ Rain (Steady)☐ Rain (Heavy) ☐

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CROSSING LOCATION (REFER SECTION 8.2)

GPS Coordinates - Latitude/Longitude (E – 6 Figs, N – 7 Figs) GDA94

Latitude (E)	711673	**Longitude (S)**	7076348
Bankfull Width (m)	19 m	**Bank Width (m):**	Left Bank: 5 m Right Bank: 4 m
Stream Width at Water Surface (m):	0 m	**Baseflow Stream Width (m):**	10 m
Bank Height: Baseflow and water surface height difference:	Downstream left Bank: 0.5 m/ 0 m Downstream Right Bank 0.5m/ 0 m	**Photographs of site** Provide photos looking upstream and downstream from crossing location, as well as relevant to watercourse / waterway determination. Label photos.	

Location	Latitude (E)	Longitude (S)
A		
B		
C		
D		
E		

Water Present:	Yes ☐ No ☒
Water Type:	Flowing ☐ Pool(s) present ☐ Dry ☒
Sample Site Length:	Water Surface Depth to Bed:

CHANNEL DETERMINATION (REFER TO SECTION 8.3)

Stream Order: 1☐ 2☐ 3☐ 4☐ 4+☐		Functional Zone Type - Sediment	Supply☐ Transfer☐ Storage☐
Identify Channel Type:	Mildly sinuous		
Channel Modifications:	None		
Bed Sediment Character:	Tight ☐ Packed ☐ Moderate ☐ Low 1 ☐ Low 2 ☒		
Bank Sediments Composition:	Bedrock % Boulder % Cobble % Pebble % Gravel % Sand Fines 100 %		
Bed Material Angularity:	Very Angular☐ Angular ☐ Sub-angular ☐ Rounded ☐Well-rounded ☐ Cobble peddle and gravel fractions not present ☒		
Bank Predominant Shape:	Concave ☒ Convex ☐ Stepped ☐ Wide lower bench ☐ Undercut ☐		
Bank Slope Downstream Right:	Vertical 80-90° ☐ Steep 60-80° ☐ Moderate 30-60° ☐ Low 10-30° ☒ Flat<10°☐		
Bank Slope Downstream Left:	Vertical 80-90° ☐ Steep 60-80° ☐ Moderate 30-60° ☐ Low 10-30° ☒ Flat<10°☐		
Channel Shape:	Flat Concave		
Bed Stability:	Severe Erosion ☐ Moderate Erosion ☐ Bed Stable ☐ Moderate Deposition ☐ Severe Deposition ☒		
Potential Fish Habitat Class:	Class1 ☐ Class2 ☐ Class3 ☐ Class4 ☒		
Fish Migratory Passage Potential:	Nil ☒ Very Restricted ☐ Moderately Restricted ☐ Partly Restricted ☐ Good Passage ☐ Unrestricted Passage ☐		

FLORA/FAUNA ASSESSMENT (REFER TO SECTION 8.4)

Does any vegetation need to be removed?	Yes ☒ No ☐	**If Yes, no more than 0.25 Ha can be removed Estimate how much needs to be removed** **< 0.25 ha**
Vegetation community description		
Has an Aquatic and Ecological Assessment been undertaken previously that encompasses the watercourse crossing point (both for flora and fauna characteristics).	Yes ☐ No ☐	If yes, reference Report No:

Has a pre-disturbance assessment been undertaken previously that encompasses the watercourse crossing point (both for flora and fauna characteristics).	Yes ☒ No ☐	If no, a pre-disturbance assessment may be required
Does the riparian zone at the watercourse fall within a mapped extent of a Regional Ecosystem and/ or TEC? (refer to Dekho maps)	Yes ☐ No ☒	If Yes, detail mapped RE code (biodiversity status) and TEC where applicable:
Does the riparian zone at the watercourse fall within any Category A, B or C Environmentally Sensitive Areas (ESAs) and/or their primary or secondary primary protection (buffer) zones (refer to Dekho maps)	Yes ☐ No ☒	If Yes, detail ESA category:
If present, is the mapped RE/TEC community consistent with the vegetation community observed on the ground	Yes ☐ No ☐	If no, Check whether discrepancies have already been recorded in previous reports and GIS layers updated. If not a pre-disturbance assessment or quaternary level assessment may be required
Does the proposed development activity comply with the clearing/significant disturbance restrictions of the applicable EA (refer Table 3)	Yes ☒ No ☐	If, no then flag with FLUOR Environment Team for review.
Are there any Cultural Heritage sites located within the crossing location or nearby area (refer to Dekho maps)	Yes ☐ No ☒	If Yes, detail site:
General Vegetation Community description: (including a list of dominant flora species within each stratum)	**Non remnant with scattered mature eucalypts, moderate shrub layer of E. populnea and ground layer of grasses and sedges**	

Are there any declared weeds within the area of the crossing?	Yes☐ No ☒	If yes, describe flag on the ground and GPS and provide on map. Opuntia spp. in general area
Are there any conservation significant species (i.e ENVT or Type A flora) within the area of the crossing?	Yes☐ No ☒	
Riparian vegetation cover: Trees > 10 m: Trees < 10 m: Shrubs: Grasses, herbs and sedges:	0 % 1 % 10% 80 %	
Riparian vegetation patchiness:	isolated	
Describe the riparian vegetation condition:	2	

Native woody vegetation regeneration:	Abundant ☒	Present ☐	Limited ☐

SAFETY CONSIDERATIONS		
Are there any safety implications at the proposed crossing due to decreased Right of Way from Environmental Sensitive Areas or other constraints like topography?	Yes ☐ No ☒	**If Yes, Note concerns**

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SKETCH OF CROSSING (BIRDS EYE VIEW) (REFER SECTION 8.5)

Sketch birds eye view (i.e. view looking from above), depict how the stream curves, any vegetation, trees, areas of significance (cultural significance if known). Complete approx 10 times the Bankfull Width upstream and downstream of crossing site. Take photographs upstream and downstream (write photo locations on your sketch). Include any names of features (i.e. roads, farm house, power poles).

Notes:

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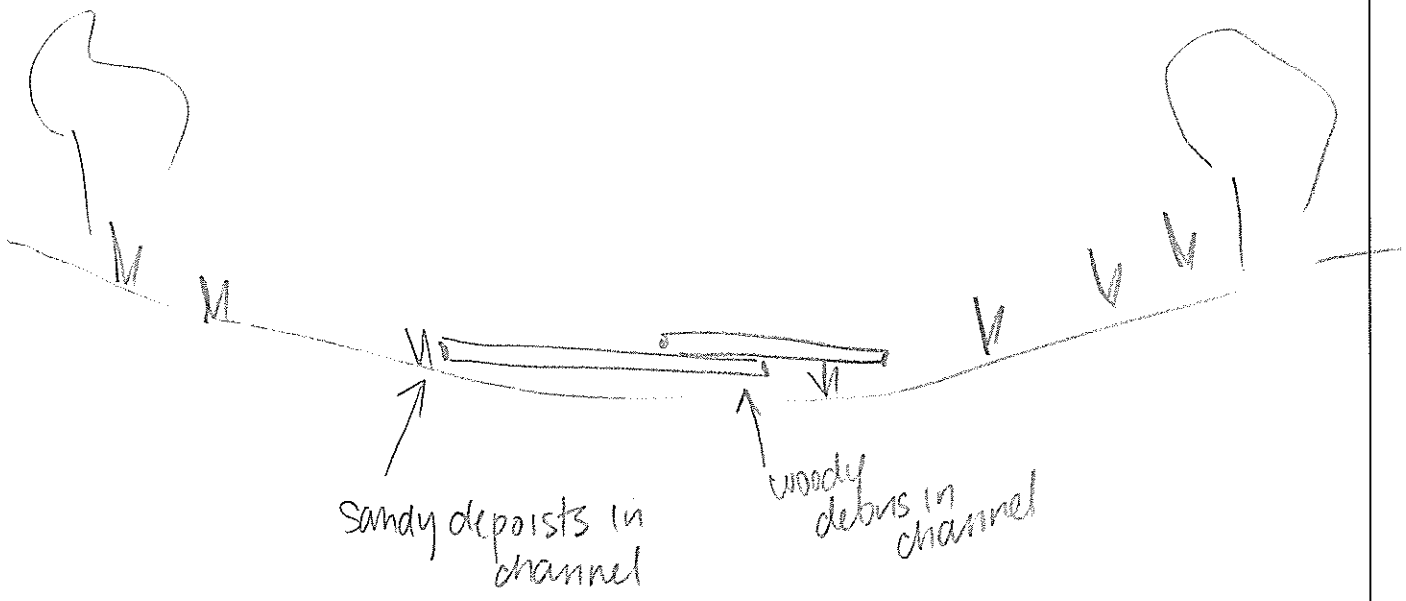
SKETCH OF CROSSING (CROSS-SECTIONAL VIEW, REFER SECTION 8.5)



Notes: poorly defined bed and banks

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ASSESSMENT OUTCOME

LEGISLATIVE REQUIREMENTS DETERMINATION				
Part 1 - Waterway Definition Assessment (*Fisheries Act 1994*)				
Environmental Value	**Checklist**	**Y / N**	**Justification for Placement**	**Field Comments**
Does the feature satisfy the waterway definition requirements of FHMOP 008 2009 (refer section 7.3.2) under the *Fisheries Act 1994*? Refer to Section 7 of Watercourse Assessment Manual	Does the feature have a defined bed and banks: The bed and banks need to be continuous rather than isolated and broken sections of a depression.	☐yes ☒no	If **Yes to all** , complete Section 2 If **No to any of these, the feature does not constitute a waterway and no further assessment is required for the Fisheries Act.** Implement waterway crossing design and environmental protection measures as required in Environmental Authority and other relevant environmental requirements.	**WATERWAY UNDER *FISHERIES ACT 1994?*** ☐ **YES** **(APPROVAL/ LODGEMENT REQUIRED)**
	Does the feature have an extended, if non-permanent, period of flow: Flow must continue for a reasonable period after rain ceases and have some reliability commensurate with rainfall? Flow for several weeks after rainfall ceases does not constitute extended flow. Consider e.g. water present, catchment size, geomorphological features, and ecological indicators of sustained flow.	☐yes ☒no	If **Yes to all** , complete Section 2 If **No to any of these, the feature does not constitute a waterway and no further assessment is required for the Fisheries Act.** Implement waterway crossing design and environmental protection measures as required in Environmental Authority and other relevant environmental requirements.	☒ **NO** **(NO LODGEMENT REQUIRED**
	Does the feature have sufficient flow adequacy: The flow needs to be sufficient to sustain basic ecological processes and to maintain biodiversity within the feature. Comment on any ecological indicators present e.g. riparian vegetation, presence/evidence of aquatic life etc.	☐yes ☒no		

Section 2 - Waterway Barrier Works Requirements (Only complete if works are to take place within a waterway)				
Environmental Value	**Checklist**	**Y / N**	**Justification for Placement**	**Field Comments**
a. **Do the works constitute waterway barrier works as defined in FHMOP 008 2009 (Appendix 3)?**	As well as dams and weirs the following are examples of developments that are considered to be waterway barrier works: ▪ Temporary dams, barriers to flow ▪ Culverts ▪ Bed level waterway crossings ▪ Causeways (water crossings slightly above stream bed) ▪ Tidal or floodgates (including maintenance and repair) ▪ Partial bunds (where the development will only partially block a waterway) ▪ Levee banks ▪ Silt curtains ▪ Netting and screens ▪ Litter booms or Trash racks ▪ Riffle structure	☐yes ☐no	If **Yes**, complete Section **2b**. If **No**, implement construction works in accordance with environmental protection measures as requires in Environmental Authority and other relevant environmental requirements. Attach/reference all records and place in Z:\653R_Environmental Complete paperwork and forward to FLUOR Environment Team for review.	
b. **Is the waterway crossing self assessable under WWBW01 for Temporary Waterway Barrier Works**	Do the works involve: ▪ Waterway barriers that will be in place for less than 42 calendar days ▪ Waterway barriers that are less than 20m in length across the waterway from bank to bank and; ▪ 10m or less in width (at the widest point). ▪ Waterway barriers that are at least 500m distance from any existing natural or artificial waterway barrier (upstream or downstream) unless: ○ the barrier is being constructed in order to perform maintenance or repairs on, or removal of, the existing barrier, or ○ the barrier is being constructed in order to facilitate dewatering between the new and existing barriers, or ○ the barrier is a silt curtain for control of sediment. ▪ Disturbance to the bed and banks of a waterway less than 5m from the toe of the barrier on either side. ▪ Construction at the time of the year when the flows are lowest or have completely stopped. ▪ A waterway barrier where there will be no ponding of water upstream.	☐yes ☐no	If **Yes**, comply with all applicable requirements of WWBW01 in addition to waterway crossing design and environmental protection measures as required in CEMP, Environmental Authority, EIS and other relevant environmental requirements. Provide evidence that waterway crossing design satisfies DAFF self assessment codes including reference to design drawings. Attach/reference all records and place in Z:\653R_Environmental Complete paperwork and forward to FLUOR Environment Team for review. If **No**, go to Section **2c**.	

Section 2 - Waterway Barrier Works Requirements (Only complete if works are to take place within a waterway)				
Environmental Value	**Checklist**	**Y / N**	**Justification for Placement**	**Field Comments**
c. **Is the waterway crossing self assessable under WWBW02 for Minor Waterway Barrier Works**	Do the works involve: • New waterway barrier works **at least 100m** from any other permanent waterway barrier works on same waterway. • Construction that is **not** on a bend or rapid section of a waterway. • Construction perpendicular to the water flow (within 10°). • Construction of minor barriers must commence and finish within 60 calendar days. • Construction during times of low flow, base flow or no flow conditions. • And either one of either: • <u>*Part 1, Dams and Weirs*</u> • Construction of a new **dam or weir** or maintenance of existing one on a waterway with a stream order of 1 or 2 • Maximum waterway barrier height is **one metre or less** above the lowest point of the waterway bed • Upstream and downstream disturbance area must not be more than **10 m** in total from the upstream and downstream toe of the barrier. • <u>Or, *Part 3, Culverts*</u> • Construction of a new **culvert** crossing or replacement/ modification or maintenance of existing culvert where the bankfull width of the waterway **is not** greater than 20m. • Construction of **culverts** where the **maximum** upstream/downstream length of the culvert cells is 15m plus apron (3m scour protection for culverts) or less. • The maximum disturbance area outside barrier footprint of 10 m (scour protection is included in the barrier footprint (upstream and/or downstream). • <u>Or, *Part 4, Bed Level Crossings*</u> • Construction of a new **bed level** crossing or replacement/ modification or maintenance of existing **bed level** waterway where the bankfull width of the waterway can be less than or greater than 20m. • **Bed level** crossing footprint is no more than **15 m wide** (upstream/downstream), with a maximum disturbance area outside crossing footprint of **10 m** (**25 m in total**). • Installation of **bed level** crossings **no higher** than natural bed level. • Installation of a **bed level** crossing at the same gradient as the waterway bed gradient.	☐yes ☐no	If **Yes**, comply with all applicable requirements of WWBW02 in addition to waterway crossing design and environmental protection measures as required, Environmental Authority and other relevant environmental requirements. Provide evidence that waterway crossing design satisfies DAFF self assessment codes including reference to design drawings. Attach/reference all records and place in Z:\653R_Environmental Complete paperwork and forward to FLUOR Environment Team for review.	

Part 3 - Water Definition Assessment (Water Act 2000) & Relevant Environmental Authority				
Environmental Value	**Checklist**	**Y / N**	**Justification for Placement**	**Overall Outcome**
Does the feature fit the definition of a ***Drainage Feature*** under the Water Act 2000? ***Drainage feature*** means a natural landscape feature, including a gully, drain, drainage depression or other erosion feature that— (a) is formed by the concentration of, or operates to confine or concentrate, overland flow water during and immediately after rainfall events; and (b) flows for only a short duration after a rainfall event, regardless of the frequency of flow events; and (c) commonly, does not have enough continuing flow to create a Riverine environment Refer to Section 7 of Watercourse Assessment Manual	1. Does the feature carrying water flow only for a short duration after a rainfall event? 2. Does the feature lack the presence of a riverine environment? (i.e flow adequacy to support riverine species). 3. Does the feature lack a defined bed and banks and the presence of in-stream islands, benches or bars	☒yes ☐no ☒yes ☐no ☒yes ☐no	If ***Yes to all*** of these questions then the feature does not constitute a watercourse and no further assessment is required for the Water Act. If ***no to any*** one of these questions then this feature constitutes a watercourse under the Water Act 2000	**Drainage Feature UNDER the *WATER ACT 2000?*** ☒ **YES** **(NO APPROVAL REQUIRED)** Implement environmental protection measures as required in Environmental authority and other relevant environmental requirements. ☐ **NO** **Determined a Watercourse – see below** **Watercourse under the *WATER ACT 2000?*** ☐ **YES** **(APPROVAL/ LODGEMENT REQUIRED – DETERMINED A WATERCOURSE)** Complete Pre and Post works checklists, and ensure appropriate lodgements are undertaken as per Environmental Authority Requirements. ☒ **NO** **Determined a drainage feature– see Above.**

Part 4 - Water Act Requirements (only complete if works are to take place within or adjacent to the watercourse – refer to Section 2 (Water Act) outcomes)				
Environmental Value	**Checklist**	**Y / N**	**Justification for Placement**	**Comments**
Do the works require approval under the Water Act? (Refer to summary flowchart within Section 9 of watercourse manual)	Do the works involve: • Excavation or placing fill in a way that would interfere with the flow of water in a watercourse, lake or spring by impounding or redirecting the flow of water (referring to completed product, following construction works).	☐yes ☐no	If **Yes**, go to Part **5**, works may require a Riverine Protection Permit under the Water Act. Provide evidence that waterway crossing design satisfies DEHP Guidelines (next section) including reference to design drawings. Attach/reference all records and store in relevant Environmental Drive. Complete paperwork and forward to FLUOR Environment Team for review. If No, adhere to EA requirements!	

Part 5 – DNRM Assessment Requirements (Guideline – activities in a watercourse, lake or spring associated with mining operations) (refer to Section 1 (Water Act) outcomes)			
What type (if any) vegetation will be required to be removed and quantity (area). (no more than 0.25ha), how will the vegetation be removed?	☒yes ☐no	List all species required for removal. Ensure FLUOR/SANTOS vegetation management plan and EA conditions are followed (indicate the requirements for this crossing).	E. populnea, grasses
Can the water crossing be located in a previously disturbed area?	☒yes ☐no	If No, why not?	Non remnant vegetation
Is the water course from groundwater origin?	☐yes ☒no	Determine upstream water sources	

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Section 6 – Overall Assessment Outcome

Has the stream order been assessed a watercourse (Water Act)	☐yes ☒no	If Yes, must comply with the "Guideline – activities in a watercourse, lake or spring associated with mining operations" – Ensure all of this checklist is completed and conveyed to all relevant staff, contractors are to ensure compliance with EA conditions – ensure lodgement of PREWORKS TO DEHP 10 Business prior	☐ **YES** **(APPROVAL REQUIRED)** X **NO** **(NO LODGEMENT REQUIRED, ASSESSED AS DRAINAGE FEATURE)**
Has the stream order been assessed as a waterway (*Fisheries Act*)	☐yes ☒no	If **Yes** complete check boxes below If **No** – no further assessment required	☐ **YES** **(APPROVAL REQUIRED)** X **NO** **(NO LODGEMENT REQUIRED)**
Is a development approval required (i.e. the self assessable code can not be adhered to)?	☐yes ☒no	If **Yes** Contact FLUOR Environment Team.	
Was the crossing assessed as a 'minor waterway barrier'?, either:		If **Yes** complete the relevant 'Minor Waterway Barrier Works Self-Assessment Sheet' lodge to FLUOR Environment Team.	
Part 1 – Dams and Weirs	☐yes ☐no		
Part 3 – Culverts	☐yes ☐no		
Part 4 – Bed Level Crossings	☐yes ☐no		
Was the crossing assessed as a 'temporary waterway barrier'?	☐yes ☒no	If **Yes** complete a Temporary Waterway Barrier Works Self-Assessment Sheet lodge to FLUOR Environmental Team for review.	
Were any EVNT species listed under the EPBC Act and/or NC Act present within the riparian zone of the waterway crossing	☐yes ☒no	If Yes GPS the position of individuals/populations, flag on site and contact FLUOR Environmental Team for review. If No – no further assessment required	
Were any vegetation mapping discrepancies identified within the riparian zone of the waterway crossing	☐yes ☒no	If Yes undertake a quaternary level RE assessment and GPS the extent of the mapped community assemblage where applicable. Contact FLUOR Environment Team for review. If No – no further assessment required	Non remnant as mapped

WORKS WITHIN A WATERCOURSE ASSESSMENT- FIELD ASSESSMENT PHOTOS

WC03 (711673, 7076348)

Looking upstream

Looking downstream

Looking across channel

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WORKS WITHIN A WATERCOURSE ASSESSMENT

This watercourse assessment is to be filled out for all watercourse crossings to ensure compliance with environmental requirements and to ensure appropriate approvals are obtained.

FIELD ASSESSMENT

Inspected by:	R. Feeney	GHD	**Inspected Date:**	17/07/2014
Company:			**Time:**	11 am

Crossing Name:	WC04	**CWP Number**	M4
Watercourse ID	WWBC-04	**Crossing Type (E.g. pipeline/road)**	Pipeline
Lot/Plan:	63WV421	**Location Reference**	Mt Hope
Site	R-HCS-02 ☒ F-HCS-04 ☐ F-HCS-05 ☐ other/area:		
Land Tenure:	Freehold / Leasehold / other :	**Petroleum Tenure**	
Crossing Disturbance Status:	Existing crossing with no upgrade required: ☐ Existing crossing with upgrade required: ☐ New crossing in previously disturbed area: ☒ New crossing in undisturbed area: ☐		
Land Access Approval to undertake assessment:	Yes ☒ No ☐	**Approval No:**	SPR 1886
Cultural Heritage Approval to undertake assessment:	Yes ☒ No ☐	**Approval No:**	
Anticipated commencement date:		**Can the crossing be installed within 10 days?** If No, development approval and other approvals may be required.	Yes ☒ No ☐

HEALTH AND SAFETY		
Have you completed a Safety Task Assessment (STA)?	Yes ☒ No ☐	If No, cease inspection and complete.
Do you have appropriate PPE for the task?	Yes ☒ No ☐	
Do you have adequate amount of water – at least 10 litres?	Yes ☒ No ☐	

GENERAL ENVIRONMENTAL CONDITIONS	
Temp: Cold (<5◦C) ☐ Cool (<15◦C) ☐ Mild (<25◦C) ☒ Warm (<35◦C) ☐ Hot (>35◦C) ☐	Weather now: Clear/Fine ☒ Scattered Clouds ☐ Cloudy ☐
	Past 24 hrs: Clear/Fine ☒ Scattered Clouds ☐ Cloudy ☐
Wind: Still ☒ Slight breeze ☐ Windy ☐ Strong Wind ☐	Air now: Dry ☒ Humid ☐ Rain (Steady) ☐ Rain (Heavy) ☐
	Air past 24hrs: Dry ☒ Humid ☐ Rain (Steady) ☐ Rain (Heavy) ☐

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CROSSING LOCATION (REFER SECTION 8.2)

GPS Coordinates - Latitude/Longitude (E – 6 Figs, N – 7 Figs) GDA94

Latitude (E)	712653	**Longitude (S)**	7076959
Bankfull Width (m)	No defined bed or banks	**Bank Width (m):**	Left Bank: NA Right Bank: NA
Stream Width at Water Surface (m):	0 m	**Baseflow Stream Width (m):**	NA
Bank Height: Baseflow and water surface height difference:	Downstream left Bank: 0 m Downstream Right Bank 0 m	**Photographs of site** **Provide photos looking upstream and downstream from crossing location, as well as relevant to watercourse / waterway determination. Label photos.**	

Location	Latitude (E)	Longitude (S)
A		
B		
C		
D		
E		

Water Present:	Yes ☐ No ☒
Water Type:	Flowing ☐ Pool(s) present ☐ Dry ☒
Sample Site Length:	Water Surface Depth to Bed:

CHANNEL DETERMINATION (REFER TO SECTION 8.3)

Stream Order: 1☐ 2☒ 3☐ 4☐ 4+☐		Functional Zone Type - Sediment	Supply☐ Transfer☒ Storage☐
Identify Channel Type:		NA	
Channel Modifications:		None	
Bed Sediment Character:		Tight ☐ Packed ☐ Moderate ☐ Low 1 ☐ Low 2 ☒	
Bank Sediments Composition:		Bedrock % Boulder % Cobble % Pebble % Gravel % Sand Fines 100%	
Bed Material Angularity:		Very Angular☐ Angular ☐ Sub-angular ☐ Rounded ☐Well-rounded ☐ Cobble peddle and gravel fractions not present ☒	
Bank Predominant Shape:		Concave ☐ Convex ☐ Stepped ☐ Wide lower bench ☐ Undercut ☐ **NA**	
Bank Slope Downstream Right:		Vertical 80-90° ☐ Steep 60-80° ☐ Moderate 30-60° ☐ Low 10-30° ☐ Flat<10°☒	
Bank Slope Downstream Left:		Vertical 80-90° ☐ Steep 60-80° ☐ Moderate 30-60° ☐ Low 10-30° ☐ Flat<10°☒	
Channel Shape:		Flat (no defined bed or banks)	
Bed Stability:		Severe Erosion ☐ Moderate Erosion ☐ Bed Stable ☒ Moderate Deposition ☐ Severe Deposition ☐	
Potential Fish Habitat Class:		Class1 ☐ Class2 ☐ Class3 ☐ Class4 ☒	
Fish Migratory Passage Potential:		Nil ☒ Very Restricted ☐ Moderately Restricted ☐ Partly Restricted ☐ Good Passage ☐ Unrestricted Passage ☐	

FLORA/FAUNA ASSESSMENT (REFER TO SECTION 8.4)

Does any vegetation need to be removed?	Yes ☒ No ☐	**If Yes, no more than 0.25 Ha can be removed Estimate how much needs to be removed** **< 0.25 ha groundcover**
Vegetation community description		
Has an Aquatic and Ecological Assessment been undertaken previously that encompasses the watercourse crossing point (both for flora and fauna characteristics).	Yes ☐ No ☐	If yes, reference Report No:

Has a pre-disturbance assessment been undertaken previously that encompasses the watercourse crossing point (both for flora and fauna characteristics).	Yes ☒ No ☐	If no, a pre-disturbance assessment may be required
Does the riparian zone at the watercourse fall within a mapped extent of a Regional Ecosystem and/ or TEC? (refer to Dekho maps)	Yes ☐ No ☒	If Yes, detail mapped RE code (biodiversity status) and TEC where applicable:
Does the riparian zone at the watercourse fall within any Category A, B or C Environmentally Sensitive Areas (ESAs) and/or their primary or secondary primary protection (buffer) zones (refer to Dekho maps)	Yes ☐ No ☒	If Yes, detail ESA category:
If present, is the mapped RE/TEC community consistent with the vegetation community observed on the ground	Yes ☐ No ☐	If no, Check whether discrepancies have already been recorded in previous reports and GIS layers updated. If not a pre-disturbance assessment or quaternary level assessment may be required
Does the proposed development activity comply with the clearing/significant disturbance restrictions of the applicable EA (refer Table 3)	Yes ☒ No ☐	If, no then flag with FLUOR Environment Team for review.
Are there any Cultural Heritage sites located within the crossing location or nearby area (refer to Dekho maps)	Yes ☐ No ☒	If Yes, detail site:
General Vegetation Community description: (including a list of dominant flora species within each stratum)	Non remnant paddock with scattered trees and shrubs and mid dense to dense groundcover	

Are there any declared weeds within the area of the crossing?	Yes☐ No ☒	If yes, describe flag on the ground and GPS and provide on map.
Are there any conservation significant species (i.e ENVT or Type A flora) within the area of the crossing?	Yes☐ No ☒	
Riparian vegetation cover: Trees > 10 m: Trees < 10 m: Shrubs: Grasses, herbs and sedges:	0% 1% 1% 90%	
Riparian vegetation patchiness:	No riparian vegetation	
Describe the riparian vegetation condition:	3	
Native woody vegetation regeneration:	Abundant ☐ Present ☒ Limited ☐	

SAFETY CONSIDERATIONS		
Are there any safety implications at the proposed crossing due to decreased Right of Way from Environmental Sensitive Areas or other constraints like topography?	Yes ☐ No ☒	**If Yes, Note concerns**

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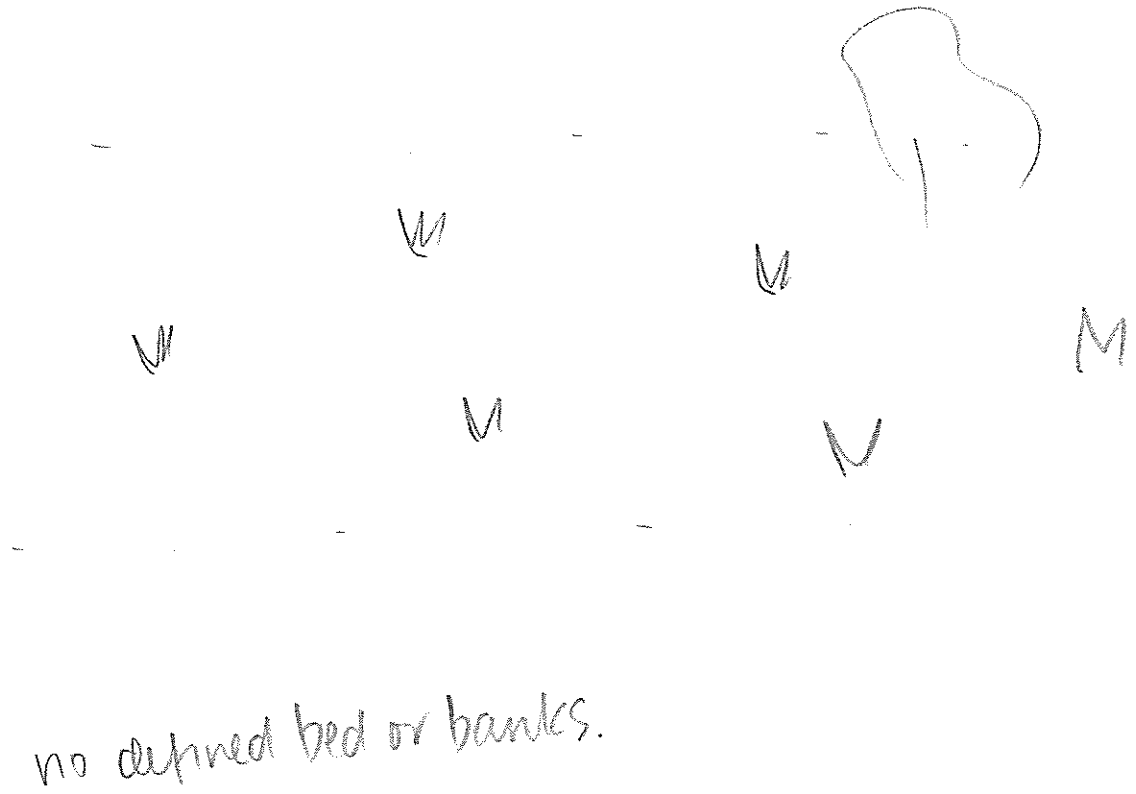
SKETCH OF CROSSING (BIRDS EYE VIEW) (REFER SECTION 8.5)

Sketch birds eye view (i.e. view looking from above), depict how the stream curves, any vegetation, trees, areas of significance (cultural significance if known). Complete approx 10 times the Bankfull Width upstream and downstream of crossing site. Take photographs upstream and downstream (write photo locations on your sketch). Include any names of features (i.e. roads, farm house, power poles).



Notes:

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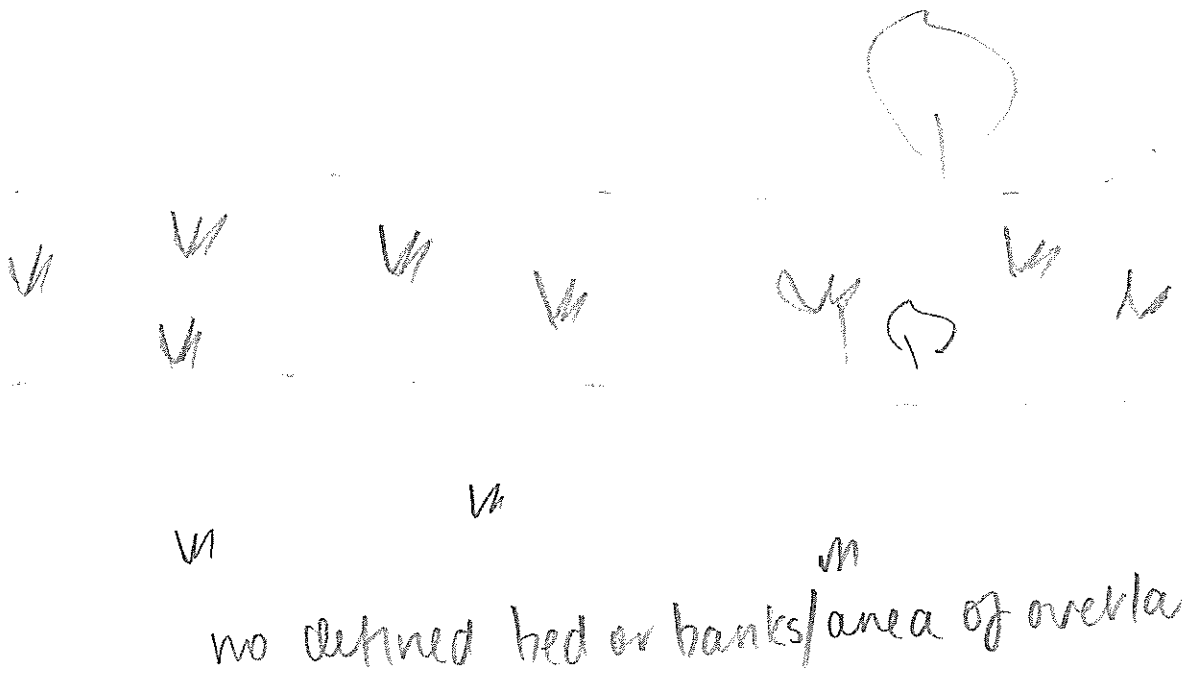
SKETCH OF CROSSING (CROSS-SECTIONAL VIEW, REFER SECTION 8.5)



Notes:

ASSESSMENT OUTCOME

<table>
<tr><th colspan="5">LEGISLATIVE REQUIREMENTS DETERMINATION</th></tr>
<tr><th colspan="5">Part 1 - Waterway Definition Assessment (Fisheries Act 1994)</th></tr>
<tr><th>Environmental Value</th><th>Checklist</th><th>Y / N</th><th>Justification for Placement</th><th>Field Comments</th></tr>
<tr><td rowspan="3">Does the feature satisfy the waterway definition requirements of FHMOP 008 2009 (refer section 7.3.2) under the Fisheries Act 1994?

Refer to Section 7 of Watercourse Assessment Manual</td><td>Does the feature have a defined bed and banks: The bed and banks need to be continuous rather than isolated and broken sections of a depression.</td><td>☐yes
☒no</td><td rowspan="3">If Yes to all , complete Section 2
If No to any of these, the feature does not constitute a waterway and no further assessment is required for the Fisheries Act. Implement waterway crossing design and environmental protection measures as required in Environmental Authority and other relevant environmental requirements.</td><td rowspan="2">WATERWAY UNDER FISHERIES ACT 1994?

☐ YES
(APPROVAL/ LODGEMENT REQUIRED)</td></tr>
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Consider e.g. water present, catchment size, geomorphological features, and ecological indicators of sustained flow.</td><td>☐yes
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<tr><td>Does the feature have sufficient flow adequacy: The flow needs to be sufficient to sustain basic ecological processes and to maintain biodiversity within the feature.
Comment on any ecological indicators present e.g. riparian vegetation, presence/evidence of aquatic life etc.</td><td>☐yes
☒no</td><td>☒ NO
(NO LODGEMENT REQUIRED</td></tr>
</table>

Section 2 - Waterway Barrier Works Requirements (Only complete if works are to take place within a waterway)				
Environmental Value	**Checklist**	**Y / N**	**Justification for Placement**	**Field Comments**
a. **Do the works constitute waterway barrier works as defined in FHMOP 008 2009 (Appendix 3)?**	As well as dams and weirs the following are examples of developments that are considered to be waterway barrier works: ▪ Temporary dams, barriers to flow ▪ Culverts ▪ Bed level waterway crossings ▪ Causeways (water crossings slightly above stream bed) ▪ Tidal or floodgates (including maintenance and repair) ▪ Partial bunds (where the development will only partially block a waterway) ▪ Levee banks ▪ Silt curtains ▪ Netting and screens ▪ Litter booms or Trash racks ▪ Riffle structure	☐yes ☐no	If **Yes**, complete Section **2b**. If **No**, implement construction works in accordance with environmental protection measures as requires in Environmental Authority and other relevant environmental requirements. Attach/reference all records and place in Z:\653R_Environmental Complete paperwork and forward to FLUOR Environment Team for review.	
b. **Is the waterway crossing self assessable under WWBW01 for Temporary Waterway Barrier Works**	Do the works involve: ▪ Waterway barriers that will be in place for less than 42 calendar days ▪ Waterway barriers that are less than 20m in length across the waterway from bank to bank and; ▪ 10m or less in width (at the widest point). ▪ Waterway barriers that are at least 500m distance from any existing natural or artificial waterway barrier (upstream or downstream) unless: ○ the barrier is being constructed in order to perform maintenance or repairs on, or removal of, the existing barrier, or ○ the barrier is being constructed in order to facilitate dewatering between the new and existing barriers, or ○ the barrier is a silt curtain for control of sediment. ▪ Disturbance to the bed and banks of a waterway less than 5m from the toe of the barrier on either side. ▪ Construction at the time of the year when the flows are lowest or have completely stopped. ▪ A waterway barrier where there will be no ponding of water upstream.	☐yes ☐no	If **Yes**, comply with all applicable requirements of WWBW01 in addition to waterway crossing design and environmental protection measures as required in CEMP, Environmental Authority, EIS and other relevant environmental requirements. Provide evidence that waterway crossing design satisfies DAFF self assessment codes including reference to design drawings. Attach/reference all records and place in Z:\653R_Environmental Complete paperwork and forward to FLUOR Environment Team for review. If **No**, go to Section **2c**.	

Section 2 - Waterway Barrier Works Requirements (Only complete if works are to take place within a waterway)				
Environmental Value	**Checklist**	**Y / N**	**Justification for Placement**	**Field Comments**
c. **Is the waterway crossing self assessable under WWBW02 for Minor Waterway Barrier Works**	Do the works involve: • New waterway barrier works **at least 100m** from any other permanent waterway barrier works on same waterway. • Construction that is **not** on a bend or rapid section of a waterway. • Construction perpendicular to the water flow (within 10°). • Construction of minor barriers must commence and finish within 60 calendar days. • Construction during times of low flow, base flow or no flow conditions. • And either one of either: • *Part 1, Dams and Weirs* • Construction of a new **dam or weir** or maintenance of existing one on a waterway with a stream order of 1 or 2 • Maximum waterway barrier height is **one metre or less** above the lowest point of the waterway bed • Upstream and downstream disturbance area must not be more than **10 m** in total from the upstream and downstream toe of the barrier. • Or, *Part 3, Culverts* • Construction of a new **culvert** crossing or replacement/ modification or maintenance of existing culvert where the bankfull width of the waterway **is not** greater than 20m. • Construction of **culverts** where the **maximum** upstream/downstream length of the culvert cells is 15m plus apron (3m scour protection for culverts) or less. • The maximum disturbance area outside barrier footprint of 10 m (scour protection is included in the barrier footprint (upstream and/or downstream). • Or, *Part 4, Bed Level Crossings* • Construction of a new **bed level** crossing or replacement/ modification or maintenance of existing **bed level** waterway where the bankfull width of the waterway can be less than or greater than 20m. • **Bed level** crossing footprint is no more than **15 m wide** (upstream/downstream), with a maximum disturbance area outside crossing footprint of **10 m** (**25 m in total**). • Installation of **bed level** crossings **no higher** than natural bed level. • Installation of a **bed level** crossing at the same gradient as the waterway bed gradient.	☐yes ☐no	If **Yes**, comply with all applicable requirements of WWBW02 in addition to waterway crossing design and environmental protection measures as required, Environmental Authority and other relevant environmental requirements. Provide evidence that waterway crossing design satisfies DAFF self assessment codes including reference to design drawings. Attach/reference all records and place in Z:\653R_Environmental Complete paperwork and forward to FLUOR Environment Team for review.	

Part 3 - Water Definition Assessment (Water Act 2000) & Relevant Environmental Authority				
Environmental Value	**Checklist**	**Y / N**	**Justification for Placement**	**Overall Outcome**
Does the feature fit the definition of a ***Drainage Feature*** under the Water Act 2000? ***Drainage feature*** means a natural landscape feature, including a gully, drain, drainage depression or other erosion feature that— (a) is formed by the concentration of, or operates to confine or concentrate, overland flow water during and immediately after rainfall events; and (b) flows for only a short duration after a rainfall event, regardless of the frequency of flow events; and (c) commonly, does not have enough continuing flow to create a Riverine environment Refer to Section 7 of Watercourse Assessment Manual	1. Does the feature carrying water flow only for a short duration after a rainfall event? 2. Does the feature lack the presence of a riverine environment? (i.e flow adequacy to support riverine species). 3. Does the feature lack a defined bed and banks and the presence of in-stream islands, benches or bars	☒yes ☐no ☒yes ☐no ☒yes ☐no	If ***Yes to all*** of these questions then the feature does not constitute a watercourse and no further assessment is required for the Water Act. If ***no to any*** one of these questions then this feature constitutes a watercourse under the Water Act 2000	**Drainage Feature UNDER the *WATER ACT 2000?*** ☒ **YES** **(NO APPROVAL REQUIRED)** Implement environmental protection measures as required in Environmental authority and other relevant environmental requirements. ☐ **NO** **Determined a Watercourse – see below** **Watercourse under the *WATER ACT 2000?*** ☐ **YES** **(APPROVAL/ LODGEMENT REQUIRED – DETERMINED A WATERCOURSE)** Complete Pre and Post works checklists, and ensure appropriate lodgements are undertaken as per Environmental Authority Requirements. ☒ **NO** **Determined a drainage feature– see Above.**

Part 4 - Water Act Requirements (only complete if works are to take place within or adjacent to the watercourse – refer to Section 2 (Water Act) outcomes)				
Environmental Value	**Checklist**	**Y / N**	**Justification for Placement**	**Comments**
Do the works require approval under the Water Act? (Refer to summary flowchart within Section 9 of watercourse manual)	Do the works involve: • Excavation or placing fill in a way that would interfere with the flow of water in a watercourse, lake or spring by impounding or redirecting the flow of water (referring to completed product, following construction works).	☐yes ☐no	If **Yes**, go to Part **5**, works may require a Riverine Protection Permit under the Water Act. Provide evidence that waterway crossing design satisfies DEHP Guidelines (next section) including reference to design drawings. Attach/reference all records and store in relevant Environmental Drive. Complete paperwork and forward to FLUOR Environment Team for review. If No, adhere to EA requirements!	

Part 5 – DNRM Assessment Requirements (Guideline – activities in a watercourse, lake or spring associated with mining operations) (refer to Section 1 (Water Act) outcomes)			
What type (if any) vegetation will be required to be removed and quantity (area). (no more than 0.25ha), how will the vegetation be removed?	☒yes ☐no	List all species required for removal. Ensure FLUOR/SANTOS vegetation management plan and EA conditions are followed (indicate the requirements for this crossing).	< 0.25 ha Only groundcover, including pasture grasses will require removal
Can the water crossing be located in a previously disturbed area?	☒yes ☐no	If No, why not?	Non-remnant vegetation
Is the water course from groundwater origin?	☐yes ☒no	Determine upstream water sources	

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Section 6 – Overall Assessment Outcome			
Has the stream order been assessed a watercourse (Water Act)	☐yes ☒no	If Yes, must comply with the "Guideline – activities in a watercourse, lake or spring associated with mining operations" – Ensure all of this checklist is completed and conveyed to all relevant staff, contractors are to ensure compliance with EA conditions – ensure lodgement of PREWORKS TO DEHP 10 Business prior	☐ **YES** **(APPROVAL REQUIRED)** ☒ **NO** **(NO LODGEMENT REQUIRED, ASSESSED AS DRAINAGE FEATURE)**
Has the stream order been assessed as a waterway (*Fisheries Act*)	☐yes ☒no	If **Yes** complete check boxes below If **No** – no further assessment required	☐ **YES** **(APPROVAL REQUIRED)** ☒ **NO** **(NO LODGEMENT REQUIRED)**
Is a development approval required (i.e. the self assessable code can not be adhered to)?	☐yes ☒no	If **Yes** Contact FLUOR Environment Team.	
Was the crossing assessed as a 'minor waterway barrier'?, either:		If **Yes** complete the relevant 'Minor Waterway Barrier Works Self-Assessment Sheet' lodge to FLUOR Environment Team.	
Part 1 – Dams and Weirs	☐yes ☒no		
Part 3 – Culverts	☐yes ☒no		
Part 4 – Bed Level Crossings	☐yes ☒no		
Was the crossing assessed as a 'temporary waterway barrier'?	☐yes ☒no	If **Yes** complete a Temporary Waterway Barrier Works Self-Assessment Sheet lodge to FLUOR Environmental Team for review.	
Were any EVNT species listed under the EPBC Act and/or NC Act present within the riparian zone of the waterway crossing	☐yes ☒no	If Yes GPS the position of individuals/populations, flag on site and contact FLUOR Environmental Team for review. If No – no further assessment required	
Were any vegetation mapping discrepancies identified within the riparian zone of the waterway crossing	☐yes ☒no	If Yes undertake a quaternary level RE assessment and GPS the extent of the mapped community assemblage where applicable. Contact FLUOR Environment Team for review. If No – no further assessment required	Non remnant vegetation on ground as mapped

WORKS WITHIN A WATERCOURSE ASSESSMENT- FIELD ASSESSMENT PHOTOS

WC04 (712653, 7076959)

Looking north

Looking east

Looking south

Looking west

Looking across channel (no defined bed or banks)

WORKS WITHIN A WATERCOURSE ASSESSMENT

This watercourse assessment is to be filled out for all watercourse crossings to ensure compliance with environmental requirements and to ensure appropriate approvals are obtained.

FIELD ASSESSMENT

Inspected by:	R. Feeney	GHD	**Inspected Date:**	18/07/2014
Company:			**Time:**	9 am

Crossing Name:	WC05	**CWP Number**	M4
Watercourse ID	WWBC- 05	**Crossing Type (E.g. pipeline/road)**	Pipeline
Lot/Plan:	63WV421	**Location Reference**	Mt Hope
Site	R-HCS-02 ☒ F-HCS-04 ☐ F-HCS-05 ☐ other/area:		
Land Tenure:	Freehold / Leasehold / other :	**Petroleum Tenure**	
Crossing Disturbance Status:	Existing crossing with no upgrade required: ☐ Existing crossing with upgrade required: ☐ New crossing in previously disturbed area: ☒ New crossing in undisturbed area: ☐		
Land Access Approval to undertake assessment:	Yes ☒ No ☐	**Approval No:**	SPR1886
Cultural Heritage Approval to undertake assessment:	Yes ☒ No ☐	**Approval No:**	
Anticipated commencement date:		**Can the crossing be installed within 10 days?** If No, development approval and other approvals may be required.	Yes ☒ No ☐

HEALTH AND SAFETY		
Have you completed a Safety Task Assessment (STA)?	Yes ☒ No ☐	If No, cease inspection and complete.
Do you have appropriate PPE for the task?	Yes ☒ No ☐	
Do you have adequate amount of water – at least 10 litres?	Yes ☒ No ☐	

GENERAL ENVIRONMENTAL CONDITIONS	
Temp: Cold (<5◦C) ☐ Cool (<15◦C) ☒ Mild (<25◦C) ☐ Warm (<35◦C) ☐ Hot (>35◦C) ☐	Weather now: Clear/Fine ☒ Scattered Clouds ☐ Cloudy ☐
	Past 24 hrs: Clear/Fine ☒ Scattered Clouds ☐ Cloudy ☐
Wind: Still ☐ Slight breeze ☐ Windy ☒ Strong Wind ☐	Air now: Dry ☒ Humid ☐ Rain (Steady) ☐ Rain (Heavy) ☐
	Air past 24hrs: Dry ☒ Humid ☐ Rain (Steady) ☐ Rain (Heavy) ☐

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CROSSING LOCATION (REFER SECTION 8.2)

GPS Coordinates - Latitude/Longitude (E – 6 Figs, N – 7 Figs) GDA94

Latitude (E)	713483	**Longitude (S)**	7077561
Bankfull Width (m)	6 m	**Bank Width (m):**	Left Bank: 1.5 m Right Bank: 1.5 m
Stream Width at Water Surface (m):	3 m	**Baseflow Stream Width (m):**	3 m
Bank Height: Baseflow and water surface height difference:	Downstream left Bank: 1.5 m Downstream Right Bank 1.5 m	**Photographs of site** Provide photos looking upstream and downstream from crossing location, as well as relevant to watercourse / waterway determination. Label photos.	

Location	Latitude (E)	Longitude (S)
A		
B		
C		
D		
E		

Water Present:	Yes ☒ No ☐
Water Type:	Flowing ☐ Pool(s) present ☒ Dry ☐
Sample Site Length:	Water Surface Depth to Bed:

CHANNEL DETERMINATION (REFER TO SECTION 8.3)

Stream Order: 1☒ 2☐ 3☐ 4☐ 4+☐		Functional Zone Type - Sediment	Supply☒ Transfer☐ Storage☐
Identify Channel Type:		Irregular	
Channel Modifications:		None	
Bed Sediment Character:		Tight ☐ Packed ☐ Moderate ☐ Low 1 ☐ Low 2 ☒	
Bank Sediments Composition:		Bedrock % Boulder % Cobble % Pebble % Gravel % Sand Fines 100 %	
Bed Material Angularity:		Very Angular☐ Angular ☐ Sub-angular ☐ Rounded ☐Well-rounded ☐ Cobble peddle and gravel fractions not present ☒	
Bank Predominant Shape:		Concave ☐ Convex ☐ Stepped ☐ Wide lower bench ☒ Undercut ☐	
Bank Slope Downstream Right:		Vertical 80-90° ☐ Steep 60-80° ☒ Moderate 30-60° ☐ Low 10-30° ☐ Flat<10°☐	
Bank Slope Downstream Left:		Vertical 80-90° ☐ Steep 60-80° ☒ Moderate 30-60° ☐ Low 10-30° ☐ Flat<10°☐	
Channel Shape:		U Shape	
Bed Stability:		Severe Erosion ☒ Moderate Erosion ☐ Bed Stable ☐ Moderate Deposition ☐ Severe Deposition ☐	
Potential Fish Habitat Class:		Class1 ☐ Class2 ☐ Class3 ☒ Class4 ☐	
Fish Migratory Passage Potential:		Nil ☐ Very Restricted ☒ Moderately Restricted ☐ Partly Restricted ☐ Good Passage ☐ Unrestricted Passage ☐	

FLORA/FAUNA ASSESSMENT (REFER TO SECTION 8.4)

Does any vegetation need to be removed?	Yes ☒ No ☐	**If Yes, no more than 0.25 Ha can be removed Estimate how much needs to be removed** **< 0.25 ha**
Vegetation community description		
Has an Aquatic and Ecological Assessment been undertaken previously that encompasses the watercourse crossing point (both for flora and fauna characteristics).	Yes ☐ No ☐	If yes, reference Report No:

Has a pre-disturbance assessment been undertaken previously that encompasses the watercourse crossing point (both for flora and fauna characteristics).	Yes ☒ No ☐	If no, a pre-disturbance assessment may be required
Does the riparian zone at the watercourse fall within a mapped extent of a Regional Ecosystem and/ or TEC? (refer to Dekho maps)	Yes ☐ No ☒	If Yes, detail mapped RE code (biodiversity status) and TEC where applicable:
Does the riparian zone at the watercourse fall within any Category A, B or C Environmentally Sensitive Areas (ESAs) and/or their primary or secondary primary protection (buffer) zones (refer to Dekho maps)	Yes ☐ No ☒	If Yes, detail ESA category:
If present, is the mapped RE/TEC community consistent with the vegetation community observed on the ground	Yes ☐ No ☐	If no, Check whether discrepancies have already been recorded in previous reports and GIS layers updated. If not a pre-disturbance assessment or quaternary level assessment may be required
Does the proposed development activity comply with the clearing/significant disturbance restrictions of the applicable EA (refer Table 3)	Yes ☒ No ☐	If, no then flag with FLUOR Environment Team for review.
Are there any Cultural Heritage sites located within the crossing location or nearby area (refer to Dekho maps)	Yes ☐ No ☒	If Yes, detail site:
General Vegetation Community description: (including a list of dominant flora species within each stratum)	Narrow strip of riparian vegetation surrounding watercourse in otherwise cleared non-remnant paddock. Canopy of mixed eucalypts including E. populnea, sparse shrubs and mid-dense ground layer (grazed).	
Are there any declared weeds within the area of the crossing?	Yes☐ No ☒	If yes, describe flag on the ground and GPS and provide on map.
Are there any conservation significant species (i.e ENVT or Type A flora) within the area of the crossing?	Yes☐ No ☒	
Riparian vegetation cover: Trees > 10 m: Trees < 10 m: Shrubs: Grasses, herbs and sedges:	1 % 30 % 2 % 60 %	
Riparian vegetation patchiness:	Semi-continuous	
Describe the riparian vegetation condition:	2	
Native woody vegetation regeneration:	Abundant ☐ Present ☒ Limited ☐	
SAFETY CONSIDERATIONS		
Are there any safety implications at the proposed crossing due to decreased Right of Way from Environmental Sensitive Areas or other constraints like topography?	Yes ☐ No ☒	**If Yes, Note concerns**

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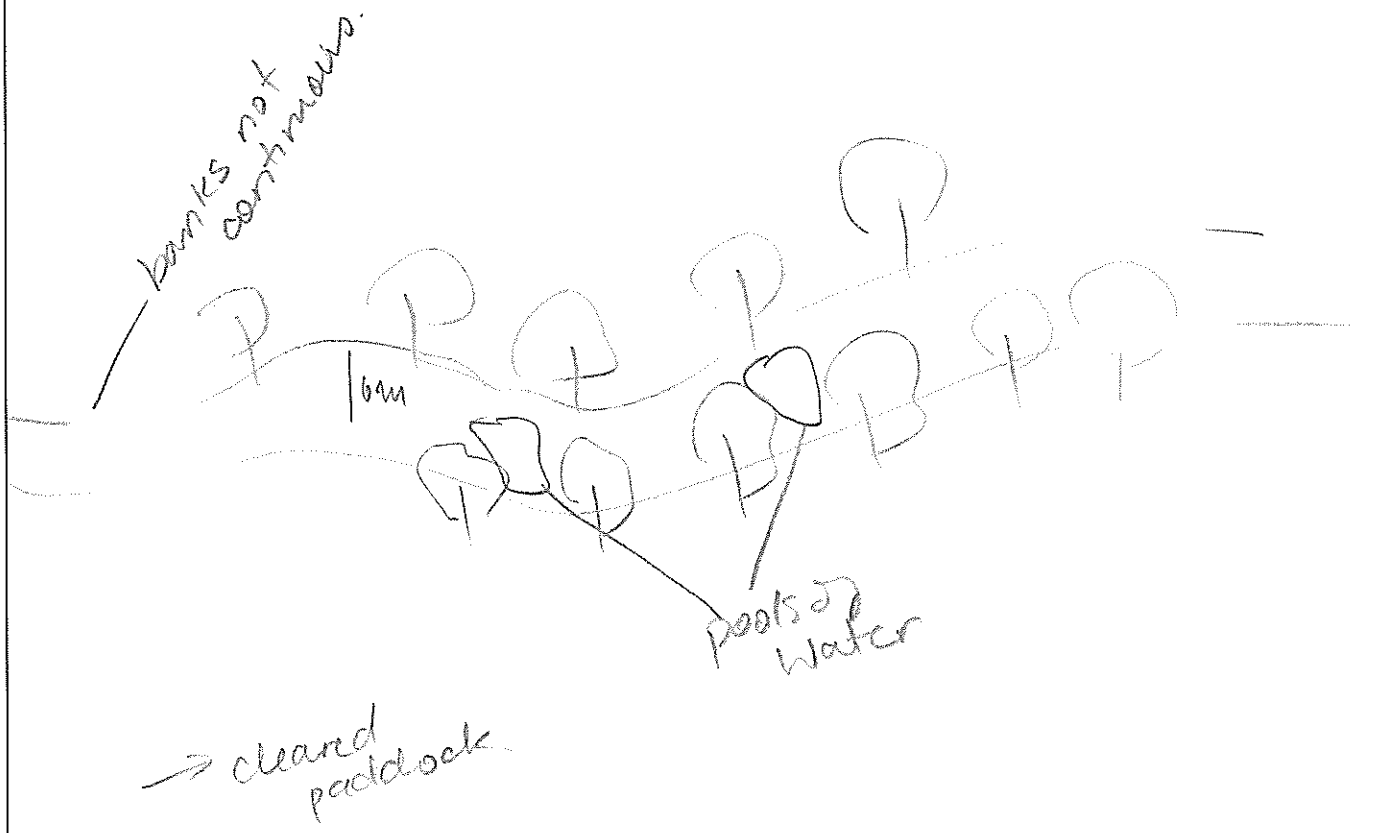
SKETCH OF CROSSING (BIRDS EYE VIEW) (REFER SECTION 8.5)

Sketch birds eye view (i.e. view looking from above), depict how the stream curves, any vegetation, trees, areas of significance (cultural significance if known). Complete approx 10 times the Bankfull Width upstream and downstream of crossing site. Take photographs upstream and downstream (write photo locations on your sketch). Include any names of features (i.e. roads, farm house, power poles).



Notes:

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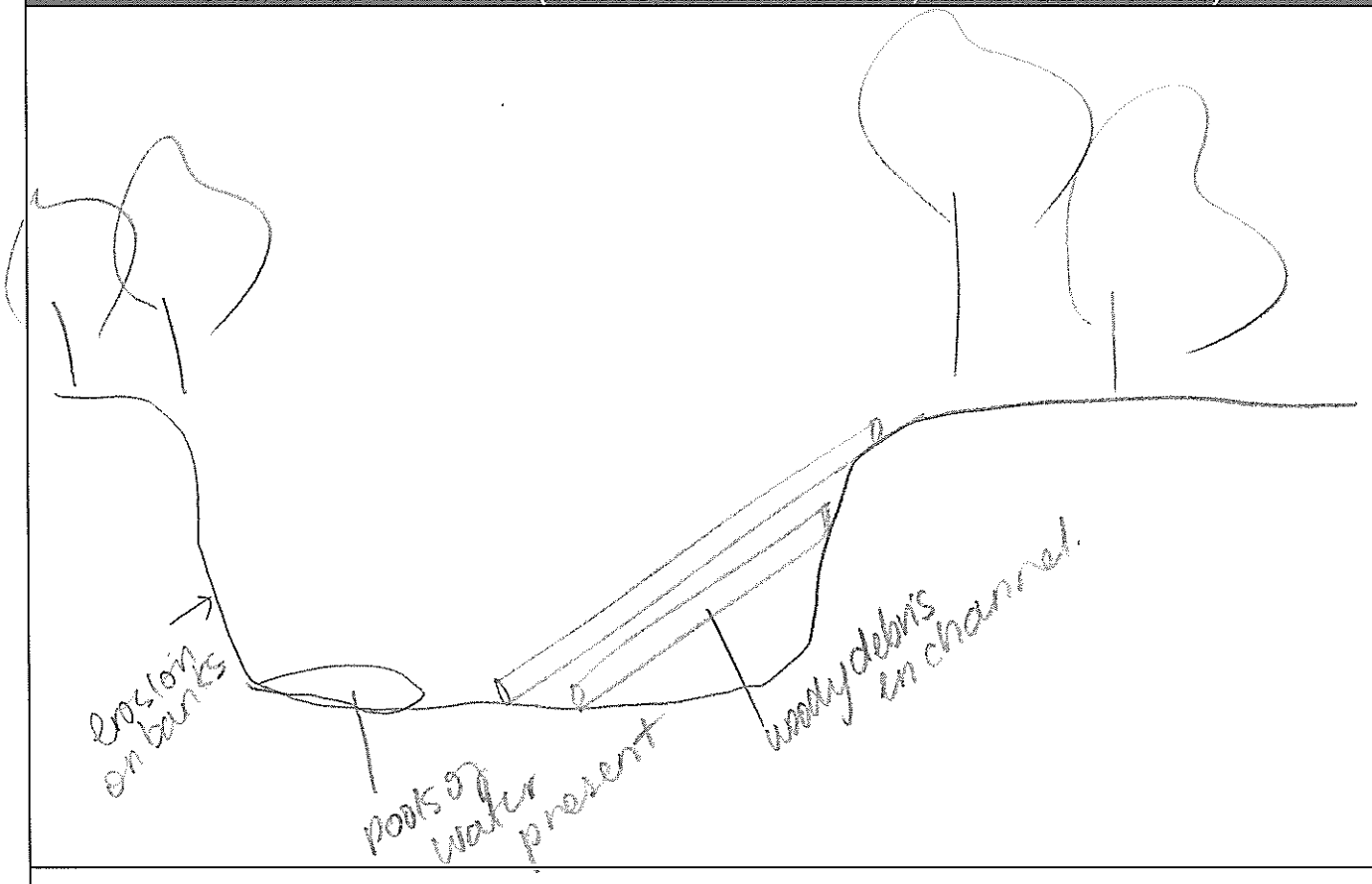
SKETCH OF CROSSING (CROSS-SECTIONAL VIEW, REFER SECTION 8.5)



Notes:

ASSESSMENT OUTCOME

LEGISLATIVE REQUIREMENTS DETERMINATION				
Part 1 - Waterway Definition Assessment (*Fisheries Act 1994*)				
Environmental Value	**Checklist**	**Y / N**	**Justification for Placement**	**Field Comments**
Does the feature satisfy the waterway definition requirements of FHMOP 008 2009 (refer section 7.3.2) under the *Fisheries Act 1994*? Refer to Section 7 of Watercourse Assessment Manual	Does the feature have a defined bed and banks: The bed and banks need to be continuous rather than isolated and broken sections of a depression.	☐yes ☒no	If **Yes to all** , complete Section 2 If **No to any of these, the feature does not constitute a waterway and no further assessment is required for the Fisheries Act.** Implement waterway crossing design and environmental protection measures as required in Environmental Authority and other relevant environmental requirements.	**WATERWAY UNDER *FISHERIES ACT 1994?*** ☐ **YES** **(APPROVAL/ LODGEMENT REQUIRED)**
	Does the feature have an extended, if non-permanent, period of flow: Flow must continue for a reasonable period after rain ceases and have some reliability commensurate with rainfall? Flow for several weeks after rainfall ceases does not constitute extended flow. Consider e.g. water present, catchment size, geomorphological features, and ecological indicators of sustained flow.	☐yes ☒no	If **Yes to all** , complete Section 2 If **No to any of these, the feature does not constitute a waterway and no further assessment is required for the Fisheries Act.** Implement waterway crossing design and environmental protection measures as required in Environmental Authority and other relevant environmental requirements.	☒ **NO** **(NO LODGEMENT REQUIRED**
	Does the feature have sufficient flow adequacy: The flow needs to be sufficient to sustain basic ecological processes and to maintain biodiversity within the feature. Comment on any ecological indicators present e.g. riparian vegetation, presence/evidence of aquatic life etc.	☐yes ☒no		

Section 2 - Waterway Barrier Works Requirements (Only complete if works are to take place within a waterway)				
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a. **Do the works constitute waterway barrier works as defined in FHMOP 008 2009 (Appendix 3)?**	As well as dams and weirs the following are examples of developments that are considered to be waterway barrier works: ▪ Temporary dams, barriers to flow ▪ Culverts ▪ Bed level waterway crossings ▪ Causeways (water crossings slightly above stream bed) ▪ Tidal or floodgates (including maintenance and repair) ▪ Partial bunds (where the development will only partially block a waterway) ▪ Levee banks ▪ Silt curtains ▪ Netting and screens ▪ Litter booms or Trash racks ▪ Riffle structure	☐yes ☐no	If **Yes**, complete Section **2b**. If **No**, implement construction works in accordance with environmental protection measures as requires in Environmental Authority and other relevant environmental requirements. Attach/reference all records and place in Z:\653R_Environmental Complete paperwork and forward to FLUOR Environment Team for review.	
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Part 3 - Water Definition Assessment (Water Act 2000) & Relevant Environmental Authority				
Environmental Value	**Checklist**	**Y / N**	**Justification for Placement**	**Overall Outcome**
Does the feature fit the definition of a ***Drainage Feature*** under the Water Act 2000? ***Drainage feature*** means a natural landscape feature, including a gully, drain, drainage depression or other erosion feature that— (a) is formed by the concentration of, or operates to confine or concentrate, overland flow water during and immediately after rainfall events; and (b) flows for only a short duration after a rainfall event, regardless of the frequency of flow events; and (c) commonly, does not have enough continuing flow to create a Riverine environment Refer to Section 7 of Watercourse Assessment Manual	1. Does the feature carrying water flow only for a short duration after a rainfall event? 2. Does the feature lack the presence of a riverine environment? (i.e flow adequacy to support riverine species). 3. Does the feature lack a defined bed and banks and the presence of in-stream islands, benches or bars	☒yes ☐no ☒yes ☐no ☒yes ☐no	If ***Yes to all*** of these questions then the feature does not constitute a watercourse and no further assessment is required for the Water Act. If ***no to any*** one of these questions then this feature constitutes a watercourse under the Water Act 2000	**Drainage Feature UNDER the *WATER ACT 2000?*** [X] **YES** **(NO APPROVAL REQUIRED)** Implement environmental protection measures as required in Environmental authority and other relevant environmental requirements. [ ] **NO** **Determined a Watercourse – see below** **Watercourse under the *WATER ACT 2000?*** [ ] **YES** **(APPROVAL/ LODGEMENT REQUIRED – DETERMINED A WATERCOURSE)** Complete Pre and Post works checklists, and ensure appropriate lodgements are undertaken as per Environmental Authority Requirements. [X] **NO** **Determined a drainage feature– see Above.**

Part 4 - Water Act Requirements (only complete if works are to take place within or adjacent to the watercourse – refer to Section 2 (Water Act) outcomes)				
Environmental Value	**Checklist**	**Y / N**	**Justification for Placement**	**Comments**
Do the works require approval under the Water Act? (Refer to summary flowchart within Section 9 of watercourse manual)	Do the works involve: • Excavation or placing fill in a way that would interfere with the flow of water in a watercourse, lake or spring by impounding or redirecting the flow of water (referring to completed product, following construction works).	☐yes ☐no	If **Yes**, go to Part **5**, works may require a Riverine Protection Permit under the Water Act. Provide evidence that waterway crossing design satisfies DEHP Guidelines (next section) including reference to design drawings. Attach/reference all records and store in relevant Environmental Drive. Complete paperwork and forward to FLUOR Environment Team for review. If No, adhere to EA requirements!	

Part 5 – DNRM Assessment Requirements (Guideline – activities in a watercourse, lake or spring associated with mining operations) (refer to Section 1 (Water Act) outcomes)			
What type (if any) vegetation will be required to be removed and quantity (area). (no more than 0.25ha), how will the vegetation be removed?	☒yes ☐no	List all species required for removal. Ensure FLUOR/SANTOS vegetation management plan and EA conditions are followed (indicate the requirements for this crossing).	Mature trees including Eucalyptus populnea
Can the water crossing be located in a previously disturbed area?	☒yes ☐no	If No, why not?	Non-remnant vegetation
Is the water course from groundwater origin?	☐yes ☒no	Determine upstream water sources	

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Section 6 – Overall Assessment Outcome

Has the stream order been assessed a watercourse (Water Act)	☐yes ☒no	If Yes, must comply with the "Guideline – activities in a watercourse, lake or spring associated with mining operations" – Ensure all of this checklist is completed and conveyed to all relevant staff, contractors are to ensure compliance with EA conditions – ensure lodgement of PREWORKS TO DEHP 10 Business prior	☐ **YES** **(APPROVAL REQUIRED)** X **NO** **(NO LODGEMENT REQUIRED, ASSESSED AS DRAINAGE FEATURE)**
Has the stream order been assessed as a waterway (*Fisheries Act*)	☐yes ☒no	If **Yes** complete check boxes below If **No** – no further assessment required	☐ **YES** **(APPROVAL REQUIRED)** X **NO** **(NO LODGEMENT REQUIRED)**
Is a development approval required (i.e. the self assessable code can not be adhered to)?	☐yes ☒no	If **Yes** Contact FLUOR Environment Team.	
Was the crossing assessed as a 'minor waterway barrier'?, either:		If **Yes** complete the relevant 'Minor Waterway Barrier Works Self-Assessment Sheet' lodge to FLUOR Environment Team.	
Part 1 – Dams and Weirs	☐yes ☐no		
Part 3 – Culverts	☐yes ☐no		
Part 4 – Bed Level Crossings	☐yes ☐no		
Was the crossing assessed as a 'temporary waterway barrier'?	☐yes ☐no	If **Yes** complete a Temporary Waterway Barrier Works Self-Assessment Sheet lodge to FLUOR Environmental Team for review.	
Were any EVNT species listed under the EPBC Act and/or NC Act present within the riparian zone of the waterway crossing	☐yes ☒no	If Yes GPS the position of individuals/populations, flag on site and contact FLUOR Environmental Team for review. If No – no further assessment required	
Were any vegetation mapping discrepancies identified within the riparian zone of the waterway crossing	☐yes ☒no	If Yes undertake a quaternary level RE assessment and GPS the extent of the mapped community assemblage where applicable. Contact FLUOR Environment Team for review. If No – no further assessment required	Non-remnant vegetation

WORKS WITHIN A WATERCOURSE ASSESSMENT- FIELD ASSESSMENT PHOTOS

WC05 (713483, 7077561)

Looking upstream

Looking downstream

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WORKS WITHIN A WATERCOURSE ASSESSMENT

This watercourse assessment is to be filled out for all watercourse crossings to ensure compliance with environmental requirements and to ensure appropriate approvals are obtained.

FIELD ASSESSMENT

Inspected by:	R. Feeney	GHD	**Inspected Date:**	8 am
Company:			**Time:**	20/07/2014

Crossing Name:	WC06	**CWP Number**	M4
Watercourse ID	WWBC- 06	**Crossing Type (E.g. pipeline/road)**	pipeline
Lot/Plan:	53W421	**Location Reference**	Mt Hope
Site	R-HCS-02 ☒ F-HCS-04 ☐ F-HCS-05 ☐ other/area:		
Land Tenure:	Freehold / Leasehold / other :	**Petroleum Tenure**	
Crossing Disturbance Status:	Existing crossing with no upgrade required: ☐ Existing crossing with upgrade required: ☐ New crossing in previously disturbed area: ☒ New crossing in undisturbed area: ☐		
Land Access Approval to undertake assessment:	Yes ☒ No ☐	**Approval No:**	SPR 1885
Cultural Heritage Approval to undertake assessment:	Yes ☒ No ☐	**Approval No:**	
Anticipated commencement date:		**Can the crossing be installed within 10 days?** If No, development approval and other approvals may be required.	Yes ☒ No ☐

HEALTH AND SAFETY		
Have you completed a Safety Task Assessment (STA)?	Yes ☒ No ☐	If No, cease inspection and complete.
Do you have appropriate PPE for the task?	Yes ☒ No ☐	
Do you have adequate amount of water – at least 10 litres?	Yes ☒ No ☐	

GENERAL ENVIRONMENTAL CONDITIONS	
Temp: Cold (<5◦C) ☐ Cool (<15◦C) ☒ Mild (<25◦C) ☐ Warm (<35◦C) ☐ Hot (>35◦C) ☐	Weather now: Clear/Fine ☒ Scattered Clouds ☐ Cloudy ☐
	Past 24 hrs: Clear/Fine ☒ Scattered Clouds ☐ Cloudy ☐
Wind: Still ☒ Slight breeze ☐ Windy ☐ Strong Wind ☐	Air now: Dry ☒ Humid ☐ Rain (Steady)☐ Rain (Heavy) ☐
	Air past 24hrs: Dry ☒ Humid ☐ Rain (Steady)☐ Rain (Heavy) ☐

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CROSSING LOCATION (REFER SECTION 8.2)

GPS Coordinates - Latitude/Longitude (E – 6 Figs, N – 7 Figs) GDA94

Latitude (E)	0709761	**Longitude (S)**	7076913
Bankfull Width (m)	13 m	**Bank Width (m):**	Left Bank: 3 m Right Bank: 1 m
Stream Width at Water Surface (m):	0 m	**Baseflow Stream Width (m):**	9 m
Bank Height: Baseflow and water surface height difference:	Downstream left Bank: 0 m, 1 m Downstream Right Bank 0 m, 2 m	**Photographs of site** **Provide photos looking upstream and downstream from crossing location, as well as relevant to watercourse / waterway determination. Label photos.**	

Location	Latitude (E)	Longitude (S)
A		
B		
C		
D		
E		

Water Present:	Yes ☐ No ☒
Water Type:	Flowing ☐ Pool(s) present ☐ Dry ☒
Sample Site Length:	Water Surface Depth to Bed:

CHANNEL DETERMINATION (REFER TO SECTION 8.3)

Stream Order: 1☐ 2☐ 3☒ 4☐ 4+☐	Functional Zone Type - Sediment	Supply☒ Transfer☐ Storage☐	
Identify Channel Type:	Irregular		
Channel Modifications:	None		
Bed Sediment Character:	Tight ☐ Packed ☐ Moderate ☐ Low 1 ☐ Low 2 ☒		
Bank Sediments Composition:	Bedrock % Boulder % Cobble % Pebble % Gravel % Sand Fines 100 %		
Bed Material Angularity:	Very Angular☐ Angular ☐ Sub-angular ☐ Rounded ☐Well-rounded ☐ Cobble peddle and gravel fractions not present ☒		
Bank Predominant Shape:	Concave ☐ Convex ☐ Stepped ☐ Wide lower bench ☒ Undercut ☐		
Bank Slope Downstream Right:	Vertical 80-90° ☒ Steep 60-80° ☐ Moderate 30-60° ☐ Low 10-30° ☐ Flat<10°☐		
Bank Slope Downstream Left:	Vertical 80-90° ☐ Steep 60-80° ☒ Moderate 30-60° ☐ Low 10-30° ☐ Flat<10°☐		
Channel Shape:	Box		
Bed Stability:	Severe Erosion ☐ Moderate Erosion ☒ Bed Stable ☐ Moderate Deposition ☐ Severe Deposition ☐		
Potential Fish Habitat Class:	Class1 ☐ Class2 ☐ Class3 ☐ Class4 ☒		
Fish Migratory Passage Potential:	Nil ☒ Very Restricted ☐ Moderately Restricted ☐ Partly Restricted ☐ Good Passage ☐ Unrestricted Passage ☐		

FLORA/FAUNA ASSESSMENT (REFER TO SECTION 8.4)

Does any vegetation need to be removed?	Yes ☒ No ☐	**If Yes, no more than 0.25 Ha can be removed Estimate how much needs to be removed** **< 0.25 ha**
Vegetation community description		
Has an Aquatic and Ecological Assessment been undertaken previously that encompasses the watercourse crossing point (both for flora and fauna characteristics).	Yes ☐ No ☐	If yes, reference Report No:

Has a pre-disturbance assessment been undertaken previously that encompasses the watercourse crossing point (both for flora and fauna characteristics).	Yes ☒ No ☐	If no, a pre-disturbance assessment may be required
Does the riparian zone at the watercourse fall within a mapped extent of a Regional Ecosystem and/ or TEC? (refer to Dekho maps)	Yes ☐ No ☒	If Yes, detail mapped RE code (biodiversity status) and TEC where applicable:
Does the riparian zone at the watercourse fall within any Category A, B or C Environmentally Sensitive Areas (ESAs) and/or their primary or secondary primary protection (buffer) zones (refer to Dekho maps)	Yes ☐ No ☒	If Yes, detail ESA category:
If present, is the mapped RE/TEC community consistent with the vegetation community observed on the ground	Yes ☐ No ☐	If no, Check whether discrepancies have already been recorded in previous reports and GIS layers updated. If not a pre-disturbance assessment or quaternary level assessment may be required
Does the proposed development activity comply with the clearing/significant disturbance restrictions of the applicable EA (refer Table 3)	Yes ☒ No ☐	If, no then flag with FLUOR Environment Team for review.
Are there any Cultural Heritage sites located within the crossing location or nearby area (refer to Dekho maps)	Yes ☐ No ☒	If Yes, detail site:
General Vegetation Community description: (including a list of dominant flora species within each stratum)	Non remnant vegetation with occasional mature eucalypts , including Eucalyptus tereticornis, sparse to moderate shrubs of Acacia decora and grazed ground layer.	

Are there any declared weeds within the area of the crossing?	Yes☐ No ☒	If yes, describe flag on the ground and GPS and provide on map.
Are there any conservation significant species (i.e ENVT or Type A flora) within the area of the crossing?	Yes☐ No ☒	
Riparian vegetation cover: Trees > 10 m: Trees < 10 m: Shrubs: Grasses, herbs and sedges:	1 % 2% 5% 40 %	
Riparian vegetation patchiness:	Occasional clumps	
Describe the riparian vegetation condition:	2	

Native woody vegetation regeneration:	Abundant ☐	Present ☒	Limited ☐

SAFETY CONSIDERATIONS		
Are there any safety implications at the proposed crossing due to decreased Right of Way from Environmental Sensitive Areas or other constraints like topography?	Yes ☐ No ☒	**If Yes, Note concerns**

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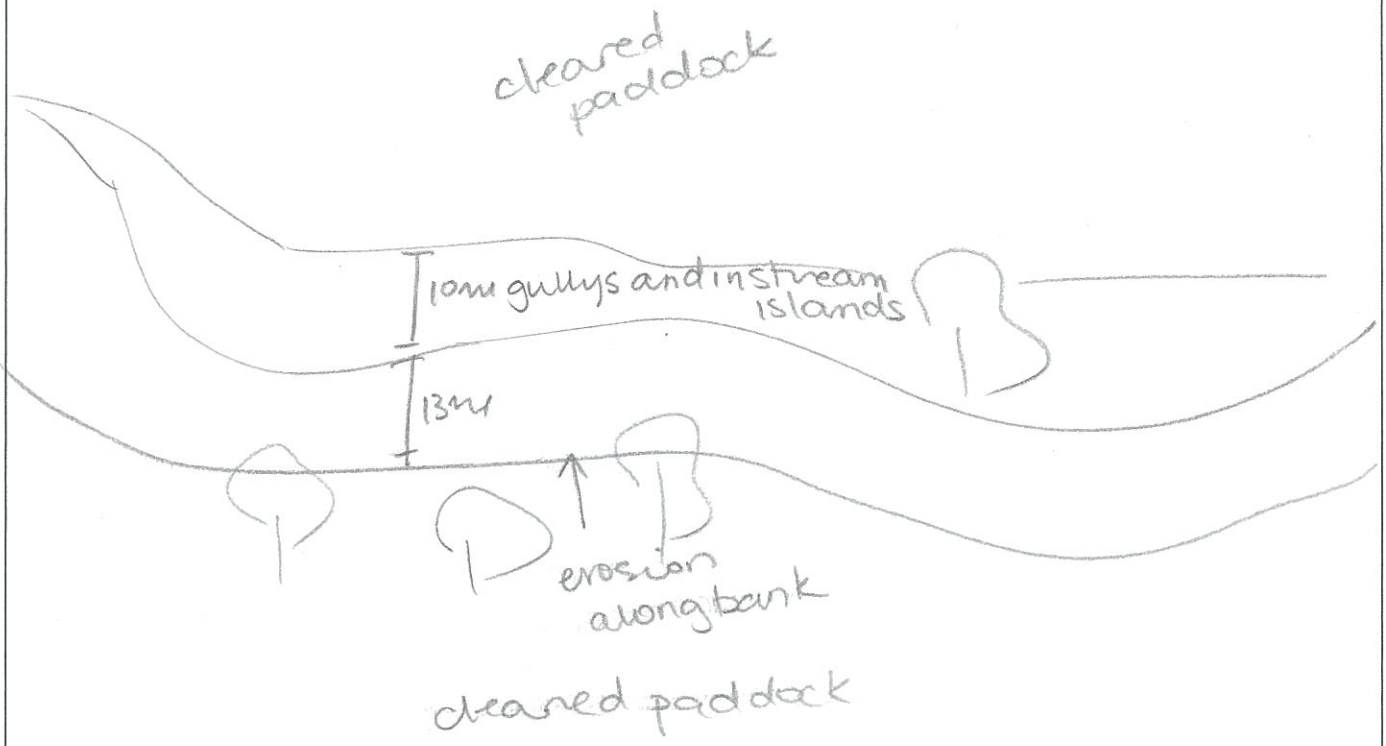
SKETCH OF CROSSING (BIRDS EYE VIEW) (REFER SECTION 8.5)

Sketch birds eye view (i.e. view looking from above), depict how the stream curves, any vegetation, trees, areas of significance (cultural significance if known). Complete approx 10 times the Bankfull Width upstream and downstream of crossing site. Take photographs upstream and downstream (write photo locations on your sketch). Include any names of features (i.e. roads, farm house, power poles).



Notes:

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SKETCH OF CROSSING (CROSS-SECTIONAL VIEW, REFER SECTION 8.5)

Notes:

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ASSESSMENT OUTCOME

LEGISLATIVE REQUIREMENTS DETERMINATION				
Part 1 - Waterway Definition Assessment (*Fisheries Act 1994*)				
Environmental Value	**Checklist**	**Y / N**	**Justification for Placement**	**Field Comments**
Does the feature satisfy the waterway definition requirements of FHMOP 008 2009 (refer section 7.3.2) under the *Fisheries Act 1994*? Refer to Section 7 of Watercourse Assessment Manual	Does the feature have a defined bed and banks: The bed and banks need to be continuous rather than isolated and broken sections of a depression.	☒yes ☐no	If **Yes to all** , complete Section 2 If **No to any of these, the feature does not constitute a waterway and no further assessment is required for the Fisheries Act.** Implement waterway crossing design and environmental protection measures as required in Environmental Authority and other relevant environmental requirements.	**WATERWAY UNDER *FISHERIES ACT 1994?*** ☐ **YES** **(APPROVAL/ LODGEMENT REQUIRED)**
	Does the feature have an extended, if non-permanent, period of flow: Flow must continue for a reasonable period after rain ceases and have some reliability commensurate with rainfall? Flow for several weeks after rainfall ceases does not constitute extended flow. Consider e.g. water present, catchment size, geomorphological features, and ecological indicators of sustained flow.	☐yes ☒no	If **Yes to all** , complete Section 2 If **No to any of these, the feature does not constitute a waterway and no further assessment is required for the Fisheries Act.** Implement waterway crossing design and environmental protection measures as required in Environmental Authority and other relevant environmental requirements.	☒ **NO** **(NO LODGEMENT REQUIRED**
	Does the feature have sufficient flow adequacy: The flow needs to be sufficient to sustain basic ecological processes and to maintain biodiversity within the feature. Comment on any ecological indicators present e.g. riparian vegetation, presence/evidence of aquatic life etc.	☐yes ☒no		

Section 2 - Waterway Barrier Works Requirements (Only complete if works are to take place within a waterway)				
Environmental Value	**Checklist**	**Y / N**	**Justification for Placement**	**Field Comments**
a. **Do the works constitute waterway barrier works as defined in FHMOP 008 2009 (Appendix 3)?**	As well as dams and weirs the following are examples of developments that are considered to be waterway barrier works: ▪ Temporary dams, barriers to flow ▪ Culverts ▪ Bed level waterway crossings ▪ Causeways (water crossings slightly above stream bed) ▪ Tidal or floodgates (including maintenance and repair) ▪ Partial bunds (where the development will only partially block a waterway) ▪ Levee banks ▪ Silt curtains ▪ Netting and screens ▪ Litter booms or Trash racks ▪ Riffle structure	☐yes ☐no	If **Yes**, complete Section **2b**. If **No**, implement construction works in accordance with environmental protection measures as requires in Environmental Authority and other relevant environmental requirements. Attach/reference all records and place in Z:\653R_Environmental Complete paperwork and forward to FLUOR Environment Team for review.	
b. **Is the waterway crossing self assessable under WWBW01 for Temporary Waterway Barrier Works**	Do the works involve: ▪ Waterway barriers that will be in place for less than 42 calendar days ▪ Waterway barriers that are less than 20m in length across the waterway from bank to bank and; ▪ 10m or less in width (at the widest point). ▪ Waterway barriers that are at least 500m distance from any existing natural or artificial waterway barrier (upstream or downstream) unless: ○ the barrier is being constructed in order to perform maintenance or repairs on, or removal of, the existing barrier, or ○ the barrier is being constructed in order to facilitate dewatering between the new and existing barriers, or ○ the barrier is a silt curtain for control of sediment. ▪ Disturbance to the bed and banks of a waterway less than 5m from the toe of the barrier on either side. ▪ Construction at the time of the year when the flows are lowest or have completely stopped. ▪ A waterway barrier where there will be no ponding of water upstream.	☐yes ☐no	If **Yes**, comply with all applicable requirements of WWBW01 in addition to waterway crossing design and environmental protection measures as required in CEMP, Environmental Authority, EIS and other relevant environmental requirements. Provide evidence that waterway crossing design satisfies DAFF self assessment codes including reference to design drawings. Attach/reference all records and place in Z:\653R_Environmental Complete paperwork and forward to FLUOR Environment Team for review. If **No**, go to Section **2c**.	

Section 2 - Waterway Barrier Works Requirements (Only complete if works are to take place within a waterway)				
Environmental Value	**Checklist**	**Y / N**	**Justification for Placement**	**Field Comments**
c. **Is the waterway crossing self assessable under WWBW02 for Minor Waterway Barrier Works**	Do the works involve: • New waterway barrier works **at least 100m** from any other permanent waterway barrier works on same waterway. • Construction that is **not** on a bend or rapid section of a waterway. • Construction perpendicular to the water flow (within 10°). • Construction of minor barriers must commence and finish within 60 calendar days. • Construction during times of low flow, base flow or no flow conditions. • And either one of either: • *Part 1, Dams and Weirs* • Construction of a new **dam or weir** or maintenance of existing one on a waterway with a stream order of 1 or 2 • Maximum waterway barrier height is **one metre or less** above the lowest point of the waterway bed • Upstream and downstream disturbance area must not be more than **10 m** in total from the upstream and downstream toe of the barrier. • Or, *Part 3, Culverts* • Construction of a new **culvert** crossing or replacement/ modification or maintenance of existing culvert where the bankfull width of the waterway **is not** greater than 20m. • Construction of **culverts** where the **maximum** upstream/downstream length of the culvert cells is 15m plus apron (3m scour protection for culverts) or less. • The maximum disturbance area outside barrier footprint of 10 m (scour protection is included in the barrier footprint (upstream and/or downstream). • Or, *Part 4, Bed Level Crossings* • Construction of a new **bed level** crossing or replacement/ modification or maintenance of existing **bed level** waterway where the bankfull width of the waterway can be less than or greater than 20m. • **Bed level** crossing footprint is no more than **15 m wide** (upstream/downstream), with a maximum disturbance area outside crossing footprint of **10 m** (**25 m in total**). • Installation of **bed level** crossings **no higher** than natural bed level. • Installation of a **bed level** crossing at the same gradient as the waterway bed gradient.	☐yes ☐no	If **Yes**, comply with all applicable requirements of WWBW02 in addition to waterway crossing design and environmental protection measures as required, Environmental Authority and other relevant environmental requirements. Provide evidence that waterway crossing design satisfies DAFF self assessment codes including reference to design drawings. Attach/reference all records and place in Z:\653R_Environmental Complete paperwork and forward to FLUOR Environment Team for review.	

Part 3 - Water Definition Assessment (Water Act 2000) & Relevant Environmental Authority				
Environmental Value	**Checklist**	**Y / N**	**Justification for Placement**	**Overall Outcome**
Does the feature fit the definition of a ***Drainage Feature*** under the Water Act 2000? ***Drainage feature*** means a natural landscape feature, including a gully, drain, drainage depression or other erosion feature that— (a) is formed by the concentration of, or operates to confine or concentrate, overland flow water during and immediately after rainfall events; and (b) flows for only a short duration after a rainfall event, regardless of the frequency of flow events; and (c) commonly, does not have enough continuing flow to create a Riverine environment Refer to Section 7 of Watercourse Assessment Manual	1. Does the feature carrying water flow only for a short duration after a rainfall event? 2. Does the feature lack the presence of a riverine environment? (i.e flow adequacy to support riverine species). 3. Does the feature lack a defined bed and banks and the presence of in-stream islands, benches or bars	☒yes ☐no ☒yes ☐no ☐yes ☒no	If ***Yes to all*** of these questions then the feature does not constitute a watercourse and no further assessment is required for the Water Act. If ***no to any*** one of these questions then this feature constitutes a watercourse under the Water Act 2000	**Drainage Feature UNDER the *WATER ACT 2000?*** ☐ **YES** **(NO APPROVAL REQUIRED)** Implement environmental protection measures as required in Environmental authority and other relevant environmental requirements. ☒ **NO** **Determined a Watercourse – see below** **Watercourse under the *WATER ACT 2000?*** ☒ **YES** **(APPROVAL/ LODGEMENT REQUIRED – DETERMINED A WATERCOURSE)** Complete Pre and Post works checklists, and ensure appropriate lodgements are undertaken as per Environmental Authority Requirements. ☐ **NO** **Determined a drainage feature– see Above.**

Part 4 - Water Act Requirements (only complete if works are to take place within or adjacent to the watercourse – refer to Section 2 (Water Act) outcomes)				
Environmental Value	**Checklist**	**Y / N**	**Justification for Placement**	**Comments**
Do the works require approval under the Water Act? (Refer to summary flowchart within Section 9 of watercourse manual)	Do the works involve: • Excavation or placing fill in a way that would interfere with the flow of water in a watercourse, lake or spring by impounding or redirecting the flow of water (referring to completed product, following construction works).	☐yes ☒no	If **Yes**, go to Part **5**, works may require a Riverine Protection Permit under the Water Act. Provide evidence that waterway crossing design satisfies DEHP Guidelines (next section) including reference to design drawings. Attach/reference all records and store in relevant Environmental Drive. Complete paperwork and forward to FLUOR Environment Team for review. If No, adhere to EA requirements!	Construct during dry period

Part 5 – DNRM Assessment Requirements (Guideline – activities in a watercourse, lake or spring associated with mining operations) (refer to Section 1 (Water Act) outcomes)			
What type (if any) vegetation will be required to be removed and quantity (area). (no more than 0.25ha), how will the vegetation be removed?	☒yes ☐no	List all species required for removal. Ensure FLUOR/SANTOS vegetation management plan and EA conditions are followed (indicate the requirements for this crossing).	< 0.25 ha Vegetation that requires removal may include mature eucalypts, shrubs and groundcover
Can the water crossing be located in a previously disturbed area?	☒yes ☐no	If No, why not?	Non remnant vegetation
Is the water course from groundwater origin?	☐yes ☒no	Determine upstream water sources	

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Section 6 – Overall Assessment Outcome			
Has the stream order been assessed a watercourse (Water Act)	☒yes ☐no	If Yes, must comply with the "Guideline – activities in a watercourse, lake or spring associated with mining operations" – Ensure all of this checklist is completed and conveyed to all relevant staff, contractors are to ensure compliance with EA conditions – ensure lodgement of PREWORKS TO DEHP 10 Business prior	X **YES** **(APPROVAL REQUIRED)** ☐ **NO** **(NO LODGEMENT REQUIRED, ASSESSED AS DRAINAGE FEATURE)**
Has the stream order been assessed as a waterway (*Fisheries Act*)	☐yes ☒no	If **Yes** complete check boxes below If **No** – no further assessment required	☐ **YES** **(APPROVAL REQUIRED)** X **NO** **(NO LODGEMENT REQUIRED)**
Is a development approval required (i.e. the self assessable code can not be adhered to)?	☐yes ☒no	If **Yes** Contact FLUOR Environment Team.	
Was the crossing assessed as a 'minor waterway barrier'?, either:		If **Yes** complete the relevant 'Minor Waterway Barrier Works Self-Assessment Sheet' lodge to FLUOR Environment Team.	
Part 1 – Dams and Weirs	☐yes ☒no		
Part 3 – Culverts	☐yes ☒no		
Part 4 – Bed Level Crossings	☐yes ☒no		
Was the crossing assessed as a 'temporary waterway barrier'?	☐yes ☒no	If **Yes** complete a Temporary Waterway Barrier Works Self-Assessment Sheet lodge to FLUOR Environmental Team for review.	Construct during dry period
Were any EVNT species listed under the EPBC Act and/or NC Act present within the riparian zone of the waterway crossing	☐yes ☒no	If Yes GPS the position of individuals/populations, flag on site and contact FLUOR Environmental Team for review. If No – no further assessment required	
Were any vegetation mapping discrepancies identified within the riparian zone of the waterway crossing	☐yes ☒no	If Yes undertake a quaternary level RE assessment and GPS the extent of the mapped community assemblage where applicable. Contact FLUOR Environment Team for review. If No – no further assessment required	Non remnant vegetation on ground as mapped

WORKS WITHIN A WATERCOURSE ASSESSMENT- FIELD ASSESSMENT PHOTOS

WC06 (7109761, 7076913)

Looking upstream

Looking downstream

Looking across channel

Wetlands Rapid assessment		
Site: Blyth Creek	**Date:** 20/07/2014	**Observers:** RF/LM
Infrastructure reference: Lot/plan 53 WV421. Within 300 m of RM03-71 wellpad and RM03-71-0 CDZ		
Photo nos: downstream: 4383	upstream: 4384	across channel: 4385–4387
	GPS coords: 708800 E; 7077464 N	

Wetland class (tick one):

Riverine ✓ Estuarine Palustrine Lacaustrine Marine
Not a wetland under GLNG EA ✓

Where not a wetland select a reason (tick one):

	Modified (tick one below if so)
	H2M1 Riverine or ex-riverine (lacustrine) water bodies associated with dams and weirs located in a channel
	H2M3p Ponded pastures;
	H2M5 Palustrine / lacustrine water bodies where ecological character has changed due to gross mechanical disturbance (eg cropping);
	H2M6 Palustrine / lacustrine water bodies that have been converted, completely or mostly, to a ring tank or other controlled storage;
	H2M7 Riverine water bodies that have been converted mostly to canals or irrigation channels;
	H3C1 Artificial stand-alone water storages not within a natural water body or channel; or
	H3C2 Artificial Channel drain / canal –bore drains, swales, bores and irrigation channel overflows/ponding
✓	**Within outer banks of watercourse**
	Spring
	Does not meet hydrology criterion
	Meets hydrology criterion but doesn't meet other criteria

(Refer to back page, if not already ticked above):

Notes (additional description or map area of wetland)**:**

Wetland is within 300 m of CDZ and is not impacted by CDZ.
Wetland is not mapped as a referrable wetland
Wetland is mapped in the Queensland Wetlands Data

Feature assessed as non-wetland feature (the area between the outer banks of a watercourse and a floodplain (other than a floodplain wetland))

No artificially modified features (H1)

The area is determined as not a wetland under the GLNG EA (EPPG00898213: Roma Shallow Gas Project Area) as it is not a mapped referrable wetland.

M4 Wetland 1 (Blyth Creek) Photographs

Photo A – Looking downstream of mapped wetland at the assessment site

Photo B – Looking upstream mapped wetland at the assessment site

Photo C – Looking across mapped wetland at the assessment site

Column Name	Data Type	Max. Chars	Mandatory?	Details
HYDROMOD	Char	30	Yes	Code representing the hydrological modifier of the wetland polygon. **Note:** Where NONWETCLASS = Modified, HYDROMOD must equal the appropriate correlating classification (one of H2M1, H2M3p, H2M5, H2M6, H2M7, H3C1 or H3C2).

Hydrological modifiers:

Description	HYDROMOD
No mocifications observed.	H1
Modified - Riverine wetlands associated with dams and weirs located in a natural channel.	H2M1
Modified - Palustrine/Lacustrine wetlands where size and/or hydrology has changed due to levee bank.	H2M2
Modified - Palustrine/Lacustrine wetlands where size and/or hydrology has changed due to levee bank and dominated by exotic pasture species.	H2M2p
Modified - Palustrine/Lacustrine wetlands where size and/or hydrology has changed the water body classification from estuarine to a fresh water system.	H2M3
Modified - Palustrine/Lacustrine wetlands where size and/or hydrology has changed the water body classification from estuarine to a fresh water system and dominated by exotic pasture species.	H2M3p
Modified - springs.	H2M4
Modified - springs (dominant).	H2M4a

Description	HYDROMOD
Modified - Palustrine/Lacustrine wetlands where ecological character has changed due to gross mechanical disturbance (e.g. cropping).	H2M5
Modified - Palustrine/Lacustrine wetlands that have been converted, completely or mostly, to a ring tank or other controlled storage.	H2M6
Modified - Riverine wetlands that have been converted mostly to canals or irrigation channels.	H2M7
Modified - Palustrine/Lacustrine/Riverine wetlands with no obvious structures, but where the local hydrology has been totally altered by irrigation activity.	H2M8
Artificial wetlands - dams, ringtanks.	H3C1
Artificial wetlands - channel drain/canals, bore drains.	H3C2
Artificial wetlands - levee bank across a floodplain.	H3C3
Unknown or Not Applicable	U

Microbat Call Identification Report

Prepared for ("Client"):	GHD
Survey location/project name:	Blythedale (Roma, SE Qld)
Survey dates:	16-22 July 2014
Client project reference:	41-27312-24
Job no.:	GHD-1407
Report date:	4 August 2014

Methods

Data receipt and processing

Bat calls were recorded over six nights (16th-21st July 2014) using an Anabat detector (Titley Scientific, Brisbane). The Anabat data file (SN 80226 140716-1518 140722-1010.dat) was downloaded from the detector by the client and submitted to *Balance! Environmental* for analysis.

Some 540 Anabat call sequence files (zero-crossing format) were extracted from the data file using *CFCread Version 4.4n* (Corben 2012).

Species identification

All Anabat sequence files were analysed using *AnalookW* (Corben 2013), with species identification achieved manually by comparing the call sonograms with those of reference calls from southern Queensland and with reference to published call descriptions (e.g. Reinhold *et al.* 2001; Pennay *et al*. 2004). Calls with fewer than four clearly-defined, non-fragmented pulses were excluded from the analysis.

Call identification was also guided by considering probability of occurrence based on general distribution information (Churchill 2008; van Dyck *et al.* 2013) and/or database records obtained from Wildlife Online (http://www.ehp.qld.gov.au/wildlife/wildlife-online/index.html) and the Atlas of Living Australia (http://www.ala.org.au).

Reporting standard

The format and content of this report follows Australasian Bat Society standards for the interpretation and reporting of bat call data (Reardon 2003), available on-line at http://www.ausbats.org.au/.

Species nomenclature follows van Dyck *et al.* (2013), except *Mormopterus* species, which follow Reardon *et al.* (2014).

Results & Discussion

Species identified

Four species were positively identified from the Blythedale July Anabat survey data (see Table 1). At least one and potentially four other species were present but could not be reliably identified, due to low recording quality and/or inter-specific call similarities.

A number of species that are likely to occur in the study area produce very similar calls that can be difficult to differentiate. Where calls were encountered that could not be resolved to species, all potential candidates are considered possibly present. The characteristics of these unresolved calls and likelihood of species' presence is discussed further below Table 1.

Table 1. Microbat species recorded during the Blythedale survey, 16-22 July 2014.

Date:	16-Jul	17-Jul	18-Jul	19-Jul	20-Jul	21-Jul
Total sequence files:	487	12	7	1	20	11
No. calls identified:	465	7	5	1	18	9
Positively identified species						
Austronomus australis	✓				✓	
Chalinolobus picatus	✓	✓	✓		✓	✓
Miniopterus orianae oceanensis	✓					✓
Scotorepens greyii	✓					✓
Calls/species NOT positively identified						
Chalinolobus gouldii or *Mormopterus petersi*	✓	✓			✓	✓
C. picatus or *S. greyii* or *Vespadelus baverstocki*	✓	✓	✓			✓
S. greyii or *Scotorepens balstoni*		✓		✓		✓
M. o. oceanensis or *Vespadelus* sp.						✓

Species/groups not reliably identified

Technical terms used in the following discussion are described in the Glossary.

Chalinolobus gouldii and *Mormopterus petersi*

A number of brief calls (4-8 pulses) had characteristic frequency (Fc) around 29-31 kHz and mixed pulse shapes, ranging from almost flat (qCF) to steep and curved (FM-qCF). It is considered that these calls most likely represented *M. petersi*, due to the lack of any evidence of the frequency alternation that is typical of *C. gouldii*; however, the calls were of insufficient duration and clarity to allow positive attribution to either species.

Scotorepens greyii and *Scotorepens balstoni*

A small number of brief and noisy calls had steep FM-qCF pulses with Fc in the overlap zone (35-36 kHz) between these two species. *S. greyii* was positively identified from numerous other calls at the upper end of its frequency range (Fc=38-39 kHz), but it is not clear if these lower frequency calls represented a different species (i.e. *S. balstoni*) or just different individual of *S. greyii*.

Chalinolobus picatus*, *Scotorepens greyii* and *Vespadelus baverstocki

Chalinolobus picatus (little pied bat) is listed as **Near Threatened** under the Queensland *Nature Conservation Act 1992* (NCA).

All three species produce a steep FM-qCF pulse with broad frequency sweep and curved or hooked body. Characteristic frequency overlaps substantially: with *C. picatus* Fc=39-43 kHz; *S. greyii* Fc=36-41 kHz; and *V. baverstocki* Fc=39-46 kHz. Most calls were reliably identified based on distinctive alternating pulse frequency (*C. picatus*) or uniform pulse frequency at <39 kHz (*S. greyii*). A number of calls with variable (but not distinctly alternating) pulse frequency around 39-41 kHz could have been from any of these three species.

Vespadelus baverstocki, Vespadelus vulturnus* and *Miniopterus orianae oceanensis

At the upper end of its Fc range, *V. baverstocki* also overlaps with both *V. vulturnus* (Fc=45-50 kHz) and *M. o. oceanensis* (Fc=43-48 kHz). The latter species was positively identified from a number of calls with relatively long pulse duration, short frequency sweep and diagonal (*cf.* curved or hooked) pulse body with no tail.

A few messy and weak calls had broader frequency sweep with variable Fc, quite short pulse duration and variable pulse body shapes. These could have been from *M. o. oceanensis* or either of the two *Vespadelus* spp.

References

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Pennay, M., Law, B. and Reinhold, L. (2004). *Bat Calls of New South Wales*. Department of Environment and Conservation, Hurstville.

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Reardon, T. B., McKenzie, N. L., Cooper, S. J. B., Appleton, B., Carthew, S. and Adams, M. (2014). A molecular and morphological investigation of species boundaries and phylogenetic relationships in Australian free-tailed bats *Mormopterus* (Chiroptera : Molossidae). *Australian Journal of Zoology* **62**, 109–136.

Reinhold, L., Law, B., Ford, G. and Pennay, M. (2001). *Key to the bat calls of south-east Queensland and north-east New South Wales*. Department of Natural Resources and Mines, Brisbane.

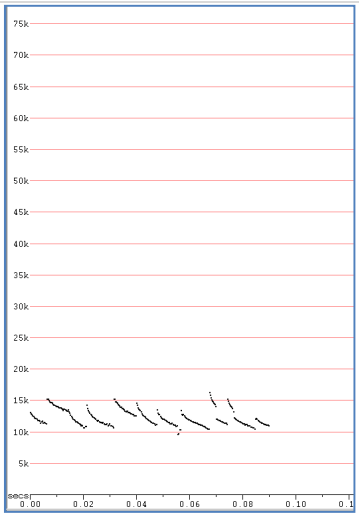
van Dyck, S., Gynther, I. and Baker, A. (eds.) (2013). *Field Companion to the Mammals of Australia.* New Holland; Sydney.

Glossary

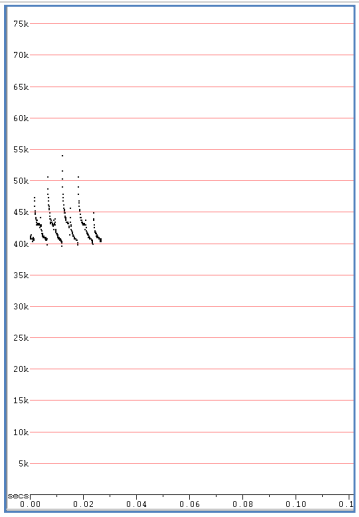
Technical terms used in this report are described in the following table.

Approach phase	The part of a bat *call* emitted as the bat starts to home in on a detected prey item; a transitional series of *pulses* between the *search phase* and *feeding buzz*, that become progressively steeper and shorter in duration.
Call	Refers to a single bat call, made up of a series of individual sound *pulses* in one or more *phases* (*search, approach, feeding buzz*).
CF (=Constant Frequency)	A type of *pulse* in which the dominant component consists of a more-or-less 'pure tone' of sound at a Constant Frequency; with *shape* appearing flat on the sonogram. Often also contains a brief *FM* component at the beginning and/or end of the CF component (*viz.* FM-CF-FM).
Characteristic frequency (Fc)	The frequency of the flattest part of a *pulse*; usually the lowest frequency reached in the *qCF* component of a pulse. This is often the primary diagnostic feature for species identification.
Duration	The time period from the beginning of a *pulse* to the end of the pulse.
Feeding buzz	The terminal part of a *call*, following the *approach phase*, emitted as the bat catches a prey item; a distinctive, rapid series of very steep, very short-duration pulses.
FM (=Frequency Modulated)	A type of *pulse* in which there is substantial change in frequency from beginning to end; *shape* ranges from almost vertical and linear through varying degrees of curvature.
FC range	Refers to the range of frequencies occupied by the *characteristic frequency* section of *pulses* within a call or set of calls.
Frequency sweep or "band-width"	The range of frequencies through which a *pulse* sweeps from beginning to end; Maximum frequency (Fmax) – minimum frequency (Fmin).
Knee	The transitional part of a *pulse* between the initial (usually steeper) frequency sweep and the *characteristic frequency* section (usually flatter); time to knee (Tk) and frequency of knee (Fk) can be diagnostic for some species.
Pulse	An individual pulse of sound within a bat *call*; the *shape*, *duration* and *characteristic frequency* of a pulse are the key diagnostic features used to differentiate species.
Pulse body	The part of the *pulse* between the *knee* and *tail* and containing the *characteristic frequency* section.
Pulse shape	The general appearance of a *pulse* on the sonogram, described using relative terms related to features such as slope and degree of curvature. See also *CF, qCF* and *FM*.
qCF (=quasi Constant Frequency)	A type of *pulse* in which there is very little change in frequency from beginning to end; *shape* appears to be almost flat. Some pulses also contain an *FM* component at the beginning and/or end of the qCF component (*viz.* FM-qCF).
Search phase	The part of a bat *call* generally required for reliable species diagnosis. A consistent series of *pulses* emitted by a bat that is searching for prey or and/or navigating through its habitat. Search phase pulses generally have longer duration, flatter slope and more consistent shape than *approach phase* and *feeding buzz* pulses.
Sequence	Literally, a sequence of *pulses* that may be from one or more bats; but generally refers to a *call* or part (e.g. *phase*) of a call.
Tail	The final component of a *pulse*, following the *characteristic frequency* section; may consist of a short or long sweep of frequencies either upward or downward from the Fc; or may be absent.

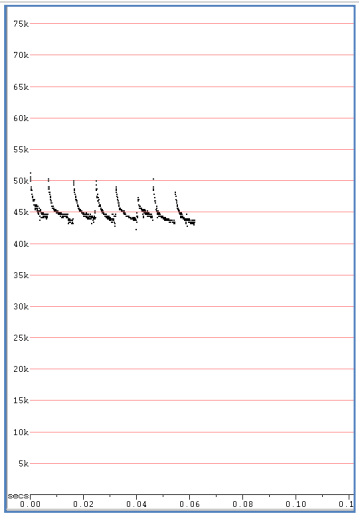
Appendix 1 Representative call sequences from the Blythedale survey, July 2014.
(Scale: 10msec per tick; time between pulses removed)



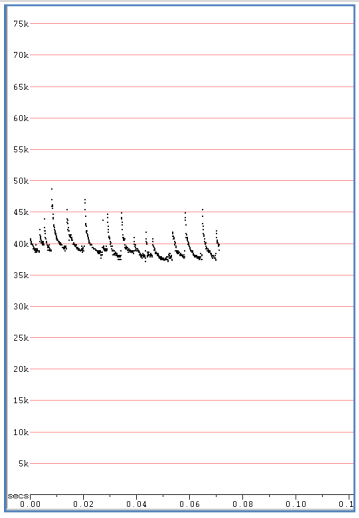
Austronomus australis



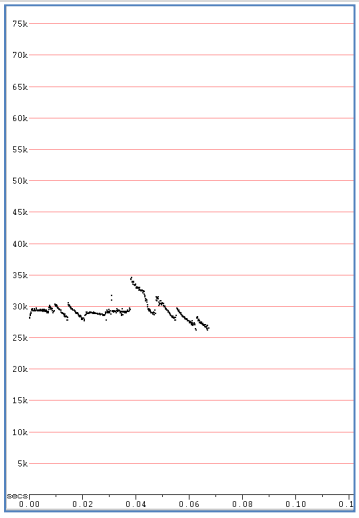
Chalinolobus picatus



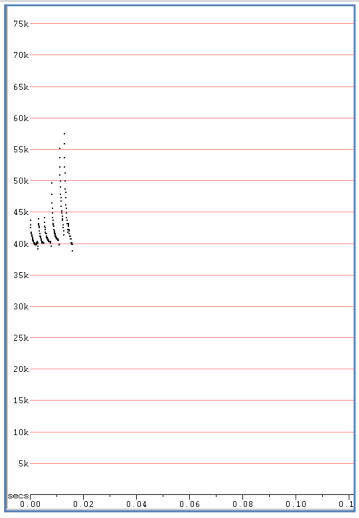
M. o. oceanensis



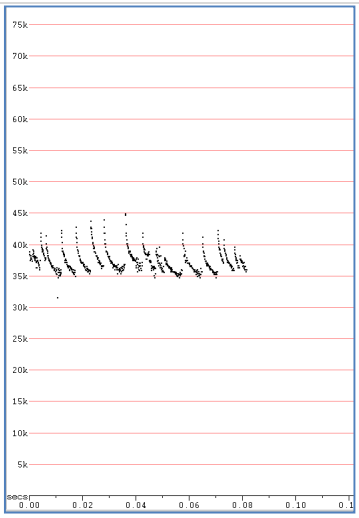
Scotorepens greyii



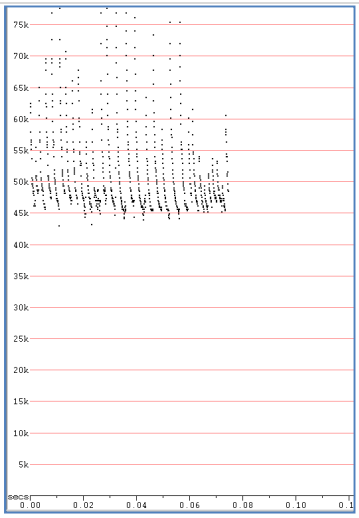
C. gouldii or *M. petersi*



C. picatus or *S. greyii* or *V. baverstocki*



S. greyii or *S. balstoni*



Vespadelus sp. or *M. o. oceanensis*

Appendix D – Habitat Mapping Assessment Tool (version A3) outputs

Infrastructure ID	*M4-15 (part)*
Site ID	*Polygon A - regrowth eucalypt woodland - HA2, HA 11*

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PART A	***Tenement***
	PL 315
PART B	***BPA Mapping - "State or Regional Corridor", "Core Habitat" or "Habitat for EVR Taxa"***
	No
PART C	***How close are you to a significant water source?***
	<1km of a water source
PART D	***What is the vegetation type?***
	Woodlands/Open forest associated with riparian zones and floodplains

PART E	***Have the following species been observed***	
	Koala	
	Squatter pigeon	
	Black-breasted button-quail	
	Red goshawk	
	Large-eared pied bat	
	South-eastern long-eared bat	
	Northern quoll	
	Ornamental snake	
	Dunmall's snake	
	Brigalow scaly-foot	
	Yakka skink	
	Collared delma	
	Australian painted snipe	
	Fitzroy river turtle	
	Murray cod	
	Boggomoss snail	

PART F	***What microhabitat features present?***	
	Dense leaf litter (> 50%)	
	Tall trees present (> 18m)	Yes
	Rocky habitats, including loose boulder-piles, rocky outcrops, steep rocky slopes	
	Deeply dissected sandstone rock faces, cliffs line and caves	
	Deeply dissected sandstone rock faces, cliffs line and caves within 5km	
	Rivers with large deep pools and abundant rock or woody habitat features	
	Rivers with large deep pools interconnected by riffles	
	Loose/exfoliating bark	Yes
	Cracking clay soils	
	Swamps, gilgai and other ephemeral wetlands	
	Hollow-bearing trees within 1km	Yes
	Hollow logs	Yes
	Coarse woody debris (non-hollow logs and large pieces of bark)	Yes
	Thick shrub layer (>30% shrub cover)	
	Myrtaceae dominated canopy	Yes
	Sink holes/tunnel erosion	
	Termite mounds	
	Burrow complexes	

Data Entry Instructions:

Data entry into the green cells is mandatory
Data entry into the blue cells is optional
1. PART A Select the relevant petroleum tenement
2. PART B Enter the BPA Mapping Results
3. PART C Select the distance to water
4. PART D Select the prevalent vegetation
5. PART E Enter any observed EVNT Fauna
6. PART F Enter the relevant microhabitat features
7. Confirm Results - Click HERE

INFORMATION ONLY	
EVNT Fauna potentially located in Tenement	***PL 315***
Koala	**Yes**
Squatter pigeon	
Black-breasted button-quail	
Red goshawk	
Large-eared pied bat	
South-eastern long-eared bat	**Yes**
Northern quoll	
Ornamental snake	
Dunmall's snake	**Yes**
Brigalow scaly-foot	**Yes**
Yakka skink	**Yes**
Collared delma	**Yes**
Australian painted snipe	**Yes**
Fitzroy river turtle	
Murray cod	
Boggomoss snail	

Species	HMAT Ouput	Confirm or Reject HMAT Result	Justification
Koala	General Habitat	Confirm	*If the HMAT results are rejected insert justification here……..*
Squatter pigeon	Unlikely Habitat	Confirm	
Black-breasted button-quail	Unlikely Habitat	Confirm	
Red goshawk	Unlikely Habitat	Confirm	
Large-eared pied bat	Unlikely Habitat	Confirm	
South-eastern long-eared bat	General Habitat	Confirm	
Northern quoll	Unlikely Habitat	Confirm	
Ornamental snake	Unlikely Habitat	Confirm	
Dunmall's snake	General Habitat	Reject	Adjusted result: Unlikely Habitat. As this habitat represents fringing vege
Brigalow scaly-foot	General Habitat	Confirm	
Yakka skink	General Habitat	Confirm	
Collared delma	General Habitat	Reject	Adjusted result: Unlikely Habitat. Suitable microhabitat features such as
Australian painted snipe	Unlikely Habitat	Confirm	
Fitzroy river turtle	Unlikely Habitat	Confirm	
Murray cod	Unlikely Habitat	Confirm	
Boggomoss snail	Unlikely Habitat	Confirm	

Note: A decision from a suitably qualified person is required for all species listed on the HMAT. The Ecologist must either agree or disagree with the output of the HMAT. Where the ecologist disagrees with the HMAT results, a detailed justification for the decision is required in the free text "Justification" box above. This step is mandatory. The ecologists' rejection of a HMAT decision must not be accepted without the detailed justification.

Infrastructure ID	*M4-11, M4-12, M4-13, M6-02, M4-01, M4-04, M4-03, M4-05, M4-06, M4-07, M4-08*
Site ID	*Polygon B - Non-remnant cleared paddocks*

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GLNG Project

PART A	***Tenement***
	PL 315

PART B	***BPA Mapping - "State or Regional Corridor", "Core Habitat" or "Habitat for EVR Taxa"***
	No

PART C	***How close are you to a significant water source?***
	>1km and <3km of a water source

PART D	***What is the vegetation type?***
	Derived Grasslands

PART E	***Have the following species been observed***	
	Koala	
	Squatter pigeon	
	Black-breasted button-quail	
	Red goshawk	
	Large-eared pied bat	
	South-eastern long-eared bat	
	Northern quoll	
	Ornamental snake	
	Dunmall's snake	
	Brigalow scaly-foot	
	Yakka skink	
	Collared delma	
	Australian painted snipe	
	Fitzroy river turtle	
	Murray cod	
	Boggomoss snail	

PART F	***What microhabitat features present?***	
	Dense leaf litter (> 50%)	
	Tall trees present (> 18m)	
	Rocky habitats, including loose boulder-piles, rocky outcrops, steep rocky slopes	
	Deeply dissected sandstone rock faces, cliffs line and caves	
	Deeply dissected sandstone rock faces, cliffs line and caves within 5km	
	Rivers with large deep pools and abundant rock or woody habitat features	
	Rivers with large deep pools interconnected by riffles	
	Loose/exfoliating bark	
	Cracking clay soils	
	Swamps, gilgai and other ephemeral wetlands	
	Hollow-bearing trees within 1km	Yes
	Hollow logs	Yes
	Coarse woody debris (non-hollow logs and large pieces of bark)	Yes
	Thick shrub layer (>30% shrub cover)	Yes
	Myrtaceae dominated canopy	
	Sink holes/tunnel erosion	
	Termite mounds	
	Burrow complexes	

Data Entry Instructions:

Data entry into the green cells is mandatory
Data entry into the blue cells is optional
1. PART A Select the relevant petroleum tenement
2. PART B Enter the BPA Mapping Results
3. PART C Select the distance to water
4. PART D Select the prevalent vegetation
5. PART E Enter any observed EVNT Fauna
6. PART F Enter the relevant microhabitat features
7. Confirm Results - Click HERE

INFORMATION ONLY	
EVNT Fauna potentially located in Tenement	***PL 315***
Koala	**Yes**
Squatter pigeon	
Black-breasted button-quail	
Red goshawk	
Large-eared pied bat	
South-eastern long-eared bat	**Yes**
Northern quoll	
Ornamental snake	
Dunmall's snake	**Yes**
Brigalow scaly-foot	**Yes**
Yakka skink	**Yes**
Collared delma	**Yes**
Australian painted snipe	**Yes**
Fitzroy river turtle	
Murray cod	
Boggomoss snail	

Species	HMAT Ouput	Confirm or Reject HMAT Result	Justification
Koala	Unlikely Habitat	Confirm	*If the HMAT results are rejected insert justification here……..*
Squatter pigeon	Unlikely Habitat	Confirm	
Black-breasted button-quail	Unlikely Habitat	Confirm	
Red goshawk	Unlikely Habitat	Confirm	
Large-eared pied bat	Unlikely Habitat	Confirm	
South-eastern long-eared bat	Unlikely Habitat	Confirm	
Northern quoll	Unlikely Habitat	Confirm	
Ornamental snake	Unlikely Habitat	Confirm	
Dunmall's snake	Unlikely Habitat	Confirm	
Brigalow scaly-foot	Unlikely Habitat	Confirm	
Yakka skink	General Habitat	Reject	Adjusted result: Unlikely habitat. Although this species can persist in cle
Collared delma	Unlikely Habitat	Confirm	
Australian painted snipe	Unlikely Habitat	Confirm	
Fitzroy river turtle	Unlikely Habitat	Confirm	
Murray cod	Unlikely Habitat	Confirm	
Boggomoss snail	Unlikely Habitat	Confirm	

Note: A decision from a suitably qualified person is required for all species listed on the HMAT. The Ecologist must either agree or disagree with the output of the HMAT. Where the ecologist disagrees with the HMAT results, a detailed justification for the decision is required in the free text "Justification" box above. This step is mandatory. The ecologists' rejection of a HMAT decision must not be accepted without the detailed justification.

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		Name	Signature	Name	Signature	Date
A	P. Wagner L. Muller R. Feeney	K. Neil	Draft	K. Neil	Draft	03/09/2014
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